



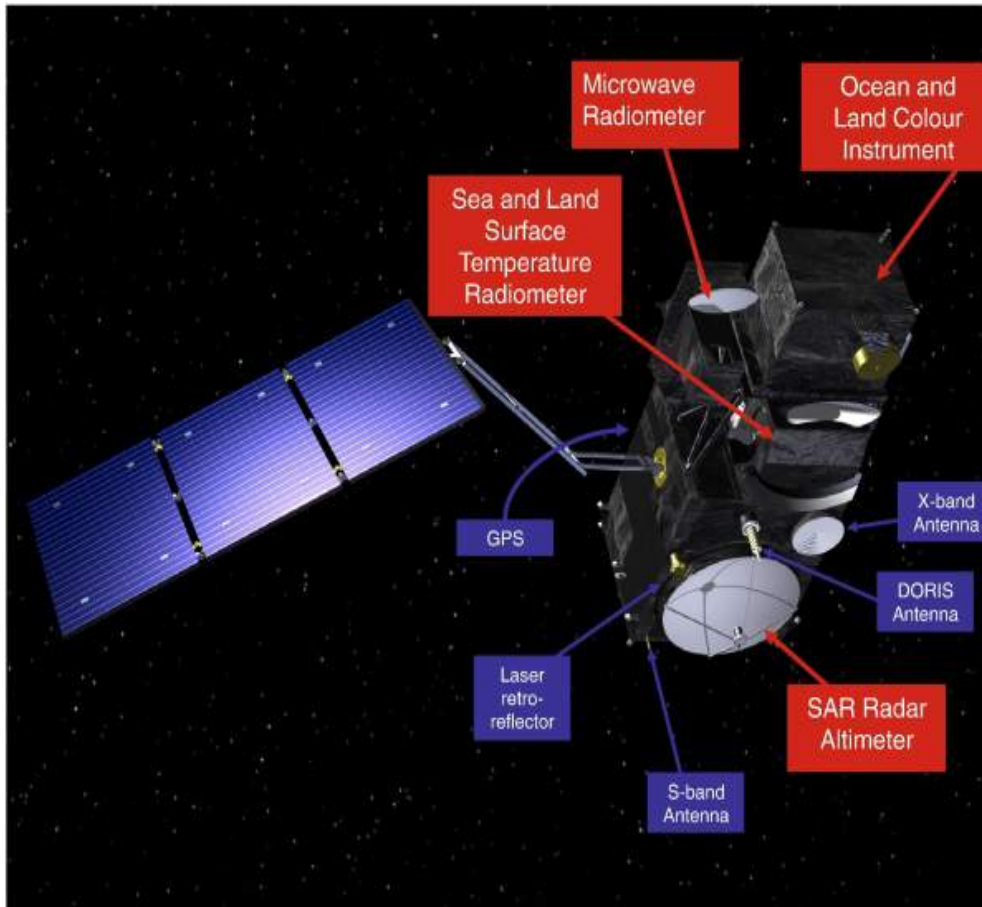
# Sentinel-3 Mission Status



Anja Strømme on behalf of the Sentinel-3 team

Scaling up the Sentinels in Europe | Wherever we all are | 26. October 2020

## Sentinel-3 mission overview

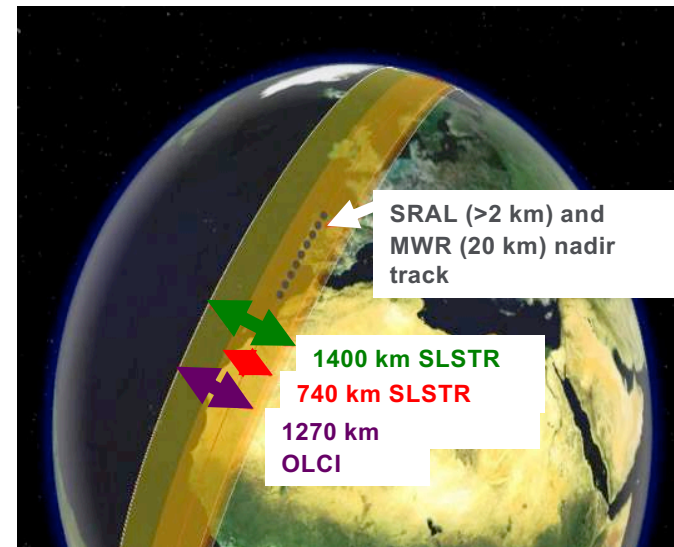


- **Operational mission:** constellation of S3A/B at 140° separation
- **Orbit:** polar, sun-synchronous at altitude of 815 km
- Full performance achieved with 2 satellites in orbit (S-3A,-3B)
- **Payload**
  - Optical: OLCI and SLSTR
  - Topography: SRAL, MWR, POD
- Data continuity of ENVISAT-MERIS (OLCI), ERS-ATSR, ENVISAT-AATSR (SLSTR)
- Data continuity of the Vegetation instrument (on SPOT4/5) and Proba-V
- Enhanced fire monitoring capabilities, river and lake height, atmospheric products

## Sentinel-3 versus legacy missions

- **100% overlap** between SLSTR and OLCI
- **Increased number of bands** compared to both AATSR and MERIS allowing
  - Synergy between OLCI and SLSTR measurements
  - Enhanced fire monitoring capabilities
- **Broader swath**
  - OLCI: 1270 km
  - SLSTR: Nadir view 1400km, Oblique view: 740km
- Optical payload **< 2 days global coverage** (with 2 Satellites) in view of the substantially increased swath
- **Increased spatial resolution:**
  - OLCI: 300m for land and ocean
  - SLSTR: 500m for VIS-SWIR, 1km for IR-Fire
- **Mitigation of sun glint** by tilting cameras 12.5 deg in westerly direction
- **Near-Real Time** (< 3 hr) availability of L2 core products

### Instrument Swath Patterns



Orbit type	Repeating frozen SSO
Repeat cycle	27 days (14 + 7/27 orbits/day)
LTDN	10:00
Average altitude	815 km
Inclination	98.65 deg



# Sentinel-3 status



The Sentinel-3A and -3B missions are in routine operations

**The overall status of the mission has stayed nominal through the ongoing COVID-19 pandemic**

All Sentinel-3 Level 1 and Level 2 core data products have been released to the user community

Re-processing of S3B SLSTR is completed and data is available through the Open Access Hub

Fire Radiative Power (FRP) products are since 19<sup>th</sup> August available through the regular data hubs.

The Aerosol Optical Depth products (SYN-AOD) are currently available through the expert hub.

Analysis on a potential 3 satellite constellation (Sentinel-3A, -3B and -3C) is ongoing

On-going analysis for extension of OLCI acquisition in low sun light conditions.

Working with the Commission and EUMETSAT on preparing Copernicus in the next MFF



# Sentinel-3 Mission Product Responsibilities

<p><u>L2 Atmosphere</u> NRT AOD &amp; FRP</p>	<p><u>L2 Atmosphere</u> Offline AOD &amp; FRP</p>

L1 Global  
OLCI Full & Reduced Resolution  
SLSTR  
SRAL/MWR

L2 Marine  
OLCI Full & Reduced Resolution  
SLSTR  
SRAL/MWR

L2 Land  
OLCI Full & Reduced Resolution  
SLSTR  
SRAL/MWR  
Synergy

# S3 STM Land Mission



“NEW” definition of the ESA S3 STM LAND products:

## Cryosphere



Inland Waters



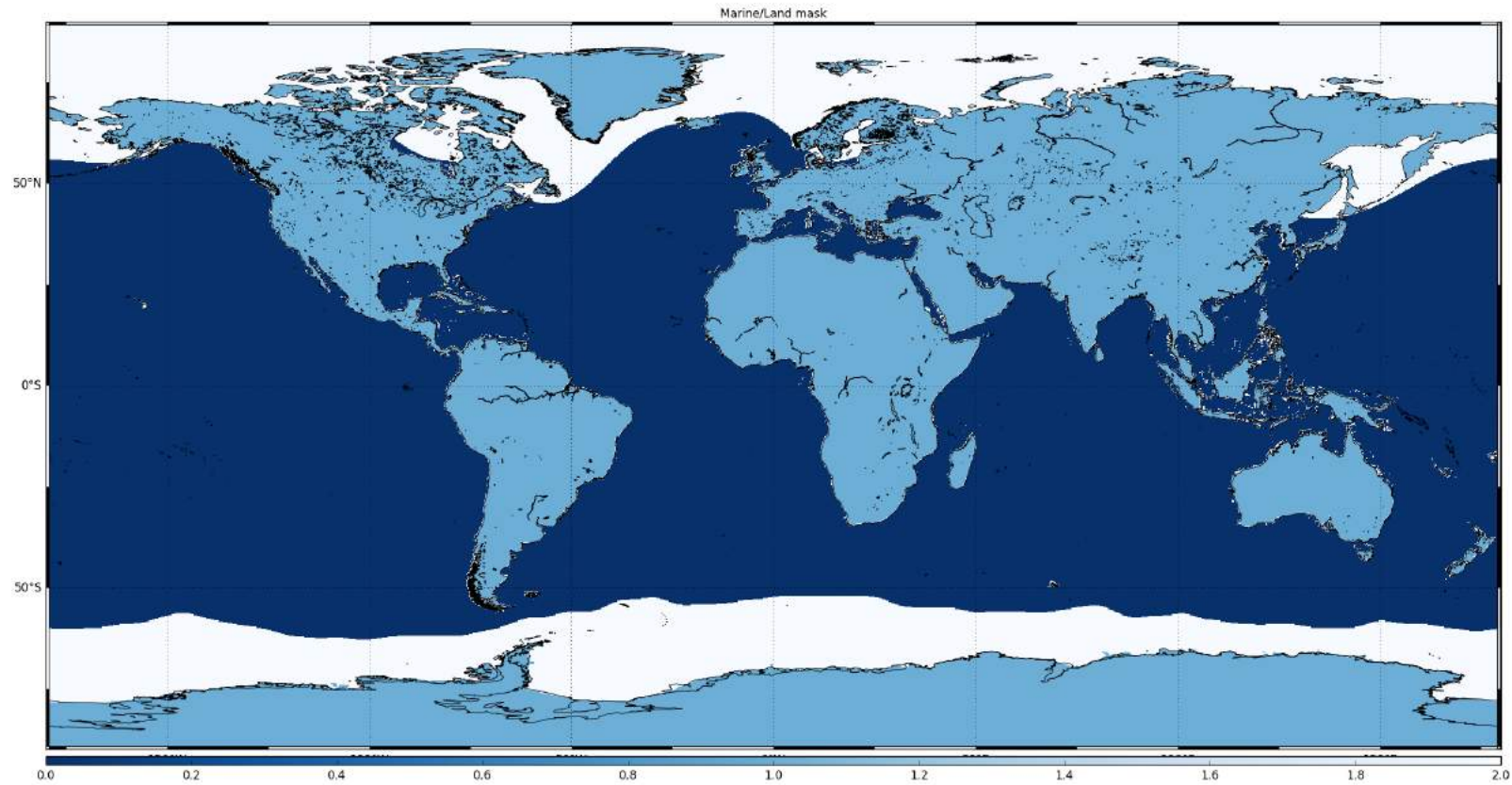
Land Ice



Sea-Ice

- ESA & EUMETSAT recently converged on a better definition of the S3 STM LAND and MARINE products!
- **ESA (LAND PDGS) takes full responsibility for the Inland Waters & Cryosphere**, i.e. land ice and sea-ice (= geophysical products describing the ice e.g. sea-ice thickness, sea-ice extent, sea-ice movement, ... are under ESA responsibility)
- EUMETSAT (**MARINE** PDGS) takes full responsibility for the coastal zone (on top of Open Ocean) and polar zones (geophysical products describing the sea e.g. SSH, SSH is under EUMETSAT responsibility)
- **"Land/Sea" mask update** with a ~20 km overlap along the coast line (Land mask reaching ~10 out in the ocean, ocean mask reaching ~10 km inland)
- **Agreed split** of the Altimetry Level-1 processing chain into different branches

# S3 STM LAND/MARINE Mask

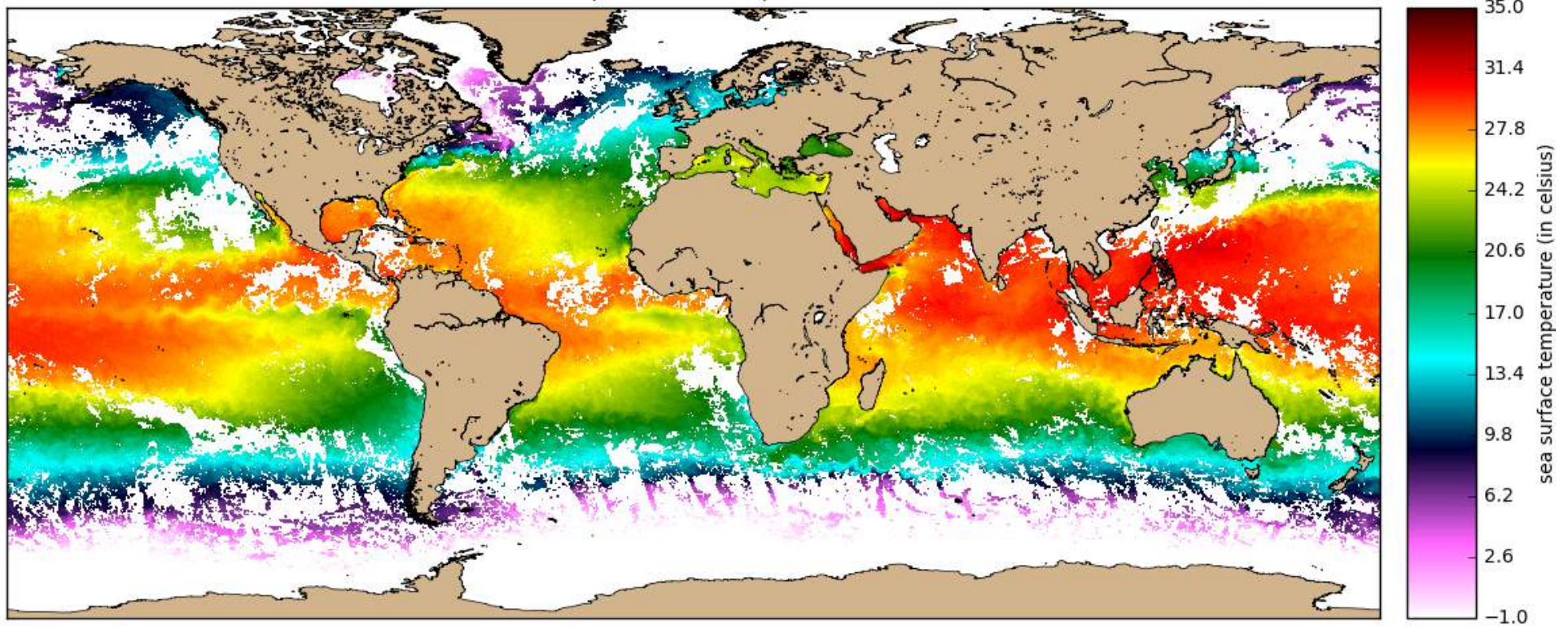


- Marine
- Land
- Common

**NEW mask!**



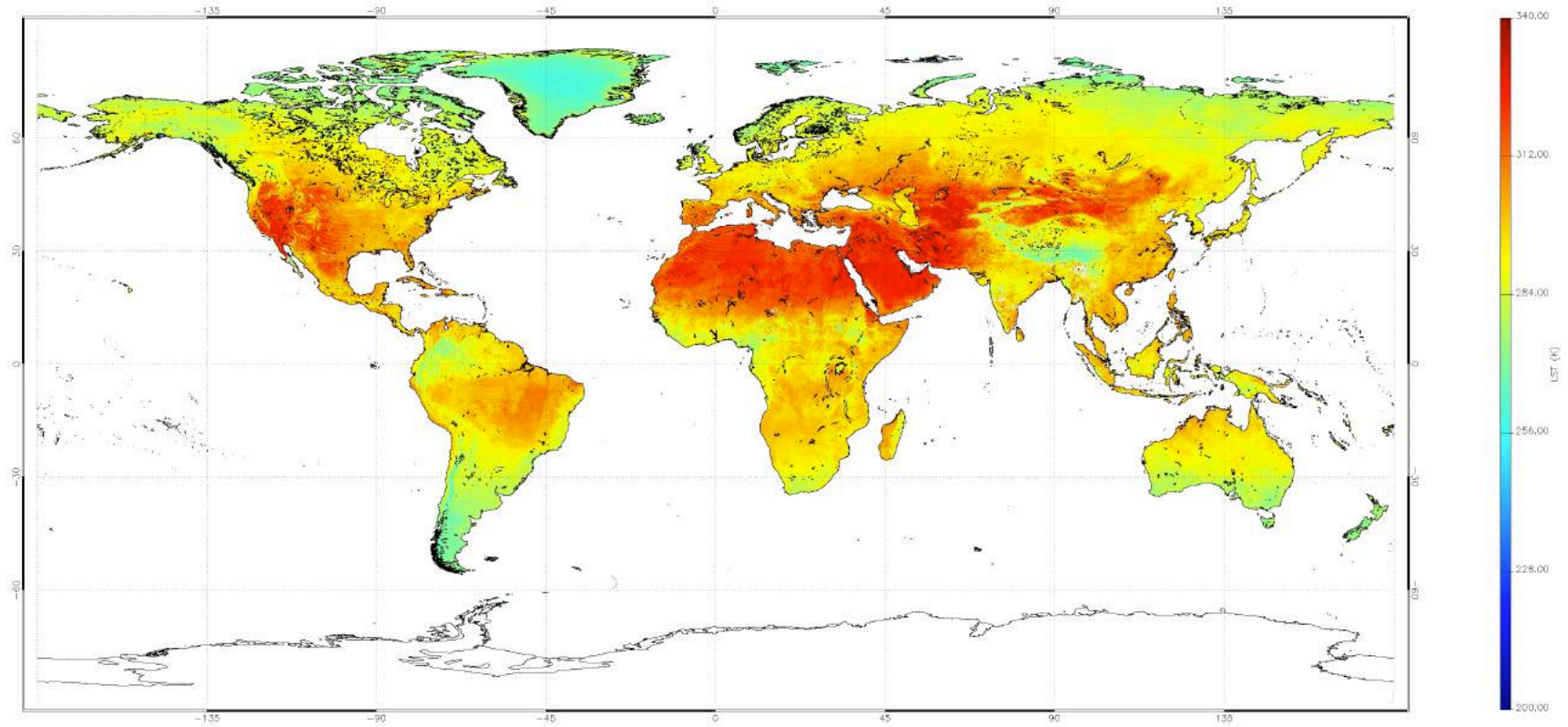
**sea surface skin temperature**  
15-19 Jun 2017 composite - Sentinel-3A / SLSTR WST NR [PB2.16]-  
N = 1427346, min = -1.99 C, max = 36.71 C



contains modified Copernicus Sentinel data

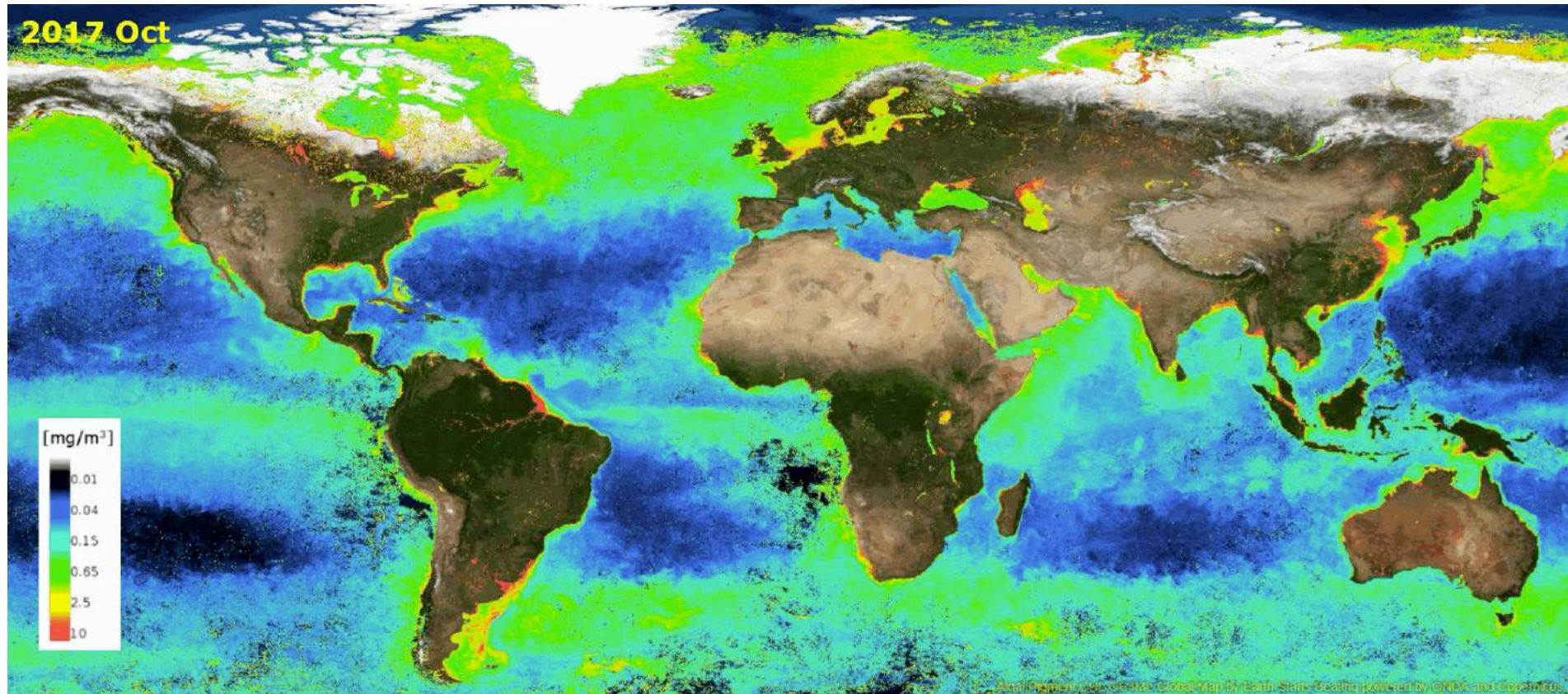


# Seasonal Land Surface Temperature 2017



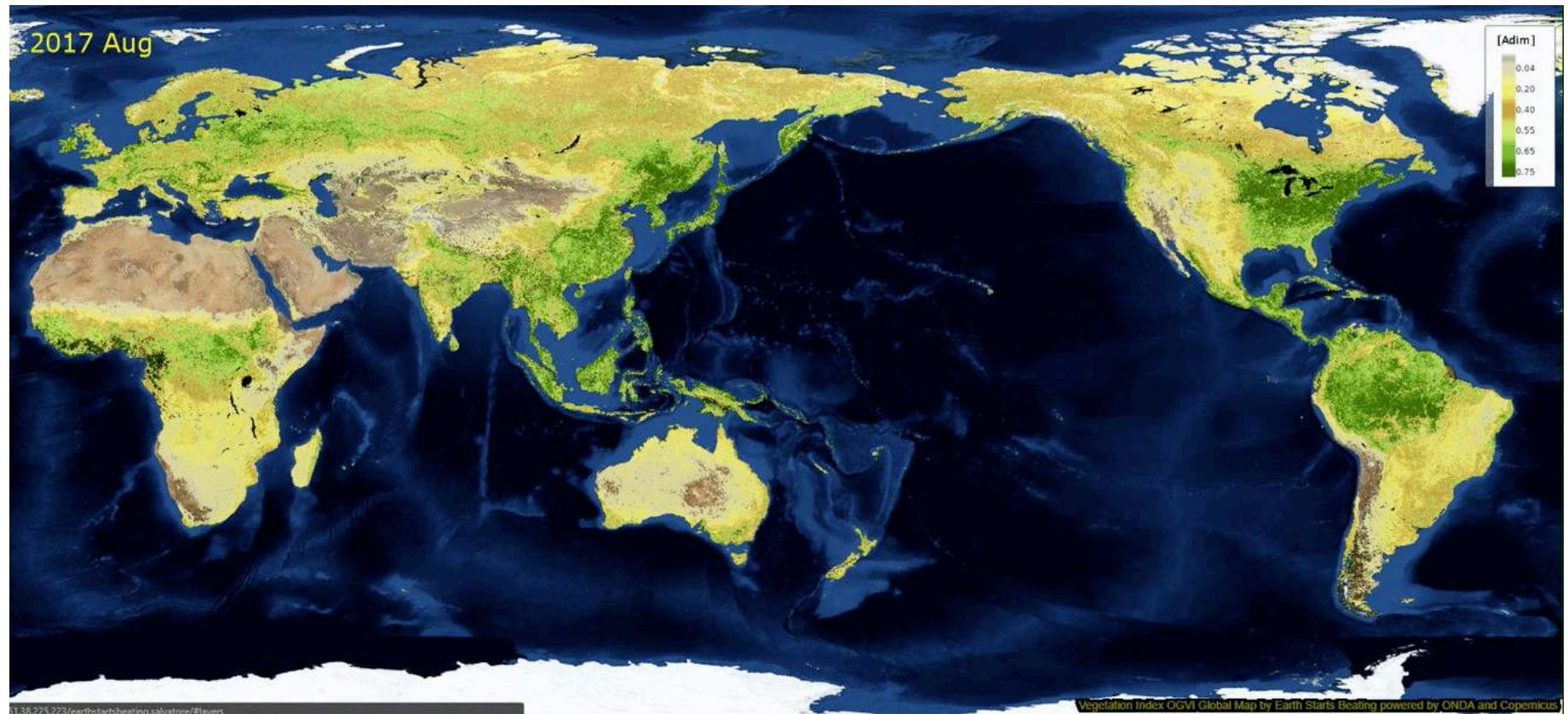
contains modified Copernicus Sentinel data

# Algal pigments



contains modified Copernicus Sentinel data

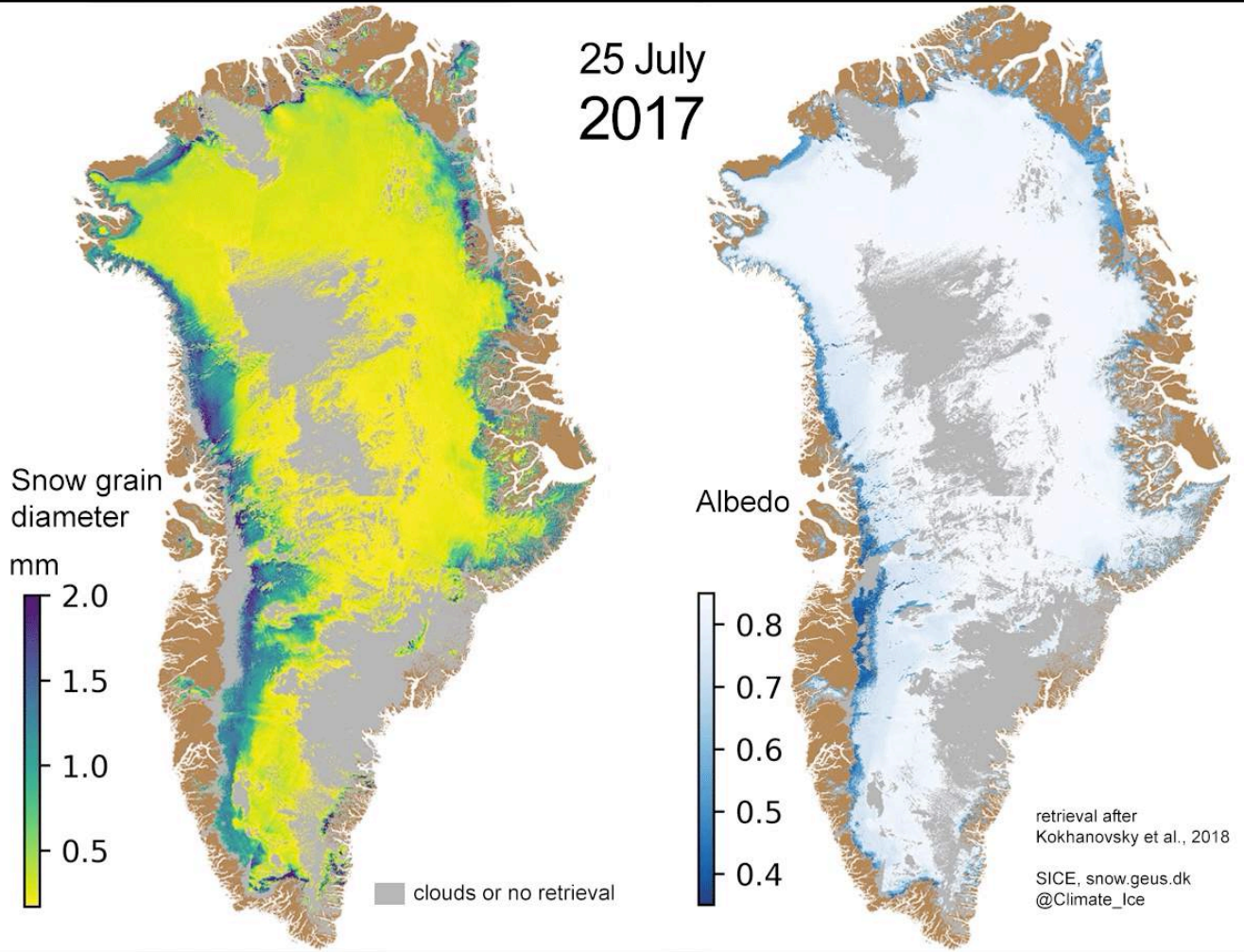
# Vegetation index 2017 - 2018



contains modified Copernicus Sentinel data

Greenland snow grain diameter and snow/ice albedo  
Copernicus Sentinel-3 Ocean and Land Colour Instrument

25 July  
2017

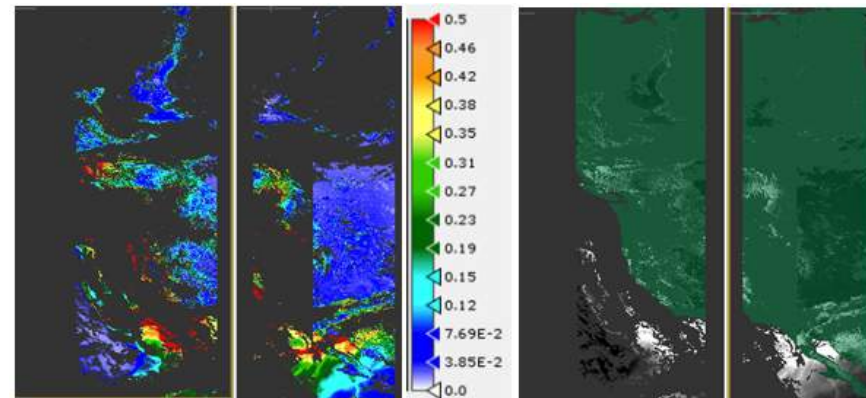


# California on fire



On this Copernicus Sentinel-3 OLCI image acquired on 10 September 2020, the huge orange cloud covering most of the California coast is clearly visible.

**Copyright:** Contains modified Copernicus Sentinel data (2020)/processed on the Sentinel-Hub EO Browser

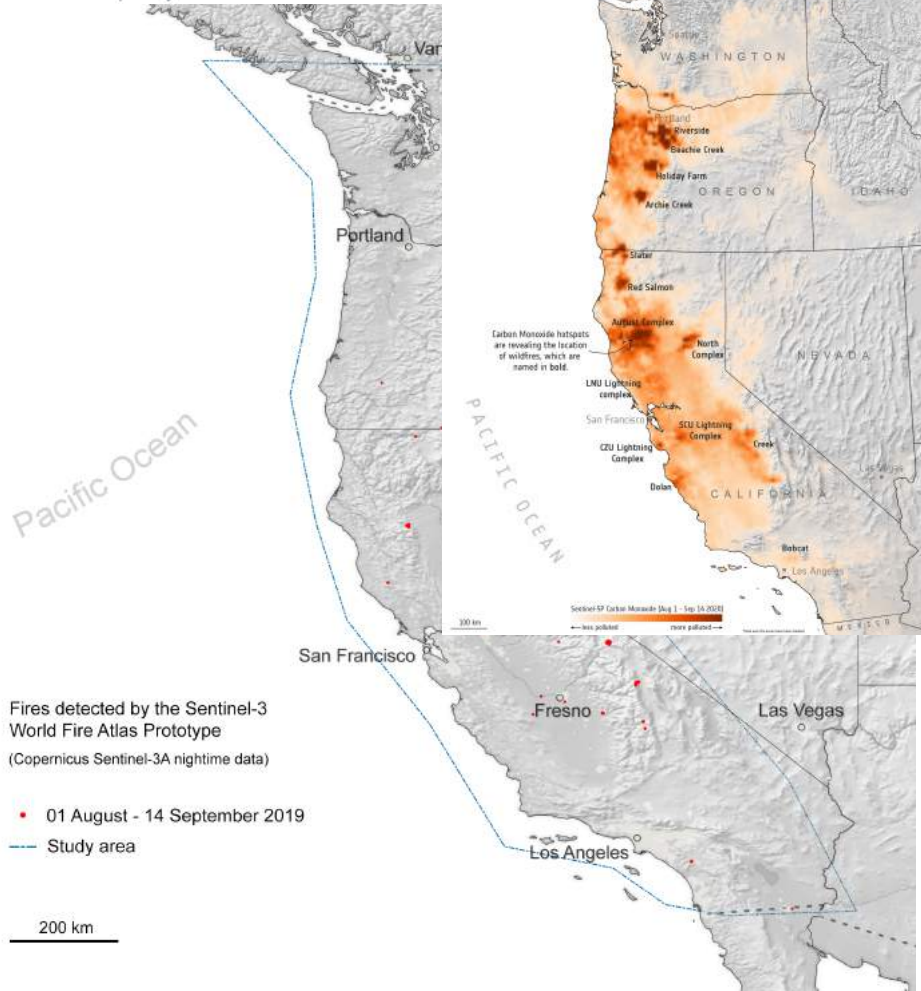


Copernicus Sentinel-3 aerosols over California

**Description:** On this image, acquired by Copernicus Sentinel-3 on 12 September 2020, we can view on the right the land flag in green, and on the left the aerosols optical depth over California and Mexico

**Copyright:** Contains modified Copernicus Sentinel data (2020)/processed by ACRI

# California on fire

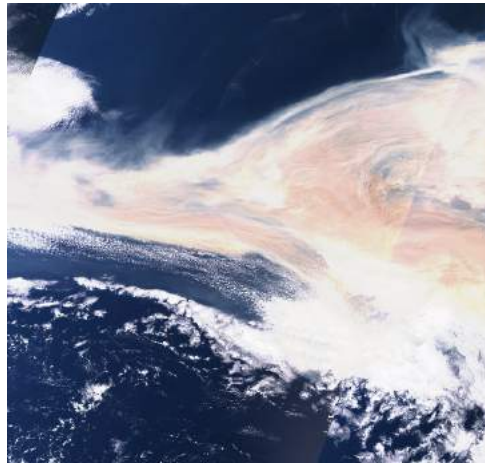


Fires detected by the Sentinel-3 World Fire Atlas Prototype (Copernicus Sentinel-3A nighttime data)

• 01 August - 14 September 2019

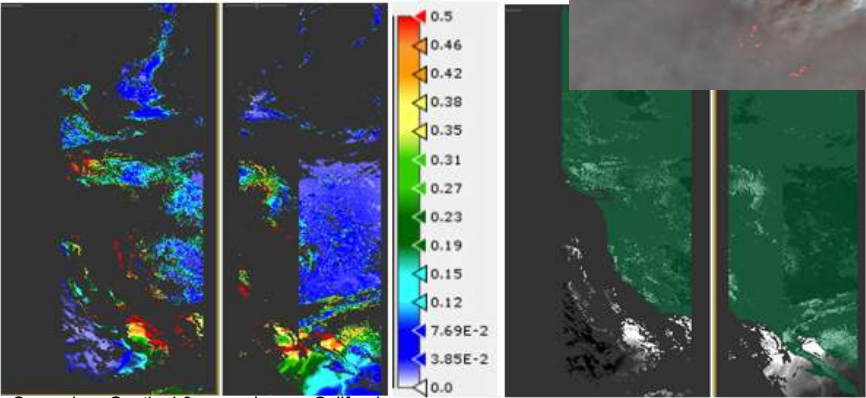
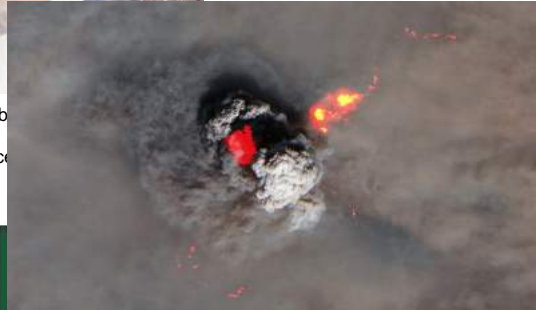
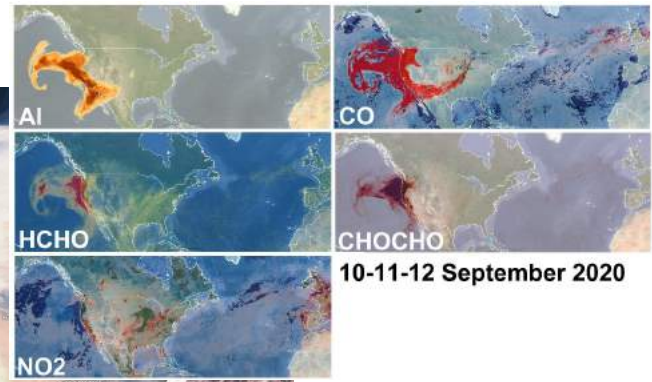
— Study area

200 km



On this Copernicus Sentinel-3 OLCI image acquired on 10 September 2020, the California coast is clearly visible.

Copyright: Contains modified Copernicus Sentinel data (2020)/processed by ACRI



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Description: On this image, acquired by Copernicus Sentinel-3 on 12 September 2020, we can view on the right the land flag in green, and on the left the aerosols optical depth over California and Mexico

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# Sentinel-3 orbital data

## Current Sentinel-3 A and B models orbital data

a. Repeat cycle : 385 orbits - 27 days duration

b. Orbit plane

- *Altitude: 814 km (equatorial)*
- *Inclination: 98.64°*
- *Local Time of the Descending Node: 10:00*

c. Two satellites separated by 140° in anomaly (140° Phasing)

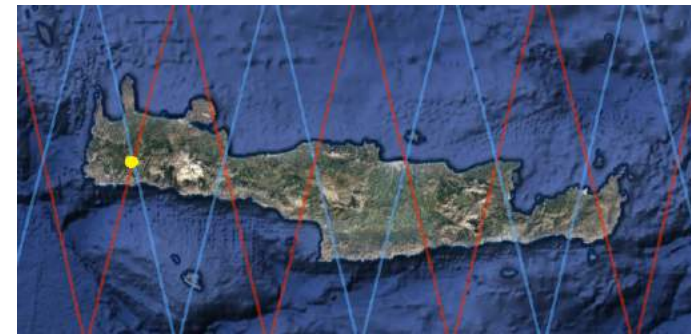
- *interleaved A and B ground tracks*
- *both flying over the Crete transponder*

d. Sentinel-3A and 3B Optical Mission Coverage time

- *OLCI*      *Maximum coverage time over Ocean surfaces*      *3.0 days*  
                   *Maximum coverage time over Land surfaces*      *2.0 days*
- *SLSTR*    *Maximum coverage time Near Nadir view*      *1.5 days*  
                   *Maximum coverage time with both SLSTR views*      *2.5 days (backward acq.)*

e. Sentinel-3 Topo mission revisit time of A and B Models is equal to the repeat cycle duration (27 Days)

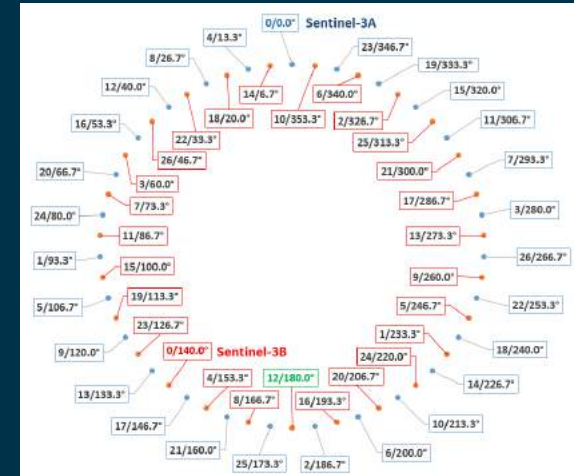
S-3A (blue) and S-3B (red)  
Crete Transponder ● Over-flight



# Sentinel-3 phasing options

## Sentinel-3A and B phasing options

- a. Having an identical A and B orbital plane, and, aiming at science acquisition along the same earth fixed ground track provides 27 phasing possibilities (Day 0 to 26), A model defines Day 0 at  $0^\circ$  phasing, any of the 26 remaining available positions allocates a Day and a phasing angle, see figure – **blue positions**
- b. Targeting a different ground track in the same orbital plane shifts the phasing angle, defining a new reference for day 0 and a dedicated set of “interleaved” phasing, initial A and B model phasing was set to  $180^\circ$  (SY-OR-210)
- c. This  $180^\circ$  was later moved to  $140^\circ$  with the same ground track, see figure – **red positions** (rationale provided in EOP-SM/2896/CD-CD : Optimised phasing of Sentinel-3 Models)
  - in order to optimize the ground track interleave space ... Topo mission benefit
  - also keeping B flight over the Crete Transponder ..... Topo mission constraint
  - while minimizing the loss of OLCI Coverage compared.... Optical mission tradeoff  
with the initial  $180^\circ$  B phasing





# Sentinel-3C phasing options

- A study identifying the options for a 3-satellite constellation phasing has been conducted related to the integration of Sentinel-3C in the Sentinel-3 Constellation
- A number of phasing options have been identified and analysed with 4 selected as the best candidates under the following assumptions:
  - a. Sentinel 3 orbital plane is unchanged : Altitude, Inclination and Local Time of the Descending Node being kept as they are
  - b. Sentinel-3 Models are operated within the 27 options provided by the two (A, B) active ground tracks, with the following rationale for what concerns the mission objectives
    - Optical: Ensuring identical acquisitions conditions for all models
    - Topo: Pursuing A duty over water and dedicated land targets after A end of life  
Ensuring Crete Transponder overflight by A, B and C
  - c. Optical Mission : Enhance the optical coverage up to requirements expectations
  - d. Topo Mission : improve the sampling of mesoscale ocean features while optimizing / reducing the inter-track minimum distance within the 4-days sub-cycle of the complete repeat cycle (27 days)

# Sentinel-3C phasing options



- The Copernicus services have been asked by ESA and EUMETSAT to provide feedback on the selected options, and in the process CMEMS suggested a fifth option which is being analysed and will be sent out to the remaining services for comments.
- The feedback from the Copernicus services will be shared with the Commission, and the selected candidate(s) will be analysed for operational constraints and cost before a selection is made



# Sentinel-3C phasing options

	Current	Optimizing Topo	Optimizing Optical	Optimizing Optical	Better Topo Optimized Optical
Constellation \ Acquisition	A 0° B 140°	A 0° B 140° C <b>293°</b>	A 0° B 140° C <b>240°</b>	A. 0° B 140° C <b>280°</b>	A 0° B 113° C. <b>240°</b>
OLCI Land	2.0 d	1.3	1.2	1.2	1.2
OLCI Ocean	3.0 d	2.0	1.8	1.8	1.8
SLSTR Nadir	1.5 d	0.75	0.75	0.75	0.65
SLSTR Back.	2.5 d	1.5	1.5	1.5	1.5
Minimum «4 day sub-cycle» intertrack distance	360 km	360	360	360	310
Revisit Time Topo	27 d	20	19	24	20

Recommendation from CMEMS: use 290° instead of 293.3° (Option 1) and 236.67° instead of 240° (Option 4). This will:

- Put unit C in between the two other (A, B) ground tracks (same time lag, same impact on downlink)
- Give a better spatial coverage (less duplication with unit A for mesoscale) and better space/time decorrelation
- Be relevant for new targets for geodesy (MSS improvement), polar ocean, coastal margins, and hydrology



**NEWS** - Sentinel-3A and -3B mission status reports available at:  
<https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-3/mission-status>



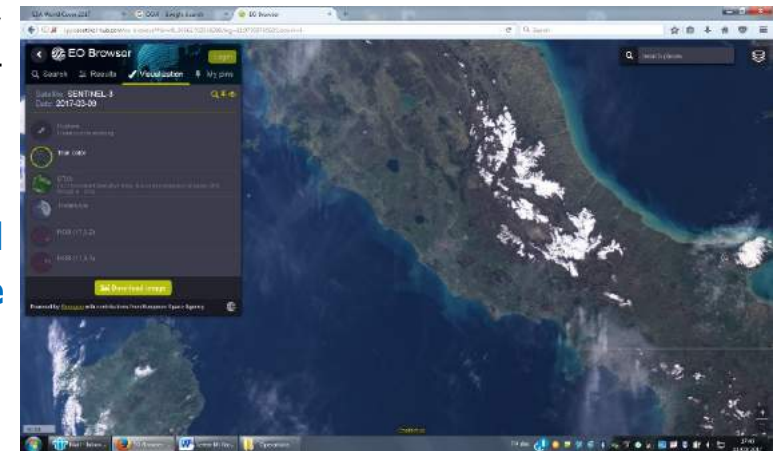
**TOOLS OVER LAND**

SNAP: Visualisation & processing of Sentinel-3 OLCI and SLSTR data and other optical data;  
<http://step.esa.int/>

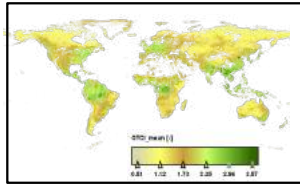


Visualisation of Sentinel-2, Sentinel-3, Landsat, Proba-V data : <http://apps.sentinel-hub.com/eo-browser/> (Sinergise, Slovenia)

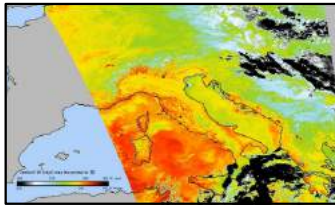
**In development: Tool to combine OLCI and SLSTR data at Level 1 – Version 1 available now**



# Sentinel-3 applications → ever increasing

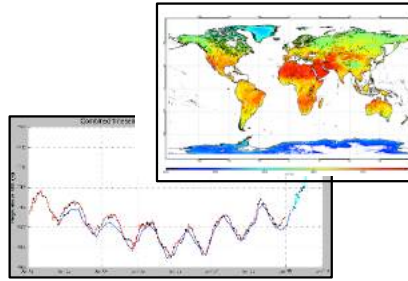
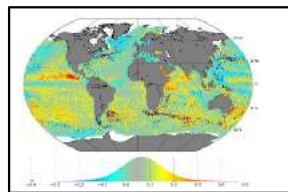


*Agriculture, vegetation monitoring*



*Climate monitoring, numerical modelling and mesoscale analysis*

*Ship routing: maritime safety*



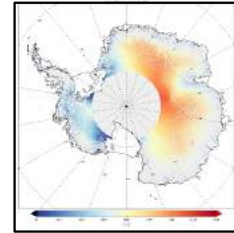
*Water resource management*



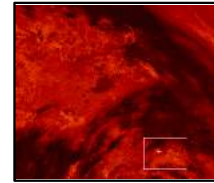
*Inland water quality*



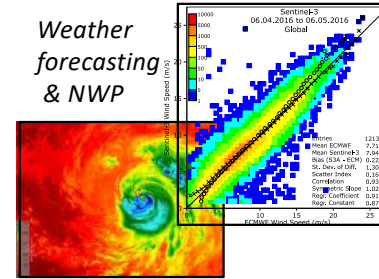
*Fisheries: Harmful algal bloom/marine biology/global ocean primary production*



*Climate research*

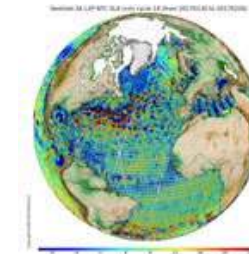
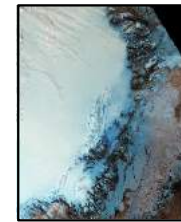


*Fire monitoring*



*Weather forecasting & NWP*

*Snow and Ice*



*Mesoscale ocean circulation, currents, tides*