ON THE SEASONAL AND INTERANNUAL VARIABILITY OF THE CIRCULATION AROUND THE HAWAIIAN ISLANDS

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Abstract

Observations indicate that the North Hawaiian Ridge Current (NHRC) demonstrates significant interannual changes. Using a high-resolution, 2.5-layer reduced-gravity ocean model, this study investigated the seasonal and interannual variability in the circulation around the Hawaiian Islands, with particular emphasis on the NHRC. The numerical model simulation shows that the NHRC exists as a mean entity with a 32-year averaged transport of $2.47Sv$. There is a generally good agreement between the modeled NHRC transport time series and that based on repeated ship-board ADCP measurements from 58 HOT cruises during 1988-1997. The NHRC exhibits a regime shift with a period of about 17 years. There is a significant ENSO frequency energy peak in the NHRC's power spectrum, but they are not directly linked to the ENSO events. By running a companion case with the steady wind in the equatorial region, we find that the these fluctuations are largely determined by the wind field over the interior ocean east of the Hawaii Islands.

The decay mechanism of Rossby wave is employed to address why the equatorial variability only plays a minor role in the circulation around the Hawaiian Islands. In the mid-latitude, the high-frequency equatorial perturbations (via coastal Kelvin waves first) cannot reach the Hawaiian Islands. On the other hand, part of the low-frequency anomalies (such as the El Nino events) can still possibly propagate to the Hawaiian Islands and affect the interannual variability of the local circulation.

The low-frequency NHRC fluctuations are due to the mass imbalance between the inflow transport (T_{in}) across the north line and the outflow (T_{is}) across the south line. The time-dependent island rule is developed to understand how the mid-latitude wind

variations east of the Hawaiian Islands determine the seasonal and interannual variability of the NHRC. The time-dependent linear theory can quite well estimate the the low-frequency fluctuations of the observed NHRC.