Adhesion of Sea Spray Ice

Microspray annual meeting

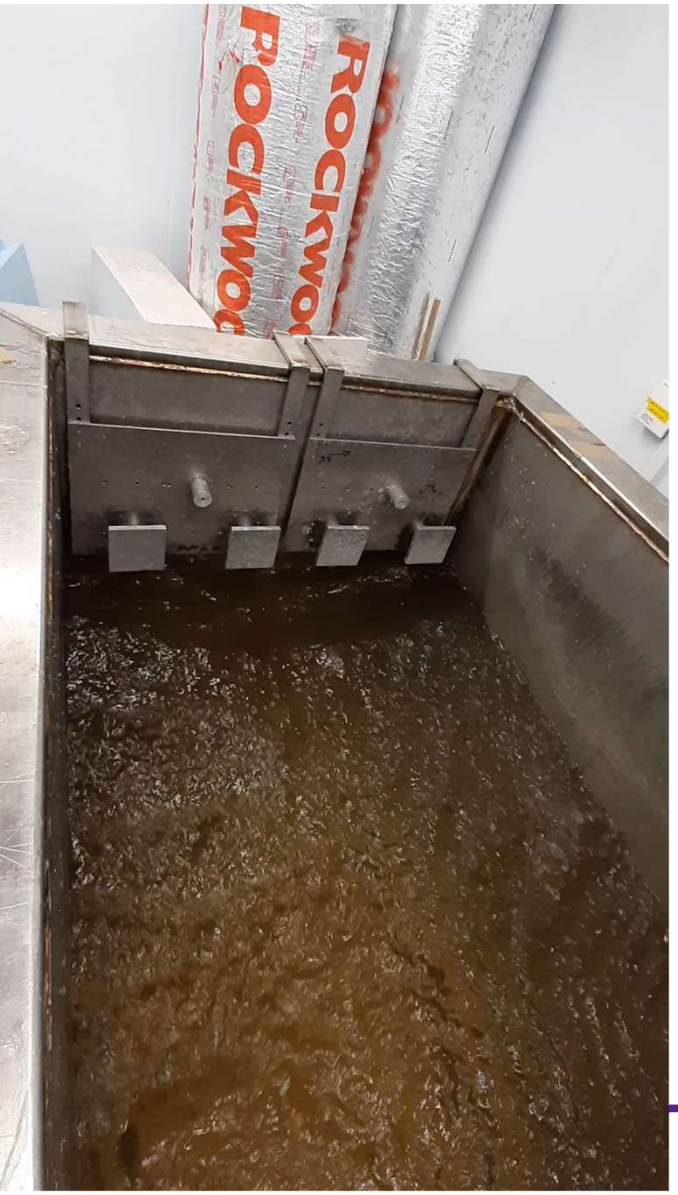
22nd of September 2022

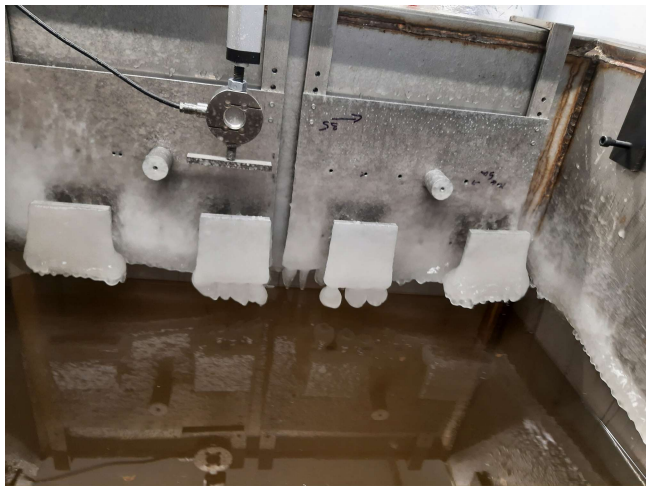
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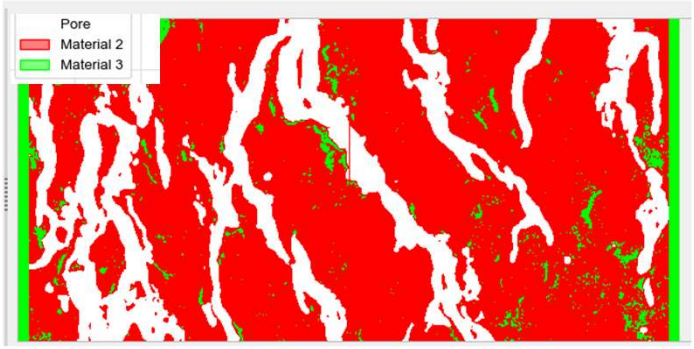
- Overview and Background
- Setup
- Challenges
- Results
- Plans





Growing ice from saline water

Measure the adhesion strength



(Determine the Microstructure)

Experimental Setup

- Stable sample mounting
- Two fans generate wind
  - Wind speed 12-15 m/s
- In tank adhesion setup
- Different sample sizes
  - 3cm, 6cm, 9cm, 12cm edge length
- Temperature measurement
  - IR-camera & thermoelements

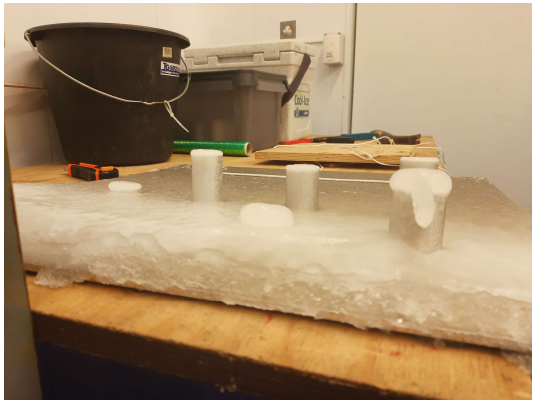




Challenges

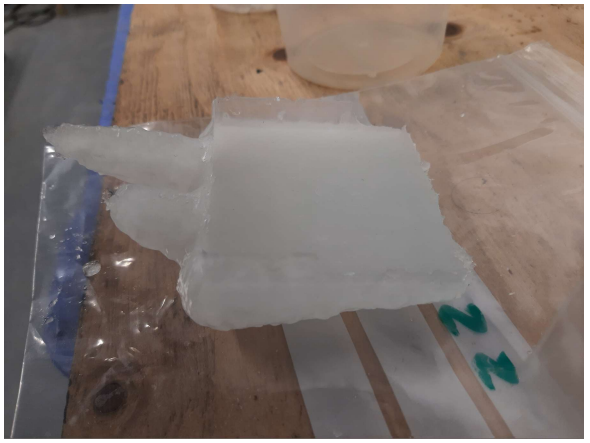
- Islab stability
  - The lab is repeatably out of order
  - Temperature raise during experiments occurs→ up to 10 °C
    - Temperature measurements during spray event
  - Problem increases with lower temperature
    - No -20 °C samples

Experimental results - Ice growth



- Growth conditions influence growth
- Sample position has noticeable impact
  - More ice closer to water surface
  - Thicker Ice at central sample positions





Experimental results - Ice growth

- 12 m/s windspeed and 85 cm water hight

  → 1 cm/h growth
- Higher windspeed

  →increases spray and waves
- Higher waterlevel

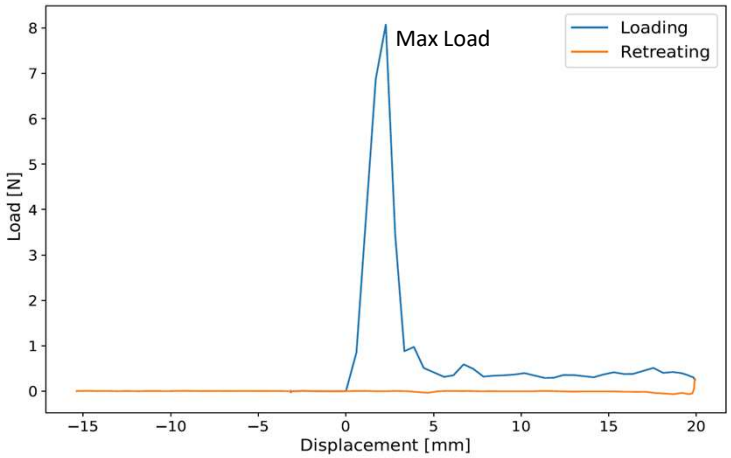
  →increases spray and waves

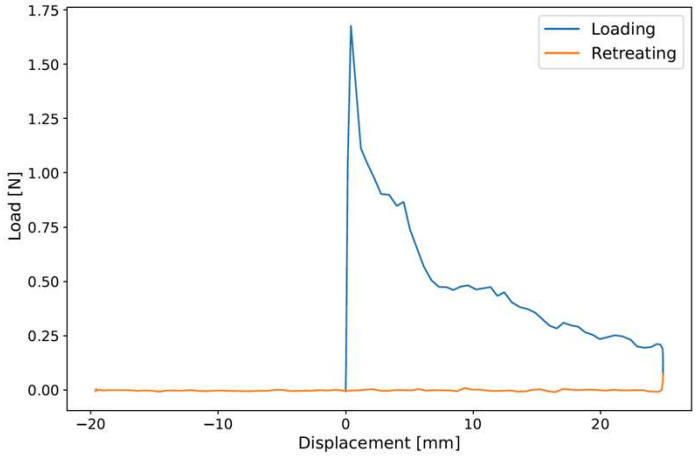


Adhesion results

- Ice adhesion setup gives Load displacement curves
- Allows to calculate adhesion strength

- Several aspects influence adhesion
  - Brine volume fraction
  - Growth conditions
  - Sample size

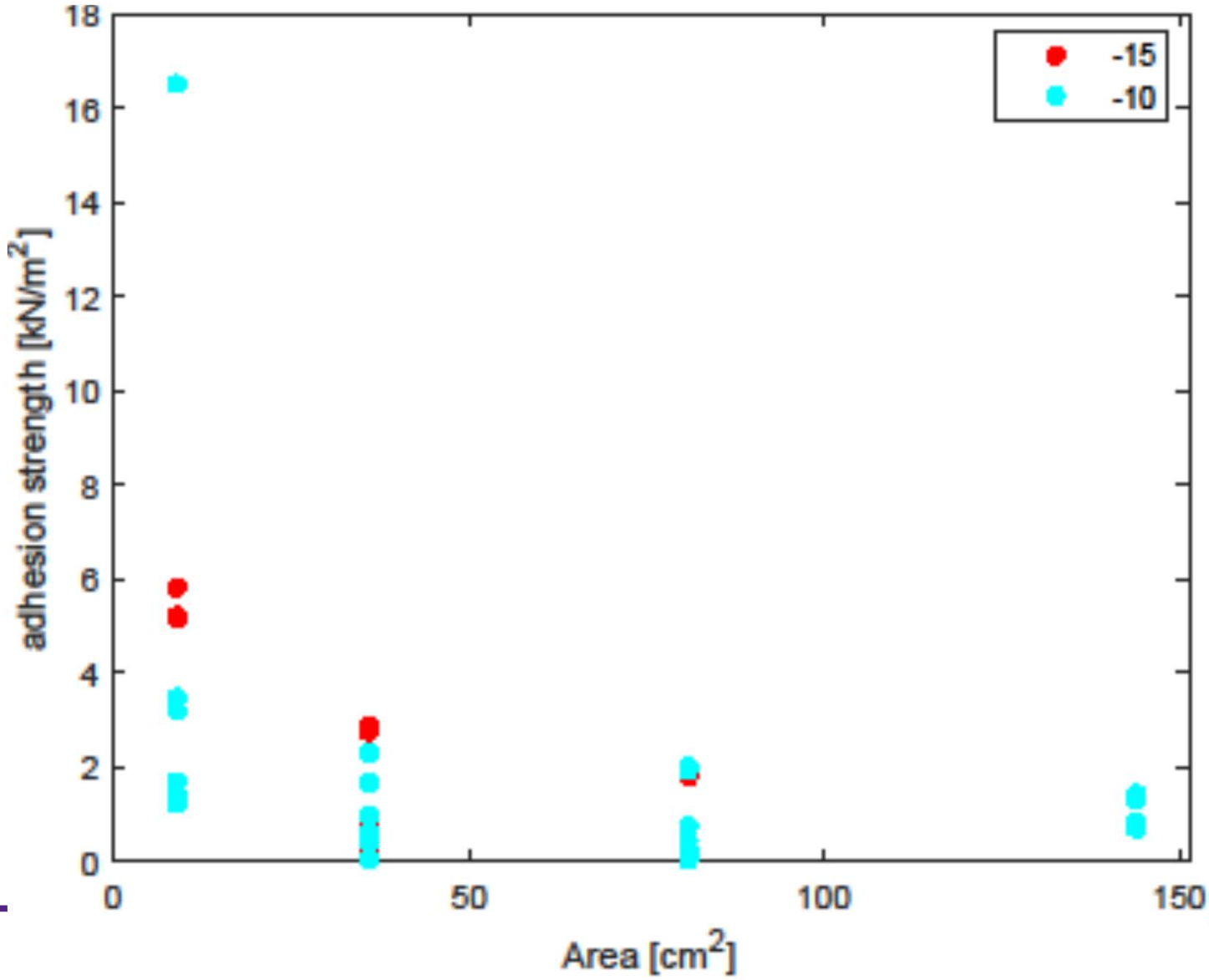




- Smaller sample

→ higher adhesion

→ higher variance



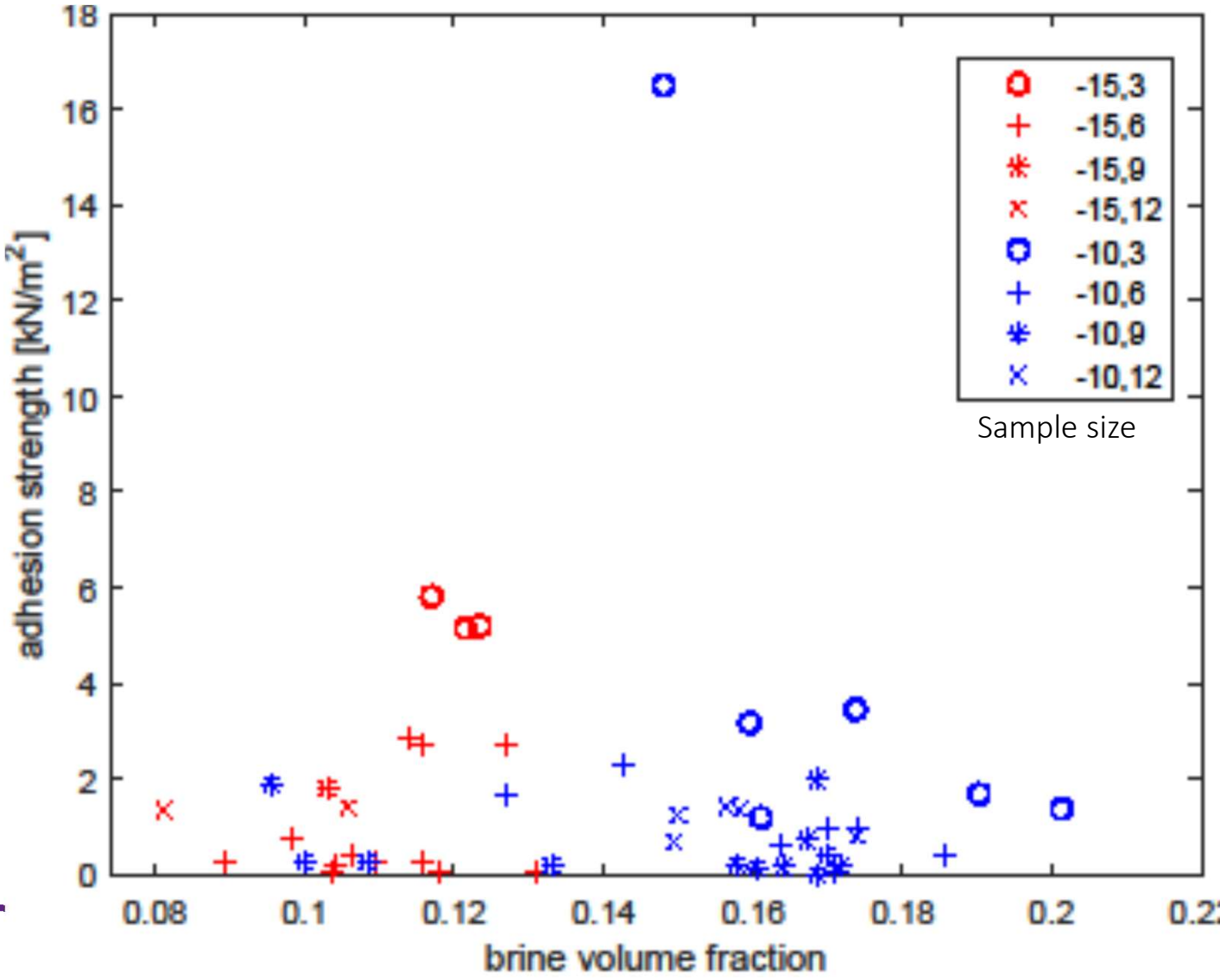
- Smaller sample

→ higher adhesion

→ higher variance

- Colder Temperature

→lower brine volume fraction



- Smaller sample

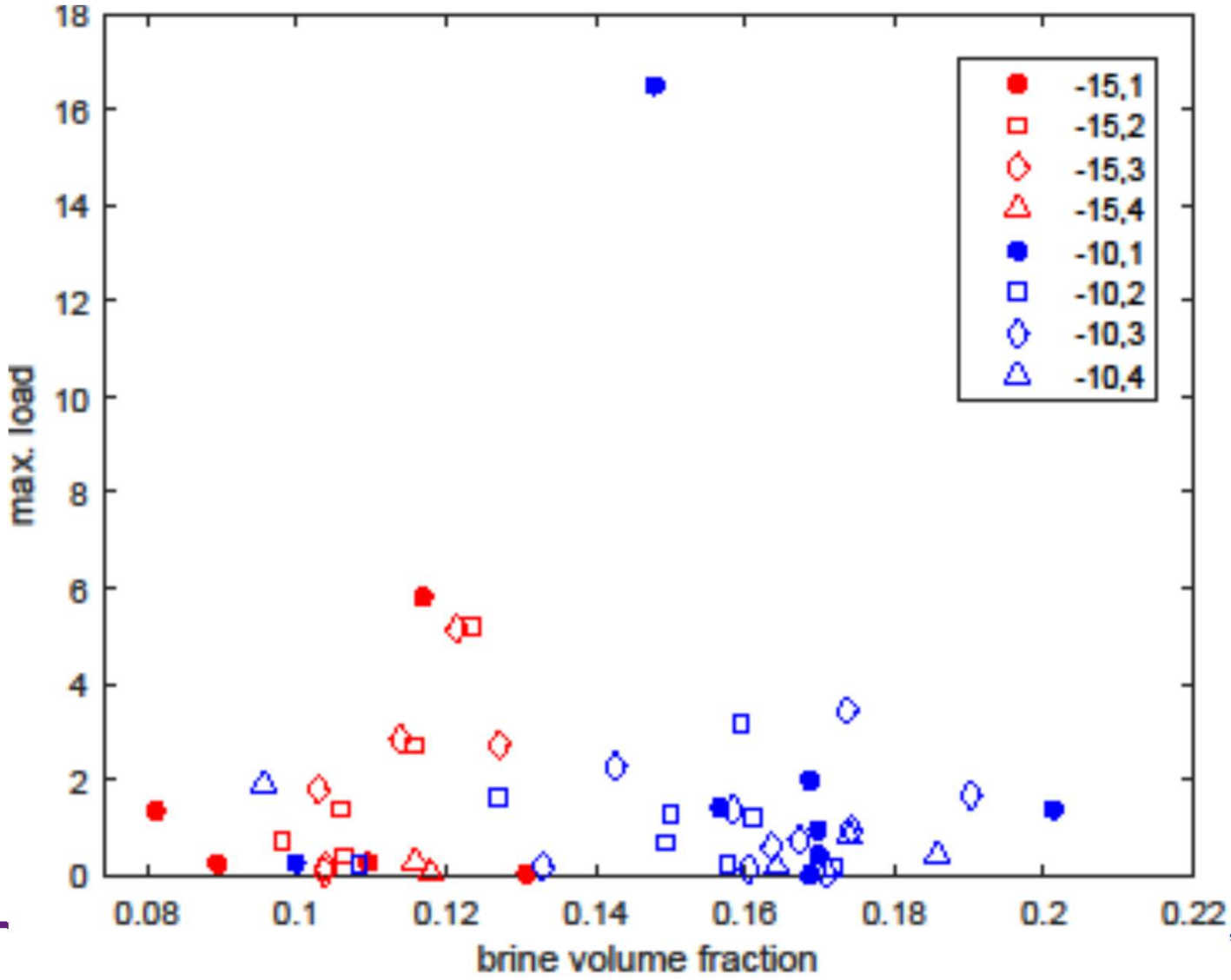
→ higher adhesion

→ higher variance

- Colder Temperature

→lower brine volume fraction

- No clear trend regarding sample position



Adhesion results

- Sea Spray adhesion strength is low
  - Freshwater adhesion ca 100 times stronger
- Adhesion overestimated for all samples
  - Icing on edges
- Highest adhesion strength for smallest sample size
  - Effect of edges larger
  - Less brine channels



Future plans

Alternative Setup:

- More adhesion data with setup in cooling box
  - 1-2 temperatures
  - Only one sample size
  - Setup is not completed yet

Field work:

- “GoNorth” cruise on Kronprins Haakon in October/November
  - 3 weeks
  - Icing conditions likely, but not guaranteed