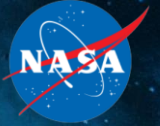


National Aeronautics and
Space Administration



NADYA VINOGRADOVA SHIFFER
ERIC LINDSTROM

Science Mission Directorate · NASAHQ

OSTST Meeting
October 21 - 25, 2019
Chicago, IL

Thank you Eric Lindstrom! You are awesome!

NASA Exceptional Service Medal

“For exceptional service and leadership excellence to the Earth Science Division, which have made profound impacts on Earth science research and NASA’s mission success”

Fellow of The Oceanography Society

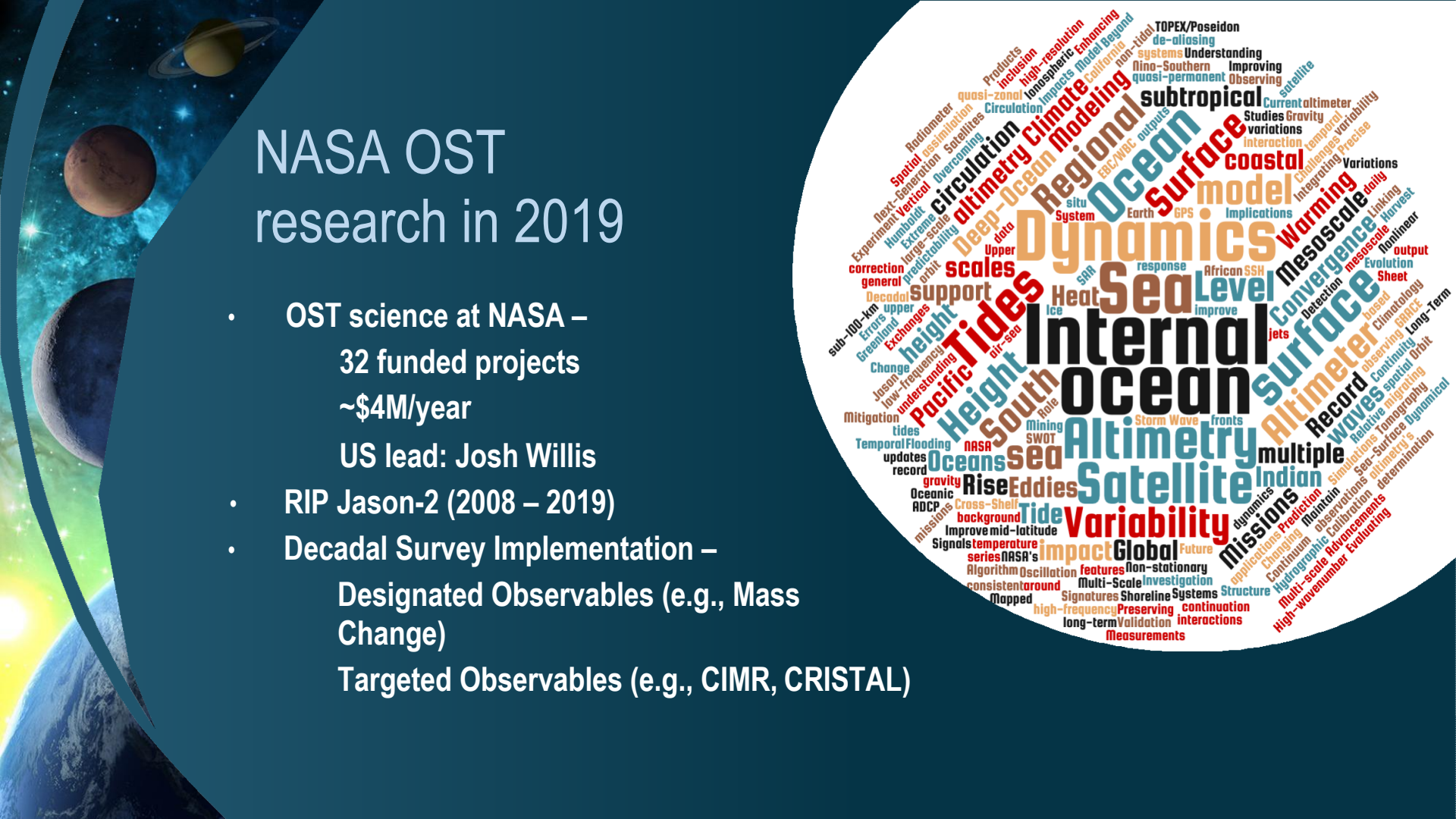
“ For leadership of the global community to advance coordinated ocean observing combining space and in-situ systems and facilitating the execution of large ocean field campaigns ”



NASA OST research in 2019

- OST science at NASA –
32 funded projects
~\$4M/year
US lead: Josh Willis
- RIP Jason-2 (2008 – 2019)
- Decadal Survey Implementation –
Designated Observables (e.g., Mass Change)
Targeted Observables (e.g., CIMR, CRISTAL)

- [illegible]





NASA OST research in 2020

New OSTST

Feb 2020 – ROSES announcement
Oct 2020 – proposals due
Apr 2021 – New OST members

Other relevant opportunities

SWOT – proposals due Nov 2019
new team ~ June 2020
Sea Level Change ST –
proposals due Oct 2019
new team ~ April 2020
Physical Oceanography –
proposals due June 2020
new team ~ Jan 2021

<https://science.nasa.gov/researchers/sara/grant-solicitations>



CNES ocean Program status

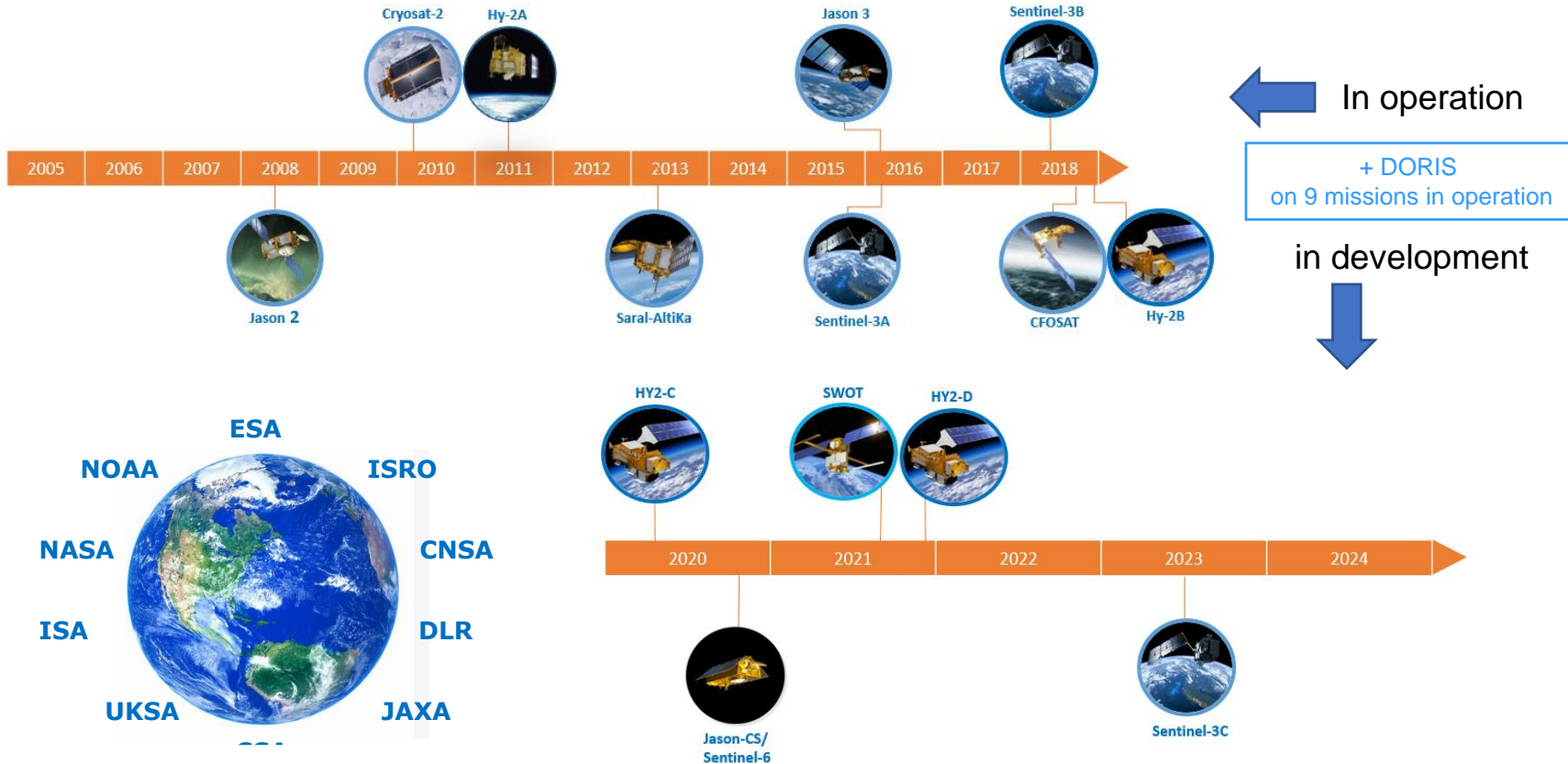
Annick Sylvestre-Baron - Ocean program manager

Sophie Coutin-Faye - Altimetry projects

21st of October, 2019

OSTST – Chicago

CNES Earth/Ocean Observation program



Breaking news since last OSTST for in orbit satellites

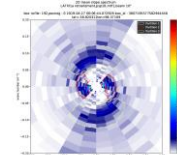
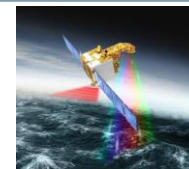
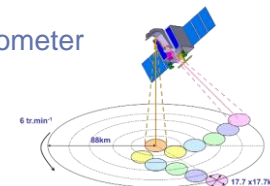
CFOSAT: China France Oceanography SATellite (10/29/2018 -)

- Two payloads: SCAT / CNSA - wind scatterometer - SWIM / CNES - wave scatterometer

- 1st CFOSAT science team call End of 2018

→ Very promising results

(see today presentation and dedicated session CFOSAT on Thursday afternoon)



SARAL: Satellite with ARGos and ALtika (02/25/2013 -)

→ Mission extended for 2 more years, until end of 2021 *(see today presentation)*



JASON2 (06/20/2008 – 10/10/2019)

→ Scientific data of excellent quality until last acquisition on October 1st

→ GREAT JOB FROM ALL TEAMS INVOLVED

(see today presentation)



Multi-mission exploitation

Missions operations:

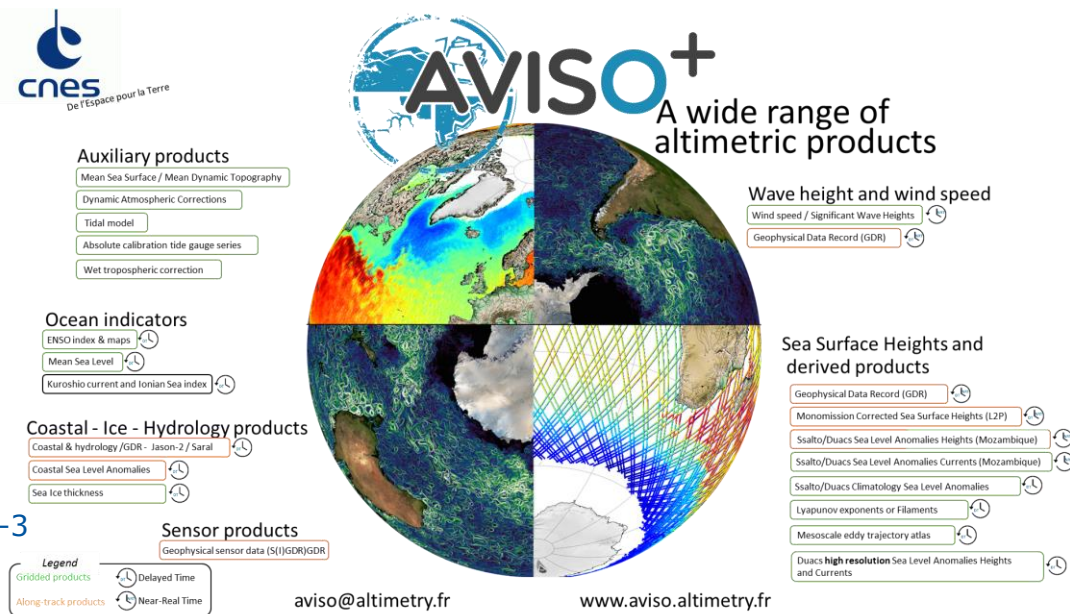
- SARAL OK > 99 % availability
- Jason-3 OK > 99% availability

DORIS and POD

- Same + Hy-2A, Cryosat-2, Sentinel-3
- Reprocessing of past and in-flight missions using new standards

Beyond GDRs:

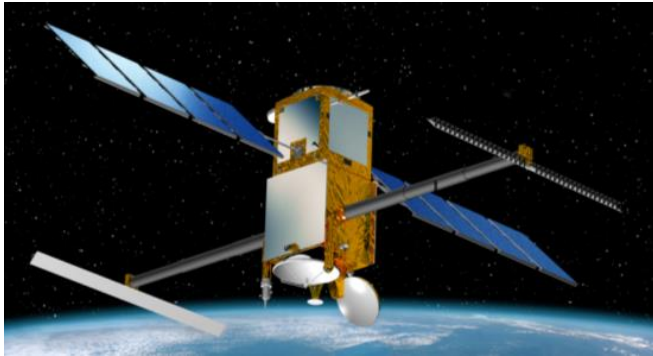
- L2P products for CMEMS
- GDR-F coming soon for Saral & Jason-3
- Expertise studies
- OSTST science projects



Missions in development

Copernicus:

- Contribution to Sentinel-3 & Sentinel 6/Jason CS (TOPO performance, DORIS/POD, level L2P & L3 products)
- Continuing support to science studies through OSTST



SWOT

- KaRIN radiofrequency unit, DORIS: delivered to JPL
- Poseidon altimeter: to be delivered soon
- Satellite bus: I&T ongoing
- Algorithm & ground segment good progress
- SWOT Science team call for French teams and international teams (excepted American teams – ROSES call) ongoing – proposal deadline Friday November 1st 2019

HY-2 altimetry series

- HY2-C & HY2-D launched in 2020
- HY2-E & HY2-F & HY2-G planned
- DORIS on all HY2 (excepted HY2-B)
- CNES in charge of POD and altimetry data performance expertise

CNES Science Prospective Seminar recommendations

- ❑ Establishment of science priorities for the next 5 years
- ❑ Large consultation of the French Science community
- ❑ European and international context (program of records) taken into account.
- ❑ Universe & Earth observation science with additional focus on : data / nanosats / technology

➤ High priority missions for Earth/Ocean observation

Mission	Observation	Scientific objectives	status
MARVEL	Gravity field	Evolution of climate, Solid Earth, water mass. Earth reference system	Collab: NASA/ESA
SKIM	Ocean Winds and currents	High frequency observation – ECV: Total Current Surface	EE9: Not selected Phase A still on going

➤ Strong support to Altimetry long term and other auxiliary ocean topics:

- WISA (in coordination with ESA): medium swath altimetry concept for Copernicus NG (including hydrology)
- CRISTAL (ESA): cryosphere, sea ice and ocean
- CIMR: polar ocean (SST, SSS)
- ULID (Nanosat) & SMOS-HR: Salinity

EUMETSAT Marine Services and Programmes Status

21 October 2019

Francois Parisot

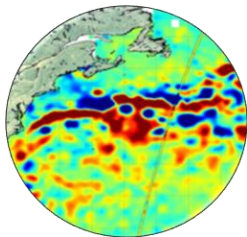
With contribution from Estelle Obligis,

Milen Tahtadjev and Hillary Wilson



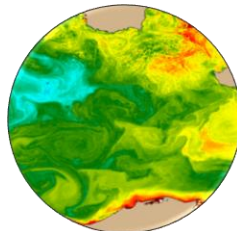
Space Segment Overview for Marine Applications

Sea Surface Height
Significant Wave Height
Wind Speed

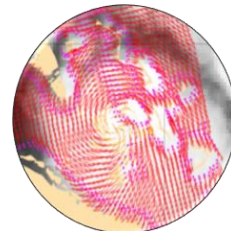


*OSI-SAF contribution

Sea Surface
Temperature
Fluxes



Wind Vectors
Sea Ice Parameters



Ocean Colour



MSG

SEVIRI*

SEVIRI

MTG

FCI, IRS

FCI

EPS

AVHRR, IASI*

ASCAT*, AVHRR*, IASI*

EPS-SG

METImage*, IASI-NG*

SCA*, METImage*, IASI-NG*

3MI

Jason-2/3

Poseidon-3/AMR

Sentinel-3 A/B/C/D

SRAL/MWR

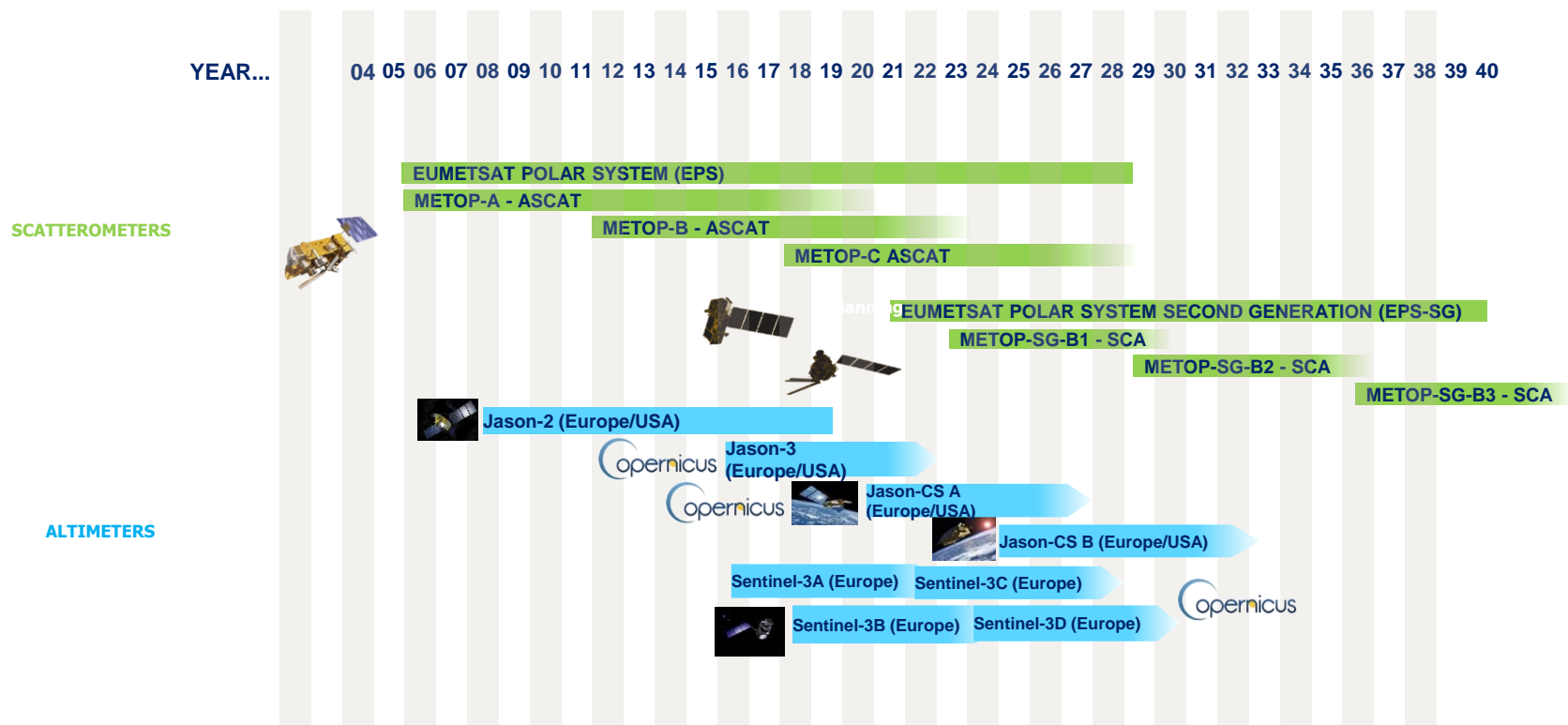
SLSTR

OLCI

Sentinel-6 Jason-CS

Poseidon-4/AMR-C

Planning



Jason-2 and Jason-3

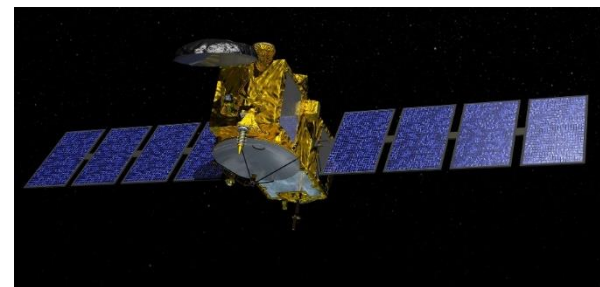
- **Jason-2**

- After more than 11 years in orbit, satellite on-board anomaly detected, preventing the continuation of further operations.
- 1 October 2019: stop of scientific data acquisition.
- 10 October 2019: completion of satellite passivation.



- **Jason-3**

- Nominal operations in the reference altimetry orbit.
- Ready to support the cross-calibration of the future Jason-CS/Sentinel-6 mission.



- Dedicated presentations later on today.

Jason-CS/Sentinel 6

- Dedicated presentation later on today
- Main highlights
 - Satellite has been moved to IABG for environmental test
 - All payload instruments on board
 - Ground segment development progressing according to schedule
 - System activities now focusing on Integration, Verification and validation
 - Commissioning and CAL/VAL activities being documented in dedicated plans

**Launch date remains
15th November 2020**



Sentinel-3A&B Operations Status

- Satellites
 - S3A&B are operating nominally with a very good availability of the instruments (reaching 100%), with only few exceptions caused by S3B SRAL anomaly in Jan and S3B OLCI anomaly in May
 - Routine activities such as orbit maintenance manoeuvres, security key changes and regular calibration activities are running smoothly
- Flight Operations Segment continues to support all routine dual satellite activities
 - S3 Mission Control System is performing the nominal satellite commanding activities
 - S3 Flight Dynamics Facility performs regular analyses and contributes to orbit maintenance and collision avoidance planning activities
 - S3 Mission Planning Facility performs the nominal and ad-hoc instrument commanding supporting e.g. regular calibration and validation tasks and ad-hoc investigation of instrument anomalies
- Marine PDGS
 - All S3A & S3B Marine Products are operational
 - PDGS is now close to or exceeding availability targets for all products
- S3B Routine Operations Readiness Review completed on 26 Marc 2019 with ESA formalising the start of the full dual satellite operations

Sentinel-3 Operational Product Release Status

- **S3A&B SRAL/MWR** ► all products operational (S3B since 12/2018)
- **S3A&B Altimetry L2P/L3 Service** ► operational (S3B L2 since 1/2019 & L3 4/2019)
- **SRAL/MWR Reprocessed Data**
 - **Second Reprocessing** of S3A **L1** and **Marine L2** user products for **SRAL/MWR** covering period from 01/03/2016 to 20/01/2018 available from CODA REP & EUMETSAT Data Centre
 - **Reprocessed Altimetry S3A L2P** products covering the period of June 2016 to April 2017 completed and available from AVISO
 - **Reprocessed Altimetry S3A L3** products covering the period of June 2016 to April 2017 completed and available with CMEMS V4

	ODA/CODA*			EUMETCast			Data Centre		
	NRT	STC	NTC	NRT	STC	NTC	NRT	STC	NTC
Level 0	✓ (special users)						✓ (special users)		
Level 1									
SRAL	✓	✓	✓	✓	✓		✓	✓	✓
MWR	✓		✓	✓			✓	✓	✓
Level 2									
SRAL/MWR	✓	✓	✓	✓	✓		✓	✓	✓
	AVISO/CMEMS			EUMETCast					
Level 2P									
SRAL	✓ (AVISO)	✓ (AVISO)	✓ (AVISO)	✓	✓				
Level 3									
SRAL	✓ (CMEMS)	✓ (CMEMS)	✓ (CMEMS)						

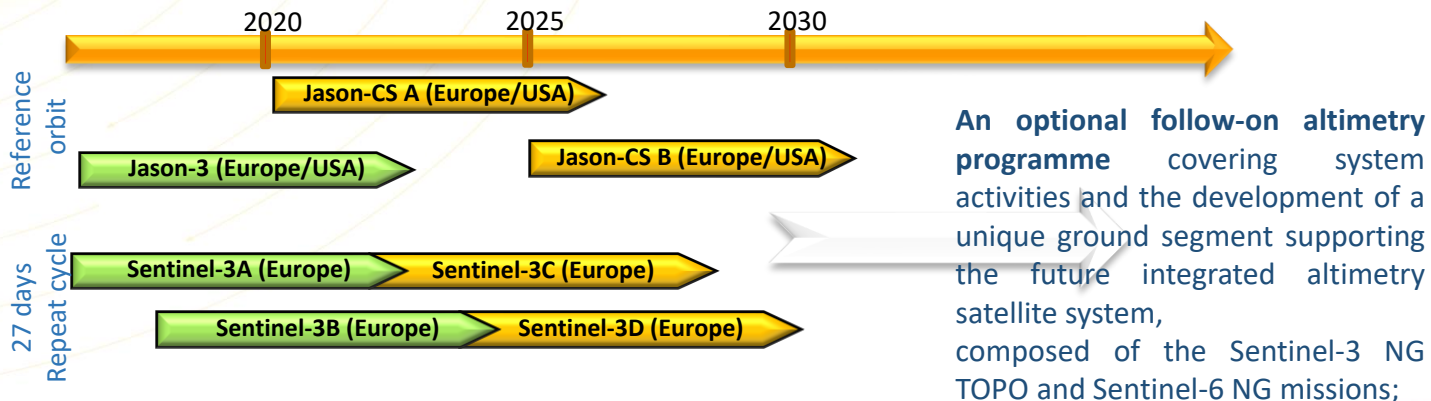
Production & Dissemination Status

Green = operational
Orange = only for special users
Grey = not applicable

Sentinel-3 What Next?

- 6th Sentinel-3 Validation Team Meeting – 10-12 March 2020 (EUMETSAT) - save the date!
- 2nd Mission Constellation Review – March 2020 (ESRIN)
- 1st Data Quality Key Point – September 2020
- Upgrades to EUMETSAT Ground Segment to operate also Sentinel-3C (launch mid 2023) and later Sentinel-3D (launch mid 2025) are in progress

EUMETSAT planned future contribution



With European Commission and ESA, additional Sentinel “expansion” missions have been identified for monitoring the ocean, the atmosphere and the polar environment

- Anthropogenic CO₂ Monitoring Mission,
- Polar Ice and Snow Topographic Mission (Cryosat FO)
- Passive Microwave Imaging Mission.

A major contribution to the Anthropogenic CO₂ Monitoring Mission, and lower level contributions to the Polar Ice and Snow Topographic Mission (Cryosat FO) focussed on the processing of global ocean and atmospheric products involving synergies with Sentinel-3/-6 and EPS-SG.

NOAA Program Status

Eric Leuliette, *NOAA Program Scientist*

Renee SmithDearing, *Project Manager*

Chris Sisko, *Acting NOAA Project Manager*

Ocean Surface Topography Science Team Meeting (OSTST)

21-25 October, 2019

Chicago, Illinois



NOAA Jason Program

NOAA Jason Ground System

- Continued Jason-2 and Jason-3 data production and distribution
- Technical refresh status

NOAA Jason Science Program

- Project, National Weather Service, and OSTST support
- STAR Science Teams
- OceanWatch/CoastWatch/PolarWatch

NOAA Jason Ground System (NJGS)

NJGS Network Upgrade/Refresh

- Network connectivity testing nearing completion using high-speed trans-Atlantic link between Darmstadt and US NOAA network (NWAVE)
- TRR scheduled for early Nov for the transition of Jason operations to using the high-speed trans-Atlantic link
 - legacy DS-3 links kept in place for backup purposes
- Decommission legacy DS-3 links and associated equipment in early January

NJGS Technical Refresh

- | | |
|--|------------------------------------|
| • Deployment to NOAA | December 17, 2018 - March 14, 2019 |
| • On-Site Testing | January 28 – Present |
| • New TM-NRTs using current FileManagers | May 29, 2019 |
| • Cabling between ESPC and SOCC | July 15, 2019 |
| • Operational Readiness Review | December 3, 2019 |
| • Transition to Operations | January 13, 2020 |
| • System Acceptance Review | February 24, 2020 |
| • NOAA Commissioning | February 27, 2020 |

APOP_008 - NOAA's Jason Products

APOP_009 - Jason-2 and Jason-3 Near-Real Time Products Latency over the Past Year

Upgrade of altimetry data assimilation at the National Weather Service (NWS)

- NWS Environmental Modeling Center effort to improve hurricane intensity forecasting
- Implementation of LETKF-based DA in HYCOM of coupled HWRF system
- Joint Effort for Data assimilation Integration (JEDI)



Support of the OSTST

- Five PIs funded through 2017-2020
- Arctic circulation, EKE, Fully-Focused SAR, Data Assimilation, and air-sea interaction
- Funded through NOAA Cooperative Institutes
- Expect to support the OSTST in the next ROSES (2021-2024), ~4 PIs ~800K/year



NOAA Research & Technology Maturation Projects

NOAA/NESDIS Office of Projects, Planning, and Analysis (OPPA) is funding two Research & Technology Maturation Projects (\$540K in FY18, \$360K in FY19)

1. Maturing Reflectometry Usefulness to the NOAA Observing System Portfolio for Winds and Altimetry applications

- Phase-Delay Altimetry Study using Spire GNSS-RO Satellites
- Masters et al. “First Results of Grazing Angle GNSS-R Altimetry from Sea Ice and Ocean Surfaces Using the Spire CubeSat Constellation,” The Future of Altimetry splinter



2. Dual-band radar satellite altimeter instrument studies for sea ice and sea state

NOAA Center for Satellite Applications and Research (STAR)

Sea Surface Height Science Team

APOP_011 - New Developments for NOAA's operational upper Ocean Heat Content product suite

APOP_010 - Satellite altimeter observations of extreme winds and waves, and special editing required for Jason-2 Geodetic Mission data

Cal/Val: Comparisons of Jason-3 and Sentinel-3A and tide gauges

Sea Ice and Polar Dynamics Team

Science IV: Assessment of ICESat-2 Performance over the Arctic Ocean During its First Year in Orbit

NOAA LSA Sea Ice Data Products Webpage:

https://www.star.nesdis.noaa.gov/sod/lisa/SeaIce/DataProducts/products_SeaIce.php

➤ Visualization of NOAA satellite sea ice data products

Access to NOAA LSA Sea Ice Products:

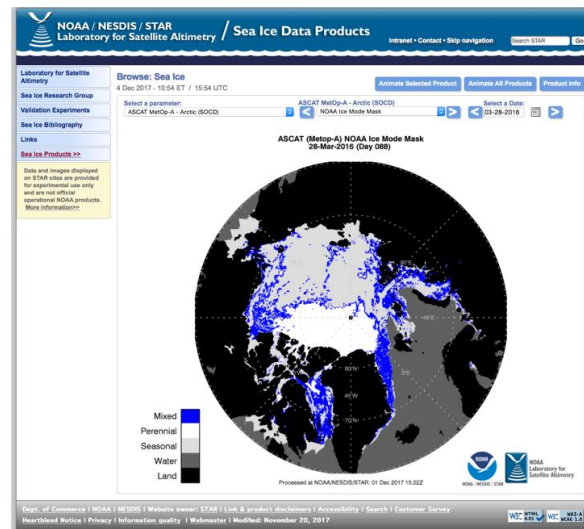
<ftp://ftp.star.nesdis.noaa.gov/pub/socd/lisa/SeaIceProducts/>

➤ Daily ASCAT ice type product available via LSA FTP

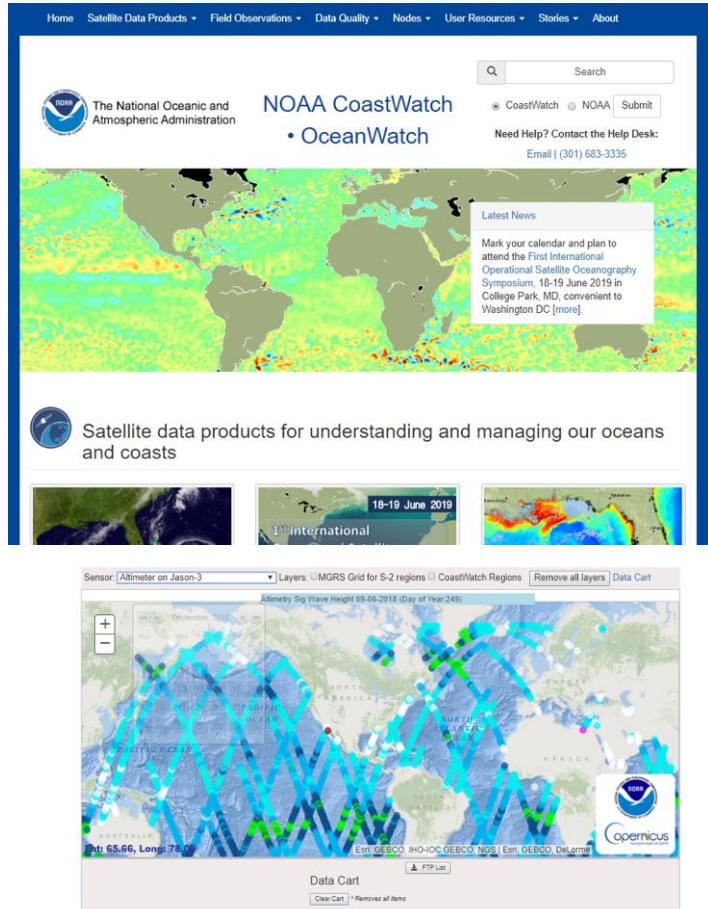
➤ IceBridge airborne products produced retrospectively for time periods for which historical source data are available

➤ New sail height product released in 2019

NOAA LSA sea ice products website



NOAA CoastWatch/OceanWatch/PolarWatch

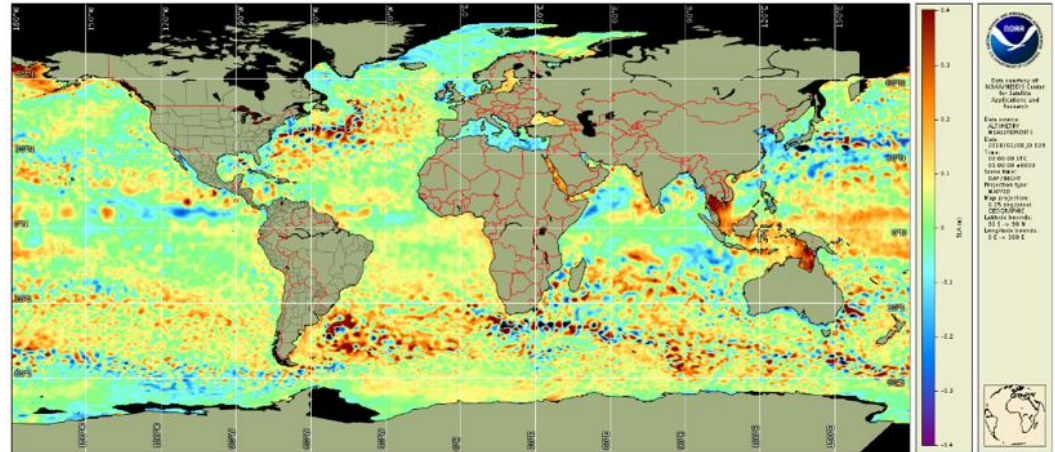


NOAA CoastWatch • OceanWatch • PolarWatch
facilitates the use of ocean satellite data for research,
applications and decision-making.

NOAA PolarWatch launched in fall 2016.

[CoastWatch.noaa.gov](https://coastwatch.noaa.gov)

ODS_013 - NOAA CoastWatch/OceanWatch Altimetry Products



ESA's Earth Observation Programmes

Ocean Surface Topography Science Team Meeting (OSTST) 2019
Chicago, 21-25 October 2019

Pierre Féménias, ESA

Data Quality Manager, Mission Management & Ground Segment Dept -
EOP-G

A successful Track-Record

ESA-Developed Earth Observation Missions

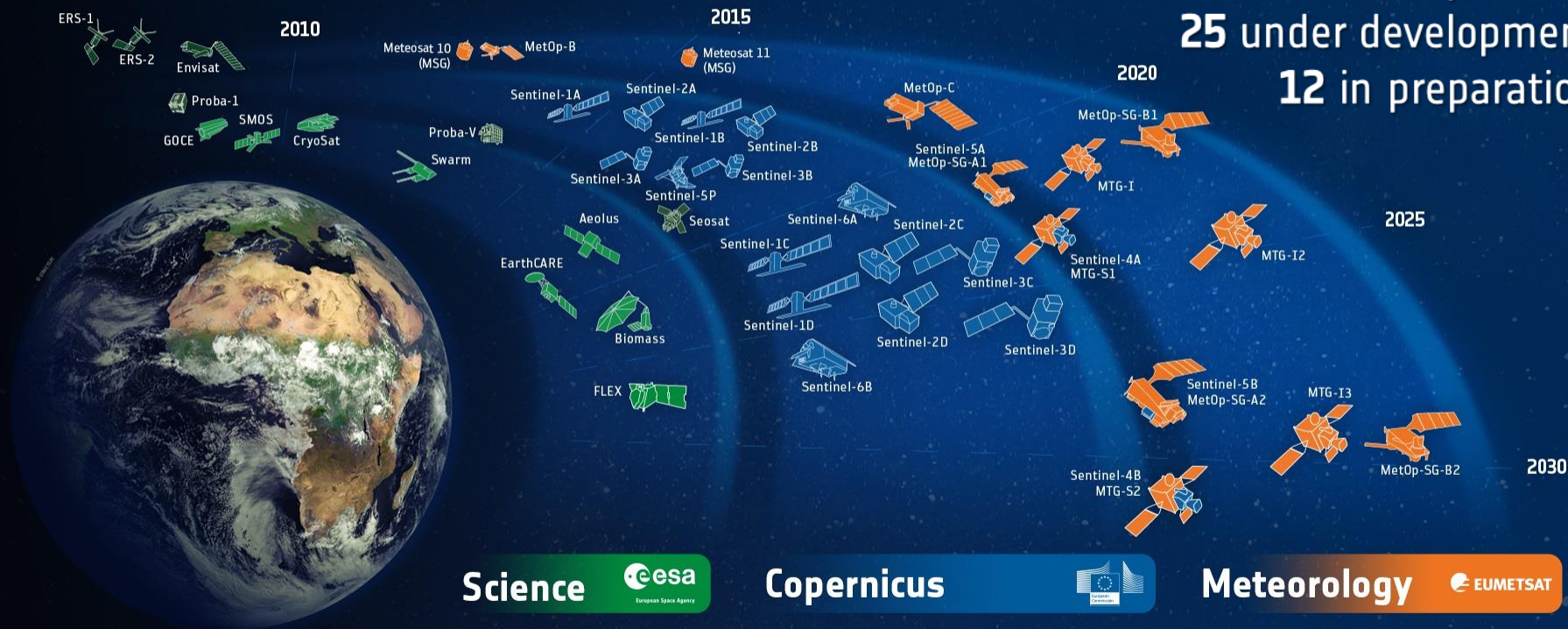


Satellites

15 in operation

25 under development

12 in preparation



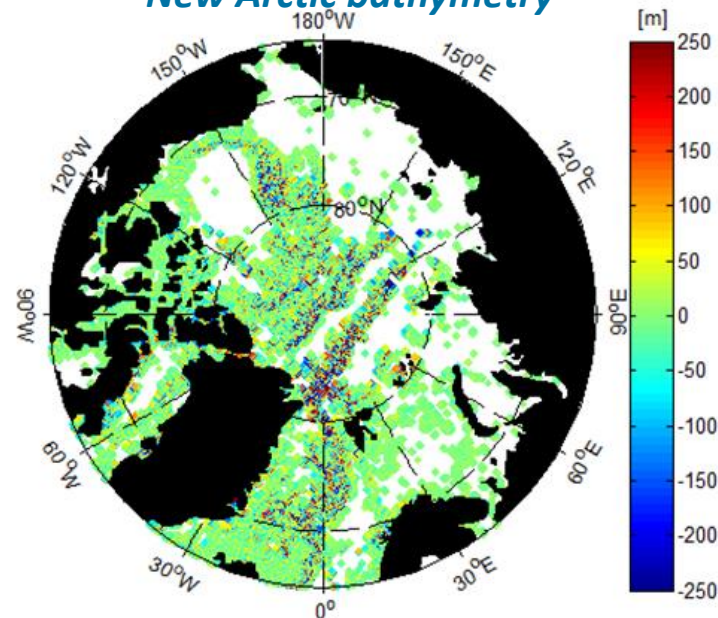
ESA UNCLASSIFIED – For Official Use



European Space Agency


- CryoSat mission remains in **excellent condition**,
- The special operation to roll the satellite (± 0.4 degrees) to calibrate the SARIn interferometer took place successfully,
- The 10th **In-flight Operation Review** confirmed that CryoSat is fit to support mission extension until end 2021. On-board fuel leakage has been confirmed but no immediate actions are required,
- The overall quality of the CryoSat products is satisfactory. Reprocessing of the ocean and ice chain are progressing according to schedule,
- Activities related to the next Antarctic and MOSAIC campaigns are progressing according to plan,
- The dialogue with **NASA ICESat-2 team** to implement coincident Lidar/Radar measurements is ongoing successfully.

New Arctic bathymetry



New bathymetry model developed by DTU Space using ERS-1, ERS-2, Envisat and 7 years' of CryoSat data: the above figure provides the difference between the new model and IBCAO V3 (International Bathymetric Chart of the Arctic Ocean) - <https://bit.ly/30Tpjro>

➔ **SESSION: Science IV: Altimetry for Cryosphere and Hydrology (Thu, Oct 24 2019, 16:15 - 18:00)**

- 
- Sentinel-3 constellation (S3A & S3B) is in **excellent condition**
 - The overall quality of the Sentinel-3 Altimetry & Optical products is satisfactory, in line with MRD
 - All L1 & L2 data core products have been released @ MARINE Centre (EUM) and LAND Centre (ESA)
 - Reprocessing of the S3 STM data products since S3A & S3B BOM is intended by Q4 2019 – Q1 2020
 - Open Rolling Call for **S3VT = Sentinel-3 Validation Team** @ <https://www.s3vt.org>
 - S3VT#6 will be held on 10-12 March 2020 @ EUMETSAT
 - S3VT-ALT Chairs: Remko Scharroo (EUM) & Pierre Féménias (ESA)

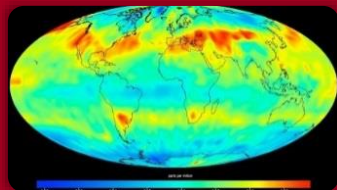
➔ SESSION: Science IV: Altimetry for Cryosphere and Hydrology (Thu, Oct 24 2019, 16:15 - 18:00)

Copernicus Space Component-4 (CSC-4)



- New segment of existing programme; Space19+ is first of three phases
- 1402 M€ at 2019 e.c. (duration: 2020 – 2029)

Phase B2/C/D/E1 of the six High Priority Candidate Missions



CO2M



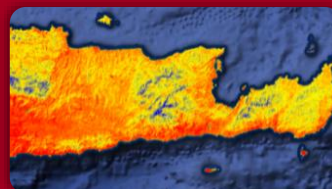
CIMR



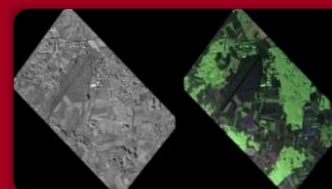
CHIME



CRISTAL



LST



ROSE-L

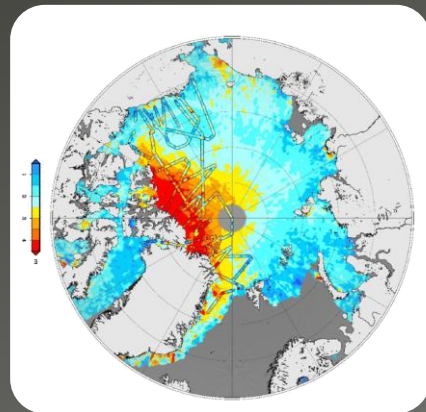
Ground Segment Development & Collaborative G/S activities

Copernicus polaR Ice and Snow Topography Altimeter Mission (CRISTAL)



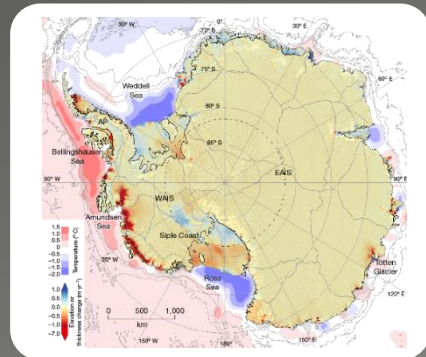
Primary Monitoring & Measuring Goals

- Variability of Arctic and Southern Ocean sea-ice thickness and its snow depth
- Surface elevation and changes of glaciers, ice caps and the Antarctic and Greenland ice sheets



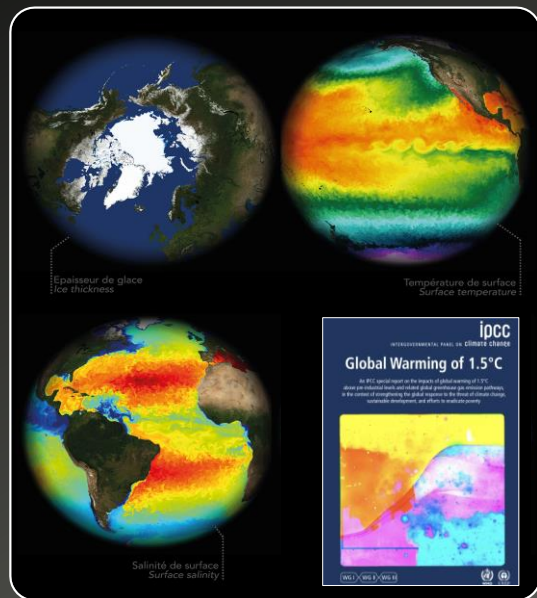
Secondary Goals

- Contribute to the observation of global ocean topography as a continuum up to the polar seas
- Support coastal and inland waters applications
- Support snow cover and permafrost applications



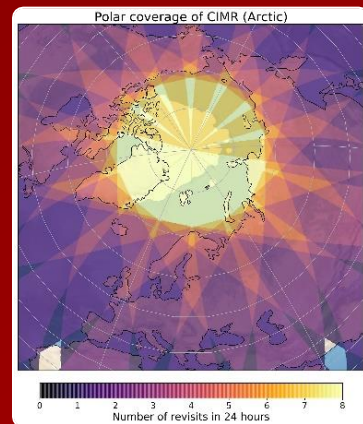
Copernicus Imaging Microwave Radiometer (CIMR)

Polar Oceans are fundamental to understanding the global environment



Sea Ice Concentration, Sea Surface Temperature, thin Sea Ice Thickness, Sea Surface Salinity, Wind Speed, Snow Water Equivalent, Soil Moisture

- Prevent data gap & be timely for an ice-free Arctic
- Measurements every ~6 hours in the Polar regions with 95% global daily coverage
- Data application in all Copernicus Services
- Directly addresses the EU Arctic Policy



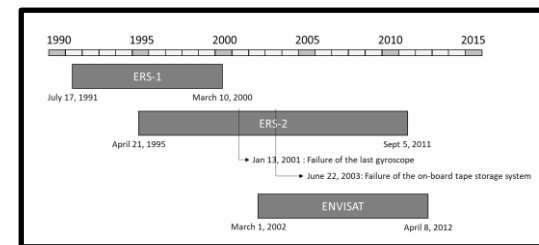


FDR4ALT



Fundamental Data Records For Altimetry

- ❑ Study kicked off by ESA/ESRIN in Sept'19 with CLS as prime contractor + partners
- ❑ ESA **Long Term Data Preservation Programme** framework (LTDP+) aiming at generating innovative Earth system data records
(**FDR** = Fundamental Data Records + **TDP** = Thematic Data Products)
- ❑ **ERS-1, ERS-2 and ENVISAT Altimeter & Radiometer reprocessing activity**, based on the best state-of-the-art algorithms/corrections with definition and provision of innovative level-1 and level-2P products
- ❑ Objective to serve the different communities involved in data exploitation of climate dataset over the different Earth surfaces : **ocean, coastal, inland water, ice sheets, sea ice** and **atmosphere**
- ❑ Strong synergies with past, current and future projects will be exploited: EMIR, FIDUCEO, REAPER, RA-2/V3.0, SL_CCI, SI_CCI, LI_CCI, SS_CCI, ...



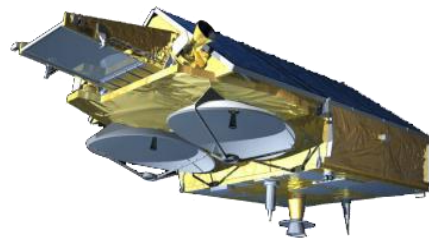
More about the project : <https://www.fdr4alt.org>_Cf **FDR4ALT poster** @session from Tuesday to Thursday



The G-POD Sentinel-3 & CryoSat-2 SAR/SARin Processing Service



The G-POD Sentinel-3 & CryoSat SAR/SARin Processing service, coined **SARvatore**, is a web platform that provides the capability to process on line and on demand **User-customised Sentinel-3 SAR and CryoSat SAR and SARin data, from L1a (FBR) data products until SAR/SARin Level-2 geophysical data products**, over any surface with alternate retracers (e.g. **SAMOSA+**). The service is **open, free of charge and accessible on line from everywhere**.



Usage In last 5 years: **142 SARvatore**, **139 SARINvatore** and **107 SARvatore for Sentinel-3 Users** supported with:

531296 CPU hours (that's **60.6 years**); **209.5 TB of CryoSat-2** & **97.5 TB of Sentinel-3 data storage**.

Number of processing tasks submitted for:

SARvatore / SARINvatore : **27129 / 4815** ; Sentinel-3: **18692**

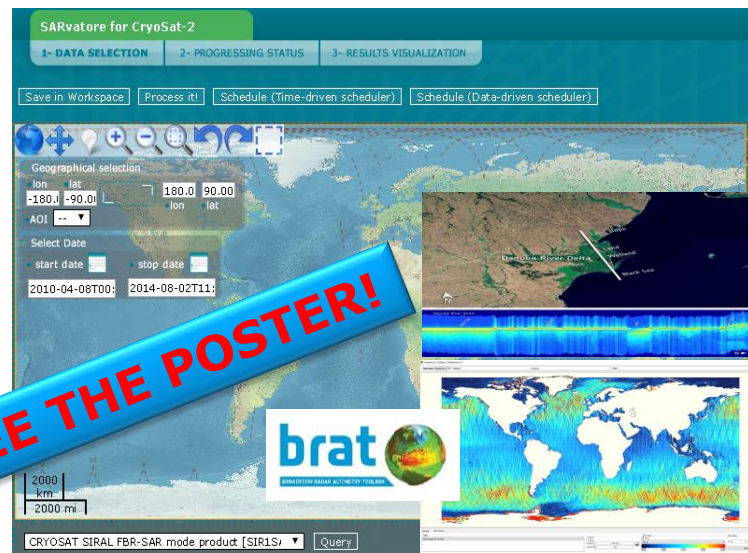
Input processed by SARvatore / SARINvatore tasks: **139.4 TB / 42.2 TB** & Input processed by Sentinel-3 tasks: **349.4 TB**

https://gpod.eo.esa.int/services/CRYOSAT_SAR

https://gpod.eo.esa.int/services/CRYOSAT_SARIN

https://gpod.eo.esa.int/services/SENTINEL3_SAR

SEE THE POSTER!



DEADLINES

- Abstract Submission Opens 21 October 2019
- Registration Opens 4 November 2019
- Abstract Submission Closes 20 December 2019
- Draft Programme 17 February 2020
- Registration Closes 15 March 2020
- Final Programme 31 March 2020

www.cryosat10years.org

www.esa.int