Earth System
Dynamics
Discussions

Interactive comment on "Towards decision-based global land use models for improved understanding of the Earth system" *by* M. D. A. Rounsevell et al.

Anonymous Referee #1

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This paper provides an interesting, coherent, well-structured and relevant summary of issues surrounding decision-based global land use models, the current barriers that exist to their development and outlines ways forward in addressing these barriers and further developing global scale land use models. This paper provides a useful contribution to land use modelling research, and although reiterates a number of points made in previous publications, it presents a clear and accessible current review and offers approaches towards greater inclusion of LULCC in ESMs.

The paper highlights the economic-centric viewpoint of most global models which do not factor in non-economic rationale in human decision-making. Indeed, my own research has found that non-economic factors are important considerations and, while

the influence of such factors could be small at an individual decision maker level, the accumulative effects through up-scaling as the system expands to the global level could be significant.

The paper recognises the key challenges of data availability, which is a particular issue at the sub-national level, for use in data-intensive models, such as ABMs. This remains an issue and is reflected in a number of recent papers. However, there was no mention of GEOSHARE, which I believe is a new project for collecting and synthesising spatial data at the global level.

The paper articulates that current knowledge is fragmented regarding up-scaling data-intensive models and no current means exist to facilitate in the coordination of data synthesis and assimilation. The paper mentions CCAFS and I'm aware they were developing what they called an online resource or 'knowledge hub' in the context of agricultural models as a means of sharing and synthesising data through facilitating the availability of raw data from research teams internationally. This will allow greater linkage between current agricultural models and create an active network of research teams. Perhaps a similar 'knowledge hub' approach is needed for decision-based global land use models to facilitate the availability of data, ideas and research exchange with other teams and improve future cooperation? Researchers could upload data and it could be centrally administered. The paper only touches on this in Section 3.8 and it does seem an area for future discussion. For example, the literature suggests that to be able to compare LULCC research, modellers need to report how they implemented land cover change in considerably more detail.

The paper mentions that at the global scale it is perhaps better 'to look at effects of decision making rather than the process of decision making per se'. I think this is an important distinction to make. Models are designed to simulate various scenarios and then test the outcomes from a range of inputs, such as the effects of policy initiatives, rather than to predict the future by representing 'reality'.

There is always a trade-off to any modelling approach and as a model is up-scaled to the global level then detail and accuracy at an agent level will be lost as more assumptions are made. The use of typologies, whilst useful as a conceptual approach to model design, can risk ignoring the heterogeneous approach, a key ability offered by ABMs.

The paper does seem to reflect a number of other papers, conference summaries and so forth that suggest what the current issues are and highlight key areas in which to make progress. There is possibly the need to move away from discussions about different modelling approaches and look more at ways to integrate the most promising aspects of each modelling approach and treat them as components of global land use models rather than alternative ways to model global land use, such as the principles behind IAMs.

With many possible modelling approaches and methodologies researchers can employ, the paper does not consider the possible future development of a standardised format for describing decision-based global land use models to aid in understanding, information exchange and duplication of work. This has been mentioned in the literature, using terms such as a 'standardised framework', so results are transferable. I also mention this because I'm aware of one attempt to do this for ABMs called ODD (Overview, Design concepts and Details) protocol (Grimm et al. 2006) (1). The authors describe ODD as a first step in establishing a more detailed common format for describing IBMs and ABMs, with the hope of this protocol evolving as it becomes used by a sufficiently large proportion of modellers. Other papers have called for a framework to be established with a focus on coupling models (e.g. Heistermann et al. 2006)(2).

At the end of Section 3.1 the paper states an 'innovative approach is needed' but offers no suggestions of what this could be or provides any ideas or proposals. One could also simply argue that to harness energy from nuclear fusion an 'innovative approach is needed'!

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Although highlighted in Section 3.1, perhaps the conclusion could be a little more forceful in emphasising what the outcomes are of not including LULCC and representing human decision-making within global scale models e.g. ESMs. For example, Pielke et al. (2011)(3) state that 'unless we undertake a thorough assessment of the role of LULCC on climate, an incomplete understanding of the role of humans in the climate system will persist' and failure to factor in LULCC will have profound consequences, leading to adaptation measures being 'founded on incomplete and potentially misleading information'.

The paper should also be consistent, such as in the use of abbreviations e.g. it is either an ABM or agent-based model but both are used, and either land-use or land use etc. Page 892, line 5 'gas' is missing after the word 'greenhouse'.

1. Grimm, V., Berger, U., Bastiansen, F., Eliassen, S., Ginot, V., Giske, J., Goss-Custard, J., Grand, T., Heinz, S.K., Huse, G., Huth, A., Jepsen, J.U., Jørgensen, C., Mooij, W.M., Müller, B., Pe'er, G., Piou, C., Railsback, S.F., Robbins, A.M., Robbins, M.M., Rossmanith, E., Rüger, N., Strand, E., Souissi, S., Stillman, R.A., Vabø, R., Visser, U., DeAngelis, D.L. 2006. A standard protocol for describing individual-based and agent-based models. Ecological Modelling. 198, 115-126.

2. Heistermann, M., Mller, C., Ronneberger, K. 2006. Land in sight? Achievements, deficits and potentials of continentalto global scale land-use modelling. Agriculture, Ecosystems and Environment. 114, 141–158.

3. Pielke, R.A., Pitman, A., Niyogi, D., Mahmood, R., McAlpine, C., Hossain, F., Goldewijk, K.K., Nair, U., Betts, R., Fall, S., Reichstein, M., Kabat, P., de Noblet, N. Land use/land cover changes and climate: modeling analysis and observational evidence. WIREs Clim Change 2011. doi: 10.1002/wcc.144.

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