A sensitivity study using the ATLID lidar simulator and upcoming plans for the validation of EarthCARE mission

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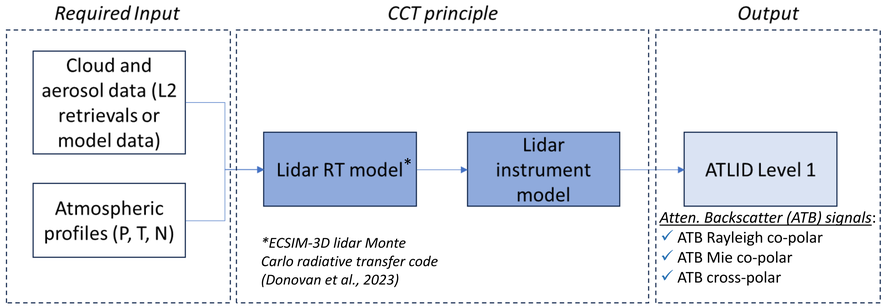
ATLID Lidar Simulator (CCT)

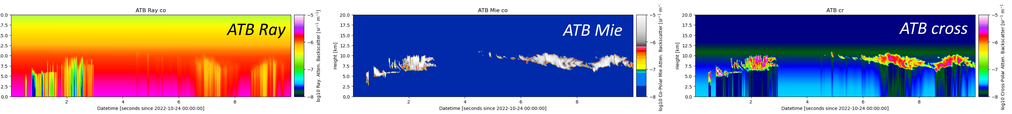
CARDINAL Campaign Tool (CCT) KNMI

- Developed in Python for Linux OS → available at https://gitlab.com/KNMI-OSS/satellite-data-research-tools/cardinal-campaign-tools

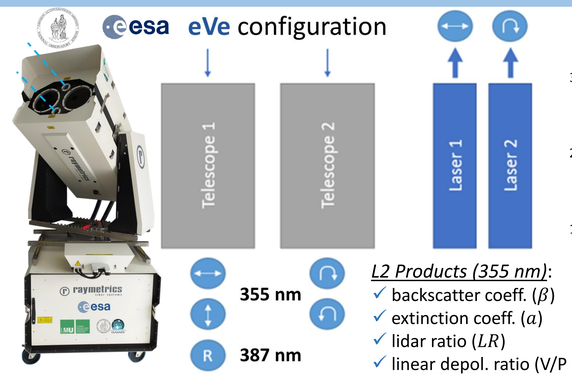
- Simulates ATLID performance and produces ATLID L1 profiles



CCT outputs of ATLID L1 from a CLOUNET test case

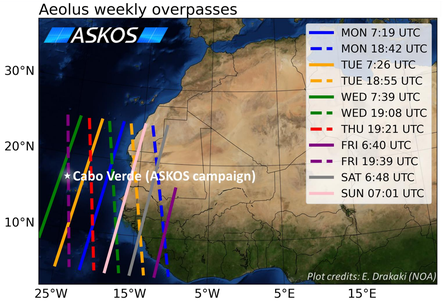


eVe Lidar



Paschou et al., 2022

Aeolus weekly overpasses

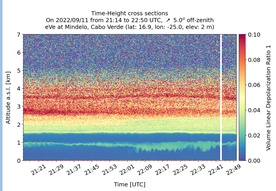


L2 Products (355 nm):
- ✓ backscatter coeff. (β)
- ✓ extinction coeff. (α)
- ✓ lidar ratio (LR)
- ✓ linear depol. ratio (V/P LDR)
- ✓ circular depol. ratio (V/P CDR)

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

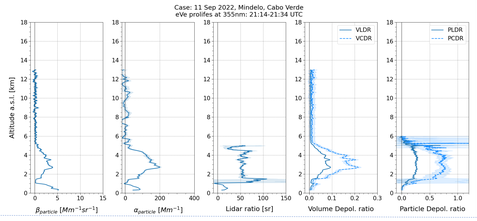
Application of CCT on eVe lidar data – Simulations of ATLID L1

11 Sep 2022 – Pure Dust case

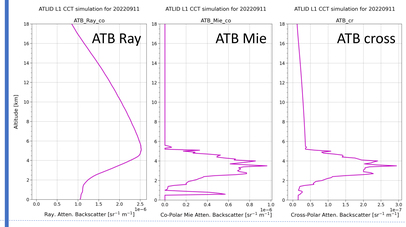


- < 1 km: Marine aerosols (LR < 20 sr, PLDR ~ 0.03)
- @ 1 km: Non-absorbing depolarizing aerosols (LR < 20 sr, PLDR ~ 0.12) -> dry marine; Haaring et al., 2017
- @ 1 – 1.5 km: Absorbing and depolarizing aerosols (LR ~ 80 sr, PLDR ~ 0.1) -> mixed dust and smoke; Floutsi et al., 2023
- @ 1.5 - 6 km: Pure dust layer (LR ~ 53 sr, PLDR ~ 0.24)

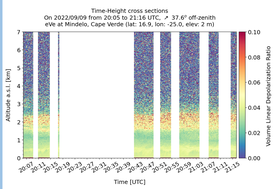
eVe L2 profiles – CCT input



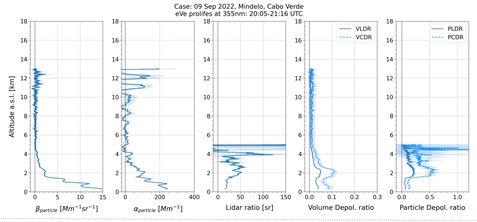
CCT outputs – ATLID L1 profiles

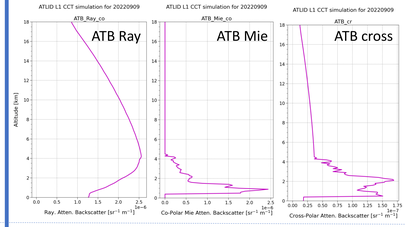


9 Sep 2022 – Mixed Dust case

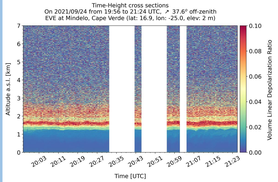


- < 1 km: Marine aerosols (LR ~ 20 sr, PLDR ~ 0.05)
- @1.5 - 4 km: Mixed dust and marine aerosols (LR < 50 sr, PLDR < 0.20)

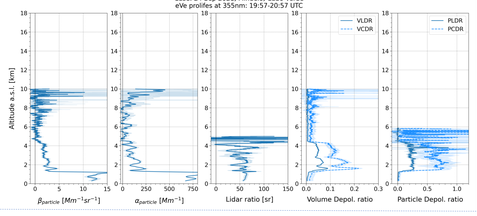


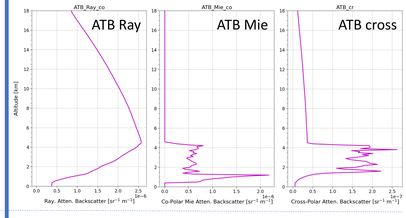


24 Sep 2021 – Volcanic mixtures (sulfates) with sea salt and dust

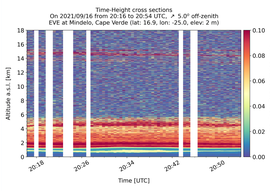


- < 1.5 km: Marine and volcanic aerosol mixture (LR ~ 67 sr, PLDR ~ 0)
- @1.8 – 4.1 km: Mixed dust and volcanic aerosols (LR < 60 sr, PLDR ~ 0.25)

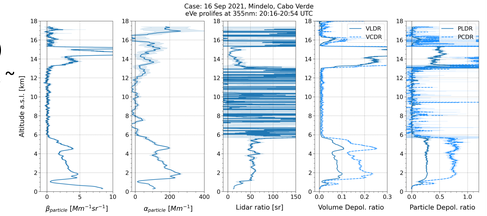


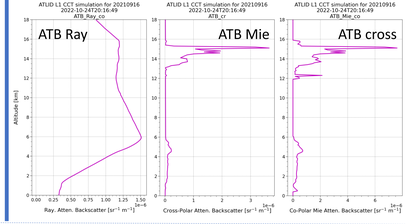


16 Sep 2021 – Pure dust with cirrus cloud



- < 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
- @1.5 – 6 km: Pure dust (LR ~ 56 sr, PLDR ~ 0.27)
- @13 – 15 km: Cirrus cloud (LR < 20 sr, PLDR ~ 0.5)

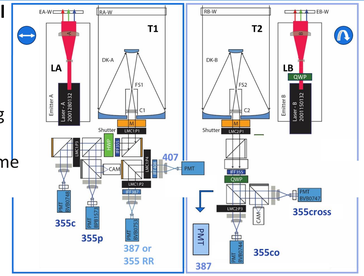




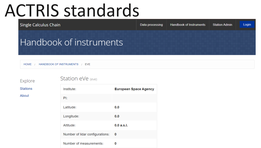
Next Steps: Use the simulated L1 ATLID profiles in the A-PRO processing chain (Donovan et al., 2024) to obtain ATLID L2A products (β, α, LDR) → Compare with the eVe L2 profiles → sensitivity of ATLID design on different aerosol conditions

Planning eVe lidar activities for EarthCARE Cal/Val

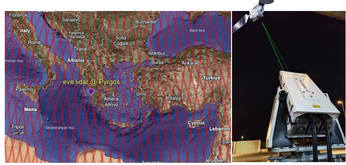
1. eVe lidar upgrade to enhance EartCARE Cal/Val
- ❑ Retainment of combined linear/circular depolarization and Raman measurements
- ❑ Daytime extinction measurements in T1
- ❑ New Raman channel (407 nm) in T1 for profiling of water vapor mixing ratio
- ❑ Extra Raman channel (387 nm) in T2 for nighttime 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 with EarthCARE for the validation of the ATLID L1 and L2A aerosol products



References

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- Donovan et al., 2024, Egusph. [preprint], https://doi.org/10.5194/egusphere-2024-218.
- Floutsi et al., 2023, Atmos. Meas. Tech., https://doi.org/10.5194/AMT-16-2353-2023.
- Haarig et al., 2017, Atmos. Chem. Phys., https://doi.org/10.5194/ACP-17-14199-2017.
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Acknowledgements

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