**Biogeosciences
Discussions**

Interactive comment on "A simple ecohydrological model captures essentials of seasonal leaf dynamics in semi-arid tropical grasslands" by P. Choler et al.

Anonymous Referee #2

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The spatio-temporal variability of rainfall in semi-arid ecosystems, together with feed-backs between plant growth and soil moisture has made modelling of leaf phenology particularly challenging. Therefore, the authors test the ability of linear and 'low dimensional non-linear' bucket models for capturing the seasonal development of leaf phenology in water-limited ecosystems using time series of MODIS NDVI (expressed as fractional vegetation cover), daily time series of rainfall and Priestley-Taylor PET, and soil information. 100 sites from 400 randomly chosen sites in C4 dominated tropical grasslands in the Northern Territory, Australia, were used for model calibration, and the rest for validation. The more complex bucket model outperforms the conventional class of simple bucket models regarding systematic error, capturing sharp transitions

in leaf cover and by performing better at the drier sites, but not mean absolute error.

The research problem is an important one because it is hard to realistically simulate water budgets in partially vegetated ecosystems – a solution is vital for accurately predicting vegetation growth and related variables in global land surface models. As these authors show, the most workable approach is to explicitly treat bare soil and vegetated components separately. Though models of this type have been around since the early 1970s, this is perhaps the first study that aims to compare the widely used 'conventional' bucket model with this more sophisticated approach over a large area.

I find the study intriguing, but there are several aspects to the work with need improvement, and/or clarification before it is published in Biogeosciences.

One of the first issues is the context – the 'big picture' is missing. Can the authors explain why it is so important to predict leaf phenology in water-limited ecosystems? They begin with the term 'land surface model' but end there. The term 'land surface model' also needs to be clarified. A few sentences would be appropriate in the introduction/rationale section.

The evaluation procedure shows that the more complex bucket model outperforms the conventional class of simple bucket models in many respects, but not others. Again, can the authors explain more explicitly the value of these benefits – particularly if the mean absolute error is not improved? A better model can certainly be built. But is a better model really required? And if so, why?

A number of ready-made products were used to conduct this study, and the products themselves are the result of 'models' of different kinds. What are the uncertainties associated with the soil information (such maps are notoriously poor), the PET layers, the rainfall and the reflectances? And how might they have affected model performance? A table might be a good idea for quickly summarizing the information.

Explain what the MOD09A2 Collection 5 is – again a table might be good for summariz-

ing the processing applied to the component reflectances. Explain the 8-day timestep. Are these composites of some sort?

Justify the application of a two-order polynomial fitting method on missing satellite data. Was the performance of the interpolation tested on simulated time series? Was it compared against other methods?

Section 2.3 needs to be re-written. It is a very dense section, and very quickly becomes tedious to read. What is a ramp function, exponential decay parameter (what is it that decays?), logistic growth term– this kind of thing. Why not include two flowcharts that show how each of the models work? Provide a key for the variables.

p. 8863 line 11 – 'temperature' is not a resource, whereas heat can be considered a resource in this context p. 8863 line 13 – what is 'Lotka-Volterra type' – please explain briefly or remove p. 8863 line 24 – what is meant by 'linear modelling' – in fact, early on the manuscript, it may be a good idea to introduce 'linear' and 'non-linear' with succinct clarifications p. 8864 lines 1-10 – these type of extended explanation feels misplaced – it reads more like it belongs in the methods p. 8865 line 22 – explain what is meant by 'anomalous' p. 8666 line 26 - Seaquist et al. (2003) reports 0.5, not 0.75. Furthermore, the context is different as the authors use MODIS data, not the Pinatubo-affected Pathfinder. p. 8670 lines 10-12 – please explain p. 8672 lines 16-20 – this seems more appropriate in a previous section e.g. study area p. 8673 line 23 – time series of what? p. 8674 line 13 – remove 'tease out,' it is a colloquialism

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