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Towards systematic evaluation of crop model outputs for global land-use models

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Land provides vital socioeconomic resources to the society, however at the cost of large environmental degradations. Global integrated models combining high resolution global gridded crop models (GGCMs) and global economic models (GEMs) are increasingly being used to inform sustainable solution for agricultural land-use. However, little effort has yet been done to evaluate and compare the accuracy of GGCM outputs. In addition, GGCM datasets require a large amount of parameters whose values and their variability across space are weakly constrained: increasing the accuracy of such dataset has a very high computing cost. Innovative evaluation methods are required both to ground credibility to the global integrated models, and to allow efficient parameter specification of GGCMs.

We propose an evaluation strategy for GGCM datasets in the perspective of use in GEMs, illustrated with preliminary results from a novel dataset (the Hypercube) generated by the EPIC GGCM and used in the GLOBIOM land use GEM to inform on present-day crop yield, water and nutrient input needs for 16 crops x 15 management intensities, at a spatial resolution of 5 arc-minutes. We adopt the following principle: evaluation should provide a transparent diagnosis of model adequacy for its intended use.

We briefly describe how the Hypercube data is generated and how it articulates with GLOBIOM in order to transparently identify the performances to be evaluated, as well as the main assumptions and data processing involved. Expected performances include adequately representing the sub-national heterogeneity in crop yield and input needs: i) in space, ii) across crop species, and iii) across management intensities. We will present and discuss measures of these expected performances and weight the relative contribution of crop model, input data and data processing steps in performances. We will also compare obtained yield gaps and main yield-limiting factors against the M3 dataset. Next steps include iterative improvement of parameter assumptions and evaluation of implications of GGCM performances for intended use in the IIASA EPIC-GLOBIOM model cluster.

Our approach helps targeting future efforts at improving GGCM accuracy and would achieve highest efficiency if combined with traditional field-scale evaluation and sensitivity analysis.