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Quantifying the effects of interacting nutrient cycles on terrestrial biosphere dynamics and their climate feedbacks (QUINCY)

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Nutrient availability plays a pivotal role in the response of terrestrial ecosystems to increasing atmospheric CO_2 and climate change. The first generation of global nutrient-carbon cycle models shows strongly diverging estimates of the nutrient effect, resulting from lacking integration of ecosystem observations and fundamental uncertainties in the representation of governing processes. The two fundamental areas in which advances in modelling are required at i)the effects of nutrient availability on plant photosynthesis and respiration by explicitly taking the energy requirement of nutrient acquisition into account, and ii) the effects of vegetation-soil interactions, namely rhizosphere processes, on plant nutrient availability and soil C turnover.

Here we present the methodology and first results of the QUINCY project, which addresses these important issues by an approach encompassing experimentation and model development. In particular, we outline a novel modelling approach to systematically link carbon, nutrient and water flows within the framework of a general land surface model at time-scales of minutes to decades, and illustrate, how (new) experimental data can (better) constrain this novel model.