# FUNDAMENTAL DATA RECORDS FOR ALTIMETRY
## 20 years of ERS and ENVISAT Microwave Radiometer
## reprocessed data

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# The FDR4ALT project in a nutshell

**ESA L**ong **T**erm **D**ata **P**reservation Programme (LTDP+) aiming at generating innovative Earth system data records

Reprocessing activity of **ERS-1**, **ERS-2**, **ENVISAT** Altimeter and Radiometer datasets
- ❖ based on the best state-of-the-art algorithms and corrections
- ❖ innovative level-1 and level-2 products
- ❖ Strong synergies with past, current & future ESA projects
  (EMIR, FIDUCEO, REAPER, ENVISAT V3.0, SS_CCI, SI_CCI, LI_CCI, S3 LAND STM Thematic processors, CRYO-TEMPO, …)

The Objective is to serve the different communities involved in long term data exploitation for different Earth surfaces

**Fundamental Data Records**
L1B products containing all the ancillary and instrumental data used to calibrate the instrument, with uncertainty included

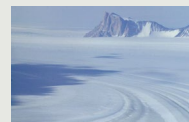FDR ALT

FDR MWR
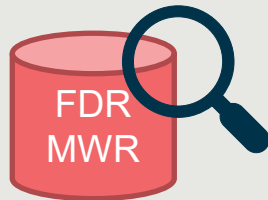
**Thematic Data Products:**
**Level-2P, easy to use, validated products with uncertainties included**

Ocean & Coastal Topography

Inland water

Land-Ice

Sea-Ice

Atmoshere

Ocean Waves

Find out more on FDR4ALT project and the first excellent results on altimetry
➔**poster** (F.Piras et al) on **session B4.01**

# What's new ?

Data at native MWR sampling rate: 7Hz (150ms) instead of 1Hz
Recovering data post ERS-2 tape failure (2003-2011)
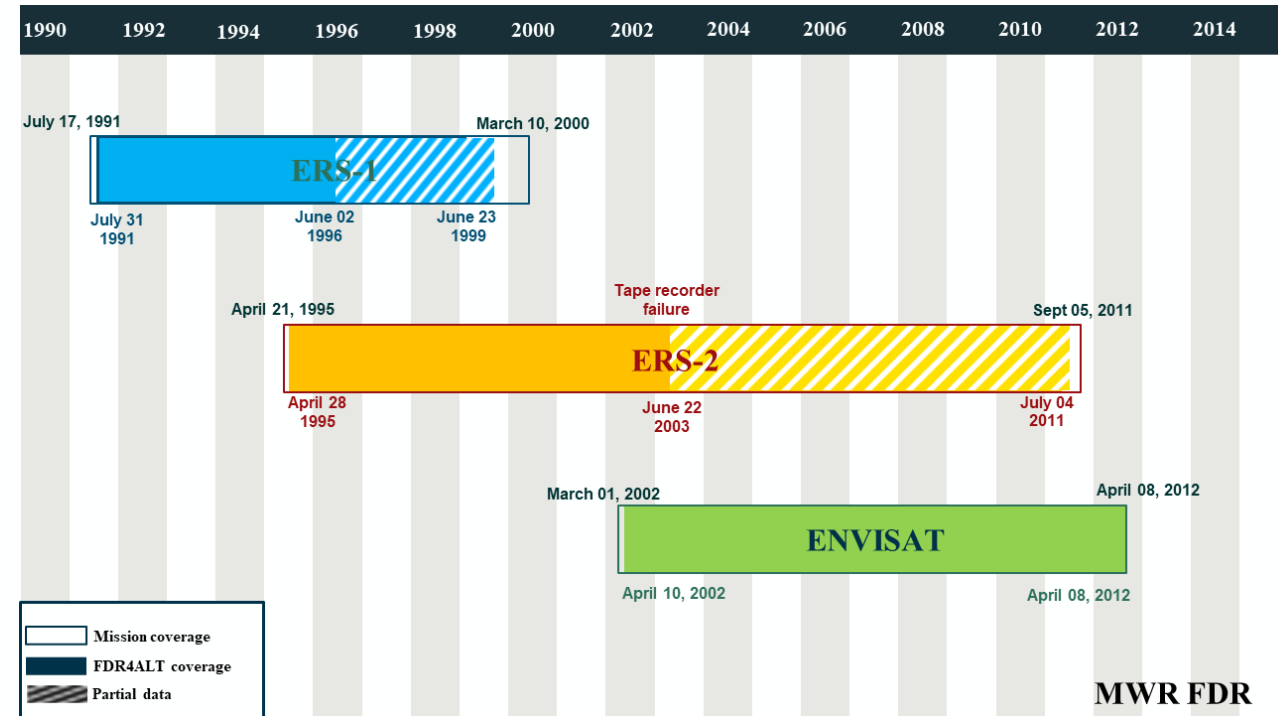
**New precise Orbit**
- ❑ ERS: POD REAPER v2 (2019)
- ❑ ENVISAT: POE-F

Harmonized L1 processing for Envisat, ERS1&2
Bias correction (homogenized TB)
**Uncertainties** for the first time !

User-friendly netCDF products
Completeness analysis

| 1990 | 1992 | 1994 | 1996 | 1998 | 2000 | 2002 | 2004 | 2006 | 2008 | 2010 | 2012 | 2014 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

July 17, 1991          March 10, 2000
**ERS-1**
July 31 1991   June 02 1996   June 23 1999

April 21, 1995          Tape recorder failure          Sept 05, 2011
**ERS-2**
April 28 1995   June 22 2003   July 04 2011

March 01, 2002          April 08, 2012
**ENVISAT**
April 10, 2002          April 08, 2012

Legend:
- ☐ Mission coverage
- ■ FDR4ALT coverage
- ▨ Partial data

**MWR FDR**

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# Harmonized processing - ERS

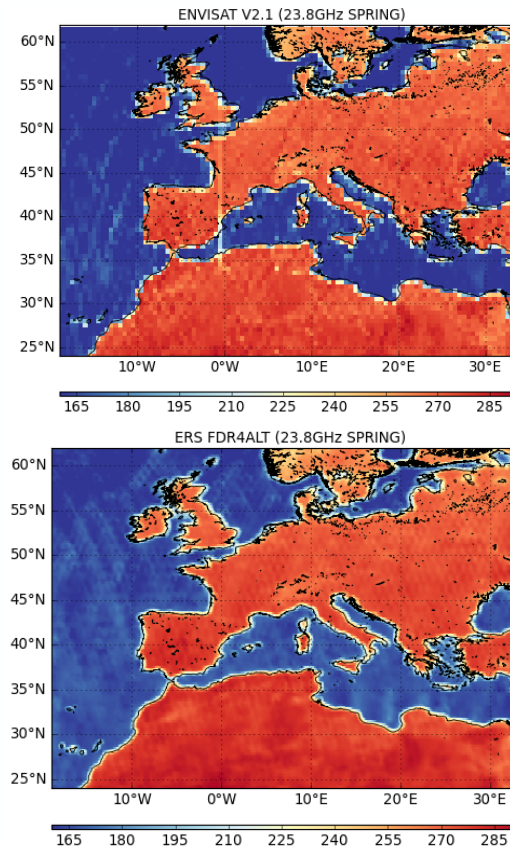*More details in Product User Guide*

## MWR model updates

- Interpolation of losses to temperature (ERS-2)
- Correction for Reflector losses (up to 6K impact)
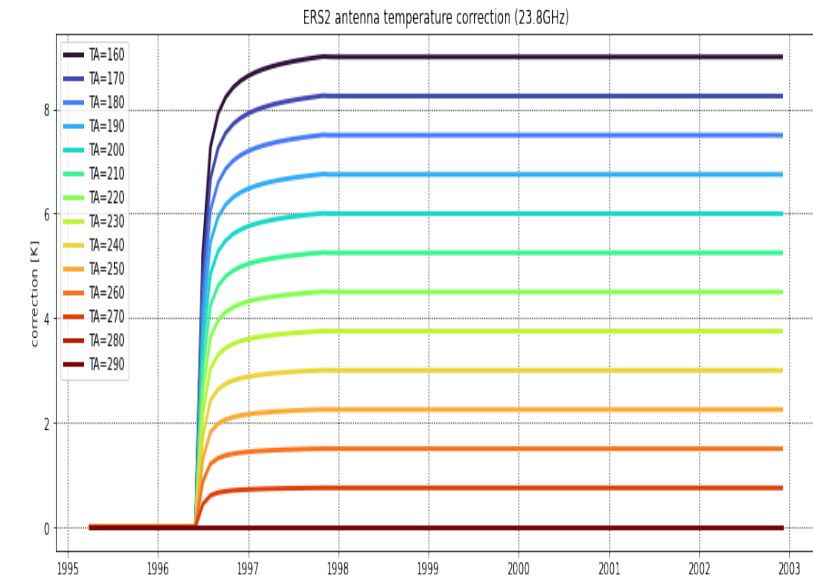- SAR temperature correction (coupling term with Tearth)
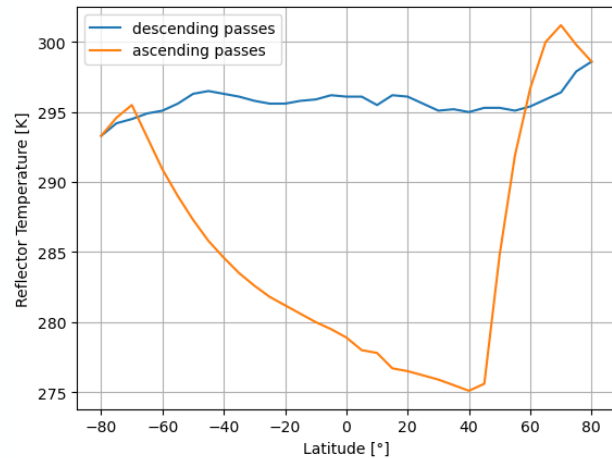
## Sidelobes correction

- S3 antenna pattern
- Seasonal maps with Enhanced resolution

## Gain drop correction

- Gain drop event on June 1996 degrading 23.8GHz TB of ERS-2
- Corrected with empirical function adapted from Sharroo et al

# Harmonized processing - ENVISAT

*More details in Product User Guide*

## MWR model updates

- Errors detected and corrected in MWR model equations
- Account for Leakage temperature in TE computation

➔ The strong difference between ascending and descending passes when comparing to simulated measurements is not observable anymore in FDR4ALT reprocessing
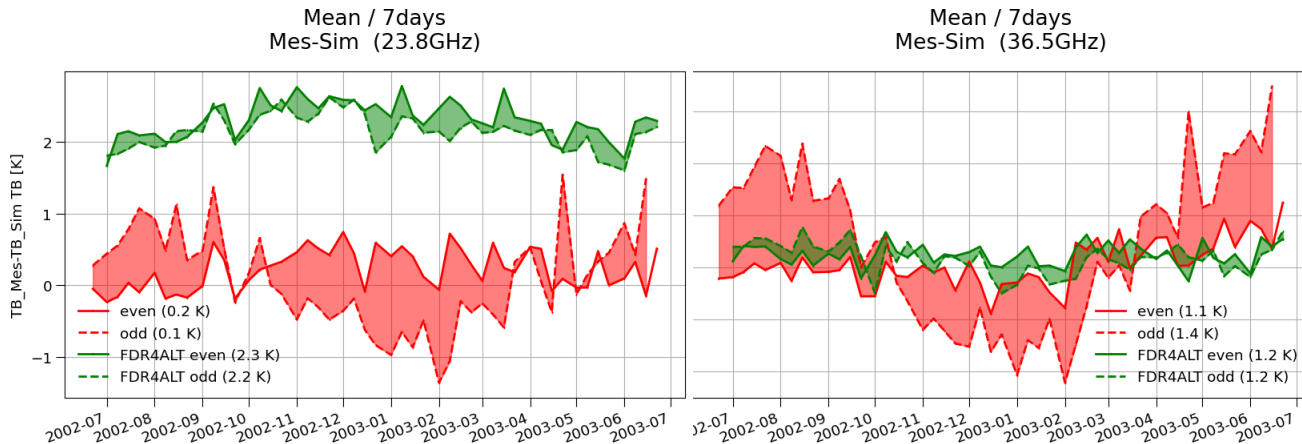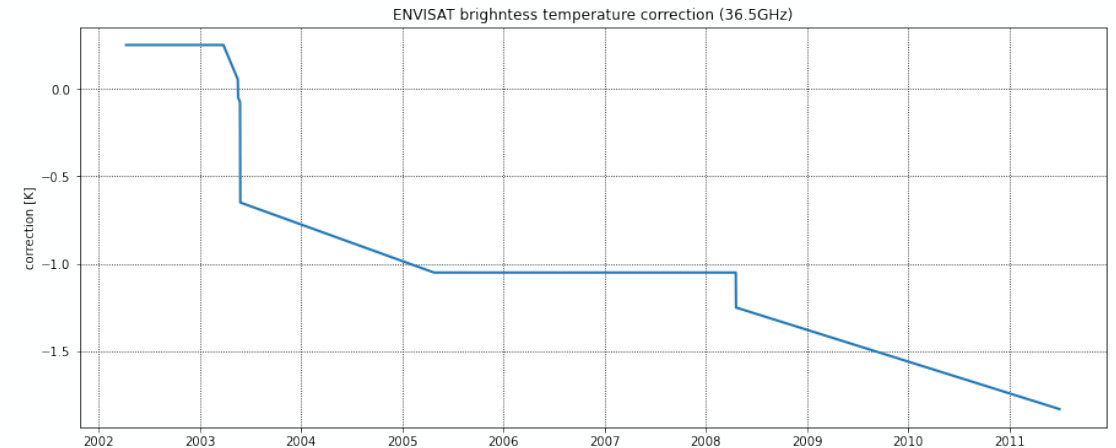
## Updated Sidelobes correction

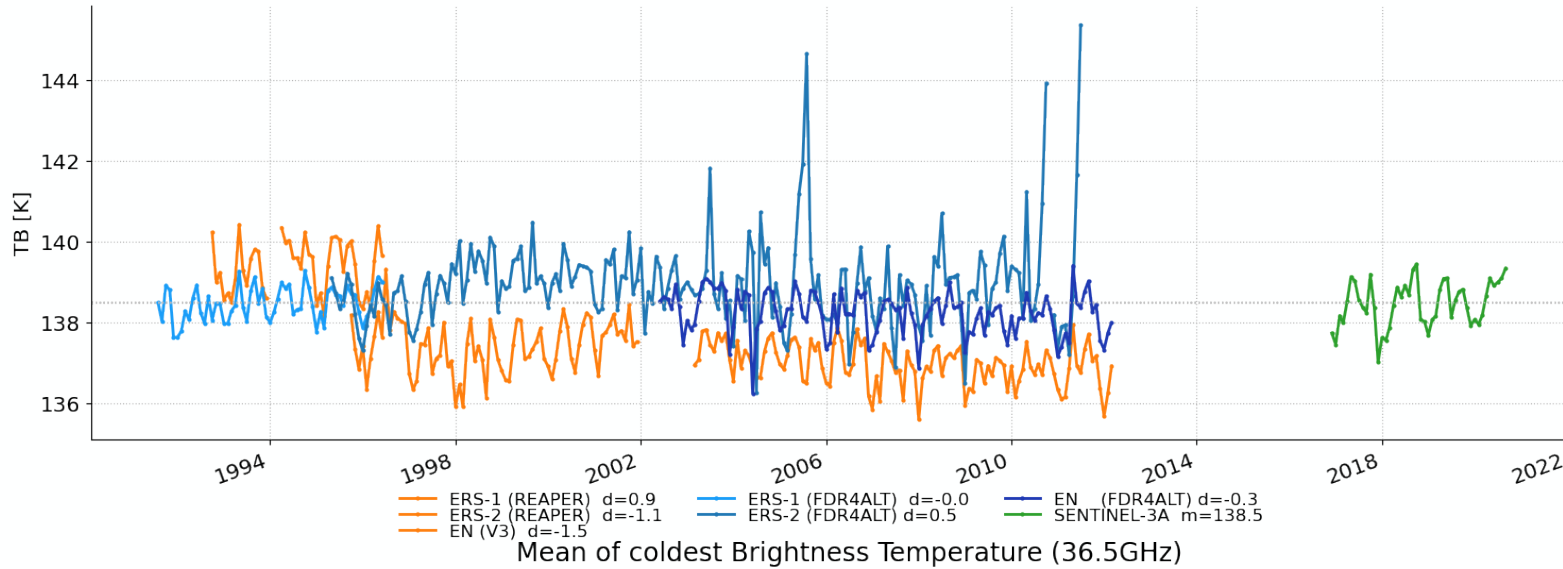- Better resolution
- Far lobes bases on S3 fit

## Drift correction

- After MWR model correction, drifts were identified and corrected
- The correction is piecewise

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Mean of coldest Brightness Temperature (23.8GHz)

REAPER/EN V3    VS    FDR4ALT

ERS-1 (REAPER) d=0.9    ERS-1 (FDR4ALT) d=-0.0    EN (FDR4ALT) d=-0.3
ERS-2 (REAPER) d=-1.1   ERS-2 (FDR4ALT) d=0.5    SENTINEL-3A m=138.5
EN (V3) d=-1.5

Mean of coldest Brightness Temperature (36.5GHz)

ERS-1 (REAPER) d=3.0    ERS-1 (FDR4ALT) d=0.1    EN (FDR4ALT) d=0.3
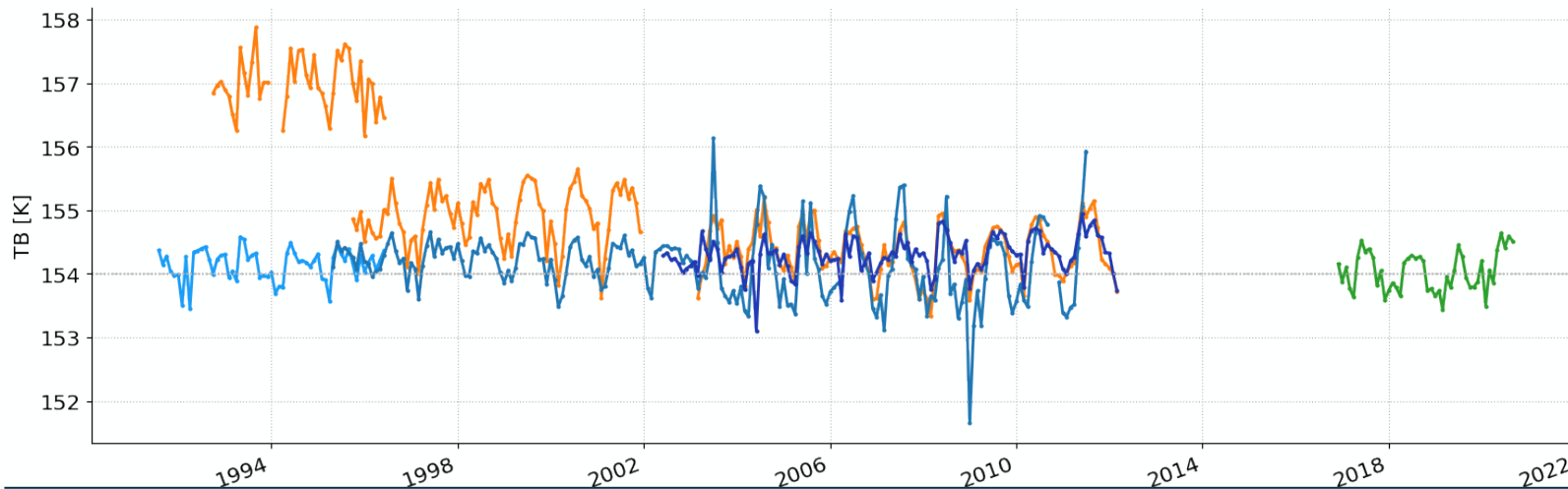ERS-2 (REAPER) d=0.9    ERS-2 (FDR4ALT) d=0.1    SENTINEL-3A m=154.0
EN (V3) d=-0.4

FDR4ALT missions now aligned with S3 calibration

➔ The harmonization of processing in FDR4ALT project has improved brightness temperatures quality

➔ The bias correction of brightness temperatures will help to remove the small residual bias between the instruments
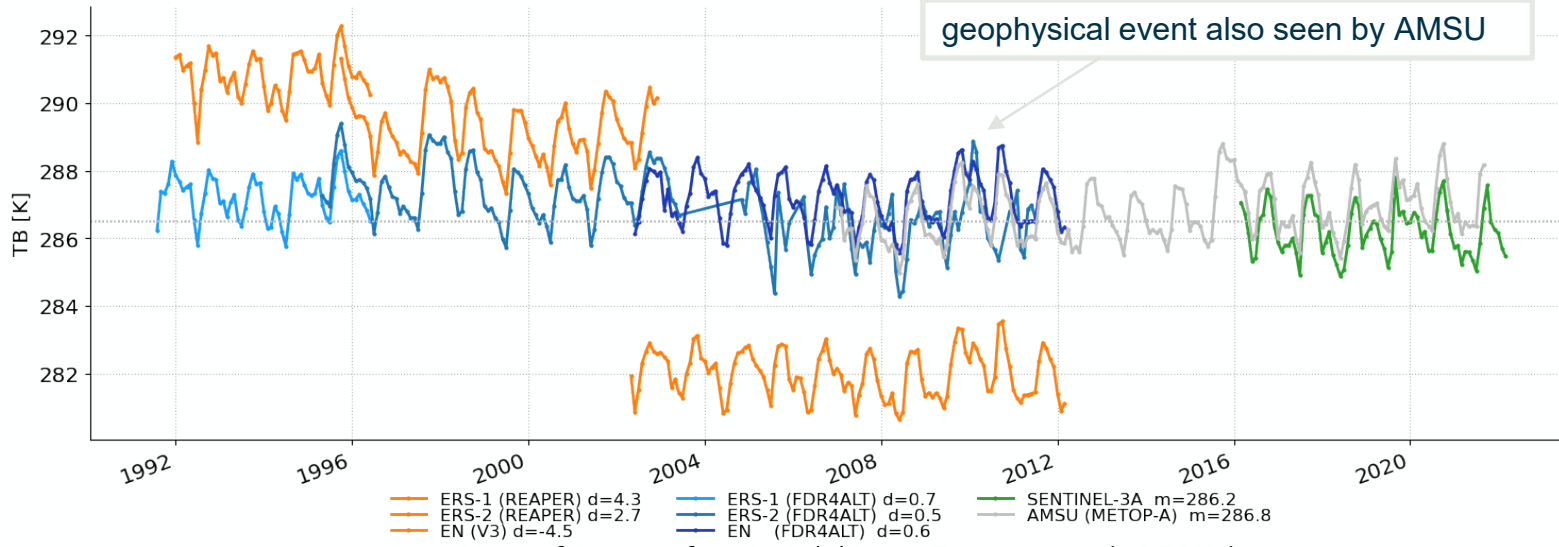
*The Vicarious calibration of coldest ocean temperatures is statistical monitoring described in Ruf et al (2000) and used to calibrate S3A/B (Frery et al, 2020)*

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# Vicarious Calibration :
## Hottest Amazon Forest points



Mean of Amazon forest - Brightness Temperature (23.8GHz)

geophysical event also seen by AMSU

Legend (23.8GHz):
- ERS-1 (REAPER) d=4.3
- ERS-2 (REAPER) d=2.7
- EN (V3) d=-4.5
- ERS-1 (FDR4ALT) d=0.7
- ERS-2 (FDR4ALT) d=0.5
- EN (FDR4ALT) d=0.6
- SENTINEL-3A m=286.2
- AMSU (METOP-A) m=286.8

Mean of Amazon forest - Brightness Temperature (36.5GHz)

Legend (36.5GHz):
- ERS-1 (REAPER) d=10.4
- ERS-2 (REAPER) d=9.5
- EN (V3) d=10.6
- ERS-1 (FDR4ALT) d=0.5
- ERS-2 (FDR4ALT) d=0.0
- EN (FDR4ALT) d=0.8
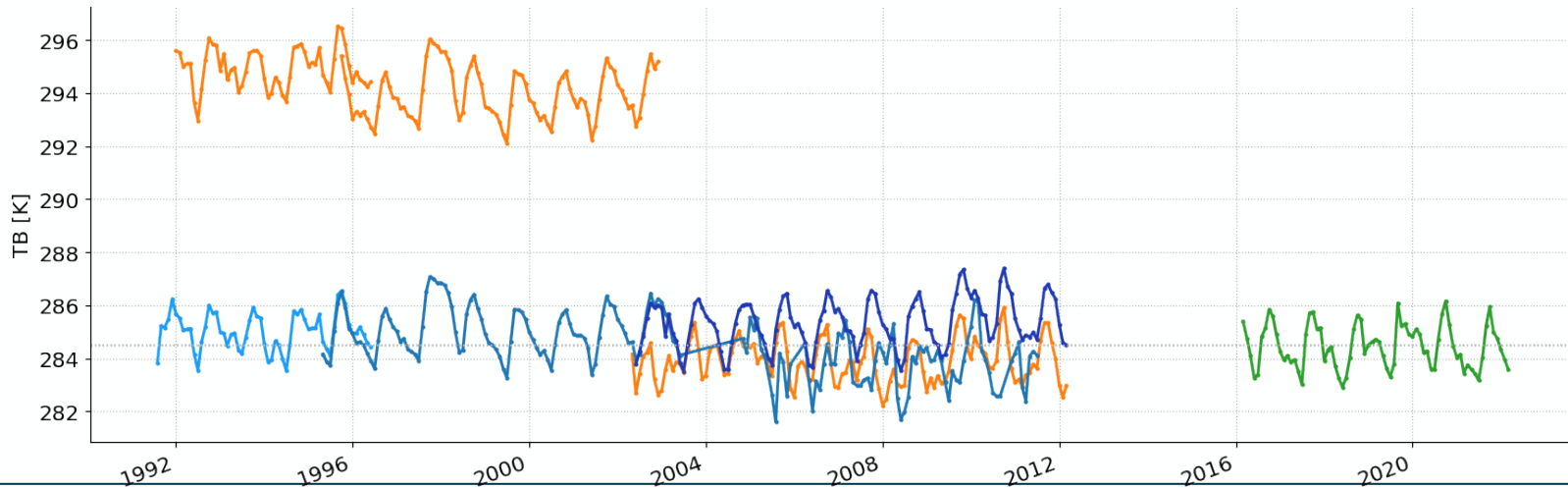- SENTINEL-3A m=284.4

REAPER/EN V3   VS   FDR4ALT

FDR4ALT missions now aligned with S3 calibration

➔ The harmonization of processing in FDR4ALT project has improved brightness temperatures quality

➔The bias correction of brightness temperatures will help to remove the small residual bias between the instruments

*The Vicarious calibration over the Amazon Forest is statistical monitoring described in Brown et al (2004) and used to calibrate S3A/B (Frery et al, 2020)*

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# Uncertainty estimation
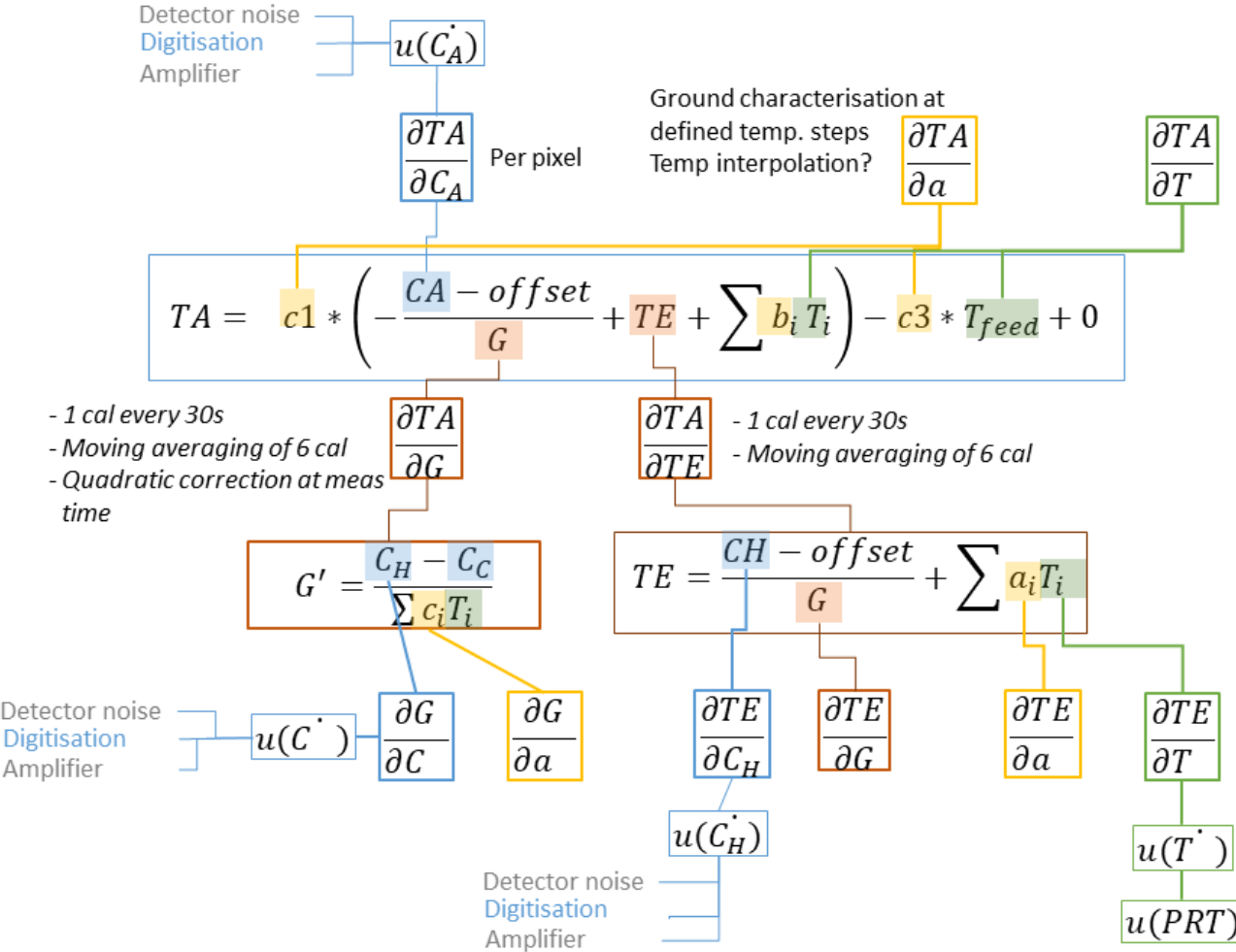


Same methodology as in FIDUCEO used for uncertainty estimation

- ❑ Definition of an uncertainty tree centered on the measurement function

- ❑ Definition of effects table

- ❑ Assessment of contributors, correlation,
- ❑ Estimation of a value to feed each contributor

➔ Goal: Providing of uncertainty for each brightness temperature measurement of the FDR

# Product content description

To meet user requirements, the FDR has a unified description for the 3 missions

☐ netCDF 4 CF 1.8

☐ User friendly completeness analysis describing data quality & gaps

## MWR FDR PRODUCT groups

**main**

### L1B calibrated & coregistered
- Intercalibrated brightness temperatures
- Bias-corrected brightness temperatures
- Quality flag
- Uncertainties

### Aux user-friendly data
- Surface type
- Distance to shoreline

**expert**

### L1B expert
- Calibration data
- Brightness temperatures prior to coregistration

### L0
- Physical temperatures

# Thank you !

FDR4ALT is a 3-years long project, planned to end in **December 2022**

- The FDR4ALT data products will be released via the ESA dissemination facility
- An article about FDR MWR is in preparation

## Keep posted on project info:

https://earth.esa.int/eogateway/news/new-reprocessing-of-datasets-celebrates-30-years-of-ers

https://www.fdr4alt.org/

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