Laboratoire de Glaciologie et Géophysique de l'Environnement

IGE

UNIVERSITÉ Grenoble Alpes

cnrs INSU Observer & comprendre

OSUG

Observatoire des Sciences de l'Univers de Grenoble

The French ASUMA scientific expedition (2016-2017)

Laurent Arnaud, Vincent Favier, Bruno Jourdain, Emmanuel Lemeur, Ghislain Picard

Institut des Geosciences de L'Environnement (IGE)
Grenoble (France)

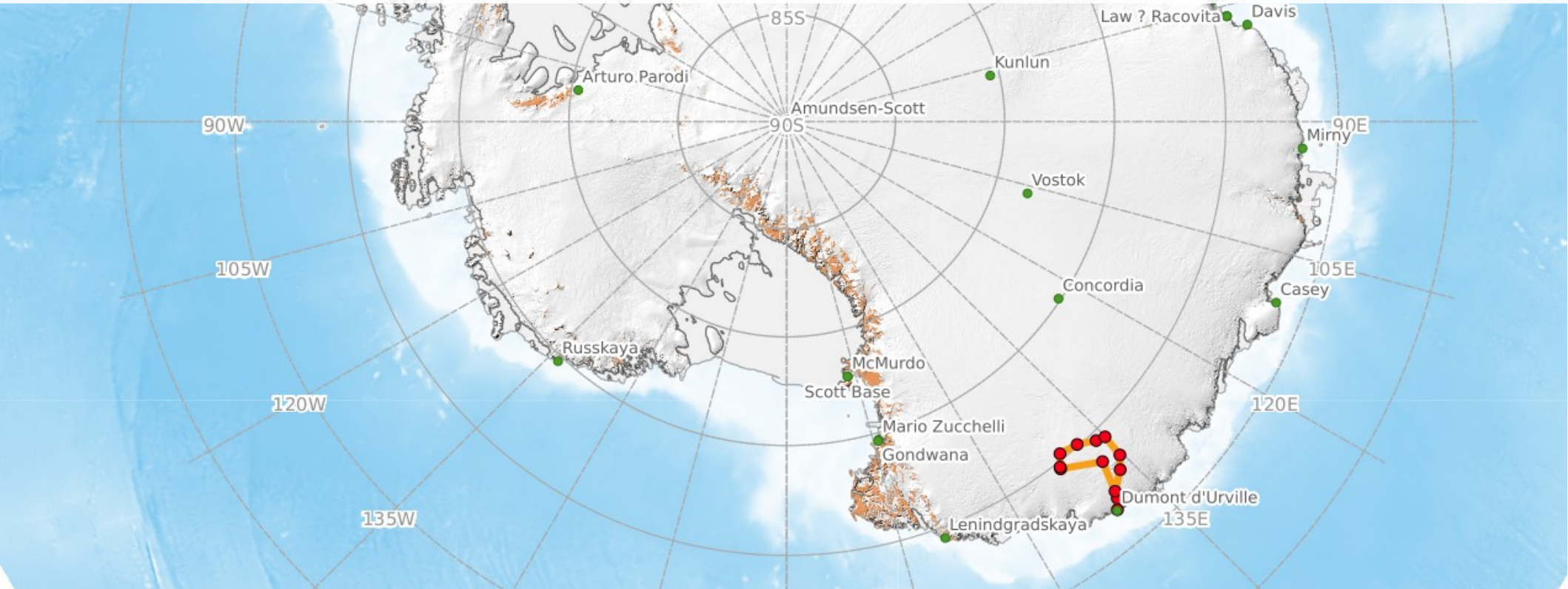
The ASUMA traverse

Context: International Trans Antarctic Scientific Expedition (ITASE)

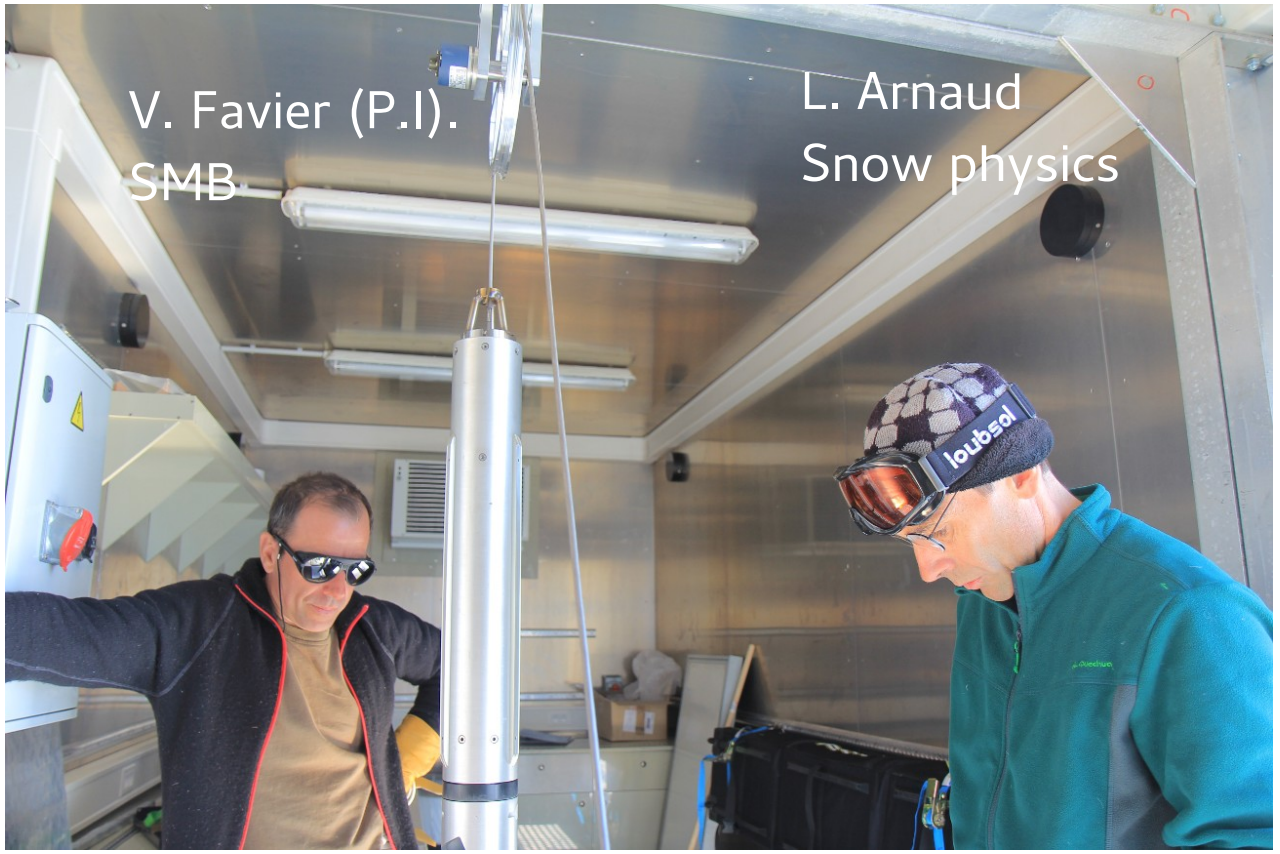
Objective: refine **Surface Mass Balance** estimates and related processes in the "transition zone"

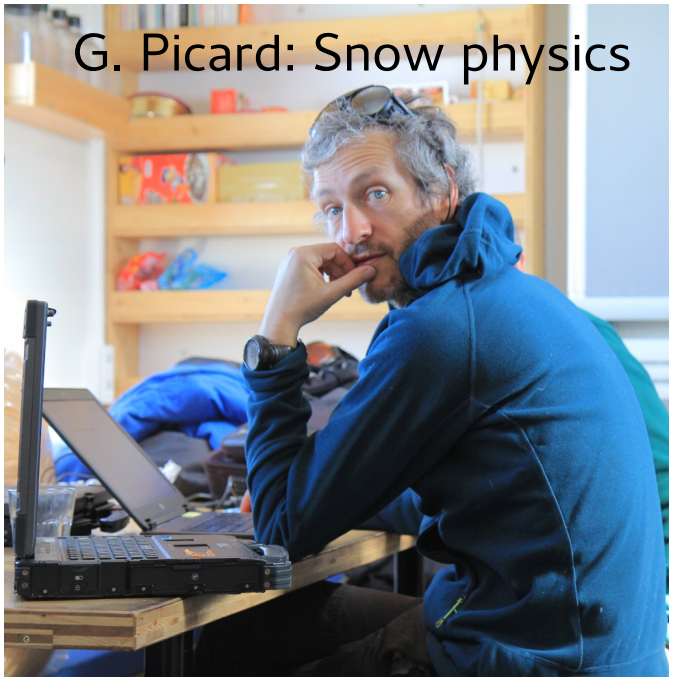
Transition zone is between
- the coastal regions: accumulation 500-1000+ mm, many stations
- the domes and the high East-Antarctic plateau: accumulation 20-50mm, a few stations

No station → accessible by traverse only.

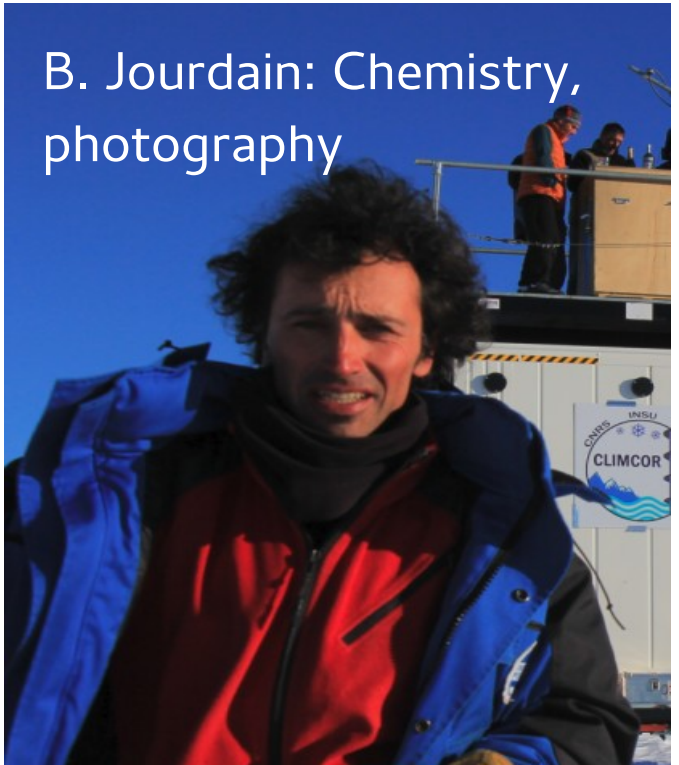


People


V. Favier (P.I).
SMB
L. Arnaud
Snow physics


G. Picard: Snow physics

E. Lemeur
SMB by radar


B. Jourdain: Chemistry, photography
CLIMCOR

People

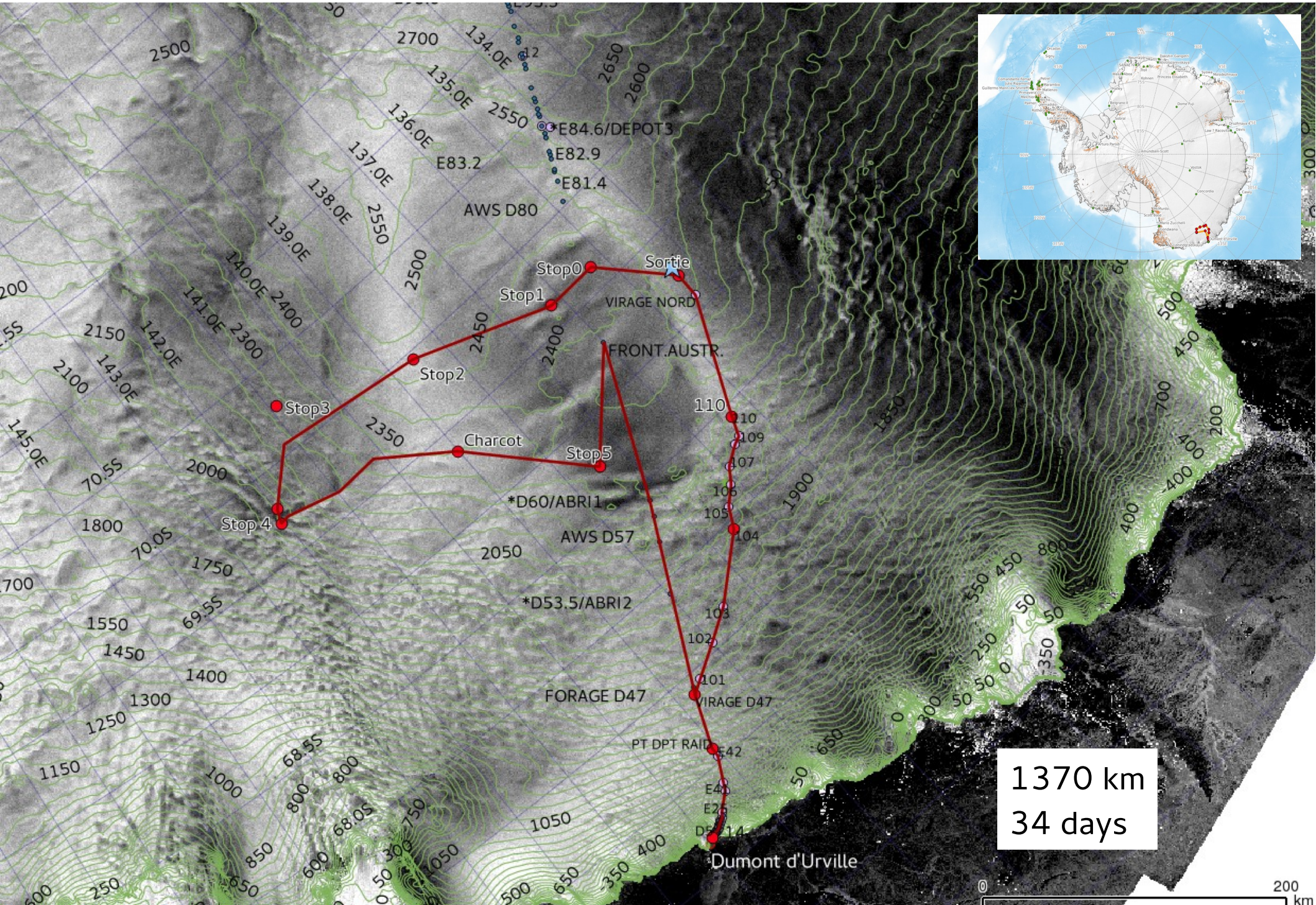
A. Vende: Raid leader

D. Beloin :
Mechanic

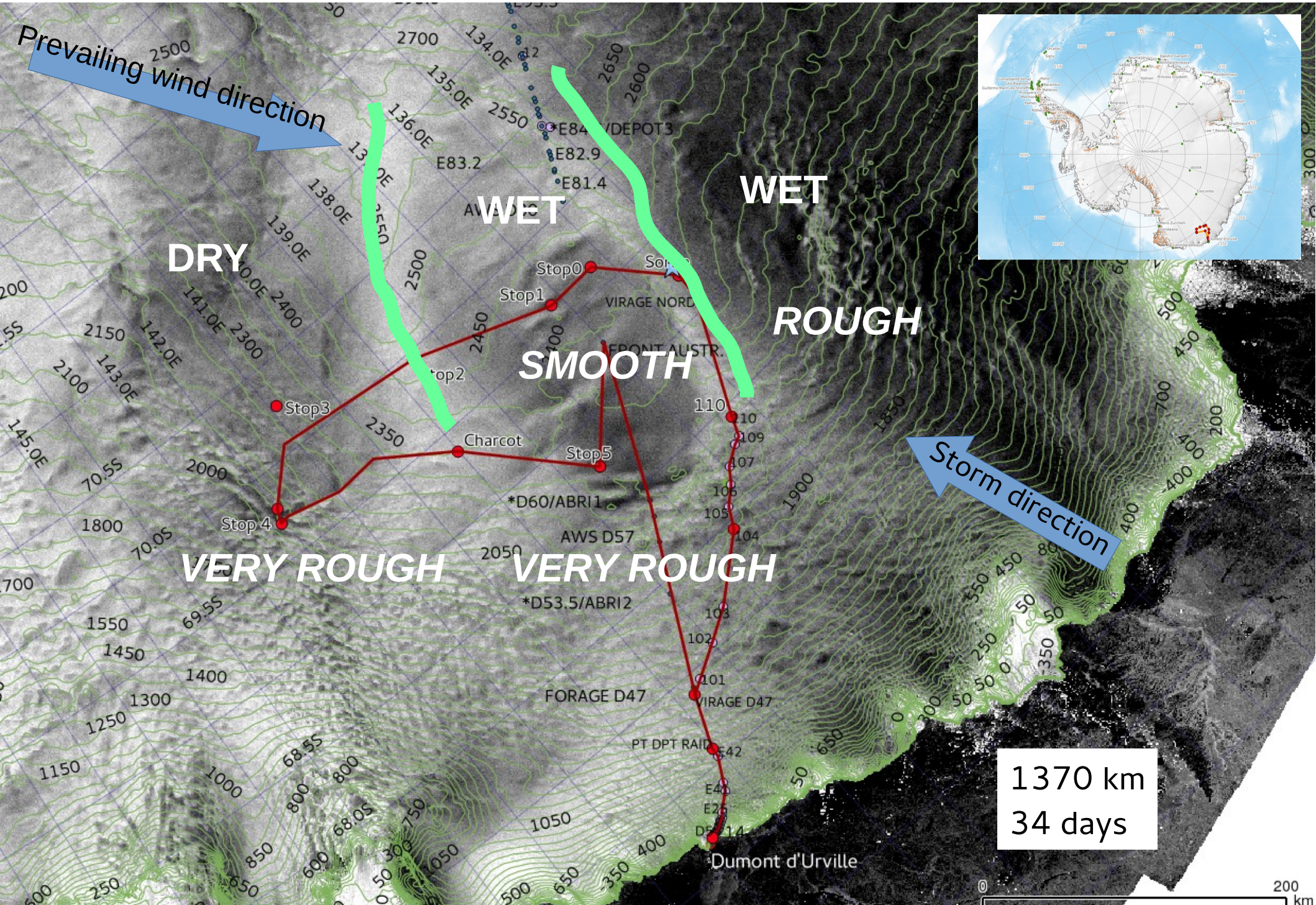
D. Colin : Mechanic

C. Laniece : Doc
GORDON'S
BERRI ESTATES
Classic Dry White
SEB

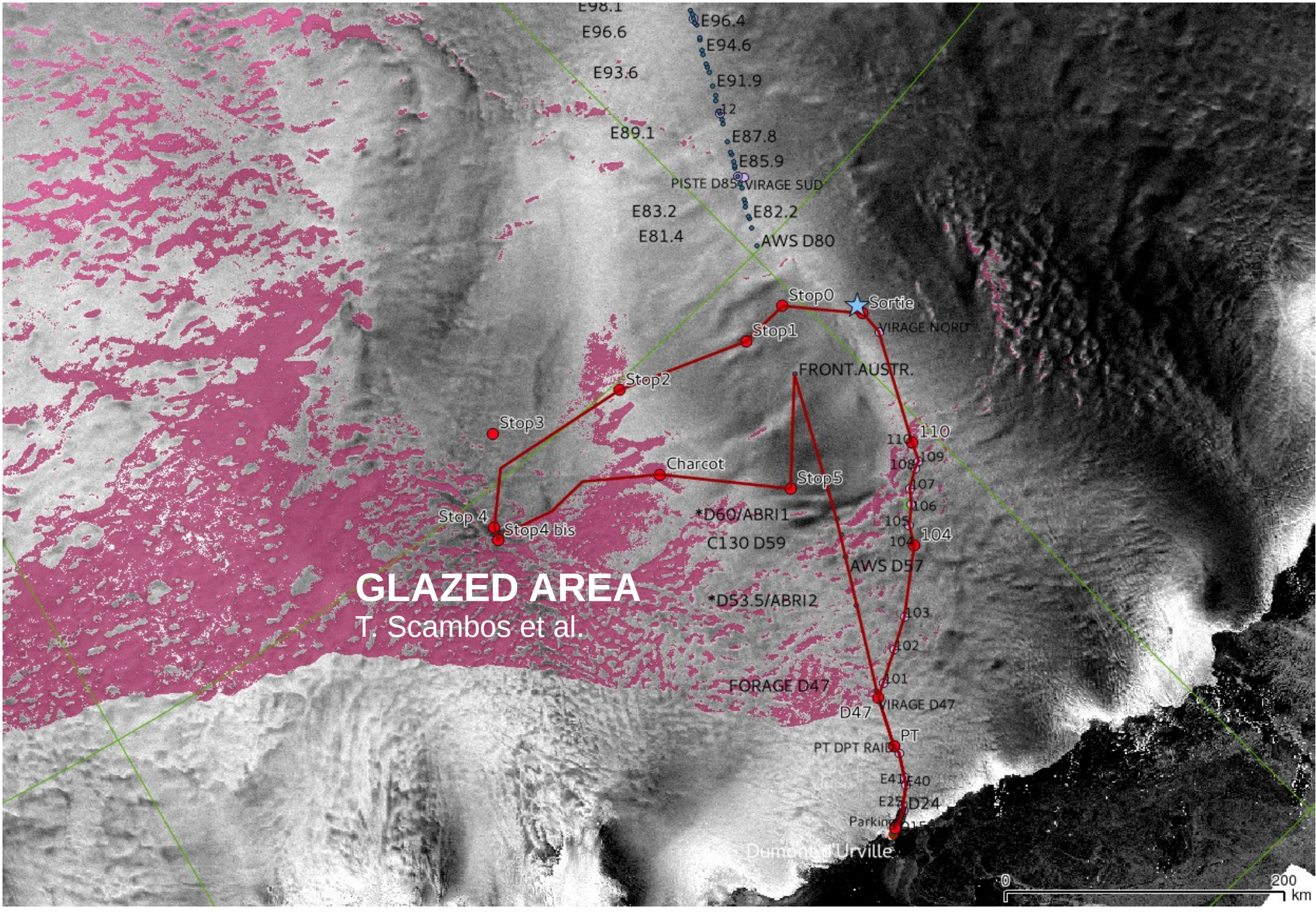
The road


Stop0
Sortie
Stop1
VIRAGE NORD
FRONT.AUSTR.
Stop2
Stop3
Charcot
Stop5
Stop 4
*D60/ABRI1
AWS D57
*D53.5/ABRI2
FORAGE D47
VIRAGE D47
PT DPT RAID
*E84.6/DEPOT3
E82.9
E81.4
E83.2
AWS D80
Dumont d'Urville
1370 km
34 days
0
200
km

The road


Prevailing wind direction
WET
WET
DRY
ROUGH
SMOOTH
VERY ROUGH
VERY ROUGH
Storm direction
Stop0
Stop1
Stop2
Stop3
Stop 4
Stop5
Charcot
VIRAGE NORD
*D60/ABRI1
AWS D57
*D53.5/ABRI2
FORAGE D47
VIRAGE D47
PT DPT RAID
Dumont d'Urville
E83.2
E82.9
E81.4
1370 km
34 days
0
200
km

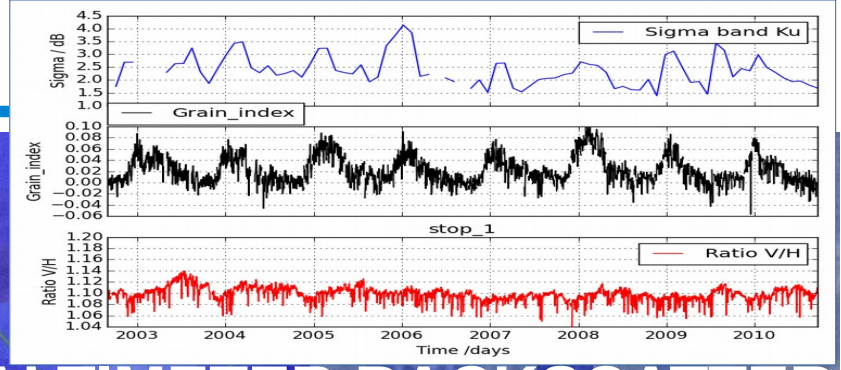
The road

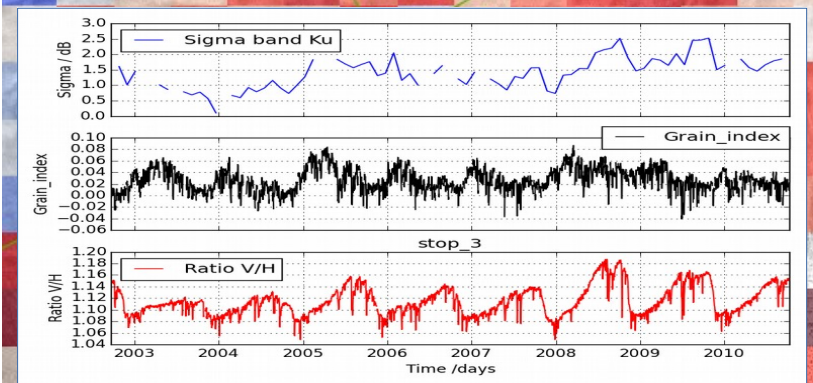

E96.4
E96.6
E94.6
E93.6
E91.9
E89.1
E87.8
E85.9
PISTE D85
VIRAGE SUD
E83.2
E82.2
E81.4
AWS D80
Stop0
Sortie
VIRAGE NORD
Stop1
FRONT.AUSTR.
Stop2
Stop3
110
109
Charcot
Stop5
107
106
*D60/ABRI1
Stop 4
Stop4 bis
105
104
C130 D59
AWS D57
GLAZED AREA
T. Scambos et al.
*D53.5/ABRI2
103
102
101
FORAGE D47
VIRAGE D47
D47
PT
PT DPT RAID
E41
E40
E25
D24
Parking
Dumont d'Urville
0
200
km

The road

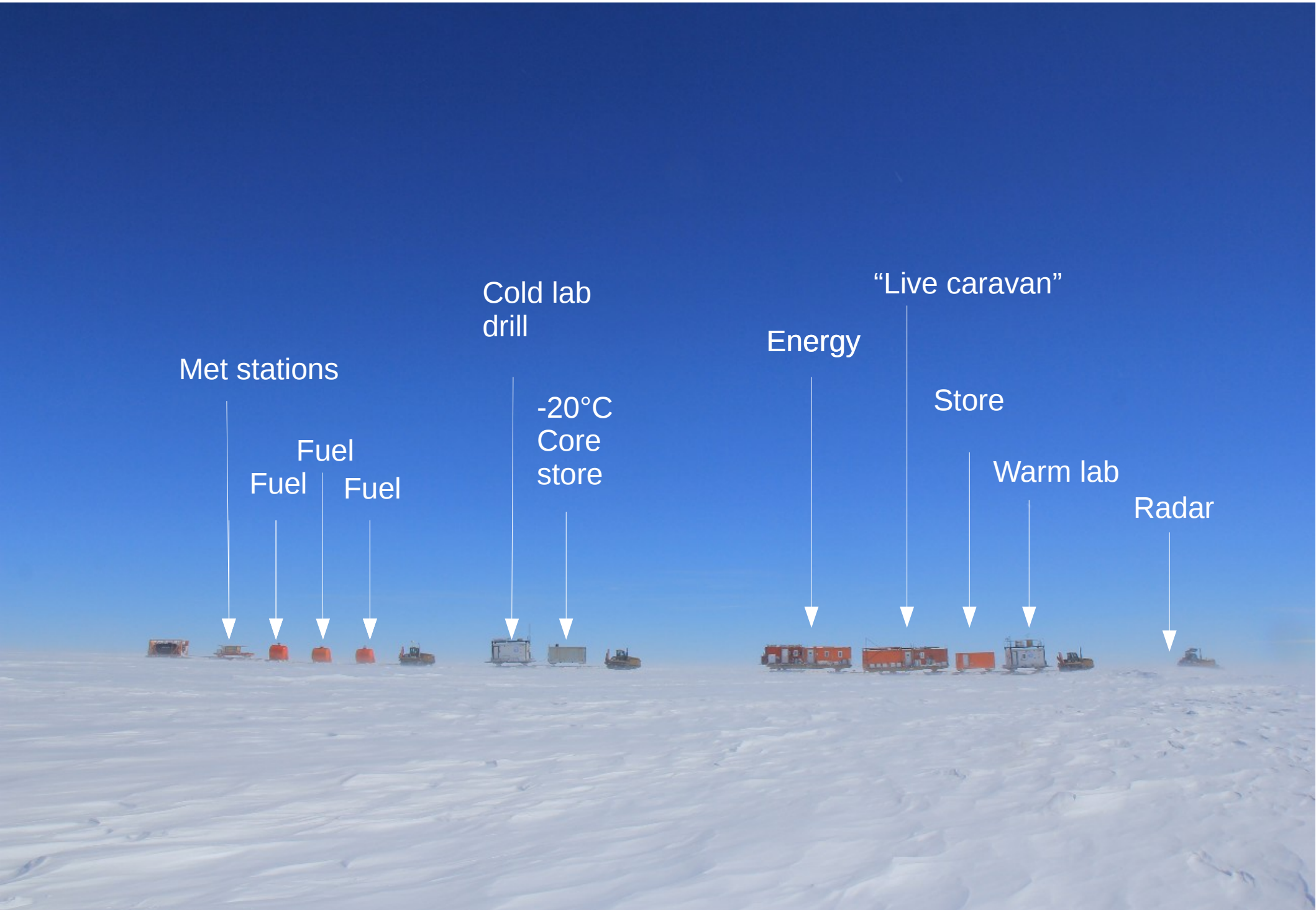
Ku ALTIMETER BACKSCATTER
Large amplitude
Max in automn/winter (red)

Ku ALTIMETER BACKSCATTER
Small amplitude
Max in summer (blue)





The logistics



The observations

Setup of nearly 50 stacks along the traverse (~every 25-40 km)
hoping to revisit them to measure the local accumulation

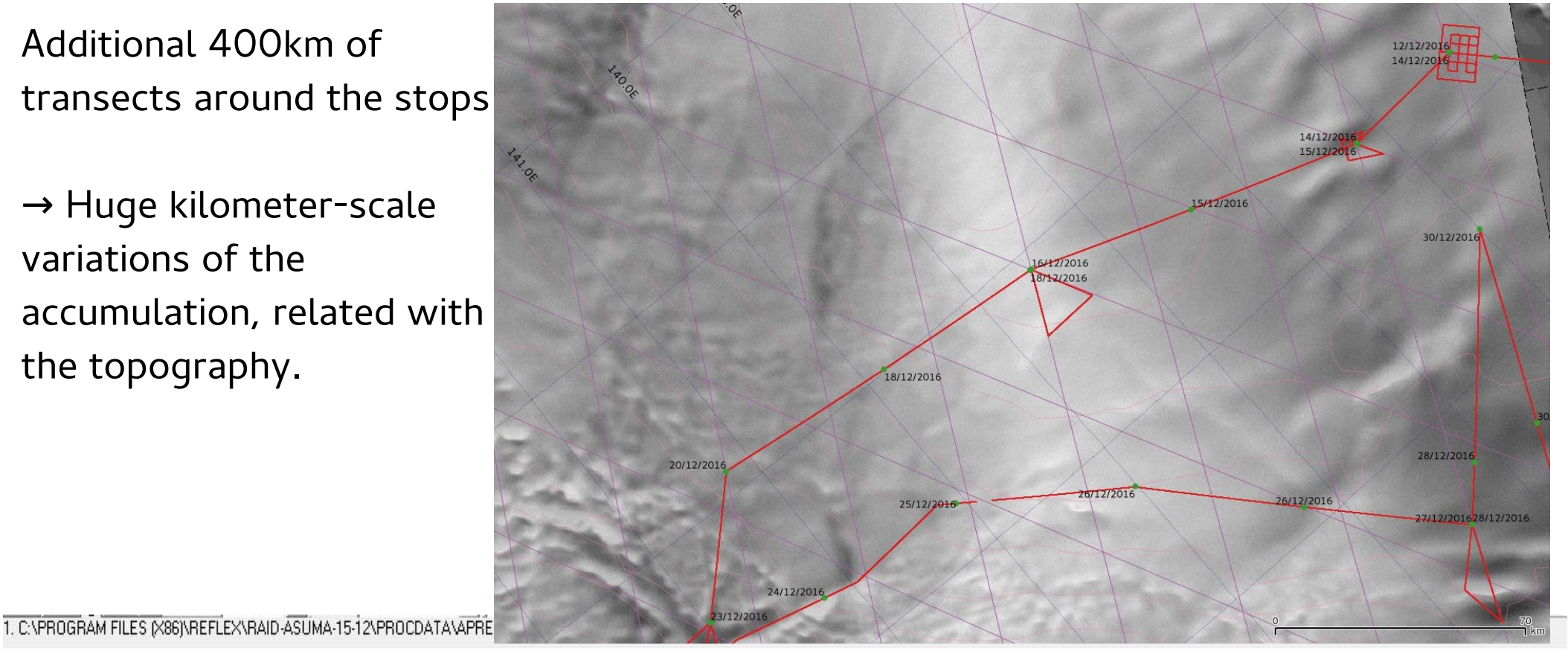
The observations

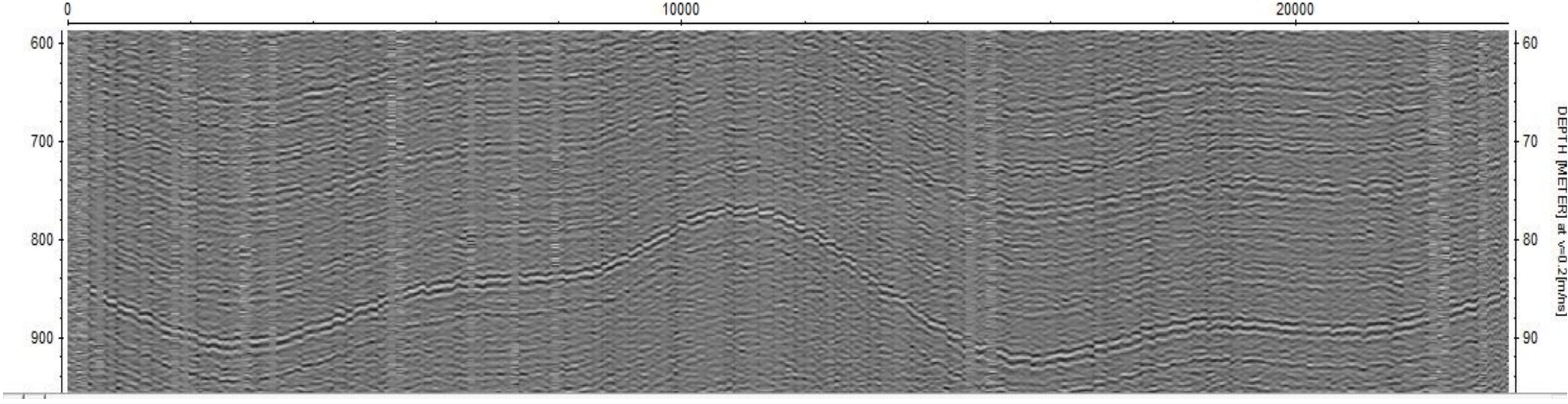
Relative accumulation measurements with GPR along the 1300km of the traverse

The observations

Additional 400km of transects around the stops

→ Huge kilometer-scale variations of the accumulation, related with the topography.





The observations

Absolute accumulation (radiochemistry), origin of precipitation (isotopes, ions) , ... from firn cores

Mini-felics: 20m in 2h

Felics: 50m in 1.5 days

The observations

We have collected 25 cores at 16 sites, or 580m of firn

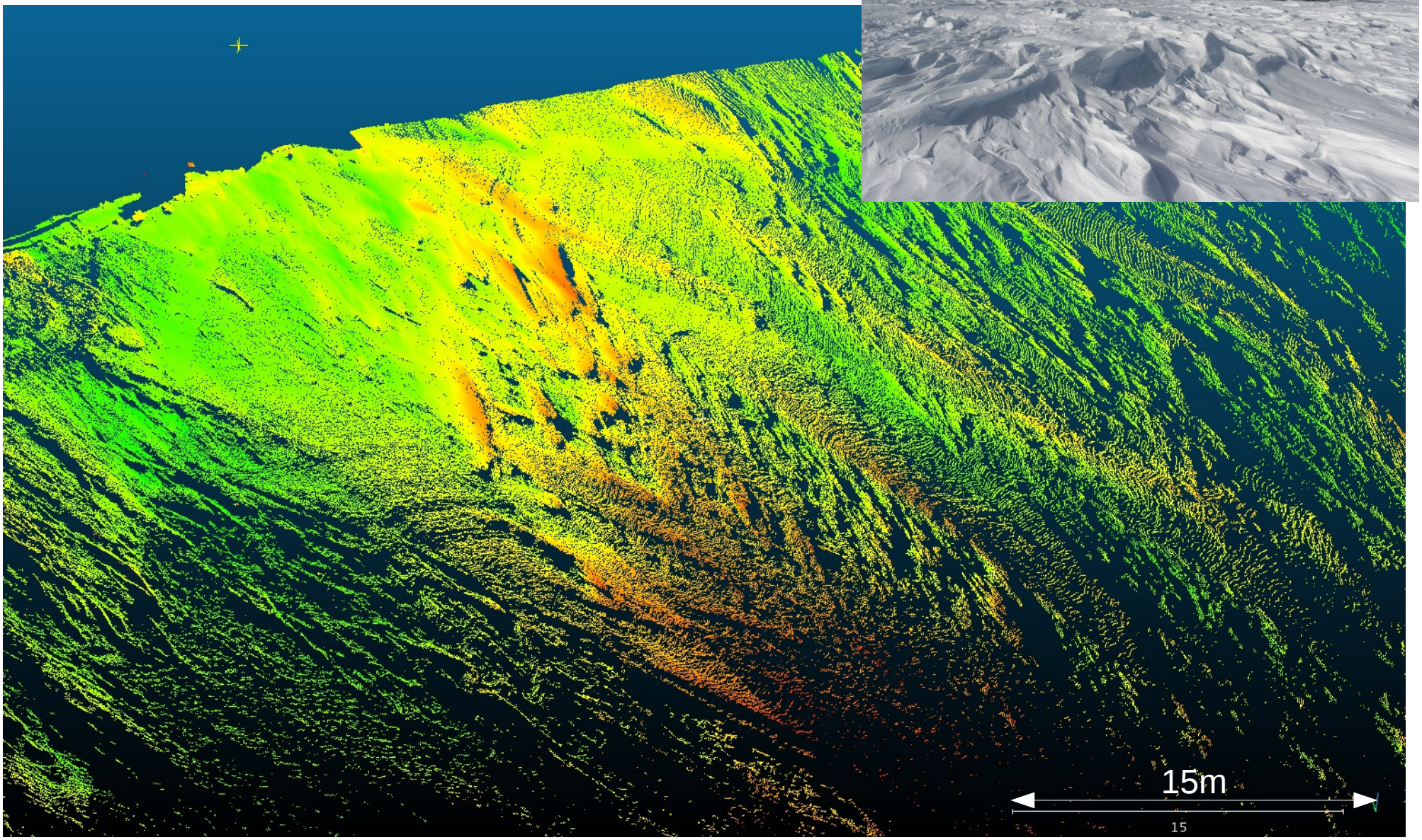
The observations

Roughness measurements: OSUG laserscan

35 scans at 25 locations

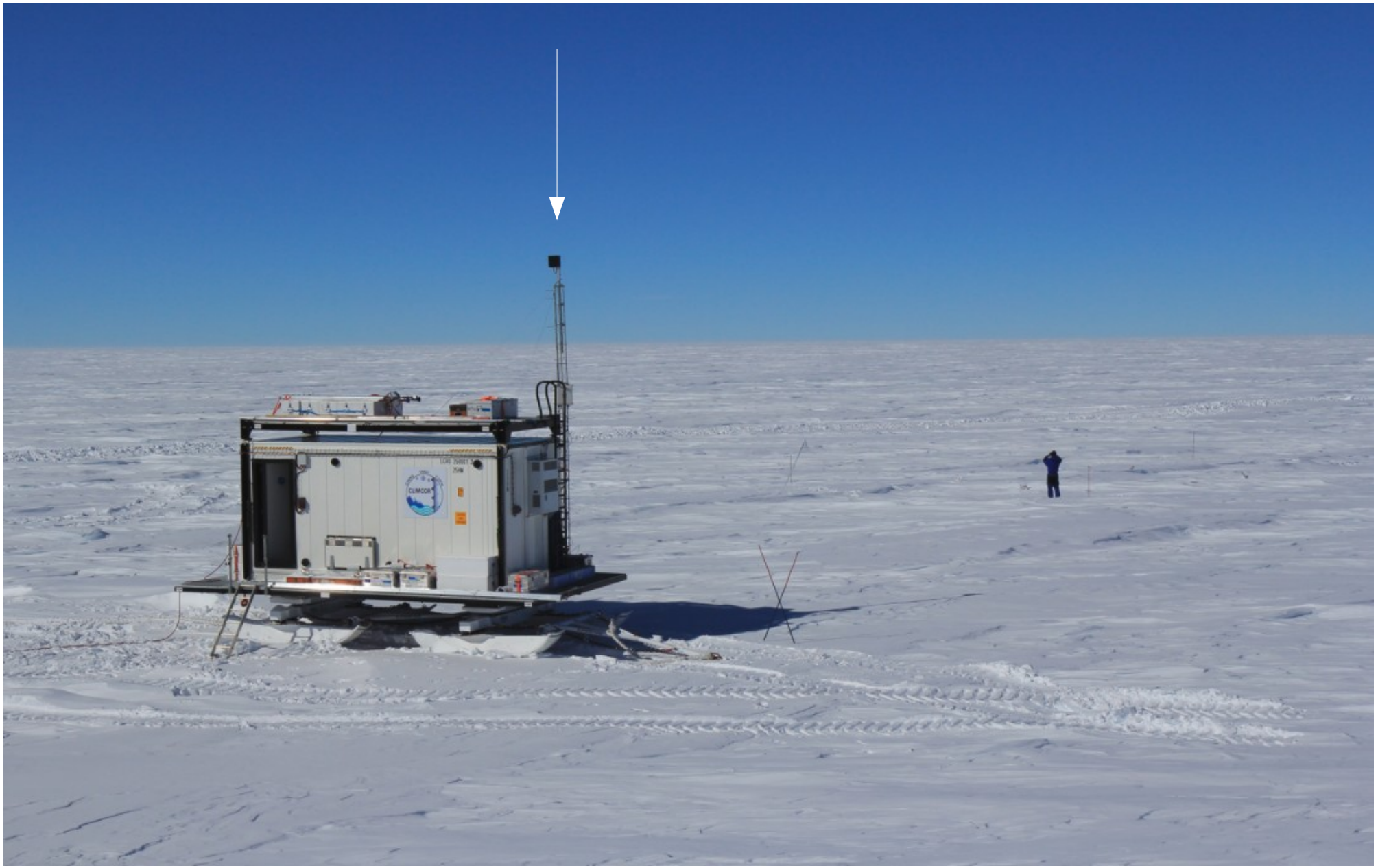
The observations

Scan at STOP3



The observations

Roughness measurements: home-made rugged laser scan

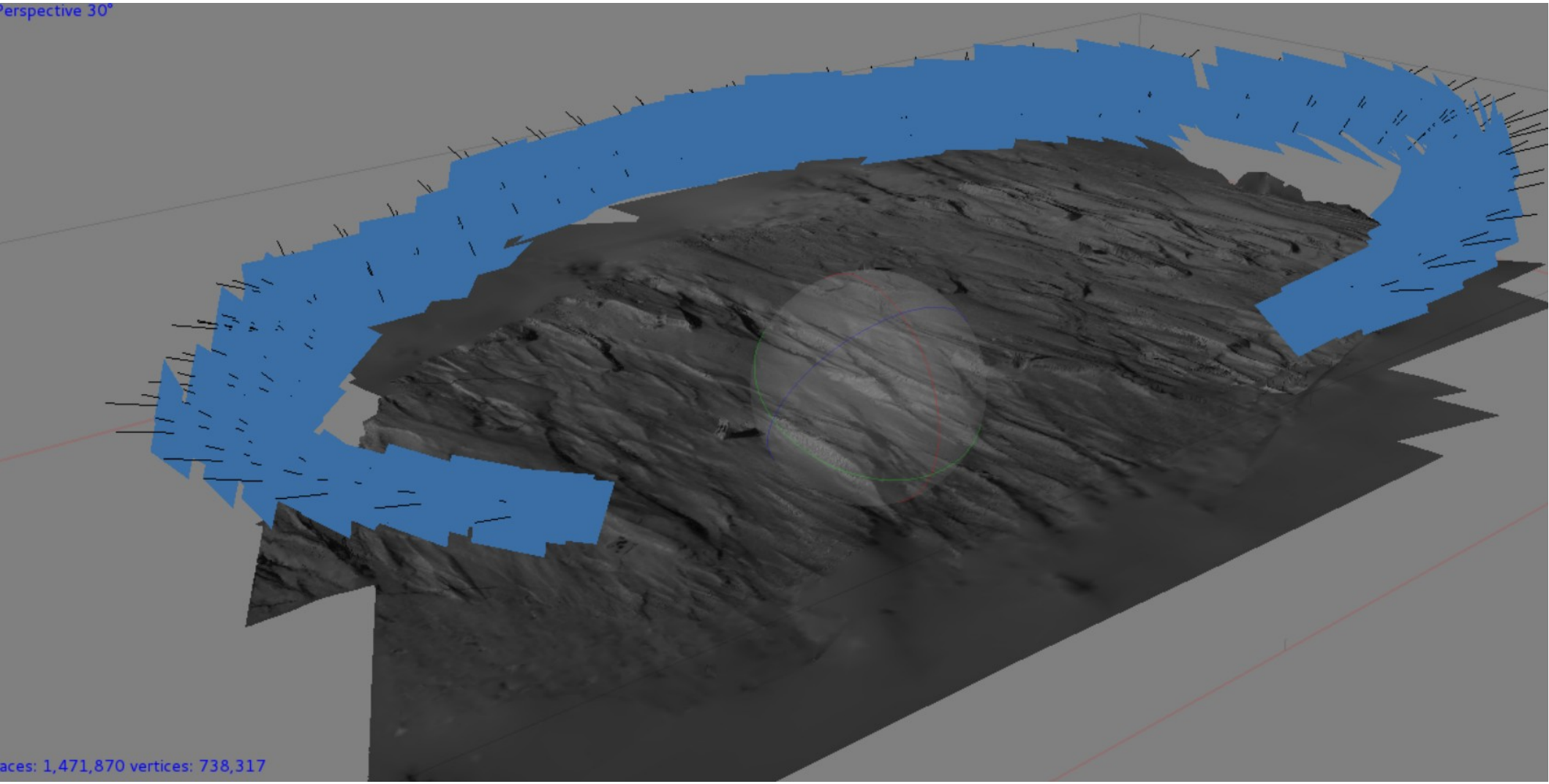


The observations

Roughness measurements: multiphotograhy and dense correlation processing (Photoscan software)

The observations

Roughness measurements: multiphotograhy and dense correlation processing (Photoscan software)



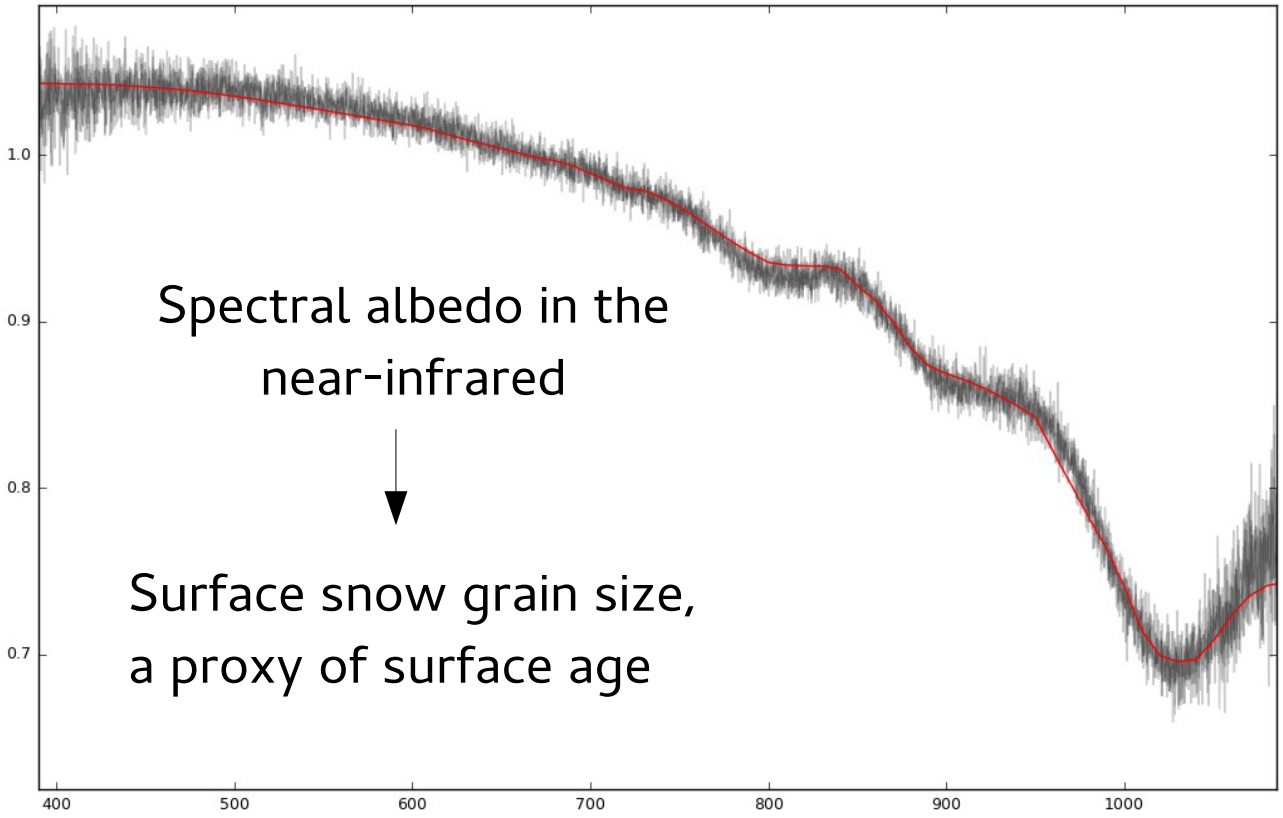
The observations

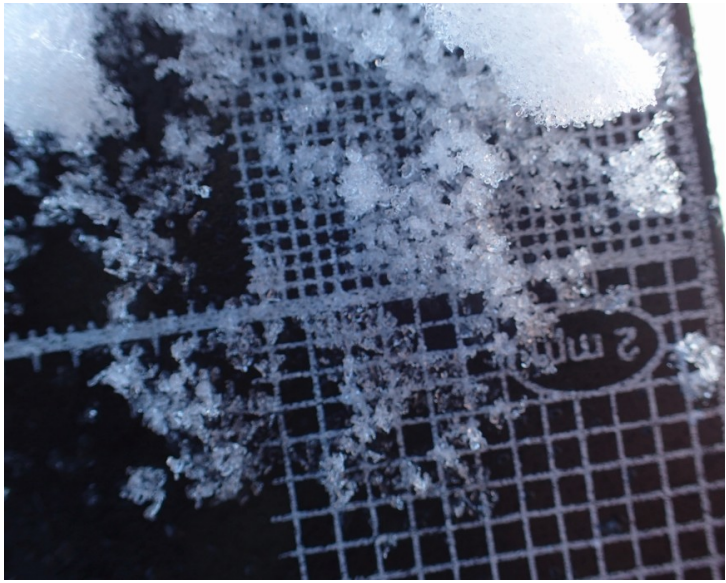
Spectral albedo measurements at every stop

The observations

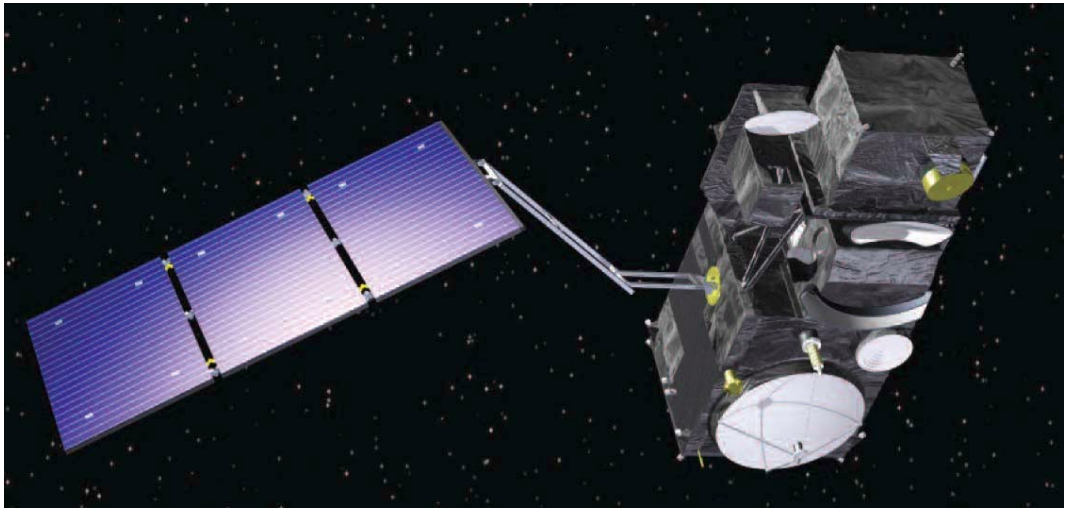
at every stop... 300 spectra collected.

The observations





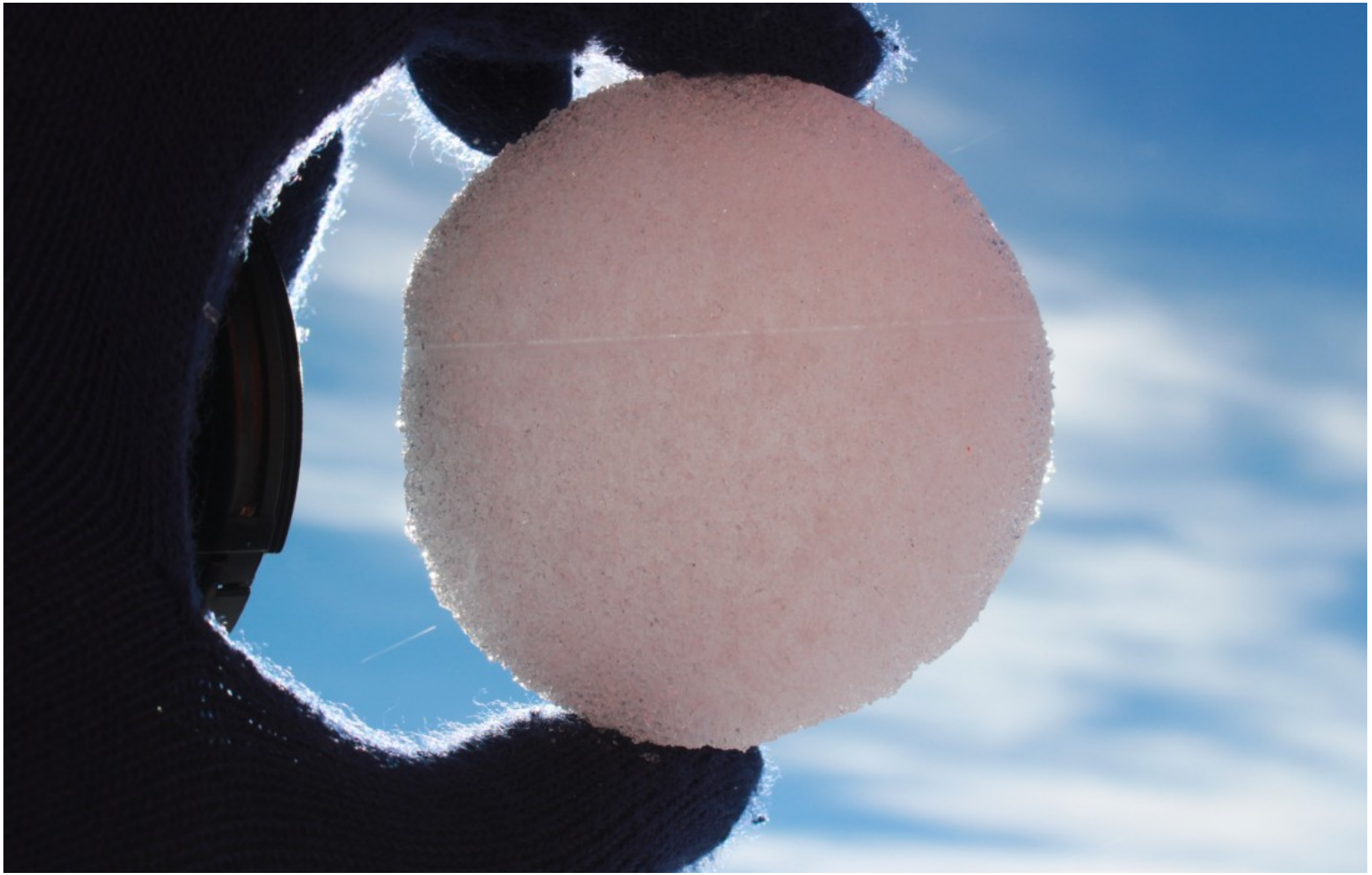
sentinel-3



Maxim Lamare (CEN/IGE)

The observations

General snow physics observations



The observations

Snow physics: profiles of **grain size** and **density** over 8m

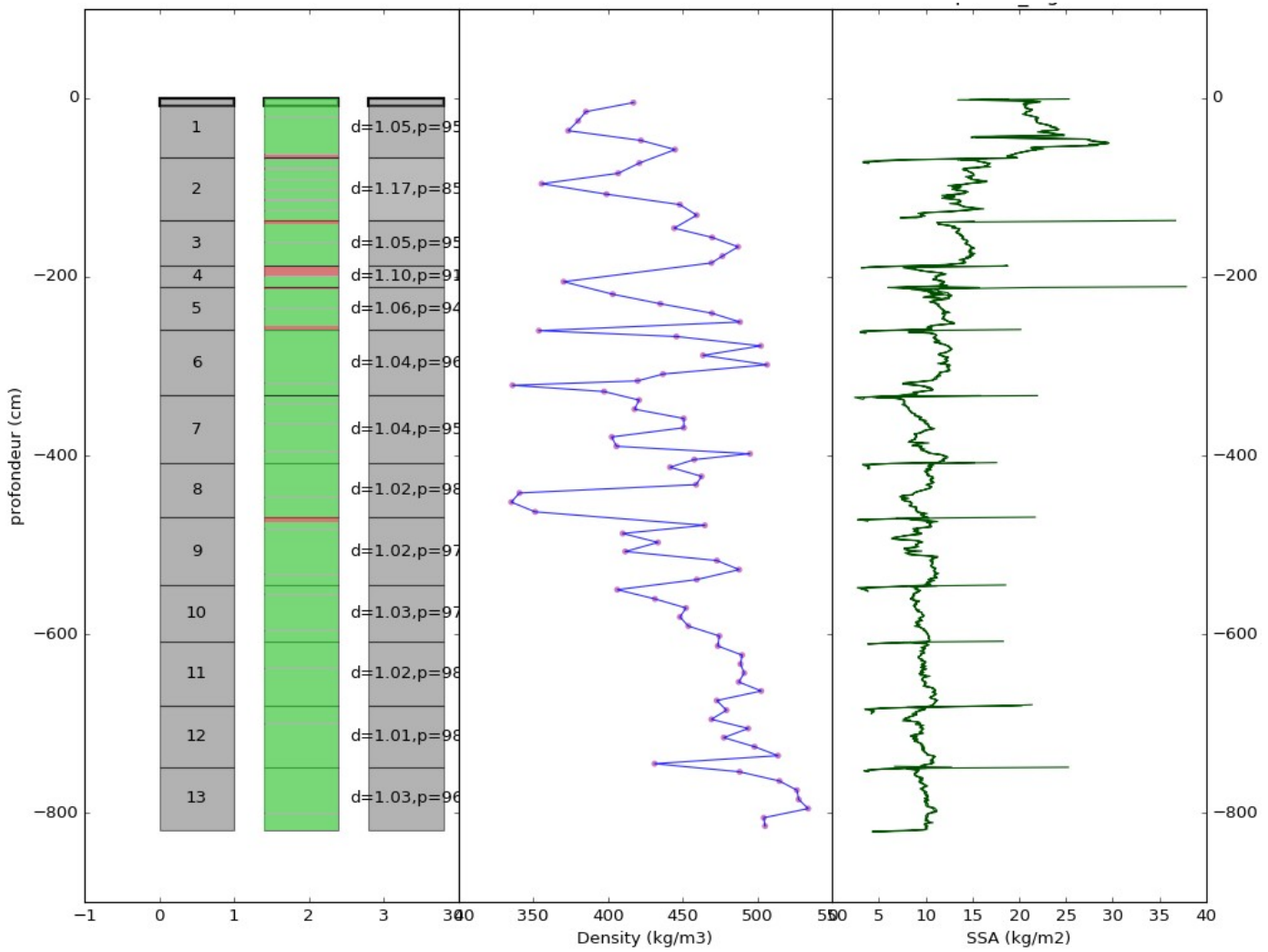
Volume+mass measurements every 10 cm

Optical grain size measurements with ASSSAP

The observations

Snow physics: ~15 profiles of grain size and density of up to 8m

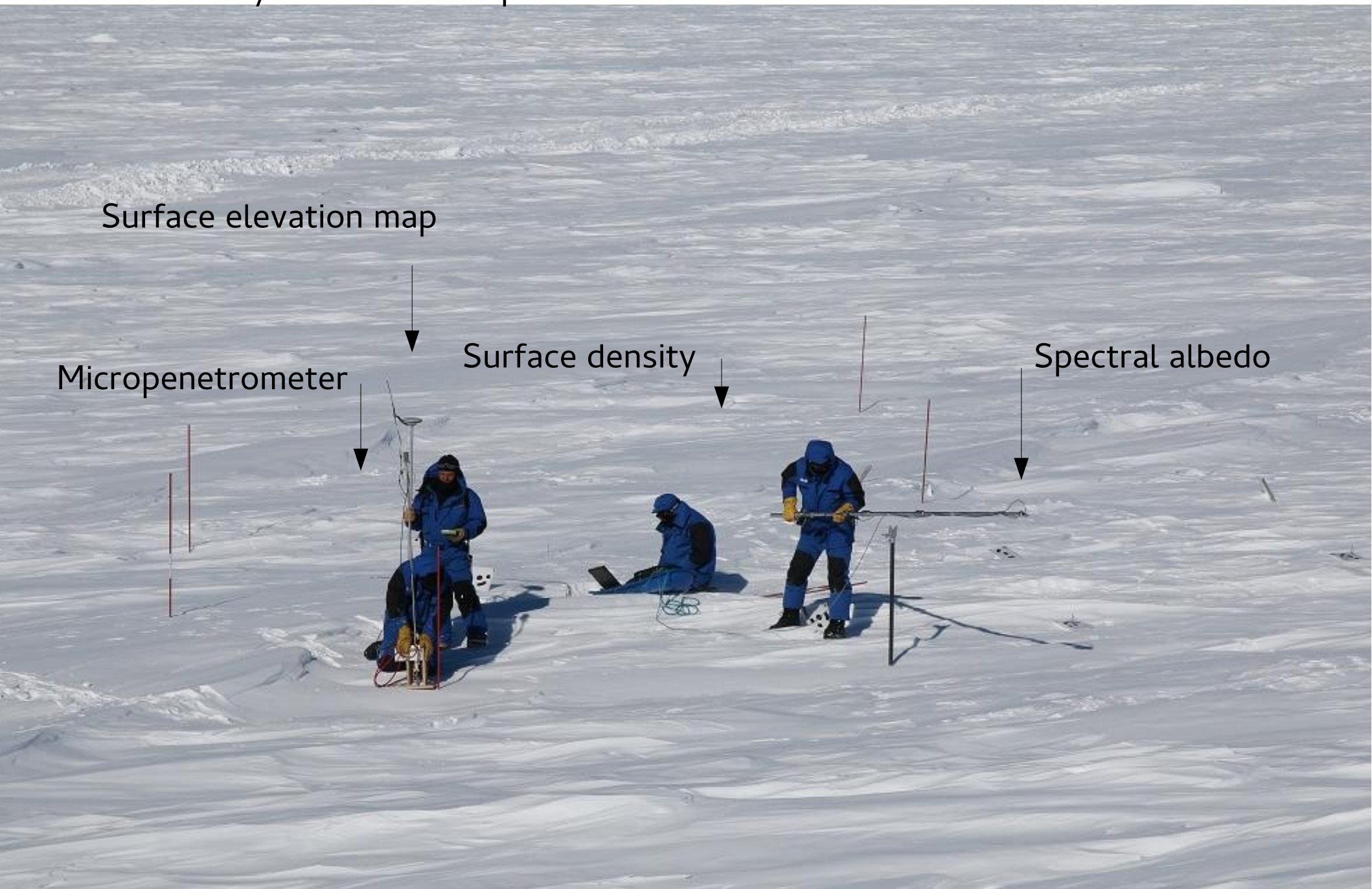
With training it takes 2h for two persons, extraction of the snow core, density and grain size processing



→ application to microwave modeling and snow evolution modeling (stage A. Lemoine)

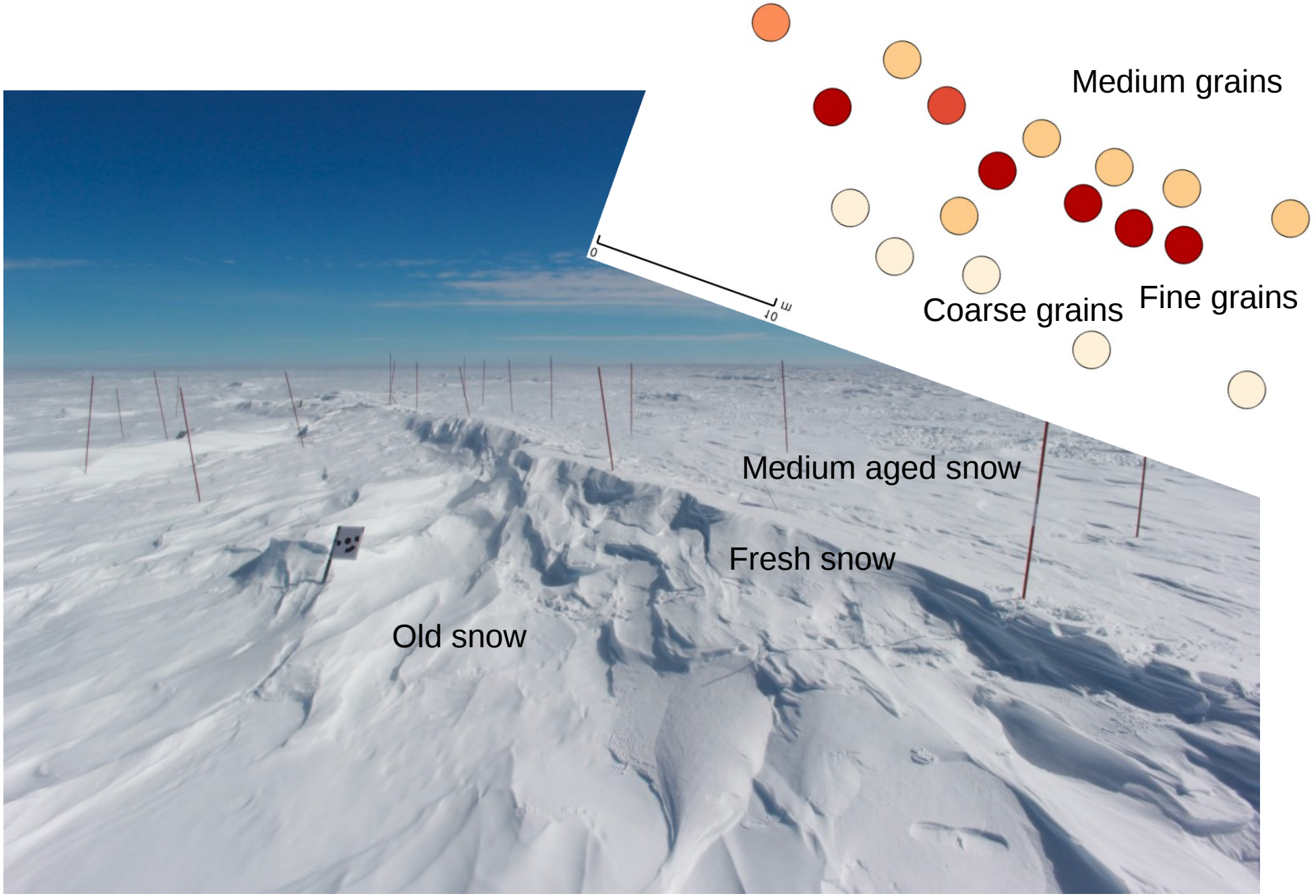
The observations

Detailed study of dunes: ~20 points in 100m^2



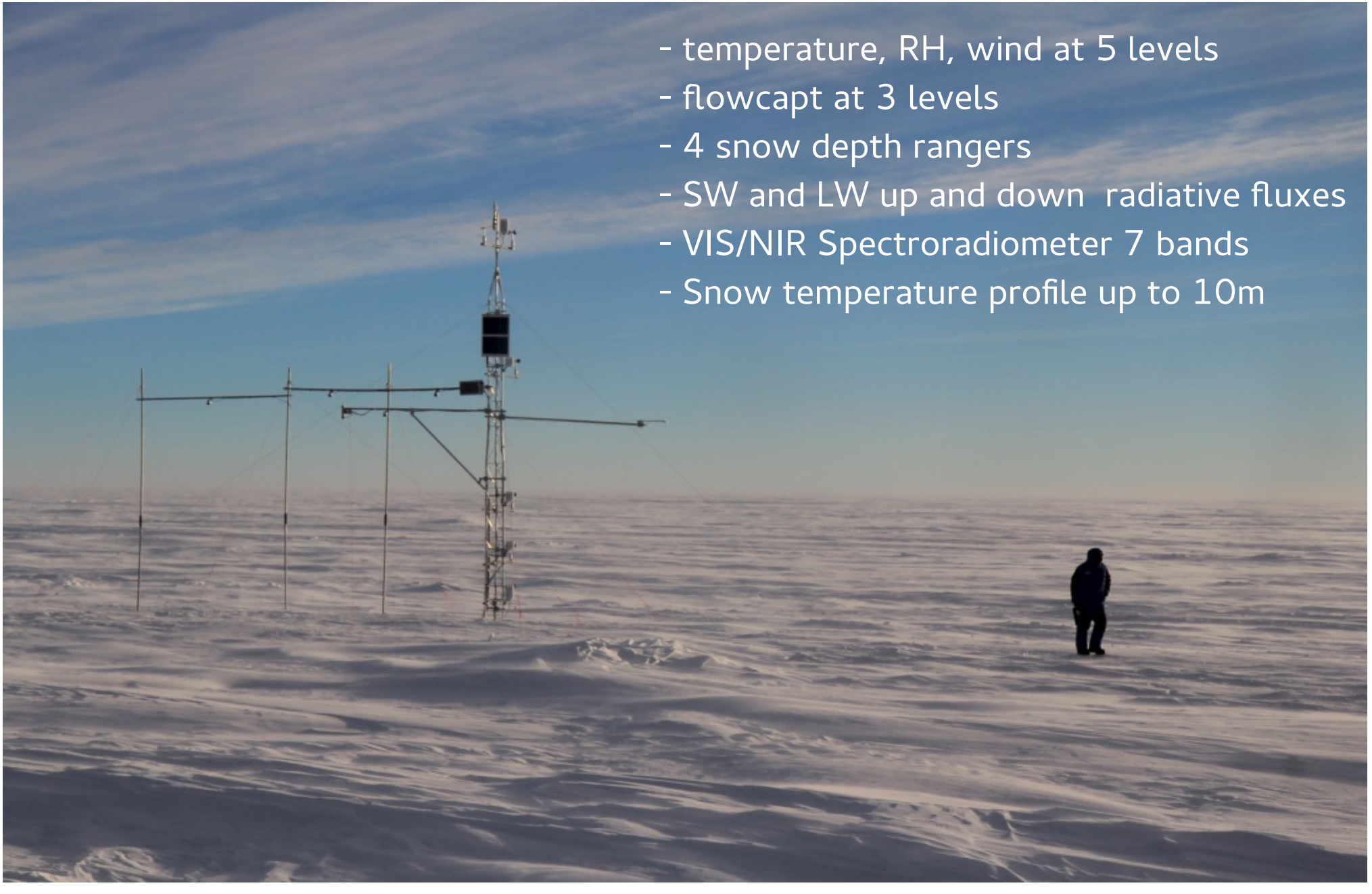
The observations

3 detailed studies of dunes



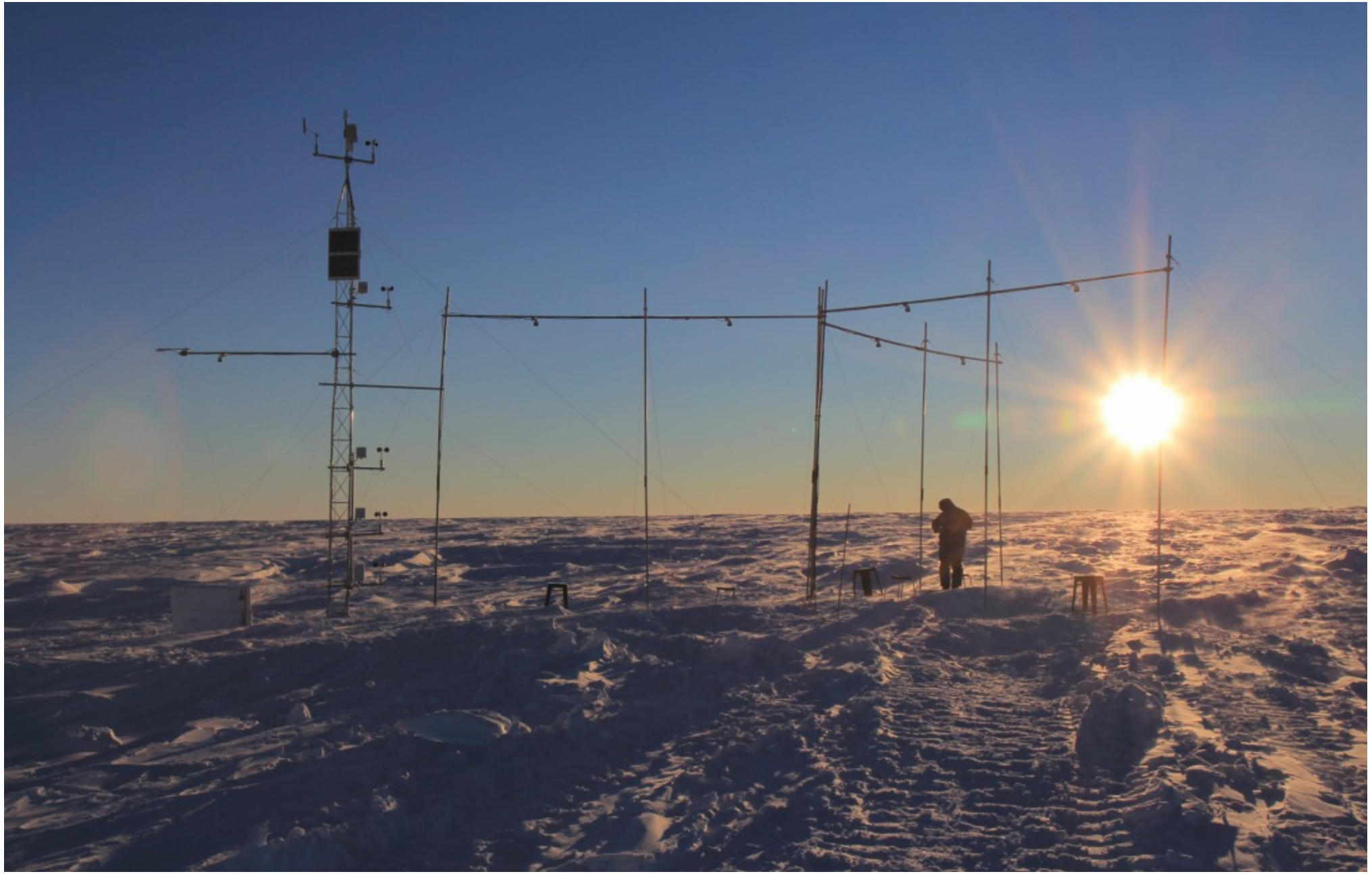
The observations

2 met stations at STOP0 (wet / smooth) and STOP4 (dry / rough)



The observations

Unfortunately, the solar panels on STOP4 station failed... the station is going to die



First scientific conclusions

- The annual accumulation varies at kilometer scale in very large proportion as a function of the small topographic changes

- High variability of surface roughness and types of roughnesses.

First scientific conclusions

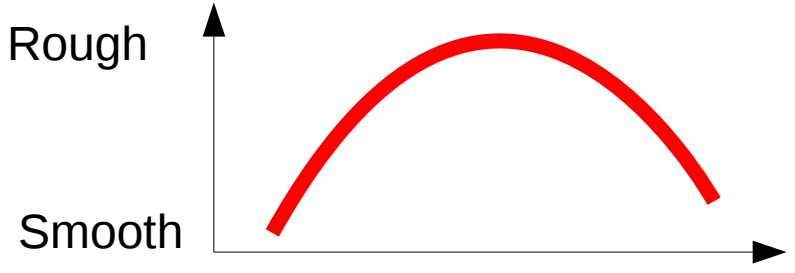
- High variability of surface roughness and types of roughness (cont.)

First scientific conclusions

- High variability of surface roughness and types of roughness (cont.)

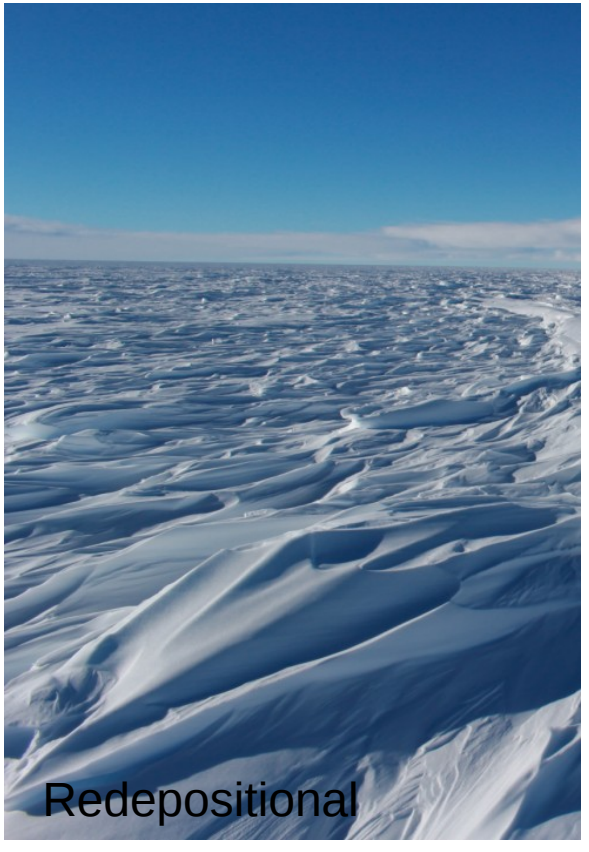
First scientific conclusions

Roughness is controlled by accumulation and wind/slope (e.g. Frezzotti et al.)



Accumulation/wind ratio: low medium high

Glazed or erosional


Redepositional

High accumulation

Main conclusion

We have collected tons of data to work on!

It has been a great experience, opening our view on the diversity of surfaces