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On sensitivity of natural vegetation and rainfed crops to soil texture

Surya Gupta, Peter Lehmann, Sara Bonetti, and Dani Or
ETH Zurich, Zurich, Switzerland (surya.gupta@usys.ethz.ch)

Crop sensitivity to soil texture guides many agronomic operations, especially under water-limited conditions. Unlike annual and mono-cultured crops, natural vegetation is subject to continuous selection of species and traits for adaptation to local climatic conditions. We report here a systematic evaluation of natural and rainfed cropped vegetation sensitivity to soil texture across biomes, rainfall anomalies, and scales using field observations and remote sensing products. Across biomes and annual precipitation amounts, natural vegetation productivity (GPP) shows no variations with soil texture. In contrast, crops (yields at small scales and GPP at large scales) exhibit sensitivity to soil texture that varies with annual rainfall anomaly and scale. Local measurements at field scale unambiguously show correlation in dry years (in agreement with conventional agronomic practices), while the strong correlation with soil texture vanishes at large scales (250 x 250 km) using remote sensing products. Subsampling of crop GPP at smaller scale (25 x 25 km) reveals a sensitivity of crop GPP to soil texture that becomes prominent in dry years. We conclude that natural vegetation across biomes represents a condition of climatic equilibrium via trait adaptation to overcome soil texture limitations, whereas annual crops retain dependency on soil texture (in rainfed agriculture) manifested at small scales, but obscured at larger scales where topography, aspect and soil map uncertainty dominate. The study provides new insights into gauging vegetation climatic adaptation via sensitivity to soil texture and the roles of scale in expressing such sensitivities in Earth Surface Models.