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Editorial

Multi-scale climate variations in the arid Central Asia

Both of the climate changes in arid Central Asia (ACA) and arid region of Northwest China (Fig. 1) were dominated by the mid-latitude westerlies (Chen et al., 2009). Chen et al. (2008) synthesized a set of high resolution lake sediment records from ACA and demonstrated that the nature of Holocene climatic and environmental evolution in both of the arid regions of Northwest China and the whole ACA differs from that of mid-latitude monsoon-dominated Asia. In fact, many studies have demonstrated the occurrence of different patterns of precipitation and/or moisture variations between westerly-dominated Asia and monsoon-dominated Asia on decadal (Ma and Fu, 2006; Jiang et al., 2009; Chen et al., 2011; Huang et al., 2013) to multi-millennial time scales (Chen et al., 2010; Zhou et al., 2011). Therefore, Chen et al. (2009) have argued that a westerlies-dominated climatic regime existed at different time-scales during the Holocene. Recent study (Huang et al., 2015) further outlined the core region influenced by the westerlies, including ACA and Xinjiang in China (Fig. 1) and indicated that the precipitation pattern of the westerlies-dominated climatic regime was caused by circum-global teleconnection (CGT) pattern (Ding and Wang, 2005). However, the study for climate change in ACA is scarce compared with the studies in monsoon-dominated Asia, and the recently climatic history and its change mechanism are specially needed to be further studied.

Along with the continuous developing of global warming, the global drylands will expand in the 21st century (Feng and Fu, 2013; Huang et al., 2016), and more population will be affected by water scarcity and land degradations. As one of the most arid regions in the mid-latitudes, the ACA will be the sensitive areas to climate change and human activities. Therefore, understanding the climate change in this region is important not only for the regional ecosystems and water resource, but also for the environmental management of the East Asian countries.

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In this special issue, the progress of climate change in ACA was presented from various aspects, such as the temporal variation, tree-ring, Central Asian vortex and new climate classification.

Using observations and ERA40 reanalysis data, Dai and Wang (2017) successfully develop a climate classification to investigate the characteristics of the climate regimes around the Tibetan Plateau. Compared to the traditional Köppen climate classification, the new climate classification developed in this paper focuses on large-scale climate classification for distinguishing the characteristics of the large-scale climate over the earth. It can be used in exploring the mechanism of desertification in the drylands of Central Asia tied to the uplift of topography as well as the plate motion that is correlated with the evolution of the Mediterranean.

Yang and Zhang (2017) evaluated the research outcomes of studies of the Central Asian vortex (CAV) in the last 50 years. It considers the definition of the CAV and the factors controlling it, as well as the effect on the weather in Xinjiang, the configuration of the vortex circulation, water vapor transport, dynamic thermal structure, and the development and maintenance of the energy features that cause the rainstorm. The study will help to promote the development of synoptic meteorology and forecasting techniques in Central Asia.

Huang et al. (2017) investigate moisture sources on different atmospheric level for two summer extreme scenarios in Northern Xinjiang. It is found that low-level and upper-level water vapor relating to most of the summer heavy rain (between 50 mm d^{-1} and 100 mm d^{-1}) in Northern Xinjiang is mainly transported by westerlies circulation from the North Atlantic and Eurasian continent. However, rainstorms (more than 100 mm d^{-1}) are dominated by vertically integrated moisture from the North Atlantic, Arctic Ocean, and Eurasian continent, in addition to low-level moisture from the Indian Ocean. Of these sources, the anomalous low-level moisture from the Indian Ocean is considered to be more important in rainstorms. Furthermore, to understand the water vapor transport process, the relationship with atmospheric circulation was also discussed.

Wang et al. (2017) investigate the effect of climate change in the Tien Shan (Kyrgyzstan) using the tree-ring width data from the upper timberline. As opposed to previous studies, the

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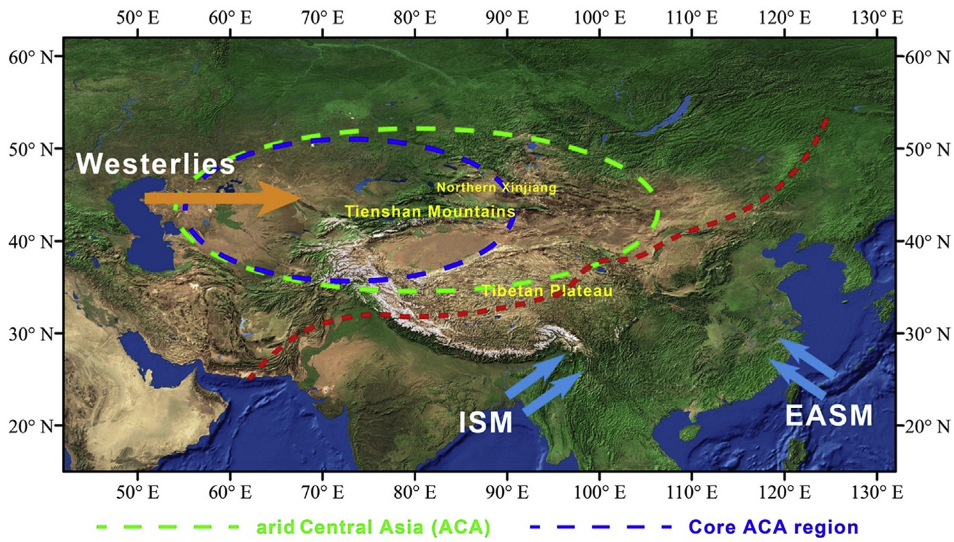

Fig. 1. The study region. The red dashed line indicates the modern limit of the Asian summer monsoon (Chen et al., 2008, 2009), and the areas enclosed by the green (blue) dashed line show the sketch of the arid Central Asia (the core arid Central Asia region, Huang et al., 2015), respectively. ACA, EASM and ISM stands for ACA, "East Asian summer monsoon" and "Indian summer monsoon", respectively.

tree-ring width series from the upper tree line of the Tien Shan is negatively associated with temperature but responds well to hydrometeorological factors. Therefore, the more detailed ecophysiological responses and the role of water availability and temperature were needed in the future studies.

We hope that all articles in this collection will enjoy a broad readership, improving the scientific understanding of climate change in ACA, and providing scientific support for the Silk Road Economic Belt and 21st-Century Maritime Silk Road initiative from the Chinese government.

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