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Going open-source with a model dinosaur and establishing model evaluation standards

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The dynamic global vegetation, hydrology and crop growth model LPJmL has been developed over approximately 20 years and is now one of the central models in global biogeochemical, hydrological and agricultural research with >90 publications in the last 10 years. Scientists from Lund (Sweden), Potsdam (Germany) and Jena (Germany) jointly developed the predecessor (LPJ), which was a carbon-only dynamic global vegetation model (DGVM). After years of further development including the re-programming in 3 different languages (FORTRAN, C++, C), the model LPJmL now covers the full terrestrial hydrology, managed agricultural ecosystems and the nitrogen cycle and is a central component of the integrated assessment model IMAGE. The model description of all features and modules was scattered over more than 30 different scientific publications, where the functionality often was only described in form of abstract formulas. Based on a complete description of the full model in GMD, the model code is now made available open source to the general public under the AGPL3 license. After briefly describing the unexpectedly complicated process of formally going open access with a model with a diverse, multi-contributor international development history, we present two model evaluation frameworks that we propose to become evaluation standards in the respective modeling communities.
The agricultural crop modules are evaluated within AgMIP's (Agricultural Model Intercomparison and Improvement Project) Global Gridded Crop Model Intercomparison (GGCMI), where 14 models are tested against national and gridded data sets. The conceptual and data-availability problems of evaluating crop models at the global scale are identified and discussed. A standardized evaluation tool is available online so that other modeling groups can test their model within the exact same evaluation framework.
For natural vegetation patterns and hydrology, more data are available for model evaluation and evaluation against different data sets for different aspects builds additional trust in the model performance. We discuss model performance and difficulties in presenting a broad set of metrics and reference data.