Measurement Techniques for Soil Freezing Characteristic Curves

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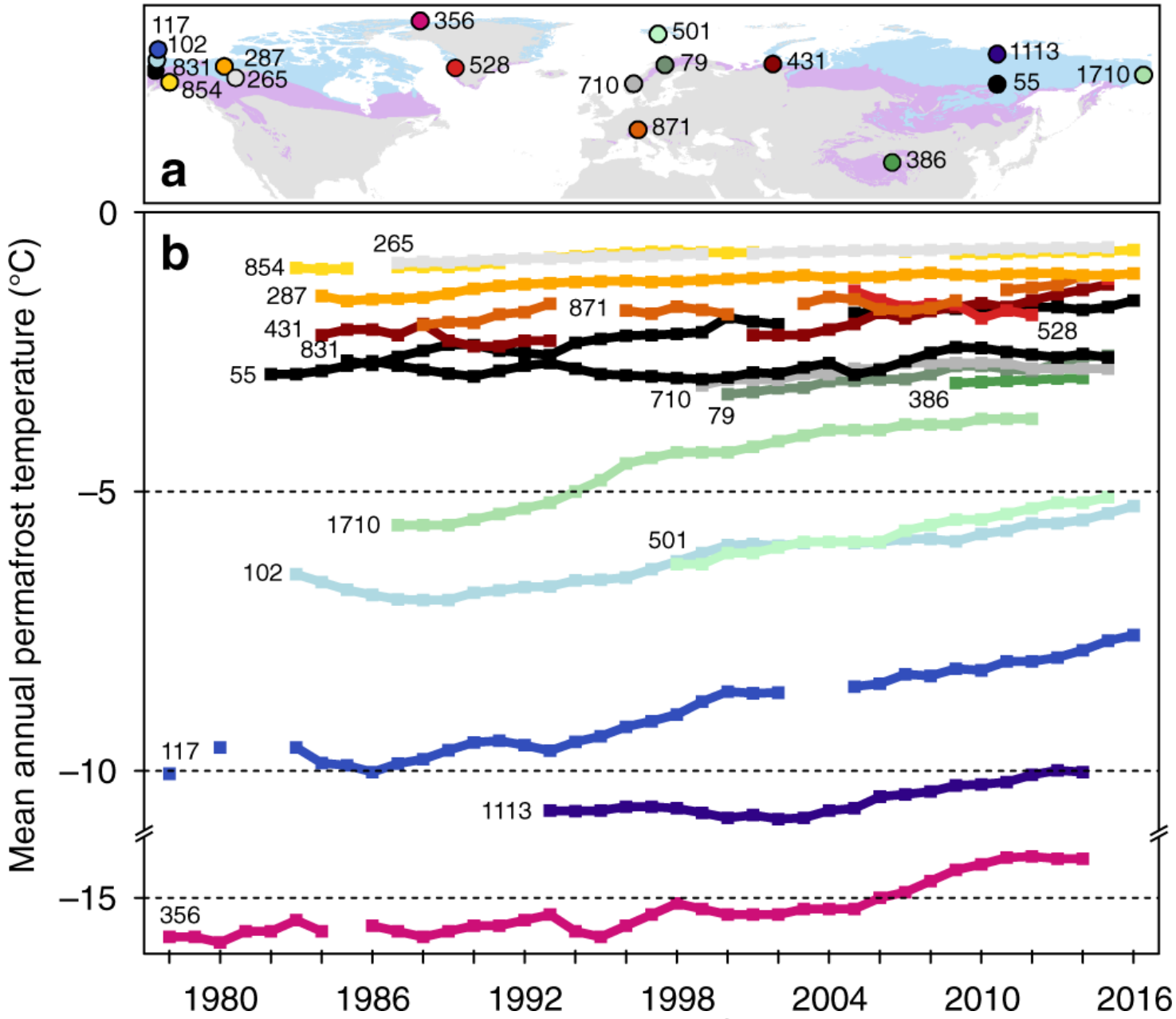
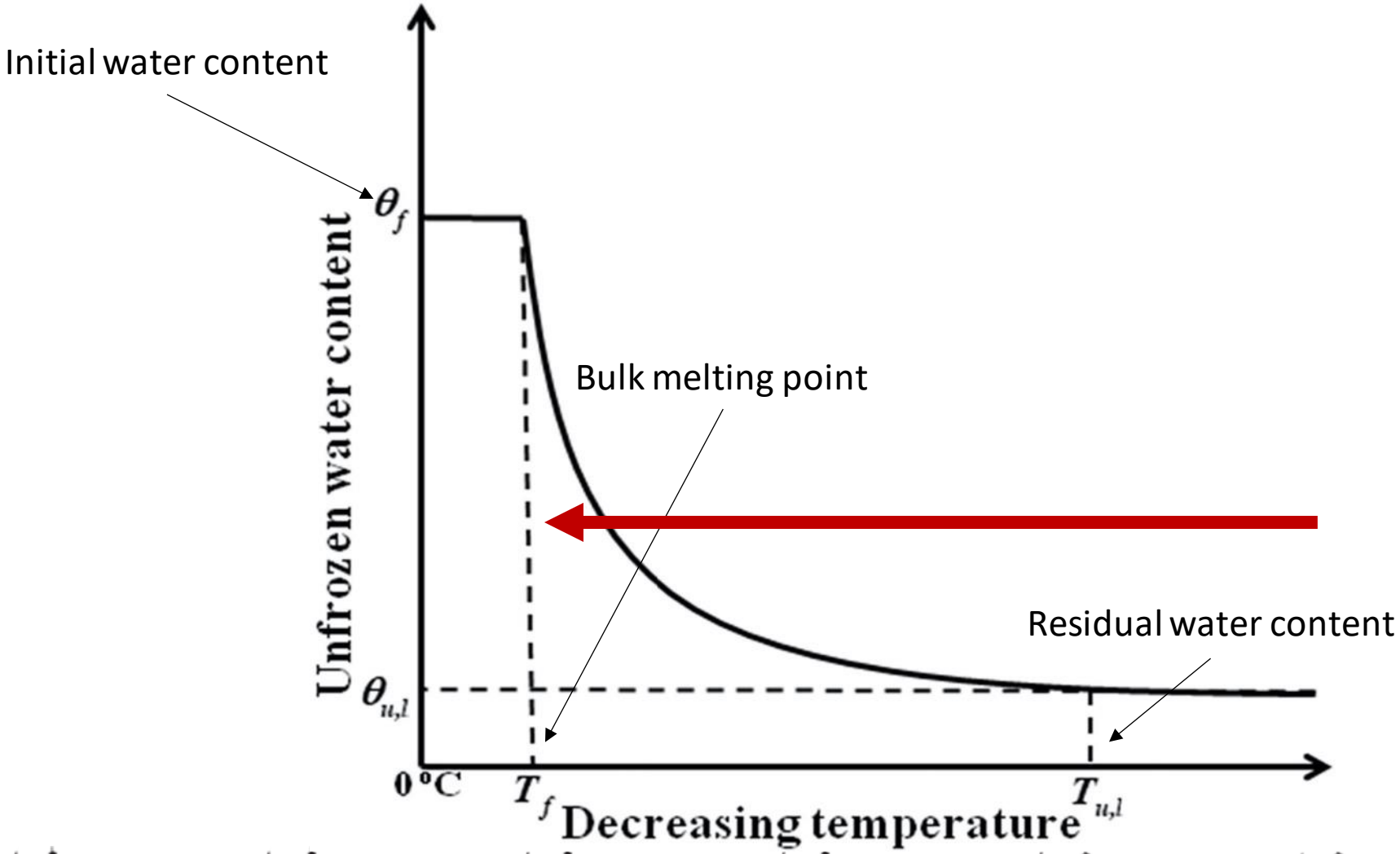
Permafrost is Warming

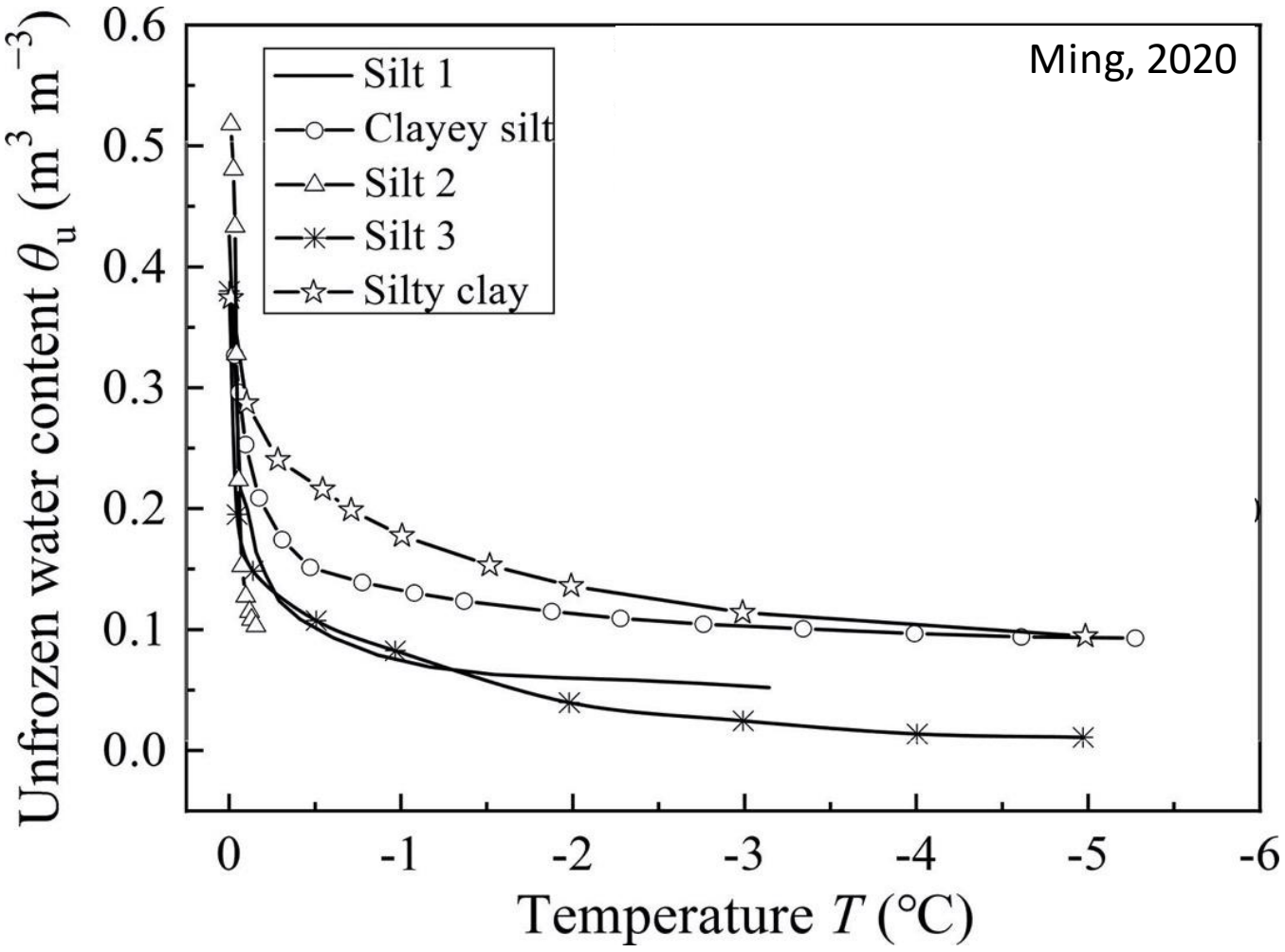
Biskaborn, Nature 2019.



Soil Freezing Characteristic Curves



Diversity in SFCCs

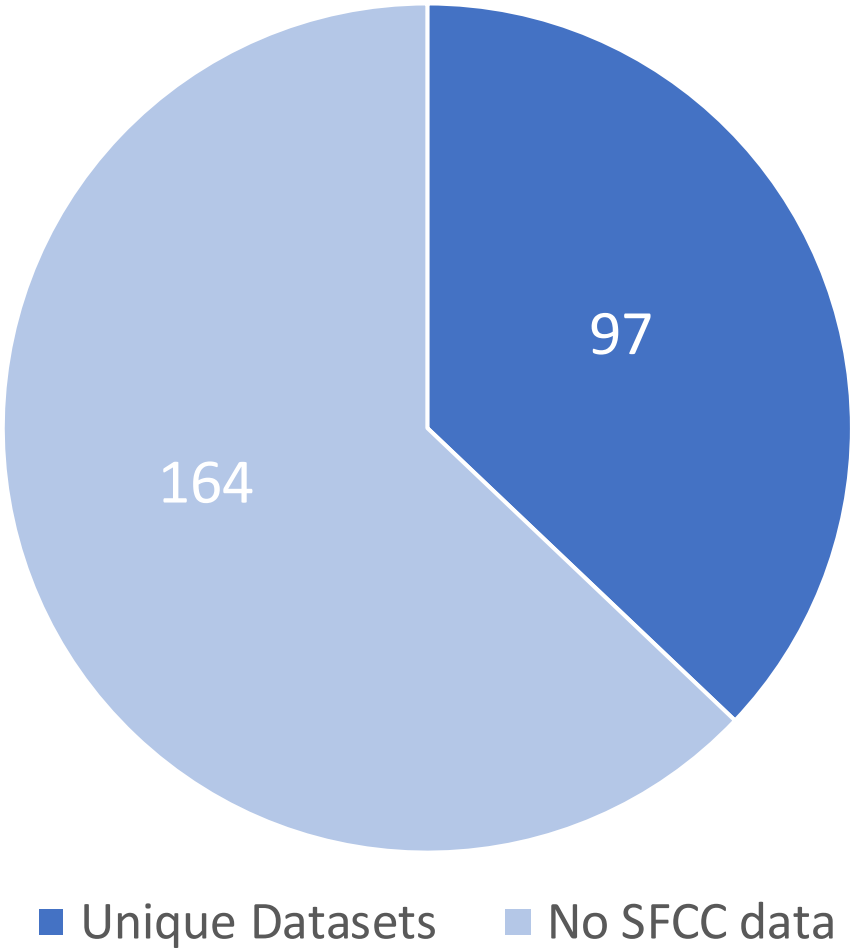


How do we estimate SFCCs?

- Empirical models need data for **the soil in question**
- Theoretical models need **detailed** soil **parameters**
- Not to mention **heterogeneity**!

How can we improve our approximations?

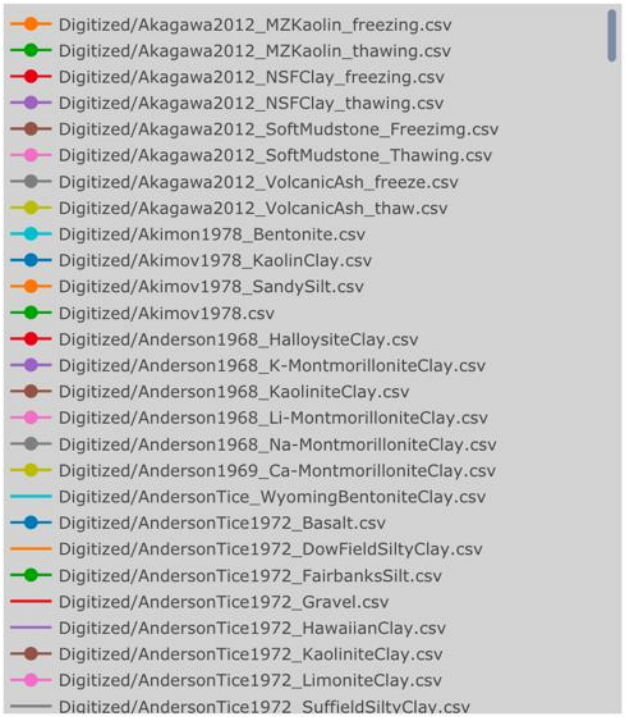
Literature Review

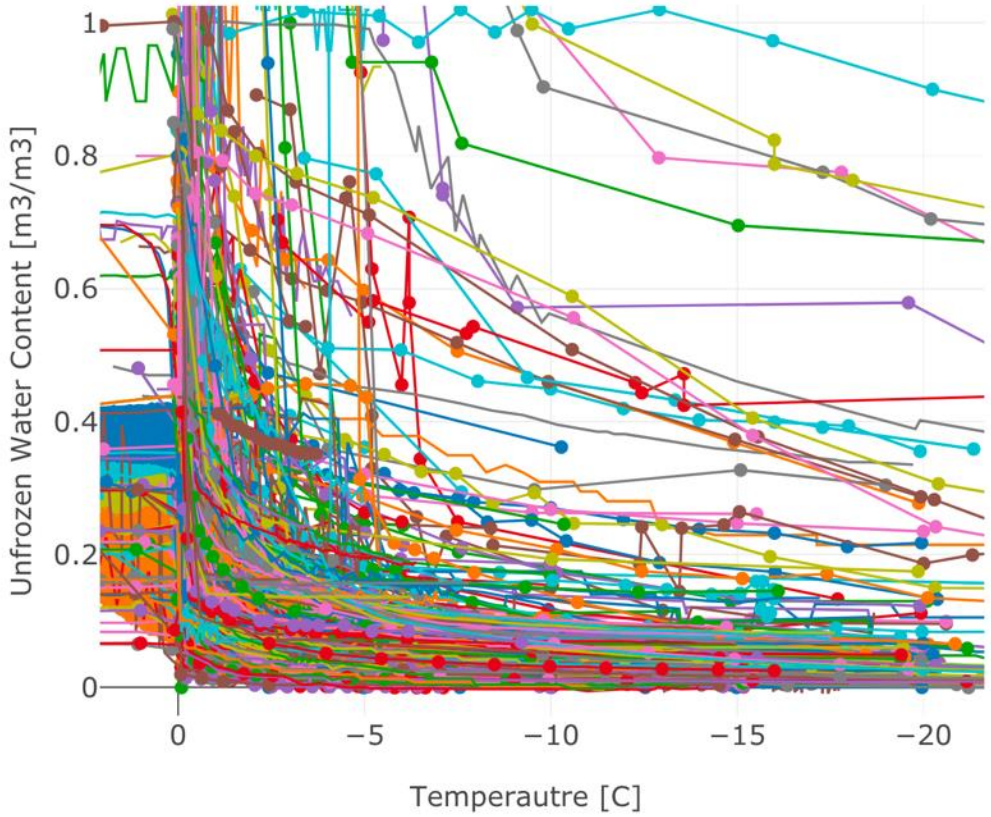


- 261 publications and counting
- 97 with unique measured datasets
- 416 unique data series digitized

... So far

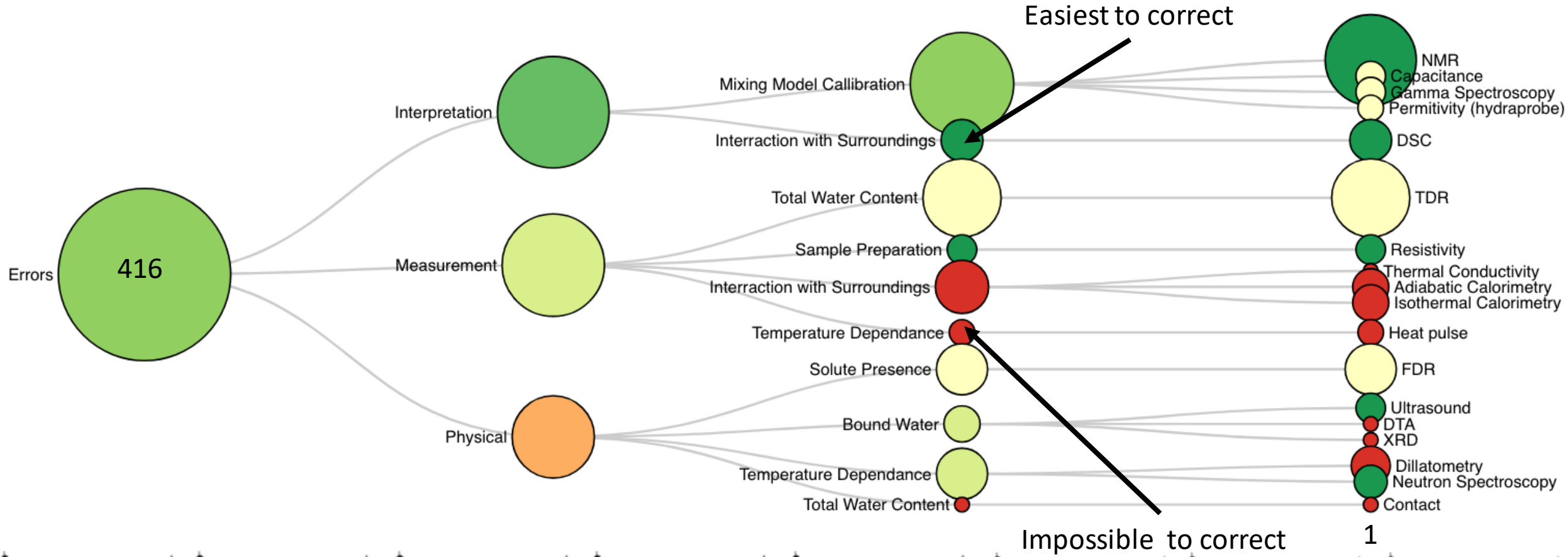
There is a lot of data …





… can we use it?

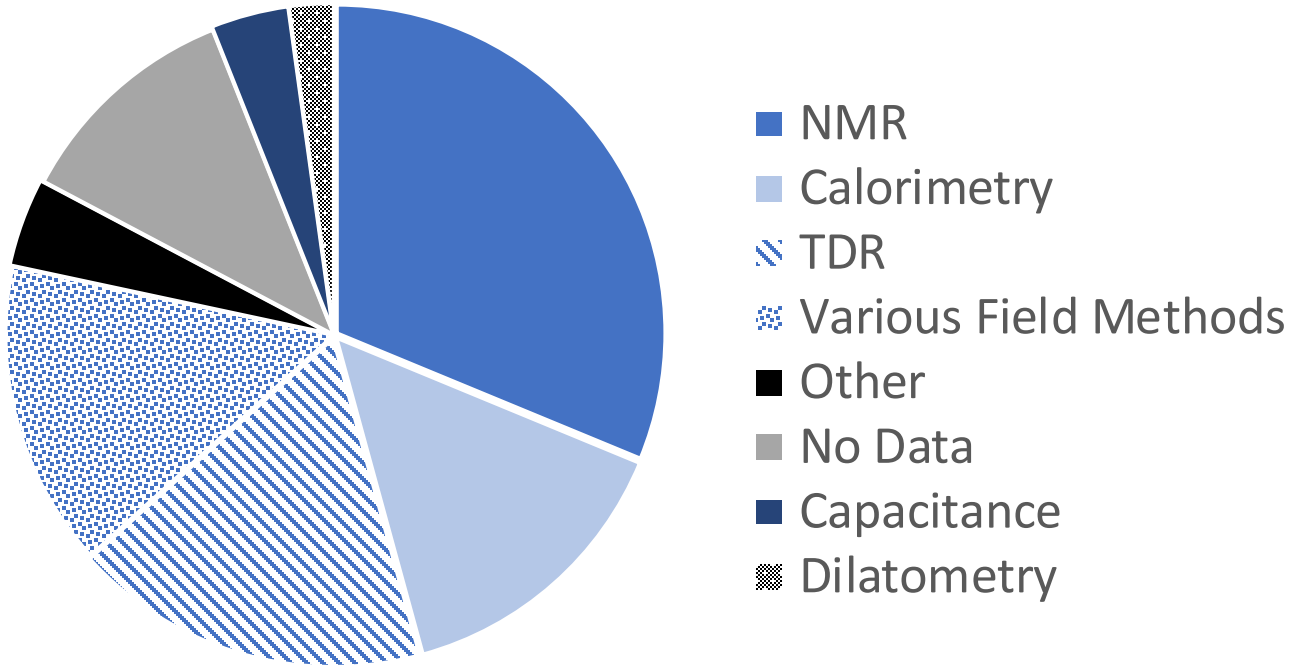
How confident are we in the measurements?



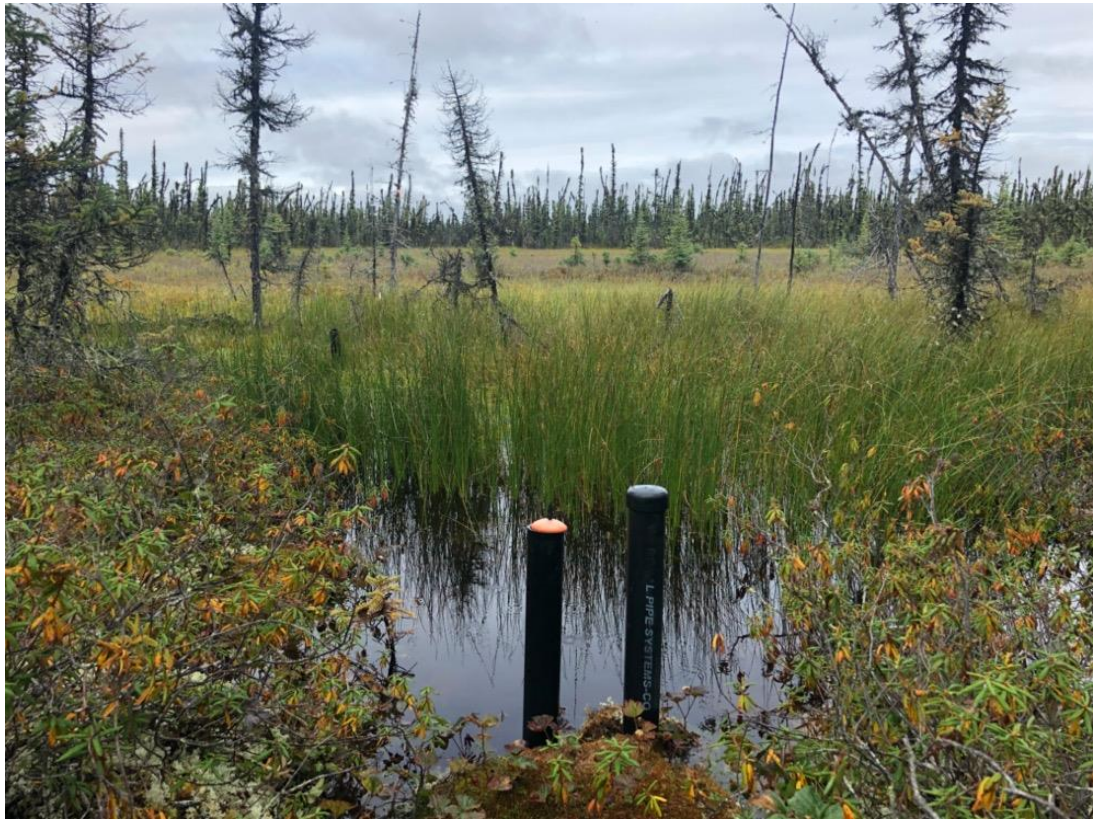
Data Compilation

Metadata:

- Measurement technique
- Sample preparation
- Soil texture
- Initial water content
- Freeze/thaw hysteresis



R Package – SFCCdb (coming soon)



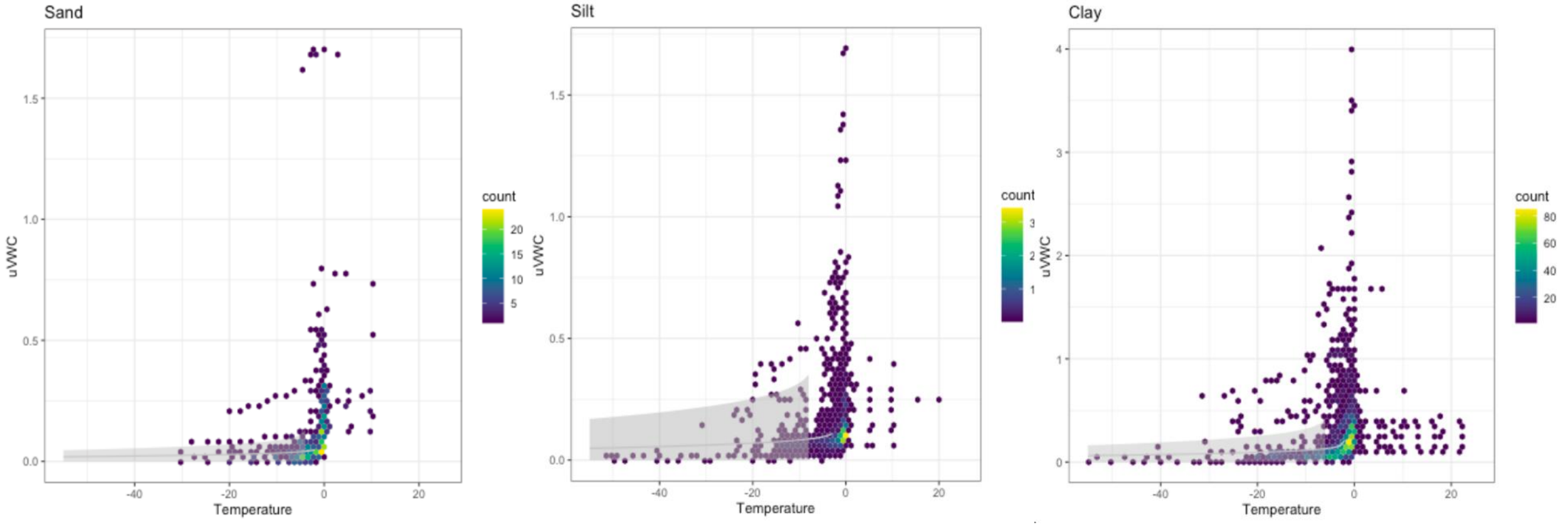
- Database of SFCCs
- Tools for SFCCs
  - Add
  - Find (given metadata)
  - Return data
  - Visualize

So What's the Use?

1. Data is transferrable
2. Estimate SFCC for specific soils

SFCC Type Curves

$$\theta_u = \bar{\theta}\left(1 - \left(\frac{T_f - T}{273.15 + T_f}\right)^{\beta}\right)$$



Hu *et al.* Geoderma 2020.

So What's the Use?

1. Data is transferrable
2. Estimate SFCC for specific soils
3. Points out global SFCC data gaps:
   - Coarse substrate
   - Estimating soil mixing models
4. Uncertainty Propagation
   - Modelling permafrost
   - SFCC sensitivity
   - Thaw below 0˚C

Open Access Archive Coming Soon!

1. **Do you have data to contribute?**
2. **What additional metadata is needed?**

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Thank you!

Dr. Oleksii Sherepenko, Dr. Julia Boike,
Dr. Gerald Flerchinger

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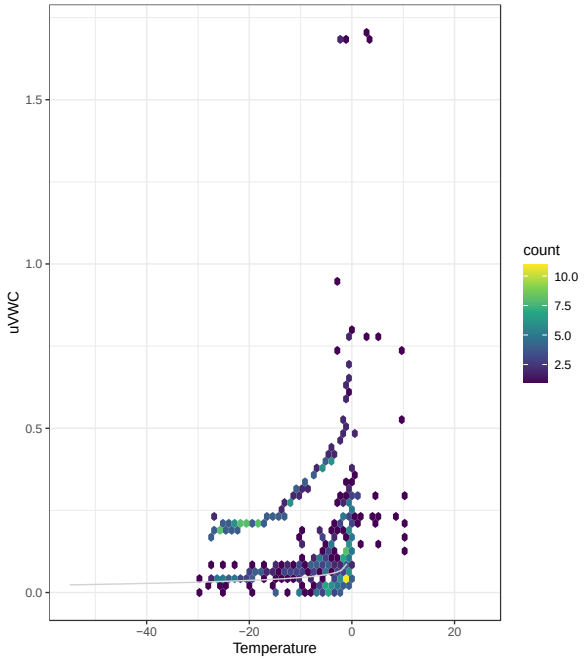
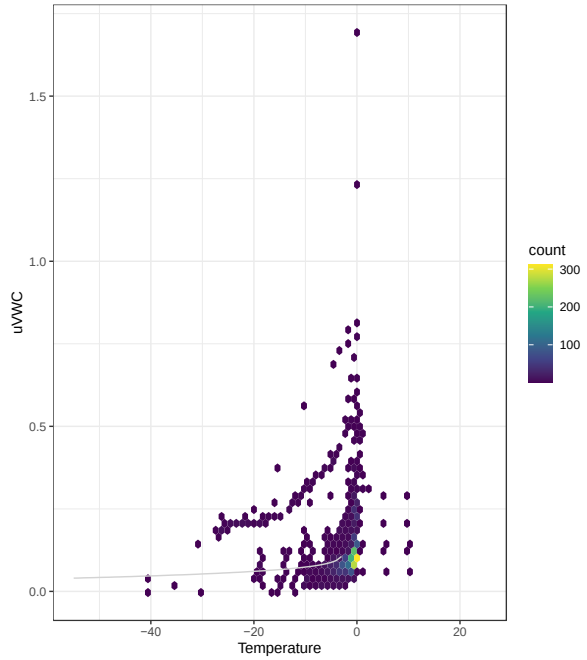
NSERC CRSNG

2021 Regional Conference on Permafrost
19th International Conference on Cold Regions Engineering

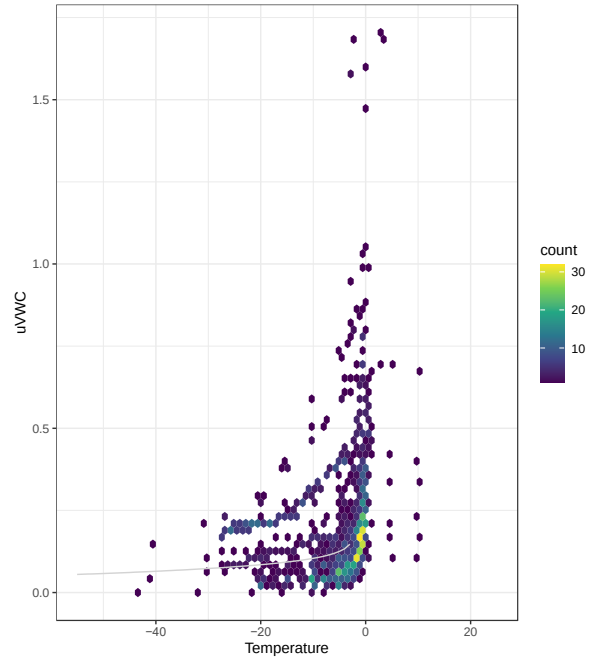
Sand − Thaw



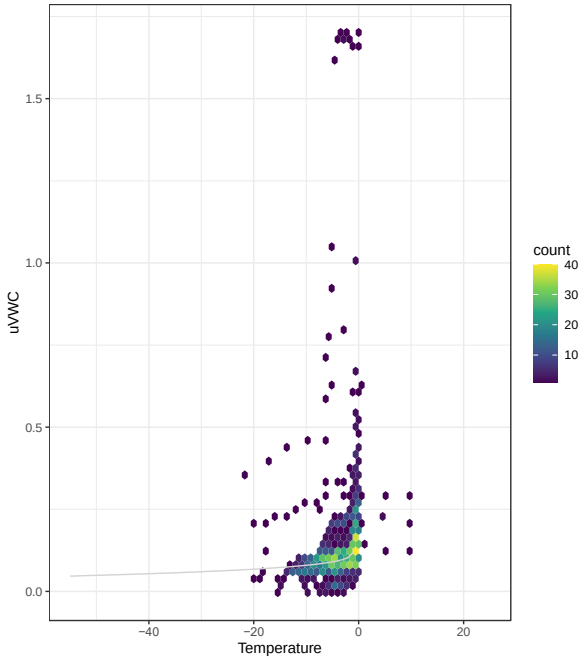
Silt − Thaw



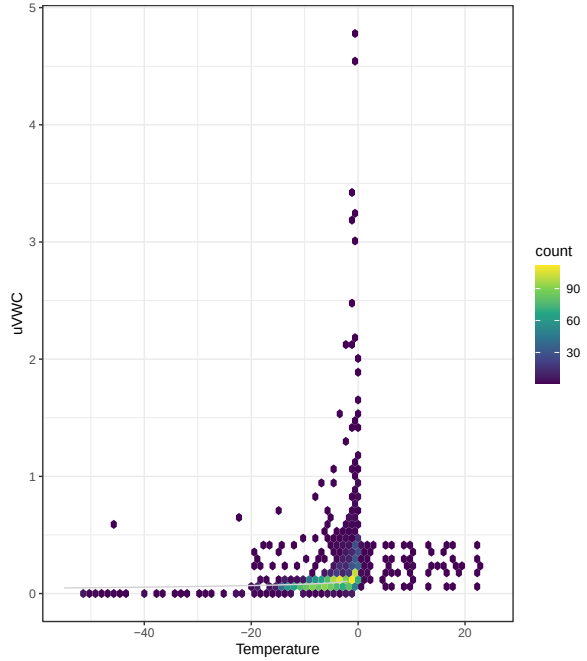
Clay − Thaw



Sand − Freeze



Silt − Freeze



Clay − Freeze