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Changes of Köppen–Trewartha climate types in the Tibetan Plateau during the mid-Holocene, present day, and the future based on high-resolution datasets

Lingxin Huang¹, Wei Huang¹, Song Feng², Kun Yang^{3,4}, and Fahu Chen^{1,5}

¹Key Laboratory of Western China's Environmental Systems (Ministry of Education), College of Earth and Environmental Sciences, Lanzhou University, Lanzhou, 730000, China

²Department of Geosciences, University of Arkansas, Fayetteville, Arkansas

³Ministry of Education Key Laboratory for Earth System Modeling, Department of Earth System Science, Tsinghua University, Beijing 100101, China

⁴Center for Excellence in Tibetan Plateau Earth Science and National Tibetan Plateau Data Center, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China

⁵Key Laboratory of Alpine Ecology, CAS Center for Excellence in Tibetan Plateau Earth Sciences and Institute of Tibetan Plateau Research, Chinese Academy of Sciences (CAS), Beijing 100101, China

Based on the Köppen–Trewartha climate classification schemes, we examined the shifts in terrestrial climate regimes in the Tibetan Plateau (TP) by analyzing the WorldClim high-resolution (~25 km) downscaled climate dataset for the mid-Holocene (MH, 6,000 cal yr BP), the present day (PD, 1970–2000), and in the future (2041–2060, represented by 2050). The climate types of the PD are compared to those of the MH and the future. Our aim was to place ongoing anthropogenic climatic and environmental changes in the TP within the context of changes due to natural forcing in the three selected warm period, and to determine the differences in the spatial expression of ecosystem among these selected periods. The results indicate that the climate of the TP will continue to warm in the future. The intensity of the South Asian monsoon may increase in the future which will affect precipitation in the southern TP. There will be a significant decrease in the areas covered by polar climate, while the spatial coverage of the other climate types will increase. A tropical climate which did not exist in the MH and PD will develop in some areas and the shrinking polar climate indicates that the cryosphere of the TP will change significantly, which in turn may cause the climate system to pass a tipping point and cause irreversible consequences. The large changes in the climate regimes of the TP suggest that there will be a widespread redistribution of the surface vegetation and significant changes in plant species distributions by 2050. Compared to changes in precipitation, increasing temperature is the dominant factor that driving the change of climate types in the TP. The warming alone may cause the climate types to change in more than 20% areas by 2050.