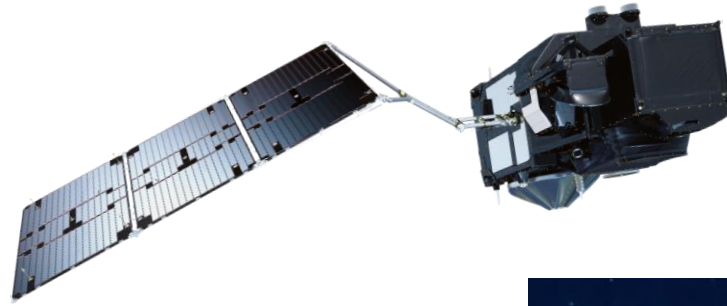


# The Copernicus Sentinel-3 Mission: Status and First Results

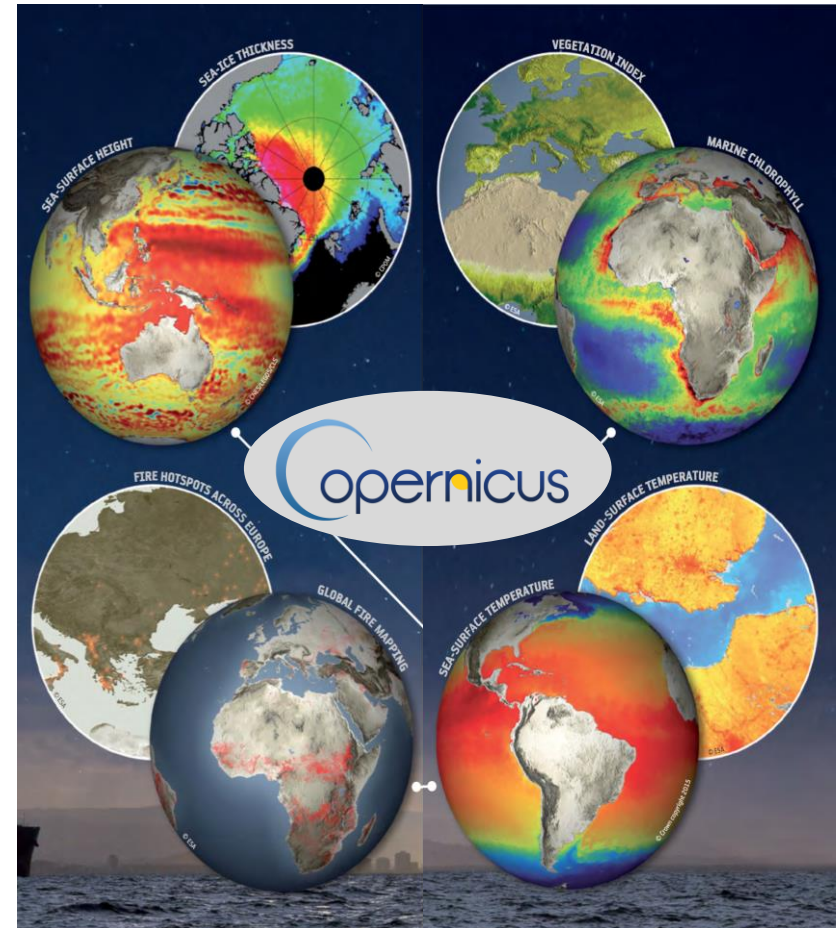
Craig Donlon Sentinel-3 Mission Scientist (ESA/ESTEC)  
Francios Boy (CNES), Remko Scharroo (EUMETSAT)  
Susanne Mecklenburg (ESA/ESRIN), Hilary Wilson  
(EUMETSAT)

Igor Tomozic and Anne O'Carroll (EUMETSAT),

Rasmus Tonboe (DMI), P. Femenias (ESA/ESRIN)



- Copernicus
- Sentinel-3A
- Sentinel-3B
- Flexible approach
  - L1A
  - Orbit change
  - Potential Tandem Mission
- Current status



# Copernicus Overview

*In-situ component not represented here*



A Programme of the European Union

[www.copernicus.eu](http://www.copernicus.eu)



- Land Monitoring
- Marine Environment Monitoring
- Atmosphere Monitoring
- Emergency Management
- Climate Change
- Security



- Overall Programme Management
- Coordination of the Services Component
- Cross-cutting user-uptake activities



**EUMETSAT**

- Operations of S3 (marine part), S4, S5, S6 and Jason-3

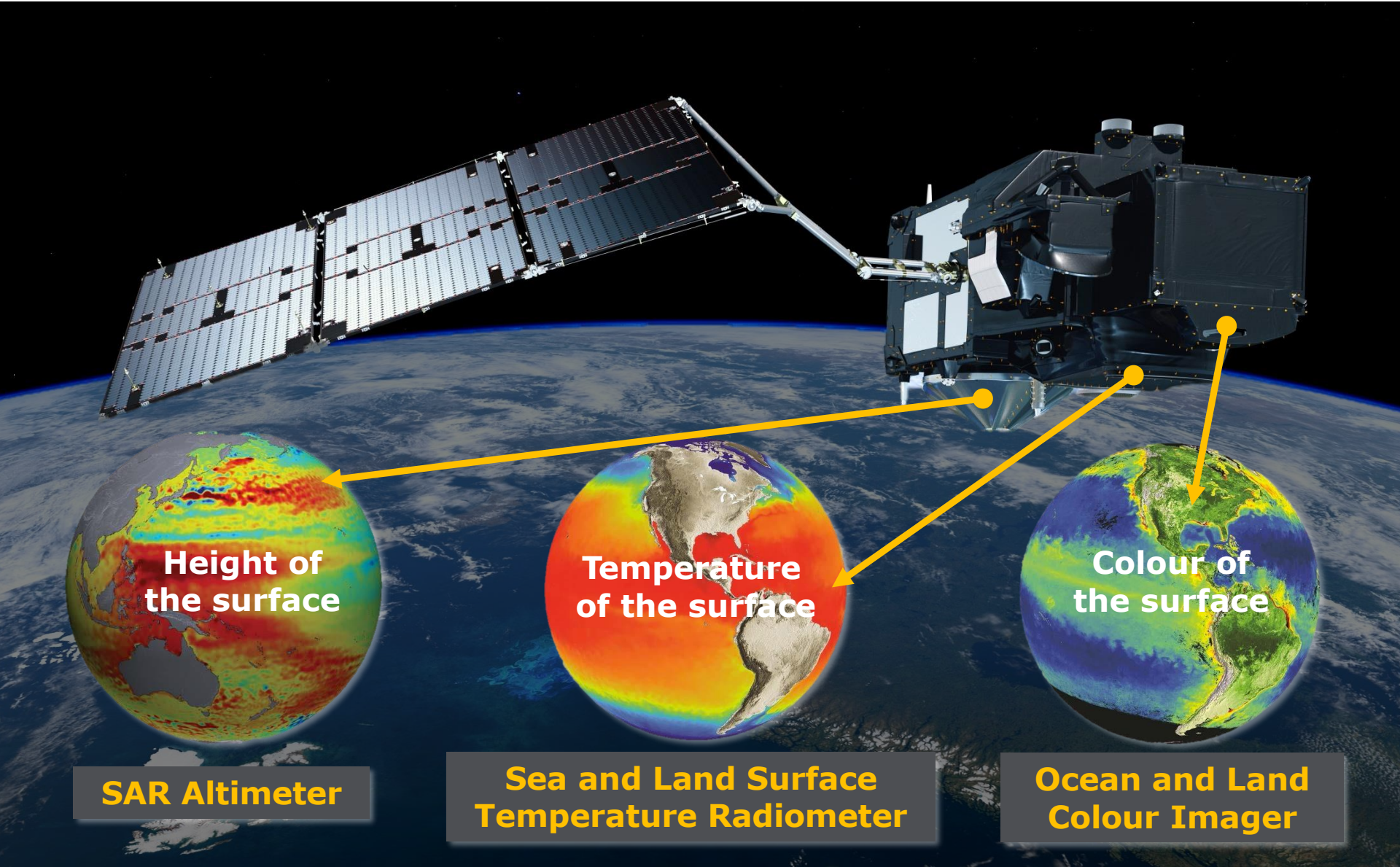


European Space Agency

- Technical coordination of the Space Component
- Development and procurement of Copernicus Sentinel missions
- Coordination and procurement of Contributing Missions data
- Operations of S1, S2, S3 (land part), S5P

*...plus other partners...*

# Sentinel-3A: The Bigger Picture



**Height of  
the surface**

**Temperature  
of the surface**

**Colour of  
the surface**

**SAR Altimeter**

**Sea and Land Surface  
Temperature Radiometer**

**Ocean and Land  
Colour Imager**

S3B has a 140° phase separation on the same orbital plane

## Instrument Swath Patterns

SRAL tracks at the equator:  
 S3A = 104 km track separation  
 S3A+B = 52 km separation

SRAL (>2 km) and MWR (20 km)  
 nadir track

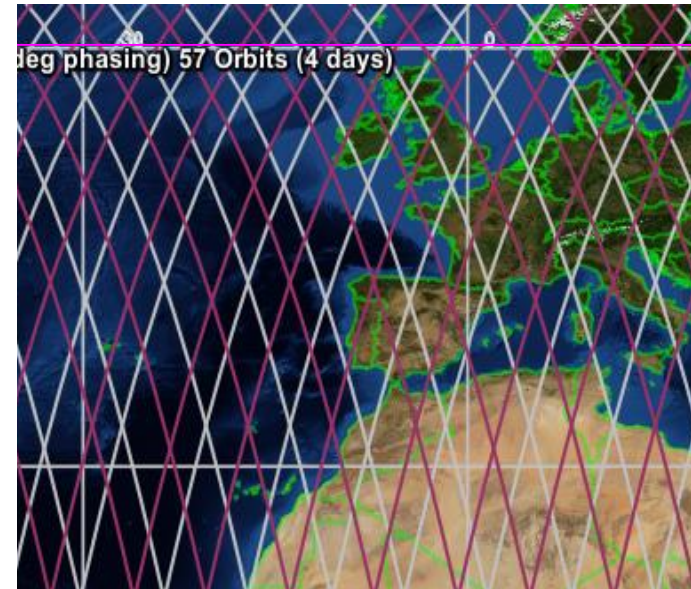
1400 km SLSTR (nadir)

740 km SLSTR (oblique)

1270 km OLCI

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

## Ground Track Pattern after 4 days (S3A and S3B)



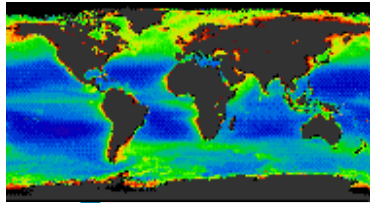
### SRAL orbit drivers:

- Ground track repeatability,
- Dense spatial sampling

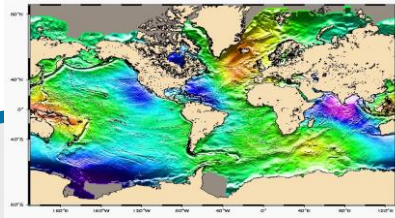
### Orbit control requirement:

- Ground track dead-band  $\pm 1$ km

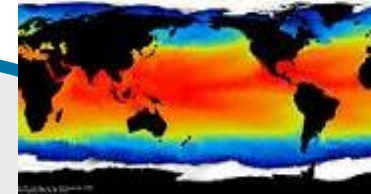
# Sentinel-3 Example products



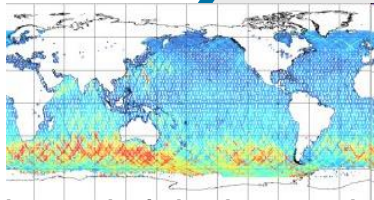
**Ocean colour products**  
(Credit: MyOcean)



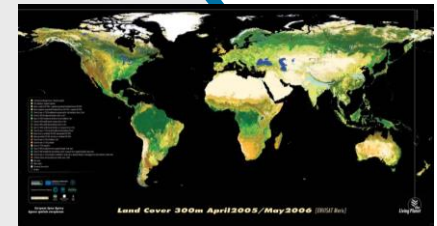
**Sea Surface Height products**  
(Credit: CLS)



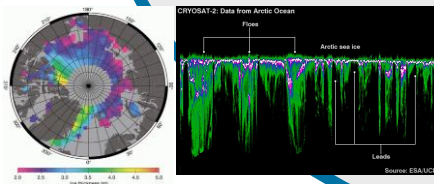
**Sea Surface Temperature products**  
(Credit: Met Office)



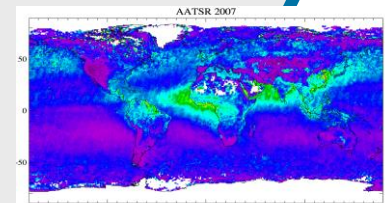
**Along track wind and wave products**  
(Credit: AVISO)



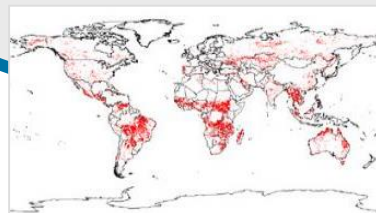
**Land cover products**  
(Credit: ESA)



**Sea Ice products**  
(Credit: UCL)



**Atmospheric aerosol products**  
(Credit: GlobAerosol)



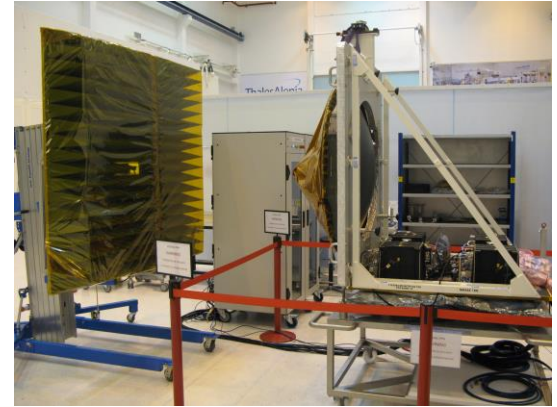
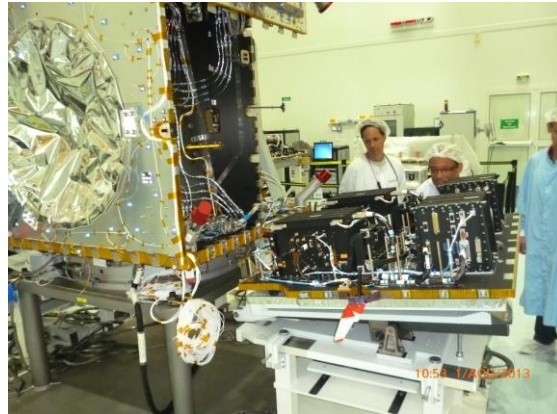
**Fire products**  
(Credit: ESA World Fire atlas)



**User parameters derived from L1b products**  
(Credit: GEO)

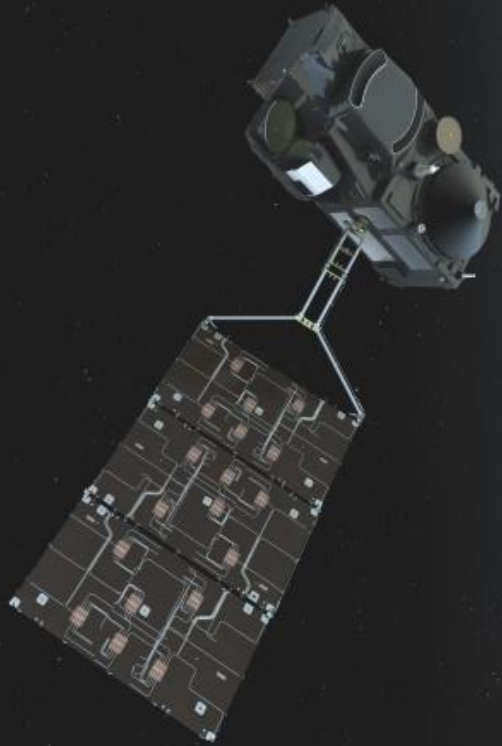
# Sentinel-3: A bigger Picture for Copernicus







Sentinel-3A: 2015-



## To meet Mission Requirements

The Sentinel-3 Mission is composed of two identical satellites

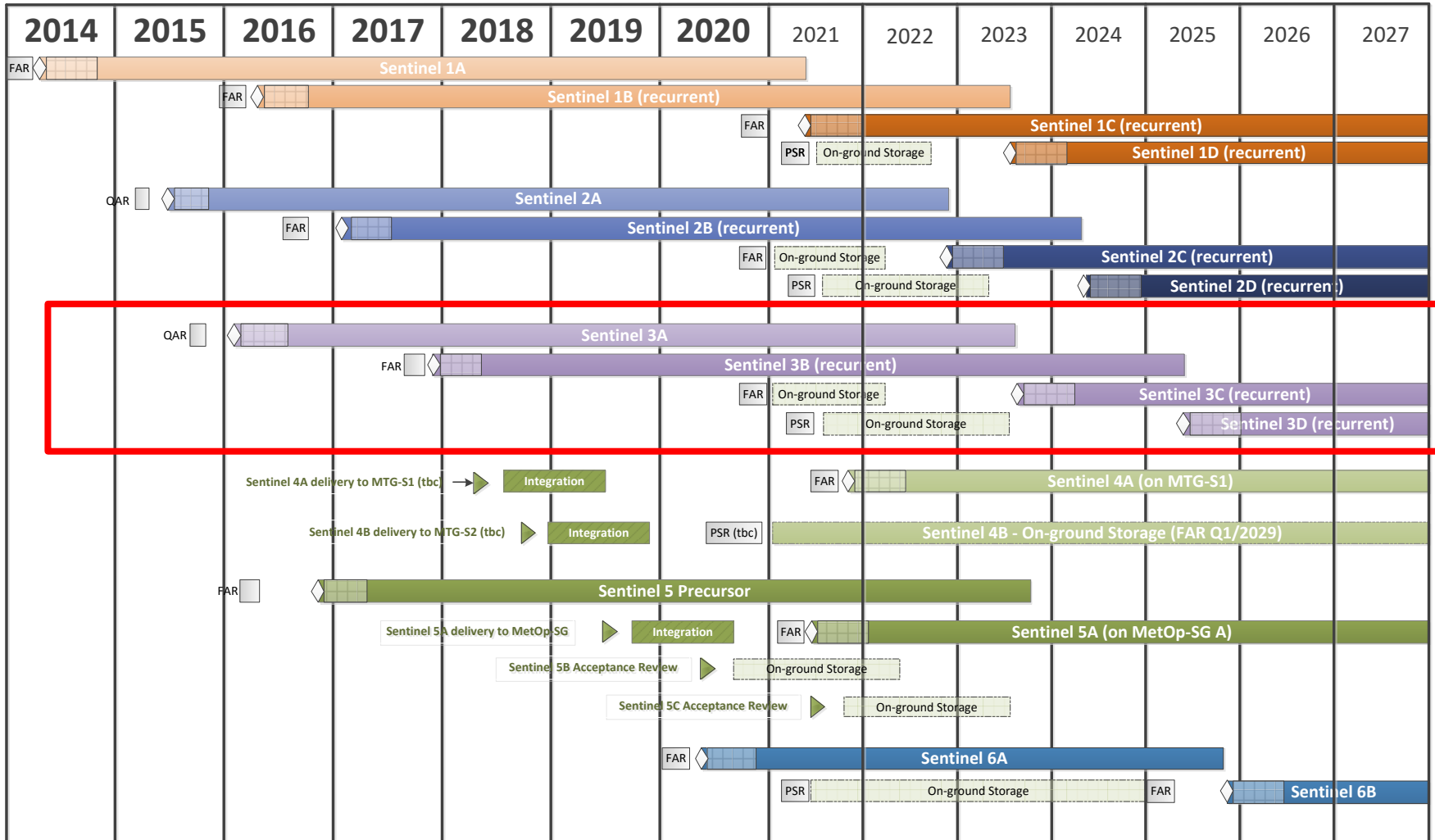
Flown together in the same orbital plane separated by  $140^\circ$

Follow-on Satellites (Sentinel-3C and Sentinel-3D) are now being procured.



Sentinel-3B: 2017-

# The Copernicus Sentinel Deployment Schedule



# Launch campaign Plesetsk, Russia...



# Sentinel-3A Launched 16<sup>th</sup> February 2016 from Plesetsk, Russia, @17:57 GMT



# Sentinel-3a launch from Plesetsk Cosmodrome 16<sup>th</sup> February 2016

(Credit: Antero Isola)



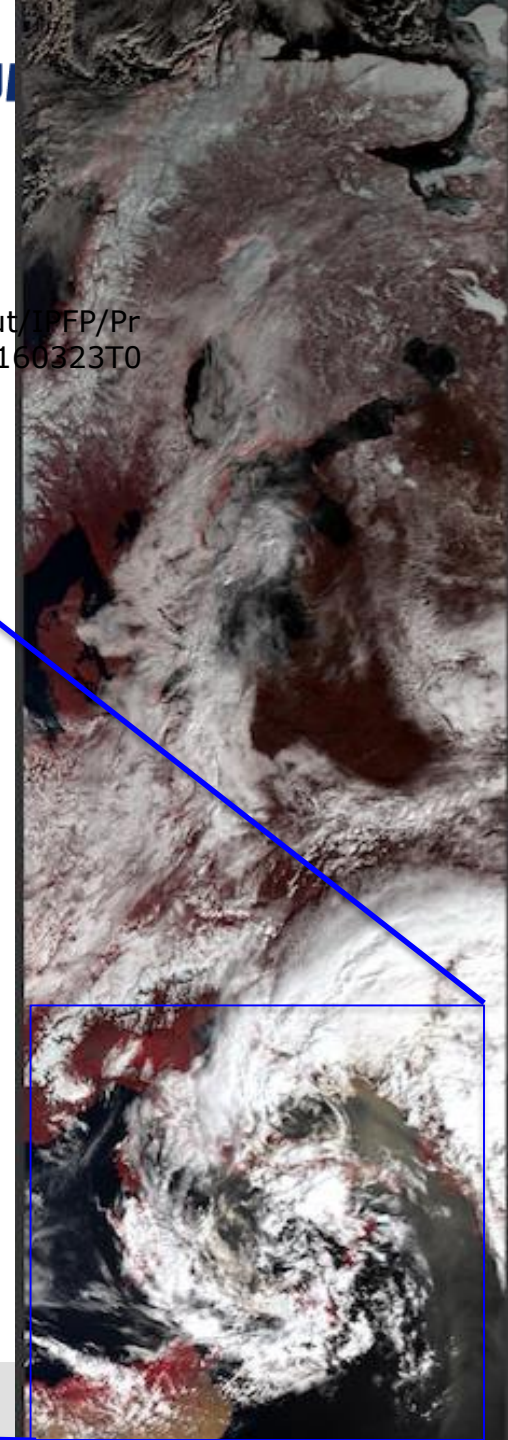
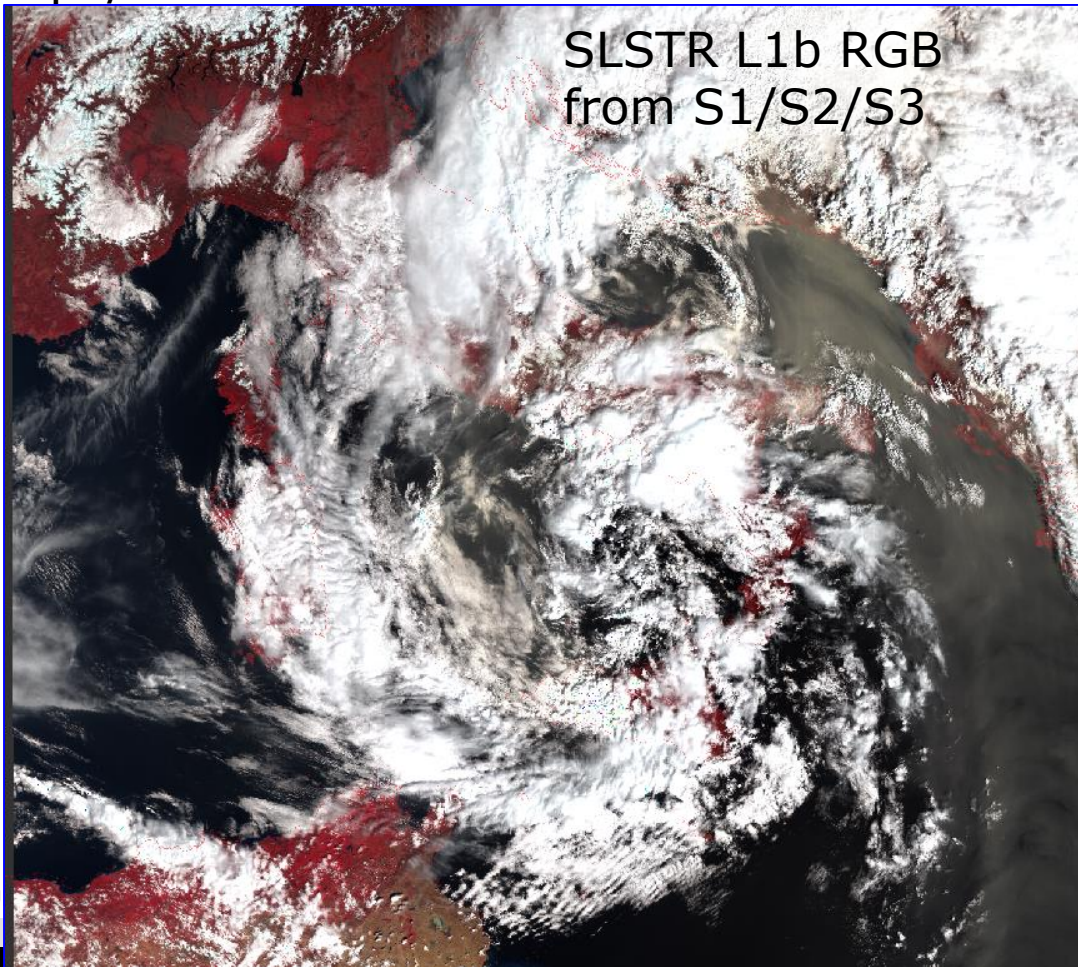
And finally on-orbit...



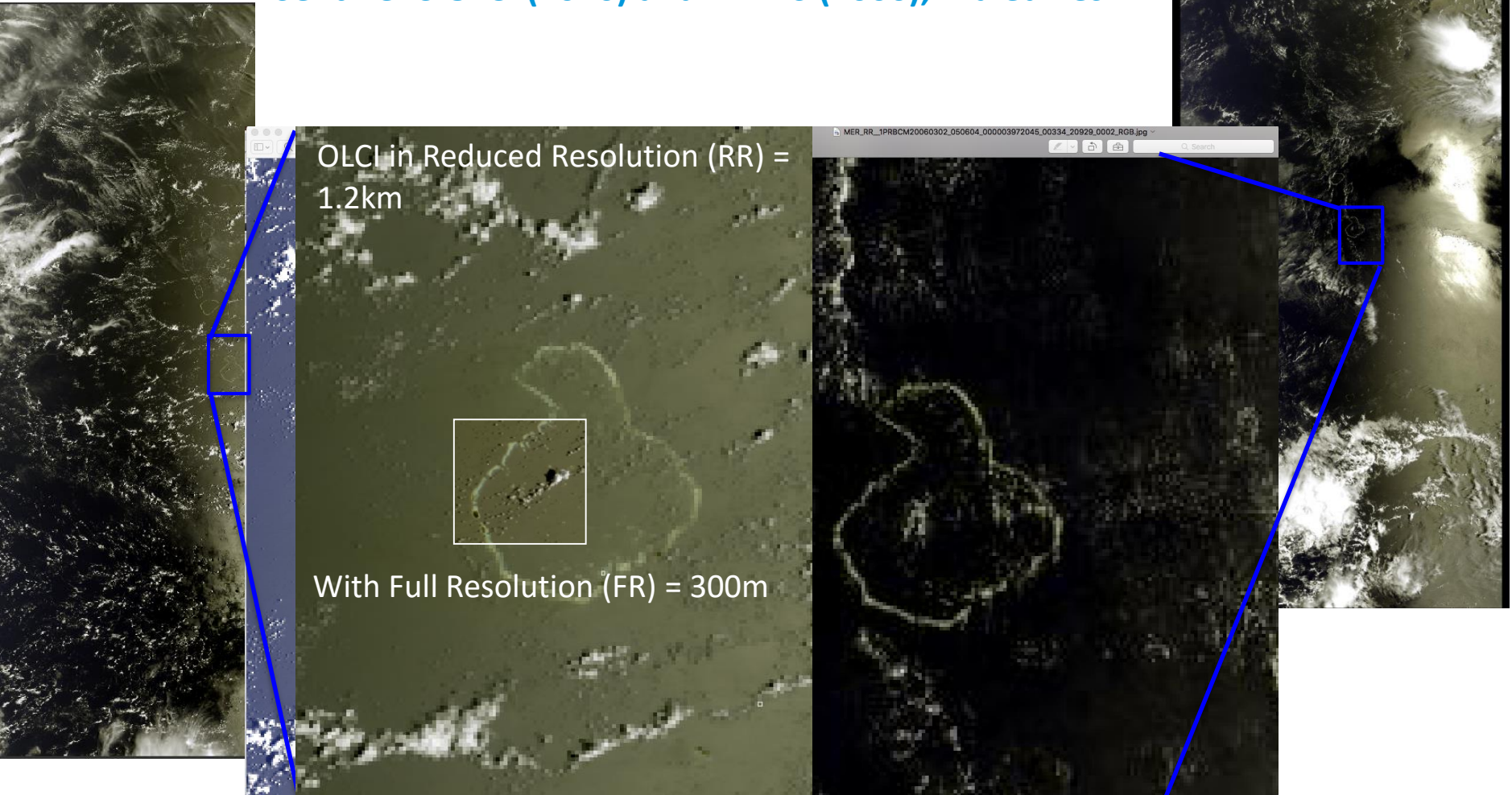
# SLSTR IR channels switch on 23-Mar-2016

Sentinel-3 SLSTR First  
IR Image over  
Europe/North Africa

[ftp://s3a-commtteam@commissioning.sentinel3.esa.int/Output/PP/Products/LI\\_005\\_ROI\\_Europe/20160323T091429\\_20160323T092523](ftp://s3a-commtteam@commissioning.sentinel3.esa.int/Output/PP/Products/LI_005_ROI_Europe/20160323T091429_20160323T092523)



## Sentinel-3 OLCI (2016) and MERIS (2006), Maldives

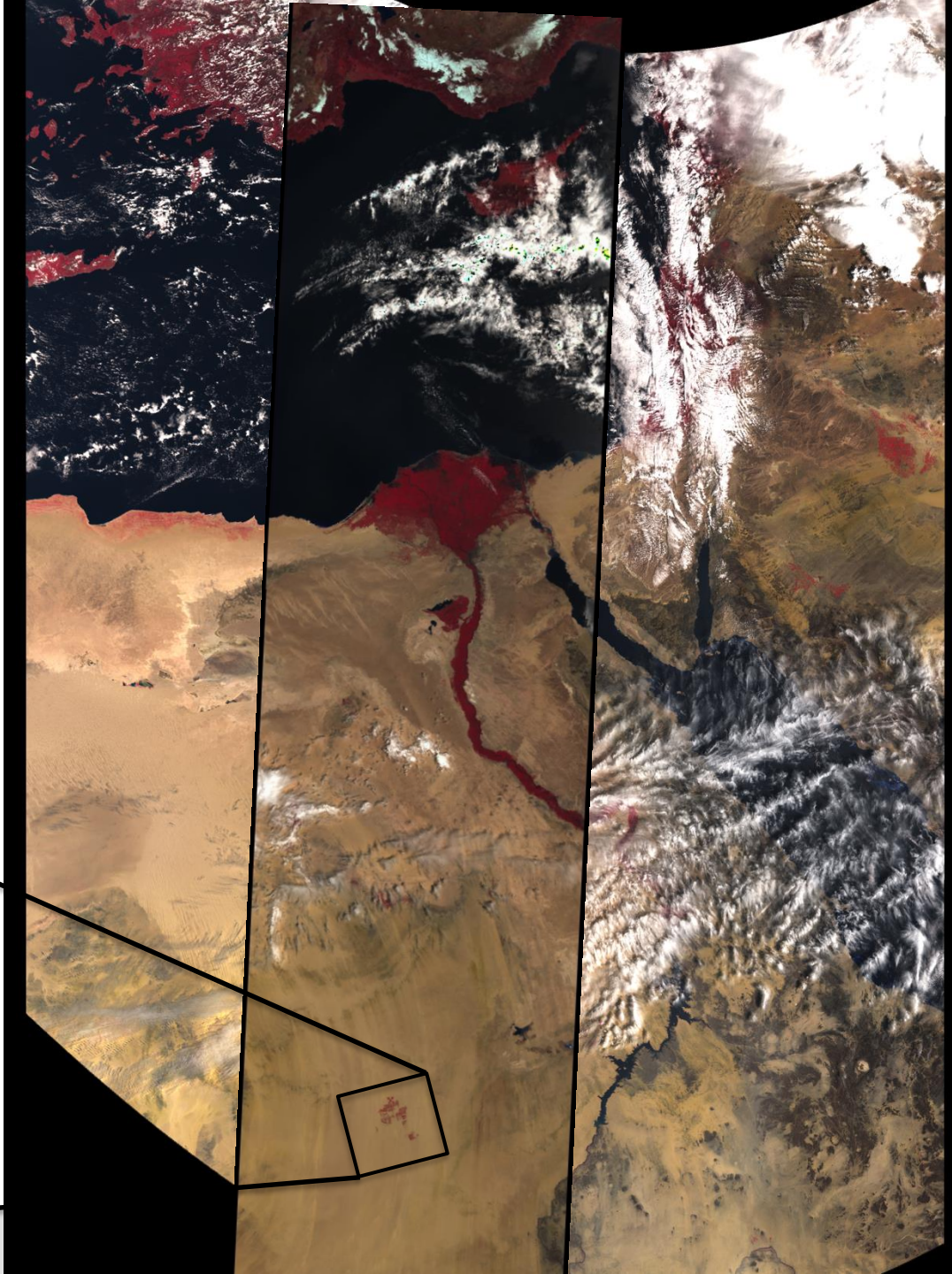




Sentinel-3 SLSTR First  
Image over Egypt  
**03/03/2016**

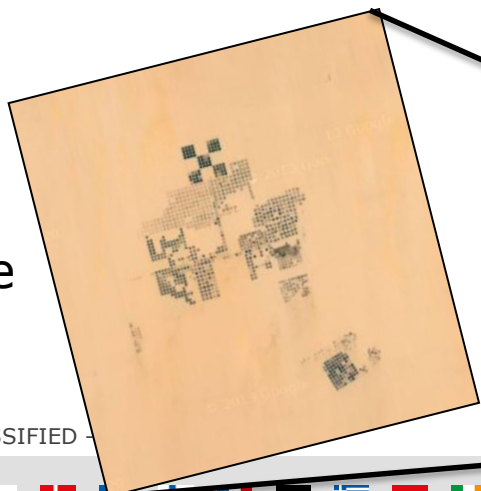
+

Last AATSR image over  
Egypt **07/04/2012**



sa

Google  
Image

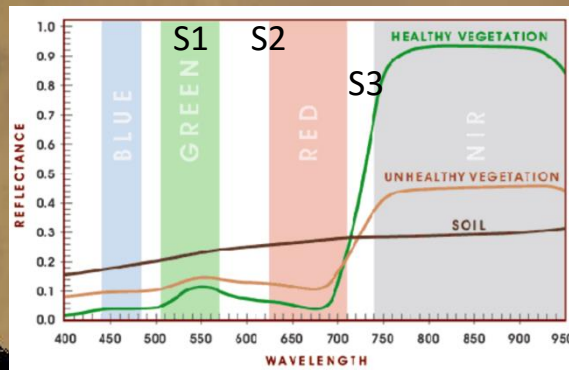


ESA UNCLASSIFIED



# SLSTR 0.5km Spatial Resolution (VIS channels) in 2106

Large irrigation fields in the desert (healthy vegetation appears in red)

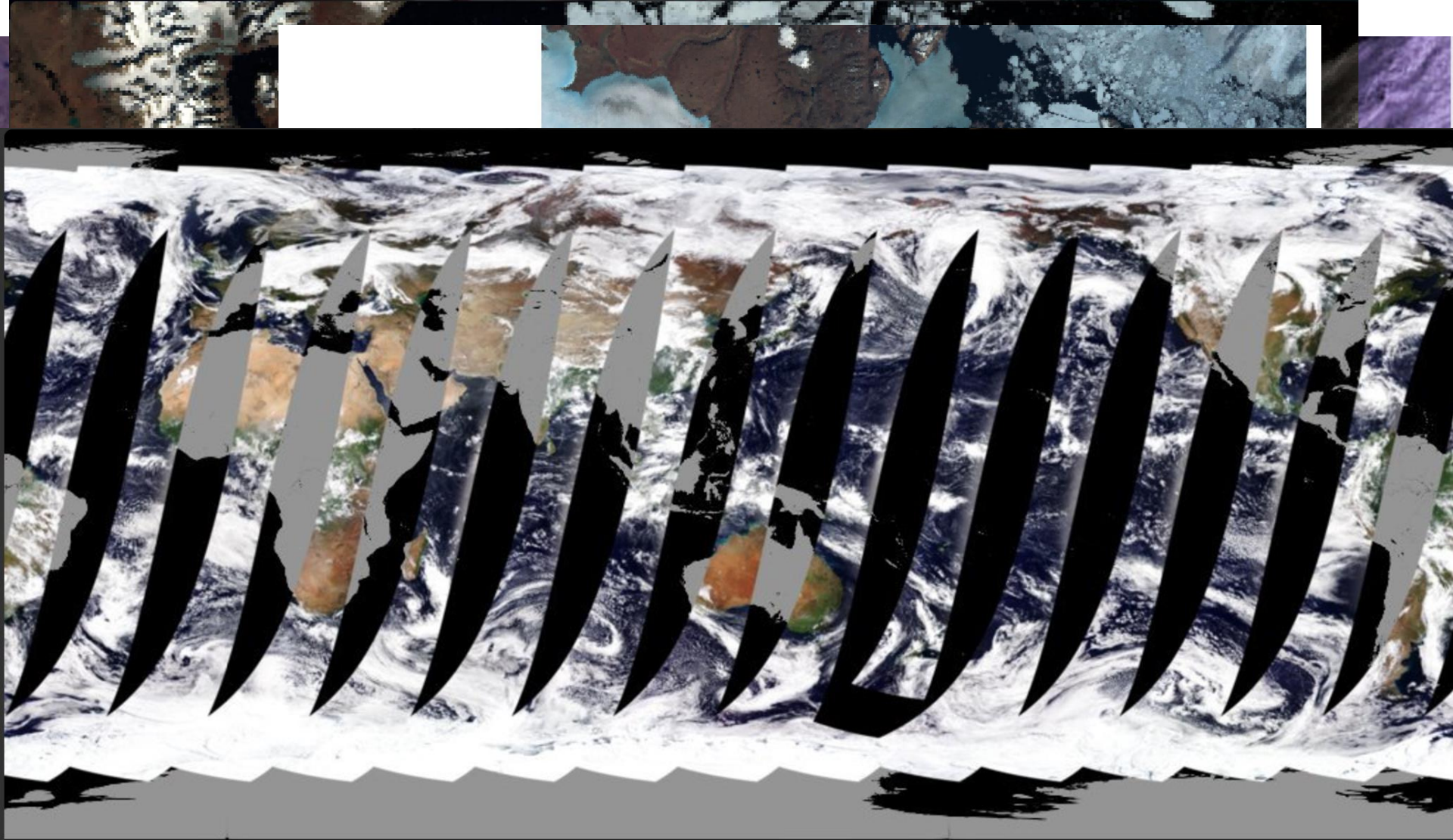


Google Image

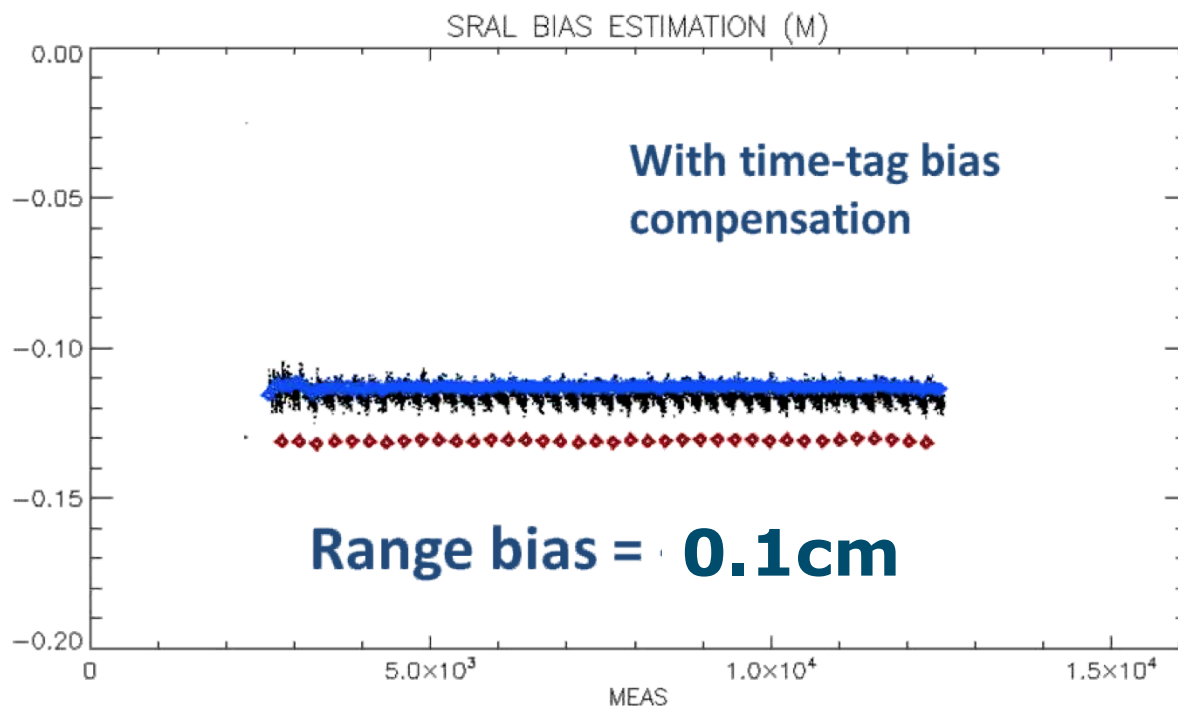
ESA UNCLASSIFIED - F



# Sentinel-3: Example data



# RESULTS : 9TH, APRIL

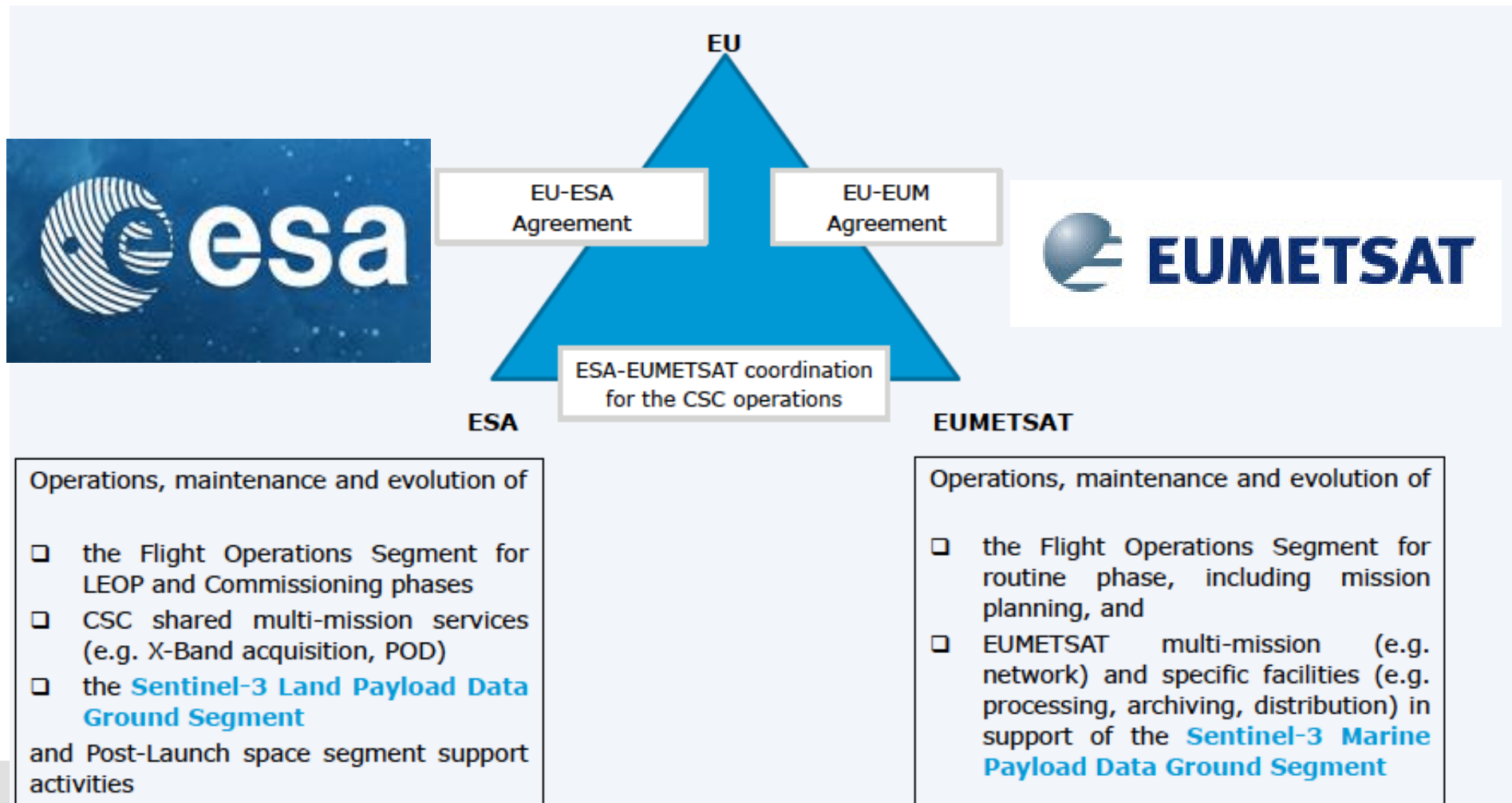


- PLRM
- SARM
- Individual Echoes

- **Good agreement between the different processing approaches**
  - IE = Doppler
  - PLRM processing gives a altimeter range bias 2cm above IE/Doppler results
- **High measurement precision;**
  - Range Bias STD = 0,4mm in SAR mode !!!
- **A 200us pseudo-time-tag bias is observed**

# ESA & EUMETSAT share operations

- **EU Copernicus Regulation:** full, open and free data policy, defining responsibilities for ESA and EUMETSAT and overall financial envelope
- **Dedicated EU-ESA and EU-EUMETSAT Copernicus agreements**



16 Feb

Successful Launch

## Sentinel-3A satellite platform and payloads are functionally in very good health

**S3-STM Data access** to S3VT validation teams and MPC for some time and following feedback reprocessing data now

**Official S-3 STM data release "L1A, L1B, L2 WAT & LAN" planned early December 2016 to the international user community.**

**L1B-S have still to be QC'd before official data release. Planned in Q1 2017.**

October 2016

Release of Level 1 data

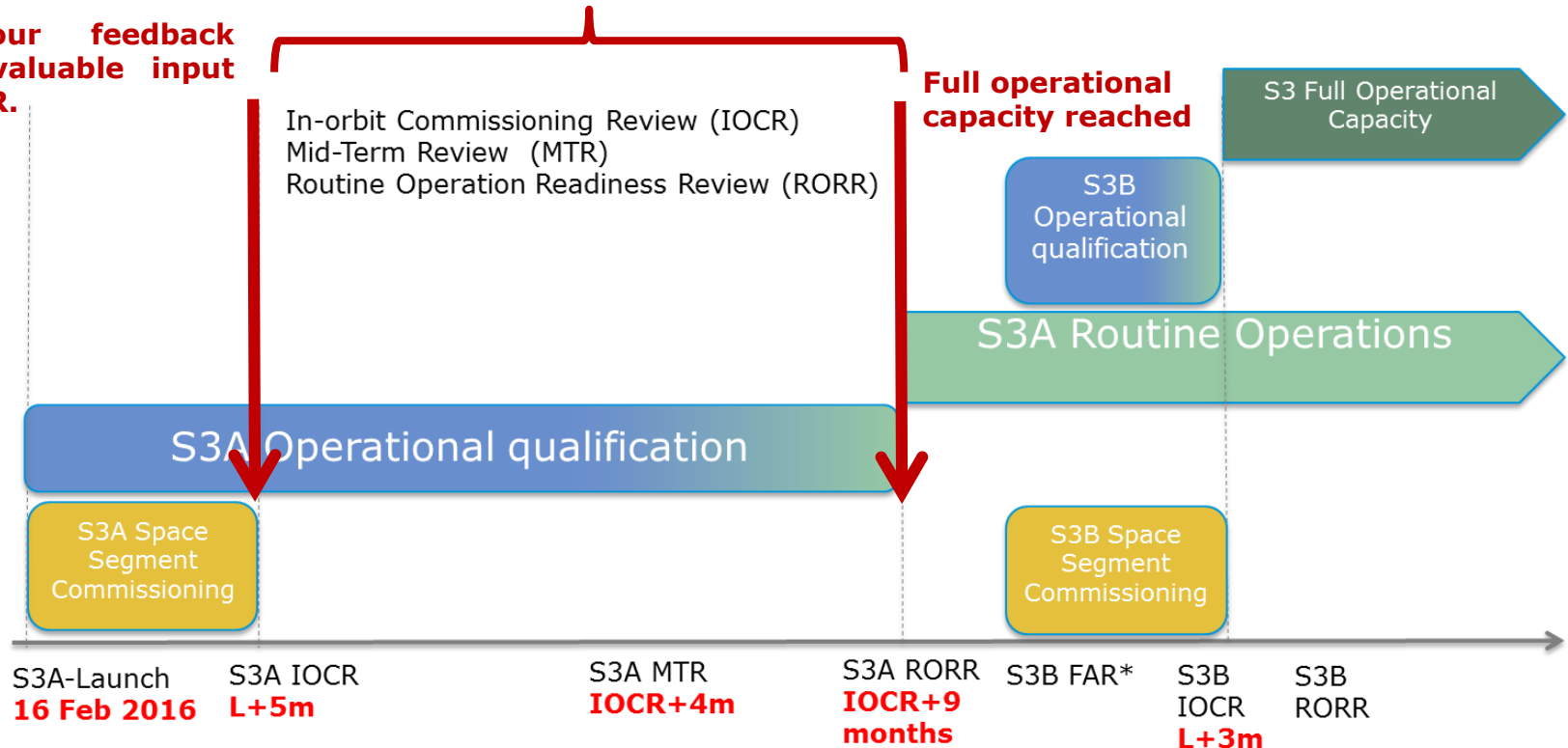
Ramp-up phase  
IOCR+9months

Release of Level 2 data

# What happens next?

**Ramp-up phase starts: Gradual ramp-up of operations and progressive release of level 1 and 2 core products**

**IOCR: Your feedback provided valuable input to the IOCR.**



*\*S3B launch 2017*

## Scientific Data Hub

Self Registration



> 33,000 Users



No Rolling Policy Applied



Sentinel-1A NTC  
Sentinel-2A L1C

03-Oct-2014



16-Nov-2015



Max 2 Concurrent Downloads

## Collaborative Data Hub



11 Collaborative Users  
4 Data Hub Relay Users



Node 1: 30 days  
Node 2: 9 days



Sentinel-1A NRT & NTC  
Sentinel-2A L1C



Node 1: Max 10 downloads  
Node 2: No limits

## International Access Hub



4 Users



30 Days



Sentinel-1A NTC  
Sentinel-2A L1C<sup>1</sup>



No limits

## Copernicus Services Data Hub

copernicus  
space component data access



No Rolling Policy Applied



Sentinel-1A NRT<sup>1</sup> & NTC

Sentinel-2A L1C  
01-Dec-2015



Max 10 concurrent downloads

L1C<sup>1</sup> coming soon

NRT<sup>1</sup> via dedicated ftp



**ESA has signed technical operating arrangements e.g. with NOAA, NASA, USGS**

ESA UNCLASSIFIED - For Official Use





## Extensive pre-and post launch performance analysis...

**Sentinel-3**  
 Rutherford Appleton Laboratory  
**SLSTR**  
**RAL In-Orbit Commissioning Report**  
 Doc. No.: S3-RP-RAL-SL-115  
 Issue: 1 Rev: 0  
 Date: 14-Jul-2016 Page 1 of 142

**Sentinel 3**  
**SLSTR**  
**RAL Phase E1 In-Orbit Commissioning Report**

	Name	Signature / Date
Prepared by	Ed Polehampton, Mireya Etzaluze, Dave Smith, Caroline Cox	<i>Ed Polehampton</i> Digitally signed by Edward Polehampton Date: 2016.07.14 11:30:43 +01'00'
Project Manager	Dave Smith	<i>Dave Smith</i> Dave Smith 2016.07.14 11:30:43 +01'00'

Science and Technology Facilities Council  
 Rutherford Appleton Laboratory  
 Harwell Science and Innovation Campus  
 Didcot  
 Oxfordshire OX11 0QX  
 United Kingdom

REFERENCE : S3-RP-TAF-RA-03497  
 DATE : 08/06/2016  
 ISSUE : 1 Page : 1/101

**Sentinel-3**

**SRAL Phase E1 verification report**

Product Tree Code : 14 000 000

Written by	Responsibility + handwritten signature if no electronic workflow tool	Date
	Sentinel-3 Topography Mission Manager	
	Documentation Officer	
	SRAL Technical Officer	
	SRAL PA Manager	
	SRAL Project manager	

on evidences are kept through the documentation management system.



# Operational Core Products - full technical documentation at <https://sentinel.esa.int>

The screenshot shows the 'Sentinel-3 OLCI' page on the Sentinel Online website. The main content area is titled '- Sentinel 3 Technical Documents' and contains a notice that the optical product specification will be available in 2014. Below this, there are sections for 'Product Specification Documents' (including GSC Sentinel-3 Products Definition and GMES Sentinels POD Service File Format Specification) and 'ATBDs' (listing various atmospheric and oceanic correction and product specifications). A 'User Guides' sidebar is visible on the right, listing guides for Sentinel-1 SAR, Sentinel-2 MSI, and Sentinel-3 OLCI, with the OLCI section expanded to show sub-topics like Overview, Applications, Product Types, etc. A 'Key Resources' section at the bottom of the sidebar lists technical documents, handbooks, and data availability information. The website footer contains navigation links for Missions, User Guides, Technical Guides, Thematic Areas, and a list of participating countries.

The cover page features the ESA and EUMETSAT logos at the top. The title is centered and reads: **GMES Space Component**, **Sentinel-3 Payload Data Ground Segment**, and **Products Definition Document**. At the bottom, the document's metadata is listed:

- EUM. Doc. No. : EUM/LEO-SEN3/TEN/13/720910
- EUM Issue : 1A
- EUM Date : 06 September 2013
- EUM WBS # : LEO-SEN3 500000 - S3 Ground Segment
- ESA Doc. No. : GMES-S3GS-EOPG-TN-12-0004
- ESA Issue : 1.1
- ESA Date : 06 September 2013

# User interaction and feedback at all levels...



**MISSION STATUS 13-28 August 2016**

**sentinel-3**  
A BIGGER PICTURE FOR COPERNICUS

**OVERALL MISSION**

- The overall status of the spacecraft is nominal, with all subsystem performing nominally.
- All instruments are switched on and perform nominally.
  - OLCI is ON with mode switching between Normal and Silent as commanded via the Attitude and Orbit Control System (AOCS).
  - SRAL is ON and operated in 100% SAR mode (SAR Open Loop and SAR Closed Loop).
  - SLSTR is switched ON in On-Duty mode, with autonomous switching between Day and Night for what concerns instrument Source Packet (SP) generation.
  - MWR is ON in operational mode.
- A FRP (FRP) anomaly re-occurred on 25 July 2016 at 03:44:04. Immediate recovery actions were taken. Following the stabilisation of the SLSTR IR detector temperatures, assessments of the SLSTR Sea Surface Temperature (SST) product quality have concluded that similar SST quality can be expected from 1st August onwards, to that found prior to the anomaly on 25th July. The impact of the slight increase in SLSTR instrument detector temperature (°K) on the quality of SLSTR radiances and the retrieved products is being assessed but the product quality appears to have reached an equivalent level as that seen prior to the anomaly.
- The Flight Operations Segment (FOS) is operating nominally.
- The Payload Data Ground Segment (PDGS) is operating broadly as expected in the initial part of the mission ramp-up phase, gradually moving towards full operational capacity. Some outages and data delays occurred due to recent upgrading of the PDGS systems in preparation of full operations. Level 0 production continues successfully for all instruments at the Core Ground Station in Swabland and at EUMETSAT's marine centre. Level 1 and some preliminary Level 2 data production continues at the Processing and Archiving Centre (PAC) and EUMETSAT's marine centre for all instruments.

**MISSION MANAGEMENT**

- The Sentinel-3A commissioning phase ended on 12th July with the successful passing of the In-Orbit Commissioning Review (IOCR). The mission is now in the ramp-up phase, moving towards full operational capacity at approximately IOCR + 9 months.



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**MISSION MANAGEMENT**

- The Sentinel-3A commissioning phase ended on 12th July with the successful passing of the In-Orbit Commissioning Review (IOCR). The mission is now in the ramp-up phase, moving towards full operational capacity at approximately IOCR + 9 months.
- The handover from ESA's Sentinel-3 development and operations team took place on 12th July, followed by the handover of the responsibility for the routine operations of the spacecraft from ESA to EUMETSAT. The handover of the Marine PDGS from ESA to EUMETSAT will take place end of September, following the successful acceptance of the next version of the PDGS (V3).

**DATA AVAILABILITY AND ACCESS**

- Following the IOCR, some remaining issues affecting the released sample data products will need to be addressed. The release of the level 1 core data products to the general user community is foreseen for late September following the resolution of these issues.
- Some on-going issues are being encountered in the Online Data Access system which have caused delays and unavailability of data to users and are under investigation.
- The following sample data products are available to Sentinel-3A export users:

Data product (*)	Released on	Available data
OLCI L1 (FRP)	11 May	19 May - today
OLCI L2 over land (ESA)	20 June	20 June - today
OLCI L2 over ocean (EUMETSAT)	22 June	22 June - today
SLSTR L1	13 June	13 June - today
SLSTR L2 - SST (ESA)	20 June	9 June - today
SLSTR L2 - SST (EUMETSAT)	21 June	21 June - today
SRAL L1B (**)	15 June	6 April - 1 May (SAR), 9-12 April (LRM)
SRAL L2 over land (ESA)	15 June	18 June - today
SRAL L2 over ocean (EUMETSAT)	15 June	6 April - 6 May (SAR), 9-12 April (LRM)

(\*) SYN, ADD, FRP products to be released in ramp-up phase  
(\*\*) Full L1A, L1B available from PDGS v3 only

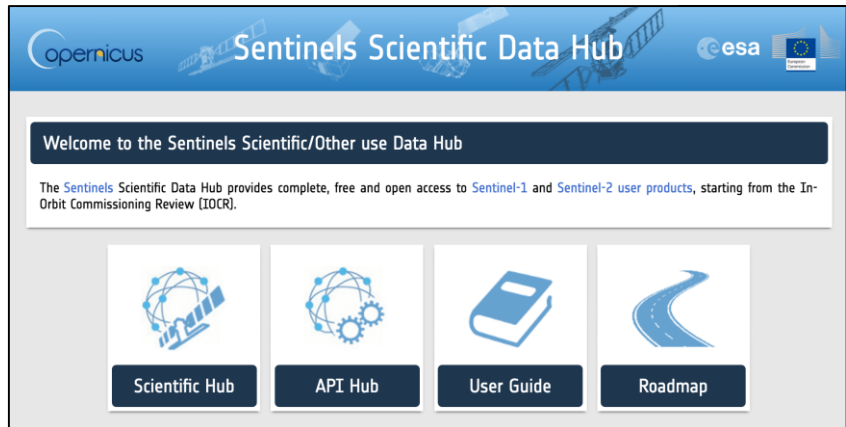
**USER INTERACTION**



- An expert user meeting engaging the Sentinel-3 validation team took place on 28-30 June at ESA-ESRIN. This meeting aimed to provide early access to sample data products to expert users and gather their feedback on data quality and data access early in the mission.
- The Sentinel-3 Quality Working Groups met for the first time on 28 June 2016, the next meeting is planned for December 2016.
- A Sentinel-3 Validation Team (SVT) meeting is planned for 22-24 November 2016 at ESA-ESRIN, Frascati, Italy.

**OUTLOOK**

- Release of operationally qualified Level 1 core data products in late September 2016.
- Provision of additional SKL Level 1 data products (L1A and L1B) from end of September after deployment of new PDGS v3.
- Gradual release of Level 1 sample products over land and ocean, including the 39m products (beginning of 2017) and the new products on Aerosol Optical Depth (AOD) and Fire Radiative Power (FRP) in 2017.
- Implementation of the v3 of the PDGS, which will provide additional SKL Level 1 data products.


Report prepared by the ESA and EUMETSAT Sentinel-3 Operations Team





**opernicus** **Sentinels Scientific Data Hub**  


Welcome to the Sentinels Scientific/Other use Data Hub

The Sentinels Scientific Data Hub provides complete, free and open access to Sentinel-1 and Sentinel-2 user products, starting from the In-Orbit Commissioning Review (IOCR).

  
**Scientific Hub**

  
**API Hub**

  
**User Guide**

  
**Roadmap**

REGISTER/SIGN IN



**EUMETSAT** MONITORING WEATHER AND CLIMATE FROM SPACE

HOME IMAGES ABOUT US SATELLITES DATA NEWS QUICK LINKS

**DATA**

EUMETSAT delivers agreed data, products and support services to our Member States and users worldwide – both from our own programmes as well as third party programmes.

A list of all EUMETSAT and Third Party products can be found in our data catalogue, called the Product Navigator.

They can be accessed and ordered from the EUMETSAT Data Centre via our Earth Observation Portal (EOP).

All our data and products follow particular Data Standards

Our Technical Bulletins includes updates about the Data Centre and EUMETSAT.

Our training team travels the world instructing users in how to get the most out of using our satellite data and products.

**RELATED LINKS**

**DATA POLICY PDF (261 KB)**

The complete official EUMETSAT Data Policy as approved by EUMETSAT Member States.

**DATA DELIVERY**

Data, products and services are made available via EUMETSAT, direct dissemination/readonly, the Global Telecommunication System (GTS) and FTP over the internet.

**PRODUCTS**

We provide an evolving range of meteorological and climate monitoring data and products that reflect the needs of the user community.

**METEOSAT SERVICES**

The Meteosat operational services are: 0 Degree, RSS, IODC and DCS.

**METOP SERVICES**

The data services from the Metop polar orbiting satellites, include instrument direct readout and generated products derived from the global data dumps and regional direct readout acquisition.



- 22 March 2012 08:17

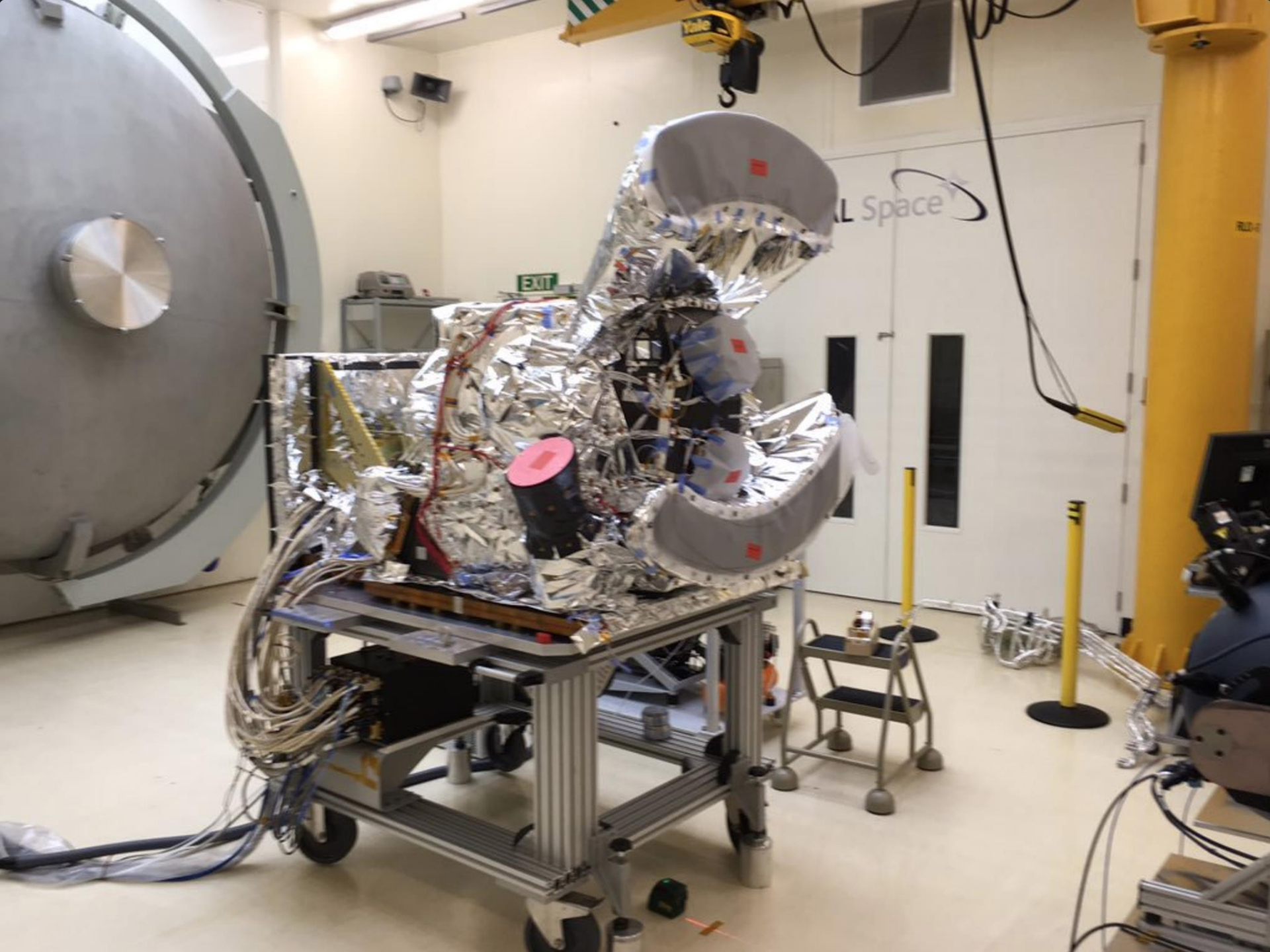
ESA UNCLASSIFIED - For Official Use

C.Donlon | 31/10/2016 | Slide 27





# Sentinel-3B



# User driven evolution...

- **The science of today become the operations of tomorrow...**
- Several elements of user driven evolution for the S3A mission have emerged and have been addressed:
  - **100% SRAL SAR coverage instead of just coastal zones and sea ice → better SNR**
  - **New products requested including L1A SAR data → Performance Evolution**
  - **Orbit phase optimization for topography mission → better sampling of mesoscale structure**
- Each has been taken up by the EC following user request and extensive technical and programmatic discussions with ESA and EUMETSAT
- **An excellent process has been established to respond effectively and relatively quickly to these large mission changes.**

Product Level	Product Description	Relevance for
L1A	Unpacked L0 data processed to engineering parameters with geo-location information	SAR processing specialists allowing fundamental studies on SAR processing such as Doppler beam formation and calibration studies using ground-based Transponders
L1B-S	Geo-located, Calibrated gathered azimuth formed complex (I and Q) power echoes after slant/Doppler range correction	geophysical retrieval algorithm developers (over ocean, land and ice surfaces), surface characterisations studies (e.g. impact of sea state bias, wave directional effects etc) and QC systems
L1B	Geo-located, Calibrated Multi-looked power waveforms	geophysical retrieval algorithm developers and QC systems

# Open Source Delay Doppler Altimeter Studio (DeDop) tool <http://www.dedop.org>



DEDOP

OBJECTIVE

BACKGROUND

PARTNERS

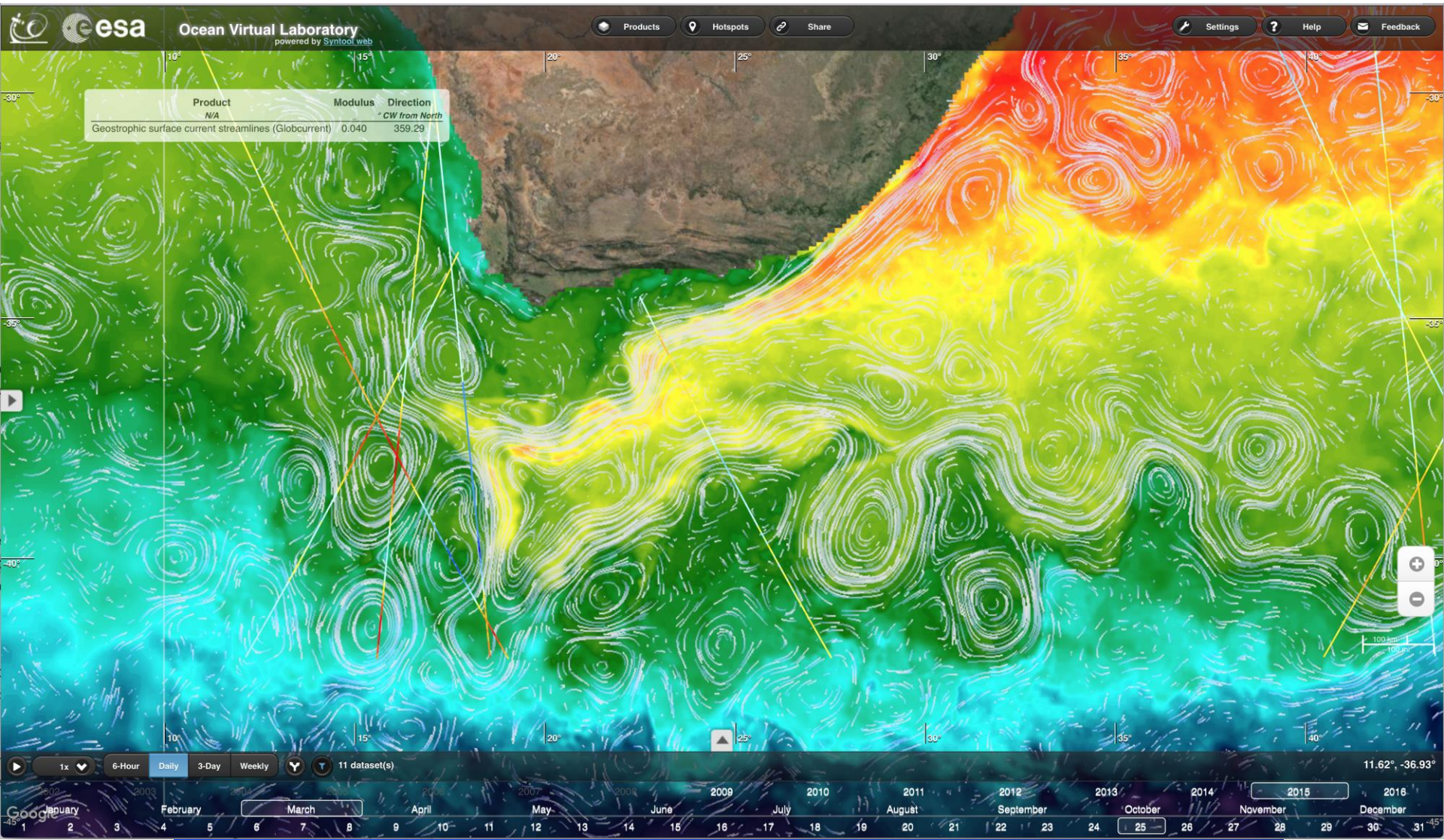
LIBRARY

*Get involved!*



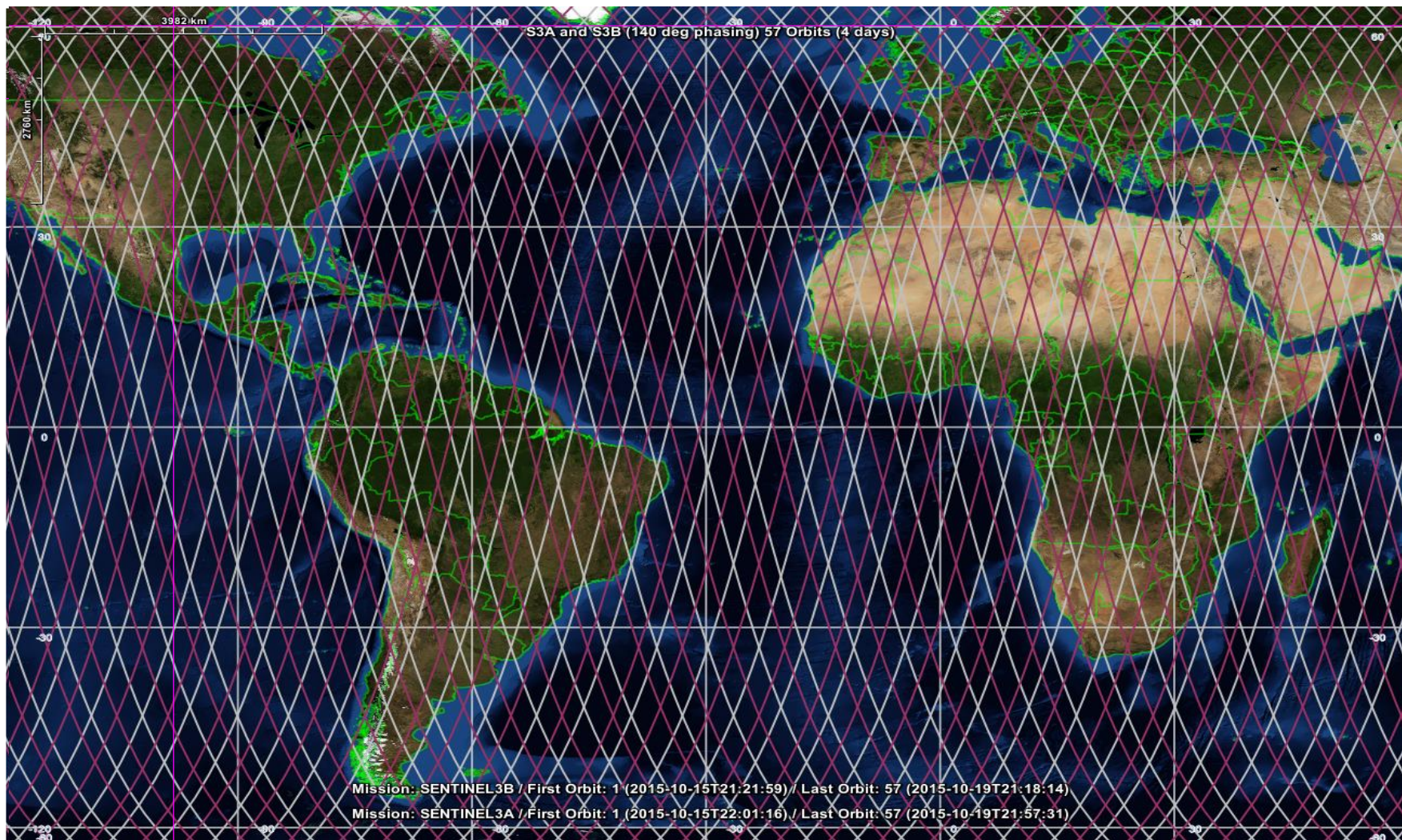
## Delay-Doppler Altimetry Studio







# Optimising the Constellation: Sentinel-3B phasing to 140° (instead of 180°) after 4 days



# S3 also responds to the NEW C3S climate service...

## Selected Significant Climate Anomalies and Events in 2015

### ALASKA

The year 2015 tied with 2002 as the

### ARCTIC SEA ICE EXTENT

During its growth season, the Arctic had its smallest annual maximum extent. During its melt season, the Arctic reached its fourth smallest minimum extent on record.

### ASIA

Much-warmer-than-average conditions were present across much of the continent. 2015 was the warmest year since continental records began in 1910. Russia had its



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The Copernicus Climate Change Service (C3S) will combine observations of the climate system with the latest science to develop authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide.

basin since reliable records began in 1971.

Jan 2015 was the driest Jan in at least five decades.

1932/33.

13 storms, cyclones

Experienced its fifth warmest year since national records began in 1910. The month of October was exceptionally warm, recording the largest anomaly for any month on record.

### ARGENTINA

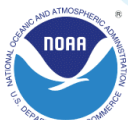
Second warmest year, behind 2012, since national records began in 1961. The four warmest years on record have occurred since 2012.

### SOUTH AMERICA

Much-warmer-than-average conditions engulfed much of the region during the year, resulting in the warmest year since continental records began in 1910.

### ANTARCTIC SEA ICE EXTENT

During its growth season, the Antarctic had its 16th largest annual maximum extent. During its melt season, the Antarctic reached its fourth largest minimum extent on record.



Please Note: Material provided in this map was compiled from NOAA's NCEI State of the Climate Reports and the WMO Provisional Status of the Climate in 2015. For more information please visit: <http://www.ncdc.noaa.gov/sotc>

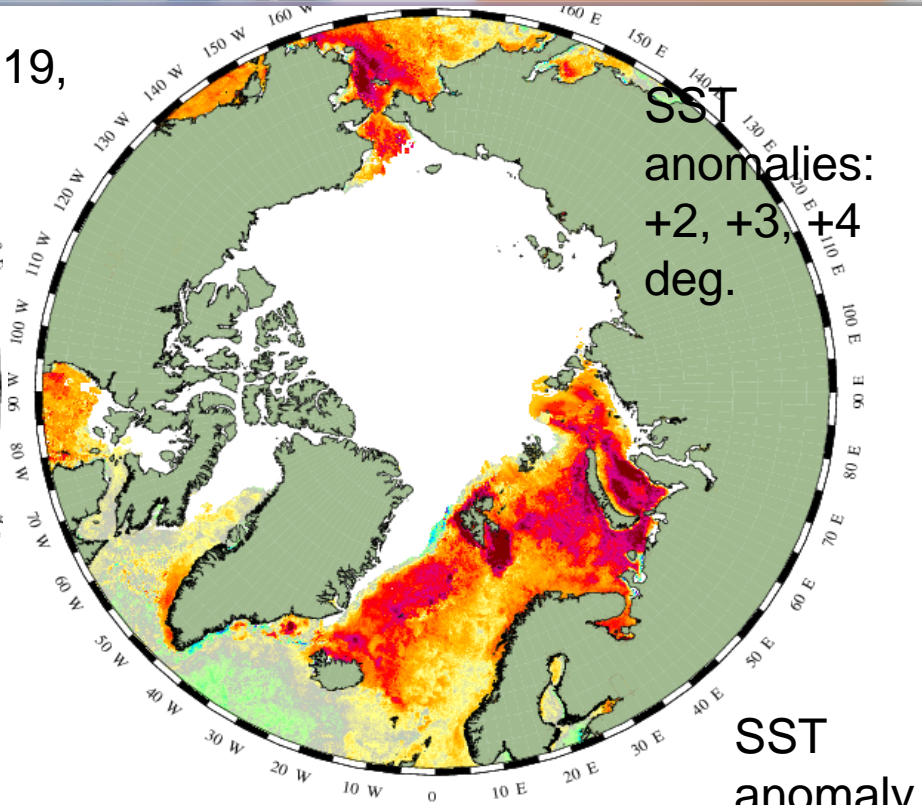
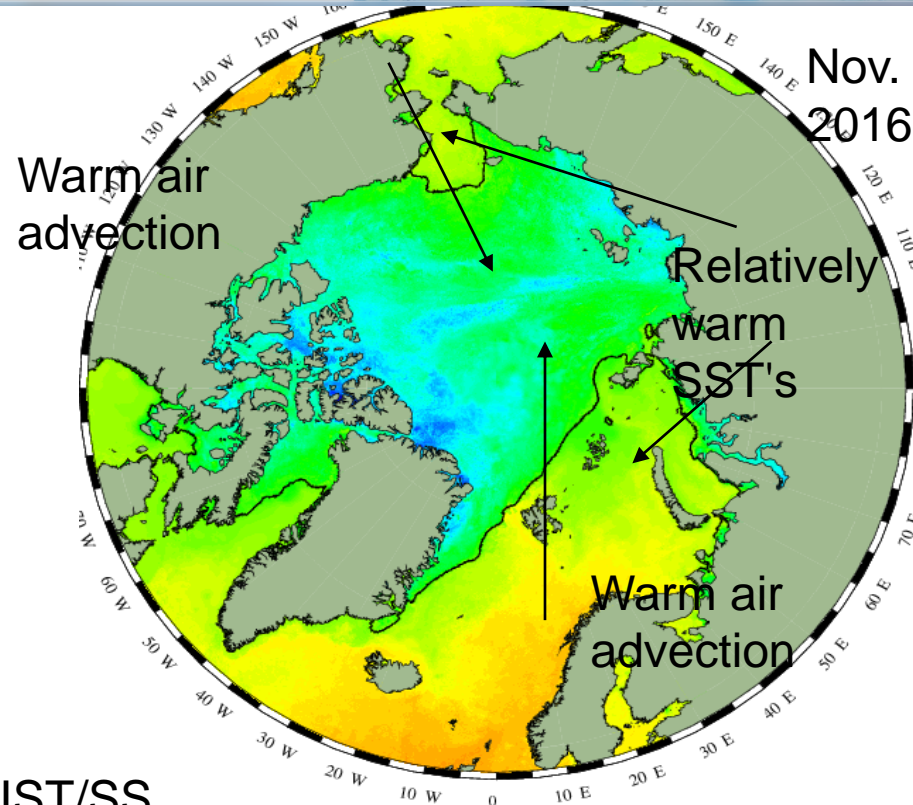
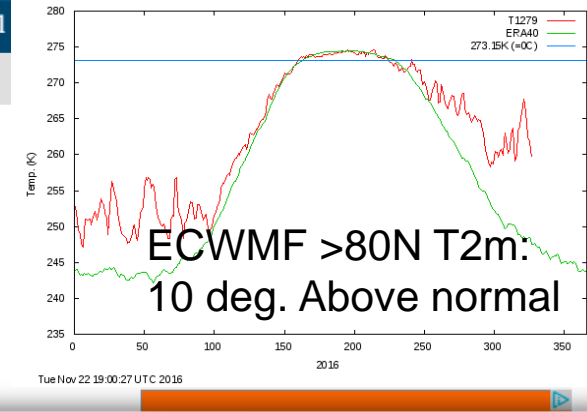
Sea ice

# 'Extraordinarily hot' Arctic temperatures alarm scientists

Nov. 22, 2016

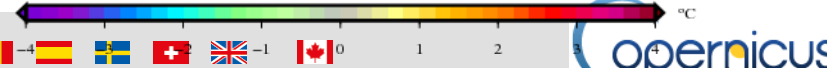
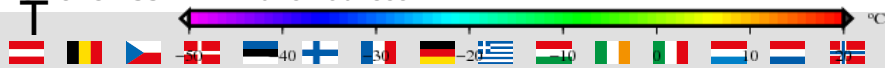
John Vidal

Danish and US researchers say warmer air and sea surface could lead to record lows of sea ice at north pole next year



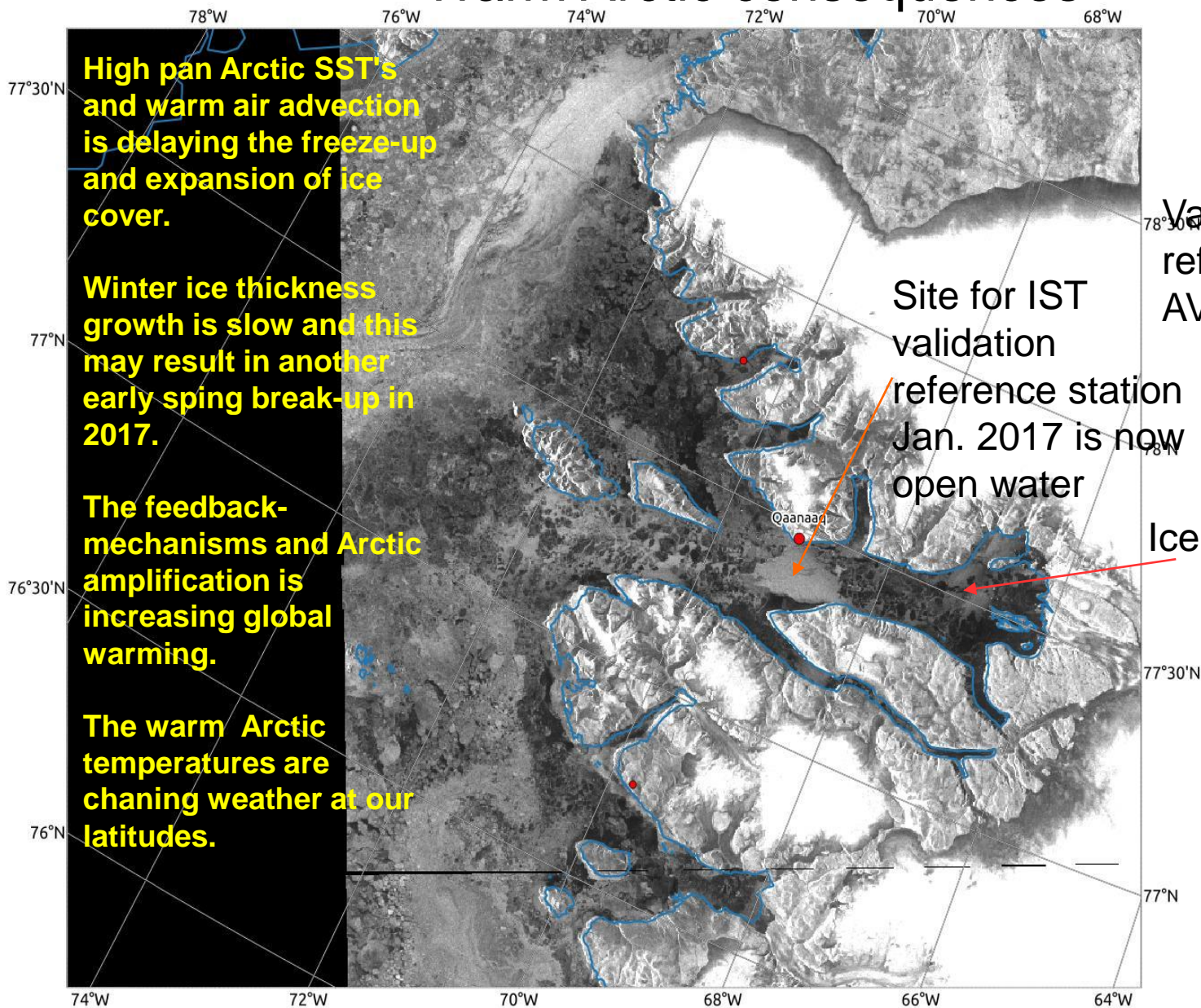
IST/SS

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C.Donlon | 31/10/2016 | Slide 35

# Warm Arctic consequences



**High pan Arctic SST's and warm air advection is delaying the freeze-up and expansion of ice cover.**

**Winter ice thickness growth is slow and this may result in another early spring break-up in 2017.**

**The feedback-mechanisms and Arctic amplification is increasing global warming.**

**The warm Arctic temperatures are changing weather at our latitudes.**

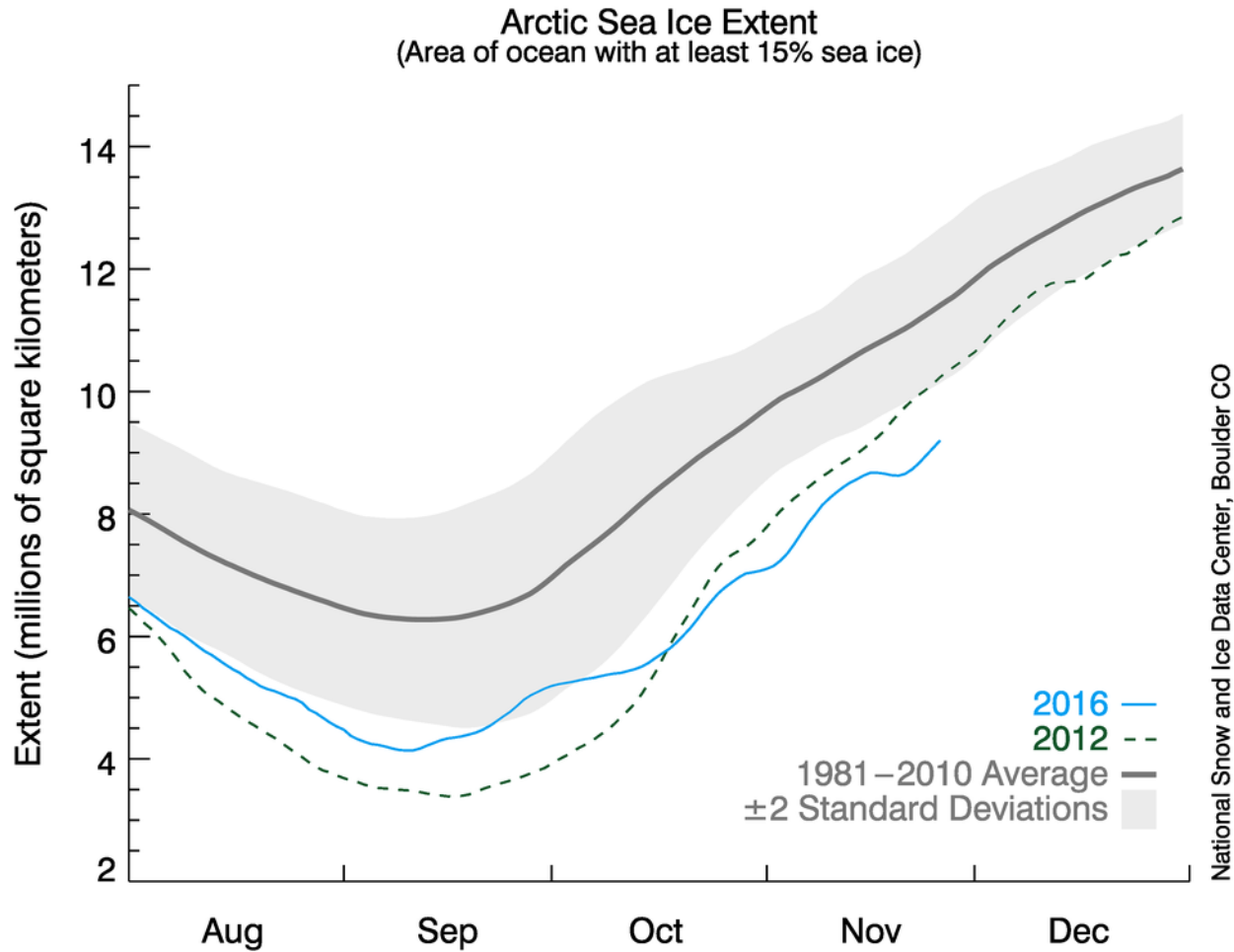
Site for IST validation reference station  
Jan. 2017 is now open water

Validation reference for AVHRR, SLSTR

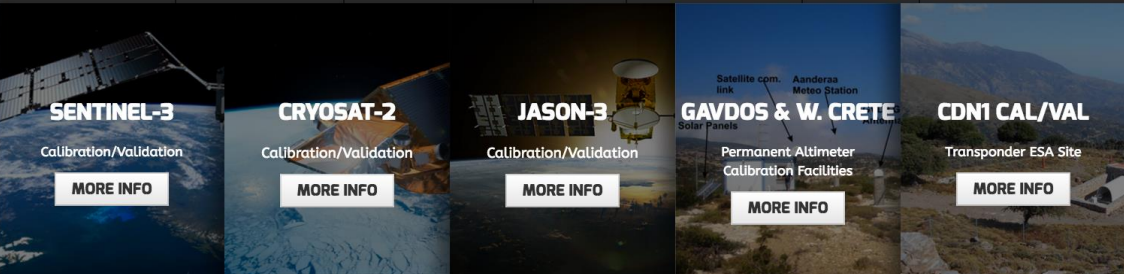
Ice is forming



Sentinel-1B:  
2016-11-21



26 Nov 2016



## FRM4ALT PROJECT

### AIM OF THE FRM4ALT PROJECT

Precise measurements of the surface topography of the ocean, and of continental waters are made through satellite altimetry missions all over the globe. An orbiting satellite emits electromagnetic waves to the surface of the Earth. Then the satellite observes and processes the reflected signals, their time of arrival, and their properties. From these altimetric observations, the range from the satellite to the earth surface, as well as ocean

### LATEST NEWS

#### TRANSPONDER CALIBRATION

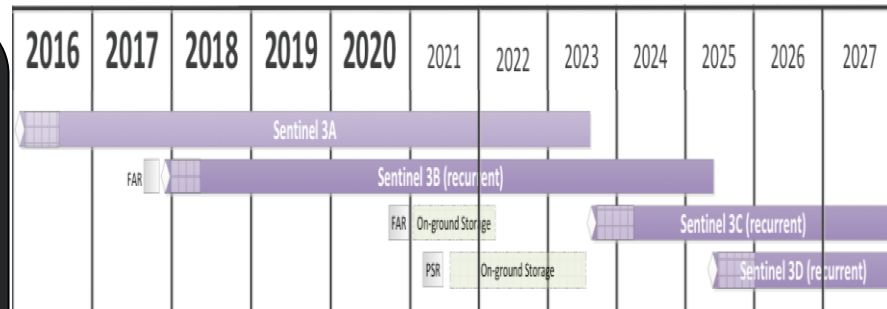
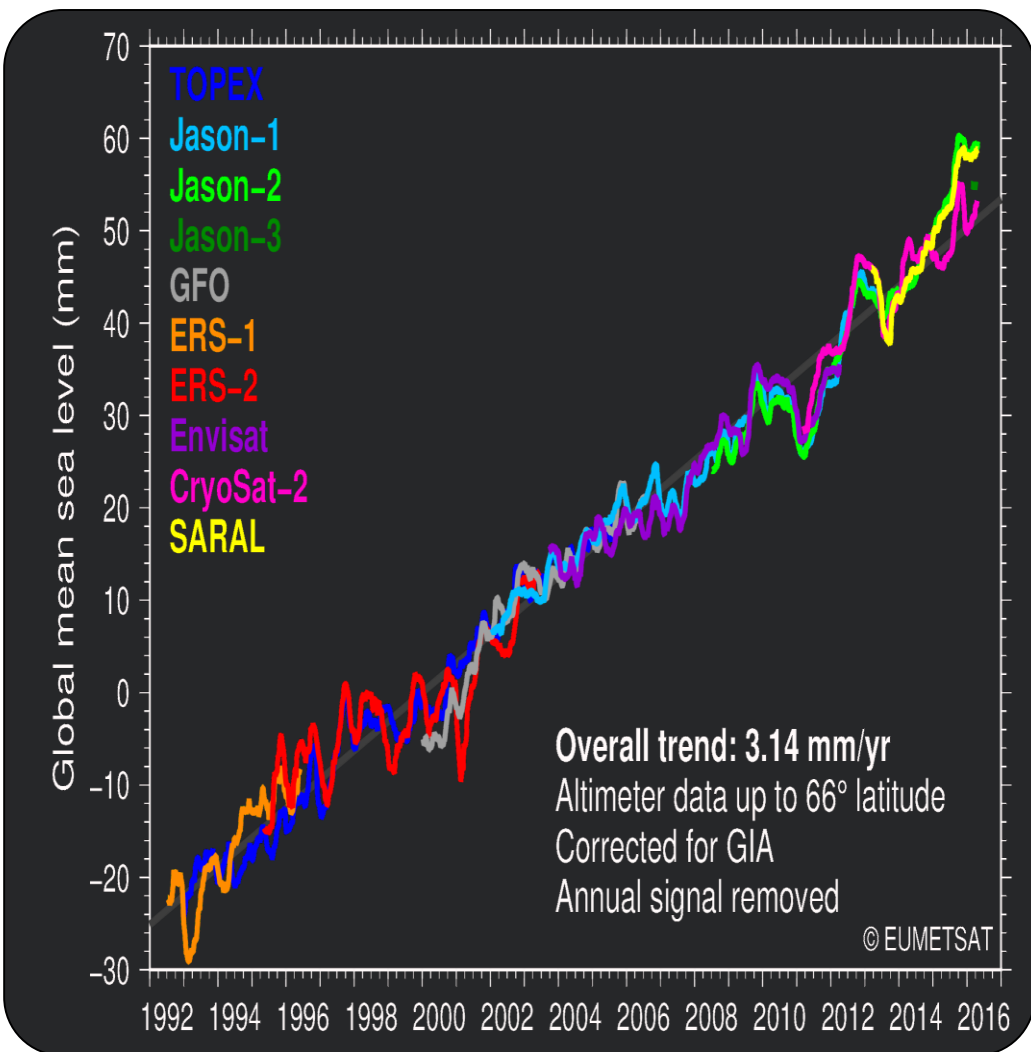
Transponder calibration at the CDN1 ESA Altimeter Calibration Site, for: CryoSat-2 on 16-Aug-2016 at 21:23 UTC

**fi·du·cial (adj)** *Regarded or employed as a standard of reference, as in surveying.*

[Late Latin fdcilis, from Latin fdcia, *trust*, from fdere, *to trust*; seebheidh- in Indo-European roots.]

**Establish and demonstrate SI traceability of Fiducial Reference Measurements (FRM) and their use for satellite derived altimeter calibration and validation.**





- **The S3 mission includes 4 satellites**
- Even though S3A and S3B are practically identical in design, *it is anticipated that differences in performance of payload instruments will exist*
- It is essential that **relative (absolute) bias between S3A/B/C/D instruments are known properly** for Climate Data Record construction

# S3 cross-satellite calibration (linking error): S3A/B Tandem flight feasibility

- There is a significant correlation between **end-to-end mission measurement uncertainties**:
  - Uncertainty due to geophysical **ocean space and time variability** (especially in regions dominated by mesoscale structure, 1-10 days, <10-50 km)
  - Uncertainty due to **atmospheric space and time variability**
- **A tandem phase** for the S3 Mission was studied at PDR
- **Flying S3A and S3B close (eg. 30s) on the same ground track (+/- 1km) together minimizes both of these aspects and maximizes the correlation between mission measurement errors**
- **GCOS Satellite Climate Monitoring Principles** (GCMP) requests a tandem flight for all satellite instruments
- This is **exactly the approach adopted routinely by the JASON altimeter time series** and stabilizes the Sea Level data set (S3 uses a transponder for range but not sigma-0)
- Exploratory studies to investigate the possibility of a limited duration (3-6 month) calibration tandem between S3A and S3B during Phase E1 would verify feasibility





- **Successful launch of Sentinel-3A on 16<sup>th</sup> February 2016**
- **Satellite and payload is stable and fully commissioned**
- **All ground segment facilities supporting Sentinel-3** are being commissioned both at ESA and EUMETSAT to full operations
- **Validation activities are well advanced and dedicated projects are in place to develop a culture of FRM validation.**
- **Sentinel-3B Satellite integration well advanced.** On track for a launch in late 2017.
- **Contract signed with Thales Alenia Space to build Sentinel-3C and -3D Satellites on 9<sup>th</sup> February 2016**
  - Delivery of the C and D models by end 2021, well in advance compared to the predicted lifetime of the A and B models (7 years min from start of operations)
- **With the inclusion of the C and D models to the fleet of Sentinel-3 satellite, mission continuity is ensured for at least 25 years from the launch of the first Satellite**

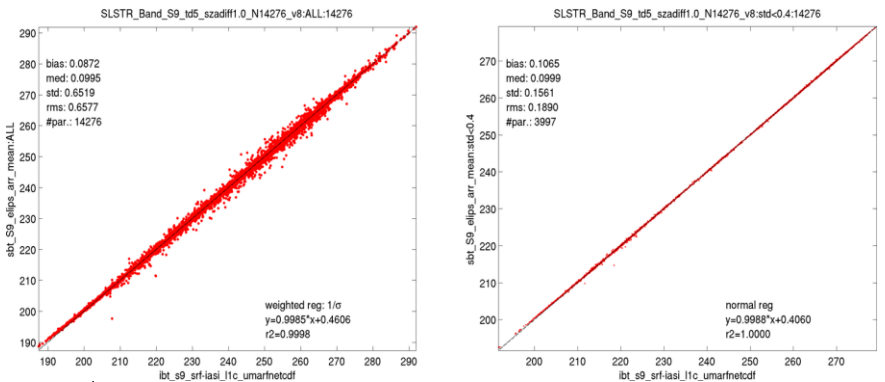
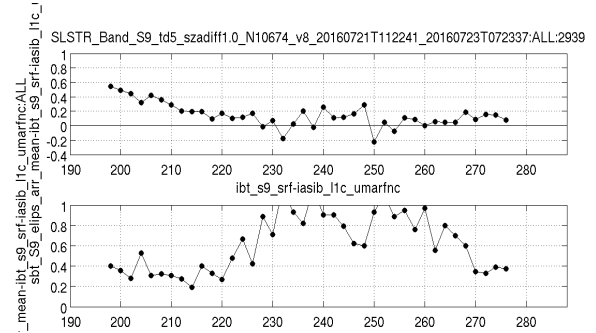
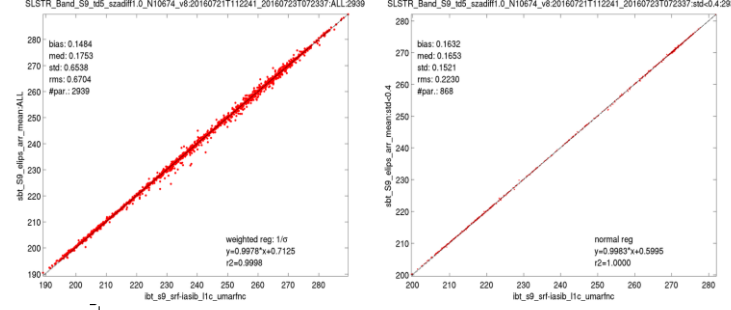


Thank You –  
any Questions  
Contact: [Craig.Donlon@esa.int](mailto:Craig.Donlon@esa.int)

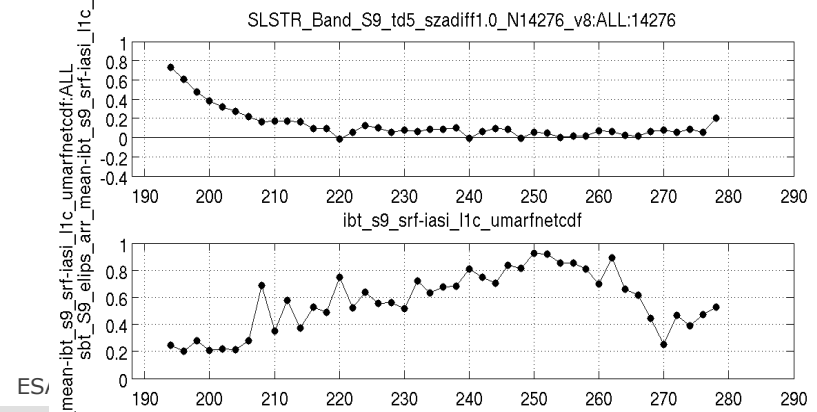


# TIR Radiometric Calibration: e.g. SLSTR vs IASI

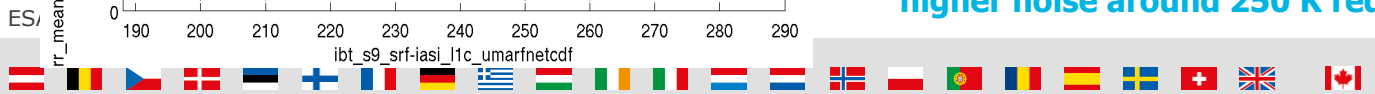
- SLSTR vs IASI-A
- Timediff: 5 min
- Distance: within pixel
- Satellite zenith angle:  $\Delta\text{SZ}/\text{SZ} \leq 1\%$
- 5 SNO events: 27-28/04; 04-06/06; 23-25/06; 12-14/07; 01-02/08
- 100% matchups



- SLSTR vs IASI-B**
- Timediff: 5 min
  - Distance: within pixel
  - Satellite zenith angle:  $\Delta\text{SZ}/\text{SZ} \leq 1\%$
  - 5 SNO events: 17-19/04; 06-08/05; 13-15/06; 21-23/07; 28-30/08
  - 100% matchups

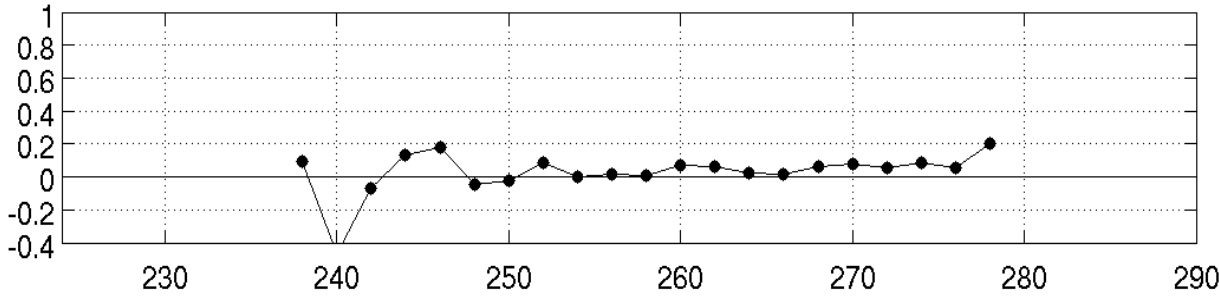


- Directly compared S3A SLSTR S8/S9 and MetopA/IASI
- SLSTR agrees well with IASI for BT 230-270 K with near zero bias
- Consistent results between SNO events
- Separate contribution from north (250-270 K) and south ( $\sim < 250$  K) SNOs
- Higher bias in very cold temperature range ( $< 230$  K) and higher noise around 250 K requires further investigation

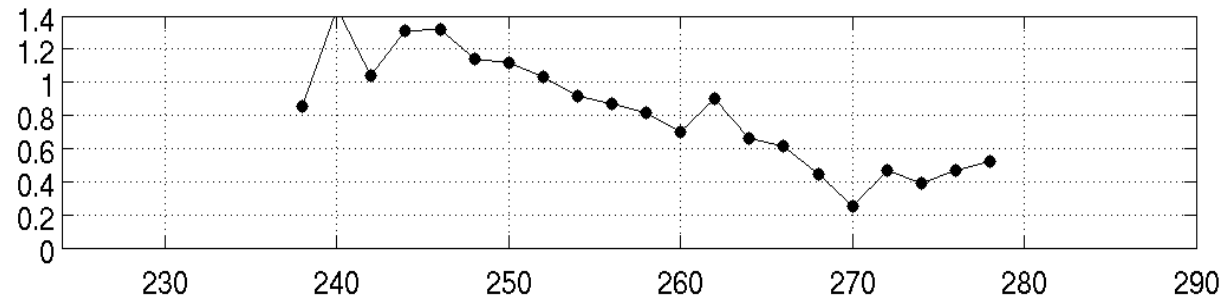


# North polar region

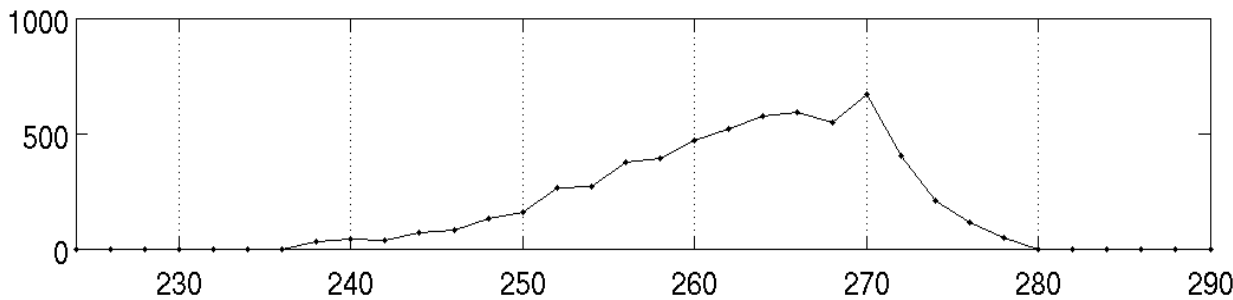
North\_pole\_SLSTR\_Band\_S9\_td5\_szadiff1.0\_N14276\_v8:std<0.4:6144



ibt\_s9\_srf-iasi\_l1c\_umarfnetcdf



ibt\_s9\_srf-iasi\_l1c\_umarfnetcdf



ibt\_s9\_srf-iasi\_l1c\_umarfnetcdf

