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Reconstructing the ocean subsurface decadal variability using surface nudging

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Initialising the ocean internal variability for decadal predictability studies is a new area of research and a variety of ad hoc methods are currently proposed. In this study, we explore how surface nudging can reconstruct the tri-dimensional variability of the ocean. We use a perfect model framework, as well a realistic set up with nudging towards observed anomalies. We illustrate that in the tropics, nudging the SST is enough to reconstruct the tropical atmosphere circulation and the associated dynamical and thermodynamical impacts on the underlying ocean. In the tropical Pacific Ocean, the profiles for temperature show a significant correlation from the surface down to 2000 m, due to dynamical adjustment of the isopycnals. At mid-to-high latitudes, SSS nudging is required to reconstruct both the temperature and the salinity below the seasonal thermocline. This is particularly true in the North Atlantic where adding SSS nudging enables to reconstruct the deep convection regions of the target. By initiating a previously documented 20-yr cycle of the model, the SST+SSS nudging is also able to reproduce most of the AMOC variations, a key source of decadal predictability. Reconstruction at depth does not significantly improve with amount of time spent nudging and the efficiency of the surface nudging rather depends on the period/events considered. Enhanced horizontal atmospheric resolution slightly improves performances in particular in the North Atlantic deep convection regions.