GROUP ON EARTH OBSERVATIONS

GEO FOREST CARBON TRACKING
2009 DATA REQUIREMENTS FOR NATIONAL DEMONSTRATORS

28 May 2009

Available at http://www.geo-fct.org/documents.html

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FCT Objectives

The GEO Task on Forest Carbon Tracking (GEO FCT) seeks to demonstrate the feasibility of forest monitoring information generated from coordinated Earth observation as input to future national forest and carbon monitoring systems.

This Task has been assigned the highest priority in 2009 by both GEO and CEOS, in particular to demonstrate to the UNFCCC COP-15 in Copenhagen in December, the value of linking coordinated acquisitions of satellite data with standardised processing methods, forest inventory and ecosystem models.

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FCT Objectives

To provide early proof that global, annual, medium resolution wall-to-wall coverage of the world's forests is feasible through coordinated satellite data acquisition strategies – combining both Optical and SAR sensors, the GEO Task on Forest Carbon Tracking requires the assistance of CEOS space agencies in the targeted acquisition of satellite data over key areas of interest. To show rapid progress, the Task seeks to demonstrate this capability initially at selected national scales in 2009 – in a number of "National Demonstrator (ND)" countries, where inter-governmental agreements already exist to conduct these studies.

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CEOS Coordination of Satellite Data Acquisitions for FCT

A key component in the establishment of long-term national monitoring systems for Forest Carbon Tracking is the development of a satellite data acquisition strategy and plan, that provides coordinated and consistent multi-sensor acquisitions, by both optical and SAR sensors, over the global forest cover on a repetitive basis, for linkage to integrated forest inventory and emissions modeling frameworks.

Given the need to show early progress in 2009, the development will be carried out in two steps:

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CEOS Coordination of Satellite Data Acquisitions for FCT

Acquisition Phase 1:

Execution of near-simultaneous wall-to-wall optical and SAR satellite data acquisitions over 7 nominated National Demonstrator regions, to be undertaken during July/August 2009 (+/- 1 month).

- Brazil (partial)
- Guyana
- Mexico (partial)
- Cameroon
- Tanzania
- Indonesia (Borneo island)
- Australia (Tasmania island)

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CEOS Coordination of Satellite Data Acquisitions for FCT

Acquisition Phase 2:

Aimed for implementation in mid-2010. It comprises the subsequent full global-scale systematic acquisition effort by CEOS agencies on a continuous basis so that the yearly, wall to wall moderate resolution, forest information products listed above can be regularly produced.

The development of this step will be undertaken in parallel with the 2009 ND acquisitions, and will seek to adopt an approach and implementation plan analogous with that established by space agencies for the coordinated satellite acquisition framework of the International Polar Year Space Task Group (IPY-STG.

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SENSOR REQUIREMENTS

NATIONAL DEMONSTRATORS

Regional/national coverage

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ALOS PALSAR (JAXA)

NDs (regional)

Observation mode:	Fine Beam Dual (FBD)
Polarisation:	HH + HV
Off-nadir look angle:	34.3°
Pass direction:	Ascending
Geographical coverage:	All National Demonstrator regions
Observation time window:	June 12-Sept.11, 2009 (ALOS cycles 28, 29)
Comments/justification:	Request corresponds in full to the ALOS Basic Observation Scenario.

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ALOS PALSAR (JAXA)

Validation Sites (local)

Observation mode:	Wide Beam 1 (WB1)
Polarisation:	HH
Pass direction:	Descending
Geographical coverage:	Borneo, South America Validation Sites
Observation time window:	June 12 – Dec. 13, 2009 (ALOS cycles 28-32)
Comments/justification:	Request correspond in full to the ALOS Basic Observation Scenario.

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Envisat ASAR (ESA)

NDs (regional)

Observation mode:	Alternating Polarisation (AP)
Polarisation:	VV + VH
Beam mode (inc. angle range):	IS4(1) (inc. 30.8°~36.2°)
Pass direction:	Ascending
Geographical coverage:	All National Demonstrator regions (2)
Observation time window:	July/August, 2009 (+/- 1month)
Comments/justification:	(1) IS4 corresponds to the AP beam with largest incidence angle range with maintained Equator swath overlap. (2) To be covered by either ASAR or RADARSAT-2. To be agreed between ESA and CSA.

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Radarsat-2 (CSA)

NDs (regional)

Observation mode:	Wide Beam (150 km)
Polarisation:	VV + VH (1)
Beam mode (inc. angle range):	Wide Beam #3 (alt. Wide Beam 2) (2)
Pass direction:	Ascending
Geographical coverage:	All National Demonstrator regions (3)
Observation time window:	July/August, 2009 (+/- 1month)

Comments/justification:

(1) VV+VH same as Envisat ASAR. Complementing RADARSAT-1 (fixed HH).

(2) Large incidence angle required to improve forest sensitivity. If operationally unavailable, alternative mode Wide Beam#2.

(3) To be covered by either ASAR or RADARSAT-2. To be agreed between ESA and CSA.

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Radarsat-1 (CSA)

NDs (regional)

Observation mode:	Wide Beam (150 km)
Polarisation:	HH (fixed)
Beam mode (inc. angle range):	Same as RADARSAT-2 (Wide Beam #3 or #2)
Pass direction:	Ascending (Same as RADARSAT-2)
Geographical coverage:	ND regions within ground receiving station coverage (SE-Asia, S. America, Australia) Validation Sites as above.
Observation time window:	July/August, 2009 (+/- 1month)

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COSMO-SkyMed (ASI)

NDs (regional)

Observation mode:	ScanSAR Wide (100 km) (1)
Polarisation:	HH (cycle 1), HV (cycle 2), VV (cycle 3) (2)
Beam mode (inc. angle range):	Beam 1: Incidence angle range 40°~50° Beam 2: Incidence angle range 50°~60° (3)
Pass direction:	Ascending
Geographical coverage:	Borneo Island; Guyana; Brazil (part)
Observation time window:	July/August, 2009 (+/- 1 month)
Comments/justification:	(1) ScanSAR Wide selected for wide swath and medium (30m) resolution (2) Only Single-polarisation possible at ScanSAR Wide, and three consecutive passes (at same angle) are thus required to achieve triple-polarisation (VH redundant). (3) For gap-free wall-to-wall coverage at ScanSAR Wide mode (100km swath), acquisitions at TWO adjacent beams - each at three polarisations - are required to assure swath overlap. Can be achieved with two satellites during three cycles (3x16 days), or one satellite during six cycles.

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TerraSAR-X (DLR)

NDs (regional)

Observation mode:	ScanSAR (100km swath)
Polarisation:	HH (cycle 1), VV (cycle 2) (1)
Beam mode (inc. angle range):	ONE beam with inc. angle range 45°~55° (3)
Pass direction:	Ascending
Geographical coverage:	Tasmania
Observation time window:	July/August, 2009 (+/- 1month)
Comments/justification:	(1) 2 cycles (2x11 days) required to for dual-pol coverage. (2) For gap-free wall-to-wall coverage at 40 deg latitude (Tasmania) with ScanSAR mode (100km swath), acquisitions at (at least) TWO adjacent beams - each at two polarisations - are required to assure swath overlap.

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TerraSAR-X (DLR)

Validation Sites (local)

Observation mode:	Stripmap (SM)
Polarisation:	Dual, HH+HV (cycle 1), VV+VH (cycle 2) (1)
Beam mode (inc. angle range):	ONE beam with inc. angle range 50°~60° (2)
Pass direction:	Ascending
Geographical coverage:	Validation Sites in Tasmania, Cameroon Tanzania and Mexico
Observation time window:	July/August, 2009 (+/- 1month) Nov/Dec, 2009 (+/- 1month)
Comments/justification:	(1) 2 cycles (2x11 days) required to for two dual-pol coverages. Acquired once in July/August, and repeated in the Nov/Dec time frame (2) Largest possible incidence angle required to improve forest sensitivity. Both acquisitions at same incidence angle.

Our task today

• Open floor (30 mins) Propose **science requirements and relevant products** for a global forest monitoring system, serving also FCT (e.g. Annual forest/non-forest map, Forest change maps , Degradation mapping, Biomass stocks & change, etc…)

• 3-4 working groups (1.5 hrs) Define a first-cut IPY-type of User Requirement Guidelines for each product

- Science rationale
- Coverge requirements (L-, C- and X-band)
- Sensor requirements for L-, C- and X-band

• Open floor (1 hour) Review of working group session

•To be sent for review by K&C team during June/July

• Presented to space agencies at FCT SAR Coordination Phase 2 meeting (August, JAXA)

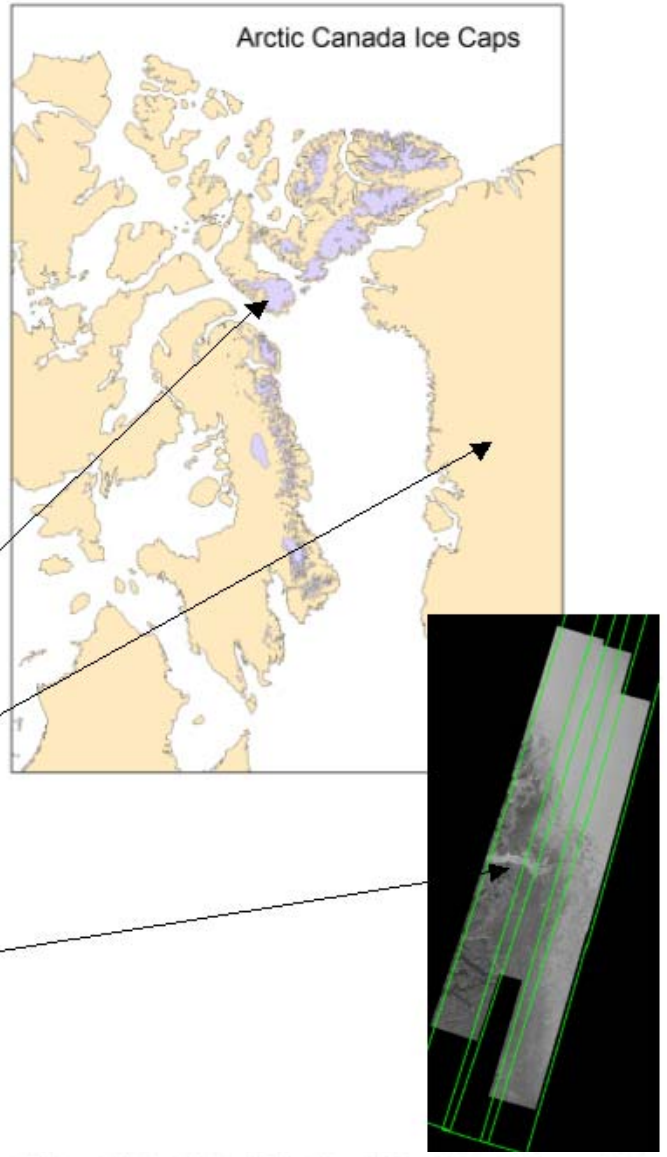
SAR Requirements for Arctic Land Ice

Thematic Objective: Sea level rise, and hemispheric climate:

1) One summer, one winter SAR snapshot of the Arctic Ice Caps. Near simultaneous imagery at L, C, and X band, polarimetric quad pole for documenting ice surface physical parameters.
2) One, winter, multi-frequency InSAR measurement of ice surface velocity.
3) Repeated InSAR observations of the most rapidly changing outlet glaciers

Coverage Requirement

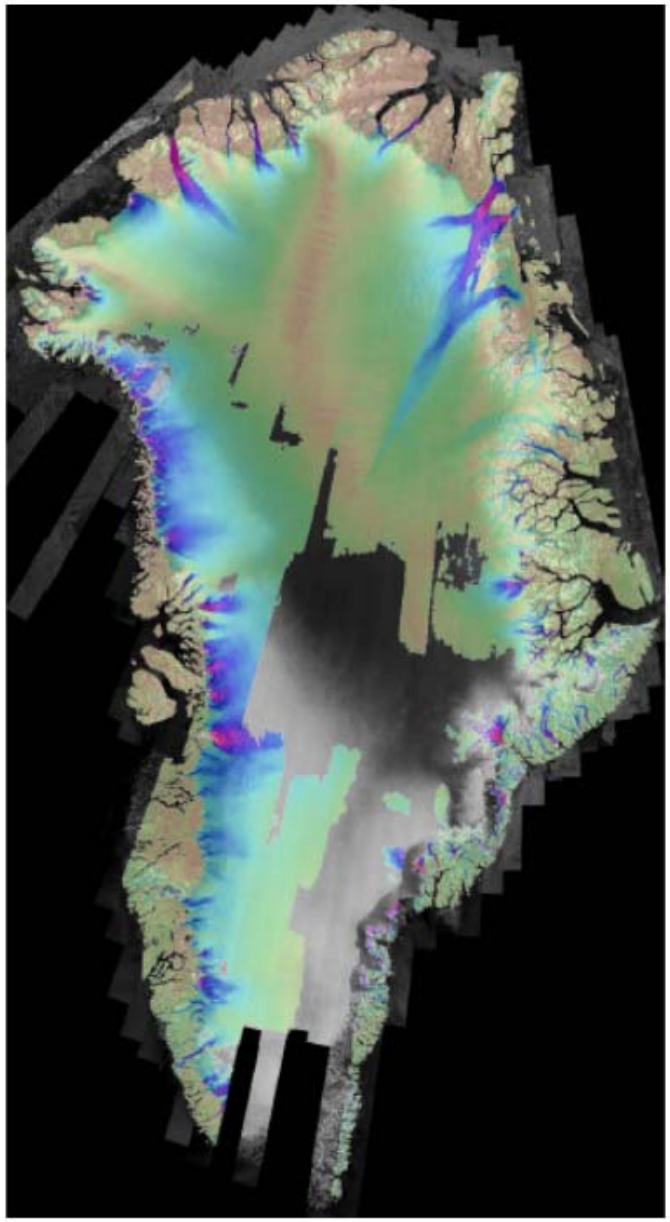
1) Canadian Ice Caps InSAR: 4 consecutive cycles in Dec 2008-March 2009 (see map at right)
2) Greenland Ice Sheet InSAR: 4 consecutive cycles covering the entire ice sheet in Dec 2008-March 2009
3) Jakobshavn Glacier: every cycle for 3 adjacent tracks



SAR Requirements for Arctic Land Ice

Sensor Requirements

1. InSAR observations: select highest bandwidth radar modes and shortest repeat cycles over fast glaciers (right image). 200 m baseline.
2. One summer and one winter, L, C and X band near simultaneous image mapping with comparable beam modes (25 m, 23°).

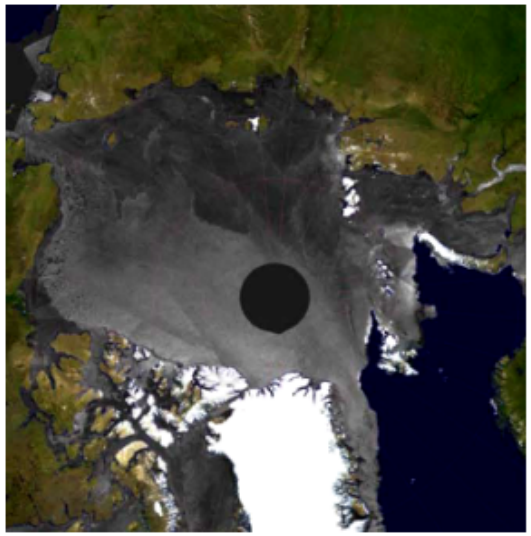


SAR Requirements for Sea Ice (Arctic and Southern Oceans)

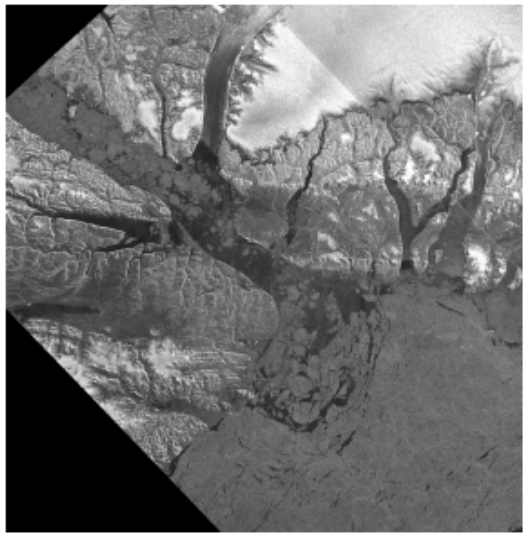
• Thematic Objective

Ocean circulation and polar air-sea interactions (Sea ice):

1) *For the first time*, L-band SAR mapping of the Arctic ocean and marginal seas sea ice cover for leads and ridges.
2) *For the first time*, repeat fine resolution SAR mapping of the entire Southern ocean sea ice cover for ice motion.
3) *For the first time*, SAR and optical fine resolution mappings of the entire Arctic ocean.
4) Systematic 3-day medium resolution SAR mapping of sea ice covered waters for motion, and melt pond coverage.



Envisat Arctic SAR Mosaic

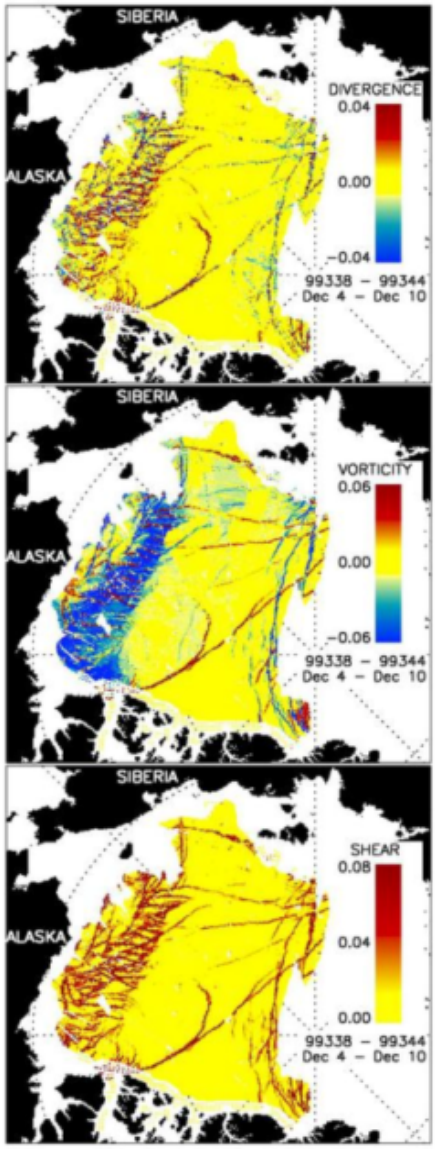


Nares Strait

Coverage Requirement

1) Coverage of ice-covered waters with the ice edge of the Arctic and Southern Oceans
2) 3-day systematic mapping of the Arctic Ocean
3) Ascending and descending coverage
4) Year round coverage defined by the time-varying ice edge

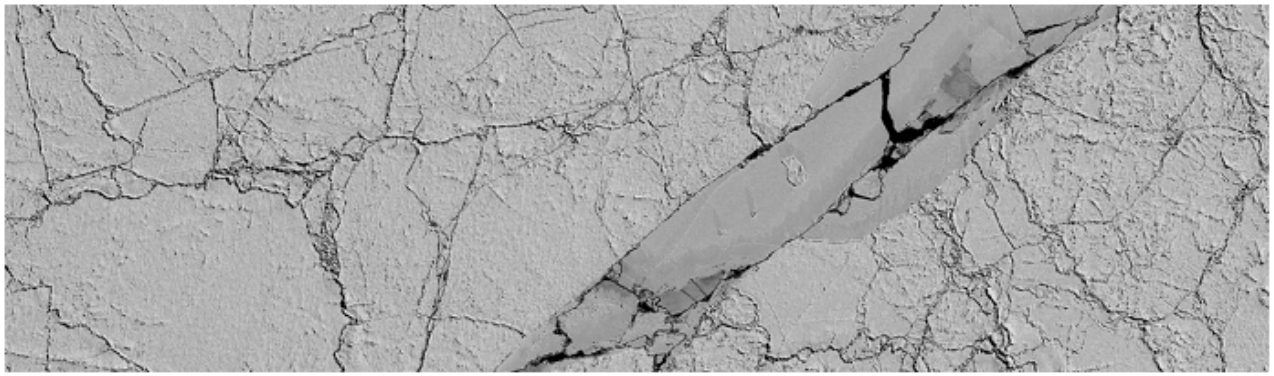
SAR Requirements for Sea Ice (Arctic and Southern Oceans)



RGPS ice deformation

Sensor Requirements

- **C-band**
  - Wide-swath C-band ScanSAR for systematic 3-day mapping of ice-covered oceans.
  - Short time-separation (daily) repeat coverage of the Lincoln Sea, Nares Strait and Fram Strait at C-band.
- **L-Band**
  - L-band quad-pol SAR coverage of the Arctic and Southern Ocean sea ice.
  - L-band ScanSAR coverage of the sea ice cover.
- **Optical coverage**
  - Optical coverage of the Arctic and Southern Oceans sea ice.



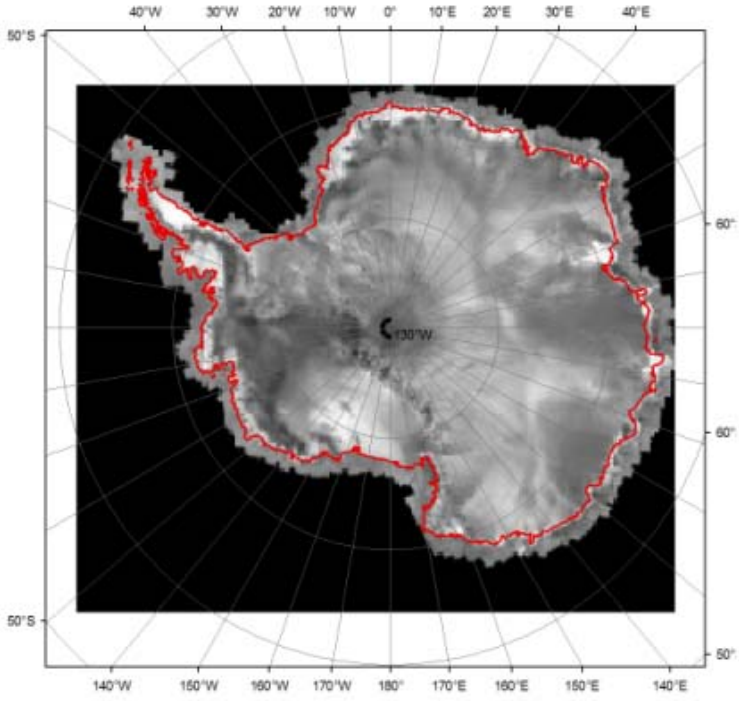
Optical coverage

SAR Requirements for Antarctica

- **Thematic Objective: Sea level rise, and hemispheric climate:**
  1) *For the first time*, one summer, one winter SAR snapshot of the polar ice sheet. Near simultaneous imagery at L, C, and X band, polarimetric quad pole for documenting ice surface physical parameters.
  2) *For the first time*, pole-to-coast multi-frequency InSAR measurements of ice surface velocity.
  3) *For the first time*, repeated X-band InSAR topography for detecting local changes in ice sheet elevation associated with motion of subglacial water.

Coverage Requirement

1) From pole to 150 km seaward of RAMP coastline (right image)
2) 4 successive cycles of observations
3) Ascending and descending coverage
4) Observations during the period of April to November (can be relaxed for regions south of 80 degrees Latitude)



SAR Requirements for Antarctica

Sensor Requirements

1. Fine beam and standard beam coverage to southerly limit of right looking satellites
2. Fine beam and standard beam coverage between about 78 South to pole for left looking satellites
3. Observations with highest bandwidth and shortest repeat over fast glaciers (right image) and Antarctic Peninsula.
4. Desirable to have overlap between left and right looking coverage areas (extended beams)