

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-136

tim artlip (Referee)

Referee comment on "Inclusion of a cold hardening scheme to represent frost tolerance is essential to model realistic plant hydraulics in the Arctic–boreal zone in CLM5.0-FATES-Hydro" by Marius S. A. Lambert et al., Geosci. Model Dev. Discuss.,
<https://doi.org/10.5194/gmd-2022-136-RC1>, 2022

- This manuscript addresses the lack of a cold hardiness component in equations designed to assess water flow and fitness in landscape-level vegetation models, which don't work for low temperature climates, particularly with trees that potentially continue photosynthesis/ transpiration during winter.
- The paper advances a logical addition of a cold hardiness component and includes novel data generated from simulations.
- The logical addition of a cold hardiness component may not be considered a substantial advance by some readers.
- The methods and assumptions are valid and clearly outlined. See also comments to the authors.
- The results are sufficient the interpretations and conclusions. See also comments to the authors.
- The model appears replicable by others in the field. See also comments to the authors.
- The authors clearly state which contributions to the model are prior work by other authors and what their contributions are.
- The title clearly indicates the contents of the manuscript including model name and number.
- The abstract is clear and concise.
- The presentation is well structured and clear.
- The language is fluent and precise.
- Mathematical formulae, symbols, abbreviations, and units are defined and precise.
- The manuscript cannot be reduced.
- The references are appropriate. See also comments to the authors.
- The supplementary materials are sufficient and appropriate.

Comments to authors:

Line 175: I suggest the authors consider providing a supplementary file with these data (if possible).

A crucial point is whether the authors will verify the model, particularly the hardiness estimations, with real experimental (biological) data as opposed to data from the literature. While the simulations and conclusions look appropriate, I think confidence in the conclusions would be strengthened with a subsequent publication that tests the algorithms with actual biological data.

Line 175: The authors should consider the findings of Kuprian et al. (Tree Physiology 38, 591–601

doi:10.1093/treephys/tpx142) who examined the relationship between winter desiccation and bud primordia supercooling (hardiness) in *Picea abies*. Their results "suggest that there is no causal relationship between desiccation and the supercooling capacity of bud primordia in *P. abies*, but rather it involves other compounds within the cells of the bud primordium that reduce the water potential". This may be an important consideration in terms of biomass production as new needles arise from bud primordia.

Figures: Many of the figures are difficult to make out as is the lettering within the figures. I suggest making the line/ symbols heavier and the colors bolder.