

## Review: CLM-FruitTree manuscript (gmd-2022-41)

### General comments

In this manuscript, Dombrowski et al. introduce a new kind of crop to the Community Land Model (CLM): fruit trees. They present a parameterization for apple trees, but note that the code they've written could be applied to other fruit-bearing trees. This represents an important step forward for CLM, which, like many global gridded crop models, has heretofore mostly excluded anything woody or perennial. Incorporating this development into CLM, especially with additional types of fruit trees, would enable the simulation of crops important not just for food security in terms of calories, but also in terms of nutrition and economic productivity.

The model performs well compared to observations in terms of most evaluated metrics, especially yield. The authors do a good job in most cases of identifying discrepancies and suggesting hypotheses for their causes, which are often structural issues with CLM which it would be outside the scope of this work to resolve. The manuscript does unfortunately use just one real-life orchard for parameterization and evaluation of the model; fully incorporating apples as a scientifically-supported crop within CLM will likely take more effort to generalize the parameterization. But the work presented here represents a significant enough advance that it does merit publication in *GMD*. Importantly, the authors performed and presented the results of a basic sensitivity analysis, which will aid in future parameterization work.

The manuscript is laid out logically, well-written, and well-supported by the provided figures. Most of my suggestions are relatively minor, and thus I recommend this manuscript be ***published pending minor revisions***.

### Specific comments

My only really substantive comments have to do with the exploration of discrepancies between the simulation and observations:

- L390-395: The simulated LAI in 2011 is too low, which the authors suggest could be due to pruning having been performed in the real world. But is the “alternate bearing behavior” something the authors actually expected the model to represent? If so, how? It seems like something that would need to be explicitly coded in.
- L405-425: I would think that real-world management practices such as fruit thinning have the aim of *reducing* interannual variability (IAV), but it sounds like the authors are suggesting that CLM's IAV is too low because they're *not* represented. In general, it seems like missing physiological processes and/or extreme event representation would be more to blame for too-low IAV.
- L472-480: It's unclear from the data presented here that autotrophic respiration actually is too high in CLM5. Yes, it's too high a proportion of total ecosystem respiration, but the authors have established that soil respiration is too low. This paragraph should discuss absolute units in addition to relative ones.

In addition, some general comments:

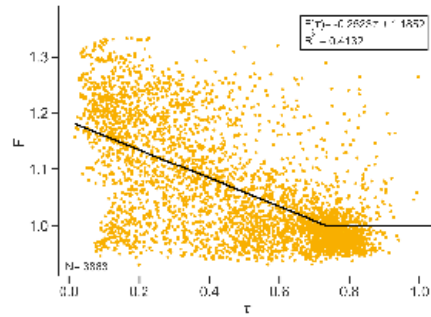
- Please consider making your parameterization script(s) available as well.
- According to *GMD* rules, the title needs a version number for CLM-FruitTree. Ideally this would correspond to a release tag in the GitHub repository.

#### Technical corrections and minor comments

- L17: EC is undefined
- L33: Apostrophe should be a comma
- L57: Adding abbreviation of “(LPJmL)” might be useful
- L67: “buildup” would be clearer than “deposition”
- L92 and throughout: Should also cite Lombardozzi et al. (2020, *JGR: Biogeosci.*: “Simulating Agriculture in the Community Land Model Version 5”), in addition to/instead of Lawrence et al. (2018)
- L116-7: “active growth in the current season” is unclear
- L144: “full bloom” is unclear
- L150 (Fig. 1):
  - “brown” would be more accessible than “ochre” for non-native English readers
  - “DISPLAY” is unclear. Is this a standard CLM term? If so, define it; if not, another word would be better.
  - Unclear from this that each plant part has its own storage and transfer pool (except, presumably, fruits)
- L162-5: Is *all* the C in storage pools transferred over the 50 days? If not, what “portion” is?
- L169-70: Are these GDD parameters something that can be set for each fruit tree PFT, or are hard-coded?
- L173: “offset”? Is this the same as senescence?
- L180 (Fig. 2)
  - What are the bars, exactly? Period of growth?
  - Would be clearer and more consistent for “canopy development” to just be “leaves”
- L211-2: “CLM-FruitTree adopts the same N retranslocation strategy as used in the BDT phenology,” but above (L149) it says “minor adaptations” were made.
- L228: “effects” should be “affects”
- L270: Was the forcing de-trended during spinup?
- L393-5: “In consequence to” should be “Due to” or “As a consequence of”.
- L399-400: This sentence is unclear.
- L405: Delete “at”.
- L437: “Returns **to** positive”
- L520: “phenomena” should be “phenomenon”.
- L531-2: This sentence is unclear. “Patchy” what?
- L579-580: But also overestimation of soil respiration!
- L588-9: What about pruning and fruit thinning?

- L630 (Fig. B1): Please use a thicker font for this (or maybe a higher-res image); it disappears at medium zoom levels.

Figure B1 shows the linear equation that was fitted to the relationship of  $F$  and  $\tau$  for the year 2010. For the calculation of clear-sky emissivity, all data where  $\tau$  was greater than 0.7 ( $N=3863$ ) was considered based on the suggestion by Campbell (1985).



- L635 (Fig. B2): Same issue as Fig. B1.