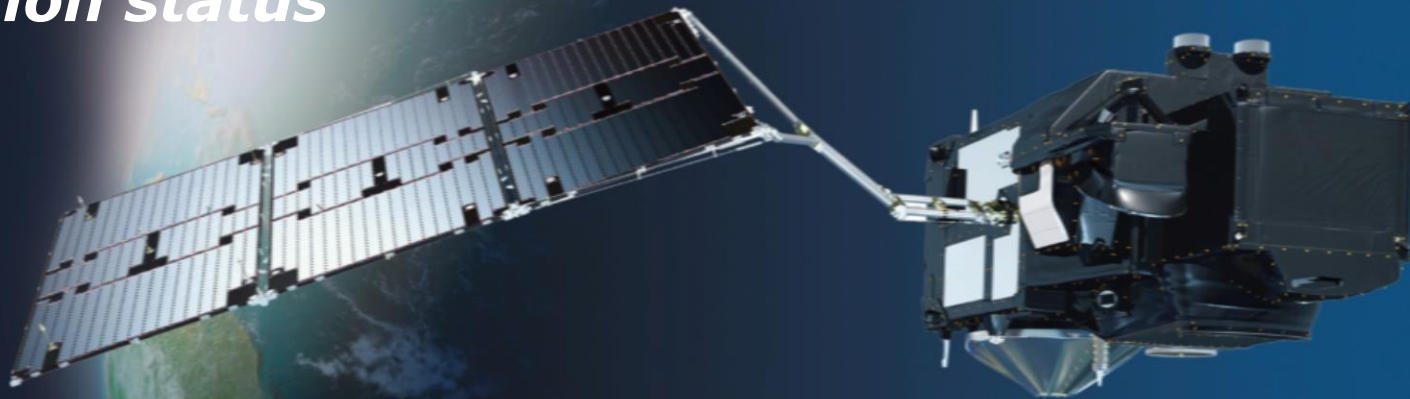




The Sentinel-3(A) Mission:

Mission status



***Steffen Dransfeld, Susanne Mecklenburg, Ferran Gascon and
Sentinel 3 MPC***

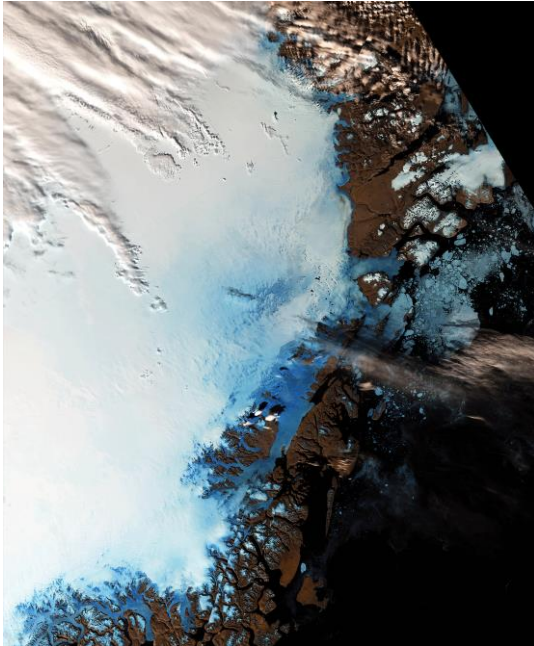


Data release until now - summary

- ❑ All **Level 1** data products have been released
(with the exception of new SRAL L1A and L1B-S, planned for Feb 2017)
- ❑ **Level 2**
 - ❑ SRAL over land and ocean released in Dec 2016
 - ❑ OLCI and SLSTR sample data products are available to expert users, official release planned for April 2017
 - ❑ SYNERGY products: Q2/2017
 - ❑ AOD and FRP: Q3/2017
- ❑ Sample products of not released core products available to expert user

Data product (*)	Released on (2016)	Available data (2016)
OLCI L2 over land (ESA)	20 June	20 June - today
OLCI L2 over ocean (EUMETSAT)	22 June	22 June - today
SLSTR L2 - LST (ESA)	20 June	9 June - today
SLSTR L2 - SST (EUMETSAT)	21 June	21 June - today
SRAL L1A/1BS	21 Dec	21 Dec - today

- ❑ Reprocessed data sets for the Sentinel-3 Validation Team workshop released end of January 2017



- ❑ Ocean and Land Colour Instrument (OLCI) designed for observation with high absolute (relative) accuracy of 2 (1) % in reflectance, providing continuity for MERIS (Envisat)

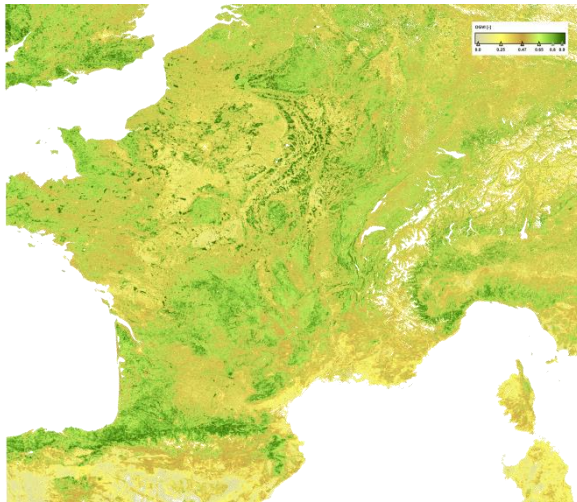
❑ Level 1 performance

- ❑ Radiometry: on-board radiometric calibration based; SNR is compliant with specification; calibration gains show some time variability but stability seems to improve with time; vicarious calibration shows spectrally/spatially/dynamically/X-track consistent results, however a $\sim +3\%$ bias (yaw steering maneuvers for diffuser BRDF characterization)
- ❑ Spectrally: fully compliant; pre-flight characterisation confirmed for all cameras in-flight ($<0.15\text{nm}$); small temporal trends since beginning of the mission (comparable to MERIS)
- ❑ Geometry: fully compliant (60m @ Nadir); bi-monthly check that thermo-elastic model is accounting for seasonal variations.

Switch on	29 Feb 2016
Sample L1/L2 data available	May/June 2016
L1 data release	20 Oct 2016
L2 data release	Spring 2017

OLCI: Status Level 2 LAND

OLCI Global Vegetation Index (OGVI), 19 July 2016



❑ **Level 2 validation on-going**

- ❑ Cloud flag needs improvement
 - ❑ L2 products unavailable for inland waters
 - ❑ Improving standard product flags
-
- ❑ ESA FRM4VEG project planned for vegetation relevant data products from S2 and S3 (2017)
 - ❑ First validation activity shows a good consistency between OLCI Terrestrial Chlorophyll Index and the historical MERIS TCI (University of Southampton, Jadu Dash).
 - ❑ Over six selected sites OLCI FAPAR shows a relatively good agreement with FAPAR derived from MODIS at 250 m (Correlation of 0.96 and RMSE of 0.07), (Jadu Dash).

Switch on	29 Feb 2016
Sample L1/L2 data available	May/June 2016
L1 data release	20 Oct 2016
L2 data release	Spring 2017

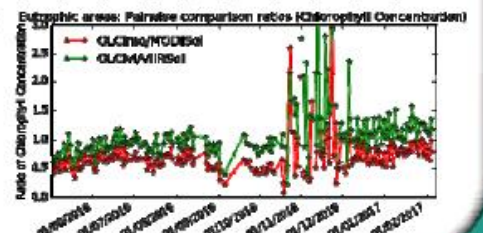
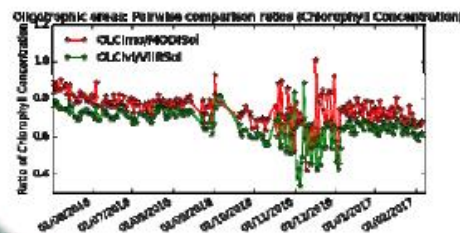
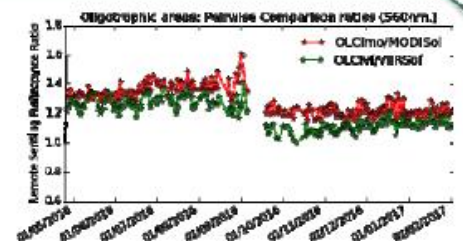
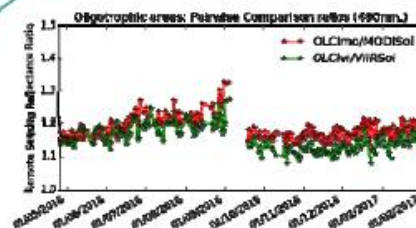
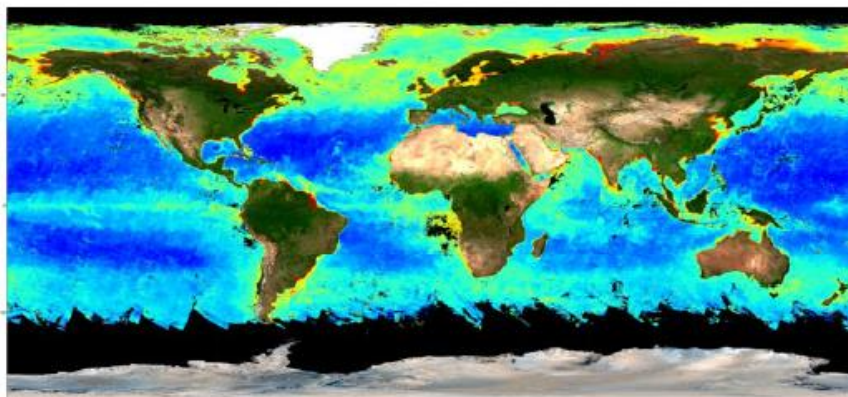
OLCI L2 Marine Status

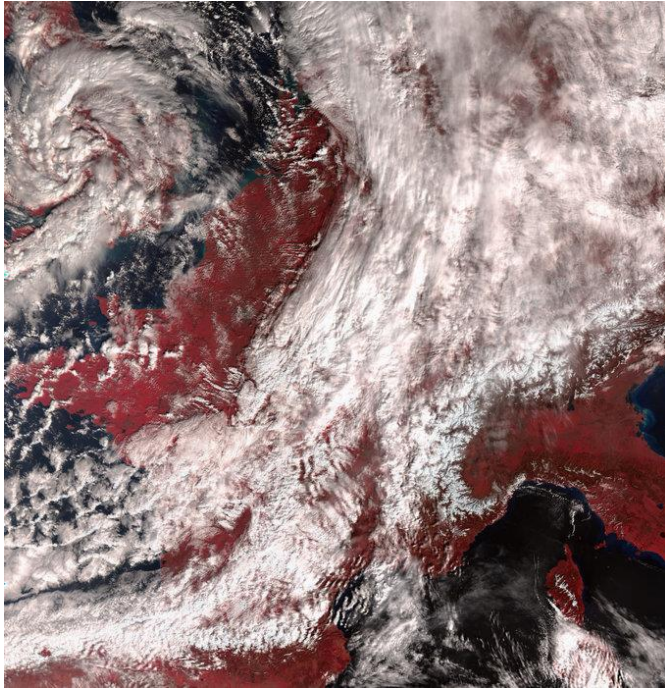
- Product Releases:

- Initial Marine Level-2 products **released** to S3VT 21st June 2016
- Reprocessed data **released** 25th January 2017 (covering 26th April to 15th August 2016)
- Operational Marine L2 NRT data release **planned** in April 2017
- Operational Marine L2 NTC data release **planned** in April 2017

- Product Validation Status:

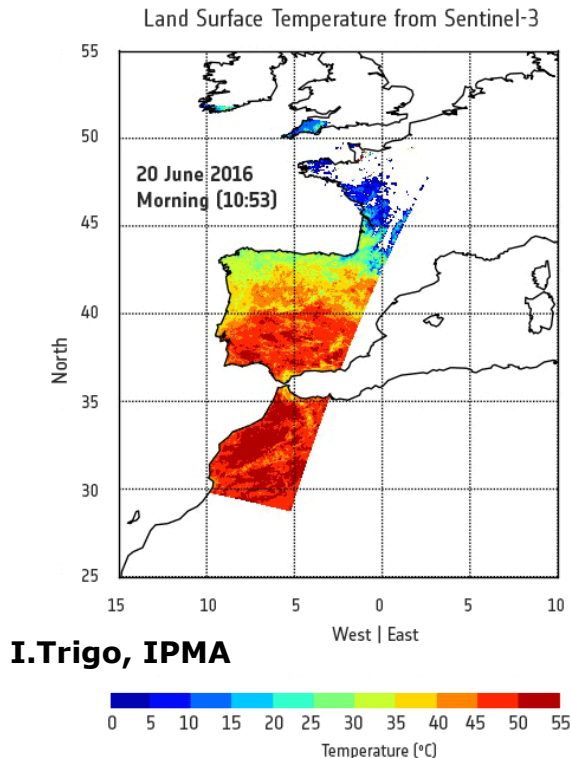
- Reprocessed Ocean Colour Level-2 products
 - Implemented turbid water products (CHL_NN, TSM_NN, ADG443_NN)
 - Updated Bright Pixel Atmospheric Correction (BPAC, i.e. NIR correction)
 - Updated cloud flagging
 - Updated atmospheric correction of inland waters
- Known product quality limitations
 - Water-leaving reflectance and bio-optical product biases
 - Quality of turbid water products, cloud flags
- L1 and L2 limitations to be addressed before L2 operational data release
 - OLCI L1 radiometric calibration bias and temporal degradation
 - Implementation of gains derived from system vicarious calibration
 - Product quality assessment (including new changes in turbid water, BPAC, flags, inland)





- ❑ Sea and Land Surface Temperature Radiometer (SLSTR) designed for observations with high radiometric accuracy $<2\%$ (BOL)/ $<5\%$ (EOL); $< 0.2\text{K}$ (0.1K goal), providing continuity for (A)ATSR (Envisat); 100% overlap with OLCI
- ❑ Nighttime acquisitions for S1-S4 ("day channels") over Siberia and Gulf of Guinea in Jan 2017 to be characterize gas flares (9 collocation with VIIRS)
- ❑ **Level 1 performance**
 - ❑ Corrections to Basic Cloud Screening - improved
 - ❑ SWIR calibration – improved, residual of 10%
 - ❑ Geometric calibration corrections in Nadir and Oblique – improved, some residual bias in oblique
 - ❑ Saturation thresholds – improved
 - ❑ Co-registration of fire channels and their nominal channels (F1/S7 and F2/S8)– TBD
 - ❑ Co-registration of VIS and SWIR – Feb 2017

Switch on	2 March 2016
Sample L1/L2 data available	May/June 2016
L1 data release	17 Nov 2016
L2 data release	Spring 2017



Level 2 validation on-going

- Depending on Level 1 quality
 - Need for fine tuning LST coefficients identified
-
- Initial validation using seven SURFRAD sites. The retrieval accuracy varies from 0.6 to 1.6 (MRD requirement < 1K) (University of Leicester, Darren Ghent)
 - Next validation steps in MPC ESL will be comparisons with MODIS and SEVIRI
 - LST coefficients are continuously being fine-tuned and uncertainty estimates will be improved
 - A probabilistic cloud mask will be introduced for better cloud flagging performance

Switch on **2 March 2016**

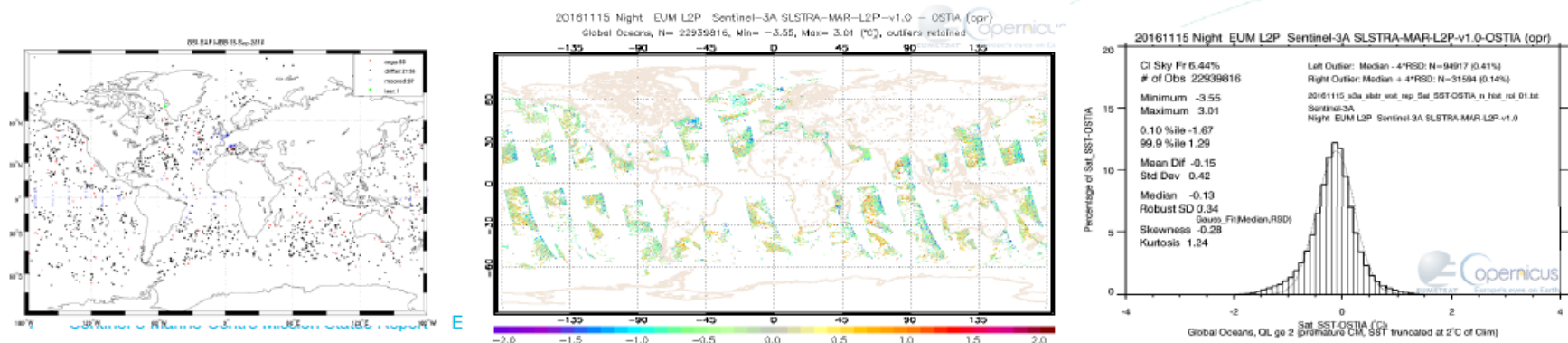
Sample L1/L2 data available **May/June 2016**

L1 data release **17 Nov 2016**

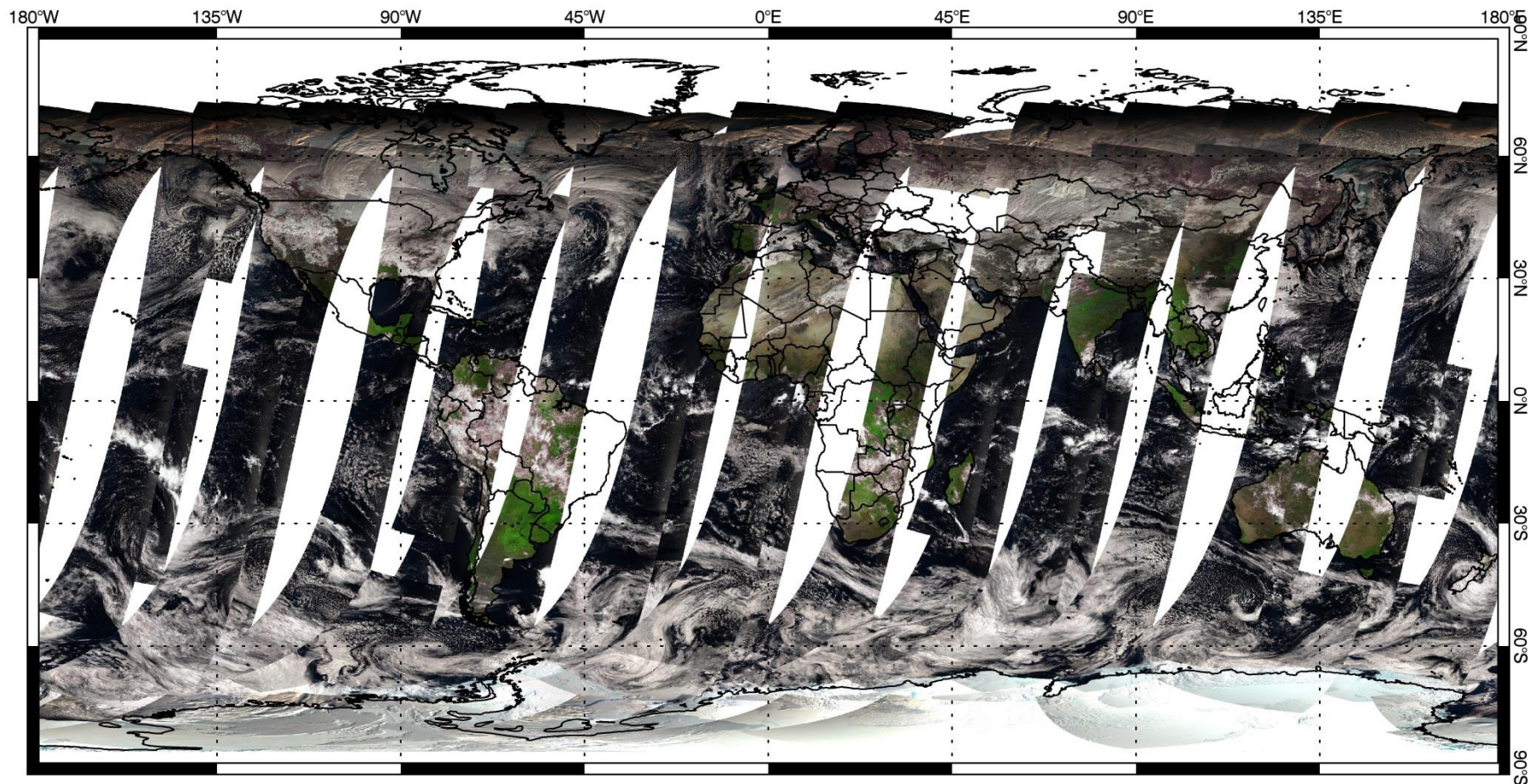
L2 data release **Spring 2017**

SLSTR L2 Marine Status

- **Product Releases:**
 - Initial Marine Level-2 products released to S3VT 21st June 2016
 - Reprocessed data released 25th January 2017 (covering 15th June to 15th November 2016)
 - Operational Marine L2 NRT data release planned in April 2017
 - Operational Marine L2 NTC data release planned in April 2017
- **Product Validation Status:**
 - Reprocessed SST Level-2 products
 - Improvements include: Theoretical uncertainty (hence quality level); correction of nedt bands; stratospheric aerosol flag incorrectly set influencing algorithm selection
 - Experimental SLSTR L1/L2 matchup dataset collocated with in situ data for reprocessed period made available to S3VT on 7th February 2016
 - Will be used to adjust the inter-algorithm biases in February to March timeframe
 - Derivation of Sensor Specific Error Statistics (SSES) to complete the SST product
 - NRT L2 products will update to Processing Baseline 2.10 (to be consistent with reprocessed products) from mid February 2017
 - Remaining L1 limitations to be addressed before L2 operational data release in April 2017
 - SLSTR L1 updates to oblique geolocation and co-registration to the nadir view
 - Further cloud screening updates
 - SST algorithm implementation improvements in May-July 2017 and further L2 tuning will continue



SLSTR L3 Quicklooks for Diagnostics based on L1 images

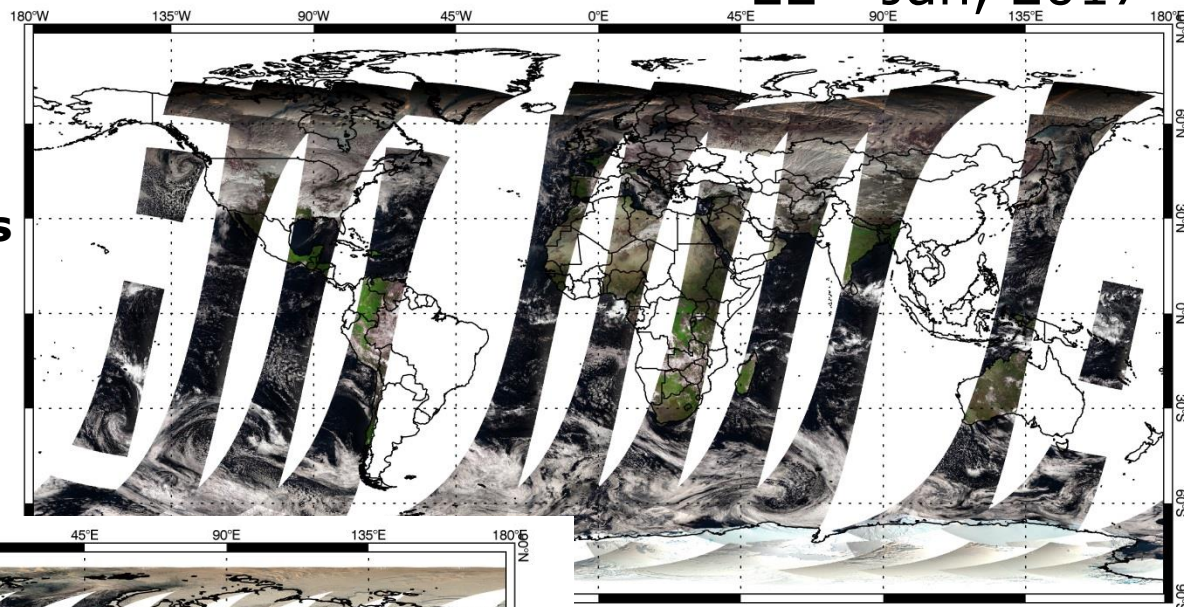


2 day composite - quick way to spot missing products,
discontinuities in solar zenith angle, cloud cover, etc

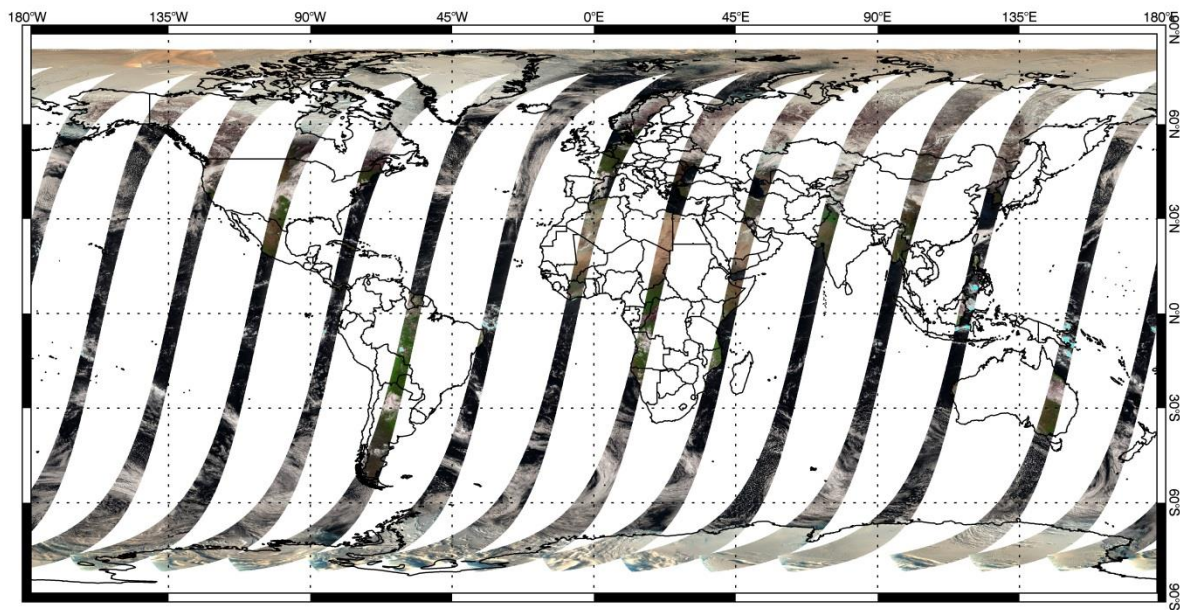
1 Day SLSTR L3 vs ATSR L3

22nd Jan, 2017

**Different coverages
immediately displayed.
Product gaps also clearly
shown, so an efficient tool
for some visible QC analysis
by the operators**



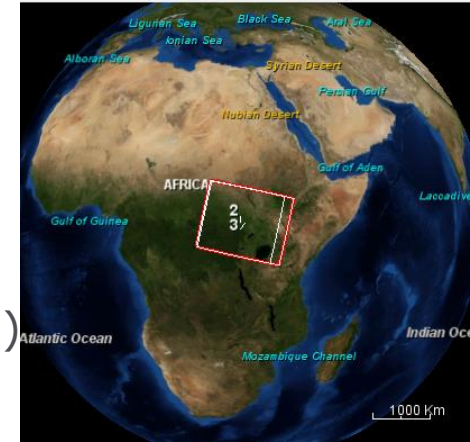
21st March, 2012



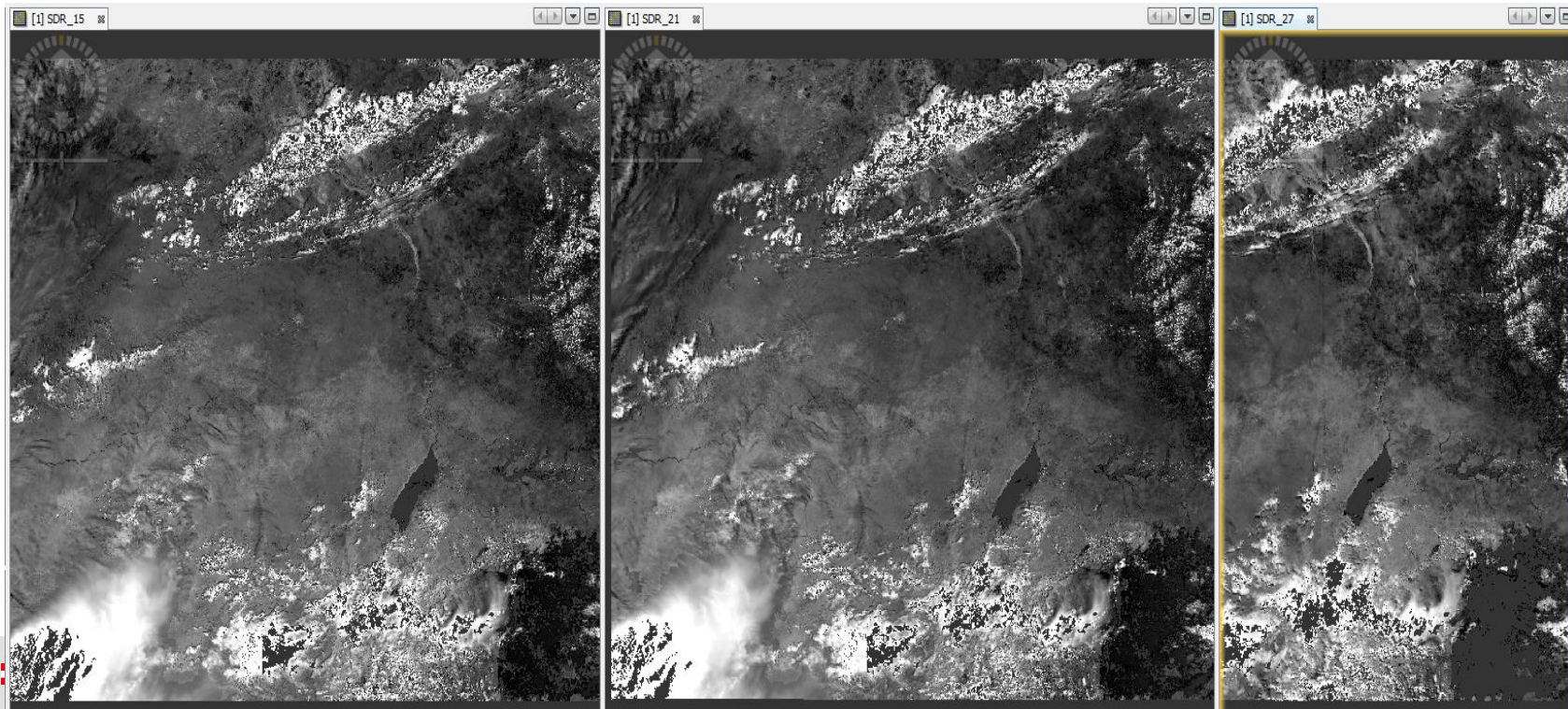
SYN/VGT L2 products

SYN 2 SYN products =

- Projected on the OLCI Image grid – 300 m resolution
- Segment product
- All OLCI + SLSTR solar channels(except Oa14, Oa15, Oa20)
- Included SDR, AOT(550 nm), AMIN, $A^\circ(550\text{nm})$, ...



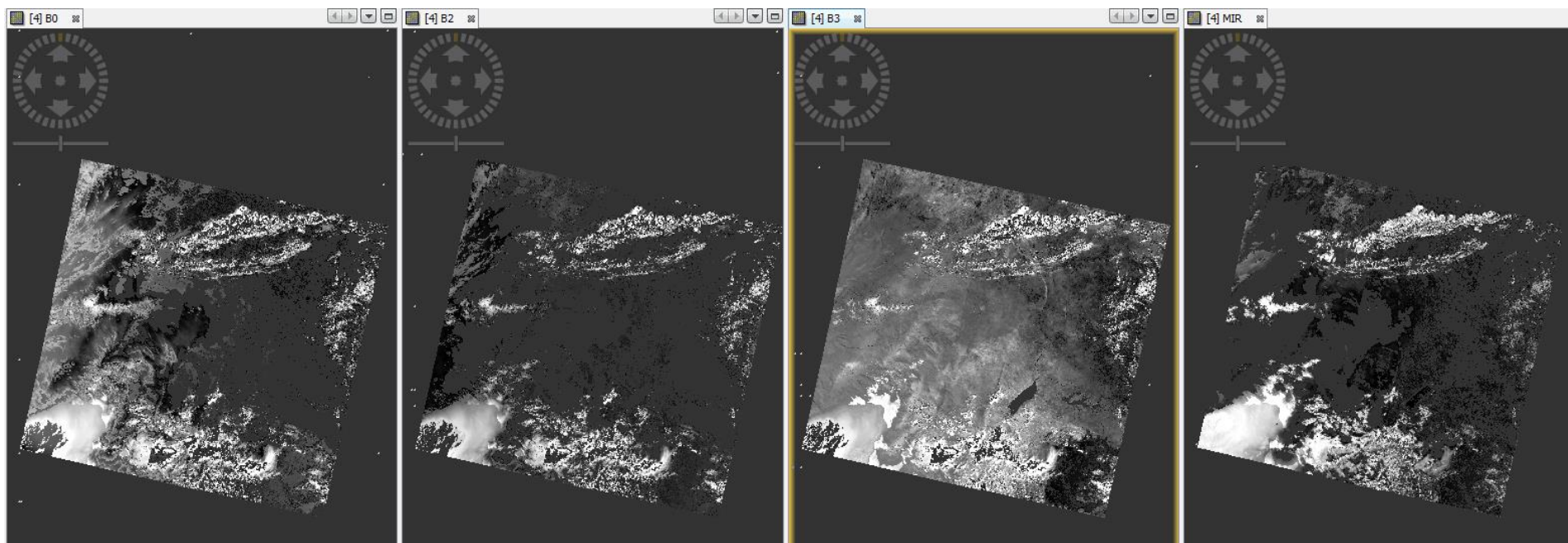
21/11/2016 – 07h51



SYN/VGT L2 products

SYN 2 VGP products =

- Projected on the 1 km Plate Carrée grid
- Segment product
- VGT channels
- Included TOA reflectance, AOT (sub-sampled), ...

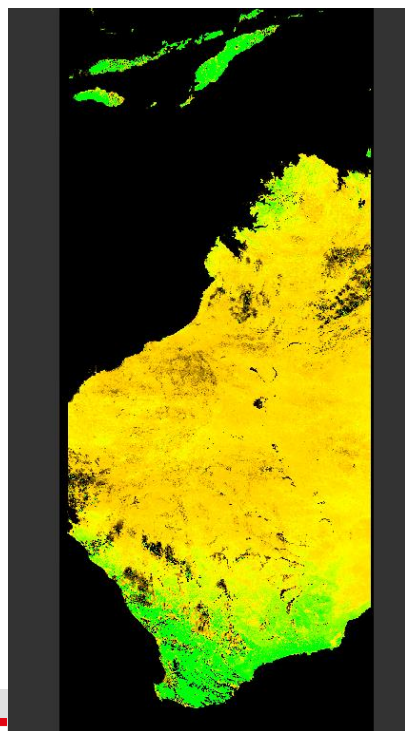


Slide 12

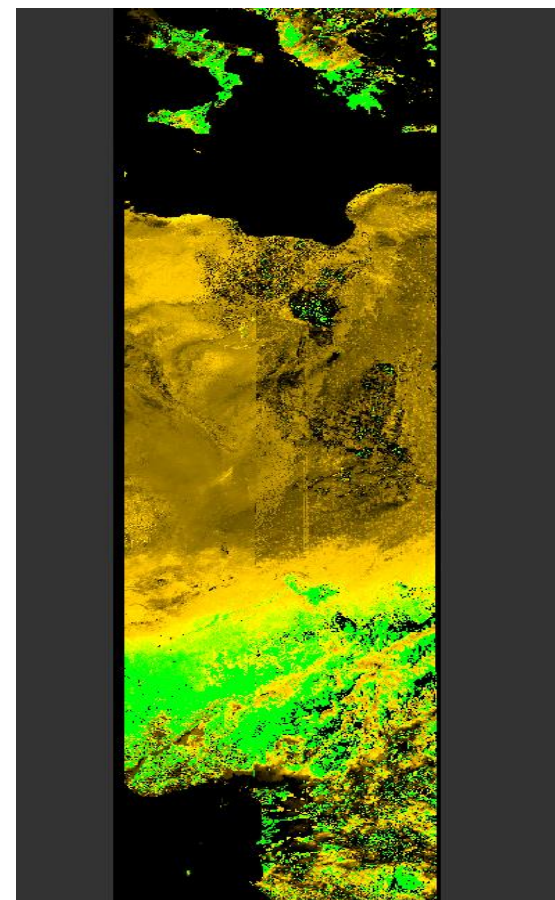
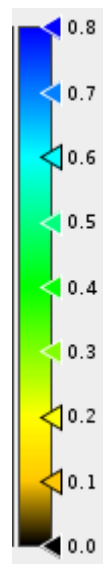
SYN/VGT L2 products

SYN 2 VG1 and SYN 2 V10 products =

- Projected on the 1 km Plate Carrée grid,
- Daily and Decadal composite
- VGT channels
- Included TOA reflectance, AOT, NDVI, ...



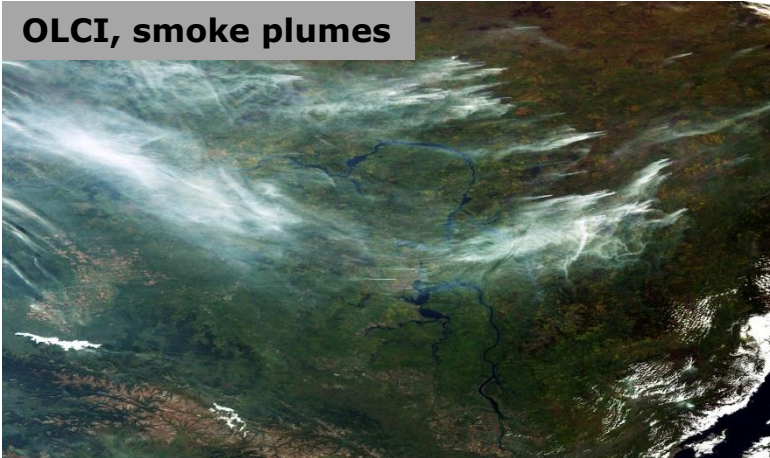
Western
Australia
(13/10/2016)



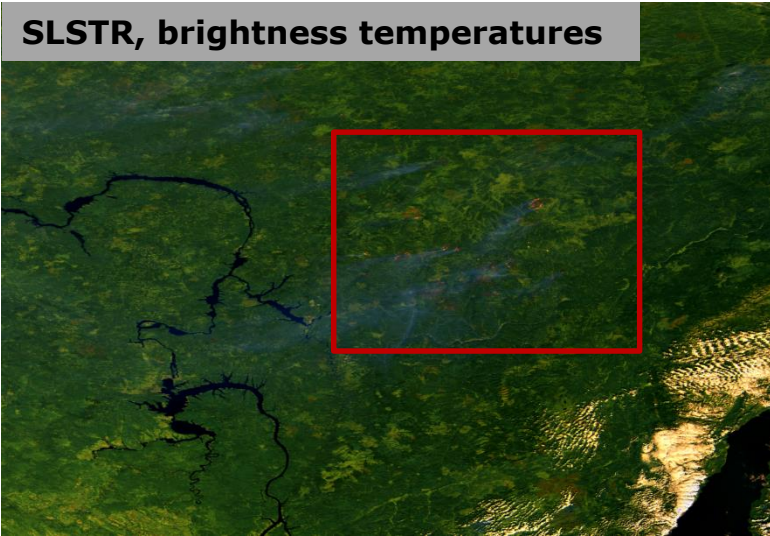
Northern Africa
(26/10/2016)

Fires in Siberia, September 2016

OLCI, smoke plumes



SLSTR, brightness temperatures



Aerosol Optical Depth (AOD)

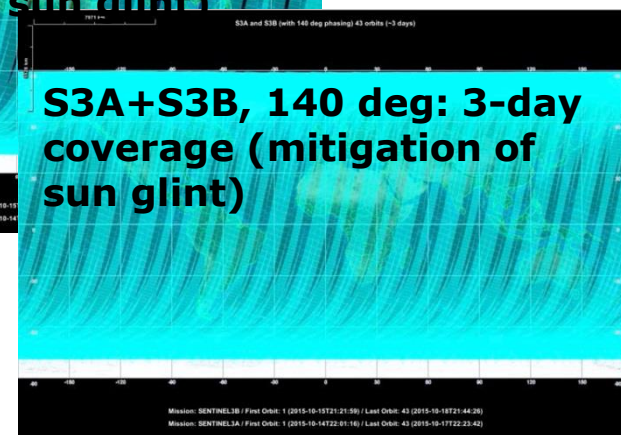
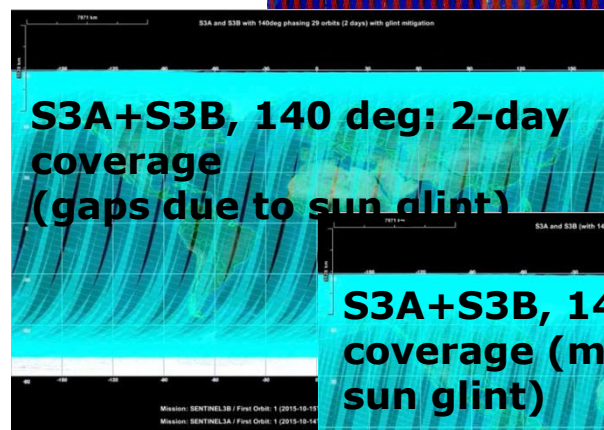
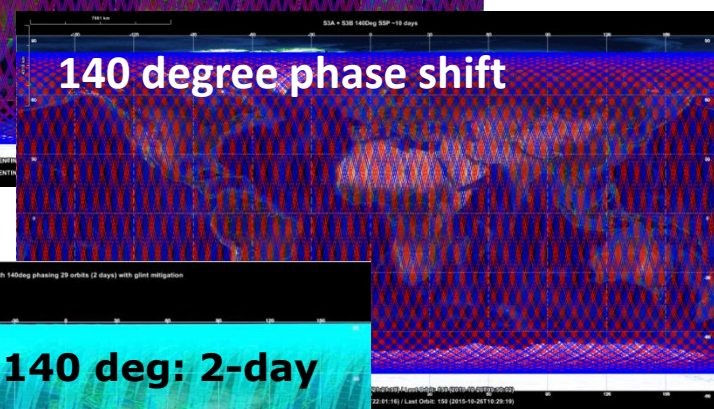
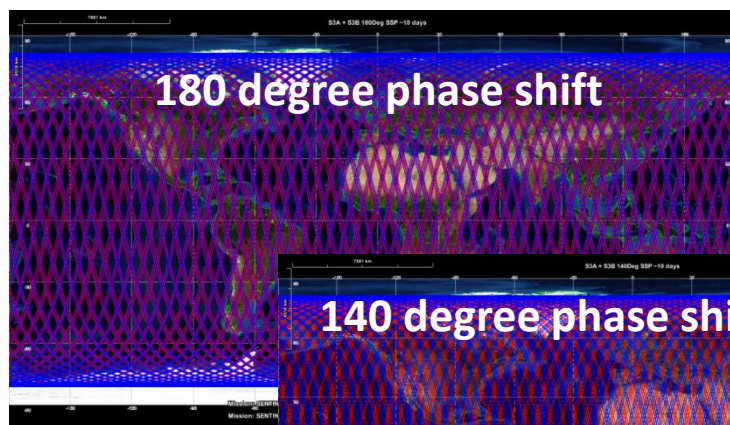
- ❑ AOD **NRT**: Based on P.North (2002): " Estimation of aerosol opacity and land surface bi-directional reflectance from ATSR-2 dual-angle imagery: operational method and validation"; Validated with AATSR data within ESA's CCI: provides best results when compared with AERONET and over bright surface.
- ❑ AOD **NTC**: Based on above algorithm adapted for SYNERGY products including spectral capacities of OLCI (North et al., 2010); Validated using MERIS and AATSR.
- ❑ The above algorithms will need to be extended to cover the retrieval of aerosol properties over ocean.
- ❑ **Implementation on-going, available in mid-2017 in NRT from EUMETSAT and NTC from ESA**

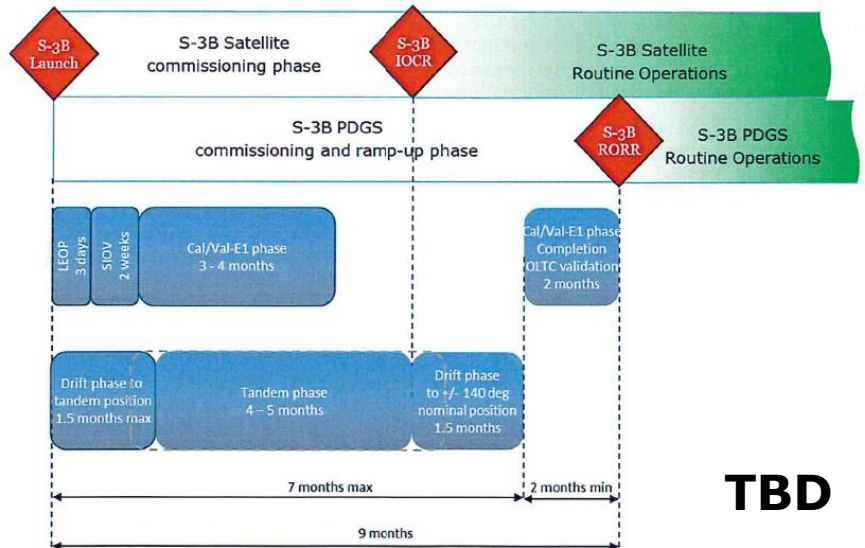
Fire Radiative Power (FRP)

- ❑ Current algorithm based on Wooster et al. (2005) JGR D21111:doi: 10.1029/2005JD006318 ; SLSTR algorithm : Wooster et al. (2012) Remote Sens. Environ, 120, 236-254.
- ❑ Needs to be extended to include detection of fire over sea surface in coastal areas and in known oil-gas producing areas.
- ❑ Database of land and ocean gas flare and volcano masks will be included in the data product to provide a hotspot classification/type to users.
- ❑ **Implementation on-going, available in end-2017 in NRT from EUMETSAT and NTC from ESA**

OPTIMISED ORBIT PHASING OF S3A/B AND C/D

- ❑ Copernicus Marine Environment Monitoring Service (CMEMS) asked for optimising orbit phase shift to **improve interleave between S3A and S3B for improved SRAL meso-scale sampling at 4-7 days**
- ❑ Solution of **140°** separation recommended by ESA, and confirmed by EUMETSAT assessment.
- ❑ EC has confirmed implementation for S3B
- ❑ **Minimal impact on optical mission**
 - ❑ **Over ocean**
 - ❑ OLCI: global coverage <2 days but parts of the swath will be impacted by sun-glint. Sun-glint free coverage by OLCI will be attained in ~3 days over the ocean.
 - ❑ SLSTR: coverage and revisit of the SLSTR remains compliant with requirements.
 - ❑ **Over land** (sun glint unproblematic, unless inland water) OLCI and SLSTR coverage is expected to remain compliant with requirements.





TECHNICAL PLANNING

- ❑ Operate S3A and S3B in Tandem for ~4-5 months at start of mission
- ❑ One satellite follows the other with a small 10-30 sec separation: minimum oceanographic and atmospheric variability reducing uncertainty in comparing measurements from both satellites
- ❑ Tandem and drift phase into final orbit separation of 140 degree between S3A/B separation completed by launch + 7 months
- ❑ Full operational capacity reached by launch + 9 months

MOTIVATION

GCOS Climate Monitoring Principles (GCMP): need to fully understand biases between satellite missions

- ❑ "Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system"
- ❑ "A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time-series observations"

Improved data quality for climate (CDR) and operational applications alike

WHAT?

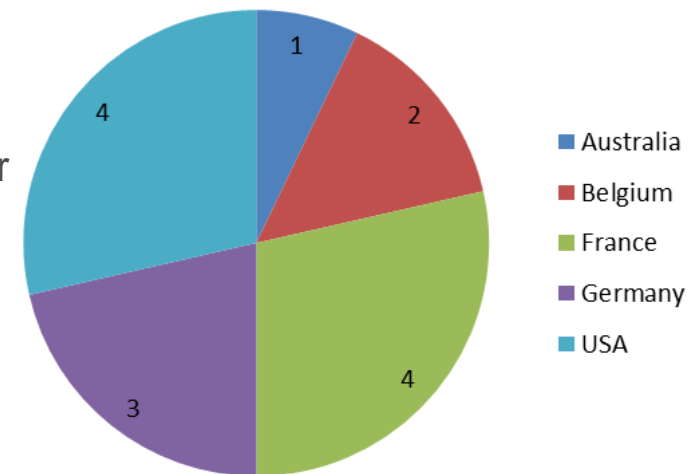
- International collaborative initiative to **inter-compare** a set of **atmospheric correction (AC) processors** for high-spatial resolution optical sensors
- Focus on **Landsat-8** and **Sentinel-2** imagery



- Better understanding of the different uncertainty contributors and help in improving the AC processors

WHO?

- **13** atmospheric correction processors over land and water
- **13** organisations, institutes, universities, companies
- **5** countries: Australia, Belgium, France, Germany, USA



How?

1. Definition of the inter-comparison protocol

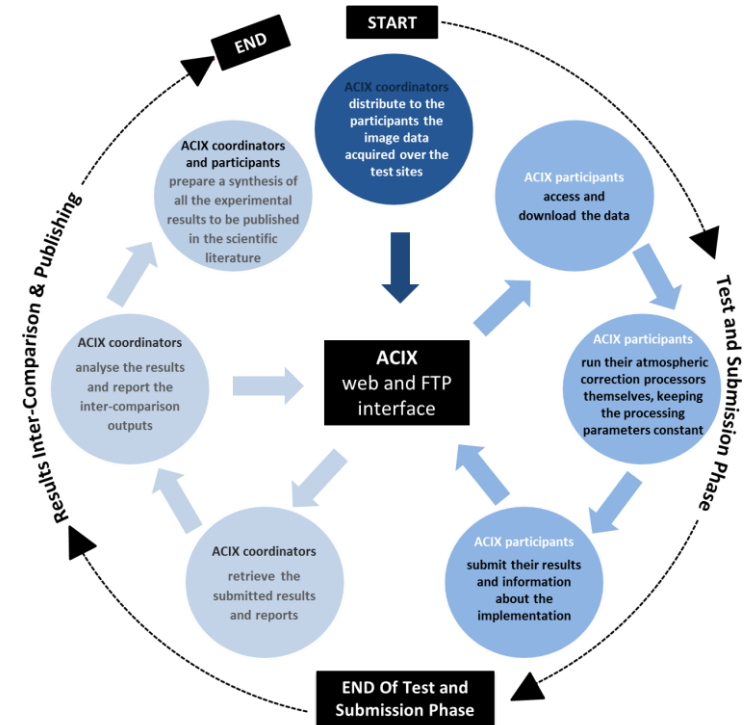
End of phase: 20/07/2016

2. Application of the AC processors

End of phase: 15/01/2016

3. Analysis of the results

End of phase: 27/03/2017



WHEN?

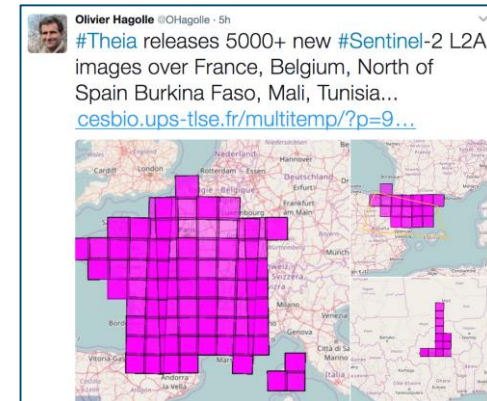
IMPORTANT DATES

1st Workshop Announcement	25 January 2016
Proposals for AC inter-comparison protocol Deadline	31 May 2016
1st Workshop of CEOS-WGCV Atmospheric Correction Inter-comparison Exercise	21-22 June 2016
Results Submission Deadline	15 January 2017
Results Analysis Report	27 March 2017
2nd Workshop of CEOS-WGCV Atmospheric Correction Inter-comparison Exercise	11-12 April 2017 (ESRIN/ESA)

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.





- Absolute geolocation has an error of $\sim 908\text{m}$
- VNIR-SWIR focal planes mis-registration of $\sim 116\text{m}$
- Radiometry “similar” to S2A for images 2 days apart over Croatia.
- Image shift in the transition between detector modules (to be corrected with first LOS calibration).
- reference orbit will be reached on 28 March.