Sentinel-2 Mission Status

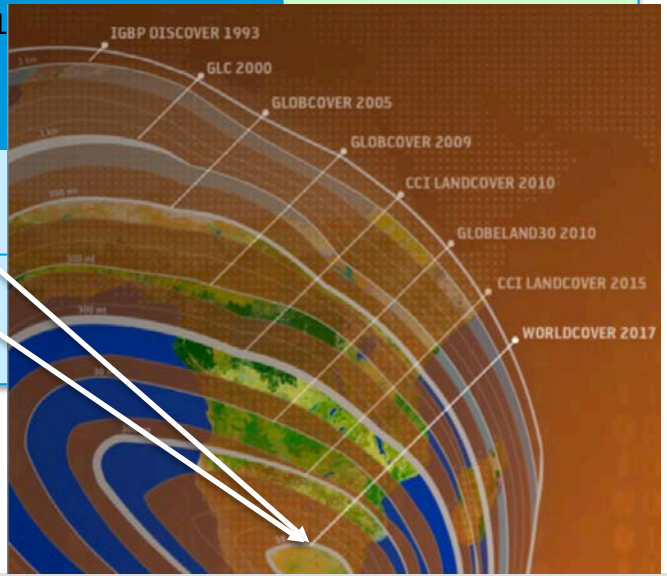
Bianca Hoersch, Sentinel-2 Mission Manager

on behalf of the S2 team

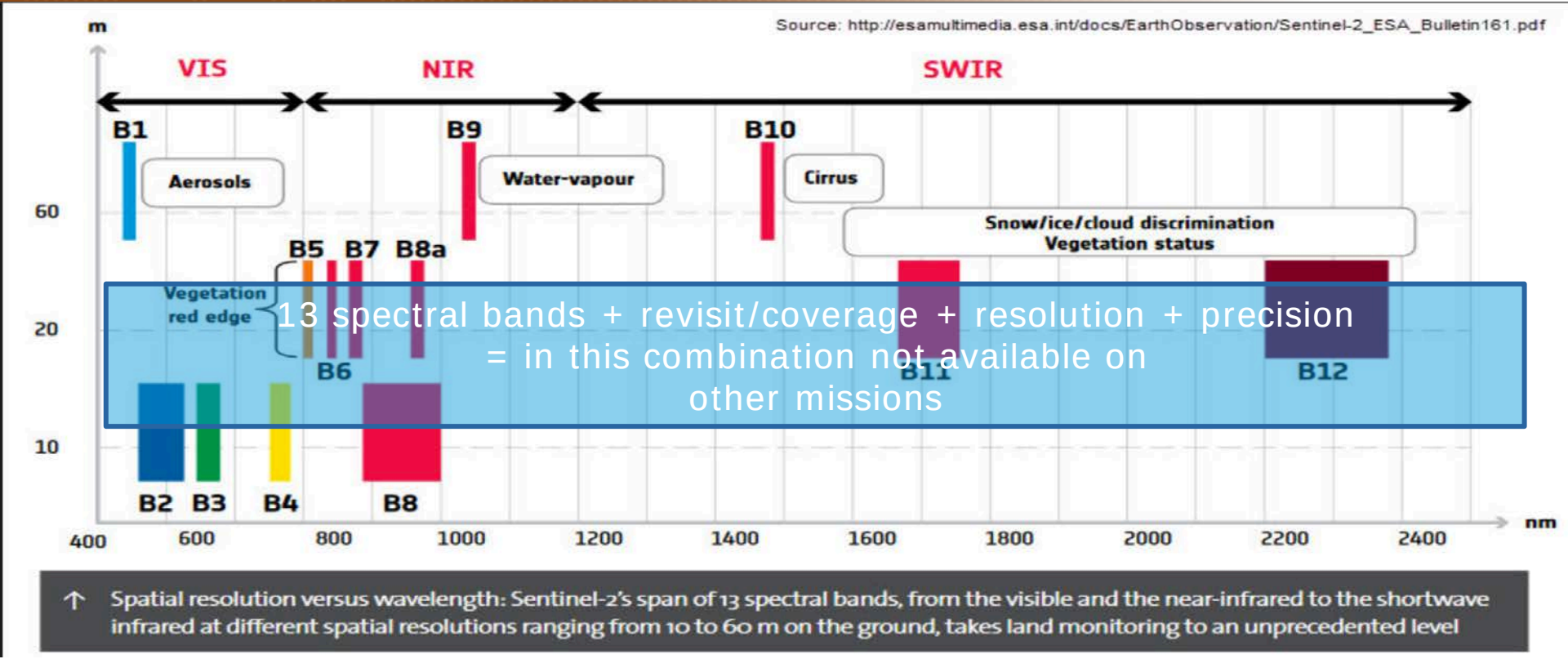
14 March 2017, Esrin

Heritage & Partner missions

	Spot(-5)	Landsat(-8)	Sentinel-2	Proba-V	Sentinel-3
Period	1986- 2015	1972 -	2015 -	2013 - 2019	2016 -
Swath [km]	60	180	290	2250	1270
Resolution multi-spectral [m]	5, 10	30	10, 20, 60	1	
# Spectral bands	4 (+1)	9 (+2 TIR)	13		
Yearly volume [TB]	~800 (all Spot sats)	250	1.500-3.000 (2 sats: L1C-L2A)		



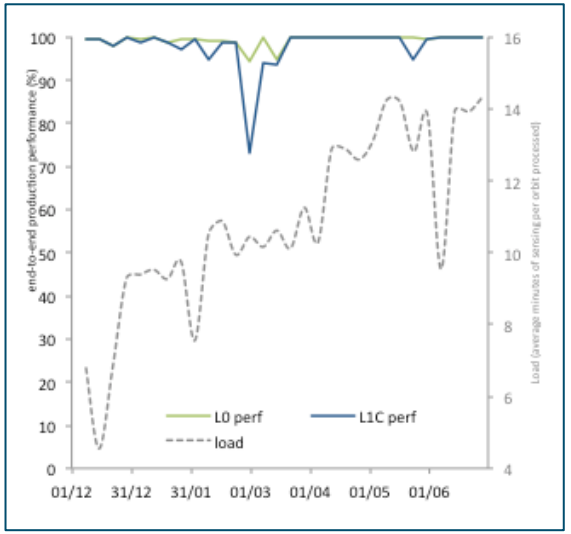
Sentinel-2 UNIQUE features

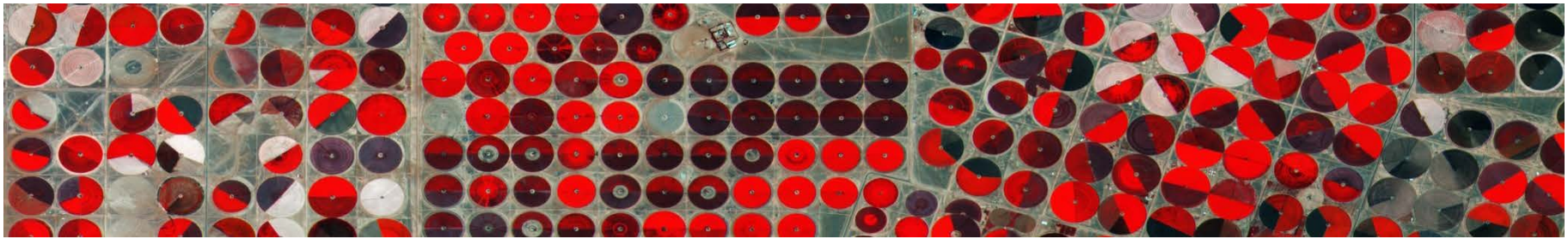


↑ Spatial resolution versus wavelength: Sentinel-2's span of 13 spectral bands, from the visible and the near-infrared to the shortwave infrared at different spatial resolutions ranging from 10 to 60 m on the ground, takes land monitoring to an unprecedented level

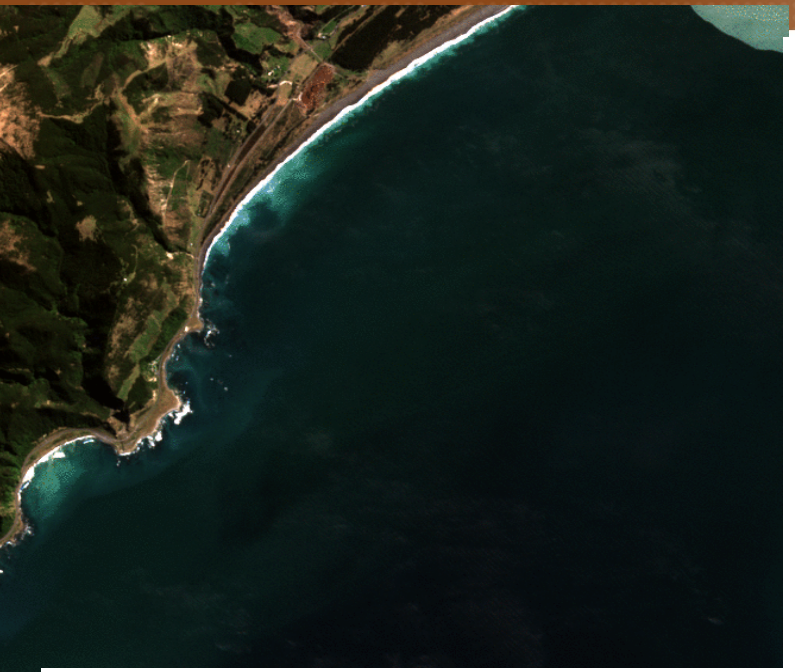
Sentinel-2A Mission Performance

- Smooth operations
- Spacecraft excellent availability
  - very few anomalies
  - Only one collision avoidance maneuver so far
  - = High level of reliability
- PDGS NRT chain operating at ~100% reliability since 1y
- All Key Performance Indicators (KPI) of Copernicus Agreement met



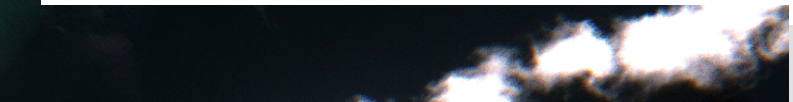


L1C Product Data Quality



Requirement	Description	Measured performance
Absolute geolocation (without ground control points)	The geo-location uncertainty shall be better than 20 m at 2σ confidence level (without Ground Control Points).	< 11 m at 95.5% confidence (baseline 02.04)
Multi-spectral registration	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 3σ confidence level.	< 0.3 pixel at 99.7% confidence
Absolute radiometric uncertainty	The absolute radiometric uncertainty shall be better than 5 % (goal 3%).	B1 to B12, excl. B10: < 5%±2%
SNR	The Signal-to-Noise Ratio (SNR) shall be higher than specified values (see Table 2-4 in this document)	All bands compliant with > 27% margin

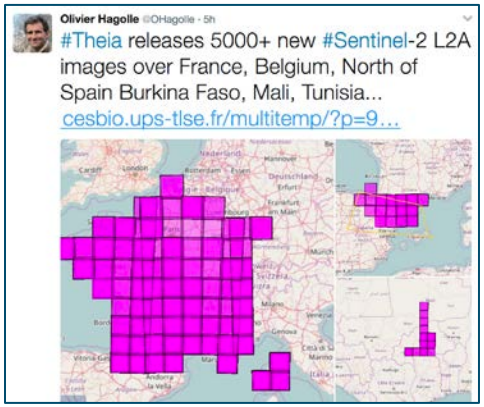
- Monthly Data Quality reports: https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/data-quality-report
- See 1st Sentinel-2 Validation Team meeting: http://esaconferencebureau.com/2016-events/16c20/presentations "S2 MPC Activities" & "S2 Level-1 Validation Activities at CNES"



Sentinel-2 – progressing towards Surface Reflectance (L2A)

State of the art: no other HR mission produces globally surface reflectance, current approaches are

- on-demand production e.g. Landsat
- regional production e.g. PEPs/TEIA (France) and others



Sentinel-2 production of L2A will increase the data volume by 120%

1. **ESA Pre-operational Pilot project**: systematic regional production Europe (see next slide)
2. **Feasibility study**: assessment of best European algorithm for systematic global production
3. **ACIXs**: International algorithm comparison

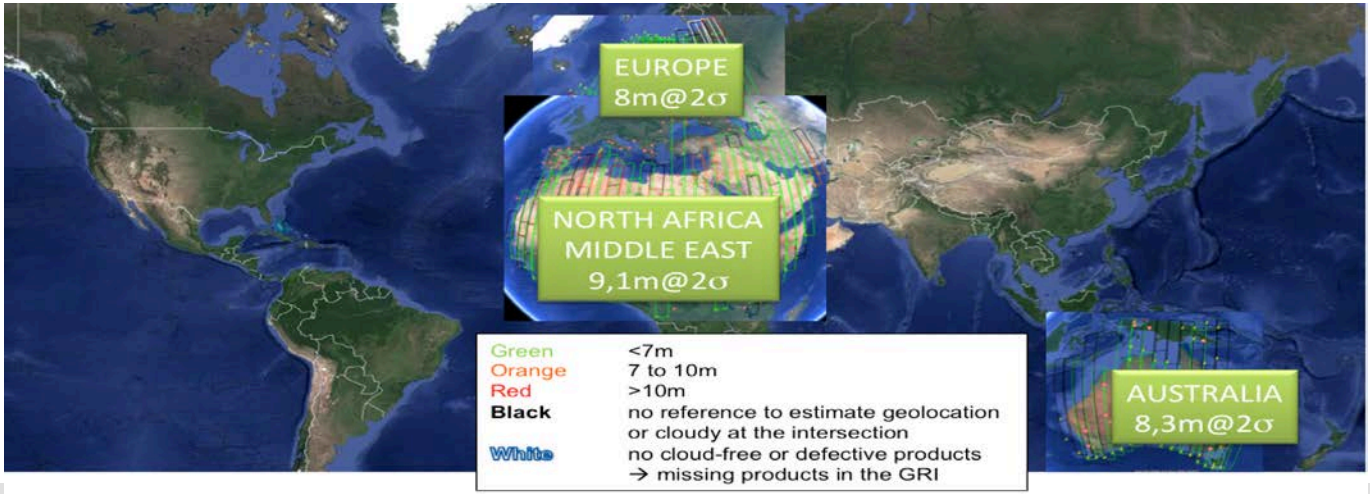
L2A Production Pilot Project ‘Europe’

- The **Sen2Cor** processor (version 2.3.0) has been integrated in the **ESA-RSS** environment
- It generates daily up to **300GB** of **L2A** products data (~600 Tiles per Day).
- L2A products will be made available in **Q1/2017** through **http://scihub.esa.int**
- Products granularity of **L2A** will be the same of **L1C** available on SciHub.
- **L2A** product format is aligned with the new compact naming convention.

Sentinel-2 Products Foreseen Evolutions

Level-1C

- Refining using Global Reference Image (GRI).
- Inclusion of sensing time associated to each Tile.
- Updated cloud masks calculation.
- Provision of raster quality and cloud masks.



Sentinel-2 Observation Scenario - Overview

The Sentinel-2 **baseline observation scenario in routine phase systematically covers all land surfaces** between 56°* South latitude (Cape Horn in South America) and 84° North latitude (north of Greenland), including also

- **Major islands** (greater than 100 km2 size), EU islands and all the other small islands located at less than **20 km from the coastline**
- The **whole Mediterranean Sea** as well as all inland water bodies and closed seas

*Antarctica added in last HLOP release, best-effort

https://sentinel.esa.int/documents/247904/685154/Sentinel_High_Level_Operations_Plan

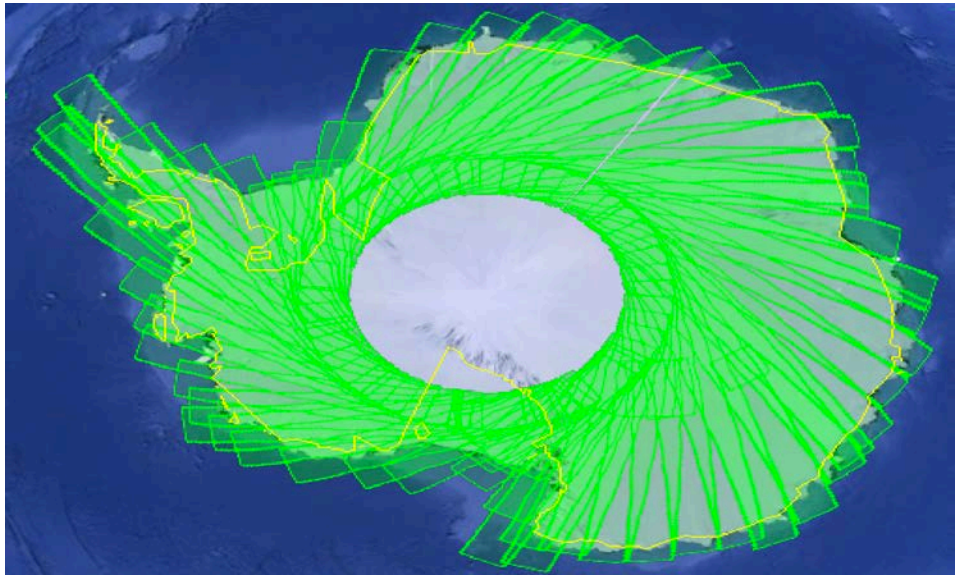
Sentinel-2A observation scenario current status

Observation plan is published online ahead of every repeat cycle as kml at https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/acquisition-plans

Currently observation of

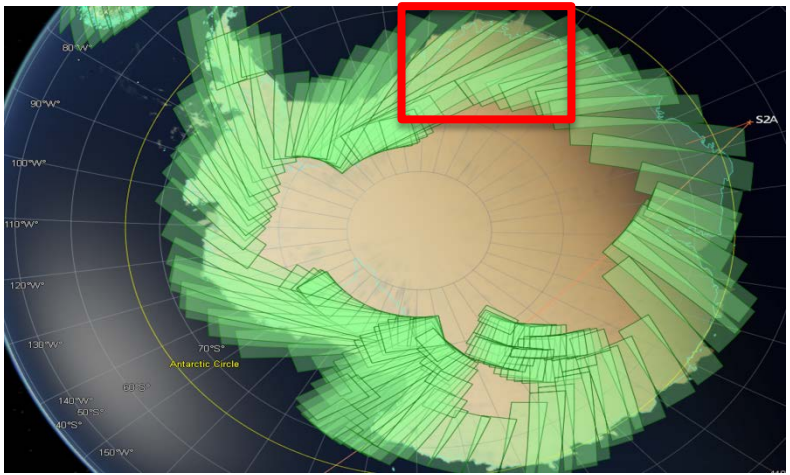
- Systematically **Europe, Africa and Greenland** on every orbit = 10 days (at equator)
- Rest of the World (RoW):
  - Oct-Feb in a alternating pattern, revisit every 10-days or 20-days
  - Since 22 Feb: back to 20-day revisit
- Coverage of global Cal/Val needs
- Antarctica (see next slide)

Use of temporary S2A spare capacity (from reduced Northern latitude illumination) to monitor Antarctica: Oct 2016- Feb 2017



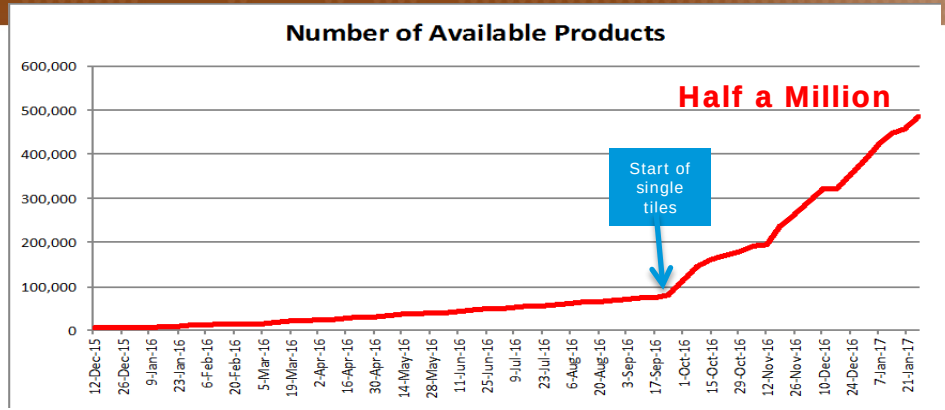
One-off full coverage in Oct 2016

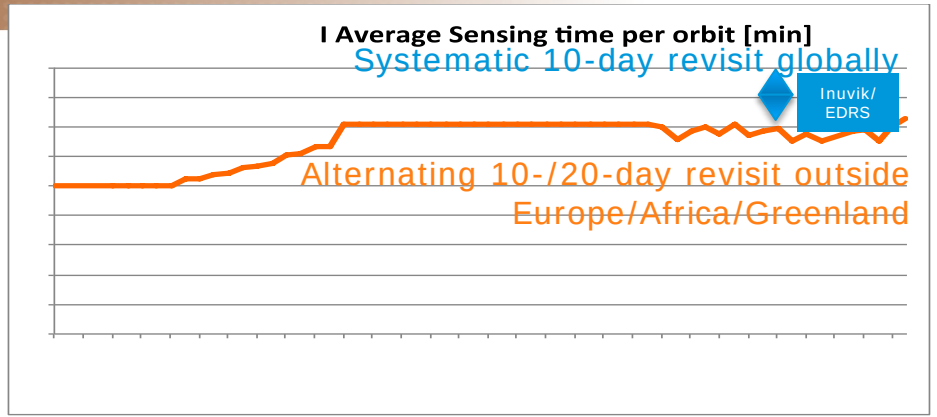
Since then, alternating every other cycle the Antarctic rim was mapped up to end Feb

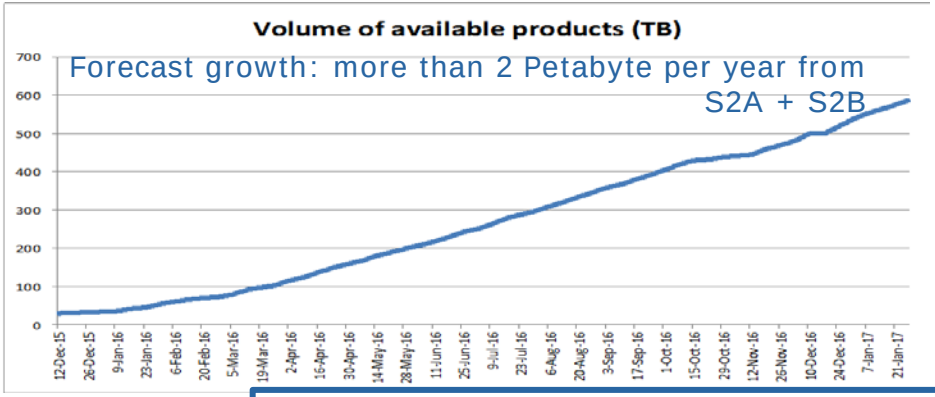


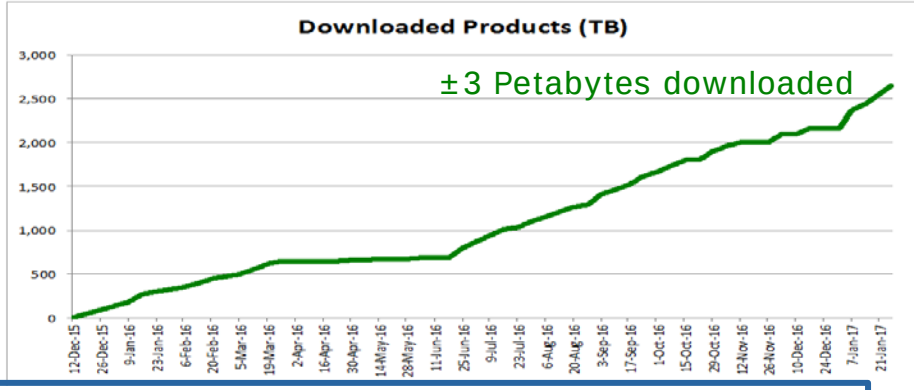
Relocation of British Antarctic Station

Sentinel-2 Data Access (since Dec 2015)



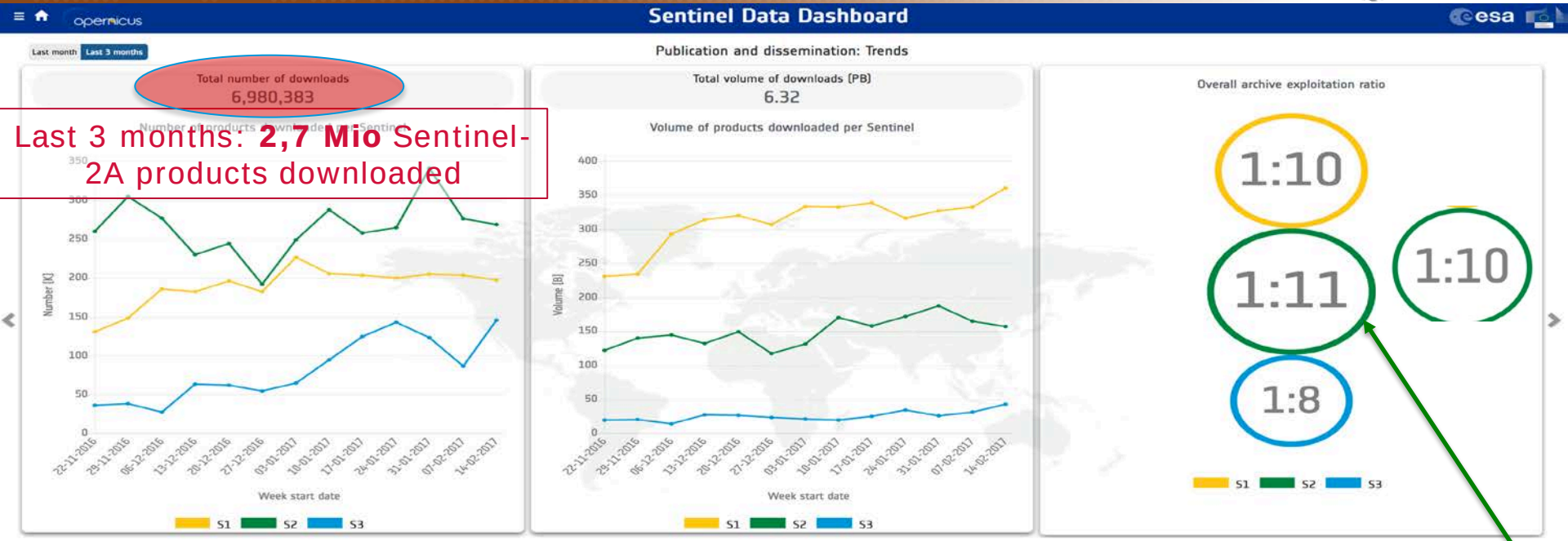






More than 6 Mio Sentinel-2 products downloaded in 15 months!

Increasing trend in last quarters

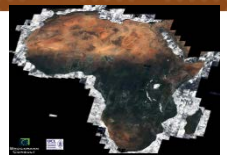


Last 3 months: **2,7 Mio** Sentinel-2A products downloaded

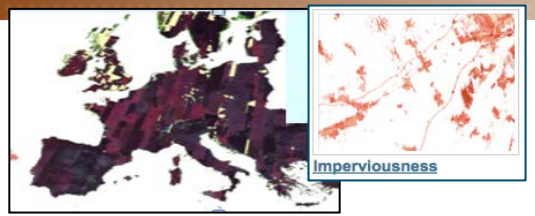
Sentinel-2A has the highest archive exploitation ratio among the Sentinels

= on average each product was downloaded by users 11 times

Ever increasing range of **S2 Applications**

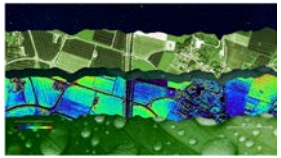


Forests & Carbon, Vegetation monitoring



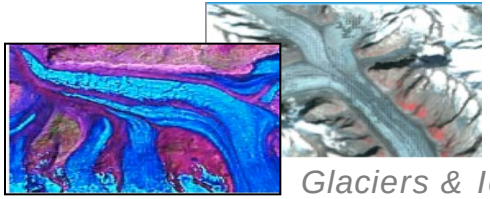
European Land cover, human impact, high resolution layers

Regional to Urban Applications

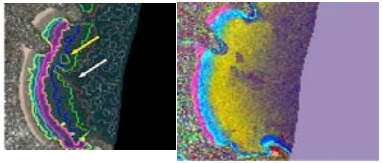


Agriculture, Fluorescence & biophysical parameters

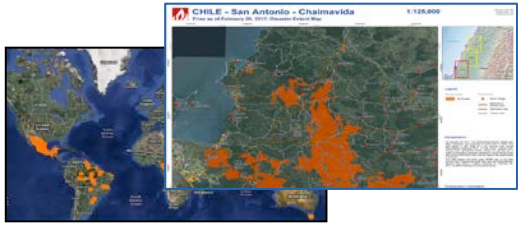
Global Land use & land cover



Glaciers & Ice

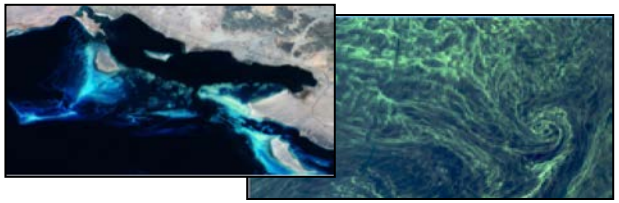


Coastal zones/bathymetry



Emergency management

Water quality, Wetlands



Geology & Geomorphology

Some Portals, Visualisation tools & Webmapping external services with focus on Sentinel-2

A number of commercial entities are actively redistributing Sentinel-2 products and offering advanced data visualisation capabilities

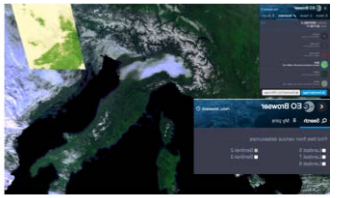
European

EOX: S2Maps, Europe 4-months mosaic from summer 2016
http://S2maps.eu

Sinergise: EO Browser, combing Sentinel-2 with Landsat and Proba-V data on-demand:
http://apps.sentinel-hub.com/eo-browser/

Sinergise: Sentinel playground, different indices and S2 bands rendering on the fly, with clouds and time definition
http://apps.sentinel-hub.com/sentinel-playground/

Mundialis: Eome, Data Analytics & filtering tool for Sentinel-2 and Landsat by e.g. cloud and bio/climate/geophysical baseline maps
http://eome.mundialis.de/eome/client/index.html

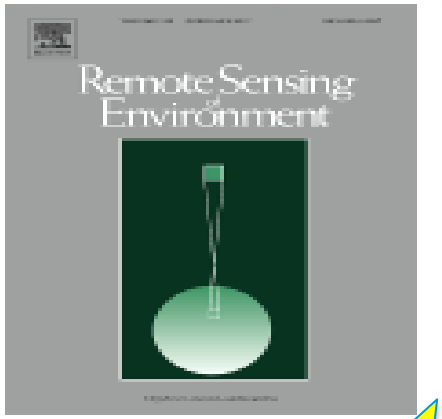


Non-European

Descarteslab: mosaics of Landsat-8, Sentinel-1 and Sentinel-2 (red-edge bands only)
https://maps.descarteslabs.com/

PlanetScope: Planetscope data, Rapideye, Sentinel-2, Landsat-8
https://www.planet.com/explorer/

Sentinel-2 Special Issue – RSE



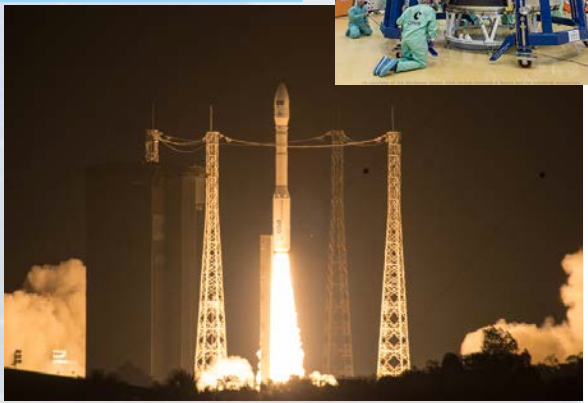
- **Title: Science and Applications with Sentinel-2**
- Open Call: Planned end March 2017
- Guest Editors:
  - Bianca Hoersch, ESA
  - Benjamin Koetz, ESA
  - Alan Belward, EC-JRC
- Topics:
  - Sentinel-2 mission & Sentinel-2 products quality
  - Synergy with complementary missions – Landsat-8
  - Diverse thematic applications

Please submit your papers

Open Access publication supported by ESA and Elsevier

Sentinel-2: we have twins!

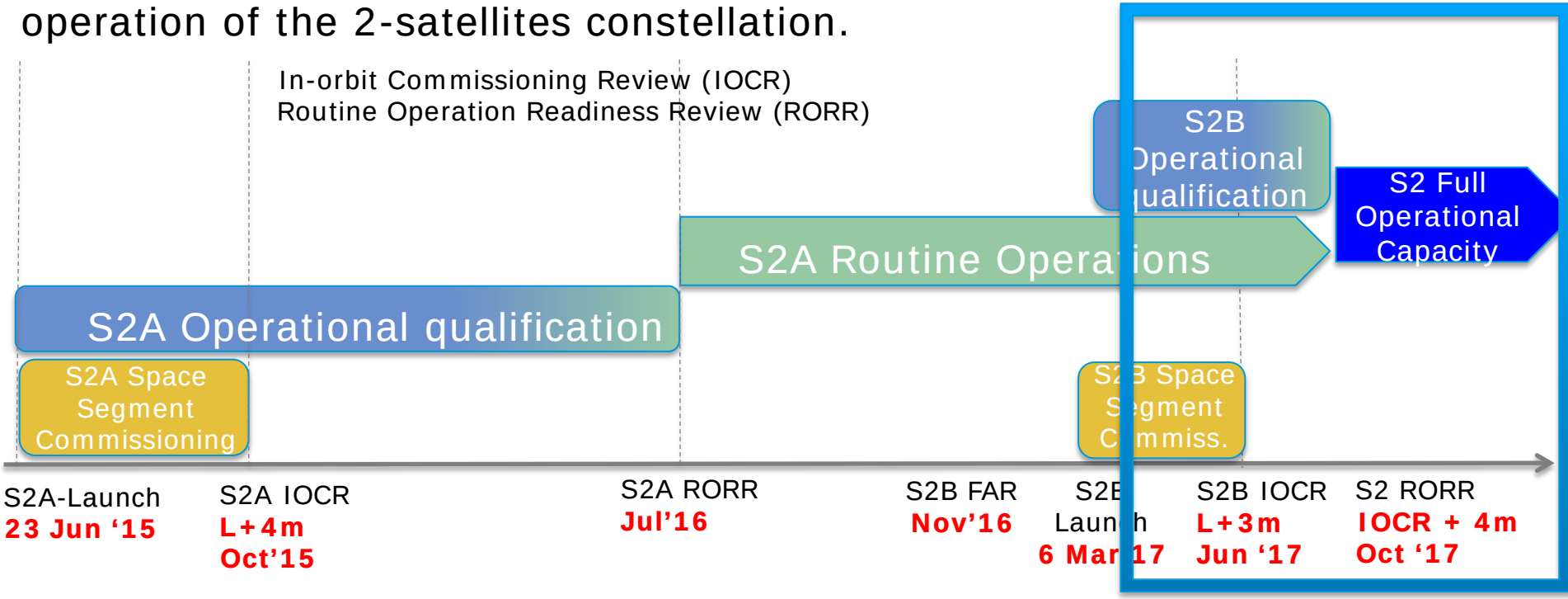
#Sentinel2Go: 15,000 messages on Twitter, Facebook, Instagram, etc. were posted in 48 hrs and ~ **20 million people** were reached all over the world



- **Doubling** the information/acquisition capacity
- Increase chances of **cloud-free imagery** globally
- Capture **fast processes** that require < weekly mapping e.g.
  - Agricultural growth periods
  - Deforestation rates
  - Glacier & Sea Ice dynamics
  - Coastal & inland water quality
  - Emergencies
- **Improved interoperability**/fusion capacity with other missions (Sentinels, Landsat-8/-9, Proba-V) due to higher revisit/more temporal overlap

Sentinel-2 Mission Operations Phases

The Sentinel-2 full mission exploitation capability is based on the routine operation of the 2-satellites constellation.



S2B latest news

Wednesday 15 March: first images of Earth - DONE!

Southern Italian port city of Brindisi, Italy

Sentinel-2 Constellation
Mission Level Activities – 2017+

- **Sentinel-2B Launch,** 6./7. March 2017 - **DONE**
- **Sentinel-2B spacecraft LEOP and commissioning**, L+3 days - **DONE**
- **1st image this week!**
- **Transfer the 4th core X-band station in operation,** summer 2017
- **IOCR & handover** ~Jun 2017
- Conclude feasibility study L2A 'European operational algorithm' Jul 2017;
- EDRS:
  - start of User Commissioning for S2A Apr/May 2017;
  - start of User Commissioning for S2B Q3/2017

✓ **Sentinel-2B end of ramp-up, Mission-level Routine Operations Review**, ±Oct 2017

- Further **improve/evolve** products (GRI, DEM, small evolutions)
- Consolidate **S2-L8 harmonisation/interoperability** activities (bilaterally, CEOS-related)
- Start systematic global L2A production, date tbc

Let’s have a good Conference!