

Sentinel-2 Mission Status

Ferran Gascon

26 October 2020

Workshop “Scaling up the Sentinels in Europe”



Sentinel-2 Mission Highlights

- ✓ Routine provision of Sentinel-2 data to operational services (despite COVID-19 situation).
- ✓ Sentinel-2 is operated beyond the initially required observation scenario.
- ✓ Good health of both Sentinel-2A and Sentinel-2B satellites.
- ✓ Top European EO mission (e.g. in terms of scientific peer-reviewed publications and data volume distributed).
- ✓ New S2+Landsat harmonised/fused demonstration products available.



Coronavirus Huoshenshan Hospital construction (Wuhan, China)

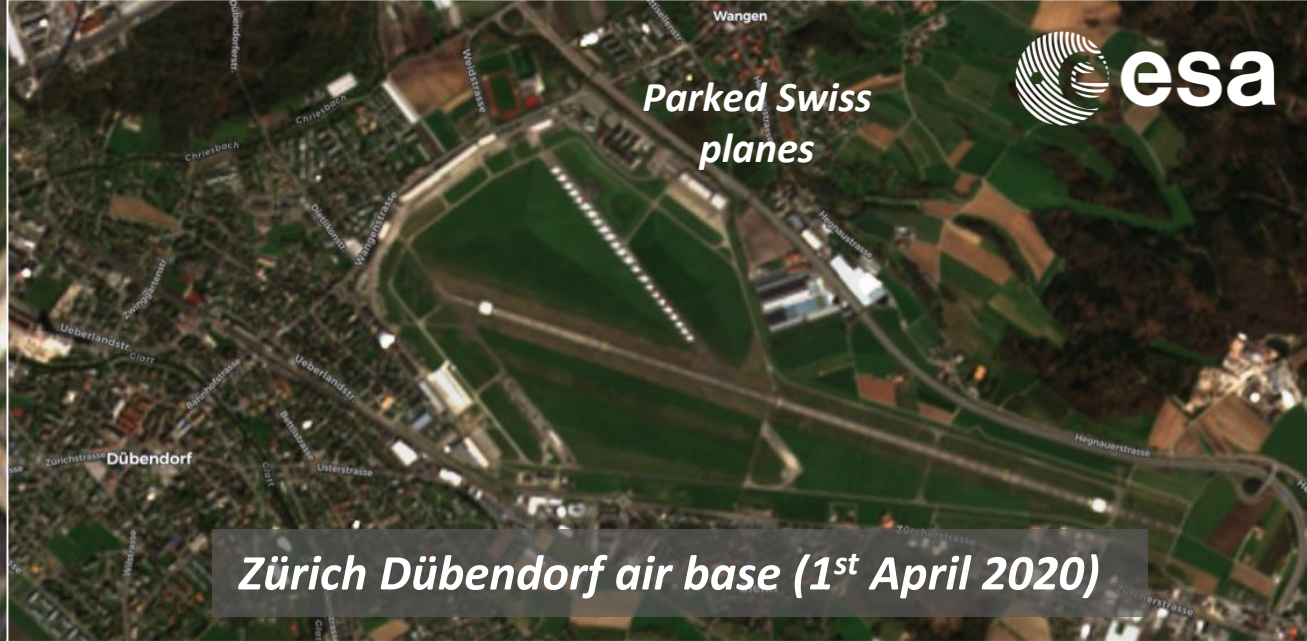
**Amsterdam
airport (31 March
2020)**



**Parked KLM
planes**

Credits: includes modified Copernicus data (2020), processed with EO Browser

**Parked Swiss
planes**



Zürich Dübendorf air base (1st April 2020)

**Parked British Airways
planes**

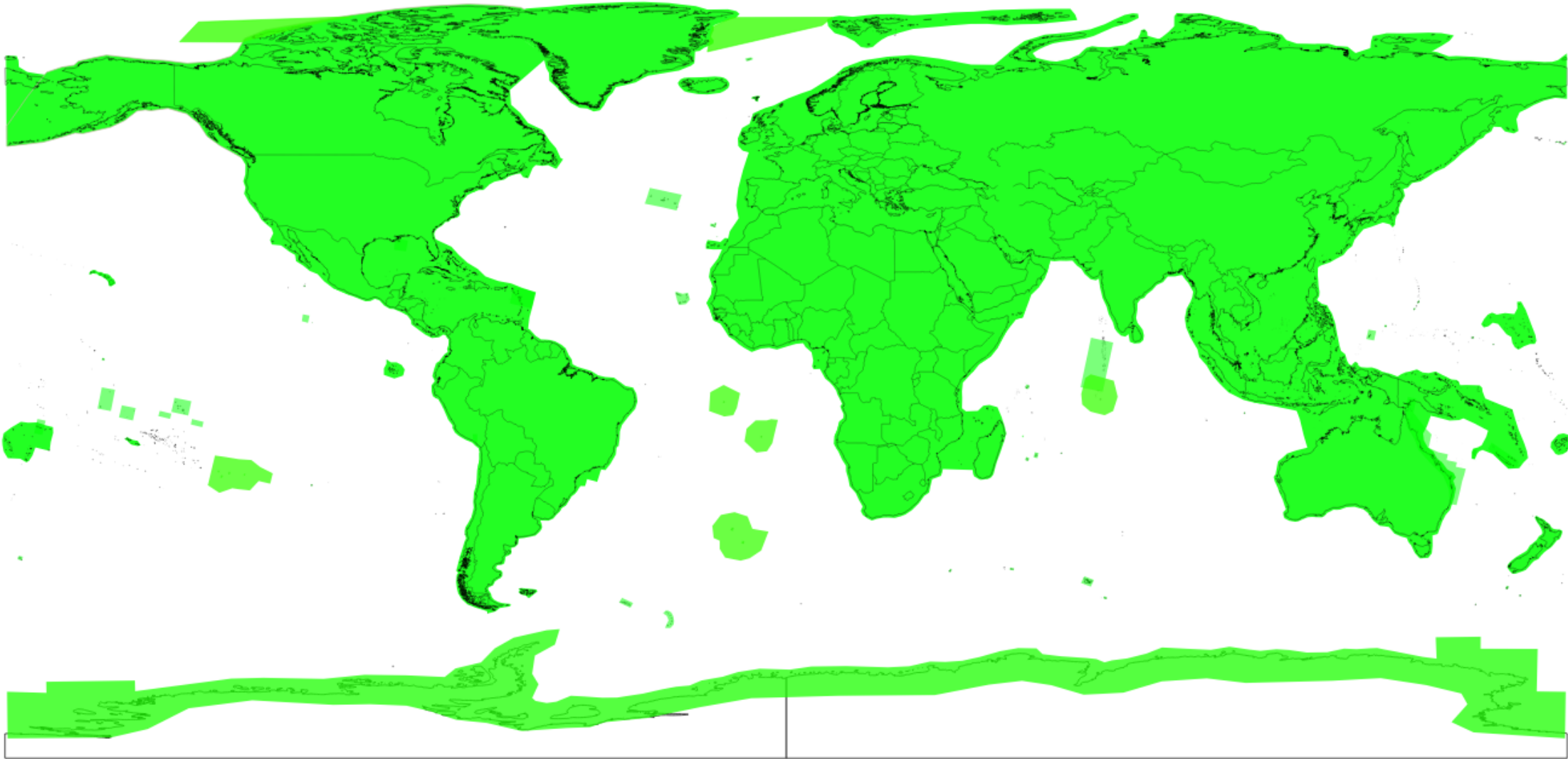


Cardiff airport (25 March 2020)

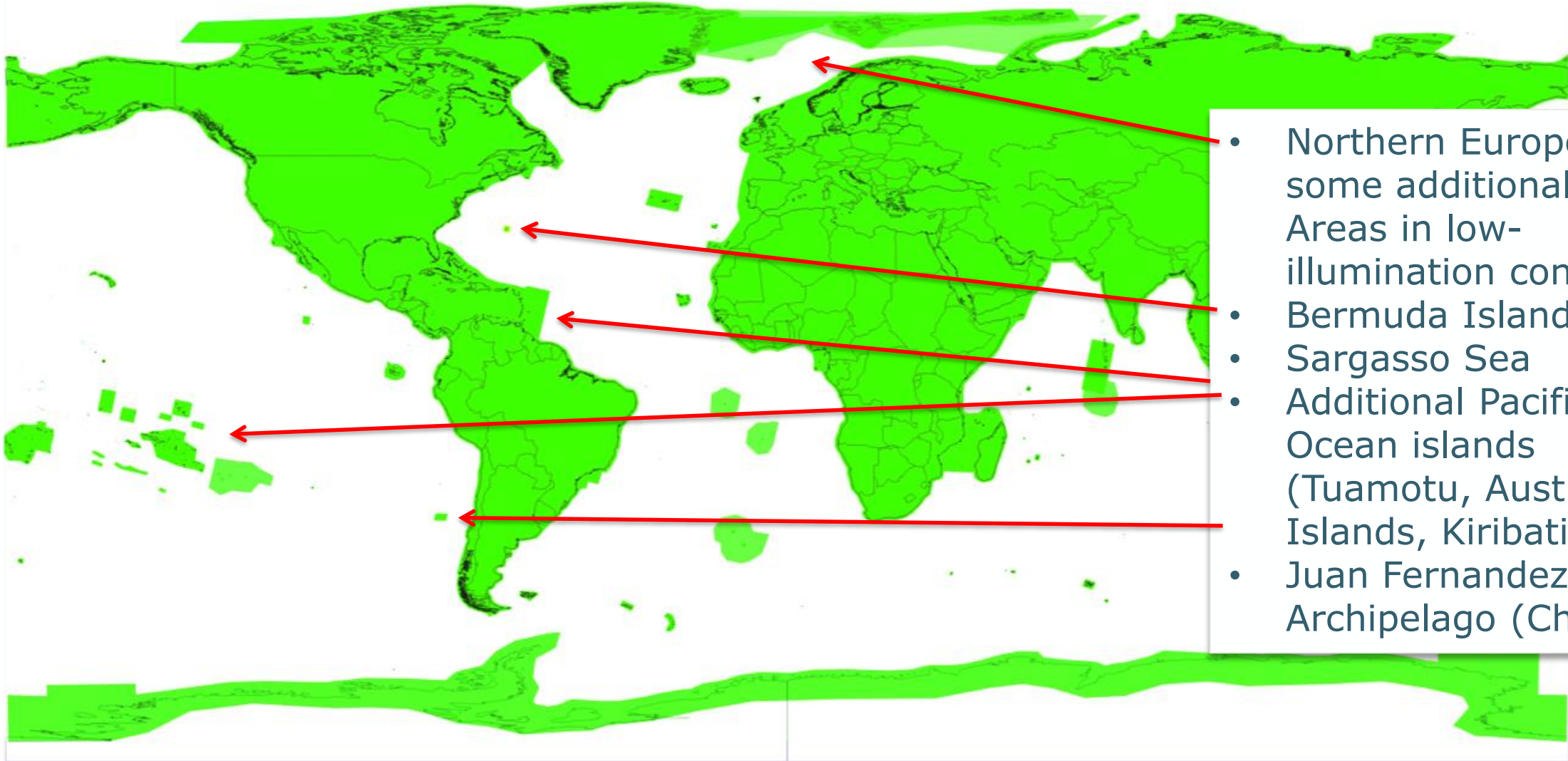
Main achievements since October 2018

- ✧ 2018 December 13: Start of Worldwide Level-2A operational production.
- ✧ 2019 April: Distribution of Sen2Cor (Level-2A processor) version 2.8.
- ✧ 2019 October: Extension of Observation Scenario.
- ✧ 2019 November: On-line products anomaly database with Application Program Interface (API).
- ✧ 2020 February: Improvement of Level-1C and Level-2A products.
- ✧ 2020 September: Availability of Level-2H and Level-2F demonstration products.

Observation Scenario (September 2019)

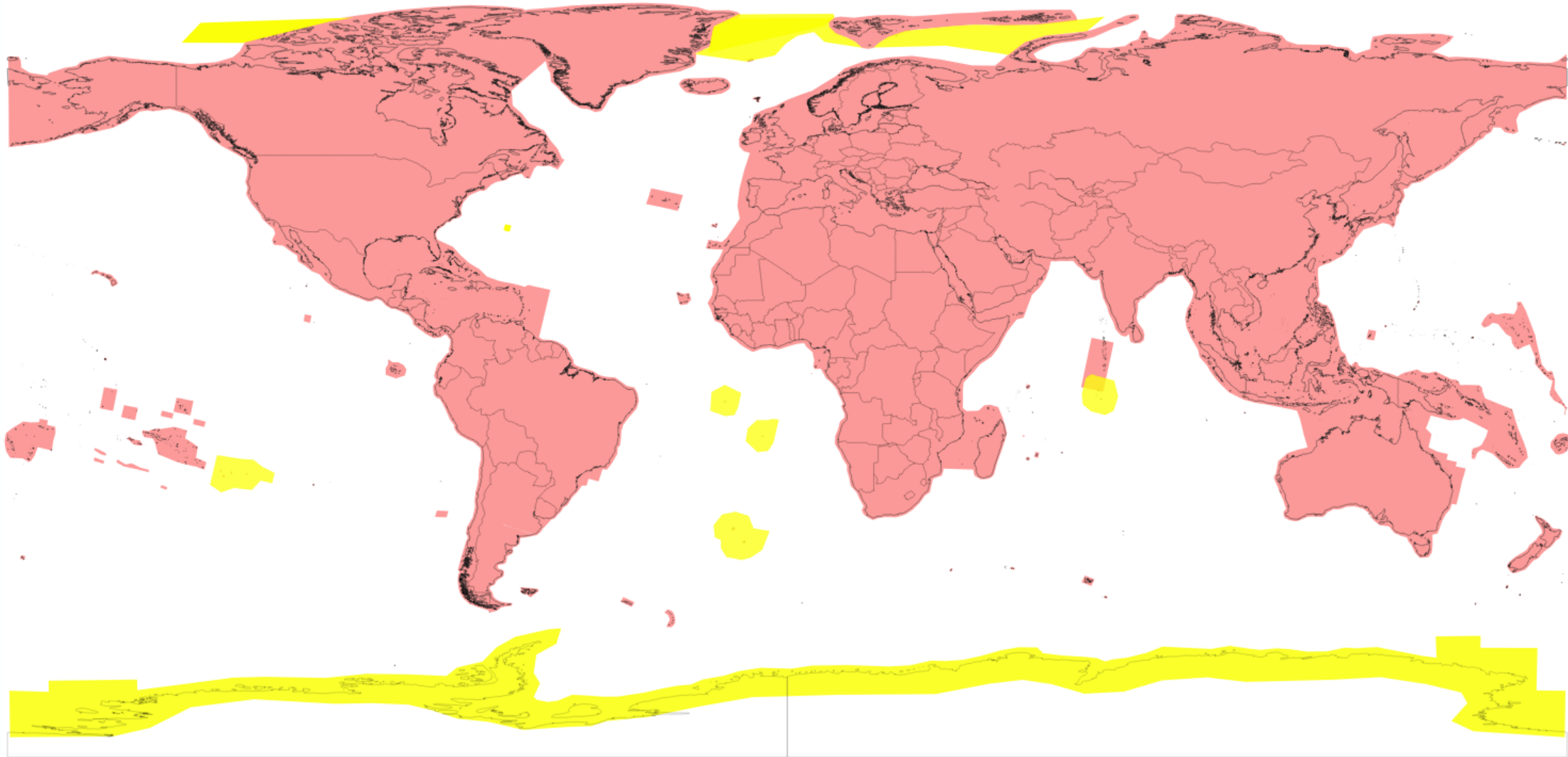


Observation Scenario (Current)



- Northern Europe and some additional Arctic Areas in low-illumination conditions
- Bermuda Islands
- Sargasso Sea
- Additional Pacific Ocean islands (Tuamotu, Austral Islands, Kiribati)
- Juan Fernandez Archipelago (Chile)

Revisit Time



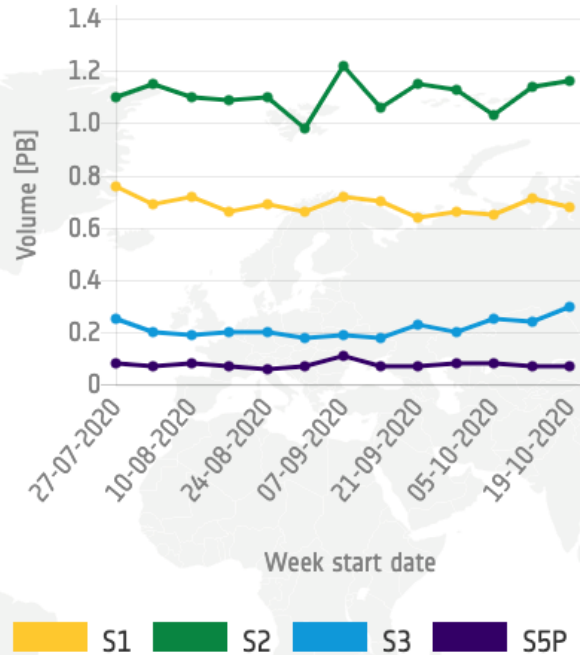
Data Access

Copernicus Data Hubs

Total volume of downloads (PB)

27.13

Volume of products downloaded per Sentinel



Private companies re-distributing Sentinel products through free and pay-per-use schemes

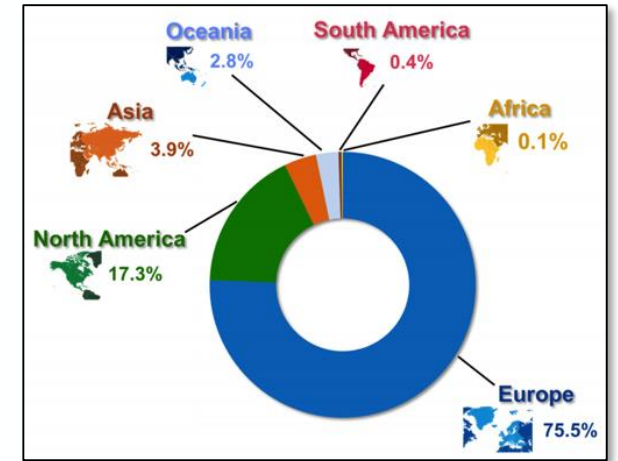
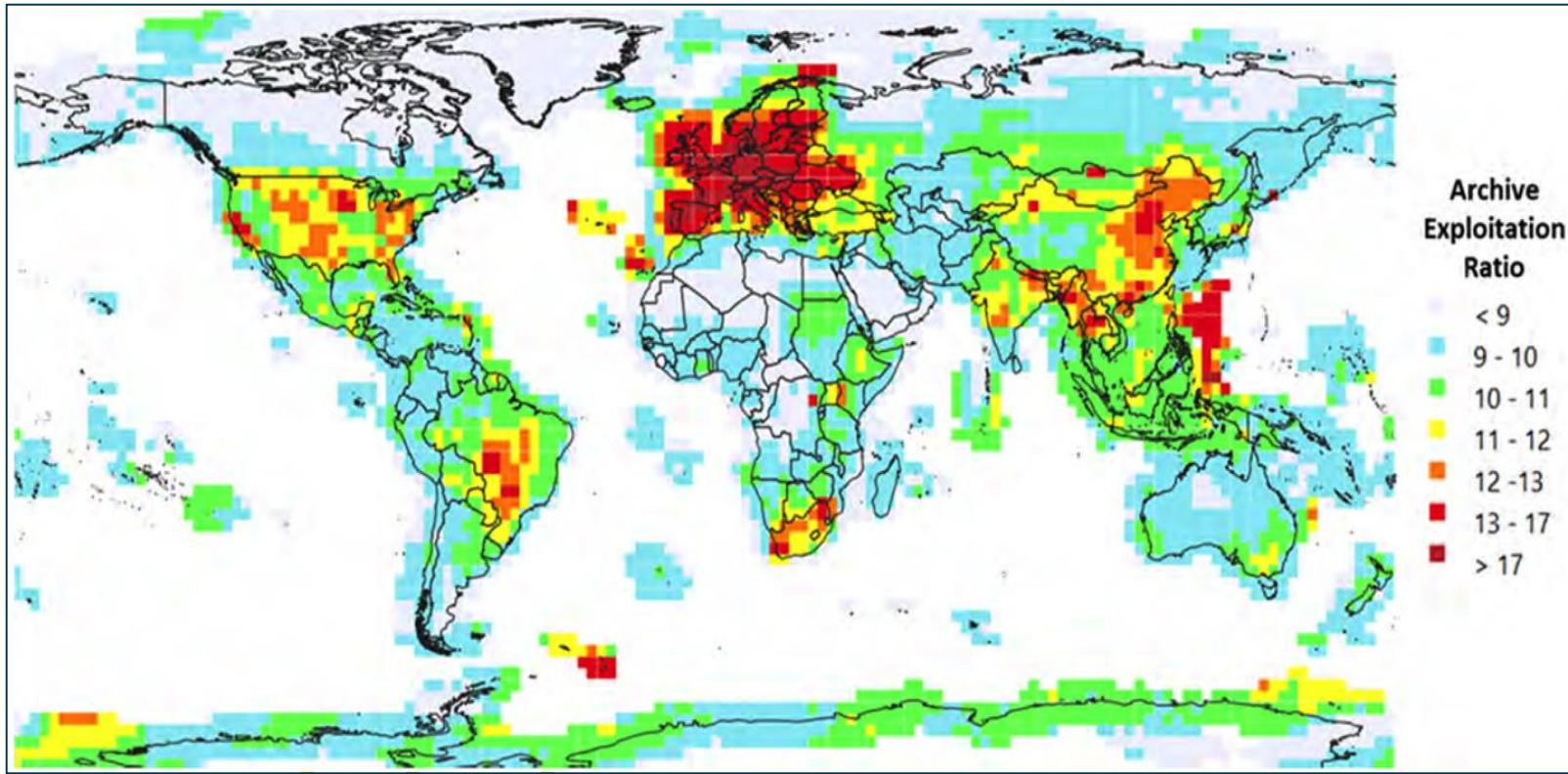


Collaborative mirror sites

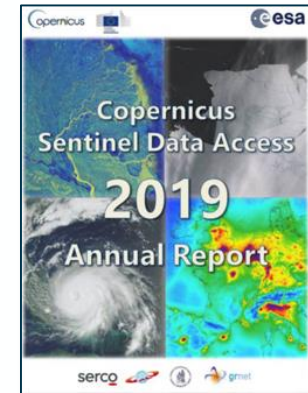
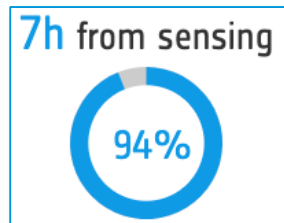


International partners mirror sites disseminating towards own national communities





Heatmap showing the archive exploitation ratio for Sentinel-2 L1C products during Y2019



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

- ✧ Start of the geometry-refined production using the Global Reference Image (GRI).
- ✧ Usage of Copernicus DEM for Level-1C and Level-2A productions.
- ✧ Improvement of Level-1C and Level-2A products.
- ✧ Generation of Level-2H and Level-2F demonstration production.
- ✧ Further extension of Observation Scenario (if possible following feasibility analysis).
- ✧ Definition of Sentinel-2 archive reprocessing plan (to start in 2021).
- ✧ Definition of potential 3-satellite constellation scenario.

Definition of Constellation with Sentinel-2C

✧ Activity on going to define the constellation set-up with 3 satellites considering needs from Copernicus Services and technical constraints on both space and ground segments.

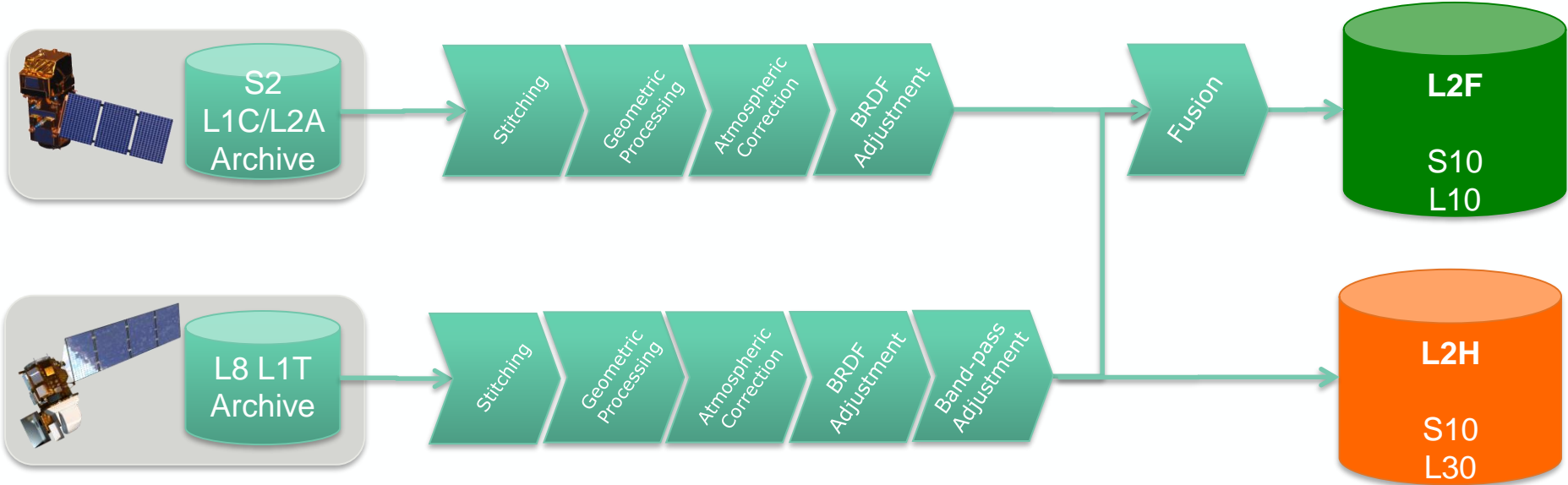
	(0-5-3)	(0-5-6)	(0-6-3)	(0-4-6)
CLMS – Global			+++	+
CLMS – Pan-European			+++	+
CSS - SatCen			++	++
CSS - EMSA			++++	
C3S			++	++
CMEMS	+		+++	
CEMS			++++	
Total	1		21	6

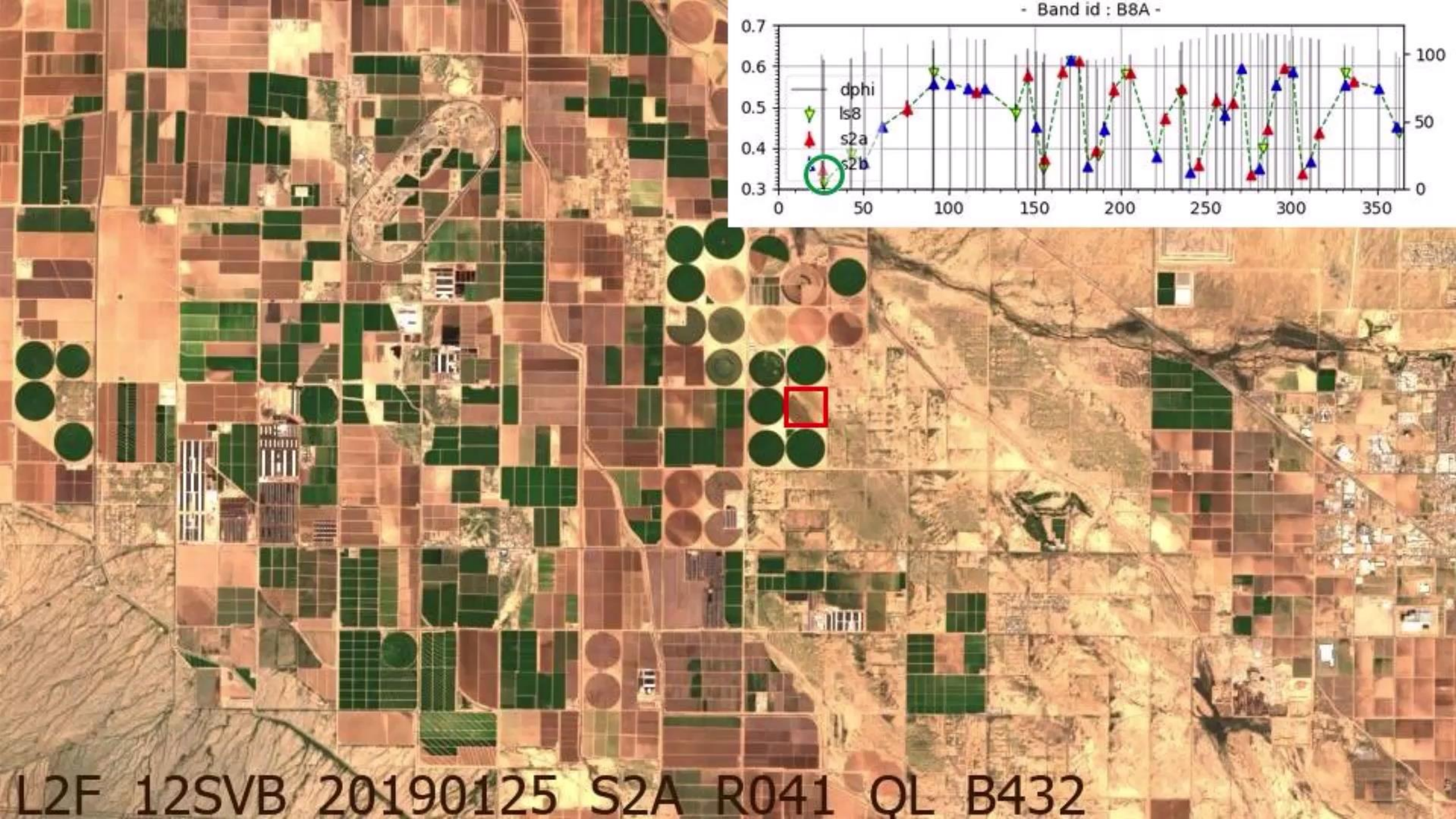
	Current	A and B "as are"	A and B "as are" Optimizing C Downlink	A "as is" relocating B	A "as is" relocating B Optimizing C downlink
Constellation	A 0° B 180°	A 0° B 180° C 324°	A 0° B 180° C 288°	A 0° B 288° C 324°	A 0° B 72° C 288°
Max Revisit time period	5 days	5 days	5 days	4 days	4 days
Revisit time sequence	(A, B) (0-5)	(A, B, C) (0-5-3)	(A, B, C) (0-5-6)	(A, B, C) (0-6-3)	(A, B, C) (0-4-6)
MSI Swath display		(0-5-3) – MSI Swath 1 Day MSI 3 Days MSI 	(0-5-6) – MSI Swath 1 Day MSI 3 Days MSI 	(0-6-3) – MSI Swath 1 Day MSI 3 Days MSI 	(0-4-6) – MSI Swath 1 Day MSI 3 Days MSI
Phasing					

✧ Decision on a 3-satellite constellation not yet taken.

✧ Feasibility assessment focusing on (0-6-3) triplet configuration.

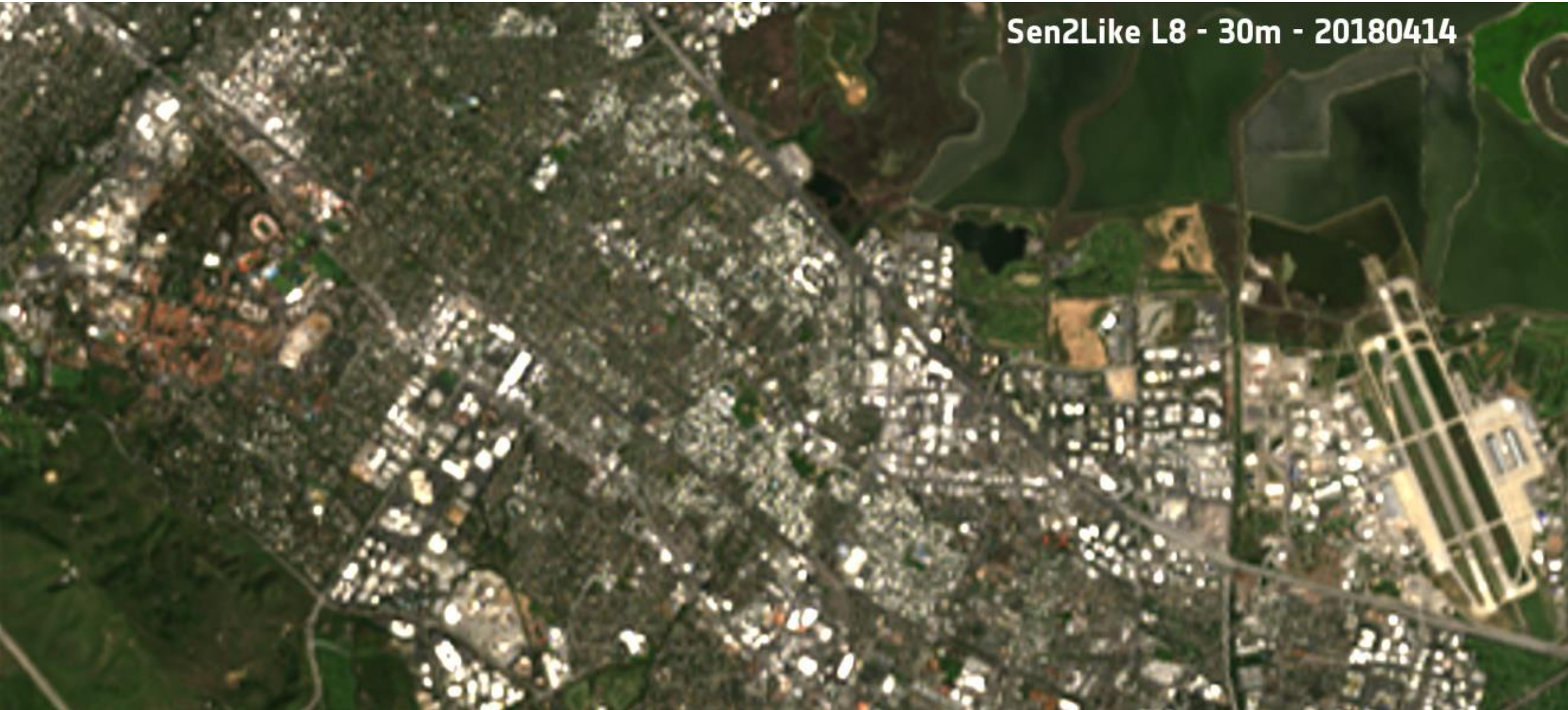
Level-2F and Level-H Demonstration Products





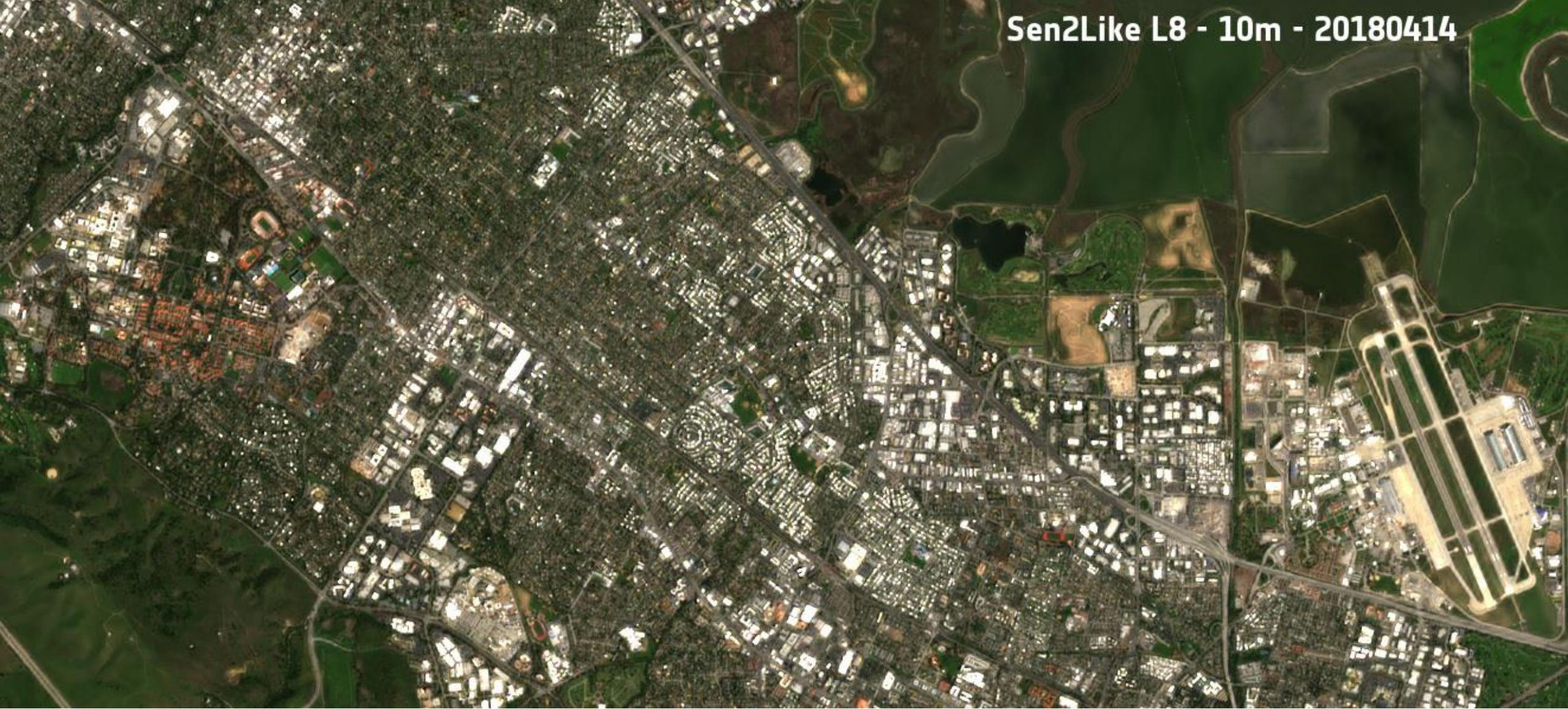
L2F 12SVB 20190125 S2A R041 QL B432

Level-2H – Output example



Level-2F – Output example

Sen2Like L8 - 10m - 20180414



Large number of innovative applications...

Aircrafts Monitoring

Remote Sensing of Environment 246 (2020) 111867

Contents lists available at ScienceDirect

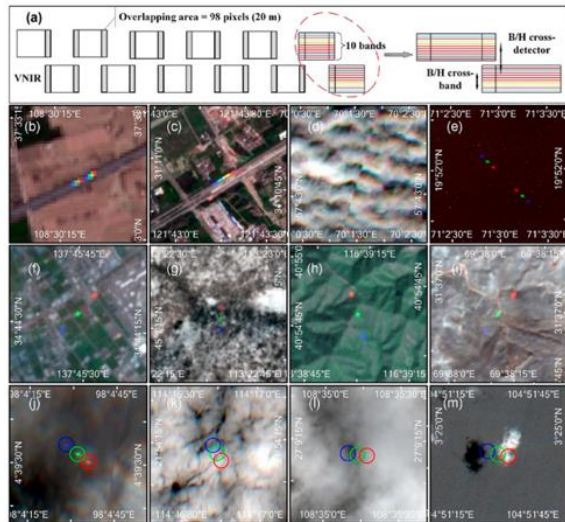
Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Space eye on flying aircraft: From Sentinel-2 MSI parallax to hybrid computing

Yongxue Liu^{a,b,*}, Bihua Xu^a, Weifeng Zhi^a, Chuanmin Hu^c, Yanzhu Dong^a, Song Jin^a, Yingcheng Lu^a, Tianxin Chen^a, Wenxuan Xu^a, Yongchao Liu^a, Bingxue Zhao^a, Wanyun Lu^a

^a School of Geography and Ocean Science, Nanjing University, Nanjing, Jiangsu Province 210046, PR China
^b Jiangsu Center for Collaborative Innovation in Geographical Information Research Development and Application, Nanjing, Jiangsu Province 210046, PR China
^c College of Marine Science, University of South Florida, St. Petersburg, FL 33701, United States



Marine Plastic Detection

www.nature.com/scientificreports

SCIENTIFIC REPORTS

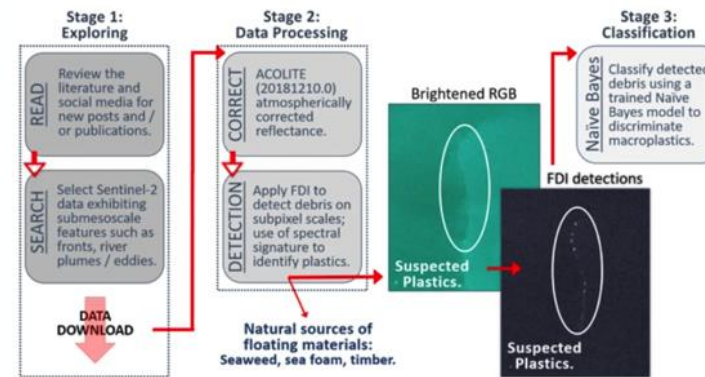
nature research

Corrected: Author Correction

OPEN Finding Plastic Patches in Coastal Waters using Optical Satellite Data

Lauren Biermann¹, Daniel Clewley¹, Victor Martinez-Vicente² & Konstantinos Topouzelis²

Satellites collecting optical data offer a unique perspective from which to observe the problem of plastic litter in the marine environment, but few studies have successfully demonstrated their use for this purpose. For the first time, we show that patches of floating macroplastics are detectable in optical data acquired by the European Space Agency (ESA) Sentinel-2 satellites and, furthermore, are distinguishable from naturally occurring materials such as seaweed. We present case studies from four countries where suspected macroplastics were detected in Sentinel-2 Earth Observation data. Patches of materials on the ocean surface were highlighted using a novel Floating Debris Index (FDI) developed for the Sentinel-2 Multi-Spectral Instrument (MSI). In all cases, floating aggregations were detectable on sub-pixel scales, and appeared to be composed of a mix of seaweed, sea foam, and macroplastics. Building first steps toward a future monitoring system, we leveraged spectral shape to identify macroplastics, and a Naive Bayes algorithm to classify mixed materials. Suspected plastics were successfully classified as plastics with an accuracy of 86%.



Carbon Cycle

nature COMMUNICATIONS

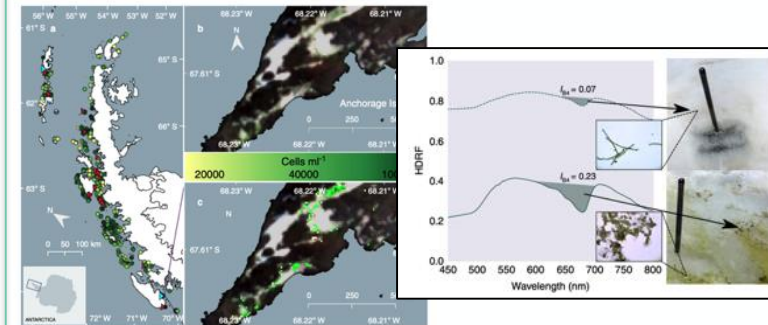
ARTICLE

<https://doi.org/10.1038/s41467-020-16018-w> OPEN

Remote sensing reveals Antarctic green snow algae as important terrestrial carbon sink

Andrew Gray^{1,2,3*}, Monika Krolikowski¹, Peter Fretwell³, Peter Convey³, Lloyd S. Peck³, Monika Mendelova⁴, Alison G. Smith¹ & Matthew P. Davey^{1,5*}

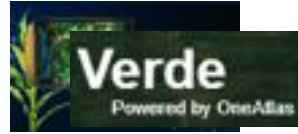
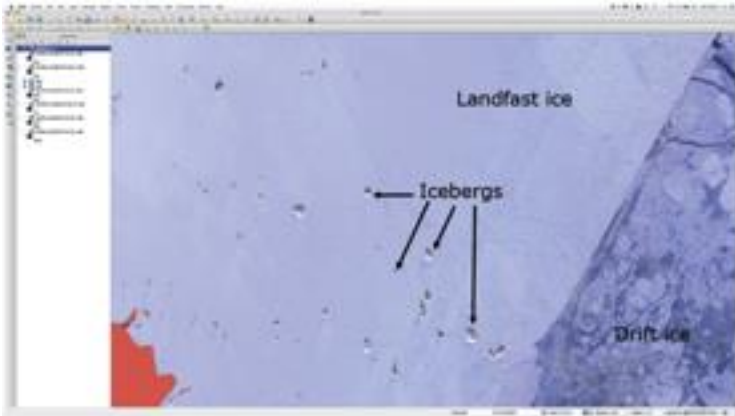
We present the first estimate of green snow algae community biomass and distribution along the Antarctic Peninsula. Sentinel 2 imagery supported by two field campaigns revealed 1679 snow algae blooms, seasonally covering $1.95 \times 10^6 \text{ m}^2$ and equating to 1.3×10^3 tonnes total dry biomass. Ecosystem range is limited to areas with average positive summer temperatures, and distribution strongly influenced by marine nutrient inputs, with 60% of blooms less than 5 km from a penguin colony. A warming Antarctica may lose a majority of the 62% of blooms occupying small, low-lying islands with no high ground for range expansion. However, bloom area and elevation were observed to increase at lower latitudes, suggesting that parallel expansion of bloom area on larger landmasses, close to bird or seal colonies, is likely. This increase is predicted to outweigh biomass lost from small islands, resulting in a net increase in snow algae extent and biomass as the Peninsula warms.



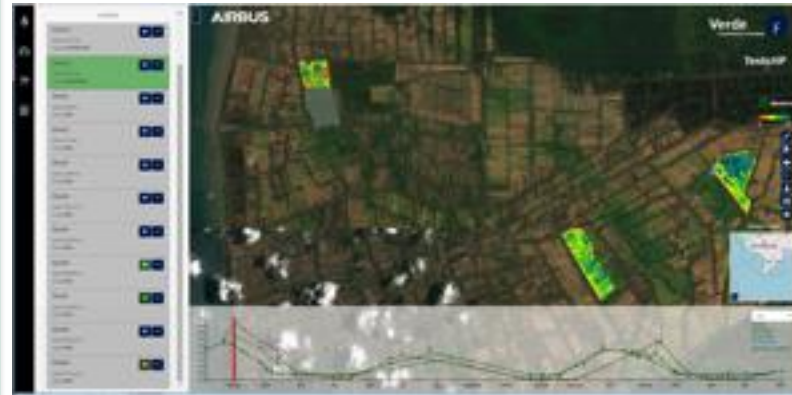
Large number of innovative applications...



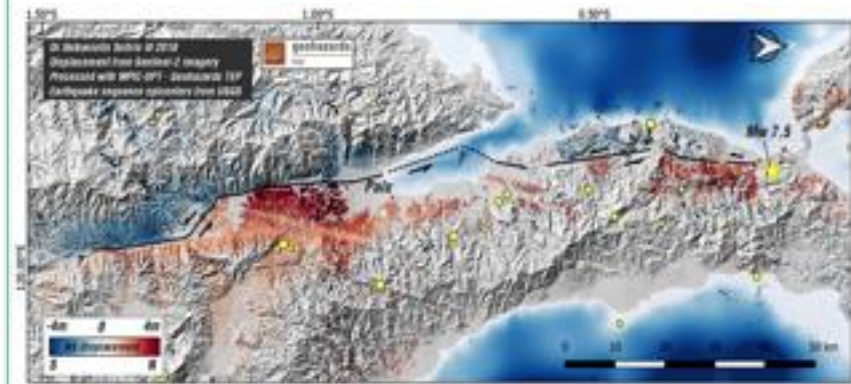
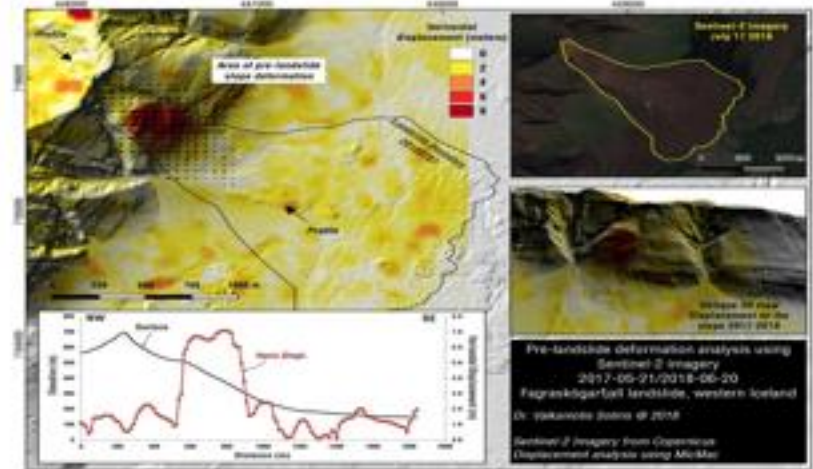
Iceberg Monitoring



Smart Farming



Ground motion (in complement to S1)



COVID-19 Custom Script Contest

COVID-19 THE BEST IDEA OF THE WEEK EURO DATA CUBE

Foreseeing the Transportation Modal Shift

Category: Economic Operators' Activity
Michel Deudon
Ecole Polytechnique, Télécom Paris Tech.



COVID-19 THE BEST IDEA OF THE WEEK EURO DATA CUBE

Lettuce, Labour and Food Security

Category: Agriculture Activity
Karl Chastko

Data Driven Insights

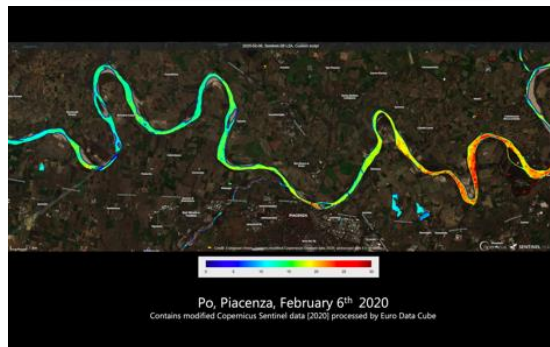
Timely information on lettuce production is critical for a wide range of stake holders including:

- Immigration services
- Regional Water Authorities
- Local and national government

COVID-19 THE BEST IDEA OF THE WEEK EURO DATA CUBE

Water Quality Monitoring for Main European Rivers During COVID-19 Lockdown

Category: Economic Operators' Activity
Francesco Mancuso and Giulio Meucci
University of Pisa



COVID-19 THE BEST IDEA OF THE WEEK EURO DATA CUBE

Is the North Eastern India April 2020 wheat harvest being disrupted by the COVID-19 lockdown?

Category: Agriculture activity
Samuel Barrett, GeoVille

The April Wheat Harvest

- Northern India is a major wheat producer and exporter
- There were media reports that the lockdown is interfering with food production and distribution.
- The wheat crop in North Eastern India is typically harvested in April over a 2-4 week period.

Between March and the end of May, the fields go through a progression of stages:

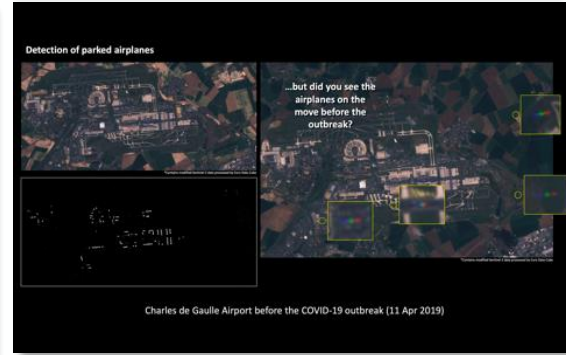
Growing	Senescing	Senesced/mature	Harvested (stubble)	Burnt stubble

Contains modified Sentinel-2 data processed by Euro Data Cube

COVID-19 THE BEST IDEA OF THE WEEK EURO DATA CUBE

Measuring Airport Activity from Sentinel-2 Imagery to Support Decision-Making during COVID-19 Pandemic

Category: Human Activity Distribution
Rodrigo Minetto, Mauricio Pamplona Segundo, Sudeep Sarkar



COVID-19 THE BEST IDEA OF THE WEEK EURO DATA CUBE

Truck detection Sensing trade from space

Category: Economic Operators' Activity
Henrik Fisser, University of Würzburg

Sentinel-2 truck detection by exploiting the sensing offset of different wavelengths

truck on the satellite image

truck on the ground

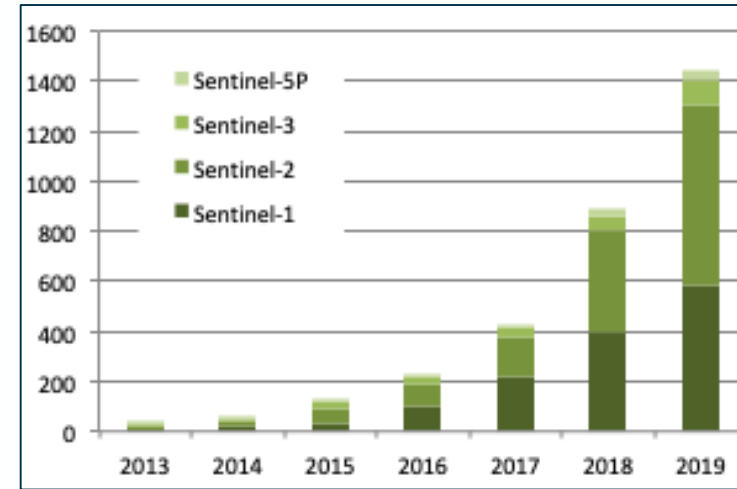
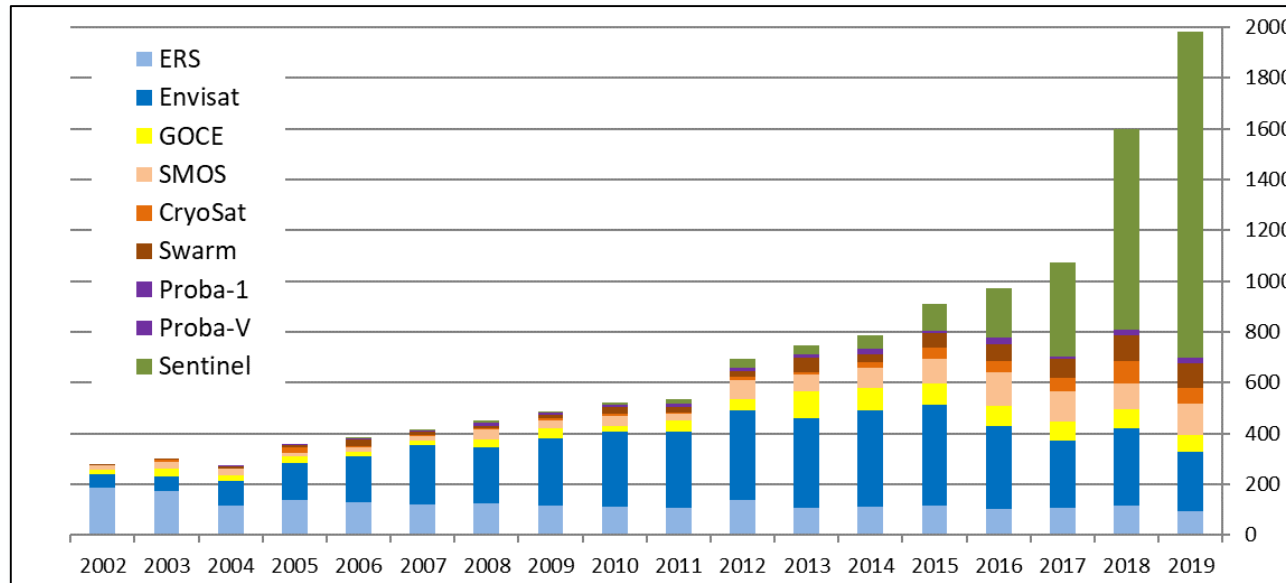
trucks on a Sentinel-2 image

Contains modified Sentinel-2 data processed by Euro Data Cube

Sentinel-2 used by 6 out of 9 contest winners

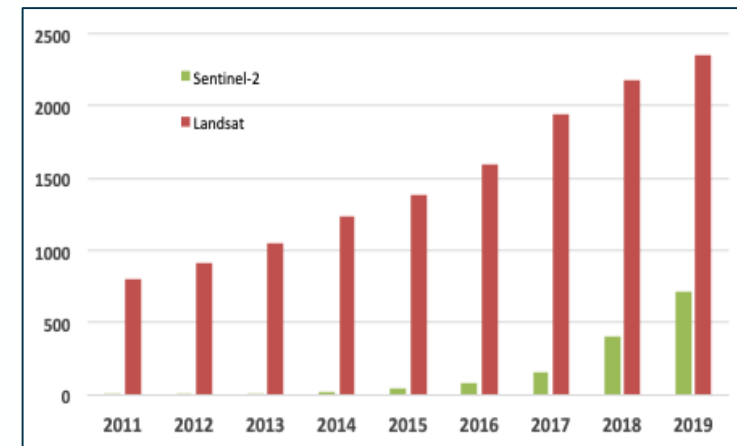


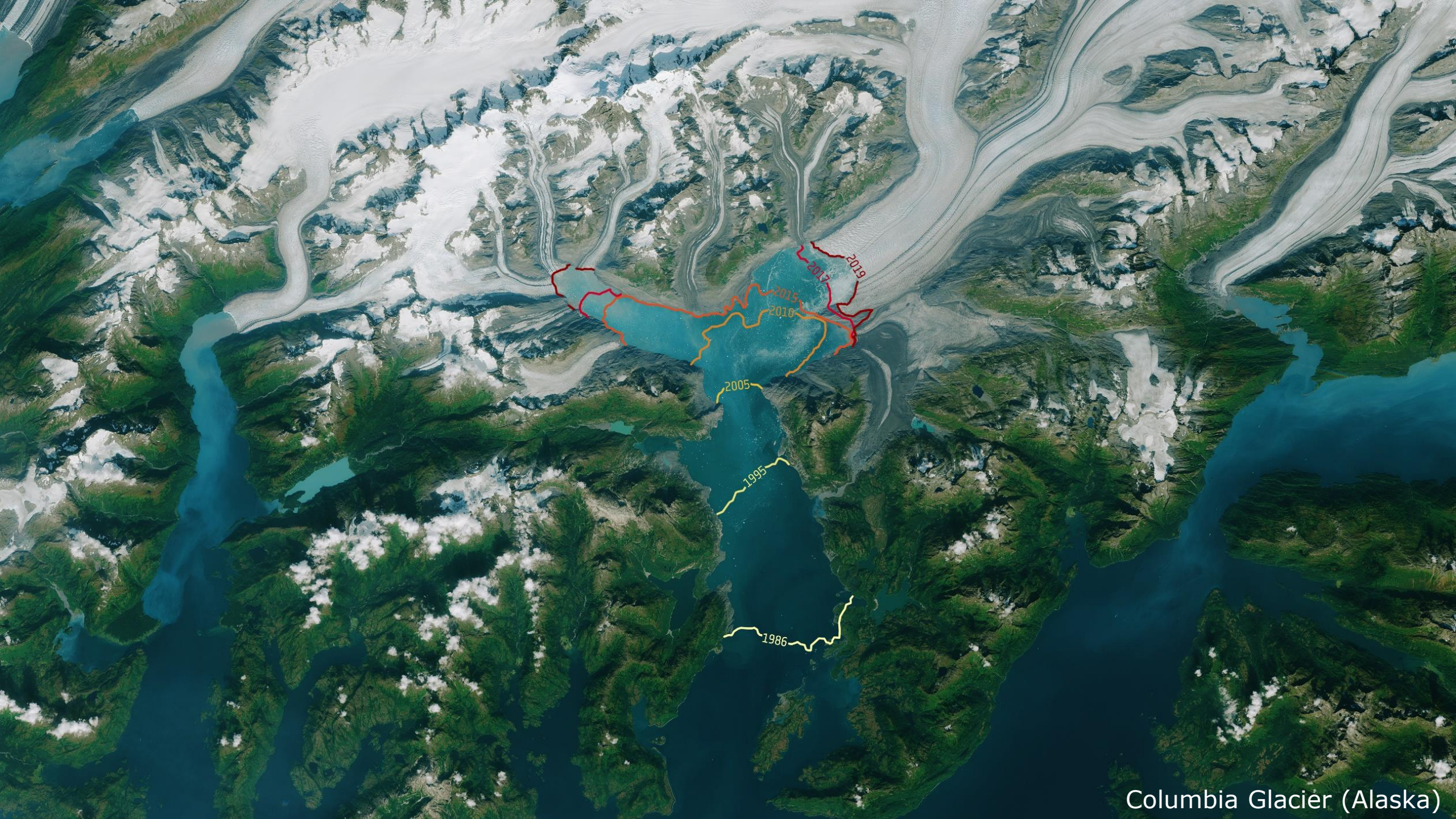
Sentinel-2 Peer-Reviewed Publications



sentinel-2
700+ publications in 2019

Method: Based on Elsevier SCOPUS database, exact number of peer reviewed publications searching for mission/instrument name within papers title, abstract and keywords, and excluding conference papers.





Columbia Glacier (Alaska)