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Evaluation of the Vegetation Optimality Model along the North-Australian Tropical Transect using a fully Open Science approach

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The Vegetation Optimality Model (VOM; Schymanski et al., 2009) was used to simulate vegetation dynamics and land surface fluxes at five savanna sites of the North-Australian Tropical Transect (NATT). Simulation results were compared with eddy covariance measurements and several land surface models (LSMs), run for the same sites.

The VOM consists of a water balance model in combination with a vegetation component schematized as two big leaves representing seasonal and perennial vegetation types. No site-specific vegetation data or model tuning is used in the VOM, but instead vegetation parameters are optimized in order to maximize the cumulated Net Carbon Profit, defined as carbon uptake minus carbon expenditure on maintenance and turnover of foliage, roots and water transport tissues.

All data and code as well as all steps of the analysis from data preparation to the generation of figures are tracked and versioned using the open science platform RENKU, developed at the Swiss Data Science Center. In this way, the full knowledge graph, i.e. the tree containing all employed workflows, can be constructed and re-analysed. At the same time, the versioning of all used contents, e.g. data, scripts and models, enables detection and tracking of outdated input data and ensures that the experiments can be fully repeated in a straightforward way by RENKU.

Our preliminary results demonstrate that the optimality-based VOM behaves fundamentally different to traditional LSMs in that it does not systematically underestimate fluxes and their seasonality along the NATT, but captures the grass dynamics at the sites with a tendency of delayed dry season decay. The fully traceable and reproducible workflows permit detailed analysis of the effects of model modifications on the results, e.g. by improved representation of hydrological processes or consideration of constraints on late season productivity of annual grasses.

Schymanski, S. J., M. Sivapalan, M. L. Roderick, L. B. Hutley, and J. Beringer. 2009. “An Optimality-based Model of the Dynamic Feedbacks between Natural Vegetation and the Water Balance.” Water Resources Research 45 (1). https://doi.org/10.1029/2008WR006841.