



Space Helps to Preserve World Heritage Sites

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in der Helmholtz-Gemeinschaft

Aeronautics

Space

Energy

Transport

Security



Research Center

&

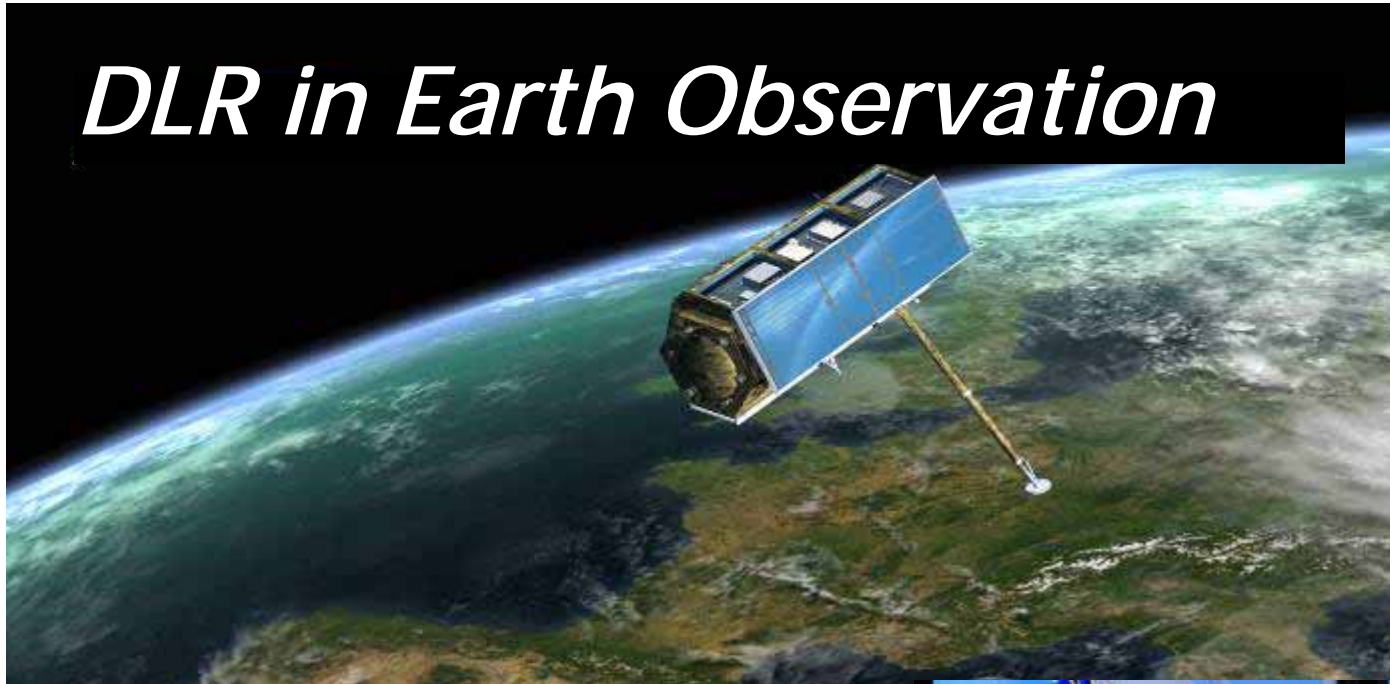
Space Agency

&

Project Management Office



DLR in Earth Observation





890 World Heritage sites inscribed

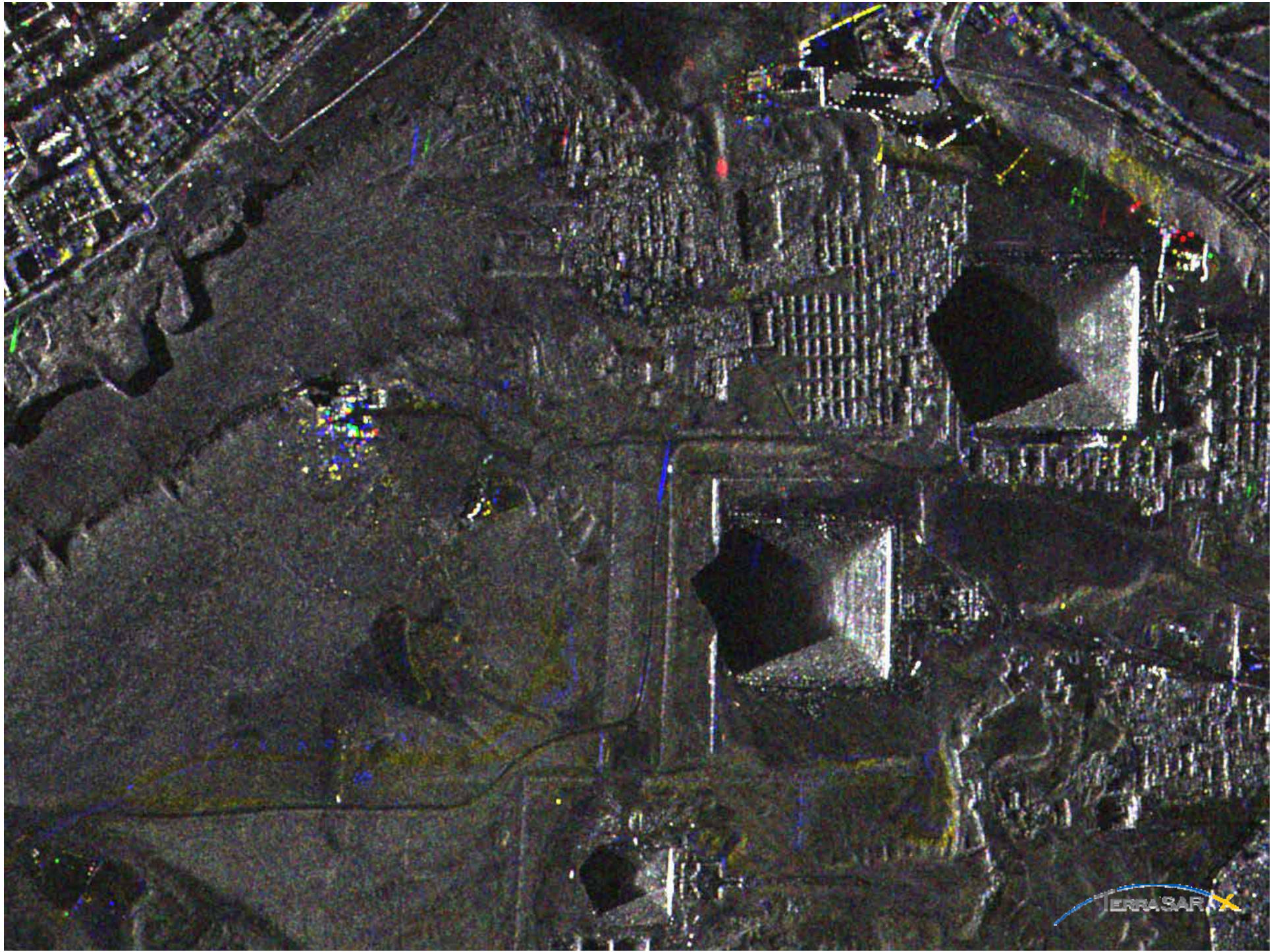


Major Threats for Cultural Heritage Sites:

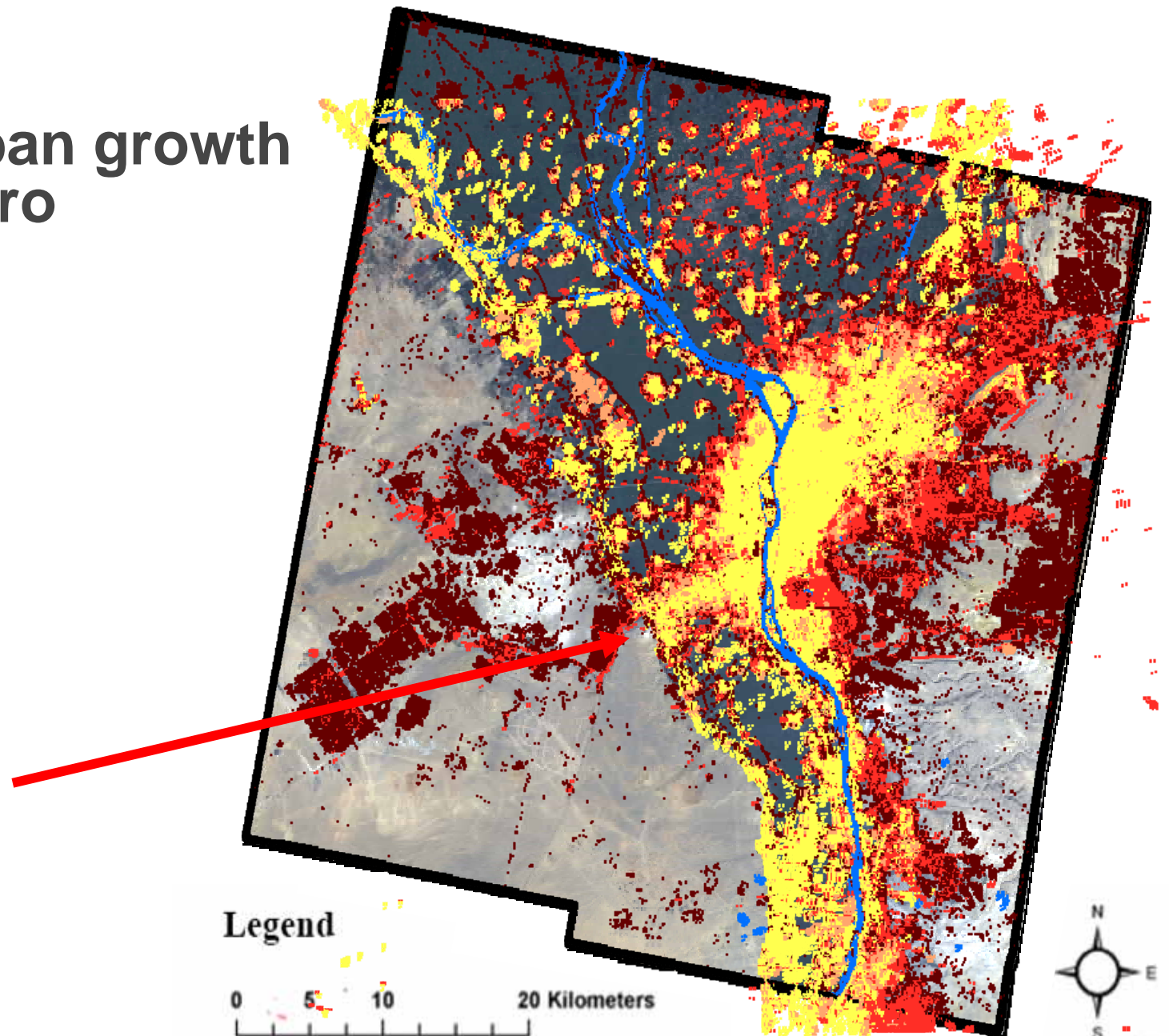
- excess of tourists
- looting of archaeological sites
- acid rain
- global warming
- natural catastrophes
- human developments

Remote Sensing:
excellent observation instrument





Urban growth Cairo



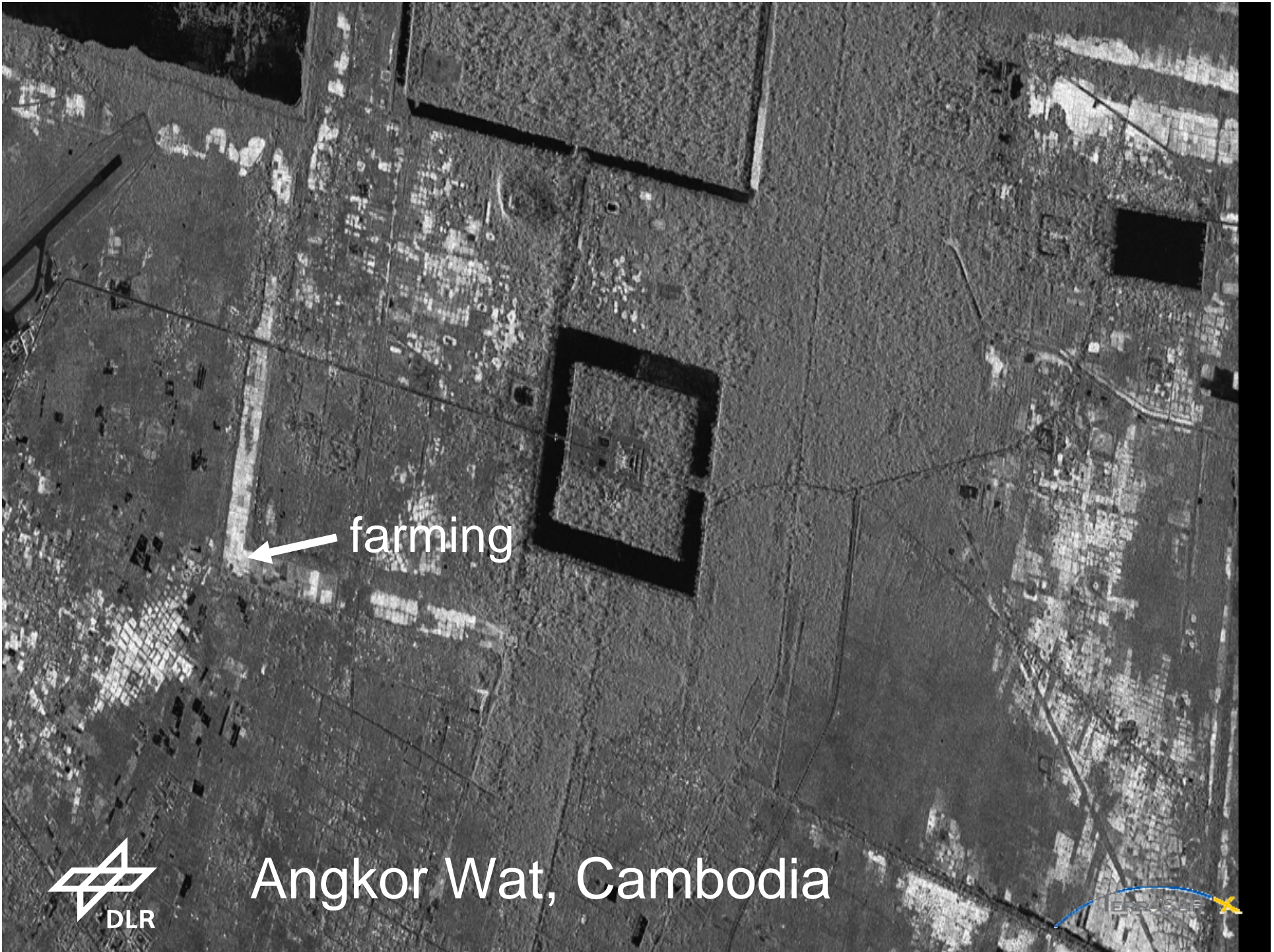
Legend



Urbanized area :	1972	2000
	1984	2008







Angkor Wat, Cambodia



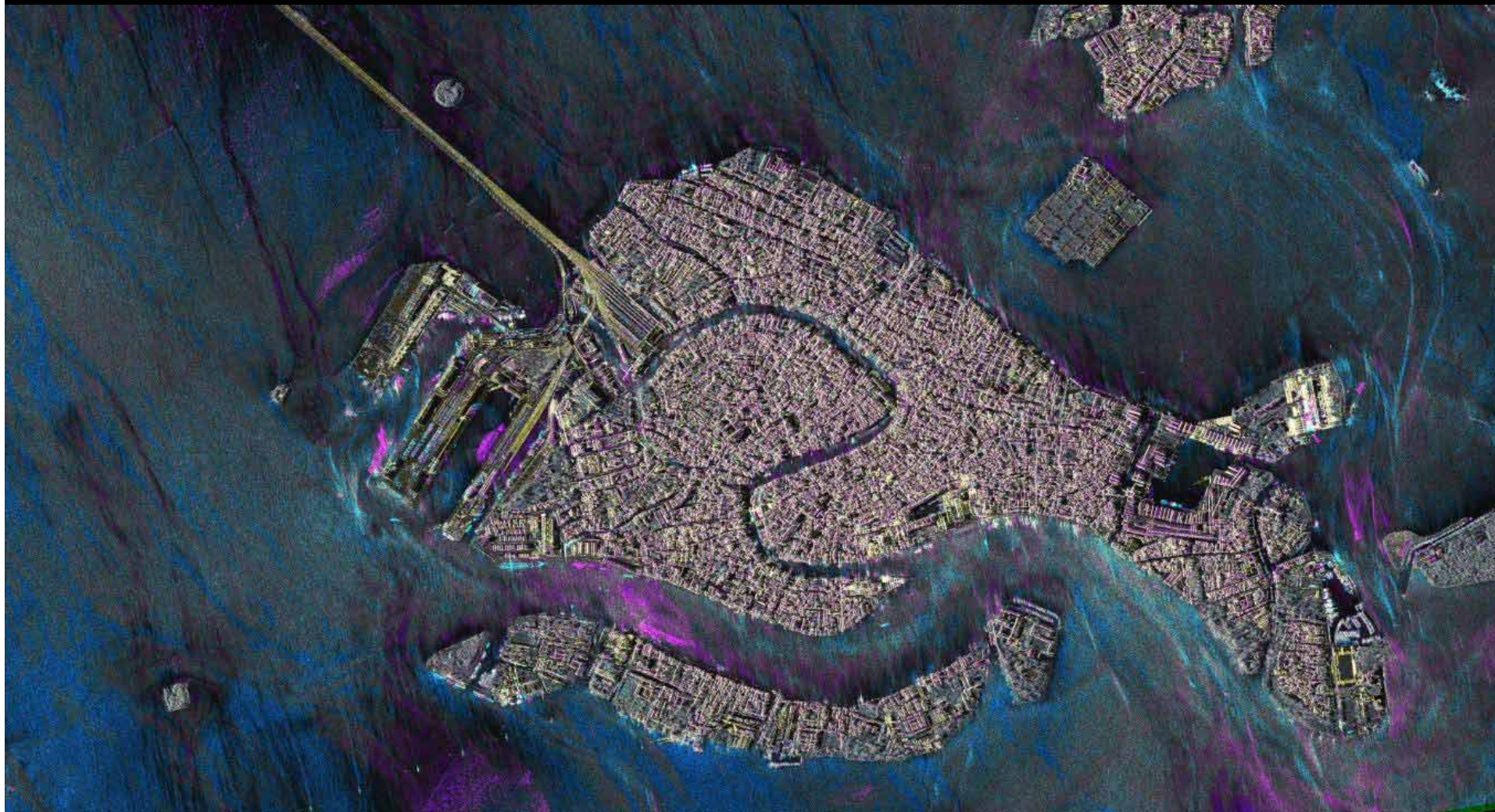
Machu Picchu, Peru



Machu Picchu, Peru

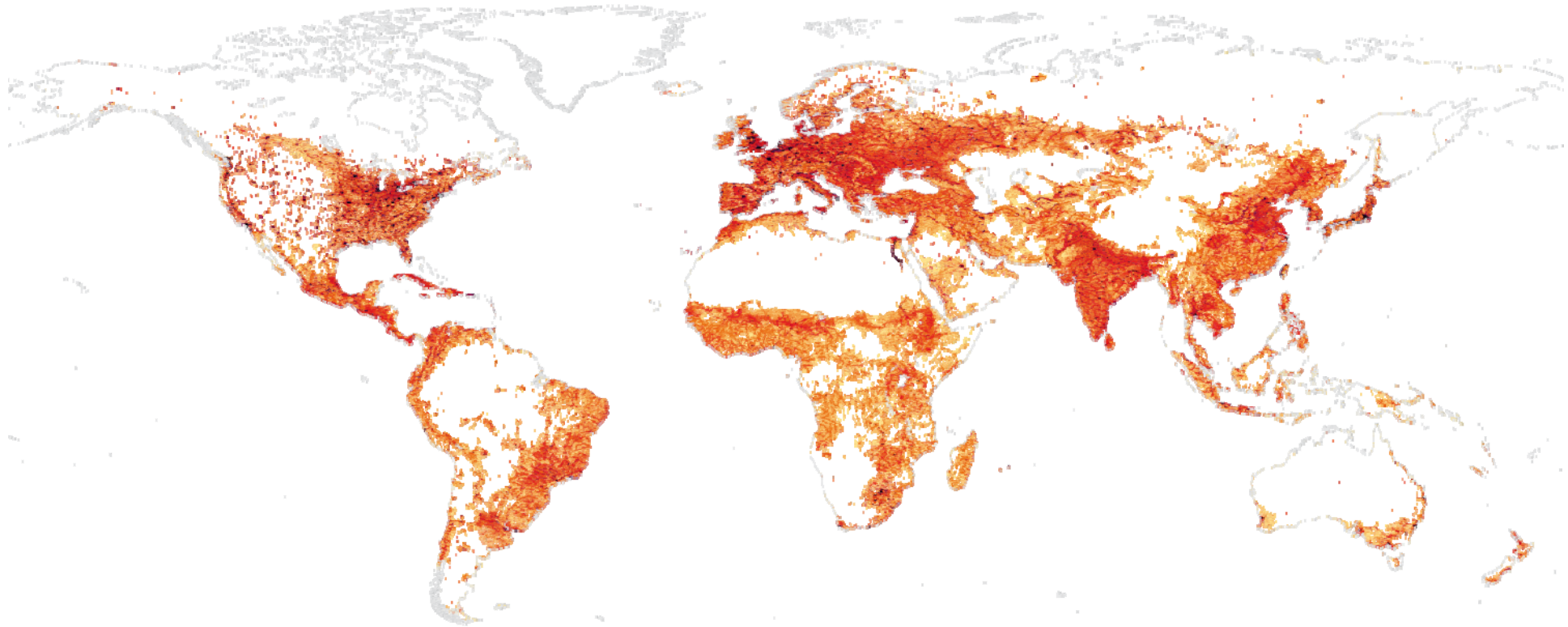


Venice, Italy





Global Change Through Mankind



Galapagos

Volcano Ecuador



Border Argentina/Brazil

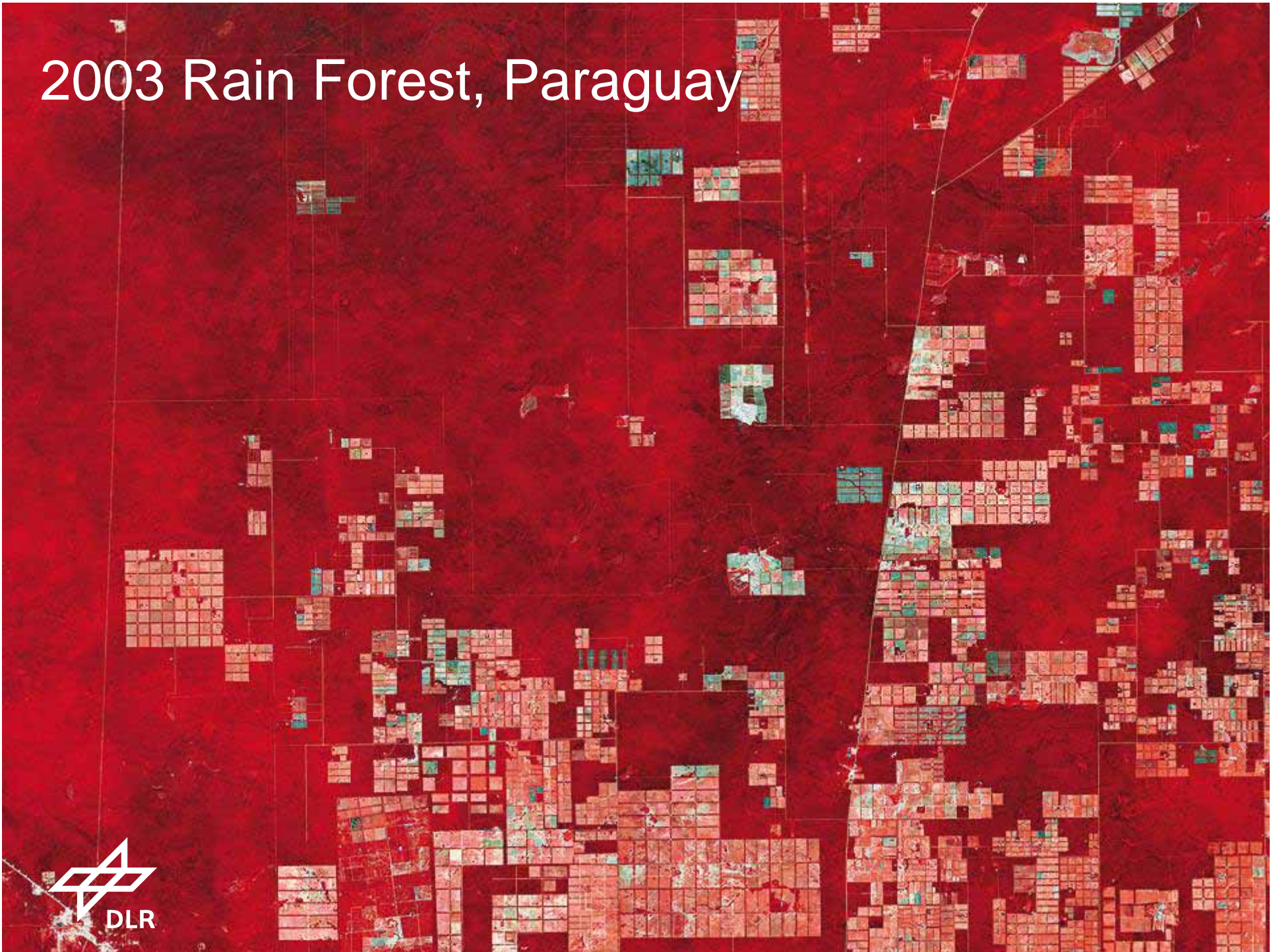


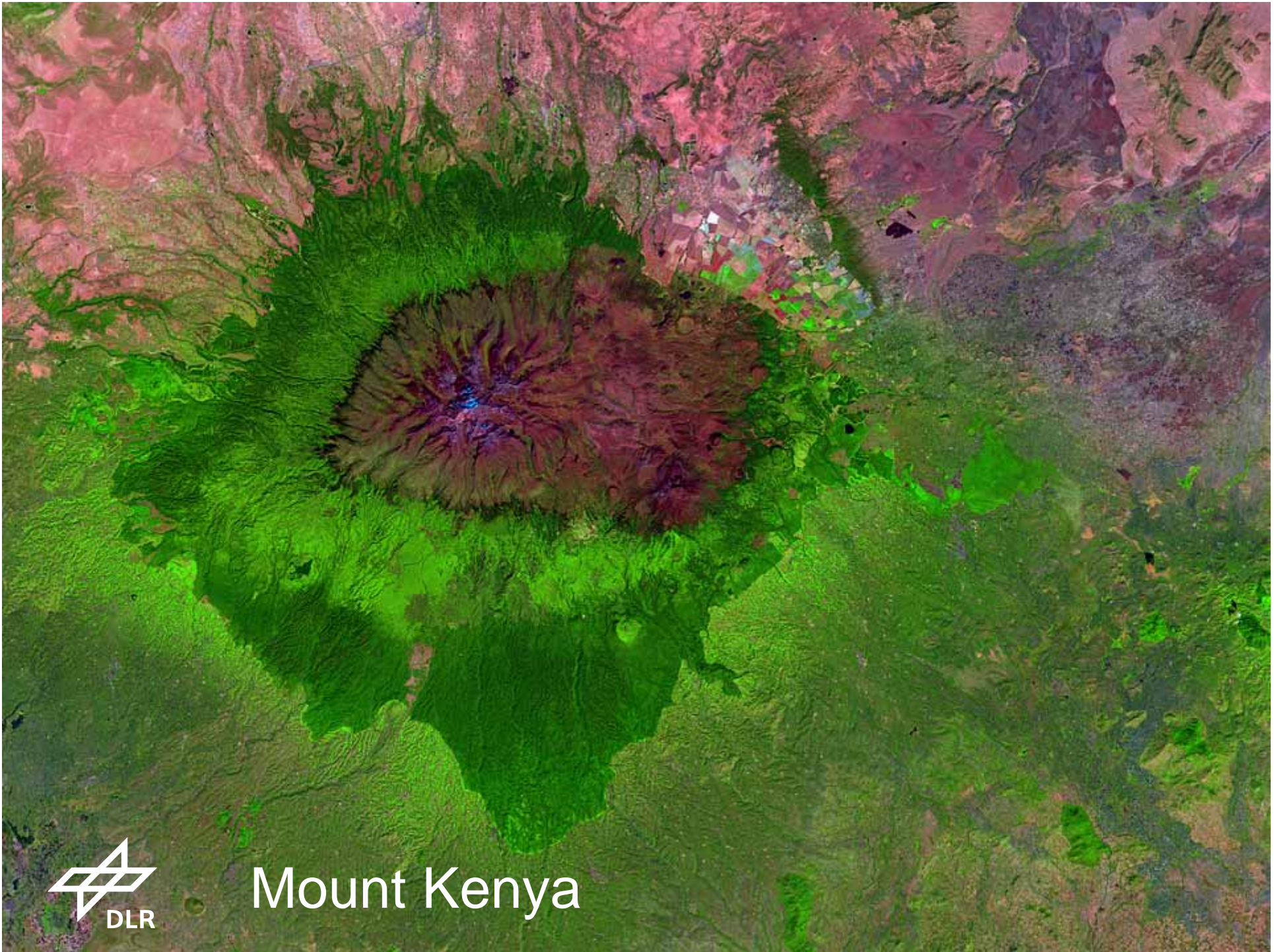
National park Iguaçu (natural heritage)

1985 Rain Forest, Paraguay



2003 Rain Forest, Paraguay





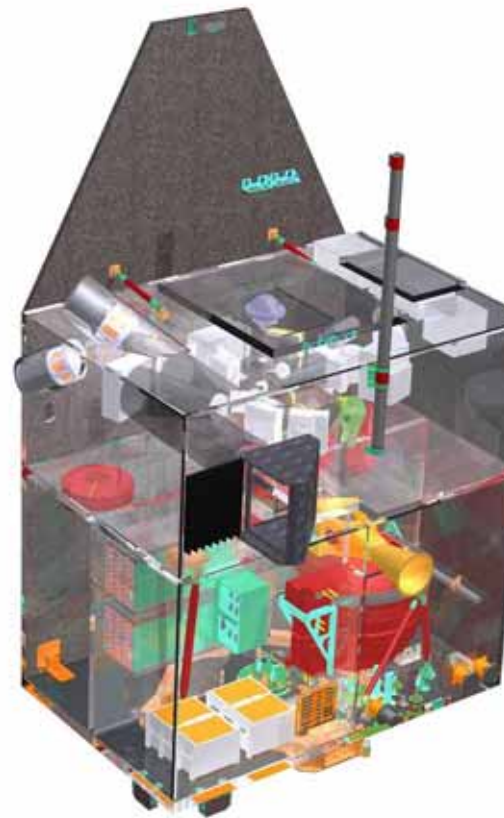
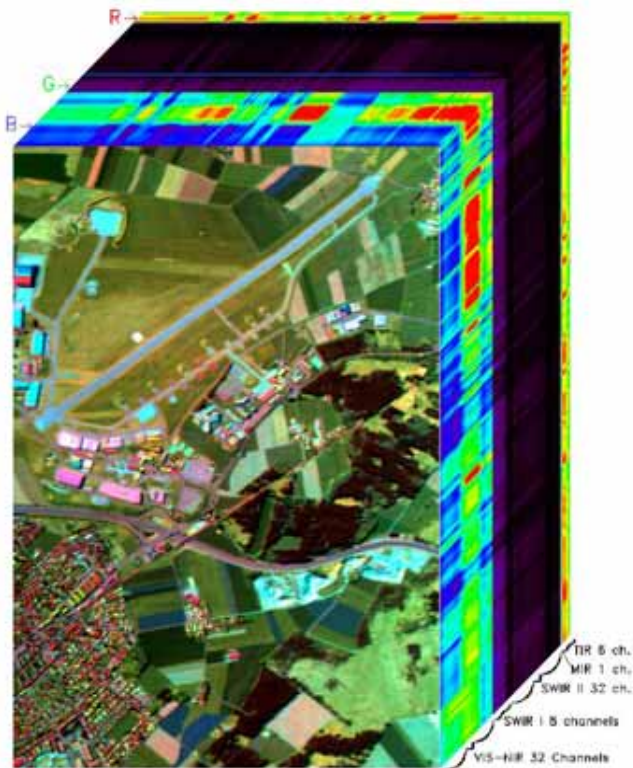
Mount Kenya



Hyperspectral data with 128 spectral channels (RGB - 79 / 41 / 9)



Hyperspectral Imaging from Space



EnMAP
Hyperspectral Imager

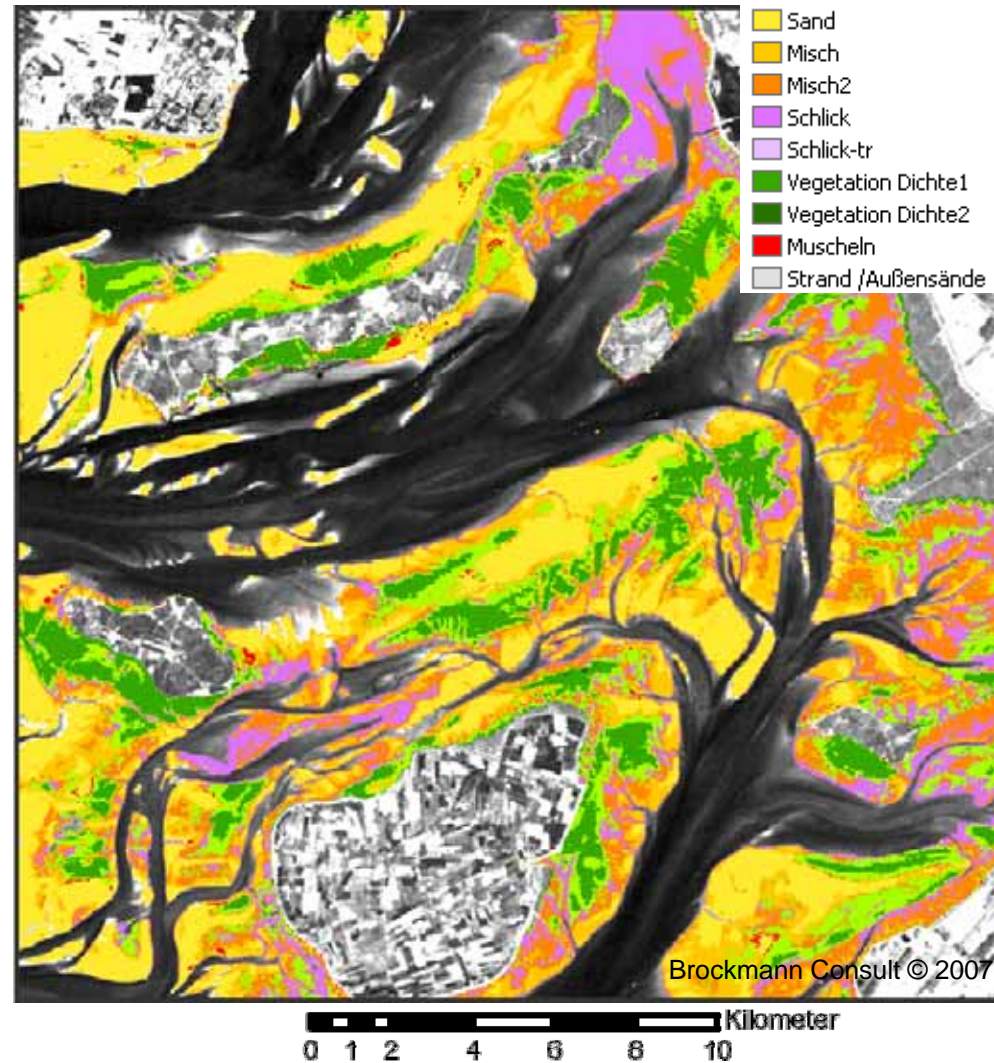


... from 2013



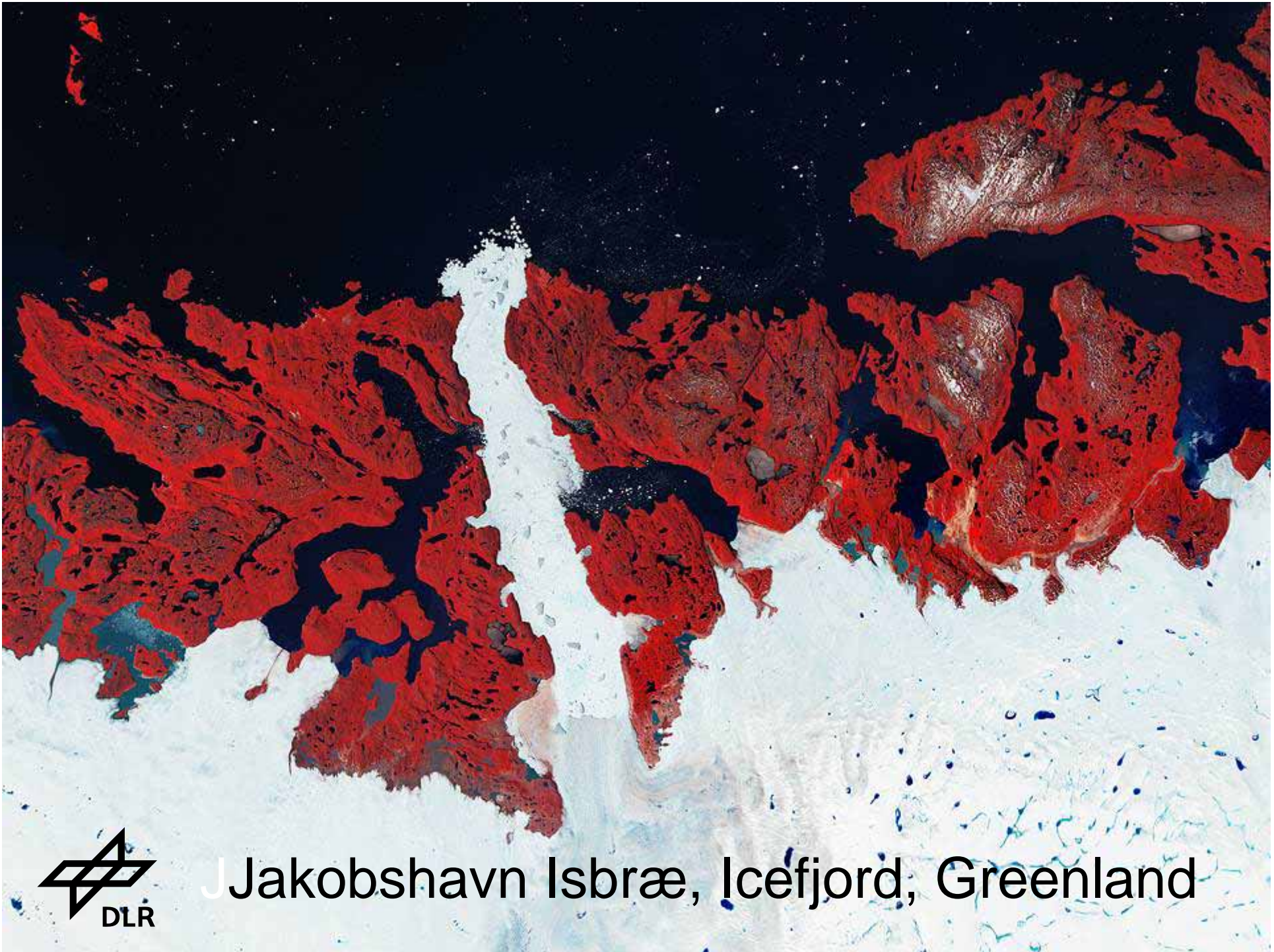
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Wadden Sea, Germany



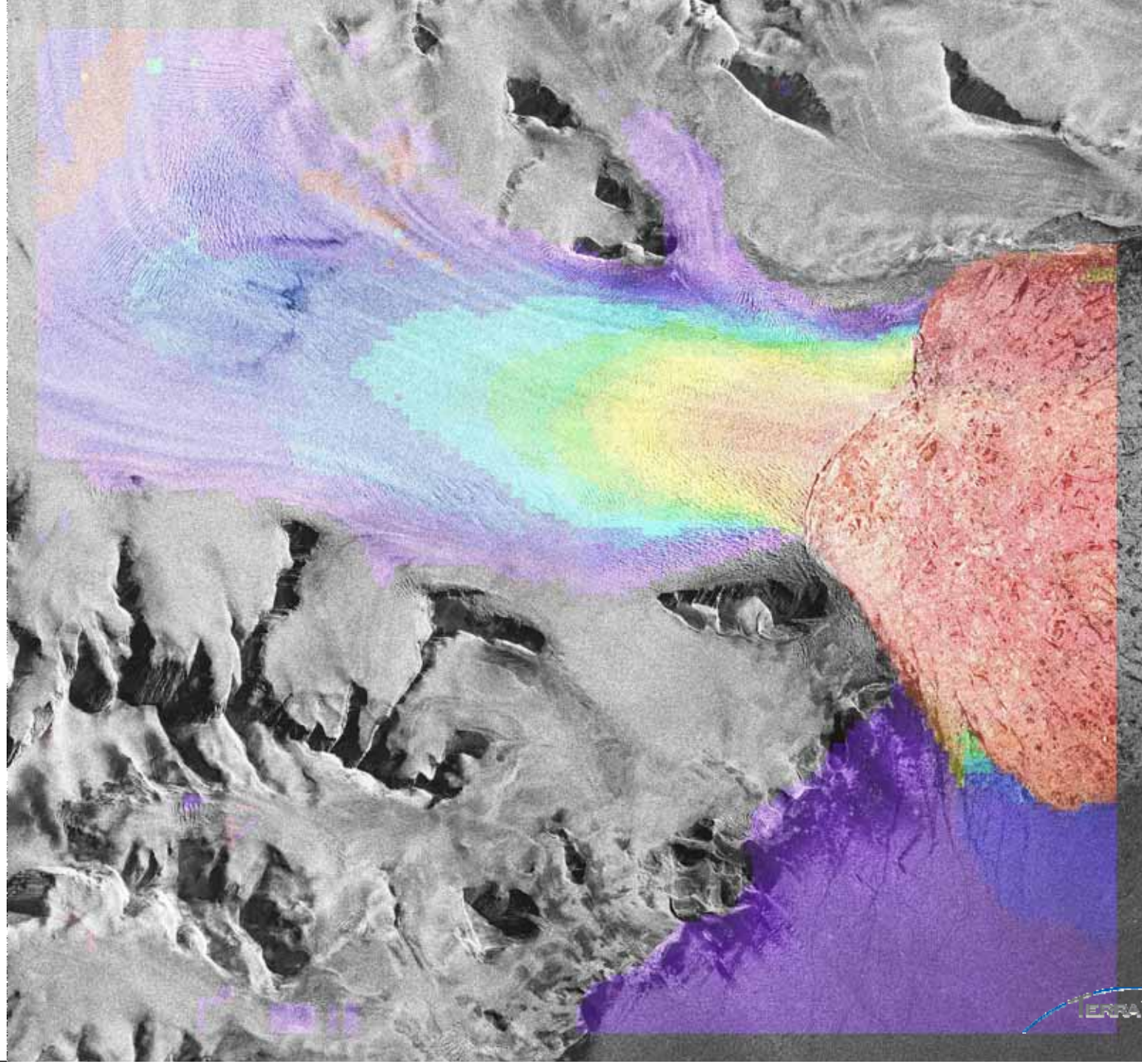
Wadden Sea, Germany





Jakobshavn Isbræ, Icefjord, Greenland

Drygalski Glacier Oct 2007 – July 2008
2-D velocity measured by TSX image correlation



Polar Ground Stations for ...



... Polar orbiting Earth Observation Satellites

A Project



- Historic name: Uruk; biblic: Erech; today: Warka
- First settlement 4000 B.C.
- Largest known city until 600 B.C.
- Gilgamesh Epos
- Largest expansion about 3000 B.C. with 5,5 sqkm
- Clay bricks buildings and channels

Uruk, Iraq (archaeologic site)



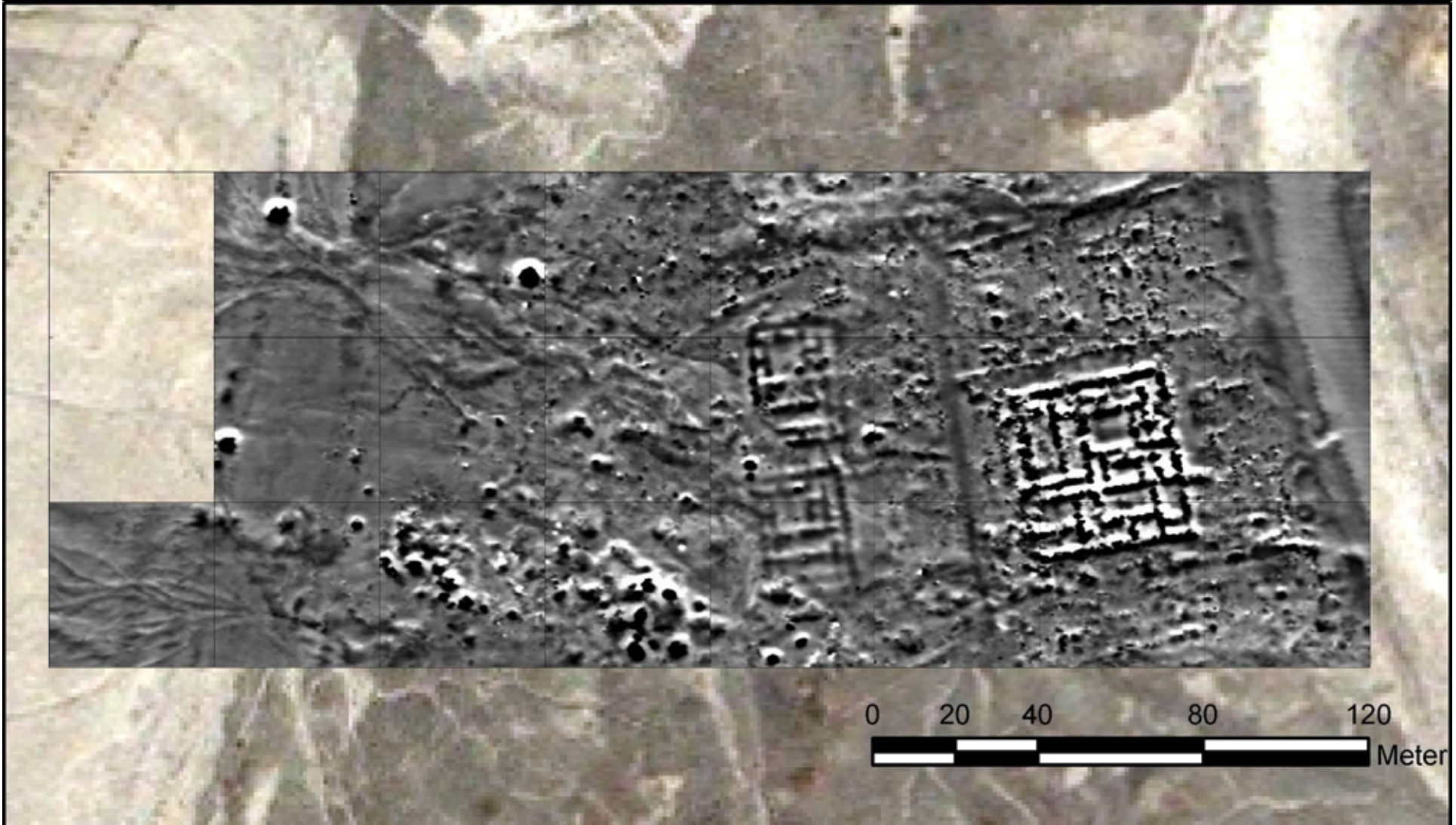


IKONOS
Resolution: 1-meter
Pan-sharpened Multispectral
Uruk

A Synthetic Aperture Radar (SAR) image of the archaeological site of Uruk, captured using TerraSAR-X Spotlight mode. The image shows a complex network of linear features, likely walls and roads, forming a grid-like pattern. The terrain is textured, and the overall color palette is dominated by shades of green and blue, typical of SAR imagery. The image is oriented vertically, with the top of the site at the top of the frame.

TerraSAR-X
SpotLight
Nov 16, 2008
Uruk

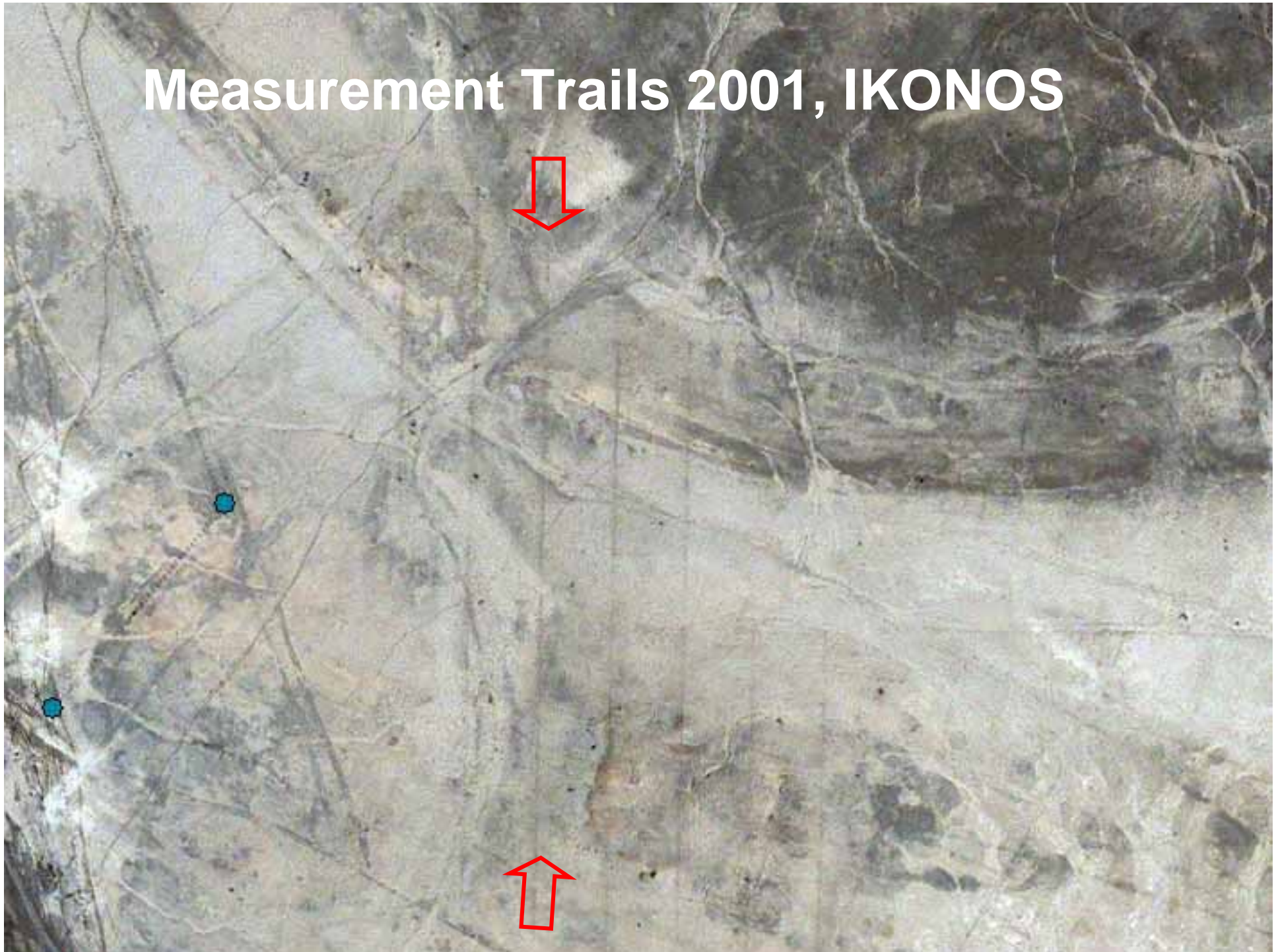




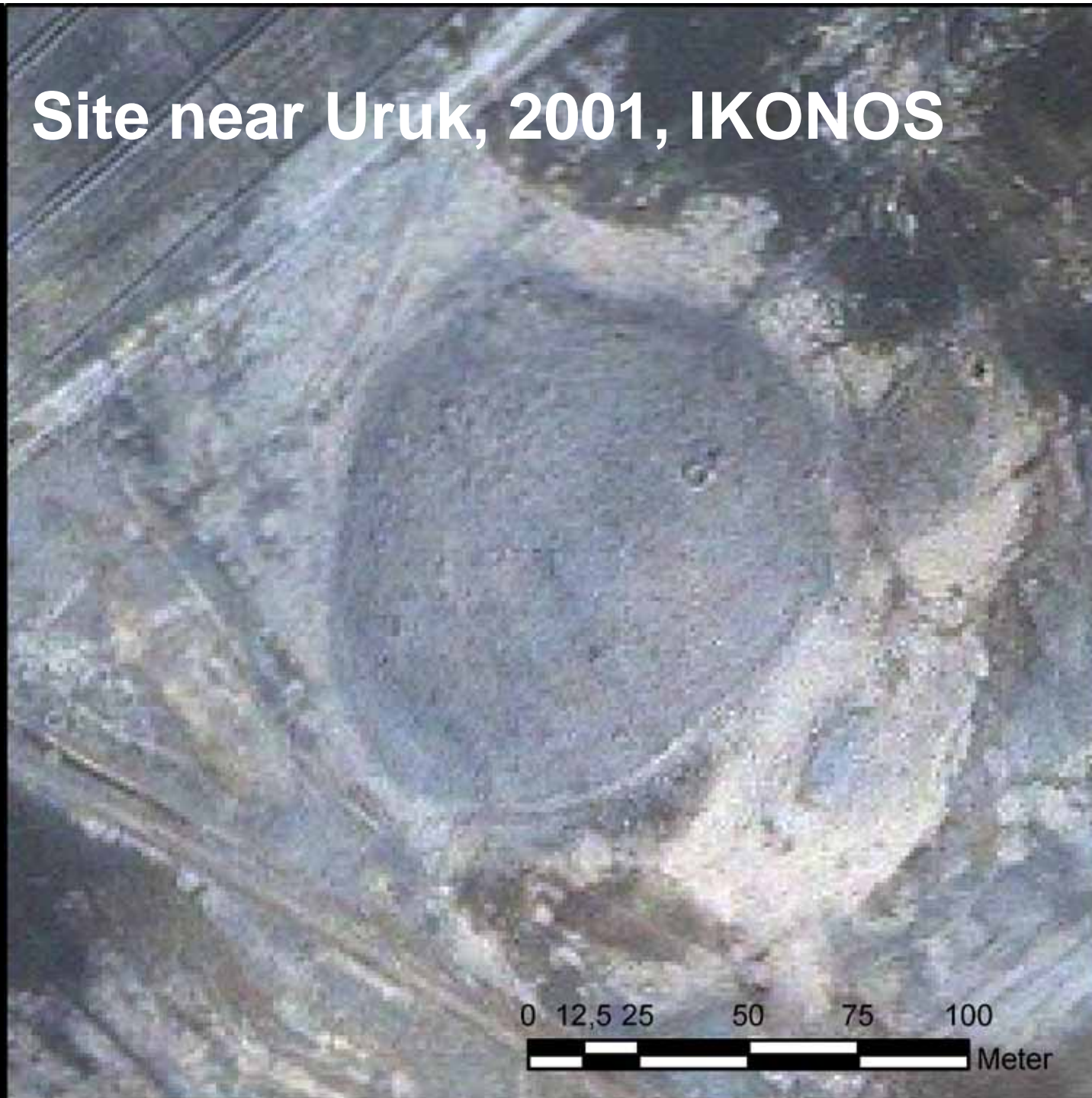
Magnetometer measurements, ground based 2001



Measurement Trails 2001, IKONOS

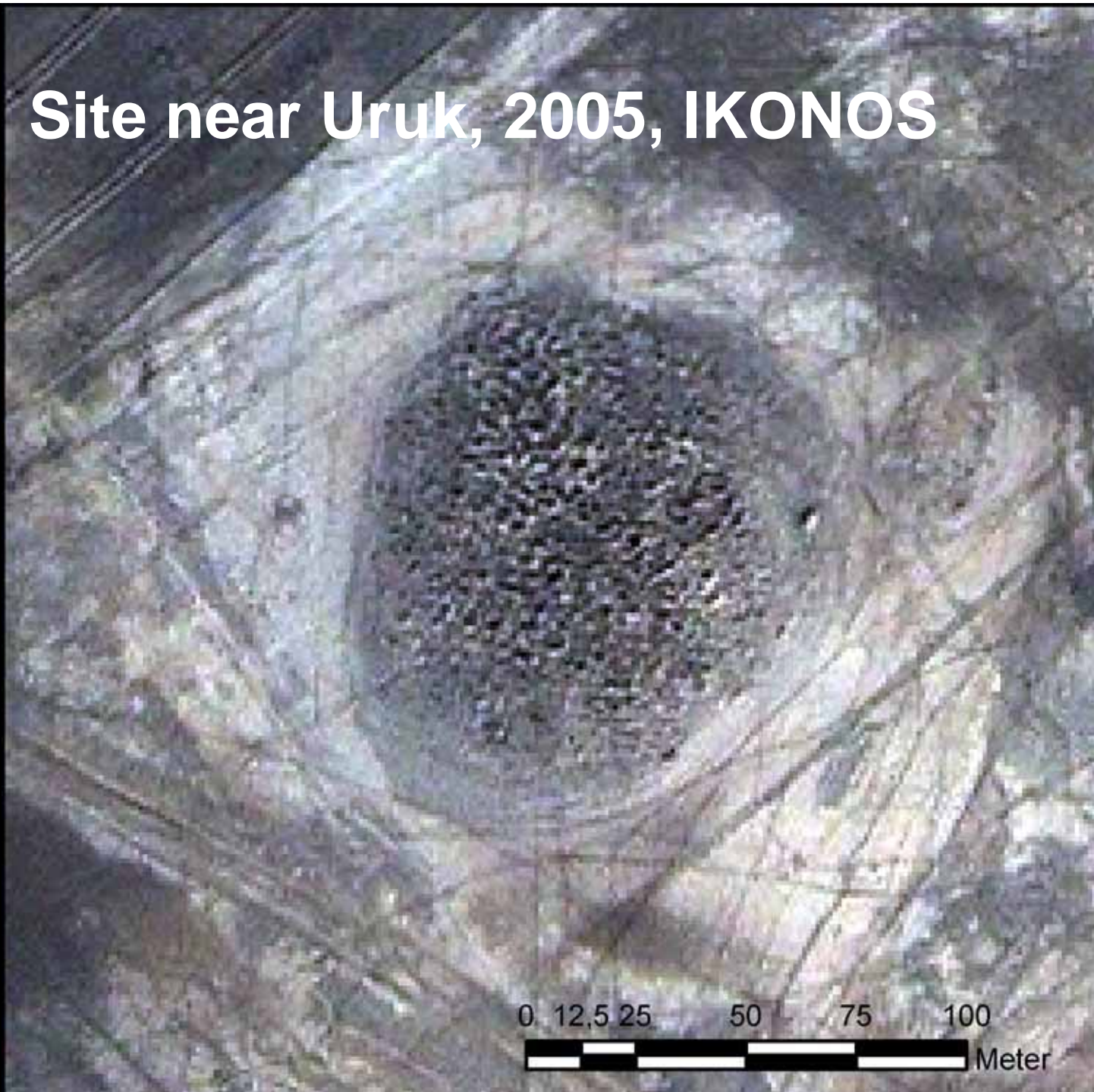


Site near Uruk, 2001, IKONOS



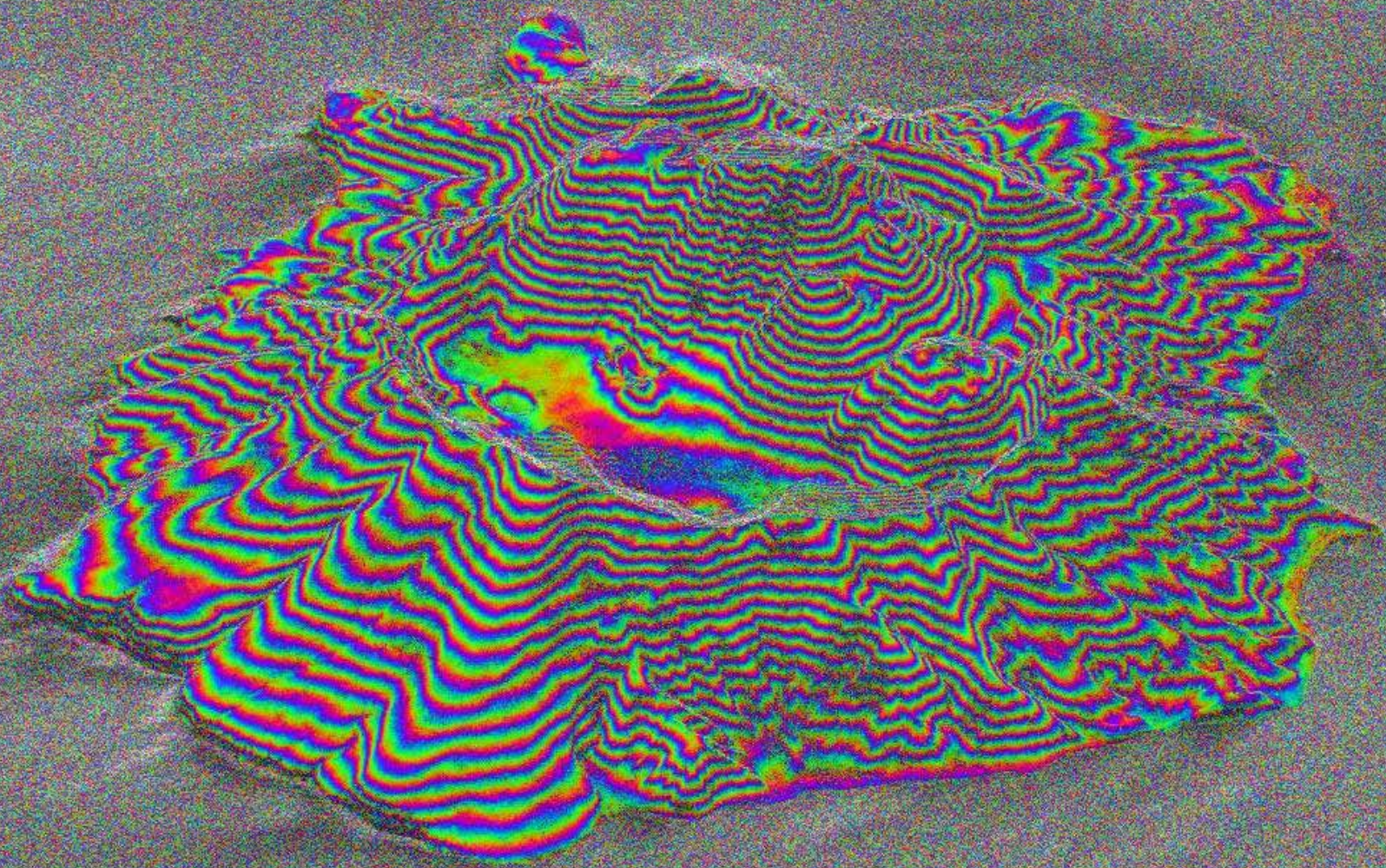


Site near Uruk, 2005, IKONOS

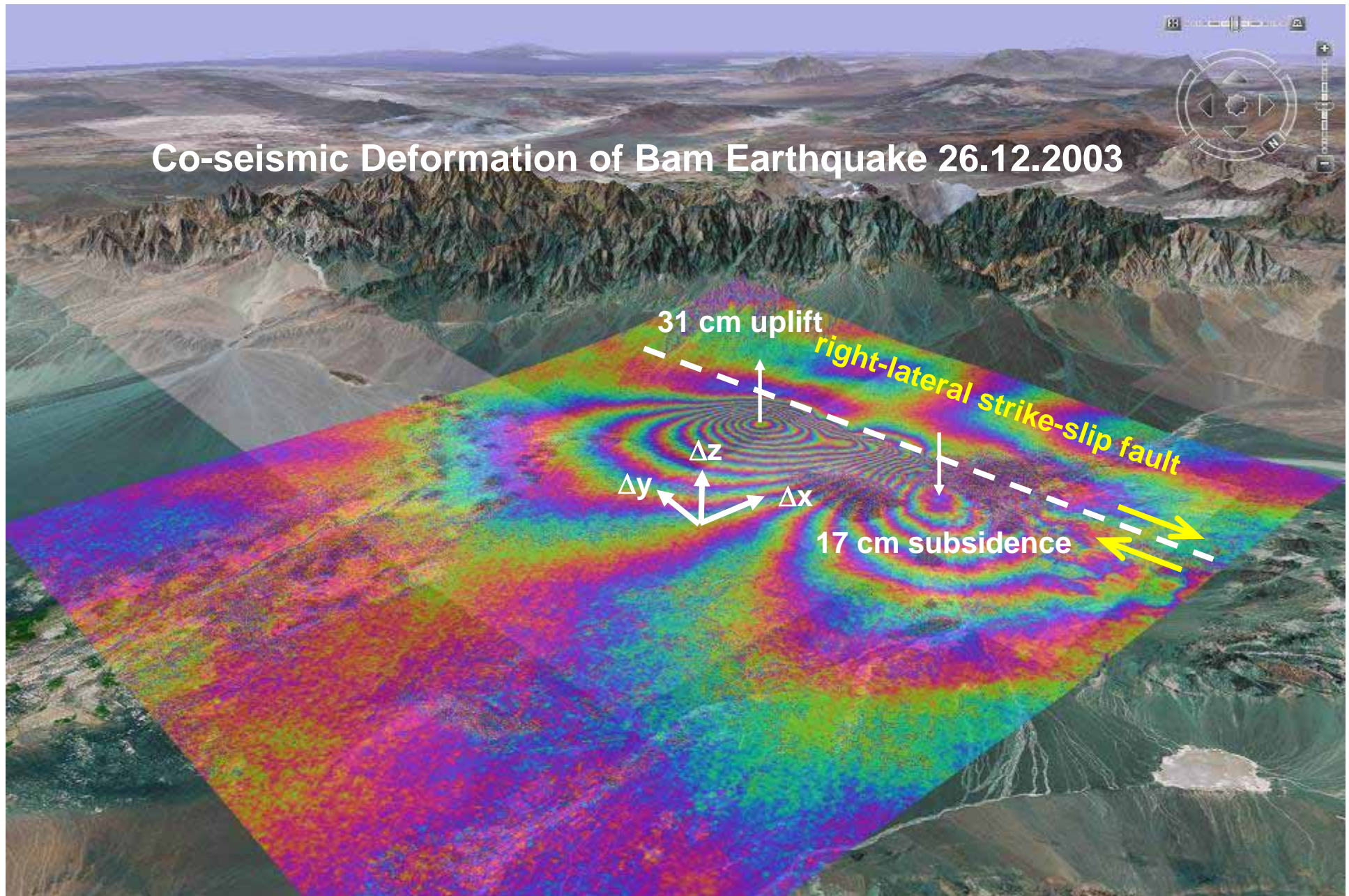


Archives, Then and Now





Co-seismic Deformation of Bam Earthquake 26.12.2003

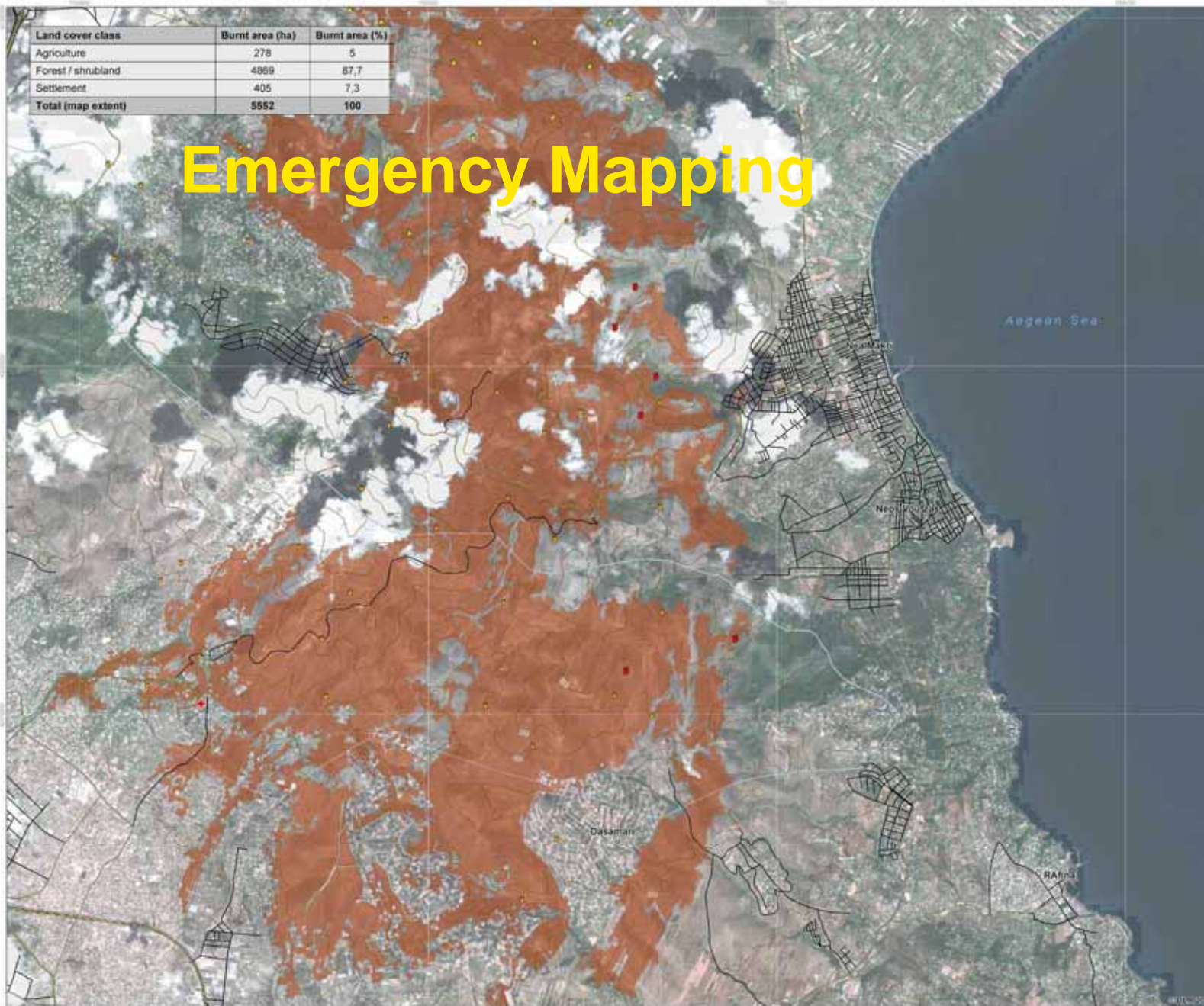


Athens, Greece





Emergency Mapping



Scale 1:1 250 000
 GREECE - Attica, Southern Part
 Forest Fires
 Burnt Areas - August 25, 2009
 Scale 1:25 000

Location Diagrams

Legend

Geospatial Image Information: Cloud coverage

Analysis Data: Burnt area

Fire hot spots (MCD12Q1): August 24, 2009; August 23, 2009; August 22, 2009; August 21, 2009

Interpretation: Contour line, Motorway, Major road, Minor road, Railway, Hospital

Interpretation: Several forest fires occurred since August 21, 2009 in the prefecture Attica, north-eastern of Athens, Greece. Many residents had to be evacuated from their homes. The map shows the burnt areas derived by the analysis of SPOT 5 satellite data acquired on August 25, 2009 and the location of active fire hot spots on different days. Only cloudless areas could have been considered for calculating the statistics of fire burnt areas. The hot spots were automatically derived from MODIS Fire Information System. Streets have been digitized on the basis of World Street Map and may only show an extract of the entire road network. All information is superimposed on a natural colour image of the SPOT 5 scene from August 25, 2009.

Cartographic Information: Scale 1:25,000 for A1 prints

Local projection: UTM Zone 34 North, Datum: WGS 84

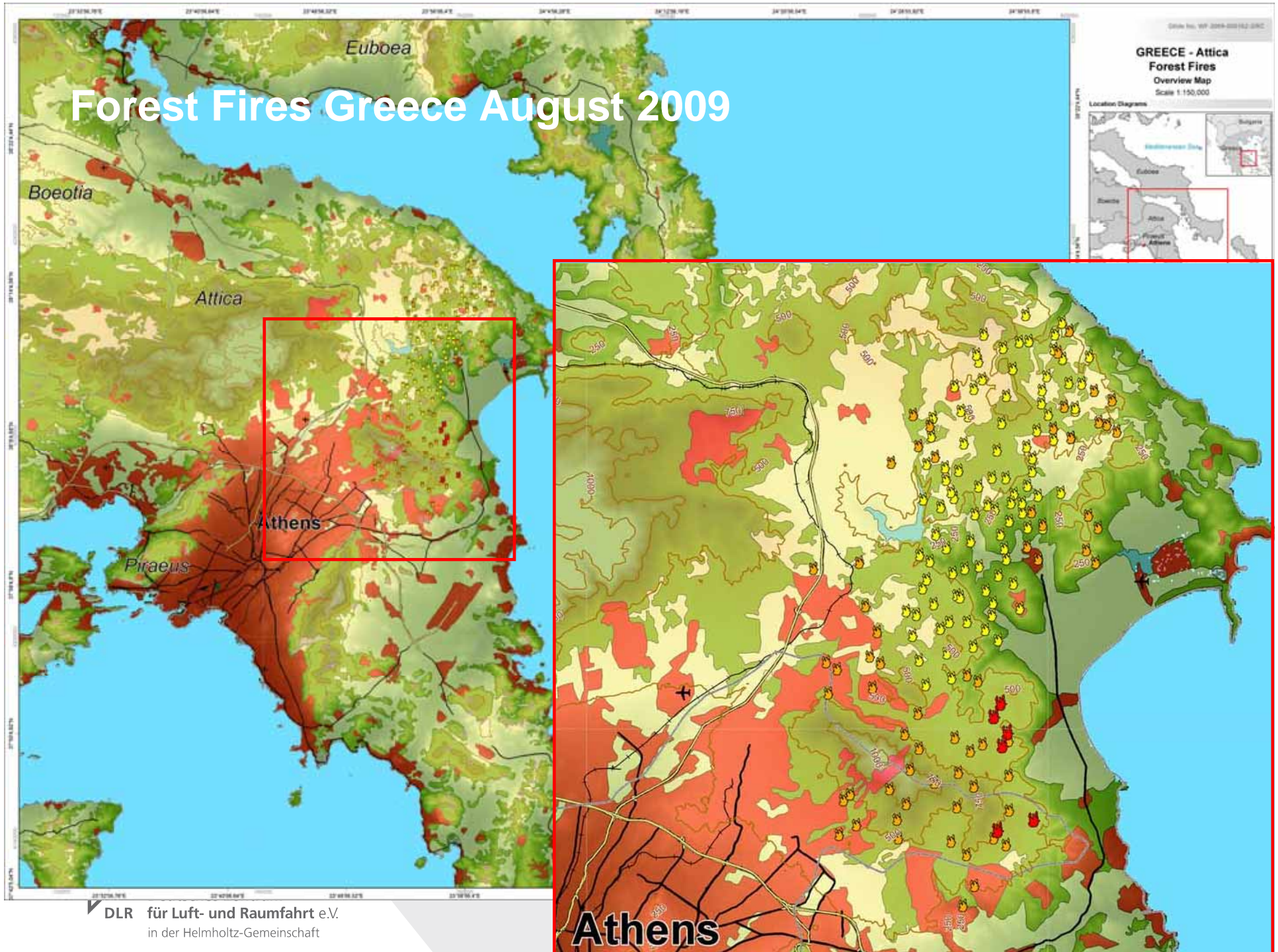
Data Sources: SPOT 5, SRTM C-BAND, Vector Data, VMap0, MODIS Hotspots, CBWMS Land Cover

Framework: The products elaborated for this Rapid Mapping Activity are realized to the best of our ability, within a very short time frame, during a crisis, optimizing the material available. All geographic information has limitations due to the scale, resolution, date and extrapolation of the original source materials. No liability concerning the content or the use thereof is assumed by the producer.

Map produced August 25, 2009 by DLR
 © DLR 2009

dlr@dlr.de
<http://www.dlr.de/rlm>

Forest Fires Greece August 2009

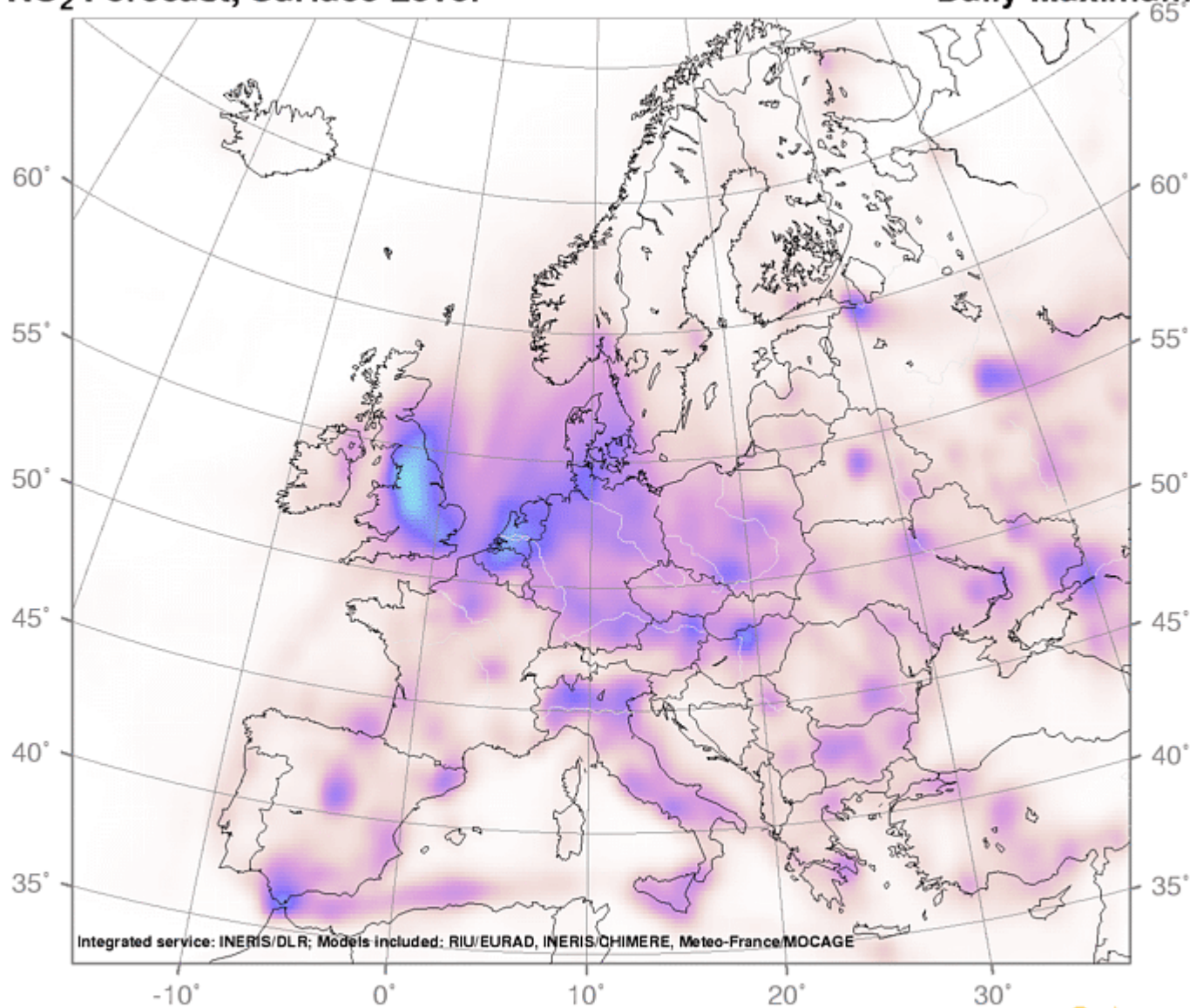


Integrated Air Quality Ensemble

Oct 06, 2009

NO₂ Forecast, Surface Level

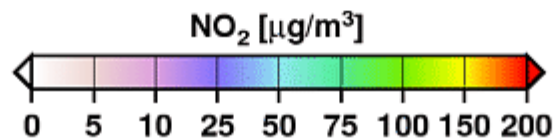
Daily Maximum

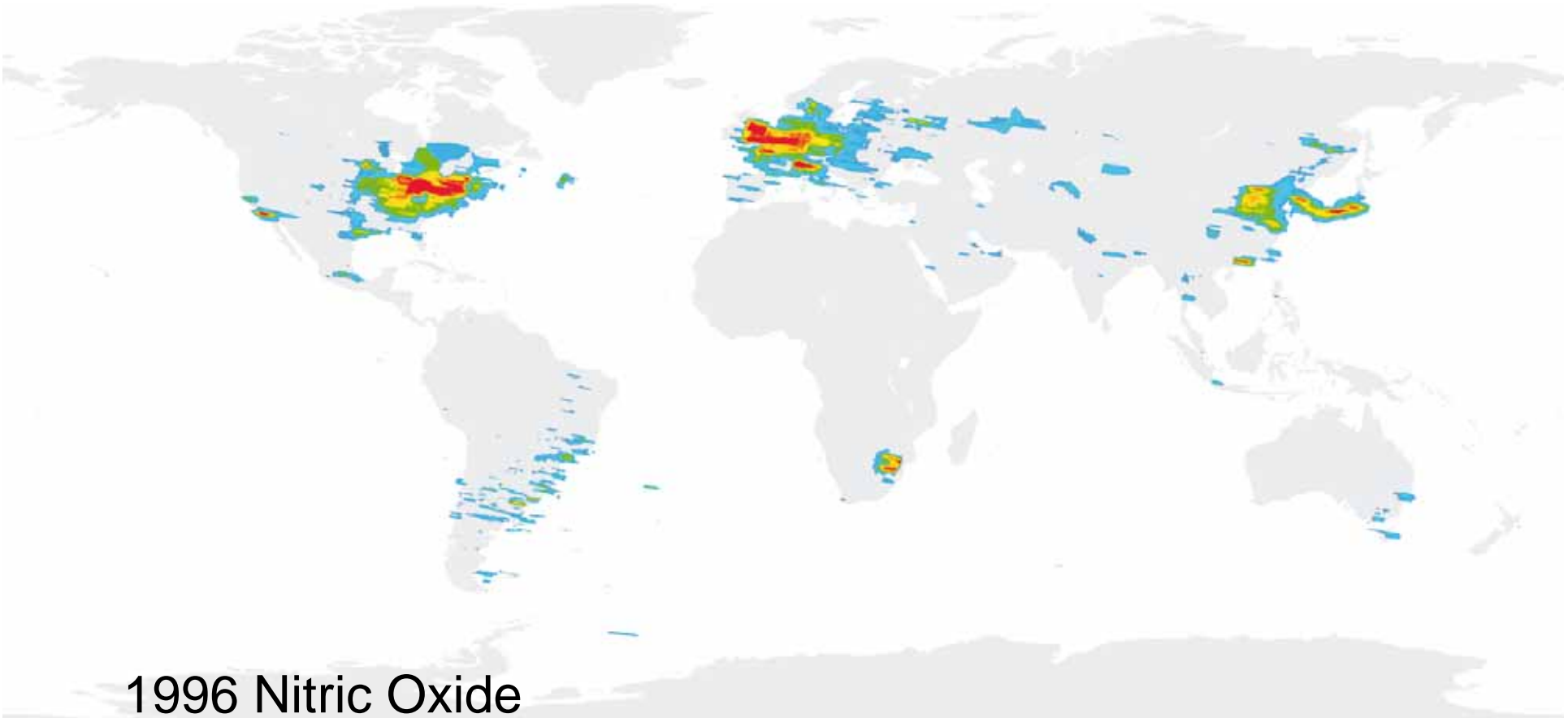


24 hour forecast (D+0)

issued on Oct 06, 2009

www.gse-promote.org

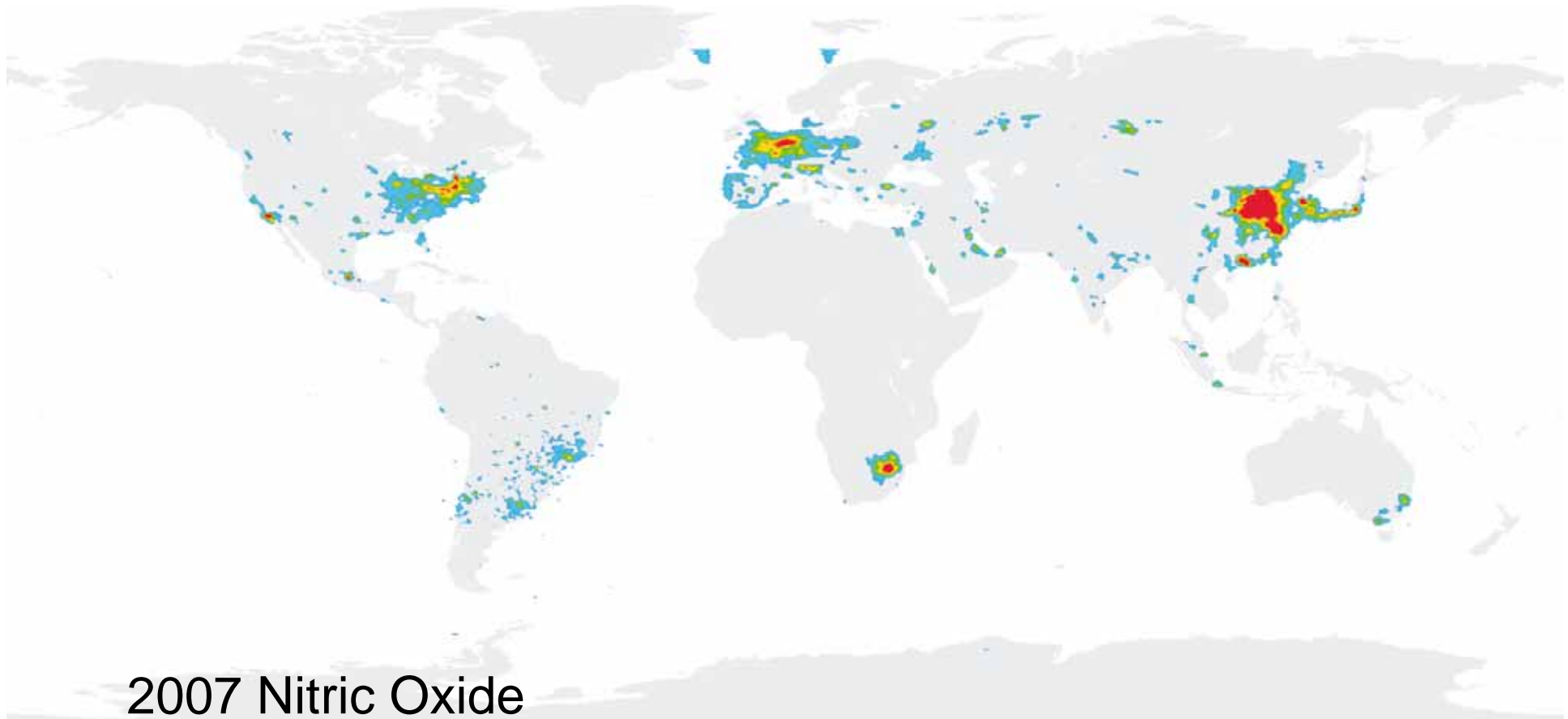




1996 Nitric Oxide



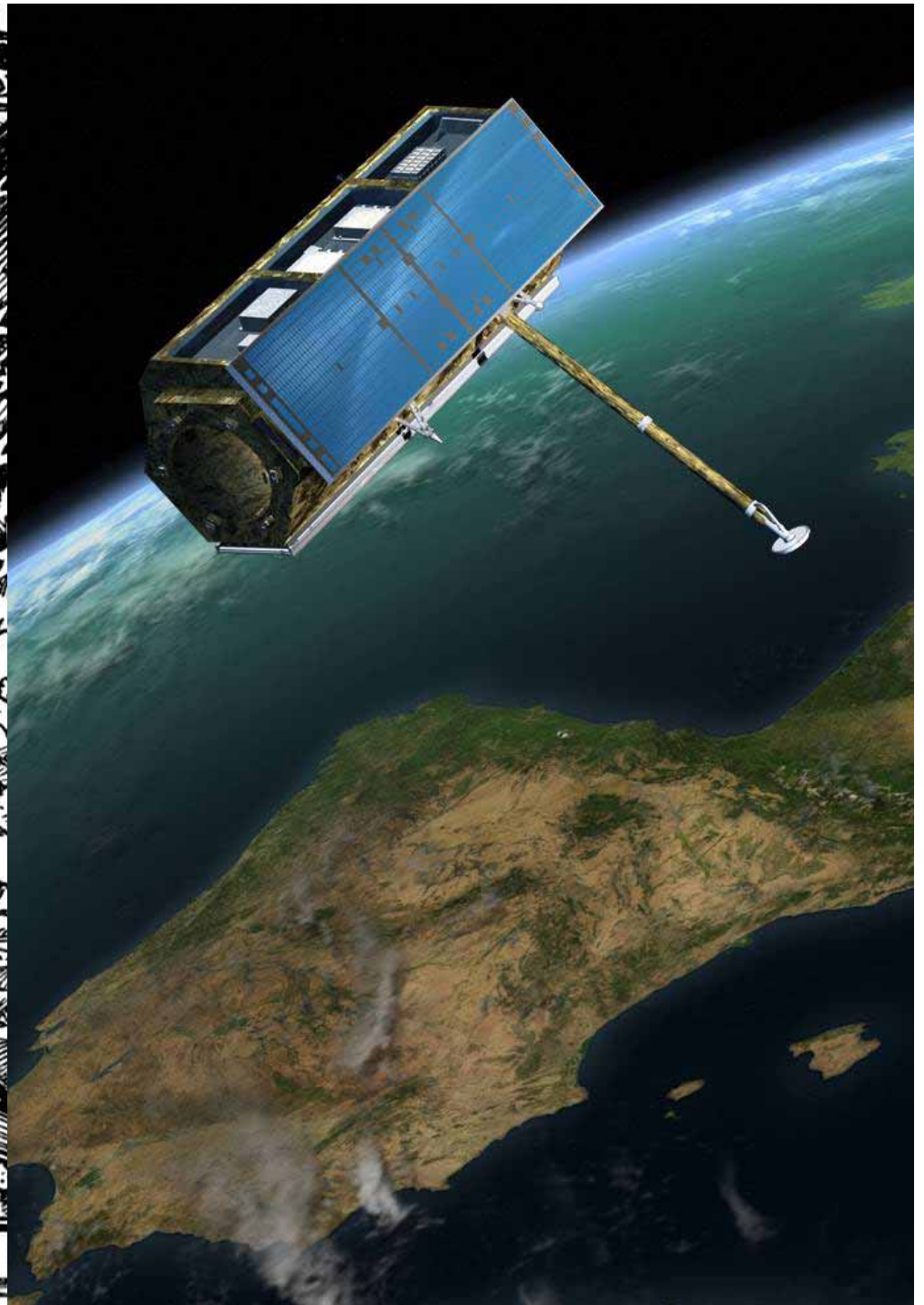
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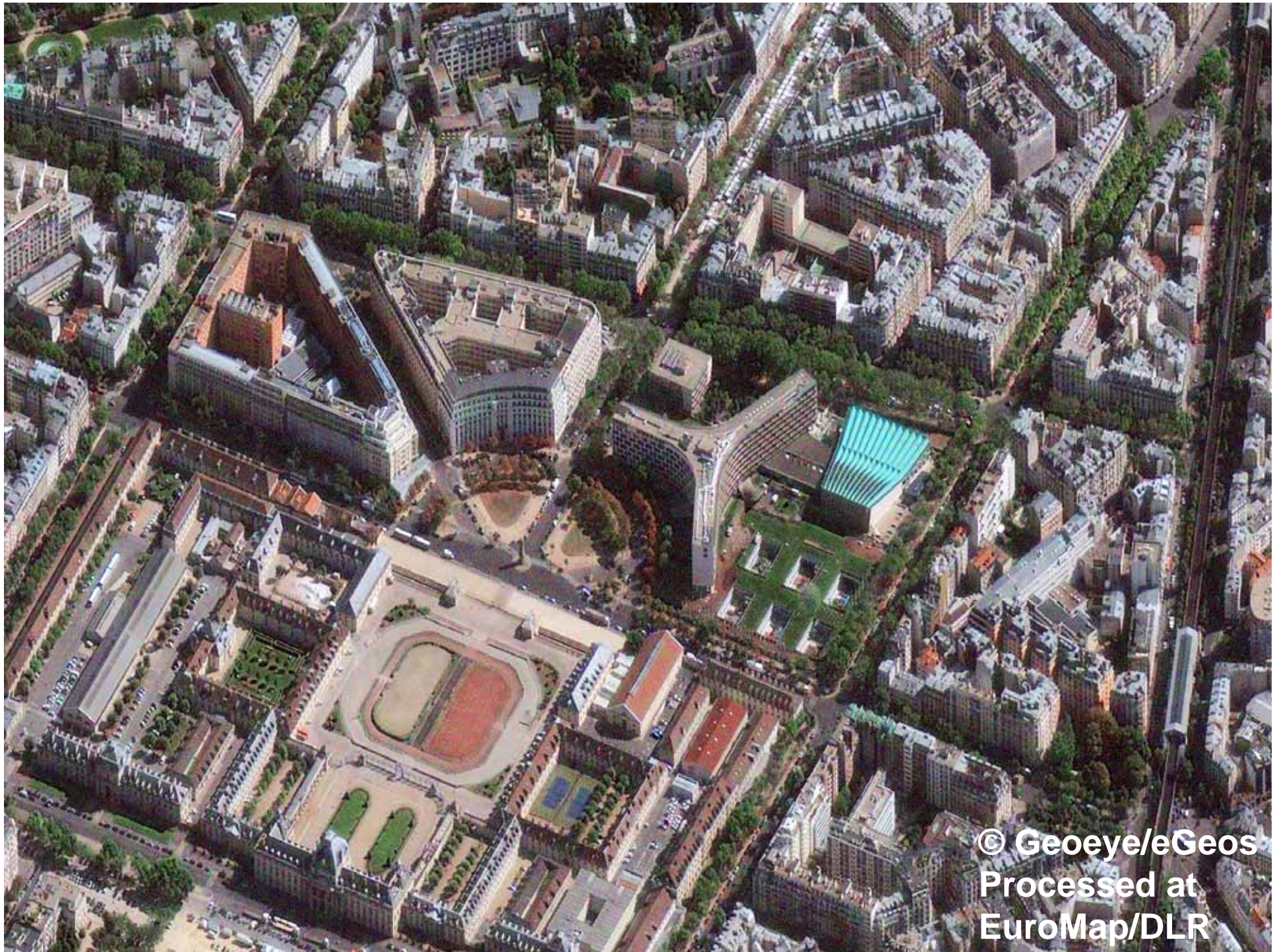


2007 Nitric Oxide



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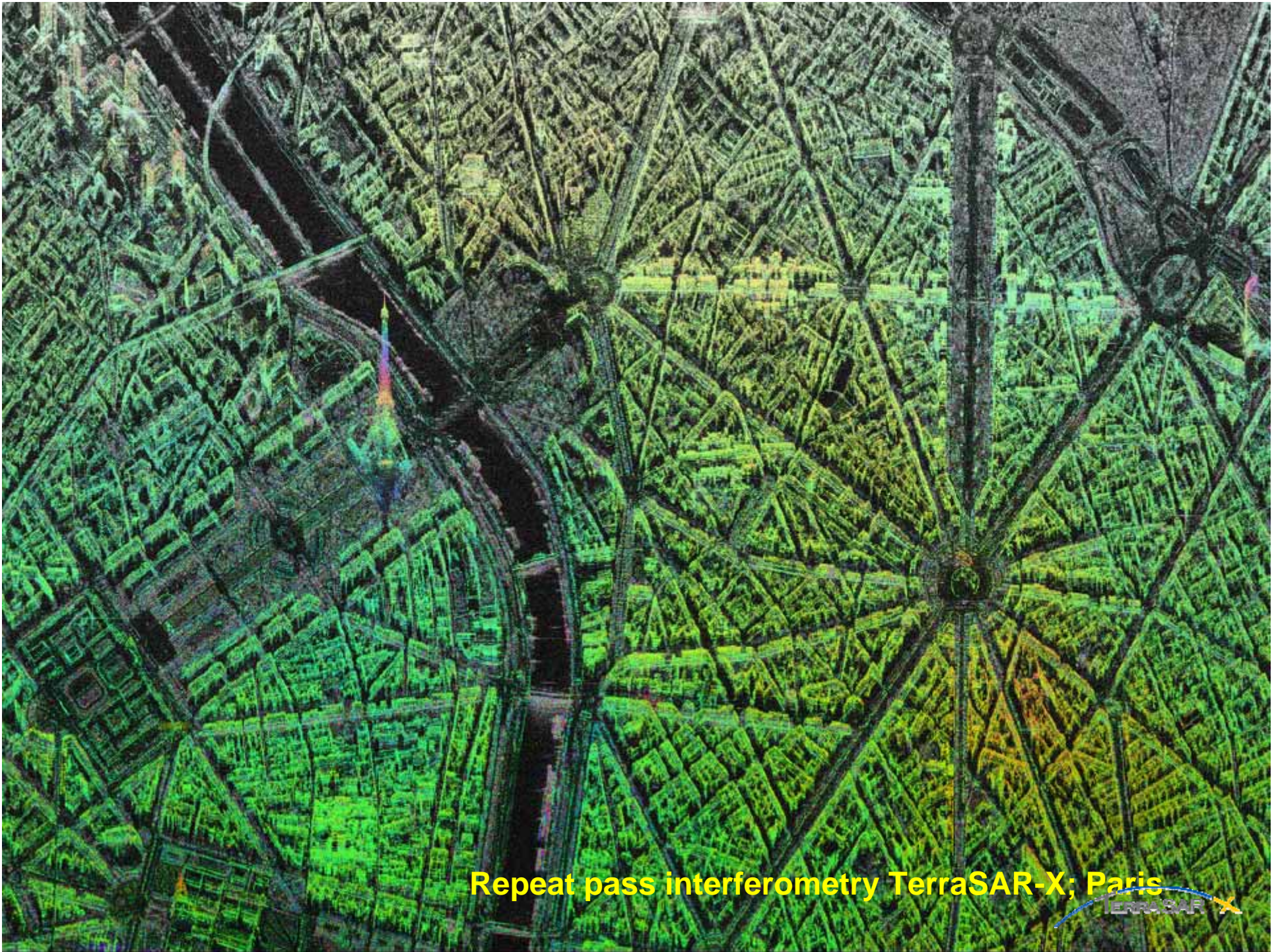
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Processed at
EuroMap/DLR



Satellites in Support of World Heritage

- Open initiative on the use of **Space Technology** in support of the World Heritage Convention
- DLR joined initiative in December 2007 at IAC in Hyderabad
- Objectives:
 - **Monitoring** of UNESCO cultural and natural heritage sites
 - **Improving** the **protection** against environmental and anthropogenic influences
 - **Supporting** of archaeological **research**



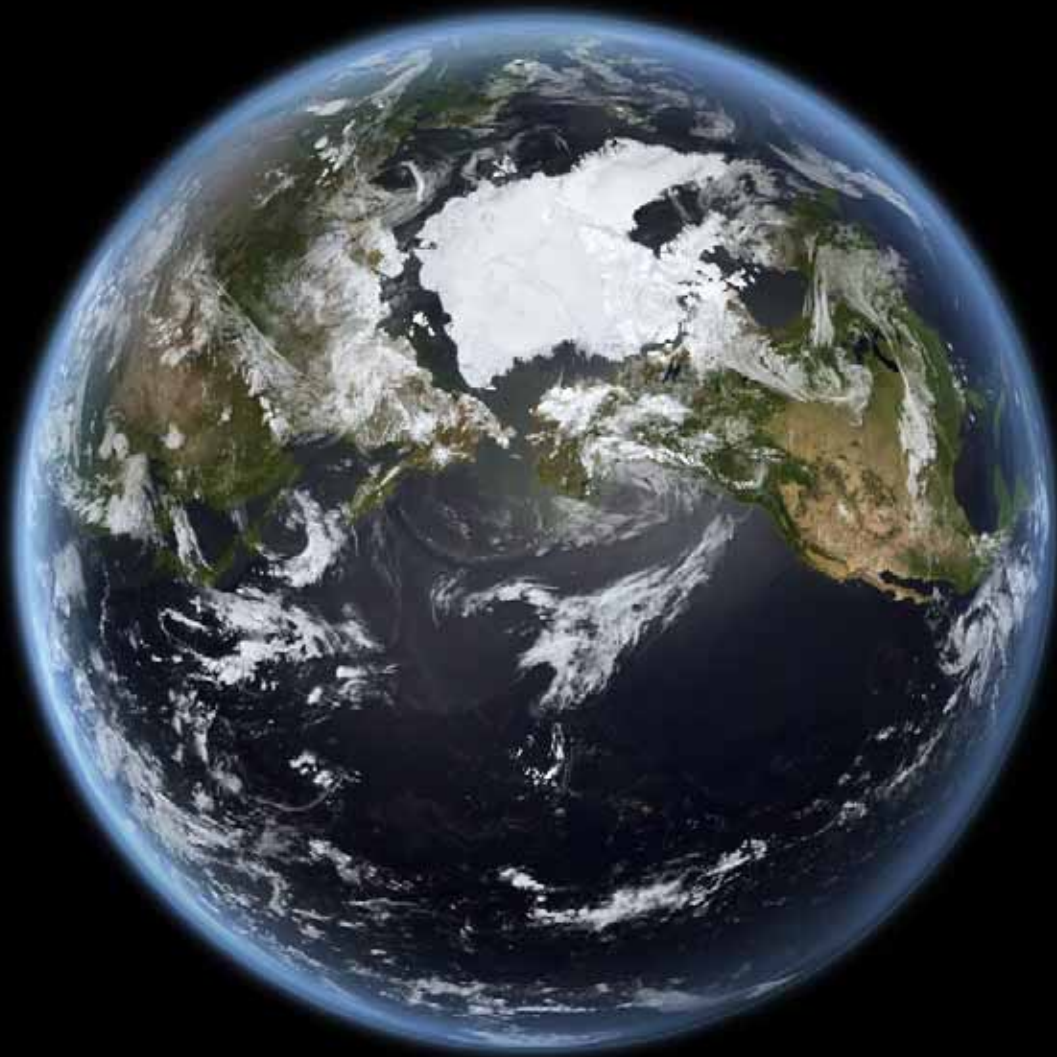


Repeat pass interferometry TerraSAR-X; Paris





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EuroMap/DLR
PEACE Performa
By Bob Sinclair



Polar Ground Stations for ...



... Polar orbiting Earth Observation Satellites



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High Resolution Spotlight
HH-Pol. 150 MHz



Ayers Rock, Australia

Machu Picchu, Peru



Retreat Upsala glacier front, Patagonia

