Detecting processes contributing to interannual halosteric and thermosteric sea level variability

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Sea level is one of the most prominent climate variables because it affects many people living in low lying coastal areas. Regional sea level changes differ substantially from global mean changes. On interannual time scales, regional sea level variability is largely determined by changes in the steric component. The relation between the thermosteric and halosteric component of the interannual variability is studied by separating the components into contributions from the mixed layer and, below the mixed layer, into the active part, the part that is related to isopycnal motion and that contributes to the steric sea level, and the inactive part (related to changes of spiciness). The results are based on the GECCO2 ocean synthesis (Köhl, 2013) covering the years 1948-2011 from the German contribution of the Estimating the Circulation and Climate of the Ocean project (GECCO). After further decomposing the anomalies of thermosteric and halosteric sea level, the variance explained by the individual components are analyzed (**Fig. 1**).

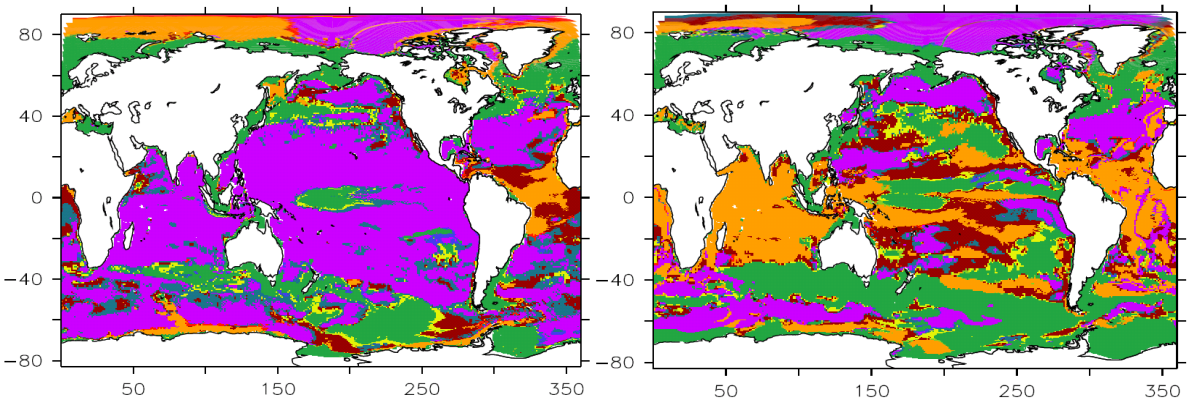

Figure 1: Explained STD of the (left) thermosteric (right) the halosteric STD by their isopycnal motion (H), spiciness (τ) and mixed layer (M) components. The colors denote regions where the explained STD, according to the relation $\sigma_X = r_{X\tau}\sigma_\tau + r_{XH}\sigma_H + r_{XM}\sigma_M$ with X temperature or salinity and r the correlation, alone or in combination, is larger than 55% of the total. If two combinations are associated with a color, both explain more than 55% of the total. Note that regions where more than one process is required are rare.

Except for mode water regions and high latitudes, temperature and salinity related steric sea level variability is governed by different dynamics. In most areas of the world oceans, steric sea level variability is dominated by the contribution from isopycnal motion to the thermosteric sea level while halosteric variability relates more to spiciness. Due to the salinity minimum, different spatial salinity gradients above and below the minimum lead to opposing contributions and thus to a small contribution from isopycnal motion to the halosteric sea level.

References

Köhl A., (2013), Evaluation of the GECCO2 Ocean Synthesis: Transports of Volume, Heat and Freshwater in the Atlantic, Q. J. Met. Soc, submitted.