Biogeosciences
Discussions

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Interactive
comment

Interactive comment on "Spatiotemporal dynamics of soil phosphorus and crop uptake in global cropland during the twentieth century" *by* Jie Zhang et al.

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This work developed a spatial explicit DPPS (Dynamic Phosphorus Pool Simulator) model based on Sattari et al., 2012. Except spatial explicit calculation, improvements include the incorporation of land use change, dynamic transfer from SP to LP, initialization P pools with global observations, dynamic P loss by runoff, use of Michaelis-Menten kinetics in the calculation of crop uptake, and time-variant maximum uptake parameter. Most improvements are based on previous studies. However, major findings from the model results are already made by previous studies such as MacDonald et al, 2011, Sattari et al., 2012, Bouwman et al 2013. The authors need to address the new findings clearly. Major comments: My major concern is the setting of max_updake.

The reason of setting a time-variant max_update is good, i.e. the development of technology in crop production. The authors used the historical uptake, but no reference and data period was given. I do not believe this change is abrupt but gradual, and the second agriculture revolution happened between 1930-1960. It is better to set a max_updake curve according to crop yield per area or other index, instead of two arbitrary values. In addition, why max_update will change for no cropland? As the uptake is quite sensitive to max_updake (table 3), I believe that the modeling results depends heavily on the setting of max_updake. And I hope there may be some new findings.

My second major concern is that it seems that the authors used the same uptake dataset (1960-2010) to calibrate and validate the model. To evaluate the model performance, the validation data should be independent from the calibration. May be use only data from 1960-2000 to calibrate and use data from 2000-2010 to validate. But you could use all the observation data in calibration to show other results after the evaluation. Furthermore, there is no observation from 1900-1960, so the model estimation for this period is a kind of reconstruction, which has higher uncertainty. This should be emphasized in the text.

Improvements of the manuscript structure should be made to make it more readable. Here are some of my suggestion. As this paper is an improvement of DPPS, you may descript the improvements in the introduction, which can make it more clear to the readers in the first impression. Move content from page 5 line 16~20 to the section 2.3. Add section 2.4 validation, and move page 5 line 16, page 6 line 21~27 to this section. Maybe add a section called initialization and calibration before section 2.3, which contains page 5 line 22~30. There are no description or interpretation of table 3 in the results or discussion.

I am confused by the two separation of the simulated 100 years: 1950 and 1960. Some parameters and calculations are set by 1960 split and some by 1950 split. Why not just set the same time split? If you choose one, why do you select 1950 or 1960? I understand that the uptake observations are from 1960, but it should not be used as a

criterion in time split of parameter setting.

What is the advantage of initialization by global observations? Does it speed up the simulation or improve the model results? What is the effect of land use change? Add a figure to show this. In the discussion, the difference with previous studies, especially spatially explicit, should be addressed and explained the possible reasons.

Minor comments: Table 1: the value of max_uptake is not 100 Figure 1: Add features of the new DPPS in the figure: land use change, spatial explicit and initialization with global data. Why change the P inputs without entering the stable pool compared to Sattari et al, 2012? Figure 3: no definition of d and NSE. Describe and explain the underestimation and overestimation in different regions. Figure 4: color are too hard to distinguish, may be use also symbols like cross. Page 3, line 20: at 30 cm over? Page 5, line 16: Due to the equation in S1, it is not RMSE but Normalized RMSE (i.e. coefficient of variance). Please correct it. Page 10, line 26: change Pin to P in