Geoscientific

Open Access

Model Development

Discussions

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

C. Xu

xuchongang@gmail.com

Thank you very much for identifying this important confusion point in your reading of our paper. It is important to point out that the "optimization" in LUNA is to maximize the carbon gain (defined as gross photosynthesis minus the maintenance respiration for photosynthetic enzyme) given the plant's strategy of leaf nitrogen use built into LUNA. Namely, it is a conditional optimization. Thus, it is possible that values of $V_{c,max}25$ and $J_{max}25$ other than the "optimal" values predicted by LUNA could have higher net photosynthetic rate, if the plant does not follow the prescribed plant nitrogen use strategy built into the LUNA model. There are two key relevant strategies in LUNA that could explain the lower net photosynthesis rate under future climate compared to that using fixed $V_{c,max}25$ and $J_{max}25$. Firstly, in response to higher CO_2 concentration,

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

the LUNA model will downregulate the Vc,max25 (see Fig.5 d) due to the increase in Rubisco nitrogen use efficiency (see eq. (A18)) and thus less nitrogen is needed to be allocated for Rubisco to maintain high photosynthetic rate. Secondly, the LUNA model will also downregulate both Vc,max25 and Jmax25 in response to higher temperature but below the maximum temperature for optimization (i.e., 42 oC for TRF1 and 33oC for TRF2) (see Fig.5 a and Fig 6a). This is resulted from the assumption in LUNA that higher nitrogen use efficiency of enzymes for electron transport and carboxylation under higher temperature and thus less nitrogen need to be allocated for electron transport and carboxylation to main a high photosynthetic rate (see Eq. (A11)). These downregulations in Vc,max25 and Jmax25 will lead to lower net photosynthetic rate under future climate conditions compared to the case that we use fixed Vc,max25 and Jmax25 . We understand that this could be a key confusion point for readers. If we are given the chance of revised paper in GMD, we will try to better explain these down-regulations and the consequent overestimation of net photosynthetic rate by using fixed photosynthetic capacities. We will also modify the introduction to introduce the optimization work for LPJmL, LPJ-GUESS and LPX. We would appreciate if you could help point out the specific citations that we can look into.

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