Motivation
Geological evidence collected from Northern Baffin Island, Canada, suggests a sudden expansion of ice caps began soon after a succession of several large eruptions in the 13th century, and they did not start to melt until roughly a century ago (Anderson et al., 2008; Geirsdottir et al., 2008). How did these ice sheets persist for so long after the short-term volcanic forcings disappeared?

We present results from three unique 6-month-long simulations which test if the snow line elevation will change based on imposed temperature perturbations to the initial and lateral boundary conditions.

Methods
We ran the Weather and Forecasting (WRF) Model over Baffin Island from April-Sept 2005 and compared results to National Climatic Data Center (NCDC) Interactive Multisensor Snow and Ice Mapping System (IMS) and ground station data.

The WRF control run specifications are described in Table 1. Two additional experiments were run, one with +3 K (WRF +3 K) added to the initial and lateral boundary conditions (applied every 6 hours of simulation time) and the second with -3 K added (WRF -3 K). All other details of these runs remained identical to those of the control run.

Results
Figure 2. Inner WRF domain over Baffin Island and available weather stations.

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Conclusions and Future Work
1. All WRF runs begin to melt about a month earlier than the IMS data suggest. This could be a result of errors in observations (e.g., cloud cover) or a tendency for the model to sublimate or melt snow more readily than in the real world.
2. The +/-3 K sensitivity test cases moderate the snow melt rate during spring, but all models reach the same minimum extent eventually. Thus, a -3 K perturbation to initial and lateral boundary conditions is not sufficient to maintain a lower snow line elevation through the melt season.
3. Further sensitivity tests which alter all ocean points to be either sea ice or open ocean for the entire model run are currently underway.
4. In the future, a reduction of the solar constant for the 6 month run will be tested to see if this has a greater impact on snow line evolution than the simple temperature tests did.

Table 1. Simulation details for WRFControl run.

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Results (continued)

Figure 7. Whisker plot of WRF and station snow depths for all available stations in both domains on April 1, 2005. This rules out the notion that early onset melt was caused by insufficient initial snow cover over Baffin Island. Therefore, cloud cover during June could have obstructed IMS observations or WRF is melting or sublimating snow too fast due to the over-exaggerated diurnal cycle or unrealistically efficient turbulent mixing.

Acknowledgments and References
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