Horizontal structure of unstable basin modes due to large scale baroclinic instability.

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Abstract

Revisiting the classical wind-driven double-gyre in a 2.5 layer shallow water model, a regime of weak forcing/moderate viscosity (Reynolds number in the range 1–1000) is found leading to interannual oscillations. The unstable mode consists in baroclinically unstable Rossby waves in the northern part of the subpolar gyre where the upper layer flow is westward. Their wavelength is set by the explicit model viscosity. Linear stability analysis allows a proper energy budget of the modes highlighting the regions where the perturbations draw energy out of the mean flow. These regions are coherent with positive eddy fluxes computed in the nonlinear simulations.
Only such a toy model allows an extensive understanding of the variability, from local to global stability analysis, and their link with the variability development and signature.
We discuss the limits of the 2.5 layer model where a single unstable vertical mode can exist, maybe prohibiting the coexistence of large-scale Rossby waves (Green modes) and mesoscale variability (Charney modes).

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