EMEP4HR

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HARMO12, Cavtat, 6.–9 October 2008.

Outline

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

EMEP4HR – aspects

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

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

Outline

Meteorological data

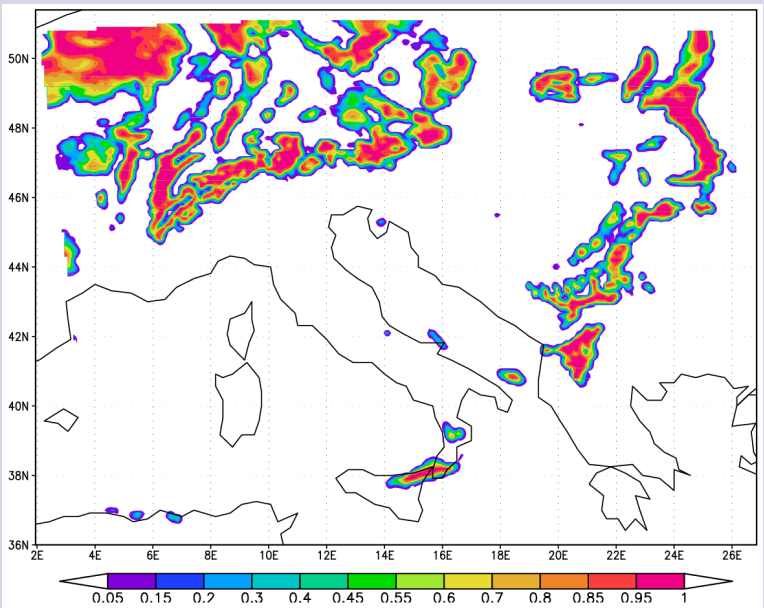
- Data from the NWP model have to be preprocessed
- Data not present in NWP output have to be derived (cumulative 3D fractional cloud cover, cumulative 3D precipitation)
- Vertical interpolation from ALADIN to EMEP model levels
- Mass balancing of data is required

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

Cloud cover



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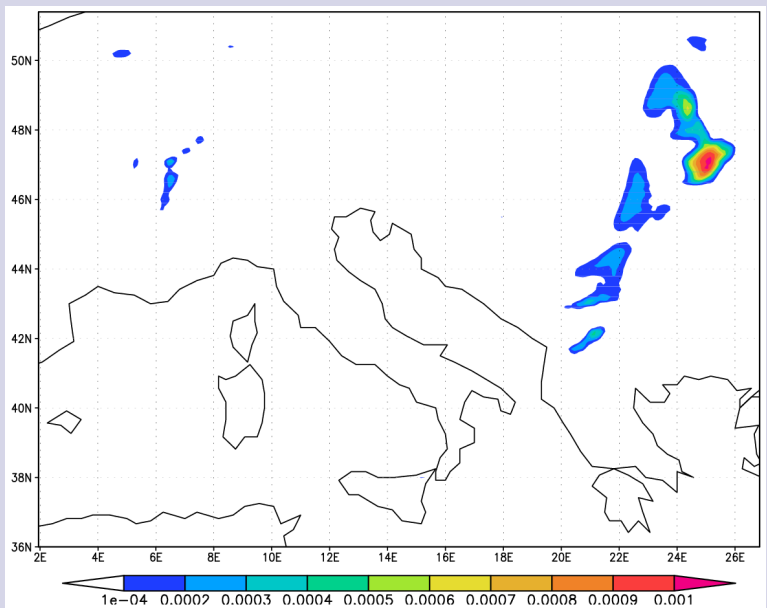

Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

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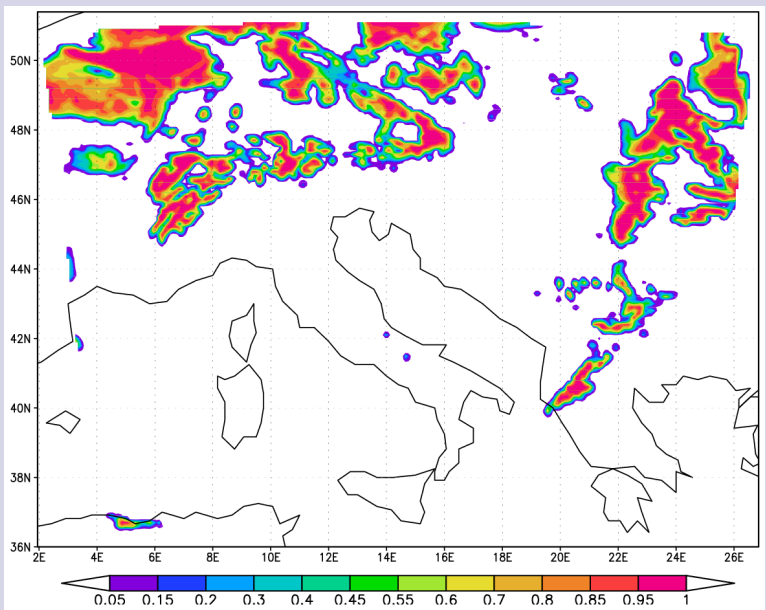
Cloud cover



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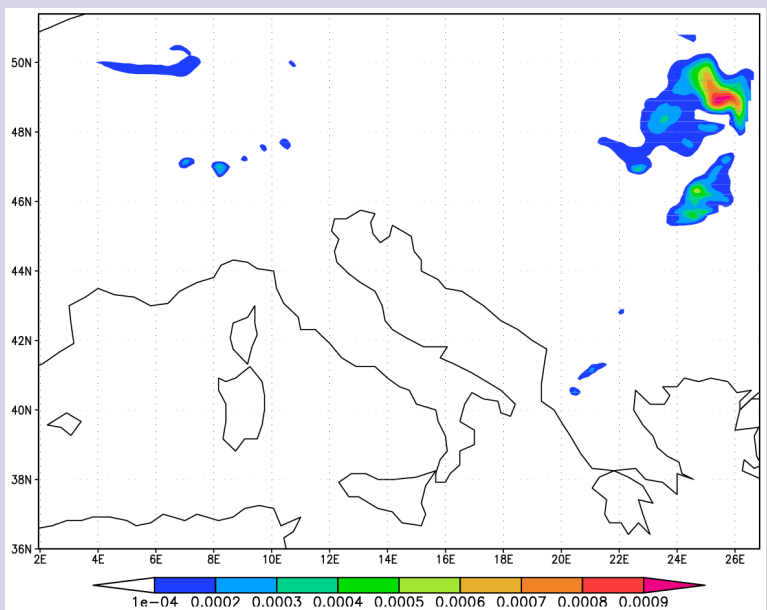
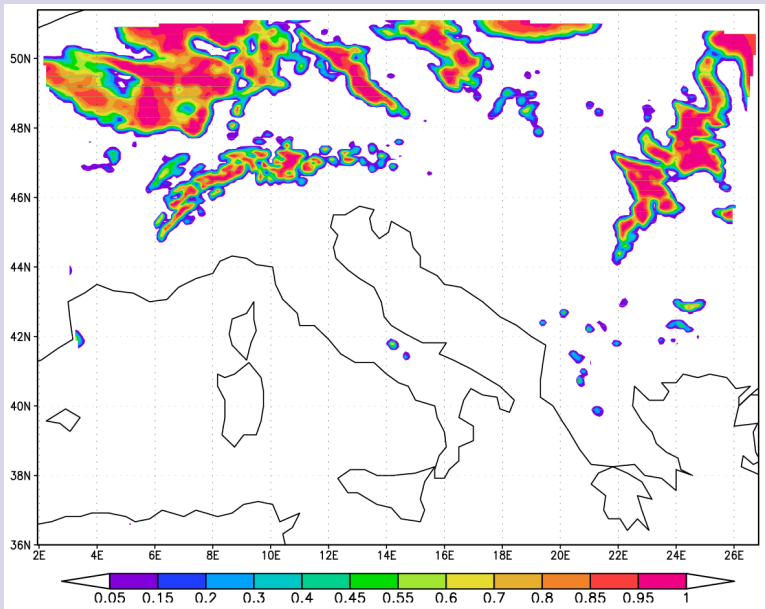


Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th σ level - 6UTC

Cloud cover



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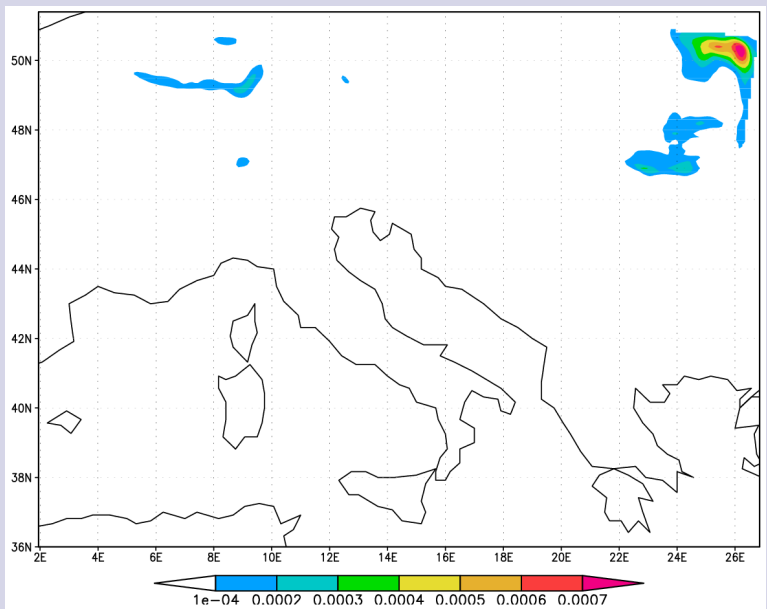

Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

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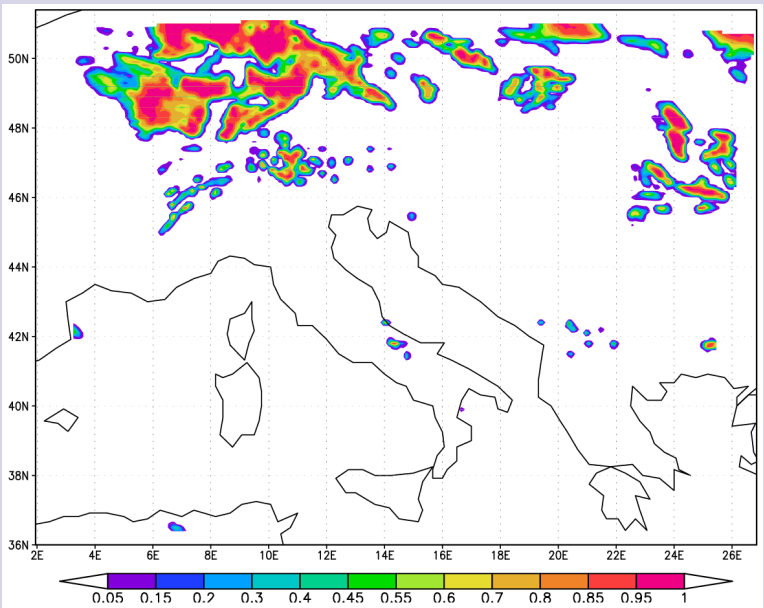
Cloud cover



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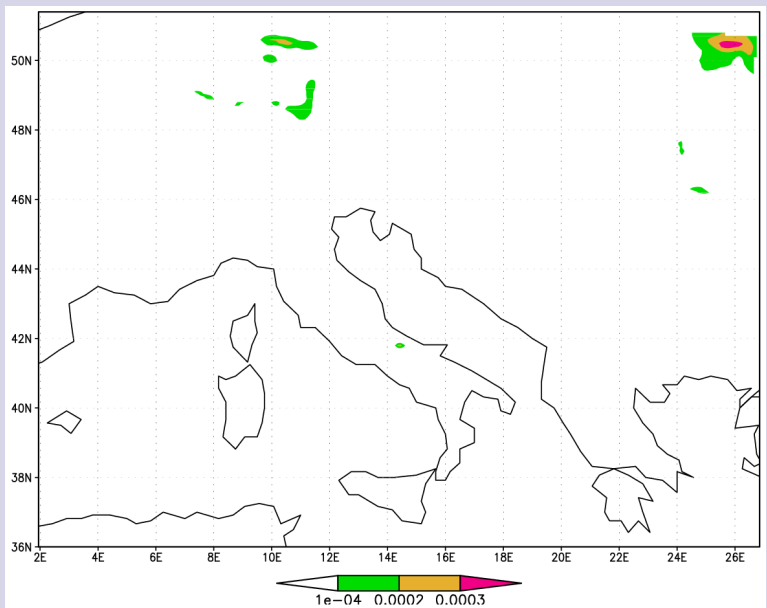
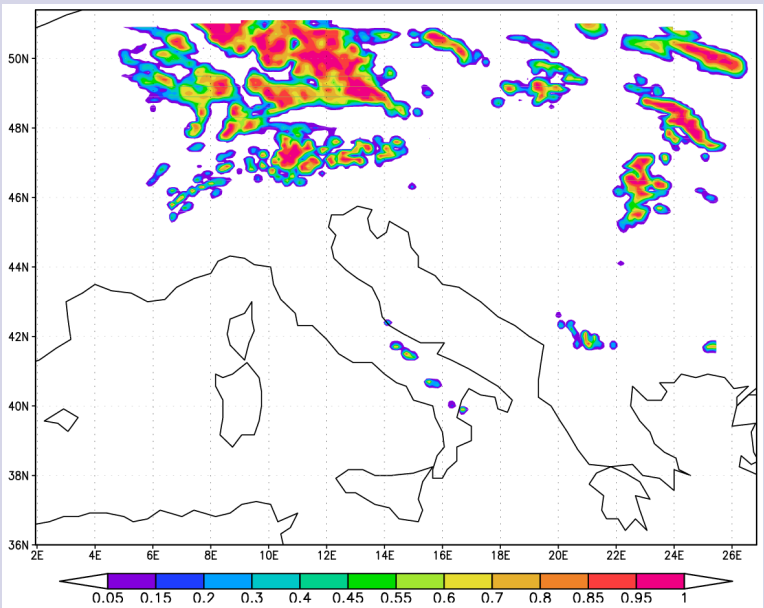


Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

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

Cloud cover



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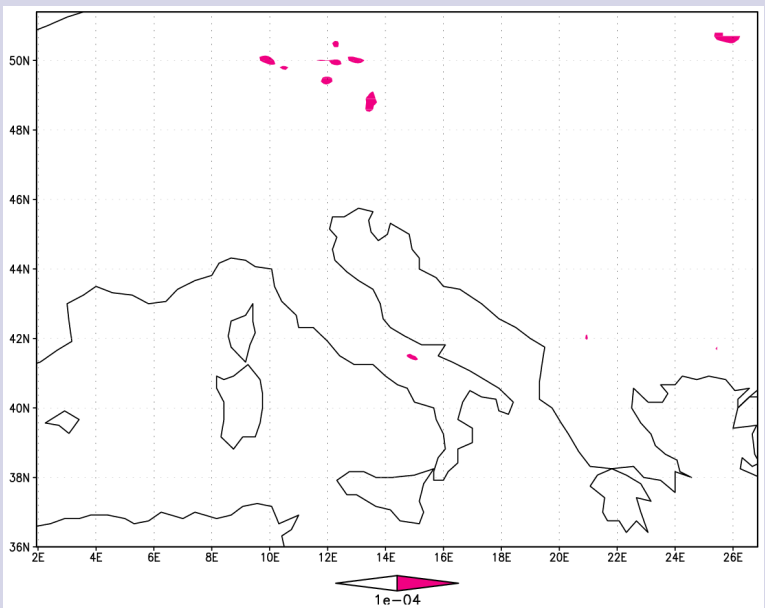

Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

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

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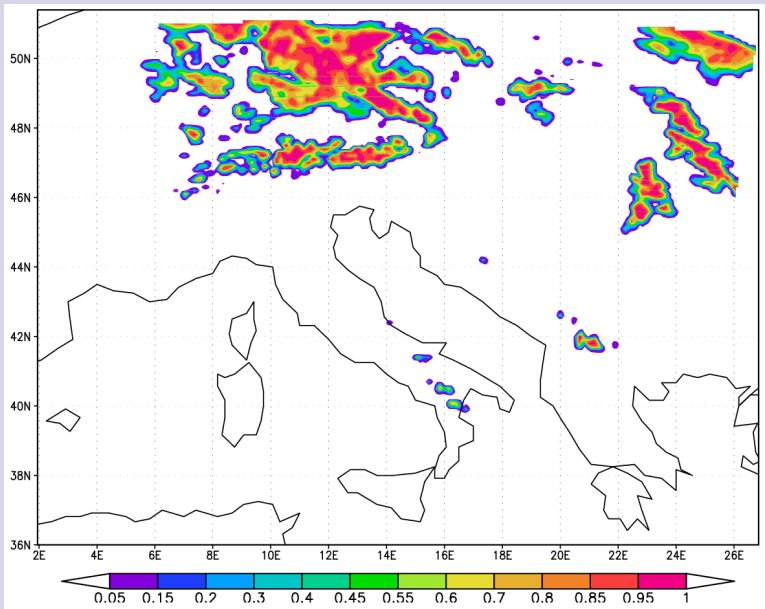

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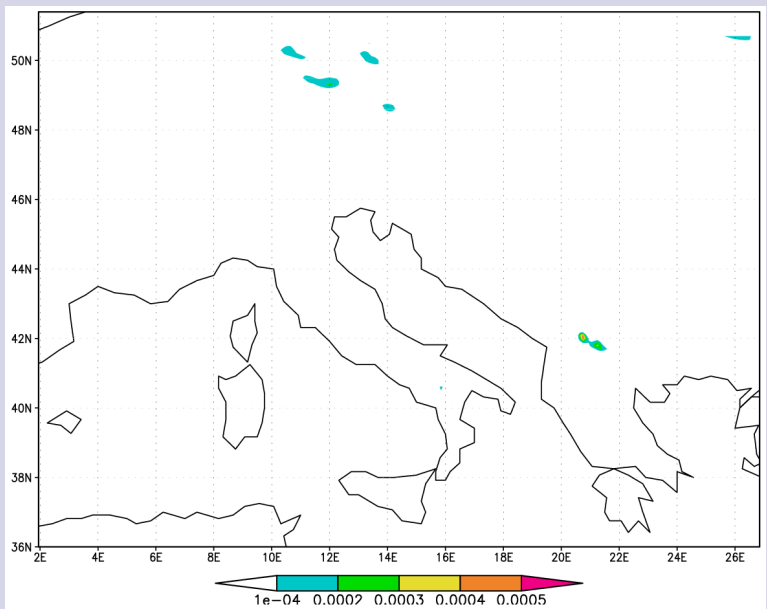
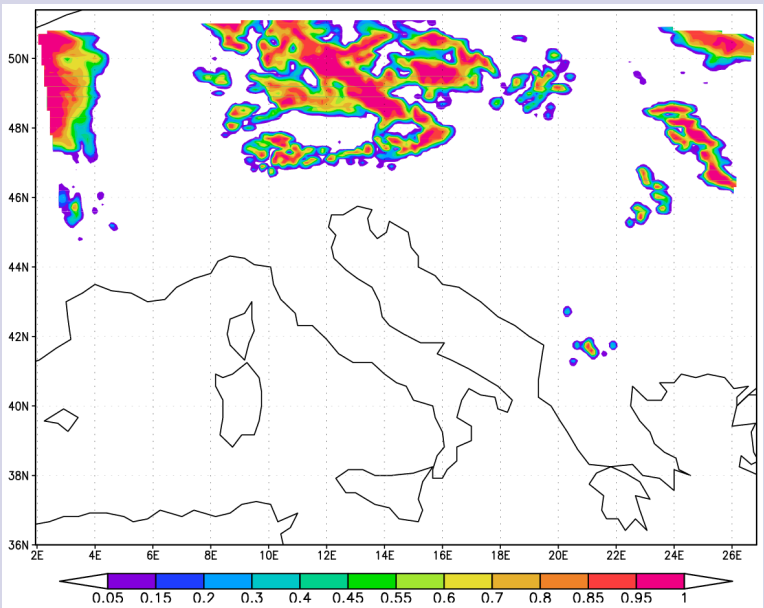


Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th σ level - 18UTC

Cloud cover



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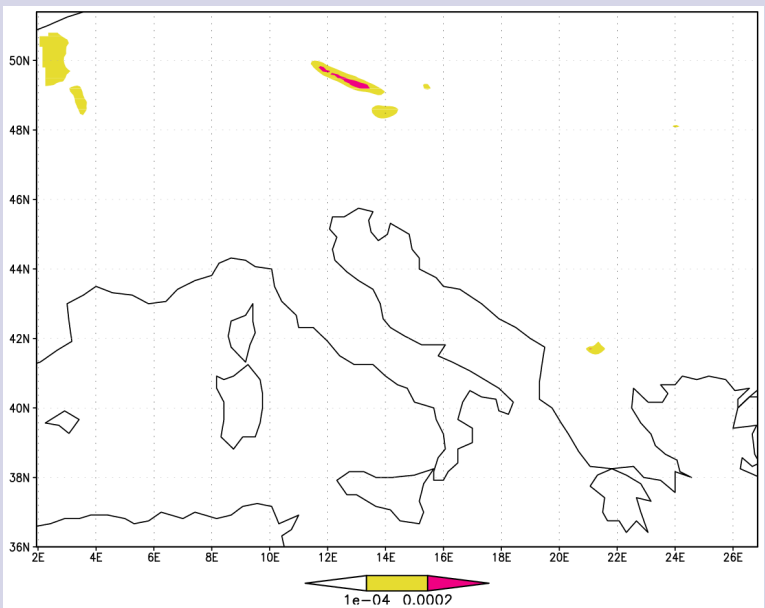
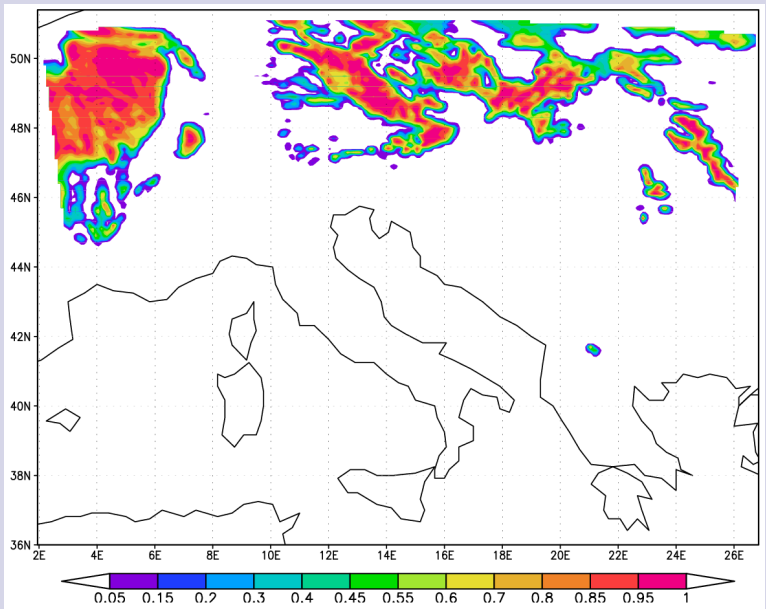


Meteo data example – 3D fractional cloud cover and 3D precipitation

Data parametrized and averaged by post-processing software

13. July 2005. on 15th σ level - 21UTC

Cloud cover



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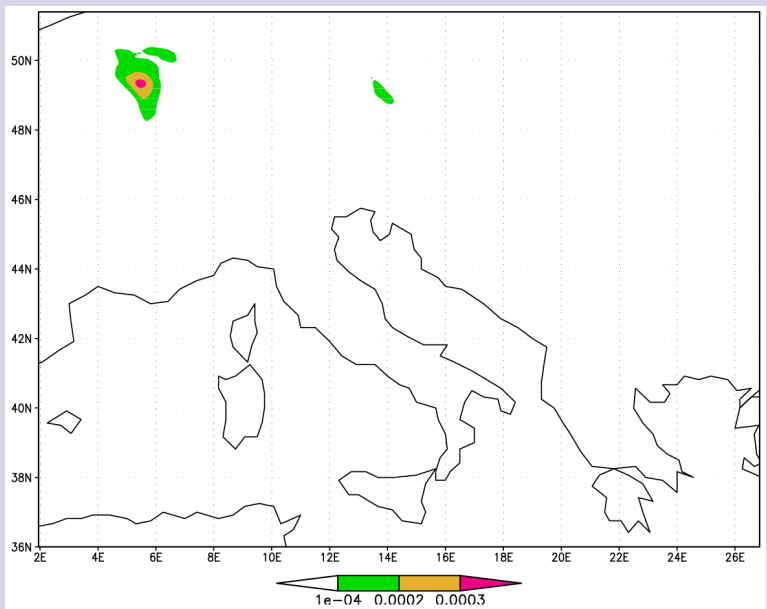


Emissions

- 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

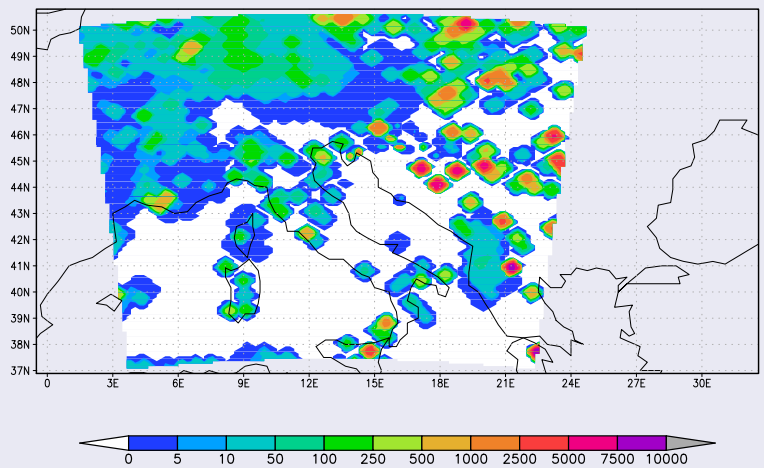
  AGRICULTURE on national register of agricultural producers

  INDUSTRY and ENERGY on reported values and economic activity per county

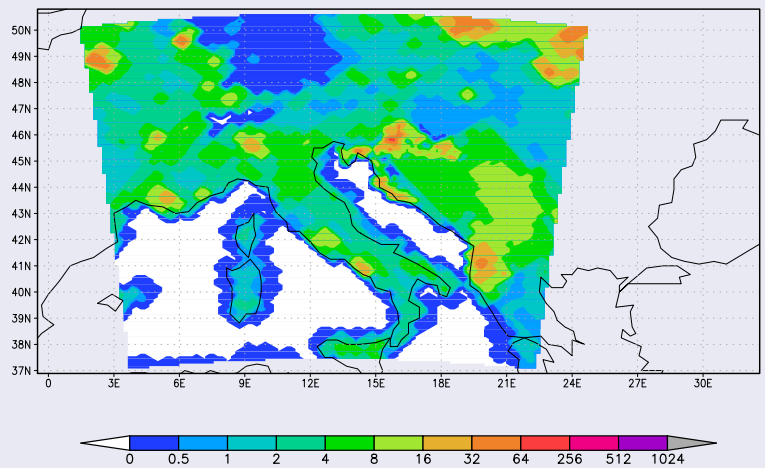
  COMBUSTION and SOLVENT on population density

Emissions – SOx

Energy production

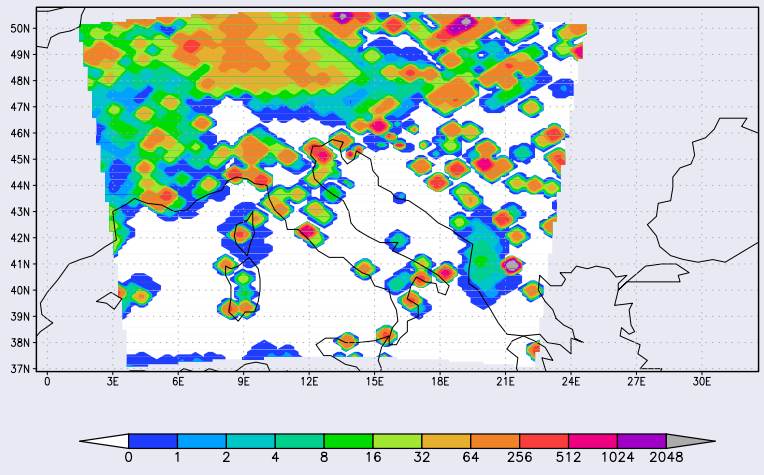


Road transport

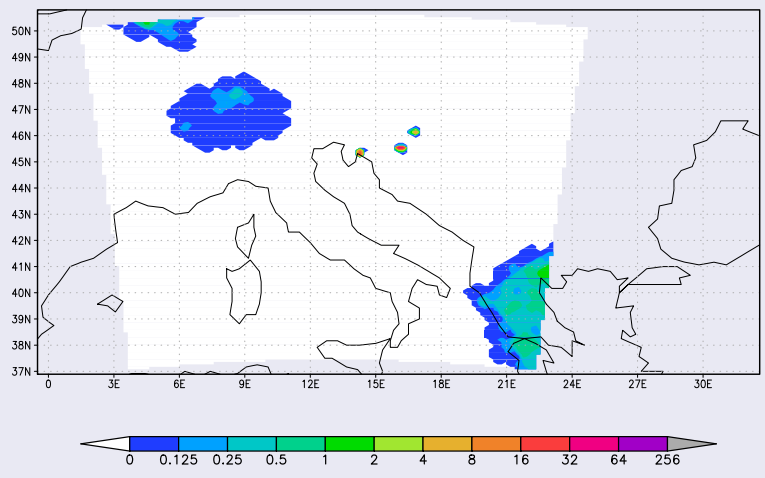


Emissions – NOx

Energy production

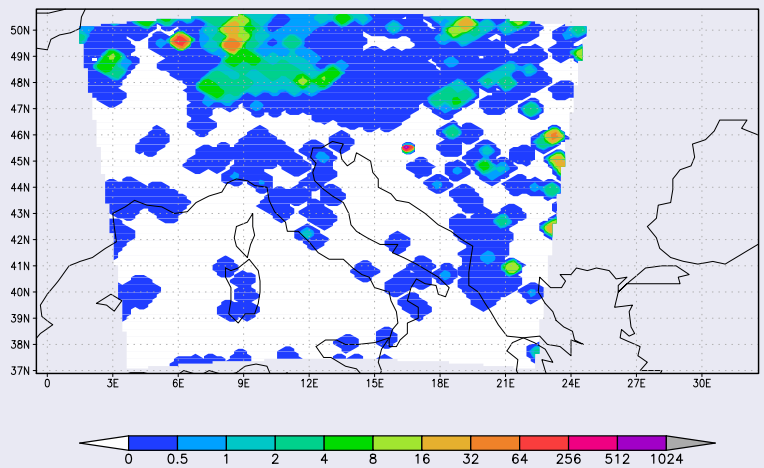


Fossil fuel extraction and distribution

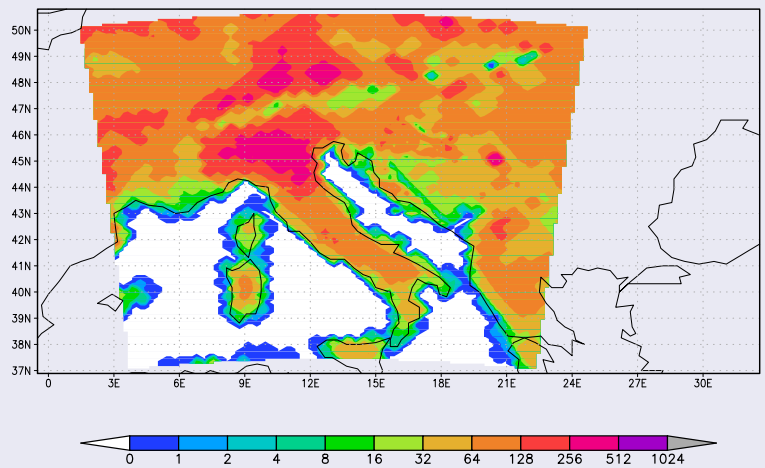


Emissions – NH3

Production processes

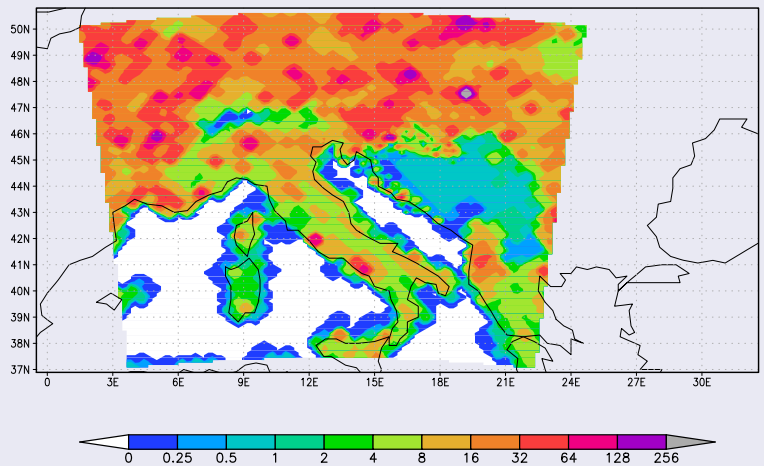


Agriculture

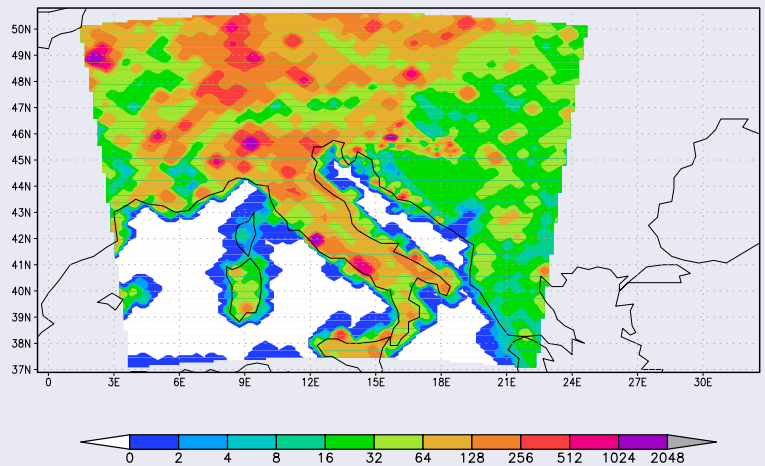


Emissions – VOC

Combustion

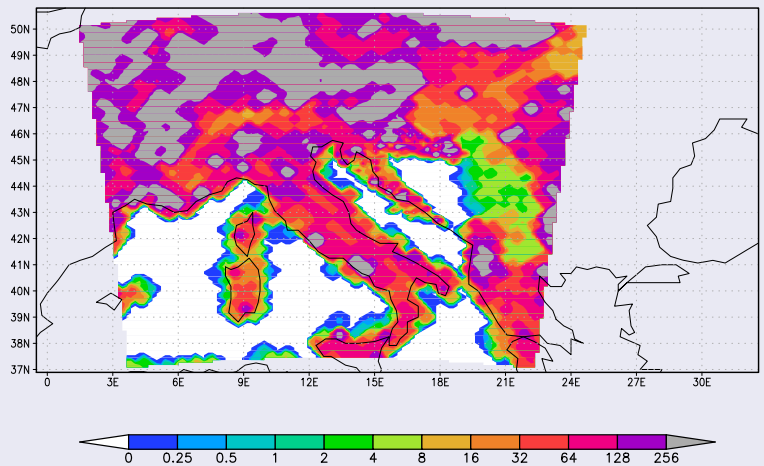


Solvent use

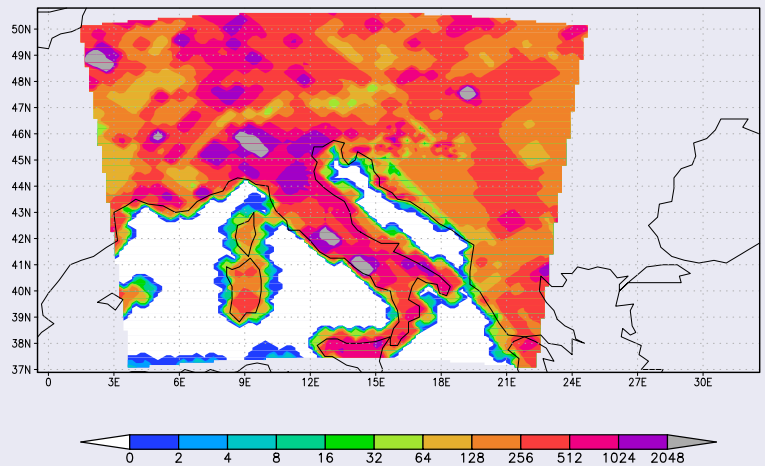


Emissions – CO

Combustion



Road traffic



Other input files

- Land use, forests and land–sea mask from USGS database
- Monthly snow cover from ALADIN climatological files
- Natural SO_2 emissions interpolated from EMEP 50x50 emissions

Outline

- 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

SO_2 concentrations from 26 to 30 January 2005.

26. January 2005.

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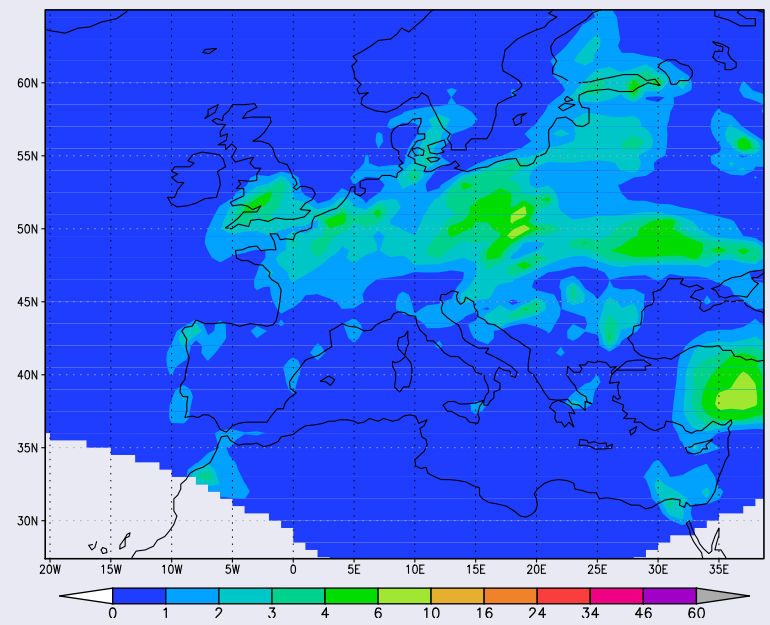

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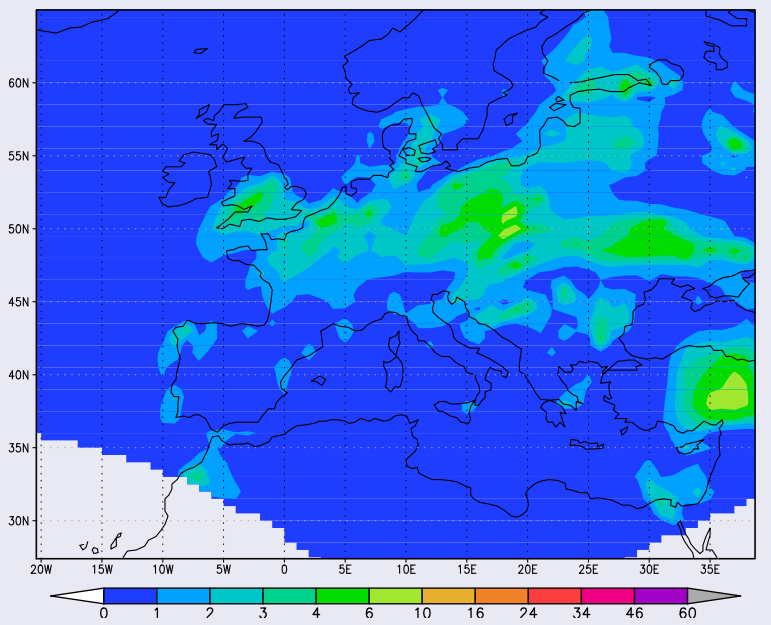

SO_2 concentrations from 26 to 30 January 2005.

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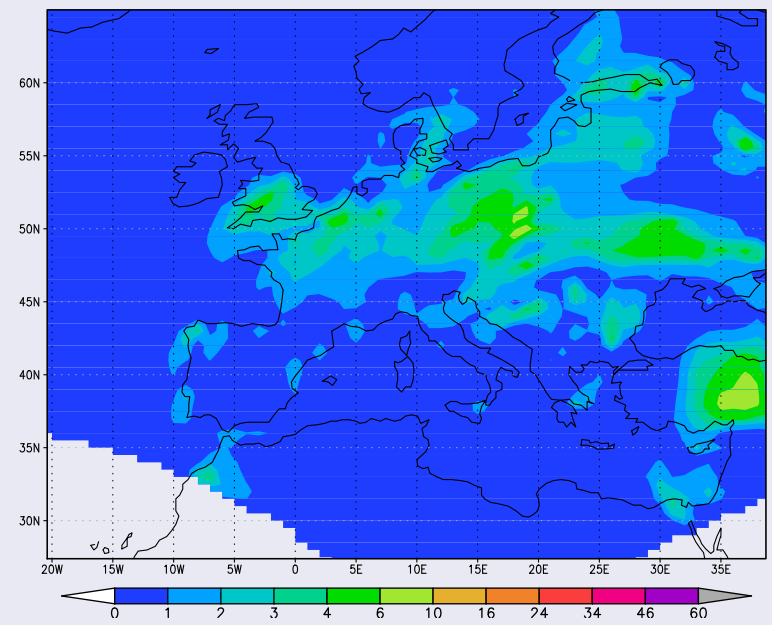

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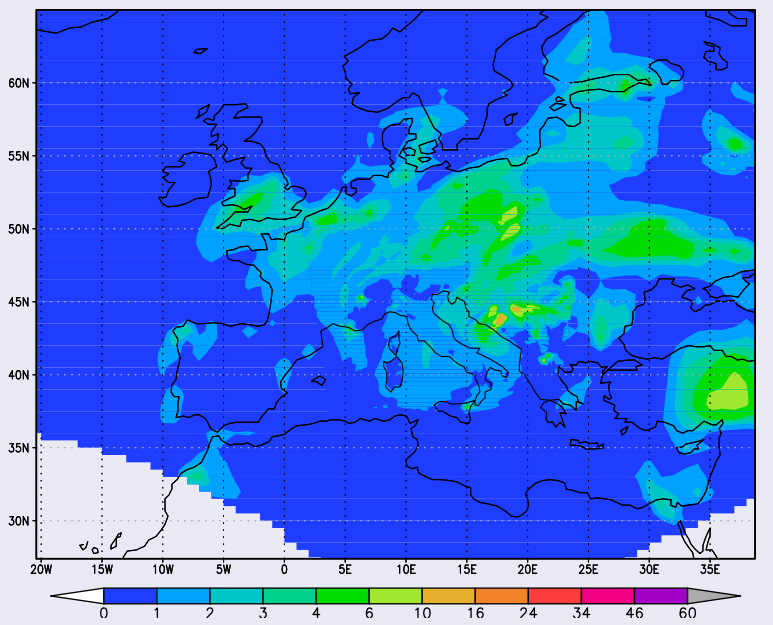

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27. January 2005.

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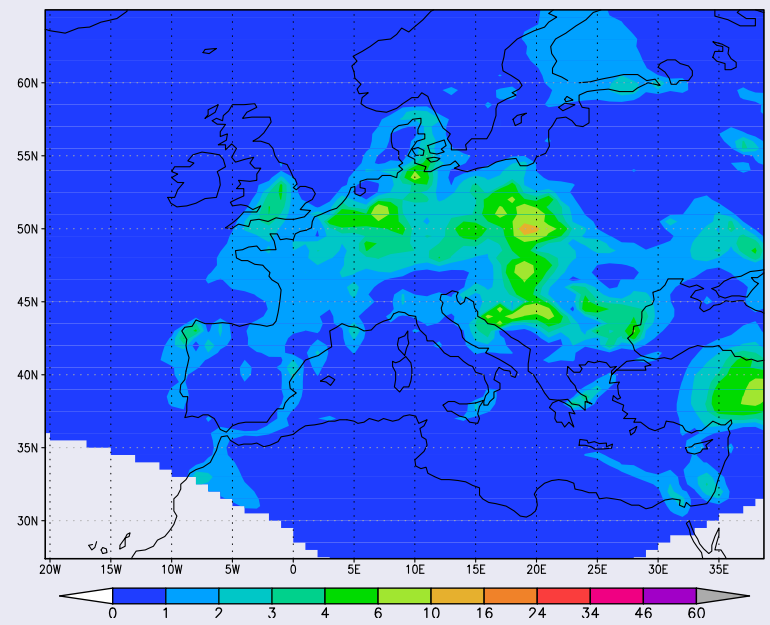

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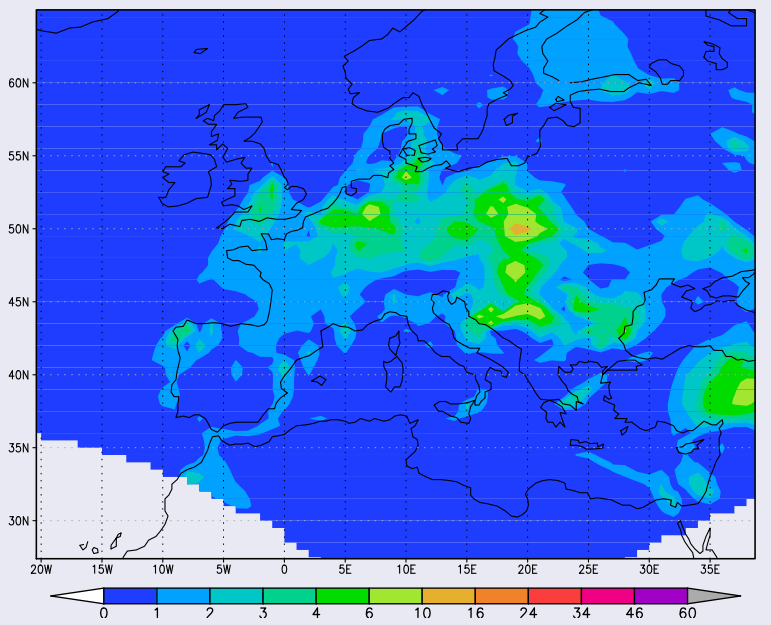

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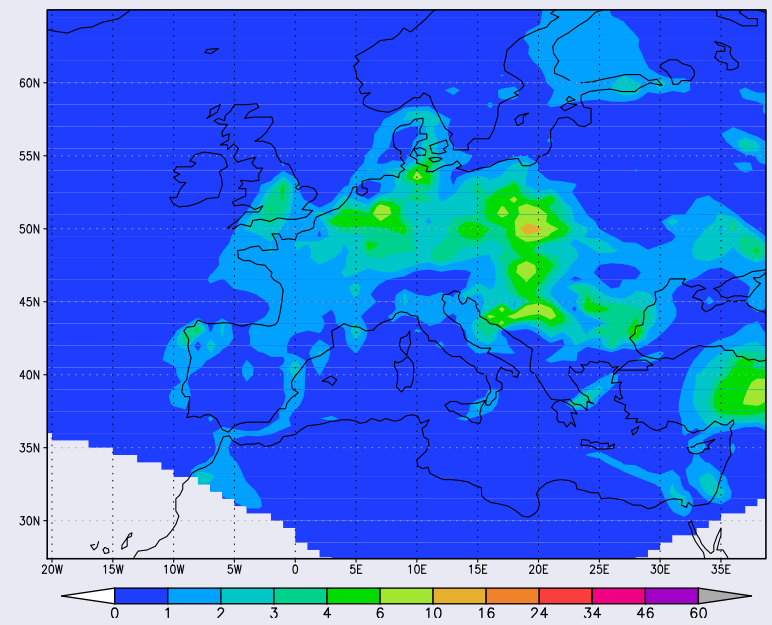

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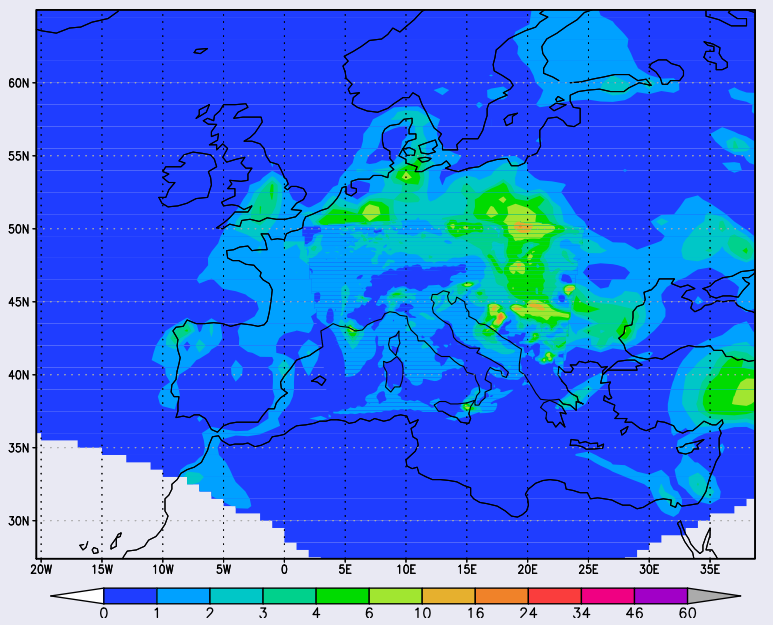
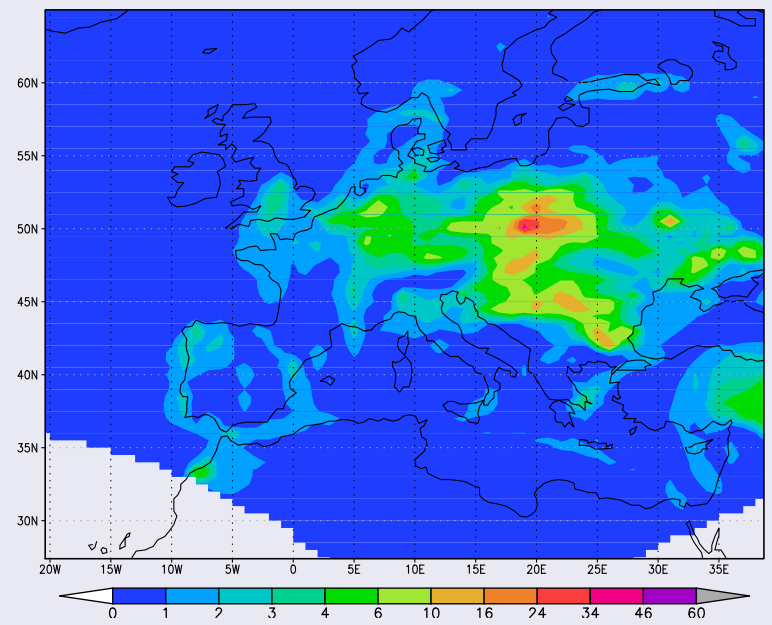


SO_2 concentrations from 26 to 30 January 2005.

28. January 2005.

EMEP 50



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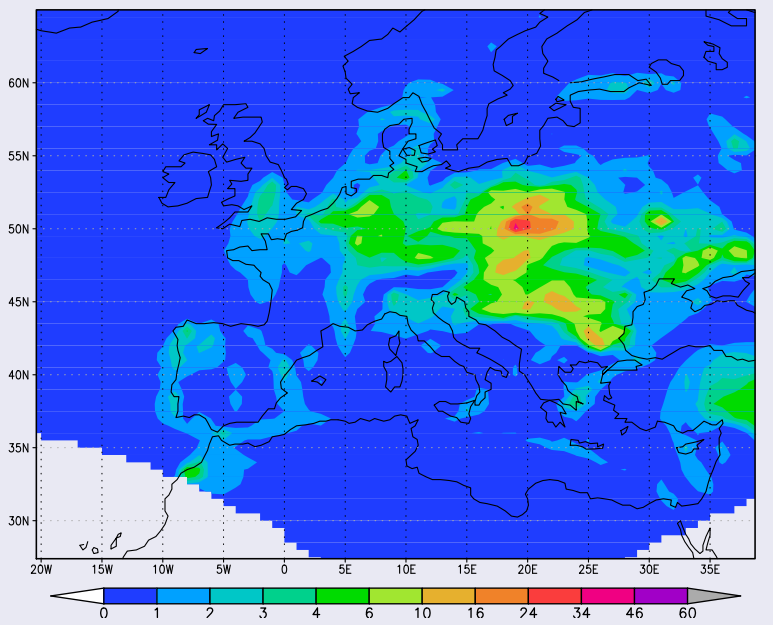

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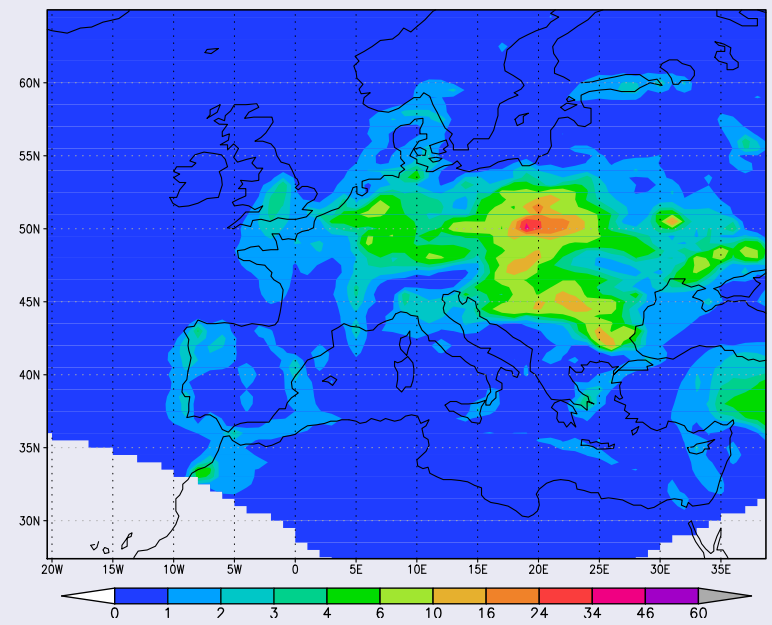

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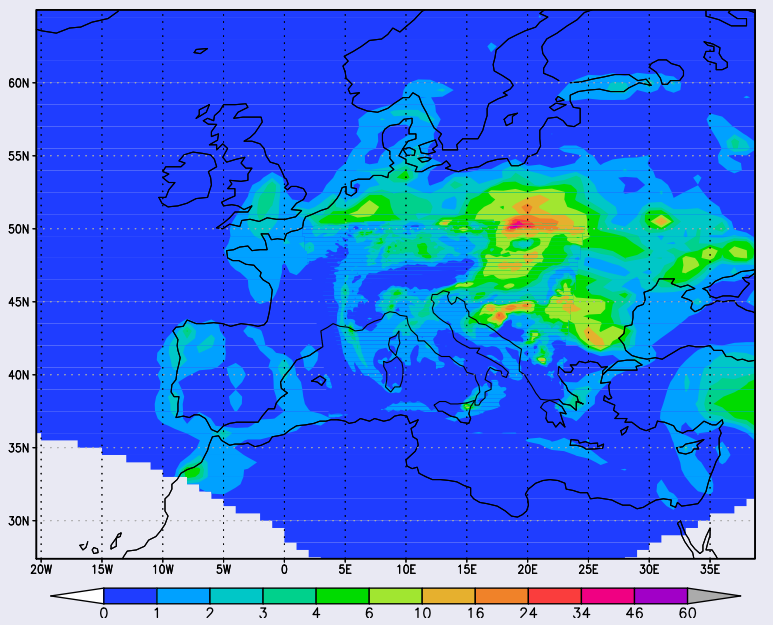
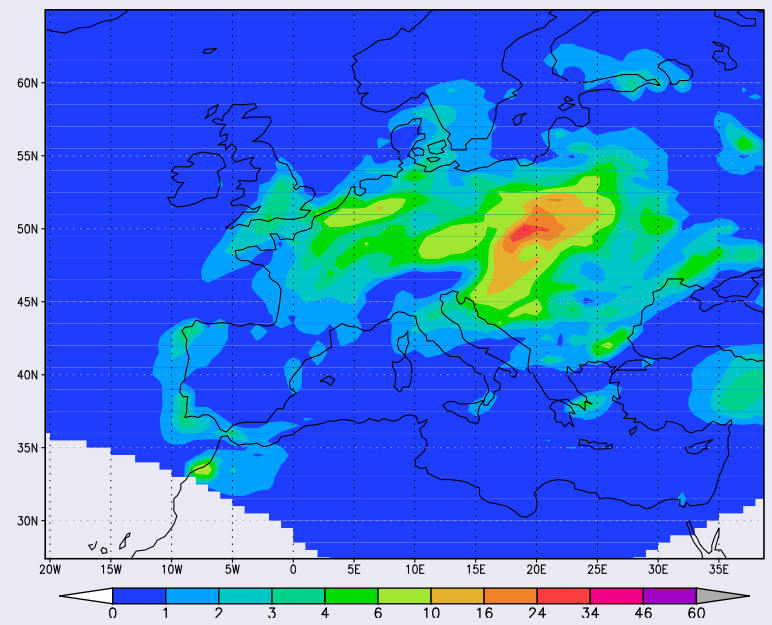


SO_2 concentrations from 26 to 30 January 2005.

29. January 2005.

EMEP 50



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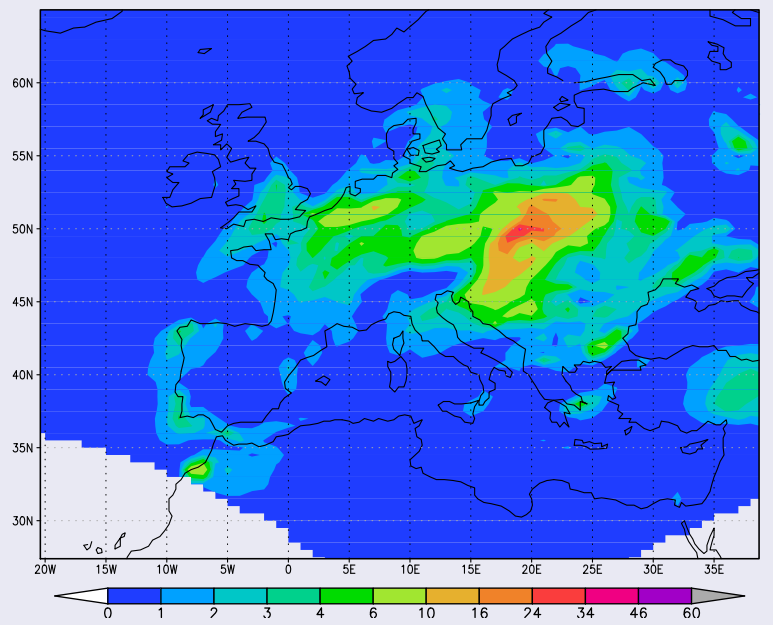
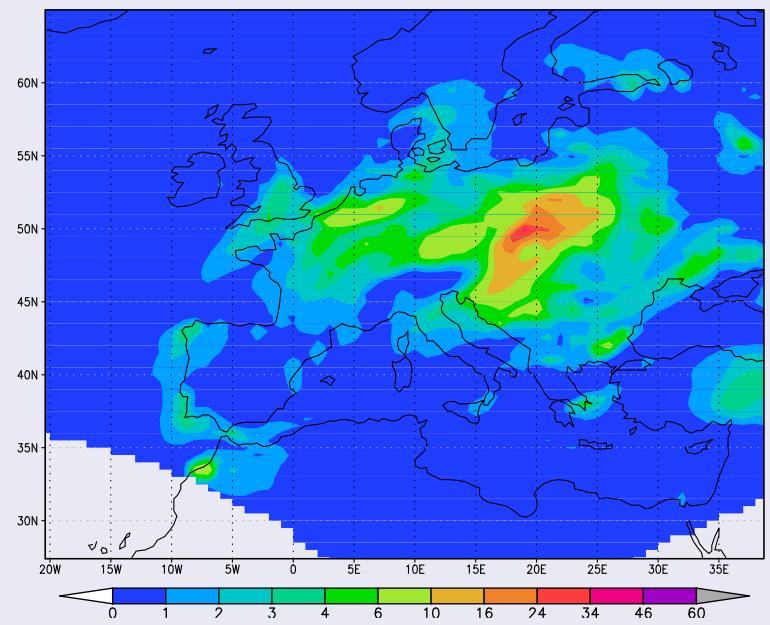


SO_2 concentrations from 26 to 30 January 2005.

29. January 2005.

EMEP 50



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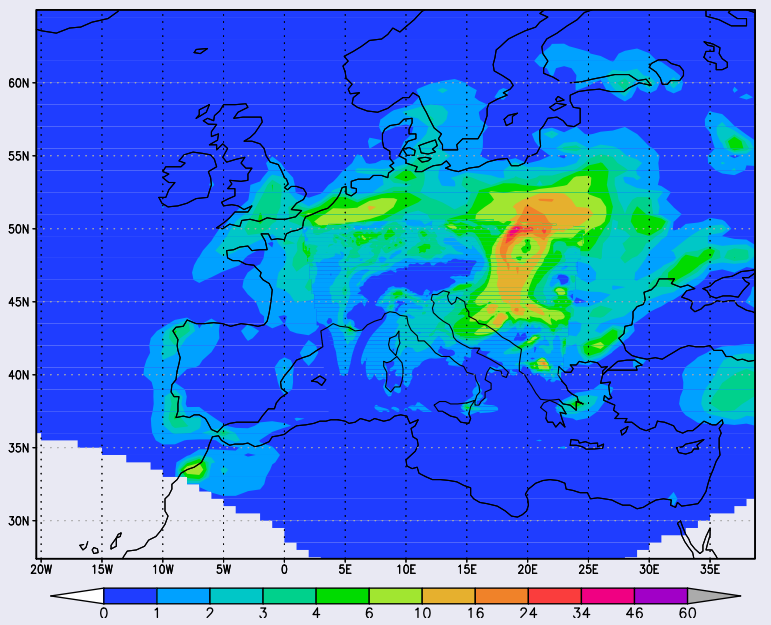
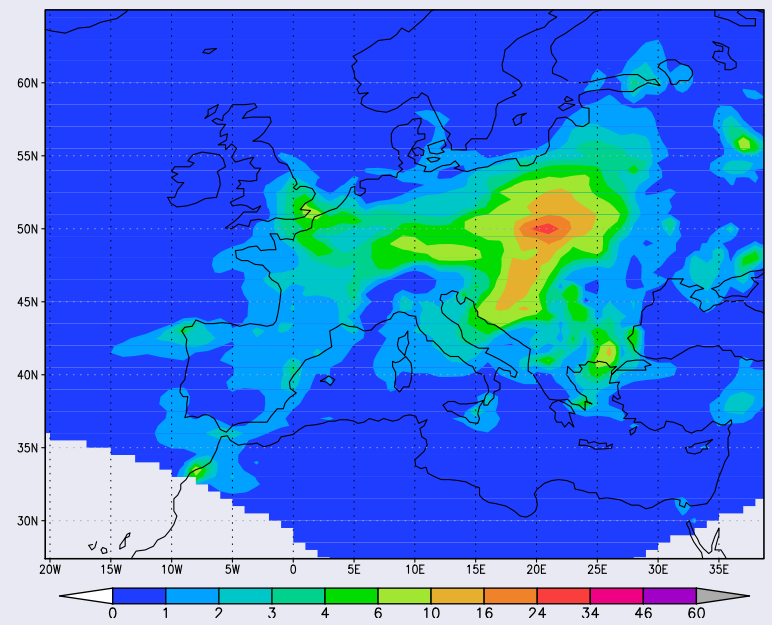


SO_2 concentrations from 26 to 30 January 2005.

30. January 2005.

EMEP 50



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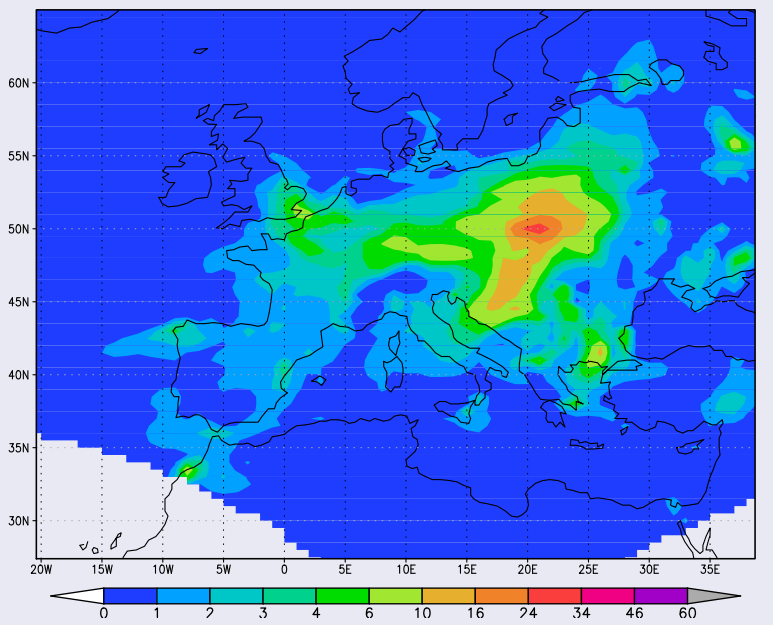
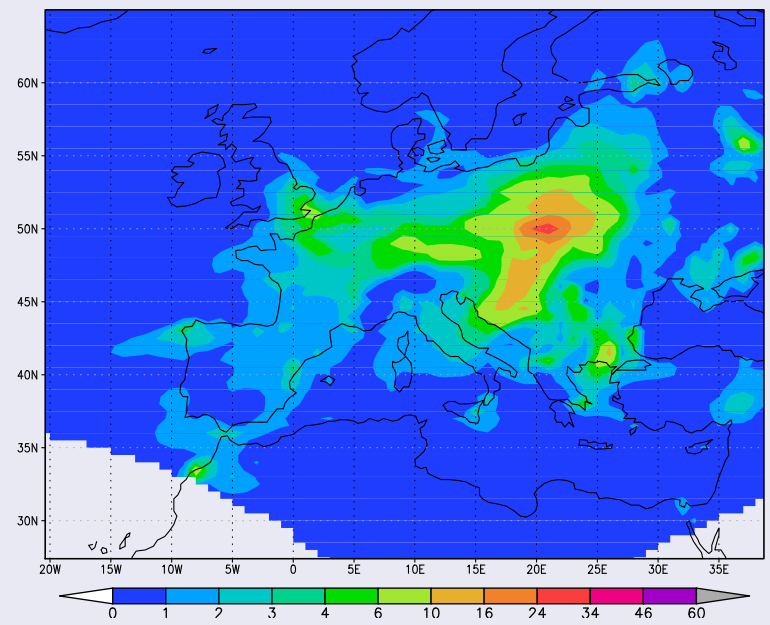


SO_2 concentrations from 26 to 30 January 2005.

30. January 2005.

EMEP 50



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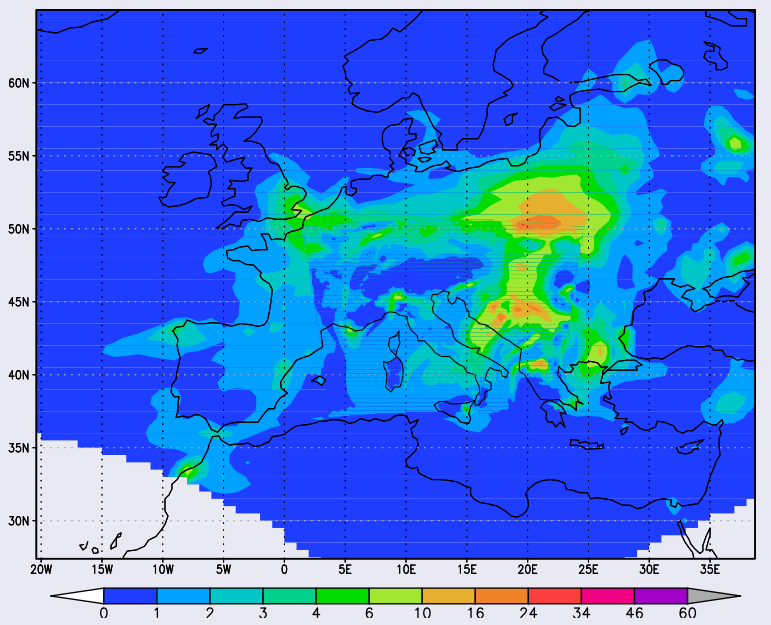
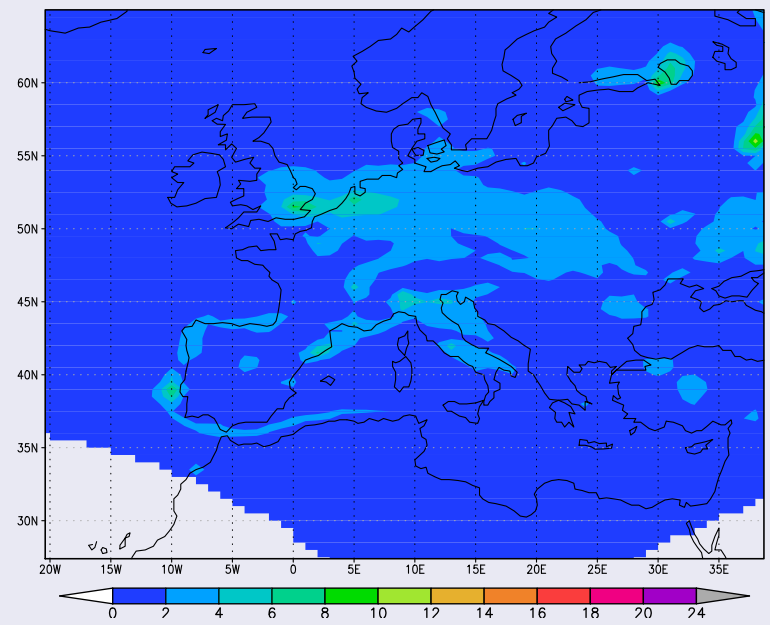


NO_2 concentrations from 4 to 8 January 2005.

4. January 2005.

EMEP 50



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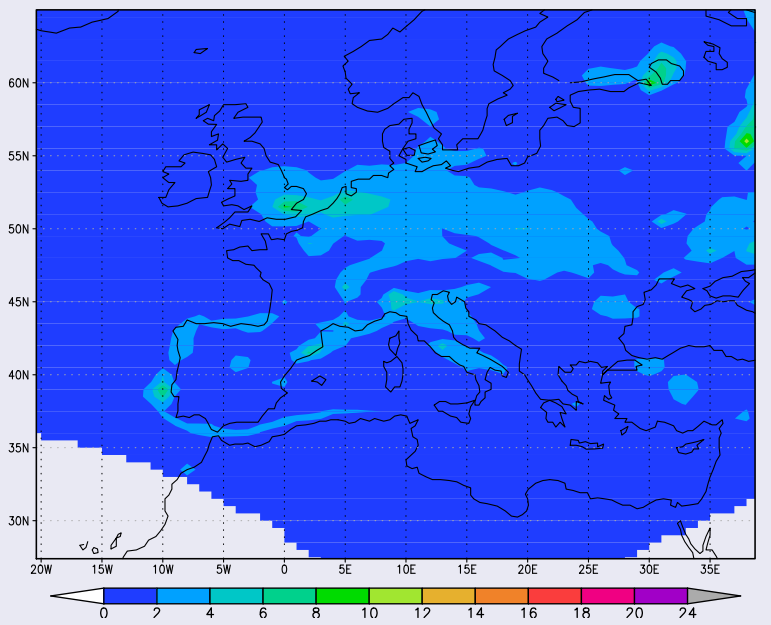
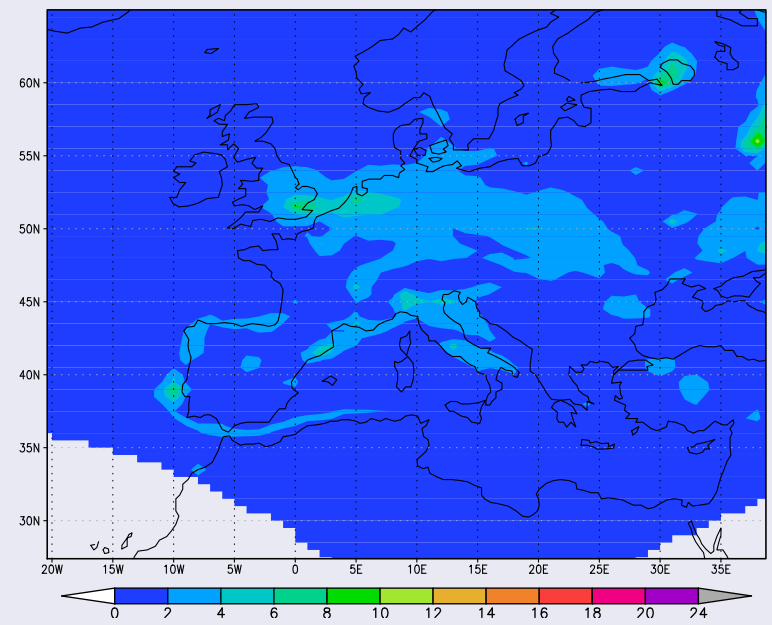


NO_2 concentrations from 4 to 8 January 2005.

4. January 2005.

EMEP 50



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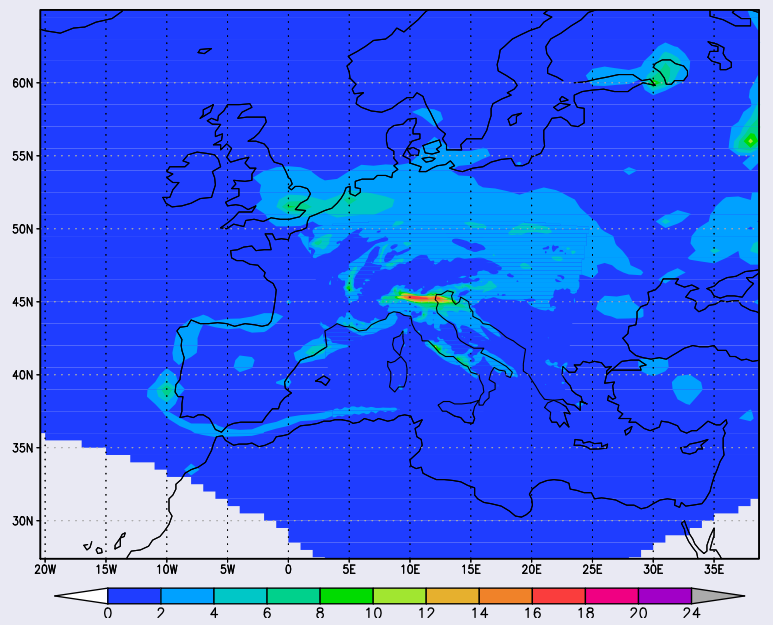
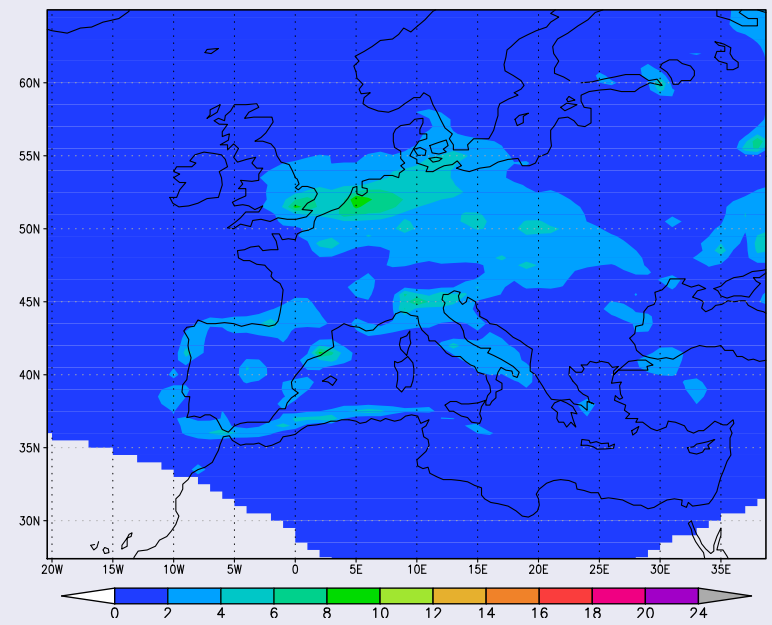


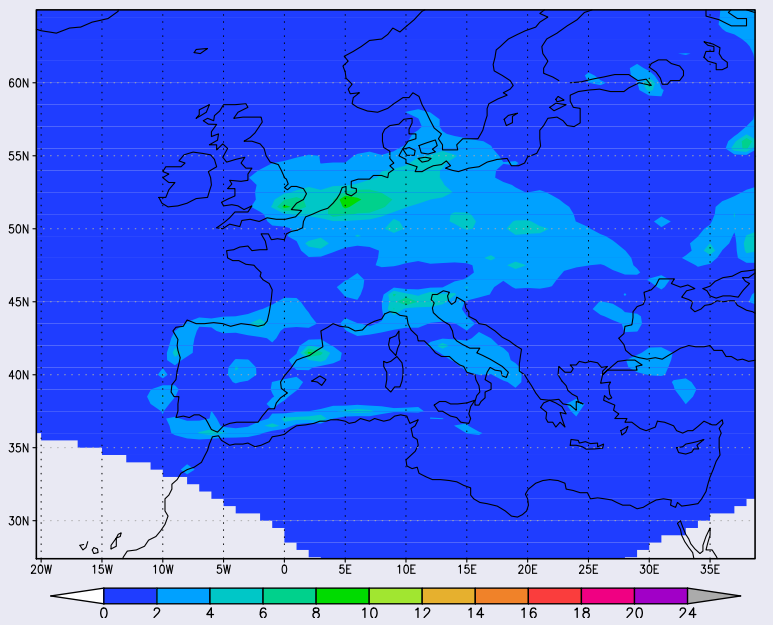
NO_2 concentrations from 4 to 8 January 2005.

5. January 2005.

EMEP 50



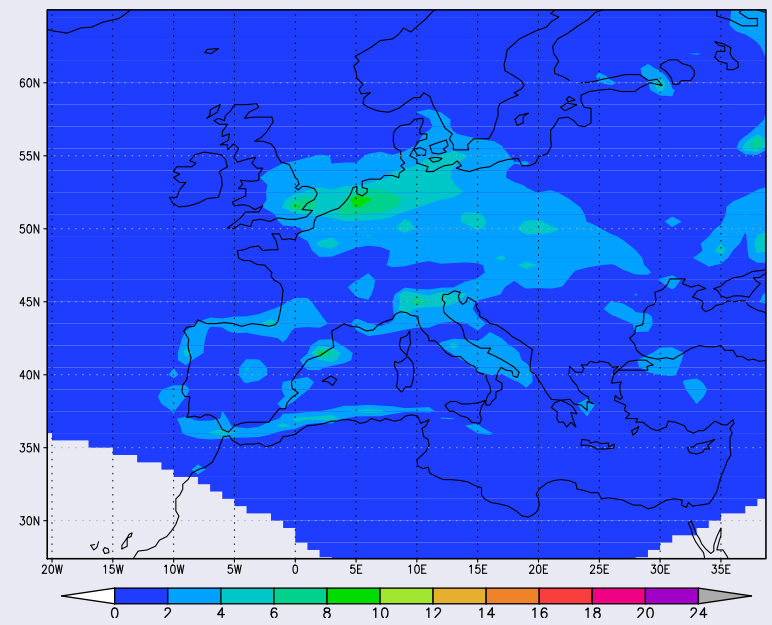
EMEP 50



NO_2 concentrations from 4 to 8 January 2005.

5. January 2005.

EMEP 50



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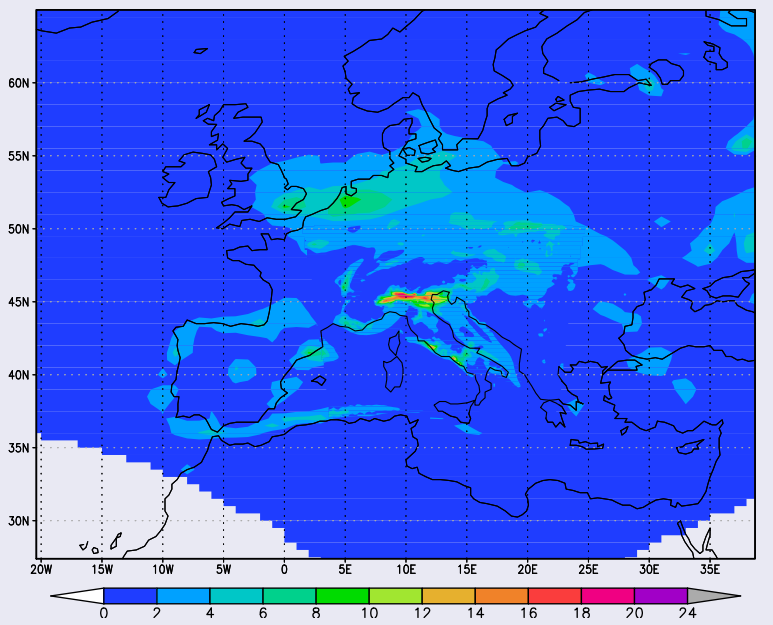
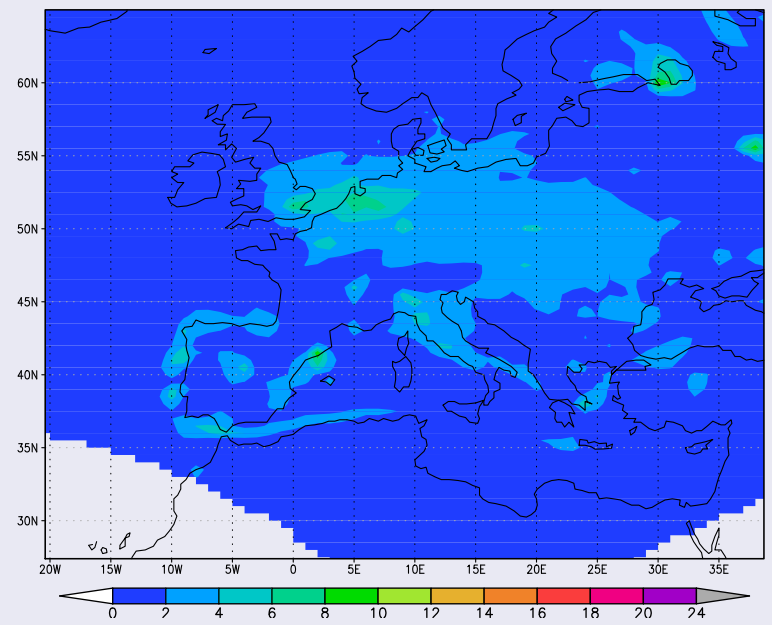


NO_2 concentrations from 4 to 8 January 2005.

6. January 2005.

EMEP 50



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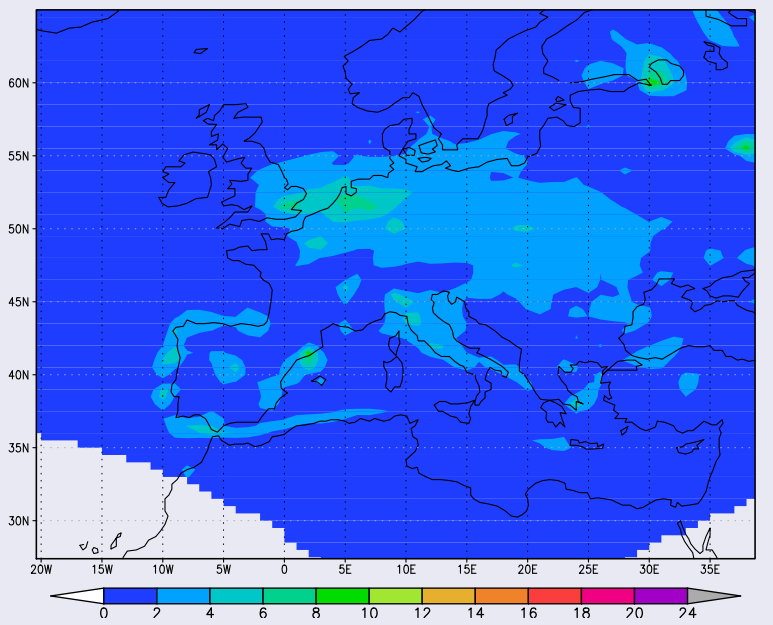
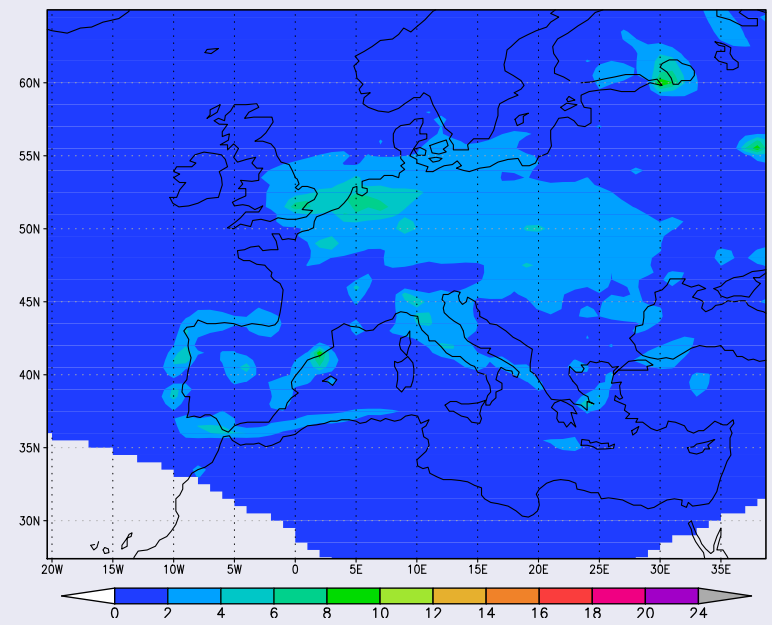


NO_2 concentrations from 4 to 8 January 2005.

6. January 2005.

EMEP 50



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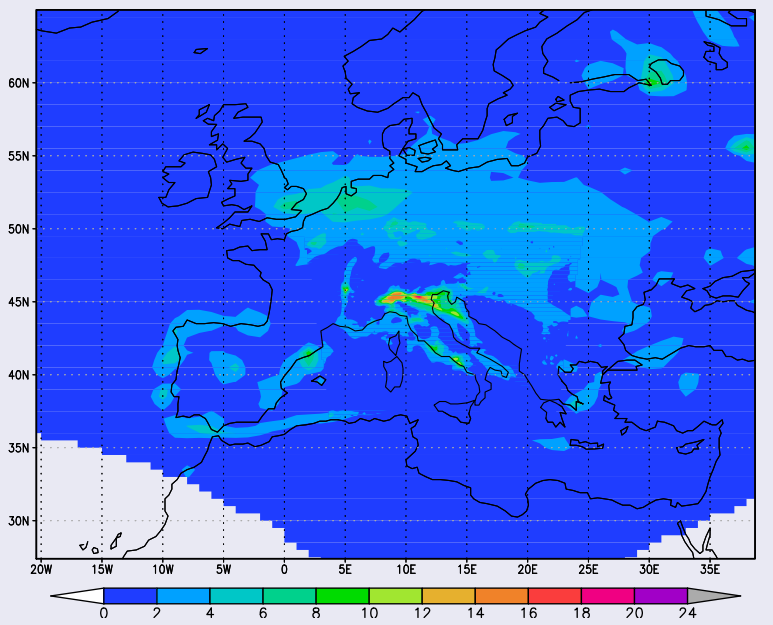
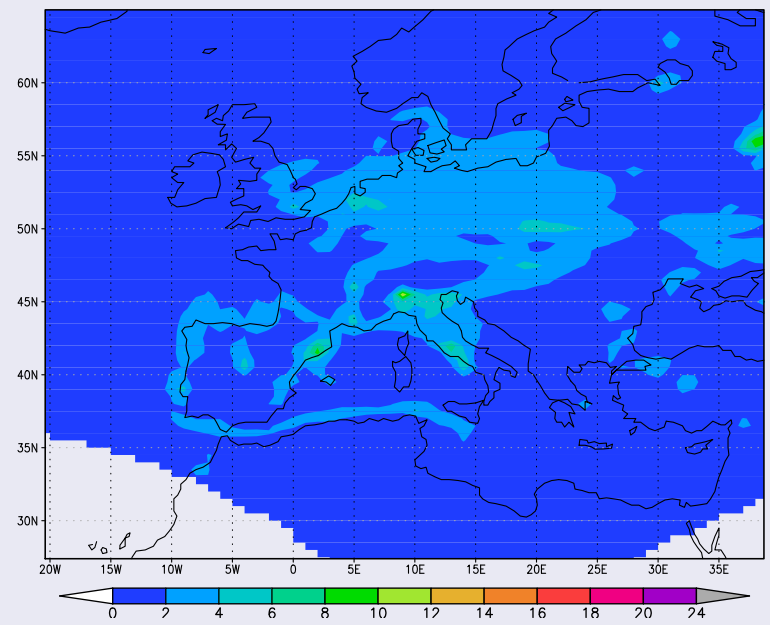


NO_2 concentrations from 4 to 8 January 2005.

7. January 2005.

EMEP 50



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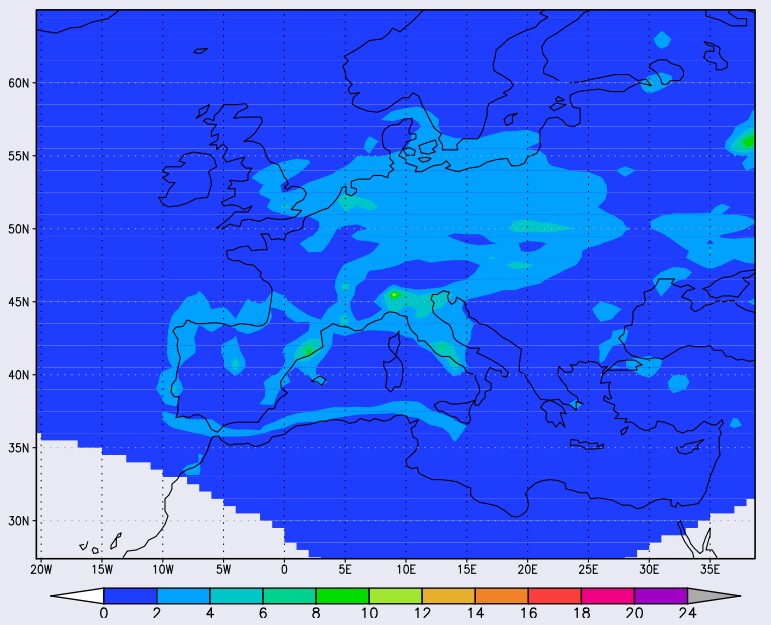
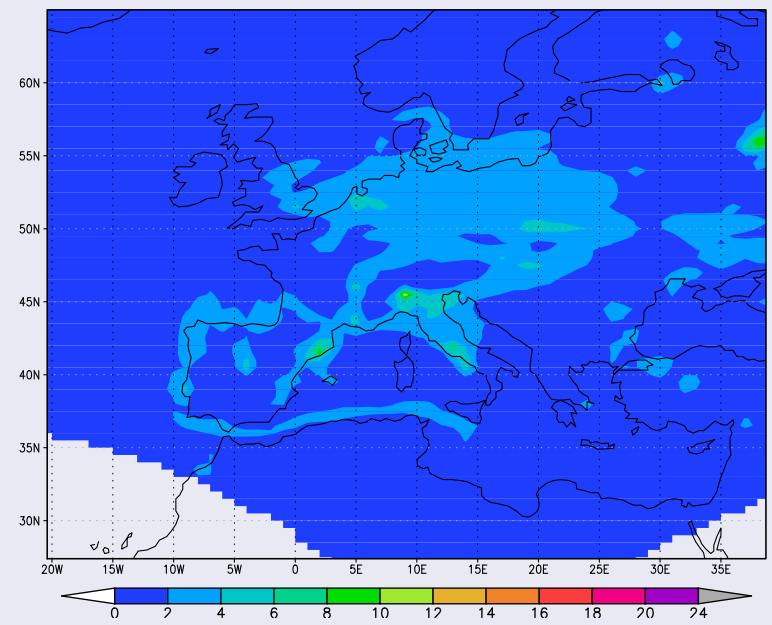


NO_2 concentrations from 4 to 8 January 2005.

7. January 2005.

EMEP 50



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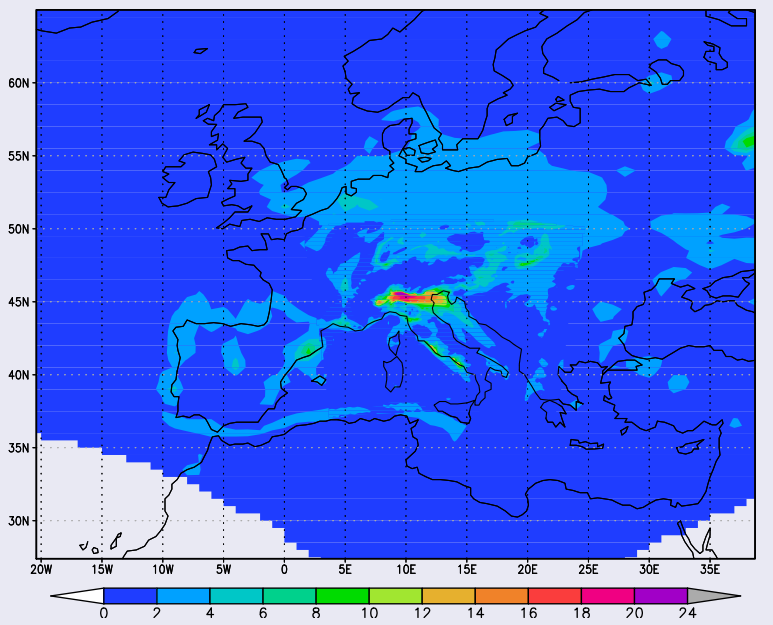
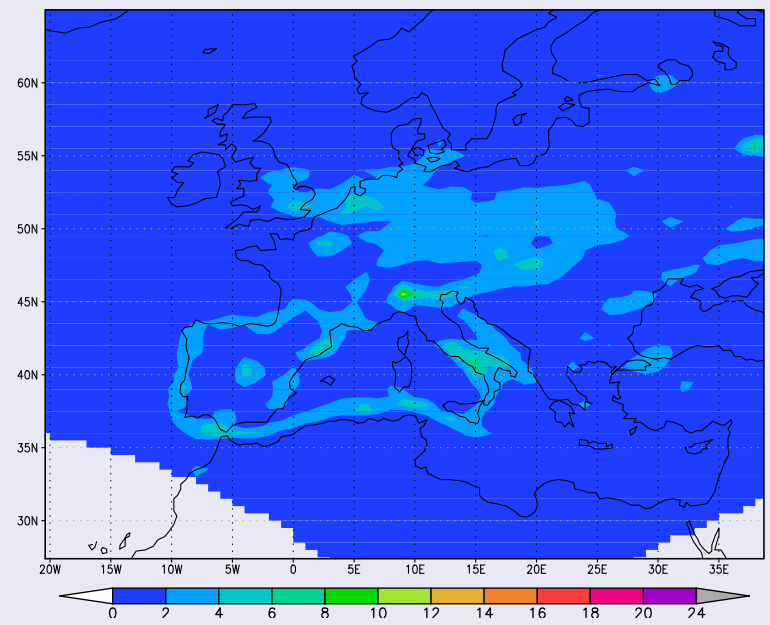


NO_2 concentrations from 4 to 8 January 2005.

8. January 2005.

EMEP 50



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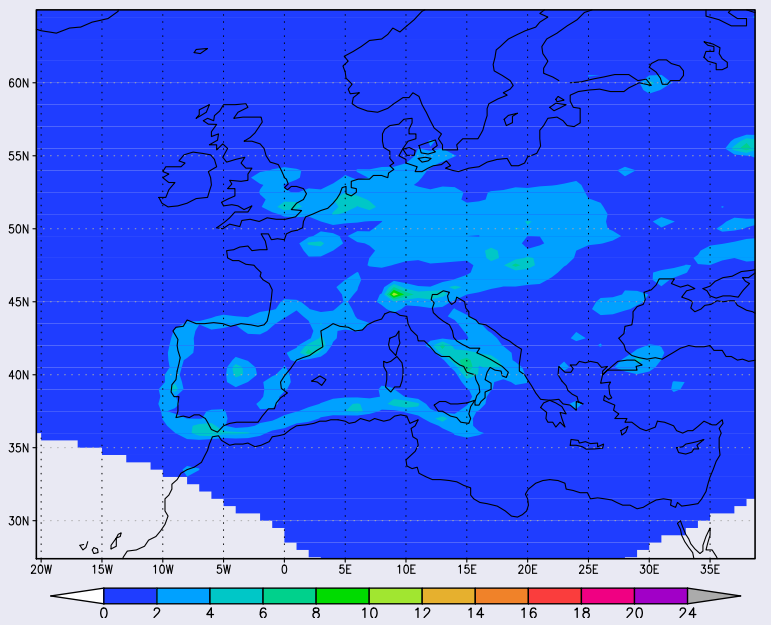
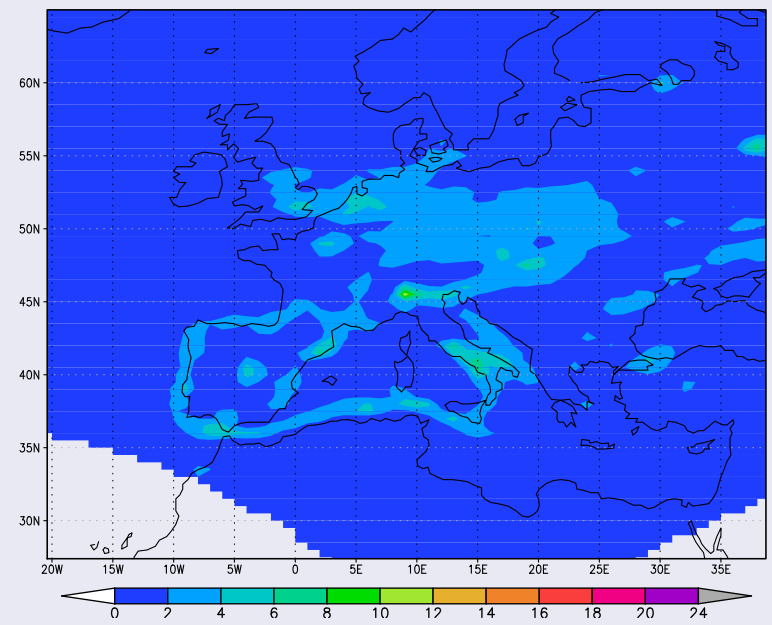


NO_2 concentrations from 4 to 8 January 2005.

8. January 2005.

EMEP 50



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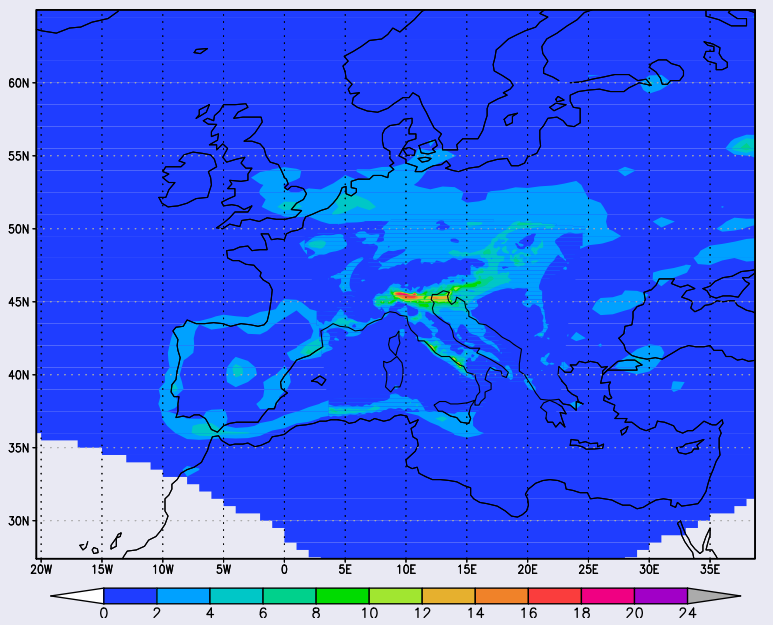
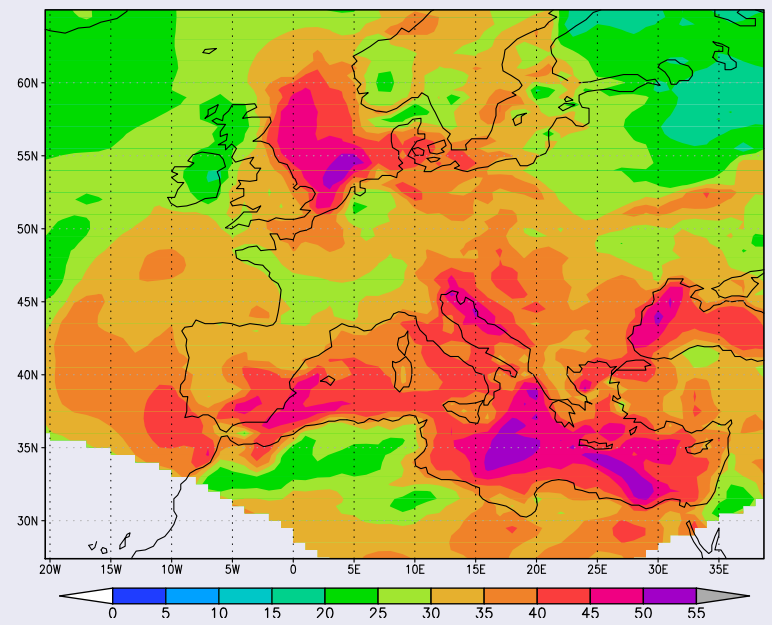


O_3 concentrations on 8 July 2005.

8. July 2005.

EMEP 50



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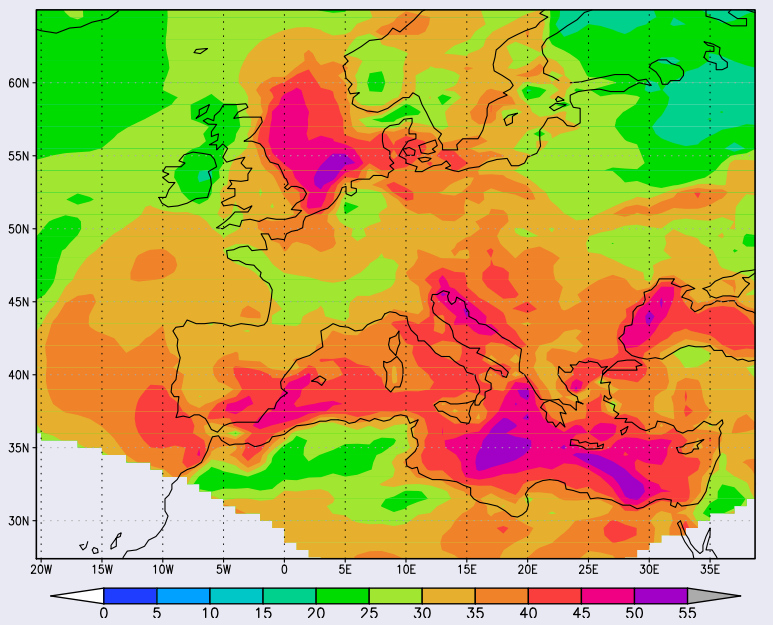
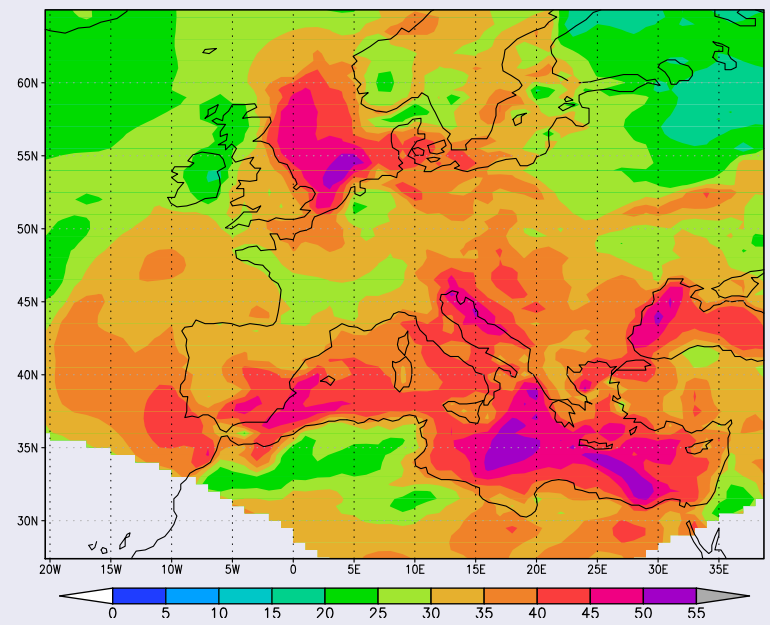


O_3 concentrations on 8 July 2005.

8. July 2005.

EMEP 50



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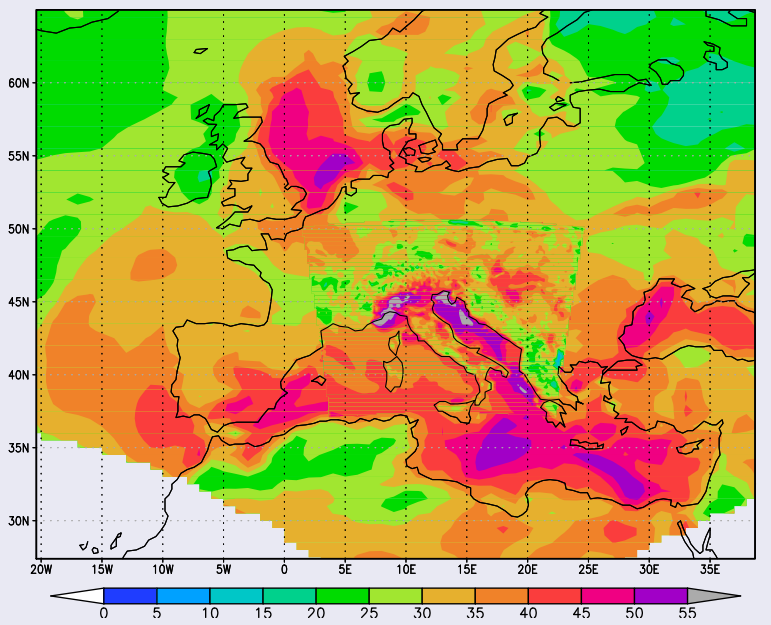
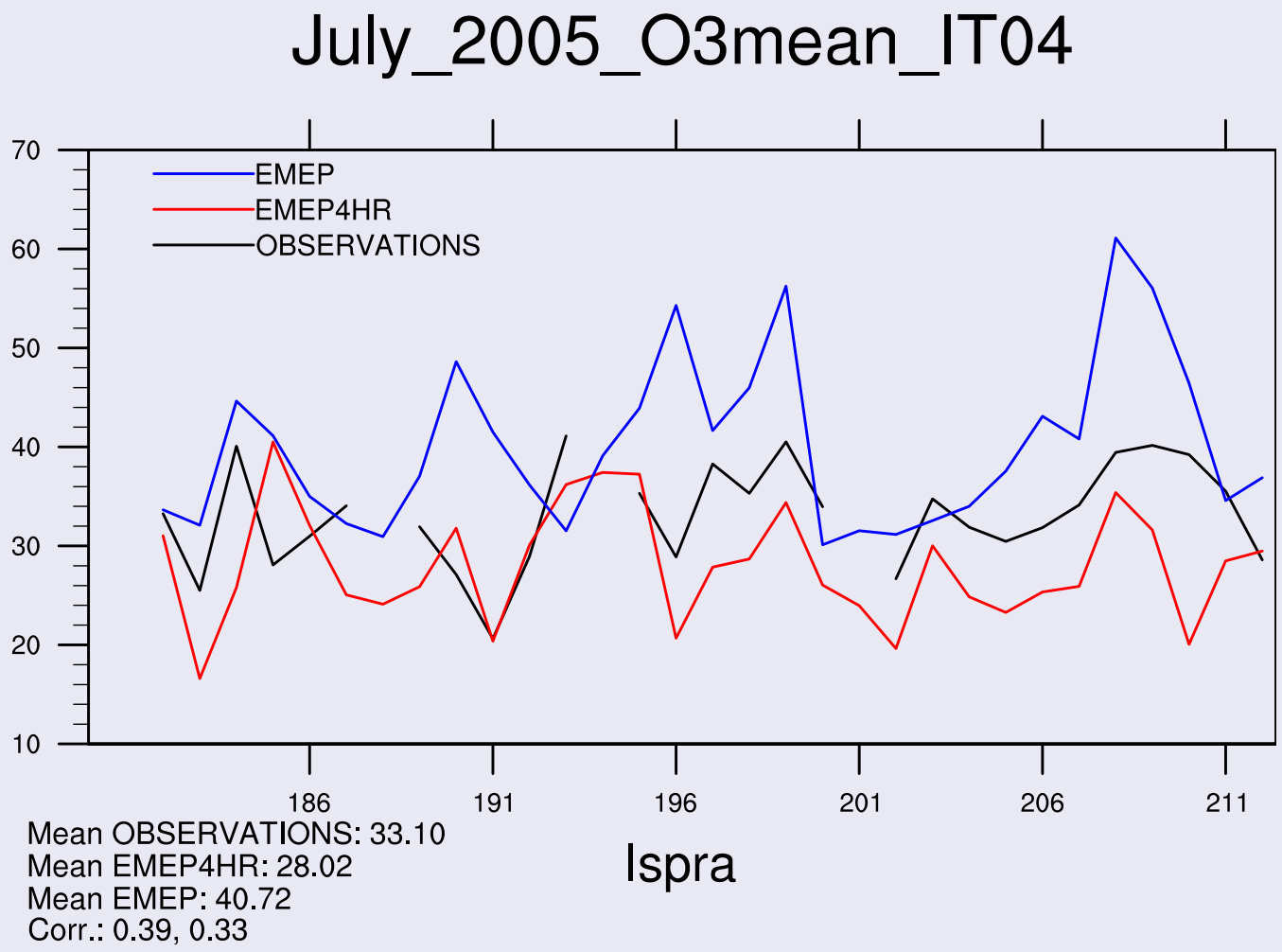


Outline

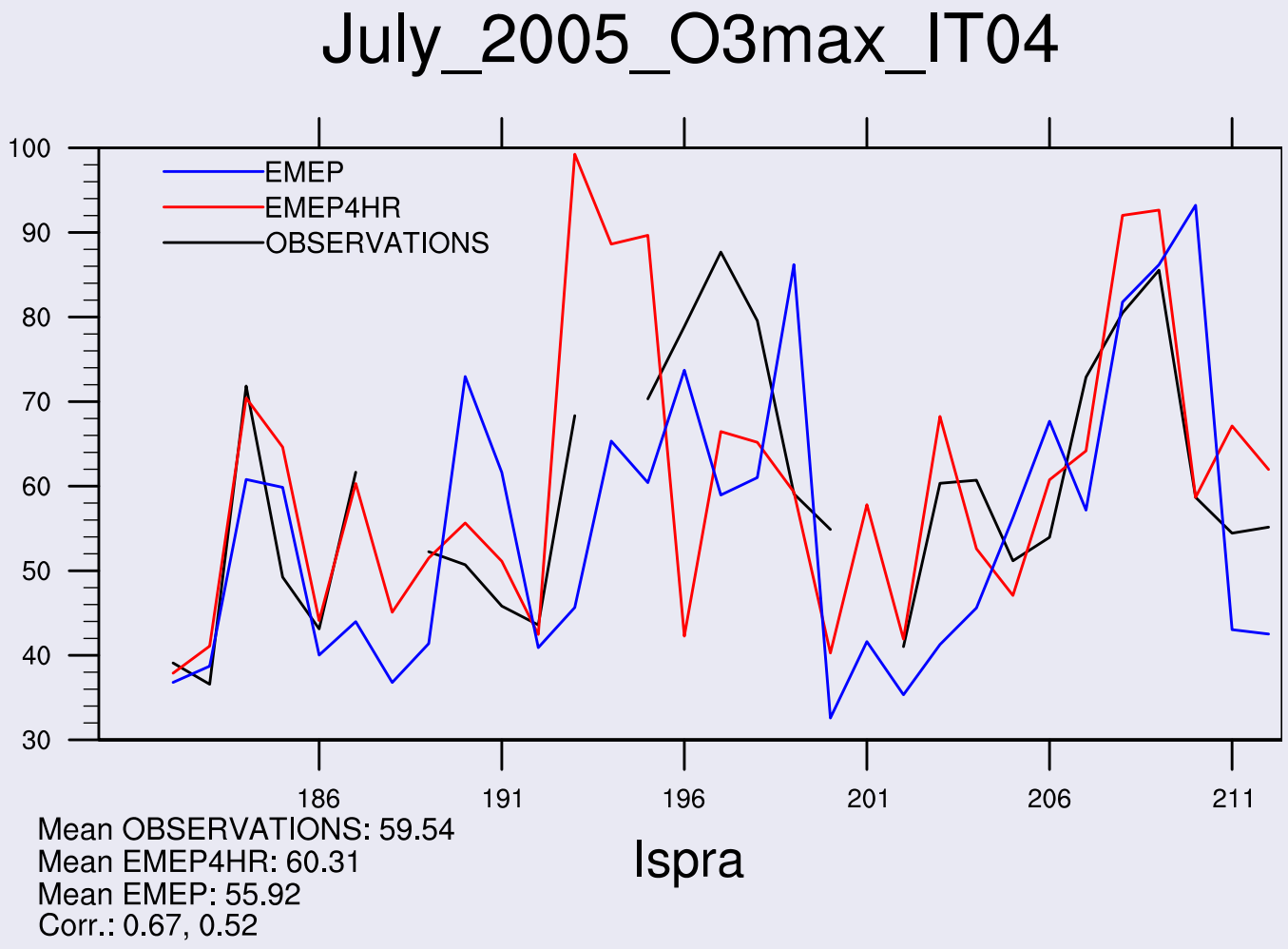
Time series at Ispra station Italy from 1. to 31. July 2005.

O_3



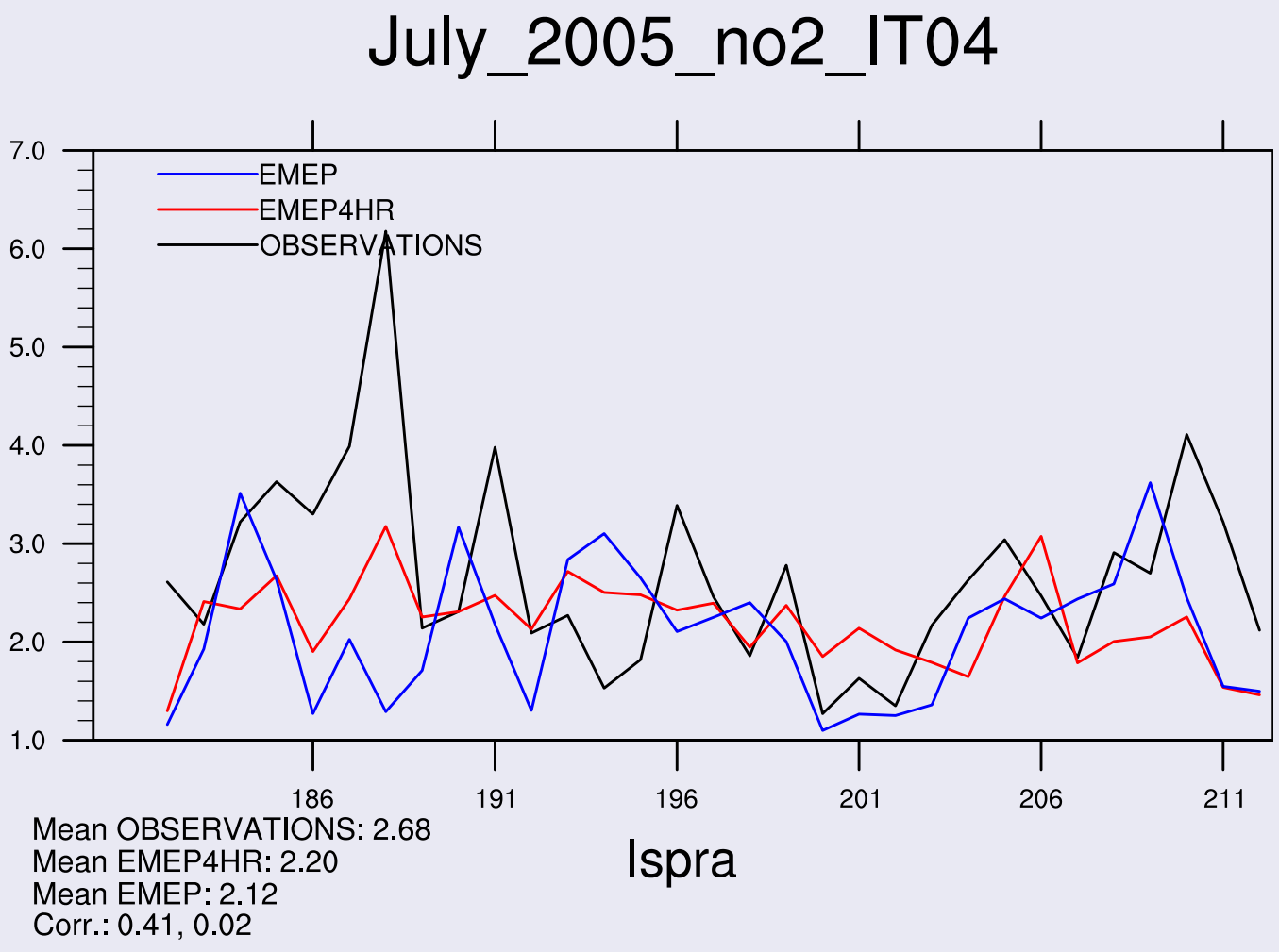
Time series at Ispra station Italy from 1. to 31. July 2005.

Max O_3



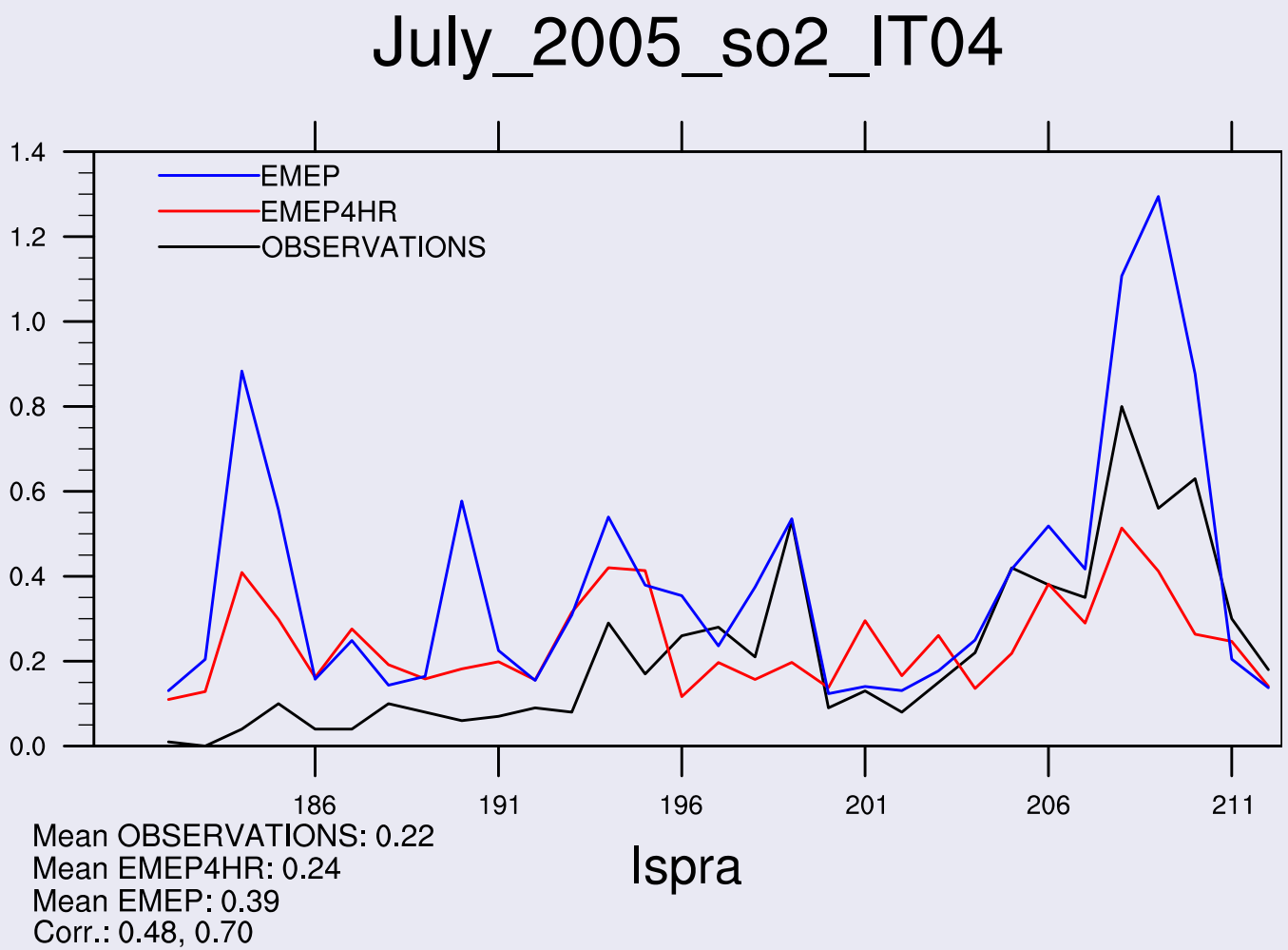
Time series at Ispra station Italy from 1. to 31. July 2005.

NO_2



Time series at Ispra station Italy from 1. to 31. July 2005.

SO_2



Outline

To do

- Make necessary modifications to ALADIN in order to have 3D accumulated fractional cloud cover and accumulated 3D precipitation as a model output
- Longer model runs – run years 2005, 2006 and 2007
- 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!