Application of Neural Networks for Multi-step Forecasting of Greenland Ice Sheet Mass Balance

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Abstract

The accelerated melting of the Greenland Ice Sheet (GrIS) has heightened impacts on global systems. Therefore, accurate predicting total mass balance of the GrIS can aid in risk management. However, due to nonlinear relationship between mass balance and climate, as well as the characteristics of time series. This study proposes a deep learning methodology for forecasting the TMB of the GrIS using a multivariable multi-step ahead approach. We utilized Long Short-Term Memory (LSTM) Neural Network. The LSTM models are driven by greenhouse gas and other relevant meteorological factors collected from April 2009 to December 2021. Feature selection is performed using the Pearson correlation coefficient, which identified 7 highly correlated features: XCO_2, Sea level, CH_4, SF_6, globalXCO_2, N_2O, and Global SST anomalies. The results demonstrate that the LSTM model outperforms in terms of reliability and accuracy in multi-step prediction.

Key word: Multi-step Forecast, Neural Network, Greenland Ice Sheet