A Review of Methods for Regression of Glacier Evolution

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1 Outline (delete later)

1. Introduction/background on glaciology, glacier modeling (can pull from proposal and Firas' notes)
2. Paper inspiration: Bobilar Deep Learning Applied to Glacier Evolution Modeling [1]
3. Adapting the methods: new dataset, different set of models
   (a) Data exploration
   (b) Linear models mostly unsuccessful, data highly nonlinear and esp. climate data is very inter-correlated
   (c) Motivates use of other methods, in particular decision trees and ML
4. Results
5. Discussion
   (a) Difficulty in applying PINNs to glaciology modeling (mostly lack of data) - cite Loc's paper

2 Introduction

This paper presents a machine learning (ML) approach to modelling annual glacier-wide surface mass balance (SMB) as a parameterized alternative to typical linear methods. SMB, which describes the difference between a glacier's mass accumulation in the winter and ablation in the summer, is a key process that drives glacier evolution on regional and sub-regional scales. As such it is also critical to understanding and predicting environmental challenges such as sea-level rise and the disruption of ocean currents and stable weather patterns globally [2].

Bobilar et. al., 2020 find that a fully-connected feed-forward model with 6 hidden layers outperforms Ordinary Least-Squares (OLS) and Least Absolute Shrinkage and Selection Operator (LASSO), which are traditionally used in parameterized approaches to simulating SMB from data [1]. However, ML does not provide the same interpretability that OLS and LASSO do, and the authors note that one challenge of the method is the limited data available - which makes it more likely that an overparameterized ML model will overfit. Furthermore, some key factors to predicting SMB may not be captured in the data, such as physical processes described by dynamical systems.

Add more to this, motivate methods used below. Also may want to cite other glaciology papers.

3 Our Methods

4 Results

5 Discussion

References

[1] Jordi Bobilar, Antoine Rabatel, Isabelle Gouttevin, Clovis Galiez, Thomas Condom, and Eric Sauquet. Deep learning applied to glacier evolution modelling. *The Cryosphere 14*, (2):565–84, 2020.

[2] Logan Rance. What are the consequences of glacial melting? 2023.