1. Executive Summary

Following decisions of the fourth HELCOM-MONAS meeting in Warnemünde, the present 2003 Joint EMEP Report for HELCOM has two main goals. First, to provide the routine annual data required by HELCOM-INPUT, considering atmospheric input to the Baltic Sea. Second, it should also provide the input data for the draft of the indicator report. Therefore, monitoring data, model results and analysis, included here, cover one specific year - 2001.

Main points for each compound

Nitrogen

Measured concentrations of NO_2 in 2001 show a clear decrease from south to north, and also a winter maxima/summer minima, both related to the burning of fossil fuels. Observations of the total oxidized nitrogen are decreasing in air concentrations moving from the Kattegat to the southern Baltic Proper. Seasonal patterns are not pronounced. Observations of the total airborne reduced nitrogen in 2001 are focused on the south. On this occasion, the decrease in concentrations away from the Kattegat region may be discernible, but is small. A seasonal pattern, however, is noticeable, the maxima occurring during summer months.

Annual emissions of nitrogen oxides and ammonia from the HELCOM Parties have not changed much from 2000 to 2001 and these changes do not influence much calculated annual nitrogen depositions in 2001. The lack of updated information about nitrogen oxides emission from the international ship traffic still remains a problem. The latest ship emission data are from 1990.

A new version of the unified model has been used for nitrogen computations for 2001. This model has been documented and verified against measurement data at EMEP stations for ten different years in the EMEP Status Report 1/2003 (Simpson *et al.* 2003).

Computed 2001 annual depositions of both, oxidized and reduced nitrogen are lower than corresponding 2000 depositions in five of six sub-basins of the Baltic Sea. A small increase of the reduced nitrogen deposition occurs only in the Belt Sea sub-basin. Since, emissions remain on the same level in both years, new model version used for 2001 computations, different meteorological conditions and larger precipitation amount over the most of the Baltic Sea region in 2000 than in 2001 are the main reasons for reduced

depositions. There is no clear seasonal pattern of computed deposition in 2001, but in general maxima of the deposition can be observed in April, and minima in May.

Source-allocation budgets for nitrogen are based on 2000 data. Main emission sources of oxidized nitrogen deposition to the Baltic Sea are located in Germany, Poland and belong to the ship traffic on the Baltic Sea. It should be noted, however, that the distant emission sources, such as United Kingdom, France and ship traffic on the North Sea have also significant contribution to the deposition. In case on reduced nitrogen, local sources are more important. The main contributors to reduced nitrogen deposition are: Germany Poland and Denmark.

In general, the agreement between model results and measurements of nitrogen compounds at HELCOM stations is good and comparable to the model performance for the EMEP sites. Thus, the model provides a reliable tool in order to assess the nitrogen supply to the Baltic Sea. However, in order to make a proper evaluation of model performance, monthly measurements from the HELCOM database are not satisfactory. Daily data for the model evaluation would be an improvement.

Heavy metals

Atmospheric input of cadmium, mercury and lead to the Baltic Sea was evaluated on the basis of official information on heavy metals emissions using the latest version of MSCE-HM model. Annual and monthly depositions of heavy metals to six sub-basins and six catchments of the Baltic Sea were computed. Source allocation budgets of lead, cadmium, and mercury depositions to the Baltic Sea sub-basins and catchments were estimated using the computations of transboundary fluxes within the EMEP region. Obtained results were compared with available measurement data of HELCOM monitoring stations.

Annual emissions from anthropogenic sources of HELCOM countries in 2001 amounted to 120 tonnes for cadmium, 66 tonnes for mercury, and 3578 tonnes for lead. Comparing to 2000 emissions of mercury and lead have somewhat decreased. In case of cadmium slight increase of total annual emission can be noted. Among the HELCOM countries the largest contributions to heavy metals emissions of HELCOM countries in 2001 belong to Poland, Germany, and Russia.

According to modelling results total annual atmospheric depositions of cadmium to the Baltic Sea in 2001 were about 8 tonnes, mercury depositions 3 tonnes, and lead depositions 143 tonnes. Comparing to the level of 2000 heavy metals depositions have decreased by approximately 10%. This decrease is mainly caused by year-to-year variation of meteorological conditions. In spatial distribution of heavy metals depositions

on the Baltic Sea the highest levels can be noted for the southern-western part of the Baltic Sea (Belt Sea and Baltic Proper). Significant levels of lead and cadmium depositions can also be noted for the Gulf of Riga.

Anthropogenic sources of heavy metals emissions of HELCOM countries contributed to the deposition over the Baltic Sea in 2001 about 40%. An essential contribution to total depositions of heavy metals belongs to the input of re-emission and natural sources. On the level of individual countries the most significant contributions to depositions of heavy metals over the Baltic Sea belong to Poland, Germany, and Russia. For mercury essential contribution to depositions comparing to other countries belongs also to Denmark.

Lindane

Atmospheric input of lindane to the Baltic Sea and its catchment area was evaluated for 2001 using MSC-E Eulerian multimedia POP transport model MSCE-POP. Modelling was performed using available emission data officially reported by EMEP countries to the UN ECE Secretariat and expert estimates of lindane emissions. Based on this information the most significant sources of lindane in 2001 were outside the Baltic Sea area in the United Kingdom, Portugal, Spain, and Belgium.

Evaluation of lindane long-range transport and depositions to the Baltic Sea area was based on computations for the period 1990-2001. Computations for long period were carried out to take into account long-term accumulation of lindane in soil and sea water. Annual and monthly deposition fluxes of lindane in 2001 were computed for six sub-basins and six catchments of the Baltic Sea. For most of sub-basins of the Baltic Sea the re-emission process takes place exceeding the wet and dry deposition fluxes. Over the southern part of the Baltic Proper sub-basin (BAP) wet and dry depositions dominate in total deposition of lindane. Obtained results were compared with available monitoring data of lindane concentrations in air and precipitation in the Baltic Sea region.