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Spatiotemporal variation of correlation between vegetation cover and precipitation in an arid mountain-oasis river basin in northwest China

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Water resources are essential for survival of both the ecosystem and human society in arid regions. The impact of precipitation on vegetation cover, especially in arid and semiarid areas, has received increasing interest. Although correlation between precipitation and vegetation cover has been reported in arid and semi-arid areas (with annual precipitation from 50 to 200 mm and from 200 to 400 mm, respectively), it is unclear whether the same correlation holds in extremely arid regions (with annual precipitation less than 50 mm). This study used remote sensing of precipitation and normalized difference vegetation index (NDVI) to investigate their correlation at different temporal and spatial scales in a typical arid mountain-oasis river system located in northwest China. The results showed that precipitation and NDVI are not evenly distributed in space. In the period before 2007, precipitation was declining at a rate of 1.1785 mm/year, while since 2007, it has increased at a rate of 2.0516 mm/year. NDVI showed no significant temporal trend in most areas (trend slope = 0.001, Significance > 0.05), except for a slight increase in regions where cropland expanded. The Pearson correlation coefficient between the time series of spatial mean precipitation and NDVI over the whole study area was 0.46 (Significance < 0.01), suggesting strong effects of precipitation on NDVI in the study area. The correlation coefficient between precipitation and NDVI varied spatially with the precipitation pattern in space. Through analysis of phase difference in space and time, it was found that NDVI in the lower reaches of the river system was significantly correlated with accumulative precipitation of the current and previous two months in the upper reaches of the system. Our study shows that the impacts of precipitation on vegetation cover have a clear phase difference in space, and that in an extremely arid area, antecedent precipitation in an adjacent region upstream has strong influences on vegetation cover downstream. Thus, the spatial distribution and antecedent accumulation of precipitation impacts should be taken into consideration when analyzing vegetation dynamics in arid areas.