Cyberinfrastructure, GIS and Remote Sensing

Image: Moshniy Glacier, Russia, August 29, 2012

Paul Morin
Polar Geospatial Center
University of Minnesota
Antarctica
Permanent US Stations

Palmer Station
Amundsen - Scott South Pole Station
McMurdo Station

500 Miles
Polar Geospatial Center
Antarctica

Antarctica: 5.4 million mi$^2$ (14.0 million km$^2$)
Contiguous 48 States: 3.7 million mi$^2$ (9.6 million km$^2$)
Blended Satellite Images (LIMA, Modis, and Radarsat)
Gilligan's Island
Polar GIS Issues

Antarctica

• 50 Nations have signed the treaty – 8 have territorial claims
• GIS data is public but poor
• First LANDSAT mosaic was produced in 2008

Arctic

• Sovereign Territory
• GIS data is Public/Private/Commercial
• Sovereign Territory of 8 Nations
• The Alaska Problem (>20 agencies producing data)

Overriding issues:
• Poor elevation data
• No consistent, publically available high-resolution imagery
A Golden Age
# Modality Comparison

<table>
<thead>
<tr>
<th>RADAR</th>
<th>Medium/Low Resolution Optical</th>
</tr>
</thead>
<tbody>
<tr>
<td>RADARSAT-2</td>
<td>MODIS</td>
</tr>
<tr>
<td>TerraSAR-X</td>
<td>LANDSAT</td>
</tr>
<tr>
<td>COSCO-SkyMed</td>
<td>ASTER</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boutique</th>
<th>High Resolution Optical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity</td>
<td>Worldview-1,2,3</td>
</tr>
<tr>
<td>Altimetry</td>
<td>Geoeye</td>
</tr>
<tr>
<td>Passive Microwave</td>
<td>SPOT</td>
</tr>
</tbody>
</table>
NASA’s Optical Satellites

Landsat 8

Landsat 7

Terra

Aqua
Submeter Optical through NGA

Worldview 2

Geoeye

Quickbird

Ikonos

Worldview 1
Bull Pass
McMurdo Dry Valleys
PGC camp in Bull Pass
QuickBird-2 (January 2009)
Atka Bay Colony
near Neumeyer Station
September 2, 2012
Pine Island Glacier Rifting

• Opened sometime between 9/25 and 10/6
• Ice down-glacier of the crack flowing ~2 m/day faster than up-glacier.
• Crack in nearly same location as event in 2001

All Imagery ©2011 Digital Globe, Inc. Provided by the NGA Commercial Imagery Program.
A high data volume day at PGC. This shipment was about 10 tb or 20-30,000 scenes.
Shaded relief image of a 4m posting elevation model near the Toolik LTER on the north slope of Alaska. Over 60% of Alaska has been shot in stereo.
Barrow, Alaska
Near Kangerlussuaq, Greenland
Scientific Holy Grails

- Topography
  - Sea ice freeboard
  - Ice surface
  - Thermokarst collapse
  - Snow accumulation

- Time series
- Imagery that can see through clouds and in the winter

- Access to more commercial data
- Data digestible by non-geospatial users
CI Specific Grails for GIS and Remote Sensing

- Web services
- Data in formats easily digestible by end users
- Big, cheap, slow storage
- Data fusion tools for data that crosses communities
The benefit of a polar orbit
Polar GIS Issues

**Antarctica**
- 50 Nations have signed the treaty – 8 have territorial claims
- GIS data is public but poor
- First LANDSAT mosaic was produced in 2008

**Arctic**
- Sovereign Territory
- GIS data is Public/Private/Commercial
- Sovereign Territory of 8 Nations
- The Alaska Problem (>20 agencies producing data)

**Overriding issues:**
- Poor elevation data
- No consistent high-resolution imagery
What is unique about polar remote sensing?

• VERY frequent coverage for polar orbiting satellites
• Little competition for satellites that can be tasked
• Ground truth is hard to come by
• Importance of licensed imagery
• Importance of satellite RADAR
• Incredible data flow