



Modeling for planetary boundaries: a network analysis of representations of complex human-environmental interactions in integrated global models

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The planetary boundaries framework is an approach to global sustainability that emphasises non-linear threshold behavior in anthropogenically perturbed Earth system processes. However, knowledge about the characteristics and positions of thresholds, and the scope for management of the boundaries is not well established. Global integrated models can help to improve this understanding, by reflecting the complex feedbacks between human and environmental systems. This study analyses the current state of integrated models with regard to the main processes identified as 'critical Earth system processes' in the planetary boundaries framework, and identifies gaps and suggests priorities for future improvements. Our approach involves creating a common ontology of model descriptions, and performing a network analysis on the state of system integration in models. The distinct clusters of specific biophysical and social-economic systems obviously has enabled progress in those specific areas of global change, but it now constrains analysis of important human-driven Earth system dynamics. The modeling process therefore has to be improved through technical integration, scientific gap-filling, and also changes in scientific institutional dynamics. Combined, this can advance model potentials that may help us to find sustainable pathways within planetary boundaries.