Geophysical Research Abstracts
Vol. 12, EGU2010-3722, 2010
EGU General Assembly 2010
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Time-variant zonal jet-like structures (striations) in the ocean circulation

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Recently, prominent jet-like features of the ocean circulation, called hereafter striations, with a meridional scale of O(300-500 km) and extending for thousands of kilometers in length, have been detected in satellite and in situ observations and in high-resolution numerical models. There are at least two distinct types of oceanic striations. The first one is quasi-stationary striations, which are best seen in multi-year time-averaged velocity fields. The second type is migrating or time-variant striations, which have been detected in velocity anomaly fields and which exhibit systematic and coherent meridional phase propagation.

In this study we focus on time-variant striations and examine their spatial and temporal properties using fourteen years of satellite sea level anomaly observations and output of the Ocean general circulation model For the Earth Simulator (OFES).

Time-variant striations are found to populate low and mid-latitudes. Rare exceptions are observed in the eastern parts of sub-polar regions. We put forward interpretation of the time-variant striations as low-frequency waves with nearly meridional orientation of the wave number vector. They have larger amplitudes in areas where the overall eddy kinetic energy level is higher. The wavelengths are, in general, decreasing with latitude and appear to be related to the first-mode deformation wavelength, with the averaged ratio of the former to the latter of about 2. Geographically, however, this ratio tends to be smaller in low latitudes and increases poleward. Zonal phase speeds are westward and decreasing with latitude, qualitatively in agreement with the Rossby wave dynamics.

The fact that meridional scale of the striations closely follow the scale of the most energetic mesoscale variability, commonly associated with large oceanic eddies, makes separation of these two phenomena difficult and suggests that their dynamics are coupled. In a regional example in the eastern North Pacific we show that eddies are organized along a set of the striations and, moreover, the striations seem to control the formation of new eddies.

Remarkably, good agreement in all parameters of the striations is found between the satellite observations and the OFES hindcast. Analysis of much longer time series from this model reveals that time-variant striations are highly intermittent in both space and time. A slight asymmetry between the eastward and westward flowing striations is also observed in the model data.