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Physical constraints on actual decadal prediction skill of internal sea surface temperature variability

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Decadal prediction of internal (unforced) sea surface temperature (SST) variability relies on proper initialisation of the ocean as well as on the ability of the models to capture the observed internal modes of SST variability. Yet the specific origins of internal decadal SST prediction skill remain unidentified. In this work, we combine physical constraints to allow an a-priori identification of regions that show high actual decadal prediction skill of unforced SST signals.

Specifically, we examine the hypothesis that skillful actual decadal SST prediction requires a combination of: reproduction of large scale persistence of SST in observations by the prediction model; initialization of the ocean state close to observations; and a strong imprint of ocean over atmosphere dynamics on the SST signal. In a MPI-ESM-LR-based decadal prediction system we find that all three criteria are met in the subpolar North Atlantic Ocean, the western Indian Ocean, and the northeast Pacific Ocean. The examined prediction system shows significant skill against HadISST observations in those three regions as well, indicating how the hypothesized physical constraints may identify regions where a decadal prediction system shows actual prediction skill.

Our work shows that internal decadal variations of ocean variables can be predicted beyond the North Atlantic region, highlighting the western Indian Ocean and the northeast Pacific Ocean as potential new hot spots of decadal prediction.