

Multi-decadal modulation of North Pacific Decadal Variability

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Recent observational studies showed that Pacific decadal variability (PDV), often defined as the leading EOF mode of sea surface temperature (SST), is not stationary in its spatial pattern over the extended decades. We have investigated this long-term modulation of wintertime PDV, focusing on the link between the basin-scale variability and the oceanic frontal variability in the western North Pacific, using a 61-year hindcast simulation of eddy-resolving OGCM (OFES) and a 150-year control integration of a coupled GCM (CFES). Our analysis of the OFES hindcast and atmospheric reanalysis, confirms the basin-scale PDV modulation: PDO-like SST variability associated with Aleutian Low change dominated during the period around the 1976/77 climate shift (Fig. 1a-c,g) while the NPGO-like ocean variability associated with atmospheric North Pacific Oscillation variability picked up after the late 1980s (Fig. 1d-g). The analysis further reveals that the large-scale PDV modulation was accompanied by the change in its characteristics of oceanic frontal variability in the Kuroshio/Oyashio extension region: the latitudinal shift (strength change) of the ocean fronts dominant during the former (latter) period. The CFES integration without the greenhouse gas concentration change represents the similar multi-decadal modulation of the basin-scale PDV and oceanic frontal variability, indicative of the modulation arisen as natural variability (not shown). The cause of these modulations is under investigation. Influences of the long-term change in tropical SST and the modulation in the large-scale atmospheric response to the oceanic frontal variability will be discussed.

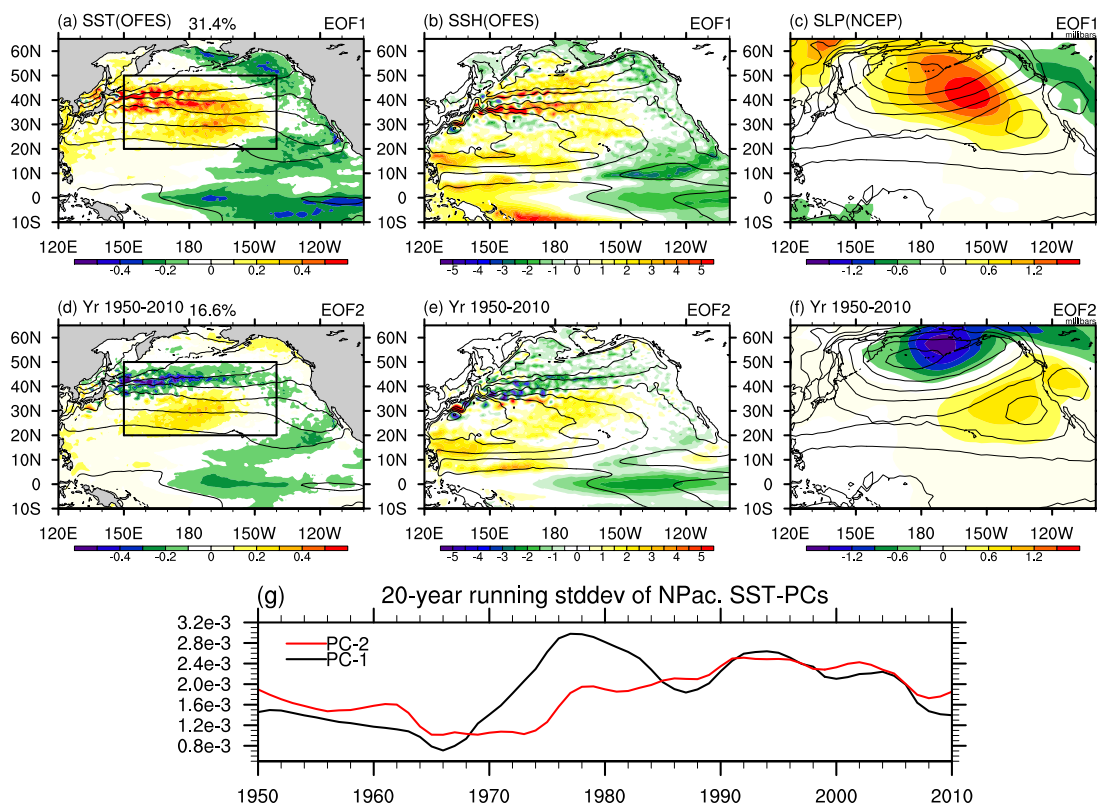


Figure 1: (a) Linear regression map (shading) of 5-year running averaged, winter-time (DJF) SST anomaly onto its 1st principal Component (PC) over an extra-tropical North Pacific domain (rectangular box) from the OFES hindcast for the period 1950-2010. (b) As in but onto the 2nd PC. (c-d) As in (a-b) but sea surface height. (e-f) As in (a-b) but sea level pressure from NCEP/NCAR reanalysis. Superimposed with black contours in (a-f) are climatological mean. (g) 20-year running mean of the standard deviation of the 1st (black) and 2nd (red) PCs.