Proposal for a TSX background mission

Antarctic Peninsula & Antarctic Ice Shelves

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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. 2007

Jan. 2008
• 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
<table>
<thead>
<tr>
<th>Purpose</th>
<th>Location</th>
<th>Mode</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>glacier extent</td>
<td>entire Antarctic Peninsula and Sub-Antarctic Islands</td>
<td>Stripmap</td>
<td>annual or bi-annual</td>
</tr>
<tr>
<td>glacier velocities</td>
<td>major outlet glaciers of the western Antarctic Peninsula, tributaries of still existing ice shelves &amp; glaciers of Sub-Antarctic Islands</td>
<td>Stripmap</td>
<td>6-8x per year, interval adapted to speeds</td>
</tr>
<tr>
<td>temporal variation of glacier velocities</td>
<td>selected target areas</td>
<td>Stripmap</td>
<td>in one year several 11 day revisits</td>
</tr>
<tr>
<td>glacier acceleration after ice shelf collapse</td>
<td>Larsen-A, Larsen-B, Wordie tributaries</td>
<td>Stripmap</td>
<td>10 revisits, same orbit</td>
</tr>
<tr>
<td>snow cover dynamics</td>
<td>subsets of King George Island</td>
<td>Spotlight</td>
<td>every 11 days (1-2 years)</td>
</tr>
</tbody>
</table>
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 fragile
February break-up
May-June break-up

ENVISAT ASAR
27-30-31 May
03-Jun 2007
© ESA
From fractures to break-up
Reasons for the fracturing

- Buoyancy forces for different ice thickness cause bending stress as large as 11 MPa
- Longitudinal stresses due to creep of ice add on (175 kPa)
July 2008 break-up

06 Jul 2008, 00:48 UTC
Where?

Antarctic Peninsula & Subantarctic Islands

Larsen C Ice Shelf

Wilkins Ice Shelf

Brunt Ice Shelf / Stancomb-Wills

Fimbulisen

Pine Island & Thwaites Glacier

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

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Questions?
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 George VI 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

TERRAASTER 02/2005