Concept of CryoSat Product Validation in the Region of Schirmacheroase / Antarctica

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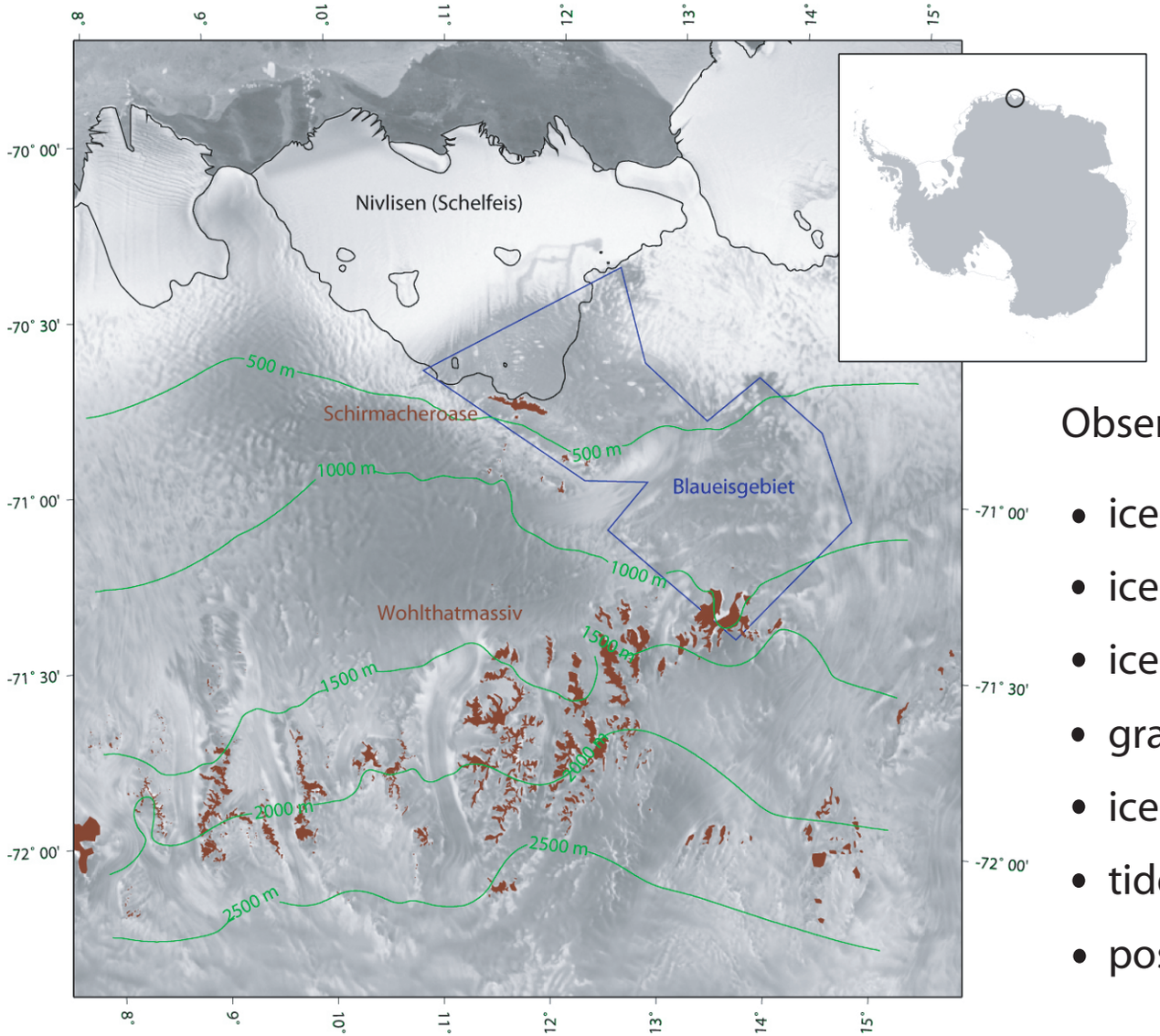
First International CryoSat Workshop
8-10 March 2005, ESA-ESRIN

Outline

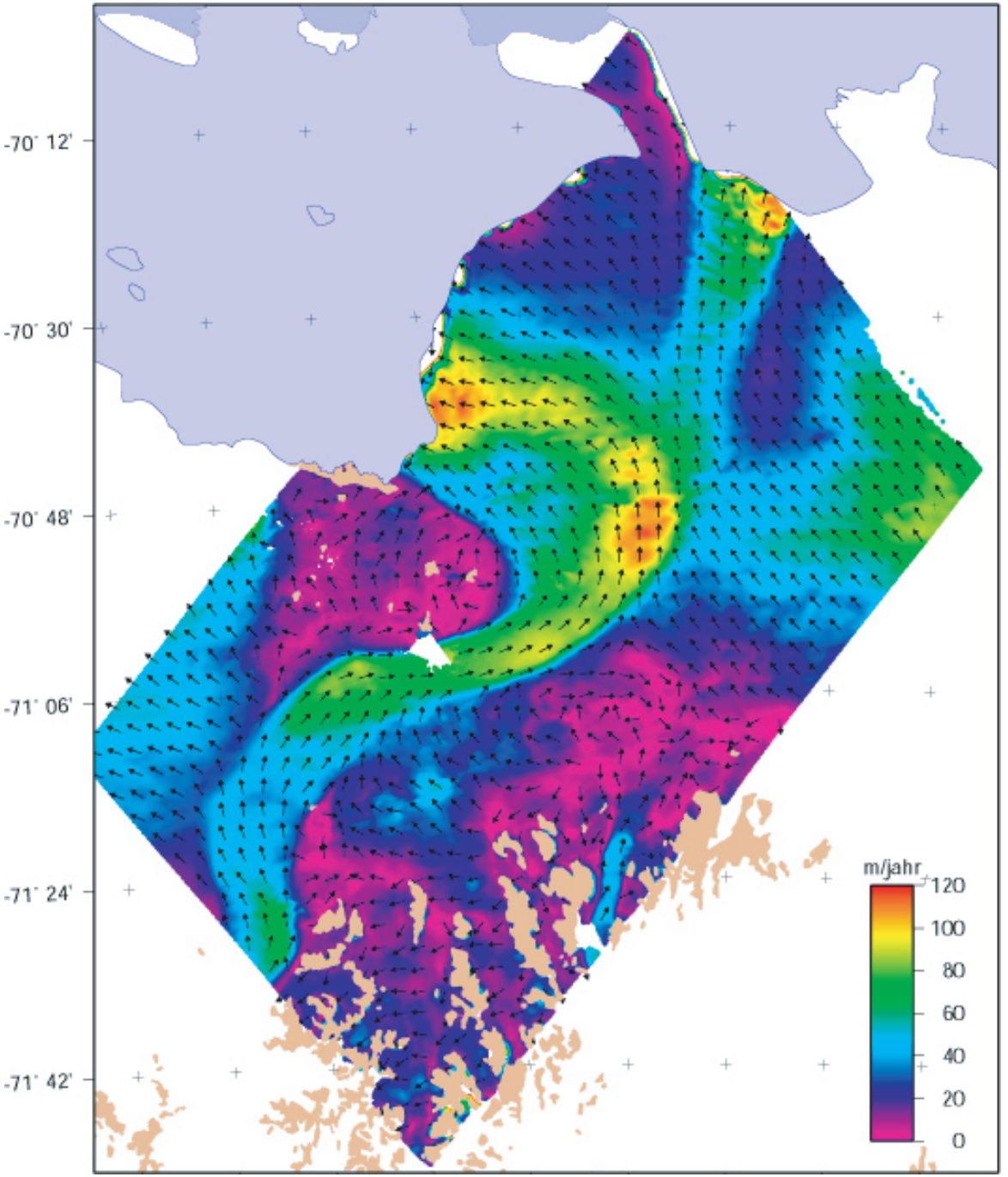
- Validation area: region of Schirmacheroase / Dronning Maud Land
- Proposed validation activities
  1. long-term topography changes in a blue ice region
  2. interferometric mode height retrieval
  3. short-term surface height changes of the Nivlisen Ice Shelf
- Schedule

Region of Schirmacheroase / Dronning Maud Land / Antarctica



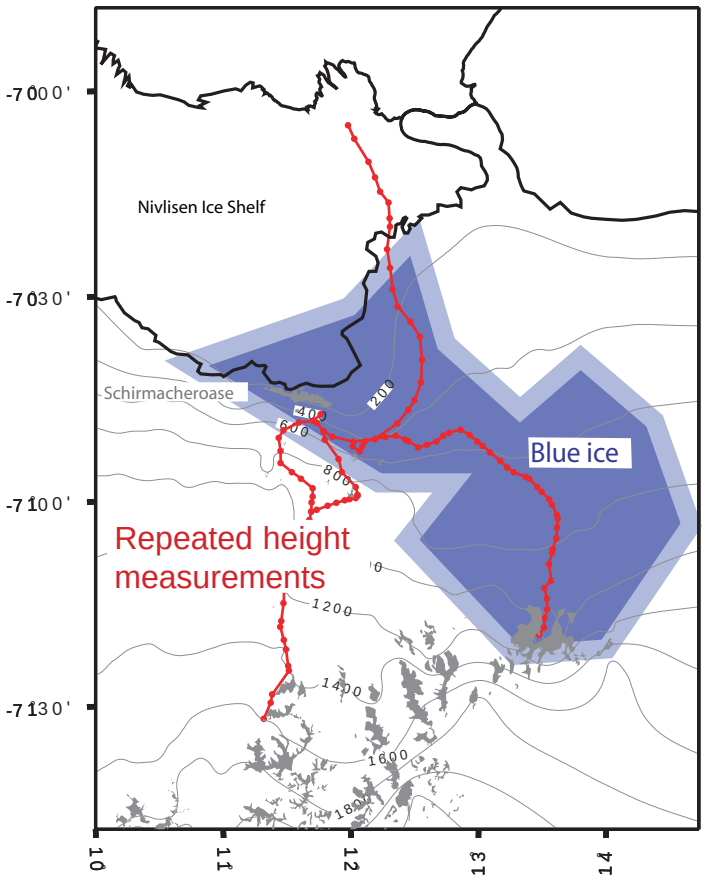
Observations for more than a decade

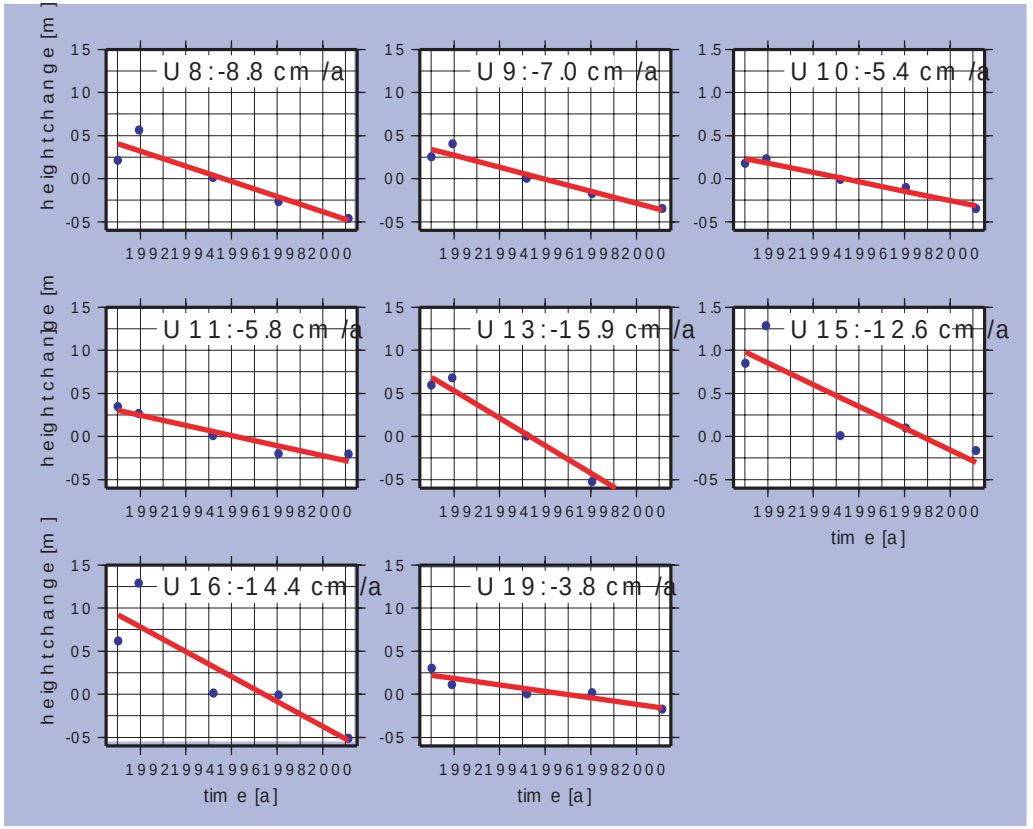
- ice surface heights
- ice surface height changes
- ice thickness
- gravity
- ice flow velocities
- tides
- postglacial rebound



Ice surface flow velocities
from ERS1/2
SAR-Interferometry

1. Validation of long-term topography changes in a blue ice





blue ice region of 110 x 50 km² size

mass imbalance up to -20 cm/a

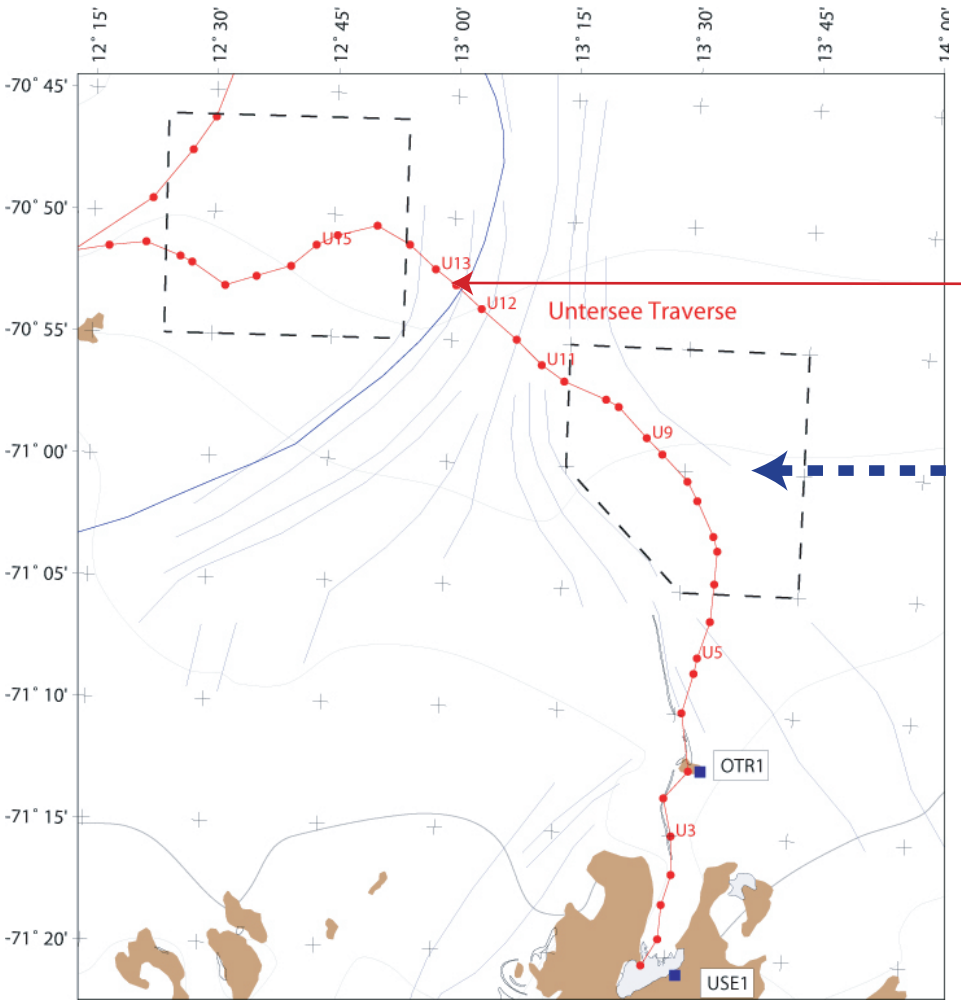
→ Validation of land ice topography changes which are a major output of the CryoSat mission

Validation of long-term topography changes in a blue ice region

Proposed field activities

- Repeated observations of surface heigths by kinematic GPS profiles with the objectives
  1. reobservation of the traverse to continue the determination of long-term trends since 1991
  2. detailed topography survey in a test area
  3. observation times close to CryoSat passes over the working area
- 2 Expeditions
  Duration: ~3 months (Nov.-Jan.), Field camp: 6 - 8 weeks
  (Restrictions due to weather conditions and crevasses have to be taken into account)
- Minimum total length of GPS profiles: 1000 km per expedition
- Height precision: ~2cm (GPS crossovers), accuracy: ~3..4cm

Validation of long-term topography changes in a blue ice region



Untersee Traverse

- to be reobserved

Regions of the test area

- dense kinematic GPS track schemes in the size of several CryoSat footprints, e.g., 1...2 km (N-S) x 5...10 km (W-E)
- Logistics: field camp (tents), skidoos

2. Validation of interferometric mode height retrieval

Objective

- Use the detailed topography information at footprint scale to validate the CryoSat height retrieval, including simulations of the altimeter response

In-situ data

- Kinematic GPS measurements in the test area of the blue ice regions

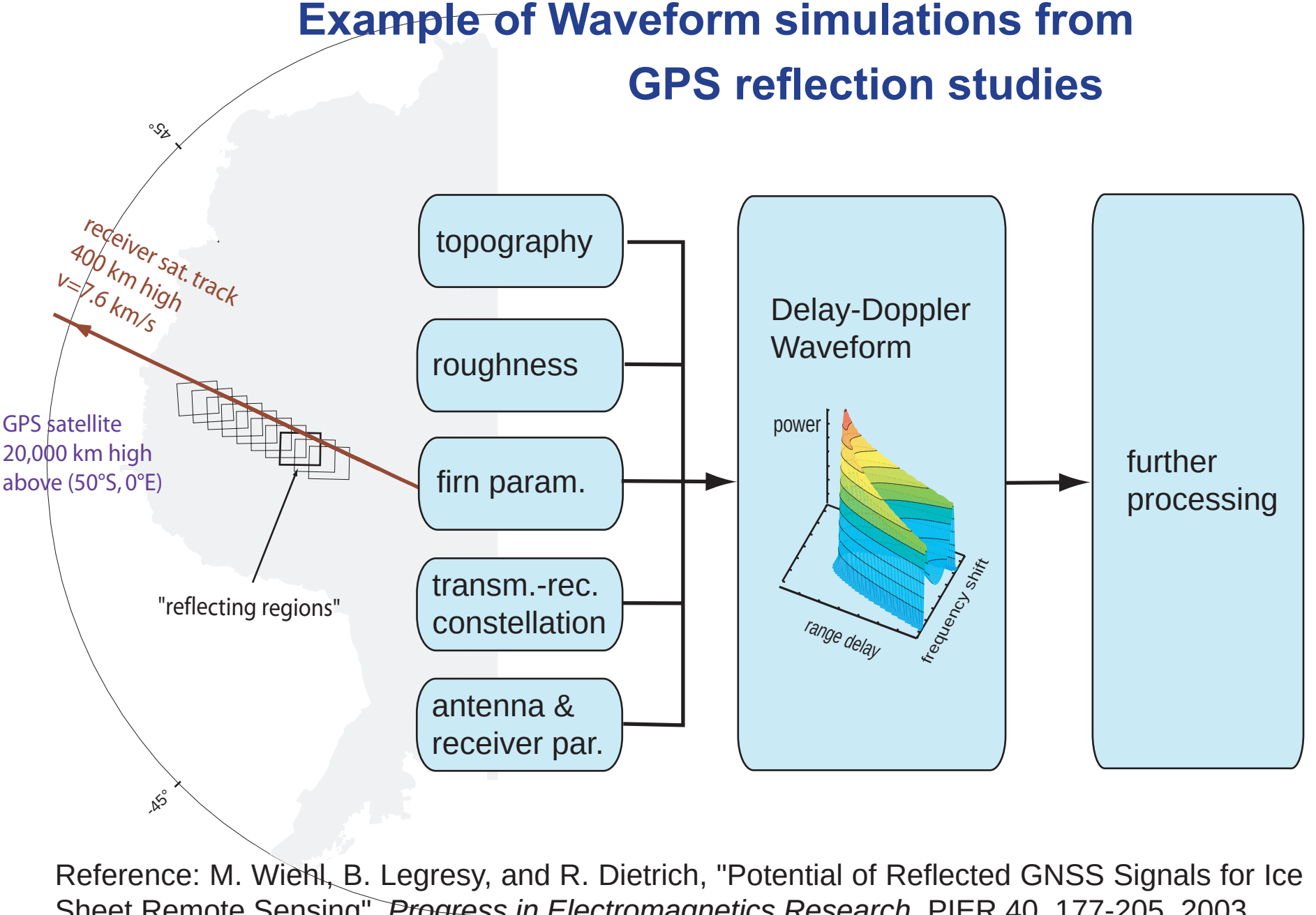
Products

- Precise topography model of the test area
- Simulation of the CryoSat altimeter response

CryoSat validation

- Validation of the CryoSat height retrieval in the interferometric mode by use of the precise topography model of the CryoSat footprint

Example of Waveform simulations from GPS reflection studies

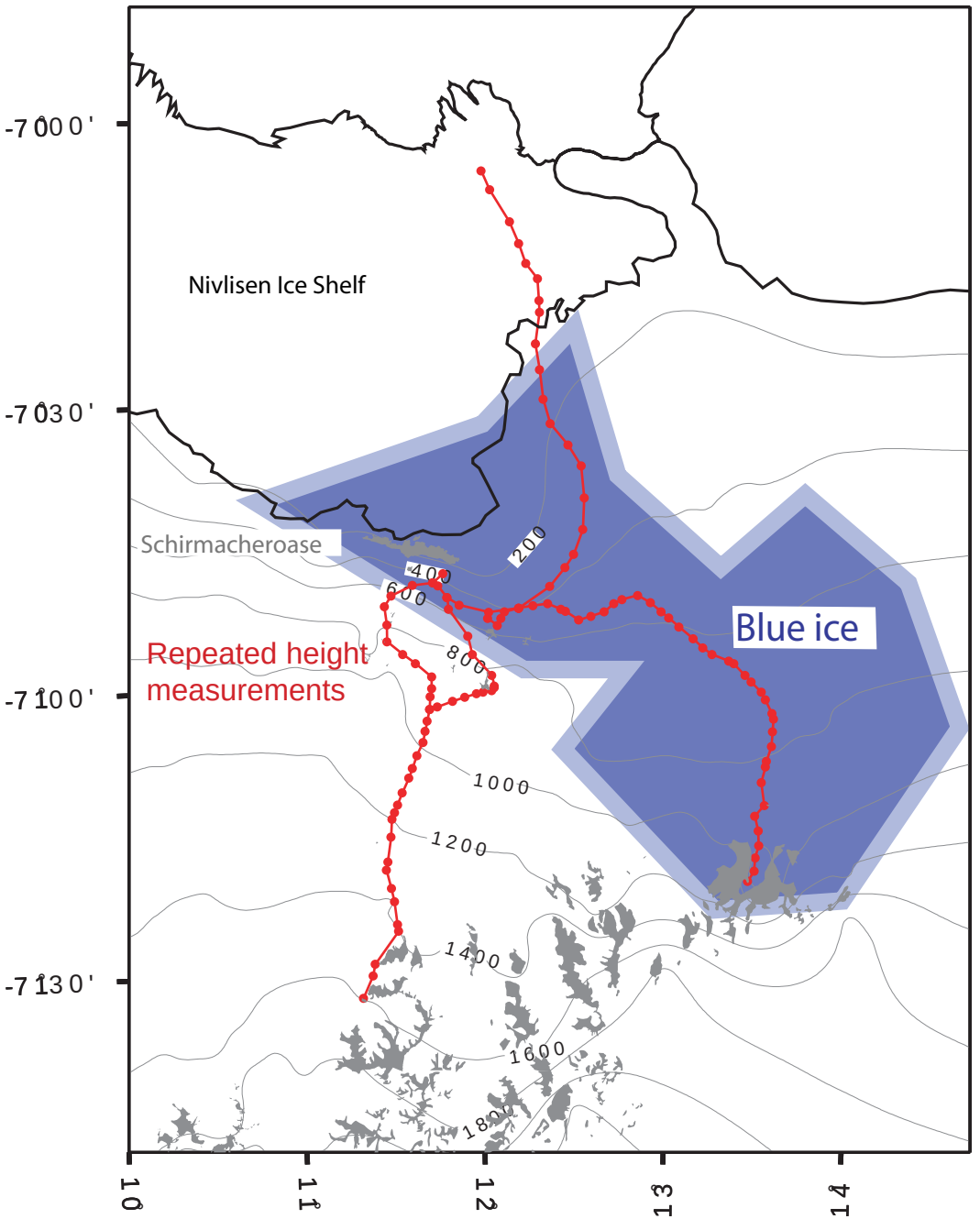


Reference: M. Wiehl, B. Legresy, and R. Dietrich, "Potential of Reflected GNSS Signals for Ice Sheet Remote Sensing", *Progress in Electromagnetics Research*, PIER 40, 177-205, 2003

3. Validation of short-term height changes of the Nivlisen Ice Shelf

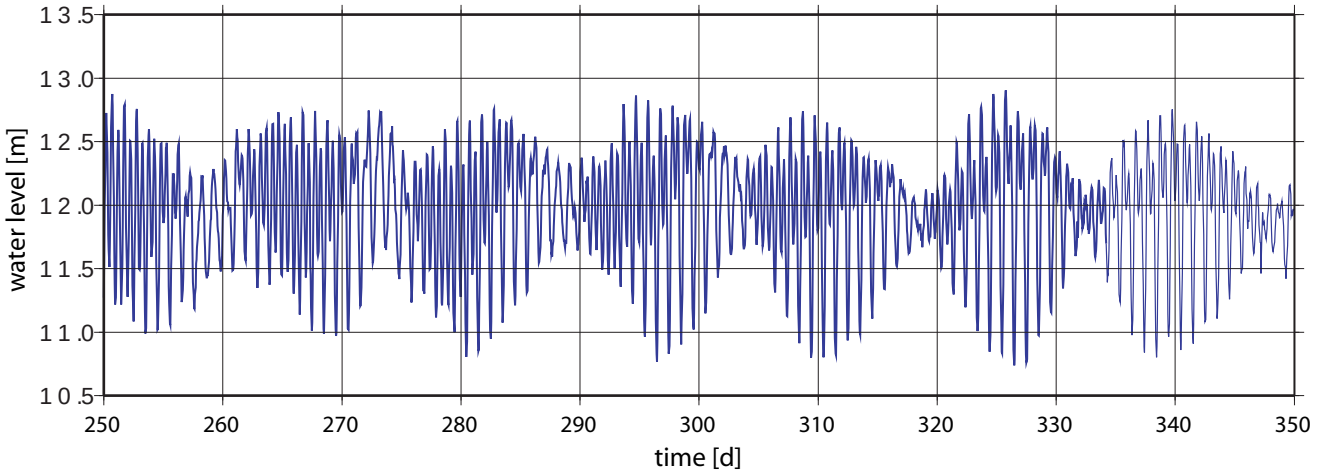
- Tidal displacements and inverse barometer effect are accurately known
  - from tide gauge observations
  - validated by kinematic GPS

→ Validate short-term surface height changes retrieved from CryoSat measurements, for the specific properties and flat topography of ice shelves


Nivlisen Ice Shelf
Schirmacheroase
Blue ice
Repeated height measurements
200
400
600
800
1000
1200
1400
1600
1800
-70 00 '
-70 30 '
-71 00 '
-71 30 '
10
11
12
13
14

Tide gauge observations

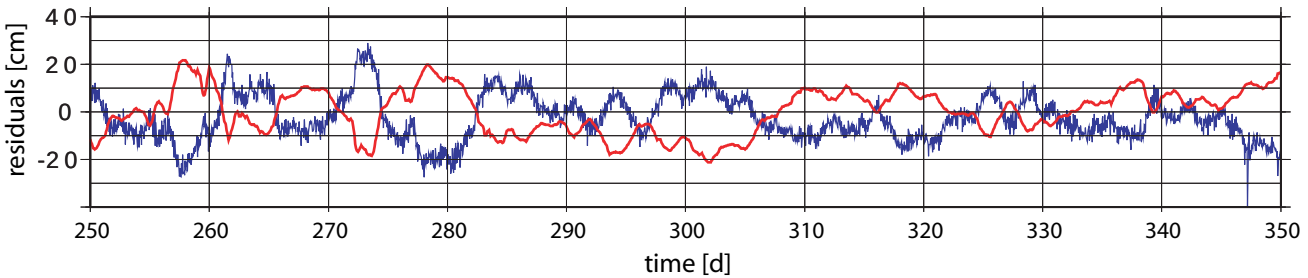
Sea level in the vicinity of Schirmacheroase, Dronning Maud Land:



Deduced tidal model:

Tidal Wave	Ampl. m	Phase deg
K1	0.26	332.73
O1	0.28	326.11
M2	0.35	139.40
S 2	0.26	163.89

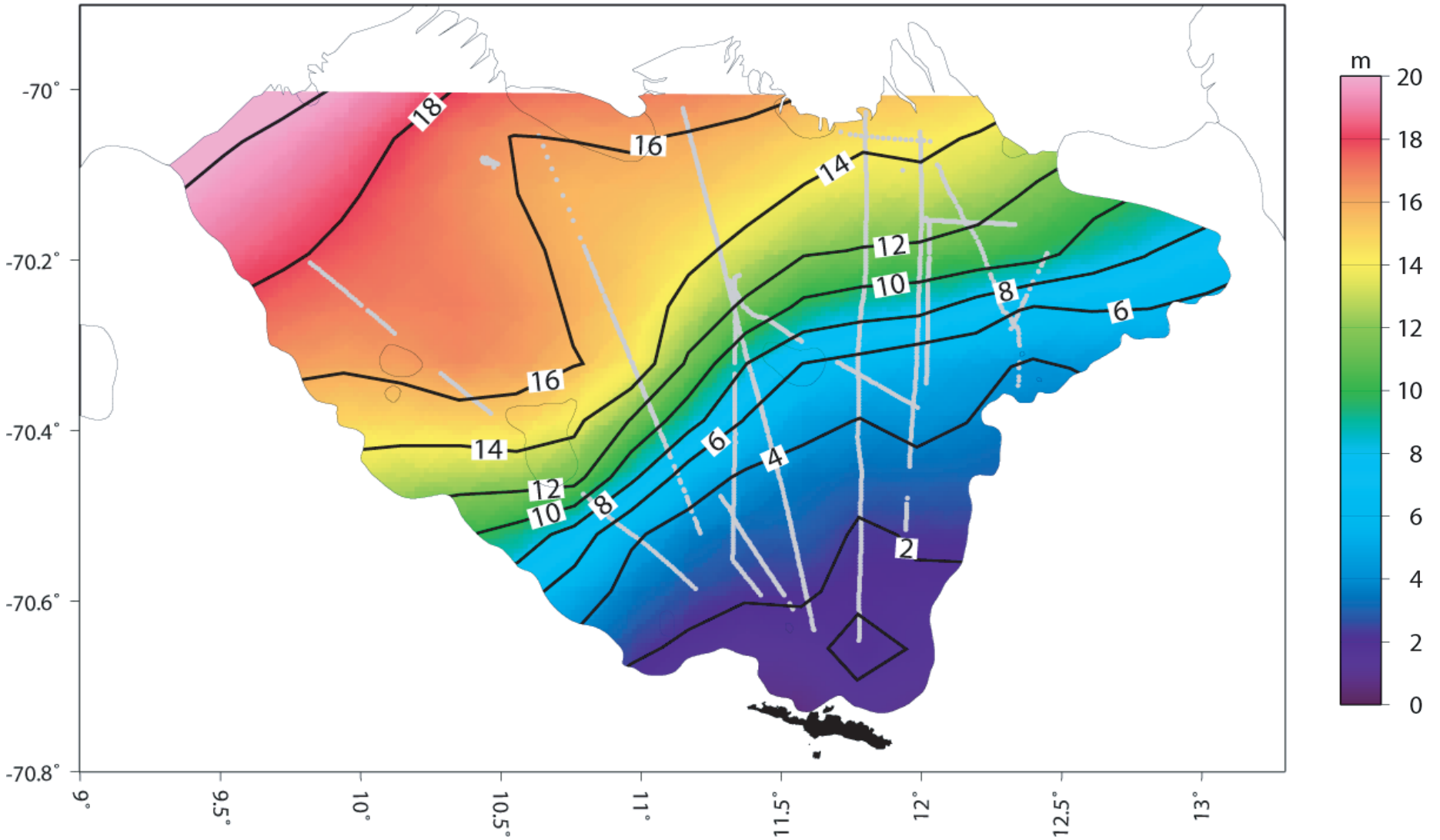
After tide reduction:



air pressure

water level

After IB reduction: 4 cm rms residual signal



Nivlisen: Model of the aparent air layer thickness (in meters)

Reference: M. Horwath, R. Dietrich, M. Baessler, U. Nixdorf, D. Steinhagel, D. Fritzsche, V. Damm, G.Reitmayr, "Nivlisen, an Antarctic ice shelf in Dronning Maud Land: Geodetic-glaciological results from a combined analysis of ice thickness, ice surfave height and ice flow observations", Journal of Glaciology (in review)

Schedule

Expeditions

- 3 persons
- 2 Antarctic summer seasons (Nov.-Jan.)
- after CryoSat launch