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Operational mapping of atmospheric nitrogen deposition to the Baltic Sea

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Abstract. A new model system for mapping and forecasting nitrogen deposition to the Baltic Sea has been developed. The system is based on the Lagrangian variable scale transport-chemistry model ACDEP (Atmospheric Chemistry and Deposition model), and aims at delivering deposition estimates to be used as input to marine ecosystem models. The system is tested by comparison of model results to measurements from monitoring stations around the Baltic Sea. The comparison shows that observed annual mean ambient air concentrations and wet depositions are well reproduced by the model. Diurnal mean concentrations of NH_x (sum of NH_3 and NH_4^+) and NO_2 are fairly well reproduced, whereas concentrations of total nitrate (sum of HNO_3 and NO_3^-) are somewhat overestimated. Wet depositions of nitrate and ammonia are fairly well described for annual mean values, whereas the discrepancy is high for the monthly mean values and the wet depositions are rather poorly described concerning the diurnal mean values. The model calculations show that the annual atmospheric nitrogen deposition has a pronounced south--north gradient with depositions in the range about 1.0 T N km^{-2} in the south and 0.2 T N km^{-2} in the north. The results show that in 1999 the maximum diurnal mean deposition to the Danish waters appeared during the summer in the algae growth season. For the northern parts of the Baltic the highest depositions were distributed over most of the year. Total deposition to the Baltic Sea was for the year 1999 estimated to 318 kT N for an area of $464\,406 \text{ km}^2$ equivalent to an average deposition of 684 kg N/km^2 .

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