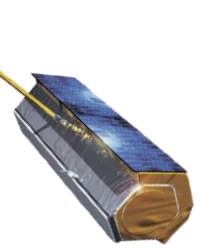




测绘遥感信息工程国家重点实验室

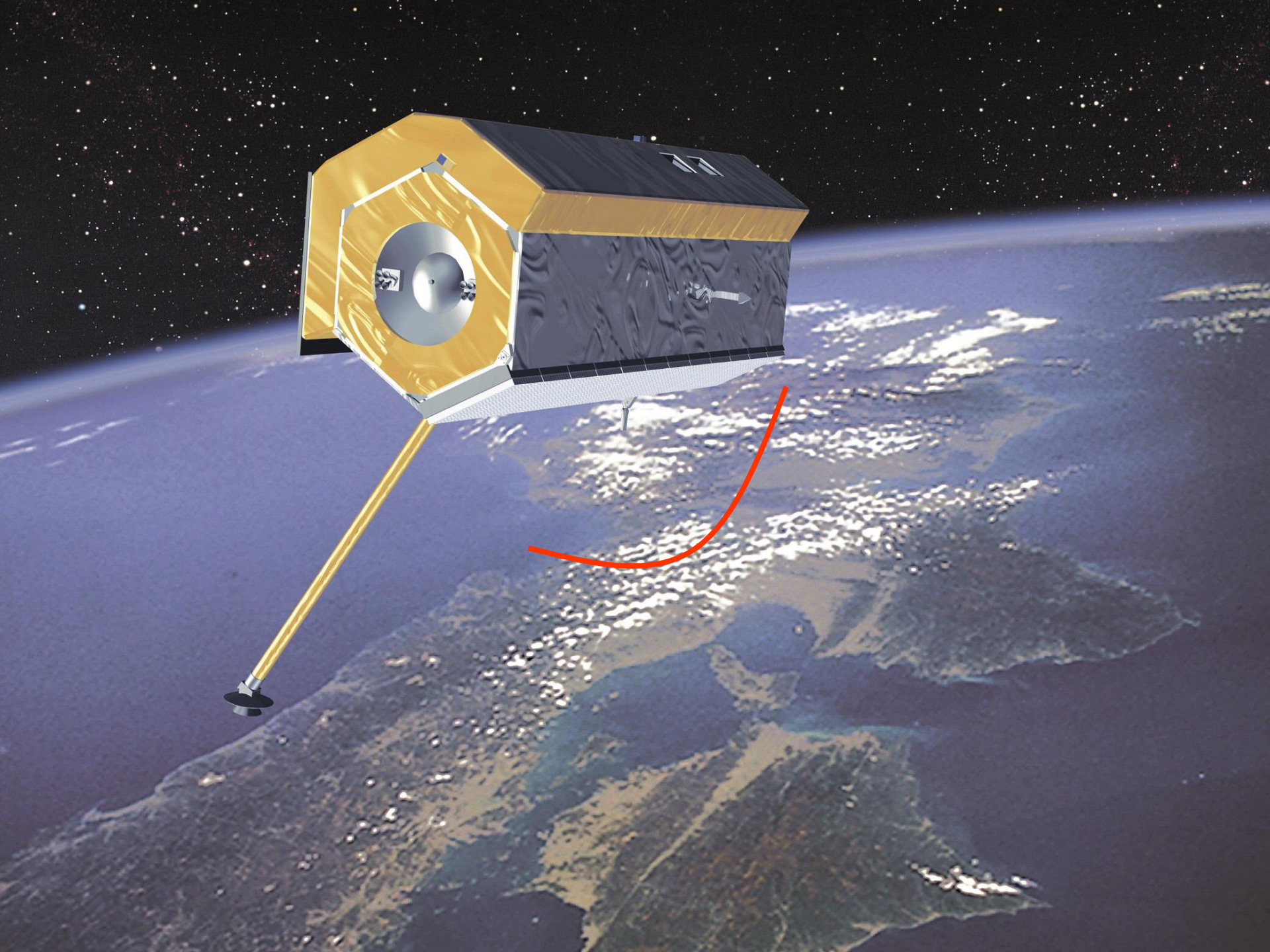
State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing



Current and future spaceborne SAR systems for monitoring natural and cultural heritage sites

Timo Balz



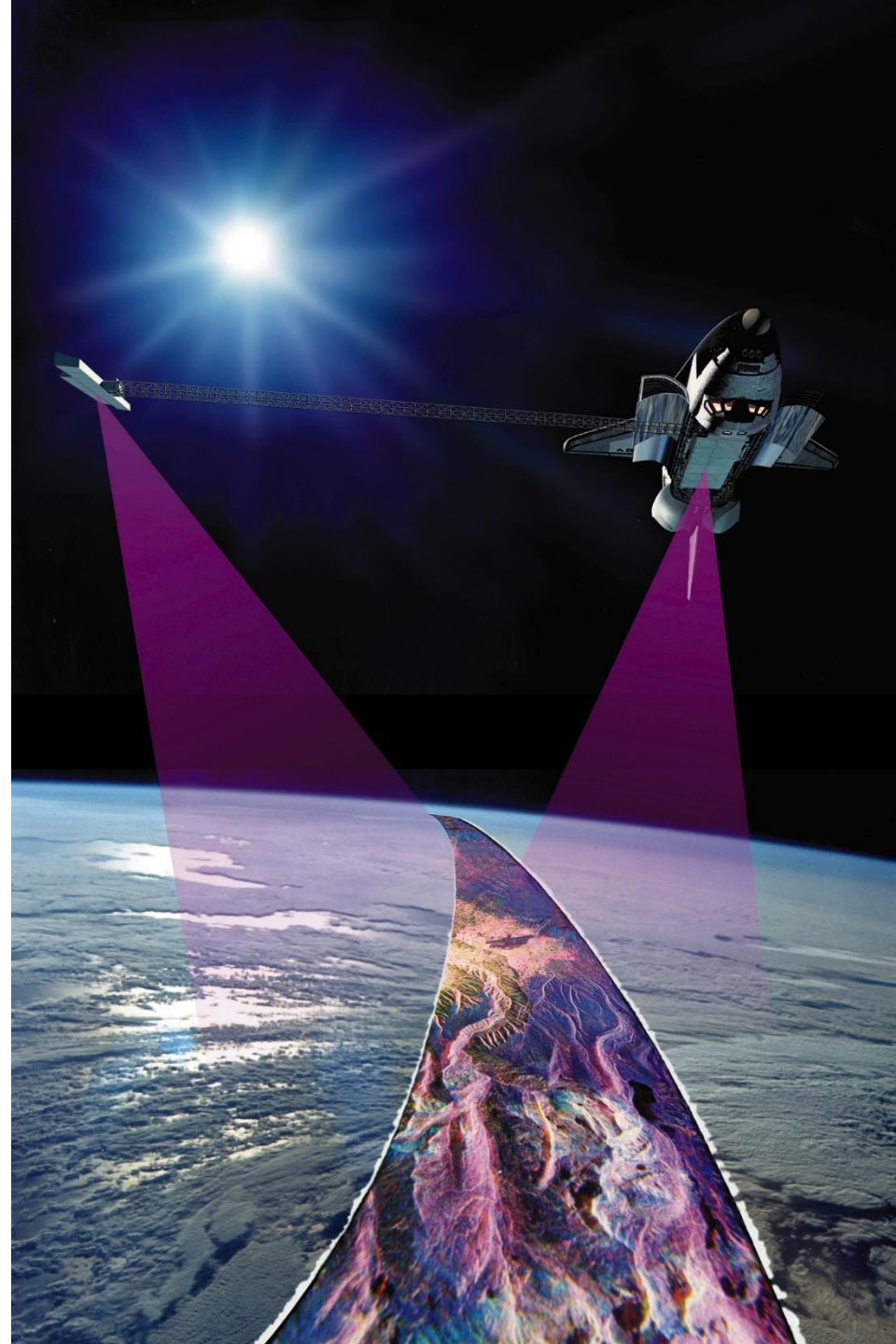
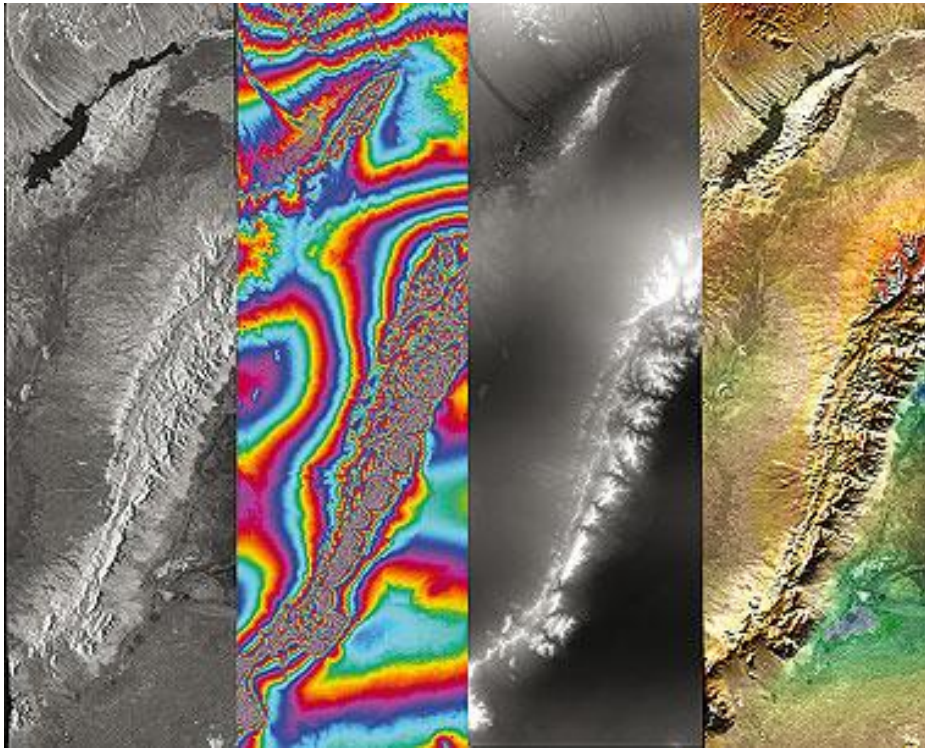


Why Synthetic Aperture Radar?

- Stable and weather independent long-term surveillance
- Synthetic Aperture Radar is a very flexible sensor offering various modes (e.g. resolutions) on one system
- Radar can precisely measure distances and speeds
 - Precise Digital Elevation Models
 - Precise surface motion estimations

SRTM

Shuttle Radar Topography Mission



Start:

21. June 2010

**Baikonur Cosmodrome,
Kazakhstan**



Last generation of SAR satellites

TerraSAR-X & COSMO SkyMed (launch around 2007)

very high resolution

up to 1m x 0.2m

X-band = short

high temporal decorrelation

TerraSAR-X = most precise RS system in space



PS-InSAR

Extraction of the Displacement variable due to target motion with high accuracy

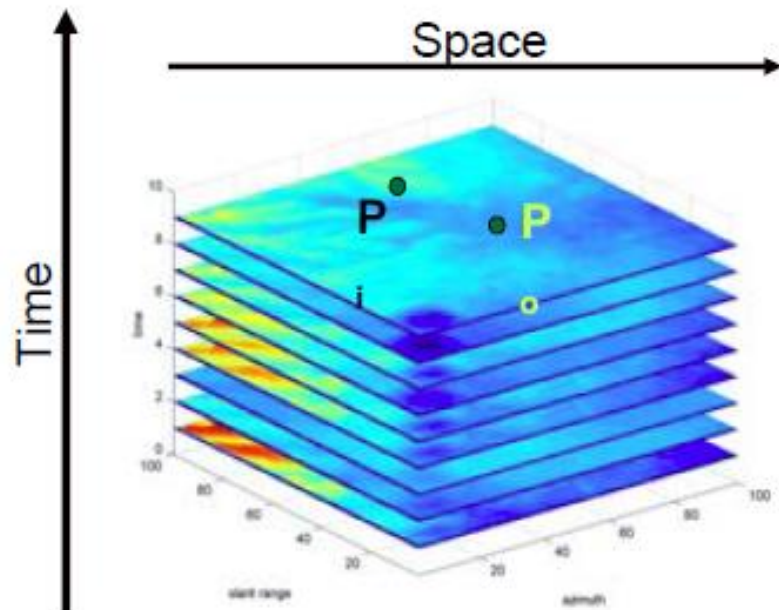
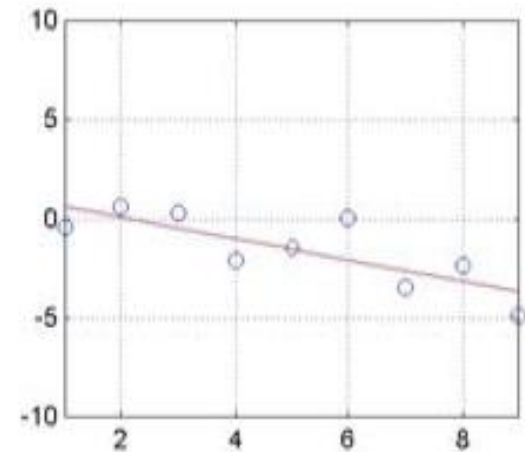
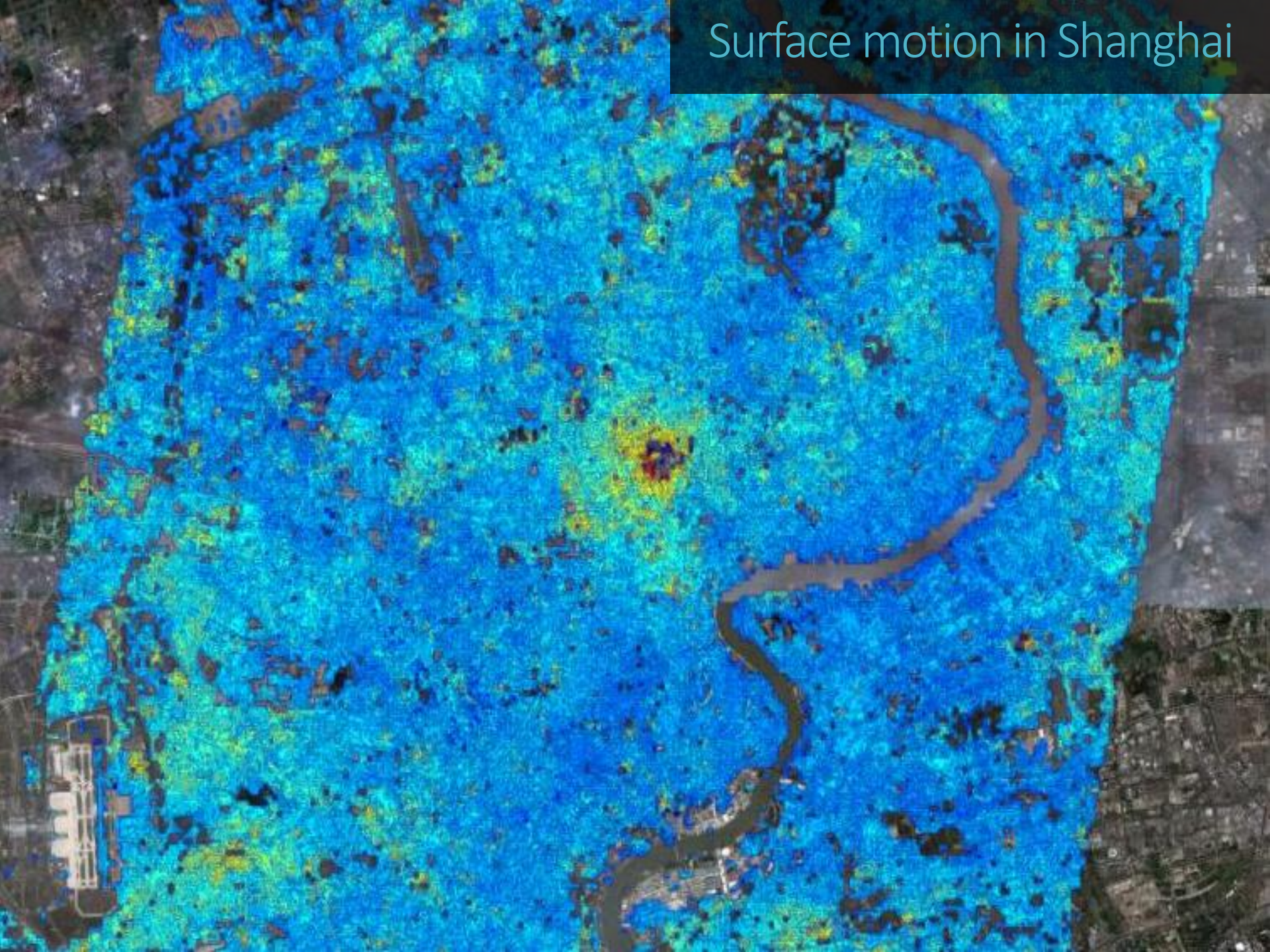


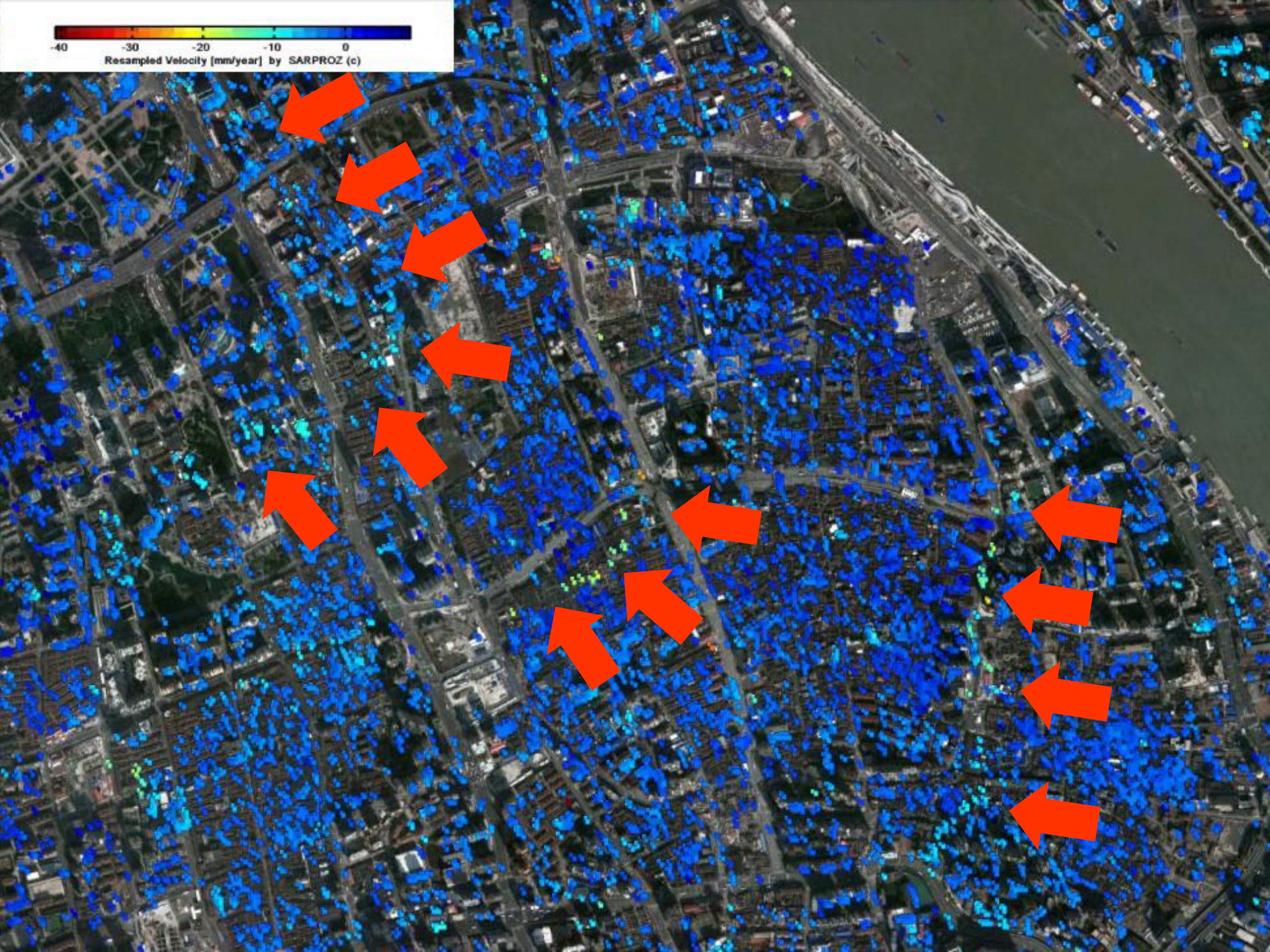
Image stack



Displacement velocity

Surface motion in Shanghai





New generation of SAR satellites

Sentinel-1A/B (launched 2014/2016)

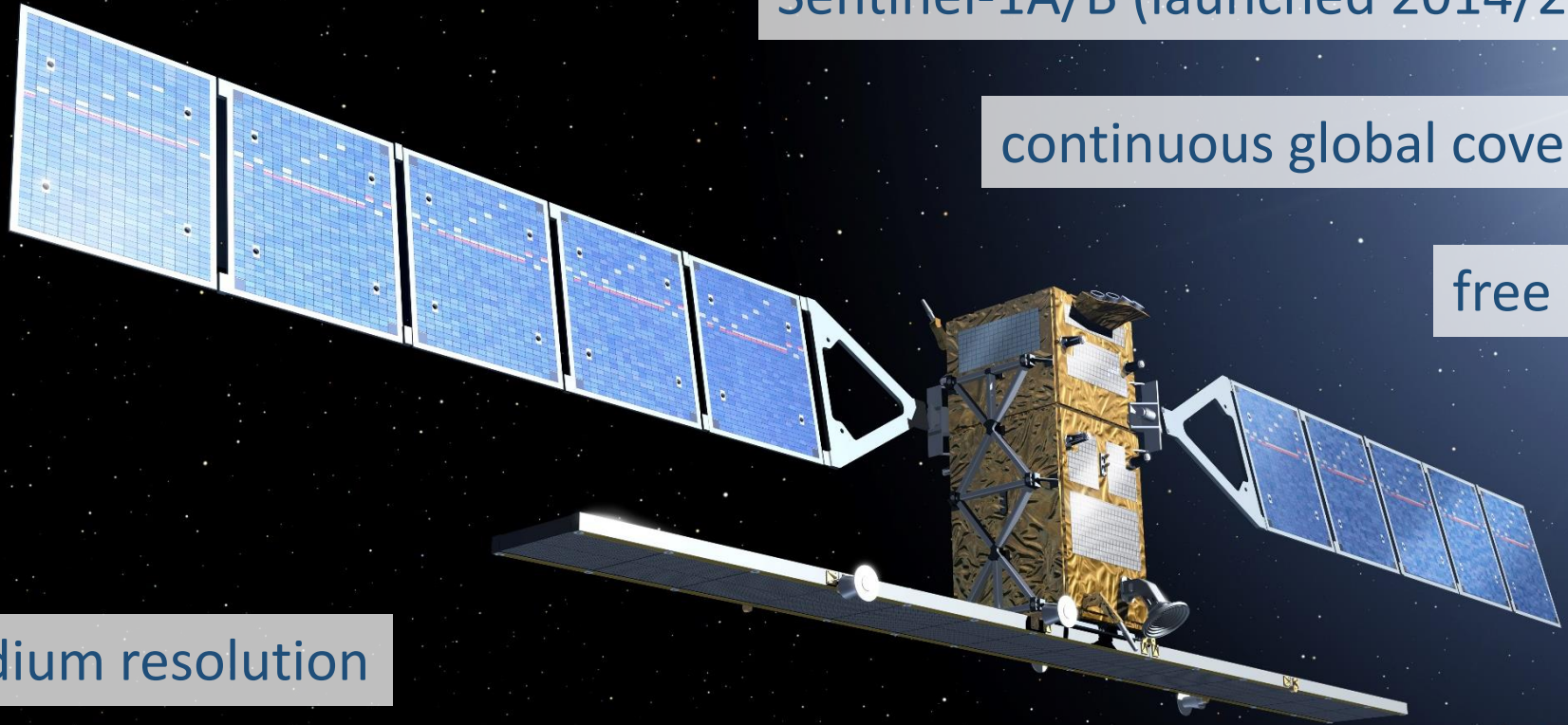
continuous global coverage

free data

medium resolution

C-band = short

TOPS mode



Natural heritage sites & Cultural heritage sites



Example on cultural heritage: Altai mountains

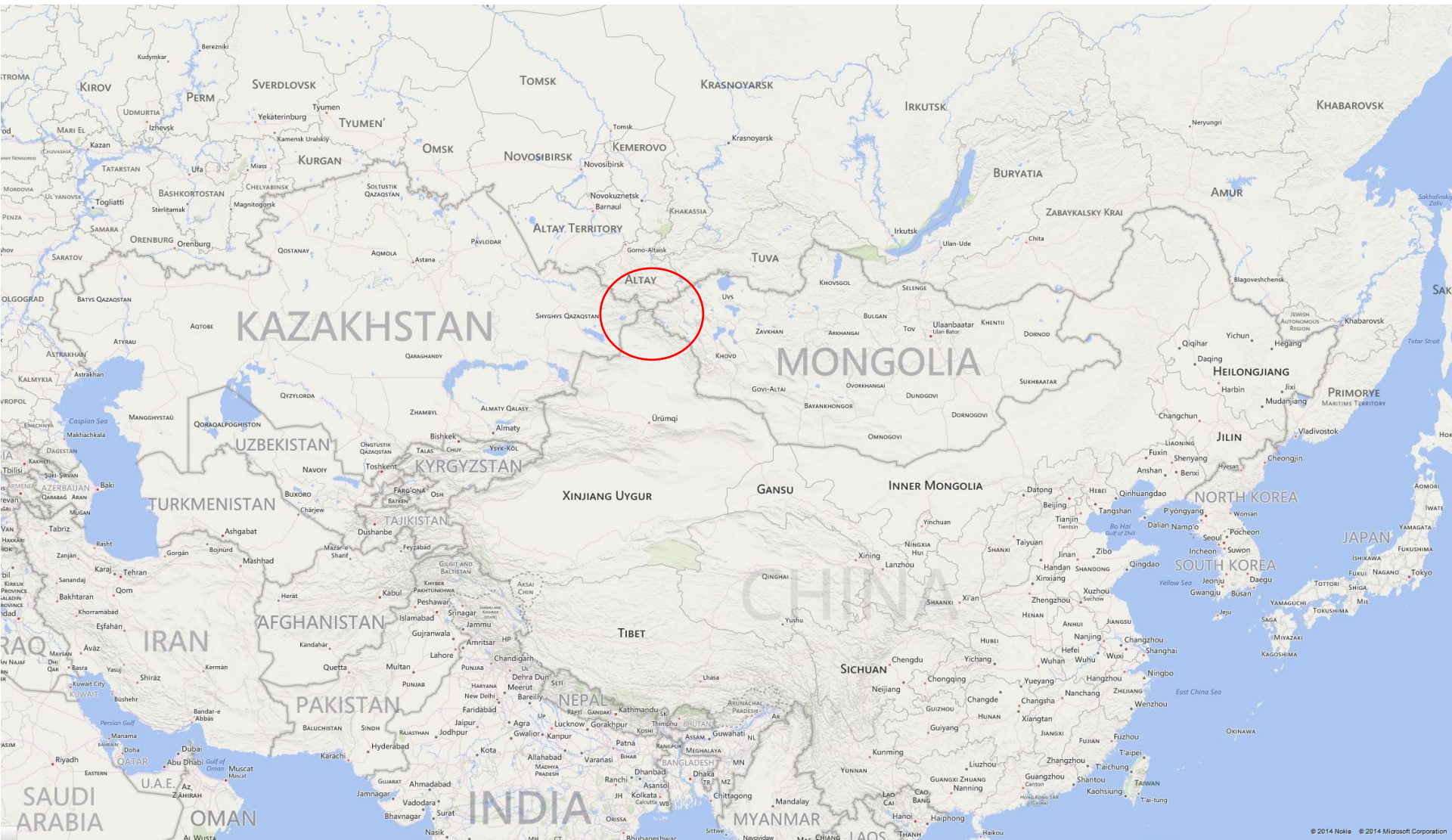
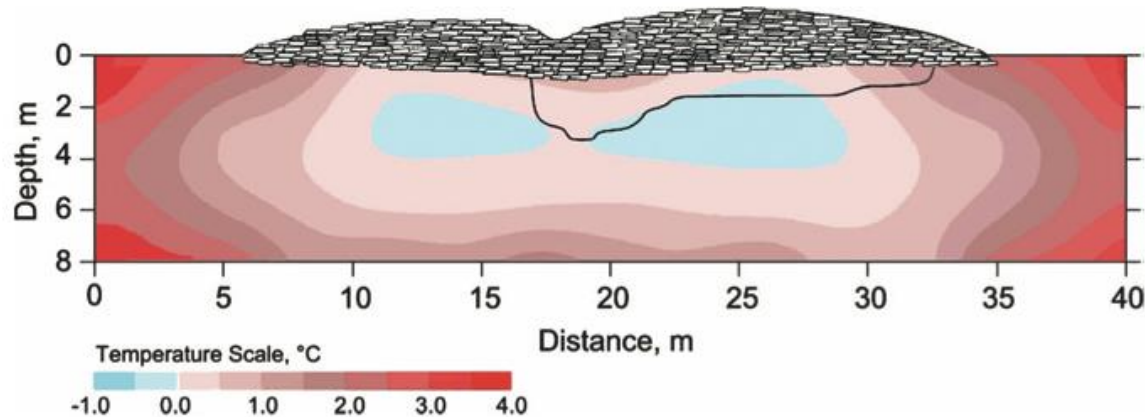


Photo of the Hailutan valley



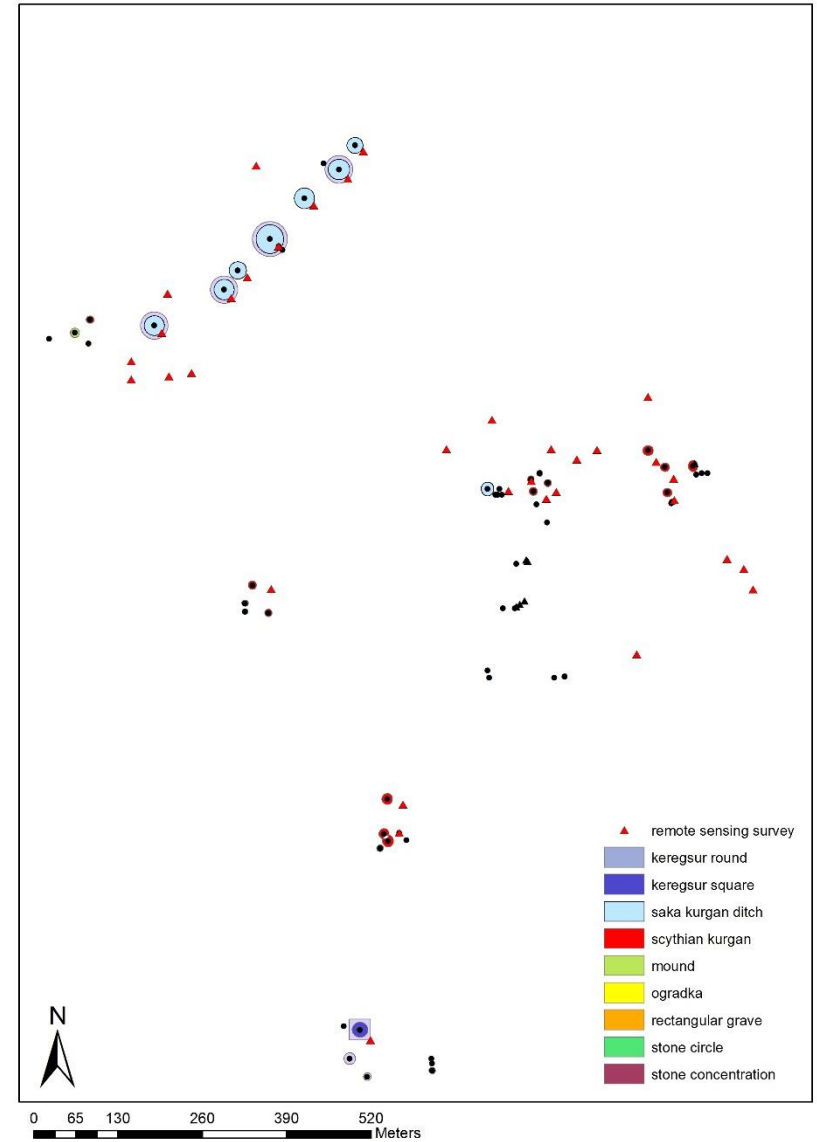
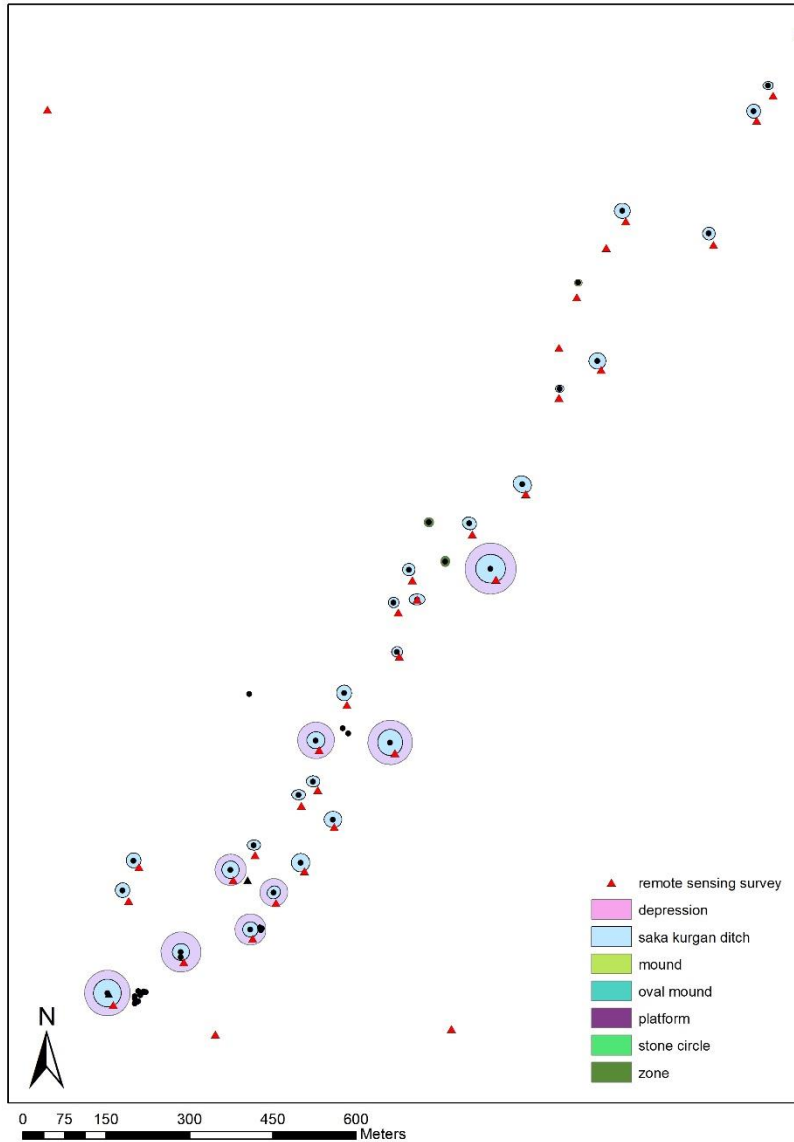
Skythian tombs of the Altai mountains



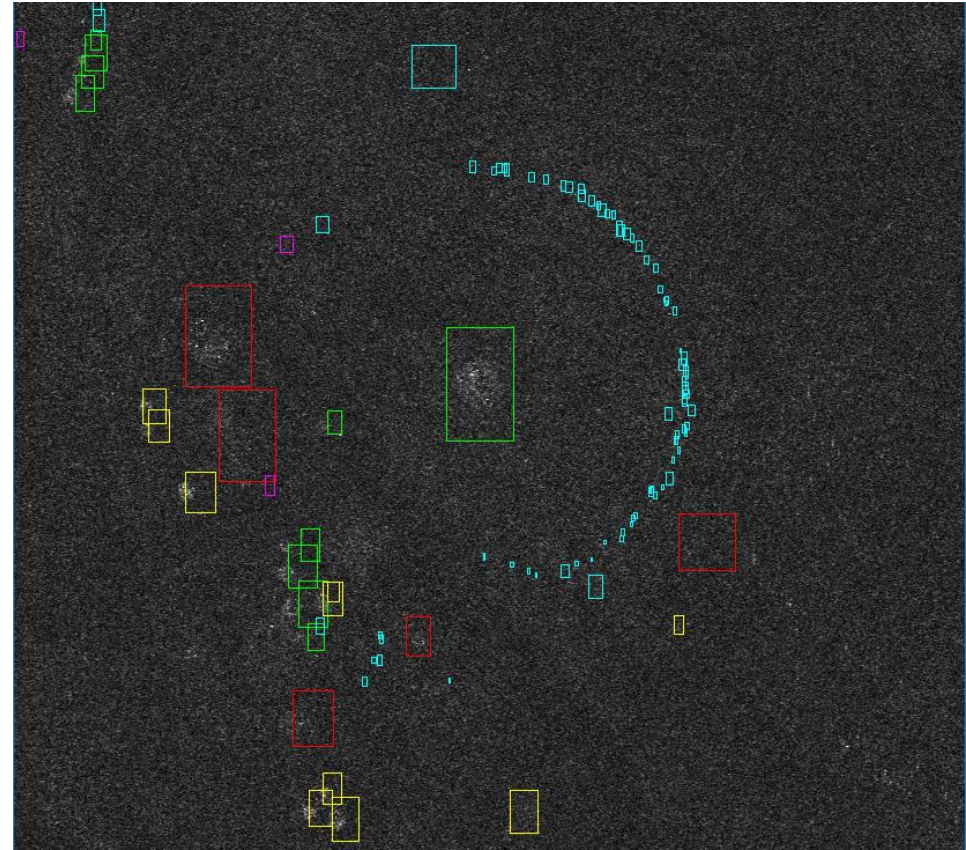
Kurgans



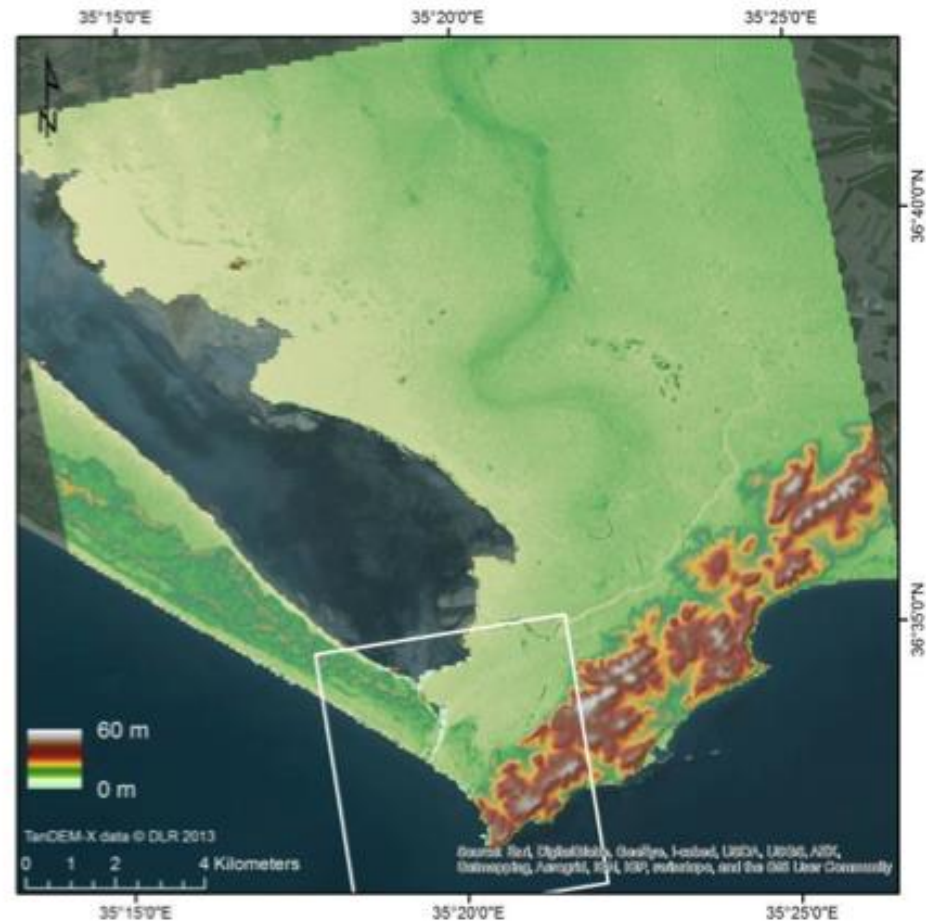
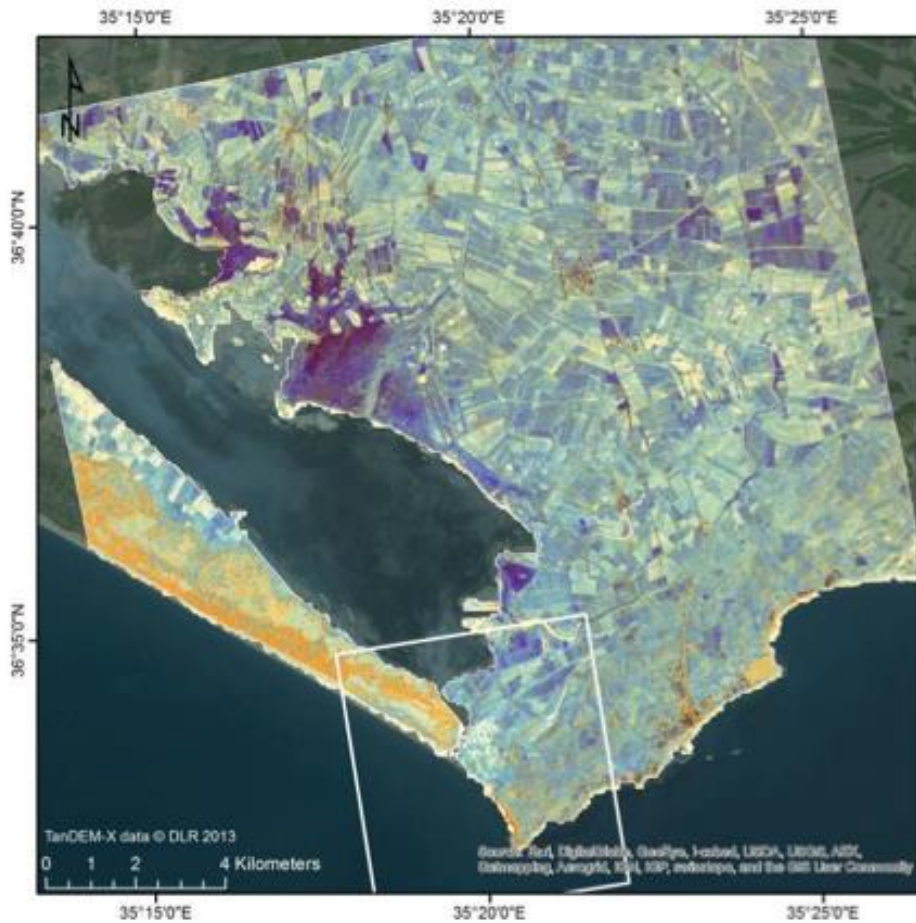
Ground Truth



Analyzing TerraSAR-X ST images



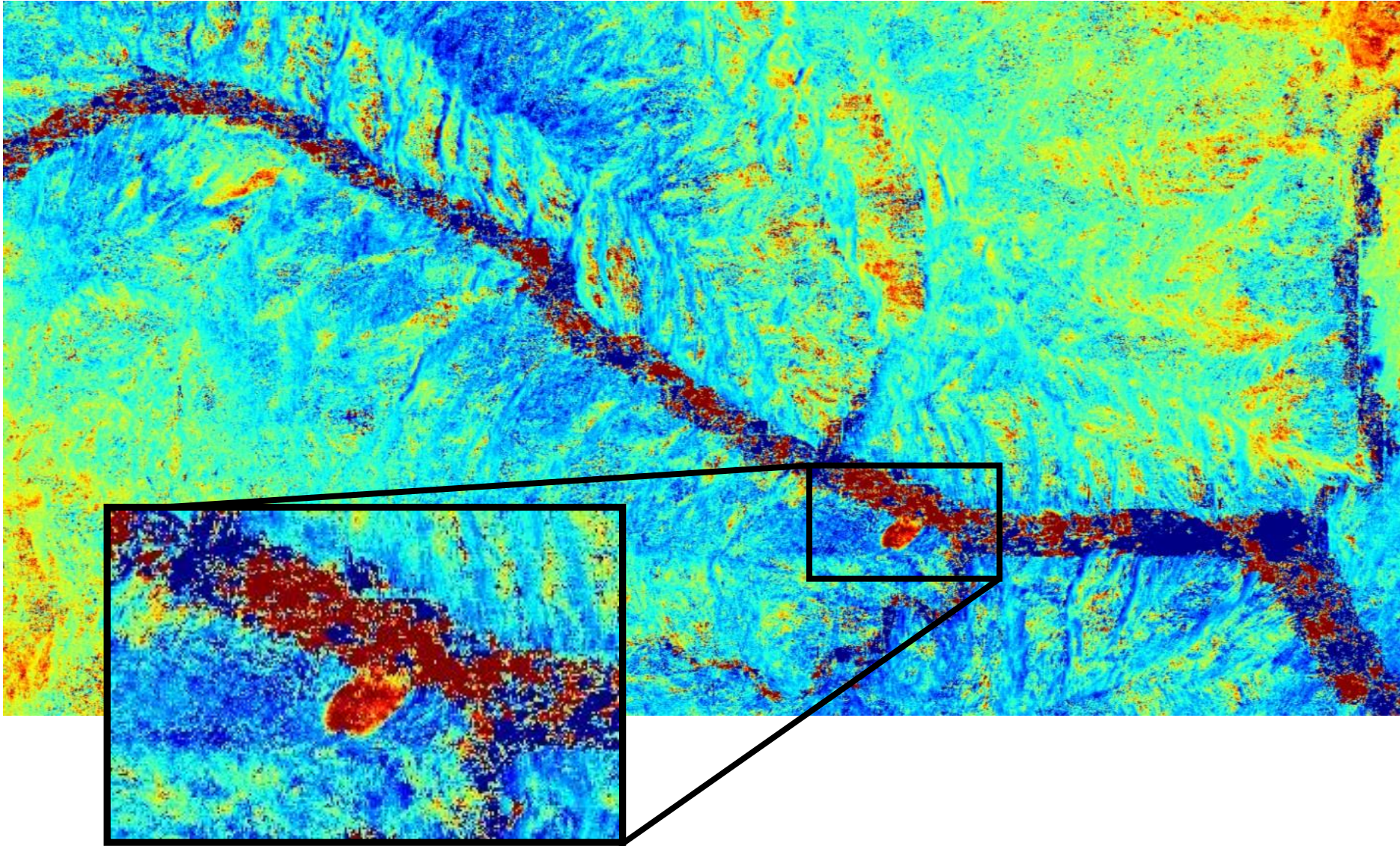
SARchaeology: paleo-landscape analysis



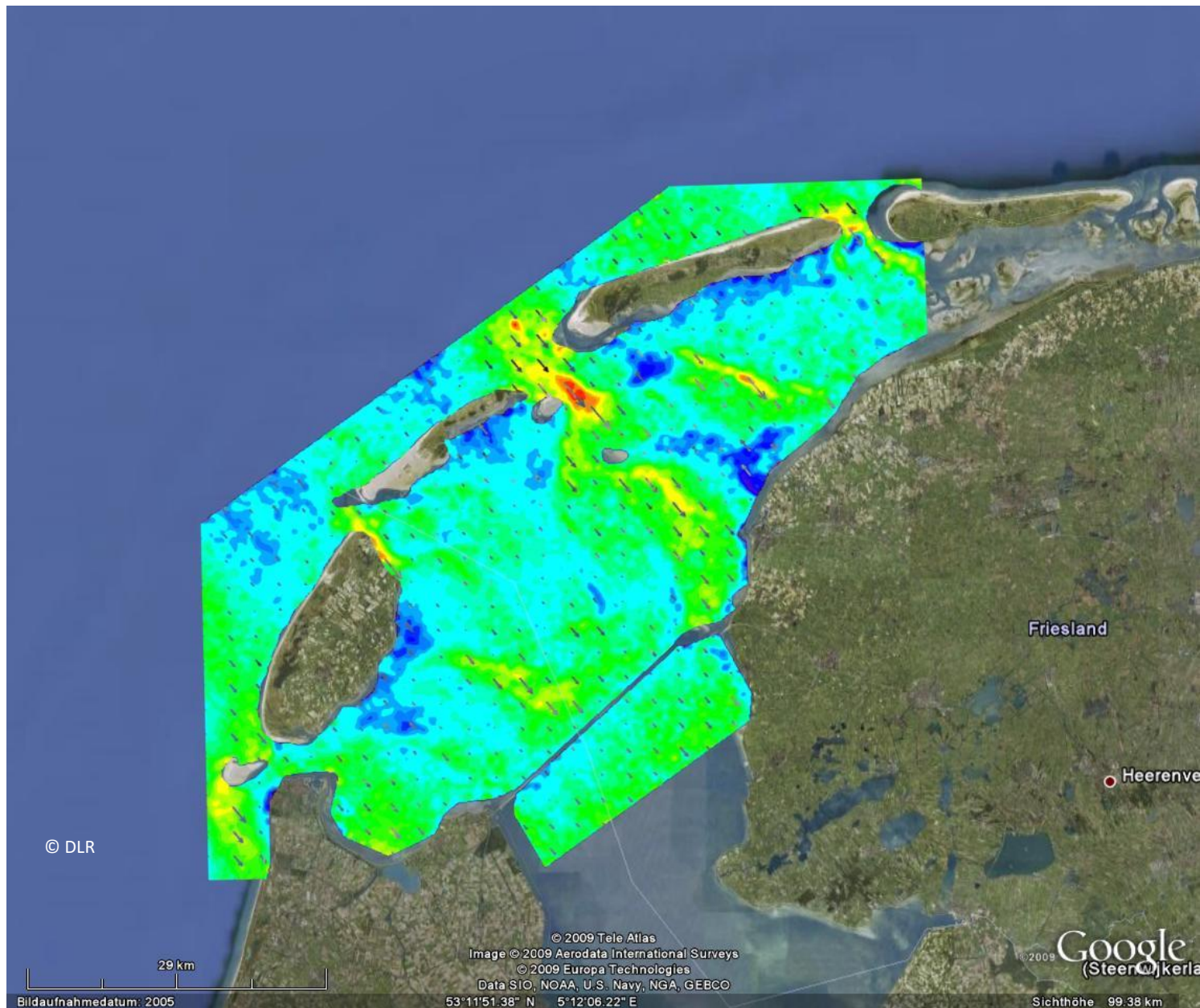
Application examples for natural heritage sites

ALOS/PALSAR differential interferogram

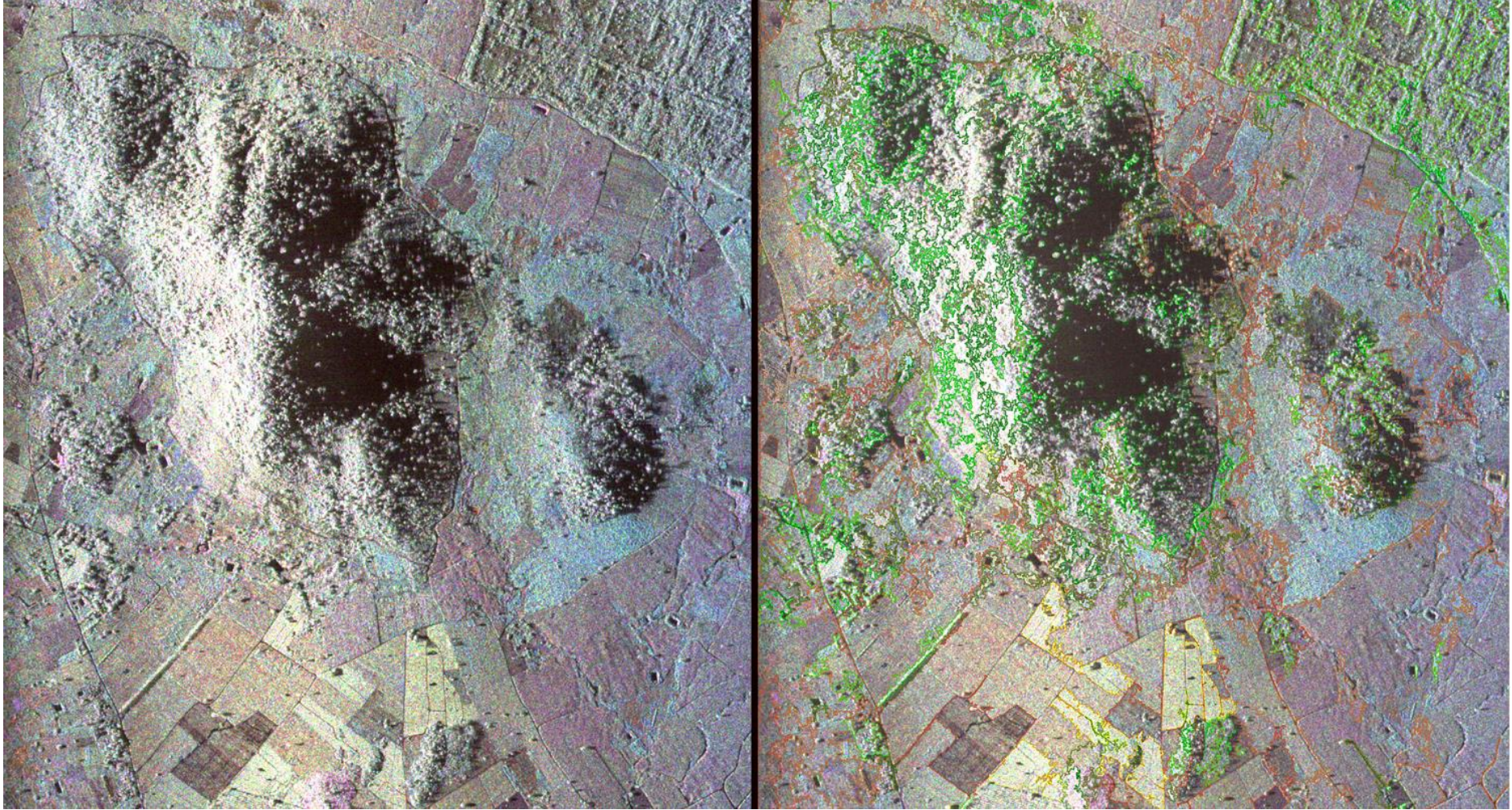
2010.2.19 – 2010.4.6



Currents & ice movements



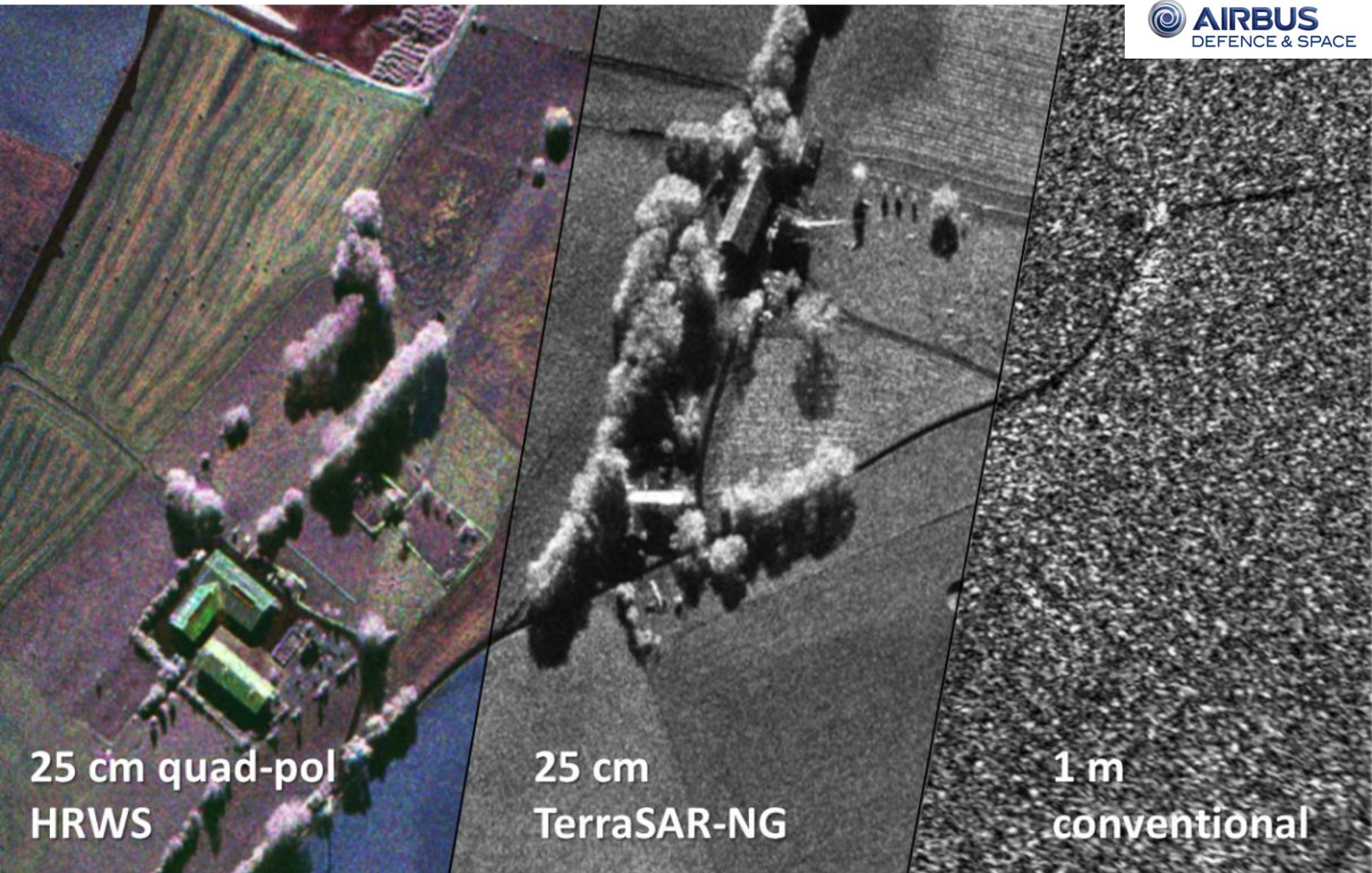
Classification & deforestation analysis



SAR sensor requirements

	Natural	Cultural
High spatial resolution		✓
Wide area coverage	✓	
High precision measurement		✓
Temporal stability (interferometric)	✓	
Multi-polarimetry	✓	(✓)
Foliage penetration capability	✓	(✓)
Suggested wavelength	L-band	X/C-band

TerraSAR-X Next Generation



**25 cm quad-pol
HRWS**

**25 cm
TerraSAR-NG**

**1 m
conventional**

HRWS – high resolution wide swath systems

TerraSAR Generation

Stripmap



Moderate Resolution & Image footprint

ScanSAR



Low Resolution & large footprint

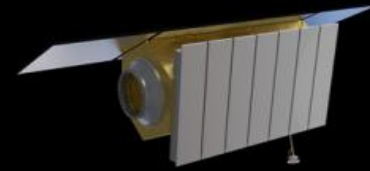
Spotlight



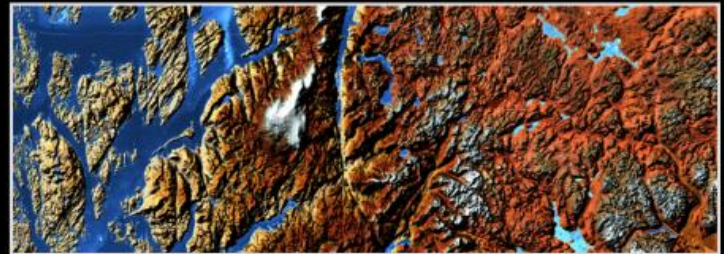
Small footprints, dis-continuous data takes

**High resolution or
Large area coverage**

HRWS - High Resolution Wide Swath



HRWS



**Large area coverage
Excellent resolution
„in colour“ (quadruple polarization)**

**Excellent resolution and
Large Area Coverage**

China's D-InSAR system

Launch planned for 2018

Conclusions

- SAR is a very precise measurement system
- It can support the surveillance of cultural and natural heritage sites as well as the influence of the climate change
- Unique capability in measuring motions
- However, it is complicated = need training
- Different system properties are needed for cultural and natural heritage sites
- With nowadays system and the upcoming systems, we will be up for the task

Questions?

balz@whu.edu.cn

