Using net primary productivity and water use efficiency for assessing the degree of land degradation and rehabilitation in the Northeast Asia dryland region

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Changes in vegetation productivity and species composition have been used as conventional indicators of land degradation and rehabilitation assessments. The two biophysical parameters vary nonlinearly during land change process with various time lags, which provide, as a whole, a useful framework to diagnose degree of land degradation and rehabilitation. In this study, the net primary productivity (NPP) and water use efficiency (WUE), which are the proxies of vegetation productivity and ecophysiological properties related to species composition, were combined to develop an eco-physiological framework to assess the degree of land degradation in the Northeast-Asia dryland regions (NADR) from 1982 to 2012. Results from long-term trends analysis showed early, middle or late degradation stages occurred in northern grassland and central barren or sparsely vegetated regions, respectively, while the rehabilitation prevailed in eastern croplands and forest, southern, and western grassland. In contrast, short-term trend analysis illustrated the recent rehabilitation in mideastern Mongolia and Loess Plateau, which was unseen in long-term trend analysis. The spatial patterns and temporal changes of land degradation and rehabilitation could be explained partly by either or both natural and anthropogenic factors. Longterm drying and warming might induce land degradation in northern and central NADR, respectively, while the recovery projects and wetting conditions after 2000s promoted the land rehabilitation in Loess Plateau and mid-eastern Mongolia. Here, our NPP–WUE framework may contribute further conceptual development and rapid assessments on land degradation and rehabilitation in wide geographic regions.