

## **Rejecting hydro-biogeochemical model structures by multi-criteria evaluation**

Tobias Houska (1), Philipp Kraft (1), Ralf Liebermann (1), Steffen Klatt (2), David Kraus (2), Edwin Haas (2), Ignacio Santabarbara (2), Ralf Kiese (2), Klaus Butterbach-Bahl (2), Christoph Müller (3), and Lutz Breuer (1)

(1) Institute for Landscape Ecology and Resources Management (ILR), Research Centre for BioSystems, Land Use and Nutrition (IFZ), Justus Liebig University Giessen, Giessen, Germany, (2) Institute of Meteorology and Climate Research - Atmospheric Environmental Research (IMK-IFU), Garmisch-Partenkirchen, Germany, (3) Institute for Plant Ecology, Research Centre for BioSystems, Land Use and Nutrition (IFZ), Justus Liebig University Giessen, Giessen, Germany

This work presents a novel way for assessing and comparing different hydro-biogeochemical model structures and their performances. We used the LandscapeDNDC modelling framework to set up four models of different complexity, considering two soil-biogeochemical and two hydrological modules. The performance of each model combination was assessed using long-term (8 years) data and applying different thresholds, considering multiple criteria and objective functions. Our results show that each model combination had its strength for particular criteria. However, only 0.01% of all model runs passed the complete rejectionist framework. In contrast, our comparatively applied assessments of single thresholds, as frequently used in other studies, lead to a much higher acceptance rate of 40 to 70%. Therefore, our study indicates that models can be right for the wrong reasons, i.e. matching GHG emissions while at the same time failing to simulate other criteria such as soil moisture or plant biomass dynamics.