



Impacts of snow cover on alpine vegetation spring phenology over the Tibetan Plateau during 2002-2017

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Plant phenology, as an indicator of environmental variation and climate change impacts, has vital effects on ecosystem biogeochemical cycles. As another major land cover type, snow cover plays an important role in influencing on ecosystem geo-biophysical processes and water availability. For Tibetan Plateau, snow cover and the alpine vegetation are more sensitive to climate change than other regions in China. In situ and regional studies provide evidence for the warming effect on phenology in the plateau. However, the understanding of how seasonal dynamic of snow cover affect the phenology by modulating soil water availability or other environmental factors, are still very limited. In our research, we use a 16-year time-series cloud-free MODIS daily snow cover MODIS dataset to extract the FSCD (Freezing of Snow Cover Date), MSCD (Melt of Snow Cover Date) and SCD (Snow Cover Duration). We also extract the spring phenology based on three vegetation indexes (NDVI, NDPI and PPI) to eliminate the snow cover's contamination. An overall enhanced spring phenology as well as a shorter SCD are observed. Snow cover area exhibited two separate peaks during autumn and late winter over the plateau. MSCD and FSCD do not show significant trend during research period. Extended SCD regions mainly distributed in middle-east of the plateau, while shrunken SCD distributed in other regions of the plateau. For the semi-arid meadow region, the autumn SCD and slightly postponed FSCD have positive effect on advancing the spring phenology along with lag effects. For the arid steppe region, the slightly postponed MSCD and the shrunken SCD have negative effect on the non-significant delay of spring phenology. The non-growing season freezing degree days (FDD) also can modify the effect of MSCD, FSCD and SCD on the spring phenology. Overall, our results suggest that for the alpine vegetation in Tibetan Plateau show distinct react to the snow cover change in different seasons. In further studies, with these effect considered, the predictions on the Tibetan Plateau's spring phenology could be improved.

keywords: alpine vegetation, snow cover, phenology, Tibetan Plateau