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Multiple Time Scale Analysis of Kuroshio Extension Dipole Mode

Zhihui Che (1,2) and Dehai Luo (1)

(1) The Institute of Atmospheric Physics, Chinese Academy of Sciences, CAS Key Laboratory of Regional Climate-Environment for Temperate East Asia, Beijing, China , (2) University of Chinese Academy of Sciences, Beijing, China

EEMD analysis is used to explore the frequency-dependent physical mechanism of the meridional Kuroshio Extension dipole (KED) mode of sea surface height (SSH) by the altimeter observation data, which is located along the flow axis in the upstream Kuroshio Extension (KE). There are three significant periodic variations at timescales of quasi-biennial, interannual (periods between 3-7 years) and low-frequency (periods longer than 8 years) for KED mode, with the variance contribution rate decreasing as the period shorten. The most dominant low-frequency mode is caused by the time-lag of the two different forced ways of low-frequency atmosphere variation. Concretely, in the low frequency the southern KED leaflet (SKE) is simulated by the westward-propagating Rossby waves, while the northern KED leaflet (NKE) reflects the much-faster consistent change of the northern Pacific subtropical circulation under mid-latitude atmospheric wind stress forcing. The interannual variation of NKE is also forced by the mid-latitude atmosphere variation, while the SKE describes the Ekman pumping forced by the local wind. The quasi-biennial signal is believed to be the self-sustained part of KE dynamic process related to the underlying bathymetry, as the SKE and NKE show a significant simultaneous correlation. And the quasi-biennial KED mode is simulated by the low-frequency mode, with a greater amplitude and longer period in the negative phase (positive-over-negative dipole pattern) of low-frequency KED mode.