Temperature time series reconstruction for the southern aspect of Mt. Baker using meteorological measurements from the northern aspect of Mt. Baker.

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15 Dec 2021
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Outline

Context of Mt. Baker, WA USA in climate problem

The meteorology data sets used here

The tools used

Model development and results

Future work

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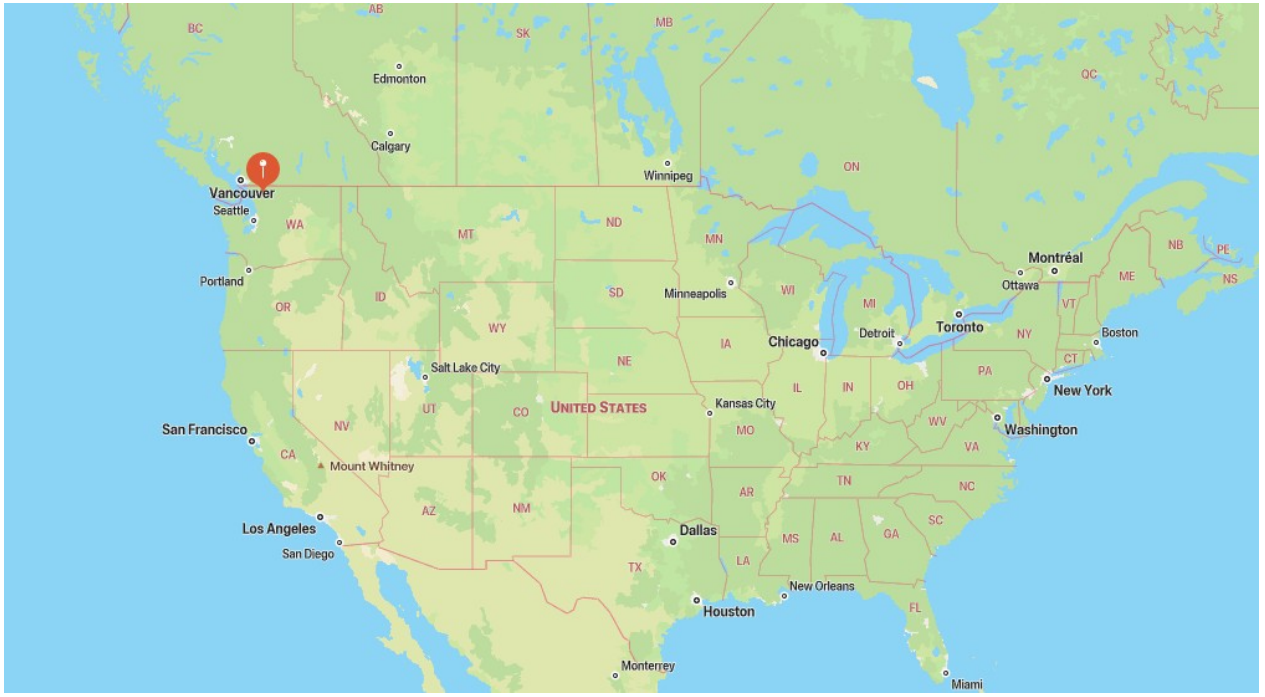

Pacific Northwest

2835 m asl

Record snowfall in 1998-9 Winter

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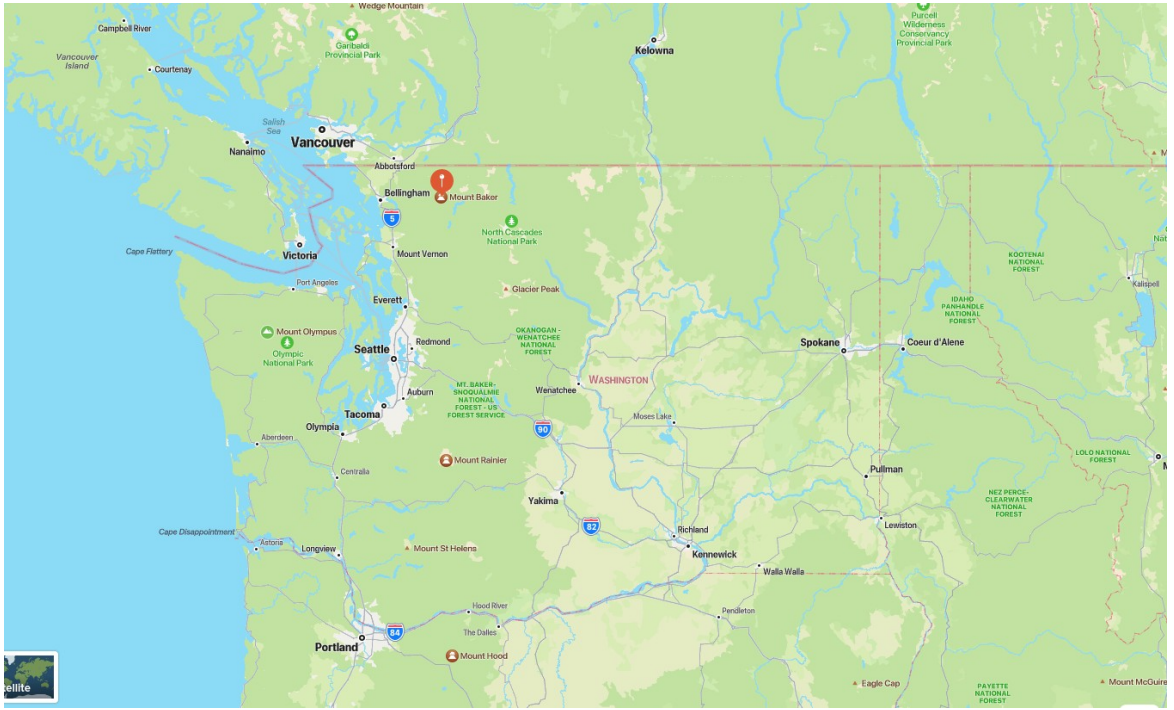

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Context of Mt. Baker, WA USA in climate problem

US National Parks are experiencing 2x the warming of rest of the United States (Gonzalez et al., 2018)

Mt. Baker has all characteristics of National Parks in study.

Snowpack in western US is very vulnerable and might disappear by 2070 (Siirila-Woodburn et al., 2021)

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Context of Mt. Baker, WA USA in climate problem

Long-term meteorological measurements of temperature on Mt. Baker began at Mt. Baker Ski Resort
Sept 2014.

These measurements are served up at nwac.us

Measurements of temperature on the south side (*Schrieber's Meadow 1030 m*) of Mt. Baker began in July 2018 as part of the Mt. Baker Climate Project (MBCP).

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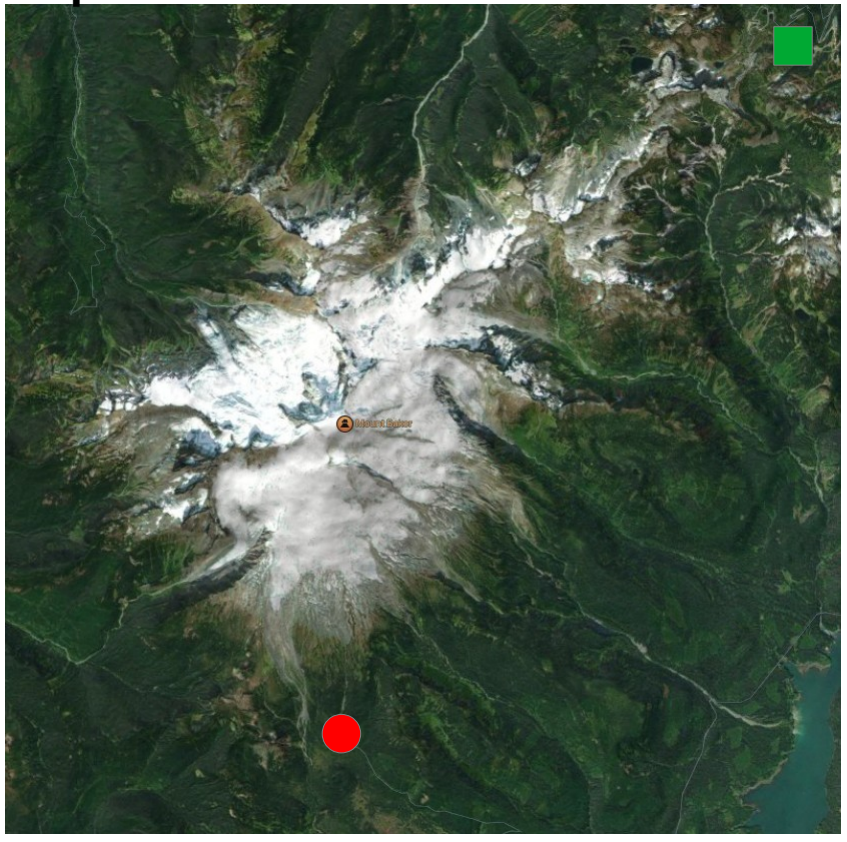
The problem to be solved here



Need:
A longer temperature record for the near-surface atmosphere on the south side of Mt. Baker.

Proposed product:
An extended time series for Schrieber's Meadow, Mt. Baker, WA USA

- *Feature data* - multiple meteorological time series from the Mt. Baker Ski Resort (Sep 2014 – Dec 2021)
- *Target data* – 2-m air temperature (Jul 2018 – Jul 2021)

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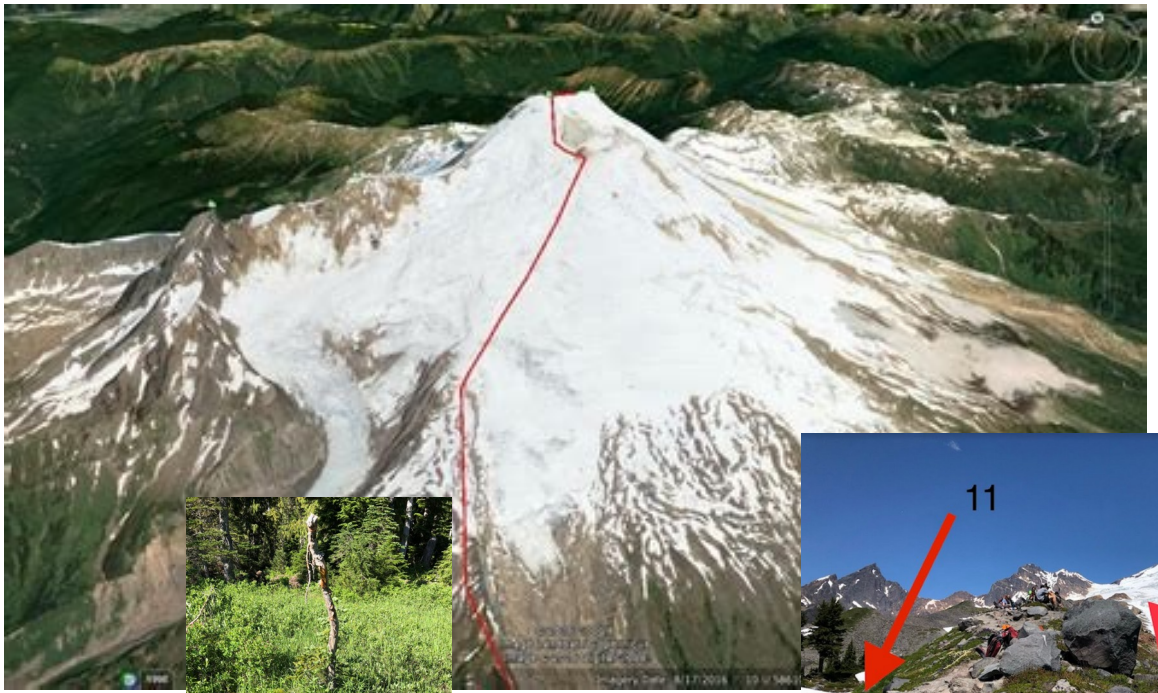

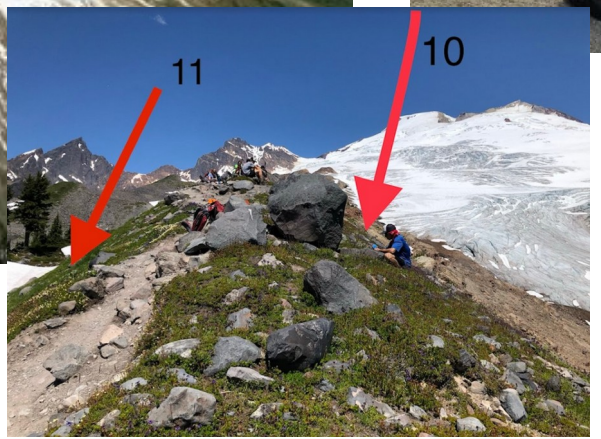

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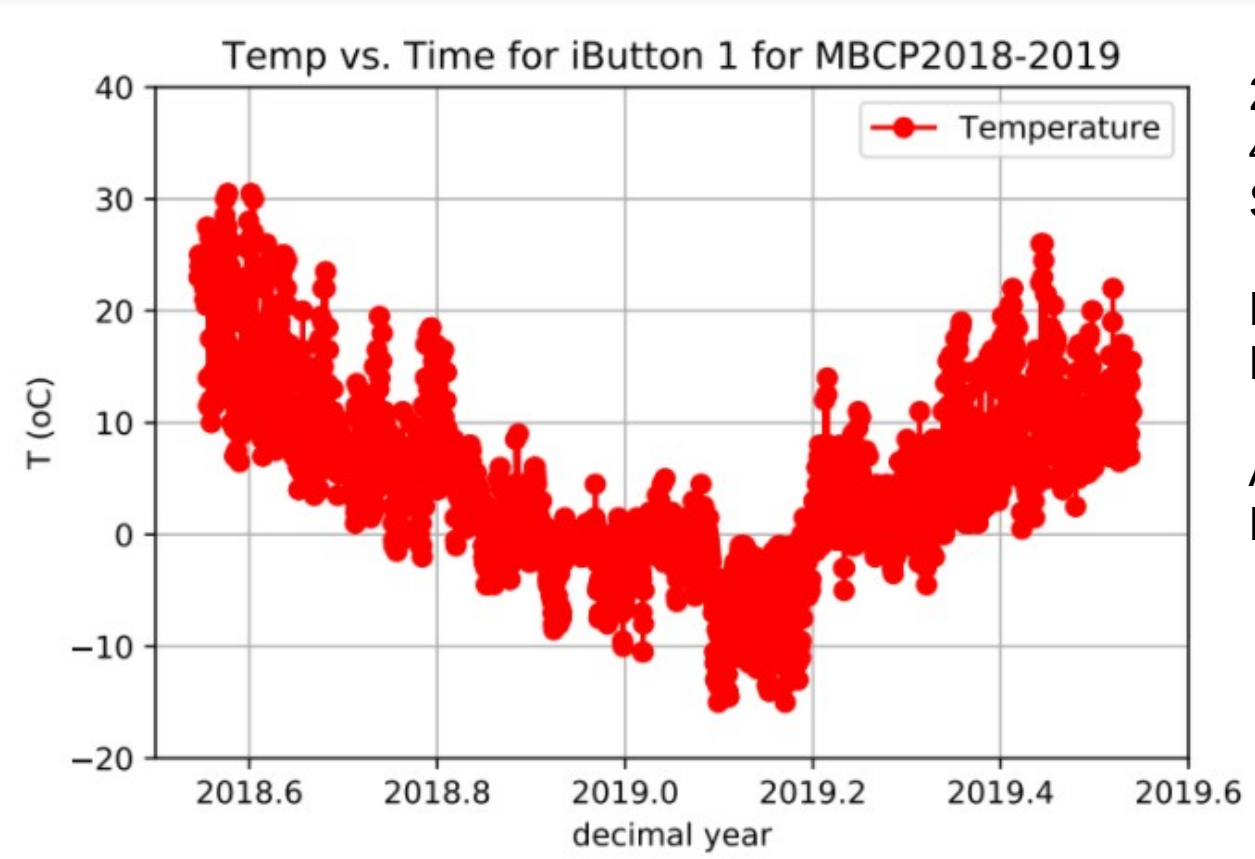

2-m air temperature
4.25-hourly
Schrieber's Meadow

Entire temperature record from MBCP is Jul 2018-July 2021

Accuracy = +/- 0.5 deg C
Precision = +/- 0.5 deg C

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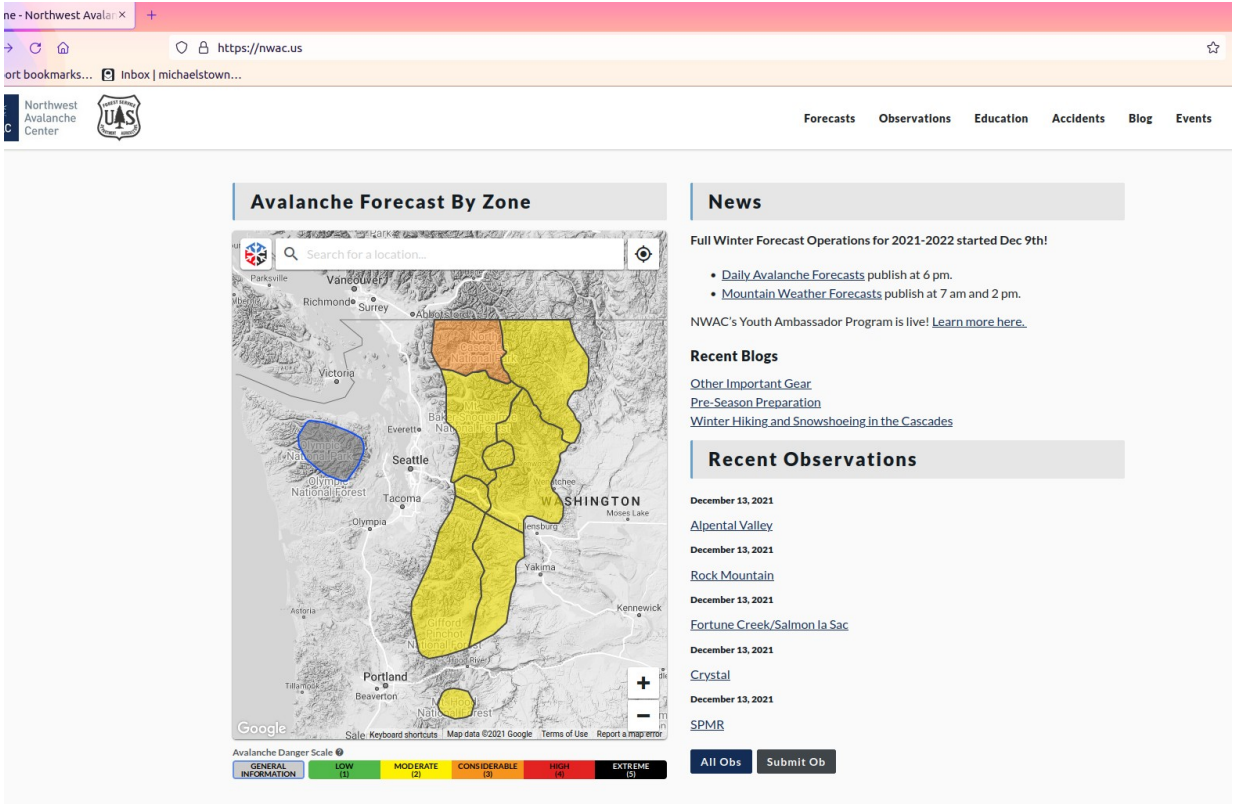

A full meteorology suite of data is available for the Mt. Baker Ski Resort.

Spread between two sites:
Heather Meadows (1300 m)
2-m T, precip

Pan Dome (1530 m)
2-m T, ws, wdir

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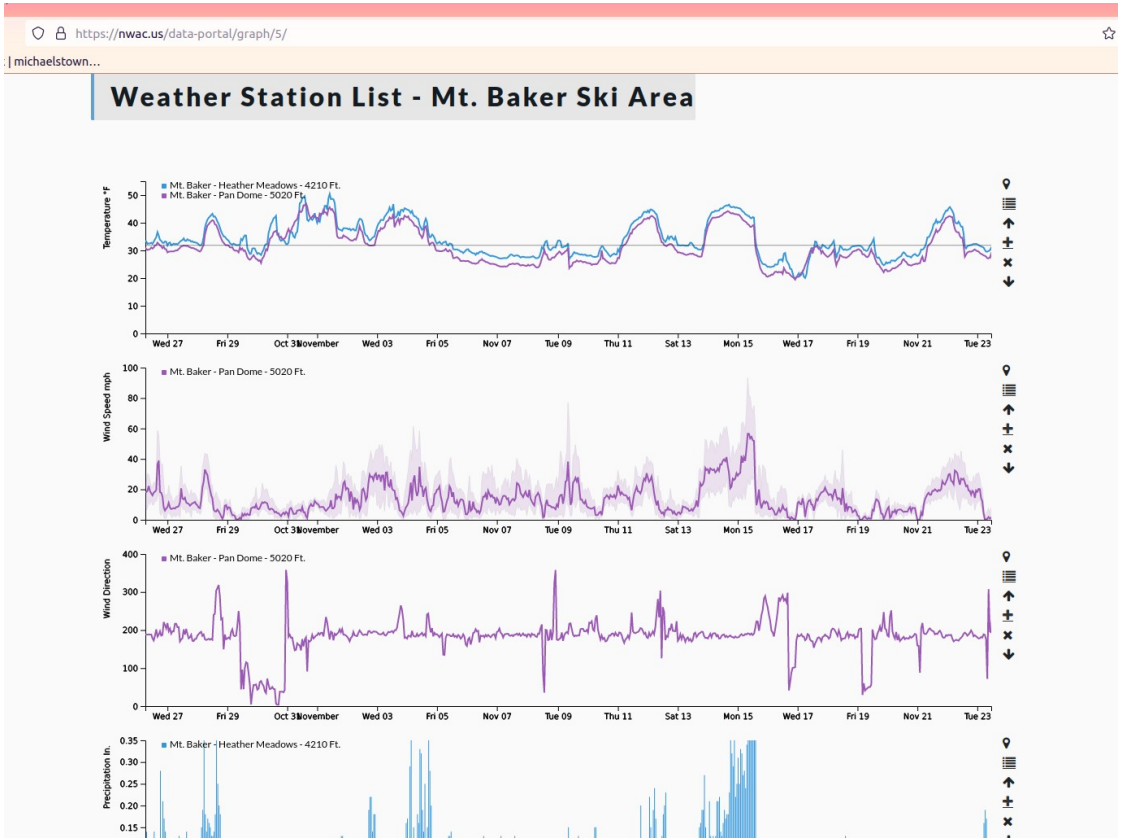

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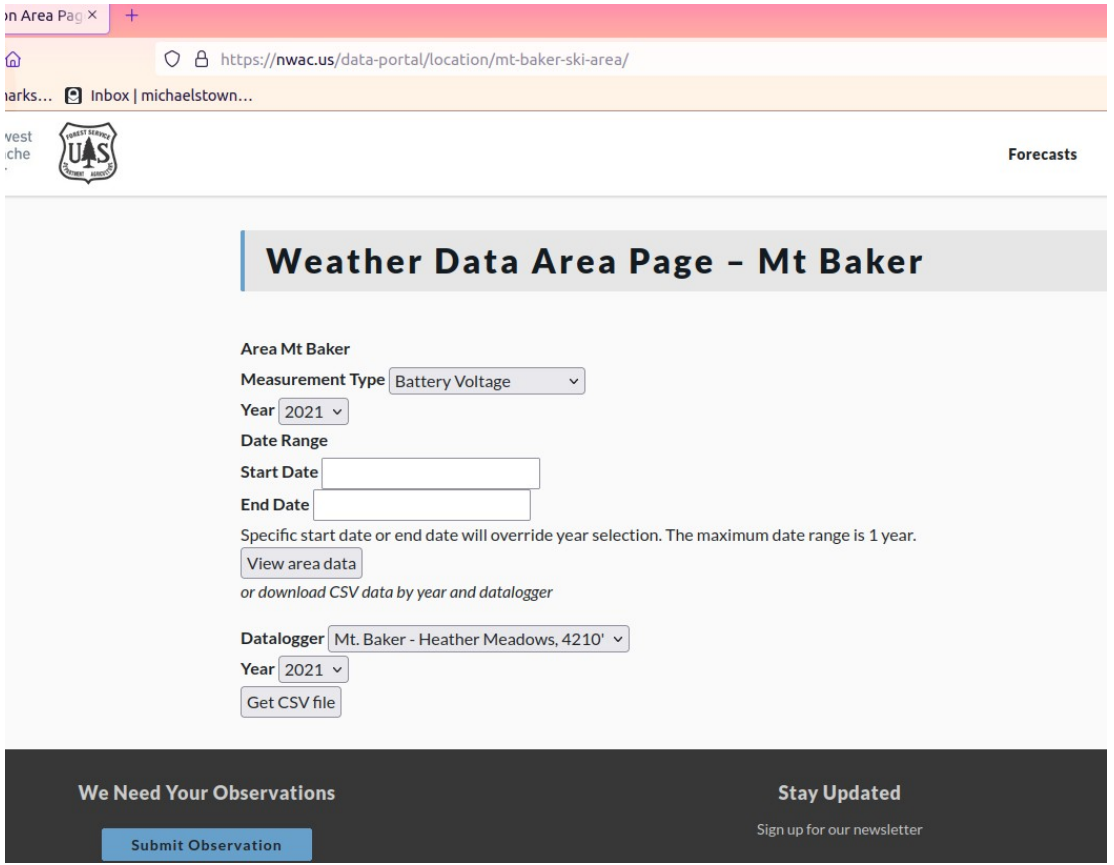

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This page was scraped with Selenium

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The tools used

OS – Ubuntu 20.04

Coding platform – Python 3.7
Pandas, Statsmodels, Matplotlib, and much more

Feature Data - NWAC Data Portal scraped using Selenium,
data processed with BeautifulSoup

Feature data composited by: season (djf, mam, jja, son)
precip rate (none, drizzle, light, moderate, heavy)

Target Data – 2-m air temperature data collected as part of the MBCP

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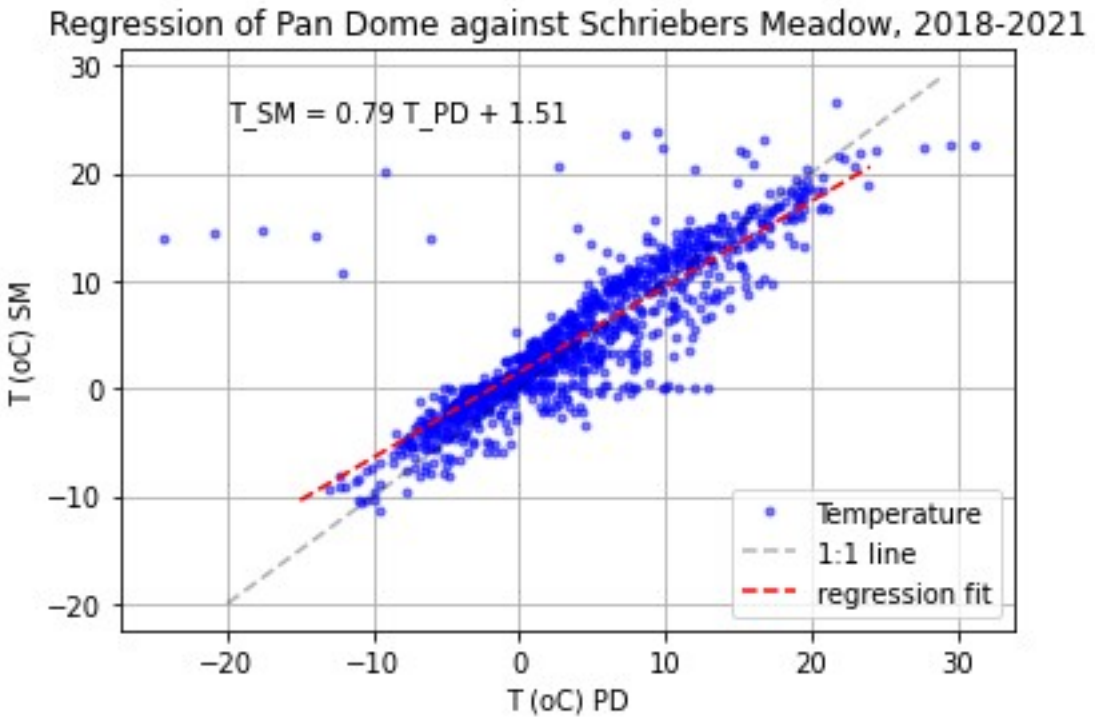
Initial results



Pan Dome (1530 m)

$R^2 = 0.758$

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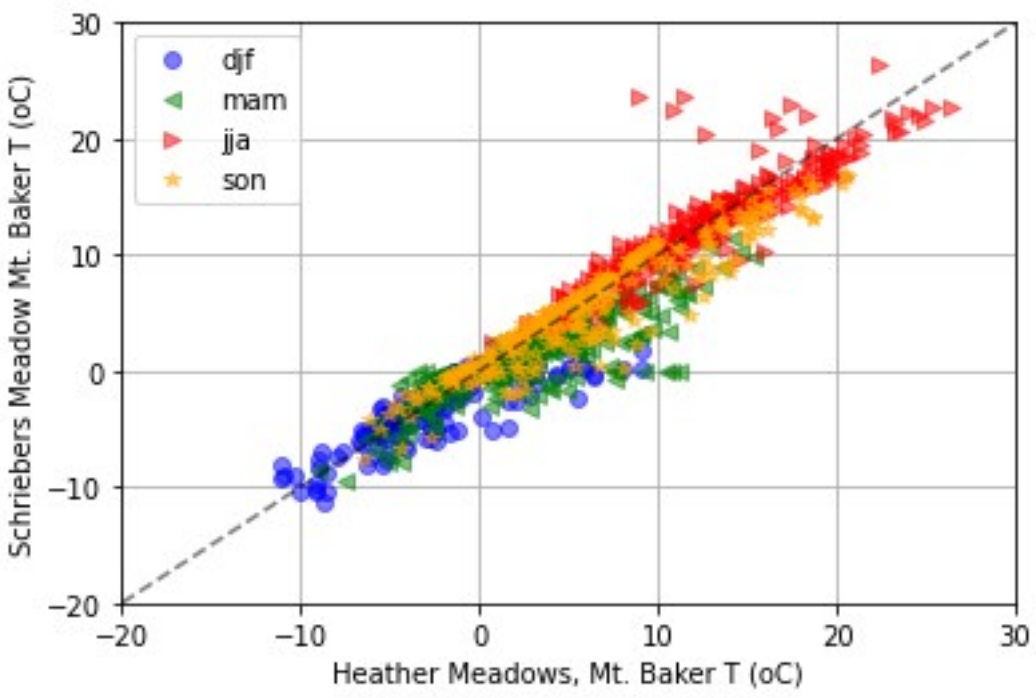
Results



Pan Dome and Heather Meadows temperature were no independent enough.

Use only Heather Meadows.

Separation by season looked promising.

MAM overlaps with all other seasons, so not independent in the model of 2-m air T.

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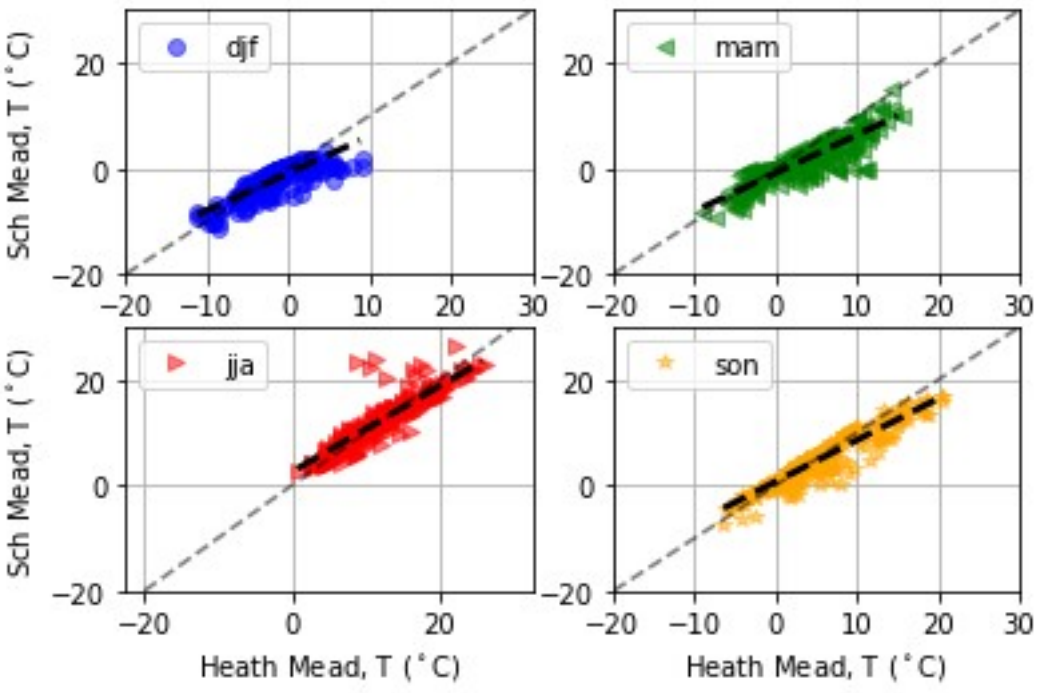

Individual regression have R^2 0.73 – 0.85 range.

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Results (evolution)

Model Performance (R^2)	Model Features	Feature Performance (p-value)	Notes
0.758	Pan Dome 2-m T	0.000	One errant event in Summer visible.
0.758	Pan Dome 2-m T wind speed	0.000 0.135	
0.933	Heather Meadows 2-m T (djf, drizzle) jja mam son heavy rain light rain moderate rain no rain	0.000 0.000 0.875 0.000 0.009 0.121 0.719 0.000	Base case is djf and drizzle.
0.758	Z-transformed Pan Dome Temp	0.000	

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Results (evolution)

Model Performance (R^2)	Model Features	Feature Performance (p-value)	Notes
0.842	Pan Dome 2-m T (djf) wind speed jja mam son	0.000 0.047 0.000 0.208 0.000	Base case is djf.
0.763	Pan Dome 2-m T (N-NE) wind speed N-NW S W	0.000 0.194 0.075 0.570 0.465	Wind direction categories chosen based on EDA of monthly wind direction histograms. Base case is N-NE wind direction.
0.843	Pan Dome 2-m T (N-NE, djf) wind speed N-NW S W jja mam son	0.000 0.058 0.216 0.941 0.442 0.000 0.301 0.000	Base case is N-NE wind direction and djf.

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Results Summary

Improving the 2-m air temperature model over using Pan Dome 2-m air T as sole feature.

Seasonal compositing	(yes, exception is MAM)
Wind speed	(no)
Wind direction	(no)
Precip rate	(yes)
Heather Meadows data	(yes, over Pan Dome 2-m air T)

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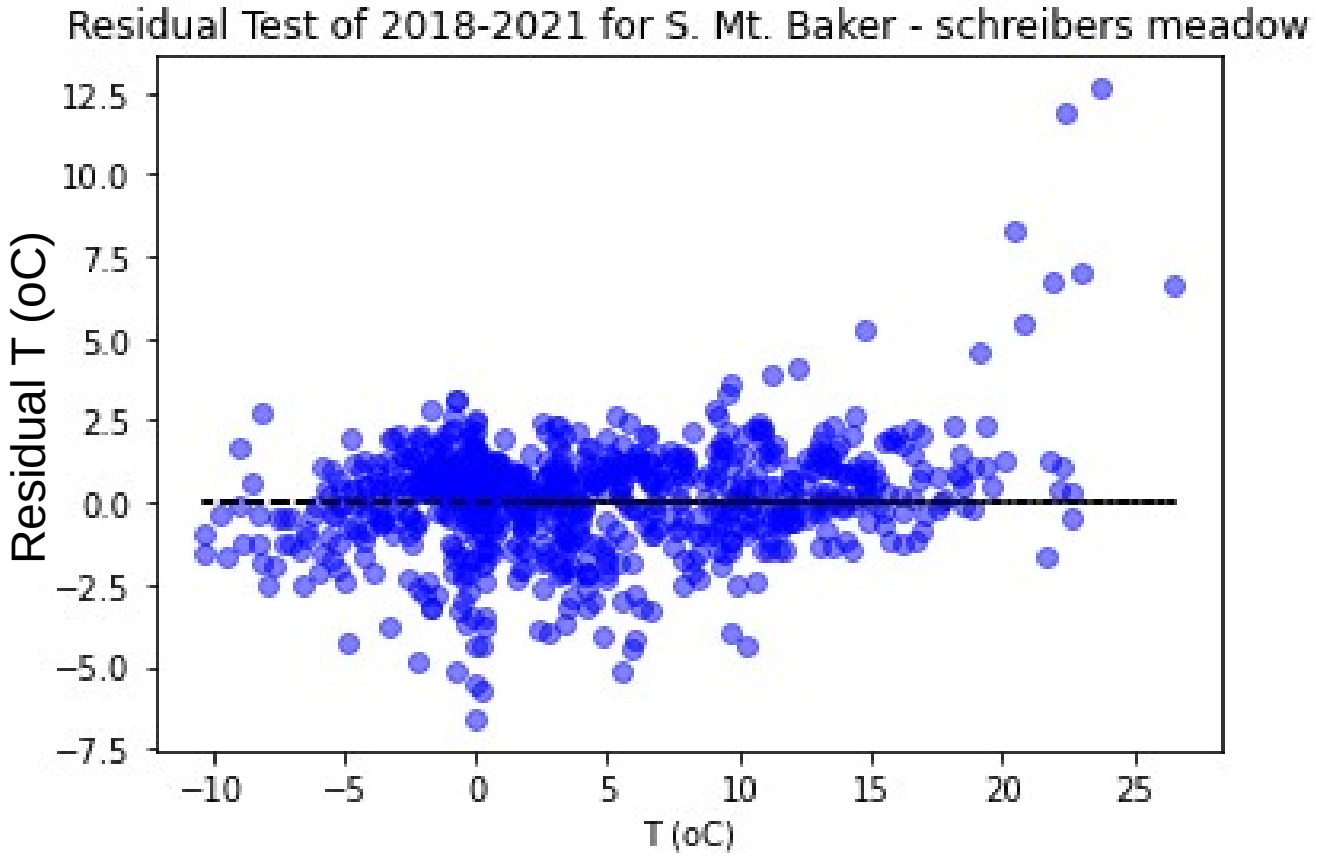
Further evaluation



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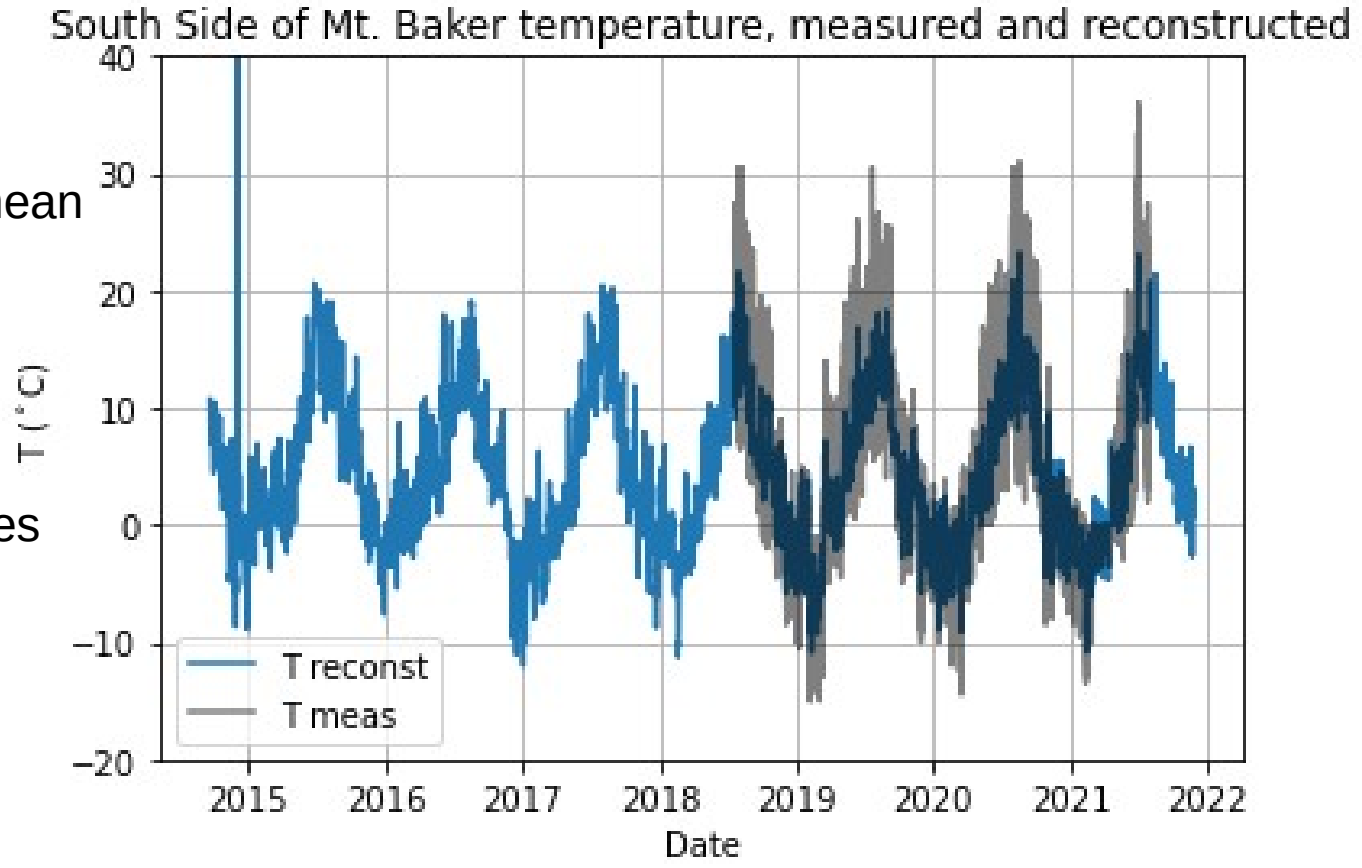
Further evaluation

Regression model accurately represents mean trends.

Regression model misses extreme values



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