THE EUROPEAN CHEMICAL WEATHER FORECASTING PORTAL OF COST ES0602

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Roberto San José∗1, Jaakko Kukkonen2, K. Karatzas3, Taru Balk2, Tassos Bassoukos3, Kjetil Torseth4, Aasmund Fahre Vik4, Thomas Klein5, Mikhail Sofiev2 and Juan L. Pérez1

1Environmental Software and Modelling Group, Computer Science School, Technical University of Madrid (UPM), Campus de Montegancedo, Boadilla del Monte, 28660 Madrid (Spain)
2Finnish Meteorological Institute, Erik Palmenin aukio 1, P.O.Box 503, FI-00101 Helsinki
3Aristotle University, Dept. of Mechanical Engineering, Box 483, GR-54124 Thessaloniki, Greece
4Norwegian Institute for Air Research (NILU), Dept. Atmospheric and Climate Research, P.O Box 100, N-2027
5Swedish Meteorological and Hydrological Institute, Folkborgsvägen 1, SE-601 76 Norrköping

∗ presenting author (roberto@fi.upm.es)
Coordinator:
Prof. Jaakko Kukkonen
Finnish Meteorological Institute

WP1 - Exchange of AQ forecasts and input data
WP2 - Multi-scale forecasting, multi-model ensemble, boundary data
WP3 - Dissemination and visualization
WP4 - Cross-cutting and integration

Environmental Software and Modelling Group http://artico.lma.fi.upm.es
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.

Non-COST institutions:
- EEA, WMO, Russia, U.S. EPA, Canada, etc.
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)

- **WPG. A cross-cutting activity**
  To coordinate with other organizations and ongoing activities
  Chair: Thomas Klein (in picture, Swedish Meteorological and Hydrological Institute)

- **Grant Holder** (to be nominated in 2009)
  Technical University of Madrid (UPM), Roberto San Jose (in picture)
The COST ES0602 team
Extensive participation, compared with most research projects.

The 19 countries participating in the COST ES0602 action (in blue). Red dots and stars = the venues of meetings (dots = past, stars = future). Russia is scheduled to be a permanent non-COST participant. Belgium has been accepted to be a member by the Action. Interested: Czech Republic.
A wide collaboration network established
Key organisations and contact persons

✓ **EEA**: Dr. Tim Haigh, Dr. Jaume Targa and Dr. Thomas Klein
✓ **U.S. EPA**: Dr. Phil Dickerson
✓ **GEMS, PROMOTE and MACC projects**: Dr. Vincent-Henri Peuch etc.
✓ **ACCENT and EMEP**: Dr. Kjetil Tørseth, Dr. Aasmund Fahre Vik, Dr. Hilde Fagerli.
✓ **COST 728**: Prof. Ranjeet Sokhi, Adj.Prof. Mikhail Sofiev, Prof. Alexander Baklanov
✓ **COST ES0203**: Adj.Prof. Mikhail Sofiev
✓ **The EUMETNET Working Group on ENVironment**: Dr. Thomas Klein
✓ **MEGAPOLI**: Prof. Alexander Baklanov
✓ **CityZen**: Dr. Michael Gauss
✓ **GURME (WMO GAW)**: Dr. Greg Carmichael, Dr. Liisa Jalkanen
GEMS = Global and regional Earth-system (Atmosphere) Monitoring using Satellite and in-situ data
PROMOTE = PROtocol MONiToring for the GMES Service Element: Atmosphere
MACC = Monitoring Atmospheric Composition and Climate

Ref. V.-H. Peuch, regarding PROMOTE, GEMS and MACC.
COST ES0602: towards a European network on chemical weather forecasting and information systems

J. Kulkonen\textsuperscript{1}, T. Klein\textsuperscript{2}, K. Karatzas\textsuperscript{3}, K. Torseth\textsuperscript{4}, A. Fahre Vilk\textsuperscript{4}, R. San José\textsuperscript{5}, T. Ball\textsuperscript{1}, and M. Sofiev\textsuperscript{1}

\textsuperscript{1}\textit{Finnish Meteorological Institute, Helsinki, Finland}
\textsuperscript{2}\textit{Swedish Meteorological and Hydrological Institute, Norrköping, Sweden}
\textsuperscript{3}\textit{Aristotle University, Thessaloniki, Greece}
\textsuperscript{4}\textit{Norwegian Institute for Air Research, Kjeller, Norway}
\textsuperscript{5}\textit{Computer Science School, Technical University of Madrid (UPM), Spain}

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Some potential combinations of models

- Operational emergency models
- Exposure and health effects models
- Stratospheric models
- Numerical weather prediction models
- Emission and air quality models
- Climate change models
- Satellite data retrieval models
- Ocean ecosystem models
- Economic models
- Transport and energy models
- Process models

Environmental Software and Modelling Group http://artico.lma.fi.upm.es
European chemical weather forecasting portal – aims and scope

- developed within the COST ES0602 action
- aims: improved usage of chemical weather forecasting information; provide an easy interface to a wide variety of web-based air quality forecasting systems in Europe
- can be used, e.g., to find out, which services are available for a specific domain, for specific source categories or for specific pollutants
- functions for obtaining relevant supplementary information
- one can inter-compare the various available forecasting systems
- such a single point of reference for the European chemical weather forecasting information has not previously been in operation.
http://www.chemicalweather.eu/

Domains

You are welcome to add your own forecasting service.

An access to about 20 chemical weather forecasting systems and their numerical forecasts; these cover more than 30 regions in Europe.
European chemical weather forecasting portal (ECWFP) - How will I get started?

- Select any point on the map -> a list of the AQ modelling systems that cover that location.
- Select one of these systems -> the domain, the group, the name of the model, a description of the service, link to specific info at the EEA Model Documentation Center, etc.
- A new feature (to be added soon): how to easily merge and inter-compare AQ maps.

A screenshot of the portal

http://www.chemicalweather.eu/ Domains
Main properties of the chemical weather services included

- European and regional scales, one global system
- One model in many cases contains several domains
- Mainly anthropogenic pollutants included
GEMS - Global and regional Earth-system Monitoring using Satellite and in-situ data: European air quality forecasting ensemble, including 10 models

+ Clearly largest operational forecasting ensemble up to date, for main gaseous and PM pollutants

+ A concerted effort with a better overall reliability and versatility

- Challenges: mass closure of PM, non-anthropogenic PM; structure and treatments of models are variable (e.g. data assimilation, evaluation)

Example forecasts using 10 models (including SILAM), and ensemble forecast
Air Quality Services in PROMOTE

- **Products**
  - Global and European Air Quality records
  - European-scale Air Quality analyses and forecasts (daily)
  - Local/urban-scale Air Quality forecasts and assessments
  - Desert dust awareness (regional)
  - **Pollen (regional ➔ European)**
  - Satellite-based ground-level PM (regional and European)
  - Regional Air Quality Scenario Tool

- **User applications**
  - Monitoring of levels and changes in global pollutants
  - Assessments of European and national air quality
  - Minimization of health impacts to European citizens, especially those with heart or respiratory diseases
Other European chemical weather forecasting portals, GEMS and PROMOTE

- ECWFP is complementary, compared with those of similar www-based services provided by the GEMS and PROMOTE projects. These projects have a closed membership.
- We hope to involve various stake-holders in a more comprehensive way.
- The ECWFP is currently mainly focused on CWF systems on regional and continental scales in Europe.

<table>
<thead>
<tr>
<th>Portal</th>
<th>Number of CWF systems included</th>
<th>Physical scales included</th>
<th>Accessibility of services included</th>
<th>Harmonisation of services included</th>
<th>Additional features and services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Global</td>
<td>European</td>
<td>Regional</td>
<td>Urban</td>
</tr>
<tr>
<td>GEMS</td>
<td>12</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROMOTE</td>
<td>12</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ECWFP systems</td>
<td>19</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The ECWFP - Future perspectives

The ECWFP could easily be extended:

- to include more detailed meta-information concerning the CWF models and the available forecasts
- to include more functionalities, e.g., for easily inter-comparing the forecasts
- include a substantially larger amount of CFW systems on urban and global scales
- to be extended for other continents
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, 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 Kioutsoukis, Marina Astitha, Kari Lehtinen, George Kallos (22 authors)
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
Inter-comparison of selected properties of the mathematical structure of a few selected European chemical weather forecasting models on regional and continental scales.

<table>
<thead>
<tr>
<th>Model Type</th>
<th>Meteorology</th>
<th>Advection &amp; Convection</th>
<th>Turbulence</th>
<th>Deposition</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM5-CHIMERE</td>
<td>CHIMERE (C): MM5 (M)</td>
<td>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.</td>
<td>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.</td>
<td>M: Nonconvective precipitation scheme, warm rain, simple ice, mixed-phase, Goddard microphysics, Reinsner graupel, Schultz microphysics. C: Dry: deposition velocity through a resistance analogy. Wet: based on Loosmore.</td>
<td>C: Over 300 reactions of 80 gaseous species. Hydrocarbon degradation is similar to the EMEP gas phase. Adaptations are made for low NOx conditions and NOx-nitrate chemistry. Heterogeneous formation of HONO from deposition of NO2 on wet surfaces.</td>
</tr>
</tbody>
</table>
Workshop on “Chemical weather information services for quality of life”, was organised in 2008

- The purpose of the workshop was to discuss existing Chemical Weather Forecasting and Information Systems. The focus was on the dissemination and the wider use of such forecasting information.
- Presentations by invited experts from 3 EU countries, the EEA and the EPA, on the regional and national solutions and services on the chemical weather forecasts, via web portals, mobile devices, etc.
- Includes a review, guidelines and recommendations for dissemination and visualization of atmospheric information data.

http://www.chemicalweather.eu/Materia
# An overview of near-real time air quality data

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

Ref. A.F. Vik, NILU, COST ES0602
Some challenges on modelling chemical weather and disseminating the services

- Availability of near-real-time concentration data
- Mass closure for PM; commonly PM10 and PM2.5 are under-predicted; secondary organic aerosols poorly predicted
- Modelling non-anthropogenic sources, e.g., forest fires, allergenic pollen, biogenic compounds, sea salt, desert dust
- Use of satellite data, data assimilation, combined use of various satellite information sources
- Use of computational intelligence for knowledge extraction and parameter forecasting.
- Ensemble modelling
- Scientific model evaluation and quality assurance
- Integrated modelling from emissions to health effects
- Quality of life information services: improvement of web portals
Future perspectives for COST ES0602

- Promising activities in progress, e.g., European AQ forecasting portal, review of chemical weather models
- Writing of numerous joint articles, finalised and in progress
- Special journal article based on AQ Conference 2009
- Workshops: Thessaloniki, Budapest and Aveiro
- Special focus in the future on the QC/QA and the synthesis of the state-of-the-art, and research recommendations