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Soil biogeochemical cycles under climate change: a new model implementation

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Rising atmospheric CO_2 concentration, as an effect of anthropogenic activities, stimulates forest growth and consequently increases dead biomass input into the soil as also the nutrient request by the plants. Hence, studying of the soil biogeochemical processes, especially those linked to soil organic matter (SOM) transformation and inorganic nutrient production, particularly nitrogen and phosphorous, is crucial to understand how the soil biogeochemical cycles influence the productivity of forests and, in turn, their mitigation role of climate change. However, to face the complexity, especially on the long-term, due to the several environmental factors involved and interacting with each other, the simulation models represent a key tool.

The analysis of the main simulation models of soil nutrient cycles shows how they may neglect some important processes, such as the plant root exudates production and mycorrhizae dynamics, that could have a relevant weight on soil biogeochemical cycles both under present-day as even more under climate change scenarios. As several recent studies show, although the high variable estimates, the plants can reserve up to 30% of their net primary productivity (NPP) to the roots to stimulates soil microbial activity and enhance nutrient uptake.

With the aim to improve the study of the effects of soil biogeochemical processes on forest growth under climate change, a new simulation model is under implementation. It is constituted by a base structure involving the key processes of litter and SOM transformations, mineralization, plant uptake, soil inorganic nitrogen input (symbiotic biological nitrogen fixation), CO_2 emission by heterotrophic respiration and the nutrient losses from the soil due to denitrification and leaching. The base structure will be subsequently integrated by the dynamics of root exudates production and mycorrhizae.