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Bioaccumulation as a driver of high MeHg in the North and Baltic Seas

David J. Amptmeijer et al.

Correspondence to: David J. Amptmeijer (davidamptmeijer@gmail.com)

Supplementary Figures

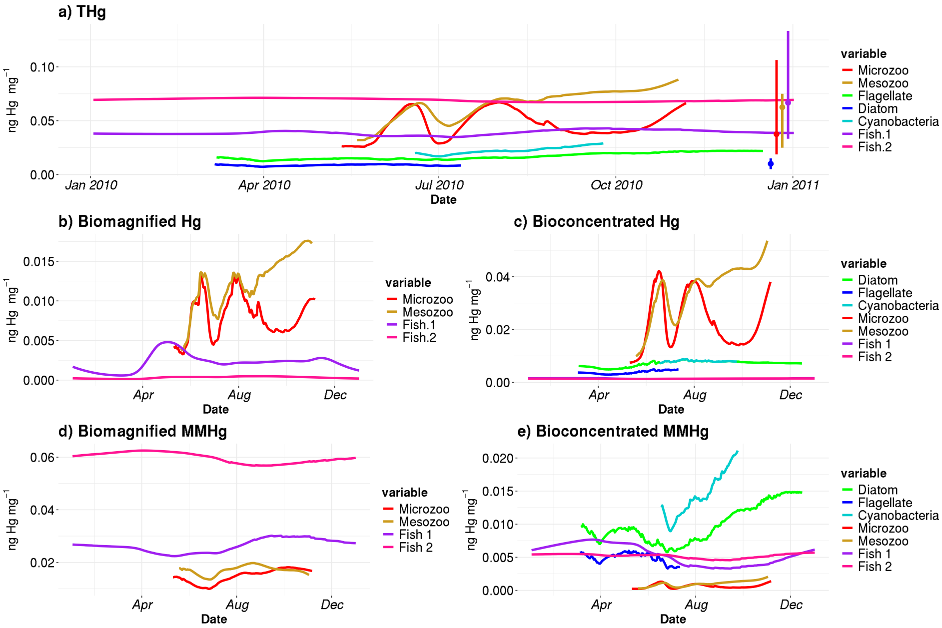

Figure S1: Hg accumulation in the Gotland Deep during the last simulation year (Jan 2010-Jan 2011). Plot S1a shows tHg bioaccumulation with mean and range of observations from Nfon et al. (2009) represented by the point and vertical bar on the right side of the plot. Bioaccumulation is displayed when biomass of the respecitive funtional group exceeds 0.1 gC m^{-2}. tHg bioaccumulation is highest in fish 2, followed by fish 1, microzooplankton, mesozooplankton, cyanobacteria, flagellates, and diatoms with tHg concentrations in observed ranges. The consecutive Fig. show the biomagnification (S1b, S1d) and bioconcentration (S1c, S1e) of Hg^{2+} (S1b, S1c) and $MMHg^{+}$ (S1d, S1e). Biomagnified Hg^{2+} is highest in microzooplankton, followed by mesozooplankton and fish, while biomagnified $MMHg^{+}$ increases notable in fish 1 and fish 2. Bioconcentrated Hg^{2+} is very low in fish and highest in zooplankton. Bioconcentrated $MMHg^{+}$ is notable higher in cyanobacteria than in all biota and lowest zooplankton.

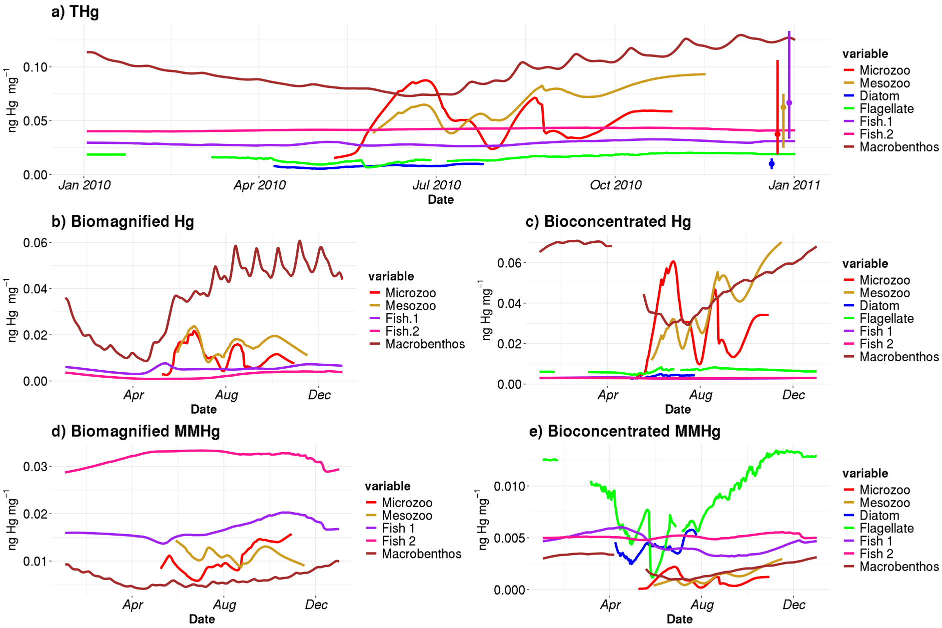

Figure S2: Hg bioaccumulation in the Northern North Sea. Plot S2a shows the tHg bioaccumulation in the Northern North Sea. Phytoplankton and zooplankton are shown if their average biomass is more than 0.1 gC m^{-2}. Phytoplankton has the lowest tHg, which is followed by fish 1, fish 2, mesozooplankton and macrobenthos. Plots S2 b-e show the origin (Biomagnification or Bioconcentration) and species (Hg^{2+} or $MMHg^{+}$) of the bioaccumulated tHg. Figure S2b and S2c show that the high tHg in microzooplankton, mesozooplankton and macrobenthos is due to high levels of Hg^{2+} bioconcentration and biomagnification. $MMHg^{+}$ Biomagnification follows a pattern in which it is lower in zooplankton and macrobenthos, higher in fish 1, and highest in fish 2. This means that while fish 2 has a lower Hg content than macrobenthos and zooplankton for part of the year, $MMHg^{+}$ is higher in fish than in zooplankton and macrobenthos. Figure S2e shows the bioconcentration of $MMHg^{+}$ and shows that this is highest in phytoplankton, followed by fish 1 and 2, macrobenthos, and zooplankton.

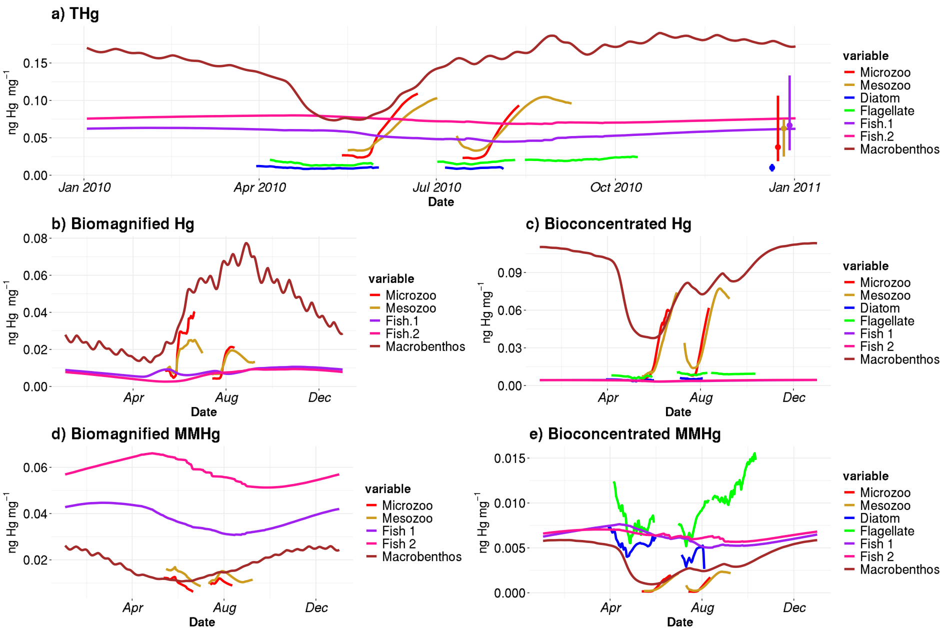

Figure S3: Bioaccumulation of Hg^{2+} and $MMHg^{+}$ in the Southern North Sea in the last year of the simulation (Jan 2010-Jan 2011). Figure S3a shows the accumulation of tHg per functional group over an annual cycle. Figures S3b-e display Hg^{2+} and $MMHg^{+}$ concentrations, while distinguishing between bioconcentration and biomagnification processes for each species. Phytoplankton and zooplankton are shown if their average biomass is more than 0.1 gC m^{-2}. tHg values for microzooplankton, mesozooplankton, and macrobenthos reach 0.10 and 0.10 ng and 0.19 ng Hg mg^{-1}. This is higher than fish 1 and fish 2 tHg which is 0.068 and 0.080 ng Hg mg^{-1}. Comparing Fig. S3b-e we see high tHg in microzooplankton, mesozooplankton, and macrobenthos is caused by high Hg^{2+} bioconcentration and biomagnification, while tHg content of fish 1 and fish 2 predominately originates from biomagnification of $MMHg^{+}$.

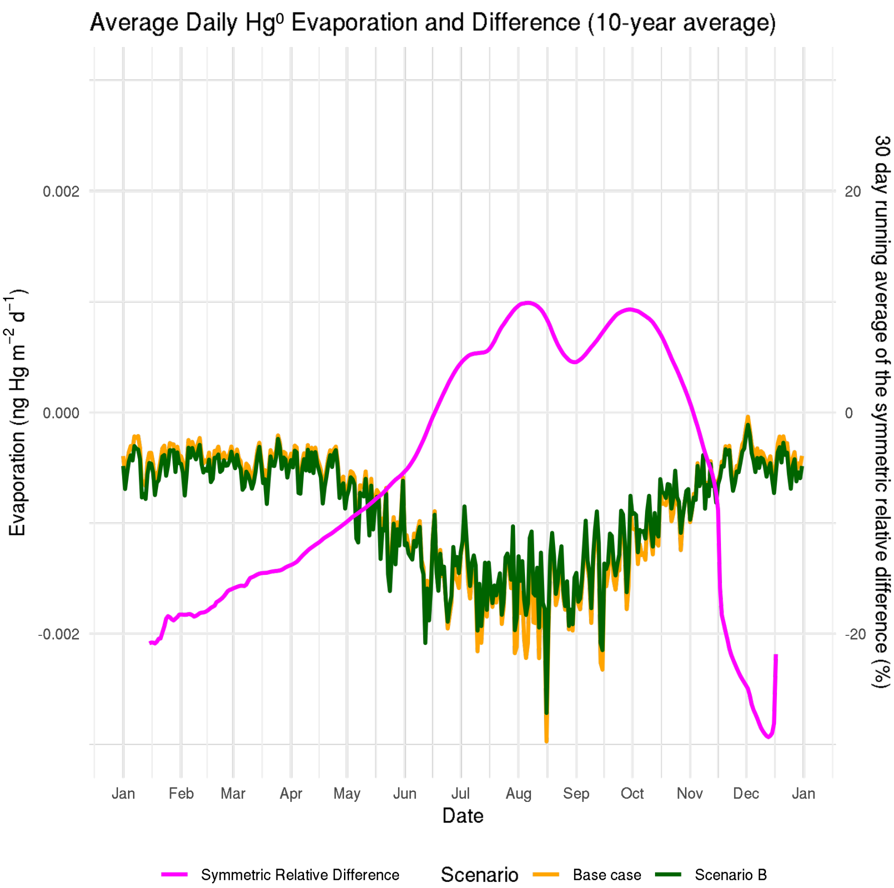

Figure S4: The 10-year average daily atmospheric exchange of Hg^0 between the atmosphere and the sea surface in the base case and scenario c (no bioaccumulation nor biogenic reduction). The symmetrical difference is calculated as (Base case-Scenario B)/((Base case+Scenario B)/2). In scenario B (no biogenic reduction). Overal there is more evaporation when there is biogenic reduction during the cyanobacterial bloom, but this is compensate with lower reduction outside of the cyanobacterial bloom period.

References

Nfon, E., Cousins, I. T., Järvinen, O., Mukherjee, A. B., Verta, M., & Broman, D. (2009). Trophodynamics of mercury and other trace elements in a pelagic food chain from the Baltic Sea.