

Aeolus Calibration, Validation and Science Campaigns

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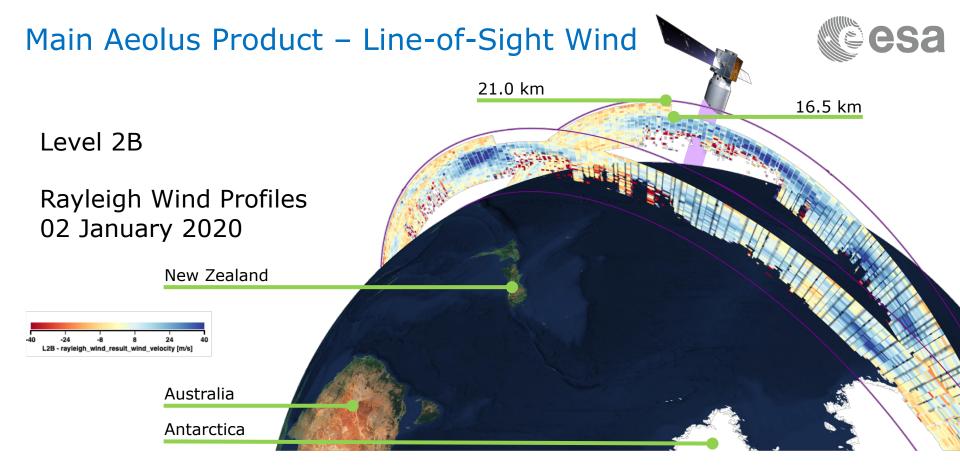


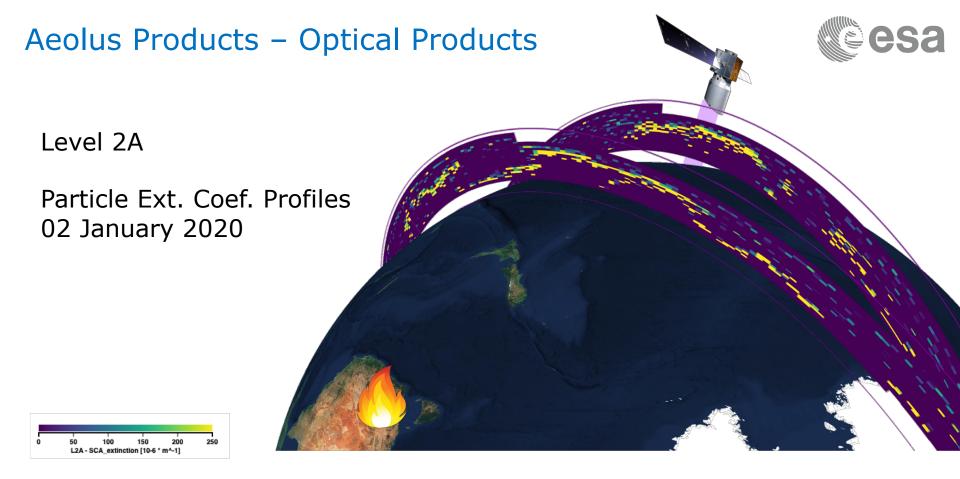
For a comprehensive overview of the Aeolus Mission and its status see:

T. Parrinello et al., ESA's Wind Mission Paper EGU2020-4091.

Session AS1.35 – Aeolus data and its application

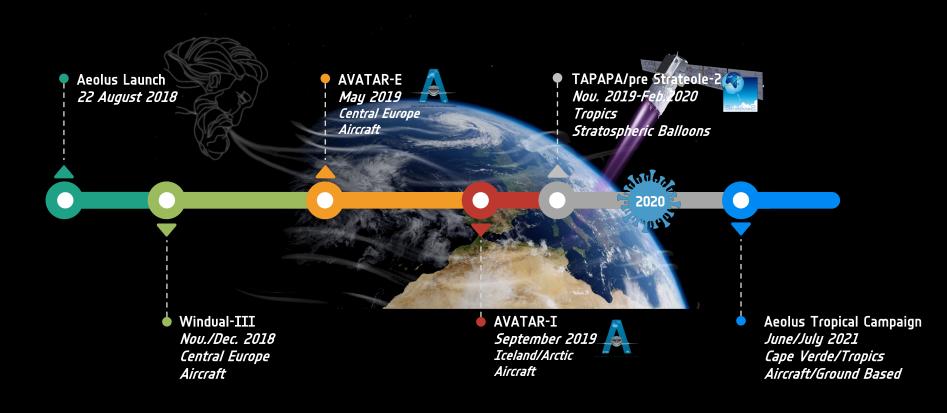






Aeolus Airborne Campaigns since Launch





Aircraft Campaigns before Launch (DLR/NASA/CNES) CSa







Aircraft Campaigns since Launch (DLR)







Aeolus Validation Through Airborne Lidars in Europe

Aeolus Validation Through Airborne Lidars in Iceland

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DLR Falcon with ALADIN Airborne Demonstrator A2D and 2-µm wind lidar





	ALADIN airborne demonstrator	2-μm Doppler wind lidar DWL ("Reference System")
Wavelength	354.9 nm (UV)	2.022 µm (IR)
Backscatter	molecules, aerosol, clouds	aerosol, clouds
Wind	line-of-sight LOS, 20°	LOS, hor. wind vector, vertical wind w
Vertical res.	250 m – 2 km	100 m / 500 m (for Aeolus)
Time res.	14 s (+4 s)	1 s LOS, 30 – 40 s vector
Horizontal res. @ 200 m/s	3.6 km	200 m LOS, 6 – 8 km vector, 42 km (for Aeolus)
Precision	2 m/s (mol.) 1.5 m/s (aer.)	< 1 m/s vector < 0.3 m/s vertical
Accuracy	0.5 – 1 m/s	< 0.1 m/s

Reitebuch et al. (2009), **JAOT**; Reitebuch (2012); **Springer**; Lux et al. (2018), **AMT**, Marksteiner et al. (2018), **Remote Sensing**, Witschas et al (2017), **JAOT**



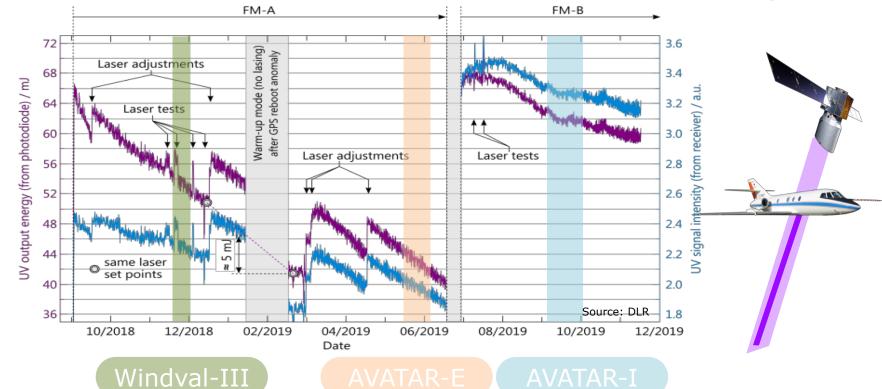
Campaigns – Central Europe and Arctic (DLR)





Validation throughout the mission



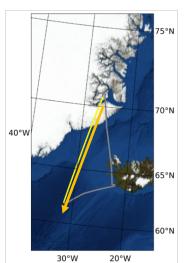


Lux et al., Optics Lett., 2020

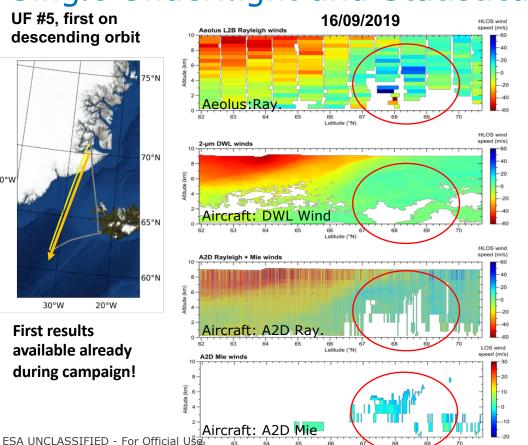
Single Underflight and Statistical Analysis (DLR)

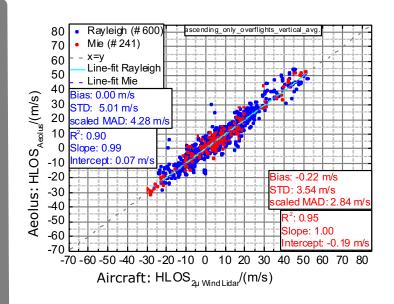


UF #5, first on descending orbit



First results available already during campaign!





AVATAR-I

Preliminary Data Only flight legs with ascending orbit

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Key results from WindVal-III, AVATAR-E/-I (DLR)



Preliminary Results	Rayleigh Winds		Mie Winds	
Orbit	Bias	Radom	Bias	Radom
Ascending	0.0 m/s	4.3 m/s	-0.2 m/s	2.8 m/s
Descending	1.8 m/s	3.9 m/s	-0.6 m/s	2.5 m/s

- Rayleigh random error scales with the range bin size → Poisson noise limited
- Mie random error does not scale with resolution → SNR driven
- Rayleigh random error AVATAR-E and -I similar, despite factor 1.5 in reported UV energy
 - → higher solar background in September (Iceland, 66°N) compared to May (Central Europe)
- Campaigns during **mission implementation phase** fundamental to the early Aeolus success



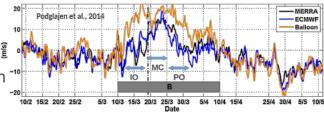
TAPAPA / pre Stratéole-2 (CNES/LMD)





Objectives:

- Few direct stratospheric wind observations exist, but are fundamental to understand the global circulation, in particular in the Tropics
- Support to Aeolus Cal/Val activities using wind observations from CNES stratospheric balloons during the LMD/CNES pre Stratéole-2 Campaign 2019/20



Campaign Details:

- Circum-terrestrial, 3-month stratospheric balloon flights in the Tropics
- Eight super-pressure long-duration balloons operating in the lower tropical stratosphere (18-20 km) in Nov./Dec. 2019 to Feb. 2020
- Pressure, temperature and GPS location every 30 s at flight level
 - 3D winds deduced from successive GPS positions
- Data analysis ongoing



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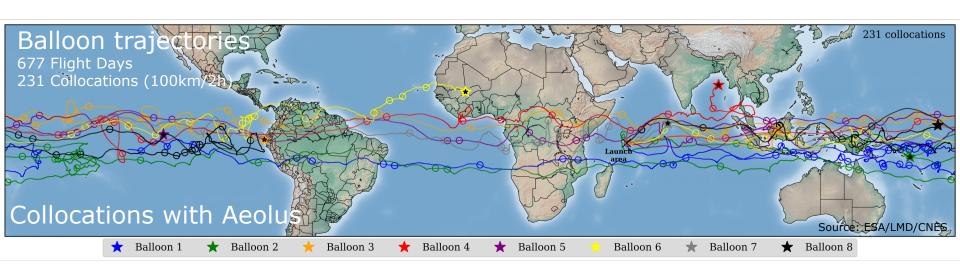




TAPAPA / pre-Strateole-2 (CNES/LMD)





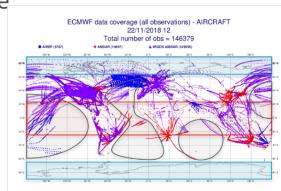


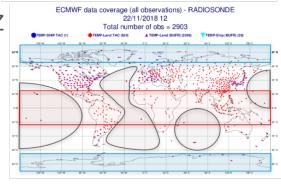
Aeolus Tropical Campaign



 Largest impact of the Aeolus observations expected in the Tropics and in particular over the Tropical oceans

- Airborne Campaign in Cape Verde/Tropics:
 - Correlative observation between Aeolus and the airborne and ground-based remote sensing and in-situ reference systems
 - Tropical wind systems, e.g., Easterly Waves, ITCZ
 - Aerosols, i.e., Saharan dust
 - Tropical clouds and convection
 - Providing proxy data for EarthCARE E2E
 - Planning prepared for July 2020



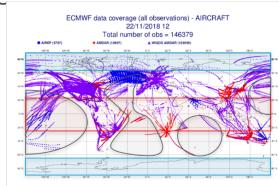


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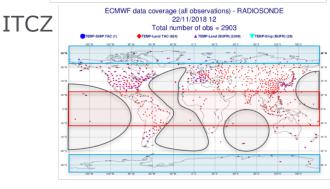
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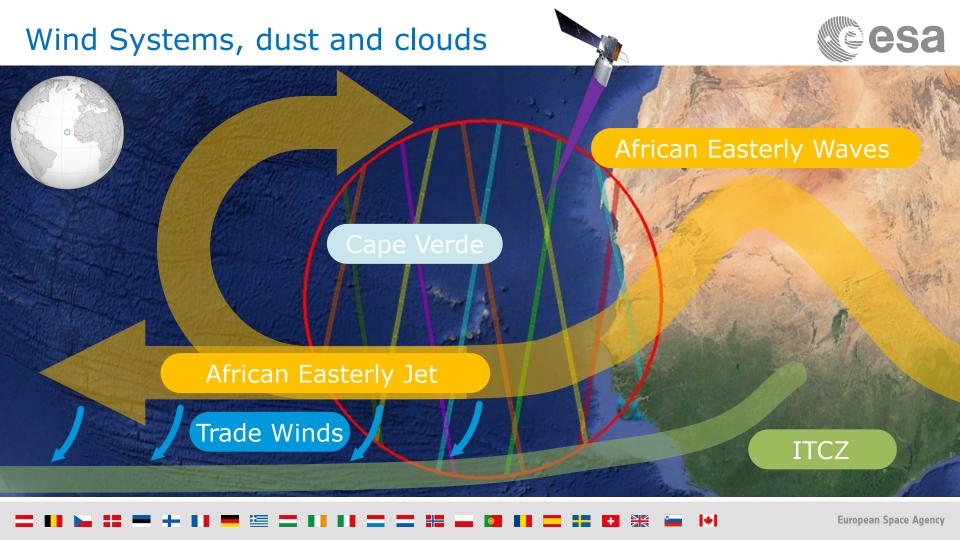
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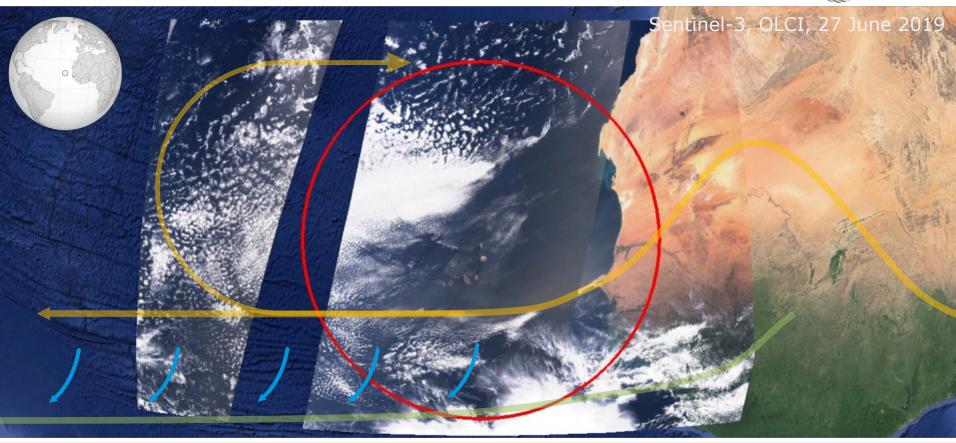


European Space Agency



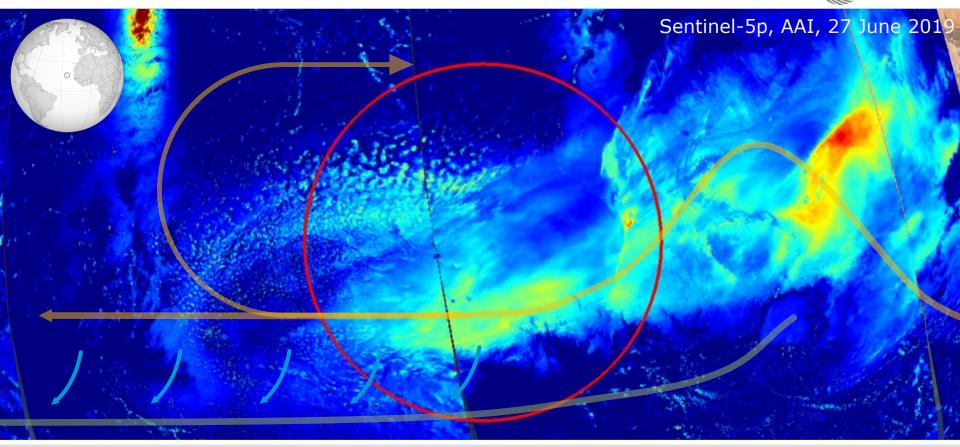
Wind Systems, dust and clouds





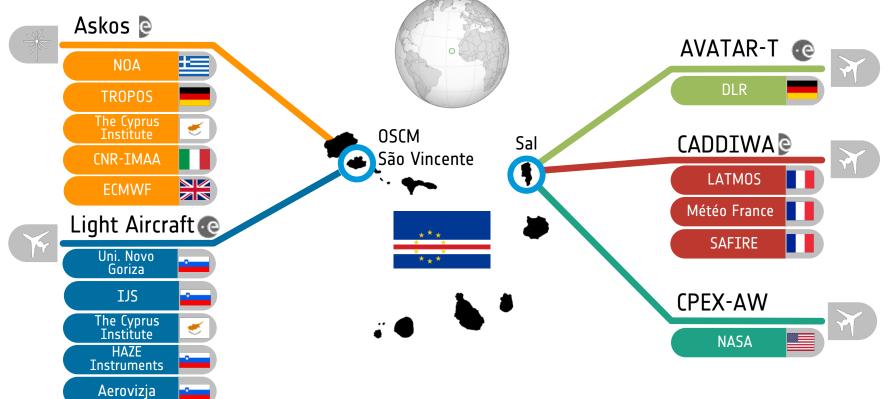
Wind Systems, dust and clouds





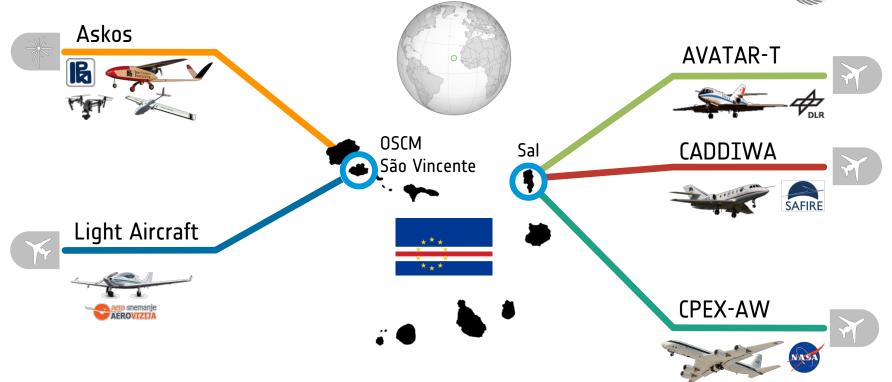
Tropical Campaign 2021 – Projects and Participants

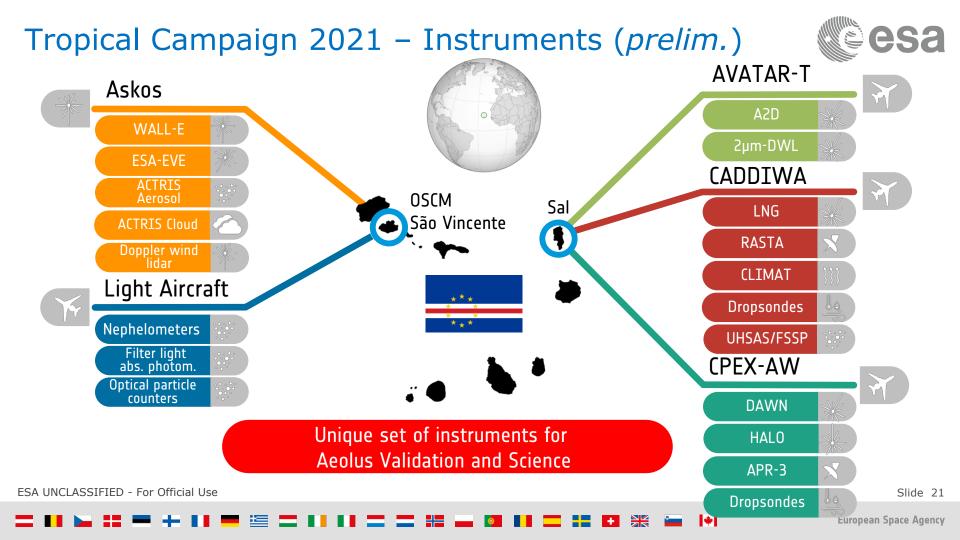




Tropical Campaign 2021 – Airborne Fleet







Conclusion & Outlook



Campaigns are an important tool supporting the Aeolus mission

- Supporting the processor and instrument developments during mission development
- Providing perfectly collocated observations for the in-orbit calibration and validation
- Establishing reference data for future mission developments and science communities
- Responding to recommendations from the instrument experts and Science Advisory Group

Future Perspectives

- Successful implementation of the Tropical Campaign 2021
- Identification of campaign needs for further product improvement (e.g., L2A products)
- Evolution of airborne instruments and campaign to support Aeolus-FO activities









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