

# Earth Observation Programme

June 2019



Earth Observation Programme

ESA Heritage SAR missions

The Copernicus Sentinels

Earth Observed by EO satellites (Achievements)

Sentinel Data Access & Big Data Concepts





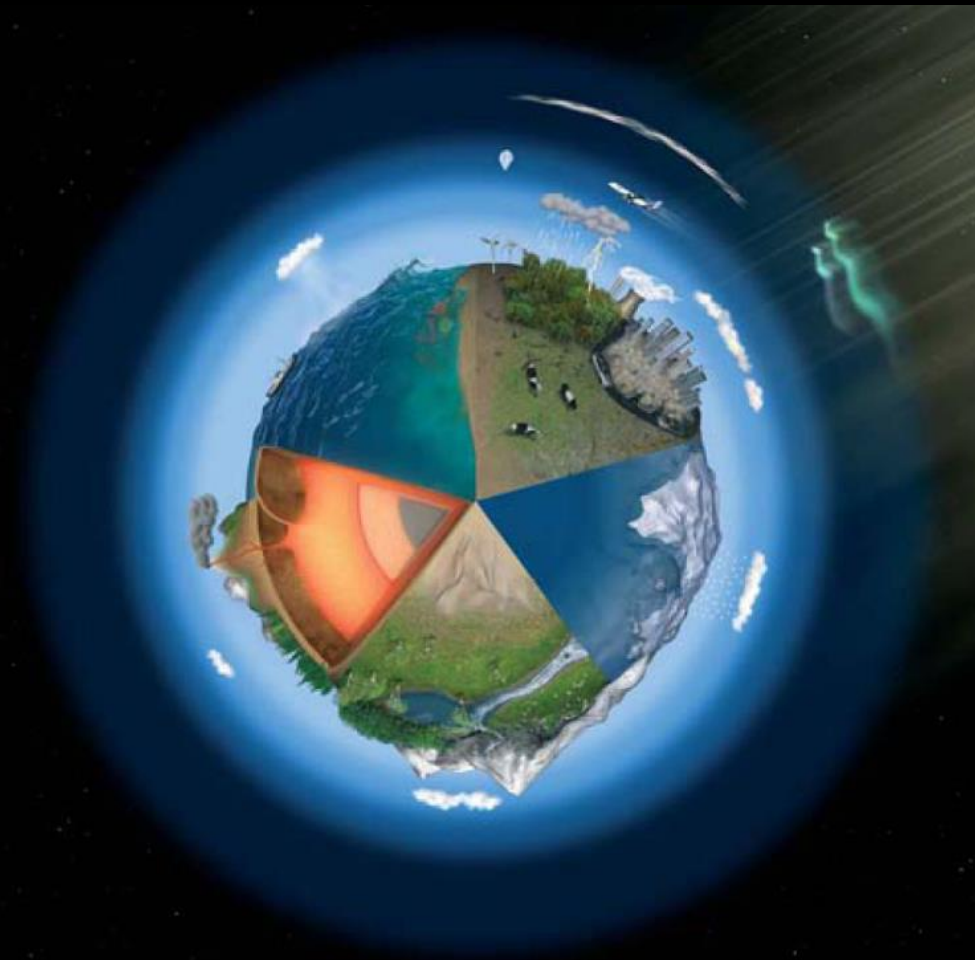
# EARTH OBSERVATION



# Why do we monitor Earth?

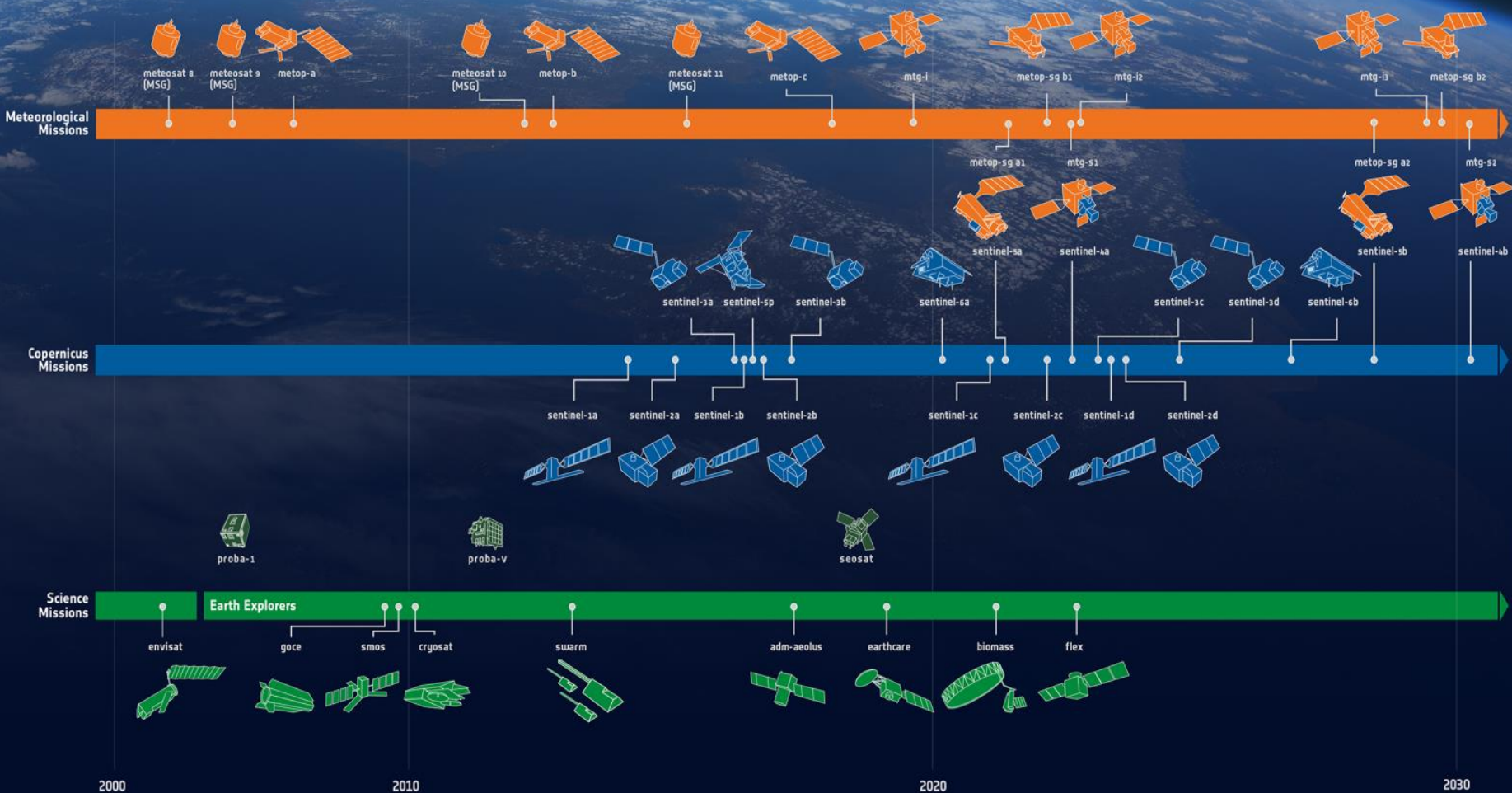
*The only place where we can learn most of our planet is not found anywhere on Earth, but high above it!*

*In answer to key questions such as: How our planet works, Does it change and Why we must preserve it!*





# → ESA-DEVELOPED EARTH OBSERVATION MISSIONS



# Sentinel-1 TOPS InSAR

<http://step.esa.int>



TOPS Interferometric  
Phase (NO 60-days)

250km (full swath)

VM pol



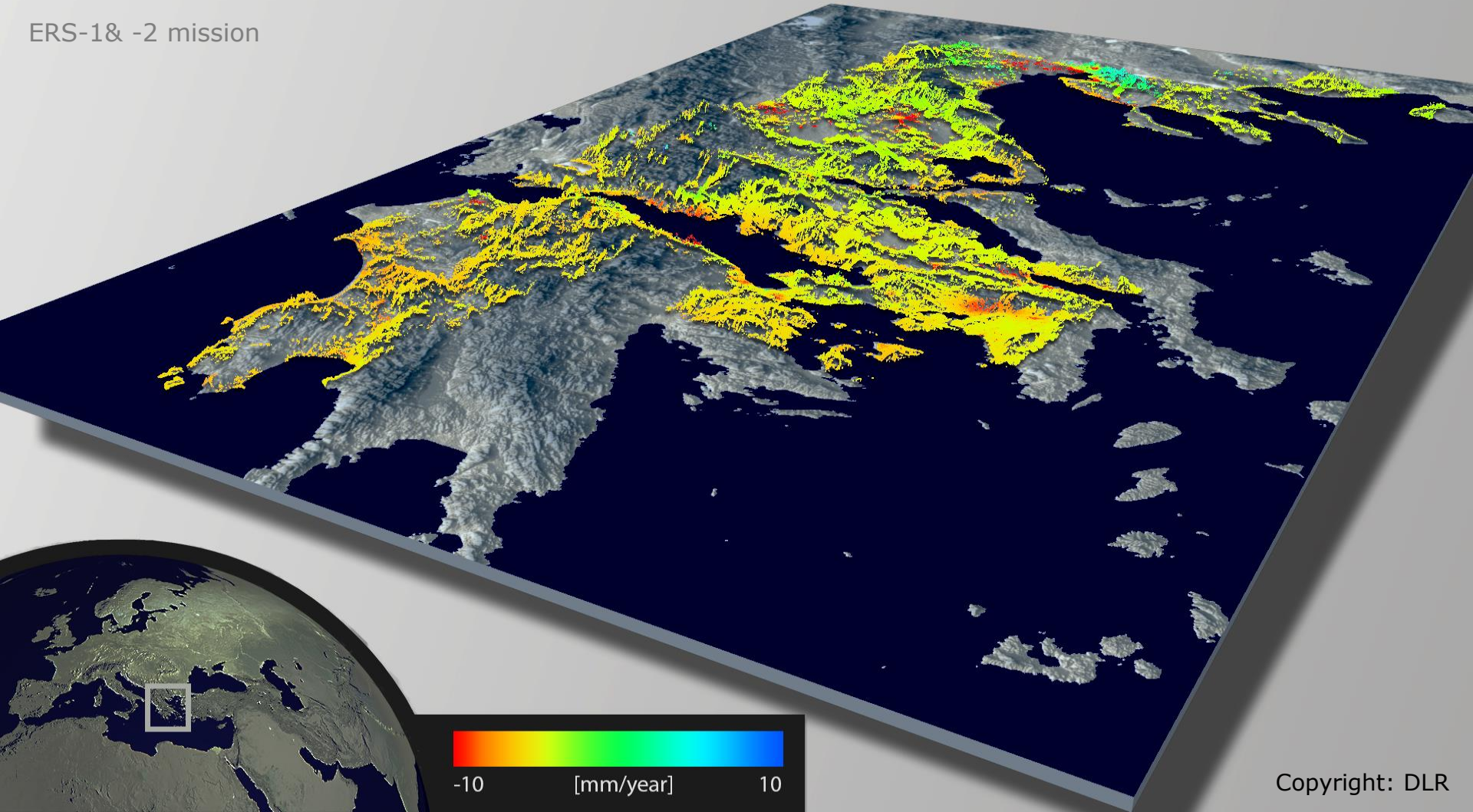
# Wide Area Processing (WAP)

## ESA's Terrafirma PSI Ground Displacement Products



Towards a pan-European information services for ground subsidence risk

ERS-1& -2 mission



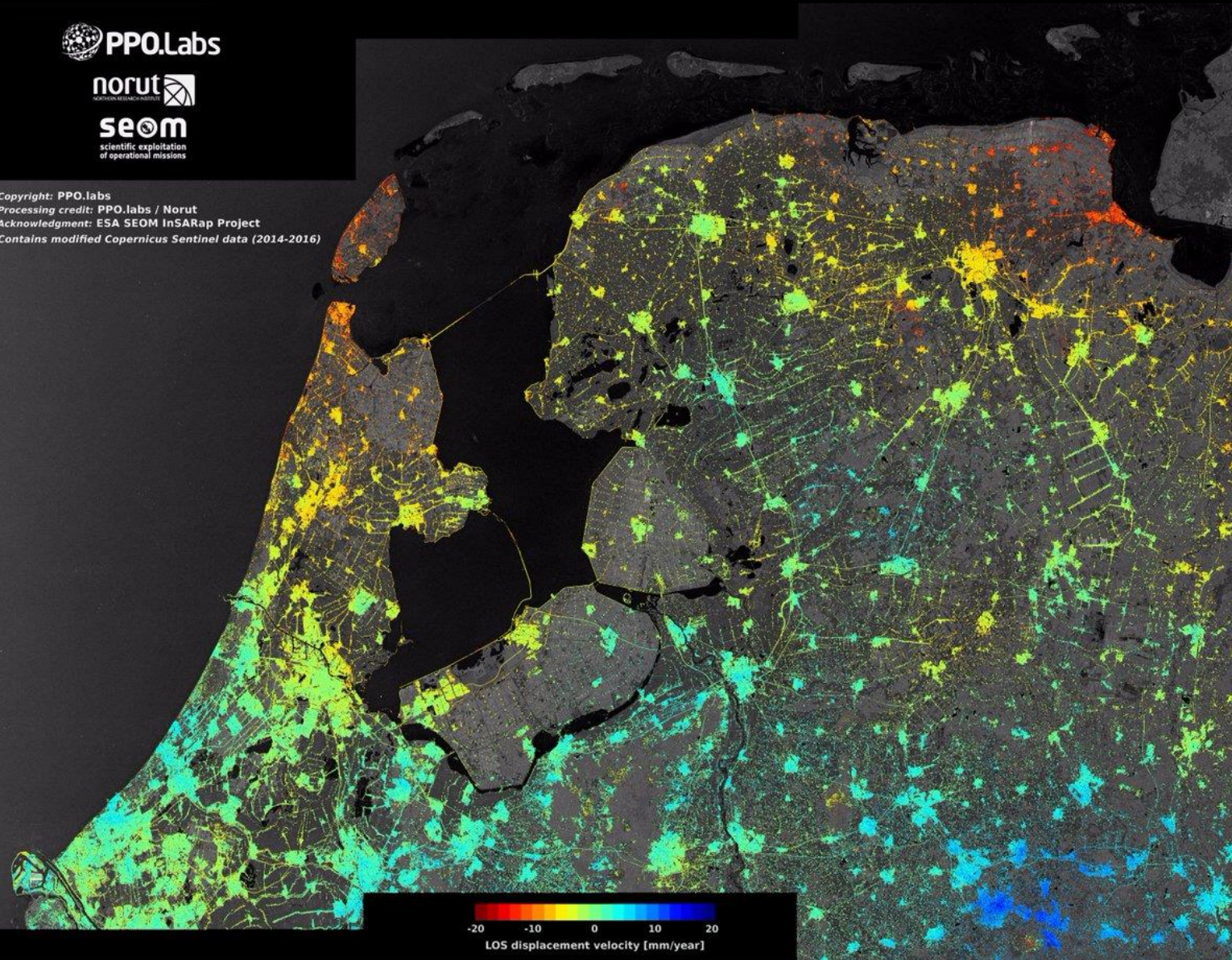
Copyright: DLR



# Country Level Results from Sentinel-1



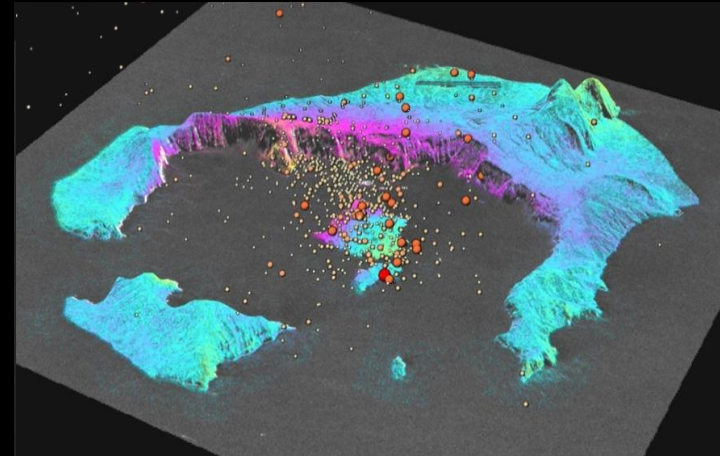
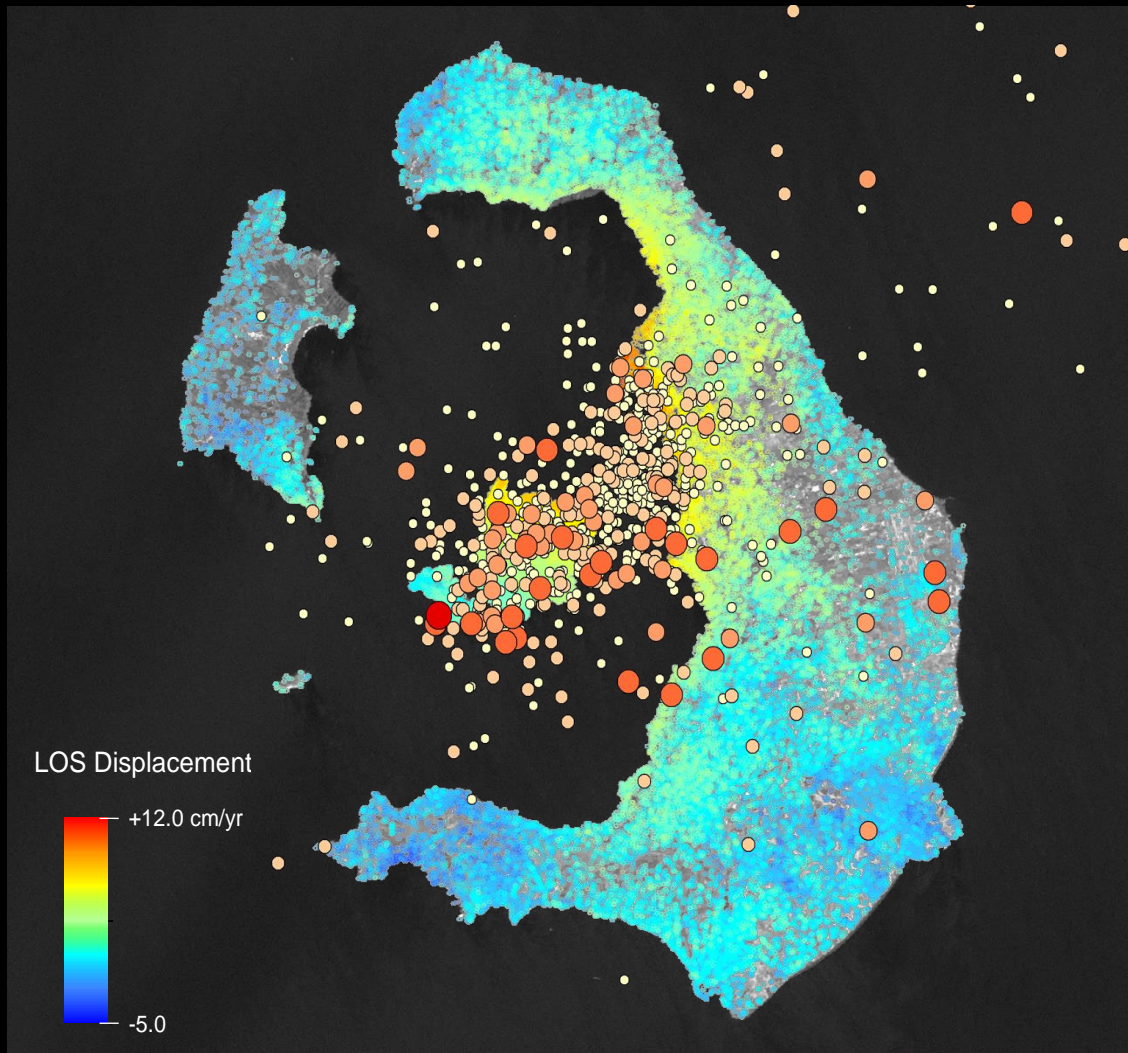
Copyright: PPO.labs  
Processing credit: PPO.labs / Norut  
Acknowledgment: ESA SEOM InSARap Project  
Contains modified Copernicus Sentinel data (2014-2016)



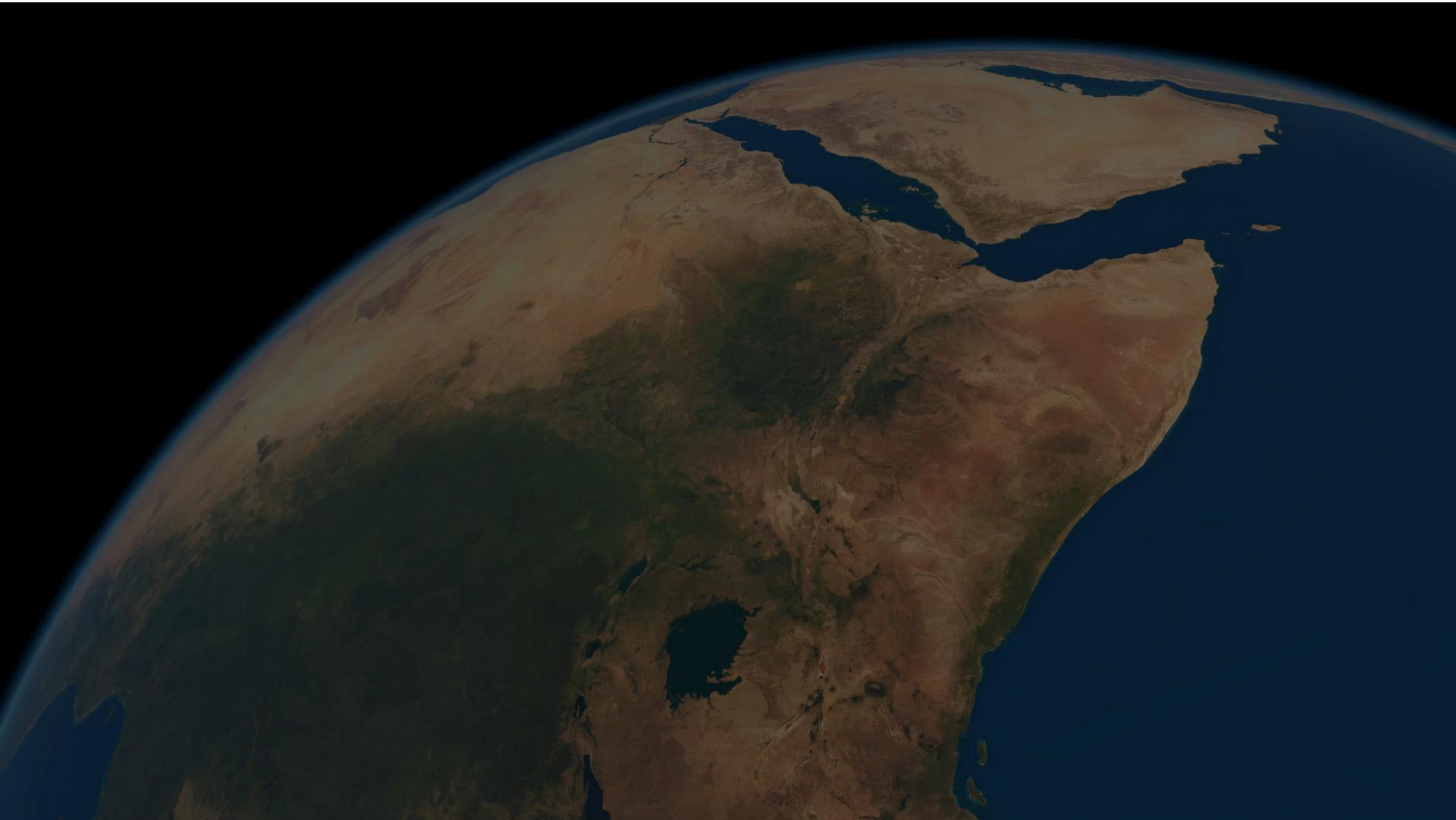


# Volcano Breathing from Space

## Unrest Episode of Santorini Volcano (Greece)



# Monitoring the Great Rift Valley (Afar, Africa)



Copyright: Univ of Bristol



European Space Agency



# ESA Heritage SAR missions: ERS and ENVISAT

prepared by ERS/ENVISAT Teams

For the last 25 years, ESA has been constantly supporting the SAR Interferometry (InSAR) communities with:

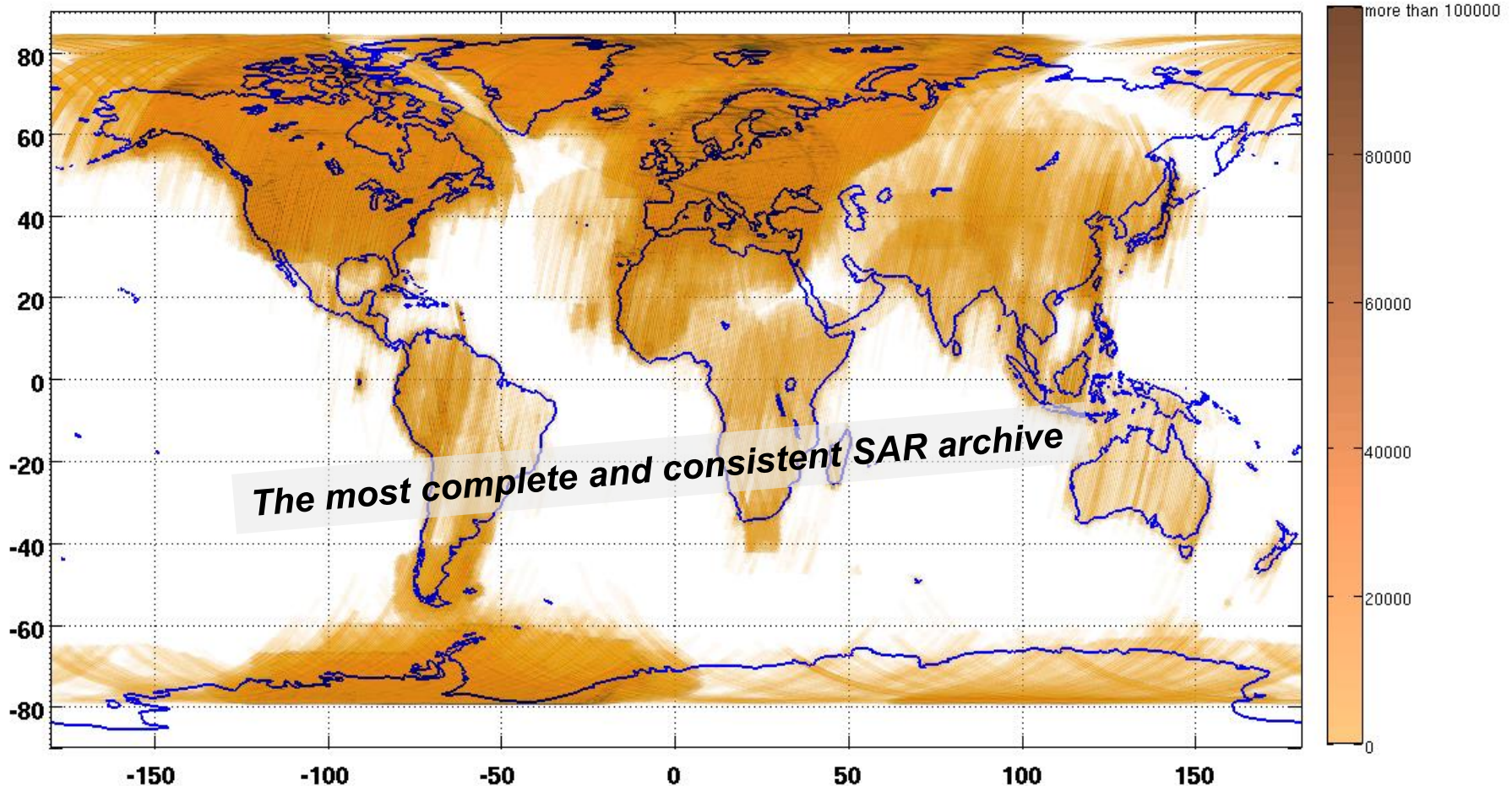
- ❑ the **provision of InSAR data**, through:
  - the development and operations of SAR satellites ([ERS-1](#), [ERS-2](#), [Envisat](#))
  - a precise satellite orbital maintenance including InSAR tandem campaigns ([ERS-1/ERS-2 tandem](#), [ERS-2/Envisat tandem](#))
  - the development of a large and consistent InSAR data archive
  - a constant effort in facilitating the use of SAR data
- ❑ the **development of InSAR science and InSAR applications**,
- ❑ bringing together the InSAR communities through **Fringe & Living Planet workshops**.

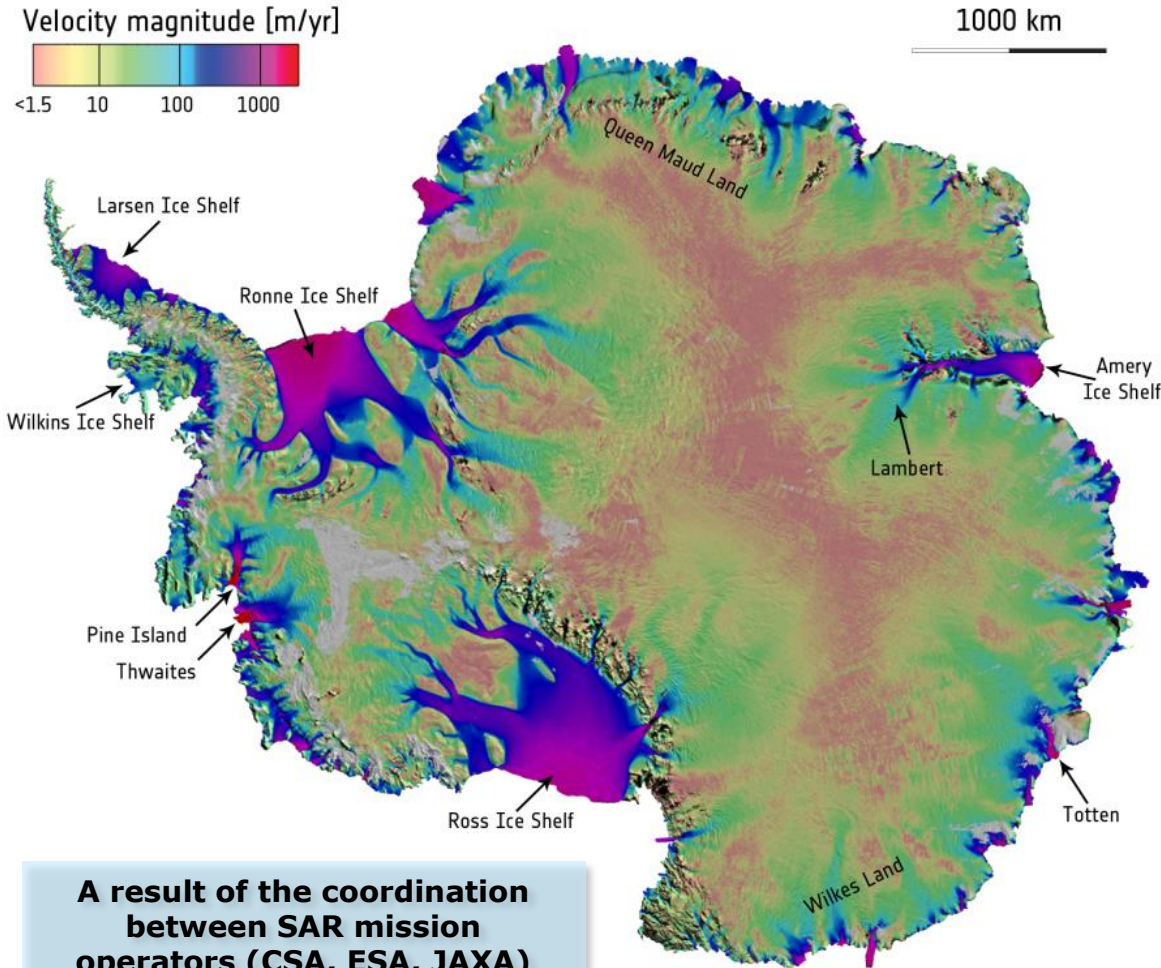




## 1991-2011

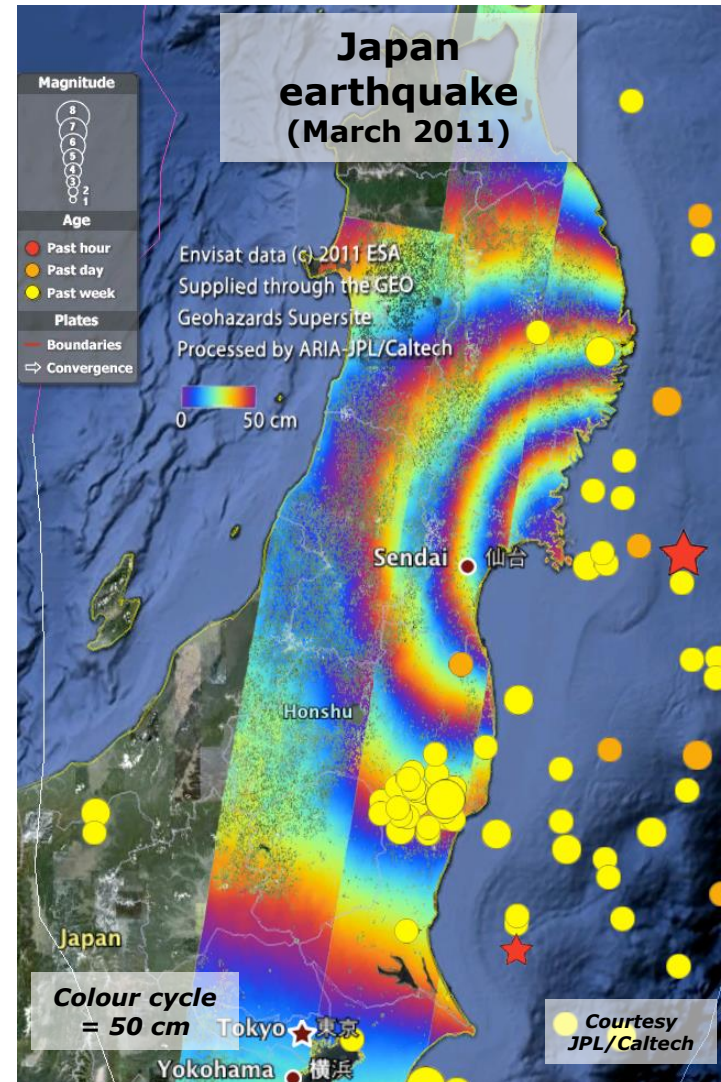
ERS SAR Polarization: VV until mid 2009





**A result of the coordination between SAR mission operators (CSA, ESA, JAXA) during the International Polar Year 2007-2008**

*E. Rignot et al., Science, September 2011*



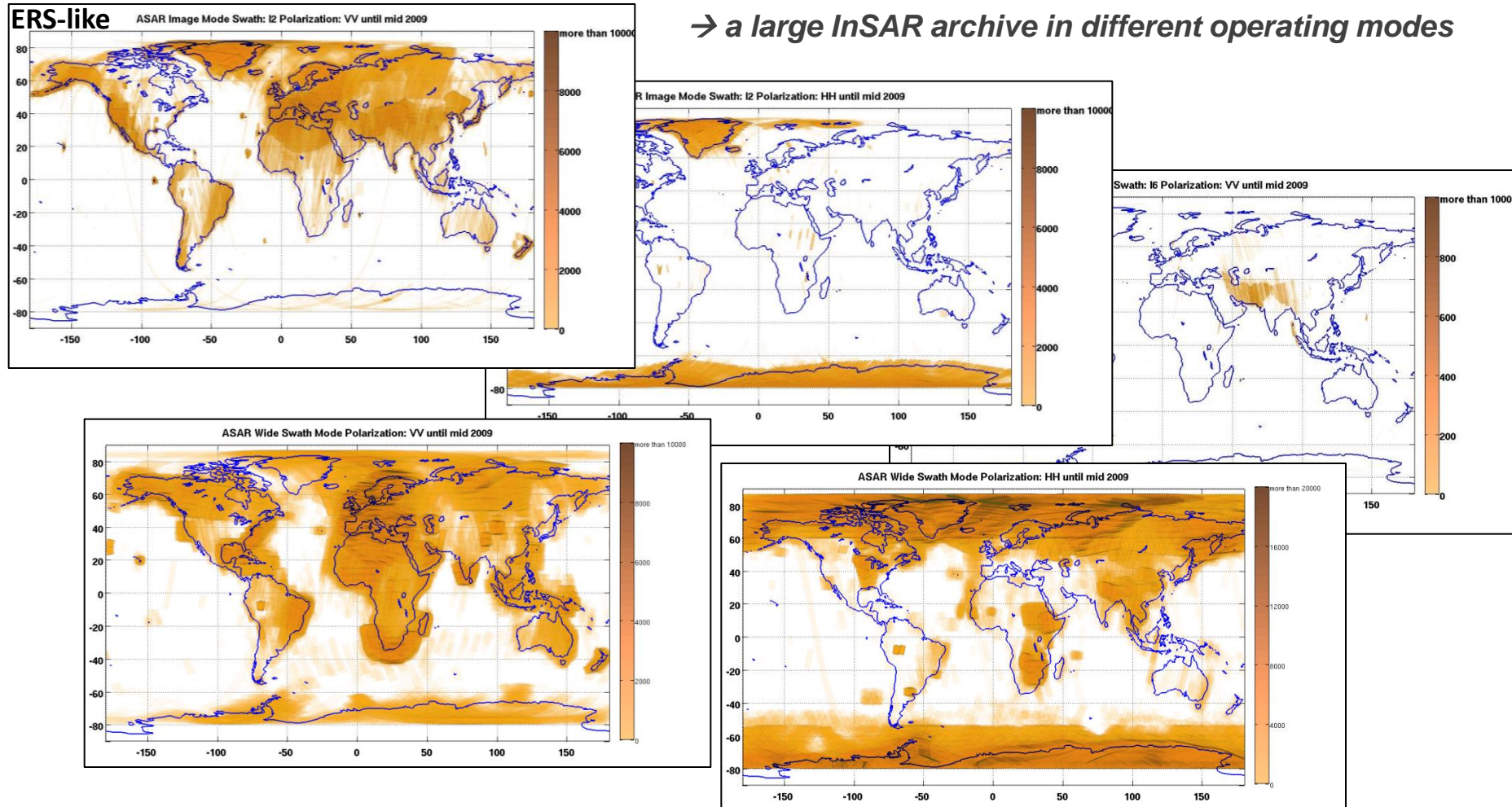


# ENVISAT Mission - Large scale exploitation of InSAR

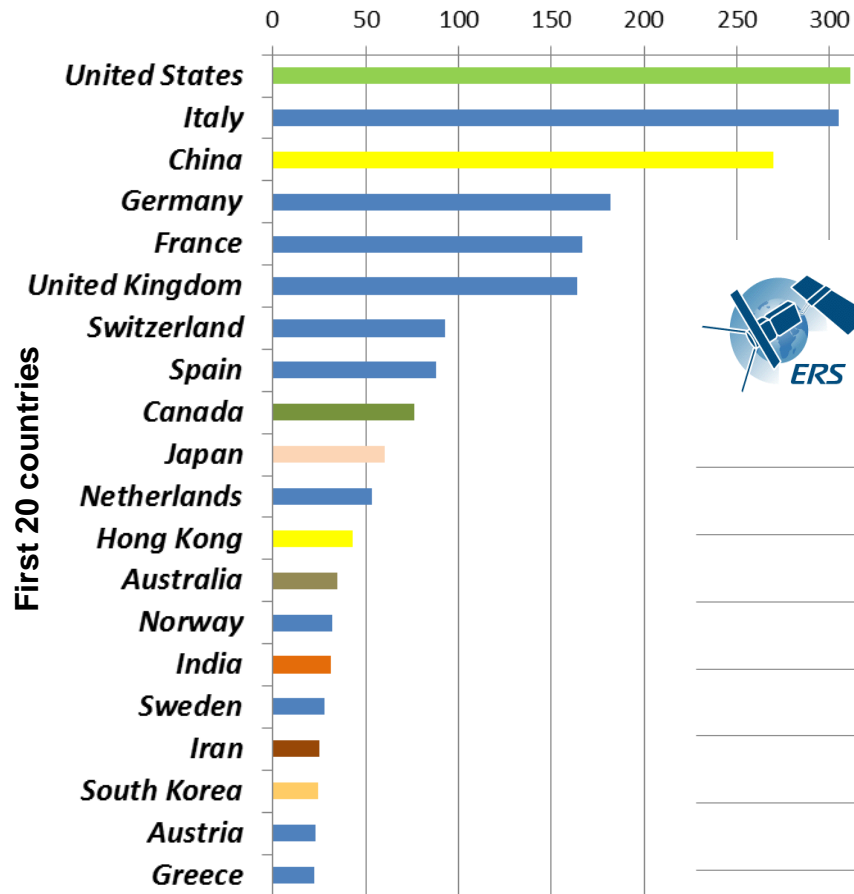


## ENVISAT ASAR data

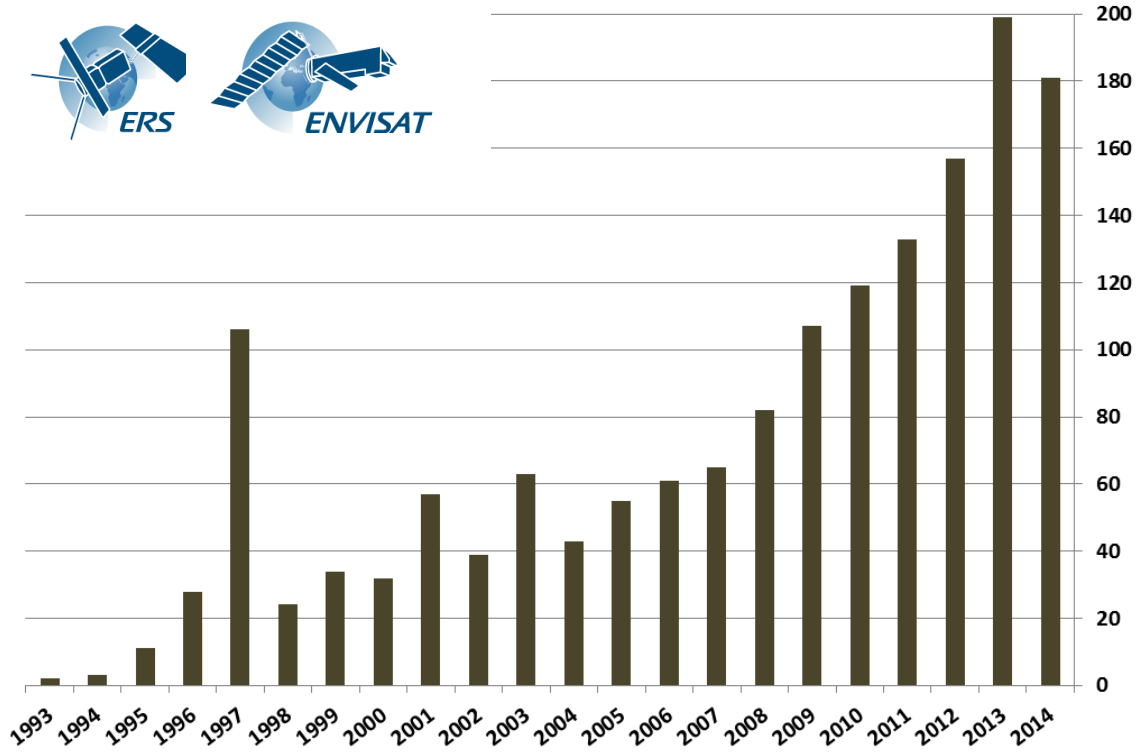
→ a large InSAR archive in different operating modes



# A large impact in the Scientific Literature



*Peer-reviewed journal papers based  
on SAR interferometry and  
on ERS or Envisat data*



Scopus database, Journal papers with search on: "ERS or Envisat and SAR Interferometry"





**Copernicus:** an Earth observation programme for global monitoring for environment and security.

Led by the European Commission in partnership with ESA and the European Environment Agency, and responding to Europe's need for geo-spatial information services, it will provide autonomous and independent access to information for policy-makers, particularly for environment and security issues. ESA is implementing the space component: developing the **Sentinel** satellite series, its ground segment and coordinating data access.

ESA has started a **Climate Change Initiative**, for storage, production and assessment of essential climate data.





Dedicated satellites (“Sentinels”):

- **S1: Radar Mission**
- **S2: High Resolution Optical Mission**
- **S3: Medium Resolution Imaging and Altimetry Mission**
- S4: GEO Atmospheric Chemistry Mission
- S5P/S5: LEO Atmospheric Chemistry Missions
- S6/Jason-CS: Altimetry Mission

# The Sentinel Family - Long Term Operational Plan

2011

2014

2020

2030

## Access to Contributing Missions

S-1 A/B/C/D

S-1 A/B 2nd Generation

S-2 A/B/C/D

S-2 A/B 2nd Generation

S-3 A/B/C/D

S-3 A/B 2nd Generation

S-4 A/B (on MTG)

S-5 Precursor

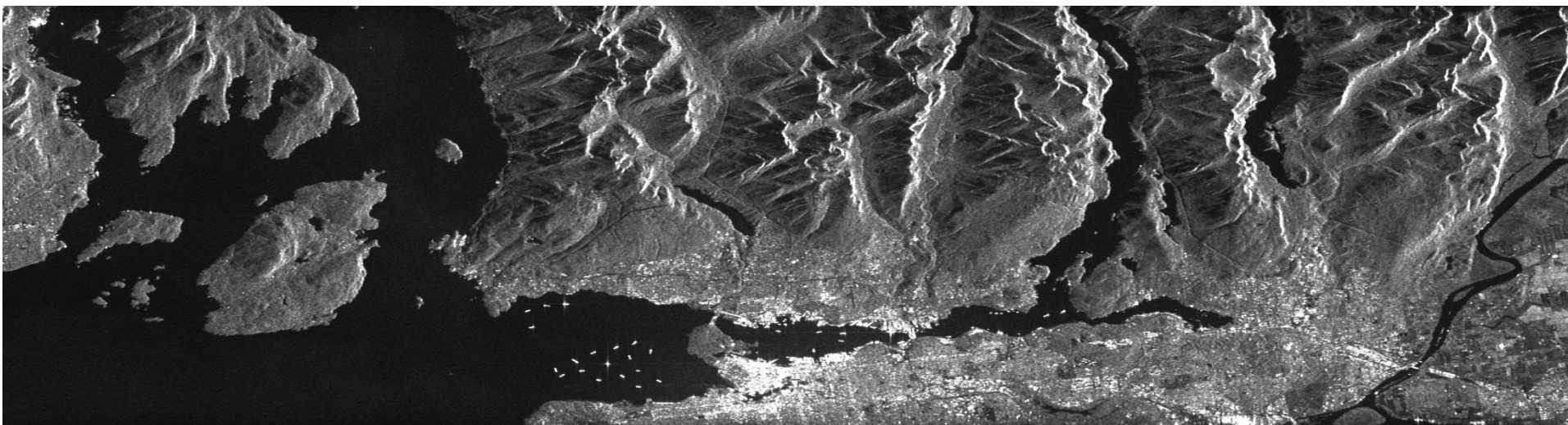
S-5 A/B/C (on MetOp-SG)

S-6 A/B



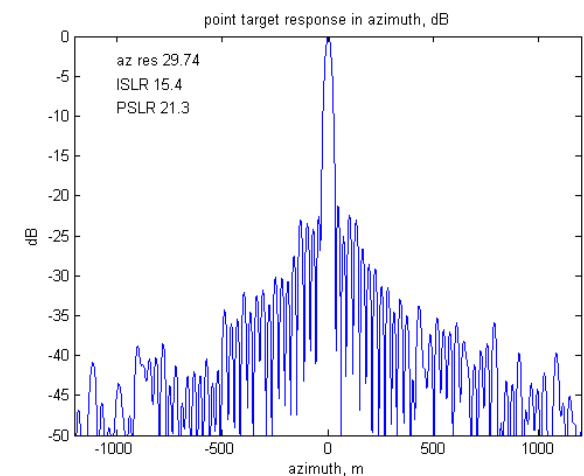
# Sentinel-1 Simulated Products

## First Radarsat-2 image in TOPS



The first RADARSAT-2 TOPS mode over Vancouver. (courtesy Radarsat-2 / MDA)

Point target analysis of  
a bright point around  
the airport



# Launch of Sentinel-1A



- April 3, 2014
- Launch from French Guiana Space Base
- Soyuz-2 rocket
- New era in Earth Observation



# Launch of Sentinel-1A (3rd April 2014)



# Sentinel-1A Deployment





4 April 2014

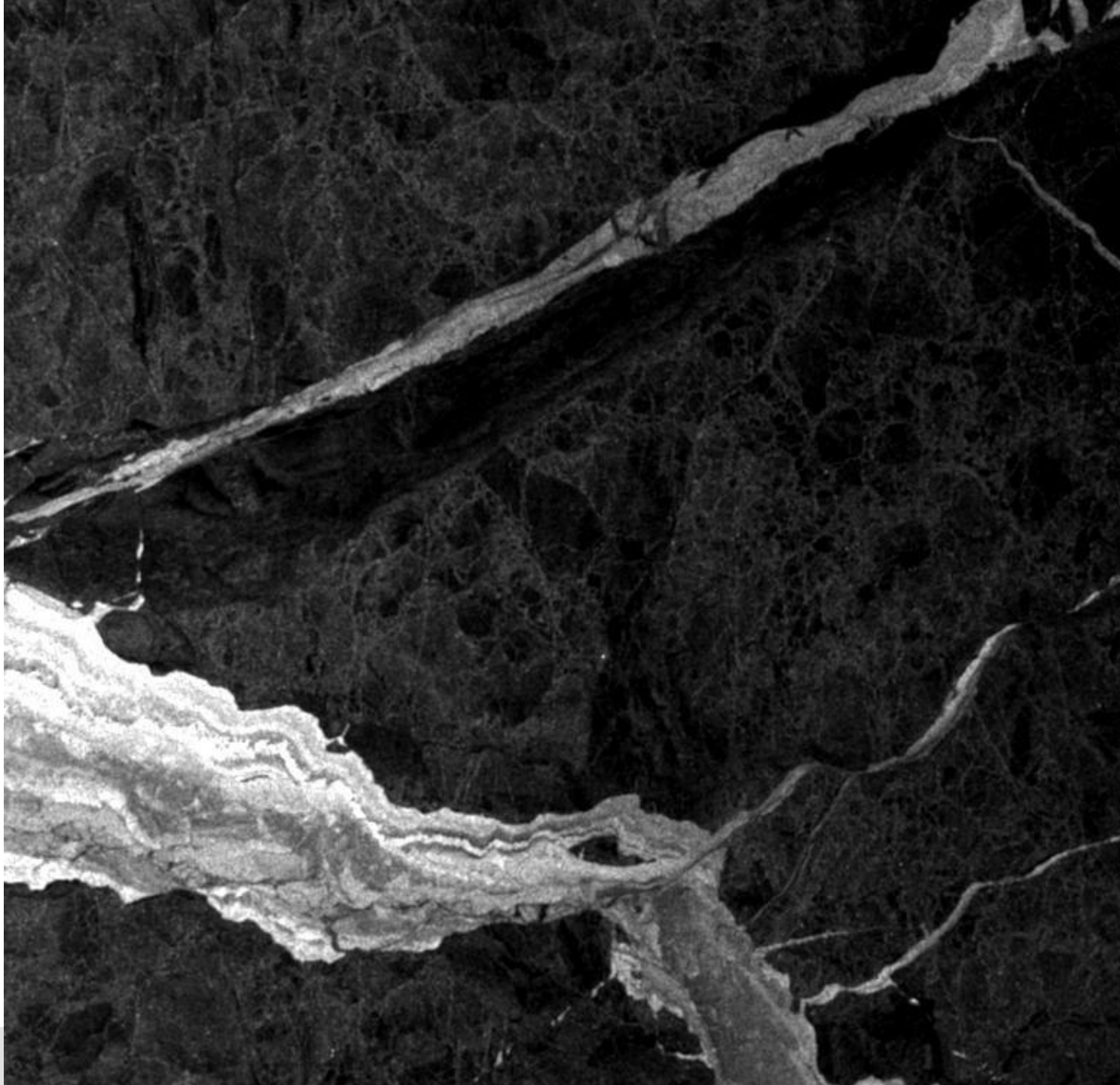
# Sentinel-1A LEOP

Completed in  
three days as  
planned

All s/s were  
switched on

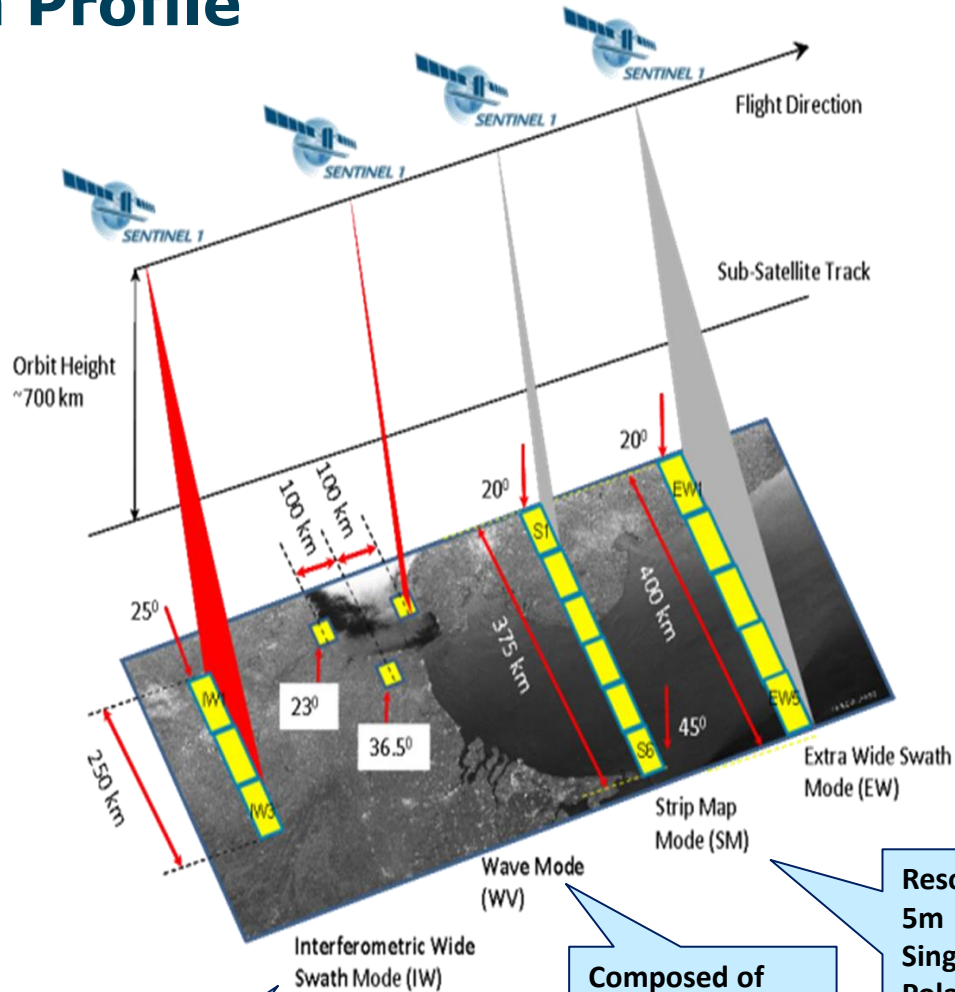
First X-band  
downlink in  
Matera (I)

First SAR  
acquisition  
occurred on 6  
April at  
L+62h33'  
(WM over Svalbard)





# Sentinel-1 Mission Profile



S-1 SAR can be operated in 4 exclusive imaging modes with different resolution and coverages.

**Resolution: 20 x 40m**  
Single and dual  
Polarisation  
Polar areas, and ocean  
relevant areas  
Can be used for  
interferometry

**Resolution: 5m x 20m**  
Single and dual  
Polarisation  
Pre-defined mode  
over Land

Composed of  
Stripmap  
imagettes  
Single  
polarisation  
Pre-defined  
mode over open  
oceans

**Resolution: 5m x 5m**  
Single and dual  
Polarisation  
Emergency Services-  
Disaster Monitoring

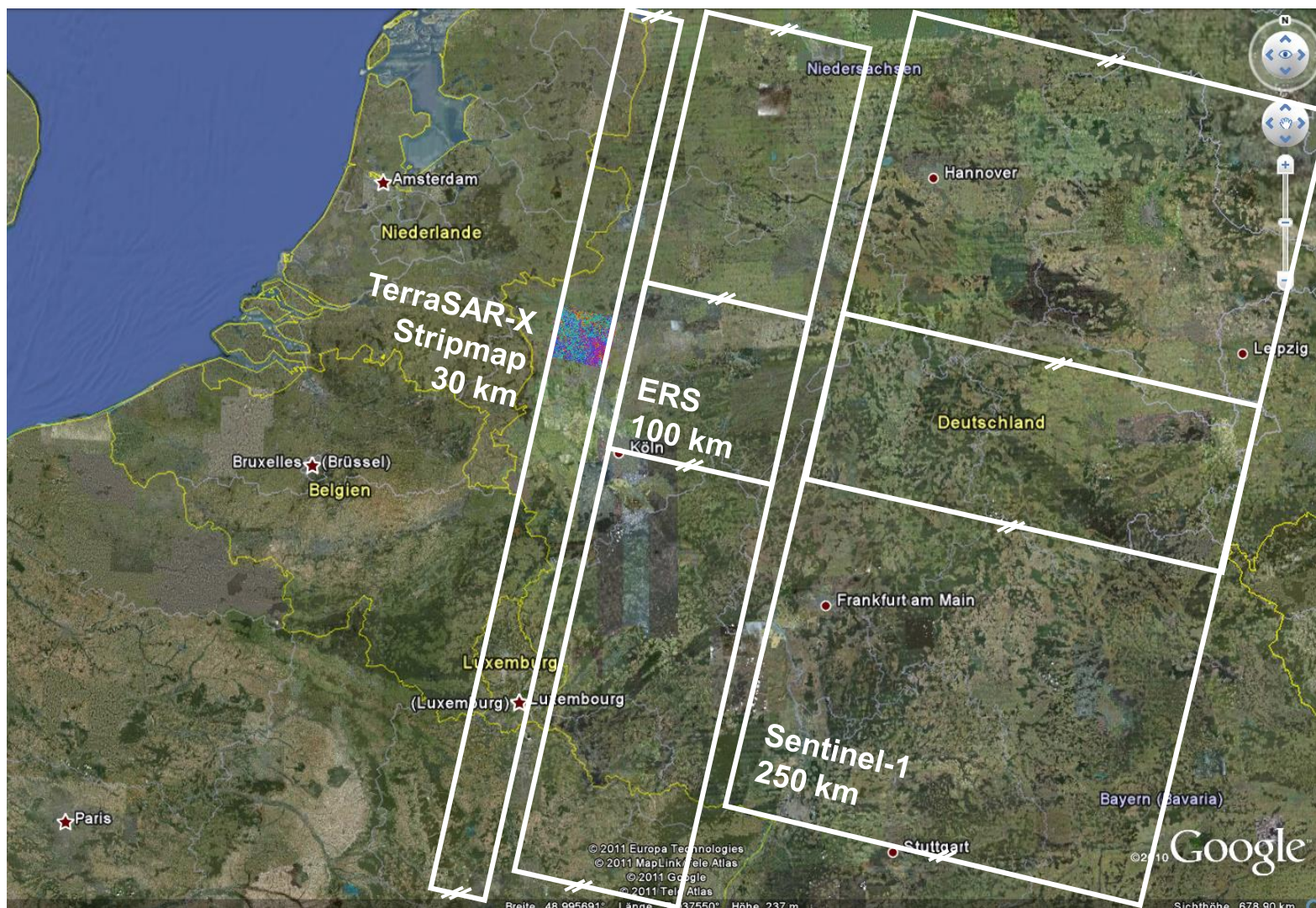


## Image Acquisition in **TOPS**

Interferometric Wide Swath  
mode (IW)



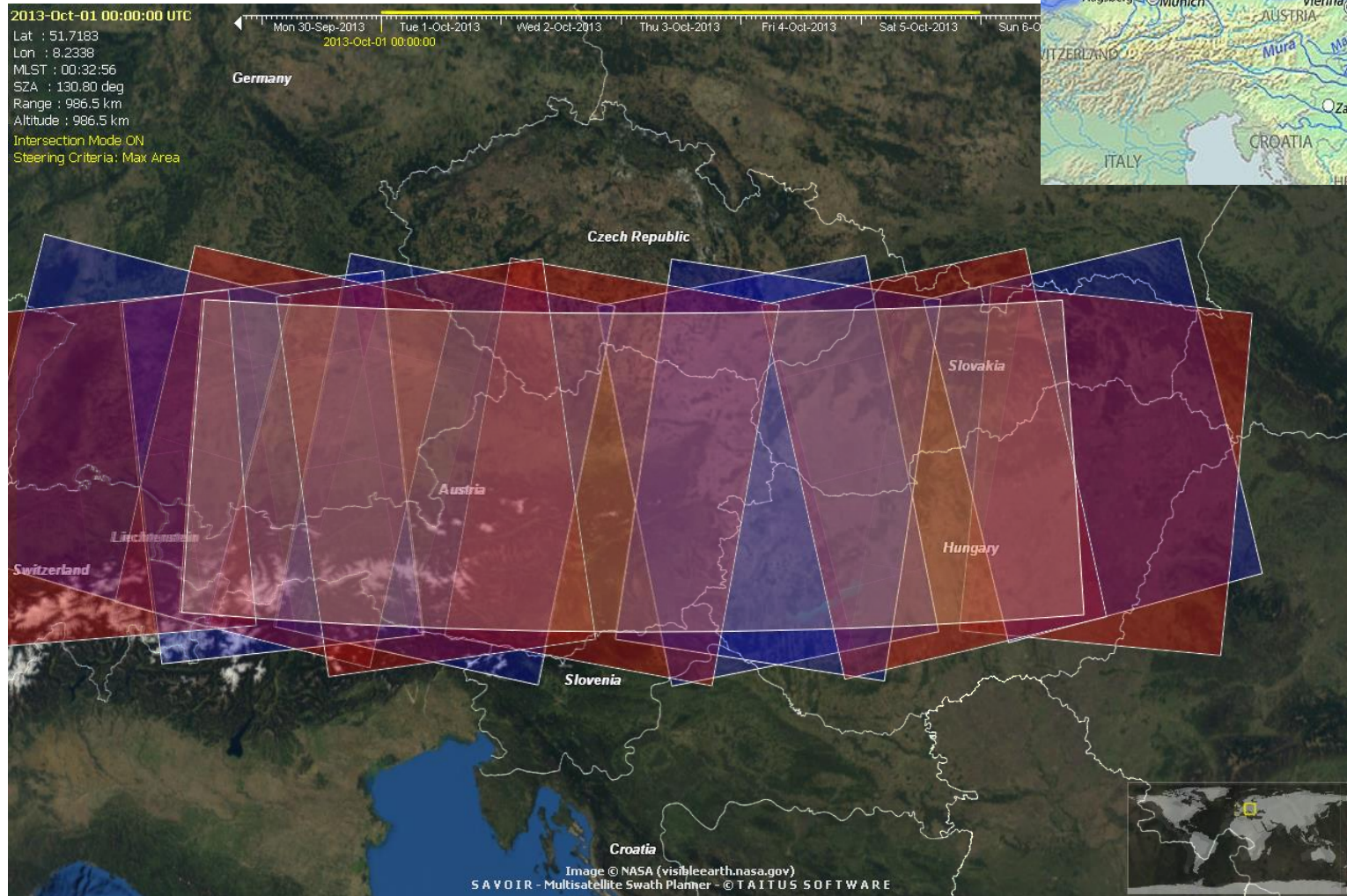
# Sentinel-1 Swath Coverage





# Sentinel-1 Improved Spatial Coverage

## Sentinel-1 vs ENVISAT 5-day coverage



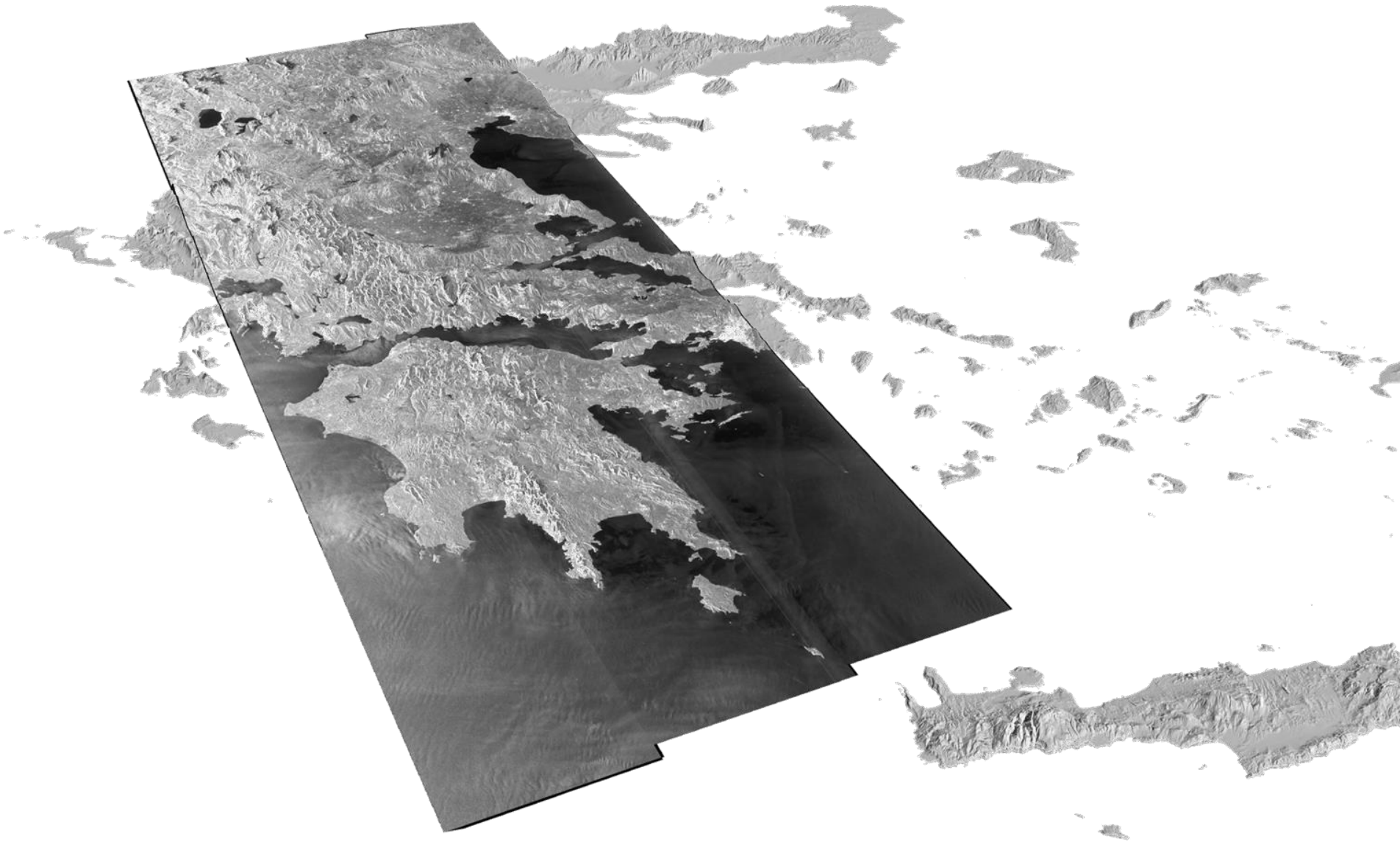
Until 2012:  
ENVISAT

2014+ :  
Sentinel1A

2016+ :  
Sentinel1A/B

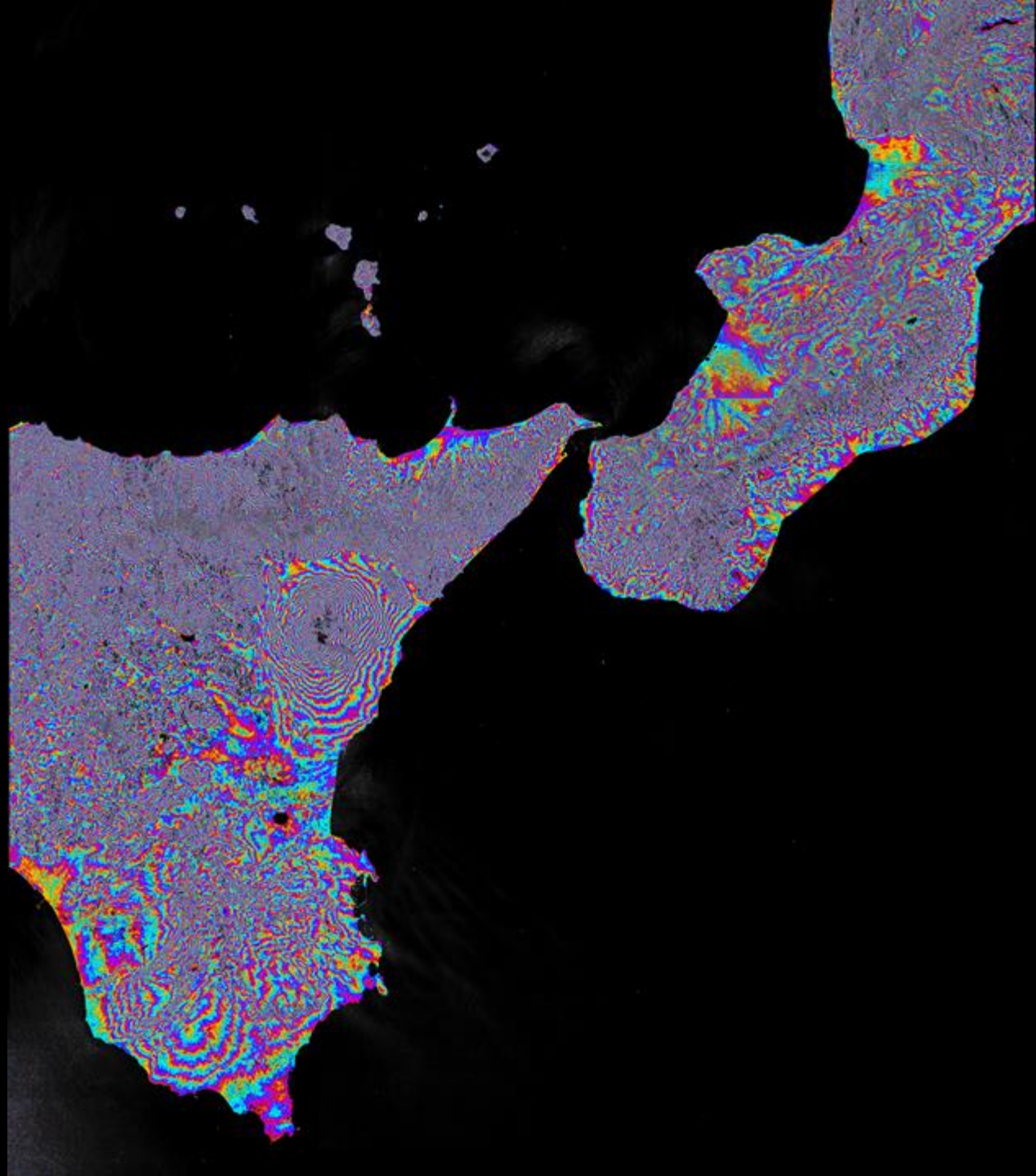
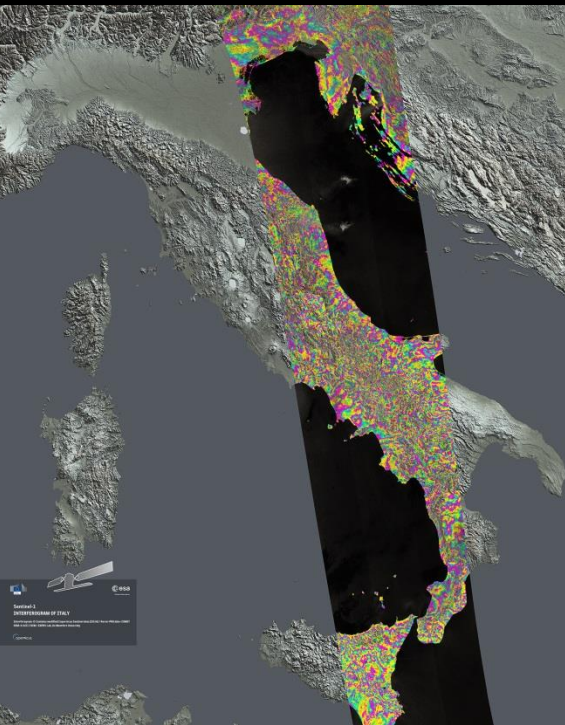


# Sentinel-1A TOPS over Greece (First Acquisitions)



# Sentinel-1A

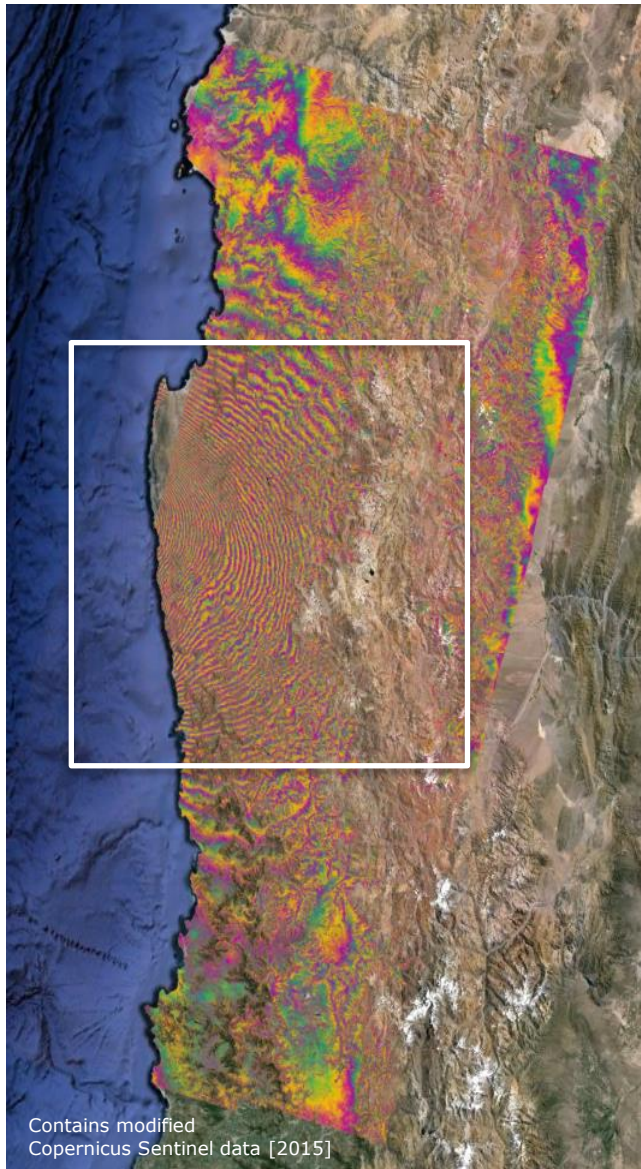
Italy (1200 Km)



Datatake (7 slices):

- IW mode
- Vertical Polarization
- Acq. Dates:
  - 09/08/2014
  - 21/08/2014





On September 16, 2015, an earthquake of **magnitude 8.3** occurred in Chile.

A coseismic Sentinel-1 TOPS interferogram combining images acquired on 24th August and 17th September was computed.

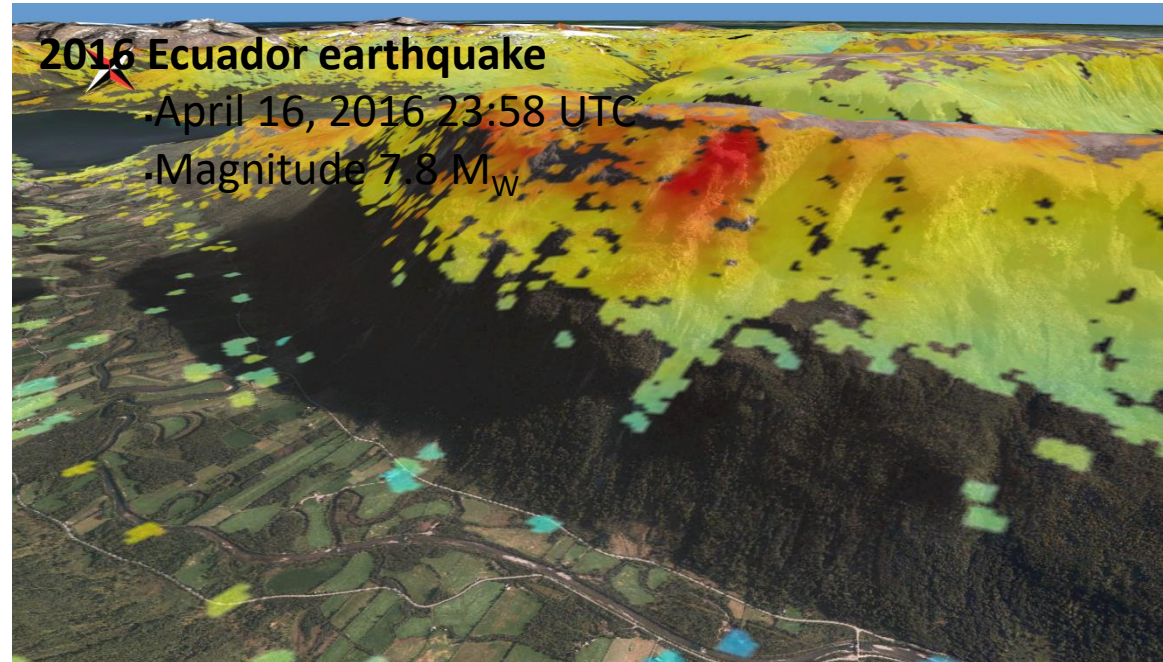
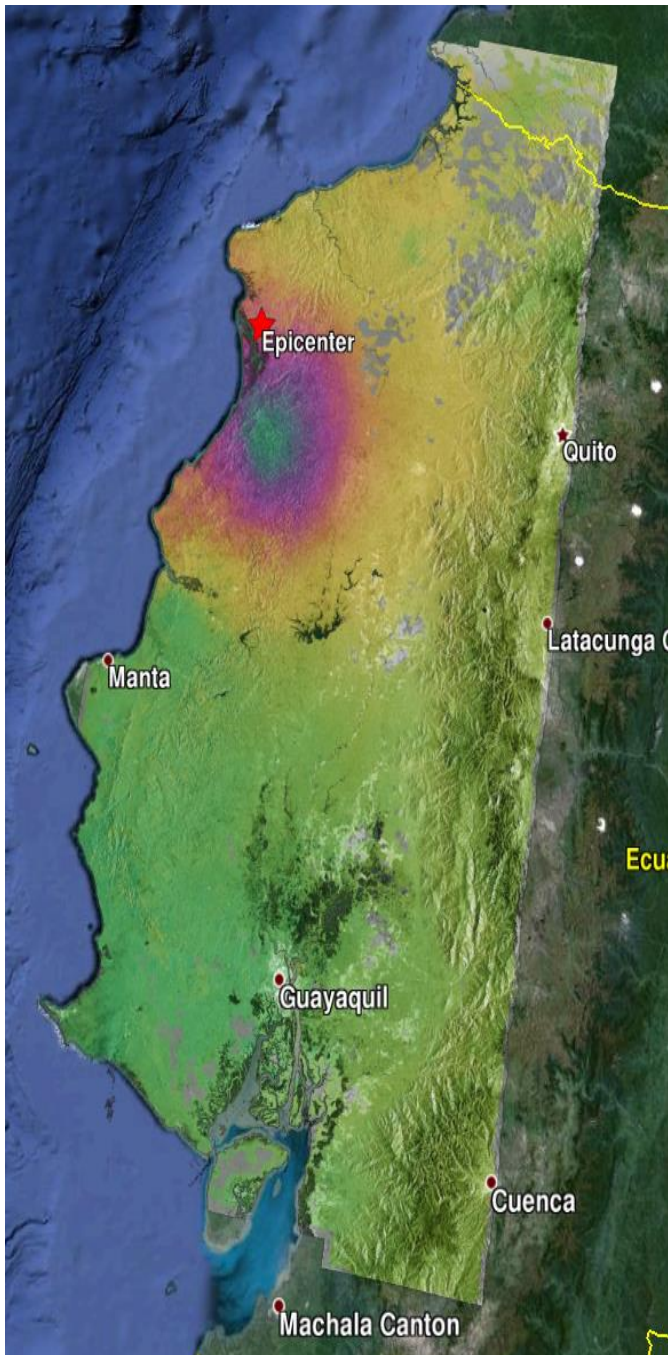
Fringe pattern suggests about **140 cm** Line-of-Sight (LOS) ground displacement.

Results, interpretation and geophysical data available on [INSARAP.org](http://INSARAP.org)

Project funded under [ESA SEOM programme](#)

# 2016 Ecuador Earthquake

NORUT/PPO.labs/Univ.Leeds –  
ESA SEOM InSARAP study



## Sentinel-1 D-InSAR

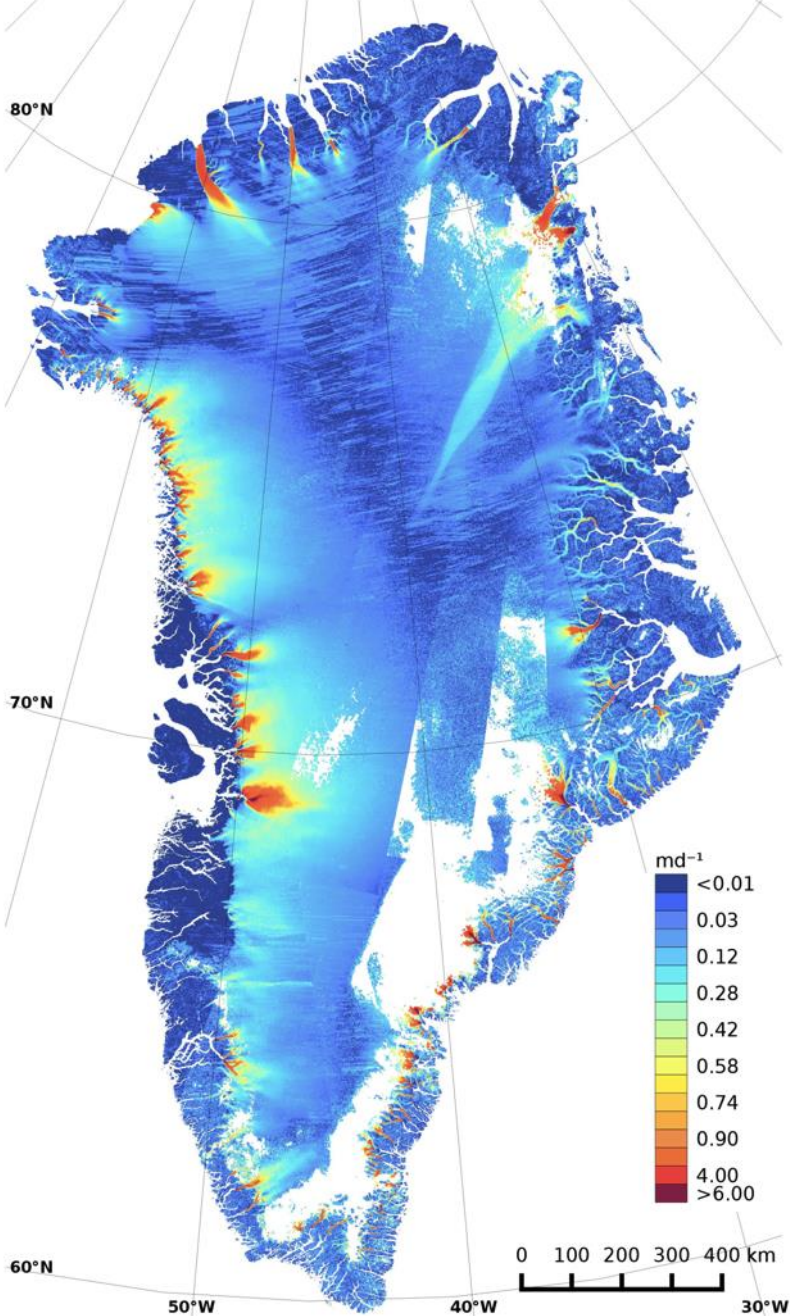
Average displacement velocity from 30 unwrapped interferograms

Data from snow free period:  
Jun – Oct 2015



# First Greenland Ice Sheet

Ice Surface Velocity Map  
based on Sentinel-1 data



Based on SLC products from  
Sentinel-1 Interferometric Wide (IW)  
Swath mode

Period: Jan-Mar 2015  
(some scenes from Oct-Dec 2014)

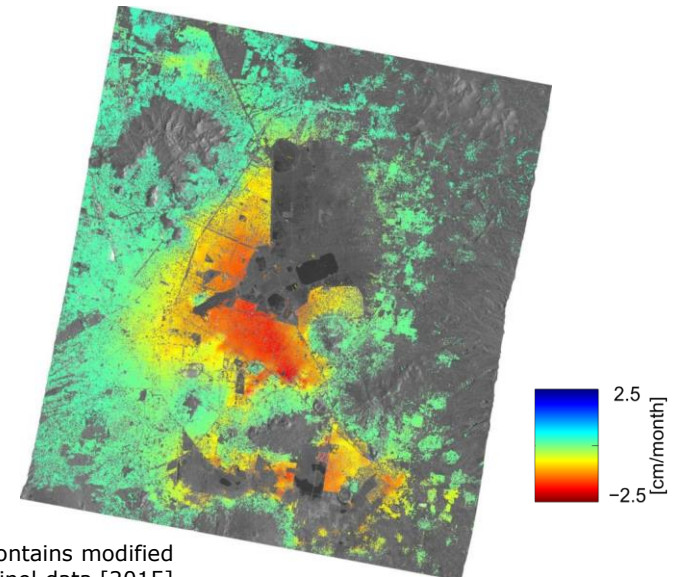
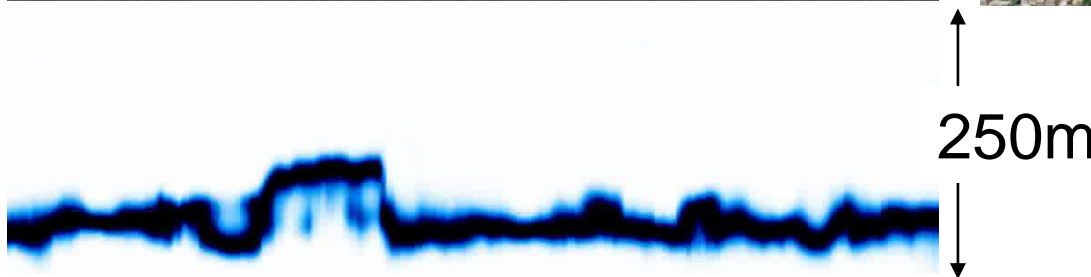
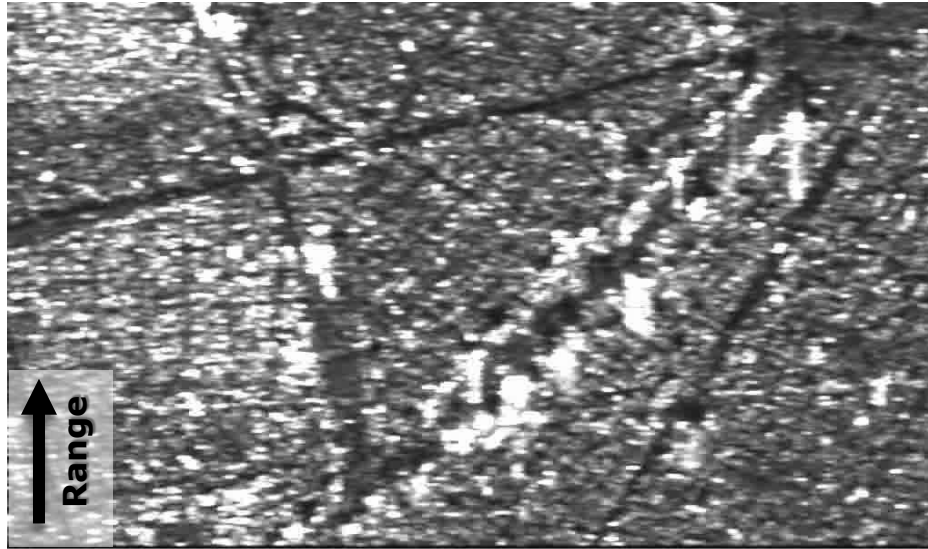
~ 800 scenes  
~ 25 000 bursts  
~ 2.7 TB of SLC data

Offset tracking technique

*Courtesy ENVEO IT GmbH / ESA CCI Ice Sheets Project*

# Sentinel-1 Tomography: Mexico City

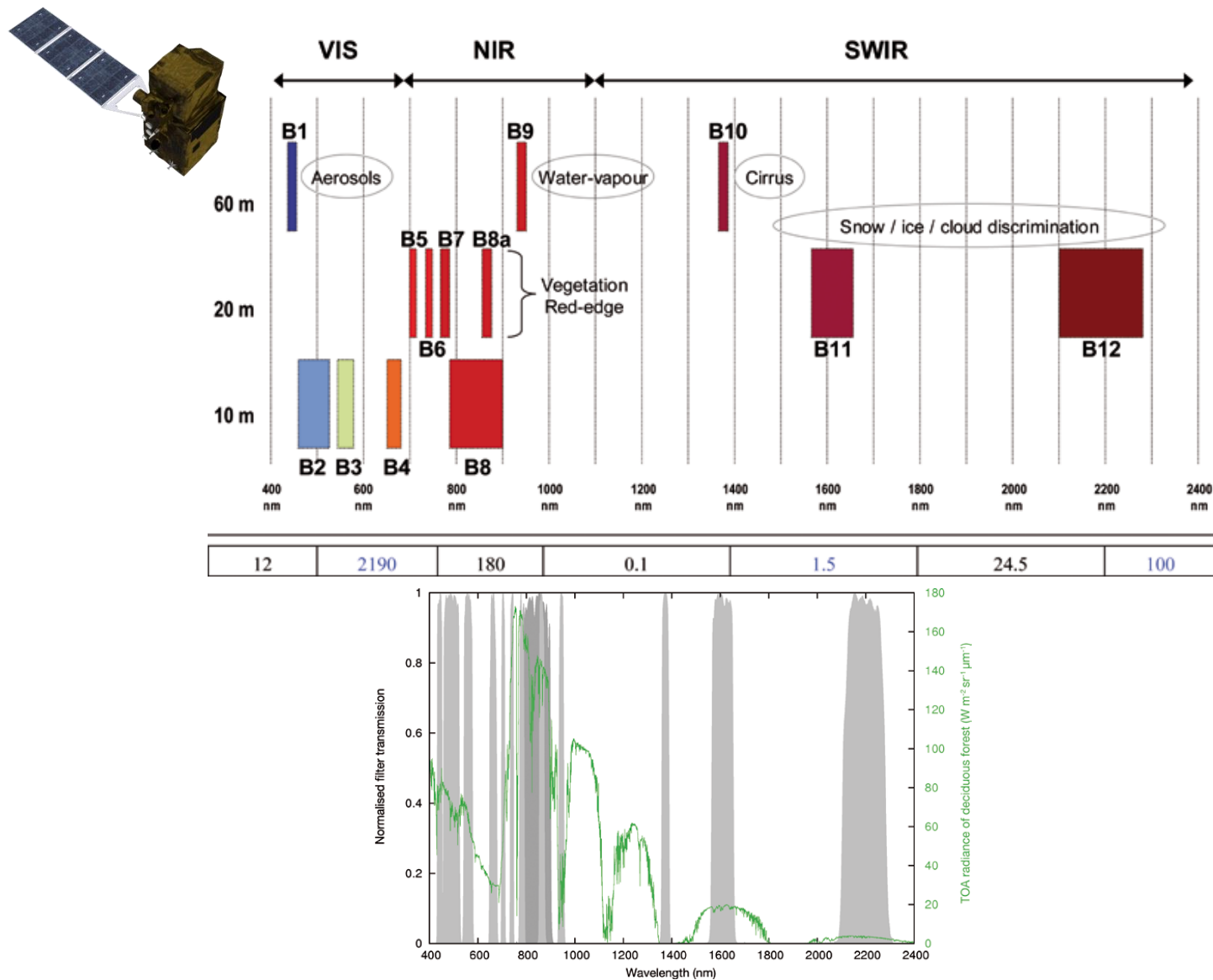
DLR Microwaves and Radar Institute – ESA SEOM InSARAP study



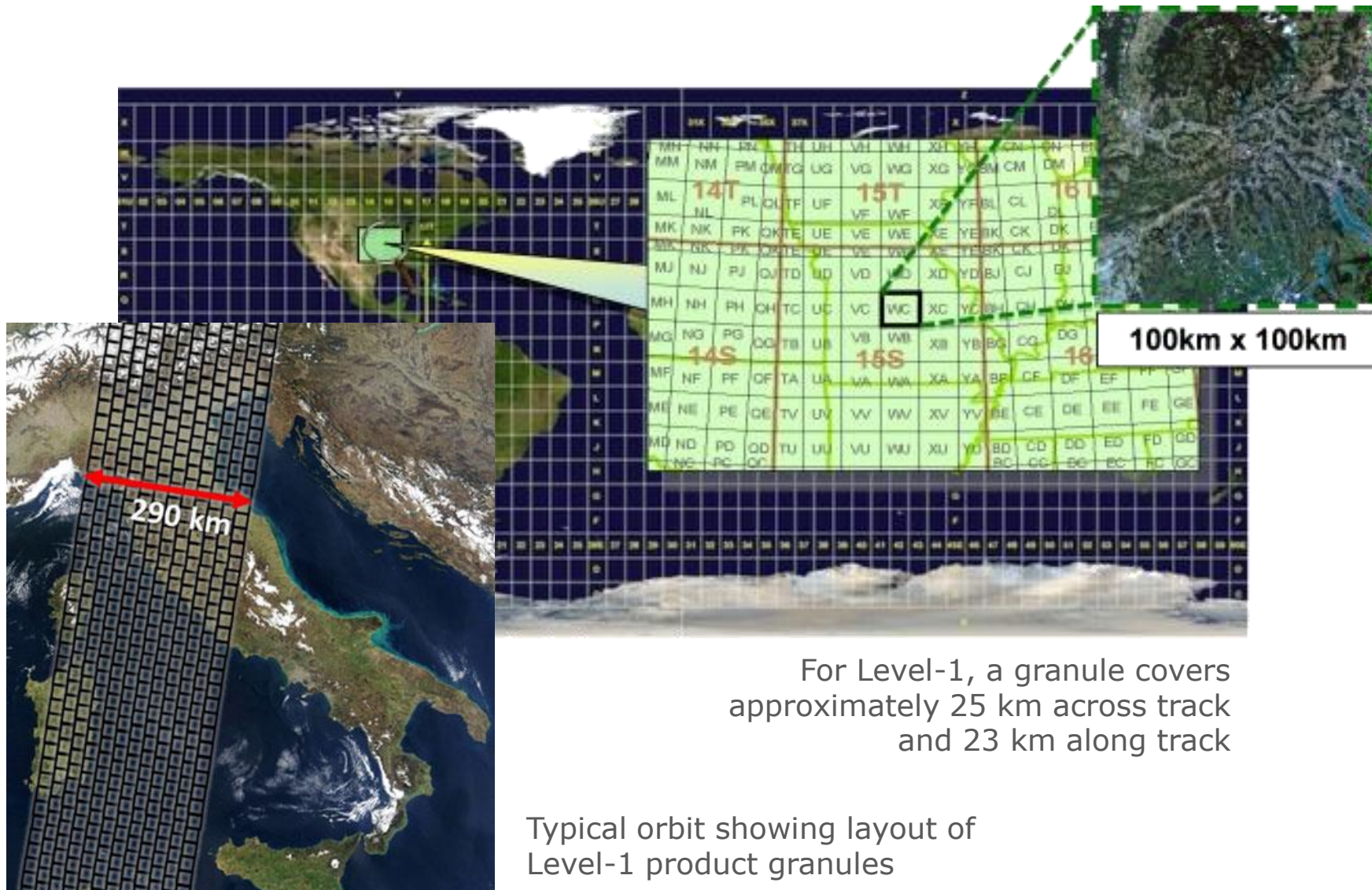
Contains modified  
Copernicus Sentinel data [2015]



# Sentinel-2 Multispectral Instrument (MSI)



# Sentinel-2 Level-1C Product Tiling








Requirement	Description	Measured performance
<b>Absolute geolocation (without ground control points)</b>	The geo-location uncertainty shall be better than 20 m at $2\sigma$ confidence level (without Ground Control Points).	< 9.2 m at 95.5% confidence (baseline 02.04)
<b>Multi-spectral registration</b>	The inter-channel spatial co-registration of any two spectral bands shall be better than 0.30 of the coarser achieved spatial sampling distance of these two bands at $3\sigma$ confidence level.	< 0.29 pixel at 99.7% confidence
<b>Absolute radiometric uncertainty</b>	The absolute radiometric uncertainty shall be better than 5 % (goal 3%).	B1 to B12, excl. B10: < 5%±2%
<b>SNR</b>	The Signal-to-Noise Ratio (SNR) shall be higher than specified values (see Table 5 in this document)	All bands compliant with > 27% margin

# Sentinel Online | The Official Sentinel Website

<https://sentinel.esa.int/web/sentinel/home>



[Need Help?](#) [FAQ](#) [Contact Us](#) [About Sentinel Online](#)

[Missions](#) [User Guides](#) [Technical Guides](#) [Thematic Areas](#) [Data Access](#) [Toolboxes](#)

[You are here](#) [Home](#) [Missions](#) [Share](#)

## SENTINEL Overview

ESA is developing a series of next-generation Earth observation missions, on behalf of the joint ESA/European Commission initiative GMES (Global Monitoring for Environment and Security).

The goal of the SENTINEL program is to replace the current older Earth observation missions which have reached retirement, such as the ERS mission, or are currently nearing the end of their operational life span. This will ensure a continuity of data so that there are no gaps in ongoing studies.


Each mission will focus on a different aspect of Earth observation; Atmospheric, Oceanic, and Land monitoring, and the data will be of use in many applications.

For mission planning information, see the [Copernicus Mission pages](#).

## Missions

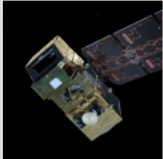
- Missions Home
- Sentinel-1
- Sentinel-2
- Sentinel-3
- Sentinel-4
- Sentinel-5
- Sentinel-5P
- Collaborative Ground Segment
- International cooperation

## SENTINEL Missions



**SENTINEL-1**  
With the objectives of Land and Ocean monitoring, SENTINEL-1 will be composed of two polar-orbiting satellites operating day and night, and will perform Radar imaging, enabling them to acquire imagery regardless of the weather. The first SENTINEL-1 satellite was launched in April 2014.

[Read more](#)



**SENTINEL-2**  
The objective of SENTINEL-2 is land monitoring, and the mission will be composed of two polar-orbiting satellites providing high-resolution optical imagery. Vegetation, soil and coastal areas are among the monitoring objectives. The first SENTINEL-2 satellite was launched in June 2015.

## Latest Sentinel News

- SciHub products publication delay:
- SciHub maintenance on 30 September 2016
- Sentinel-1B products available from 26
- Call for Sentinel-2 Validation Team (S2VT)
- Sentinels International Access Hub

## Browse to Other Sites

- ESA Copernicus website
- European Commission
- Astrium
- EUMETSAT
- European Space Operations Centre (ESOC)
- Thales Alenia Space





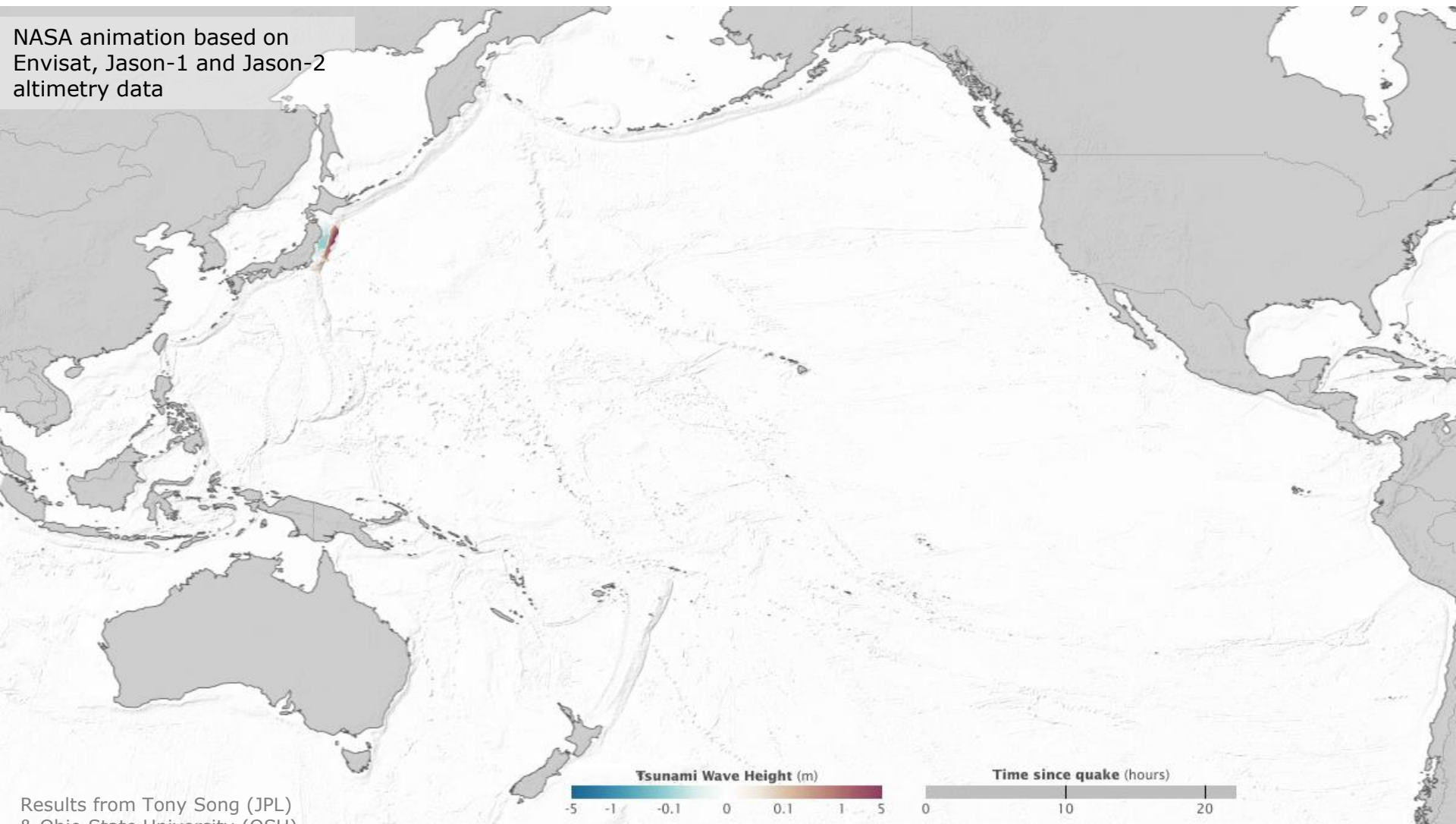
# Observing Events with Multiple Assets



# Observing an event with many assets

→ Tohoku-Oki earthquake (2011)

NASA animation based on  
Envisat, Jason-1 and Jason-2  
altimetry data



Results from Tony Song (JPL)  
& Ohio State University (OSU)

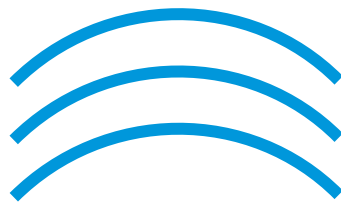


# Observing an event with many assets

→ Tohoku-Oki earthquake (2011)



*After 18 hours, the tsunami reaches Antarctica and destabilizes the Sulzberger ice shelf*

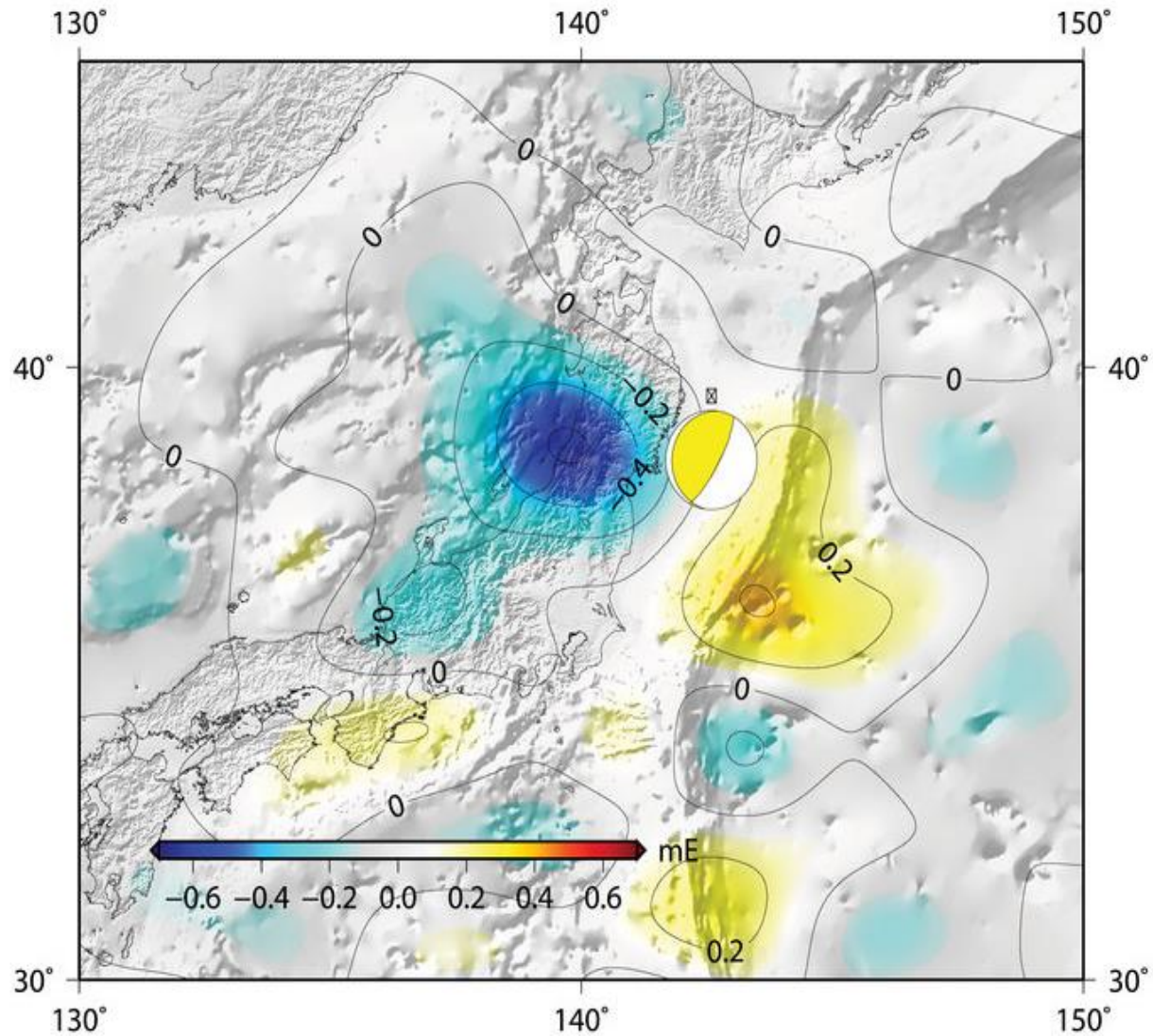


5 km

Brunt, K.M et al., Antarctic ice-shelf calving triggered by the Honshu (Japan) earthquake and tsunami, Journal of Glaciology, July 2011.

# Observing an event with many assets

→ Tohoku-Oki earthquake (2011)





# Observing an event with many assets

→ Tohoku-Oki earthquake (2011)

## **Tohoku Earthquake**

**11 March 2011**

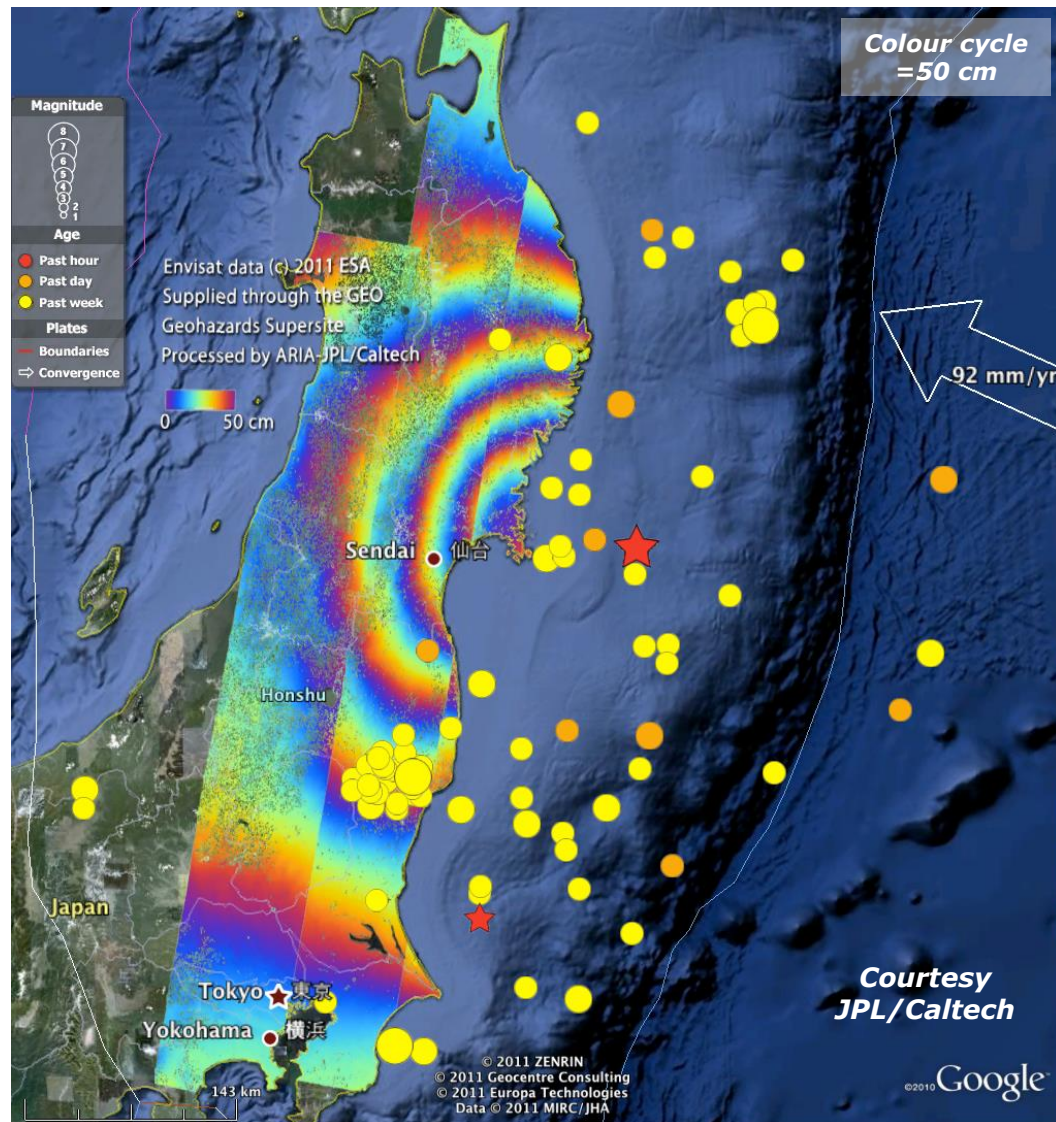
**latitude 38.32°N, longitude 142.37°E**

**magnitude 9.1**



# Observing an event with many assets

→ Tohoku-Oki earthquake (2011)



Thanks to the background data acquisitions (several pre-seismic acquisitions in February 2011), it was possible to generate an ENVISAT ASAR interferogram (combining with several post-seismic acquisitions in March 2011) which provided a detailed estimation of the terrain movement on a very large scale.





# Sentinel Data Access



Heat map showing the collaboration networks between researchers in different cities using the Scopus database (papers published between 2008 and 2012).  
<http://olihb.com/2014/08/11/map-of-scientific-collaboration-redux/>

# Sentinel Ground Segment Overview

## Sentinel-1 Ground Segment Operational Centres

### S1 Core Ground Stations

The S1 CGSs provide the X-Band data acquisition service for the Sentinel-1 mission

In addition, the following operations are located at the CGSs:

- SAR L0/L1/L2 production & on-line access for NRT data
- Systematic SAR L0 production and circulation to PACs for all data acquired
- Systematic GPS L0 production and circulation to POD service
- Systematic HKTM L0 production and circulation to FOS

Svalbard  
X-Band station & NRT Centre

### COPERNICUS WAN

High performance Wide Area Network, ensuring high performance and bandwidth connection through the PDGS centres and providing large data dissemination capacity

Farnborough (UK-PAC)

Brest MPC

### COPERNICUS WAN

Oberpfaffenhofen (DLR-PAC)

### S1 Mission Performance Centre

The S1 MPC provide the following main services for the S1 mission operations:

- Operational user products calibration and verification
- Routine systematic quality control monitoring of S1 product quality and instrument performance
- Long-term instrument performance assessment and calibration

### S1 Processing and Archiving Centres

The S1 PACs provide the the Long Term Archiving Service for the S1 mission operations.

In addition the following operations are located at the PACs:

- Systematic 24h SAR L0 production
- Systematic 24h SAR L1, L2 products generation
- Systematic supported product generation
- On-line data access

ESRIN  
PDMC

Matera

X-Band station

### S1 Payload Data Management Centre

The following operations are located at the PDMC:

- Mission planning: instrument sensing and downlink activities
- Production planning: set-up and dispatching of systematic production rules for any new acquired data
- E2E mission monitoring and management

X-Band station



Payload Data management Centre (PDMC)



Mission Performance Centre (MC)



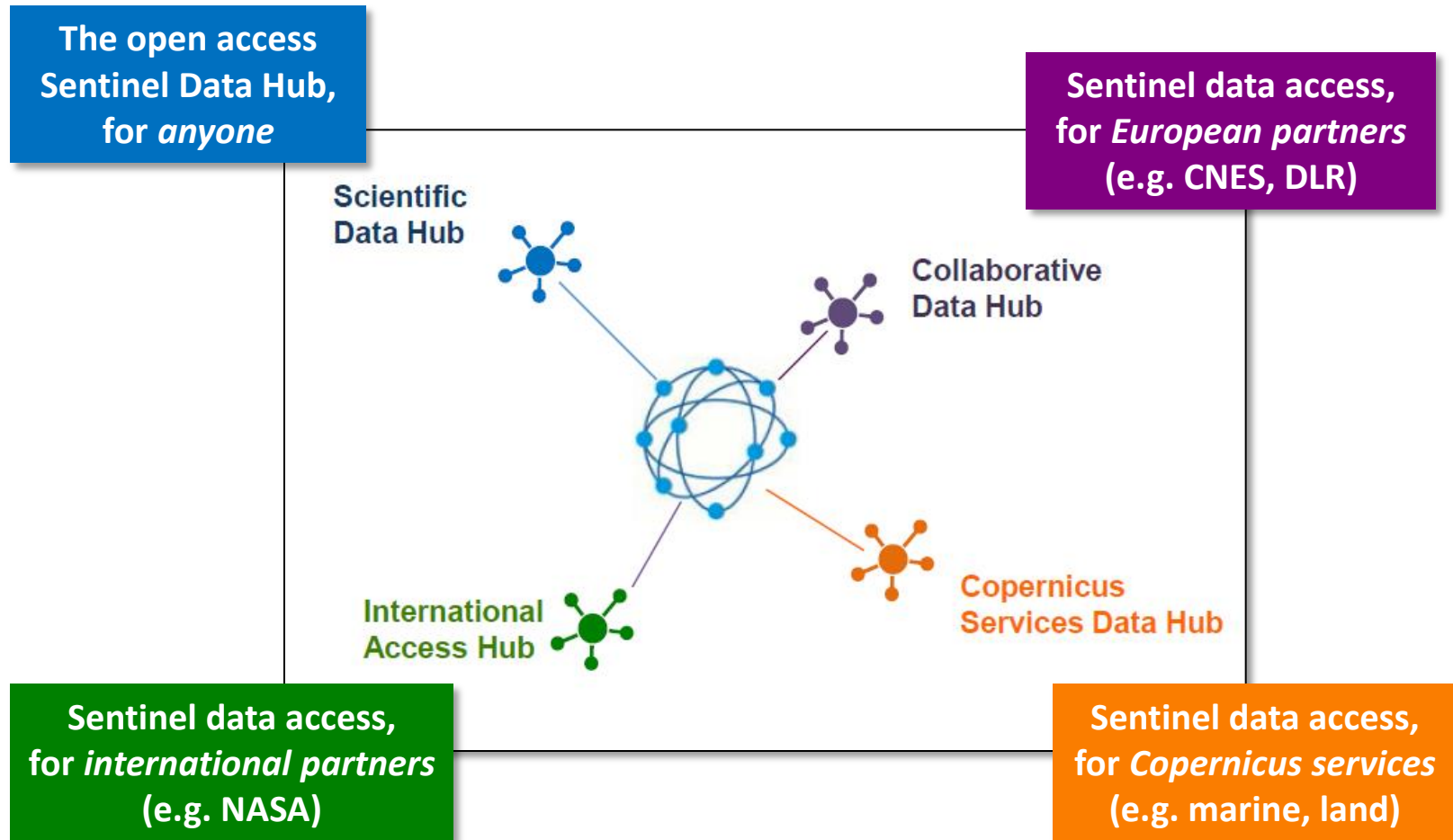
Archive and Offline Processing Centre (PAC)



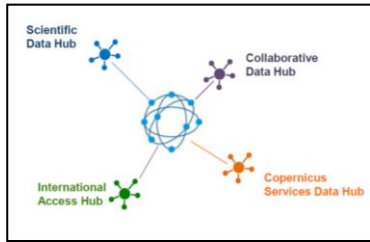
X-Band Stations & Near Real Time Processing Centre (CGS)



# ESA operated Sentinel Data Hubs





# Sentinel Data Hubs - Latest Configuration



## ESA operated Sentinel Data Hubs

### Open Data Hub

#### Self Registration

   
> 36,600 Users



No Rolling Policy Applied



Sentinel-1A NTC  
Sentinel-2A L1C

03-Oct-2014



16-Nov-2015



Max 2 Concurrent Downloads

### Collaborative Data Hub



11 Collaborative Users  
4 Data Hub Relay Users



Node 1: 30 days  
Node 2: 9 days



Sentinel-1A NRT & NTC  
Sentinel-2A L1C



Node 1: Max 10 downloads  
Node 2: No limits

### International Access Hub



4 Users



30 Days



Sentinel-1A NTC  
Sentinel-2A L1C<sup>1</sup>



No specific threshold

L1C<sup>1</sup> coming soon

### Copernicus Services Data Hub

**copernicus**  
space component data access



108 Users



No Rolling Policy Applied



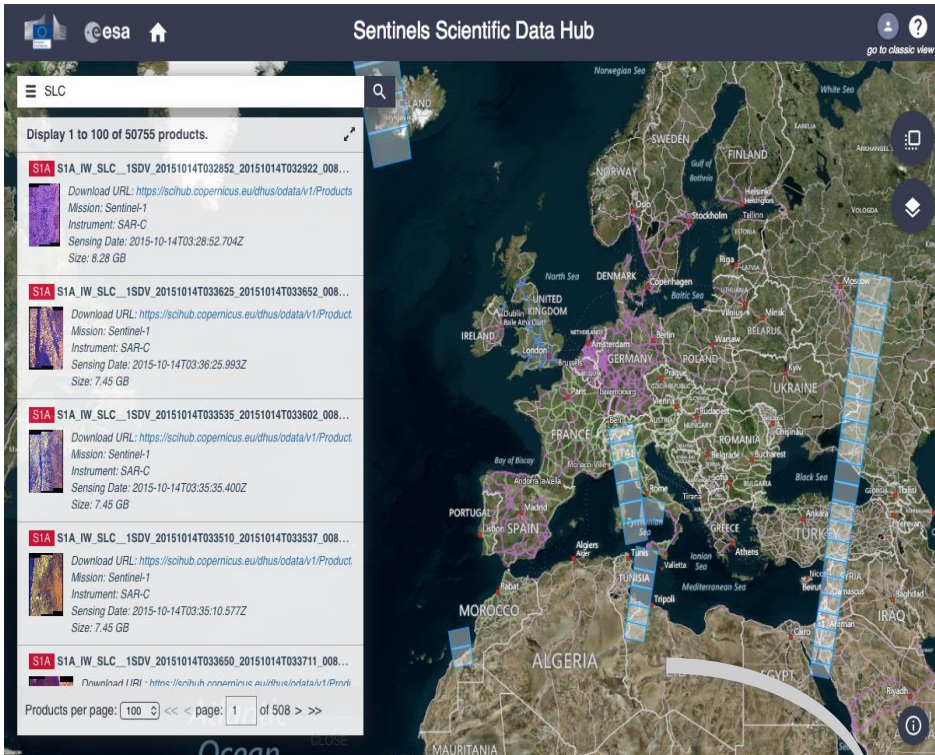
Sentinel-1A NRT & NTC  
Sentinel-2A L1C

01-Dec-2015



Max 10 concurrent downloads

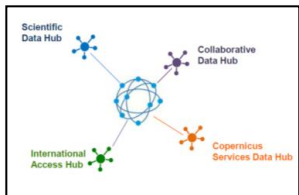




**scihub.copernicus.eu**

- ✓ Simple self registration
- ✓ Currently all data generated since October 2014 is available online
- ✓ APIs provided for automatic downloads via scripts
- ✓ Quota restriction of 2 concurrent downloads to ensure bandwidth availability for all users
- ✓ Single user can engage up to 500 Mbps output network bandwidth

[illegible]



# Collaborative Ground Segment Data Hub



[colhub.copernicus.eu](https://colhub.copernicus.eu)

Data Centre infrastructure in operations since January 2015:

- 11 accounts enabled, one per Participating States with formalised Collaborative Ground Segment agreements
- No restrictions in simultaneous downloads

Welcome to the Collaborative Data Hub

The Sentinels Collaborative Data Hub provides to its users a dedicated access to a Rolling Archive of user products.

The access to the Sentinels Collaborative Data Hub is restricted towards Collaborative Ground Segments. No self-registration is possible. A rolling policy for the retention of 1 month of the latest data is applied.

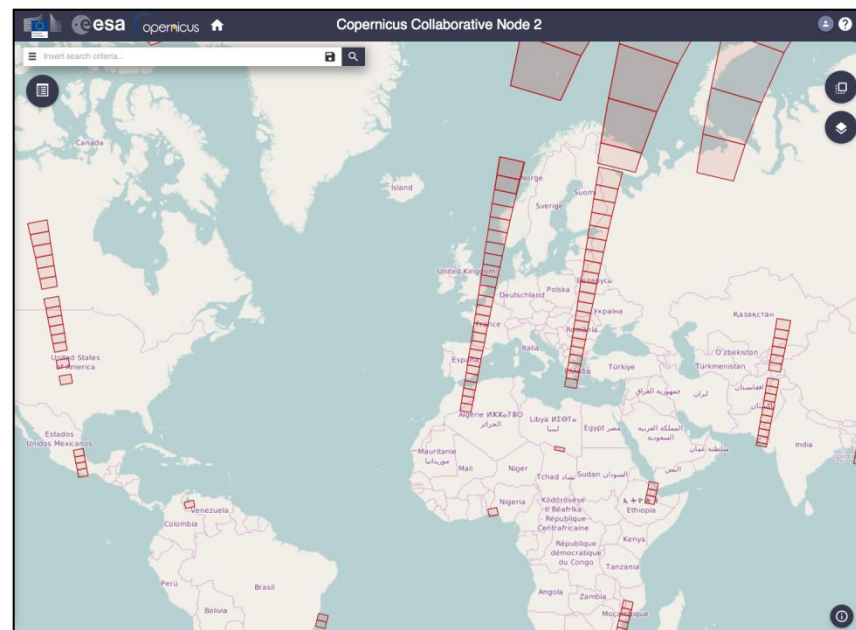
The qualified product sets are published for both the Near Real Time and Non Time Critical production following the In-Orbit Commissioning Review of each satellite.

**Access Points**

Access is provided through two data hub Nodes:

- **NODE 1** – Collections: *Sentinel-1\_NRT* and *Sentinel-1\_NTC*
- **NODE 2** – Collections: *Sentinel-2* and *Sentinel-1\_NRT*

Sentinel-1 NRT data is provided with redundancy through publication on both Nodes. Login credentials are the same for both Nodes.



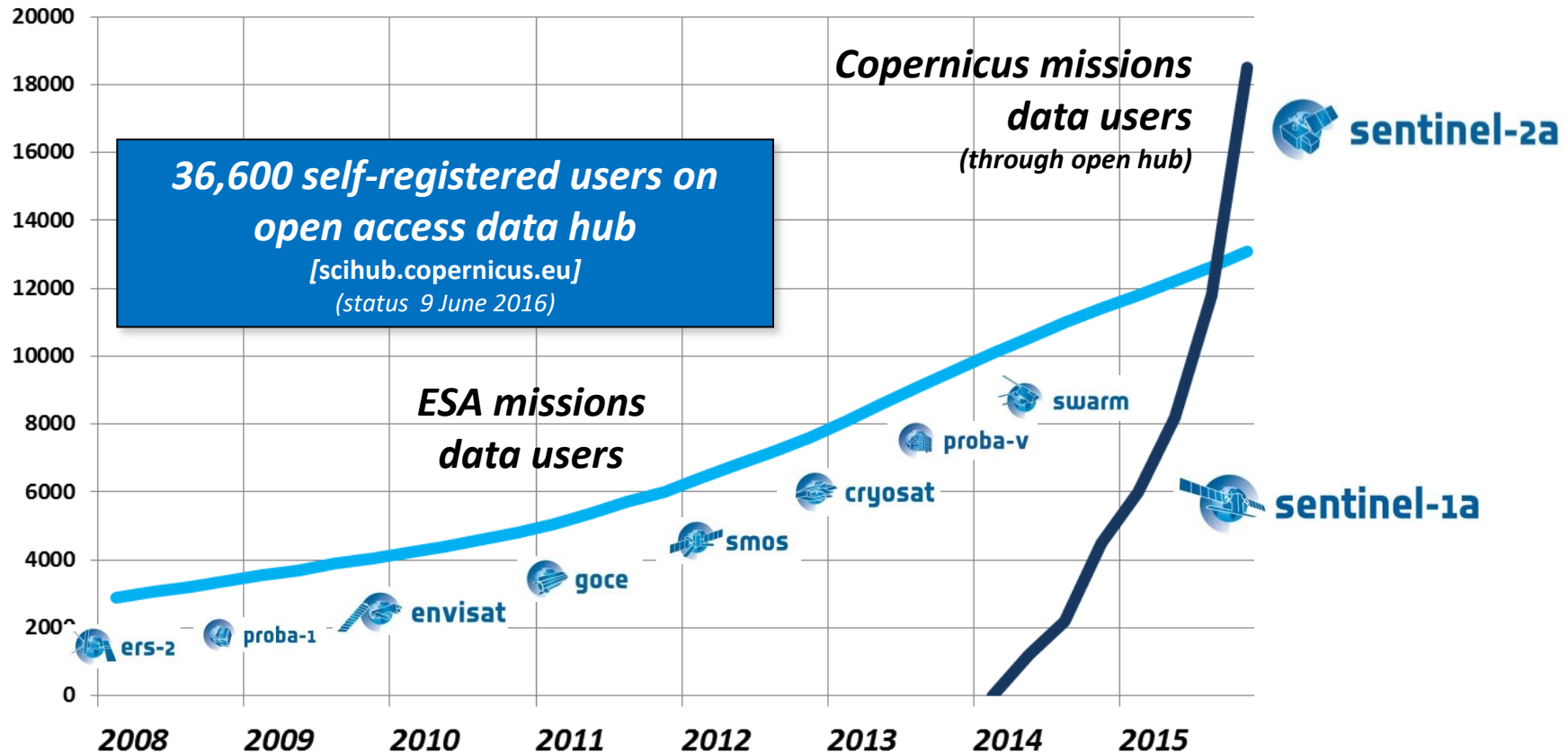


# Sentinel data

## Users registration on Open Access Data Hub

Number of  
registered users

A steady sharp increase of users  
as a consequence of Data Policy and Mission Operations Concept:  
*systematic observation, acquisition, processing and dissemination*



# Weekly Mission Status Reports published online

<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/mission-status>



## sentinel-1

→ RADAR VISION FOR COPERNICUS

### Mission Status Report 1

Reference Period: 3 April - 7 April 2014

#### Mission Status

- Sentinel-1A was successfully launched from Kourou on 3 April 2014, 21:02 UTC
- The Launch and Early Orbit Phase (LEOP) was successfully performed according to the planned timeline and declared closed on 6 April at 16:00 UTC
- The Commissioning Phase has started

#### Satellite

The LEOP covered the main following key activities:

- Deployments of the solar panels (including rotation) and of the Synthetic Aperture Radar (SAR) antenna
- Achievement of Satellite Nominal Mode and AOCS Nominal Pointing Mode
- Switch ON and initial checks of the spacecraft sub-systems
- First operations of the X-Band Transmitter and the SAR instrument (3 min of Wave mode)

In addition, a collision avoidance manoeuvre was performed on 5 April

#### Ground Segment

- The Flight Operations Segment performed nominal during the complete 3 days of LEOP
- First X-band data acquisition took place at the Matera ground station on 6 April, early morning
- First SAR instrument data acquisition was performed on 6 April. The related measurement was successfully processed at UK-PAC
- The FOS and the PDGS were declared ready to support the commissioning phase

#### Outlook

- Start of platform and payload commissioning activities
- First SAR acquisitions driven by the operational PDGS mission planning system are planned to start on 9 April, as part of the initial verification and calibration activities
- Start of orbit manoeuvre sequence to acquire the target reference orbit.

Report prepared by the ESA Sentinel-1 Team -



## sentinel-1

→ RADAR VISION FOR COPERNICUS

### Mission Status Report 57

Reference Period: 26 May 2015 – 1 June 2015

#### Mission status

- The Sentinel-1A operational qualification phase is on-going. The first yearly Routine Operations Review is planned on 9 June 2015
- The opening of the Sentinel-1 data flow to all users took place on 3<sup>rd</sup> October. Data can be accessed from: <https://sentinels.copernicus.eu>
- The implementation of the ramp-up observation scenario is on-going, including in particular the coverage of a first set of Copernicus Services areas of interest, of European land and coastal waters, of a set of global tectonic/volcanic areas, as well as of other specific targets worldwide for various applications. The observation plan is gradually complemented with observations outside the above areas to achieve a full mapping of all land areas worldwide (Antarctica excluded) before the end of the ramp-up phase. The dedicated campaign for Antarctica ice sheet monitoring has started and will run till early October 2015 indicatively. See an overview of the observation scenario at: <https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario>
- The detailed observation plan in the form of instrument acquisition segments is published on Sentinel Online at: <https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario/acquisition-segments>
- The use of Sentinel-1A data by the Copernicus Marine Environment Monitoring Service for sea-ice and iceberg monitoring activities is on-going
- Sentinel-1 products were used by authorities in Alaska for monitoring a major flood. More information at: <https://sentinel.esa.int/web/sentinel/missions/sentinel-1/news/article/sentinel-1-monitors-alaskan-flood>
- The Sentinel-1A spacecraft is in a stable state, operating in Nominal Mission Mode (NMM), with all sub-systems working on prime units. The Flight Operations Segment (FOS) ensuring the monitoring, control and commanding of the satellite is operating nominally. Orbit control manoeuvres are performed once a week typically
- A planned satellite unavailability took place on 28 May from 06:30 UTC to 13:30 UTC in order to perform an on-board maintenance activity. No SAR acquisitions were performed during this period
- The Sentinel-1A – Alphasat TDP-1 inter-orbit link characterisation phase is on-going
- X-Band data acquisitions are routinely performed over Matera, Svalbard and Maspalomas X-band core stations. The acquired data are circulated within the PDGS, systematically processed to Level-0 and Level-1 products and archived. Level-2 product operational qualification is on-going
- Operations are performed regularly at the Processing and Archiving Centres (DLR-PAC and UK-PAC). All other PDGS operational services (i.e. Mission Performance, Precise Orbit Determination, Wide Area Network) are operating nominally
- The areas where acquired data are systematically processed to Level-1 SLC products are gradually being extended. The SLC production scenario description has been updated and can be consulted at: <https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/production-scenario>
- By 28 May, a total of 7461 users have self-registered; 1,071,399 product download have been made by users, corresponding to 1.31 PB of data. At the time of publishing this report, about 145,000 products are available on-line for download
- The overall operations mission performance is nominal

#### Outlook

- Continuation of ramp-up mission operations

Report prepared by the ESA Sentinel-1 Team -





# Copernicus Open Access Hub | <https://scihub.copernicus.eu>

**Welcome to the Copernicus Open Access Hub**

The Copernicus Open Access Hub (previously known as Sentinels Scientific Data Hub) provides complete, free and open access to Sentinel-1, Sentinel-2, Sentinel-3 and Sentinel-5P user products, starting from the In-Orbit Commissioning Review (IOCR).

Sentinel Data are also available via the Copernicus Data and Information Access Services (DIAS) through several platforms.

Please visit our [User Guide](#) for getting started with the Data Hub Interface. Discover how to use the APIs and create scripts for automatic search and download of Sentinels' data.

Latest update: see the section on [Long Term Archive](#) for the upgrade of the interfaces for access to offline data.

For further details or requests of support please send an e-mail to [eosupport@copernicus.esa.int](mailto:eosupport@copernicus.esa.int)

**Reports & Stats**

Data updated hourly

37,862  
prod. published in the last 24h  
(S1 - S2 - S3 - S5P)

138,096  
downloads in the last 24h  
(SciHub - API Hub - S-3 PreOps - S-5P PreOps)

**Resources**

- DHUS Open Source Portal
- Copernicus Portal
- Sentinel Online

**Latest News**

**Copernicus Data Hub Web Portals maintenance: 13 June 2019, 13:00 UTC** 12 Jun 2019

Users are informed that the Copernicus data hub web portals will be unavailable on 13 June 2019 from 13:00 UTC to 14:00 UTC. A maintenance activity on the servers hosting the websites will make the user guides and the news page inaccessible for about one hour. The affected web portals are:

**Copernicus Open Access Hub | <https://scihub.copernicus.eu>**

The screenshot displays the Copernicus Open Access Hub interface. On the right, a map of Southeast Asia shows SAR data overlays in red and orange, indicating areas of interest. On the left, a sidebar lists search results for Sentinel-1 SAR-C data. The list includes product IDs, download URLs, mission details, and file sizes. The interface also features a search bar at the top and a navigation menu on the far left.

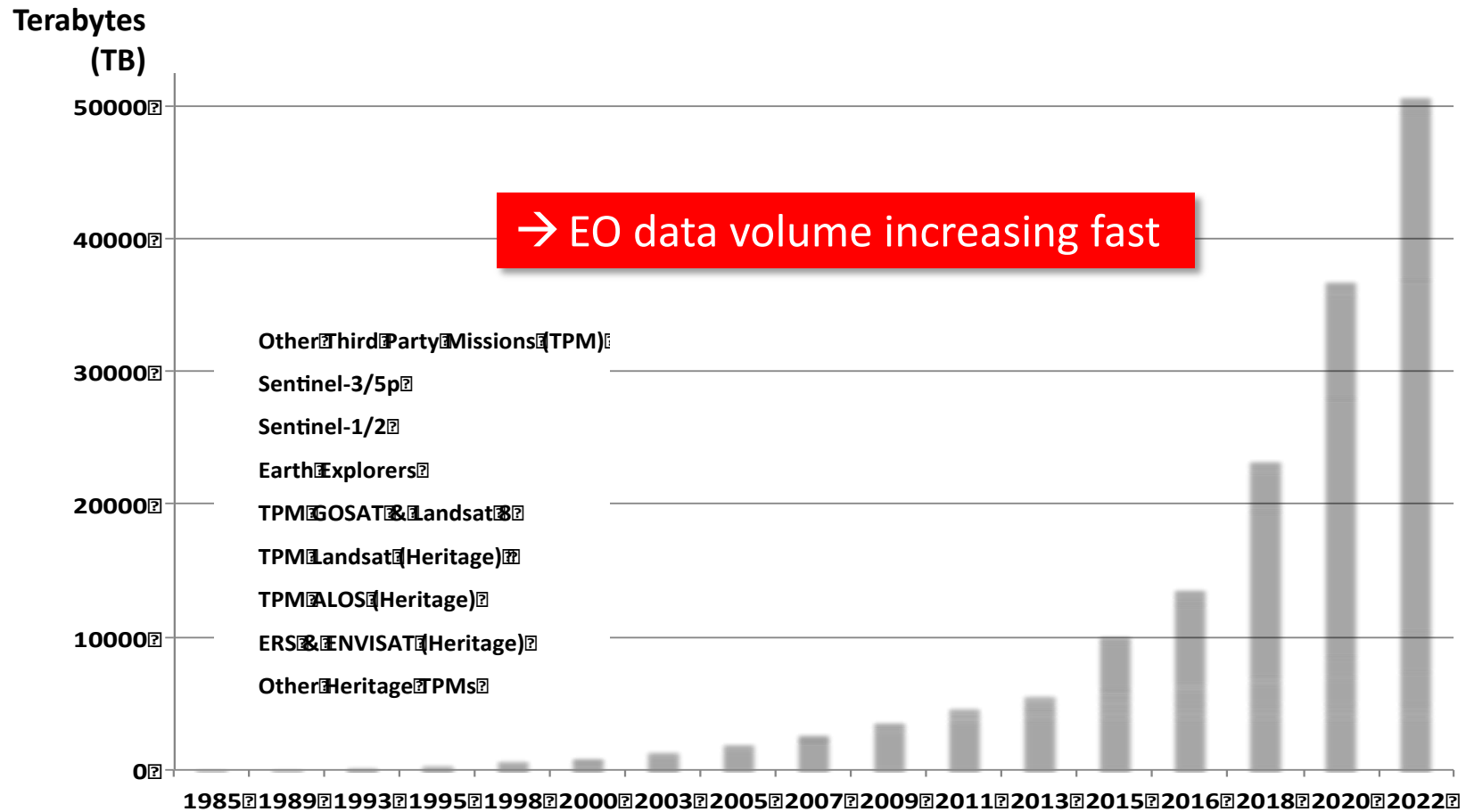
**Search Results:**

Product ID	Download URL	Mission	Instrument	Sensing Date	Size
S1A_IW_SLC__1SDV_20190612T111442_20190612T111512_027645_031ED2_8493	<a href="https://scihub.copernicus.eu/data/v1/Products/e288a20d-1d19-4da1-b539-3abd2b780366">https://scihub.copernicus.eu/data/v1/Products/e288a20d-1d19-4da1-b539-3abd2b780366</a>	Sentinel-1	SAR-C	2019-06-12T11:14:42.561Z	8.03 GB
S1A_IW_SLC__1SDV_20190612T111510_20190612T111538_027645_031ED2_D841	<a href="https://scihub.copernicus.eu/data/v1/Products/ed98c48b-9291-42c3-a531-162e38379bc1">https://scihub.copernicus.eu/data/v1/Products/ed98c48b-9291-42c3-a531-162e38379bc1</a>	Sentinel-1	SAR-C	2019-06-12T11:15:10.138Z	7.46 GB
S1A_IW_SLC__1SDV_20190612T111535_20190612T111602_027645_031ED2_449B	<a href="https://scihub.copernicus.eu/data/v1/Products/35f9c9aa-387-46e1-8403-e670d88c4344">https://scihub.copernicus.eu/data/v1/Products/35f9c9aa-387-46e1-8403-e670d88c4344</a>	Sentinel-1	SAR-C	2019-06-12T11:15:35.915Z	7.22 GB
S1A_IW_SLC__1SDV_20190608T223346_20190608T223414_027594_031D34_9C4E	<a href="https://scihub.copernicus.eu/data/v1/Products/239ae083-2db7-4226-b3e4-57ed091d7afb">https://scihub.copernicus.eu/data/v1/Products/239ae083-2db7-4226-b3e4-57ed091d7afb</a>	Sentinel-1	SAR-C	2019-06-08T22:33:46.286Z	7.31 GB
S1A_IW_SLC__1SDV_20190608T223320_20190608T223348_027594_031D34_FA68	<a href="https://scihub.copernicus.eu/data/v1/Products/743e2962-e251-4747-b4f5-6f339b21923b">https://scihub.copernicus.eu/data/v1/Products/743e2962-e251-4747-b4f5-6f339b21923b</a>	Sentinel-1	SAR-C	2019-06-08T22:33:20.503Z	7.32 GB
S1A_IW_SLC__1SDV_20190607T110650_20190607T110717_027572_031C93_B8F5	<a href="https://scihub.copernicus.eu/data/v1/Products/ef24a973-ed1d-4441-bff5-e343bded0146b">https://scihub.copernicus.eu/data/v1/Products/ef24a973-ed1d-4441-bff5-e343bded0146b</a>	Sentinel-1	SAR-C	2019-06-07T11:06:50.067Z	7.19 GB



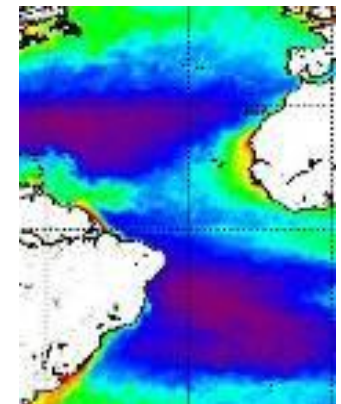
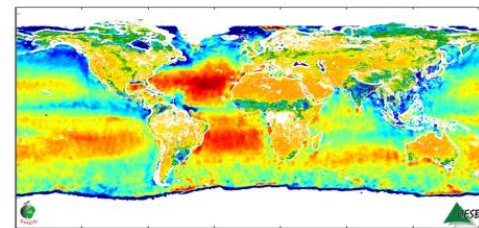
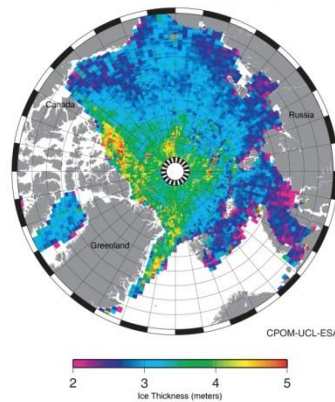
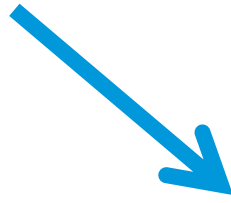
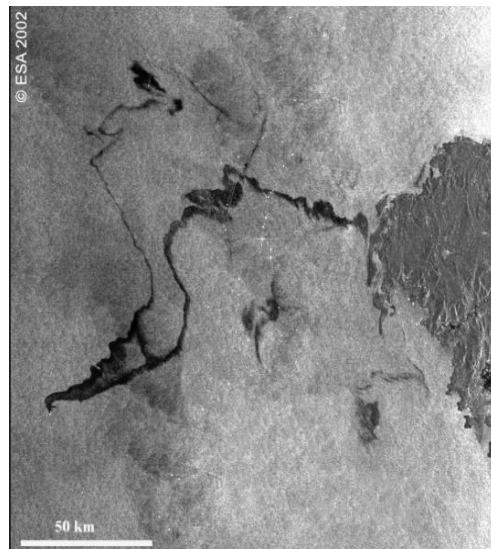
# Big Data

→ *increasing volume of EO data*



# Big Data - Increasing diversity of EO data

## Increasing diversity of usage of EO data





We are at the **golden era of EO** with numerous missions providing imagery for several application domains, including the Copernicus Sentinels with the open and free data policy.

Ever **increasing volume and diversity of data** impose innovative concepts for both data storage and processing capacity, currently addressed by cloud-based platform solutions.

Apart from pure technical developments, value adding and generation of **Analysis Ready Data (ARD)** within an **interoperable ecosystem** are crucial steps to properly address modern community needs.

[www.esa.int](http://www.esa.int)