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An Overview of Imaging Radar and Commercial Space Systems

May 2011

Thomas P. Ager
Lead Radar Engineer
NGA Acquisition

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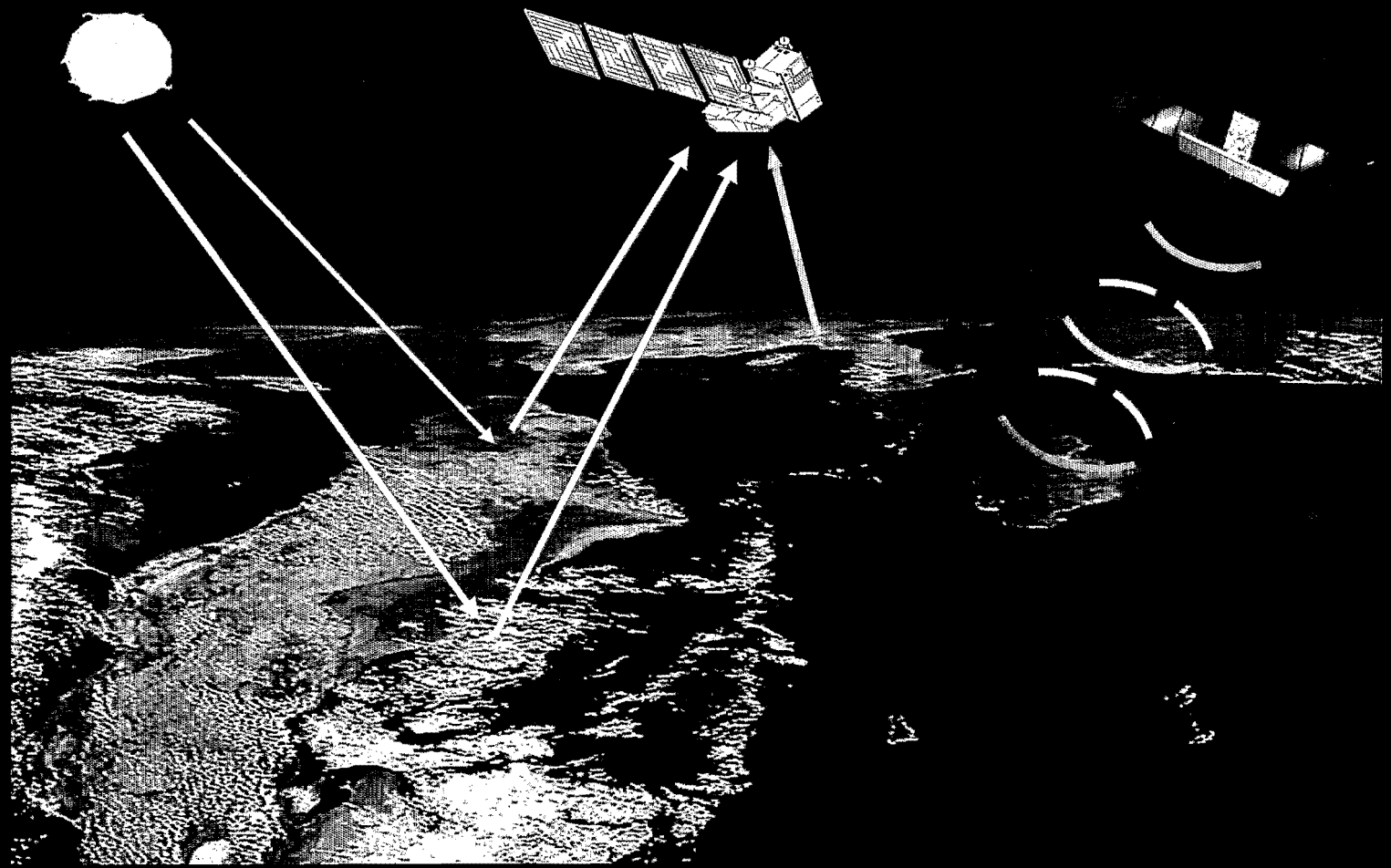
The Basis of Imaging



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For Radar Clouds Don't Matter

Properly selected radar frequencies are not affected by the atmosphere

Clouds, dust, gas content, rain

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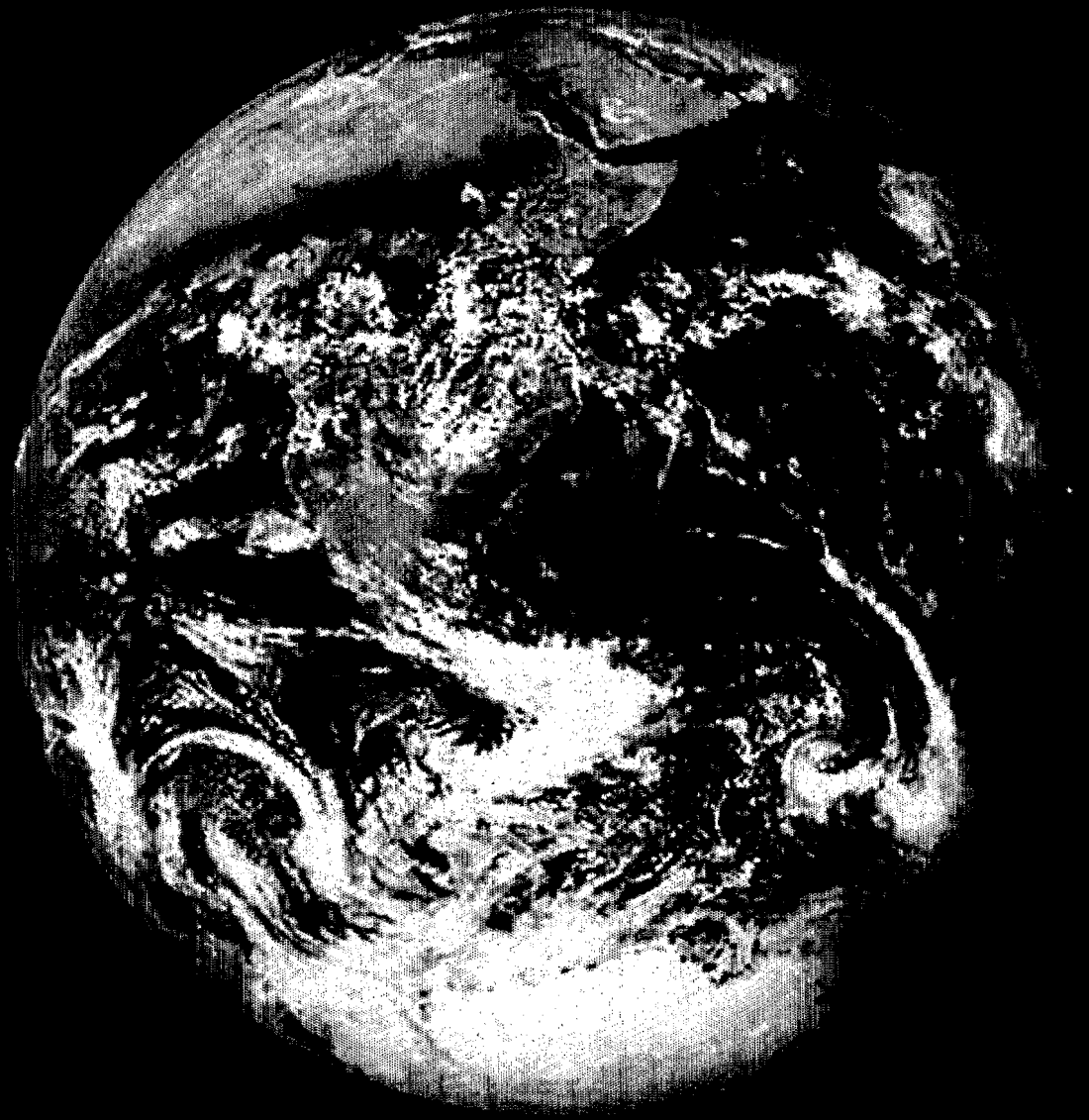
Planet Ocean



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Other Useful Properties

- Sunlight not needed
  - Active sensor that provides its own illumination
- Synthetic Aperture Radar (SAR) technique provides high resolution
  - Resolution is based on the characteristics of the pulses and collection time
  - Distance does not degrade resolution
- There is no lens… So, flexible resolution and coverage in one system
  - High resolution, small area
  - Mid resolution, medium area
  - Low resolution, large area
- Coherent nature of radar energy
  - Harmonic synchronicity

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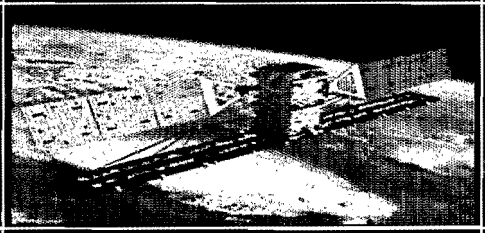
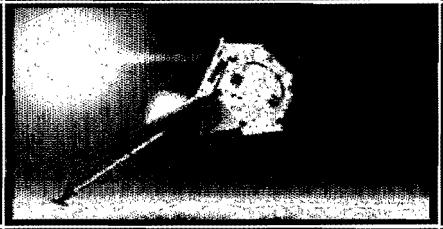
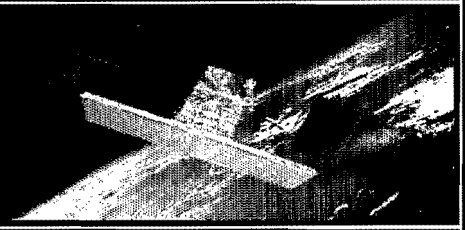
The New Commercial Space Radars

	RADARSAT2	TerraSAR-X TanDEM-X	Cosmo-Skymed
			
Launch Date	14 Dec 2007	15 July 2007 21 June 2010	8 Jun and 12 Dec 2007 25 Oct 08, 5 Nov 2010
Frequency Band	C-Band	X-Band	X-Band
Channel Polarization	Quad	Dual	Dual
Nominal Target Revisit Time at mid-latitudes	3 days	2.5 days	0.5 days (4 vehicles)
Best Resolution	0.8 m x 3 m	1 m	1 m
Widest Swath	500 km	100 km	200 km

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Cosmo Skymed *Strait of Gibraltar*

Notice the geometry of collection…

Long duration exposure, side looking, long distance from ground area

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COSMO SkyMed

Strait of Gibraltar

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COSMO SkyMed

Myanmar Flooding in Irawady River Delta

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COSMO SkyMed

Antarctic Ice

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TerraSAR-X

Copper Mine, Chile

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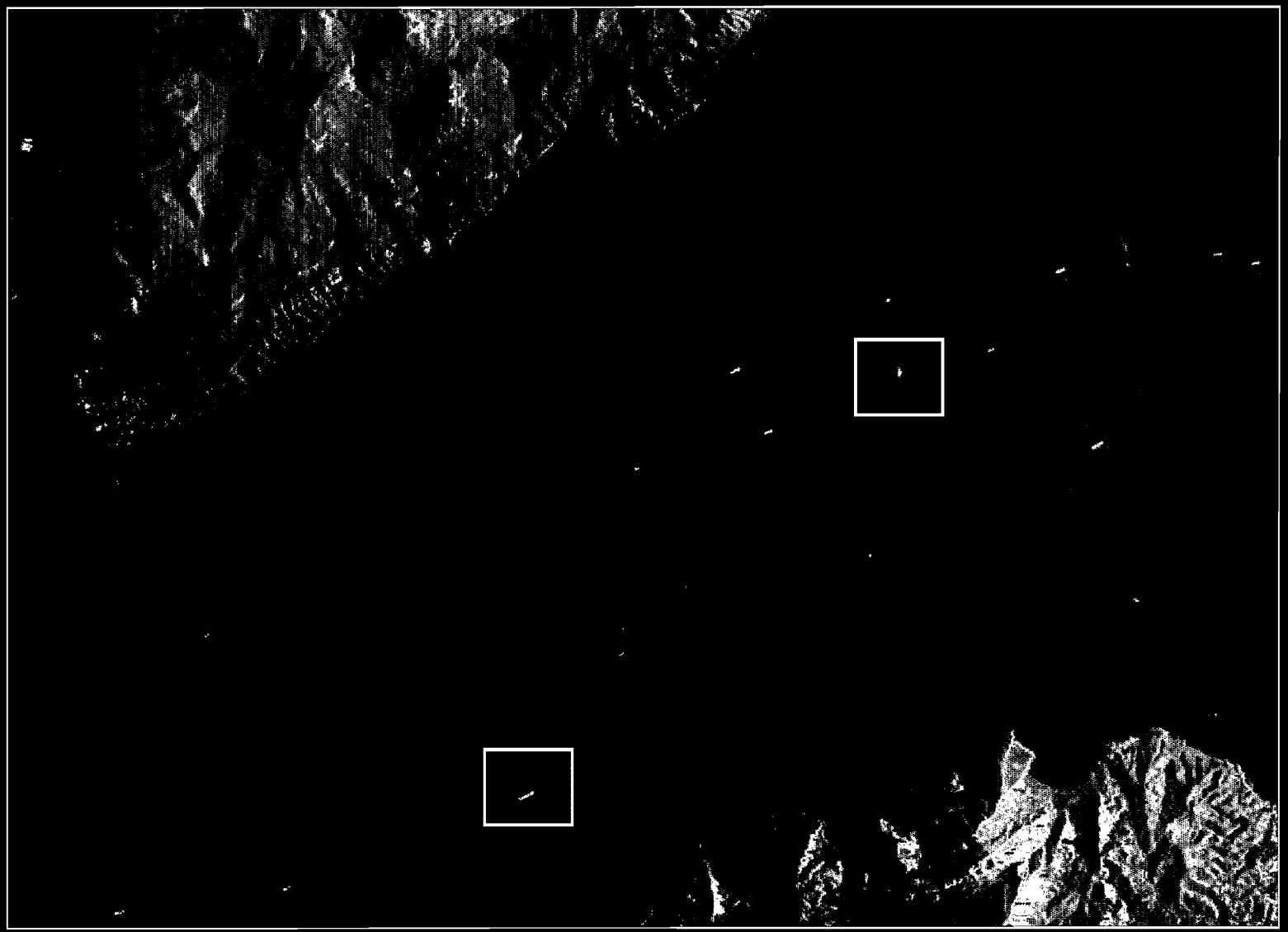
TerraSAR-X

Ships, Wakes, Displacement



Strait of Gibraltar

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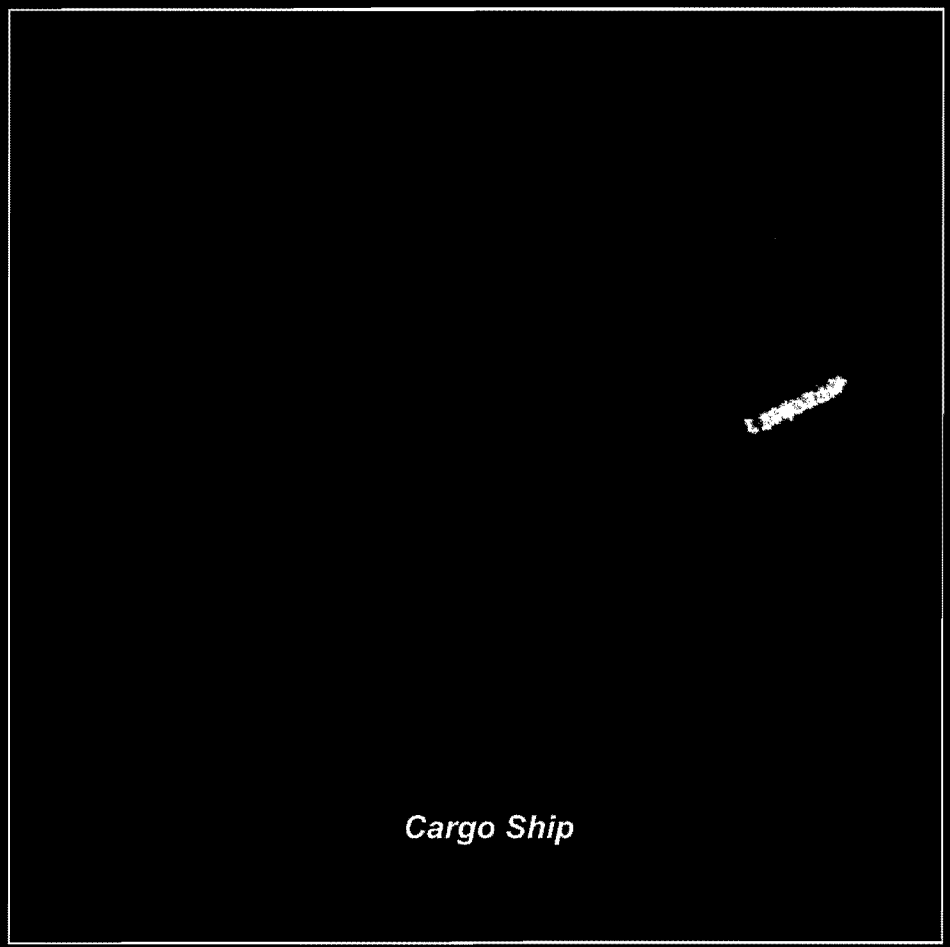
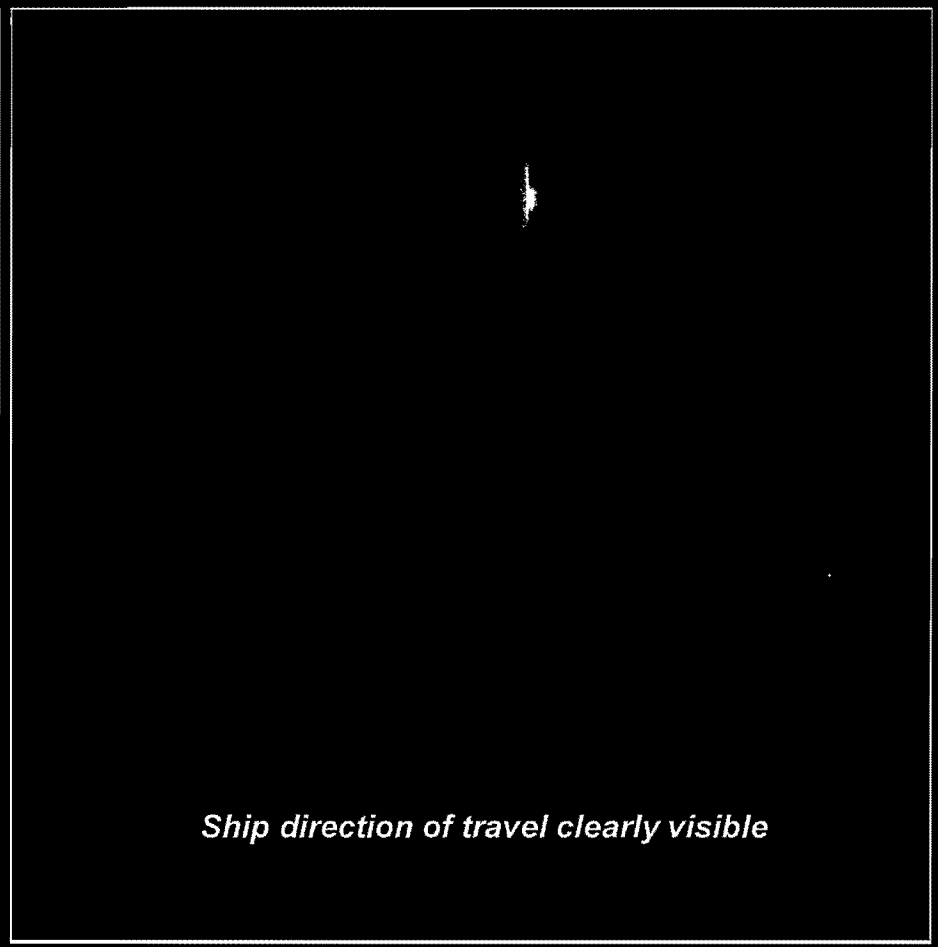


Cargo Ship



Ship direction of travel clearly visible

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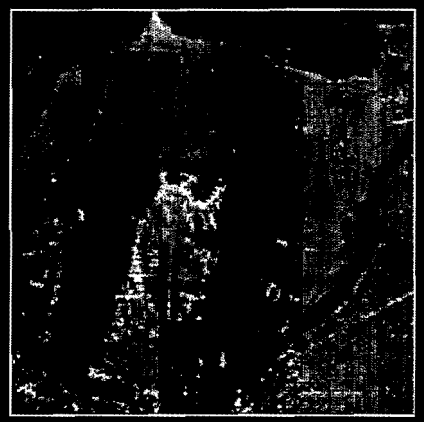
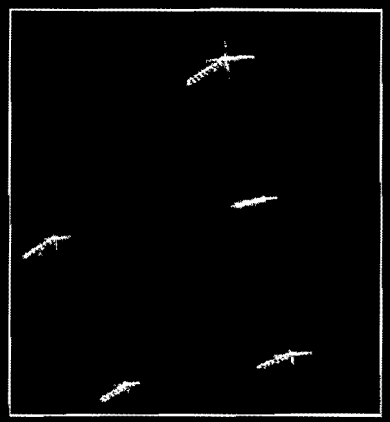
RADARSAT 2

Vancouver, BC





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RADARSAT 2 Multi-Pol

Gulf of St Lawrence

RADARSAT 2

Mode: ScanSAR Narrow

Polarity: HH

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RADARSAT 2 Multi-Pol

Gulf of St Lawrence

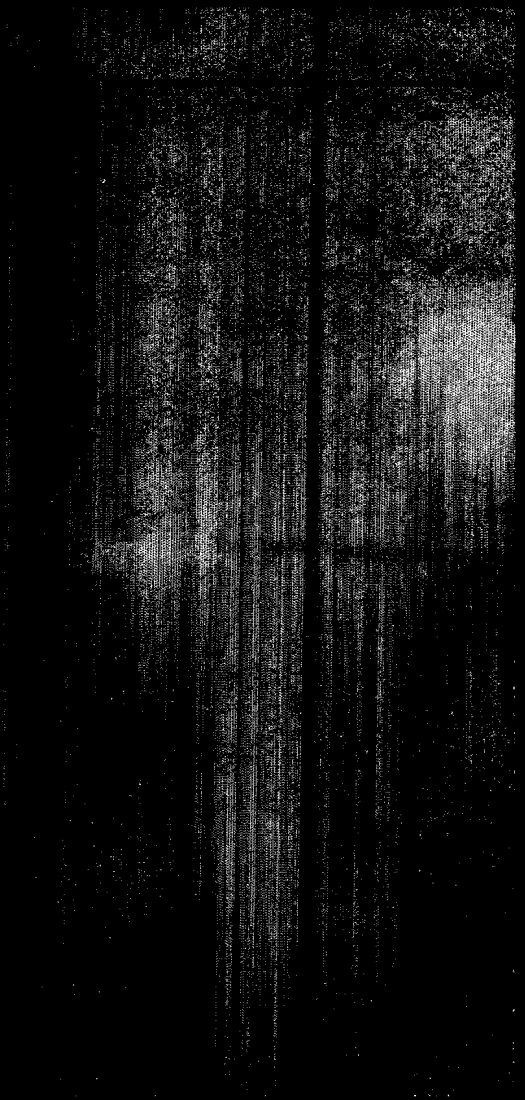
RADARSAT 2

Mode: ScanSAR Narrow

Polarity: HH

Note the texture of the water returns. Notice any valuable information ?

Perhaps we'd see it better if we could make the water disappear…



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RADARSAT 2 Multi-Pol

Gulf of St Lawrence

RADARSAT 2

Mode: ScanSAR Narrow

Polarity: HV

Mixed polarity… now use your ship detection software…

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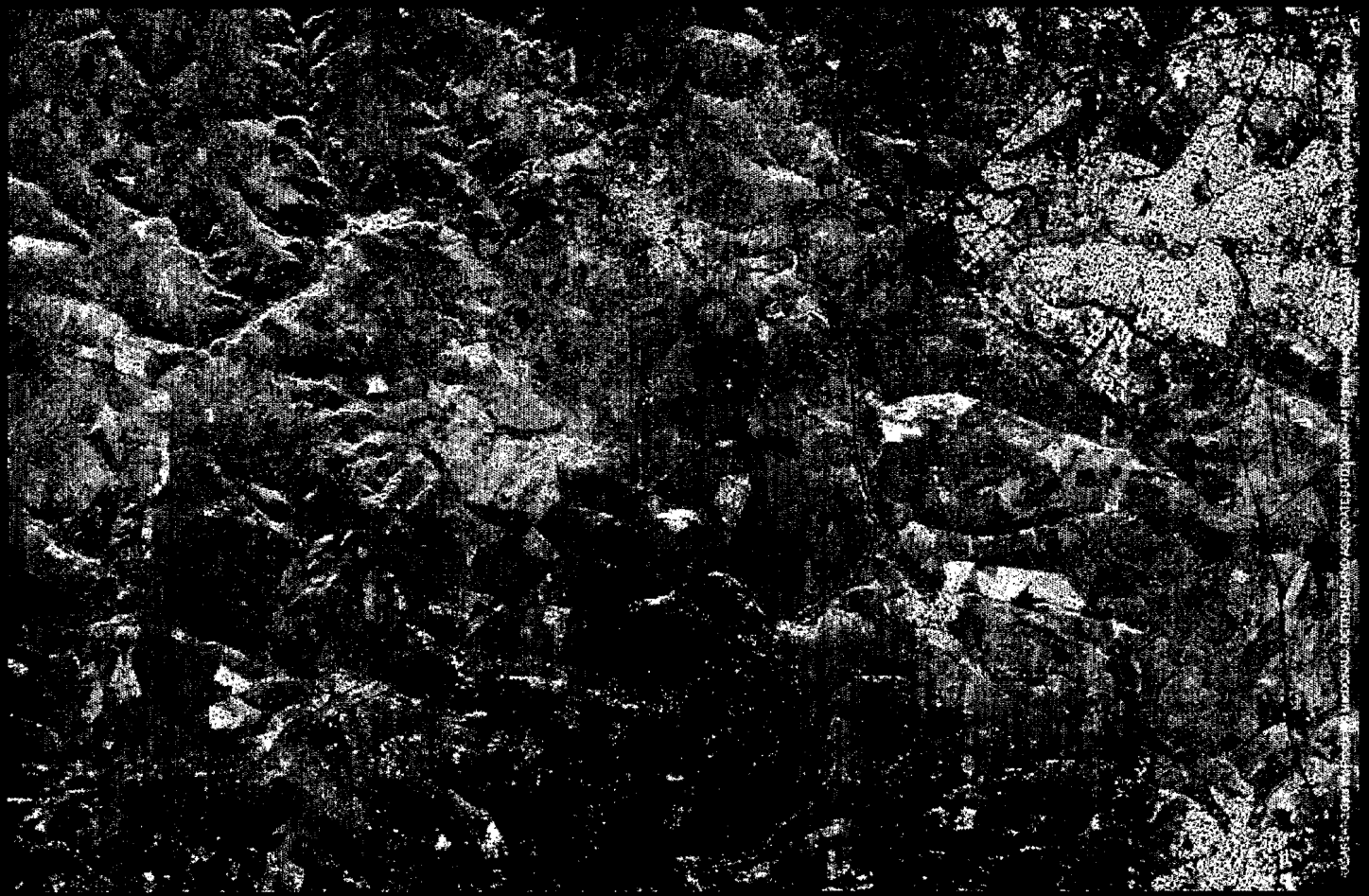
RADARSAT2

Traditional Grayscale Image, Brazil



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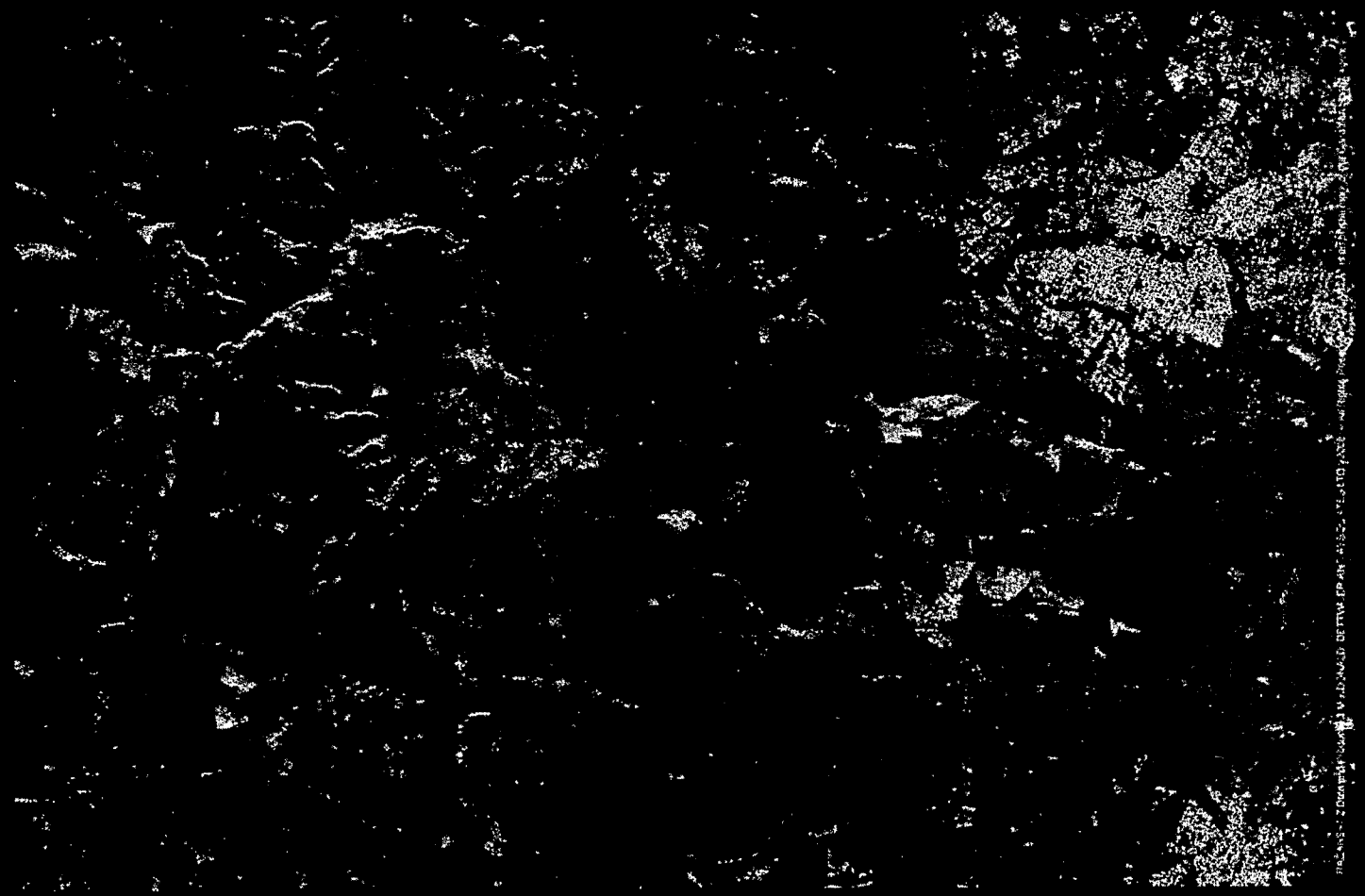
RADARSAT2

Quad Polarimetric, Brazil



HH, HV, VV, VH collected simultaneously

Three images projected through Red, Green, Blue color guns of monitor

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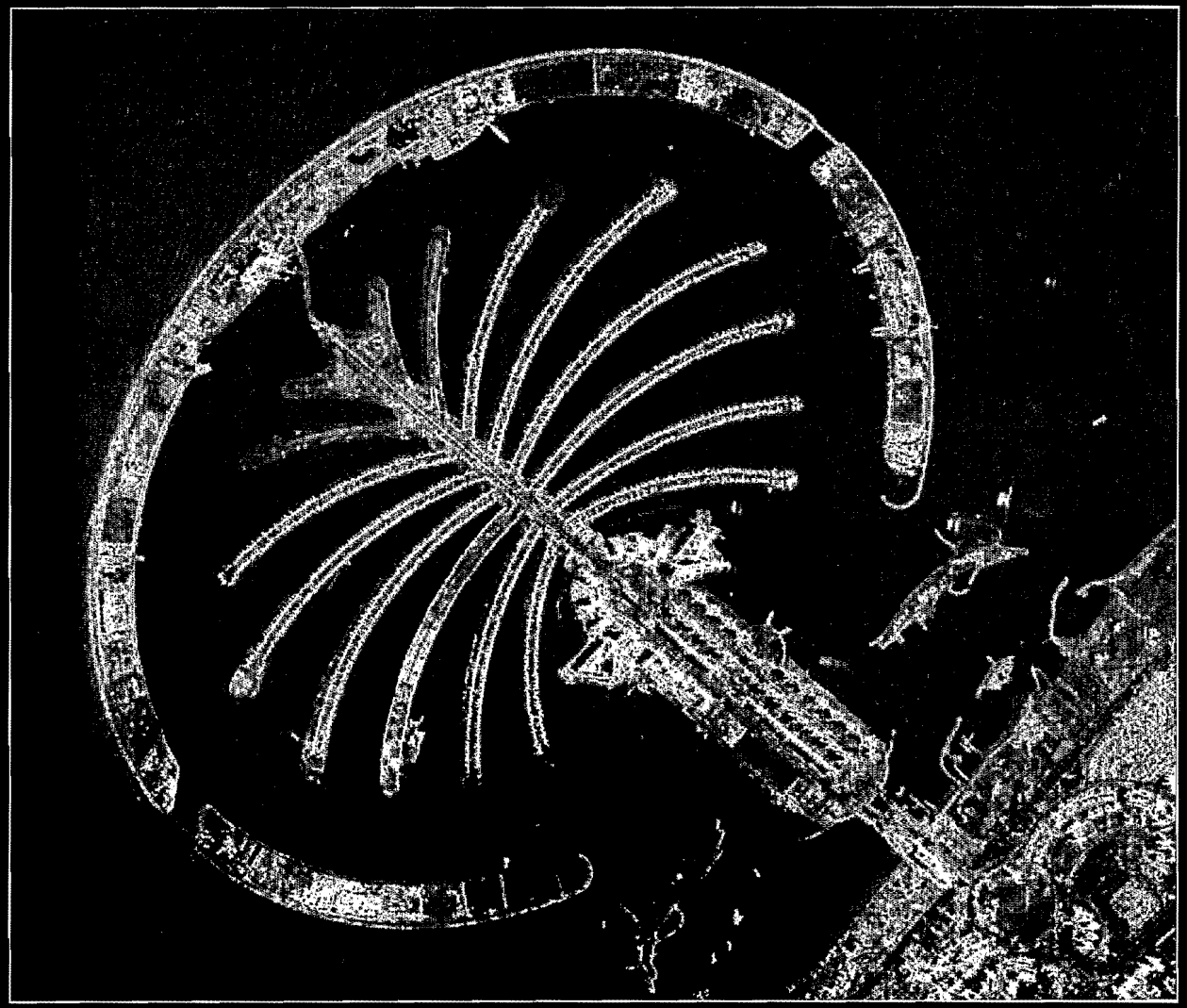
TerraSAR-X

Palm Island, Dubai



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Colorized Surface Texture Image

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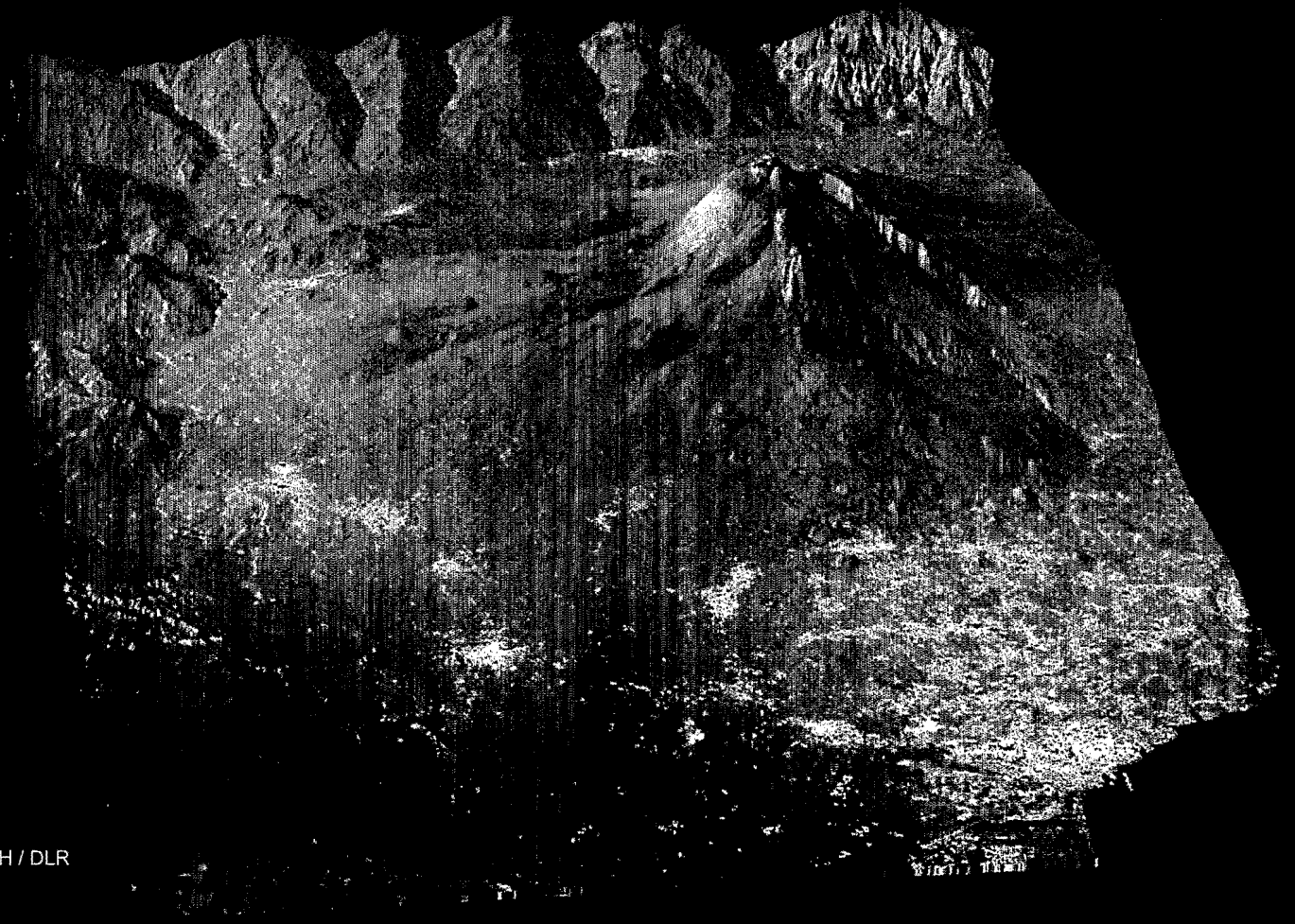
TanDEM-X System

IFSAR Elevation Model, Mt Etna



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Peterman Glacier... The Movie

Change Detection Series

Brought to you by Cosmo SkyMed

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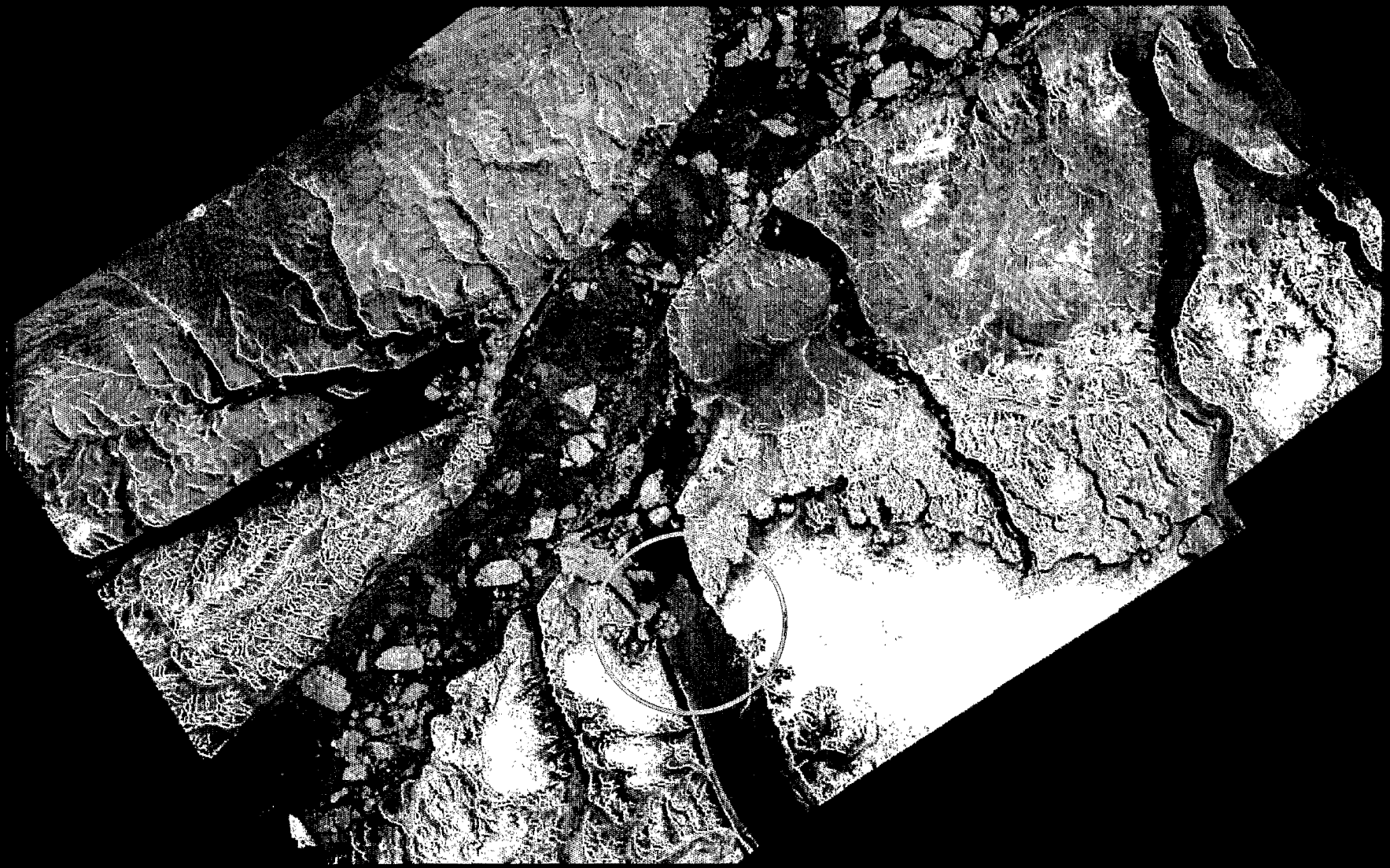

COSMO SkyMed ©ASI
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Slides show motion of glacier break up

Deleted to reduce file size

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The Beautiful Sensor

Properly selected frequencies are not affected by the atmosphere

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The Beautiful Sensor

Properly selected frequencies are not affected by the atmosphere

Radar illumination is not reliant on sunlight

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Radar processing generates images and many other products

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She will be there when you need her

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She will be there when you need her

And …

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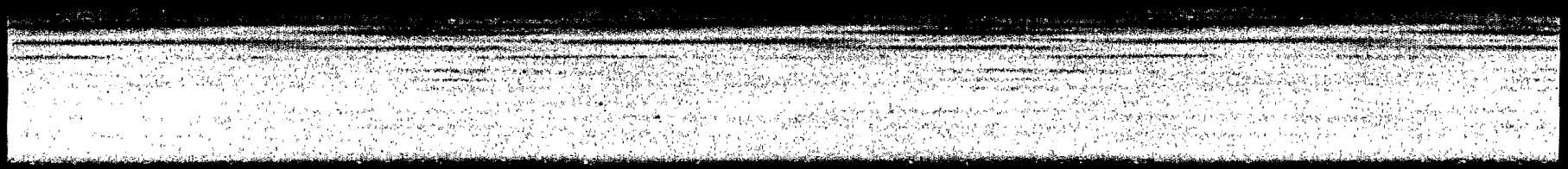
The Beautiful Sensor

Radars emit waves in harmonic synchronicity

and the characteristics of the echoes are measured with exquisite precision



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Thank You

Danke

Grazie