Validation Plans for the EarthCARE Aerosol Products Using the ATLID Lidar Simulator and the ESA and ACTRIS lidar systems

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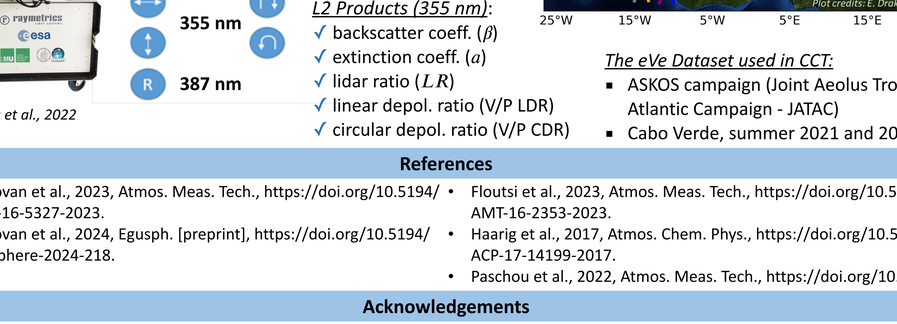
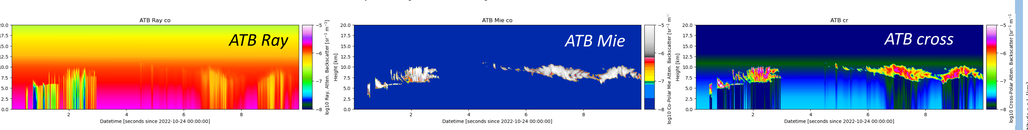
ATLID Lidar Simulator (CCT)

CCT: CARDINAL Campaign Tool

- Developed in Python for Linux OS → available at https://gitlab.com/KNMI-OSS/satellite-data-research-tools/cardinal-campaign-tools
- Simulates ATLID performance and produces ATLID L1 profiles

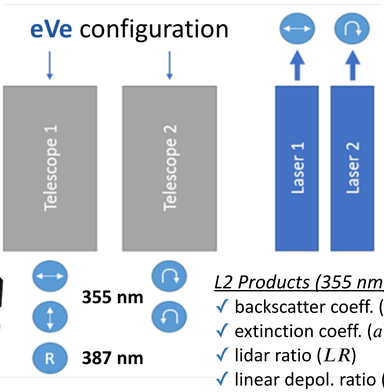


CCT outputs of ATLID L1 from a CLOUDNET test case

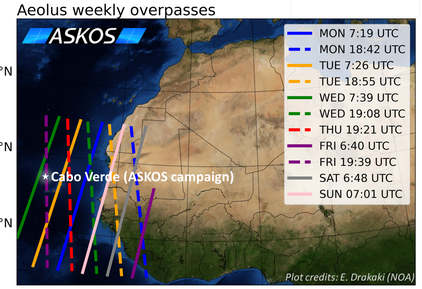


eVe Lidar

Paschou et al., 2022



Aeolus weekly overpasses

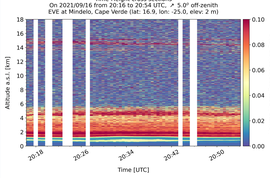


L2 Products (355 nm):
- ✓ backscatter coeff. (β)
- ✓ extinction coeff. (a)
- ✓ lidar ratio (LR)
- ✓ linear depol. ratio (V/P LDR)
- ✓ circular depol. ratio (V/P CDR)

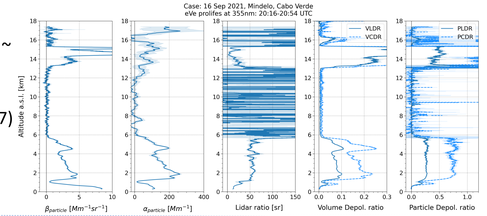
The eVe Dataset used in CCT:
- ASKOS campaign (Joint Aeolus Tropical Atlantic Campaign - JATAC)
- Cabo Verde, summer 2021 and 2022

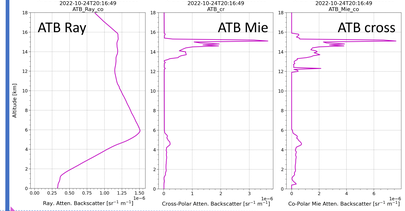
Application of CCT on eVe lidar data – Simulations of ATLID L1

16 Sep 2021 – Pure dust with cirrus cloud

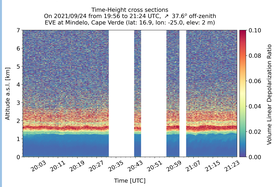


- < 1 km: Marine aerosols (LR < 20 sr, PLDR ~ 0)
- ~1 km: Depolarizing aerosols (LR ~ 33 sr, PLDR ~ 0.19) -> dry marine or mixed dust marine (Haaring et al., 2017; Floutsi et ., 2023)
- @1.5 – 6 km: Pure dust (LR ~ 56 sr, PLDR ~ 0.27)
- @13 – 15 km: Cirrus cloud (LR < 20 sr, PLDR ~ 0.5)

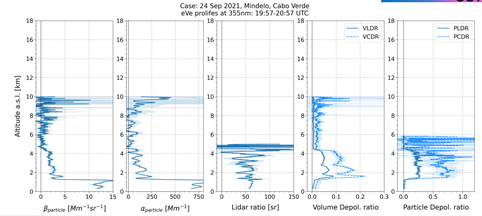


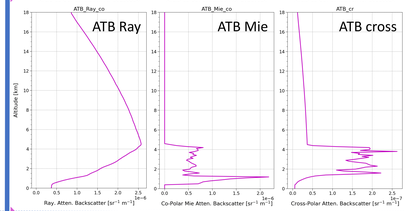


24 Sep 2021 – Volcanic mixtures (sulfates) with sea salt and dust

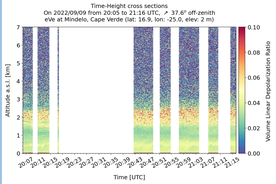


- < 1.5 km: Marine and volcanic aerosol mixture (LR ~ 67 sr, PLDR ~ 0)
- @1.8 – 4.1 km: Mixed dust and volcanic aerosols (LR < 60 sr, PLDR ~ 0.25)

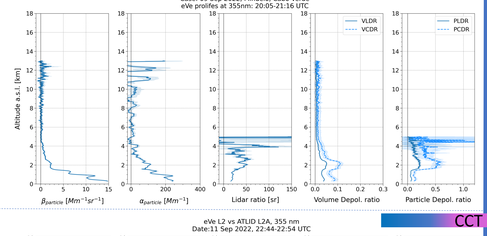


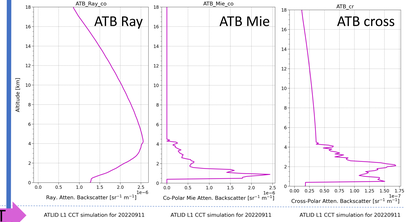


9 Sep 2022 – Mixed Dust case

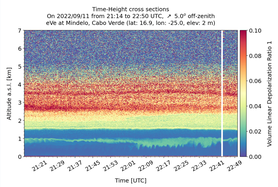


- < 1 km: Marine aerosols (LR ~ 20 sr, PLDR ~ 0.05)
- @1.5 - 4 km: Mixed dust and marine aerosols (LR < 50 sr, PLDR< 0.20)

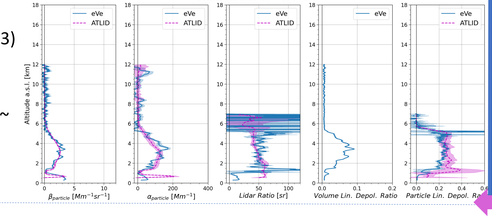


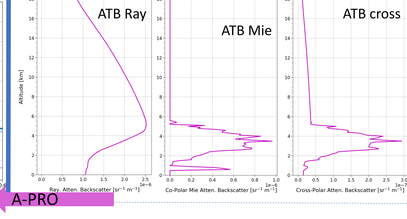


11 Sep 2022 – Pure Dust case



- < 1 km: Marine aerosols (LR < 20 sr, PLDR ~ 0.03)
- @ 1 km: Non-absorbing depolarizing aerosols (LR < 20 sr, PLDR ~ 0.12) -> dry marine
- @ 1.5 - 6 km: Pure dust layer (LR ~ 53 sr, PLDR ~ 0.24)



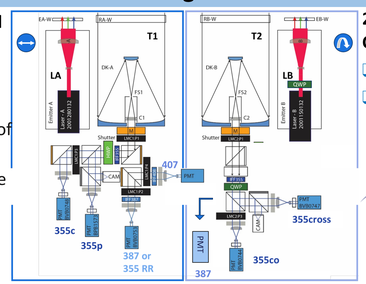


Summary and Next Steps:

- ❑ eVe L2 vs ATLID L2A: Good agreement for β; under/over estimations for α and LR; large deviations (up to 0.3) for depolarization → issue on the A-PRO depolarization retrieval
- ❑ Ongoing update of A-PRO processor to fix the depolarization retrieval (Donovan et al., 2024) → obtain updated ATLID L2A profiles for the eVe cases
- ❑ Comparison between the updated ATLID L2A and the eVe L2 profiles → finalize the sensitivity study of ATLID design on different aerosol conditions
- ❑ Use of ESA eVe and NOA PollyXT lidar profiles as input to CCT for the ATLID L1 validation

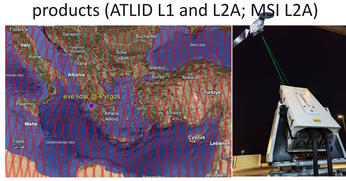
Planning eVe lidar activities for EarthCARE Cal/Val

1. eVe lidar upgrade to enhance EarthCARE Cal/Val
- ❑ Retainment of combined linear/circular depolarization and Raman measurements
- ❑ Daytime extinction measurements in T1
- ❑ New Raman channel (407 nm) in T1 for profiling of water vapor mixing ratio
- ❑ Extra Raman channel (387 nm) in T2 for nighttime extinction profiling to enhance the Dual-FOV capabilities
- ❑ Automations to enhance measurement procedures



2. Integration of eVe lidar to the EARLINET Single Calculus Chain (SCC)
- ❑ only eVe linear polarization measurements for now
- ❑ quality controlled and assured eVe L2 retrievals according to ACTRIS standards

3. eVe lidar to an EarthCARE cross overpass point
- ❑ Collocated measurements for the validation of the EarthCARE aerosol products (ATLID L1 and L2A; MSI L2A)



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Acknowledgements

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