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A global probabilistic study of the Ocean Heat Content low-frequency variability: atmospheric forcing versus oceanic chaos

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A global 1/4° ocean/sea-ice 50-member ensemble hindcast has been performed over the period 1960-2015 in the context of the OCCIPUT project. It is used to disentangle the low-frequency imprints of the atmospherically-forced oceanic variability and of the chaotic Intrinsic Oceanic Variability (IOV) on the large-scale (10°x10°) Ocean Heat Content (OHC) field between 1980 and 2010.

We show that the chaotic IOV explains most of the interannual-to-decadal large-scale OHC variance over a substantial fraction of the global ocean area, and that this fraction increases with depth: 9%, 22%, and 31% in the 0-700m, 700-2000m and 2000m-bottom layers, respectively. This low-frequency chaos has the strongest impact in eddy-active regions (Southern Ocean, western boundary current extensions), and in the subtropical gyres at intermediate and deep levels.

The chaotic IOV actually reaches multi-decadal timescales, and manifests itself as random trends in 30-year timeseries. Consequently, large-scale regional OHC trends computed over the 1980-2010 period cannot be unambiguously attributed to the atmospheric forcing in several oceanic basins at various depths.

These results raise open questions about the potential impact of this ocean-driven chaotic thermal variability on the atmosphere and climate, and issues about the detection and attribution of climate change from temperature observations.