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Variability and long-term trends of the wintertime precipitation in China during 1979-2010

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With observed station precipitation data in China, a gauge-based analysis of daily precipitation over East Asia, the ERA-Interim reanalysis data and the simulations of CMIP5 models, we investigate the interannual variability and the long-term trends of wintertime precipitation in China and over East Asia in this study. It is shown that China has experienced a decreased precipitation trend in its Southern part and increased trend in Yangtze-Huaihe river basin since 1979, consistent with low-level wind field convergence enhanced in Yangtze-Huaihe river basin but divergence enhanced in Southern China in the ERA Interim reanalysis.

EOF analysis of wintertime precipitation field shows that the leading EOF (EOF1) is characterized by the uniformly enhanced rainfall over the Southern China, without obvious long-term trend in the corresponding PC time series. The second EOF mode (EOF2) is represented by meridionally banded dipole-like structure with the more (less) precipitation changing over the Yangtze River Basin (the South China), with significant trend in its PC time series (about 1.27mm/30yr, which is significant at the 5% level).

SVD analysis between precipitation in China and SST in the tropics shows that the EOF1-like precipitation variability in China is closely related to the traditional ENSO-like SST forcing in the tropical Indo-Pacific basins, while dipole-like EOF2 precipitation variability in China is associated with the SST anomalies in the western-central Pacific. This indicates that the equatorial western-central Pacific SST warming in the past decades might have contributed to the long-term trends of precipitation in China.

Based on the simulated results of the AMIP and Historical runs from CMIP5 Models, we find several GCMs, including the HadCM3 and GFDL-CM3 models, have reasonably reproduced long-term trends of wintertime precipitation in China, including the spatial patterns and amplitude of the trend associated with the EOF2 mode. Our preliminary results suggest that both SST forcing and external anthropogenic forcing associated with increasing greenhouse gas concentration are important factors that have lead to long-term changes of wintertime precipitation in China in the past decades.