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COST Action ES0602

*“Towards a European Network on Chemical Weather
Forecasting and Information Systems”*

*– Fostering scientific and technical cooperation within
and beyond the realms of GMES*

Thomas Klein, Jaakko Kukkonen, Kostas Karatzas, Kjetil
Tørseth, Mikhail Sofiev, Aasmund Fahre Vik, Roberto San
José, and the COST ES0602 team

GMES operational capacity workshop, 25 - 26 March, Sofia, Bulgaria



What is the objective of COST ES0602?

- To establish a forum for benchmarking, harmonising and developing approaches, practices and protocols in forecast data exchange and multi-model capabilities, working towards a chemical weather forecasting network and near-realtime information systems in Europe.
- To offer a neutral, multi-national and multi-institutional platform for the exchange of information, knowledge and best practices between stakeholders in the chemical weather domain:
 - meteorological services, academia, environmental agencies, international initiatives, users etc.
- To support and complement ongoing initiatives such as GMES
- www.chemicalweather.eu



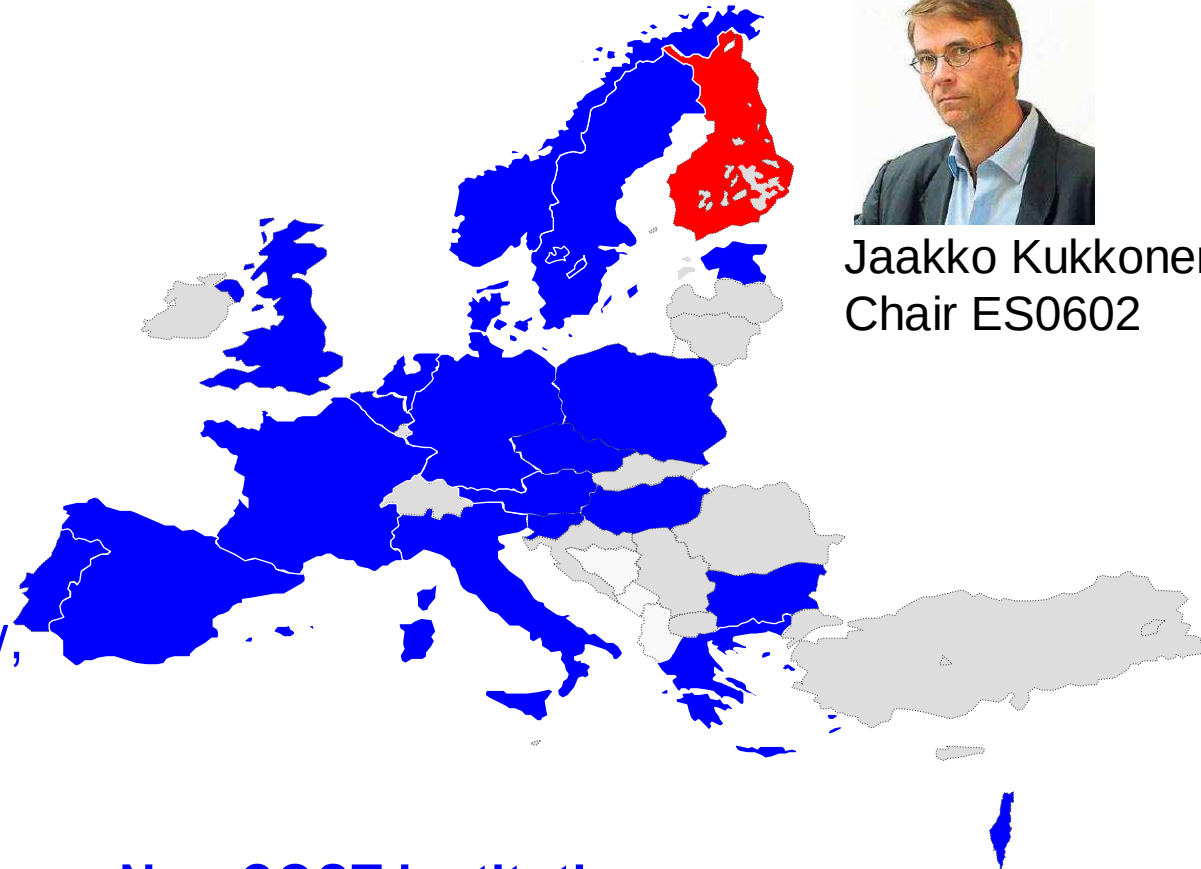
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COST ES0602 (2007 – 2011) includes 21 countries

Chair : Finland

Austria, Belgium,
Czech Republic,
Bulgaria, Denmark,
Estonia, Finland,
France, Germany,
Greece, Hungary,
Israel, Italy, the
Netherlands, Norway,
Poland, Portugal,
Slovenia, Spain,
Sweden, and the
United Kingdom.



Jaakko Kukkonen
Chair ES0602

Non-COST institutions:

- EEA, US-EPA, WMO, Russia, Canada, etc.



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Working Groups and grant holder

❖ WG1. Exchange of AQ forecasts and input data

Chair: Kjetil Torseth (in picture), Aasmund Fahre Vik
(Norwegian Institute for Air Research, NILU)



❖ WG2. Multi-scale forecasting, multi-model ensemble, boundary data

Chair: Mikhail Sofiev (in picture, Finnish Meteorological Institute, FMI)



❖ WG3. Dissemination and visualization

Chair: Kostas Karatzas (in picture, Aristotle University, Greece)



❖ WP4. Cross-cutting and integration

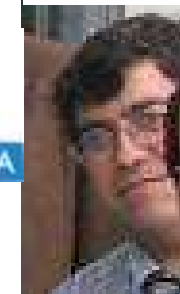
To coordinate with other organizations and ongoing activities

Chair: Thomas Klein (in picture, Swedish Meteorological and Hydrological Institute)



❖ Grant Holder

Technical University of Madrid (UPM), Roberto San Jose (in picture)





The COST ES0602 team

Time scales of some related projects



2007

2008

2009

2010

2011

COST 728 (Mesoscale met)

GEMS

PROMOTE-2

COST ES0602 (Chemical Weather)

COST ES0603 (Pollen)

MEGAPOLI

CITIZEN

MACC = Monitoring Atmospheric
Composition and Climate

PASODOBLE = Development Of Basic
Localised Information for Europe

MACC

PASODOBLE

TRANSPHORM

GEMS = Global and regional Earth-
system (Atmosphere) Monitoring using
Satellite and in-situ data

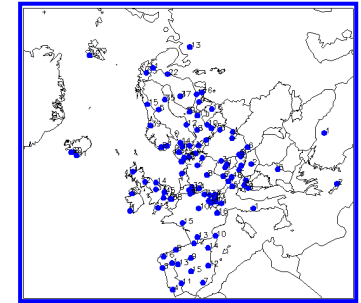
PROMOTE = PROtocol MOniToring for
the GMES Service Element:
Atmosphere



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ecost



WG1: Exchange of AQ forecasts and input data

- Evaluate ongoing approaches and provide recommendations for future developments
- Exchange of information with ongoing activities, e.g. EEA and EMEP, and the GEMS/PROMOTE/MACC projects.
- Community feedback on needs related to data access, output formats, timeliness etc. as seen from a user perspective. Contribution to EEA's work on the access requirements for near real-time data.



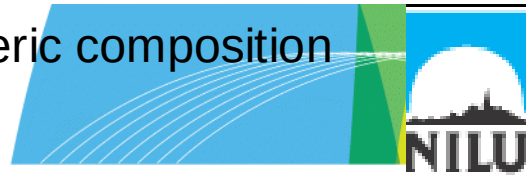
An overview of near-real time air quality data

Item \ Project	EEA NRT AQ (e.g. Ozone Web)	EMEP	Citeair	GEMS	PROMOTE	EUSAAR
Number of measurement points	More than 700	Probably 100 – 120 rural background stations	Unknown number of measurement stations from 26 cities	Not known	More than 100	20
Limitations	Few parameters currently implemented. Based on large number of data providers using various QA procedures.	Only rural background stations. Still only an idea – no data yet submitted.	Only AQ indices available and only from a few cities across Europe.	A closed system based on bilateral agreements. Not possible for others to access data.	Data are only available on the basis of Service Level Agreements to service providers.	Only 20 sites available and limited prospects for increase. Main focus on process studies, not AQ monitoring

Data dissemination – atmospheric composition

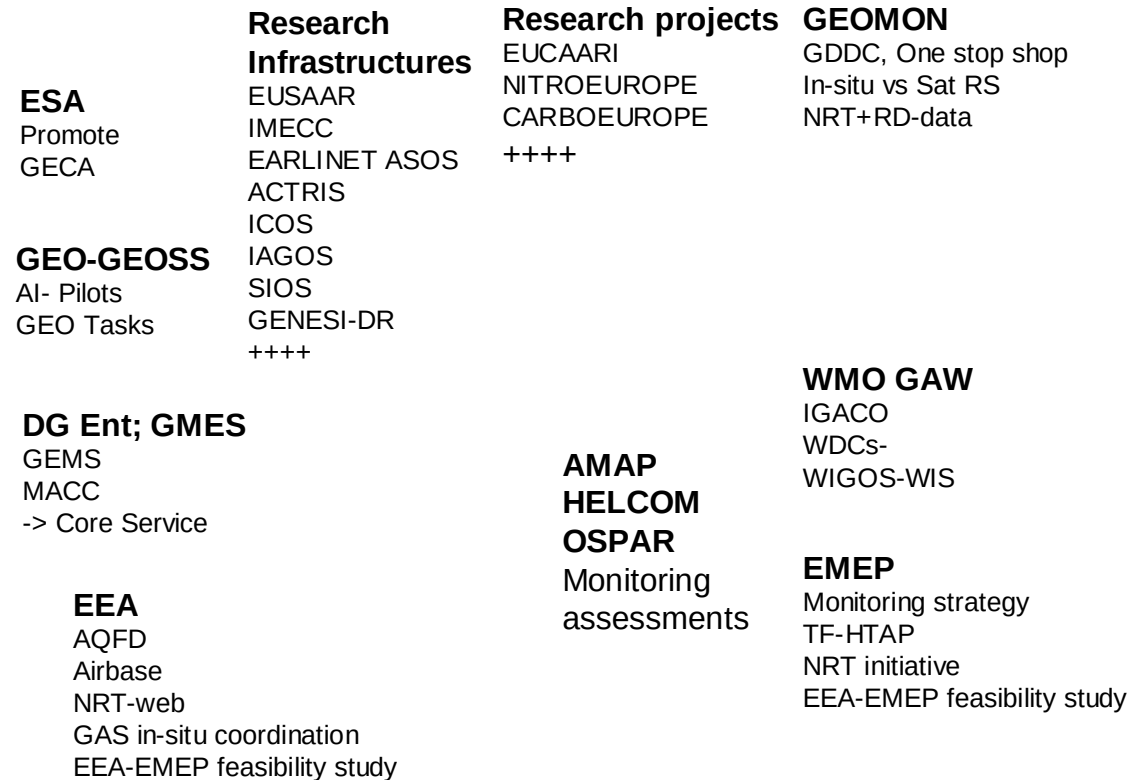


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“complexity of monitoring”

“external/legal steering”



“Data providers”

Official databases for EC-directives and International Conventions
National authorities and national focal points
Research projects (IPY, EUCAARI, NitroE, CarboE, +++
Research institutions (reference labs, research infrastructures etc.)
Individual scientists



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WG2: Multi-scale forecasting, multi-model ensemble, boundary data

- Model inventory based on the Model Documentation System of the EEA and the COST-728 database -> Report on the state-of-the-art and peer-reviewed paper
- Joint case studies with COST-728. Intercomparison of models and evaluation against experimental data; re-analysis of specific cases in 2003 and 2006. A set of preliminary model runs has been performed.
- Operational forecasting ensemble. A set of selected stations will be selected from each country (total number about 50). Each group will then archive the results of the operational forecasts for these sites.



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Review of operational, chemical weather forecasting models on a regional scale in Europe – A manuscript for ACP

Jaakko Kukkonen, Taru Balk, David Schultz, Alexander Baklanov, Thomas Klein, Konstantinos Karatzas, Roberto San Jose, Eberhard Reimer, Marcus Hirtl, Sandro Finardi, Martijn M. Schaap, Mikhail Sofiev, Ranjeet S. Sokhi, Virpi Tarvainen, Michael Boy, Alexandra Monteiro, Vincent-Henri Peuch, Ana Isabel Miranda, Anastasia Poupkou, Ioannis Kioutsioukis, Marina Astitha, Kari Lehtinen, George Kallos (20+ authors)

Joint COST ES0602, COST 728 and GMES team



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Review of operational, chemical weather forecasting models on a regional scale in Europe – Information sources and aims

The main sources of information on the modelling systems:

- the available literature and internet resources
- more detailed information provided by the action participants
- the COST-728 database of modelling systems and the EEA model documentation system

This study aims to evaluate:

- the relative advantages and limitations of various modeling systems, modules and approaches
- present prominent gaps of knowledge
- suggest priority directions for future research

	Model types		Treatments of physical and chemical processes			
	Dispersion and Chemistry	Meteorology	Advection & convection	Turbulence	Deposition	Chemistry
LOTOS-EUROS The Netherlands	3D Eulerian.	ECMWF.	Advection based on Walcek (2000). Vertical grid follows planetary boundary layer from meteorology.	Vertical turbulent mixing based on K-theory.	Dry: resistance approach. Wet: scavenging rates depend on Henry law constants for gases and Scott (1979) for particles.	Gas phase: updated CBM-4 with Carter's 1-product isosphere scheme: homo- and heterogenous conversion of NO ₂ to HNO ₃ , Aerosol chemistry using ISORROPIA.
MATCH Sweden	3D Eulerian.	ECMWF, HIRLAM.	Bott-type advection scheme (Bott, 1989).	Vertical turbulent mixing based on K-theory.	Dry: resistance approach. Wet: assumed to be proportional to the precipitation intensity using species-specific scavenging coefficients.	110 thermal, 28 photochemical, 2 aqueous-phase, 5 aerosol reactions and 4 gas-phase aqueous-phase and aerosol equilibria between 61 chemical components. Gas phase: based on the EMEP MSC-W.
MM5-CHIMERE France	CHIMERE (C): 3D Eulerian.	MM5 (M)	M: finite difference formulation of the time-dependent Navier-Stokes equations. C: for advection the parabolic piecewise method, the Godunov and the simple upwind first-order schemes.	M: several PBL schemes (Bulk PBL, high resolution Blackadar PBL, etc.) C: Vertical turbulent mixing takes place only in the boundary-layer. K-diffusion, without counter-gradient term.	M: Nonconvective precipitation scheme, warm rain, simple ice, mixed-phase, Goddard microphysics, Reisner graupel, Schultz microphysics. C: Dry: deposition velocity through a resistance analogy. Wet: based on Loosmore.	C: Over 300 reactions of 80 gaseous species. Hydrocarbon degradation is similar to the EMEP gas phase. Adaptations are made for low NO _x conditions and NO _x -nitrate chemistry. Heterogeneous formation of HONO from deposition of NO ₂ on wet surfaces.

Inter-comparison of selected properties of the mathematical structure of a few selected European chemical weather forecasting models on regional and continental scales.

WG3: Dissemination and Visualisation

- Assess how various organisations select the AQ data and information on display, and by which means, platforms and format.
- Review of dissemination and visualization solutions for information on chemical weather.
- Workshop “Chemical weather information services for quality of life”, Thessaloniki, May 2008: Invited experts from several EU countries, user communities, the EEA and the US-EPA -> Thessaloniki-book, including a review, guidelines and recommendations for dissemination and visualization of atmospheric air quality information.
- Development of the European chemical weather forecasting portal (ENCWP)
 - see separate presentation



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WG4: Cross-cutting and integration

- Coordinate the Action's liaison with projects, other COST Actions, international organizations, conventions and initiatives, and relevant bodies of the EU
- Foster cross-cutting and integration between different scientific domains, e.g. meteorology, atmospheric chemistry and biology.
- Review paper (in preparation): Advances and new directions in integrated weather forecast and information systems – Integrating the physical, chemical and biological elements. A review by COST Action ES0602 –



COST ES0602 Chemical Weather network

Projects

[APNEE FP5-project](#)
[CAIR4HEALTH](#)
[CITYZEN](#)
[ENSEMBLE](#)
[EUCAARI](#)
[EUSAAR](#)
[GEMS](#)
[GEOMON](#)
[GURME](#)
[MEGAPOLI](#)
[PROMOTE](#)

AQ/CW Forecast and Information Systems and Services

[AIRNow](#)
[AIRTHESS](#)
[AirAlert](#)
[Sussex-Air](#)
[CHIMERE](#)
[EOAQF](#)
[GMES Atmospheric Pilot Services](#)
[MATCH](#)
[NAAF](#)
[SILAM](#)

International organizations, agencies and bodies of the EU

[ECMWF](#)
[EEA](#)
[EUMETNET](#)
[GEO](#)
[JRC](#)
[WHO](#)
[WMO](#)

Initiatives, networks, programmes and conventions

[ACCENT](#)
[AIRNow](#)
[CLRTAP](#)
[EEA ozone-web](#)
[EIONET](#)
[EMEP](#)
[GAW](#)
[GMES](#)
[INSPIRE](#)
[SEIS](#)

Related COST Actions

[COST ES0602](#)
[COST ES0603](#)
[COST 728](#)

...scientific and technical cooperation within and beyond the realms of GMES



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Thematic Workshops organized by COST ES0602

- Thessaloniki, May 2008
 - “Chemical weather information services for quality of life”, invited experts from several EU countries, user communities, the EEA and the US-EPA
 - Thessaloniki-book: review, guidelines and recommendations for dissemination and visualization of atmospheric air quality information.
- Budapest, May 2009
 - “Modelling and forecasting atmospheric composition: from individual chemical transport models towards multi-model ensembles”
 - Budapest-book, in preparation
- Aveiro, Oct 2009
 - COST ES0602, COST ES0603 and WMO joint workshop on “Chemical and Biological Weather Forecasting: State of the art and future perspectives”
 - experts with a background in atmospheric physics, chemistry, biology and health and included keynote presentations by EEA and WMO
 - Aveiro conclusions -> www.chemicalweather.eu, www.eupollen.eu

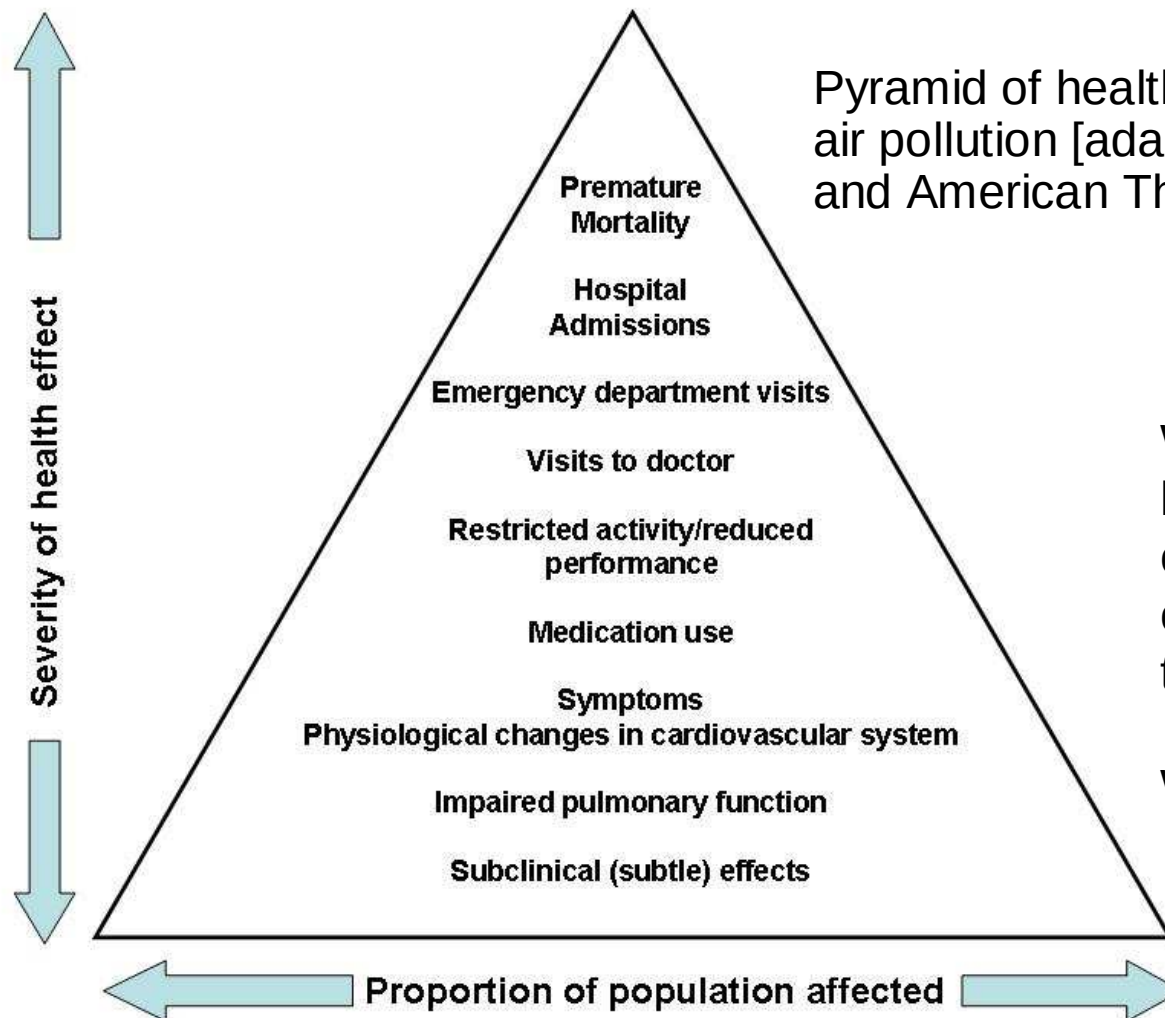


Conclusions from Aveiro workshop (shortened)

- Need for further research on natural allergens
 - release, atmospheric dispersion, exposures and health impacts of natural allergens,
 - improved public information and alert thresholds that take into account interactions and combined impacts of chemical and biological pollutants
- Growing incentive for the inclusion of pollen into the WHO and European Union AQ guidelines and the legislative framework (e.g., through the provision of public information and warning levels)
- Need for improvements of monitoring and modelling capabilities and organizational arrangements to allow for operational physical, chemical and biological weather services for a better quality of life
- Airborne pollen and spore species are currently monitored within national networks in Europe, which are unfortunately in many cases under-funded and rely on short-term financial sources.
- Need for integrated biochemical weather information services



Health impacts of physical, chemical and biological weather?



Pyramid of health effects associated with air pollution [adapted from WHO (2006) and American Thoracic Society (2000)]

What about joint effects, e.g., heat stress, air pollution due to conventional pollutants combined with air pollution due to allergenic pollen?

What about interactions?



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Cross-cutting aspects beyond COST ES0602: Physical, chemical and biological weather and climate change

- Climate change and variability are observed and projected to affect
 - the frequency and intensity of heat waves and cold spells,
 - the timing, peaks and length of the pollen season as well as the frequency of exposure, pollen concentration and the allergen load, and
 - the concentrations of conventional air pollutants such as ground-level ozone (e.g. ozone formation and dry deposition processes)
- Air pollution policy choices and CC mitigation policies affect each other
 - Preference of measures that simultaneously address emissions of air pollutants and greenhouse gases
 - Aligning policy sectors of air and climate to exploit co-benefits and avoid negative side effects of policy measures such as emission control (“co-control”)

Conclusions – COST ES0602 achievements so far

- ✓ Significant enhancements in networking of national chemical weather forecast and information systems and communities
 - ✓ Supporting seamless pan-European provision of chemical weather information and services
 - ✓ Neutral platform for the exchange of information, knowledge and best practices
 - ✓ Building bridges between chemical weather stakeholders (meteorological services, academia, environmental agencies, international initiatives, users etc.)
- ✓ Strong scientific and technological cooperation in the domain of chemical weather and interconnected fields such as biological weather and meteorology
 - ✓ Thematic workshops, summer schools, short-term scientific missions, etc
 - ✓ Reviews, scientific and technical publications and recommendations



Outlook – Open issues, questions and gaps

- Integrated services on physical, chemical and biological weather still missing
 - 1-stop shop for physical, chemical and biological weather variables?
 - Integrated indices, taking into account joint impacts?
- Negative gradient in level of sophistication of capacities (operational monitoring, modelling and services): physical → chemical → biological
 - This has partly "traditional" reasons, e.g. collaboration in the physical weather domain has the longest history → Blueprint for other domains?
 - Level of complexity of chemical weather is significantly higher than for physical weather (many more species and variables, additional processes, etc) → implications for monitoring, modelling, service design → GMES catalyzes progress in that area significantly
 - Biological air pollution (allergenic pollen): Still does not get the attention it deserves → Aveiro Workshop Conclusions and COST Action ES0603 "Pollen"
- Outlook beyond COST ES0602
 - Much progress has been achieved, but still many open issues, questions and gaps to be addressed by follow-up Actions, projects and initiatives