



Excessive afforestation and soil drying on China's Loess Plateau

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Afforestation and deforestation are human disturbances to vegetation, which have profound impacts on regional eco-hydrological processes, the water and carbon cycles, and consequently, ecosystem sustainability. Since 1999, large scale revegetation has been carried out across China's Loess Plateau following the "Grain-to-Green Program" implemented by the Chinese government. This revegetation, particularly with forest, has caused negative eco-hydrological consequences, including streamflow decline and soil drying. Here, we have used "ecosystem optimality theory" and satellite observations, to assess the water balance under the climate-defined optimal and actual vegetation cover during 1982-2010 and its responses to future climate change (2011-2050) over the Loess Plateau. Results show that the current vegetation cover (0.48 on average) has already exceeded the climate-defined optimal cover (0.43 on average) in the most recent decade, especially in the middle-to-east Loess Plateau, indicating that it is the widespread over-planting, which is primarily responsible for soil drying in the area. In addition, both the optimal vegetation cover and soil moisture tend to decrease under future climate scenarios. Our findings suggest that further revegetation on the Loess Plateau should be applied with caution. To maintain a sustainable eco-hydrological environment in the region, a revegetation threshold should be urgently set, to limit future planting.