Calibration and reprocessing of the ASCAT-A mission

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Agenda

Reprocessing of ASCAT

What are the steps? Where are we now?

The reprocessed backscatter (ASCAT-A)

Some results; what has changed?

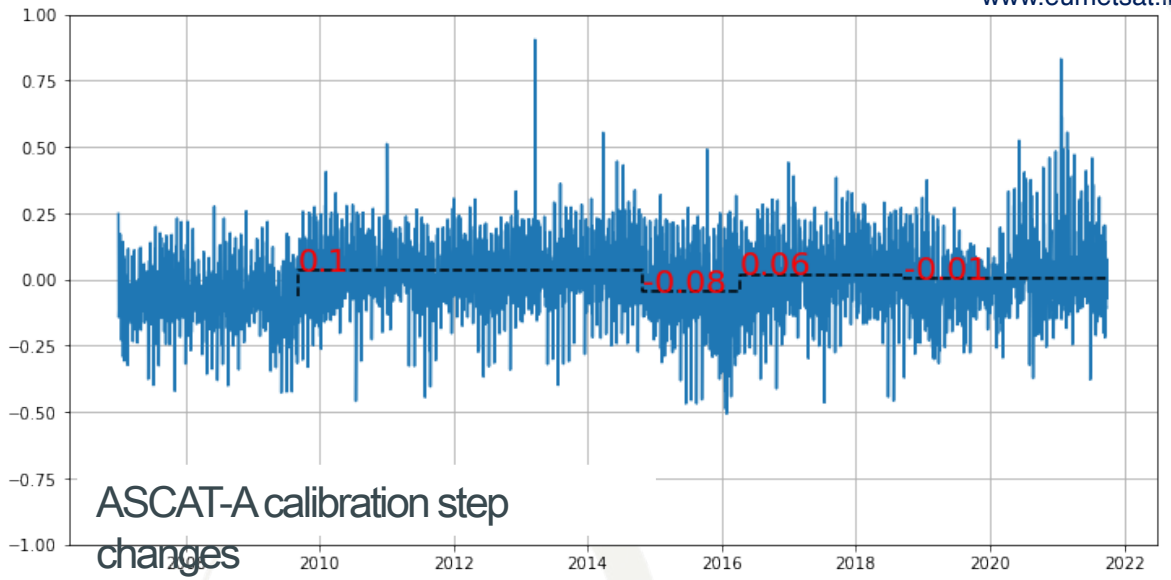
Reprocessing of ASCAT-B and -C

How does it look like? An outlook on the upcoming months

ASCAT L1 reprocessing walkthrough

1. Analyse the time series to identify changes in the calibration: $\gamma_0 = \sigma_0 / cos(\theta)$
2. Investigate the calibration changes (e.g. to distinguish between calibration and orbit changes)
3. Develop / refine the calibration baseline and a correction for the changes
4. Re-process the data
5. Analyse the results, go back to step 3 if needed
6. Quality check, remove corrupted data (e.g. affected by instrument anomalies)
7. Provide test data to selected core users
8. Finalise validation report
9. Release

For ASCAT-A here we are

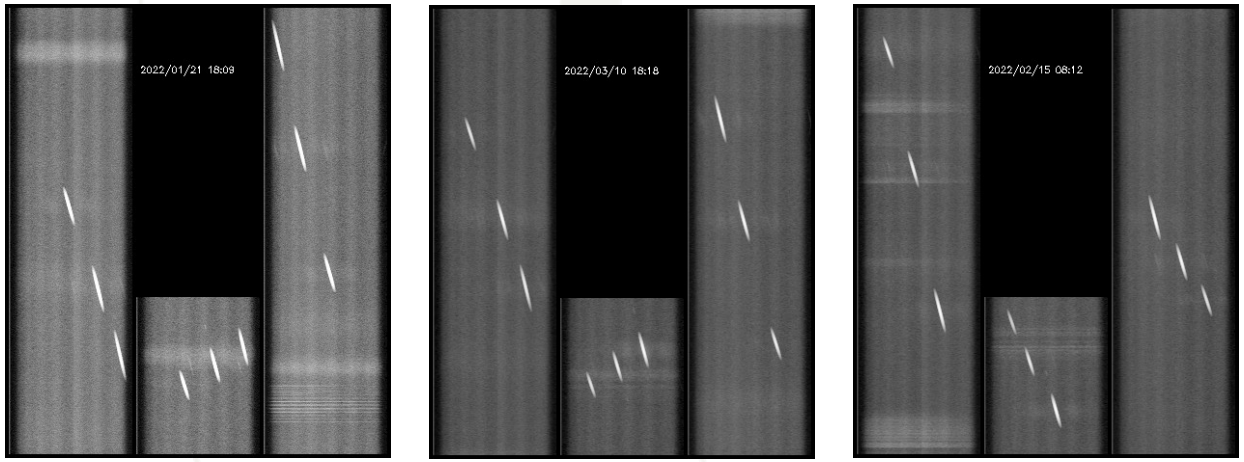


ASCAT-A calibration step changes

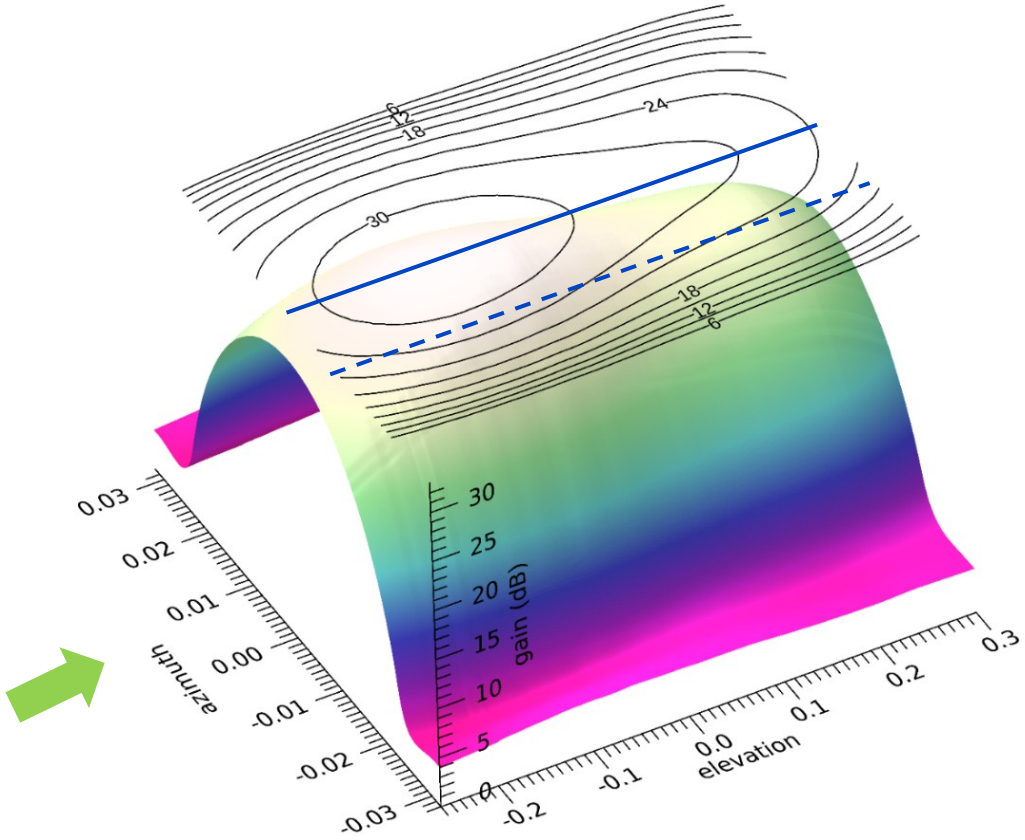
Absolute calibration

Direct measurement of the in-flight antenna gain pattern

- Use transponders which have a well-defined and very accurate radar cross-section
- The antenna gain pattern is sampled over the swath during repeated passes
- A full orbital cycle provides the samples required to reconstruct the full pattern



Examples: ASCAT calibration mode L0 with transponder signals

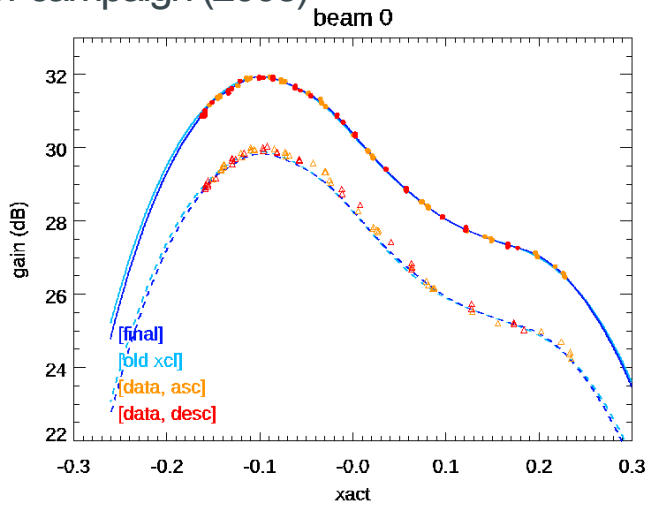


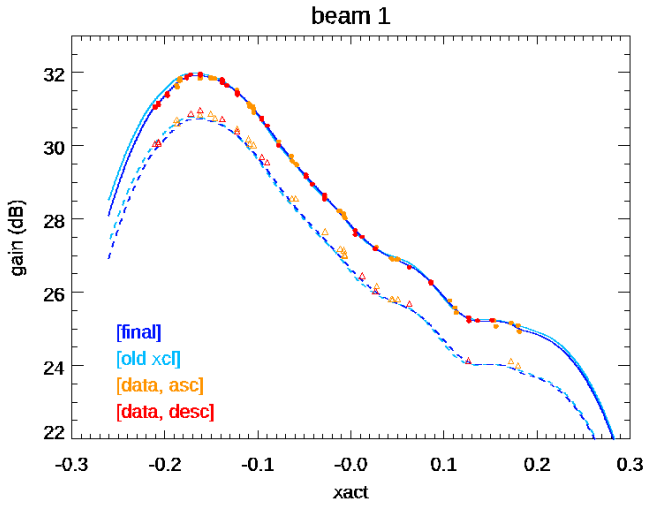
Absolute calibration

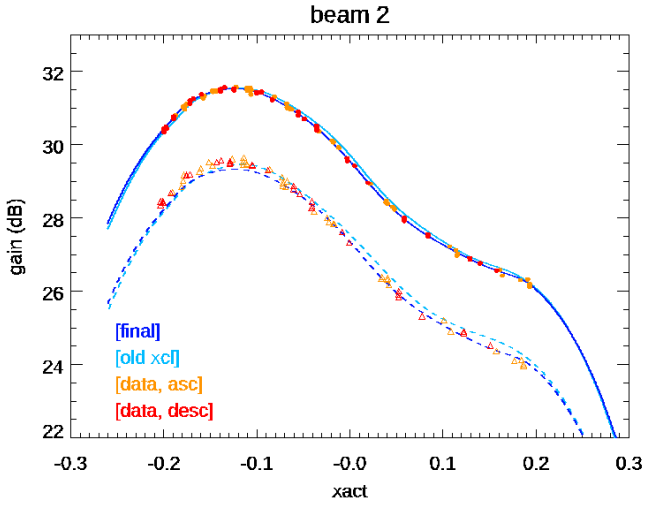
Re-visited all available transponder campaigns, re-processed transponder data with a consistent processing baseline

Example: A1 campaign (2008)

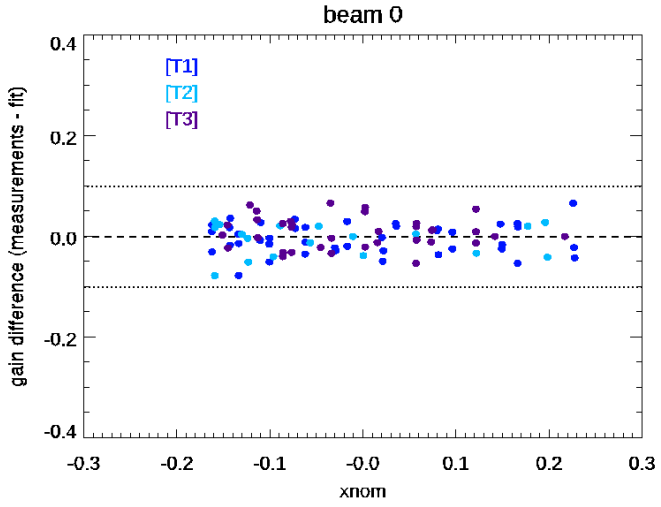
Cuts through the gain

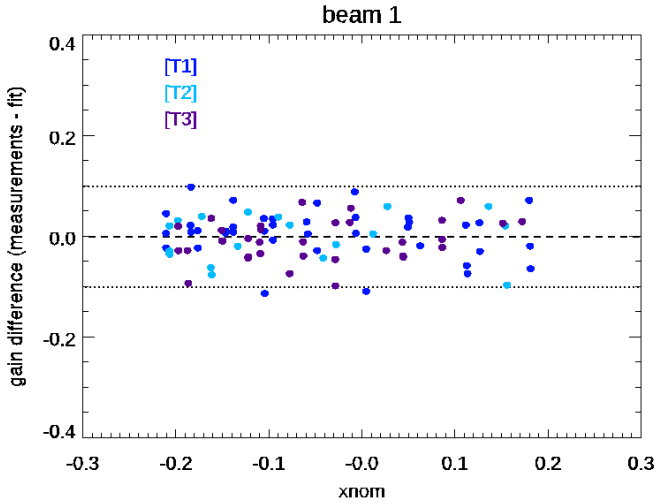


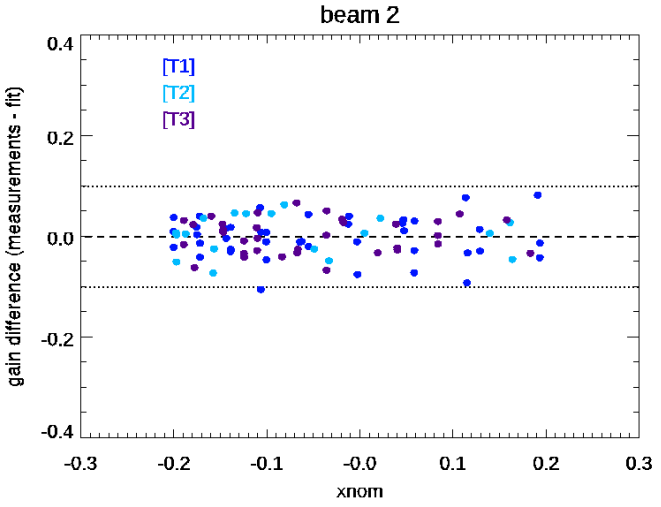




Measurement residuals:





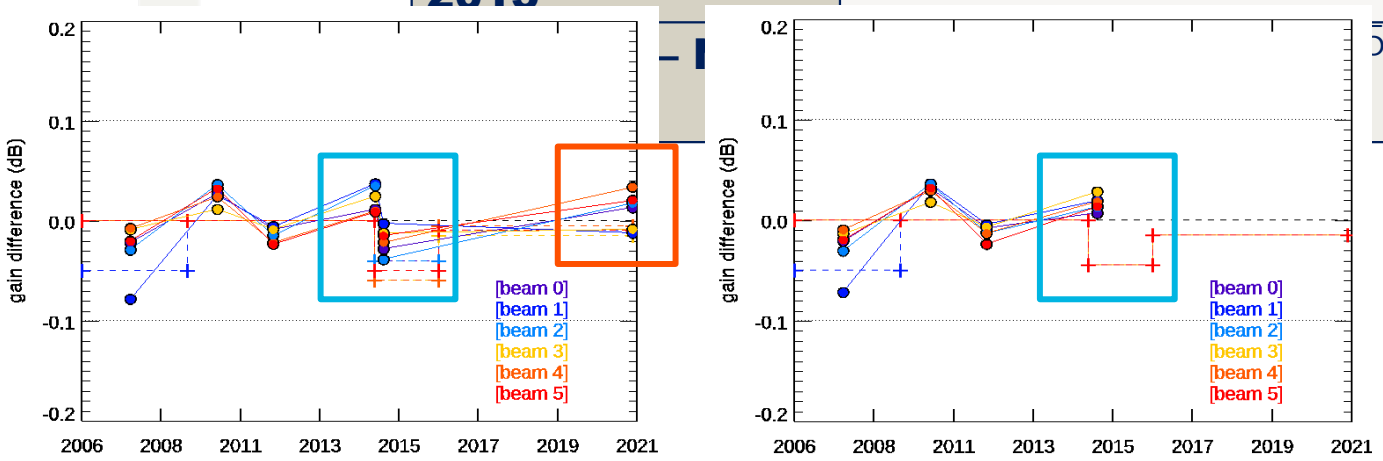


Calibration Campaigns

- Calibration campaigns analysed
- Reference gain pattern generated and corrected for step changes

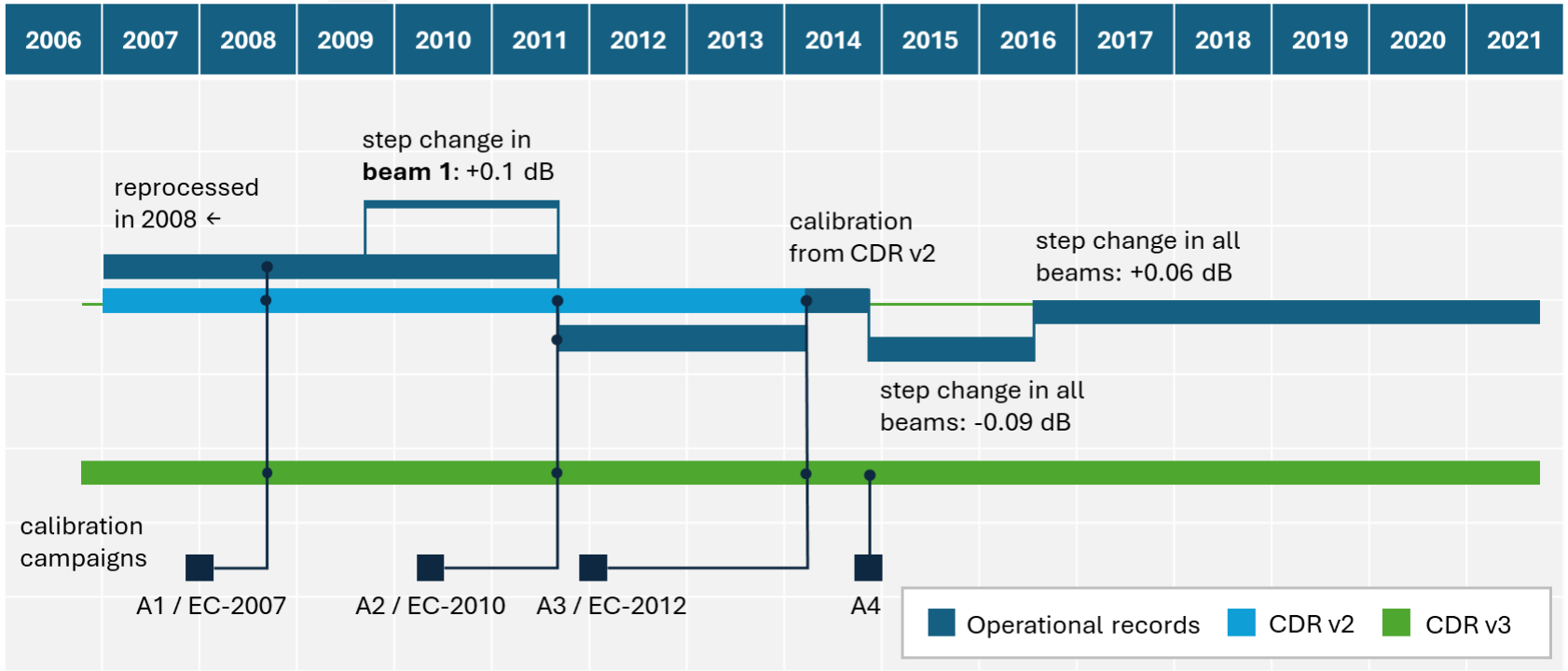
Date	Campaign
Nov 2007 – Feb 2008	ASCAT-A commissioning (A1) (EC 2007)
Mar 2010 – Jul 2010	2nd calibration campaign (A2) (EC 2010)
Oct 2011 – Jan 2012	3rd calibration campaign (A3) (EC 2012)
Sep 2014 – Jan 2015	4th calibration campaign (A4)

A B



Step change correction

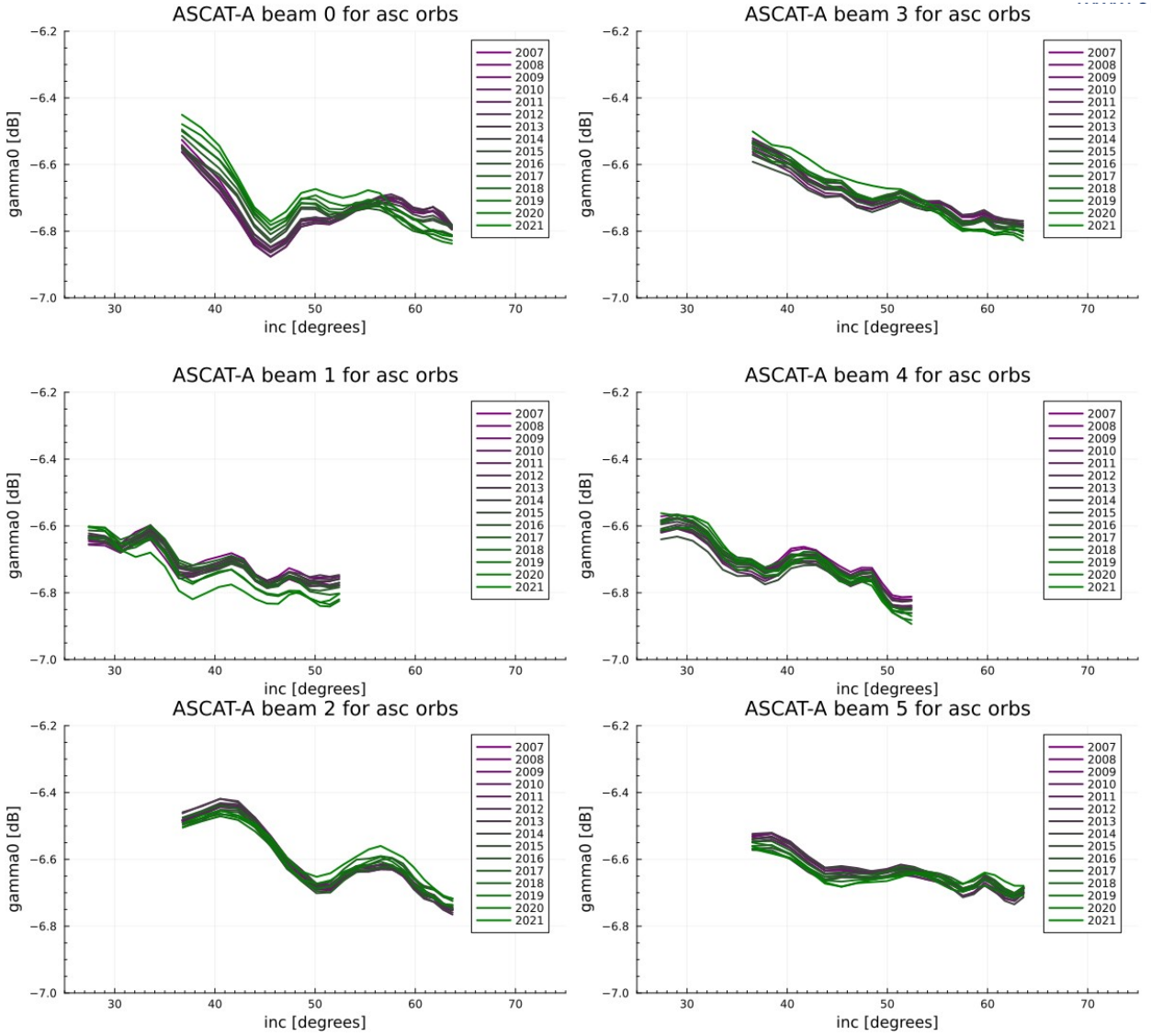
- Reprocessing of the full ASCAT-A mission to provide a consistent time series of the full mission duration
- Data record to be released now-ish…



ASCAT-A calibration changes and external calibration campaigns

Some results

- Reprocessed ASCAT-A mean annual γ_0 in each beam as a function of incidence angle over the Amazon rainforest →
- Effects of the beam-0 oscillation anomaly in 2014 have been compensated by the A4 calibration campaign (remaining residuals are within the measurement accuracy)
- Apparent outliers towards the mission end are due to different sampling (Metop-A LTAN drift)



Quality control

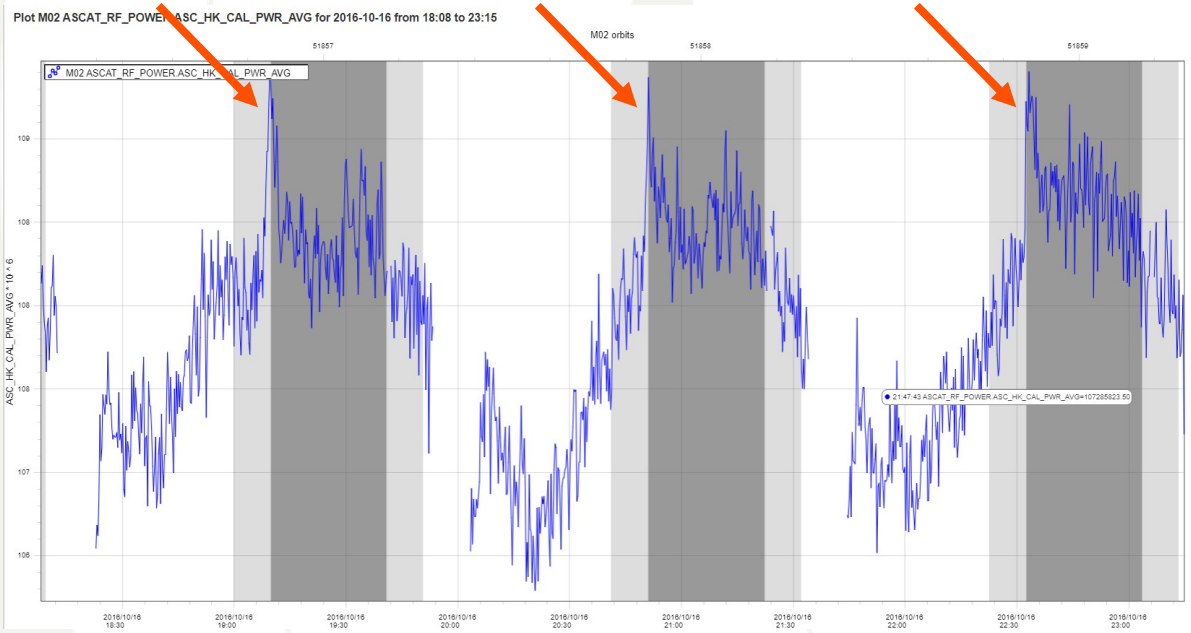
Investigate impact of

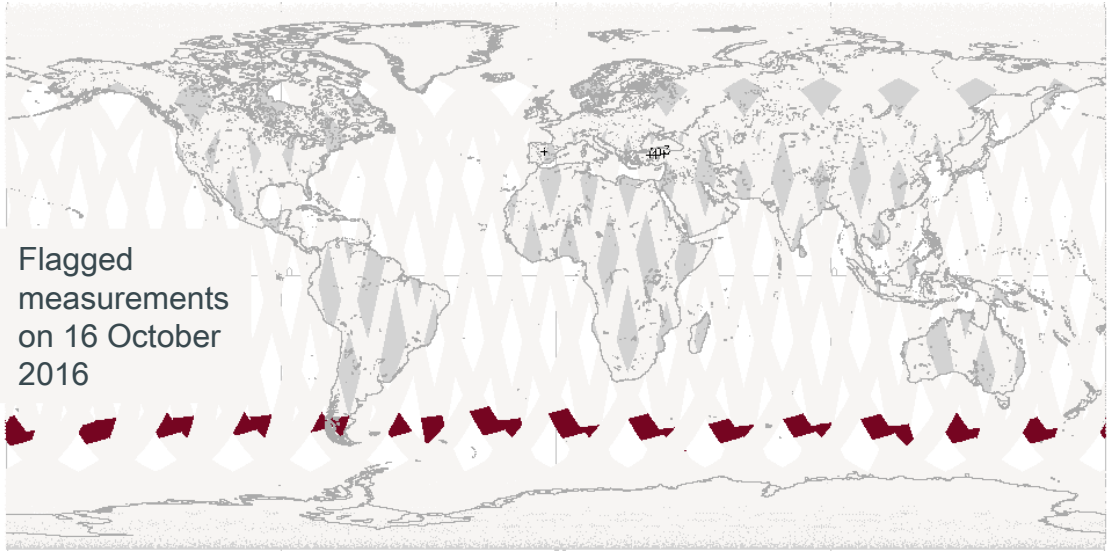
- Instrument anomalies, gaps
- Level-0 problems
- Manoeuvres
- Technology tests (end of life)

… and assess the impact on the data (and whether it's correctly flagged)

Surprises

- Flag for the power gain product is set when the PGP change in the L1A data exceeds a certain threshold
- Happens occasionally, will set the summary data quality flag (F_USABLE) to 1
- But there is a pattern here →

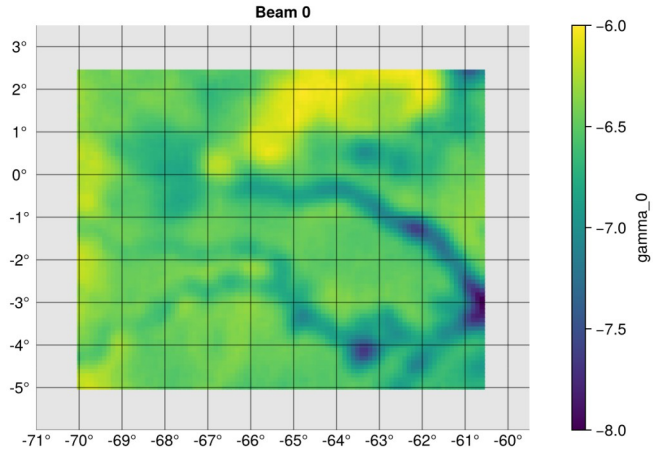




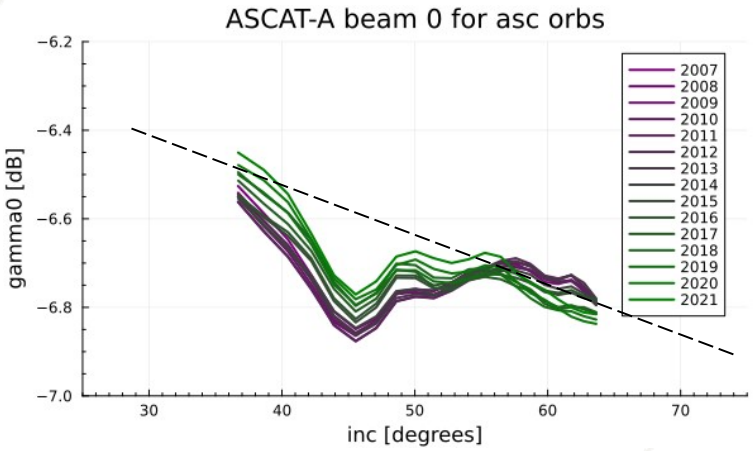
- Instrument telemetry tells us that the jump always happens at the transition into the eclipse
- Behaviour is co-incident with a small anomaly in one of the service module batteries, which recovered after some time

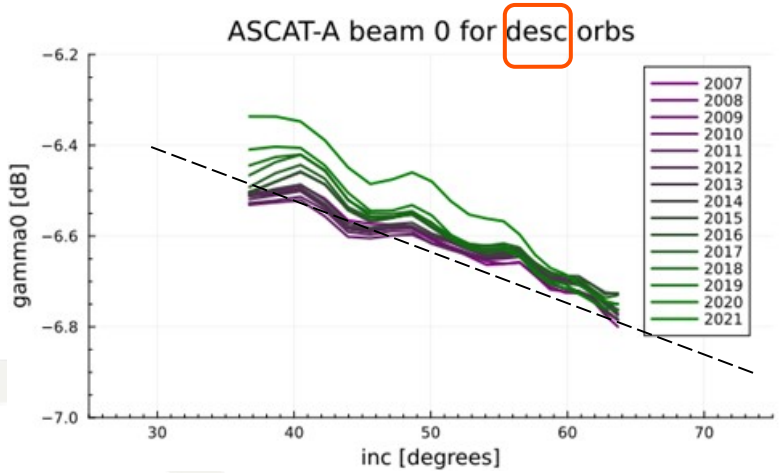
Surprises

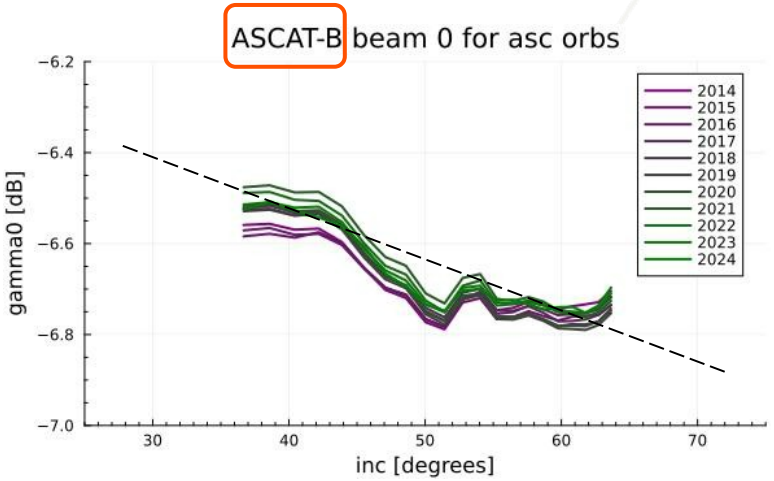
- Over the rainforest, one would expect an approximately linear behaviour over the incidence angle range
- But γ_0 across the swath looks like this →
- Feature is present in all ASCAT-A data (old release and operational data)
  - Residual geophysical signal from the (inhomogeneous) rainforest?



ASCAT "default" rainforest box







→ Not likely! This is observed in other regions as well (thanks to feedback from TU Wien colleagues)

→ Must be an instrument-specific feature. But why only in ascending orbits?

→ Can't be a transponder problem

→ Uncorrected in the current release, but needs further investigation

Summary

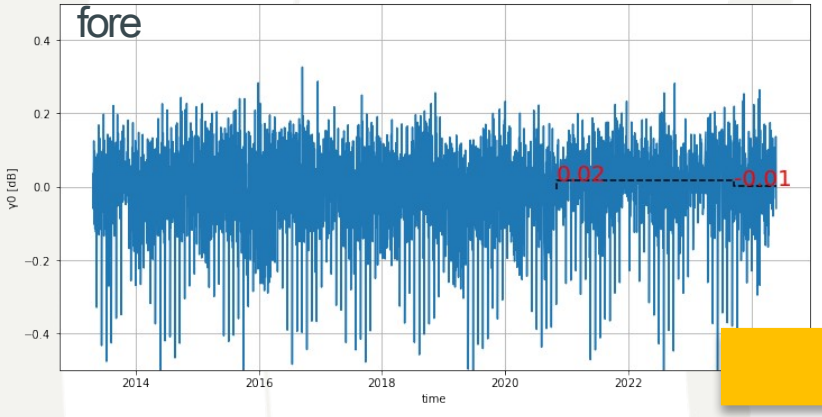
- Finished reprocessing ASCAT-A full time series: Consistent time series processed with a common calibration baseline → to be released soon!
- Some issues remain but could not be addressed within the time constraints for this release
- Many more details are covered by the validation report

Your feedback is very important!

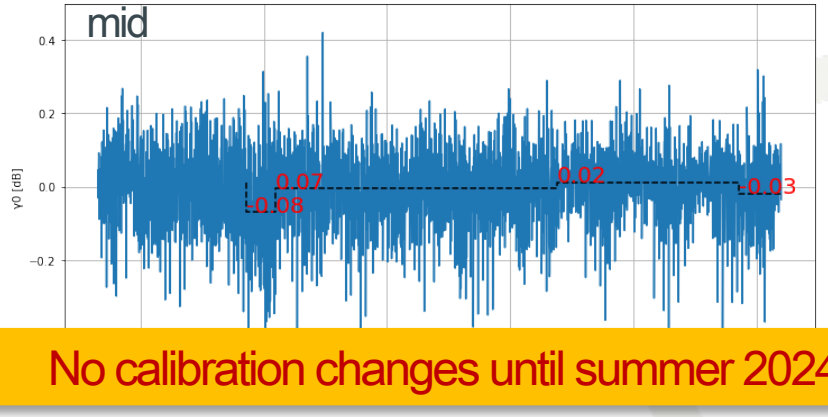
ASCAT-B

- Step change detection based on rainforest
- Seasonality is removed by subtracting the monthly mean γ_0 value from each year month
- Severe drought between September 2015 and March 2016, consistently observed by ASCAT-A and -B

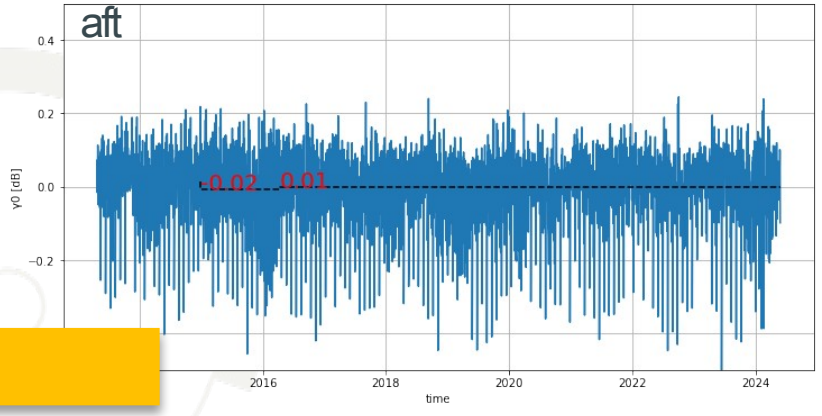
Beam 0: left fore



Beam 1: left mid

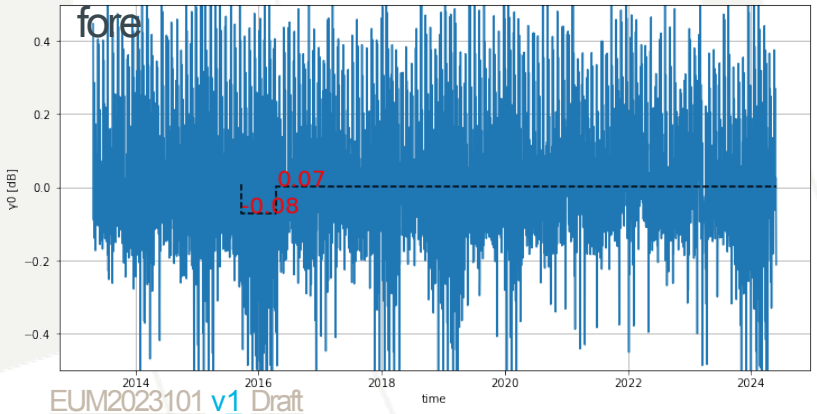


Beam 2: left aft

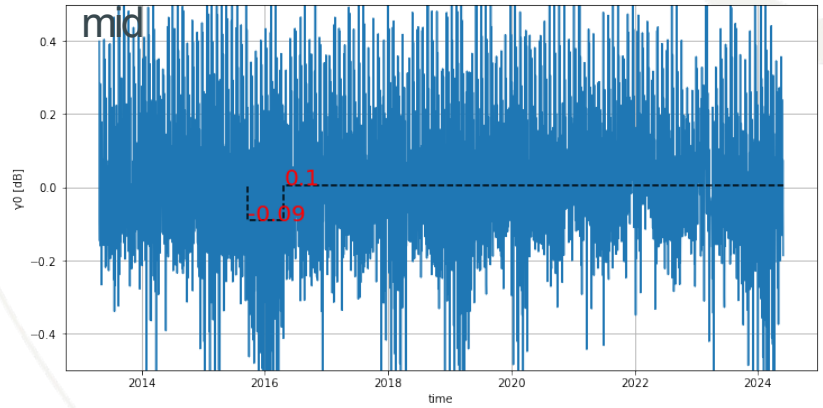


No calibration changes until summer 2024

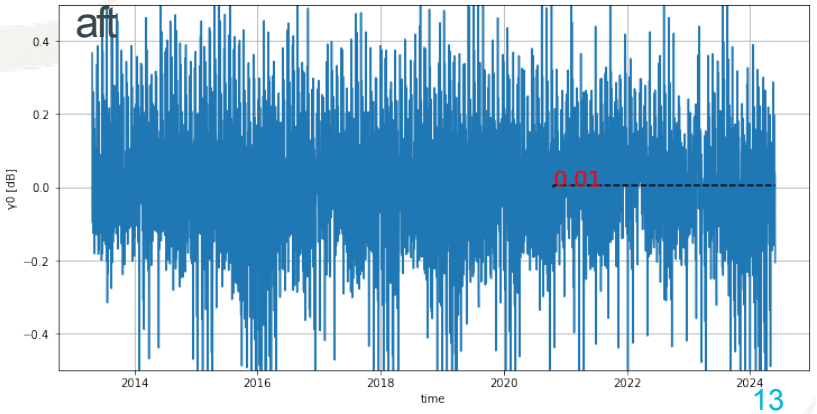
Beam 3: right fore



Beam 4: right mid



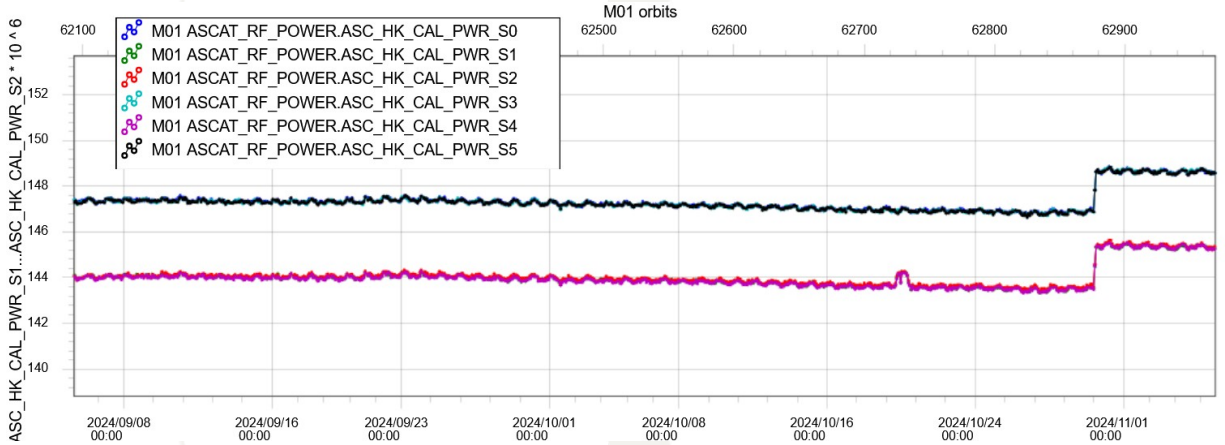
Beam 5: right aft



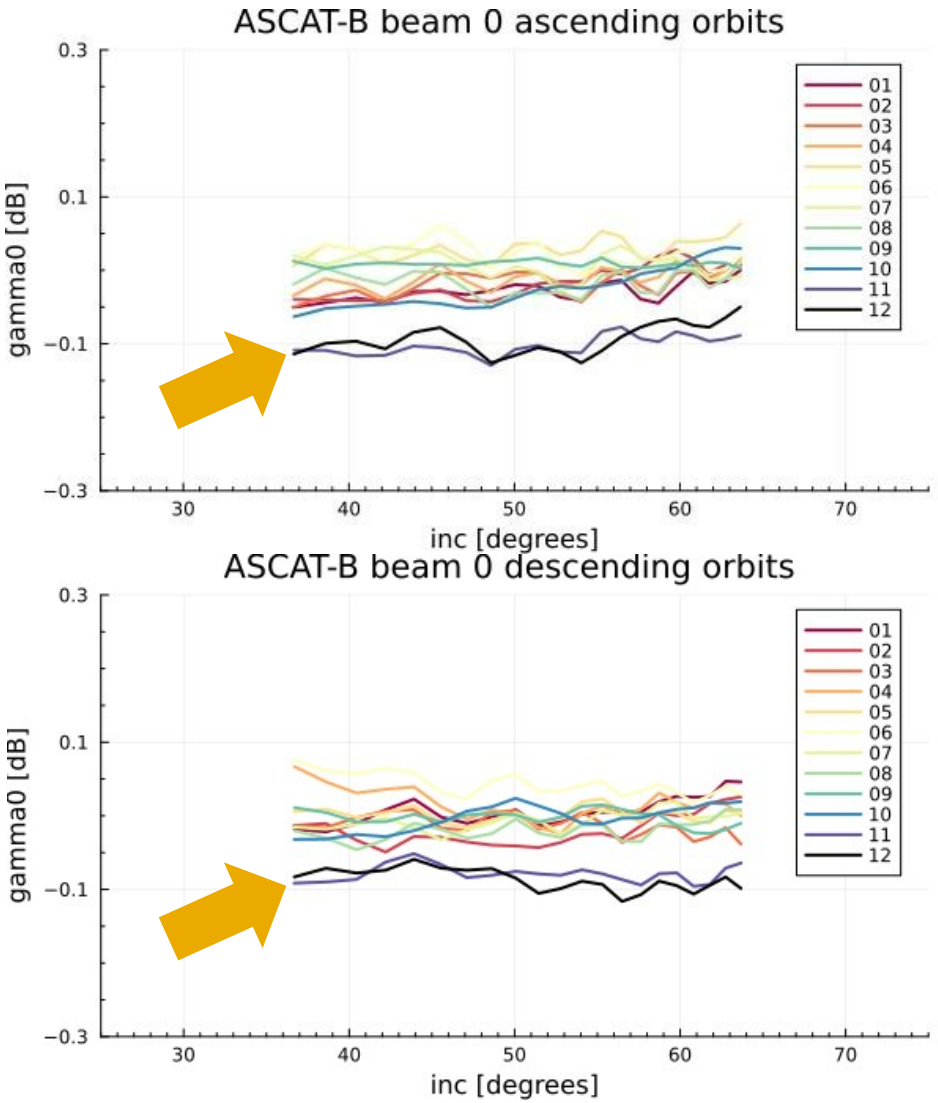
ASCAT-B anomalies after summer 2024

Step change of about -0.1 dB in all beams on ASCAT-B

- This anomaly can be traced back to a step change in the power gain product that occurred on **30th October 2024** at around 12:21 UTC.

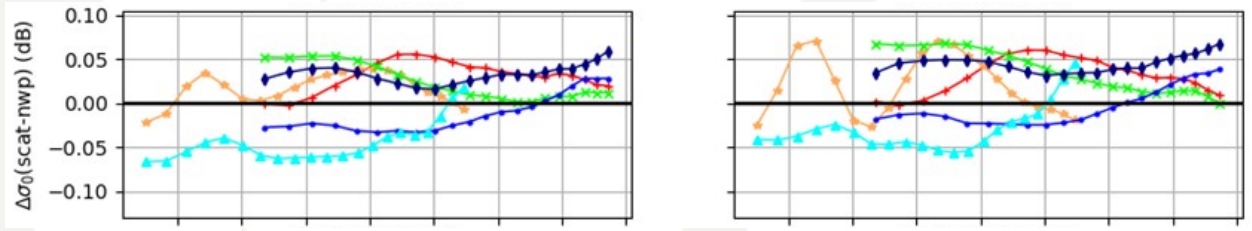


Magnitude of the complex calibration powers for the period 2024-09-05 to 2024-11-05



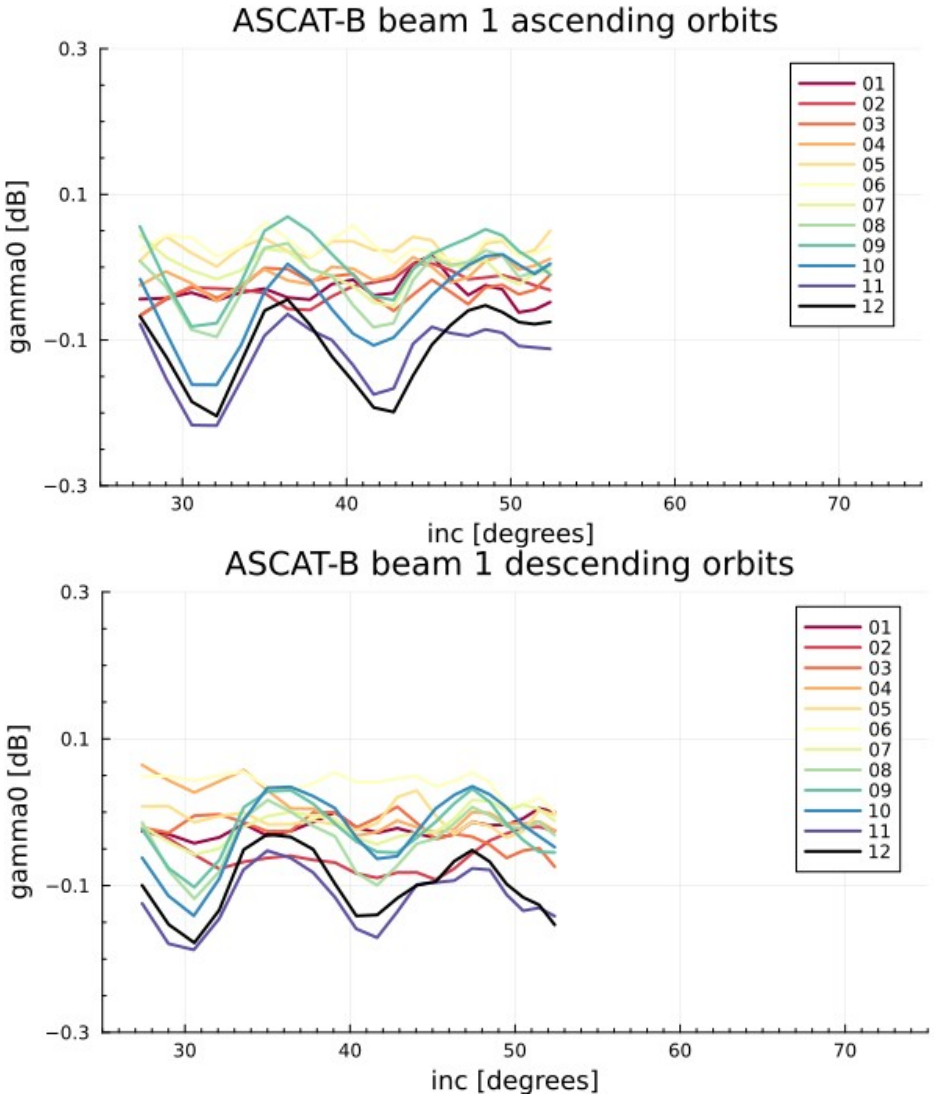
Rainforest: month(2024) – mean_month(2016-2023)

ASCAT-B anomalies after summer 2024



Across-swath oscillation in beam 1

- First observed in mid-July, initially reported by KNMI ↑
- The oscillation could not be linked back to any change in the instrument or platform telemetry, the root cause is currently unknown.
- Similar to the oscillation on ASCAT-A, beam 0?
- Appears to be static & persistent



Rainforest: month(2024) – mean_month(2016-2023)

Work in progress

- Cut-off date for this release is summer 2024 (before the anomalies on ASCAT-B)
  - Consistent with the operational data
  - Includes LCR
- Anomalies on ASCAT-B are under investigation and will be corrected
- Will continue reprocessing ASCAT-B and -C now (work in progress, to be finished before SCA launch)

Thank you!

Questions are welcome.