EUMETSAT

Status of EUMETSAT scatterometer activities

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IOVWST F2F meeting, Nanjing
30 Nov 2023

Agenda

SCA

Update on the mission status, planned activities

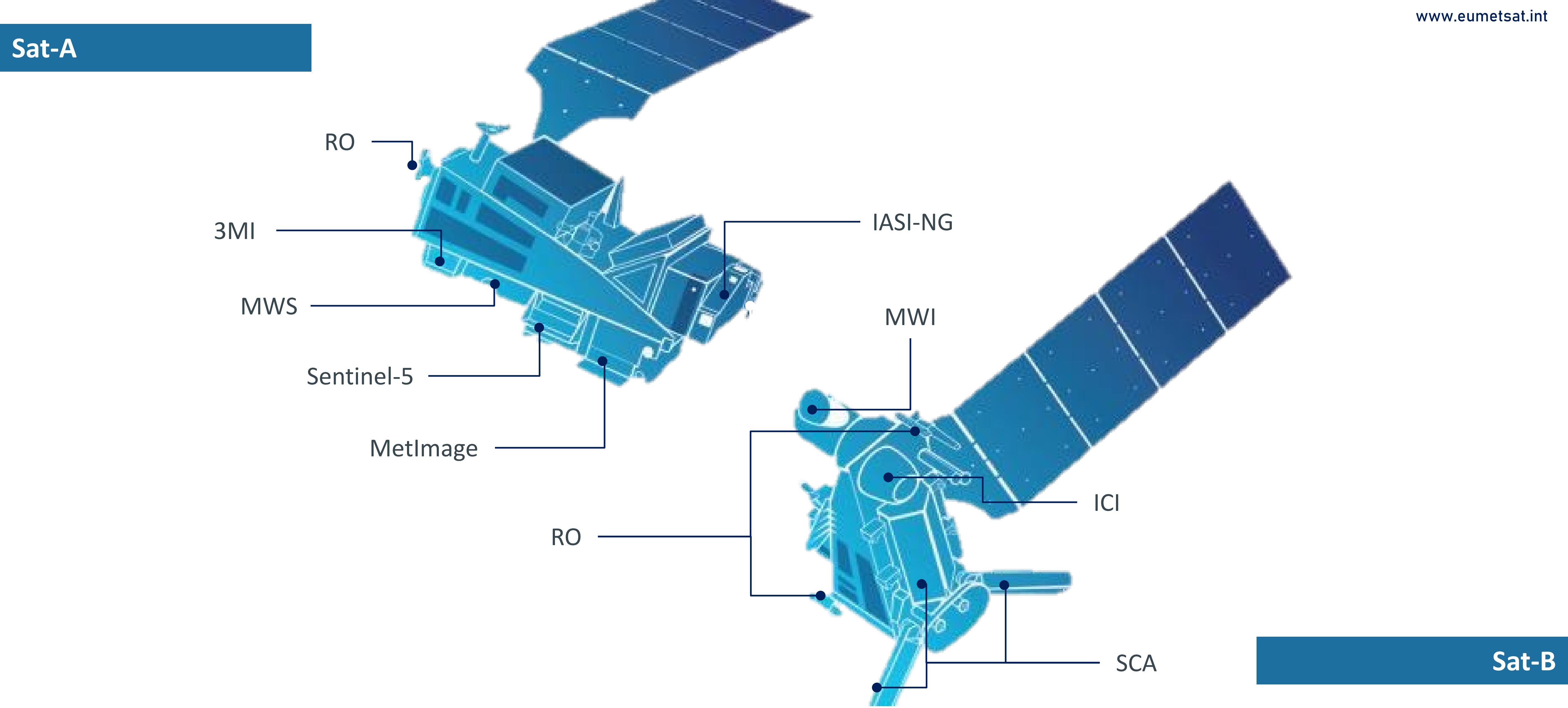
ASCAT

Instrument status and current work

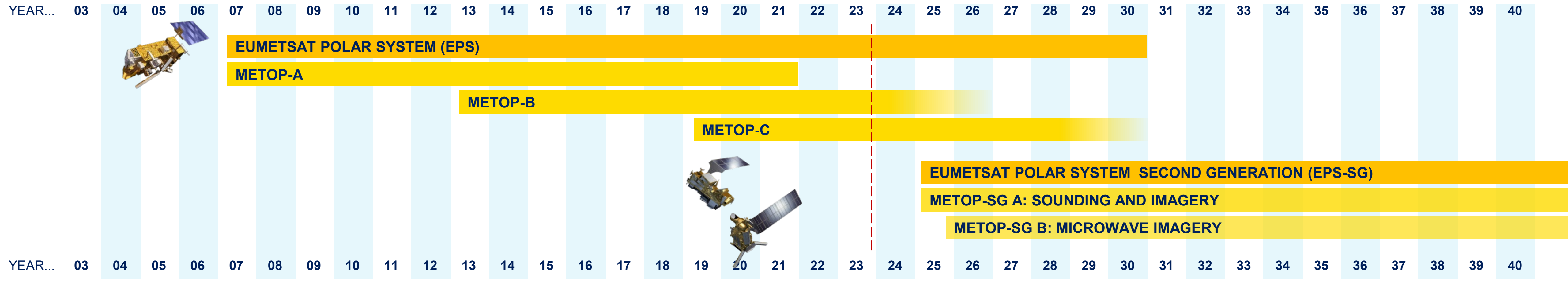
EPS-SG Objectives

- Primary mission: further improve observational inputs to Numerical Weather Prediction models.
- Continuation and enhancement of service from mid morning polar orbit in 2025 – 2046 timeframe
- Significant contributions to other real time applications: Nowcasting at high latitudes; Marine meteorology and operational oceanography; Operational hydrology; Air quality monitoring.
- Climate monitoring: expand by 20+ years the climate data records initiated in 2006 with EPS (first generation).

EPS-SG: Metop-SG satellites and instruments



EUMETSAT scatterometer missions



Metop

- ASCAT-A (19 October 2006 – 15 November 2021)
- ASCAT-B (launched 17 September 2012)
- ASCAT-C (launched 07 November 2018)

Metop-SG

- Scatterometer instruments (SCA) are on the SAT-B series
- SG-A1 launch planned for Q1/2025
- SG-B1 launch planned for Q4/2025

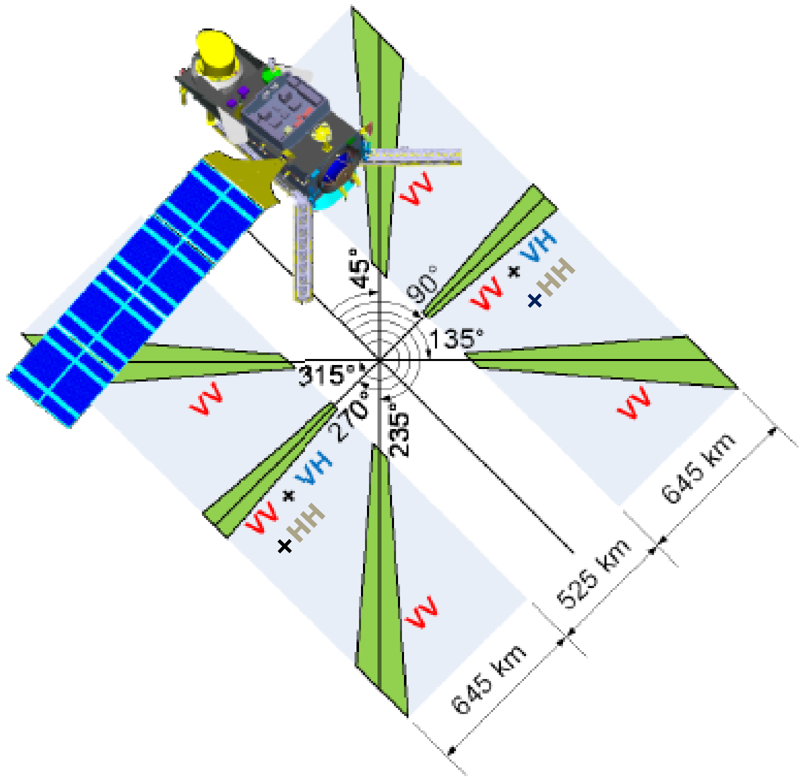
Scatterometer instruments

First Generation – ASCAT

- Frequency 5.255 GHz (C-band)
- Swath width 550 km
- Incidence angles
  - 25° to 53° (mid beams)
  - 34° to 65° (side beams)
- Polarisation: VV

Second Generation – SCA

- Frequency 5.355 GHz (C-band)
- Swath width ~650 km
- Incidence angles
  - 20° to 53.7° (mid beams)
  - 28.4° to 65° (side beams)
- Polarisations: VV plus HH + HV + VH on mid-beams for improved high winds retrieval



EPS-SG SCA processing chain

EUMETSAT OSI SAF OCEAN AND SEA ICE

EUMETSAT H SAF SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

Level-0
- unprocessed data

Level-1A
- radiometric and spectral corrections and calibration factors
- telemetry

EUMETSAT internal products

Level-1B full resolution (SZF)
- Radiometrically calibrated backscattering coefficients
- Geolocation in the original range location
- Quality flags

Level-1B resampled (SZR)
- Radiometrically calibrated backscattering coefficients
- Resampled on a swath grid
- Quality flags

EUMETSAT HQ

Level-2
- Soil moisture
- Ocean surface wind vectors

Level-3
- Sea ice parameters (ice edge, type, low-resolution drift)

EUMETSAT SAF network: OSI SAF + H SAF

L1 product dissemination

Product ID	Global / Regional	EUMETCAST	Others	Destination (Others)	Archive
SCA-1B-SZF	G		NetCDF-4	KNMI	BUFR NetCDF-4
SCA-1B-SZR	G	BUFR NetCDF-4			BUFR NetCDF-4
SCA-1B-SZF	R		NetCDF-4	KNMI	BUFR NetCDF-4
SCA-1B-SZR	R	BUFR NetCDF-4			BUFR NetCDF-4

Some updates expected.

No dissemination via GTS is currently planned for SCA L1B data.

Timeliness

ASCAT

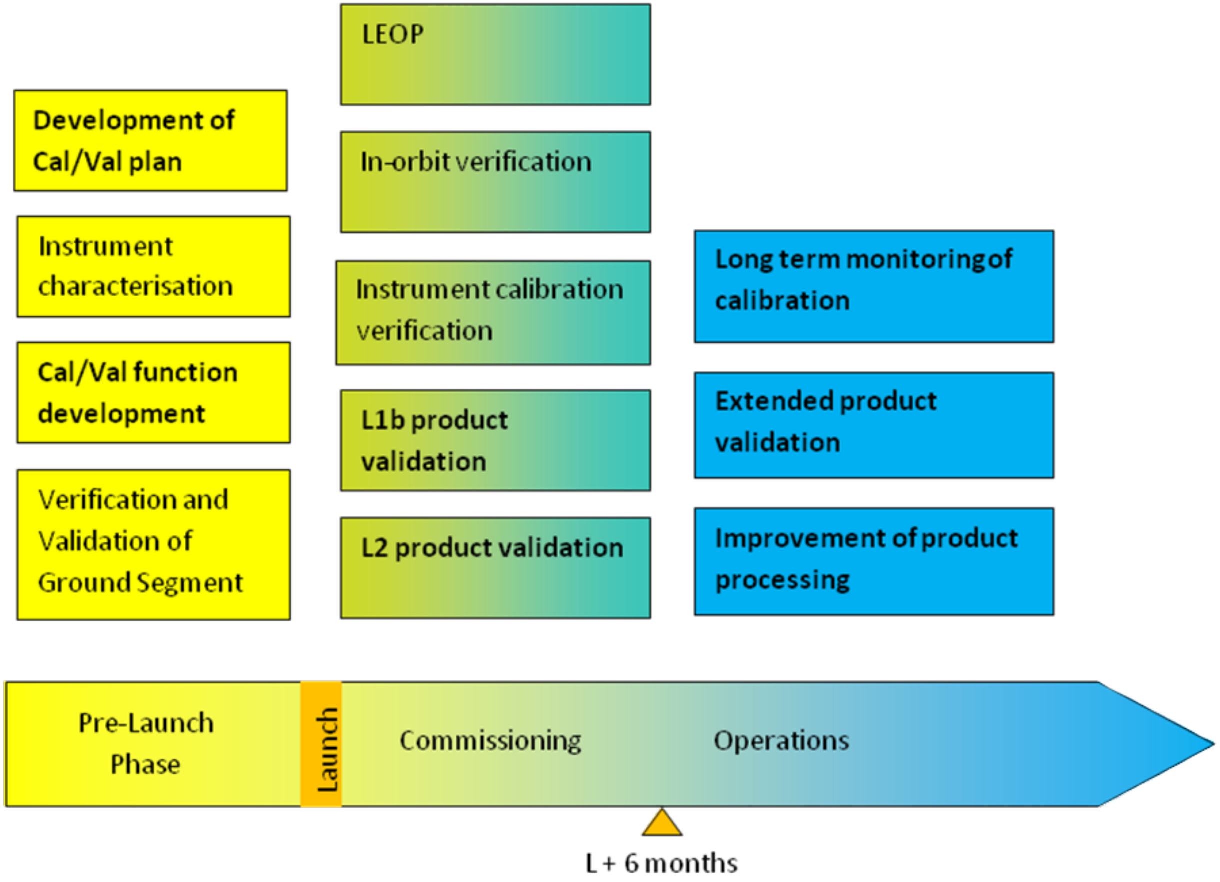
- ASCAT-A 2 hours 15 mins
- ASCAT-B: 90 min
- EARS (regional): 15-30 min

SCA

- Global data: target 70 min
- Regional data: target 30 min

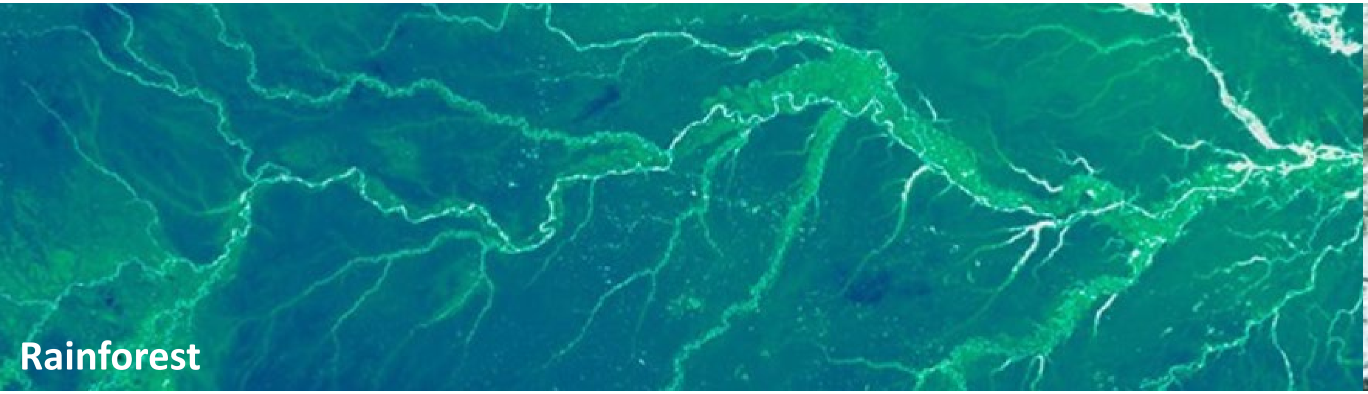
SCA status

- Final pre-launch version of processing specs and test data set delivered in Q3/23
- Working on the cal/val plan, corresponding tools and test plan
- SCA cal/val will follow the approach used for ASCAT:
  - Validation using natural targets to assess long-term stability
  - Ground-based transponders as absolute reference



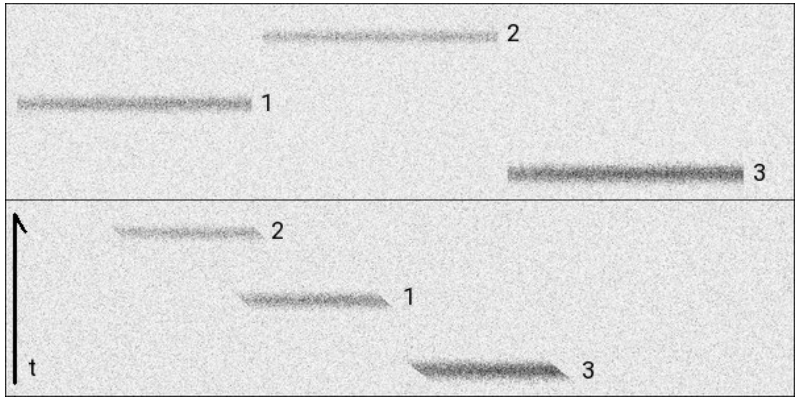
Validation using natural targets

- Selection of natural targets: near-constant σ_0 and well-understood scattering properties over a long time
- Allow relative assessment of long-term σ_0 stability of one / more instruments
- Sudden changes can be observed and analysed
- Several well-established methods exist
- Difficult to separate instrument changes from changes in the target region



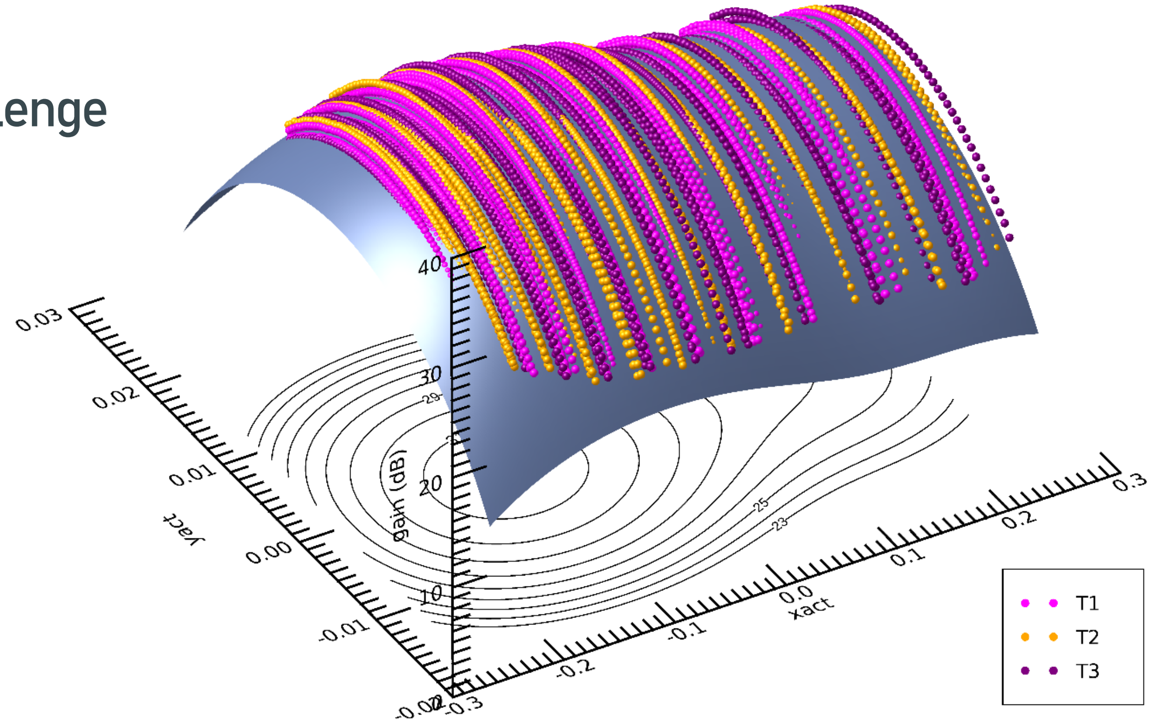
Absolute calibration

- Absolute calibration using transponders with a well-defined and very accurate cross-section
- Direct measurement of antenna gain pattern
- Required accuracy / stability of the RF equipment is a challenge



SCA L0 example, LFVV beam

- top: noise measurements (containing transponder signals)
- bottom: raw echoes (transponder signals + "point" targets)
- numbers correspond to transponder id's



ASCAT gain pattern example:

- nominal gain model + raw transponder cuts

Studies

ASCAT / SCA Deblurring

Study KO: 06 October 2021
Status: finished in Q2/2023
Summary:
Investigate scatterometer image reconstruction methods, aiming to improve the resolution along the coastlines

SCA Doppler capabilities

Study KO: TBD
Status: upcoming
Summary:
Follow-on from the ESA Doppler study, will specifically address SCA

Revisit of the direct assimilation of scatterometer 'sigma0'

Study KO: 8 December 2022,
Status: will run until Q1/2024
Summary:
Study investigates the possibility of the direct assimilation of $\sigma 0$ into the IFS using an Artificial Neural Network (ANN) approach.

Summary - SCA

- SCA will ensure continuity of the EUMETSAT scatterometer missions for a time period of >> 30 years
- Instrument builds on ASCAT heritage (processing and cal/val)
- Improves high winds retrieval capability (addition of cross-pol channels)
- Better coverage due to wider swath, higher spatial resolution
- Upcoming study: SCA Doppler

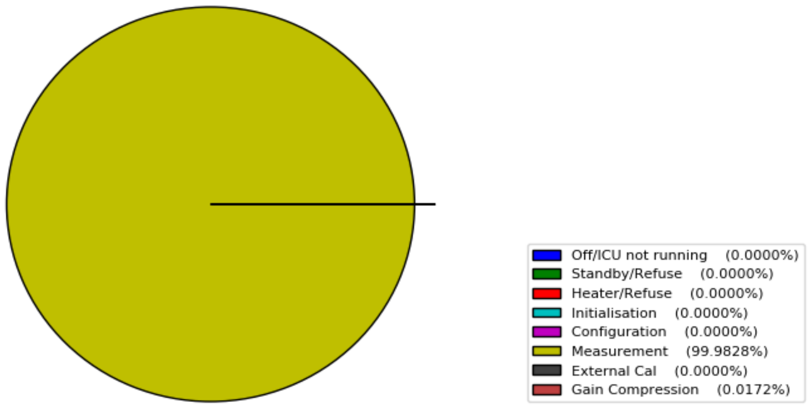
ASCAT status

Activities in the last year

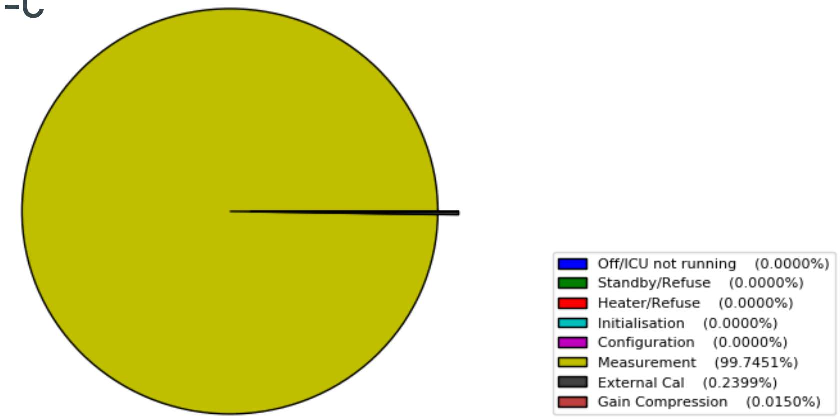
- L1 processor update: introduction of the LCR
- Support to Ground Segment processing infrastructure upgrade (transparent to the users)
- ASCAT-A time series analysis (reprocessing)

Instrument availability over the past year

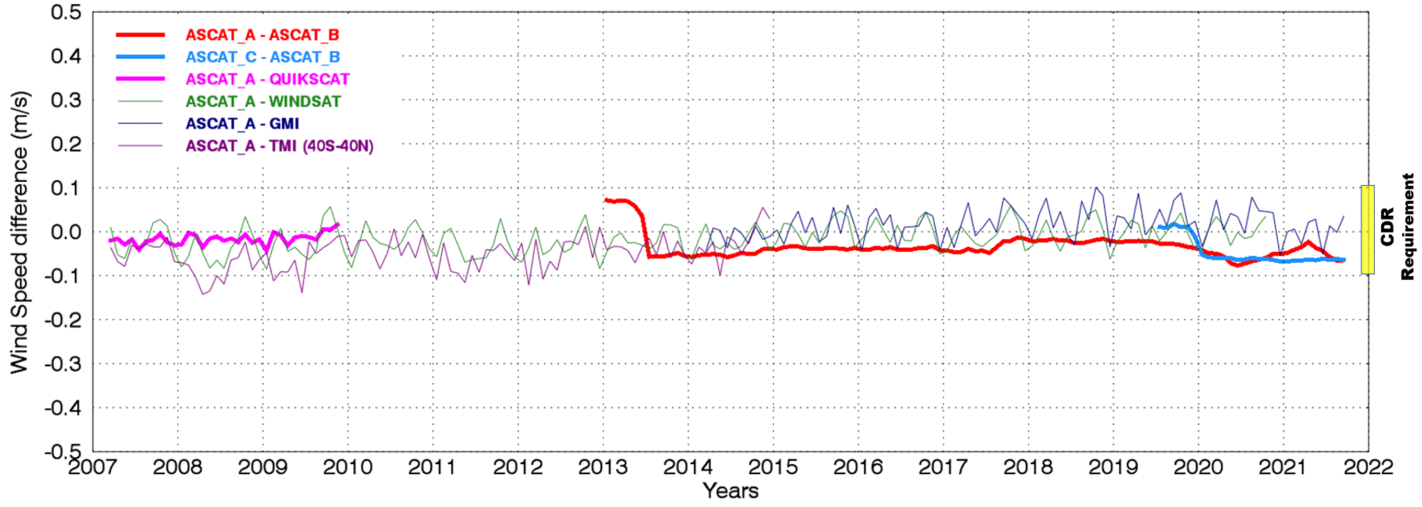
ASCAT-B



ASCAT-C



ASCAT-A long-term behaviour I

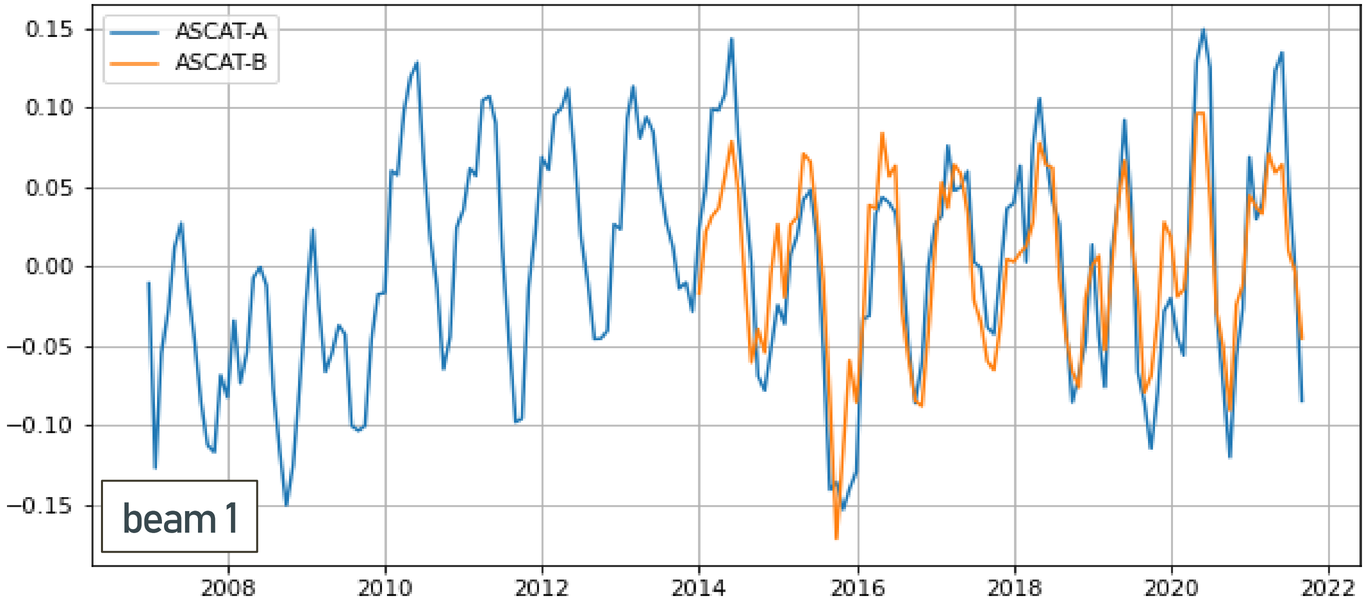


A Stable Satellite Wind Climate Data Record for Climate Variability Studies

Lucrezia Ricciardulli, Andrew Manaster, Thomas Meissner, and Carl Mears

Remote Sensing Systems, Santa Rosa, CA, USA

IOVWST 2023

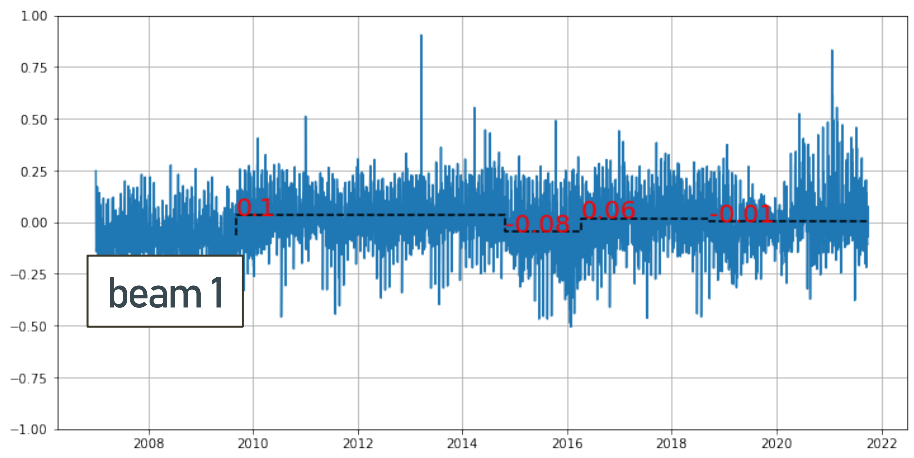


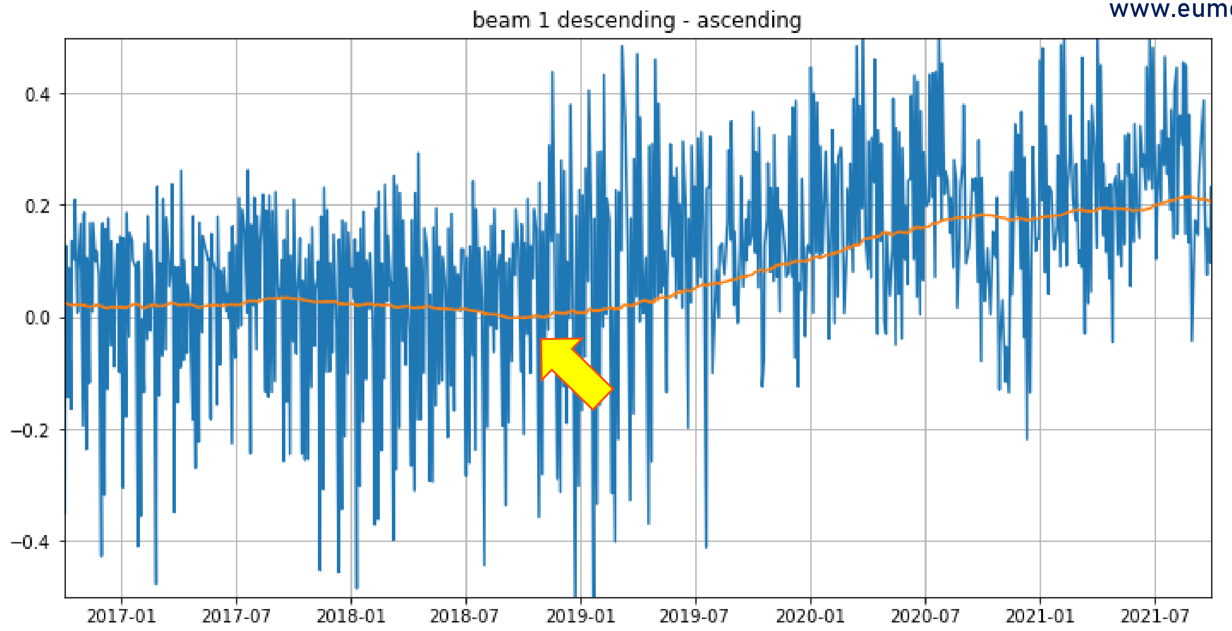
Monthly averages of ASCAT-A and ASCAT-B gamma0 backscatter normalised by incidence angle) over the rainforest calibration site:

- Identify calibration jumps caused by sudden changes in the instrument state
- Drift at the end of the ASCAT-A mission?

ASCAT-A long-term behaviour II

Amazon rainforest





Daily gamma-0 (seasonality removed):

- Shows the discontinuities in the time series
- Some of them can be traced back to anomalies on the instrument

- Difference between the Gamma-0 obtained from descending and ascending orbits over the rainforest
- Discrepancy between ascending and descending orbits, starting around 2019
- Drift documented by Ricciardulli et al. starts around the same time

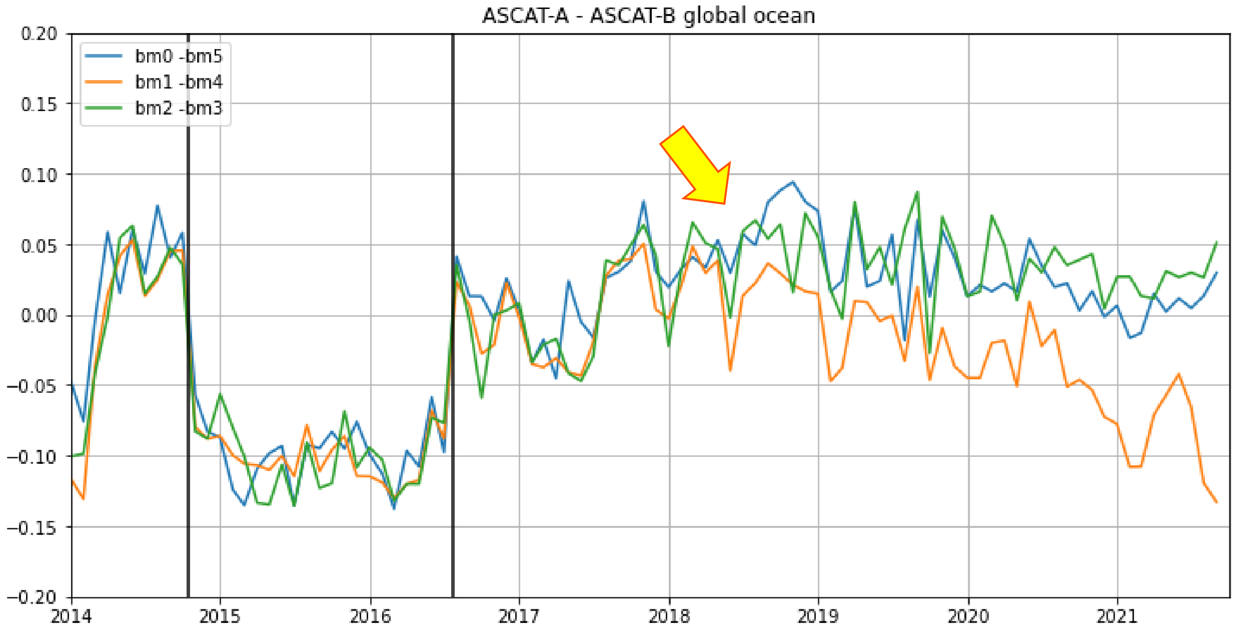
What do we see here?

ASCAT-A long-term behaviour III

ASCAT-A ground track

The last inclination maintenance of ASCAT-A occurred on 31.08.2016

- after that, a slow drift has started leading to the local time of the ascending node to be shifted to about 90 minutes earlier by the end of the mission i.e., ~ 20:00 for ascending and ~08:00 for descending orbits.
- What we see might be an effect of the diurnal water cycle / different sampling location on the backscatter, rather than an instrument effect?

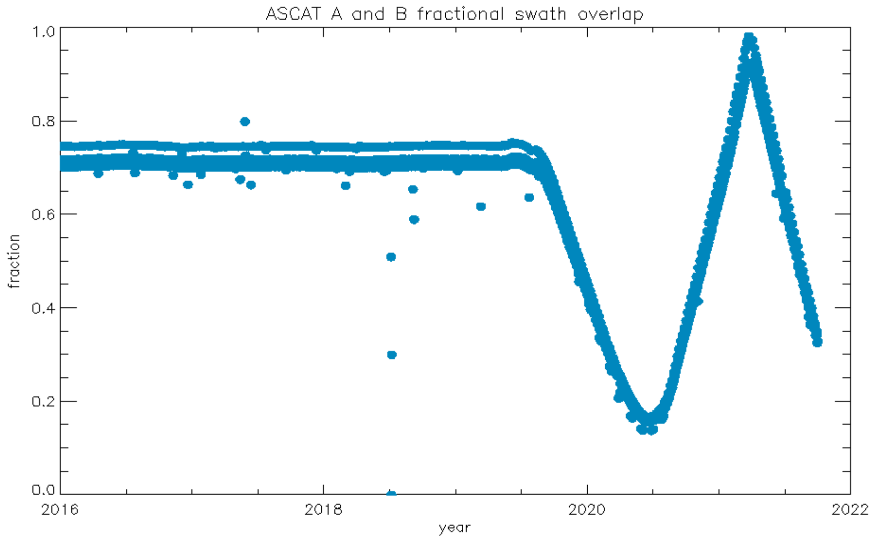


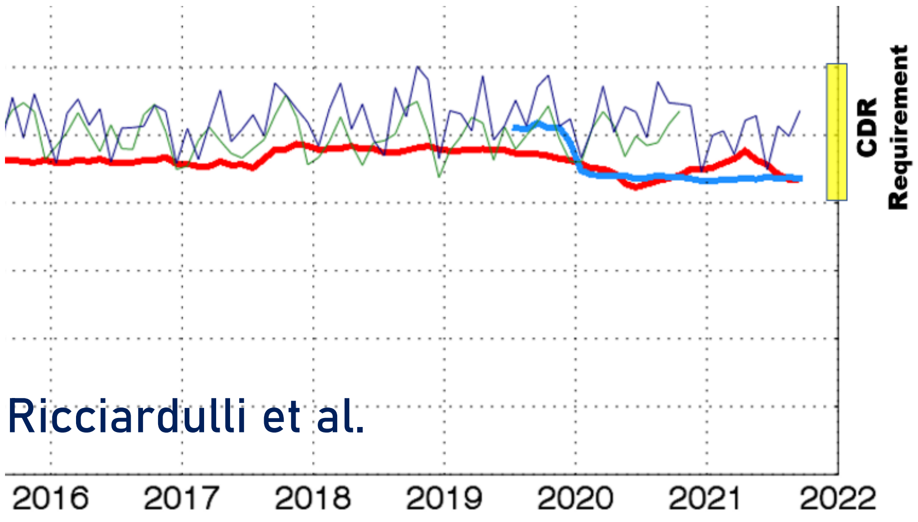
Global ocean:

- Similar trend in the differences between the opposing beams
- Also here, different spatial sampling of ASCAT-A and ASCAT-B

ASCAT-A long-term behaviour IV

www.eumetsat.int





ASCAT A and B fractional swath overlap for ascending passes (daily)

ASCAT transponder campaigns:

- Reanalysis of all data shows consistent antenna de-pointing up to the end of the mission
- Data indicates stable antenna gain until the mission end (but last campaign needs further analysis due to stability issues)

Conclusion:

- Drift observed since 2018 is most likely caused by different spatial sampling due to the drifting ground track of ASCAT-A, and is not a calibration issue

Summary - ASCAT

- Looking into the full ASCAT-A mission to provide a consistent time series of the full mission duration
- Open points:
    - Transponder data needs further investigation (long-term stability)
    - ASCAT-B and ASCAT-C long-term behaviour

Thank you!

Questions are welcome.