Variability of Dust Optical Properties during Severe Dust Events over the Mediterranean

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HARMONIA

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National and Kapodistrian University of Athens

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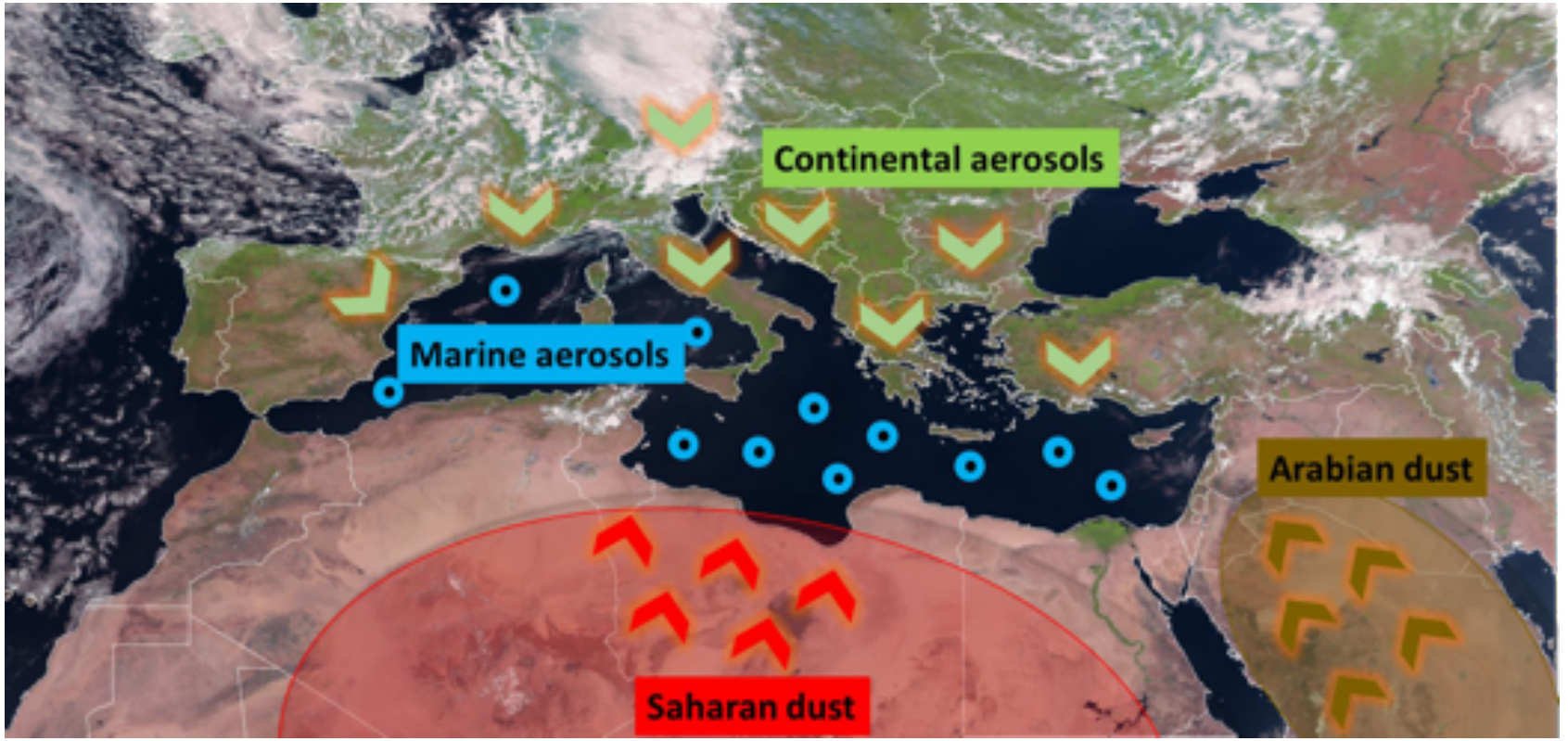
ARISTOTLE UNIVERSITY OF THESSALONIKI

The Cyprus Institute

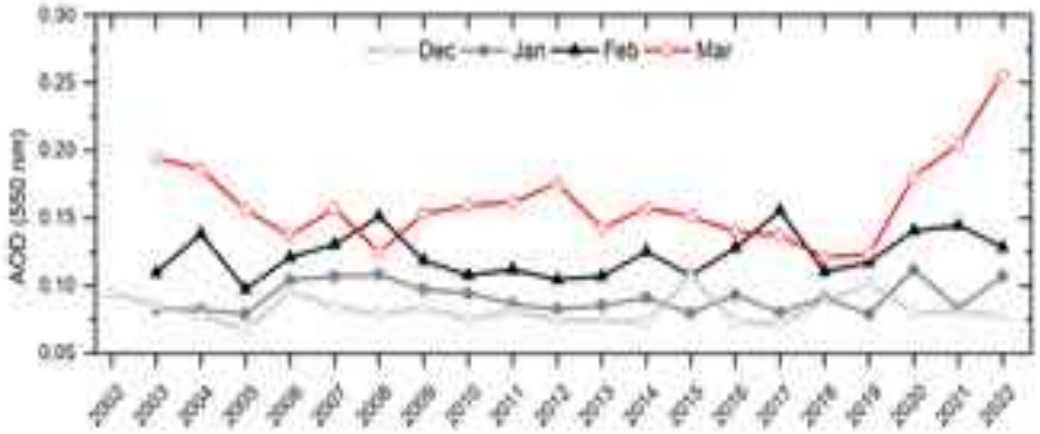
Mediterranean Basin – Dust events

- Aerosol radiative forcing in this region is among the highest globally (Zittis et al. 2022).
- Heavily influenced by dust events from Saharan and Arabian desserts



Increasing frequency of dust storms

- Unprecedented dust transport observed between 2020 and 2022 (Cuevas-Agulló et al., 2024)



Source: Cuevas-Agulló et al., 2024

This study

How do dust properties and aerosol mixing evolve during atmospheric transport across the Mediterranean?

1

Identify significant and diverse dust events that affected the Mediterranean Basin between 2021 and 2022

2

Examine the optical and mineralogical properties of dust during the identified dust events based on remote sensing observations and models

3

Evaluate how in-situ observations compare with remote sensing data and model outputs

Identifying Events

Intensity – Optical properties

-AERONET

-MIDAS

-IASI

Altitude

-EARLINET

-IASI

Trajectories

-HYSPLIT

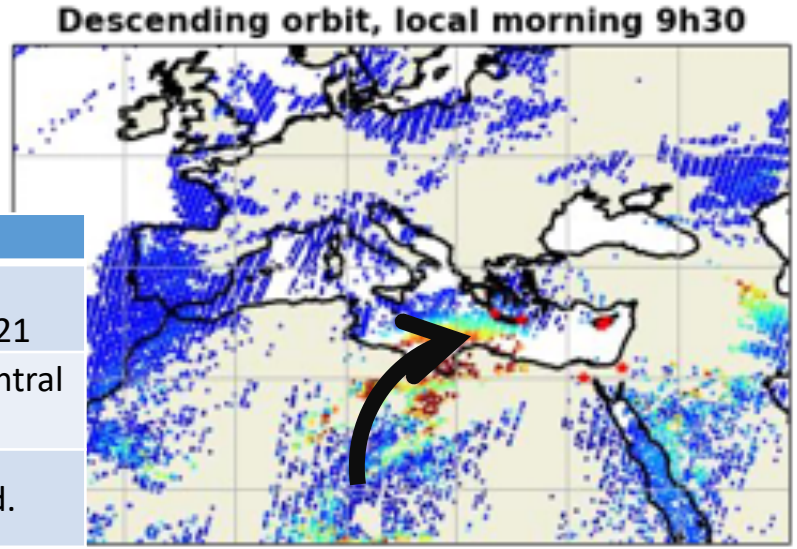
-MIDAS

-IASI

HYSPLIT
AIR RESOURCES LAB

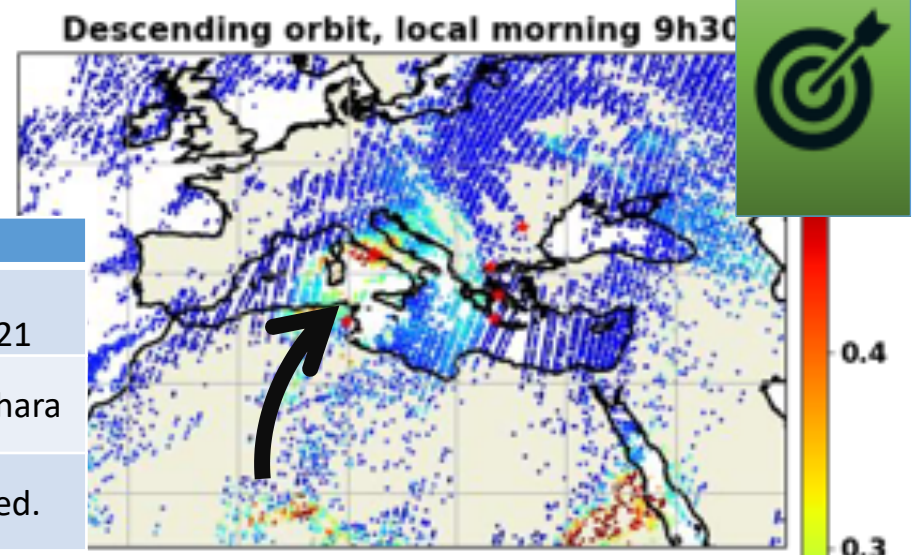
4 Dust Events

22/03/2021-IASI AOD

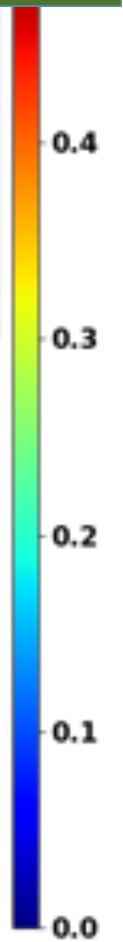


Event	A
Dates	18/03-29/03/2021
Origin	East and Central Sahara
Affected regions	East Med.

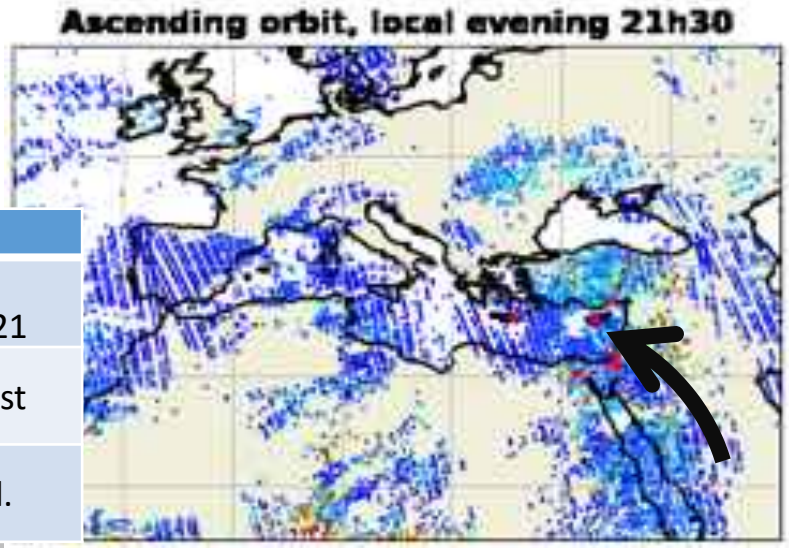
21/06/2021-IASI AOD



Event	B
Dates	17/06-28/06/2021
Origin	Western Sahara
Affected regions	Central Med.

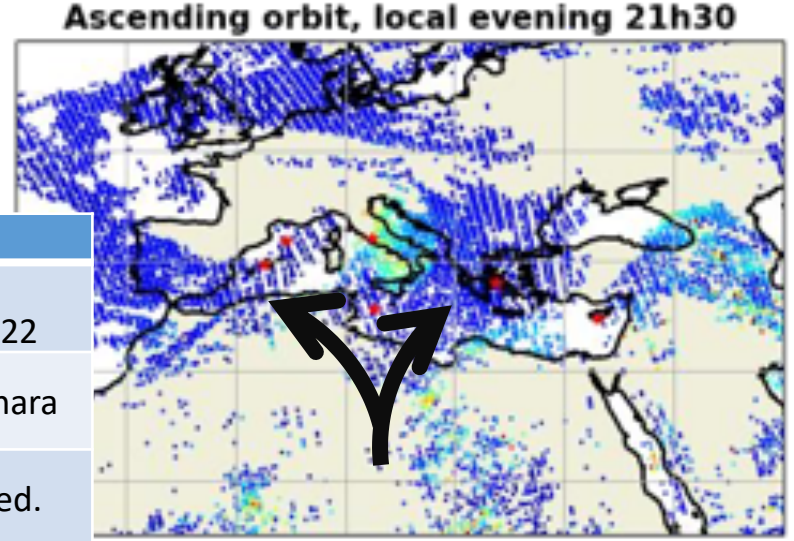


17/11/2021-IASI AOD



Event	C
Dates	10/11-21/11/2021
Origin	Middle East
Affected regions	East Med.

23/04/2022-IASI AOD

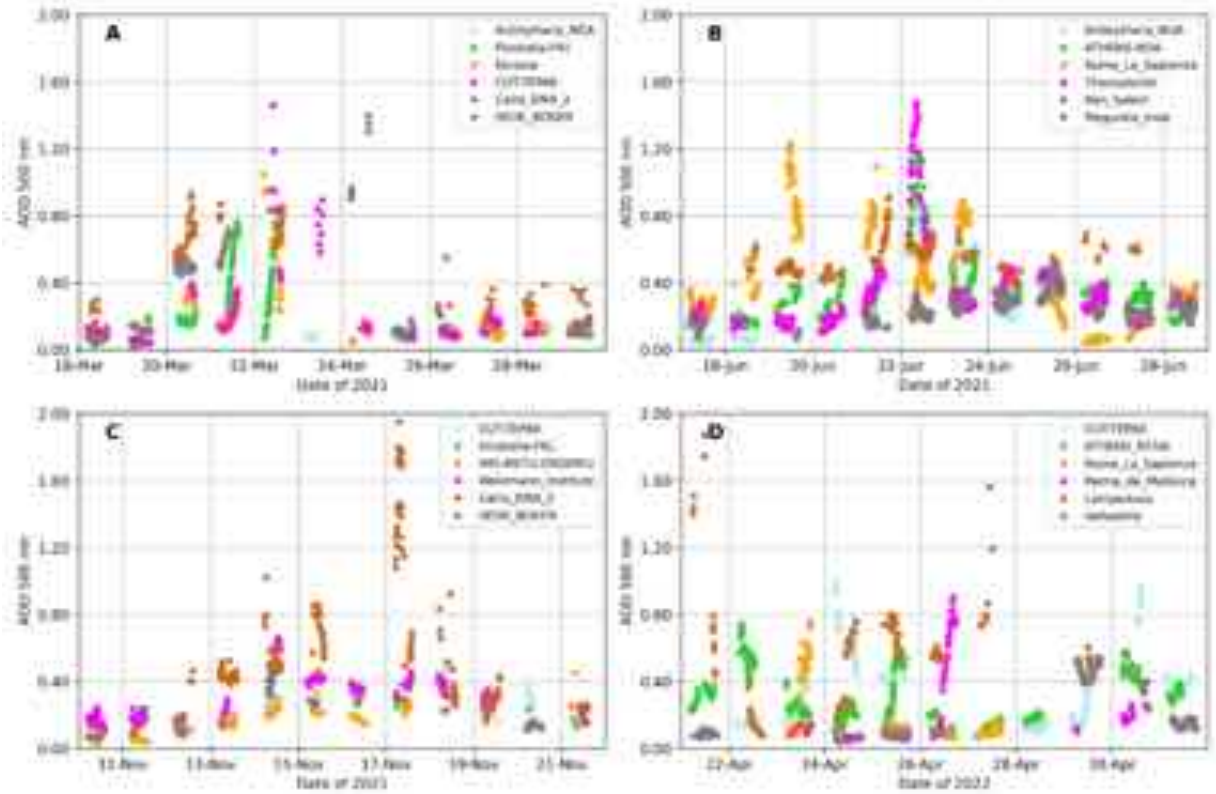


Event	D
Dates	21/04-01/05/2022
Origin	Central Sahara
Affected regions	Whole Med.

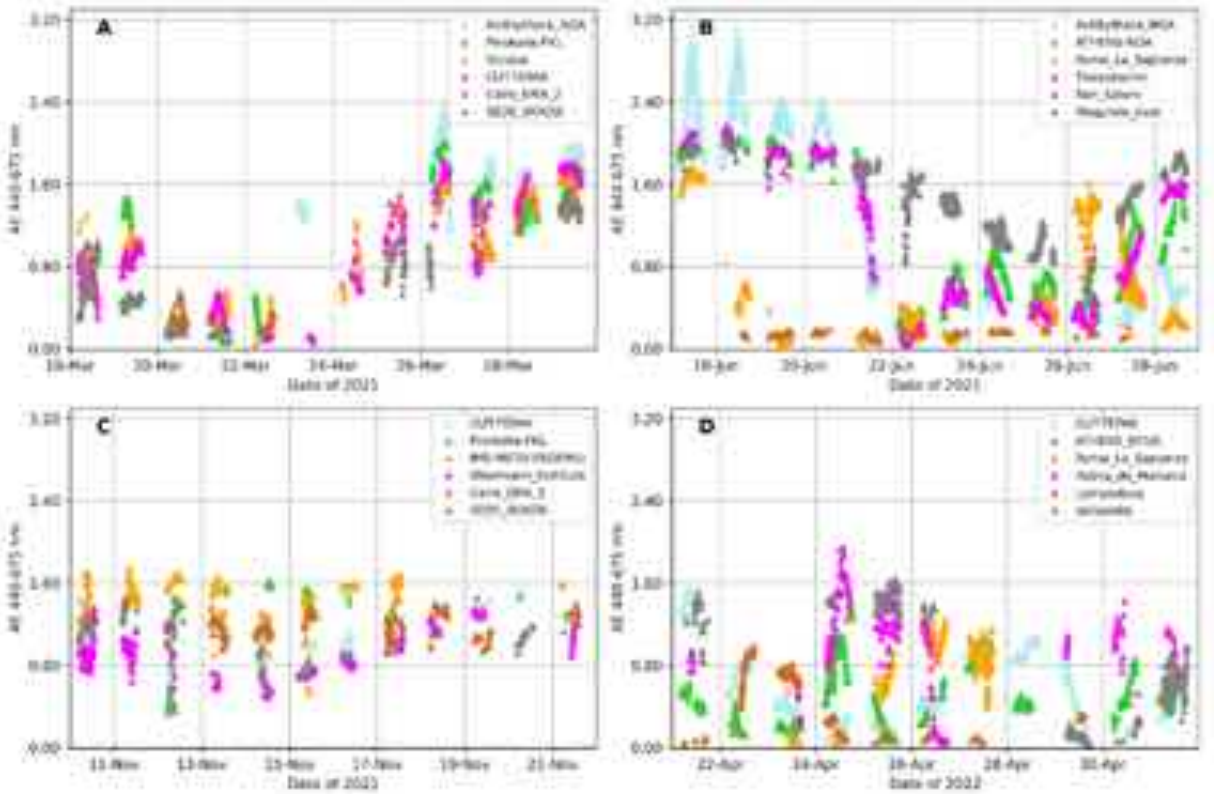
***Different transport patterns and intensity**

Optical properties

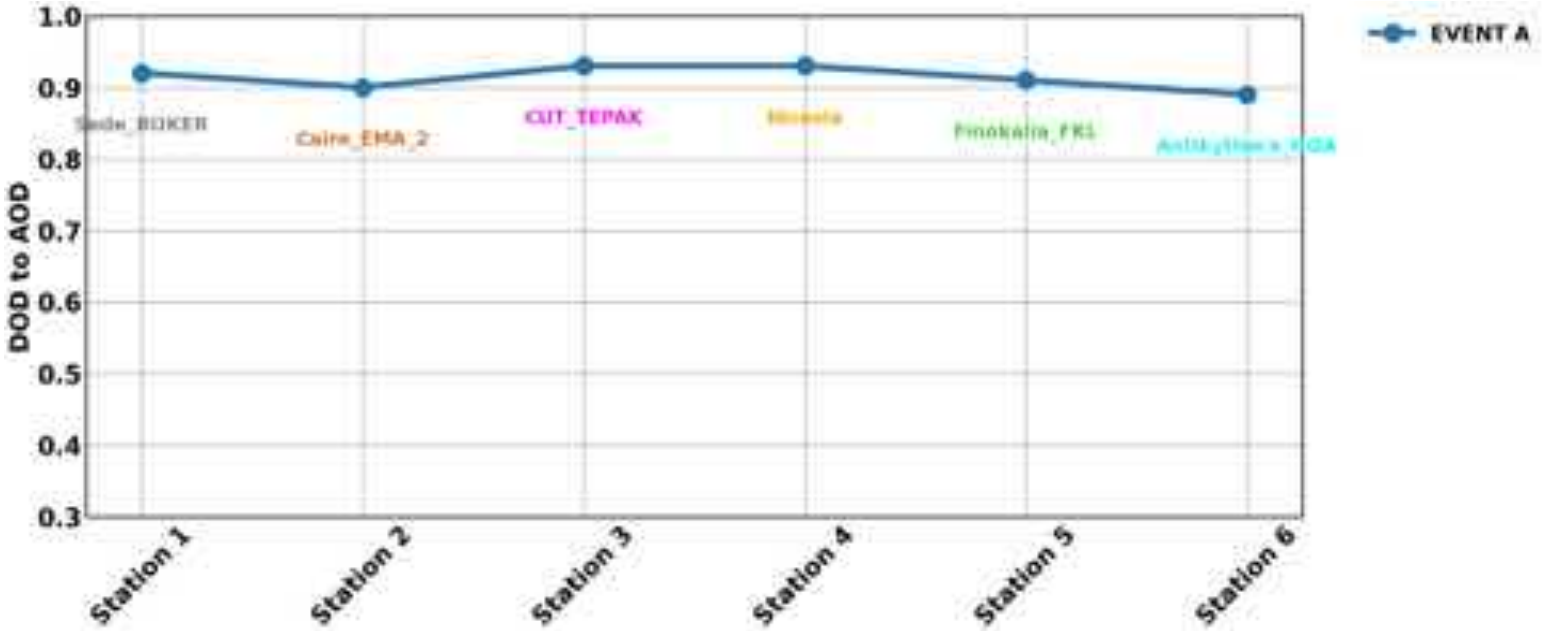
AOD



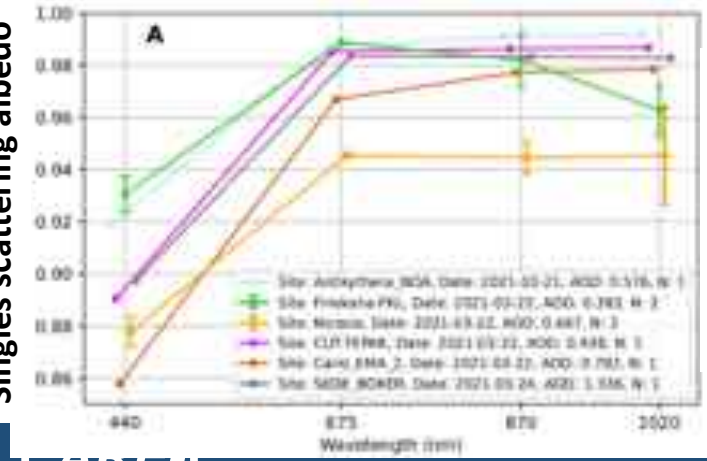
Ångström Exponent



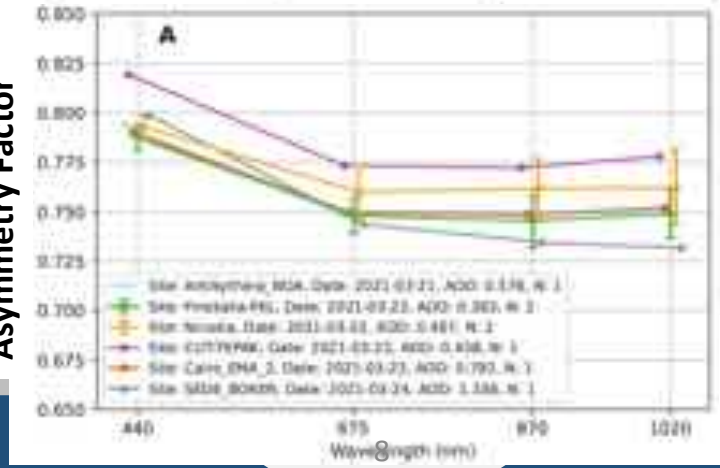
MIDAS DOD-AOD



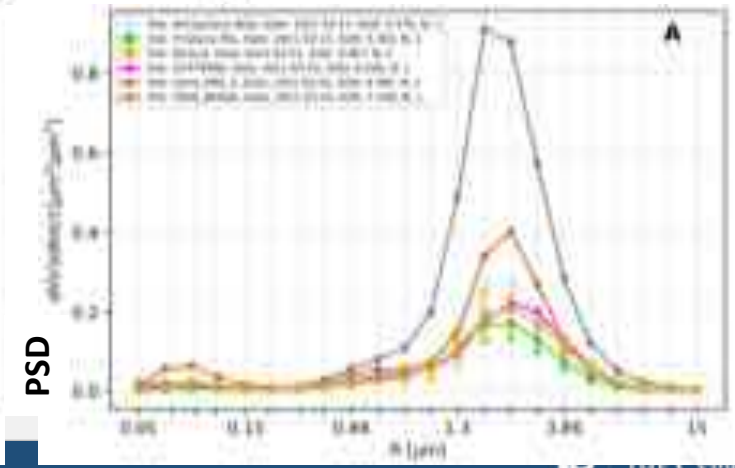
Singles scattering albedo



Asymmetry Factor



PSD



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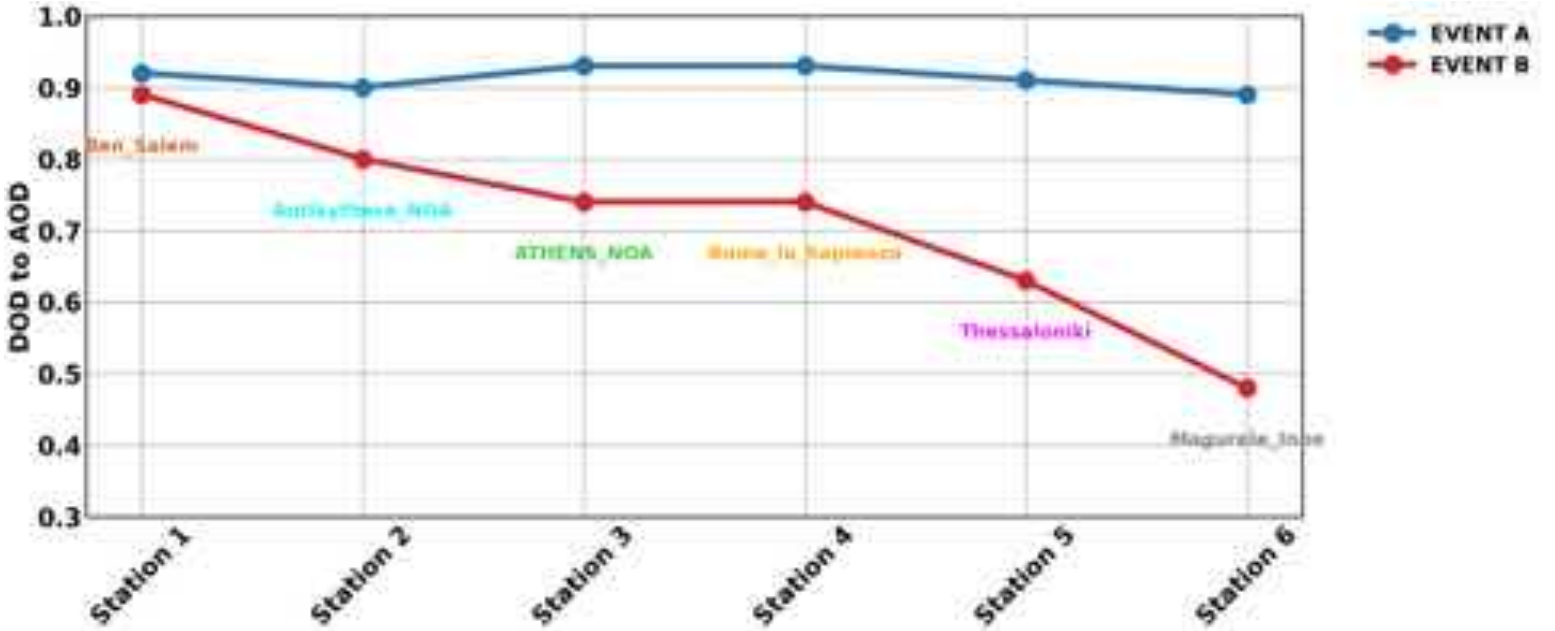

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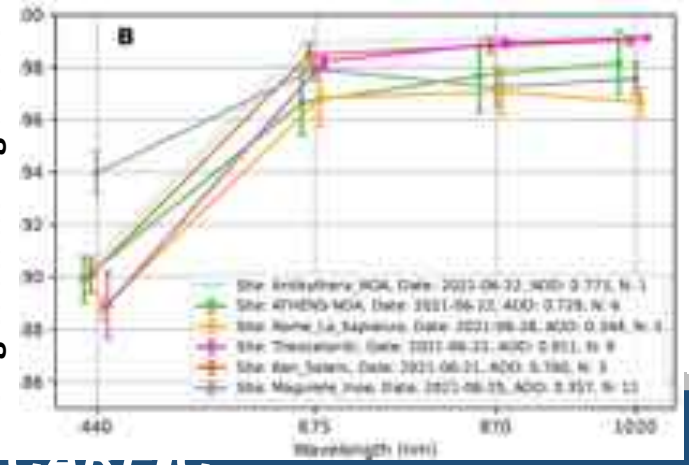

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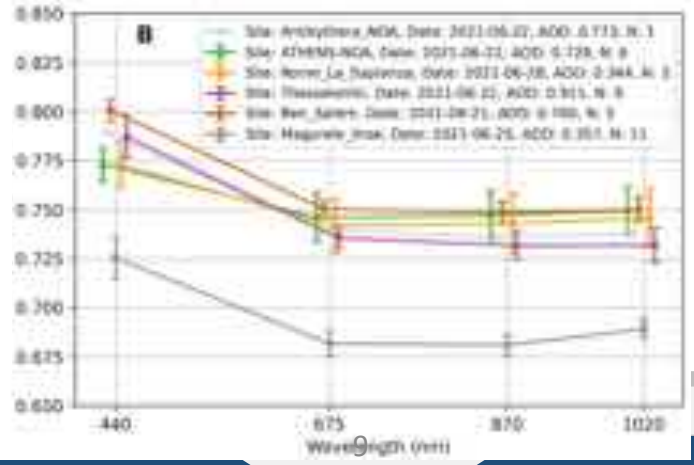

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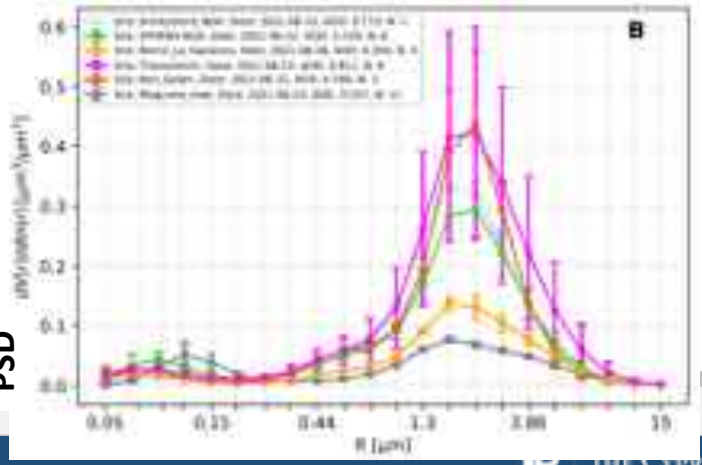

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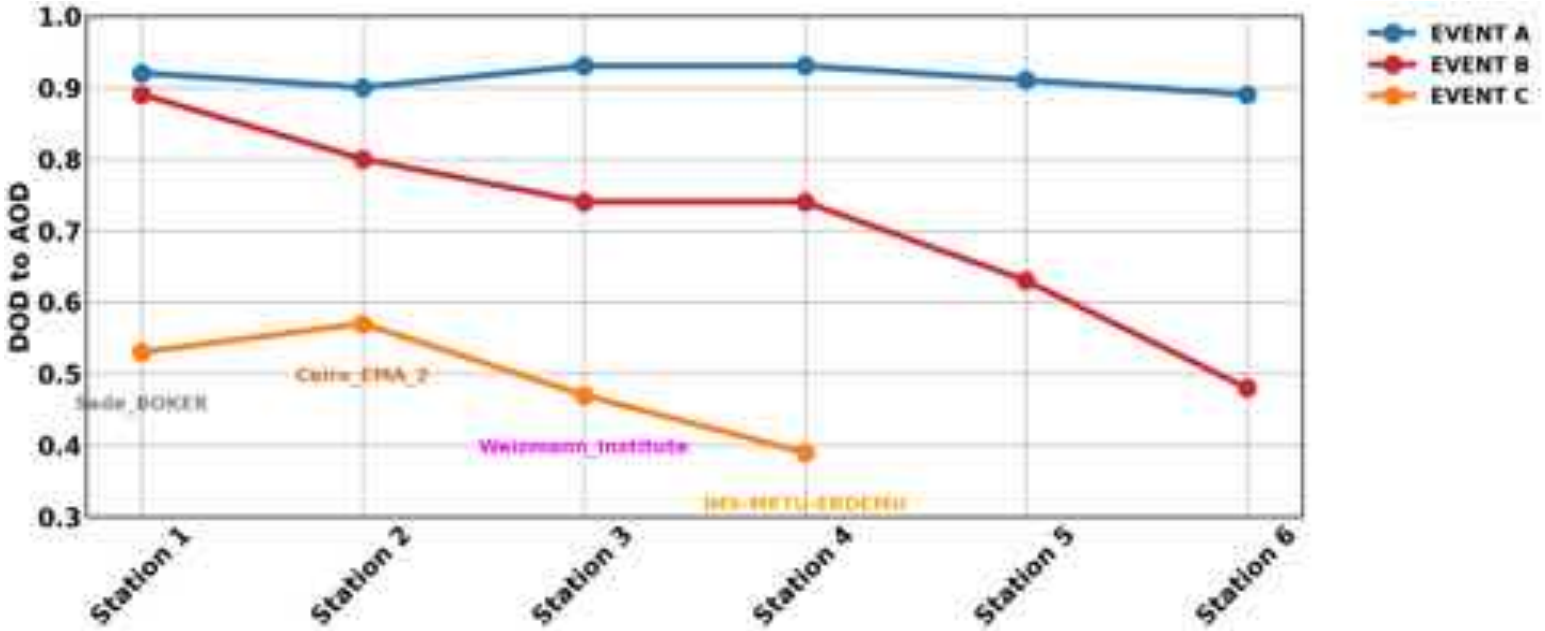

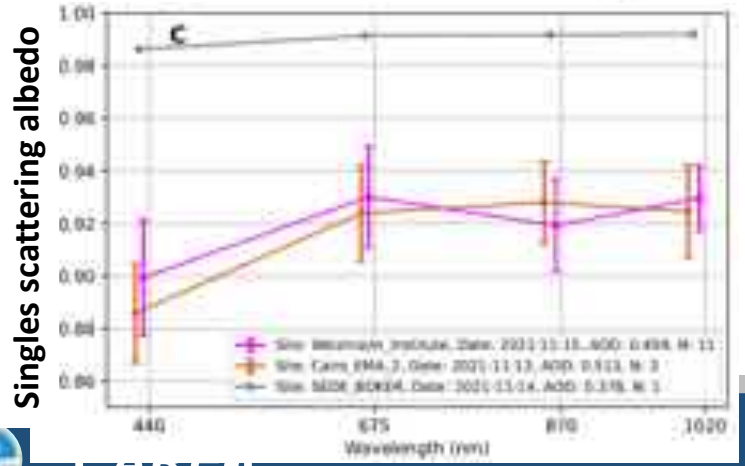

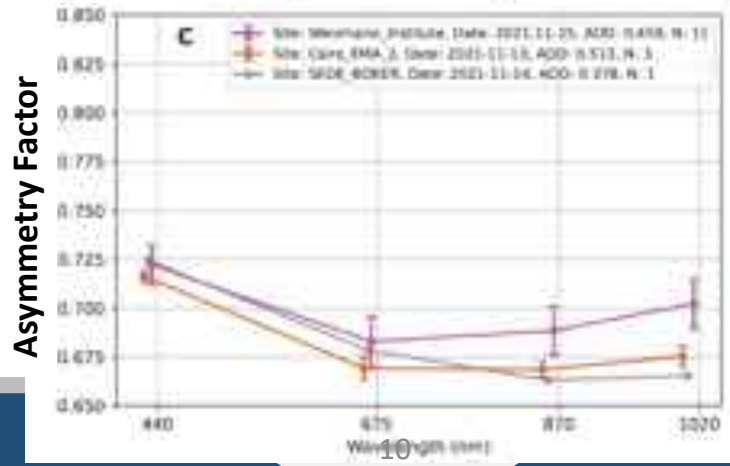

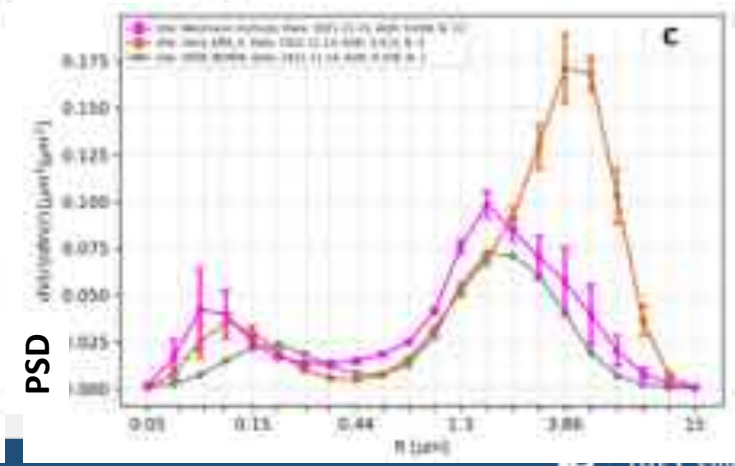

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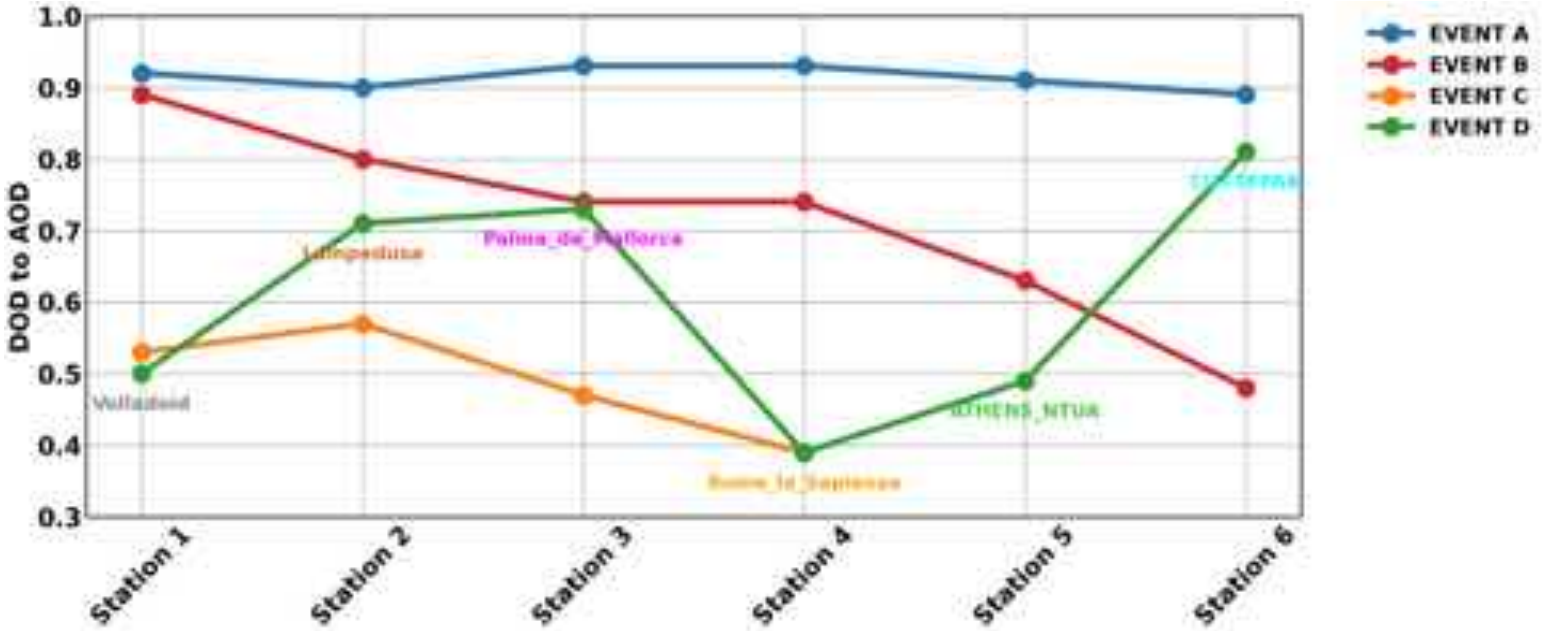

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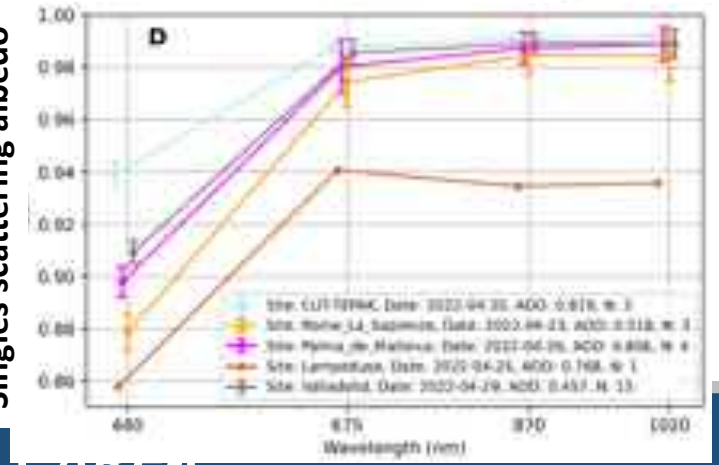

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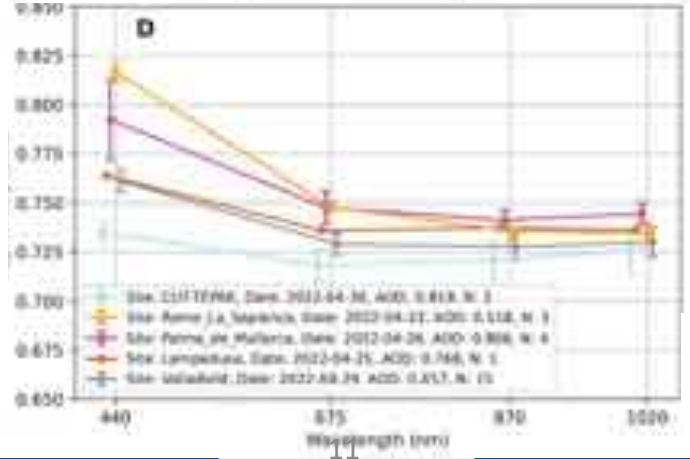

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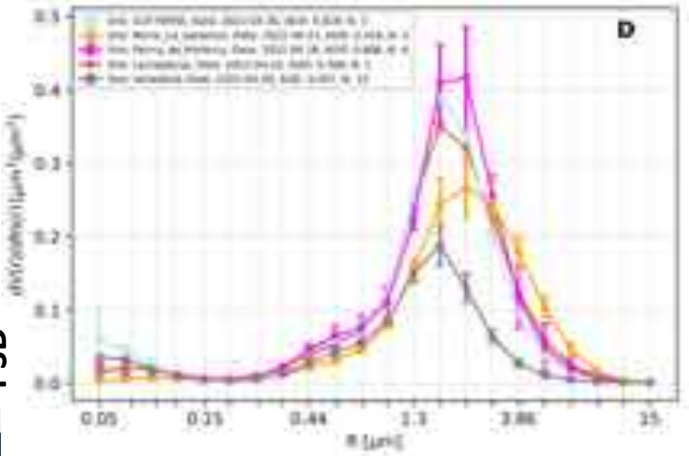
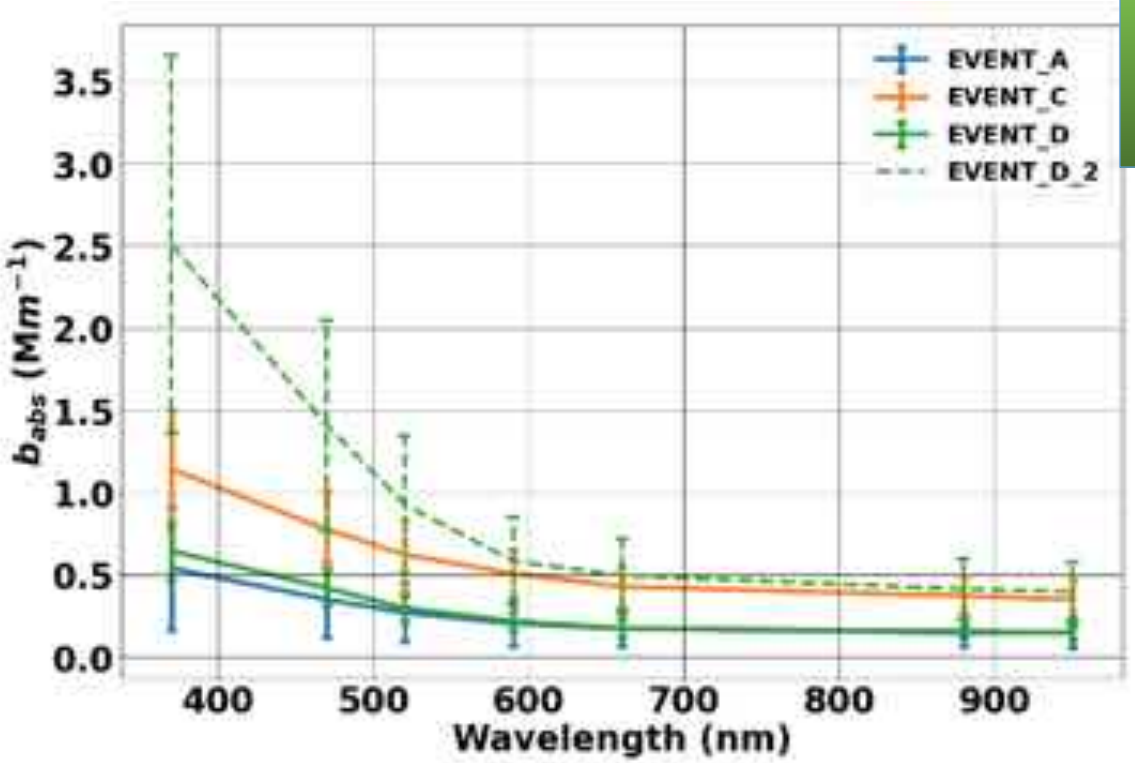


Case study Cyprus

- Cyprus affected by 3 out of 4 events
- Ground based observations of concentration and absorption coefficient.
- **Event C:**

  Higher absorption levels

  More absorbing aerosols



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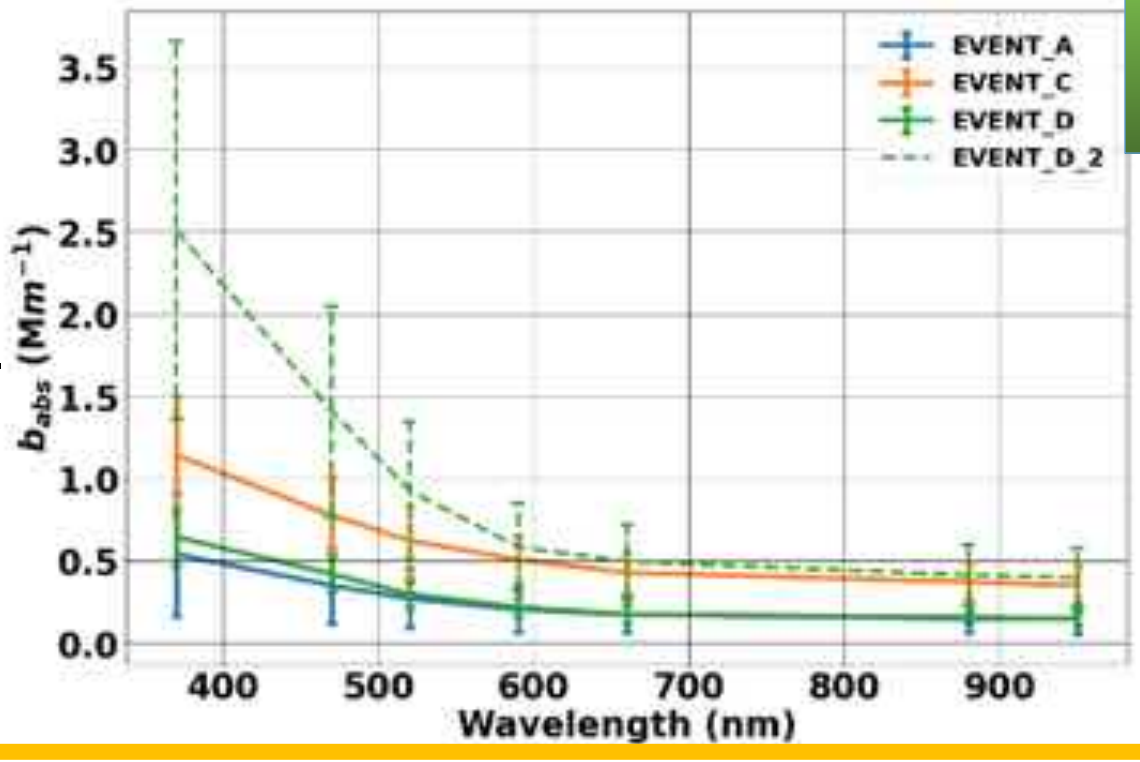
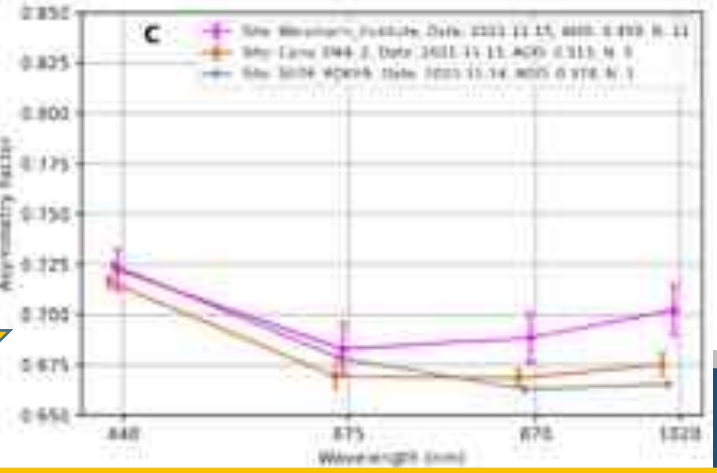
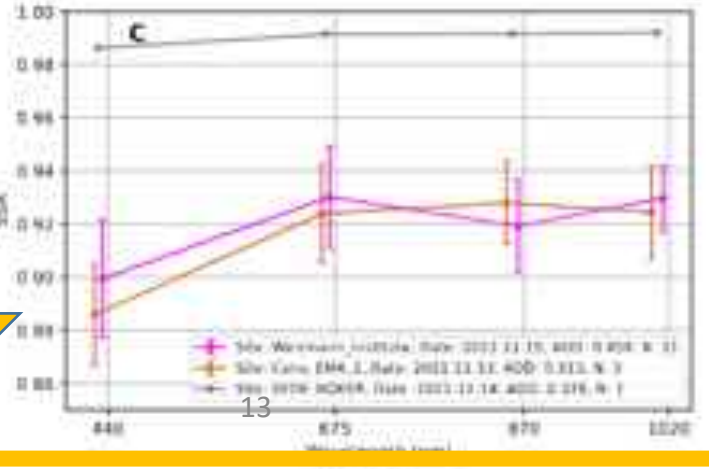


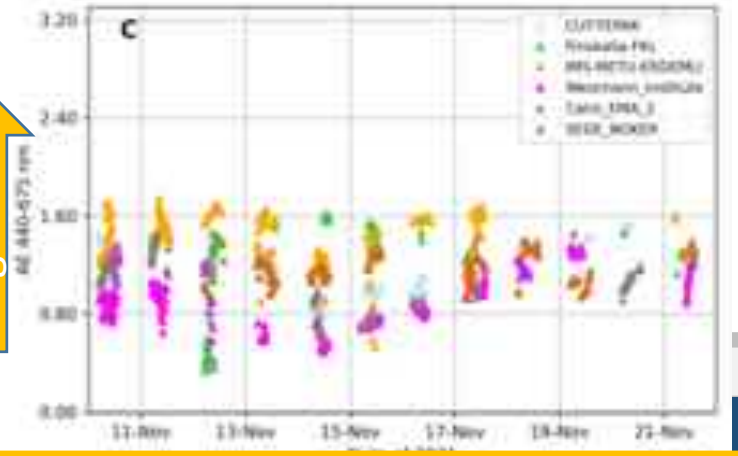
ASYM



SSA

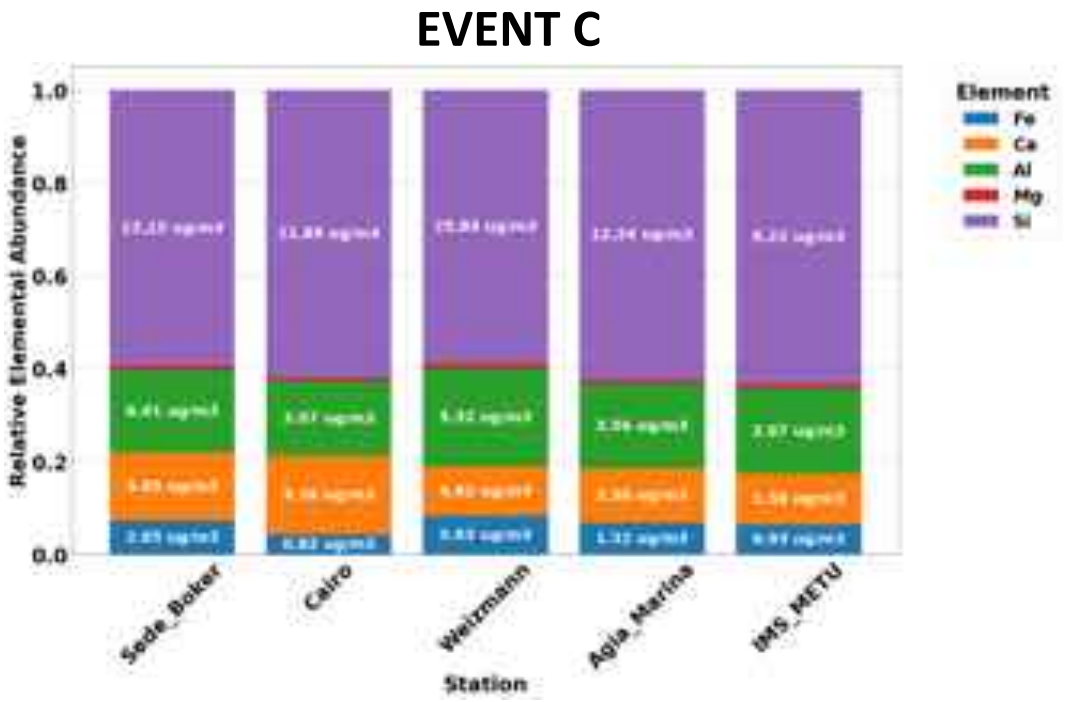


Angstr. Ex.



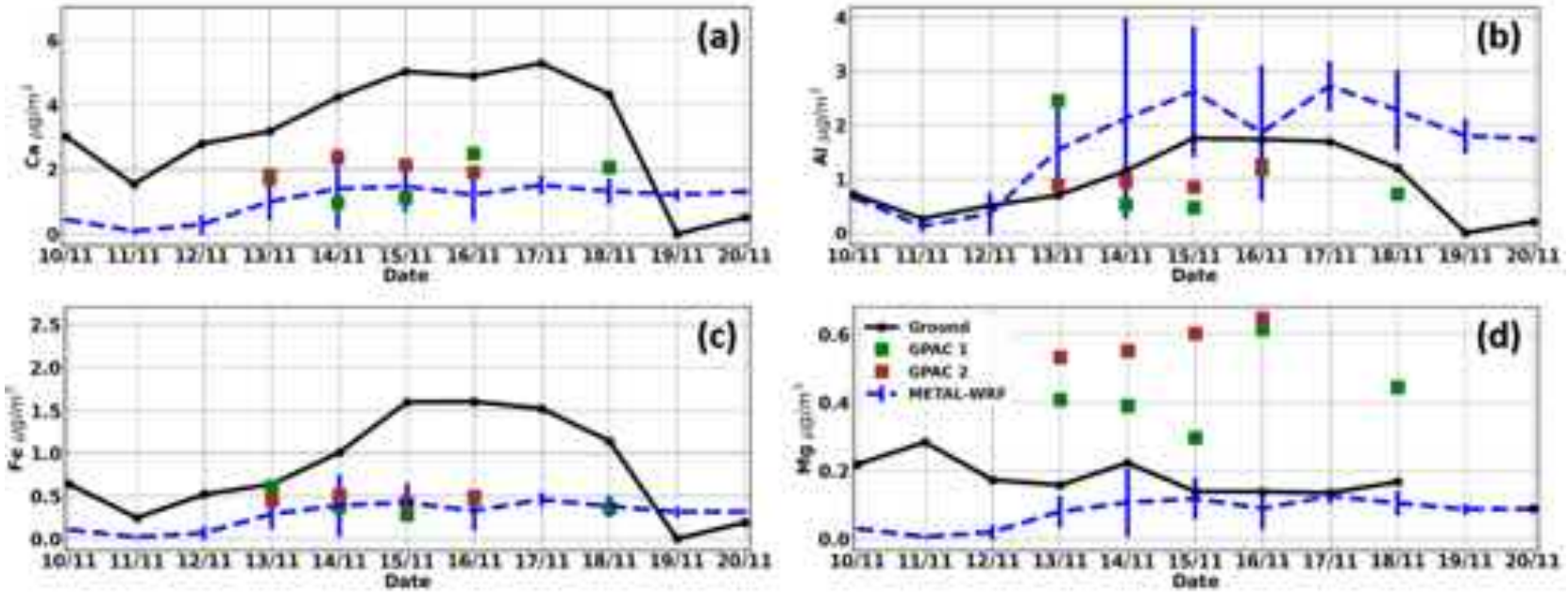
Chemical composition

- METAL-WRF simulations of chemical composition (Solomos et al. 2013)
- Some variability between stations
- Significant abundance of Fe (iron-bearing minerals i.e. goethite and hematite)



Chemical composition

- Event C concurrent with Cyprus Fall Campaign (Kezoudi et al. 2025)
- Simulations compared with UAV-based in-situ observations of chemical composition (SEM analysis on impactors)



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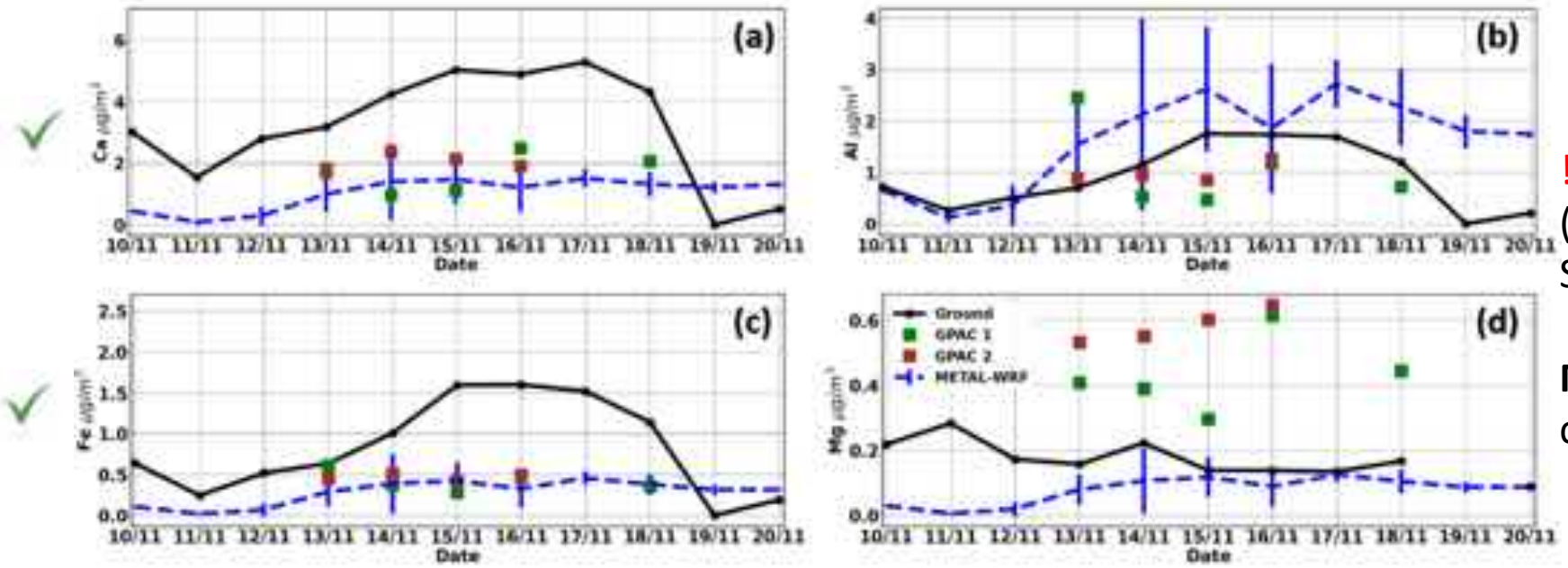
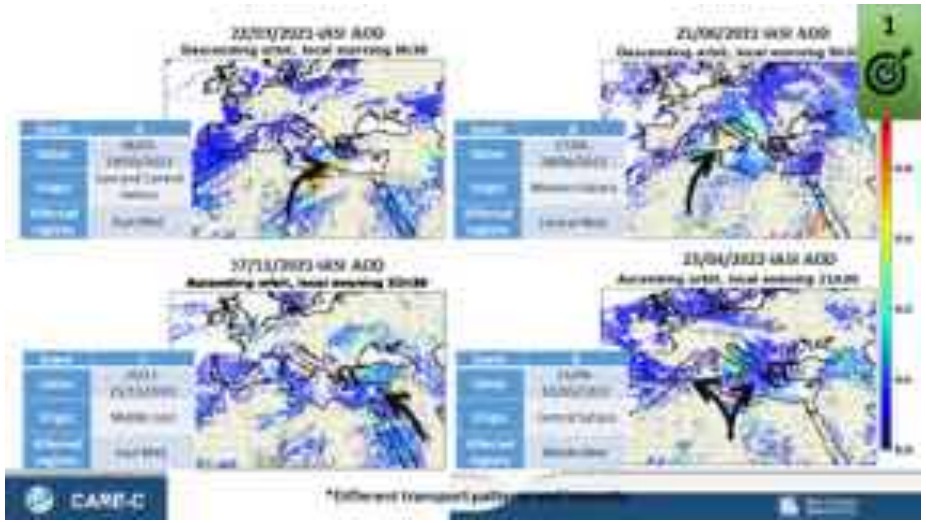


! **Al** → overestimated (in contrast to Solomos et al. 2013)

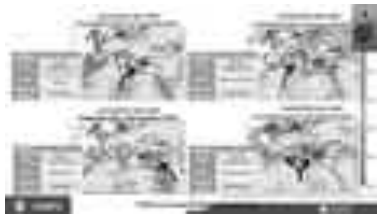
Mg → small concentrations

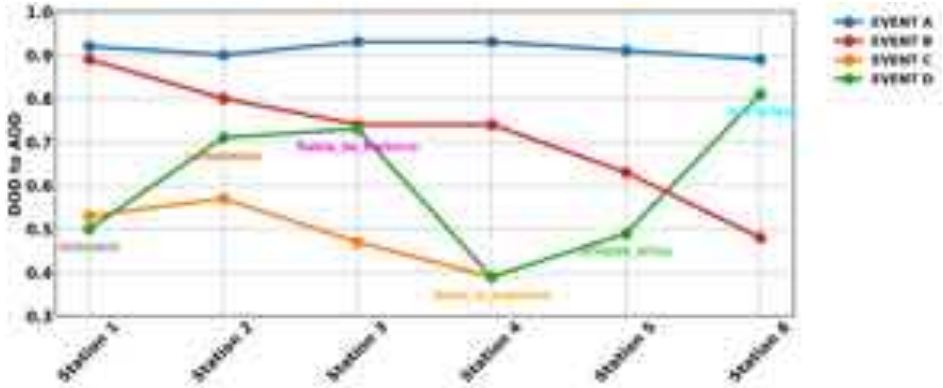
Summary and conclusions



- Identified **4** diverse dust events over the Mediterranean over **~1 year**.

Summary and conclusions





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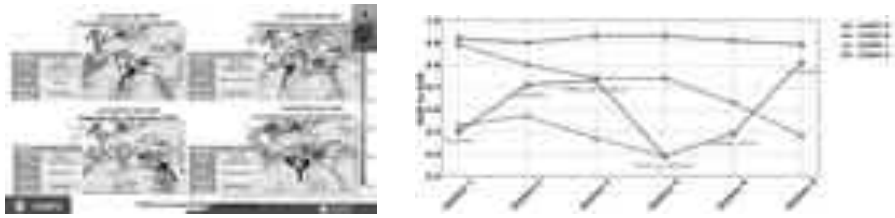

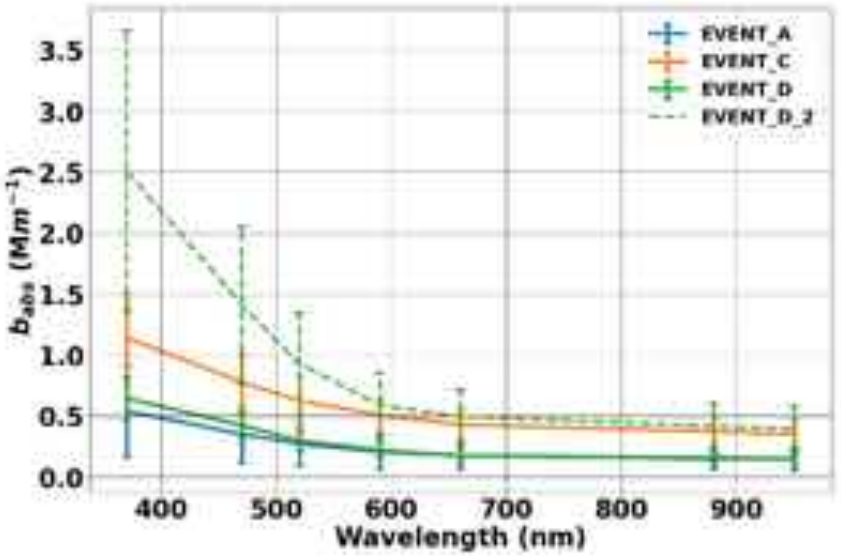

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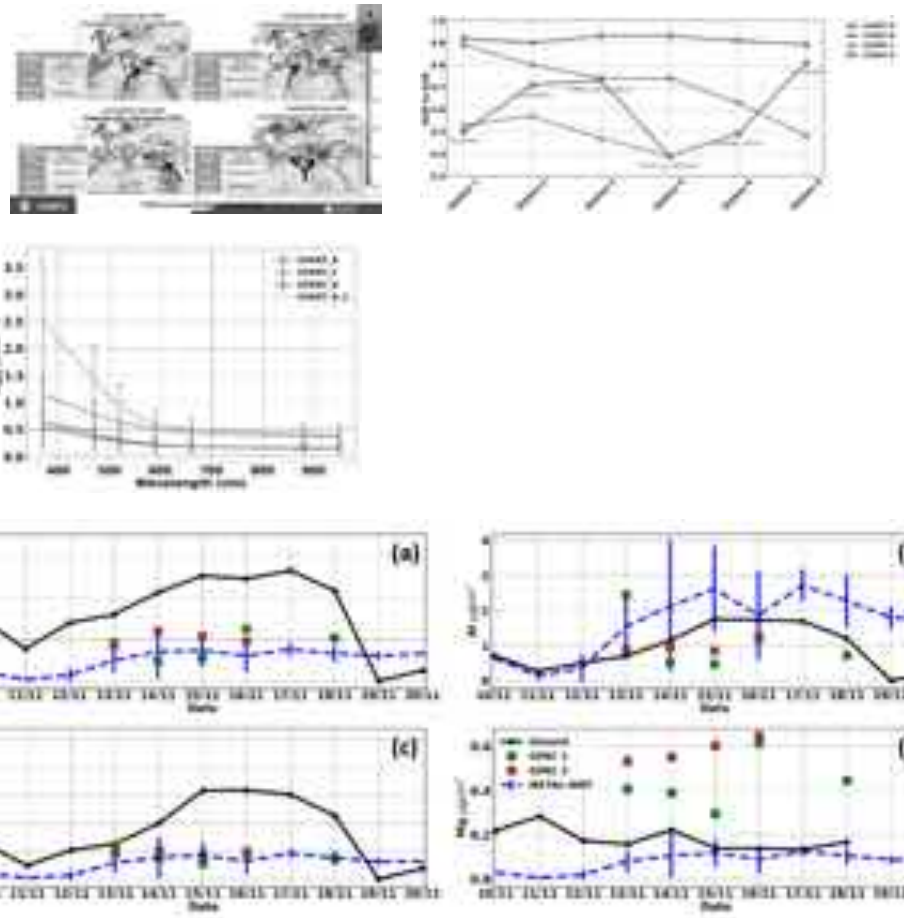

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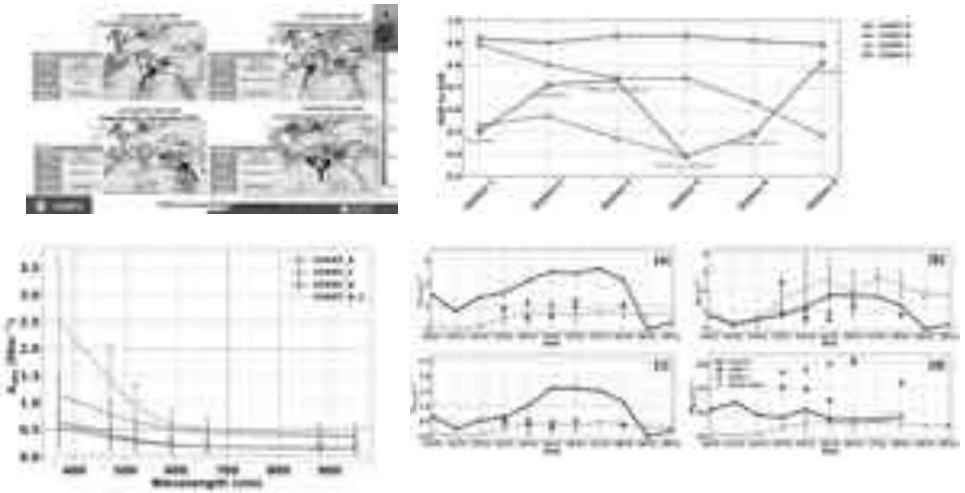

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- Model results aligned well with UAV-based composition data.
- These results will be used in a radiative transfer model to estimate the radiative effect of dust.

*These results will be part of the manuscript in preparation Papetta et al. 2025

Thank you!

Contact: a.papetta@cyi.ac.cy

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