Low-frequency variability in a mid-latitude coupled model : Gulf Stream influence on the tropospheric jet

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We examine the influence of the Gulf Stream front on the troposphere above through a coupled ocean–atmosphere model. Thermal fronts have been shown by Feliks et al. (*JAS*, 2004, 2007) to strongly influence the free atmosphere through Ekman pumping. Such pumping injects potential vorticity into the atmosphere through the Laplacian of the sea surface temperature (SST) field.

In these previous studies, thermal oceanic fronts were prescribed to study their impact on a barotropic (Feliks et al., 2004) and a baroclinic (Feliks et al., 2007) atmosphere in an idealized setting. A persistent atmospheric jet stream develops and it exhibits significant intraseasonal variability in the 20–80-day range.

In the present work, we consider a fully coupled ocean–atmosphere model of the North Atlantic basin and the surrounding areas. We consider a three-layer, quasi-geostrophic turbulent ocean model coupled to an atmospheric mixed boundary layer (AMBL) and a barotropic free atmosphere. The ocean model has realistic geometry for the U.S. East Coast, along with idealized flat-bottom bathymetry, and is forced by the Hellerman-Rosenstein climatology of wind-stress curl. Except for this forcing, the ocean and the atmosphere interact freely, via the AMBL.

Results show a realistic Gulf Stream with meso-scale turbulent activity that exhibits strong decadal variability. The troposphere above reacts by forming a persistent eastward jet exhibiting intraseasonal variability, modulated by the ocean's decadal one. We confront the coupled model's low-frequency oscillations with those observed in and over the North Atlantic, in particular with the 70-day atmospheric one, and the interannual 7–8- and 14–15-year oscillations in SST and other fields.