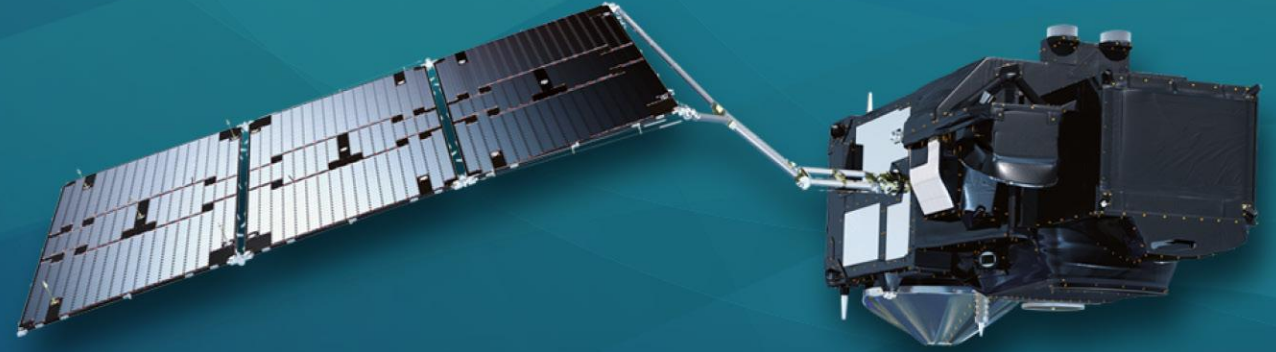




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9th Sentinel-3 Validation Team meeting 2026

30 March–01 April 2026 | ESA–ESRIN | Frascati (Rome), Italy

Sentinel-3 microwave radiometers over ocean surfaces: long-term monitoring and performance assessment within the COPAS project

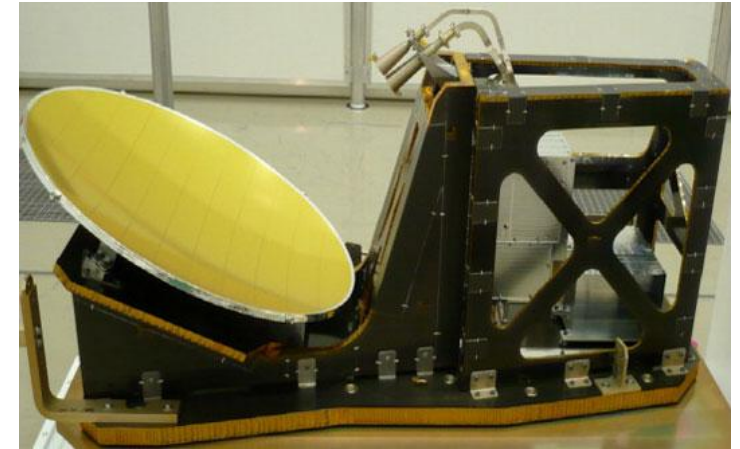
*A. Saint Georges-Chaumet⁽¹⁾, H. Roinard⁽¹⁾, T. Pirotte⁽¹⁾, L. Amarouche⁽¹⁾, F. Nencioli⁽¹⁾,
S. Dinardo⁽²⁾, C. Nogueira Loddo⁽²⁾, B. Lucas⁽²⁾*

1) CLS, 2) EUMETSAT



○ Sentinel-3 radiometer monitoring

- Passive Microwave radiometer
- Measures brightness temperatures in two channels
23.8GHz (water vapor) and 36.5GHz (liquid water channel)
- Allows estimating Wet Tropospheric Correction (WTC) for correcting the altimeter range
- **Important spatial and temporal variability**
=> source of uncertainty in the altimeter error budget
- Monitoring health of the instrument to ensure performance and stability.



Sentinel-3 MicroWave Radiometer (MWR) instrument.

○ COPAS framework

- Focus on **open ocean** surfaces
- Variables monitored at various levels: L0 / L1 CAL / L1 / L2 => **focus on L1/L2**
- Reports on an annual and quarterly basis publicly available
[on EUMETSAT's website](#)



- **Goal** Have an overview of the performance of Sentinel-3 radiometers after respectively 10 and 8 years of service

○ Vicarious calibrations

- **Comparing brightness temperatures averages over four specific targets:**

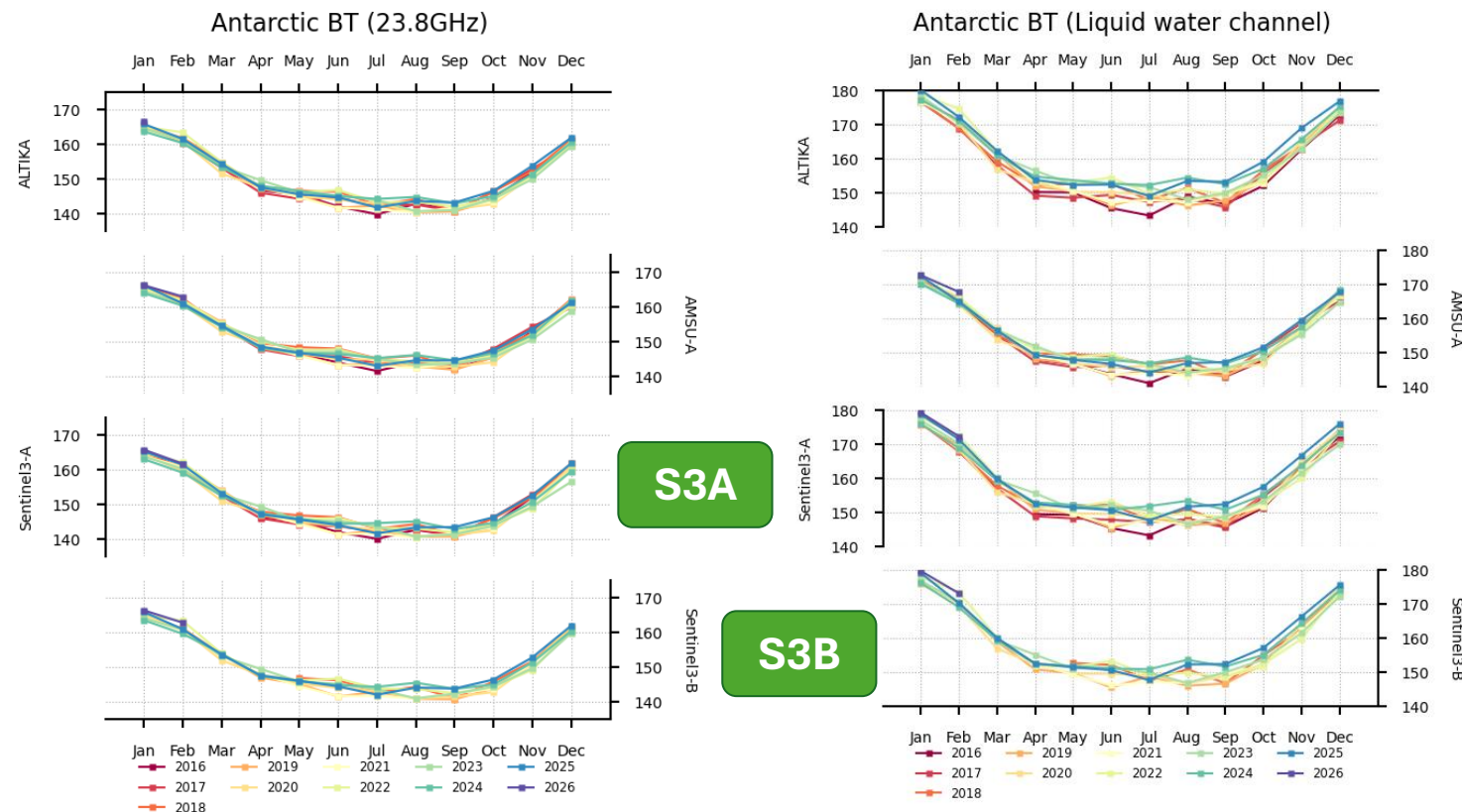
- Coldest ocean
- Amazon forest
- Antarctic (Shown here)
- Greenland

- Multi mission diagnosis: ALTIKA, Metop-B, S3A/B (+ S6, Jason-3)

- Piled years monitoring for better stability analysis

- S3A and S3B remain **very stable over the years**

- **Coherent behavior with over missions**



Monthly mean brightness temperatures over Antarctic for 23.8GHz channel (right) and liquid water channel (left). Studied satellites are SARAL/ALTIKA, AMSU-A onboard Metop-B, S3A and S3B. Each color denotes a different year.

○ Vicarious calibrations

- **Comparing brightness temperatures averages over four specific targets:**

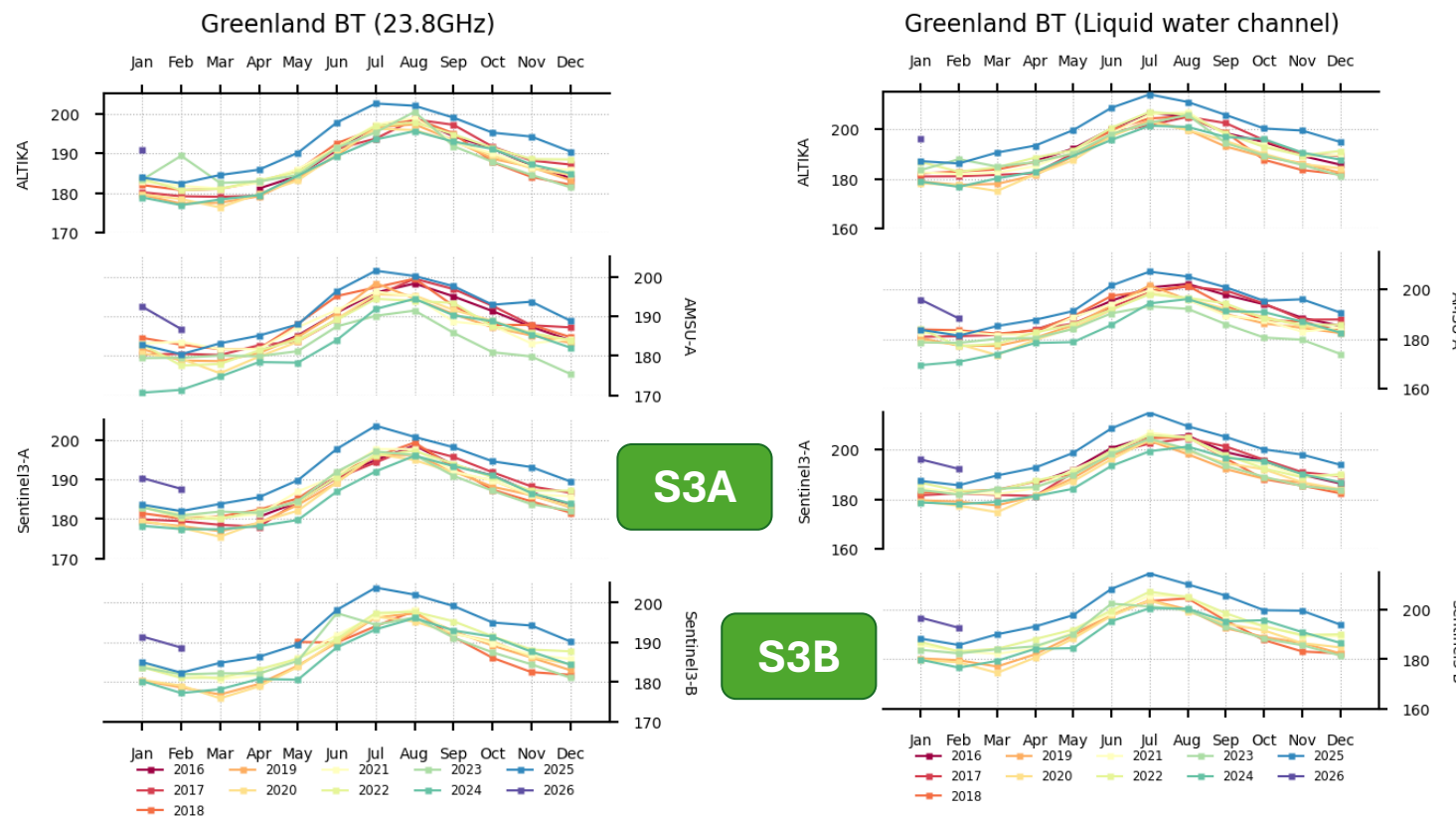
- Coldest ocean
- Amazon forest
- Antarctic
- Greenland (Shown here)

- Multi mission diagnosis: ALTIKA, Metop-B, S3A/B (+ S6, Jason-3)

- Piled years monitoring for better stability analysis

- S3A and S3B show variations over the years over Greenland (BT rise esp. in 2025/2026). **Coherent behavior with over missions.**

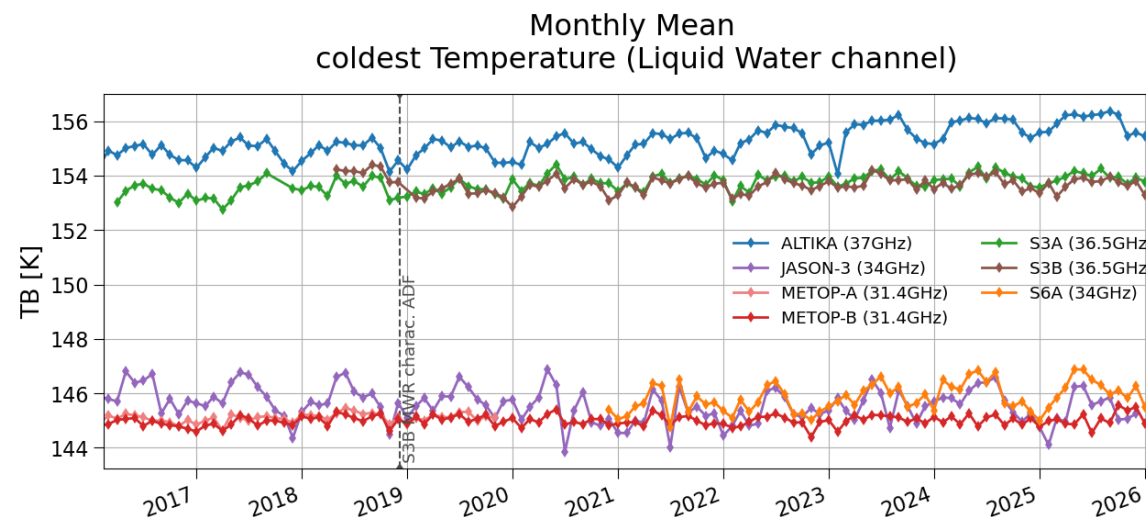
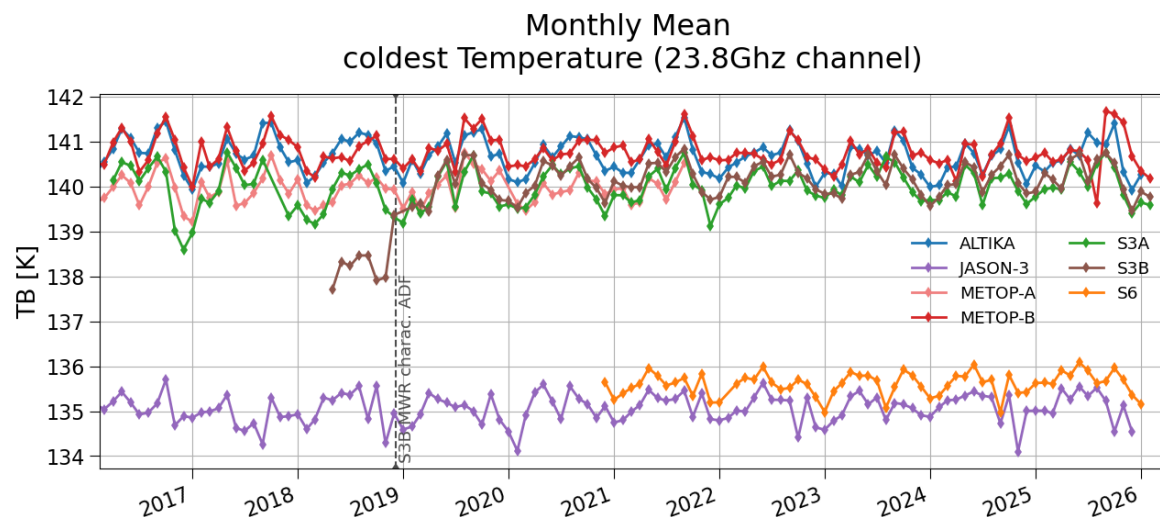
- => **Geophysical explanation**



Monthly mean brightness temperatures over Greenland for 23.8GHz channel (right) and liquid water channel (left). Studied satellites are SARAL/ALTIKA, AMSU-A onboard Metop-B, S3A and S3B. Each color denotes a different year.

○ Vicarious calibrations

- **Coldest ocean:** S3A/B very consistent with other altimetry and imagery missions
- Residuals wrt to IFS model show **no significant drifts of brightness temperatures ($< 0.03\text{K/yr}$, $< 0.06\text{K/yr}$)**



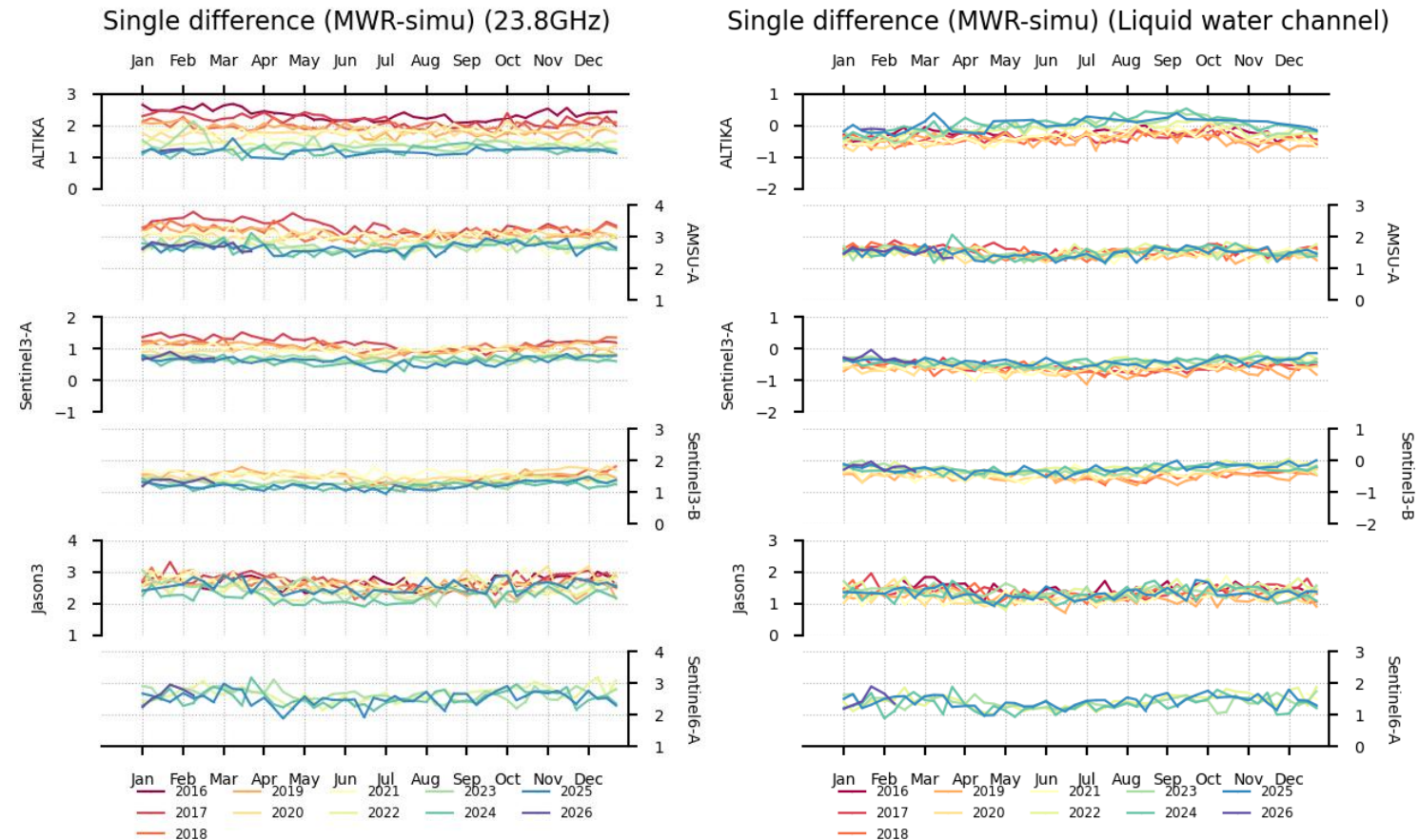
Trend (K/yr)	AltiKa	AMSU	S3A	S3B	J3	S6A
23.8GHz	-0.01 (-0.02/-0.00)	-0.00 (-0.01/0.01)	0.03 (0.01/0.05)	0.03 (0.01/0.04)	0.02 (0.00/0.03)	0.03 (-0.03/0.09)

Trend (K/yr)	AltiKa	AMSU	S3A	S3B	J3	S6A
Liq. Water Chan	0.16 (0.15/0.18)	0.00 (-0.00/0.01)	0.06 (0.05/0.08)	0.04 (0.02/0.06)	-0.05 (-0.07/-0.03)	0.26 (0.05/0.48)

Coldest ocean brightness temperatures (monthly mean of statistical selection) for 23.8GHz channel (top right) and liquid water channel (top left). Studied satellites are SARAL/ALTIKA, Metop-A, Metop-B, Jason-3, S6A, S3A and S3B. Trends of the residuals wrt the IFS model indicated

○ Simulations

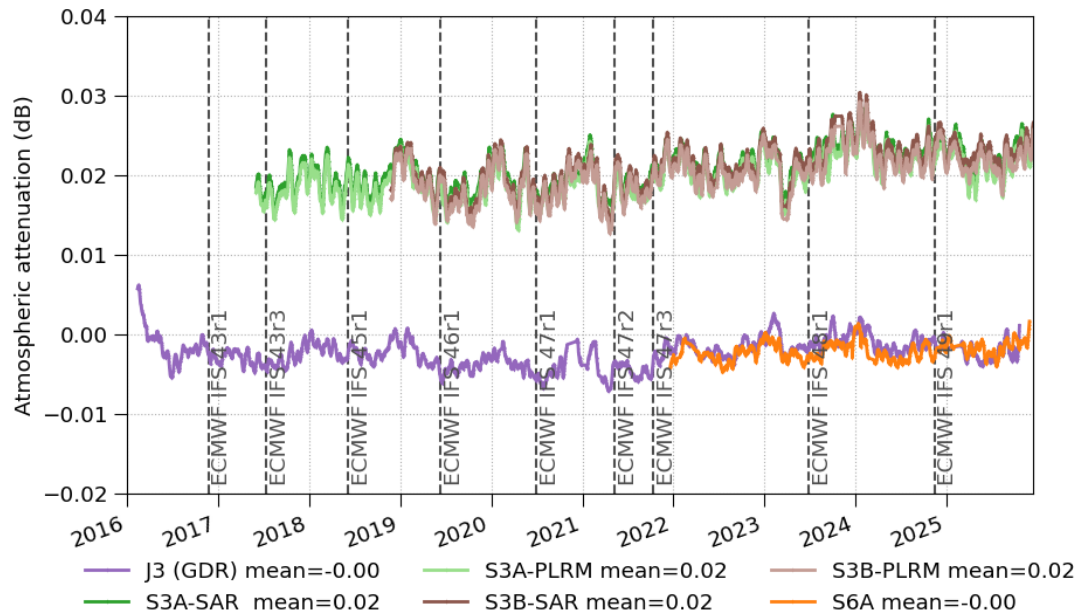
- Based on IFS + UCL radiative transfer model
- Multi-mission
- Sentinel-3 brightness temperatures **show smallest differences to simulations** (<2K for 23.8GHz; <1K for 36.5GHz)
- Slight drifts visible along lifetime but coherent across missions



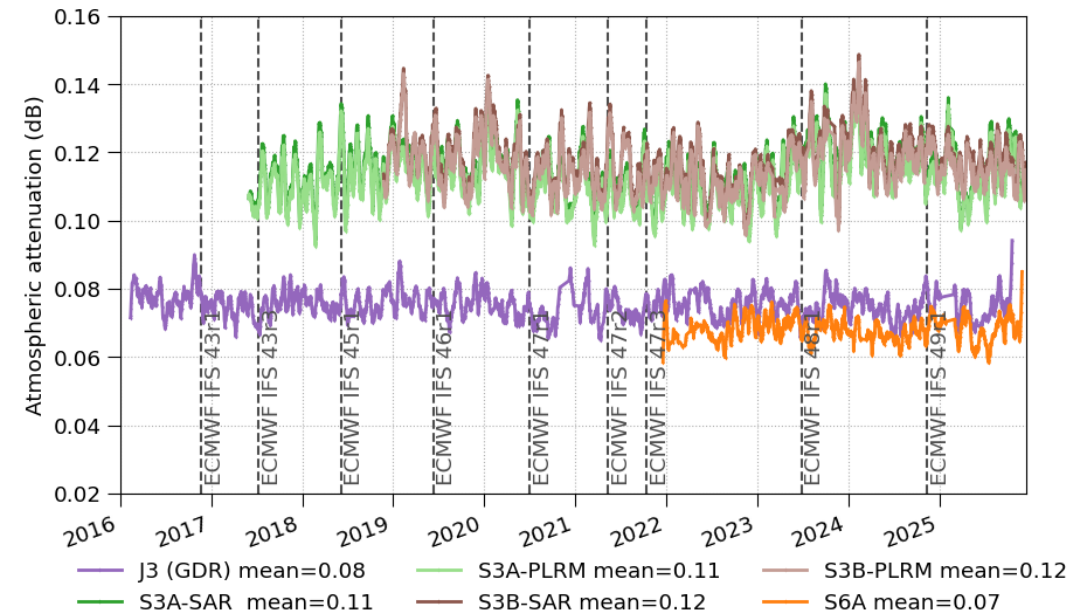
Brightness temperatures differences between MWR and simulations, for 23.8GHz channel (right) and liquid water channel (left). Studied satellites are SARAL/ALTIKA, AMSU-A onboard Metop-B, S3A and S3B. Each color denotes a different year.

- Water Vapour, Cloud Liquid Water Content, Atmospheric Attenuation, Wet Tropospheric Correction
- **Atmospheric Attenuation**
 - Residuals wrt to IFS model show **very consistent behavior across S3 satellites** and modes (SAR/PLRM)
 - Mean/day $\sim 0.02\text{dB}$

Mean / day - Difference of atmospheric attenuation (MWR - model)



Std / day - Difference of atmospheric attenuation (MWR - model)

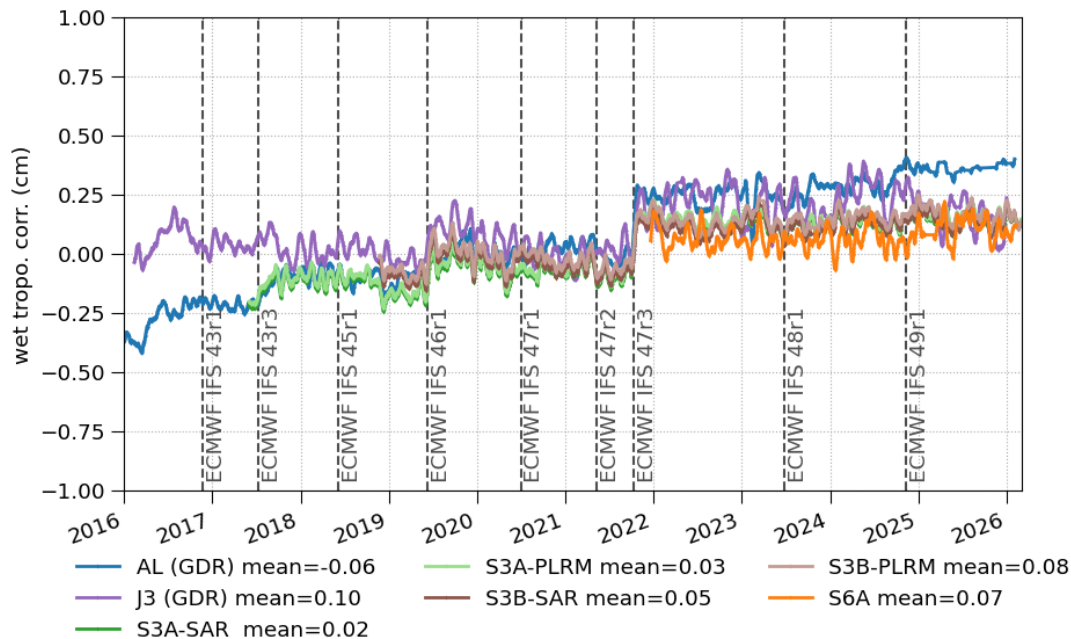


Timeseries of mean per day (left) and std per day (right) of the atmospheric attenuation residuals between various radiometers and IFS model

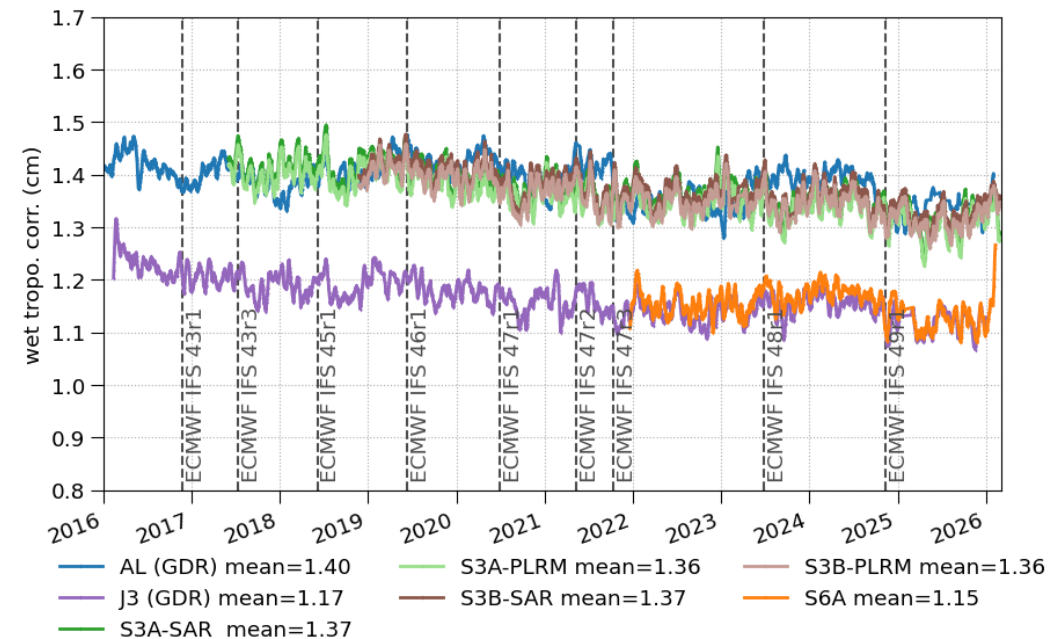
○ Wet Tropospheric Correction

- Residuals wrt to IFS model show **very consistent behavior across S3 satellites** and modes (SAR/PLRM)
- Significant variations of mean differences **due to updates of IFS model**, especially visible in Oct 2021

Mean / day - Difference of wet tropo. corr. (MWR - model)



Std / day - Difference of wet tropo. corr. (MWR - model)



Timeseries of mean per day (left) and std per day (right) of the wet tropospheric residuals between various radiometers and IFS model

Influence of model on WTC differences



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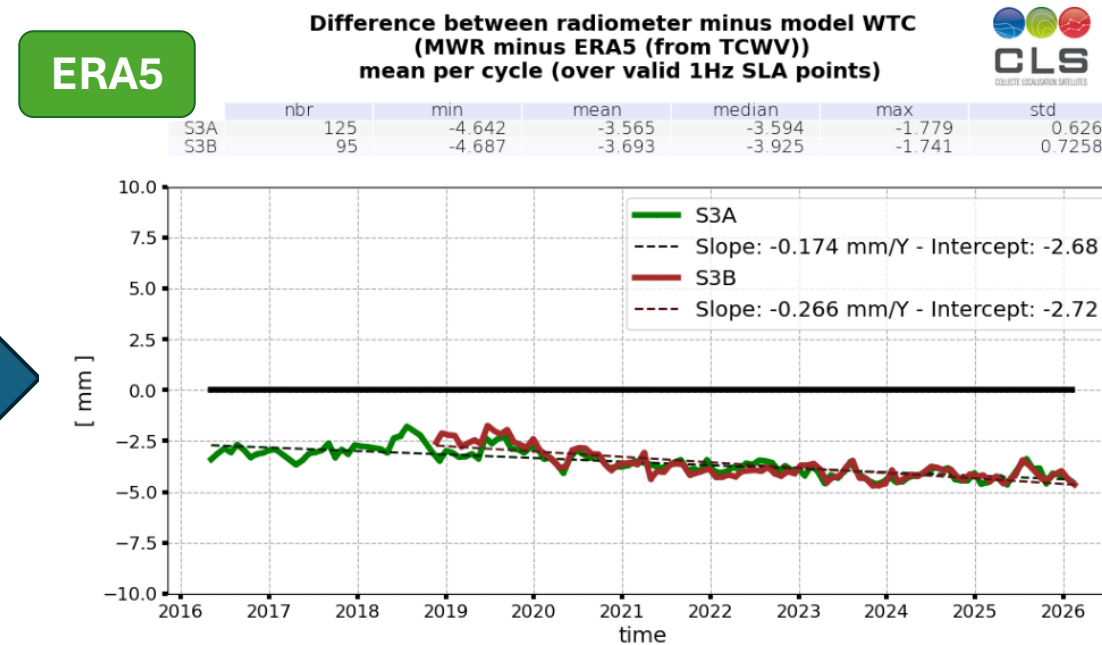
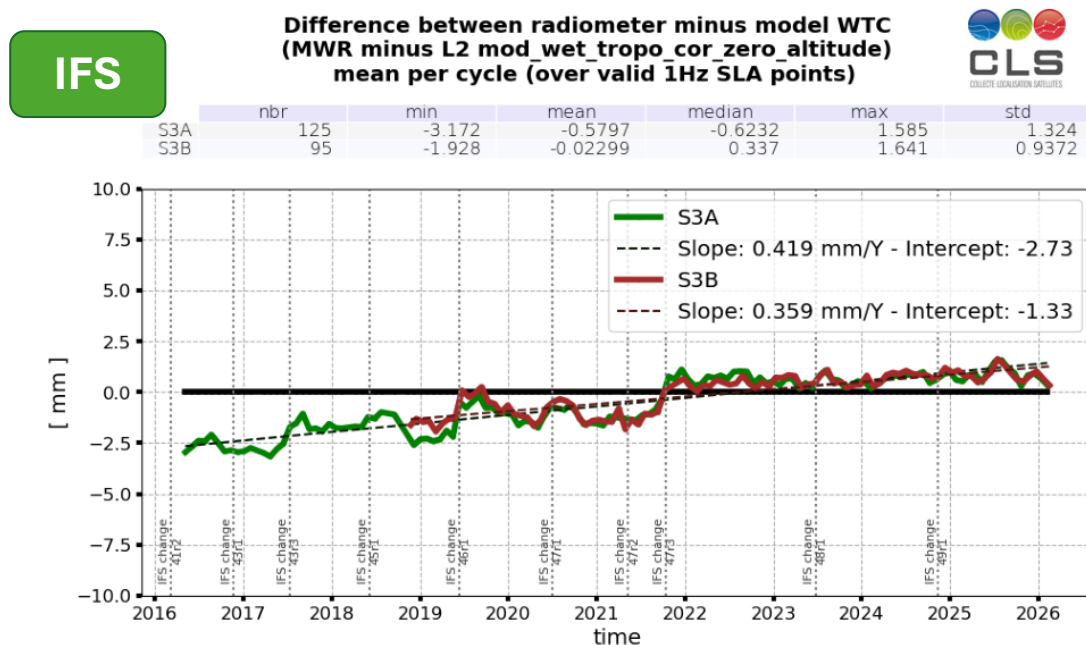
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Wet Tropospheric Correction

- Long-term WTC stability is evaluated through comparison with models
- L2 WTC (zero altitude) impacted by IFS version updates
- Reduction of MWR WTC drift estimation related to models using ERA5 data deduced solution:

-58,5% for S3A and **-25,9% for S3B**



Timeseries of mean per day (left) and std per day (right) of the wet tropospheric residuals between various radiometers and IFS model



○ **Sentinel-3 radiometer monitoring**

- Various diagnostics are made to monitor the health and the performance of the radiometer onboard Sentinel-3A/B.
- Analysis focused on ocean surfaces and geophysical variables.
- **Status of the instrument is good** after resp. 10 and 8 years.
- **Geophysical variables are stable and coherent with other satellites.**
- Comparisons with IFS model impacted by updates of the latter for WTC.
- Reassuring insight on what can be expected on Sentinel-3C
- Perspectives:
 - **Upcoming S3C commissioning** phase with tandem phase with S3A and S3B will be of great use to **intercalibrate** the satellites

Thank you for your attention !