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Decadal variability of tropical Pacific subsurface ocean temperature anomaly and its impact on climate of China

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In this study, we investigate the decadal variability of the tropical Pacific subsurface ocean temperature anomaly (SOTA) and associated anomalous atmosphere circulation over Asia-North Pacific-North America, through analyzing 50 years of atmosphere-ocean data from the National Center for Environmental Prediction (NCEP) reanalysis project and Simple Ocean Data Assimilation (SODA). Relationship between the ENSO-Like mode and climate of China is also revealed. Main results are as follows: (1) Decadal variability of tropical Pacific SOTA has two dominant ENSO-Like modes. The primary mode is a El Niño-Like or La Niña-Like mature phase pattern, and the second mode is associated with the El Niño-Like/La Niña-Like developing (La Niña-Like/El Niño-Like decaying) phase. These two modes forms the cycle of ENSO-Like events, which has a background fluctuation of about 40-year's period, superimposed with an oscillation of 13-year's period. (2) The ENSO-Like events have significant influence on the decadal variations of Asian-North Pacific-North American and subtropical atmospheric circulation. During the mature phase of El Niño-Like events, usually in winter, a meridonal atmospheric circulation pattern develops in the mid-high latitude, a high pressure ridge over Lake Baikal and a ridge of North American high intensify, the West Pacific subtropical high strengthens and extends westward, and a strong anomalous anticyclone exists over the Mongolian plateau. When El Niño-Like events decays (La Niña-Like develops), usually in summer, the troughs over Lake Baikal grow deep, the West Pacific subtropical high weakens, and an anomalous anticyclone controls the Xinjiang-Hetao region. The case during the La Niña-Like events is generally opposite. (3) The ENSO-Like events in the tropical Pacific influence the atmosphere system of the mid-high latitude and subtropical regions, resulting in decadal variability of south wind over the northern China, and hence the East Asian monsoon and climate of China. During the mature phase of El Niño-Like events, the anomalous north wind prevails over the northern China, the East Asian monsoon weakens, with little rain in north China and wet in the middle-lower reaches of the Yangtze river. When El Niño-Like events decays (La Niña-Like develops), the above characteristics generally persists with drought in north China. Vice versa for the La Niña-Like events. The pattern of anomalous climate of China is mainly controlled by the first ENSO-Like mode, while the second mode can increase or decrease the contribution of the fist one, depending on whether its phase is the same with that of the first mode. The climate shift in China around 1978 and successive occurrence of drought for more than 20 years in north China are primary induced by the influence of the first two ENSO-Like modes. The lastest La Niña-Like phase started from 1998, and will presumably end around 2018, during which more rainfall is expected in north China and less rainfall in the middle-lower reaches of the Yangtze river.