Pollution Assessment on a Country Scale

EMEP case studies on heavy metal pollution assessment with fine spatial resolution
Introduction

The main objective of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) is to provide sound scientific support for the Convention on Long-range Transboundary Air Pollution (Convention) in the areas of atmospheric monitoring and modelling, emission inventories and projections. Assessment of transboundary air pollution is fulfilled by regular monitoring of pollution levels at the EMEP measurement network and application of chemical transport models for the whole EMEP domain. Nevertheless, currently produced information on pollution levels in a country can be significantly extended by assessment performed on a country scale that involves variety of country specific information. A particular benefit of such assessment is achieved by close co-operation between EMEP and national experts. In order to reveal peculiarities and challenges of the national scale analysis and to demonstrate its additional value, a number of country specific case studies were initiated under EMEP. In the framework of these activities contamination of selected EMEP countries by heavy metals was investigated with fine spatial resolution. The approach allows taking into account specific features of countries' relief, weather conditions, location of emission sources, monitoring data etc. Additionally to the available EMEP data countries submitted complimentary information on national emission inventories and observations to facilitate the assessment. At current stage Croatia, the Czech Republic and the Netherlands participate in the study.

This brochure is prepared in accordance with the EMEP TFMM recommendation. It overviews approach and input data for the country specific case studies and summarizes main findings of the research.
Country-scale assessment: an approach

Model assessment was carried out for three countries (Croatia, the Czech Republic and the Netherlands) located in different parts of Europe and characterized by different environmental conditions. Pollution levels were simulated by MSC-E for limited model domains with high spatial resolution for 2007. Experts from participating countries delivered detailed country-specific input data. Results of the research were jointly analyzed, discussed at bilateral and TFMM meetings, and reported at the EMEP Steering Body sessions.
Contributions from the countries

In addition to available EMEP data, national experts submitted various country-specific data on emissions, monitoring, meteorological observations, concentrations of heavy metals in media etc.

**Emissions**

The countries provided gridded emission data with fine spatial resolution, including information on source categories and large point sources (the Netherlands and the Czech Republic with 5x5 km², Croatia with 10x10 km² resolution).

**Measurements**

Measurements from national monitoring programmes were presented. For example, concentrations and wet deposition fluxes from almost 100 stations were submitted by the Czech Republic.

**Supporting information**

Supporting information including meteorological observations and concentrations of heavy metals in media was also delivered by the countries.
Assessment with fine resolution

Modelling with fine spatial resolution provides more detailed information on pollution levels and generally leads to the improvement of agreement between modelled and observed values.

Total deposition of Cd in the Czech Republic

Modelled and observed Cd air concentrations at station Rudolice v Horah (the Czech Republic)

Quality of the country-scale assessment is determined to great extent by various factors including peculiarities of local conditions, resolution of emission data, adequacy of model parameterizations etc.
Effect of small-scale orography and meteorology

Transition to fine resolution allows capturing small-scale country-specific peculiarities, which are not resolved when coarse resolution is used. For example, modelling with fine resolution reproduces orographic precipitation along mountainous regions and associated increased deposition. When resolution is coarse, precipitation and deposition fields are smoothed.

Refinement of Pb deposition field in Croatia due to increased resolution of precipitation data
High resolution allows to better resolve emissions and deposition along state borders. Coarse resolution of emission data in neighbouring countries can lead to additional uncertainties of pollution levels in a country. An example for Croatia and neighbouring Bosnia and Herzegovina is demonstrated below.
Refinement of model parameterizations

Refinement of spatial resolution does not always lead to the improvement of the assessment results. It often requires refinement of model parameterizations and supporting input information. For example, transition to finer resolution (‘original’) as such does not improve agreement between modelled and measured air concentrations in the Netherlands.

However, refinement of model parameterization of wind re-suspension with fine resolution (‘refined’) helps to significantly reduce discrepancies between the modelled and observed values. This experience can be transferred for the other EMEP countries.

Modelled and observed Pb air concentrations at Dutch and Belgian stations

Wind re-suspension of Pb in the Netherlands, kg/km²/y
Policy-relevant information

Assessment of pollution levels with fine spatial resolution makes possible to provide countries with variety of detailed country-specific information, such as:

- Spatial distribution of pollution levels with high resolution (concentrations, deposition, contributions of external sources etc...)
- Contamination of country’s provinces
- Pollution levels caused by different emission source categories
- Contamination from individual large point sources (LPS)
- Transboundary transport of pollution between country’s provinces.

Contamination of country’s provinces

Model assessment with fine resolution allows determining pollution levels not only for a country as a whole, but also for its individual provinces. This detailed country-specific information can be used by country’s authorities for the improvement of national environmental policy.
Deposition from emission source categories

Information on pollution levels caused by emission source categories can be produced for individual provinces. For example, in the eastern part of the Czech Republic (Moravskoslezsky region) the main contribution to Cd levels is made by the category *Iron and Steel production*, while in the western part - by the category *Public energy production*.

Cd deposition from national sources in the Czech Republic and contribution of different emission source categories to deposition in the provinces
**Contribution of large point sources to deposition**

Emission data on individual large point sources (LPS) allow to evaluate their contributions to pollution both in a country and in neighbouring countries. Two figures below exemplify contributions of Prunerov II power station and Arcelor-Mittal steel plant to Cd deposition in the Czech Republic.

**Prunerov II Power Station**
*Emission: 207 kg/y (6%)*

**Arcelor-Mittal Ostrava Steel Plant**
*Emission: 859 kg/y (26%)*

The study could be of interest not only for national environmental authorities but also for industries.
Transboundary transport

Transboundary pollution from other EMEP countries

Modelling with fine resolution provides detailed maps of pollution levels from external sources to anthropogenic deposition in a country. This information could be significantly improved if emission data with fine resolution in neighbouring countries become available.

Atmospheric transport of Cd between country’s provinces

Increased spatial resolution gives opportunities to assess transboundary transport between individual administrative regions.
Concluding remarks

- Modelling with fine spatial resolution provides detailed information on pollution levels in a country and generally leads to the improvement of the pollution assessment quality.

- Transition to fine resolution allows taking into account influence of peculiarities of individual countries on pollution levels (e.g., relief, meteorological conditions, individual LPS, etc). However, detailed analysis of factors affecting the assessment is needed.

- In addition to the EMEP annual information on transboundary air pollution countries can receive the following information: spatial distribution of pollution with fine resolution, contamination levels caused by emission source categories and large point sources, transboundary transport between country’s provinces, etc.

- Coarse spatial distribution of emissions in neighbouring countries leads to additional uncertainties of pollution level assessment in a country.

- Assessment of pollution levels with fine resolution requires refinement of the EMEP model parameterizations and input data.

- Modelling tool developed in this study can be provided to countries in order to support air pollution assessment at a country level.

- The study involves national experts in more close cooperation within EMEP and could help countries in improving national air quality management strategies.
This booklet has been prepared by the EMEP/Meteorological Synthesizing Centre – East (MSC-E).

More detailed information is available at MSC-E website (www.msceast.org) and in the EMEP reports:


“Assessment of Heavy Metal Pollution Levels in the Czech Republic (EMEP case study)” Joint MSC-E/CHMI Report, 1/2012.

“Heavy Metal Transboundary Pollution of the Environment” EMEP Status Report 2/2013.