EGU23-2749, updated on 09 Mar 2023
https://doi.org/10.5194/egusphere-egu23-2749
EGU General Assembly 2023

Understanding the Effects of Revegetated Shrubs on Energy, Water and Carbon Fluxes in a Semiarid Steppe Ecosystem Using STEMMUS-SCOPE Model

Enting Tang[1], Yijian Zeng[1], Yunfei Wang[1], Zengjing Song[1], Danyang Yu[1], Hongyue Wu[2], Chenglong Qiao[2], Christiaan van der Tol[1], Lingtong Du[2], and Zhongbo Su[1]
[1]Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, Enschede, the Netherlands (e.tang@utwente.nl)
[2]Breeding Base for State Key Laboratory of Land Degradation and Ecological Restoration in Northwest China, Ningxia University, Yinchuan, China (dult80@nxu.edu.cn)

The revegetation practice is one of the most efficient ways to alleviate soil erosion and desertification. However, the land cover change can considerably disturb ecohydrological processes, particularly in arid and semiarid regions where ecosystems are fragile and suffer intense water stress. This study evaluated the effects of revegetation on the energy, water and carbon fluxes in a desert steppe in Yanchi County, Ningxia Province, Northwest China, by simulating two scenarios of shrubs-grassland and grassland ecosystem with the STEMMUS-SCOPE model. The STEMMUS-SCOPE model integrates canopy photosynthesis, fluorescence, energy balance model and soil water and heat transfer model in the soil-plant-atmosphere continuum system. The model was validated by field observations from May to September of 2016-2019, and showed good performances in simulating the energy, water and carbon fluxes. It indicated that the revegetation facilitated carbon fixation (+69.34%). Latent heat flux was the primary consumer of the available energy and was stronger in the shrubs-grassland ecosystem (+16.76%). With the remarkably increased transpiration of the shrubs-grassland ecosystem (+86.72%), revegetation intensified the soil water losses, especially the soil water content within the 0-200 cm depth (−18.97%). Moreover, the water consumption of the shrubs-grassland ecosystem tended to exceed the received precipitation over the growing seasons. These results emphasized the necessity of considering the adverse impacts of revegetation in future ecological restoration, especially the irreversible soil water depletion and imbalance of energy, water and carbon cycles.