ATMOSnet

Aerobiological Territorial Mediterranean-Oriental Systemic network

ACTA

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Aereobiological Territorial Mediterranean
Oriental System Network

ACTA

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editing by Massimo Menegozzo, Anna Maria Matrone, Diego Guglielmelli

www.atmosnet.org

via Vicinale Santa Maria del Pianto,
Centro Polifunzionale, Torre 1
80143 Napoli (Italia)
info@arpacampania.it
www.arpacampania.it

Graphic editing
Caterina Marmo

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Regional Agency for Enviromental Protection of Campania

Legal Representative
Luciano Capobianco

Project Manager
Massimo Menegozzo

Staff
Raffaele Barbato
Silvana Del Gaizo
Diego Guglielmelli
Anna Maria Matrone
Giuseppe Onorati
Adriana Quaglietta
Nunzia Riccardi
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Anna Elisa Viscardi

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Extra-mediterranean Centre for Climate Change
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University of Napoli "Federico II"
Giovanna Aronne

Ministry for Infrastructures
Maria Tiziana Scabardi

Agency for the Environment and for Technical Services

Legal Representative
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Project Manager
Vincenzo De Gironimo

Staff
Francesca Bottinelli
Roberto Caracciolo
Antonio De Maio
Anna Luise
Daniela Sintonico
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Università di Napoli "Federico II"
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Marco Fornaciari

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Alessandro Travaglini

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Sicilia Region

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Giandomenico Maniscalco
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ARPASicilia
Sergio Marino
Stefania La Grutta
Marzia Ceccherini Nelli
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Donatella Spera
Liana Pecorella
Massimo Sanfilippo

CNR Pisa
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Bachisio Arca
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Francesca Tignola
Michele Casilli
Gaetano Patanè

University of Firenze
Simone Orlandini

Aristotle University of Thessaloniki

Legal Representative
Stavros M. Panas

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Gerrasimos Martzopoukos

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Chrisoula Nikita
Margarh Paraskeyh
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Konstantina Chika
Dionisia Papadopoulou
N. Misopolinis
Vea Margari
Charalampos Brathsas
Nikolaos Silleos

University of Malta

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Project Manager
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Juliette Attard
Liberato Camilleri
Raymond Ellul
Martin Salibe

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Saviour Baldacchino
Saviour Zammit
Marie Louise Zammit
Henrietta Attard
Mariella Bonello
Raymond Cilia
Stephen Motefort
Francis T. Gauci
Maurice Zarb Adami
Avertano Role

Government - Rural Affairs Department
Eleanor Ciantar

Government Health Department
Ian Mifsud

University of Karlsruhe
Hans Güsten - Germany

Preface

The research applied to environmental protection is one of the most innovative activity areas carried out by ARPAC. Over the years ARPAC has been co-operating with research and training centres as well as with the network of Enviromental Agencies that have favoured the capacity building of its employees and the implementation of national projects. Since 2005 the Agency has been co-operating with european organisations as well, being aware that an effective way to address environmental problems is working within a super-national dimension, searching for interpretation keys and effective forecasting/problem solving tools.

To ARPAC the mediterranean area is the privileged action field for a cooperation at the european level. Amongst the common problems shared by southern-european countries, climate change-induced desertification is a crucial critical factor: actually desertification phenomena are constantly extending and involve the mediterranean areas, with substantial impacts on agriculture, silviculture, ecosystems, water supply and tourism.

ATMOSnet project (Aerobiological Territorial Mediterranean Oriental Systemic network) was suggested by ARPAC to study the dynamics of draught and desertification phenomena, with the aim to develop a standard methodology to monitor airborne pollens and study the impacts of climate changes on the Mediterranean area. When the project (submitted within the framework of the Community Initiative Programme INTERREG III B ARCHIMED - Mediterranean Archipelago) was approved, the Agency was recognised the role as lead partner charged with the relationships with the Managing Authority and administrative and financial management.

In my opinion this is an important acknowledgment of the work carried out by ARPAC and of the constant professional development of its employees. I also consider it as a prize for a model of applied research involving experts from different countries who are networked to achieve the common objective to protect our environment. I am deeply convinced that a high integration between theoretical and practical expertise translates into a value added for improving forecasting and environment protection tools.

In this volume, including the proceedings of the various meetings of the Steering Committee and of the final meeting, the outcomes of the research work, the methods and tools used are made available to the research world, institutions and citizens.

I would like to thank the Managing Authority of the INTERREG III B ARCHIMED programme for its constant and effective cooperation and the partners that have been working with ARPAC to add an additional piece to our knowledge on environment: APAT, Sicilia Region, University of Thessaloniki and University of Malta. I wish all of them to go ahead following the pathway already set out.

Luciano Capobianco
General Manager ARPAC

Foreword

Development lines of the territorial cooperation in the Mediterranean area

The aim of the project named "ATMOSnet" (Aerobiological Territorial Mediterranean Oriental System Network), that has reached its final event with the presentation of the outcomes achieved, was to develop a shared and standard method to monitor airborne pollen and create a database of aerobiological data useful to carry out in the area analyses and studies on the climate change-induced impacts on environment (drought, desertification), health (allergies prevention) and agriculture (farming of specific crops)
This aim represents a proper interpretation of the "system-based approach" that should be adopted when planning any "territorial cooperation" actions and any "project ideas" developed by institutional stakeholders and social-economic partnerships to support a sustainable development of the areas involved.

As well known, the project was implemented within the framework of one of the strategic action lines identified by the Community Program INTERREG III B (transnational section) "ARCHIMED", i.e. Axis 3 "Integrated and sustainable management of cultural, natural and landscape resources and risk management", Measure 3.3 "Management, prevention and mitigation of natural risks".
The negotiation stage of the "ARCHIMED" Programme – aimed at supporting the transnational territorial cooperation among the regions located in the central and south-eastern Mediterranean area (including the neighbouring countries with which the European Mediterranean area wanted to establish long-term relationships) and, specifically, at favouring the sustainable development of the cooperation area, promoting a balanced competitiveness, increasing the effectiveness of the transport networks and communication systems, as well as enhancing its natural and cultural resources - has been a long-lasting and complex stage. The critical points typical of the area identified by the European Commission (e.g. geographical fragmentation and peripheral position vis-à-vis the other European regions; deficiency of infrastructures, internal links and transport networks with the northern regions; resulting implementation of a closed and highly dependent local development model; fragility of the ecosystems and pollution risk generated by the growing development of urban centres; difficulty in managing and preserving cultural and natural resources) required a major

effort to outline the objectives to be pursued by the transnational partnership and the tools to be used to implement a territorial co-operation.

The Programme was approved through resolution of the European Commission C(2003) 117 of March 3rd 2003, as amended through resolution of the European Commission C(2004) 5056 of December 13th 2004.

The Countries involved in the Interreg III B Archimed Programme were Greece, Italy (only five regions of southern Italy, i.e. Sicily, Calabria, Basilicata, Apulia, Campania), Malta an Cyprus, both of them as from 2004.

The third countries involved in the Programme – whose partners participated as observers and with their own resources (being out of the time limits required to start with the offices of the European Commission the procedures to use the MEDA funds allocated to the "ARCHIMED area") - were the following: Turkey (in the EU pre-accession stage), Lebanon, Syria, Palestinian Authority, Israel, Jordan, Egypt and Libya. These countries, except for Libya, entered into agreements with the European Union within the framework of the Euro-Mediterranean co-operation.

The resources of the European Regional Development Fund (ERDF) allocated to the programme (€ 79.536.208) had to finance actions with different participating shares of the Partner Countries: 75% for Greece and Malta, 50% for Italy and Cyprus. Percentage shares of national offsets were then generated that were equal to 25% for Greece and Malta and 50% for Italy and Cyprus respectively. Italy participated in the "ARCHIMED" Programme with a national-co-funding share equal to € 19.712.324 (including the financial share for technical support), that has balanced an equal amount of ERDF resources for a total amount of € 39.424.648, as illustrated hereinafter:

Table 1

EU Countries	**ERDF**	**National Offsets**	**Total Amount**
Greece	59.004.000	19.668.000	78.672.000
Italy	19.712.324	19.712.324	39.424.648
Malta	237.379	79.126	316.505
Cyprus	582.505	582.505	1.165.010
TOTAL AMOUNT	**79.536.208**	**40.041.955**	**119.578.163**

The ERDF financial resources allocated to the Programme (€ 79.536.208) were distributed among the various priority axes as illustrated hereinafter:

Table 2

Priority Axes	Total Amount	ERDF	%	National Co-funding
Axis 1: Strategies for the development of the territory and urban systems and for the integration of the island areas	32.558.782	21.604.627	27%	10.954.155
Axis 2: Transport and communication networks – information society	23.306.449	15.601.700	20%	7.704.749
Axis 3: Integrated and sustainable management of cultural, natural and landscape resources; risk management	56.538.259	37.557.717	47%	18.980.542
Axis 4: Technical support and Programme management	7.174.674	4.772.164	6%	2.402.510
Total Amount	**119.578.163**	**79.536.208**	**100%**	**40.041.955**

The implementation stage of the Programme was also adversely affected by weak management structures, time-wasting procedures, a low level of responsiveness and standardisation in transferring data to potential and actual project partners. These points of weakness were critically and ironically highlighted by the representative of the Greek Management Authority of the Programme during the Workshop organised to launch the MED programme that is starting within this new planning cycle (2007-20013) of the Cohesion European Policy co-funded by the Structural Funds.

Furthermore, the enlargement of the European Union and the access of new Mediterranean countries such as Malta and Cyprus required a Programme adjustment and re-allocation of the financial resources (Deliberation of the European Commission C(2004) 5056 of December 13th 2004 hereinabove). This circumstance, while resulting in a delayed start-up of the Programme and in postponed calls for proposals, has nevertheless generated a higher number of opportunities and produced more "crucial" partnerships due to the specific geographical location of these Countries, to their environmental and cultural specificities and common problems.

The problems mentioned above have been a real challenge for both the Administrations involved in the Programme management and those potentially involved in the projects. However these difficulties have not prevented us from identifying issues to analyse, address or promote through a co-operation based approach.

The sensitivity of regional and local institutions and other public-like bodies - along with their interest in the opportunities provided by the ERDF to finance actions aimed at implementing the priority objectives of the Programme - was clearly proven on the first call for proposals (237 project proposals submitted and 72 projects approved in March 2006) and on the second call for proposals (117 project proposals submitted and 5 projects approved in February 2007).

The decrease in the resources to invest in the second call for proposal was due to the automatic cancellation of the resources for the year 2003 (equal to 9,31 million Euros), that resulted in a re-definition of the Programme financial plan (refer to resolution of the European Commission C(2006) 7006 of December 18th 2006).

As to the projects of the first call for proposals, the difficulties arisen – during the phase of drawing up and signing of the agreements by the Management Authorities and Project Leaders and the phase of intra-partner conventions – led to delays or failure in starting the activities and, consequently, delays in the expenditure procedures to be implemented by the partners. This has heavily affected the overall progress of the commitments and expenditures, generating an automatic cancellation of the financial resources for the year 2004 (equal to 17,67 million Euros) and the resulting reduction of the financial plans of the projects.

Allowing for the critical points mentioned above, the work carried out and the project outcomes illustrated in this paper are even more noteworthy.
Firstly we have to highlight the potential related to the identification of synergies among different thematic areas; secondly the creation of permanent facilities (13 pollen monitoring pilot stations) that will keep on operating and of a network that will make it possible to share knowledge and data.
Both these elements will enable to "capitalise" the experience, transfer it to other regions of the Mediterranean area and, as wished by the project partners of the European shore of the Mediterranean Sea, involve the countries of the north-African coastal line as well.

The environmental issue, specifically the "Protection of environment and promotion of a sustainable territorial development" (Axis 2) and the relevant measure aimed at preventing and combatting natural risks (2.4) still is one of the strategic priorities of MED Programme (2007-2013) that allocates to this priority 34% of the overall financial resources, equal to round 256 million Euros (193 million Euros out of the ERDF).

The table including the overall financial plan of MED Programme and the breaking down by priority axis is illustrated hereinafter:

Table 3.

Priority Axes	Total Amount	ERDF	%	National Co-funding
Axis 1: Enhancement of the innovation capability	76.966.717	57.957.399	30%	19.009.318
Axis 2: Environment protection and promotion of a sustainable territorial development	87.228.946	65.685.053	34%	21.543.894
Axis 3: Improving mobility and territorial accessibility	51.311.145	38.638.266	20%	12.672.879
Axis 4: Promotion of a polycentric and integrated development of the MED space	25.655.572	19.319.133	10%	6.336.439
Axis 5: Technical support	15.455.306	11.591.480	6%	3.863.827
Total Amount	256.617.688	193.191.331	100%	63.426.357

The planning phase of the actions required to implement the European Cohesion Policy that is about starting includes both elements of continuity and relaunching vis-à-vis the previous phase that will finalise on December 31st 2008.

In a 25 enlarged Europe (27 countries as from January the 1st 2007), the general objectives (enhancement of economic and social cohesion and Community contribution to a balanced and sustainable development of the whole area) are more strategic than ever.
The priorities identified in Lisbon (European Council of March 23rd-24th 2000) and Götenborg (European Council of June 15th-16th 2001) are better specified as performance improvement in the following fields: growth, competitiveness and accessibility, employment and social inclusion; environmental protection and risk prevention.
Three objectives resulted from these priorities, that shall be pursued through the Structural Funds financial tool (refer to Regulation (EC) n.1083/2006 of the Council):

1. Convergence
2. Regional Competitiveness and Employment
3. European Territorial Cooperation.

The recognition of "Territorial Cooperation" as an independent objective of the cohesion policy led to an improvement in the juridical tools aimed at facilitating the management of the Funds (specific provisions for cooperation, introduction of new figures such as the European Group for Territorial Cooperation) and making their use more consistent with the other objectives of the Structural Funds and of other support tools such as EAFRD.
A higher financial commitment is also provided for (increase to 75% of the community co-funding for EU countries and to 85% for new EU countries), as well as flexibility of the funds (20% flexibility for expenses out of the eligible area and 10% for expenses in third countries' territories).
From the operational point of view, the new community guidelines have translated into specific forecastings aimed at funding "strategic projects" as well, involving private partnerships, promoting top quality projects and real co-operation when transnational, concrete and sustainable outcomes are the main selection criteria.

In defining wider cooperation spaces (the so-called Transnational Cooperation) the Mediterranean area has been identified as a unicum including all Countries previously involved in the "ARCHIMED" and "MEDOCC" transnational programs (Cyprus, 4 regions of France, Greece, 18 regions of Italy, Malta, 2 regions of Portugal, Slovenia, Spain and Gibraltar).
As to the possibility of spending in the territory of non EU countries (in compliance with the Community Regulations up to 10% of the Programme total budget, provided that the relevant actions are beneficial to the European regions) Med Programme has provided for the Monitoring Committee to decide whether this possibility should be made available or not; if made available, the Committee mentioned above shall specify how to implement it.
On behalf of Italy, the Ministry for Economic Development, Department for Cohesion Policies, has coordinated the phase of negotiation and drawing up of the operational programmes (now finalised) and shall coordinate the implementation of the programmes in line with the forms of governance that will

be agreed upon during the State-Regions Conference and transposed in a specific CIPE resolution.
Central administrations shall promote or be partners of strategic projects requiring the presence of institutional bodies responsible for planning, co-ordination and guidance, or having exclusive or competitive expertises on specific matters or intervention areas.

The Regions shall play a more crucial role: actually at the transnational level the European Commission has decided to assign to the regional bodies the challenging and sensitive task of acting as Management Authorities of transnational Programmes; at the national level Regions have been identified by the Commission as the institutional bodies that shall chair the national Committees to be established for each Programme.
January 15th, 2008

Maria Tiziana Scabardi
Official – National Co-ordination of PCI Interreg III B ARCHIMED
Ministry for Infrastructures - Italy

Outline of project

ATMOSnet project

INTERREG III is a Community Initiative financed under the European Regional Development Fund (ERDF), for the cooperation among regions in the period 2000-2006, which aims to avoid that the national borders hamper the balanced development and the integration of the European territory.

In the framework of the transnational cooperation among national, regional, local authorities, the programme INTERREG III B ARCHIMED (Mediterranean Archipelago), aims to contribute to the territorial integration of the South-Eastern Mediterranean area and to accompany (on a Mediterranean basin level) the procedure of Barcelona, through actions that will eventually lead to the establishment of a Euro-Mediterranean Zone of Free Trade.

In particular the priority axis 3 Integrated and Sustainable Management of Cultural and Natural Resources and of Landscapes and Risk Management, which the project ATMOSnet refers to, aims to create synergy among environment, culture and development in order to improve the natural landscape and the cultural sites, as well as to ease the development and the territorial cooperation.

ATMOSnet project aims to define a shared and standardised methodology of air dispersed pollen monitoring to contribute to the study of the impacts induced by the climate changes in the Mediterranean area, with particular reference to drought and tendential desertification.

Pollens are significant bio indicators of the climate changes, since the increase of temperature that characterized the climatic evolution of the last decades has determined the modification on the timing and way of flowering in many typical herbaceous and arboreal plants of the eastern Mediterranean.

At the beginning of 2007 among Campania, Sicilia, Greece and Malta it has been activated a net of 13 pilot stations, where pollen traps were located and that represent the first nucleus of an experimental network of air biological monitoring among Eastern Mediterranean Countries.

The air biological data were collected by using an agreed and standardised system of pollen monitoring, aimed not only to prevent allergy but also to create further

possible forecasting models linked to the drought and desertification phenomenon and to the impacts on the production of particular agricultural cultivations.
The outputs of the monitoring activities, collected in a specific data management software, are spread through the website www.atmosnet.org, where the study and analysis contributions of the numerous experts of the scientific and university world intervened to the project's meeting held in Napoli, Malta, Palermo and Thessaloniki are also reported.

The results of the experimentation could provide an useful contribution for a better understanding of the climatic change phenomenon in the Centre Eastern Mediterranean Area, as well as an instruments for the European Community that could acknowledged the proposal to extend in the future such cooperation to the whole Mediterranean region, including also the African coastal strip Countries.

ATMOSnet project has been coordinated by ARPAC, as Lead Partner, in collaboration with the Partners APAT, Sicilia Region, University of Thessaloniki and University of Malta.

Reports

Partnership: management and project coordination

Anna Dorangricchia

Gruppo Soges S.p.A - Italy

The overall coordination of project activities has been carried out by the Lead Partner, ARPACampania, supported by the technical assistance provided by Gruppo Soges in order to secure a smooth management of the project partnership.

The project management has been, notwithstanding the several bottlenecks incurred during the project implementation such the partnership modification in June 2006 and the ERDF de-commitment or the delays in some technical activities as the setting up of the software, can be considered a successful practice: no request of extension have been submitted to the MA, all the budget have been allocated and spent and all the deliverables have been correctly provided.

As concerns the administrative coordination, the working group supported the ARPAC staff in order to:

- set up an efficient financial management system for the accountancy of the project expenditures;
- draft the progress reports related to the technical and financial activities;
- organise the documentation for the first level control procedure according to the Programme Manual;
- update the action plan as well as the allocation of financial resources among the partners.

This support has been provided in several steps and trough by different tools (financial guidelines for the partners, technical meetings with internal staff, etc).

According to the Lead Partner principle set up in the Subsidy Contract and in the Joint Convention, all the official relationships with the Managing Authority as well as with the National Coordinator have been managed with the technical and linguistic support of the working group.

The ARPAC staff has been also supported in the management of all the relations with the Managing Authority on behalf of the partnership as concerns:

- updates of action plan and financial tables;
- forecast of project expenditures each six months;
- the allocation of ERDF reduction;

• the submission of the progress reports;
• the format of all project deliverables;
• the implementation of communication plan.

As concerns the partnership Management, the working group set up the Project Management Board rules approved during the kick-off meeting and integrating the Joint Convention.

The Lead Partner was supported punctually in the communication flow with the Partners forwarding and explaining all the communications and the related requests received by the Managing Authority concerning the documents to be provided both via email and in original for the Progress Reports and the Payment claims.

The working group drafted, checked and forwarded to the partners copy of the Progress Reports approved by the MA as well as it circulated both the draft and the definitive version of the minutes of the Project Management Boards meetings held in different places according to the approved action plan.

The working groups has been actively involved in the all logistic steps for the meeting organization and the for the final conference held in Sorrento at the end of November. During each project meeting the technical assistance provided a detailed update of the financial and technical update of the action plan, suggested solutions and procedures to be followed up in order to fulfil all the Programme and project requirements.

Bottlenecks and solutions

As already said, the project faced up with some majors problems and the first just at the beginning when a new application package was sent on 19th May 2006 (following the communication received during the meeting with the Managing Authority held in Rome on 5th May) and approved by the Managing Authority in June 2006

Because of the withdrawal of the former partner 4 (University of Athens), the Lead Partner started a new partners research requiring the same kind of skills and financial commitment; the research has been successfully finalised thanks to the adhesion of the University of Thessaloniki.

This partnership modification required an additional work by the Leader Partner staff (presentation of the project activities, agreement on the role and contribution by the new Partners, ect.)

Following the official communication sent by the Managing Authority in July requiring to sign the Subsidy Contract and the Joint Convention within the 4th September, the Lead Partner, applying for the cooperation from all the Partners, pointed out all the administrative procedures to provide the Managing Authority with the required documents as well as the financial table filled in with the planned expenditures to carry out until November 2006.

This project finalisation as well as the project scientific coordination has involved the ARPAC staff supported by the technical assistance.

The technical-scientific activities have been carried out complying with the action plan updated to September 2006 allowing both the implementation of the pollen trap and monitoring sites and the activation of a network for the collecting of the historical data series.

A new and really heavy work of updating has been carried out again in 2007 when, according to the percentage established by the Managing Authority of 9,5% a reallocation per budget line, per partners per Work Packages was drafted and approved by the Partners and the revised application form was submitted to the Managing Authority by the end of September.

According to the Lead Partner principle, has formally reminded to some project partners to comply with the undertaken financial commitment, asking them to provide an official reason for their delay, cause of decommittment of the ERDF amount for the whole project.

Besides this administrative work, ARPAC staff has carried out a structured work involving the other Partners on the scientific contents of the project to be revised according to new financial availability.

All the official project documents have been put in the Intranet section dedicated the Partners of the project web site (S.C. Subsidy Contract, J.C. Joint Convention, internal rules, Progress Reports, minutes, power point presentation of the meetings, Work Packages reports, etc..).

The Project Manager has been supported also during the participation in the Lead Partner Seminar held in Athens in 2006 as well as during the national info day held in 2007 and in the Meeting with the Managing Authority held in Greece and Italy in 2007.

Conclusions

An INTERREG project is generally a good practice for testing the Management capacity of a Lead Partner and ATMOSnet can be considered as a successful example of a smooth and efficient management especially if we considered that for the Lead Partner was the first experience of a European project leadership. But the ATMOSnet network is also a good and sustainable result as confirmed by the willingness subscribed by all the Partners to follow up the project activities in the framework on enlarged European and Mediterranean cooperation.

Pollen monitoring in forecasting models

Daniela Nuvolone

CNR: Institute of Information Science and Technogies, Pisa - Italy

Projects and initiatives on desertification

A brief state of art is presented, showing studies and initiatives where pollen monitoring is related to climatic change. It emerges that historical data of at least twenty years, both meteorological and aerobiological, is necessary to perform such kind of studies. A review of activities on desertification is presented as well. Generally desertification is defined in terms of climatological parameters and soil quality parameters; when vegetational parameters are considered, various indexes are included e.g. plant cover, drought resistance, fire risk, erosion protection.

The international community has long recognized that desertification is a major economic, social and environmental problem of concern to many countries in all regions of the world. For this reason in 1994 United Nations established an International Convention to Combat Desertification (UNCCD). In the "Final text of the Convention" we find the official definitions useful for the purposes of the Convention, among which:

(a) "desertification" means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities;

(b) "drought" means the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems;

(g) "arid, semi-arid and dry sub-humid areas" means areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65.

In Italy one of the most important projects on desertification was the Riade Project (Integrated Research for Applying new technologies and processes for combating Desertification) performed in 4 sites of South Italy (Basilicata, Puglia, Sardinia and Sicily Regions). The project was cofinanced in 2000-2006 by MIUR (the Italian Ministry of Education, University and Research) and its objective was the development of an integrated and technologically innovative system for mo-

nitoring desertification processes localized in the southern areas of Italy, able to contribute at determining the cause - effect relationship in the observed phenomena, and to promote interventions towards the territory safeguard.
The partnership composition was as follows: Advanced Computer Systems A.C.S. S.p.A., ENEA (Institute for the New Technologies, Energy and Environment), Desertification Research Group (NRD) of the University of Sassari. Within this project innovative systems for data acquisition were used, for example remote sensing, gathering historical data such as vegetation indexes, aerial erosion, cloud climatology, temperature, steamtraspiration over a period of 25-30 years.

Another important project was the Desertnet Project (2002-2004), developed in the frame of the Interreg IIC-MED-OCC Program (Italy, Spain and Tunisy) aimed to the study, the monitoring and the management of areas threatened with desertification, in the Mediterranean basin. The objectives of the project were to rationalise the information and the technical-scientific experience acquired and processed for chosen areas as well as to create a platform of services and a network of pilot-activities in order to contribute towards setting up a homogeneous system for the exchange of data/information and for the control of desertification processes.

Also funded by Interreg initiative (Interreg IIIB MEDOCC) together with FESR, Sedemed and Sedemed II Projects (Sécheresse et Désertification dans le bassin Méditerranée, 2000-2006) aimed to develop a monitoring and assessment system for drought and desertification and to identify measures to mitigate the impacts of drought and desertification. The partners were Italy, Portugal, Spain, Greece and Tunisy and worked to carry out a hydrometeorological data base and to extend the analysis of the hydrological cycle to all the Medocc zone. The main activities consisted in applying and checking already existing methodologies for the monitoring of the phenomena of drought and desertification, improving pilot schemes and new indicators, defining interventions adapted to the fight against drought and desertification, exchanging information on the good practices.

Another major project dealing with environmental change in Mediterranean Europe, the Medalus Project (Mediterranean Desertification and Land Use, 1991-1999) proposed a methodology through the identification of Environmentally Sensitive Areas (ESA's), using a multi-factor approach based on both a general and a local knowledge of the environmental processes acting (Kosmas *et alii*, 1999). Four key quality indexes are the basis for ESA's determination: soil, climate, vegetation and management. Partners of this project were Greece, Israel, Portugal, Spain and Italy

Pollen monitoring and climate change

Classical aerobiological studies focus on pollen as the target of the study; that is, by means of climatological and aerobiological data, pollen forecasting is performed, often using neural networks or statistical models.
A study by E. Tedeschini ("The influence of climate changes in Platanus spp. pollination in Spain and Italy", Emma Tedeschini *et alii*, Grana, 2006;45: 222-

229) deals with the analysis of the relation between global warming and pollination in Platanus species. In the two Italian stations (Perugia and Torino) about 20 years of pollen and meteorological data are used, shorter time series were used in Spanish sites: Perugia from 1982 to 2003, Torino from 1985 to 2003, Santiago de Compostela from 1992 to 2003 and Vigo from1994 to 2003. Main results report an earlier start of pollination (-0.66; -1.21; days/year) in both Italian stations where the temperature have significantly increased. A delay of 0.2-0.8 days/year is reported in Spanish stations where a different trend of temperature is recorded.
An article of C. Galán ("The role of temperature in the onset of the *Olea europaea* L. pollen season in southwestern Spain", C. Galán *et alii*, Int J Biometeorol, 2001, 45:8-12) refers to a study performed using 17 years of data collected in Cordoba (from 1982 to 1999). Highly significant relationship between the start of the olive pollen season and the temperature recorded during the months prior to the flowering period (January-March) were found. The maximum temperature of the first fortnight of March was the best predictor of pollen season onset.
In a study of J. Emberlin ("Responses in the start of *Betula* (birch) pollen seasons to recent changes in spring temperatures across Europe", J. Emberlin *et alii*, Int J Biometeorol, 2001, 45:8-12) the analyses show regional contrasts. Historical series of pollen monitoring and meteorological data were considered with reference to Kevo (1982-1999), Brussels (1982-1999), Zurich (1982-1999), Turku (1982-1999), Vienna (1982-1999) and London (1982-1999). Kevo shows a marked trend towards cooler springs and later starts. London, Brussels, Zurich and Vienna show very similar patterns in trends towards earlier start dates. If the trend continues the mean start dates at these sites will advance by about 6 days over the next 10 years.
In a study by Van Vliet ("The influence of temperature and climate change on the timing of pollen release in the Netherlands", Arnold J. Van Vliet *et alii*, Int J Climatol, 2002, 22:1575-1767) a very long time series of pollen and meteorological data is used for 14 species (Leiden, 1969-2000). Also in this work an ealier start of pollen season has been observed (3 to 22 days).

Another major project dealing with environmental change in Mediterranean Europe, the Medalus Project (Mediterranean Desertification and Land Use, 1991-1999) proposed a methodology through the identification of Environmentally Sensitive Areas (ESA's), using a multi-factor approach based on both a general and a local knowledge of the environmental processes acting (Kosmas *et alii*, 1999). Four key quality indexes are the basis for ESA's determination: soil, climate, vegetation and management. Partners of this project were Greece, Israel, Portugal, Spain and Italy.

Forecasting models

One of the most predicted pollination parameters is the Start Date of Pollen season (SDP). Different methods for the prediction of SDP are generally applied and they use temperature as the predictive parameter. One of these provides the application of multiple-regression model using as indipendent variables minimum, maximum or average temperature in the period prior to flowering time. The onset date of the pollen season is also predicted using heat-summation

methods. Among these ones, three are the most common: (1) Heat Units (HU) accumulated after the chilling requirements and untill the starting date of pollen season are calculated from the difference between the daily mean temperature and a specified threshold; (2) Growing Degree Days (GDD) accumulated after the chilling are calculated up to the starting date of pollination; (3) accumulated temperature is calculated using maximum temperatures recorded after chilling and until the starting date.
Time series analysis is also widely used in forecasting modeling (a time series is the collection of orderly observations periodically recorded at the time). ARIMA (Autoregressive Integrated Model of Running Mean) are often applied to predict pollen concentrations. Time series are a mixture of several components: Tt that is the long trend value, St that is the seasonal fluctuations, Ct that is the cyclic fluctuations and Et that is the random factors. The equation followed by a Time Series is an addititive model: Yt = Tt + St + Ct + Et. A model is considered as autoregressive if the values of the series depend on or are related with previous values of the variable.
In another approach, it is possible to establish a multiple linear regression function in which the dependent variable is the observations in the "t" period and the indipendent ones are those variables of the previous periods that are significantly related to the dependent variable. In all cases the indipendent variables are weather parameters, mainly temperature.
In an article by Arca ("Airborne pollen forecasting: evaluation of ARIMA and neural network models", Bachisio Arca et alii, Proceedings of 15th Conference on Biometeorology and Aerobiology, Kansas City, MO, 2002) a comparison between Arima and Neural Network models is presented. Authors use long time series of pollen monitoring and meteorological data collected in Sassari, Italy (from 1986 to 2001). ARIMA and neural network models to forecast daily values of airborne pollen and the day of the maximum pollen concentration were developed. Experimental results showed the capabilities of ARIMA methodology in the long-term forecasting. The study also verifies the capabilities of ANN as a tool for short-term forecasting, due to their good performances with complex and non-linear phenomena.
Another example of the use of neural network models to forecast pollen concentrations is reported in an article of Ranzi ("Forecasting airborne pollen concentrations: development of local models", A. Ranzi et alii, Agrobiologia, 2003, 19: 39-45) related to 14 years pollen data collected in Emilia-Romagna (from1988 to 2002). A local neural network model to predict grass pollen concentrations was developed. To test if the model was suitable for the prediction to exceed specified thresholds, error in delay or anticipation days have been calculated: the mean errors never exceed 2 days.

ATMOSnet WP4 action 1

WP4.1 target is desertification risk forecasting, starting from pollen monitoring; in ATMOSnet pollen is the base from which information for desertification risk analysis is extracted. So we could assume a two step methodology for ATMOSnet: 1 – to forecast phenological phases by means of climate data and pollen monitoring; 2 – to forecast drought and desertification due to climate change using the results of step 1.

It should be noted that while step 1 is widely documented in literature, as shown, and various forecasting models are proposed by scientific community, no study applied to the second step was found in literarture. Hence the need to define in which way pollen monitoring can be used to forecast desertification and drought, that means the need to specify the pollen parameters to be considered to implement the model. A quantitative approach must be stated, with identification of critical cut-off values.

Data

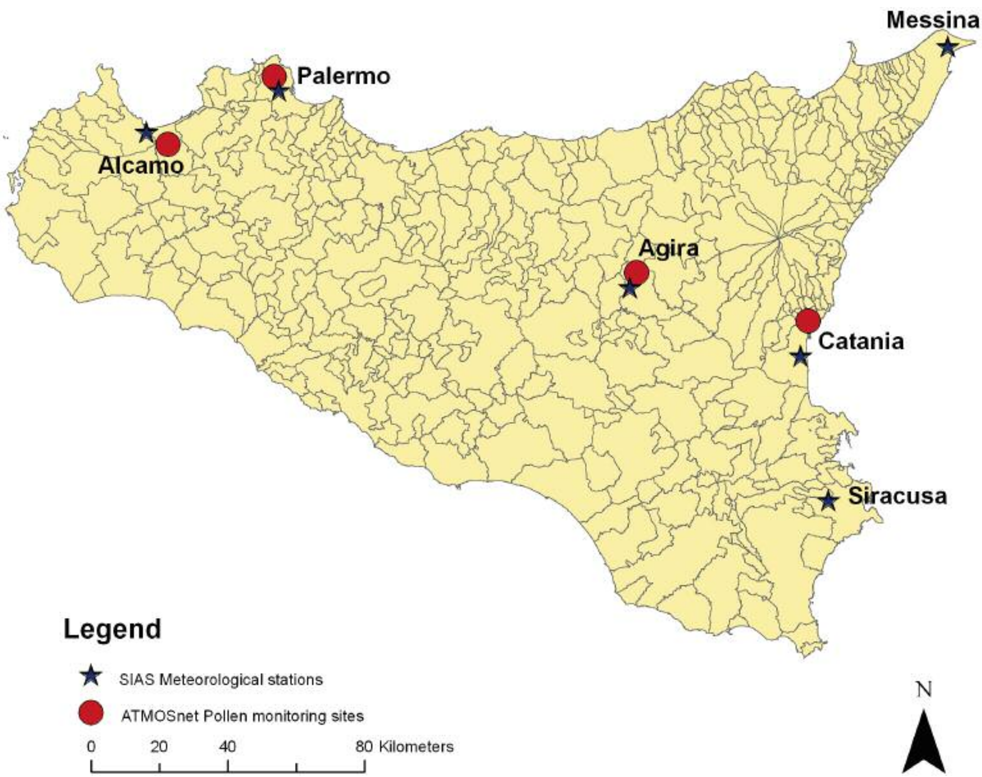
As regards the species to be considered in the model, to analyse more than one monitored species seems to be more suitable to ATMOSnet WP 4.1 goal as it can give information on the whole ecological system showing the effects of drought and desertification on biodiversity. Wild species could be more useful than cultivated ones (*Parietaria*, *Cupressus*, *Ambrosia*, etc.).

Monitoring activity within ATMOSnet project started from February 2006 at four sites: Palermo, Catania, Agira, Alcamo. The monitored species are the following:

Aceraceae
Araliaceae
Betulaceae: Alnus
Betulaceae: Betula
Boraginaceae
Cannabaceae
Caprifoliaceae
Casuarinaceae
Cheno-Amarantaceae
Compositae Liguliflorae
Compositae: Ambrosia
Compositae: Artemisia
Compositae: altre
Corylaceae: Corylus
Corylaceae: Ostrya/Carpinus
Cruciferae
Cupressaceae/Taxaceae
Cyperaceae
Ericaceae
Euphorbiaceae
Fagaceae: Castanea
Fagaceae: Fagus
Fagaceae: Quercus
Graminae
Hippocastanaceae
Juglandaceae
Juncaceae
Lauraceae
Leguminose
Mimosaceae
Myrtaceae
Oleaceae: Fraxinus
Oleaceae: Olea
Oleaceae: Ligustrum
Palmaceae
Papaveraceae
Pinaceae
Plantaginaceae
Platanaceae
Polygonaceae
Ranunculaceae
Rosaceae
Rubiaceae
Salicaceae: Populus
Salicaceae: Salix
Saxifragaceae
Tiliaceae
Typhaceae
Ulmaceae
Umbelliferae
Uricaceae
Vitaceae

Daily pollen count is available for the species and the years resumed in the table contained in the following page. The localization of the monitoring site is still to be acquired. Data quality for the dataset is still to be assessed.
Meteorological data can be free downloaded from the Internet site of Agro-meteorologic Information Service of Sicily (SIAS, www.sias.regione.sicilia.it). Data are available from 2002 up to now.
The four sites of Palermo, Catania, Agira and Castellammare del Golfo best correspond to pollen monitoring stations of ATMOSnet Project in Sicily (Palermo, Catania, Agira and Alcamo). Meteorological data are also available at the Internet site of Italian National Agricultural Information System (SIAN-UCEA, www.politicheagricole.it/ucea/forniture/index3.htm) and can be free downloaded. Data are available from 1996. Seven stations are active in Sicily, with 7 meteorological variables available (temperature, total precipitation, relative humidity, wind direction and speed at 10m, pressure, sunshine).
For the years before 1996 meteorological data can be acquired from the Italian Meteorological Service.

The attached map shows the localization of ATMOSnet pollen monitoring sites, as well as those of related SIAS meteorological stations.



Quality assurance statement and biodiversity in Sicily

Cinzia Lupo, Patrizia Cascio, Pietro Vitale, Domenico Nuzzo, Giovanni Duro

CNR: Institute of Biomedicine and Molecular Immunology, Palermo - Italy

According to WP1 Action 2 a protocol which guarantees the quality of pollen monitoring was realized. Indications were estabilished to describe a procedure to measurement of the pollen grains and spore concentration, in order to guarantee a common method therefore to obtain data that are comparables.
This action will be focused on the analysis of the present quality assurance statement in pollen monitoring and networking. An analysis of critical points, gaps and uncertainties of single procedures and general methodological approaches will be carried out.
The aim is to implement, during the project, a quality assurance applied to an innovative and clear approach in pollen monitoring, to be proposed as best practice for the European Commission (WP3).

The following protocol, in line with UNI 11108:2004, previews five points.

1. Setting up of pollen monitoring station (with reference to the high from the ground, the presence of obstacles such as walls and protections, areas as parks and industrial installations, presence of electrical power)

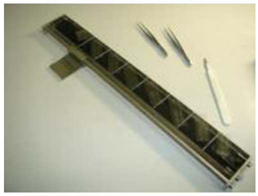
The sampler used for qualitative and quantitative investigations on airborne pollen is based on volumetric measurement. The procedure is based on the arrest for impact of atmospheric particles on a specific surface, through aspiration of a known air volume.
The commonly used sampler, which applies this principle, is proposed by Hirst on which was built the machine currently on the market VPPS 2000 Lanzoni or Burkard spore-trap (to informations look at www.lanzoni.it and www.burkard.co.uk). The air sucked out by a vacuum pump through a slit of 2 X 14 mm, placed under the flange rain caps and oriented always against wind. The vacuum pump is positioned in the lower part of the sampler, and thanks to the action of the vertical wing that apparatus spins on its axis.
The apparatus captures particles of 1 to 100 microns in size from a surrounding place with a medium radius of 10-15 km, according to the height to which is installed. The air is collected on a drum of 345 mm in circumference, that is controlled by a clock system and has an autonomy of seven days and spin at the speed of 2 mm/time. So, the drum complete one rotation in a week.

On the surface of drum, which flows near the slit, is stretched a strip of transparent plastic coated with adhesive material, suitable for the capture of the particles. At the end of the week of sampling the drum is removed and replaced by another drum, loaded with a new adhesive strip.

The sampler must be located in a place where the local atmospheric circulation is not affected by the presence of obstacles nearby. The apparatus must be installed preferably at the centre of terraces at the top of buildings between 15 and 20 m from the ground and away from walls and protections. The sampler opening will be locates above the rail terrace in order to allow a samples collection not influenced by the structures nearby.

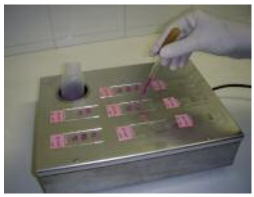
It is a good criteria, recording the location and type of vegetation nearby the building on which is placed the sampler, in order to understand the origin of the pollen found on the slide. In order to select the position of the sampling station it must be privileged areas away from public parks and industrial emissions.

Crucial: overestimation of the results can be due to the vegetation nearby the place of sampling



2. Preparation of the surface of sampling (use of Melinex of 340mm of lenght to be able to monitor for seven days, tape is made sticky from a solution of silicone in carbon tetrachloride, 3%)

The surface of sampling is designed as a plastic transparent not absorbent film transparent (Melinex) long 340 mm for one week. This tape is prepared by fixing a thin film of silicone fluid on the surface that gives adhesive properties, in order to retain the particles on the surface and avoiding the loss for dragging or springing back due to the air flow. To keep sticky the surface is used a 3% solution of fluid silicone (polydimethylsiloxanes) (2,500,000 centistokes viscosity) in carbon tetrachloride. The high viscosity fluid silicone maintains unchanged its physical and chemical properties within a range of temperature between -20 and + 125 °C.



The tape should be coated using a brush abundantly imbued with the solution, the brush should wipe the tape once, slowly but firmly. The rapid evaporation of the solvent makes the distribution of the silicon homogeneous despite the possible excess of the solution. The limited amount of the solution applied may compromise the result of sampling. It is advisable to carry out this operation under hood or in a ventilated and dust- free place.

The painting brush must be smooth and flat, of 15 mm of width (made from marten). The use of bigger and harder brushes to coat larger surfaces (e.g. common brushes from painting) produce layers of dyshomogeneous thickness. The sampling surfaces prepared must be stored in a dust-free place until using it (no time limit).

In alternative to this method, is possible to use the SILKOSTRIP product by Lanzoni srl. or Mowiol by Burkard Manufacturing CO Ltd.

Crucial: the tape must perfectly adhere to the drag system to prevent alteration in sampling efficiency caused by wrong distance between the tape and the opening system which will lead changes in the air flow. The silicone film must be as uniform as possible to avoid different focal levels.

3. Preparation of daily samples (cutting portions of Melinex by 48mm corresponding to 24 hours monitoring, use of thermostatically controlled plate (40-50°c), use of basic fucsin melted in a water bath, create labels and coverslip);

Samples preparation
Once the tape is removed from the drum it is laid on a graph paper (cutting block) and cut with a knife in 48 mm long stripes, corresponding to the days of the week. Each stripe of 48 mm, corresponding to daily sample, is laid (with the layer siliconized upwards) on normal microscope slides. Some drops of glycerine jelly previously melted in a water bath are put between stripe and slide. In this way the strip of 48 mm is fixed on the slide.
Thereafter some drops of coloured jelly (3-4 gtt) are applied on the stripes and covered by a coverslip.
Glycerine jelly and coloured jelly are prepares as follows: 10 g jelly + 60 ml water + 55 ml glycerine + about 2 g phenol. In coloured gel are added some drops of basic fuchsin in saturated aqueous solution (Ogden et al., 1974).
So the tape remains incorporated between two gel layers and two glass-slides. The slides are kept about 30 minutes on thermostatically controlled at 40-50 °C plate to facilitate the gel flowing and remove any air bubbles. The microscope lenses, the glass-slides and coverslips, the glycerine jelly and the sampled tape have the same index of refraction in order to reduce the dispersion of the light and get a good vision. Lastly, the glass-slide is labelled on the left side and dried in horizontal position for few hours before the analysis under the microscope.

Crucial: the temperature of the water bath must be adeguate to the melting of the gels used. At the same time attention must be paid in not forming air bubbles between the surface of the sample and the cover-slide.

4. Examination of the samples (Samples are observed under the optic microscope with different magnification range (200X-400x), statistical counting of the granules, counting methods, minimum percentage of reading

Samples examination
The samples are examined under optical microscope at different magnifications. In the routine calculations is recommended the 200X magnification, however, the 400x magnification is currently used by many operators especially in the learning phase of different particles.
Generally, the pollen count is not made on the whole surface of sampling of 14x48 mm, but is made on a fraction of the entire deposit (statistical count). Therefore, the glass-slide is examined on parallel horizontal lines (the largest side of the slide) with the technique of the continuous field under the microscope.
The technique of the continuous field can be described by the following procedure:

- Count the entire field
- Moving the slide from right to left side through continuous rotation of the micrometric screw.
- Read progressively without stopping.

It has been established to choose horizontal lines of reading since changing in pollen concentration during the day is along this axis (sense of scroll of the tape in the sampler); the position of the horizontal lines must be uniformly distributed and should not coincide with the upper and lower edges of sampling surface.
The minimum number of horizontal lines of reading, must correspond to an area equal but not less than 20% (approximately) of the sampled surface.The accuracy of the measure will be proportional to the number of lines of reading.
The total of counts, broken down by pollen species, are entered on count form.
Normally, the aim of the count is calculating the daily average of certain type of pollen, but at the same time, with the same pattern of reading, is possible to obtain hourly average preparing the system of registration in a proper way.
The conversion of the data from counting values to concentration values (number of pollen per m3 of air) may be made through the use of simple calculation programs, or manually with the procedure described below.

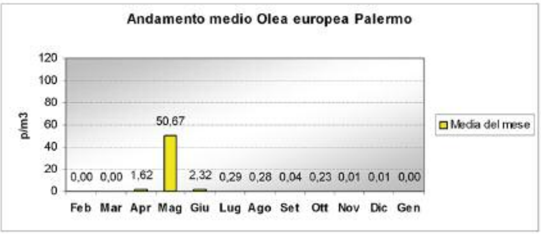
Crucial: the position of horizontal lines must be uniformly distributed and should not coincide with the upper and lower edges of the sampling surface.

5. Calculation of atmospheric concentrations pollen (collection of data in counting modules and calculation of pollen for air cubic meter)

The data are expressed as daily average concentration from 0 to 24hours (p/m3).
The pollen count values, relating to the explored surface, are extrapolated for the whole surface of sampling. For this calculation we need to know the diameter of the microscope field used for all the readings carried out on the sample.
The diameter of the microscope field can be made correctly only by using the micrometer screw that consists of a micrometric scale photoengraved build on microscope slide (generally 2 mm divided into 200 parts of 10 micrometres division).
The value of the diameter depends on the magnification used.

Necessary data for the calculation

- Diameter of the microscope field expressed in mm (e.g. 0.6 mm);
- Number of horizontal lines of reading;
- Number of granules, by type of pollen, identified on the entire region under exam (e.g. 360 pollen of grasses);
- Method of reading and Area of sampling (14x48 mm^2);
- Volume of air sampled (14, 4 m^3 day)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p/m3
Media del mese
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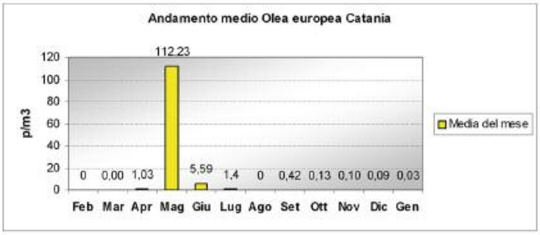
Feb Mar Apr Mag Giu Lug Ago Set Ott Nov Dic Gen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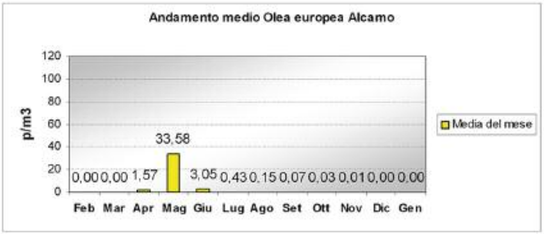
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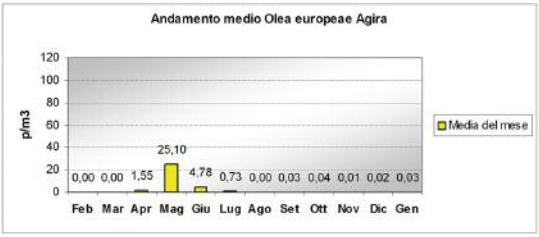
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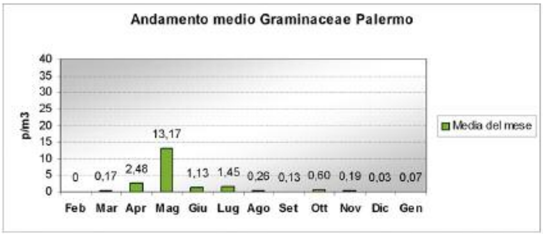
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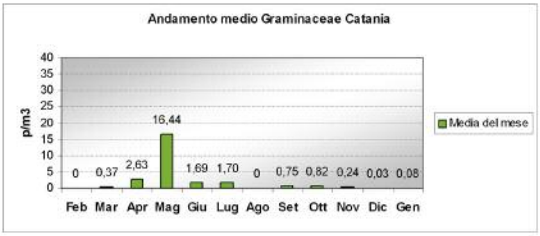
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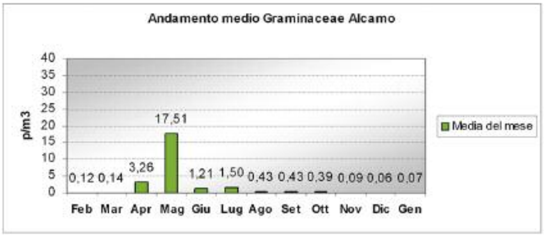
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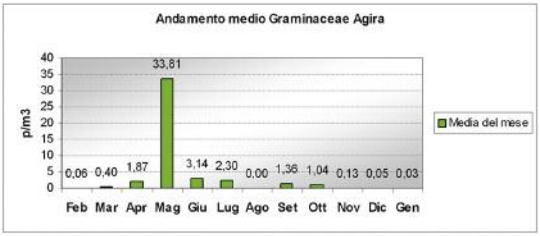
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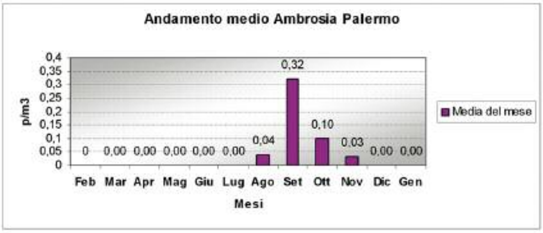
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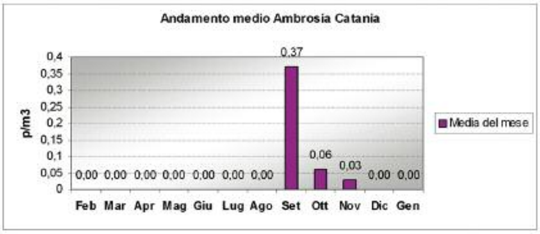
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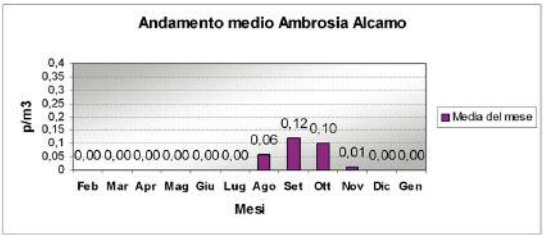
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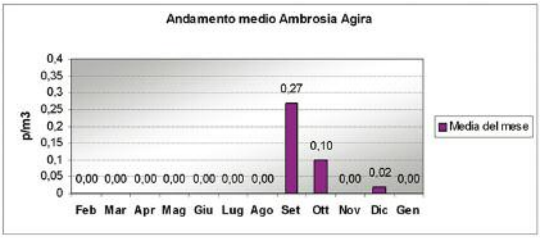
Mesi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p/m3
Media del mese
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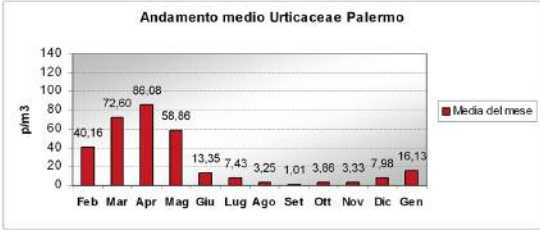
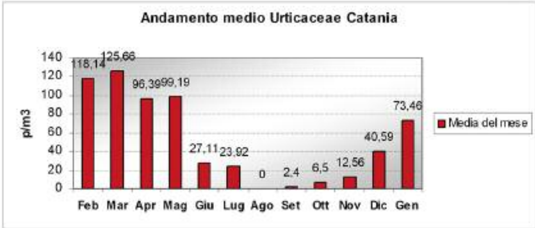
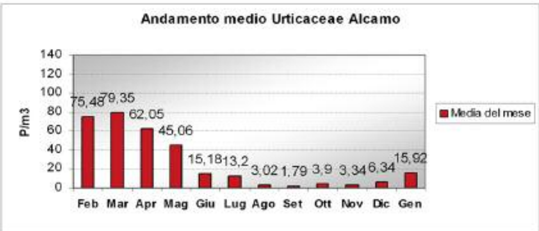
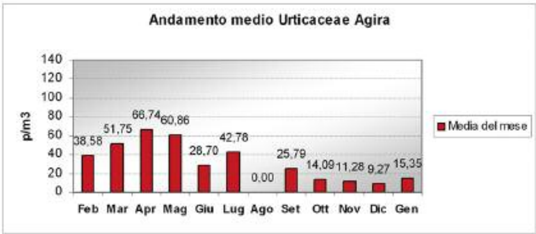
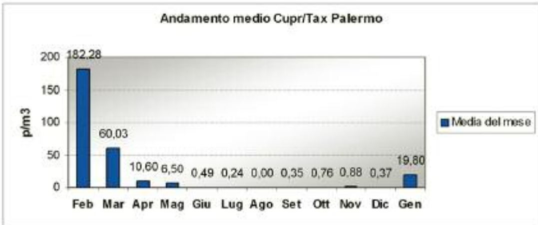
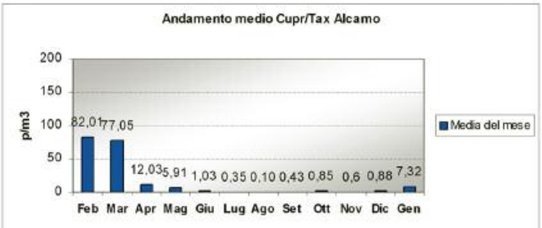












Example of calculation
Reading by continuos dragging

• Total area examined
Field diameter (in mm) x 48 x on number of dragging sample
es.: 0,6 x 48 x 4 = 115,2 mm^2

• Relationship between region sampled/region examined
es.: (14 x 48) / 115,2 = 5,8 (continuum method)
In this example the region examined is 1/5, 8 of the area of sampling

• Calculation of the air collected in a day:
10 liters/min x 60 min x 24 hours = 14.4 m^3

• Count of the conversion factor factor to report the value at 1m^3 air:
es.: 5,8/14,4 = 0,40

The sampler type, Hirst, collects 600 litres/hour, equal to 14,400 litres a day or 14, 4 m^3/day

• Calculation of the of daily pollen concentrationes.: 0,40 x 360 (n. read pollens) = 144 p/m^3

We defined the diameter of the microscope field while all the other values remain constant, with the exception of the counts;We use the same conversion factor to calculate all daily average concentrations. In the counting procedures, above mentioned, is recommended to make an approximation to the nearest first decimal number and not to the whole, as the final value. Because the atmospheric pollen concentration may have a completely different meaning when the values are less than 1; in this case, the first decimal number allows us to detect the presence of a type of pollen which otherwise would disappear from the results. This procedure is very important, either in the manual that in the automatic calculation, especially in the beginning of atmospheric dispersion phase of the pollen.

Crucial: the count of atmospheric concentration may undergo to errors introduced in operational phases like microscope counting of the particles and calculation of the atmospheric concentration.

Biodiversity

Aerobiological monitoring application about biodiversity studies make possible to evaluate modifications of local flora, using pollen identification.
An example of plant that has been by mistake introduced in the mediterranean area is Ambrosia (Compositae). It is an overgrowing grass very resistent to the pollution and gives allergic reactions. Higly spread in the northen Italy but slowly moving to the southern (about 6 Km for year)
Ambrosia pollens is present, in particular, in the northern part of America.
During the last years of XIX century, probably due to seeds contamination, the plant has stated to diffuse in Europe. So far, the Ambrosia growing areas are present in France and the centre-east lands like Ungheria.
In Italy the plant is present in the northern, especially in Lombardia and Friuli.
The pollen grain is small and the plant has the capacity of high pollen production. This feature makes Ambrosia one of the most important plant under allergic point of view.

The experience at ARPA Emilia Romagna in the field of pollen monitoring

Stefano Marchesi

Regional Agency for Environmental Protection of Emilia Romagna
Italy

Introduction

The present document deals with an overview of the various activities developed during recent years at ARPA (the Regional Agengy for Environmental Prevention) in the Emilia Romagna region (ARPA-ER in the rest of the text). First, the activities in the field of pollen monitoring, which are suitably summarized through the review of the content of ARPA-ER pollen website, are described.
In addition, the activities related to the development of a pollen forecasting models are presented; this subject has been started more recently. Among the possible types of models, the so-called neural networks has been selected, since they have proved to be a powerful and robust numeric tool in many fields of application.
The purpose of the use of neural networks in the framework of the problem of pollen forecasting is mainly due to the possibility of neural networks to reproduce the day-by-day variation of the concentration according to a meteorological forcing, as it was already shown in literature. From this point of view, this could be a way to implement a true forecasting model once it is observed that such a tool is able to reproduce the main features of the observed time-series of pollen concentration in terms of both the day-by-day variation and the corresponding statistical properties (such as number of days above a certain threshold during a whole season, starting and ending date of the pollen season, peaking value of the season, etc.).

Pollen monitoring at ARPA Emilia Romagna

ARPA-ER is involved in the field of pollen monitoring since more than 15 years. The activity in this field can be usefully summarized according to the contents and to the sections of the official pollen website (web address: http://www.arpa.emr.it/pollini).
ARPA-ER pollen website has undergone a major revision during 2007 and since October the new version of the website is online. The main objectives of the revision were to enrich the information already present in the previous version as well as to make the existing contents easier for the public. The aspect re-

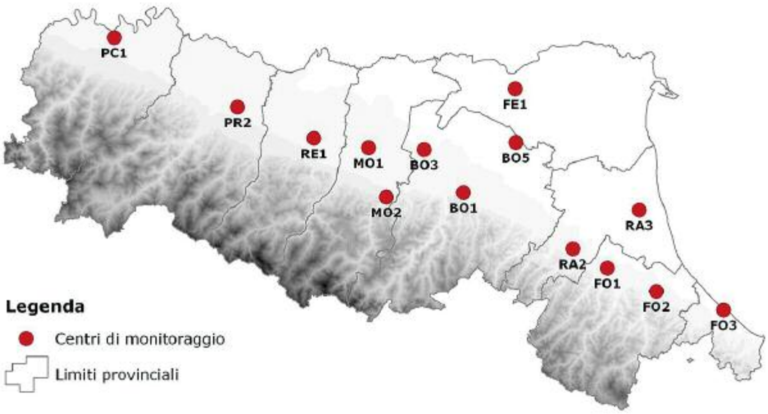


Figure 1
ARPA-ER pollen monitoring network (on the left) and an example of the volumetric sampler VPPS 2000 Lanzoni located at the stations (on the right)

lated to the communication of the information has always been of primary importance in the development of various ARPA-ER activities and all the more reason in the field of pollen monitoring. The diffusion of the information set up one of the guidelines for the planning of the revision itself. In fact, the categories of people who regularly consult the website are very diversified, ranging from medical specialists and family doctors, to chemists interested in the current diffusion of pollen, to researchers from various institutes, as well as allergic people who only want to be informed about the pollen situation in a certain area and during the course of the year. Dissemination of products is non restricted to the web, since also fax, teletext and local newspapers are used in order to reach most of the population.

Among the products a largely diffused PDF bulletin is issued every Tuesday afternoon, including all the various information related to pollen monitoring collected at a number of sites covering the whole Emilia Romagna region; ARPA-ER network of stations is reproduced in figure 1. The network works during the whole year and is made up of 14 monitoring samplers: 10 of them are managed by ARPA-ER itself (PC1, PR2, RE1, MO1, BO1, FE1, RA3, FO1, FO2, FO3, all of them located in urban environment), while the other 4 of them belongs to different institutions such as University, AUSL, research institutes ((MO2, BO3, BO5, and RA2). The sampling method is based on AIA standard (official project code U53000810). Data from the samplers located at the different monitoring stations are collected from Monday to Sunday on the week previous to the emission of the bulletin. Data are then read and stored on a database from which they can also be downloaded. The main body of the bulletin is made up of the data collected at the various stations, as well as a regional summary of the situation for the different pollen families: pollen concentrations are converted into concentration classes based upon the values elaborated by the Institute of Atmospheric Sciences and Climate of the National Research Council (ISAC-CNR) located in Bologna: the available concentration classes are "absent", "low", "medium" and "high". Data collected at a

subset of the previously listed stations are now available also on RIMA (the acronym for the Italian Network for Aerobiological Monitoring) website (web address: http://rima.siag.it/Default_it.aspx).
In addition a sinthetic pollen concentration forecast is shown in terms of tendency to stability, increase or decrease of pollen concentration; at the moment the tendency is basically derived from the meteorological forecast for the same week and to the phenological data of the current period of the year when the bulletin is issued. The future plan is to integrate the results from a pollen forecasting model, based on a neural network strategy, which is currently under development at ARPA-ER in order to have more detailed information available to make up the forecast.
In the following some specific sections of the website will be presented and described in more details, with particular reference to the contents of the site which are related to peculiar activities developed at ARPA-ER with the cooperation of the various units of ARPA-ER. Again in the framework of the importance of communicating the information related to the presence of pollen in Emilia Romagna a consistent effort was addressed to a systematic development of botanic information taking the form of online cards: these cards collect the information on the various botanic families which are present in the regional territory and contain both the essential information in order to recognize such families and the species belonging to the families themselves, including several pictures, and some hints more specifically related to their allergenic effects, such as the flowering calendar based on climatologic data and the diffusion in the various types of the natural environment.
Another very important aspect, which is contained in an ad hoc section of the website is related to the comment which is periodically issued by a medical specialist in allergology; the comments deal with specific subjects which may be of particular interest for allergic people. The topics covered up to now can be summarized as follows:

- health effects on allergic people, including:
  - the explanation of the importance of symptom prevention and of a correct therapy;
  - an overview of possible types of therapy;
  - the description of the link between pollen monitoring and therapy;
  - the interaction between allergy and food;

- effects of climate change and of unusual meteo-climatic conditions, such as:
  - the presence of "new" botanic species and/or families in Emilia Romagna region depending on modified meteo-climatic conditions;
  - he particular mildness of winter 2006-07, which had a very relevant impact also on allergic people.

The basic importance of such an approach is certainly linked to the very large incidence of pathologies of allergic origin in many layers of the population, in particular children living in urban areas, and a great effort must be devoted to the analysis of the relationship between pollen monitoring and the health impact that such diffusion have on the population living in a certain area.

Pollen forecasting models based on neural networks

Numerical forecasting is a field which is receiving an always increasing interest also for pollen simulation for many reasons, such as the large diffusion of pathologies which can be related to allergic symptoms and the importance of an early warning system, especially for those environmental situations when severe conditions will probably occur. There may be different levels of forecasting which can be set up. The first level of forecast is the so-called calendar forecast, which is based on the computation of the multi-annual trend of flowering and/or pollen concentration at a certain site; obviously, this approach is not able to modulate variations related to the phenological and meteorological conditions which may developed according to the distinctiveness of a certain year. Then, there are actual forecasting models, which can be classified according to the types of output they produce: in other words, there may be point models, reproducing the situation at a certain point in space, spatial models, reproducing a specified portion of territory, or temporal models, reproducing a temporal cross-section of the pollen situation.
According to the features of the models, they can be classified in:

- empirical models, which are based on statistical analysis, thus providing estimates of pollen data starting from long-term records of pollen and meteo-climatic data;
- simulation models, which are set up in order to follow the history of the pollen grains based on transport equations, starting from the production and emission in the atmosphere, the dispersion and, finally, the collection in the sampler (a sub-model structure is requested in order to take into account the various phases of the pollen transport from the sources to the samplers).

Both of the previously outlined model categories has obviously advantages and disadvantages. As for simulation models, the numerical solution of the transport equations allow them an outstanding predictive quality, since the phenomenon under consideration (the pollen diffusion in this case) can be reproduced in a very detailed and precise way. The counterpart is the enormous complexity of such models for various reasons: the complex design of the model structure, the huge amount of data requested, both in terms of the spatial and temporal extension. As for the empirical models, it must be underlined that such models are relatively simple and the presence of a robust link between pollen and meteo-climatic data allows the implementation of these models under very different conditions (geographical regions, pollen seasons during the year and so on). On the other hand, the need for long and homogeneous time series both of meteorological and pollen concentration data is a very strong constraint to the forecast ability of such models and the actual availability of good-quality dataset in order to obtain a robust statistical relationship is not always the case.
Among the statistical models, a remarkable interest was devoted quite recently to the exploration of the neural network strategy, which is briefly outlined in figure 2. Units or cells simulate the nervous cells, receiving a pattern of information on input, elaborating it and producing an output value, while the connections simulate dendrites and axons, linking the various units through a

variable value (a “weight”). Basically, neural networks are non-linear, semi-parametric regression techniques. The non linearity is due to the activation function of the cells; the only parameters to be tuned refer to the topology of the network and to the training procedure. The network considered for the current activity is the so-called, very popular feed-forward multi-layer perceptron (usually called also MLP) in which we have:

- an input layer, which is made of as many units (cells) as the independent variables are;
- an hidden (or more) layer, which is actually optional;
- an output layer which is made of as many units as the dependent or output variables are.

The topology of the structure distributes the information among the cells and modulates the various contributions by means of the weights. The modifications of the weights amplify or reduce the importance of initial data. The computation of the weights through an iterative process is performed until a certain tolerance is reached. The available observations are split into two periods:

- the “learning” period of the procedure, which is used in order to train the network according to a subset of the available observational data referring to a certain site: in this phase the network develops the weights to be attributed to the cells of the input layer in order to find out the importance of the different variables;
- the “test” period of the network, which is used in order to apply the model to unknown patterns, which were not considered in the building of the network: this phase gives an estimate of the forecast ability of the procedure.

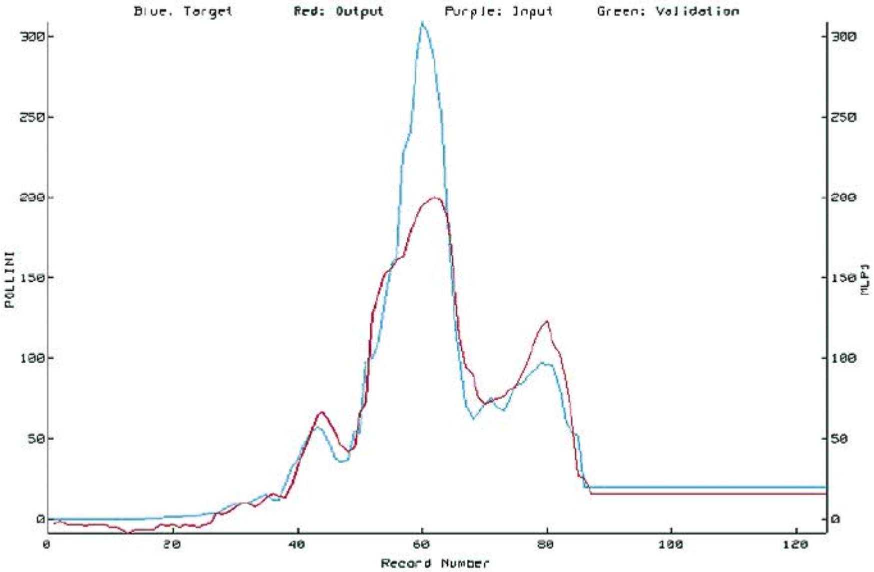
Neural networks share the advantages and disadvantages of the other statistical models: in general, this tool can be very useful for the analysis of cases in which non-linear relationships are present and when the complete dynamics of the problem is not clearly understood; on the other hand, the consequent “black-box” behaviour of the network usually gives birth to a very difficult design of an optimal structure of the network itself, since the topology and the training procedure must anyway be tuned for the specific problem under consideration.

Results, conclusions and possible developments

Input variables for the pollen forecasting models were selected among meteorological variables. First of all some of the variables are directly measured by a meteorological gauge and they are called “primary” variables; among them temperature, relative humidity (minimum, mean and maximum values for temperature as well as relative humidity were tested) and rainfall. For the time being wind was not taken into consideration, neither intensity nor direction. Another series of derived meteorological variables (hence called “secondary” variables) was also taken into consideration; examples of secondary variables are: temperature sums (degree-day) above different thresholds, cumulated rainfall during

Figure 2

Performance of the neural network on a 1-year test data set [2].



a fixed previous number of days; the number of days with rainfall and/or temperature over a certain threshold; the number of hours with temperature over a certain threshold; the water deficit based on an empirical formula to compute potential evapo-transpiration (the so-called Hargreaves formula). In addition, past pollen concentrations were also used as an auto-regressive component and periods of different lags have been considered in order to verify the possibility to insert also these input variables in a situation where an actual forecast for the next days is going to be issued, depending on the availability of the observed data of pollen concentration at the monitoring stations when the pollen model is effectively run.

The output layer from the neural network applied to the forecasting of pollen is the daily concentration in number of pollen grains per unit volume; an example of an application of neural networks is shown in figure 3. A very good agreement between pollen concentration and meteorological situation is clearly present in such result (referring to the site of Bologna) though the neural network tends to underestimate the observed peaking values. Since that a lot of other simulations were performed using the longest available data from other Emilia Romagna monitoring stations and also from different pollen families in order to tune the neural networks for the specific problem.

The comparison between forecast and observed daily concentration is not restricted to the analysis of the time evolution of the forecast and observed curves. According to the output results, other features were compared, in particular the advance/delay in the forecast of the day when the pollen season starts and ends and of the day when the peaking value of the season is shown by the model with respect to the corresponding observed values. For the time being, the start of the season is well reproduced, while the corresponding end shows a longer difference in days between simulated and observed. Again, a certain underestimation of the peaking value is still present, but it must be taken into ac-

count that an efficient communication to allergic people is probably more interesting in terms of prediction of pollen variations at a certain site rather than the exact concentration values in a preventive measure framework.
The results obtained have put into evidence that there is a strong dependence on the various sites under consideration and on the meteorological condition of the test year(s). Although the site-dependence is somehow implicit in the meteorological information which is supplied to the neural network, an important remark is related to the possible different quality of the data (in terms of length of the observed records and of availability of meteorological data at the proper location to represent the meteorological conditions of the specific site). This is probably suggesting that the length of the period is of outstanding importance in determining the better or worse quality of the result.
A possible field of interest could also be related to the test of a real forecasting suite, in order to have a quantitative estimate of the forecasting ability of the model based on neural networks in case a forecast for the next following days is actually requested.

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Measurement uncertainty and data quality in aerobiology

Emanuela Zieger

Environmental Protection Provincial Agency of Bolzano
Italian Association of Aerobiology
Italy

Aerobiology is the science that studies the airborne biological particles, their origin, transport and deposition in relation to meteorological conditions and their effects on living systems and on the environment. Aerobiology has marked characteristics of interdisciplinarity with applications in public health, agriculture, plant pathology, palynology and many others.
Traditionally one of the main goals of aerobiology is to measure and report quantities of airborne pollen and fungal spores as service to allergy sufferers (Figure 1). World-wide the various aerobiological monitoring networks adopt different protocols to estimate the atmospheric concentrations of pollen grains and fungal spores.

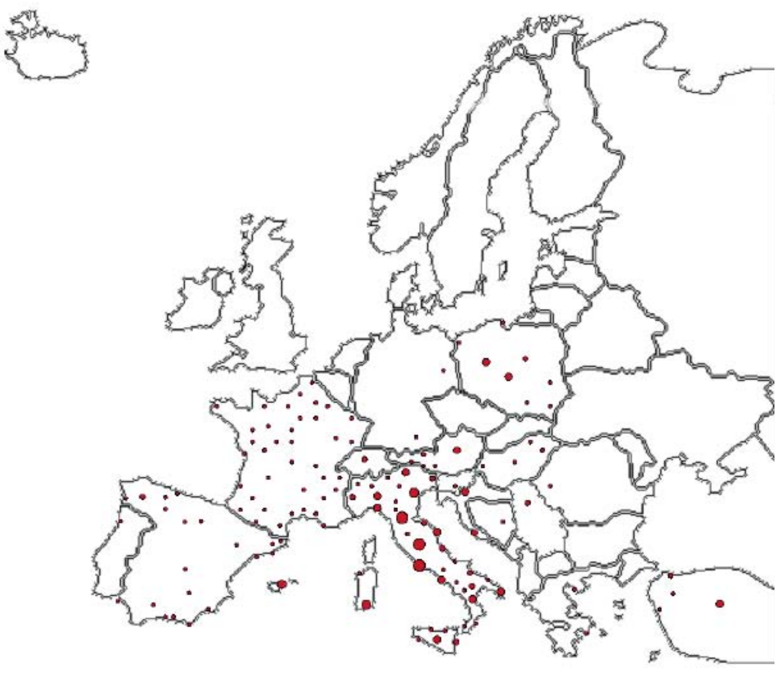

Figure 1
Overview of European aerobiological monitoring stations - Red dot size is proportional to number of samplers (Lanzoni VPPS 2000), which are present in a given area (image provided by Dr. Lanzoni).

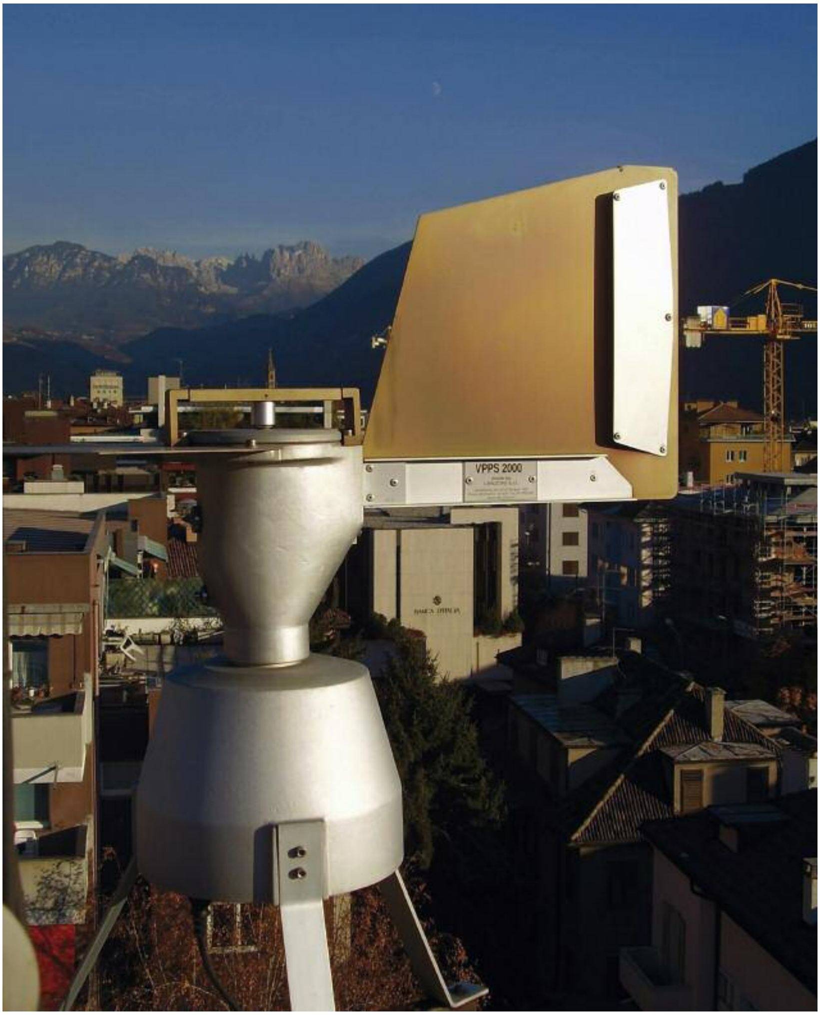

Figure 2.
Hirst-type continuous volumetric pollen sampler - Monitoring station of Bolzano (South Tyrol - Italy).

At present several testing laboratories apply a quality management system and act according to the management and technical requirements dictated by the UNI CEI EN ISO/IEC 17025 standard. Accreditation is the formal recognition that a testing laboratory is competent to carry out specific tests and able to produce accurate, reliable and consistent results using validated methods. In this context the measurement quality plays a central role, nevertheless the measurement uncertainty and the data quality do not appear maybe as being exhaustively treated in the field of aerobiology.
The principle of the methodology is always the same: the air to be analyzed is captured by a vacuum pump and, through an orifice, is directed to a suitably prepared collection surface, where the particles contained in the air end their trajectories, depositing by impact. Afterwards the sampling surface is examined with an optical microscope for the identification and count of the captured particles. The counting of the pollen grains does not occur over the whole slide (48 x 14 mm), but only over a small portion of the daily microscope slide (sta-


NORMA ITALIANA

Qualità dell'aria
Metodo di campionamento e conteggio dei granuli pollinici e delle spore fungine aerodisperse

UNI 11108

AGOSTO 2004

Air quality
Method for sampling and counting of airborne pollen grains and fungal spores

CLASSIFICAZIONE ICS — 13.040.20

SOMMARIO — La norma descrive un procedimento per la misurazione della concentrazione dei granuli pollinici e delle spore fungine disperse in atmosfera. È applicabile per indagini in atmosfera libera o in ambienti confinati, a concentrazioni minori di 10^4 particelle al metro cubo di aria.

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Gr. 4 UNI 11108:2004 Pagina I

Figure 3
UNI 11108:2004 standard – Italian official reference method for sampling and counting of airborne pollen and fungal spores.

tistical count). The slide reading can be regarded as a sub-sampling (of a surface), which follows the first sampling relating to a small part of the atmosphere (14,4 m^3 per day). The concentrations obtained at the end represent an estimation of the true value and as for any estimation, it is tainted with error.
All monitoring stations use the sampler proposed by Hirst (Figure 2) and recommended in 1972 by the International Biological Program which applies the above described principle. On the contrary, the slide observation protocol is different between the several national networks. Also the slide sampling method (longitudinal, transverse or random) and the number of lines (or fields) can differ. Furthermore, the samples are examined with the optical microscope at variable magnifications.
The International Association for Aerobiology recommends for the screening of slides the reading at magnification 400x minimum of 3 longitudinal bands or at least 12 transverse (vertical) bands or minimal 500 random fields.

An official reference method from UNI (Ente Nazionale Italiano di Unificazione) for sampling and counting of airborne pollen and fungal spores exists in Italy since 2004: the UNI 11108:2004 standard, Air quality "Method for sampling and counting of airborne pollen and fungal spores" (Figure 3). This method can be applied for both outdoor and indoor surveys in the concentration range between 0 and 104 particles per m^3 of air.

The standard defines the slide reading protocol. The samples are examined with a magnification that can vary according to the situation: in the routine counts the 250X is recommended, nevertheless the 400X can be used by operators during the learning phase of the different type of particles recognition. The slide is examined on parallel (longer side of the slide) horizontal sweeps with the technique of the tangent fields or of the continuous sweeps. The choice of horizontal sweeps is due to the fact that the variation of the concentration during the day can be observed along this axis (direction of the shift of the tape in the sampler); on the contrary, the counts done only by vertical sweeps (parallel to the shorter side of the slide) are strongly influenced by the choice of the lines (e.g. a vertical sweep can casually be positioned on a point of high concentration of particles) and subsequently influence the final result expressed as average daily concentration. The minimum number of horizontal sweeps is the one that assures a total observed area which is at least 20% of the sampled area. A 2006 Italian monitoring station survey has showed that it is observed on average 13.1% of the sampled area; the maximum and the minimum discovered values correspond to a percentage respectively of 24.6% and 10.3%.

The chosen slide reading method determines the accuracy of measurements. Accuracy and precision are characteristics of a measurement. Accuracy is the conformity degree of a measured or calculated quantity to its actual (true) value. Precision is the degree of how much further measurements or calculations show the same or similar results.

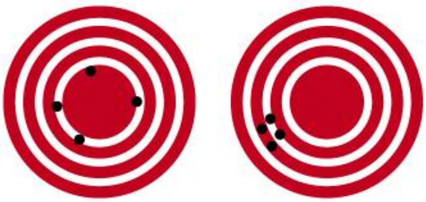
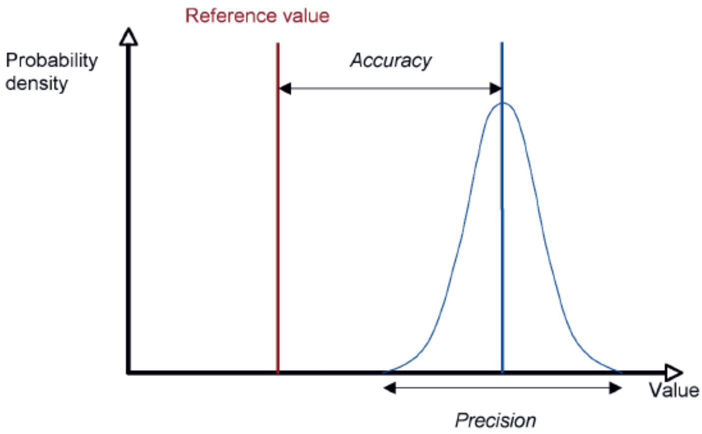


Figure 4

Target analogy related to the accuracy and the precision of a measurement – High accuracy, but low precision (left), high precision, but low accuracy (right) (from Wikipedia).

The target analogy can explain the difference between accuracy and precision. Repeated measurements are compared to arrows that are fired at a target (Figure 4). Accuracy describes the closeness of arrows to the target centre: arrows that hit closer to the bull's-eye are considered more accurate. Precision is represented by the size of the arrow cluster: when all arrows are grouped tightly together, the cluster is considered precise since they all hit close to the same spot, even if not necessarily near the bull's-eye. The measurements are precise, though not necessarily accurate. Figure 5 shows a statistical view of accuracy versus precision.

Figure 5
Statistical view of accuracy versus precision (from Wikipedia)



The measurement of atmospheric concentration of pollen grains and fungal spores is subject to errors introduced in the following operative phases: the microscope count of the particles and the calculation of the atmospheric concentrations. In the counting phase, the error is determined by the accuracy of the counting itself and by the uncertainties in the identification. In the phase of the atmospheric concentration calculation, which is the passage from the values obtained by counting and the values estimated, trough calculation, for the whole sampling surface, an error is detected which depends both on the number of particles counted and on the observed area/sampled area ratio.
The precision of the measurement is determined in the counting phase and is estimated around 10% of the counting value of each type of particle.
The specificity of the measurement depends on the ability of the operator to correctly recognize a certain type of particle present in the sample. Assuming that the operator is perfectly trained, the specificity is considered 100%.
The accuracy depends on the size of the sample, which is represented both by the percentage of the sampled area that is observed and by the particle density. The UNI 111108 standard contains the relation to determine the error on the estimated concentration value, which has been obtained experimentally by modifying the relation proposed by Comtois et al., (1999). It is a negative exponential function and can be expressed as:

$$E\% = 128 - 34.2 (\ln COUNT) + 2.3 (\ln COUNT)^2$$

where ln is the natural logarithm and COUNT is the number of particles of a certain type counted in the observed area.
The committed error is higher for low count values; some examples are reported in the following:

Count = 10 pollen grains	E% = 62%
Count = 100 pollen grains	E% = 20%
Count = 1000 pollen grains	E% = 2%

Since the difference between the real value and the calculated value is greater in conditions of low concentration (few particles per field) and low number of sweeps examined, the Italian standard enunciates that the minimum number of

reading horizontal sweeps is the one that assures a total observed area which is at least 20% of the sampled area. It is believed that in this way the average error appears acceptable in case of in the sample under-represented pollen types.
A regular control of the instrument is required by the UNI standard to guarantee:

- constant flow with flow rate at 10 l/min, equivalent to 14.4 m^3 in 24 hours at standard temperature and pressure and 50% of relative humidity;
- constant distance between the collecting surface and the internal side of the intake orifice (0,7 ± 0,05 mm); this distance determines, if other conditions are equal, the capture efficiency;
- constant velocity of advancement of the collection surface (2 ± 0,02 mm/h).

The reason appears clear when the data for the calculation of the atmospheric concentrations are considered:

- diameter of the microscope field in mm;
- number of horizontal sweeps;
- number of pollen grain, for each pollen type, identified on the whole observed area;
- method of the count (tangent fields or continuous sweep);
- sampling area (14 x 48 mm2);
- volume of sampled air (14.4 m3 per day).

In conclusion, we never know the whole biological population of a certain volume of air. We can only estimate it, and as for any estimation, it is tainted with error. Pollen counting is just the last step of a chain of successive approximations, where each stage represents a sub-sampling and produces a decrease in the accuracy of the ultimate representation. Our knowledge of the aerobiological content is based on partial observation and it is only through statistical inference that we can reach conclusions. These conclusions therefore have limits. We must agree on an acceptable sampling error before we can determine an acceptable slide reading protocol. This decision must also be based on the expected use of data we are collecting: allergy risk forecasts don't need probably the same degree of accuracy and precision desirable for regression analysis purposes or biogeographical and dispersal studies. No counting method can be satisfactory for all taxa all the time.
The existence of an official reference method is very important for the quality and the comparability of data arising from aerobiological monitoring. The publication of the UNI 11108 standard established univocally the percentage of sampled area the operators must read. There were only general indications previously in Italy: 12%, 10-12% of the sampled area. It is required a great effort from the operators to reach the by the standard fixed value. Not all Italian monitoring sites follow the official reference method. We found criticalities, due to which maybe it will be necessary to require a revision of the standard. We need for some features related to the sampler the collaboration with the builder.

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Launching the ATMOSnet Website

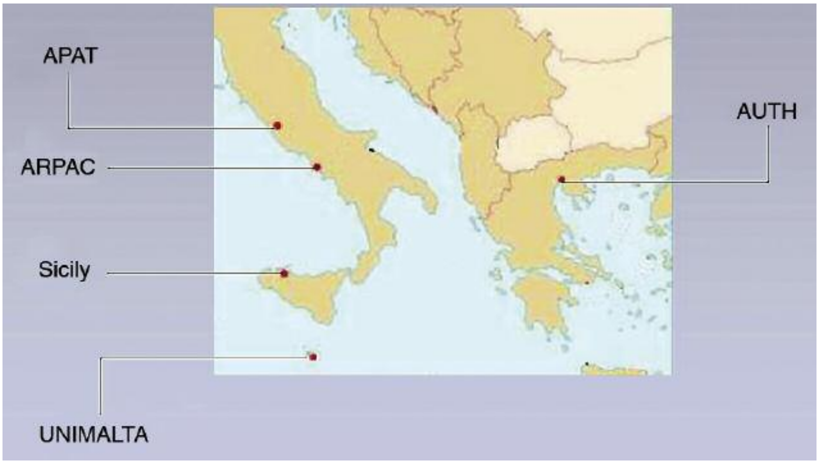
Everaldo Attard

University of Malta, Institute of Agriculture - Malta

As one of the major deliverables of the ATMOSnet project, the University of Malta, was given the responsibility to launch and maintain a website, for the duration of the project and beyond. The aim of the website was to secure an ongoing communication between partners with in the project and to disseminate information to potential beneficiaries, including inhabitants living in the monitored areas, farmers using the land for agricultural purposes in the monitored areas, public bodies responsible for the identification of mitigation measures, the European Commission for the implementation of a common standard among Europe and the scientific community in climate change research. This could be achievable only through the regular publication of new material and up-dating of exisiting material on the website.

Figure 1

Figure 2



To fulfil this deliverable, a part-time ICT expert was engaged with duties related to the website maintenance, and to facilitate the communication between partners, especially in case of ICT problems arising during the project period. An initial plan was implemented to devise which information pertained to the project partners and which information could be displayed to the general public. In fact, two website access modes were devised, one was termed as the public area, while the other the partners' private area. A password is required to access the partners' private area. This contains sensitive information such as

- Organogram with work package leaders' and task leaders' coordinates
- Unrestricted Project Deliverables area with completed work as well as work in progress
- Data access area giving access to all project results
- Collaboration Tools area
- Research material repository

The public access area is accessible without requiring authentication. Such information includes:

- Project information
- Partner information
- Marketing information
- Released Project Deliverables
- Released Project Results
- Early warning data
- Links to relevant sites
- Contact Us

The website is developed to meet EU norms. Typical website design parameters may be accessed at the following website:http://www.eionet.europa.eu/software/design. A prototyping development methodology was used to have a website with basic functionality up and running in the shortest possible time, but at the same time employing the best practices.

The information is stratified into three layers:

• Layer 1: Information on project (ATMOSnet) with special emphasis as an Interreg IIIB and Archimed programme.
• Layer 2: Interactive level, i.e. web tools and information for children and the general public, including FAQs
• Layer 3: The early warning system for the Eastern Mediterranean Region

When all the information was segregated into the two different accessibility areas and the three layers mentioned, the first step in the website setup was the creation of a homepage (figure 1). The home page is accessible through the link www.atmosnet.org. The homepage contains the following features

• The website has a 'quick links' section and 'detailed links' section.
• Description of the ATMOSnet project, including expected outcomes
• The current situation and problems related to drought and desertification

Layer 1 information includes background and problems, main goal and specific objectives and concrete outputs & expected results. Layer 2 information includes Frequently Asked Questions (FAQs), contact us (Feedback), an 'ask an expert link' and useful links and resources. The third layer includes the Early Warning System and the information to be collected over the whole year and preparation of models. This should be done before the results can be made public.

Due to the nature of the research, visual information could appeal more to the public. In fact, a page for the information on the pollen stations is being setup (figure 2). This will enhance the graphical representation of the monitoring sites and in the near future it is perceivable that for each monitoring site, information on the site and surrounding habitat will be displayed. This will be facilitated through a geographical positioning tool that will give the exact location

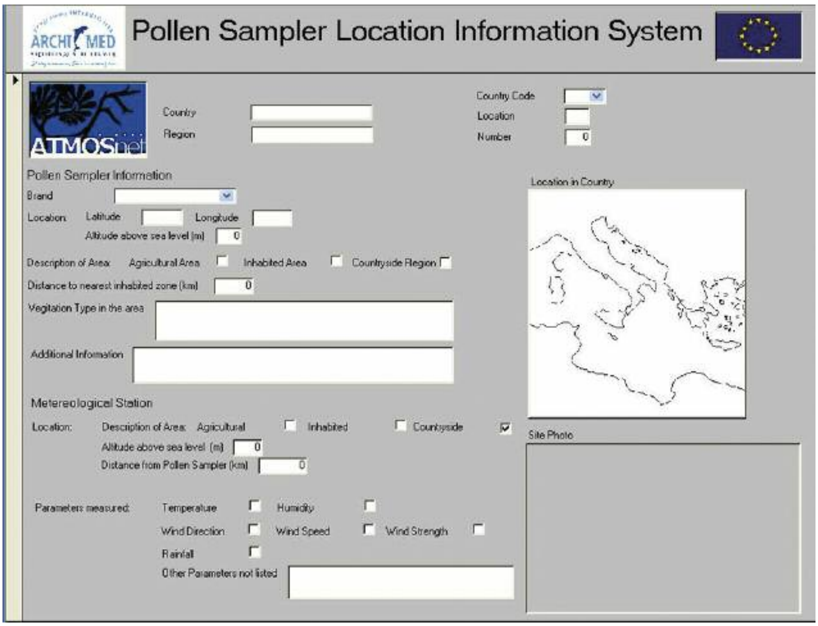


Figure 3

of the monitoring site on an interactive map of the Eastern Mediterranean. As a matter of fact, a questionnaire (figure 3) was distributed amongst the project partners to make an inventory of the pollen stations that are involved in the project and provide the necessary information that will possible affect the parameters mentioned on drought and desertification, human health and agriculture.

One of the features which is under discussion with the project partners is the uploading of information on the project's website and possible transformation of the raw data into a graphical format that will appeal to the public. There is the possibility of linking the ATMOSnet website to the Italian Aerobiological Association website to facilitate the uploading and restricted downloading of data.

It is intended that more information will be included in the public area. A typical example is the creation of a database for anemophyllous pollens, that will provide basic information and education on pollens and their characteristics, to the general public. Information of indicator pollens, considered during the research period of the project, will also be included.

Fulfilling the above-mentioned tasks will be detailed further in future ATMOSnet meetings. However, several suggestions may be proposed, but the main aims of the website are:

• The facilitation of communication between partners,
• Dissemination of information through the world wide web

The public area may be enhanced by including links to sites that publicise the ATMOSnet project, videoclips of interviews, short documentaries on project, material for public use e.g. pdf and other electronic material, "Contact us" for flyers, stickers, and other related material.

ATMOSnet project contribution within the framework of the expected climate changes in the Mediterranean area

Massimo Menegozzo

Regional Agency for Enviromental Protection of Campania - Italy

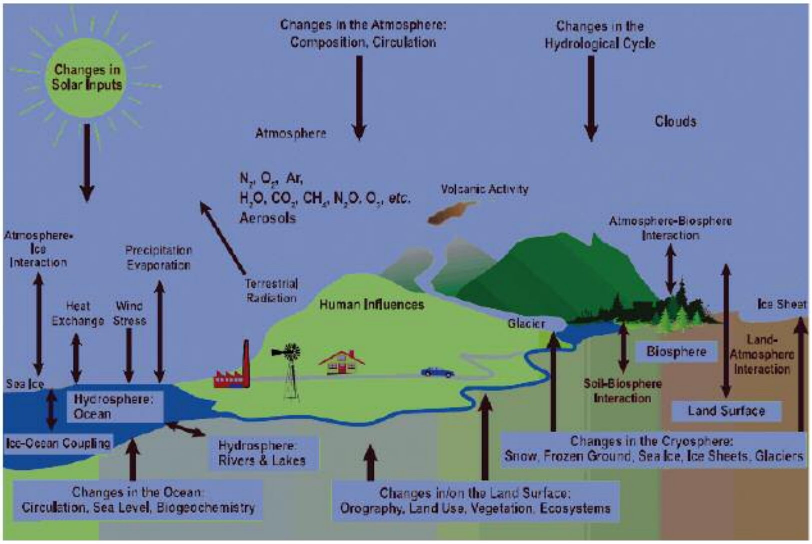
The main objective of ATMOSnet project in the presentation phase (2005) was to use pollen monitoring as a tool to assess the environmental impact induced by the expected climate changes in the Central Eastern Mediterranean area.
In that period the European Community recorded:

- a high concern on the long-term effects that man-induced climate changes would produce in the Mediterranean area and, specifically, in the central-eastern area that is more exposed to the global warming phenomena (drought and desertification in particularly vulnerable areas);
- an open debate on the reasons for the climate changes being recorded in the past decade; there was still an open debate whether climate changes were the result of a structural climate alteration induced by human activities or only the effect of a casual distribution within the major natural climate cycles of our planet.

We can maintain that in the year 2007 the assumption was clearly accepted that the potential climate changes of our planet are structural changes that can be often correlated to the man-made irrational activities that are destabilising natural reserves (with a specific view to green-house gases production).
Two events (occurred in 2007) have generated this degree of certainty and environmental alarm that requires suitable and global mitigation measures, along with adjustment measures to the risks resulting from the expected climate changes.

- IPCC Fourth Assessment Report
- Europe's environment - The fourth assessment

The outcomes of these two rigorously conducted research works confirm not only the existence of potential climate changes at world-wide level but also specify the extent of the impacts that will be generated by these changes in the different geographical areas of our planet.
Clearly enough the effects will differ according to the specific features of the different geographical areas, as a function of latitude, pre-existing geo-morphological features, mitigation measures implemented.
The Earth's climate is changing. The mean temperature – at world-wide level and in Europe – keeps on increasing. At world-wide level it has increased by 0.74 °C between 1906 and 2005. In Europe it is round 1.4 °C higher than the



temperature recorded in the pre-industrial period. The past decade was the warmest one in the past 150 years, while the years 1998 and 2005 were the hottest ones ever recorded (CRU, 2006; GISS/NASA, 2006; IPCC, 2007).
Mean global temperatures tend to increase by 1.8–4.0 °C, during this century; a number of studies suggest a possible wider range equal to 1.1–6.4 °C (IPCC, 2007). Likely enough Europe will be warmer in the eastern and southern areas of the continent.
The impacts induced by climate changes, including those on natural eco-systems, biodiversity, human health and water resources (e.g. drought and floods) are already visible and are becoming increasingly stronger.

In particular in the Eastern Mediterranean Area, that is the geographical area chosen by ARCHIMED Program, global warming phenomena are expected to become increasingly stronger generating an increase in drought and desertification phenomena.

Although from many points of view "global warming" is the result of natural factors, the latest scientific findings prove that in the past decades it was due to green-house gas emissions (GHG) generated by human activities (IPCC, 2007): carbon dioxide (CO2) mostly contributes (round 80%) to the total emissions of GHG, while methane and nitrogen dioxide contribute to a lesser extent. Substantial reductions in GHG emissions are required to keep the climate change-induced impacts at manageable levels.

The climate changes expected (based on IPCC studies), are not distributed and will not distribute homogeneously on the earth; they will have specific profiles by macro-regions.

In particular the central-eastern Mediterranean Area is expected to be particularly vulnerable to global warming effects, mostly potential drought and deser-

tification phenomena. However it is worth stressing that not all global warming effects are negative effects.
Modelling studies have actually predicted an agricultural production increase in central and even more in northern Europe, and a substantial decrease in Mediterranean and south-eastern Europe (Schröter et al., 2005). The main cause of the increase in agricultural production is due to CO2 increase and to changes in the agricultural potential.

Vice-versa, the expected agricultural production decrease in southern and south-eastern Europe is particularly linked to the extent and severity of the drought periods. It is clear that in front of the severity and inevitability of the environmental impact phenomena resulting from the expected climate changes it is paramount to implement the following:

• Mitigation

• Adjustment

Political decision-makers of the European Community are aware that the strategy to combat climate changes shall include long-terms strategies and substantial financial tools.

To implement these strategies more reliable forecasting models have to be developed to study: potential development of climate changes; expected impacts on the environmental matrices and, in particular the effects that might be produced by proper mitigation and adjustment measures.

The development of forecasting models is then a pre-requirement to understand the future development of climate changes, a topic on which a wide range of assumptions have already been made.

These assumptions include the emission scenarios illustrated in the IPPC Special Report.

A1. The cluster of scenarios A1 describes a future world characterised by a very rapid economic growth, with a peak of the global population in the middle of this century (that will then tend to decline), and a rapid introduction of new and more efficient technologies, This cluster breaks down into three groups that differ based on their focus on technology:

• Sources of intensive fossil energy (A1FI);

• Sources of non fossil energy (A1T)

• Balance of all sources of energy (A1B)

A2.The cluster of scenarios A2 describes a very heterogeneous world.The focus is on the conservation of local identities. The fertility features of the regions convey very slowly, with a resulting constant increase of the population. Economic development is mostly region-oriented while per-capita economic growth and technological changes are more fragmented and slower than in the other clusters of scenarios.

B1. The cluster of scenarios Bi describes a world that reaches a peak of population in the middle of this century (that then tends to declines, similarly to the group A1); however there is a rapid change in the economic structures with a reduction in the intensity of the materials used and the introduction of clean and efficient technologies.

B2. The cluster of scenarios B2 describes a world where the focus is on local solutions for an economic, social and environmental sustainability. It is a world characterised by a constantly increasing population (although at a lower level than in the A2 scenario), an intermediate degree of economic development and less rapid but more different technological changes compared to the groups B1 and A1.

Political decision-makers, at world-wide and European level, and in particular in our specific case in the Central-Eastern Mediterranean region, need to consult effective analytical forecasting models capable of making short-medium and long term forecasting on the impacts produced by climate changes, so as to develop proper strategies to combat them and acquire the necessary financial tools.
The aim of ATMOSnet Project was then to understand whether a "traditional methodology", such as pollen monitoring, traditionally used in the human health field to forecast and prevent allergy-related pathologies (pollinosis) could be re-used to carry out studies on forecasting models correlated to climate changes.
This not only to study the effects on human health but also:

- To improve forecasting models on climate changes;
- To implement forecasting models related to the most crucial impacts resulting from climate changes in the most vulnerable Mediterranean areas (with a specific view to draught and desertification).

To test this assumption a unitary work methodology for all ATMOSnet Project partners had to be developed in order to guarantee the comparability of all data gathered.
Therefore the following activities were started:

- Standardization of the methods for pollen sampling
- Training courses addressed to operators;
- Development of an experimental network of pollen catchers;
- Creation of a unitary data base for data gathering and processing;
- Creation of a WEB site to gather data and disseminate them to stakeholders;
- Development of forecasting models that, by using the pollen monitoring variable, would provide new elements to refine and implement already existing models.

ATMOSnet Project has already operated within the following context of the initiatives planned and funded by the European Union:

Programme and project title

1. Community initiative	INTERREG III, STRAND B
2. Programme	ARCHIMED
3. Priority axis	3 - Integrated and sustainable management of cultural and natural resources and of landscapes and risk management
4. Measure	3.3 – Management, prevention and reduction of natural risks: drought, desertification, fires, earthquakes etc.
5. Project title	Aerobiological territorial mediterranean-oriental systemic network
6. Project acronym	ATMOSnet
7. Field of intervention	353 – protection, improvement and reformation of the natural environment

States involved as partners

Member states	
Member state 1	*number of partners 3*
Italy	Arpac
	Apat
	Sicily region - department of territory and environment
Member state 2	*number of partners 1*
Greece	Aristotle University of Thessaloniki 1
Member state 3	*number of partners 1*
Malta	University of Malta – Institute of agriculture

To develop the project the work was sub-divided into a number of functional work packages:

Work Package (WP)	**Work Package Leaders:**	
WP1 set up of transnational pollen monitoring network	UNI Malta	WP1 leader Everaldo Attard
WP2 implementation of monitoring pilot sites-training of personnel	APAT	WP2 leader Vincenzo De Gironimo
WP3 quality assurance	AUTH	WP3 leader Maria Dimou
WP4 potentiality of pollen analysis on climate change forecasting models	Sicily Region	WP4 leader Stefania La Grutta
WP5 Dissemination and Communication of results and early warning system	UNI Malta	WP5 leader Saviour Zammit
WP6 Management	ARPAC	WP6 leader Massimo Menegozzo

To achieve the expected outcomes of the project the following meetings were organised:

- KICK OFF Meeting 22nd September, 2006 – Naples
- WP I Meeting 14th – 16th December, 2006 – Malta
- WP II Meeting 18th – 20th April, 2007 – Palermo
- WP III Meeting 9th – 10th July, 2007 – Thessaloniki
- PMB Meeting 1st October, 2007 – Naples
- ATMOSnet Final Conference 29th – 30th November, 2007 Naples

In each meeting the leaders of the work packages and actions included in the application form of the project, the local authorities and the scientific community (Universities, Research Institutes) invited by the partners, actively participated in the discussion of the topics included in the agenda.
To support the activities of the Project Management Board the following scientific committee was established

- Prof. Giovanna Aronne – Università di Napoli "Federico II"
- Engineer. Vincenzo De Gironimo - APAT
- Mr. Salvatore Anzà – Region of Sicily
- Professor Gerrasimos Martzopoulos – University of Thessalonica
- Mr. Joseph Callus – University of Malta

The documentation related to the various contributions can be found in the WEB site developed for ATMOSnet project www.atmosnet.org

Outcomes of ATMOSnet project

The final outcomes and the future prospects of ATMOSnet Project will be dealt with in the final report (A. Matrone, D. Guglielmelli).
However it is worth making a general evaluation of the project.

It was an experimental project to assess the feasibility of a proposal aimed at using a specific methodology (pollen monitoring) within the framework of the forecasting models on climate change-induced environmental changes.

The experimental phase was finalised; it resulted in a substantial knowledge advance that needs to be tested on larger areas, increasing both the number of pollen monitoring stations and the number of Mediterranean countries involved, also recruiting the countries of the African coastal line of the Mediterranean region.

Standardised pollen monitoring methods were developed that make it possible to compare the data gathered by the monitoring stations. Nevertheless there is a clear need to develop new and more sophisticated methodologies capable of monitoring not only the pollen species but also their variants (more resistant to climate changes) in order to create proper adjustment strategies.

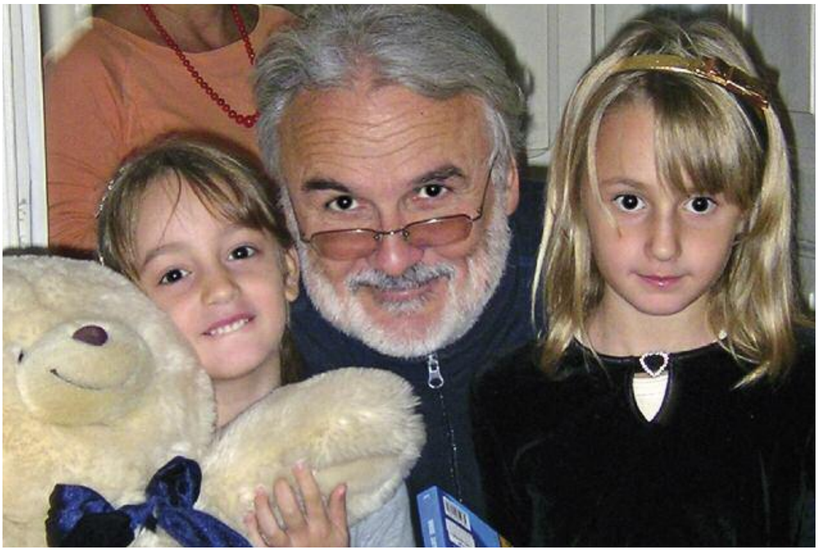
In conclusion, this experimentation conducted within the framework of ATMOSnet Project enables us to state that only the initial part of the pathway has been covered. The knowledge acquired in this experimental phase of first approach to the problem, leads us to consider the opportunity to implement further activities on pollen monitoring in different application fields:

- Forecasting models on human pollinosis
- Forecasting models on impacts in the agricultural field.

These preliminary evaluations will be widely covered in the contributions that will be provided during the Final Conference of ATMOSnet Project.

As ARPAC Project Manager I would like to thank all participants in this final Conference, all those who have provided their contribution to implementing this project, the authorities who are attending this Conference, the representatives of the Project Partners, the speakers and the public.

I wish that the work carried out so far will be useful to provide effective suggestions to political decision-makers in order to develop proper mitigation measures and measures aimed at getting adjusted to the climate changes that are threatening our Mediterranean areas, so wonderfully represented by the town of Sorrento that is hosting us.
I also wish that future generations will be able to enjoy this planet. Our hope is that we have been able to provide our contribution for this to happen.



Aerobiological monitoring in the ATMOSnet Project

Giovanna Aronne

University of Naples "Federico II", Faculty of Agriculture - Italy

Aerobiology is a branch of biology that studies airborne organisms and airborne biological particles, for example, pollen and spores.
As regards the pollen its presence in the air is a consequence of plant flowering. Therefore pollen presence in the trap depends on the effects of environmental factors on flowering and pollen release.
Any scientific discussion useful for the ATMOSnet project will be based on the knowledge of what is a pollen grain and how the release in the atmosphere can be affected by the variation of the environmental factors. Following is reported a) an overview of this topic and b) the description of the main goals and critical aspects of the project.

Everybody knows that pollen is produced by the flowers and is fated to move from one flower to another to get plant reproduction. However, very few people knows what a pollen grain represent for the life cycle of the plant and which are the environmental factors constraining the modality and the period of pollen release.
Within the life cycle of the higher plants, pollen represents the haploid generation. Numerous cells within the anthers undergo meiosis and develop young gametophytes (pollen). Each grain, transferred on the proper stigma, might develop a pollen tube with two microgametes which can fertilize the macrogamete starting the development of the embryo in the seed (Fig. 1).
Life cycle represents the period during which a plant develops from a seed, grows, produces new seeds and dies. In the Mediterranean environment, most of the flowering plants can be classified either as annual species or perennial species. The life cycle of the annual species last less than one year: generally they survive the winter as seeds, while development of the adult plant, flowering and fruiting occurs in spring and the plant dies in the summer after seed dispersal. Life cycles of the perennials start from seed germination and take long time (often years) to develop adult plants able to flower and fruit. After the first flowering/fruiting event (season), these plants survive and reproduce again for many years. Following the senescence, they eventually die (Fig. 2).
The environmental control of reproductive development is exhaustively described by R.F: Lyndon in 1992 (in Fruit and seed production, edited by C. Marshall and J Grace, Cambridge Univ. Press) and reported hereby.

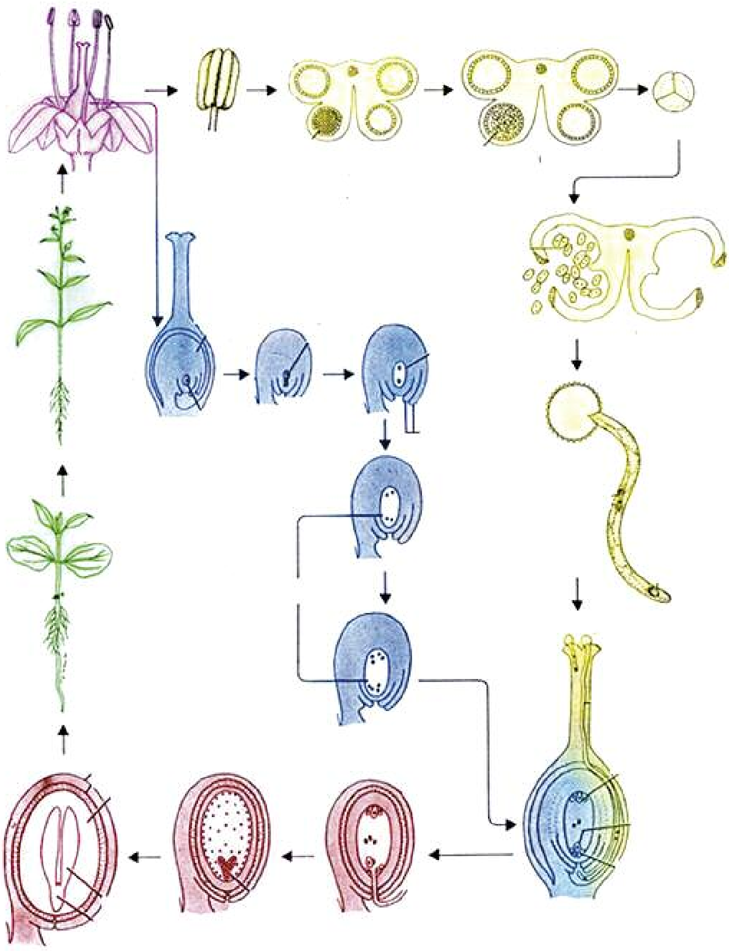


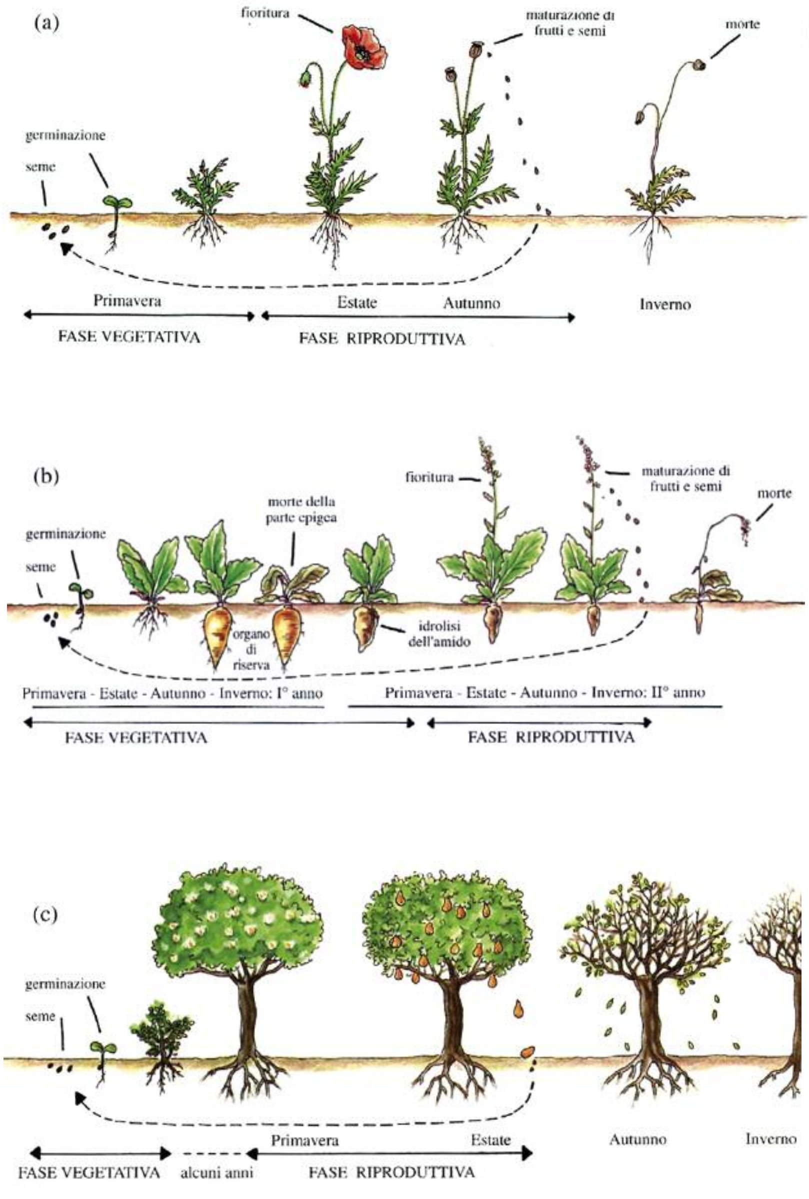
Fig. 1

Reproductive cycle of a generic flowering plant. Different main phases are reported in different colours (Modified from Greulach V.A., Adams J.E. Introduzione alla botanica moderna. Liguori, Napoli)

It is well known that each plant species flowers at a particular season or time of the year and this implies that flowering depends by changes in the environment. All plants require conditions in which they can grow and develop in order to reproduce. Therefore, environmental controls are those that determine plant distribution. In all habitats the transition to reproductive growth coincides with the conditions most likely to lead to successful completion for flowering, fruiting and seed dispersal.

Why should plants use environmental cues to regulate flowering? Plants may be influenced by environmental signals either to promote flowering, so that a favourable environment for reproductive growth can be quickly and successful exploited, or to delay it until it can be achieved optimally as, for instance in biennials. The critical parts of the reproductive process are pollination, fertilization and fruit/seed formation. The whole process has to be set in sequence, by the transition to flowering, several weeks or months in advance of the eventual bloom (Fig. 3). For successful out-crossing, individual plants must flower

Fig. 2
Life cycle of annual plants (a), biennals (b) and perennials (c) (Modified from Venturelli F., Virli L. Invito alla botanica*, Zanichelli, Bologna)*.



synchronously with others of the same species. Those plants relying on specific animals or insects for dispersal may also require their seeds or fruits to reach ripeness at fairly precise time, which may depend on the timing of the previous stages of reproductive development. If, however, the season is abnormal then the environmental changes on which the plant may normally depend to promote flowering may not occur. In this case the plant may need a fallback po-

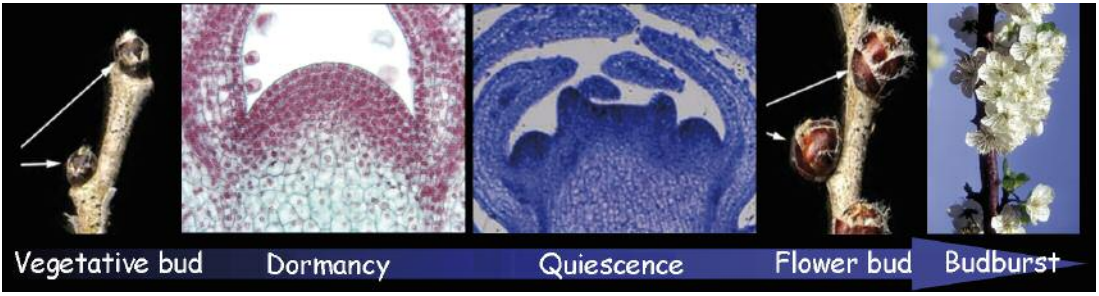


Fig.3

Sequential development of flowering. Flower induction from vegetative buds is showed with two microscope views of the transforming bud representing the break of dormancy and quiescence.

sition where internal controls can be overriding so that the plant reproduces although suboptimally. This would be consistent with the observation that most plants eventually flower, however unfavourable the conditions may be, so long as they can support some growth and with the view that in the last resort, plant growth substances may provide a failsafe system to allocate scarce metabolic resources and so allow flowering.

Which environmental factors affect plants to switch from vegetative phase to reproductive phase?

Any environmental variables are potentially available to plants for the control of flowering. The main variables are likely to be photoperiod, temperature and water availability. Mineral nutrients can also regulate flowering in crop and ornamental plants although this may be a consequence of a general effect on growth. In most plants growing the in natural environment, minerals are not usually likely to change sufficiently to affect flowering.

Photoperiod is one of the most investigated variables controlling flowering. It may delay or promote the start of the phenomenon and since it is very precisely predictable within and between years it is the most reliable environmental cue. In all latitudes more than half the plants examined experimentally can respond to photoperiod by floral initiation. The difference between plants of the tropics and those of more temperate regions seems to be that short-day-plants predominate in the tropics and long-day-plants in higher latitudes. However, both long- and short-day types can be found at all latitudes. Plants almost certainly measure photoperiod itself rather that whether it is changing. Within the scenario of a changing climate, photoperiod is not considered as a major problem therefore in this report the effect of photoperiod will be not longer discussed.

Excluding photoperiod, temperature is certainly the environmental variable most triggering for flower induction and it is affected by global climate changes.

In crop plants with minimal or no photoperiodic requirements the time from sowing to anthesis and seed maturation can often be accounted for simply as a function of the accumulated day-degrees above a baseline value characteristic of that crop. This does not mean that light is unimportant for flowering but that temperature is broadly correlated with intercepted radiation. In general increased temperature within the physiological range promotes flowering as promotes growth, unless it is overridden by juvenility or by requirements for vernalization or photoperiod. However, flower initiation in long-day-plants may often be promoted by lowering temperature.Vernalization (by exposure to low temperatures in the range of about 0-12 °C) act to promote progress toward flowering or to allow it to continue in low temperature and short days. Characteristically, only long-day-plants or day-neutral-plants respond to vernalization while short-day-plants do not.

An important point is that the seasonal cycles of photoperiod and temperature interact. In short-day-plants flowering is delayed by long days and by low temperatures; in long-day-plants flowering is delayed by short days but not by low temperature. Short-day-plants can therefore be regarded as a strategy for delaying flowering by long days in high temperatures; and long-day-plant a strategy for delaying flowering by short day in high temperature but allowing it to go ahead irrespective of day length at low temperature. So that short days do not inhibit development in an otherwise permissive but non-optimum environment. SDP can therefore be thought of as a strategy to delay or synchronize flowering in an otherwise optimum environment for flowering; whereas LDP are a strategy to control and optimize flower development in a period of long day irrespective of the environment before the long day occur.

Water availability as a factor controlling flowering is most obvious in habitats with seasonal rainfall.These may range from tropical forests to deserts but with the common factor of having high evapotranspiration rates so that water availability to the plant may be readily altered. Some plants respond to rain directly, others require a dry period first.

Plants control flowering by using those seasonal factors of their environment that vary most or in a regular fashion.The particular environmental signals used by plants can therefore depend on their habitat. For those Mediterranean species growing also in temperate regions (i.e. winter deciduous, early flowering shrubs) water availability may vary greatly and is a limiting factor. Here vernalization may be a further requirement for flowering, preventing premature winter flowering.They might have a vernalization requirement for flower initiation and flower best in long days and high temperatures.

The effects of environment can be on both flower initiation and subsequent development. Available scientific data are quite limited considering that flowering is scored only by the appearance of visible flowers or buds. For the plant this may perhaps be irrelevant, but for the researcher it is important to distinguish between the factors affecting flower initiation and flower development if the aim is to understand the processes involved in controlling flowering and the critical times at which the time might exerts its control.

Flower development may be promoted by environmental conditions the same as or different from those affecting flower initiation. Flowering may be controlled by release of flower buds from dormancy rather that by their initiation per se.

The structure of the flower can be controlled by environmental conditions. Sex expression can be controlled by environment in a number of plants. However, environmental conditions may not only affect the presence or absence of male and female organs but also cause deviations from the typical numbers of floral parts.

It has been reported that pollen release in grasses can occur at very precise times of the day, which are different for different species.

Environmental factors affect the plant in three main ways: through water status, changes in assimilate and mineral availability and distribution within plant, and changes in the production of, and reaction to, endogenous plant growth substances. Water status in most plants will have a general effect in that if water is insufficient, growth will be affected and flowering may be retarded or impaired. In some plants changes in water status may be an essential signal to provoke flowering or to synchronize it. Flowering may also depend on the rate and amount of assimilate production or on changes in assimilate distribution. The effects of the environment on flowering are probably elaborated in the plant by the involvement of plant growth substances.
The plant in its normal growth tends towards flowering as the culmination of the growth process. One point of view is that endogenous changes in growth substances will normally tend to favour the completion of flowering by promoting and coordinating normal development but that the environment can override this internal control to delay flowering until the plant has made a sufficient growth to support or until environmental conditions again become permissive. This suggestion that growth substances are the normal coordinators of flower development is similar to the view that growth substances act to coordinate growth by controlling resource allocation under poor conditions. One implication would be that under prolonged extreme conditions which, none the less, allow some growth, the normal growth substance balance may eventually be restored so that the plant then flowers despite unfavourable conditions.
Many investigations of the effects of the environment on the control of flowering have been done on plants of agricultural or horticultural interest. Very little has been done on wild plants to understand the environmental control of their flowering.

The main goal of the ATMOSnet project is to improve and support the forecasting of drought and desertification due to climate change in the Eastern Mediterranean area by transnational cooperation in monitoring and elaboration of pollen concentration in five areas in Greece, Malta and Southern Italy.
Moreover, its concrete output can be synthesized in the following points:

1. Set-up of a Eastern Mediterranean network for long-term aerobiological monitoring
   - a. implement/up-grade monitoring sites
   - b. choice of methodologies and protocols
   - c. training of personnel – quality control
   - d. development of a network software for data management

2. Elaboration of aerobiological data to get 3 models:
   - a. effect of climate change on drought and desertification
   - b. forecast of agricultural products
   - c. forecast of allergenic pollen seasons

3. Development a methodology to be used for management and decision making in Europe

The real challenge of this project is to utilize the aerobiological monitoring, which generally is used for health purposes, to get information on drought and desertification.

To reach these goals several critical points must be solved. A few of them are reported as follows:

1. Analysis and selection of the protocols to be used by the ATMOSnet network;

2. Training of personnel

3. Set-up of quality standard

4. Geographical localization of the new pollen traps

5. Micro-site effects on flowering

6. Analysis of time series of data

As regards the development of the model on the "Effect of climate change on drought and desertification" a deep scientific discussion is really needed to establish first of all the end-points of the model and the theoretical and technical decisions.
For the model to forecast agricultural products it is necessary to select the species to be monitored (for example olive) and to evaluate the possibility to use other models previously developed as basis for that of ATMOSnet.
This should be done also for the model to forecast the allergenic pollen season.
Finally, the synthesis of the three models should be used to produce a European standard

Utilization of phenoclimatic models to study the climatic changes on fruit trees phenology

Francesco Paolo Marra, Giuseppe Campisi,
Michele La Mantia, Tiziano Caruso
Università di Palermo - Faculty of Agriculture - Italy

Introduction

In plants, day length and temperature are the major climatic factors that affect the rate of transition from one phenological phase to the next. Time of fruit ripening, for instance, depends from bloom time and from the length of the Fruit Development Period (FDP), which is regulated chiefly by the temperatures range during the period from bloom to ripening and by the species response to temperature (Boonprakob et al., 1992). As a matter of fact, numerous studies have used inter-annual temperatures variation to built up models able to predict blooming or harvest time (Munoz et al., 1986; Boonprakob et al., 1992; Caruso et al., 1993; Motisi et al., 1998).
In fruit trees, fruit development period (FDP) has been associated to the amount of heat units calculated from the average of daily mean temperature (Munoz et al., 1986) or from the mean monthly temperature (Topp and Sherman, 1989). The heat unit summation have been also used to predict fruit ripening (Arnold 1959). The assumption is that no growth occurs below and above specific threshold temperature values. Arnold (1959) showed that the appropriate "Base

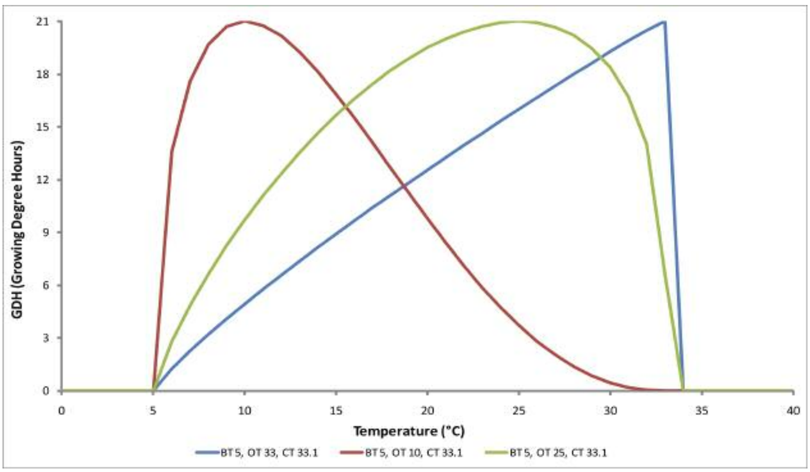
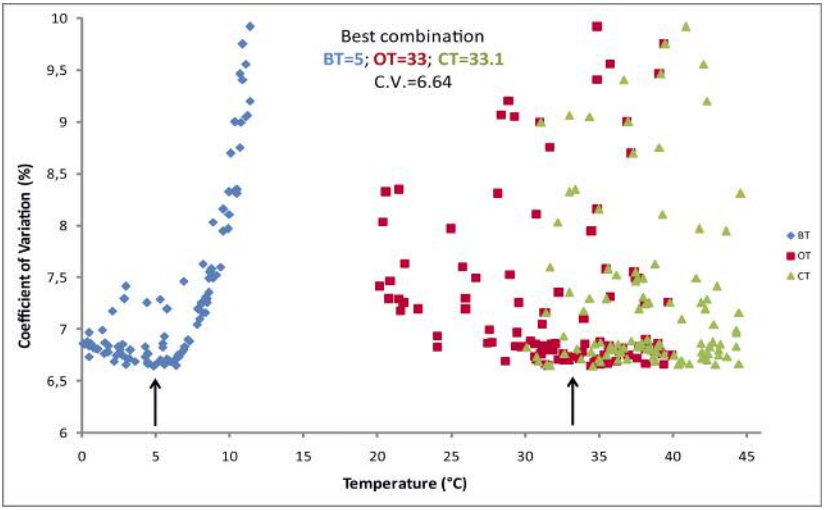


Fig. 1
Beta function reported in three different parameterizations

Fig. 2
Coefficient of variation values of "GDH" accumulations among Italian sites, generated with 200 random sets of cardinal temperatures.



Temperature" (BT) could be calculated using heat unit summation (Degree Days = DD) by choosing the BT giving the smallest coefficient of variation (c.v.). More recently, Anderson et al. (1986) proposed a non-linear model to estimate the heat requirement, calculated in terms of summation of Growing Degree Hours (GDH) needed to achieve bud break after the offset of winter dormancy. The model (ASYMCUR) takes into account optimal (OT) and critical temperature (CT) beside BT. To predict harvest, in a field vs. greenhouse experiment, ASYMCUR showed to be more accurate than linear heat unit summation, with same values of GDH accumulated from bloom to harvest in greenhouse or in the field without distinction (Caruso et al., 1993).
The coefficient of variation (c.v.) of plant thermal time requirement, between different years and different environments, should be close to zero. Based on this hypothesis, it has been widely applied as a tool to test or optimize different heat accumulation models (Munoz et al. 1986; Motisi et al., 1992: Marra et al., 2002). Growing Degree Hours (GDH) are highly dependent by the function parameterization, in other words, from the right choice of the cardinal temperatures (Anderson et al., 1986; Motisi et al., 1994; Marra et al. 2000) The physiological values of these parameters are different between species, among different cultivars and for each ontogenetic stage of development; thus, the function parameterization must be performed consequently (Marra et al., 2002).
Recently GDH has been used to predict harvest time in fruit trees (Caruso et al., 1993; Marra et al. 2002). In those experiments, the prediction capacity of linear and non-linear (GDH) models were compared. Thermal time was calculated applying a linear model, with base temperature of 7° C; and critical temperature of 35°C, and non-linear model, with base temperature of 4.2° C, optimum temperature of 26° C and critical temperature of 35°C. The authors showed an higher prediction capacity of the non-linear models respect to the linear one.
In latest years, the interest in tree phenology, as an indicator of global climatic change, has raised significantly (Myneni et al. 1997; Schwartz 1998; Crick &

Sparks 1999; Parmesan et al. 1999; Thomas & Lennon 1999; Osborn et al. 2000). Numerous studies, indicate that the rising of spring temperatures during the past century have advanced the timing of leafing and flowering in many species (Schwartz 1998; Bradley et al. 1999).
In olive trees, particularly, climatic factor affect the occurrence of phenological phases, like flowering and harvest time. Canu et al (1998), analyzing 13 seasons, in an urban area of north Sardinia, showed an high variation of blooming data, ranging between the first week of May to the second week of June. The authors confirmed the influences of annual temperature course in olive flowering process and, thus, on the dispersal of the airborne pollen.
Unfortunately in olive, compared with other species, few researches have been published on prediction model of blooming and ripening time (Acalà and Barranco, 1992; Canu et al. 1998; Osborne et al. 2000).
With the purpose to give a contribution to fill up this gap, the objectives of this study were: develop a non-linear model, in terms of curve shape and parameters (Base, Optimal and Critical Temperature), that could accurately describe olive blooming time; test the model capacity on olive blooming time prediction; apply the model on different climatic scenery and evaluate the impact of global warming on the phenology of olive trees.

Material and method

Climatic and olive's phenological data (blooming dates) of various years, available from 10 different Research Institution throughout the Italian territory, have been used. The climatic data were made up of maximum and minimum daily temperatures, whereas phenological data were obtained both, from direct full bloom observations and from the maximum olive pollen concentration recorded by a volumetric spore traps.
A Beta function (fig. 1) has been implemented in a visual basic computer program to calculate "GDH". To optimize the model, 200 random sets of cardinal temperatures (BT; OT and CT), were random generated and so, for each set, was calculated the thermal time accumulation.
The function's target was to minimize the coefficient of variation (C.V.) of GDH accumulated among different years and locations.

Results

A base temperature of 5 °C and an optimal temperature of 33 °C were the most effectives to increase the predictor capacity of the model, whereas, critical temperature didn't displayed any effect (Fig. 2). This results was most likely due to lack of high temperatures during the winter period.
On the basis of our model parameterization, the olive rest to bloom thermal time requirement seems to sum about 29.000 GDH (tab. 1). When the thermal time is compute in terms of GDH, in fact, the coefficient of variation calculated throughout years or location was lower then the cv computed in terms of days elapsed between rest to bloom. Furthermore, the high relationship between observed vs estimated development period showed that the heat-unit

Location (Year)	Rest Date	Blooming Date		Rest to Blooming Period (days) observed	estimated	GDH cumulated
Montepaldi (97-98)	13/10	02/06		233	224	32062
Montapaldi (98-99)	19/10	**03/06**		227	230	28718
S.Apollinare (97-98)	11/10	29/05		229	236	27732
S.Apollinare (98-99)	**01/10**	28/05		239	247	26569
Sassari (97-98)	11/11	19/05		189	195	28247
Sassari (98-99)	05/11	20/05		196	204	27463
Battipaglia (05-06)	16/11	23/05		188	197	27046
Palermo (05-06)	20/11	18/05		179	167	32863
Palermo (06-07)	11/12	15/05		155	146	32259
Catania (05-06)	19/11	15/05		177	178	29404
Catania (06-07)	18/12	16/05		149	149	29601
Alcamo (05-06)	19/11	20/05		182	176	31403
Agira (06-07)	22/11	28/05		187	178	32678
Castelvetrano (97-98)	13/11	**30/04**		168	172	28874
Castelvetrano (99-00)	**19/12**	15/05		147	150	28654
Sciacca (02-03)	30/11	09/05		160	165	27949
Sciacca (03-04)	5/12	18/05		164	168	28771
Sciacca (04-05)	14/11	16/05		183	176	32043
Sciacca (05-06)	18/11	07/05		170	176	28294
Mean	14/11	19/05		185	186	**29507**
Min	01/10	**30/04**		147	146	26569
Max	19/12	**03/06**		239	247	32863
			S.E.	6.50	6.87	469
			CV (%)	**15.28**	**16.10**	**6.64**

Tab. 1

Comparison of the variability of GDH accumulations, rest and blooming dates among different Italian locations

model based on air temperature is able to give an accurate estimation of flowering dates for each site throughout Italian regions (fig. 3).

The model showed the ability to predict in advance the period of the presence of olive pollen in the atmosphere, thus to schedule the proper decisions to avoid the occurrence of pollen human diseases. However, further sets of climatic and phenological data (locations and years) would be very welcome to improve the accuracy of the model developed within the current project.

The model, ultimately, by drawing up maps of phenological variables, together with the use of appropriate spatial interpolation techniques, could be suitable to characterize areas that, throughout the years (historical data), could be used, as an indicator of global climatic change, particularly during the winter to spring period.

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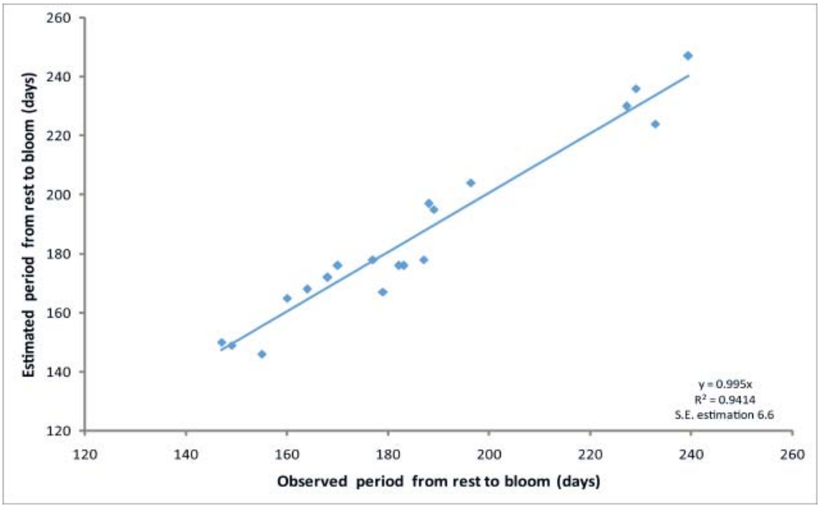

Fig. 3
Relationship between observed vs estimated rest to bloom period (numbers of days)

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Forecasting models and pollen monitoring General consideration

Stefania La Grutta

Regional Agency for Environmental Protection of Sicilia - Italy

Background

The monitoring of the concentration of pollens in the atmosphere is a valid bio indicator for studying effects of droughts and desertification due to climate change. The change in pollen concentration of an important plant (such as the olive tree) for the specific area over time makes it possible to predict the further distribution of the plant (reduction, extinction, overpopulation).
The long-term qualitative and quantitative pollen monitoring is one of possible bio-indicators used in climate change analysis, both for long-medium term and short term climate variability and forecasting. In the last decades many studies on vegetation dynamics and climatic trends have been developed.
Forecasting impacts by continuous monitoring on a local level for droughts and desertification occurrences is a good basis for decision-makers to decide on mitigation or adaptation measures. Therefore, the implementation and improvement of monitoring systems can represent a powerful tool for integrating climate change models in Mediterranean countries.

The Contribution of WP4 to project objective are the following items:

- Elaboration of acquired data from the transnational network on long-term aerobiological (pollen concentration) monitoring of municipalities and universities in Greece, Malta and South Italy, by a specifically developed software with monitoring over time on drought and desertification impacts on agriculture and health

- Elaboration of the forecast model based on historical data of pollen concentration in order to approach a reliable evaluations of climate changes by pollen analysis

- Elaboration of the forecast model based on historical data of pollen concentration and its health effects

- Elaboration of the forecast model based on historical data of pollen concentration and its effects on agriculture

Management organisation

The goal of the Work Package 4 (WP4) "Potentiality of pollen analysis on climate change forecasting models" was to ensure that the objectives of the project, as outlined in the proposal, was achieved within the projected time - May 07-December 07- and the allocated budget.
A trained staff and a permanent and close contact with the Tasks's Responsables and all partners of the project and a sound communication with external actors in the pollen-monitoring field was continously required.
The WP4 structure was efficient step-by-step achievement of the project goals. The work package was divided regarding objectives, contents and tasks of the different project partners, with a logic interdependencies.
This clear structure leads the project partnership as a whole, and each Task partner to a step-by-step achievement of the WP4 goals.

In addition the WP4 management of the specific Task activities were:

- Set-up of WP4 organisational structure and definition of decision-making processes;
- Definition and quality processes of historical data of pollen concentration
- Technical & Scientific management;
- Financial and administrative support;
- Regular monitoring on quality and results.

PP3 ARTASicily – ARPA Sicilia were the WP4 Responsible.

The specific Role and Functions of WP4 Leader was to:

- Coordinate the Tasks Responsables and also the implementation of the respective activities

In the same time the Tasks Role and Functions were to

- Increase the individual task
- Refer to WP4 Leader
- Assure a regular activity in their own improvements

The networking of various experts and beneficiaries of the monitoring of pollen concentration was to support the development and the adoption of pollen forecasting models useful for three main task objectives.
The choice of the three different models was the most important decision point, therefore the different models were choosen and applied, finally based on available historical pollen data the more precise forecasting models were developed.
About the Task Responsible 1 a close collaboration with ARPA technical support and the well trained Aerobiological Staff of Institute of Biomedicine and Molecular Immunology – IBIM of National Council of Research –CNR – Palermo-Italy, was really effective. The Task1 objective was to development of forecasting model for drought and desertification due to climate changes.

To address this point a specific cooperation with the Aerobiological Staff - Giovanni Duro, IBIM-CNR-Palermo-Italy, and External well trained experts were achieved.

External well trained experts
DCA – UNIPA, Palermo - Italy
Tiziano Caruso, Francesco P. Marra

Statistics assistance for models
ISTI – CNR Pisa, Italy
Roberto Della Maggiore, Daniela Nuvolose

Bioclimatology Center
IBIMET – Sassari, Italy
Bachisio Arca, Grazia Pellizzaro

The Task Responsable 2 was PP1 ARPAC Napoli-Italy – Giuseppe Onorati, MD. The specific objective was the development and adoption of forecasting models useful to the reduction of the impacts on the agriculture caused by climate change effects on environment (desertification drougth,soil degradation, vegetal pathologies) in order to improve the management of environmental policies.

The Task Responsable 3 was PP4 AUTH – Greece, Stelios Tamvakidis
The specific objective was the development of a forecasting system for health purpose. Pollen analysis provided a useful tool to detect, prevent and mitigate the effects of allergic pathologies. More detailed analysis were attempted about the short-term effects induced by climate change on the increase and/or appearance of diseases related to respiratory apparatus such as Alternaria as cause of death for asthma.

Outputs

The elaboration of the acquired data of historical data pollen was necessary to address the following outputs related to the three different Task activities.
This actions might allow to achieve more informations about :

- Drougth and desertification indicators: plants according to their flowering phenological phases
- Quantity of pollen production in species used for agricultural purpose in order to forecast seed and fruit production
- Air quality by measuring allergenic pollen and forecast of the future pollen season

Another WP4 output was to support the envisaged effects, benefits and beneficiaries. Particularly the following actions were developed:

- Improved cooperation on climate changes among involved Partners by monitoring pollen concentration data as environmental indicator for drought and desertification

- Forecast on allergenic pollen flow useful for people suffering from allergies which provides basis for mitigation measures
- Forecast on pollen flow impact to agricultural production which provides basis for mitigation measures
- Presentation of approach to scientific community working in the field of climate changes research

The final output of WP4 action in the field of knowledge about the climate change was to cooperate for the improvements, and long-term impacts.
The three different forecasting models might contribute in climate changes research at different levels:

- Improved comparability of pollen concentration data as environmental indicator for drought and desertification
- Provision of scientific information for improvement of planning the agricultural use of land
- Provision of scientific information for improvement of health measures for allergic people

Conclusion

The WP4 results represent the specific contribution to the ATMOSnet objectives about the forecasting models in the field of climate change research.
Forecasting impacts by continuous monitoring on a local level for droughts and desertification occurrences is a good basis for decision-makers to decide on mitigation or adaptation measures.
The more relevant WP4 outputs are the improvement of climate change forecasting models in Mediterranean countries
In addition, the provision of scientific information on allergenic pollen flow useful for people suffering from allergies is one of the main result for the improvement of health measures for allergic people;
Finally, the provision of scientific forecast model for agricultural system is really important for the improvement of planning for the agricultural use of land and also to plan the basis for mitigation measures.

Oleaceae pollen data as indicator of climatic change in mediterranean area

Bachisio Arca, Annalisa Canu, Grazia Pellizzaro,

CNR: Institute of Biometeorology -Sassari

Arnoldo Vargiu

Aerobiologic observatory - Sassari - Italy

Introduction

In vegetal species living in temperate area, variations in the beginning, in the duration and in the intensity of the various phenophases, and especially of flowering, are governed by meteorological factors and, to a large extent, by temperature. As a consequence plant phenological observation series were often used to document climatic variability and changes (Sparks et al., 2000; Kramer et al., 2000; Defila and Clot, 2001; Menzel, 2000; Chmielewski et al., 2005). Previous works showed that increasing spring temperature during the past century determined an advance of the timing of flowering in many species at high northern latitudes in Europe and in North America (Schwartz et al., 2006; Schwartz, 1999; Beaubien and Freeland, 2000; Studer et al., 2005)

Airborne pollen concentration pattern is associated to the release of pollen from anthers. Then pollen emission data can be considered as an indirect manifestation of the flowering phases that occurs in plant population surrounding the sampling station (Osborne et al., 2000; Jato et al, 2002; Van Vliet et al., 2002). As a consequence, in recent years, several studies suggested that airborne pollen data could be considered as a possible indicator of the responses of plants to climate change (Newnham, 1999; Orlandi et al., 2005; Emberlin et .l, 2002;. Osborne et al., 2000; Van Vliet et al., 2002).

Olive (Olea europea L.) is one of the largest crops in Mediterranean countries, particularly in those areas were the climate is generally warmer. In Sardinia it represents an important economic activity and in the North of the island it accounts for 74% of all cultivated fruit species.

The aims of this paper were (i) to verify whether there has been a significant change over time of olive season pollen dates recorded in the last two decades in North Sardinia (Italy), (ii) to evaluate whether olive airborne pollen data could be used as indicator of climate change in Mediterranean areas, and (iii) to determine the best method for predicting the time of peak pollen concentration of Olea europea L. in the air.

Material and methods

Oleaceae daily pollen concentration data were measured for 20 years (1984-2003) in a urban area of northern Sardinia (Italy) using a Burkard seven-day recording volumetric spore trap. Daily pollen data were expressed as number of pollen grains per cubic meter of air. The date of the maximum pollen concentration was defined as the day when the cumulated daily pollen values reached the 50 % of the total annual pollen concentration. Daily maximum (Tmax) and minimum (Tmin) temperature values were recorded during the same period by an automatic weather station. The same analysis was performed using 10 years of pollen data collected in Naples (Campania).
Cumulative Degree days (°D) were calculated, for each year, from different starting dates until two fixed dates using the daily averaging method (Zalom et al., 1983) with a threshold temperature (Ts) of 0 °C:

$$^{\circ}D = \sum_{d=1}^{d=n} \left[(T_{max} + T_{min})/2 \right] - T_s$$

Because the full flowering dates for oleaceae family started between the middle of May and the middle of June, cumulative °D were calculated from different starting dates until April 30 and May 30.
Trends of full flowering dates and of °D accumulation over the two decades were analyzed. Two-years running means were calculated, and a linear regression model was used for the trend analysis. A seasonal ARIMA model was used in order to describe the pattern of pollen time series. Dates of full flowering stage were related to cumulative degree day, calculated for the periods preceding flowering phases, by a linear regression analysis.
In addition, Degree days were calculated for 15 years (1984-1998) using the daily averaging method and the single triangulation method (Zalom et al., 1983) from nine starting dates (December 1 and 15, January 1 and 15, February 1 and 15, March 1 and 15, and April 1), and five lower base temperatures (0 °C, 4 °C, 8 °C, 12 °C, and 14 °C). The least standard deviation in days (σd) was used to determine the best method, the starting date and the base temperature value that provide the best estimate of the dates. The 1999-2001 temperature and airborne pollen concentration data were used for the testing phase. ARIMA models were also used in order to forecast the pollen concentration on long-term base.

Results and discussion

The full flowering dates of olive, based on percentages of total pollen emission, showed a significant decreasing trend. The olive dates advanced over the examined period with a linear significant mean trend of 1.3, day/year (Fig. 1). These results are in accordance with those found by other authors who observed a trend towards earlier beginning of pollination for many species in Europe (Frenguelli et al., 2002; Osborne et al., 2000; Clot, 2003).

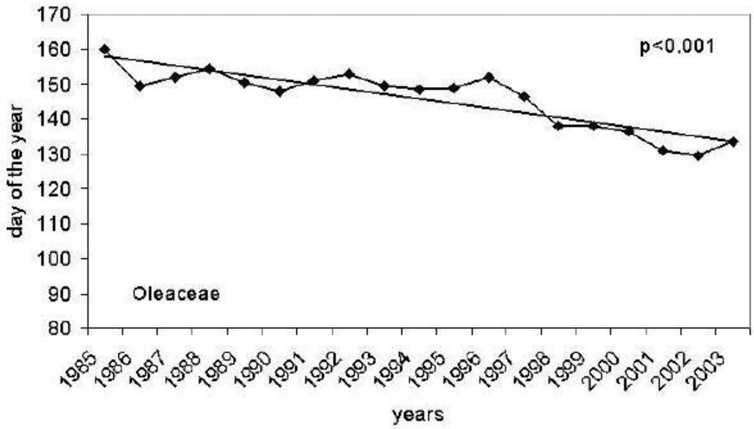

Figure 1

Full flowering dates of Olea europaea at the study site of Sassari (2-year running means from 1984 to 2003). The significance of regression equation which estimate the trend is also indicated.

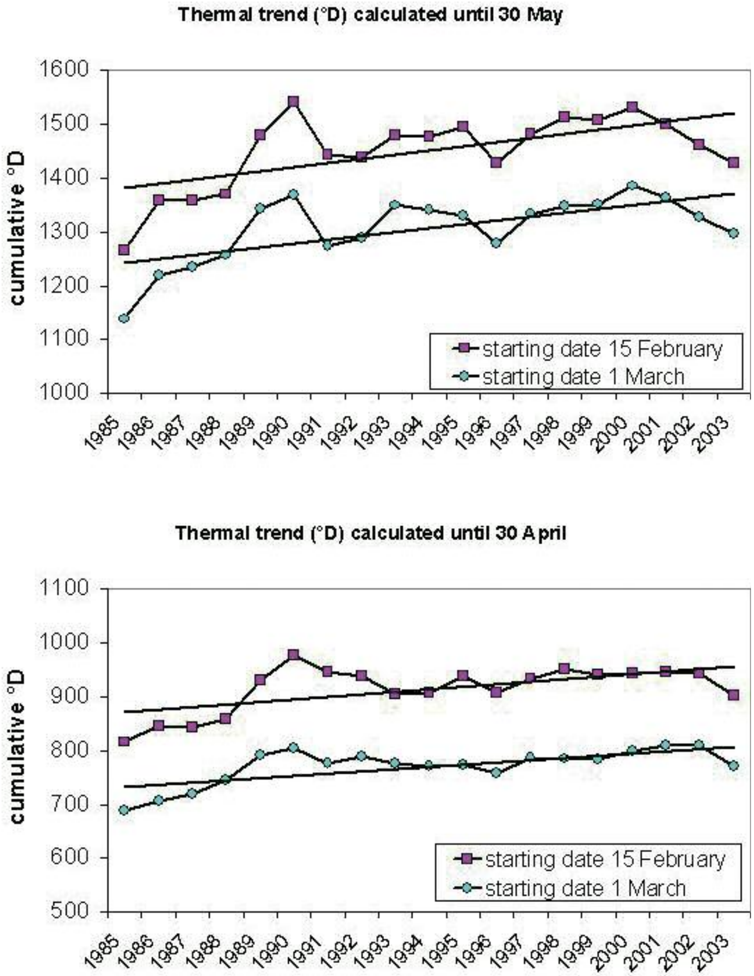

Figure 2

Trends of cumulative degree day (2-year running means from 1984 to 2003) calculated until April 30 (a) and until May 30 (b) and considering two different starting dates. Level of significance of thermal summation (degree days) trends for the different starting and ending dates are also shown.

Because the olive full flowering date occurs on average between the middle of May and the middle of June, cumulative °D were calculated from different starting dates until April 30 and May 30. The time trend of the cumulative °D values, calculated for all different periods, showed a significant increase during the 20 studied years This tendency was particular evident for spring temperature. The most significant increases were observed, in fact, when February 15 and March 1 were used as starting date for calculation (Fig. 2). No significant trend was observed for pollen concentration collected in the Naples area.
The results suggest the hypothesis that during the last two decades phenological trends observed for olive was probably linked to temperature values recorded during the periods preceding the flowering dates. The negative trend of the starting dates values could be a response to rising spring temperature.
This assumption was confirmed by the results of linear regression analysis of full flowering dates on the °D cumulated until both April 30 and May 30 (Table 1). Negative relations between dates of full flowering and cumulative degree day were observed. The inverse relations were clearly identifiable for February-April and February-May periods, which precede pollination of Olea europaea in our region. The highest significant relations were observed when cumulative °D were calculated using February 15 and March 1 as starting dates.
Relative to the third objective, a reduction in the standard deviation in days was always observed as the base temperature was lowered, with the best results when 0 °C base temperature was used (Table 2). Little change in σd was observed when the starting date varied from December 1 to April 1. The starting date, February 15, had the lowest standard deviation (± 6.7).
The average degree day accumulation from February 15 until the date of peak pollen concentration was 1424.6 °D with a range from 1211.6 °D in 1998 to 1560 °D in 1992 for the triangulation method. The average degree day accumulation using the daily averaging method was 1421.8 °D ranging from 1200.2 °D in 1998 to 1560.7 °D in 1992. No significant differences between the two methods were observed in the statistical parameters (Table 3).
The expected dates of the peak airborne pollen concentration calculated for the years 1999-2001, using single triangulation method, using 0 °C as the base temperature and February 15 as the starting date, are shown in table 4. An average absolute difference of 4 days between the predicted and observed dates was obtained.
The pollen concentration data follow a seasonal pattern that can be described by an ARIMA(1,1,1)365 model. Table 5 shows the statistics for the values of daily pollen count predicted by the ARIMA model. The Oleaceae pollen count was highly correlated with observed data in 1999, while showed a low accuracy in 2000 ($P \leq 0.05$) and was not significant ($r=0.17$) in 2001. This loss in accuracy could be explained by the alternate bearing of Olea europaea L. (Galan et. al., 2001a; Galan et. al., 2001b; Atzei and Vargiu, 1990), which probably affected the time series of Oleaceae pollen, determined the high inter annual variation of mean and variance, and reduced the convergence of the ARIMA model, although we performed the logarithmic transformation of time series.

Table 1 – Level of significance of linear regression of dates of pollen maximum concentration versus cumulative degree days calculated for the different starting and ending dates.

	Starting date				
	Jan 1	**Jan 15**	**Feb 1**	**Feb 15**	**Mar 1**
April 30	ns	ns	ns	**	**
May 30	ns	ns	*	**	**
n.s. p> 0.05, * p≤ 0.05, ** p≤0.01					

Table 2 – Standard deviation in days calculated using five base temperatures and different starting dates for two methods.

	Single triangulation method					**Daily averaging method**				
	Base temperature					**Base temperature**				
Starting date	0	4	8	12	14	0	4	8	12	14
1 Dec	9.7	11.8	11.5	25.1	31.5	8.3	11.5	19.3	31.1	45.3
15 Dec	8.8	10.7	11.3	24.4	27.8	8.8	11.8	18.8	33.1	46.4
1 Jan	8.0	9.5	9.5	21.7	23.1	8.1	10.3	15.9	29.5	42.5
15 Jan	7.6	8.8	7.7	18.5	20.4	7.6	9.2	14.4	27.2	38.5
1 Feb	7.1	8.2	7.9	13.9	17.2	7.4	8.5	12.6	24.6	34.4
15 Feb	6.7	7.4	6.9	11.3	14.1	6.9	7.6	10.7	21.6	30.4
1 Mar	7.6	8.2	7.8	8.7	11.5	7.6	8.2	10.6	19.4	26.4
15 Mar	7.9	8.5	8.2	7.2	10.3	7.9	8.5	10.4	17.2	22.8
1 Apr	8.0	8.4	8.8	8.3	9.4	8.1	8.5	9.8	14.2	18.1

Table 3 – Statistics of degree days calculated using 0 °C base temperature and accumulated from February 15 by two methods (Mean D = mean of degree days; σD = standard deviation in degree days; cvD = coefficient of variation in degree days; σd = standard deviation in days).

	Single triangulation	**Daily averaging**
Mean $_D$	1424.62	1421.83
σ_D	91.40	94.54
cv_D	6.42	6.65
σ_d	6.71	6.96

Table 4 – Differences between the observed dates and the expected dates calculated using the 1984 1998 data.

Years	**Observed dates**	**Expected dates**	**Differences (days)**
1999	23 May	24 May	1
2000	14 May	21 May	7
2001	27 May	23 May	4
Mean			4

Table 5 – Summarizing table of statistics between daily pollen count observed and predicted by ARIMA$(1,1,1)_{365}$ model (1999 2001); regressions were forced through the origin.

Years	r	b	n
1999	0.81 ***	1.3	29
2000	0.40 *	1.9	23
2001	0.17	0.6	27

r, correlation coefficient for regression through the origin; b, regression coefficient for regression through the origin; n, number of observations; *, **, *** indicate significance at level P≤0.05, P≤0.01, P≤0.001 respectively

Conclusions

In conclusion, our results seem to confirm, as reported by other authors, that the course of temperature between February and April affects in large measure the timing of spring phenological phases (Chmielewski and Rotzer, 2001; Chmielewski et al., 2005).
Airborne pollen of Olea europaea is sensitive to spring thermal variation and could be taken into consideration as bioindicator of changes in air temperature. In addition measurements of airborne pollen may be a complement of existing direct phenological observations and provide valuable information about the impacts of climate change on flowering phases of this specie.
In addition, in this research, the use of 0 °C as the base temperature and February 15 as the starting date, provided a good prediction with a difference of 4 days between forecast and actual dates of peak olive pollen concentration observed in an urban area.

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WP 4 Potentiality of pollen analysis on climate change forecasting models

Giuseppe Onorati

Regional Agency for Environmental Protection of Campania - Italy

WP 4.2 goals

Action n. 2 starting 05/07 ending 12/07, Responsible partner 1 ARPAC, participating partners 1,3,4

Expected output/deliberable: D4.2 Forecasting model for the environmental system.

As is reported in the project, "The main goal of the project is to improve and support the forecasting of drought and desertification due to climate change in the Eastern Mediterranean area by transnational cooperation in monitoring and elaboration of pollen concentration in five areas in Greece, Malta and Southern Italy". One of the most relevant foreseen outputs is the evaluation of the potentiality of pollen analysis in relation to climate change. This topic is addressed in the WP4:

WP 4 Potentiality of pollen analysis on climate change forecasting models.

The expected contribution to the project objective is the " elaboration of the acquired data by a specifically developed software with monitoring over time on drought and desertification, impacts on agriculture and health"

This WP is partitioned in 3 actions:

• developing a forecasting model for drought and desertification duo to climate change;

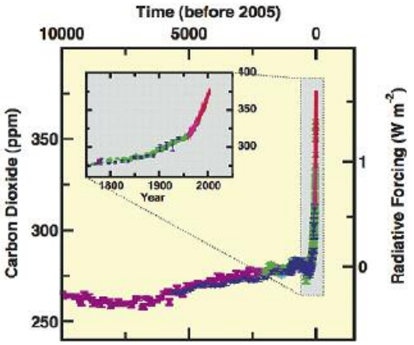
• developing a forecasting model useful for agriculture;

• developing a forecasting system for health purposes.

The action 2 is dealt with in detail in this report. One of the priority of this action is "the development and adoption of forecasting models useful to the reduction of the impacts on agriculture caused by climate change effects on environment (i.e. desertification, drought, soil degradation, vegetal pathologies) in order to improve the management of environmental policies". The expected deliverable is: D4.2 Forecasting model for the environmental system.

Relations with other project actions

The aim of WP4, in relation with the other ATMOSnet project actions, is to set up a data chain from the monitoring network of the pollen to the models for specific purposes. In this framework goal of WP4.2 is to verify the usefulness and limitations of the data gathered by the new stations in order to assess



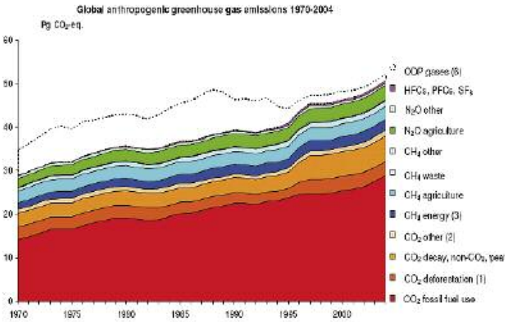


Fig. 1
Carbon Dioxide increase (left). From IPCC 2007

Fig. 2
Global anthropogenic greenhouse emissions 1970-2004 (right). From IPCC 2007

the evolution of agriculture in the Mediterranean landscapes. Moreover WP4.1 and WP4.2 are strongly related, indeed WP4.1 outputs are useful for the estimation of changes in pollination needed in WP4.2.

Climate Change and Agricolture: State of Art

The topic of impacts on agriculture caused by climate change is, since the publication of the IPCC TAR reports a major research field (IPPC 2000, 2001a, 2001b). The state of art at international level is the IPCC IV Report, which has been definitively approved the 17th of November 2007 in Valencia (IPCC 2007). In order to give a very short overview of the terms of reference concerning climate change, which are relevant for Atmosnet project, some key sentences and graphics are presented. First of all the data on carbon dioxide and anthropogenic greenhouse emissions as forcing factor are mentioned. The IPCC summary for policy makers (2007) states "Global atmospheric concentrations of CO2, methane (CH4) and nitrous oxide (N2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. {2.2}
Atmospheric concentrations of CO2 (379ppm) and CH4 (1774 ppb) in 2005 exceed by far the natural range over the last 650,000 years. Global increases in CO2 concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is very likely that the observed increase in CH4 concentration is predominantly due to agriculture and fossil fuel use. Methane growth rates have declined since the early 1990s, consistent with total emission (sum of anthropogenic and natural sources) being nearly constant during this period. The increase in N2O concentration is primarily due to agriculture. {2.2} There is very high confidence that the net effect of human activities since 1750 has been one of warming

As effect of the increase in greenhouse emission the "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Figure 3)".

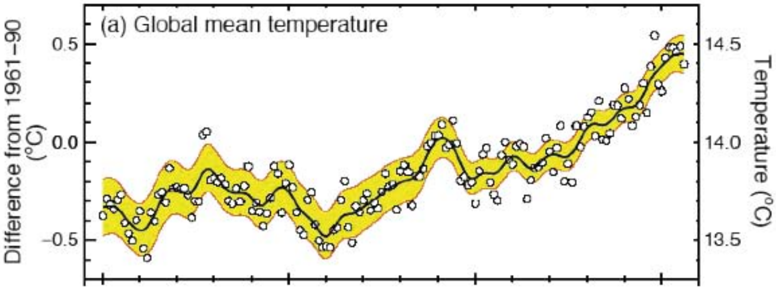


Fig. 3

The temperature of the air will further increase in this century as showed by fig.4 in which the GCM results are presented.

As far as the consequences of climate change are concerned, in the IPCC WGII Fourth Assessment Report Summary (published 6.4.2007) it is stressed that: "There is very high confidence, based on more evidence from a wider range of species, that recent warming strongly affecting terrestrial biological systems, including such changes as:

- earlier timing of spring events, such as leaf-unfolding, bird migration and egg-laying;
- poleward and upward shifts in ranges in plant and animal species.

Based on satellite observations since the early 1980s, there is high confidence that there has been a trend in many regions towards earlier 'greening' of vegetation in the spring linked to longer thermal growing seasons due to recent warming.

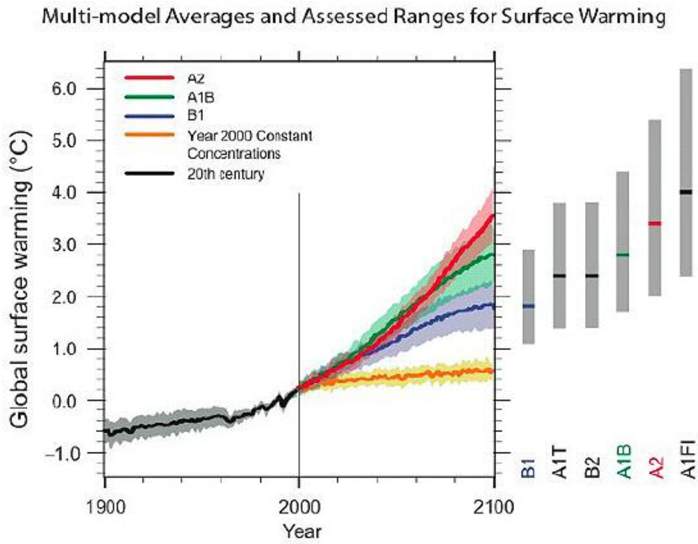
…Other effects of regional climate changes on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.

Effects of temperature increases have been documented in the following systems (medium confidence):

- effects on agricultural and forestry management at Northern Hemisphere higher latitudes, such as earlier spring planting of crops, and alterations in disturbance regimes of forests due to fires and pests;
- some aspects of human health, such as heat-related mortality in Europe, infectious disease vectors in some areas, and allergenic pollen in Northern Hemisphere high and mid-latitudes".

A review report on the effects of Climate Change on Agriculture has been published by WMO (2006). Moreover also applied research is ongoing by public institutions, in order to cope with climate change, for instance the California Climate Change Center published a report (2006) in which the topics water

Fig. 4
GCM scenarios.
From IPCC 2007



and agriculture, plants and animal diseases, landuse modifications are addressed looking at the GCM forecasts. At European level the reference document is the Green paper recently published by the European Commission (EC, 2007), stressing that "The most vulnerable areas in Europe are:

• Southern Europe and the entire Mediterranean Basin due to the combined effect of high temperature increases and reduced precipitation in areas already coping with water scarcity…"

The European scenario of climate change has relevant impacts also on the phenology and on agricultural practices (see fig.5).

Concerning land use and agriculture further desertification in the Mediterranean area is expected and in 2003 a dramatic drought in Central Europe occurred.(fig. 6).

At national level studies on climate change and agriculture are in progress. A reference is the recent National Climate Change Conference 2007, held in Rome in September 2007. As far as agriculture is concerned A. Bonati (2007), in the presentation of the Agricolture Session achievements, stressed the need of improvement of the knowledge about biology and of conceptual models for the relations between climate change, human activities and desertification. Perhaps the most detailed research project in Italy on this topic is CLIMAGRI (www.climagri.it) carried out by UCEA, FAO, Meteorological Service of ARPA Emilia Romagna and other research institutes. In the cited studies there is also the use of forecasting models, however in this field the uncertainties and feedbacks hinder, up to now, the adoption of widely accepted and used standard models.

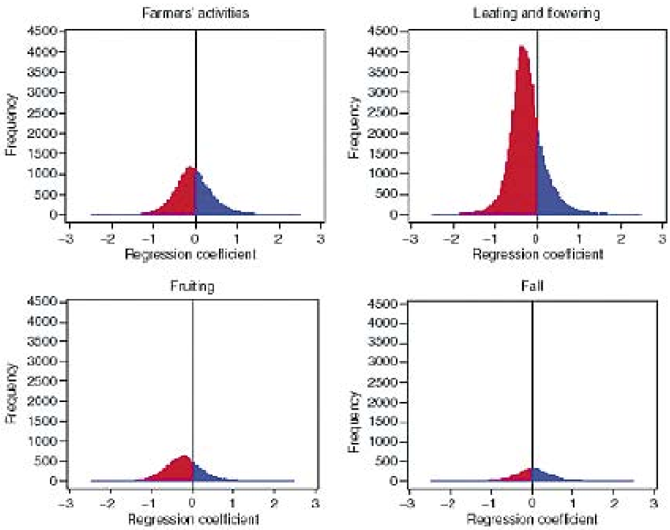


Fig. 5

Phenology and climate change

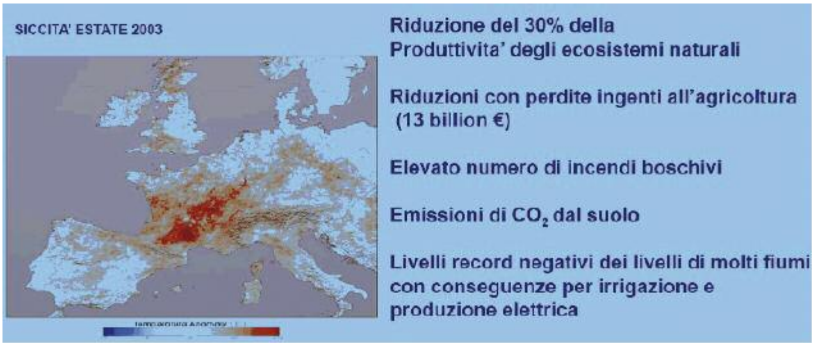


Fig. 6

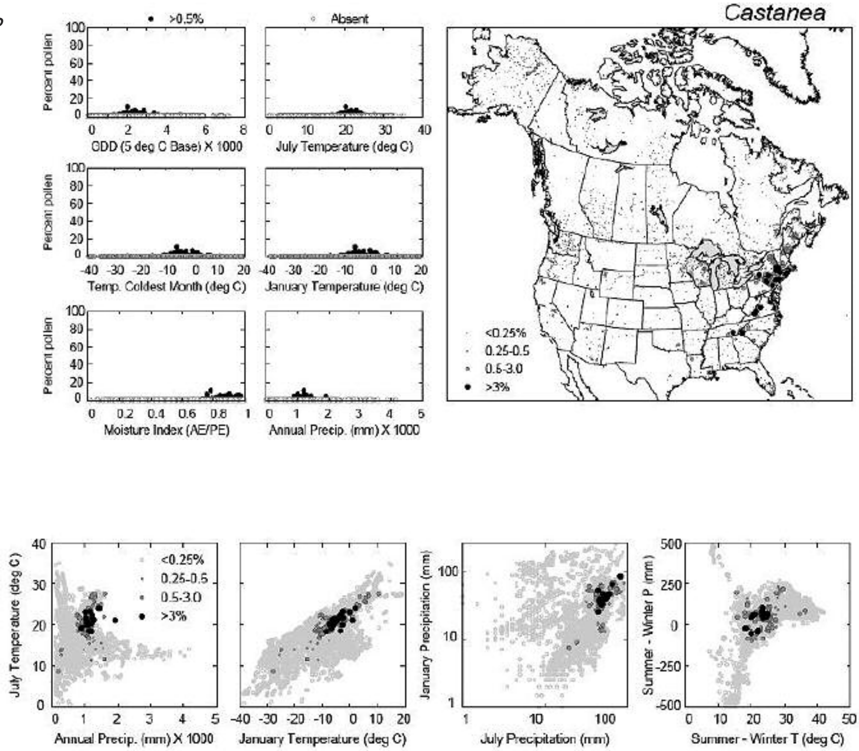
2003 Heatwawe in Europe

Pollens as indicator

As far as climatology is concerned, pollens data have been used in the last century mostly to estimate past climates looking at the spatial distribution of vegetation in the Olocene, and to evaluate the phenology of plants linked with meteorological parameters (Finsinger et al. 2007). In this framework a relevant contribution is Atlas of Pollen-Vegetation-Climate Relationships for the United States and Canada (American Association of Stratigraphic Palynologists, 2006).(Fig 7)

As agreed by the scientific community in the late '90 (Osborne et al. 2000), pollen are integrated plants change indicator related to climate variability. In the following fig. some changes in phenology linked to rainfall are shown (fig from Penuelas).

Fig. 7
Atlas of Pollen from AASP 2006



In order to better describe the relevance of pollens, firstly the question what is an indicator ? should be answered for biologic factors:
an environmental indicator is a species or group of species or characteristics of a species that responds predictably and sensitively, in ways that are readily observed and quantified, to an environmental disturbance.

Criteria for selecting indicators:

Climate sensitivity
Species or features of species whose distributions, physiology or life cycles are predominantly sensitive to climate (especially T and P) and less vulnerable to other changes in environmental conditions.

Availability of historical data:
Previous data have been collected and serve as a baseline against which to monitor future change. This criterion will rarely be met for italian pollen because of the scarcity of long-term monitoring studies available.

Position within geographic range:
Climate-related changes in performance will be detected earlier at the boundary of a species' geographic range. Shifts in the boundaries between vegetation types (ecotones) may be particularly sensitive indicators.

Dispersal capacity
Species with the greatest mobility (plants with small wind-dispersed seeds) will be the most capable of shifting with climate zones and should thus indicate changes sooner than species with limited dispersal capacity.

Suitability for monitoring
The indicator should be easy to observe, recognise and identify. The cost of monitoring it should be minimal, and measurements should be readily repeatable.

Several examples of adoption of pollen as indicator are reported in literature. For instance Osborne et al. (2000) dealt with the olive phenology as a sensitive indicator of future climate warming in the Mediterranean, with forecasts until the 2100 (fig. 8). This topic is addressed further in WP 4.1.

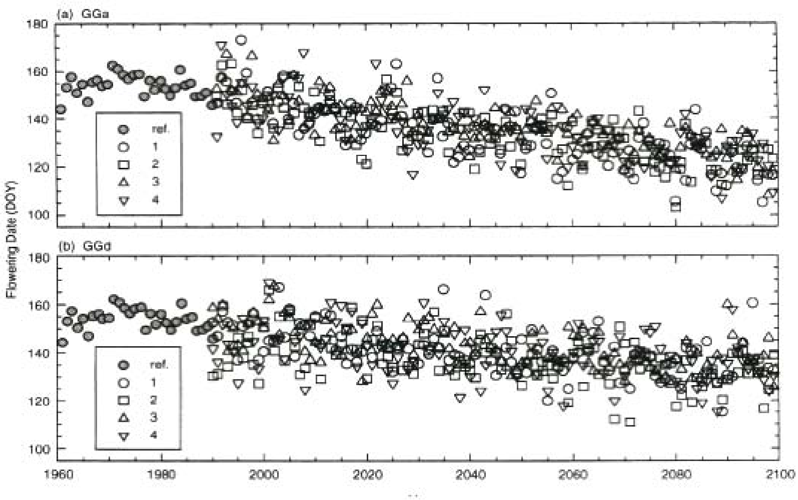


Fig. 8
from Osborne et al. 2000

Conceptual model for pollen and agricolture

Top-down evaluation of climate change impacts in agriculture can be undertaken by 3 main approaches:

Using theoretical concepts to qualitatively assess how climate change might influence agriculture.

Using small-scale quantitative simulation models, either statistically based or mechanistic, to predict crop responses to climate change.

Using system-scale quantitative modelling, which can be mechanistic, empirical, statistical or, more likely, a combination of all three.
It is necessary to define the specific objectives of this model,

Fig. 9
Pollens ans phenology

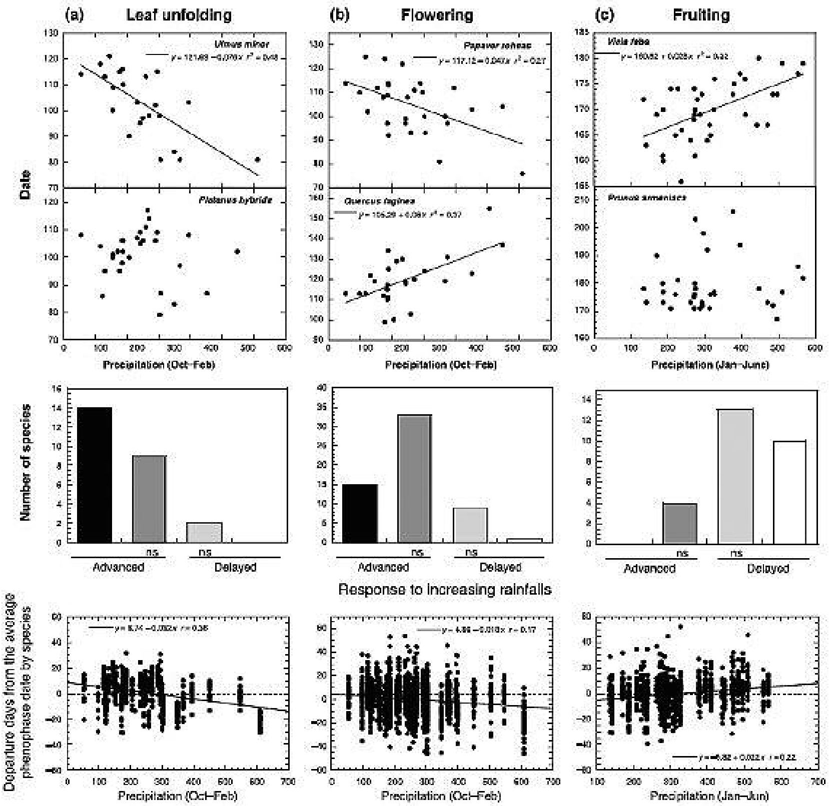


Fig. 3 Species-specific phenological responses to precipitation over the last 50 yr. Relationships between the Julian date of different phenophases (a, leaf-unfolding; b, spring flowering; and c, fruiting) and rainfall over the previous months in plant species near the Cardedeu field station (central Catalonia) from 1952 to 2000. Lines represent linear regressions fitted to the data. The frequency distribution of the plant species with advanced or delayed trends in phenophase response to increasing rainfall (Oct–Feb for leaf unfolding and flowering, and Jan–Jun for fruiting) is also depicted. Leaf-unfolding dates for 25 species (a), flowering dates for 57 species (b) and fruiting dates for 27 species (c). Significant trends ($P < 0.05$) are shown in black for advances and white for delays. Non-significant trends are depicted in gray. Finally, the departure days from the average phenophase date by species is also depicted by considering the data for all studied species grouped together.

there are two possibilities:

a) to foresee the production of a given crop on the basis of the quantity of pollen released in that year (Prof. Fornaciari presented in Palermo the forecasting model results from the analysis of olive production)

b) to try to define the effect of climate on agronomic parameters (for example the precocity of crop production) linking the agronomic event with the pollen phase of one or more air dispersed species. (fig.9)
In the conceptual model the attention has been focused on the approach a).

Indeed to check the impact of climate change in 2050 and 2099 in agriculture on basis of the IPCC scenario the field of research must be further defined and it will be the estimate of possible changes in productivity which might be inferred using pollen data.

The sequel of steps which have been undertaken in order to define target species and operational sub models are summarised in the following conceptual model:

The lack of reference data hindered up to now a complete application of the proposed conceptual model.
In order to accomplish step 10 the model 8 is based on Fornaciari (2002, 2005) Fig. from Fornaciari et al.
For step 13 dispersion should be taken into account with the aid of Hidalgo et al. approach (2002) in which pollen emissions are coupled with meteorological data and forecasts as well as a dispersion model (CALMET, CALPUFF).

Kind of data necessary to implement the model

In order to develop and adopt the forecast model useful for the reduction of climate change impacts the following steps have been carried out:

a. Delineation of the spatial and time spans to be taken into account:

1 Spatial resolution is related to the choice, however the forcing factor is the resolution of the Global Circulation Model (GCM) forecasts, downscaling if available is useful but is beyond the goal and means of this action;

2. Time references are driven by the IPCC 2007 estimates, since the forecasts are for the 2090-2099 period relative tho the 1980-1990 period the most reasonable reference times are 1980-1999 as starting point, 2040-2049 as intermediate forecast, 2090-2099 as long term forecast.

Historical series of palynological and meteorological-climatic data

The data related to pollen series take into consideration:

- the regions where the operative partners of the AtMOSnet Project work
- the Objective 1 Regions
- the Mediterranean geographical regions potentially affected by drought and desertification phenomena

For the time series it has been evaluated:

- Monitoring period
- Site characteristics and geographical coordinates
- List of the pollen species available to ATMOSnet

The following variables for each time series are necessary:

- Starting time of pollination for each significant species
- Ending time of pollination
- Quantitative distribution curve of the species during the year

Data availability for model validation

The validation of forecast models is always a puzzling task, indeed for the GCM the validation is based on the runs for the 1900-2000 period and the comparison with the measured climatic parameters. For environmental impacts on

Fig. 16
Diapersion model

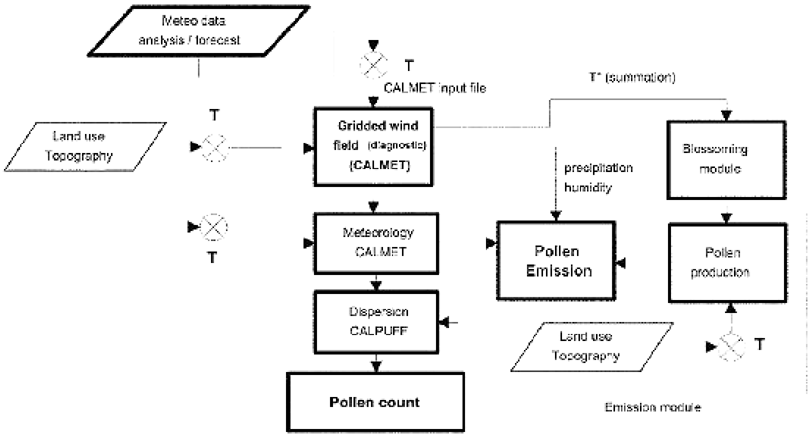
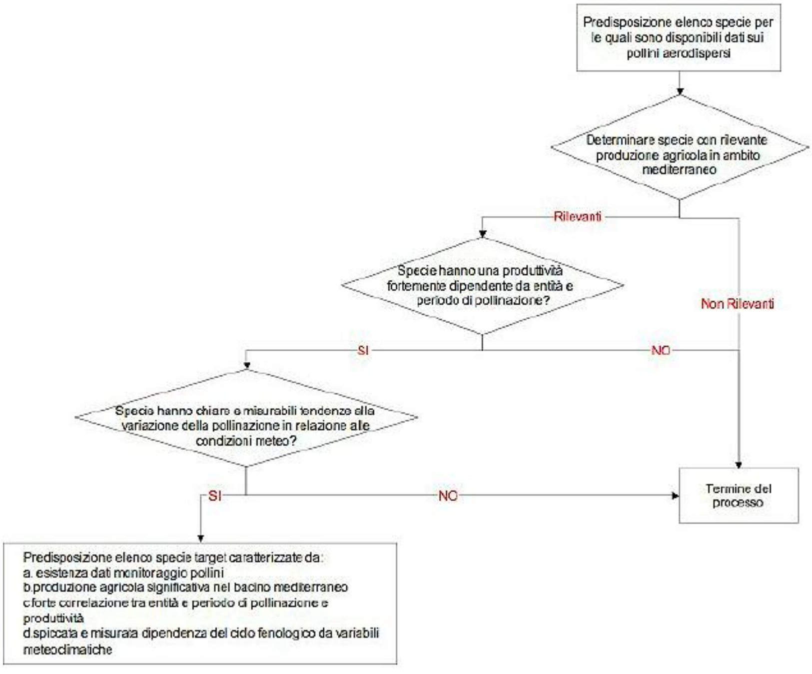
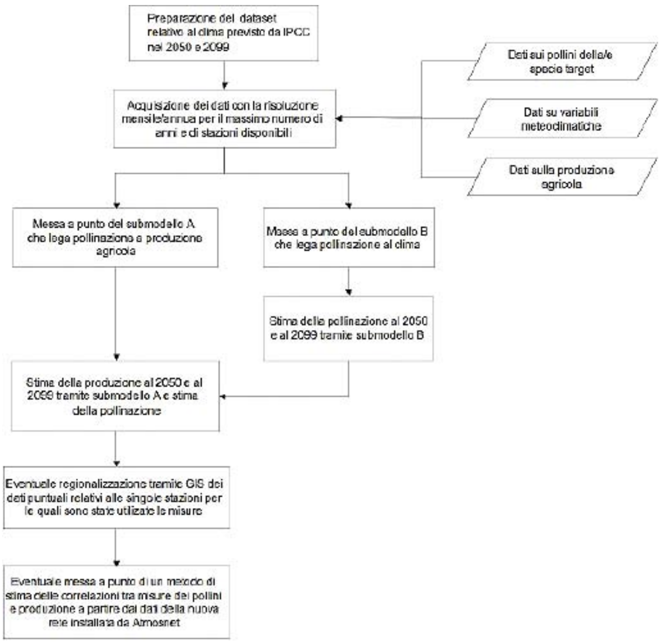


Figure 4. Architecture of the system. Inputs, computation modules and outputs.

Fig. 11
WP4 conceptual model





agriculture in the last century the most relevant trigger factor was the so called green revolution, hence it is very difficult to adopt the same approach as in climate models. The data on landuse, drought, desertification, soil degradation are available for the "satellite period" starting 40 years ago, but these data might not be easily compared with runs of forecast models due to major changes in agricultural practices. The suggestion, is to carry out the validation for the 1980-1999 starting point.

Pollen models application

An application of pollen model has been performed concerning Olea crop yeld in Italy, according the approach proposed by Fornaciari and colleagues in several papers (2002-2005 and references)

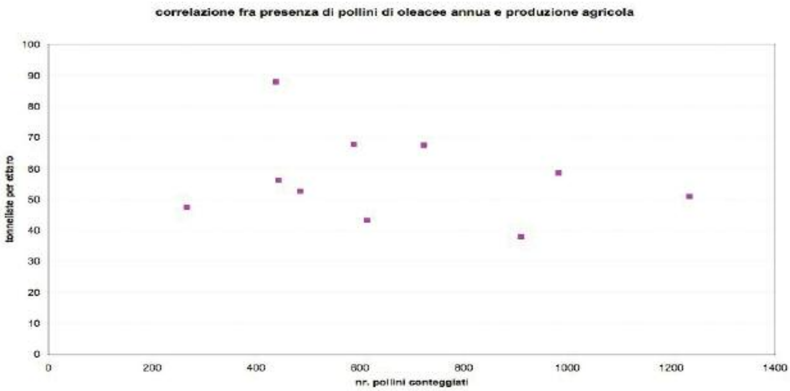
ATMOSnet pollen monitoring network and modelling

Up to now traditional pollen data seem not to be suitable for a direct forecast, data analysis carried out on Naples time series show the absence of correlation with crop yield for Olea.

To define the further finalisation of the proposed model a discussion of Atmosnet results with the open scientific community is highly recommended, looking at the state of the art two steps should be further developed:

a. develop a lumped conceptual model looking at the whole eastern Mediterranean and at the 4 effects cited in the description of activities (desertification,

Fig. 12



drought, soil degradation, vegetation pathologies) in order to produce forecast scenarios at regional scale;

b. develop a distributed model looking at a test area (a NUTS 2 region or a physiographic unit) with the calculation via GIS of the spatial distribution of the forecast scenarios for the environmental impacts

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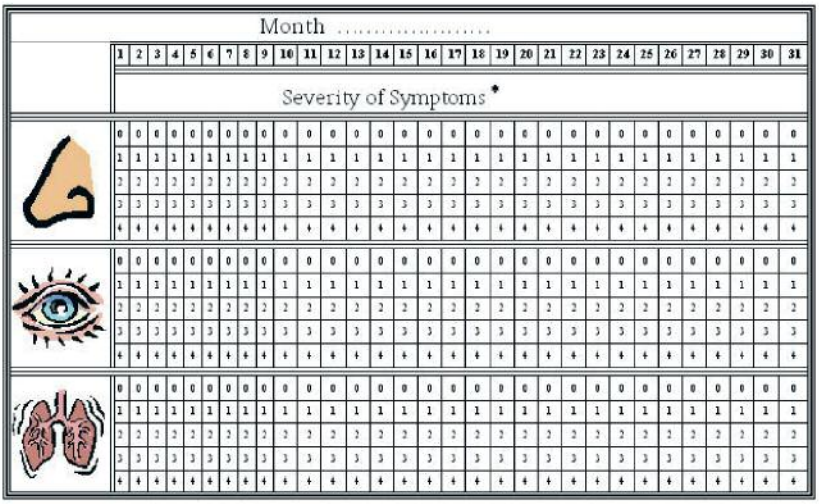
Pollens “Forecasting Model” on Human Health

Charalampos Bratsas, Vea Margari

Aristotle University of Thessaloniki, School of Medicine - Greece

Introduction

It is generally accepted that inhalation of pollen grains induces respiratory allergic symptoms in sensitized individuals (R.E. Dales et al., 2000, F.Feo Brito et al., 1998). Moreover, allergic symptomatology is positively correlated with atmospheric pollen counts, but it has not been established whether a quantitative dose-response model exists. I fact, the already proposed complex non-linear relationships between pollen levels and intensity of clinical manifestations seem to reflect both the priming effect and late-phase reactions (A.Tobias et al., 2004, H. Bibi et al., 2002). To this point, no consensus reports have been issued for interpretation of pollen data. The currently proposed models are limited to specific geographic areas (R.Anderson et al., 1998, R. Newson et al., 1998), R.E.Dales et al., 1996). Therefore, their validation requires aerobiological and clinical trials, especially after the recent climate changes that have dramatically altered plant distribution and pollination.



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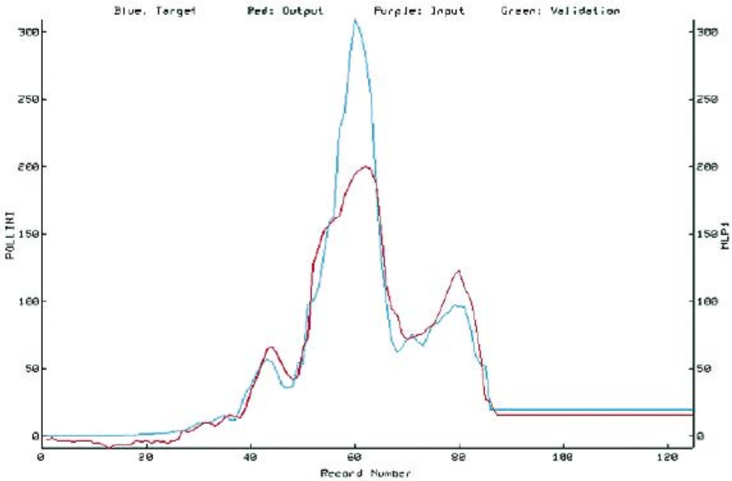
* 0 : None 1 : Mild 2 : Moderate 3 : Severe 4 : Debilitating

Fig.1
Symptom-score questionnaire table

Fig.2
Variations of eye symptoms (%) and average pollen concentrations



Goals of the proposing model

The main objective of project is to create a forecast model for airborne allergenic pollens in the Mediterranean region. The development of this model is based on the establishment of a correlation between measured air pollen levels and clinical manifestations in pollen sensitized patients, taking also into account the interfering meteorological factors. In the future, such a model could help to the prediction of pollen concentrations for the next day or the next few days (short-term forecast). So, the forecast model could assist doctors and health authorities, working in the field of allergy, by preventing or at least ameliorating the manifestation of allergy symptoms. This can be succeeded, either by limiting patients' pollen exposure and/or by starting the appropriate anti-allergic treatment before the beginning of the pollination of the responsible plant. For the above reasons this model is considered as a tool to serve and an aid to the allergy suffers, directly.

Materials and Method

Two pollen monitoring pilot sites were installed in Thessaloniki. The first pilot site was in Aristotle University campus (N 40 63', E 22 96') and the second one was in Aristotle University Farm (N 40 54', E 22 96'). The technical equipments used in both monitoring sites are the following:

• The Weather Station: The weather station was an ATMS Zeno 32000 and it was equipped with thermometers SKYE rht+, barometers DELTA-T BS4, hygrometers SKYE rht+, anemometers ELTA-T AN1, wind vanes DELTA-T WD4 and Rain Gauges EM ARG100. All data were available in Real Time and were collected to a portable pc.

• The Sampling Unit: The Sampling Unit was Hirst Buckard and it was placed at a height of 15m above ground at the Aristotle University campus and at a height of 15m above ground at the Aristotle University Farm.

• The equipment used for monitoring: The equipment used for the monitoring was a microscope Olympus BX51. In order to recognise the pollens and to

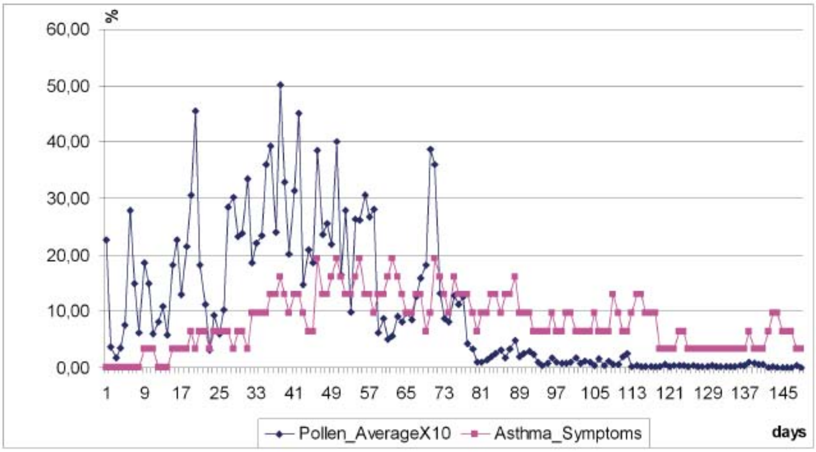


Fig.3
Variations of asthma symptoms (%) and average pollen concentrations

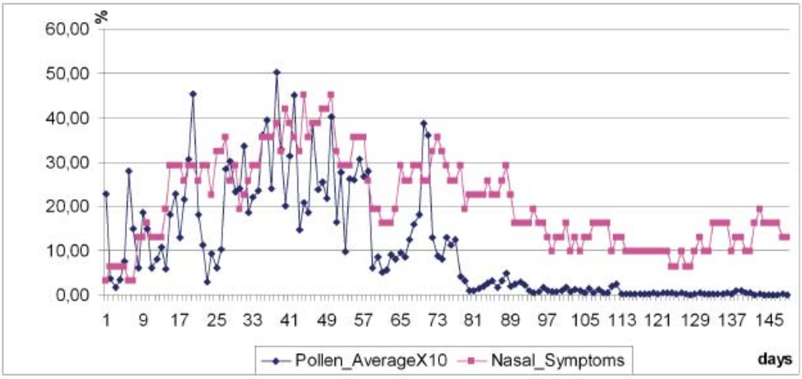


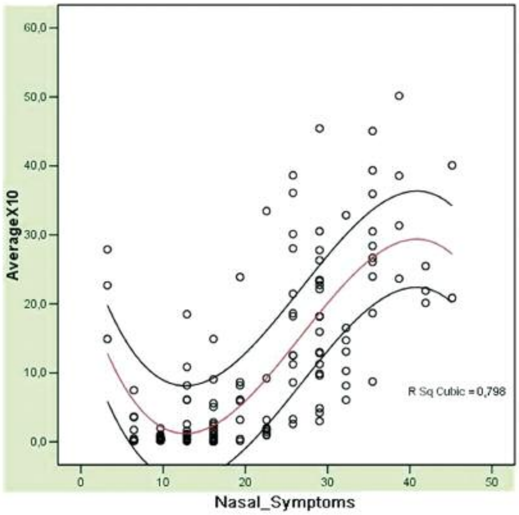
Fig.4
Variations of nasal symptoms (%) and average pollen concentrations

achieve image analysis, a software programme "Image Pro Plus version 6.1" was installed All the monitoring data were saved using Microsoft Excel programme. For the purpose of this project, data were selected from 26 different types of pollens, which are known for their effect on human health in terms of allergic symptoms.

For the scheduled clinical part of the study, a number of patients were selected from a pool of patients with known seasonal respiratory allergy to pollens. These patients were obliged to complete symptom-score questionnaire tables (fig.1). The included patients were either mono-sensitive to a specific pollen or poly-sensitive to a variety of common allergenic pollens in the Mediterranean region. The pollen sensitivity is confirmed by skin prick tests and/or by detection of serum pollen-specific IgEs. The questionnaires facilitated the reporting of the initial manifestation of allergic symptoms as well as their intensity (based on visual analog scales), before and after induction of an appropriate standardized medical treatment.

To be more specific, the severity of allergic rhinitis, conjunctivitis and asthma was assessed by assigning numerical values on the symptom-score table (fig.1)for eye, nasal and asthma symptoms, with 0 denoting none, 1 mild, 2 moderate, 3 severe and 4 very severe.

Fig.5
Nasal symptoms vs Pollen concentrations



The purpose of the statistical analysis was to correlate symptom appearance with the pollen county. For this reason, only the symptom appearances as a percentage of the total number of the sample patients, were taken into account, ignoring the severity of the symptoms from the above mentioned table. After the collection of the reported data, appropriate statistical analysis will follow, in order to correlate symptom appearance with pollen counts.

The duration of this experimental period, from the beginning of the pollen measurements (Feb. 2007), was 149 days.

The assumptions made for the creation of our draft model were:

• The collected data were only for one year period.

• Data received only from one region (Thessaloniki, Greece).

Results

The variations of the nasal, eye and asthma symptoms versus the average pollen counts during the experimental period (149 days) are shown in the fig.2, fig.3, fig.4. Table 1 shows the mean, min., max. and standard deviation of pollen averages, as well as, of nasal, asthma and eye symptom appearances.

Both Pearson's and Spearman's correlations showed a very close relation between nasal symptoms and pollen counts. Asthma and eye symptoms were not found to be so close related to the pollen concentration (table 2). For this reason three types of regression (linear, quadratic, cubic) tried only for the nasal symptoms vs. pollen counts. The coefficient of determination was r2=0.471 for linear, r2=0.511 for quadratic and r2=0.798 for cubic regression.

The variables of the cubic equations derived (fig.5) from the available data, are presented in table 3. Analysis of variance examined the significance of the cubic regression and found a high degree of confidence (table 4.)

Conclusion

The human health "Forecasting Model" was based on the air pollen levels and the appearance of symptoms in pollen sensitized patients. The data were collected within a relatively short period of time (149 days). The extreme weather conditions, existed during the above period, which affected he florescence, do not permit to lead in the conclusion, that seasons play a substantial role to human pollination.

Among the symptoms examined, the nasal symptoms were found to be close related to the air pollen concentration, unlikely the asthma and eye symptoms, which may be affected by other factors, as well.

The statistical model developed in this study was of a cubic equation with high degree of confidence ($r2=0.79$ and $Sing=0.00<0.1$)

Nevertheless, more data and replications in time and in sites are needed in order to validate this model.

Finally, it is known that the expanding use of medical algorithms, in an evidence based medicine, is a modern way of medical practice. Therefore, it is considered of worth, forecasting models for airborne allergenic pollens to take place in relative sites, such as MedAl (G. Kantor et al.) or, the recently developed, KnowBaSICS-M (C. Bratsas et al.) sites, so as to assist medical doctors and health authorities to prevent or, at least, to ameliorate the manifestation of allergies.

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Tables

Table 1. Mean values of pollen averages and symptoms appearances

Descriptive Statistics

	Days	Range	Minimum	Maximum	Mean	Std Deviation
Pollen_AverageX10	149	50,1269	0,0221	50,1490	10,456353	12,3964620
Nasal_Symptoms	149	42%	3%	45,00%	20,68%	10,187%
asthma_Symptoms	149	19%	0%	35,00%	10,67%	6,903%

Table 2. Spearman's and Pearson's correlation coefficients of Pollen vs. Symptoms

Symptoms	Spearman's Rho	Pearson's Rho
Nasal	0.762	0.686
Asthma	0.324	0.325
Eye	0.345	0.350

Correlations are significant at the 0.01 level (2-tailed).

Table 3. Estimation of the variable values in the cubic equation "Nasal vs Pollen"

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
Average_X	4,210074	,349683	2,958383	12,040	,0000
Average_1	-,175902	,023896	-4,060998	-7,361	,0000
Average_2	,002225	,000385	1,986989	5,784	,0000

Notes:
* Equation was estimated without the constant term; Rsq is redefined.

Abbreviated	Extended
Name	Name
Average_1	Average X10**2
Average_2	Average X10**3
AverageX	Average X10

Table 4. Significance of the cubic regression "Nasal vs Pollen"

Analysis of variance

	DF	Sum of Squares	Mean Square
Regression	3	63118,587	21039,529
Residuals	146	15934,482	109,140

F = 192,77509 Signif F = ,0000

Paving the way for consensus towards a common pan-European standard code of practice in the field of applied aerobiology

Joseph Callus

University of Malta, Institute of Agriculture - Malta
Consultant

Maria Dimou

Aristotle University of Thessaloniki - Faculty of Agriculture - Greece

The ATMOSnet project,, an EU funded initiative, knows its inception with the Regional Agency for the Protection of the Environment (ARPAC) of the Campania region in Italy. The network was established in 2007 and comprises five contributing partners, namely the University of Naples, the Italian Agency for Protection of the Environment and for Technical Services (APAT), the Sicilian Environmental Department together with the University of Palermo, the University of Thessaloniki (Greece) and the Institute of Agriculture of the University of Malta. The network now boasts 15 contionous monitoring station.

This review paper focuses on one of the intended deliverables of the project, namely that of conducting a thorough research exercise, using various techniques and covering a plethora of books and papers on the subject, interviews etc., in order to provide for a holistic assessment of the standards, methodologies and quality assurance practices currently in force in other EU Member States vis-à-vis pollen monitoring and the monitoring of other aerobiological agents. Disparities across EU Member States are disclosed and advantages and disadvantages elaborated upon in appreciable
detail where this was indicated.

Several recommendations have been put forward with respect to the establishing standard protocols to ensure a unified sampling programme design, one that would eventually support any similar project that purports to assess and evaluate any eventual trends resulting consequent to the changes in climate that are being apprehended not solely in the European Union but also in other regions of high economic importance. It is imperative that any newly established network works in consonance with others, but at the same time, emerging networks are paving the way to improvements. There seems to be the necessity to improve on the temporal assessments, considering that information as relates to the spatial dimension is already available. Few, if any research studies, have to date been afforded, to provide other useful information concerning the prevalence and other attributes of pollen within the vertical (altitude) profile.

Moreover, due to geographical niches attributed to certain species, it may already be indicative that finding common indicator taxa for the whole of the

European territory may pose a problem. For example, for the Mediterranean region, Olea europea seems to be the major identical species, but further studies are required in order to assess the response of this species and to determine whether this suits all the characteristics that an indicator species should possess.

There is general consensus that phenological and meteorological information is required in conjunction with the gathered data, in order to assist forecasting, early warning and climate-change or health related modeling. In this respect, use of remote-sensing tools together with current monitoring regimens can help provide more insights into the underlying mechanisms of pollen dispersion and its ultimate fate.

Introduction

Anthropogenic activities are resulting in increases in atmospheric greenhouse gases and changes in global climate. These, in turn are likely to have had and will continue to have, impacts both on human health, agriculture and the environment (IPCC, 2001).

Beggs (2004) outlines a number of research challenges that scientists need to embrace so that eventually, scientists will have a better understanding of the mechanisms underlying the response and prevalence of aeroallergens in a changing climate. Several researchers have pointed to considerable evidence suggesting, that this phenomenon, has been affording a diversity of impacts on aeroallergens, including effects that invariably influence pollen amount, pollen allergenicity, pollen season, plant and pollen distribution, and other plant attributes (Burge, 2002; Estrella et al.,2006; Garcia-Mozo et al., 2006).

The unprecedented rates of climatic changes that are anticipated in the near future, coupled with land use patterns that are likely to obstruct or impede gene flow, can be expected to disrupt the interplay of adaptation and migration, in turn adversely affecting the productivity and threatening the persistence and survival of many species (Davis and Shaw, 2001). In the last decade, it has become even more clear, that the timing of many phenological processes like the start of flowering and leaf unfolding in spring-time, have changed (van Vliet et al., 2002). The earlier start of flowering will have consequences for the start of the pollen season and consequently on the health of the people and the produce of forests (Loehle and LeBlanc, 1999), and the yield of fruit-trees and many important arable and economically important crops, including wheat (Miglietta, Tanasescu and Marica, 1995).

Additional threats will emerge as climate continues to change, especially as climate interacts with other stressors such as changes in species composition of communities, shifts in land and cultivation use, as well as habitat fragmentation (McCarty, 2001).

Community-wide projects and networks, such as APHEA, ULTRA, RUPHIO, PHEWE, AIRNET, EUROHEAT, INTARESE and last but not least, other regional projects and networks, similar to the one that has recently been established under the EU-funded ATMOSnet project, will definitely and to some extent provide some additional contribution, possibly by providing valuable input to models and in turn, affording useful insights about how citizens will be affected and the manner by which certain species will or may already be responding to climate change in certain regions.

Methods for aerobiological sampling and collection

Air sampling provides information about the bio-aerosol composition of the atmosphere. Several air sampling instruments, have in time been proposed for the collection and evaluation of atmospheric contaminants (Ogden et al., 1974; Mandrioli, 1994; ACGIH, 1995; Mandrioli, Comtois and Levizzani, 2000. The sampling methods which have been adopted in Europe in former years were reviewed by Rantio-Lehtimaki (1991). Principal methods currently in use include volumetric sample collection devices based on impaction, impingement and filtration technology. The most widely used are slit impactors, rotating arm impactors and sieve impactors (Levetin, 2007). It is to be emphasized that no single sampler fulfils the characteristics of the ideal sampler i.e. to measure the total human exposure to aerobiological particles, and each technology has its advantages and its limitations. But what is important, for the sake of inter-operability and inter-comparability, is that whatever the option, the characteristics of the sampler must be similar to those in use by other research bodies. This is especially true for attributes and other specification variables related to flow rate, size of orifice or collection surface, cut-off, speed of collection and capture efficiency (Mullins and Emberlin, 1997).

The most common sampler used by palynologists are the Burkard and Lanzoni traps, both of which are based upon the principle proposed by Hirst (1952). Since these devices have been recommended and accepted by the International Biological Program (Benninghoff et al., 1972), it comes as no surprise that national research centres have, in time, been investing in these type of devices; and this accounts for their superior and prominent proliferation worldwide (British Aerobiological Federation, 1995).

Rotating arm impactors, such as intermittent cycling rotorod samplers, have also been and are still commonly used in research and monitoring studies conducted in other parts of the world (Edmonds, 1972; Smith, 1984; Newnham et al., 1995). Rotorod samplers have been used to identify hotspots, as well as spatial and temporal trends, especially in an urban setting (Frenz et al., 1995a). Analyzing Rotorod pollen samples can be time-consuming when one uses the standard method for evaluating an entire collector rod (Frenz et al., 1995b). The Rotorod sampler, developed by Perkins in 1957, now finds widespread applications in many countries, especially in the United States (Frenz et al., 1996), where it has been used for over 25 years (Frenz et al., 1997a). A study comparing pollen and spore counts collected with Rotorod Sampler and Burkard spore trap, showed that whilst the Burkard trap appears to be a superior instrument for sampling particles with an aerodynamic diameter of less than 10 mm; the Rotorod appears to be equal and even superior for collecting particles with a diameter larger than 10 mm (Frenz et al., 1999). This has serious connotations, since current urban pollen monitoring strategies being adopted in Europe cannot be kept in isolation, particularly if cross-continent comparisons need to be made with palynologists and clinicians employed in other research centres and established bodies of knowledge, like those prevailing in the United States, Japan, Canada, Australia and New Zealand.

Other types of samplers developed in Europe include the Cour sampler. It is a device designed by Cour (1974) in Montpelier (France), and it is widely used for some purposes in some countries in the Mediterranean area to trap a diversity of pollen and spores, whatever their size. However, for national programmes, the main samplers used in France are the Hirst type, operated at 10 litres per minute to mimic the respiratory mean rate.

But the sampling and trapping method used may also be determined by scope (Burge and Solomon, 1987). For example in the case of studying health related effects, it is more common and certainly logical to measure spore and pollen counts on a two hourly basis, with meteorological data being measured every hour (Epton et al, 1997).

Aerobiology and the Design of Future Monitoring Programmes

Designing a specific sampling programme requires consideration of the aim of the sampling initiatives, the nature of the biological particles (including the size and the expected concentrations) and parameters that determine the choice of the sampling and quantification method, the sampling strategy (e.g. location, season, duration and frequency), and approaches for statistical analysis and interpretation of the data (IPCS, 2000). No aerobiological monitoring programme can ever be complete, if it does not include temporal and spatial profile assessments for major pollutants, as well as adequate and scientifically supported evidence on the effects that these are likely to impart. Our point of departure, when it comes to designing monitoring programmes for such purpose, should have resided with the international standard ISO/TR 4227:1989.

But since most of the pollen monitoring and research programmes in most countries across Europe started sporadically, with each research institute deciding the modus operandi and the set of target taxa, based on what best suited the exigencies and circumstances of the country where these were established, we come across a diversity of approaches. Regrettably, the need of moving in course with some internationally accepted standard was somehow overlooked. Even in our appraisal of the national databases held by certain countries, we find disparities in the dates when monitoring for pollen and other aeroallergens first started, but still one questions the validity of some of the data, considering that no intra-Community quality assurance practices were in force at that time.

Many European countries have been monitoring pollen and aeroallergens for many decades now and these also boast a plethora of papers and host a multitude of observations and experience. Among these we find Italy, the United Kingdom, Austria, Spain, France, Germany, Greece and many Nordic countries like Denmark. The richness is also expressed in the foundation of dedicated bodies in all the corners of EU territory, and to mention but some the authors would like to refer to the Italian Aerobiological Association (IAA), the Spanish Aerobiological Association (REA), the Danish Aerobiological Group (Danish Asthma & Allergy Association), Le Réseau National de Surveillance Aérobiologique (R.N.S.A.) in France and the British Aerobiological Federation, all of which foster and promote research and study in the field of Aerobiology, provide means of communicating information amongst several academic, medical and other research institutions via national networks, bulletins and newsletter, as well as promote the benefits of aerobiology to the community.

Until recently, there has been little convention or need for uniformity of methods. This problem had been partly solved following the establishment of networks and fora involving groups of researchers hailing from several Member States and nonetheless following the founding of the European Aerobiological Network (EAN). The EAN database was created in 1988 and contains pollen count data from 1974 to 2006. More than 600 stations all over Europe participate to supply the European Information System (EPI) with more than 140,000 records per annum. The database is currently growing by 12,000 records each year. Malta is expected to join next year. The impetus of the EPI/EAN is now being focused towards increasing the quality of its data quality assurance programmes, on adding new functionalities (including security access and data import programmes, defined statistics, charts, graphics) and towards introducing a policy whereupon 2-hourly values will be stored in addition to daily averages . The EPI has been connected via web interface since 1999 and the group is now working for enhancements in the handling of pollen groups and triggers to define actions for updates for specific stations/pollen types.

Certain variations in the pollen counts have been associated to the siting of the sampling devices (Ranthio-Lehtimaki et al., 1991; Galan et al., 1995). Yet in practice what do we observe when an appraisal is carried out in respect of the altitude and the distance from the sea of the pollen monitoring stations? Notwithstanding that the protocol currently adopted by EAN suggests that the sampler should be positioned between 15 to 20 metres from the ground. But nevertheless several variations have been noted with respect to the mean altitude above sea-level. This is possibly due to topographical characteristics, where the stations are situated. For example, in Denmark there are circa 8 stations, the height at which these are situate ranges from 24 metres above sea level up to 129 metres above sea level. Even if we consider the stations that are currently participating in the ATMOSnet project, covering for part of the eastern Mediterranean, one also notes these disparities (vide Table 1 below). But certainly some corrections would need to be introduced to cater for this effect.

Moreover, concerning the stipulated height of the sampler above the ground, there should be a valid reason to support this thesis, for if the station is part of a network aimed for making predictions on the effects of pollen and fungal spores on human health that is one thing, whilst if the station is part of another network aimed to assess long-range transport or research the pollen profile and fluxes across the atmospheric or tropospheric gradient, that is another story.

Table 1: Location characteristics of stations participating in ATMOSnet

			Height	Distance from coast	Orientation
	Northing	**Easting**	**m.a.s.l.**	**km**	
Castel Volturno	41.0346	13.9408	10	2.00	South West
Napoli	40.8667	14.2707	80	2.50	South
Portici	40.8119	14.3428	20	0.75	West
Policastro Bussentino	40.0727	15.5215	10	0.26	South
Palermo	38.1655	13.3100	75	4.17	North East
Alcamo	37.9812	12.9636	256	6.00	North
Agira	37.6580	14.5176	650	42.69	North
Messina	38.1788	15.5466	40	0.92	South East
Catania	37.5300	15.0764	160	3.22	South East
Siracusa	37.0708	15.2680	20	1.00	South East
Tal-Gordan-Malta	36.0720	14.2183	140	0.84	North
San Lucjan-Malta	35.8304	14.5436	20	0.05	South East
Thessaloniki Uni.	40.6330	22.9582	50	1.12	South West
Thessaloniki Farm	40.5376	22.9897	15	1.00	North West

Another issue that is likely to raise some concern relates to the number of stations in respect of the per capita or territorial coverage. For example, there are some 9 stations in Denmark, whilst in the UK there are 33 monitoring sites, with only 13 of these are part of the continuous monitoring network. In France, there are circa 15 such monitoring sites, but this only accounts for the number of stations participating in EAN. In Italy and Spain as well, the number of stations participating in the national pollen monitoring programmes is substantial. So what should be distance between the stations to prevent overlap and possible double counting? How many stations should be installed to ensure representation and to satisfy the remit of the programme of which these form part? Several researchers have pointed out to the errors and economic viability as a result of samplers being stationed in close proximity close to each other (Frenz et al., 1997).

Sample Analysis: Pollen and Spore Counting Protocols

Samples can be analysed by various methods, with microscopy and culturing being the most important approaches that have been adopted by palynologists all over the world (Muilenberg, 1989). However, immunoassays, molecular methods such as Polymerase Chain Reaction (PCR) and other new techniques are becoming more widely used to analyse the samples (Levetin, 2007).

Standard methods used for the counting of pollen in most Nordic countries, including Denmark and the United Kingdom are based on those proposed by Käppylä and Pettinnen (1981), i.e. pollen grains are counted in 12 transverse traverse stripes at a magnification of up to x640. In this manner, the pollen concentrations are determined for every 2 hour-period. Pollen are then identified to generic genus. The first pollen trap, a Burkard-trap, was placed in Copenhagen on the roof of DMI, app. 15 meters above ground level in 1977. Later similar traps were placed at the hospitals in Viborg in 1979, and in periods also in Odense (1981-1991), Nykøbing Mors (1979-83) and Nykøbing Falster (1979-83). In the United Kingdom the daily total pollen count is obtained by summing the counts found in the twelve transects and these figures are then converted to grains per cubic metre of air using an equation called the correction (or conversion) factor. In Malta, a pollen station was run for the first time by the Department of Public Health, between 2000 and 2003, and the methodology that was adopted followed that used by NPARU (UK), namely in that a Burkard trap was used and 12 transverse traverse strips were counted. There may be two plausible reasons why this method is more appropriate for Malta's circumstance, these being linked to Malta's extensive diversity of wild flora and nonetheless to the tree species that were introduced by the British during the occupation. Moreover, public health and environmental health codes of practice invariably follow UK standards codes of good laboratory and quality assurance practices.

In Italy, Spain, Portugal and many other countries, the pollen grains are generally counted on a fraction of the entire deposit of the slide, rather than on the entire sampled area. Then the counts are read at x250 or x400, depending on the circumstances. Scientists from these countries contend that using horizontal sweep methods give a better representation, because the use of vertical sweeps introduce a lot of bias and error and give a wrong or false reading. The use of vertical transects, according to some scientists (Mandrioli, 2000) adversely affects the accuracy of the measurements administered. Similarly, the horizontal sweeps should at least cover and cater for 20% of the sampled area, for otherwise, these scientists contend that the % error that would be introduced would certainly be greater, due to the fact that the difference and disparities between the real value and the calculated values is likely to be widened.

Three pollen counting procedures are currently in use, namely one employing 12 transverse traverse sections, one employing four vertical traverse sweeps and one based on random selection of parts (random fields) of the sampled area.

This brings us to yet another important discussion, which is invariably tied to the reliability and accuracy of the data that has been collected for many decades, as well as relates to the methods that should be employed in future to ensure better inter-comparability of the data and inter-operability of any envisaged forecasting models. Rull (1987) contends that pollen counting is the last stage in a chain of successive approximations, where each step represents a sub-sampling and produces a decrease in the accuracy of the ultimate representation. Reliability of estimation has always been the main preoccupation for many researchers. Statistical methods that are used therefore have a lot of bearing on the validity and reliability of the data. Pollen slide counting is nothing less than a complex statistical entity (Hill, 1996).

Käpyla and Pettinnen (1981) were among the first palynologists to venture to comparing and evaluating the different counting procedures. They report a significant difference between the two methods of estimation (namely transverse versus random fields). Tormo Molina et al. (1996) also report a significant difference of 7% between 4 longitudinal transverses and a stabilization of diversity after a count of 1000.

Comtois, Alcazar and N ron (1999) discussed the statistical methods employed for reading pollen counts and their relevance to achieving the much needed precision. The authors contend that the percentage of error that is acceptable in aerobiology, is not a statistical decision, but a personal and collective decision, related to significance. Moreover, they reported that the 4 longitudinal lines procedure showed the largest average count estimation error (23%) and that this may indicate that the Hirst-type sampler is more prone to lateral variation of efficiency than expected, since theoretically, complete longitudinal lines, should give better estimation of the slide total than transverses, which could miss pollination peaks if these fall between 2 transverses.

The debate continues as Cari anos et al. (2000) came out with their paper entitled "Comparison of two pollen counting methods of slides from a hirst-type volumetric trap". They compared the two most frequently used pollen counting methods, namely the transverse traverse and the longitudinal traverse counting methods. Statistical results showed that the daily concentrations followed similar trends, even though the counts were slightly higher using the longitudinal traverses method. However, Cari anos et al. (2000) concluded that both methods give a reasonable approximation to the count derived from the slide as a whole, and that more studies need to be procured to work towards a Universal Methodology in Aeropalynology. The issue concerning the accuracy of these two methods does not solely reside with European research networks, because in North America the same debate prevails as to which counting method gives the best representation. Sterling, Rogers and Levetin (1999) discuss some of these issues. They compared the two counting methods by assessing fungal spore concentrations of ascospores, basidiospores, smut teliospores, Cladosporium, Alternaria, Epicoccum, Curvularia, Drechslera, Pithomyces and total spores. Comparison with concentrations obtained by counting the total slide surface indicated that neither method was equivalent to the total slide spore count, although the twelve transverse traverse method gave a lower percent difference from the total slide surface concentration and therefore provides for slightly better approximations of the spore concentration.

Whatever the outcome, it is worth mentioning that each of these methods has some disadvantages that should be taken into account. In the case of the four longitudinal traverses counting method, overestimates can arise from counting only the central regions of the slide where most of the pollen is deposited (Galán Soldevilla, personal communication). Smaller grains and fungal spores can be deposited nearer to the edges in some weather conditions and may be omitted from the count (Tormo Molina et al., 1996). In the case of transverse traverse method, pollen or spores that are deposited within a very short time on the tape may be missed despite the overlap of sample area beneath the inlet nozzle. Yet, both methods have the advantage of producing results of acceptable accuracy quickly and should be viewed in the context of the overall efficiency of the sampling technique used to capture pollen and spores from the air (Bhat and Rajasab, 1989). In conclusion, it would be pertinent to mention that there have been several attempts to use modern technological devices and transducers to scan slide or their projections in an effort to conduct more precise counting and to improve optical recognition (Chen et al., 2006). Maybe this would revolutionize contemporary data acquisition methods, resolve most of the problems that palynologists have so far encountered in their efforts to reach the desired level of accuracy and precision, and in turn, possibly leading to the adoption of a universally accepted protocol.

Aeroallergens commonly targeted across the European Union

Studies on allergenic pollen and fungi date back to several decades (Lewis, Vinay, and Zenger, 1983; Weber and Nelson, 1985; Bush, 1989) and since the main focus then centred on public concerns related to the negative impacts of aerobiological agents on public health, the allergenicity of several pollen taxa has long been investigated and established e.g. Timothy (Lowenstain, 1980), rye-grass (Mourad et al., 1986; Ford and Baldo, 1986), pine (Fountain and Cornford, 1991), grasses (Singh and Knox, 1985), and last but not least Cedar (Spinozzi et al., 1990; Cimignoli et al., 1992).

But pollen monitoring and research studies have also been applied for other important purposes e.g. those covering for environment and agricultural related issues, such as those concerning the transport of pollen from genetically-modified (GM) crops (Rieger et al., 2002), as well as those having an agro-economic concern, including that of predicting harvests for a particular years or number of years.

Regional European pollen calendars were the subject of a paper by Spieksma (1991). Pollen calendars started being developed in many parts of the world during the 80's and the early 90s, but these varied from single taxa calendars, similar to those developed by Spieksma et al., (1985) for Lieden (The Netherlands); Nardi et al. (1996) for the Province of Ascoli Piceno (Italy), to rather elaborate and comprehensive seasonal incidence of airborne pollen like that covering for no less than 22 taxa which were collected from the atmosphere of Melbourne between 1991 and 1993 and which was developed by Ong, Singh and Knox, in 1994. Pollen calendars may prove useful for comparing trends across the years, in particular for noting any shifting in seasons as well as for calculating the cumulative or yearly average count. Therefore we find research articles with very persuasive conclusion, like the one by Vliet et al., (2002), based on the daily pollen counts of the Leiden University Medical Centre, stating that based on data gathered between 1969 till 2000, besides a strong positive correlation had been observed between temperature and the start of the pollen season, an advance of the start of the pollen season of 3 to 22 days had been observed. How will the pollen calendars look 20 years from the present? The answer is not that simple, because the question opens the doors to even further and more profound research.

An overview of the continous airborne pollen monitoring programmes (and targeted taxa) conducted in Austria and some other Nordic countries between 1980 to 1993 are provided in a paper by Jäger et al., 1996. In Denmark, continuous monitoring of airborne pollen has been conducted since 1977. The results of daily pollen have been reported to the public from 1979 for alder (Alnus), hazel (Corylus), elm (Ulmus), birch (Betula), grass (Poaceae) and mugwort (Artemesia). These pollen types are considered to be of greatest allergological importance in Denmark (Dirksen and Østerballe, 1980). In Denmark, the most important allergenic pollen listed according to the time of the year are: alder, hazel, elm, birch, grass and mugwort. The same applies to most of the other Nordic countries as well as Austria and Germany.

In Switzerland, monitoring for airborne pollen has been undertaken as way back as 1969. Frei and Leuschner (2000) reported that pollen originating from trees have lately become more relevant in respect to allergenicity, compared with previous years. Hazel, birch and grass remain the main concern, but values for many other taxa are also being recorded. These include alder, elm, poplar, plantain and mugwort. Frei (1998) reports that records of pollen counts for Switzerland and covering the period 1969 to 1996 seem to denote the presence of several interesting trends, which are possibly attributed to the effects of climate change.

In the United Kingdom, the major airborne pollen targeted include elm, yew, alder, elm, willow, poplar, birch, ash, plane, oak, oil-seed rape, pine, grass, plantain, lime, nettle, dock and mugwort. But then the pollen count is not given for public information singularly for each species, but assigned as a total pollen count read (or forecasted) for that particular day.

In France, a whole range of pollen species are targeted in turn covering for the whole territory. However, different regions have different taxa and in particular regions, only the set of the most important taxa are scheduled coverage. Therefore, the characteristics of the pollen calendars in the southern regions of France are similar to those of Italy, Spain, Greece and other Mediterranean countries; whilst the pollen calendars for the northern regions in France are similar to those of other Northern European countries. This has important connotations, for whilst for example, olive is listed for the southern districts, this species is not even listed in the sampling schedules for the northern stations in France. This makes the task of finding a pan-European indicator species even more difficult, since whilst certain pollen taxa are more prevalent in certain sub-regions of the European Union, other taxa are more profuse and endemic to other sub-regions.

This is more evident when one considers the taxa targeted by Italy and Spain. These include, amongst others, the Cupressaceae, the Urticaeae, Betulaceae, the Corilaceae, Fagaceae, the Compositae, Oleaceae and the Graminaceae. Therefore the disparities across the regions of the European Union are very evidently the result of the prevalence and distribution of species thriving within specific ecological niches or bioclimate envelopes (Pearson and Dawson, 2003), in turn pointing to the strategy that needs to be adopted by the European

Commission. Pieces would still have to fit in the jigsaw to produce a holistic outlook and a true representation of the real situation facing the European Union territory.

In Greece, the most frequently implicated and targeted pollen taxa are cypress, hazel, wall pellitory, plantain, olive, grasses, goosefoot and mugwort; whilst Alternaria spp and Cladosporium spp. are the most studied fungal spores. A rich database covering for more than 20 years are retained by the Pulmonary Department of the University of Thessaloniki (Gioulekas et al., 2003). Studies on allergenic pollen and pollinosis in Northern Greece have been the subject of a paper by Gioulekas, Chatzigeorgiou and Sppieksma published as way back as 1991.

Environmental Threshold Limit Values – finding a common ground

There is a need for finding a compromise or common indicator in order to facilitate cross-country comparison and interpretation. The difficulties mainly arise due to the fact that the allergenic response may vary with age, gender, ethnicity and other biometric factors.

For example in Australia, high grass pollen days are currently defined as those with more than 50 grains/m3 (Erbas et al., 2007). In the United States, a allergy risk index is used based on total pollen counts. The index scale ranges from 0 to 12, with 0 to 2.4 being regarded as being a 'low'; a level between 4.9 to 7.2 denoting the presence of a 'medium' risk; whilst an index of 9.7 to 12 is considered to be 'high' risk exposure level. These levels take into account how much pollen the allergy sufferer is likely to be exposed to during that given period and are based in their most on historical data gathered during the 25 years; as well as possibly on other factors and variables integrated in the algorithm that drives the forecasting model. Allergy Alert™ provides a four-day forecast for every state through a very user-friendly presentation.

One can therefore appreciate the disparities that prevail even between continents when it comes to the interpretation and dissemination of pollen information. One of the instances, which for this purpose one feels the need to recall, i.e. where consensus seems to have been conveniently achieved, concerns pollen monitoring and reporting that was conducted by the Greek authorities, namely by the University of Thessaloniki, during one of the most important events involving multinationals and this relates to the preparations for the Olympics held in Athens in 2004 (Gioulekas et al., 2004). We can learn a lot from this experience.

Reaching a consensual agreement as relates the environmental threshold limit values for certain taxa may not be that easy. So far we have been basing our threshold values on apparent ill effects on health either in an occupational setting (ACGIH, 1991; Bush and Peden, 2006) or via EU Technical guidance documents on risk assessments for chemical and biological substances. But most of the biological exposure indices and limit values assigned by each respective Member State originate from research studies conducted in-house. This is partly because the immunological response to a particular aeroallergen may vary from one region to another and partly because several studies reveal a diversity in the degree of response depending on age, gender, ethnicity, sensitivity and the influence of other attributes, including the presence of co-morbidities, e.g. diabetes. There is then the problem related to several unknowns, for whilst most studies have focused and concentrated their efforts on pulmonary exposure, there is a hiatus when one ponders on other possible negative effects on other body organs e.g. ophthalmic, dermal etc. and other possible routes of exposure. This partly explains the disparities observed in assigned environmental threshold limit values for pollen in several European countries.

The problems of setting environmental threshold limit values or critical levels for different pollen taxa is further compounded by the fact that some pollen may be transported over very long distances (Hjelmroos, 1991; Hallsdóttir, 1999), whilst others are more prevalent in one region than in another, such as for example Olea europea, and Cupressus spp. which are more endemic to the Mediterranean region. On one hand, air pollution knows no frontiers and what happens in other regions will invariably affect us and on the other hand, the fact that most of the aeroallerogens are of natural origin does not mean that these are benign and innocuous. Through airborne dispersion, ingestion or direct contact, humans confront fungi, moulds and other allergenic bioaerosols, to which they may become sensitized. Pollens, spores and plant parts are implicated in hay fever, allergic rhinoconjunctivitis, asthma and upper airway irritation. Fungi are also the cause of infection, toxicosis and tumours (Burge, 1995).

Common outdoor fungi are Cladosporium, Alternaria, Botrytis and Epicoccum, Penicillum, Aspergillus, and Stachybotrys have been repeatedly isolated in the course of ad hoc research studies. Outdoor viable spores usually decrease in the winter (Garrett, 1996). In temperate climates, outdoor spore counts are highest during or just following the growing season. A possible increase in counts following thunderstorms has also been proposed (Dales, 2003).

There are two possible fora where critical values for pollen and fungal spores can be agreed upon, namely under the auspices of the UN-ECE Convention on Long-Range Transboundary Air Pollution 1979, with transboundary airborne pollen monitoring becoming part of the envelope of the EMEP Protocol, as well as under the EU Air Quality legislative framework, namely Council Directive 96/62/EC on ambient air quality assessment and management. During the last three decades, most of the EU legislation on air quality directly and indirectly addressed traditional gaseous pollutants or particulate matter (PM10 and PM2.5), such that we have a rich base both as relates to information, as well as those relating to enforceable measures. However, in view of future predictions and altered awareness on the part of the general public, to the presence in air of pollens, spores, fungi, plant parts, bacteria, viruses and other allergens, aerobiology will soon find its deserved place on the agenda of the European Commission. Today we have to cope with a wide array of environmental pollutants. Traditionally, the primary concerns with air pollution focused on the adverse effects that these were likely to have on the population. But then again, there is also a growing concern with respect to the inevitable loss of species, habitats, ecosystems and genetic diversity of crops.

Predicting and modelling pollen seasons for early warning purposes

Attempts to forecast and predict seasonal pollen counts in Europe started so many years ago. But these studies were sporadic and generally supported by nationally funded projects (Dreissen et al., 1989).

Understanding the climatic regimens of the various European regions is essential. Damialis et al., (2005), provide practical examples as to how pollen counts are invariably effected by meteorological factors such as wind direction, speed and persistence. Frenguelli et al., (1992) clearly explains the role of air temperature in determining dormancy release and flowering of certain species. Emberlin et al. (1993, 1997) following extensive research, also suggest that annual variations of some species may be cyclical and possibly attributed to biotic responses to changes in weather conditions. Cascio et al., (2007) shows how the bloom-start period is progressively starting earlier in Sicily, compared with dates documented in published literature. Moreover, Cascio et al. (2007) report that the Sicilian Aerobiological team has been detecting the presence of palm pollen during the whole year, overriding the seasonal expected values which normally starts peaking in April and then starts subsiding by the end of June, the latest.

The Danish Aerobiology Group of the Danish Asthma & Allergy Association started its national project for the continuous trapping and registration of pollen and fungal spores in 1977. Since 1979 "Today's Pollen Counts" have been published in the daily press and broadcastd on the radio. In Denmark, forecasts of the predicted concentrations of pollen in the air the following day have been performed for birch, grass and mugwort since 1981 (Dirksen and Østerballe, 1980). Birch pollen is known to be a major cause of pollen allergy in Denmark. Linneberg et al., (1999) report an increase in prevalence of this type of allergy from 1989 to 1997. Forecasts are primarily based on the measured pollen concentration and the weather forecast with special focus on the maximum temperature, sunshine coverage and precipitation.

In the United Kingdom, pollen reports are given in terms of total pollen counts. The pollen count is a measure of the number of pollen grains of a certain type per cubic metre of air sampled, averaged over 24 hours. The pollen forecasts are produced by the National Pollen and Aerobiology Research Unit (NPARU) using the pollen counts measured each day at the Pollen UK network sites, together with information about the weather, growing seasons and the flowering times of the plants. The pollen forecast is usually given as low, moderate, high or very high. 'Low' means that less than 30 pollen grains per cubic metre of air are present, 'Moderate' refers to a value of 30 to 49 pollen grains present in every cubic metre of air , 'High' is 50 to 149 pollen grains per cubic metre of air whilst a reading above 150 or more pollen grains per cubic metre of air is labeled as 'Very High'.

In most European countries, therefore, when predictions are made, these are conducted based on extrapolations searching for diurnal variations and seasonal trends, or through surveys conducted on historical data and observations made over a span of years, as is the case with Finland (Käpyla, 1981, 1984), United Kingdom (Emberlin et al, 1990, 1993, 1994, 1997; Corden and Millington, 1999), Austria (Jäger et al., 1991), and Spain (Galan, 1991; Trigo et al., 1996). Resorting to a common forecasting model applicable for the whole Europe can never hold, unless the data gathered by each respective country is processed together with satellite imagery and meteorological data.

Whatever the approach that is used to predict fluctuations and expected inundations of airborne pollen, phenology always plays a very important role. Based on its well known variation with the annual course of weather elements, it is expected that plant phenology might be expected to be one of the most responsive and easily observable traits in nature that change in response to climate. Phenology plays a crucial role in agricultural zoning (Fischer et al., 2002), in vegetation feedback onto atmospheric boundary layer (Schwartz and Crawford, 2001); in plant competition (Rathcke and Lacey, 1985) and in pollen-flight forecasts (Traidl-Hoffman et al., 2003). In many cases, higher temperatures have been shown to speed up plant development (Saxe et al., 2001) and that this may lead to earlier incidence of switches to the next ontogenetic stage. A correlation between the date of onset of the phenopause and antecedent heat sums, mainly temperatures of the preceding months, is to be expected. Environmental factors , other than temperature also modify plant phenology, but always to a lesser extent compared to temperature, are namely the photoperiod length, the weight of which is species-specific (Schaber and Badeck, 2003), precipitation, nutrients and soil physical properties (Sparks et al., 1997).

Long-term regional programmes for predicting effects of climate change

The rapidly increasing atmospheric concentrations of greenhouse gases may lead to significant changes in regional and seasonal climatic patterns. Such changes can strongly influence the diversity and distribution of species.

For example, in 1996, Loehle and LeBlanc suggested that whilst several climate change models predict substantial alteration of forest composition, forest dieback or even loss of forest cover in response to altered temperatures and carbon dioxide concentrations, the climate response functions of these simulation models may lead to unrealistic conclusions and may tend to exaggerate the direct impact of climate change on tree growth and mortality. Loehle and LeBlanc (1996) also stated that since these models ignore other factors such as competition with other tree species, soil characteristics, barriers to dispersal and distribution of pests and pathogens. Moreover they fall short of actual measurements of tree responses to climate stressors. Monitoring and recording airborne pollen may provide for insights about the actual responses, even if the potential effects of global climate change on allergenic pollen production are still poorly understood (Wayne et al., 2002).

Bakkenes et al. (2002), developed a model called EUROMOVE. The model uses climate data from 1990 to 2050 and determines climate envelopes for about 1400 plant species, and for each European grid cell, EUROMOVE calculates which species would still occur in forecasted future climate conditions and which not. Bakkenes et al. predicted that in 44% of the modelled European area, 32% or more of the species present in 1990 will disappear. Thuiller (2003) developed BIOMOD, with the intent of species distributions in Europe and for projecting potential future shifts resulting from climate change. Thuiller (2004) used four niche-based models, two methods to derive probability values from models into presence-absence data and five climate change scenarios managed to project the future potential habitats of 1350 European species for 2050. All 40 different projections of species turnover across Europe suggested high potential species turnover (up to 70%) in response to climate change. But what in reality is the accuracy of these hypothetic models, and what use are these to us, if on the other hand we are faced with so many unknowns and shortfalls, especially as concerns to the validity of our data and observations?

Pearson and Dawson (2003) reviewed the current modelling strategies being used in order to predict the potential impact of climate change on the natural distribution of species. Pearson and Dawson in their paper present reviews and evaluates criticisms of bioclimate envelope models and there is a stress that the spatial scale at which these models are applied and other limitations are of fundamental importance. This is particularly relevant when one considers the geographical area covered by the ATMOSnet Project. Besides the fact that the locations were stations were located have similar atmospheric, hydrospheric and cryospheric attributes, the sensitivity of vegetation response to climate trends can be followed with much more confidence. But so many uncertainties remain, that is still quasi-impossible for European scientists to come to terms and agree upon one approach which is reliable and robust enough to predict present-data distributions of various taxa from regional to continental scales (Pearce and Ferrier, 2000; Moisen and Frescino, 2002; Stockwell and Peterson, 2002).

Most of these complications can be overcome, if models for predicting climate change effects would simply be based on phenology (Badech et al., 2004). Walther et al. (2002) reviewed phenophases for animal and plant species during the period 1950 to 2000, but a clear trend for advancement in the spring phenophases only showed from about 1985 onwards. The proposal of adopting models for the Mediterranean region based on phenology makes more sense in view that the output from any such model can then be substantiated by data observed via satellite (Botta et al., 2000).

There has to be tacit agreement, however, in respect of the most viable indicator species. The indicator species should be sensitive enough to respond effectively even to the slightest fluctuations in climate conditions. Galan et al., (2004) had suggested that Olea europapaea would best suit this purpose. Galan states that olives are possibly the one of the largest crops in the Mediterranean region. Using airborne pollen and meteorological data from 1982 to 2001, Galan et al. managed to produce a thermal model to forecast the start of the olive pollen season at five localities in Spain with appreciable precision, in turn confirming that olive flower phenology can be considered as a sensitive indicator of the effects of climate fluctuations in the Mediterranean area.

Recommendations and conclusions

The European Commission has recently sent its communication concerning its 'Legislative and Work Programme for 2008' to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

Lying plumb in the priorities for 2008, the EU is set to see how public policies need to help the process of adaptation to new realities that are inextricably linked to climate change. Regional and integrated approaches to R&D and other measures intended to protect EU citizens as relates their health and their environment are likely to be favoured under the Commission's current better regulation initiatives. The case for supporting pan-European research centres and other sub-regional research networks, such as ATMOSnet, would then be more justified, in view of the apposite aims and objectives of the Lisbon Agenda. Considering the little time span afforded to this project, with robust mandates that would certainly require more than three years for tangible results to be fully delivered, it is anticipated that more funds would be forked out by the Commission, possibly under the aegis of FP7. This not only to ensure that the outputs are tested over the coming years, but also to see to the inclusion of other countries in the Eastern Mediterranean into the network established through the ATMOSnet initiative. It does not make any logical nor any financial sense to abort the project, when so much could have been achieved in the years to come. The stations are in place, a lot of data is being generated and so much more insights into the intricate mechanisms involved in the transport and fate of airborne pollen and fungal spores in the Eastern Mediteranean region could have been revealed, in turn providing for new breakthroughs into the science of phenological variations, allergenicity potential and their effects on human health and agriculture, to the benefit of the scientific community residing and indulging in similar studies, in other parts of the European Union.

Our apprehension and definition of air pollution needs to be reviewed. It should not solely address those pollutants or aerosols known to impart a negative or harmful effect on our citizens, but should also incorporate any other undesirable modification of the atmospheric constituents that may equally affect flora, fauna and vital economic activities that are invariably dependent on current land use patterns and agricultural practices.

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Capacity building actions to develop an european aerobiological monitoring network

Vincenzo De Gironimo

Agency for the Environment and for Technical Services - Italy

In the framework of ATMOSnet project, the project partners faced up some specific issues such as the gathering of historical pollen monitoring series with the specific characteristic and the quality and comparability of the monitoring procedures adopted by each of them.

In a so small group and in a so "controlled" situation such as the Atmosnet partnership, (four working partners only, the same technical provisions, reference's point to evaluate the different conditions for the pollen monitoring and the same training path) the quality of achieved results is largely inadequate and the forecasting models could become only empty exercises without a scientific base. These elaborations will be really useful if there will be a temporal space and the geographic extension of pollen monitoring data base.
Many European Countries are involved in the pollen monitoring and the produced data show a large variability in the quality of data : how to compare the data gathered in different conditions and according different procedures?.

The risk to produce a very reduced environmental and health information is to avoid.

In order to be able to set up an European Network for pollen monitoring we need two fundamental elements:

- Only one technical regulation providing some common standards to evaluate the different circumstances and aspects in pollen monitoring activity
- Adequate applied procedures and quality of gathered data

As the same equipment has been employed in the pollen monitoring as well as the procedures are not so different, but they usually show, in the larger part of events different overemphasizing of pollen concentration peaks in collected data.

But beside the technical procedure a key element for the quality of gathered data is represented by the "human factor" involved in the observation and analyse of gathered data : in this sense the efficiency of the operator plays a key role

The main quality procedures can therefore listed:

Training courses. All operators must follow a theoretical and practical training course in order to be able to recognize the microscopic pollen grains species to be monitored. The course should be managed by qualified personnel who will also evaluate the training level achieved by each participant.

Updating Courses. Each year should be organised specific courses to update their knowledge in order to compare the practical experiences of the various operators and laboratories.

Tools of support. It is essential for the operators to have a database of pictures (online) of pollens and spores in order to recognize the particles which are difficult to classify.

Intercalibration between operators coming from the same laboratory. As mentioned, the quality of monitoring depends on the individual operator. If in a laboratory there are more people involved in the recognition of pollen is important that their work be periodically compared in order to standardize the method..

Intercalibration between laboratories. The performance of the network components laboratories must be compared periodically in order to make them uniform and comparable.

Some of these procedures (Training course and intercalibration between laboratories) have been implemented in the project ATMOSnet

In any case, it is important that the experience made for this pilot network could be considered among operators, extended and implemented by new projects.

The ATMOSnet Project Website

Saviour Baldacchino

University of Malta, Institute of Agriculture - Malta
Consultant

Introduction

Detailed information about the research project ATMOSnet can be found in the project website, at www.atmosnet.org.
The World Wide Web has become a major information channel. This success is explained by the variety and multitude of information it makes available to a wide number of people at any time with a few clicks of a mouse. Search engine technology also makes possible extremely powerful and rapid research in the gigantic library that appears to be growing exponentially without stop. It has become indispensable for producers of information – particularly in the scientific and technical domains – to publish on the web (1)

The ATMOSnet project website covers part of work package five, which is outlined in the Deliverables section of the website (2), namely Dissemination and Communications of the results and early warning system. It is part of the instruments of communication and dissemination of activities. This report gives a general description of the website, its objectives, features, platform and further development.

The site has two main areas: one which is publicly available and a restricted area which is available only to project partners.

Website objectives

The ATMOSnet project website is considered as a tool to raise the image of the project and improve dissemination to specialists, potential users of the technologies being developed, politicians and public funding authorities, as well as the general public. The site has been designed to take most multimedia content used on the World Wide Web so there is really no limit as to what can he included.

The main objectives of the ATMOSnet website are to:

1. be a source of information about ATMOSnet;

2. disseminate information on project activities;

3. serve as a repository of project documentation;

4. provide the foundations for an early warning system;

5, provide collaboration facilities for the project partners.

6. Source of information on ATMOSnet

7. One of the main objectives of the website is to serve as a source of factual information about the project. This is a key source of information and includes a project description, background information on the Partners, contact details and hyperlinks to related works and other information sites.

8. Information pages include technical and geographical information about the fourteen pollen stations including maps and aerial imagery showing the location of each station, photos of nearby vegetation, instruments used and their technical specifications. Most of this information can be accessed via a click-through map with active flags marking the pollen station locations.

9. Dissemination of project activities

10. The data collected from the pollen stations is captured and stored into a back-end database developed by one of the project partners. In order to make it easier for partners' users to load their data, links to this data capture site have been provided. The ATMOSnet website is prepared to query a back-end database and using the necessary software tools, can convert the raw data into a variety of graphs and charts. In this format, the information is more user-friendly and suitable for a wider audience of site visitors.

12. Project activities can also be communicated to the press and general public in the form of news articles published in the news section. In addition to information that is generated within the project, the News section has links to other related news coming from external sources.

Repository of project documentation

Another objective of the website is to serve as a repository of proceeds from meetings held throughout project duration. These include contributions of the numerous experts from the scientific and academic worlds. The site can take any of the soft copy formats that are in common use on the World Wide Web, such as PowerPoint presentations, documents in PDF, MS Word format, etc. Video and audio clips can also be added to enrich this specialised library of information.

Foundation for an early warning system

"Early warning varies in its accuracy, predictability and usefulness. When an early warning system is developed three stages need to be made clear, and these are the Proof of Concept, information (product development) and value (utility). For example the time scale needs to make sense to be useful as early warning tool by decision makers; the forecasts need to contain relevant information for relevant empirical targets, like the health workers; risk management scenarios need to be played through beforehand and the costs of the system need to be contained but also the costs of acting too late or of inaccurate predictions need to be considered. Early warning is only effective if it triggers a response. However here are not always effective response mechanisms for all diseases, or situations. The value of soliciting an early response will be if the effect of this early response sufficiently out ways the potential problems of false alarms".(3)

This first phase of the ATMOSnet project, spanned fourteen months from kickoff and although pollen data was gathered regularly, there is not enough historic data to be used as base information for an early warning tool. However, over time, pollen concentration data can give detailed information and be one of the prime inputs into an early warning system. There are other factors that may need to be taken into account such as weather conditions and climate change in the monitored areas.

Collaboration tools and archive

This objective is aimed at making the site more complete in the sense of making some collaboration facilities available at the disposal of the project partners.

Firstly there is the possibility for partners to have an e-mail address under the same domain as the website. This option can be used by the partners to keep e-mail messages related to the project organised on their computers. Furthermore, there are other advantages that may accrue, including:

• Domain name and hence website URL (Universal Resource Locator) indirect promotion when sending e-mail messages; <name>@atmosnet.org;

• Being part of the virtual team of partners which are geographically in different locations but have common aims.

A Subscribe / Unsubscribe facility to a Mailing list (list@atmosnet.org) and to a Newsletter are also available for partner members.

The second part of this objective is to have a section in the website dedicated as an Archive aimed at holding a copy of the official documentation of the project for partners' reference.

Platform technology

A key factor that was considered before selecting a server setup was to have full control on the server environment that will host the site. Selecting a shared server environment with hundreds of other users, who could easily use up all the resources or cause the server environment to become unstable, was not desired even though this would have been the cheapest solution. But at the same time, the website did not require a dedicated server. The Virtual Private Server (VPS) solution was a very attractive solution giving the stability of a dedicated server but on a smaller scale and much cheaper.

The following table outlines technical specifications of the platform used and other software packages that have been installed on the server. Because there is full control on the server, it can be customised with any software that is or that may be required in the future.

Server	VPS with initial disk size of 40GB Firewall protected
Operating system	MS Windows 2003 server
Web server	Internet Information Server Ver 6.0
Dynamic content technologies	Active Server Pages (ASP); ASP.NET; PHP 5 (ISAPI version)
Databases supported	mySQL 5; MSSQL 2005 Express MS Access
Physical Location	University of Malta

Website features

Public area

- The Home page
- Project objectives and overview
- Partner résumé
- Links to related work
- Contact detail
- Project News
- ATMOSnet in the news
- Site Map
- Interactive geographical area map (Figure 2)
  - Click-through monitoring stations flags
  - Aerial view of station location
  - Drill down facility to access pollen station technical details
  - Graphical presentation of data
- Charting facilities for user friendly representation of data (figure 3)

Figure 1
Home Page

Figure 2
Interactive Geographical Area Map

Figure 3

Charting facilities for graphical representation of data

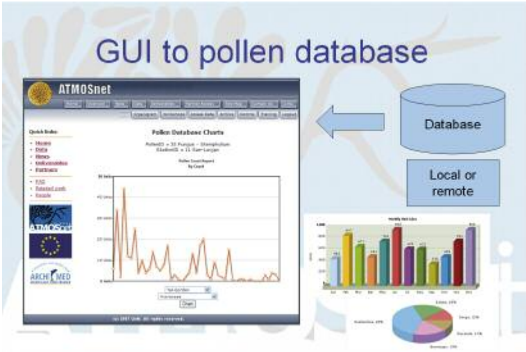
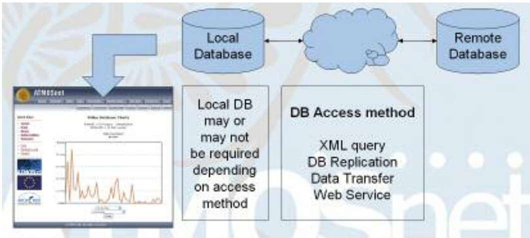


Figure 4

Database access



Database access

Currently data is acquired from a local database to demonstrate the presentation potential of the charting package added to the website. In real terms there is no limitation on where the database is physically located (figure 4) There are various methods that may be used to query a remote database in real time, including:

• XML queries,

• Database replication,

• Web services, and

• Any other suitable method agreed upon by the Partners.

The pollen count data is currently being captured by a system administered by the lead Partner. It is up to the Partners to agree and set up the necessary communications facilities required to show the captured data in the form of graphs and charts on the site. All the necessary tools are there to come into action as soon as they are required.

Additional features in the Partners' area

A Partner will remain logged into the system until he/she opts to logout using the Logout button or until the inactivity timeout activates (after about 20 minutes of inactivity)

- Partner login page
- Organization chart
- Workshop proceeds
- Link to data entry site (http://atmosnet.siag.it)
- Detailed description of monitoring sites
- Collaboration Tools
- Training related material

Figure 5
Partner login page

Future enhancements

• Forecasting based on a longer period of historic information and other environmental and meteorological data (ref: Section 0)

• Real time presentation of the pollen database (ref: Section 0)

• A wider selection of graphs and charts can be included based on what information the partners decide to make available on the website.

• Other website modules can include RSS syndication, structure and content management system (CMS), image and video galleries, pollen general information reference database for the general public and more.

• Other optional modules that may be added to the website include:

- System users' management (Admin)
- Article comments
- Site search (public access)
- Advanced News
- Advanced Events
- Document Archive database
- Video library
- RSS feeds (incoming news)
- Home page quick information panels
- Blacklist management (incoming)
- Alert Text Scroller
- Slide Shows
- Guest Book

Figure 6
Document Archive Index Page

- Data Archive
- Legal and Financial
- Progress Reports
- PMB Rules and Minutes
- Annex
- Collaboration tools
- Application for atmosnet.org e-mail account
- Subscription to list@atmosnet.org
- Subscribe/unsubscribe to newsletter

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ATMOSnet: final assessment

Anna Maria Matrone

Regional Agency for Environmental Protection of Campania - Italy

The growing attention paid in the last years by researchers to the study of climate changes reaches its peak in 2007 with the publication of the "Fourth Assessment Report" by the Intergovernmental Panel on Climate Change (IPCC) The results of model studies contained in the Report show that, at least in the last 50 years, human activities substantially contributed to climate changes.
In its report "Europe's environment – The fourth Assessment" (2007) the European Environment Agency (EEA) came to similar conclusions.
The starting point is the statement that a climate change is taking place.
This is the global environmental challenge that must be faced in the 21st century.
The studies carried out highlight that, in the following 100 years, the Euro-Mediterranean region will be the most vulnerable one to climate changes.
Many of the effects occurring in this region are associated to temperature increase and reduction of rainfalls. Drought, increase of forest fires, northwards shifting of tree species distribution and loss of land agricultural potential can be predicted.
Urgent interventions are then needed in order to minimize impacts and keep them at tolerable levels.
The scientific community is working to understand this phenomenon and its potential impacts, (especially risks for human beings), as well as the possible response, adjustment and mitigation measures to be implemented.
ATMOSnet Project was launched within this context, and constitutes a contribution to the research aimed at understanding man-induced changes applied to a limited territorial scale.
More specifically, the project aimed at improving forecasting methods on climate change-related drought and desertification in the area of Central-Eastern Mediterranean according to the variable of airborne pollens monitoring.
Actually, the temperature increase recorded in the latest years has generated modifications in the flowering times and modes of many herbaceous and arboreous plants typical of Eastern Mediterranean areas, thus changing the pollen distribution in the air.
Even if we consider the limited extension of the areas monitored – Campania and Sicily in Italy, Malta and Gozo islands in Malta and Thessaloníki in Greece – the study highlights that airborne pollen can be considered as a bio-indica-

tor for assessing, through forecasting models, climate changes effects on environmental matrixes.
Nevertheless, results effectiveness is not homogeneous in all the forecasting models studied within the framework of ATMOSnet project.
It can be maintained that different contributions were provided to the three models object of the study:

Forecasting model on climate changes

The pollen monitoring variable does not seem to contribute significantly to improving forecasting models aimed at identifying climate change evolution.
Present models seem to be advanced enough to define these changes, meteorological and climatic variables can be used, gathered through highly sophisticated technologies such as weather satellites.
A contribution to these forecasting models might be provided for limited geographical areas as, resorting to the amount of the data collected, forecasting in limited areas can be improved

Forecasting model on environmental impacts induced by climate changes

In this field of application, the contribution of pollen monitoring might be very interesting to define forecasting models, with a specific view to agricultural productions and crops related economy.
In this case pollen monitoring is a major forecasting variable able to provide useful data on the production of specific vegetable species, and to warn the community on potential risks for production.
The data provided by this tool, interpreted and processed by field specialists, can be successfully used to plan agricultural strategies having real economic and financial benefits for the community.
Hence, three scenarios of development become possible for ATMOSnet project, related to the following measures:

- Extending pollen monitoring to the species that seem to be particularly sensitive to the expected climate changes in the Mediterranean area. This selective monitoring can be considered as a refinement of the forecasting model, particularly if pollen types particularly resistant to global warming phenomena are selected. The selective monitoring of these pollen species (including olive tree) would allow the use of specific bio-indicators for climate changes induced phenomena such as drought and desertification.
- Identifying cultivated intra-specific pollen varieties or ecotypes with a specific capability to adapt to increasing temperatures, through biochemical techniques able to supplement the traditional monitoring based on morphological methods.
- Extending the partnership to the whole of the Mediterranean basin, including North African countries, in order to carry out comparative studies between Euro-Mediterranean and North-African regions where drought and desertification phenomena are more visible.

- Pollens monitoring in order to test the effectiveness of the adjustment and mitigation measures implemented.

Forecasting model on climate change-induced impact on human health

The contribution of pollen monitoring to the forecasting model on human health is different.
This field of investigation has highly developed over time.
Almost all countries of the Mediterranean area have pollen calendars to predict the quality and quantity of the distribution of the different species of pollen responsible for respiratory diseases in human beings (pollinosis).
Developing forecasting models able to simulate the appearance and evolution of allergenic airborne pollens, is a useful tool for allergists and physicians carrying out clinical trials and for pharmaceutical industries; it is then a crucial contribution to primary prevention strategies addressed to allergic persons.
The studies carried out within the framework of ATMOSnet provided a value added to the already advanced research, by improving the reliability of the Euro-Mediterranean data and facilitating short- term prediction of pollen concentrations. These studies also emphasized the need:

- To develop the existing aerobiological monitoring network by creating the ATMOSnet Euro-Mediterranean network

- To integrate the ATMOSnet network with the other bio-monitoring networks already operating in this field at the European level with the aim to achieve a good level of cooperation

- To share a standardised method for collection, analysis and integration of known quality data from the scientific point of view so as to obtain a product always meeting the requirements set out.

- To create a Euro-Mediterranean centre for prevention of respiratory allergic diseases accessible via the WEB; to launch a programme of specialised information addressed to different stakeholders (specialists, mass media, citizens, industry, decision makers, etc.) in order to provide them with prompt information on climate change-induced pollen concentration variations and enable them to implement effective prevention measures.

Conclusion

To conclude, the data gathered by the Euro-Mediterranean ATMOSnet monitoring network are linked to the web site www.atmosnet.org that allows publication, timely and widespread circulation of the results obtained thus providing concrete benefits to the whole process of research and planning of territorial interventions.
ATMOSnet is then equipped with a potentially developing database; each partner, on the basis of its own needs, will be able to access its data and contribute to their processing.

It will also be possible, through passwords, to choose the kind of data and the level of details desired and create personalised tables.
Free access is also provided to the general public who will be able to view predictive data broken-down by geographical areas.
This first core of a database for pollens monitoring, developed in the regions participating in ATMOSnet project, can be a starting point for a European network gathering in a single WEB site the trend of pollens distribution in the whole of the Mediterranean area.
The ATMOSnet WEB site experience is a virtual aggregation and exchange site for all researchers interested in studying airborne particles with a biological origin and their impact on environment; it aims at supporting government actions on environment within a context increasingly oriented to including the environmental dimension in sector and territorial policies.

ATMOSnet: New Perspectives in European Funds 2007-13

Diego Guglielmelli

Regional Agency for Environmental Protection of Campania - Italy

The new 2007-13 community planning offers different kind of financing that could be used to re-propose the positive experience of ATMOSnet project .Actually the environmental thematic presents in the MED, ENPI and FP7programs, perfectly agrees with the purposes to reach that are already underlined in the previous part.
Here below the above mentioned programmes will be examinated:

Med operational programme

The Med programme continues the tradition of the European programmes for cooperation (previously named Interreg). It takes place within the objective « European territorial cooperation » of the period 2007-2013. With a budget of more than 250 billion euros, the programme covers the coastal and Mediterranean regions of nine EU Member States. The partnership is enlarged by the participation of Mediterranean countries wich are candidates or potential candidates to the European Union.
Its priorities are :

- To improve the area's competitiveness in a way that guarantees growth and employment for the next generations (Lisbon strategy).

- To promote territorial cohesion and environmental protection, according to the logic of sustainable development (Goteborg strategy).

Eligible Area

Cyprus: the entire country

France: 4 regions – Corse, Languedoc-Roussillon, Provence Alpes Côte d'Azur, Rhône-Alpes

Greece : the entire country

Italy : 18 regions : Abruzzo, Apulia, Basilicata, Calabria, Campania, Emilia-Romagna, Friuli-Venezia Giulia, Lazio, Liguria, Lombardy, Marche, Molise, Umbria, Piedmonte, Sardinia, Sicily, Tuscany, Veneto.

Malta: the entire country

Portugal : 2 regions – Algarve, Alentejo

Slovenia: the entire country

Spain: 6 autonomous regions and the two autonomous cities – Andalusia, Aragon, Catalonia, Balearic islands, Murcia, Valencia, Ceuta and Melilla

United-Kingdom : 1 region of economic programming – Gibraltar

Beyond these regions, the participation of non eligible Med areas is possible but limited. In addition, the Med programme has invited Mediterranean countries candidates or potentially candidates to the European Union. With the starting of the programme, its cooperation area includes Croatia and Montenegro.

The axes is composed of several specific objectives:

Axe 2: Environmental protection and promotion of a sustainable territorial development

Main issues :

• Because of its geographical feature (peninsulas, islands, mountains, large coastal conurbations, peripheral areas) the Mediterranean area is subject to high environmental pressures

• More specifically, biodiversity, maritime habitat, landscape and its heritage, forests, water resources, are under direct threat due to the intensity of human activity (domestic activity, urbanisation, industries, intensive agriculture, over fishing, tourism…) The sea is particularly subject to a range of pollution sources due to the levels of maritime traffic that represent a high level of risk.

• Besides, Mediterranean space concentrates most of the major risks: fire, floods, draughts and reduction of water resources, seism, tsunami, and landslides. These risks represent a danger for the populations, for economic activities, for the environment and for local resources.

• With the objective to promote a sustainable regional development, bodies in charge of regional development, spatial planning and other sectors concerned are expected to cooperate in order to ensure responsible management, preservation and valorisation of natural resources and heritage (notably sustainable tourism).

• Main stakes and orientations of the European union concerning Maritime issues are developed in the Green Paper Towards a future Maritime Policy for the Union : A European vision for the oceans and seas, COM(2006)275.

Objective 2.1. Protection and enhancement of natural resources and heritage. Description:

• As highlighted by the AFOM analysis, the Mediterranean area boasts a very rich and diverse natural environment and heritage which however suffer due to its high level of attractiveness (continuing urbanisation, mass tourism, road traffic…).

• Protection and enhancement of natural resources, landscapes (agriculture, forestry) and their cultural dimension is an essential objective which requires a strong policy of fighting against pollution and against the damage made to heritage. It concerns as much urban areas, rural areas, the sea and sensitive areas such as coasts, mountains or islands. This implies that economic and industrial activities, tourism activities as well as individual behaviours should be based on the Integrated management of the territories, wherein sustainable tourism and economic diversification take up a significant function.

• In the specific geographic and climatic context of the Med area, particular attention shall be paid to water resources, by adapting both behaviour and management modes to safeguard a sustainable water supply in the years to come.

• In front of these threats which weigh on the environment, the transnational co-operation is essential in coordinating the intervention, prevention and observation means between territorial systems.

Possible actions:

• Promoting transnational initiatives to improve and coordinate assessment, measurement, certification, monitoring and management systems of natural resources and pollution ; developing common standards and promoting the application of European and international standards in public policies (reducing greenhouse gas emissions…) : harmonising data, information and intervention strategies at the transnational scale.

• Promoting transnational partnerships to protect, enhance, and increase the awarness of the fragile areas (reserves, coasts, small islands, halieutic resources, forests, landscapes) and their resources (both physical and virtual) in a logic of integrated territorial development and sustainable tourism; promoting biodiversity through protection and enhancement of natural resources;

• Promotion of natural resources and heritage through the elaboration of transnational strategies of development for fragile areas, especially for sustainable tourism initiatives; support to the implementation of integrated management strategies for coastal areas; elaboration of strategies to anticipate and adapt to climate changes;

• Promoting innovative initiatives for the safeguarding and stocking of water resources ; promoting water saving and reuse (domestic, industrial, agricultural…); improvement of water management to fight against the desertification process;

• Promoting transnational initiatives that aim at improving information systems and awareness-raising with regards to climate changes and risks on natural heritage and landscapes.

Potential beneficiaries:
Local authorities ; association of municipalities and local authorities ; regions ; reserves and natural parks ; agencies and institutes specialised in the sectors con-

cerned (planning, environmental protection, coastal protection, natural heritage management, water management …); association specialised in sectors concerned (protection of the environment ; protection of natural heritage) ; town planning agencies ; research institutes specialised in the sector concerned (water, environment, pollution…);

Financing plan and cofunding rates:

Budget distribution (current prices in Euro):

- The global estimated budget is 256.617,688
- The community contribution is 193.191,331
- The participation of ERDF for each Member state varies from 75% (France, Great-Britain, Greece, Italia, Portugal, Spain) to 85% (Cyprus, Malta, Slovenia).

AXIS 2: Environmental protection and promotion of sustainable territorial development

Community contribution:	65.685,053
National counterparts:	21.543,894
Total:	87.228,946

Expected call for proposal: February 2008

Cross-border cooperation within the european neighbourhood and partnership instrument (ENPI)

ENPI CBC Mediterranean Sea Basin Programme 2007-2013 provides the framework for the implementation of cross border and cooperation activities in the context of the European Neighbourhood Policy, with the final aim of developing an area of prosperity and good neighbourliness involving EU countries and Partner Countries as they are listed in the Strategy Paper on Cross Border Cooperation Programmes within the ENPI.
Based on the EU orientations for the cross-border cooperation component of the ENPI, the representatives of all involved countries have identified the topics of the Programme: promotion of socio-economic development and enhancement of the territories, promotion of environmental sustainability at Basin level, promotion of better conditions and modalities for the circulation of persons, goods and capitals, promotion of cultural dialogue and governance at local level. The general objective of the Programme is to contribute to promoting the sustainable and harmonious cooperation process of the Mediterranean Basin by dealing with the common issues and enhancing its endogenous potential.

Eligible area:

Algeria: Tlemcen, Aïn Témouchent, Oran, Mostaganem, Chlef, Tipaza, Alger, Boumerdès, Tizi Ouzou, Béjaïa, Jijel, Skikda, Annaba, El Taref

Cyprus: the whole country

Egypt: Marsa Matruh, Al Iskandanyah, Al Buhayrah, Kafr ash Shaykh, Ad Daqahliyah, Dumyat, Ash Sharquiyah, Al Isma'iliyah, Bur Sa'id, Shamal Sina'

France: Corse, Languedoc-Roussillon, Provence-Alpes-Côte d'Azur

Greece: Anatoliki Makedonia - Thraki, Kentriki Makedonia, Thessalia, Ipeiros, Ionia Nisia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki, Voreio, Aigaio, Notio Aigaio, Kriti

Israel: the whole country

Italy: Basilicata, Calabria, Campania, Lazio, Liguria, Puglia, Sardegna, Sicilia, Toscana

Jordan: Irbid, Al-Balga, Madaba, Al-Karak, Al-Trafila, Al-Aqaba

Lebanon: the whole country

Libya: Nuquat Al Kharms, Al Zawia, Al Aziziyah, Tarabulus, Tarunah, Al Khons, Zeleitin, Misurata, Sawfajin, Surt, Ajdabiya, Banghazi, Al Fatah, Al Jabal, Al Akhdar, Damah, Tubruq

Malta: the whole country

Marocco: Oriental, Taza-Al Hoceima-Taounate, Tanger-Tétouan

Palestinian Authority: the whole country

Portugal: Algarve

Spain: Andalucía, Cataluña, Comunidad Valenciana, Murcia, Islas Baleares, Ceuta, Melilla

Syria: Latakia, Tartous

Tunisia: Médenine, Gabès, Sfax, Mahdia, Monastir, Sousse, Nabeul, Ben Arous, Tunis, Ariana, Bizerte, Béja, Jendouba

Turkey: Tekirda , Balıkesir, Izmir, Aydın, Antalya, Adana, Hatay

United Kingdom: Gibraltar

The Countries which have partecipated in the programming phases in the Joint Task Force are Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Malta, Portugal, Spain, Syria and Tunisia. The Countries with eligible territories, which have not participated in the programming phase, can join the Programme once it will be adopted by the European Commission.

Priority 2: Promotion of environmental sustainability at the basin level.
Taking into account the characteristics of the Programme, as well as the results of the SWOT analysis, the partner countries jointly decided to focus this prio-

rity only on environmental challenges, particularly the effects of climate change, which represent a shared concern considering their relevant impact on the social and economic life of the territories and considering that they refer to areas likely to be considered at basin level.

The natural capital of the Programme's cooperation area is exposed to relevant pressures and risks, due to: its geographic configuration; economic activities not always respectful of the environment (manufacturing and mining industry, intensive agriculture, mass tourism, urbanisation and coastal development, fishing overexploitation, intensive and growing maritime traffic, etc.); demographic trends which lead to a relevant urbanisation interesting mainly coastal areas, and to the abandonment of rural ones – processes which contribute to the destruction of unique landscapes forged over centuries; ways of living which do not sufficiently allow for the rational use of natural resources, etc.

Environmental degradation has implications on the living quality of populations, as well as on economic activities, therefore a strong engagement and a coordination of efforts by local actors involved in territorial cooperation will contribute to the safeguarding of the natural heritage for future generations.

In addition, the SWOT analysis underlined that the cooperation area has an important potential to build on strategies for the development of sustainable energies and – considering its production, urbanisation and transport systems - it also has interesting opportunities of promoting a better environmental attitude and awareness (from both a production and consumption point of view), so as to allow higher performances in terms of energetic efficiency. A start in this direction will contribute to reducing the impact of greenhouse gas emissions which, according to forecasts, are going to generate phenomena with a significant incidence on Mediterranean countries, jeopardising the living quality of its populations and socio-economic activities.

Activities under this priority should be specifically coherent and contributing to develop appropriated synergies with the "Horizon 2020" regional initiative as well as with the environmental elements of the EMP five-year work programme. This, alongside with the coherence with national strategies and priorities, should be clearly underlined in project's proposals to be presented for financing. Taking this framework into account, participating countries agreed on the following measures in order to address this priority.

Measure 2.1: Prevention and reduction of risk factors for the environment and enhancement of natural common heritage.

All territories participating in the Programme have a large natural and diversified heritage mainly composed of a rich maritime and land bio-diversity together with a unique landscape resulting from the combined effects of the natural elements and of the know-how of their population which have left their mark over the centuries. This capital is nevertheless fragile.

Environmental risks and degradation affecting the Mediterranean basin are different and originate from human activities (industry, intensive agriculture, mass tourism, intensive and growing maritime traffic, etc.), but they are also linked to the geographic specificities of the territories and to demographic trends. Considering their relevance, participating countries decided to adopt the fol-

lowing areas of intervention: i) fighting against land desertification, coastal erosion and littoralization in particular through activities aiming at improving the management of the forest/vegetation cover; ii) prevention of natural risks (floods and fires); iii) water cycle management and fighting against sea and river pollution; iv) reduction of the effects of different sources of pollution at the level of urban, industrial, and agricultural areas; v) waste management and recycling; vi) Protection and sustainable enhancement of natural, land, and marine resources for economic and tourism purposes; vii)adoption of sustainable fishery techniques and promotion of ecotourism; viii) support for adaptation strategies to increase ecosystem resilience to climate change and reduce risk of loss of ecosystem values and services. These areas of intervention will be taken into account especially through cross-border actions and the transfer of prevention practices with specific reference to new technologies and management systems, of approximation of procedures (for prevention, evaluation of impacts and joint intervention in case of natural disasters or caused by human activities), of management and monitoring of phenomena, of communication and awareness raising of local actors. These actions could be complemented by pilot projects which have a strong transferability potential, through research and innovation.
If the natural, maritime and land heritages are to be protected, they are also likely to promote actions aimed at their effective and sustainable use. To this extent cross-border actions must aim to set up networks between natural parks, reserves and environmental education centres, and to enhance the specificities of the Mediterranean landscapes, fishing tourism, etc. in order to diversify the offer of tourism products, mainly in less advanced areas.
These actions should systematically include the adoption of modalities of conservation/preservation able to ensure the sustainability of natural resources.
Taking into account the different interventions in the area of preservation and enhancement of environmental resources interesting the Mediterranean, it will be fundamental to promote a coordinated involvement of local communities in the different ongoing programmes.

Possible actions:

- Support for the reduction of marine pollution through the implementation of transnational initiatives for the adoption of environmental monitoring systems in port areas and during maritime navigation, and drawing up of joint protocols for dealing with shipping damages
- Development of good practices, mainly through the exchange of experiences, in the management of coastal areas, in combating coastal over-exploitation, beach degradation, in preventing and reducing the pollution of natural resources (water and soil) in urban, industrial and agricultural areas; mitigation and management of the effects of the climatic changes
- Support for the conservation and enhancement of the maritime heritage (flora and fauna, archaeological sites, etc.) by adopting transnational joint monitoring systems

• Promoting pilot initiatives for the joint use of new technologies for environmental protection, risk management and territorial planning

• Development of pilot projects for the transfer of experiences on management and urban waste recycling and integrated planning in the framework of the management of natural resources

• Adoption of joint forms of environmental impact assessment for the Mediterranean's greatest urban areas

• Adoption of joint approaches on water cycle planning and management, including rivers

• Adoption of standards for "maritime social responsibility" for SMEs at the level of operators of maritime clusters

• Support for the creation of networks among the Mediterranean's natural parks and protected areas for sustainable tourism purposes

• Enhancement of halieutical resources to guarantee sanitary quality of products

• Improving technical and administrative skills at local level for the prevention, monitoring and management of natural and technological risk, particularly through the exchange of best practices on environmental planning methodologies

• Promoting coordination among emergency services and civil protection departments in order to promote the development of joint intervention procedures in cases of major crises as consequence of natural phenomena or human activities

• Promoting joint awareness, information and mobilising campaigns for people on common challenges and environmental issues related to the valorisation and the rational utilisation of natural resources.

Potential beneficiaries:
Actors to be involved in activities related to this measure include local authorities, local development agencies, environmental agencies or similar organisations, governmental public national services centralised and decentralised, universities (particularly in terms of research and monitoring), community and environmental associations, economic operators and management bodies for protected areas (including parks).

Financing plan and cofunding rates:

Budget distribution (current prices in Euro):

Total programme budget:	189.231.983
Co-financing:	15.624.659
EU funds:	173.607.324
EU contribution	90%

Priority 2. Promotion of environmental sustainability at the basin level

Budget : 46.873.977

Expected approval of the Operational Programme: June 2008
Expected call for proposal: October 2008

The Seventh Framework Programme (FP7)

The Seventh Framework Programme for research and technological development (FP7) is the European Union's main instrument for funding research in Europe. FP7, which applies to the years 2007-2013, is the natural successor to the Sixth Framework Programme (FP6), and is the result of years of consultation with the scientific community, research and policy making institutions, and other interested parties.
Since their launch in 1984, the Framework Programmes have played a lead role in multidisciplinary research and cooperative activities in Europe and beyond. FP7 continues that task, and is both larger and more comprehensive than earlier Framework Programmes.
Running from 2007 to 2013, the programme has a budget of 53.2 billion euros over its seven-year lifespan, the largest funding allocation yet for such programmes.
The Seventh Framework Programme (FP7) includes several specific programmes:

- **Cooperation**
- Ideas
- People
- Capacities

The specific programme on 'Cooperation' supports all types of research activities carried out by different research bodies in trans-national cooperation and aims to gain or consolidate leadership in key scientific and technology areas.

FP7 allocates EUR 32 413 million to the Cooperation programme. The budget will be devoted to supporting cooperation between universities, industry, research centres and public authorities throughout the EU and beyond.

The Cooperation programme is sub-divided into ten distinct themes. Each theme is operationally autonomous but aims to maintain coherence within the Cooperation Programme and allowing for joint activities cutting across different themes, through, for example, joint calls.

Theme: Environment - including Climate change

The main objective of research for the environment under FP7 is to promote sustainable management of both man-made and natural environment and its resources.

To this end, increased knowledge on the interaction between the climate, biosphere, ecosystems and human activities is sought and, new environmentally-friendly technologies, tools and services are developed.

Possible actions:

As environmental problems extend beyond national frontiers and natural resources are under pressure, Europe needs a new sustainable relationship with the environment. Funded actions focus on:

- predicting climate, ecological, earth and ocean systems changes;
- tools and technologies for monitoring, prevention and mitigation of environmental pressures and risks including on health;
- sustainability of the natural and man-made environment.

Funding in this area will also improve competitiveness and strengthen European industries' position in world markets for environmental technologies.

Financing plan and cofunding rates:

Budget distribution (current prices in €):

- Total programme budget: 53.2 billion
- Cooperation: 32 413 million
- Theme- Environment - including Climate change: € 1.9 billion

Potential beneficiaries:

Participation in the Seventh Framework Programme is open to a wide range of organisations and individuals. Universities, research centres, multinational corporations, SMEs (small to medium-sized enterprises), public administrations, even individuals, from anywhere in the world – all have the opportunity to participate in FP7. Different participation rules apply depending on the research initiative in question

Expected call for proposal: December 2007

Abstracts

Pollen Monitoring in the Maltese Islands

Ian Mifsud

Government Healt Department - Malta

The elegance about pollen monitoring is that it does not require high cost/ high tech facilities. The two basic pieces of equipment required include a volumetric spore trap and a compound light microscope. If taken good care of, the equipment will give excellent reliability with minimal maintenance requirements. Modern spore traps approved by the international aerobiology association are based on the 1950's design by Hirst (then developed for agricultural purposes). Pollen counting is carried out using an optical microscope normally under x400 magnification.

The location of the trap depends on the scope of the exercise. In this study the trap was sited in an urban setting in order to monitor the weekly pollen distribution in relation to allergy sufferers.

The most promenent taxom of allergenic importance, observed throughout the recording period was the Urticaceae. Other taxa of notable importance included the Poaceae, Olea and, Cupressus. Minor taxa which were identified included: Alnus, Corylus, Quercus, Rumex, Mimosa, Ericaceae, Artemisia and Chemopodium.

The genus Parietaria belongs to the family of Urticeae, which includes the allergenically unimportant genus Urtica. Among the different species of the genus Parietaria, the most abundant species growing locally is Parietaria judaica. The Urticaeceae had the most extended pollen season of all the monitored taxa covering a period of 5 months starting around the beginning of February and reaching a peak of almost 150 grains m/3. This was followed by Cupressus which had a pollen season of 3 months with a peak of less than 100 grains m/3. When compared with the Italian classification of airborne pollen loads, pollen concentrations fall into the low and medium categories during the spring season. Such concentrations tend to be expected due to the insularity of the country and the absence of extensive vegetative cover on the islands. The classification is based on the average pollen loads in ambient air, and does not relate in any way to the potential allergenicity of a particular taxom.

During the monitoring period, pollen from various species not found locally were observed. Pollen specimens of Alnus and Corylus were recorded on the trap. Most of these records were observed between mid- February and the end of March; the peak of the pollen season of these two taxa. Both taxa lack suitable habitat locally and are not represented in the local flora. The closest geographic range for these species is Sicily. Other species not represented in the local flora, such as Quercus suber could also indicate long range transport of pollen. Not much literature is available on the long range atmospheric transport of pollen in the Mediterranean.

The regular monitoring of airborne pollen by an educational or research institute is commendable as this will provide data about the temporal distribution of the highly allergenic strains of pollen. This will be fundamental in the construction of the pollinosis of the Maltese population.

A ten-year study of background surface ozone concentrations on the island of Gozo in the Central Mediterranean

Martin Saliba, Raymond Ellul

University of Malta, Department of Physics - Malta

Liberato Camilleri

University of Malta, Department of Statistics and Operations Research - Malta

Hans Güsten

Universität Karlsruhe, Institut für Meteorologie und Klimaforschung, Forschungszentrum Karlsruhe - Germany

A ten-year study of surface ozone concentrations in the Central Mediterranean was conducted based on continuous ozone measurements from 1997 to 2006 by a background regional Global Atmospheric Watch (GAW) station on the island of Gozo. The mean annual maximum concentration is of the order of 66 ppbv in April-May with a broad secondary maximum of 64 ppbv in July-September. No long-term increase or decrease in the background level of surface ozone can be observed over the last ten years. This is in contrast to observations made in the Eastern Mediterranean, where a slow decrease in the background ozone concentration was observed over the past 7 years.

Despite the very high average annual ozone concentration exceeding 50 pbbv - in fact, the highest average background ozone concentration ever measured in Europe, - the diurnal O3 max/O3 min index of < 1.40 indicates that the island of Gozo is a good site for measuring background surface ozone. However, frequent photosmog events from June till September during the past ten years, with ozone concentrations exceeding 90 ppbv, indicate that the central Mediterranean is prone to long-range transport of air pollutants from Europe by northerly winds. This was particularly evident during the so-called "August heat wave" of the year 2003 when the overall ozone concentration was 4.6 ppbv higher than the average over all other nine months of August since 1997. Air mass back-trajectory analysis of the August 2003 photosmog episodes on Gozo confirmed that the ozone pollution originated from the European continent.

Regression analysis was used to analyse the ten-year data set in order to model the behaviour of the ozone mixing ratio in terms of the meteorological parameters of wind speed, relative humidity, global radiation, temperature, month of year, wind sector, atmospheric pressure, and time of day (predictors). Most of these predictors were found to significantly affect the ozone mixing ratios.

From March to November, the monthly average of the AOT40 threshold value for the protection of crops and vegetation against ozone was constantly exceeded on Gozo during the past ten years.
Keywords: Ozone, Mediterranean, Gozo, long-range transport, forecast, statistical model, AOT40 value.

European network of pollen monitoring

Giuseppe Frenguelli

University of Perugia, Faculty of Agricolture
International Association for Aerobiology - Italy

The enormous quantity of pollen released in the flowering period of species with anemophilous pollination, lifted up by aerial currents, floats in the air for a varying period of time and then settles like rain with variable uniformity. The information which interests the biologists is to determine which pollen species are present in the atmosphere, to know the number of pollen grains of each species present in a given volume of air, and how their concentration varies in space and time. To reach these objectives several of the bioaerosols samplers used for the collection of other kinds of airborne particles and which basically operate according to a few fundamental principles can be employed. Currently the most commonly used samplers for the study of pollen in the atmosphere are suction samplers such as the Hirst pollen-trap (Lanzoni or Burkard).
A single pollen-trap, in a chosen area, is enough to monitor the presence of the pollens released by plants present in a very wide area (several square kilometres), and to show the variations in pollination start date, season length, peak concentration, date of peak and cumulative season total, therefore, in other words, to monitor day by day the evolution of the flowering phenophase of a given species in a given area.
Almost every European country has installed several aerobiological monitoring stations linked in regional or national network, to detect pollination parameters and to give information above all for the benefit of persons with seasonal allergic complaints.
There are two considerations for making the decision to invoke an overregional pollen information system: first, although local information is much more detailed than an overregional one, it remains restricted to local conditions. Local information is extremely helpful for hay fever patients and must be continued in the same way in order to the regional duties, but to fulfil the demands of a simple, easily understandable general information, in addition to local information systems, an overregional service will doubtlessly be pleasant for hay fever sufferers as well as for allergologists, but to study also climatic changes or monitor, over time, any modification of vegetation, or introduction of alien species, the impacts on agriculture, and as bioindicators of the quality of the air.
The first European pollen data bank has been installed in 1988 in Vienna, and now about 20 national networks are sending weekly pollen information to the

European Coordinator Centre of the European network. It is important to consider that aerobiology in Europe currently operates having common standards for the collection, the analysis, the representation and the interpretation of the pollen counts data, thank to bi-annual European Basic Courses on Aerobiology organized by leading European experts in aerobiology (the 8th Basic Course on Aerobiology will take place in Novi Sad, Serbia, 12-18 July 2007). The European network collect all available pollen count data and store them in a common database which is used for various scientific purposes, such as trend evaluations for start dates of pollination in different areas for various plants, or monitoring the progressive spreading out of new aeroallergens, or for studies on changes in climate and vegetation. Moreover one of the most important goals is to forecast the start, duration and severity of the pollen season, regarding the most widespread allergenic pollens.

New prospectives of MED Programme 2007-2013 and Atmosnet /Desertnet synergy

Liliana Tomarchio

Agency for the Environment and for Technical Services - Italy

MED is a transnational programme of European territorial cooperation, cofinanced by the European Commission by ERDF fund and regulation. It takes place within the territorial cooperation objective of the 2007 – 2013 period.
This programme continues the tradition of the European programmes for cooperation based on previous Interreg cooperation areas, drawing Medocc and Archimed areas together .
The programme have a budget of more than 250 billion euros and covers the coastal and Mediterranean regions of nine EU Member States.
The partnership is enlarged by the participation of Mediterranean countries wich are candidates or potential candidates to the European Union.
According to the global objectives of MEd and the orientations defined by the European Union, especially in the ERDF regulations, four priority axes have been determined.
The main priorities of this new programming period concern the issues of the EU competitiveness through its regions, employment and sustainable development promotion.
Innovation, good governance, environmental protection and natural risks prevention are now the key notions for the projects funded.
The MED programme finances projects according to its priorities, based on the strategic orientations defined in Lisbon (…"improve the area's competitiveness in a way that guarantees growth and employment for the next generations…").
and Gothenburg (promote territorial cohesion and environmental protection, according to the logic of sustainable development) agendas:
According to environmental protection item APAT since from Interreg II C and III B has developed some environmental projects in Medoc and Archimed cooperation areas.
The latest projects are ATMOSnet (Aerobiological Territorial Mediterranean Oriental System network) and Desertnet 2 on desertification problems.
Both projects are finalized to enhance the environmental quality and to implement and promote the knowledge on the environment also by the definition of new environmental indicators.

Both these projects have some common value (climate change), data flows, mediterranean parteships and objectives.
Results from these projects can be used in a sinergy way to strengthen environmental knowledge and quality and to define new indicators to manage sustainability at different level of governance.

Data diffusion and communication strategy

Alessandro Travaglini

University of Rome "Tor Vergata", Faculty of Mathematics, Phisics and Natural Sciences

Italian Association of Aerobiology - Italy

The writing of pollen bulletins and calendars constitutes an important instrument in various applications of aerobiology: in sanitary field it represents an aid in the treatment of the pollinosis, in environmental field it has them important applications in phenology, agriculture and more recently used in order to estimate the climatic changes.
In the course of the last years it has grown the debate on the value of the various classes of concentration for the various pollen types and for the spore and analogous argument it has regarded also the composition of the card of survey proposed from the AIA.
The comparison between some of diffused bulletins in Europe and in the world it puts in evidence as not great agreement neither between the levels of concentration neither between the floristica bulletin composition is one such. Only few then give indications on the concentration and the classes of the spore. This lack of information is little comprehensible when it is given to a information reported to the threshold value
In some countries it is evidenced a family or the genus of greater allergological interest, as an example in north America ragweed, or in North Europe, birch and/or graminacee. Not there is moreover homogeneity between the number of concentration classes, normally are four or five adding, in some cases, the class correspondent to "concentration much high", particularly useful one for families of plants like Cupressacee, Graminacee or Oleacee etc characterized by abundant pollinations.
Some network of aerobiological monitoring make reference, for the location of the classes concentration, to the values threshold. The value threshold depends very on the degree of sensibility of the subject and risks to being "a too much personal" value: for this method the elaboration of great amounts of data and cases is demanded, to local level, with the unknown of being little exportable at a distance. In other words it risks to being and rather valid a punctiform indication for the local population, that in age of easy travelling for great flows of persons it can constitute a serious problem
An ulterior confirmation of this criticality can be found in literature thinking, for example, to the threshold value for Ambrosia that is remarkably various from Author to Author. A better solution could be that one than to supply through the bulletin, the value and not only the concentration class so that the

patient, knowing just the value threshold, knows like behaving itself. An ulterior appraisal to make regards some factors parks them: the distance between the sampler and the surrounding vegetation, in particular the species of allergological interest, the height of the sampler from the ground and still, the acquaintance of the floristic-vegetation composition of the area comprised in the range of the sampler (without obviously to take in consideration, at least in before battered, the coming from contributions of pollen from a lot far away, allochthonous).

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Forecasting model in agricolture

Giuseppe Onorati

Regional Agency for Environmental Protection of Campania - Italy

In the Mondello meeting preparing the activities of ATMOSNET WP4 action 2, to define the approach for the forecasting model in agricolture, the topics "Updated Climate Change reference framework" and "Pollen and climate change" have been discussed. Starting from the IPCC IV Report, the state of art of Climate Change studies has been reviewed with a focus on the expected impact for agricolture. The IPCC WGII IV Assessment Report (published 6.4.2007) tells that "There is very high confidence, based on more evidence from a wider range of species, that recent warming strongly affecting terrestrial biological systems, including such changes as:

- earlier timing of spring events, such as leaf-unfolding, bird migration and egg-laying;
- poleward and upward shifts in ranges in plant and animal species.

Based on satellite observations since the early 1980s, there is high confidence that there has been a trend in many regions towards earlier 'greening' of vegetation in the spring linked to longer thermal growing seasons due to recent warming." Furthermore ..." Effects of temperature increases have been documented in the following systems (medium confidence):

- effects on agricultural and forestry management at Northern Hemisphere higher latitudes, such as earlier spring planting of crops, and alterations in disturbance regimes of forests due to fires and pests;
- some aspects of human health, such as heat-related mortality in Europe, infectious disease vectors in some areas, and allergenic pollen in Northern Hemisphere high and mid-latitudes;"

Hence relevant effects of Climate Change on agricolture and phenology of plants are expected up to 2100. In this framework pollens are useful because Palinology is a needed for paleoclimate reconstructions (proxy data of climate parameters) and pollen are an integrated plants change indicator related to climate variability contributing for some species to crop yeld changes evaluation. Indeed an environmental indicator is a species that responds predictably and sensitively, in ways that are readily observed and quantified, to an environmental disturbance. Indica-

tors are generally selected to act as surrogates of at least a subset of other organisms present in the same habitat. Pollen are used as markers of species spatial distribution and phenology.
As far as modeling is concerned, using pollen data top-down evaluation of climate change impacts in agriculture can be undertaken by 3 main approaches:
Using theoretical concepts to qualitatively assess how climate change might influence agriculture.
Using small-scale quantitative simulation models, to predict crop responses to climate change.
Using system-scale quantitative modelling, which can be mechanistic, empirical, statistical or, more likely, a combination of all three.
For a crop model to be useful as a climate change impact assessment tool it has to:

• reliably predict yield as a function of pollen and weather variables

• have a relatively limited number of essential variables and parameters

• be available to users in a robust yet flexible package that readily facilitates implementation

• have a CO2 response equation in the simulation

• operate at suitable spatial and temporal scales

The needed data sets include:

• Pollen data

• Landuse data (CLC 90 and CLC 2000, Satellite)

• Climatological data and estimates (rainfall, temperature, wind, evapotraspiration, solar radiation…)

• Climate change forecast model outputs

• Agriculture water needs,

• Vegetation pathologies data

• Crop production data

In order to develop and adopt a forecast model useful for the evaluation of climate change impacts on agriculture the following steps are anyway necessary: review the literature, create a conceptual model, gather meteorological and pollen data, delineate the spatial and time spans to be taken into account. The contribution of the Project Partners is welcome aiming at the implementation of the cited steps and answering the following open questions:

• Selection of environmental/agriculture model targets

• Choice of relevant plants (Olive, Chestnut..)

• Availability and integration of pollen data.

Climate Change and Agriculture

N. Misopolinos
Aristotle University of Thessaloniki, Faculty of Agriculture - Greece

The main driving forces are Temperature, Precipitation and CO2. The effects on global warming in agriculture are the increase frequency of weather extremes (storms, floods and droughts), loss of biodiversity in fragile environments/tropical forests, loss of fertile coastal lands caused by rising sea level, longer grower seasons in cool areas, more unpredictable farming conditions on tropical areas, increase of incidence of pets and vector borne diseases, dramatic changes in distribution and quantities of fish and sea food.
The effects of enhanced CO2 on crop growth are more CO2 is absorbed and converted to carbohydrates, higher levels of atmospheric CO2 also induce plants to close the stomates, crops may use less water even while they produce more carbohydrates In middle and higher latitudes, global warming will extend the length of the potential growing season. In lower latitude regions, increased temperatures may accelerate the rate at which plants release CO2, heat stress, accelerated physiological development, results in hastened maturation and reduced yield.
Climate variability is due to extreme meteorological events (high temperature, heavy storms, or droughts, disrupt crop production, changes in the variability as well as in the mean values of climatic variables.
Soil fertility and erosion issues as the speed of the natural decomposition of organic matter, additional application of fertilizer, heavier rainfall, increased soil erosion Pests and diseases as proliferation of insect pests in warmer climates, longer growing seasons will enable insects such as grasshoppers to complete a greater number of reproductive cycles during the spring, summer, and autumn. Altered wind patterns may change the spread of bacteria and fungi, livestock diseases, greater use of chemical pesticides, integrated pest management techniques
Adaptation at the level of farms are the introduction of later- maturing crop varieties or species sowing earlier, conserving soil moisture through appropriate tillage methods, improving irrigation efficiency, breeding of heat- and drought-resistant crop varieties, Crop varieties with a higher harvest index

Development of a common operational standard

Chiroula Nikita - Martzopoulou

Aristotle University of Thessaloniki, Faculty of Agriculture - Greece

After the set-up of the monitoring network, a common operational standard among the different laboratories will be applied with reference to the methodology used for data collection and data analysis. This could represent a starting point for the standard for the European Commission. Standard operating procedures (SOPs) are the procedures used in all the processes of the monitoring system, i.e. in the field, laboratory, and data management areas.

SOPs provide a method to ensure that all personnel follow the same procedures to avoid variance of data quality between personnel in charge, and that they conduct their works with good understanding of Quality Assurance and Quality Control.

SOPs must be sufficiently specific and easy to understand, and they should be reviewed and updated on the basis of latest information and circumstances

The pollen monitoring should be done on the basis of a methodology agreed among all participants in order to achieve comparable and reliable results. The pollen and spore types that the participant countries must count and report, along with their taxonomy, have been determined and published on-line. Data transfer among partners will also be achieved through the on-line sharing of information.

All partners have agreed, and already apply the pollen monitoring method proposed by the European representatives of the International Association for Aerobiology (IAA), approved by the EAACI Subcommitte «Aerobiology and Environmental Aspects of Inhalant Allergens». This method reports specific instructions about the volumetric samplers, their installation, function and control. The protocol of this method also specifies directives for the preparation of the sampling surface, the mounting of the samples, the examination of the samples and the calculation of the atmospheric concentration of pollen. Finally, the precision and accuracy of the measurements is analysed and presented. In order to ensure that the methodology will be applied uniformly among the participants and that the results will be reliable, the pollen counters have been already trained by experts in the aerobiological course in Naples (more information about the programme of this course has been published). Each of the participants is responsible for quality control of the data set collected. It is assumed that each working group is performing the quality control calibrations and adjustments needed. In addition, the following information will be reviewed and evaluated:

Calibration information

Data handling information

Field and lab blank data

The accuracy, specificity, precision etc calculation for the data set via ring test and audit standards.
Any other tests that the reviewers deem useful.
From this information, the reviewers will be able to assess whether the operation of the instruments, the application of the agreed methodology and the data satisfy the quality standards. If the data is failing the standards then it should be removed or invalidated. The results of all monitoring sites must be compared and the data must be adapted / corrected / integrated in case of differences. The application of quality assurance on pollen data collection is necessary in order to use this data to achieve the further goals of this project. For example the development of a forecasting model.

Quality assurance

Maria Dimou

Aristotle University of Thessaloniki, Faculty of Agriculture - Greece

Quality Assurance (QA) is the activity of providing evidence needed to establish confidence among all concerned, that the quality-related activities are being performed effectively. In order to succeed QA in a project the following tasks should be taken into account:

- Accurate and complete information
- All appropriate elements must be addressed
- Identification of any limitations on the use of the data
- Confirmation that the planned assessment procedures will be adequate to evaluate the project
- Identification of the project's technical and quality objectives, and satisfaction of the objectives through the intended measurement and data acquisition methods

Quality assurance Project objectives are thedevelopment of a best practice pollen monitoring approach for identification and monitoring of drought and desertification features as indirect effects of climate change for Europe and especially for the European Union:

- Monitoring of pollen concentration on basis of agreed and trained methodology
- Quality procedures elaboration and adoption
- Comparison of results and quality of the various monitoring sites and data evaluation and adaptation/correction/integration in case of differences
- Development of a European standard focused on the methodology of a monitoring network setup, data collection, data analysis and integration of pollen data for improving climate change forecasting on droughts and desertification
- Quality insurance and control of data:
- Methodology
- Training

- Reference material
- Good laboratory and measurement practices
- Interlab comparisons
- Field and lab blank data
- Ring test
- Audit /Audit standards
- Dynamic system/continues improvement

The adopted Pollen monitoring methodology-taxonomy was that all the samples were prepared and examined according to the method proposed by the European representatives of the International Association for Aerobiology (IAA), adopted by all partners and demonstrated in Naples' training course. The data is expressed as an average daily concentration, considering the day from hour 0 to hour 24 (n/m3) according to agreed taxonomy

Methodology related to the pollen allergy

Margari Vea

Aristotle University of Thessaloniki, School of Medicine - Greece

The right way of the study should include two continuous periods of flowering. In this case the model should be considered more reliable.
Anyway our teams independently of the time will be able to confirm the data of the year 2007 during the year 2008.
Due to the limited time, we are obliged to conclude in the study mainly patients checked in the past. Of course we will add new patients on condition that they will be examined immediately after the appearance of the symptoms.
The number of patients per country, according to our opinion, should not be less than 300.
Statistically, the ideal number should be about 450 – 500 patients.
The diseases examined will be:

- Allergic rhinitis
- Allergic conjunctivitis
- Allergic asthma

The pallen is responsible also for some more diseases but the majority of aeroallergens patients suffer from the above mentioned.
All the patients must be checked by a basic control which includes the followings:

- Patient history – Analitically.
- Serum total IgE levels.
- Skin prick tests or/and serum antigen specific IgE levels with methods certified internationally.

On the basics of Mediterranean literature data and also of our experience the sensitivity should be oriented to the following pollens:

- From the class of *Graminaceae*, the Pooideae and the Panicoideae should be represented. The plants Cynodon dactylon and *Dactylis glomerat*a are proposed. Instead of *Dactylis glomerata*, the plant Phleum pretense should be studied.
- *Olea eurpaea*.

• *Paritaria*, as basic representative of *Urticaceae*. According to allergy data, each country can choose among the Parietaria officinalis and the *Parietaria judaica*.

• From the class of *Compositae*, the problem of *Taraxacum* vulgare which belongs to the Liguliflorae and the pollen of Artemisia vulgaris which belongs to the *Tubuliflorae* (*Anthemideae*).

• The pollen of *Cupressus sempervirens*.

• As far as the pollen of other trees, our patients are also checked. Therefore if the other countries ask for information we will be able to answer.

• Our desire is the study of one representative of *Plantaginaceae* and we propose the *Plantago lanceolata*. Also, one representative of *Chenopodiaceae* and we propose the *Chenopodium album*. The above is just a desire.

It has to be noted that the check of the pollen to the patients is not enough. Knowing that the cost of check is high we propose the sensitivity of the patients to be checked with some other allergens and specifically:
House dust mites, *Dermatophagoides pteronyssinus* and *Derrmatophagoides farinae*.
Moulds: *Penicillium notatum, Cladosporium herbarum, Aspergillus fumigatus and Alternaria alternata* (*tenuis*). For these moulds, in order to check the IgE, a very cheep mixture exists.
According to our opinion a number of patients must be supplied by an allergic survey sheet. If you agree we are able to prepare such a sheet in the frame of European and International Organizations and then to give it to our partners.

Authors

Reports

Anna Dorangricchia
Gruppo Soges - Italy

Daniela Nuvolose
CNR, Pisa - Italy

Cinzia Lupo, Patrizia Cascio, Pietro Vitale, Domenico Nuzzo, Giovanni Duro
CNR, Palermo - Italy

Stefano Marchesi
Regional Agency for Environmental Protection of Emilia Romagna - Italy

Emanuela Zieger
Environmental Protection Provincial Agency of Bolzano - Italy

Everaldo Attard
University of Malta - Malta

Massimo Menegozzo
Regional Agency for Environmental Protection of Campania - Italy

Giovanna Aronne
University of Napoli "Federico II" - Italy

Caruso Tiziano, Campisi Giuseppe, La Mantia Michele, Marra Francesco Paolo
University of Palermo - Italy

Stefania La Grutta
Regional Agency for Environmental Protection of Sicilia - Italy

Bachisio Arca, Annalisa Canu, Grazia Pellizzaro
CNR, Sassari - Italy

Arnoldo Vargiu
Osservatorio Aerobiologico, Sassari - Italy

Giuseppe Onorati
Regional Agency for Enviromental Protection of Campania - Italy

Charalampos Bratsas, Vea Margari
Aristotle University of Thessaloniki -Greece

Maria Dimou
Aristotle University of Thessaloniki - Greece

Joseph Callus
University of Malta - Malta

Vincenzo De Geronimo
Agency for Enviroment and Protection for Technical Services - Italy

Saviour Baldacchino
University of Malta - Malta

Anna Maria Matrone
Regional Agency for Environmental Protection of Campania - Italy

Diego Guglielmelli
Regional Agency for Environmental Protection of Campania – Italy

Abstracts

Ian Mifsud
Government-Health Department
Malta

Raymond Ellul
University of Malta - Malta

Martin Saliba
University of Malta - Malta

Liberato Camilleri
University of Malta - Malta

Hans Güsten
University of Karlsruhe - Germany

Giuseppe Frenguelli
University of Perugia - Italy

Liliana Tomarchio
Agency for the Environment and
for Technical Services - Italy

Alessandro Travaglini
University of Roma "Tor Vergata" - Italy

Giuseppe Onorati
Regional Agency for Environmental
Protection of Campania - Italy

N. Misopolinos
Aristotle University of Thessaloniki -
Greece

Chiroula Nikita – Martzopoulou
Aristotle University of Thessaloniki -
Greece

Maria Dimou
Aristotle University of Thessaloniki -
Greece

Margari Vea
Aristotle University of Thessaloniki -
Greece

Partners of project

ATMOSnet project has been coordinated by ARPAC, as Lead Partner, in collaboration with the Partners APAT, Sicily Region, University of Thessaloniki and University of Malta.

agenzia regionale
protezione ambientale
campania

Regional Agency for Environmental
Protection of Campania (ARPAC) - Italy
The regional agency for the enviromental protection of Campania was set up on the basis of the regional law n. 10 of 29th July 1998; according to article 4 paragraph 3 of this law, ARPAC is a public legal entity, having managing, administrative, accounting and technical independency.
Its mission is linked to the evironment monitoring, conservation and recovery in the regional territory. From 2005 the Agency is involved in the development of European cooperation projects in fields of intervention consistent with its institutional mission.
In the ATMOSnet project, ARPAC carries out Lead Partner tasks, in partnership with APAT, Sicilia Region, Univeristy of Thessaloniki and University of Malta, coordinating the project scientific and administrative activities. In particular the Management and Coordination tasks refer to the following activities: finalization of the Joint Convention, drafting and check of the Progress Reports, management of the partnership relationships with the INTERREG III B - ARCHIMED Managing Authorithy, coordination of all Work Packages, check and validation of the Work Packages deliverables, organisation of Project Management Board meetings, communication plan of the project activities, monitoring and control of the incurred expenditures.
Besides the management activities, ARPAC supported the technical activity of the project, by contributing:

- to the launch of a transnational network of the pollen monitoring through the implementation of four pollen monitoring stations in Campania regional territory and of a laboratory for the data gathering, reading and analysis;
- to the training of local personnel, 5 employed, to be assigned to the basic pollen and spora recognition, as well as to the data acquisition and elaboration;
- to the application of common methodologies for the pollen monitoring according to the quality procedures, for the definition of European standard and Guidelines on quality assurance;
- to the development of forecasting models to assess, in particular, the impacts on agriculture of the foreseen climate change in the Mediterranean area (drought, desertification, soil degradation);
- to the organization of the final conference where the results of all the Work Packages will be presented to the European Community representatives.

ing. Luciano Capobianco - Legal Representative
segreteria@arpacampania.it
tel.+39 081 2326215 fax +39 081 2326225

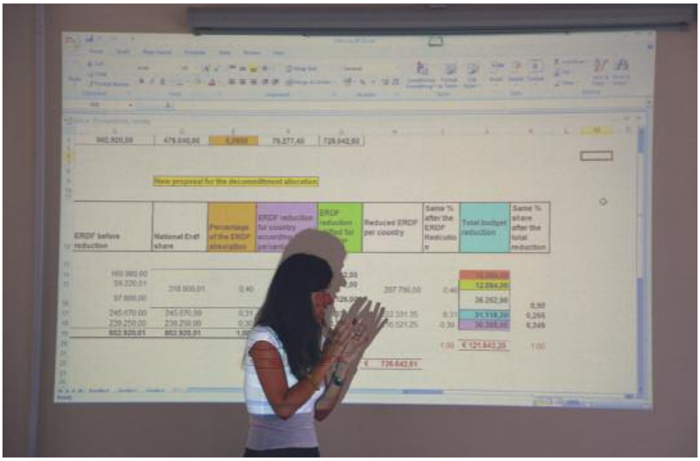
prof. Massimo Menegozzo - Project Manager
m.menegozzo@arpacampania.it
tel.+39 081 2326218 fax +39 081 2326324

Agency for the Environment
and for Technical Services (APAT) - Italy

The Agency for the Environment and for Technical Services (APAT) perform the tasks and technical activities of national interest for the protection of the environment, the protection of water and soil, and was founded by the merger between the National Agency for the Protection of Environment (ANPA) and the Department for National Technical services of the Presidency of the Council of Ministers (DPR 207, 8.8.2002).
In ATMOSnet project APAT is involved in:

Partners' Training
- how use the monitoring site to collect pollen monitoring data
- where place and how use the pollen traps
- recognition of pollen
- how to work in laboratory, standard methods
- pollen count – measures
- pollen types and fungal spore as a cause of hay fever


Forecasting model for the human system
Project Management Board and Scientific Board Meeting
Progress Report by WPs Leaders
Malta - Dr E. Attard



Pollen Monitoring – Management's software and Network Server
- Pollen Monitoring - Handbook on the use of data
- insertion of counts (automated or manually way)
- configuration of the detection's stations
- configuration of used microscope
- creation of user profiles of employees
- data extraction from the database
- data processing
- data publication

To produce a set of guidelines to standardize the pollen monitoring procedure, the laboratory methods, the preparations counting and the results analysis.
Weekly report, which contains counts and concentrations of particles observed daily. Yearly report with the average weekly of a given year. The publication of reports in the web site is due to an interface between the software of data management and the site "ATMOSnet". The ATMOSnet software uses a web interface and an Oracle database for storing data.
In the course of this inter-meeting period, various problems could arise and the trainers provide extra guidelines and also clarify some aspects of original set.
The aim throughout is to keep monitoring as standardized as possible so that the resulting pollen influx values from diverse parts of Italy and Europe can be reliably compared.
The training of other partners was held for the duration of the project through lectures, online assistance, and guiding operators with experts. APAT will take too the responsibility for the network database activities after the end of the project.

avv. Giancarlo Viglione - Legal Representative
giancarlo.viglione@apat.it
tel. +39 06 50072450 fax +39 06 50072059

ing. Vincenzo De Gironimo - Project Manager
vincenzo.degironimo@apat.it
tel. +39 06 50072975 fax +39 06 50072059

Sicilia Region - Italy
The Arta Sicilia (Regional Office for Environment and Territory) is the organism of Sicilian Government for the policy, management and conservation of the environment. The Department of Territory and Environment is involved in the specific field of pollution and emissions measurements and in the managing and protection of the air quality.
Using UE Structural Fund the Department is a Partner of several projects on environmental pollution, natural habitats protection, ecological network, management of coastal areas, etc. Service 3 is involved in the project Interreg IIIB

ATMOSnet as Partners 3 having a specific role of WP4 leader –"Potentiality of Pollen analysis on climate change forecasting models".
The elaboration of the acquired data by a specifically developed software and also the monitoring over time on drought and desertification impacts on agriculture and health are the main contribute of the PP3 to the project 's objectives.
In order to achieve all the project task activities, ARPA Sicily was involved as technical partner of ARTA Department. According to the specific Action Plan program, ARPA has a role of coordination and implementation of both technical supports of Aerobiological Unit of IBIM-CNR Institute of Palermo and of the Department of Crops Arboree of Palermo University.
The following Work-packages represent the PP3 Sicily specific outputs in the ATMOSnet Project:

WP1 task-action 2: Analysis of the present quality assurance statement in pollen monitoring and networking in particular: installation, upgrade, supply and installation of surveillance devices on six pilot sites control in Sicily; Training staff on the basis of recognition of spora and pollen; According to the methodological agreement among the Partners 52 different species of pollen and 10 spores are now available.
WP4 4 task-action 1: Forecasting model for the environmental system" developing a model for drought and desertification due to climate change. PP3 Sicily Partner as Task 1 Responsible contribute to the develop and adoption of the predictive models using information control aerobiological and significant historical data.

arch. Pietro Tolomeo - Legal Representative
DTA@artasicilia.it
tel. +39 091 7077807 fax +39 091 7077294

dott. Salvatore Anzà - Project Manager
sanza@artasicilia.it
tel +39 091 7078969 fax +39 091 7078968

Aristotle University of Thessaloniki - Greece
The Aristotle University of Thessaloniki is the largest university in Greece. The realisation of the project is through the Faculty of Agriculture which is the largest school for undergraduate and postgraduate university studies in agricultural sciences in Greece. The Contribution of AUTH to the project activities was:

- The development and implementation of two new monitoring sites in the area of Thessaloniki and the training of newpersonnel on basic pollen and spore recognition, data acquisition, elaboration and dissemination addressed to en-


nstructions Control Center
le University of Thessaloniki

monitoring stations

vironmental monitoring. The type and quantity of pollen concentration measured in the monitoring sites is based on an agreed and trained methodology, assuring the application of common operational standard among the different laboratories of the project.

- The elaboration and adoption of Quality procedures. Further, a ring test among the participant laboratories was, also organised by our laboratory, in order in order to assure quality standards in pollen monitoring and evaluate the data among the various sites of this project. For this reason, the comparison of results and quality of the various monitoring sites and data evaluation and adaptation/correction/integration in case of differences, were among our activities. Finally, along with airborne pollen monitoring, a pollen atlas of the anemophilus plants of the area has also been prepared.
- The development of a forecast model for airborne allergenic pollens in the Mediterranean region, by establishing a correlation between measured air pollen levels and clinical manifestations in pollen sensitized patients, taking also into account the interfering meteorological factors. In the future, such a model could help to the prediction of pollen concentrations for the next day or the next few days short term forecast). So, the forecast model could assist doctors and health authorities, working in the field of allergy, by preventing or at least ameliorating the manifestation of allergy symptoms. This can be succeeded, either by limiting patients' pollen exposure and/or by starting the appropriate anti-allergic treatment before the beginning of the pollination of the responsible plant. For the above reasons this model is considered as a tool to serve directly the allergy sufferers.

prof. Stavros M. Panas - Legal Representative
research@rc.auth.gr
tel. +30 2310 996745 fax +30 2310 853283

prof. Gerrasimos Martzopoulos - Project Manager
martzopo@agro.auth.gr
tel. +30 2310 998714 fax +30 2310 998749

University of Malta - Malta
The Institute of Agriculture is a tertiary agriculture institution within the University of Malta. The aims of the Institute are to offer Degrees & Diplomas, conduct scientific research, assist in planning for agricultural development, provide in advisory services to the local rural community and pioneer new, modern technologies in Maltese agriculture.

The Institute aims at the highest academic and research standards. The Institute runs a number of courses, from the diploma level upto a Ph.D. The main research areas include crop production & health, animal production & health, medicinal & aromatic Plants, soil & water and legislation & rural Affairs. In partnership with the public and private sectors, we endeavour to: enhance the role of the Institute of Agriculture in the development of the agricultural and food sectors in Malta, broaden of the public awareness for the importance of Maltese agriculture and the rational utilisation of natural resources and continue its commitment to the promotion and preservation of a Maltese viable and sustainable agriculture.
Regarding the field of action of the project, a pollen grain library has been devised from a considerable number of edible and medicinal plant species. This collection extends to other autochtonous plants, especially certain grasses and trees. The purpose of this collection is to determine the incidence of respiratory diseases with quality and quantity of pollen grains, identifying problems related to climate change, forecasting crop production and disease incidences, characterisation of honey by pollen grain analysis, and eventual use of pollen grain analysis in forensic medicine.
Through this project an aerobiological laboratory was setup at the institute with two compound microscopes and ancillary equipment. In the past, a Hirst pollen sampler was located on the central part of Malta for health purposes. Through this project, two pollen samplers were placed at the two extremes of the Maltese Islands. Their purpose is to capture both local and transboundary pollens.
The Institute of Agriculture contributed to the project by the setting up of the website and networking of the pollen stations in the Eastern part of the Mediterranean and contributed to the formulation of proposed guidelines on quality assurance and European standards.

prof. Juanito Camilleri - Legal Representative
rector@um.edu.mt
tel.+35 621333907 fax +35 621336436

dott. Everaldo Attard - Project Manager
everaldo.attard@um.edu.mt
tel.+35 623402323 fax +35 621346519