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Forced and chaotic variability of basin-scale heat budgets in the global ocean: focus on the South Atlantic crossroads.

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The OCCIPUT eddy-permitting (1/4°) global ocean/sea-ice 50-member ensemble simulation is analyzed over the period 1980-2015 to identify how the atmosphere and the intrinsic/chaotic ocean variability modulate the basin-scale Ocean Heat Content (OHC) at various timescales. In all regions of the simulated world ocean, the atmospherically-forced interannual OHC variability is driven by both air-sea heat fluxes (Qnet) and advective heat transport convergences (Conv), while the intrinsic component is driven by Conv, and damped by Qnet.

We focus on the Atlantic sector of the Southern Ocean (SA), where the oceanic “chaos” explains 36 to 90% of the interannual and decadal heat transport variability across the limits of the basin, and 22% of this huge basin’s OHC variability at interannual and decadal timescales.

The model also simulates the Antarctic Circumpolar Wave (ACW) that was observed in the 80-90’s, with large impacts on OHC and heat transports in the Southern Ocean. This forced signal appears south of Australia, propagates eastward around Antarctica and northward into the Tropical Atlantic and the Tropical Indian Ocean.

These results highlight the substantial contribution of large-scale low-frequency chaotic heat advection in eddy-active regions, and its major impact on decadal OHC variations over key basins. They suggest that climate simulations using eddying ocean models include an oceanic and random source of large-scale low-frequency variability whose atmospheric impacts remain to be assessed.