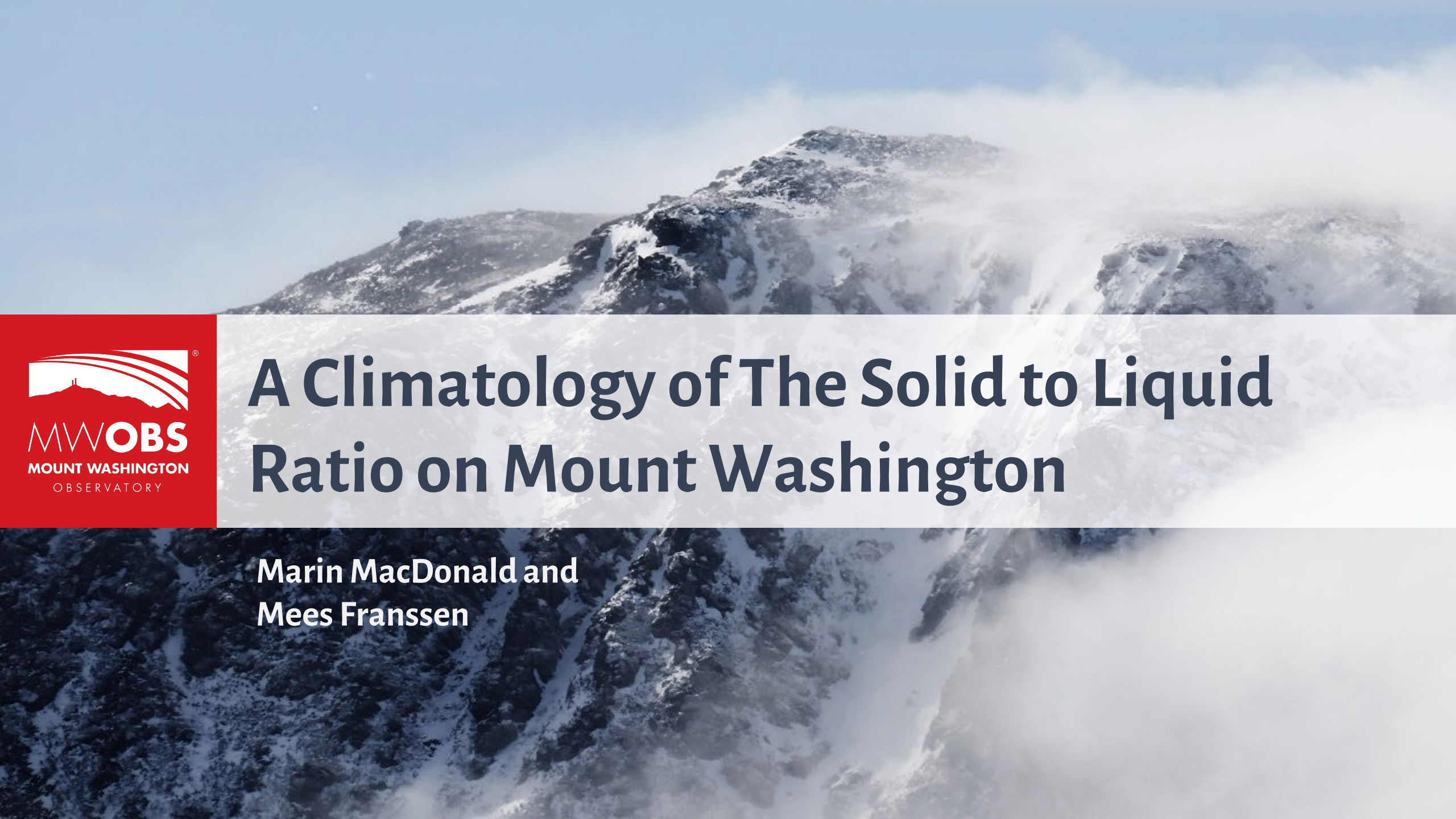

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A Climatology of The Solid to Liquid Ratio on Mount Washington

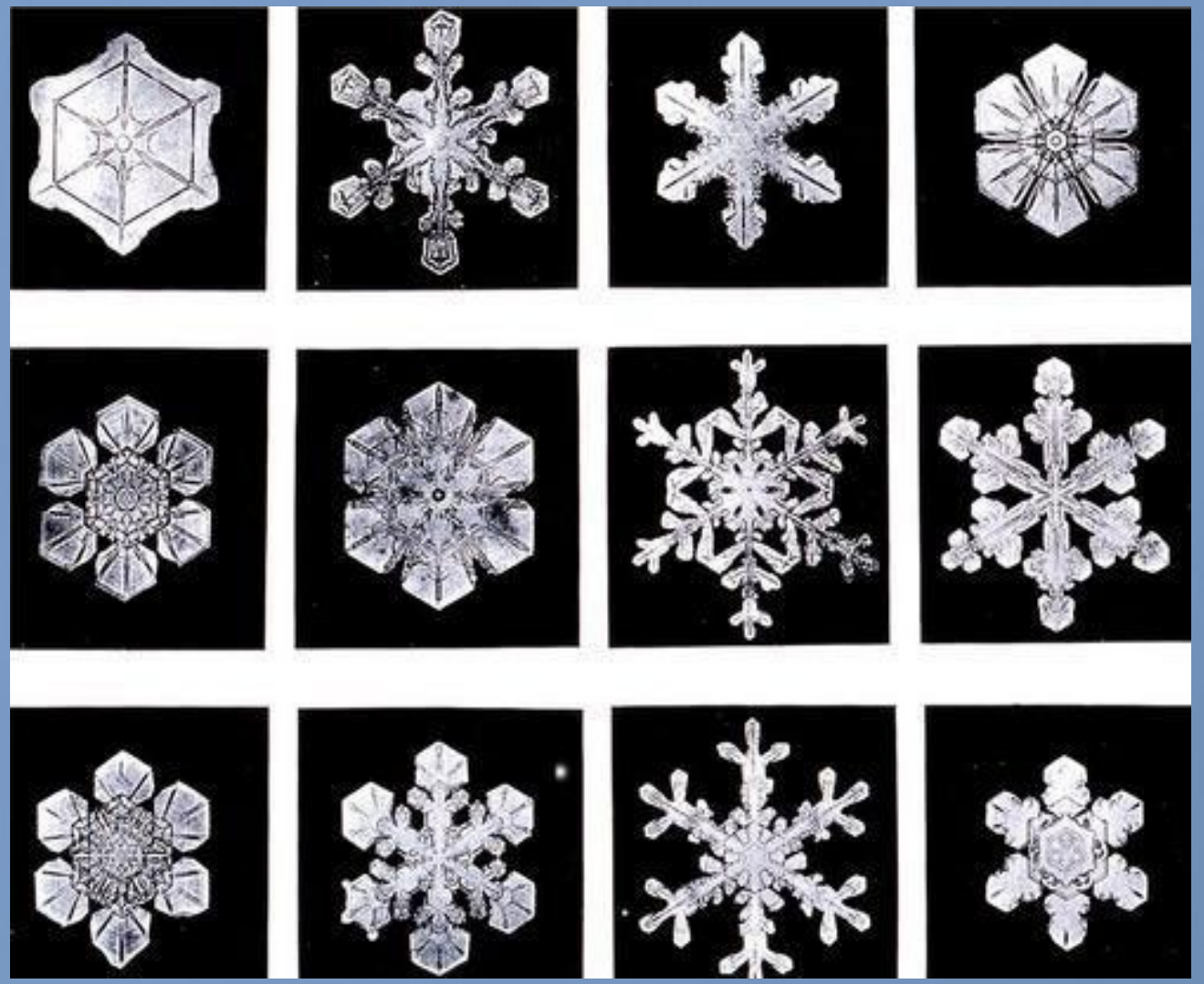
Marin MacDonald and
Mees Franssen

What is the Solid-to-Liquid Ratio?

Solid to Liquid Ratio (SLR) =
amount of solid accumulation / amount of liquid equivalent

Understanding SLR is important for:

- Reducing uncertainty when forecasting mixed precipitation
- Refining Quantitative Precipitation Forecast (QPF) models
- Understanding snow characteristics



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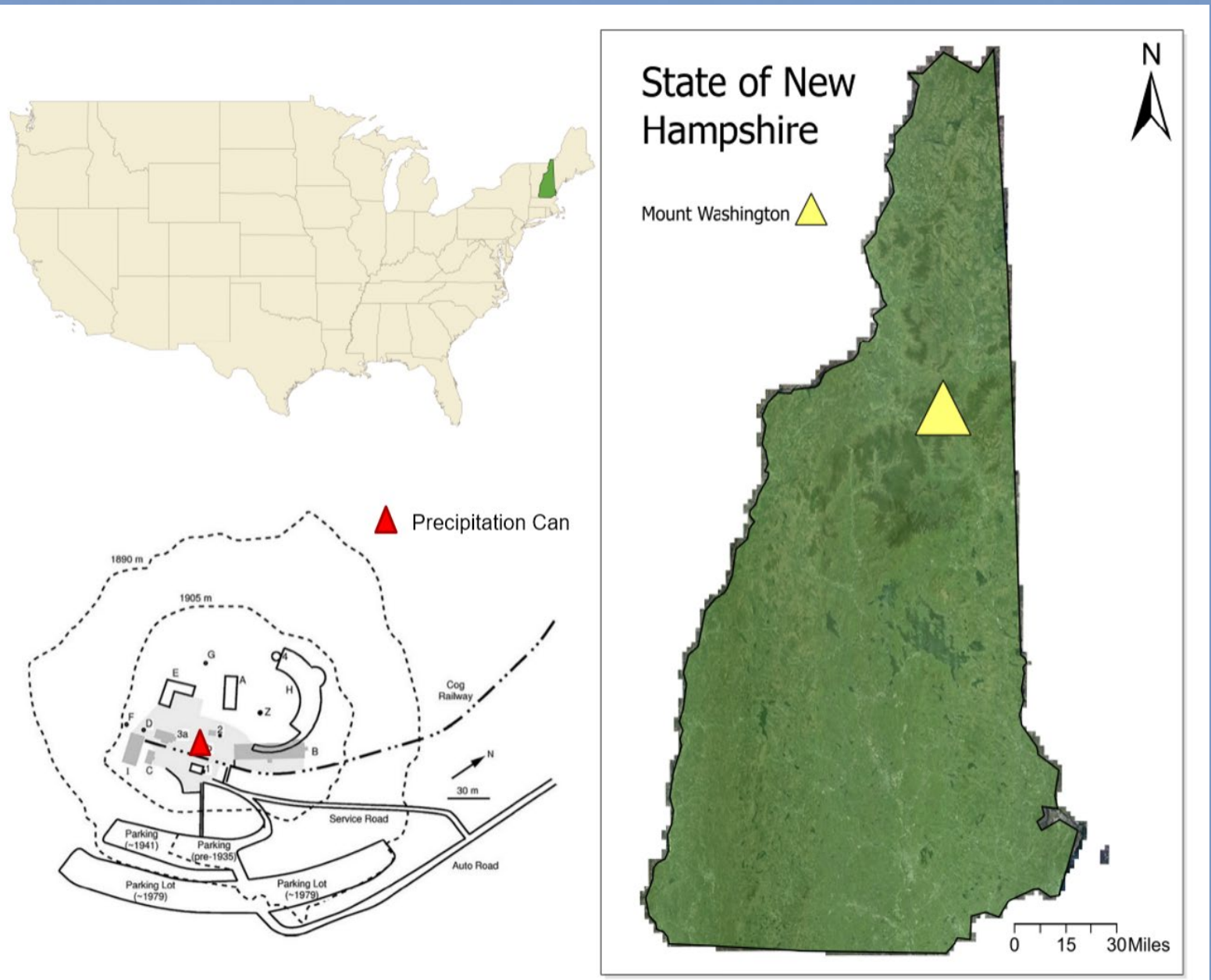

Figure 1. Study area, Mount Washington Observatory. Summit of Mount Washington NH

Precipitation Collection on Mount Washington

- Measurements are collected **every 6 hours**
- Weather on the summit can be **EXTREME**
  - Observers can use **estimates** to help record accurate precipitation and SLR values

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How does Solid-to-Liquid Ratio (SLR) vary on the summit of Mount Washington? What atmospheric variables influence the SLR on the summit? How do estimates impact the period of record?

OBJECTIVES:

- Create a comprehensive climatology of SLR values for the winters of 1980-2024
- Understand what atmospheric variables impact SLR values (Temperature, wind)
- Assess the impact of estimated SLR values on the climatology

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Data Processing

Data

- Daily data spanning from 1980-2024. Including variables: average wind, average temperature, 24-hr accumulated solid precipitation, and 24-hr accumulated water equivalent.
- The “Snow Year” October through to May of the following year, and is considered a distinct season.

Filtering

- Any observations following these parameters were filtered out:
  - Accumulated solid precipitation depth < 0.50 inches
  - Liquid water equivalent > solid precipitation depth
- A record of estimates is kept, including all dates where accumulated solid precipitation **or** water equivalent had to estimated for any reason.
  - These dates were used to create two datasets: one with estimates included, and one without.

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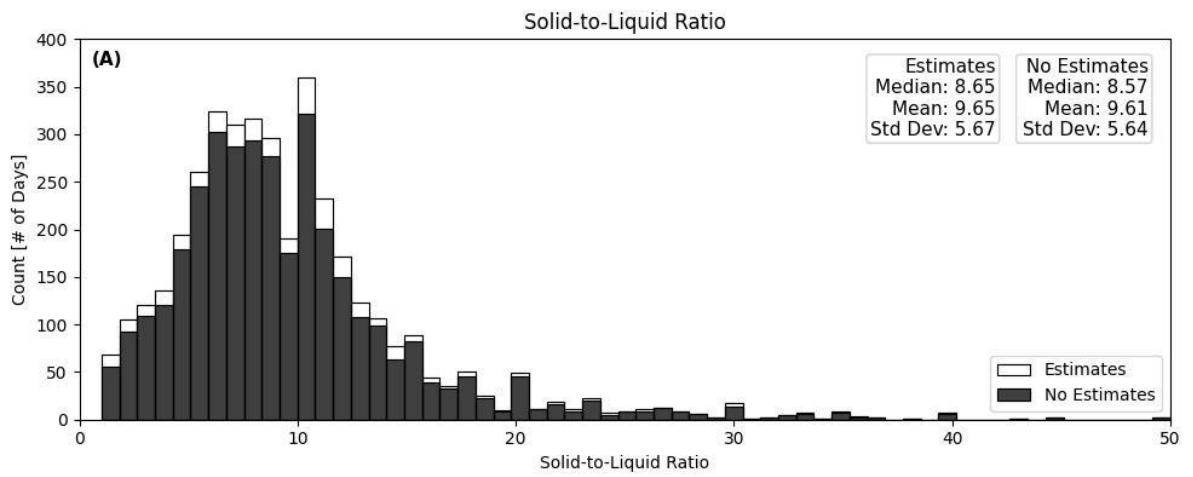

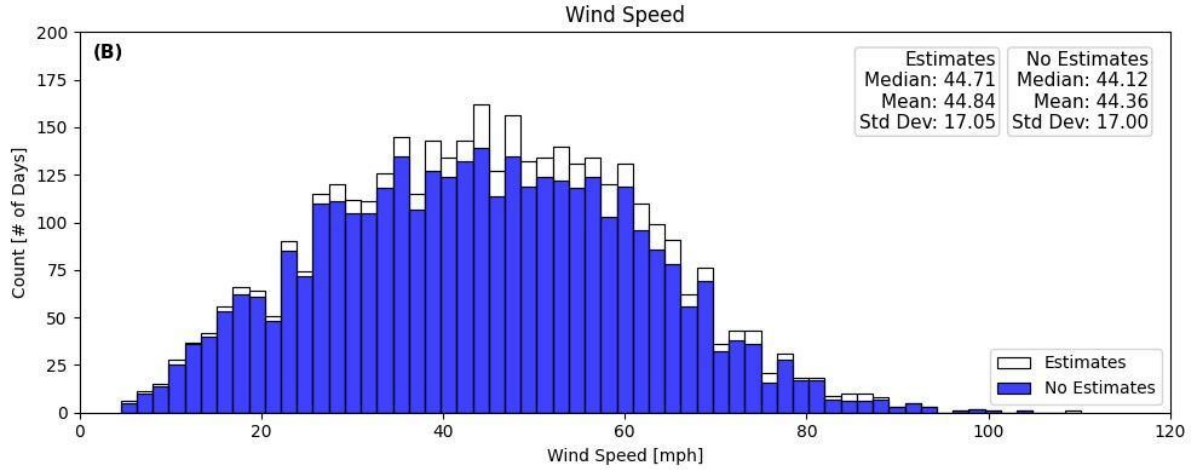

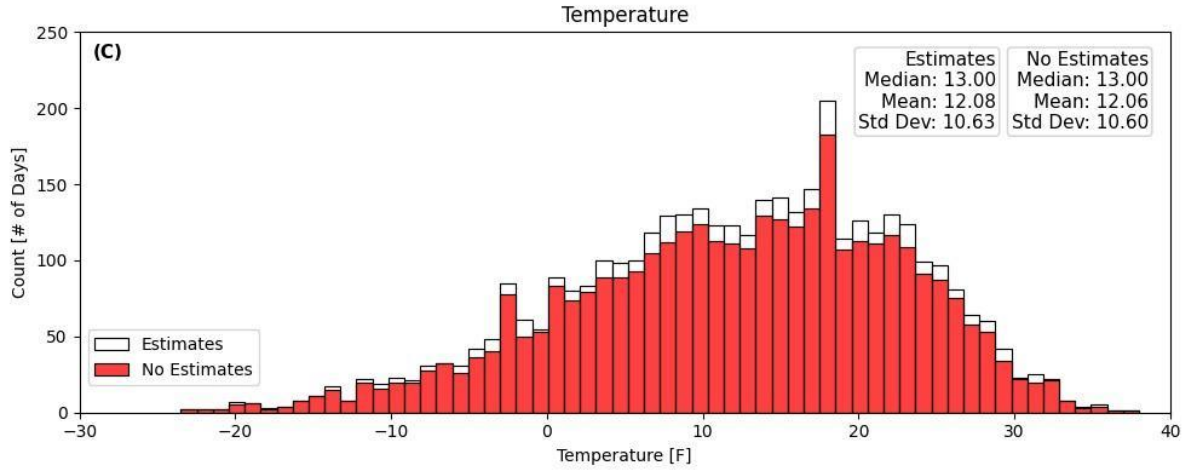

What we see

- Distributions are skewed
- Summit SLR varies greatly, and is significantly different from SLR=10
- Estimates are reflective of real data. And there are no particular conditions under which more estimates are made.

Variable	K-S Test (95% CI)
SLR	Fails
Wind	Fails
Temperature	Fails

Table 1. Results of the Kolmogorov-Smirnov comparison test between histograms including and excluding estimated data to assess the impact of estimates on data. Three variables are assessed: SLR, Wind, Temperature.

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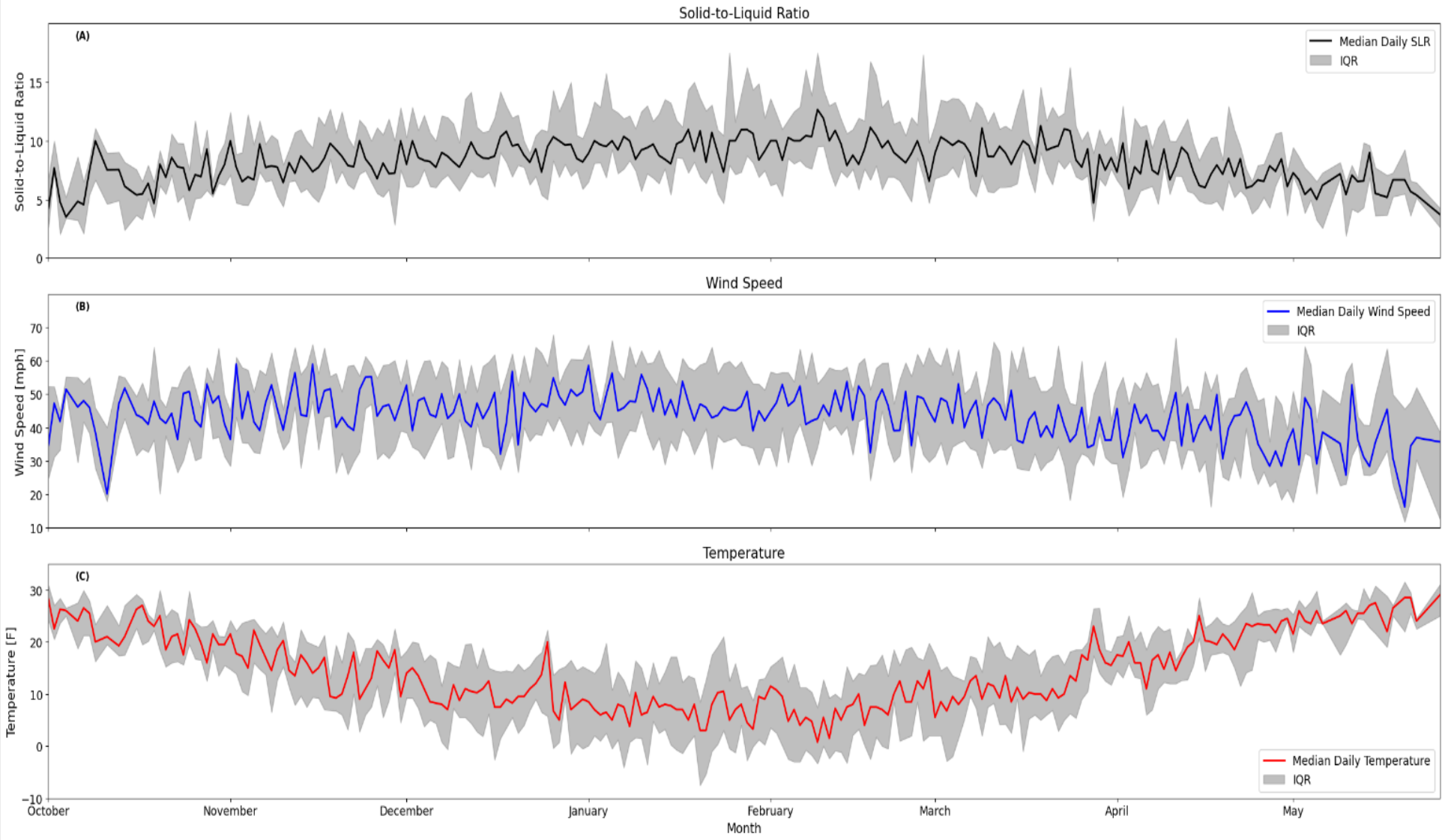

What we see

- SLR has a seasonal cycle through the snow year
- Temperature also has a seasonal cycle through the snow year. Wind does **not**

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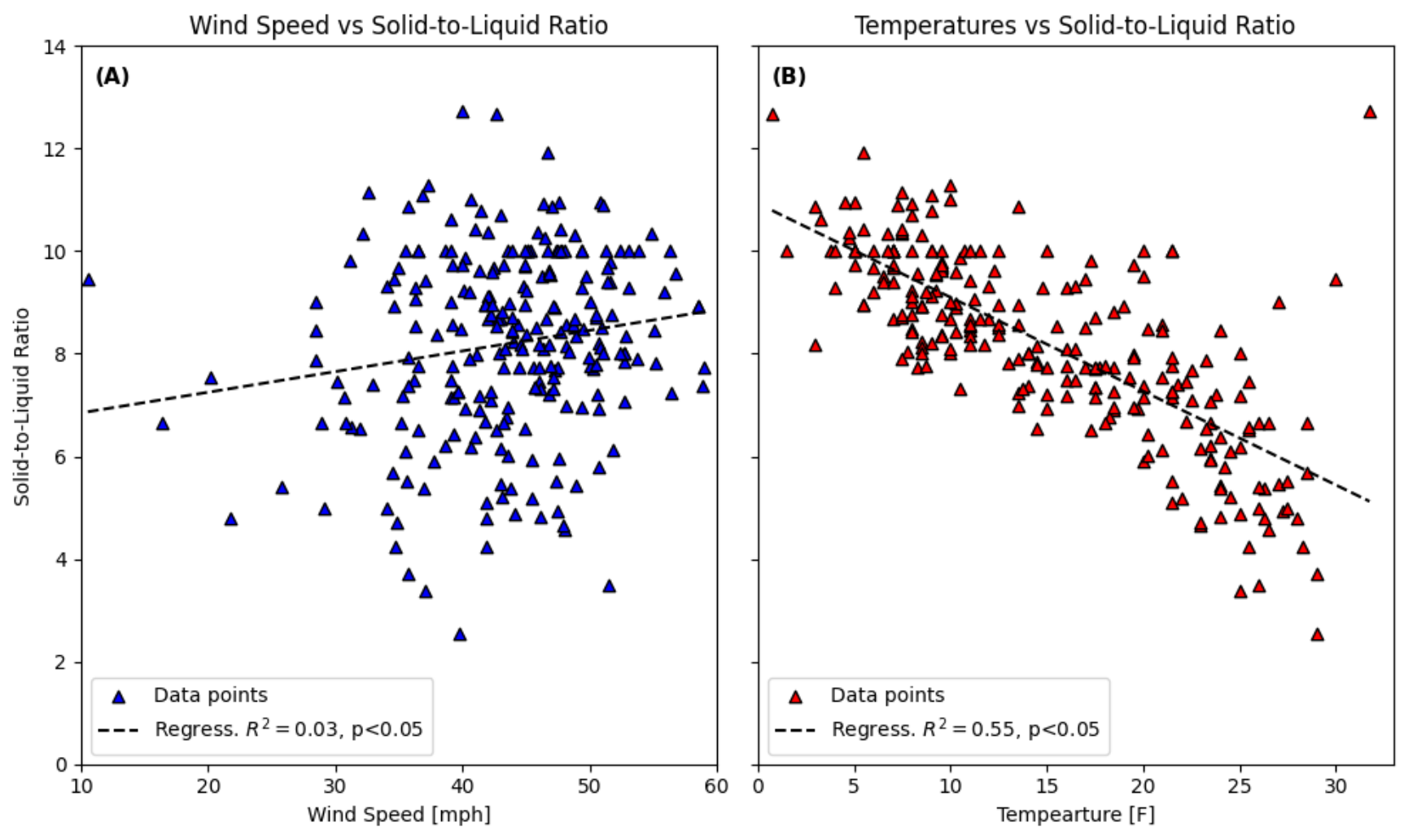

What we see

- SLR and Wind **are not** significantly correlated
- SLR and Temperature **are** significantly correlated

Variable	R-Square Value	P value < 0.05
Wind	0.03	False
Temperature	0.55	True

Table 2. Assessing the correlation between Solid-to-Liquid Ratio and variables wind and temperature. It was found that SLR does not correlate significantly with wind. It was found that SLR does correlate significantly with temperature.

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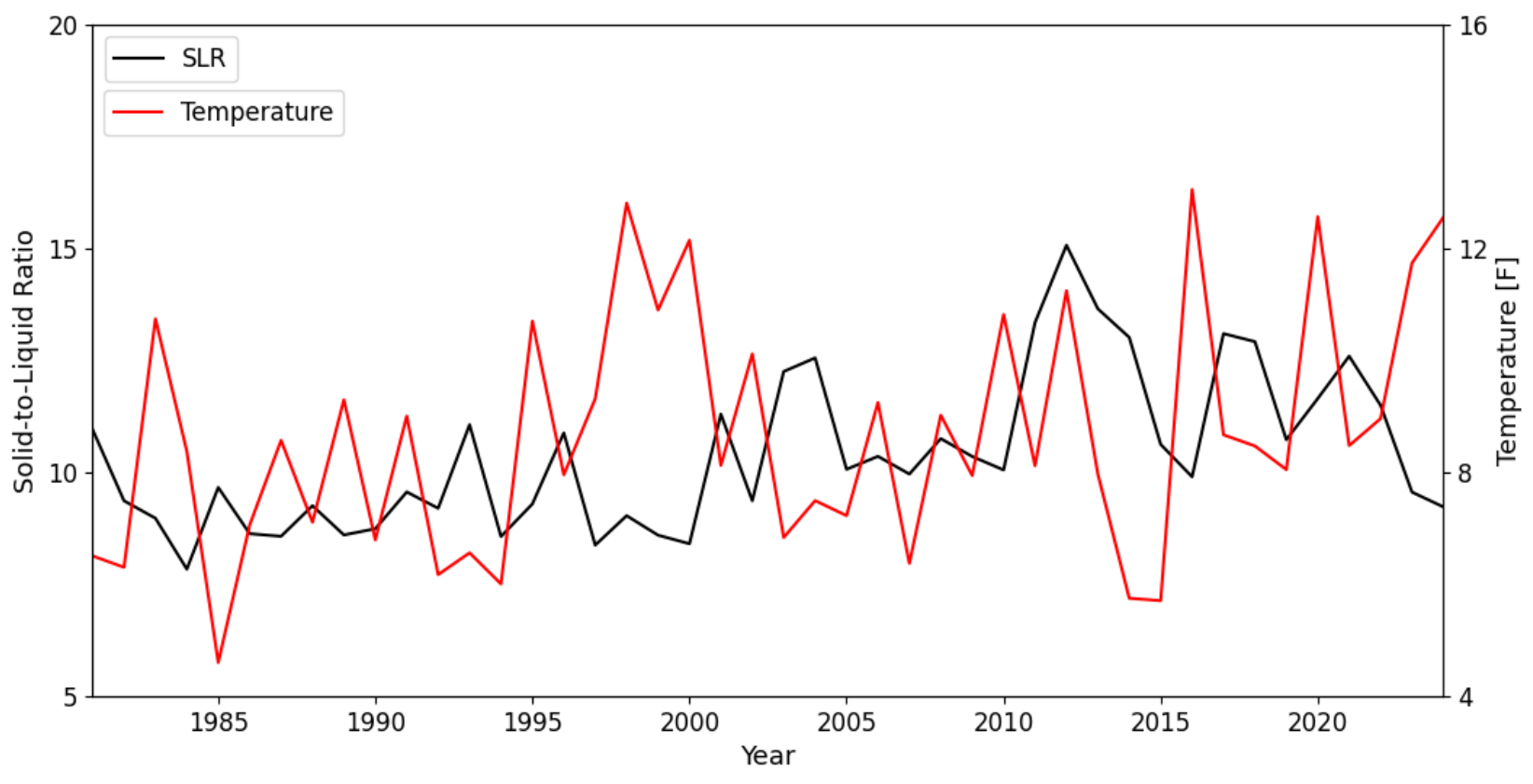

What we see

- **Both** Temperature and SLR have a significant increasing trendline over time
- Previous correlation is evident in annual basis. But not observed on an interannual basis.

Variable	Trend (dec^{-1})	R-Square
SLR	0.76 ± 0.17	0.32
Temperature	0.58 ± 0.24	0.121

Table 3. Trend line of SLR and Temperature with respect to time, for the period 1980-2024 only including median "Deep Winter" values across years.

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What we found

- SLR deviates from the 10:1 standard
- SLR varies seasonally
- SLR on the summit of Mount Washington is dependent on temperature on an annual basis
- Estimates are found to be generally representative of real observations

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What's next?

- Case study analysis, how do particular synoptic setups influence SLR.

- Differentiate solid precipitation/mixed precipitation from snow events

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Thank You!