
Title: Global Datasets of Leaf Photosynthetic Capacity for Ecological and Earth System Research
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If we accept the Farquhar-von Caemmerer-Berry photosynthetic model as the dominant paradigm for computing leaf and ecosystem photosynthesis and to apply it to the challenge of assessing photosynthesis everywhere and all the time, we will need to assess such key parameters as Vcmax, at a reference temperature. Chen and colleagues have been leading the way in developing a means to do this and here is their global dataset. It profits from the sharing of data by many through the TRY plant traits dataset (>3700 datasets) and use of optimization theory by many of the co authors and inferences with information from satellite remote sensing to upscale information.

For the upscaling the authors use two multiple constraints and plausible means, SIF and leaf chlorophyll information deduced from plant reflected spectra. These are useful and defensible. Though I do worry about SIF as the signal is small and many show that it represents absorbed light more. But I don’t see this as a fatal flaw and it is worth exploring.

My other words of wisdom, having spent time with books on the ground assessing \text{Vcmax} is that we know there is lots of seasonality in this parameter, with changes in leaf allocation of N and effects of soil moisture deficits. But this request may be beyond the scope of this work. But I strongly argue for future efforts to create seasonal maps of Vcmax. My other experience is to find vertical variations in Vcmax with depth in deciduous forests, as there is much light acclimation and strong vertical gradients in leaf N that affect Vcmax. This complication, too, is beyond the scope of this work.

In the methods, I am glad to see the authors consider clumping and sun and shade leaves. This is an effort I would insist upon if one is working on a specific canopy. Though for global assessments I worry that by doing so it may introduce error in Vcmax as we may not know these other factors with enough precision.

With regards to inverting information derived from leaf chlorophyll I am satisfied to see them using a state of art radiative transfer model, PROSPECT, for this inversion. It is the best way to proceed in my mind. Yes, one may use simple empirical algorithms instead, but are they good enough? Nor may they be mechanistic enough.

As noted above using 3700 datasets on A/Ci brings the remote sensing inversion to reality. Can’t ask for a better way to do this.

Temperature normalization is always the trickiest as we see lots of temperature acclimation in the field. But don’t know what else to suggest. Better than nothing.
Results

While it is nice to see computations compared with ground based measurements, realize that the model is fitted with information from the ground. So a bit circular. Would be better to reserve a subset of data for model testing. It probably wont change things because with 3700 data points there is over sampling, especially given the scaling work of Reich and others showing that 80% of variances in leaf photosynthesis scales with only a few factors, leaf N, specific leaf weight and age. Maybe comparing your results to this economic leaf scaling result may be a reasonable alternative.

Glad to see a section on response to drivers. Useful. The issue on irrigation is interesting and could be a scale emergent property from this work. Remember irrigated fields are also fertilized so they will stand out compared to native vegetation.

Discussion

Looking at your maps I see high Vcmax in desert and semiarid areas (Africa, India, Australia and the Cerrado of Brazil) In my early work on stress, I looked a lot at Park Nobel’s work on desert species and indeed did see among the higher Vcmax values. Thinking about Prentice optimization theory I think it makes sense. They need to acquire enough carbon to outpace respiration. But they have a short growing season due to low water supply and high demand. The only way they can make the economics work is to achieve very high rates of photosynthesis, which comes at the cost of high Vcmax and N. I find this interesting and the authors may want to discuss this a bit
The quality of the figures is good enough. Looks like they are generated by Matlab and have nice color gradients.