Spatiotemporal Prediction of Snow Accumulation with Recurrent Graph Convolutional Networks

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ABSTRACT

The accurate prediction and estimation of annual snow accumulation has grown in importance as we deal with the effects of climate change and the increase of global atmospheric temperatures. Airborne radar sensors, such as the Snow Radar, are able to measure accumulation rate patterns at a large-scale and monitor the effects of ongoing climate change on Greenland's precipitation and run-off. Tracking and forecasting these internal ice sheet layers is important for calculating snow mass balance, extrapolating ice age from direct measurements of the subsurface, and inferring otherwise difficult to observe ice dynamic processes. Precise understanding of the spatiotemporal variability of snow accumulation in the Greenland ice sheet is important to reducing the uncertainties in current climate model predictions and future sea level rise. Given the amount of snow accumulation in previous years using the radar data, in this paper, we propose a machine learning model based on recurrent graph convolutional networks to predict the snow accumulation in recent consecutive years at a certain location. In this work, we proposed a temporal, geometric, multi-target machine learning model based on GCN-LSTM that predicts the annual snow accumulation of Greenland from 2007 to 2011 given the annual snow accumulation from 1997 to 2006. Our proposed model was shown to perform better and with more consistency than equivalent non-geometric and non-temporal models. While our model succeeds at predicting shallow layer thicknesses with reasonable accuracy, there are opportunities for improvement and generalization.

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