EMEP4HR

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EMEP4HR – project

- Joint project of
  - Norwegian Meteorological Institute
  - Meteorological and Hydrological Service of Croatia
  - University of Zagreb, Faculty of Sciences, Andrija Mohorovičić Geophysical Institute, Croatia
  - Energy Research and Environmental Protection Institute (EKONERG)

- Started in 2006 to last until 2010

- Funded by Research Council of Norway
EMEP4HR – goals

- Implementation and further development of a mesoscale version of EMEP Unified model coupled with ALADIN and WFR NWP models
- Development of emission inventories of air pollutants in Croatia at 10 km resolution
- Development of emission inventories at selected urban areas at 1 km resolution
- Development of a new capability for the assessment of urban air quality in Croatia
The project has two aspects:

1. **Scientific**:
   - Produce 2 PhD thesis on the subjects of vertical and horizontal diffusion
   - Test the urban performance of the model at 1 km resolution as a part of a post-doc research

2. **Technical**
   - Develop ALADIN–EMEP coupling interface
   - Implement and verify model suite for the Croatian domain at 10 km (called EMEP4HR) – the main focus of this presentation
Outline

1. Project overview
2. Suite description
3. Input data
4. Results – 2D fields
5. Results – time series
6. Final remarks
The Unified EMEP model

- Atmospheric chemical transport model developed at EMEP MSC-W (met.no)
- Eulerian model employing 4th order Bott’s advection scheme in horizontal and 2nd order in vertical direction
- Flexible chemistry – UNI-OZONE version has 56 advected and 15 short-lived species and 123 reactions
ALADIN NWP model

- Aire Limitée Adaptation dynamique Développement InterNational
- Developed as international collaboration with Meteo France as a principal partner
- Mesoscale NWP model
- Hydrostatic Semi–Lagrangian semi–implicit spectral model
- Used operationally at MHSC
- Post–processing software developed for treatment of ALADIN output
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Meteorological data

- Data from the NWP model have to be preprocessed
- Data not present in NWP output have to be derived (cumulative 3D fractional cloud cover, cumulative 3D precipitation)
- Vertical interpolation from ALADIN to EMEP model levels
- Mass balancing of data is required
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th σ level - 0UTC
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th $\sigma$ level - 3UTC
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th $\sigma$ level - 6UTC

Cloud cover

Precipitation
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th σ level - 12UTC

Cloud cover

Precipitation
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th $\sigma$ level - 15UTC

Cloud cover

Precipitation
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th $\sigma$ level - 18UTC
Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th $\sigma$ level - 21UTC

Cloud cover

Precipitation
Emissions

- Croatian emissions at 10x10 km
- Developed by EKONERG
- Interpolated from EMEP 50x50 emissions outside Croatia (using mass conservative interpolation)
- Croatian emission data based on:
  - **ROAD** on road distribution, and number of registered vehicles per county
  - **AGRICULTURE** on national register of agricultural producers
  - **INDUSTRY** and **ENERGY** on reported values and economic activity per county
  - **COMBUSTION** and **SOLVENT** on population density
Emissions – SOx

Energy production

Road transport
Emissions – NOx

Energy production

Fossil fuel extraction and distribution
Emissions – NH3

Production processes

Agriculture
Emissions – VOC

Combustion

Solvent use
Emissions – CO

Combustion

Road traffic
Other input files

- Land use, forests and land–sea mask from USGS database
- Monthly snow cover from ALADIN climatological files
- Natural SO₂ emissions interpolated from EMEP 50x50 emissions
Tentative first results will be shown – this is a work in progress

No in–depth verification is done yet

Model tested on EMEP verification kit based on the data from EMEP stations for January and July 2005

No verification on any other data (including Croatian monitoring network) yet
SO₂ concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

SO\textsubscript{2} concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

SO\textsubscript{2} concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

SO$_2$ concentrations from 26 to 30 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

NO₂ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.
NO₂ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

NO$_2$ concentrations from 4 to 8 January 2005.

O$_3$ concentrations on 8 July 2005.

O₃ concentrations on 8 July 2005.

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Mean OBSERVATIONS: 33.10
Mean EMEP4HR: 28.02
Mean EMEP: 40.72
Corr.: 0.39, 0.33

Max $O_3$

July_2005_O3max_IT04

Mean OBSERVATIONS: 59.54
Mean EMEP4HR: 60.31
Mean EMEP: 55.92
Corr.: 0.67, 0.52

**NO$_2$**

**July_2005_no2_IT04**

Mean OBSERVATIONS: 2.68  
Mean EMEP4HR: 2.20  
Mean EMEP: 2.12  
Corr.: 0.41, 0.02

SO$_2$

July_2005_so2_IT04

Mean OBSERVATIONS: 0.22
Mean EMEP4HR: 0.24
Mean EMEP: 0.39
Corr.: 0.48, 0.70
To do

- Make necessary modifications to ALADIN in order to have 3D accumulated fractional cloud cover and accumulated 3D precipitation as a model output
- Verification on Croatian data
Instead of conclusions

- The work is progressing well
- The model setup is showing promising results
- High resolution emissions for Croatia are developed for the first time for this project
Thank you!