Proposal for a TSX background mission

Antarctic Peninsula & Antarctic Ice Shelves

Matthias Braun & Angelika Humbert

(Univ. Bonn & Münster)

11 Jul 2008
Wilkins Ice Shelf
TerraSAR-X ScanSAR

Why the Antarctic Peninsula?

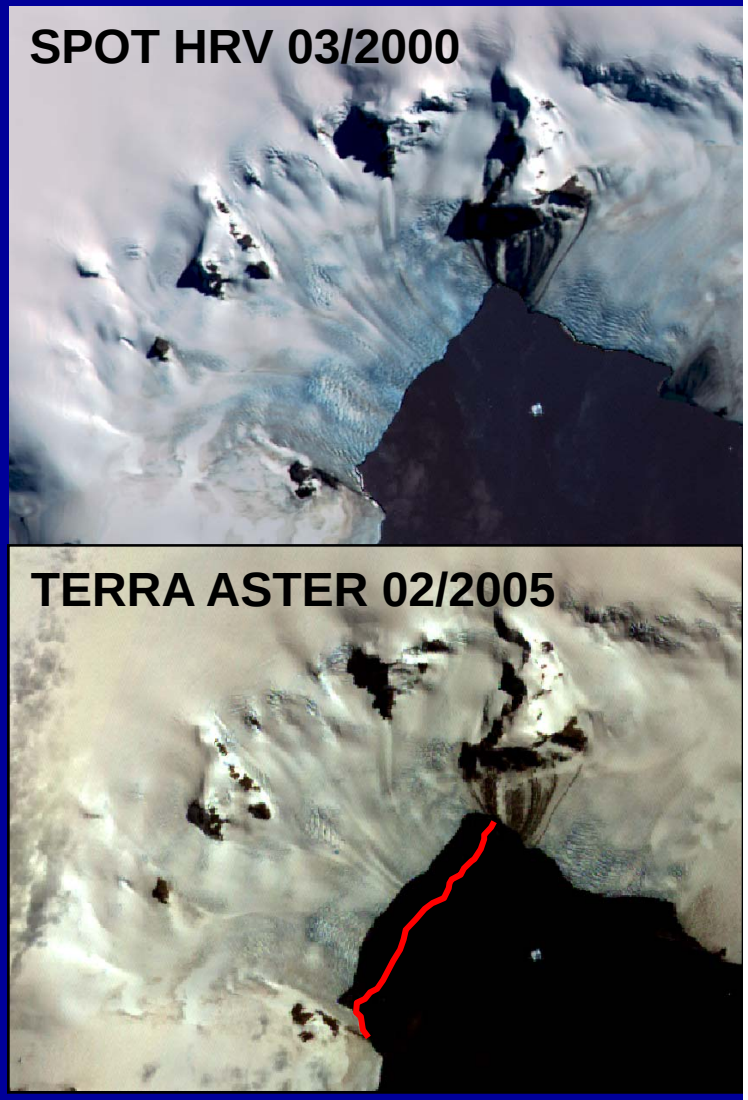
- Hot spot of global warming (2.5 – 3K in 50-60 years)
- Strong E-W and N-S climatic gradients
- Acceleration of tidewater glacier tongues
- Acceleration of tributary glaciers after ice shelf collapse (Larsen-A, B, Wordie)
- Retreat of glaciers on the West coast of the AP
- 7 ice shelves have disappeared
  (some of them collapsed, others continuously retreated)

Why AP?

Jan. 2008

What?

- Spatial and temporal variability of ice dynamics (seasonal, annual)
- Monitoring of glacier termini and their changes
- Detection of surface structures and melt patterns of glaciers
- Snow cover dynamics on ice free areas



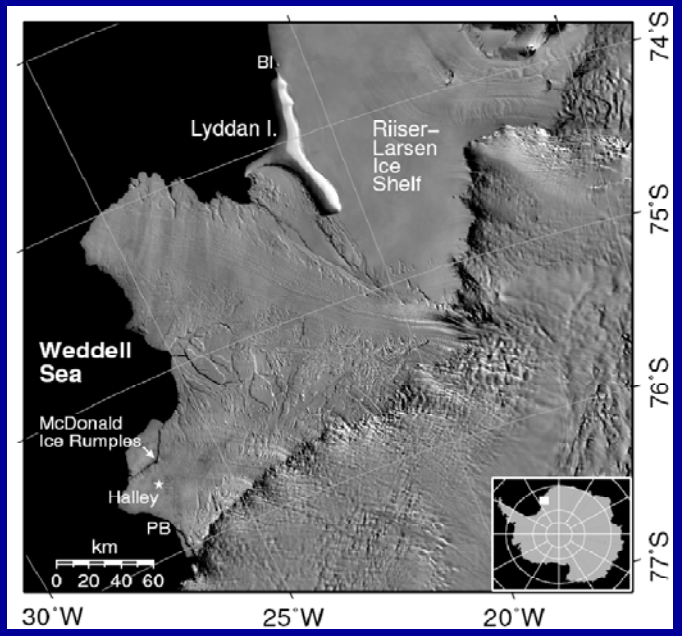
How?

Purpose	Location	Mode	Interval
glacier extent	entire Antarctic Peninsula and Sub-Antarctic Islands	Stripmap	annual or bi-annual
glacier velocities	major outlet glaciers of the western Antarctic Peninsula, tributaries of still existing ice shelves & glaciers of Sub-Antarctic Islands	Stripmap	6-8x per year, interval adapted to speeds
temporal variation of glacier velocities	selected target areas	Stripmap	in one year several 11 day revisits
glacier acceleration after ice shelf collapse	Larsen-A, Larsen-B, Wordie tributaries	Stripmap	10 revisits, same orbit
snow cover dynamics	subsets of King George Island	Spotlight	every 11 days (1-2 years)

Why? (Ice Shelves)

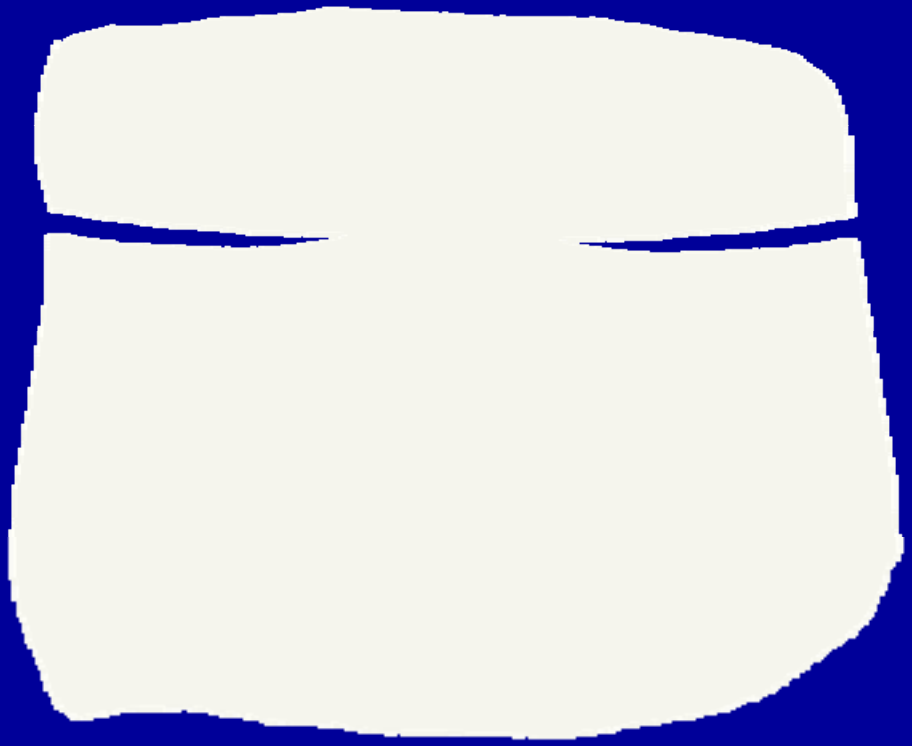
- Detection of fine scaled ice shelf structures
- Mapping of deformation patterns and ice shelf velocities
- Improved understanding of ice mechanics and physics

What did we learn from Wilkins?

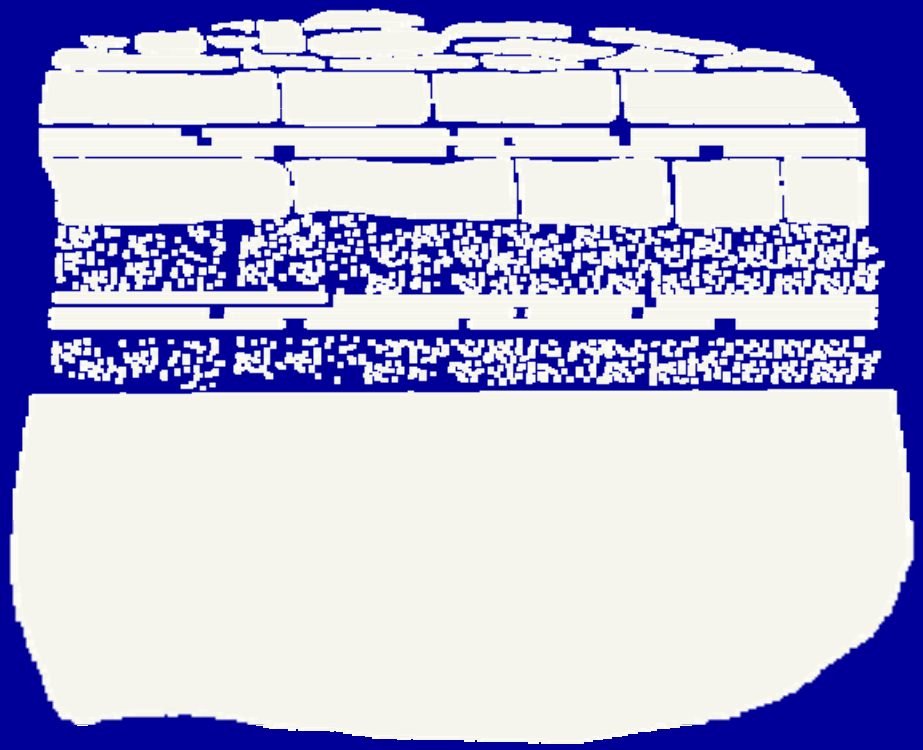


Wilkins Ice Shelf

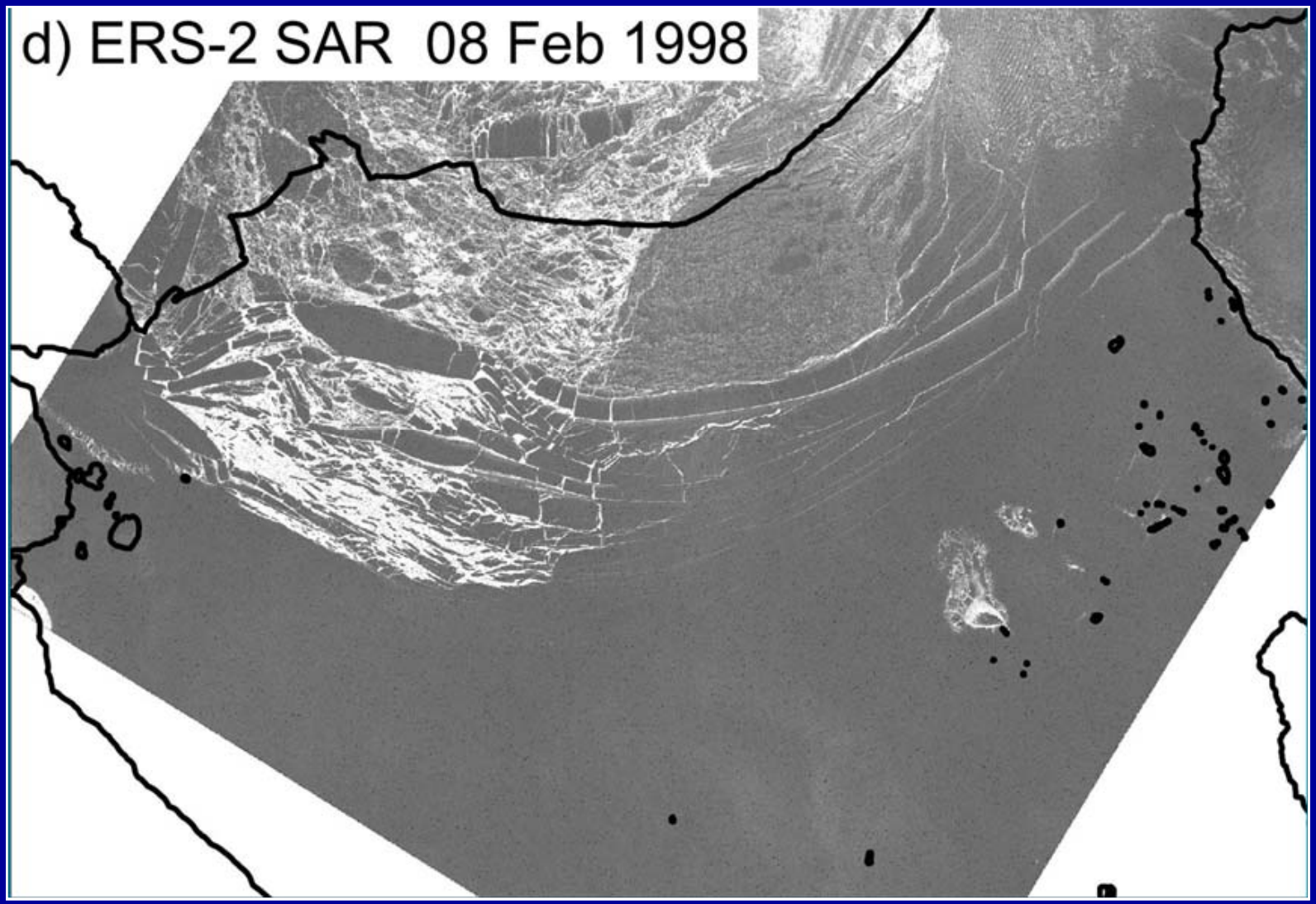
Calving



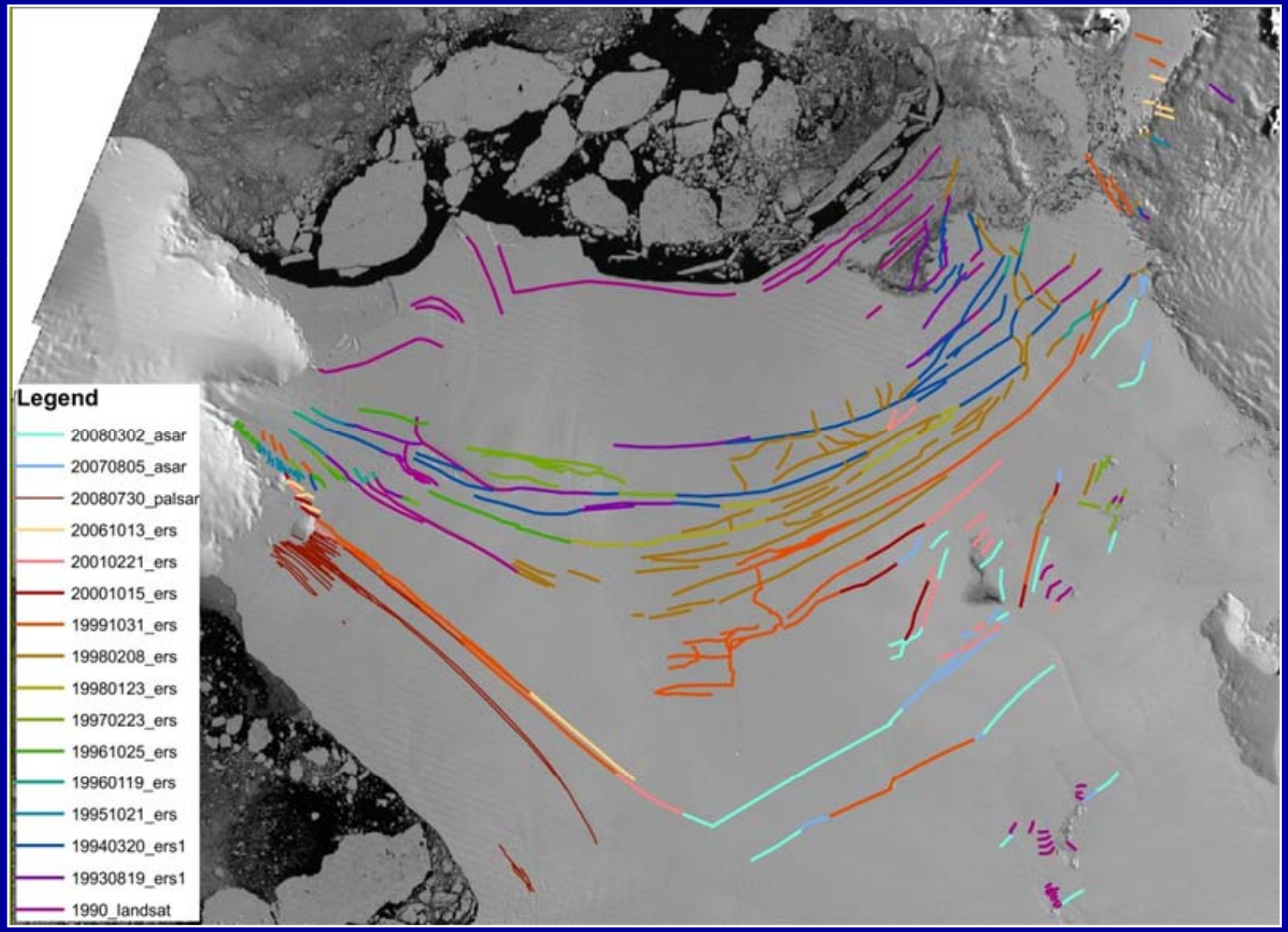
break-up



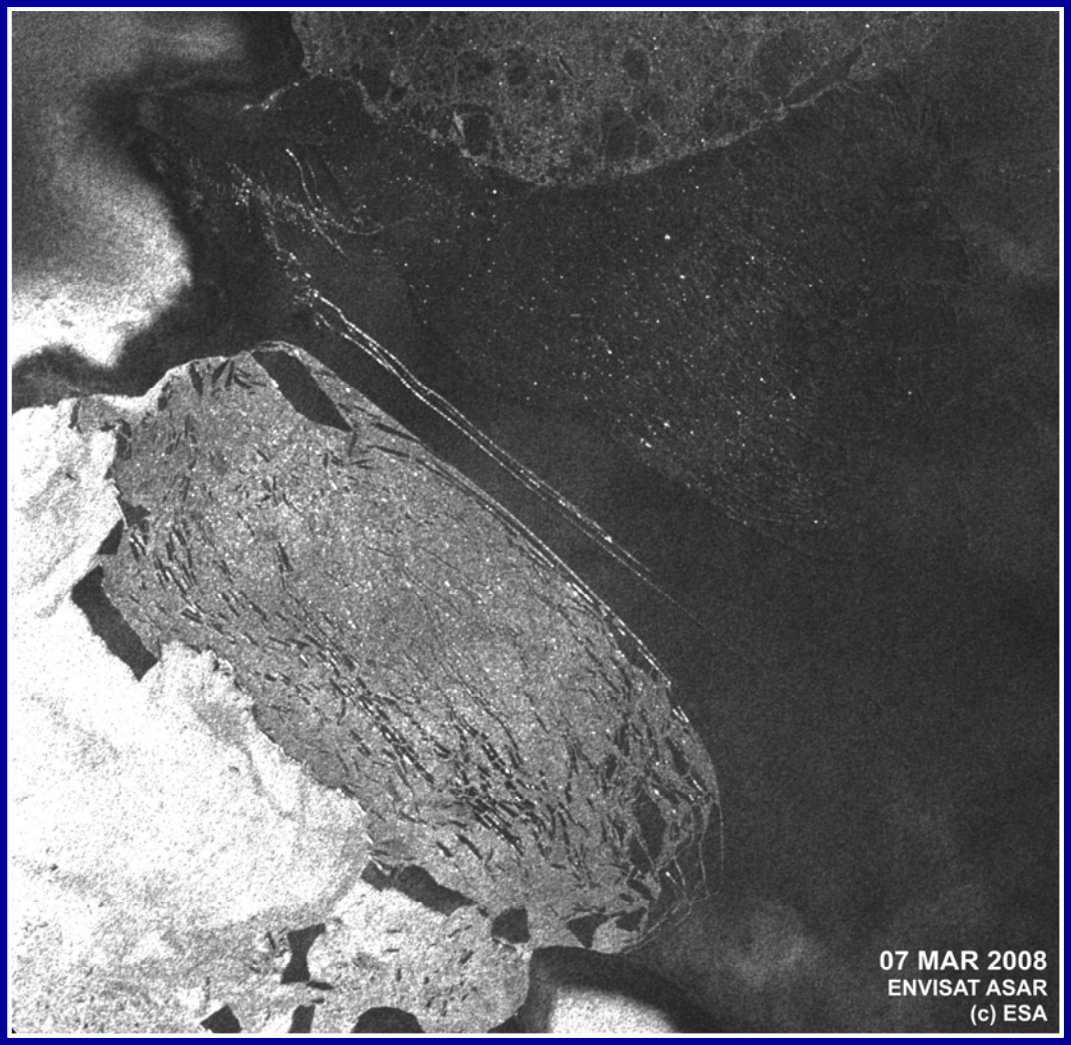
From healthy to fragil



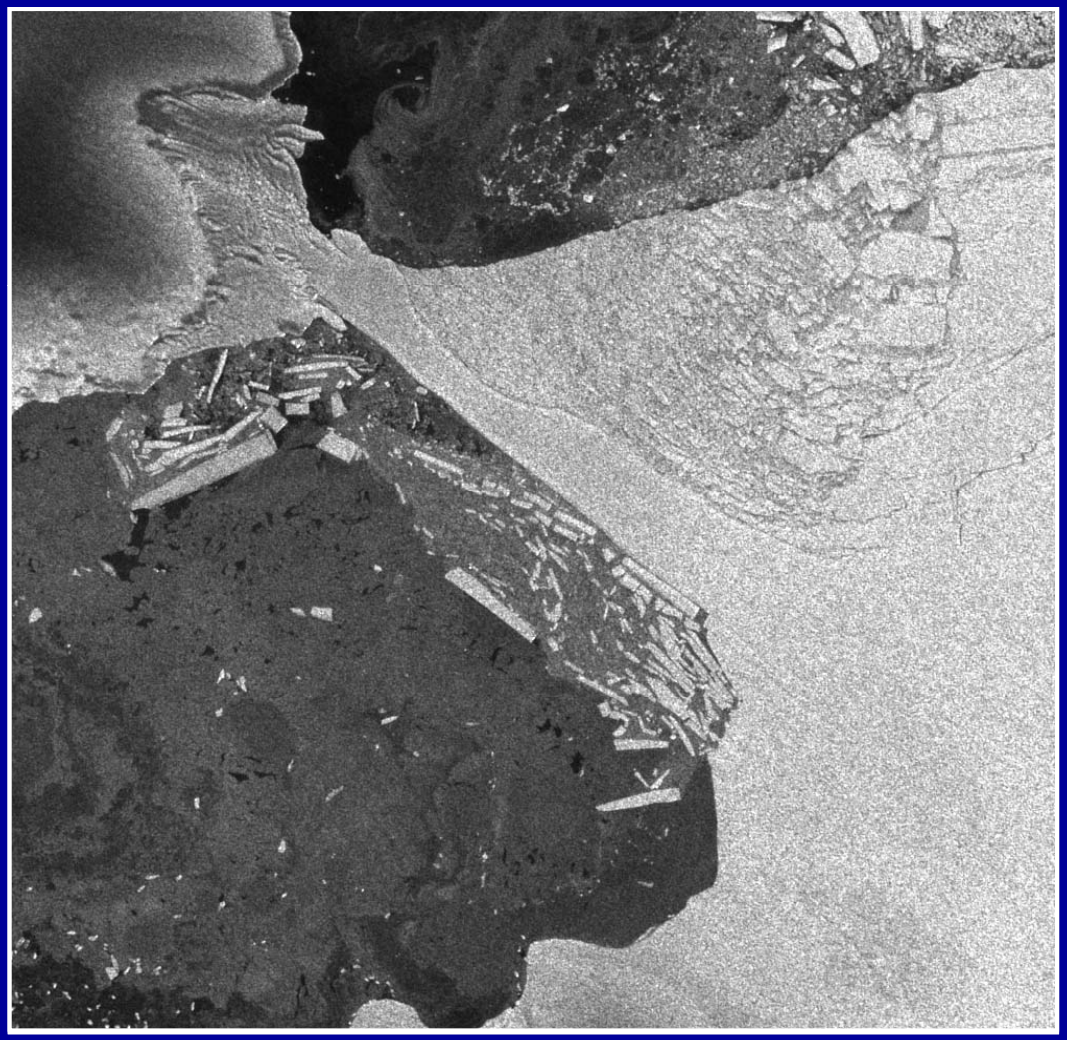
From healthy to fragil



February break-up

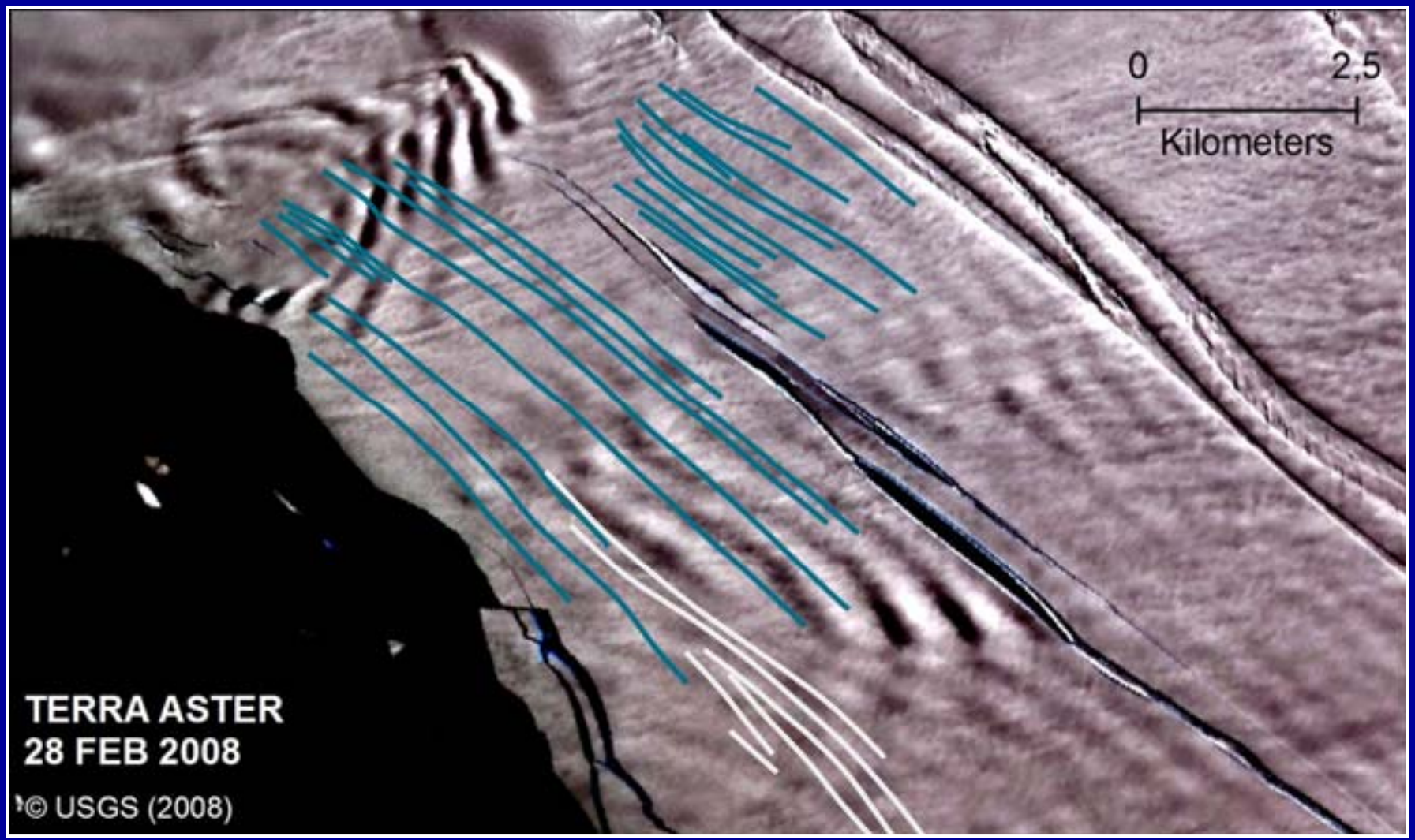


May-June break-up

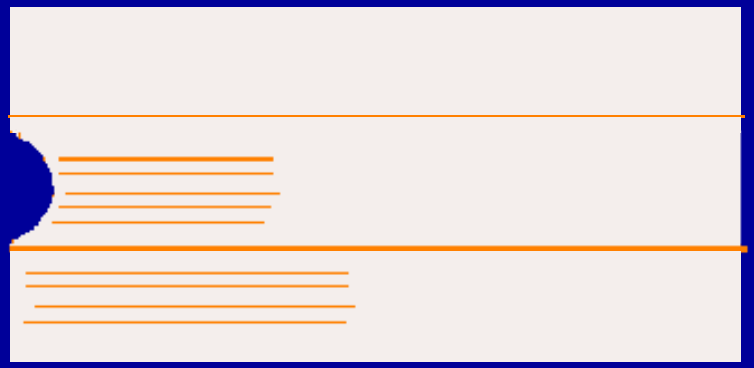


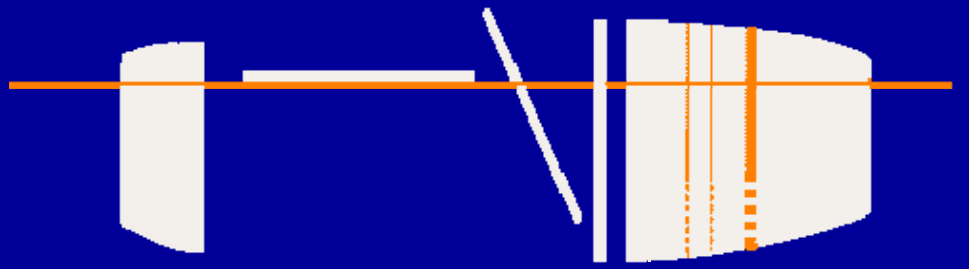
ENVISAT ASAR
27-30-31 May
03-Jun 2007

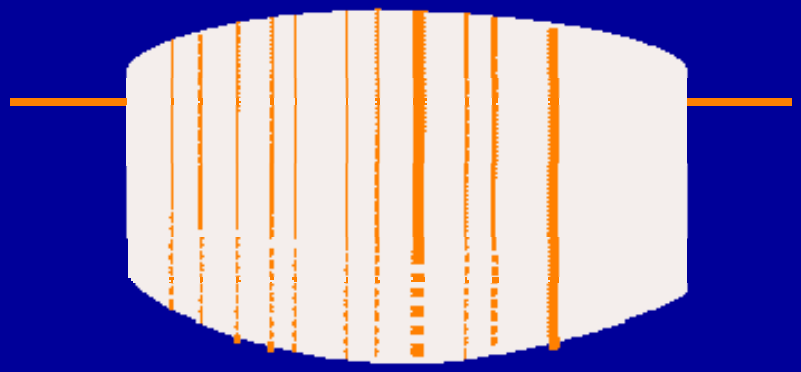
July 2007

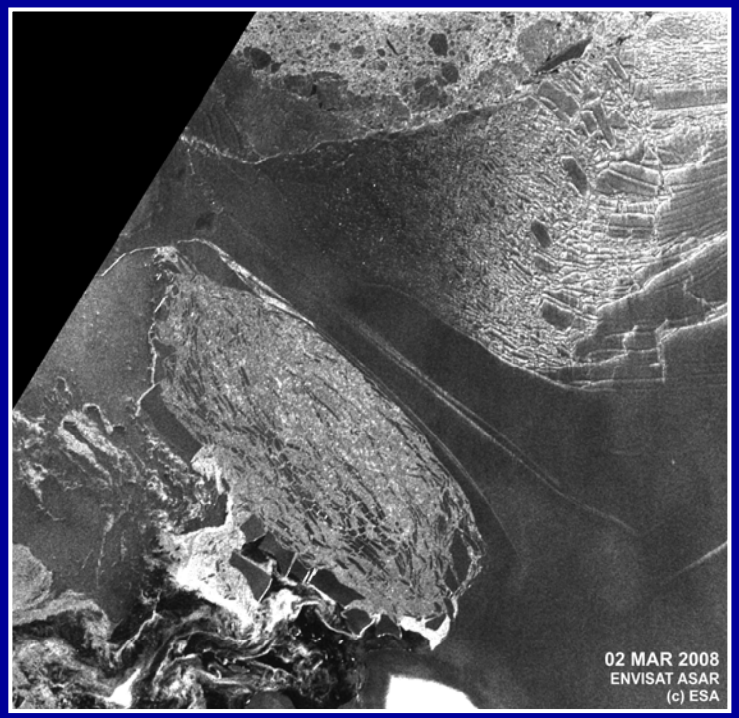


From fractures to break-up



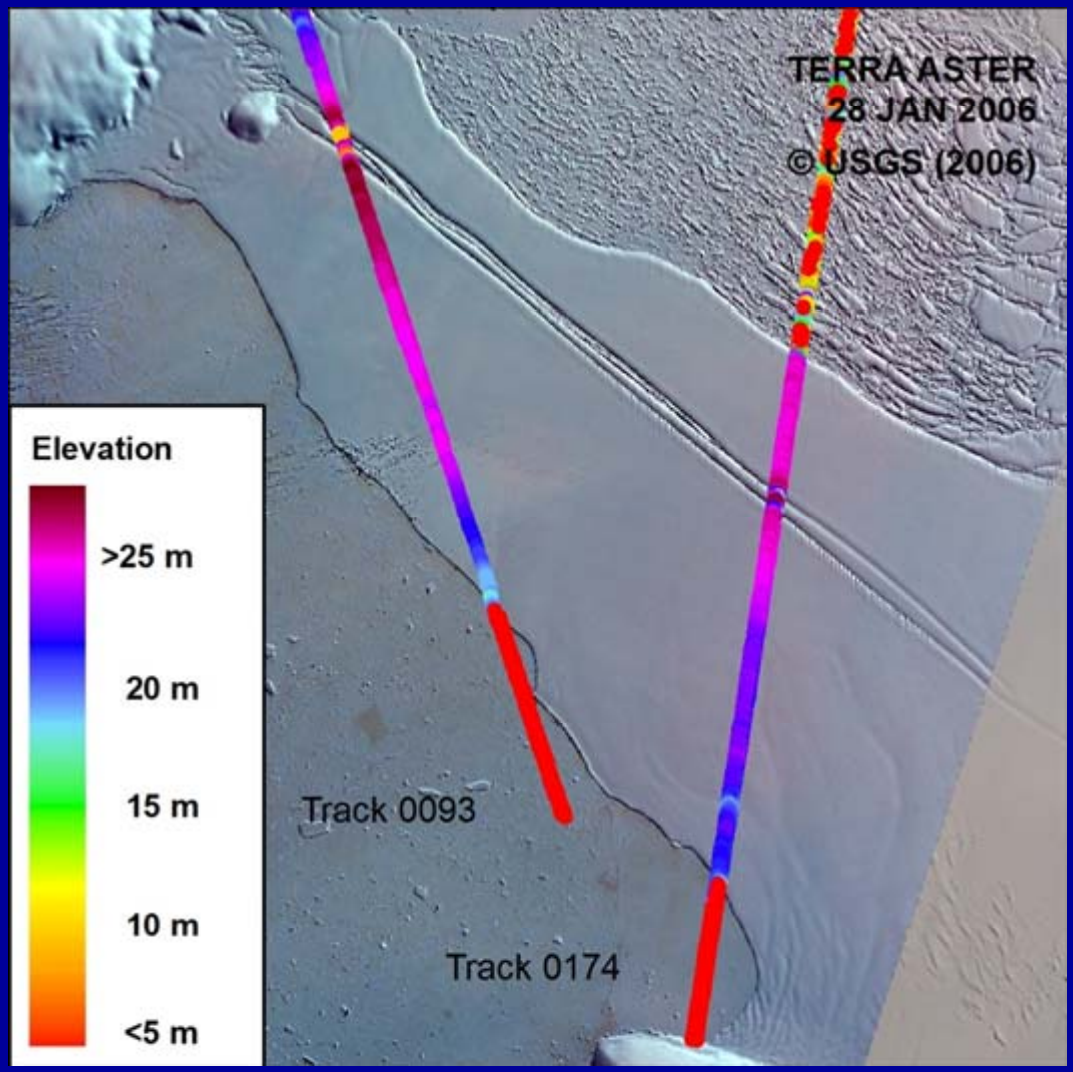




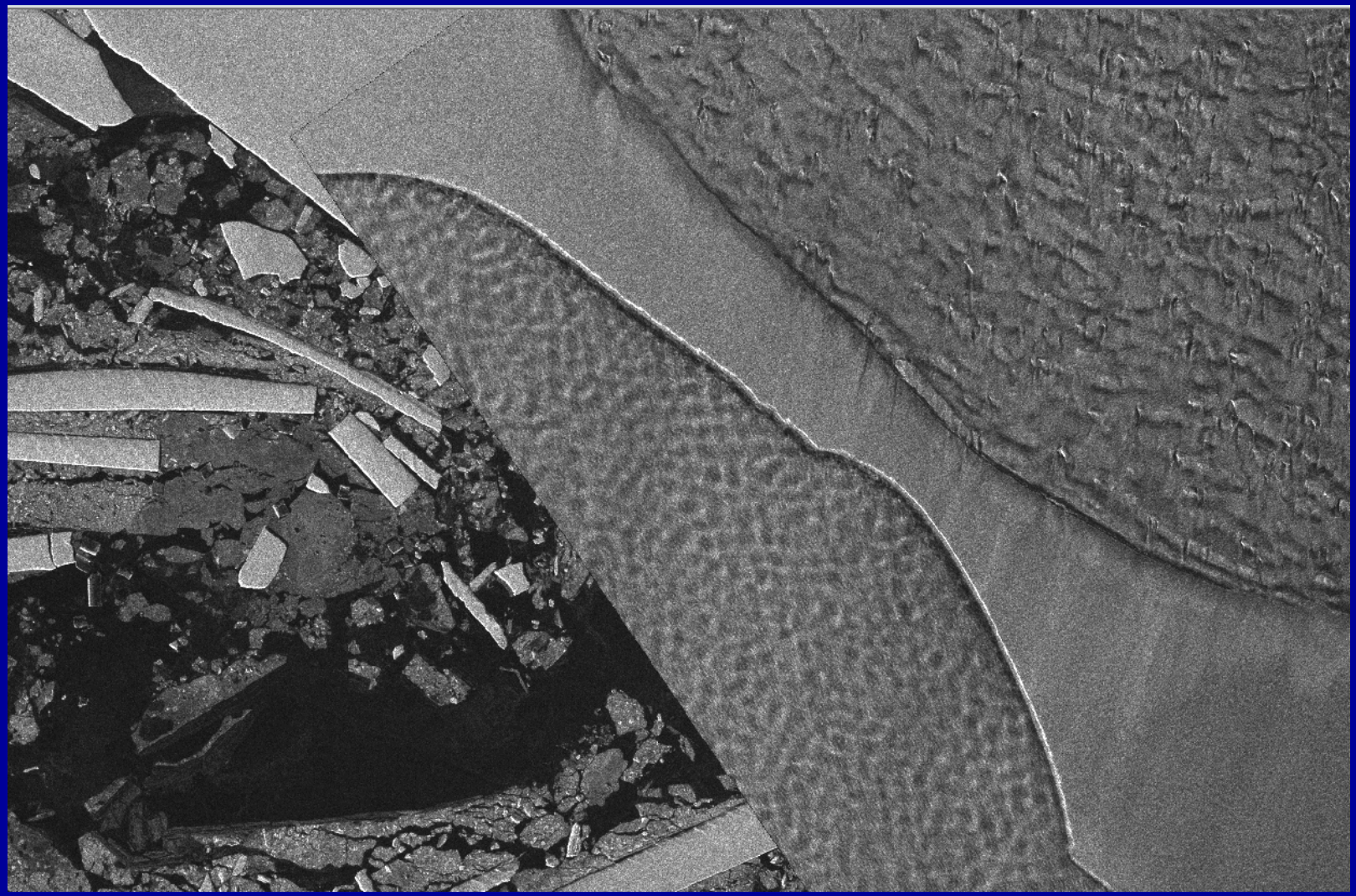


Reasons for the fracturing

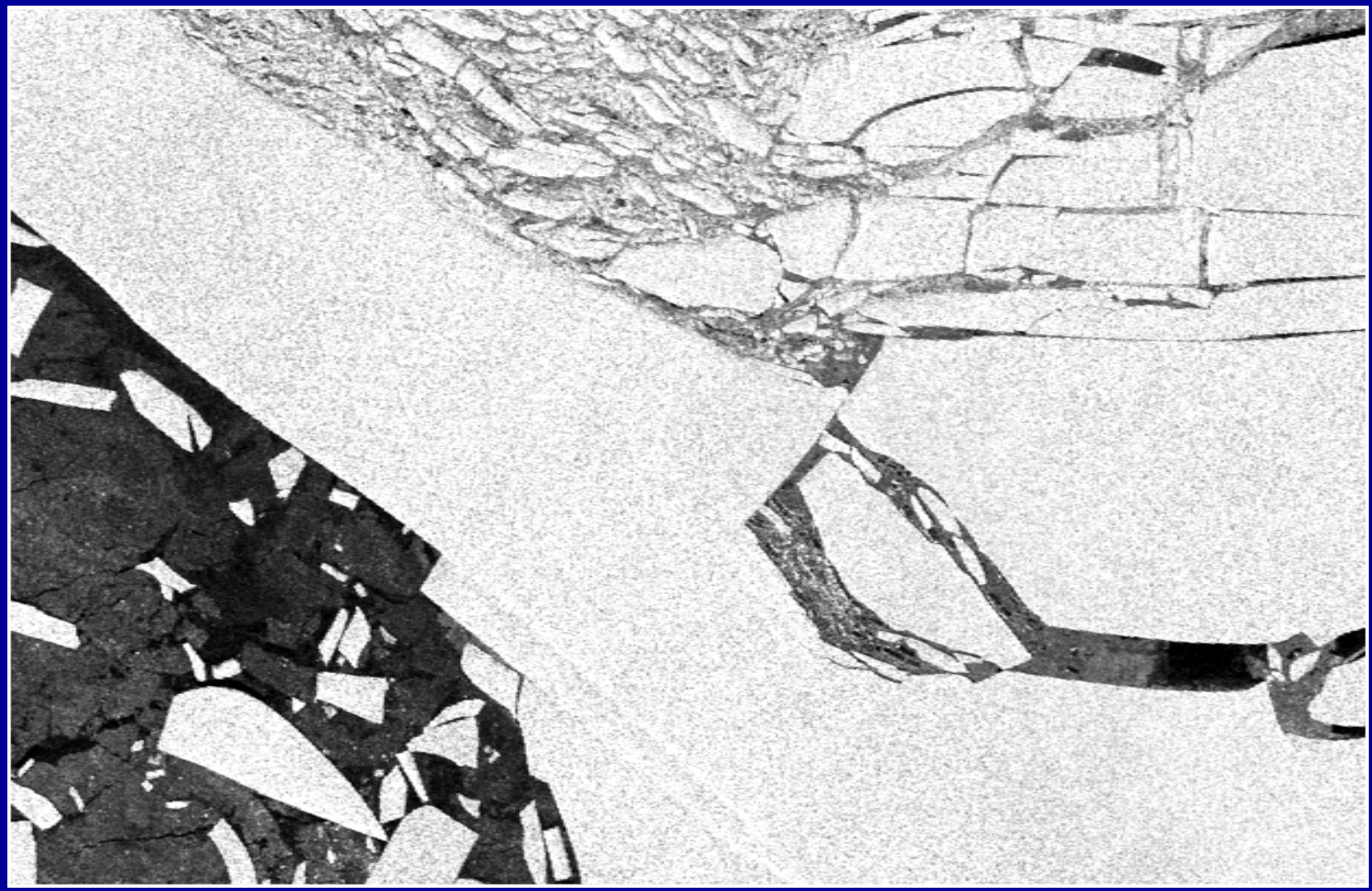
- Buyoancy forces for different ice thickness cause bending stress as large as 11 MPa
- Longitudinal stresses due to creep of ice add on (175 kPa)



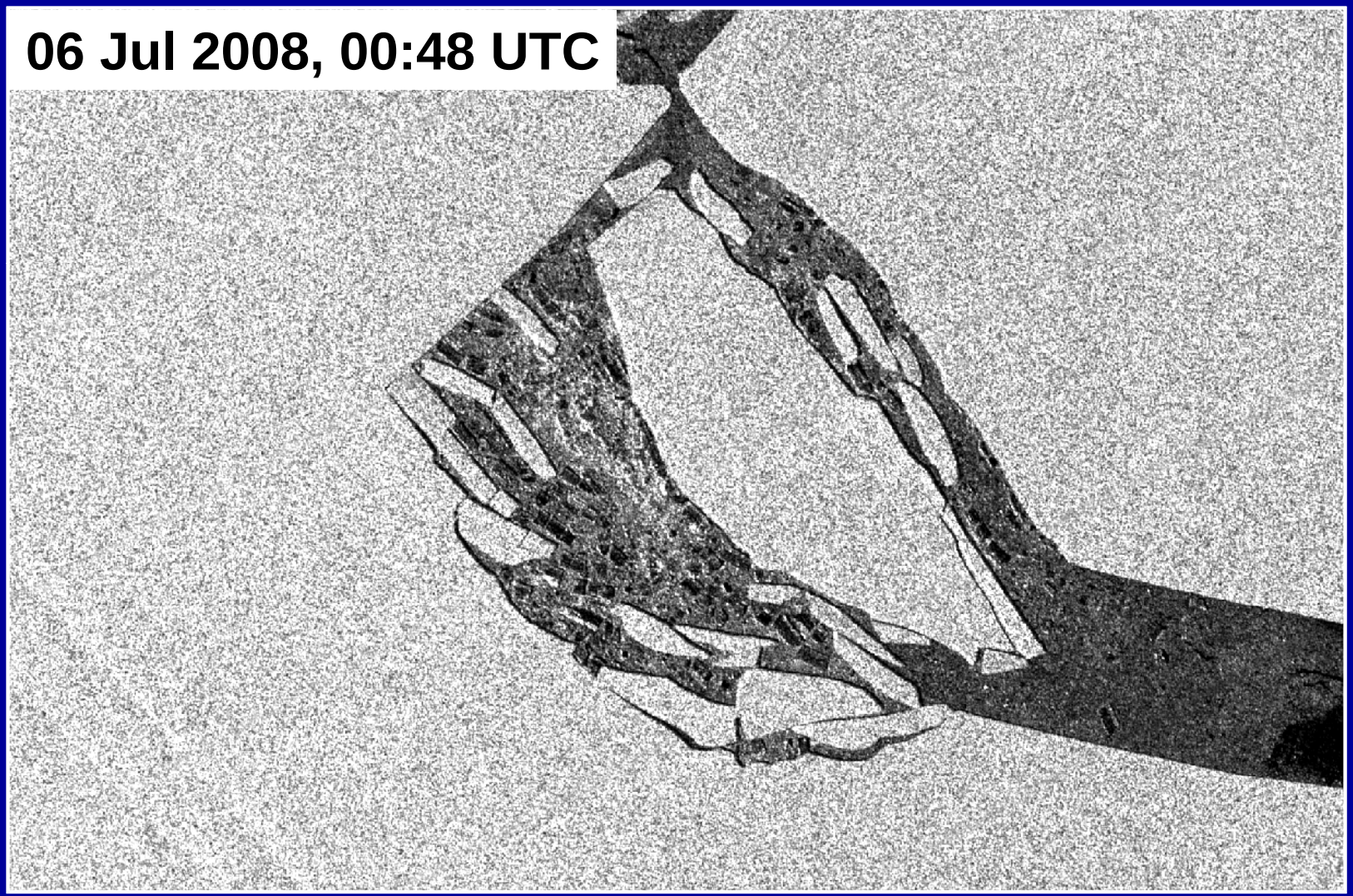
Why TSX

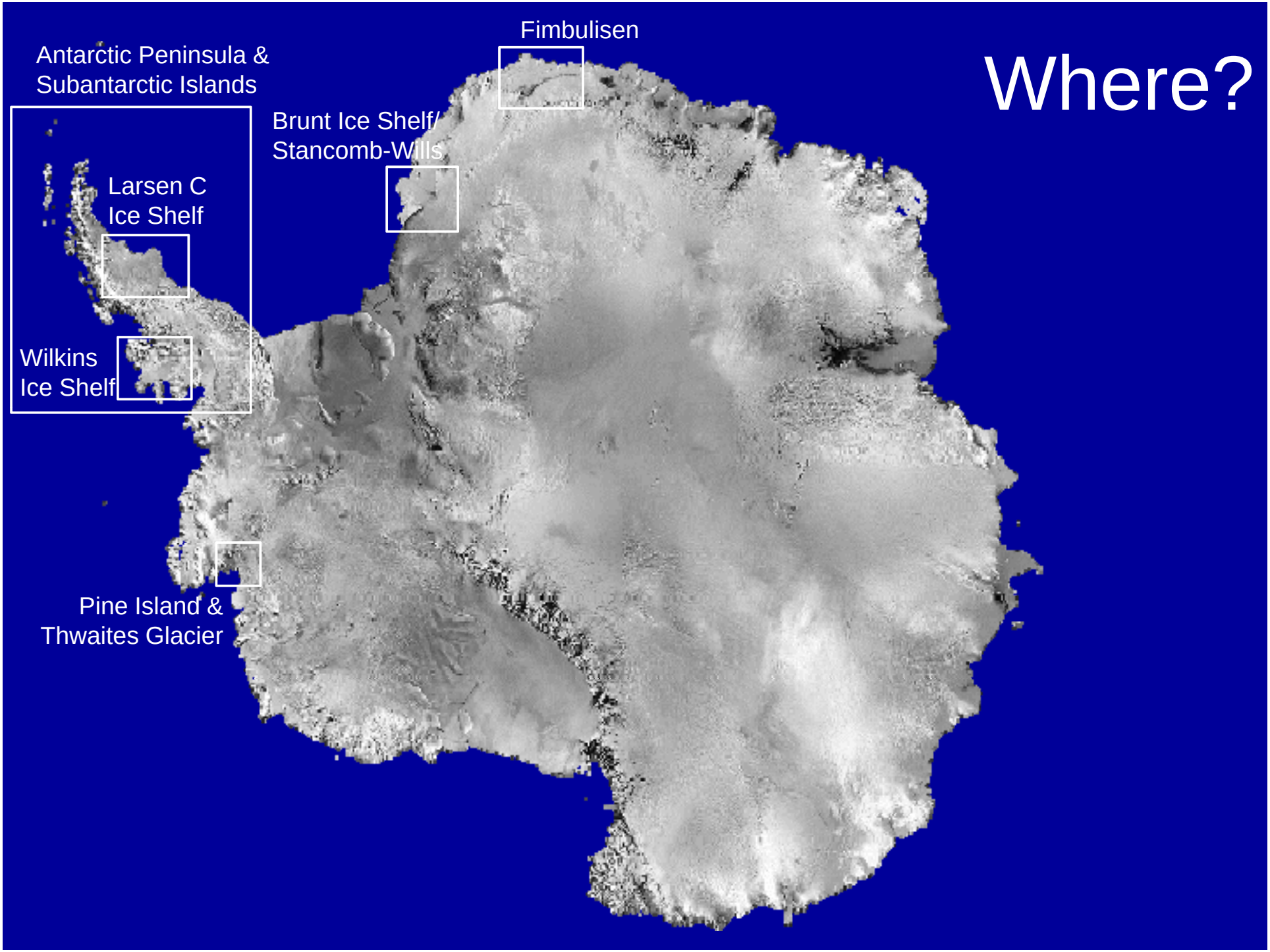


TerraSAR-X



July 2008 break-up




Where?
Fimbulisen
Antarctic Peninsula &
Subantarctic Islands
Brunt Ice Shelf/
Stancomb-Wills
Larsen C
Ice Shelf
Wilkins
Ice Shelf
Pine Island &
Thwaites Glacier

How?

Purpose	Location	Mode	Interval
annual mapping	selected (all) ice shelves	ScanSAR	1x per year
identification of changes & rift development	selected ice shelves	Stripmap	1x every 3-5 years
ice shelf velocities, shear zones, rift development	subsets of selected ice shelves & tributaries	Stripmap ScanSAR	4-5 times within austral winter
temporal variation of ice velocity	subsets of selected ice shelves& tributaries	Stripmap	in one year several 11 day revisits
break-up processes, rifts and surface structures in sensitive areas	Wilkins Ice Shelf	ScanSAR Stripmap	weekly or 2x weekly

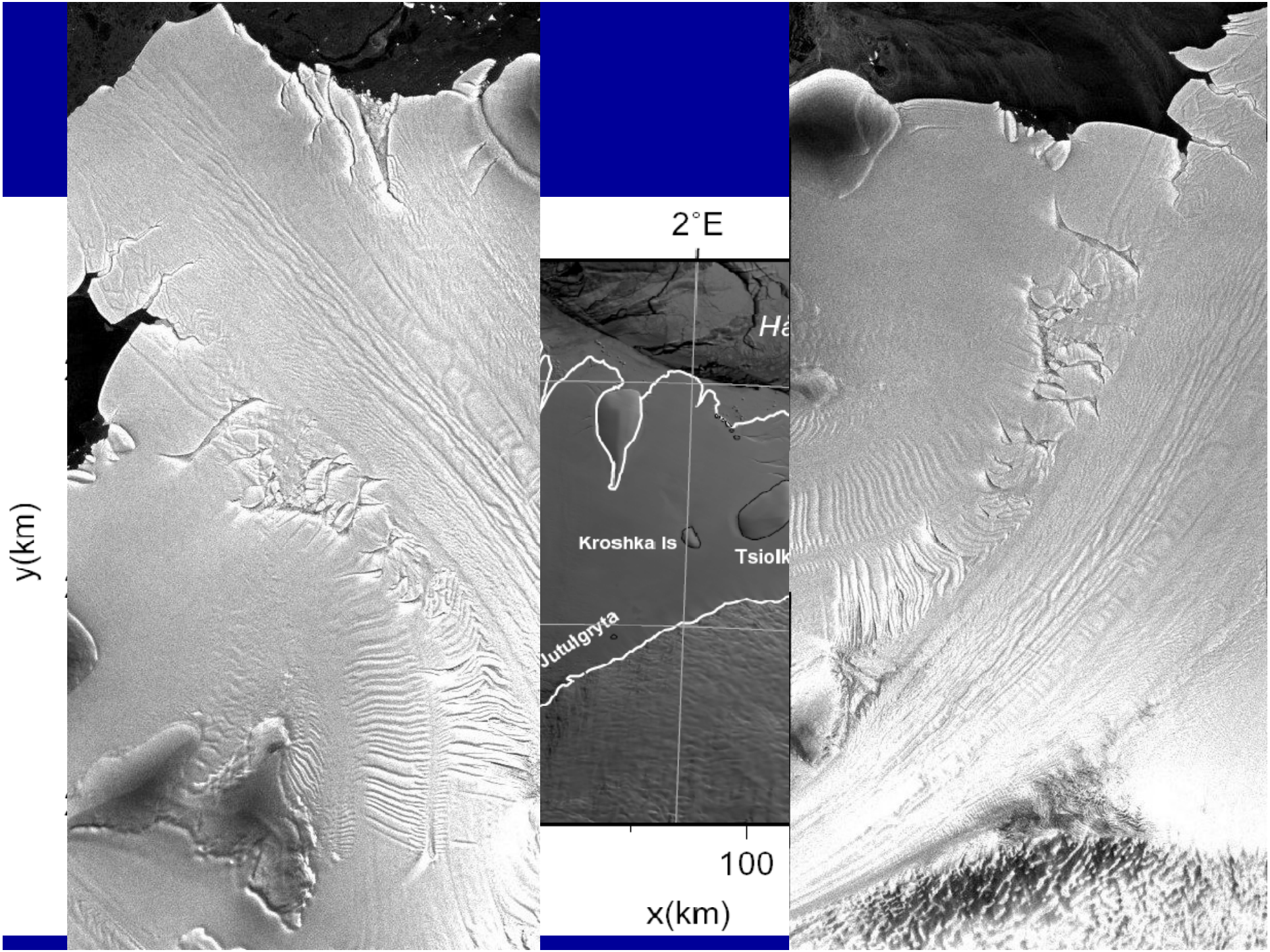
Cooperations

Confirmed

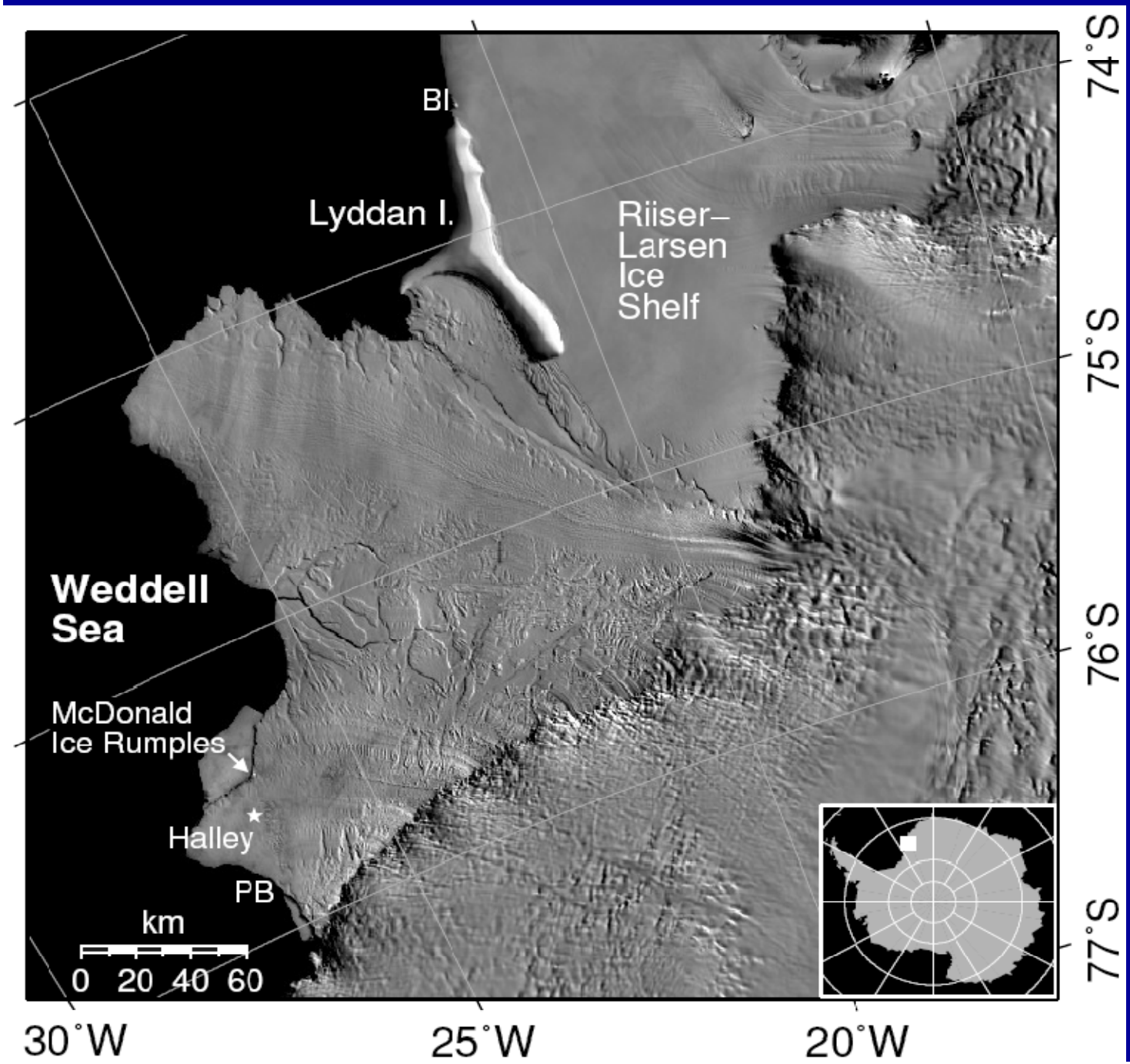
- Dr. Ricardo Jana, Instituto Antártico Chileno (INACH), Punta Arenas, Chile (King George Island, Antarctic Peninsula)
- Dr. Jorge Arigony, Professor Adjunto for Geoinformatics, Universidade Federal do Rio Grande (FURG), Brazil (King George Island, Antarctic Peninsula)
- Drs. Jack Kohler, E. Isaksson, O.A.Nøst, Norsk Polar Institut, Tromsø, Norway (Fimbulisen)
- Dr. Hilmar Gudmundsson, British Antarctic Survey, U.K. (Brunt Ice Shelf/Stancomb-Wills Ice Tongue System)

- ……..

Questions?


2°E
Kroshka Is
Tsiolk
Jutulgryta
100
x(km)
y(km)

Brunt IS


BI
Lyddan I.
Riiser–
Larsen
Ice
Shelf
Weddell
Sea
McDonald
Ice Rumples
Halley
PB
km
0 20 40 60
74˚S
75˚S
76˚S
77˚S
30˚W
25˚W
20˚W

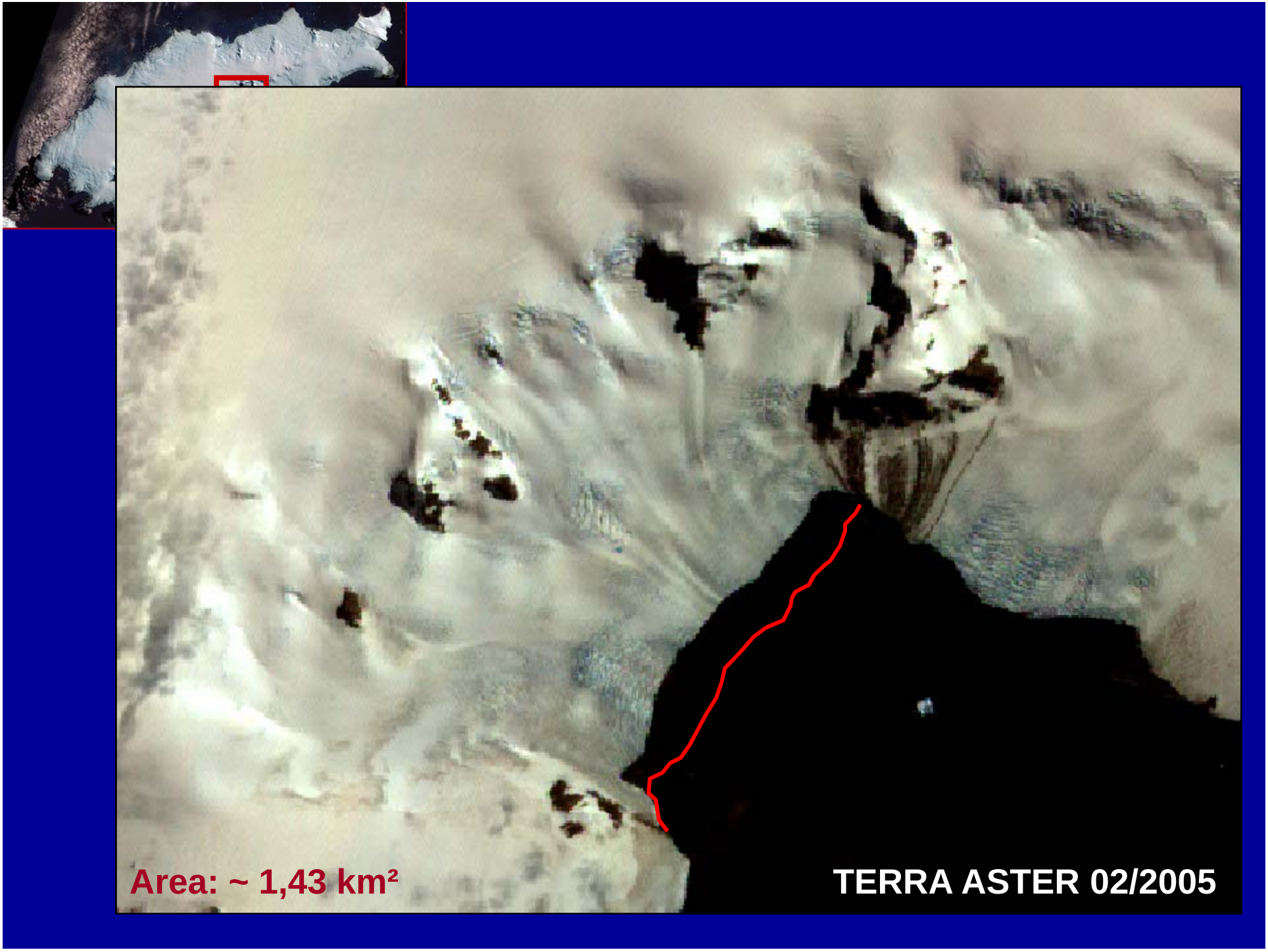
Where?

- Sub-Antarctic Islands (South Georgia / South Orkney Islands)
- South Shetland Islands (e.g. King George Island)
- Major outlet glaciers on the west and east coast of the AP
- Tributaries of already disintegrated ice shelves: Larsen-A, Larsen-B and Wordie
- Tributaries of Wilkins and GeorgeVI ice shelves

Why TSX for the AP?

Observation requirements:

- High-resolution for feature tracking
- Regular revisiting over the year, adapted to expected flow speeds
- Stripmap mode for high spatial resolution and geometric integrity
- Consistent viewing geometry
- Very good geolocation


Area: ~ 1,43 km²
TERRA ASTER 02/2005