

Monitoring Landscapes on Oceanic Islands: Sub-meter Imaging from IKONOS in the Context of RADARSAT SAR

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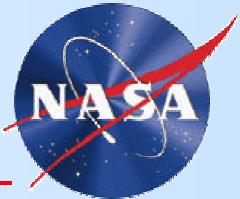
(CSA)

Jacob Yates

(SSAI)



Outline

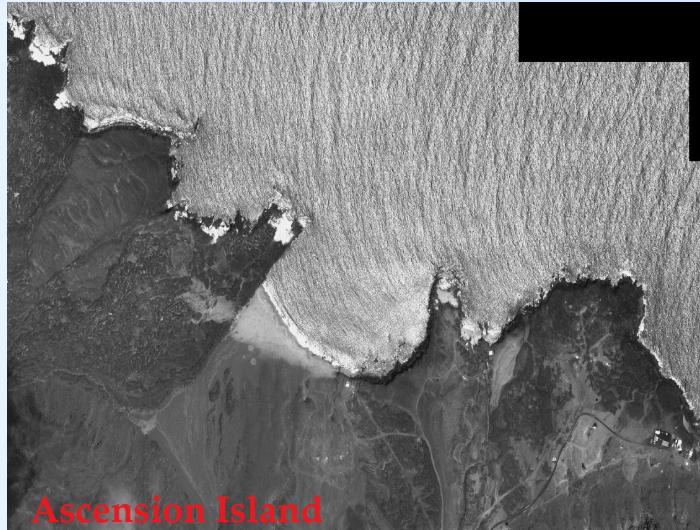


- Oceanic Islands: Why Monitor them?
 - Sensitive landscapes
 - Extremely Responsive to any forcings
 - Diverse set of fragile landscapes, landcover
- Index Set of Oceanic Islands:
 - From Ice-covered islands to phosphate atolls
- Establishing Context: RADARSAT SAR
 - Background mission monitoring of 175 islands (time series)
- RADARSAT (+Landsat-7) focuses IKONOS on where the “action” is:
 - Targeted monitoring at sub-meter resolution
- EXAMPLES: Case studies underway
- What's Next?
- Summary

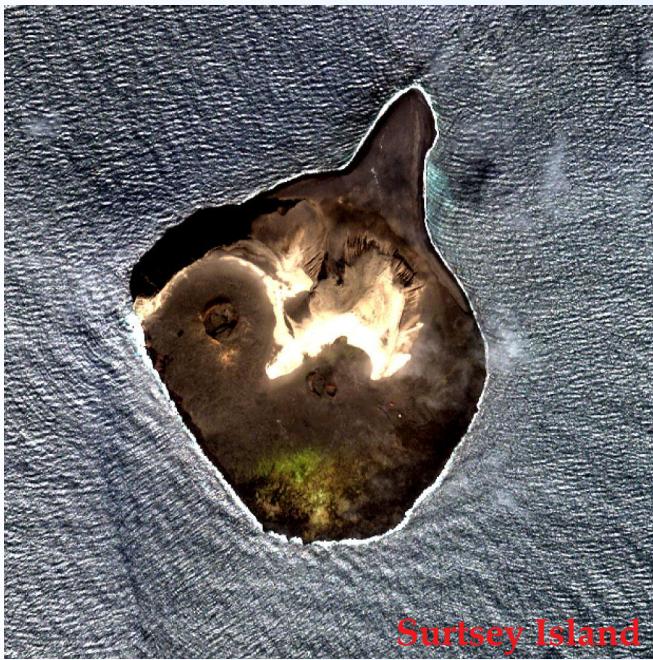
Examples of IKONOS Monitoring Sites



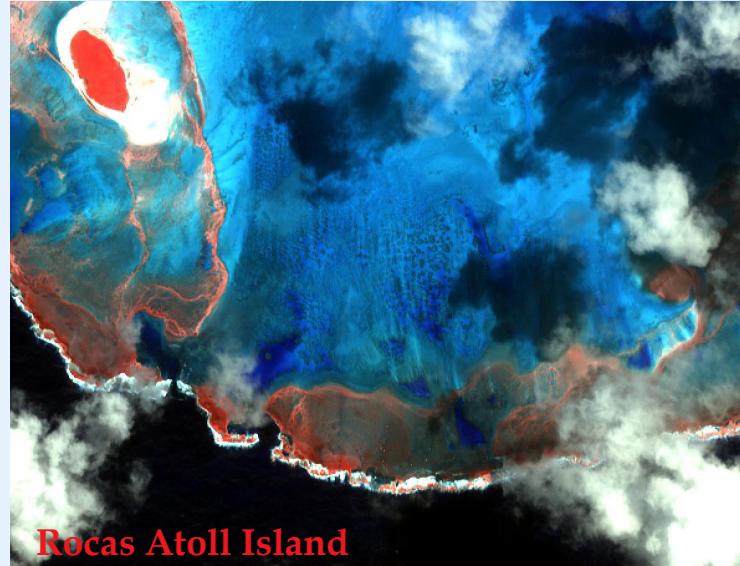
Tristan da Cunha



Ascension Island



Surtsey Island

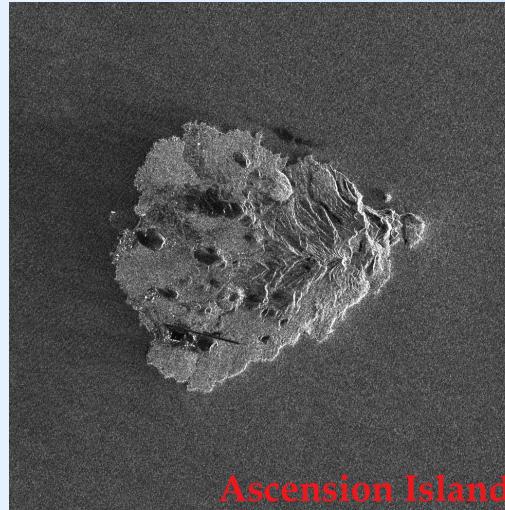


Rocas Atoll Island

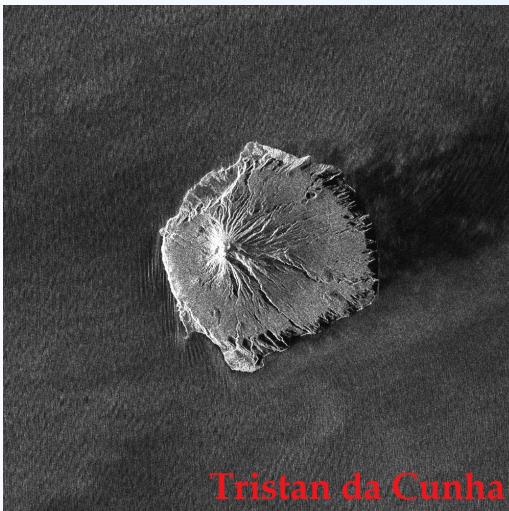
Examples of IKONOS Monitoring Sites



Fogo Island



Ascension Island



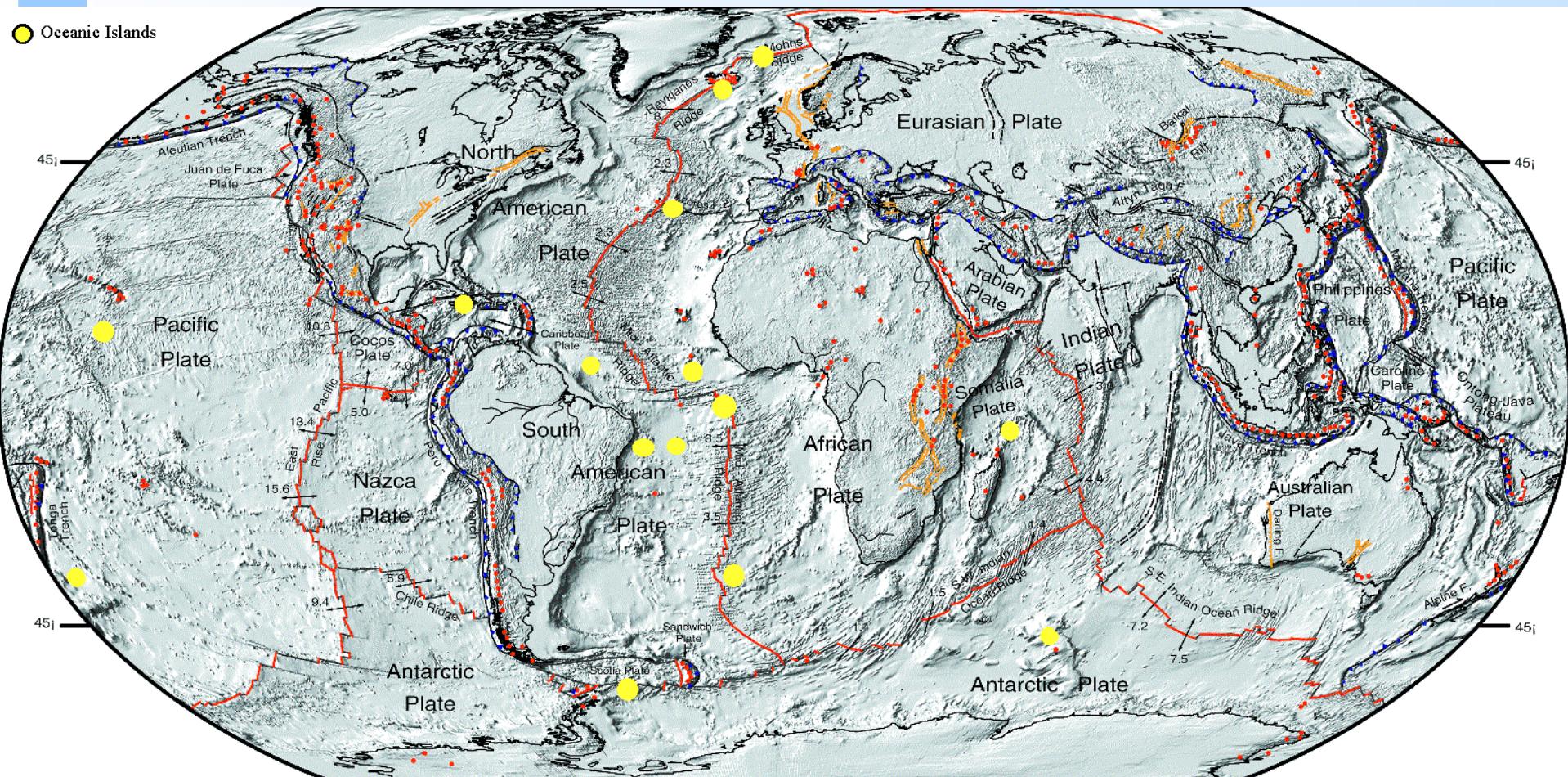
Tristan da Cunha



Deception Island



Map of Islands on Earth



Index Islands under study with IKONOS, RADARSAT, etc.



Island Name	Location	Comments
Surtsey	N. Atlantic, Iceland	Time series analysis underway with comparison with laser DEMs
Capelinhos	Faial, Azores	Time series analysis and DEM (comparison with Surtsey)
Fogo	Cape Verdes, Atlantic	Impact of 1995 eruption, coastal erosion
Rocas Atoll	Equatorial Atlantic	Sea-level changes, erosion, landcover
Martin Vaz	Central Atlantic	Coastline analysis, mass-wasting, landcover
Trindade	Central Atlantic	Coastline analysis, gully erosion, landcover
Ascension	Central Atlantic	Coastal erosion, sea-level effects, landcover
Tristan da Cunha	South Atlantic	Sea-level, erosion of 1961 eruptives, gullying snow-cover effects at summit
Bouvet*	South Atlantic	Ice-cover change, coastal erosion, sea-level comparison with RADARSAT time series
Kerguelen	S. Indian Ocean	Ice-cover change, coastal erosion, landcover comparison with RADARSAT SAR, L-7 time series
Deception	S. Shetlands	Ice-cover change, active volcanism, erosion comparison with RADARSAT SAR time series
Nauru	Equatorial Pacific	Sea-level, rehabilitation from mining, runoff, landcover
Jan Mayen*	Arctic Ocean	Ice-cover change and dynamics, coastal erosion comparison with RADARSAT time-series

Surtsey, Iceland

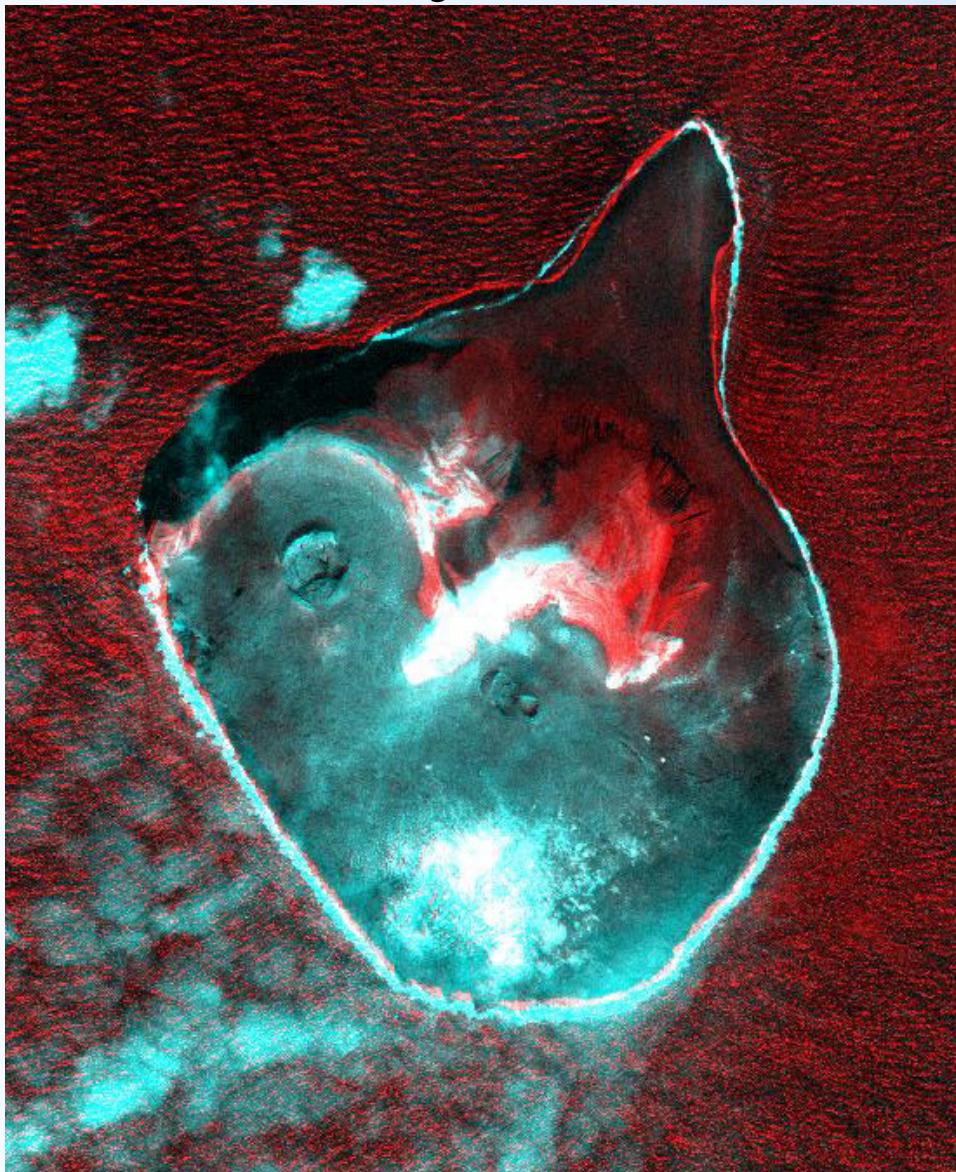


8/14/00



6/12/01

Surtsey, Iceland



Time-Series
Analysis

IKONOS: 1~m pan
Blue: 8/14/00
Red: 6/12/01

Surtsey, Iceland



6/12/2001 (IKONOS)



NASA
Aerial Photos
(May 2001)



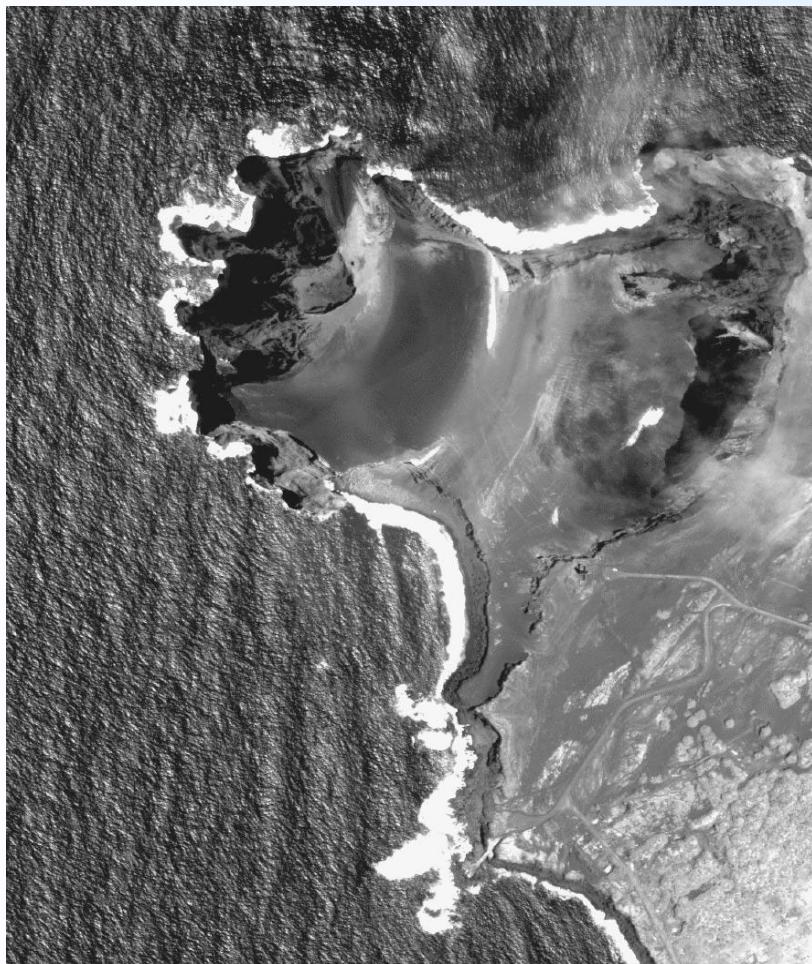
Surtur I

Capelinhos, Western Faial, Azores

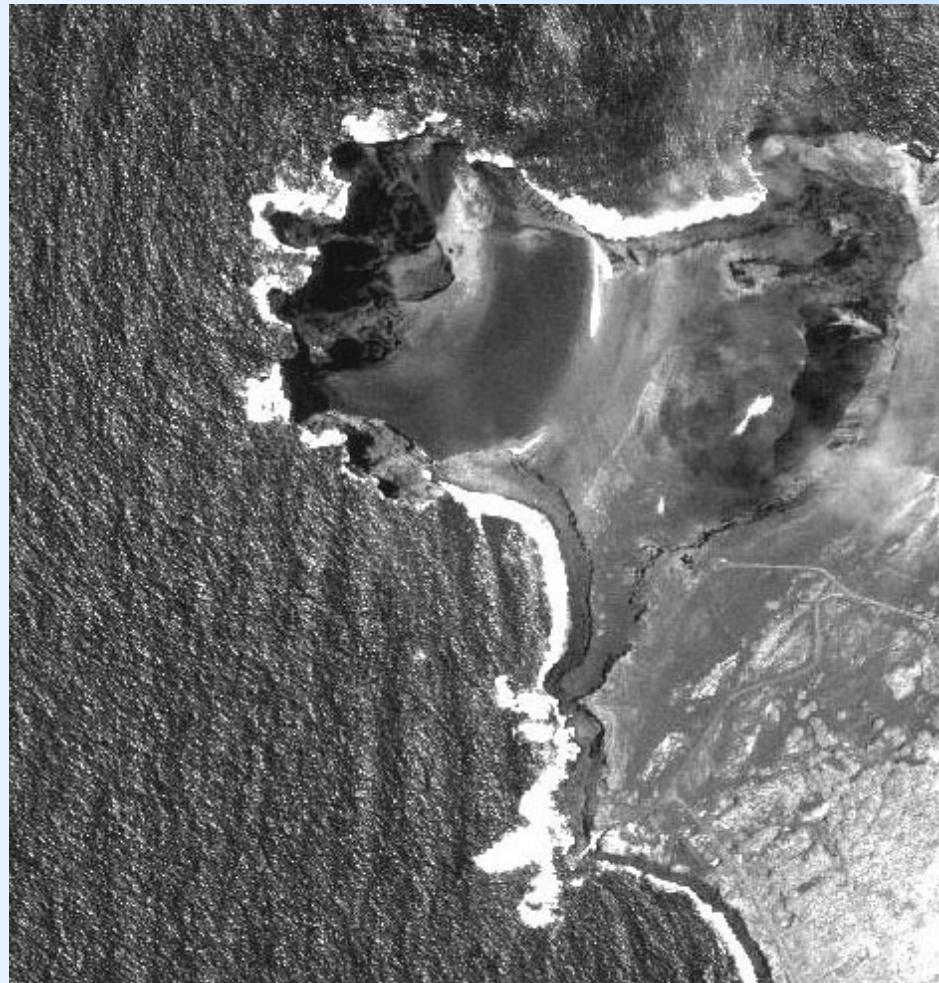


Monitoring Coastal Erosion at "Surtseyan" Eruptive Center

Capelinhos, Western Faial, Azores



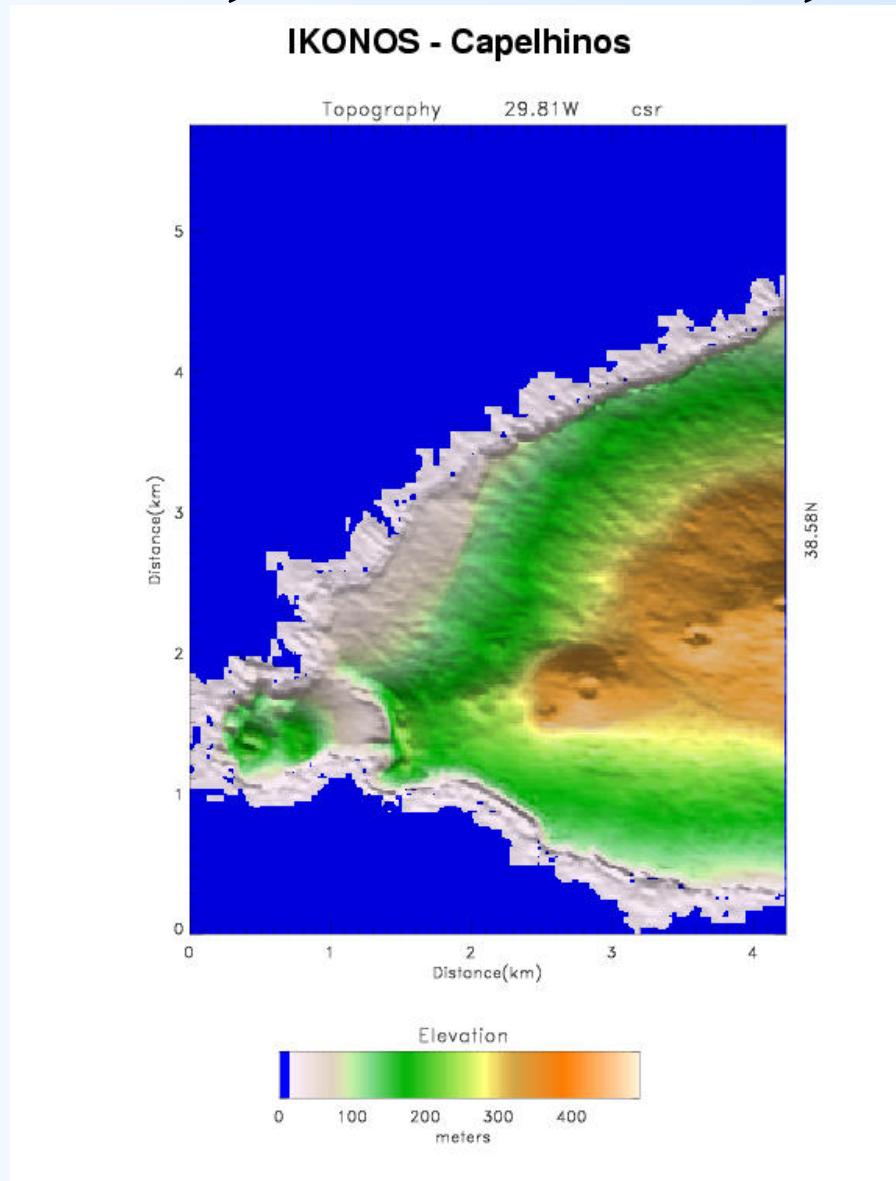
May 2000



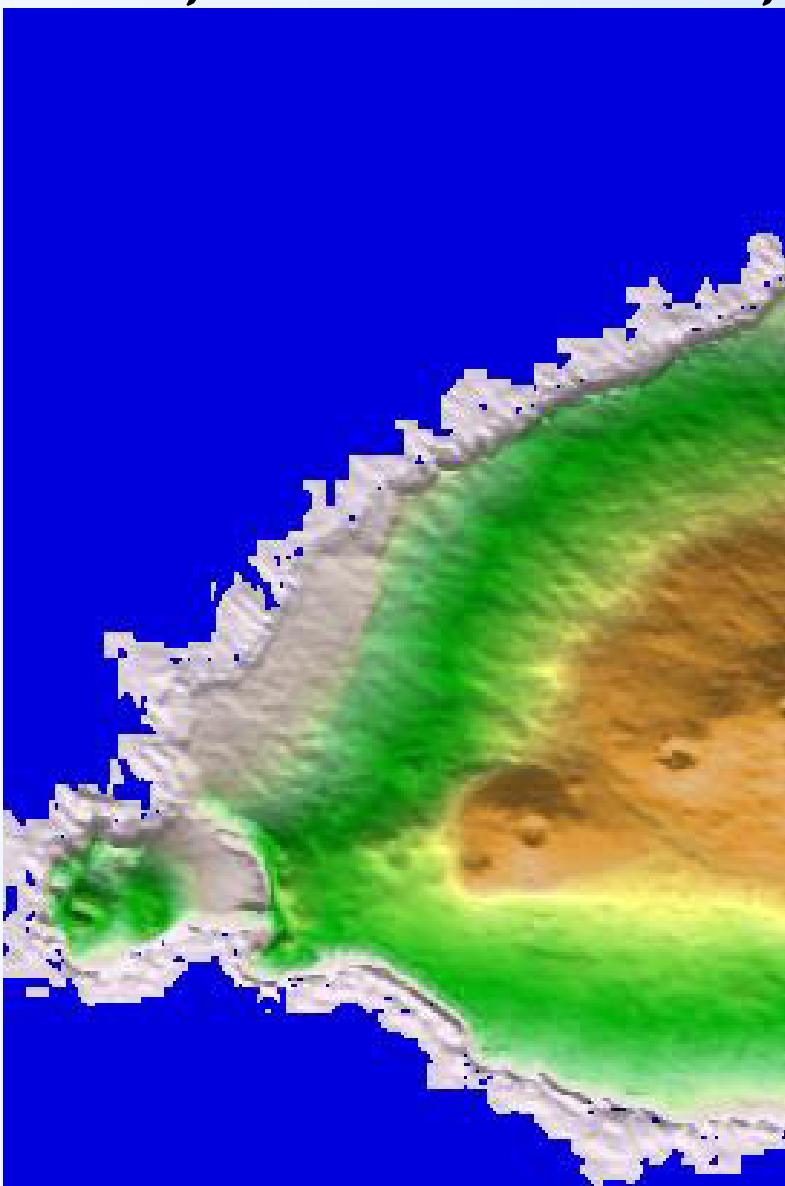
August 2001

Monitoring Coastal Erosion at “Surtseyan” Eruptive Center

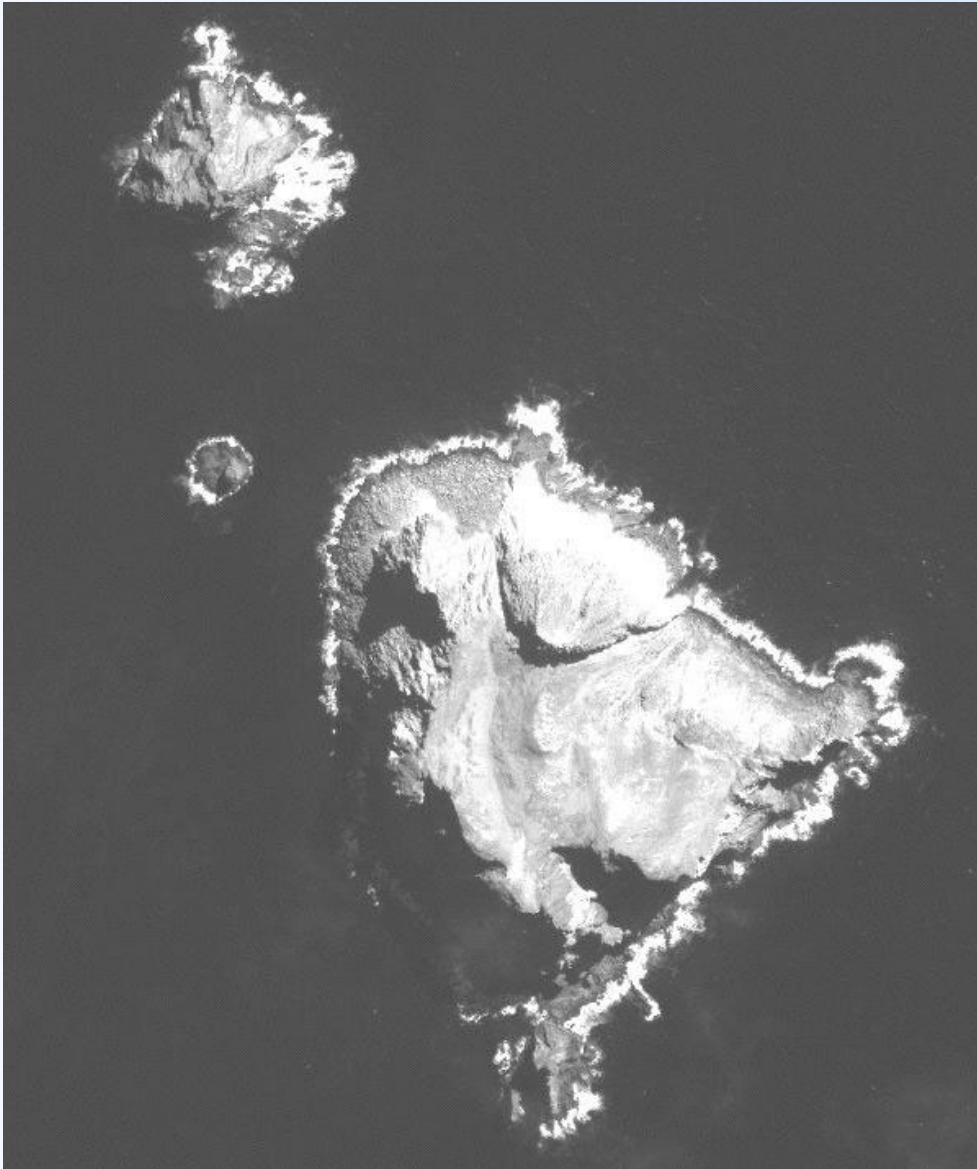
IKONOS DEM of Capelinhos, Western Faial, Azores



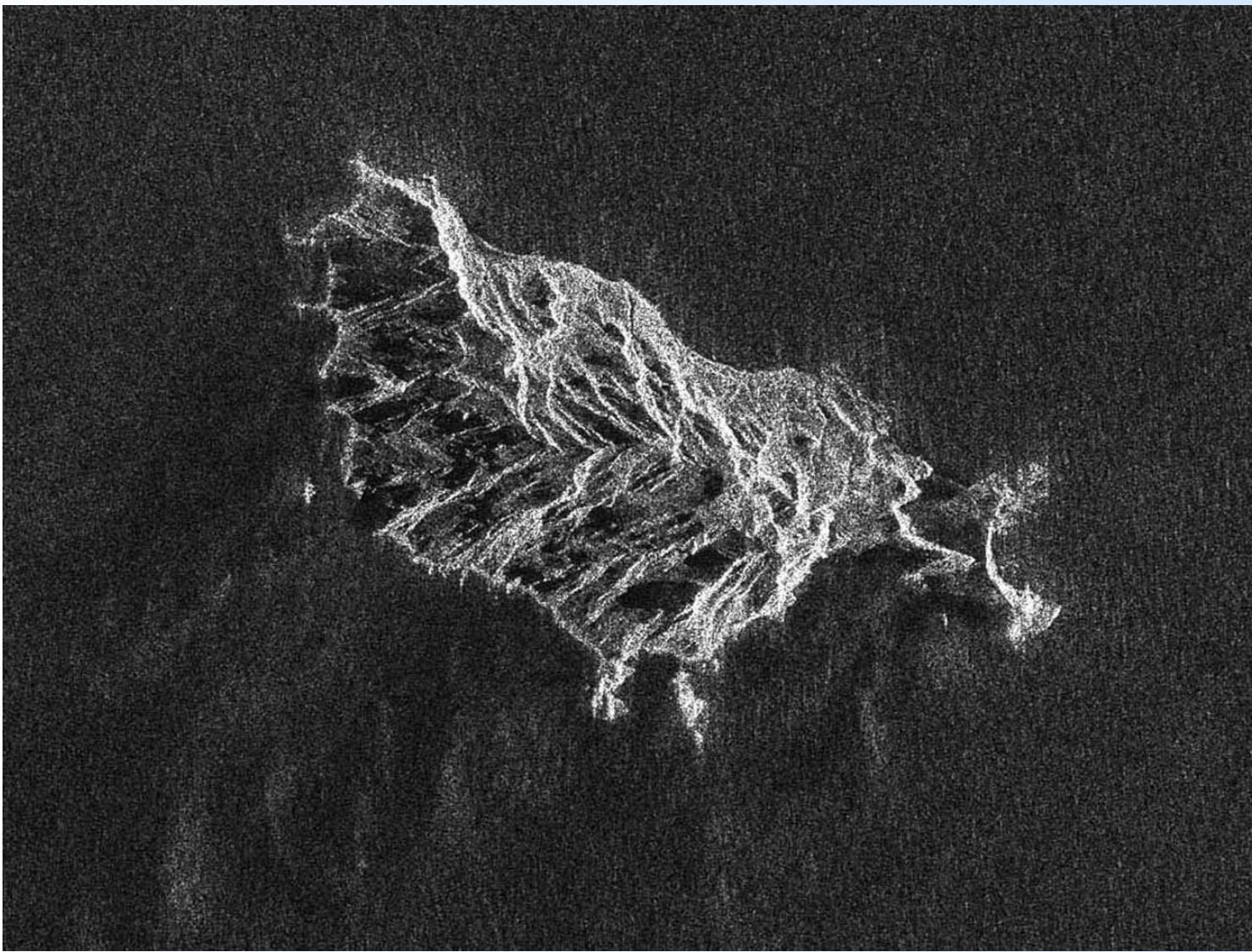
IKONOS DEM of Capelinhos, Western Faial, Azores



Martin Vaz, Atlantic Ocean



Trindade, Brazil RADARSAT SAR



South Coast of Trindade

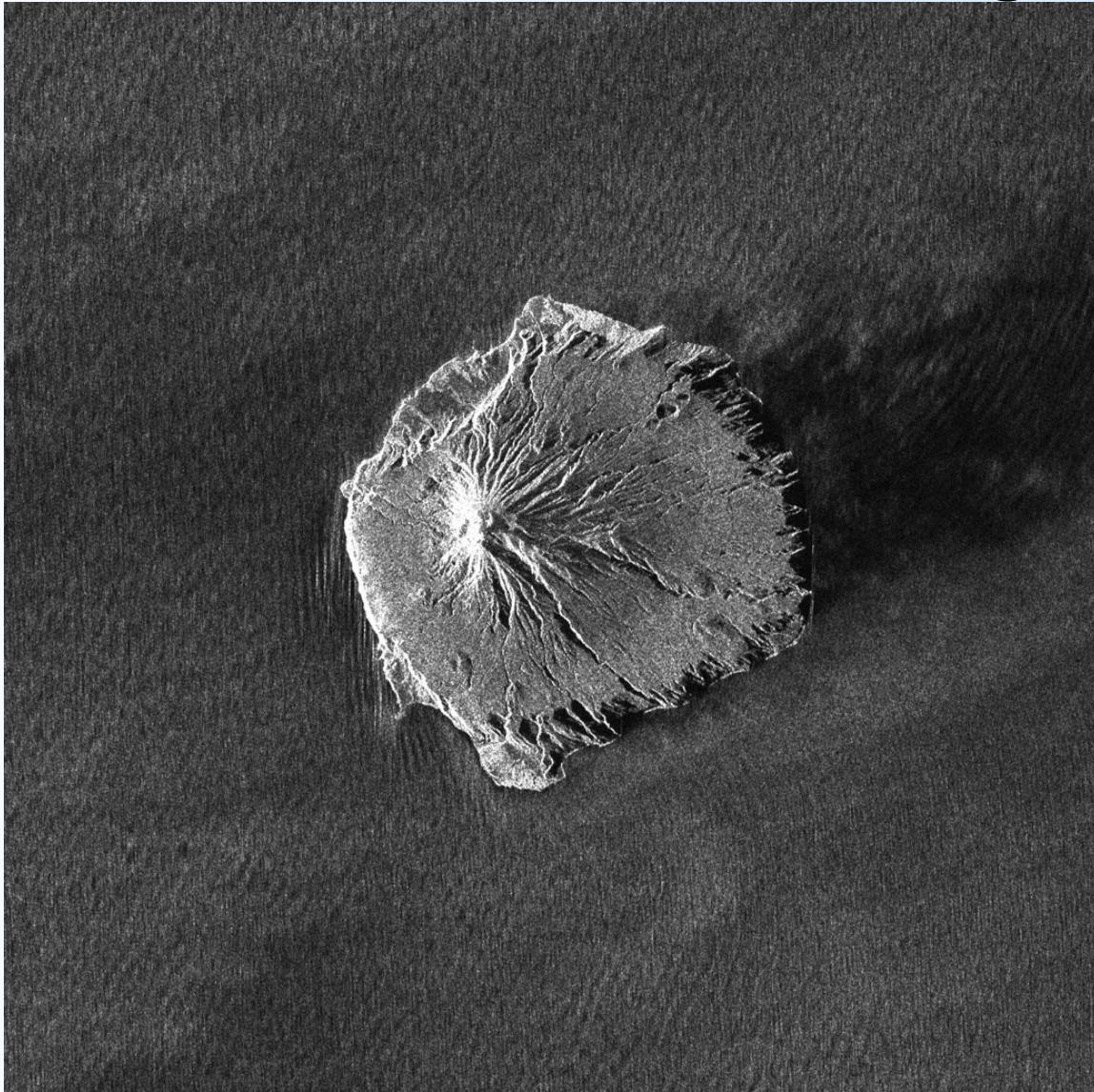


Revealing Coastal Erosion, Mass-wasting, and Downslope Movements

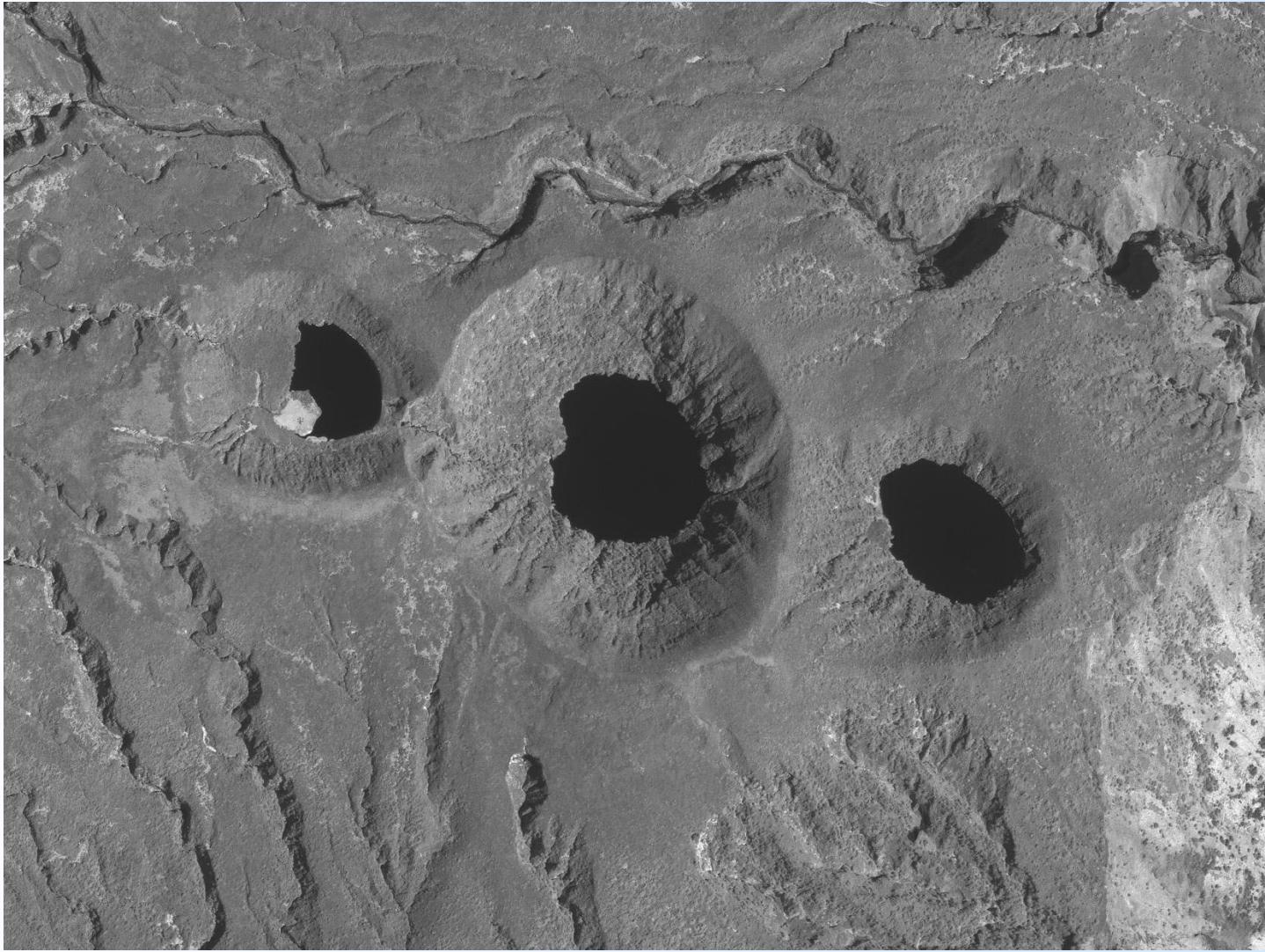
North Coast Beach of Trindade



Tristan da Cunha RADARSAT Context Image

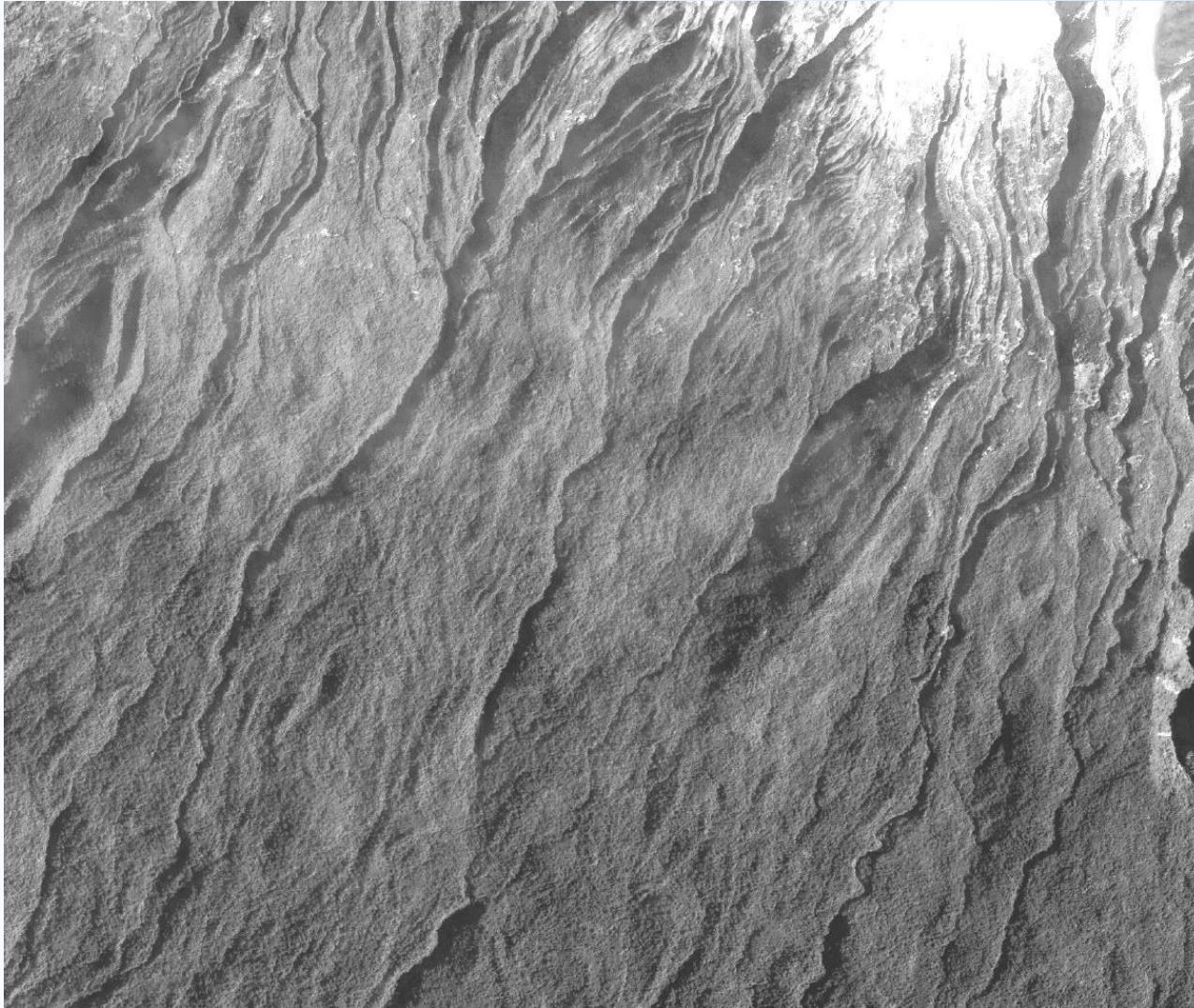


Tristan da Cunha



East Side of Maars Craters

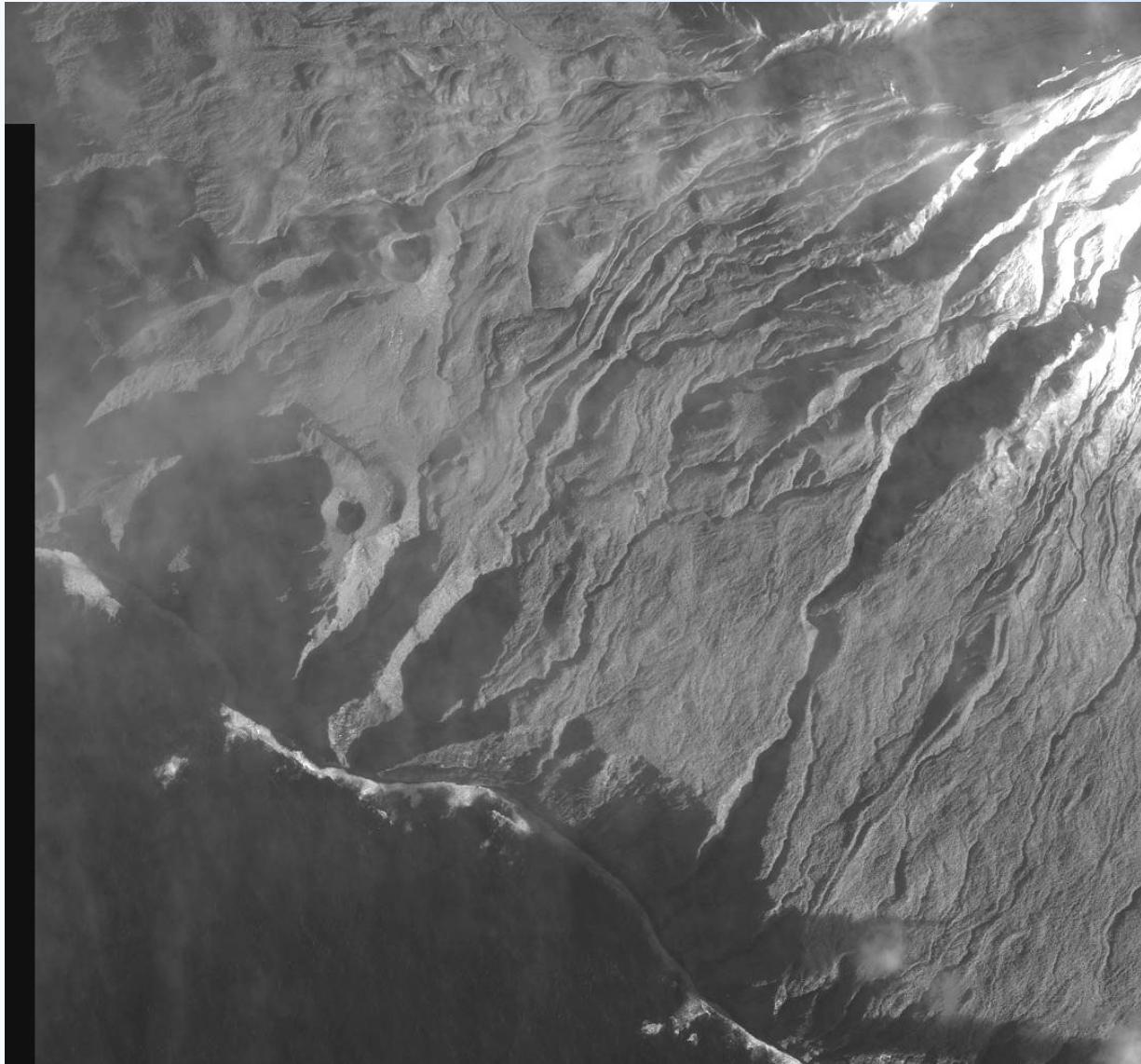
Tristan da Cunha



Gully Erosion Controlled by Flank Topography

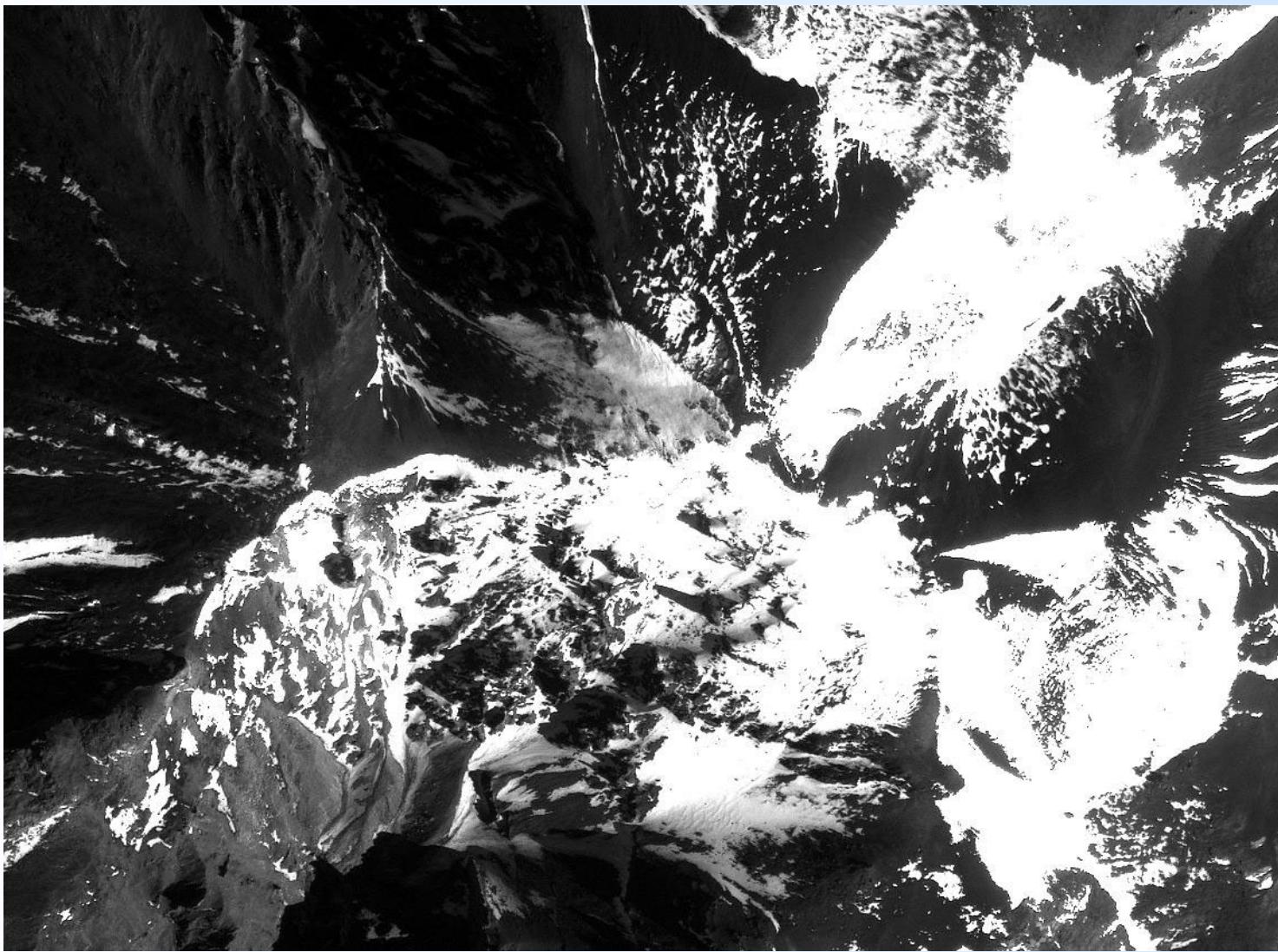


Tristan da Cunha



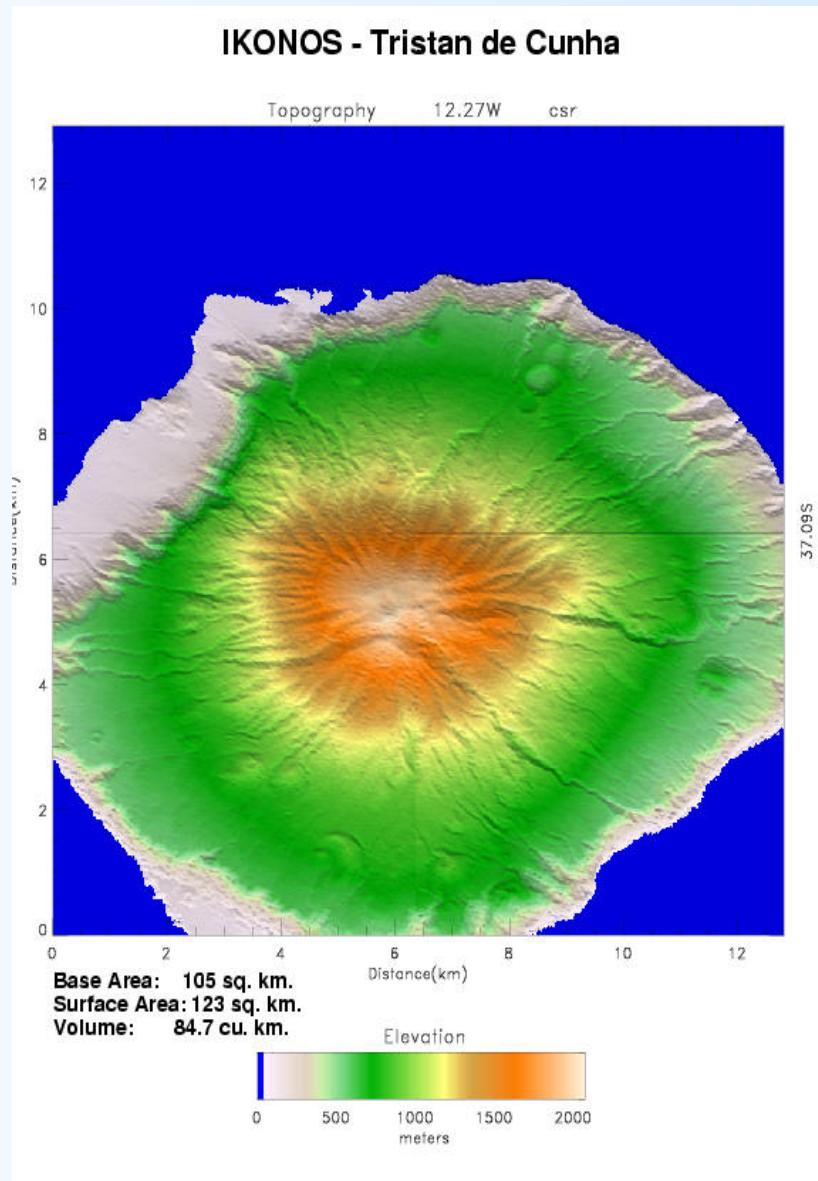
Tristan da Cunha: SW coastal margin with hanging valleys

Tristan da Cunha

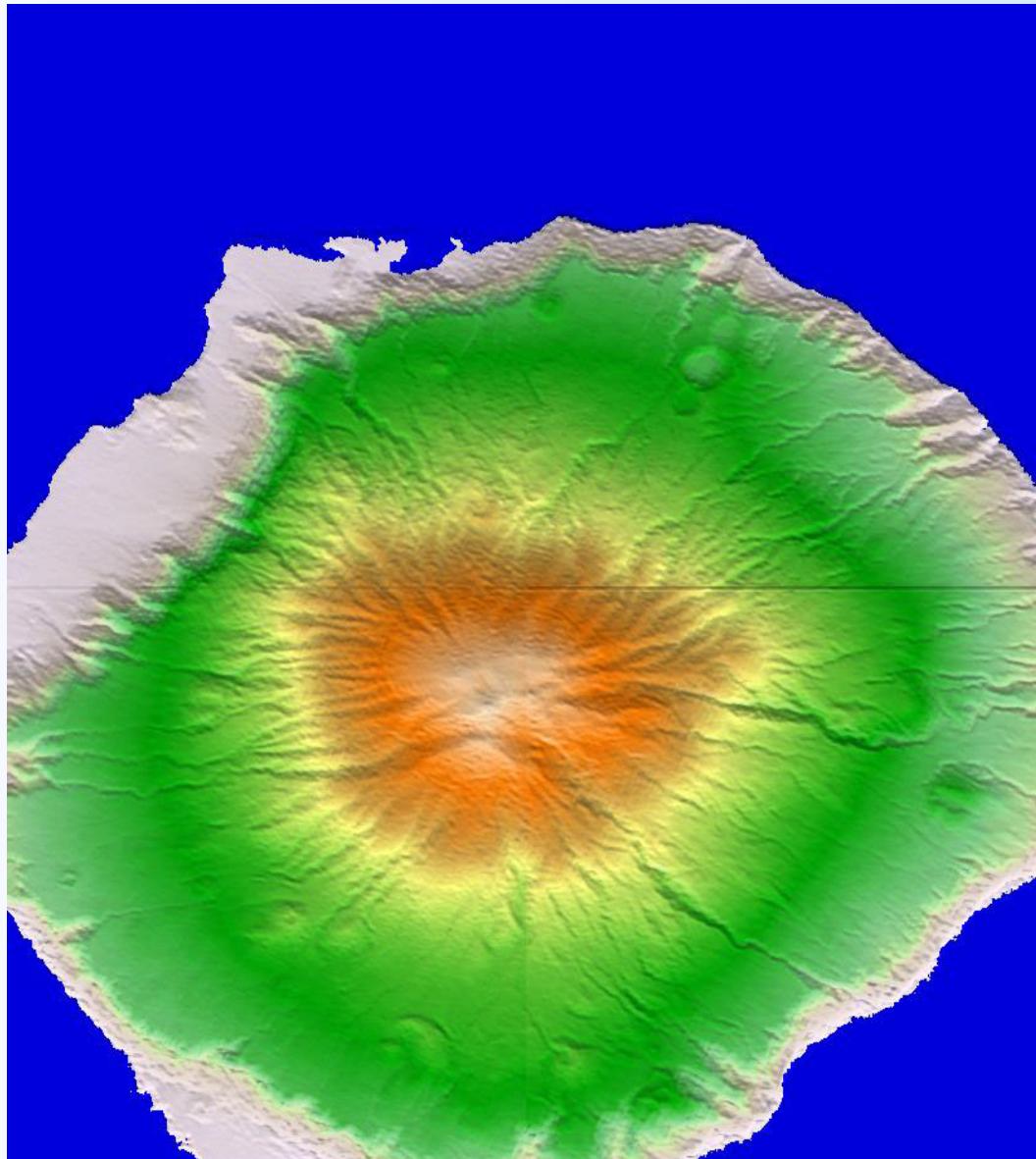


Summit

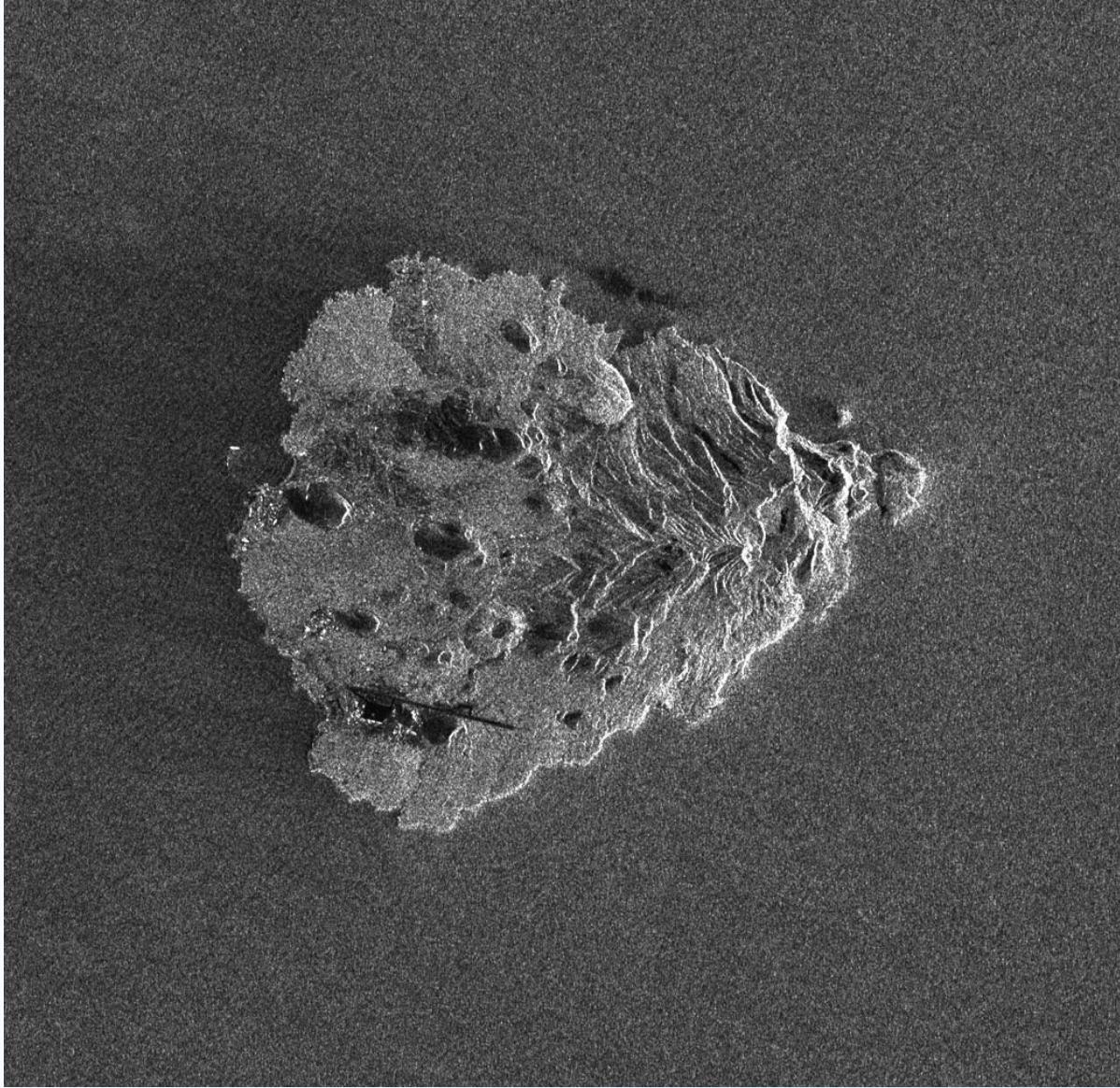
IKONOS DEM of Tristan da Cunha



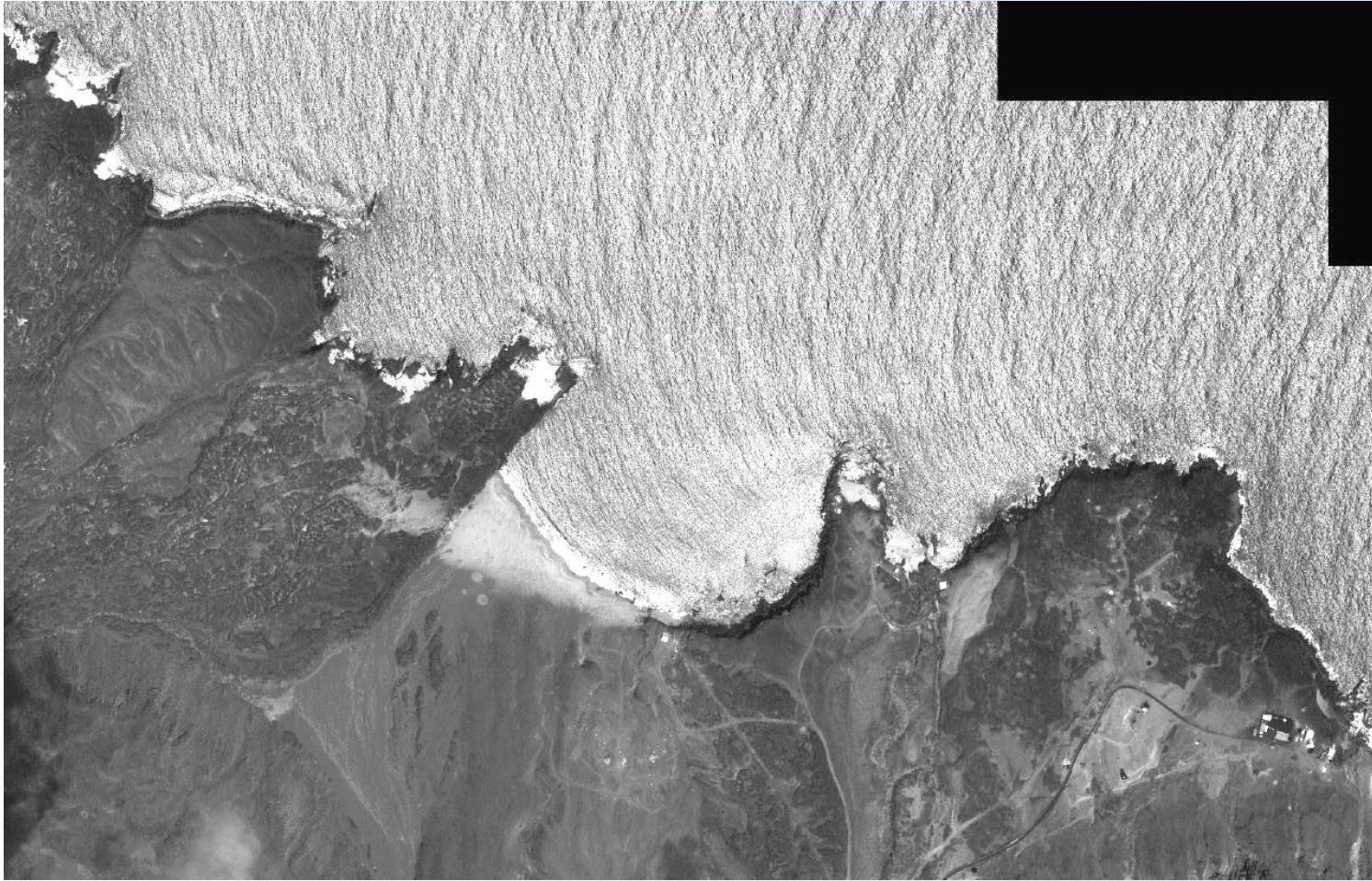
IKONOS DEM of Tristan da Cunha



Ascension RADARSAT Context Image



Ascension Island



Ascension Island: North Coastal Zone showing erosion and deposition

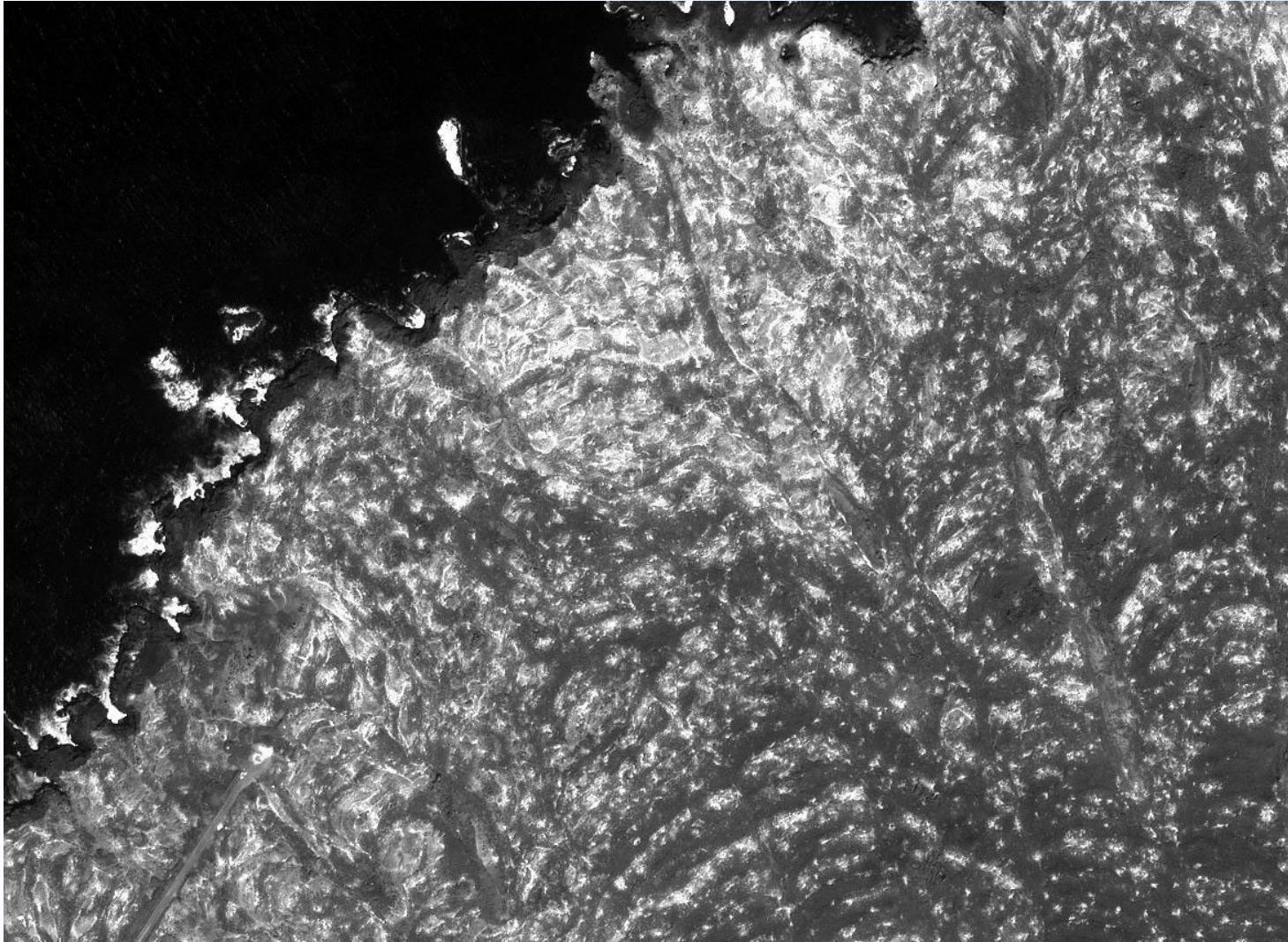


Ascension Island



Example of “Modern” Eruptive center and hillside gully development (on scoria cone)

Ascension Island

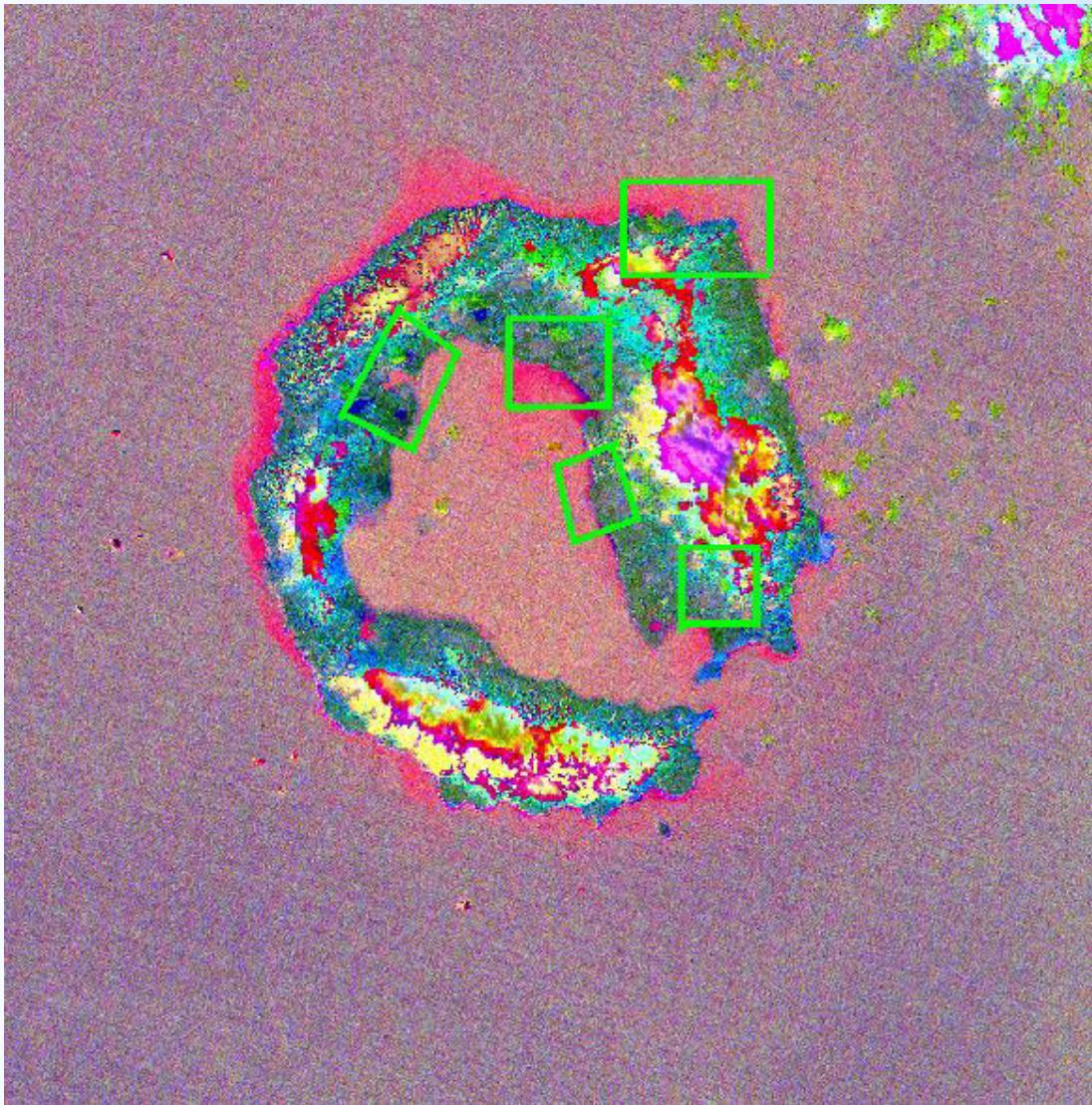


High Silica lavas on NW coast

Deception Island: RADARSAT Context Image (S. Shetlands)

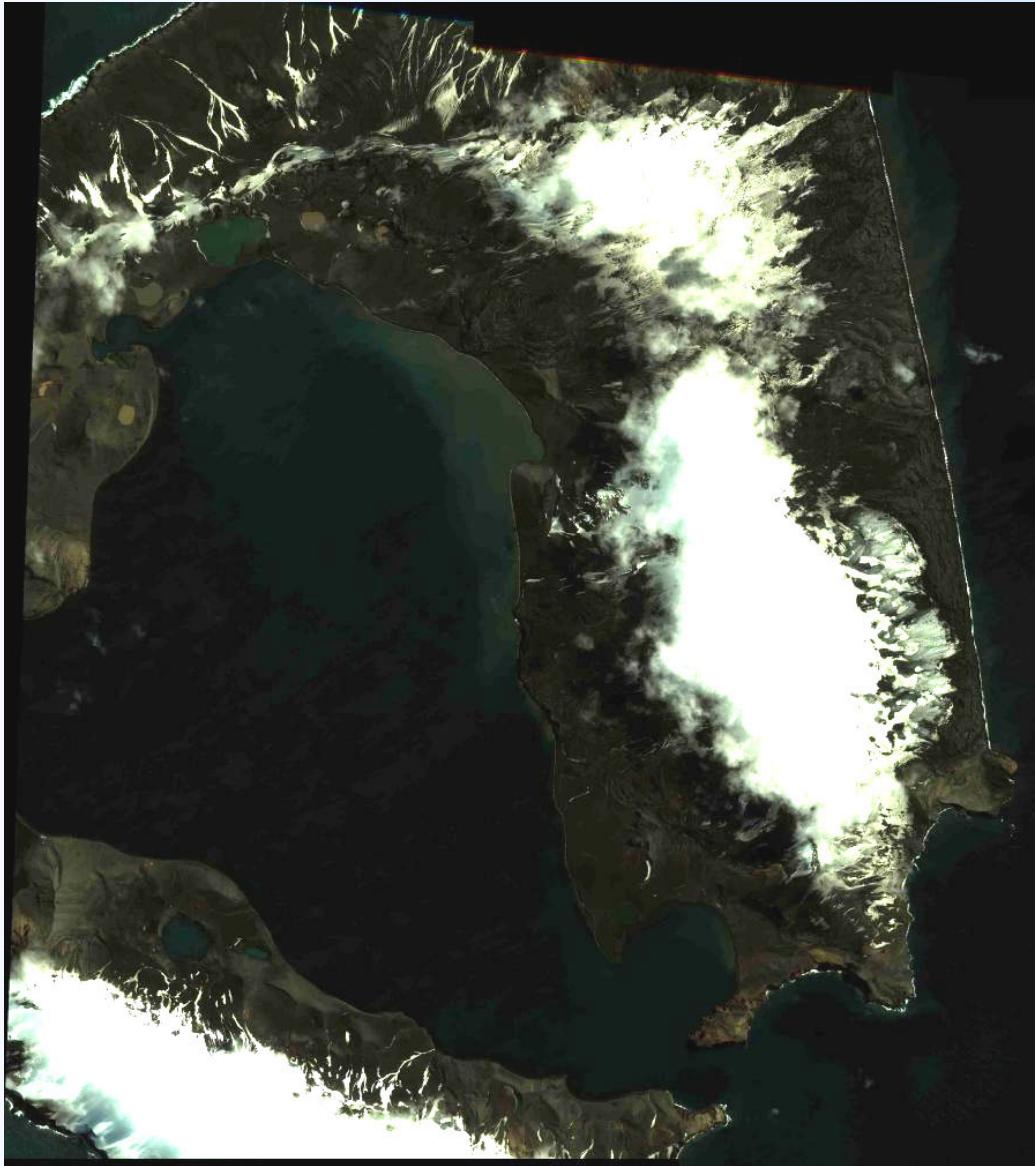


Deception Island: LANDSAT-7 PCA Image



PCA 567

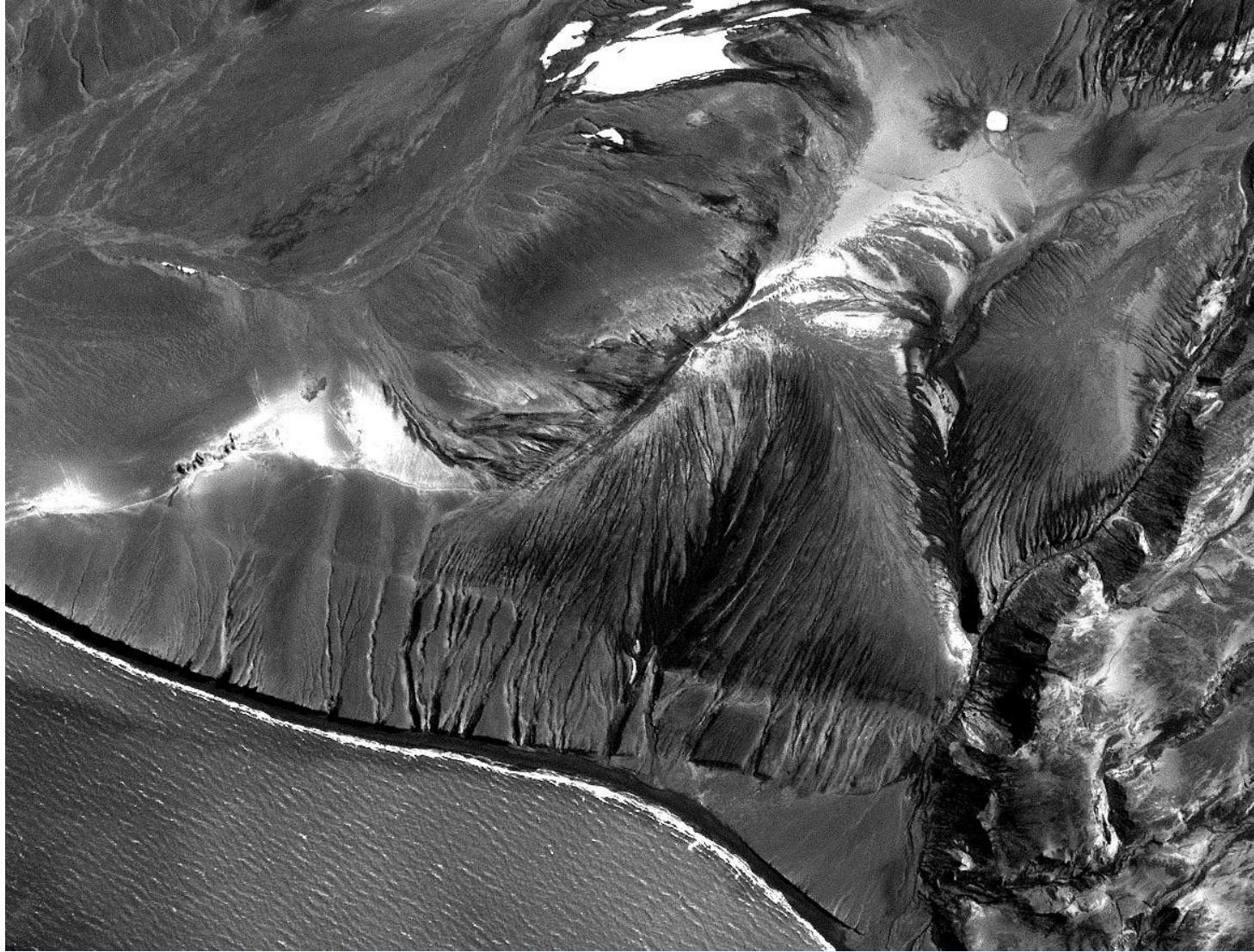
Deception IKONOS Context Image



ENE Straight Coast of Deception Island



Deception Island: Erosional Gullies in Tephra with Unconformities

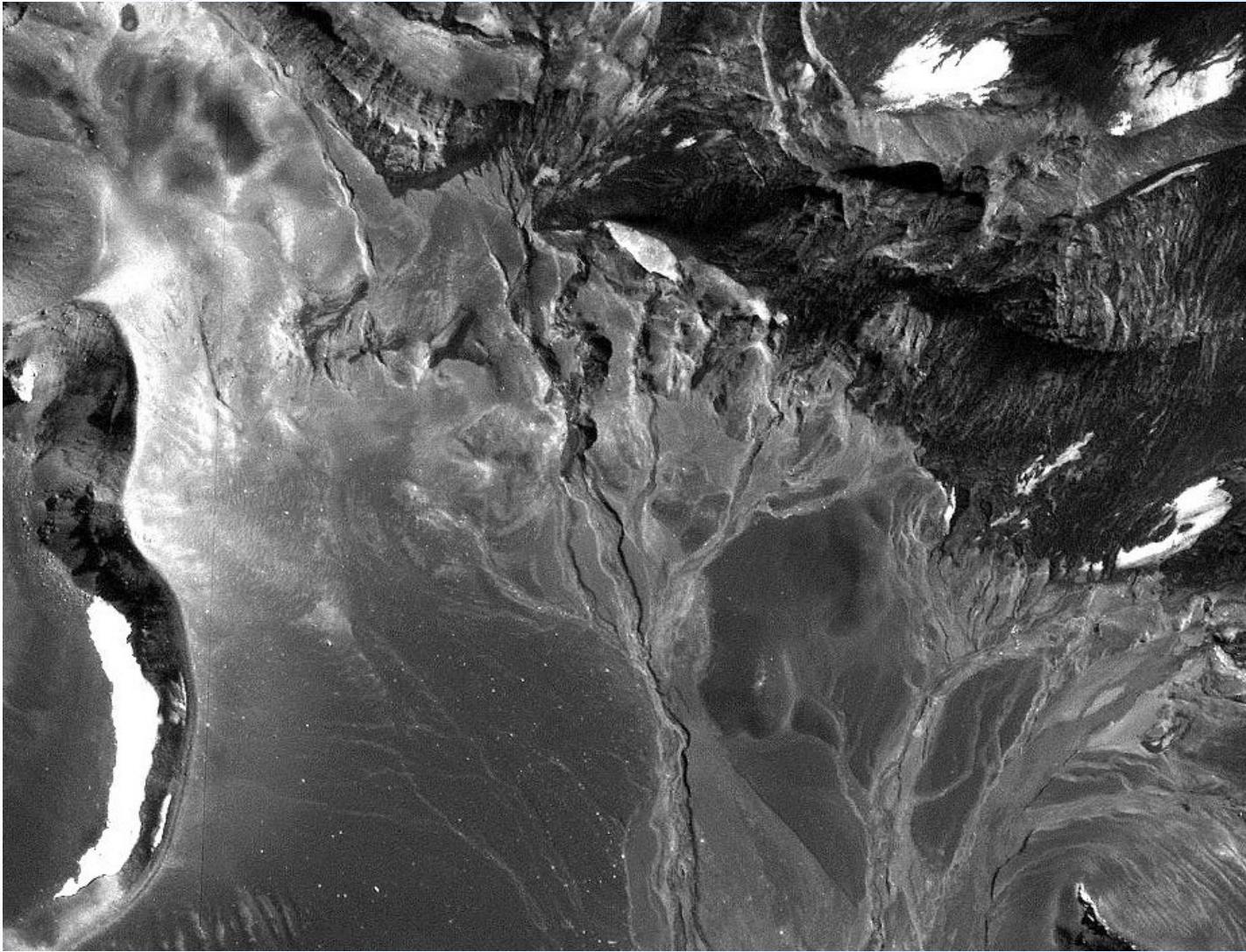
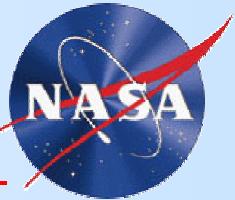


Deception Island: South Shetlands



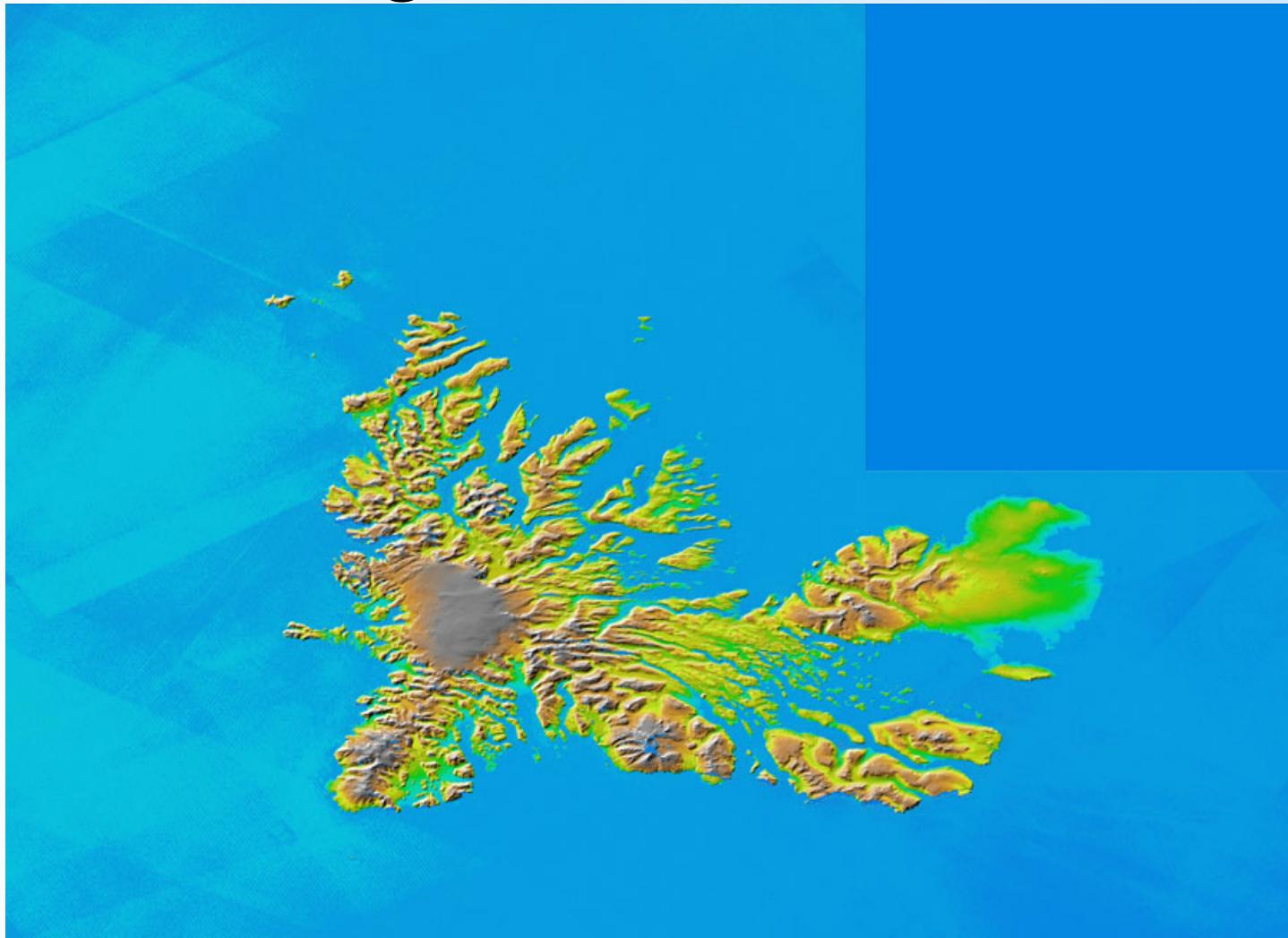
Deception Island: Concave Coastal Margin Demonstrating Landscape Change

Deception Island: South Shetlands



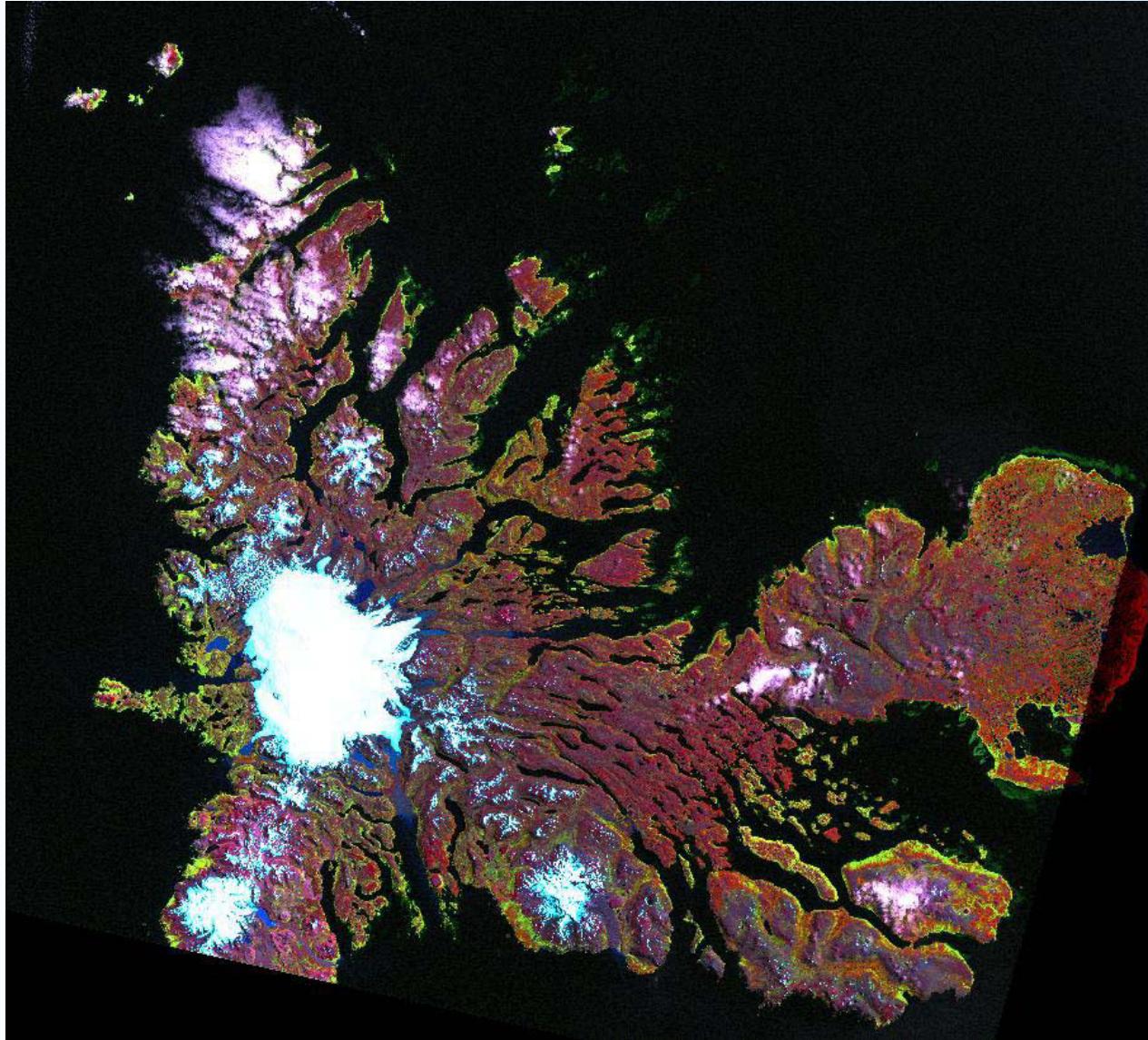
Deception: Hillside Gully formation due to ice melting

Iles Kerguelen (TAAF, France)



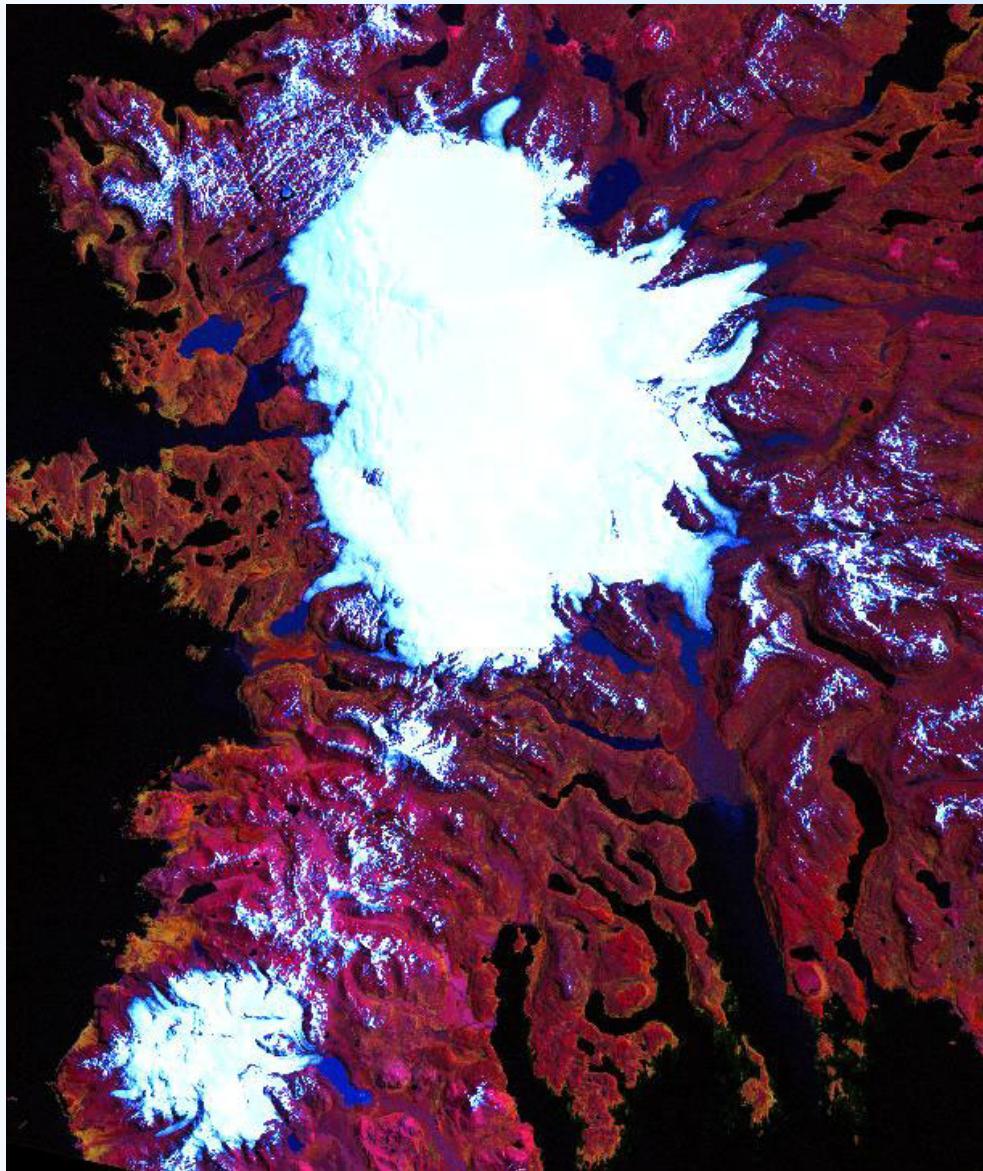
SRTM
Topography

Kerguelen Landsat-7 Context Image

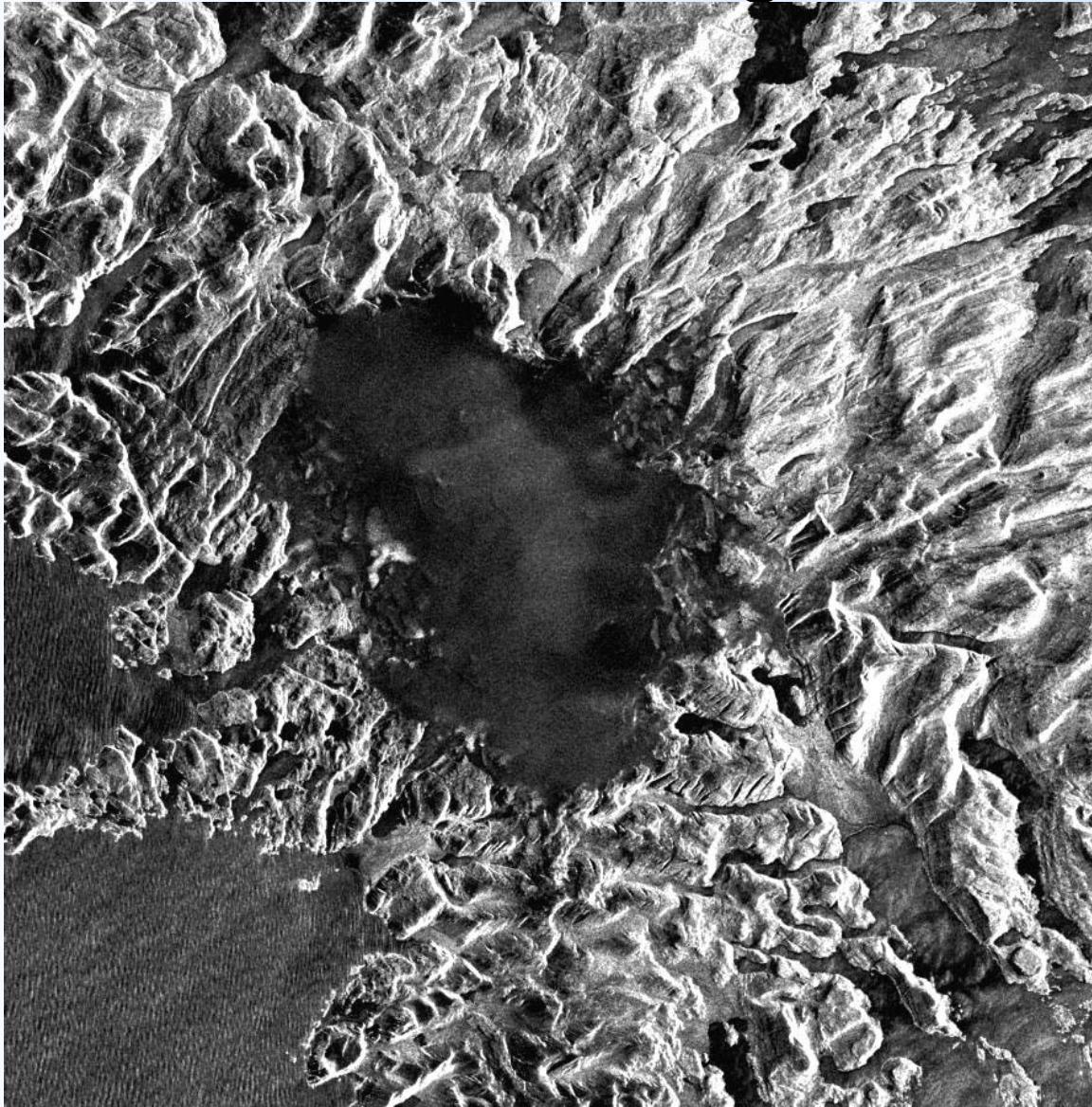


11/27/01

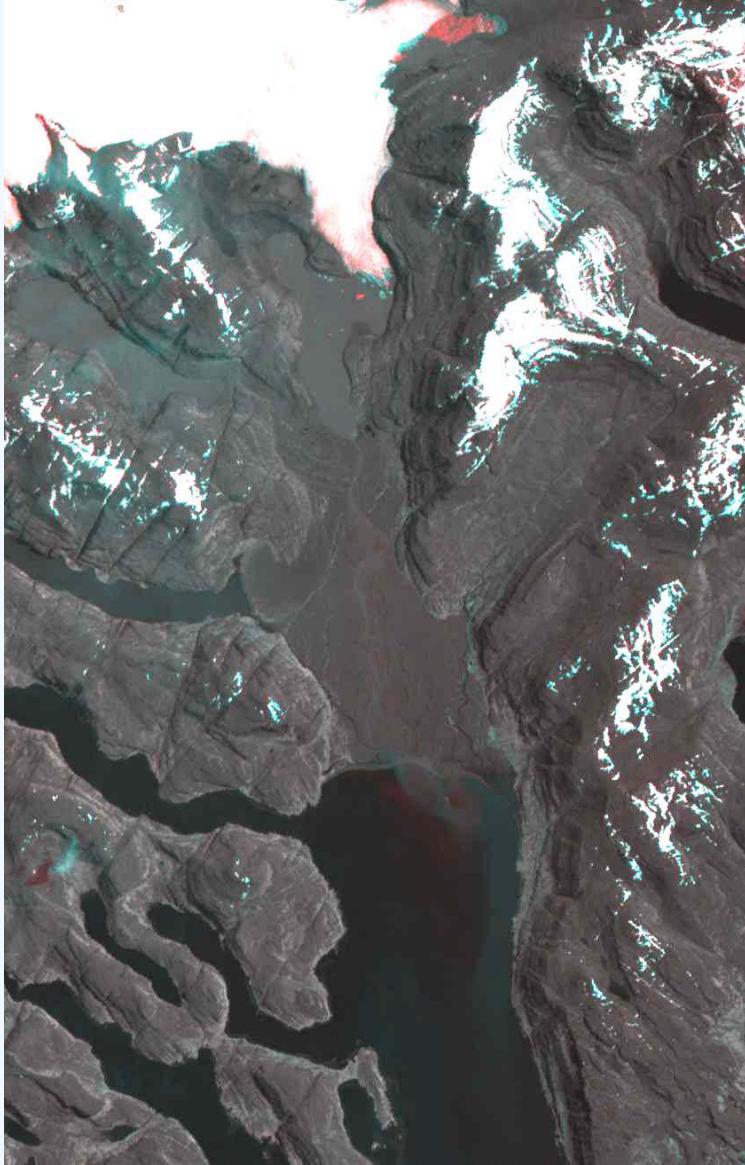
Kerguelen



Kerguelen RADARSAT Context Image

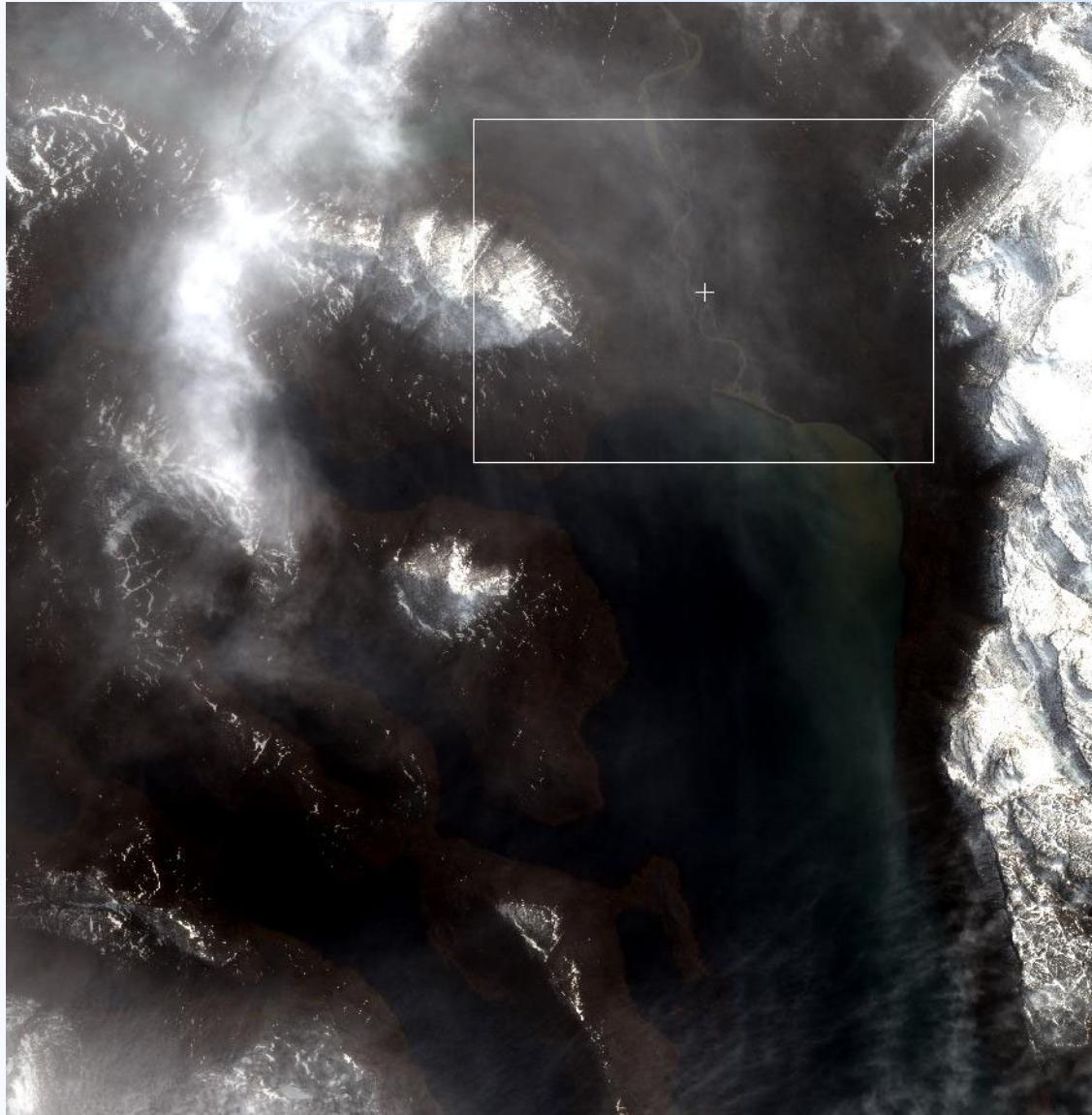


Kerguelen (Ampere Glacier, Sandur, Fjord..)

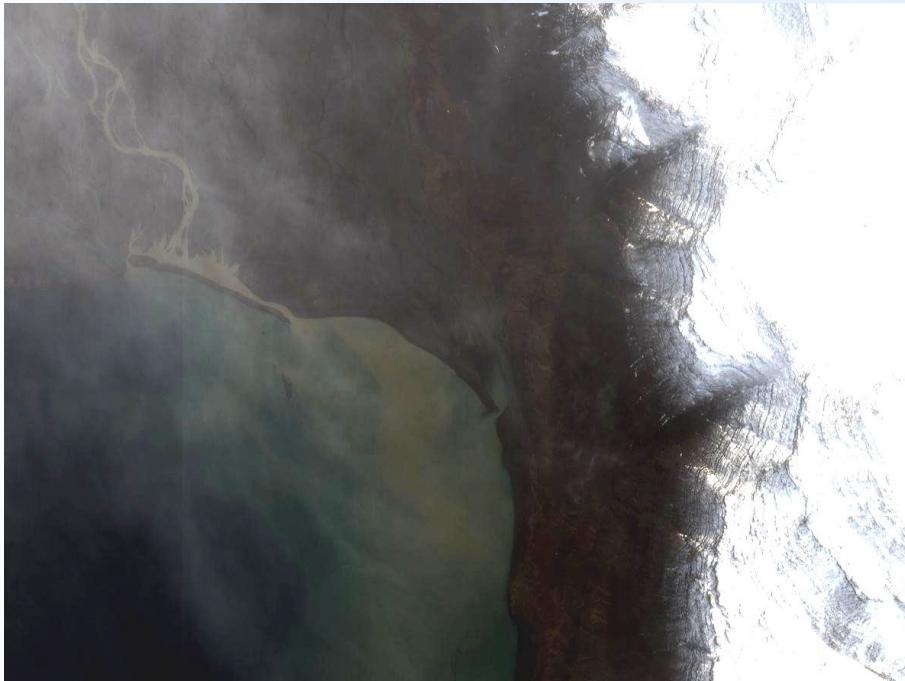


Landsat-7

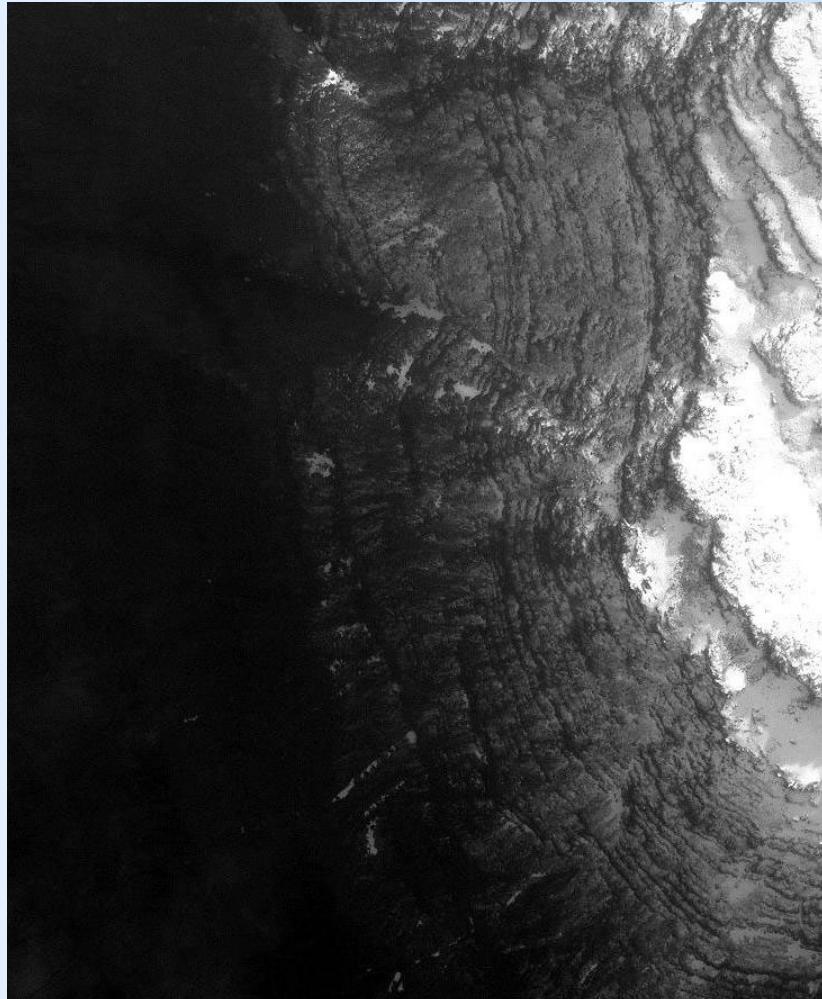
Kerguelen IKONOS Context Image



Kerguelen: Coast of Sandur

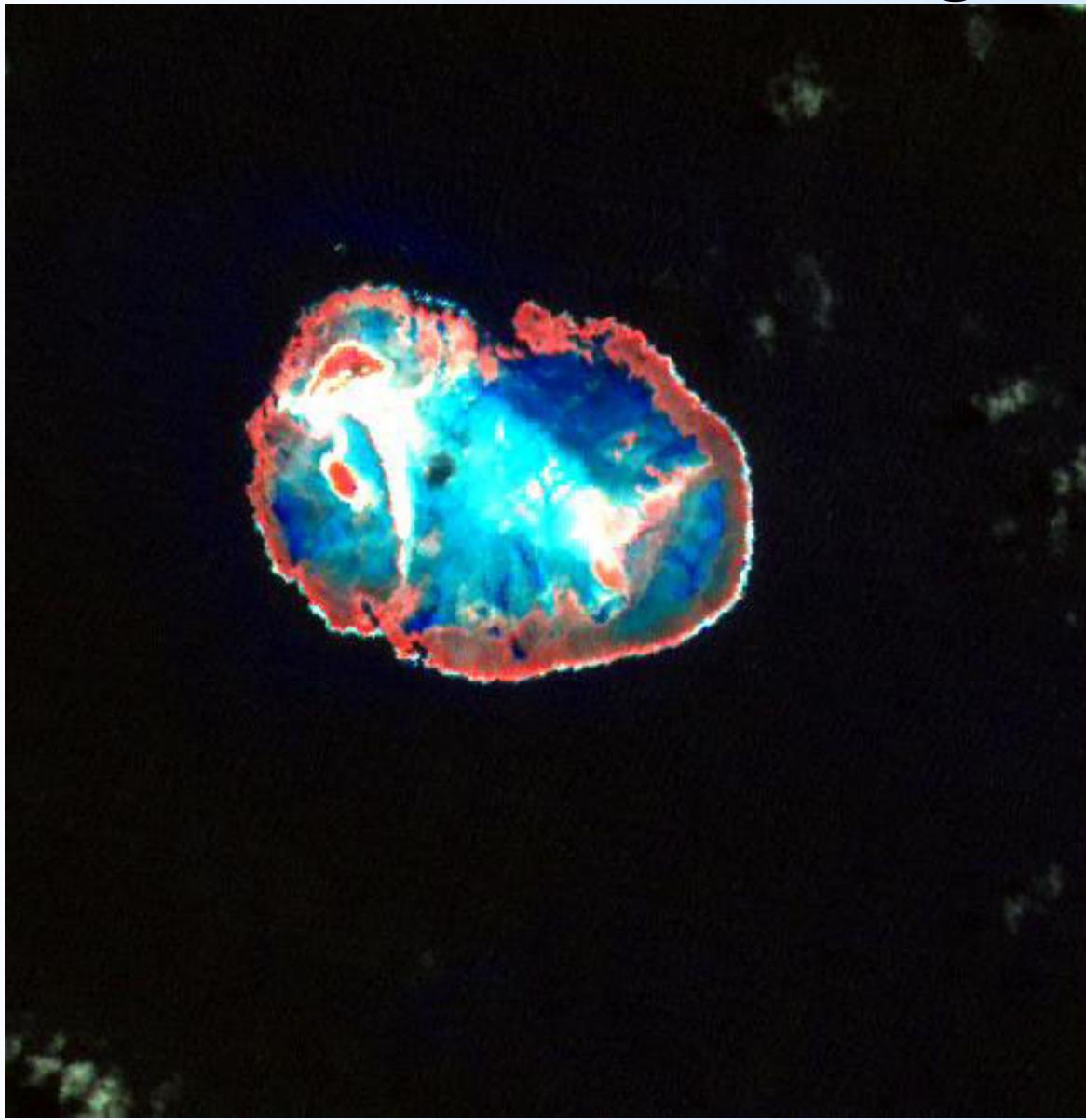


Coast of Sandur

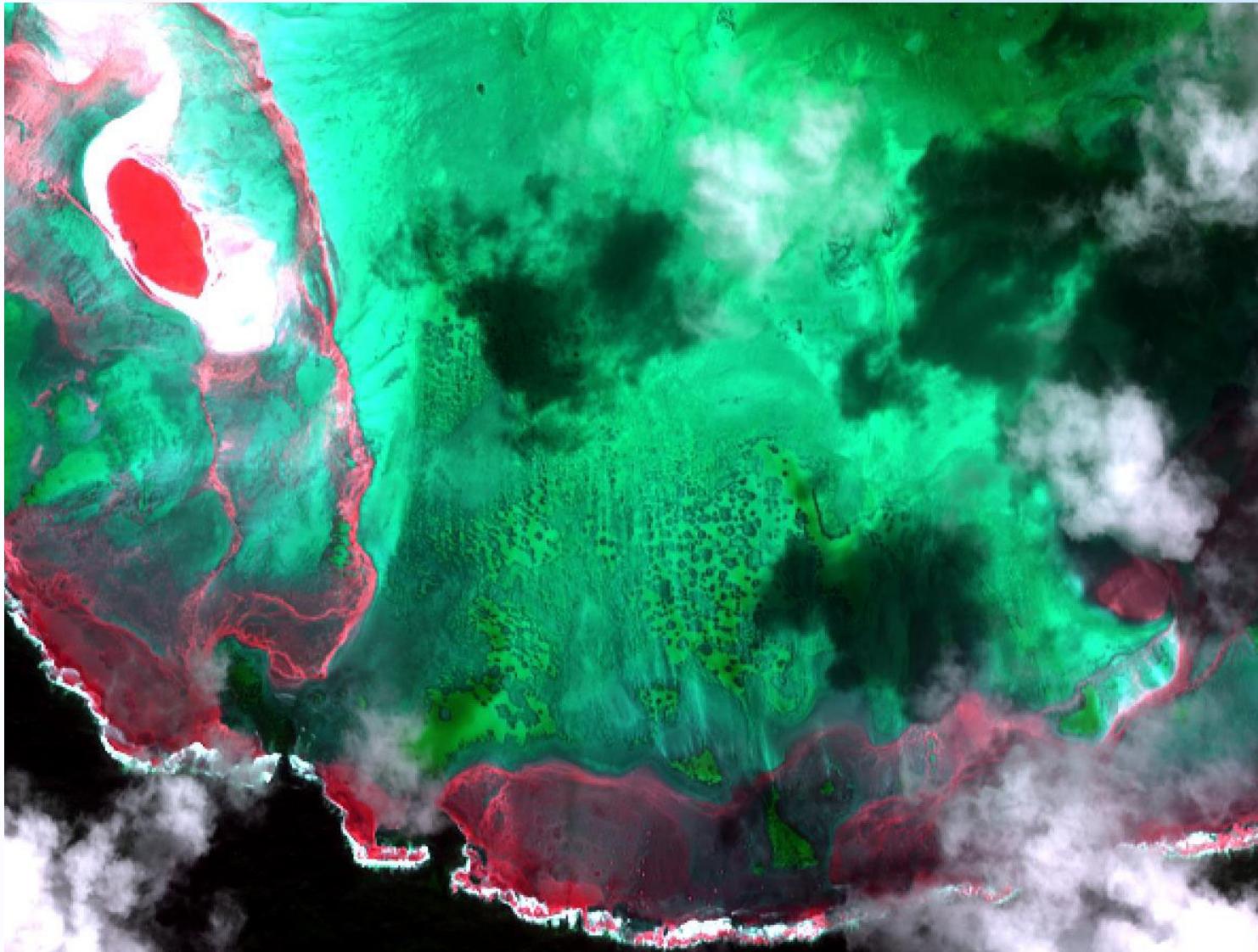


Cliffside Phonolites

Rocas Atoll Island Landsat-7 Context Image



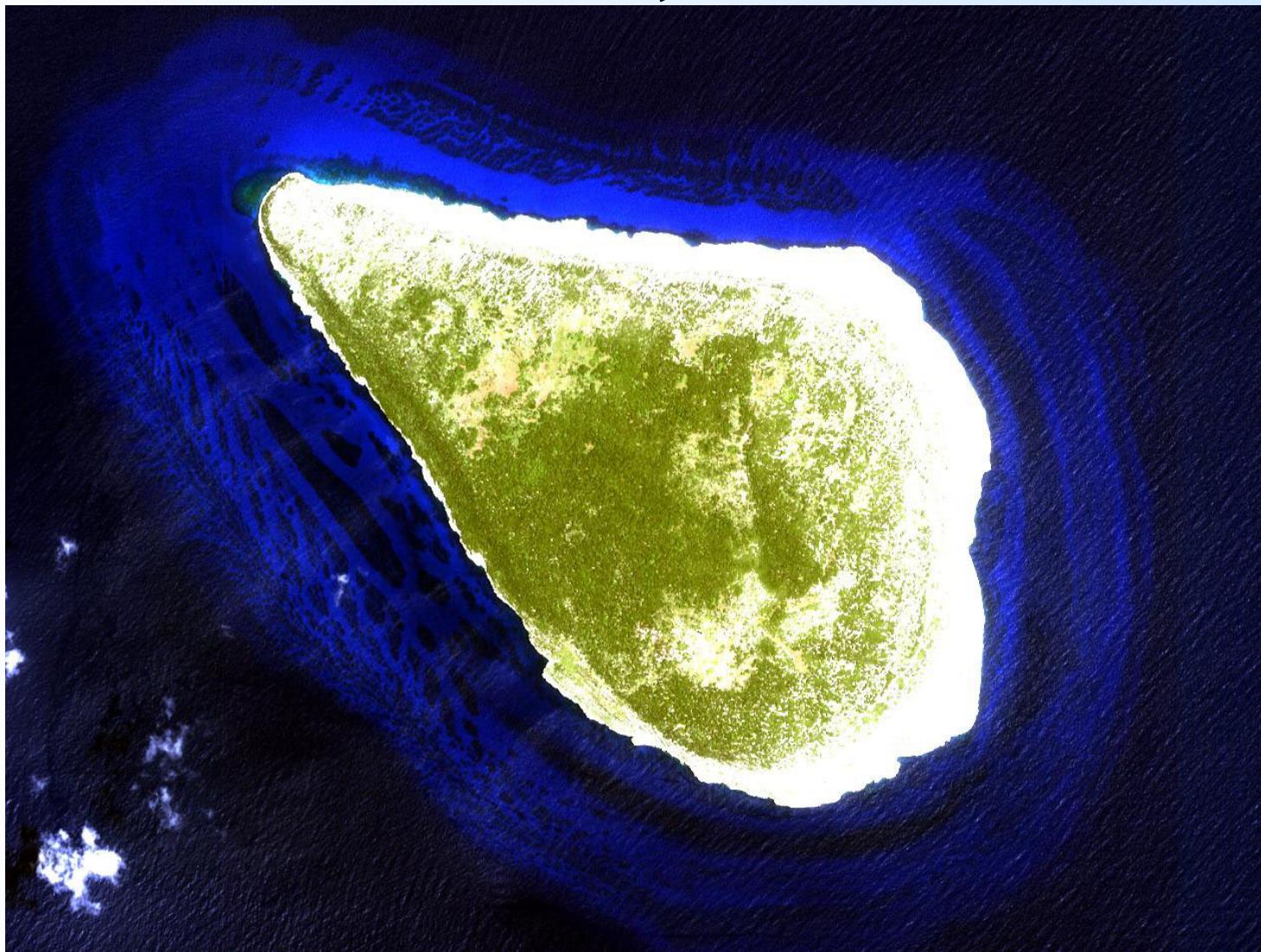
Roches Champignons from Space



Roches Champignons in PAN

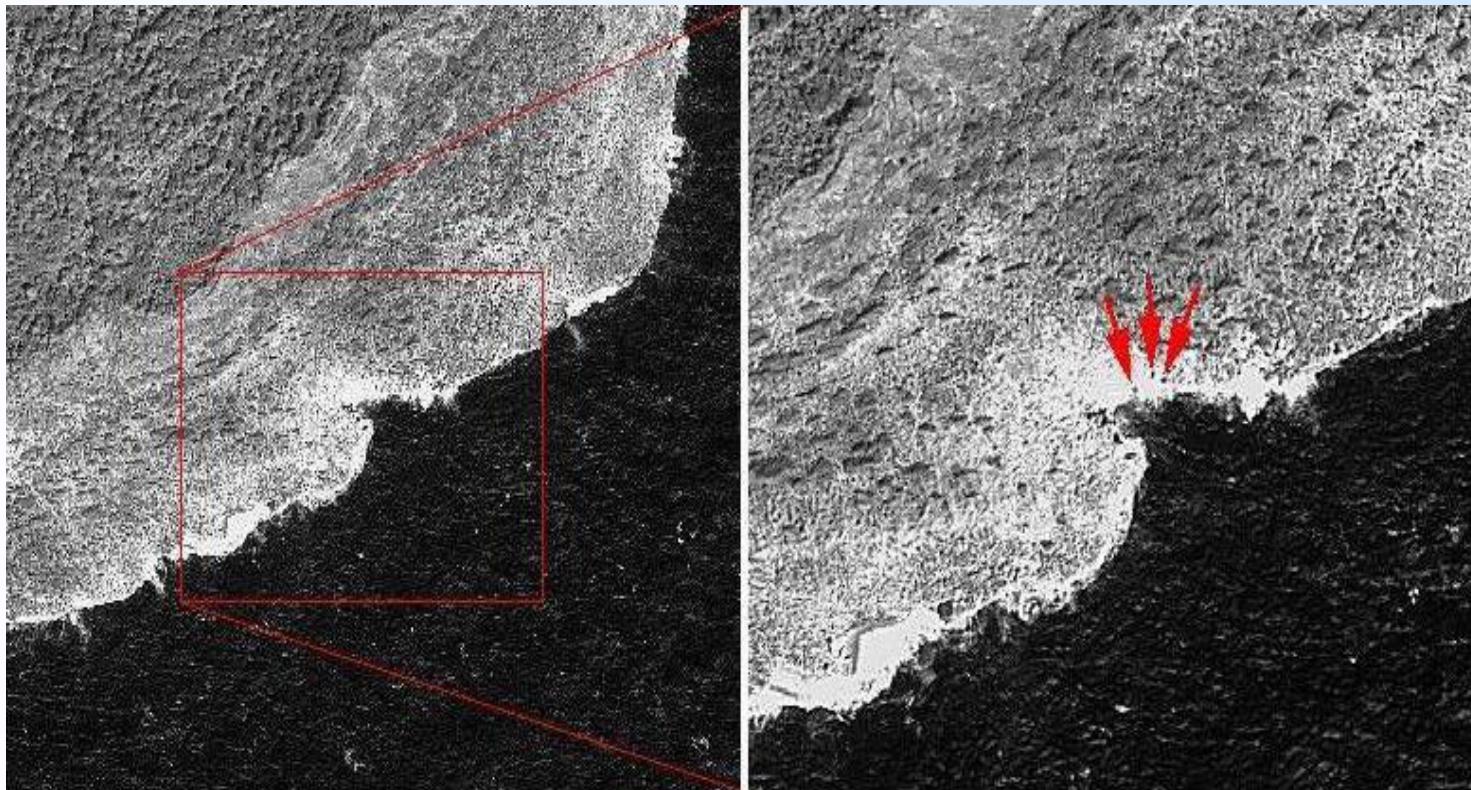
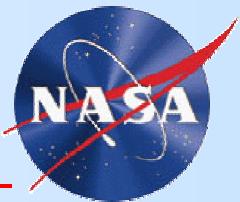


Navassa Island, West Indies



IKONOS: 9/9/00

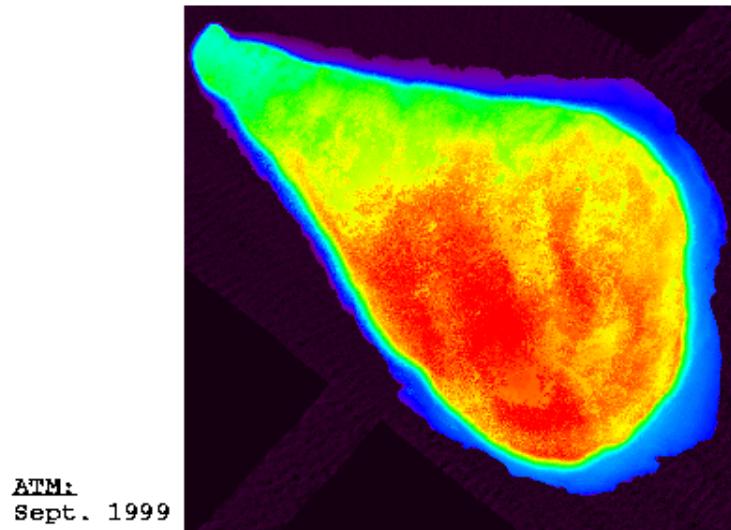
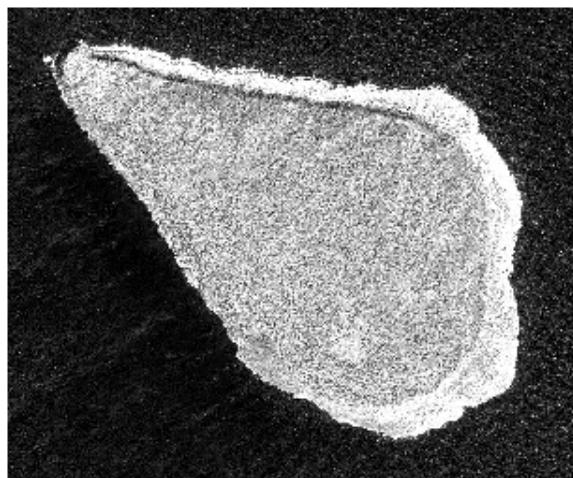
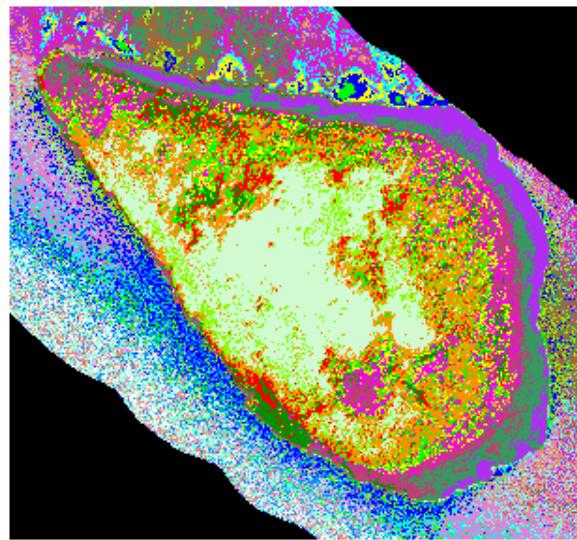
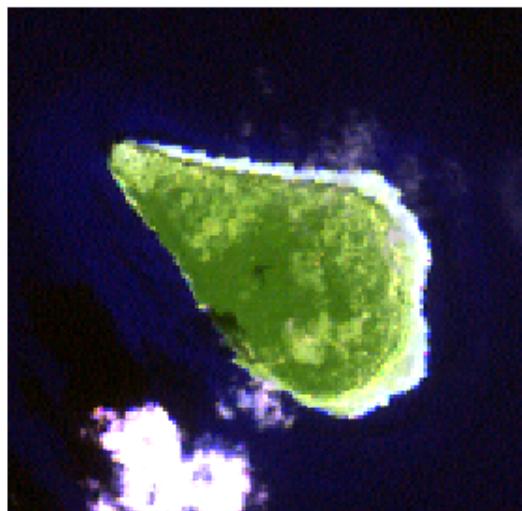
Navassa Island - IKONOS Pan



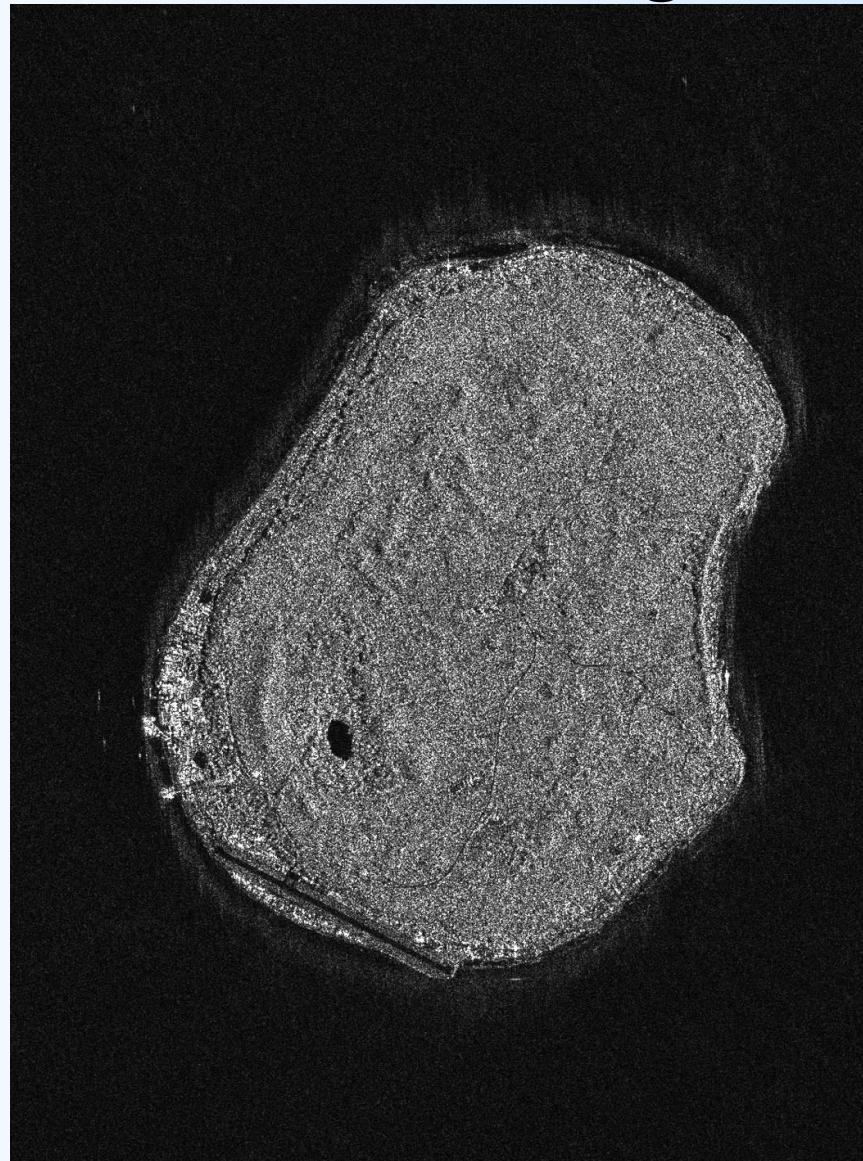
Tsunami displaced boulders

SW Terrace

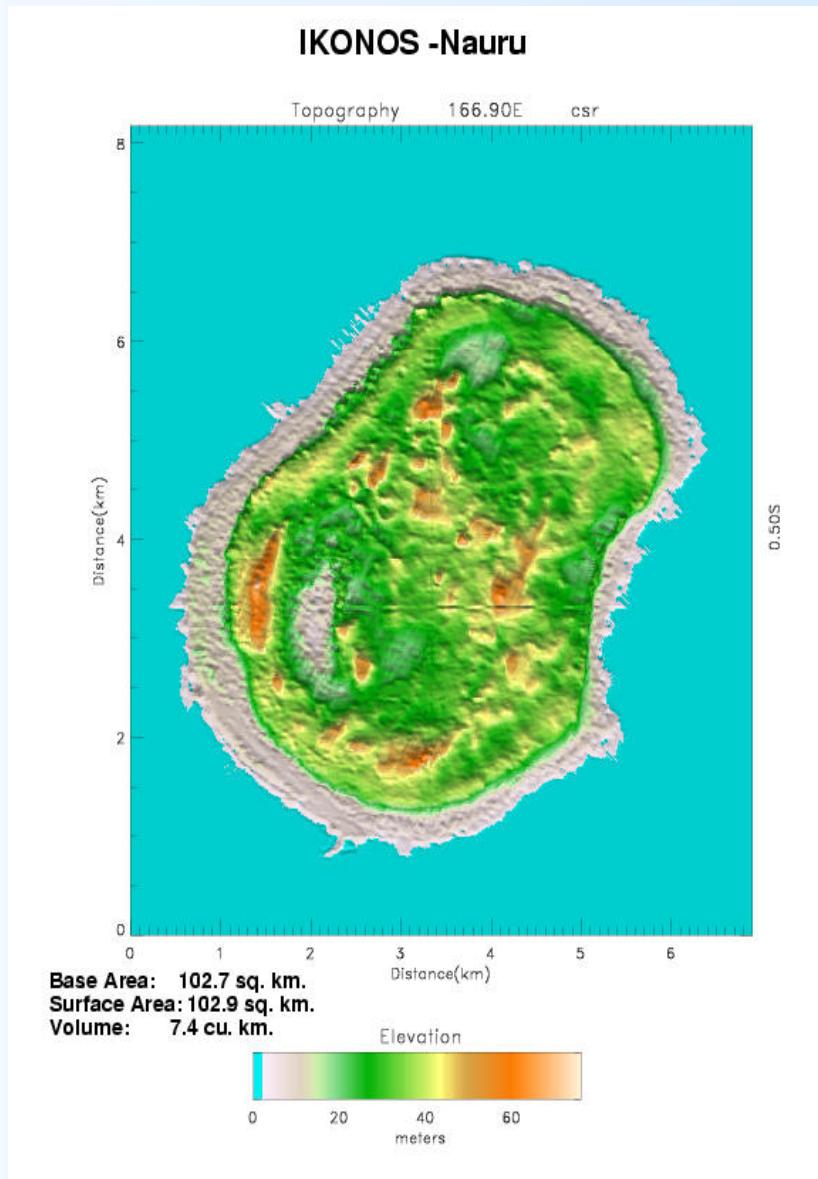
Navassa Island



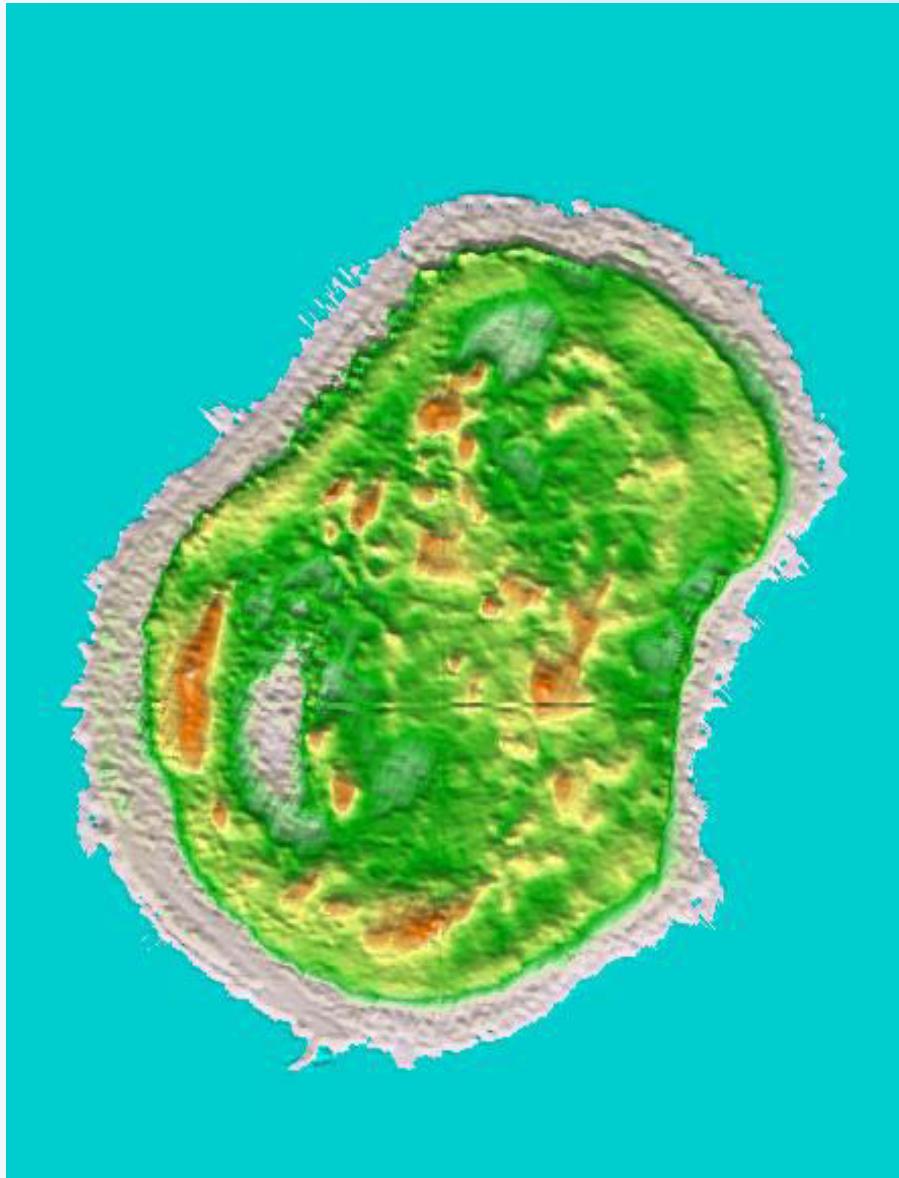
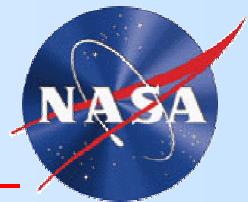
Nauru Island RADARSAT Context Image



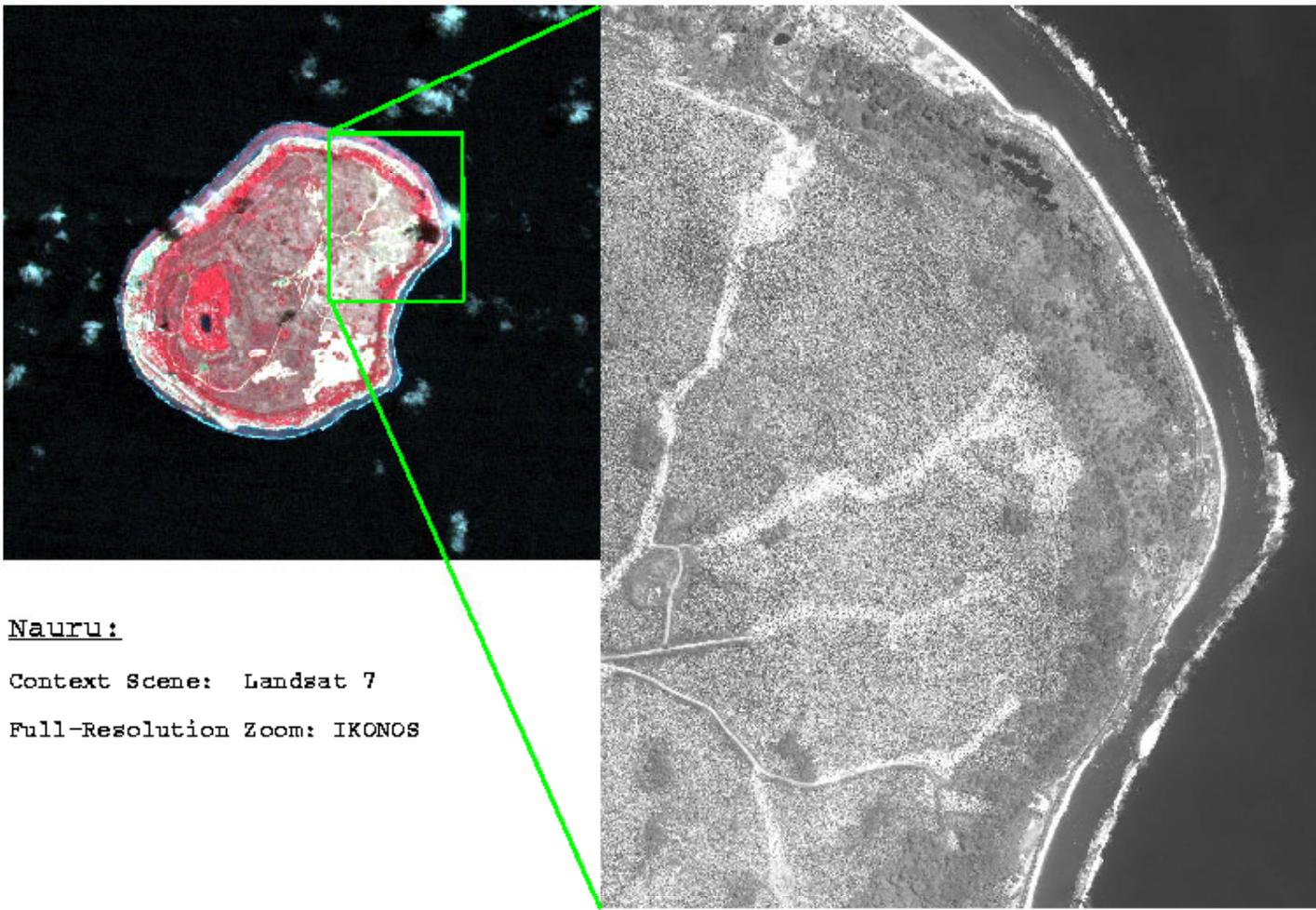
IKONOS DEM of Nauru Island



IKONOS DEM of Nauru Island



Nauru Island

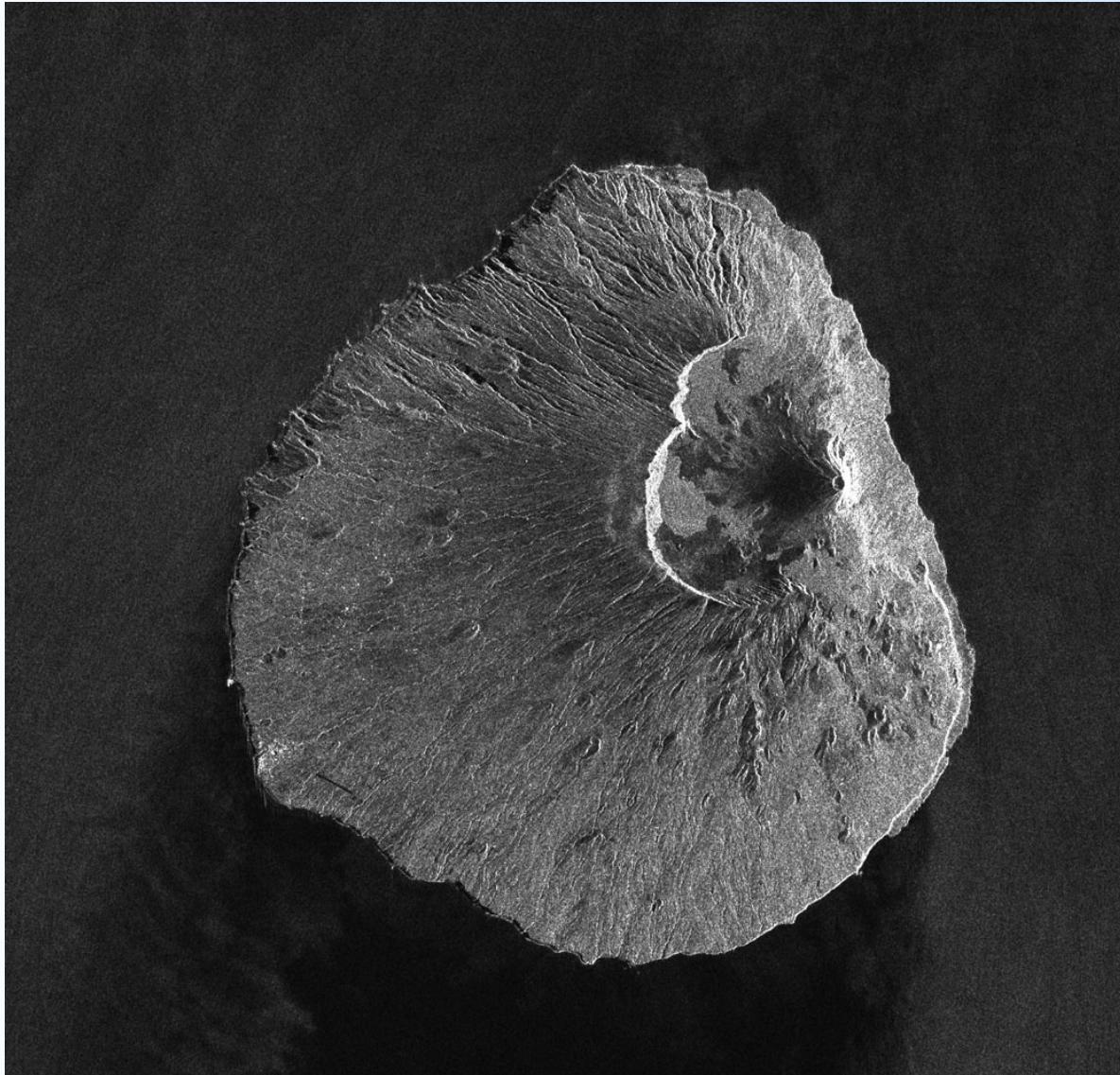


[Nauru:](#)

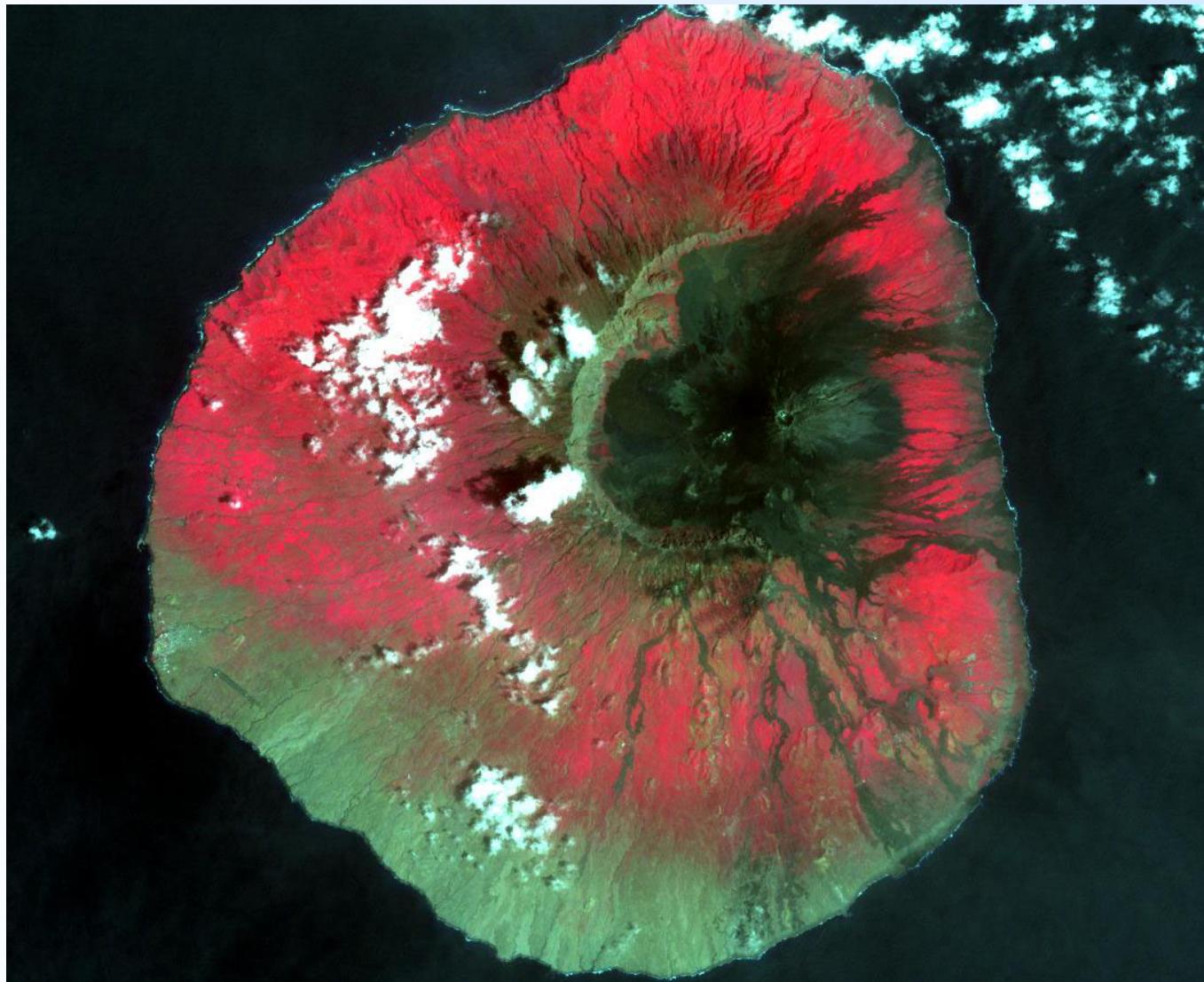
Context Scene: Landsat 7

Full-Resolution Zoom: IKONOS

Fogo Island RADARSAT Context Image



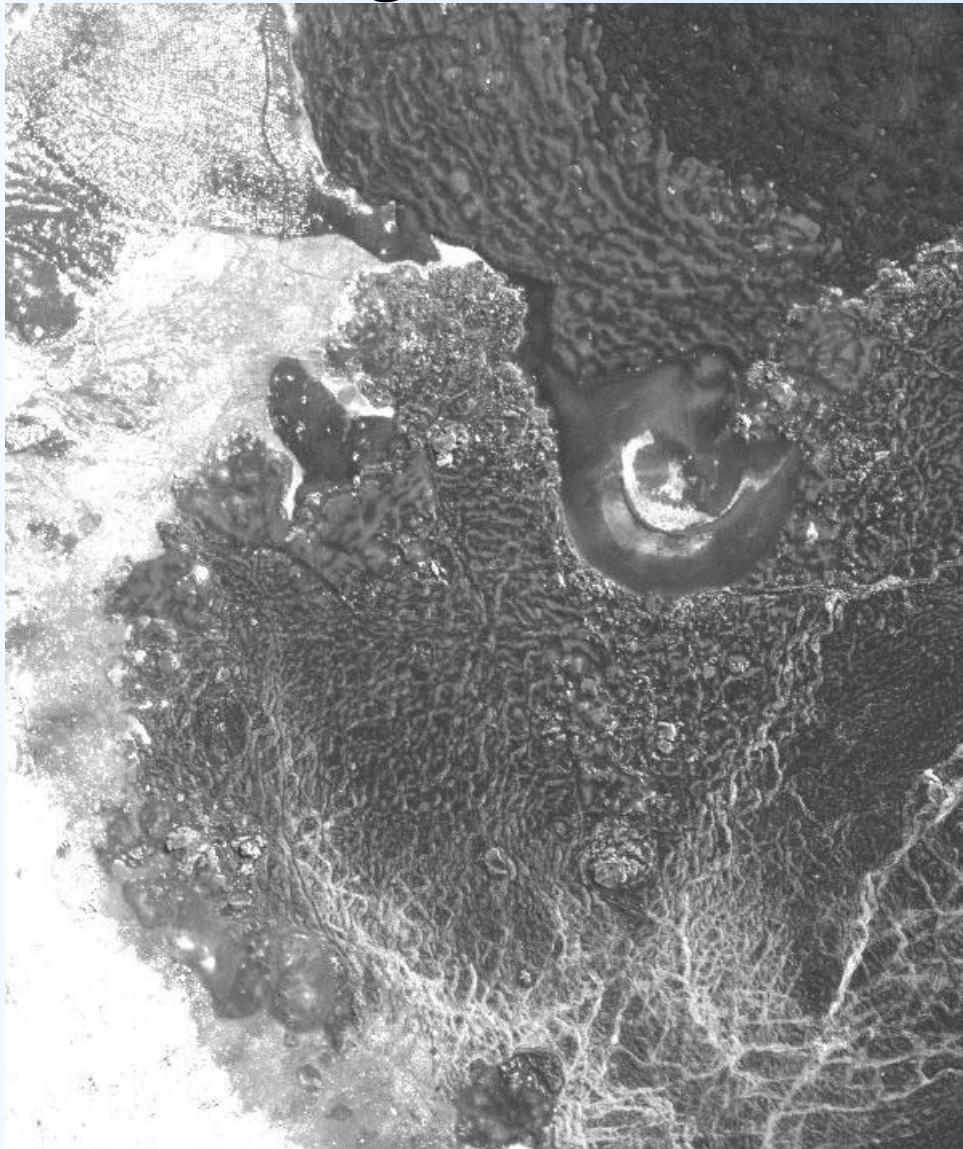
Fogo Island



Landsat-7: 543

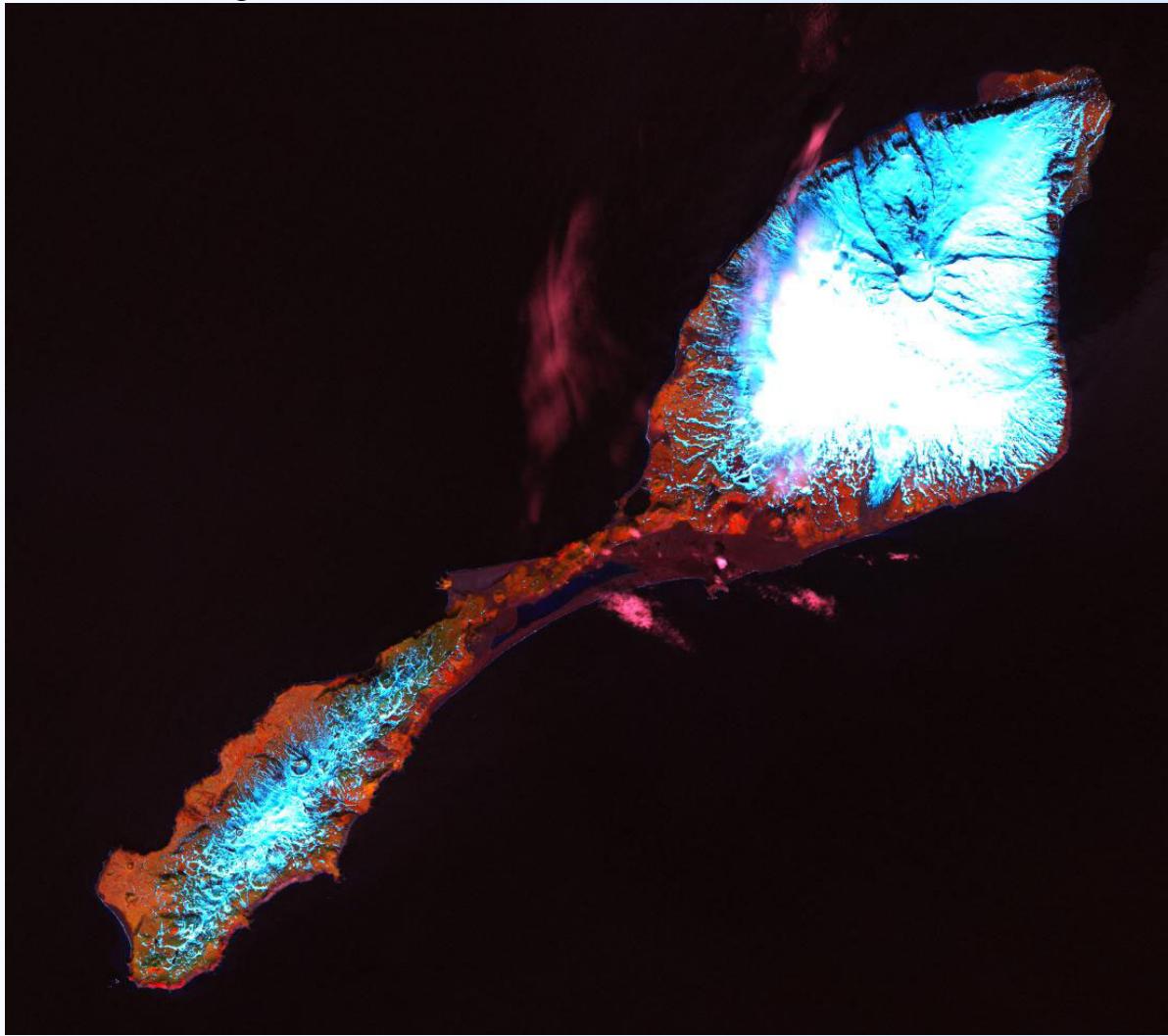
9/20/99

Fogo Island



1995 Eruptive Vent within Fogo Caldera

Jan Mayen Island, North Atlantic

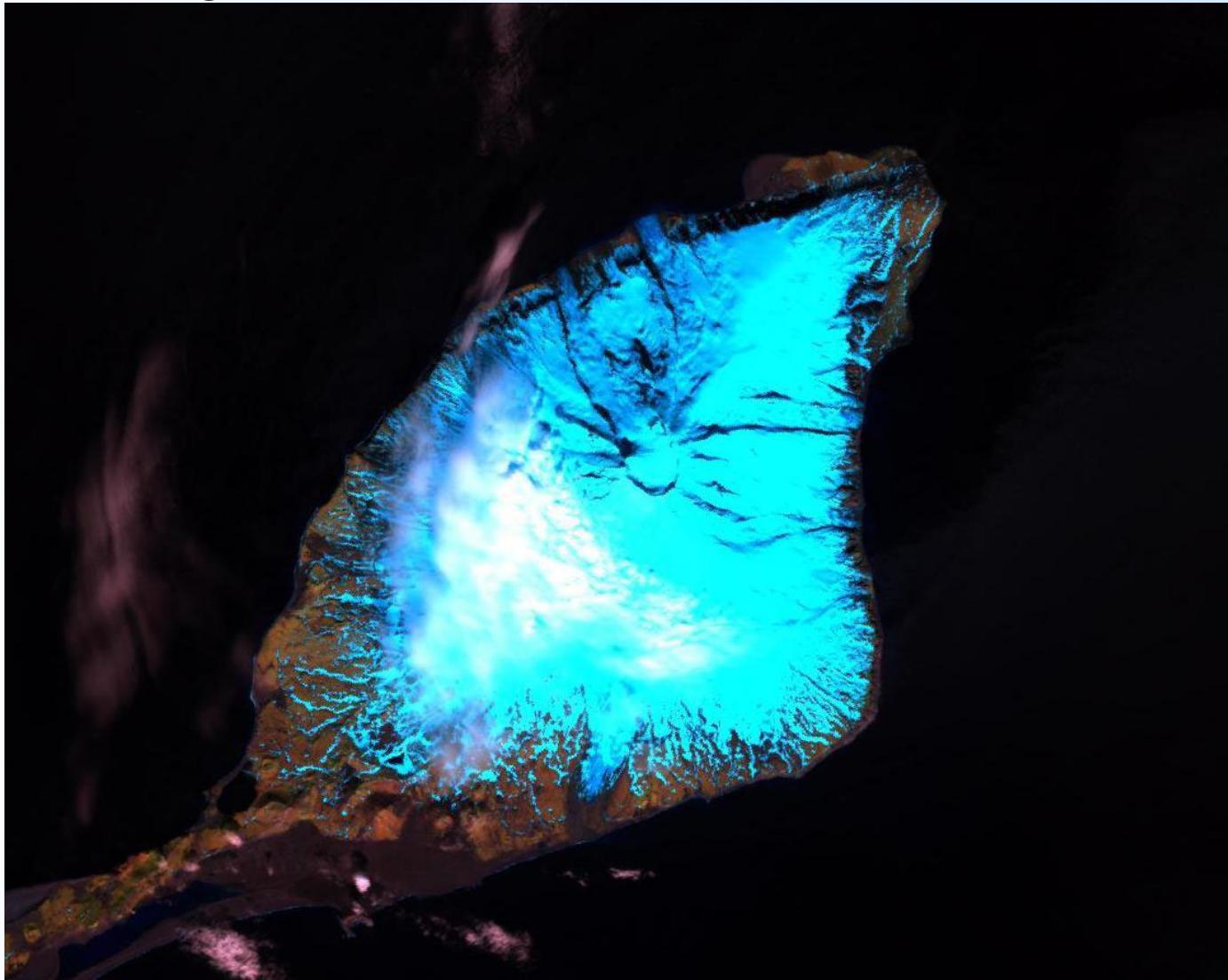


IKONOS (Approved for Summer '02)

Jan Mayen Island



- Beerenberg Volcano



What's Next ?



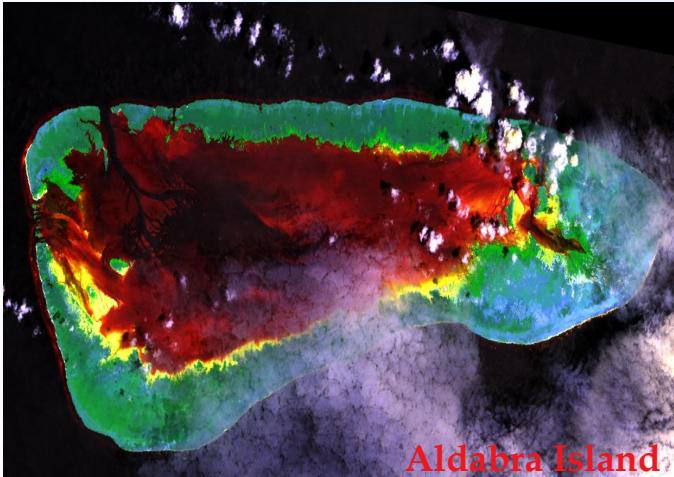
- **Bouvet Island (S. Atlantic):** IKONOS data coming soon.
- **Jan Mayen Island (N. Atlantic):** Approved in 2001, awaiting illumination
 - Expect IKONOS to resume attempts May 2002
- **New Island Imaging Requests to SDP for 2nd time steps for Key Islands [Rocas Atoll, Tristan da Cunha, Surtsey, Trindade, Kerguelen, etc.]**
- **Additional “Benchmark” Islands Recommended:**
 - Kerguelen (Ampere glacier terminus)
 - Rocas
 - Corvo (Azores)
 - Selvagens
 - Gough
 - Niuafou’ou (Tonga)
 - Jarvis
 - St. Paul’s Rocks
 - Aldabra

Summary



- Established 1st Sub-meter Imaging Time Steps (t_o) for 12 Oceanic Islands
 - Identified Targets on Basis of Ongoing RADARSAT SAR Monitoring Program
- Demonstrated Detection of Key indicators in IKONOS Images:
 - Roches Champignons
 - Drowned Coastlines
 - Truncated Gullies
 - Receding Ice Cover
- Discovered evidence of former Ice Cover on Tristan da Cunha Island
- Identified Tsunami-emplaced Mega-blocks on Navassa Island
- Measured AREAL changes at Surtsey Island(interannual)
- Observed Ice-Cover Retreat at Deception Island
- IKONOS DEM's Potentially Valuable for Volumetric Erosional Studies
- Value of RADARSAT SAR time series to Direct IKONOS sub-meter Imaging Demonstrated
- Need to acquire 2nd time steps for Most Dynamic Islands

Future IKONOS Island Monitoring Sites?



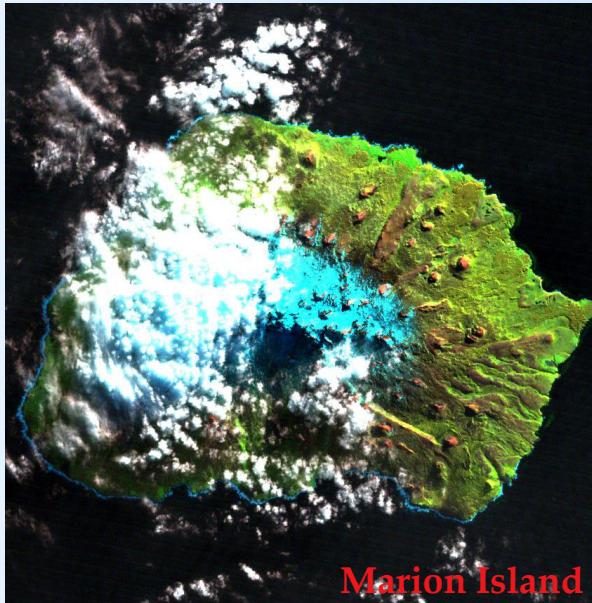
Aldabra Island



Niuafou Island

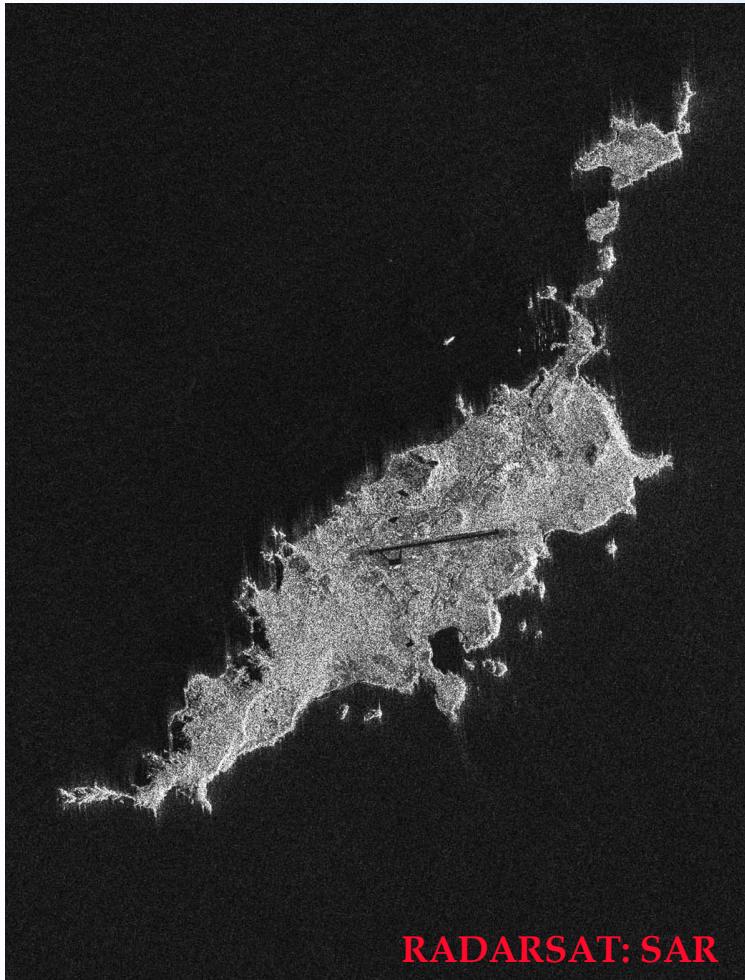


Gough Island

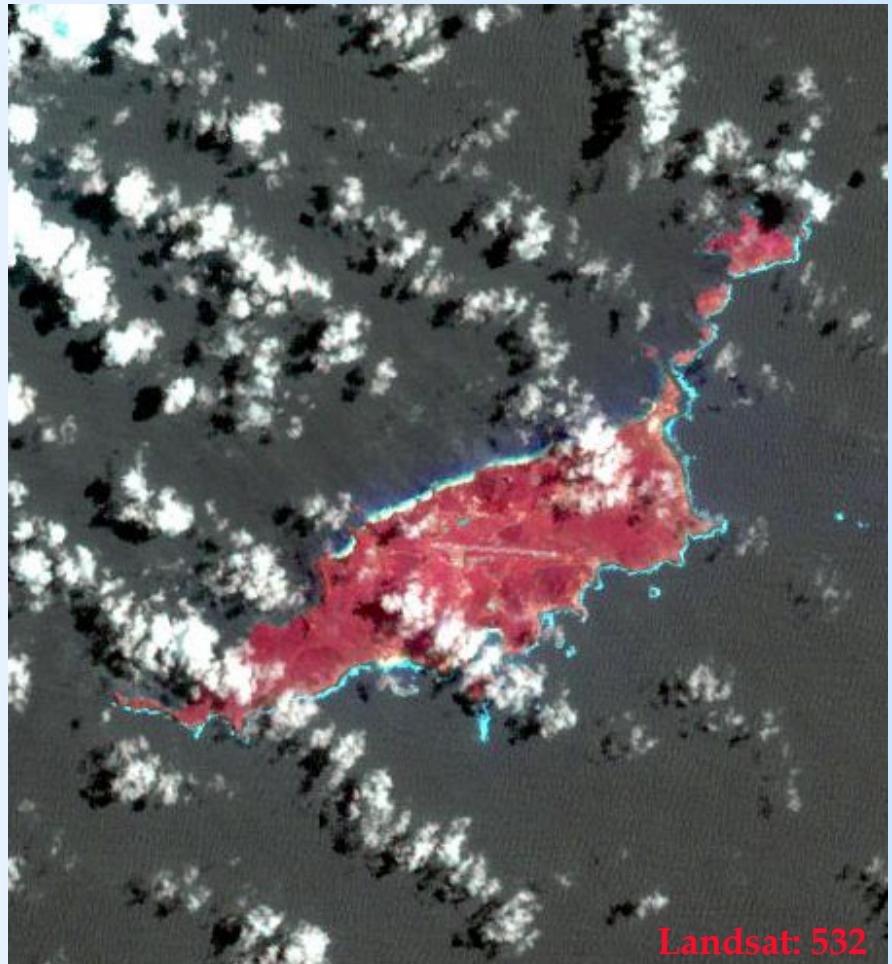


Marion Island

Future IKONOS Island Monitoring: Fernando de Norohna



RADARSAT: SAR



Landsat: 532

Value of Sub-meter Imaging in Terrestrial Analogue Studies



Mars (gullies)

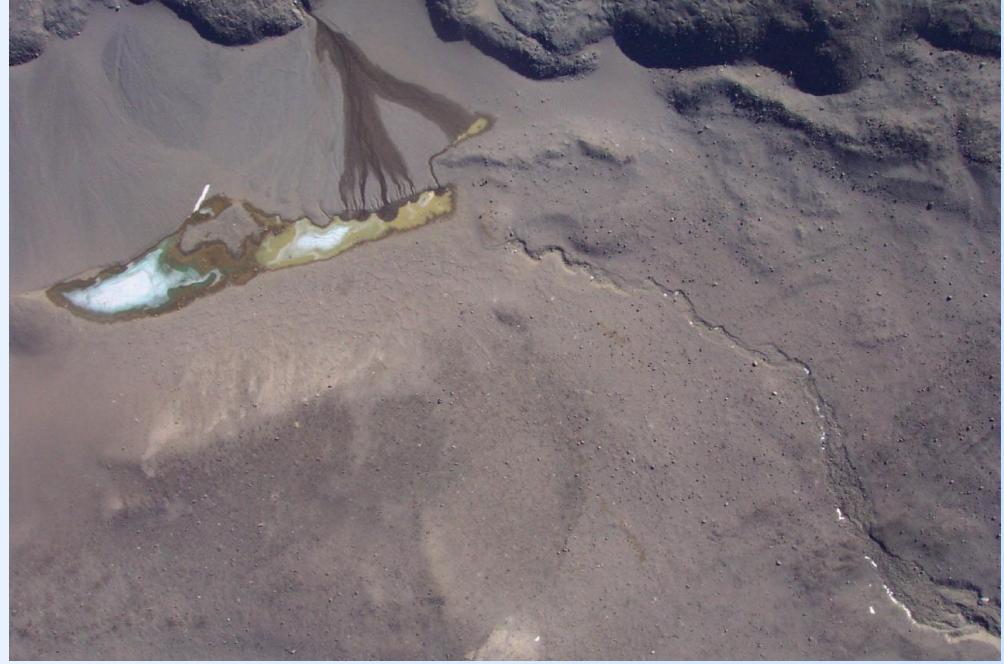


Nirgal Valleys

1.5 m/pixel MOC (MGS)

(Courtesy of NASA, JPL, & MGS)

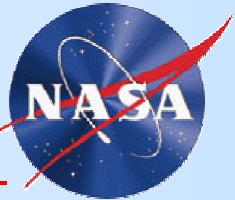
Taylor Dry Valleys, Antarctica



(Courtesy of NASA, NSF, & USGS)

< 50 cm/pixel airborne
NASA Image

Special Thanks to:



- **NASA Scientific Data Purchase (SDP) Program (Fritz Pollicelli, Troy Frisbie, Bruce Davis)**
- **Kathy Still (SSAI at NASA's GSFC)**
- **James Frawley (HBG at NASA's GSFC)**
- **Christine Giguere (CSA, Canada)**
- **Susan Sakimoto (UMBC at NASA's GSFC)**
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 - **SENH Program (c/o: Drs. E. Paylor, J. Labreque)**
 - **Dr. Ghassem Asrar (AA for NASA OES)**
- **Space Imaging: Andrew Mettee et. al.**
- **Darrel Williams (NASA GSFC, Landsat-7 Project Scientist)**
- **Bill Krabill and the ATM team (NASA's WFF)**
- **Canadian Space Agency: RADARSAT Background Mission**
- **NASA-GSFC's Directors Discretionary Fund (thanks to A. Diaz)**