



Shrub encroachment decreases soil inorganic carbon stocks in Mongolian grasslands

Shangshi Liu^{1,2}, Luhong Zhou¹, He Li¹, Xia Zhao¹, Yankun Zhu^{1,2}, Haihua Shen¹, and Jingyun Fang^{1,3}

¹State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, Chinese Academy of Sciences, Beijing 100093

²University of Chinese Academy of Sciences, Beijing 100049, China

³Institute of Ecology, College of Urban and Environment, and Key Laboratory of Earth Surface Processes of the Ministry of Education, Peking University, Beijing 100871, China

Widespread shrub encroachment in global drylands may increase plant biomass and change soil organic carbon stocks of grassland ecosystems. However, the response of soil inorganic carbon (SIC), which is a major component of dryland carbon pools, to this vegetation shift remains unknown. Here, we conducted a systematic field survey in 75 pairs of shrub-encroached grassland and control plots at 25 sites in the grasslands of the Inner Mongolia Plateau to evaluate how shrub encroachment affects SIC density (SICD) in these ecosystems. We found that shrub encroachment significantly reduced SICD in the upper 100 cm, especially in the subsurface soil (20-50 cm layer). The magnitude of SICD changes was related to the change in soil pH, shrub patch size, and initial SICD, reflecting that the reduction in SICD might be attributed to the shrub encroachment-related soil acidification. Our results also revealed that the lost SIC was mainly released into the atmosphere rather than redistributed into deeper soil layers. Overall, we provide the first evidence for the soil acidification-induced SIC loss caused by shrub encroachment. Our findings highlight the non-negligible role of SIC dynamics in the C budget of shrub-encroached grassland ecosystems and the need to consider these dynamics in terrestrial C cycle research.