1. Executive Summary

Following decisions of the third HELCOM-MONAS meeting in Ispra, the present 2002 Joint EMEP Report for HELCOM has two main goals. First, to provide the data required by PLC task, considering atmospheric input. 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 the five-year period 1996 – 2000, instead of usual one year.

Main points for each compound

Nitrogen

A new Unified model has been used for nitrogen computations for the period 1996 – 2000. All tests performed up to now indicate that the new model is better and more credible than the old one. However, one has to be careful and we recommend that the result for nitrogen presented here should be concerned as preliminary, until the new model becomes operational – this is planned for December 2002.

Emission data used for the model computations slightly declined between 1996 and 2000, both in case of nitrogen oxides and ammonia. Annual emissions of nitrogen oxides from all HELCOM countries were reduced 13.5%, ammonia emissions 11% and total nitrogen 9%. Nitrogen oxides emissions from the international ship traffic on the Baltic Sea were not taken into account in these computations because of the lack of data for the considered period. Nitrogen emission reduction was more effective in case of HELCOM countries than for the entire EMEP domain (9% - nitrogen oxides, 4% - ammonia).

However, the pattern in observed air concentrations for nitrogen compounds in the years 1996-2000 has been uncertain. There is some suggestion of decline in concentrations on the southern Baltic shore, but otherwise the temporal pattern is somewhat erratic. Also the observed concentrations of nitrate and of ammonium in precipitation do not themselves reveal clear temporal patterns in the period 1996-2000.

Similar to observations, the time series of computed annual depositions for the period 1996 – 2000 also do not follow the reported emission changes. Taking into account uncertainty in the model results, which is roughly 30%, both measured and computed values do not differ significantly. One possible explanation why the effects of the modest emission changes are not reflected in the computed depositions, may be a dominant effect of meteorology over this short time period.
A second and potentially important reason for slightly different pattern of emission on

one side versus measurements and computed depositions on the other side is the lack of information on nitrogen emissions from the international ship traffic on the Baltic Sea for other years than 1990, together with inevitable uncertainty in the reported terrestrial emissions. The shipping emission source is a major contributor to the nitrogen deposition to the Baltic Sea and if neglected or underestimated can create significant errors in computed depositions. Finally, the influence of distant emission sources, from countries beyond the HELCOM region, should not be underestimated. Some nitrogen components can be long lived in the atmosphere.

Heavy metals

Based on available official data and expert estimates, the emissions of heavy metals from the HELCOM countries have decreased during 1996-2000 by 26% for Cd, 15% for Hg, and 10% for Pb. For the entire EMEP region, the decrease of heavy metal emissions is more significant. Thus lead emissions in 2000 were 31%, cadmium 22%, and mercury 17% lower than those in 1996.

Measured air concentrations of heavy metals, like in the case of nitrogen, do not indicate a consistent regional pattern in the years 1996-2000. Air concentrations in Germany and Denmark indicate some decline, but with a variable pattern elsewhere.

Temporal patterns are equally unclear. The analysis was started only from 1990 in order to maintain reasonable comparability in the stations with available data. However, the degree of inter-annual variability appears quite large, such that by this approach patterns are not apparent. Care should be taken, as stations utilized did vary slightly year-to-year. However, reviewing the observed concentrations at individual stations does not indicate consistent regional patterns. For example, for lead there appears to be decline at Zingst and Vilsandy in Germany and Estonia respectively, while between these there is a very variable pattern.

According to modelling results for the period 1996-2000, atmospheric depositions of lead and cadmium to the Baltic Sea region decreased by approximately 4%. Atmospheric depositions of mercury increased by 14% during this period.

As in the case of nitrogen, computed depositions of heavy metals do not follow closely the emission pattern for the years 1996 – 2000. Again one reason for such behavior could be sensitivity of the heavy metals model to meteorological conditions. However, in this case, information about heavy metals emissions from the international ship traffic on the Baltic Sea does not exist. If taken into account, this important emission source can significantly change the existing emission pattern for the period 1996 – 2000.

Source allocation budgets of heavy metals depositions to the Baltic Sea were computed for the entire period 1996 – 2000. In comparison with 1996 the input of anthropogenic sources to atmospheric depositions in 2000 is decreased. An essential contribution belongs to the input of natural, previous and remote anthropogenic sources.

For cadmium, the contribution of HELCOM countries to total deposition onto the Baltic Sea is decreased during the 1996-2000 from 50% to 39%. Among these countries, the most significant contribution belongs to anthropogenic emission sources of Poland – 34% in 1996 and 24% in 2000. Other EMEP countries contribute 7% in 1996 and 11% in 2000.

For lead, the contribution of HELCOM countries to total deposition onto the Baltic Sea is decreased from 39% to 31%. Among these countries, the most significant contribution belongs to sources of Poland – 14% in 1996 and 11% in 2000. Other EMEP countries contribute about 20%.

For mercury, the contributions of HELCOM countries and other EMEP countries to total depositions onto the Baltic Sea were practically on the same level during the period 1996-2000. The most significant contribution from HELCOM countries in 1996 belongs to Poland (15%) and in 2000 to Germany (19%). Other EMEP countries contribute 5-6%.

Lindane (γ-HCH)

According to available official information and expert estimates, most of the changes in γ-HCH emissions have taken place in the 1970s and 1980s as a result of restrictions or banning of the use of lindane in these countries. During the period 1990-1998 emissions of lindane (γ-HCH) in the Baltic Sea region decreased by almost two orders of magnitude. At the same time lindane emissions of the entire European region decreased only by 20% during this period.

In spite of significant decrease in emissions of HELCOM countries during the period 1990-1998 the level of lindane (γ-HCH) depositions to the Baltic Sea decreased only by 14%. This is connected with the influence of sources of lindane emissions outside the Baltic Sea region.

Recommendations to HELCOM

The new Unified model used for nitrogen computations is still being extensively tested and not in operational use yet at least until December this year. All tests performed up to now indicate that the new model is better and more credible than the old one. However, one has to be careful and we recommend that the result for nitrogen presented here should be concerned as preliminary, until the new model becomes operational.

Lack of, or inaccurate, emission data for international ship traffic on the Baltic Sea can be a potential reason for the differences between the pattern of computed depositions and emission pattern for the years 1996 – 2000. Therefore, we recommend the update of nitrogen emission data from the ship traffic on the Baltic Sea for all five years, or at least for the beginning and end of the considered period.

Corresponding emission data do not exist for heavy metals at all. At least for lead and cadmium, emissions from the ship traffic can be an important source to the deposition of these metals on the Baltic Sea. Therefore, we recommend that such emission inventories should be developed, at least for two mentioned metals and one of the recent years.

Regional pattern of atmospheric deposition to the Baltic Sea varies strongly from component to component. Both measurements and model results are needed for estimation of the atmospheric load of pollution. Long term measurement series from the stations close to the cost or located on the islands are especially useful for this purpose.