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Baltic Sea salinity: a complex interplay between small scale physics, basin geometry and large scale forcing

The Baltic Sea's salinity dominated stratification is a consequence of a balance between intermittent inflow events bringing saline water from the neighbouring Kattegat and a large input of freshwater primarily from rivers. Both of these drivers could change considerably as a consequence of global warming and large uncertainties persist in their future trajectories. A consequence of these large uncertainties is that even the sign of future Baltic Sea salinity changes is hard to pin down. Here we will discuss an approach, which is complementary to regional climate projections, where Baltic Sea salinity is given a functional representation in terms of these drivers. More specifically, a state-of-the-art regional ocean model is used to estimate a Taylor polynomial giving Baltic Sea mean salinity as a function of freshwater forcing and salinity changes in the North Atlantic. Key results are that the polynomial can be used to infer salinity changes without having to run a model and the coefficients of the polynomial give information about the bulk effects of the drivers and their interactions.

Water mass transformation through small scale mixing is another agent determining the stratification of the Baltic Sea. A new paradigm for the overturning in the global ocean has shown how bottom intensified mixing and an insulating bottom boundary condition sets up a circulation where water is rising in bottom boundary layers and sinking in the interior. Here, similar ideas are applied to the Baltic Sea. The resulting picture is an overturning circulation strongly constrained by the hypsographic curve, with strong transformation occurring in certain depth ranges. However, it is also noted that these transformation hotspots are not visible when water mass transformation is visualized in buoyancy space, indicating that the effect of these hotspots is spread naturally over a large range of water masses.