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Modelling the contributions to marine acidification from deposited SOx, NO_x and NHx in the Baltic Sea: Past and present situation

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We have examined the effects of historical atmospheric depositions from land and shipping of sulphate, nitrate and ammonium on the acid-base balance in the Baltic Sea. The modelling considers the period 1750 to 2014, a period when land and ships emissions have under gone large changes with increasing carbon dioxide concentrations, increasing emissions of SOx, NO_x, NHx and increasing loads of nutrients.

The results from the present study illustrates that acidification in the Baltic Sea due to atmospheric deposition of acids reached its maximum around 1980, with a pH decrease of about 0.01 in surface waters. This is one order of magnitude less than the acidification due to increased CO_2 in the atmosphere. The contribution from shipping is one order of magnitude less than the acidification from land emissions. However the pH decline due to atmospheric acids has started to recover due to reductions in land emissions, but the effect caused by shipping remains.

As the deposition of acidic species from land has decreased, the alkalinity levels are recovering, but are still affected and have changed about 30 μmol/kg during the study period. In the Bothnian Bay the recovery rate is much lower than the earlier loss rate. However, the alkalinity loss due to shipping is still ongoing. The largest AT sink per surface area has occurred in the south-western Baltic Sea where the shipping is intense and the surface areas of the basins are small. The sink due to shipping is around 10% of the total during the150 years.