Resolving spatial variability in SWE using a ground based GPR system

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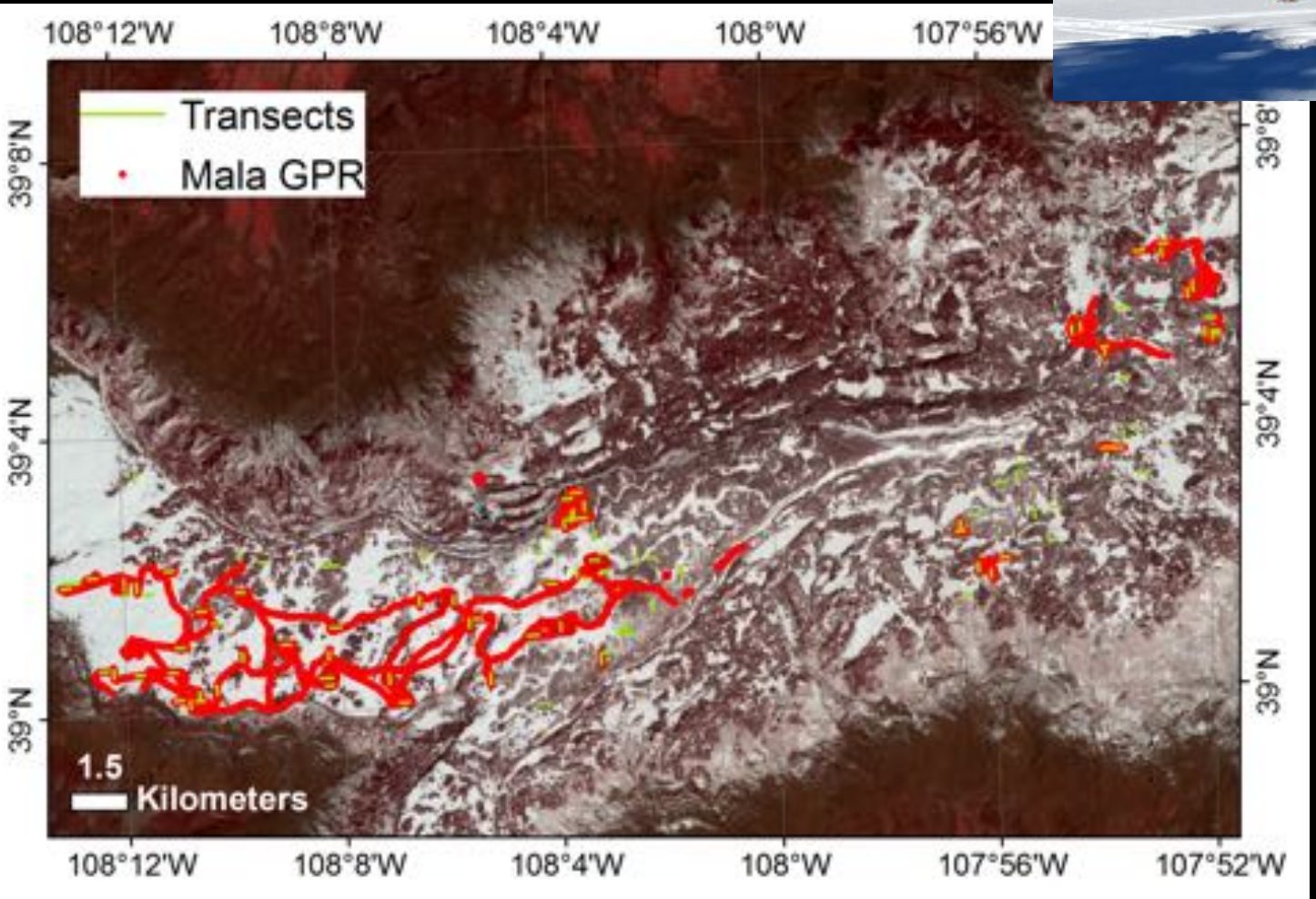
And many, many collaborators (Ryan Webb, HP Marshall, Noah Molotch, Chris Hiemstra, Shad O'Neel, Louis Sass, Emily Baker, Chris McNeil and SnowEx ground team)

GEOSCIENCES
COLORADO STATE UNIVERSITY

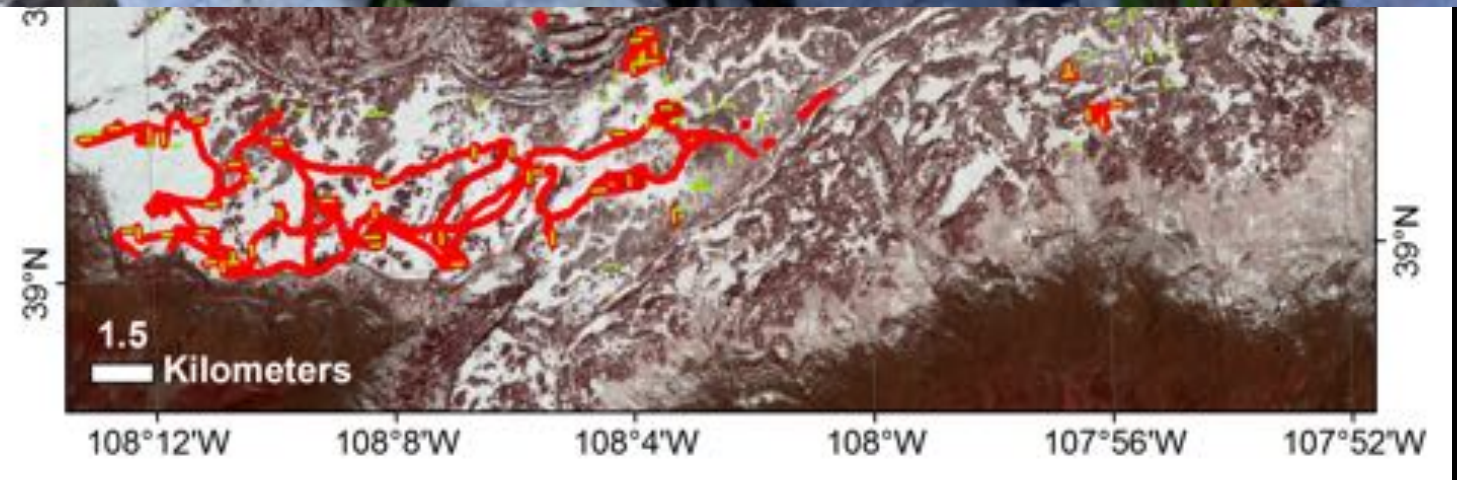
USGS
science for a changing world

SNOWEX
NASA

SnowEx 2017


108°12'W
108°8'W
108°4'W
108°W
107°56'W
107°52'W
39°8'N
39°4'N
39°N
Transects
Mala GPR
1.5
Kilometers

SnowEx 2017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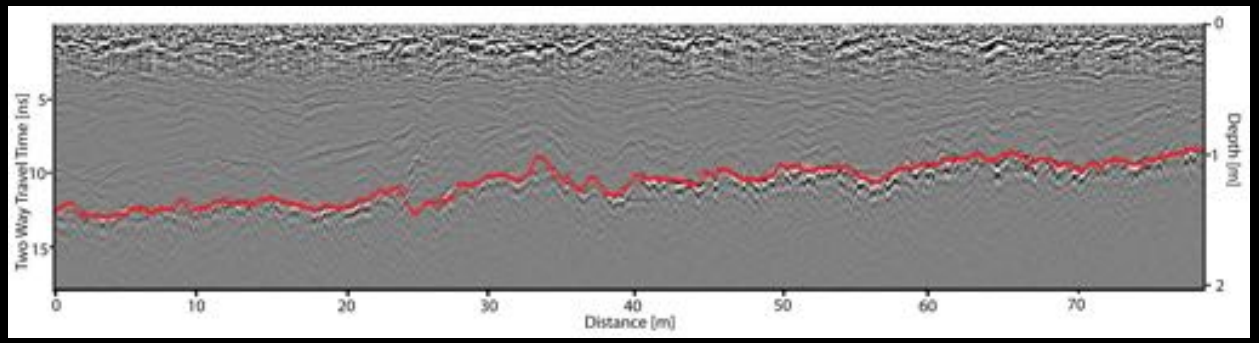
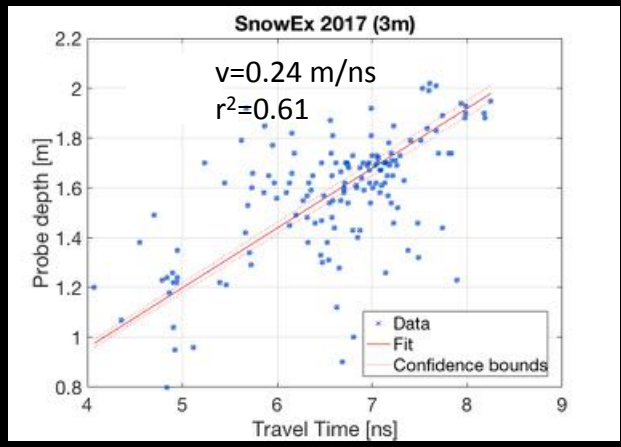
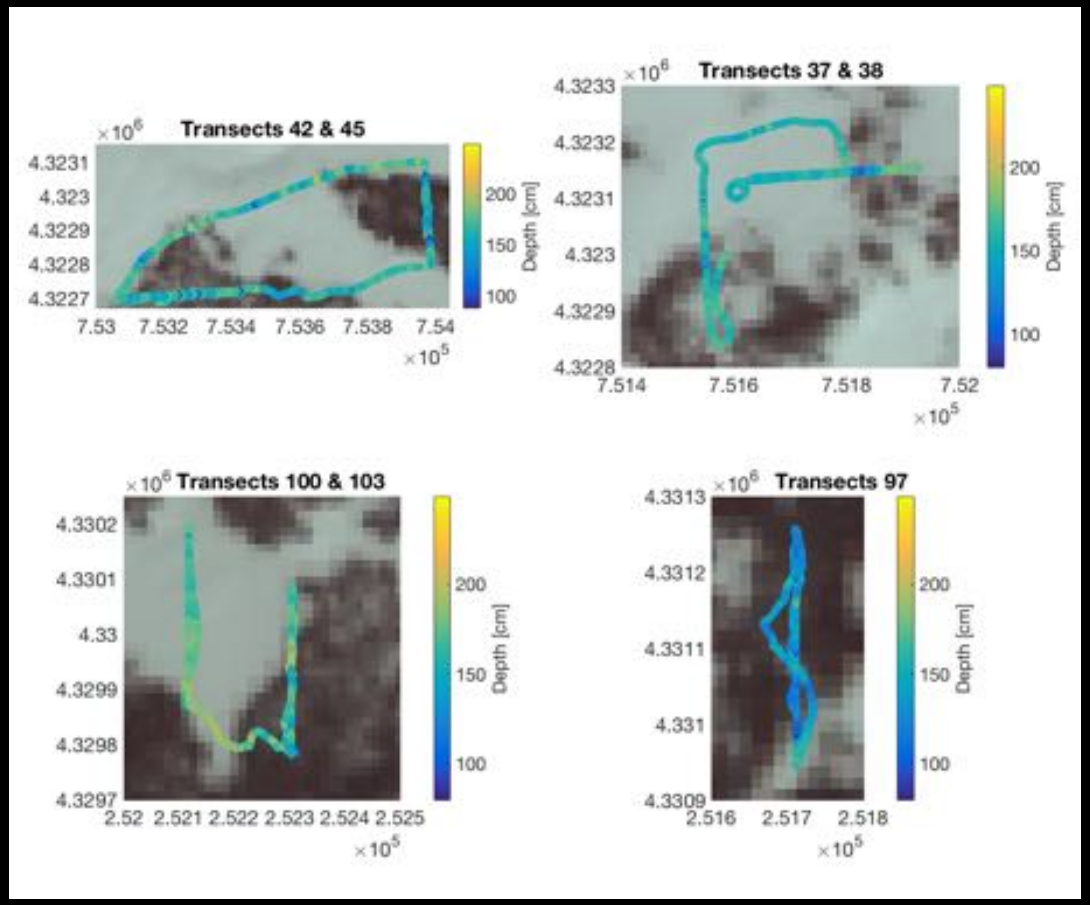
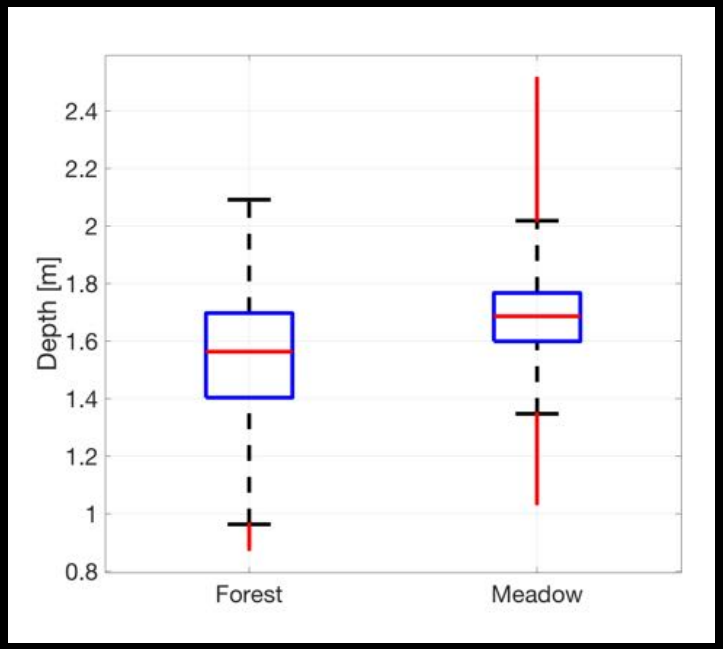
39°N
1.5
Kilometers
108°12'W
108°8'W
108°4'W
108°W
107°56'W
107°52'W
39°N

Example Transects

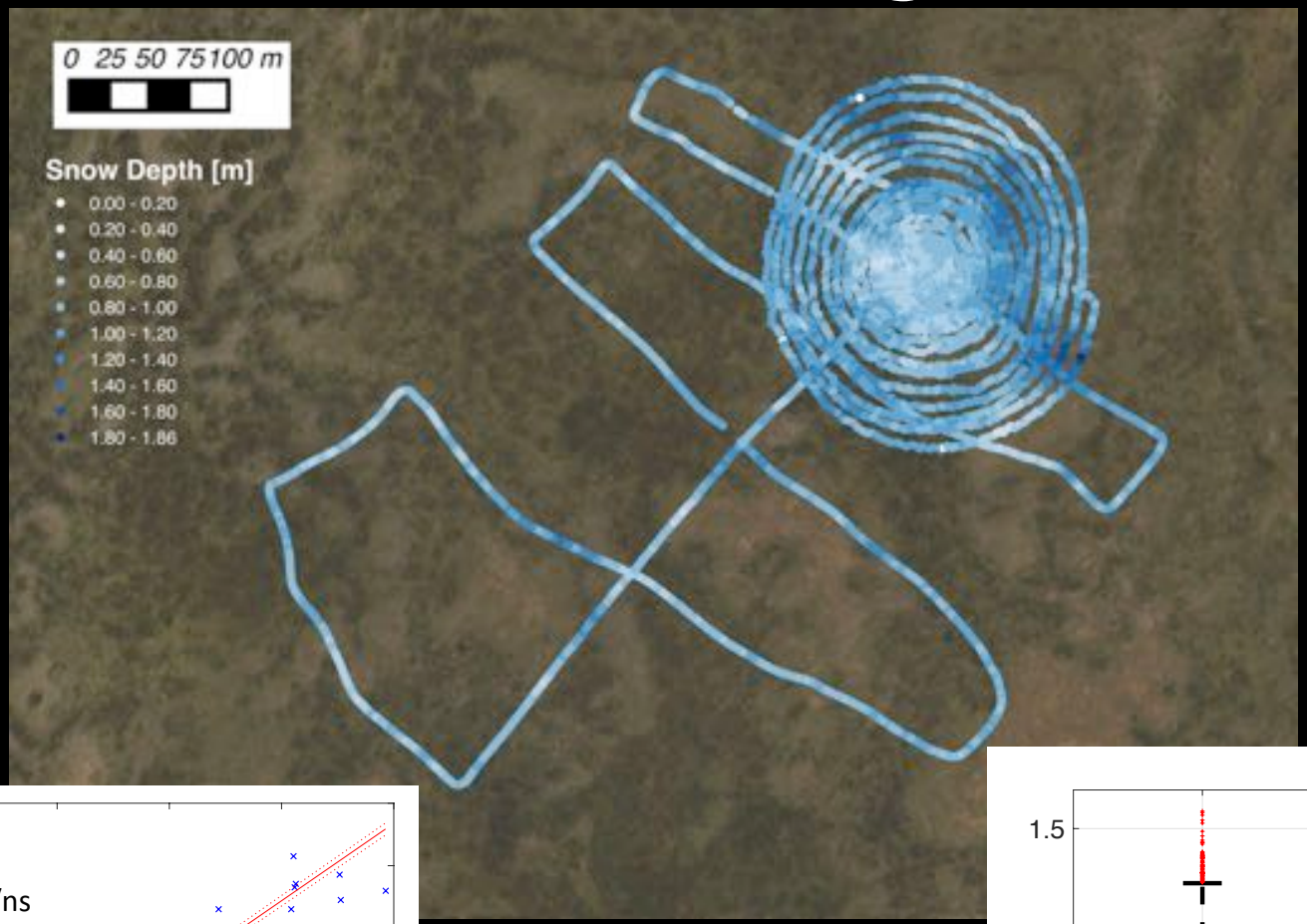


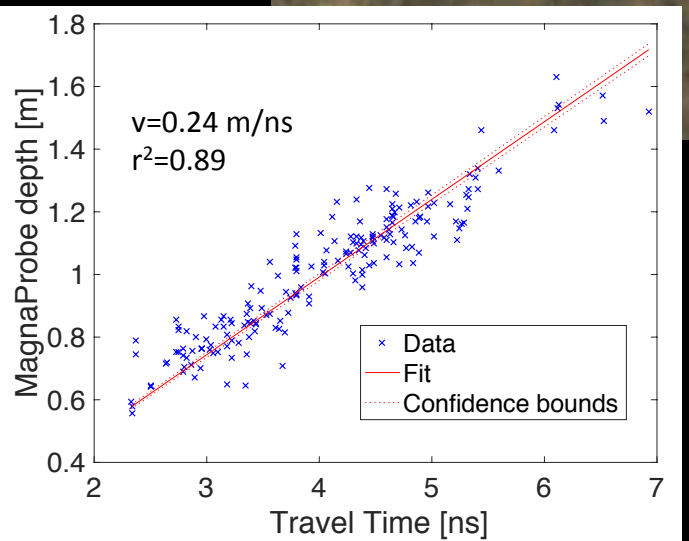


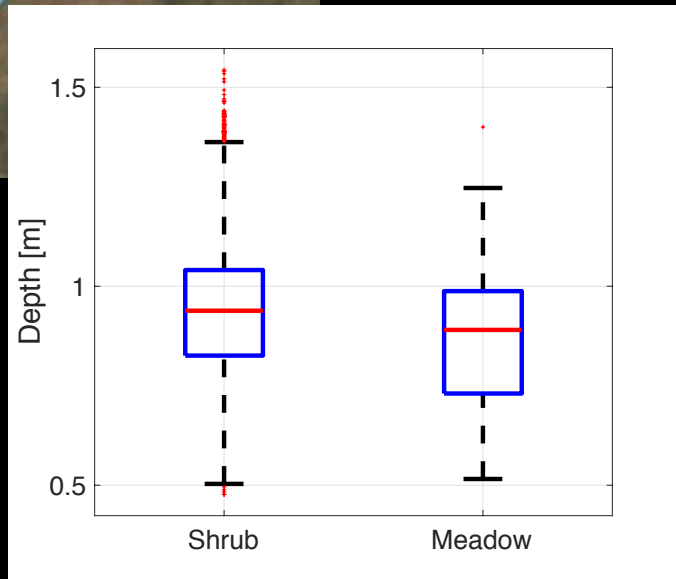




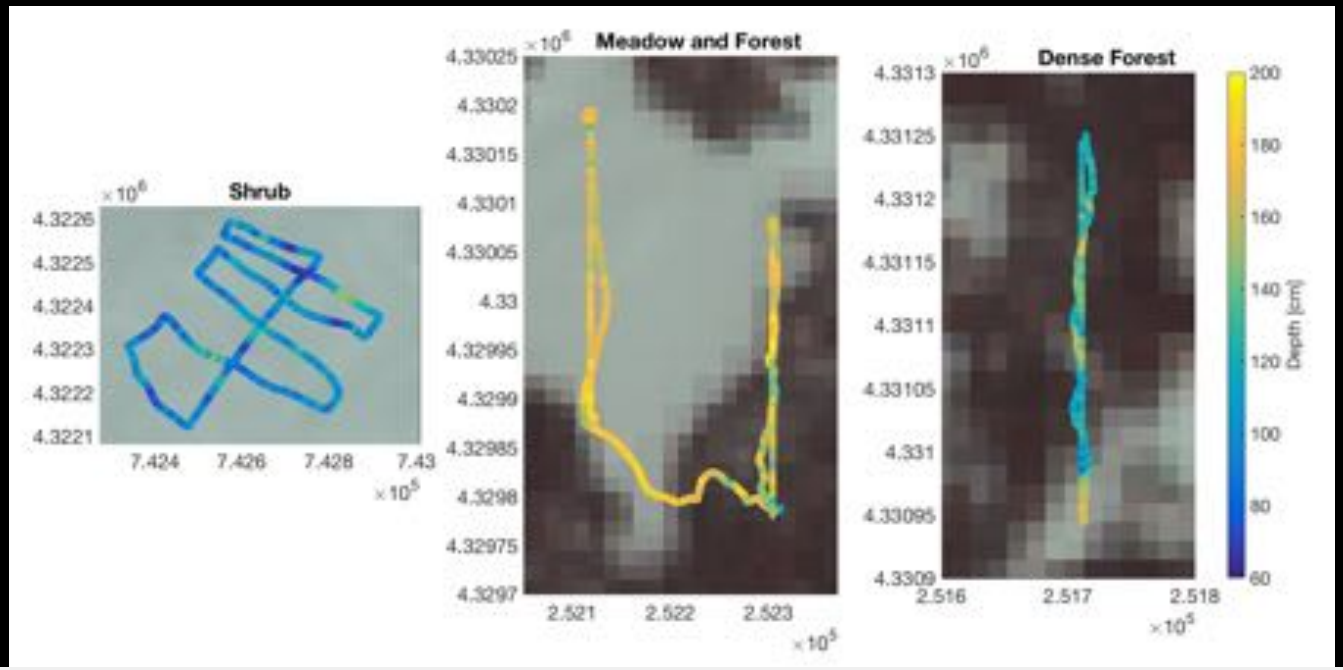
Alien Landing Pad

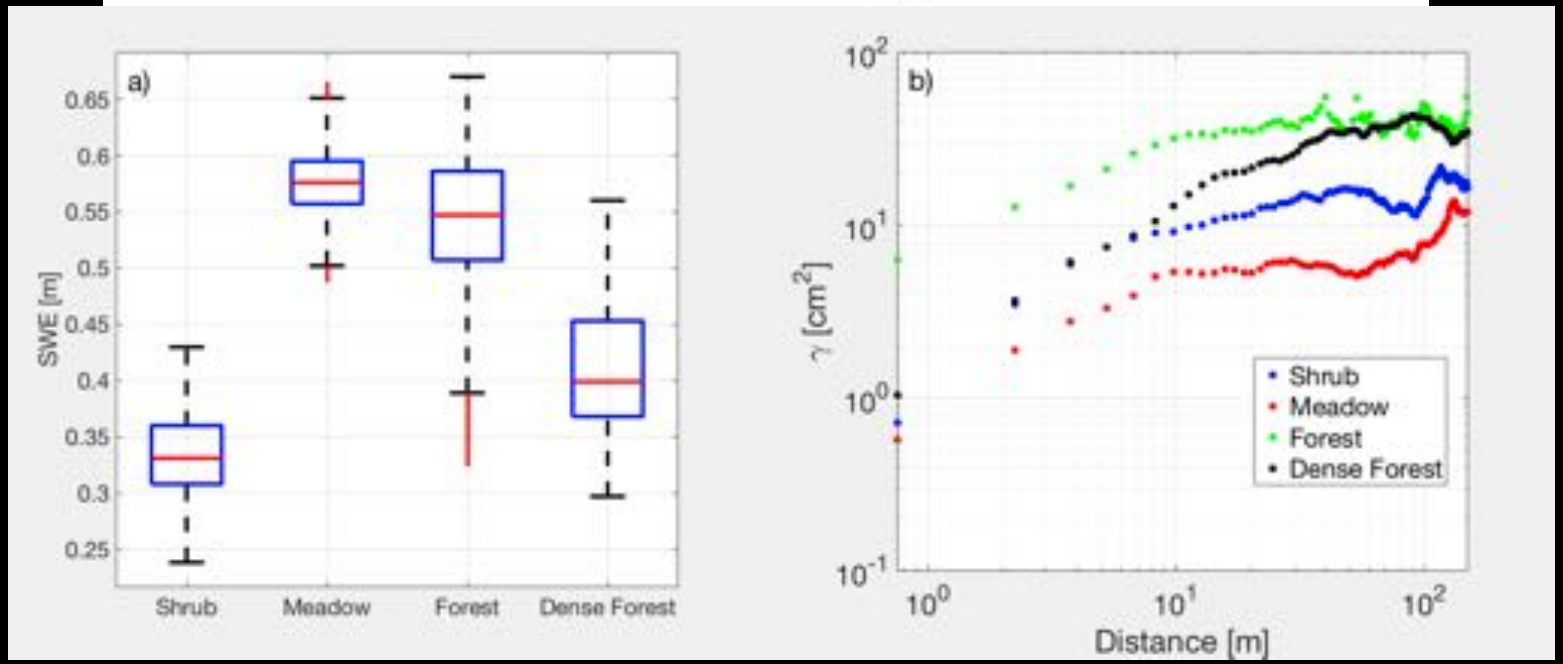




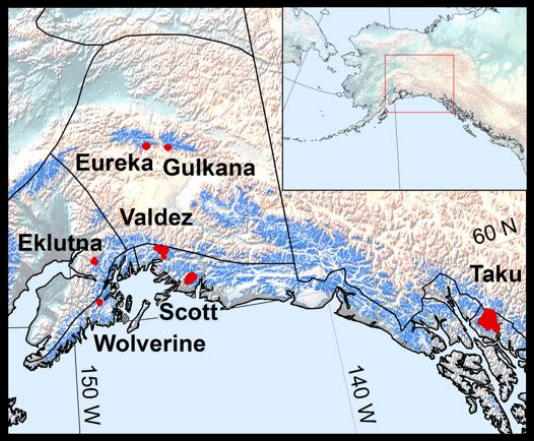


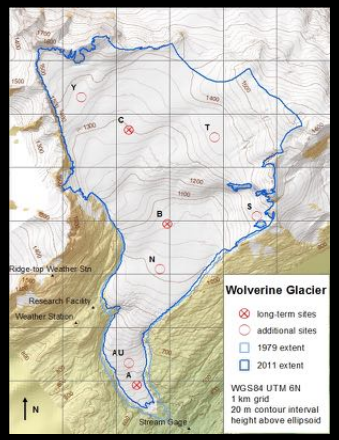
Land cover control on SWE variability

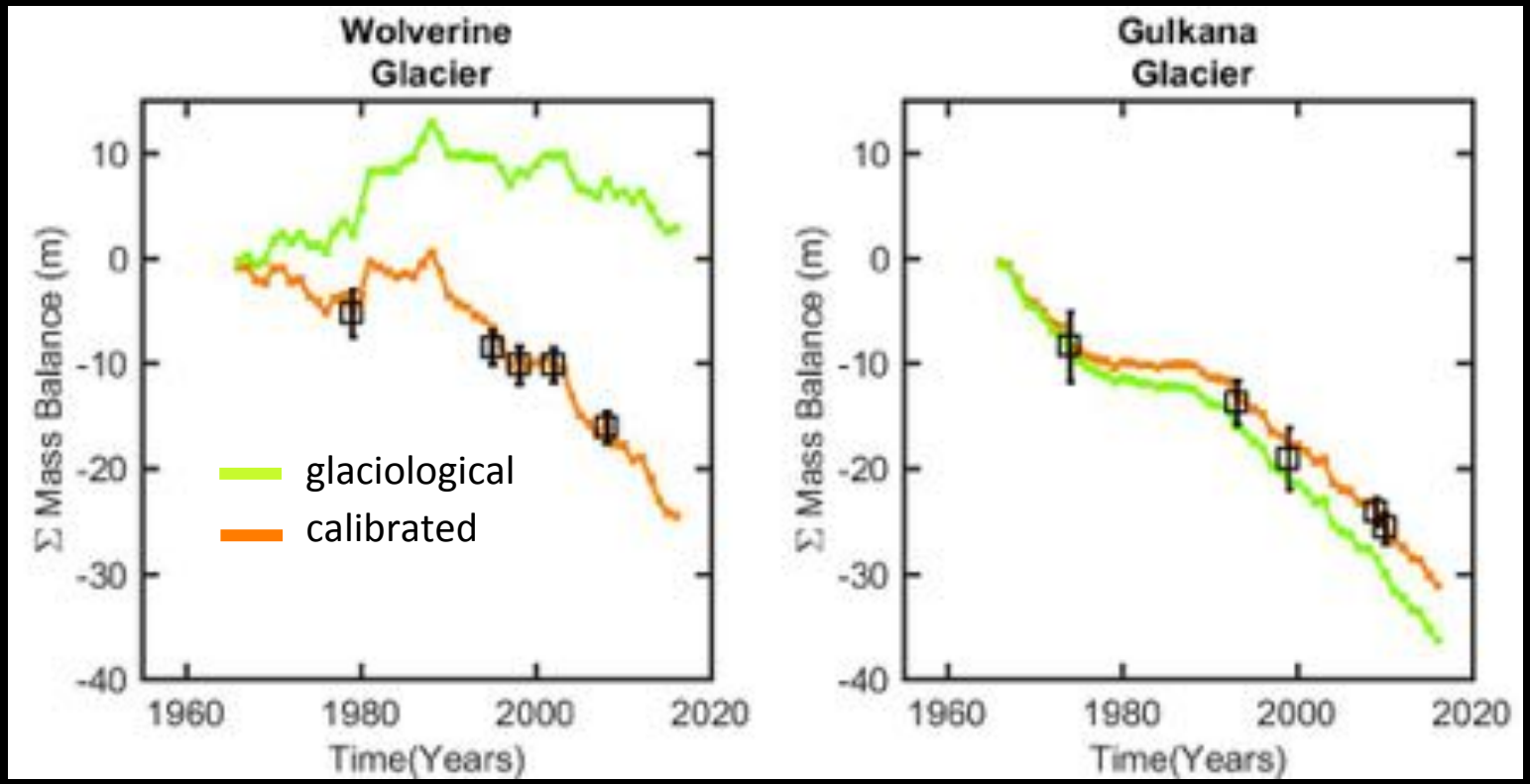




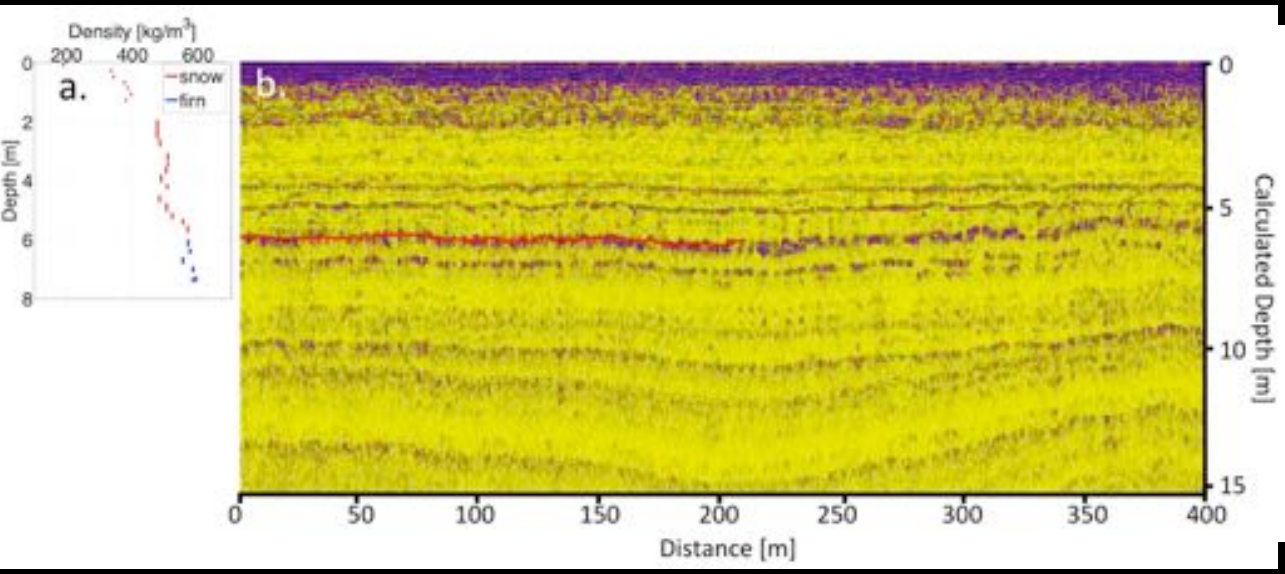
USGS Alaska Benchmark Glaciers

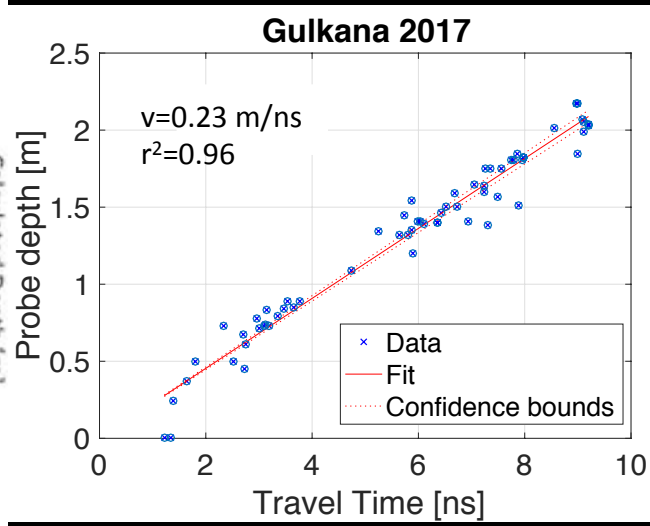




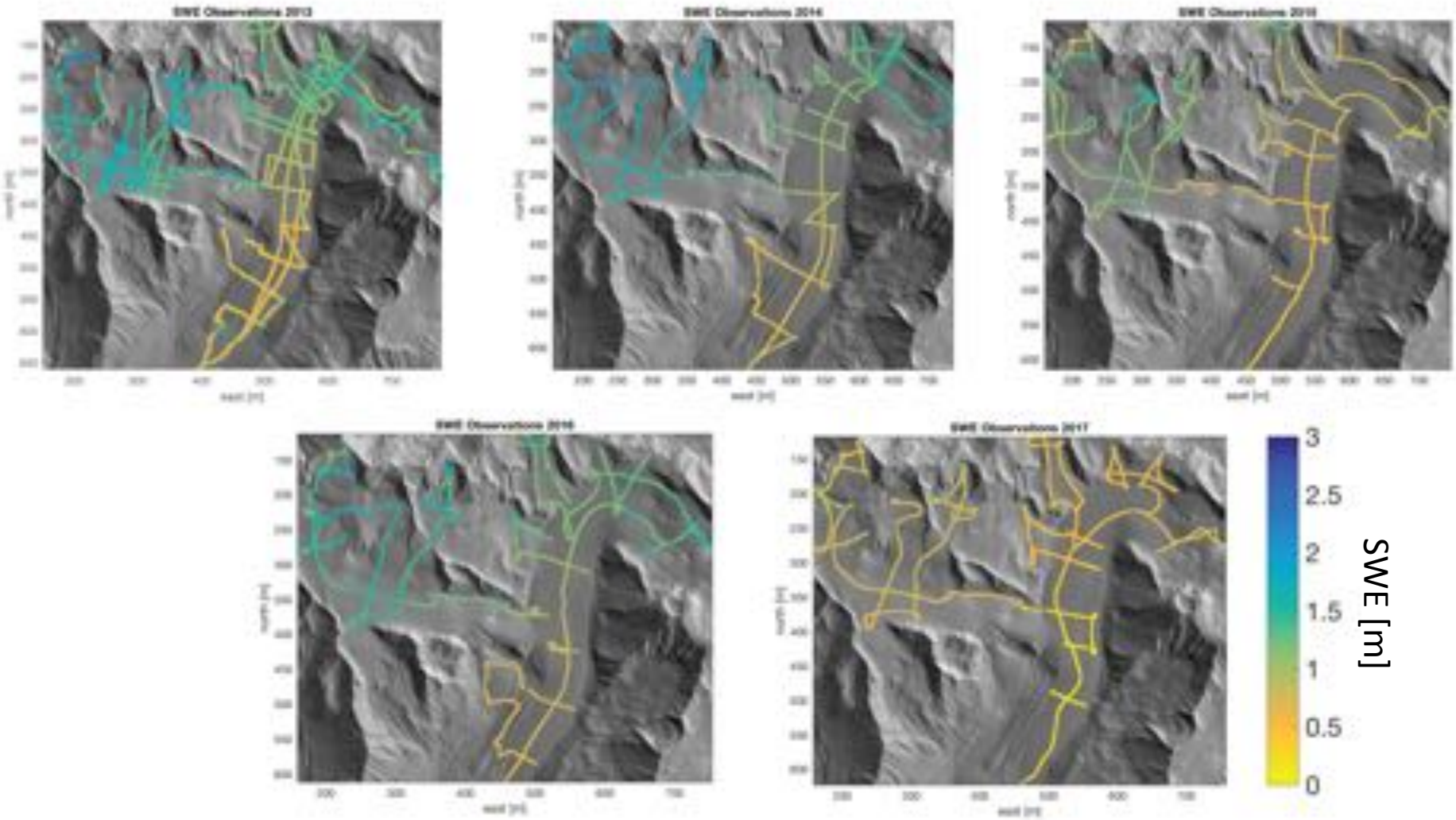


From n=3 to n =200,000



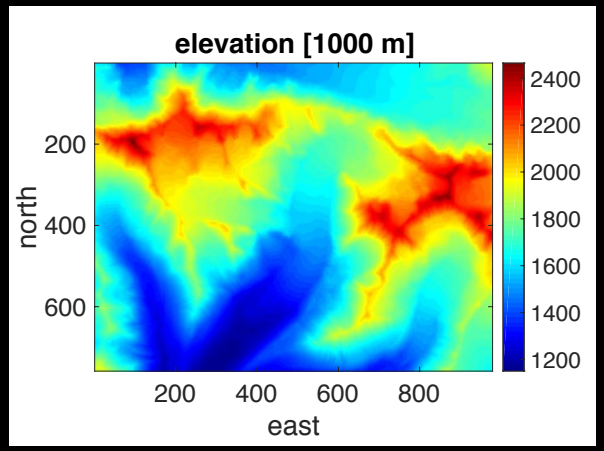


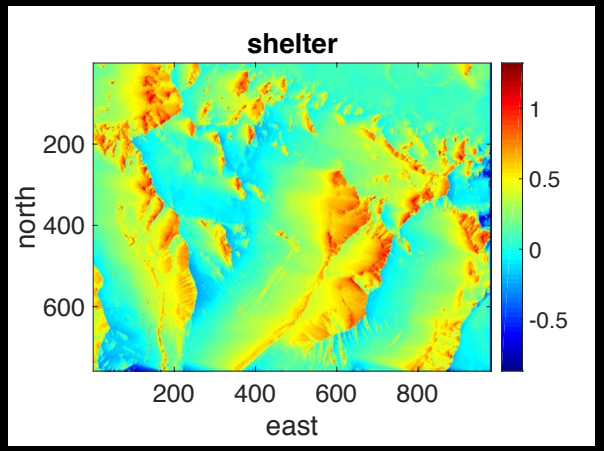
GPR Observations – 2013 – 2017

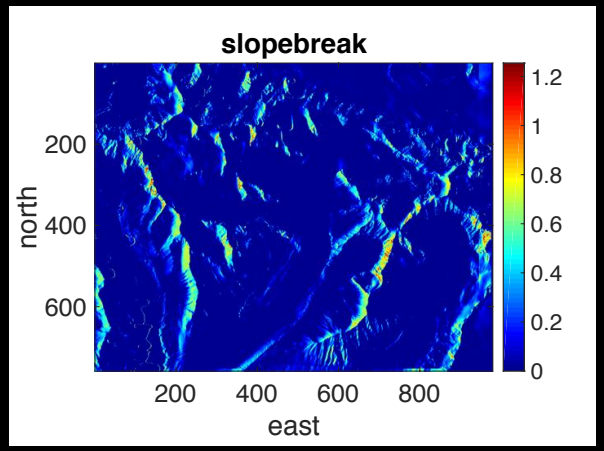


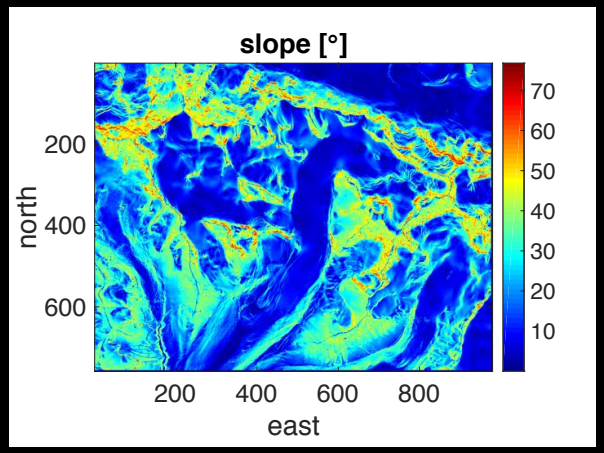
- Extensive surveys across both glaciers (~25 km)
- Consistent tracks to avoid known crevasse and avalanche hazard; possible bias

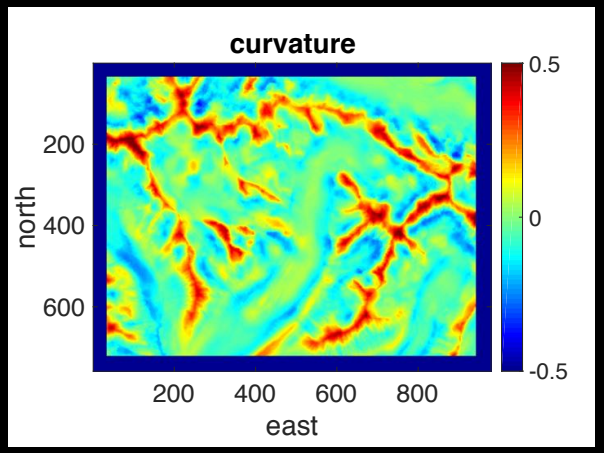
Terrain control on SWE distribution

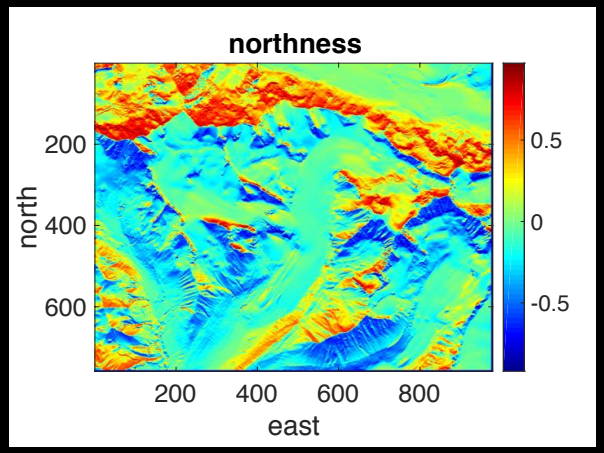






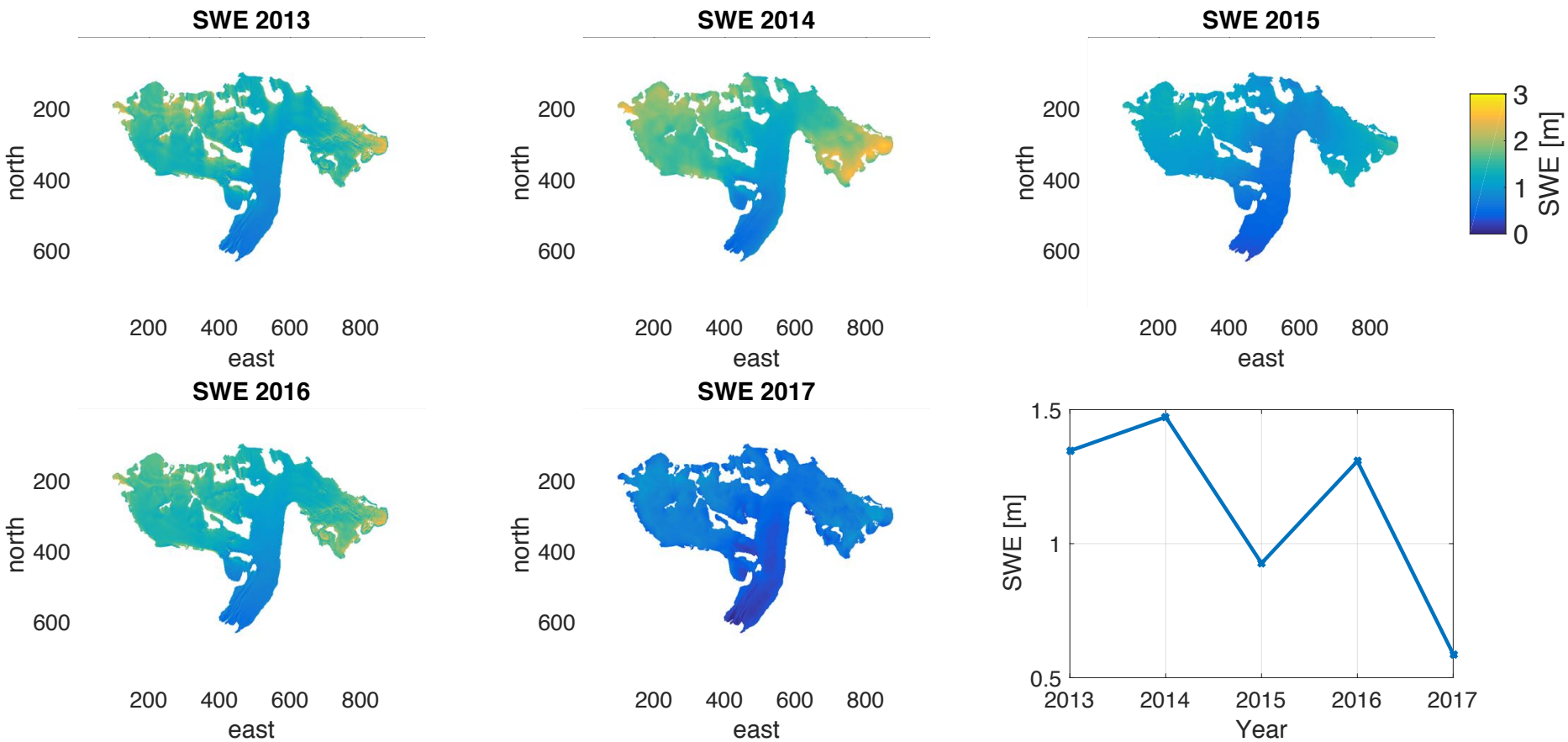




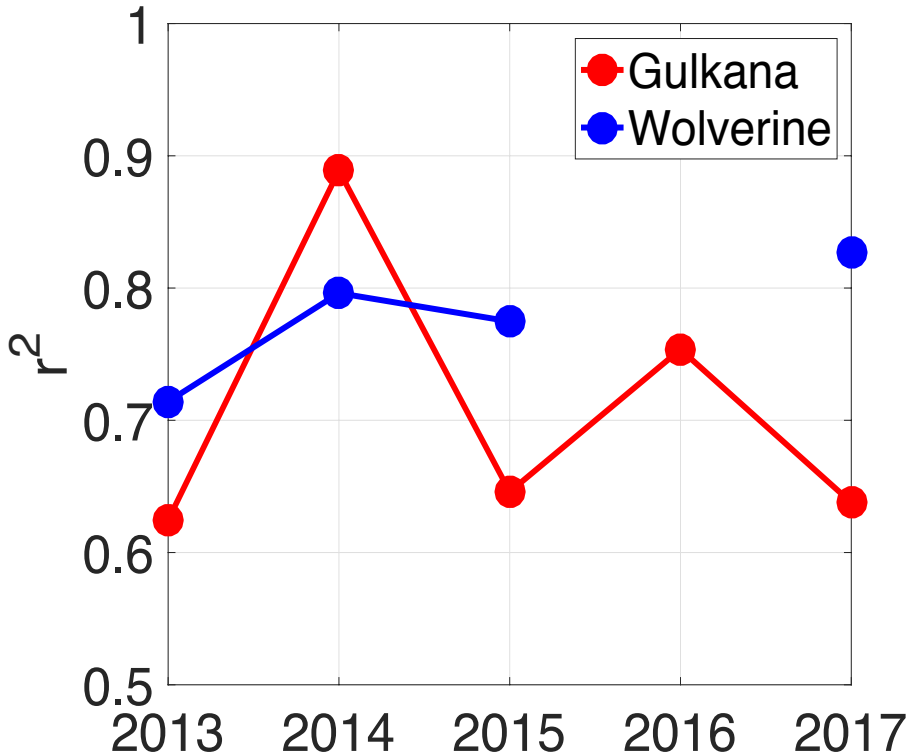


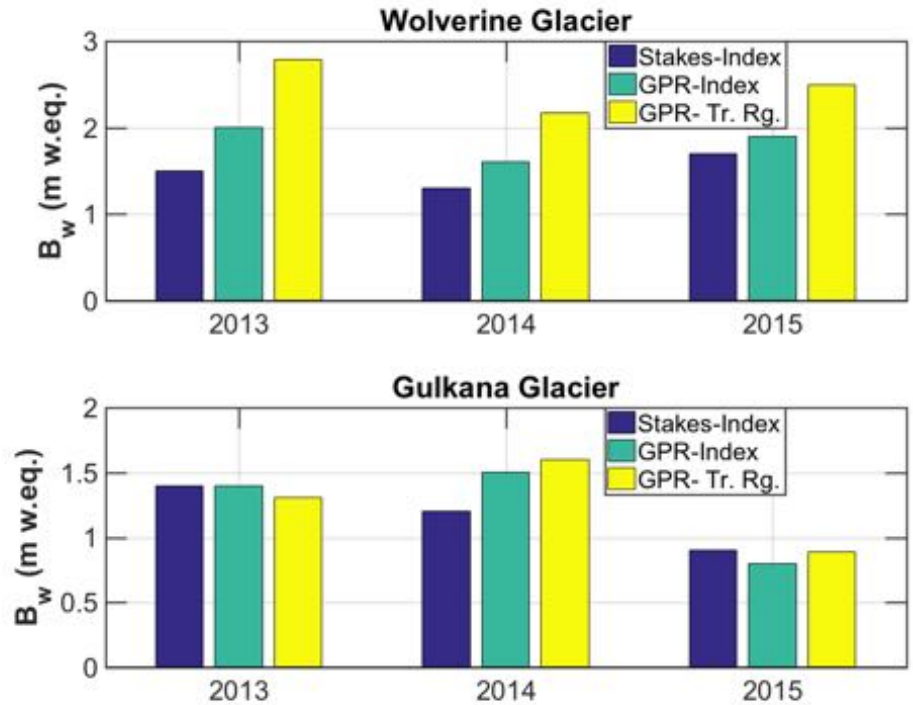
- Develop multi-variable stepwise regression, with a threshold for parameter inclusion, between terrain parameters and our SWE observations

Extrapolated SWE – 2013 – 2017



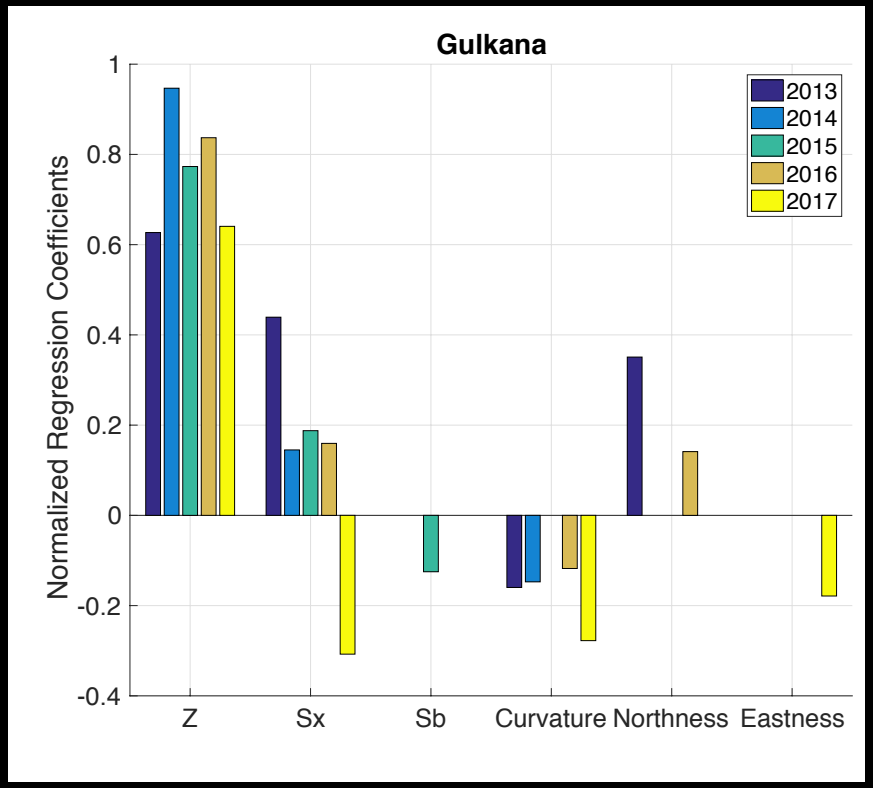
Model Performance – 2013 – 2017

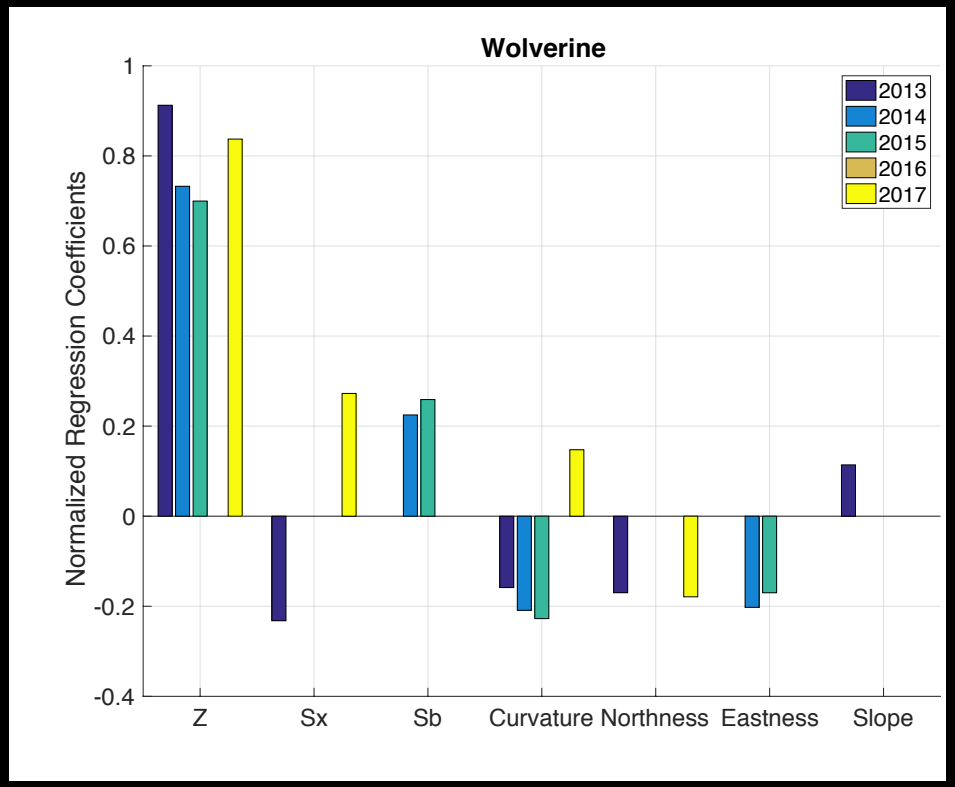




- Terrain parameters do a decent job explaining the variability in the observations
- Radar derived winter balance exceeds stake derived estimates

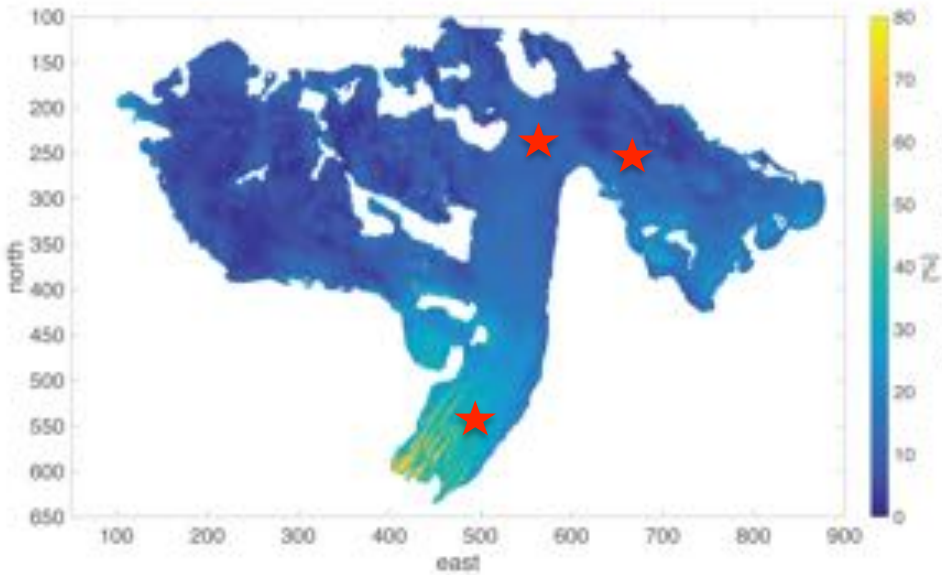
Terrain Parameter Consistency?

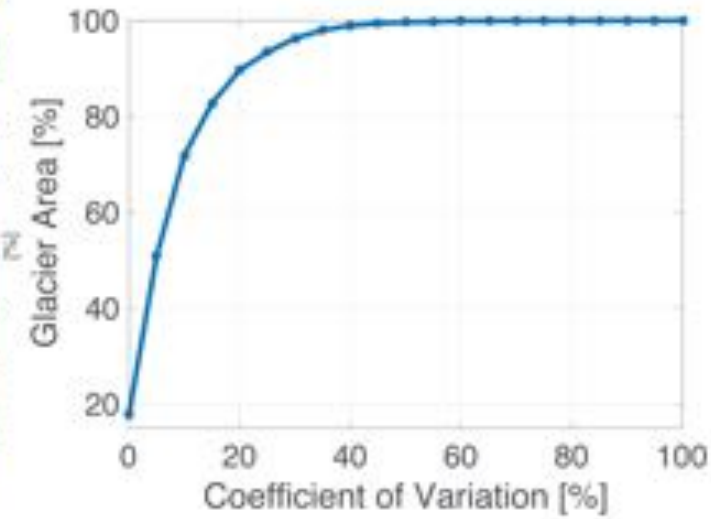


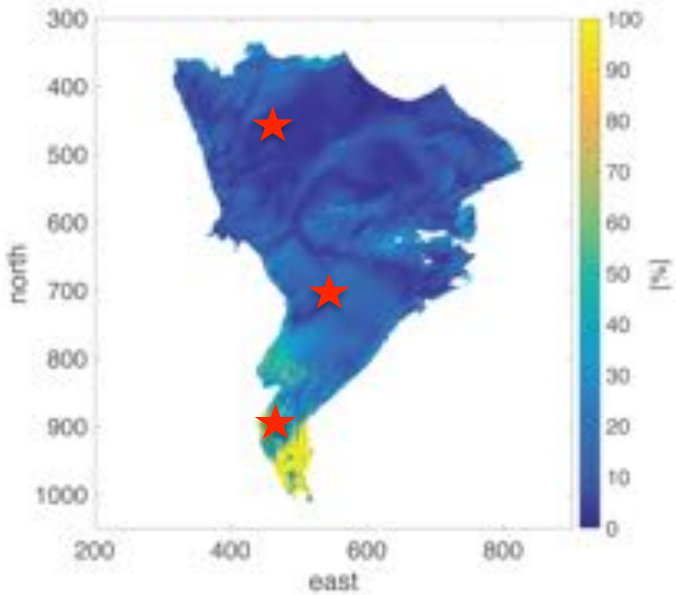


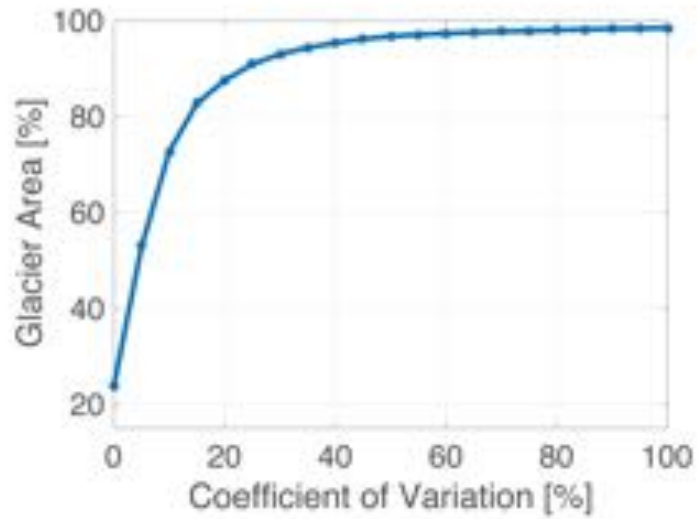
- Dominance of elevation
- Sx and curvature → capture wind redistribution
- Quite variable

Year to Year Consistency (CoVs)



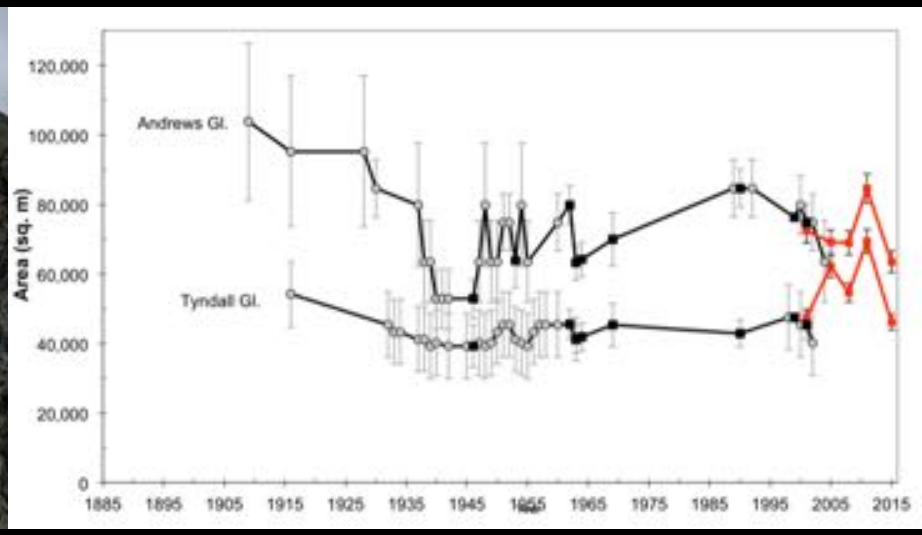
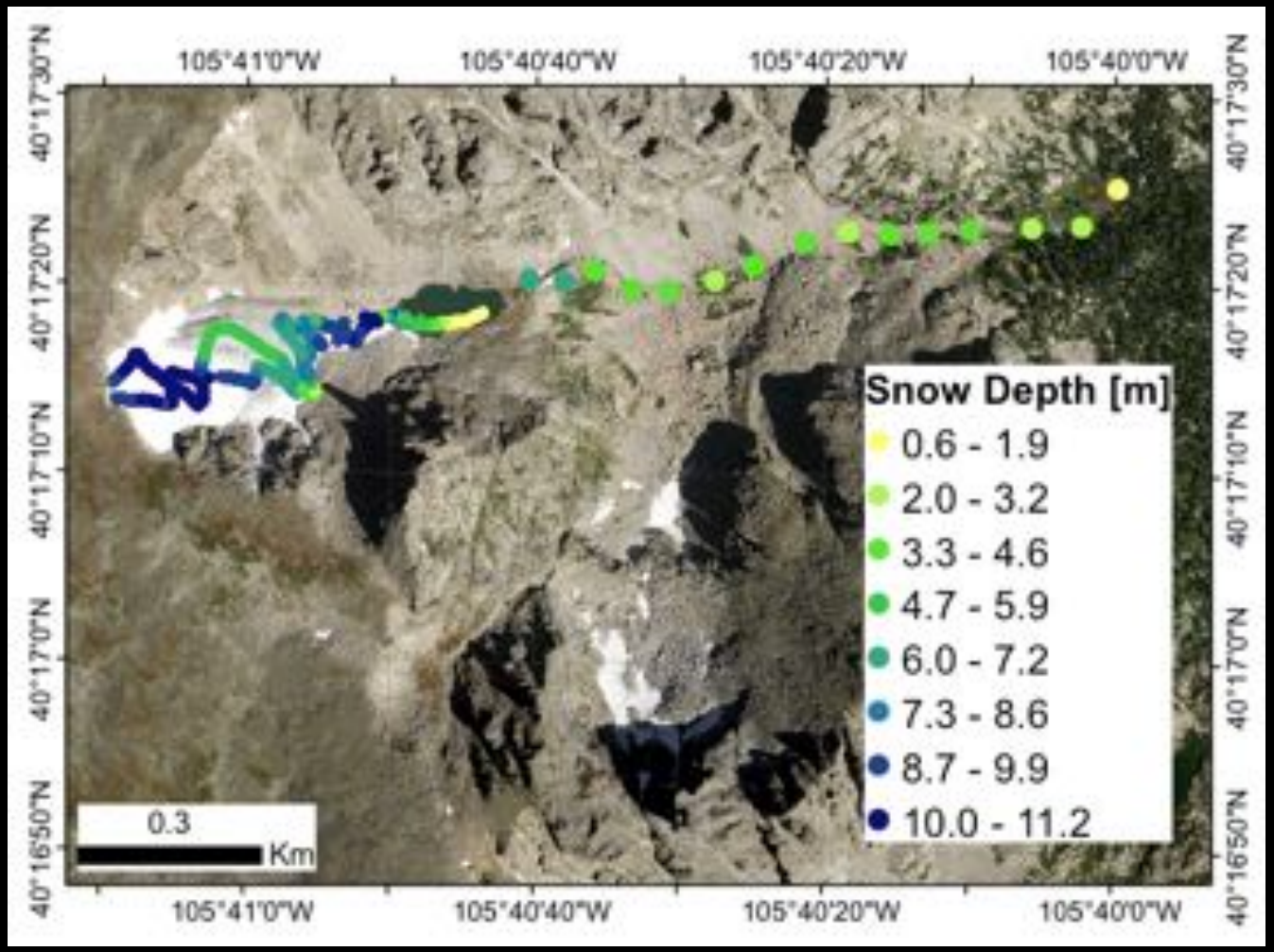






Thanks!

Small glaciers, big SWE



High rates of mass turnover