Geoscientific
Model Development
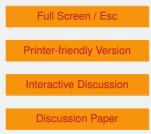Discussions

Open Access

Interactive comment on "A global scale mechanistic model of the photosynthetic capacity" *by* A. A. Ali et al.

Anonymous Referee #1

Received and published: 7 September 2015

A.A. Ali et al 2015 present a model to predict photosynthetic capacity across C3 plants based on optimization principles and a global data set used for estimation of model parameters. The topic of this paper is highly relevant and timely in ESM science, as parameterization of photosynthetic capacity in most of these models does not reflect the variability shown in the observations, therefore a model to parameterise Vcmax and Jmax in ESM is highly needed. The study uses i) the Xu et al (2012) model to estimate allocation of nitrogen within the leaf and the ii) Ali et al 2015 data set to derive Xu's model parameters necessary to predict Vcmax and Jmax at 25 C.

The study uses two temperature functions to represent uncertainty of the temperature response of these parameters. TRF1 includes thermal acclimation of photosynthesis while TRF2 does not. There is a potential problem with using TRF2 as currently pa-

rameterized, as the optimum temperatures for Vcmax and Jmax do not vary in space on these simulations but we know they do in reality, therefore the assumption is that all C3 plants in the world are represented with the same temperature optimum for Vcmax and Jmax. How representative and valid are these values for cold adapted plants? Possibly, this has implications for some of the conclusions of the paper when taking the difference between simulations with and without acclimation under both future and present day conditions. You could still have a simulation without thermal acclimation of photosynthesis, that accounts for special variability of Topt of Vcmax and Jmax (Kattge and Knorr, 2007, show the data, Medlyn et al 2002 as well) . I think the authors ought to check / demonstrate whether this assumption (having the a constant temperature optimum of Vcmax and Jmax on their non acclimated temperature function) for has implications for their main conclusions.

There are other studies trying to do the same as this paper is doing, but based on empirical relationships (Verheijen et al 2013, Biogeosciences), between environmental drivers and Vcmax and Jmax at 25C , deriving relationships for each pft. The authors should acknowledge this type of work, which has also been used to extrapolate under future conditions (Verheijen et al 2015, GCB).

The manuscript is well written and structured. All the equations are given in the Appendix and are clearly explained.

Minor comments -Missed paper on your references, Maire et al 2015, Global Ecol. Biogeog. See comments on soil ph, worth to include this on your limitations.

-The discussion on model limitations could also include the fact that there is inherent intraspecific variation of photosynthetic capacity (See Moran et al . 2015, GCB)

-There are a lot more papers out using optimization now, perhaps you should cite them too.

Page 6221 , line 15, replace 'need' with 'needs'

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Page 6222, lines 21-22 replace 'Optimal approaches are an important tool of land surface models', with Optimal approaches are an important tool for land surface models,

Page 6224, lines 7-8 & 14 no need to repeat references on line 8 when already given in line 7

Page 6224, define MCMC

-Although you do not specify pfts on your model, it would be good to give an idea to the reader (most probably a modeler) of the geographical distribution of your data set (used to calibrate your model) in terms of plant functional types.

-Parameter estimation and evaluation is done with same data set. Please comment on implications of this. I wonder if you could fit the model with a portion of the data, then use your LUNA to predict Vcmax and Jmax and then evaluate the goodness of the model.

-Section 2.6 is model sensitivity analysis. Then on p 6227 another sensitivity is mentioned, is this the same?, why to have it twice, confusing and repetitive

-Fig 4 & 5, very poor color scale as it does not show much of the variation on key ecosystems.

Fig 5, is this the + or the minus 15% sensitivity?, not clear in the Fig caption

P 6229., Lines 25-26 replace '.It also well captured ..' with It also captured well . . . '

P 6232, L10, you mean high growing season temperatures?, add word 'season'

———————————————

Interactive comment on Geosci. Model Dev. Discuss., 8, 6217, 2015.