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Soil and vegetation feedbacks on climate change in high mountain ranges of the Tibetan Plateau__using near and mid-infrared spectroscopy (FT-NMIRS) in soil properties, phosphorus (P) as example

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The Tibetan Plateau is the third-largest glaciated area of the world and is one of the most sensitive regions due to climate warming, such as fast-melting permafrost, dust blow and overgrazing in recent decades. In the past 50 years, the warming rate on the Tibetan Plateau is higher than the global average warming rate with 0.40 ± 0.05 °C per decade. The climate warming is most distinct in the northeastern Tibetan Plateau, implying increasing air and surface temperatures as well as duration and depth of thawing. The main ecological consequences are a disturbed vegetation cover of the surface and a depletion of nutrient-rich topsoils (Baumann et al., 2009, 2014) coupled with an increase of greenhouse gas emissions, mainly CO_2 (Bosch et al., 2017). Due to the extreme environmental conditions resulting from the intense and rapid tectonic uplift, highly adaptive and sensitive ecosystem have developed, and the Plateau is considered to be a key area for the environmental evolution of Earth on regional and global scales, which is particularly sensitive to global warming (Jin et al., 2007; Qiu, 2008). Climate warming and land-use change can reduce soil organic carbon (SOC) stocks as well as soil nitrogen (N) and phosphorus (P) contents and soil quality. Many species showed their distributions by climate-driven shifts towards higher elevation. In Tibetan Plateau, however, the elevational variations of the alpine grassland are rare (Huang et al., 2018) and it is largely unknown how the grass line will respond to global warming and whether soils play a major role. With this research, the hypothesis is tested that soil quality, given by SOC, N and P stocks and content, is a driving factor for the position and structure of the grass line and that soil quality is one of the major controls of biodiversity and biomass production in high-mountain grassland ecosystems.

A Fourier transformation near and mid-infrared spectroscopy (FT-NMIRS) should be used to measure soil P fractions rapid and for large numbers of soil samples, and analyze environmental factors, including temperature, precipitation, soil development, soil fertility, and the ability of plants to adapt to the environmental impact of climate using FT-NMIRS.

We explored first near-infrared spectroscopy (NIRS) in soils from grassland on the Tibetan Plateau, northwestern China and extracted P fractions of 196 samples from Haibei Alpine Meadow Ecosystem Research Station, Chinese Academy of Sciences, at four depths increments (0-10 cm

10-20 cm 20-40 cm and 40-70 cm) with different pre-nutrient additions of nitrogen (N) an P. The fractionation data were correlated with the corresponding NIRS soil spectra and showed significant differences for depth increments and fertilizer amendments. The R^2 of NIRS calibrations to predict P in traditional Hedley fractions ranged between 0.12 and 0.90. The model prediction quality was higher for organic than for inorganic P fractions and changed with depth and fertilizer amendment. The results indicate that using NIRS to predict the P fractions can be a promising approach compared with traditional Hedley fractionation for soils in alpine grasslands on the Tibetan Plateau.