Space Helps to Preserve World Heritage Sites

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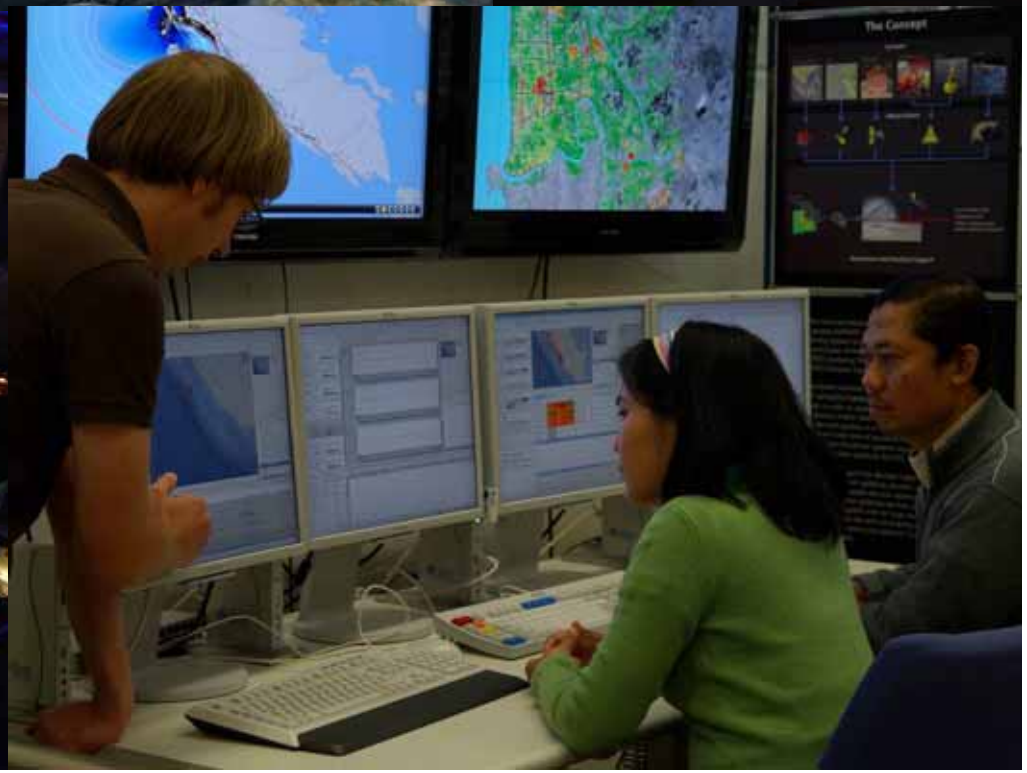
in der Helmholtz-Gemeinschaft

Research Center
&
Space Agency
&
Project Management Office

DLR in Earth Observation




PATRIMONIO MUNDIAL
WORLD HERITAGE
PATRIMOINE MONDIAL

890 World Heritage sites inscribed

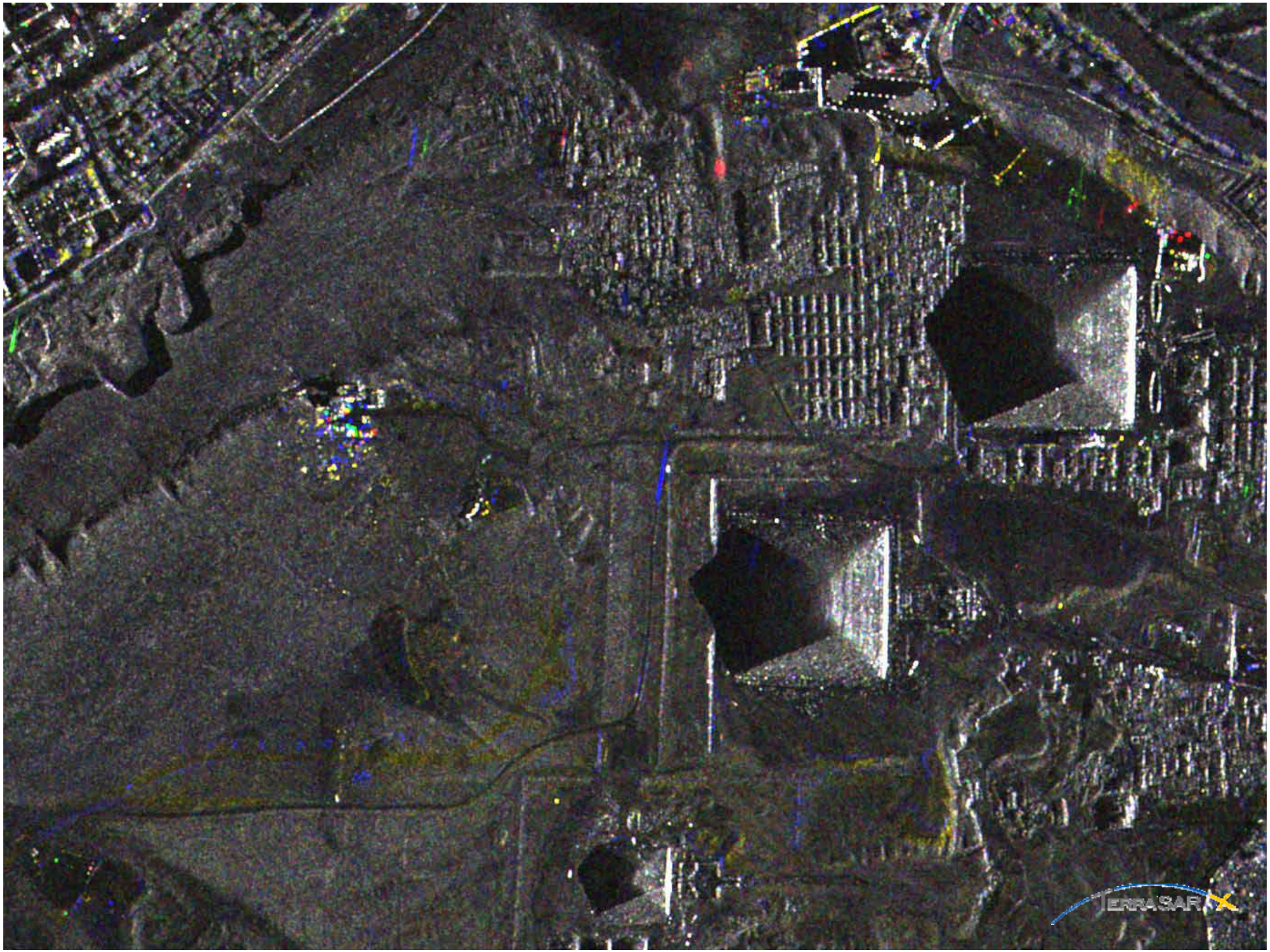
**These include 689 cultural,
176 natural and 25 mixed
properties in 148 States.
As of April 2009, 186 States
have ratified the World Heritage Convention**

Major Threats for Cultural Heritage Sites:

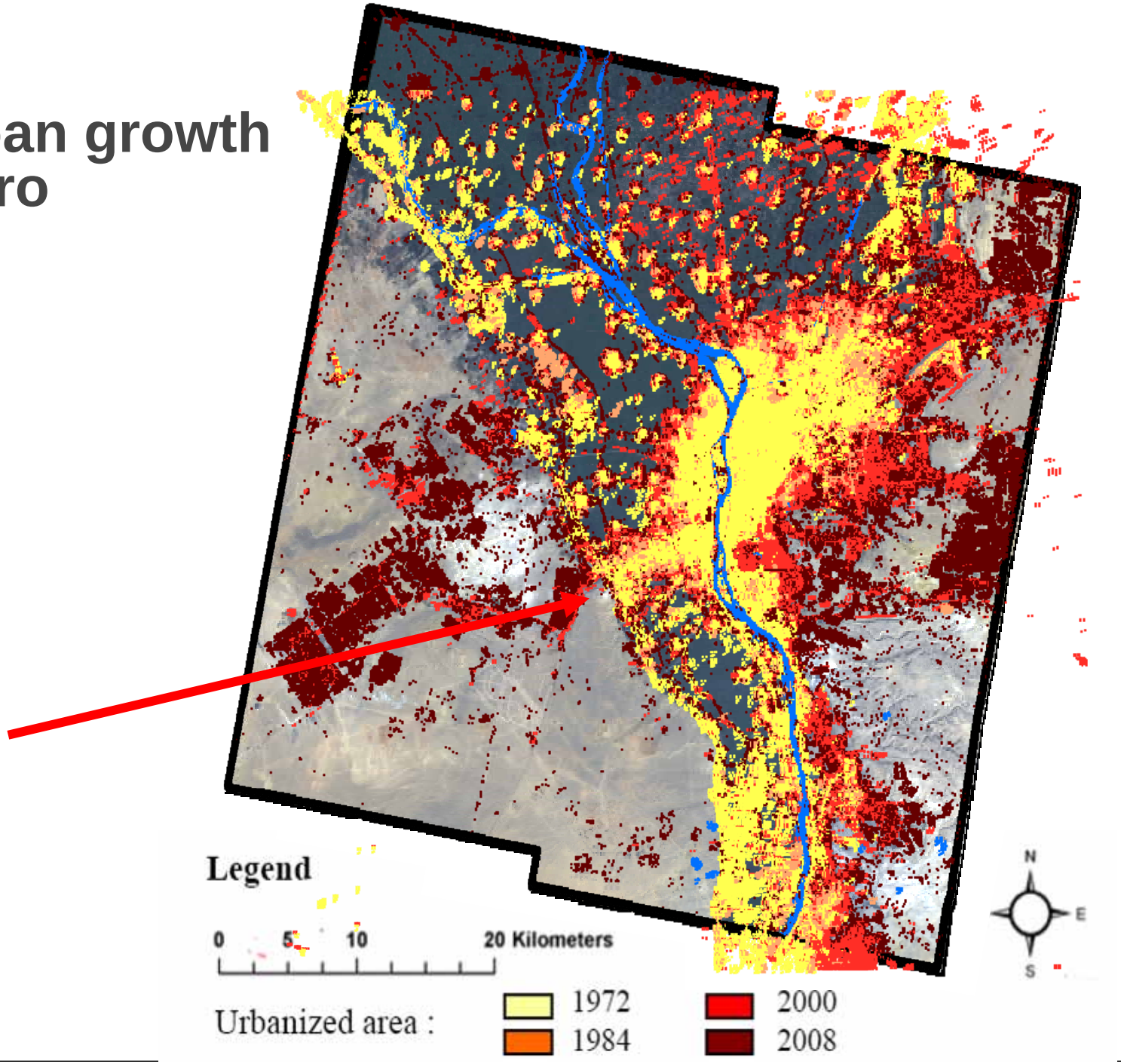
- excess of tourists
- looting of archaeological sites
- acid rain
- global warming
- natural catastrophes
- human developments

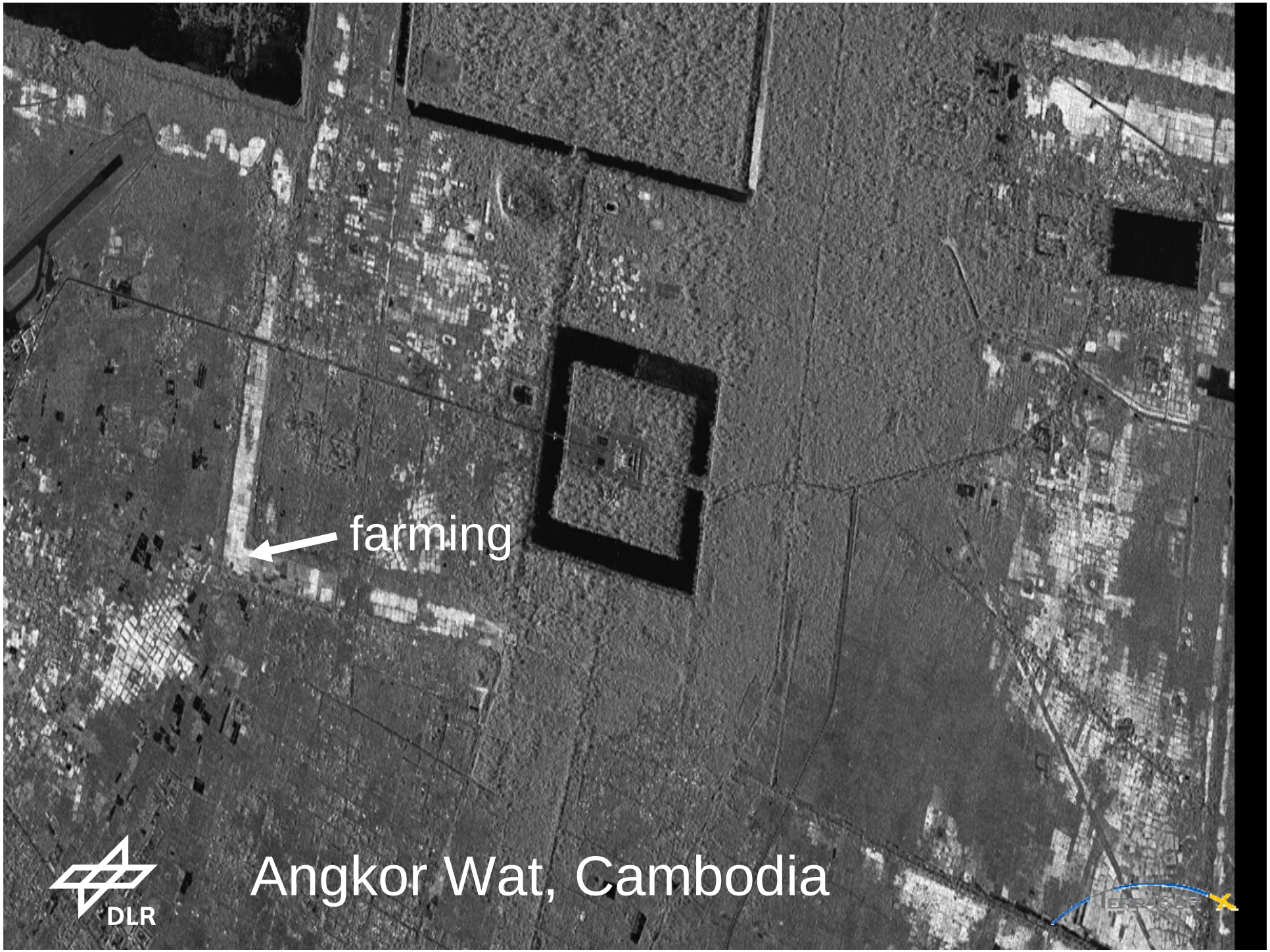
Remote Sensing:
excellent observation instrument

DLR


TERRASAR-X

Urban growth Cairo

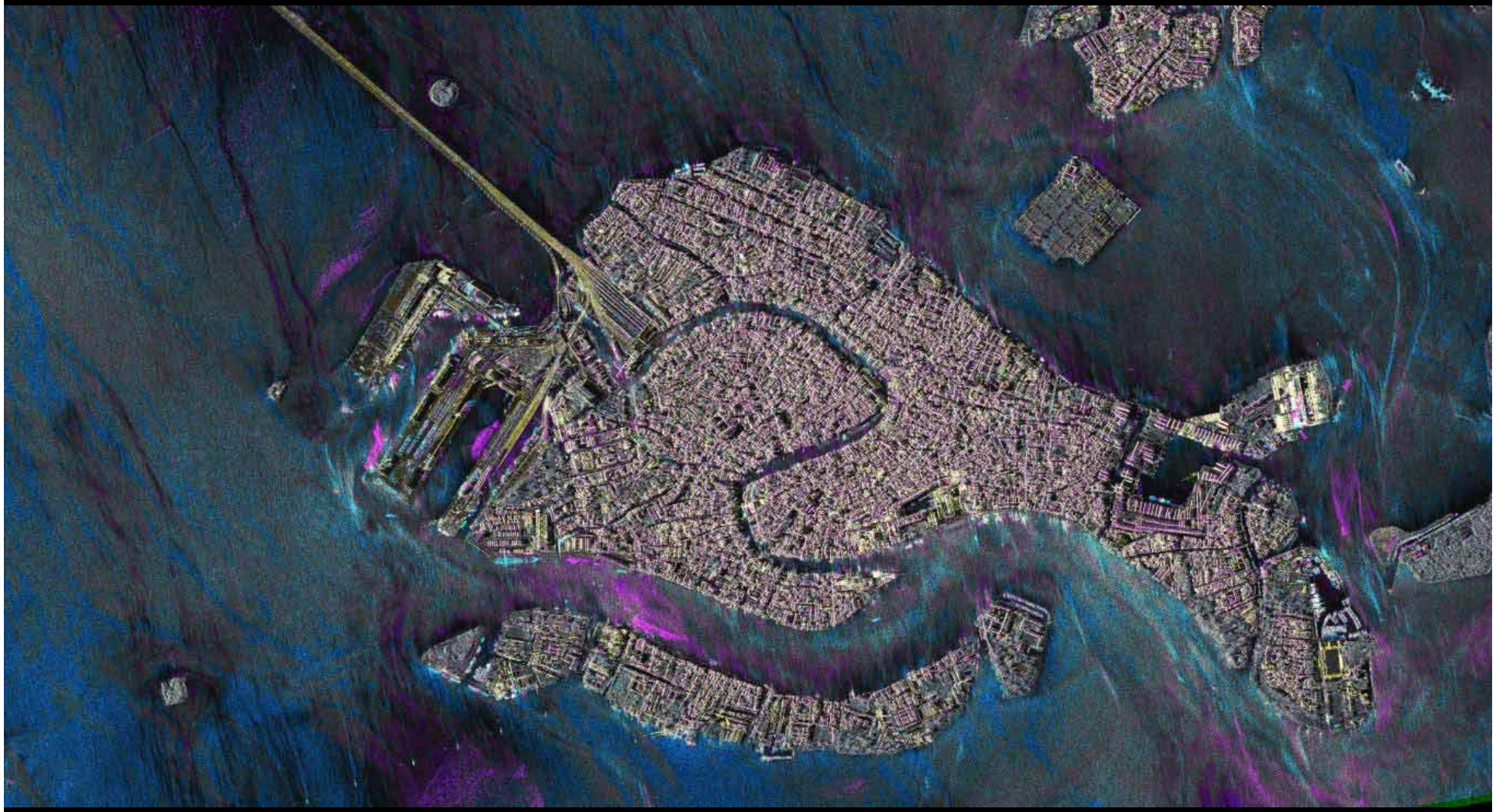



farming
DLR
Angkor Wat, Cambodia

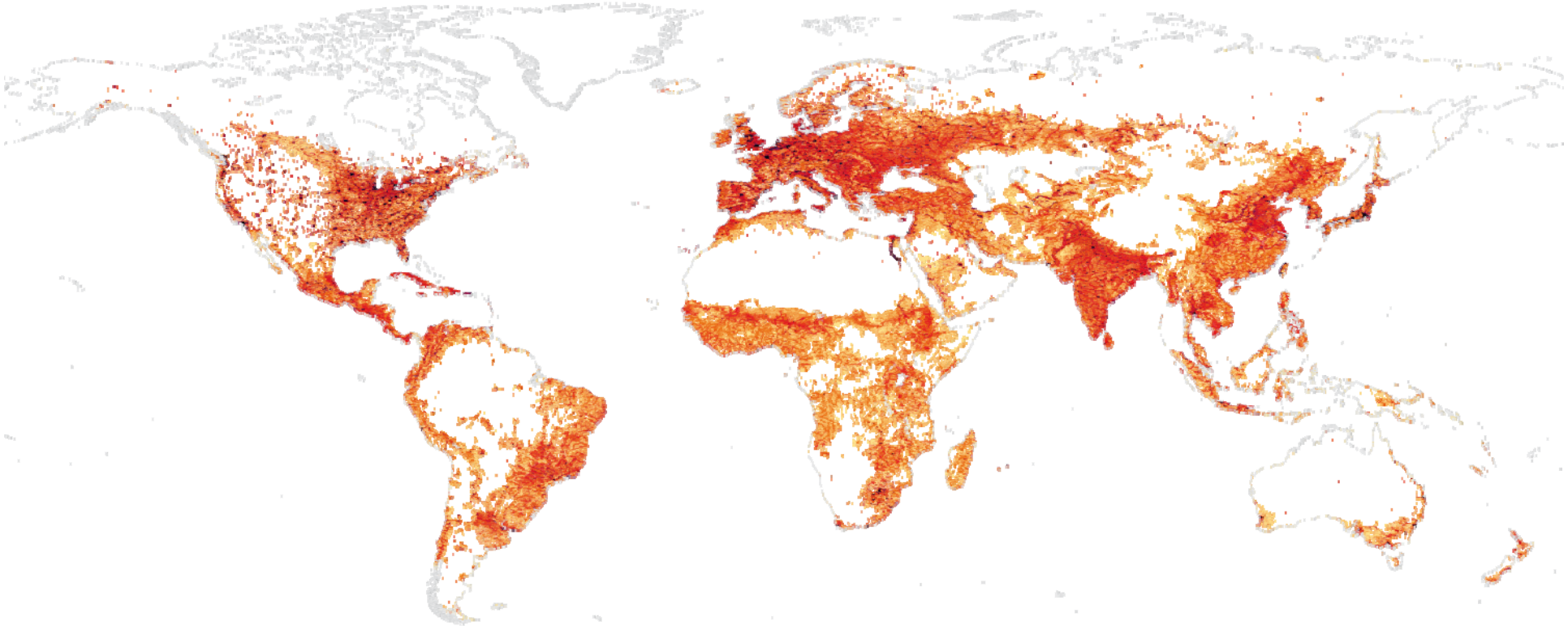
Machu Picchu, Peru


Machu Picchu, Peru
DLR

Venice, Italy



Global Change Through Mankind



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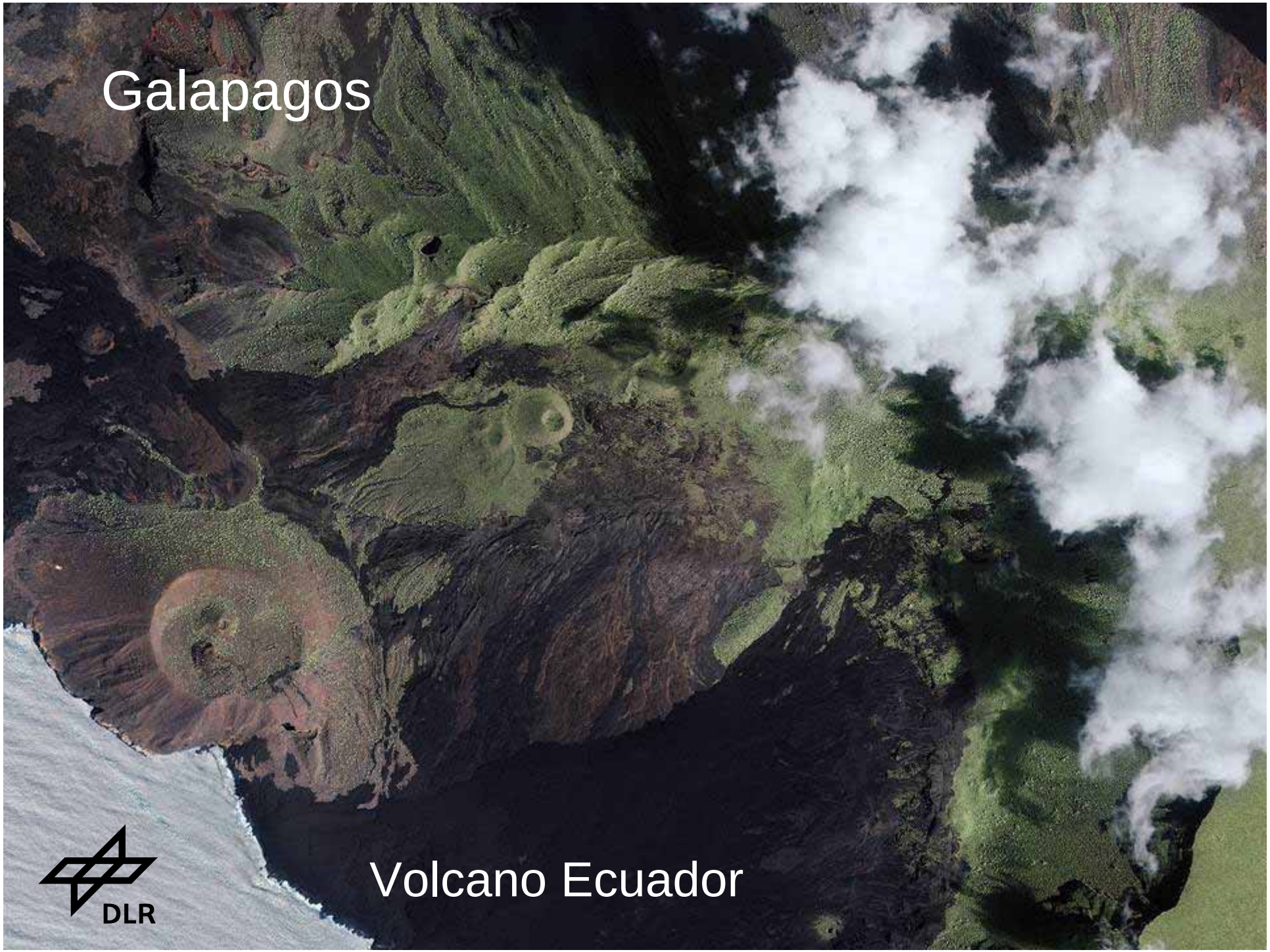
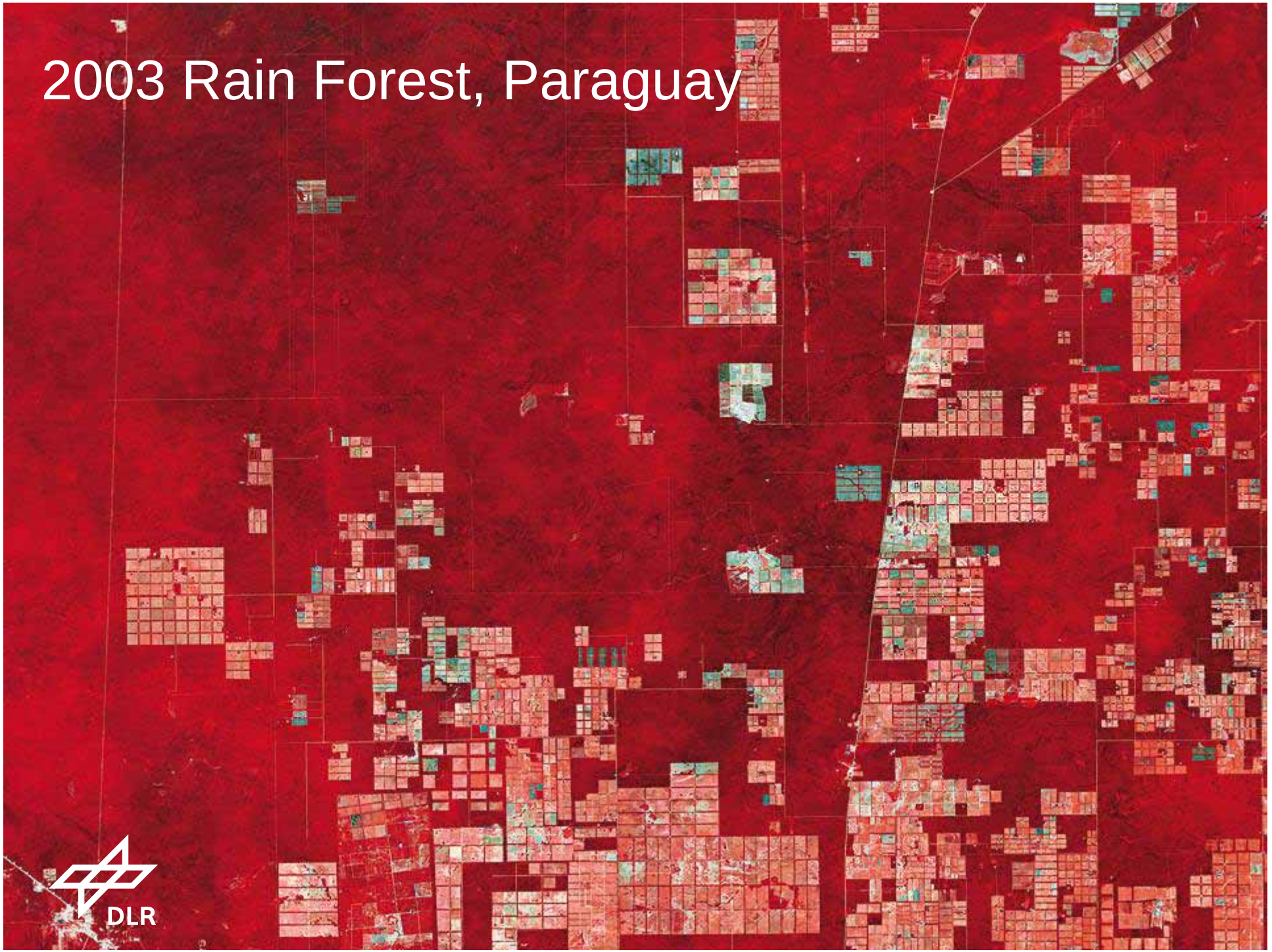
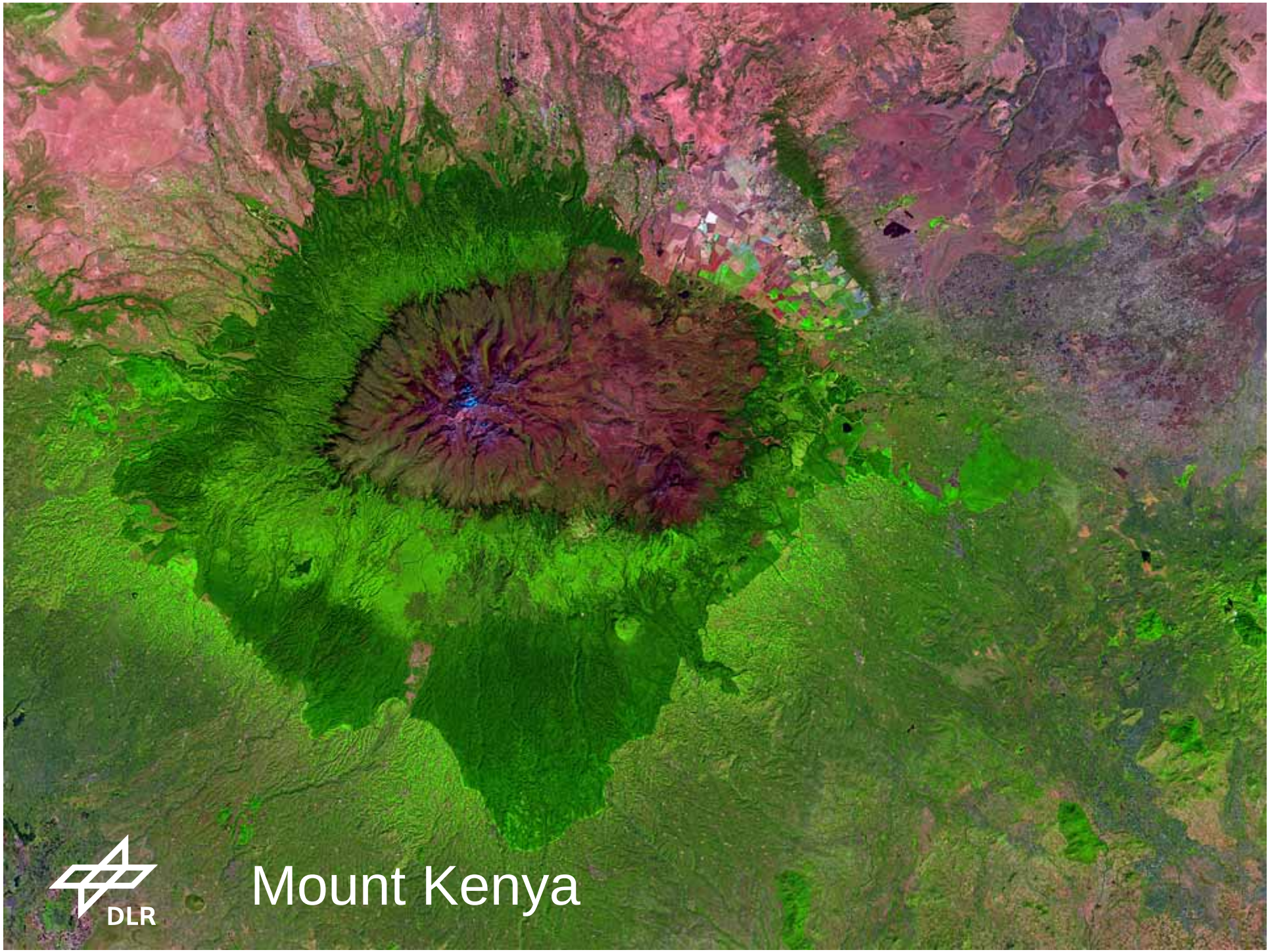
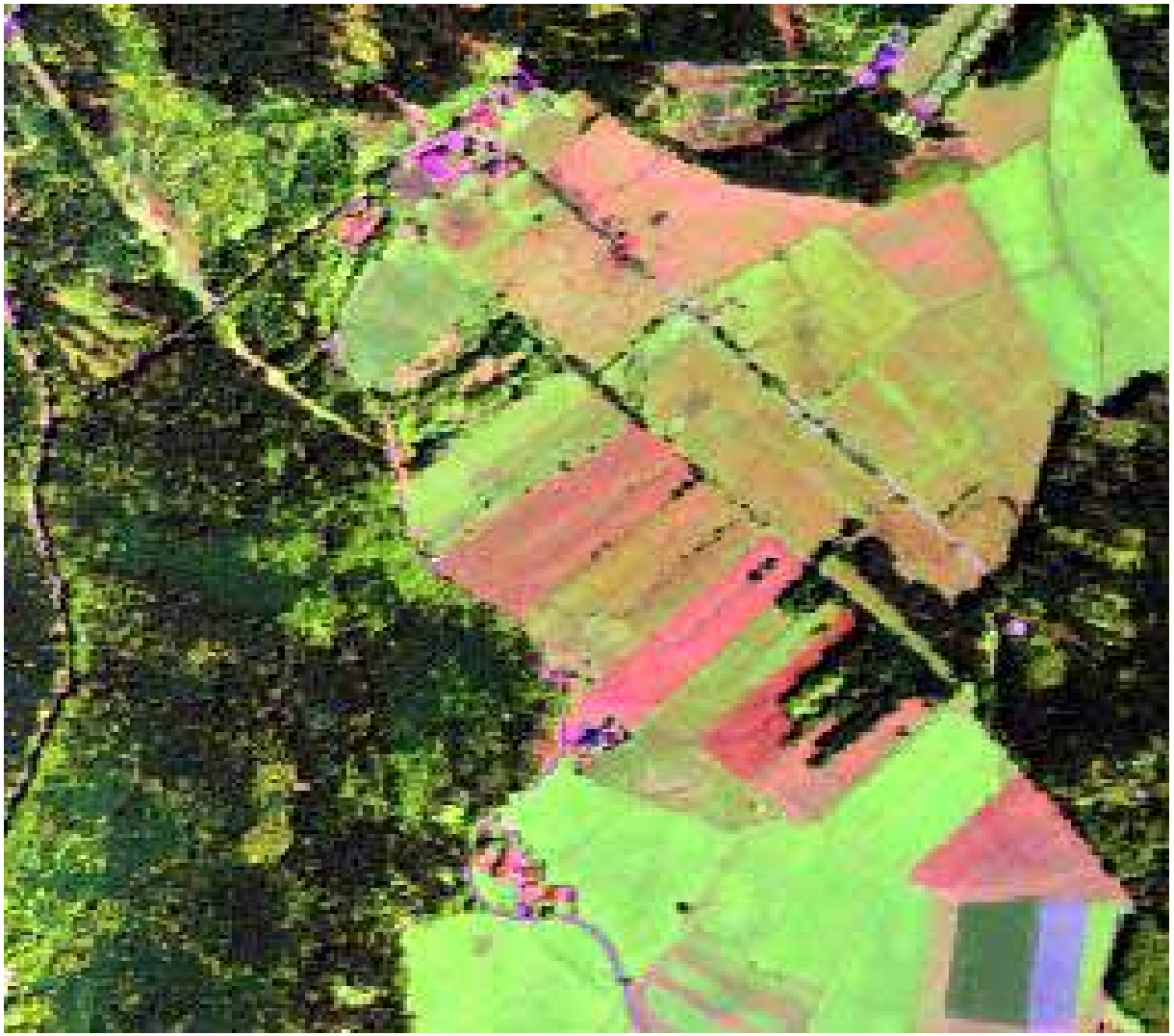

Galapagos
Volcano Ecuador
DLR


Border Argentina/Brazil
DLR
National park Iguaçu (natural heritage)

1985 Rain Forest, Paraguay

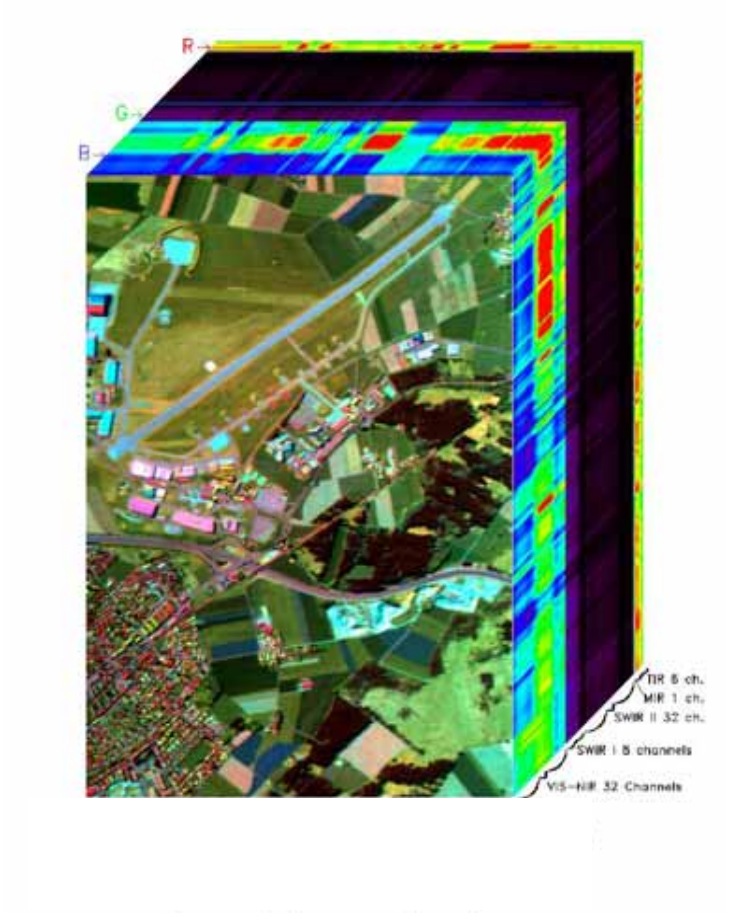

2003 Rain Forest, Paraguay
DLR

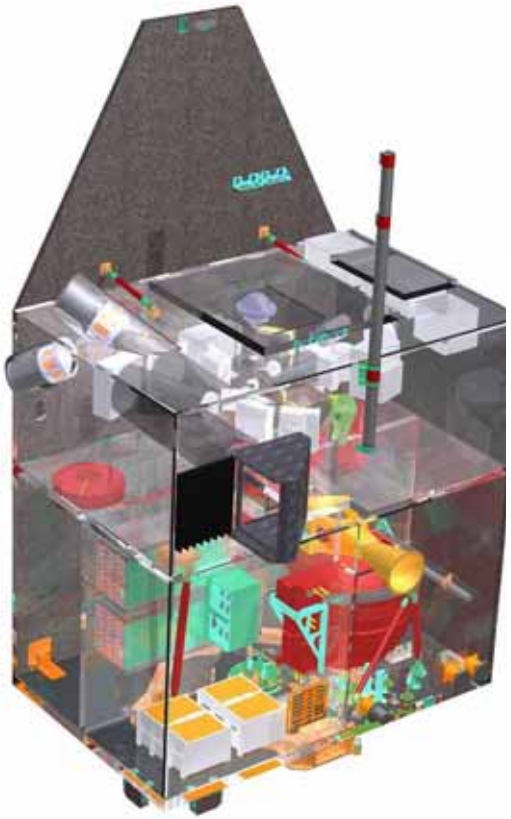

DLR
Mount Kenya



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

Hyperspectral Imaging from Space

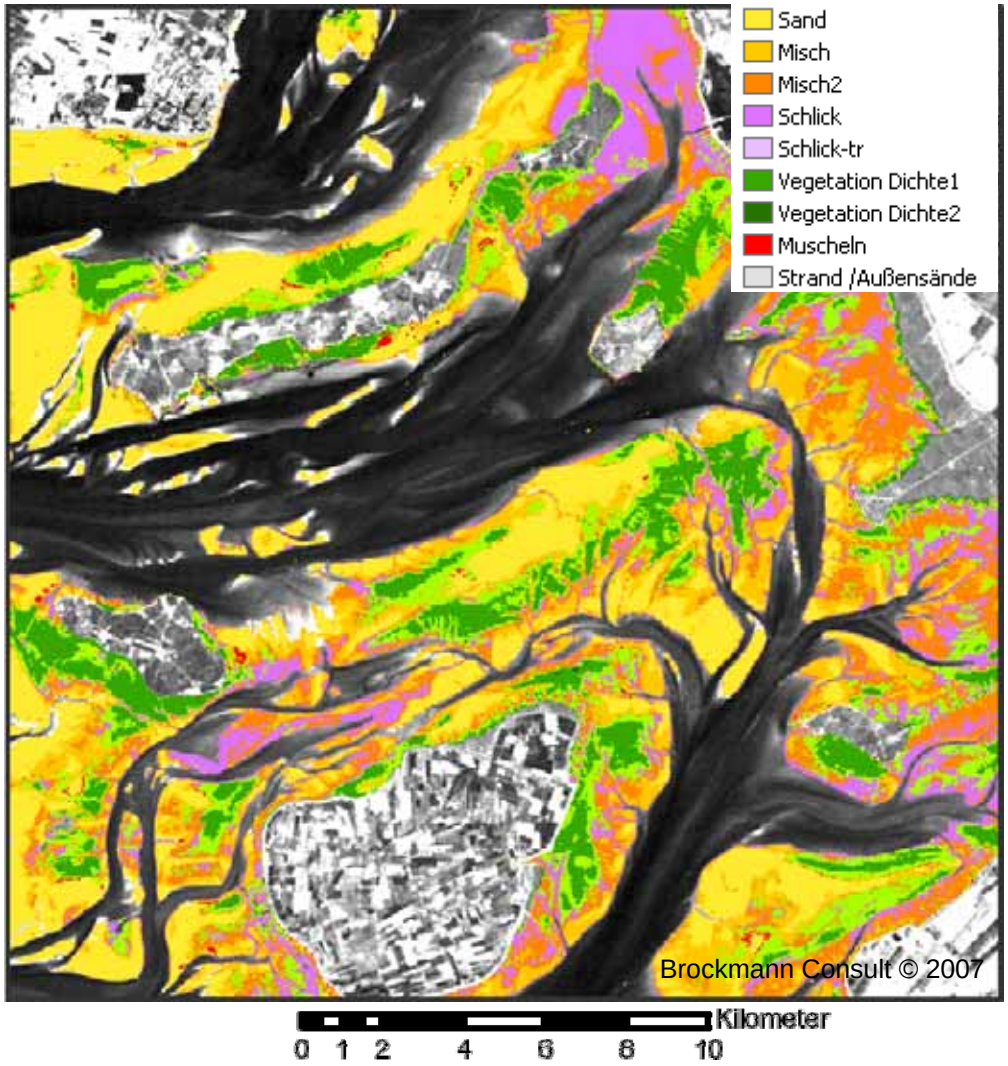




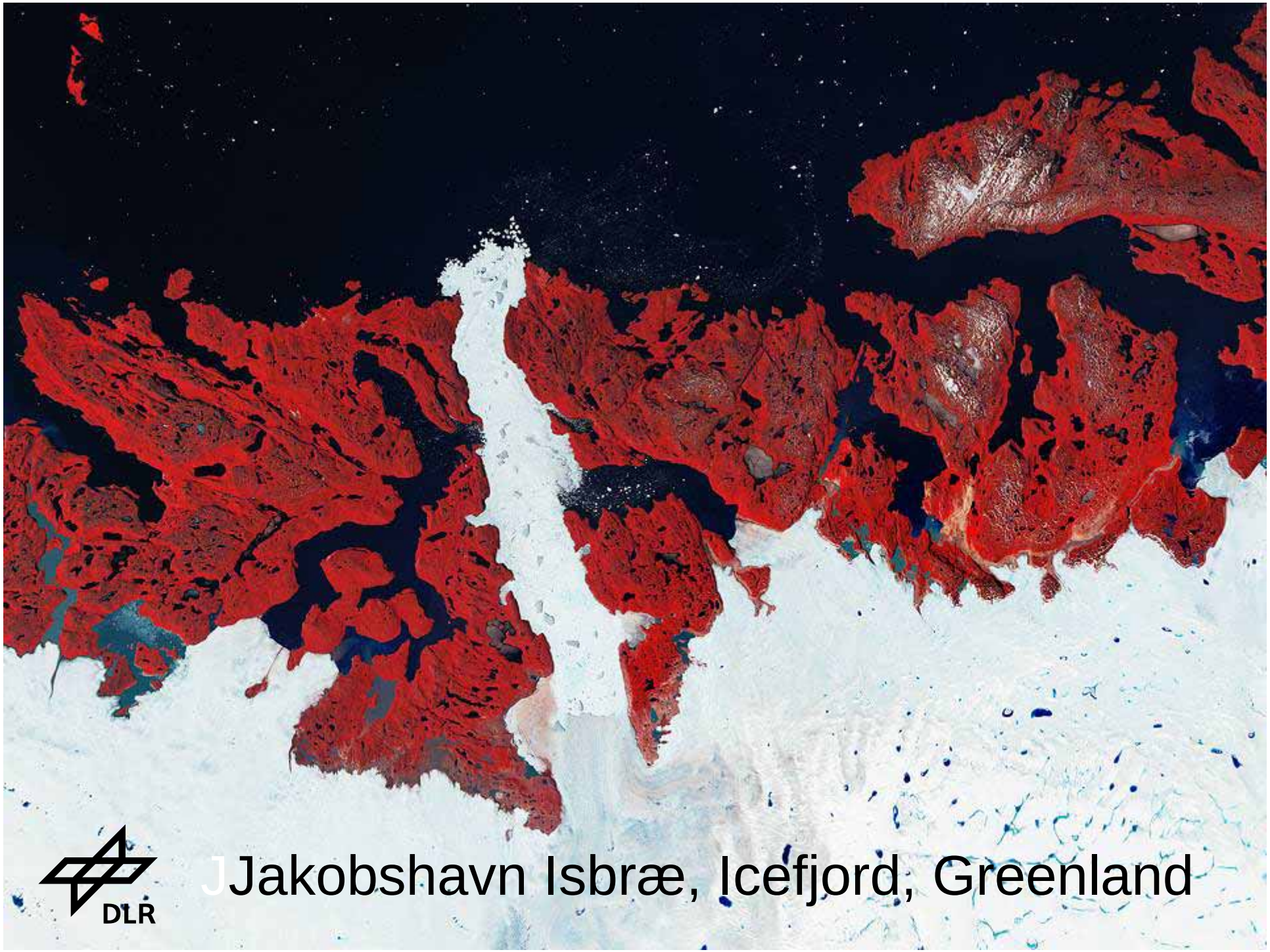
EnMAP
Hyperspectral Imager

… from 2013

Wadden Sea, Germany



Wadden Sea, Germany

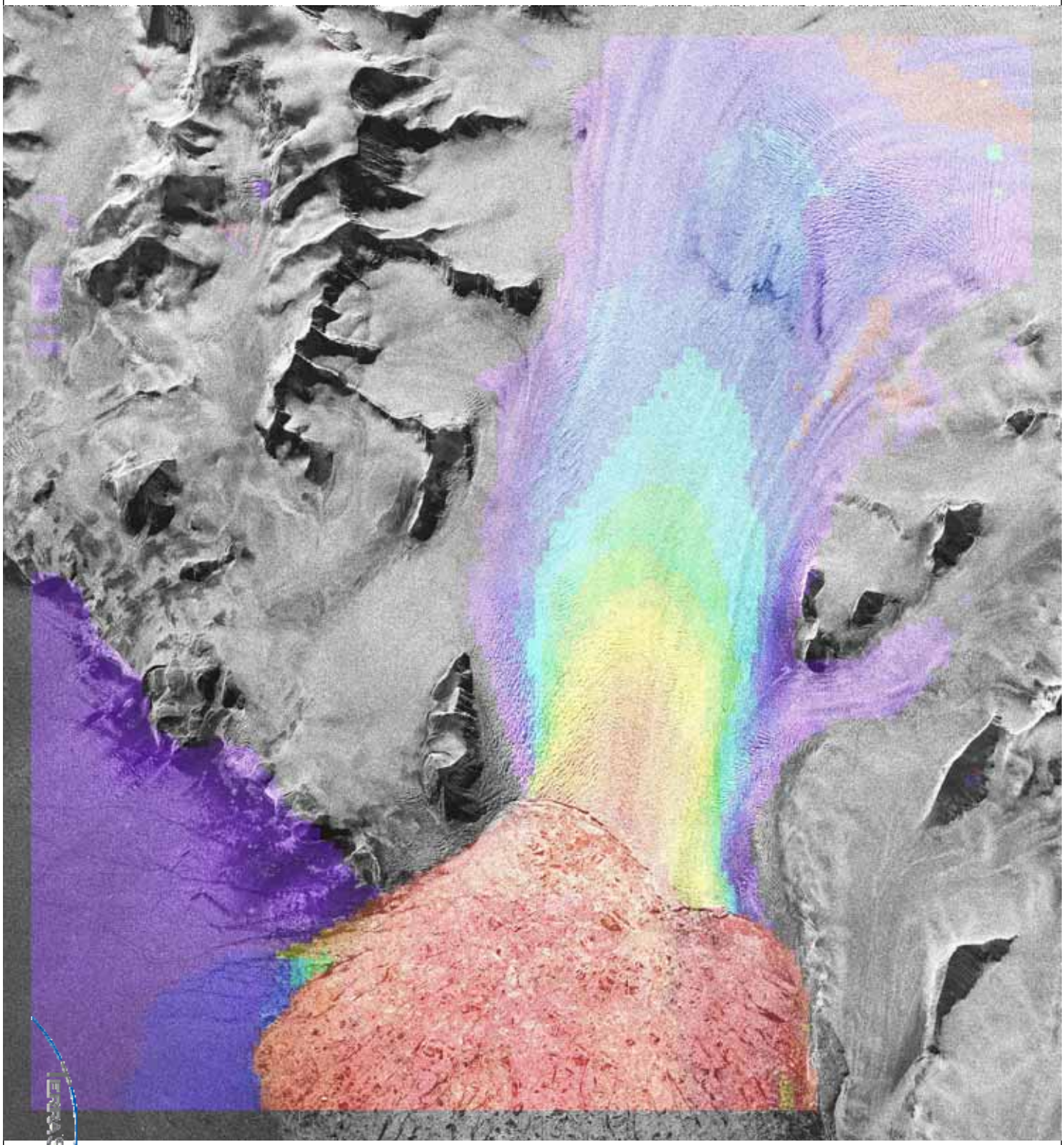


DLR

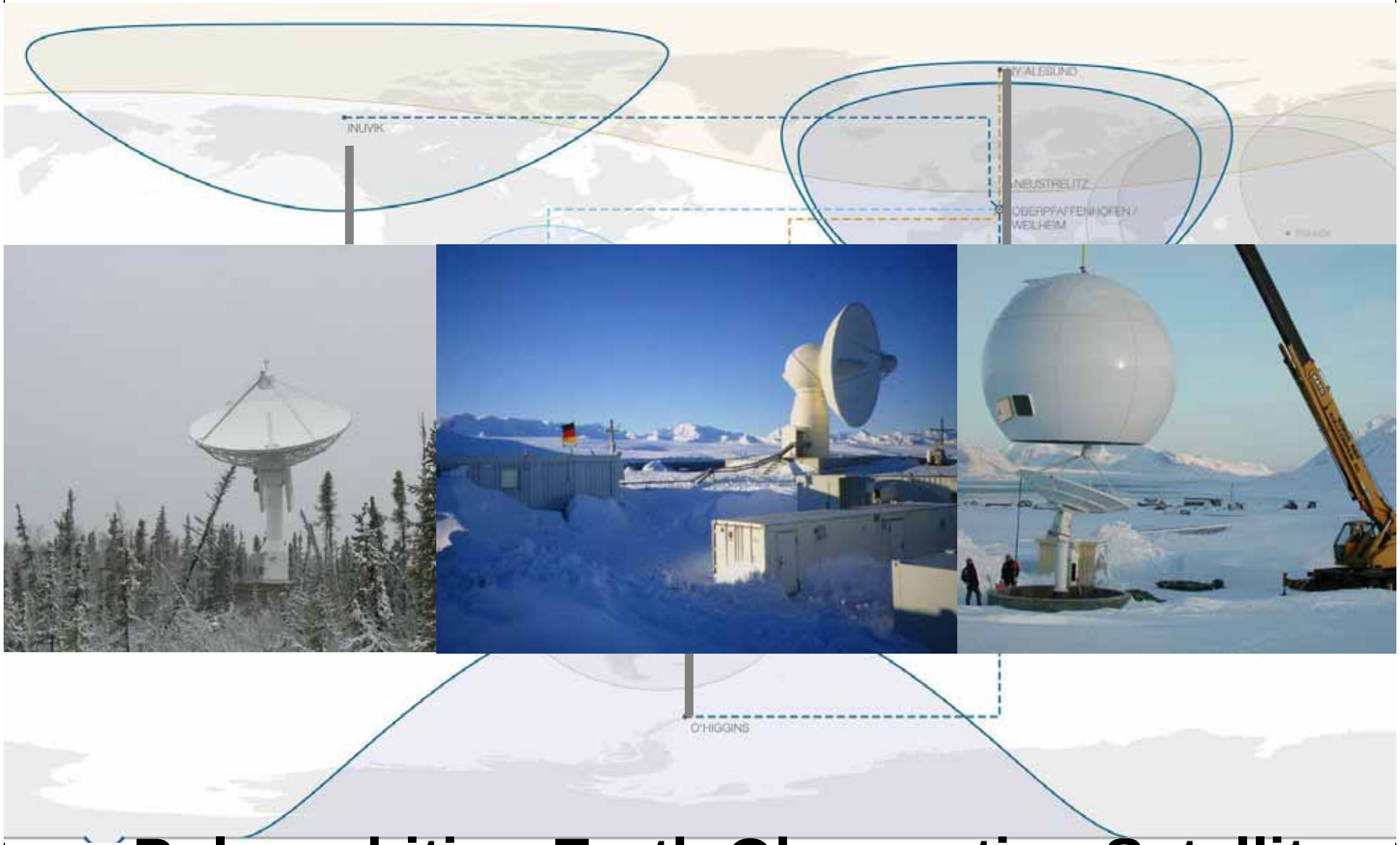
Jakobshavn Isbræ, Icefjord, Greenland

Drygalski Glacier Oct 2007 – July 2008

2-D velocity measured by TSX image correlation



Polar Ground Stations for …



… Polar orbiting Earth Observation Satellites

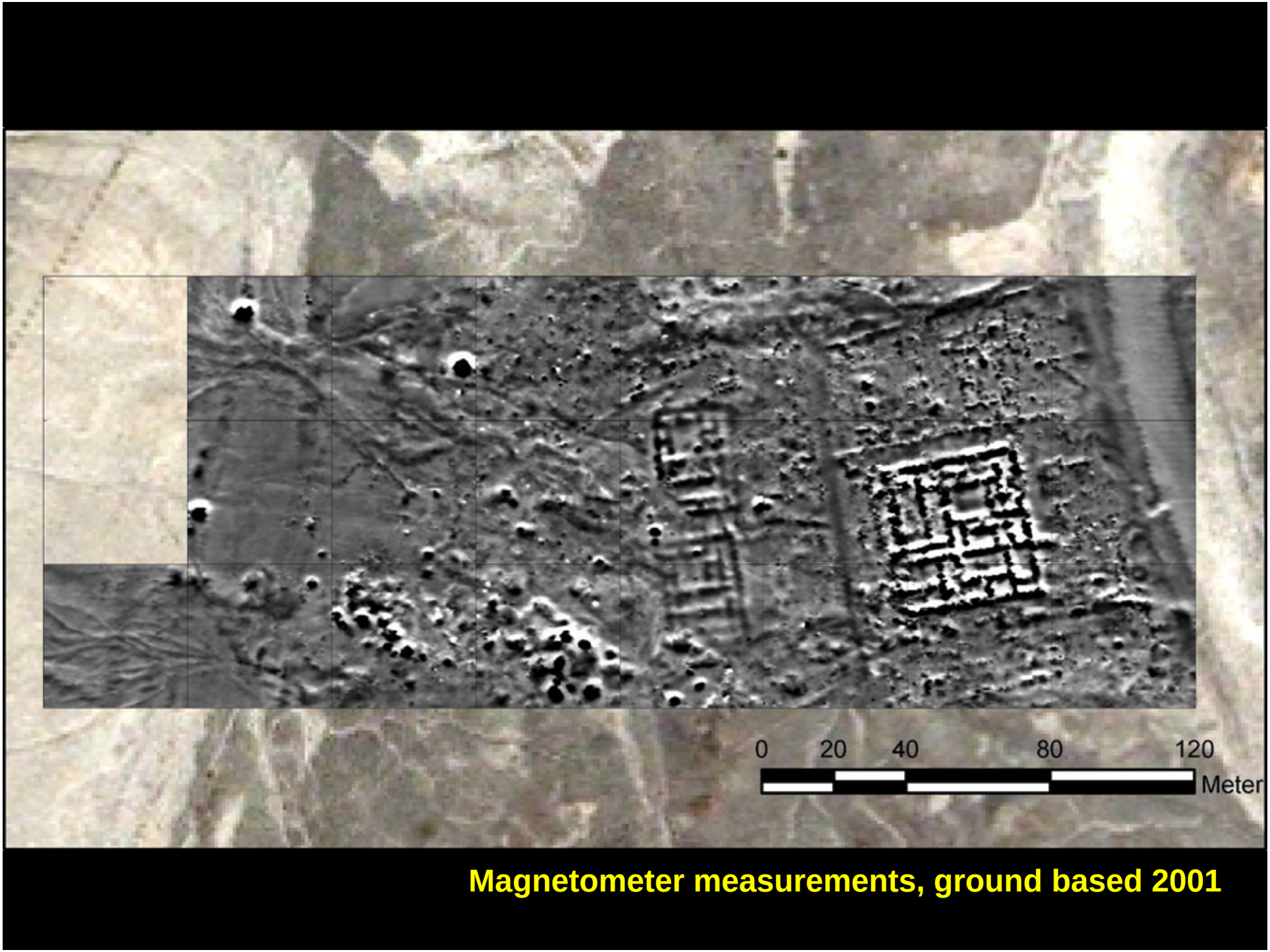
A Project ....

- 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

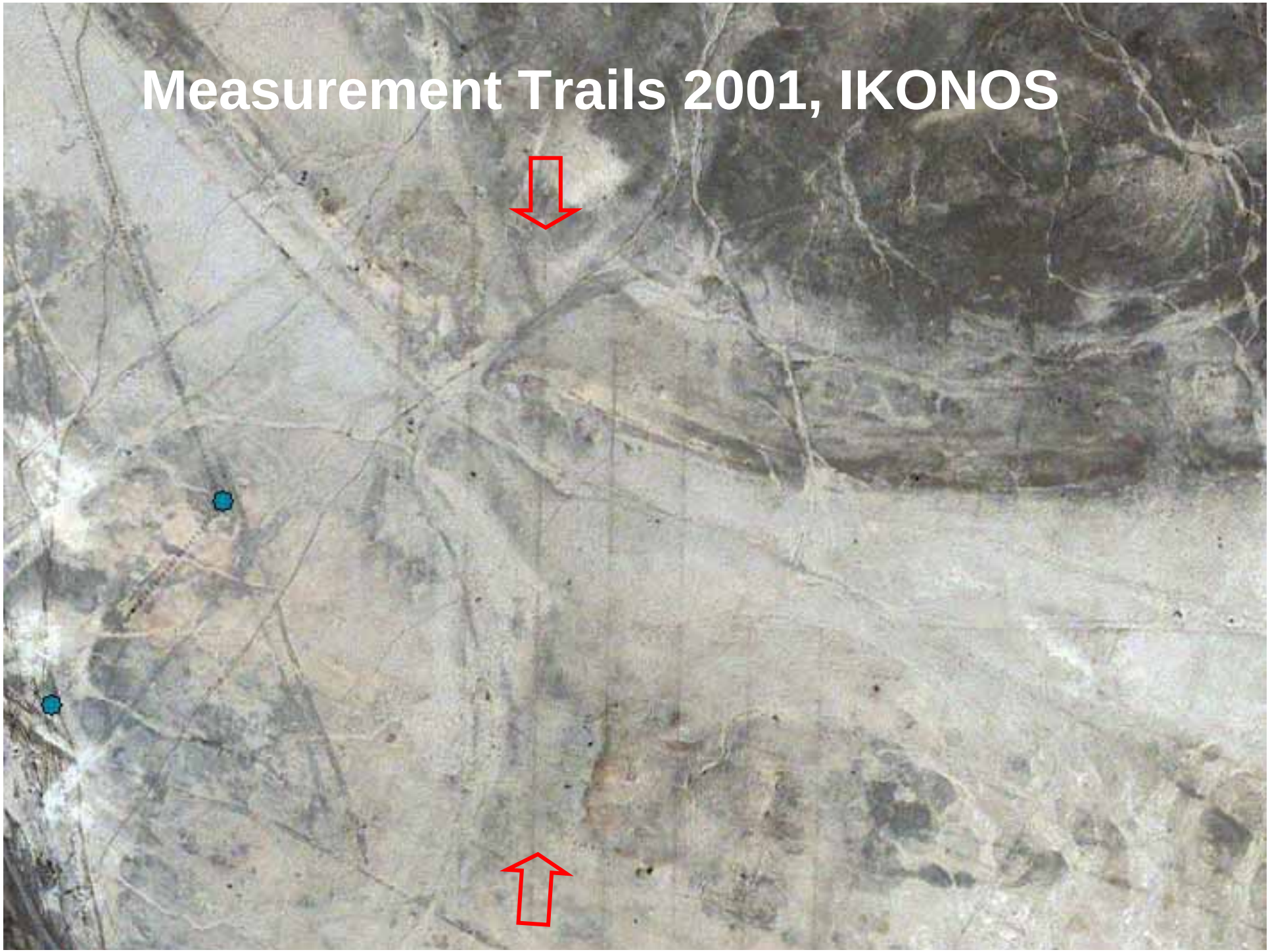
Uruk, Iraq (archaeologic site)


IKONOS
Resolution: 1-meter
Pan-sharpened Multispect
Uruk

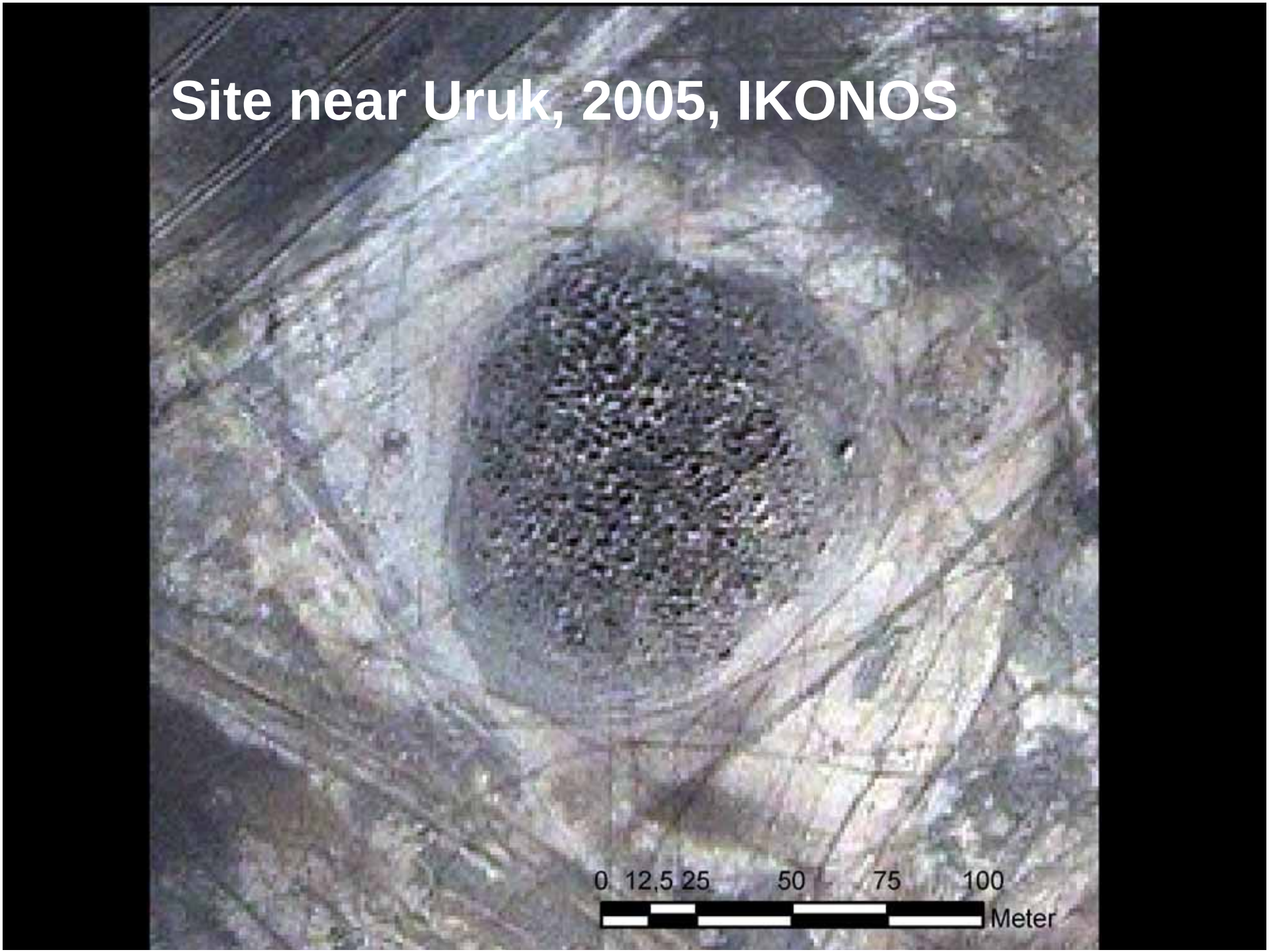

TerraSAR-X
SpotLight
Nov 16, 2008
Uruk



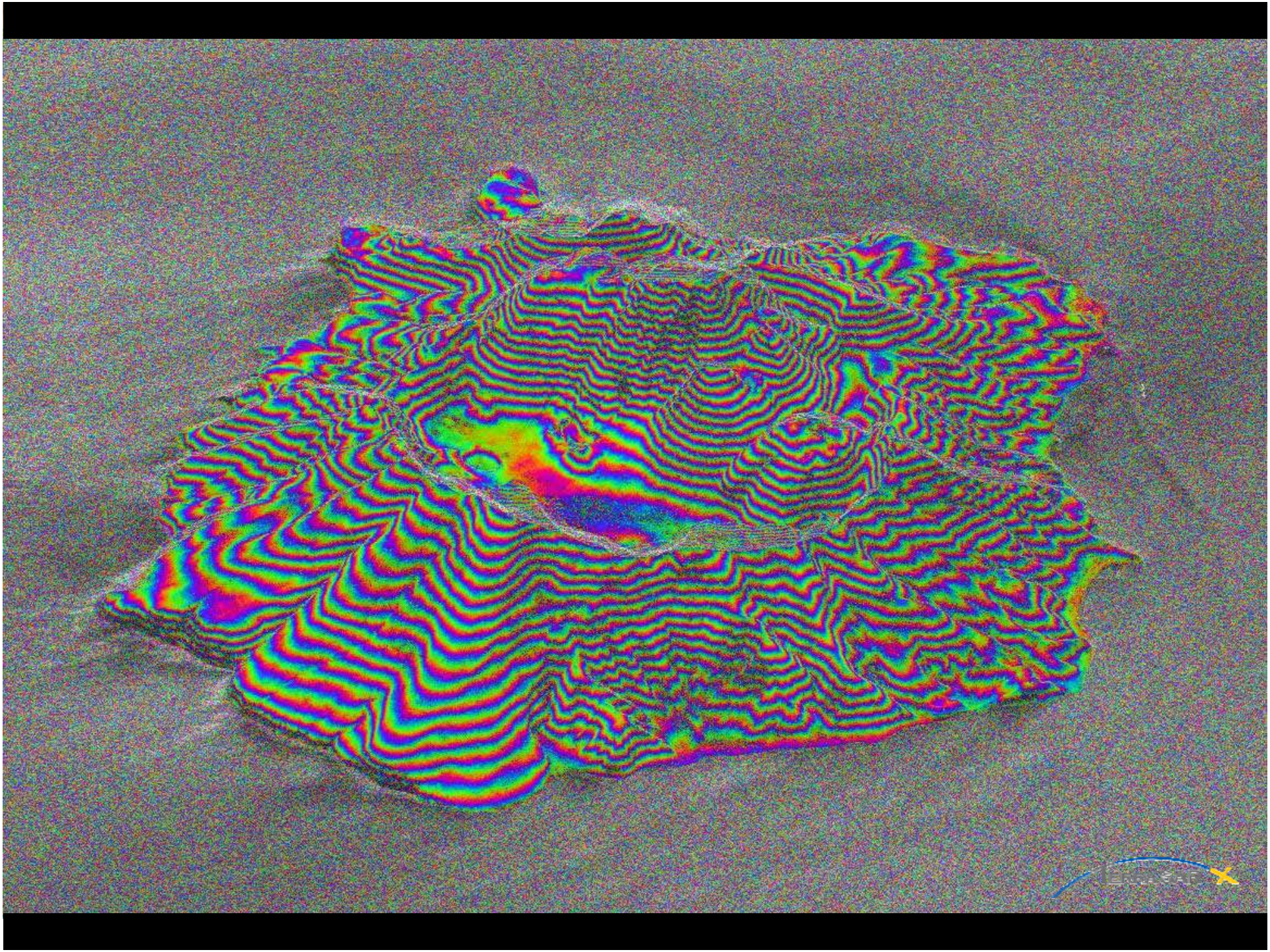
Magnetometer measurements, ground based 2001

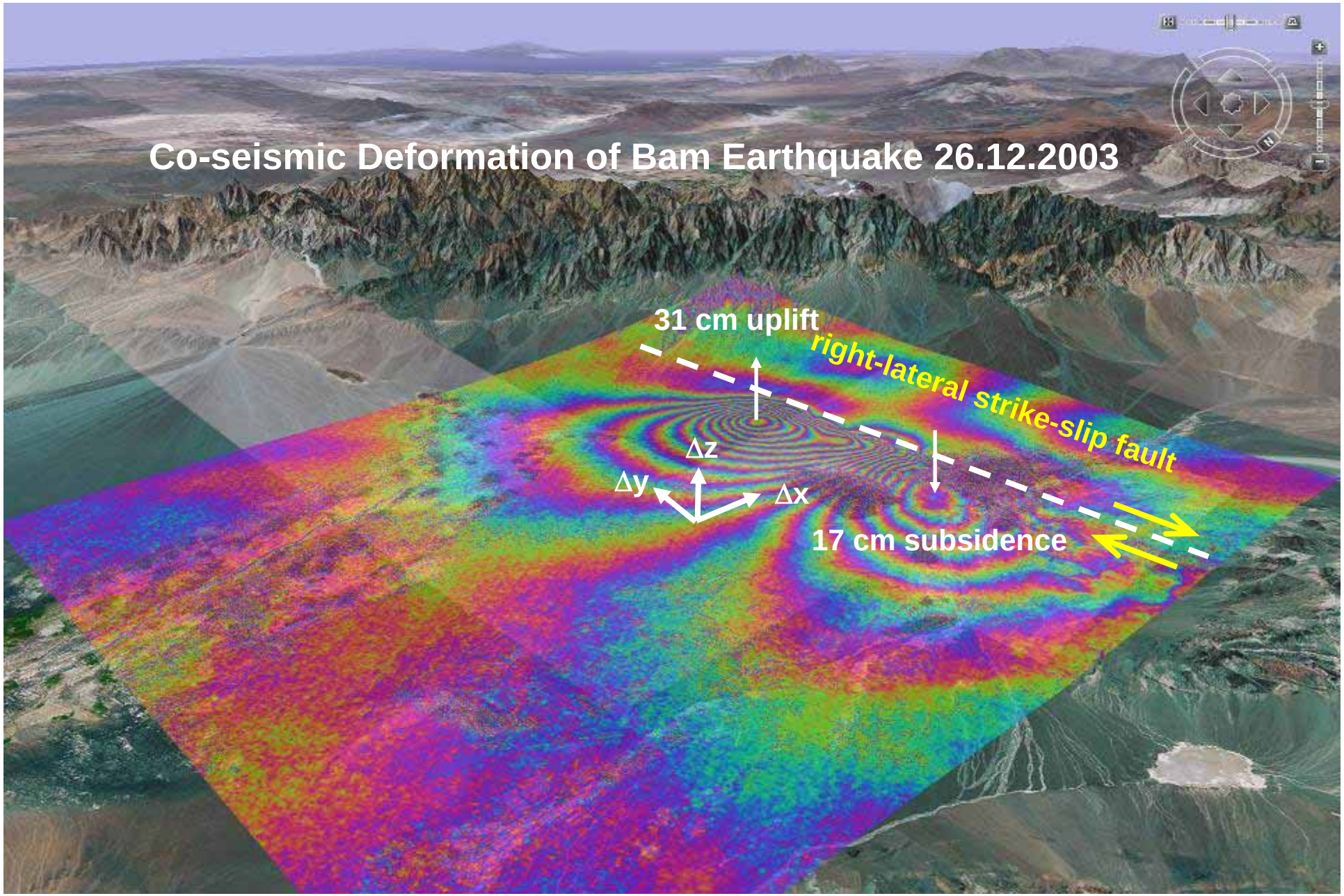

Measurement Trails 2001, IKONOS


Site near Uruk, 2001, IKONOS
0 12,5 25 50 75 100
Meter


Site near Uruk, 2005, IKONOS
0 12,5 25 50 75 100
Meter

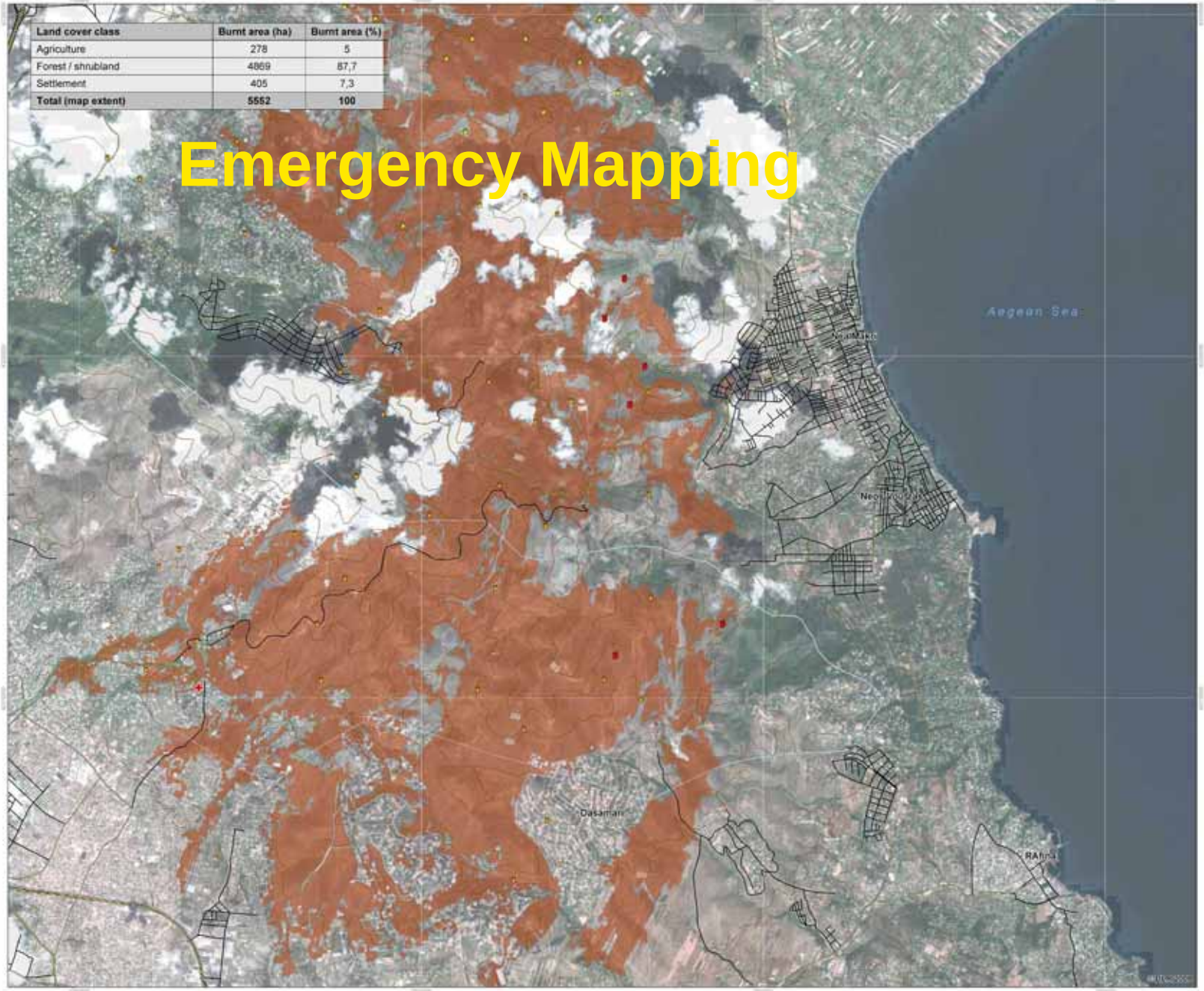
Archives, Then and Now



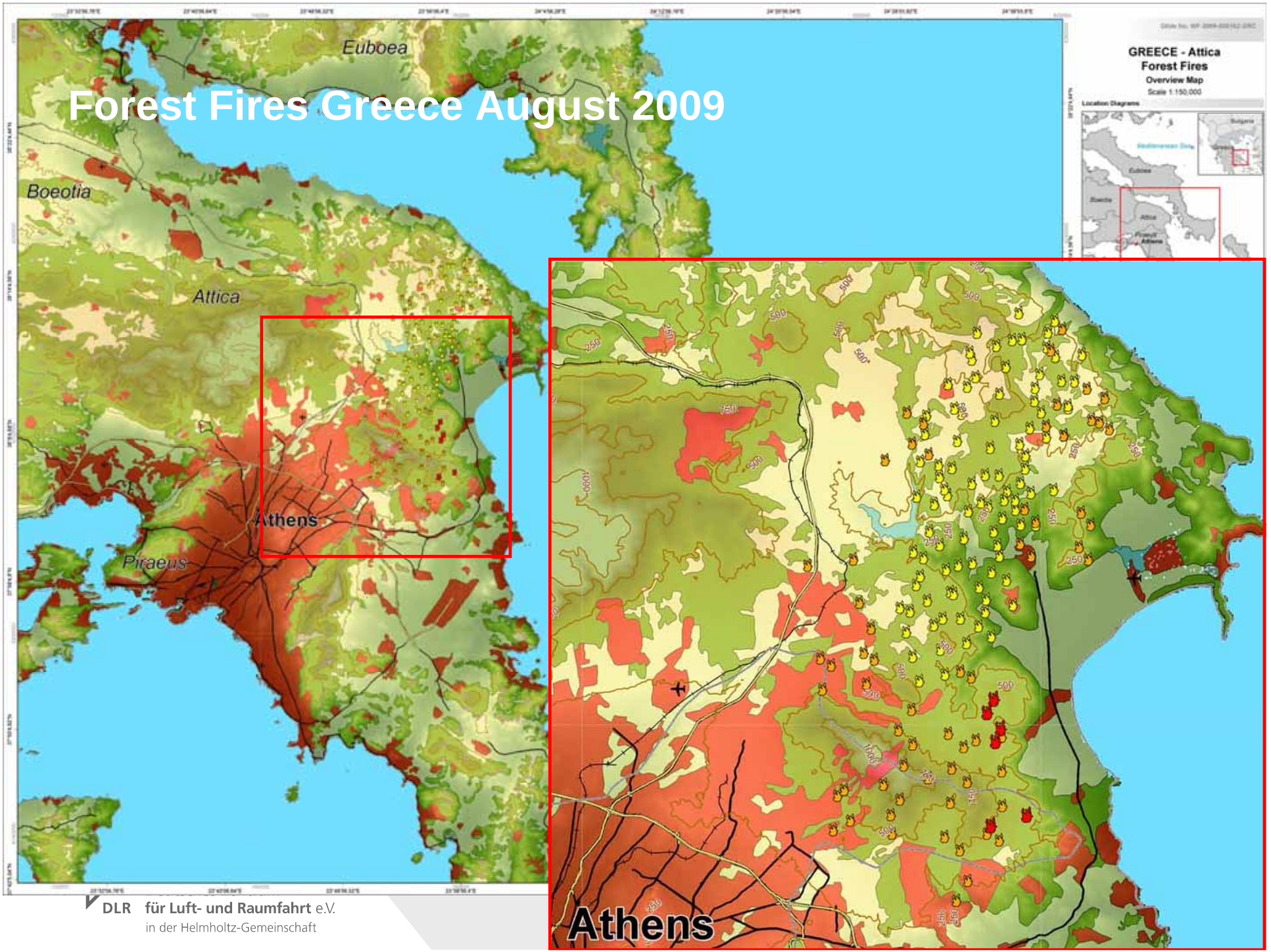

Co-seismic Deformation of Bam Earthquake 26.12.2003
31 cm uplift
right-lateral strike-slip fault
Δz
Δy
Δx
17 cm subsidence

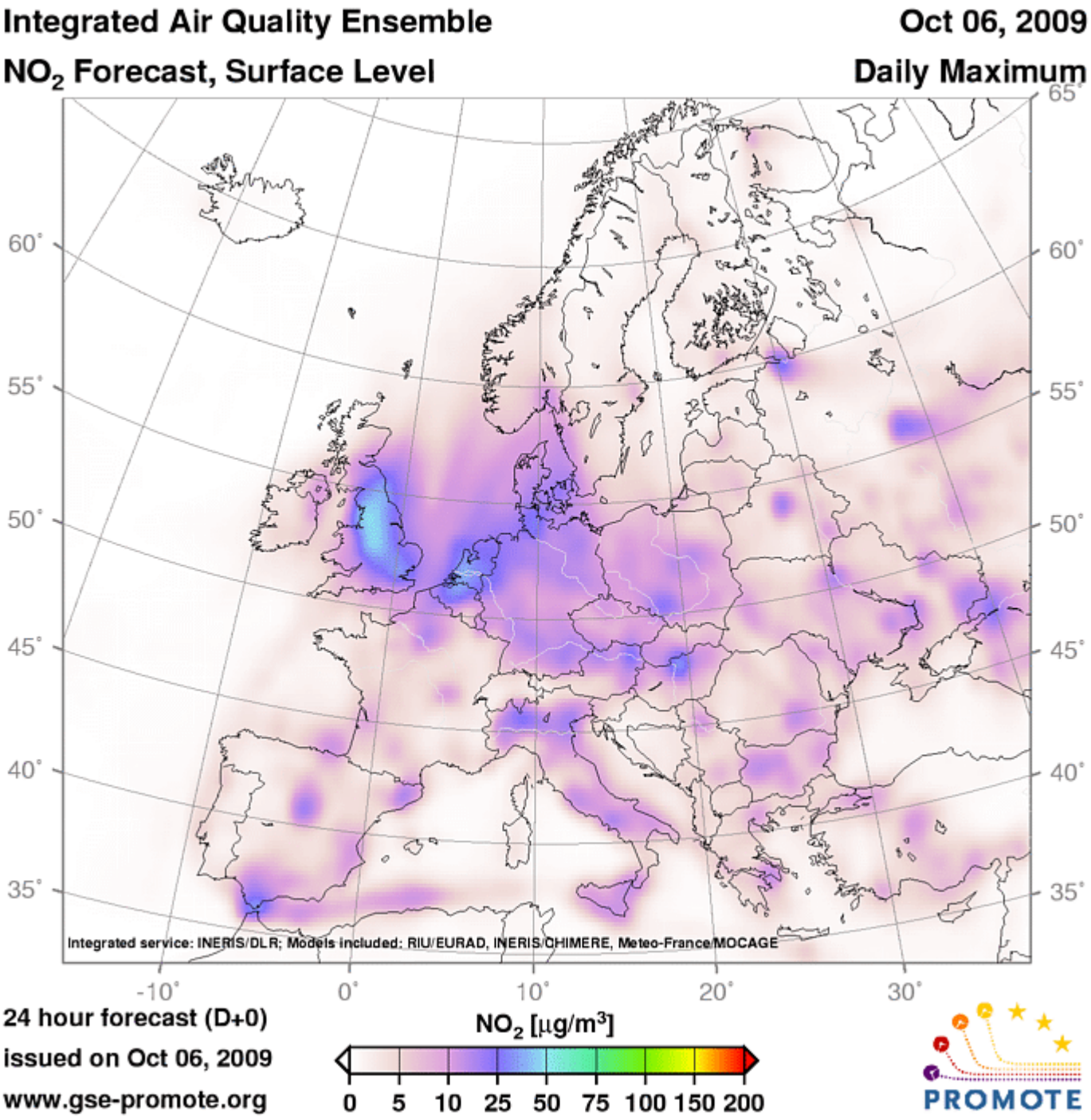
Athens, Greece

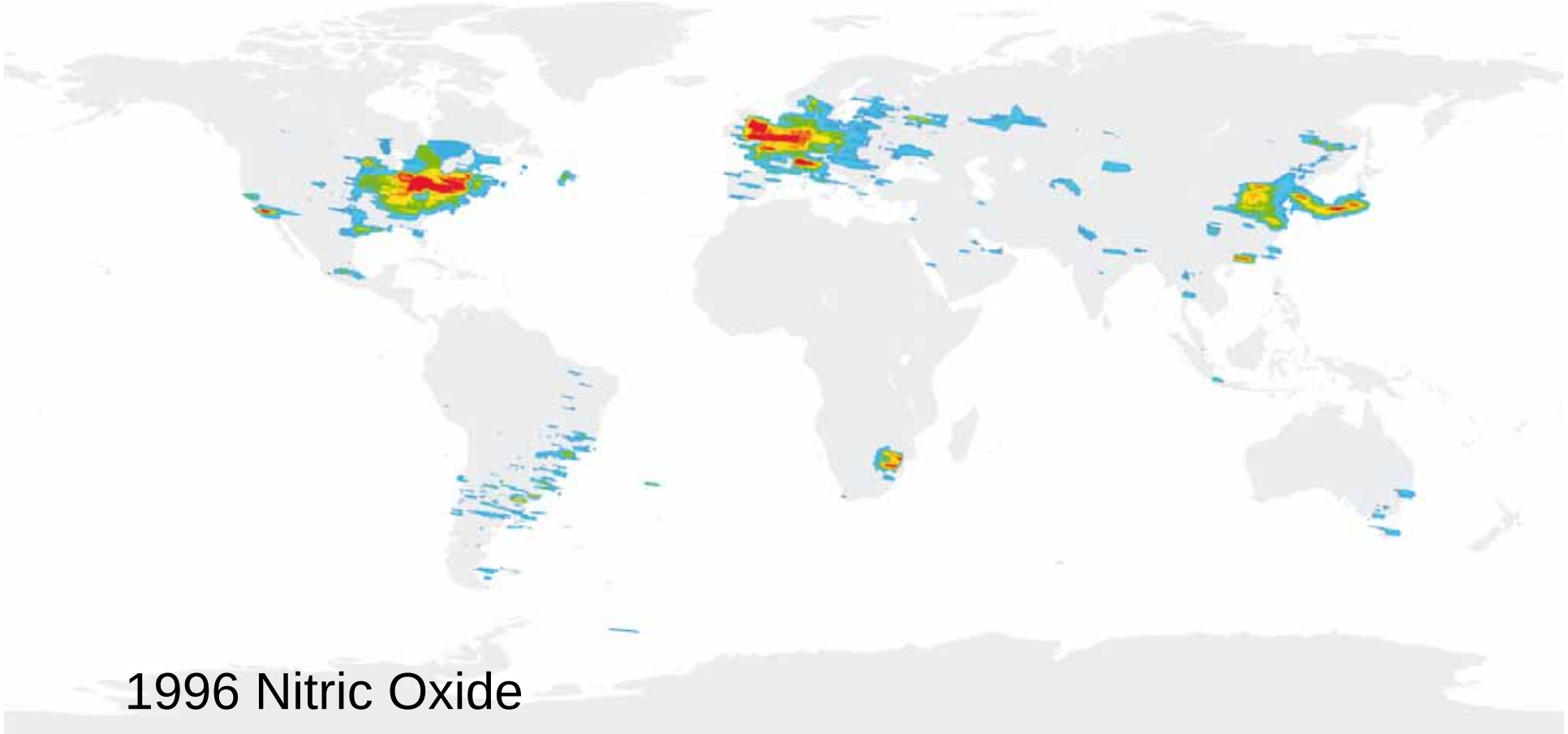
Emergency Mapping



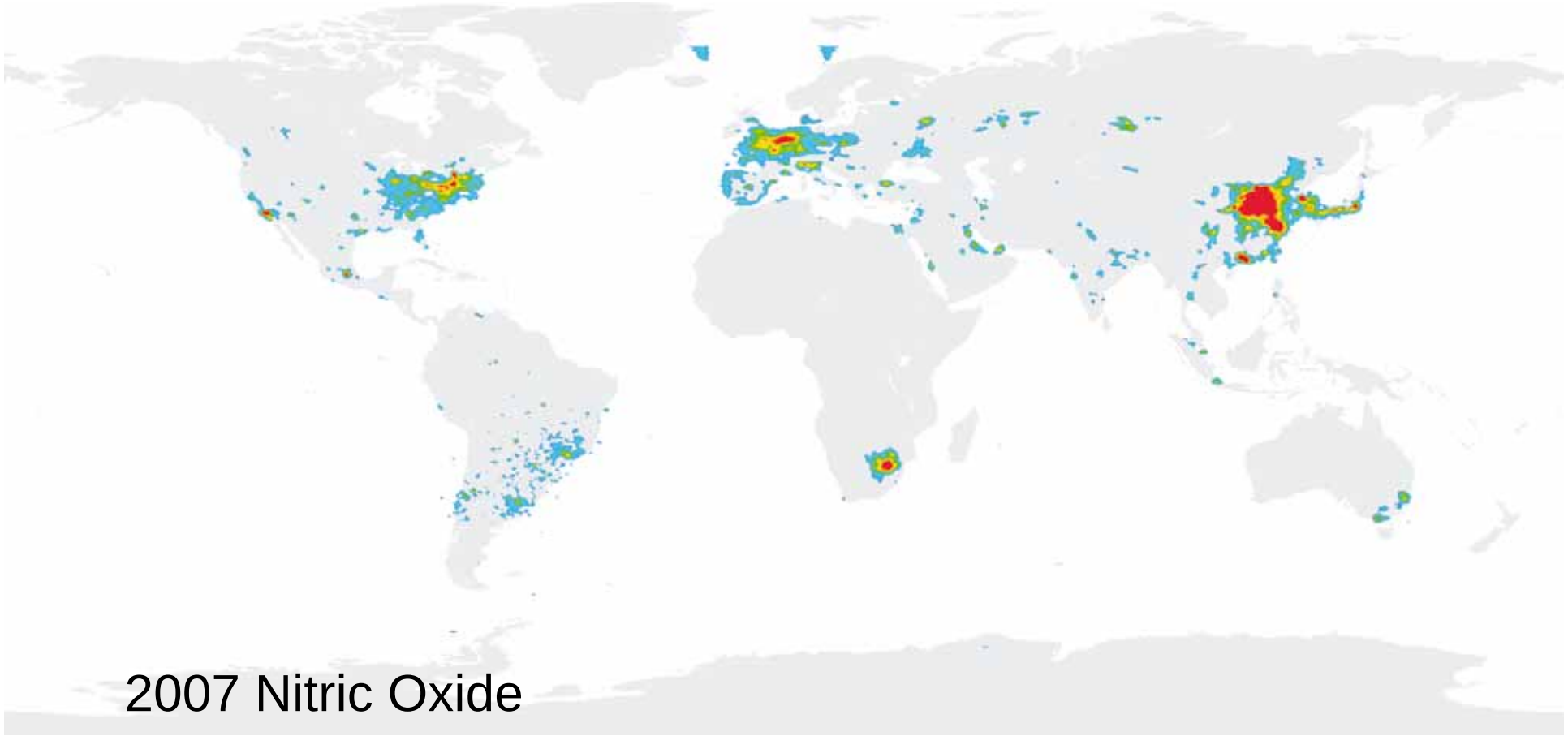
Forest Fires Greece August 2009




Integrated Air Quality Ensemble
Oct 06, 2009
NO2 Forecast, Surface Level
Daily Maximum
65˚
60˚
55˚
50˚
45˚
40˚
35˚
-10˚
0˚
10˚
20˚
30˚
Integrated service: INERIS/DLR; Models included: RIU/EURAD, INERIS/CHIMERE, Meteo-France/MOCAGE
24 hour forecast (D+0)
issued on Oct 06, 2009
www.gse-promote.org
NO2 [µg/m3]
0 5 10 25 50 75 100 150 200
PROMOTE



1996 Nitric Oxide



2007 Nitric Oxide

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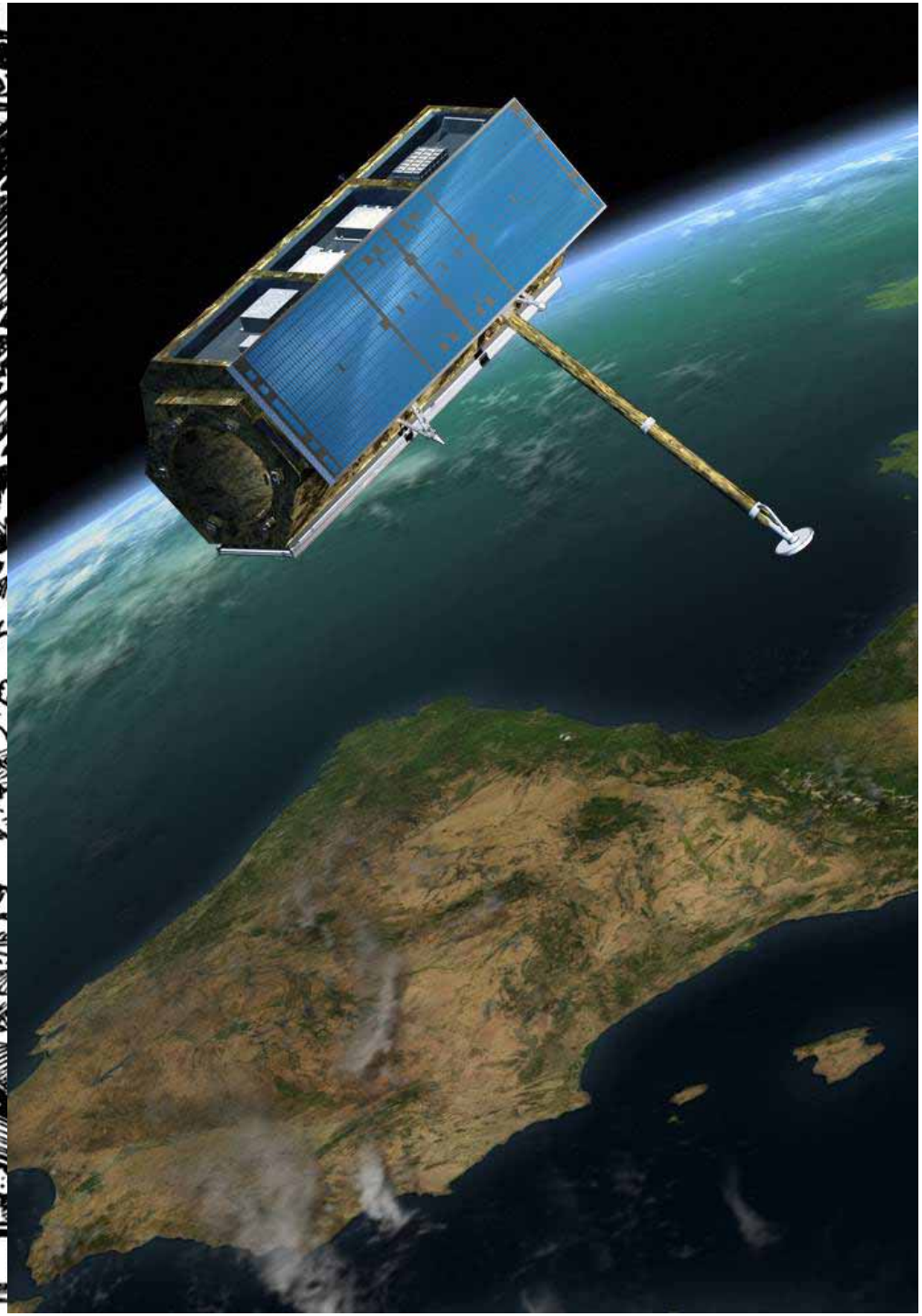
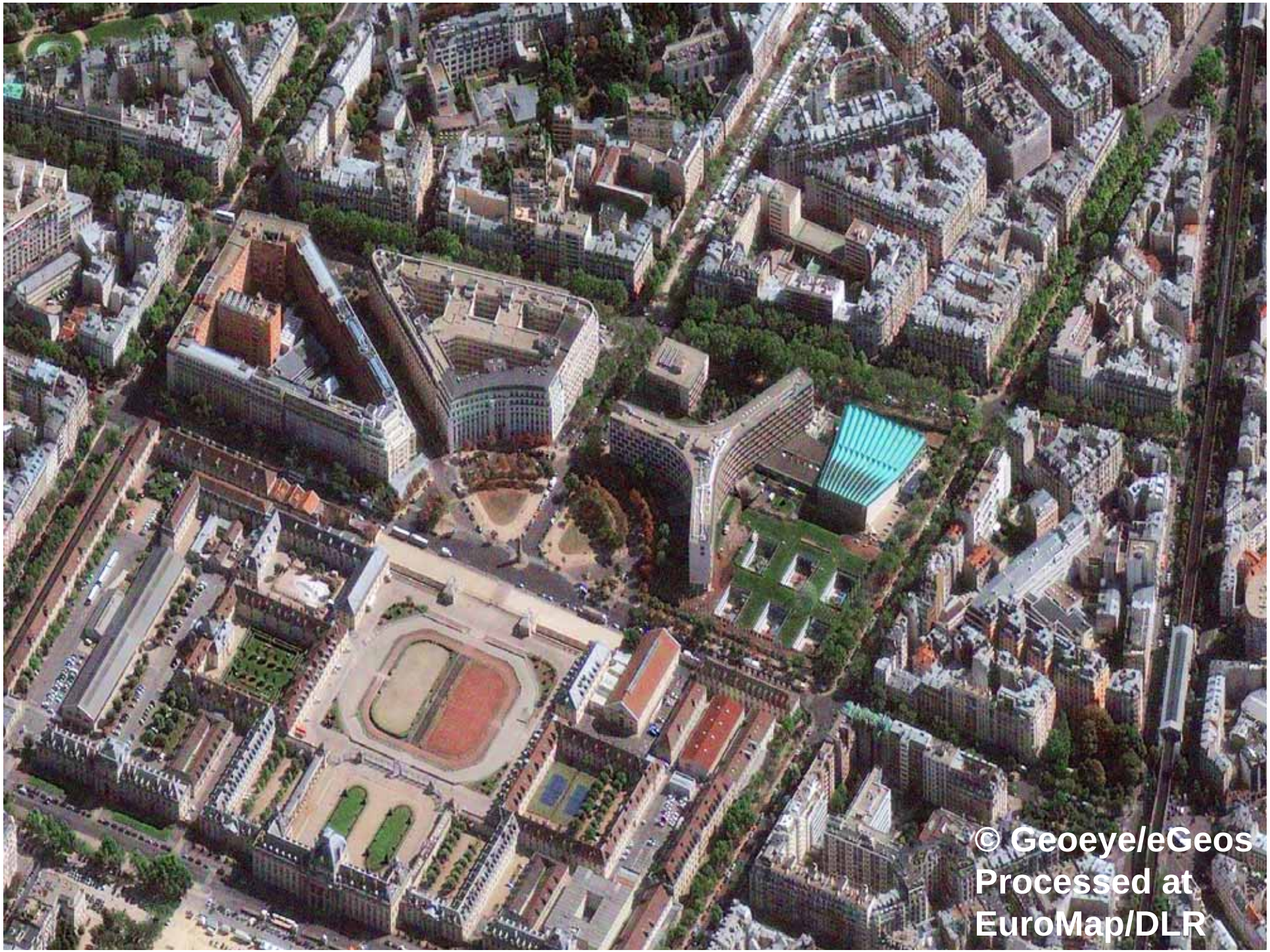


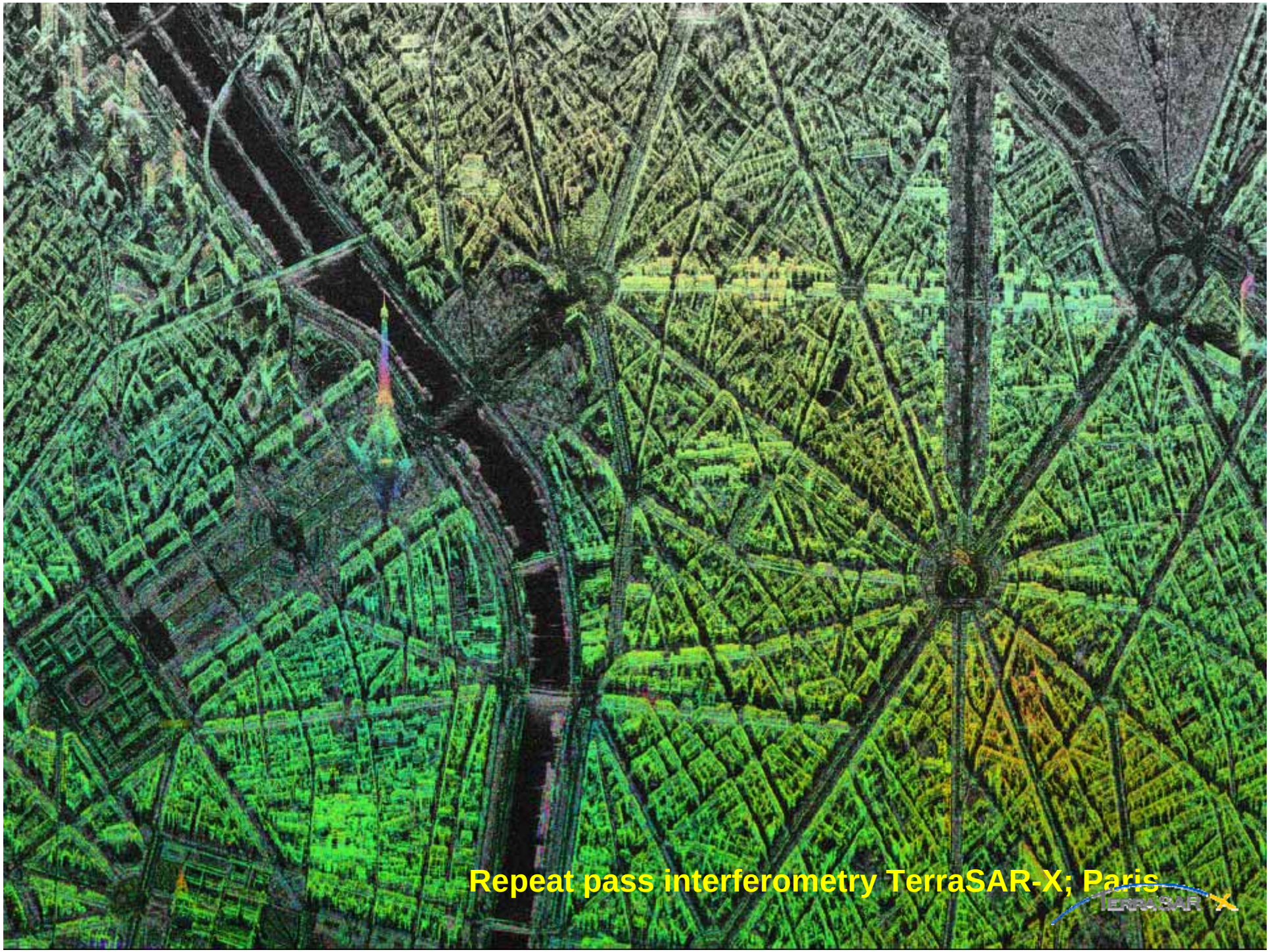

© Geoeye/eGeos
Processed at
EuroMap/DLR

Satellites in Support of World Heritage

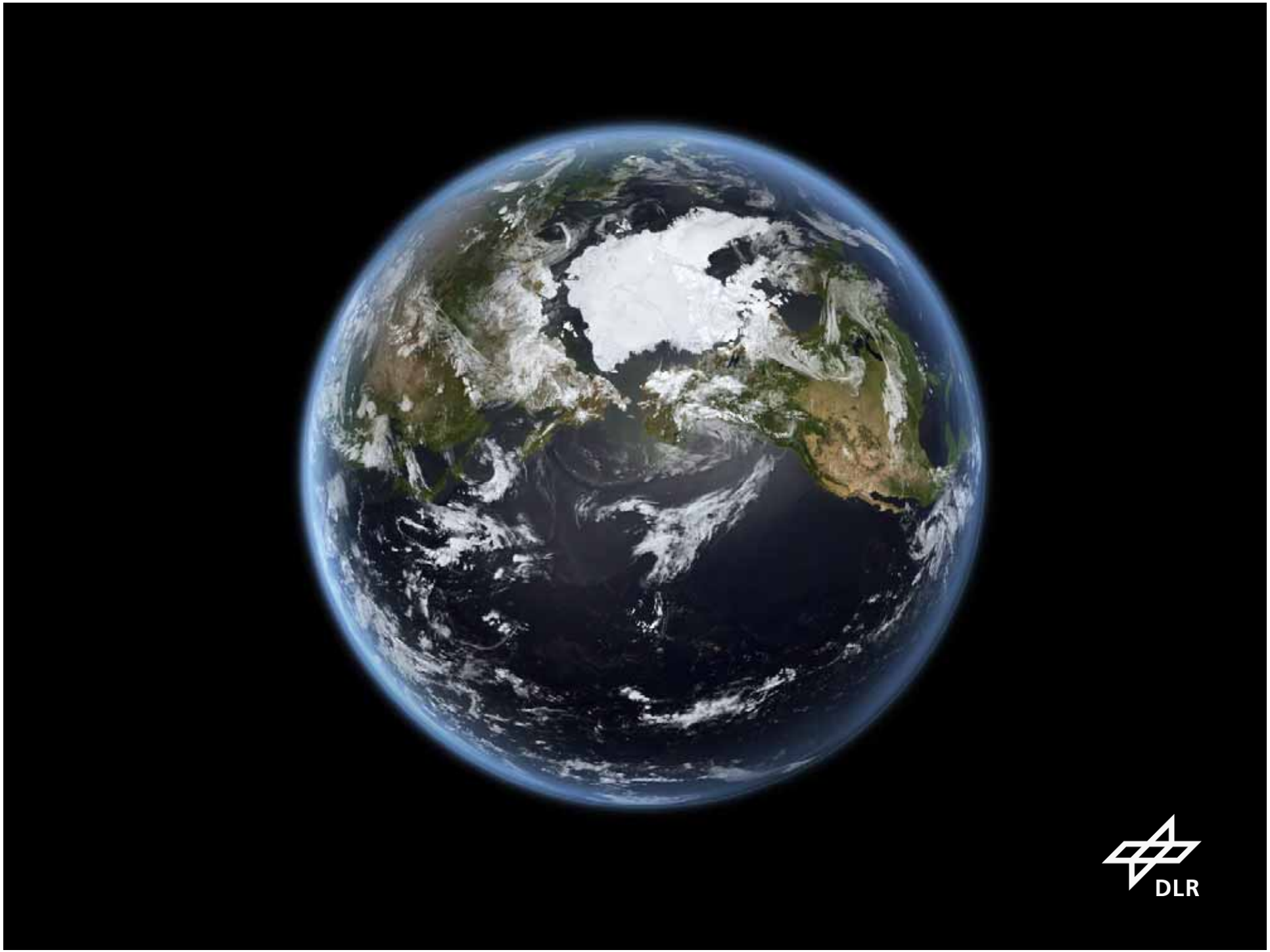
- Open initiative on the use of **Space Technology** in support of the World Heritage Convention

- 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


PEACE
© Geoeye/eGeos
Processed at
EuroMap/DLR
PEACE Performa
By Bob Sinclair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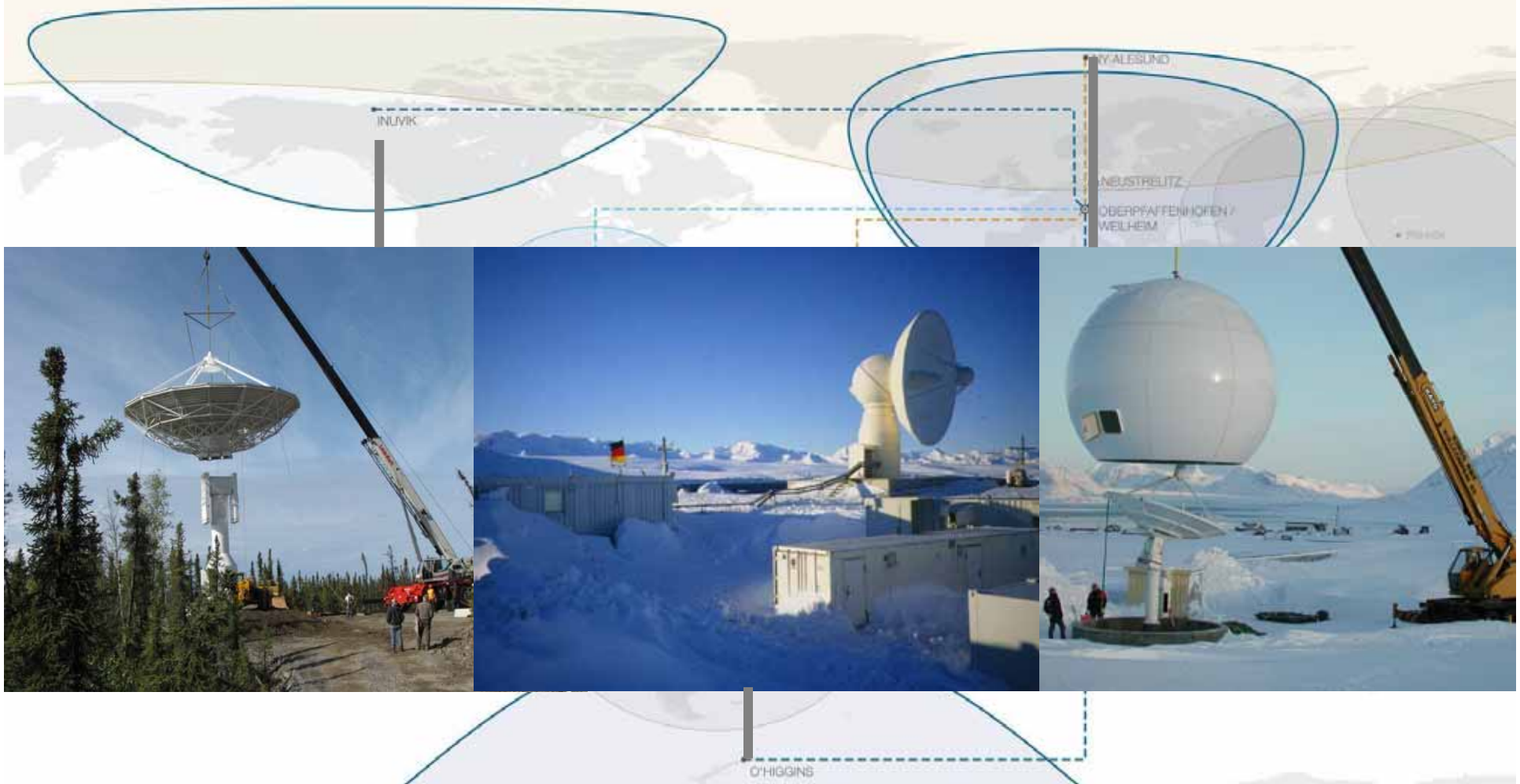

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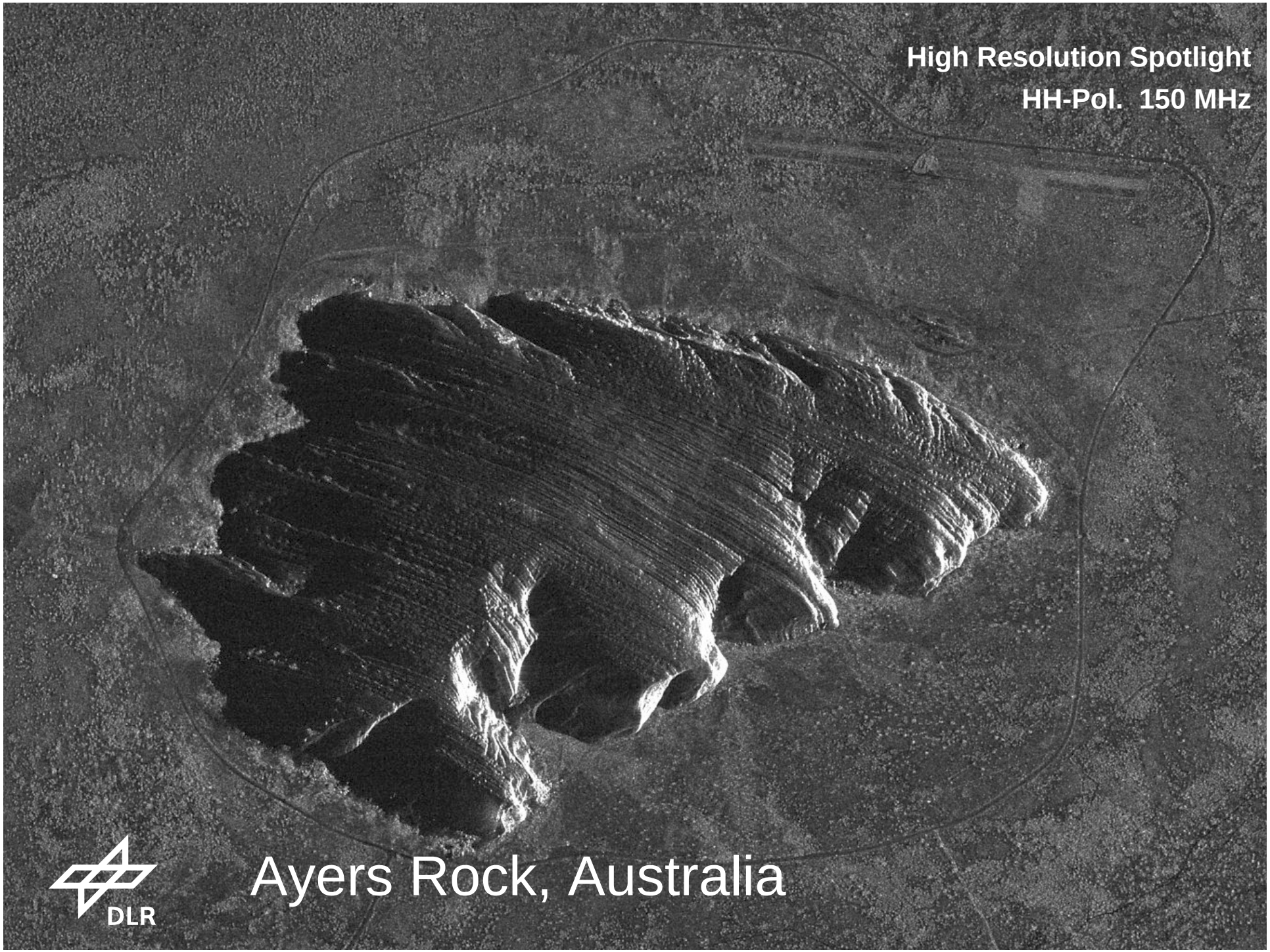
High Resolution Spotlight
HH-Pol. 150 MHz
Ayers Rock, Australia
DLR


Machu Picchu, Peru
DLR

Retreat Upsala glacier front, Patagonia