

2nd STG/IPY SAR Coordination Meeting

DLR, Oberpfaffenhofen, Germany, September 30th to October 1st 2008



Alfred-Wegener-Institut
für Polar- und Meeresforschung
in der Helmholtz-Gemeinschaft

V. Helm, H. Miller
Alfred Wegener Institute

AWI activities and interests



CryoVEx – CryoSat Calibration Validation Experiment
ASIRAS – Airborne SAR Interferometric Radar Altimeter

AWI Activities and Interests

general Interests:

How to understand microwave signals?

(SAR backscatter, Altimetrie waveform shape and influence on elevation estimates)

- Snow properties and their variations in time and space in different snow regimes (coastal to plateau → traverse !!)
- SMB and change of phys. parameters of (sub)surface snow/firn (density, stratigraphy, porosity, densification)

Ice flow velocity and its variation in time of Greenlands major outlet glacier
(mass balance and sea level)

Sea ice extend and thickness?

Satellite validation on Antarctic plateau and Blue Ice (Kohnen and Novo Airbase)?

Region:

Antarctic Peninsula to Syowa station (mainly DML)

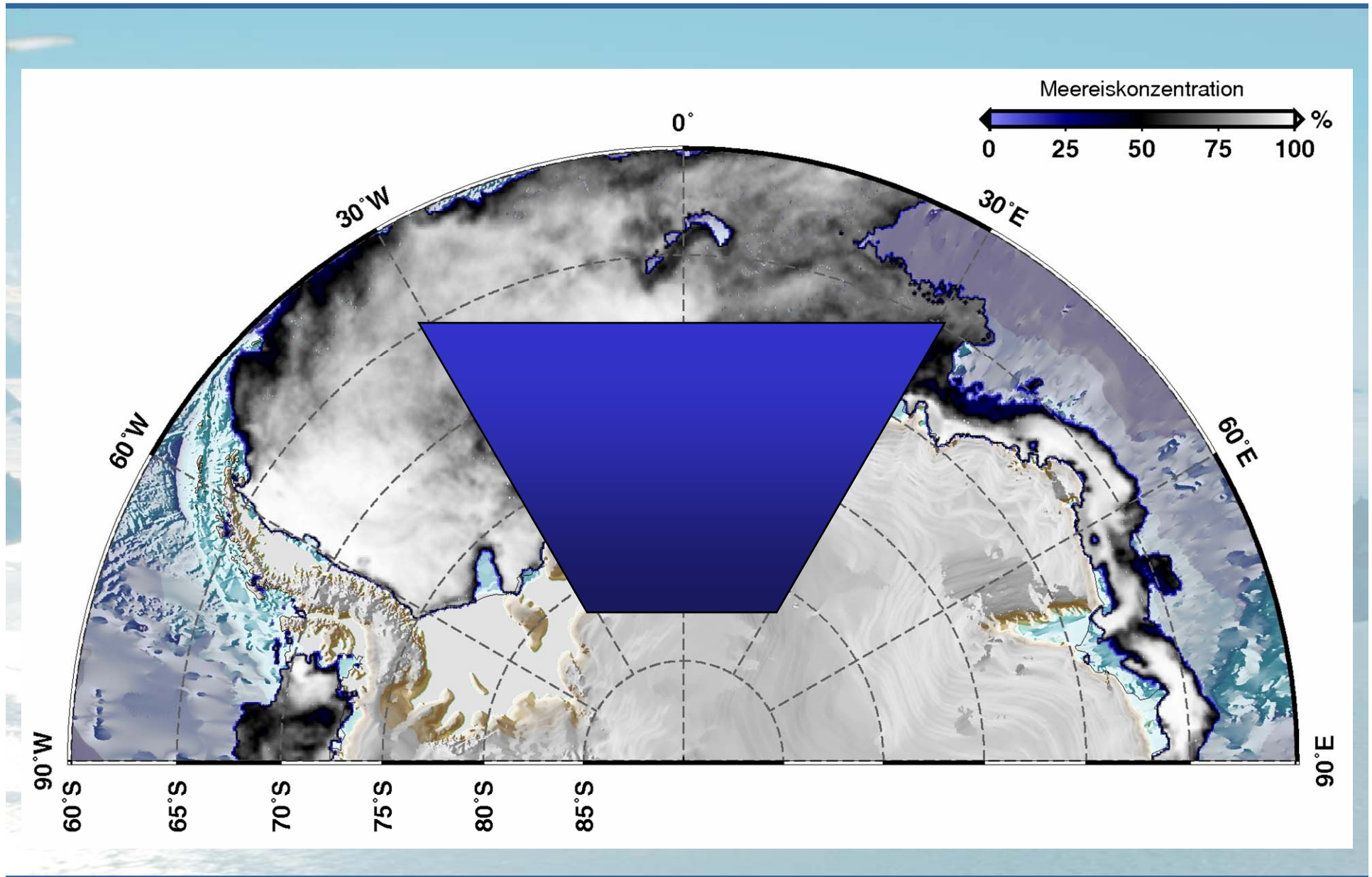
Greenland (outlet glaciers and Percolationzone)

Data:

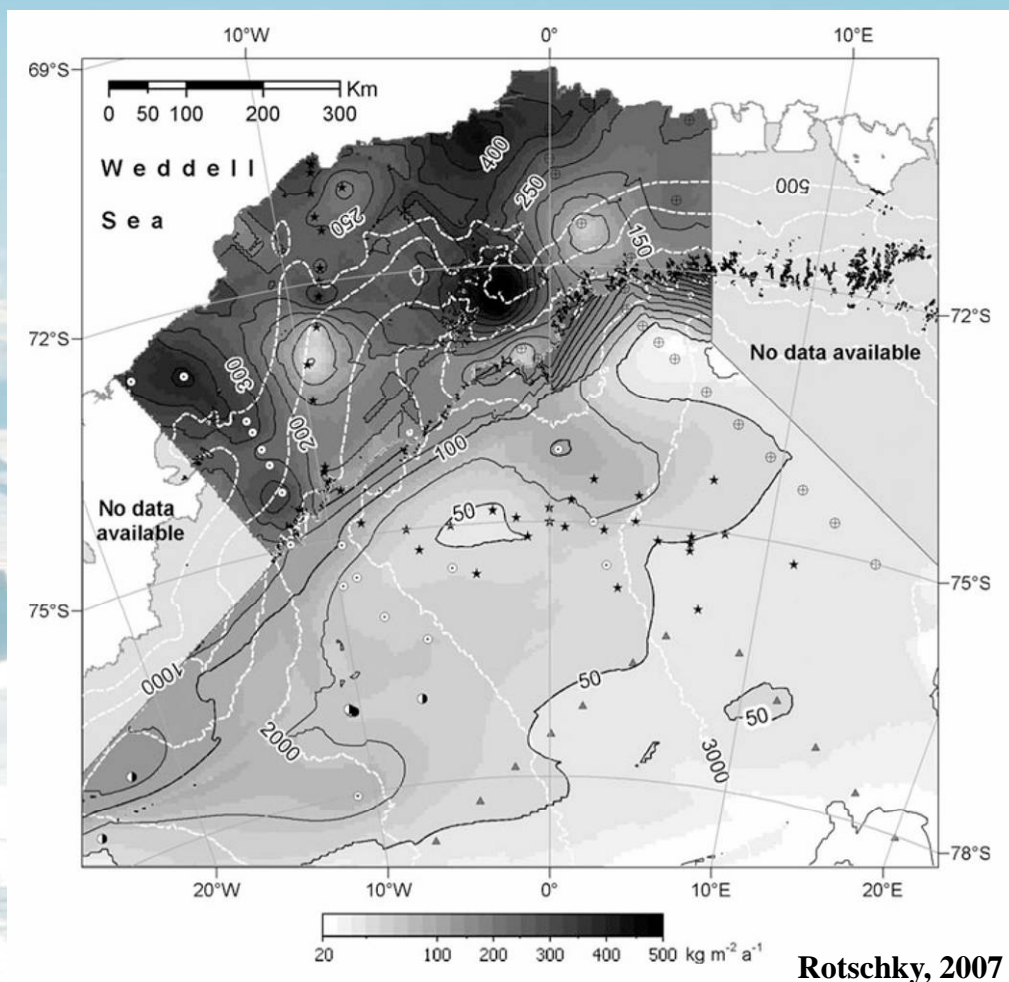
Altimetrie: CryoSat2, IceSat

SAR/InSAR: TerraSAR-X, TanDEM-X, ENVISAT, Radarsat2

Antarctica (DML) - Drill and pit positions



Accumulation map of DML



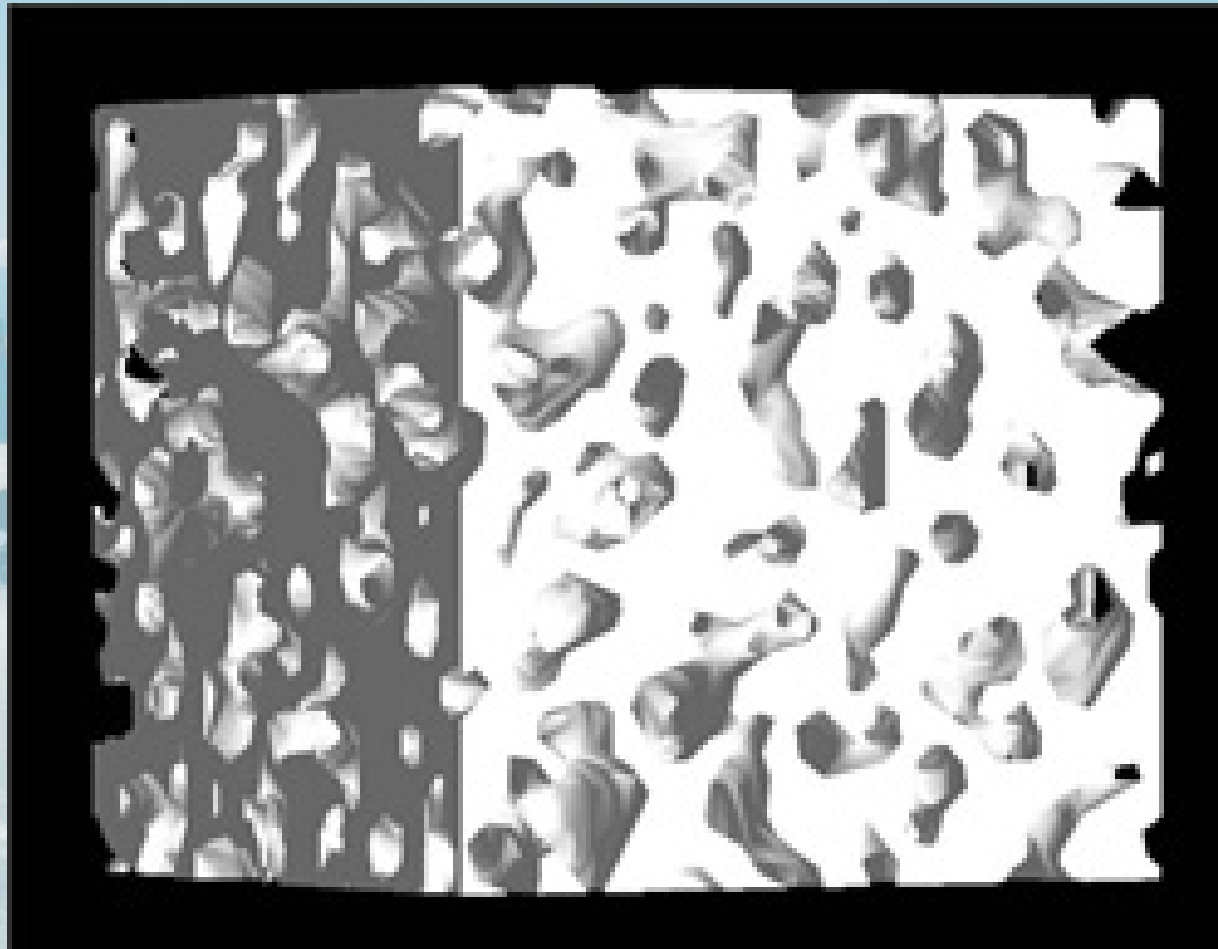
AWI's new accumulation radar will fill gaps in the next years

Basis for satellite derived accumulation

Micro CT

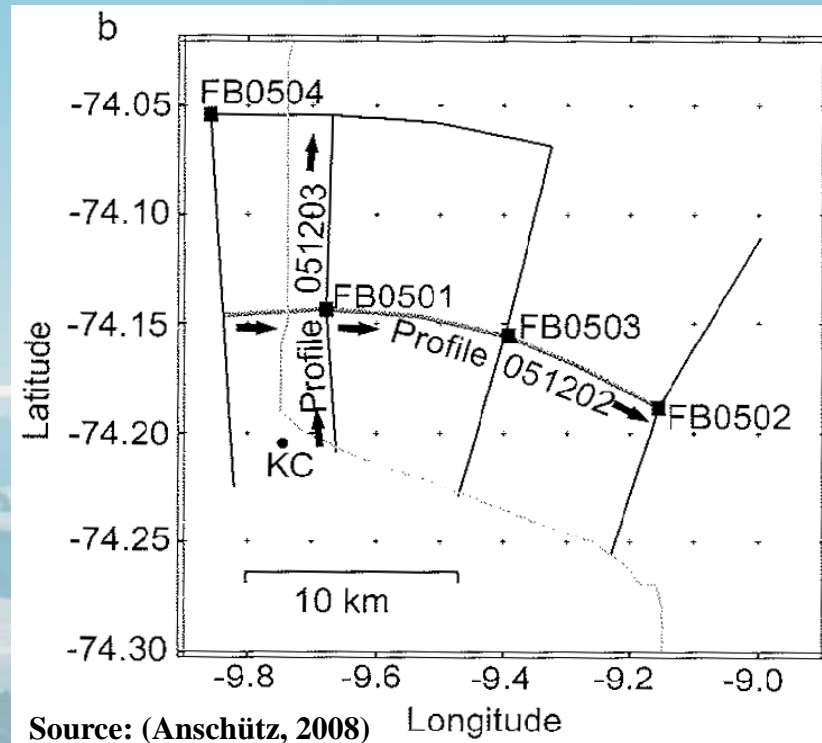
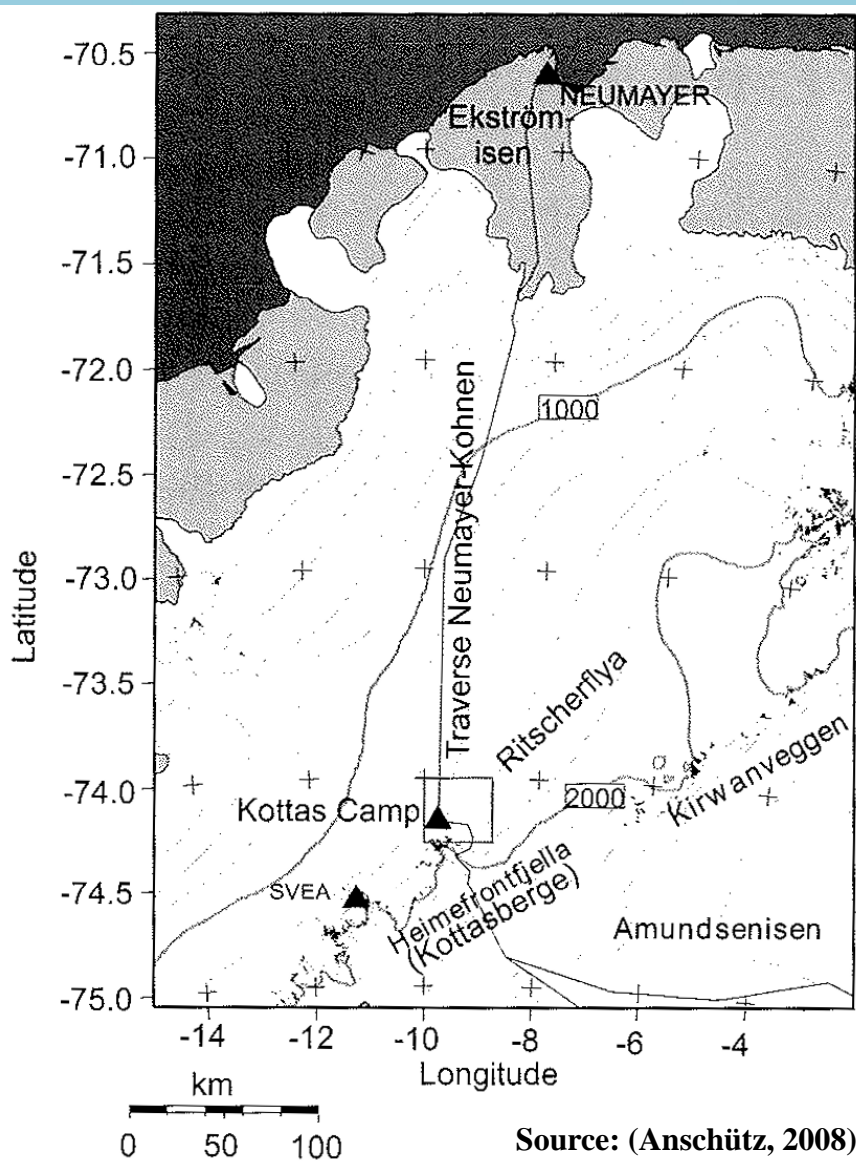


Micro structure of near surface firn (2.5 m depth)



Hörhold

Kottas traverse and Ritscherflya



Ground data:

- Stake and GPS along traverse
- shallow firn cores (~12 m)
- snowpits
- GPR
- different snow regimes (coastal to plateau) !!!**

Satellite validation

Kohnen station: (Antarctic plateau)

Available datasets shallow firn cores
 snowpits
 GPR grid
 EPICA deep ice core



Future activities: continue longterm observations
(revisited site) (sub)surface phys. Parameters
 shallow cores
 surface roughness

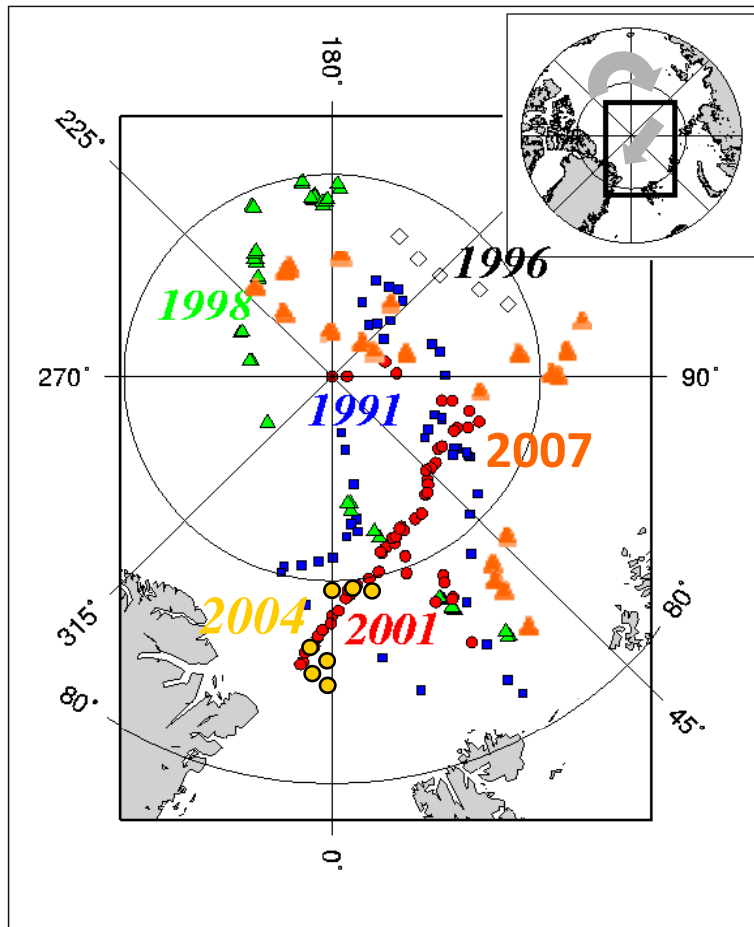
Kohnen represents the vast Antarctic plateau

(low accumulation, katabatic winds, dry cold snow)

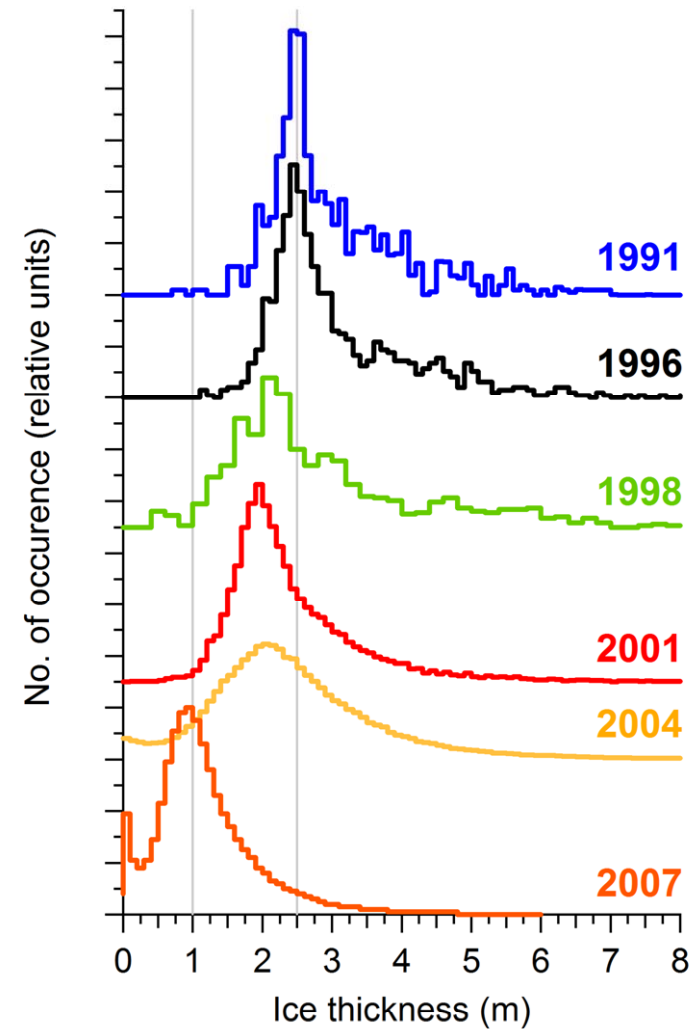
Longterm datasets are available in combination with a high scientific standard in field data analysis and techn. equipment at AWI

Airborne acquisition can be combined with field activity

Variability of sea ice thickness in the central Arctic



Haas, 2004



Rabenstein, Hendricks, Leinweber, 2007

CryoVEx and ASIRAS

CryoVEx: (**Cryo**Sat **V**alidierungs-**Ex**periment):

Calibration and Validation of CyoSat by simultaneous acquired ground- and airborne measurements

Ground measurements:

- snow stratigraphie (upper 2m)
- shallow firn cores (~10 m)
- density profiles
- surface topography
- GPR (Dunse, 2008)

Airborne measurements:

- Radar altimeter – ASIRAS
(**A**irborne **S**ar **I**nterferometric **R**adar **A**ltimeter **S**ystem)
- laser scanner



POLAR5



Parameter		POLAR 5
length, height, width	(m)	20,66 / 5,20 / 29,00
cabine: length, height, width	(m)	12,85 / 2,00 / 2,34
max. payload	(kg)	3900
fuel consumption	(kg/h)	500
operating distance	(km)	2900 (up to 10h)
number of passengers		18
max. flying altitude	(m)	7600
min./max. speed	(km/h)	185/400
max. take off altitude (ski)	(m)	>3850

Instrumentation



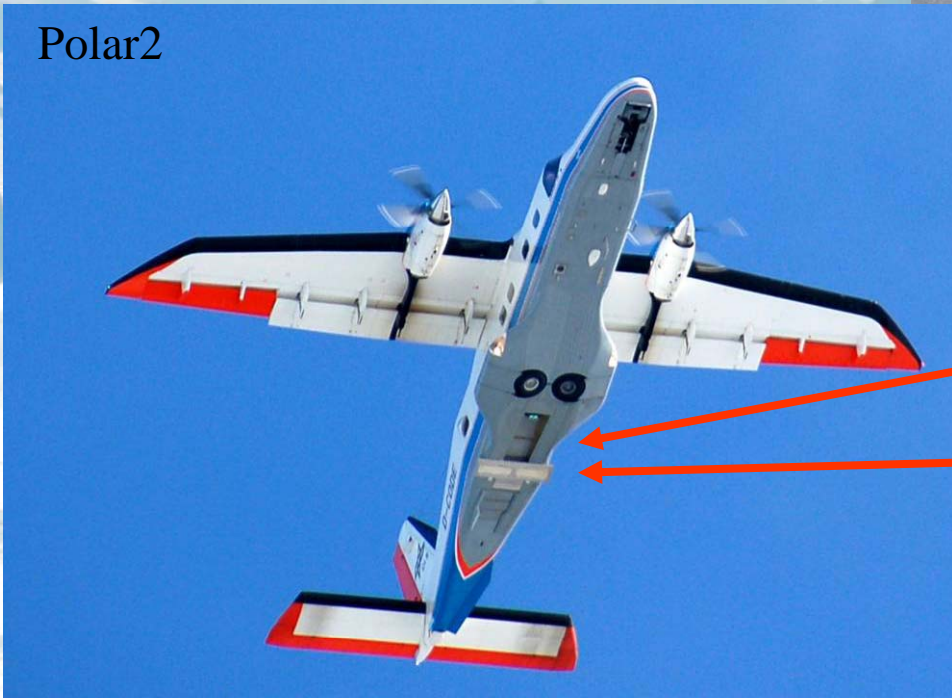
Polar5



GPS

INS (Trägheitsplattform)

Polar2

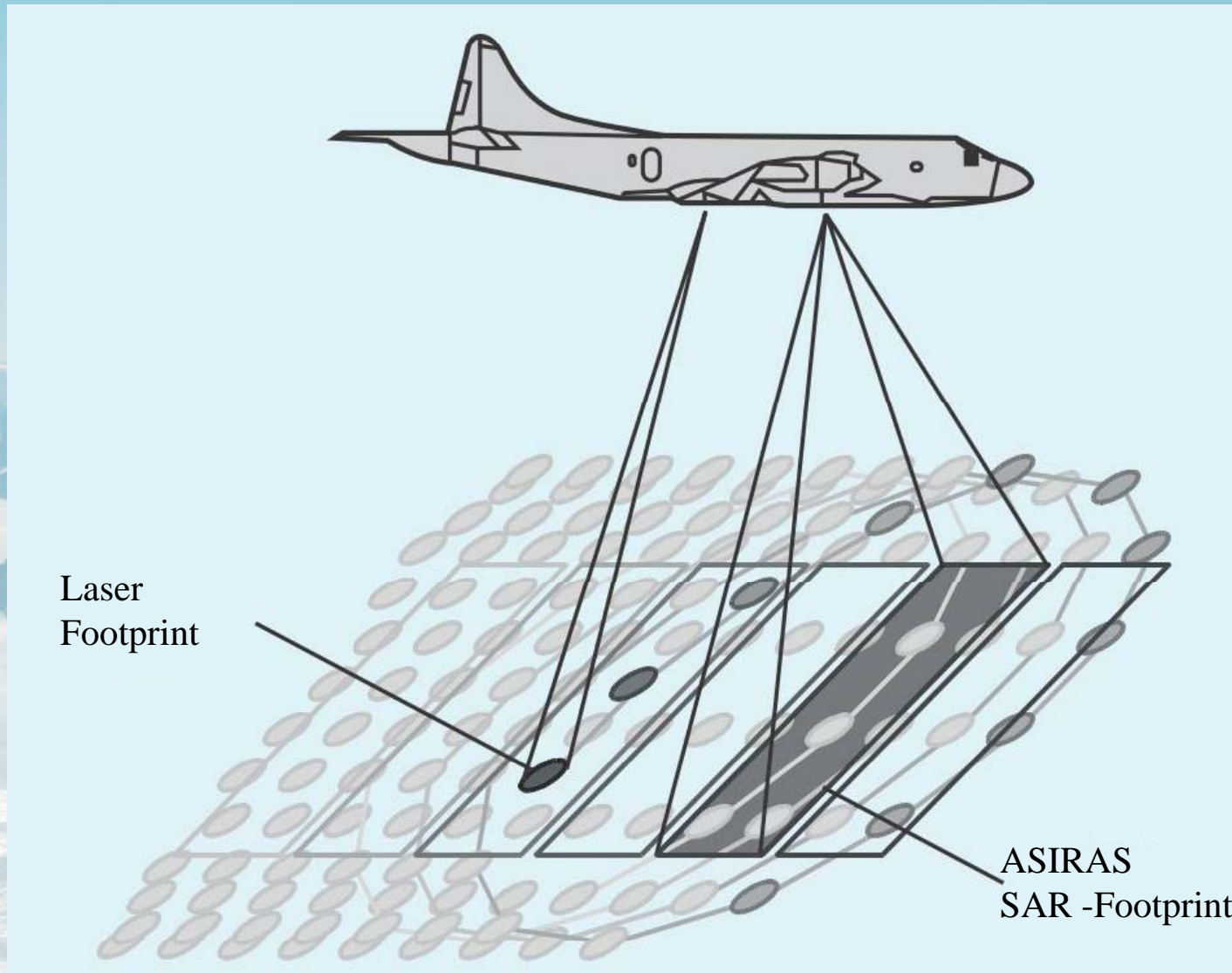


Laserscanner

ASIRAS

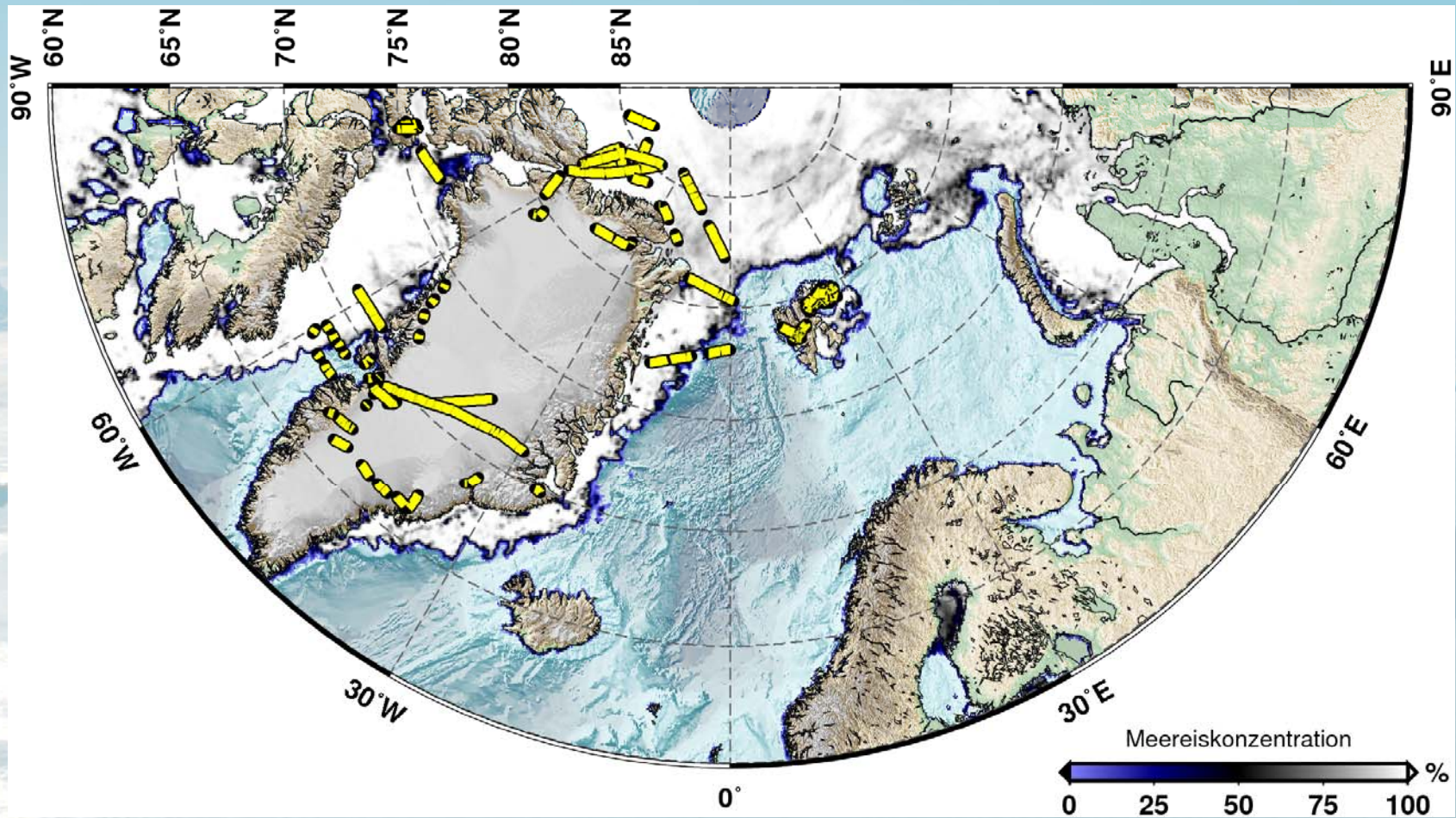
Bildquelle: <http://www.esa.int/SPECIALS/Cryosat>

Instrumentation



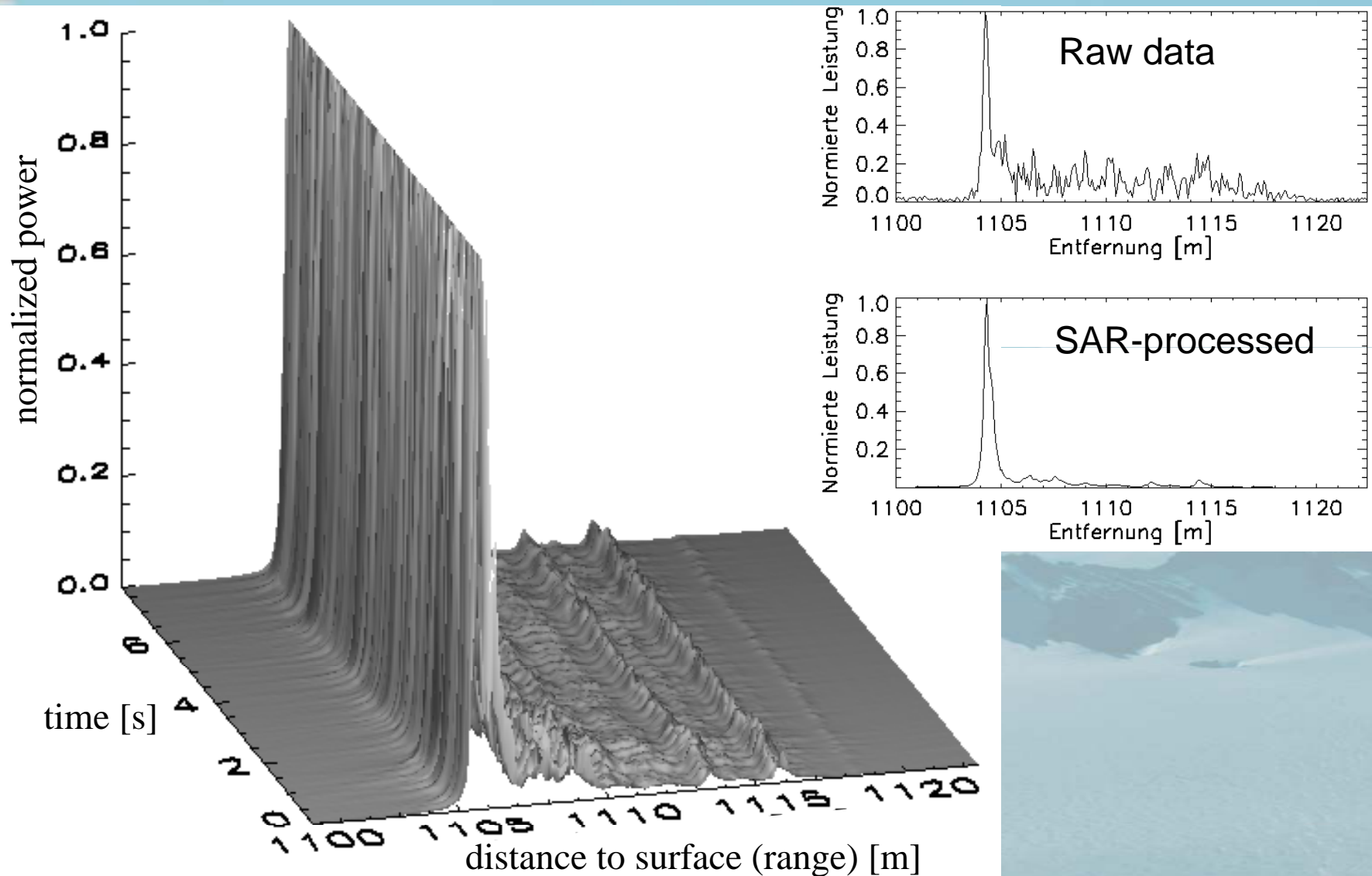
Bildquelle: Leuschen, C. (2005)

Area of operation

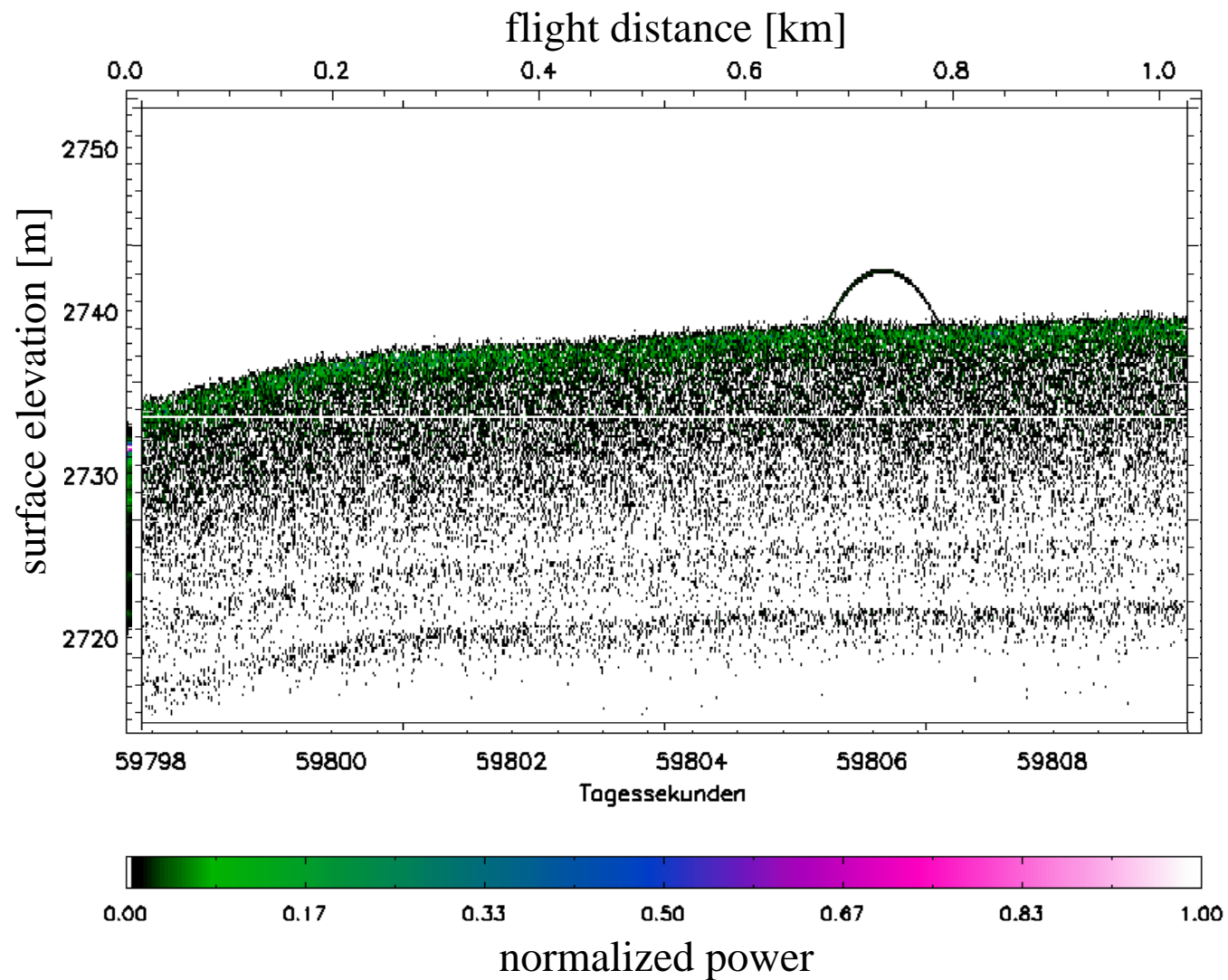


general map of campaigns 2004 - 2007

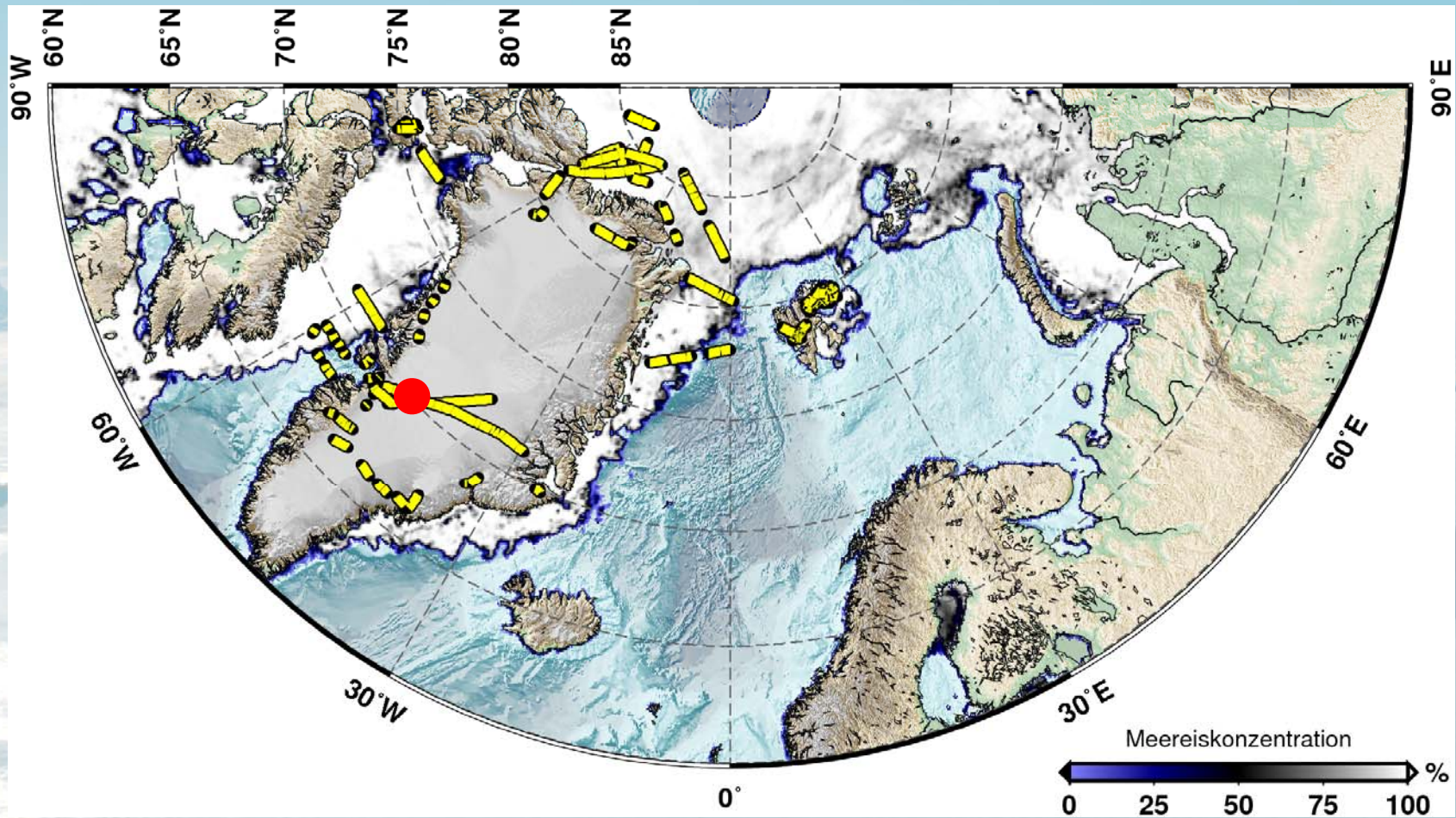
SAR-processed ASIRAS echos



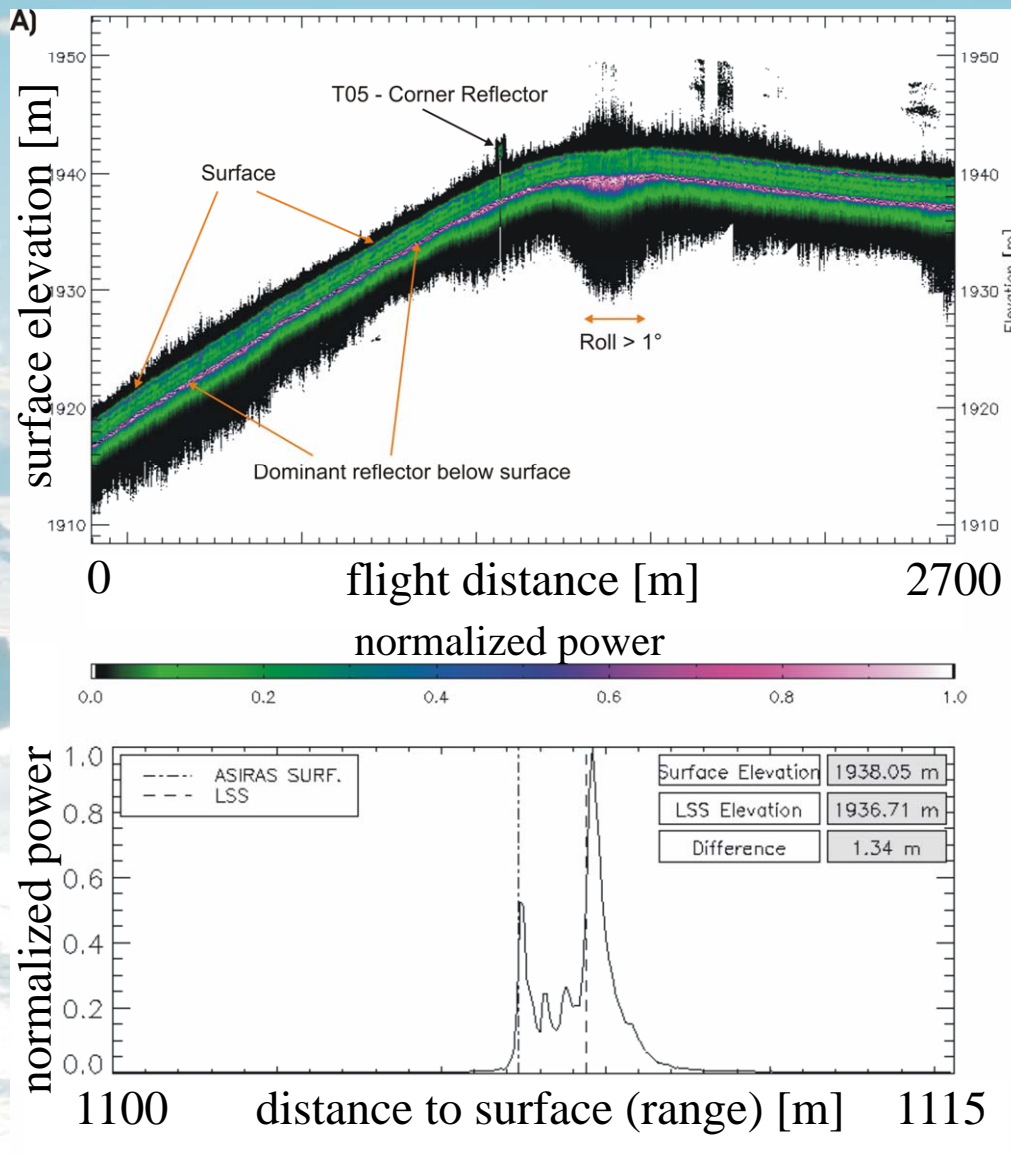
Internal layering in Greenland's dry snow zone



Area of operation: percolation zone



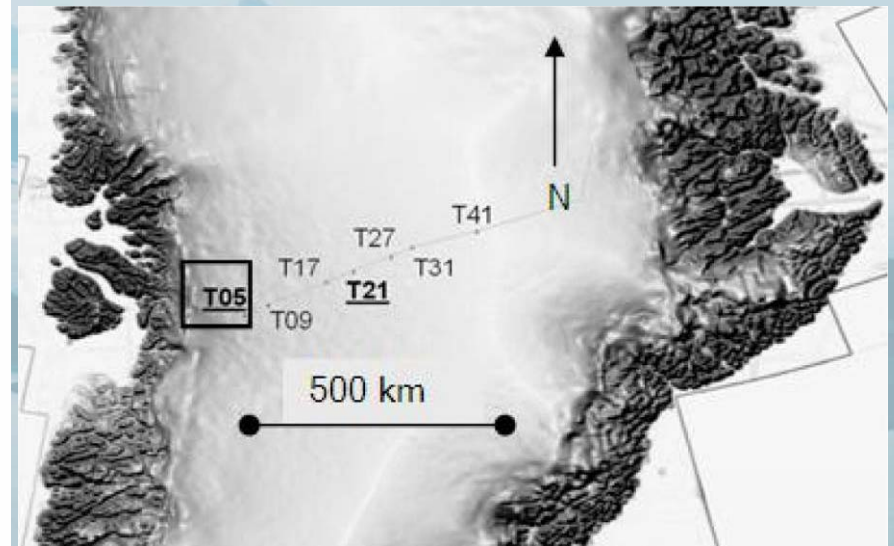
Determination of winter accumulation



Helm (2007)

Next to the surface a second very strong reflector is visible

This corresponds to the previous summer horizon (Parry, 2006)



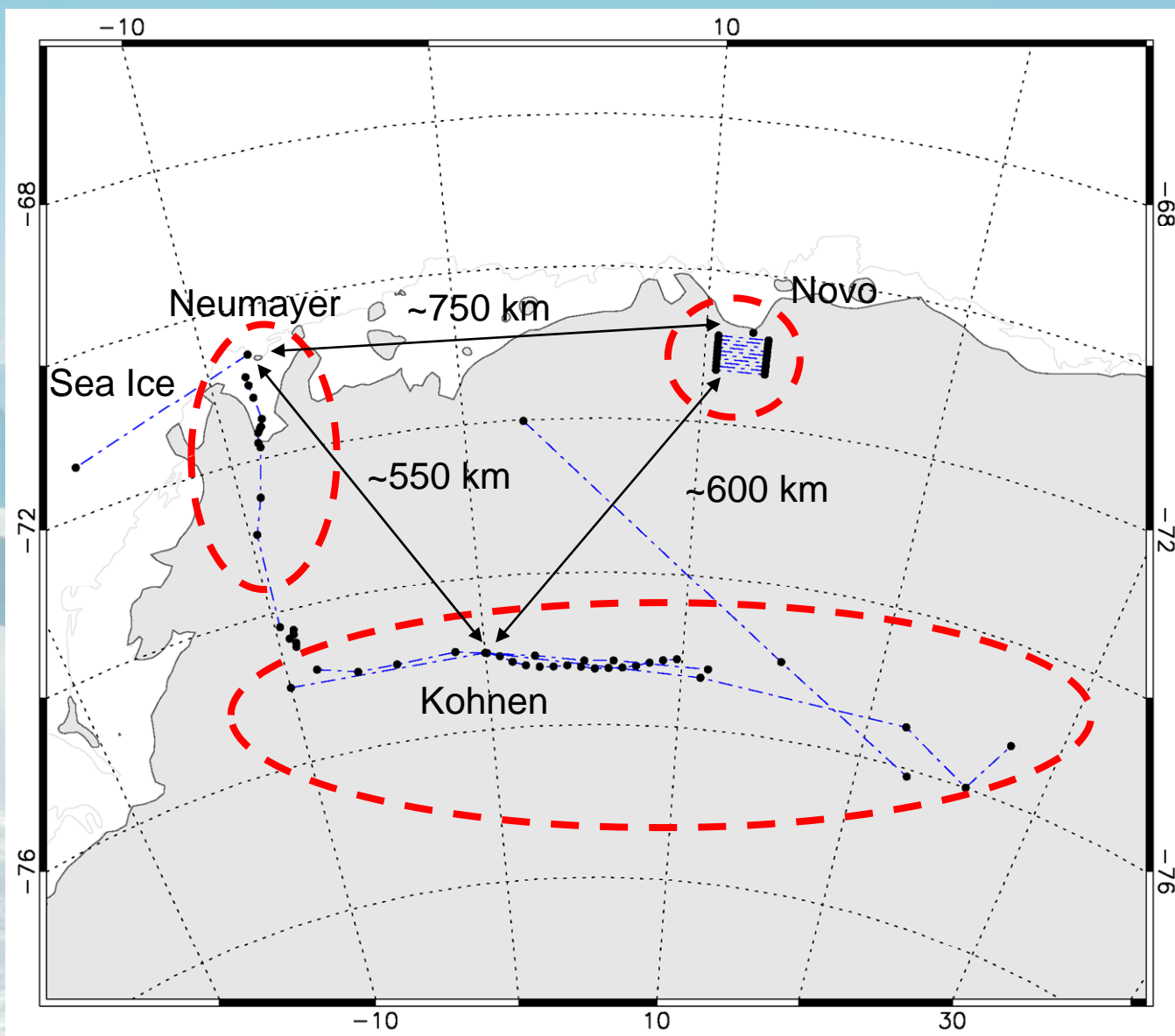
difference yields the winter accumulation
(Density obtained from snow pit)

Thanks

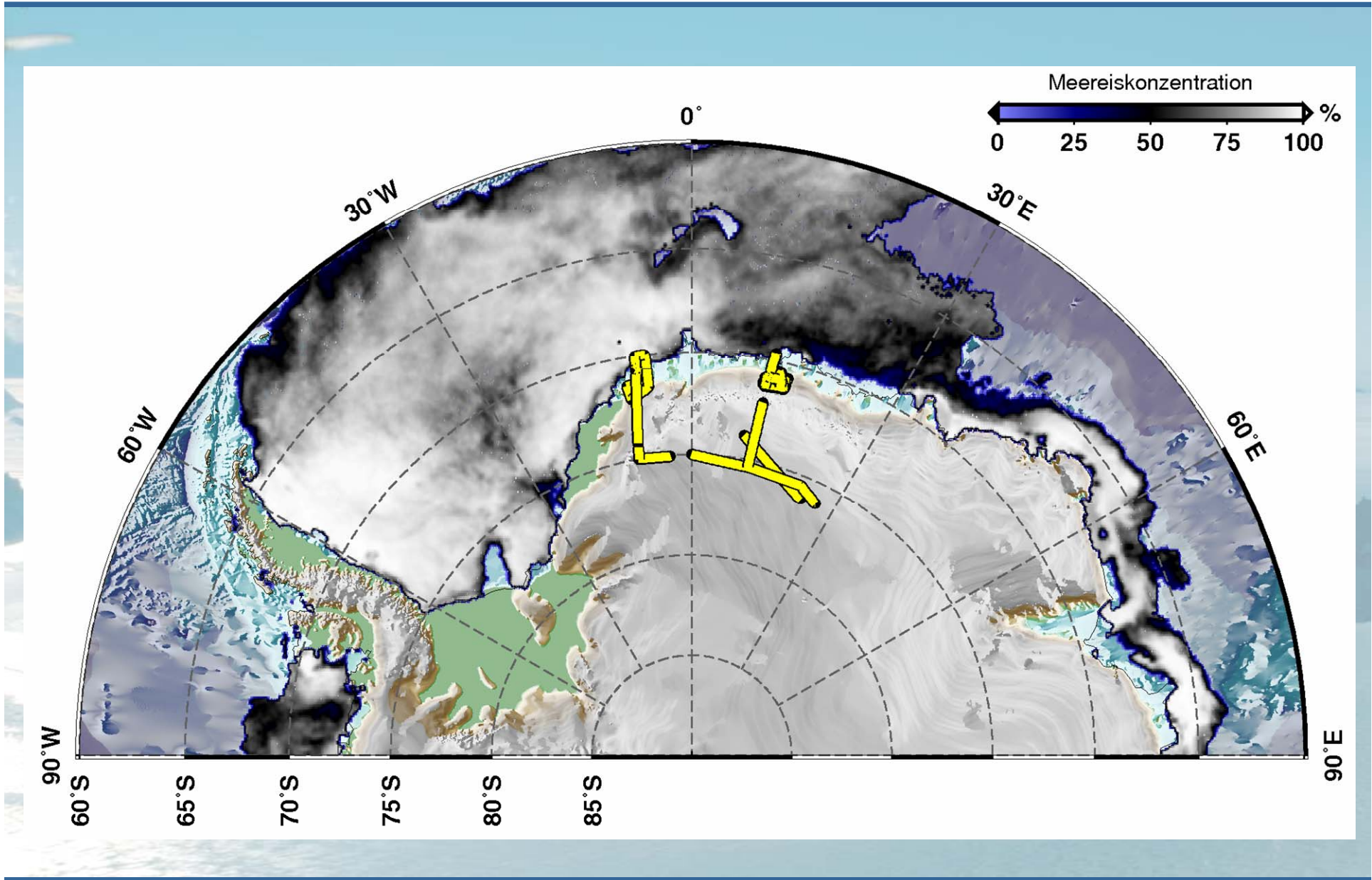


CryoVex – Projektpartner:

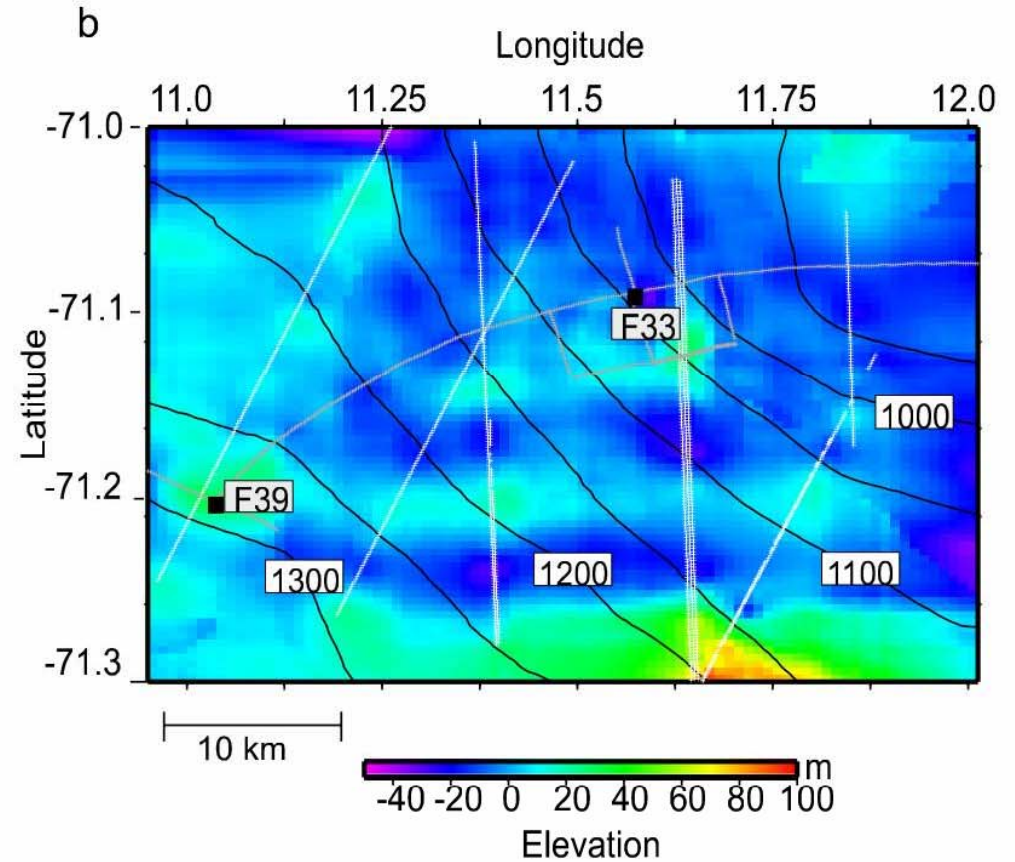
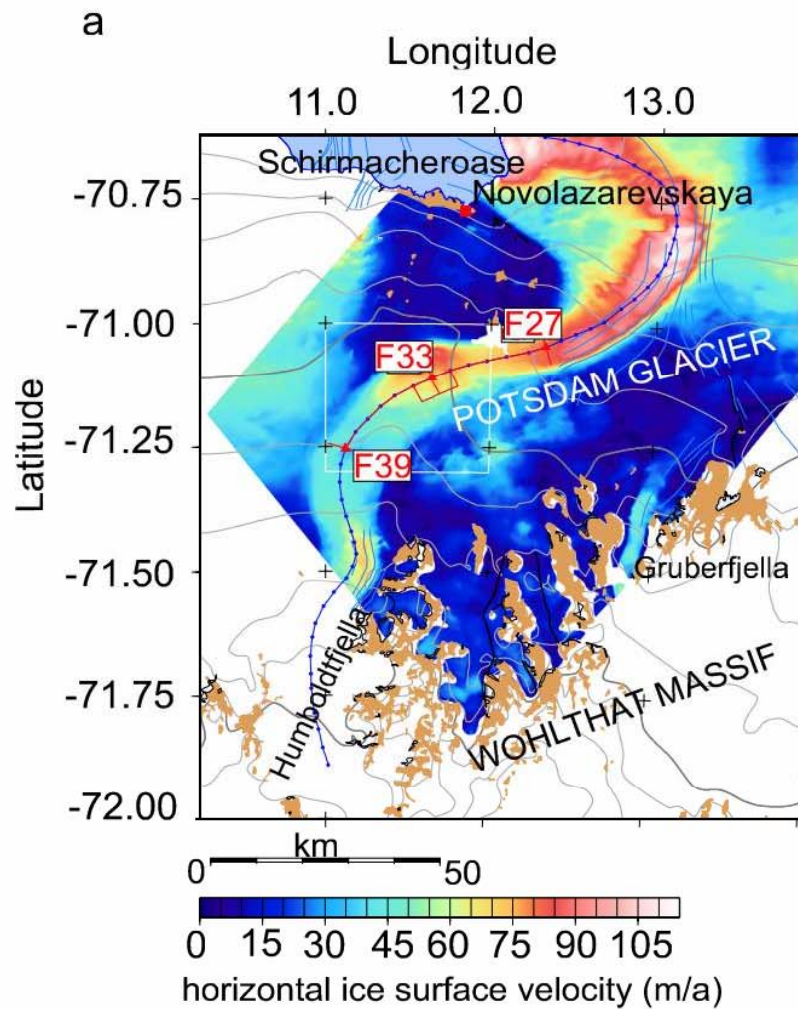
- Meereisgruppe (AWI – Stefan Hendricks)
- ESA (R. Cullen)
- Gateway Antarctica (W. Rack)
- Danish National Space Center (L. Stenseng)
- University of Oslo (J. O. Hagen)
- Scott Polar Research Institute (R. Hawley)
- University of Alberta (C. Haas, Dave Burgess)
- University of Edinburgh (P. Nienow, A. Shepherd)
- University of Aberdeen (D. Mair)
- University College London (D. Wingham)
- TU-Dresden (R. Dietrich),



ASIRAS - Profiles

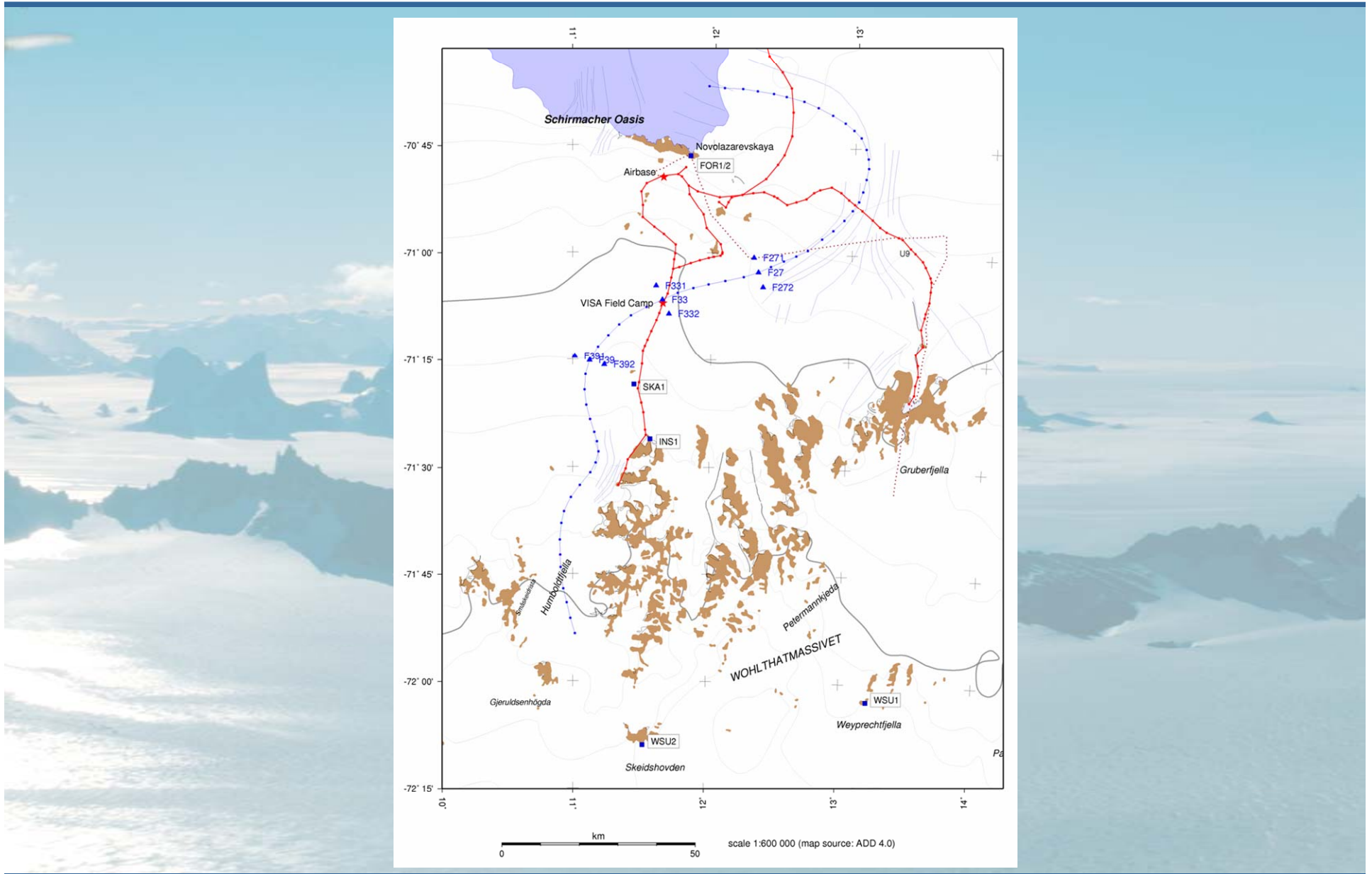


Potsdam glacier - Drill positions



Source: (Anschütz, 2006)

Potsdam glacier - Drill and pit positions

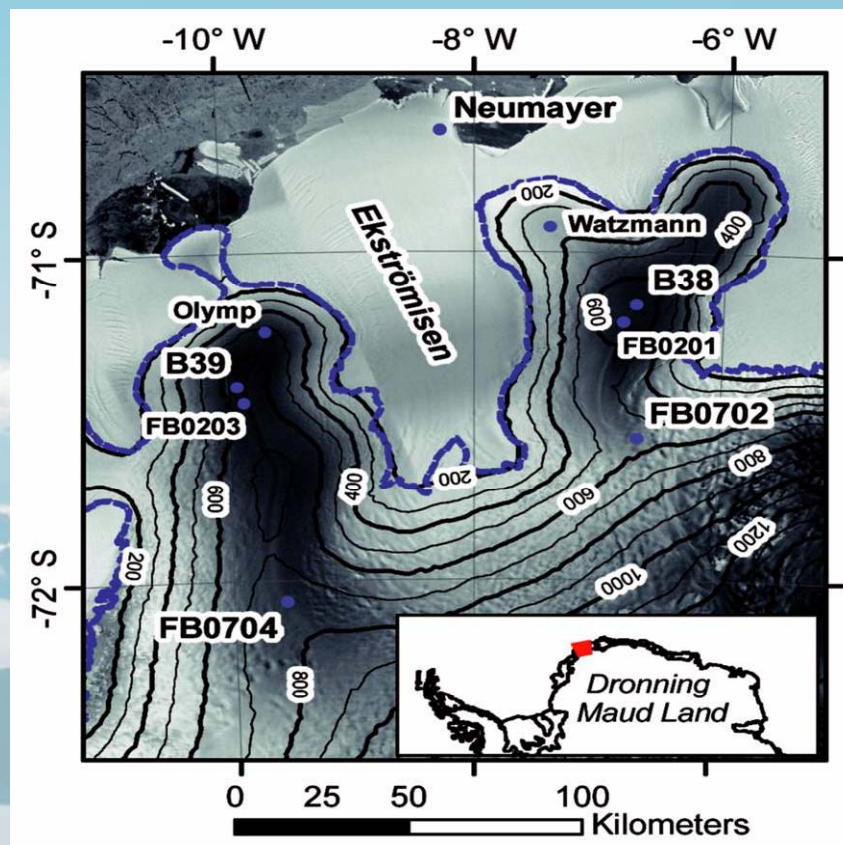


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DLR, Germany

Halvfarryggen and Søråsen - Drill positions



C. Wesche, AWI

Location	Project	Period	Cores/Pits	Latitude	Longitude	Elevation
Halvfarryggen, North	Pre-IPICS	2006/2007	B38	-71.1621	-6.6989	690
Halvfarryggen, South	Pre-IPICS	2006/2007	FB0702	-71.5680	-6.6670	539
Søråsen, North	Pre-IPICS	2006/2007	B39	-71.4083	-9.9167	655
Søråsen, South	Pre-IPICS	2006/2007	FB0704	-72.0640	-9.5583	760

Instrument characteristics



	CryoSat	ASIRAS
transmitted power	25 W	5 W
comp. pulse length	3.125 ns	1 ns
bandwidth	320 MHz	1 GHz
frequency	13.575 GHz	13.5 GHz
PRF	18.182 kHz	2 – 4 kHz
flight altitude	~717 km	0.2 km bis 10 km
pulslimited footprint	~2.3 km	~51 m (R = 1100 m)
beamlimited footprint	~13.5 km	~44 m (R = 1100 m)
SAR – resolution cell	0.3 km x 1 km	4 m x 50 m
theo. resolution in range	~0.47 m	~0.15 m
range window	60 m	22.5 m (HAM)
sample resolution	~0.47 m (128 samples)	~0.10 m (224 samples)
antenna gain	42 dB	26 dB
antenna angle (ac x al)	~1.2° x ~1.1°	~2.3° x ~9.8°
interferometric baseline	1.172 m	0.76 m