Imprints of coastal mountains on ocean circulation and variability

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Coastal mountains often induce large wind curls in the lee, exerting a significant forcing on ocean circulation via the Rossby wave and other mechanisms. This study compares the ocean response to coastal mountain forcing in the summer South China Sea and winter far-east Pacific off Central America. Both oceans feature high sea surface temperatures and can potentially affect the atmosphere. Orographic forcing in the former and latter regions comes from the western and eastern boundaries of the respective basins.

In the summer South China Sea, the southwest monsoon winds are accelerated at the southern tip of the Annam Cordillera. The dipole wind curls force a double-gyre circulation, cyclonic to the north and anticyclonic to the south. The offshore ocean jet in between advects cold upwelled water from the Vietnam coast, forming cold filaments (Xie et al. 2003). This double-gyre circulation displays pronounced intraseaonal and interannual variability, forced by the atmospheric Madden-Julian Oscillation (Xie et al. 2007) and El Nino/Southern Oscillation. The OFES QuikSCAT run simulates the seasonal development and intraseasonal to interannual variability of the double gyre circulation, in response to variations in the southwesterly wind jet.

In the far-east Pacific warm pool, three major gap winds all leave significant imprints on the thermocline depth field (Xie et al. 2005), as observed from satellite altimeters and simulated by an eddy-resolving, ocean GCM for the Earth Simulator (OFES). Subseasonal variability in the eastern Pacific features two bands of high variance, off the Gulfs of Tehuantepec and Papagayo, respectively. The collocation of high SSH variance and gap winds suggest that the former forces the latter. Indeed, the strengthened Tehuantepec wind jet forces an anticyclonic eddy near the shore, which then propagates offshore in a southwest-titled track suggestive of a Rossby wave ray. With QuikSCAT winds, OFES successfully simulates the bands of high variance but the correlation of simulated variability with satellite observations is low, especially in the high-variance band off Papagayo. The talk will present additional results to illustrate wind forcing effects and instability mechanisms.

References

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