Predicting Glacier Terminus Retreat Using Machine Learning

Kevin Shionalyn[1,2] (kevin.shionalyn@austin.utexas.edu)

Ginny A Catania[1,2], Daniel Trugman[3], Denis Felikson[4,5], Leigh Stearns[6], Michael Wood[7]

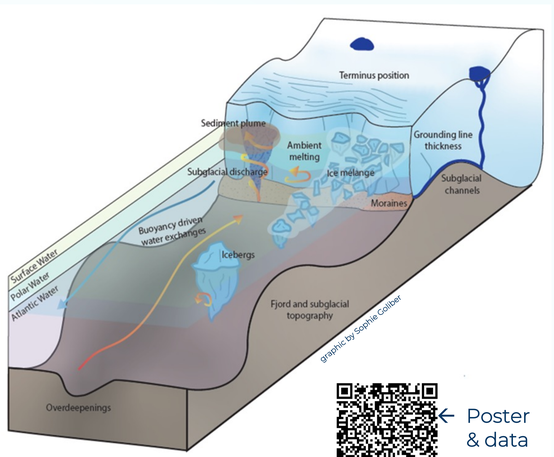
(1) University of Texas at Austin, Jackson School of Geosciences, Austin, TX, USA (2) University of Texas Institute for Geophysics (UTIG), Austin, TX, USA
(3) University of Nevada, Reno, Nevada Seismological Laboratory, Reno, NV, USA (4) Cryospheric Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA
(5) Goddard Earth Sciences Technology and Research Studies and Investigations II, Morgan State University, Baltimore, MD, USE
(6) University of Kansas, Department of Geology, Lawrence, KS, USA (7) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

Motivation

Problem: Parameterization of glacier terminus retreat in models is poorly defined

Goal: Use ML to define variables ("features") in the terminus equation

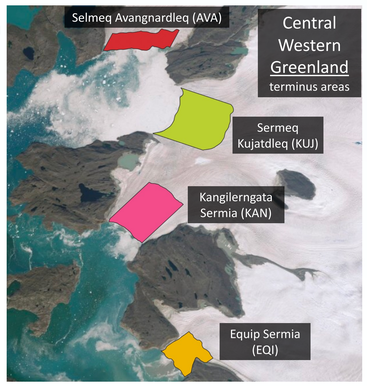
dL/dt = f(internal features, environmental features)



← Poster & data sources

Data

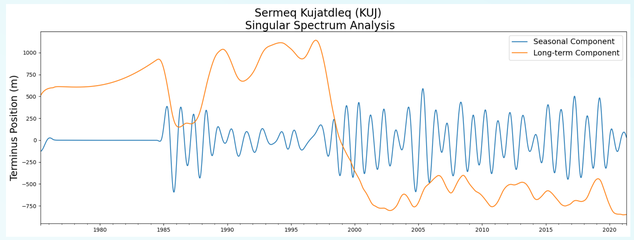
- From 4 glaciers in central western Greenland
- All features as time series, with daily interpolation[I]
- Geometric features in Lagrangian frame with changing terminus



Methods & Results

Methods:

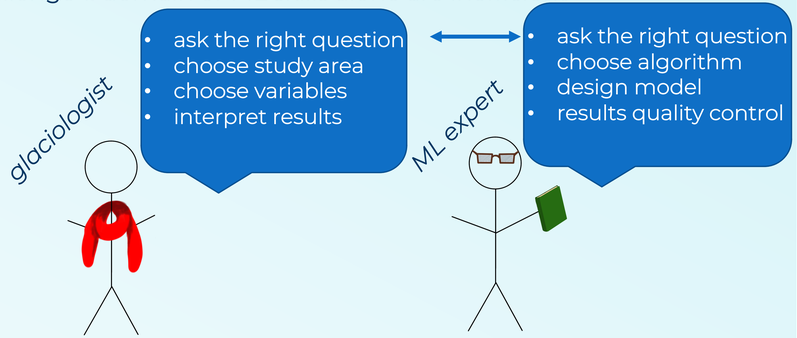
- Target feature: terminus position split into seasonal & long-term components
- Best-fit hyperparameters determined for calibration
- Model created with XGBoost[II] algorithm
- Features evaluated with SHAP[III] analysis



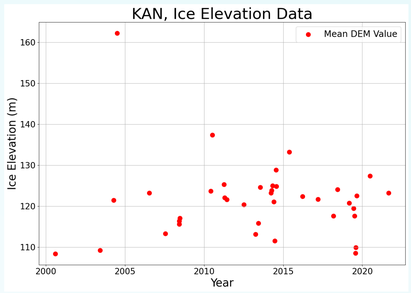
Seasonal results by glacier:

Challenges & Future Work

Challenge 1: domain or ML skills alone are inefficient



Challenge 2: sparse data

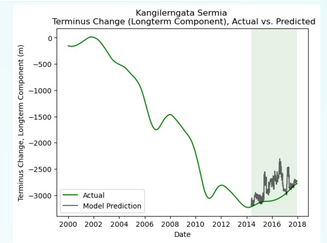


Challenges 3 & 4:

- data collection takes substantial time [~ 1 yr. for this project, vs. 5 min. model runtime]
- ML modeling is an iterative process

Future Work

- Run model with Eulerian geometric data
- Improve data quantity & quality for numerous variables
- Model long-term components of terminus change →
- Create & use complex model (i.e. neural networks)
- Repeat process on more glaciers



Acknowledgments & References

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(I) Shekhar et al., 2014, "ALPS: A Unified Framework for Modeling Time Series of Land Ice Changes," Journal of Latex Class Files, v. 13, no. 9.
(II) Chen et al., 2015, "Xgboost: extreme gradient boosting," R package v. 0.4-2, 1.4.
(III) Lundberg & Lee, 2017, "A Unified Approach to Interpreting Model Predictions," 31st Conference on Neural Information Processing Systems, Long Beach, CA, USA.