EGU General Assembly 2022

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

Mineralogical Dust Study from Laboratory to Satellite Remote Sensing IASI Measurements: Application to East Asian Deserts

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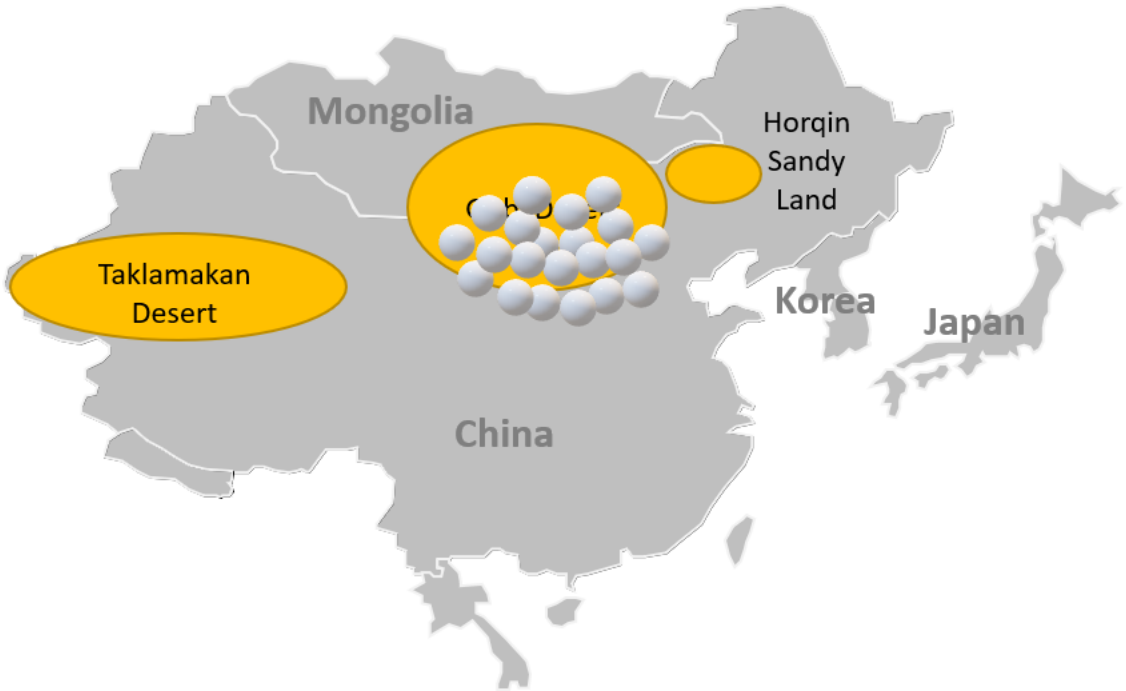
[2] Physicochimie des Processus de Combustion et de l'Atmosphère-PC2A, Université de Lille, Lille, France

[3] Laboratoire des Biomatériaux and des Matériaux Intelligents-LBMI, Université Libanaise, Jdeidet, Lebanon

Context of Study

East Asian Deserts



Plume passes across 5000 km!
Equivalent to a flight from the U.K to the West Russia!

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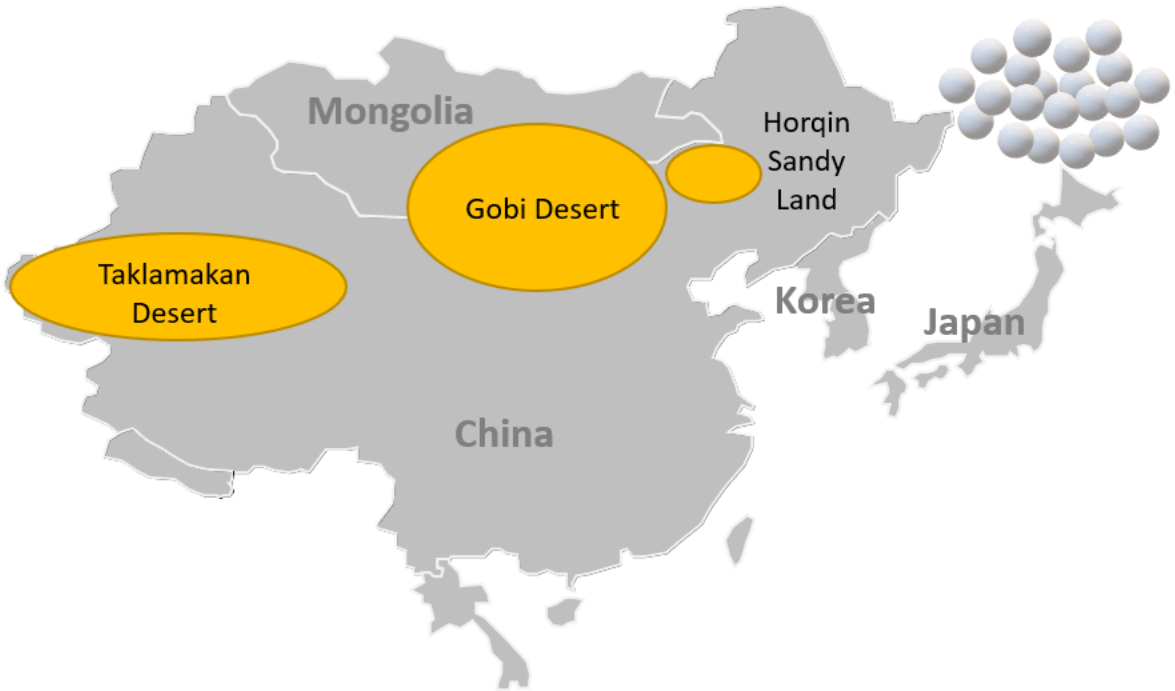

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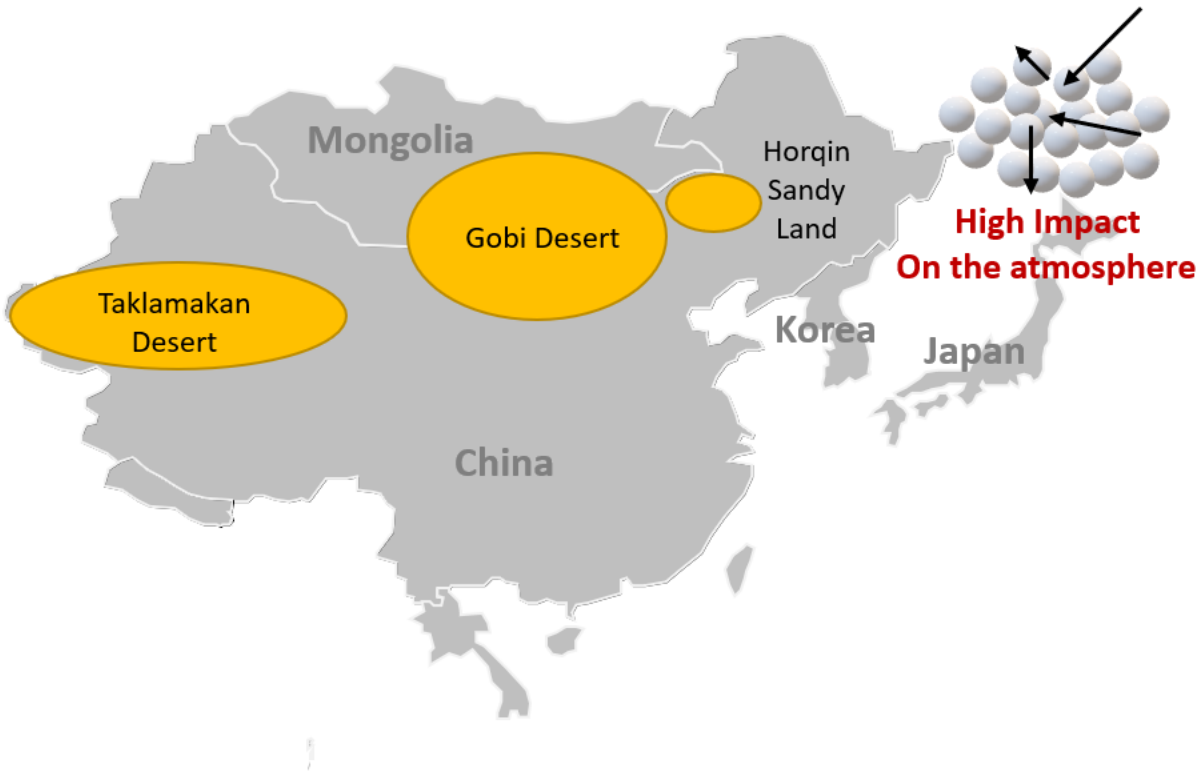

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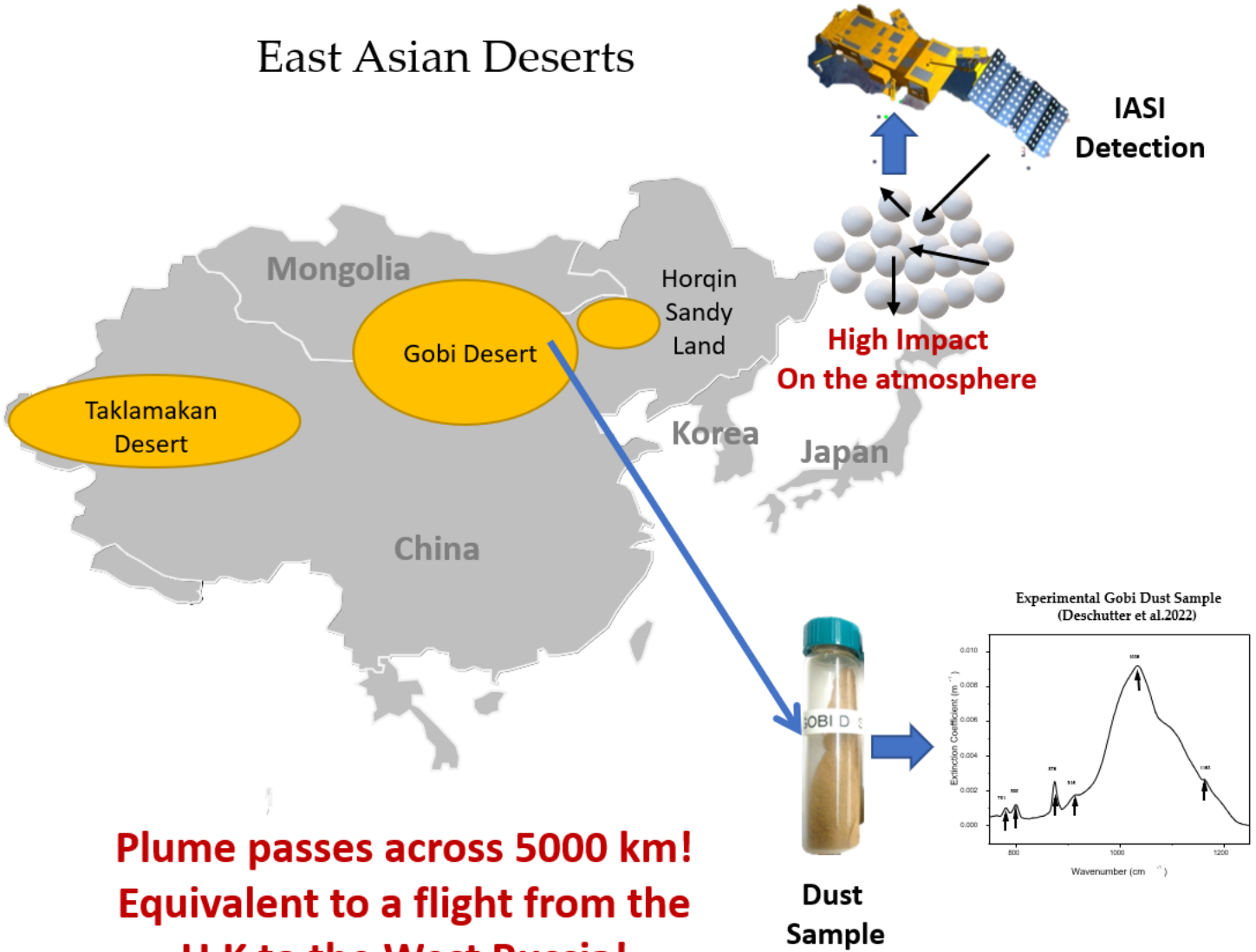

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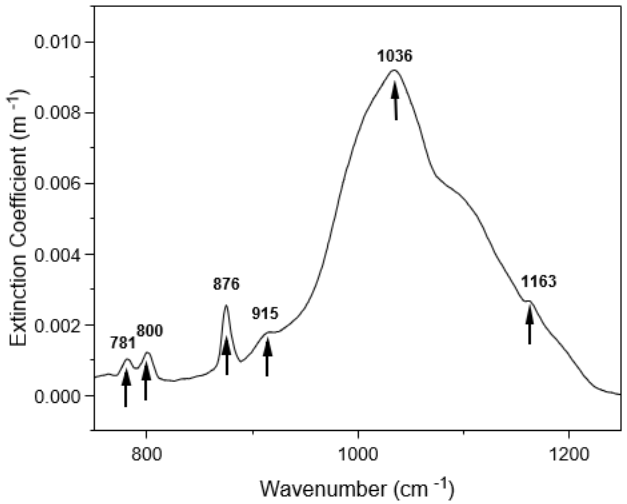
Objective

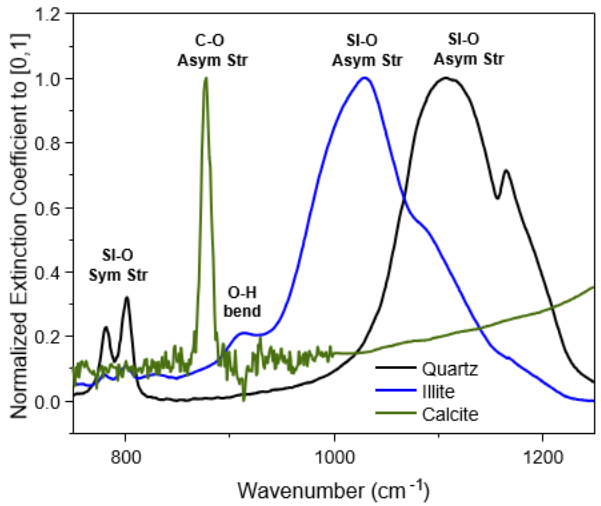
Obtain new information about **Mineral Dust Chemical Composition** from **Laboratory Optical Properties** and **Satellite Remote Sensing Detection**

I- Experimental Measurements

Experimental Gobi Dust Sample (Deschutter et al.2022)



Pure Minerals Spectra (Deschutter et al.2022)



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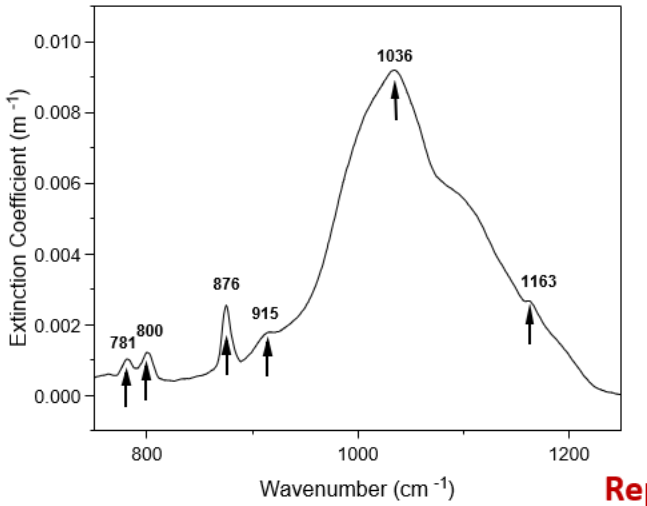

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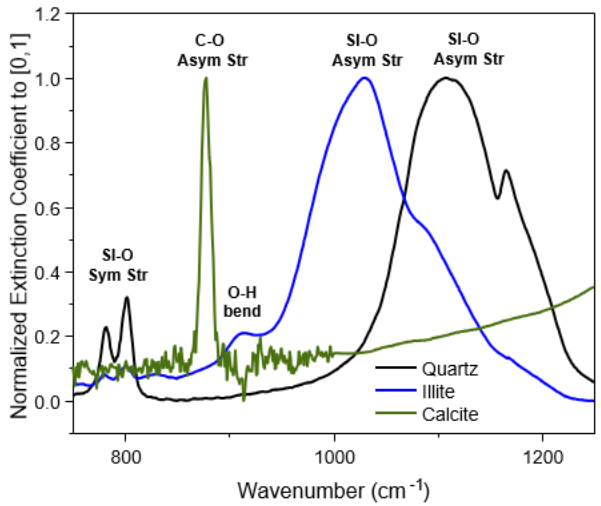

Reproducible dust extinction from Pure minerals extinctions?

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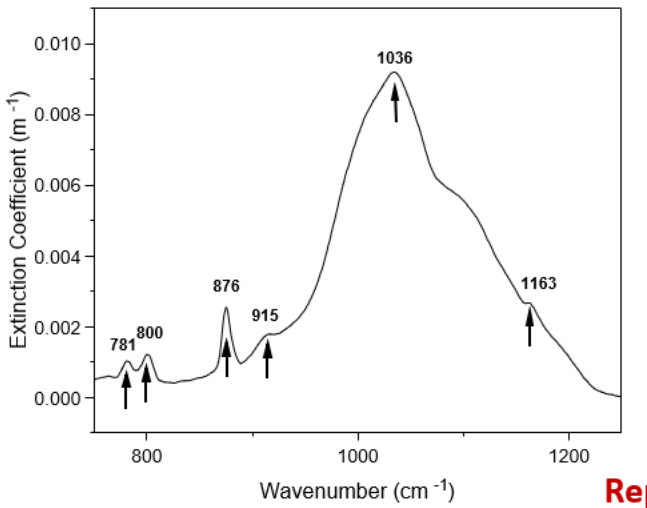

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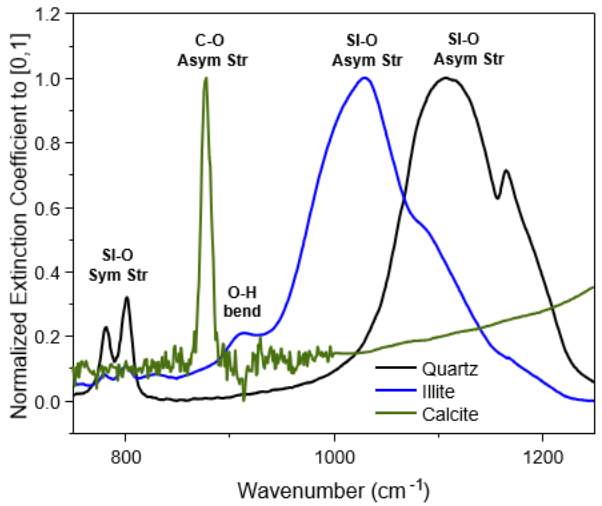

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Linear Combination (LC) Method

Consider mineral dust as an external mixture of mineral.

$$k_{eff}(v) = f_{Tec}\bar{k}_{Q}(v) + f_{Phy}\bar{k}_{I}(v) + f_{Ca}\bar{k}_{Ca}(v)$$

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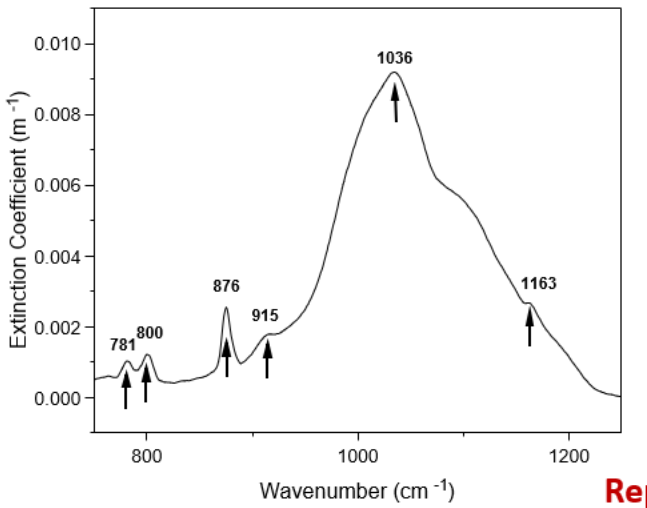

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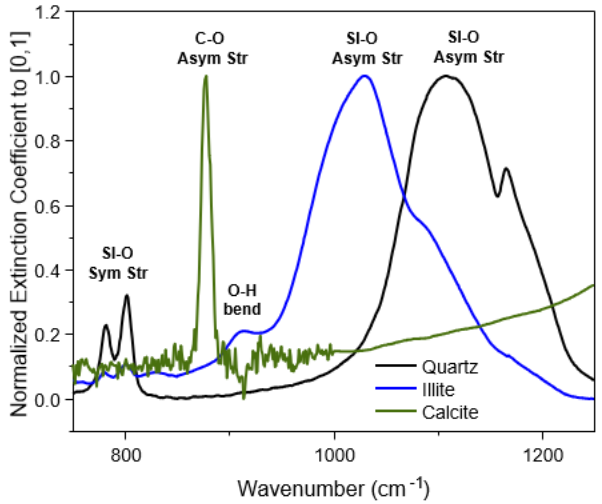

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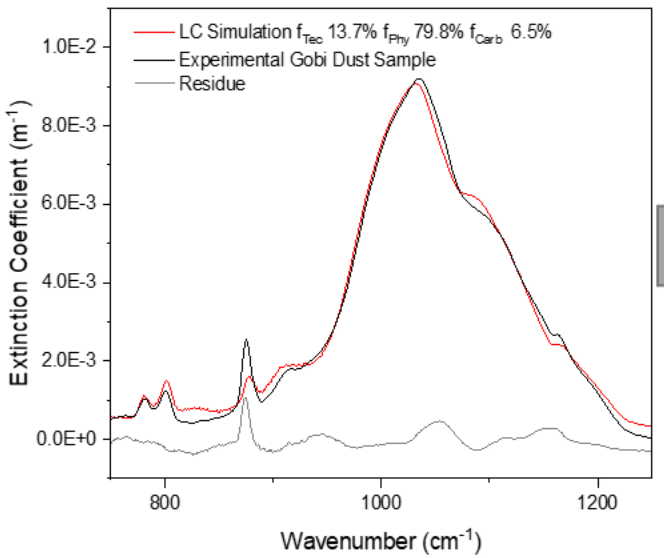

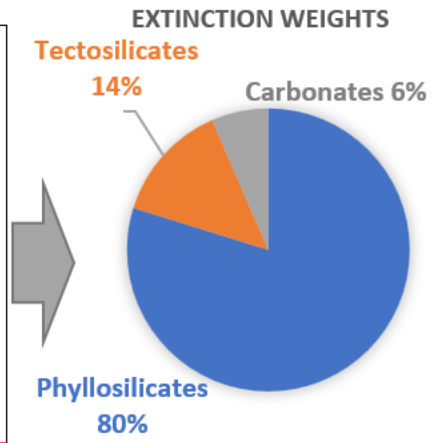

Residue of 2.5 %

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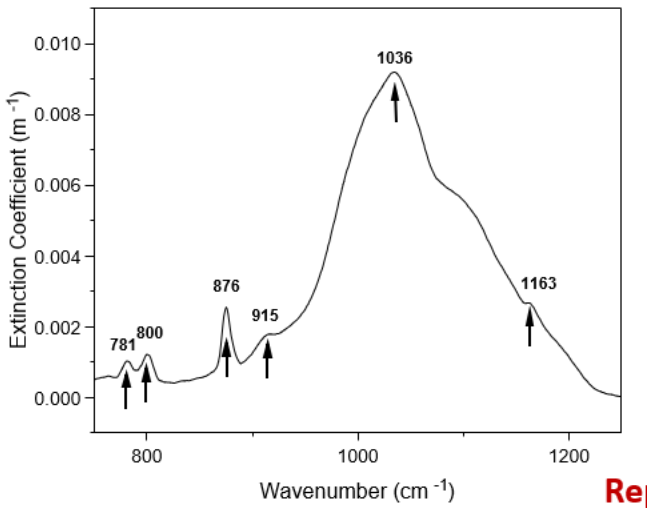

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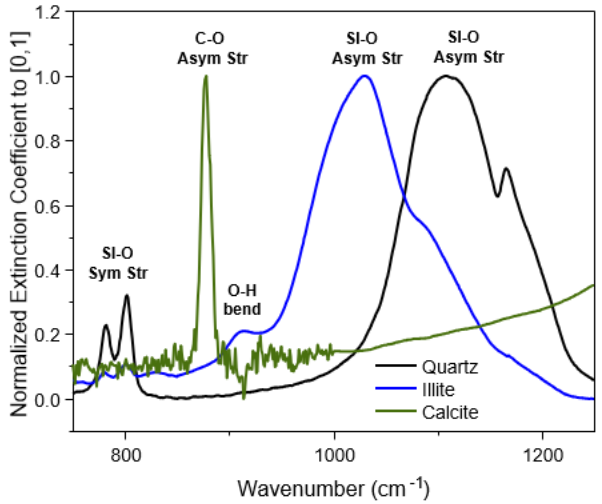

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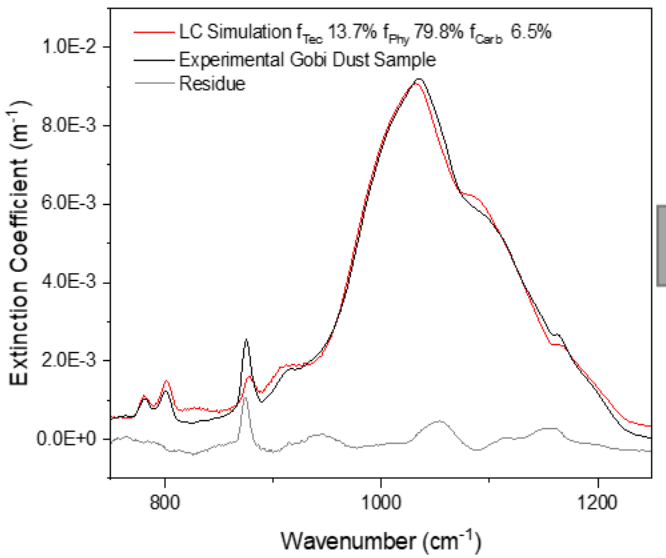

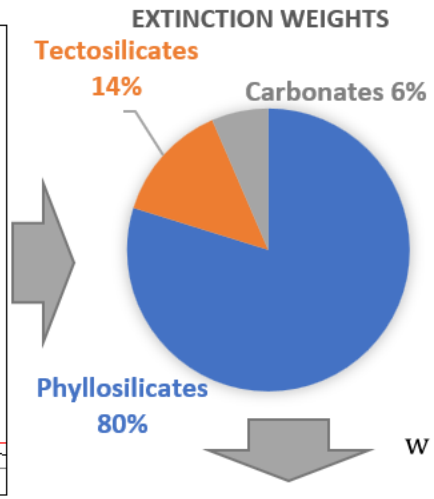

$$w_i = \frac{f_i \cdot \frac{k_i(v)}{MC_i}}{\sum_i f_i \cdot \frac{k_i(v)}{MC_i}}$$

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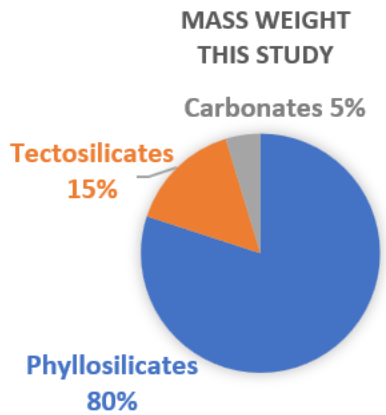

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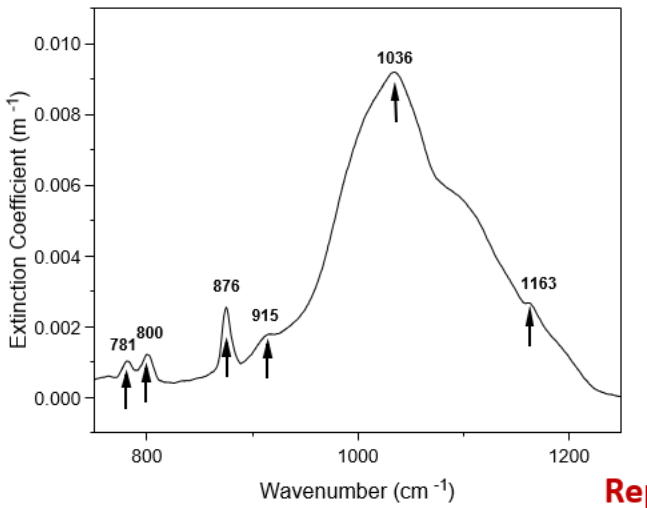

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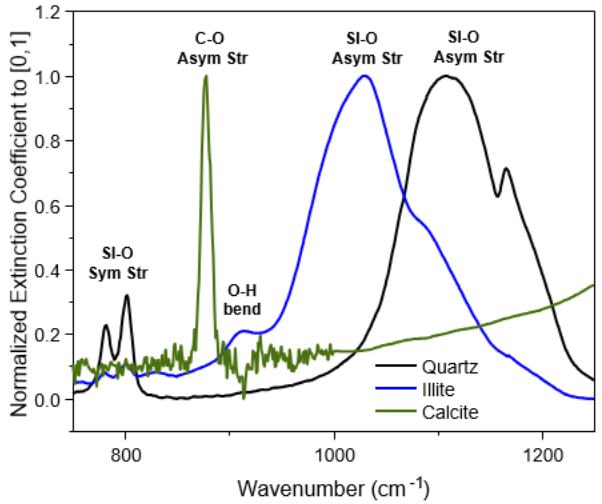

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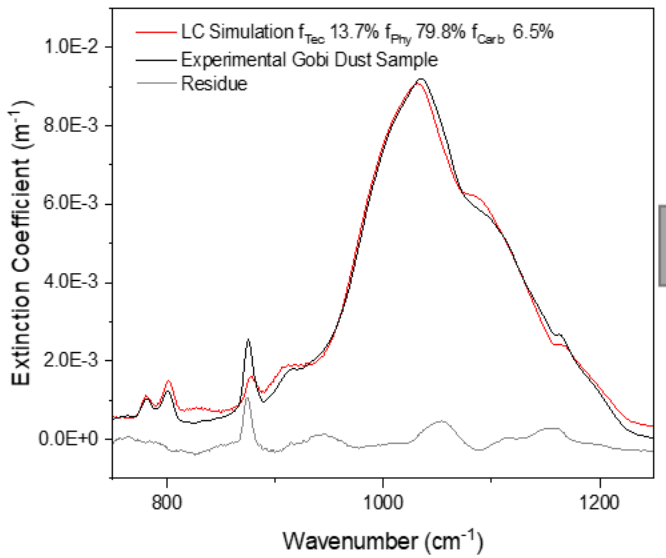
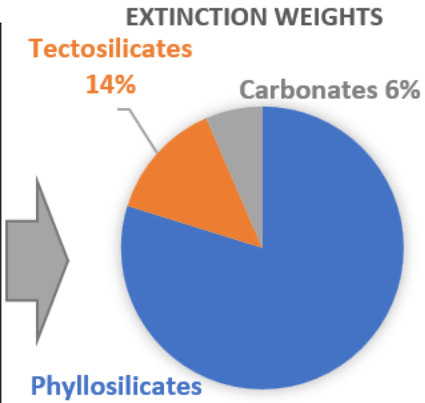


EXTINCTION WEIGHTS



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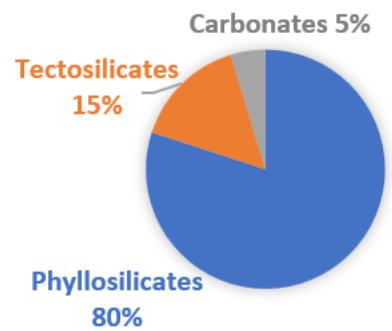
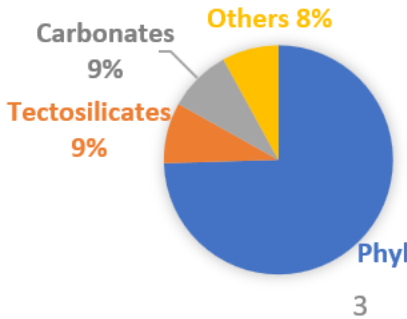
MASS WEIGHT
THIS STUDY

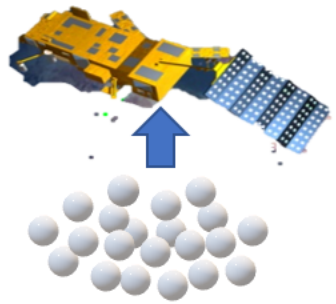


AVERAGE MASS WEIGHT
(JOURNET ET AL.2014)



II- Satellite Observation: IASI Optical Thickness

Infrared Atmospheric Sounding Interferometer (IASI) on MeTop Satellite



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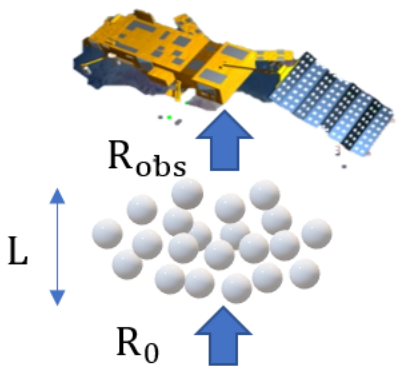

Lambert-Beer's Law:

$$R_{obs}(\nu) = R_0(\nu)e^{-K_{ext}^{aerosol}(\nu)L}$$

- $R_{obs}(\nu)$: Observed Spectral Radiance
- $R_0(\nu)$: Incident Spectral Radiance
- $K_{ext}^{aerosol}(\nu)$: Aerosol Extinction Coefficient
- L: Layer Thickness

Optical Thickness:

$$\tau(\nu) = \ln\left[\left(\frac{R_0(\nu)}{R_{obs}(\nu)}\right)\right] = k_{ext}^{aerosol}(\nu)L + \epsilon_{Re}$$

ϵ_{Re}: instrument noise + gases residues

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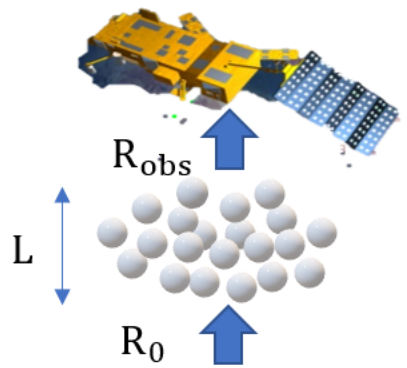

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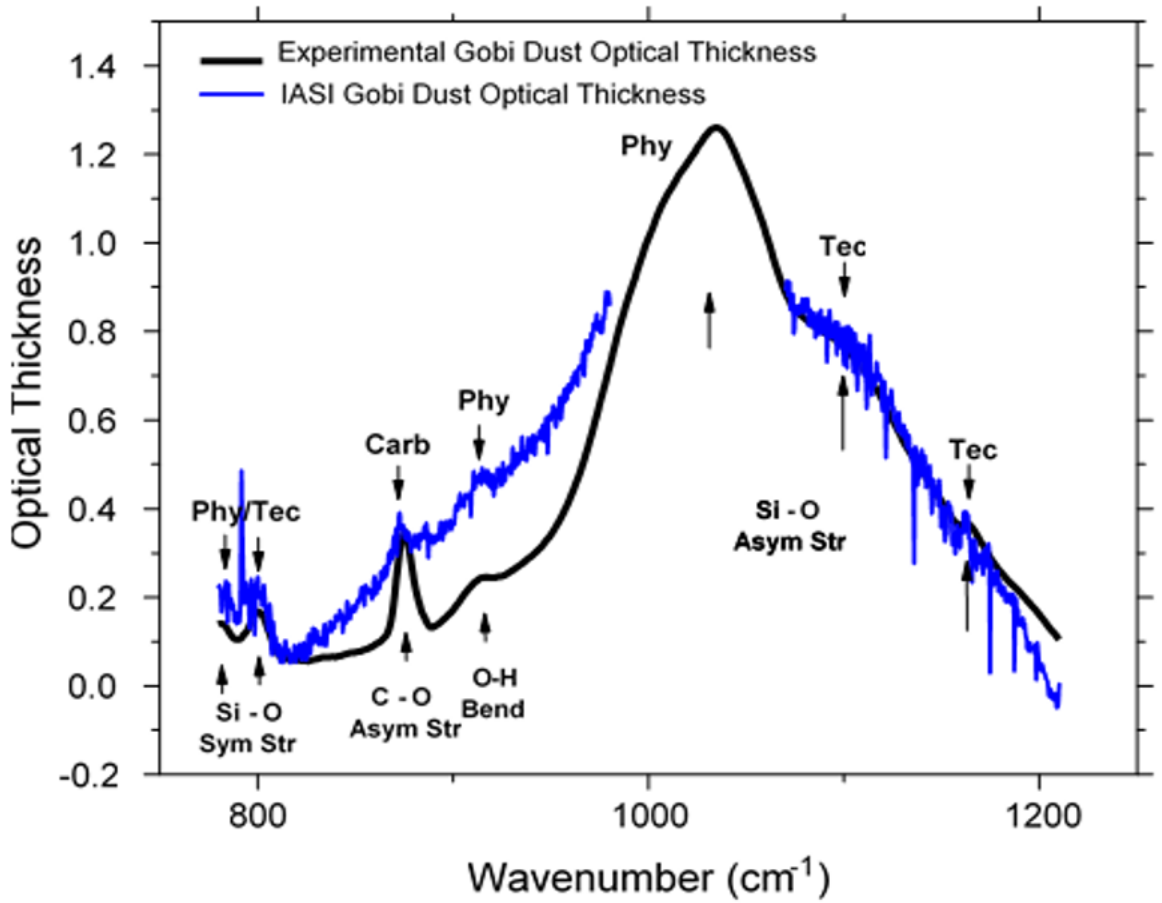

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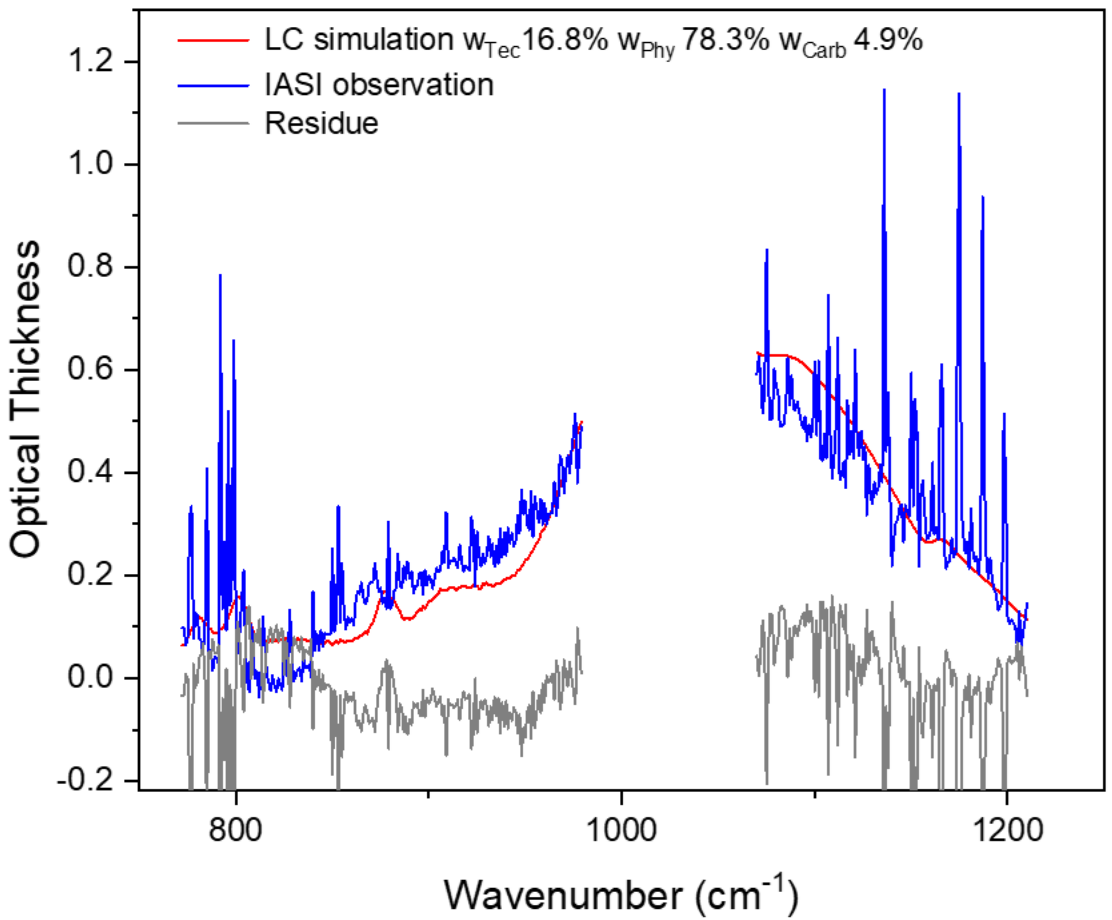

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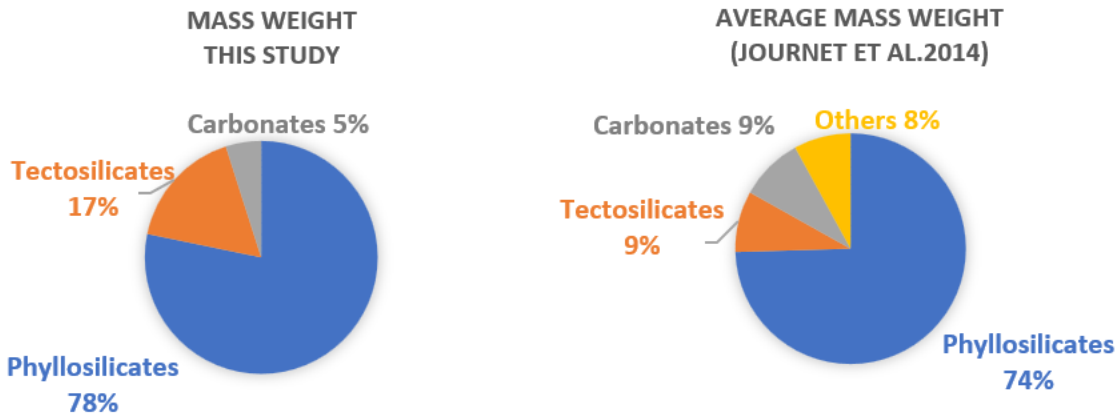
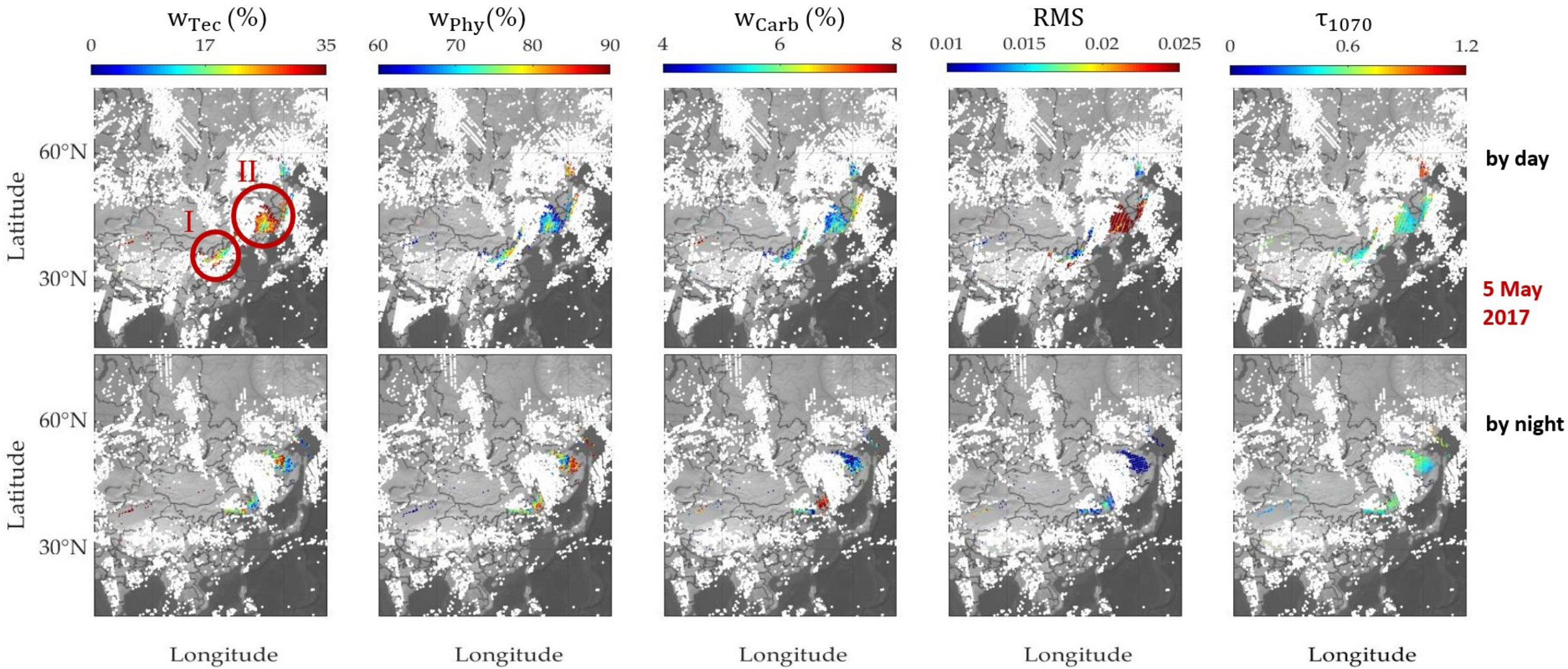
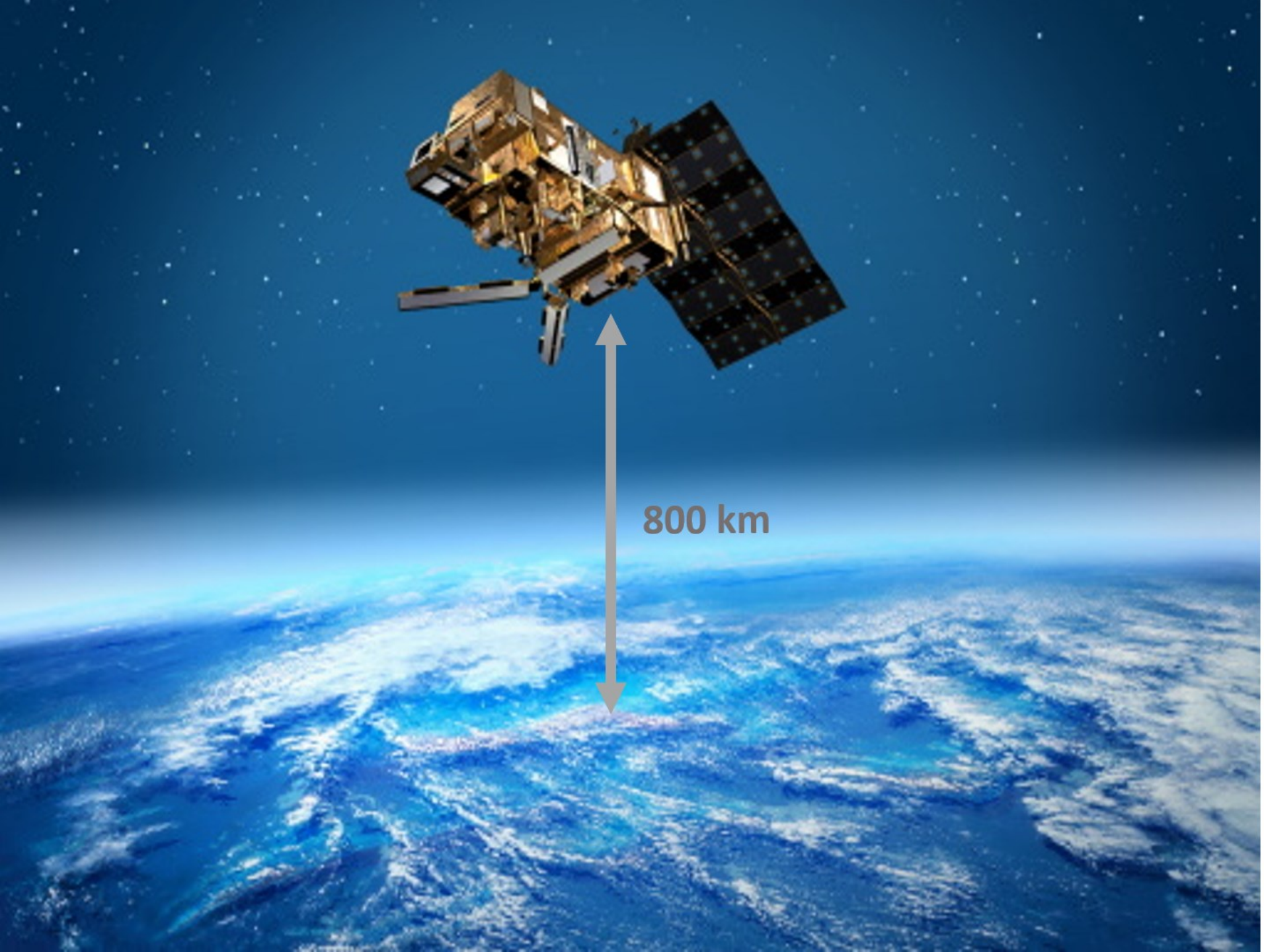


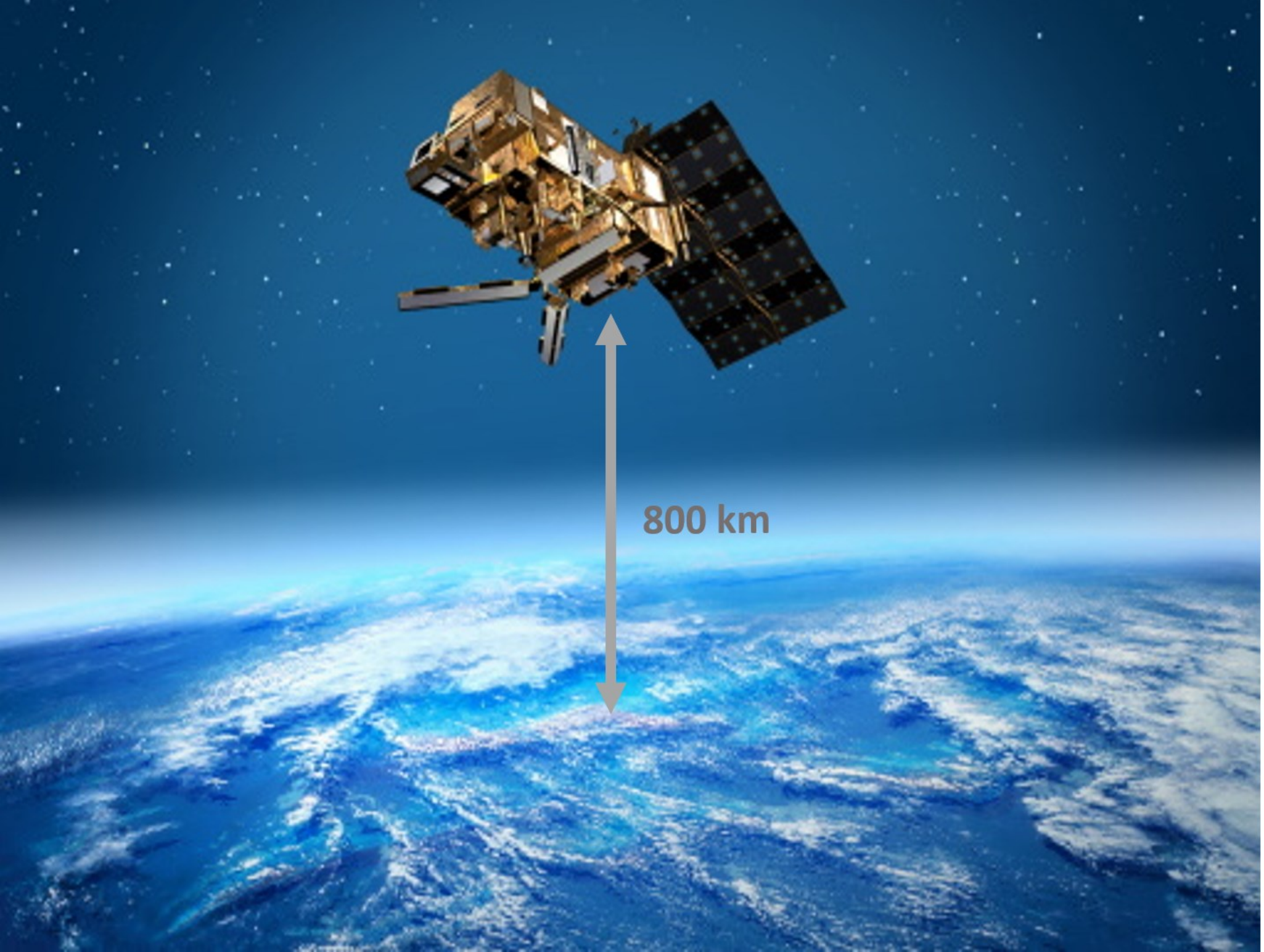
Smoothening gases narrow bands:

Before:	After:
Residue = 20%	Residue = 5%

III- Case of study Example




800 km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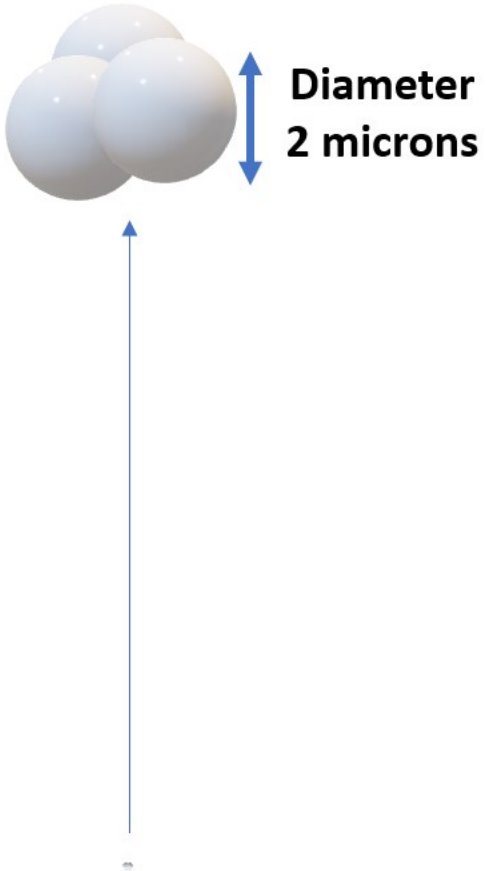
Diameter
2 microns

Conclusion

- LC Method is applicable on both laboratory (Residue of 2.5 %) and satellite spectra (Residue 5%).

- Mineralogical Mass Weights was applied on:
  - Two cases (May 2017 and March 2021) of study in two different seasons.
  - Two IASI platforms (A and B).

Perspectives

Experimental optical properties (i.e. refractive indices) will be used :

- To retrieve dust microphysical properties (size distribution, concentration, altitude).
- With different particle size distribution to better characterize the mass weights (particularly for tectosilicates).

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