Global Scale Mapping of Mineral Dust in situ Optical Properties in the MIR+FIR spectral domain (100 to 2000 cm^{-1}): Spectroscopic studies towards the exploitation of IASI–NG and FORUM forthcoming missions

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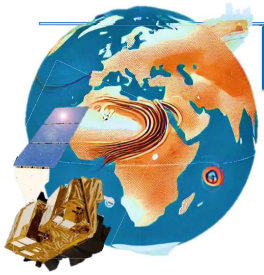


Mineral dust

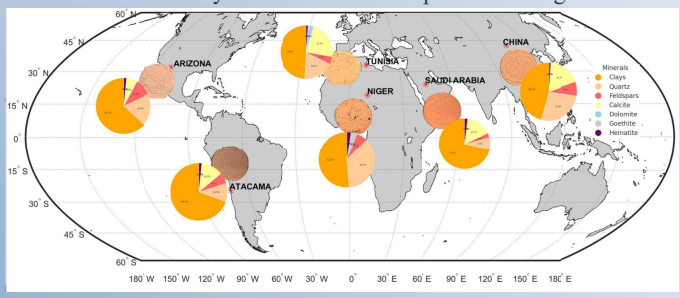
Carried by winds from deserts, mineral dust is one of the most abundant aerosols in the atmosphere. It affects the Earth's climate by interacting with solar and terrestrial radiation. Satellites observations can detect dust in the infrared spectrum allowing to quantify its size, concentration, and composition—important data for climate models. Over the past 20 years, research has focused on satellite observations in the mid-infrared range, leaving a gap in understanding the dust interactions in the far-infrared spectrum, especially at night and in colder regions.

This study aims to measure the optical properties of dust in the far-infrared for the first time, helping improve climate models and satellite observations for more accurate climate predictions.

Methodology and Results

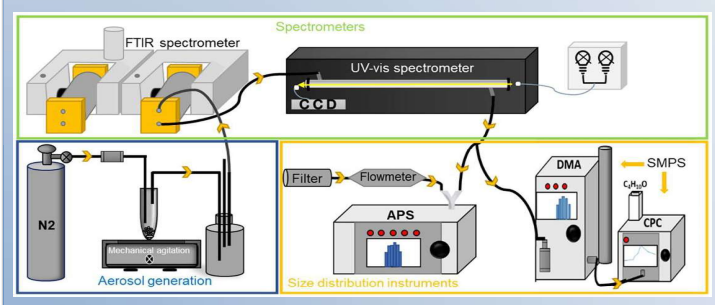
1- SOIL COLLECTION AND SELECTION

Six samples were selected to represent different geographic regions and cover the diversity of mineral dust composition on a global scale



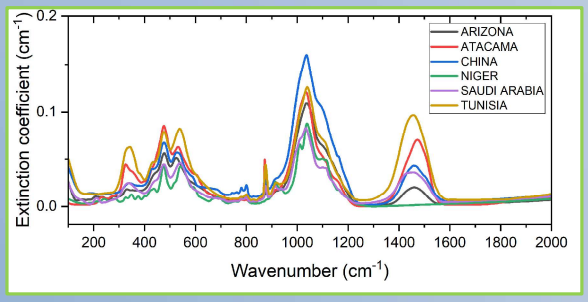
Samples and minerology from *Di Biagio et al., 2017*

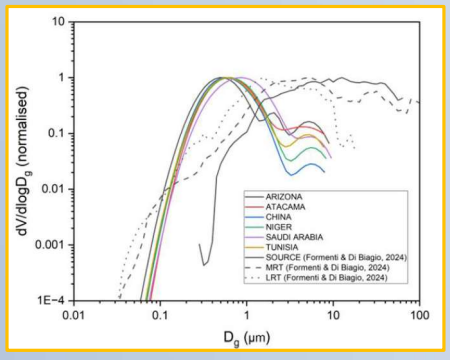
2- EXPERIMENTAL MEASUREMENTS



Chehab et al., 2024

EXTINCTION MEASUREMENTS : The spectral features reveal diverse mineral compositions, including the first-time detection of iron oxides peaks.

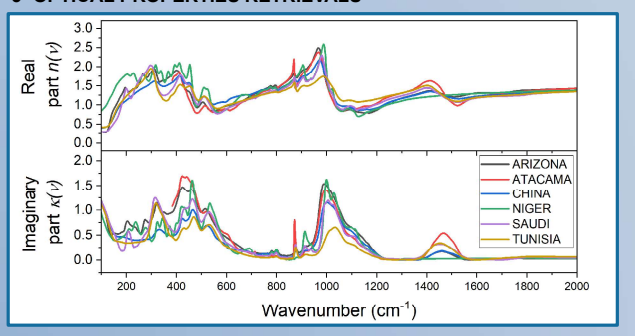




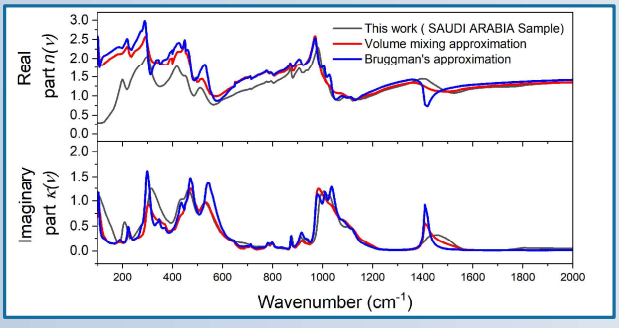
SIZE DISTRIBUTION MEASUREMENTS:

Results compared to mean size distributions representing:
SOURCE: Emissions;
MRT: Mid-range transport (1 to 4 days);
LRT: Long-range transport (> 4 days).
Best coherence with LRT size distribution.

3- OPTICAL PROPERTIES RETRIEVALS



Complex refractive indices of dust were obtained in the infrared range filling the gap for the first time in the far-infrared spectrum.



With knowledge of the mineral composition percentages, the results were compared to pure mineral mixtures from literature, revealing similarities

Conclusions and Perspectives

First-time measurements of mineral dust's optical properties filled a crucial gap in the far-infrared spectrum. Future spectral measurements at SOLEIL synchrotron will provide high signal-to-noise data, which can be implemented in radiative transfer models to improve dust characterization and support IASI-NG and FORUM satellite missions.

References

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Di Biagio et al., 2017. *Atmos. Chem. Phys.* https://doi.org/10.5194/acp-17-1901-2017
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