

Using High-Resolution Commercial Imagery in the Geosciences

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The Geoscience Data Firehose



- Dramatic increase in the amount of data from sensor networks, satellites, and other platforms
- Geoscience groups are hiring more:
 - Programmers / data scientists
 - IT workers
 - GIS analysts
 - Web developers

High-Resolution Imagery

- Part of the new generation of remote sensing tools available to a growing science user base
- Important tradeoffs: **resolution...**
vs. extent, repeat frequency, and band range
- Proprietary
 - Bad news: Legally restricted, costs \$, difficult to publish, republish, and to have others reproduce your results
 - Good news: Users can request specific acquisition places/times, can often replace expensive aerial surveys, resolution benefits science logistics (thus benefiting science)

What can these satellites do?

The DigitalGlobe Satellite Constellation



DigitalGlobe Satellite Constellation



Product options									
		Pixel Resolution*			Image Bands				
Panchromatic		30 cm, 50 cm, as collected			Panchromatic				
Multispectral (4-band)		1.2 m, 2.0 m, as collected			Blue, Green, Red, NIR1				
Multispectral (8-band)		1.2 m, 2.0 m			Coastal, Blue, Green, Yellow, Red, Red Edge, NIR1, NIR2				
Spectral characteristics (nanometers)									
	Coastal	Blue	Green	Yellow	Red	Red Edge	Near-IR1	Near-IR2	Pan (B&W)
GeoEye-1		446 – 522	506 – 587		655 – 697		773 – 929		447 – 808
WorldView-1									397 – 905
WorldView-2	396 – 458	442 – 515	506 – 586	584 – 632	624 – 694	699 – 749	765 – 901	856 – 1043	447 – 808
WorldView-3	397 – 454	445 – 517	507 – 586	580 – 629	626 – 696	698 – 749	765 – 899	857 – 1039	445 – 808
Scene size ^{**}									
At nadir		Minimum size of 15.3 km x 14 km (230 km ²)							
Image accuracy specifications									
WorldView-1, WorldView-2***, WorldView-3 and GeoEye-1					5.0 m CE90				



Figure from DigitalGlobe, Inc.; images from Apollo Mapping

College Station, Texas. 250-meter MODIS Terra.

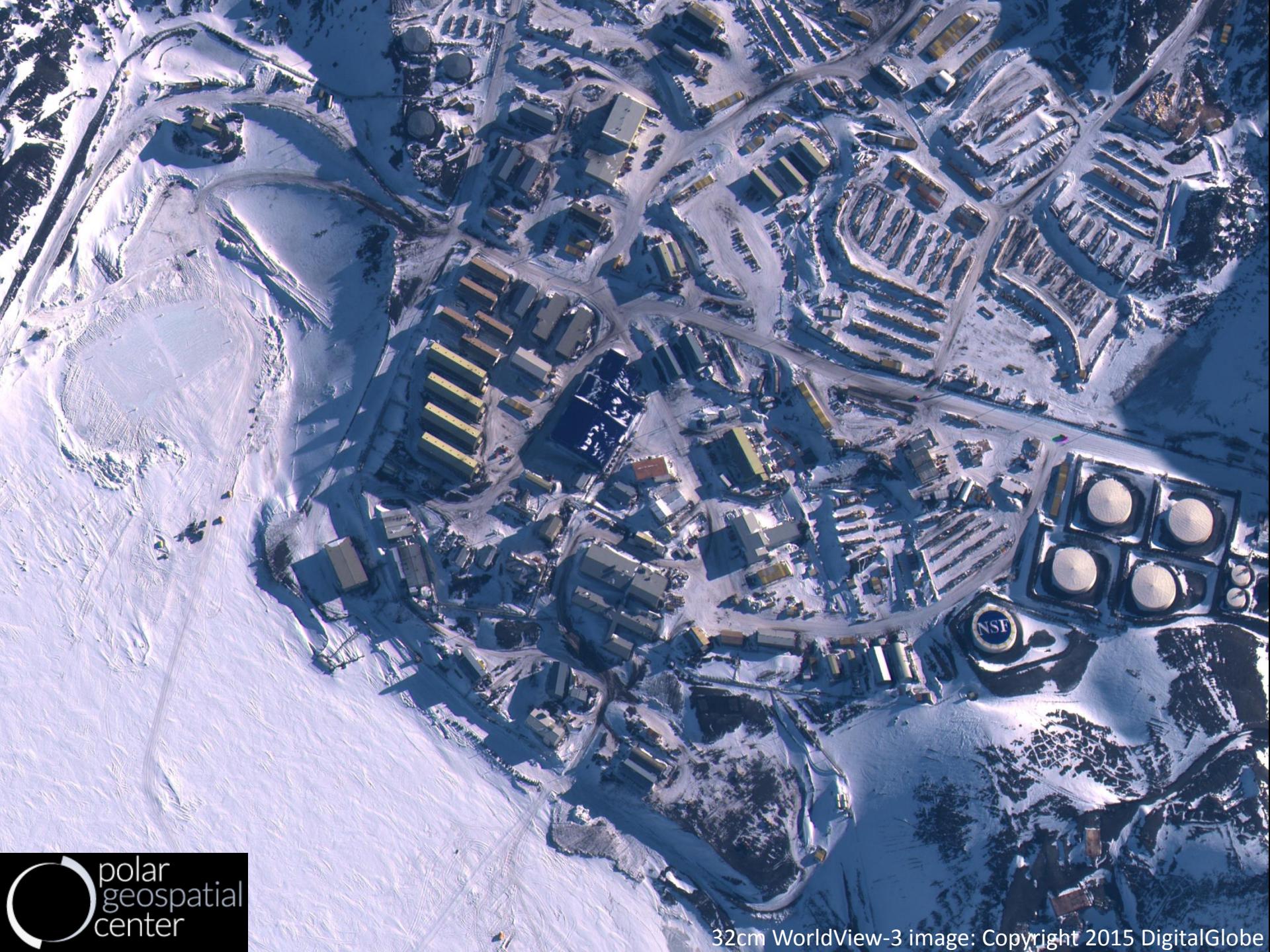
1/2 mile

College Station, Texas. 15-meter Landsat 8.

1/2 mile

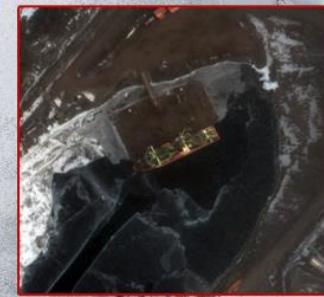
College Station, Texas. 50-cm GeoEye-1.

1/2 mile



USAP Vessels

WorldView-2 Imagery © DigitalGlobe, Inc.
Image Date: February 9, 2013



Bull Pass Camp, McMurdo Dry Valleys, Antarctica.



Bull Pass Camp, McMurdo Dry Valleys, Antarctica.



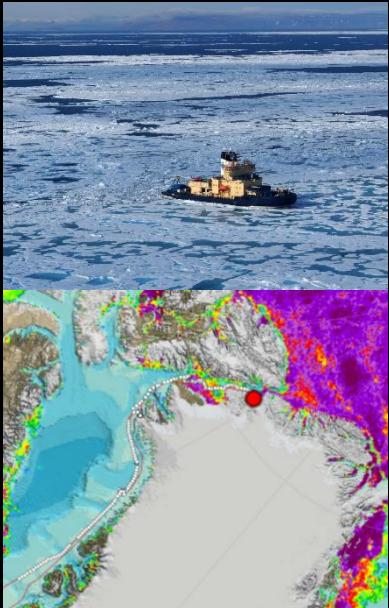
Geoscience Examples

Proven applications of high-res imagery from PGC users

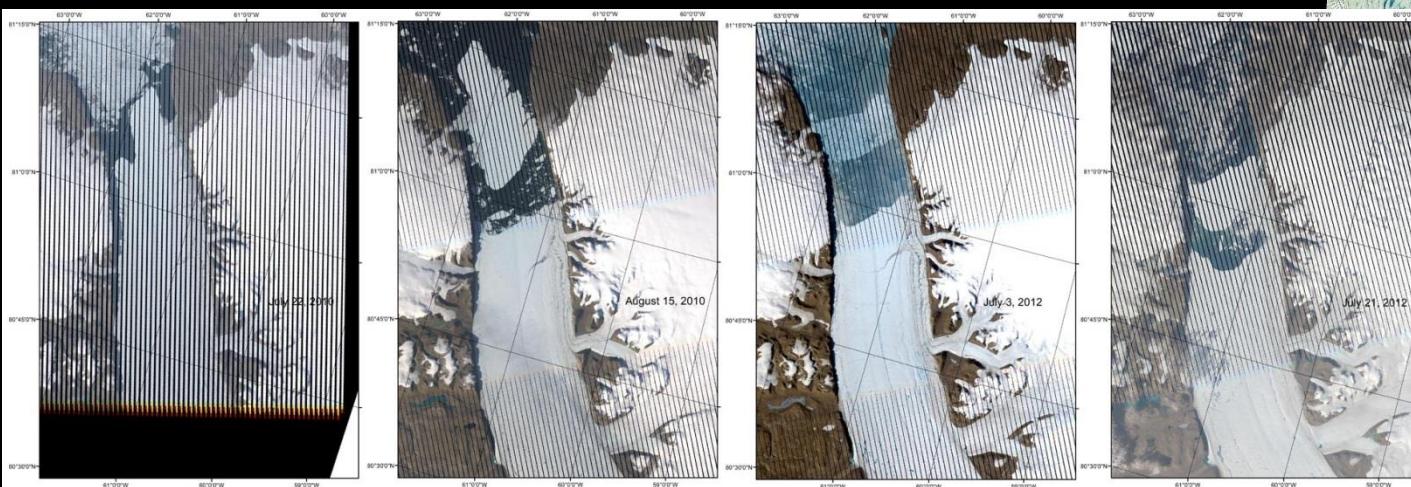
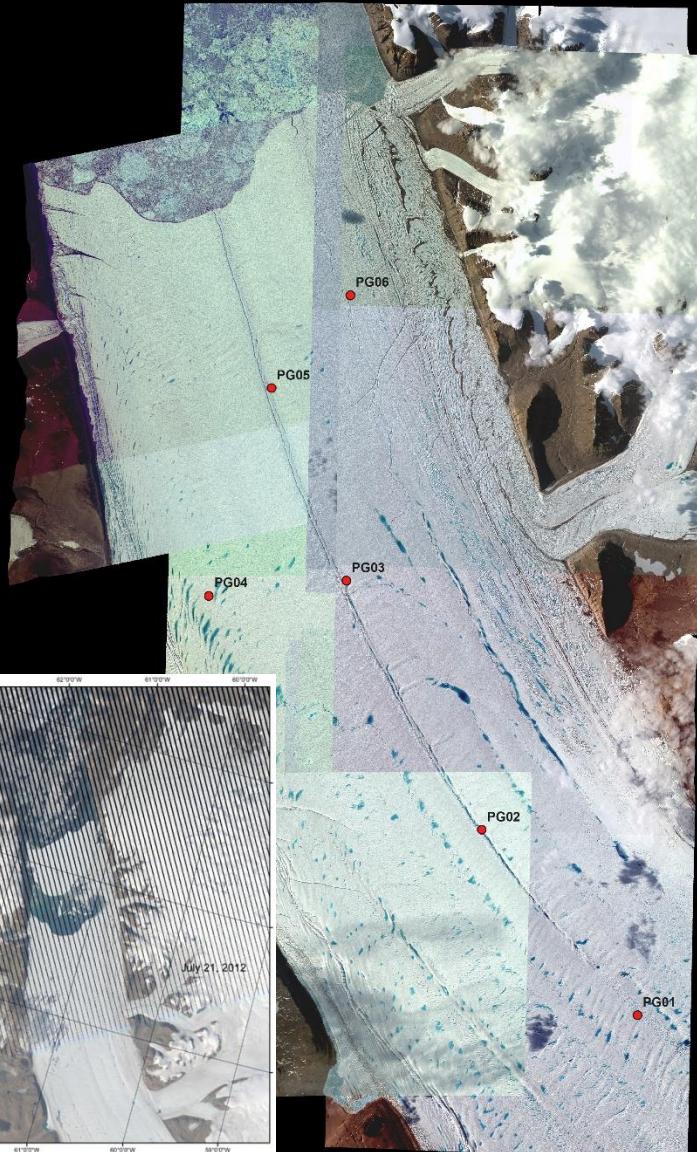
Visual analysis and derived products

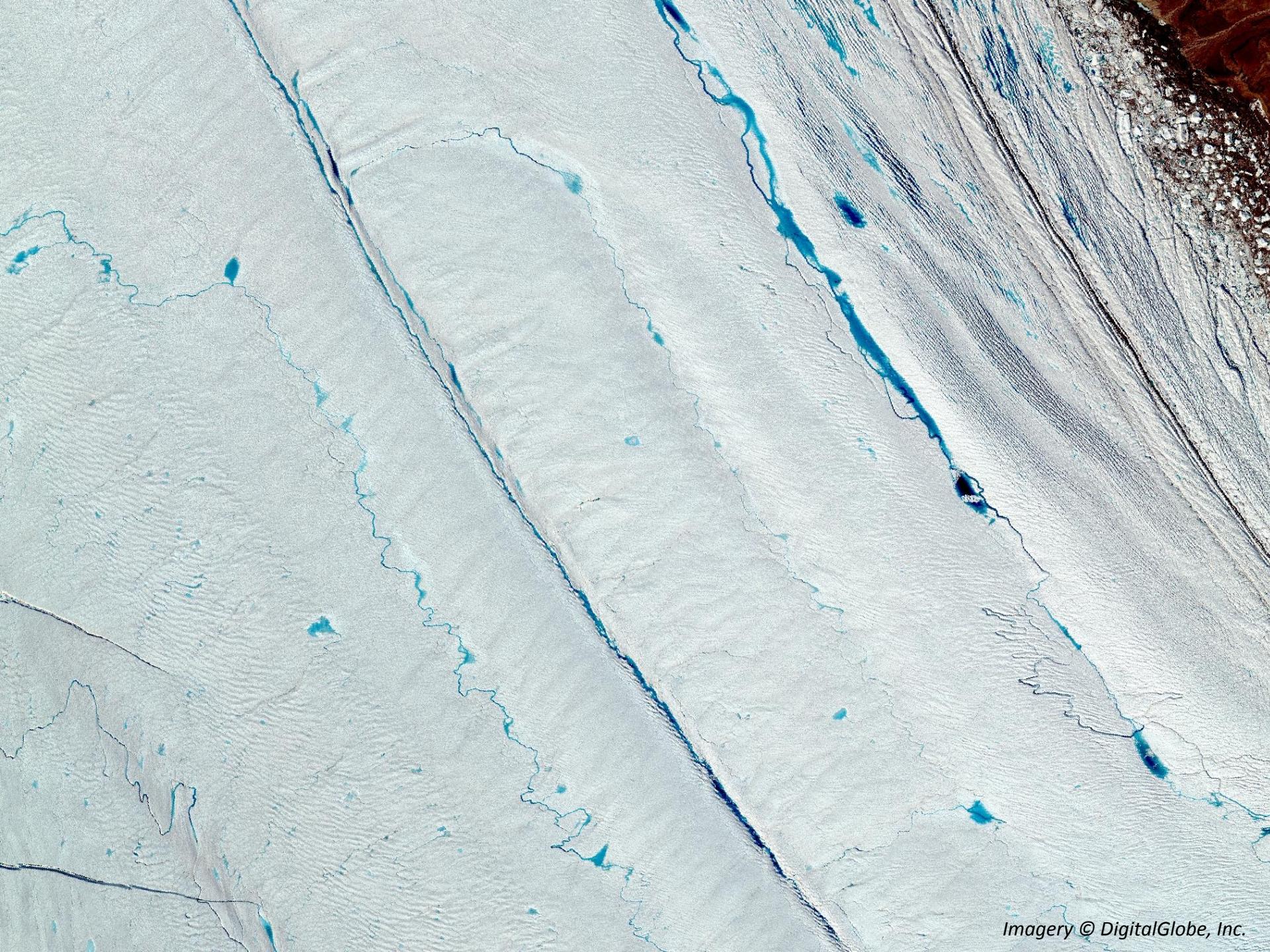
Examples: Petermann Glacier

Integrated science support

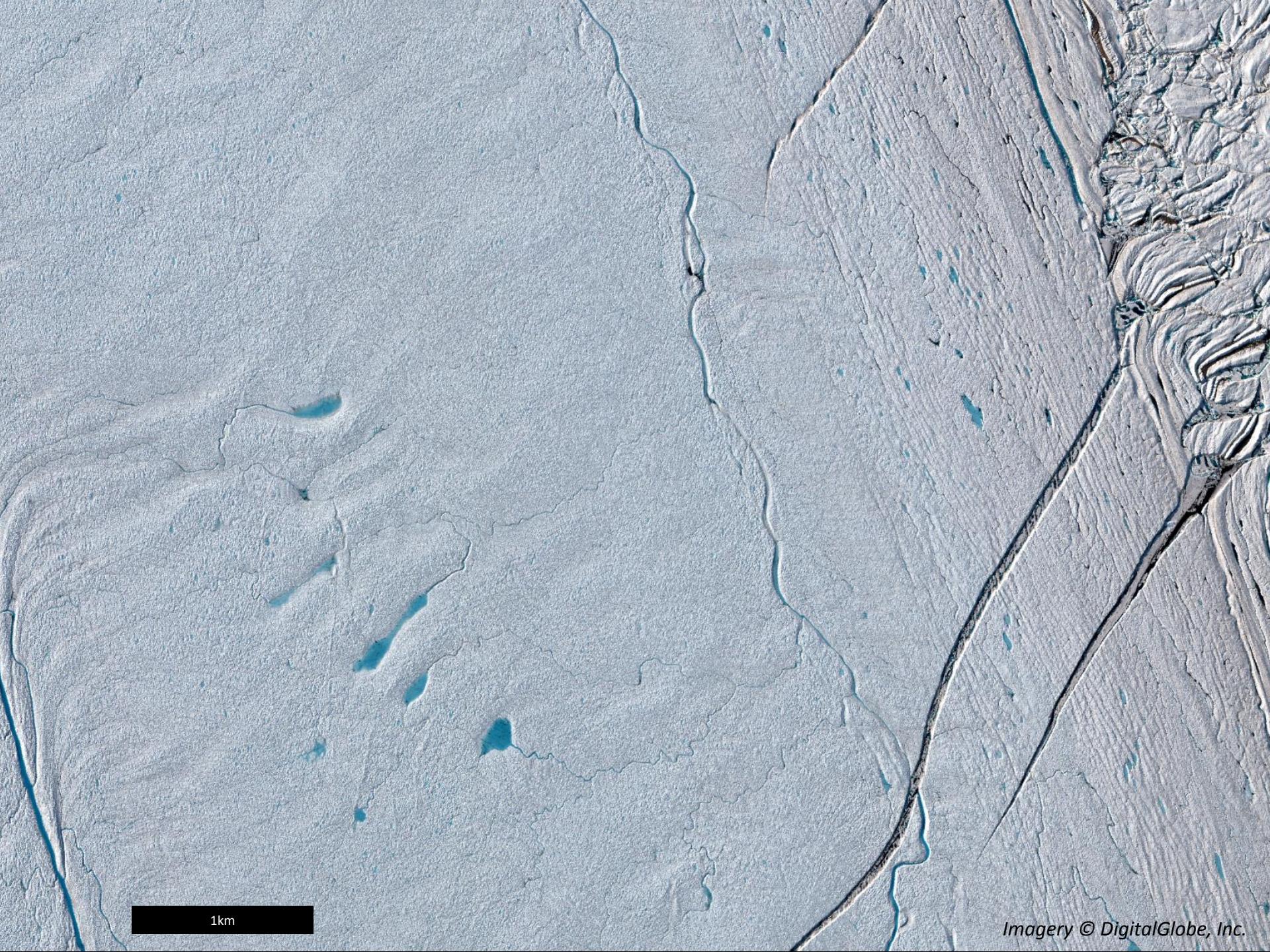


- Marine science
- Ice drilling
- Boulder sampling
- Paleo- deltas



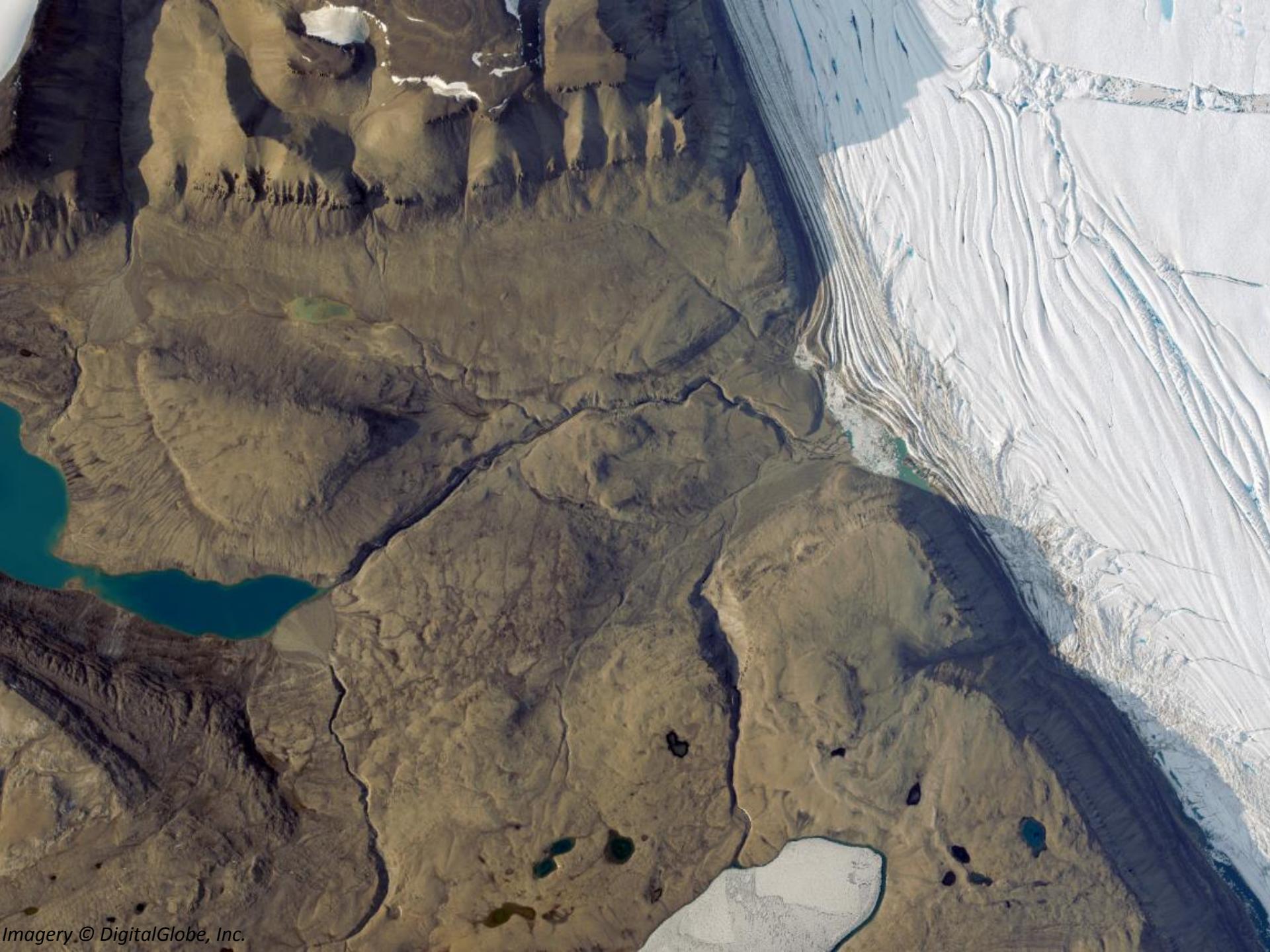


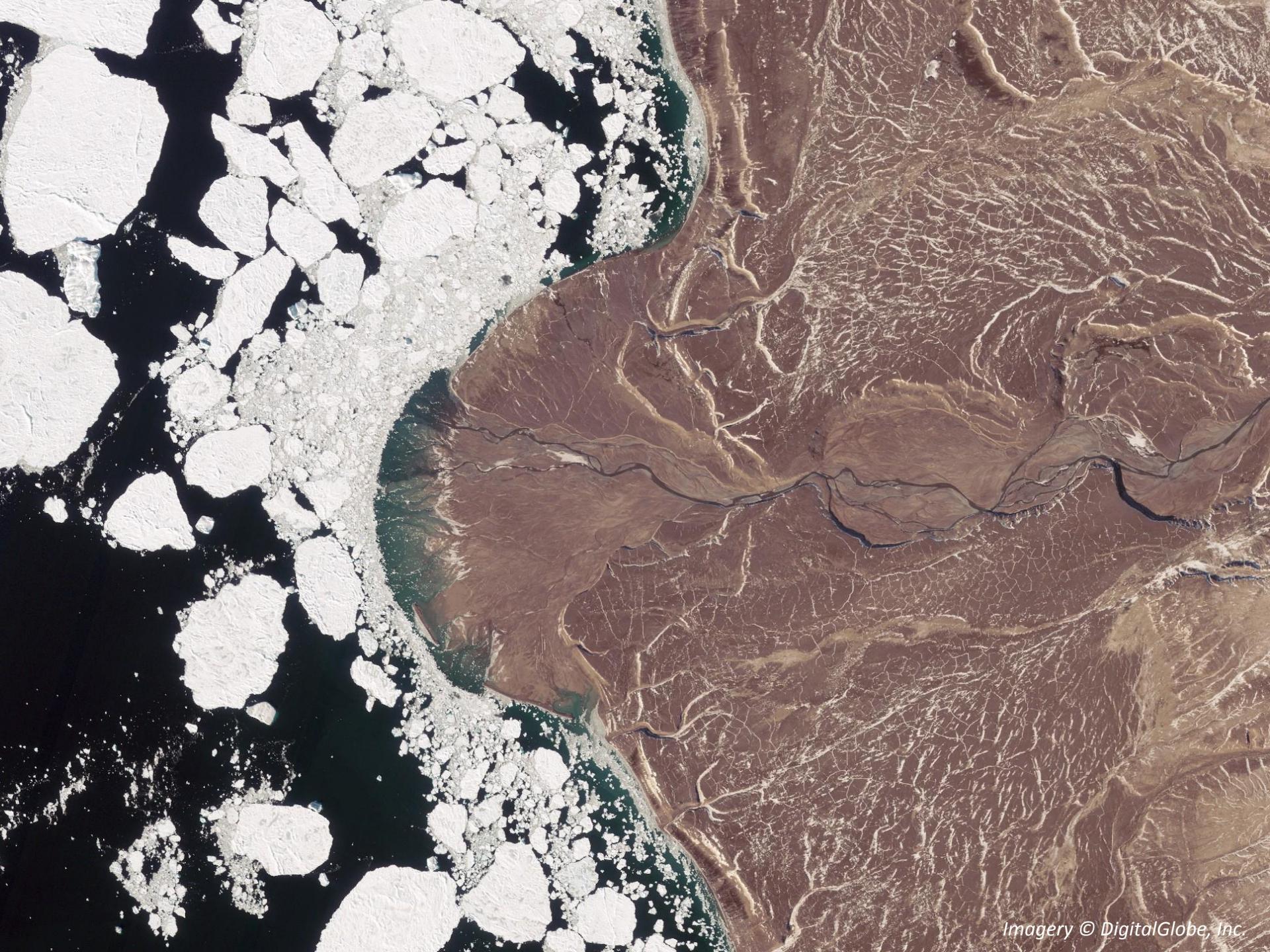
Imagery © DigitalGlobe, Inc.



1km

Imagery © DigitalGlobe, Inc.

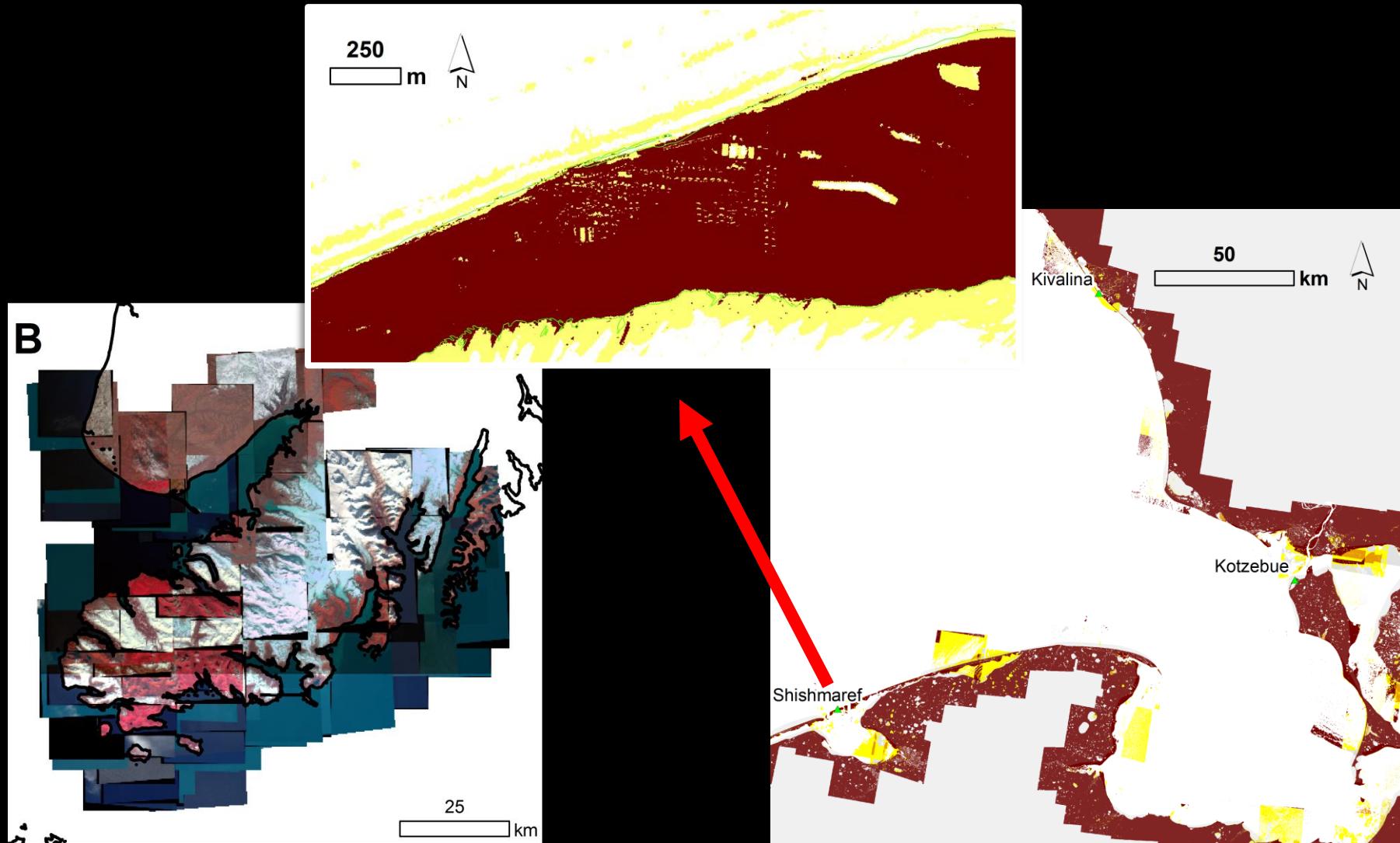




Imagery © DigitalGlobe, Inc.

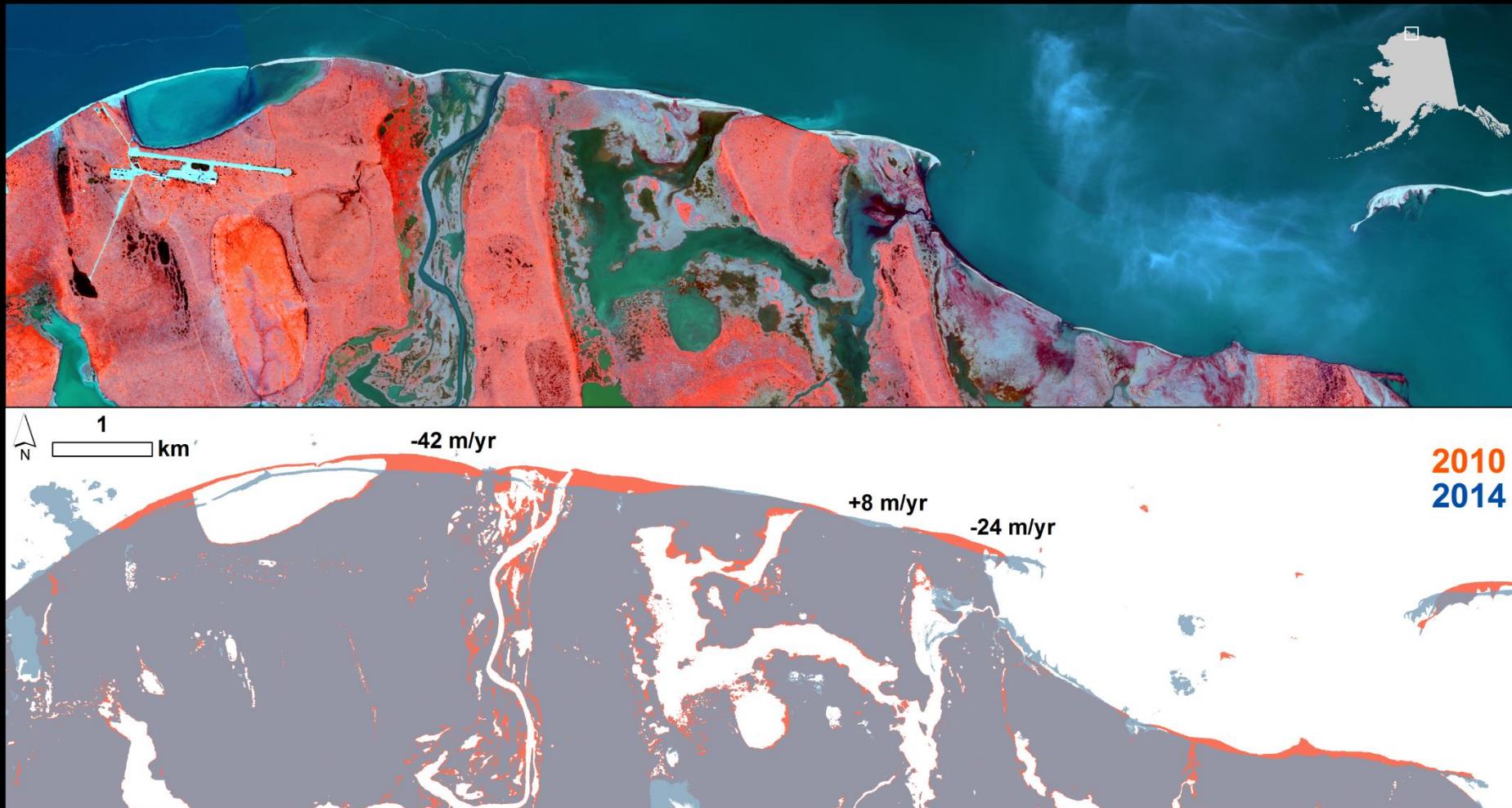
Examples: Alaska Coastline

Automated coastal mapping



Examples: Alaska Coastline

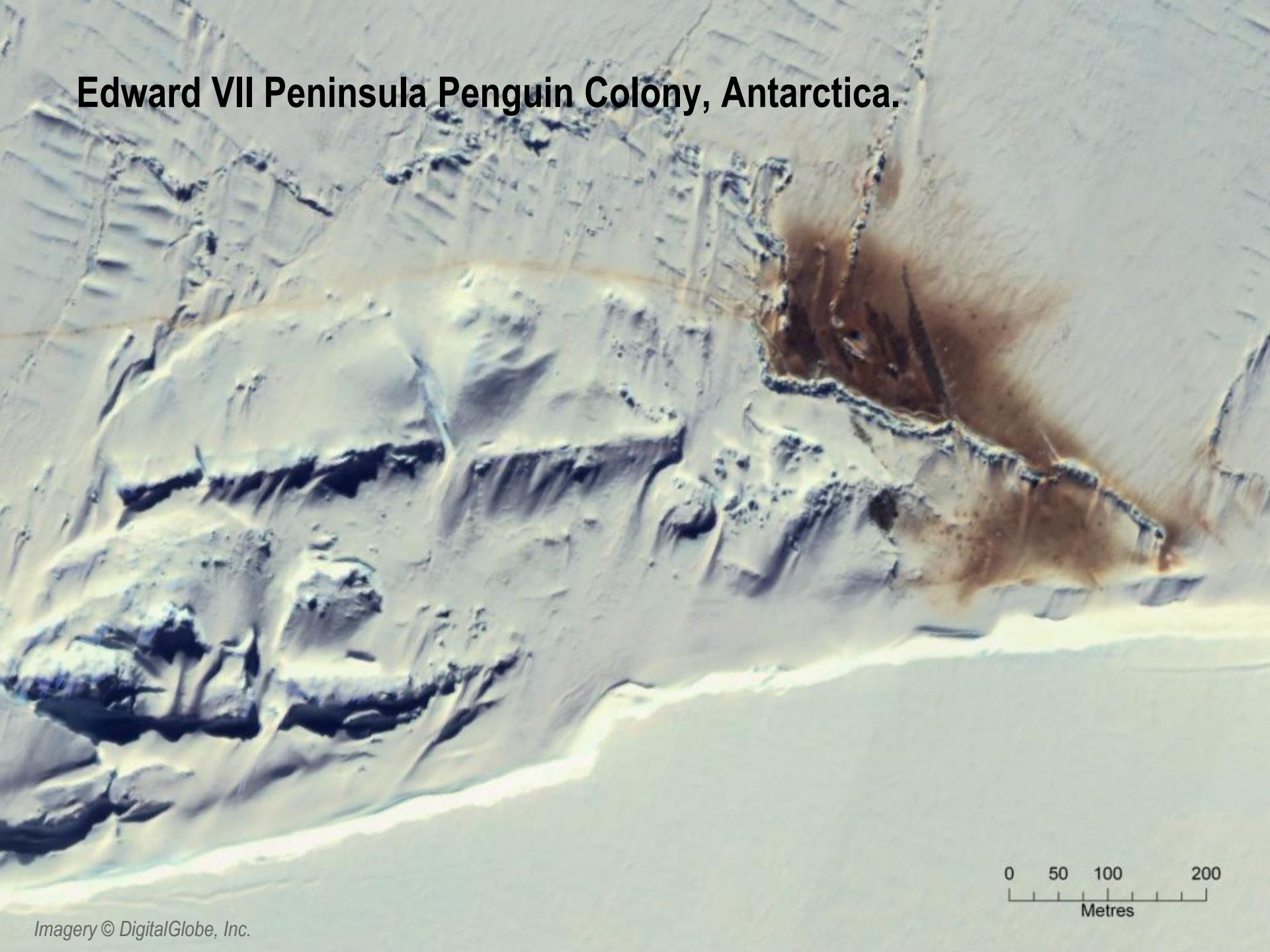
Automated coastal mapping



EP23A-0939: Automated Generation of the Alaska Coastline Using High-Resolution Satellite Imagery

Tuesday, 15 December 2015 13:40 - 18:00 Moscone South - Poster Hall

Edward VII Peninsula Penguin Colony, Antarctica.

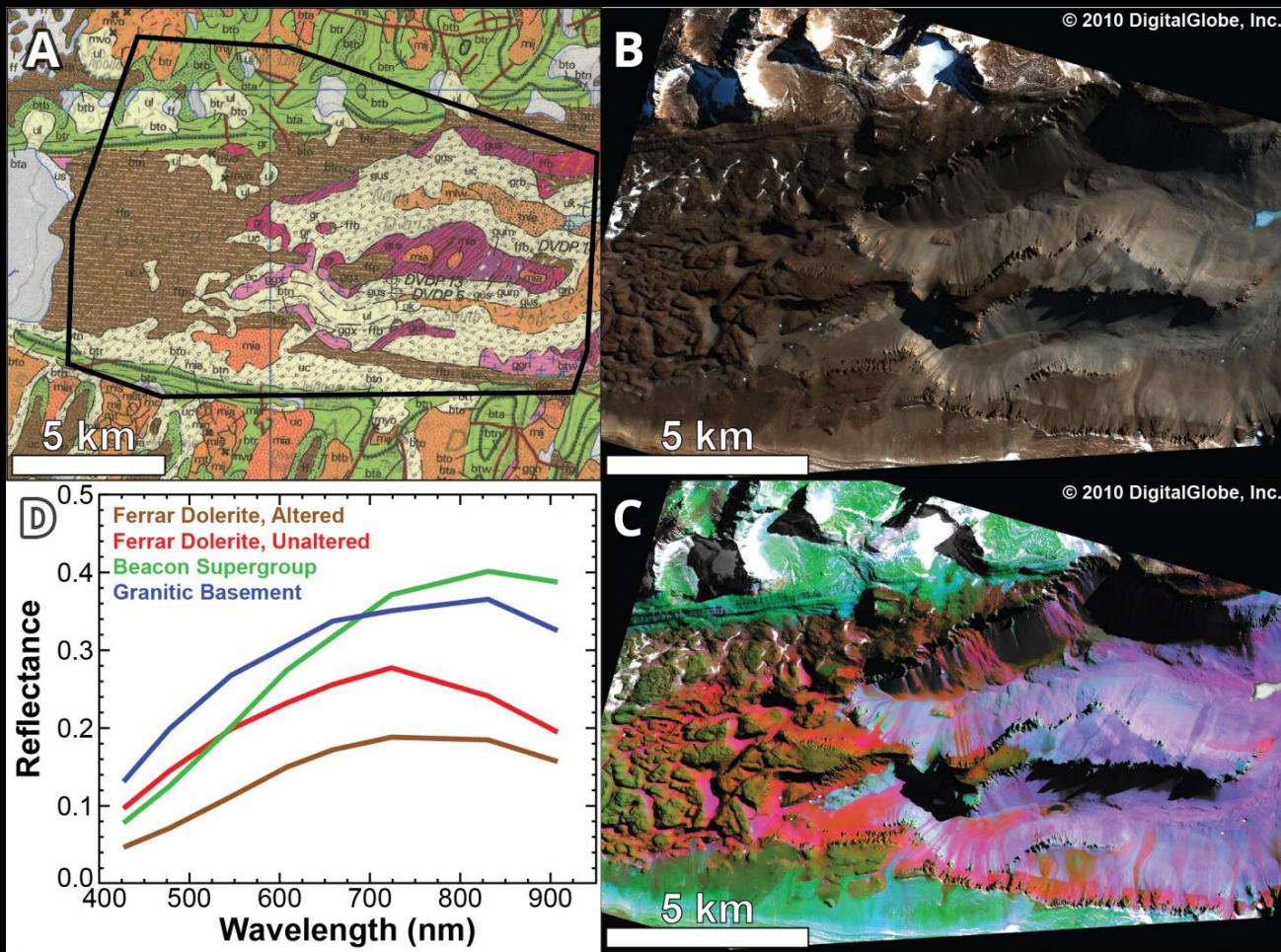


Examples: SpecMap

Geologic Mapping from Space

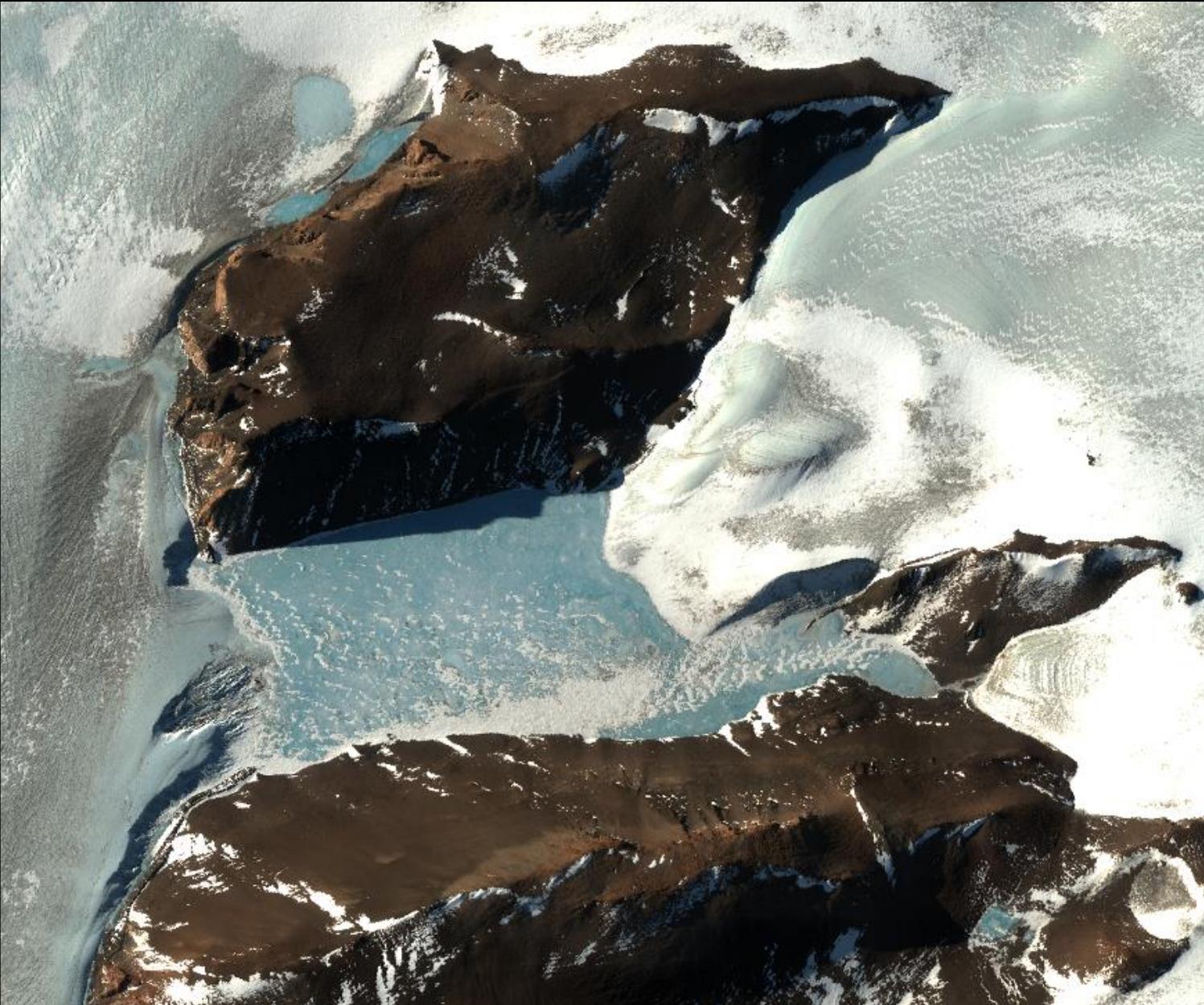


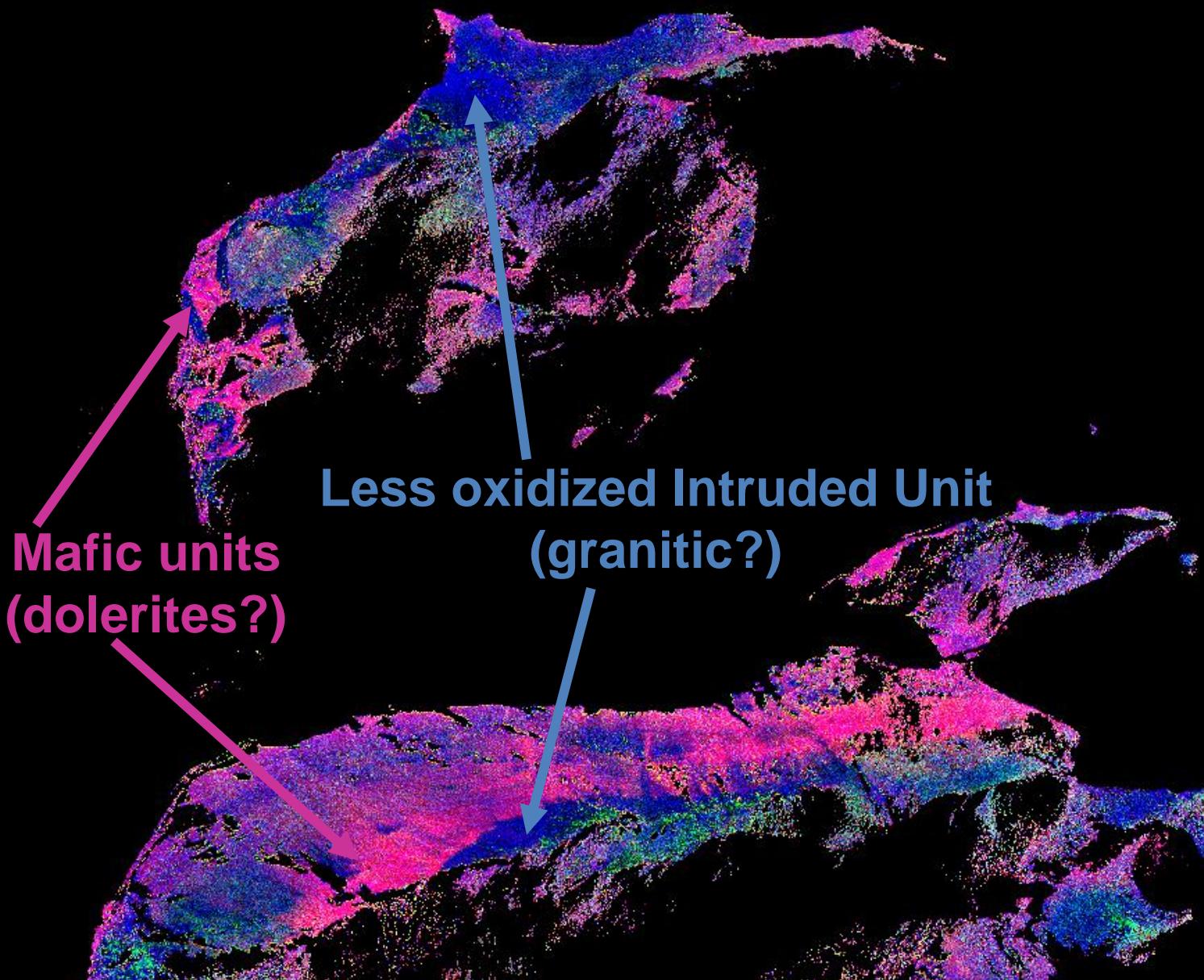
- RSV parameters are designed to highlight compositional diversity using limited data.
- Combined into the same red, green, blue color combination:
 - Red: A measure of the strength of the 1000 nm absorption feature, which is due to octahedrally coordinated Fe^{2+} in mafic minerals (e.g., pyroxene, olivine)
 - Green: A measure of the inflection near 546 nm, due to an Fe^{3+} charge-transfer absorption and commonly dominates stained sedimentary lithologies
 - Blue: An inverse measure of the inflection near 478 nm, which is common in coarse-grained igneous and metamorphic lithologies
- Same RGB color combination allows for easy comparisons



PA33C-2197: Linking Samples to Orbital Imagery: Cataloging the Spectral Signatures of the Transantarctic Mountains for Future Compositional Studies and Remote Ground Truthing
Wednesday, 16 December 2015 13:40 - 18:00 Moscone South - Poster Hall

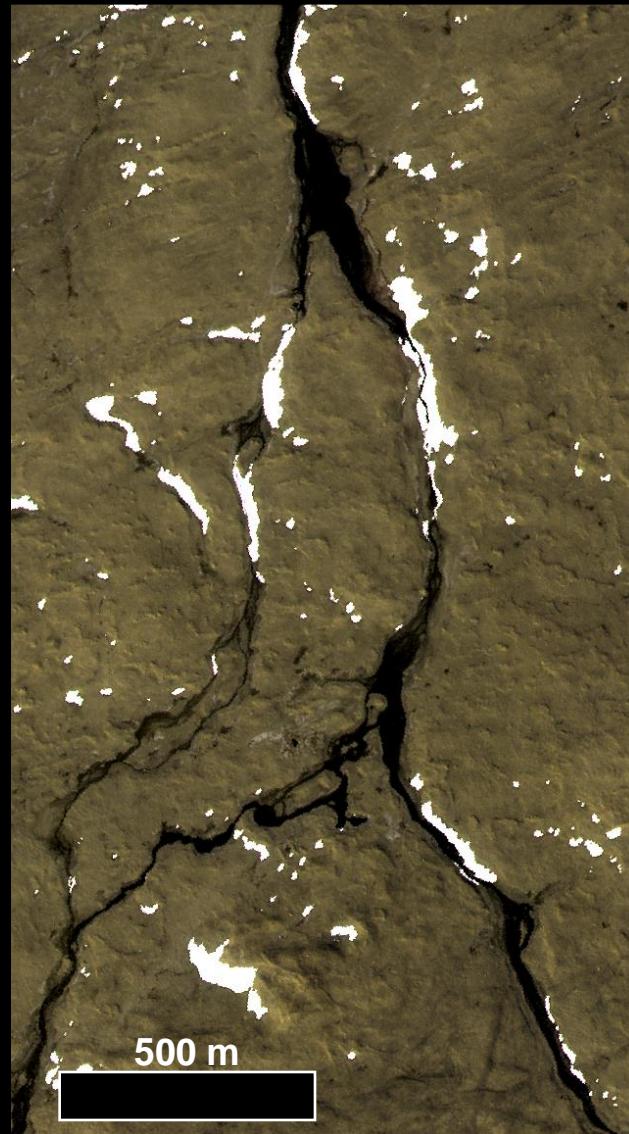
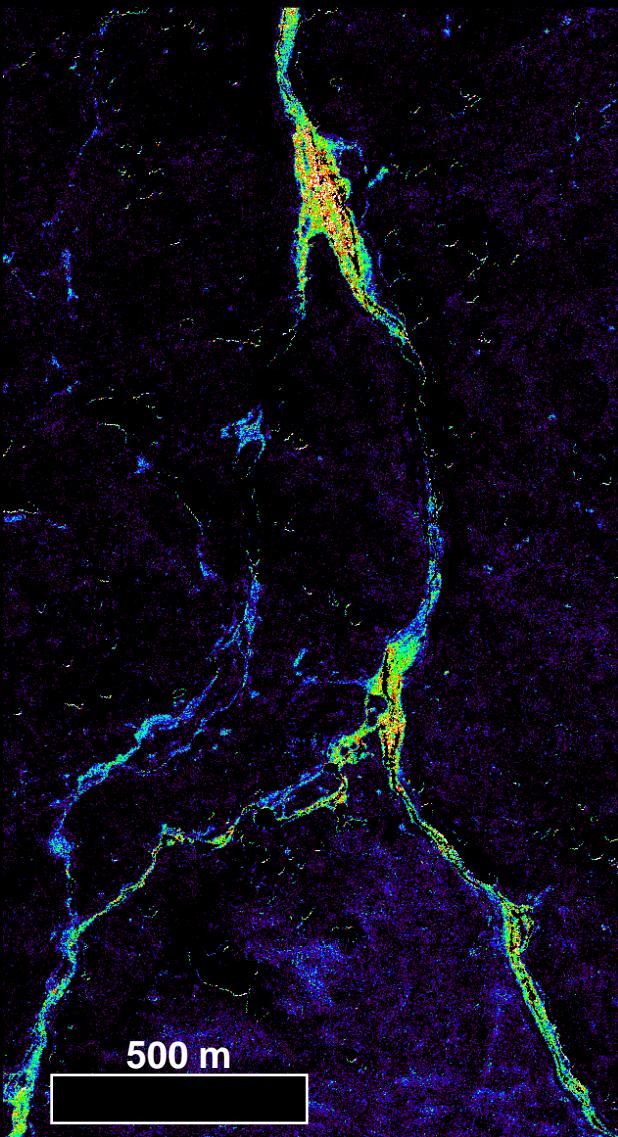
Salvatore, M. R., et al.
"Characterization of spectral and geochemical variability within the Ferrar Dolerite of the McMurdo Dry Valleys, Antarctica: weathering, alteration, and magmatic processes." Antarctic Science: 1-20.
doi:10.1017/S0954102013000254.





Mapping Photosynthetic Materials in Taylor Valley

- Biological “hot spots” can be identified by mapping the photosynthetic “red edge” across a landscape.
- Only possible using multi-spectral data with high spatial resolution.
- Repeat measurements can be used to track the migration and evolution of these ecosystems as the local hydrologic cycle changes.



How do I get this imagery?



Level of access to imagery through PGC (pgc.umn.edu) depends on your funding source:

- NSF-PLR or NASA Cryosphere
- Other Academic: DigitalGlobe Foundation (grant application process)

Big shift in how science is done

- Remote Sensing is no longer limited to large scales, low resolutions
- Fieldwork is becoming increasingly “optional”
- ...But more focused, productive, and efficient!

Data considerations



- Filesize
- Transfer
- Computing
- People!

Conclusion

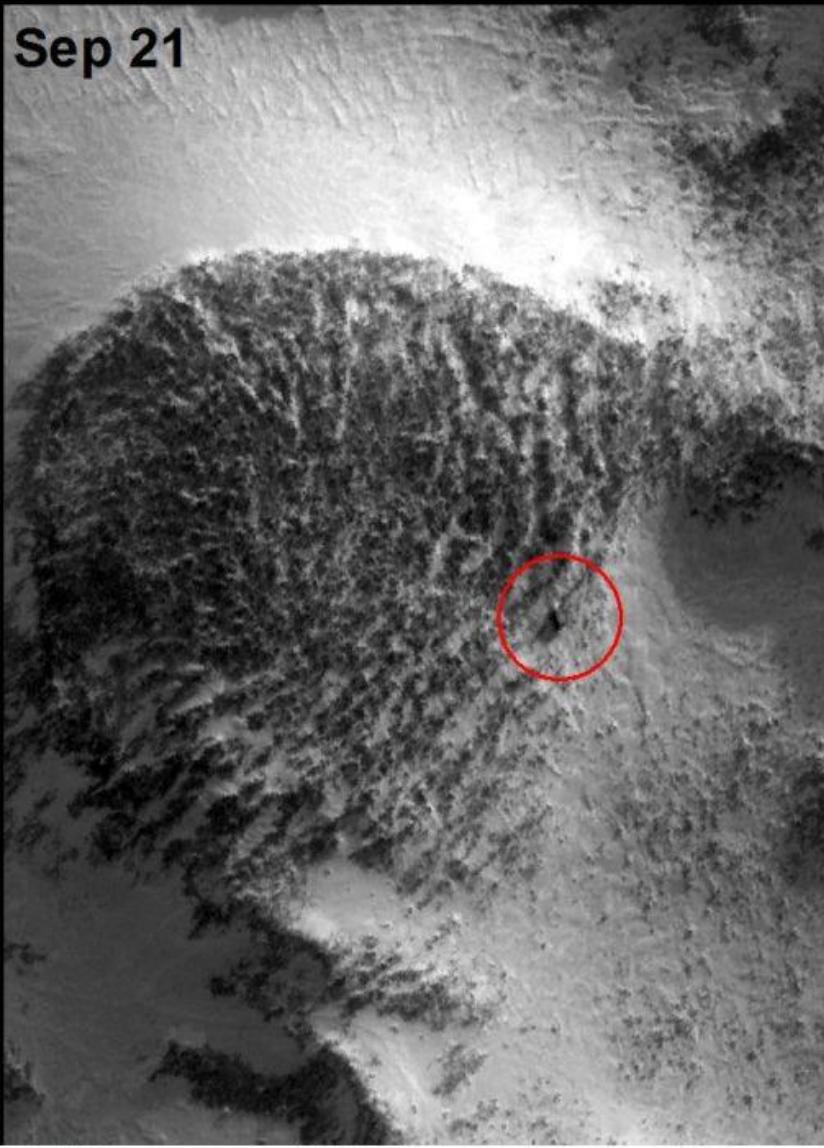


- GIS/RS skills are becoming important, assumed, and even mandatory for early career geoscientists.
- As a geoscientist, tackle problems geospatially.

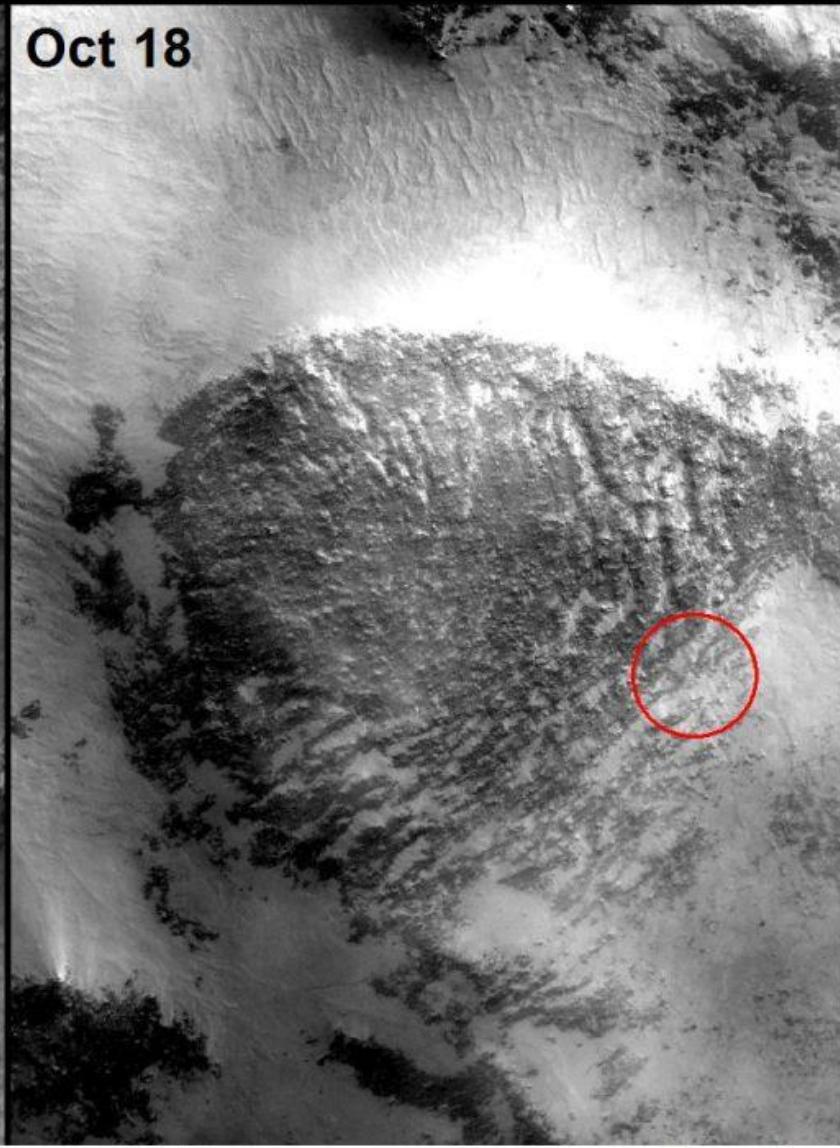
Thanks!

geroth@umn.edu

Sep 21



Oct 18



Upper Hut Mount Erebus, Antarctica

Data Source:

Imagery ©DigitalGlobe, Inc.

Imagery orthorectified but not ground-truthed

1:3,000 scale when printed at 8.5"x11"

version 1.0 - updated 12/3/2015

Credits:

Cartography by George Roth
Polar Geospatial Center



0 50 100 150 200 m