Implementation and evaluation if the unified stomatal optimization approach in the Functionally Assembled Terrestrial Ecosystem Simulator (FATES)

In this paper Li et al., implement the optimality-based stomatal conductance model from Medlyn et al., (2011) (MED) into the FATES dynamic vegetation demography model. They compare the behaviour of this model to the existing empirical Ball-Woodrow-Berry (BWB) model. Firstly they assess how the response of simulated carbon and water fluxes to meteorological drivers (CO_2 concentration, air temperature, radiation, and VPD) differ between the two models to aid in understanding model representation and behaviour. These changes in meteorological drivers are applied in a sensitivity study, and differences arising from model parameterisation versus model structure are explored over a wide range on environmental conditions. Secondly, the authors evaluate the performance of each model at a tropical forest site in Panama. Thirdly the authors explore the application of the soil moisture stress function (the β factor) at different points in the physiological pathway which modifies simulated photosynthesis and stomatal conductance according to available soil moisture. This paper is well written and concise, and provides a nice evaluation of the impact of different representations of stomatal opening on carbon and water fluxes in a dynamic vegetation model, assessing the impact of both model structure and model parameterisation. I believe this paper fits within the scope of GMD and would be of interest to readers. I have a few comments below:

Introduction:

- Lines 70 to 80: Please add which models do what with regards to the β factor i.e. which models apply β to g_0 and/or g_1, and which models apply it to V_{cmax}/J_{max}, or elsewhere in the physiological pathway.
- The authors may find this paper relevant to their discussion on the application of the β factor within land surface models (particularly in the discussion around line 362): "On the Treatment of Soil Water Stress in GCM Simulations of Vegetation Physiology. 2021. Vidale et al., Frontiers in Environmental Science. https://doi.org/10.3389/fenvs.2021.689301".

Methods:

- Section 2.1: For clarity, can the authors be a bit more explicit about how they implemented the MED scheme, was it as straightforward as replacing equation 1 with equation 2 and adding the β factor?
- What is the photosynthesis scheme used to calculate *A*?
- Line 110: What measurements are being made at the site to compare with the simulations?
- Please add more detail about the model and simulations for clarity. FATES is initialised with real-world forest inventory data – so for these simulations that are at a single study site what does that represent – a single tree, an area of forest? Later on PFT specific parameterisations for the g_1 parameter are used, so are there different PFTs each with their own cohort structure? What meteorological forcing is required to drive the model, at what temporal resolution? Is the driving data provided by the test site, or from elsewhere? How is LAI modelled? A bit more clarity on the model and how it is run is required for those not familiar with FATES or CLM.

Results:

- What causes the difference between MED and BWB in VPD response when VPD > 1.5kPa? What do observations suggest is a more realistic response? Are there any observations from this site for the tropical trees to try and help pin down how *A* and *gs* are responding?
- Why is there a bigger difference (comparing MED-B and MED-default) in simulated *gs* compared to *A*?
- Why does simulated ET increase with increasing VPD when *gs* decreases?
- Line 255: Can you explain the abrupt changes better – I don't really see that MED is behaving that differently to BWB, and VPD rarely gets as low as 0.1 kPa.
- Could Figs 5, 6,7 and 8 be condensed? I wonder whether the diurnal cycles for the days without measurements are necessary? The months could then be plotted side by side for easier comparison (and on the same scale for the Met vars to make it easier to see how conditions change by month as the dry season progresses)?
- Are there any observations of soil moisture at the site? In April it seems that although the model is simulating reduced soil moisture availability which depresses *A* and *gs*, the measured *A* and *gs* remain as high as in other months. Could it not be that the simulation of soil moisture stress itself in the model is not right and more of an issue than where the β factor is applied? How are soil parameters set in the model? Are these informed by the site-level information?

Discussion:

- Line 320 onwards: I am unclear on the third point. It says the response curves of *Anet* and *gs* are directly comparable to the leaf-level gas exchange measurements, but these data are not shown anywhere and do not seem to be used in this evaluation. These indeed would be invaluable to help determine which model behaviour is more realistic, for example to help pin down the VPD response which is largely where the two models seem to diverge. If they are available could they be included?
- Some discussion around the g_0 parameter would be interesting. Studies have shown that the g_0 term affects predictions of *gs* at all times, not just when *A* is close to zero, making predictions of plant water use very sensitive to this parameter. Is it right to have a minimum conductance when *Anet* is zero? What are the authors' justification for including the g_0 term in the MED formulation? Did the authors look at sensitivity of simulated *gs*/*Anet* to g_0?