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Geoscientific Model Development Discussions

Interactive comment on "The Polar Vegetation Photosynthesis and Respiration Model (PolarVPRM): a parsimonious, satellite data-driven model of high-latitude CO_2 exchange" *by* K. A. Luus and J. C. Lin

Anonymous Referee #1

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"The Polar Vegetation Photosynthesis and Respiration Model (PolarVPRM): a parsimonious, satellite data-driven model of high-latitude CO_2 exchange", by K.C. Luus and J.C. Lin

The manuscript by K. Luus and J. Lin describes PolarVPRM, A model that computes high-latitude NEE with descriptions of photosynthesis and respiration that are regulated by remotely sensed driving variables. The manuscript describes specifically the additions to VPRM that were made for high-latitude applications.

PolarVPRM applies seven vegetation classes, of which four were simulated using the

equations and parameterization as in the original VPRM. The remaining three classes (barren/wetland, graminoid tundra and shrub tundra) were calibrated and validated against a number of eddy covariance sites in North America. Apart from this calibration and validation, the manuscript addresses the differences between PolarVPRM NEE estimates and estimates from two other model products, and it analyses the trends in NEE for the period 2001-2012.

Overall, this is a thorough paper with a clear description of the model, its calibration and validation, and well-suited for publication in GMD. Some unclarities remain as to how the calibration has taken place, and I have some remarks on the results and discussion, but I am confident that the authors can address these in a revised version. Please find my remarks below (with reference to page/line numbers).

Major remarks:

985/26: It is unclear how $LSWI_{max}$ (Eq. 3), T_{min}, T_{max} and T_{opt} (Eq. 4) were determined, if not from the calibration procedure. The temperature parameters are mentioned later (989/5) as originating "from the calibration sites", but it is unclear whether these parameters are specific to the vegetation class or generic, and how these were determined.

994/4 (Validation): The validation section describes that MBE and RMSE were determined at 3-hourly, daily and monthly intervals, but this section reports only the 3-hourly values. It would be interesting to see how well the estimates were at daily or monthly scale: 3-hourly values provide primarily insight in the model's ability to capture the diurnal cycle, whereas the daily and monthly values would give more insight in the ability regarding seasonal variations. I would recommend the authors to address the seasonal variations as well. Likewise, it would be interesting to see how good the model captures the interannual variability, which is typically much harder to simulate. However, I can imagine that the amount of validation data may not be enough to analyse this.

1001/11: The authors stress in their conclusions the changes from VPRM to PolarVPRM, but, whereas a comparison has been made to two other models, there is no comparison to the original VPRM in the manuscript. Therefore, the statement that "accuracy of snow season estimates has improved" is not supported by the manuscript. It would be nice, though, to have a short summary of how PolarVPRM compares to VPRM earlier in the manuscript. Such a summary could emphasize the importance of capturing these specific high-latitude dynamics, and would as such strengthen the study.

Minor remarks:

980/21: "enough to double or triple the atmospheric CO_2 concentrations" - This is of course only valid if the compensating roles of marine and terrestrial uptake are not considered. As it is used in an illustrative manner here, it may not be so important, but one could phrase this more carefully as "ca. twice as much as the current atmospheric amount of C" (or likewise).

984/20: Eq. 6: The mathematical notation with the condition in between the "R=" and the "alpha*..." is somewhat confusing, please alter to a more common notation with the condition at the end of the line.

Table 1, caption: A short sentence on the nomenclature used for the trees in the table would be helpful, to explain what "trees mixed mixed" means.

985/26: A reference to Eqs. 5 and 6 would be helpful here.

994/7: It would be good to mention here that these numbers refer to 3-hourly values.

998/4 (Fig. 5): It could be interesting to show Fig. 5b and 5c (multiplied by -1) in one panel, which would more easily show for which years R exceeds GEE (and reversed) - it would also illustrate that R varies more between years, whereas GEE is more stable.

998/19: Remove brackets around "Fig. 5b"

999/11 (Fig. 7): If possible, it would be nice to see the non-significant pixels in Fig. 7-9 coloured differently than the water body pixels.

1001/10: The remark on day length variations comes rather late here (I have not noted it earlier in the manuscript) - if this is a difference between VPRM and PolarVPRM, it should be brought up earlier.

Interactive comment on Geosci. Model Dev. Discuss., 8, 979, 2015.