EXECUTIVE SUMMARY

Model assessment of atmospheric inputs of selected heavy metals, including cadmium (Cd), lead (Pb), and mercury (Hg) to the maritime area of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) was carried out. The results of the assessment comprise annual anthropogenic emissions of Pb, Cd and Hg from the OSPAR Contracting Parties for the period 1990-2019, modelled time-series of total annual atmospheric deposition of the selected heavy metals to 5 regions of the OSPAR maritime area in 1990-2019 and contributions of the OSPAR Contracting Parties to total annual deposition of Cd, Pb, and Hg to the OSPAR regions in 1995, 2005 and 2015. In addition, the modelling results were evaluated against monitoring data from the OSPAR Comprehensive Atmospheric Monitoring Programme (CAMP) for available years of the period. The modelled time-series of total annual atmospheric deposition to the OSPAR maritime regions were also compared with previous estimates performed for the period 1990-2006 (OSPAR, 2009).

Emissions of Pb, Cd and Hg in the OSPAR Contracting Parties were reduced over the considered period by 96%, 73%, and 83%, respectively. The most significant emissions reduction occurred in the first third of the period. Among the OSPAR Contracting Parties the largest reduction of Pb emissions took place in France (98%), Sweden (98%) and the United Kingdom (97%), whereas Pb emissions in Iceland increased by 77%. The strongest decline of Cd emissions occurred in Finland (88%) followed by France (87%). Mercury emissions the most significantly decreased in Denmark (93%) and the United Kingdom (90%).

Deposition of the considered heavy metals to the OSPAR maritime area considerably decreased in the period from 1990 to 2019, following the emission reduction. The largest deposition decline was found for the Greater North Sea (Region II), where the deposition decreased by 87%, 80% and 45% for Pb, Cd and Hg, respectively. The lowest deposition reduction was estimated for the Arctic Waters (Region I) and the Wider Atlantic (Region V), where deposition decline amounted to about 55 – 60% for Pb, about 35 – 40% for Cd, and below 25% for Hg. The decline of deposition to the OSPAR regions is lower than the emission reduction because of the effect of secondary and global sources.

The largest contribution of the OSPAR Contracting Parties to atmospheric deposition of heavy metals is estimated for the Greater North Sea (Region II), while the lowest – to the Arctic Waters (Region I) and the Wider Atlantic (Region V). The major contributors to the Regions I, II, III are the United Kingdom, France and Germany, whereas the Regions IV and V are mostly affected by Spain, Portugal, France and the United Kingdom. Due to reduction of anthropogenic emissions contribution of the total deposition declined markedly from 1995 to 2005, and insignificantly decreased from 2005 to 2015.

Modelled Pb and Cd air concentrations and wet deposition agree with the observed values within a factor of two at most of monitoring stations. However, the model tends to somewhat underestimate wet deposition fluxes. Most of the modelled and observed wet deposition fluxes of Hg agree within ±40%. At most of stations with a long monitoring period the modelling results agree with observations demonstrating declining trends over the considered period. Discrepancies between modelled and measured values are caused by uncertainties of emissions estimates, monitoring data as well as the model parameterisations

The estimates of heavy metal deposition to the OSPAR maritime area are in general agreement with the results of previous OSPAR assessment covering the period 1990-2006. The modelling results were revised due re-calculation of national emissions by the EMEP countries, updates of meteorological and other input data as well as refinement of the model parameterisations. The new model estimates demonstrate 10-30% lower average fluxes and somewhat higher reduction rates of heavy metal deposition to most of the OSPAR regions.