1. Introduction

The first EMEP Centres Joint Report for HELCOM was delivered in 1997 (Tarrason *et al*. 1997) and was followed by eight annual reports (Bartnicki *et al*. 1998, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008). The present EMEP Centres Joint Report for HELCOM is focused on the year 2007. It is based on the modelling and monitoring data presented to the 33rd Session of the Steering Body of EMEP in Geneva in September 2009.

Following decisions of the 9th HELCOM MONAS Meeting held in Silkeborg in 2007, the main deliverables expected from the EMEP Centres are the Indicator Fact Sheets for nitrogen, heavy metals and PCDD/Fs. These Indicator Fact Sheets include time series of emissions and depositions of selected pollutants, and can be found on the HELCOM web pages (links shown in Appendix C). In this report we present additional important information about emissions, depositions and source allocation budgets for nitrogen, heavy metals and PCDD/Fs in the year 2007.

Eight countries have submitted data for 2007 from all together twenty three HELCOM sites, with measurements representative for all six sub basins defined for measurements. Here Bothnian Sea and Bay are combined to one common basin, Gulf of Bothnia. Though, not all sites measure all the HELCOM relevant parameters. Thirteen sites have reduced and oxidised nitrogen in air and eighteen in precipitation. For heavy metals there were nine stations with cadmium and/or lead in air, while twelve in precipitation. There are two sites with mercury measurements in air and precipitation. All the data can be downloaded from ebas.nilu.no.

The EMEP Unified Eulerian model system has been used for all nitrogen computations presented here. The model has been documented in detail in EMEP Status Report 1/2003 Part I (Simpson *et al.* 2003) and in EMEP Status Report 1/2004 (Tarrasón *et al*., 2004). In EMEP Status Report 1/2003 Part II (Fagerli *et al.* 2003) we presented an extensive evaluation of the acidifying and eutrophying components for the years 1980, 1985, 1990 and 1995 to 2000. In EMEP Status Report 1/2003 Part III (Fagerli *et al.* 2003), a comparison of observations and modelled results for 2001 was conducted, and in EMEP Status Report 1/2004 (Fagerli, 2004) we presented results for 2002 with an updated EMEP Unified model, version 2.0. This version differed slightly from the 2003 version, as described in EMEP Status Report 1/2004 (Fagerli, 2004), however the main conclusions on the model performance was the same. In 2005, we presented results for the year 2003 in EMEP Status Report 1/2005 (Fagerli, 2005) and last year we presented results for 2004 in EMEP Status Report 1/2006 (Fagerli *et al.* 2006). It has been shown that the EMEP model performance is rather homogeneous over the years (Fagerli *et al.* 2003), but depend on geographical coverage and quality of the measurement data. The EMEP model has also been validated for nitrogen compounds in Simpson *et al*., 2006, and for dry and wet deposition of sulphur, and wet depositions for nitrogen in Simpson *et al*., 2006b with measurements outside the EMEP network. Since last year, no changes with significant effects on the results for acidifying and eutrophying compounds have been introduced in the model. Moreover, the comparison between model results and observations for 2005 give similar correlation coefficients and bias as the comparisons performed for earlier years. The previous evaluations of the model are thus still valid.

Last year, the Steering Body adopted an extension of the official EMEP domain to facilitate the inclusion of countries in Eastern Europe, Caucasus and Central Asia (EECCA) in the EMEP calculations (ref. ECE/EB.AIR/GE.1/2007/9, Item 3 of the provisional agenda of thirty-first session of the EMEP Steering Body, available from http://www.unece.org/env/lrtap/emep/emep31_docs.htm). Thus from 2008, the official 50 x 50 km^2 polar stereographic EMEP grid has been extended from 132 x 111 to 132 x 159 grid cells, following Stage 1 in ECE/EB.AIR/GE.1/2007/9. In geographical projection it leads to an extension eastward as well as northward. Both the old and new extended EMEP domains are presented in Figure 1.1.

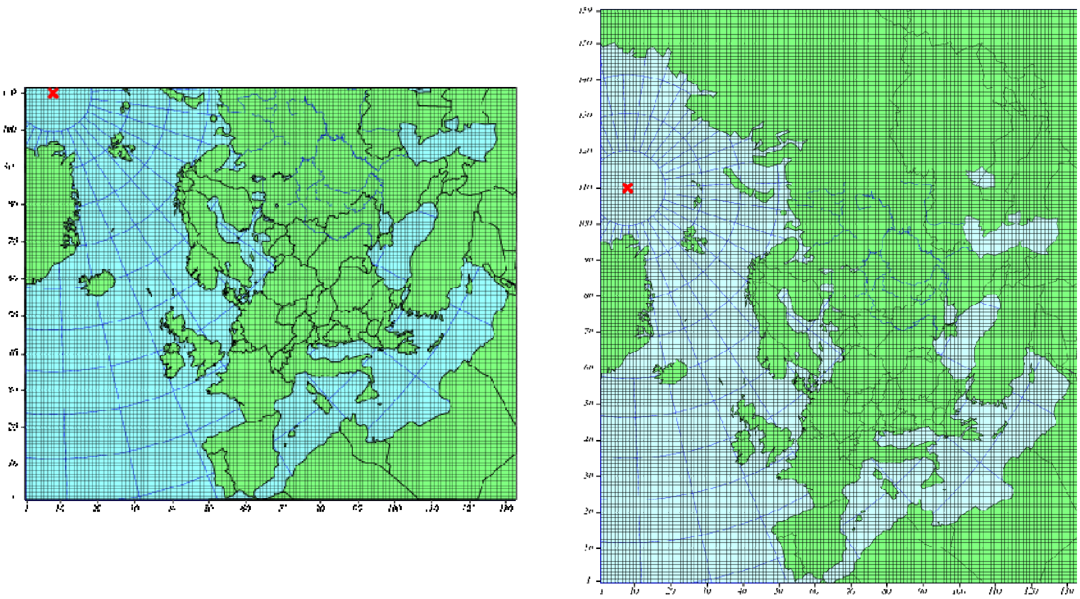

Figure 1.1. Comparison of old (used before 2009) official EMEP domain on the left side and new official EMEP domain on the right side

The present extension of the EMEP modelling area has many advantages, but also recognized drawbacks. Min advantage is a possibility of taking into account much larger part of the Russian emissions in the extended model domain. One of the drawbacks is that the current extended EMEP domain still only partly covers the Russian Federation. It is also recognized that results on air pollution in central Asian countries are highly dependent on sources outside the calculation domain. Countries in Central Asia are contiguous with other Asian countries like China, India, Pakistan and Iran, that significantly affect pollution levels over the ECCA territories but are not included directly in the calculations. Additional disadvantage of using the extended EMEP domain is the lack of consistency between the model results for the period 1995 2006 and the model results for 2007. Consequently, the current EMEP modelling capacity for EECCA countries and the related grid domain is an interim solution upto 2011. After that, a new EMEP official domain covering adequately transport of pollution to all 12 EECCA countries is expected to be adopted.

Atmospheric input and source allocation budgets of heavy metals (cadmium, lead, and mercury) to the Baltic Sea were computed using the latest version of MSCE-HM model. MSCE-HM is the regional-scale model operating within the EMEP region. This is a three-dimensional Eulerian model which includes processes of emission, advection, turbulent diffusion, chemical transformations of mercury, wet and dry depositions, and inflow of pollutant into the model domain. Horizontal grid of the model is defined using stereographic projection with spatial resolution 50 km at 60º latitude. The description of EMEP horizontal grid system can be found in the internet (http://www.emep.int/grid/index.html). Vertical structure of the model consists of 15 non-uniform layers defined in the terrain-following σ-coordinates and covers almost the whole troposphere. Detailed description of the model can be found in EMEP reports (Travnikov and Ilyin, 2005) and in the Internet on EMEP web page http://www.emep.int under the link to information on Heavy Metals.

Evaluation of PCDD/F atmospheric input to the Baltic Sea was carried out using the latest version of MSCE-POP model. MSCE-POP model is a three-dimensional Eulerian multimedia POP transport model operating within the geographical scope of EMEP region with spatial resolution 50 km at 60º latitude. Vertical structure of MSCE-POP is defined similar to MSCE-HM model. MSCE-POP considers the following compartments: air, soil, sea, vegetation and forest litter fall. The model includes the following basic processes: emission, advective transport, turbulent diffusion, dry and wet deposition, gas/particle partitioning, degradation, and gaseous exchange between the atmosphere and the underlying surface (soil, seawater, vegetation). Detailed description of MSCE-POP model is given in EMEP report (Gusev *et al*., 2005) and in the Internet on EMEP web page http://www.emep.int under the link to information on Persistent Organic Pollutants.

The formulation of MSCE-HM and MSCE-POP models and their performance were thoroughly evaluated within the framework of activity of EMEP/TFMM on the EMEP Models Review (ECE/EB.AIR/GE.1/2006/4). One of the main conclusions of the TFMM Workshop held in Moscow in 2005 was that MSCE-HM and MSCE-POP models represent the state of the science and fit for the purpose of evaluating the contribution of long-range transport to the environmental impacts caused by HMs and POPs.

As decided by HELCOM all depositions, as well as, source allocation budgets have been calculated for the six sub-basins and catchments of the Baltic Sea. Names and acronyms of these regions, often used in the report are given below:

1. Gulf of Bothnia (GUB)
2. Gulf of Finland (GUF)
3. Gulf of Riga (GUR)
4. Baltic Proper (BAP)
5. Belt Sea (BES)
6. The Kattegat (KAT)

Depositions and source allocation budgets have been also calculated for the entire basin and the entire catchment of the Baltic Sea. According to HELCOM requirements, the present annual joint report includes mainly figures and tables describing emissions, depositions and source allocation budgets for nitrogen, heavy metals and PCDD/Fs.