Welcome to the 9th issue of the Newsletter

Editorial

The MEGAPOLI consortium is pleased to present the 9th issue of the MEGAPOLI Newsletter. Short contributions from Partners and Collaborators, as well as Research Teams introductions are given here. Details on the project progress can be found in public documents available at the project website (www.megapoli.info). The purpose of the newsletters is to inform about activities, progress, and achievements of the MEGAPOLI project as well as to establish a dynamic communication link with the Partners, Collaborators, and Users Community, to monitor the project activities and to exchange input and experiences. For these reasons your contributions to newsletters and news at the web-site as well as comments are always welcome (send to news.megapoli@dmi.dk).

Latest News

- Coming soon – special MEGAPOLI, CityZen, MILAGRO session "Megacities: Air Quality and Climate Impacts from Local to Global Scales" at the European Geosciences Union (EGU-2011) General Assembly, Vienna, Austria; 3-8 Apr 2011
- Coming soon – 6th MEGAPOLI WP Leaders telephone conference (mid-Jan 2011)
- Coming soon – Merry Christmas and Happy New Year 2011
- 1-2 Nov 2010 – 2nd Annual MEGAPOLI Meeting (UHam; Hamburg, Germany)
- Oct 2010 – access /sign agreement/ to MEGAPOLI database on Paris campaigns
- Sep-Nov 2010 – 2nd year reporting on WPs progress, milestones and deliverables (sci. reports) and Annual Dissemination Report of the MEGAPOLI project

MEGAPOLI 2nd Annual Meeting (1-2 Nov 2010)

See details on the next pages
The FP7 EC MEGAPOLI project has passed into the 3rd year and it is time to make summary overview on realisation of project tasks and scientific achievements during the 2nd year. As reported in the 7th Newsletter the project successfully passed the Mid-Term Assessment (the results were discussed at the 2nd MEGAPOLI annual meeting in Hamburg, Germany). Here, only a very short statement of the MEGAPOLI results achieved during the 2nd year is presented.

MEGAPOLI is contributing to the strategic goal of promoting sustainable management of the environment and its resources by advancing our knowledge on the interactions between air quality, climate and human activities related to large urban centres and hotspots. The main MEGAPOLI objectives are:

(i) to assess impacts of megacities and large air-pollution “hot-spots” on local, regional, and global air quality and climate;

(ii) to quantify feedbacks between megacity emissions, air quality, and local, regional and global climate;

(iii) to develop and implement improved, integrated tools to assess the impacts of air pollution from megacities on regional and global air quality and climate and to evaluate the effectiveness of mitigation options.

The main scientific results achieved during the 2nd year of the project include the following:

1. Intensive winter (15 Jan – 15 Feb 2010) measurement campaign was successfully completed in the Paris metropolitan area. The campaign aimed at better quantifying primary and secondary organic aerosol (SOA) sources for a European megacity. Measurements were performed at primary and secondary fixed ground sites, an aircraft and mobile vans. During the winter measurements, large PM levels were observed due to both a strong local wood burning and continental advection. Database has been setup at CNRS-LISA website with login & password access. The Paris measurement campaign database was prepared including measurement results from the summer 2009 and partly from the winter 2010 campaigns.

2. Prototype inventories for anthropogenic (base year of 2005, 6 km resolution) and natural (e.g., fire, sea salt) emissions were compiled. For the 1st level megacities (Paris, London, Rhine-Ruhr area, Po Valley) high-resolution emission datasets were prepared and integrated into the final European scale emission map. An anthropogenic heat flux (AHF) model (0.25 x 0.25 arc-minute resolution) was developed and used to compute the AHF inventories for Europe and London.

3. A morphology database for Paris has been developed, along with a hierarchy of urban canopy and energy budget parameterisations for different scale models, which are being used to evaluate the surface flux balance modelling and urban features needed for climate and air quality models.

4. New physical and chemical parameterisations and zooming approaches have been implemented and are being tested for several megacities (e.g. Paris, Mexico City, and Po Valley), providing information about the relative importance of the various parameterisations when examining megacity air quality and especially its relation to meteorology. Coupled ACT-NWP models with two-way feedbacks were used to classify meteorological patterns favouring development of urban air pollution episodes in European megacities as well as to study effects of megacity emissions on meteorological processes. Urban aerosols were found to significantly affect several meteorological variables (temperature, inversion layers, radiation budget, cloud processes, precipitation, fog, etc.) in and far from the megacities due to the direct and indirect effects.

5. Substantial progress was made in developing and evaluating the satellite-based methods for the measurement of tropospheric gases and aerosols, especially NO2, in and around megacities. For construction of a regional model ensemble the harmonization of European domain parameters, input data and other modelling details was realized.

6. The radiative forcing from megacity emissions on the global scale was examined. Generally, megacities contribute about 2% to 5% of the total global annual anthropogenic emission fluxes for various compounds.

7. Progress has been made on producing a European framework for online and offline coupling of meteorological and atmospheric chemical transport models.

After Mid-Term Assessment the achieved results have been reported in a series of scientific reports, Newsletters and in a number of journal publications (see more at http://megapoli.info).

References
Day 1 - 1 Nov 2010

09:00–09:25
Heinke Schluenzen, UHam
“Welcome: KlimaCampus, University of Hamburg & Center for Climate Research”

09:25–09:50
Alexander Baklanov, DMI
“MEGAPOLI: General Outlook and Mid-Term reporting results”

09:50–11:10
**WP1: Emissions**

- Hugo Denier van der Gon, TNO
  MEGAPOLI WP1 Emissions: Progress in Year 2, Deliverables
- Jochen Theloke, IER/USTUTT
  The baseline scenario results, Del 1.3
- Thomas Loridan, KCL
  Anthropogenic heat flux inventory: the LUCY model
- Thomas Wagner, MPIC
  Determination of Megacity Emissions from Satellite and Car MAX-DOAS observations

11:30–12:20
**WP2: Megacity Environments: Features, Processes and Effects**

- Igor Esau, NERSC
  “Megacity Features & Urbanized turbulence-resolving model of Paris & Improved urban parameterizations based on prognostic equations, utilizing LES results”
- Antti Helsten, FMI
  “Morphology database for a target megacity”
- Thomas Loridan, KCL
  “The International Urban Energy Balance Models Comparison Project: overview of Phase 1 and 2”
- Alexander Mahura, DMI
  “Hierarchy of Urban Canopy Parameterisations for Different Scale Models”
- Stefano Galmarini, JRC
  “Stochastic fields method for sub-grid scale emission heterogeneity in mesoscale atmospheric dispersion models”

12:20–13:00
**WP3: Megacity Plume Case Study**

- Andre Prevot, PSI
  “The Paris MEGAPOLI campaign to better quantify organic aerosol formation in a large agglomeration: Results of the winter campaign”
- Matthias Beekmann, CNRS-LISA
  “WP3 general overview”

13:00–14:00
Lunch
Location: ZMAW, seminar room 022/23, Gr. Floor

14:00–14:30
**WP4: Megacity Air Quality**

- Nicolas Moussiopoulos, AUTH
  “Megacity air quality: progress report and current status”
- Alexander Baklanov, DMI
  “Interactions between Air Quality and Meteorology/Climate Aerosol Feedbacks”
- Jaakko Kukkonen, FMI
  “Exposure maps for selected megacities”

14:45–15:15
**WP5: Regional and Global Atmospheric Composition**

- Jaakko Kukkonen, FMI
  “Regional atmospheric composition: progress report and current status”
- Andreas Stohl, NILU
  “Global atmospheric composition: boundary conditions, global dispersion characteristics, annihilation scenario”
- Steve Rumbold, UKMetO
  “Megacities impact on global composition”

15:20–15:55
**WP6: Regional and Global Climate Effects**

- Bill Collins, UK MetO
  “Climate impacts of megacities - global”
- Steve Rumbold, UK MetO
  “Comparison of coupled and uncoupled models”
- Fabien Salmon, ICTP
  “Regional climate modeling effects”
- Tomas Halenka, CUNI
  “Urban impact on air quality in REGCM/CAMx couple for MEGAPOLI Climate Change Study in High Resolution”

16:20–16:45
**WP7: Integrated Tools and Implementation**

- Heinke Schluenzen, UHam
  “Integrated Tools and Implementation: progress report and current status”
16:45–17:25
**WP8: Mitigation, Policy Options and Impact Assessment**
- Jochen Theloke, USTUTT –
  "Mitigation, Policy Options and Impact Assessment: progress report and current status"
- Rainer Friedrich, USTUTT –
  "Integrated assessment of policies"

17:25–17:35
**WP9: Dissemination and Coordination**
- Alexander Baklanov, DMI –
  "Reporting on WP9 tasks, mils, dels, dissemination and coordination"

17:35–18:15
**Overview of Megacities in Focus**
- Sandro Finardi, ARIANET –
  "Status of Po Valley Activities & Italian emission scenarios at national and sub-national scale"
- Melinda Uzbasich, USTUTT –
  "The Rhine – Ruhr region"
- Xavier Francis, UH-CAIR –
  "Effect of Megacities on Air Quality and Climate – London and Paris"

18:15–18:45
**MEGAPOLI Steering Group Meeting**
- lead by Alexander Baklanov, DMI -

Day 2 – 2 Nov 2010
*Location: ZMAW, seminar room 022/23, Gr. Floor*

09:00-09:15
Morning gathering and announcement of parallel sessions
ZMAW, seminar room 022/23 & 101, Geomatikum 1729

09:15–10:45
**Parallel/Specific WPs Meetings and Discussions**
(lead by WP leaders)

Meeting of WP5: Regional and global atmospheric composition
- lead by Mikhail Sofiev, FMI -
  MEGAPOLI European Ensemble (status, expected results, outcome)

Meeting of WP7: Integrated Tools and Implementation
- lead by Heinke Schluenzen, UHam -
  Synthesis of outcomes of WPs, Integration framework, Evaluation of integrated methods, Implementation of integrated tools to megacities, Recommendations on sci. analysis of megacity impacts

Meeting of WP8: Mitigation, Policy Options and Impact Assessment
- lead by Rainer Friedrich, USTUTT -
  Tasks to do / Questions - overview

10:45-11:15
**Coffee break**

11:15–12:30
**Discussions in Thematic Groups on Different Scale Studies**

Global Group
- lead by Mark Lawrence, MPIC -
  Emissions, Simulations, Impact on Climate, Publications

Regional Group
- lead by Spyros Pandis, FORTH & Mikhail Sofiev, FMI -
  Regional modeling specifics (scientific questions; comparison with observations: representativeness issue; communication with WP7)

Local Group
- lead by Alexander Baklanov, DMI/ Nicolas Moussiopoulos, AUTH -
  Megacity Scales Study: questions to answer from the 1st year meeting, and questions for the 2nd year meeting; Calculation of the urban increment

*Location: ZMAW, seminar room 022/23, Gr. Floor*

12.30–13.15
**Summary Presentations from each group & linkage between groups**

- Mikhail Sofiev, FMI -
  Groups: WP5 & Regional Modelling
- Heinke Schluenzen, UHam -
  Group: WP7: Integrated Tools and Implementation
- Rainer Friedrich, USTUTT –
  Group: WP8: Mitigation, Policy Options and Impact Assessment
- Mark Lawrence, MPIC –
  Group: Global Modelling
- Alexander Baklanov, DMI –
  Group: Local Modelling – Megacity scales study
- Nicolas Moussiopoulos, AUTH –
  Group: Local Modelling – Calculation of urban increment

13:15-14:15
**Lunch**

14:30–15.15
**MEGAPOLI Third Year Plans: Overview and Discussions**
- lead by Mark Lawrence, MPIC -
  Deliverables by main topics (Emissions; Campaign Data & Analysis; Modelling – Urban, Regional, Global; Integration; Mitigation)

15:15–15:45
**Collaborative Projects / External partners presentations**
- Bob Bornstein, San Jose State University, USA -
  MEGAPOLI & my research on observation & simulation of polluted coastal urban PBLs in a changing change
- Liisa Jalkanen, WMO, Switzerland -
  GURME connections: WMO GAW Urban Research Meteorology and Environment project

16:20–16:30
- Alexander Mahura, DMI -
  Items/ topics of the 2nd year MEGAPOLI reporting (deliverables, milestones, dissemination reporting)

16:30–16:45
- Alexander Baklanov, DMI -
  Publications: planned/written articles, special issues, meetings, etc.

16:45–16:50
- Heinke Schluenzen, UHam -
  Conclusions/ summary of the 2nd MEGAPOLI meeting; End
MEGAPOLI workpackage 1 (lead by TNO) provides emission data for various modelling WPs of the project. A previous article in newsletter by van der Gon et al., (2009) describes the activities in WP1 for the regional (European) emissions. In this newsletter the focus is on the global emissions used by the modellers in MEGAPOLI. A short deliverable report describing the global emission data was prepared and it is available from the MEGAPOLI website (van der Gon et al., 2010).

**Global Emissions**

WP1 focuses on emission inventories at local, regional and global scale. Emission inventories are created, using where possible currently available state-of-the-art emission inventories at local, regional and global level. At the global level, the initial plans were to use the EDGAR v4.0 emission dataset, which should provide global emissions at 0.1x0.1° (longitude x latitude). However, the release of this dataset was delayed and not available in time for MEGAPOLI. A good alternative is the gridded emission dataset developed in support of the IPCC Fifth Assessment Report (ARS) by Lamarque et al. (2010). The resolution of this dataset is 0.5°x0.5°. The most recent year is 2000. However, the IPCC Representative Concentration Pathways (RCPs) provide emission projections for future years. In MEGAPOLI the RCP8.5 scenario (Riahi et al. 2007) was selected to derive global emissions for 2005. Fig. 1 shows an example of the emission map for year 2005.

**Emissions from Megacities**

In total 36 megacities (MC) were identified in the global emission dataset using the 1x1° MC emission mask by Butler et al. (2008). Emissions from these megacities were extracted and combined with population data to derive MC emissions per capita. A weighted average of the emissions per capita from the megacities in each continent shows significant differences between continents (Fig. 2). The high emissions per capita in Oceania are related to Sydney, Australia (the only megacity on this continent) and suggest that emissions in this city are relatively high. However, this conclusion may be preliminary since the allocation of emissions from the global dataset may lead to a bias, or the spatial distribution of emissions may allocate too big share of the Australian emissions in Sydney.

Emissions of CO, NMVOC and SO₂ are higher for Asia and Africa compared to other continents, reflecting the use of older technologies and less clean fuels. In European megacities the NH₃ emission per capita is remarkable, but it is likely to be explained by the inclusion of non-urban areas in the MC domain (Rhine-Ruhr area and Po Valley), especially the latter has substantial animal husbandry.

**Acknowledgements**

We thank to Lamarque et al. (2010) and Riahi et al. (2007) for the possibility to use their data in the MEGAPOLI project.

**References**


MEGAPOLI Database of Chemical Composition, Size Distribution and Optical Parameters of Urban and Suburban PM and its Temporal Variability on Regional Scale PM Levels (MEGAPOLI Dels 3.1 & 3.4)

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M. Beekmann1, U. Baltensperger2, Catherine Schmechtig1, and the MEGAPOLI campaign team

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This contribution describes two MEGAPOLI Deliverables accomplished by autumn 2010, which presents the description of the measurements set-up performed during the MEGAPOLI Paris campaigns and the set-up of a local database at the CNRS-LISA website for their storage and distribution. Del. 3.1 deals with measurements at fixed locations/sites; Del. 3.4 - with measurements performed on mobile platforms (i.e. vans and aircraft).

Two intensive measurement campaigns were performed in the Ile-de-France region during a one-month summer and a one-month winter period (July 1 – 31, 2009 and January 15 to February 15, 2010, respectively). The campaigns aimed at better quantifying primary and secondary organic aerosol sources for the example of a big European Megacity (the Paris region) according to the MEGAPOLI WP3 core objectives. The campaign design included 3 primary and 7 secondary fixed region) according to the MEGAPOLI WP3 core objectives. The organisation of the campaign database at the CNRS–LISA is described. In this database, measurement data are now available to FP7 project partners and to campaign participants (listed in Appendix 1 of the Deliverable), after signature of a data exchange protocol which can be downloaded at http://megapoli.lisa.univ-paris12.fr/DATA/data.php.

For other groups, data can be available upon a request. The campaign database for the Paris MEGAPOLI campaign has been set-up by Catherine Schmechtig, research engineer at CNRS-LISA. It is accessible via the CNRS-LISA MEGAPOLI website (http://megapoli.lisa.univ-paris12.fr), which also gives general information about the campaign and is linked with the general public MEGAPOLI project website. The database is file oriented, which means that files are stored and can be downloaded as they come in, with the exception of a format control. The common campaign data base format is NASA / Ames for 1D data (time series). This format is in common use also for other campaign databases (for example, for the FP6 EUCAARI project). Lidar data will be distributed as netCDF or HDF format.

The data base can be accessed at: http://megapoli.lisa.univ-paris12.fr

Data and Measurements To DATABASE

To enter the site, a username and a password are required. These are provided by the database administrator Catherine Schmechtig (1), research engineer at CNRS-LISA, after signature of the data protocol, which should be sent to her. The data base is organised in the following way. An entry page shows the different fixed primary and secondary sites, and gives access to mobile sites. From this page, sub-pages for the different sites can be reached. On each site page, a list of the performed measurements is displayed. A different list of data files is then available for the summer and winter period on a click.

The database coverage for contractual data is good for the summer campaign (about 90%), but slightly less for the winter campaign (about 80 %), for which time for data reduction was less. Also non-contractual data have already been submitted by many groups.

At a later stage, in the middle of year 2011, data will be transferred from the local CNRS-LISA to the CNRS / CNES topical center Ether data base (http://ether.ipl.jussieu.fr) for longer term storage and distribution. This data base will be active also after the formal end of the FP7 project.

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Figure: Entry page of the CNRS-LISA campaign data base


SAFIRE Piper Aztec Flights – The Other Successful Campaign

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During MEGAPOLI Winter (January-February 2010) measurement campaign the SAFIRE Piper Aztec airplane performed successful scientific flights. The field team of SAFIRE included 4 persons: Philippe Pohar (pilot), Remi Caillou and Marc Laurens (experimenters), and Pierre Vitupier (mechanic).

Each flight was following the same scenario:
(i) Round around Paris to study the initial conditions in all directions; (ii) Legs moving away from Paris and in the downwind area to study the evolution of the pollution plume.

The labs who operated the aircraft instrumentation were: CNRM (Toulouse, F; PI: L. Gomes), LaMP (Clermont-Ferrand, F; PI: A. Schwarzenboeck), and LISA (Creteil, F; PI: A. Borbon).

SAFIRE Team for Paris Winter 2010 Campaign

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Satellite observations of aerosol optical depth (AOD) are used to estimate the contribution of emissions from European Megacities to the regional aerosol load. In this study data from the Advanced Along Track Scanning Radiometer (AATSR), flying on the ENVironmental SATellite (ENVISAT), are used together with AERONET Sun photometer level 2.0 data for validation.

**Instrument**

The AATSR is designed for monitoring land and sea surface temperatures. The special feature of the AATSR instrument is that it provides measurements at two viewing angles, at 55° forward and about two minutes later at nadir. The spatial resolution is approximately 1x1 km² at nadir and its swath width is 512 km. The AATSR instrument has seven wavelengths in the visible and infrared regions, centred at 555, 659, 865, 1610, 3700, 11000, and 12000 nm. AATSR reaches global coverage in about five days, while at mid-latitudes the return time is about three days.

**Method**

The radiance measured by AATSR at the top of the atmosphere is due to reflectances by the surface, clouds, gases and aerosols. For cloud-free pixels the path radiance has to be separated from the surface contribution. This is accomplished with the AATSR Dual View Algorithm (ADV) which uses the two AATSR views for retrievals over land. The path radiance is retained and compared with radiative transfer model results, at three wavelengths, to determine the spectral AOD. ADV results are validated by comparison with ground-based measurements from the AERONET network. The retrieved parameters include the AOD at three different wavelengths (555, 659, and 1610 nm) and the Ångström coefficient which describes the AOD wavelength dependence. The aerosol mixing ratio can optionally be made available.

**Results**

To retrieve the AATSR data over Europe a combination of a non-absorbing model for coarse particles (geometric radius 0.51 μm) and an absorbing model for fine particles (geometric radius 0.11 μm) was used. Figures 1 and 2 show the AOD at 555nm and the Ångström Exponent (555-675) (AE), respectively, aggregated from all retrievals in 2009 over NW Europe. Aggregates are shown rather than averages because AATSR overpasses this region every third day and aerosol retrieval is only possible in clear sky. The aggregate AOD over London for 2009 was 0.28±0.14 and over Paris 0.24±0.25. The large standard deviation in Paris is due to alternate periods with clean and polluted air associated with circulation patterns.

During clean air episodes the AOD is clearly enhanced with respect to its surroundings as opposed to episodes with more polluted air when cities can less clearly be identified from the AOD pattern. The AE re-enforces this conclusion because high values are associated with the occurrence of fine particles. It is noted that the high AOD over the North Sea is an artefact due to the occurrence of sediment in the water which is not properly accounted for in the AATSR aerosol retrieval algorithm.

**Conclusions**

Satellites provide aerosol properties over larger areas. From the regional distribution sources can be identified in the aggregates provided that they are strong enough to locally enhance the column aerosol concentrations and thus the AOD.

**References**

Processing of Land-Use Database for Meso-Scale Model Urbanization

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General Approach

This study is devoted to elaboration of general methodology for adjustment of original land-use dataset (CORINE Land Cover 2000; CORINE, 2000) for urban scale modelling in numerical weather prediction (NWP) and environmental applications. Three metropolitan areas – Paris (France), Copenhagen (Denmark), and Bilbao (Spain) – of different spatial sizes and population were considered. The CORINE and Basque Government land use (UDALPLAN, 2009) databases of different details and resolutions were selected. Several approaches were suggested for treatment of selected databases to allow their use as Geographical Information System (GIS) tools, depending on the data available in each case. It is applied to an operational online coupled numerical weather prediction and atmospheric chemical transport modelling system Enviro-HIRLAM (Environment-High Resolution Limited Area Model; Baklanov et al. 2008; Korsholm, et al., 2009). The interaction Soil-Biosphere-Atmosphere (ISBA) land surface scheme was modified to include urban effects using the Building Effect Parameterization (BEP, Martilli et al., 2002) module and Anthropogenic Heat Fluxes (AHF) extracted from LUCY model (which considers energy fluxes from traffic, metabolism and energy consumption, Allen et al., 2010). The methodology is based on the extraction of the modelling domain from the Enviro-HIRLAM climate files. By processing the grid in GIS environment it was possible to convert the irregular grid points into regular polygons. Then, they were integrated with the regional/European database and finally, performed the urban classification into different types of districts over the domain (Table 1).

High resolution short-term runs (2.4 km) for specific dates (summer 2009 and winter 2010) with variable wind conditions were performed for the Bilbao metropolitan area, based on different urban scenarios generated by means of this approach. Several scenarios were generated with AHF= 40 W/m² modifying the size of the city: firstly, the area considered in CORINE 2000 (16 urban grids); then the double size city expansion (30 urban grids) and the triple size city expansion (48 urban grids). Other scenario considers an increased of AHF in double (80 W/m²) with the original size of the city (16 urban grids). The last scenario combined the triple size city expansion (48 urban grids) plus the increased AHF in double (80 W/m²). The goal was to evaluate the urbanized with (BEP module and AHF) Enviro-HIRLAM and to estimate the influence of the city on formation of the air temperature at 2 m and wind velocity at 10 m. Three nested domains were selected with spatial grid resolution of 15, 5 and 2.4 km which contain 181x148, 130x136 and 70x70 cells, respectively. There were performed two simulations for each urban scenario: 1) control runs, without any modifications and 2) urban runs including BEP+AHF within the corresponding modification for scenarios.

Table 1: Information of the climate files extracted from Enviro-HIRLAM to be processed in GIS tools for the three cities studied.

<table>
<thead>
<tr>
<th>Metropolitan area</th>
<th>Res. (km)</th>
<th>Total grid points</th>
<th>Urban grid points</th>
<th>Metrop. grids</th>
<th>Area Covered (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilbao</td>
<td>2.4x2.4</td>
<td>14834</td>
<td>68</td>
<td>16</td>
<td>92.16</td>
</tr>
<tr>
<td>Paris</td>
<td>2.5x2.5</td>
<td>10148</td>
<td>580</td>
<td>220</td>
<td>1267.2</td>
</tr>
<tr>
<td>Copenhagen</td>
<td>1.4x1.4</td>
<td>65022</td>
<td>3080</td>
<td>500</td>
<td>980</td>
</tr>
</tbody>
</table>

As it was found, for the urban area considered with 16 urban cells and AHF=40 W/m², on average, for air temperature at 2 m the difference was 1.3 °C between 3-6 UTC (with a maximum of 1.9 °C at 6 UTC) (Fig. 2a). For wind velocity at 10 m the difference was 1 m/s between 3-6 UTC (with a maximum of 1.5 m/s at 6 UTC). However, for the scenario combining triple size city expansion and double increased in AHF, on average, for temperature at 2 m the difference was 1.8 °C between 3-6 UTC (with a maximum of 3.1 °C at 6 UTC) (Fig. 2b). For wind at 10 m the difference was 1.9 m/s between 3-6 UTC (with a maximum of 2.9 m/s at 6 UTC).

Acknowledgements

Thanks to Dr. M. Mendizabal for the constructive discussions related to GIS processing.

References

Multi-Scale Air Quality Forecast: Downscaling from Regional to Street Scale

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Due to increasing supercomputer power modern nested numerical meteorological and air pollution models realise model nesting/down-scaling from the global to the local scale and approach the necessary horizontal and vertical resolutions to provide weather and air quality forecasts for urban and local scales. Most of urban simulations for real conditions consider only a small part of the urban area in a micro-meteorological model and urban heterogeneities outside the simulation domain affect the micro-scale processes. Therefore, it is important to build a chain of models of different scales with nesting of high resolution models into larger scale lower resolution models.

Figure 1. Urban-Street downscaling system for Copenhagen, DK.

Usually, the up-scaled city-scale (sub-meso) or meso-scale models consider parameterisations of urban effects or statistical descriptions of the urban building geometry, whereas the micro-scale (street canyon) models are obstacle-resolved and consider a detailed geometry of the buildings and the urban canopy. The first element in the downscaling chain is ensemble forecast from regional/meso-scale models as input for DMI’s downscaling system (Fig. 1).

Figure 2. Micro-scale Model run for Urban Environment (M2UE) downscaling for the selected Copenhagen area (Jagtvej street; top – figure extracted from http://sketchup.google.com); Results (bottom) of the M2UE model run for: grid cells number: 107 x 162 x 38, domain size: 280 x 400 x 60 m, maximum inflow speed - 5.5 m/s)

Boundary and initial conditions for the nested M2UE model are used from the Enviro-HIRLAM model with corresponding interpolation (like Radial Basis Function or bilinear techniques).

In some cases, when it is switch from the roughness to the obstacle-resolved approach in the nested model (Fig. 2), the interpolation procedure can be difficult for meteor/chemical fields between buildings and will lead an increase of the computation time due to necessary additional iterations. In such cases, as a possible alternative, the perturbation approach can be recommended, where the main meteorological variables (or chemical species) are considered as a sum of two components: background (large-scale) values, described by the coarse-resolution model, and perturbations due to micro-scale features, described by the nested fine resolution model.

References

After that two nested domains are used for downscaling from the regional- to meso- and city-scale using Enviro-HIRLAM (Environment - HigRes Solution Limited Area Model, Korsholm et al., 2008). Several levels of urban parameterisation are used in the chain depending on considered scales (Baklanov and Nuterman, 2009): for regional scale urban parameterisation is based on the roughness and flux corrections approach; for urban-scale on the Building Effects Parameterisation (Martilli et al., 2002). For local- and micro-scale nesting the Micro-scale Model for Urban Environment (M2UE) is used. This is a comprehensive CFD-type obstacle-resolved urban wind-flow and dispersion model (based on the Reynolds averaged Navier-Stokes approach and different two-equation turbulence closures, Nuterman et al., 2008).
The Russian MEGAPOLIS project aims to develop integrated technologies of megacities air-pollution assessment based on results of remote sensing and in-situ monitoring for mitigation option. The project is funded in the scope of the Federal Framework Program of Ministry of Education and Science of Russian Federation. The MEGAPOLIS project is a partnership project with the European FP7 MEGAPOLI project (http://megapoli.info).

Head organization of the MEGAPOLIS project is “AEROCOSMOS” Scientific Centre of Aerospace Monitoring. The project is carried out together with a group of scientific organizations representing:
(i) the Faculty of Geography, Lomonosov Moscow State University;
(ii) the Institute of Atmospheric Physics, Russian Academy of Sciences;
(iii) Hydrometeorological Centre of Russia (Federal Service for Hydrometeorology and Environmental Monitoring).

MEGAPOLIS project runs for more than a year now. The following results have been achieved during that time:

- Ground and remote sensing data for the Moscow area were collected and analyzed; these included meteorological (temperature, humidity, pressure) and chemical (concentration of ground-level ozone, nitrogen oxide, nitrogen dioxide, sulfur dioxide, carbon monoxide, total hydrocarbons, PM10) data. Statistical analysis of concentration of chemical species distribution over the Moscow area showed that concentrations of some pollutants depend on a distance from pollution sources.

- Studies of snow cover properties in the eastern district of Moscow have allowed getting an objective picture of its pollution, reflecting the atmospheric pollution during the winter season.

- Atmospheric boundary layer and urban surface properties were investigated using ground-based and remote data for episodes of extreme events (such as -30 degrees of frost in the winter of 2010 and the strong heat in the summer of 2010). Results of the data processing confirmed the importance of meteorological conditions and the properties of the underlying surface in the assessment of air pollution in megacity like Moscow, especially in periods of extreme weather conditions.

- Estimates of carbon monoxide (CO) emissions caused by extreme forest fires during the summer of 2010 were made for the European part of Russia and the Moscow region on the basis of remote sensing data (Figures 1-2).

- Advanced approach for megacity air pollution assessment has been developed on the base of Russian and international experience, taking into account the diversity of sources of pollution, specifics of different cities of Russia, and having the potential to improve through the sharing of ground and remote sensing data. Algorithm of calculation of complex air pollution index will allow specifying the representative time range of baseline data and a minimal set of measured components.

- Methodological support of integrated technologies for simulating meteorological and pollution phenomena in the atmosphere of large cities and metropolitan areas was developed on the base of different scale atmospheric models (global spectral model of the Hydrometeorological Center of Russia, the regional model RAMS and the COSMO-RU).

- Preliminary design and technical plan of integrated technologies, and also some software modulus have been elaborated.

Gained experience and results of the European partnership project MEGAPOLI have been taken into account in the MEGAPOLIS research. For instance, the approach to morphological database development for Moscow, assessing the megacity impact using the satellite data, etc. was considered.

The achieved results have been already reported in 4 scientific reports and in a number of journal publications.

References
Coming and Recent Presentations and Publications

Dear colleagues, please, pay your attention to presentations and publications related to the MEGAPOLI Project:

- Baklanov A. and the MEGAPOLI Team (2010): MEGAPOLI: concept of multi-scale modeling of megacity impact on air quality and climate. Advances in Science and Research, 4, 115-120; doi:10.5194/asr-4-115-2010


- Oral presentations given at the 2nd Annual MEGAPOLI Meeting (1-2 Nov 2010; Hamburg, Germany) (2010) – available at the MEGAPOLI project internal website (http://megapoliforum.dmi.dk)


- See more MEGAPOLI Publications/ Presentations at http://megapoli.info

Coming Conferences

Dear colleagues, please, pay your attention to conferences you might be interested to attend and/or present MEGAPOLI Project results and findings:

- American Meteorological Society (AMS-2011) Annual Meeting
  Seattle, Washington, USA, 23–27 Jan 2011
  http://www.ametsoc.org/meet/annual

- European Geosciences Union (EGU-2011) General Assembly
  Vienna, Austria, 3-8 Apr 2011
  (special MEGAPOLI, CityZen, MILAGRO session)
  http://meetings.copernicus.org/egu2011

- Urban Air Quality and Climate Change Workshop (UAQCC)
  Hamburg, Germany, 16-18 Aug 2011
  contact: Heinke Schluenzen, UHam (heinke.schluenzen@zmaw.de)

- European Meteorological Society (EMS-2011) Annual Meeting
  Berlin, Germany, 12–16 Sep 2011

- 3rd Annual MEGAPOLI Project Meeting/ Workshop
  Paris, France, 26-28 Sep 2011
  contact: Matthias Beekmann, CNRS-LISA (beekmann@lisa.univ-paris12.fr)