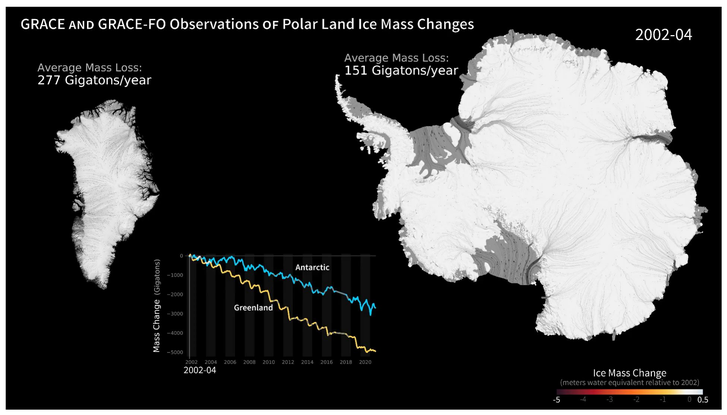
iHARP: Institute for Harnessing Data and Model Revolution in the Polar Regions

UMBC R1 DOCTORAL UNIVERSITY

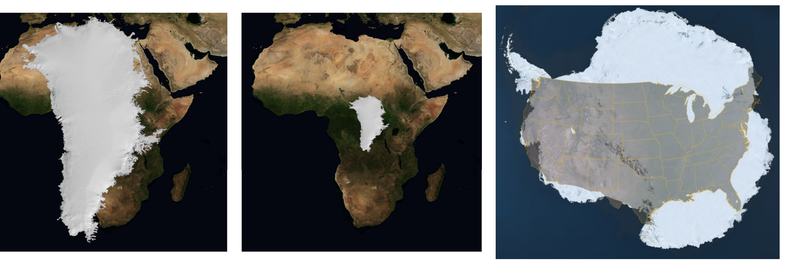
iharp.umbc.edu

Motivation



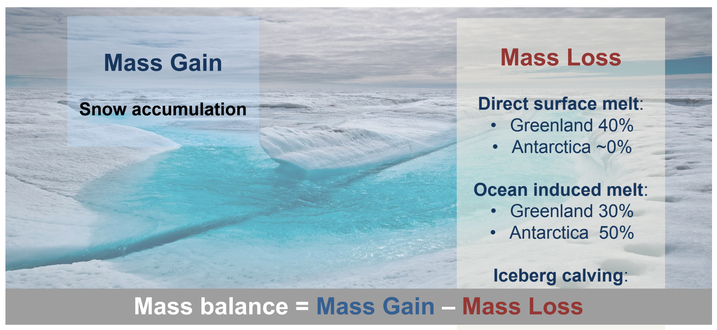
Why do ice Sheets matter?
Potential contribution to sea level rise (IPCC AR6)

- Mountain glaciers: 0.25 m (10”)
- Greenland ice sheet: 7.4 m (24.3 feet)
- Antarctic ice sheet: 58.3 m (191 feet)

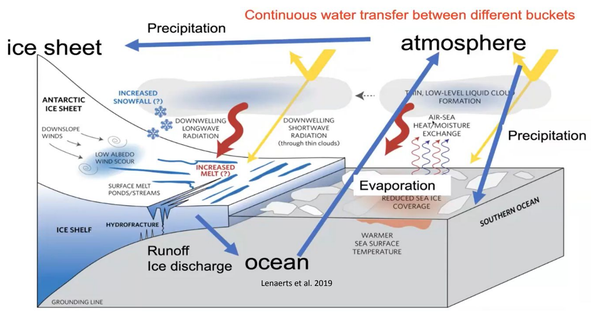


Current contribution to sea level rise:

- 52% Increased melting of land-based ice
- 39% Thermal expansion of the oceans
- 9% Land water storage (rivers, lakes, reservoirs,...)



Causality related iHARP Science Needs

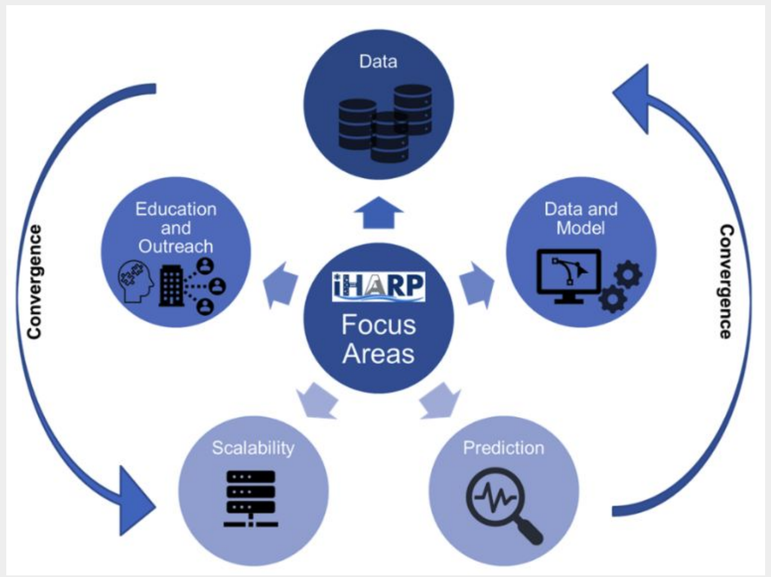


Lenaerts et al. 2019

- Better understand the connections among components (sea ice, ice sheet, atmosphere, ocean) in the Arctic climate system
- The results will eventually inform climate models with more realistic physical relationships so that the future mass balance of the Greenland Ice Sheet (GrIS) can be accurately predicted

Vision

iHARP advances our understanding of the response of polar regions to climate change and its global impacts by deeply integrating data science and polar science to spur physics-informed, data-driven discoveries.



Research Focus Areas

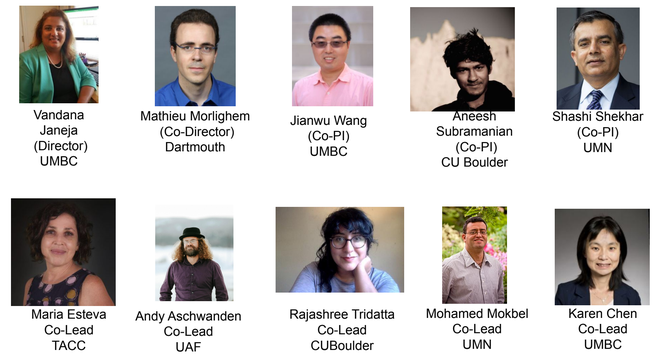
Data: Develop fundamental, transformative, and integrative solutions to prepare data for use by ML and physical models

Data & Model: Integrate data with numerical and physical models via physics informed ML and causal AI

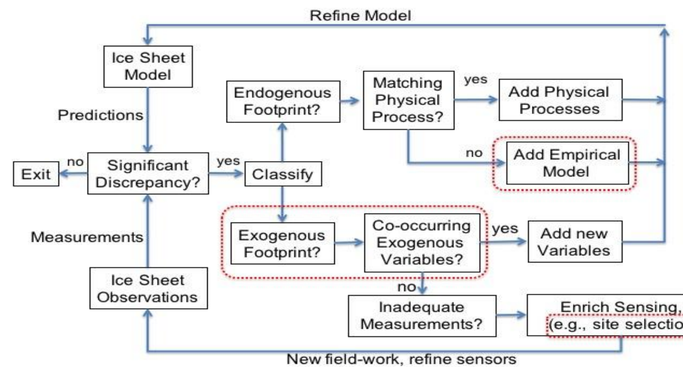
Prediction: Develop spatial-temporal algorithms to forecast the future changes to the Greenland and Antarctic ice sheets

Scalability: Build scalable algorithms to apply our solutions on a global scale.

Scalability Resources



Spatio-Temporal Data Science



Spatial Pattern Families	Polar Science Example
Spatial Anomalies	Which sensors reports are very different from reports of neighbors?
Hotspots	Geographic concentration of high prediction-error
Spatial Relationships (e.g., Co-occurrence, Teleconnection)	Which proximate factors co-occur with hotspots of high prediction-error? Which remote factors co-occur with hotspots of high prediction-error?
Spatially-explicit prediction models	Leverage historic data to predict persistence of lakes in different areas and fill gaps in current time-series of lake data.
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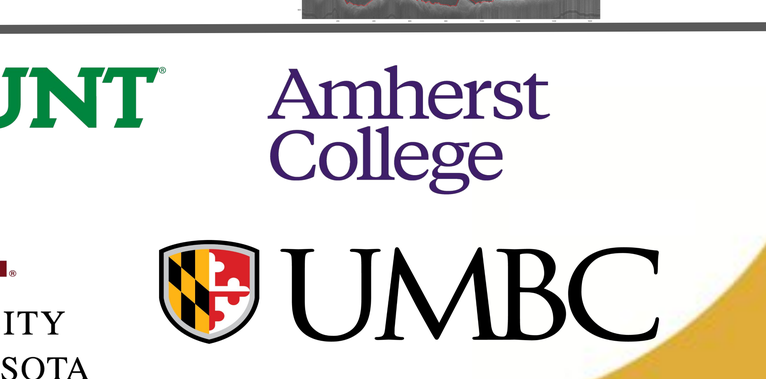
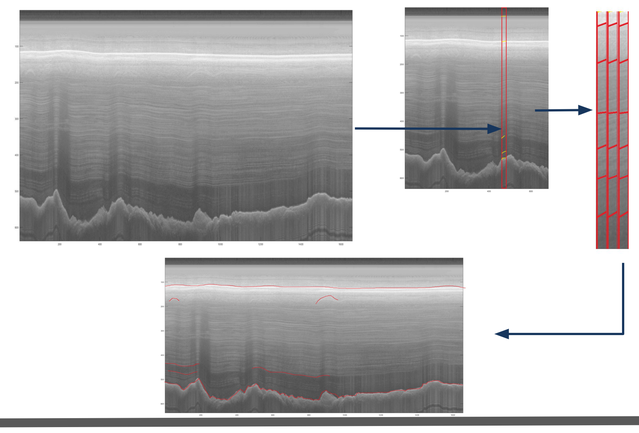
Example types of spatio-temporal patterns



Computer Vision and Auto Annotation



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