Enhancing Aeolus' Data Quality: From Processor Evolution to Reprocessing Campaigns in Aeolus DISC Phase F

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AEOLUS DISC

The **Aeolus Data, Innovation and Science Cluster** (DISC) is a vital component of the European Space Agency's (ESA) data quality strategy for the Aeolus mission. It is an international consortium of experts dedicated to the continuous study, monitoring, and improvement of Aeolus data quality, to processor evolution, and to the calibration, validation and Numerical Weather Prediction (NWP) impact assessment, ensuring that the mission delivers reliable and scientifically robust products.

Key tasks of the Aeolus DISC include:

- Instrument monitoring
- Calibration & Characterization
- Product quality monitoring
- Mission support
- User support, VirES
- Scientific and public outreach
- Algorithm refinement
- Processor evolution
- On-site support
- Wind & aerosol impact studies
- Product validation
- Reprocessing campaigns

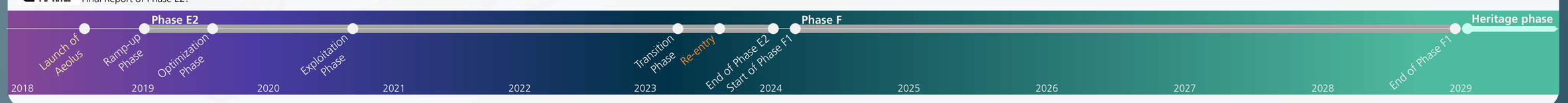
You want to learn more about the previous work of the Aeolus DISC? Then have a look at the Final Report of Phase E2!

AEOLUS MISSION PHASE F

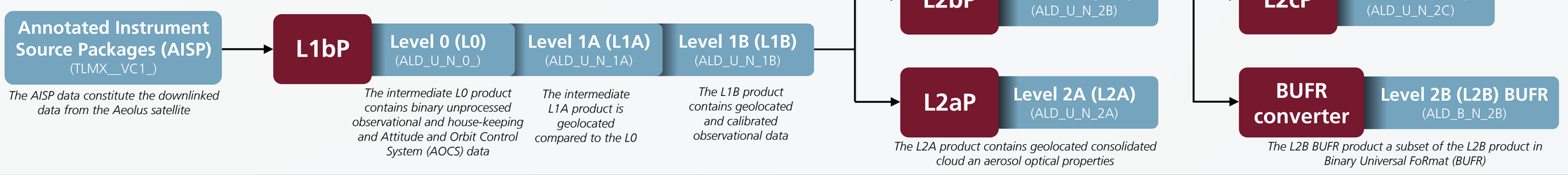
In **Phase F** of the Aeolus mission, the Aeolus DISC will continue its work with a focus on working towards a uniformly processed Aeolus dataset covering the entire mission.
The work of the Aeolus DISC aims to further foster atmospheric science, improve weather forecasts and paving the way for future operational Doppler wind lidars, e.g., the follow-on mission EPS-Aeolus/Aeolus-2.

FIVE years accomplished.
FIVE more years to come.

Two reprocessing campaigns, the 5th and 6th reprocessing campaigns, will be conducted during Aeolus Phase F. The **5th reprocessing campaign** will include major algorithm and product updates, the **6th reprocessing campaign** will harmonize the entire mission dataset for long-time storage.



AEOLUS PROCESSOR CHAIN



AEOLUS PROCESSOR BASELINE EVOLUTION

new parameters

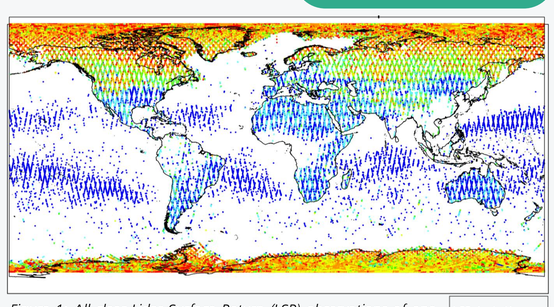


Figure 1: All clear Lidar Surface Return (LSR) observations of one month of Aeolus observations in March 2019. All clear is governed through applying the quality control criteria qflag = 0 and AOD < 1.0. Figure adapted from Labzovskii et al. (2024).

B17

- **L1B Processor Updates**:
  - Improved Rayleigh and Mie signal-to-noise ratio (SNR) calculations including the addition of the detection chain offset (DCO) and read-out noise to the Mie SNR calculation.
  - New orbital average calculation of DCO for Rayleigh and Mie SNR.
  - Inclusion of the new Mie Core 3 algorithm for the scattering ratio (SR) calculation, SNR calculation, and L1B Mie winds and error estimates for SR.
  - New algorithm and products for a spike detection (e.g. due to cosmic rays) and correction for solar background and atmospheric range gates.
  - Inclusion of the Copernicus DEM with high resolution of 90 m (currently ACE 2 from early 2000's).
- **L2A Processor Updates** :
  - Introduction of a new Lidar Surface Return (LSR) product.
  - Addition of quality flags for the attenuated backscatter coefficients
- **L2B Processor Updates** :
  - Improved handling of moon-blinding periods, flagging only periods with significant wind bias.
  - Adapted and refined grouping for Mie-cloudy and Rayleigh-clear scenes based on updated L1B SNR and SR.
  - Improved alignment of SR and SNR calculations between L1B and L2B.
- **General Updates**:
  - Digital Object Identifier (DOI) added to L0, L1A, L1B, L2A, and L2B products for better traceability and accessibility of data.
  - Refined quality controls and improved error estimates for all processor levels.
  - netCDF versions will be available of the L1A, L1B, L2A, and L2B products.

B18

- **General Updates**:
  - Primary focus on bug fixes and code optimization to ensure robust operation for future usage.
  - Baseline B18 will be used for the Aeolus long-time heritage archive.
  - Facilitating future applications of the processors for the follow-on mission Aeolus-2/EPS-Aeolus.

improved algorithms

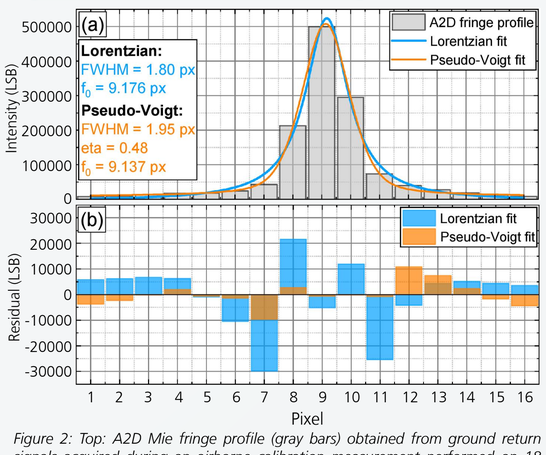
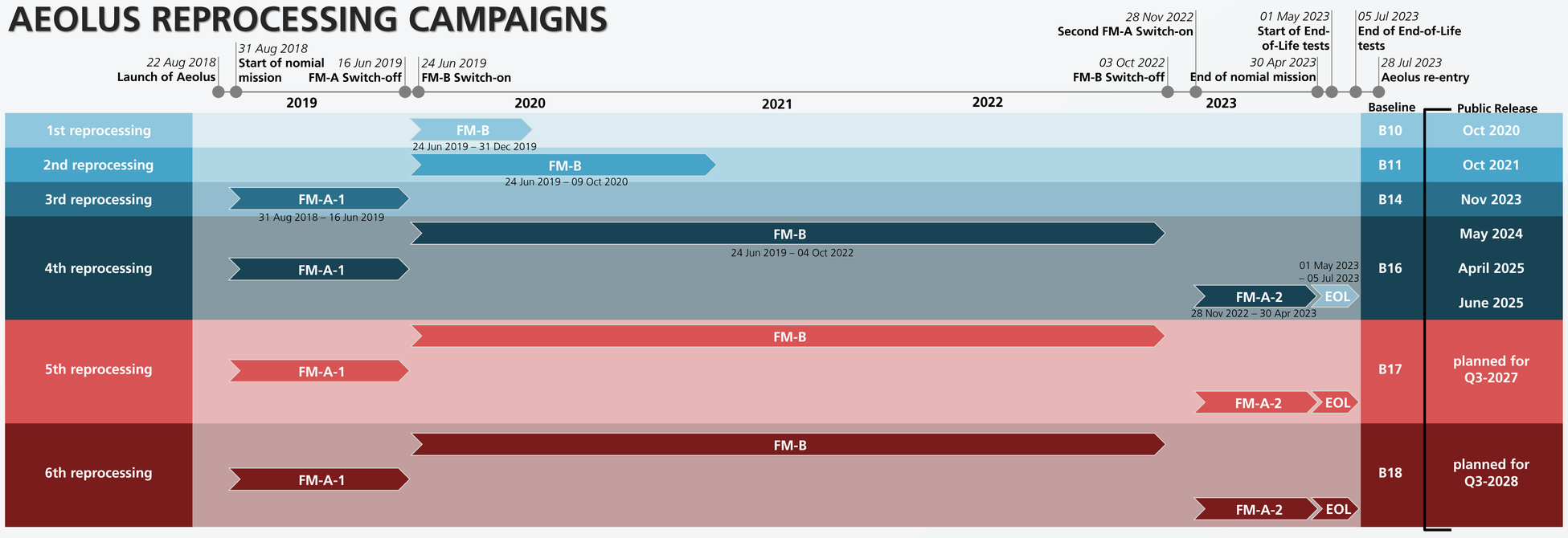


Figure 2: Top: A2D Mie fringe profile (gray bars) obtained from ground return signals acquired during an airborne calibration measurement performed on 18 September 2019. Best fits of the Lorentzian function and the pseudo-Voigt fit function are indicated by the blue and orange lines, respectively. Bottom: Corresponding residuals between measurement data, and best fits. Figure taken from Witschas et al. (2023).

AEOLUS REPROCESSING CAMPAIGNS



During the mission the operating laser of the instrument was switched between the **Flight Model laser A** (FM-A) **and Flight Model laser B** (FM-B). Thus, the Aeolus dataset is devided in the phases FM-A-1, FM-B, and FM-A-2. Additionally, the data from the End-of-Life (EOL) tests are avaible starting from B16.

Aeolus products can be accessed and downloaded via the AEOLUS Online Dissemination Service upon registration:

[1] The Aeolus DISC consortium, "The Earth Explorer Mission Aeolus for atmospheric wind observations - Final report from the Aeolus Data Innovation and Science Cluster DISC of Phase E", DLR-Forschungsbericht, DLR-FB-2024-20 (2024), https://doi.org/10.57676/93c3-n766
[2] Benjamin Witschas, Michael Vaughan, Oliver Lux, Christian Lemmerz, Ines Nikolaus, and Oliver Reitebuch, "Verification of different Fizeau fringe analysis algorithms based on airborne wind lidar data in support of ESA's Aeolus mission", Appl. Opt. 62, 7917-7930 (2023), https://doi.org/10.1364/AO.502955
[3] Lev D. Labzovskii, Gerd-Jan van Zadelhoff, David P. Donovan, Jos de Kloe, L. Gijsbert Tilstra, Ad Stoffelen, Damien Josset, and Piet Stammes, "Aeolus lidar surface return (LSR) at 355 nm as a new Aeolus Level-2A product", Atmos. Meas. Tech., 17, 7183–7208 (2024), https://doi.org/10.5194/amt-17-7183-2024

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