Geophysical Research Abstracts
Vol. 17, EGU2015-9922, 2015
EGU General Assembly 2015

Low-frequency variability of Western Boundary Currents in the turbulent ocean: intrinsic modes and atmospheric forcing

Guillaume Sérazin (1,2), Thierry Penduff (1), Laurent Terray (2), Sandy Grégorio (1), Bernard Barnier (1), and Jean-Marc Molines (1)

(1) CNRS - LGGE, MEOM, Grenoble, France (thierry.penduff@legi.grenoble-inp.fr), (2) CERFACS - SUC, Toulouse (terray@cerfacs.fr)

Ocean-atmosphere heat fluxes are particularly strong in Western Boundary Current (WBC) regions where SST front variations influence basin-scale climate variability. Observed low-frequency fluctuations in latitude and strength of these oceanic jets are classically thought to be essentially atmospherically-driven by wind stress curl variability via the oceanic Rossby wave adjustment. Yet academic eddy-resolving process-oriented models with double-gyre configurations have revealed that an idealized WBC may exhibit low-frequency intrinsic fluctuations without low-frequency external forcing (e.g. Berloff et al., 2007, Dijkstra and Ghil, 2005, etc). Experiments with eddying Ocean General Circulation Models (OGCMs) have also shown that the amount of low-frequency Sea Level Anomaly (SLA) variability is largely intrinsic in WBCs (Penduff et al. 2011; Sérazin et al 2014) and that the frontal-scale (<10°) pattern of the Kuroshio Extension (KE) variability is similar to intrinsic modes (Taguchi et al. 2010).

Based on a pair of atmospherically-forced 1/12° OGCM experiments that simulate with accuracy either the intrinsic variability (seasonally-forced) or the observed total variability (forced with the full range of atmospheric timescales), Empirical Orthogonal Function analysis is performed on zonally-averaged SLA fields of four main WBCs (e.g. Gulf Stream, Kuroshio Extension, Agulhas Current and East Australian Current). The first two modes of the KE and GS exhibit a similar spatial structure that is shaped by oceanic intrinsic processes. The frequency content is however different between the intrinsic and total Principal Components, the former containing a wide range of timescales similar to a red noise and the latter being more autocorrelated at interannual-to-decadal timescales. These modes are compared with those obtained from the 20 years of altimetry observation and relationships with low-frequency westward propagative features in the respective oceanic basin are investigated.

We argue that OGCM studies of intrinsic dynamic of WBCs are key to interpreting their observed total variability, which might result from a subtle mixing between a non-linear small-scale response of intrinsic modes to the atmospheric forcing and a direct basin-scale linear response to the atmosphere.