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Low-frequency variability in the Southern Ocean in a QG model

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In this work we study patterns of interannual variability in the Ocean-Atmosphere system in the Southern Hemisphere extratropics as simulated by a simple dynamical model, in order to determine the basic physical processes that characterize them. The model used is an atmospheric quasi-geostrophic tridimensional model coupled to an ocean "slab" mixed layer, which includes mean geostrophic advection by the antarctic circumpolar current (ACC). The atmosphere-ocean coupling is obtained via surface sensible heat fluxes.

We analyse three configurations of the model, a "passive ocean" one, where the ocean responds to the atmopheric forcing but does not feeds back to the atmosphere; a "passive atmosphere" one, where the stationary reponse of the atmosphere to prescribed SST anomalies is studied; and a fully coupled one.

The two forced experiments show separately a positive feedback in the coupled system. The passive ocean experiment shows low frequency variability in the ocean, ie a propagating SST anomaly with 8-10 years period. SSTa amplitude created were around 0.7K which is less than observed anomalies (1.5K). This means that the stochastic forcing of the atmosphere is sufficient to substain a variability of the SST whose periodicity is set by the mean advection. The passive atmosphere experiment exhibits an equivalent-barotropic response with high pressure and high air surface temperature roughly 50 degrees downstream of warm SST anomalies. This response follows SST aomalies if they are made eastward propagative.

We next study the fully coupled simulation to measure the effect of the feedback on the SST anomaly propagation, the dependence on surface fluxes intensity is also studied and the relevance to observed climate discussed.