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Pasture degradation modifies the water and carbon cycles of the Tibetan highlands

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Abstract

© Author(s) 2014. The Tibetan Plateau has a significant role with regard to atmospheric circulation and the monsoon in particular. Changes between a closed plant cover and open bare soil are one of the striking effects of land use degradation observed with unsustainable range management or climate change, but experiments investigating changes of surface properties and processes together with atmospheric feedbacks are rare and have not been undertaken in the world's two largest alpine ecosystems, the alpine steppe and the *Kobresia pygmaea* pastures of the Tibetan Plateau. We connected measurements of micro-lysimeter, chamber, ¹³C labelling, and eddy covariance and combined the observations with land surface and atmospheric models, adapted to the highland conditions. This allowed us to analyse how three degradation stages affect the water and carbon cycle of pastures on the landscape scale within the core region of the *Kobresia pygmaea* ecosystem. The study revealed that increasing degradation of the *Kobresia* turf affects carbon allocation and strongly reduces the carbon uptake, compromising the function of *Kobresia* pastures as a carbon sink. Pasture degradation leads to a shift from transpiration to evaporation while a change in the sum of evapotranspiration over a longer period cannot be confirmed. The results show an earlier onset of convection and cloud generation, likely triggered by a shift in evapotranspiration timing when dominated by evaporation. Consequently, precipitation starts earlier and clouds decrease the incoming solar radiation. In summary, the changes in surface properties by pasture degradation found on the highland have a significant influence on larger scales.

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