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Assessing spatiotemporal variation of drought in China and its impact on agriculture during 1982-2011 by using PDSI indices and agriculture drought survey data

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Inspired by concerns of the effects of a warming climate, drought variation and its impacts have gained much attention in China. Arguments about China's drought persist and little work has utilized agricultural drought survey area to evaluate the impact of natural drought on agriculture. Based on a newly revised self-calibrating Palmer Drought Severity Index (PDSI) model driven with ARTS E_0 [PDSI$_{ARTS}$; *Yan et al.*, 2014], spatial and temporal variations of drought were analyzed for 1982-2011 in China, which indicates that there was nonsignificant change of drought over this interval but with an extreme drought event happened in 2000-2001. A warming climate did not necessarily result in a drying trend for 1982-2011 in China. However, using air temperature (T_a)-based Thornthwaite potential evaporation (E_{P_Th}) and Penman-Monteith potential evaporation (E_{P_PM}) to drive the PDSI model, their corresponding PDSI$_{Th}$ and PDSI$_{PM}$ all gave a significant drying trend for 1982-2011. This suggests that PDSI model was sensitive to $E_P$parameterization in China.

There existed different trend and spatial pattern of drought in China during 1990's and 2000's, respectively. China had a drying trend over 1990's featuring a spatial pattern of Northern drought and Southern wet, whereas a wetting trend was found in China during 2000's accompanied by a contrasting drought pattern of Southern drought and Northern wet. In addition, an extreme drought event occurred in 2000 and 2001, indicating a turning point, caused an unprecedented large area of agriculture drought during 1982-2011, which indicates a typical spatial pattern of severe drought in China on yearly scales, i.e., Northern drought and Southern wet.

Drought-covered area from agriculture survey was initially adopted to evaluate three PDSIs' performance in detecting agriculture drought area. We found that that PDSI$_{ARTS}$ drought area (defined as PDSI$_{ARTS}$ $<$ -0.5) correlated well with the agriculture drought-covered area and PDSI$_{ARTS}$ successfully detected the extreme agriculture drought in 2000-2001 during 1982-2011, i.e., climate factors dominated the interannual changes of agriculture drought area, while PDSI$_{Th}$ and PDSI$_{PM}$ drought areas had no relationship with the agriculture drought-covered area and overestimated the uptrend of agriculture drought. This study highlights the importance of coupling PDSI with drought survey data in evaluating the impact of natural drought on agriculture.