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Interactive Comment

Interactive comment on "Reliable, robust and realistic: the three R's of next-generation land surface modelling" *by* I. C. Prentice et al.

Anonymous Referee #3

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This manuscript makes two welcome contributions to the literature. The first is an overview of the history and state-of-the-art of land surface models which traces their development from simple bucket models without vegetation through to the use of ecosystems that respond dynamically to external forcing. The second part of the paper puts forward the authors' vision for how future development in this area should proceed. Particular emphasis is given to the use of multiple constraints, benchmarking and data assimilation.

It is difficult to disagree with any specific part of this paper. However in my opinion its whole is not quite equal to the sum of its parts. The overview of model developments is fairly brief and skims over a number of important considerations and competing paradigms. This is fine in the sense that it is not the intention of the authors to

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provide an exhaustive review, but I would argue that the brevity of this part of the paper should be compensated by more detail in the discussion that follows. The discussion of how model development should proceed is very thought provoking and will hopefully stimulate coordinated activity in the community but is ultimately lacking in any solid advice as to how these activities should be done. The Data Assimilation section, for example, provides a description of what Data Assimilation is, what the problems and advantages with the different flavours of it are, and states strongly that it should be a part of any model development activity. Beyond that there is little discussion of what form this should take. The assimilation problem for the land surface is markedly different for that in fluid media (for which Data Assimilation was originally developed). There is lots of research activity in this area, which the authors acknowledge, but the impact of the manuscript could have been increased by suggesting areas for coordinated activity in this field: what are the problems we need to solve? I think similar comments can be made about other sections of the manuscript also.

This paper should be published because it puts forward the beginnings of a roadmap that will hopefully galvanize the modelling community and I am not aware of a similar attempt to provide this in the literature. I have no doubt it will have impact. It is my hope however that something more concrete follows soon. The manuscript is well written and well structured throughout.

My only minor comments are that the figures in general could be better presented, and that I am not convinced the inclusion of the data in Table 1 is necessary.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 24811, 2014.