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A simple model of coupled ocean-atmosphere decadal variability in midlatitudes

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A simple approach to modeling the decennial variability of the ocean-atmosphere system in mid-latitude is presented. The model is based on a quasi-geostrophic atmospheric part, including full transient dynamics, and a slab model of the ocean mixed layer. Coupling is obtained via surface heat fluxes and Ekmann currents.

Two application of this model are shown, the first is the analysis of the effect of the anomalous wind-driven ocean currents in the north Atlantic on the variability of the North Atlantic Oscillation. A negative feedback is found between the anomalous heat transport by the gyres and the NAO, that tends to damp the NAO energy at ultra-low frequency. At decennialtimescales a coupled oscillation is also found.

The second application of the model is on the coupled dynamics of the Southern Hemisphere atmosphere and the Antarctic ocean. Atmospheric forcing of the oceanic mixed layer appears to explain the existence of travelling SST anomalies along the antarctic circumpolar current (ACC), a phenomenon often referred to as antarctic circumpolar wave. Propagation appears to be due to the mean geostrophic advection by the ACC. On top of this fundamentally forced dynamics, a positive feedback between the atmopshere and the ocean is however also found, which contributes to maintaining the SST anomalies via anomalous Ekmann current advection.