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Arctic and Antarctic sea ice freeboard from SARAL/AltiKa

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- Freeboard comparison between AltiKa CryoSat-2
  (Arctic and Antarctic)
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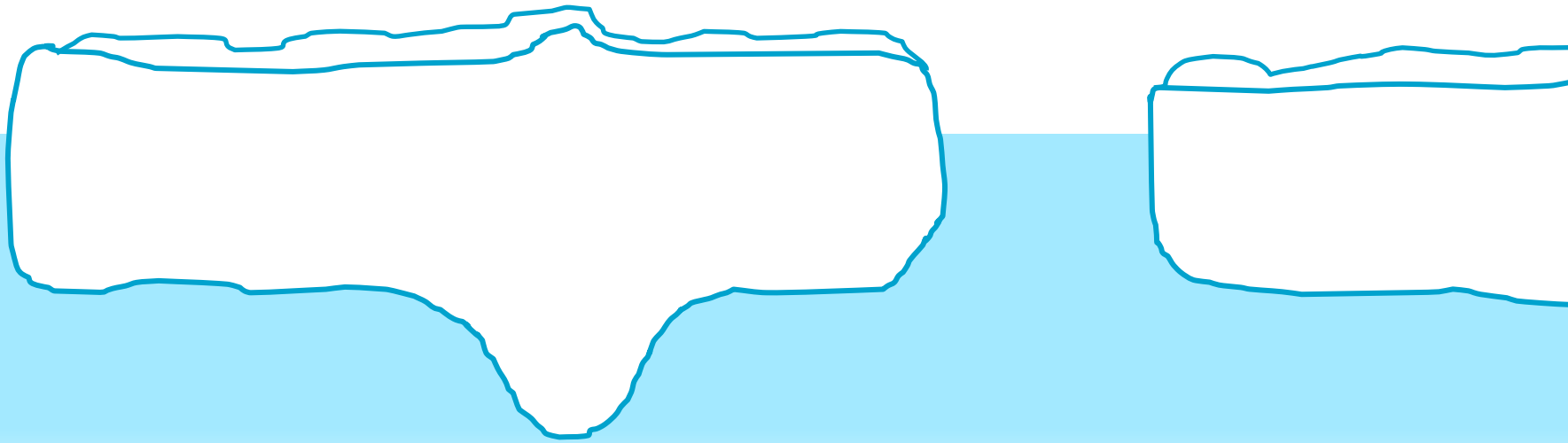
Sea ice freeboard

- Use elevation of leads for sea surface height
- Interpolate underneath ice floes
- Freeboard is elevation of floe above local SSH
  - Derive thickness from hydrostatic balance



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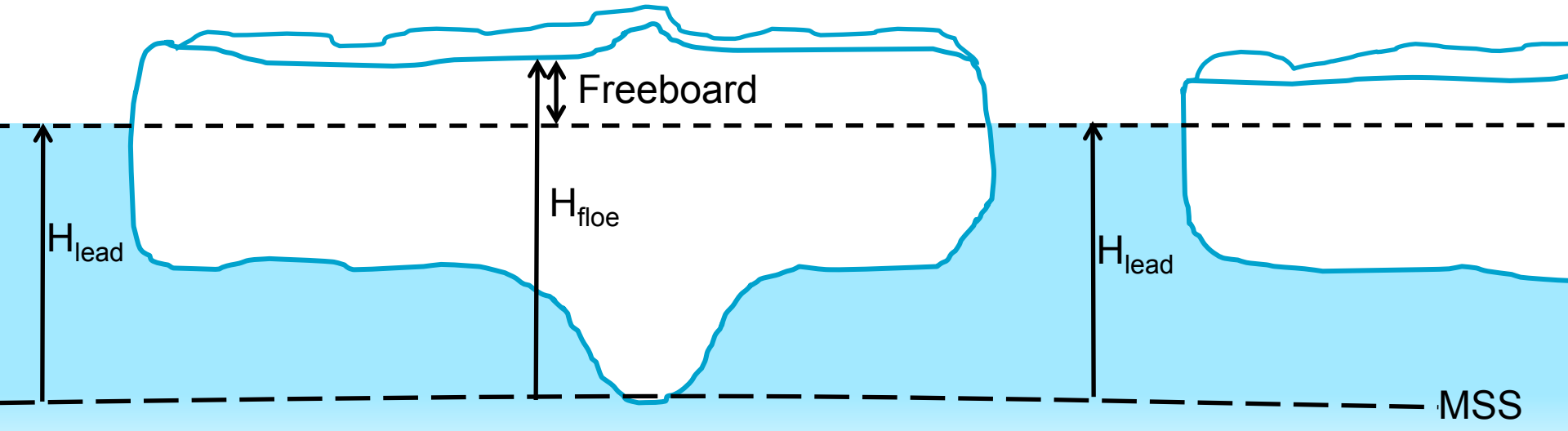

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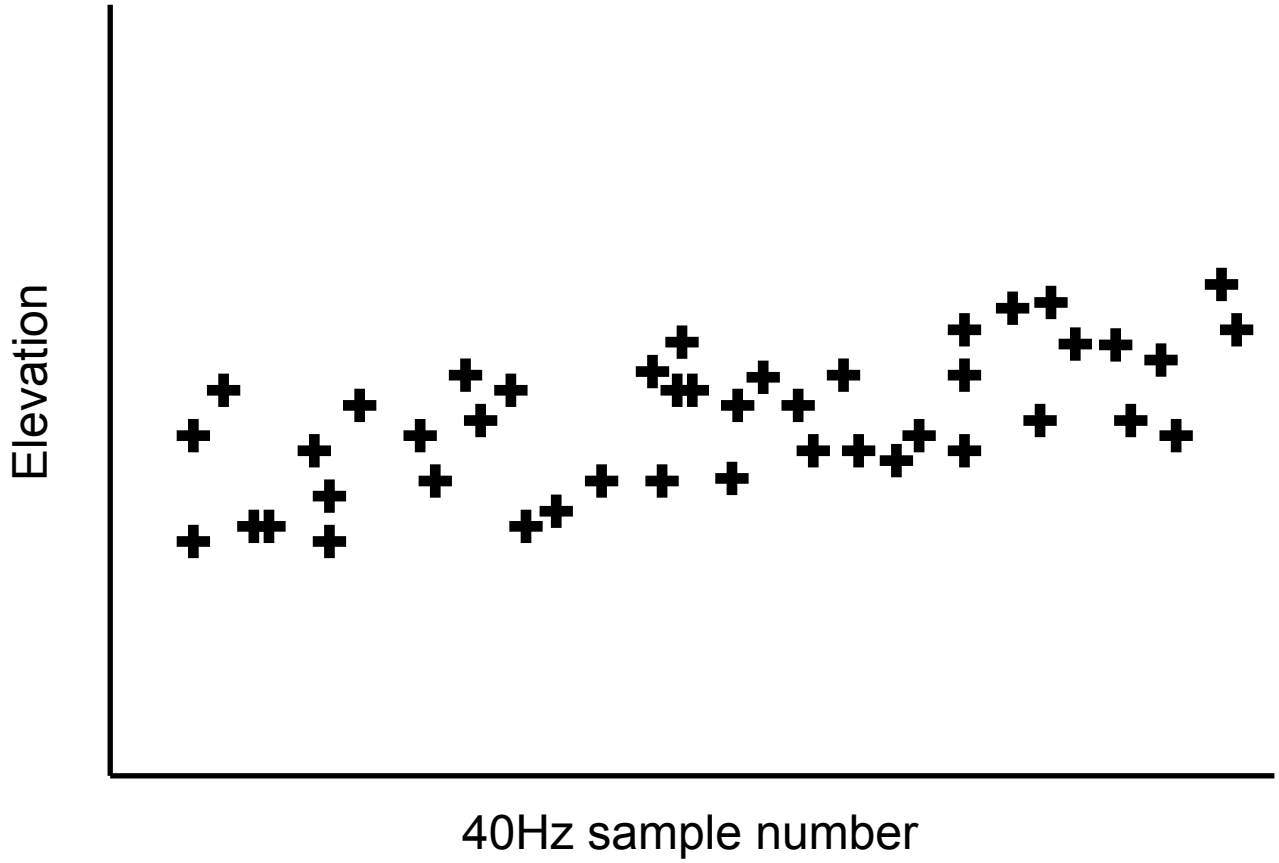
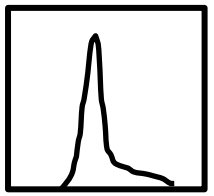
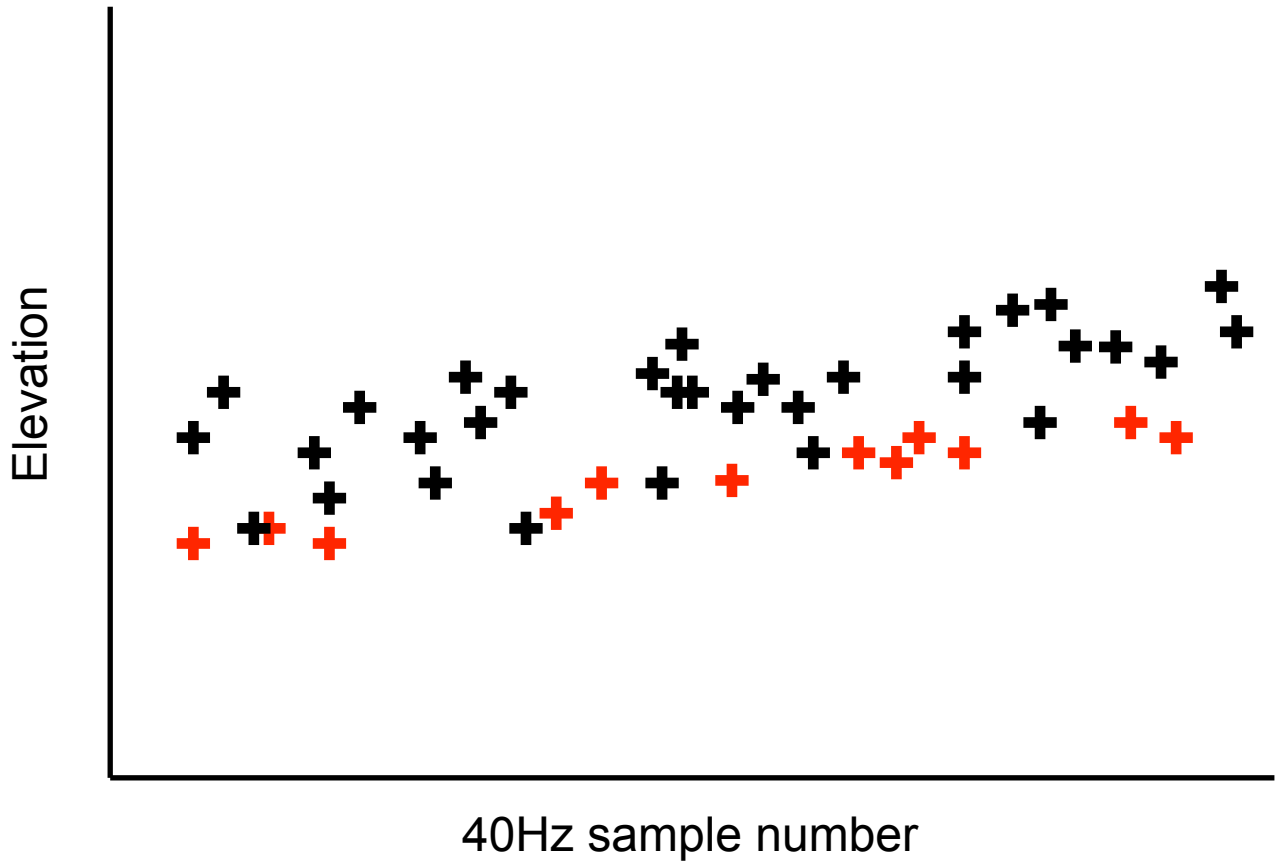


Sea ice freeboard

Leads





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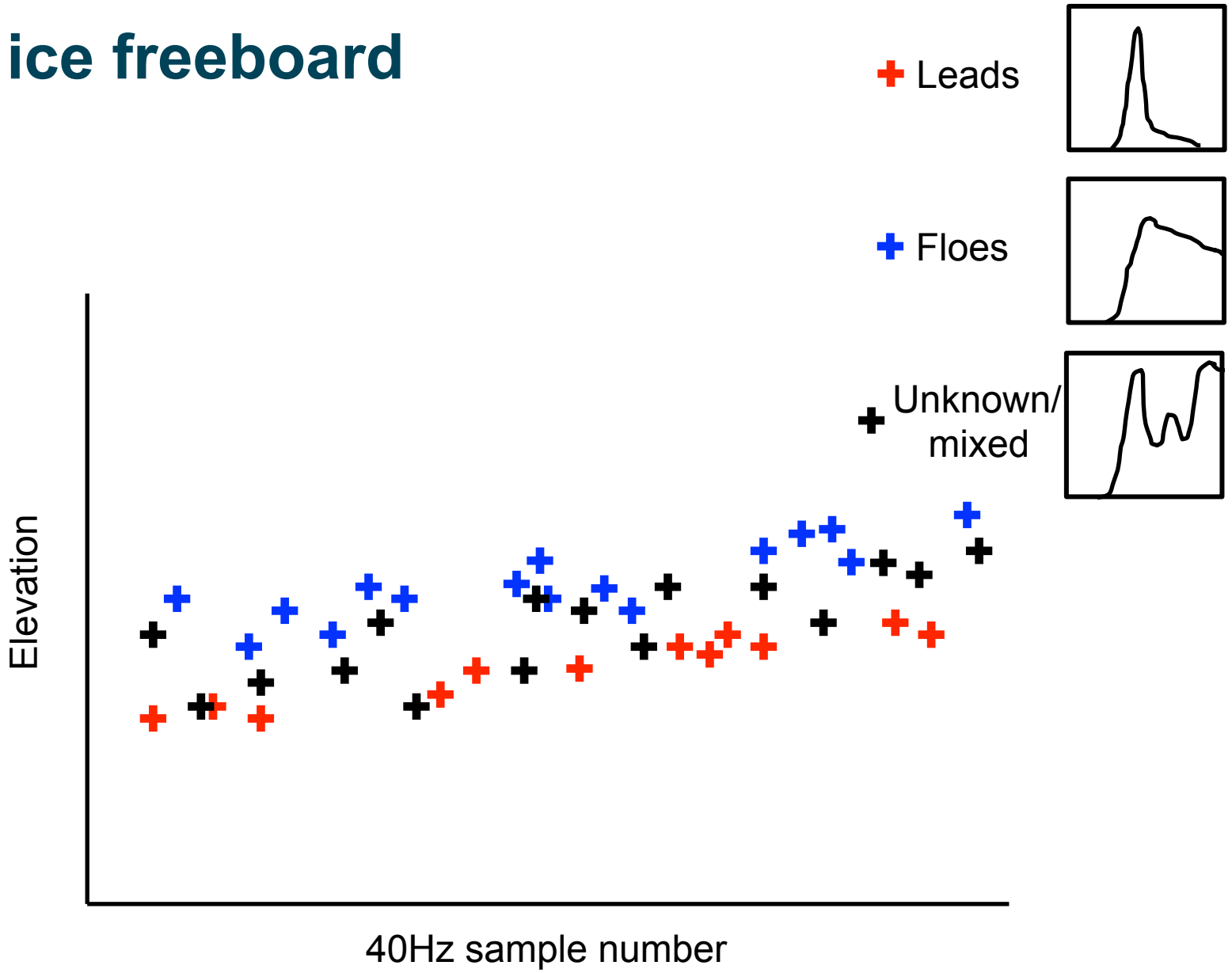

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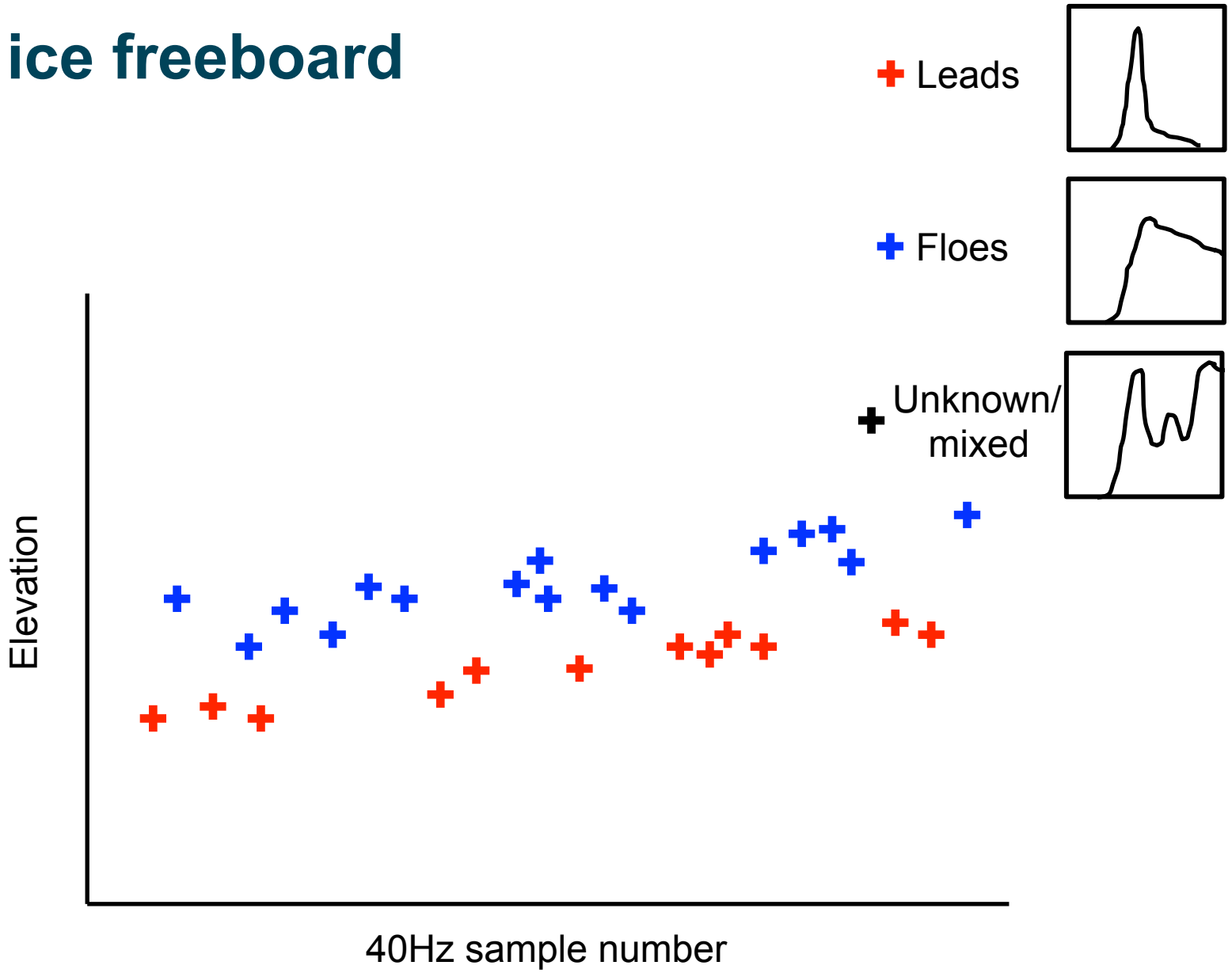

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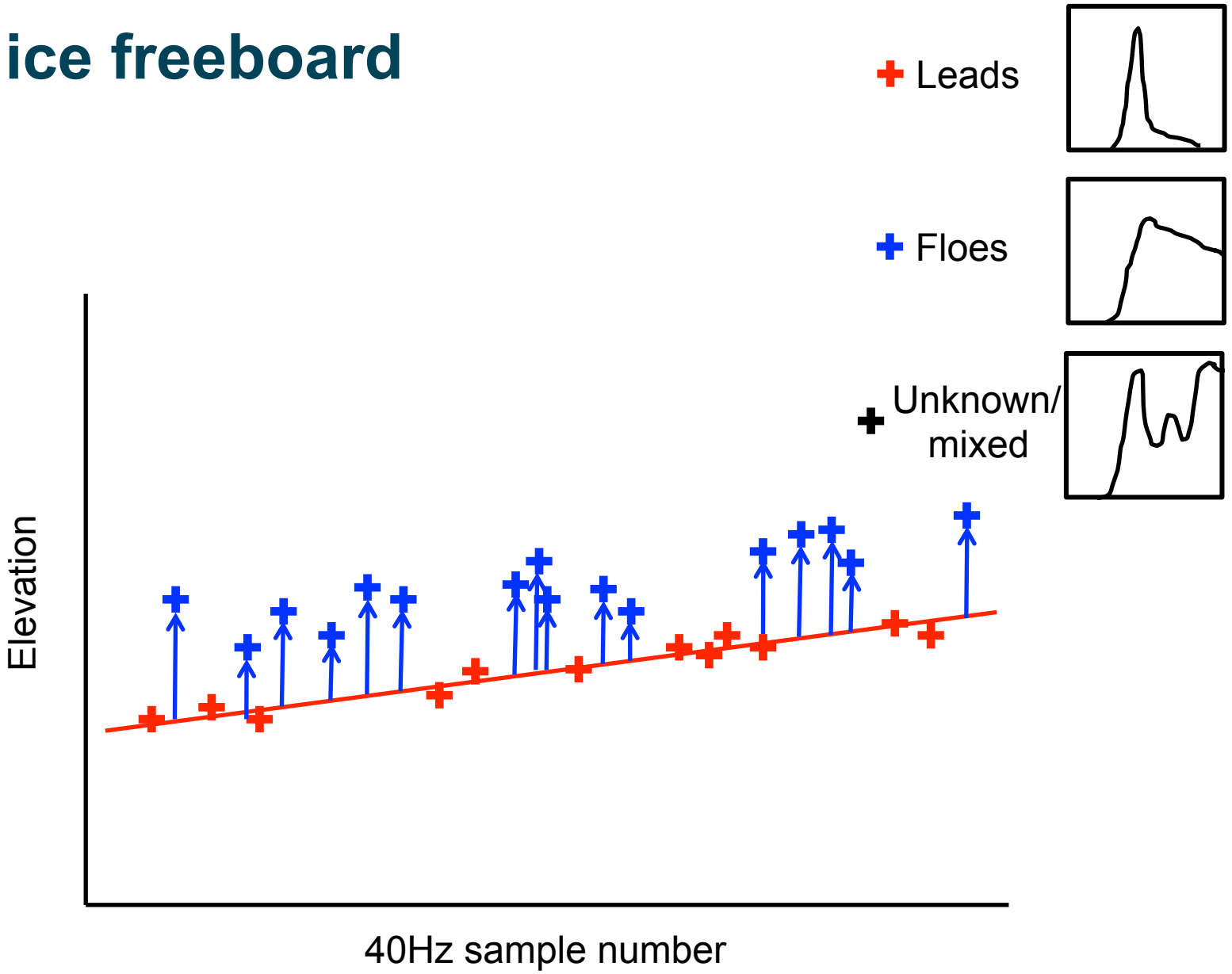
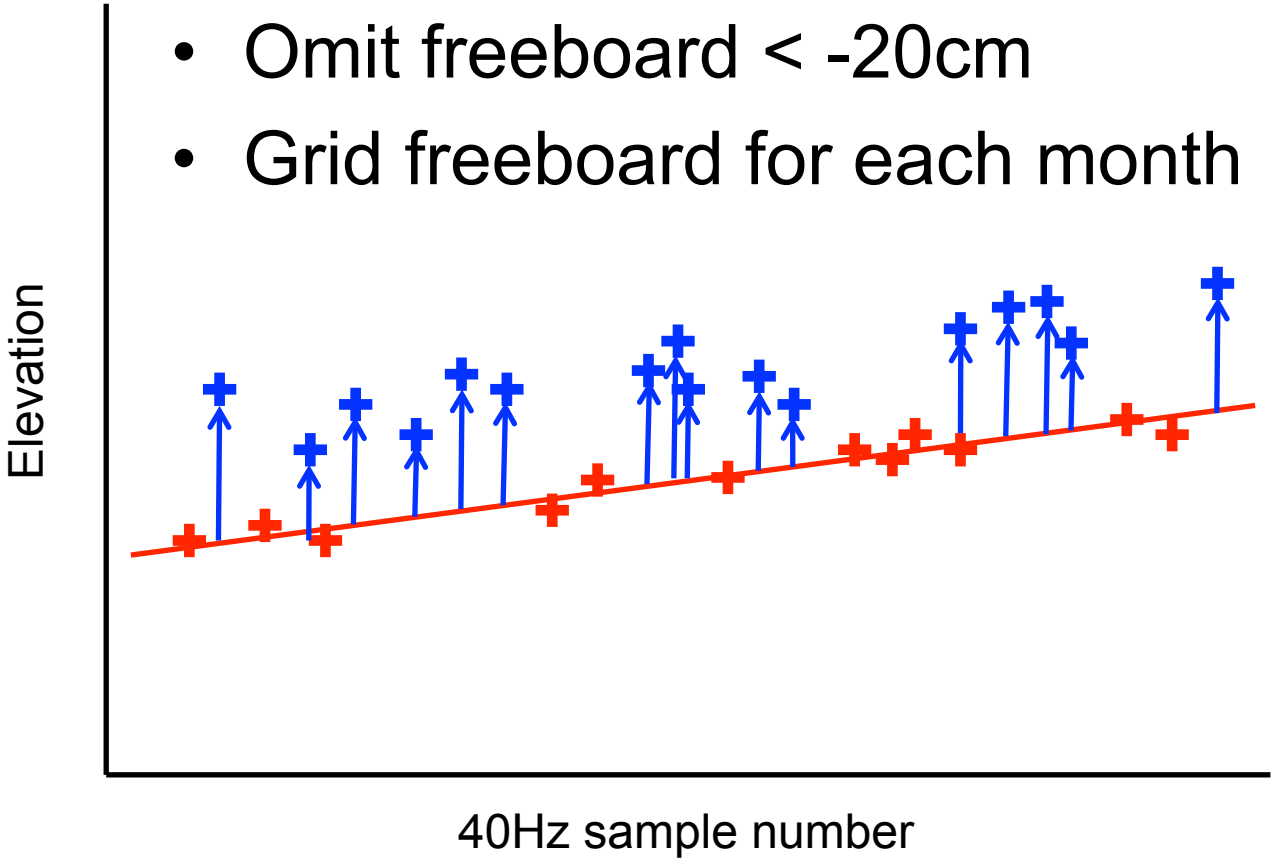
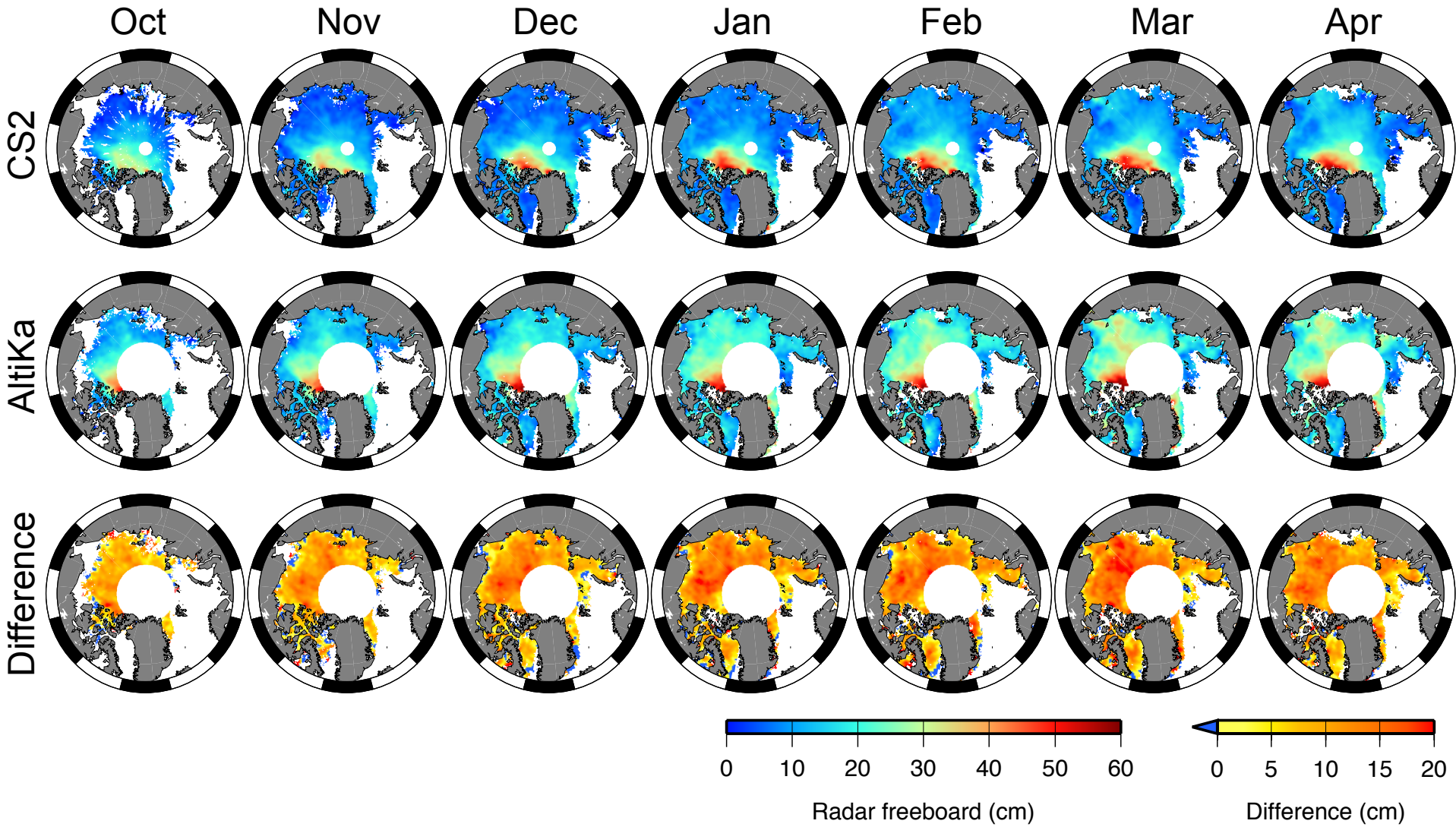


Sea ice freeboard

- Filter by ice concentration
  - Only ice conc > 75%
- Omit freeboard < -20cm
- Grid freeboard for each month



Comparison: AltiKa vs. CryoSat-2



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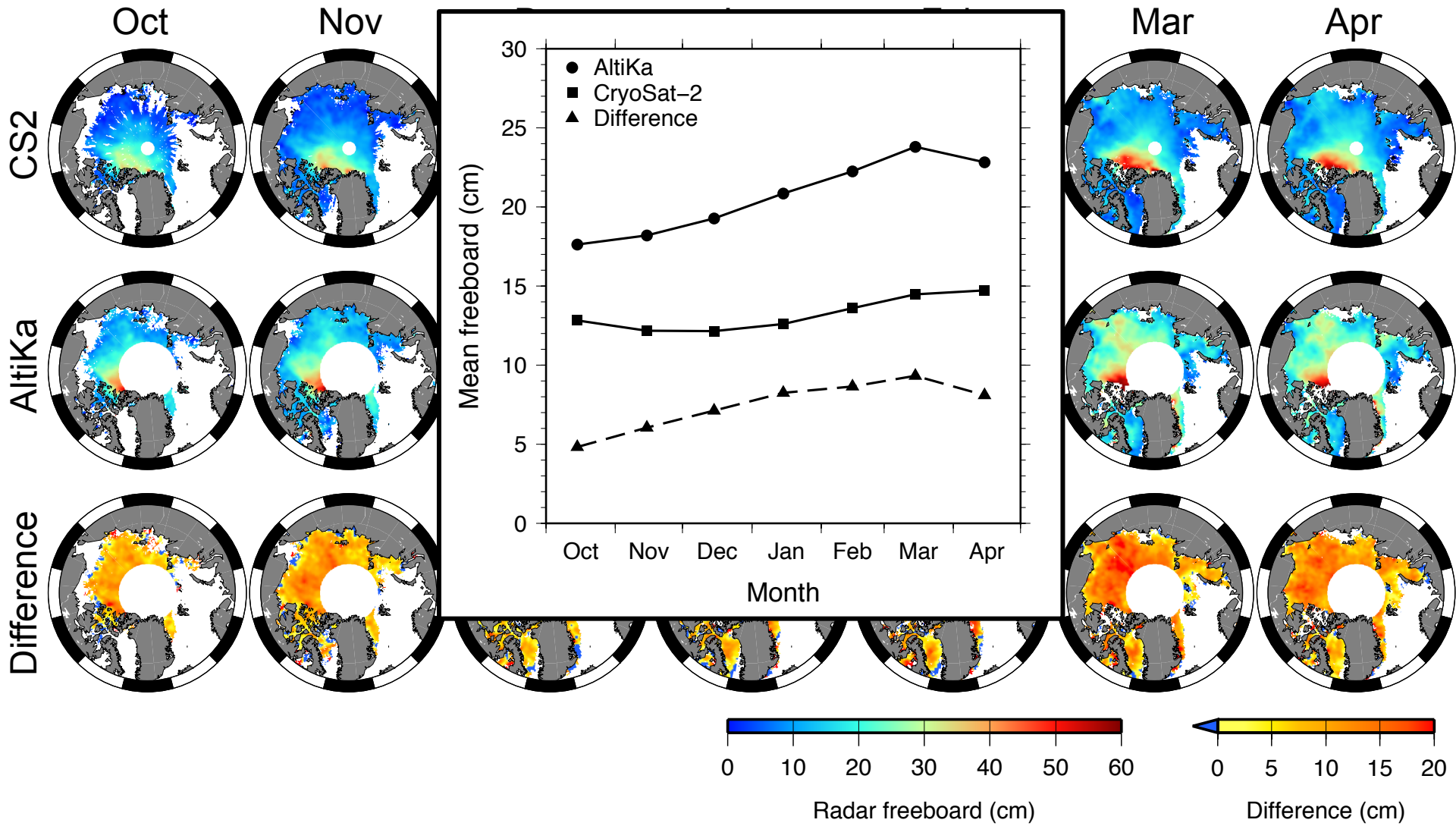

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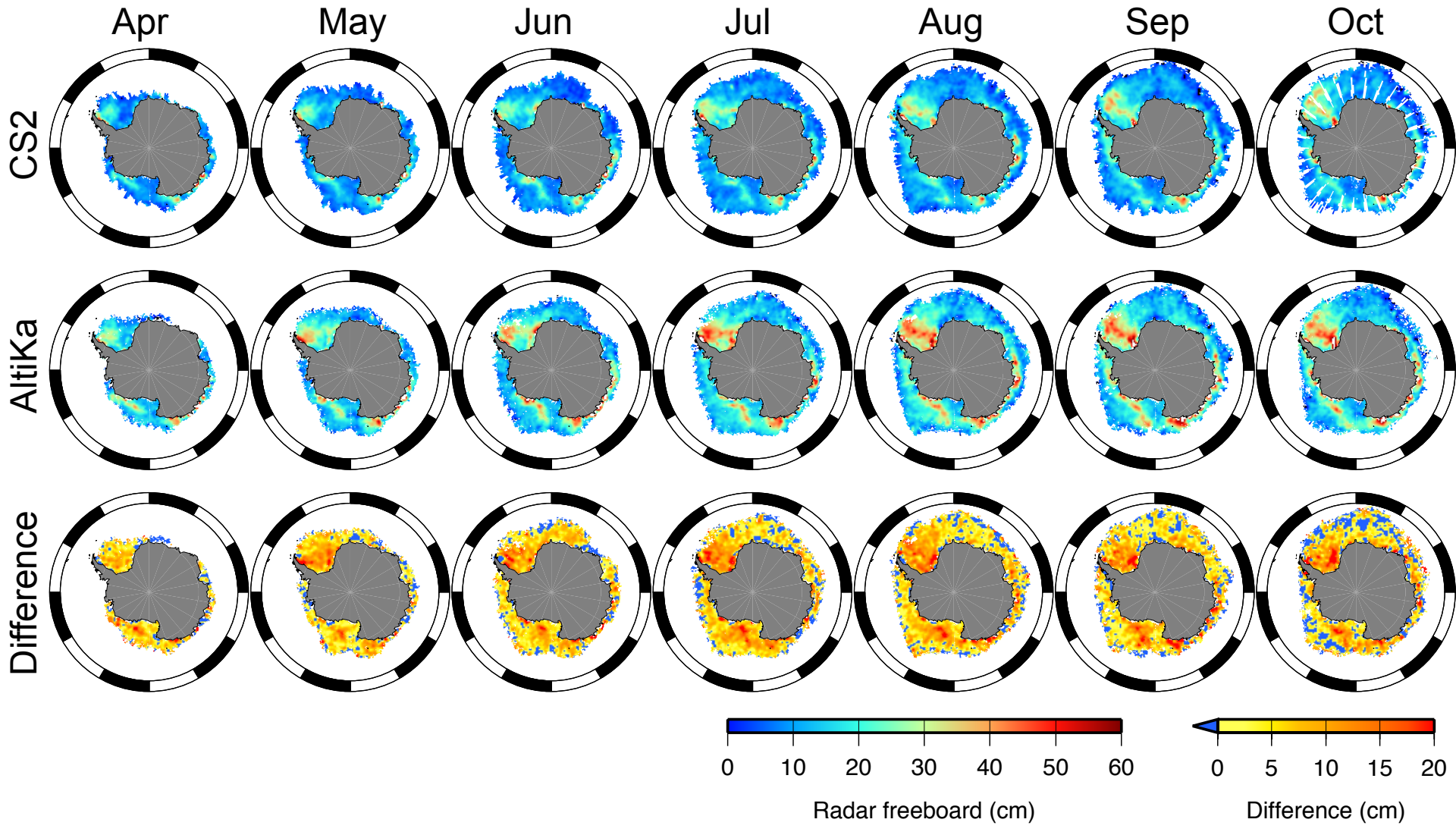

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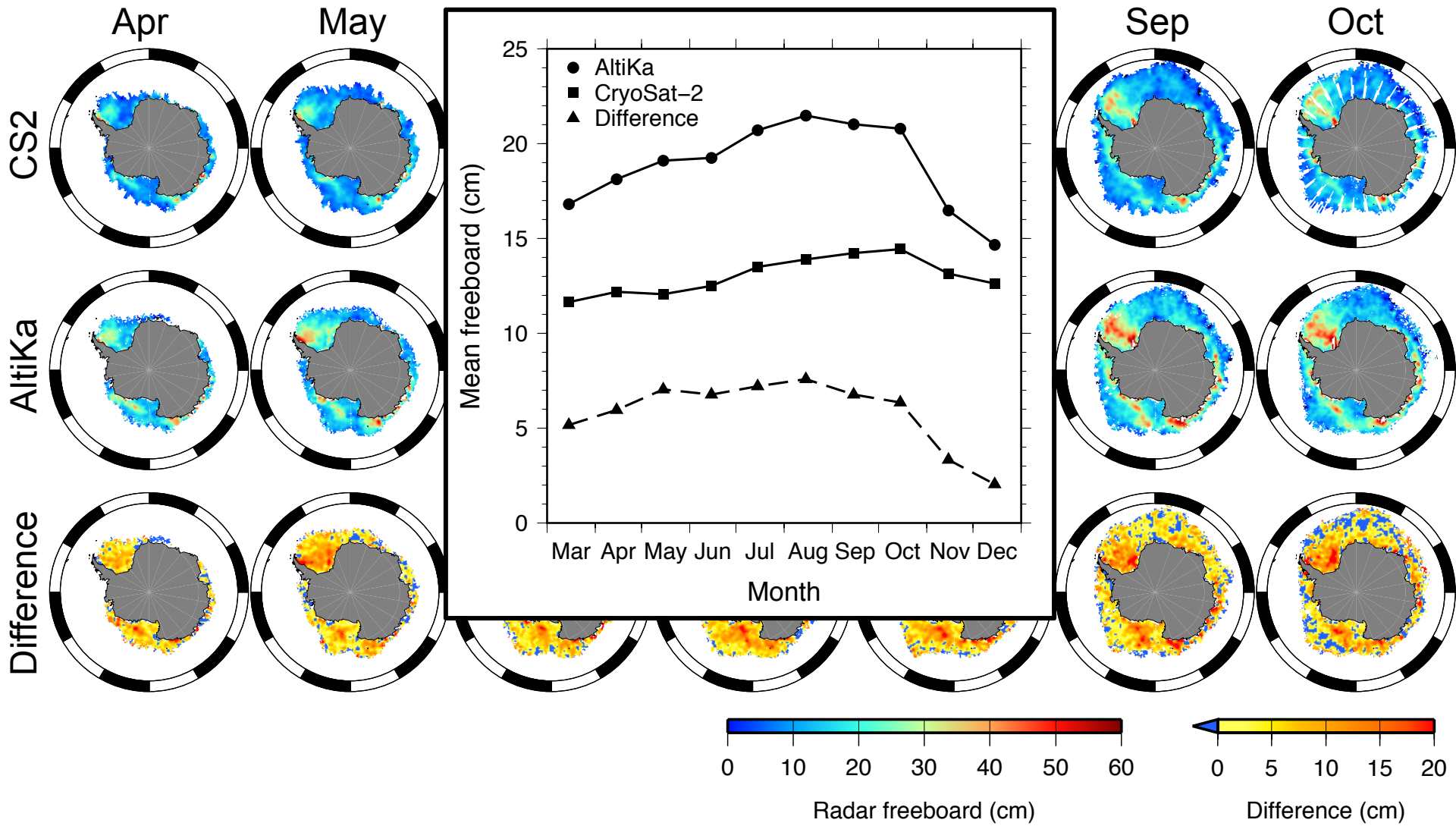
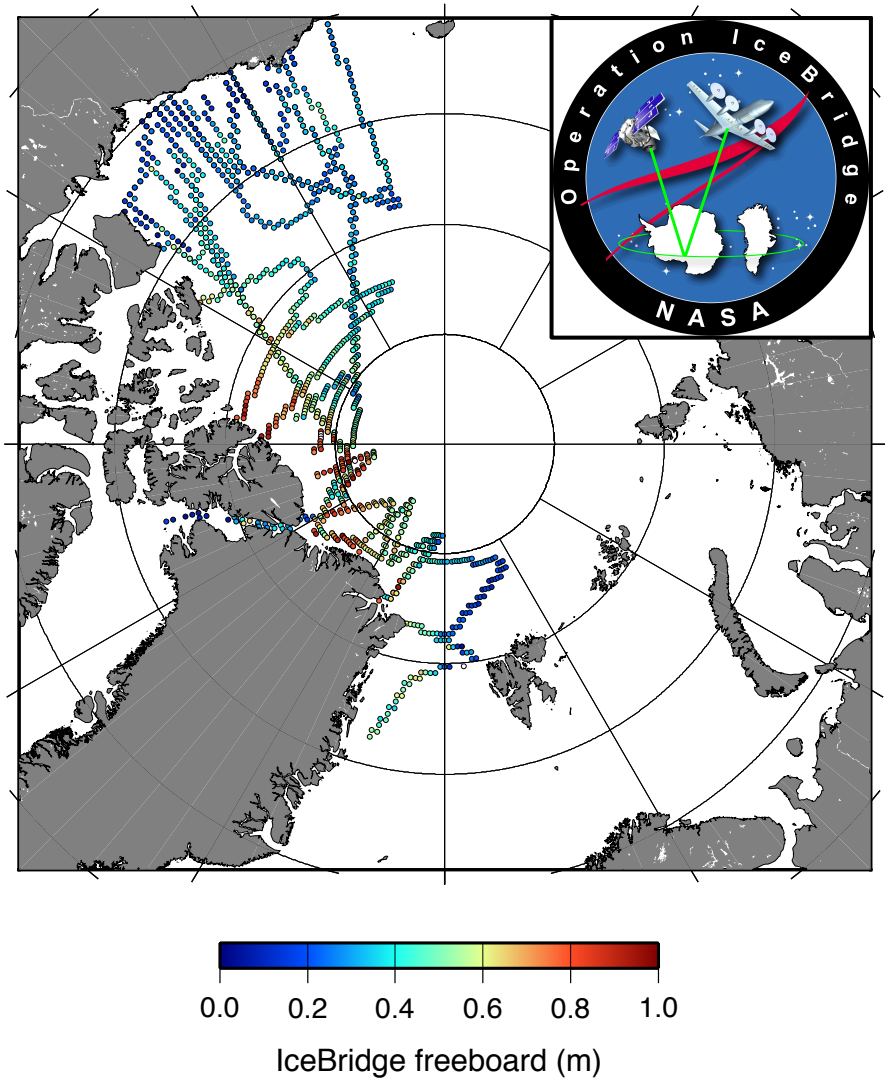


Comparison with Operation IceBridge

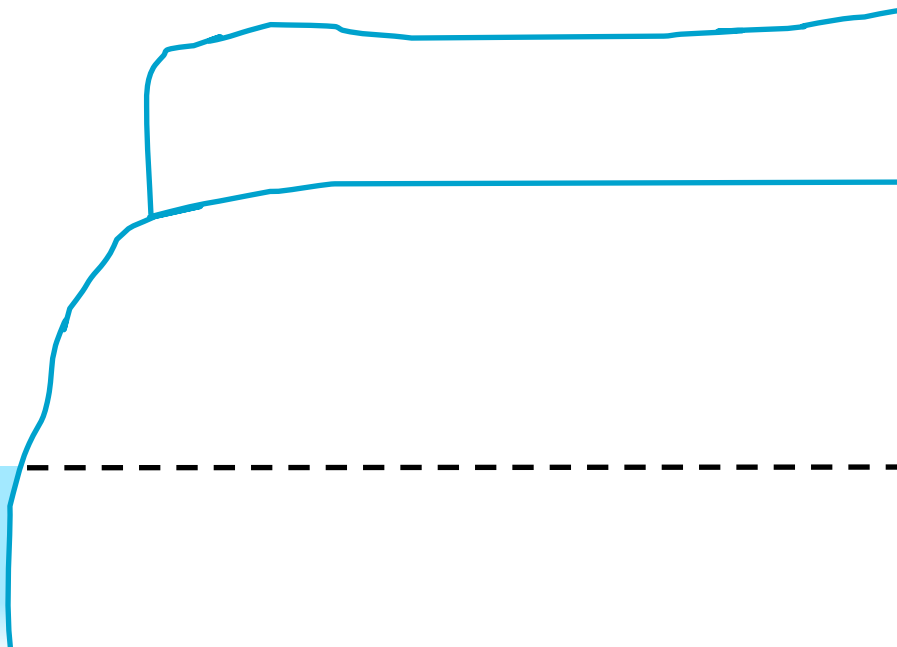
- Airborne campaign linking ICESat-1 and ICESat-2
- Suite of geophysical instruments:
  - Laser scanner
  - Snow radar
  - Radiometer
  - High-res photography
- Five sea ice flight in spring 2013
- Fourteen sea ice flights in spring 2014



Comparison with Operation IceBridge

- Calculate the “theoretical radar freeboard” from OIB:
  - Radar freeboard measured if snow-ice interface dominates return i.e. snow freeboard minus snow depth
  - Correct for propagation speed in snow pack
- Compare with space/time coincident freeboard from AltiKa and CryoSat-2

$$FB_{tr} = FB_s - d_s - d_s\left(1 - \frac{c_s}{c}\right)$$



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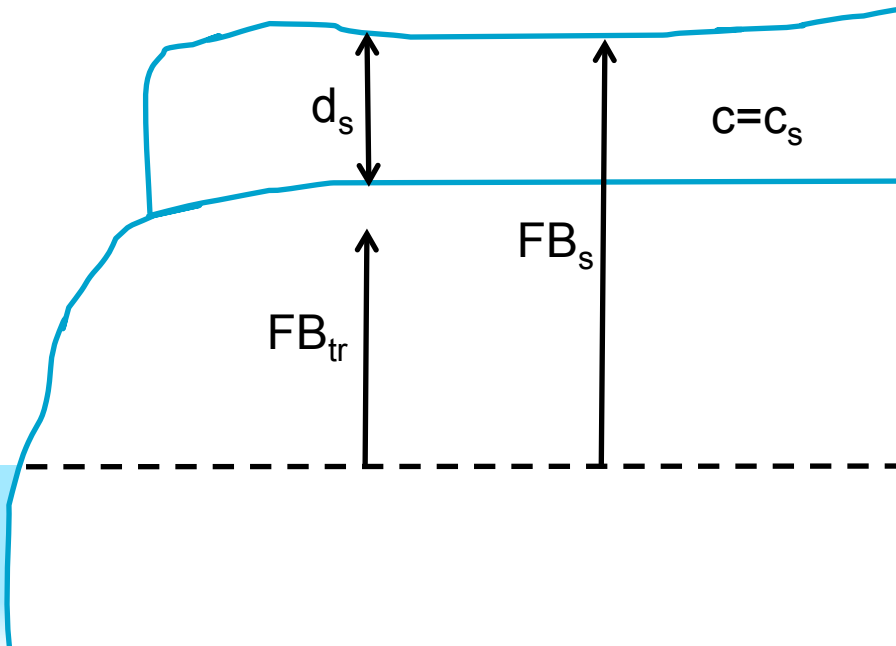

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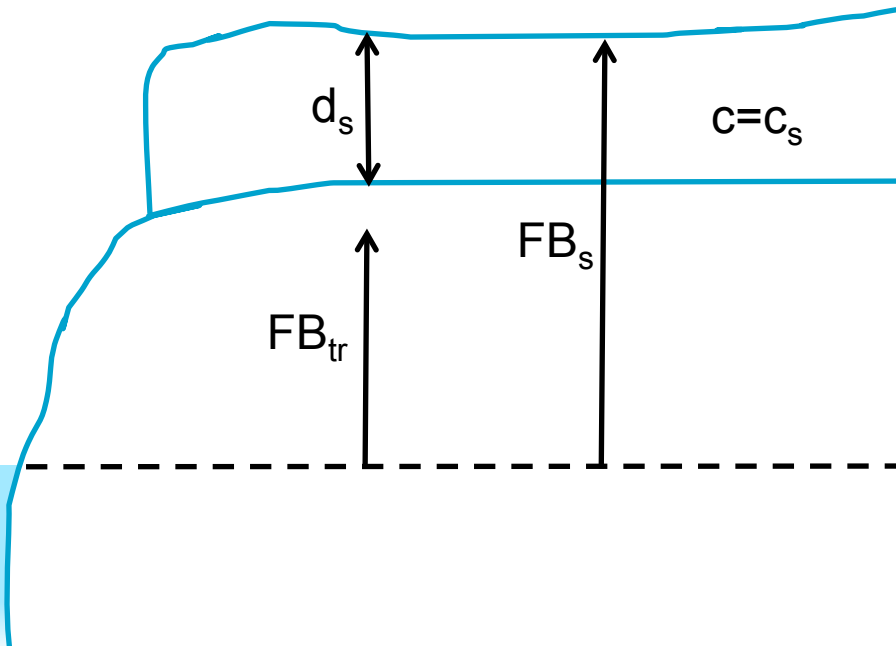
Laser

Snow radar

~0.2



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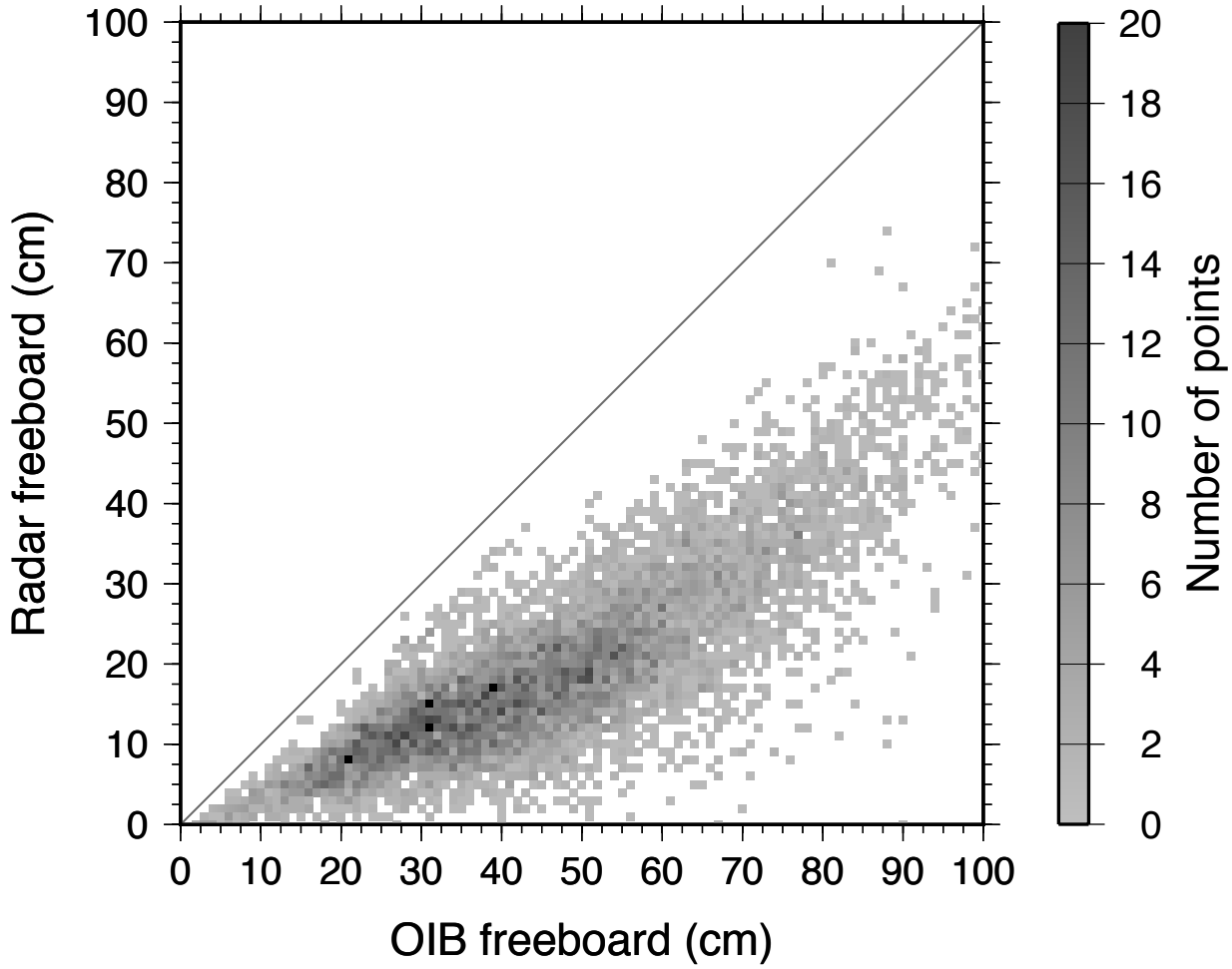

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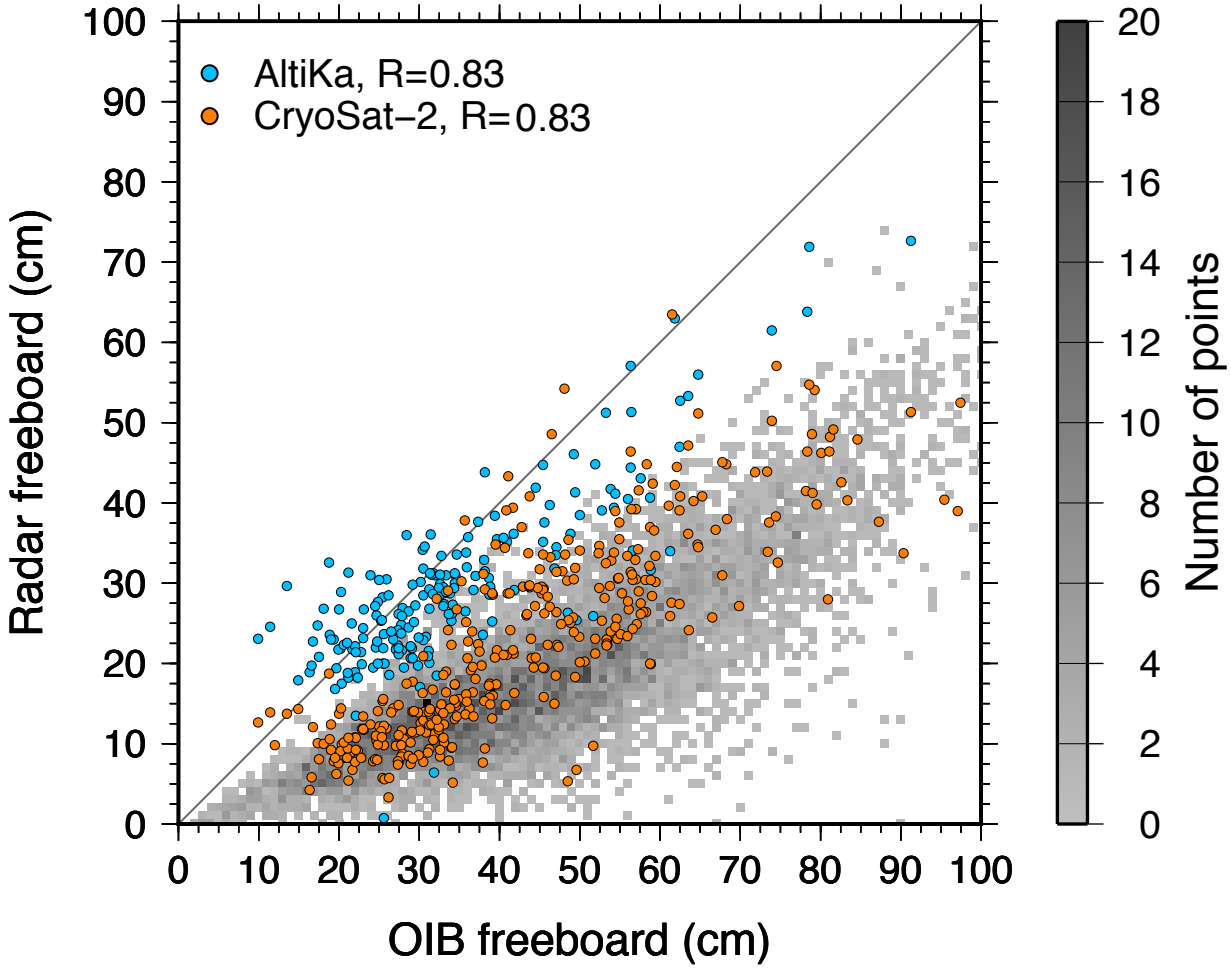

Conclusions

- AltiKa provides the first Ka-band sea ice freeboard from space
  - Better than conventional Ku-band altimeters, not as good as CryoSat-2 (over sea ice)
- AltiKa offers a new perspective on radar altimeter interaction with snow on sea ice in both hemispheres
- AltiKa freeboard seems to be closer to the snow freeboard in the Arctic
- When combined with CryoSat-2 could yield new information about the snow layer depth on Arctic sea ice