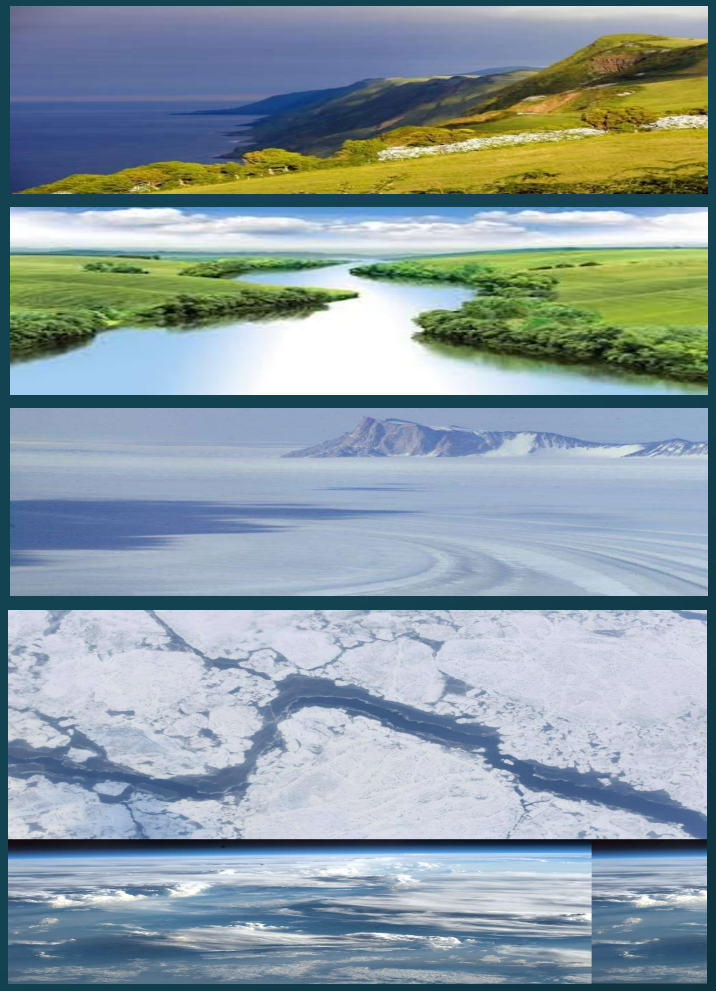
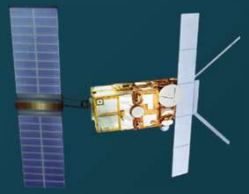
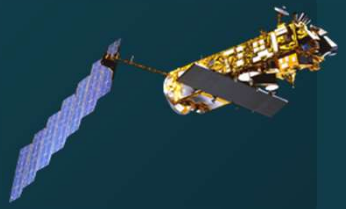






Fundamental Data Records for Altimetry :

FDR4ALT project

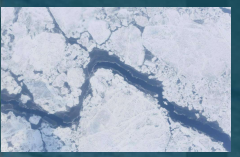
Ocean Surface Topography Science Team meeting
(virtual)
October 19th-23th, 2020

Fanny Piras, Pierre Thibaut (CLS)
JA Daguzé, M-L Fréry, M. Siméon, H. Roinard, B. Calmettes (CLS), S.Fleury, F.Nino, F.Birol (LEGOS) , E. Rinne (FMI), M.McMillan (Lancaster Univ.), E.Woolliams(NPL) F.Fell, R.Bennartz (Informus) , A. Tarpanelli (IRPI), B. Picard (Fluctus), M. Cancet (Noveltis)

Pierre Féménias (

Introduction



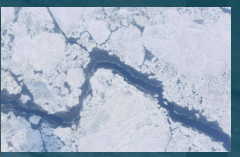

- ESA Framework : Long Term Data Preservation Programme (LTDP+) aiming at generating innovative Earth system data records in high resolution :
  - **Fundamental Data Records (FDR)**
  - **Thematic Data Products (TDP)**
- The FDR4ALT project aims at reprocessing ERS-1, ERS-2 and ENVISAT Altimeter and Radiometer datasets based on the best state-of-the-art algorithms and corrections with definition and production of innovative level-1 and level-2P products

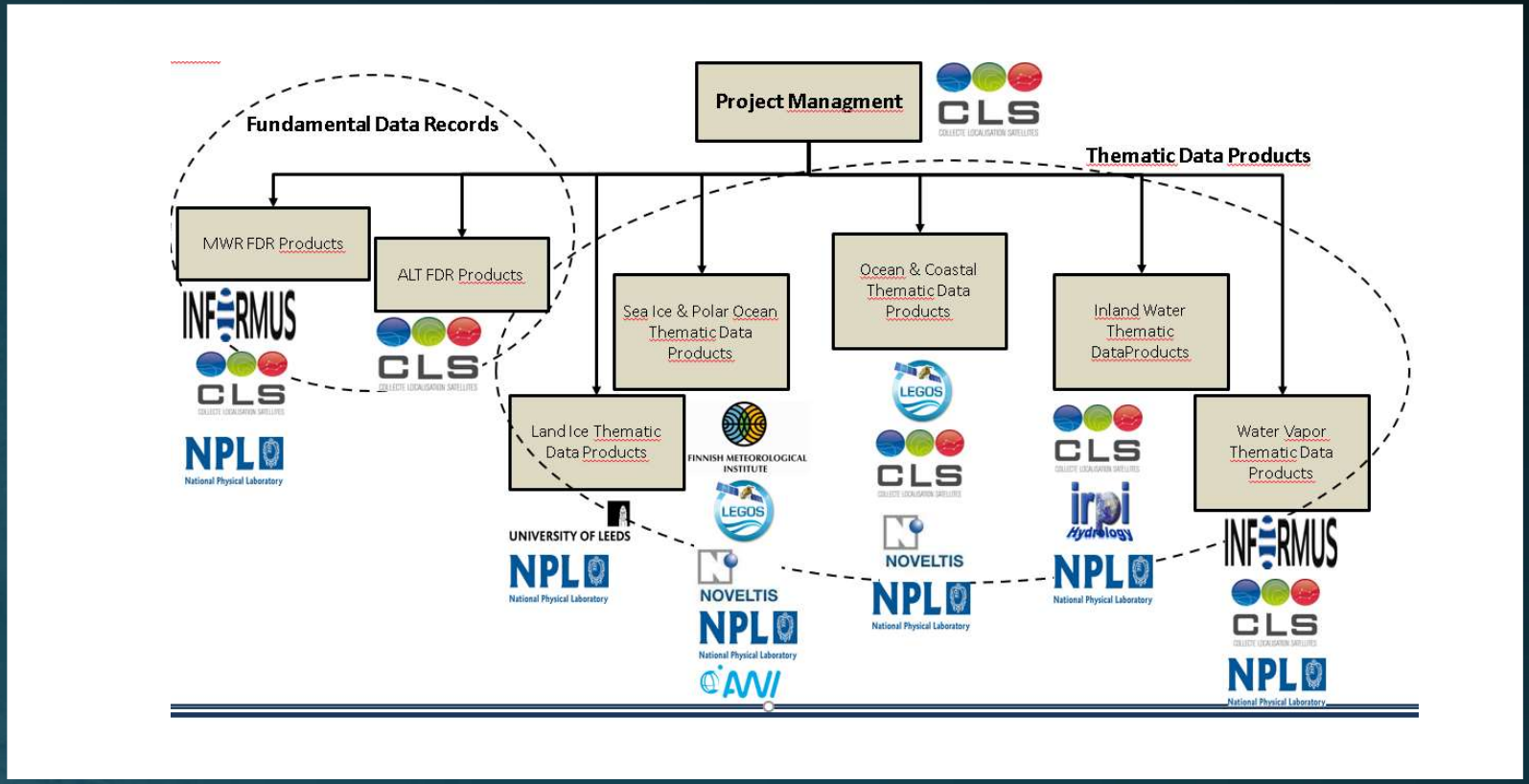
→ The goal is to serve the different communities involved in long term data exploitation of the different surfaces : **ocean**, **coastal, inland water ice sheets**, **sea-ice** and **atmosphere**

- Strong synergies with past, current and future projects are used: EMIR, FIDUCEO, REAPER, ENVISAT V3.0, SL_CCI, SI_CCI, LI_CCI, S3 LAND STM Improved branches, CRYO-TEMPO, …

Consortium



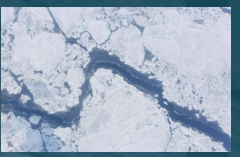



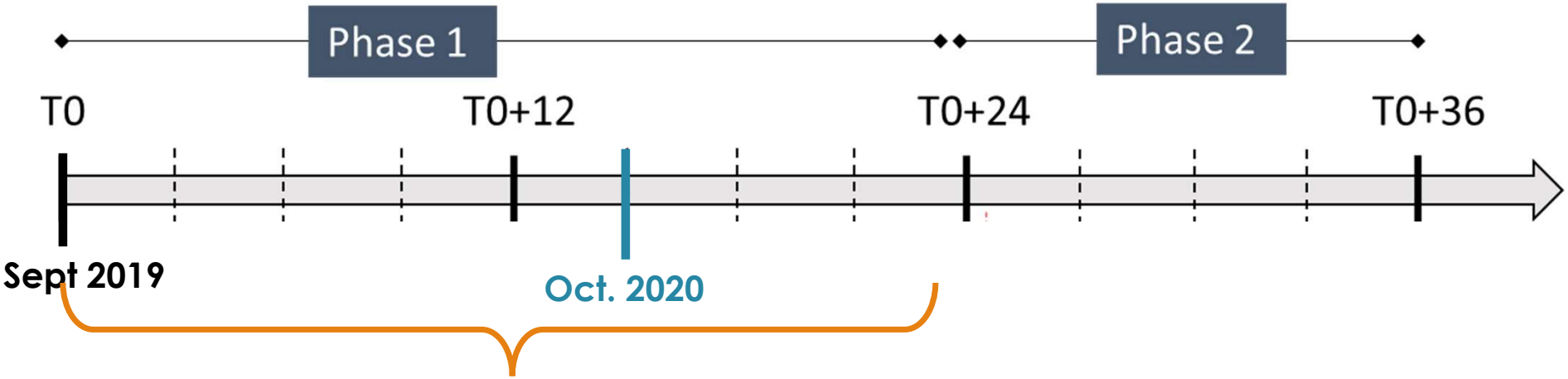
The consortium is composed of well-skilled experts that have been involved for many years on various activities related to the processing and exploitation of radiometer and altimeter measurements

Technical Planning of the FDR4ALT Project




→ **FDR4ALT : a 3-year project divided in two main phases**

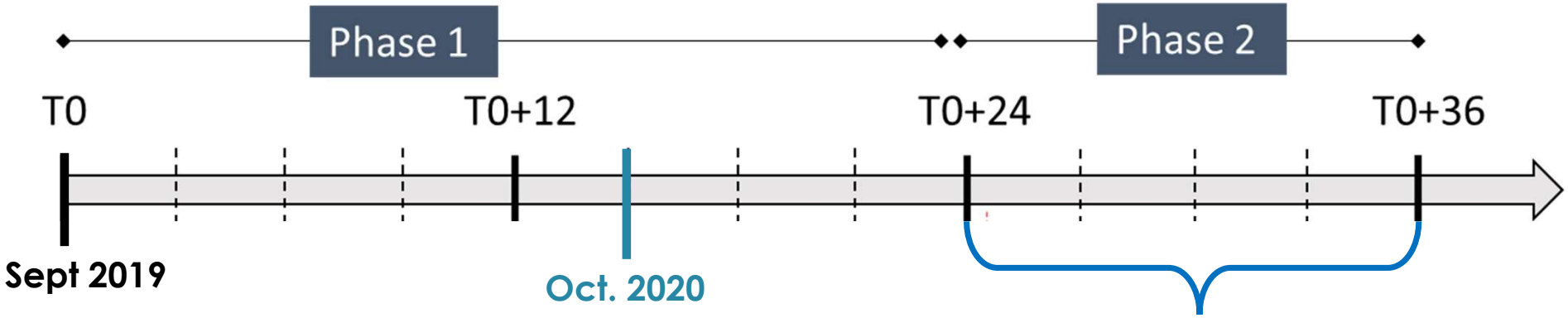


Phase 1 : FDR & TDP product definition

- Completeness analysis of ERS and ENVISAT datasets
- Selection of the algorithms for the FDR & TDP products (Round Robins)
- Definition of a validation plan
- Organisation of the reprocessing facilities

Technical Planning of the FDR4ALT Project

→ **FDR4ALT : a 3-year project divided in two main phases**

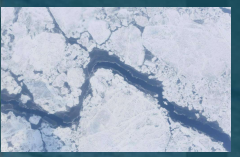


Phase 2 : FDR & TDP production and validation

- Algorithm implementation in the CLS/CNES core system
- Massive production of the FDR and TDP for the whole dataset
- FDR and TDP validation
- Uncertainty characterization

Fundamental Data Records (FDR)



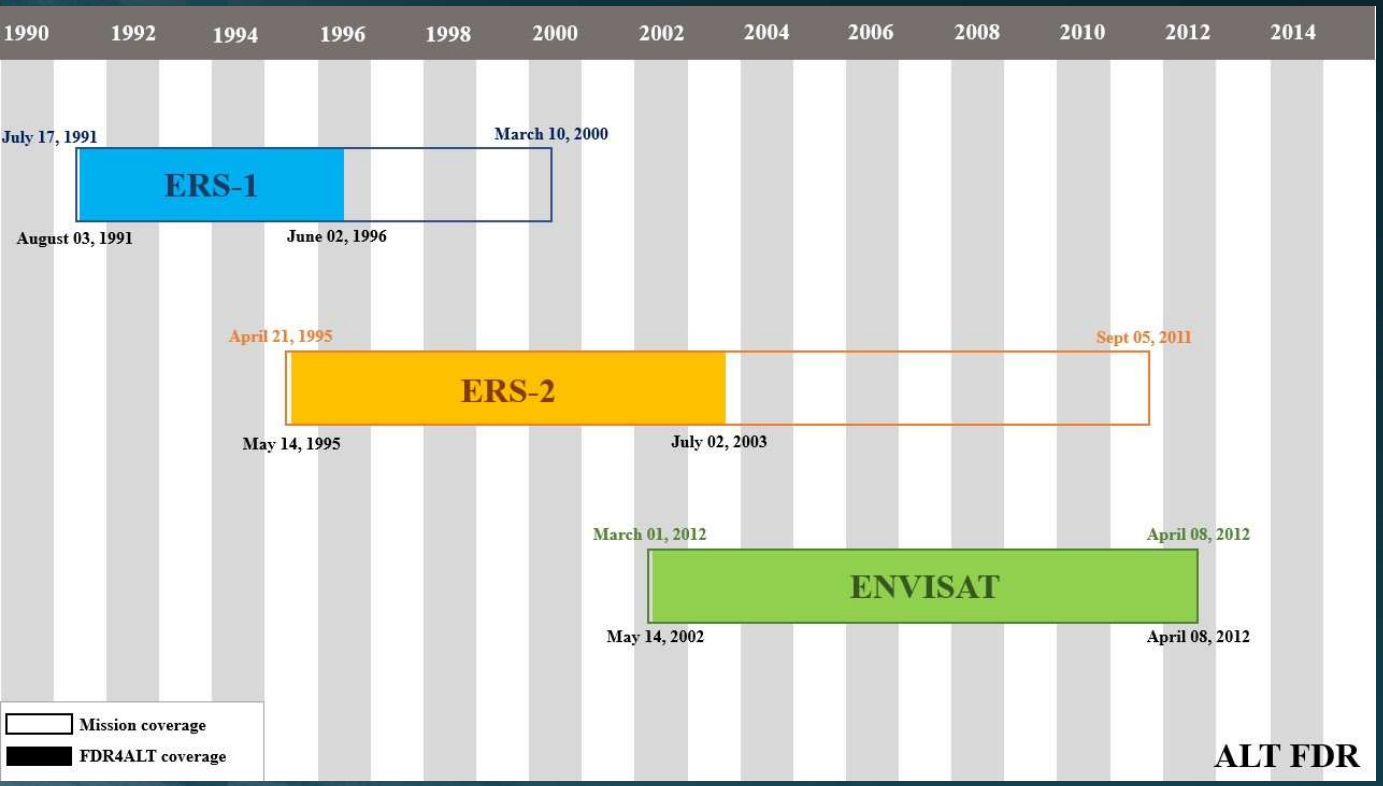

FDR must satisfy ESA needs for :

- Long term EO data preservation
- Unified and coherent long-term time series (between ERS and ENVISAT)
- Definition and uncertainty information to be included in the products
- Quality improvement and valorisation of level-1 products in terms of content but also file format

Two FDR products will be delivered by the FDR4ALT project :

✓ FDR Altimetry
✓ FDR Radiometry

Fundamental Data Records (FDR) : Altimetry

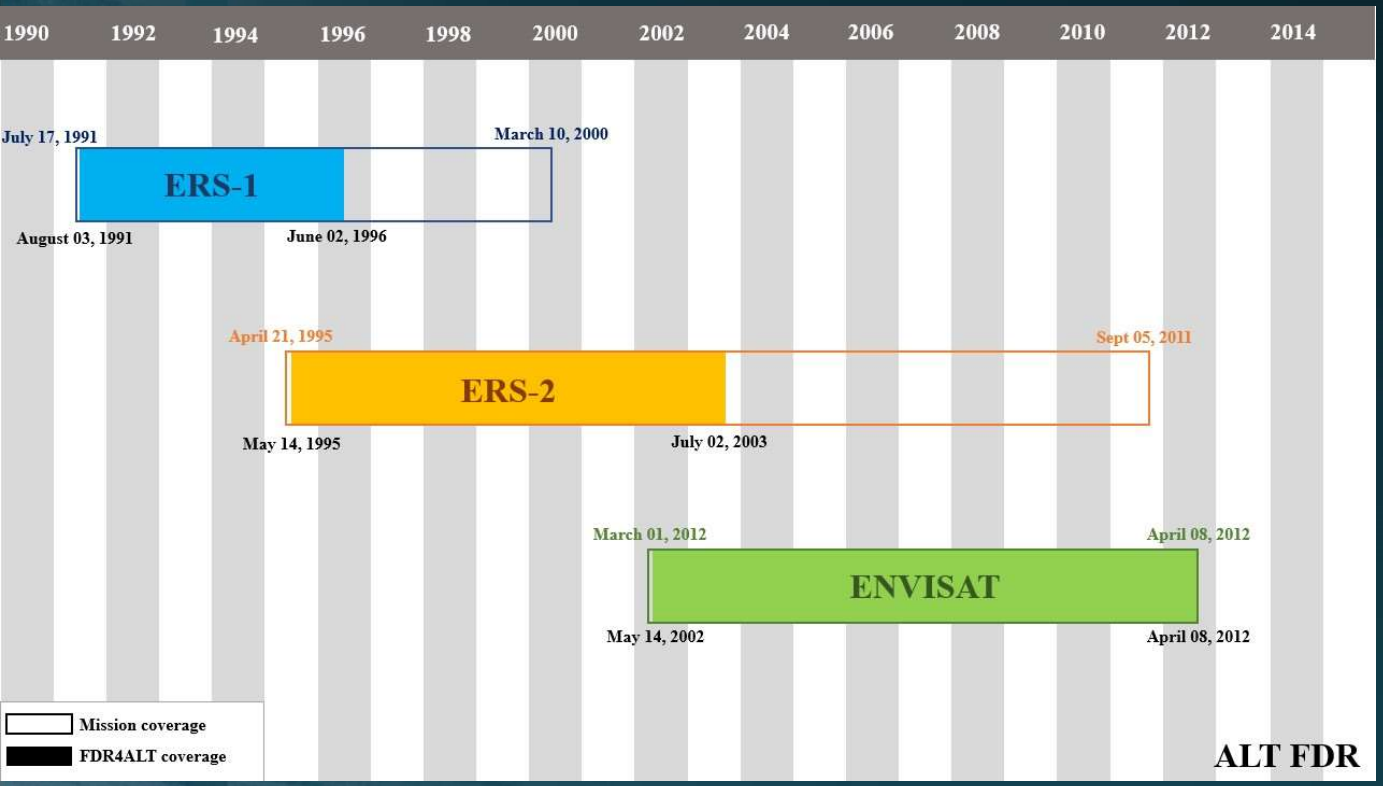


→ **More than 20 years of continued data in total !**

ERS 1 & 2

- The REAPER products have been provided with an optimal L1 processing.
- For this project we start from the REAPER SGDR products and will correct some drawbacks impacting L1 data
- The FDR4ALT ERS products will be limited to the REAPER coverage, but the missing data is degraded anyway (on-board storage failure for ERS-2 in June,2003)

Fundamental Data Records (FDR) : Altimetry



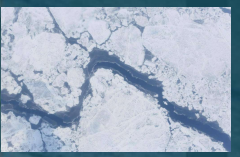
ENVISAT

- The ENVISAT-V3 products have been provided with an optimal L1 processing.
- For this project we start from the ENVISAT V3.0 reprocessing that covers the whole mission

→ More than 20 years of continued data in total !

Fundamental Data Records (FDR) : Altimetry




ERS REAPER L1B drawbacks

- Time-tag issue (forward and backward jumps) affecting ~1% of the data
- Numerical overflow of the waveform inducing negative values on the waveforms, especially over very reflective surfaces
- Pulse blurring phenomenom (Peacock &al) → **Impossible to modify directly the waveform, currently under evaluation in the Sea-ice TDP**
- Incorrect variable attributes → **will be modified in the ALT products**

Already implemented and will be corrected for in the FDR4ALT products

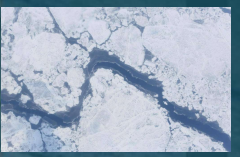
ENVISAT V3 drawbacks

- S-band anomaly
- USO abnormal behaviour

Correction already existing in the V3.0, no need to manage it

Fundamental Data Records (FDR) : Altimetry

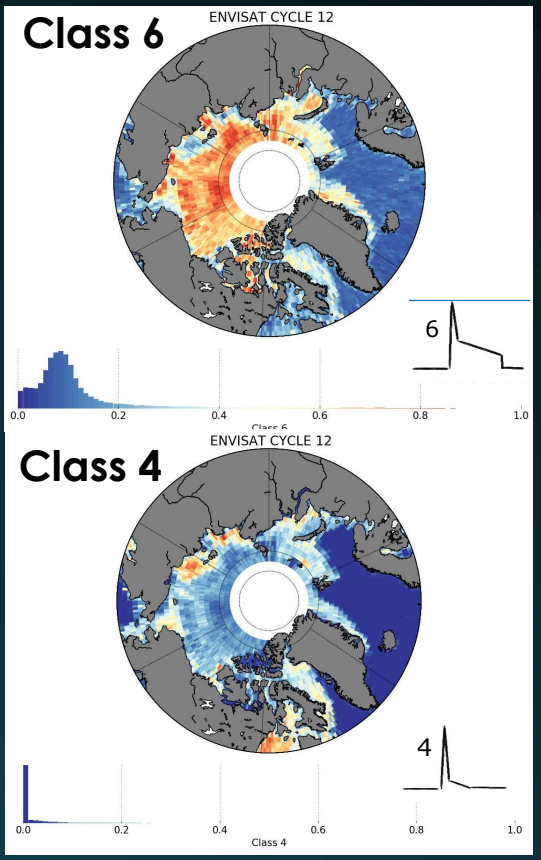



Guidelines of the future ALT FDR products

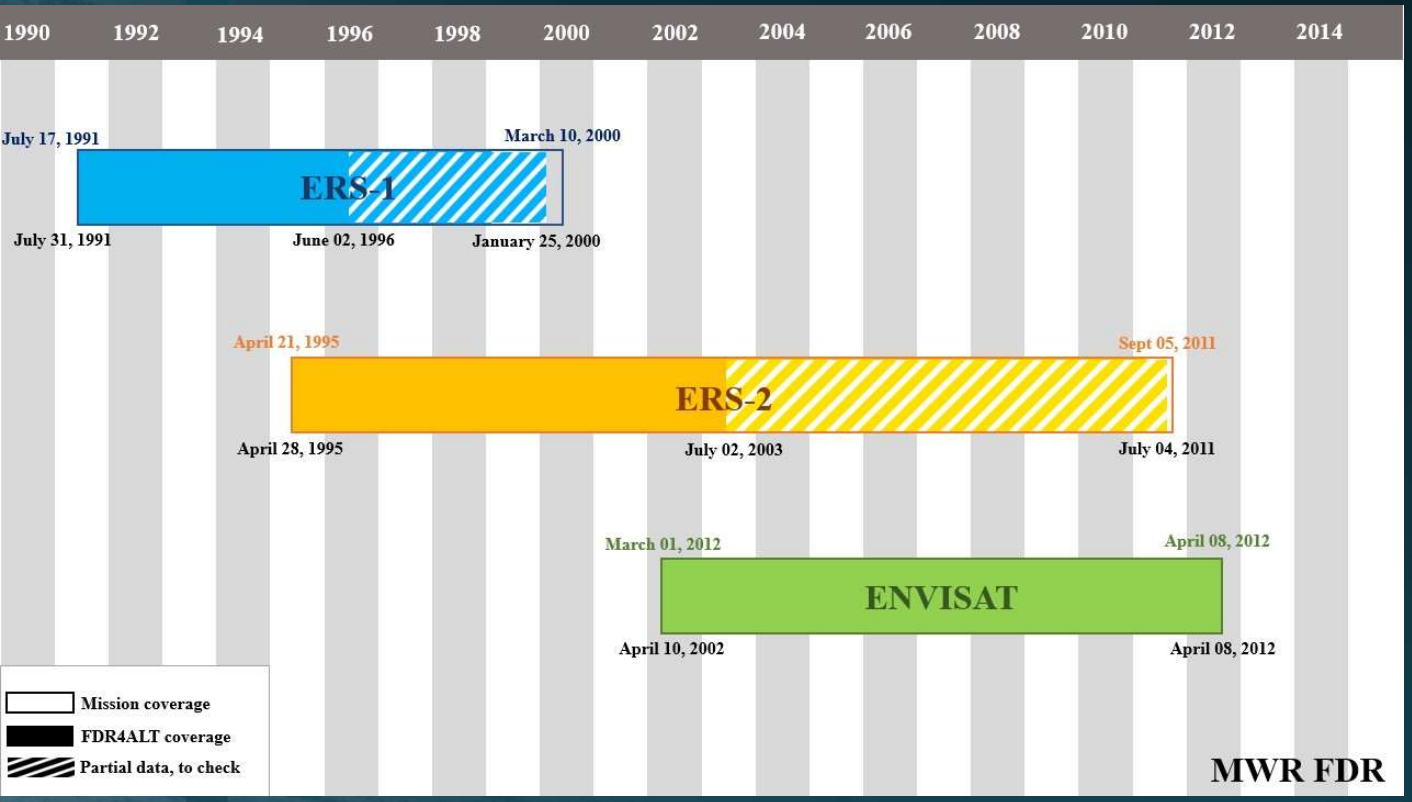
- Unify the product format (NetCDF) and variable names between ERS-1/2 and ENVISAT as much as possible
- Enhance the L1 products by adding extra information
  - Surface type classification (Globcover)
  - Distance to the nearest coast (GSHHS)
  - Waveform classification (Neural Network)

  → Already developed for ENVISAT, under developpement in the frame of this project for ERS
- Provide waveforms accounting for the Low Pass Filter (CAL2)
- Store calibration data in the same products (different rate)



ENVISAT classification : class 4 & 6 over the Arctic

Fundamental Data Records (FDR) : Radiometry



Previous projects and existing products to review

- EMIR, ESA (2013-2019)
- REAPER : reprocessing of ERS-1 & 2 data from 1991 to 2003 intercalibrated with ENVISAT
- Envisat 3.0 reprocessing : FMR covering period from 2002 to 2012

→ More than 20 years of continued data in total !

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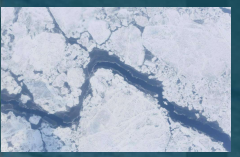
Fundamental Data Records (FDR) : Radiometry




Guidelines of the future MWR FDR products

Analysis of Difference of processing/instrument

- Differences of instruments: instrumental issues, drifts, ...
- Differences of processing: calibrations, corrections (sidelobe, …)

Define the processing model for harmonisation

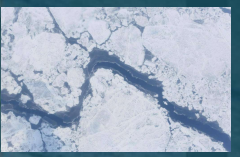
- Define a common processing model
- Define common corrections (**sidelobe,...**)
- Inter-calibration of three instruments (possible residual bias)

Define the processing model for homogenisation

- Define the processing model
- Assess biases in the context of the forward model needed in the retrieval
- Correct for both, remaining calibration issues and model biases in order to arrive at unbiased retrievals

Fundamental Data Records (FDR) : Radiometry



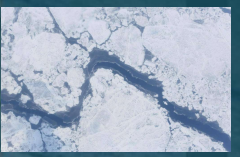




Status on instrument differences

		STATUS
INSTRUMENTAL MONITORING	Level 0 temperature and calibration daily statistics	Analysis in progress
VICARIOUS CALIBRATION	Detect drifts/instrumental issues using • Cold ocean points • Hottest Amazon forest measurements • Simulations • Crossovers	In progress
SPECIFIC ISSUES	ERS2 gain drop on 23.8GHz	In progress

Fundamental Data Records (FDR) : Radiometry




Status on processing definition

Huge preliminary work for the 3 missions due to the lack of detailed documentation

REVIEW

Review the existing processing:
- Manufacturer technical documents
- Processor specifications
- Code review

IMPROVE

Highlight the drawbacks and propose improvements
- Identify possible limitations
- Test the improvements

DEFINE

Define a common processing fit to the 3 missions
- Common output format
- Same calibration method, radiometric model…

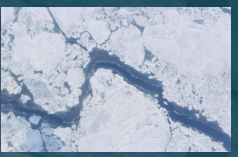
STATUS

In progress

In progress

Thematic Data Products (TDP)




TDP must satisfy ESA needs for :

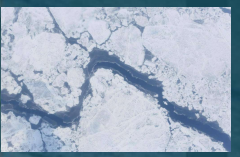
- Geophysical parameters relevant for scientific application (topography, wave height, freeboard, etc..)
- Simple to use with few variables
- Uncertainty parameters must be associated
- Valid data must be identified
- Geographic coverage must be suitable for the TDP parameters
- Product organization should maximize TDP use by end users for different applications
- Seamless continuity between the missions
- Product format must follow EO data principles
- Scientific content up to date must follow altimetry community recommendations

Six TDP products will be delivered by FDR4ALT :

- ✓ TDP Ocean & Coastal
- ✓ TDP Sea ice
- ✓ TDP Ice sheets
- ✓ TDP Inland Water
- ✓ TDP Atmosphere
- ✓ TDP Waves

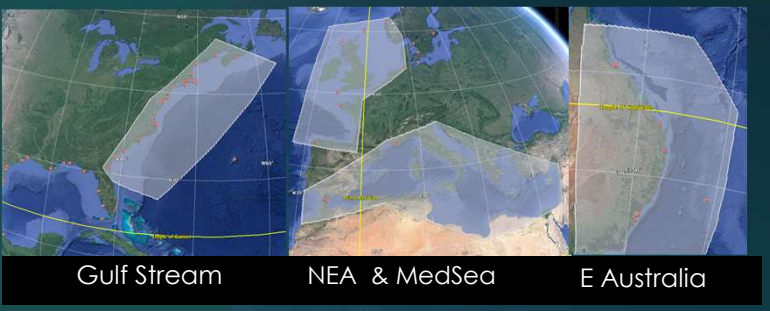
Thematic Data Products (TDP)



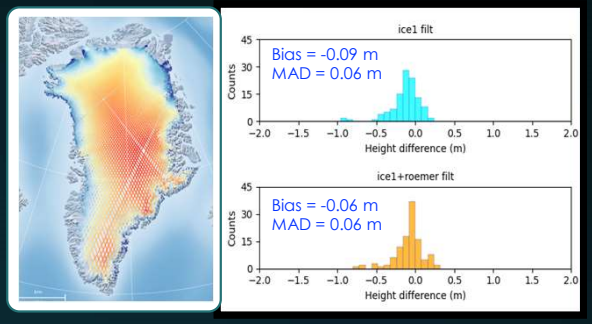




- Work is currently in-progress for each TDP to define the best possible product using state-of the art algorithms.
- Different solutions are being compared (retracking outputs, geophysical corrections, land-ice elevations, freeboards, etc…) and validation diagnoses are being defined.
- Some instrumental issues are also under investigation in the TDPs such as the « blurring » effect affecting ERS waveforms especially over sea-ice areas.

Thematic Data Products (TDP)

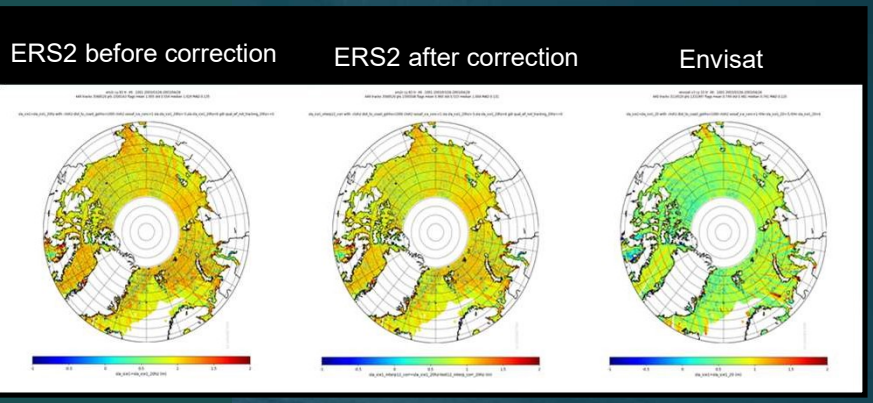


Definition of the test zones (TDP Ocean & Coastal)

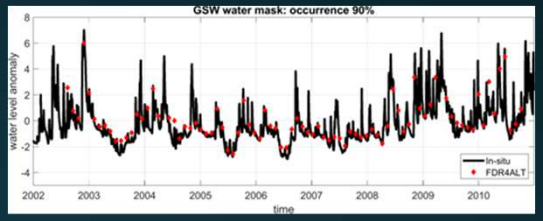


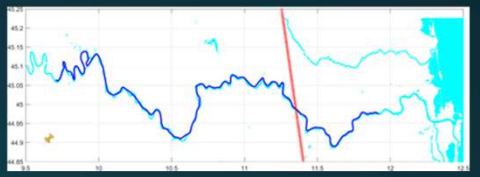
Linear Slope correction VS Roemer relocation on ENVISAT (TDP Ice-sheet)

A few examples of the on-going TDP analysis



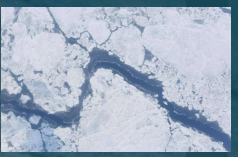
Analysis of a preliminary correction for the blurring effect (TDP Sea-Ice)





Analysis on the Po river using GSW water mask(TDP Inland-Water)

Thematic Data Products (TDP)



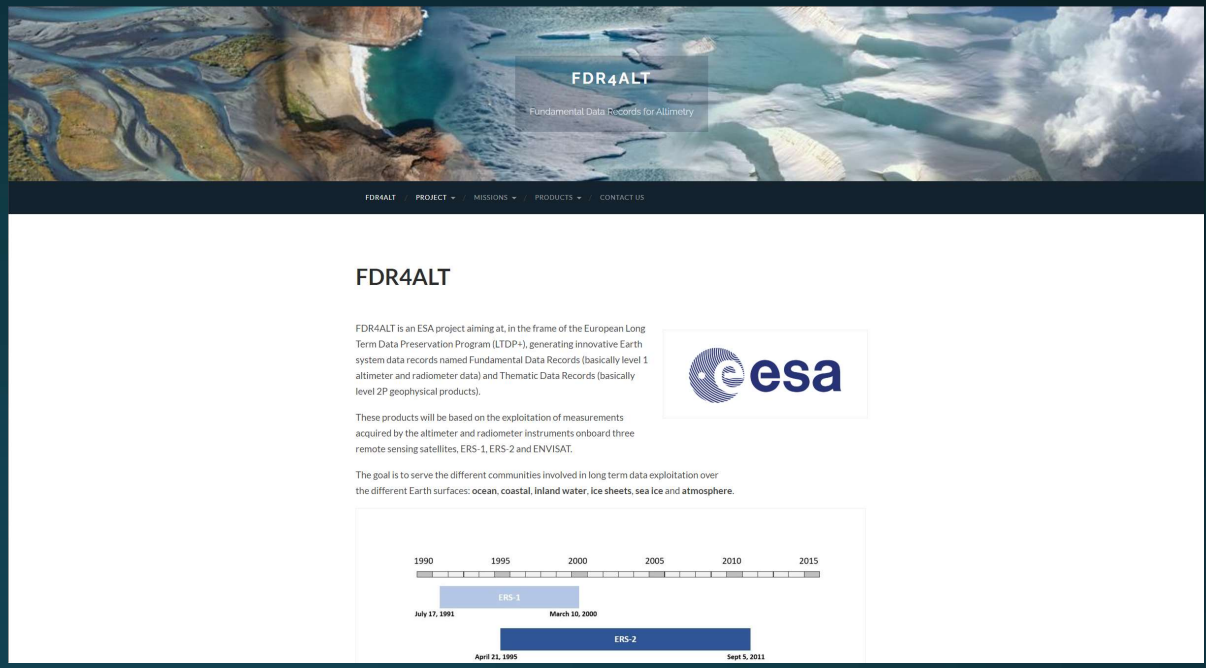
The definition of the content of the FDR4ALT products, based on the on-going investigations and round-robins, will be finalized in 2021.

→ Stay tuned !!!

Please visit our website for more information about the project :

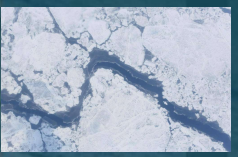
www.fdr4alt.org

It will be updated regularly. Links to the future outputs of this project will be available on this website.



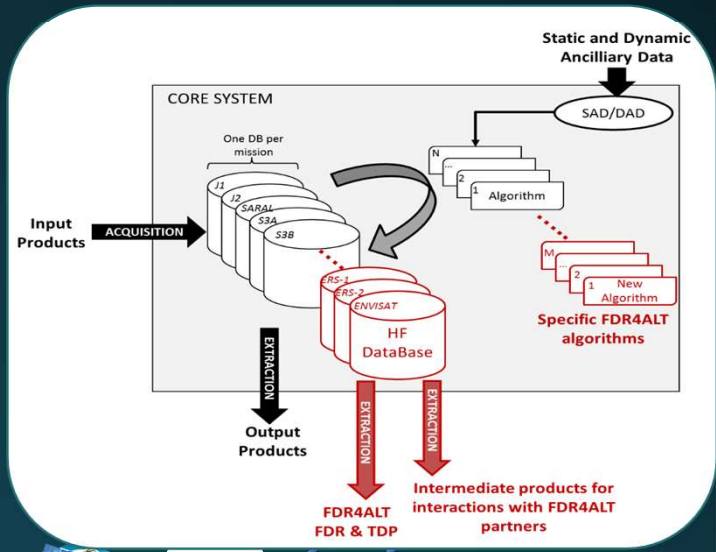
Reprocessing facilities




- For this crucial step, the FDR4ALT project benefits from the support from CNES and the experience from different projects, especially a CNES project aiming at producing and maintaining **High-Resolution** databases for Jason-2, Jason-3, SARAL, Sentinel-3A and Cryosat-2 missions. The goal is to make available L2 HR databases for experts. These databases contain most of the L2 product fields and are continuously **enhanced** with parameters from innovative algorithms(adaptive retracking, new standards of geophysical corrections...).
- FDR4ALT is a nice opportunity to enrich these databases with 3 new missions : **ENVISAT**, **ERS-1** and **ERS-2**.
- All processing and production of these long-time series of data will be done using the CNES computing facilities (HPC).

→ **Thanks to CNES for this !**



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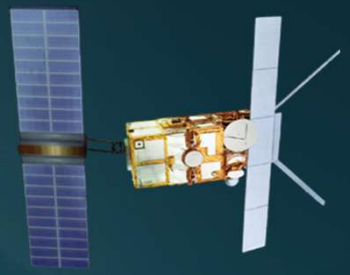

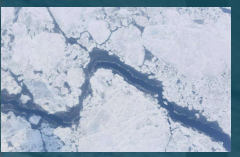

Thank you for your attention,

Any questions ?

➔ fpiras@groupcls.com
or
pthibaut@groupcls.com