More Realistic Intermediate Depth Dry Firn Densification in E3SM

Objective

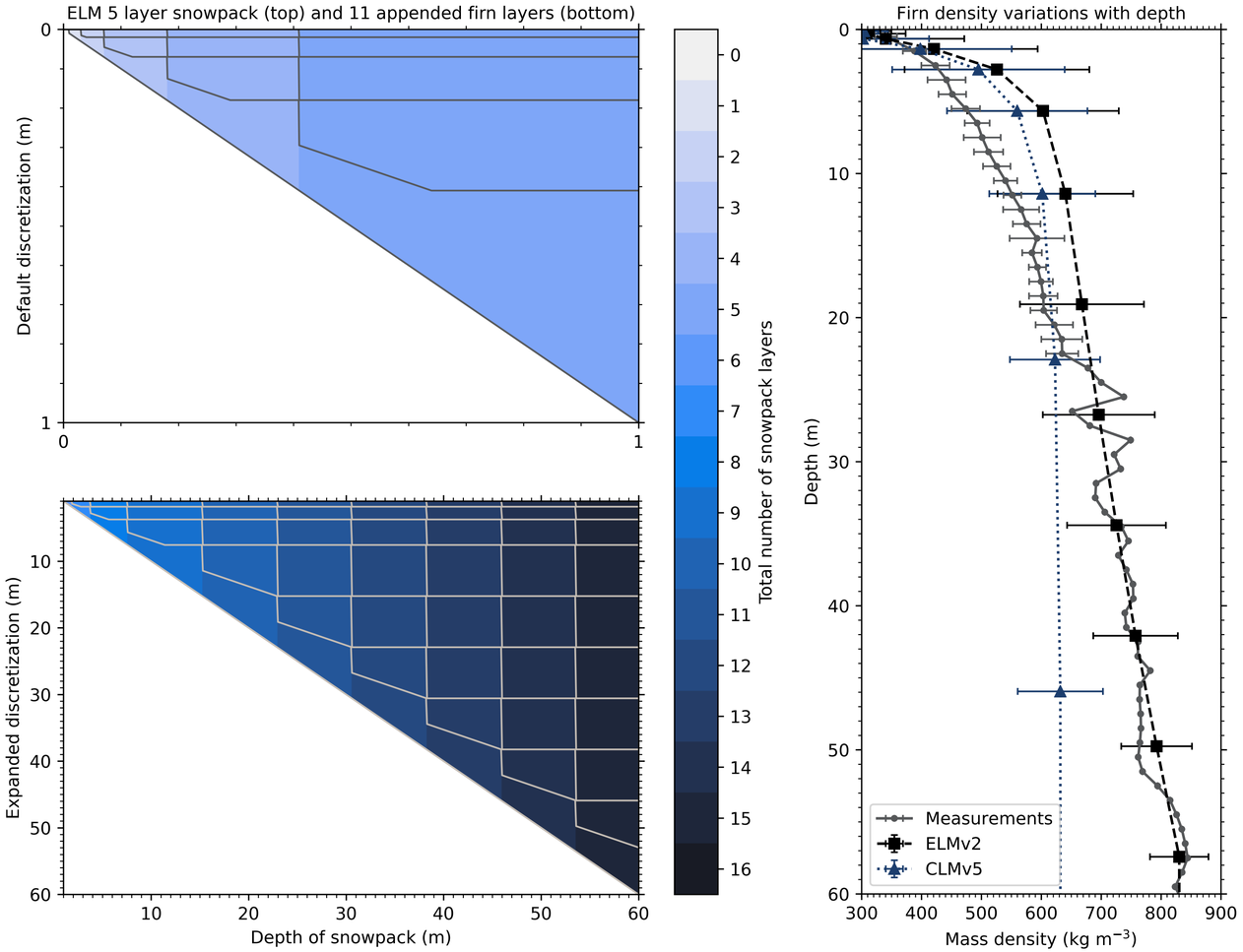
- Adapt the E3SM Land Model (ELM) seasonal snowpack scheme to accommodate perennial snowpack on ice sheets (aka firn)
- Resolve intermediate depth (0 to 60 m) firn processes relevant to ice sheet surface mass balance

Approach

- Increase the maximum number of snowpack layers in ELM
- Test the new 16 layer discretization by evaluating dry firn densification with comparisons to empirical models and shallow ice core measurements
- Implement a state-of-the-art firn density configuration that results in more realistic simulations of firn air content

Impact

- Improve estimates of surface mass balance and ice shelf hydrofracture
- Will improve how land ice and sea level rise respond to climate change in Earth system models



Left: ELMv1 default snowpack grid (top; 1 m) beneath which (bottom; 60 m) the new ELMv2 firn model, activated by the “use_extrasnowlayers” namelist variable, appends up to 11 new layers. **Right:** Mean Greenland ice sheet density variations with depth (and standard deviations) simulated in ELMv2 and with the Community Land Model (CLMv5) density formulation, compared to measurements by Mosley-Thompson et al. (2001).

Citation: Schneider, A. M., Zender, C. S., & Price, S. F. (2022). More realistic intermediate depth dry firn densification in the Energy Exascale Earth System Model (E3SM). *Journal of Advances in Modeling Earth Systems, 14*, e2021MS002542. https://doi.org/10.1029/2021MS002542