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Co-variability between the Northern Hemisphere atmospheric meridional transient eddy fluxes and ocean frontal variability near the western boundary current regions

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Covariability between the meridional transient eddy heat and moisture fluxes in the Northern Hemisphere atmosphere and the variability in the position of ocean fronts associated with the Kuroshio Extension (KE), Oyashio Extension (OE) and Gulf Stream (GS) is examined with a focus on the interannual to decadal time scale. Daily atmospheric variables from the NASA Modern Era Retrospective-analysis for Research and Applications (MERRA) at 1/2 degrees latitude by 2/3 degrees longitude resolution are band-pass filtered for 2-8 day band prior to calculating the covariance between the meridional velocity (v') and temperature (T') and v' and specific humidity (q'), respectively. Subsequently, time series of winter (January-March) mean transient eddy heat and moisture fluxes (<v'T'> and <v'q'>) for 1979-2009 are compared with the ocean frontal variability. GS position is defined as the location of the 15degreeC at 200 m depth using the available temperature observations from the World Ocean Database. Likewise, the KE position is defined based on the 14degreeC isotherm at 200 m in the western North Pacific. On the other hand, OE is defined as the location of the maximum meridional gradient of 1/4degree NOAA Optimum Interpolation SST. For the all three fronts, the leading modes of empirical orthogonal function represent the north-south fluctuation of the fronts in interannual to decadal time scale. The leading principal component time series are used as the indices for the respective ocean frontal variability in this analysis. Maximum mean and variability of winter <v'T'> and <v'q'>, i.e. the storm tracks, are found to be collocated with the ocean fronts in the North Pacific and the North Atlantic, respectively, from the surface to upper troposphere. In addition, statistically significant correlations are found between the <v'T'> as well as <v'q'> and the ocean fronts from the surface up to 250 hPa for all three ocean fronts. For example, the <v'T'> at 850 hPa exhibits strengthening of the local maximum mean transient eddy heat flux in conjunction with the northward shift of the OE and GS in the North Pacific and North Atlantic, respectively. On the other hand, covariability between the KE and <v'T'> at 850hPa suggests northward shift of the storm track associated with the northward shift of the ocean front and additional significant remote signal near the North Atlantic storm track. The remote North Atlantic signal associated with the meridional fluctuation of KE is found at all levels up to 250 hPa. Moisture flux in the upper troposphere suggests a tropical influence. The sum and relative contributions of the sensible and latent components of the transient eddy meridional energy flux are discussed by converting both <v'T'> and <v'q'> to J/kg m/s.