**Developing a Glacial Surface Model for Greenland to Improve the Projections of Surface Runoff**

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Over the past several decades, the Greenland Ice Sheet has been losing mass through a combination of increased surface melt and accelerating ice flux to the ocean. Our understanding of the ice sheet's response to climate change is crucial for predicting future changes in sea level and the impact on coastal ecosystems. The MAR (Modular Atmospheric Regional) model is a regional climate model used extensively in Greenland because of its proven record at simulating precipitation and firm and snowpack evolution over glaciated surfaces. Our study focuses on the surface hydrology and ice sheet melt in MAR-simulated climate data and forces many simulations needed. Our goal is to develop a surface-only model, derived from MAR, to study the forcings of the surface climate components, and MAR biases to improve projections of surface runoff. This model includes the ability to integrate observations from surface weather stations, translate the data into a model forcing format, force different simulations with various configurations or datasets, visualize model outputs, find key correlations between atmospheric drivers and modeled firm discharge.

In the model development, we extract the surface data from the full MAR for the simulations initialized and forced with the following snow and atmospheric fields: snow depth, temperature, density, water volume, and grain size. We verify that the surface model generates the same outputs as the full MAR data if initialized with the same initial conditions. The bias is checked with snowpack time depth plots for multiple sites around Greenland, including Summit and Swiss Camp. We have found a very small bias when compared to the fully-coupled MAR. We have found that the surface physics are implemented correctly, but also the modeling speed. The model’s first release is currently being deployed over different sites across Greenland to understand the importance of atmospheric forcing versus snow model biases in projections of future mass loss due to surface melt.

The images below show our results and proofs of the MAR-L accountability. 

**Interfacing with users for the choices of the simulation parameters, taking the MAR output as the input, and integrating the stations' real measurements in the input, MAR-L has forced these parameters and their data into the simulation, in generating the ice surface data and thin ice in our exploring.**