



# **Topographic Mapping in the Canadian Arctic: Update on production and recent developments**

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Earth Sciences Sector

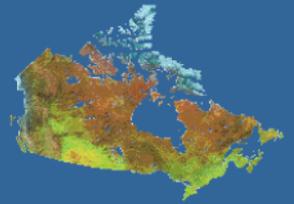


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Canada

Ressources naturelles  
Canada

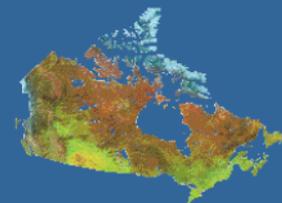
Canada

# Presentation

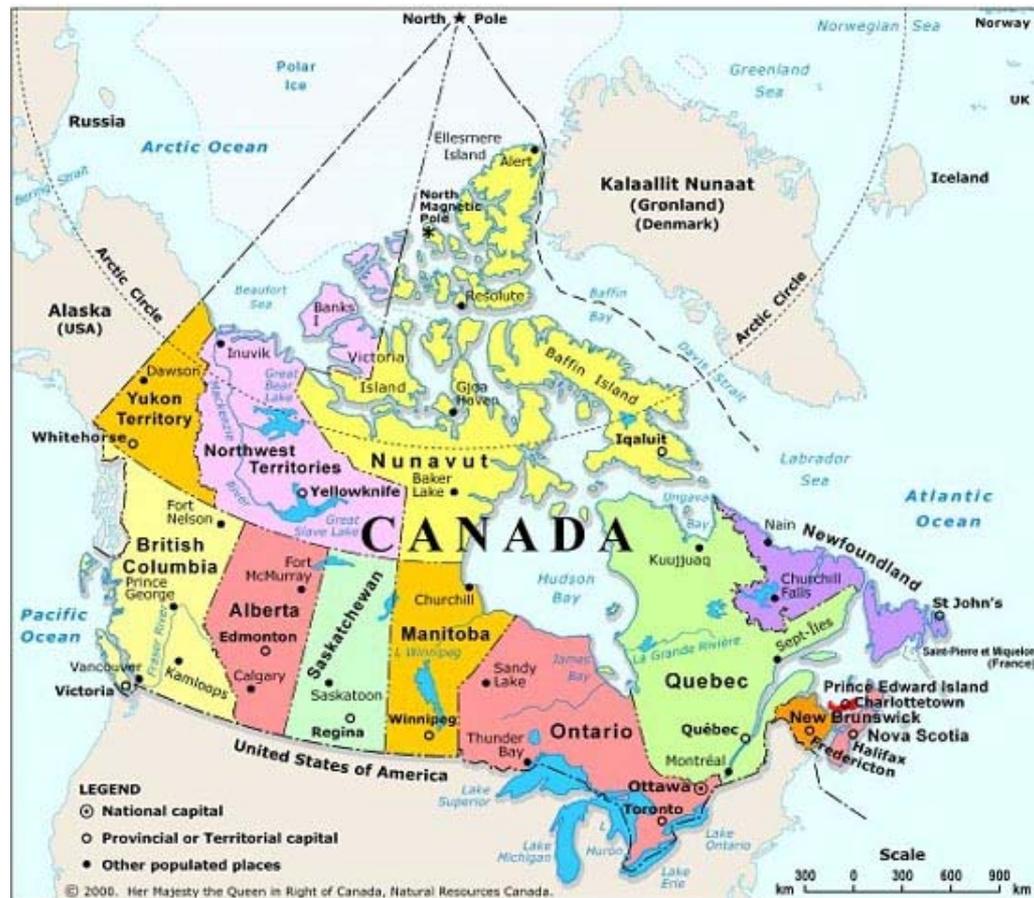


- Canada's North
- Topographic Mapping Project
- Progress since GeoNorth2007
- SPOT5/HRS
- Radarsat-2

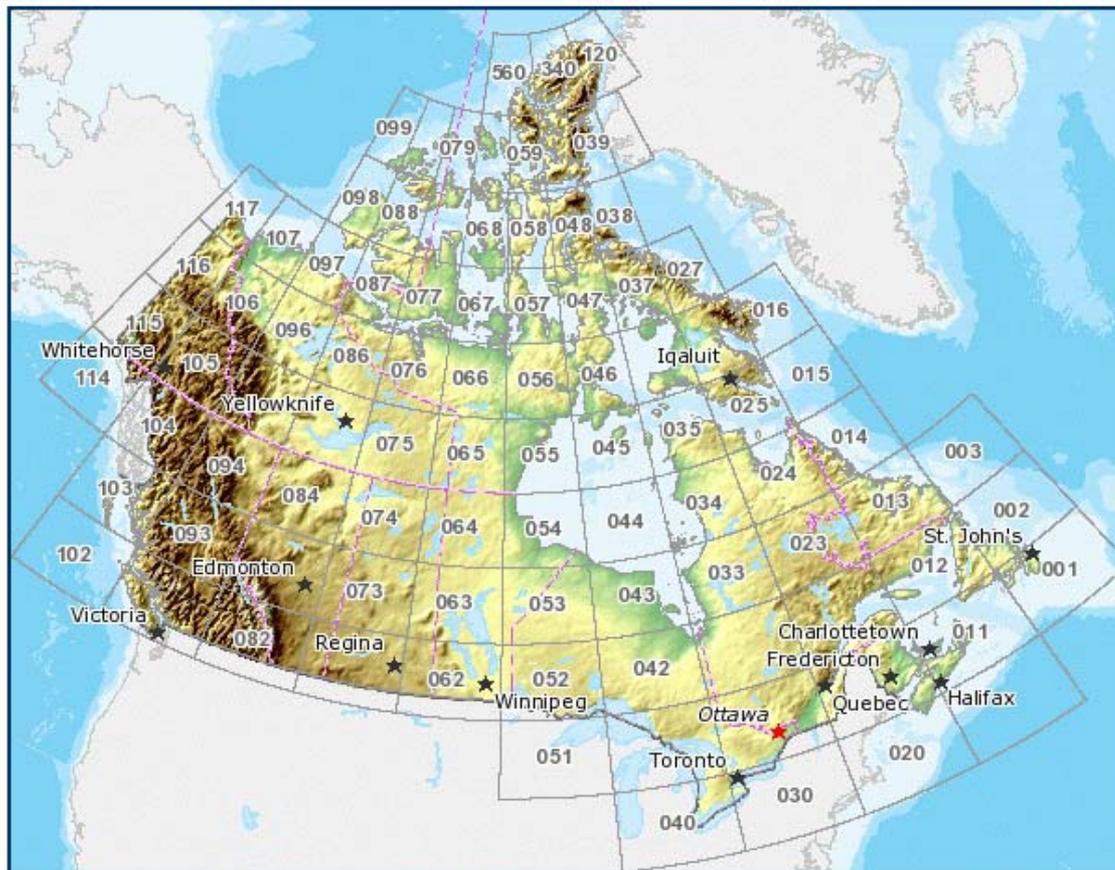
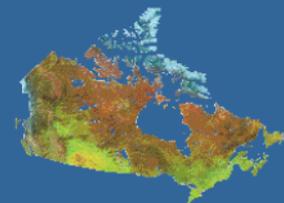
# Canada's North



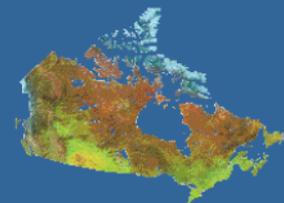
- Nunavut : 21% of Canada's landmass
- Northwest Territories : 13,5% of Canada
- Yukon : 5% of Canada



# Relief

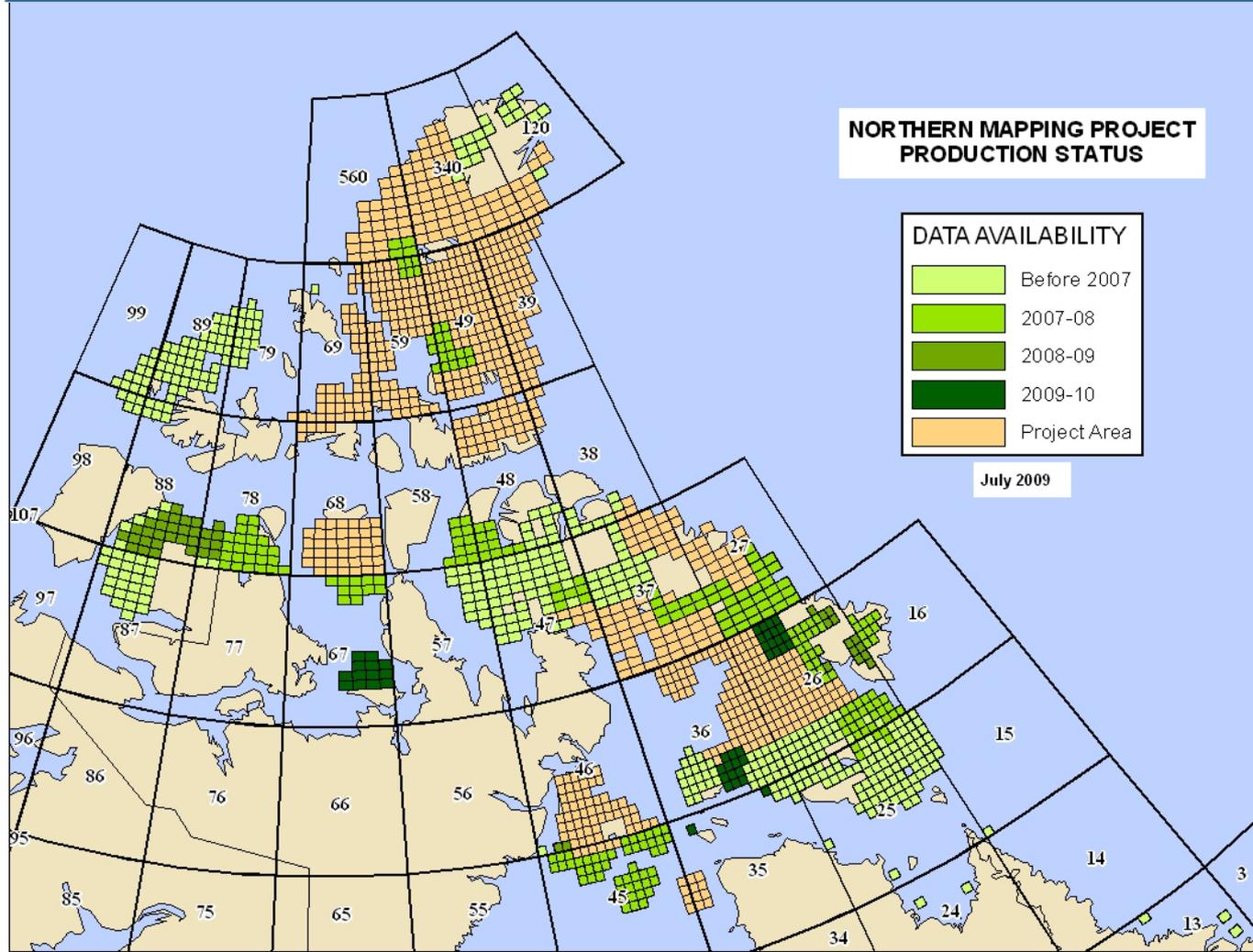
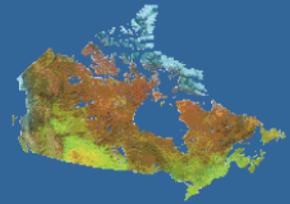


# Topographic Mapping Project

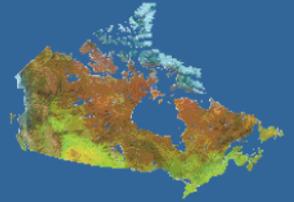


- Project goal:
  - Complete the 1:50,000 scale map coverage with EO data according to user needs
- R & D efforts:
  - New data sources (Radarsat-2, SPOT5/HRS)
  - Technical and financial support from the CSA under GRIP
- Production:
  - Financial involvement from INAC, NTI and Geoconnections
  - Qualified companies for planimetric and altimetric production

# Progress since GeoNorth2007



# Progress...



- 2007
  - 121 CDEDs available
  - 462 CanVec (planimetric) data sets available without contour lines and toponymy
  - 1,000 data sets to produce
  
- 2009
  - 730 CDEDs available
  - 743 CanVec data sets available
  - 853 data sets to produce

# Data availability



www.geogratis.ca

www.geobase.ca

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CanVec is a digital cartographic reference product produced by Natural Resources Canada. CanVec originates from the best available data sources covering Canadian territory and offers quality topogr... [\[More details\]](#) [\[Documentation\]](#)

Access the [FTP download directory](#) in order to quickly download a large amount of data.

**Search Datasets by Name**

Dataset Name:

**Search Datasets by Spatial Extents** [How to navigate?](#)

Scale = 1 : 120M

**Search available datasets**

- New data
- Modified data
- Unchanged data
- No data

Locate an area of interest on the map

Use one of the following location methods in order to limit spatial extents of your search to a specific region of interest.

- by Geoname
- by Postal Code
- by NTS Mapsheet
- by Geographic Coordinates

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**GeoBase** Building on common ground

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**Data**

**Data Selection**

Click on the map to select a region

■ 5500m  
■ 1000m Available  
■ 0m  
 Unavailable

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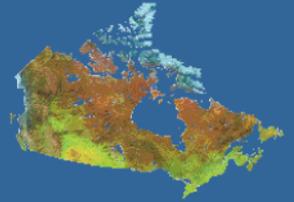


Natural Resources Canada

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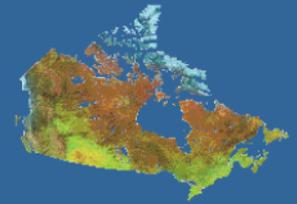
Canada

# SPOT5/HRS

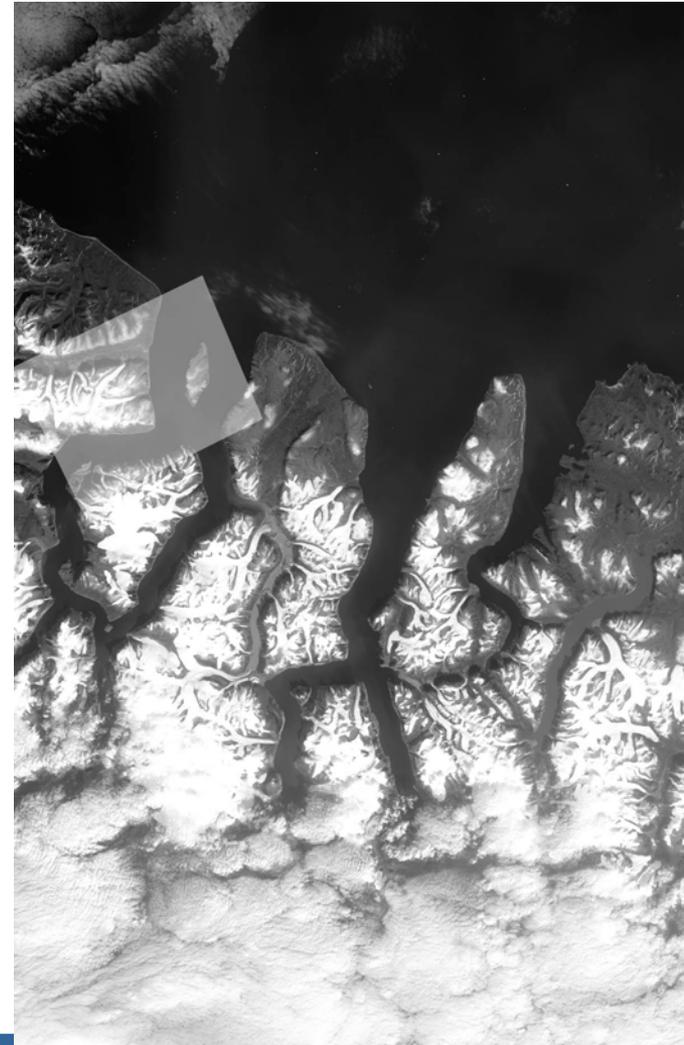


- Objective:
  - Evaluate SPOT5/HRS for stereo-compilation at the scale of 1: 50,000 in the Arctic for :
    - Topographic Data acquisition
    - Digital Terrain Model creation

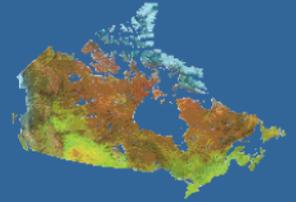
# 1 SPOT 5 HRS...



- Test site: Clyde River, Baffin Island
  - Accurate Photogrammetric data (gcp, vectors, DEMs)
  - Mountainous environment (Fjords, 1 000 meter rel. elev.)



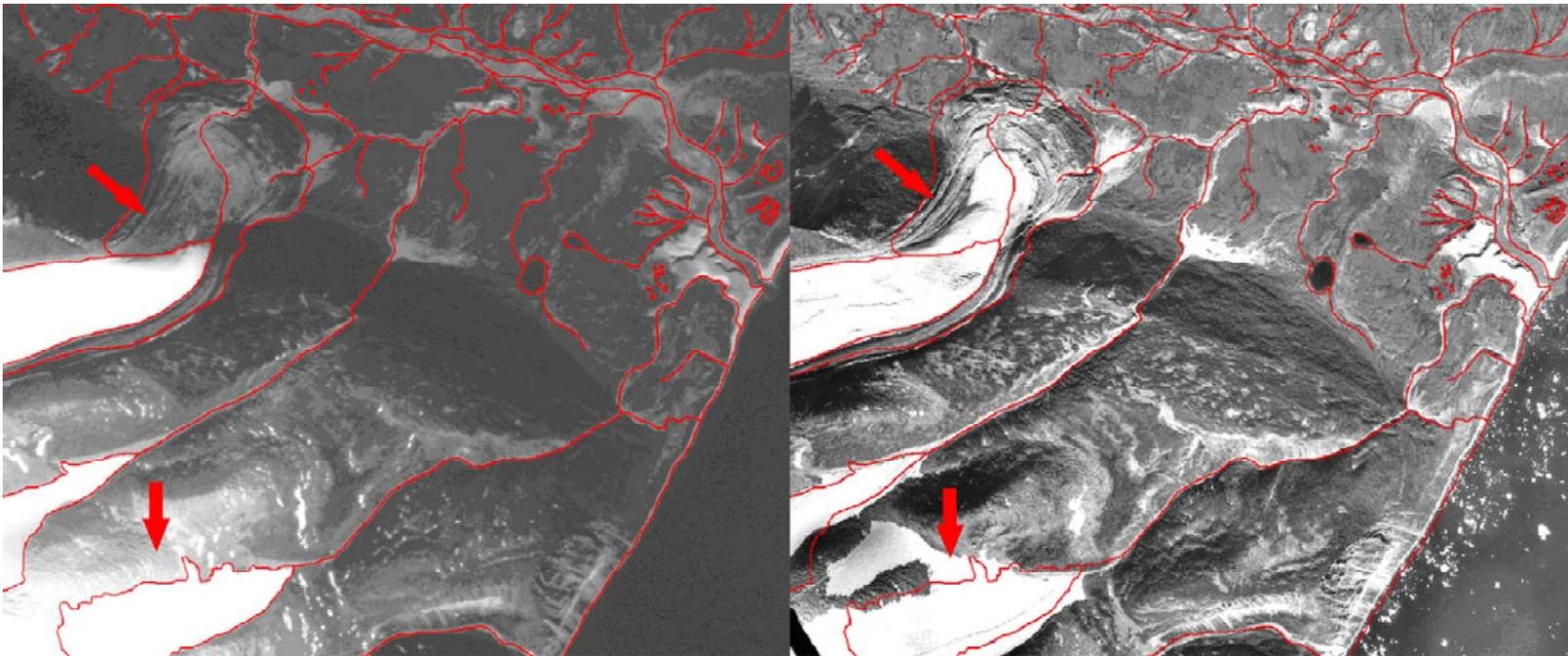
# SPOT5/HRS...



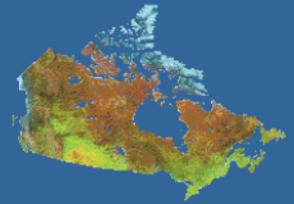
## Temporal differences

### SPOT 5 HRS 2004

### Air photo 1959



# SPOT5/HRS...



- Model accuracy

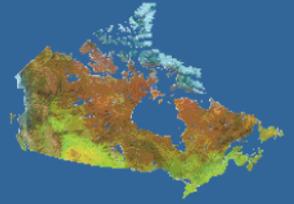
Model residuals	
Residuals in X (metres)	Residuals in Y (metres)
<b>5.4</b>	<b>5.5</b>

- Planimetric accuracy

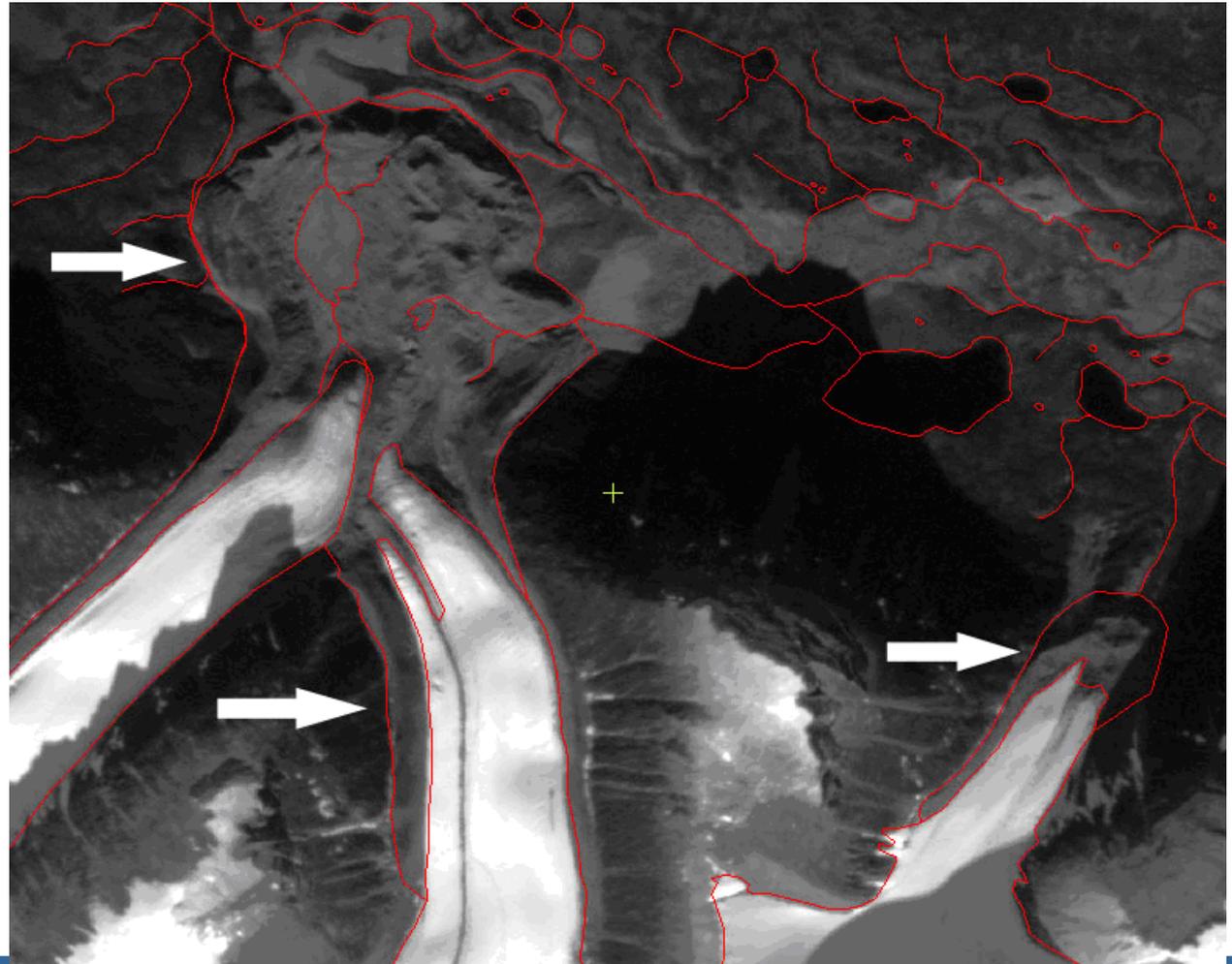
Error vectors	CE90 (m)
HRS vs Aerial photography	<b>15</b>

- Altimetric accuracy

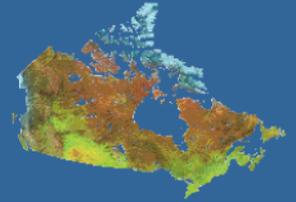
DEM accuracy SPOT5/HRS			
	Average(m)	Std. Dev. (m)	LE90 (m)
ICESat	4.5	8.4	<b>15.6</b>



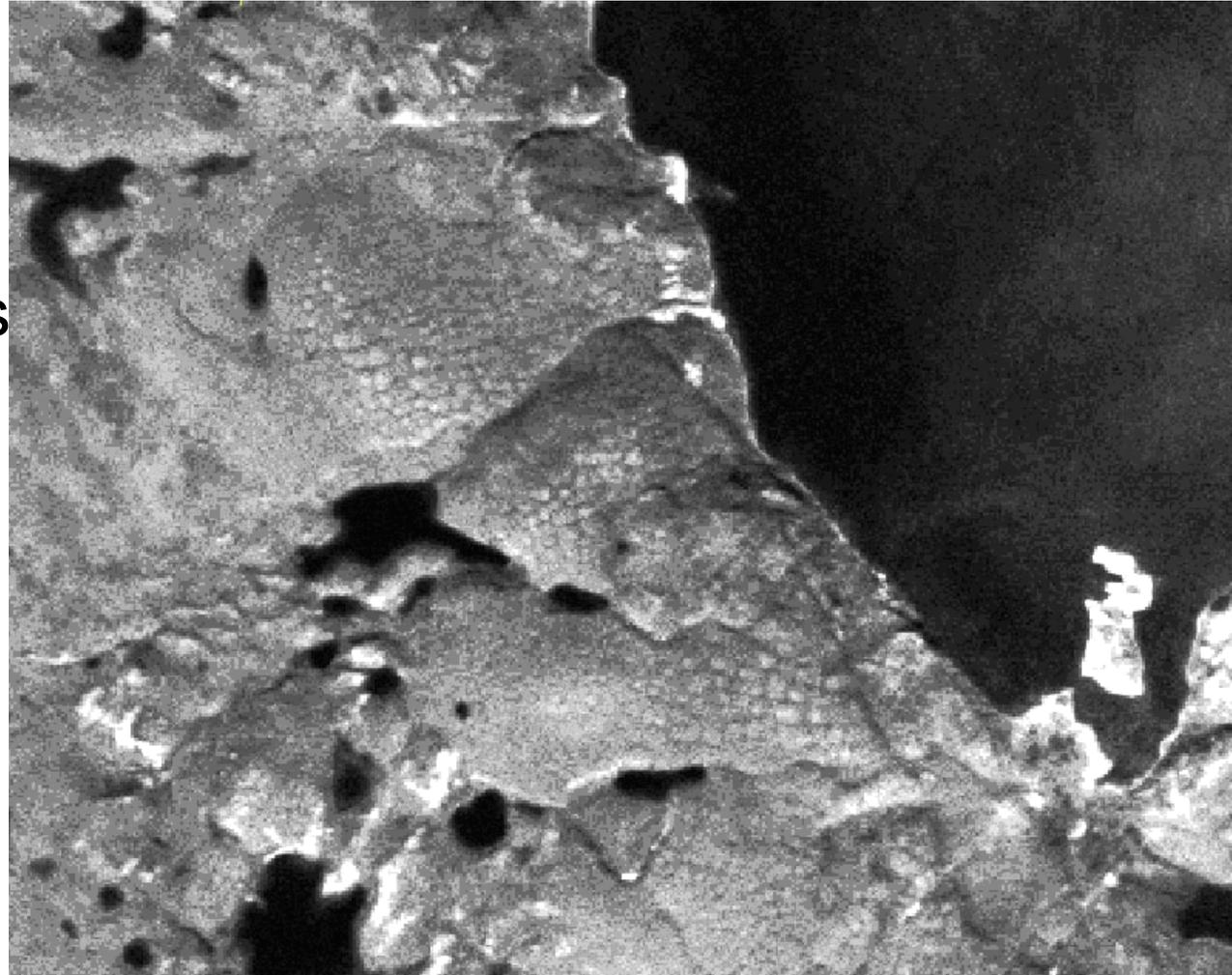
- Moraines

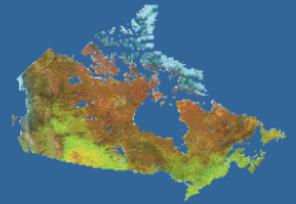


# SPOT5/HRS...

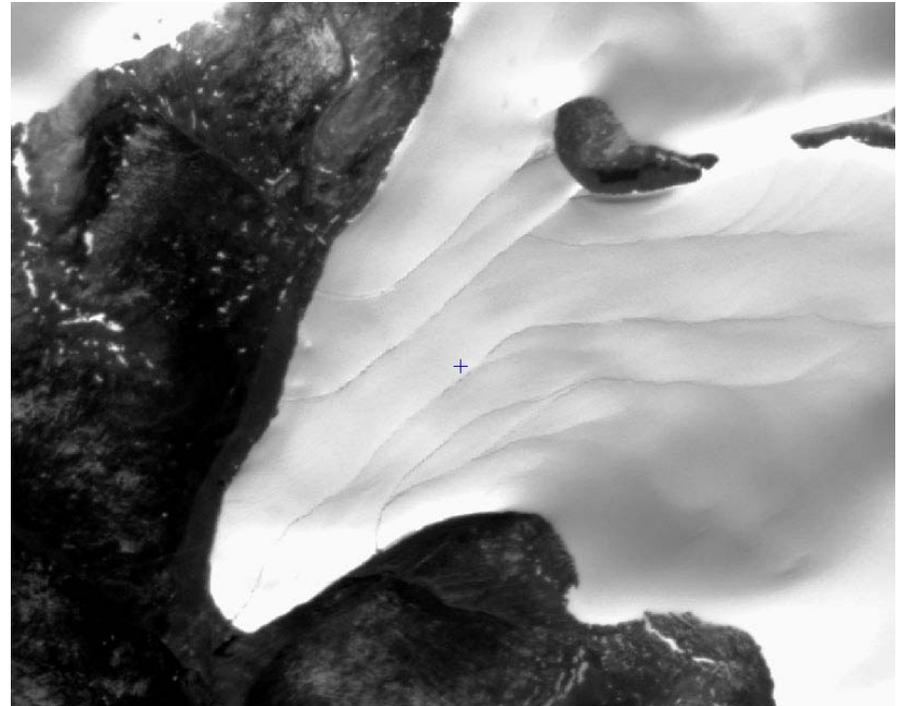


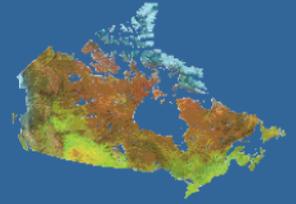
- Tundra polygons





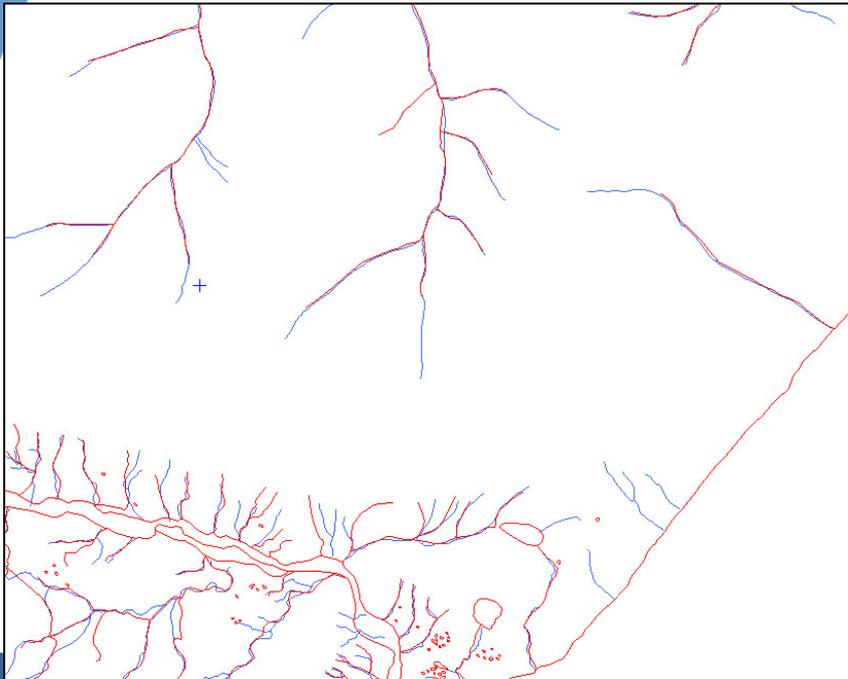
- Hydrography and glaciers



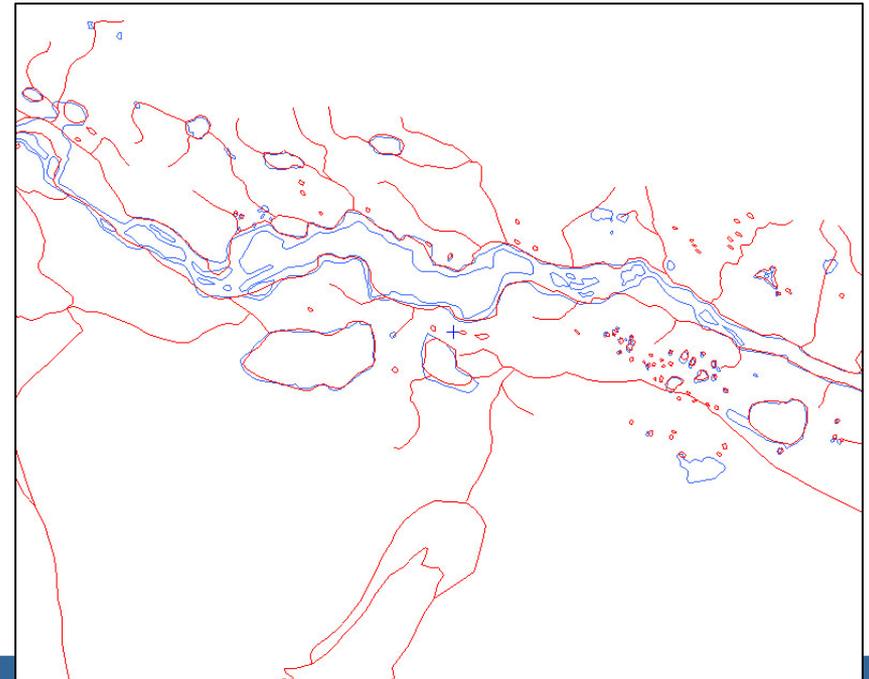


- **Hydrography**
  - SPOT 5 HRS vectors (Red)
  - Air photo vectors (Blue)

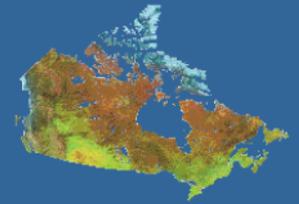
**Single line streams**



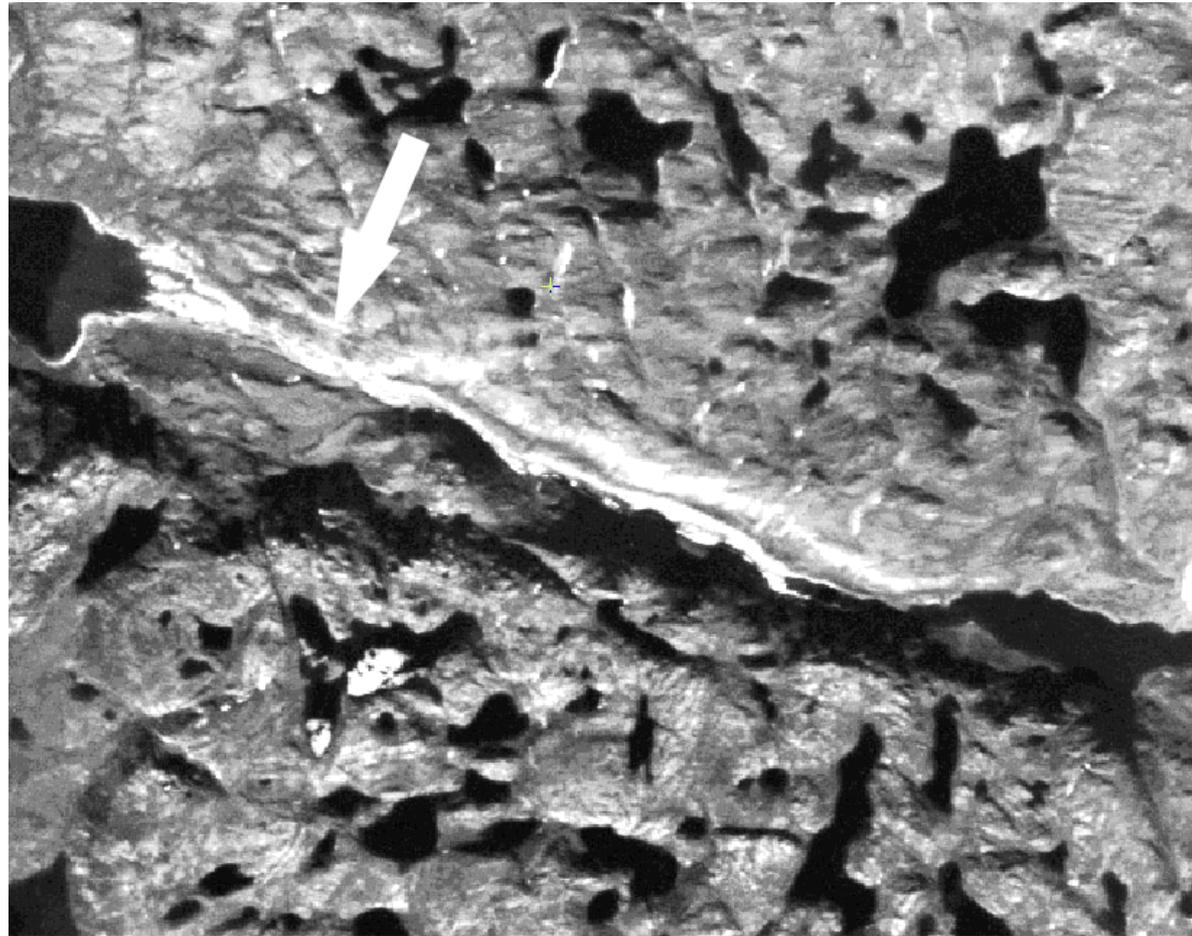
**Double line streams and waterbodies**



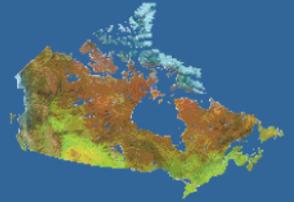
# SPOT5/HRS...



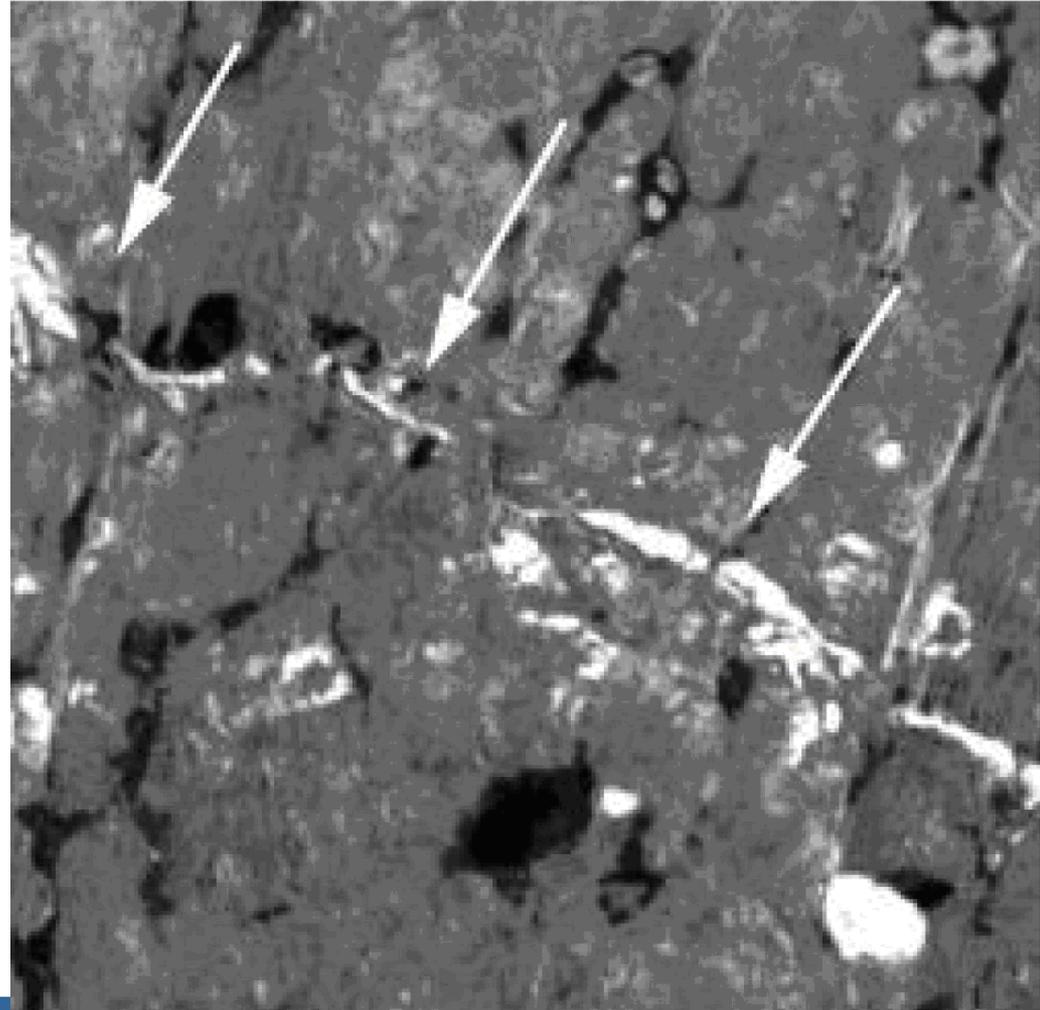
- Rapids/Falls



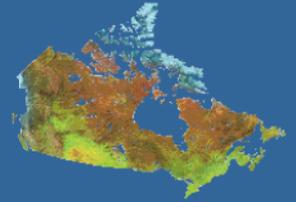
# SPOT5/HRS...



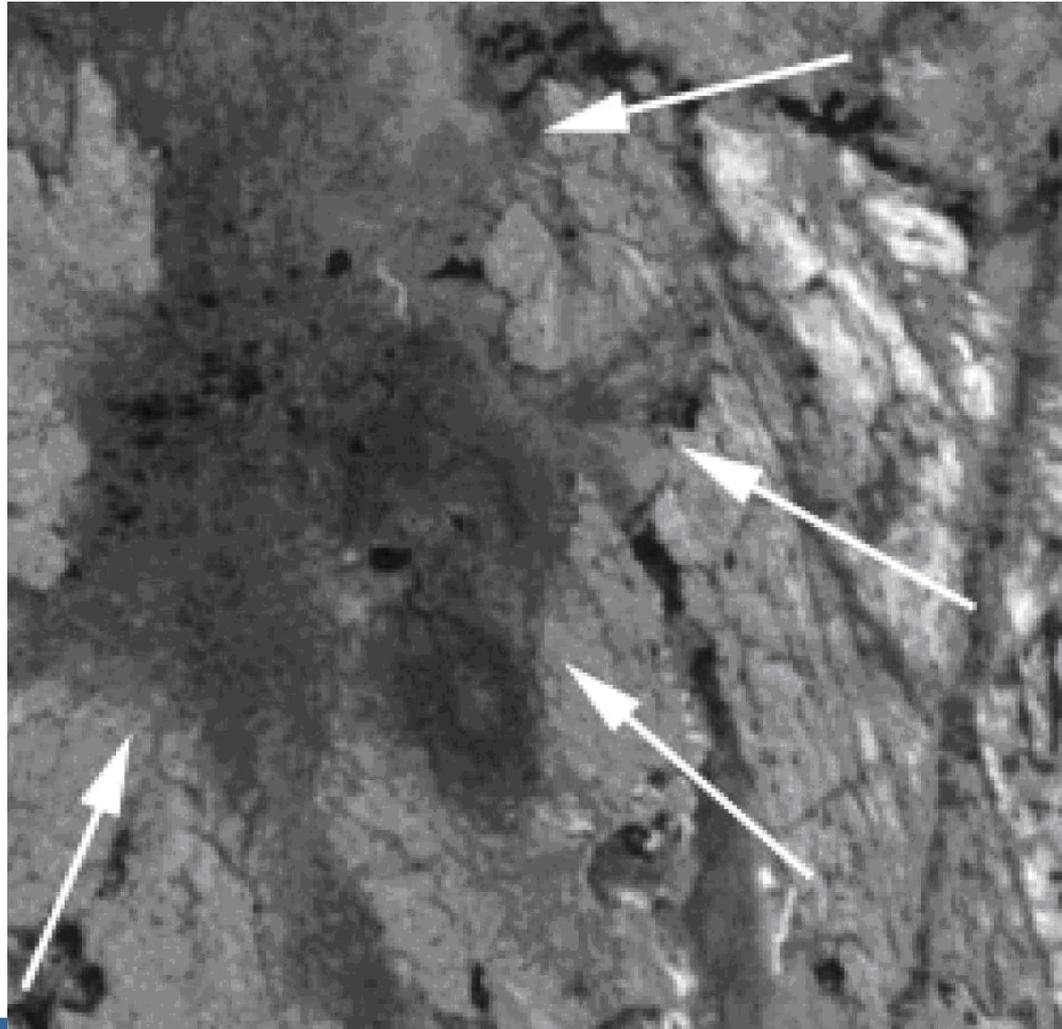
- Esker



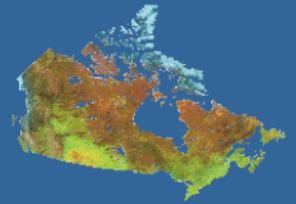
# SPOT5/HRS...



- Water saturated soils



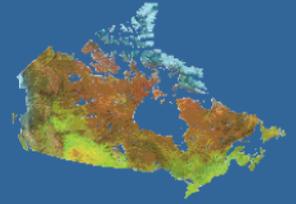
# SPOT5/HRS...



- Sand (raised beaches)

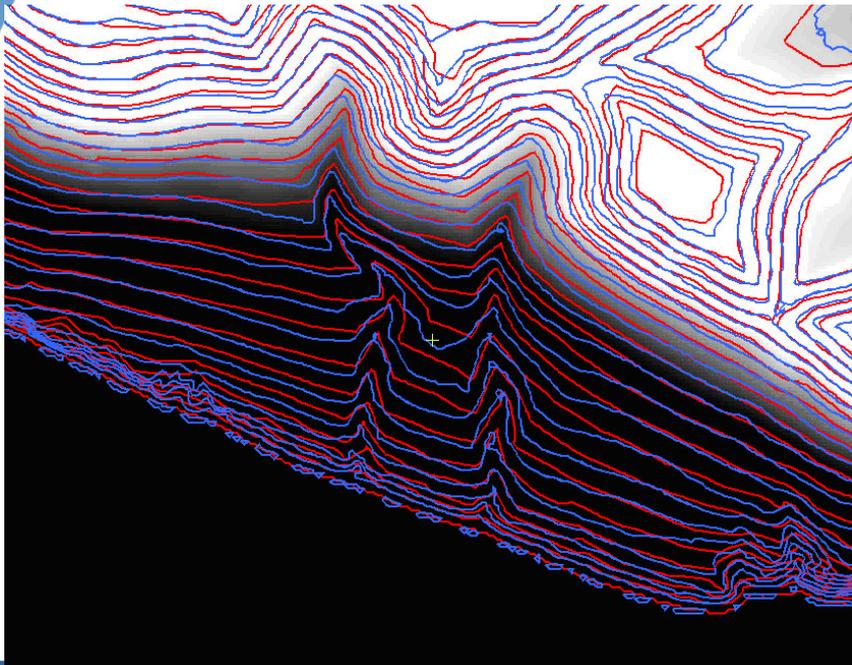


# SPOT5/HRS...

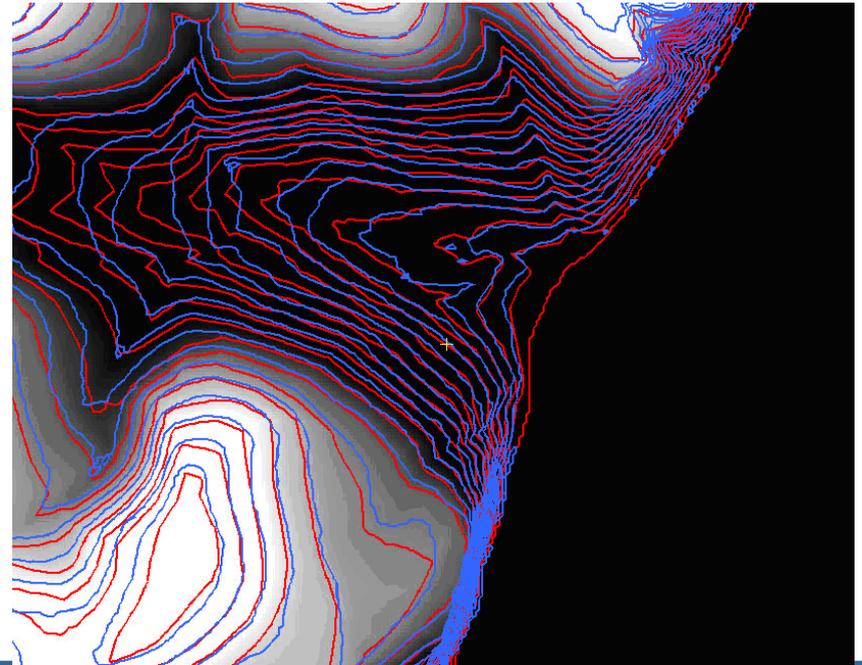


- **Altimetric coherence**
  - Photogrammetric contours (Blue)
  - SPOT 5 HRS contours (Red)

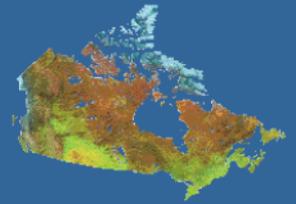
Steep slope/coastline



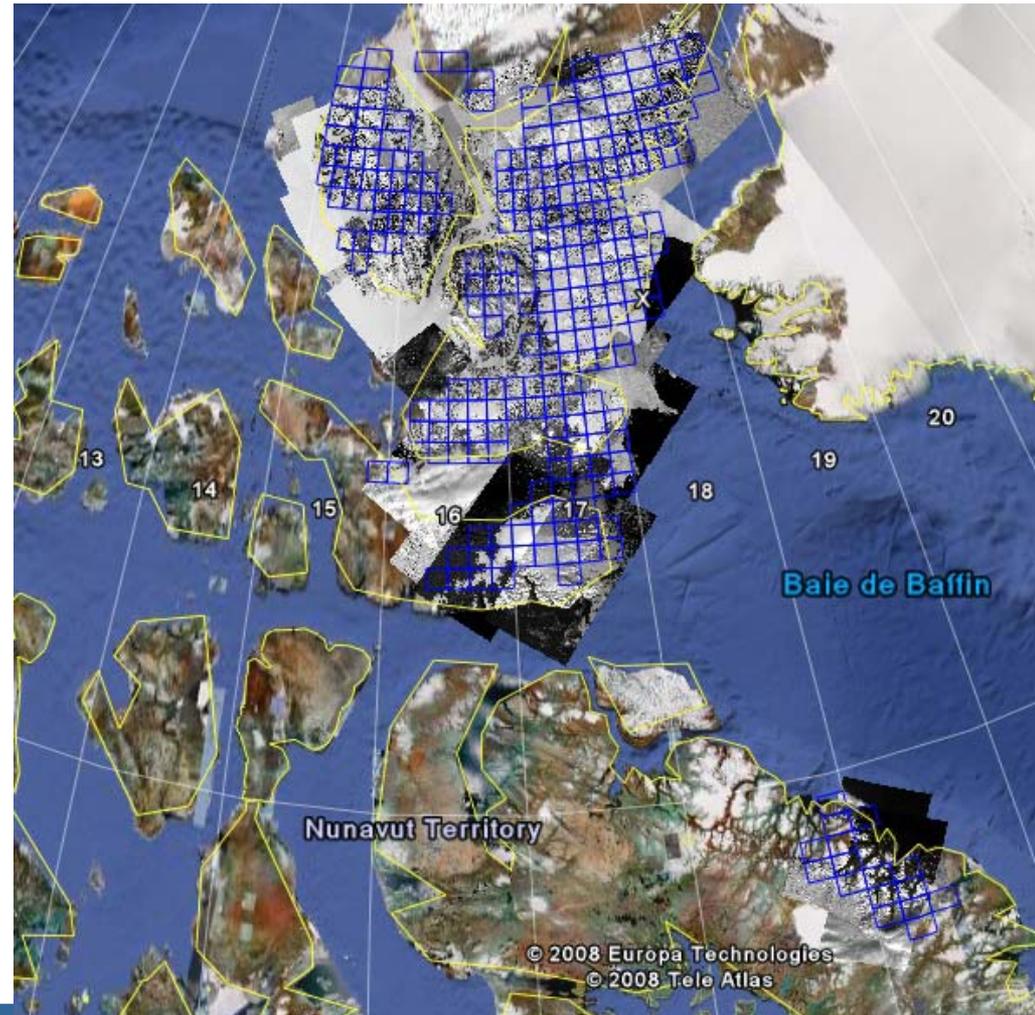
Valley glacier (temporal diff.)



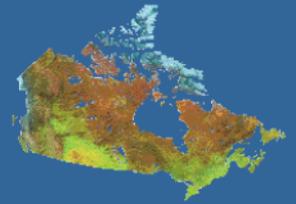
# SPOT5/HRS...



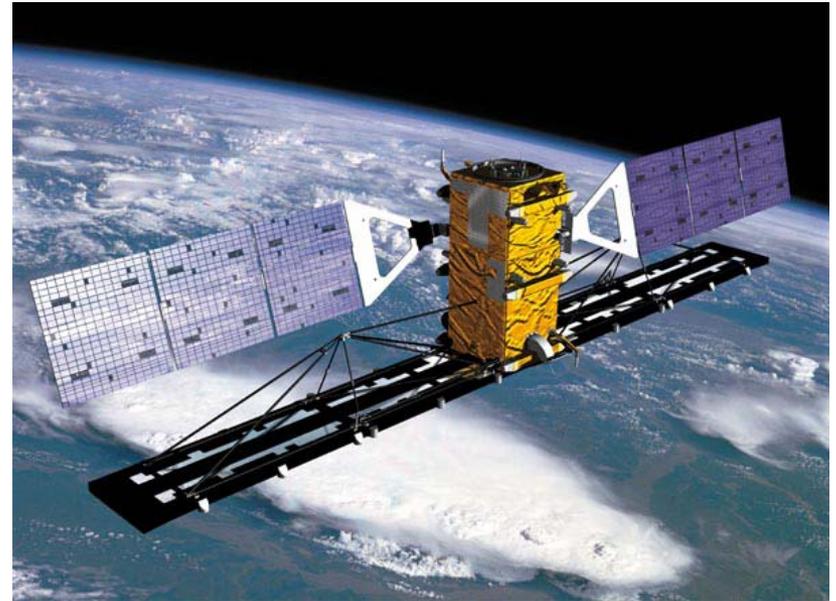
- Area of Interest  
**NTS**  
**Imagery**



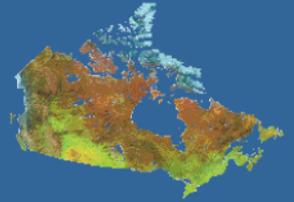
# Radarsat-2 Project



- Radarsat-2 :
  - New topographic mapping in the North
  - Topographic map updating
- Joint CCRS/CTIS Project
- Partnership with CSA/GRIP program
- Feasibility tests: 2008-09
- Implementation: 2009-10
- Exp. production: 2010-11



# Model Accuracy



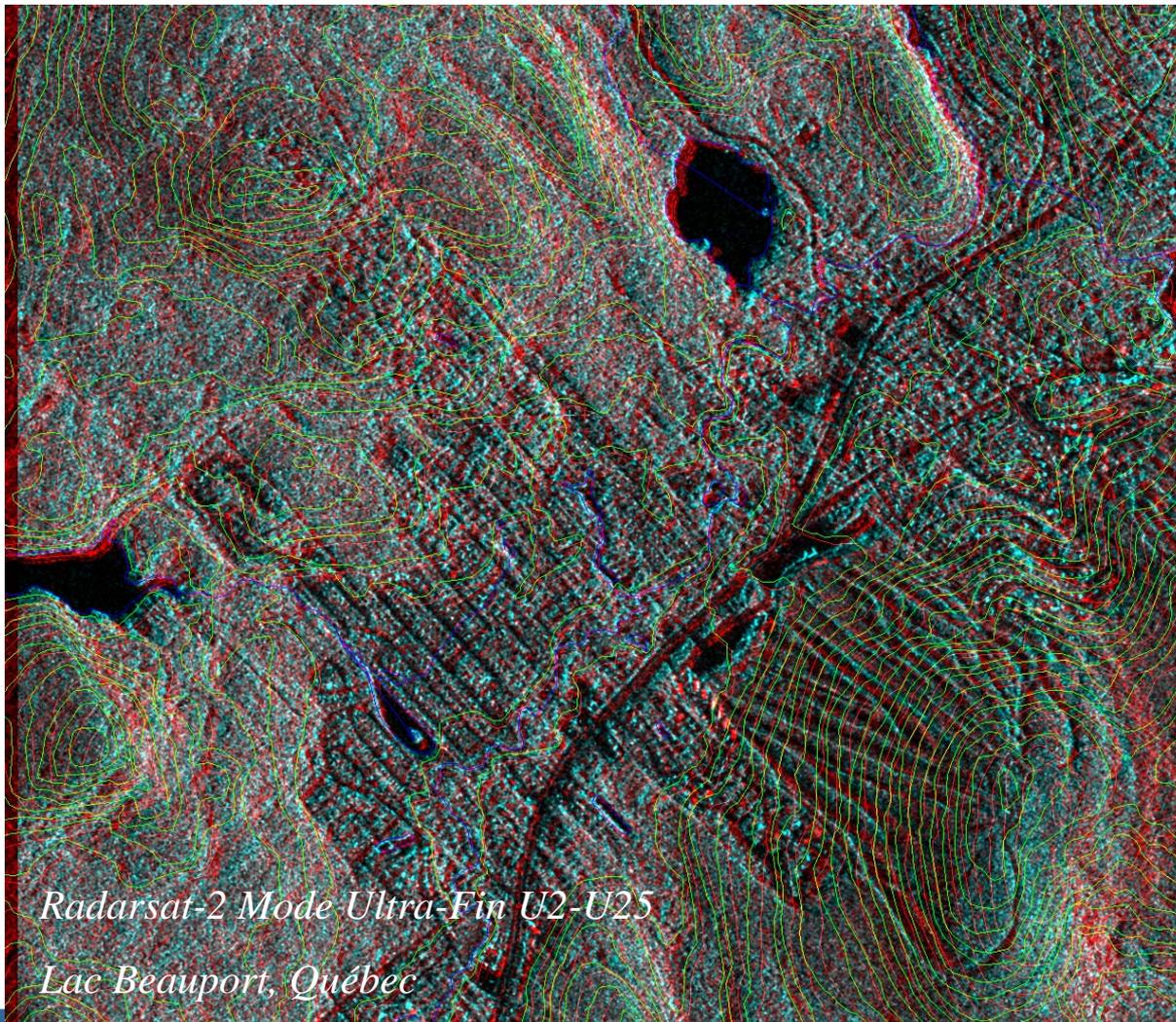
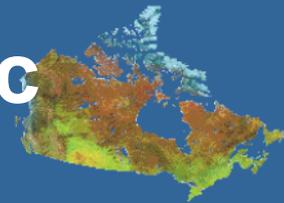
## Monoscopic results: errors computed over ICPs

Image	ICP	RMSE-X	RMSE-Y	Min X	Max X	Min Y	Max Y
U2	<b>44</b>	2.1	2.2	-5.5	3.5	-5.1	3.7
U25	<b>70</b>	2.2	2.0	-6.5	3.1	-7.0	3.8

## Stereoscopic results: errors computed over 44 ICPs

RMSE-X	RMSE-Y	RMSE-Z	Min X	Max X	Min Y	Max Y	Min Z	Max Z
1.1	0.9	2.2	0.3	5.0	0.3	4.5	-5.2	3.2

# U2-25 Stereo model with CanVec contours and hydrography

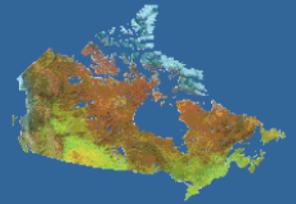


*Radarsat-2 Mode Ultra-Fin U2-U25*

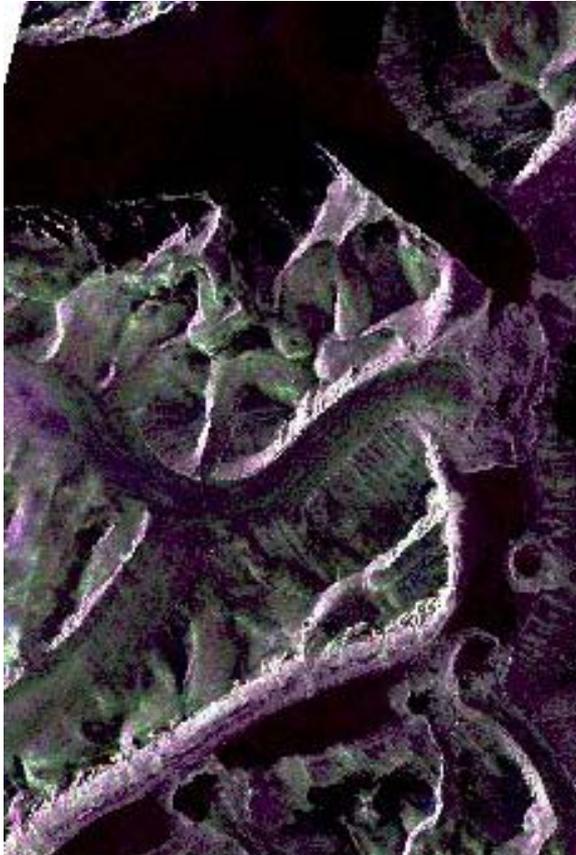
*Lac Beauport, Québec*



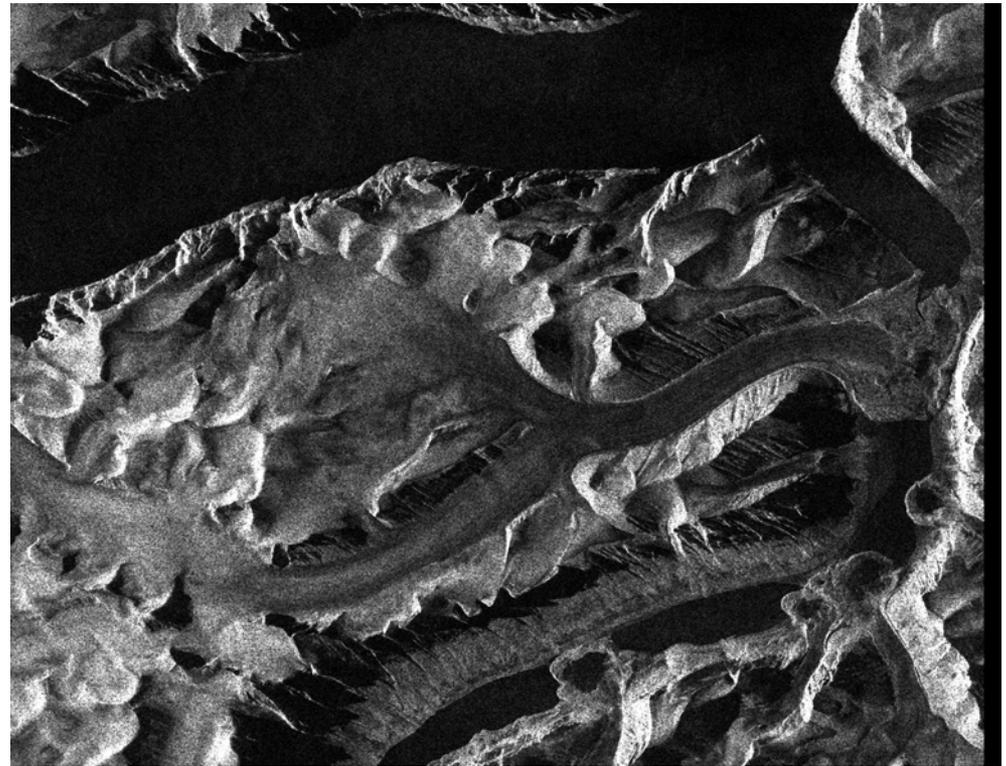
# Image Modes Tested



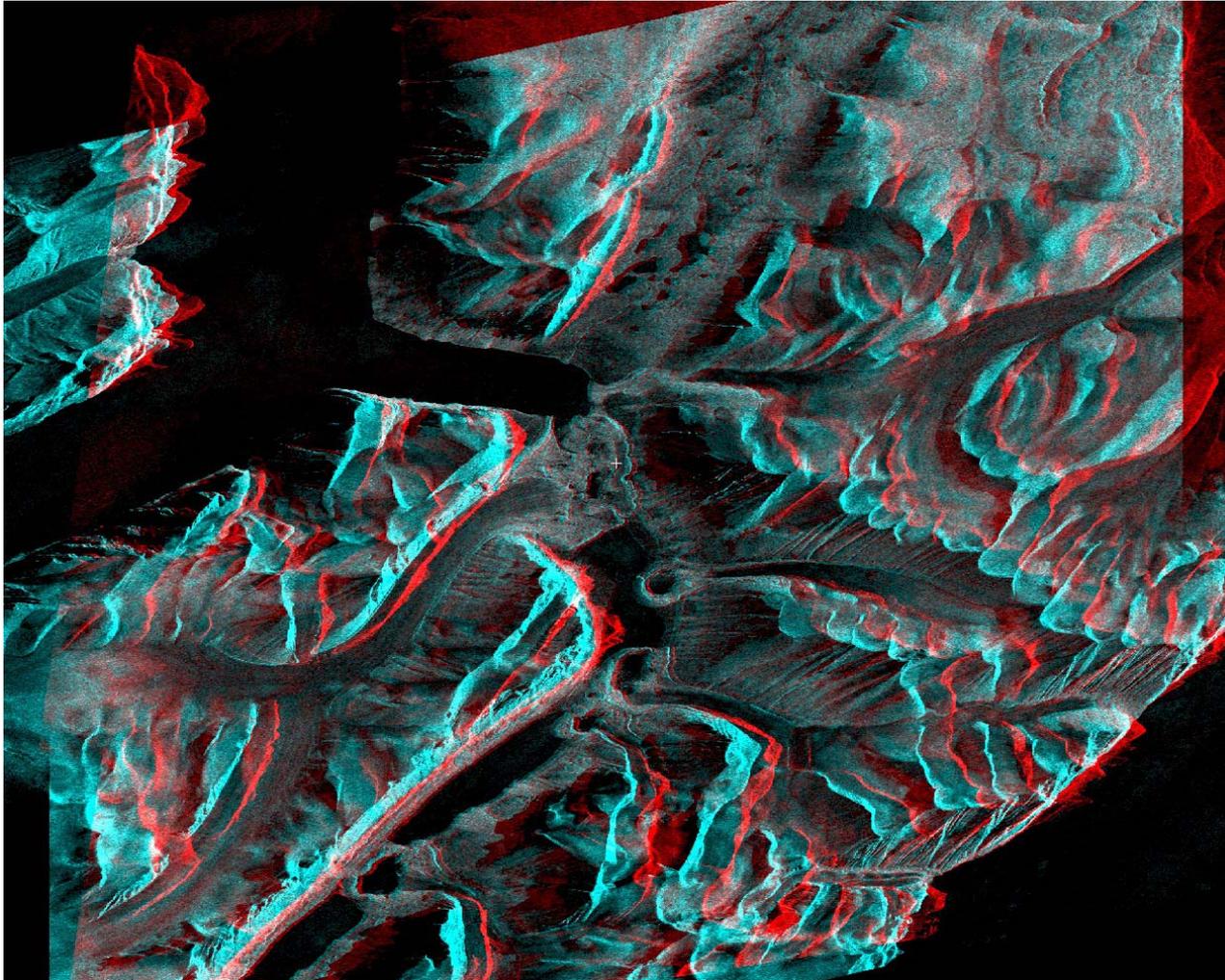
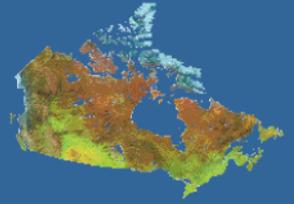
**Radarsat 2 Image, FQ21,  
HH, HV, VV**



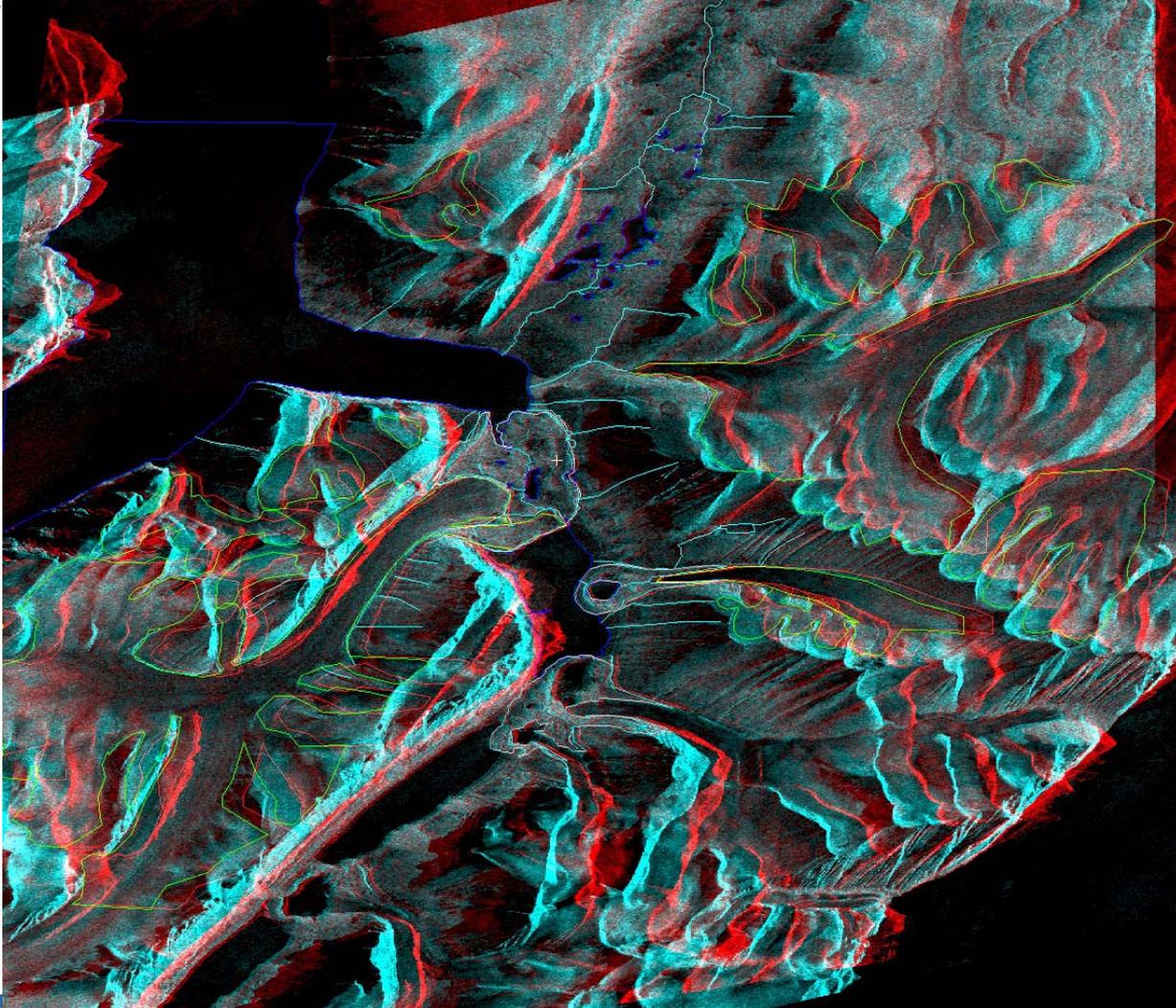
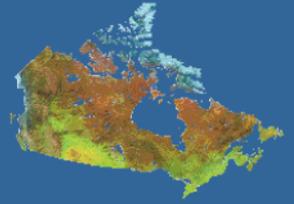
**Radarsat 2 Image, U27, VV**



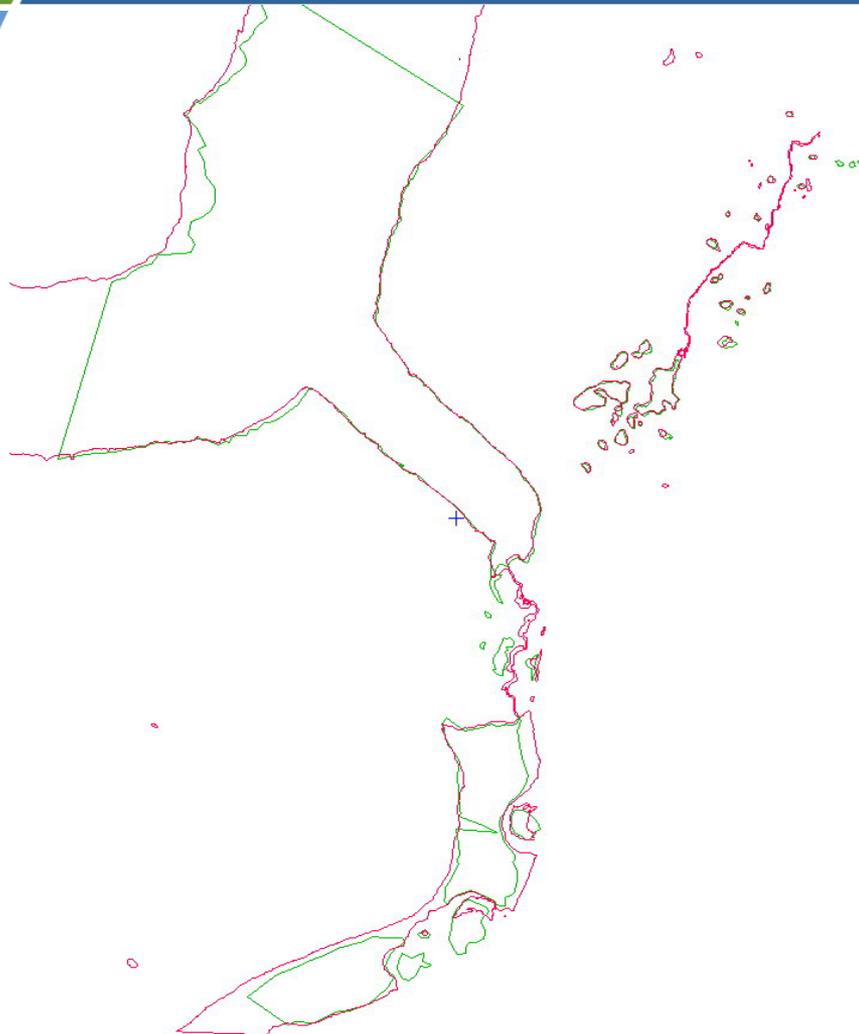
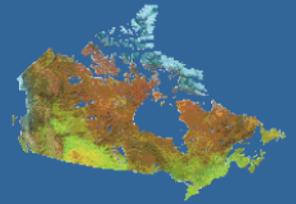
# FQ8-21 Stereo model



# FQ8-21 Stereo model with 3D vectors



# Radarsat-2 / Canvec vectors

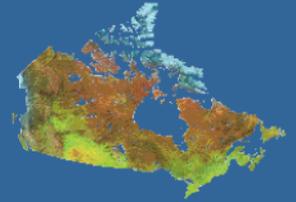


Radarsat-2 vectors  
(20 metre RMS)



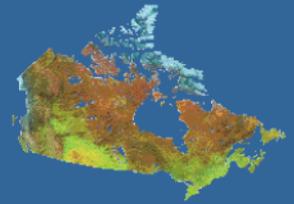
Ground truth vectors

# Some statistics...



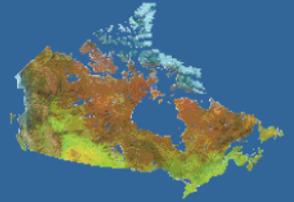
Planimetric features	3D model content	Detected features	Omissions Nb	Comissions Nb	Conformity Nb	Conformity %	Extraction %
<b>Permanent snow &amp; ice</b>	6	5	1	0	6	100	85,7 %
<b>Lakes</b>	119	17	112	2	15	11,8 %	88,2%
<b>Watercourses</b>	218	32	186	1	31	97	14,3 %
<b>Coastline</b>	2	2	0	0	2	100	100 %
<b>Moraine</b>	1	1	0	0	1	100	100 %

# Observations and Recommendations



- Toutin's radargrammetric model complies with Radarsat-2 2D or 3D data
- 2D or 3D restitution precision is in the pixel order (1.5 m RMS in the three axes for the ultra-fine mode)
- DTM generation with Ultra-Fine mode imagery, in low to moderate terrain (slopes  $< 10$  degrees), is 8m LE90

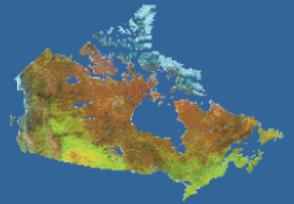
# Conclusion/Recommendations...



- Detection of topographic features that are visible on aerial photography at the approximate scale of 1:60, 000 is possible.
- Elevation data acquisition will not be possible in mountainous areas
- Tests in glacial environments with ultra-fine mode imagery



# Yellowknife GeoNorth2007 Photo Contest Winner



*Robert Skoye, 2007*

