Geoscientific
Model Development
Discussions

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[GMDD]

Interactive
comment

Interactive comment on "The Community Firn Model (CFM) v1.0" *by* C. Max Stevens et al.

Anonymous Referee #1

This paper presents a new firn model (the Community Firn Model or CFM) which is open source (available on Github) and includes 13 previously published firn densification models. It also includes modules of firn densification, heat transport, meltwater percolation and refreezing, water isotope diffusion, and firn air diffusion. Users can easily choose model parameterizations by using different module options. They show two applications of this model including 1) forcing it with MAR3.9 SMB and skin temperature at Summit, Greenland to see a model comparison of firn densification and depth integrated porosity (DIP) and 2) the effect of thickening and thinning firn column on noble gas isotope records in ice cores.

This is an extremely important contribution to the firn modelling and ice sheet community. Having an open source, modular firn model with the framework already built in that is easily customizable is a huge step in the right direction of making our science more reproducible and advancing firn modelling. As a whole, the paper is well written

Discussion paper

and generally straightforward.

Specific Comments:

1. Make sure that the manuscript is consistent in adding in reference observations (i.e. Table 1) and mentioning that this is only a model comparison study. As a reader, I don't mind the addition of observations for reference in the first model application; frankly I think it is helpful in understanding. However, it is heavily implied that there should be no takeaways of the "best" model and adding in these observations is a bit confusing to the overall message.

2. Both applications are done in a completely dry location (Summit, Greenland). There is a reference to using CFM to examine locations in the percolation zone in Verjans et al, 2019 and validate it using observations, but I would be curious to see how much more of a spread the models would have had if a location experiencing melt.

3. Since the CFM has already been used in some studies, it may be useful to outline how other published studies have already used the model in a few sentences, and not just reference them. I realize this is away from the main point of the paper (to describe the model), but it may be a good addition to the applications.

In-Line Comments:

L24 – "density" inside parentheses?

L27 – Mention zone 3 here.

L65-70 – Great job outlining clear goals of the paper in the last paragraph of the introduction.

L83 – Is there a default .json configuration file or do you have to choose all parameters individually? If there is not a default, are there recommended parameters for a first time user?

L83 – Are there limitations to the time step or the model-domain thickness?

L87 – Are these .csv files the forcing files? Normally MAR and RACMO come in netCDF files, do users need to reformat these prior to using?

L92 – Can you prescribe a number of layers or is it all based on volume? For example, if a large amount of accumulation was added and I want to look at a higher resolution vertically, could I break that accumulation into more layers?

L101 – How can you specify what resolution it is outputting at? Is that by specifying "firn depth"?

L159/L172 Be consistent in using the delta symbol or "delta".

L168 – Define as zone 3 equation.

Section 2.2.7 – Add in that LIG and KM included refreezing, and meltwater retention and percolation compared to Arthren.

L257 – radar layers from ground based or airborne instruments?

L330 – Include what Fick's second law is or a reference?

L344-346 – This sentence is difficult to follow. Maybe break into two?

L349 – How is the air moving upward relative to the downward moving grid? Because it is slower than the firn then the magnitude is upward because the downward moving grid is what it is referencing? Confused here, maybe rephrase.

L352 – In what scenarios would it be worth it to include this effect if previous models have ignored it?

L367 – Define gravitational enrichment.

L392 – Would there be a difference if looking at dendritic grains instead of spherical?

L443 – Reference for using 300 kgm-3 constant surface density at Summit?

L459 – How did you generate temperature and accumulation rate histories for 1000

years prior?

Table 1/L599-609 – There needs to be consistency between the text and this Table. The text continually repeats that this study is not to compare models to observations and rather to look at only model results. This is fine, but providing a reference is going to lead readers to make a direct comparison between the models and observations.

L512-520 – Here, the author compare the models to the observed core and provide reasons why they are different. As a reader, a takeaway is whether the models are doing "well" at that test site.

L573 – Unsure about using "trend" from 2008-2018 period. Isn't this most likely just inter-annual variability?

Figure 2 – Similar to my other figure comment, should a reference observation be provided here for dH/dt from Summit if a reference is provided for DIP and age earlier? Even if for just comparing to the model mean? Just make sure this is consistent.

L622 – Is this the gravitational enrichment definition?

L626 – I think LID is already defined from earlier.

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