PROJECT INFORMATION

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

Project ID: 158

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PROJECT DESCRIPTION

Stoichiometric constraints to plant growth are one of the key uncertainties in current efforts to project the future development of forest growth subject to co-occurring changes in atmospheric deposition of nitrogen, increasing atmospheric levels of CO_2 and climate change (Zaehle 2013, Phil. Trans. Roy Soc.). One key components of this stoichiometric constraint is to understand natural spatial gradients as well as long-term trends in foliar stoichiometry. Data from ICP forest have been a unique data source to study this question (e.g. Jonard et al. 2015, Global Change Biology).
We have developed a novel general land ecosystem model (QUINCY v1.0: QUantifying Interactions between terrestrial Nutrient CYcles and the climate system, Thum et al. in review, Geoscientific Model Development) for the coupled terrestrial carbon, nitrogen, and phosphorus cycles suitable for coupling to land surface models simulating the atmosphere-land exchanges of energy and water in Earth system models. We aim to include a better representation of key processes such as source-sink limitation of growth, and the importance of soil-plant interactions in shaping ecosystem nutrient and carbon dynamics. The modular framework of the model enables simulations in different level of detail at different scales to test new process representations and their implications for large-scale biogeochemical feedbacks.
The specific sub-project of the on-going ERC consolidator grant QUINCY, for which the ICP Forest data will be used, aims to better understand the driving factors behind stoichiometric change, and to elucidate potential plant mechanisms controlling these changes. Novel concepts, for instance taken from use of optimality principles, will be employed to understand

the trade-offs between nutrient and carbon availability across space and time. Plant optimality concepts have been proposed as a solution to this problem as they offer a way to represent plastic plant responses in complex models.

We aim to predict spatial patterns and temporal trends in leaf nitrogen content and biomass growth across European forest ecosystems and contrast these predictions with IPC forest observations, specifically time series of leaf nutrient (nitrogen) content, vegetation biomass and biomass increment and ancillary variables that can help explain the spatial and temporal variation of these variables (soil conditions, vegetation properties, atmospheric nitrogen deposition levels).