Evaluating and Improving Northeastern US Snow in the National Water Model by Leveraging Advanced Mesonet Observations: Point Simulations and Sensitivity Experiments

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ABSTRACT

The NOAA National Water Model (NWM) is used for operational forecast of hydrology, including surface snowpack, across the continental United States (US). It initializes surface snowpack conditions using a simple deterministic analysis cycling every hour and represents snowpack physics using the Noah-MP land surface model. However, performance of the NWM at simulating snow over the northeastern United States is poorly characterized, in part due to limitations in the observational network. Our group is working to improve snow state initialization and prediction within the NWM by leveraging observations from the advanced New York State Mesonet (NYSM; *http://nysmesonet.org/*), which includes 126 stations with detailed meteorology measurements and sub-networks with additional snowpack water equivalent (SWE) and surface energy flux measurements.

As part of this larger effort, we are identifying specific sources of bias in model forcing and physical parameterizations to target for improvement. This presentation will focus on the results of single-column simulations of snowpack properties at NYSM stations from the 2019-2020 and 2020-2021 snow seasons. These simulations are forced by meteorological measurements (temperature, humidity, winds, solar radiation, precipitation) from the NYSM in order to minimize forcing uncertainty and focus on model structural biases. Simulated snow depth and SWE are evaluated against automated NYSM and manual snow course measurements taken around select NYSM stations.

When using the baseline configuration of the NWM, most stations show substantial positive biases in snow depth, SWE, and snow cover duration. To isolate and reduce the sources of these biases, we conduct controlled sensitivity experiments wherein we re-run the simulations after changing a selected model component. Results from these experiments show that large positive biases in simulated snow accumulation are likely caused by a poor representation of precipitation phase partitioning and can be substantially reduced by changing the temperature threshold used or by diagnosing precipitation phase from an operational high-resolution atmospheric model. We also use these results to examine biases in snow albedo that may contribute to biases in springtime snow ablation rates. Preliminary results suggest that reductions in snow albedo following rain-on-snow events are not adequately captured by the model.

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