Spatial patterns of soil pH and the factors that influence them in plantation forests of northern China

Songbai Hong, Yongwen Liu, and Shilong Piao

Sino-French Institute for Earth System Science, College of Urban and Environmental Sciences, Peking University, Beijing 100871, China.

Climate and anthropogenic activities such as afforestation and nitrogen deposition all impact soil pH. Understanding the spatial pattern of soil pH and the factors that influence it can provide basic information for generating appropriate strategies for soil resource management and protection, especially in light of increasing anthropogenic influences and climate change. In this study, we investigated the spatial and vertical pattern of soil pH and evaluated the influence of climate and nitrogen deposition using 1647 soil profiles 1 meter in depth from 549 plots in plantation forests of northern China. We found that soil pH decreased from the southwest to the northeast in the study region and had a similar spatial pattern before and after afforestation. Furthermore, our results show that climate and nitrogen deposition fundamentally influence the pattern of soil pH. Specifically, increasing precipitation significantly decreased soil pH (with a mean rate of 0.3 for every 100 mm rainfall, $p<0.001$), whereas increasing temperature significantly increased soil pH (0.13 for every degree centigrade, $p<0.001$). Nitrogen deposition, especially nitrate nitrogen, significantly decreased soil pH ($p<0.01$). All these factors impact soil pH directly and indirectly through climate-plant-soil interactions. As the risks from both climate change and nitrogen deposition increase, there is an urgent need to further understanding of soil pH dynamics and to develop informed policies to protect soil resources.