Geophysical Research Abstracts
Vol. 16, EGU2014-11143-2, 2014
EGU General Assembly 2014

Mesoscale ocean-atmosphere coupling in the Peru-Chile upwelling system

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Understanding the dynamics of Eastern boundary upwelling systems such as the Peru-Chile region is of major interest as these regions host an intense biological activity and productive fisheries. Moreover, they are generally poorly represented in global climate models due to biases in low cloud cover and a misrepresentation of mesoscale processes. The mesoscale activity of these systems has been studied quite extensively with observations and with ocean models which generally do not take into account the feedback of the ocean mesoscale (eddies, filaments and fronts) on the atmospheric forcing. However it has been evidenced that oceanic thermal gradients associated with oceanic eddies induce an atmospheric response, in particular in the surface wind, which is the main forcing in upwelling systems. As a consequence, the Humboldt current system appears to be a fully coupled system in which mesoscale air-sea interactions are to be taken into account.

Using a regional coupled model (WRF-NEMO) at $\sim$9 km resolution, we study the interactions between wind stress and sea surface temperature (SST) mesoscale structures in the Peru region. The relevant coupling scales are isolated and the spatial and temporal variations of these interactions are characterized. Correlations between mesoscale wind stress and SST compare well with results from satellite data when model fields are smoothed on the observations grid ($\sim$50 km), while model small-scale structures (at $\sim$10km resolution) are more strongly coupled. The large-scale wind intensity and steadiness modulate the coupling intensity spatially and at seasonal time scales. The physical mechanisms of the atmosphere response to an SST gradient are also investigated, including the role of the sea surface oceanic current.