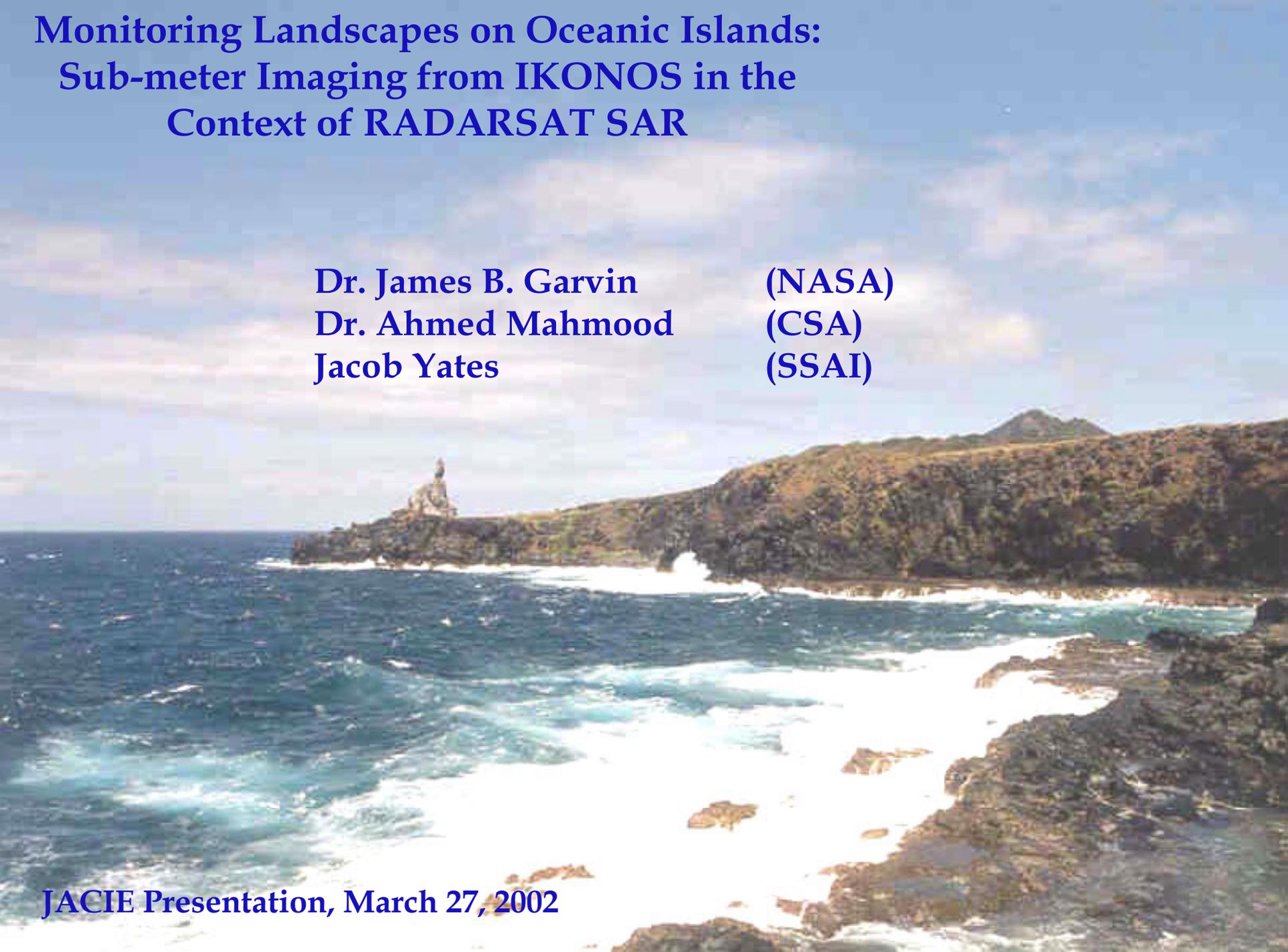


Monitoring Landscapes on Oceanic Islands: Sub-meter Imaging from IKONOS in the Context of RADARSAT SAR

Dr. James B. Garvin (NASA)
Dr. Ahmed Mahmood (CSA)
Jacob Yates (SSAI)

JACIE Presentation, March 27, 2002

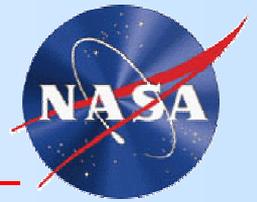




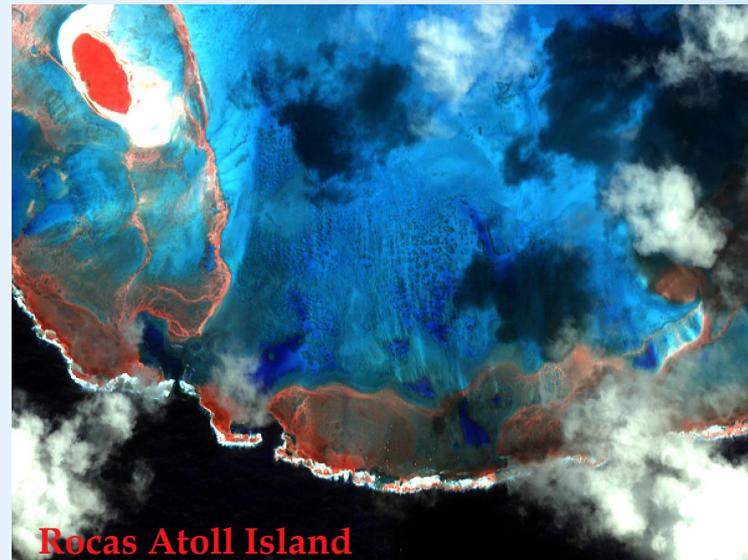
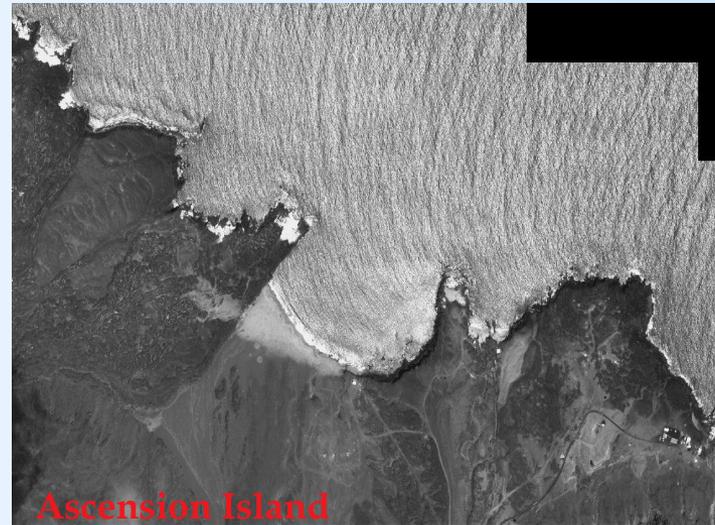
Outline

- **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**

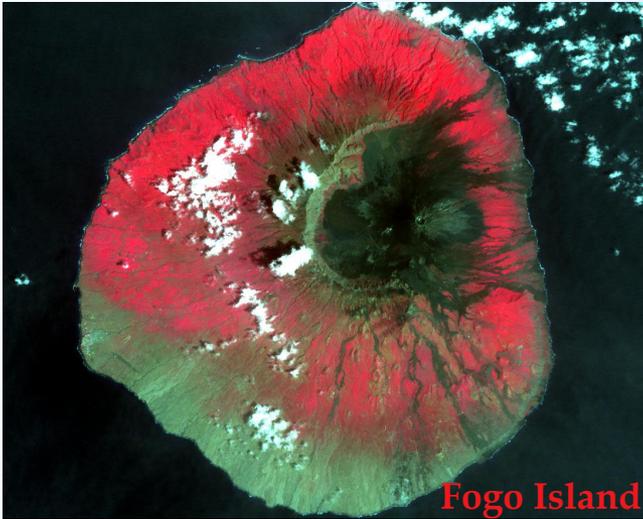
Examples of IKONOS Monitoring Sites



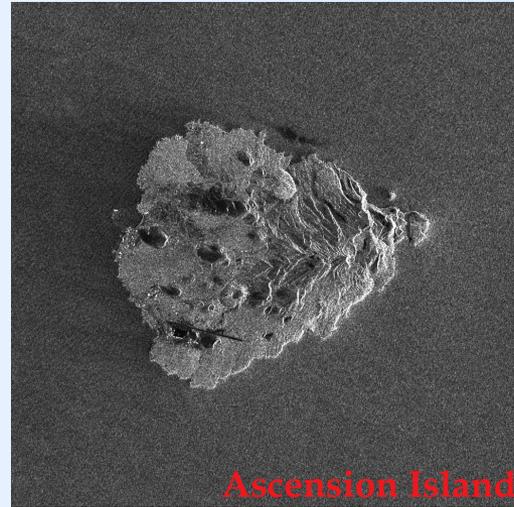
Ocean Island Monitoring



Examples of IKONOS Monitoring Sites



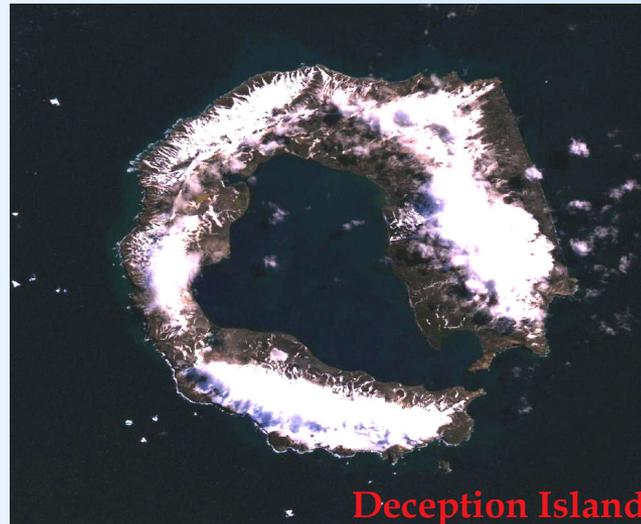
Fogo Island



Ascension Island



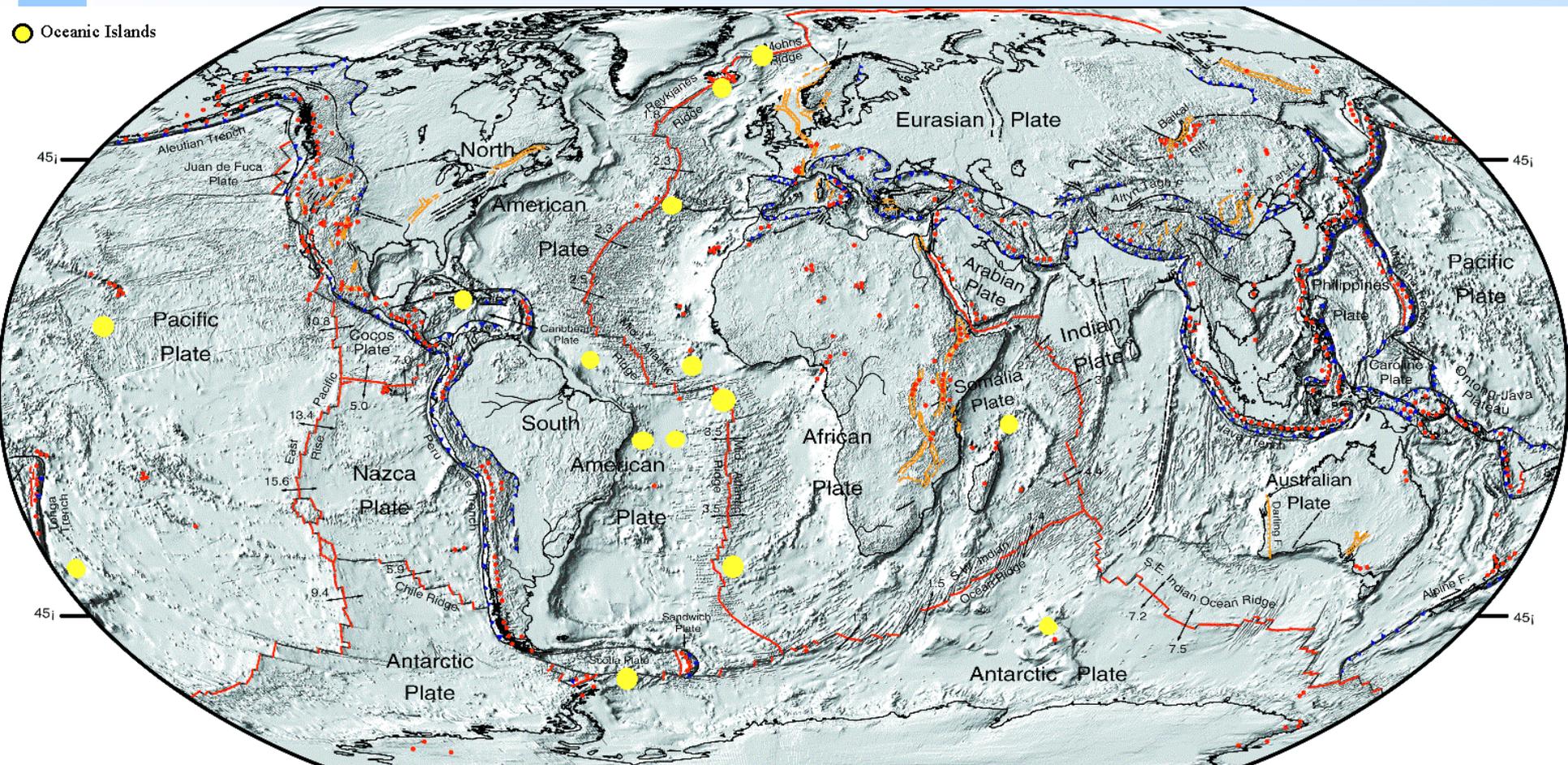
Tristan da Cunha



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

Ocean Island Monitoring



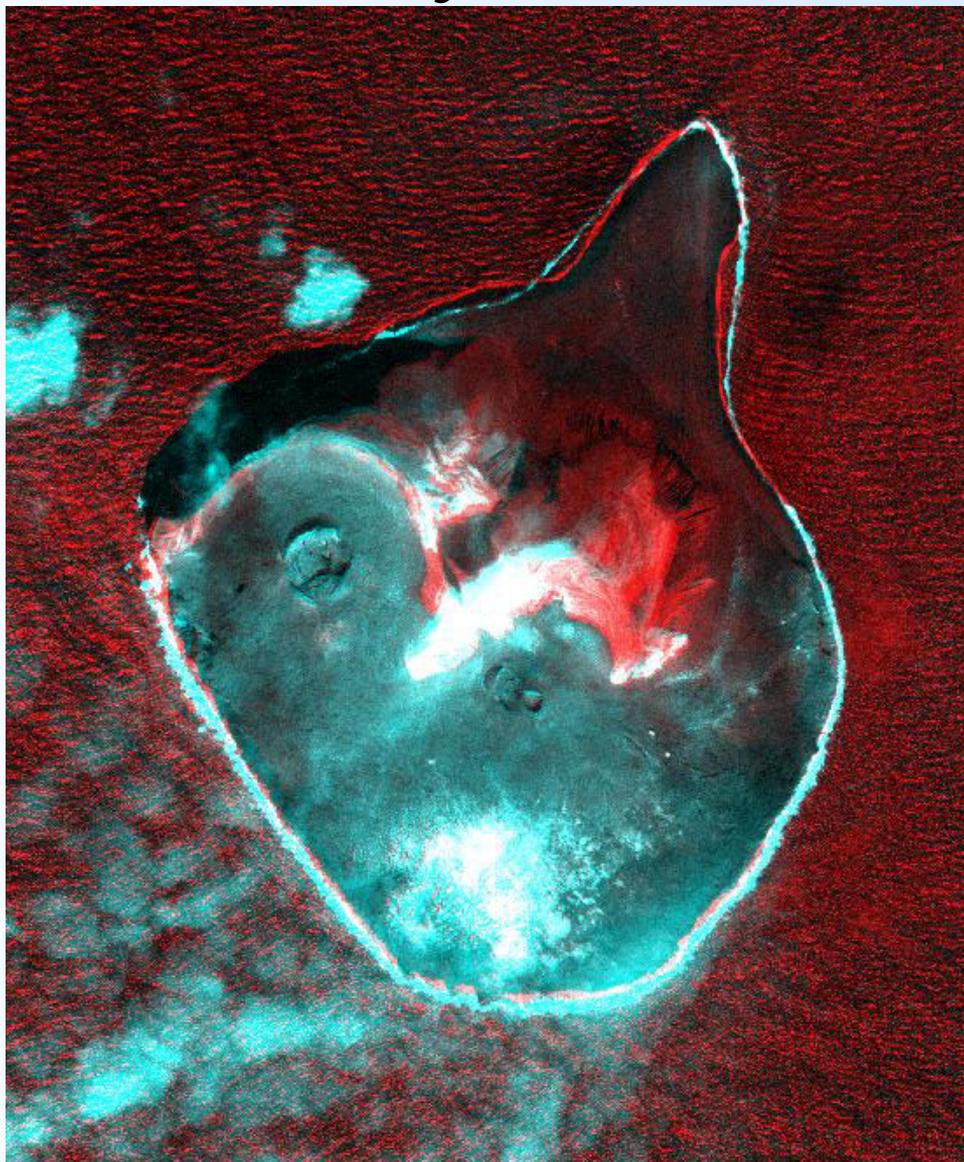
8/14/00



6/12/01



Surtsey, Iceland



**Time-Series
Analysis**

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

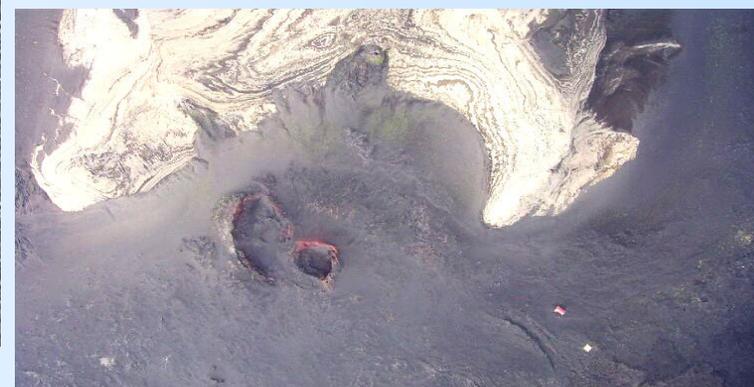


Surtsey, Iceland

Ocean Island Monitoring



**NASA
Aerial Photos
(May 2001)**



Surtur I

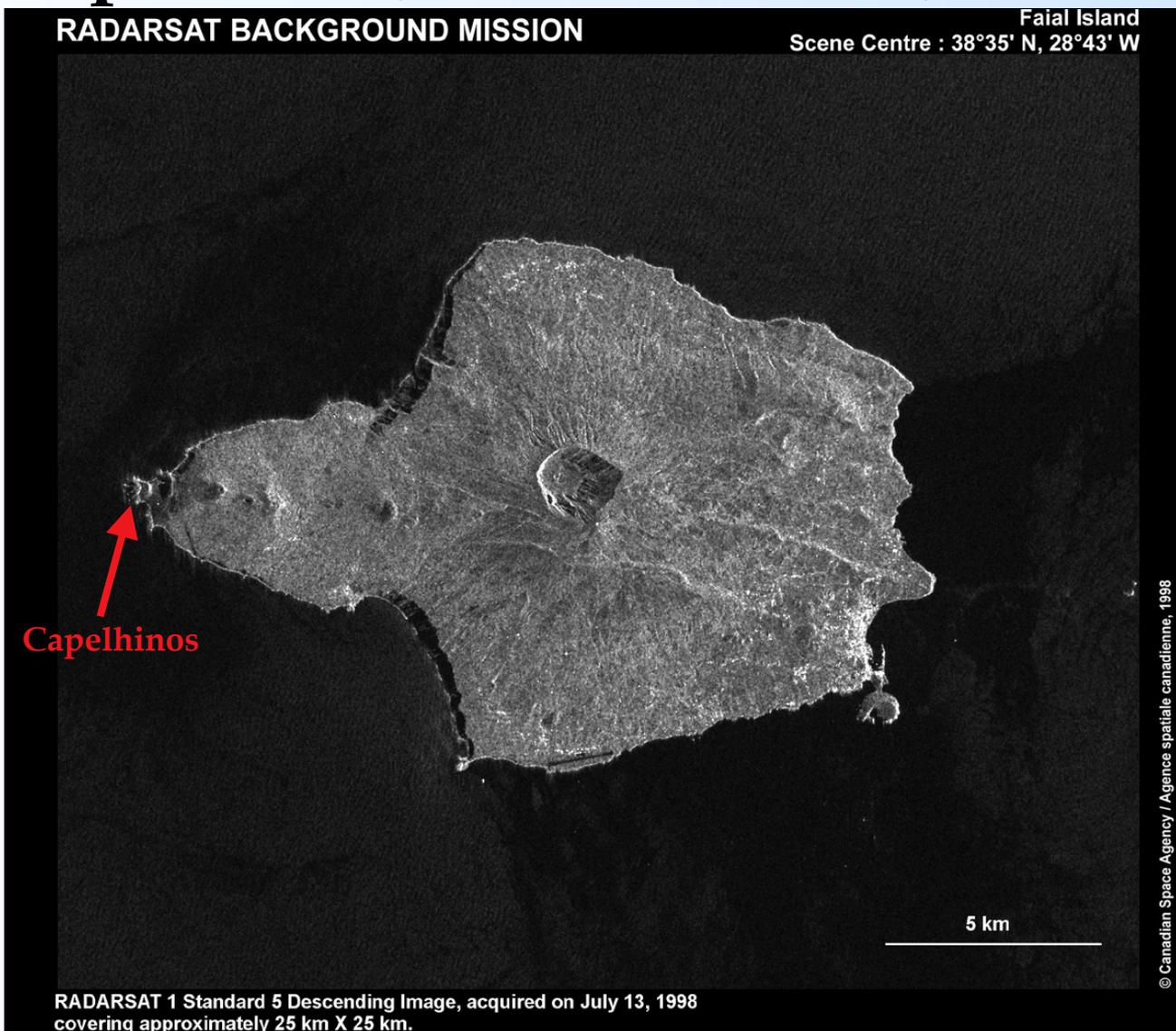
6/12/2001 (IKONOS)



Capelinhos, Western Faial, Azores

RADARSAT BACKGROUND MISSION

Faial Island
Scene Centre : 38°35' N, 28°43' W



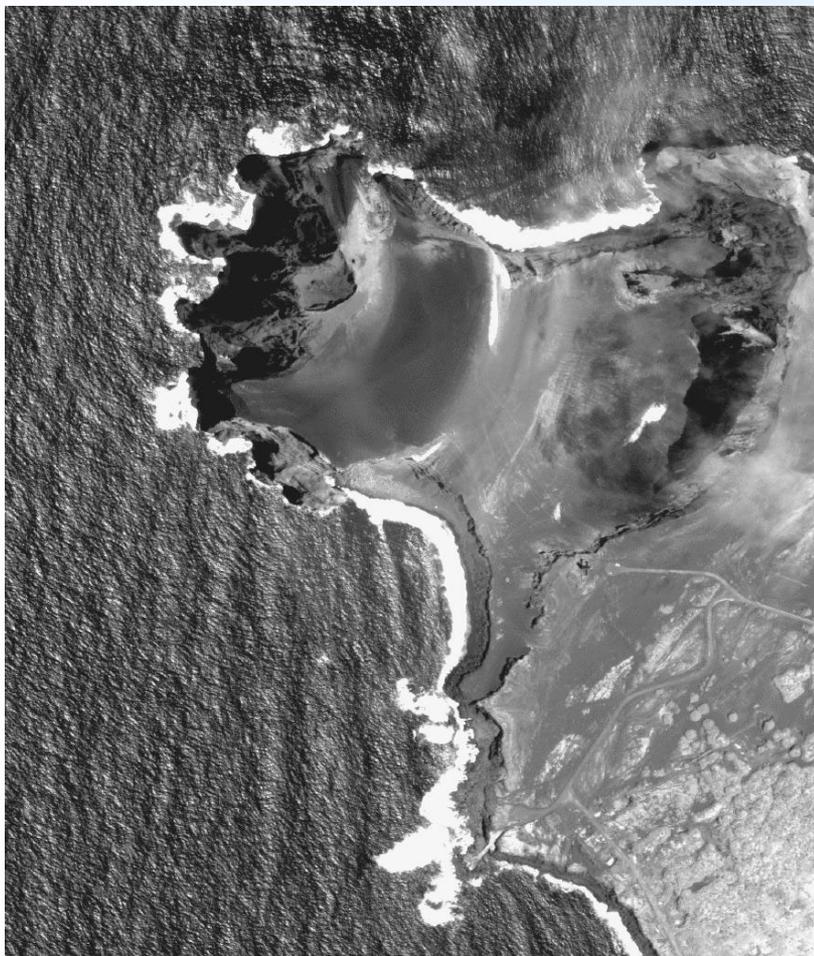
RADARSAT 1 Standard 5 Descending Image, acquired on July 13, 1998
covering approximately 25 km X 25 km.

© Canadian Space Agency / Agence spatiale canadienne, 1998

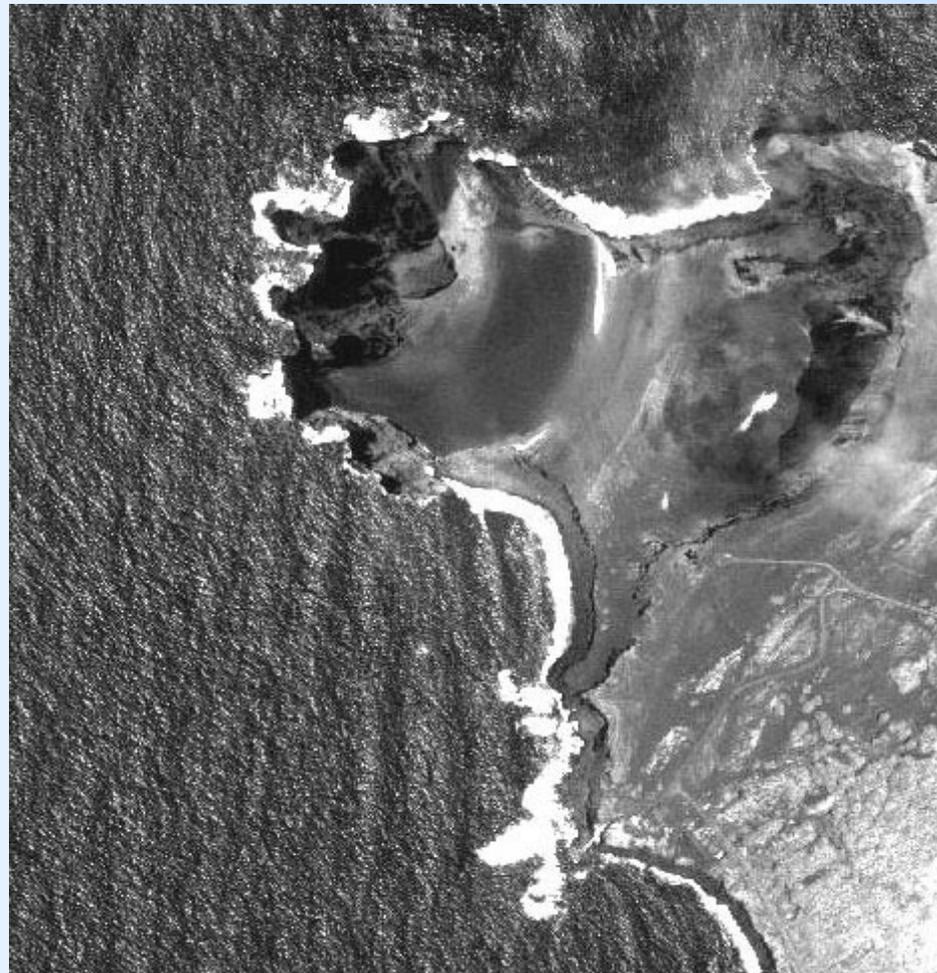


Capelinhos, Western Faial, Azores

Ocean Island Monitoring



May 2000



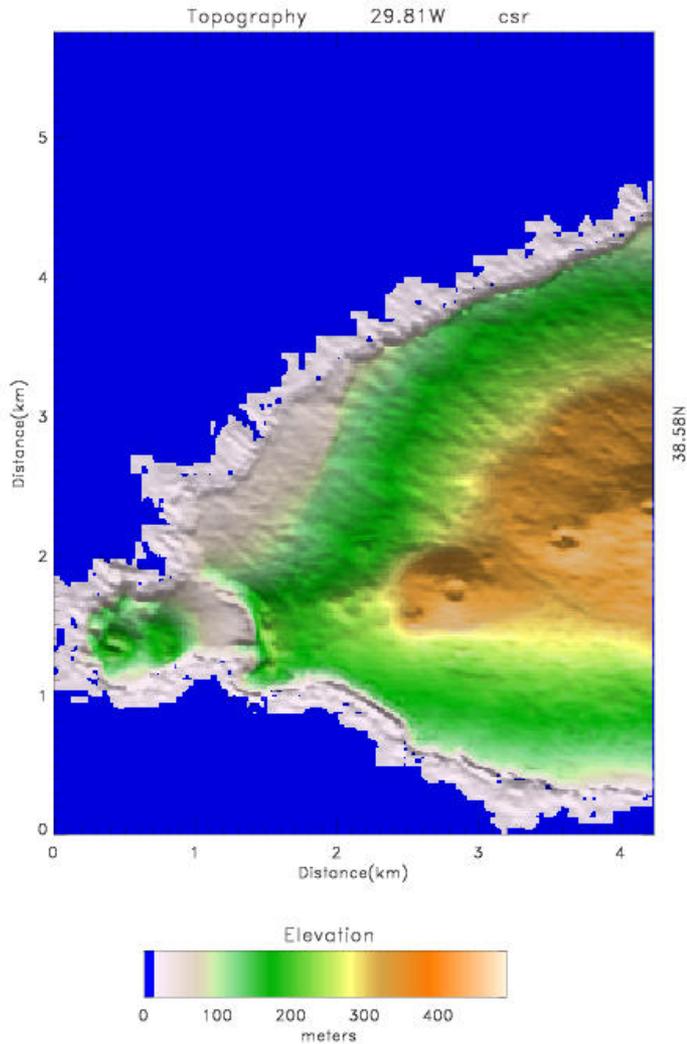
August 2001

Monitoring Coastal Erosion at "Surtseyan" Eruptive Center

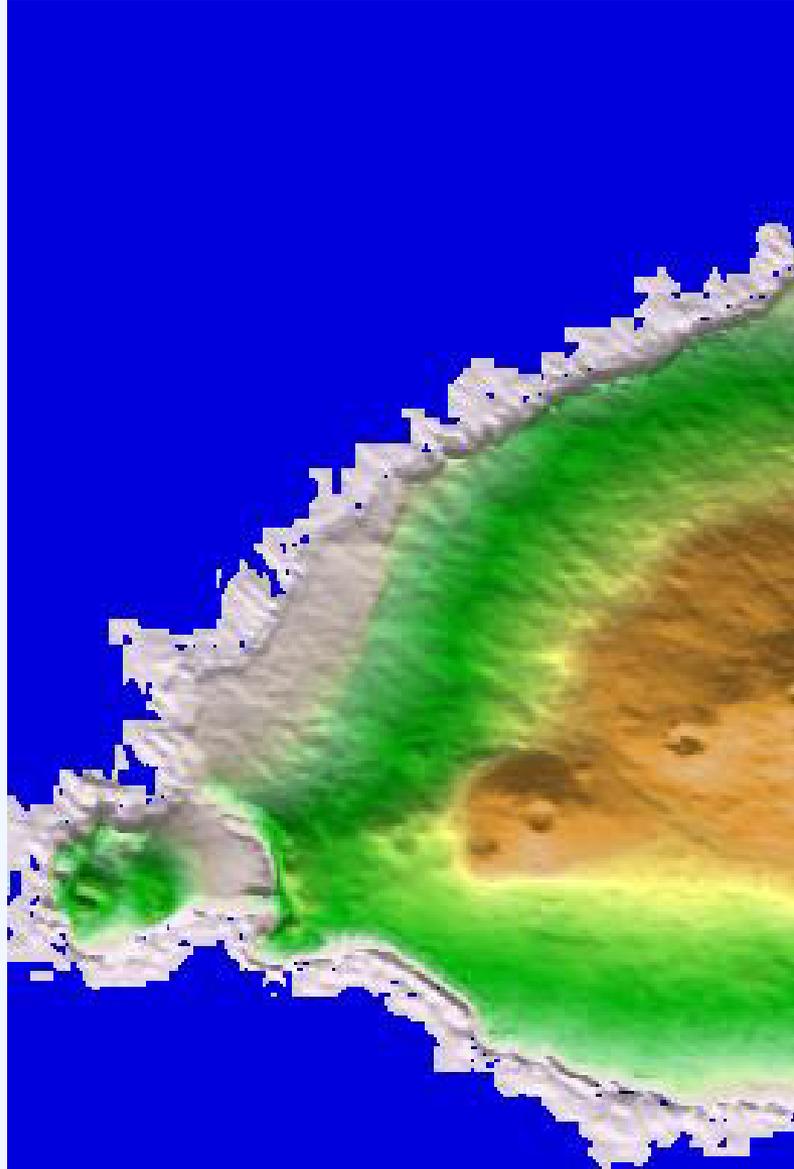
IKONOS DEM of Capelinhos, Western Faial, Azores



IKONOS - Capelinhos

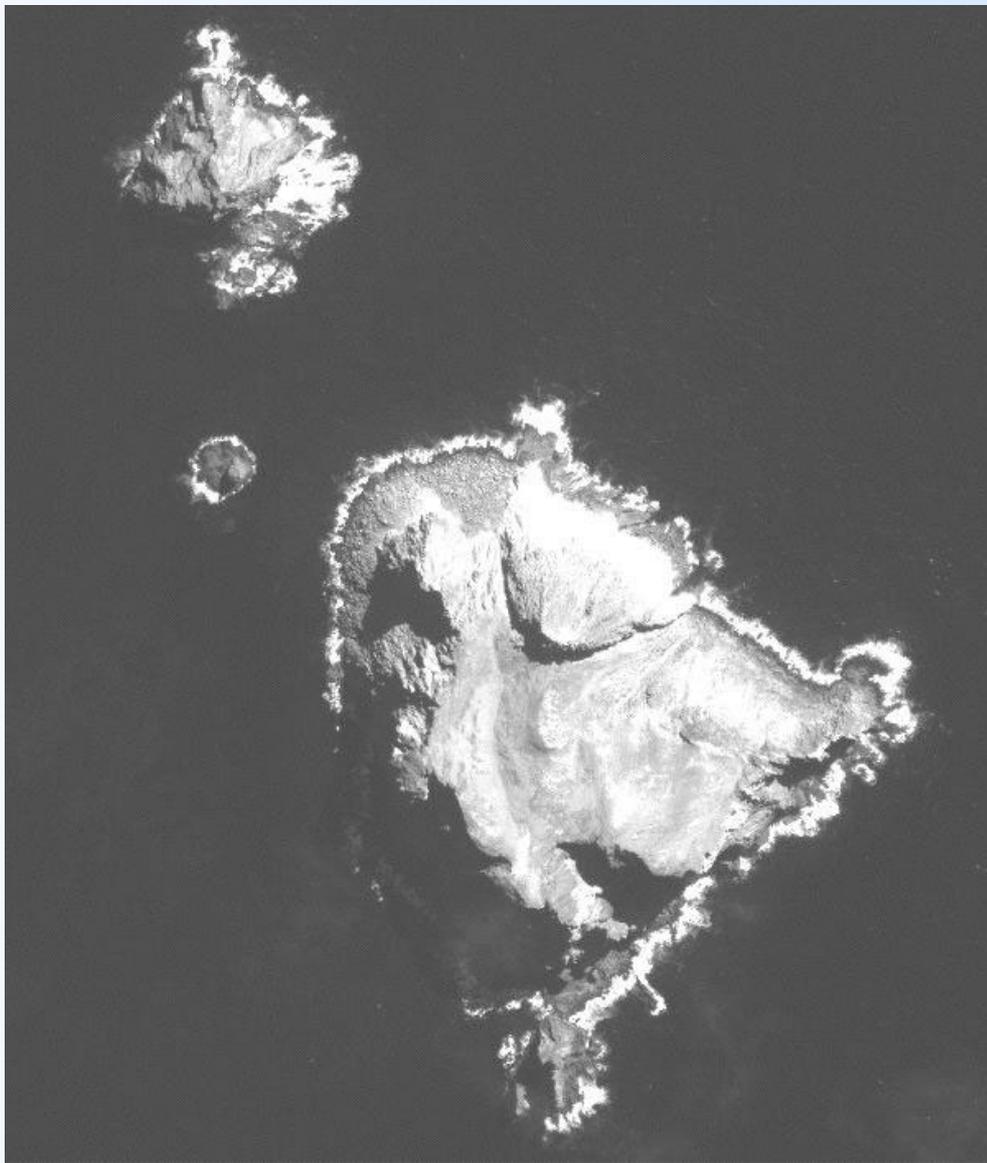


IKONOS DEM of Capelinhos, Western Faial, Azores





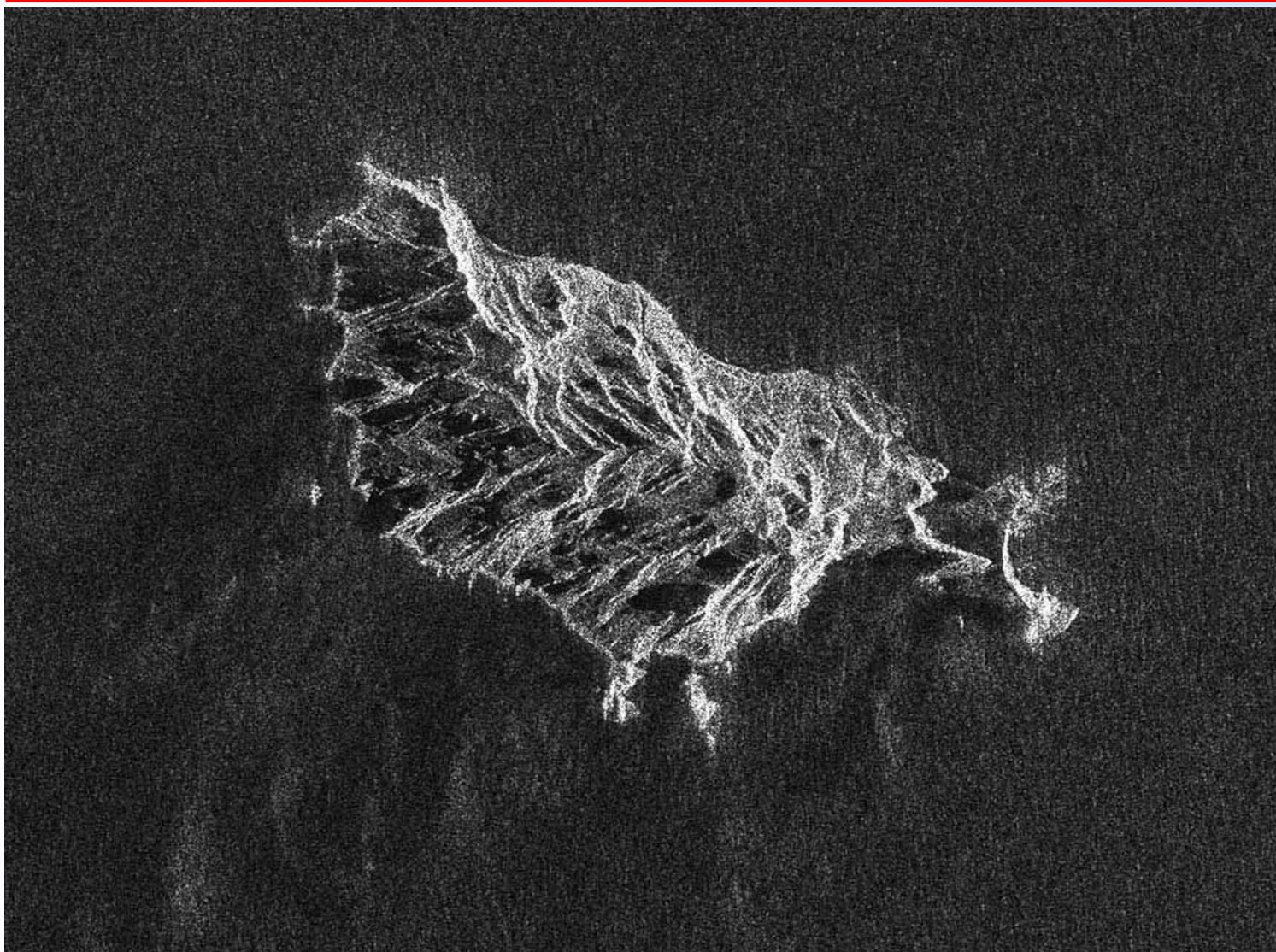
Martin Vaz, Atlantic Ocean



Trindade, Brazil RADARSAT SAR



Ocean Island Monitoring





South Coast of Trindade



Revealing Coastal Erosion, Mass-wasting, and Downslope Movements

North Coast Beach of Trindade



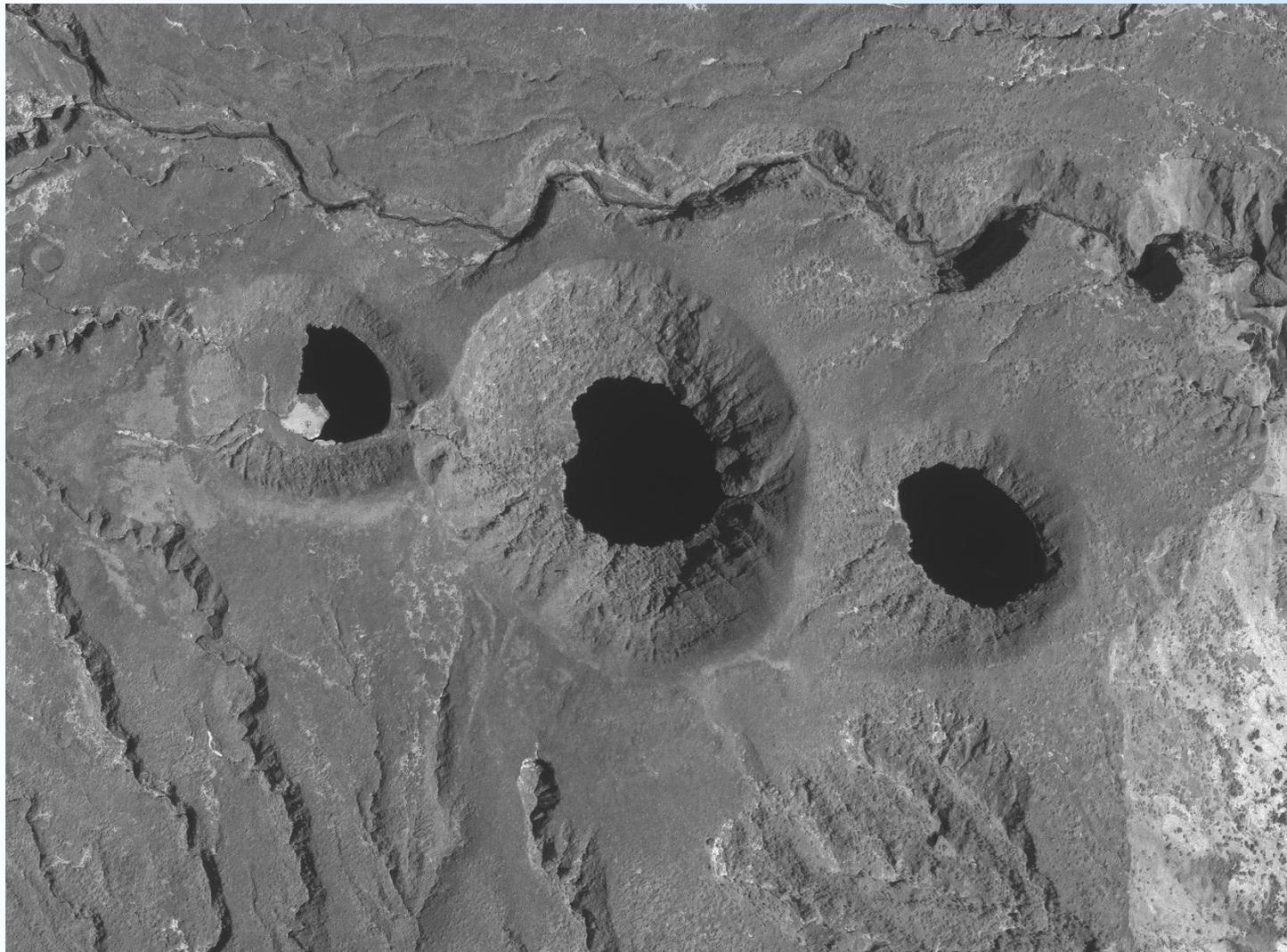
Tristan da Cunha RADARSAT Context Image





Tristan da Cunha

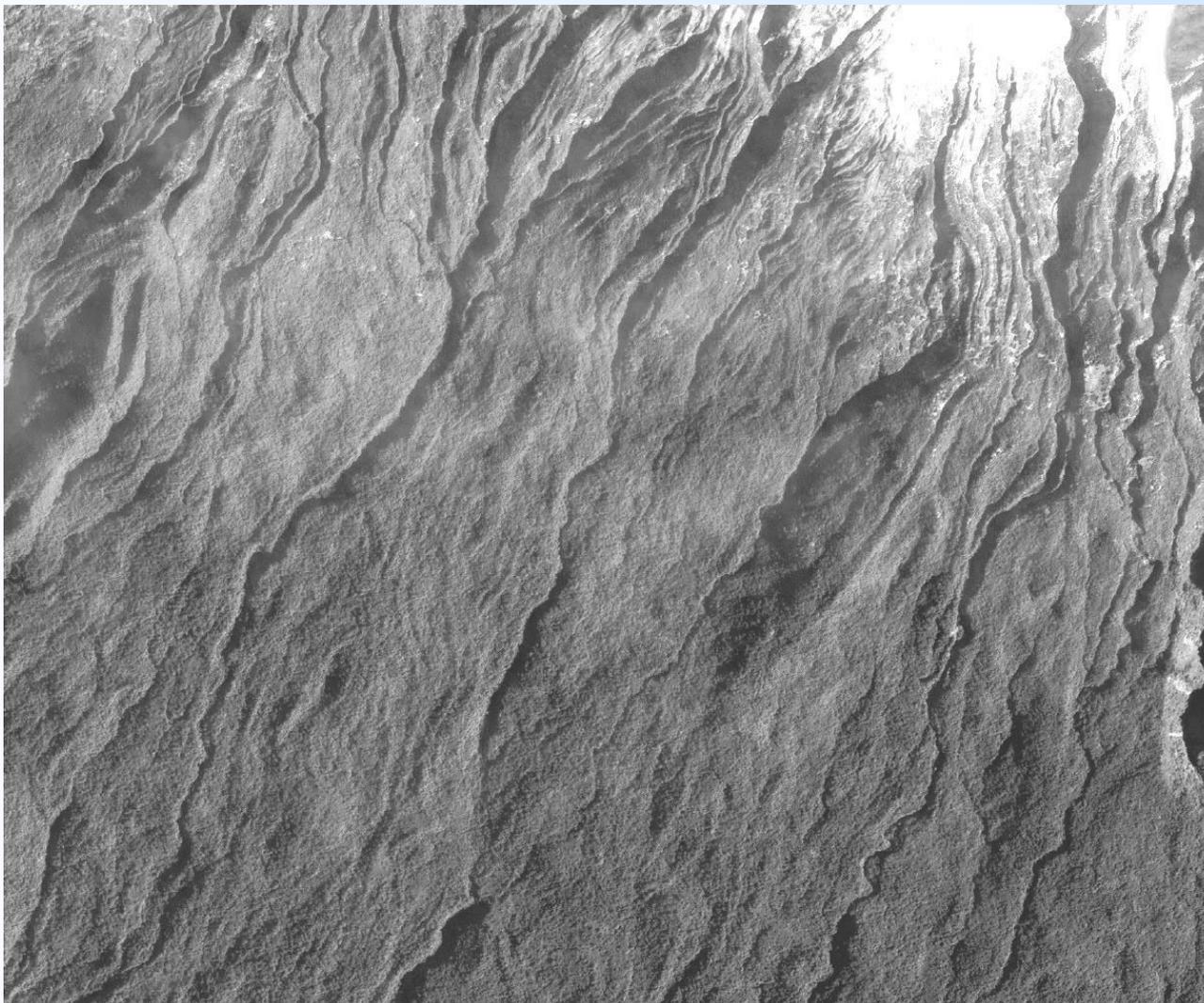
Ocean Island Monitoring



East Side of Maars Craters



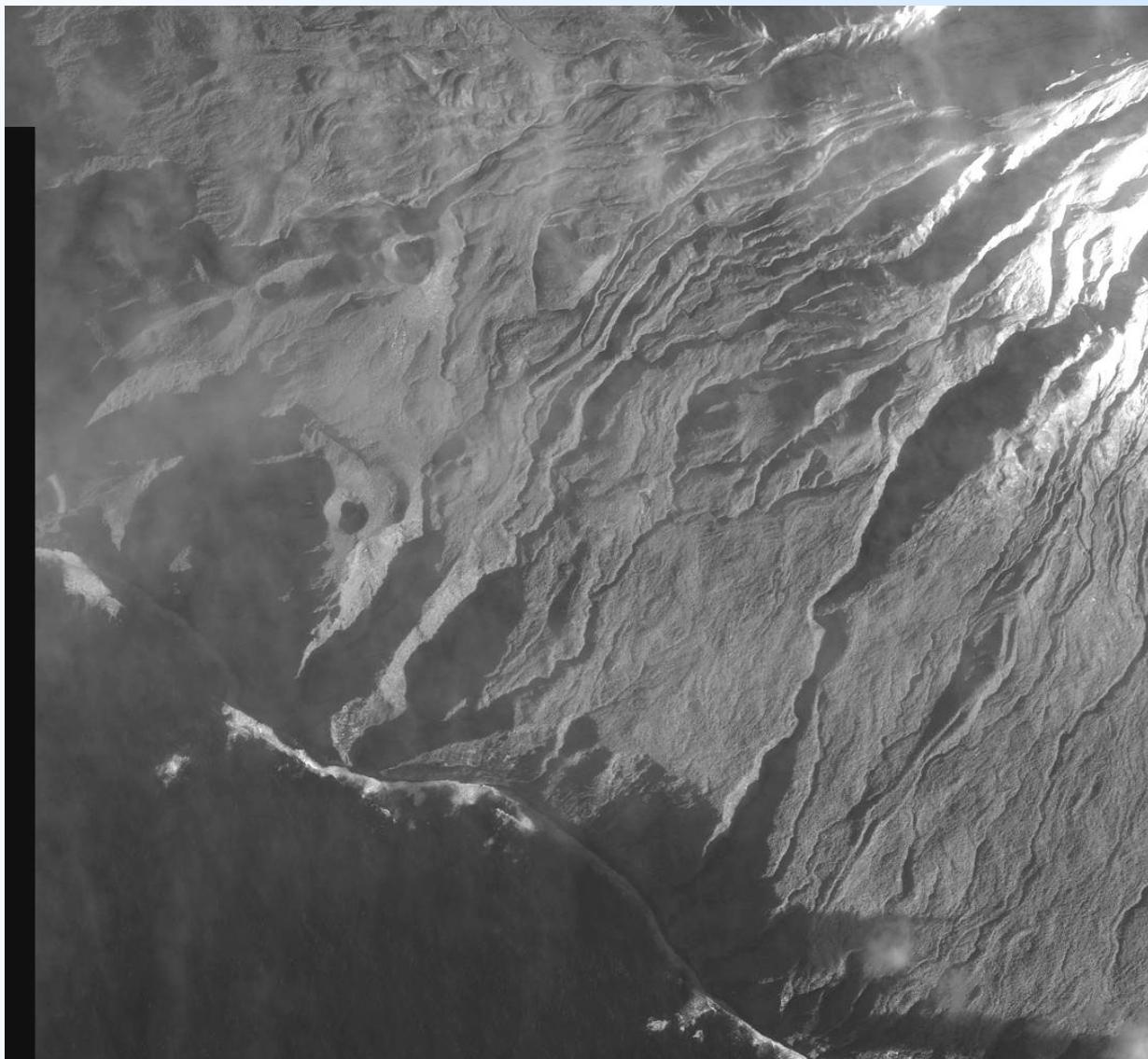
Tristan da Cunha



Gully Erosion Controlled by Flank Topography

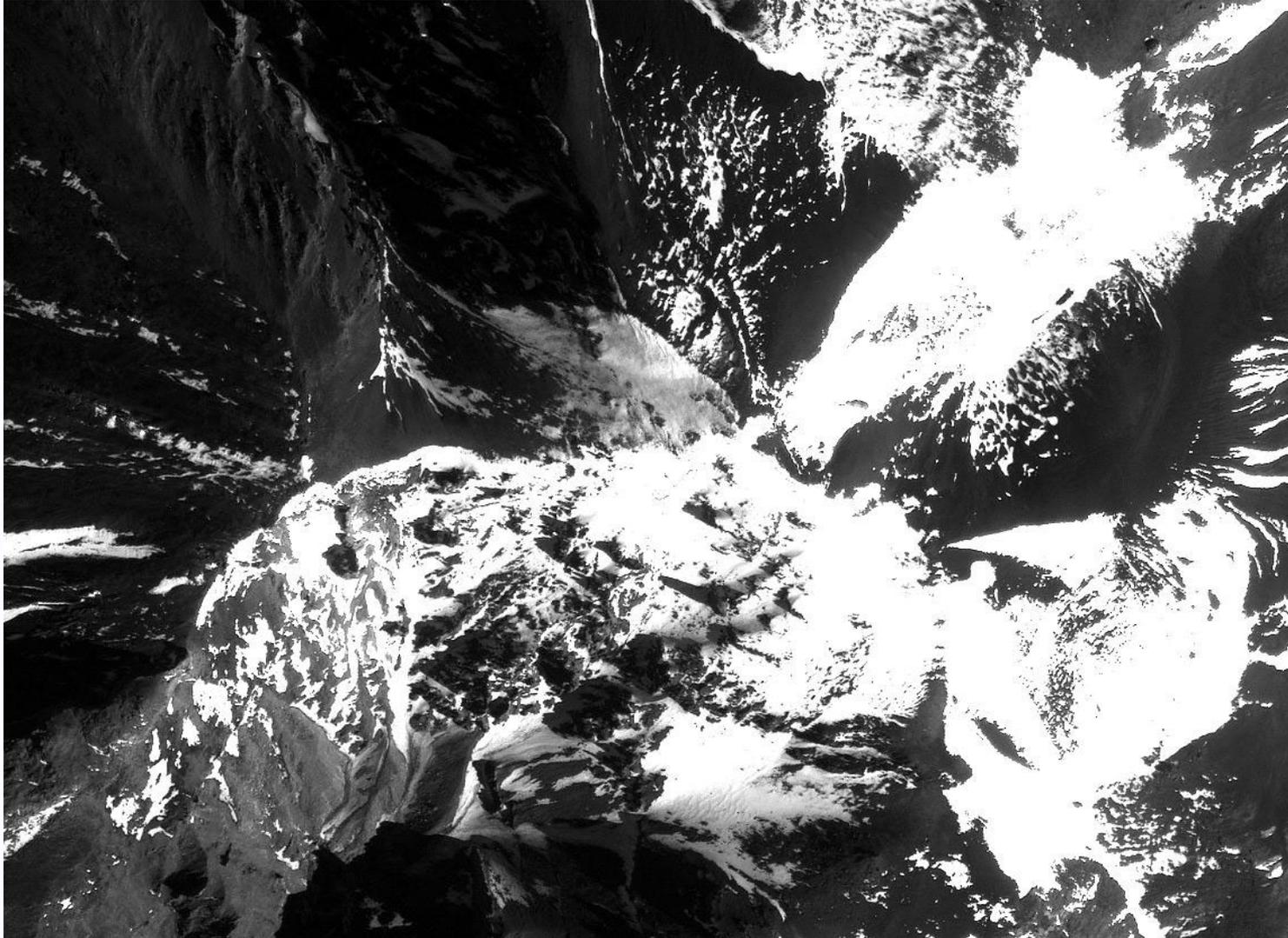


Tristan da Cunha



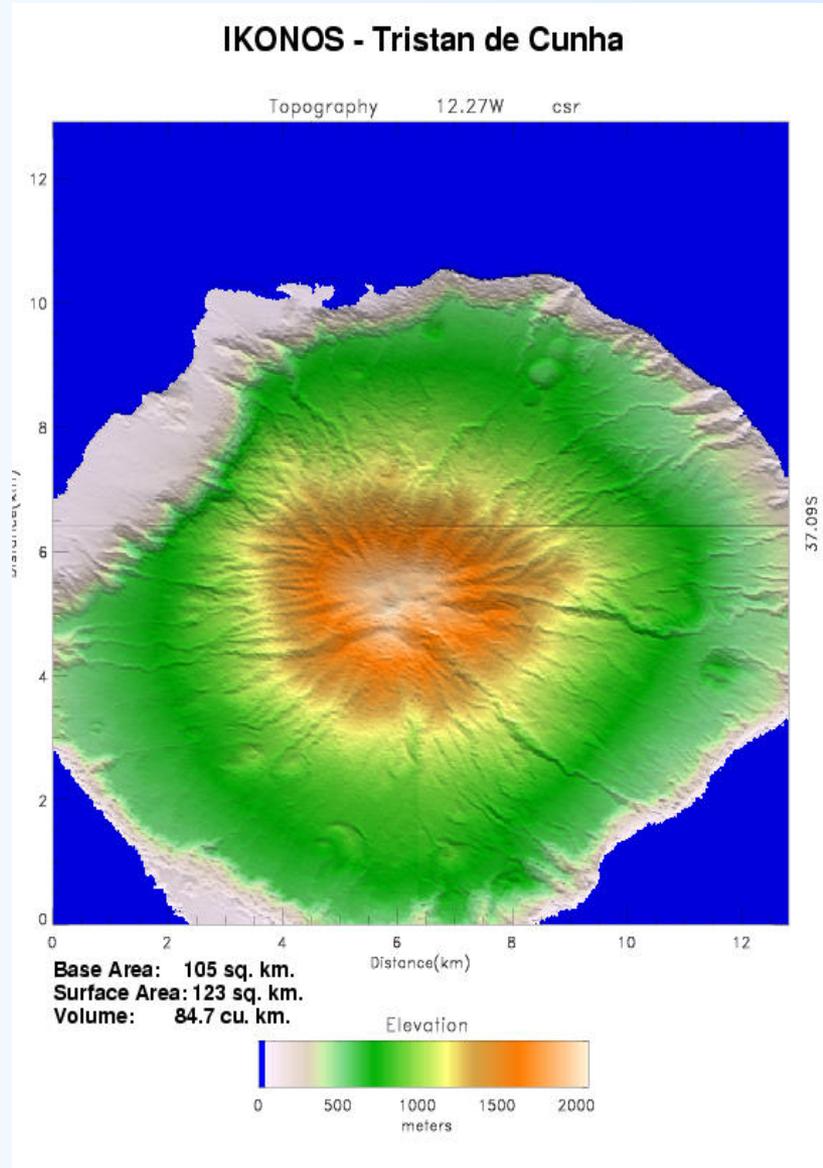
Tristan da Cunha: SW coastal margin with hanging valleys

Tristan da Cunha

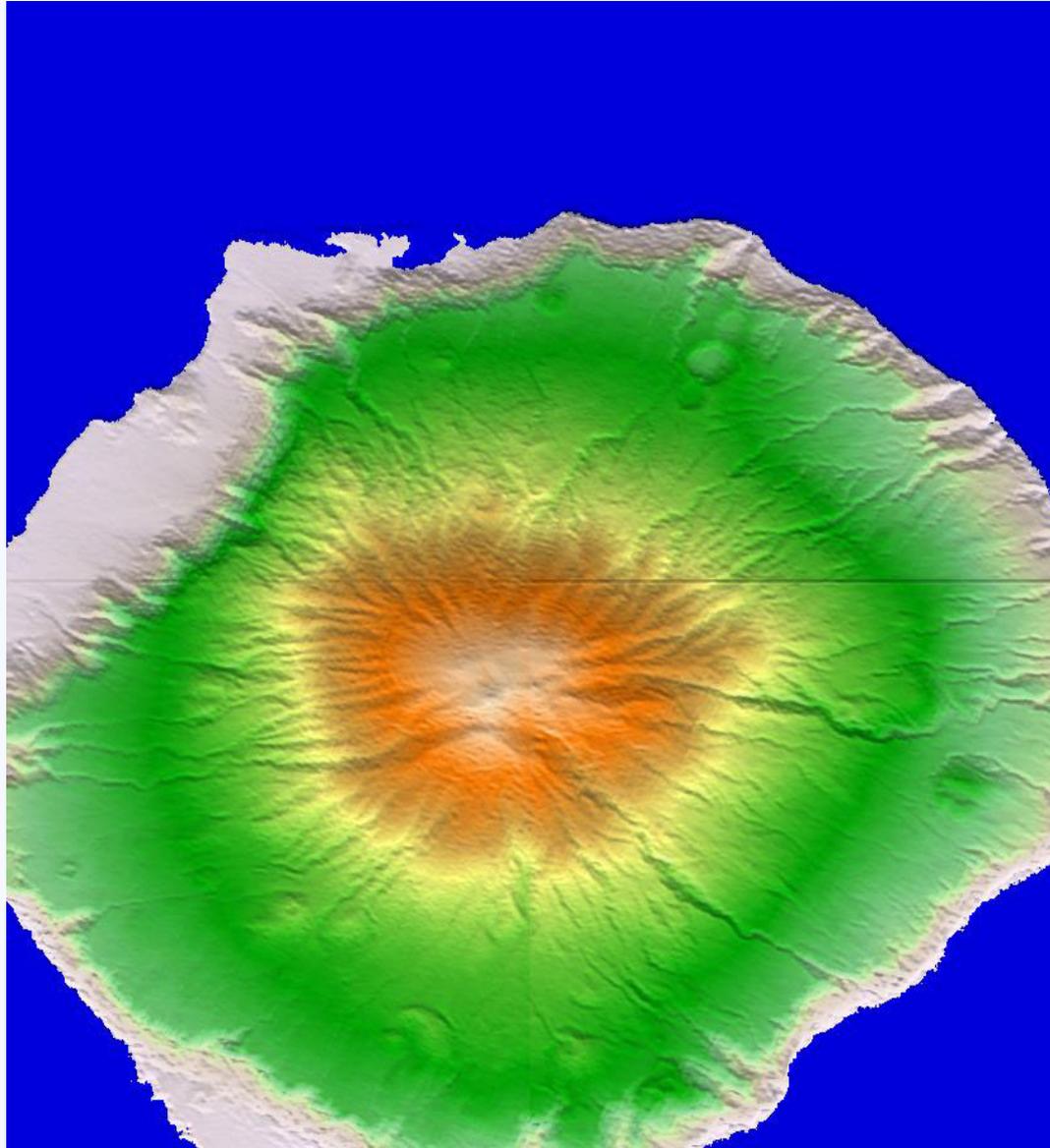


Summit

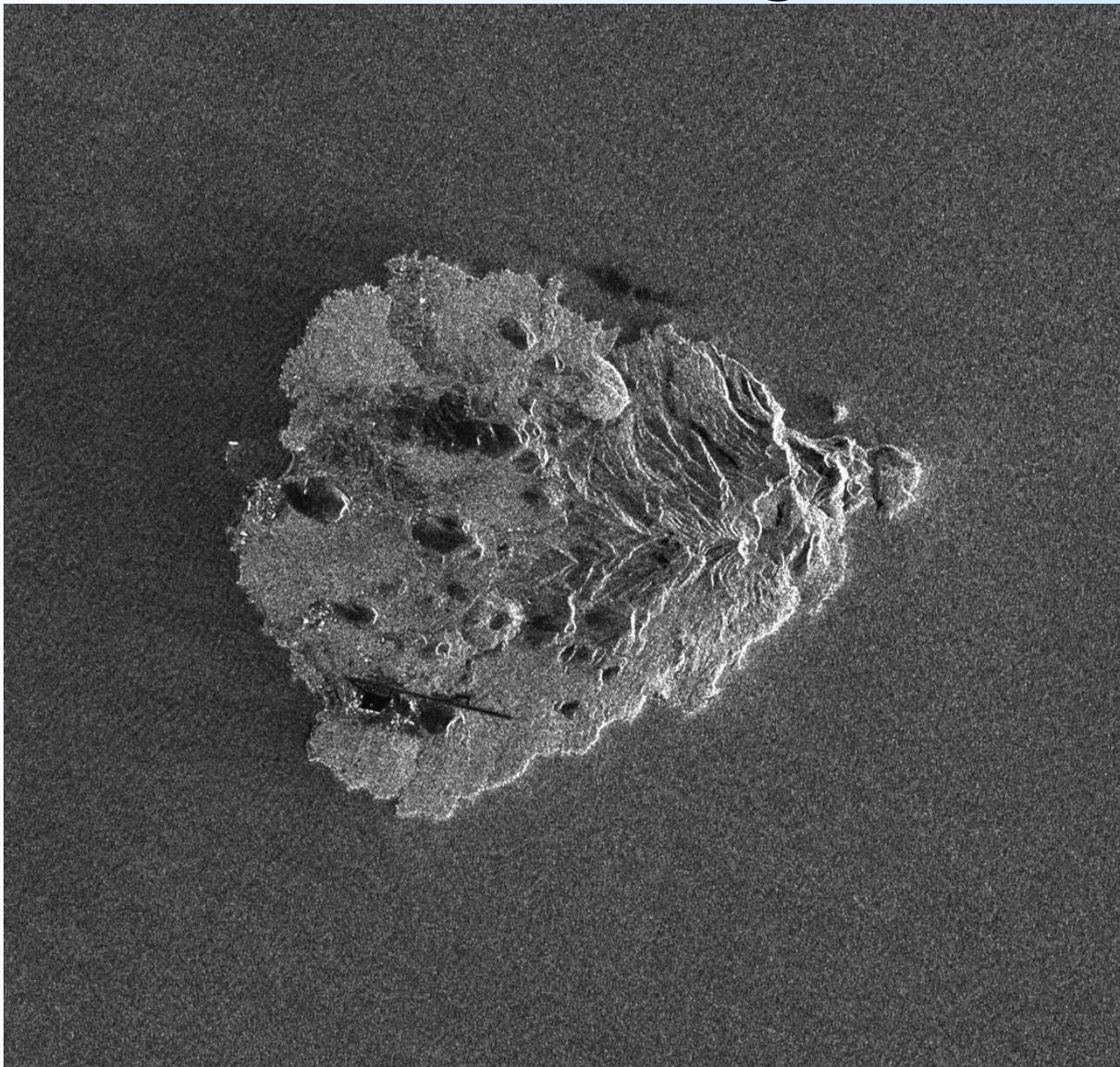
IKONOS DEM of Tristan da Cunha



IKONOS DEM of Tristan da Cunha



Ascension RADARSAT Context Image





Ascension Island



Ascension Island: North Coastal Zone showing erosion and deposition



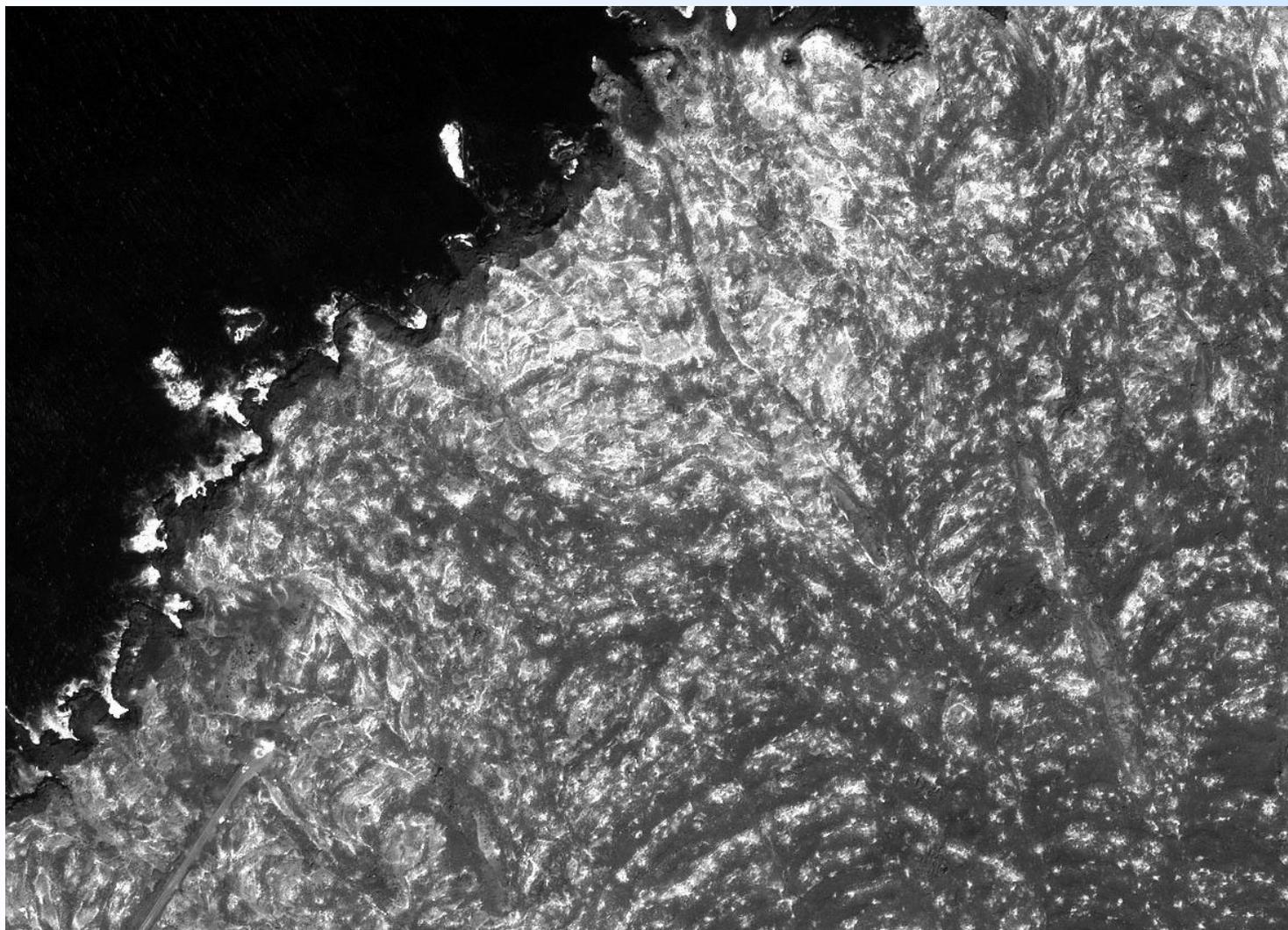
Ascension Island



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



Ascension Island



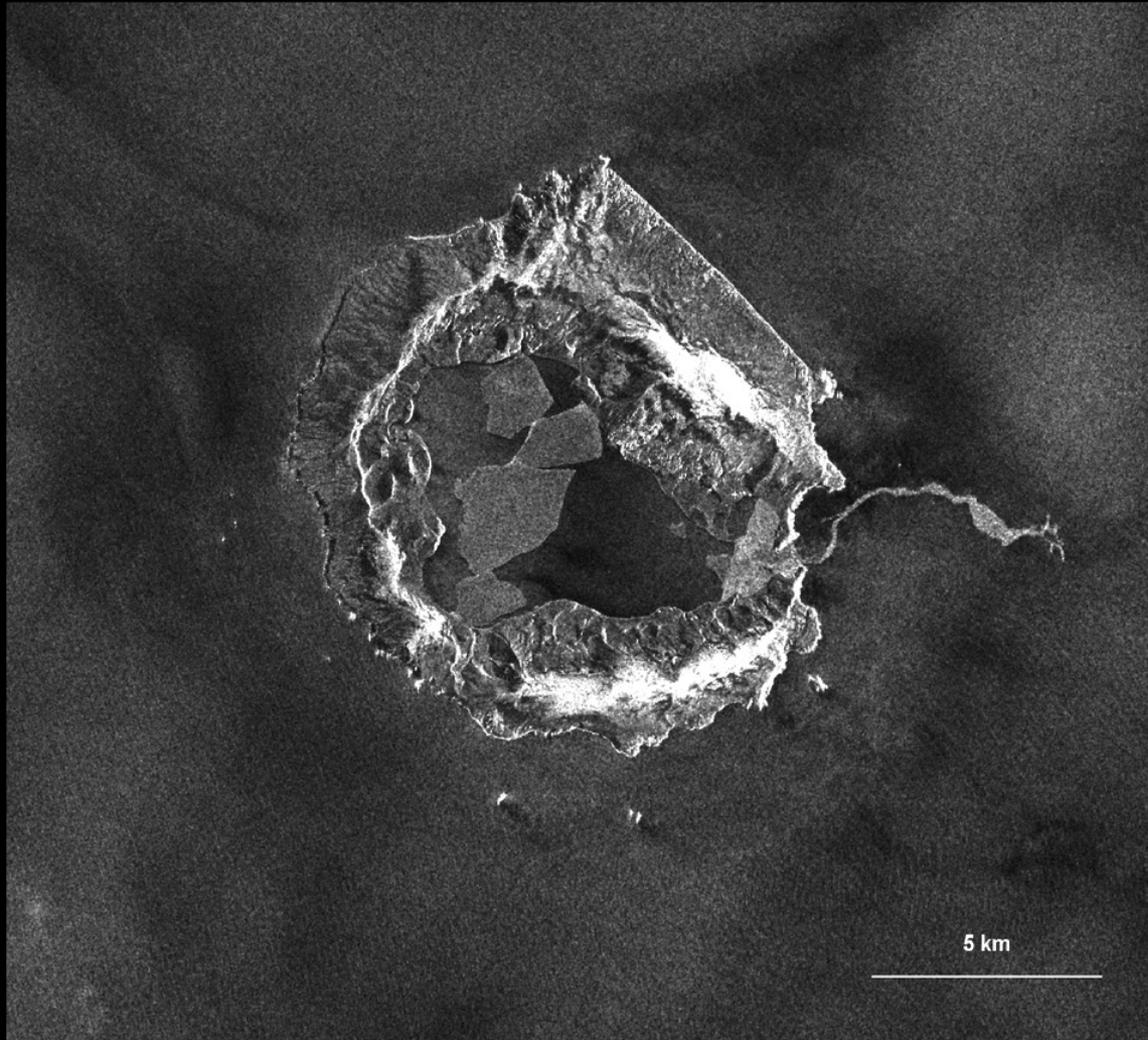
High Silica lavas on NW coast

Deception Island: RADARSAT Context Image (S. Shetlands)



RADARSAT BACKGROUND MISSION

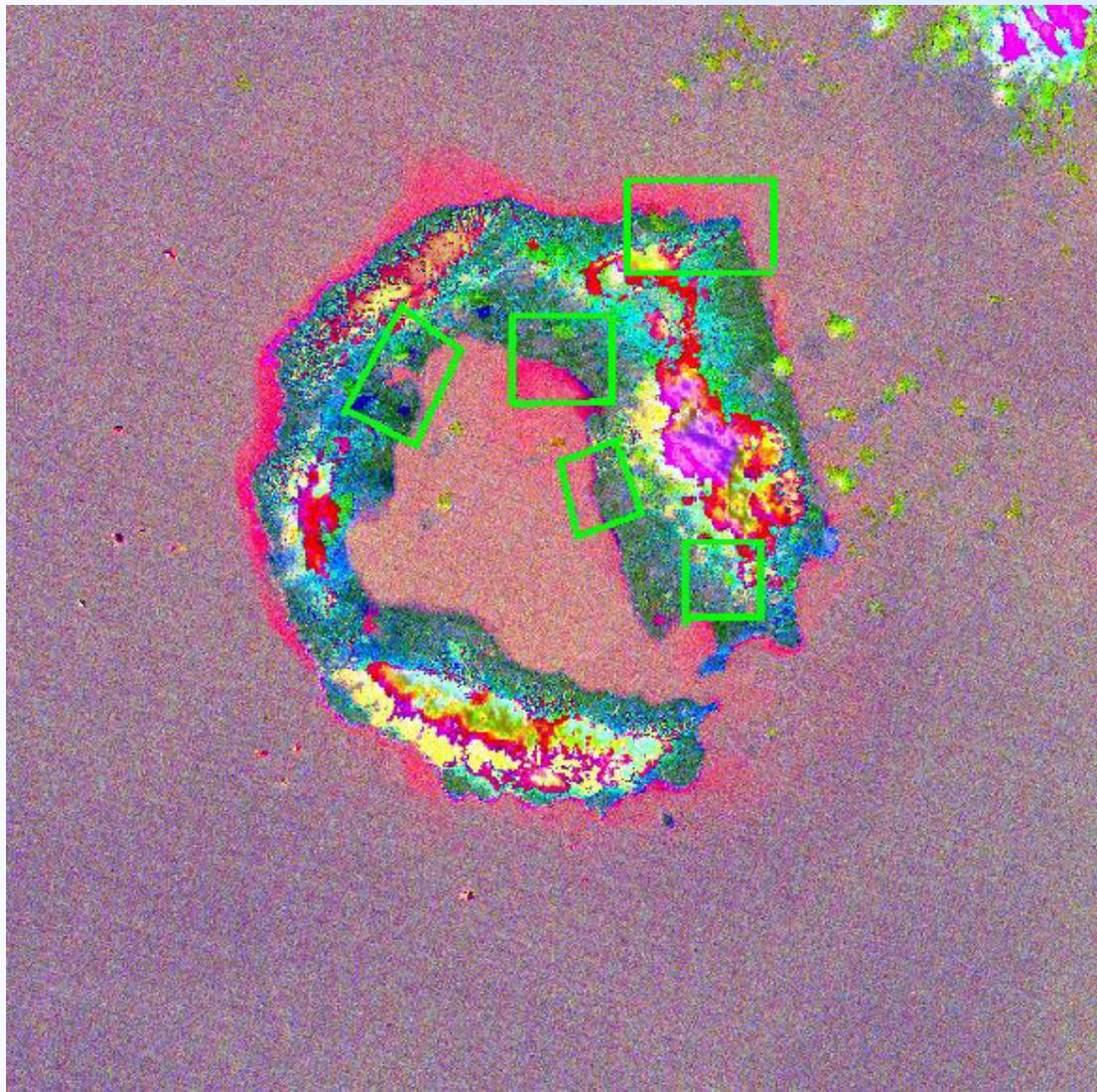
Deception Island
Scene Centre : 62°57' S 60°40' W



© Canadian Space Agency / Agence spatiale canadienne, 1998

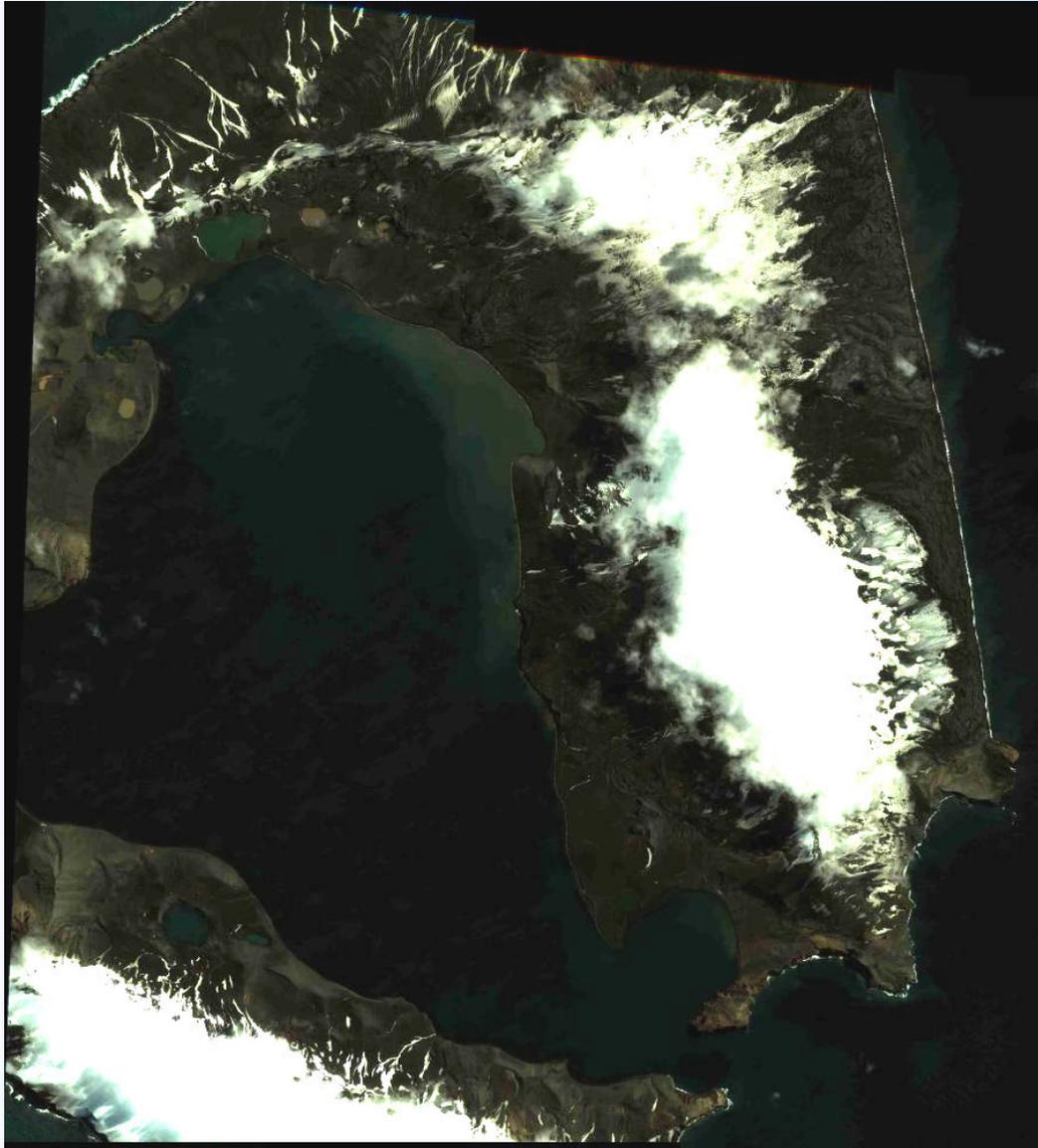
RADARSAT 1 Standard 5 Descending Image, acquired on November 21, 1998
covering approximately 25 km X 25 km.

Deception Island: LANDSAT-7 PCA Image



PCA 567

Deception IKONOS Context Image



ENE Straight Coast of Deception Island



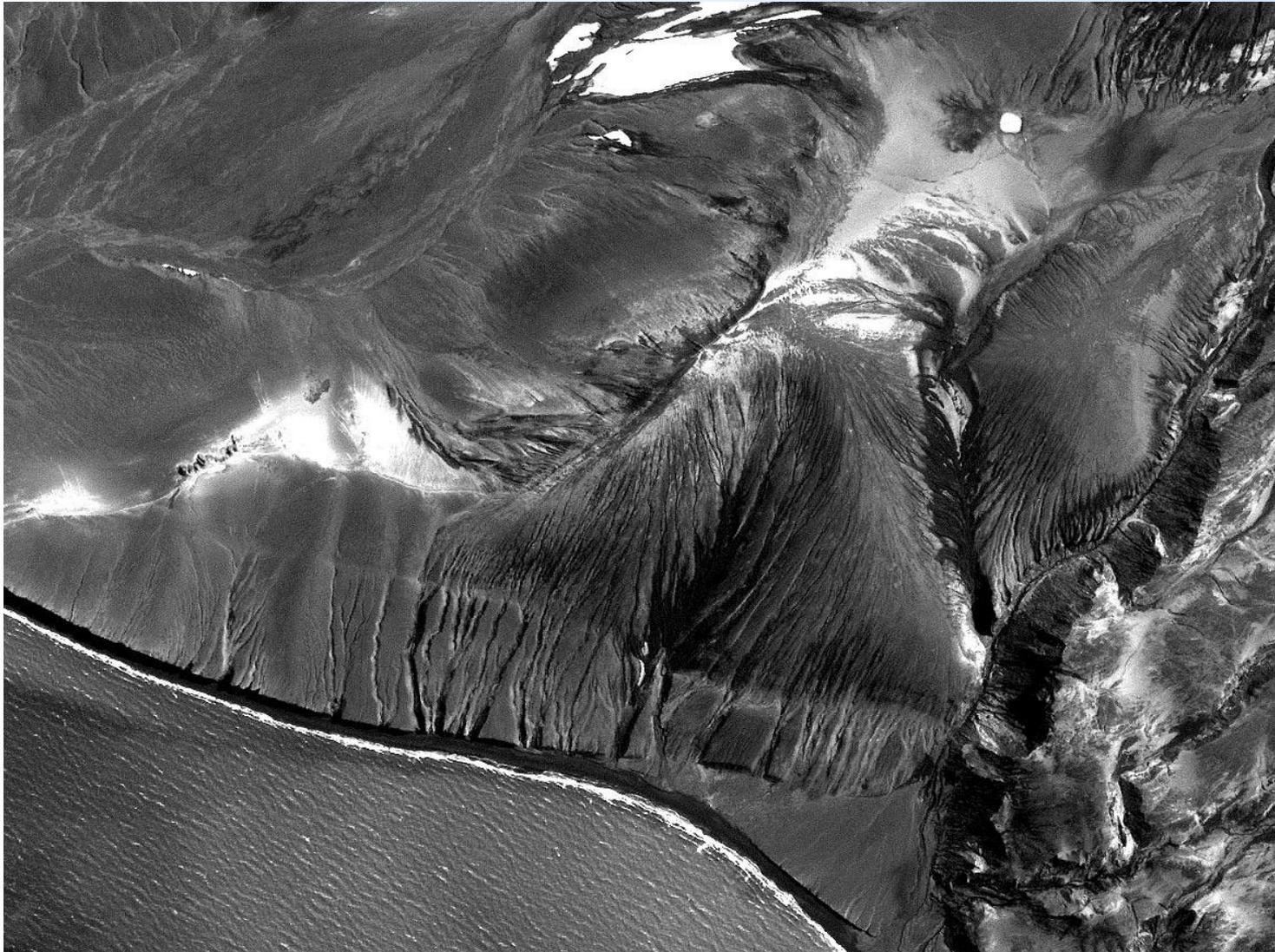
Ocean Island Monitoring



Deception Island: Erosional Gullies in Tephra with Unconformities



Ocean Island Monitoring





Deception Island: South Shetlands

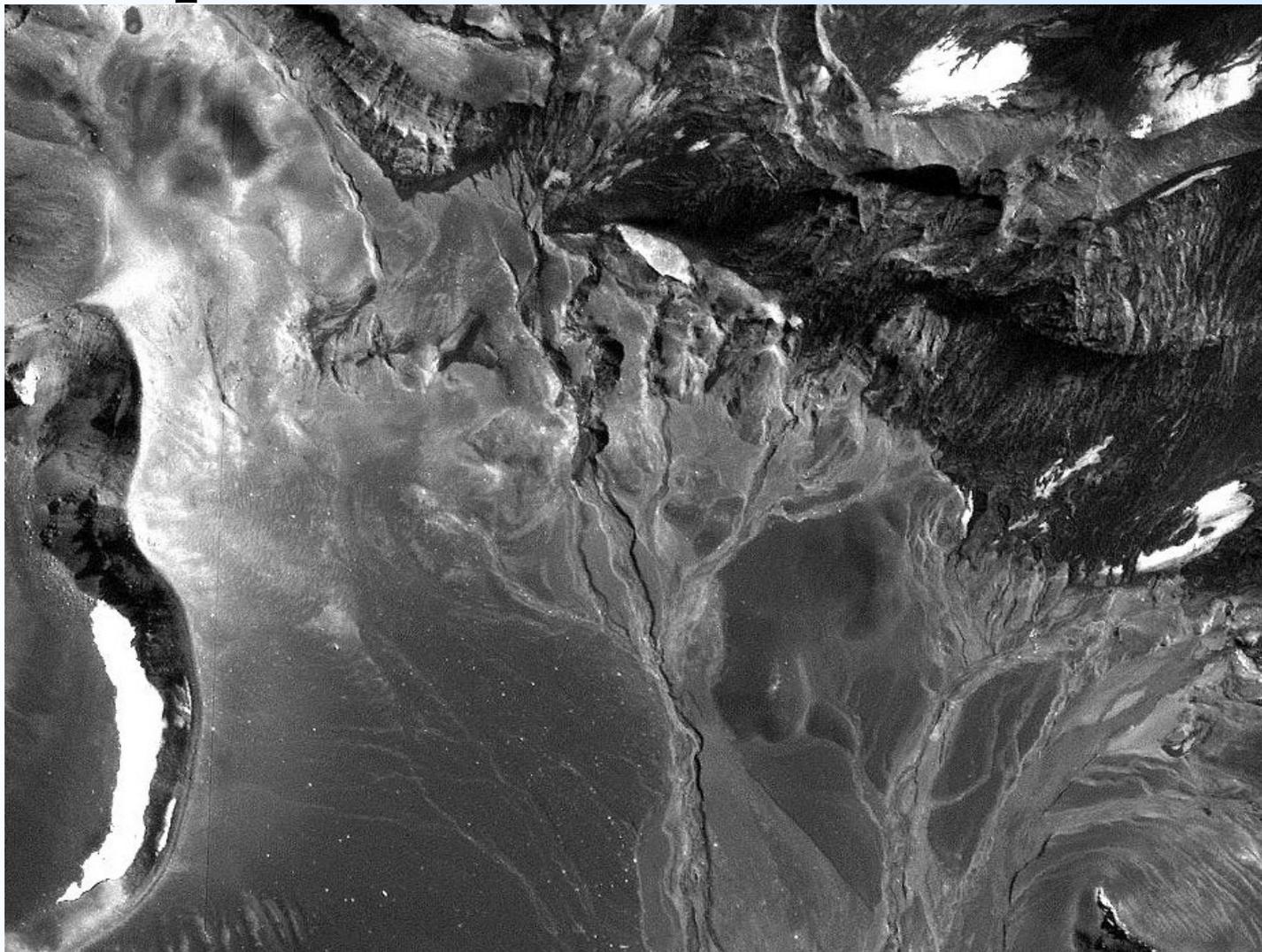
Ocean Island Monitoring



Deception Island: Concave Coastal Margin Demonstrating Landscape Change



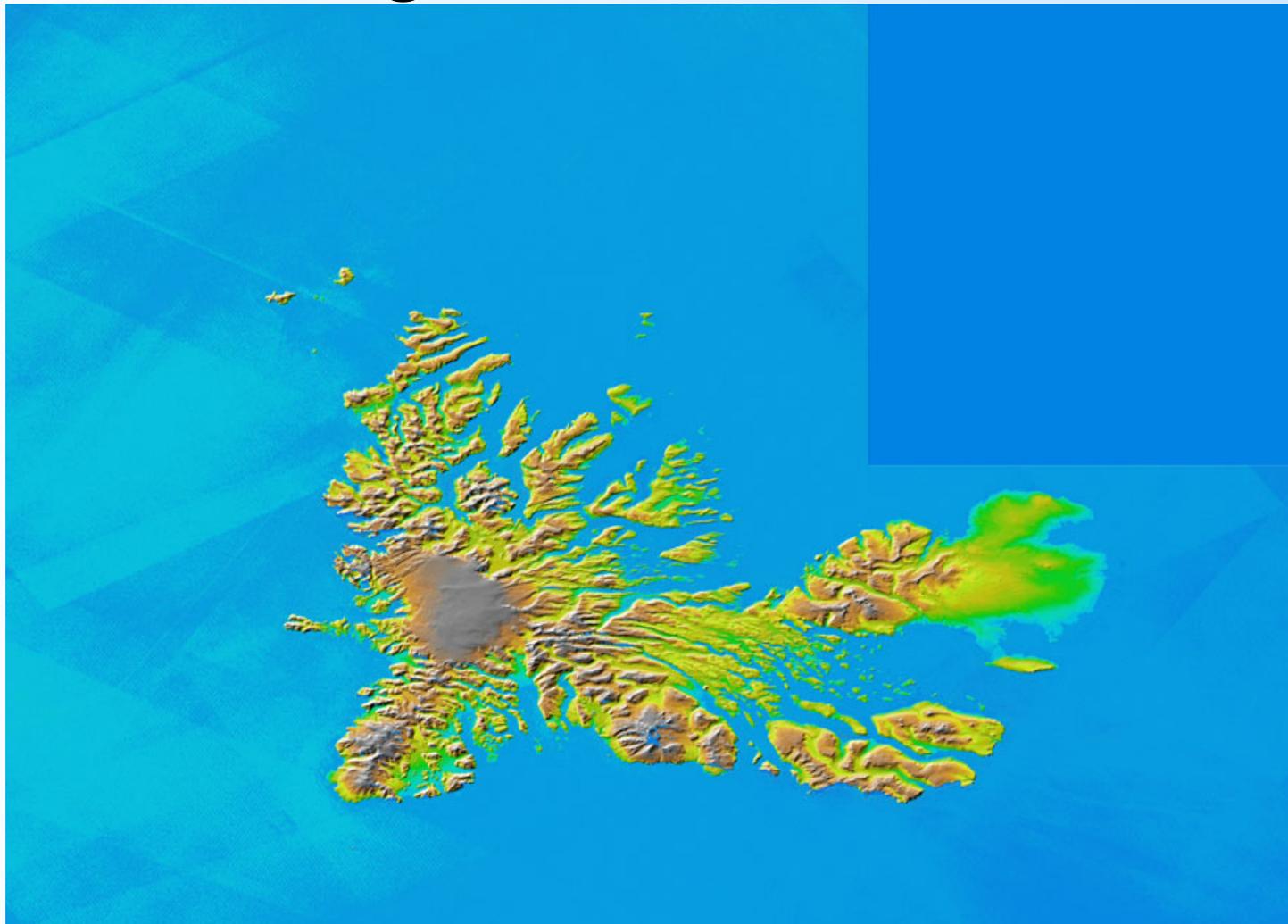
Deception Island: South Shetlands



Deception: Hillside Gully formation due to ice melting

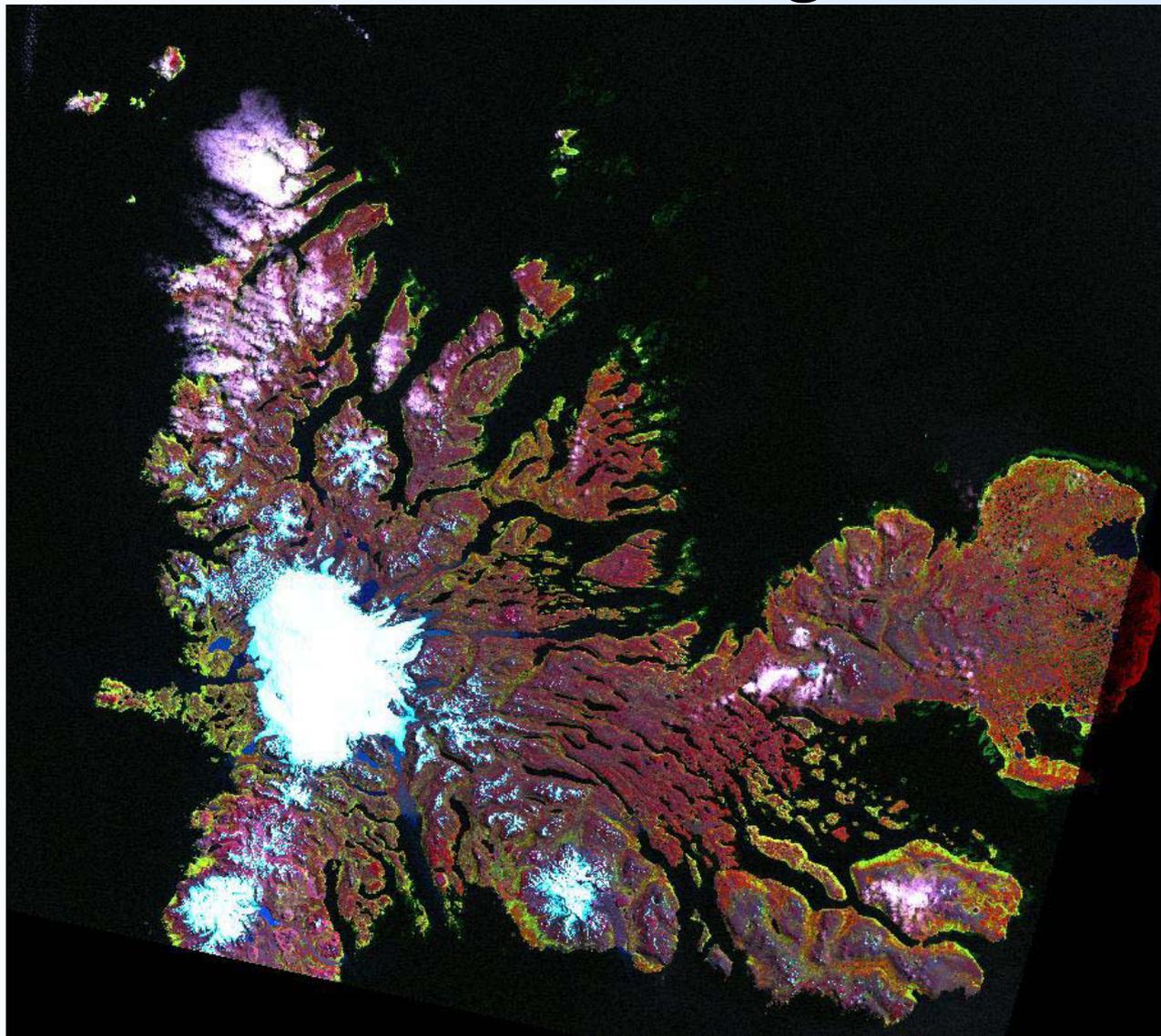
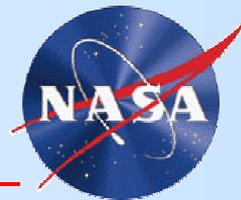


Iles Kerguelen (TAAF, France)



**SRTM
Topography**

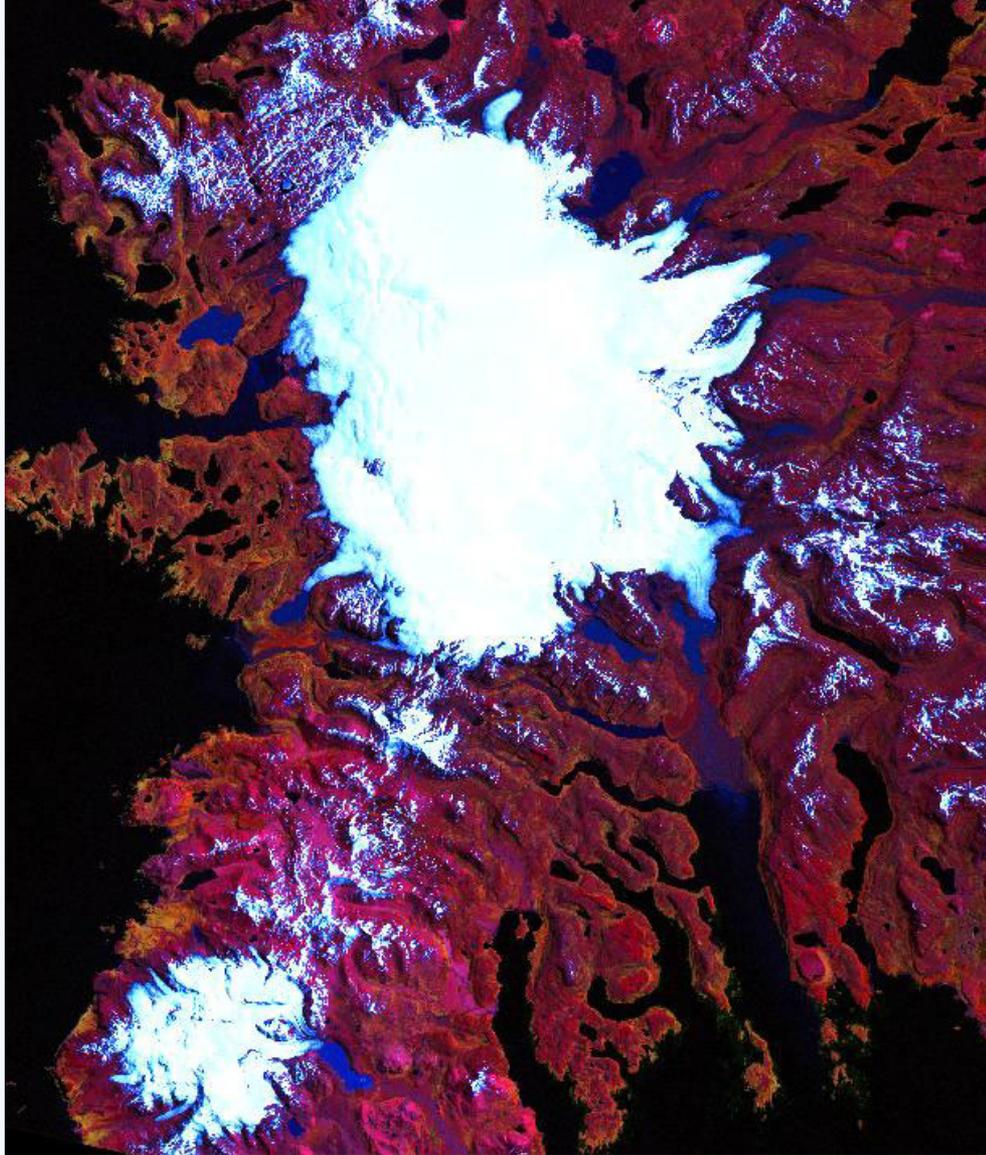
Kerguelen Landsat-7 Context Image



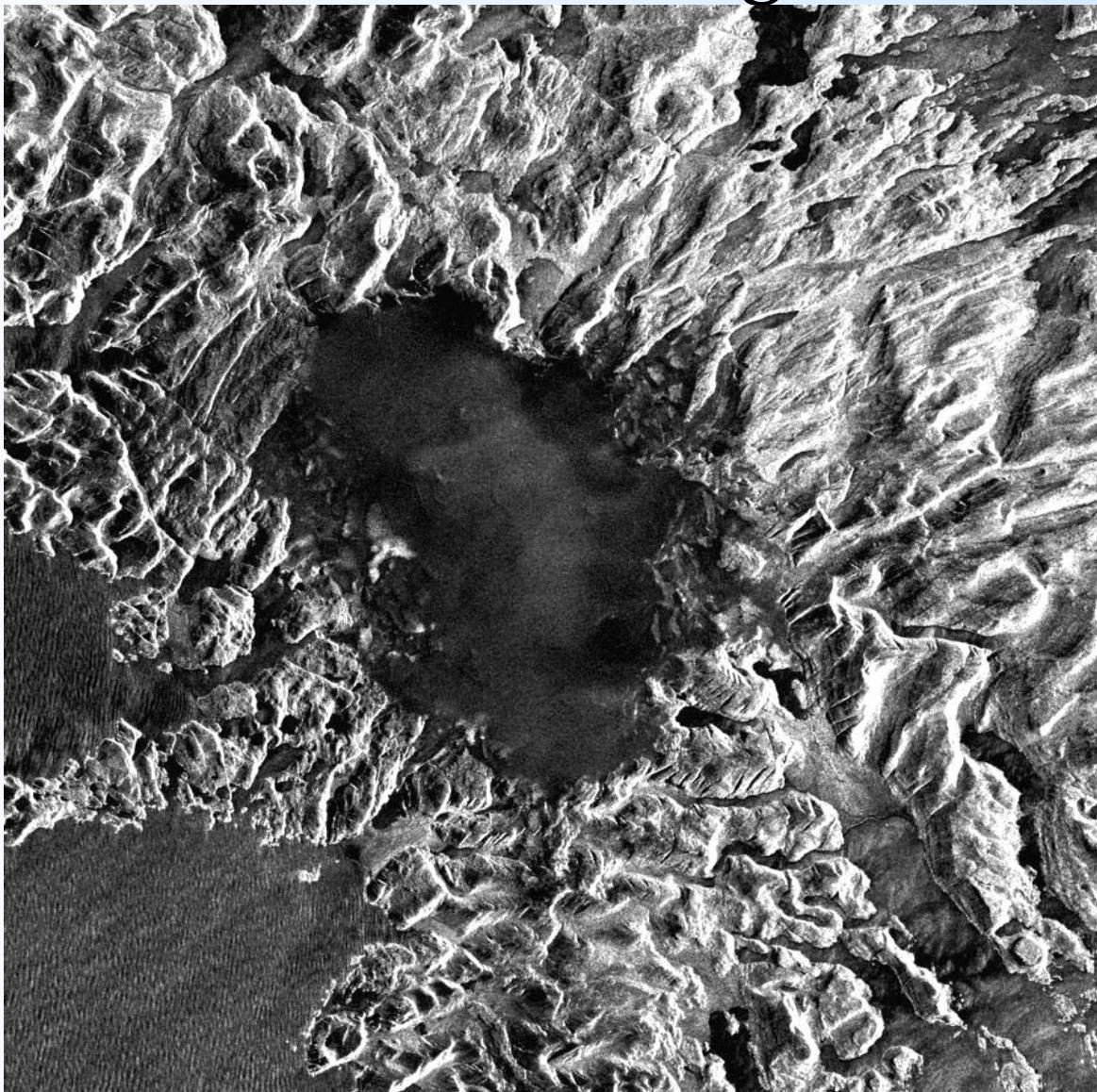
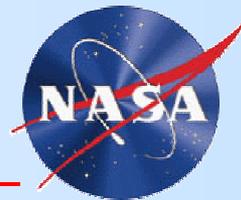
11/27/01



Kerguelen



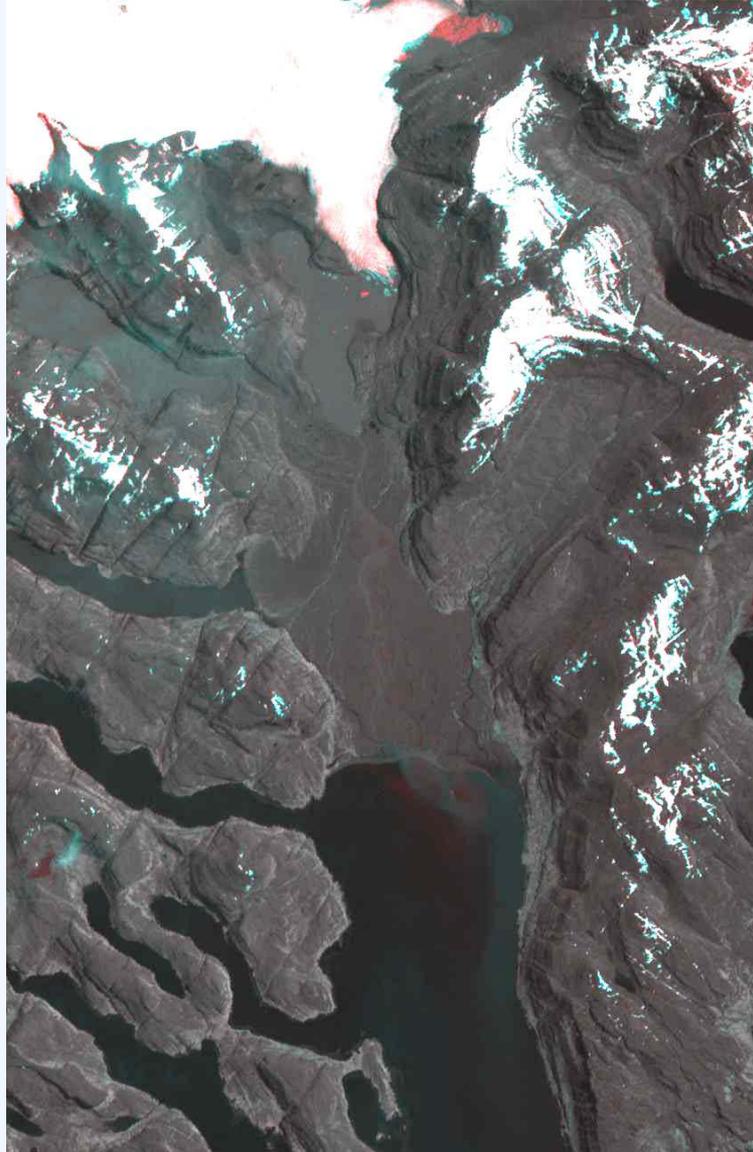
Kerguelen RADARSAT Context Image



**Cook
Icefield**

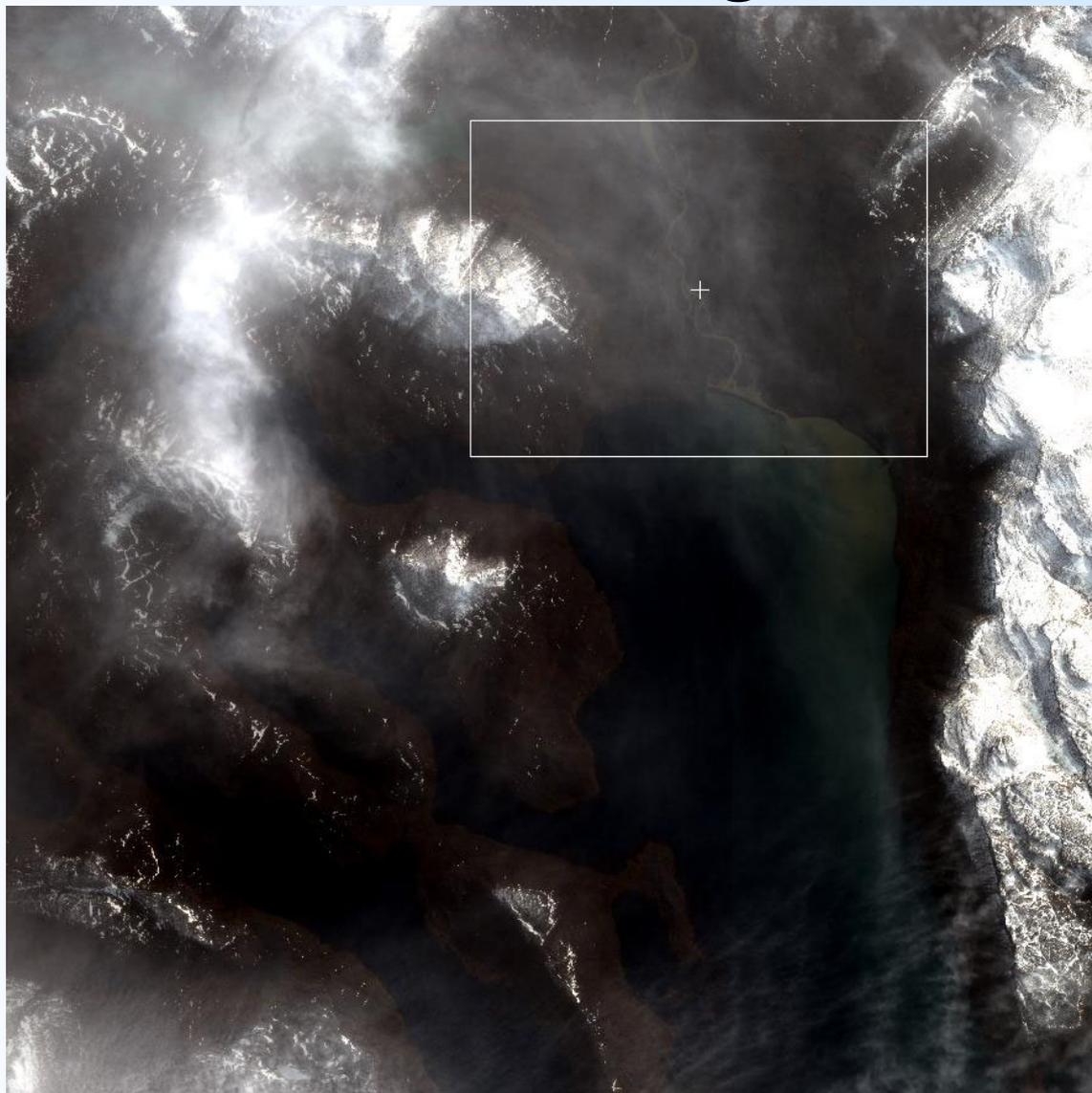
8/9/98

Kerguelen (Ampere Glacier, Sandur, Fjord..)



Landsat-7

Kerguelen IKONOS Context Image

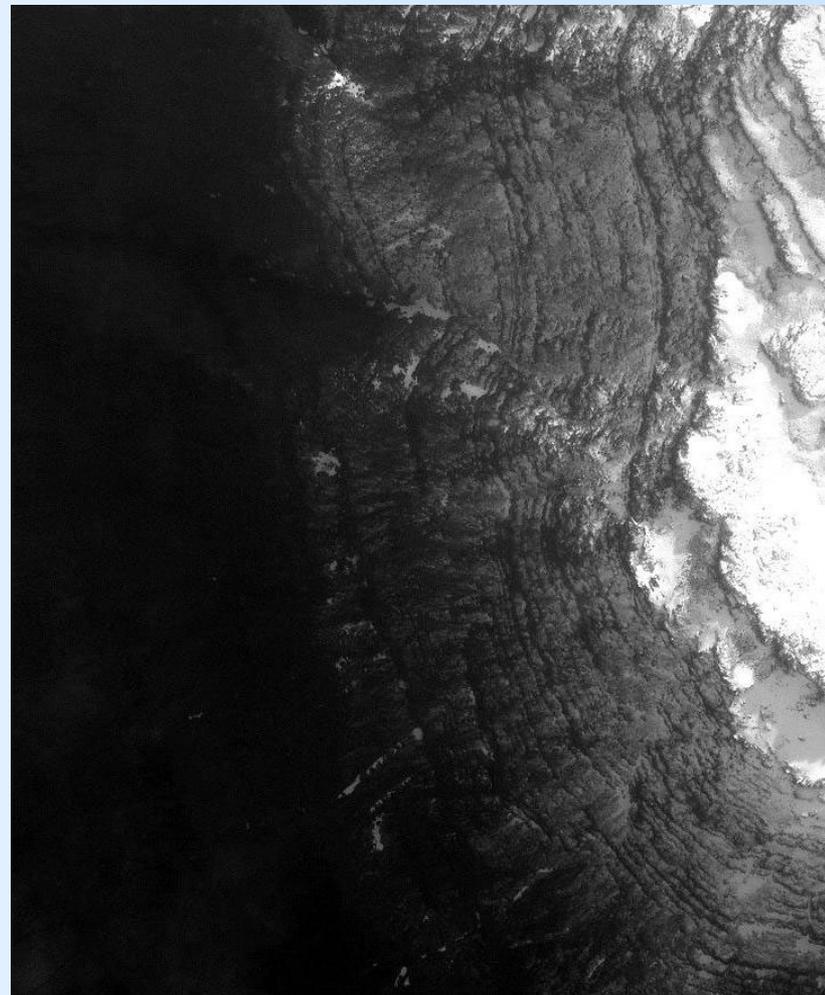




Kerguelen: Coast of Sandur

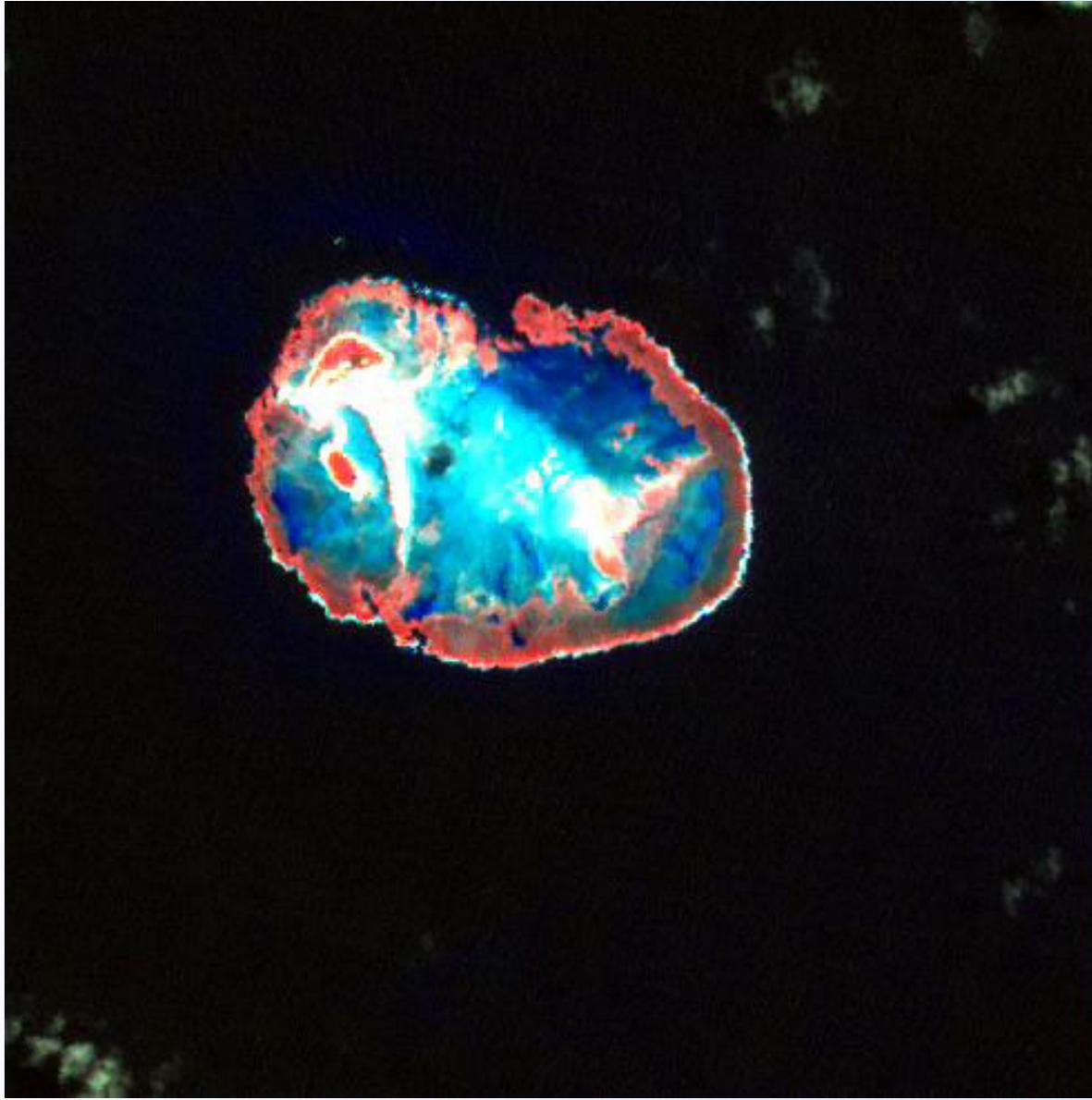


Coast of Sandur



Cliffside Phonolites

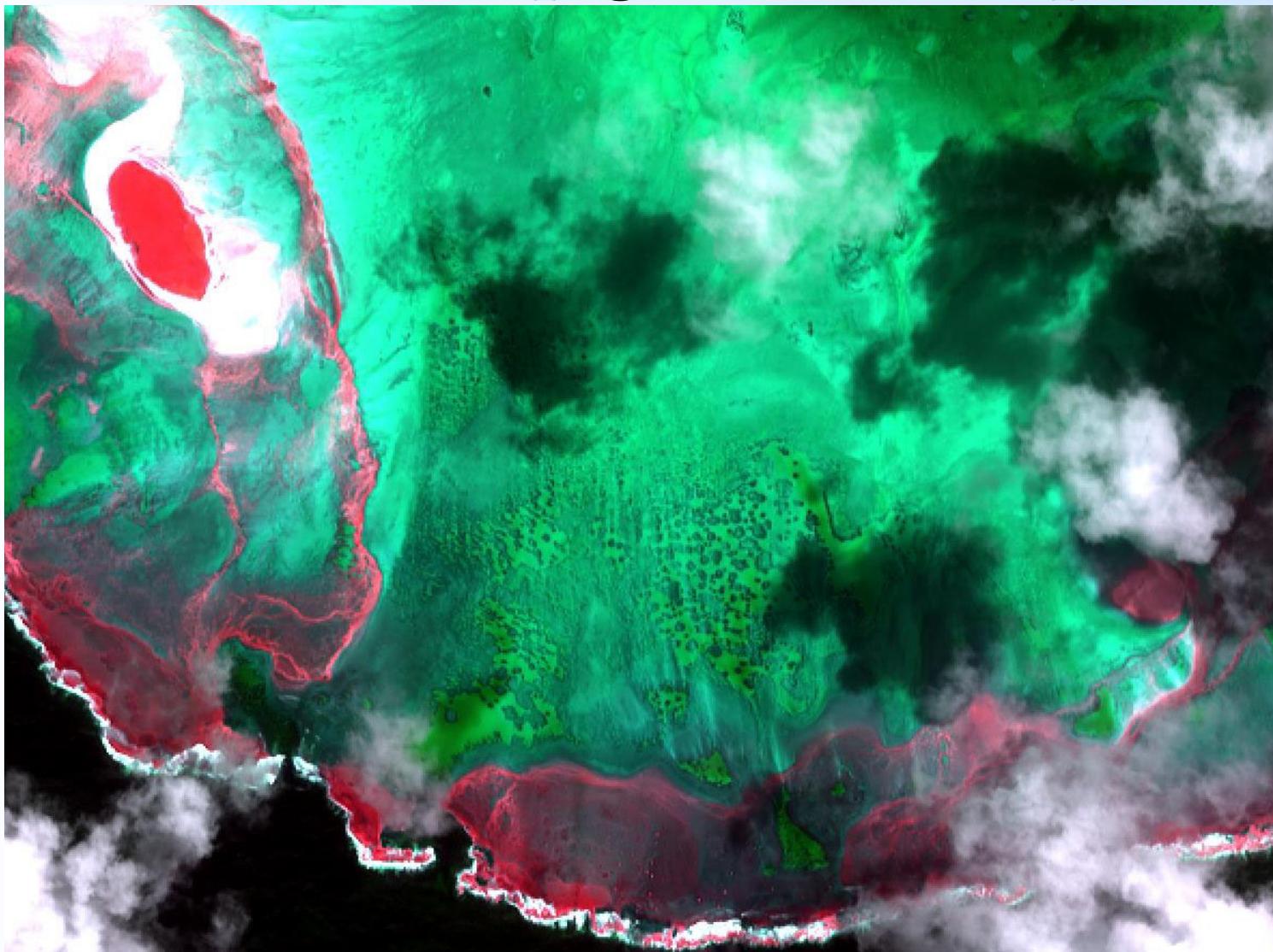
Rocas Atoll Island Landsat-7 Context Image





Roches Champignons from Space

Ocean Island Monitoring





Roches Champignons in PAN

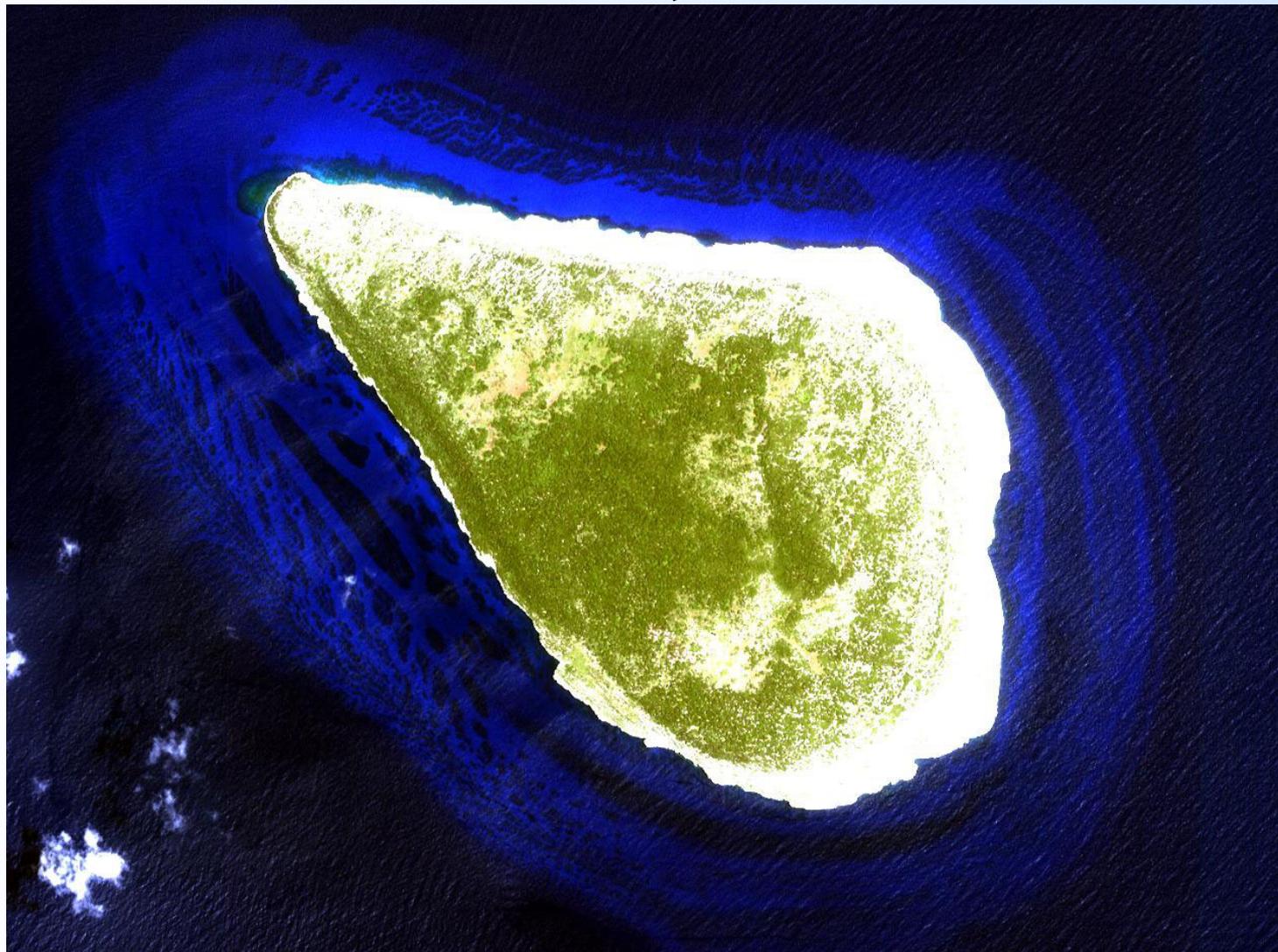
Ocean Island Monitoring





Navassa Island, West Indies

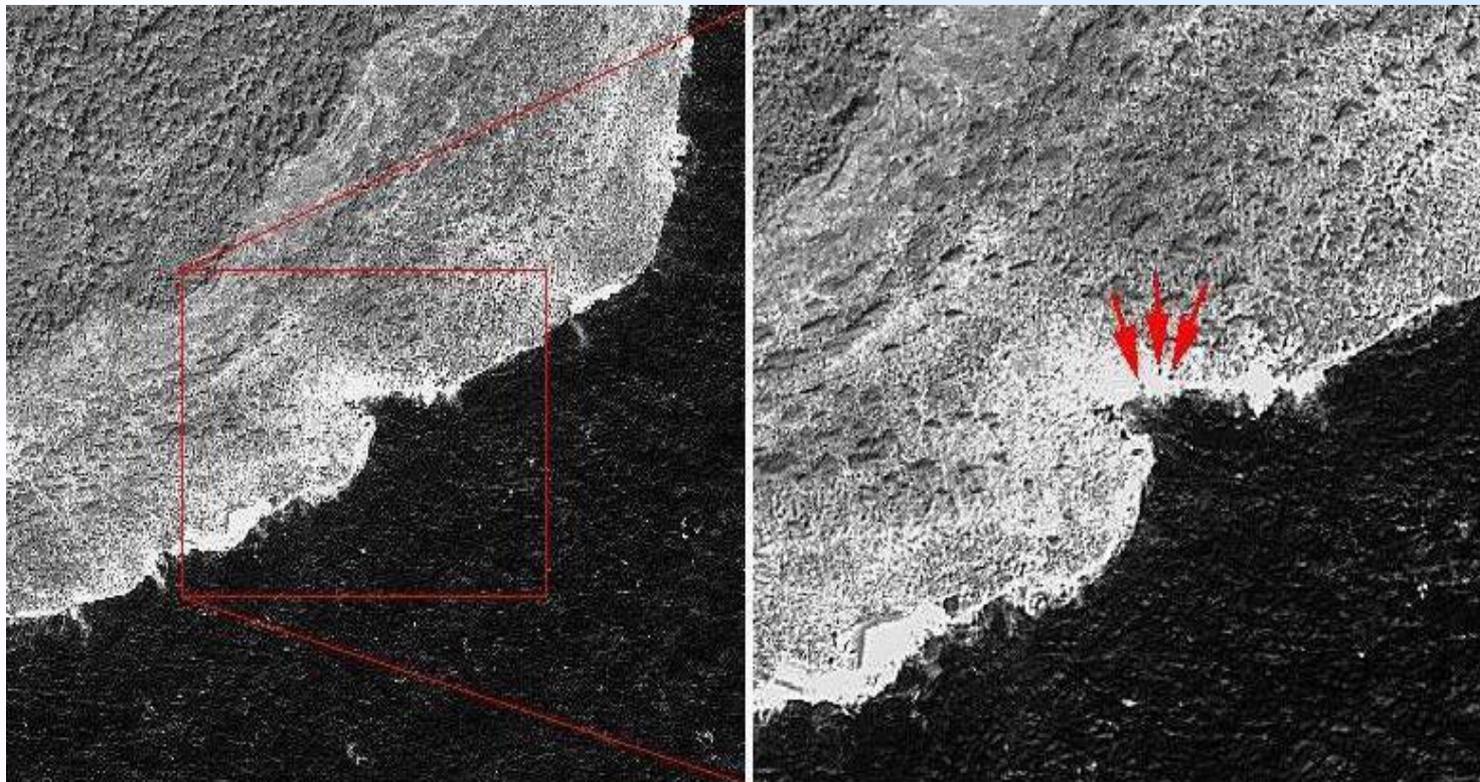
Ocean Island Monitoring



IKONOS: 9/9/00



Navassa Island - IKONOS Pan

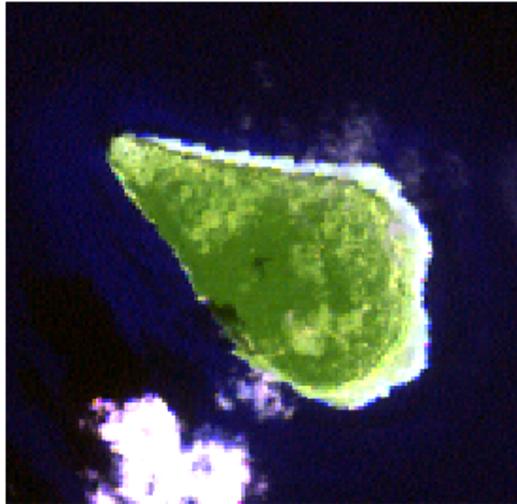


 Tsunami displaced boulders

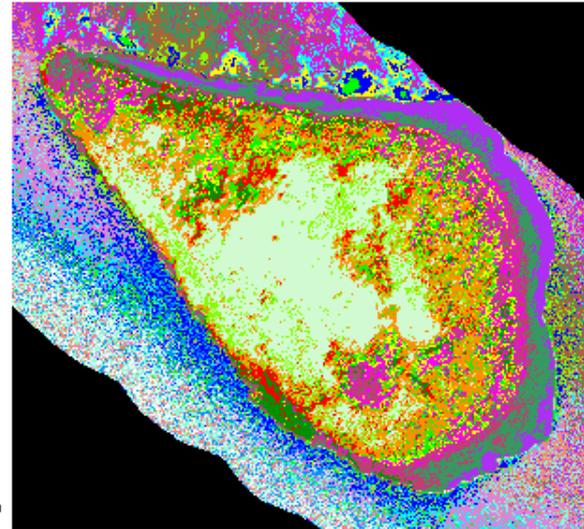
SW Terrace



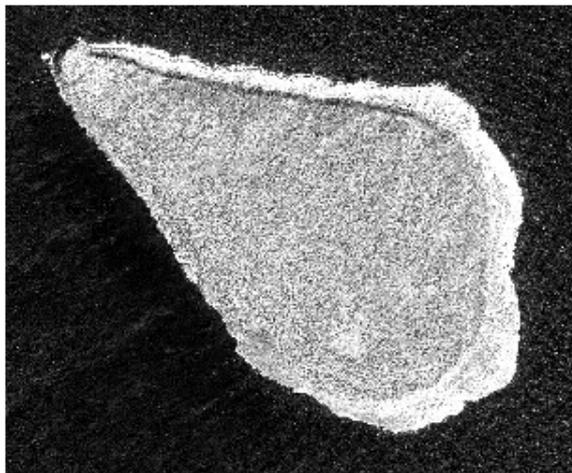
Navassa Island



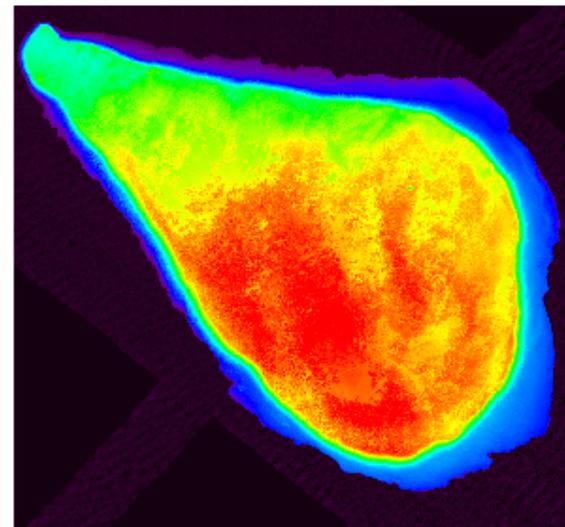
Landsat 7:
Jan. 2000



ASAS:
Sept 1999

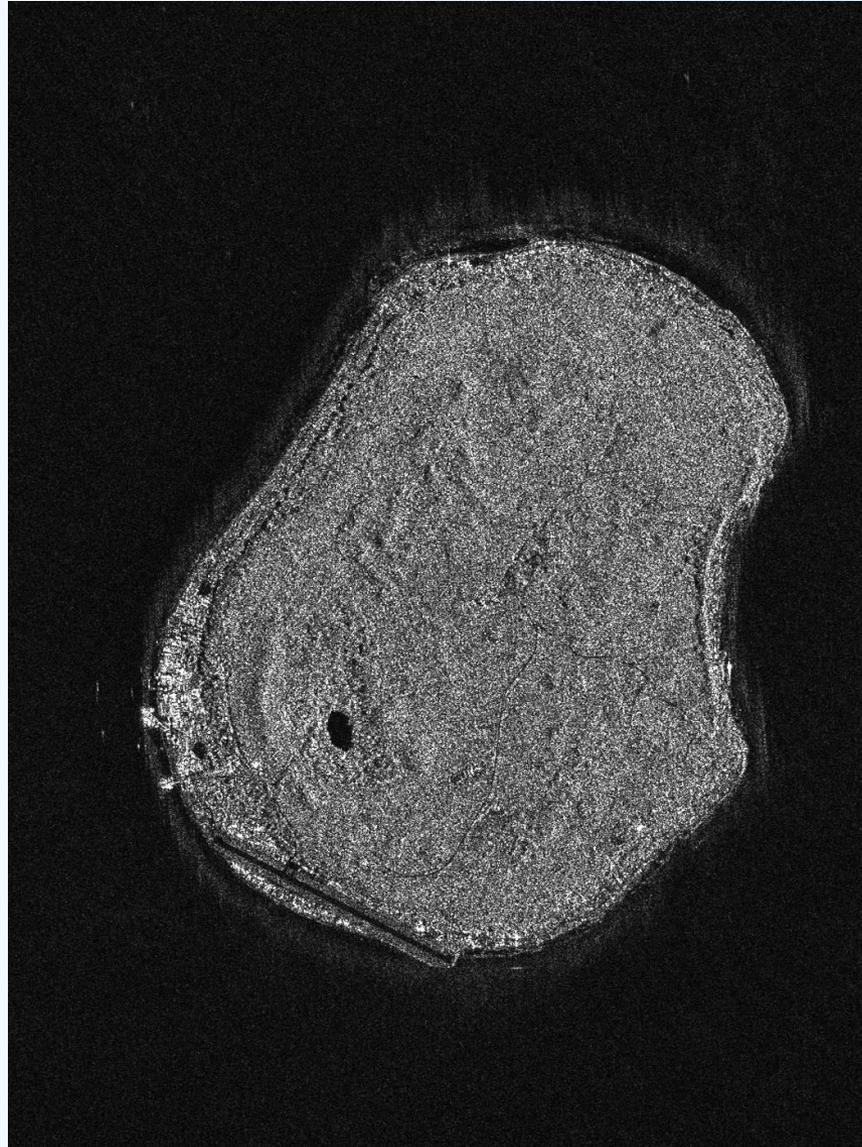


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Jan. 2000

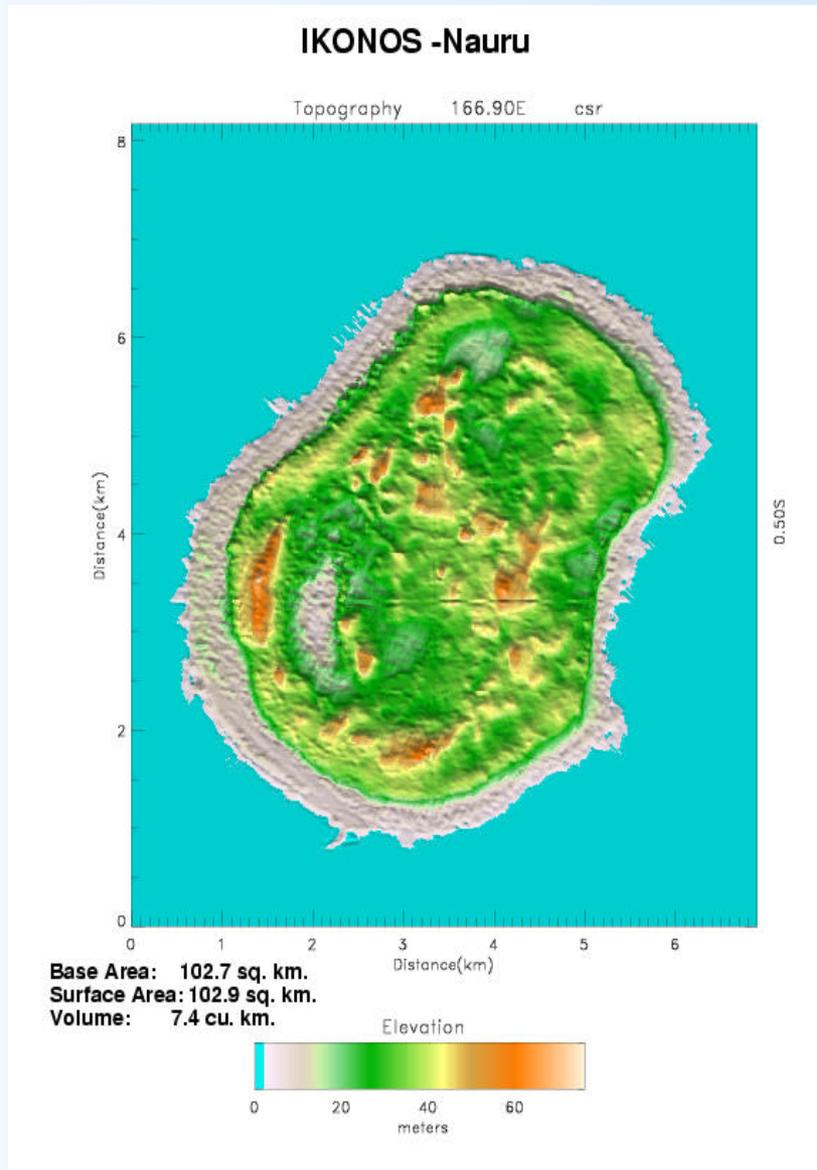
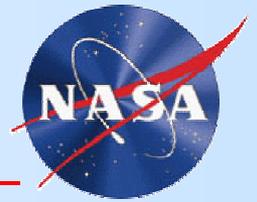


ATM:
Sept. 1999

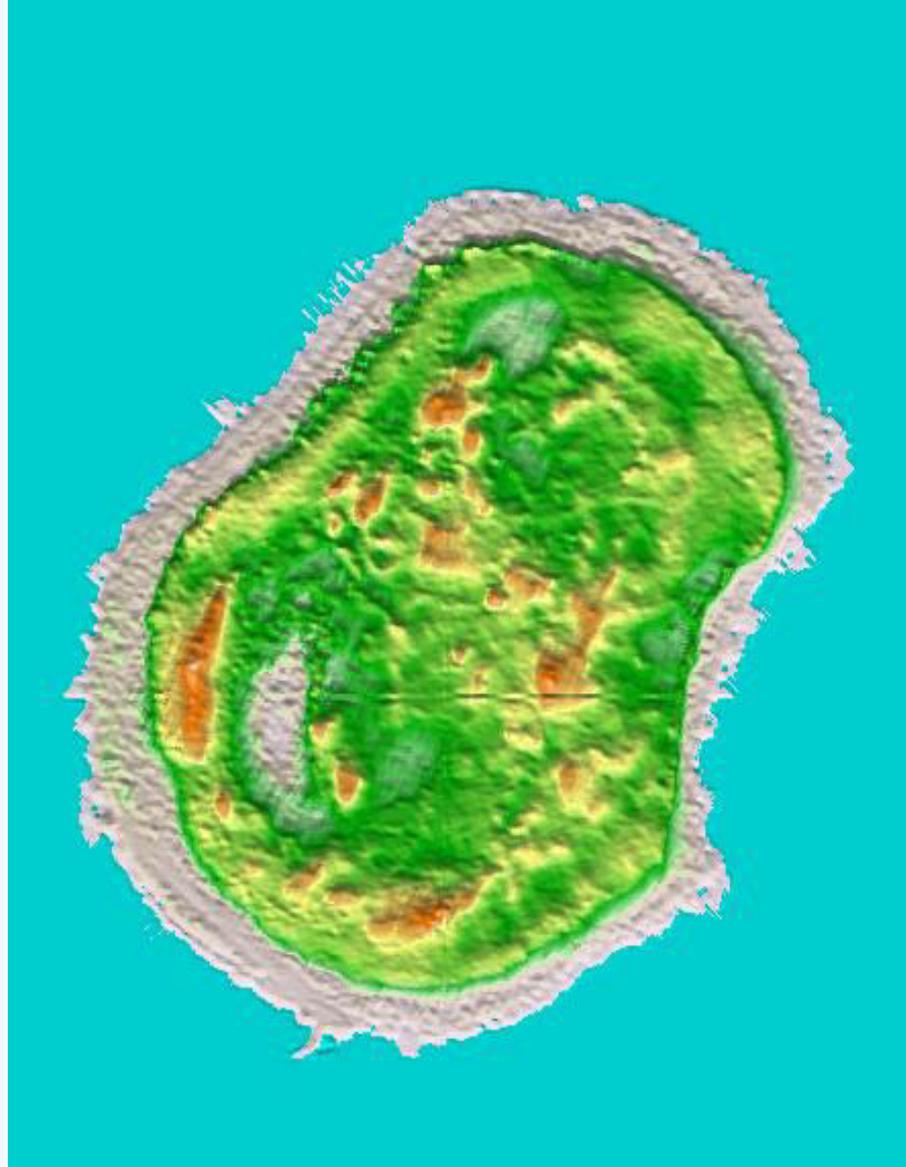
Nauru Island RADARSAT Context Image



IKONOS DEM of Nauru Island

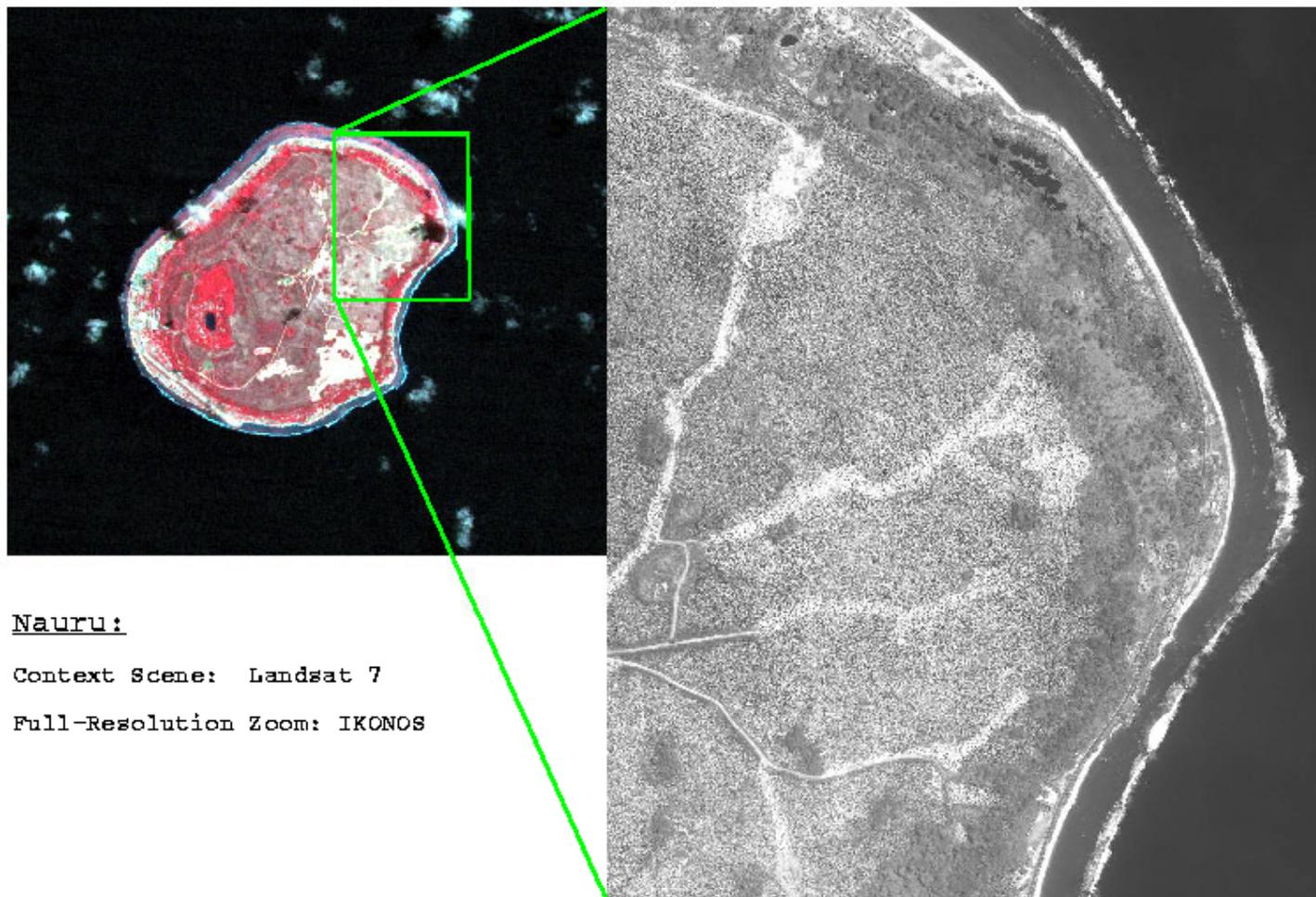


IKONOS DEM of Nauru Island





Nauru Island

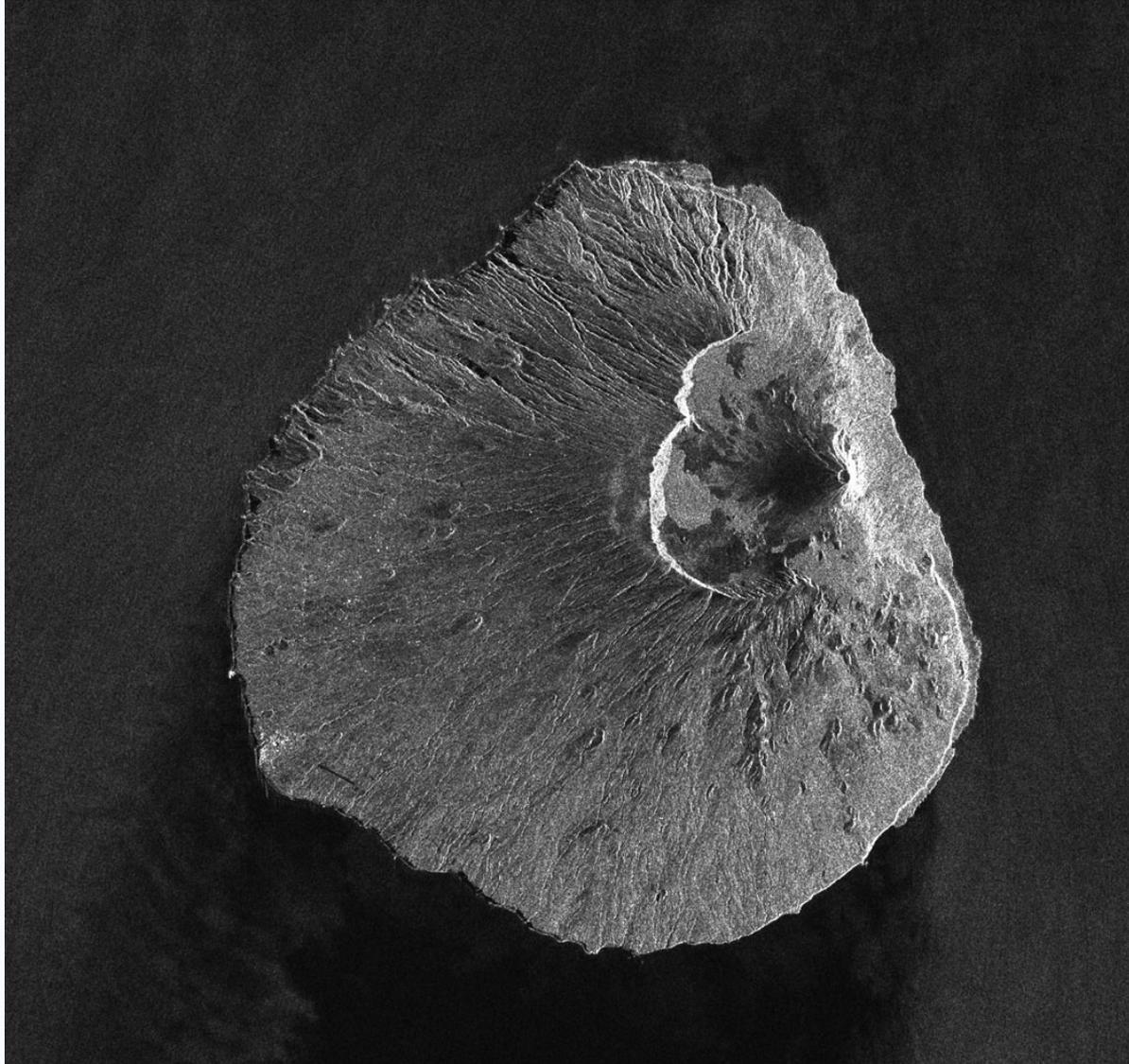


Nauru:

Context Scene: Landsat 7

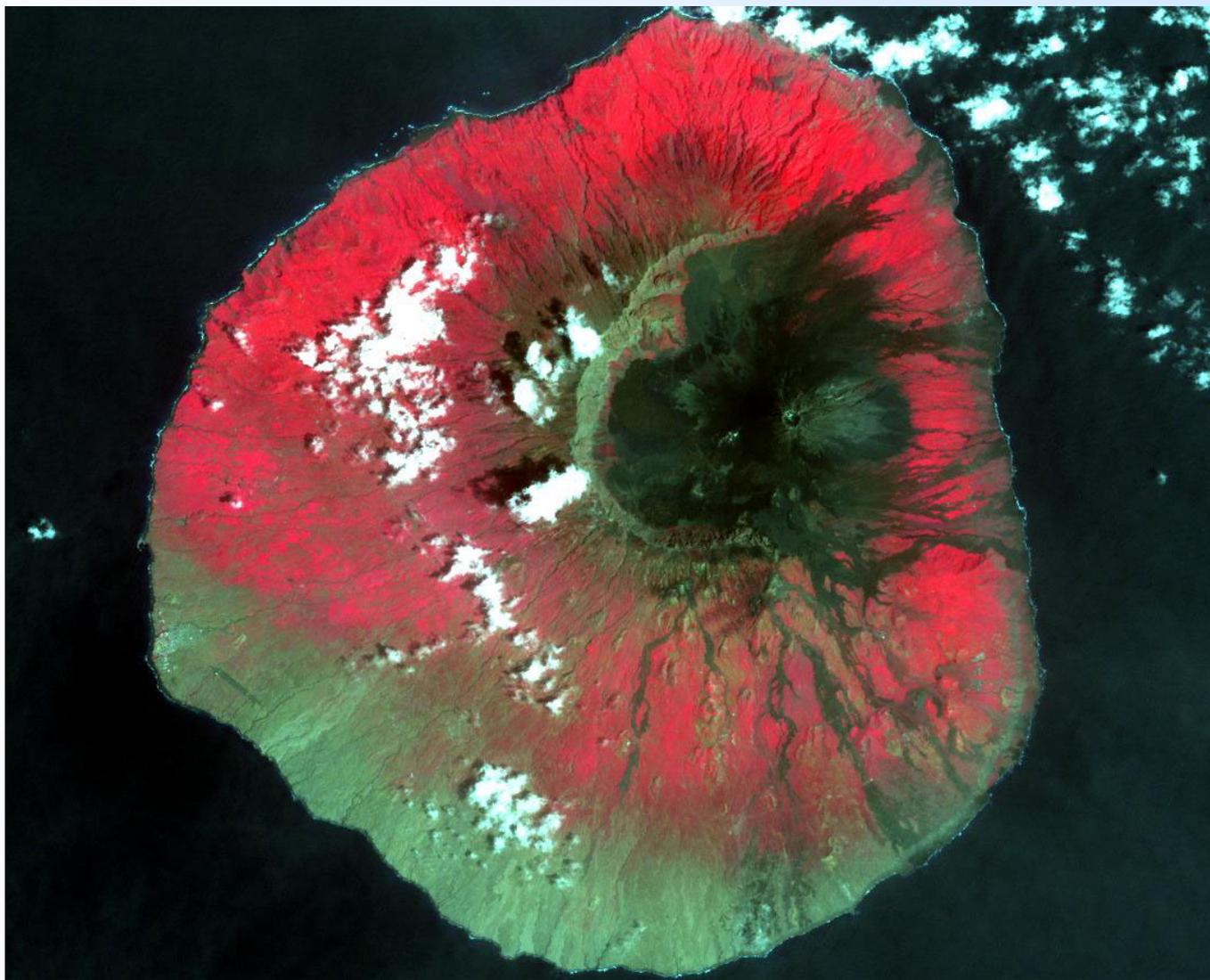
Full-Resolution Zoom: IKONOS

Fogo Island RADARSAT Context Image





Fogo Island

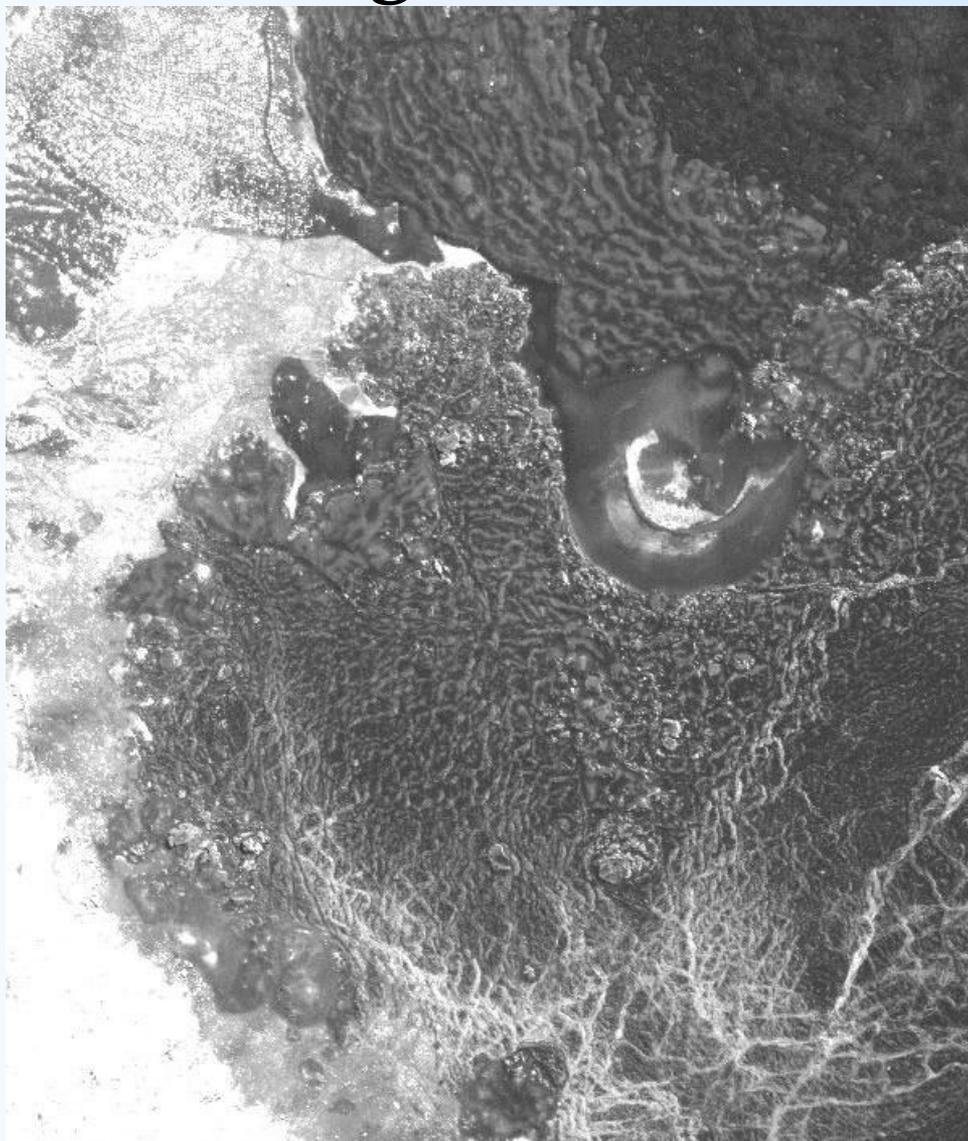


Landsat-7: 543

9/20/99



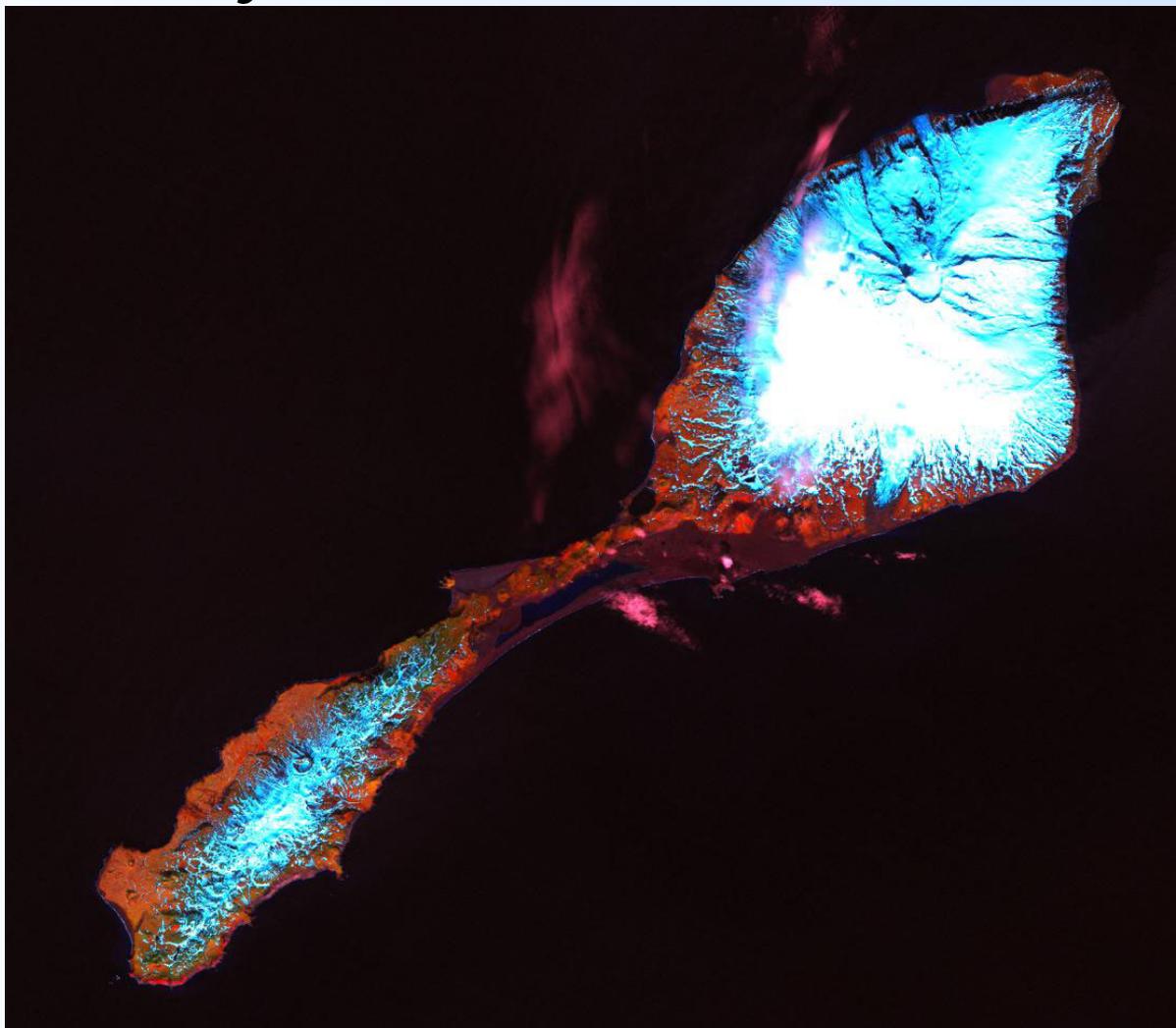
Fogo Island



1995 Eruptive Vent within Fogo Caldera



Jan Mayen Island, North Atlantic

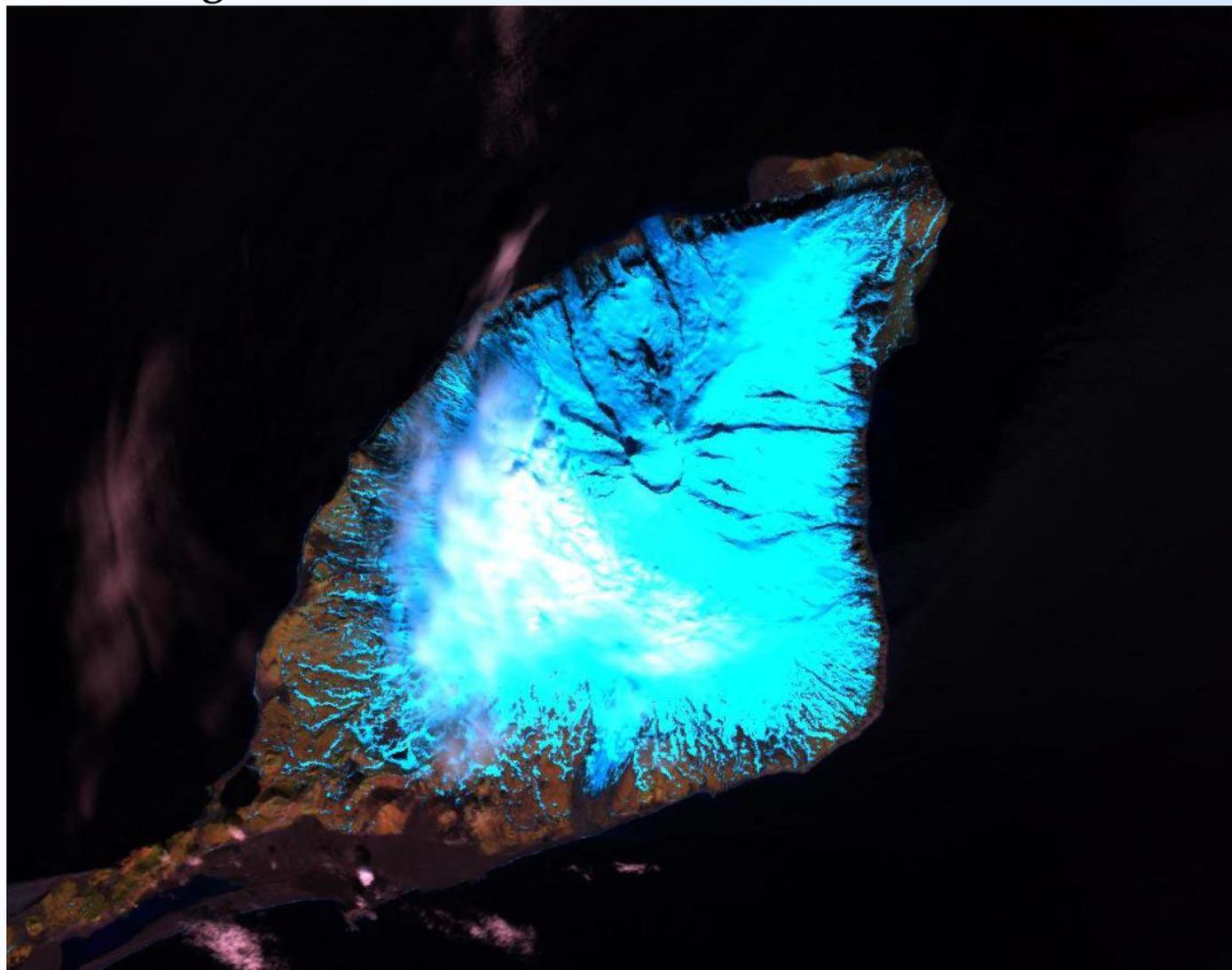


IKONOS (Approved for Summer '02)



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
 - Niuafo'ou (Tonga)
 - Jarvis
 - St. Paul's Rocks
 - Aldabra



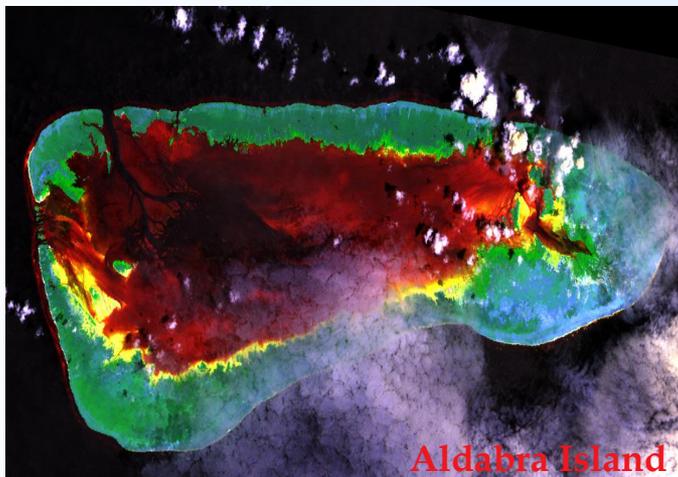
Summary

- **Established 1st Sub-meter Imaging Time Steps (t_0) 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?



Ocean Island Monitoring



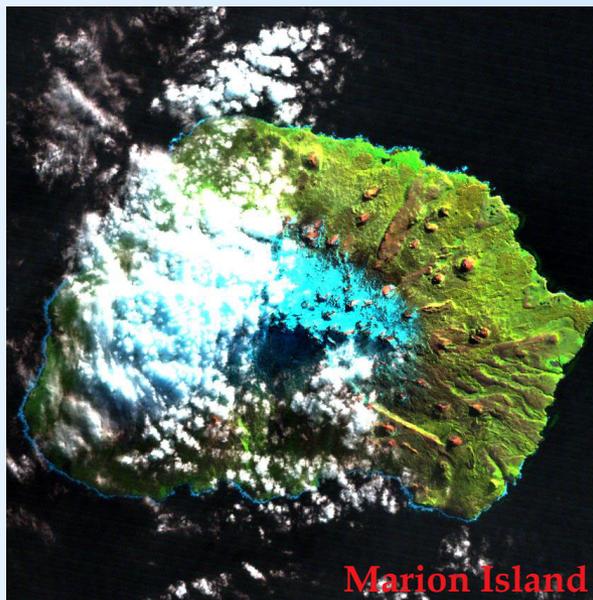
Aldabra Island



Niufo'ou Island



Gough Island

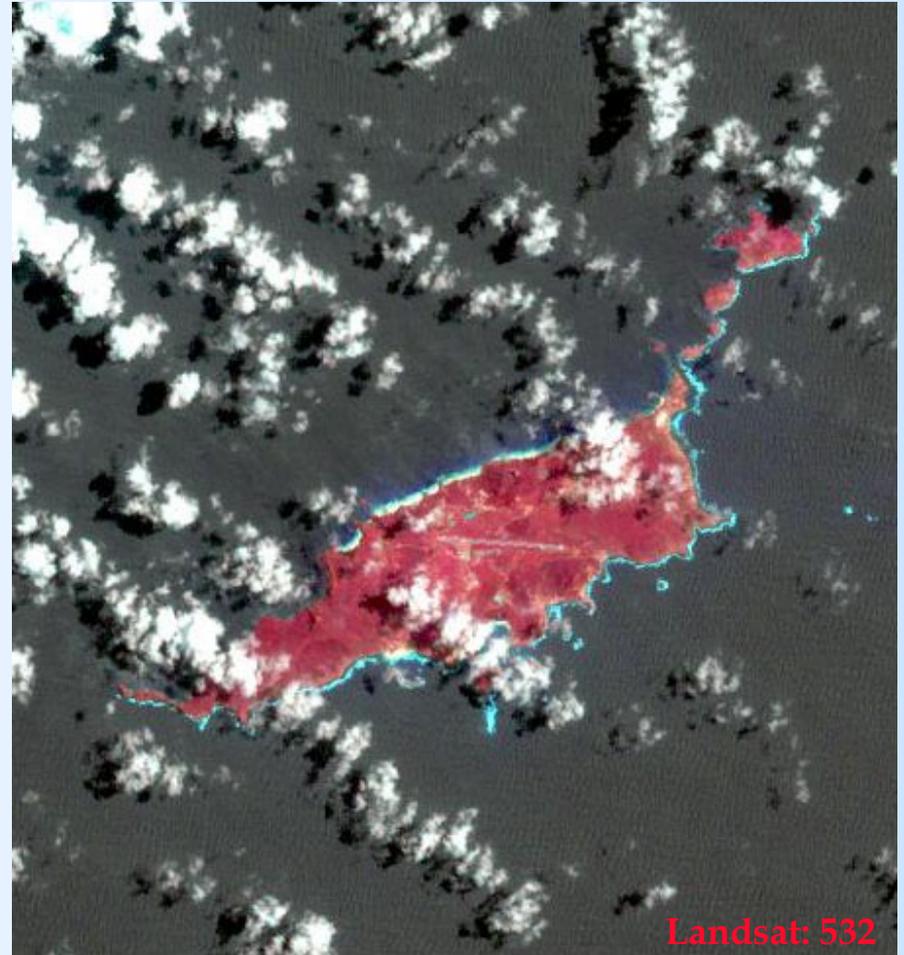
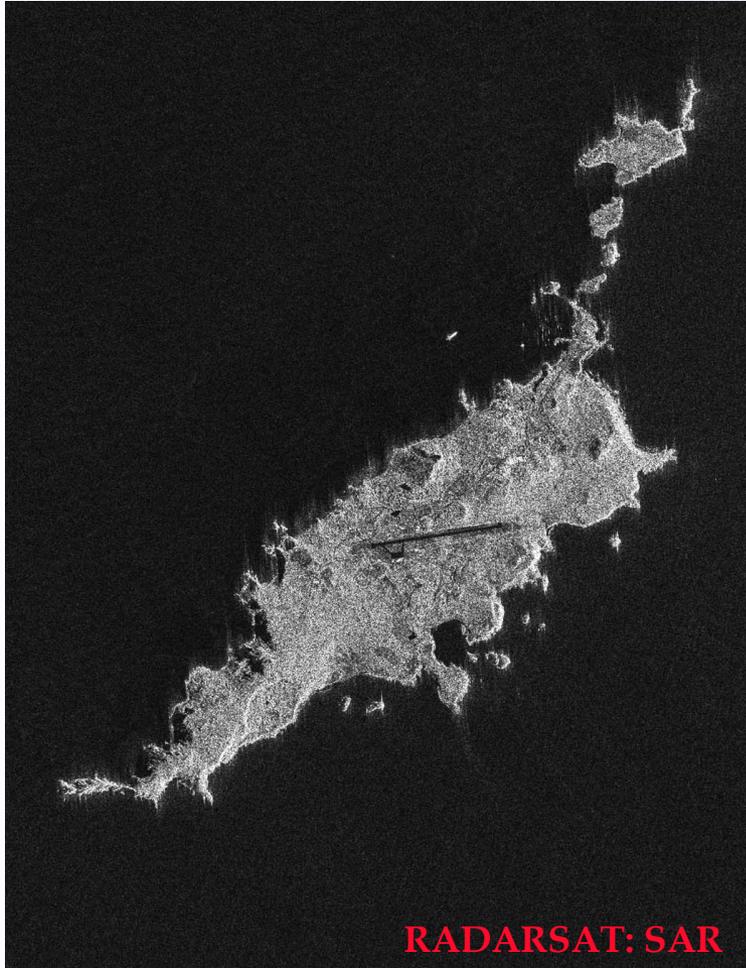


Marion Island

Future IKONOS Island Monitoring: Fernando de Noronha



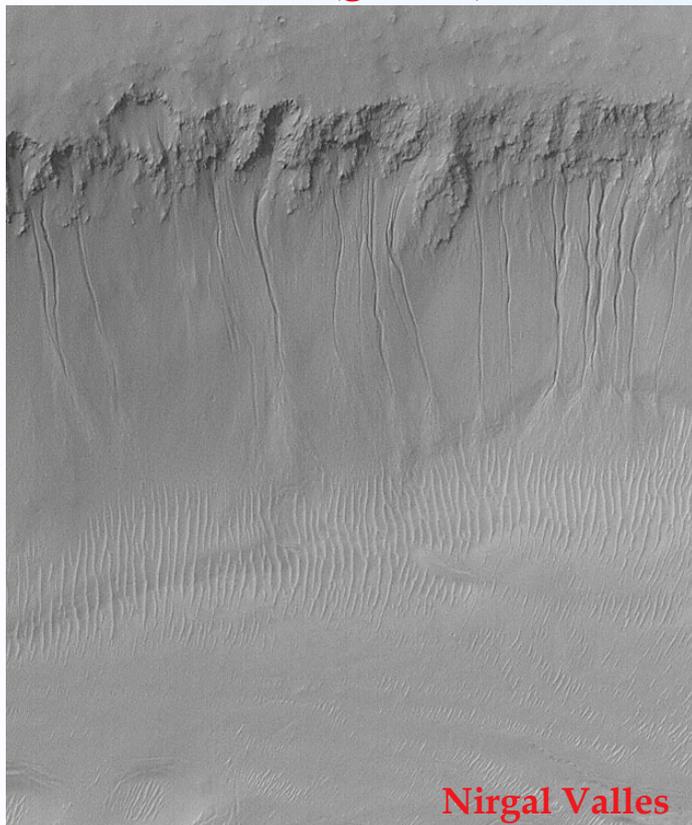
Ocean Island Monitoring



Value of Sub-meter Imaging in Terrestrial Analogue Studies



Mars (gullies)



Nirgal Valles

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)**
- **Continuing Support by the NASA Office of Earth Science:**
 - **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)**