# THE IMPACTS OF NUTRIENT SUPPLY ON AQUATIC MERCURY DYNAMICS AND PLANKTON METHYLMERCURY CONCENTRATIONS

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## Introduction

Eutrophication in coastal areas and continental seas is expanding worldwide (Diaz and Rosenberg, 2008) potentially altering mercury (Hg) dynamics. Eutrophication can change the net flux of divalent Hg ($Hg^{II}$) into the more toxic monomethylmercury (MeHg) and the MeHg biological uptake and magnification in the food web (Driscoll et al., 2012). While many studies have investigated the impact of eutrophication on isolated aspects of the Hg cycle its overall effect at the ecosystem level is unknown. We developed a biogeochemical model for speciated Hg cycling and phytoplankton uptake of MeHg. Here we use the model to quantify the total effect of eutrophication on MeHg levels in plankton in the Baltic Sea.

## Methods

The Baltsem model is a coupled physical-biogeochemical model that simulates eutrophication in the Baltic Sea (Gustafsson et al., 2012; Savchuk et al., 2012). The model divides the Baltic Sea into 13 interconnected sub-basins and simulates nutrient (Nitrogen, Phosphorus, Silica) and carbon cycling in the water column and sediment (Gustafsson et al., 2014). We add biogeochemical cycling of four Hg species ($Hg^{II}$, MeHg, gaseous elemental Hg ($Hg^0$), and gaseous dimethylmercury ($Me_2Hg$)) and phytoplankton uptake of MeHg to the model. We run a baseline scenario for the Baltic Sea with nutrient loads kept at 1920's level and compare it to a scenario with 20$^{th}$ century (high) nutrient loads. Results from the comparison are from the years 2005-2014 (Soerensen et al., 2016).

## Results and conclusion

Our model simulation suggests that eutrophication turns the Baltic Sea into a net sink for atmospheric Hg by increasing the water column scavenging of Hg. Overall eutrophication results in a decrease of the total Hg water reservoir of ~25% compared to the baseline scenario. We find that eutrophication stimulates water column methylation by increasing organic matter remineralization. This leads to an increase of the MeHg reservoir compared to an oligo/mesotrophic system (40% in a normoxic system (represented by the Bothnian Sea sub-basin) and >100% in a system with anoxic bottom water (represented by the Gotland Sea sub-basin)). While surface water MeHg concentrations also increase (Figure 1), the very high MeHg levels in anoxic bottom water in some basins does not significantly influence surface water concentrations as vertical exchange of MeHg is suppressed by the permanent halocline in the Baltic Sea. Eutrophication is believed to reduce plankton MeHg levels through growth dilution. Our model simulation indicates that while growth dilution occurs during peak biomass production events, it has a small overall impact on plankton MeHg at the ecosystem scale (<15% difference between baseline and high nutrient scenario). These and further results from the Baltsem model simulations will be discussed.

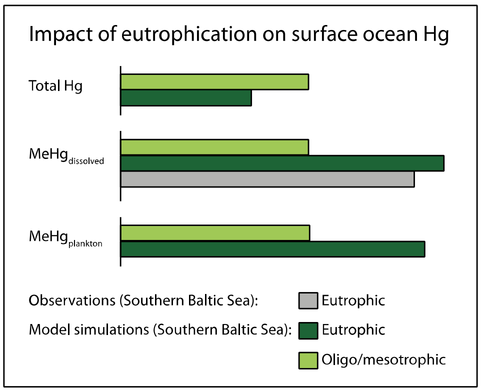


**Figure 1.** Predicted relative change in total mercury (Hg) and monomethylmercury (MeHg) concentrations in the surface waters of the Baltic Sea in September 2014 (Soerensen et al., 2016).

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