

4.057 Long-term variation of precipitation frequency and its correlations with aerosols in China during the past 50 years.

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Abstract:

The spatial and temporal variations of the global precipitation have been investigated both in the frequency and the amount since the past several decades. Confident evidence have shown the significant increasing of the heavy rainfall but decreasing of the light one both in observation and multi-model simulations. Most studies connected it to the global warming, which brings the unbalance between the increasing magnitude of global evaporation ($2\text{-}3\% \text{ K}^{-1}$) and precipitation intensity ($7\% \text{ K}^{-1}$) according to Clusius-Clapeyron equation, and indicated the decreasing of light precipitation. And a number of studies suggested the effects of the aerosols are responsible for the variation of global precipitation via changing the cloud microphysical properties and solar radiation balance. In this study, 50 years (1964 - 2013) monthly averaged precipitation frequency (PF), evaporation, cloud fraction data from the Climatic Research Unit (CRU) with the resolution of $0.5^\circ \times 0.5^\circ$, as well as the daily precipitation amount, surface temperature and visibility data at more than 2000 observation sites from China Meteorological Administration (CMA) were used to analyze the spatial distributions and the temporal variations of precipitation in China based on the Combined Empirical orthogonal functions (CEOF) method. The significant changes of the PF distribution were located in Beijing-Tianjin-Hebei (BTH) and Inner Mongolia, where sandstorm and heavy haze occurred frequently, indicating a strong link might exists between the aerosols and PF. Qiu's parameterization model of aerosol optical depths (AOD) in China inversed based on the observed visibility was deployed to characterize the aerosol concentrations. A good correlation of the time-series of the first EOF eigenvector was found between the AOD and PF. Although there is a great challenge on determining which dominants the variations of precipitation in China, further study might focus more on the variation of PF rather than the amount.