GC31B-1171: Importance of Nitrogen Availability on Land Carbon Sequestration in Northern Eurasia during the 21st Century

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Atmospheric nitrogen deposition, nitrogen fixation, and the application of nitrogen fertilizers provide subsidies to land ecosystems that can increase nitrogen availability for vegetation production and thereby influence land carbon dynamics. In addition, enhanced decomposition of soil organic matter (SOM) from warming soils and permafrost degradation may also increase nitrogen availability in Northern Eurasia. Here, we examine how changes in nitrogen availability may influence land carbon dynamics in Northern Eurasia during the 21st century by comparing results for a “business as usual” scenario (the IPCC Representative Concentration Pathways or RCP 8.5) and a stabilization scenario (RCP 4.5) between a version of the Terrestrial Ecosystem Model that does not consider the effects of atmospheric nitrogen deposition, nitrogen fixation and soil thermal dynamics on land carbon dynamics (TEM 4.4) and a version that does consider these dynamics (TEM 6.0). In these simulations, atmospheric nitrogen deposition, nitrogen fixation, and fertilizer applications provide an additional 3.3 Pg N (RCP 4.5) to 3.9 Pg N (RCP 8.5) to Northern Eurasian ecosystems over the 21st century. Land ecosystems retain about 38% (RCP4.5) to 48% (RCP 8.5) of this nitrogen subsidy. Net nitrogen mineralization estimated by TEM 6.0 provide an additional 1.0 Pg N to vegetation than estimated by TEM 4.4 over the 21st century from enhanced decomposition of SOM including SOM formerly protected by permafrost. The enhanced nitrogen availability in TEM 6.0 allows Northern Eurasian ecosystems to sequester 1.8x (RCP 8.5) to 2.4x (RCP 4.5) more carbon over the 21st century than estimated by TEM 4.4. Our results indicate that consideration of nitrogen subsidies and soil thermal dynamics have a large influence on how simulated land carbon dynamics in Northern Eurasia will respond to future changes in climate, atmospheric chemistry, and disturbances.