

living planet symposium | BONN

23–27 May
2022

TAKING THE PULSE
OF OUR PLANET FROM SPACE



CryoSat Data Quality and Product Evolution

Alessandro Di Bella, Jérôme Bouffard, Tommaso Parrinello & QA4EO Team

23/5/2022

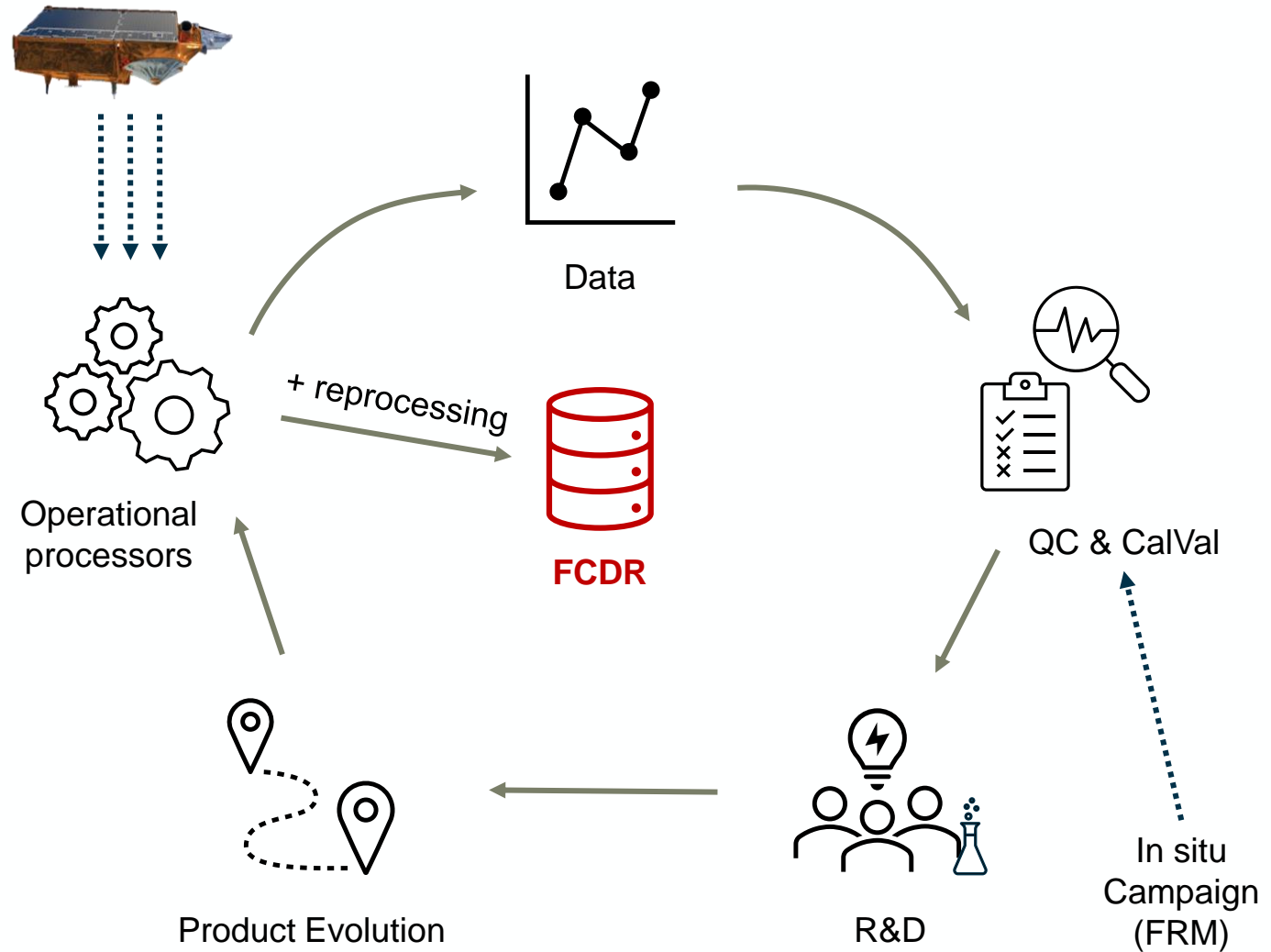
Why Data Quality & Product Evolution?



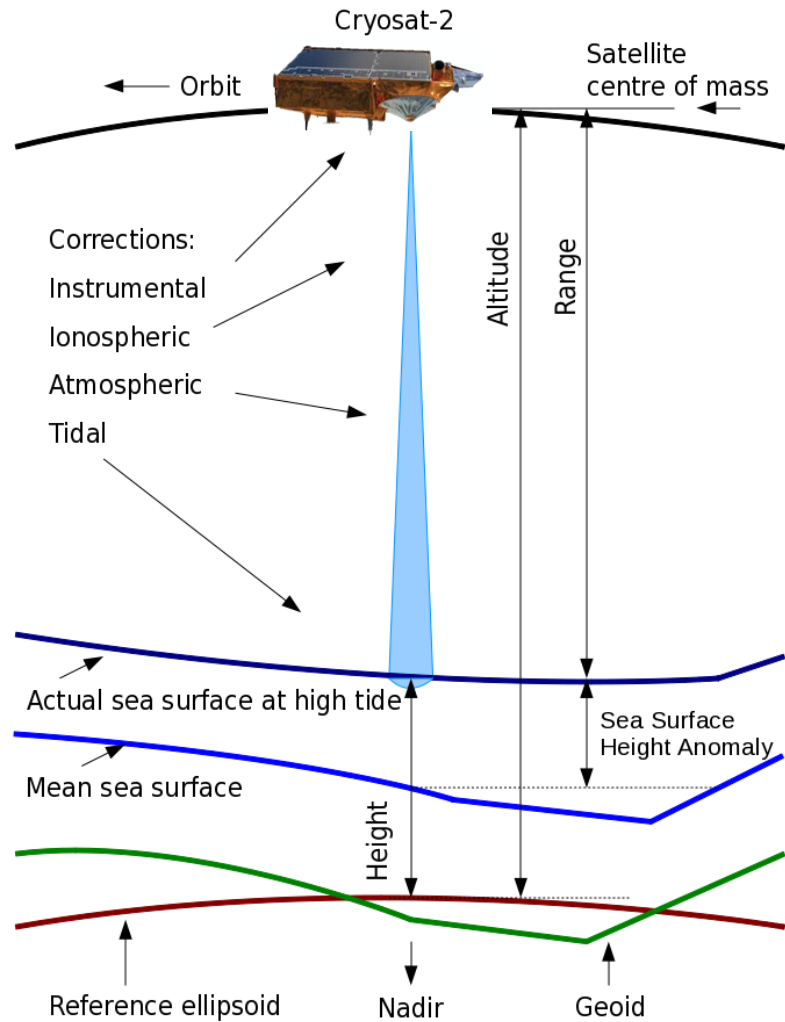
Address key environmental and **Climate** issues



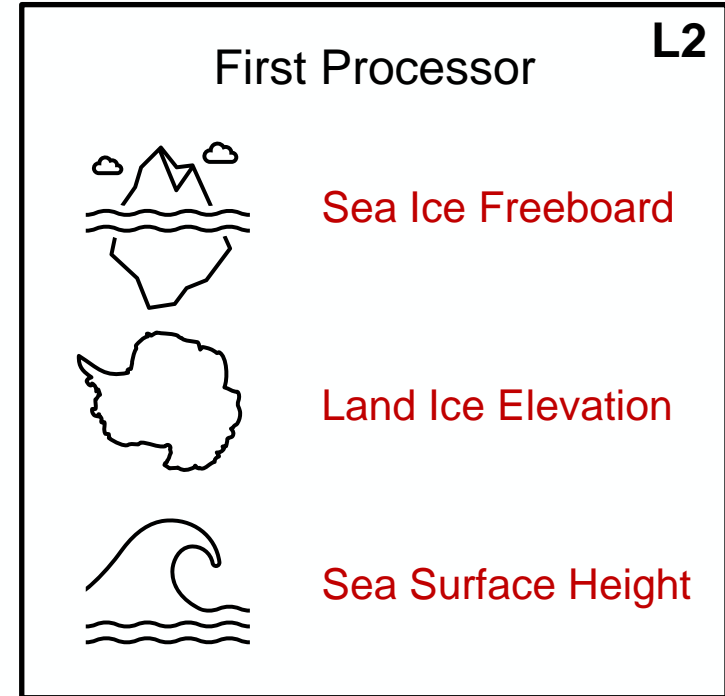
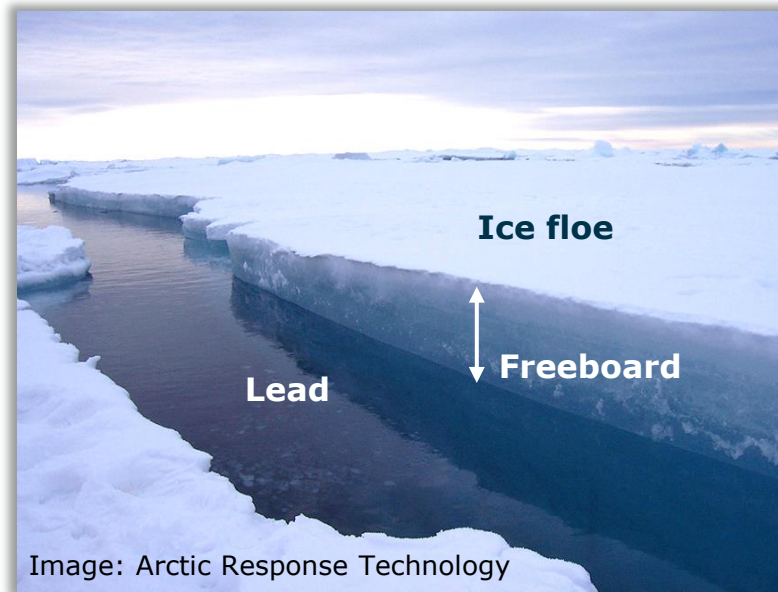
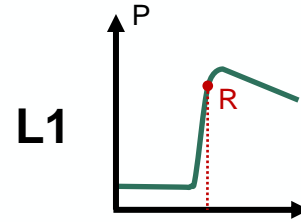
Long-term Records



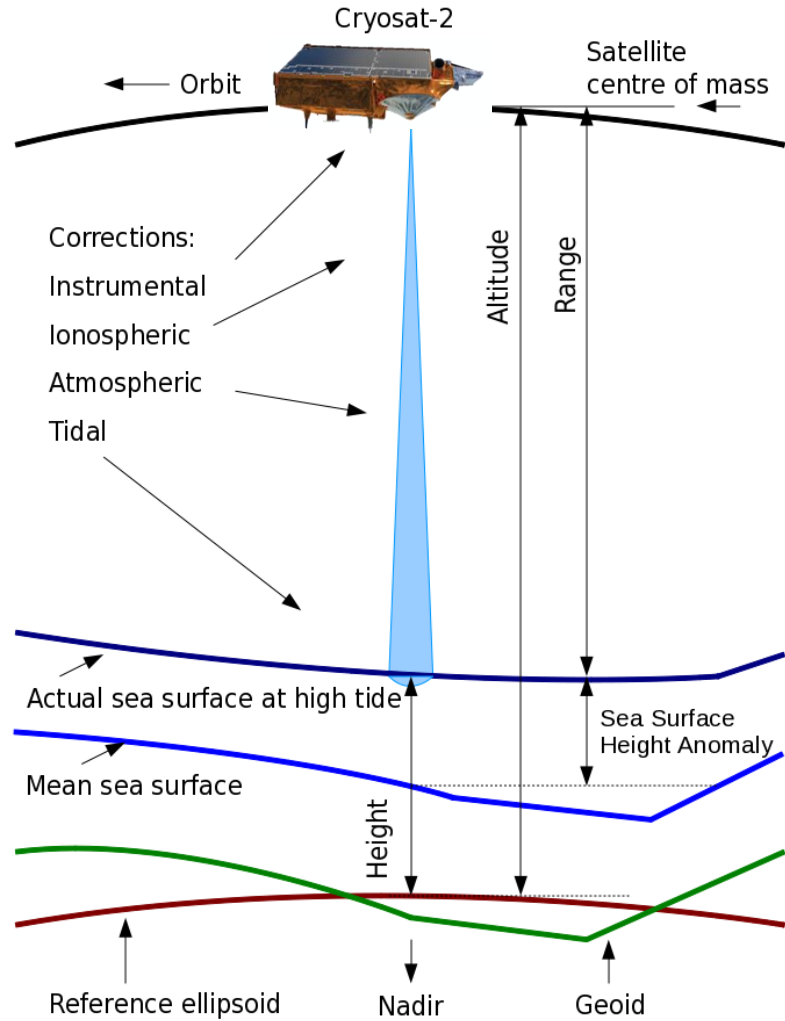
From L1 Data to L2 Geophysical Parameters



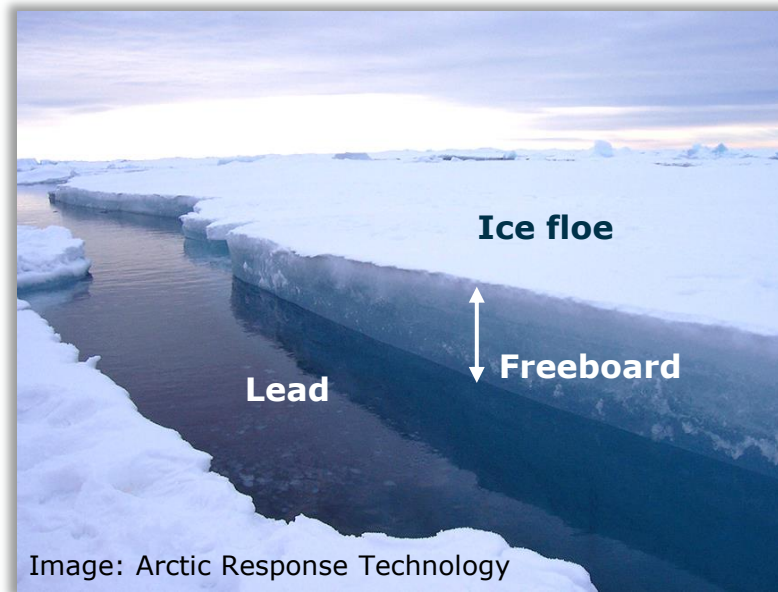
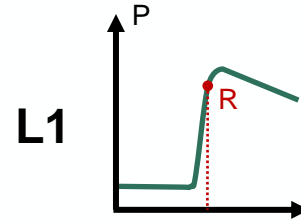
$$H = \text{Altitude} - \text{Range} + \text{Corrections}$$



From L1 Data to L2 Geophysical Parameters



$$H = \text{Altitude} - \text{Range} + \text{Corrections}$$



Ice Processor L2

Sea Ice Freeboard

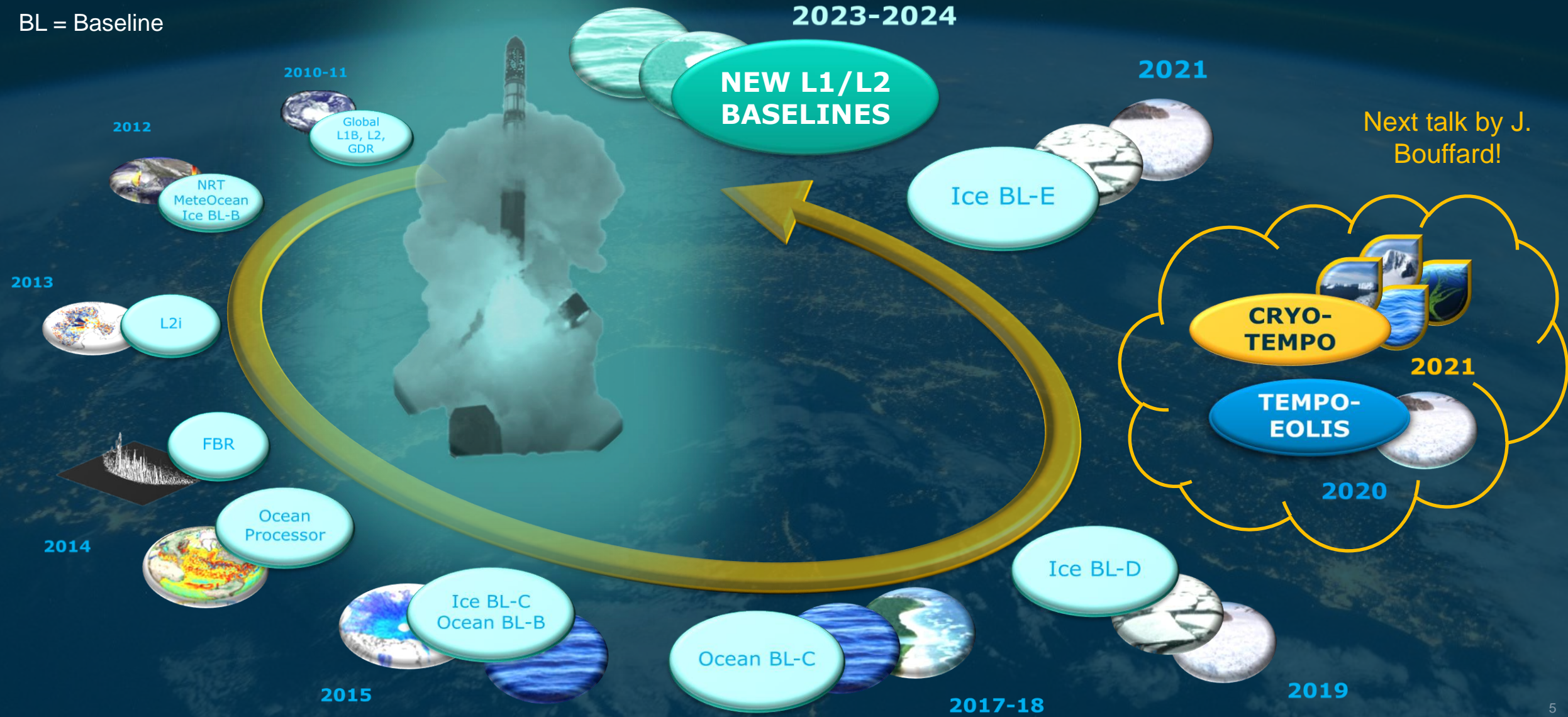
Land Ice Elevation

Ocean Processor L2

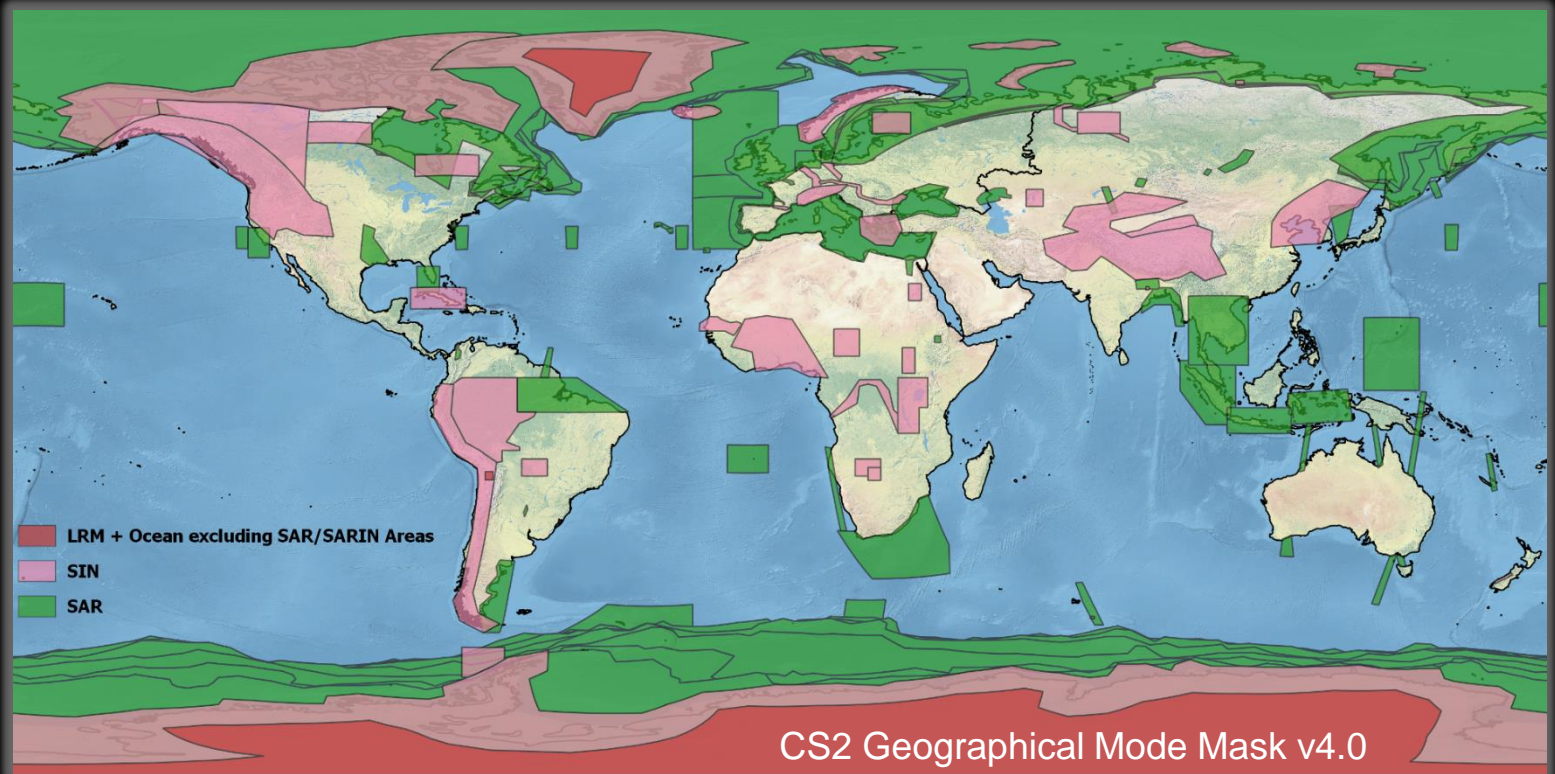
Sea Surface Height

Product evolution throughout mission

BL = Baseline



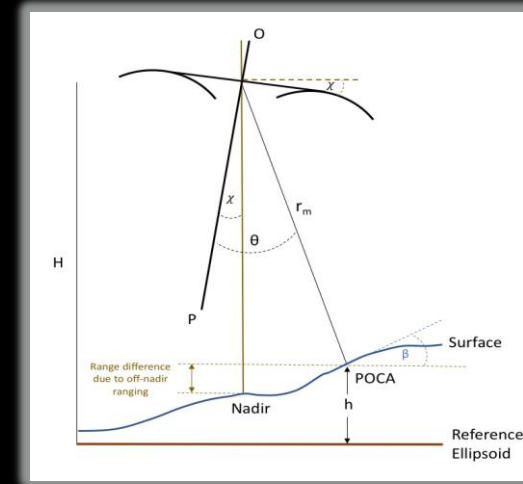
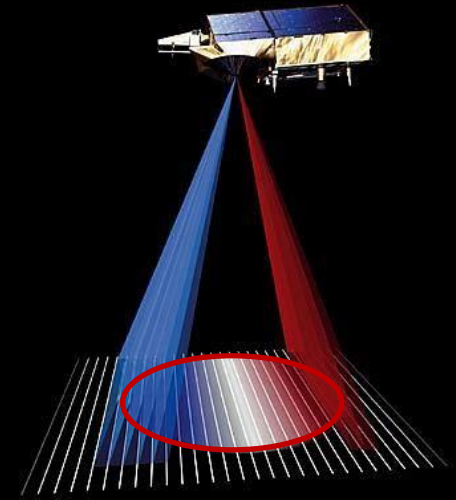
CryoSat Acquisition Modes



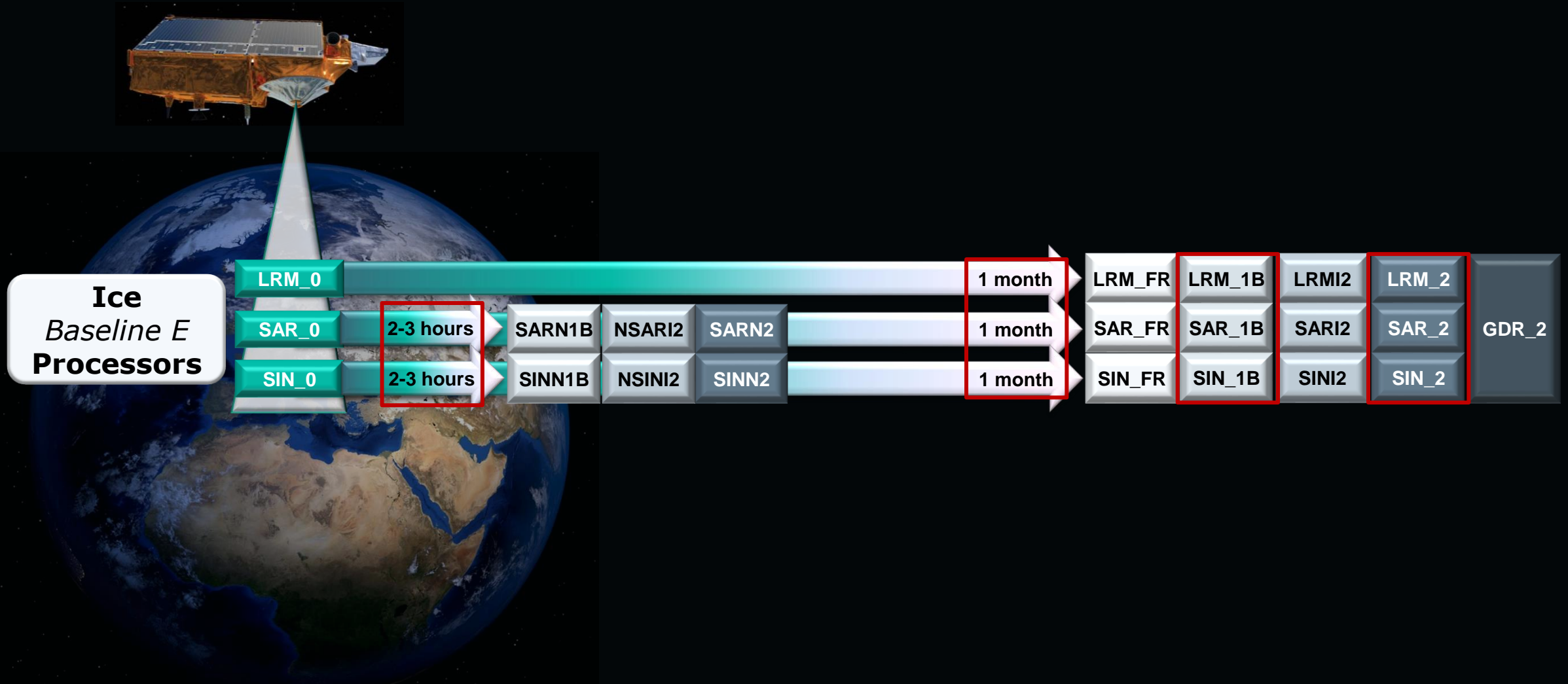
Land Ice interior & Ocean: **LRM**

Sea Ice: **SAR**

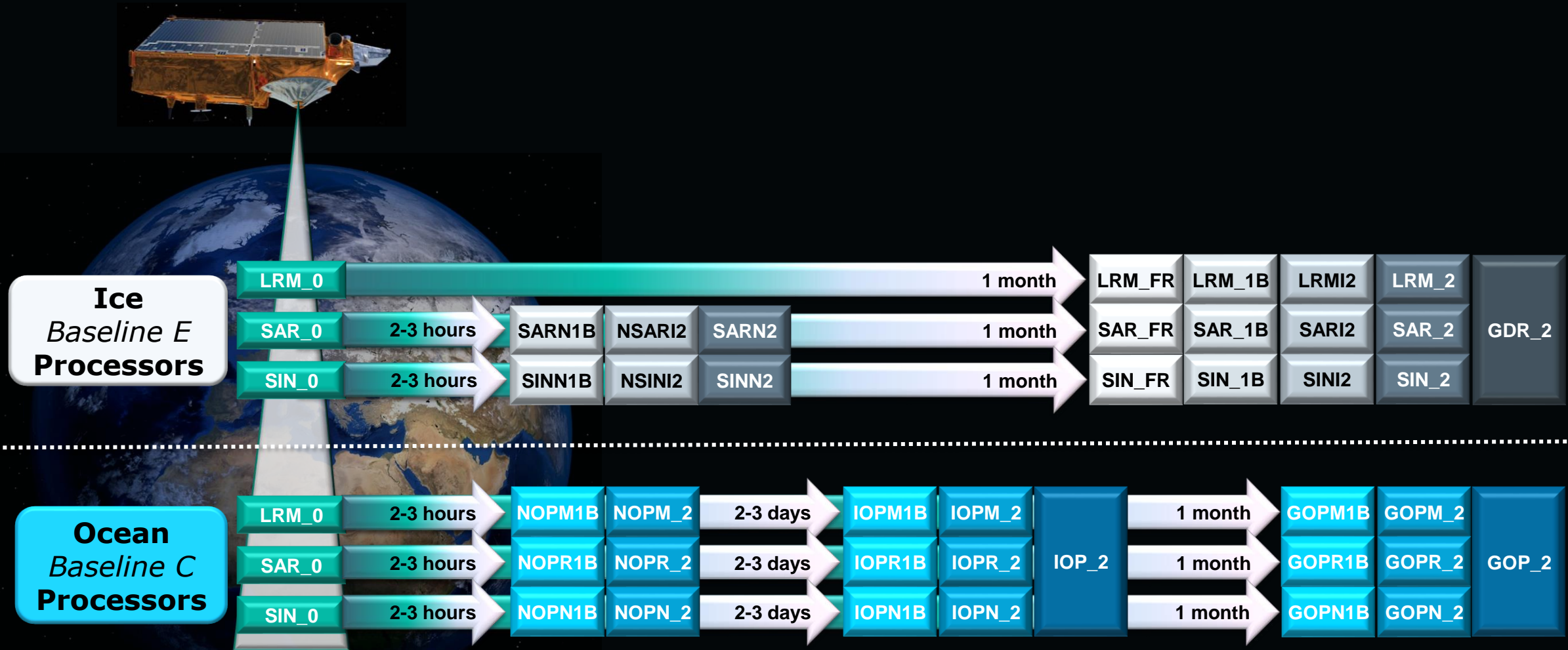
Glaciers & Ice Margins: **SARIn**



Operational processors




Operational processors




The Ice Baseline E includes a significant number of **fixes** and algorithm **evolutions** w.r.t. Ice Baseline D

- Transferred to operation in Sept 2021, after QWG endorsement
- Main evolutions:
 - Sea surface height anomaly
 - Snow depth correction
 - Land-ice retracking
 - Addition of pseudo-LRM estimates to the L1B products
- Reprocessing status
 - Partial LRM reprocessing (28/4/2019 – 21/8/2021)
 - Start end of June, ~10 months processing + QC

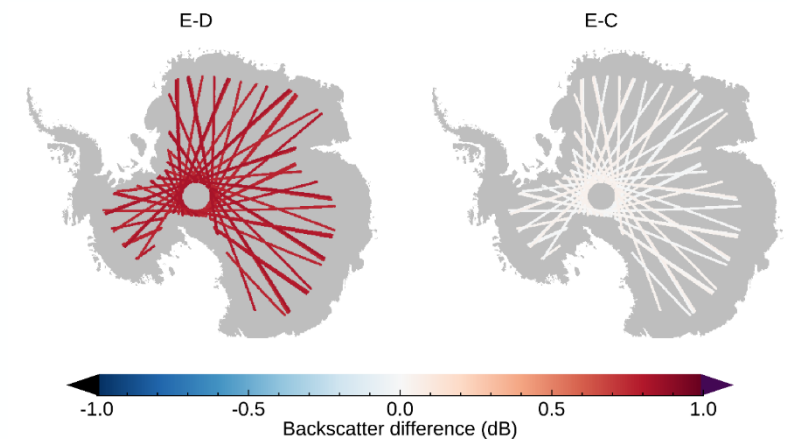
The Cryosphere, 15, 5483–5512, 2021
<https://doi.org/10.5194/tc-15-5483-2021>
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The Cryosphere  Open Access

Advances in altimetric snow depth estimates using bi-frequency SARAL and CryoSat-2 Ka–Ku measurements

Florent Garnier¹, Sara Fleury¹, Gilles Garric², Jérôme Bouffard³, Michel Tsamados⁴, Antoine Laforge⁵, Marion Bocquet¹, Renée Mie Fredensborg Hansen³, and Frédérique Remy¹



Credits: Otsuka, Leeds University

Ice Baseline E Quality & CalVal Activities



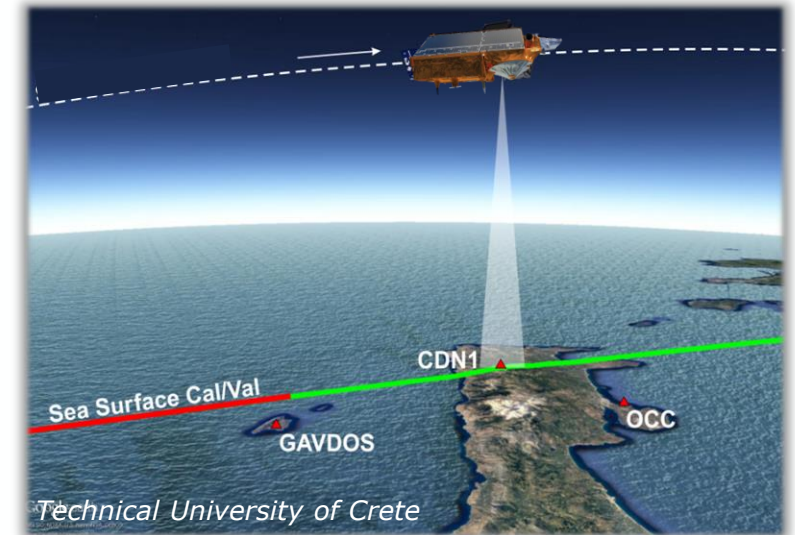
Fundamental activities, ensure high-quality of CryoSat data and drive product evolution

Talk by T. Casal & L. Fioretti

- Internal CAL monitoring
- Daily & monthly Routine QC on all products and more!
- External transponder & tide gauges calibration
- Continuous validation of ice parameters challenging! CalVal campaigns
- Data QC tools available online

<https://earth.esa.int/eogateway/instruments/siral/quality-control-reports>

- Product evolution: Baseline F → ~end of 2023



CryoSat-2 - SIRAL Calibration with Transponder

Adrián Flores¹, Albert Garcia-Mondéjar¹, Marco Fornari², Jérôme Bouffard³, Alessandro Di Bella⁴, Monica Roca¹
¹ isardSAT, ² ESTEC, ESA, ³ ESRIN, ESA

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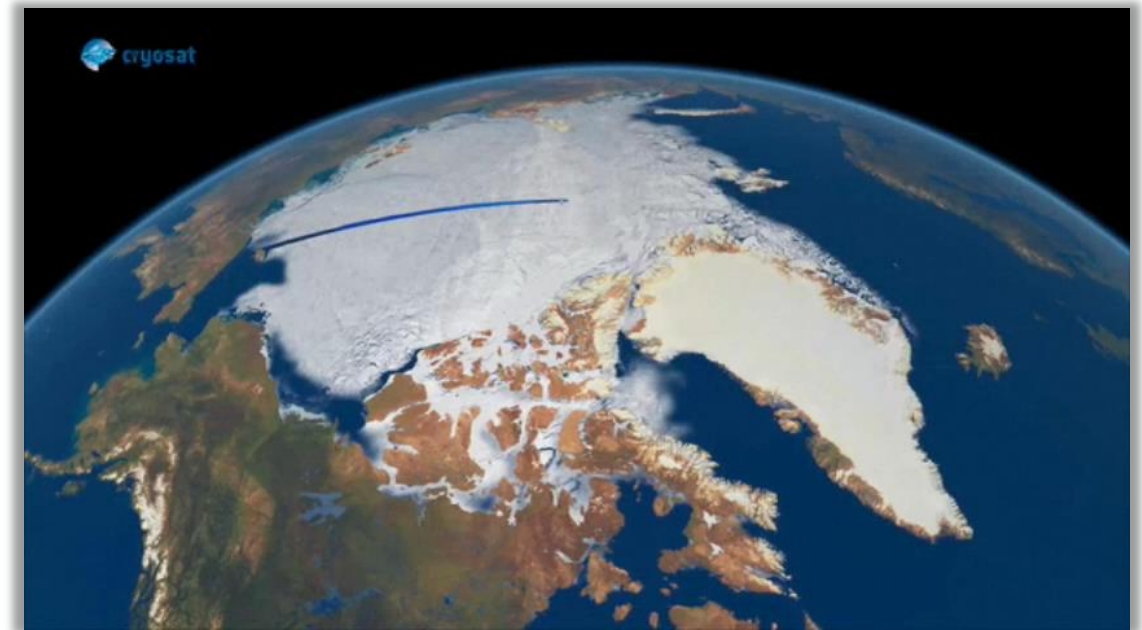
**12 years of CryoSat Quality Control:
Evolution and Current Status of the Ice Processors**

E. Turner^{1,2}, L. Toonen^{3,4}, M. Williams^{1,2}, A. Di Bella^{2,5}, J. Bouffard^{3,6}, T. Parrinello^{3,7}, D. Brockley^{4,8}, T. Geminalo⁹
¹ Telespazio UK Ltd (UK), ² ESTEC, ESA, ³ ESTEC, ESA, ⁴ ESTEC, ESA, ⁵ ESTEC, ESA, ⁶ ESTEC, ESA, ⁷ ESTEC, ESA, ⁸ ESTEC, ESA, ⁹ ESTEC, ESA



Sea Surface **Topography** for the Global **Open Ocean**

- In operation since Nov 2017, data for full mission
- Tailored to Open Ocean geophysical parameters
 - Improved LRM retracker
 - SAMOSA v2.3 for SAR & SARIn
 - Improved Wet Tropospheric correction
 - Pseudo-LRM in SAR/SARIn products
 - NOP low-latency products

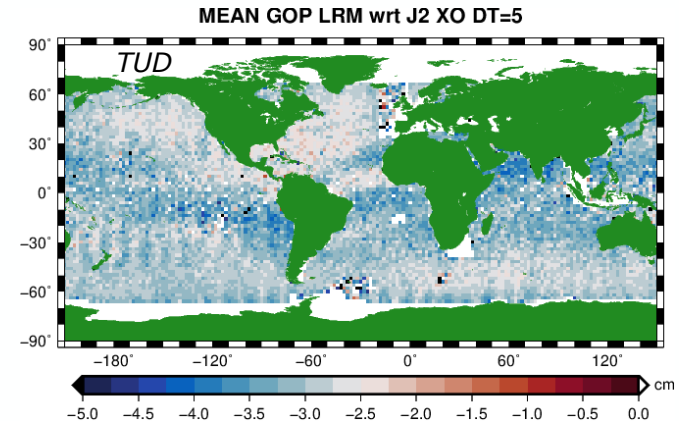
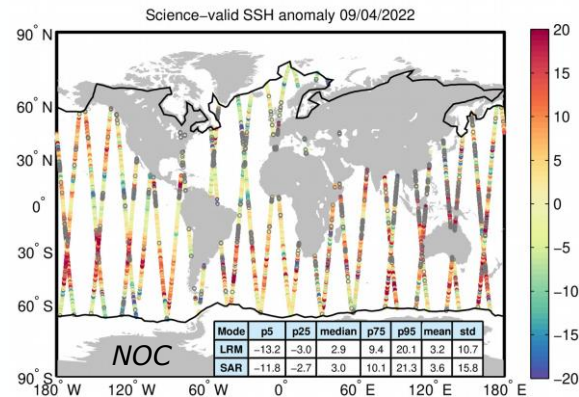


Ocean Baseline C Quality & CalVal Activities



Great agreement with **reference** Ocean missions and very well suited for **oceanographic applications**

- Internal CAL monitoring
- Daily & monthly Routine QC on Ocean products
- CryoOcean Scientific CalVal
- Long-term Ocean Data Analysis and Validation
- Known anomalies to be solved in Baseline D



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12 years of CryoSat Quality Control:
Evolution and Current Status of the Ocean Processors

E. Turner¹, L. Toonen², M. Williams³, A. Di Bella², J. Bouffard³, T. Parrinello³, T. Geminale²

IDEAS-QA4EO
TELESPAZIO
a LEONARDO and THALES company

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Evaluation and scientific exploitation of CryoSat ocean products for oceanographic studies

Chris Banks¹, Francisco Mir Calafat², Helen M. Smith³, Christine Gommenginger⁴, Andrew G.P. Shaw⁵, Jérôme Bouffard⁶ and Alessandro Di Bella⁷

¹National Oceanography Centre, UK, ²British Oceanographic Data Centre, SOIC, UK, ³SRMST Ltd, UK, ⁴European Space Agency, ⁵Terra C/O ESA, DLRN, UK, ⁶European Space Agency, ⁷Terra C/O ESA, DLRN, UK

Orbit accuracy at the 12th year anniversary of Cryosat-2 mission

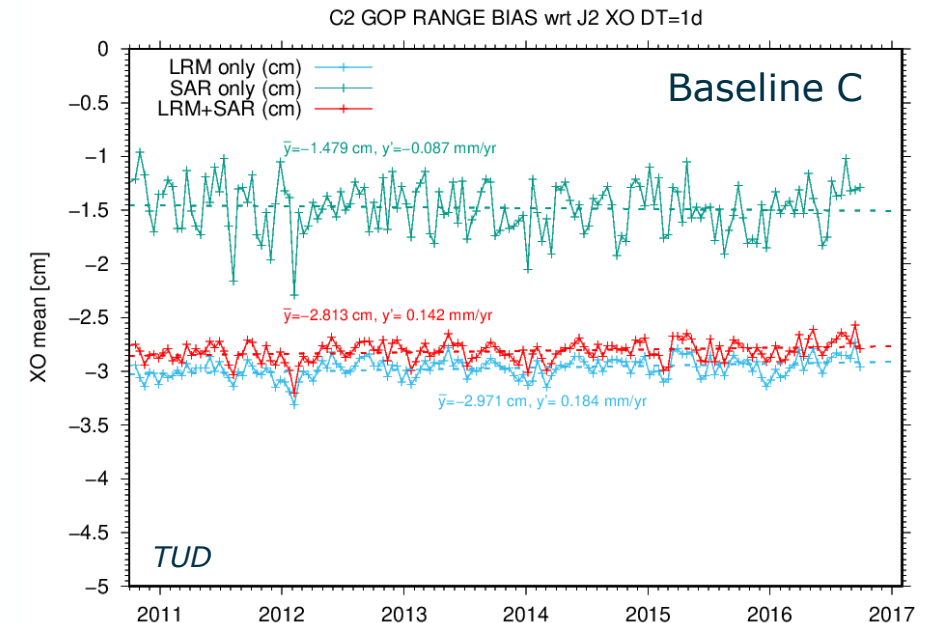
Ernst Schrama, Pieter Visser,
Delft University of Technology
e.j.o.schrama@tudelft.nl

Living planet symposium 23-27 May 2022 Bonn



The Ocean Baseline D will bring **significant improvements** to the ocean products

- Main fixes & evolutions
 - Occasional problem with 20 Hz to 1 Hz mapping
 - Mode dependent bias reduction
 - Upgrade to SAMOSA v2.5 for SAR & SARIn
 - Improved sea state bias, wind speed and sigma-0 solutions
 - Upgraded surface type mask, models and corrections...
- When:
 - Test Data Set to Quality Working Group in Q4 2022
 - Transfer to operation in Q1 2023



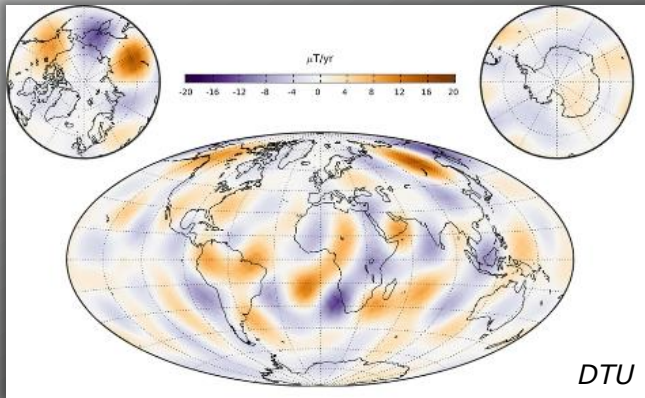
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12 years of CryoSat Quality Control: Evolution and Current Status of the Ocean Processors

E. Turner⁽¹⁾, L. Toonen⁽²⁾, M. Williams⁽¹⁾, A. Di Bella⁽²⁾, J. Bouffard⁽³⁾, T. Parrinello⁽³⁾, T. Geminateo⁽⁵⁾

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Magnetometer Data



Updated CryoSat magnetometer data now available with new baseline 0201

#SwarmMission



11:40 am

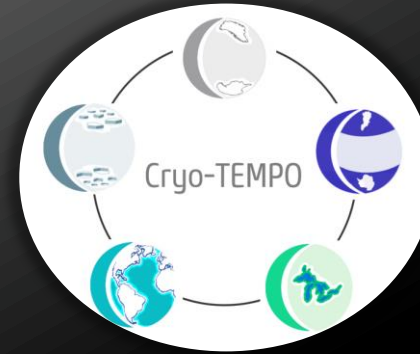
Towards a true swarm of magnetic satellites - scientific use of measurements taken by navigational magnetometers onboard Low-Earth orbiting satellites

[Prof. Dr. Nils Olsen](#) | [DTU Space](#) | [Denmark](#)

[Show details](#)

Wednesday 25 @11:40, room Tokyo

Cryo-TEMPO Products

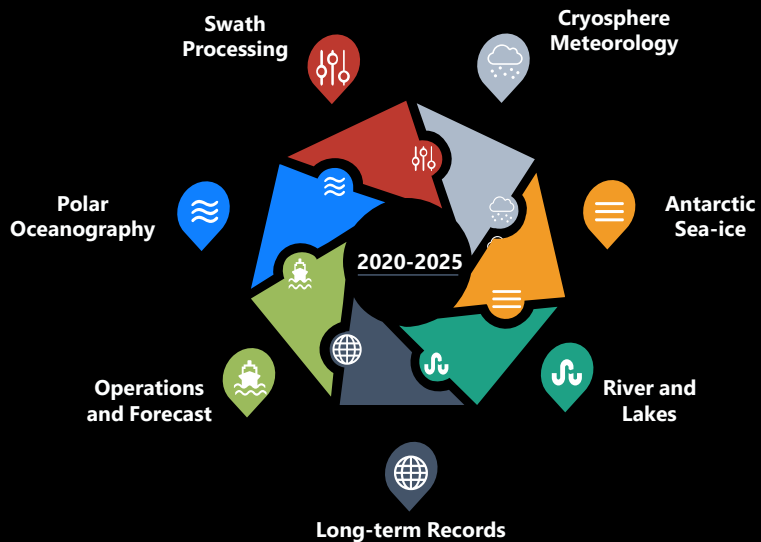


Quaternions product



The Take Home Message

- Nominal data quality after 12 years in orbit!
- New challenges?
- Continuous core product evolution



+ Cryo-TEMPO!

