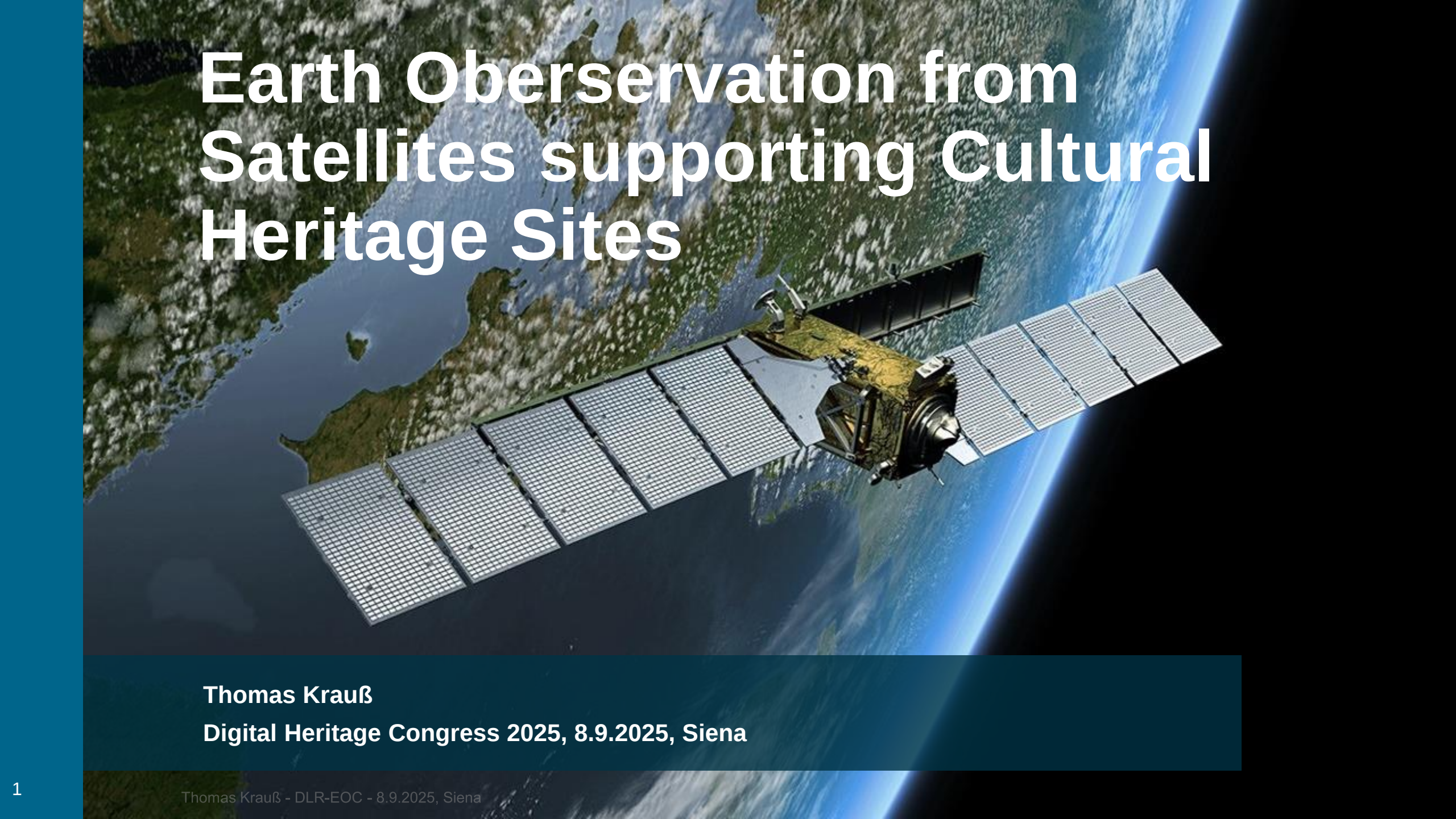


Earth Observation from Satellites supporting Cultural Heritage Sites

A detailed illustration of a satellite in orbit above Earth. The satellite has a central body with various instruments and two long, rectangular solar panel arrays extending outwards. The Earth's surface below shows a mix of green landmasses and blue oceans, with white clouds scattered across the scene. The curvature of the Earth is visible on the right side of the image.

Thomas Krauß

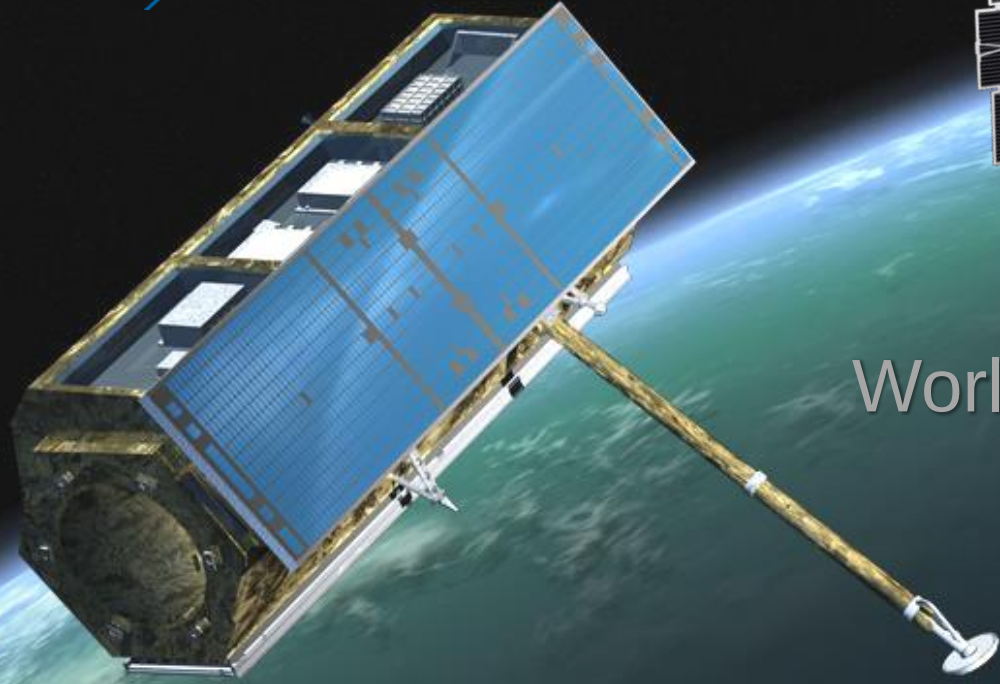
Digital Heritage Congress 2025, 8.9.2025, Siena

Earth Observation

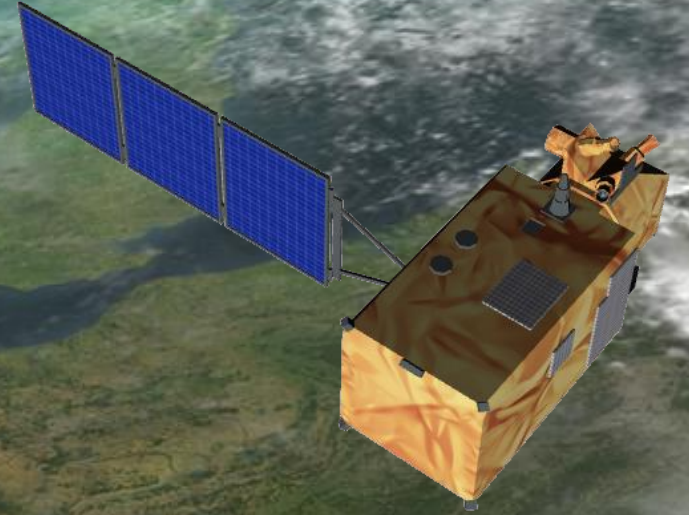




TERRA SAR X



WorldView-3



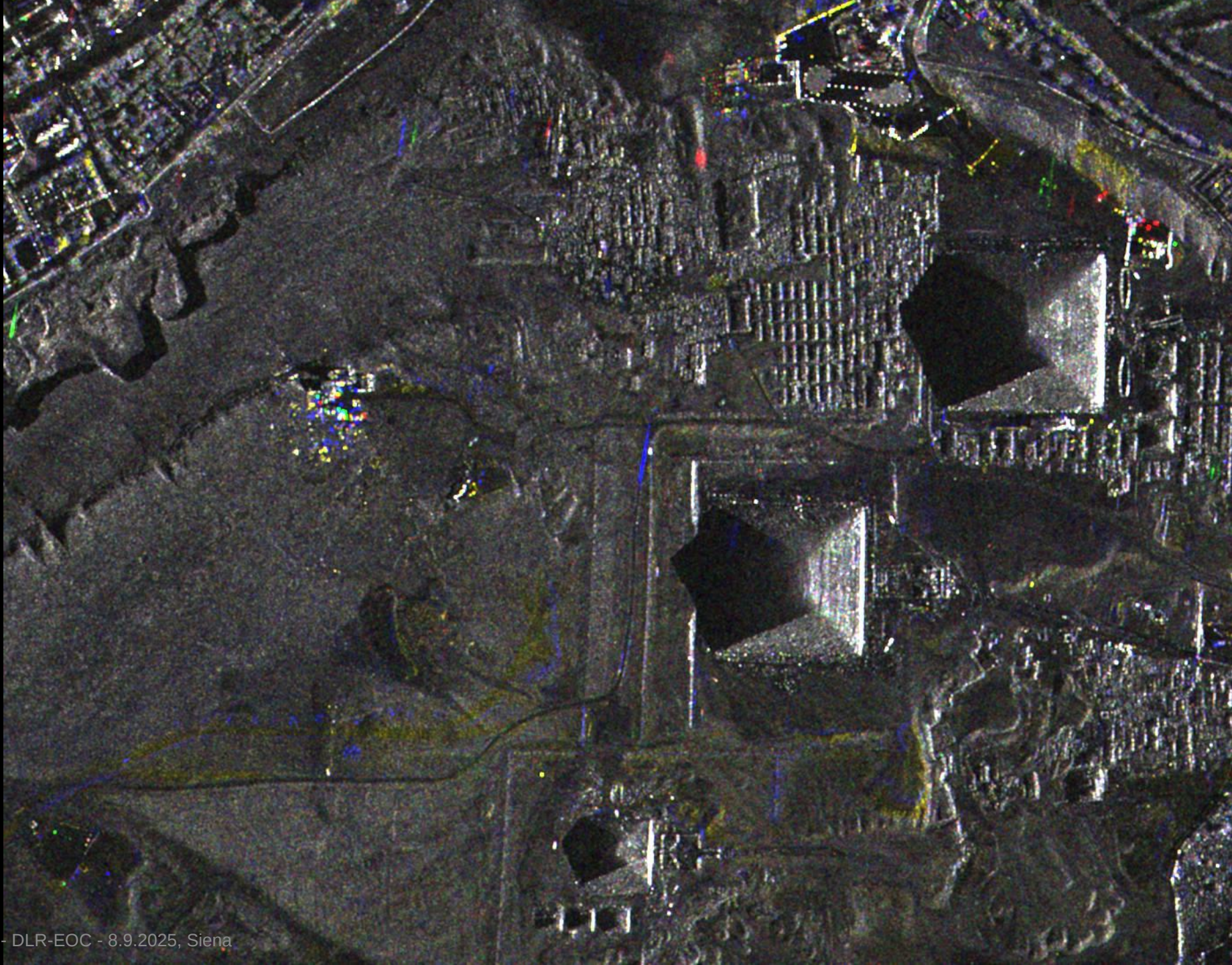
Sentinel-2



Planet Dove

Ground resolution: 1 m/Pixel

Thomas Krauß - DLR-EOC - 8.9.2025, Siena



TerraSAR-X

Ground resolution: 50 cm/Pixel

Thomas Krauß - DLR-EOC - 8.9.2025, Siena



WorldView-2

© DigitalGlobe supplied by European Space Imaging

Ground resolution: 3 m/Pixel



Ground resolution: 10 m/Pixel



Sentinel-2

Using Satellites for Cultural Heritage



Satellite data for Cultural Heritage



- Satellites allow
 - Continuous monitoring
 - Detailed mapping
 - 3D-reconstruction and modeling
- of mostly inaccessible cultural heritage sites
- But:
 - Relatively coarse image resolution (30 cm ... 10 m)
 - Relatively few images only every 2 ... 20 days



Why satellite data for cultural heritage?

- Detect new heritage sites



4
R

Why satellite data for cultural heritage?

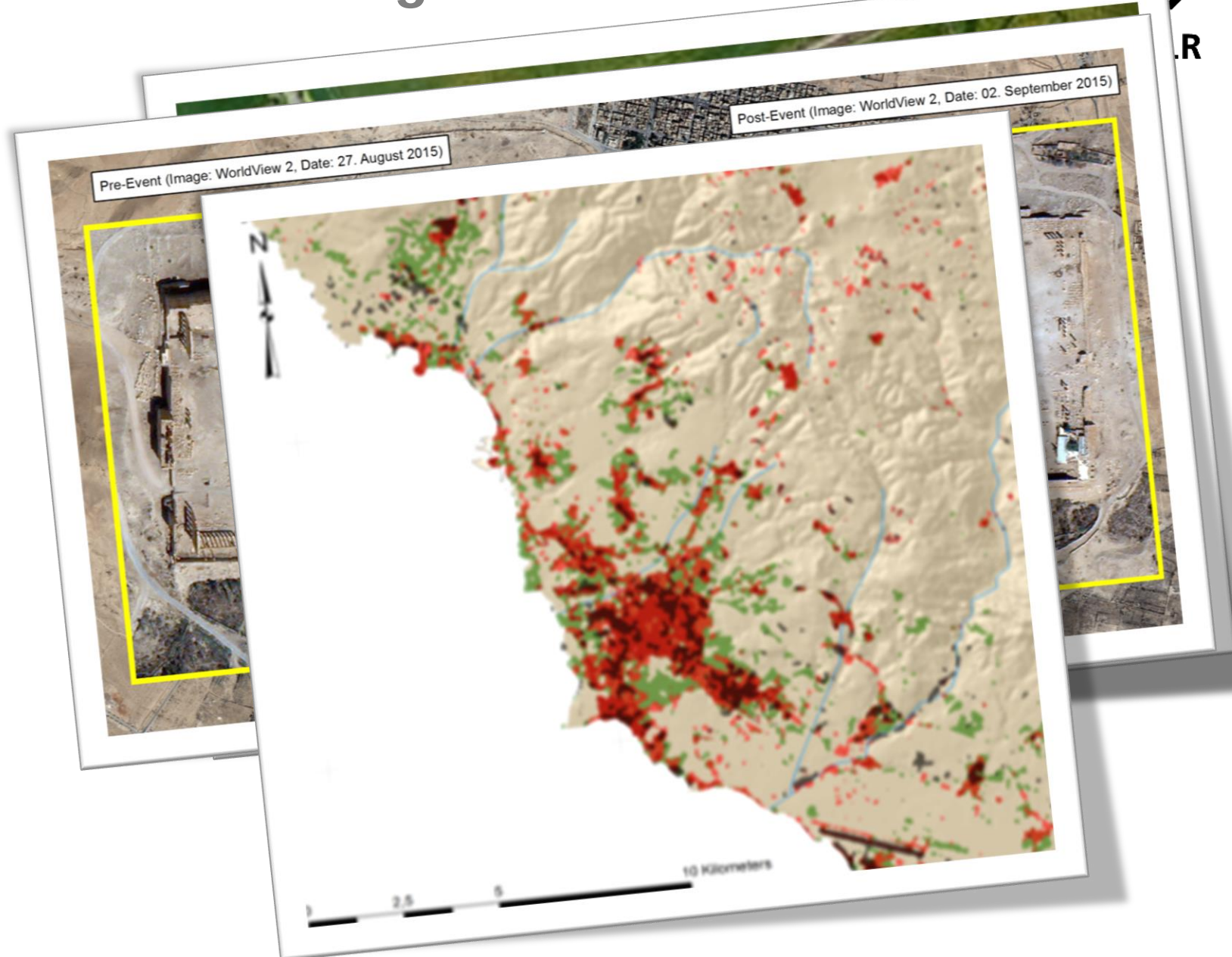
- Detect new heritage sites
- Detect destructions



R

Why satellite data for cultural heritage?

- Detect new heritage sites
- Detect destructions
- Monitor existing sites



R

Why satellite data for cultural heritage?

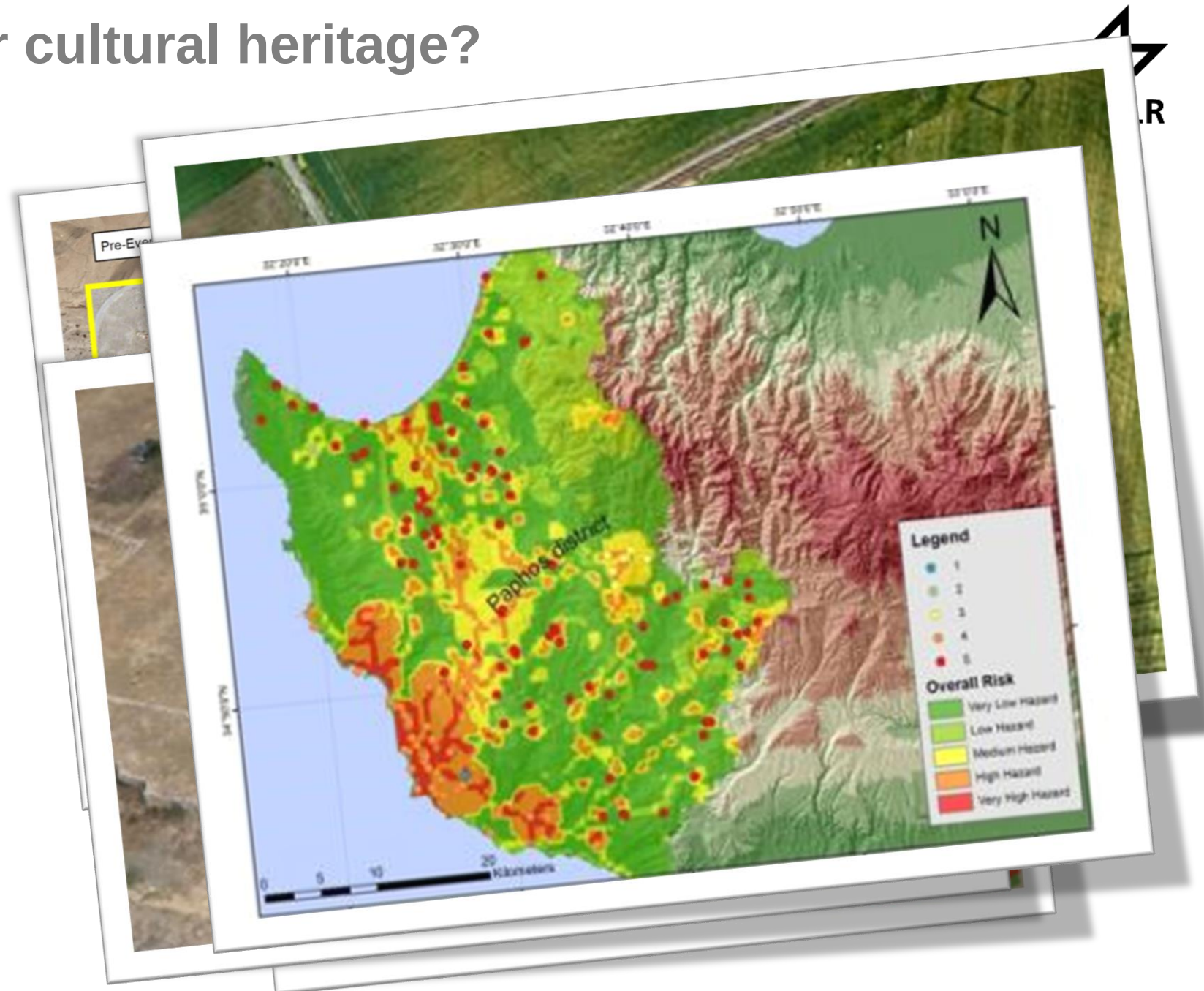
- Detect new heritage sites
- Detect destructions
- Monitor existing sites
- Documentation



R

Why satellite data for cultural heritage?

- Detect new heritage sites
- Detect destructions
- Monitor existing sites
- Documentation
- Risk assessment



R

Why satellite data for cultural heritage?

- Detect new heritage sites
- Detect destructions
- Monitor existing sites
- Documentation
- Risk assessment
- Use old archive data
- Micro movements



Examples



Palmyra – destructions by IS in 2015



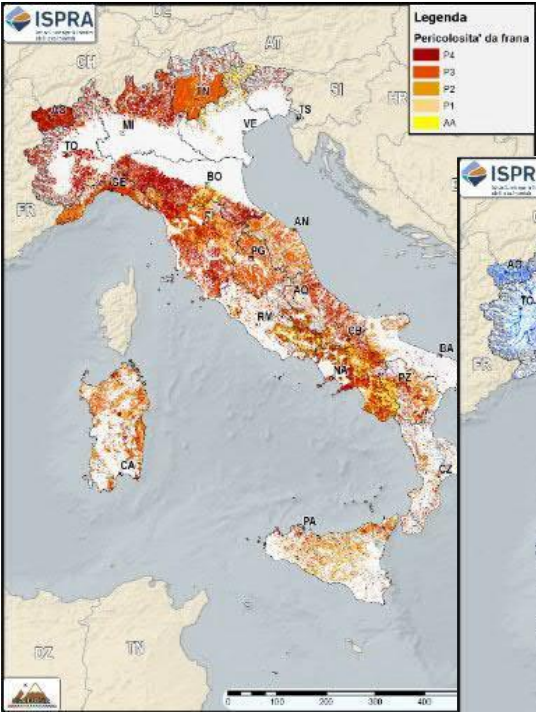
Quelle: <http://www.asor-syrianheritage.org/special-report-update-on-the-situation-in-palmyra/>

Palmyra – destructions by IS in 2015

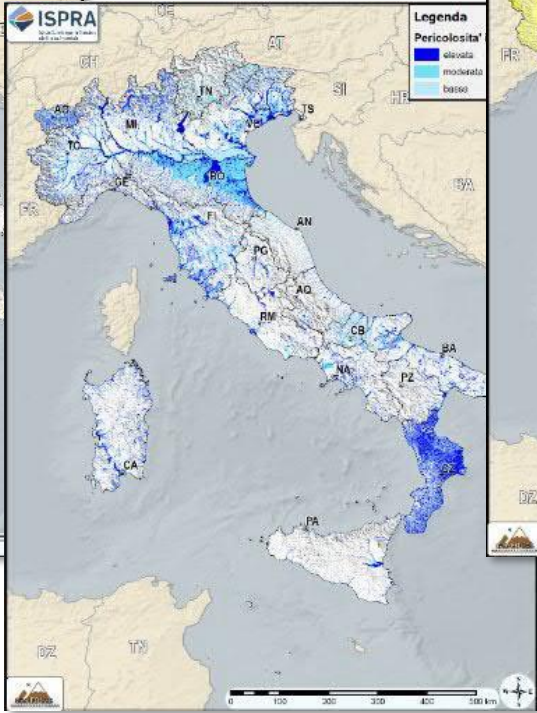


©European Space Imaging / DigitalGlobe

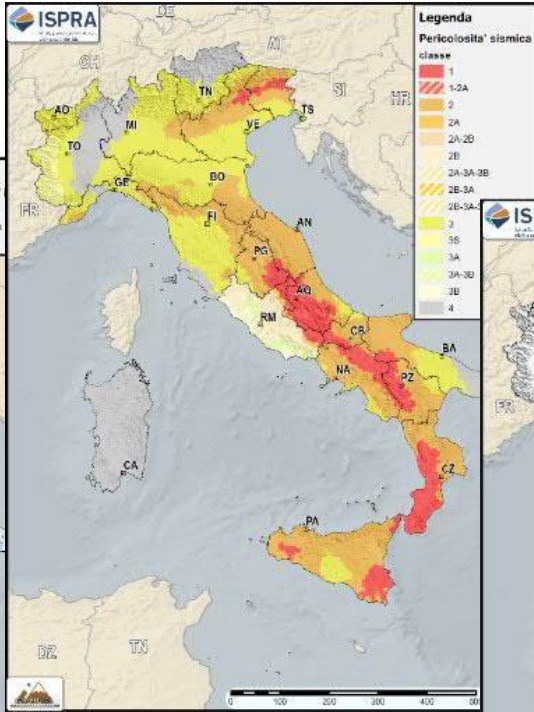
Risk analysis from Satellites



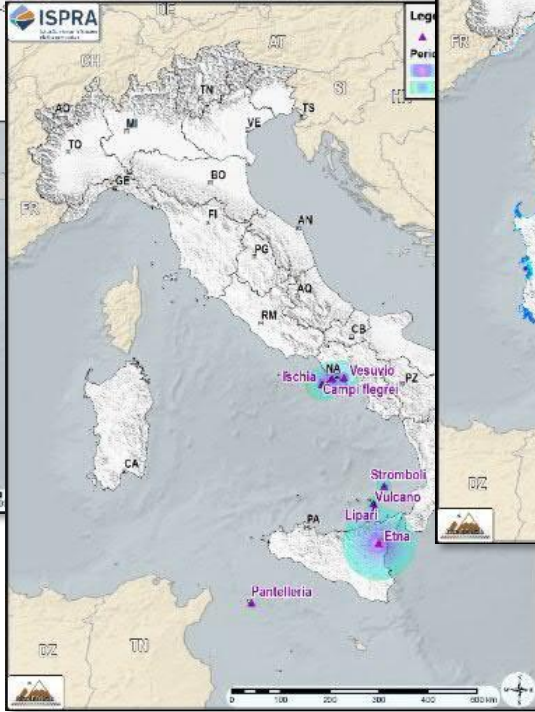
Landslides



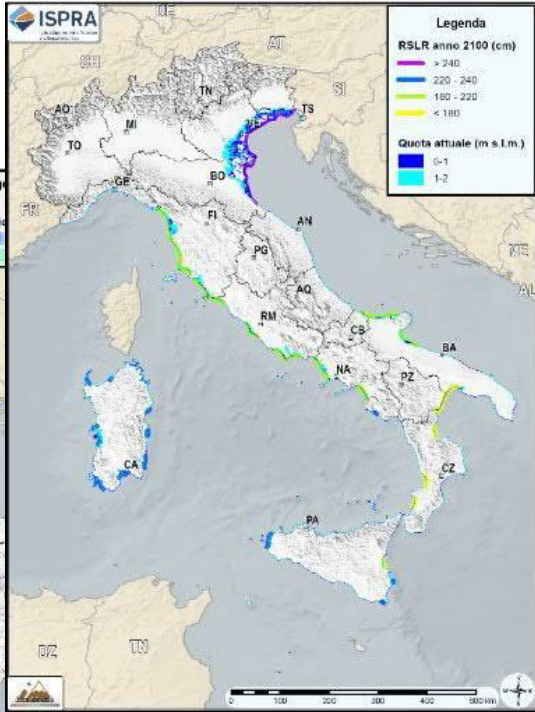
Flooding



Earthquakes



Vulcanoes



Sea level rise

Detect unknown heritage sites – Crop marks

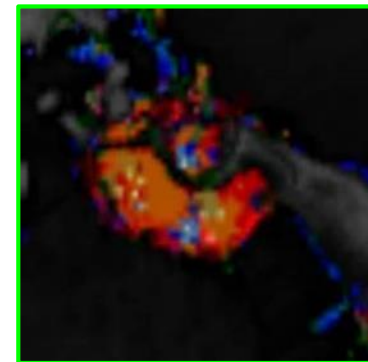
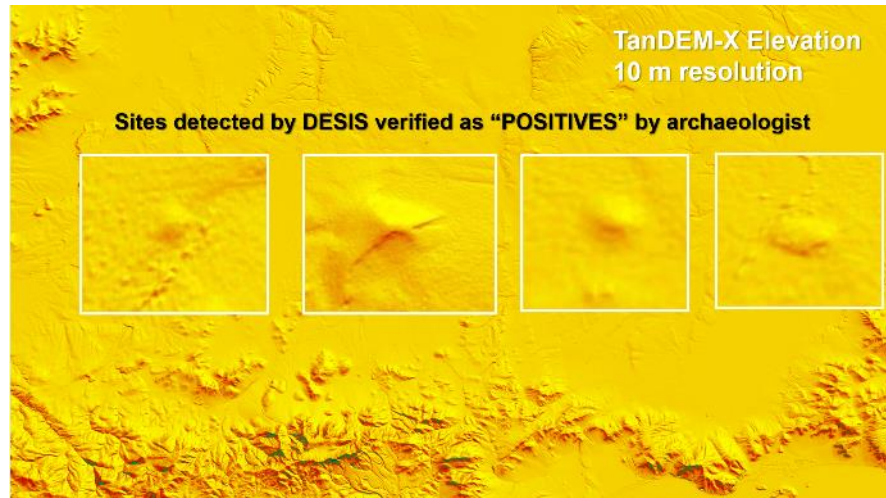


Grezac, France (Quelle: wikipedia)

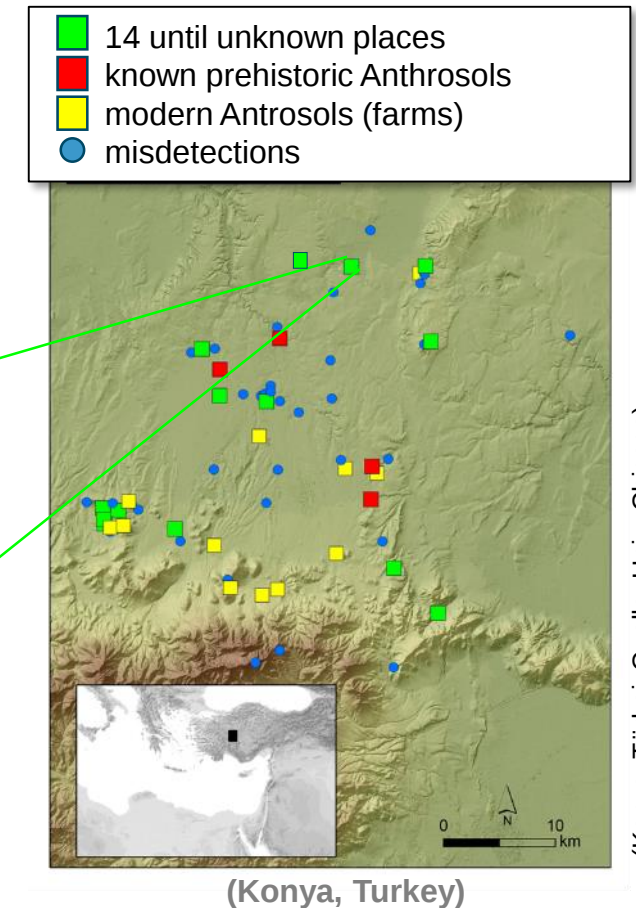
Thomas Krauß – DLR-EOC – 8.9.2025, Siena

Detect unknown heritage sites – Anthrosoles

- **Anthrosoles** are anthropogenic (by humans created) soils, characterized by a high ratio of organic matter
- Mostly the result of long human residence
- Many of such places are still unknown

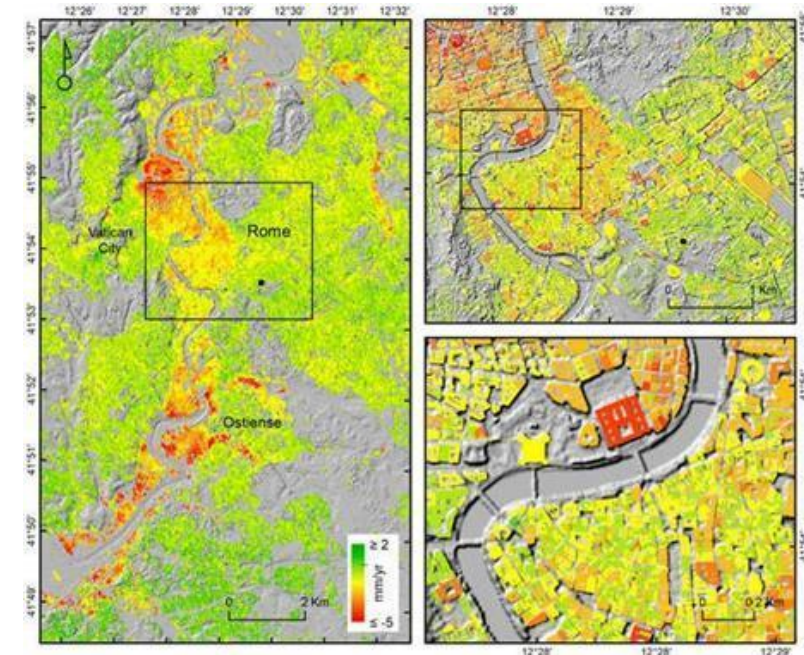
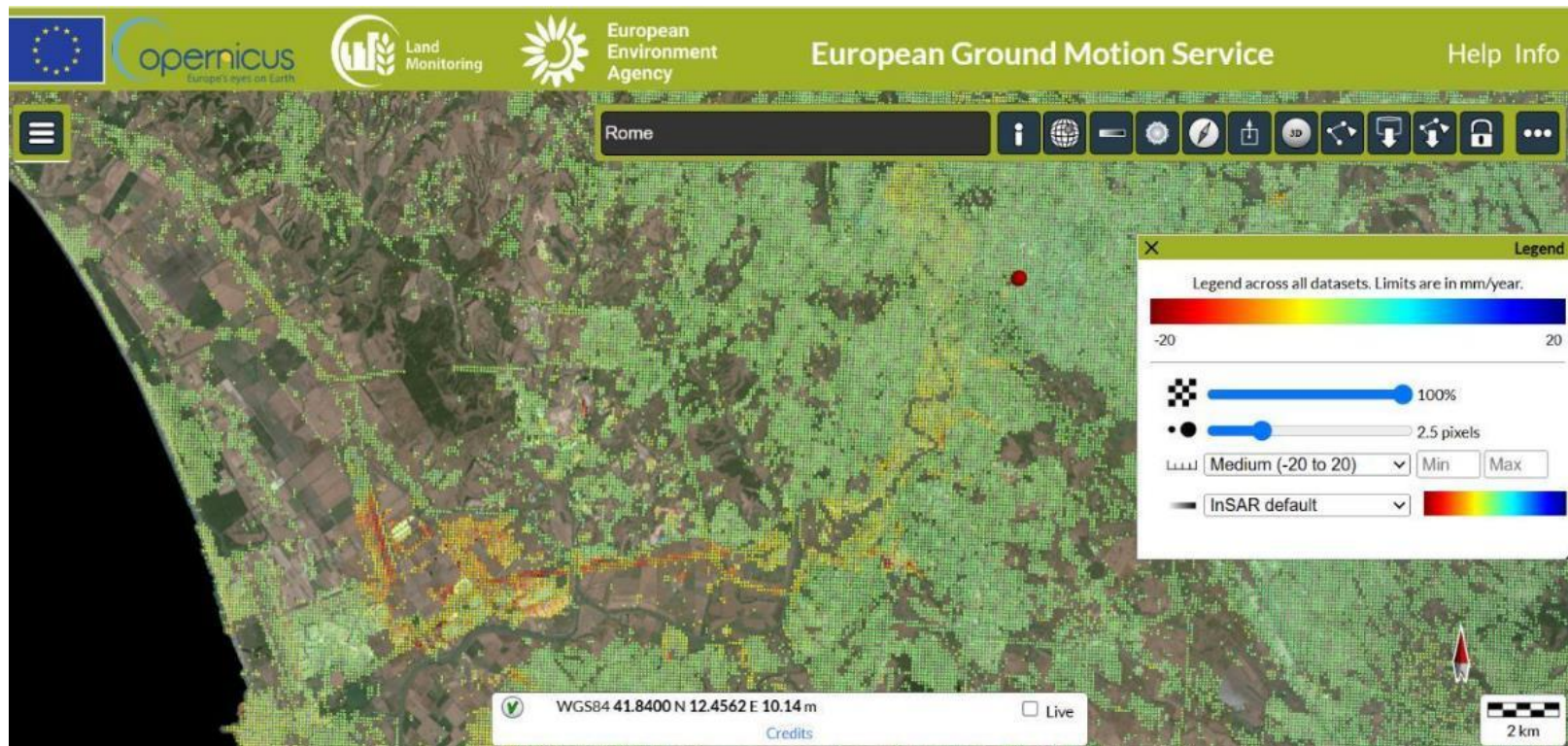


Probability of Anthrosoles



Detection of Ground Motion in millimeter scale

- Radar satellites allow the detection of ground movements in the range of millimeters
- The European Ground Motion Service provides those data to all EU citizens free of charge



Ground motion map based on Copernicus Sentinel-1, Rome and surrounding
© M. Delgado Blasco et al.

Conclusion



Conclusion – „Why satellite data for CH?“

- Detect unknown cultural heritage sites
- Monitor existing CH sites for dangers by:
 - Settlement growth
 - Mass tourism
 - Fires, Floods and droughts
 - Landslides and ground motion
 - Climate change
 - Looting
 - Wars and conflicts
- Regularly for large areas
- All over the world

