



CNES program STATUS

P. Escudier, CNES

Ocean Program Manager

**En route towards
High Resolution Oceanography**

Physical oceanography CNES program

Priorities :

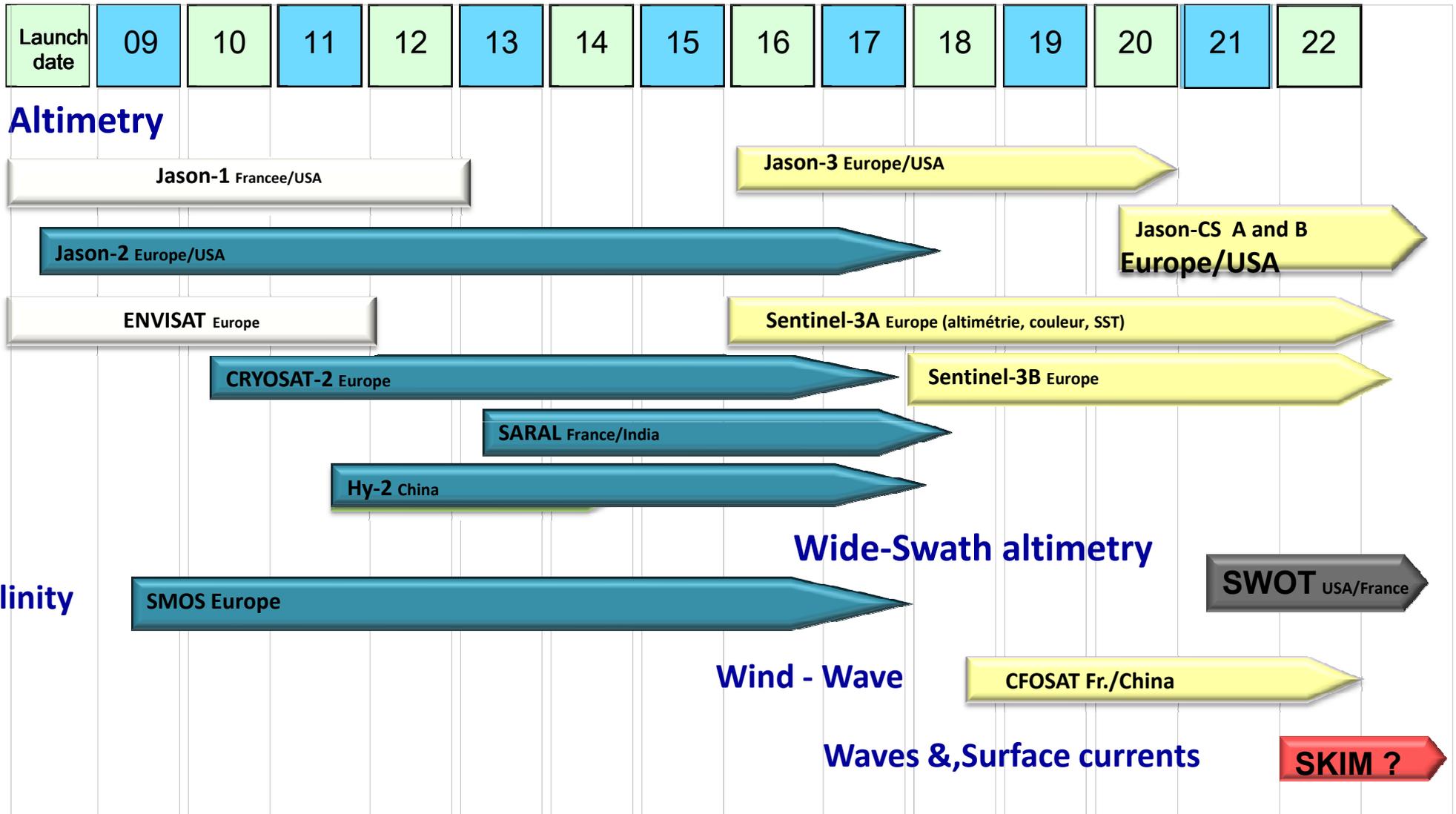
- **High quality nadir altimetry to support medium resolution oceanography**
Active support and multiple partnerships :
 - Long term monitoring
 - Guarantee product accuracy, Cross calibration between mission
 - High level products

→ **Jason 2, Jason 3, Sentinel 3, HY-2, SARAL/ALTIKA, Sentinel 6/Jason CS**

→ **Copernicus Marine Service**

 - DUACS products fully integrated in the Copernicus Marine Environment Service
- **Ocean / Atmosphere interactions :**
 - Short term : Wave directional spectrum & wind → **CFOSAT**
 - Mid term : Ocean currents and Waves → **SKIM**
- **High resolution oceanography challenge :**
 - Short term : Space resolution through Wide swath altimetry → **SWOT**
 - Longer term perspective :
 - Definition of the appropriate space measurement system appropriate to support the next phase of high resolution oceanography
 - On going phase 0 study
 - International cooperation : CEOS OST VC

Ocean missions @ CNES (Partnerships)



Operational

Validation

Being developed (C/D)

Proposed (A/B)

Concept (O)

Science Support

Nadir Altimetry : OSTST

- AO process for new team selection in 2016
 - 45 proposals received, 13 non French,
 - External reviews under way
 - Selection to be announced by the end of 2016
- CNES will continue to support nadir altimetry science efforts :
 - Calval
 - New algorithm and new products
 - SWOT perspective → new requirements for nadir altimetry products

Wide Swath altimetry : Science Team now in place

- 52 teams selected by NASA and CNES, 25 for Ocean applications
 - 19 teams selected by CNES for ocean applications
 - Including 4 mixed : Ocean + In Land waters or Ice
 - Including 7 Non French teams
- First SWOT ST meeting : June 2016 in Pasadena

Wind/wave/sea state : CFOSAT

- International AO expected to be released in 2017
 - Data policy to be finalized with Chinese partners



OSTST 2016 - EUMETSAT Programmes

F. PARISOT



Main EUMETSAT entrusted tasks (Delegation Agreement with EC signed in 2014)

Building Block I

Operations (**Sentinel-3, Jason-3, Sentinel-6 / Jason-CS**) and delivery of operational data and support services to the Copernicus Marine Service

Building Block II

Operations (**Sentinel-4, Sentinel-5 as part of MTG and EPS-SG**) and delivery of operational data and support services to the Copernicus Atmosphere Service

Building Block III

Deliver selected Mission Data services, incl. Third Party data (building on operational cooperation established by EUMETSAT with U.S., China, India,...)

Relevant to this OSTST, EUMETSAT is today involved in:

- **Sentinel-3 operations and Cal/Val activities**
 - **Performance on SAR in coastal regions**
 - **Jason-3 operations and Cal/Val activities**
 - **Jason-CS Products and Performance definition**
- **See dedicated presentations or posters**

Sentinel-3 Overall Status of Operations



Achieved Milestones/current activities :

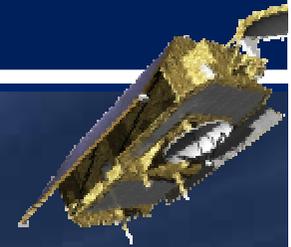
- Satellite under EUMETSAT control since July 2016.
- Marine Payload Data Ground Segment (PDGS) now running at EUMETSAT and under corrective and evolutive maintenance
- Activities to prepare for the launch of Sentinel 3B in 2017

Next Milestones / Events:

- w/c 14th November: SLSTR L1 NRT products distribution to all users following the confirmation of the readiness and product validation status on 8th November
- **w/c 5th December: SRAL L1A, L1B and L2 NRT and STC products distribution to all users following the confirmation of the readiness and product validation status on 29th November**
- 8-9th December 2016: OLCI/SYN QWG Meeting
- 16-17th January 2017: SLSTR QWG Meeting
- **February 2017: SRAL/MWR Quality Working Group**

Talk to EUMETSAT team if you want more info regarding the status of Sentinel-3 SRAL product releases

JASON cooperative missions



Sentinel-6/Jason-CS
2020

Jason 3
2016



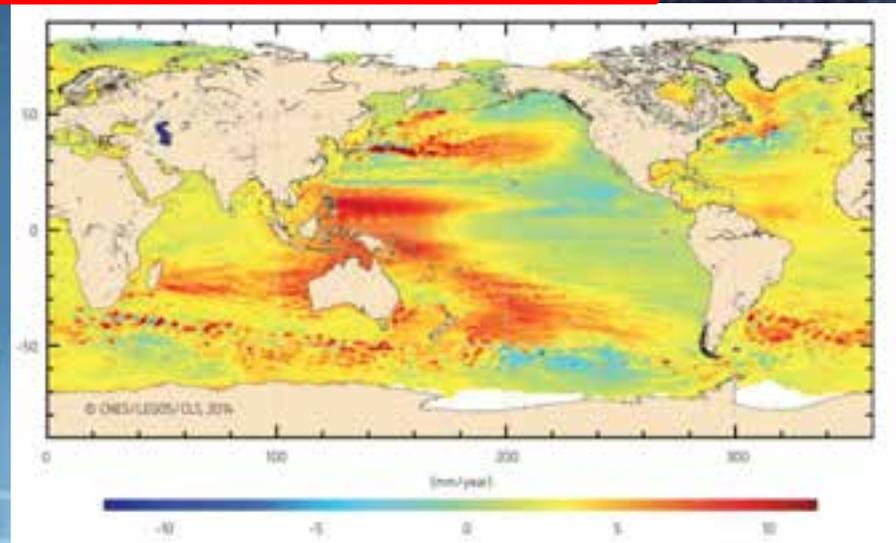
OSTM/Jason 2
2008



Jason 1
2001



TOPEX/Poseidon
1992-2006



Important achievement: transition from research to operational mission

Sentinel-6 / Jason-CS, EUMETSAT Status



Overall programmatic

- EUMETSAT owned Programme fully approved, addressing two Jason-CS.
- EUMETSAT Operations in Europe will be funded by the European Commission, as for Jason-3 and Sentinel-3
- All Agreements (multi partner and bilateral) signed or under final agencies approval process.
- System support and services from CNES secured through a dedicated agreement.

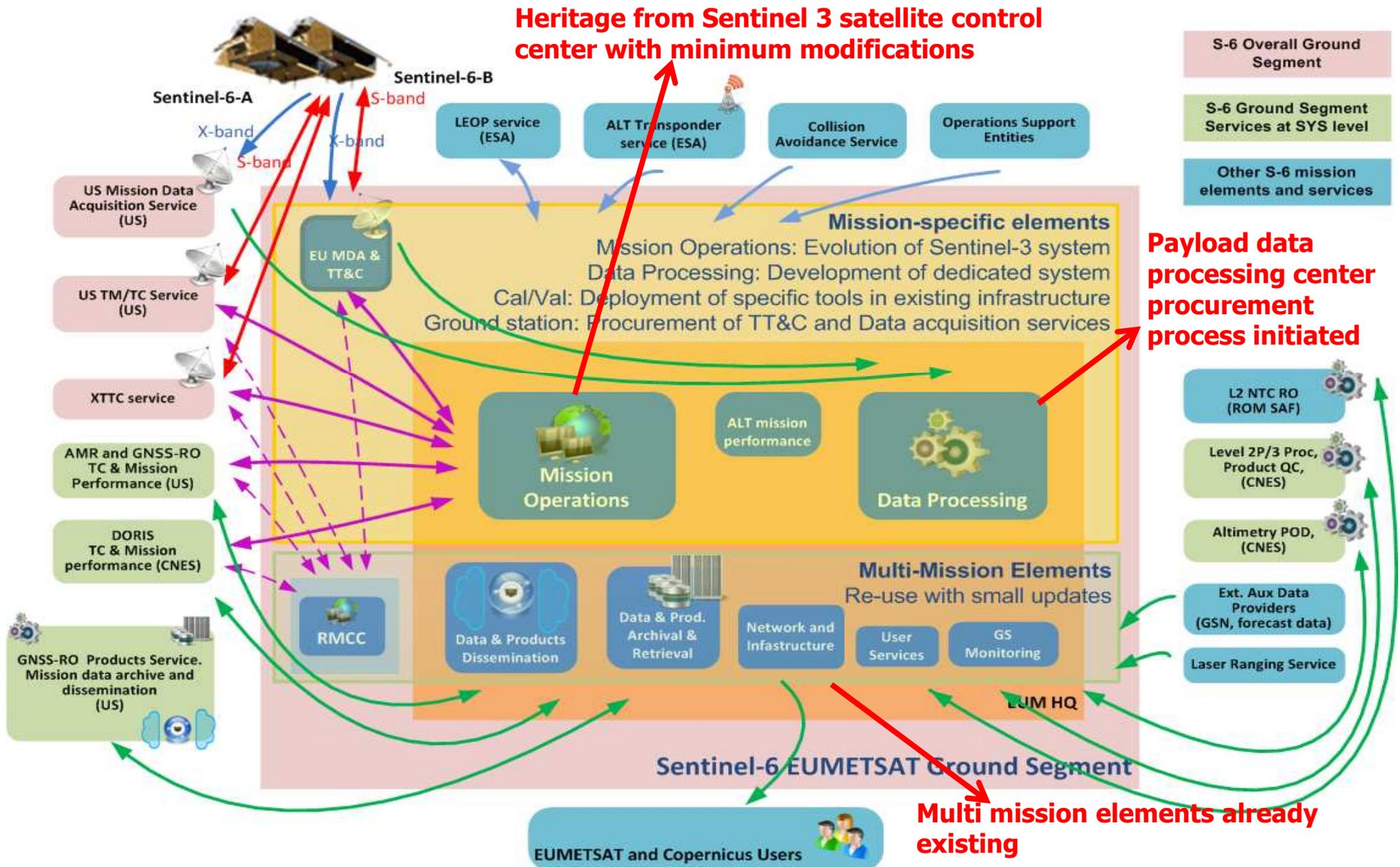
Mission/System activities

- EUMETSAT system coordinator covering engineering, V&V, operation preparation and science:
 - Consolidating with partners the mission performance, mission schedule and joint partner management processes
 - Successfully conducted System Requirements Review (SRR)
 - SRR key point held on (27th Sep) with partners teams to close residual points moving forward towards to Mission/System PDR planned in early 2017
 - End User Requirement / System Requirement Document mature and traces to lower levels under finalization
 - Mission Performance and System Engineering work in place

Ground segment development and procurement in EUMETSAT with coordination with NASA/NOAA

Look at poster on Jason-CS products and talk to Remko or Carolina if you have comments or inputs.

Overview of the S-6 Ground Segment



Altimetry over the years – past missions

30
YEARS
1986-2016

PAST MISSIONS



Altimetry over the years – current and future missions

30
YEARS
1986-2016

CURRENT MISSIONS

FUTURE MISSIONS



From Assmanhausen 2008 to La Rochelle 2016



Eight years after the Assmannhausen workshop, all recommendations are implemented or will be in the coming years.

- **Maintain continuity of high-accuracy Jason altimetry.**
- **In addition to a highly accurate Jason-class altimeter, maintain continuity with altimeters on at least two and preferably three complementary, high-inclination satellites.**
- **In addition to the above, extend the capability of altimetry to denser observational coverage through wide swath altimetry.**
- **Maintain an open data policy including near-real time data for operational purposes.**
- **Maintain a continuing partnership with the scientific community.**
- **Maintain a broad collaboration between engineering and science, research and operations, and international partners.**

New era of altimetry,
new challenges

31 October >
4 November
2016

IDS workshop
SAR altimetry
workshop
OSTST meeting

La Rochelle - France

EUMETSAT
CNES
CENTRE NATIONAL
DES ETUDES SPATIALES

www.ostst-altimetry-2016.com

NOAA

Jason Altimetry Program



- *Tandem Mission – January to October 2016*

- Jason-2 & -3 flown 80 seconds apart – NOAA, managed both ground operations, first for same agency
- New remote antenna at Barrow, AK, working jointly with Fairbanks antenna
- New ground system design

Arctic Ocean



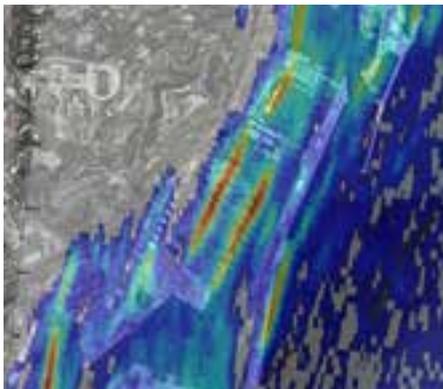
- *Jason-3 Near Real-Time Workshop*

June 2016 – hosted at College Park, MD

- Set public release of OGDR's
- Date to move J-2 to Interleave Orbit

New NOAA Jason Measurement System Engineer (MSE) -- Alejandro Egido

- Working with Walter Smith/LSA
- Extensive background with delay Doppler SAR
- Recently published IEEE TGRS
DOI: [10.1109/TGRS.2016.2607122](https://doi.org/10.1109/TGRS.2016.2607122)
Increases along track resolution from 300m to 0.5m



Fully Focused SAR Altimetry: Theory and Applications

Alejandro Egido, *Member, IEEE*, and Walter H. F. Smith

2016 OSTST US Re-competition

NASA with NOAA 1st time funding

- 56 ROSES proposals
- Decisions by end of 2016

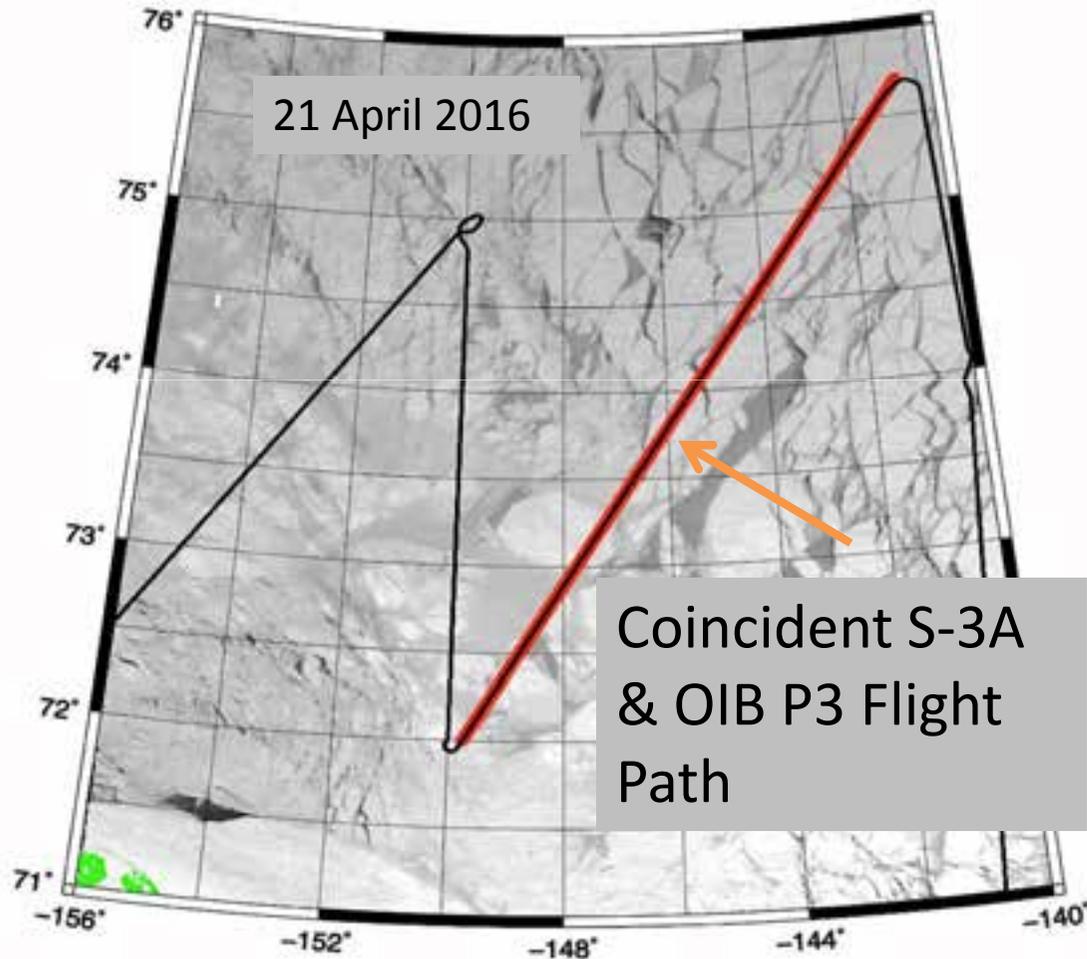
NOAA Jason Data Assimilation Projects

Upgrading NWS ocean DA systems

- NWS Climate Prediction Center: MOM-5 model/ Climate Forecast System → **for improved seasonal & ENSO predictions**
- NWS Environmental Modeling Center: HYCOM model → **for Improved hurricane intensity forecasting**

NOAA Contribution to Sentinel-3A VT

NASA Operation IceBridge Under-flight of S-3A on NOAA P3



Large sea ice floes in study area interspersed with open and refrozen leads. P3 flight-line (black) & S3A orbit (red) overlaid on MODIS image.

IceBridge vs S-3A freeboard, etc., to be compared. (See [Leuliette et al.](#) workshop poster online). Additional S3-VT under-flights planned for 2017.



La Rochelle - France - Nov. 2016

OSTST meeting



ESA Programmes Status

Jérôme Benveniste

Mission: 5' to cover...

- Envisat and ERS Reprocessing
- CryoSat Mission Status
- Goce and Swarm Activities
- Sentinel-3 Mission Status
- Jason-CS/Sentinel-6 (Pierrick Vuilleumier's talk @10:10)
- R&D, Training and Outreach

Contributions from Pierre Féménias, Tommaso Parinello, Jérôme Bouffard, Rune Floberghagen, Susanne Mecklenburg

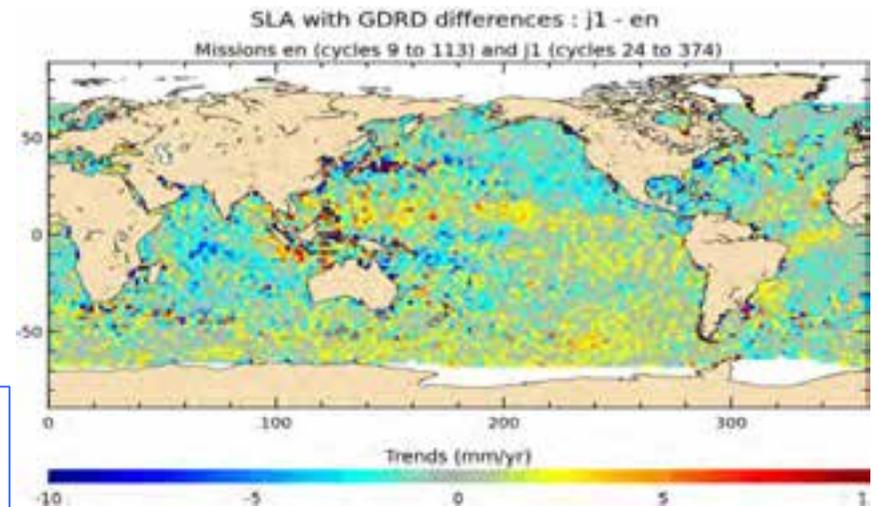
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ERS-ENVISAT Altimetry Data Quality Status

- **ENVISAT RA2&MWR V3.0 data set**
- Upgrade of L1B and Level 2 IPF upgrade completed and validated
 - Include numerous L1B & L2 algorithm improvements
 - **NetCDF** format (S-3 compliant!) for user L2 products
- Reprocessing campaign will start in Nov 2016 @ F-PAC
- **Intended data set delivery after validation: Q3-Q4 2017**
- **Peer-reviewed paper will be issued along with V3.0 data set**

(Ref: [ESA LPS 2016](#) → [Envisat ocean altimetry performance assessment: Getting ready for future reprocessing](#) - Marielle Guibbaud (CLS), Annabelle Ollivier (CLS), Stéphanie Urien (CLS), Nicolas Picot (CNES), Pierre Féménias (ESA))



Large and short scales error reduction: Mean Sea Level (MSL) improvement and Sea Surface Height (SSH) variance at crossovers decrease !

- **ERS RA&MWR REAPER data set**
- Peer-reviewed paper on ERS Altimeter REAPER data set submitted in Q3 2016 to “IEEE Transactions on Geoscience and Remote Sensing”
- **Reprocessing of ERS-1 & ERS-2 Precise Orbit Products** for both complete missions under preparation
 - Serve all ERS science product reprocessing campaigns
- **Reprocessing of ERS-1 & ERS-2 Altimetry data for alignment with Envisat v3.0 dataset intended in 2017**

Mission: 5' to cover...

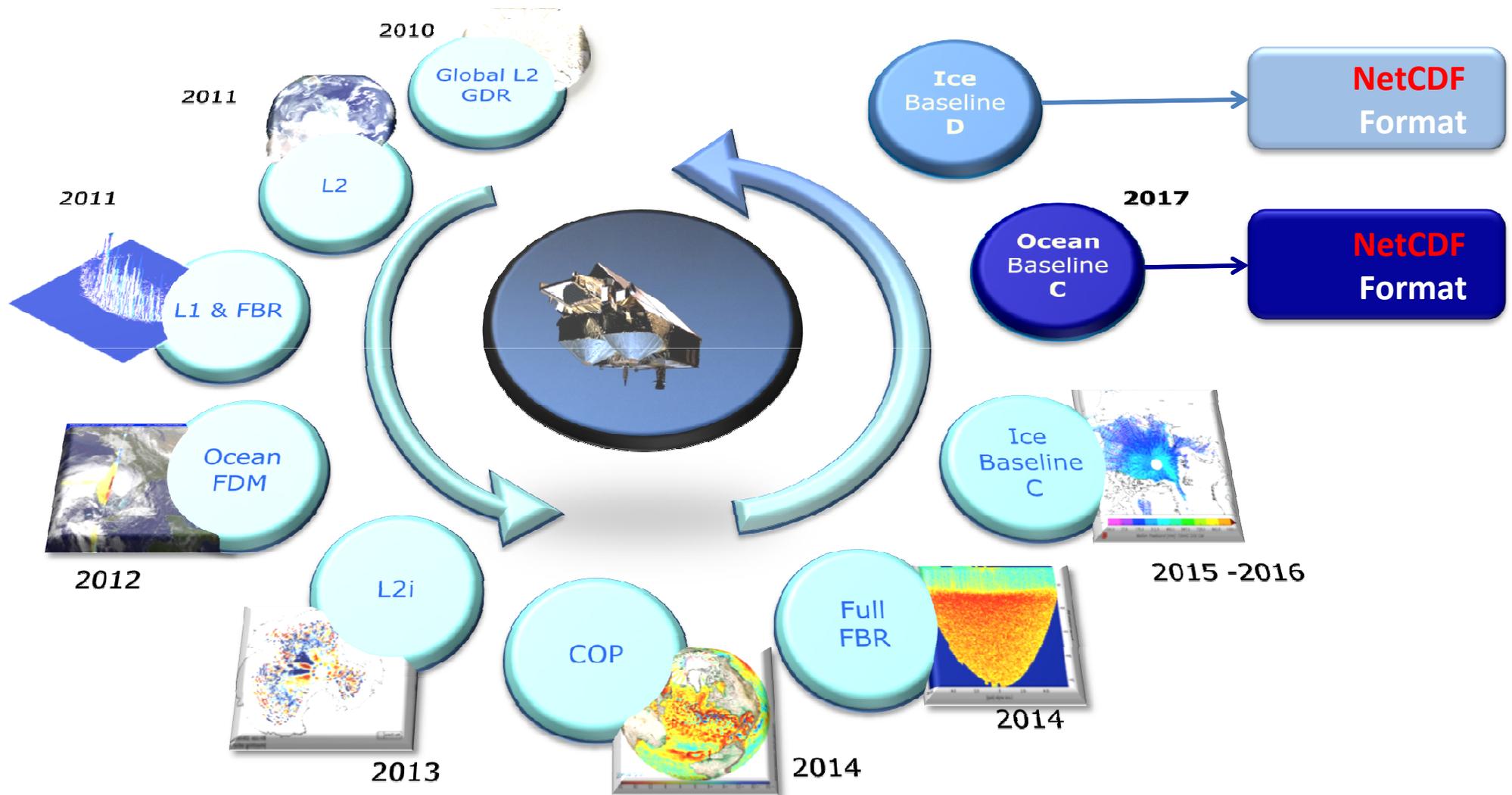
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CryoSat Mission Status

7 years in operations

CryoSat Product Evolutions



More information and Details in Bouffard et al. (Poster CVL_016)

Home ▶
Venue ▶

Cryosat Science Meeting and Geodetic Missions
20-24 March 2017
Banff, Alberta, Canada



Abstract submission opened

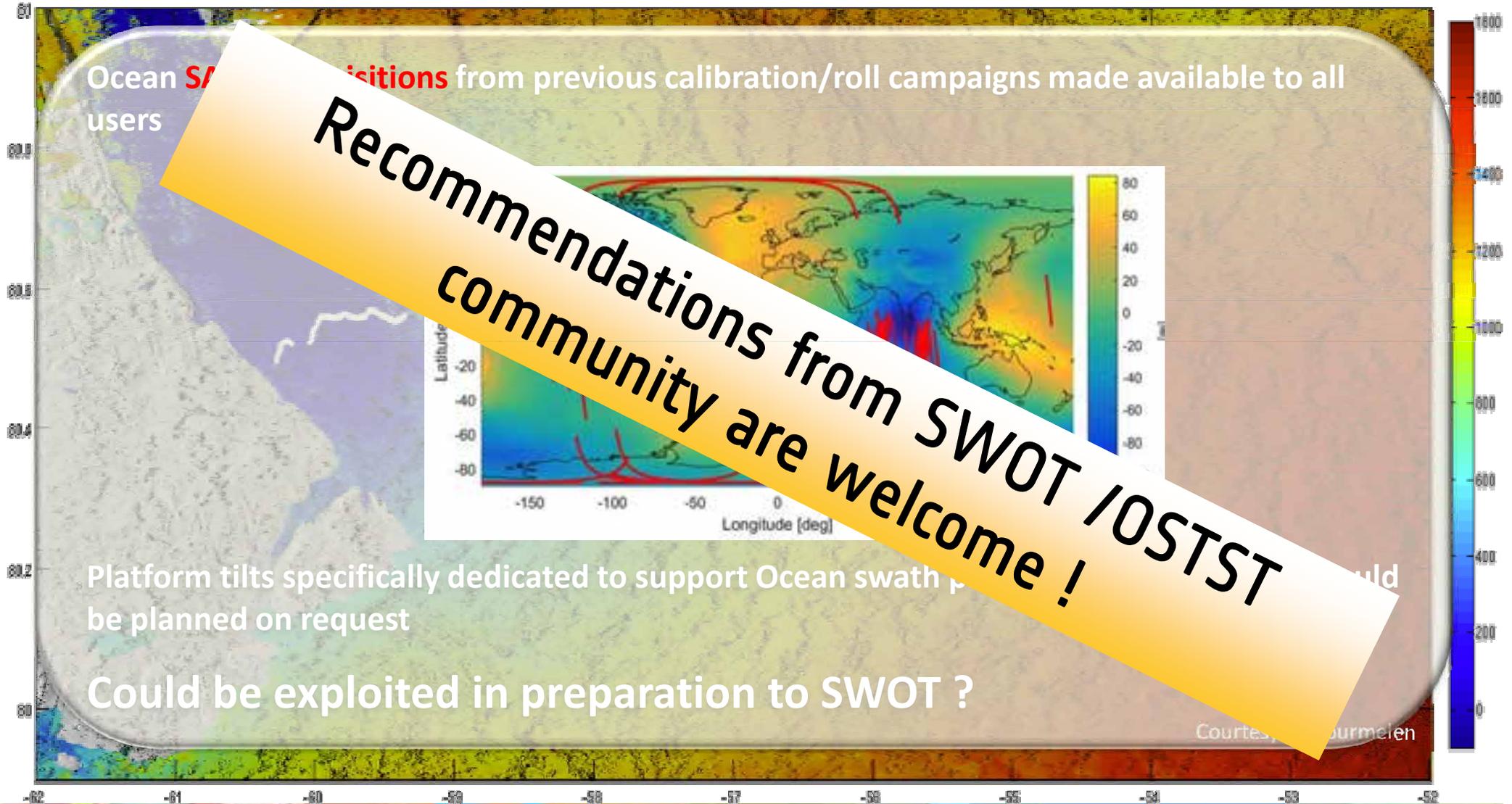
CryoSat: Special Issue on Advances Space Research



Advances in Space Research
CryoSat Special Issue
Closing 2017

Abstract submission still opened

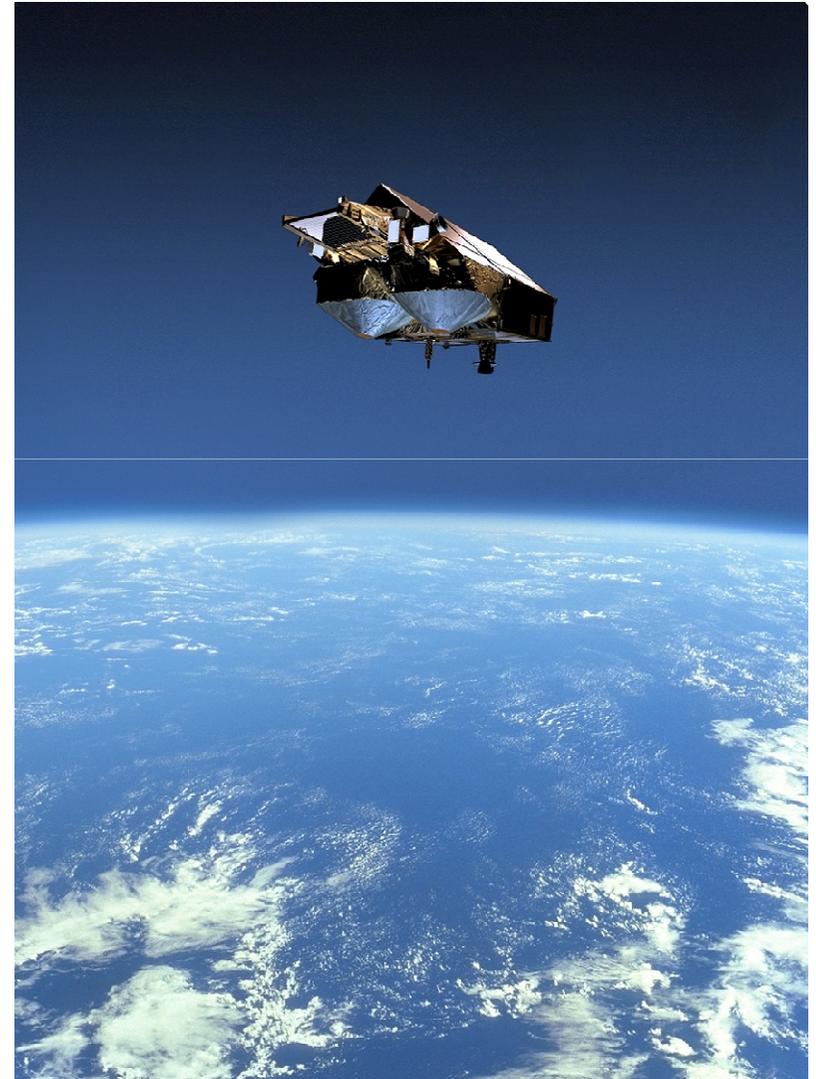
CryoSat : SWATH Processing from SARIN data!



More information in Posters Bouffard et al. (CVL_016) & Scagliola et al (SAR_003)

CryoSat: Outlook to the future

- Better characterisation of snow load and Antarctica sea-ice
- Improve assessment of mass balance of ice caps and mountain glaciers
- Better integration of CryoSat measurements in **climate assimilation model**.
- Maximise the use of **NRT capabilities of CryoSat** for forecast communities (meteo, marine, sea-ice)
- **New releases of ice and marine products in NETCDF format in 2017**
- Collaboration in operations with ICESAT-2 after 2018 is a goal
- New exploitation activities focusing of **SARin** interferometric measurements both over land, **ocean and coastal**



CryoSat: Geographical Mask

Ku-band radar altimeter operating in **3 Modes**



unlimited ... Do we still need to maintain these SAR areas?

Several request to support R&D & S-3 commissioning phase

Any new requests for mask changes over the Ocean?
Coastal zones in SARin?

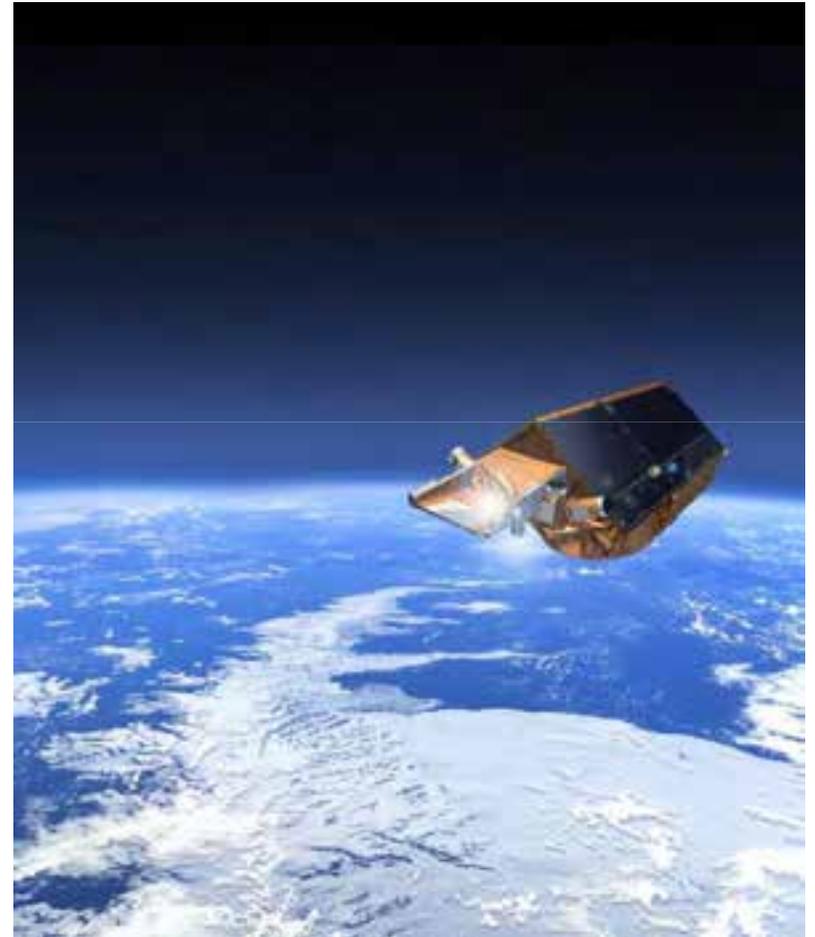
Land ice and Ocean: LRM
LRM

Sea-Ice Regions: SAR

Glacier + Ice Regions: SARin

CryoSat: Outlook

- Space and Ground Segment are in **very good status** and well fitted to continue **mission exploitation until 2025**. **The operations are reliable, stable and performing.**
- The mission is well positioned to continue delivering in future front line science as well as valuable contributions to long data records, key climate change indicators, novel applications and operational services



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GOCE – project to bridge geoid and ocean communities. Workshop next year...

Long title

Optimal Geoid Modelling based on GOCE and GRACE third-party mission data and merging with altimetric sea surface data to optimally determine Ocean Circulation.

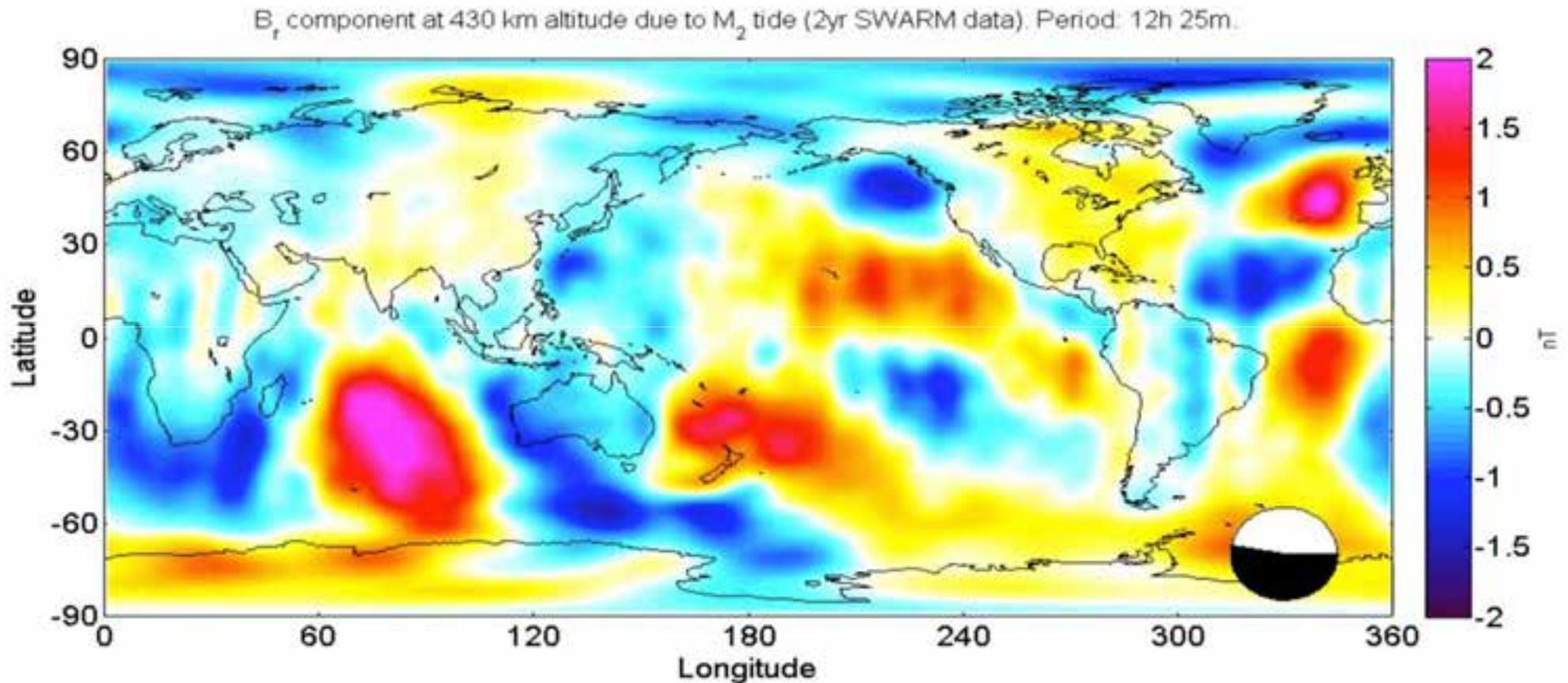
Goals

- Examination of influence of the satellite missions GRACE and in particular GOCE in ocean modelling applications.
- Improved processing of satellite and ground data for the preparation and combination of gravity and altimetry data on the way to an optimal MDT solution.

Main Objectives

- Enhancement of GRACE error modelling and **optimal combination of GOCE and GRACE** (and optionally **terrestrial/altimetric data**),
- **Integration of optimal Earth gravity field model with MSS and drifter information to derive a state-of-the art MDT including error assessment.**

Swarm as an oceanographic mission



Magnetic signal due to the M_2 lunar tide derived from 20 months of Swarm magnetic gradient data. Swarm is mapping the oceanographic signal with excellent precision. Long-term implications for inference of ocean temperature and salinity?

Credits: Terry Sabaka, GRL(2016)

SWARM, GOCE and CryoSat Workshops @ Banff, AB, Canada 21-24 March 2017

- ❑ Geodetic Missions Workshop with strong focus on Future Missions
- ❑ Geodetic Missions Workshop: report, reference frames, height systems and absolute positioning
- ❑ Meeting shall engage the community in a on-to-one discussion on future needs
- ❑ Fourth Swarm Science Meeting will feature a dedicated session on extraction of oceanic (depth-integrated) oceanic signals

Abstract submission opened

www.swarm2017.org

www.cryosat2017.org



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MAIN MESSAGES



- ❑ Sentinel-3A successfully launched on 16 February 2016
- ❑ Commissioning phase successfully completed in July 2016
- ❑ All instruments are switched on and are working well.
- ❑ SRAL now in 100% SAR Mode with CL/OL transitions.
- ❑ Sample data products for expert users are available.
- ❑ Official data release:
 - ❑ **SRAL L1A, L1B and L2 NRT and STC: early Dec 2016**
 - ❑ **SRAL L1B-S: 16 January 2017**
 - ❑ Access through the ESA Sentinel Data Hub and through EUMETSAT's EO Portal (EUMETSAT's ODA, Data Centre, EUMETCast)
- ❑ EC change requests in process to be implemented: Orbit shift between S3A and S3B.
- ❑ S3 Validation team
 - ❑ Rolling Call on ESA Earth Online
 - ❑ **Next S3VT meeting planned for 15-17 February 2017 in ESA-ESRIN, Frascati, Italy**

Weekly mission status

at <https://sentinel.esa.int/web/sentinel/missions/se>

Data product ID	Release date	Available data
SRAL L1A	15 Aug 2016	1.5M samples
SRAL L1B	15 Aug 2016	1.5M samples
SRAL L1B-S	16 Jan 2017	1.5M samples
SRAL L2	15 Aug 2016	1.5M samples
SRAL L2 SAR	15 Aug 2016	1.5M samples
SRAL L2 SAR (Polar)	15 Aug 2016	1.5M samples
SRAL L2 SAR (Equator)	15 Aug 2016	1.5M samples
SRAL L2 SAR (Tropics)	15 Aug 2016	1.5M samples
SRAL L2 SAR (Polar) (Polar)	15 Aug 2016	1.5M samples
SRAL L2 SAR (Equator) (Equator)	15 Aug 2016	1.5M samples
SRAL L2 SAR (Tropics) (Tropics)	15 Aug 2016	1.5M samples



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R&D, Training and Outreach

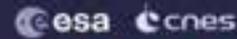


- SCOOP – Ocean and Coastal (IPM_002)
- SHAPE – Inland Water
- SPICE – Ice sheets
- DEDOP (PM_012)
- SARvatore, SARINvatore, S3SARvatore (OUT_001)
- BRAT (OUT_005)
- GUT (GEO_001)
- ...and more... SL_cci, SLBC_cci
- SAR Altimetry Training Course
- 10th Coastal Altimetry Workshop
- Banff Geodetic Missions Workshop





RADAR ALTIMETRY TUTORIAL & TOOLBOX



[Toolbox](#) [Code](#) [Data Access](#) [Links](#) [Altimetry Tutorial](#) [Use Cases](#) [Missions](#) [Helpdesk](#)



TOOLBOX



TUTORIAL



FORUM



HELPDESK



SENTINEL-3
SRAL



[Sitemap](#) [Glossary](#) [Helpdesk](#) [Forum](#) [Acknowledgments](#)

NEWS & UPCOMING EVENTS

- OSTST 2016**
 We will have a poster at the Ocean Surface Topography Science Team (OSTST) meeting 01 - 04 November in La... more info... →
- Gravity, Geoid and Height Systems 2016**
 We will have a poster at the International Symposium on Gravity, Geoid and Height Systems 2016 in Thessaloniki, Greece on the 19-23 September... more info... →
- EO Open Science 2016**
 We will have a poster at the Earth Observation Open Science 2016 Conference in ESRIN (Frascati, Italy) on 12-14 September... more info... →
- ESA Living Planet 2016**
 We will have a presentation at the ESA Living Planet Symposium [09:00-09:20 - 10 May 2016] presenting the official version of... more info... →





Thank you for your attention!

Get the slides from the OSTST web site!!