

Scattering characteristics and snow depth determination from KuKa Ku- and Ka- band polarimetric, dual frequency, ground-based radar deployed in altimeter mode during MOSAiC

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1 University College London

2 University of Manitoba

3 National Snow and Ice Data Center

4 Danish Meteorological Institute

5 Alfred Wegener Institute

6 ProSensing

7 Arctic University of Norway

8 Colorado State University

9 Tsinghua University

10 WSL

11 Ohio State University

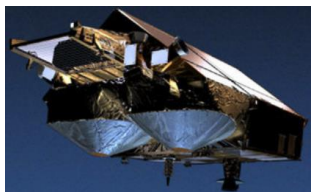
12 University of Alaska Fairbanks

13 British Antarctic Survey



Dominant scattering surfaces

CryoSat-2



13.575
GHz

AltiKa

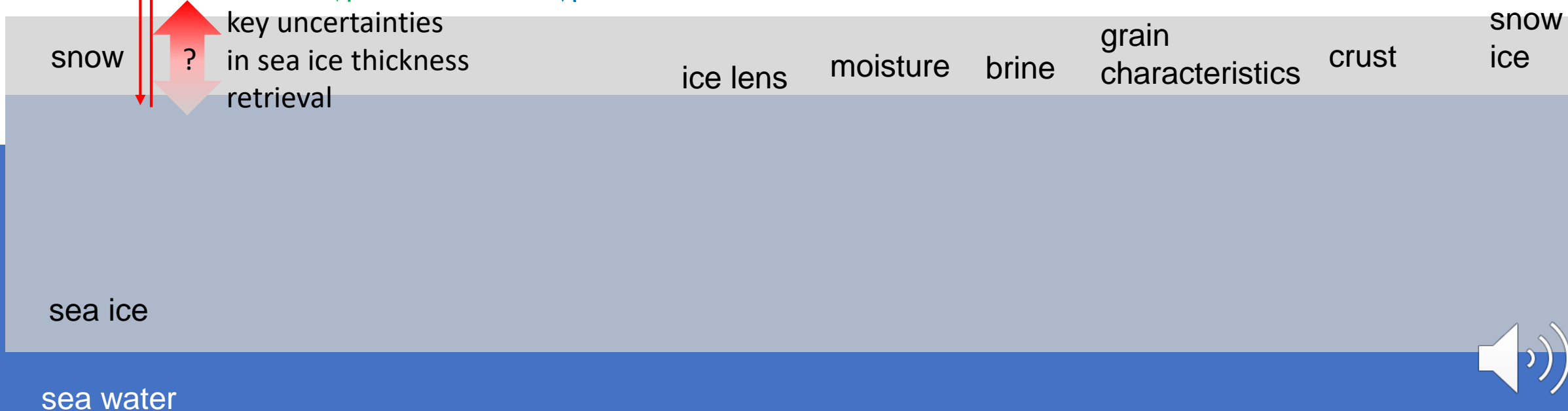
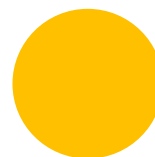


35
GHz

ICESat



532
nm

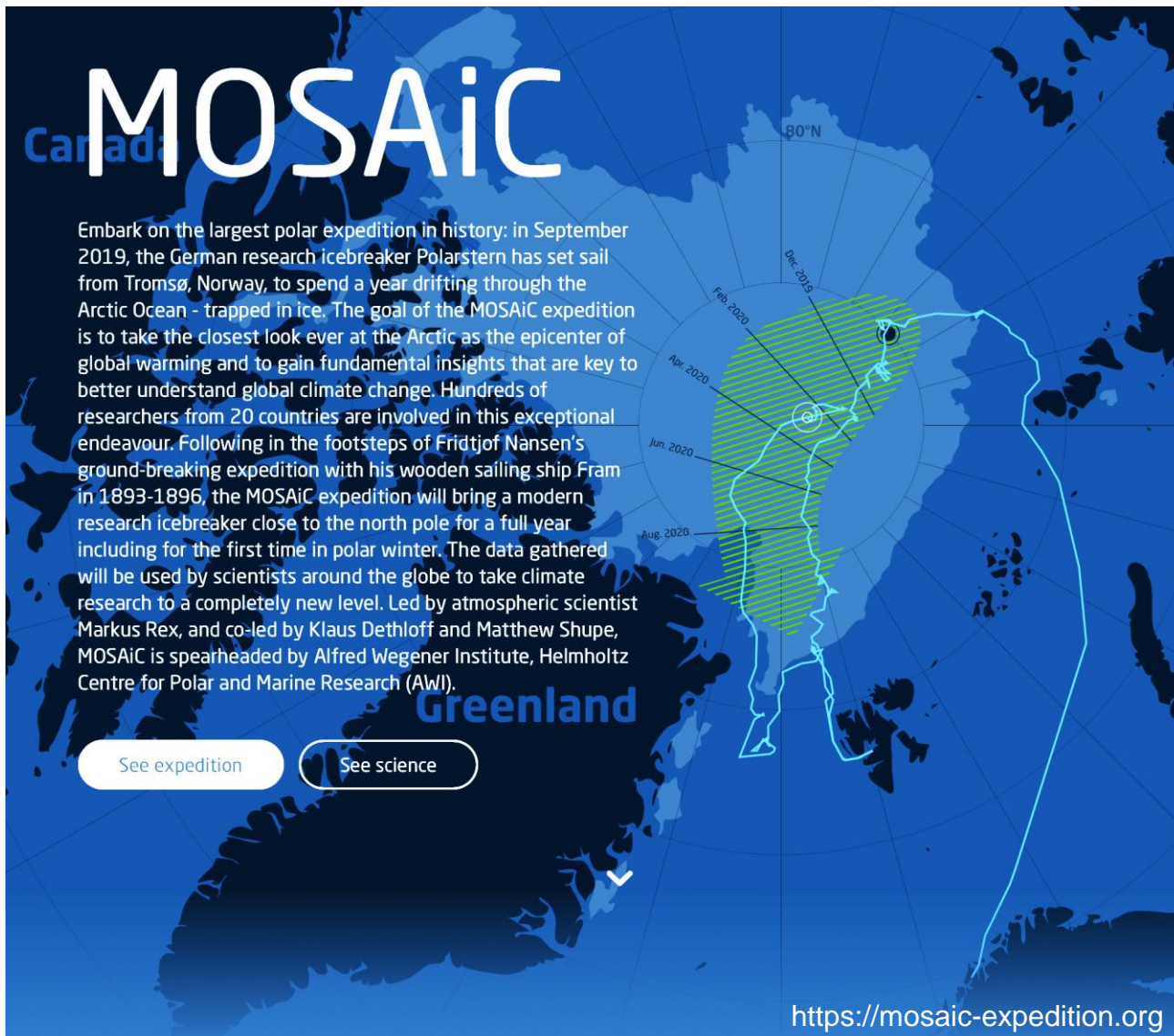


MOSAiC

Embark on the largest polar expedition in history: in September 2019, the German research icebreaker Polarstern has set sail from Tromsø, Norway, to spend a year drifting through the Arctic Ocean - trapped in ice. The goal of the MOSAiC expedition is to take the closest look ever at the Arctic as the epicenter of global warming and to gain fundamental insights that are key to better understand global climate change. Hundreds of researchers from 20 countries are involved in this exceptional endeavour. Following in the footsteps of Fridtjof Nansen's ground-breaking expedition with his wooden sailing ship Fram in 1893-1896, the MOSAiC expedition will bring a modern research icebreaker close to the north pole for a full year including for the first time in polar winter. The data gathered will be used by scientists around the globe to take climate research to a completely new level. Led by atmospheric scientist Markus Rex, and co-led by Klaus Dethloff and Matthew Shupe, MOSAiC is spearheaded by Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI).


[See expedition](#) [See science](#)

<https://mosaic-expedition.org>

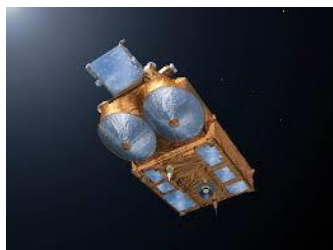



	Ku-band (~CryoSat-2)	Ka-band (~ALTIKA)
Frequency	12-18 GHz	30-40 GHz
Range resolution	2.5 cm	1.5 cm
Antenna beamwidth	16.9°	11.9°

(Stroeve et al, 2020)



CryoSat-2



~700 km



Pulse-limited
+ SAR
~ 1.7 x 0.3 km

AltiKa



~800 km



Pulse-limited
~8 km

simulator

KuKa



~1.5 m



~ 40 cm

Beam-limited

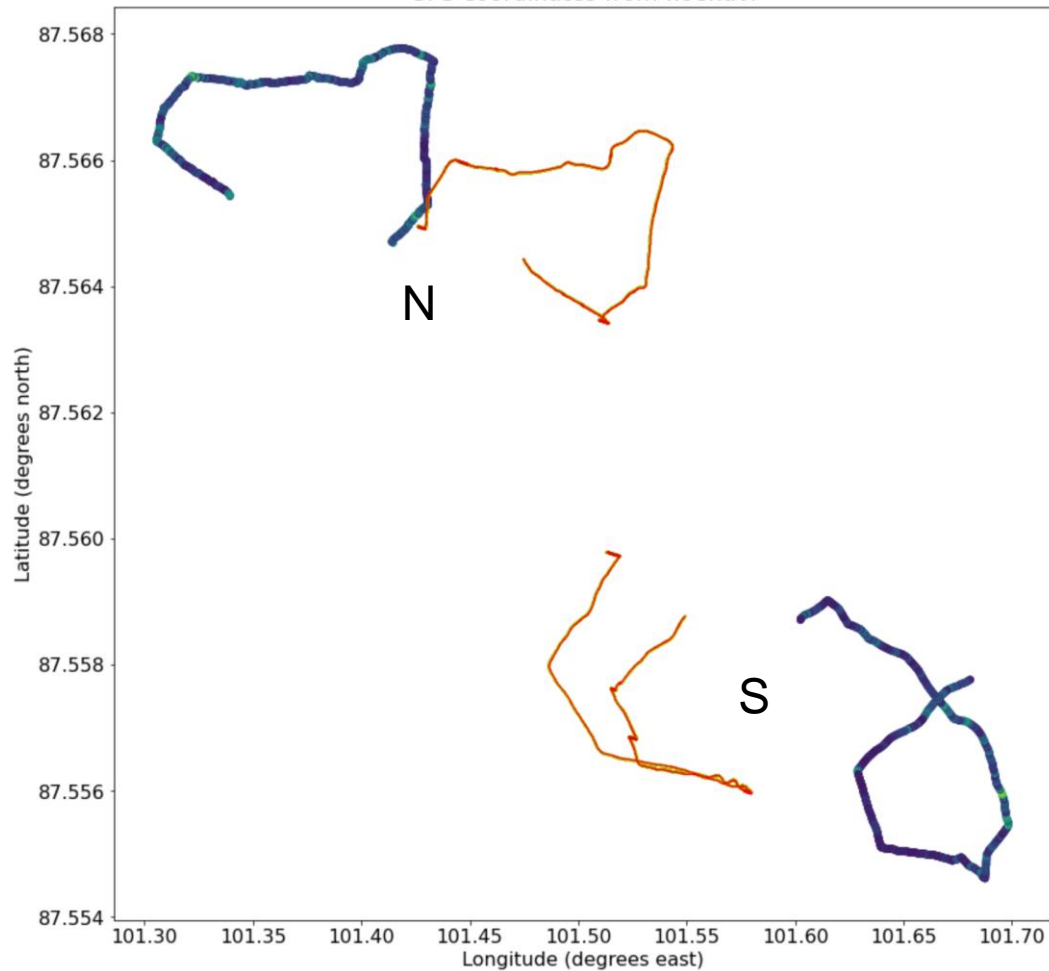


~1.5 m

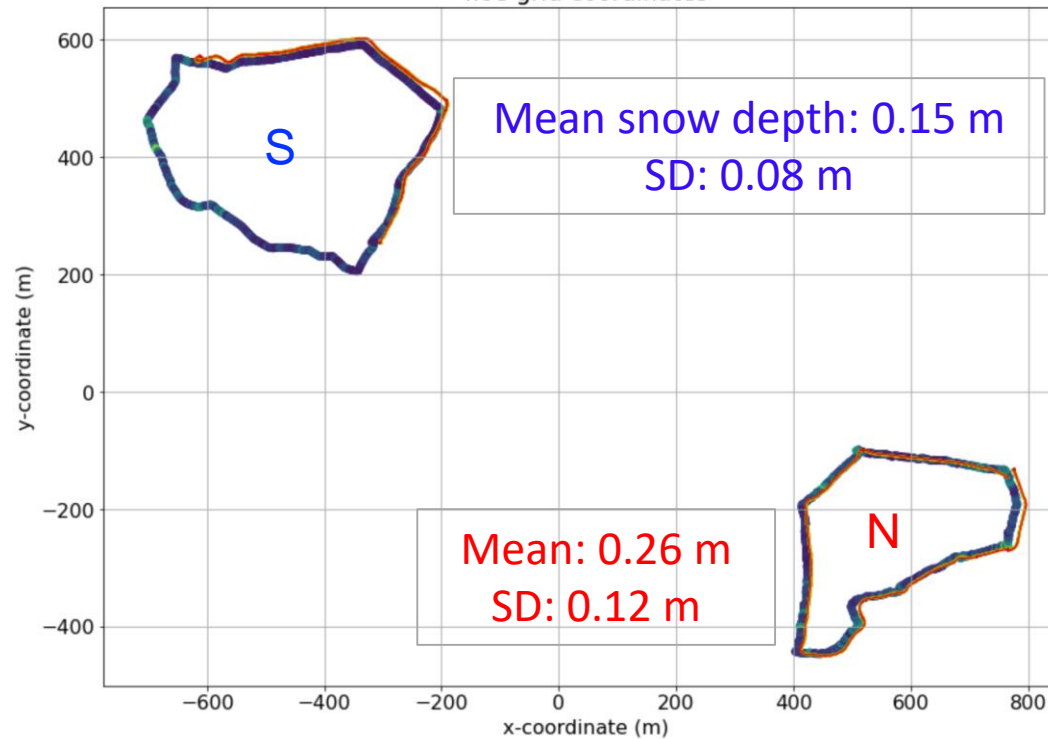
~ 30 cm



GPS coordinates from floenavi

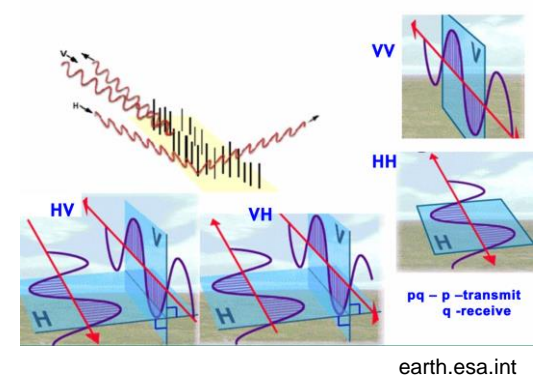
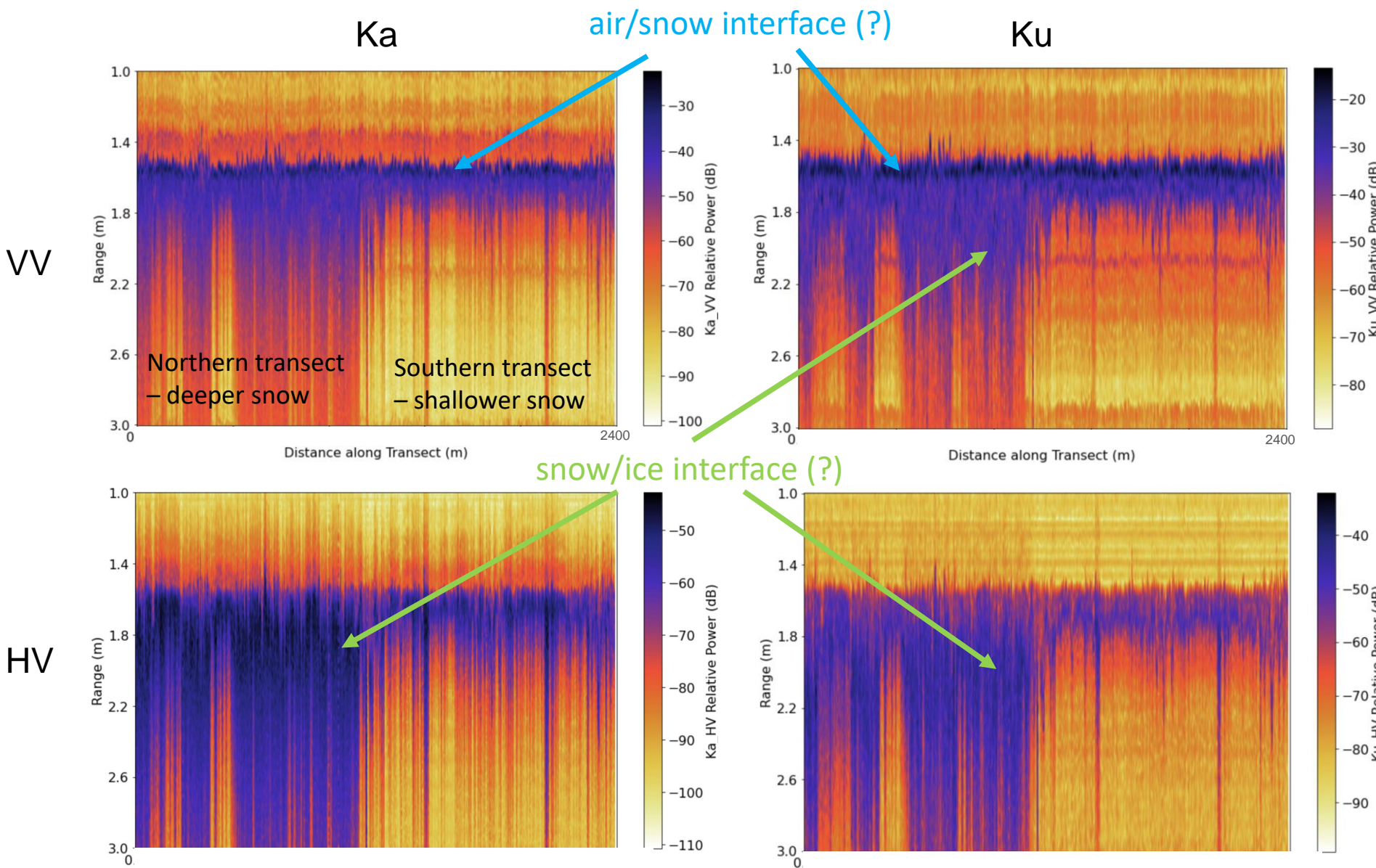


floe grid coordinates

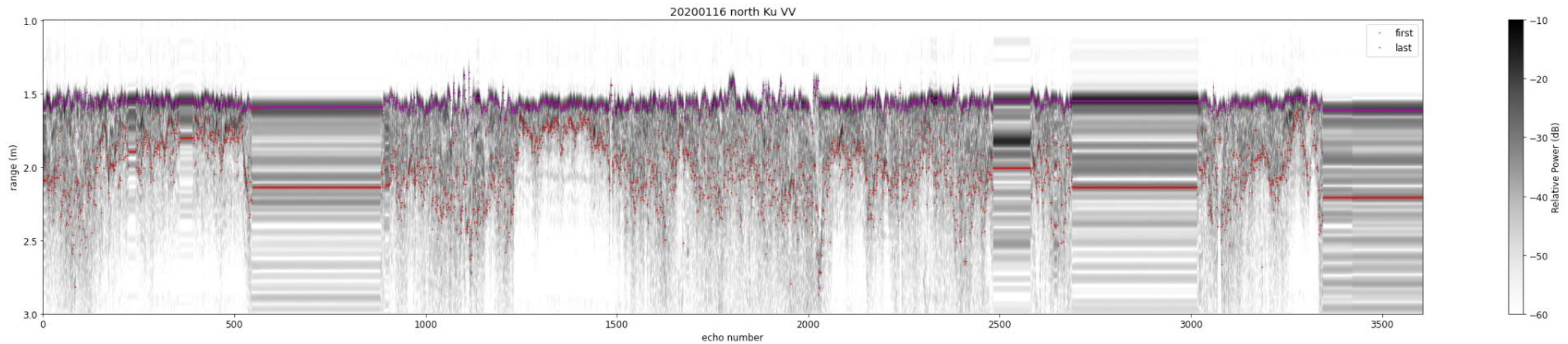


Data from 16th January 2020





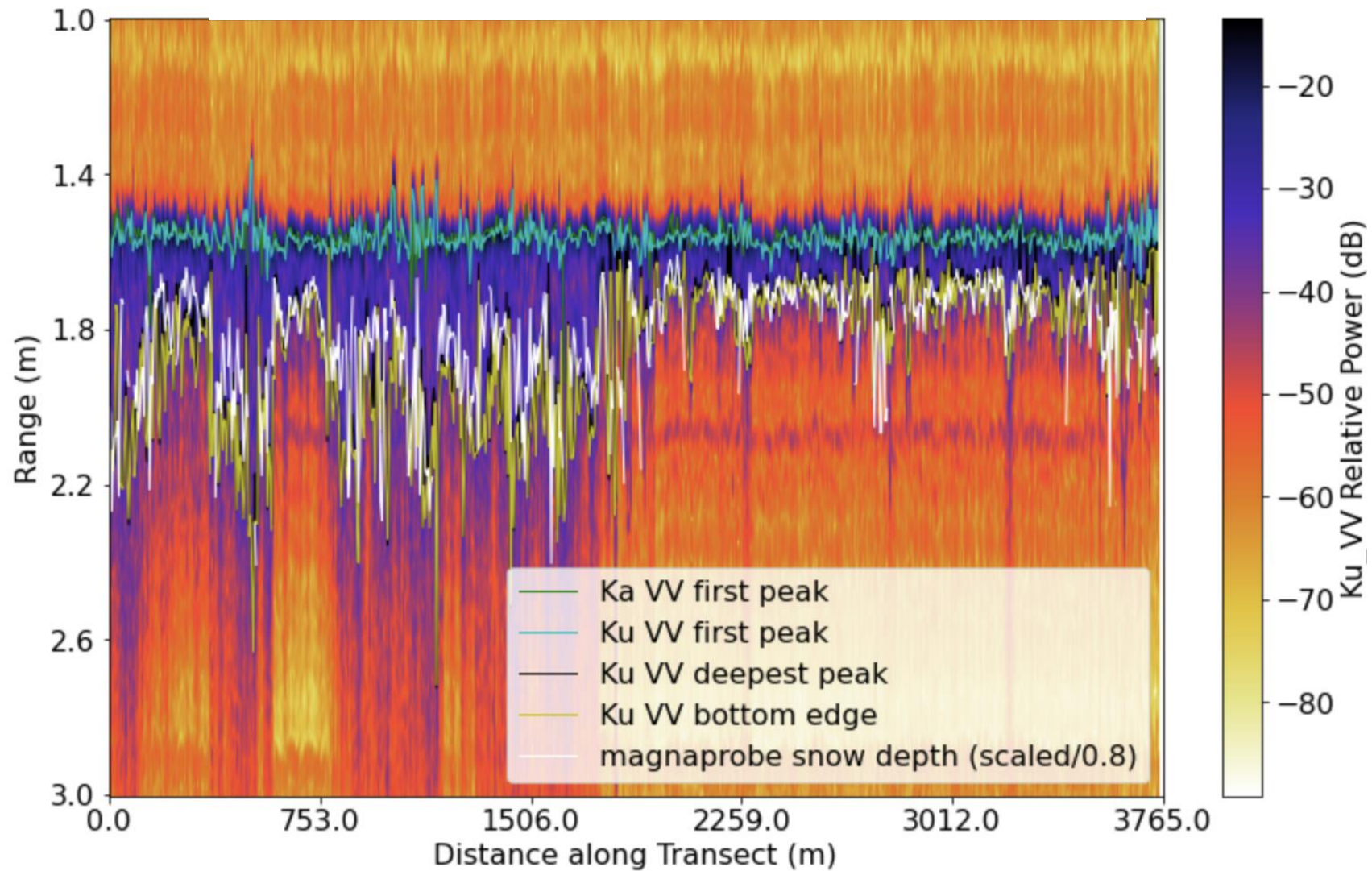
Data from January 2020



Current/future work:

- Deconvolution
- AI/ machine learning



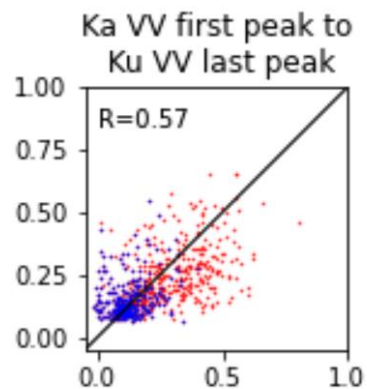


Data from  January 2020

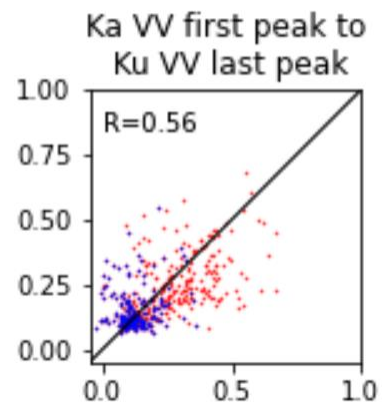
- Northern transect
- Southern transect

MagnaProbe-derived
snow depth (m)

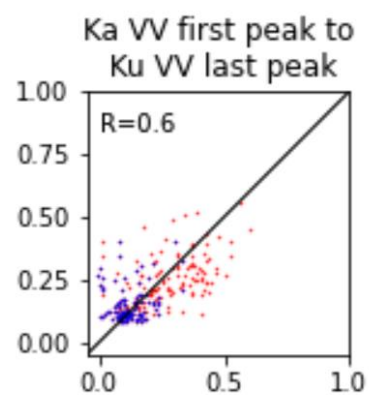
binsize: 3



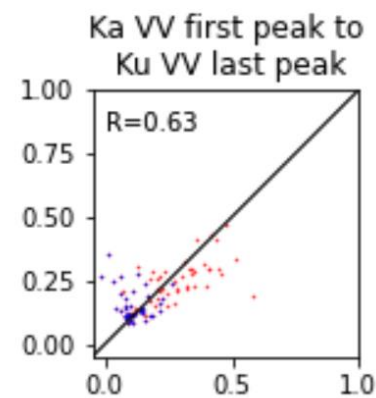
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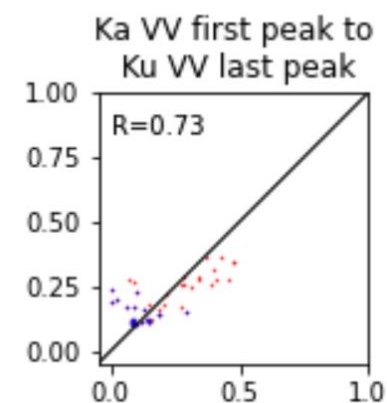
binsize: 10



binsize: 25



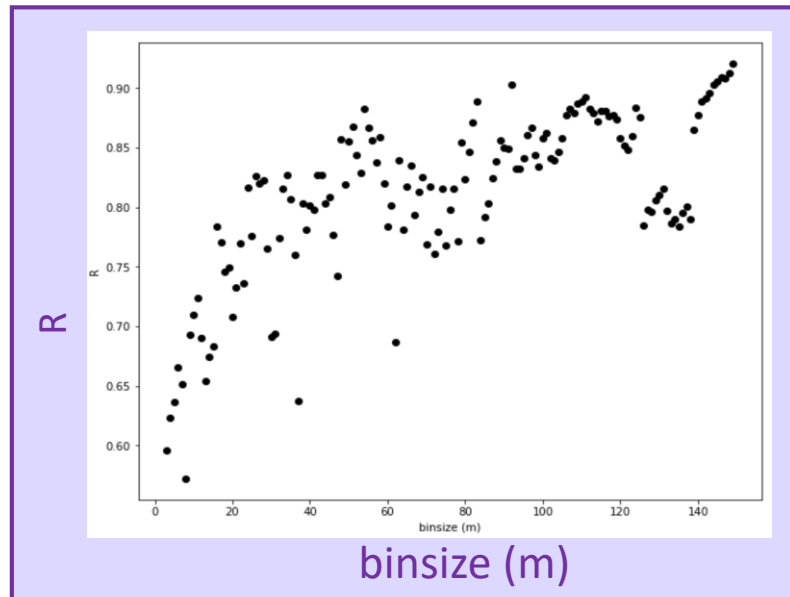
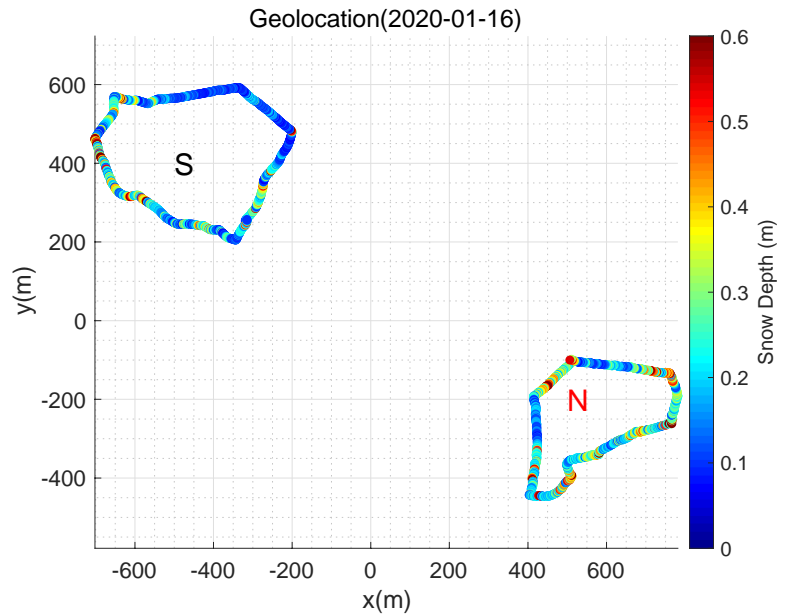
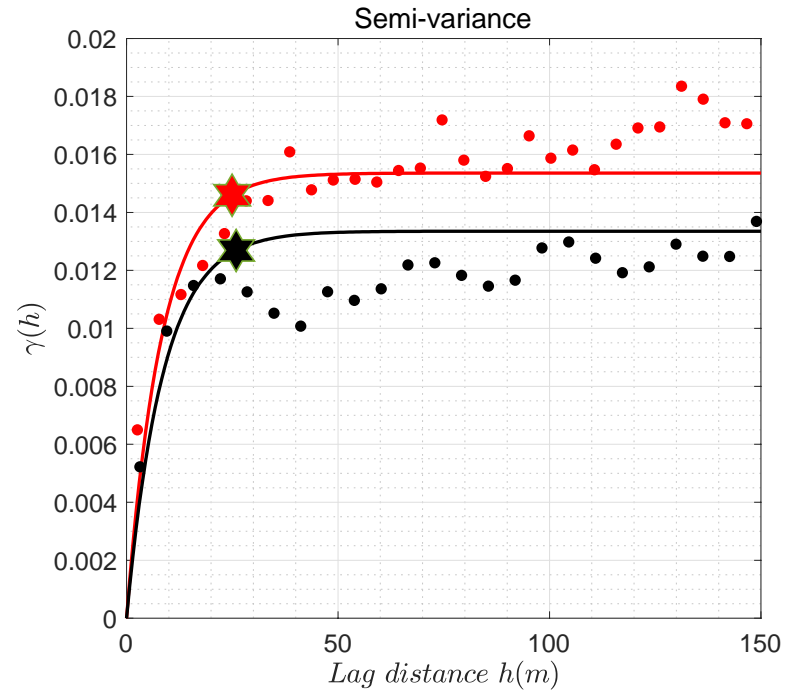
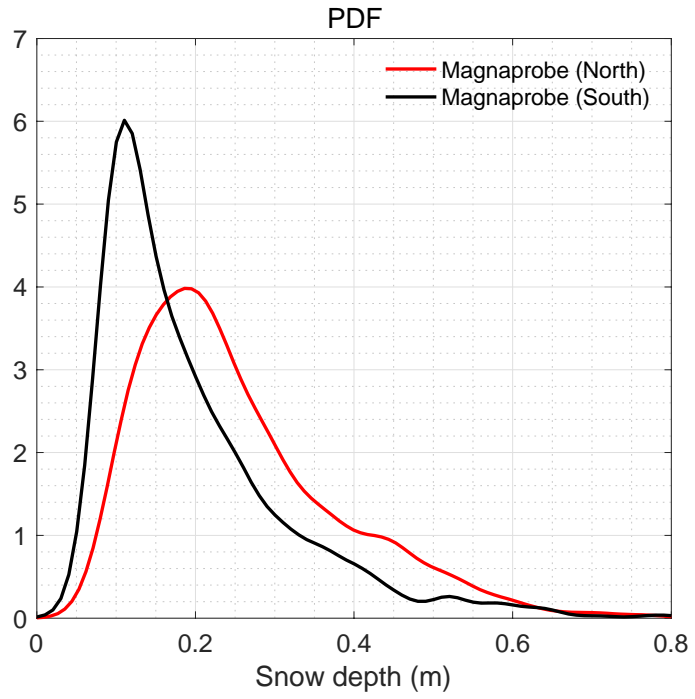
binsize: 50



KuKa-derived snow depth (m)



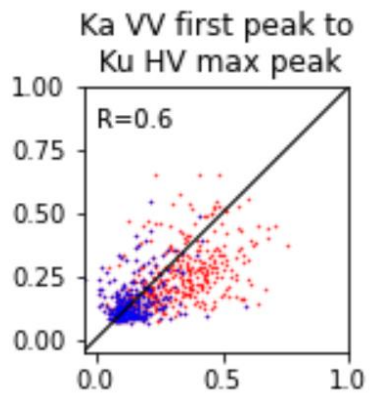
2020-01-16 Variogram analysis by Lu Zhou



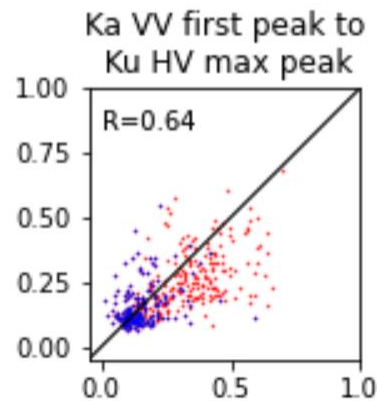
- Northern transect
- Southern transect

MagnaProbe-derived snow depth (m)

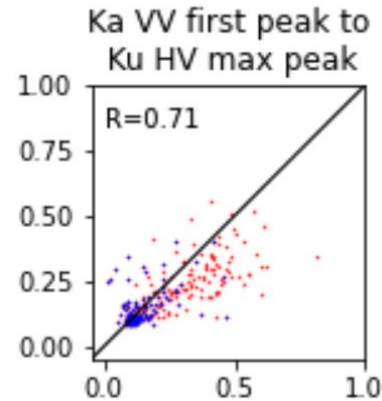
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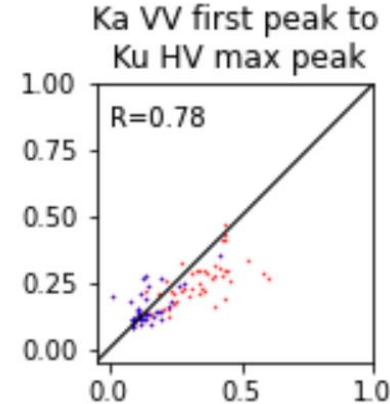
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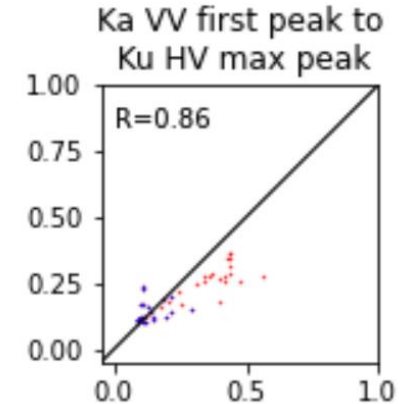
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binsize: 25

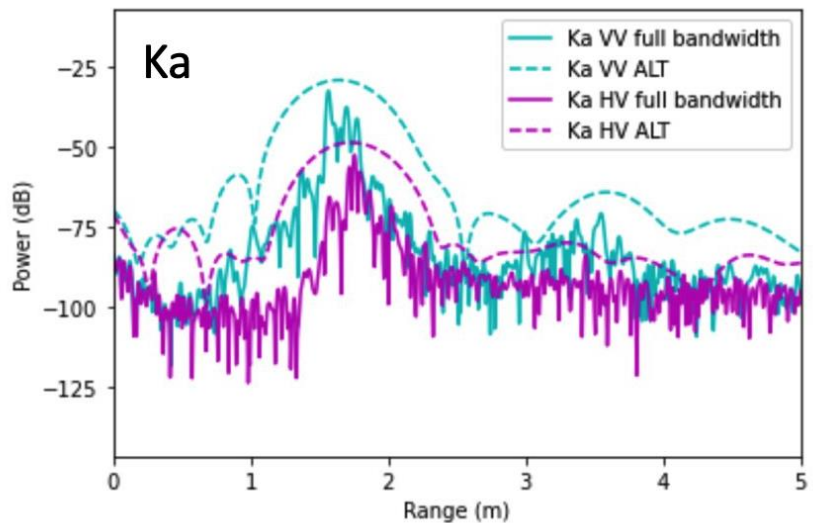
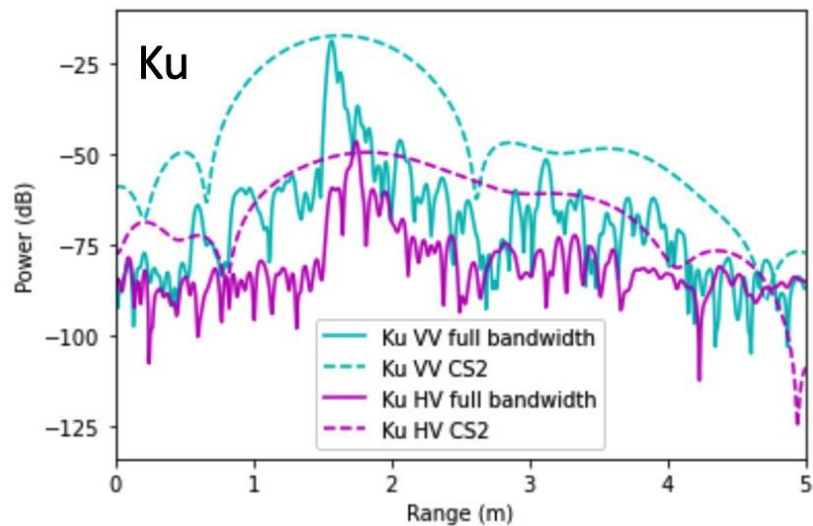


binsize: 50

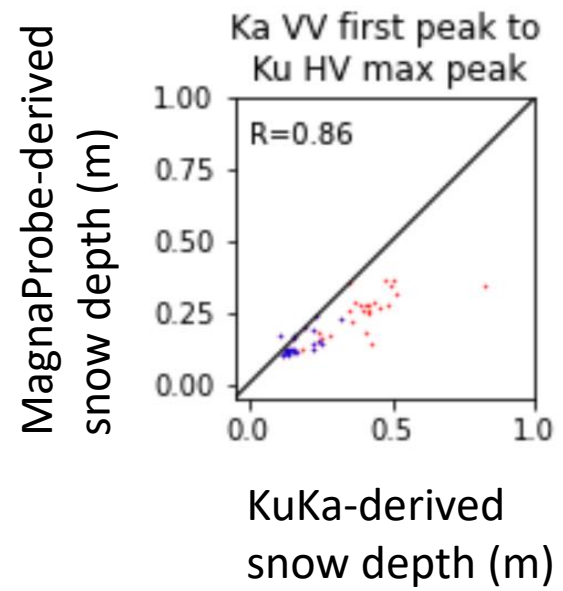


KuKa-derived snow depth (m)

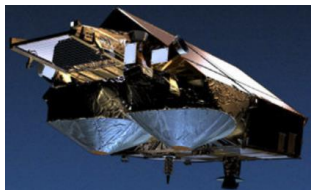




- Northern transect
- Southern transect

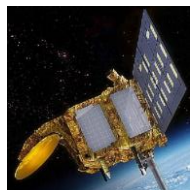


CryoSat-2



13.575 GHz

ALTiKa

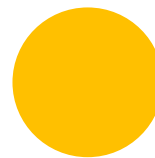


35 GHz

ICESat



532 nm



snow

?

speed = f(density, wetness ...)

ice lens

moisture

brine

grain characteristics

crust

snow ice

sea ice

sea water



Frequency

Ku-band (~CryoSat-2)

Ka-band (~ALTiKa)

Range resolution

2.5 cm

1.5 cm

Antenna beamwidth

16.9°

11.9°



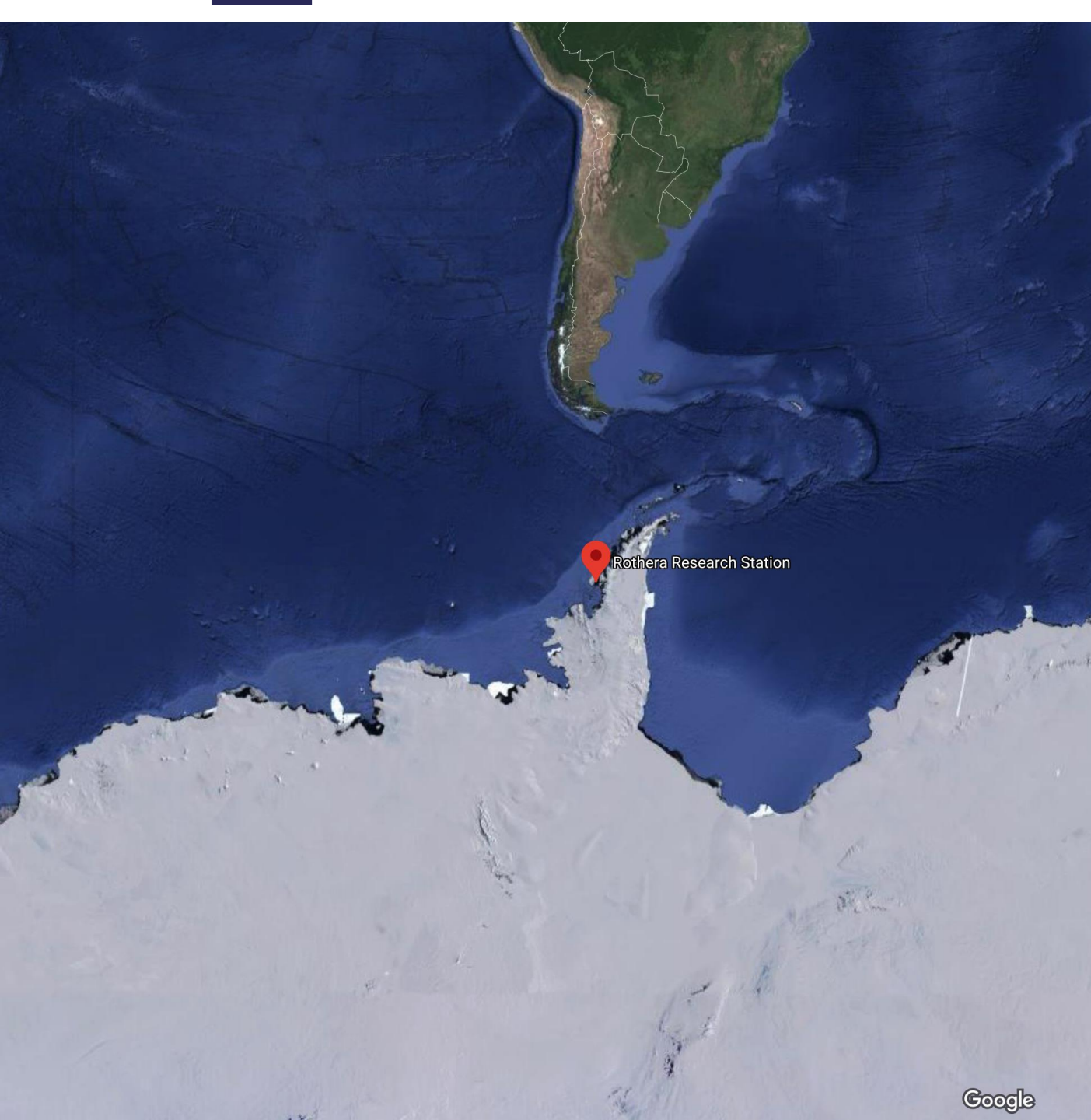


Photo: Stefan Hendricks



Thank you!

NERC NE/S002510/1

