

10TH ADVANCED TRAINING COURSE ON LAND REMOTE SENSING



Sentinel-1 Mission Status

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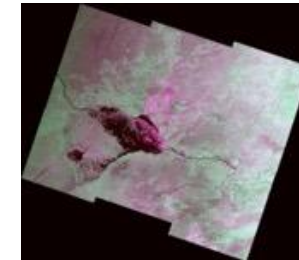
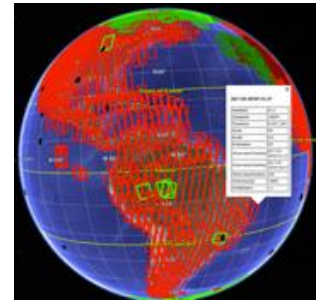
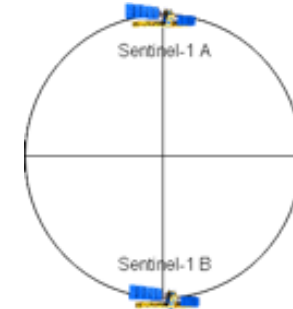
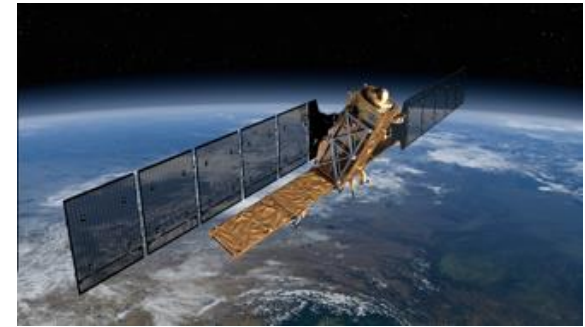
→ RADAR VISION FOR COPERNICUS



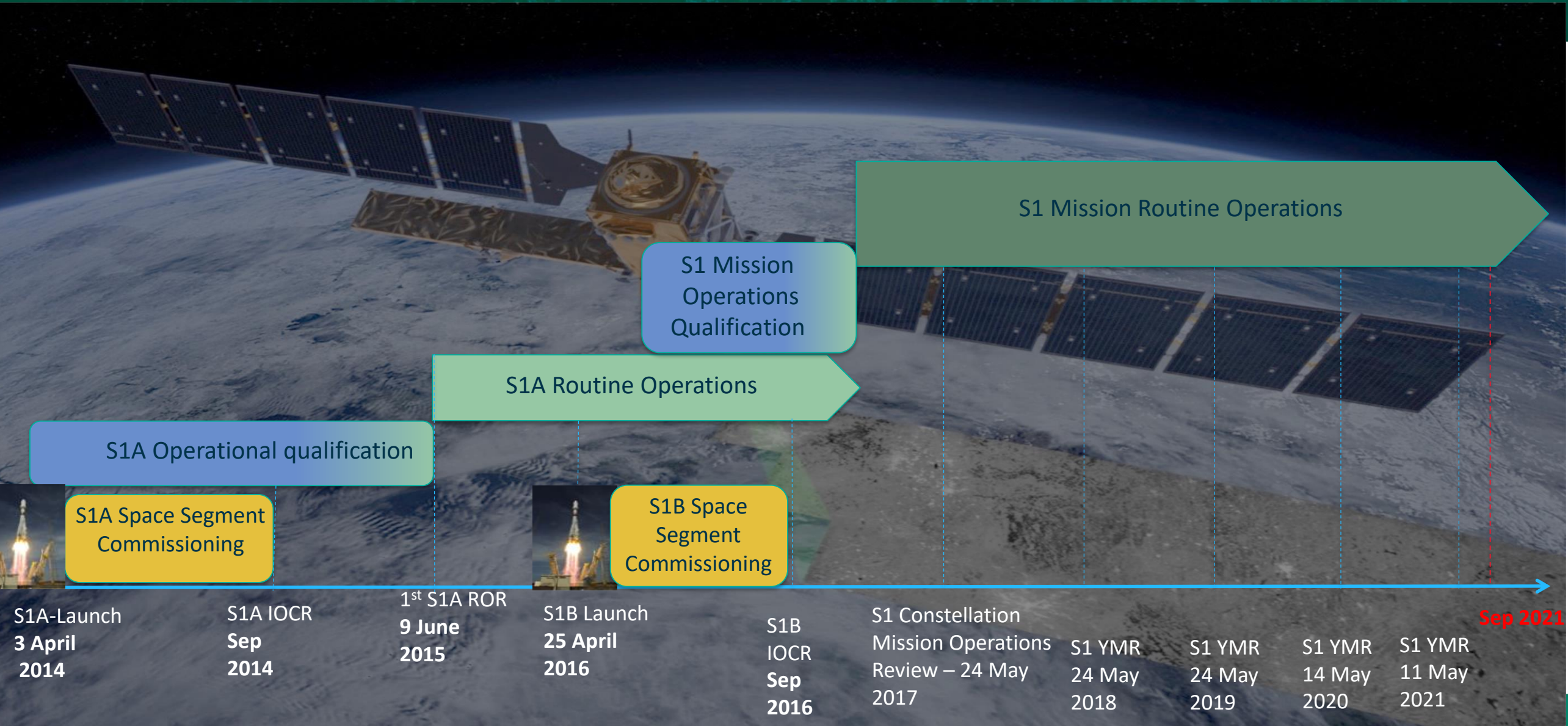
→ THE EUROPEAN SPACE AGENCY

Sentinel-1 Constellation Mission Facts

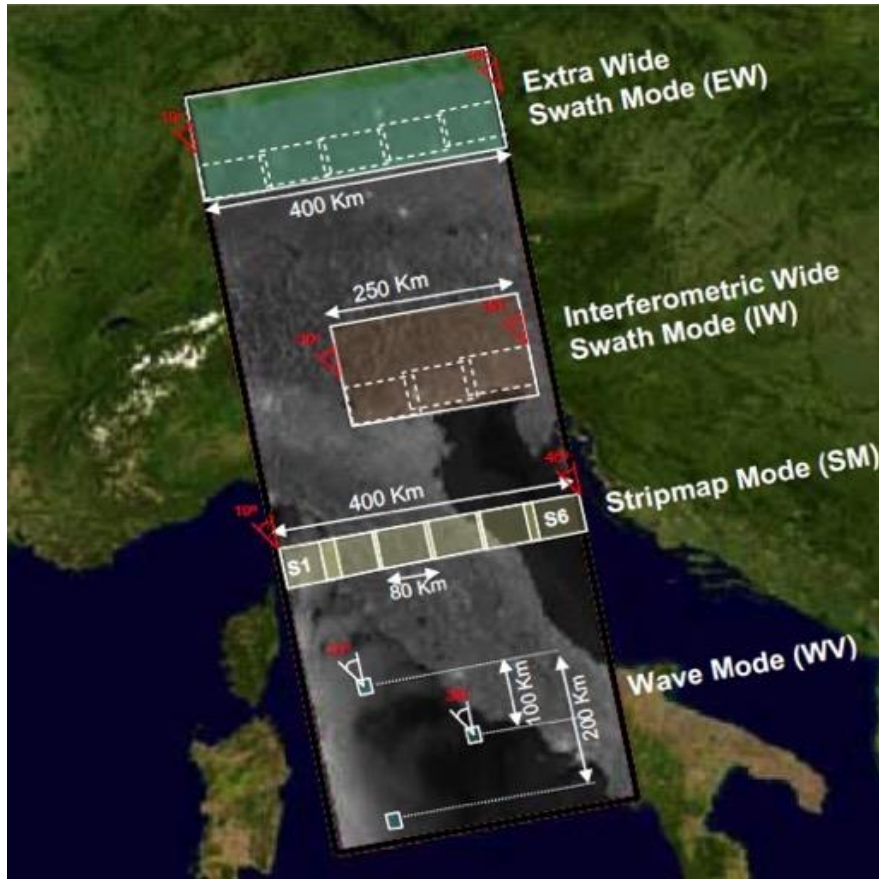
- Constellation of two identical SAR C-band (5.405 GHz) satellites (A & B units)
- Sentinel-1A launched on 3 April, 2014 & Sentinel-1B on 25 April, 2016
- Near-Polar, sun-synchronous (dawn-dusk) orbit at 698 km
- Instrument duty cycle of max. 25 min/orbit in High Bit Rate modes (30 min outside eclipse) and 75 min/orbit in Low Bit Rate mode (Wave)
- 12-day repeat cycle (each satellite), 6 days for the constellation
- Systematic SAR data acquisition using a predefined observation scenario
- 7 years lifetime, consumables for 12 years at least
- Operational use of the European Data Relay System (EDRS) service



Sentinel-1 Mission Phases



SAR operational modes and related GRD level 1 products



EW

IW

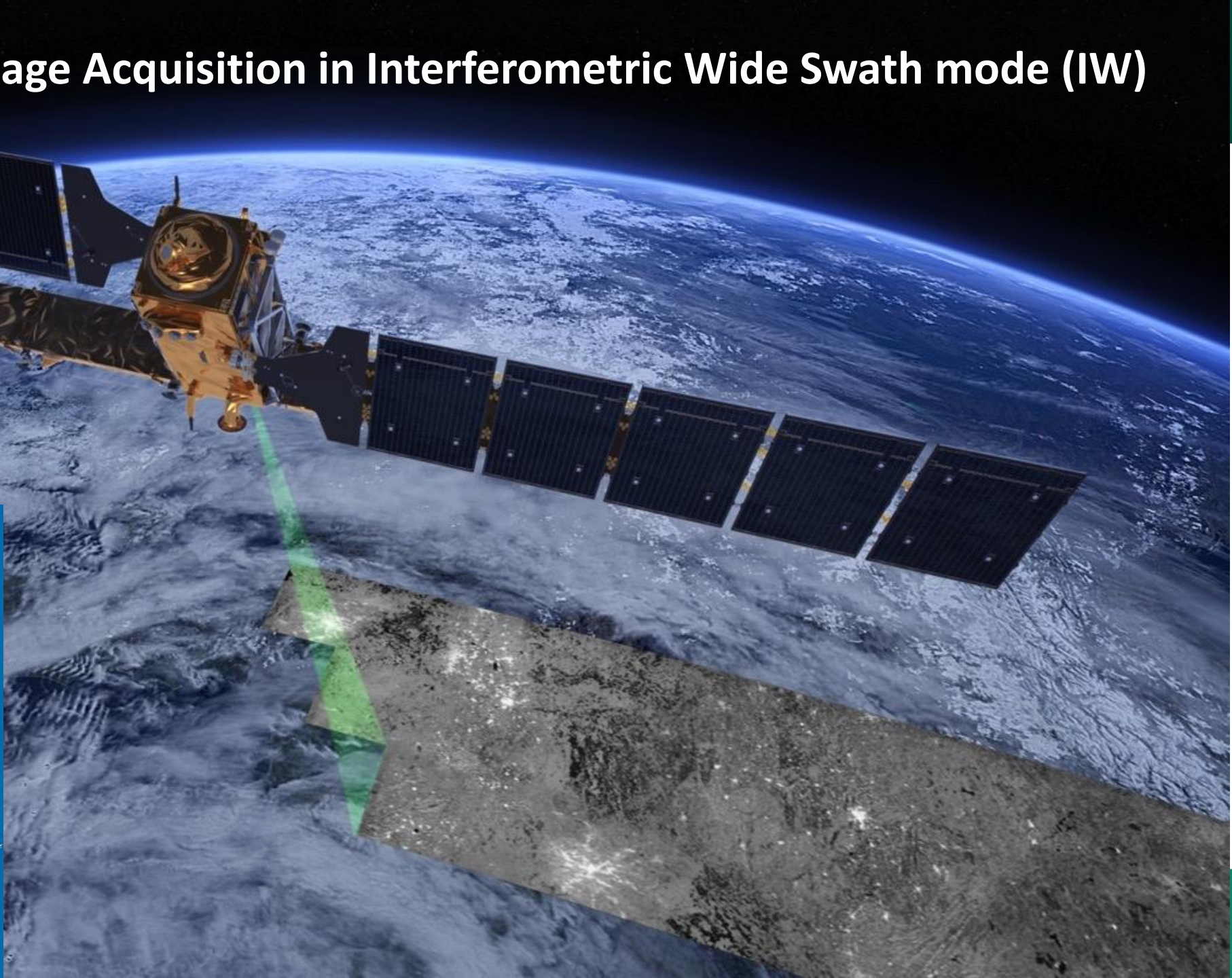
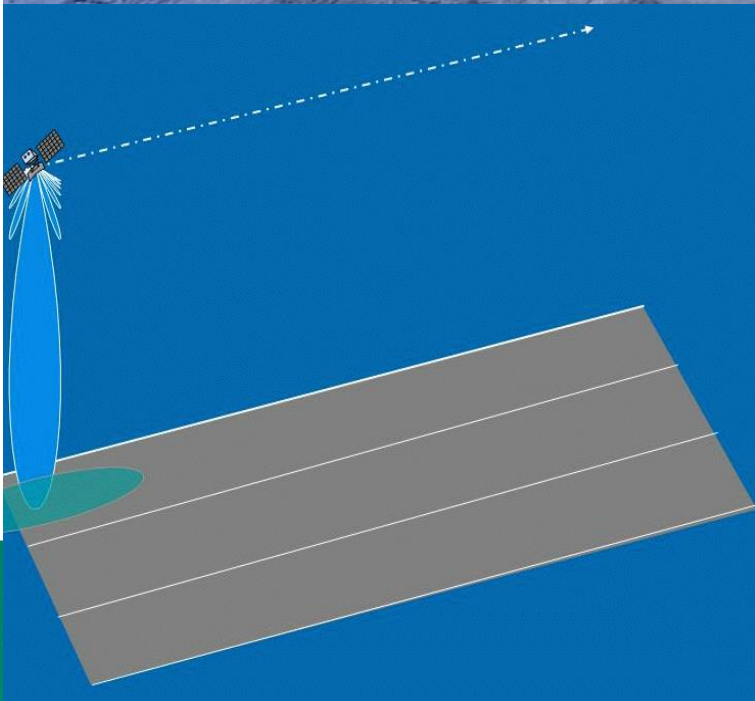
SM

WV

GRD Level 1 product resolution	Swath Width	Polarisation
50m (3 ENL)	> 400 km	HH+HV or VV+VH
20m (5 ENL)	> 250 km	HH+HV or VV+VH
9m (4 ENL)	> 80 km	HH+HV or VV+VH
50m (140 ENL)	20 x 20 km ² at 100 km spacing	HH or VV

Image Acquisition in Interferometric Wide Swath mode (IW)

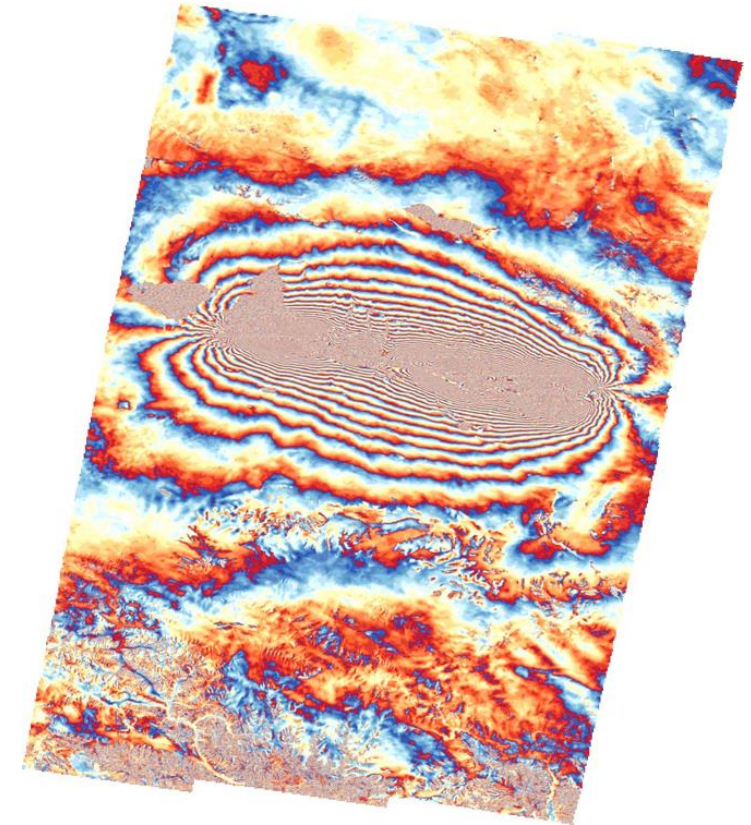
**Terrain Observation
by Progressive Scans
(TOPS)**



Sentinel-1 Mission Status in short

- The Sentinel-1 mission is overall in an excellent status
- Sentinel-1A in orbit since 7 years, Sentinel-1B since 5 years
- Despite the critical situation in Europe due to the COVID-19 crisis, important efforts have been and are still being made to ensure the continuity of the S1 mission operations, which remain nominal
- Routine provision of Sentinel-1 data to operational services and users worldwide
- User / product statistics:
 - 520,000 users have registered on the Open Access Data Hub (all Sentinels)
 - 36 million S1 product download (44 PB of data)
 - 7 million S1 products available (11 PB of data)
- Sentinel-1 contribution to emergency activations continues to be very high
- Sentinel-1 is operated close to its full mission capacity (i.e. difficulty to accommodate additional observations)

Mw7.4 earthquake, Southern Qinghai, China, 21 May 2021
Descending pass interferogram



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Sentinel-1 Constellation Observation Scenario: Mode - Polarisation - Observation Geometry

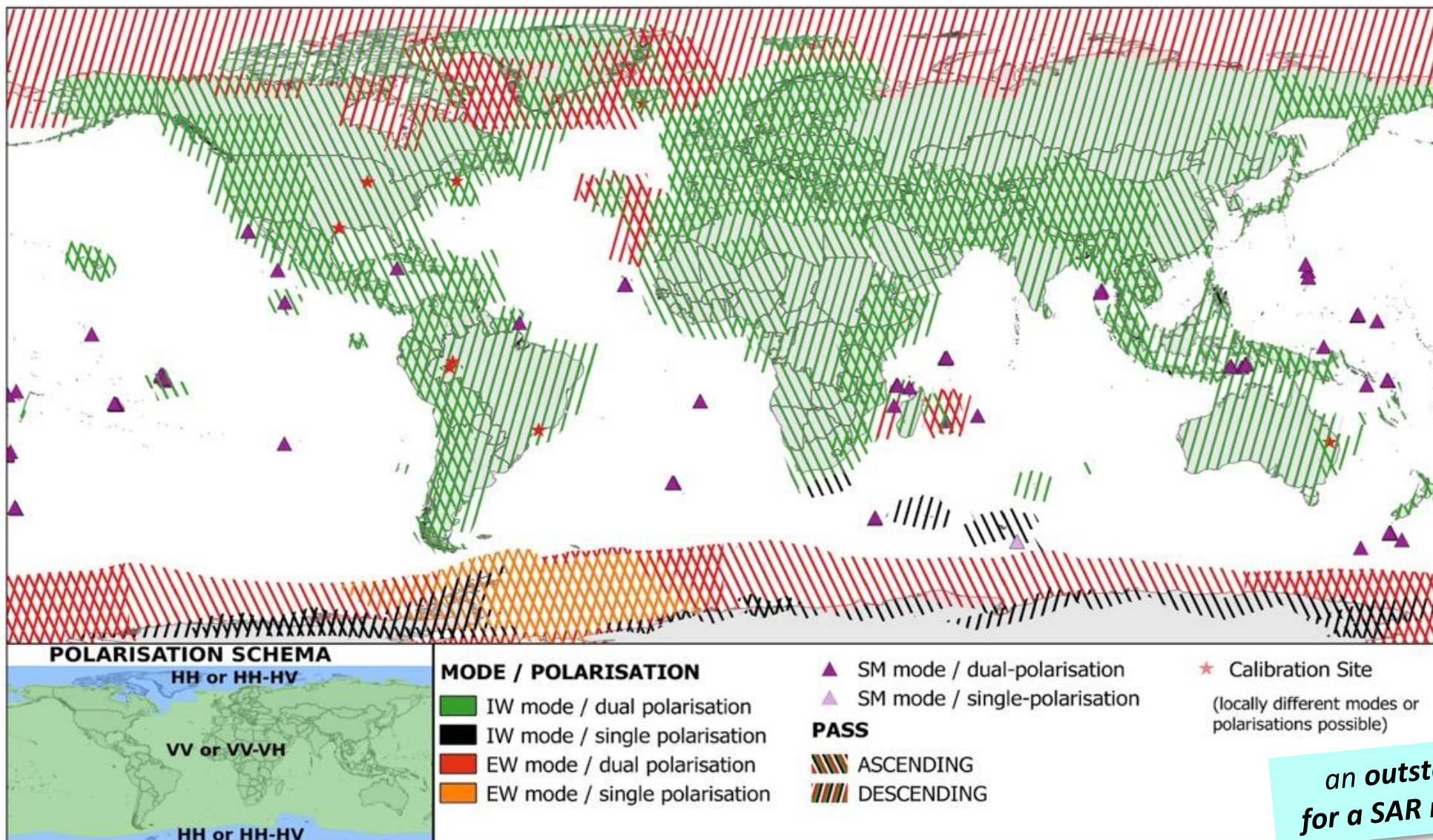


validity start: 05/2019



Starting
May 2019,
no major
changes since
then...

This map is
related to SAR
High Rate
modes only.
Wave mode
operated by
default over
open oceans
(not shown)



*an outstanding coverage achievement
for a SAR mission, predictable and reliable!*



Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency

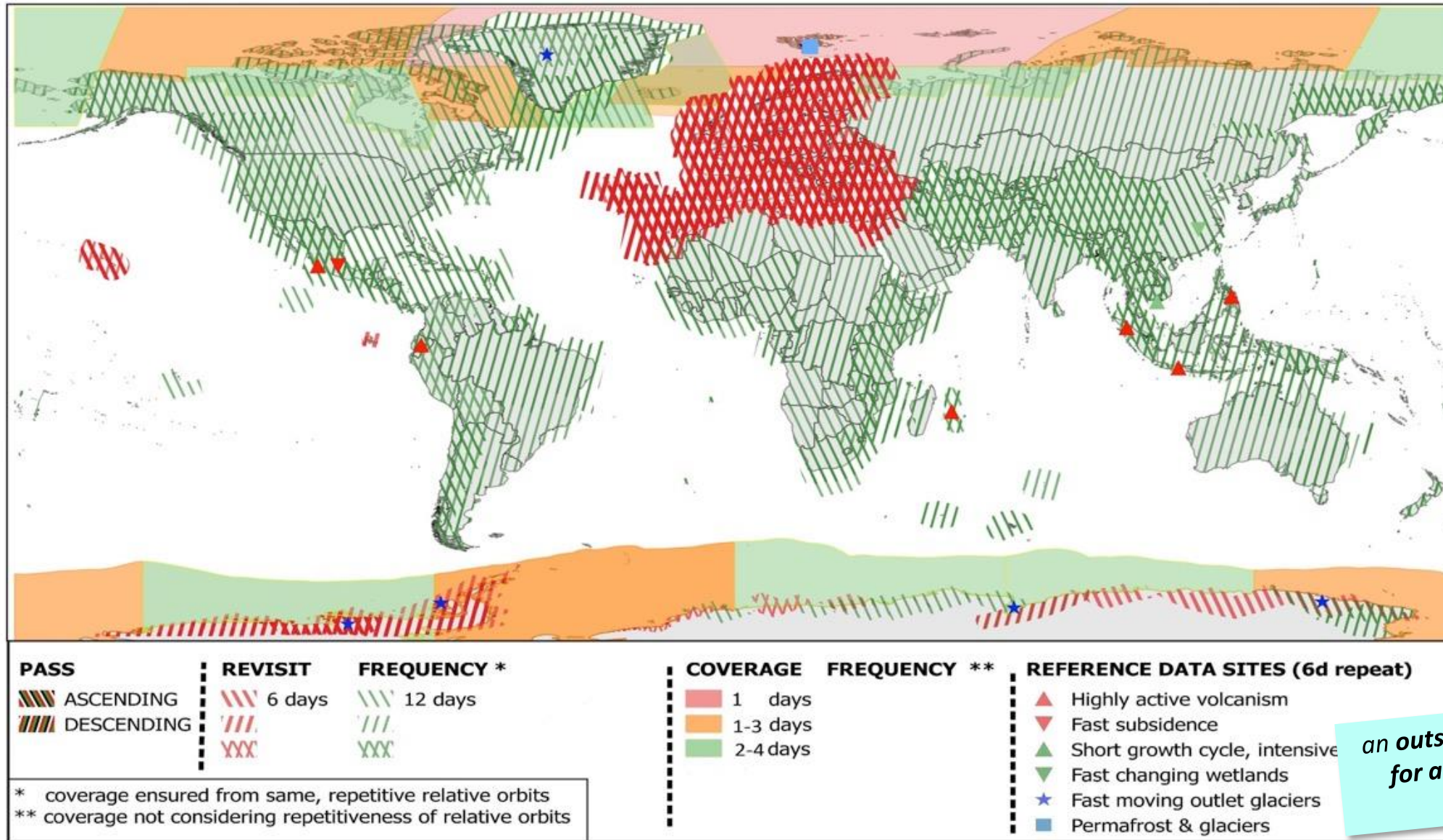


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Starting
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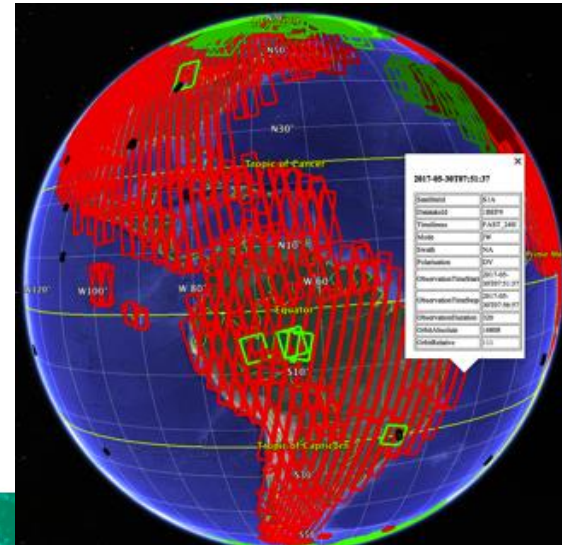
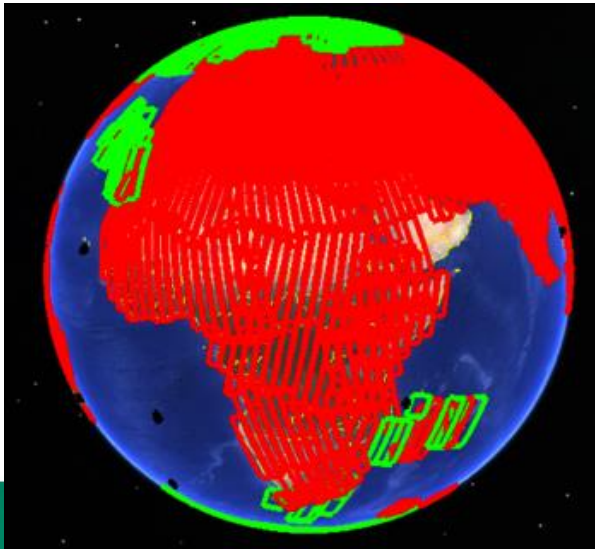
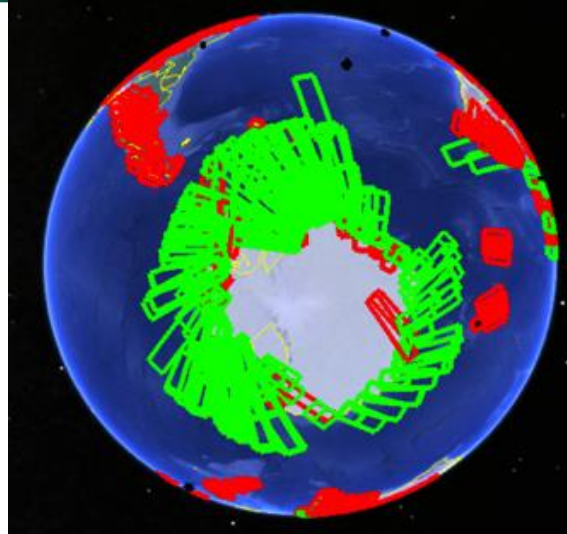
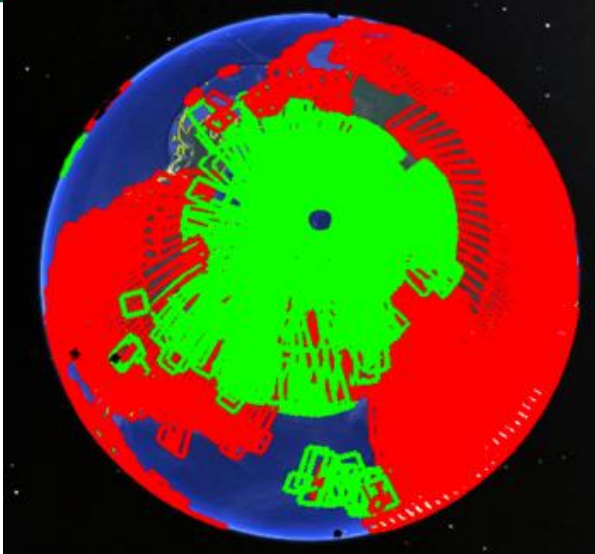
This map is
related to SAR
High Rate
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Wave mode
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Sentinel-1 observation scenario: detailed acquisitions

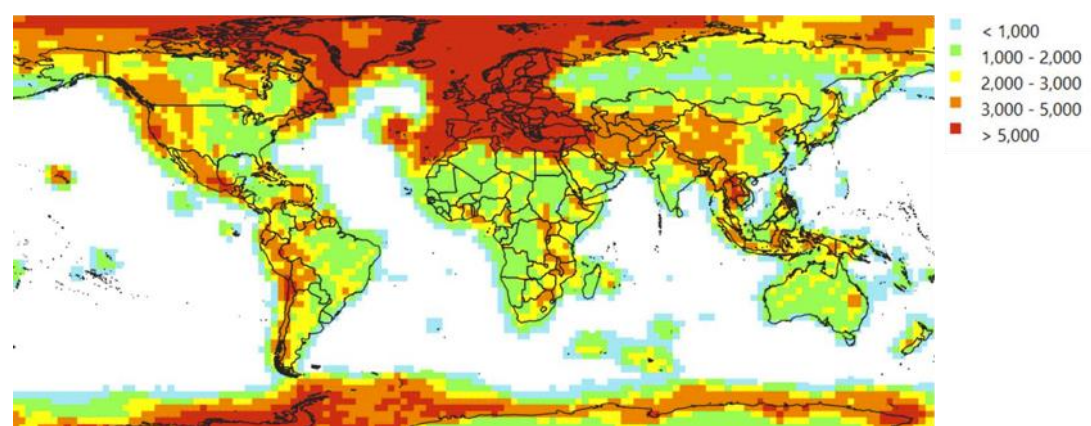


KML files providing detailed information on the planned acquisitions, regularly published on Sentinel Online

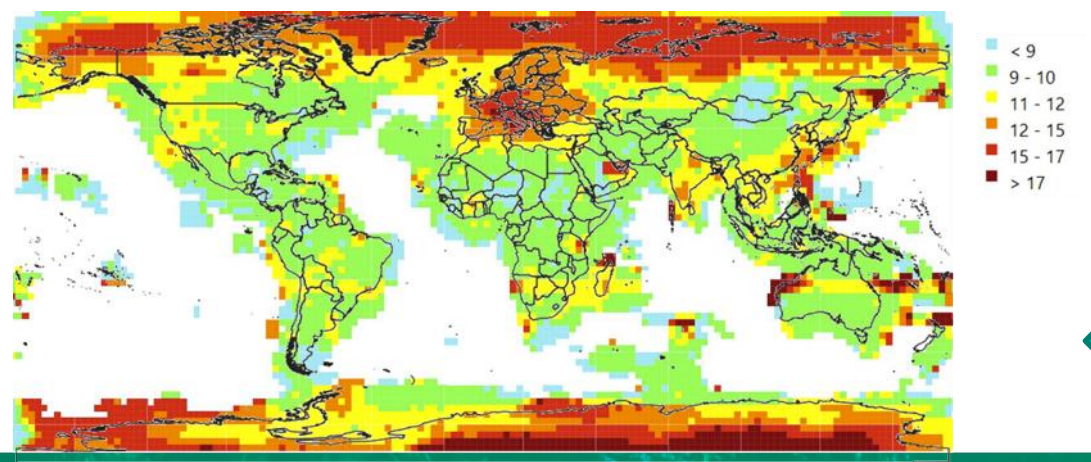
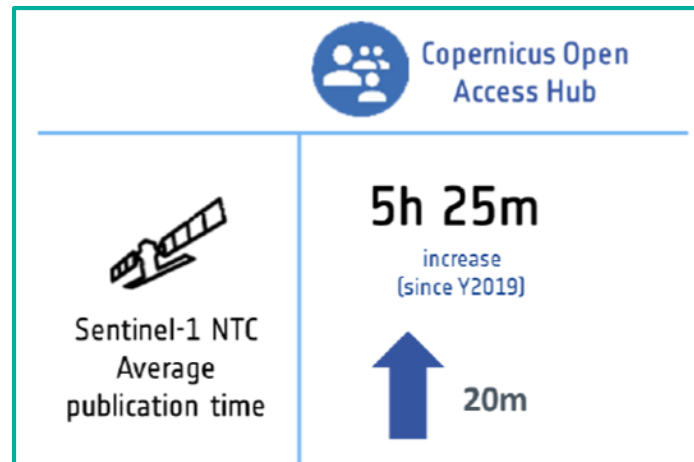
<https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario/acquisition-segments>

Sentinel Data Access 2020 Report

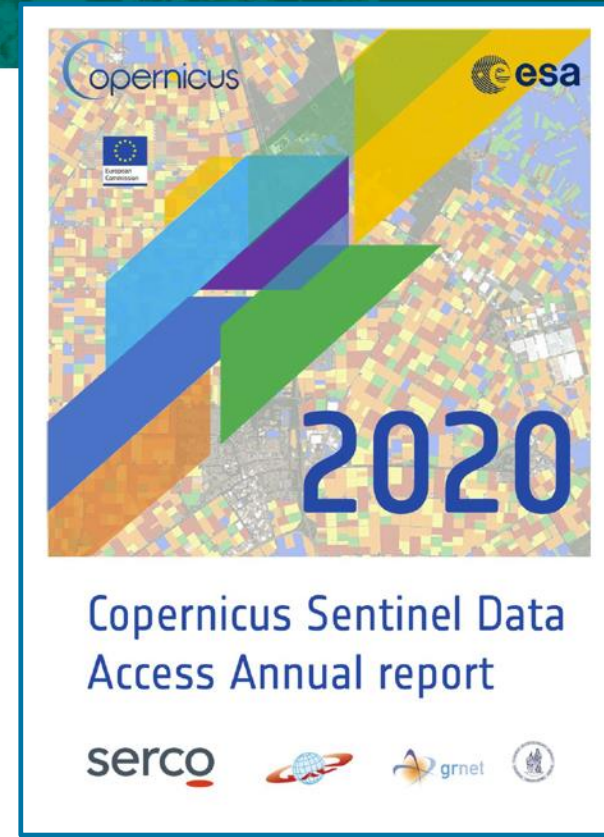
Examples of Sentinel-1 data product / user statistics



Heatmap of Sentinel-1 products (excluding OCN) published since the start of operations till end 2020



Heatmap showing the archive exploitation ratio for Sentinel-1 L0 and L1 NTC products (excluding WV mode) during Y2020



<https://scihub.copernicus.eu/reportsandstats/>



Product publication timeliness during the last month (August 2021)

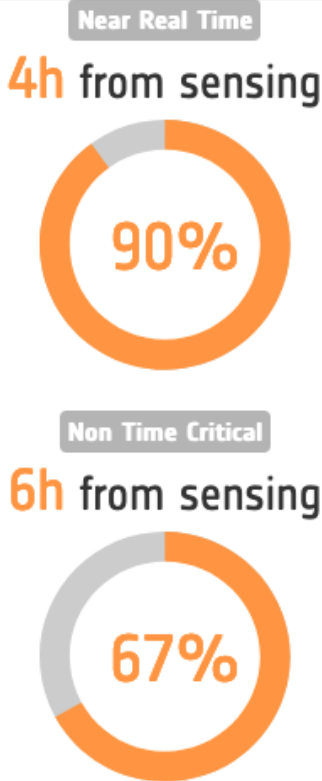
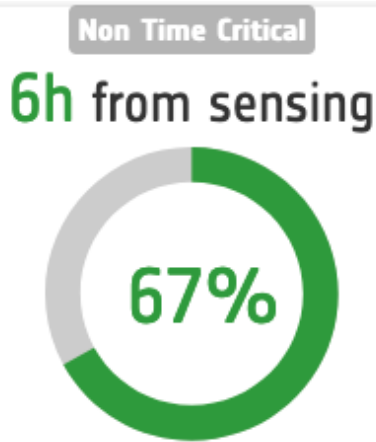
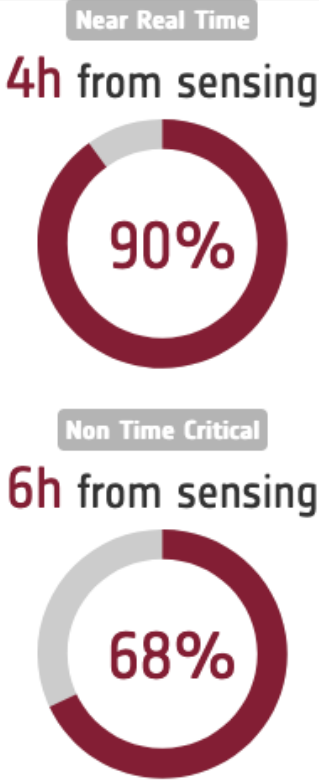
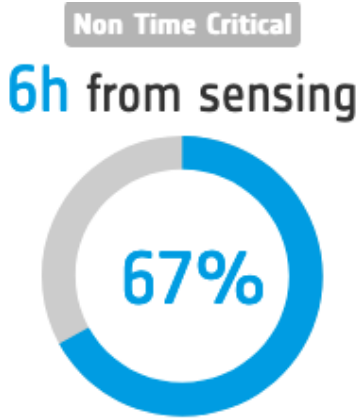


Copernicus Open Access Hub

Collaborative Hub

International Hub

Copernicus Services Hub

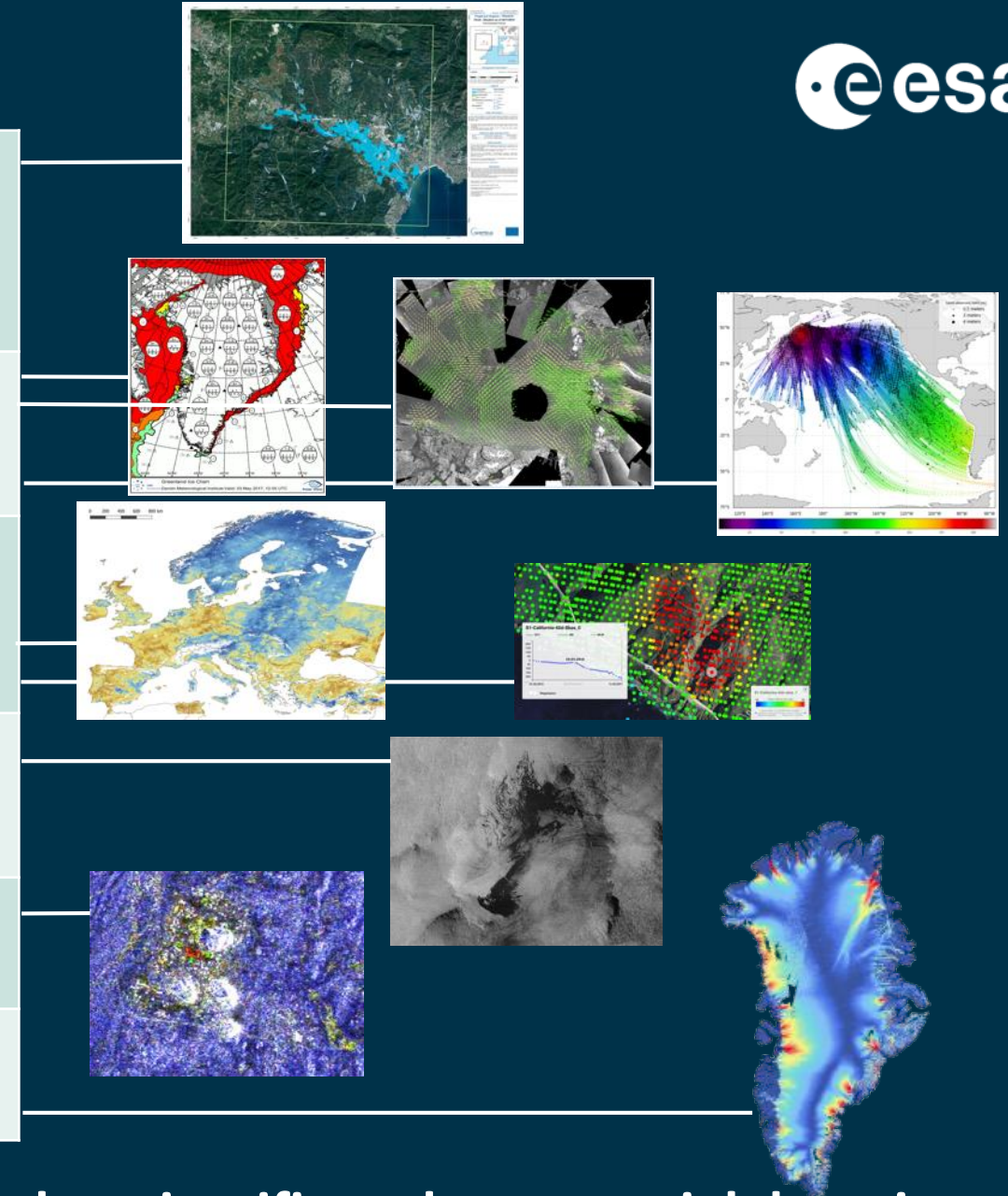


Source: <https://dashboard.copernicus.eu/>

Sentinel-1 used in most Copernicus services...



CEMS Copernicus Emergency Management Service	<ul style="list-style-type: none"> - Emergency response to rapid mapping (flood mainly) - Risk recovery (e.g. ground deformation) - Validation (e.g. floods, landslides) - Automated global flood monitoring (in development)
CMEMS Copernicus Marine Environment Monitoring Service	<ul style="list-style-type: none"> - Sea-ice (incl. charting, concentration, thickness, drift) - Icebergs concentration - Wave / swell
CLMS – Pan-European & Global Copernicus Land Monitoring Service Global Land Ground Motion Service	<ul style="list-style-type: none"> - HRLs: Wetness and Water, Imperviousness, Tree cover & Forest, Grassland, Snow, River/Lake ice - Global: Soil moisture - European ground motion (in development)
CSS – CMS Copernicus Security Service Copernicus Maritime Surveillance Service European Maritime Safety Agency / CleanSeaNet	<ul style="list-style-type: none"> - Oil spill detection and polluter identification (CleanSeaNet) - Maritime surveillance (e.g. ship detection, search and rescue, anti-piracy)
CSS – SEA Copernicus Security Service Support to External Action	<ul style="list-style-type: none"> - Change detection - Feature identification
C3S Copernicus Climate Change Service	<ul style="list-style-type: none"> - Ice sheets & ice shelves - Ice velocity - Glaciers



... as well as in national services, and the scientific and commercial domain



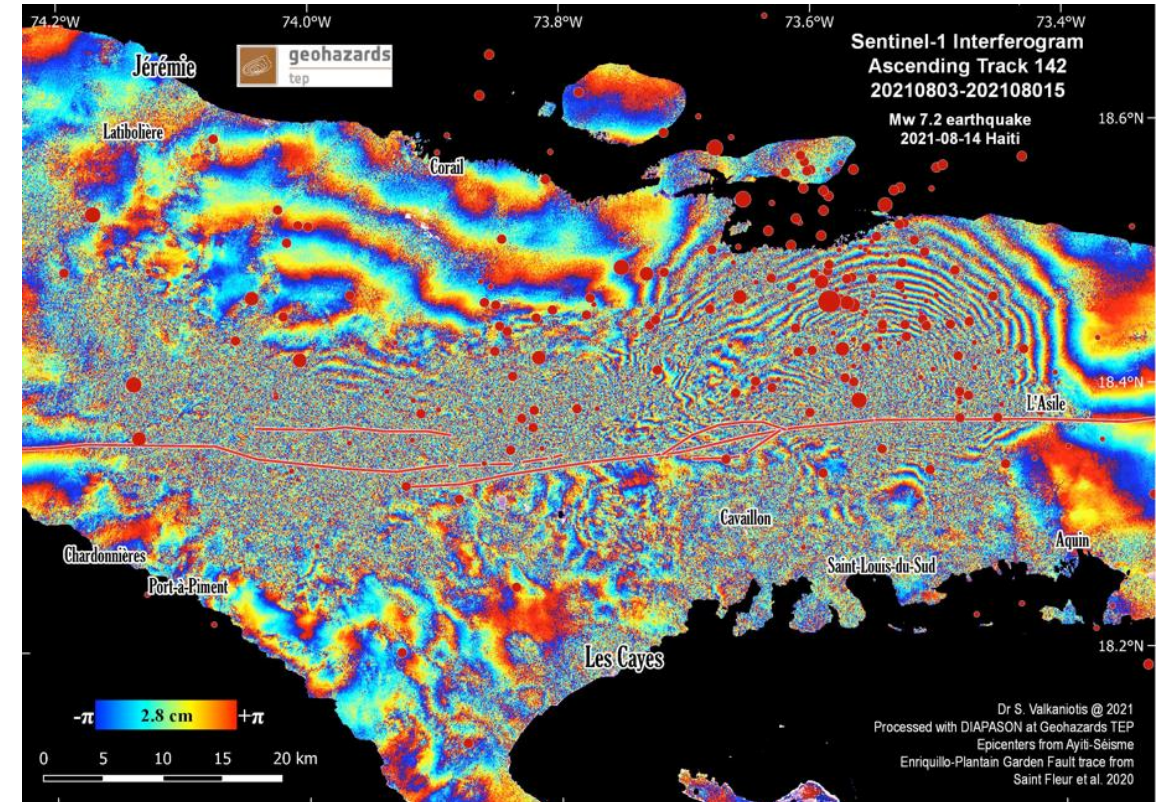
Examples of recent applications

Major floods in Germany and Belgium in July 2021
Example of flood map based on a Sentinel-1 images acquired on
15 and 16 July, area of Bonn

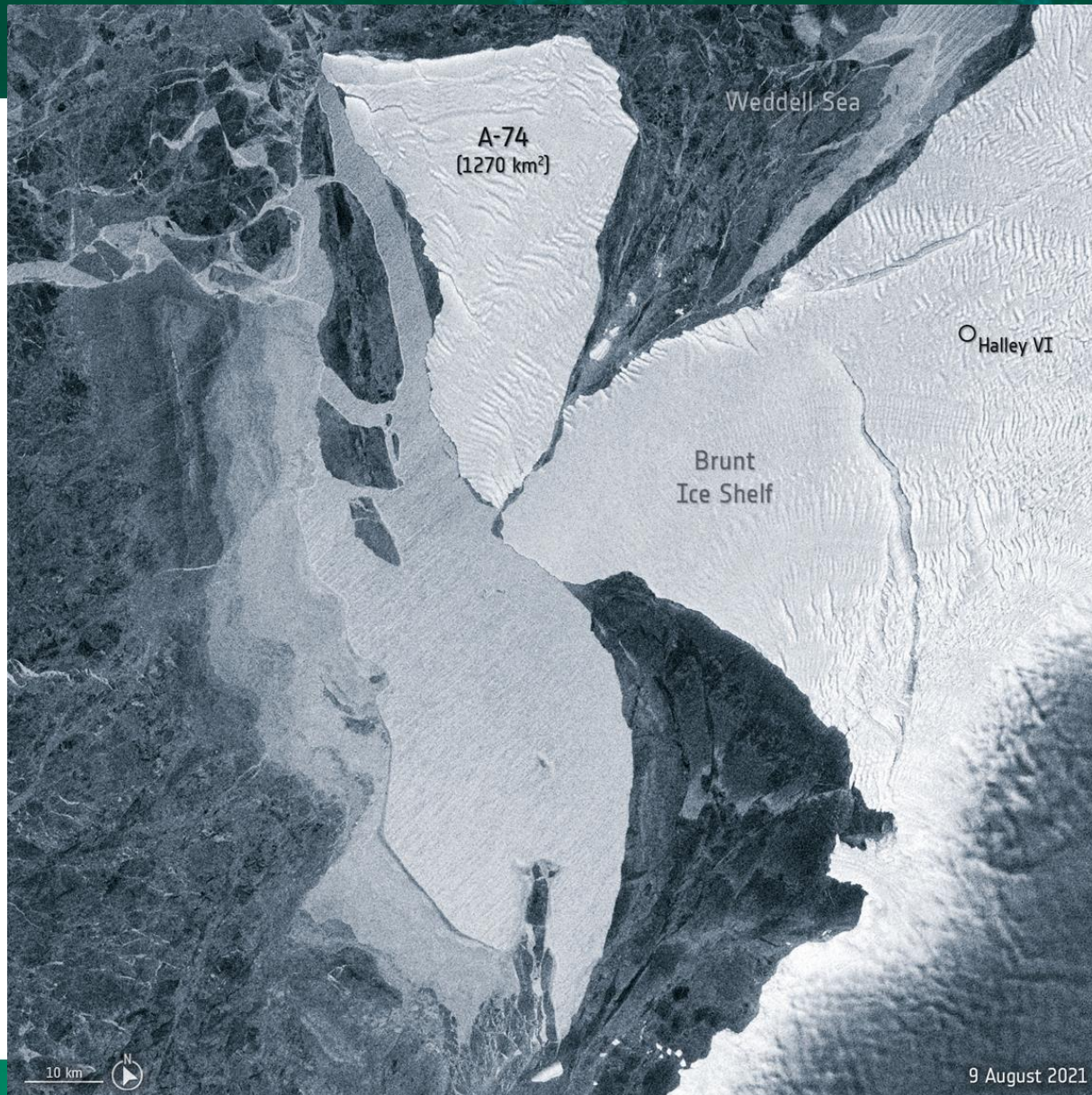


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 Copernicus Emergency Management Service / processed by SERTIT

M7.2 earthquake in Haiti, 14 August 2021
Rupture follows the sinistral Enriquillo-Plantain
Garden Fault for ~ 70-80km



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 processed by S. Valkaniotis with DIAPASON at Geohazards TEP



A-74 iceberg near collision with Brunt Ice Shelf

Iceberg A-74, approximately 1.5 times the size of Greater Paris, calved from Antarctica's Brunt Ice Shelf earlier this year. Over the last six months, it has remained close to the shelf it broke away from owing largely to ocean currents. In early August, strong easterly winds have spun the iceberg around the western tip of Brunt, brushing slightly against the ice shelf before continuing southwards. Radar images, captured by the Copernicus Sentinel-1 mission, show the movement of the 1270 sq km berg from 9 until 18 August.

Details at:

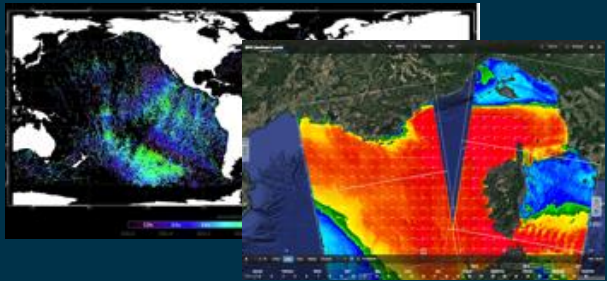
https://www.esa.int/ESA_Multimedia/Images/2021/08/A-74_iceberg_near_collision_with_Brunt_Ice_Shelf

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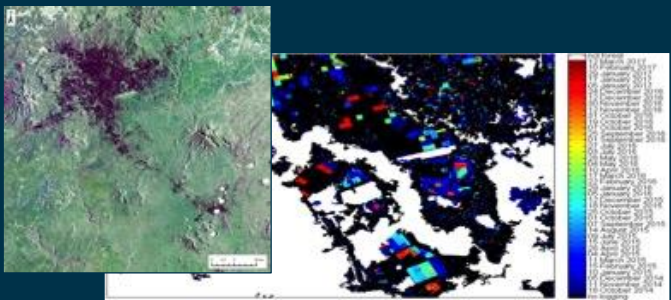
Sentinel-1 applications → ever increasing



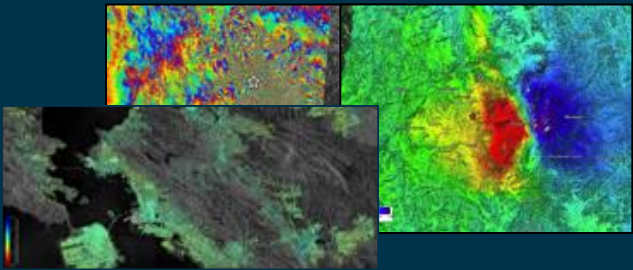
Maritime surveillance: oil spill monitoring, ship detection, illegal fisheries, etc.



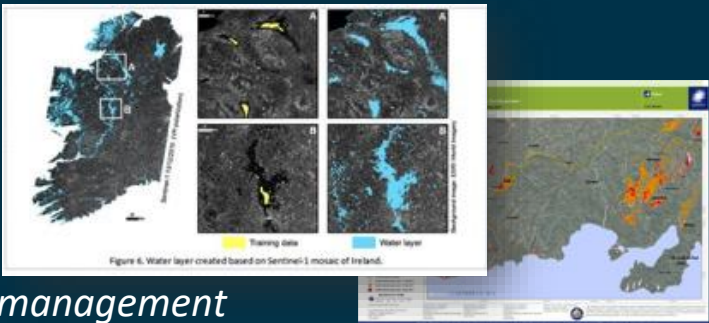
Sea state: wind, wave



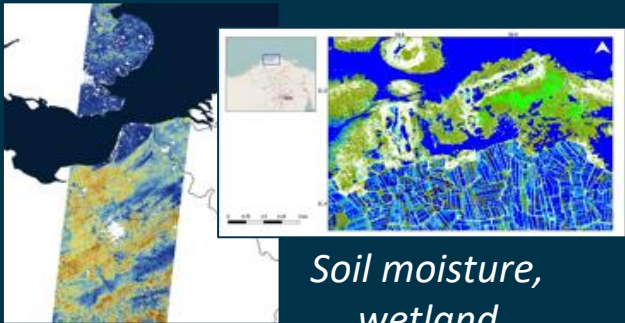
Land use, agriculture, forestry, logging, land classification, urban planning



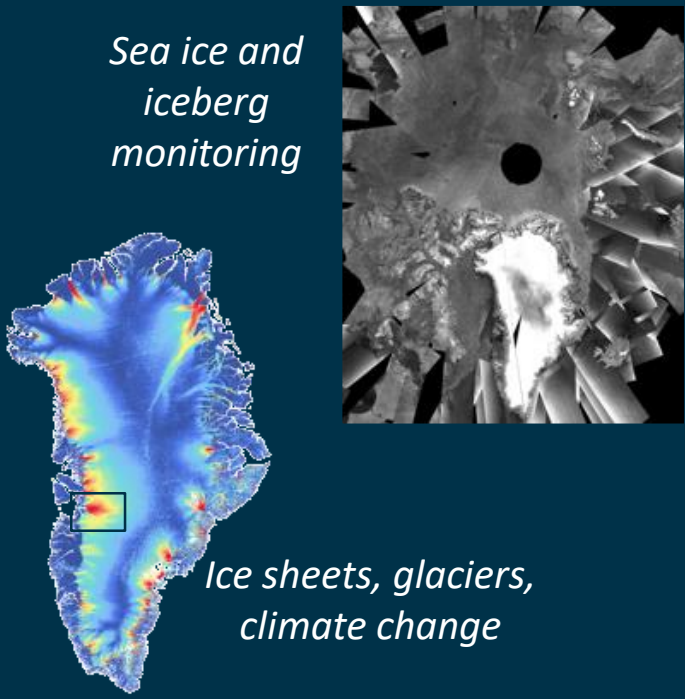
Ground deformation: subsidence, landslides, earthquakes, volcanoes, infrastructure monitoring



Emergency management

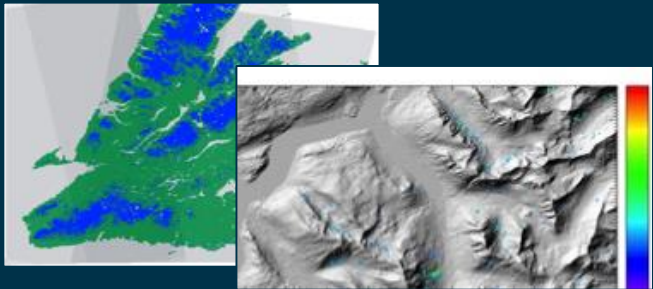


Soil moisture, wetland



Sea ice and iceberg monitoring

Ice sheets, glaciers, climate change

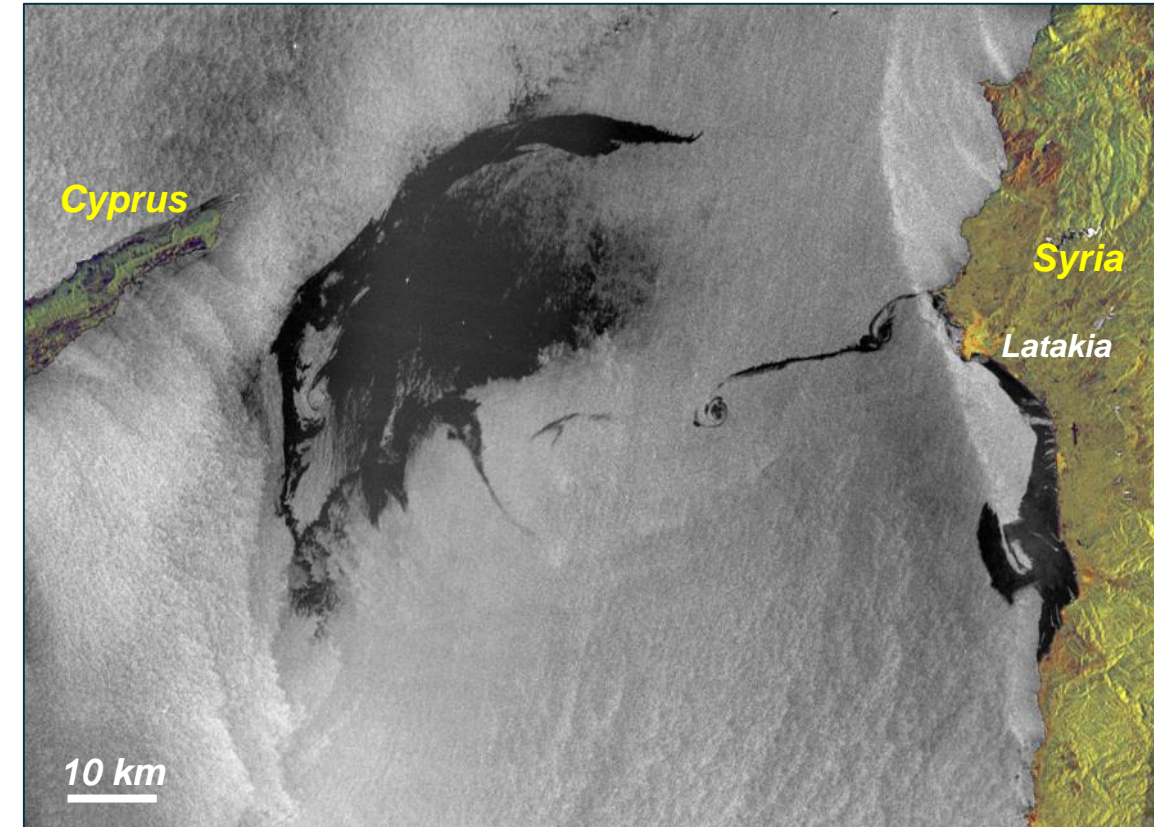


Snow, permafrost, avalanches,...

Thank you for your attention !

Oil spill in East Mediterranean in August 2021

Oil spill generated by a leak in a fuel tank of the Baniyas power plant on the Syrian coast (S1 image of 30 August 2021)



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Sentinel Online: sentinels.copernicus.eu
CSC Data Access: spacedata.copernicus.eu
ESA Sentinel app: available for iOS and Android

