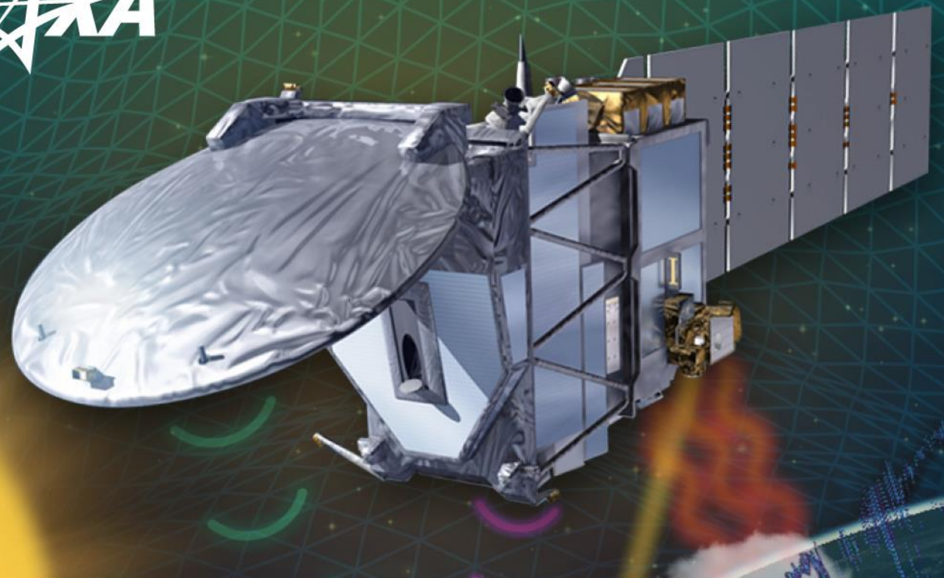

ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

Validation of EarthCARE's aerosol model HETEAC with airborne in-situ observations

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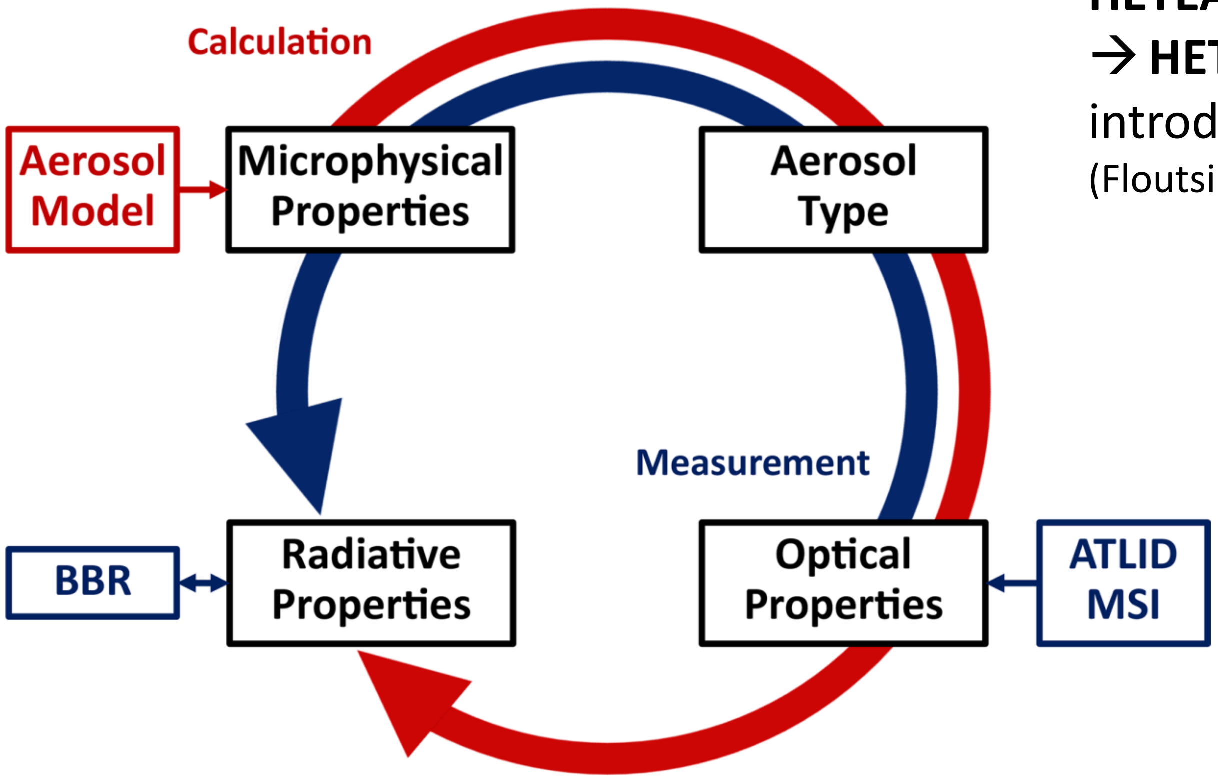
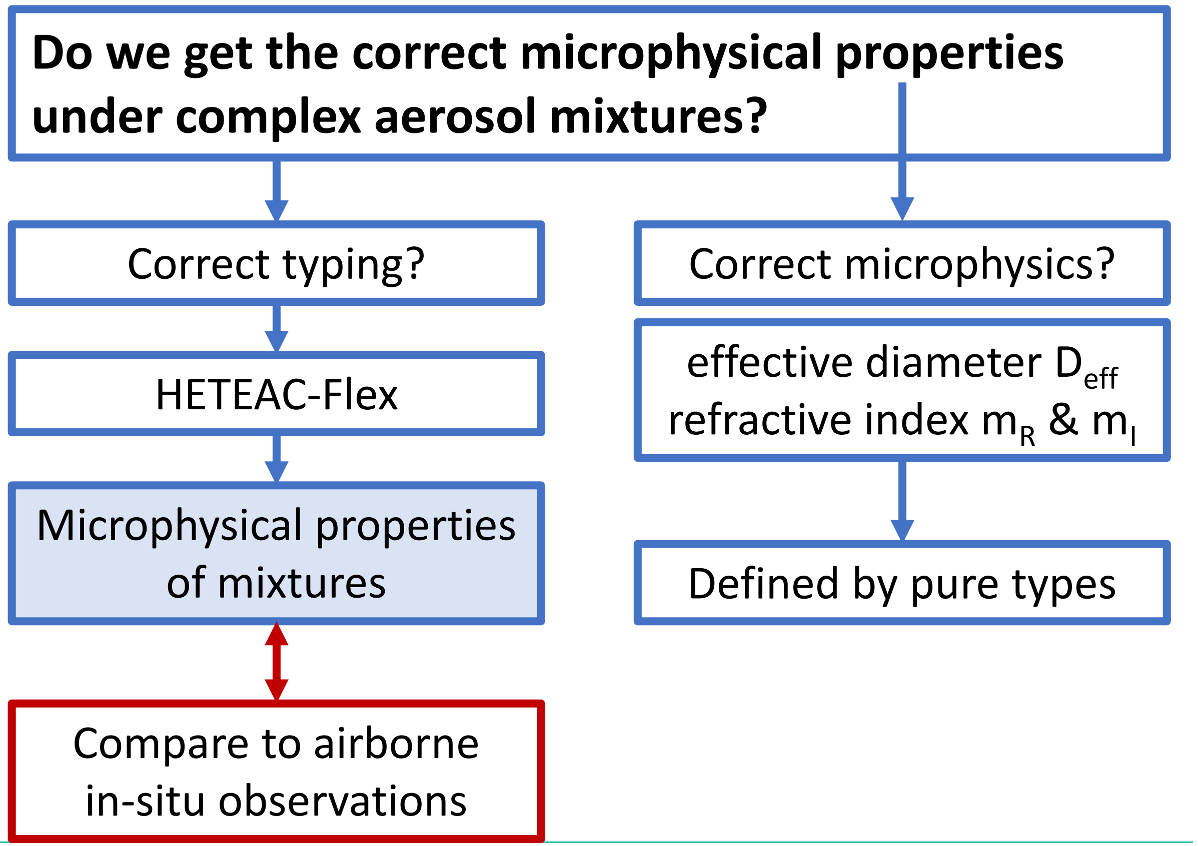
HETEAC-Flex Validation

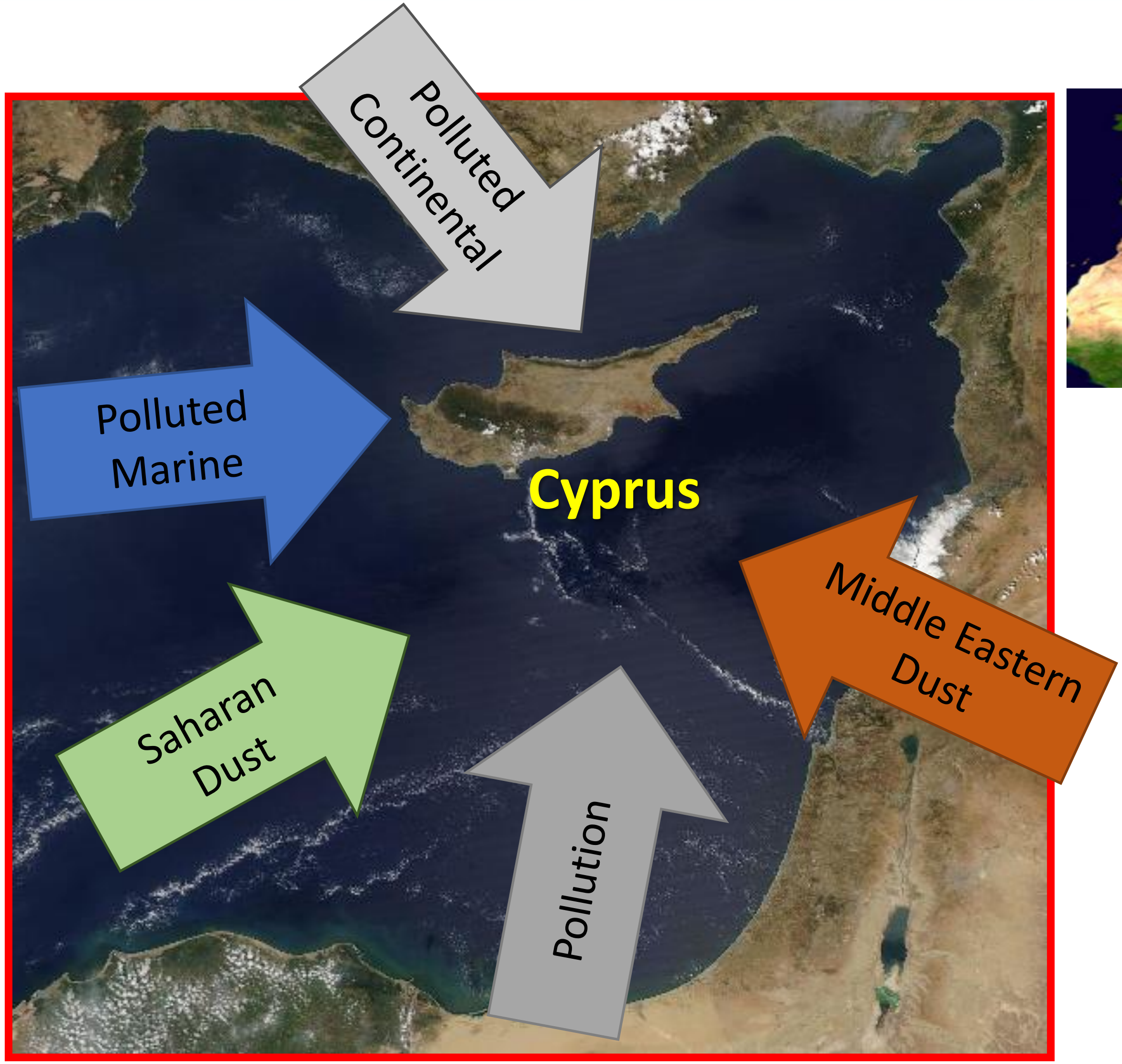


HETEAC: Aerosol model behind all calculations in EarthCARE processors (Wandinger et al., 2023)

HETEAC (Look-Up Tables at 355 nm)
→ **HETEAC-Flex** (Optimal Estimation at 355, 532 and 1064 nm)
introduced in previous talk by Athena Floutsi
(Floutsi et al., in discussion 2023)



Cyprus – Complex aerosol mixtures



A-LIFE campaign
- April 2017
- ERC grant of B. Weinzierl
- Additional funding from ESA for HETEAC Validation

In situ (air)
Aircraft in-situ
- size distr.
- refractive index

Remote sensing (ground)
Lidar (**3** bsc. + **2** ext. + **2** depol.)
Cloud radar
Radiation

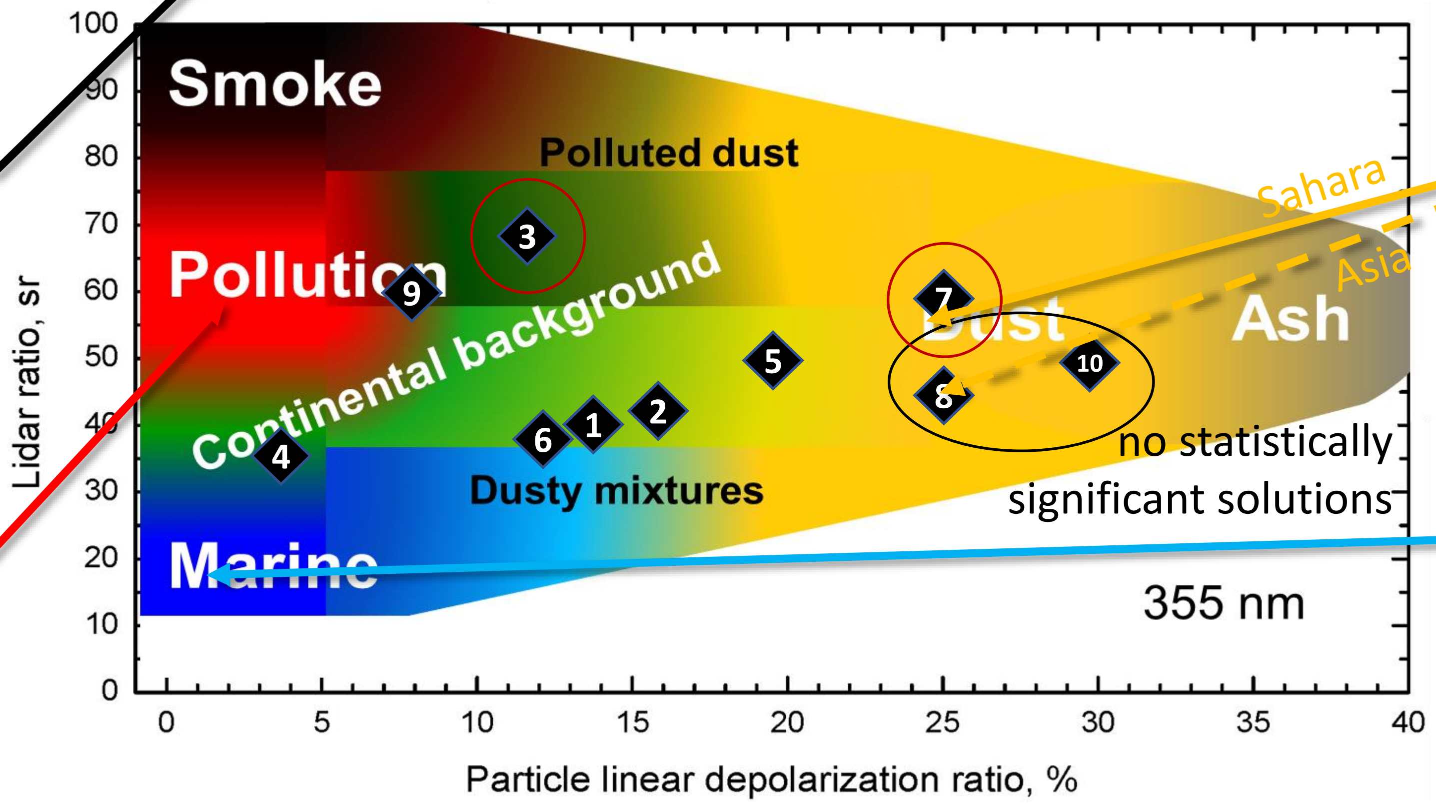
355
532
1064

TROPOS

10 Cases for comparison

Fine Spherical Absorbing (FSA)
D_{eff} = 0.28 µm
m_R = 1.50
m_I = 0.043

Fine Spherical Non-Absorbing (FSNA)
D_{eff} = 0.28 µm
m_R = 1.45
m_I = 0.001



Coarse Non-Spherical (CNS)
D_{eff} = 3.88 µm
m_R = 1.54
m_I = 0.006

Coarse Spherical (CS)
D_{eff} = 3.88 µm
m_R = 1.37
m_I = 4e-8

Fine mode

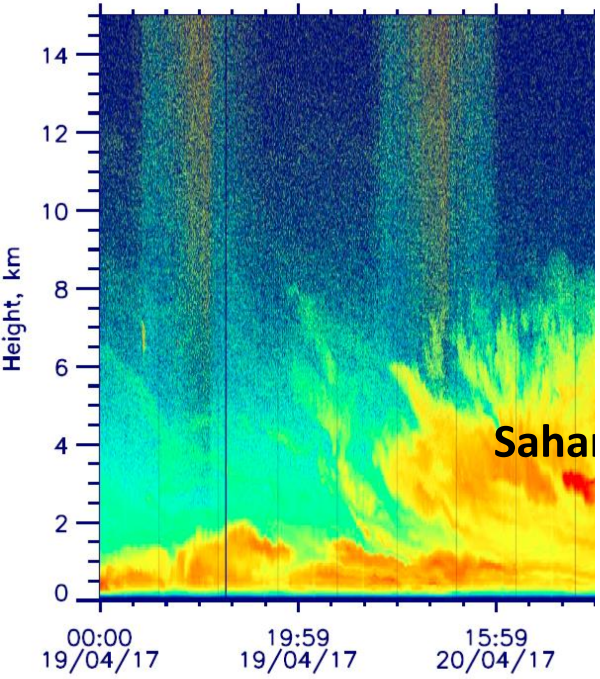
Coarse mode

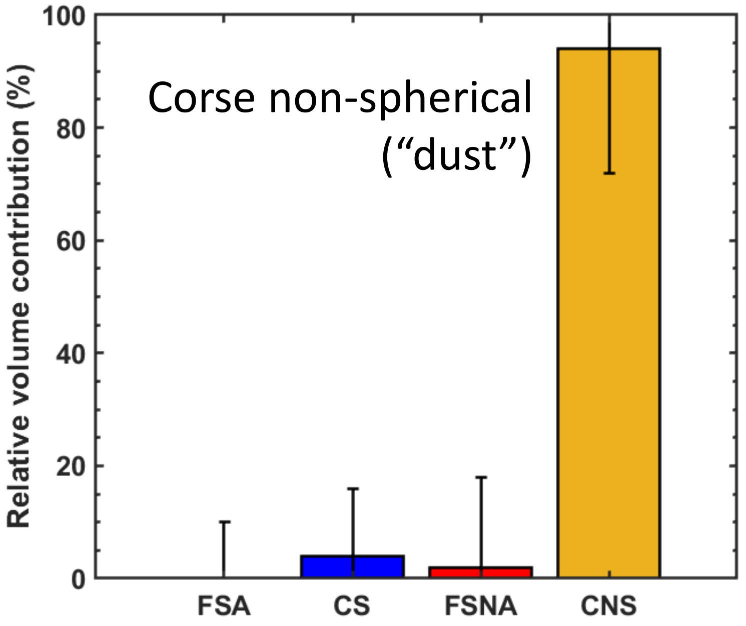
Rarely pure cases → Complex mixtures in the Eastern Med.

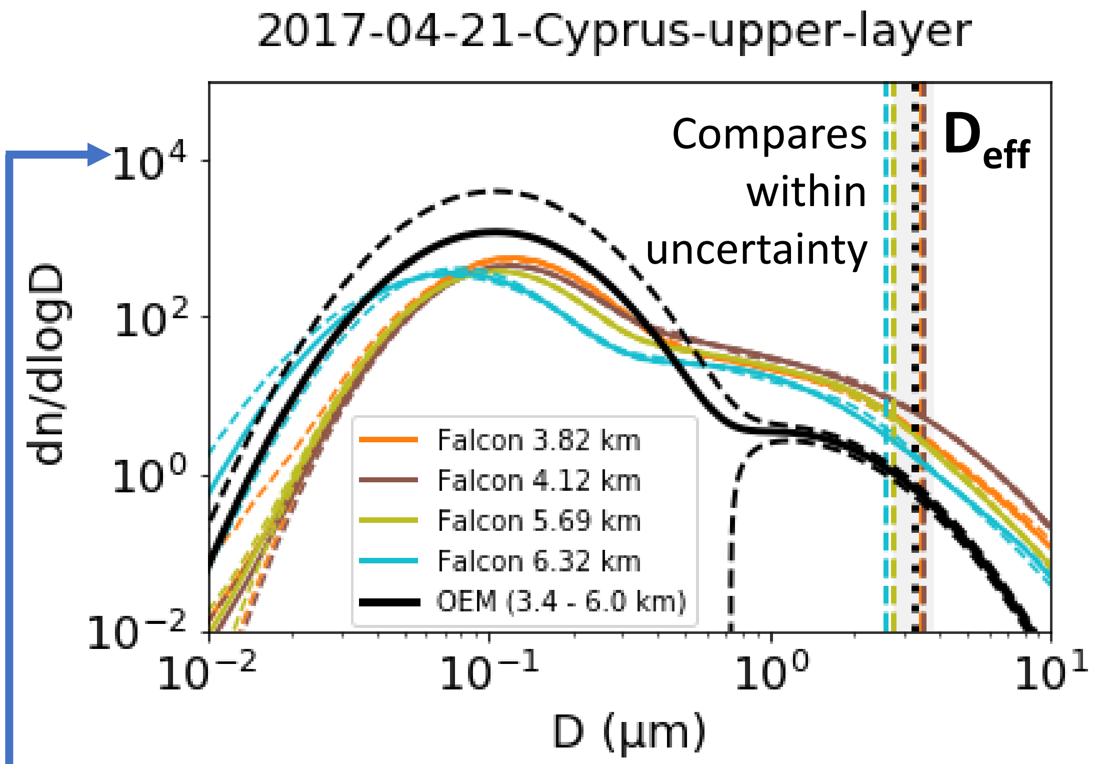
Optical properties for HETEAC-Flex do slightly differ from HETEAC

Floutsi et al., 2023
Wandinger et al., 2023

Dust-dominated case 21 April 2017





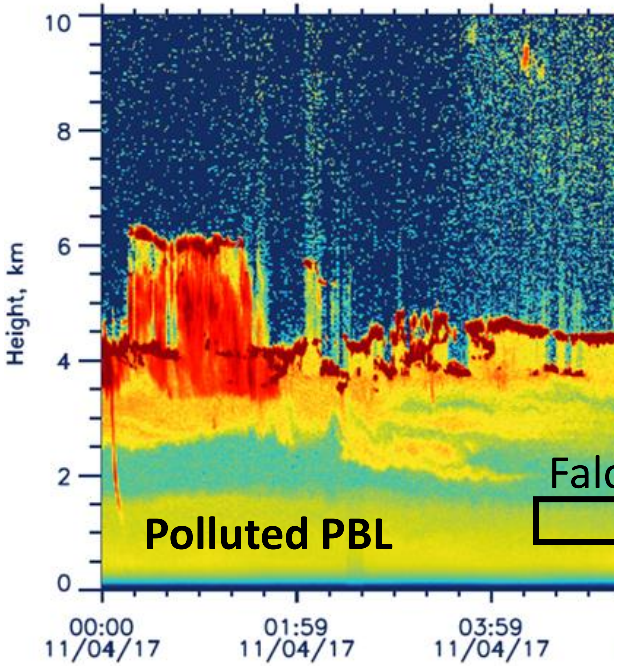


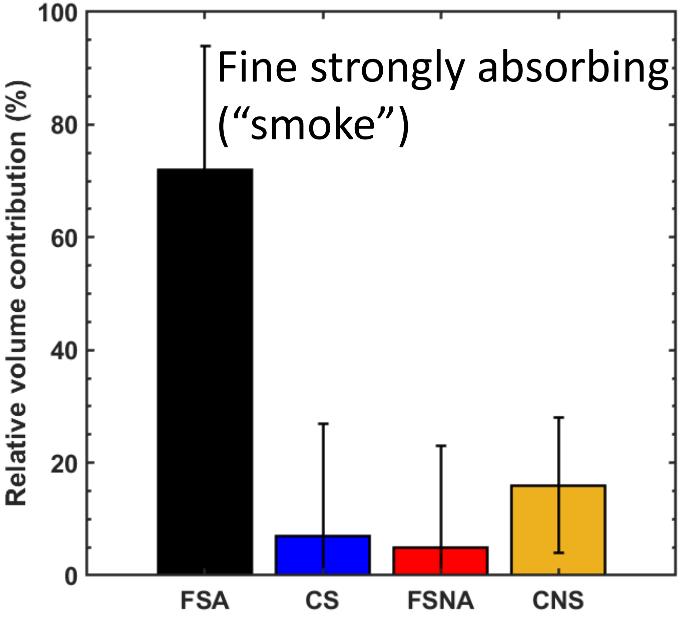
HETEAC-Flex

Optical Properties at 3.4 – 6.0 km height (355, 532 nm)	355 nm	532 nm
Lidar Ratio (sr)	60 ± 9	51 ± 8
Depolarization Ratio	25 ± 2%	28 ± 2%

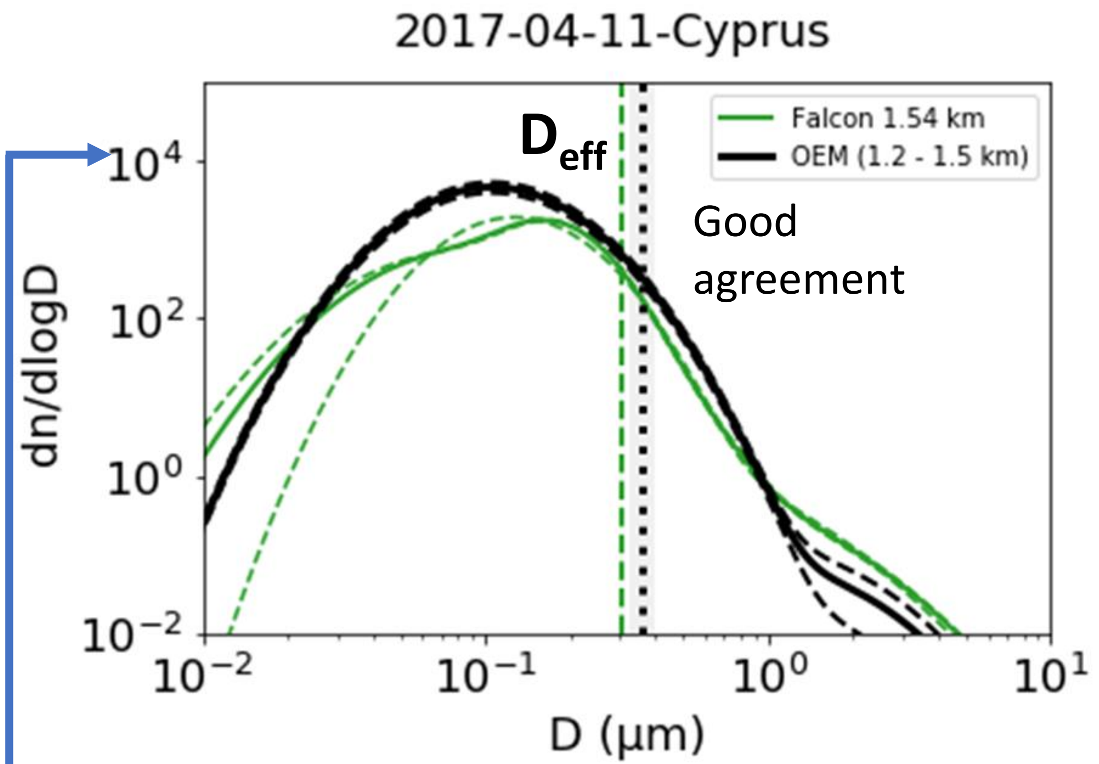
Refractive Index (Preliminary)	HETEAC_flex	in-situ
Real part	1.534 ± 0.008	1.58
Imaginary part	0.0057 ± 0.0013	0.0111
	355 nm	550 nm 370 nm

Non-dust-dominated case 11 April 2017





HETEAC-Flex



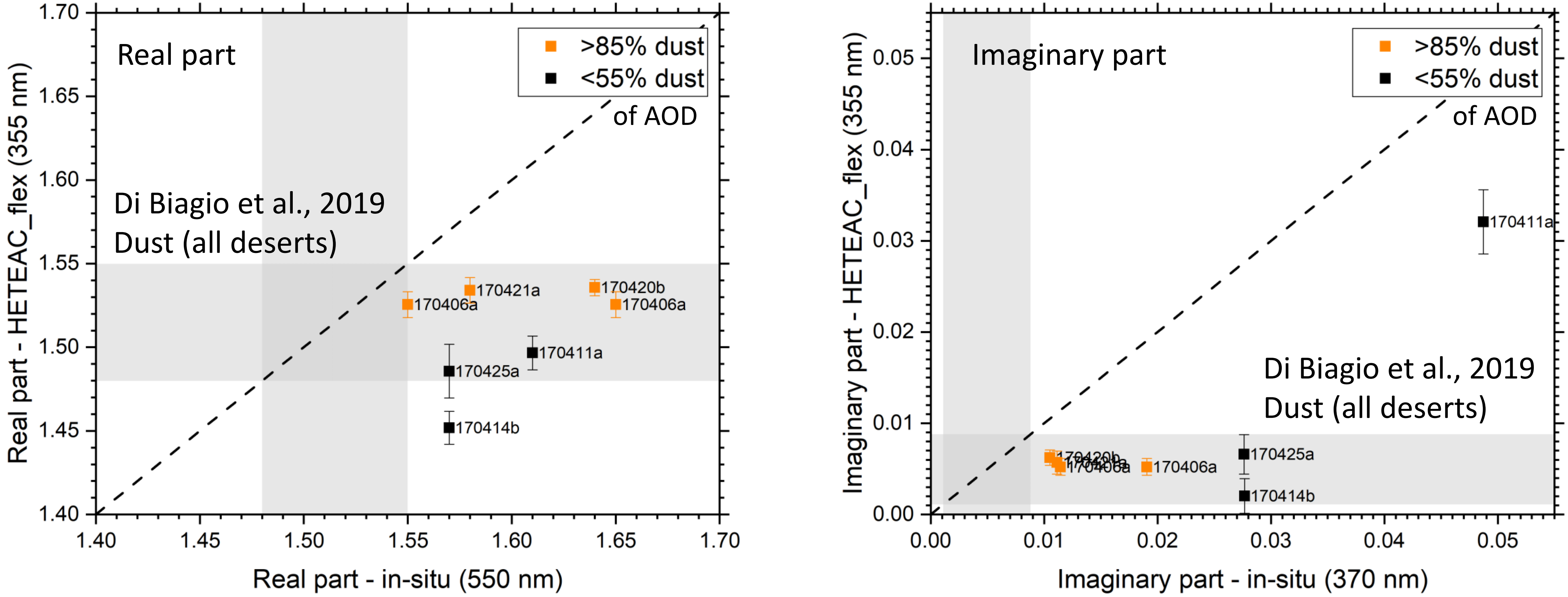
Optical Properties at 1.2 – 1.5 km height (355, 532 nm)	355 nm	532 nm
Lidar Ratio (sr)	67 ± 13	66 ± 32
Depolarization Ratio	12 ± 2%	4.5 ± 2%

Refractive Index

(Preliminary)	HETEAC_flex	in-situ
Real part	1.497 ± 0.010	1.61
Imaginary part	0.032 ± 0.004	0.049
	355 nm	550 nm 370 nm

Refractive Index Comparison (preliminary)

in situ: Offline analysis of filter samples at TU Darmstadt



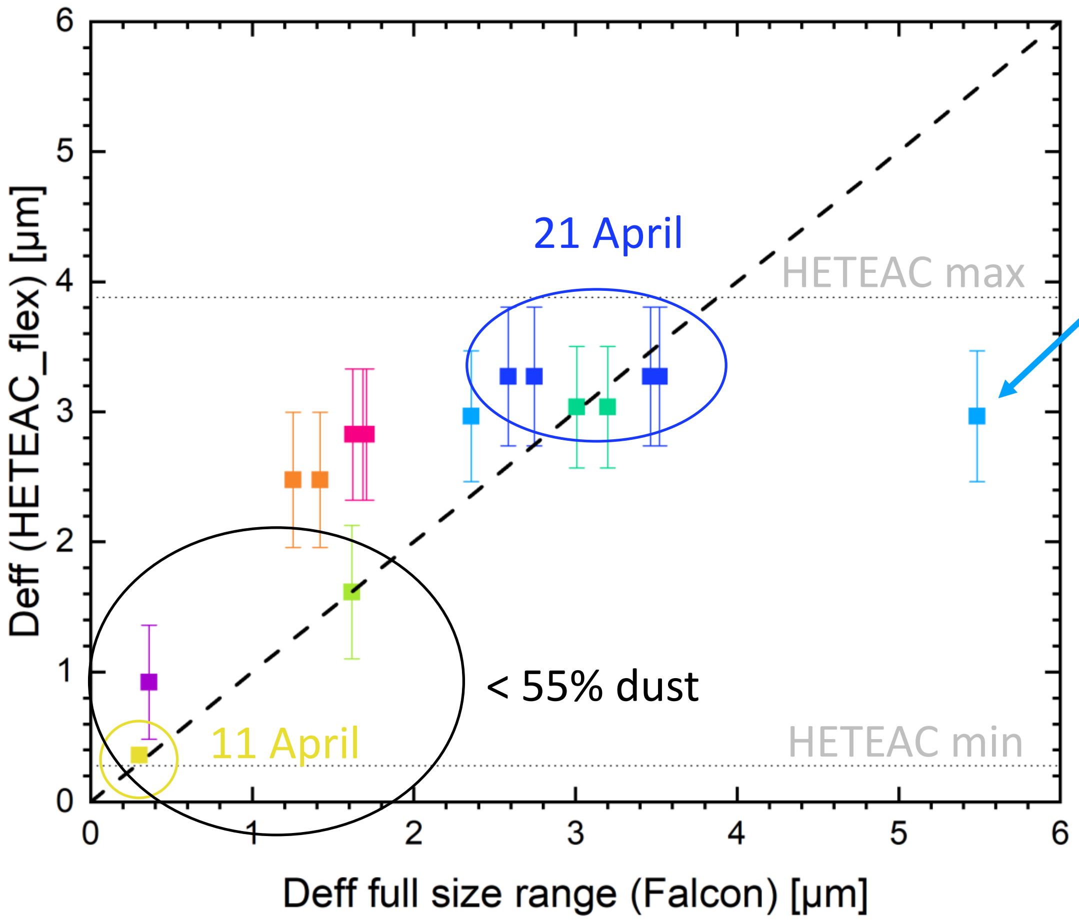
Underestimation by HETEAC-Flex compared to filter sample analysis

HETEAC-Flex based on previous observations (maximum value of m_R = 1.54)

Preliminary comparison
Maybe more absorbing aerosol and polluted dust in Eastern Mediterranean?

Effective Diameter Comparison

in situ: combination of several instruments (10 nm – 50 µm) of University of Vienna



- If a statistically significant solution was found: Good agreement for dust-dominated and non-dust-dominated cases
- Single events of large particles are not covered
- All cases represent (complex) mixtures of aerosol components
  → Confidence that HETEAC-Flex provides good estimates of effective diameter

Conclusion

HETEAC-Flex

- is available for EarthCARE validation (Floutsi et al., 2023 in discussion)
- uses 4 aerosol components with prescribed properties

  to derive the microphysical properties of aerosol mixtures
- **effective diameter** is in good agreement with airborne in situ observations
- work on **refractive index** comparison is ongoing

Lidar + airborne in situ is important source of information to validate retrievals

- In-situ observations should cover full size range (≈10 nm – 50 µm)
- A-LIFE provided good comparisons in complex mixtures
- We are open to include further data sets (lidar + in-situ), e.g., from ACTIVATE

We acknowledge funding from ESA for the A-CARE project (ESA RFP 3-15303/18/NL/CT/gp)