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Plant Nitrogen Uptake in Terrestrial Biogeochemical Models

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Most terrestrial biogeochemical models featured in the last Intergovernmental Panel on Climate Change (IPPC) Assessment Report highlight the importance of the terrestrial Carbon sequestration and feedbacks between the terrestrial Carbon cycle and the climate system. However, these models have been criticized for overestimating predicted Carbon sequestration and its potential climate feedback when calculating the rate of future climate change because they do not account for the Carbon sequestration constraints caused by nutrient limitation, particularly Nitrogen (N). This is particularly relevant considering the existence of a substantial deficit of Nitrogen for plants in most areas of the world.

To date, most climate models assume that plants have access to as much Nitrogen as needed, but ignore the nutrient requirements for new vegetation growth. Determining the natural demand and acquisition for Nitrogen and its associated resource optimization is key when accounting for the Carbon sequestration constrains caused by nutrient limitation. The few climate models that include C-N dynamics have illustrated that the stimulation of plant growth over the coming century may be two to three times smaller than previously predicted. This reduction in growth is partially offset by an increase in the availability of nutrients resulting from an accelerated rate of decomposition of dead plants and other organic matter that occurring with a rise in temperature. However, this offset does not counterbalance the reduced level of plant growth calculated by natural nutrient limitations. Additionally, Nitrogen limitation is also expected to become more pronounced in some ecosystems as atmospheric CO_2 concentration increases; resulting in less new growth and higher atmospheric CO_2 concentrations than originally expected.

This study compares alternative models of plant N uptake as found in different terrestrial biogeochemical models against field measurements, and introduces a new N-uptake model to the Joint UK Land Environment Simulator (JULES)..

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