An Analysis of Decadal-Scale Variability

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Abstract

An analysis of multi-decadal variability (MDV) relative to the current centennial global warming trend in available observation data is performed based on three sets of climate variables, including sea surface temperature (SST), ocean temperature from the surface to 700 m, and the NCEP and ERA40 reanalysis datasets, respectively.

The result identifies two dominant modes, with their respective temporal variability resembling the Pacific Decadal Oscillation/Inter-decadal Pacific Oscillation (PDO/IPO) and the AtlanticMulti-decadal Oscillation (AMO). The spatial structureof the PDO-like oscillation is characterized by an ENSO-like structure and hemispheric symmetric features. The structure associated with the AMO-like oscillation exhibits hemispheric asymmetric features with anomalous warm air over Eurasia and warm SST in the Atlantic and Pacific basin north of 10◦S, and cold SST over the southern oceans. The Pacific and Atlantic MDV in upper-ocean temperature suggest that they are mutually linked. We also found that the PDO-like and AMO-like oscillations are almost equally important in global-scale MDV by EOF analyses. In the period 1975–2005, the evolution of the two oscillations has given rise to strong temperature trends and has contributed almost half of the STgm warming. Hereon, in the next decade, the two oscillations are expected to slow down the global warming trends.

Extreme rainfall trends in the tropical climate system are further analyzed to identify contributions from global warming and MDV based on SSM/I and GPCP (1988-2009) data. The partial Least Squared Regression Analysis (PLSRA) method is applied to regressed out the influence of natural oscillations in SST (and other variables) on precipitation over tropical-ocean (30oS-30oN). Results show that a more reasonable (physical) estimate of the trend associated with global warming can be obtained by reducing the influence from nature variability. The same analysis method is also applied to precipitation in CMIP5 RCP8.5 run and CESM large ensemble RCP8.5 run to compare the result between Models and observation.