Aeolus - 5 Years of Advancing Wind, Aerosol and a Atmospheric Lidar Science

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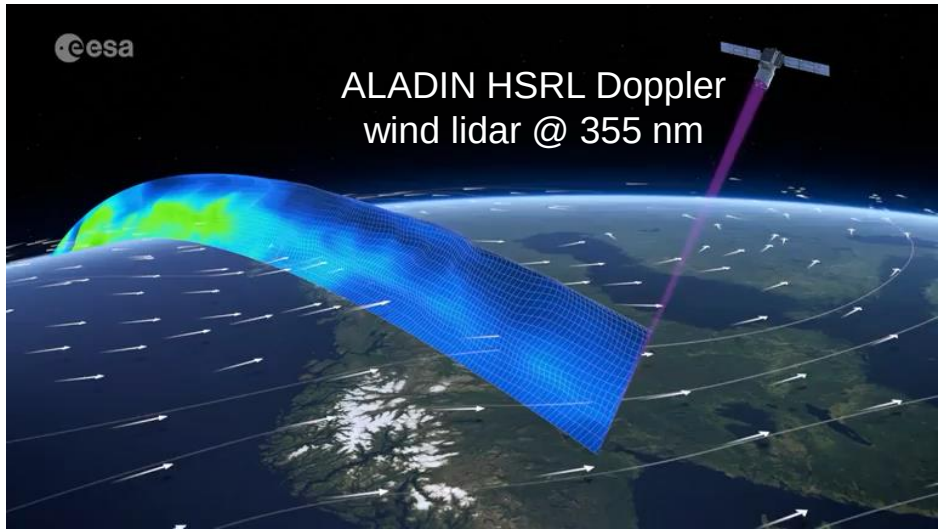
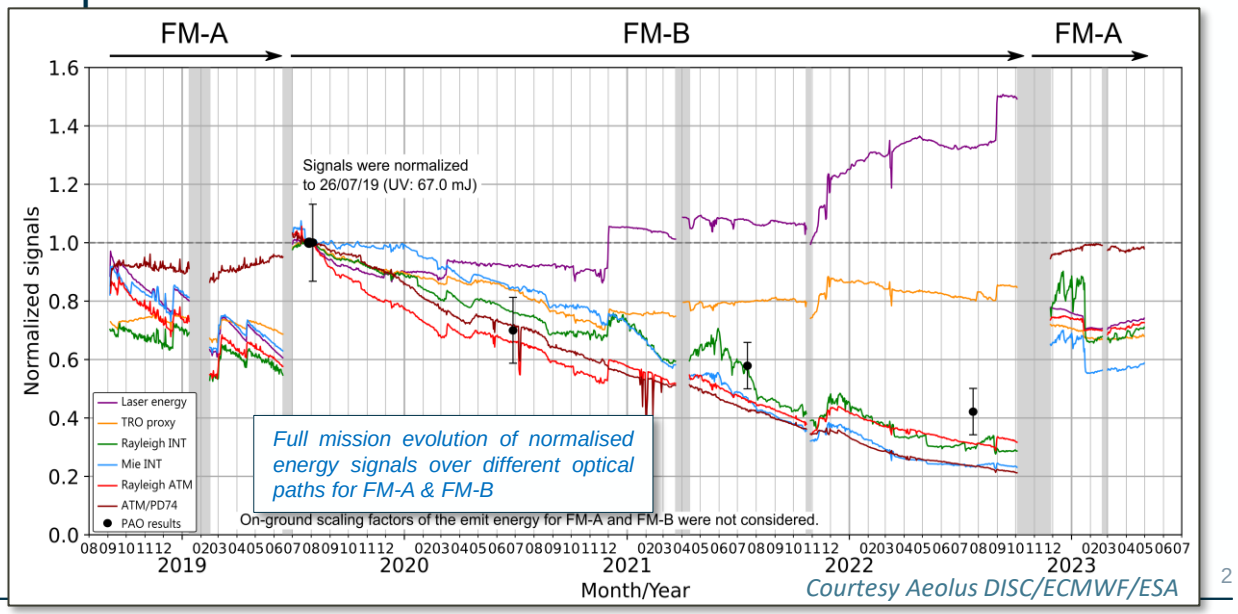
ATMOS2024, Bologna, 01July 2024

Aeolus Mission in a Nutshell



- **Aeolus** is the second Earth Explorer Core Mission of ESA's Directorate of Earth Observation
- **Launch:** 22nd August 2018 from Kourou on a Vega rocket
- **Orbit**: Altitude of 320 km, inclination of 97deg, sun-synchronous, 7-days repeat cycle
- **Designed Mission Life**: 3 years [until end 2021]
- **Line-of-sight (LOS) pointing 35º from nadir** to capture profiles of single component horizontal wind

- Nominal **Mission Operations ended on 30 April 2023** followed by the start of the end-of-life activities**.**
- **ALADIN** instrument operated for around **4.7 years** accumulating some **7.6 billion laser shots.**
- The final overall performance of Aeolus mission went **beyond any expectations.**



Courtesy Aeolus DISC/ECMWF/ESA

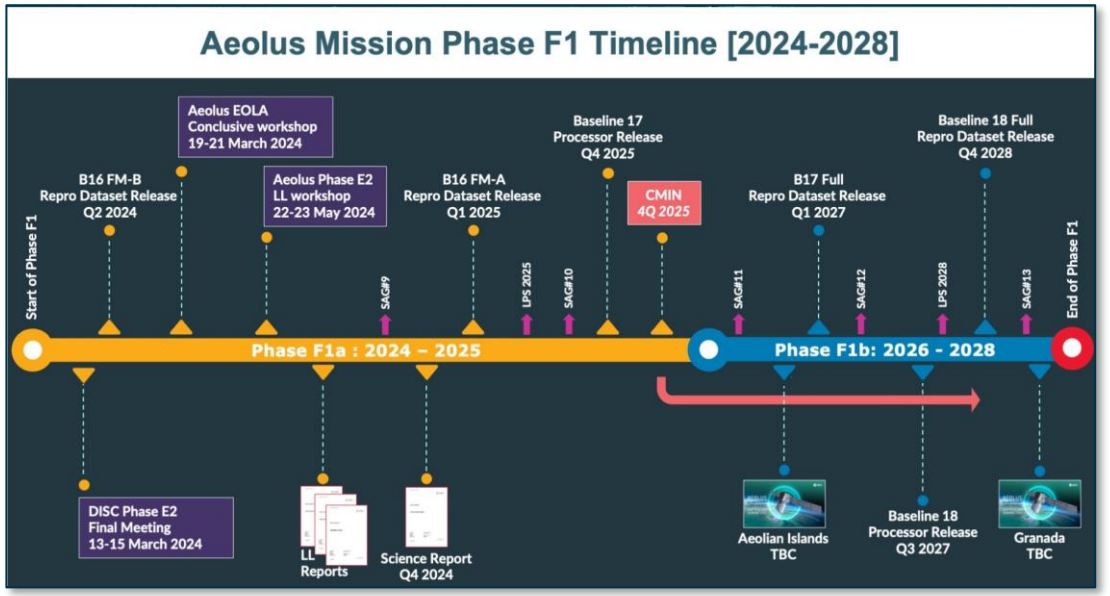
Aeolus mission status

- **Phase F1 has started on 1st January 2024.** It focuses on processor evolution and reprocessing of the mission dataset, confirming the impact on *Numerical Weather Prediction* as well as fostering atmospheric science.

Aeolus Lessons Learnt Workshops:

- Aeolus Reentry (Nov 2023)
- Aeolus End-of-life Activities (March 2024)
- Aeolus Phase E2 (May 2024)

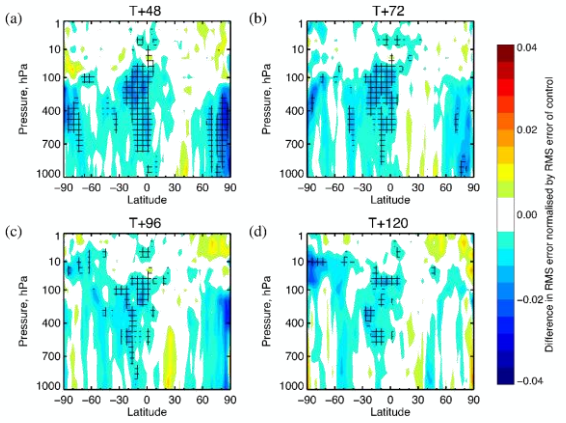
- The Final Report of the *Reentry Lessons Learnt Workshop* released.
- The *EOA Lessons Learnt Workshop* took place on 19-21 March 2024 at DLR. The Final Report will be released in Q2 2024 and will suggest several technical and scientific peer review papers.
- The *Phase E2 Lessons Learnt workshop* takes place today (22-23 May 2024) @Hotel Flora (Frascati), It will be followed by the release of the Final Report in 2Q 2024.



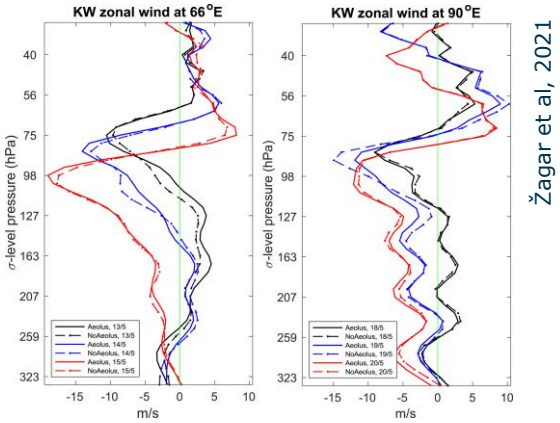
- The **Reprocessed Aeolus Dataset** (B16, FM-B) will be released in Q2 2024. Small delay on the initial plan.
- **New Aeolus DISC contract** (led by DLR) is in place. It covers the period 2024-2025 with an option for the next conclusive 3 years in Phase F1, following CMIN 25.

(Just a few) Aeolus NWP and Science Highlights

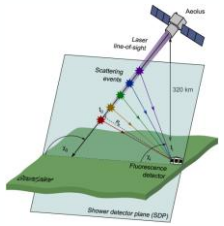
- Impressively **quick use of HLOS data in operational NWP**
- **First global-scale measurements** of the quasi-biennial oscillation (QBO) using direct wind measurements, including QBO disruption, leading to improvements in models
- **Hunga-Tonga Hapai volcano eruption** with volcanic aerosols' circumnavigation in the stratosphere ~24 km altitudes for almost one year.
- Accurately resolve atmospheric **gravity waves** (GWs)
- Observed **Saharan Air Layer** and marine aerosols above Cabo Verde during the Joint Tropical Atlantic Campaign
- Measure optical characteristics of numerous **Polar Stratospheric Clouds**
- Combination of wind and aerosol profiling improving aerosol modeling related to the **transport of desert dust, volcanic ash, sea salt, and fire smoke**, towards improving forecasting **for air quality application**
- Impact on **volcanic ash early warning systems** for aviation
- Positive impact in **Limited Area NWP Models** demonstrated
- Key for the **Atmospheric Lidar Science** domain

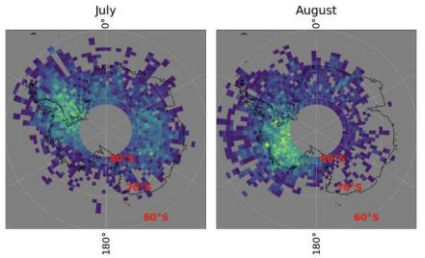


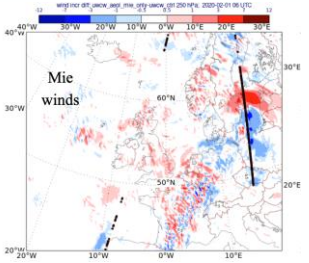
Rennie et al,2021

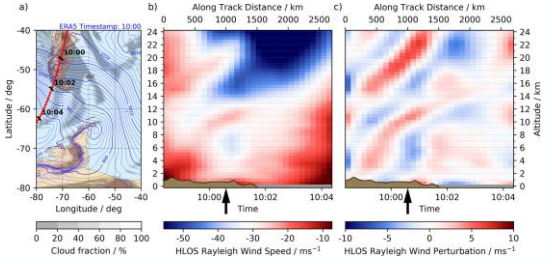


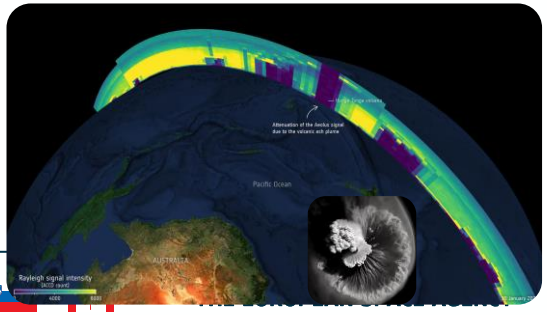
Žagar et al, 2021











Aeolus Campains

AVATARI
2019/09
DLR (D)

AVATARE
2019/05
DLR (D)

WindVal-3
2018/11-12
DLR (D)

CPEX-AW
2021/08-09
NASA
(USA)

CPEX-CV
2022/09
NASA
(USA)

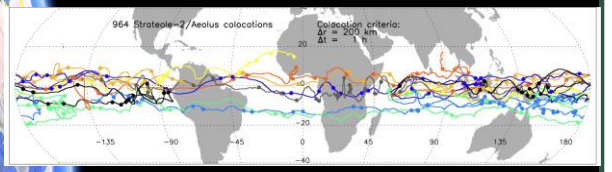
AVATART
2021/09
DLR (D)

CADDIWA
2021/09
LATMOS (FR)

ASKOS
2021/07-09
2022/06-07,09
NOA (GR)

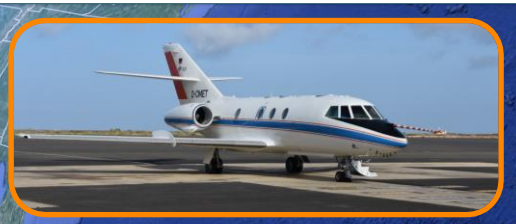
CAVA-AW
2021/09
2022/09
U. Nova Gorica (SL)

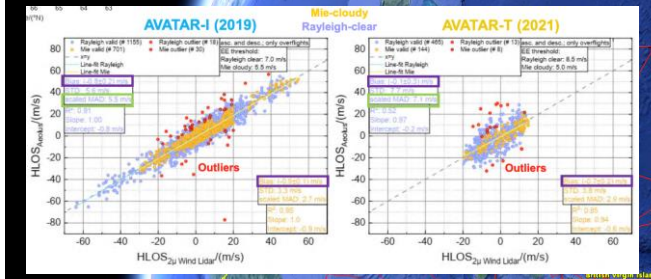
JATAC

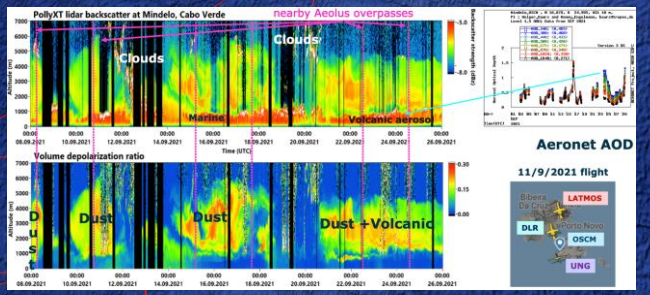


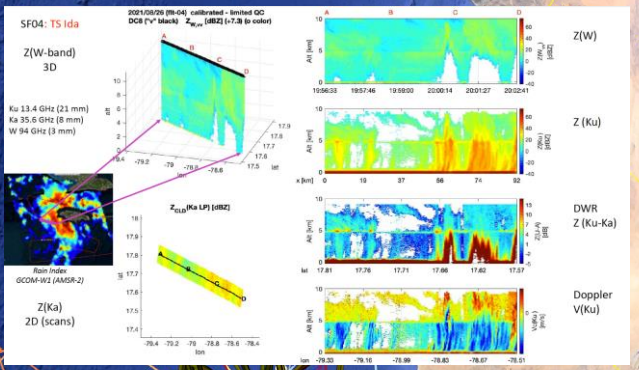
pre-Stratéole-2/TAPAPA
2019/11-2020/02
CNES (FR)

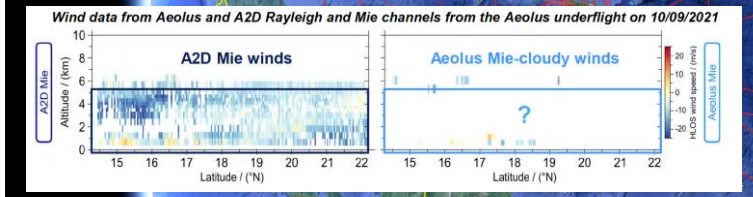
Joint Aeolus Tropical Atlantic Campaign – 2021 + 2022

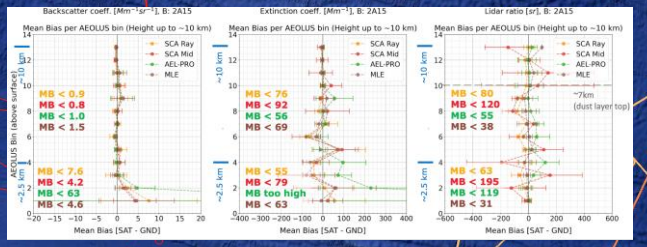



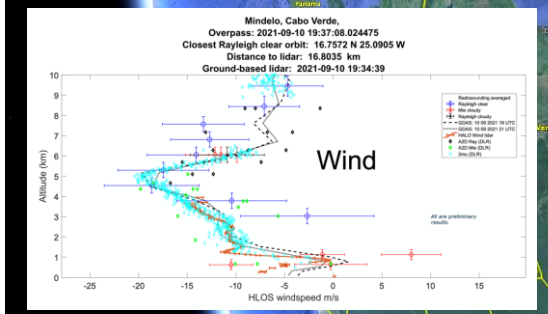



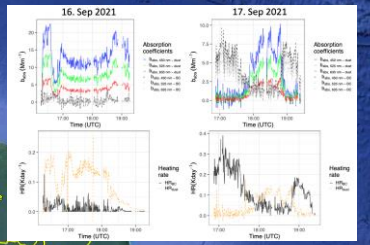


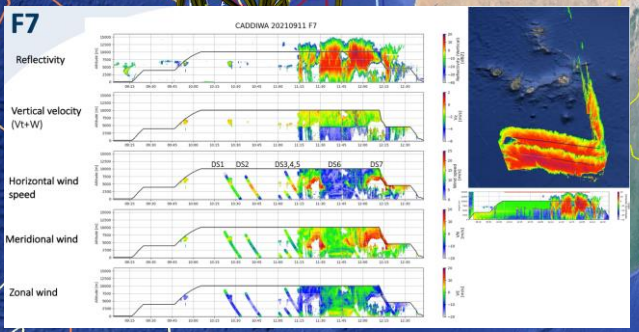




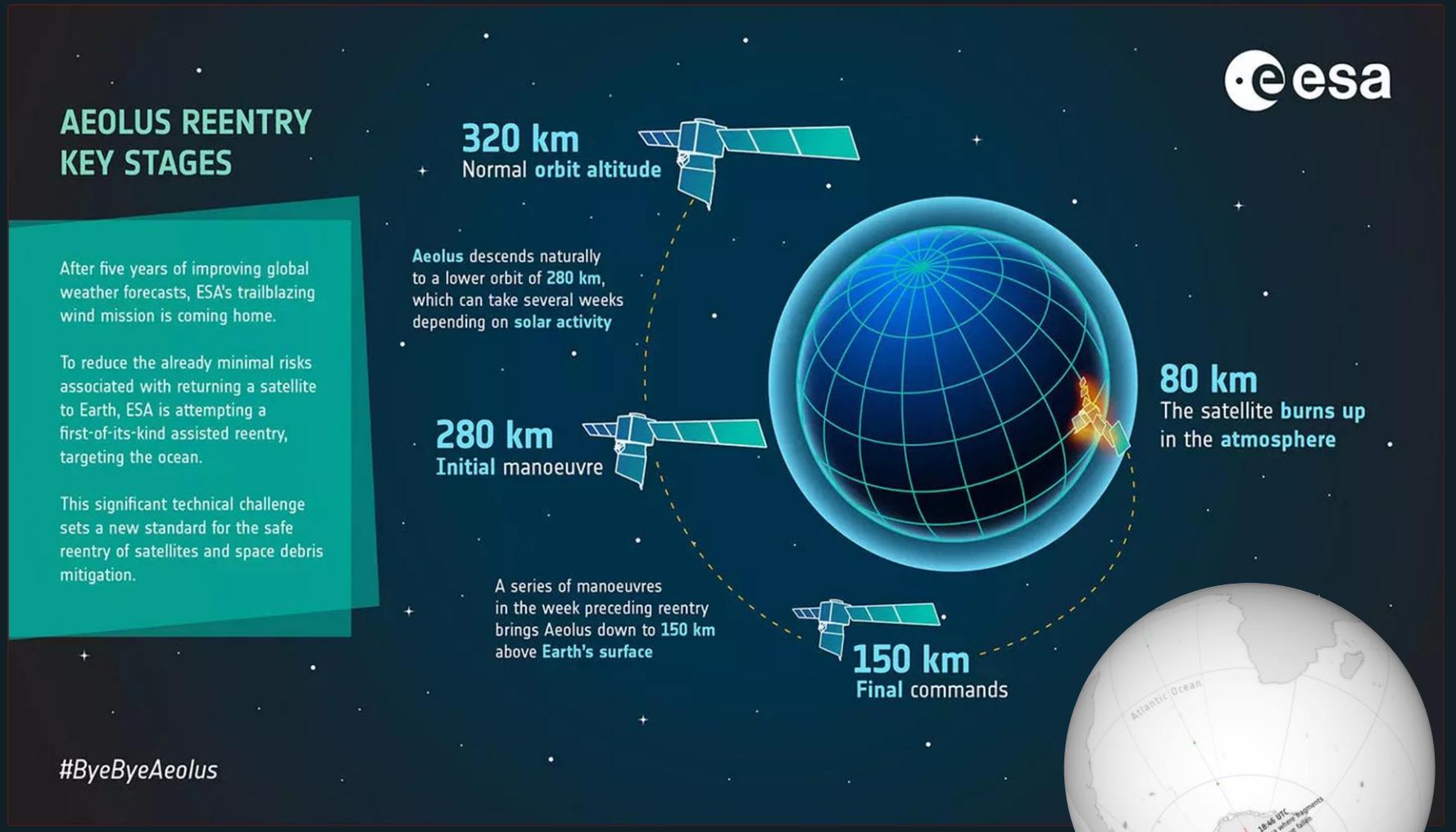








Aeolus Reentry



- Performed the first-of-kind assisted reentry
- The main operations occurred between the 24th to 28th July 2023 with a successful reentry over Antarctica @18:46 UTC 28th July close to entering the Atlantic ocean on the predicted corridor.
- All objectives were achieved reducing the casualty risk to $1.2 \cdot 10^{-6}$, 150 times lower than uncontrolled and well within ESA's Policy

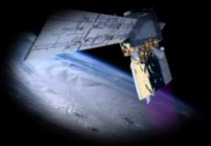
AEOLUS TOP TEN MILESTONES

1 Aeolus Launch

Aug 2018

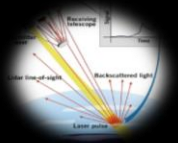
2 Start of Operations

Feb 2019



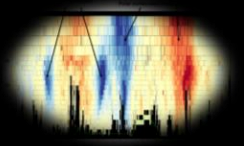
3 Switch to FM-B

Jul 2019



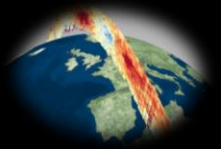
4 ECMWF Assimilates Aeolus Data

Jan 2020



5 Public Release NRT Aeolus data

May 2020



6 First JATAC Campaign

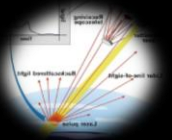
Jul 2021

7 3rd Anniversary Conference

Apr 2022

8 Back to FM-A

Oct 2022



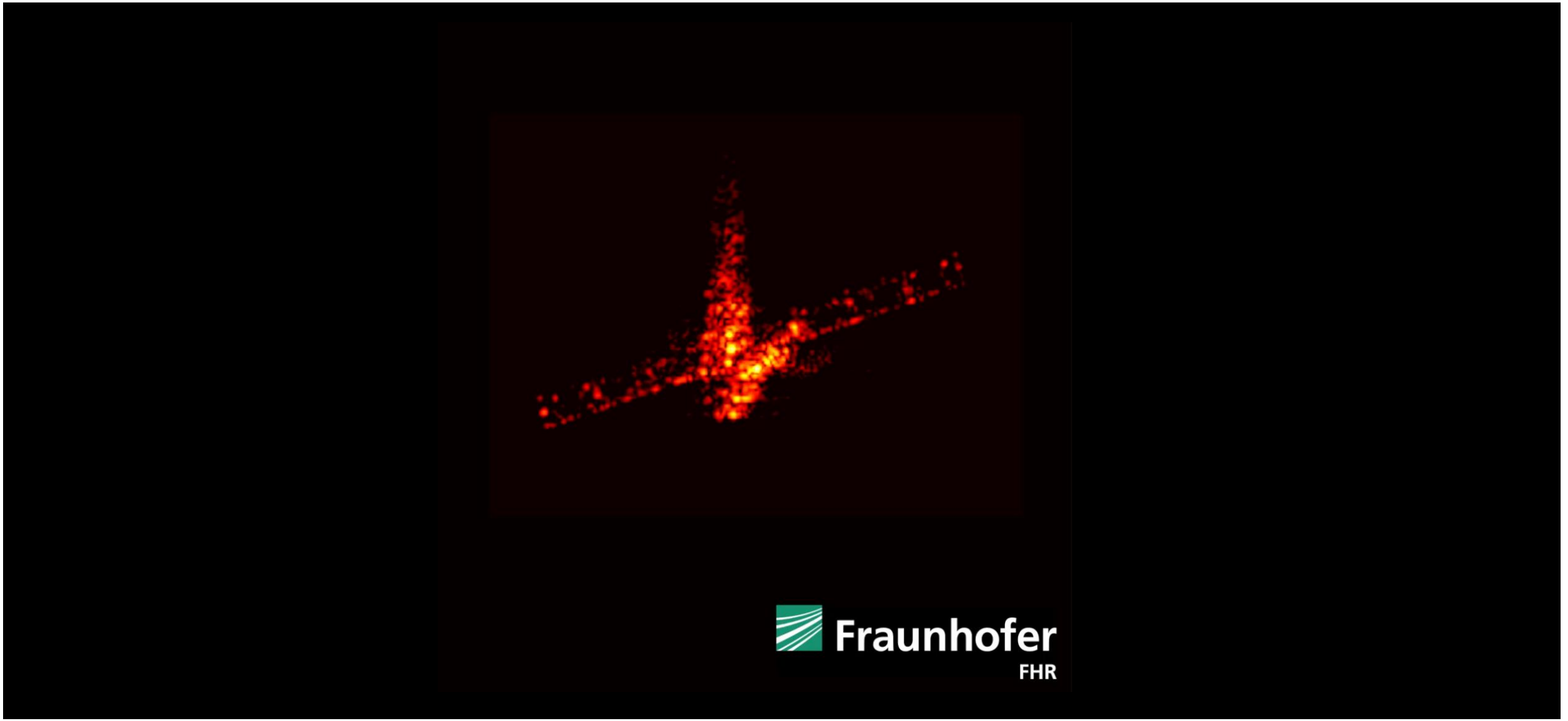
9 End of Operations

Apr 2023

X Aeolus Reenters Safely from Space

Jul 2023

Goodbye Aeolus …



… looking forward to eps-Aeolus/Aeolus-2