



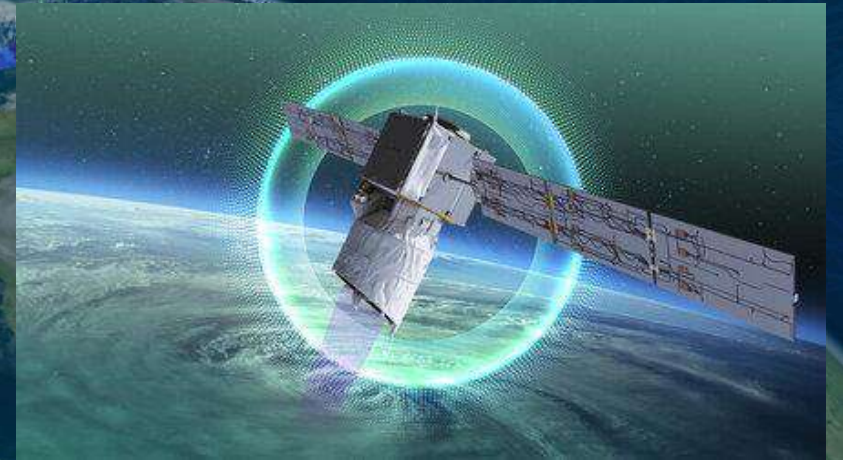
ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

LESSONS LEARNT FROM AEOLUS CAL/VAL

Sebastian Bley¹, Oliver Reitebuch², Jonas von Bismarck³, Anne Grete Straume³, Holger Baars¹, Thorsten Fehr³ Dimitri Trapon¹

¹TROPOS, ²DLR, ³ESA



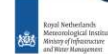
Leibniz Institute for
Tropospheric Research



serco



ABB



Koninkrijk
Nederland
Meteorologisch Instituut
Ministerie van Infrastructuur
en Water Management



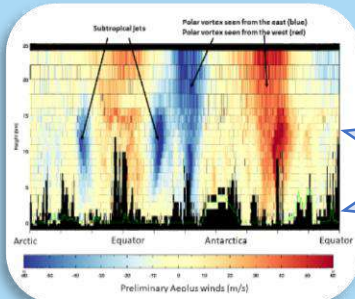
s[&]t

5 years Aeolus DISC and Cal/Val at a glance



Launch on
22/08/2018

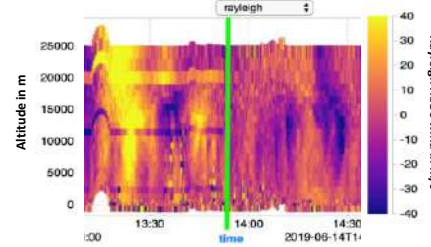
First wind on 12 Sept 2018



aeolus cal/val & science workshop
26-29 March 2019 | ESA-ESRIN | Frascati (Rome), Italy

Data release to
Cal/Val teams
on 18/12/2018

Hot-Pixel fix operational on 14/06/19

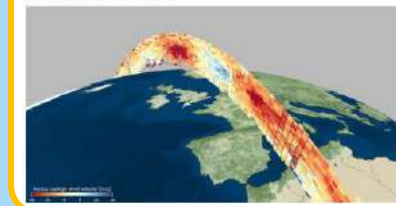


12 May 2020:

Public release of wind products

Aeolus Space Mission Goes Public – Already Hailed a Success

TOPICS: Aeolus, European Space Agency, Weather, Wind
by EUROPEAN SPACE AGENCY (ESA) | MAY 12, 2020



Public release of
L2A aerosol
product
12 July 2021



28 July 2023:

Aeolus assisted re-entry



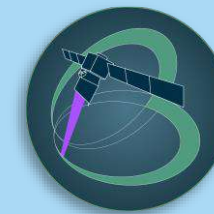
22-26 May 2023:

Aeolus Science
Conference



22 November 2022:

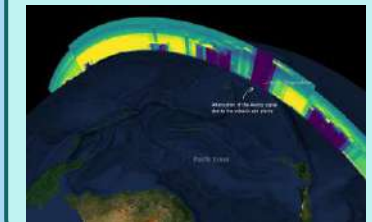
Public release of 3rd
reprocessed dataset
→ 4 years of high-
quality Aeolus data
available to the
public



28 March –
01 April 2022:
3rd Anniversary
Conference in
Taormina

January 2022:

Aeolus data helped to
track Hunga Tonga
volcanic eruption



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We are one Aeolus team



Allow interaction between validation, science, NWP, industry and mission expert teams

Being experimental can bring unexpected findings

Be earth explorers

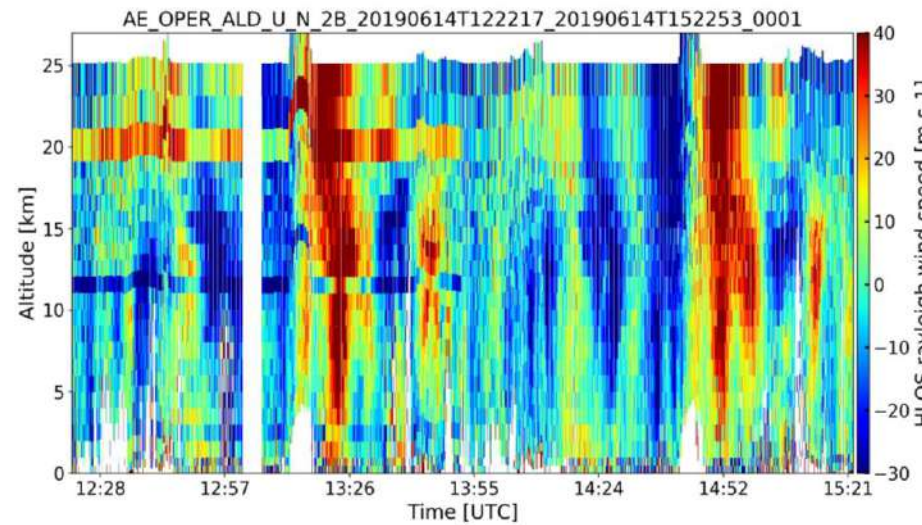
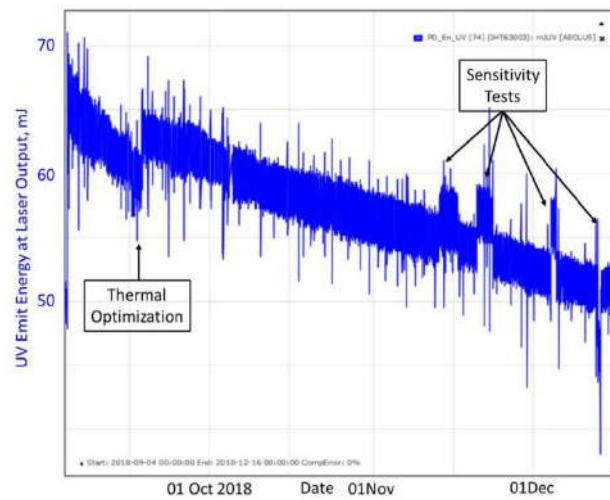


NWP working meeting, September 2019, Darmstadt

Early data access to validation teams pays off

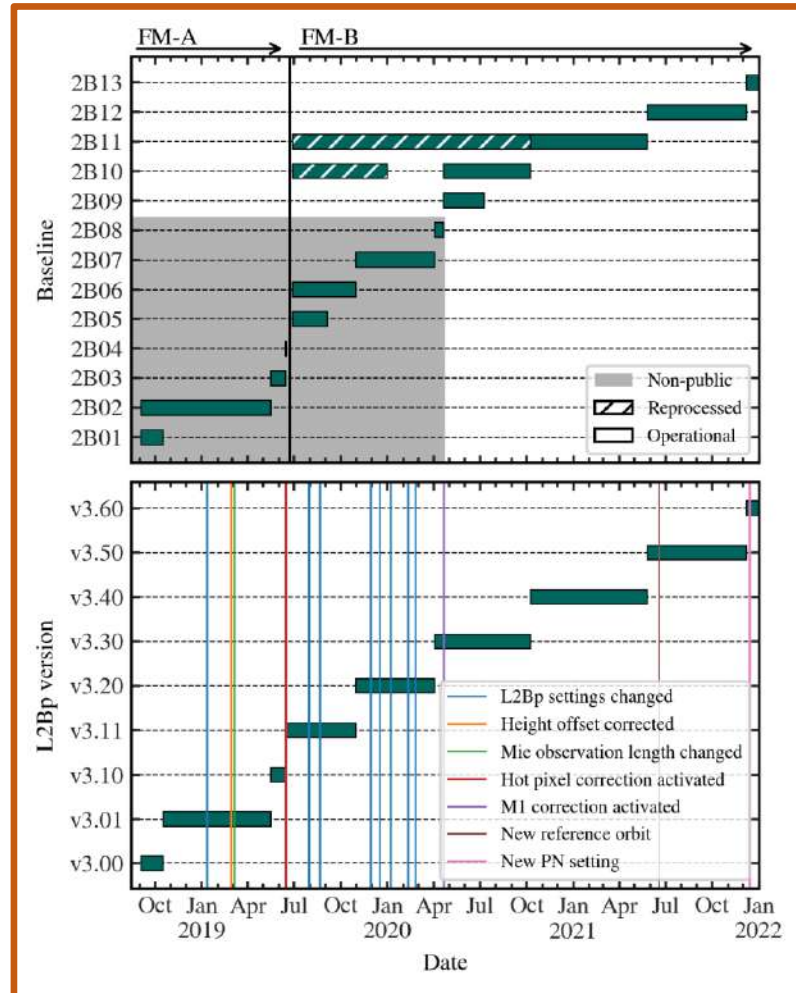


Aeolus data products were early released to Cal/Val teams after 3 months already in the commissioning phase, although several issues were known with the product quality...



Input from Cal/Val teams provided evidence to also release the wind products to public users in May 2020 (after several corrections have been implemented).

Regular updates to validation teams required



Courtesy of Alexander Geiß, LMU

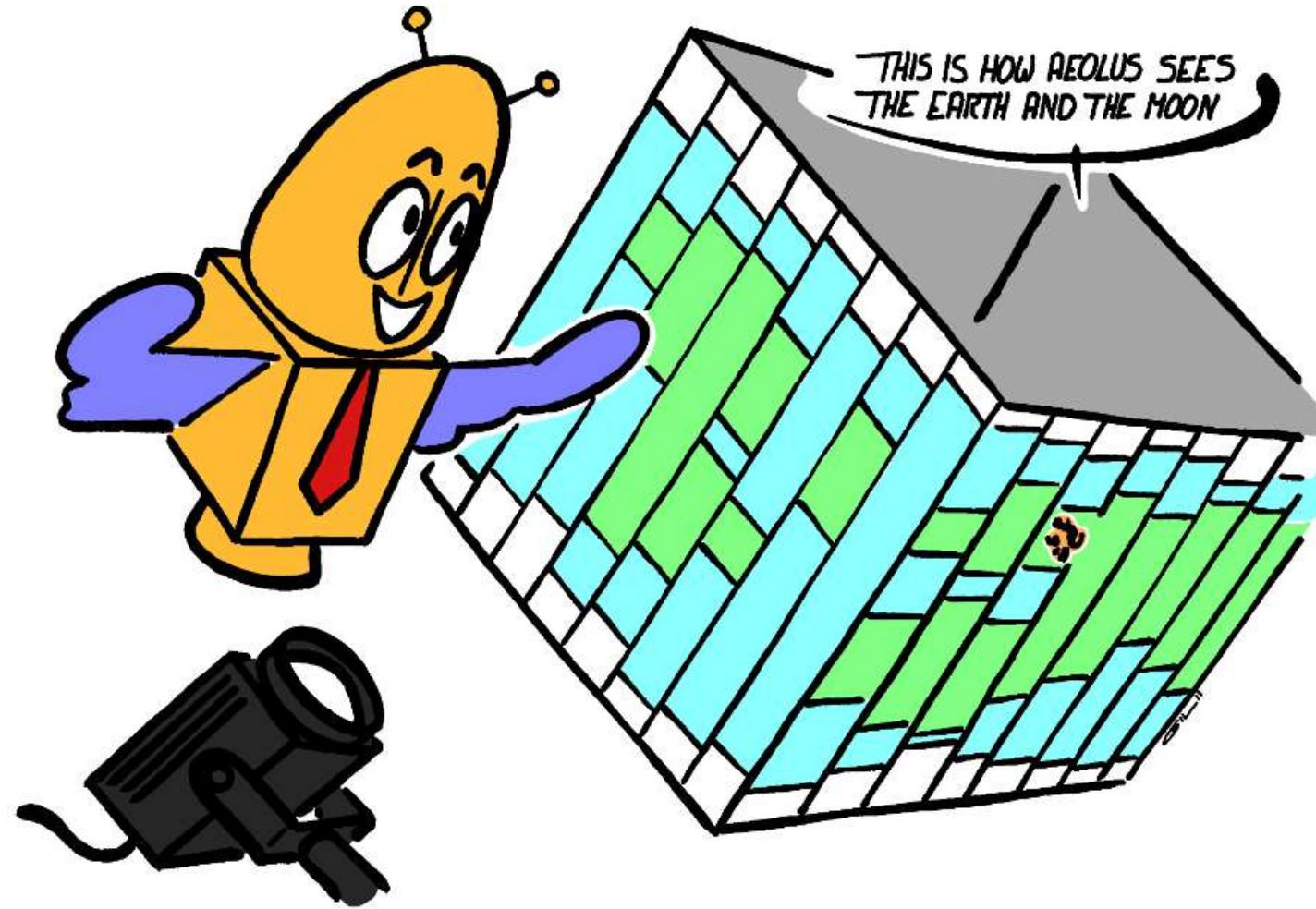
Table 5. Horizontal resolution possibilities depending on ALADIN N/P settings with 1 BRC = 87 km

N/P settings	Number of measurements accumulated per sub-profile						
	1	2	3	5	6	10	15
30/19 (until 2021-12-13)	2.9 km	5.8 km	8.7 km	14.5 km	17.4 km	29 km	43.5 km
15/38 (until 2022-04-04)	5.8 km	-	17.4 km	29 km	-	-	87 km
5/114 (until last operational)	17.4 km	-	-	87 km	-	-	-

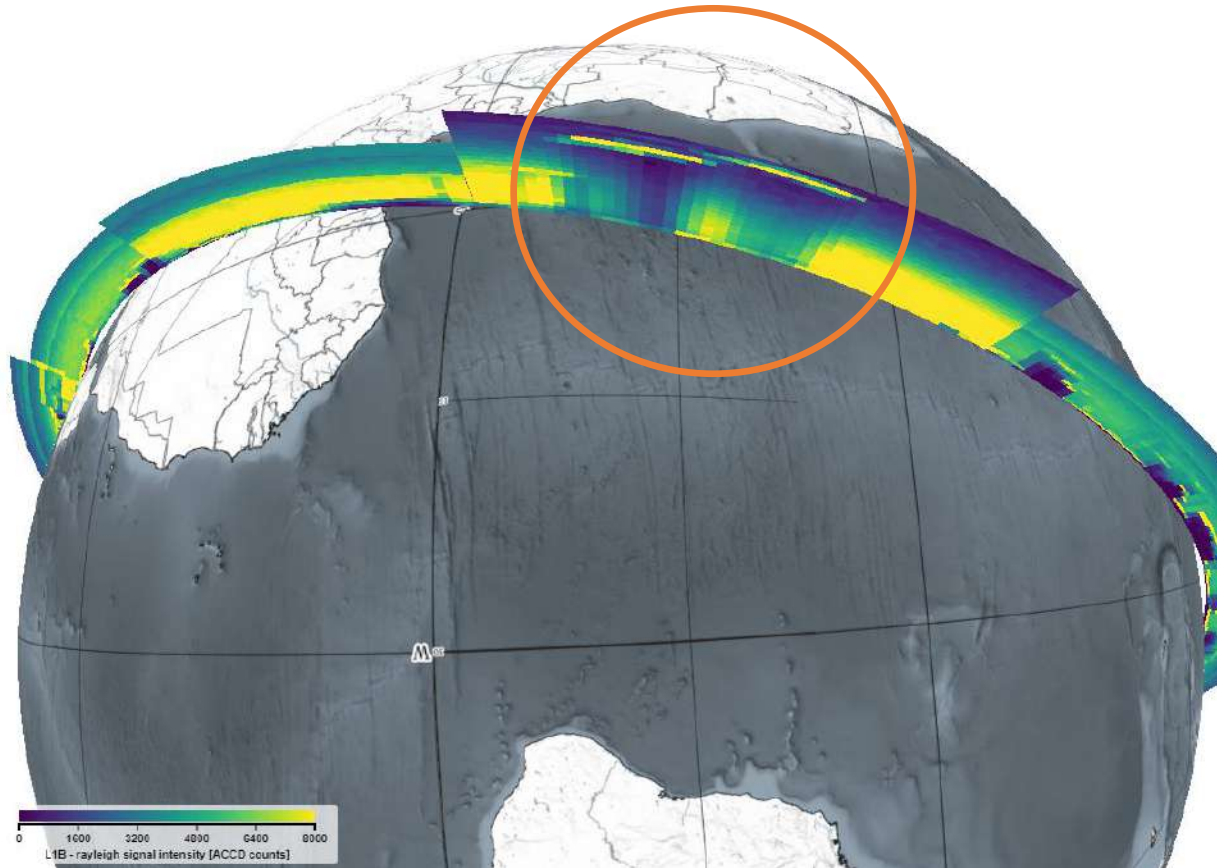
Courtesy of Dimitri Trapon et al., L2A user guide

- Tuning of horizontal resolution (**N/P setting**)
- **N**=number of measurements accumulated in one BRC
- **P**=Number of pulses in one measurement
- Request to improve horizontal resolution also triggered from Cal/Val teams
- Wind and aerosol/cloud processor updates (usually every six months)
- Information when new product versions become available!

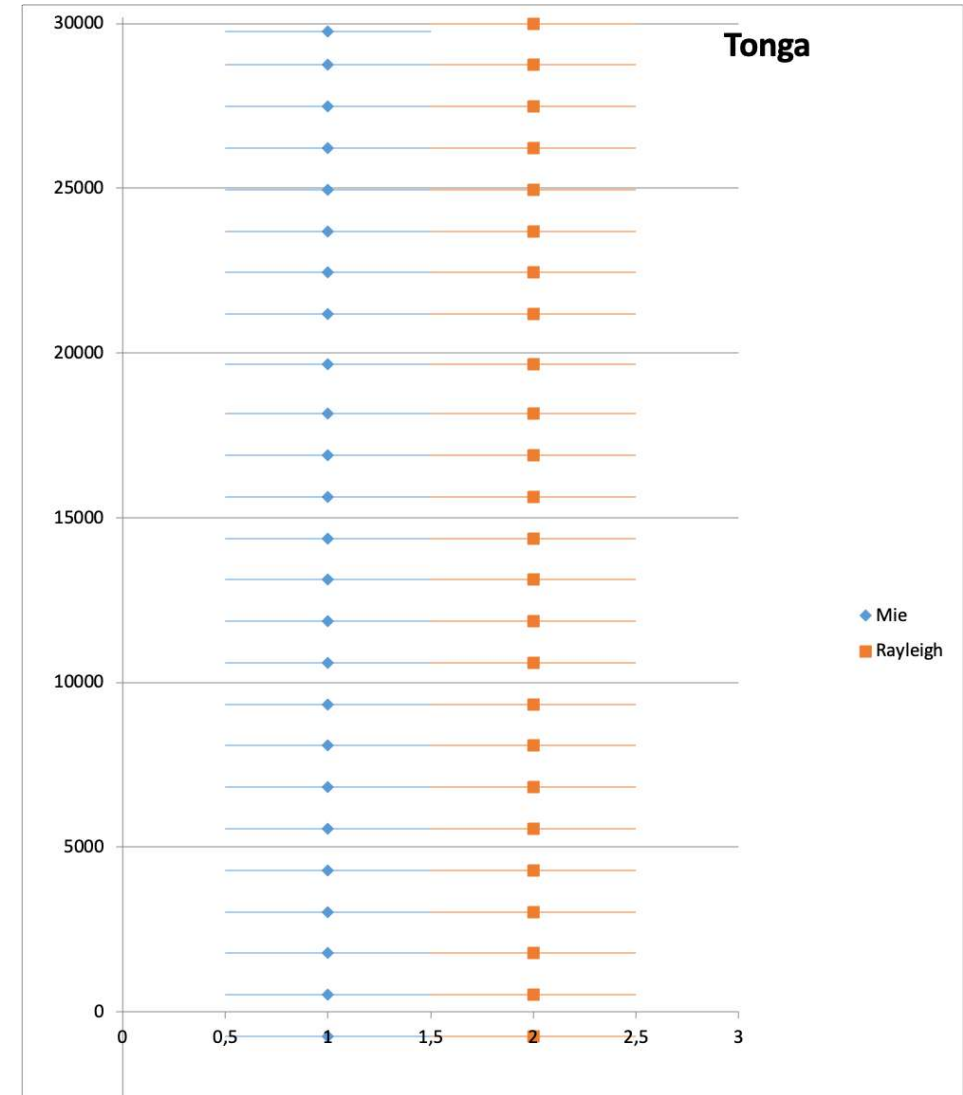
- One Aeolus profile consists of 24 vertical range bins distributed between ground and 30 km
- Vertical resolution varies between 500 m and 2 km
- Planning was done in the range bin setting working group during regular meetings every six months and upon ad-hoc requests
- This flexibility allowed to react on temporary events (e.g. volcanic eruptions, campaigns)



Flexible range bin settings highly increased science impact



- Tonga RBS setting, highest sampling with ALADIN in the mission
- Activated after ad-hoc request following the Tonga eruption



Communication platform brings teams together



Introducing Aeolus

ESA's Doppler Wind Lidar Mission, Aeolus, was successfully launched on 22 August 2019. The mission provides vertical profiles of the tropospheric and lower stratospheric wind field on a global scale to improve numerical weather prediction (NWP) and to advance our understanding of atmospheric variability. In addition, Aeolus provides valuable profile information on optical properties, which are relevant to air quality and the atmospheric radiation budget. Furthermore, Aeolus is a demonstrator for space-based Doppler Wind Lidars and their potential for climate variability.

Latest News

- Aeolus Operational Notice: [Aladin in STDBY - Status Update](#)
- The first in-orbit [Aeolus Cal/Val & Science Workshop](#) will be held at ESA-ESRIN in Frascati, Italy from 26-29 March 2019 (~~Abstract submission deadline is 7 January 2019~~). **Deadline extended! You are invited to submit your abstract until 14 January.** (Already existing abstracts can be edited until this deadline).
- [Living Planet Symposium](#) in Milan, Italy from 13-17 May 2019 will have a dedicated session on Aeolus (B1.07 ESA's Earth Explorer Aeolus - First Results)
- [Where is Aeolus right now?](#)
- For access to [Aeolus Cal/Val data](#) please sign the [Data Access Terms](#) and send it to info.aeolus-calval@esa.int.
- The Aeolus reference orbit is ANX 4.5 degrees East. More information about the calculation of the orbit can be found at [Aeolus weekly overpass visualisation](#).

Calibration Activities with Aeolus

- Timeline of planned [Aeolus activities](#)
- Predicted [overpasses](#) for Cal/Val stations

Our Data Access

- [Data access](#) and [data description](#) for Aeolus
- [Read Aeolus data by using CODA](#)
- [Data quality](#)
- Direct link to the [first Aeolus performance document](#) generated by dedicated analysis core team
- General [Cal/Val ftp server](#) and BUFR file distribution via [ECMWF ftp](#)

Our Cal/Val projects

Aeolus mission calibration and validation is essential in order to evaluate its performance and improve its product quality. Different Cal/Val teams will perform diverse and widespread activities, including aircraft, radiosonde, balloon and ground-based measurements, satellite intercomparisons, model and NWP impact assessment studies.

- Overview of [Cal/Val proposals](#)
- Overview of upcoming [airborne campaigns](#)

Useful Links to get started

- Guidelines for [Aeolus weekly overpass visualisation](#)
- Guidelines for our discussions and email communication
- [Overpass prediction and mission flight visualisation tools](#)
- Upload portal for Cal/Val Reference measurements: [EVDC - ESA Atmospheric Validation Data Centre](#)
- ESA's [Aeolus homepage](#)
- Aeolus page on the [ESA Earth Online portal](#)
- Aeolus page on the [ESA Earth Observation portal](#)
- Aeolus page at [ECMWF](#)
- Aeolus in the different [media](#)
- Further links to Aeolus main documentation can be found [here](#)

- Not only one direction information of news, instrument settings, baseline updates, documentation, but also Cal/Val questions, discussions and preliminary results of ESA, DISC and Cal/Val teams
- Open communication strategy but restricted to registered Cal/Val users
- At the end of the Aeolus mission, 499 users have been registered to the Aeolus Cal/Val confluence

Joint validation campaigns including aircraft

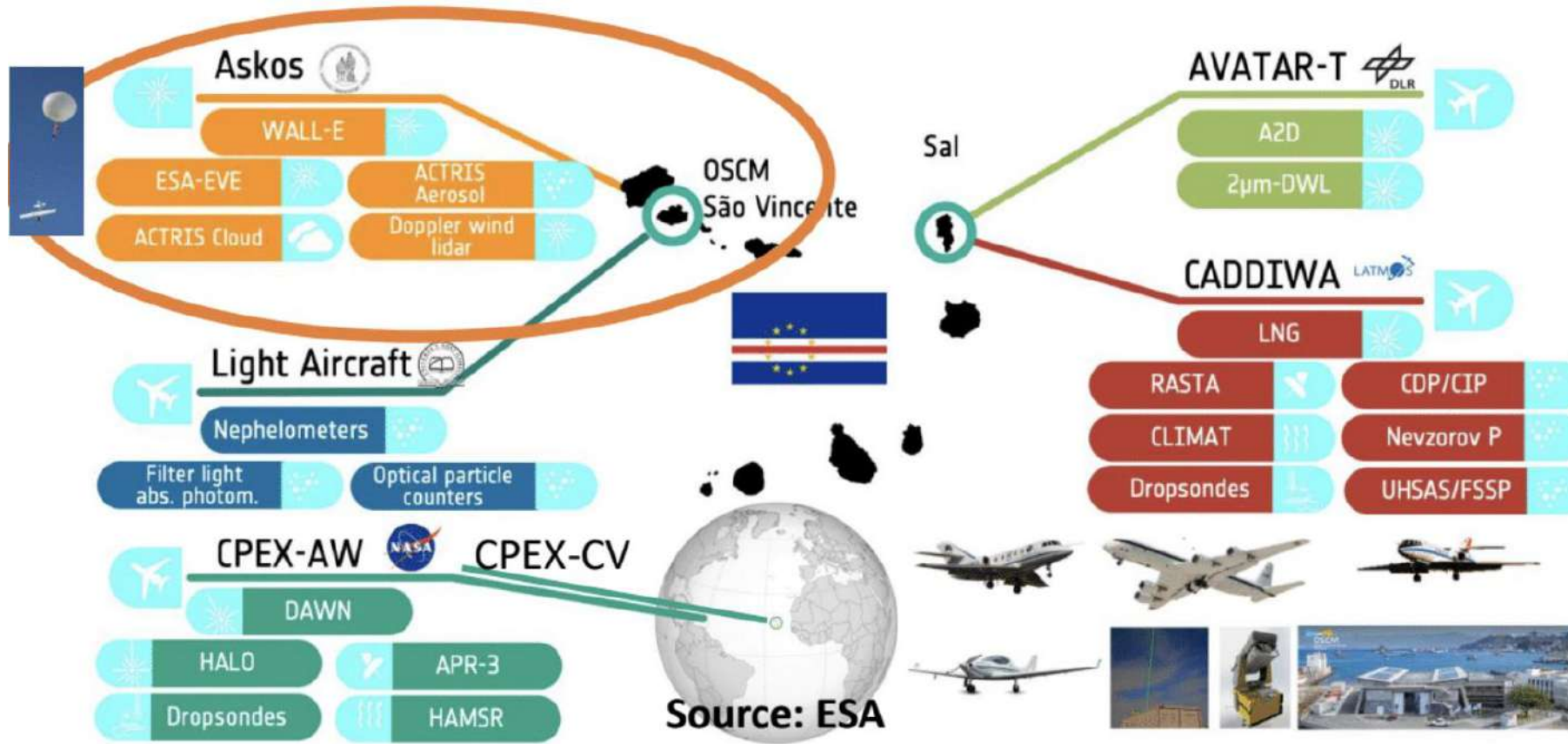
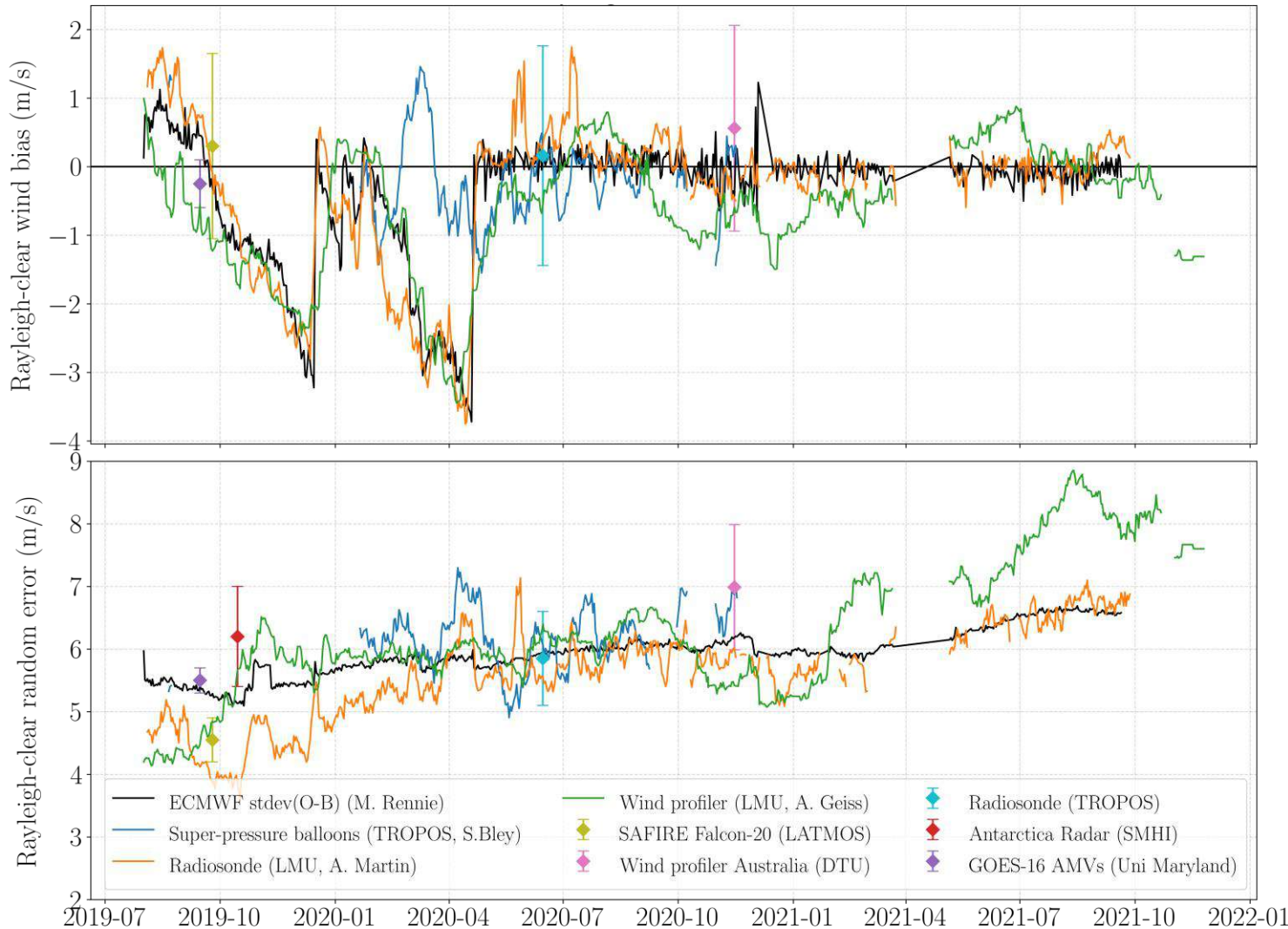


Image: Instrumental setup during Joint Aeolus Tropical Atlantic Campaign (JATAC)

- Complementing profile to profile comparisons from ground-based validation stations, aircraft campaigns allow analysis of larger spatial domains

Validation throughout the whole mission is important



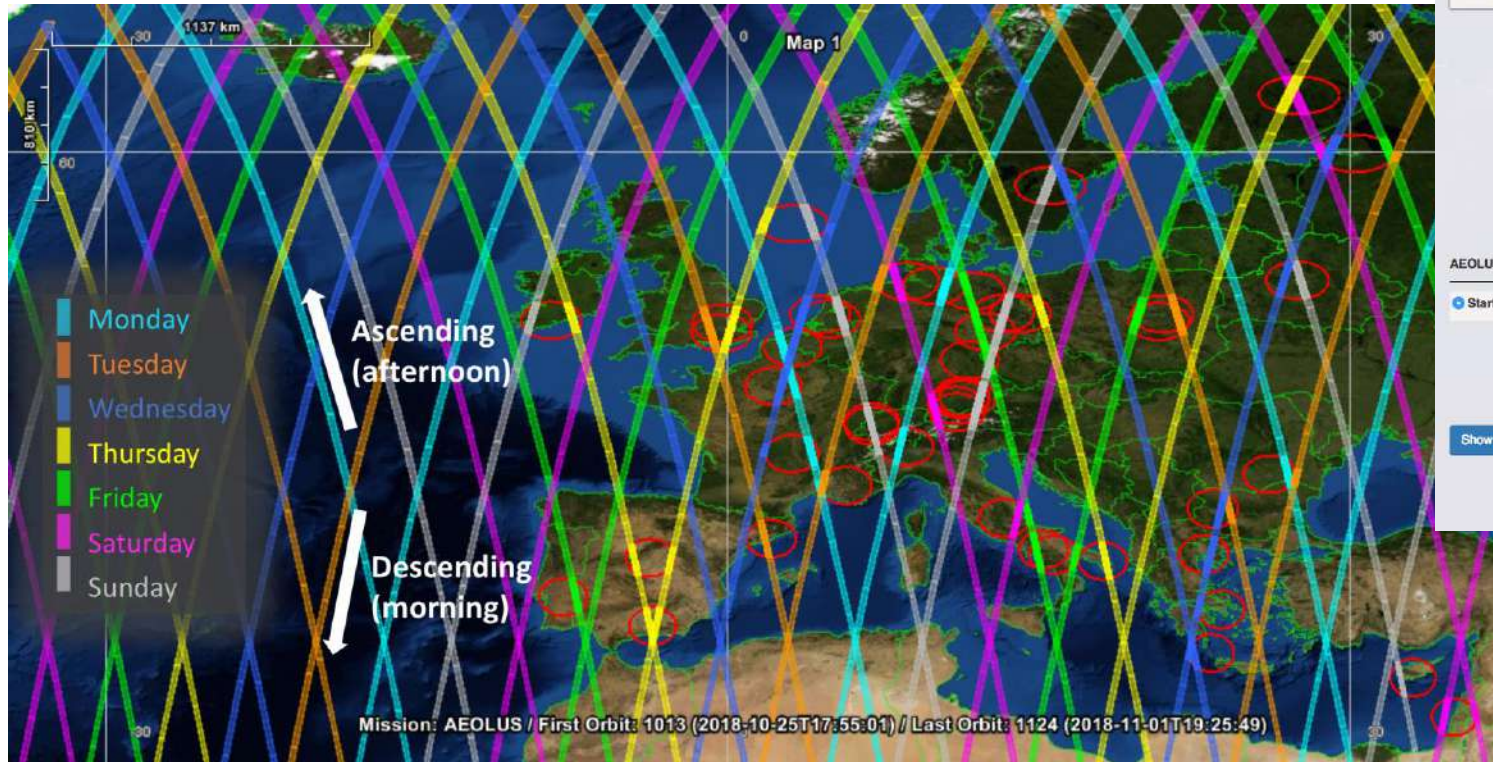
- Continuous validation of the products is essential for the quantification (and correction) of biases/random errors which need to be taken into account for scientific studies
- Also after the end of the mission, validation is required for the reprocessed datasets (with corrections that were not in place for previous processor versions)

Image: Aeolus Rayleigh clear wind product bias (top) and random error (bottom) from NWP monitoring and confirmed by validation teams. Source: Aeolus Cal/Val synthesis report.

Inform validation teams when to measure



- Sounds trivial, but it isn't.
- Not everyone is familiar with the orbit tools.
- Overpass tables can help overcoming hurdle.



Satellites

- All
- AEOLUS
- AGUA
- ARIRANG-5 (KOMPSAT-5)
- AURA
- CALIPSO
- DESIS (FS)
- DLR-TUBSAT
- EarthCARE (FS)

Instruments

- Aladin
- AMSU-A
- ATLID
- BBR (backward)
- BBR (forward)
- BBR (nadir)
- CCD
- COSI (WS)
- CPR
- C-SAR
- ETM+
- IASI
- IIR
- LISS-4
- MERIS
- MIPAS (Rearward)
- MIPAS (Sideways)

AEOLUS

Start: 2019-01-27 05:27:13Z - Aladin

Longitude: 12.21831502 Latitude: 48.13874835 Format: DDD.DDDD

Start: 09 / 01 / 2019 15 : 51

End: 31 / 01 / 2019 15 : 51

Joint Overpass: 20 Max Time Difference (minutes)

Show Overpass Download Results

Predict Orbits Get Spatial Overpasses Get Temporal Overpasses

Add Satellite Search Satellite Data

Choose Data File Upload

Aeolus overpass predicted with web-based OPOT tool within EVDC (talks by Ann Mari Fjaeraa & Jarek Dobrzanski on Thursday)

Aeolus overpasses predicted with ESOV (talk by Montse Pinol Sole on Thursday).

Listening to recommendations from validation teams



Changed N/P settings have a big influence on the random error → Further increasing accumulated laser shots per measurement could be an option to compensate for the decreasing signal intensity

Provide an interim possibility for exchange of information and discussion among the Cal/Val teams (e.g. 1 day on-line meeting) between the Cal/Val workshops

Further user support needed because of different products (SCA, MLE, AEL-PRO)

Missing cloud screening is currently largest problem.

Aeolus Follow-On: Improve vertical resolution and include depolarization channel measurement for an Aeolus Follow-On mission to enhance aerosol product capabilities; allow cloud screening on laser shot level

Include cloud flag within product

Timeliness needs to be considered, when implementing range-bin settings for specific atmospheric events of limited duration, e.g. volcanic eruption, biomass burning aerosol

Prominent place on the Cal/Val confluence for blocklisted data periods

Follow on: Improve vertical resolution up to 100 m

Thank you!



Group photo from Aeolus Cal/Val and science conference in March 2019 in Frascati