Interactive comment on "Benchmarking and Parameter Sensitivity of Physiological and Vegetation Dynamics using the Functionally Assembled Terrestrial Ecosystem Simulator (FATES) at Barro Colorado Island, Panama" *by* Charles D. Koven et al.

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In this analysis, the authors explore FATES's sensibility to parameter uncertainties using mainly observation-based trait and benchmarking the outputs against BCI's forest inventory and eddy covariance data. With large ensemble simulation, using a single PFT (no competition), they first evaluate the model. FATES performs reasonably to represent physiological processes and forest structure. The authors also show the

systematic biases of the model and explain the further needed development. Adding competition lead the model to simulate higher productivity and biomass, pointing out that even tough multiple PFTs should be a more realistic configuration to represent tropical forest, the Âń́ǎmono-specificǎÂż approach performed better. They also show that, with more disturbances, the model favor early successional PFTs (over late succesional PFTs). They conclude on the importance to differentiate parameters that are or are not influenced by competition to better quantify the source of uncertainties in VDMs.

I found the paper proposed by Koven et al, fully relevant to the community. Besides, despite the complexity of the model and the exhaustive sensitivity analysis performed, the paper is relatively easy to follow, the model description is crystal clear and the key messages are well highlighted. I particularly appreciated the effort of the authors to explain the sensitivity analysis through the ecological processes undergoing in the model. Therefore I think the paper is ready for publication, and I only have minors comments (or questions) detailed below.

Comments

In the introduction, it might be nice for non-landsurfacemodelling reader to sum up in a sentence the connections between ESM, LSM and VDM.

L163: Is RH calculated by the LSM or by FATES?

L 282: Units?

L315: Can you describe a bit more BCI and BCI data? Also, what are the time period of the eddy fluxes data? Did you recycled the meteorological data from 1986-2017 to force CLM-FATES several hundreds years, or did you took an averaged climate?

L369 I didn't get why each simulation is initialized with the observed size distribution. I would guess that the size distribution of a population will strongly depends on the PFT definition. Because FATES is able to compute the size distribution, why not start the

simulation from scratch?

L434 Might be a naive question, but do you cover a large enough range of the observed variability by taking the same number of ensemble for 1PFT, 3PFT and 10PFT?

L530 While I think it's interesting to show how insensitive is FATE to the ấńÂãhost modelÂãÂż by comparing CLM-FATE and ELM-FATE, I wonder how relevant this analysis is. Indeed, both model are forced by the same atmospheric conditions, and as pointed by the author, the only difference reside in the soil representation. My guess, is that both host models provide enough soil moisture to FATE (because they are likely to share the same soil parameterization and BCI is relatively wet), therefore it is logical that FATES behave similarly. I wonder what is the point of this test.

L615 I'm wondering how climate variability can play a role in simulating species co-existence (thus my question on the forcing file).

L758 While I agree with your conclusion, you might want to be a bit more explicit. VDM are certainly one of the way to go in ESM to better quantify how environmental changes will affect ecosystems and the associated feedbacks. In the analysis, you show how large (and unconstrained) can be the effect of competition, and how difficult simulating co-existence is. However, the comparison with the observed data suggest that 1 PFT perform usually better than the simulation that integrate competition (Fig. 9). I think it would be nice to have a sentence bridging complexity (and reliability) vs. simple (and therefore easy-to-tune) models.

Fig. 6 You might want to give more detail on the units of "Tree number density". Is it a number of tree per ha, per diameter class. Idem on Fig. 13.

Fig. 9e Is the log scale necessary?