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Seasonal forecast skill of upper-ocean heat content in coupled high-resolution systems

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Seasonal forecasts of marine variables are not used nor validated to the same level that atmospheric variables are, despite their great potential for the planning of maritime activities. Ocean heat content (OHC) anomalies, for example, typically persist for several months, making this variable a vital component of seasonal predictability in both the ocean and the atmosphere. However, the ability of seasonal forecasting systems to predict OHC remains largely untested. Here, we present a global assessment of OHC predictability in two state-of-the-art and fully-coupled seasonal forecasting systems. Overall, we find that dynamical systems make skilful seasonal predictions of OHC in the upper 300m across a range of forecast start times, seasons and dynamical environments. Predictions of OHC are typically as skilful as predictions of sea surface temperature (SST), providing further proof that accurate representation of subsurface heat contributes to accurate surface predictions. We also compare dynamical systems to a simple anomaly persistence model to identify where dynamical systems provide added value over cheaper forecasts; this largely occurs in the equatorial regions and the tropics, and to a greater extent in the latter part of the forecast period. Regions where system performance is inadequate include the sub-polar regions and areas dominated by sharp fronts, which should be the focus of future improvements of climate forecasting systems.

Lastly, we describe efforts to encourage the use of marine variables in operational seasonal forecasting, as part of the European Union Horizon 2020 EuroSea project. We present encouraging results on the predictability of marine heat waves using OHC, which marks the first step of our strategy to provide forecasts of stakeholder-defined indicators.