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Light absorbing particles in air and rain at the Maldives climate observatory

Organic Aerosol Summer School 2008

Seminar by Erik Engström

Atmospheric Brown Cloud Project

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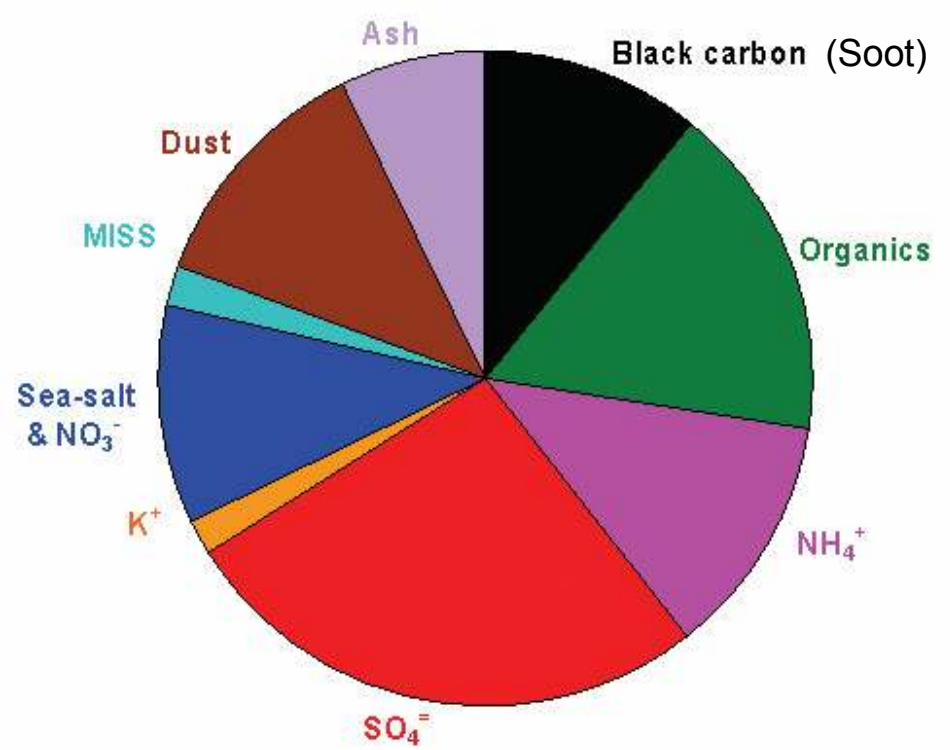

Mass composition of a brown cloud.
Ramanathan, Crutzen and
INDOEX Science Team

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Radiation balance

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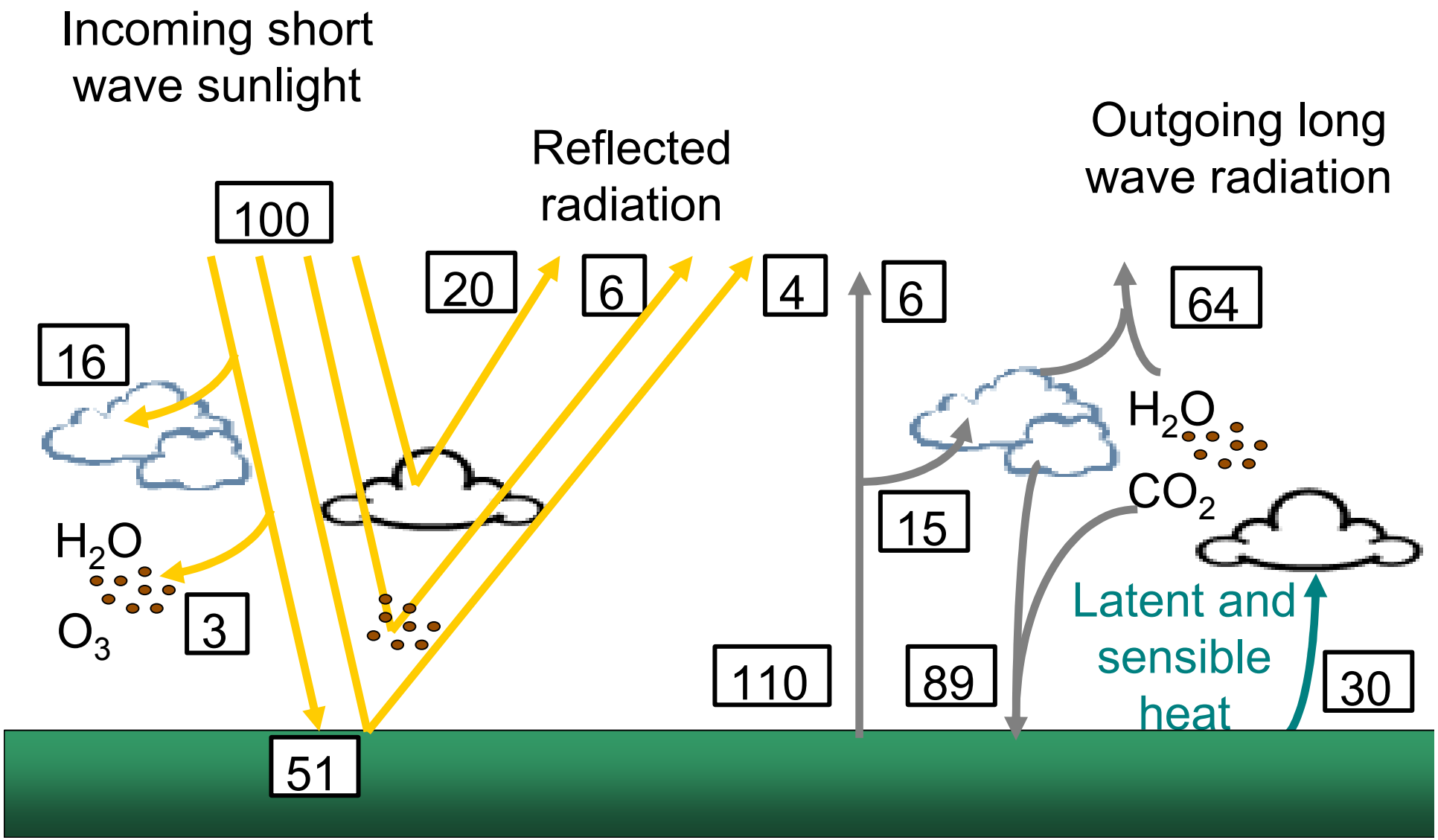

Radiation balance

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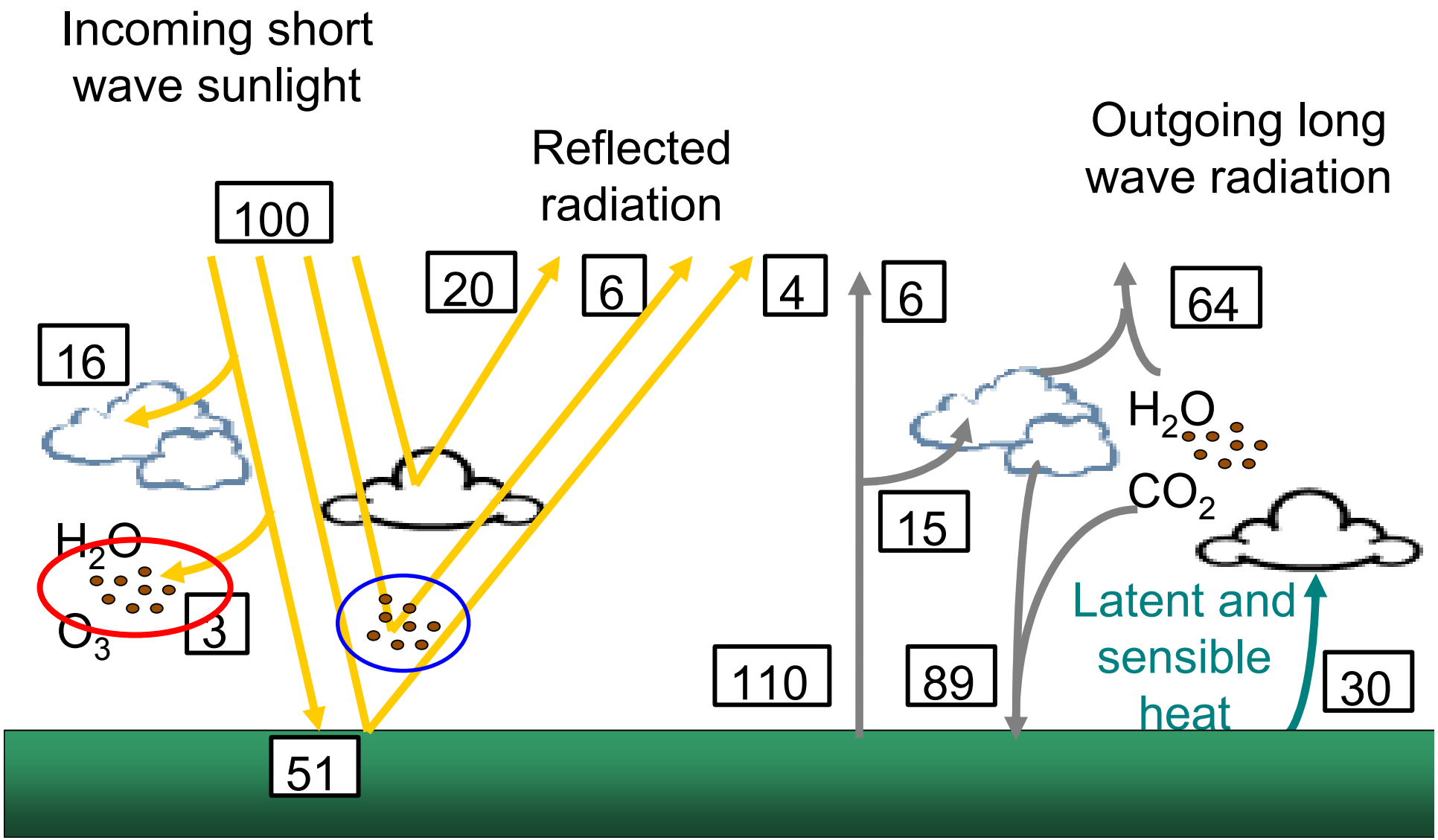
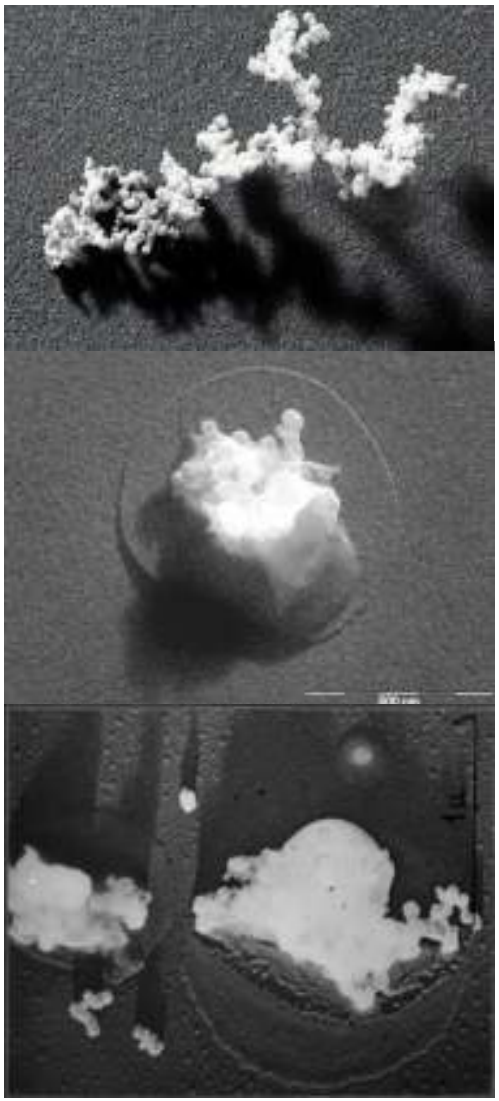


Aerosol particle transformation

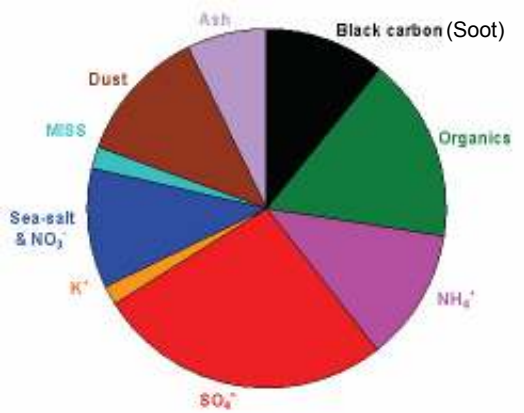


Soot
Hydrophobic

Source

Soot + Organic
Less hydrophobic

Transport



Mass Composition of a brown cloud.
Ramanathan, Crutzen and
INDOEX Science Team

Soot + Sulphuric acid
Hydrophilic

Sink
Dry and wet deposition

Aerosol particle absorption spectra

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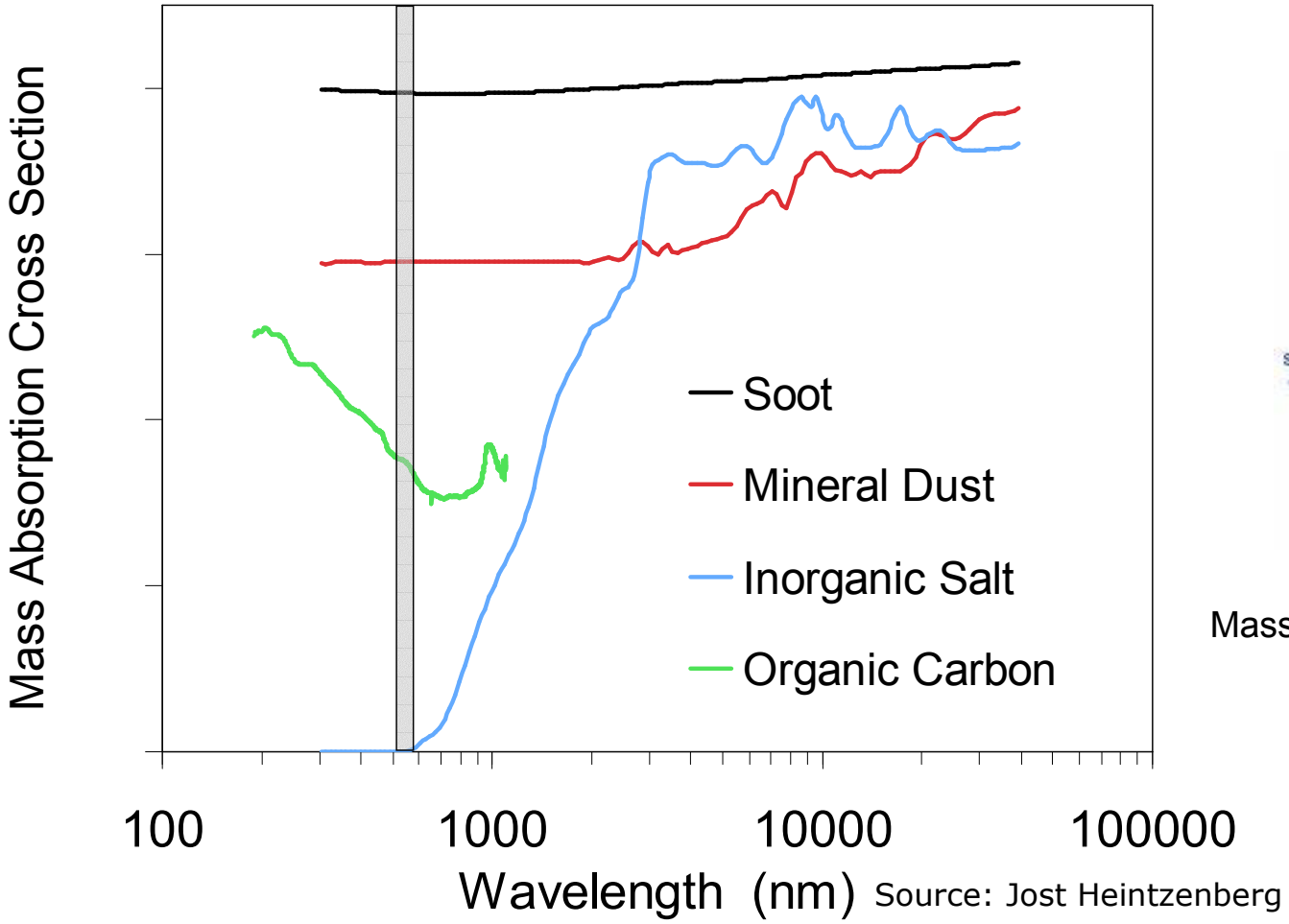
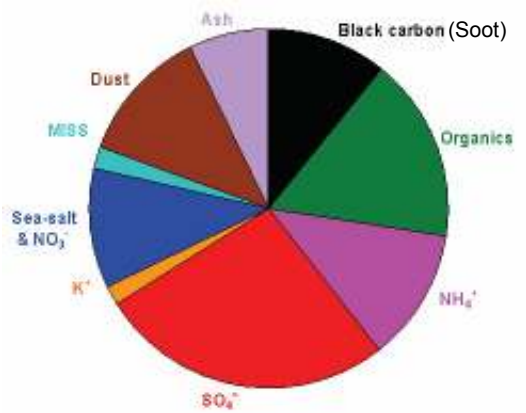


Source: Jost Heintzenberg



Mass Composition of a brown cloud.
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Aerosol particle absorption spectra

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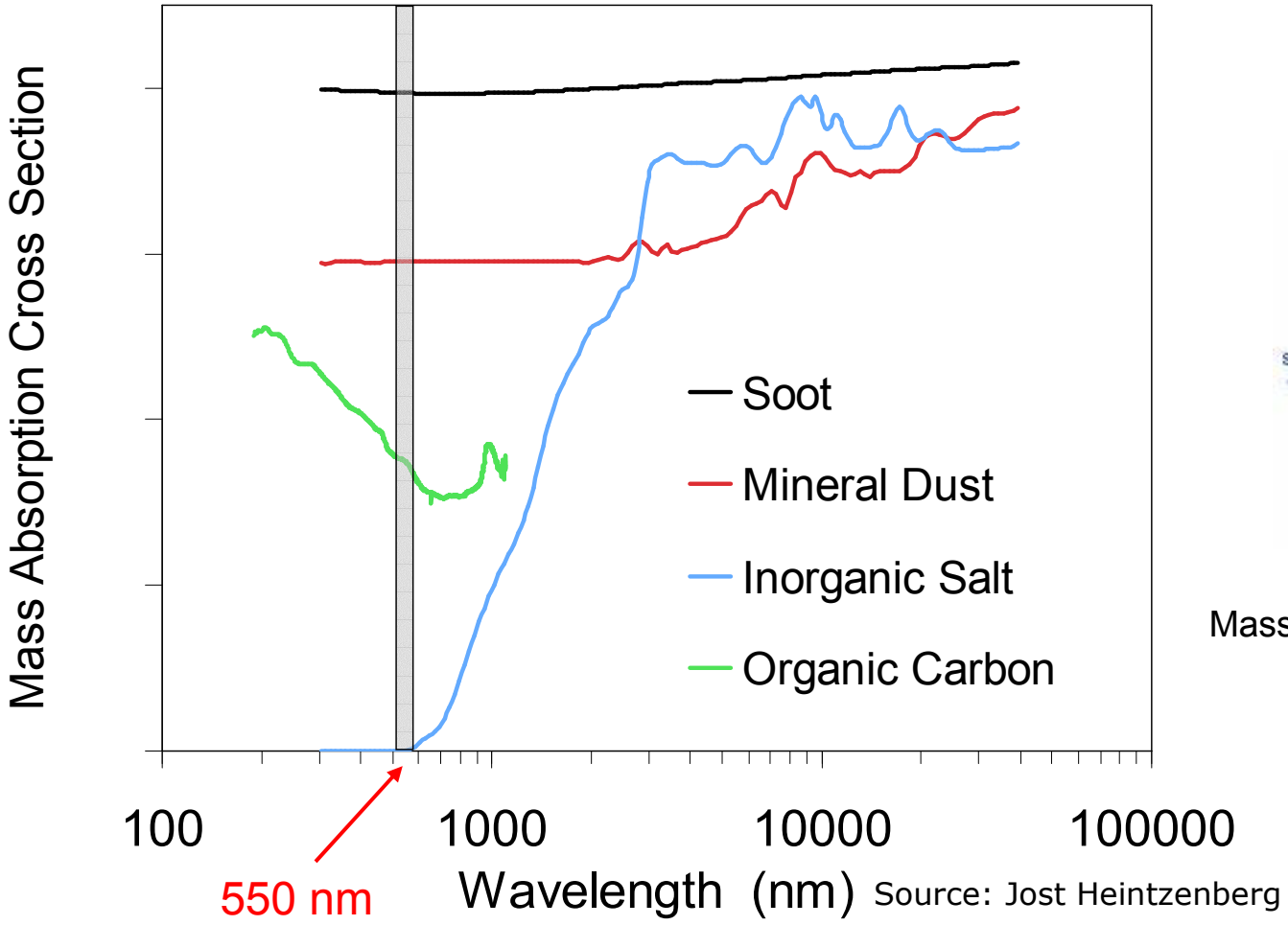
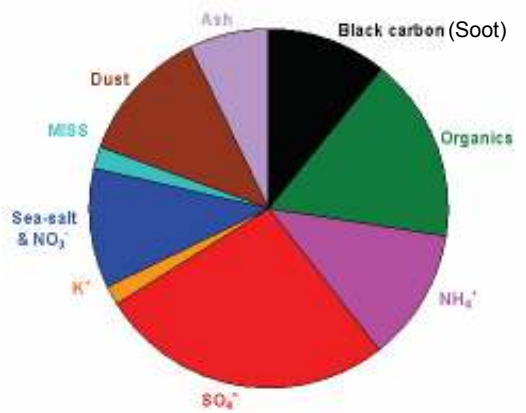


Source: Jost Heintzenberg



Mass Composition of a brown cloud.
Ramanathan, Crutzen and
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MISU-ABC observatories

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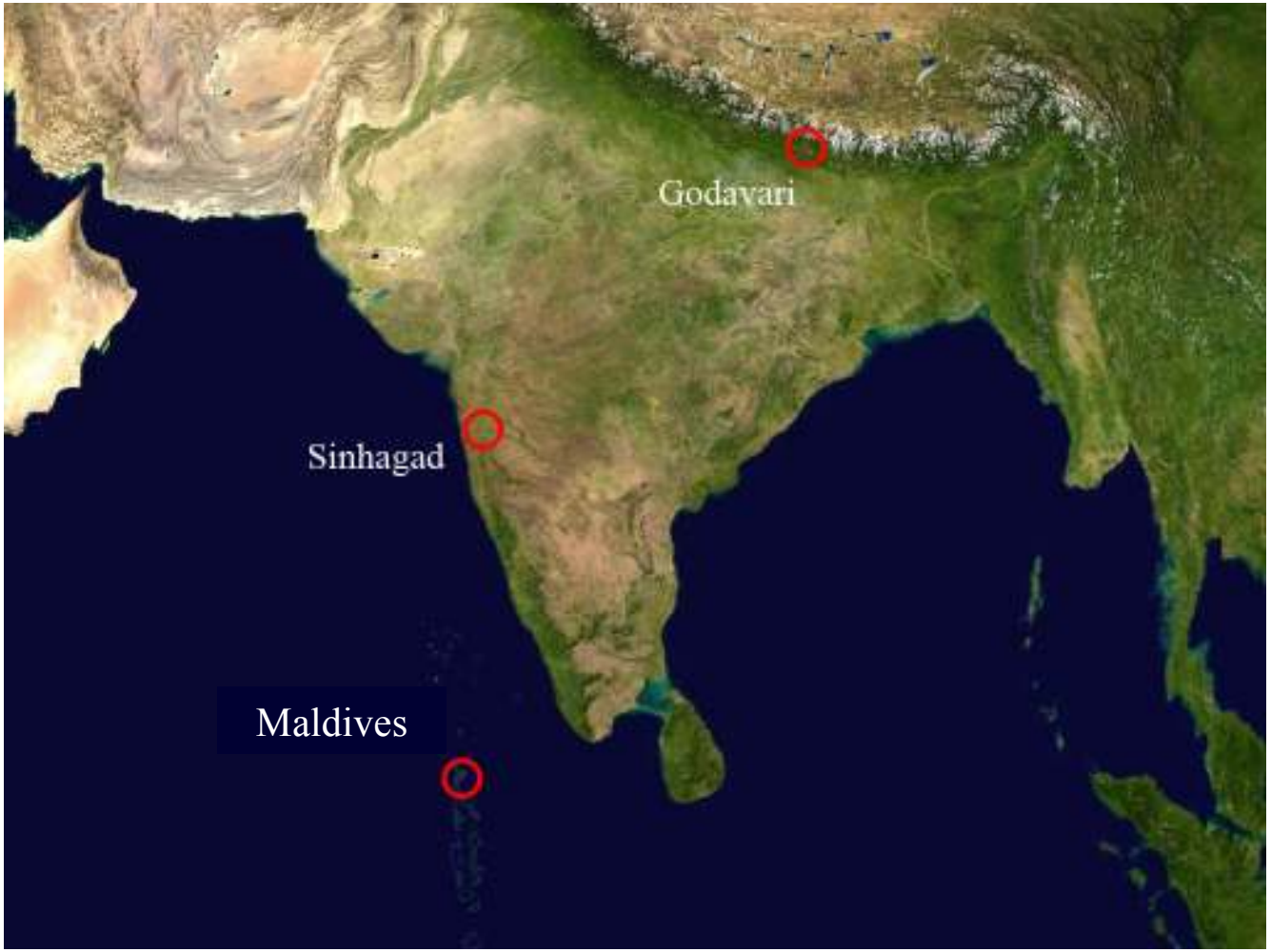

MISU-ABC observatories

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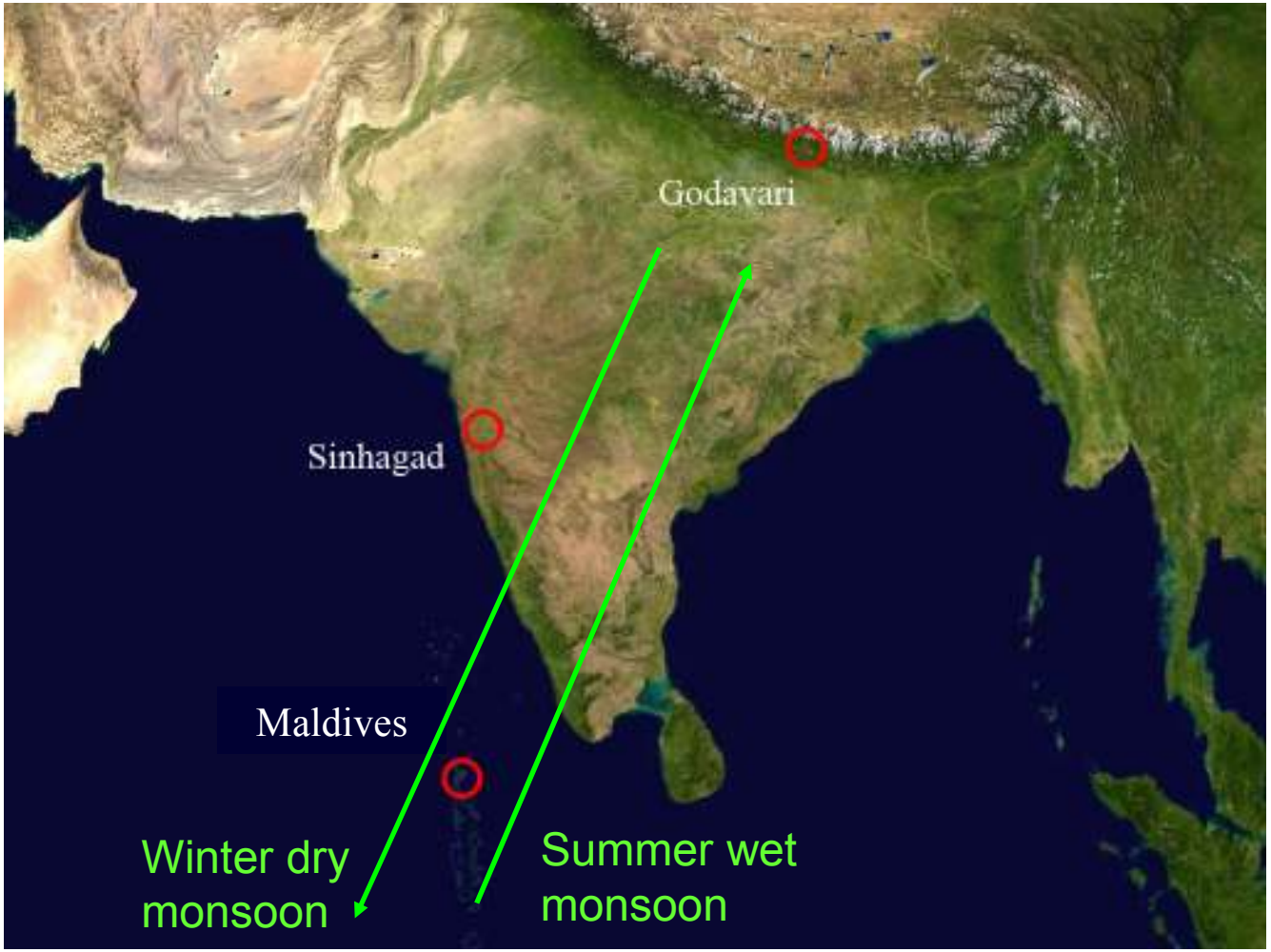

MISU-ABC observatories

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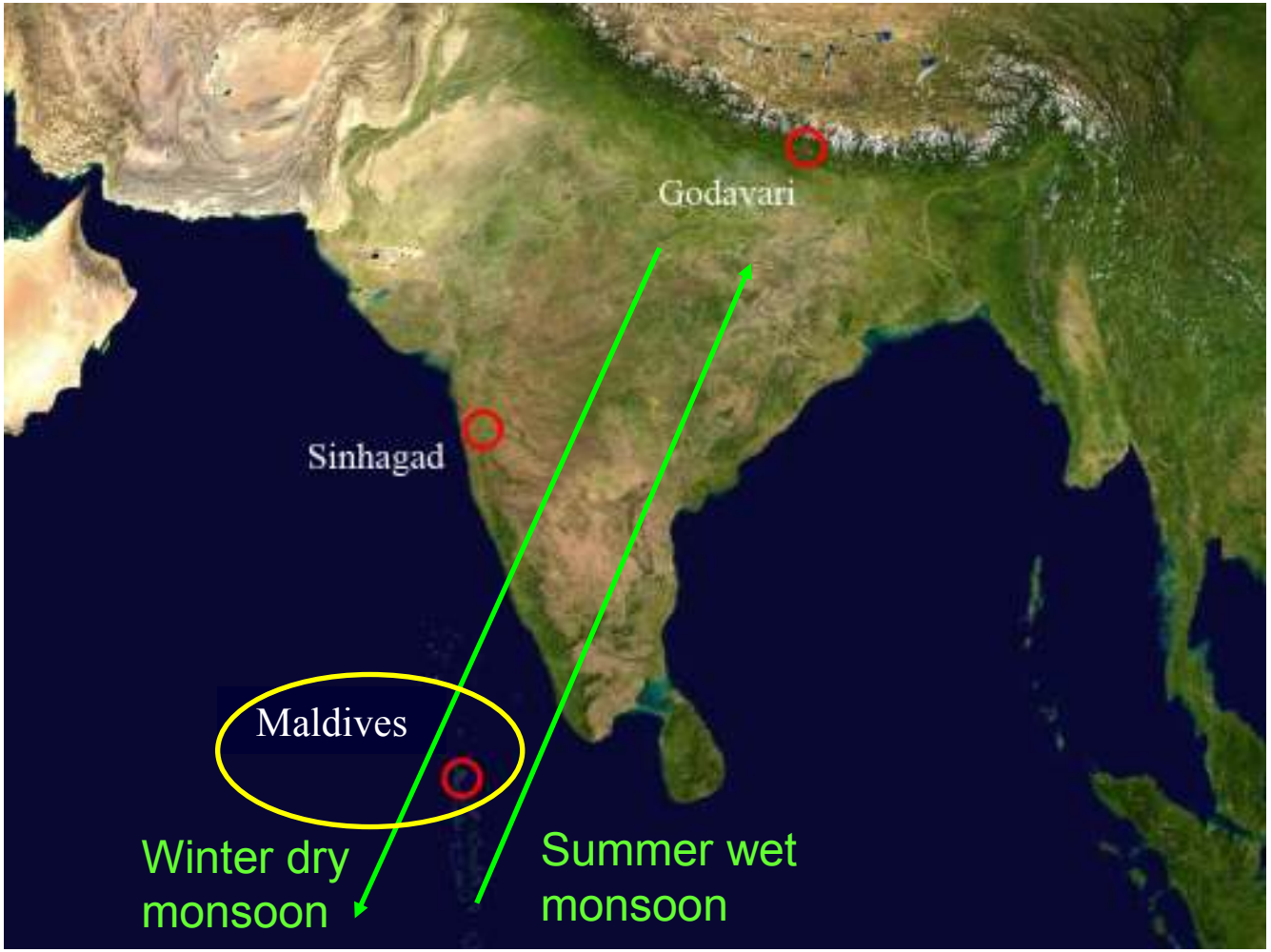

Particle Soot Absorption Photometer (PSAP) measurements at the Maldives

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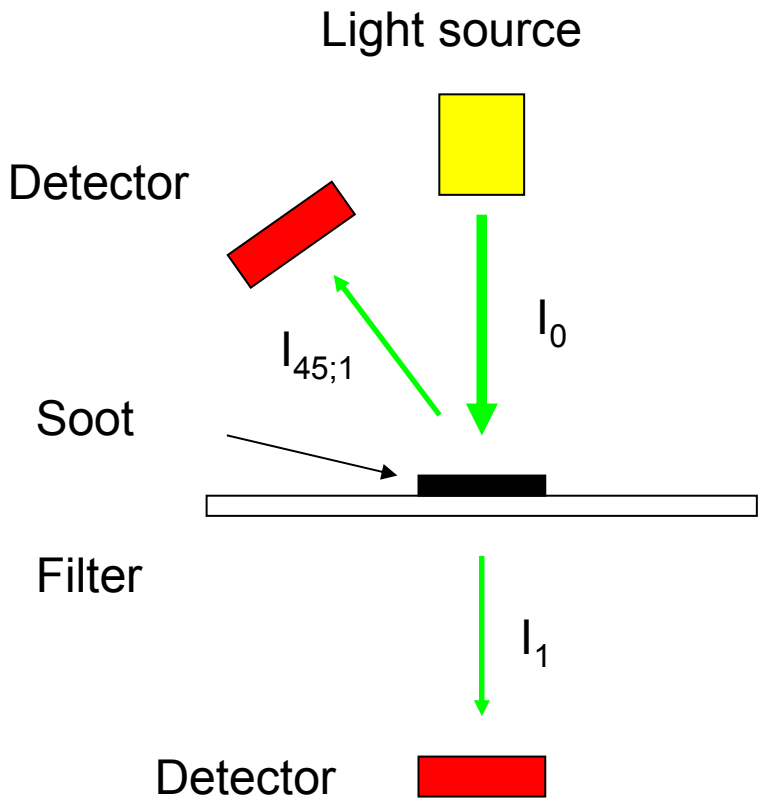
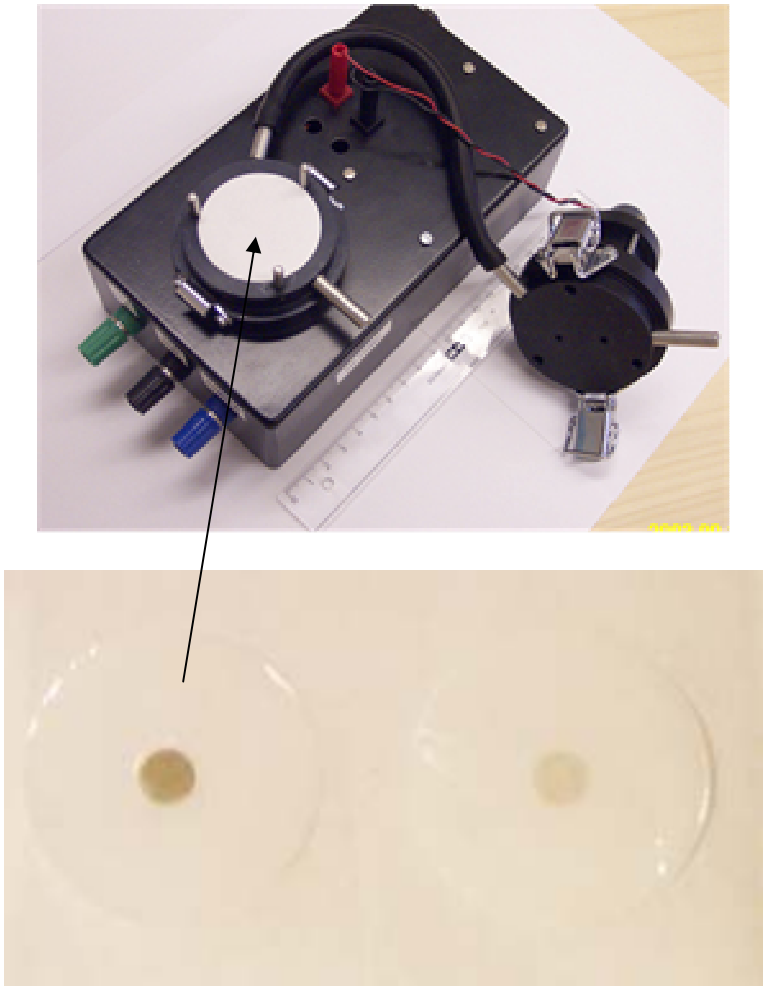
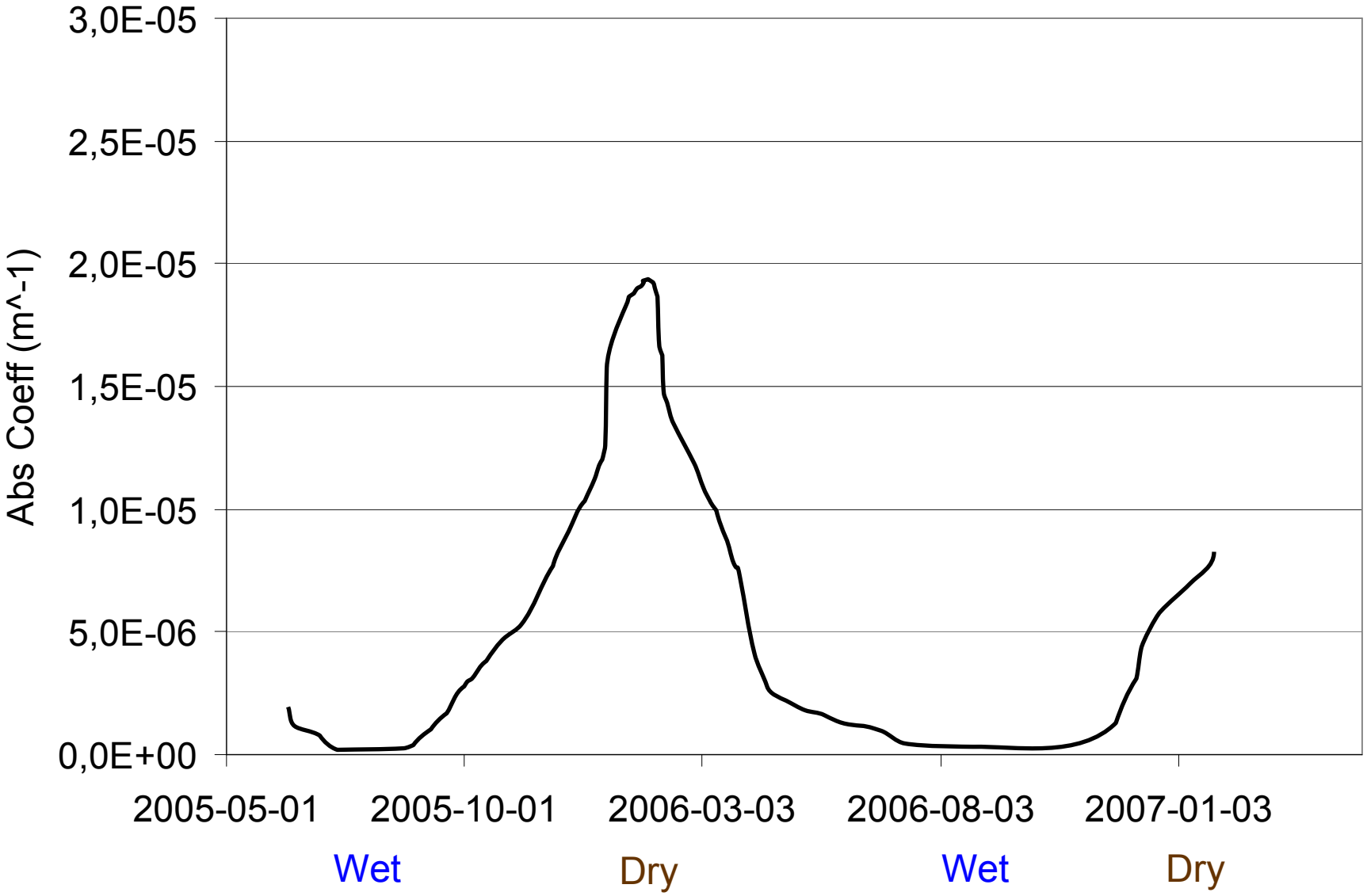


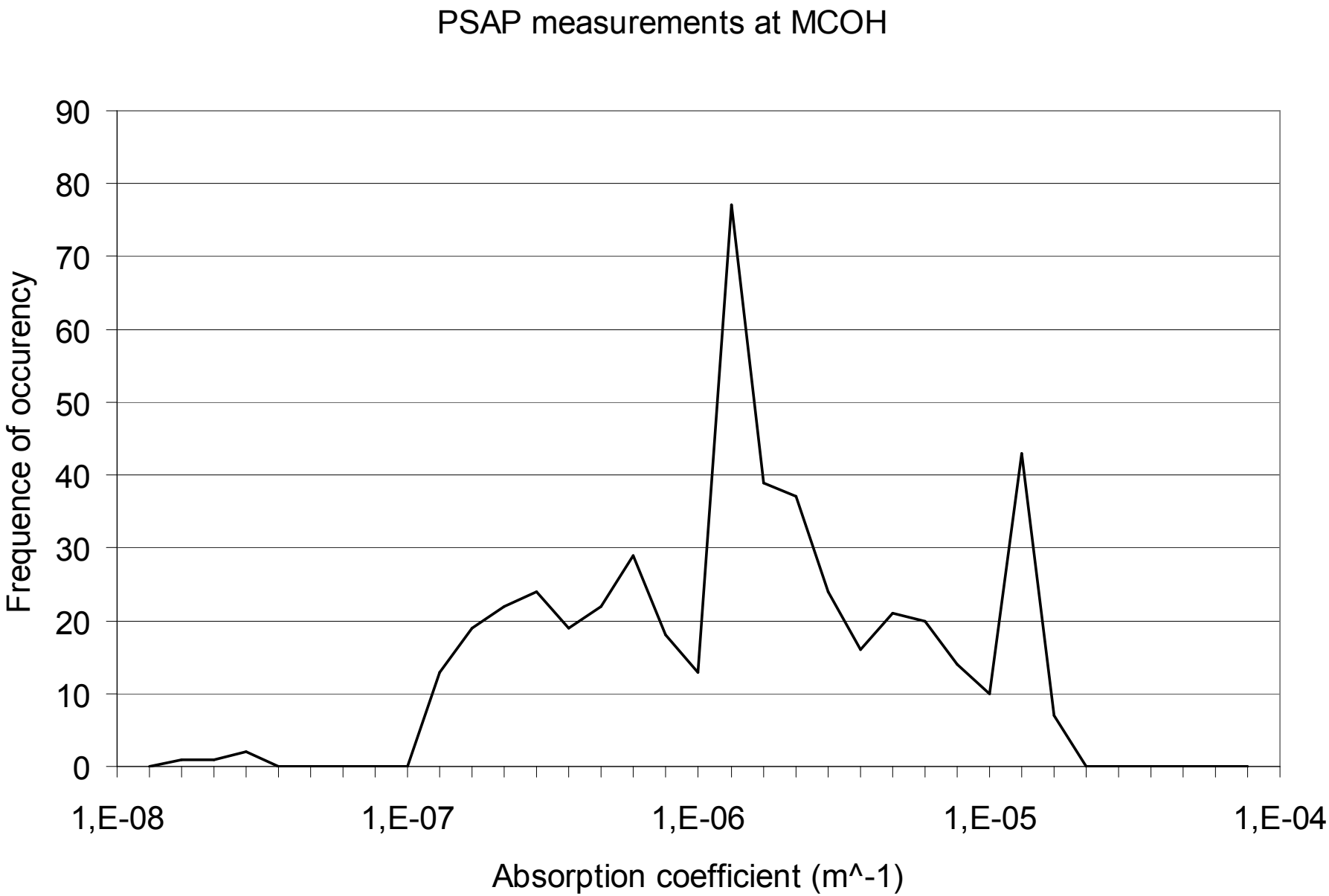


PolyCarbonate Membrane (PCMB) filter

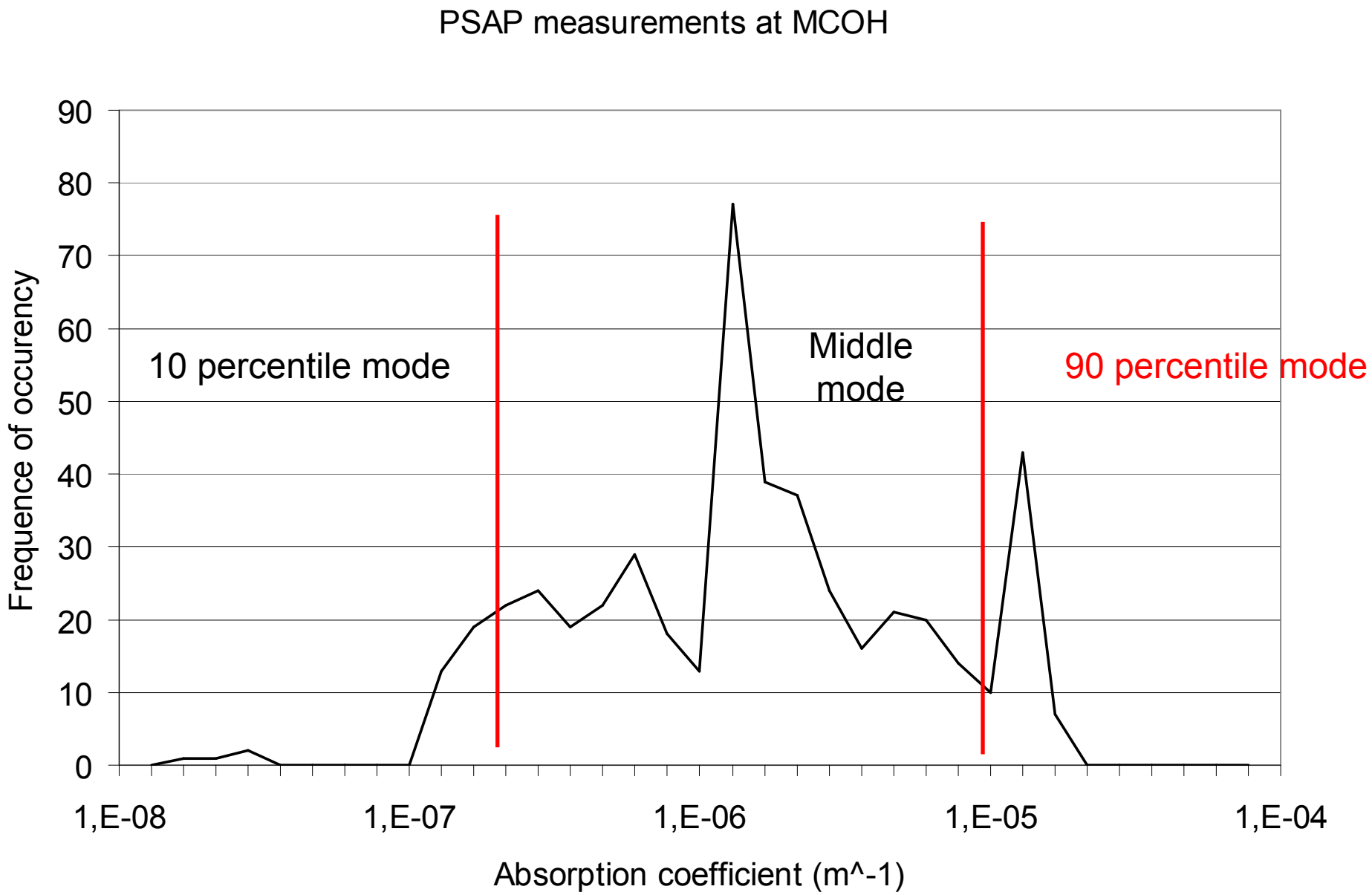
Seasonal variation of soot at the Maldives



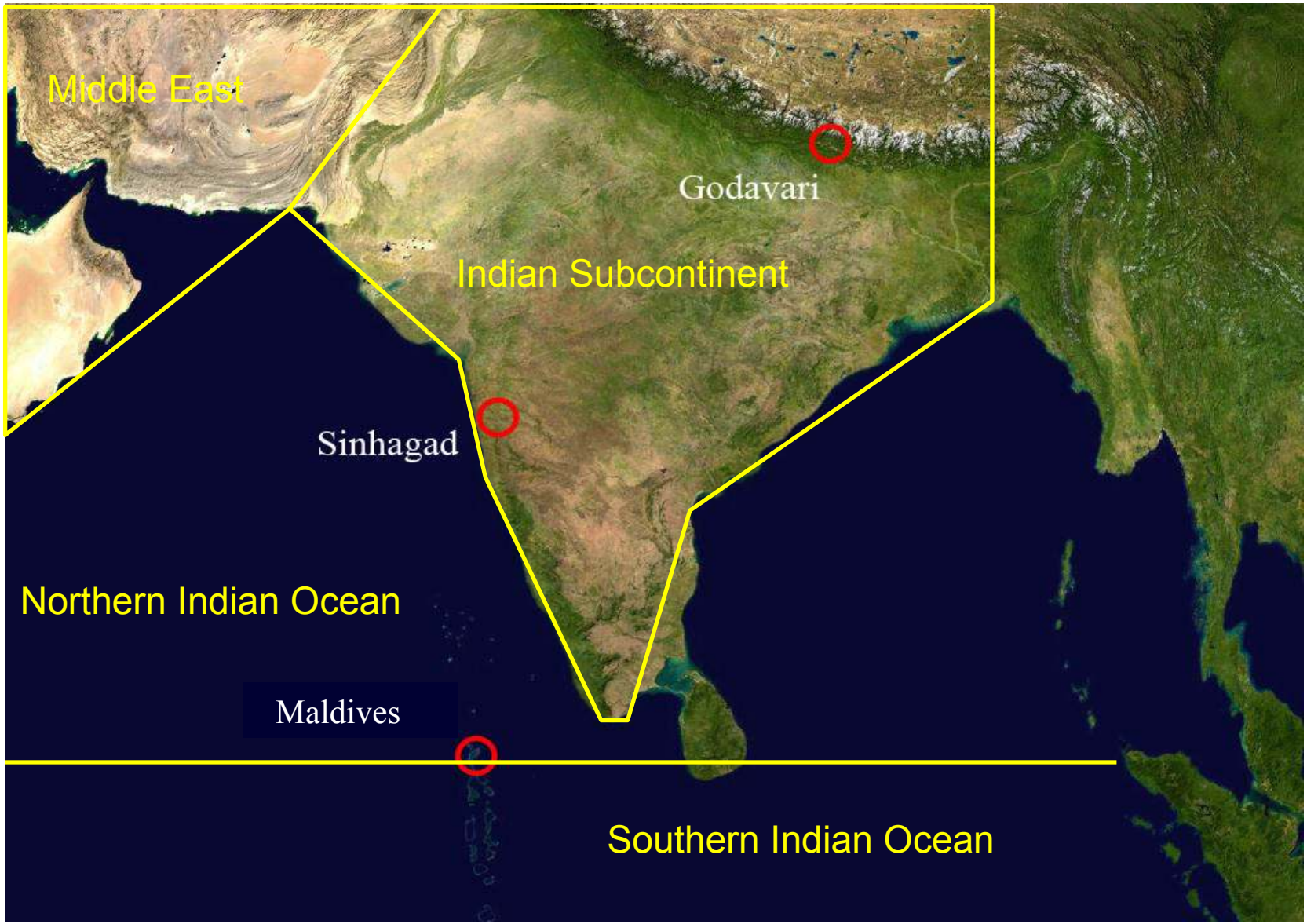
Frequence distribution of soot absorption



Frequence distribution of soot absorption



Source regions



Trajectories for samples with the highest soot concentrations (90 percentile)

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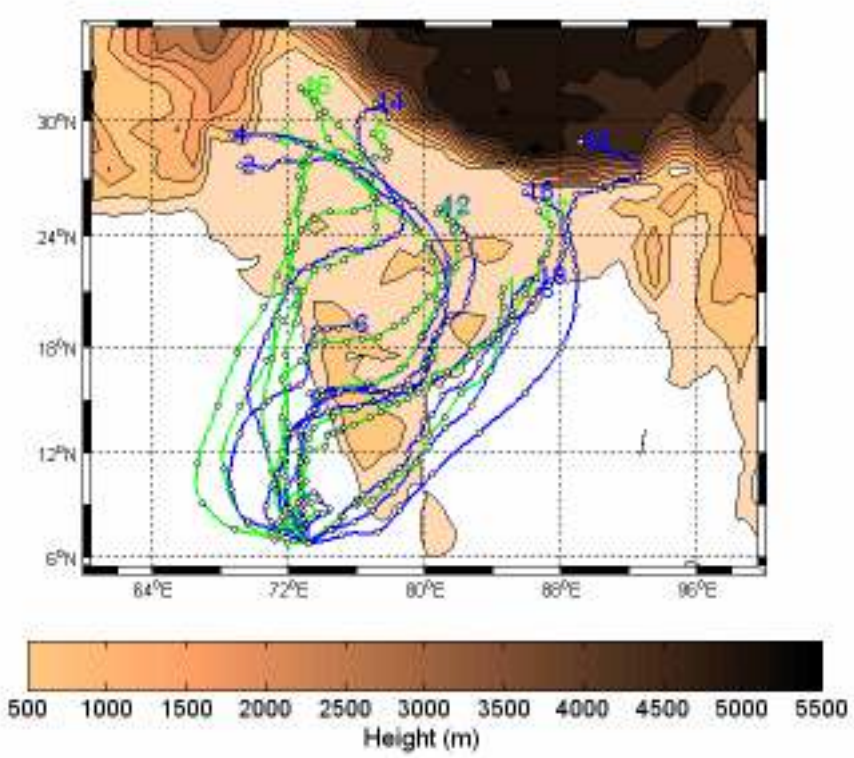
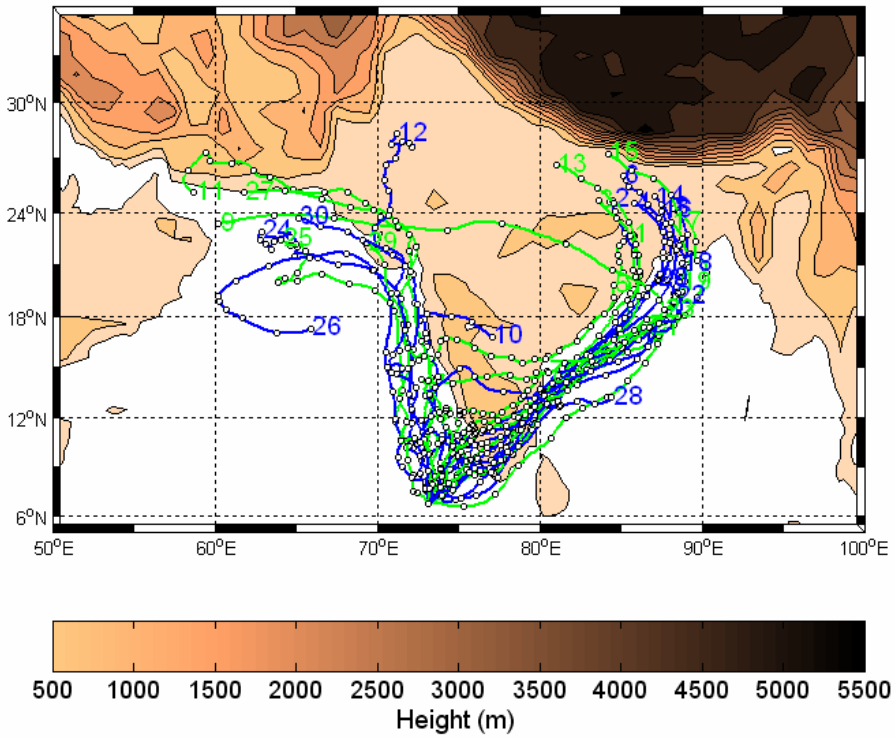
2005



2006



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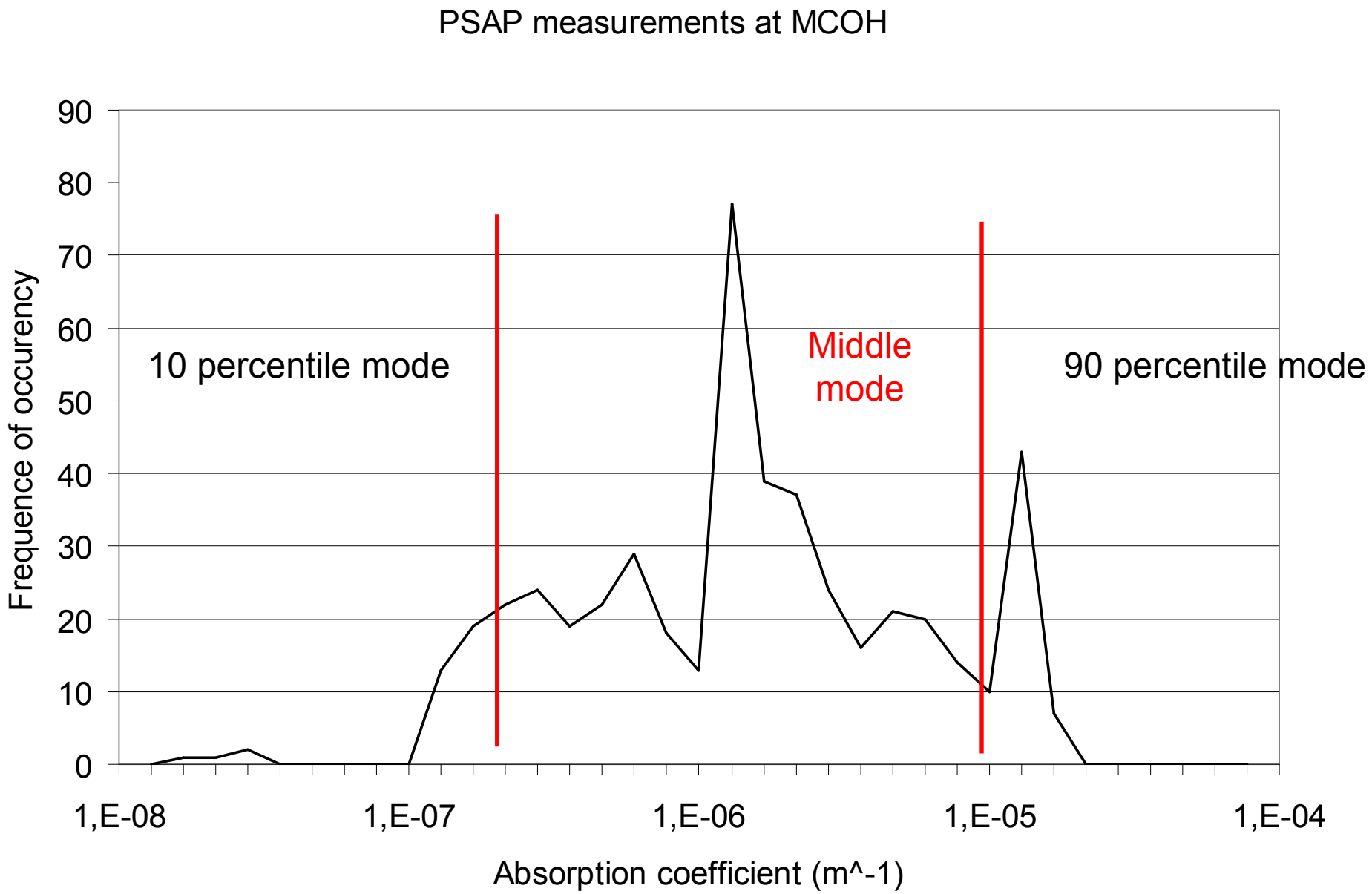
Frequence distribution of soot absorption



Source regions for the middle mode

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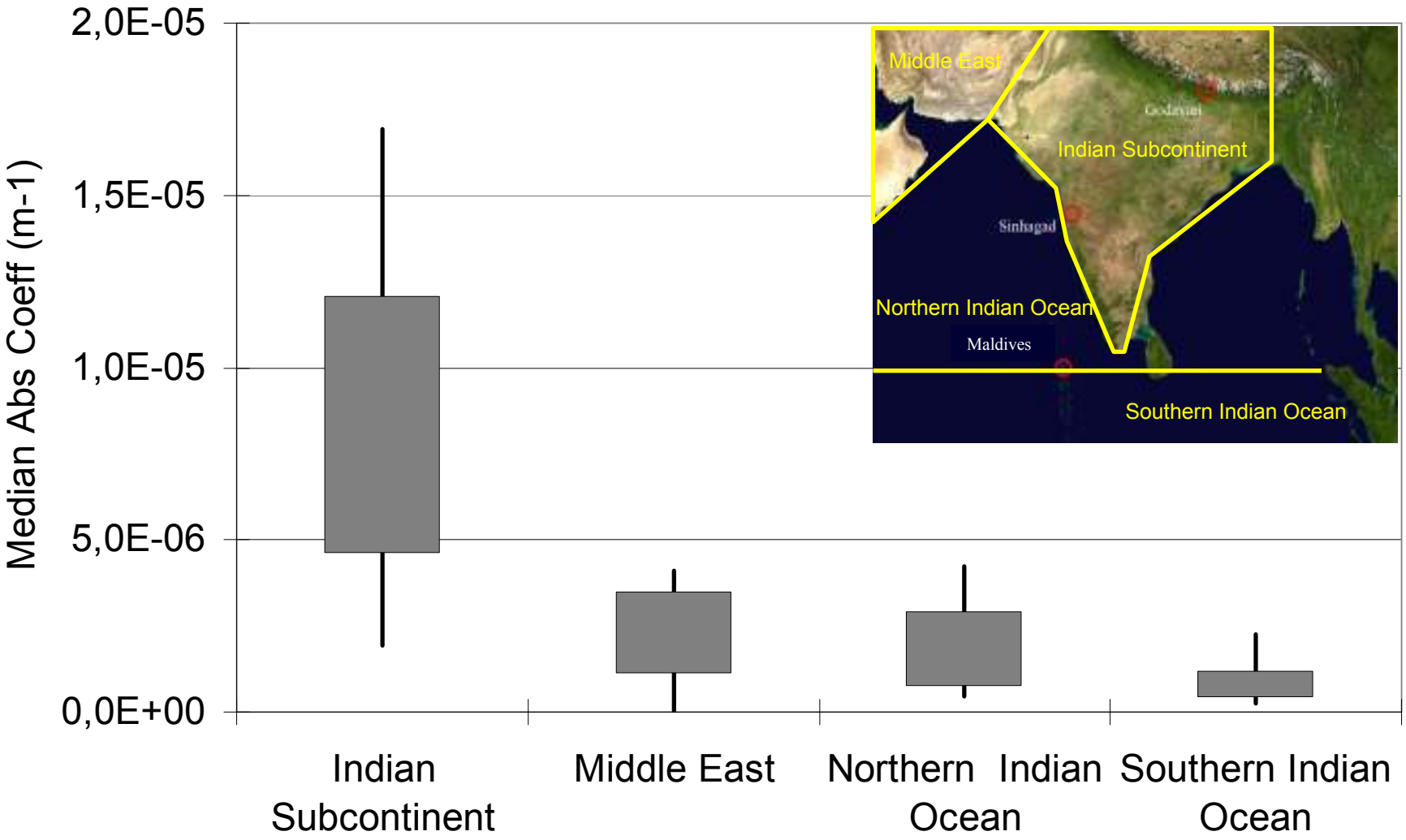
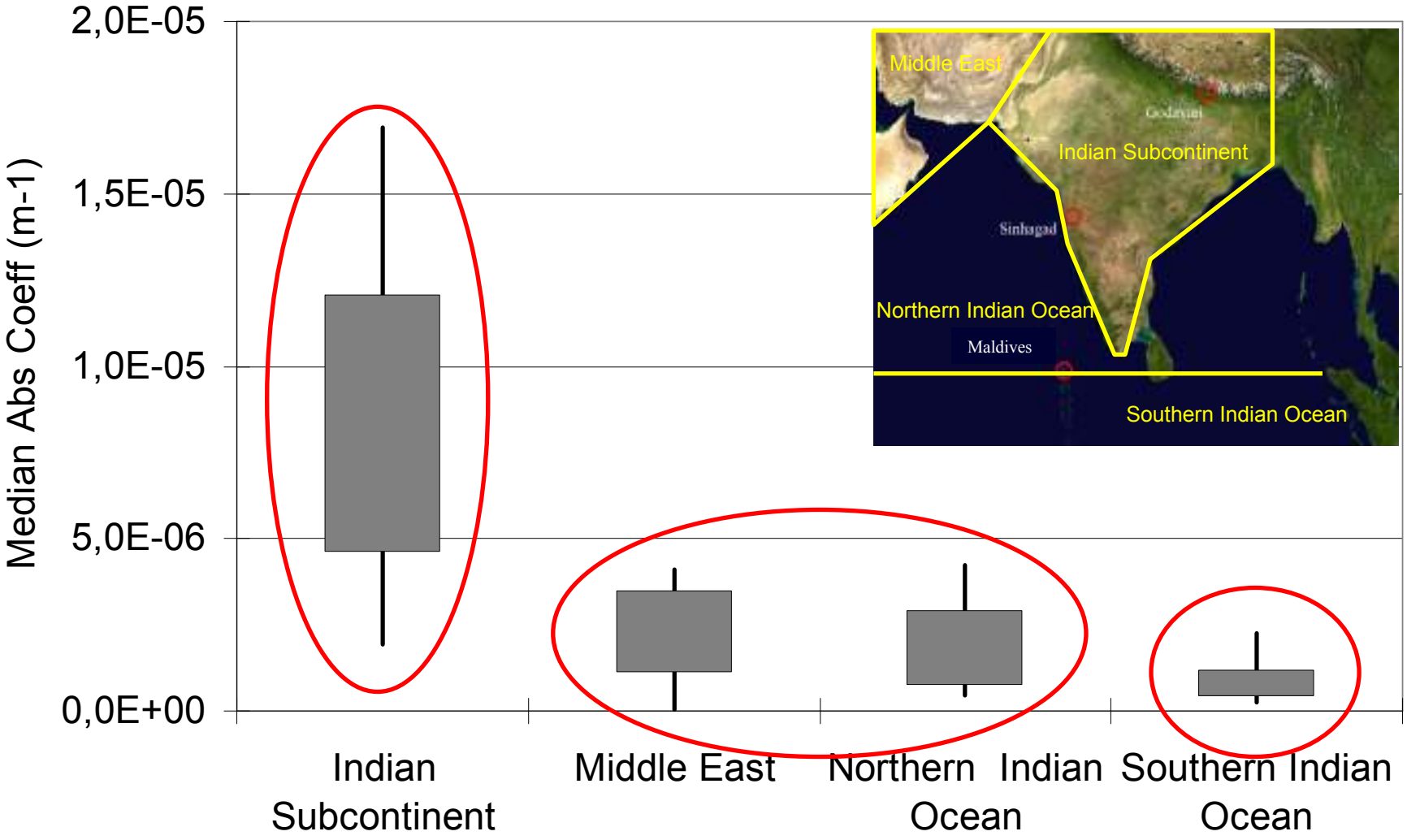


Source regions for the middle mode

Stockholms universitet



Source regions for the middle mode

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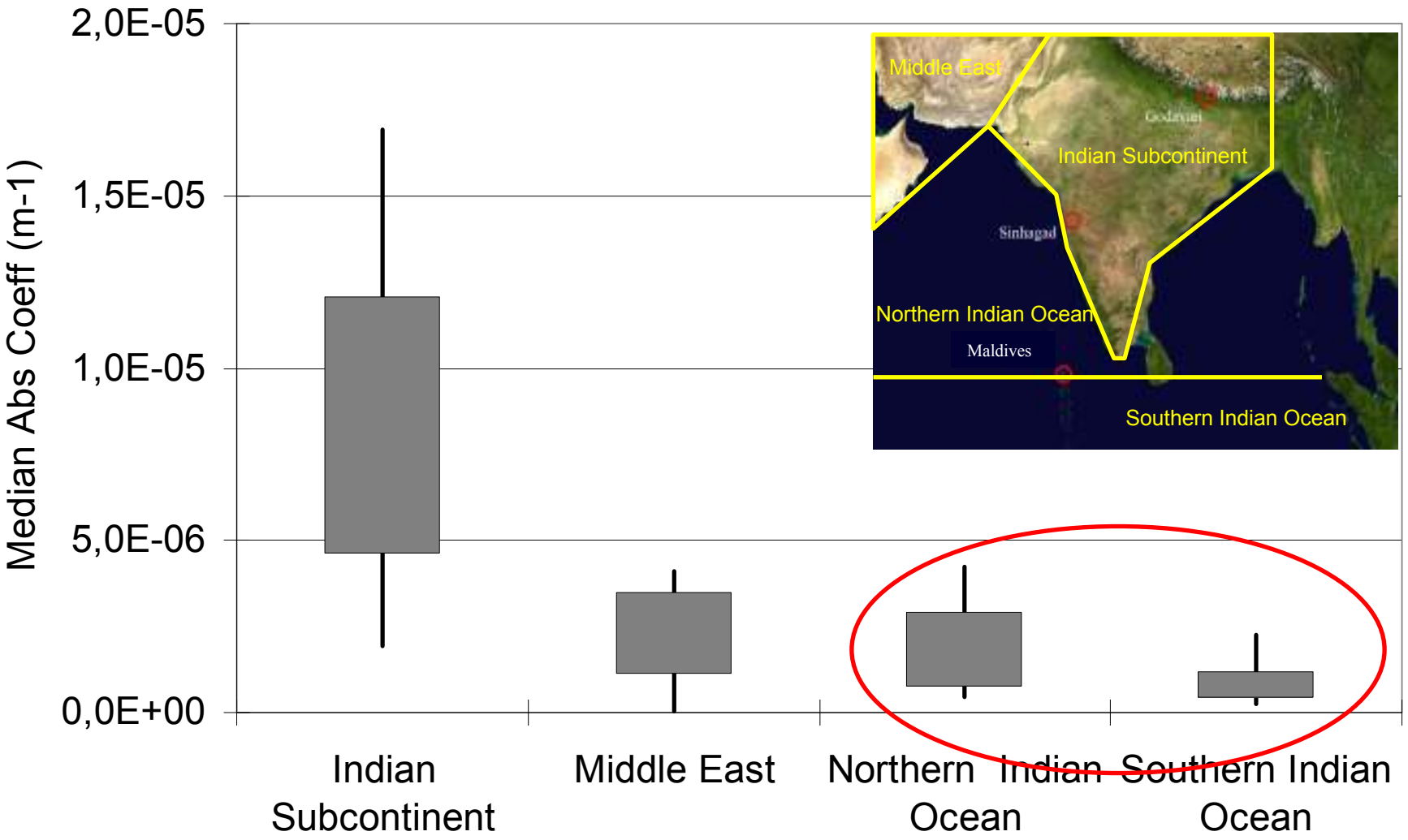
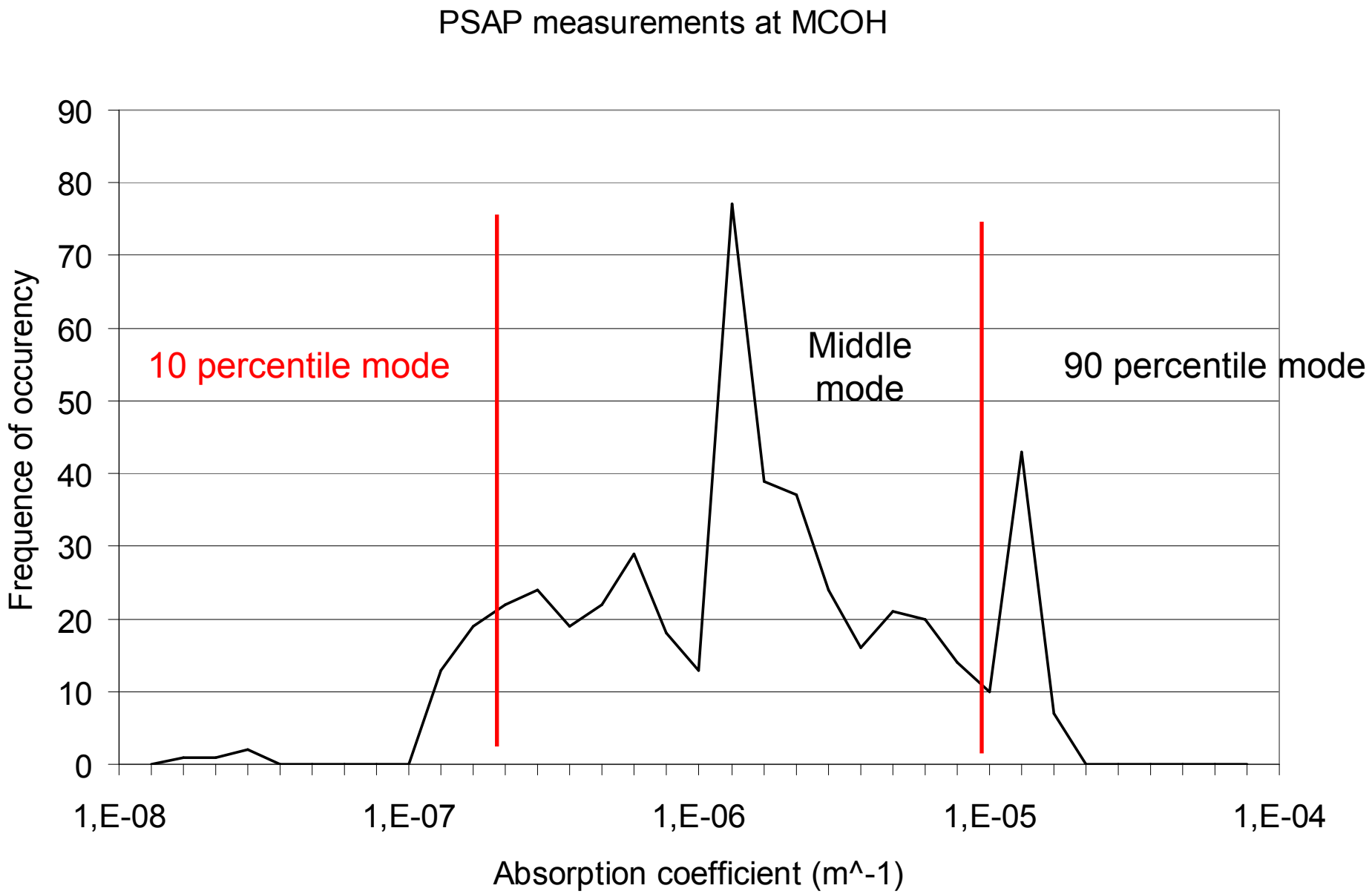


Frequence distribution of soot absorption



Trajectories for samples with the lowest absorption (10 percentile)

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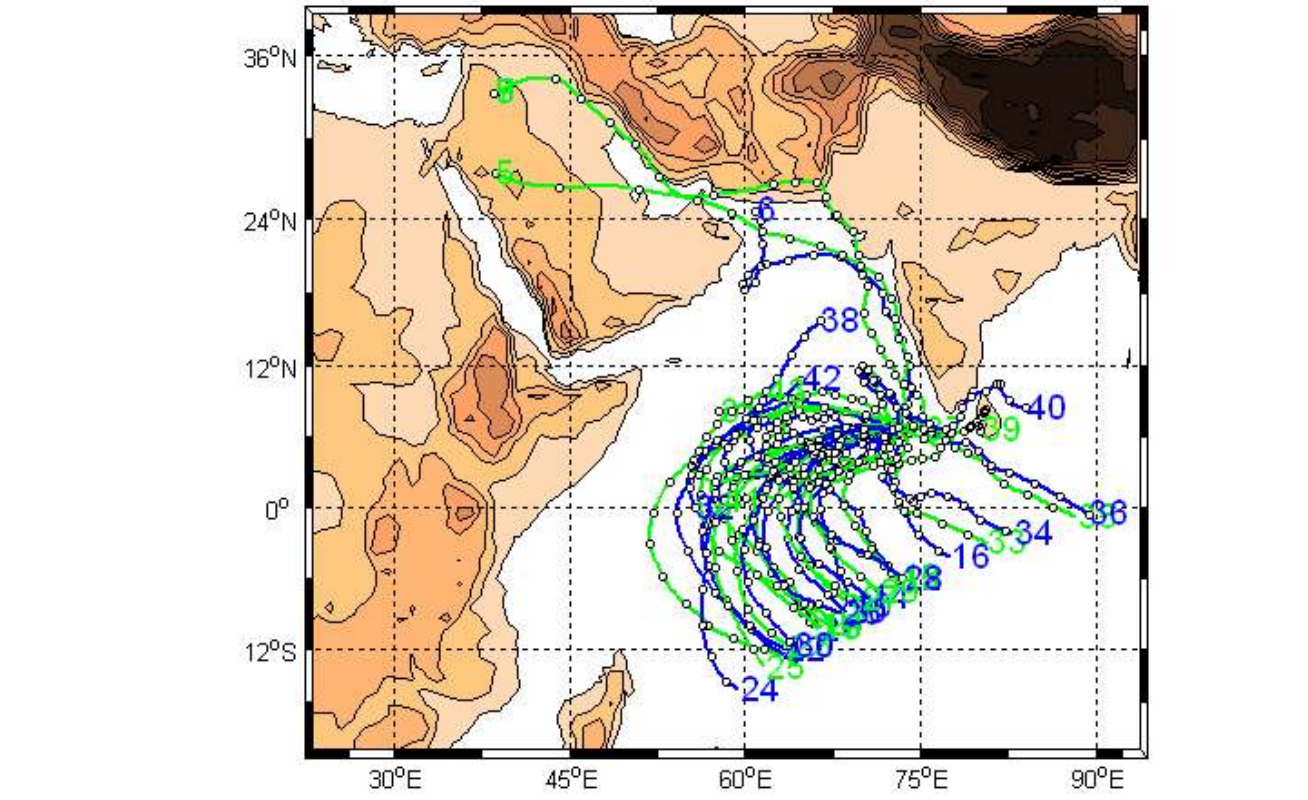
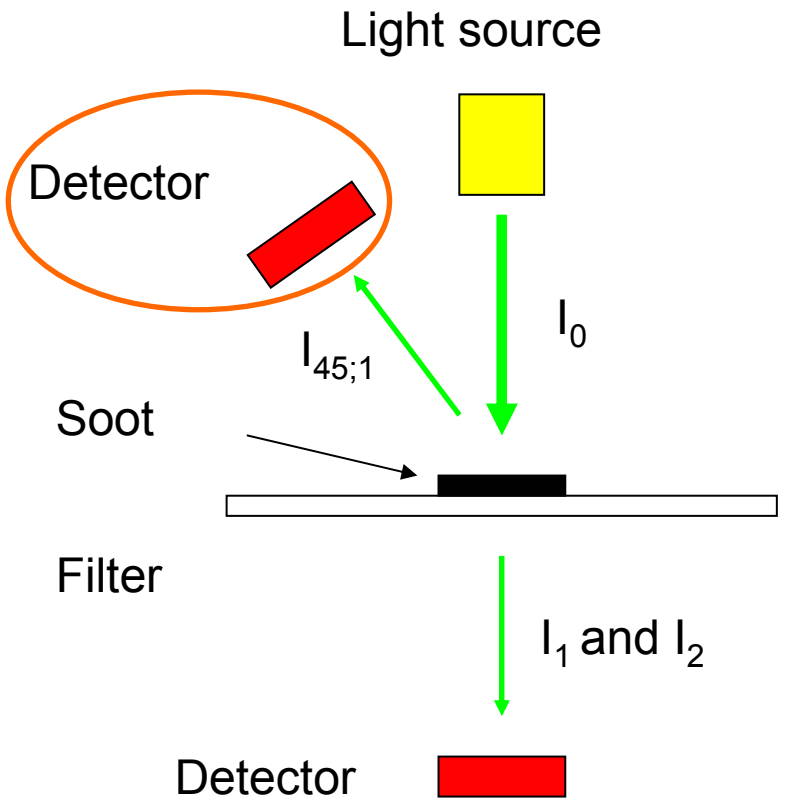


Scattering Index (Si)



$$Si = \frac{I_{45;2} / I_{45;1}}{I_1 / I_2}$$

Relative instrumental response to scattering and absorption

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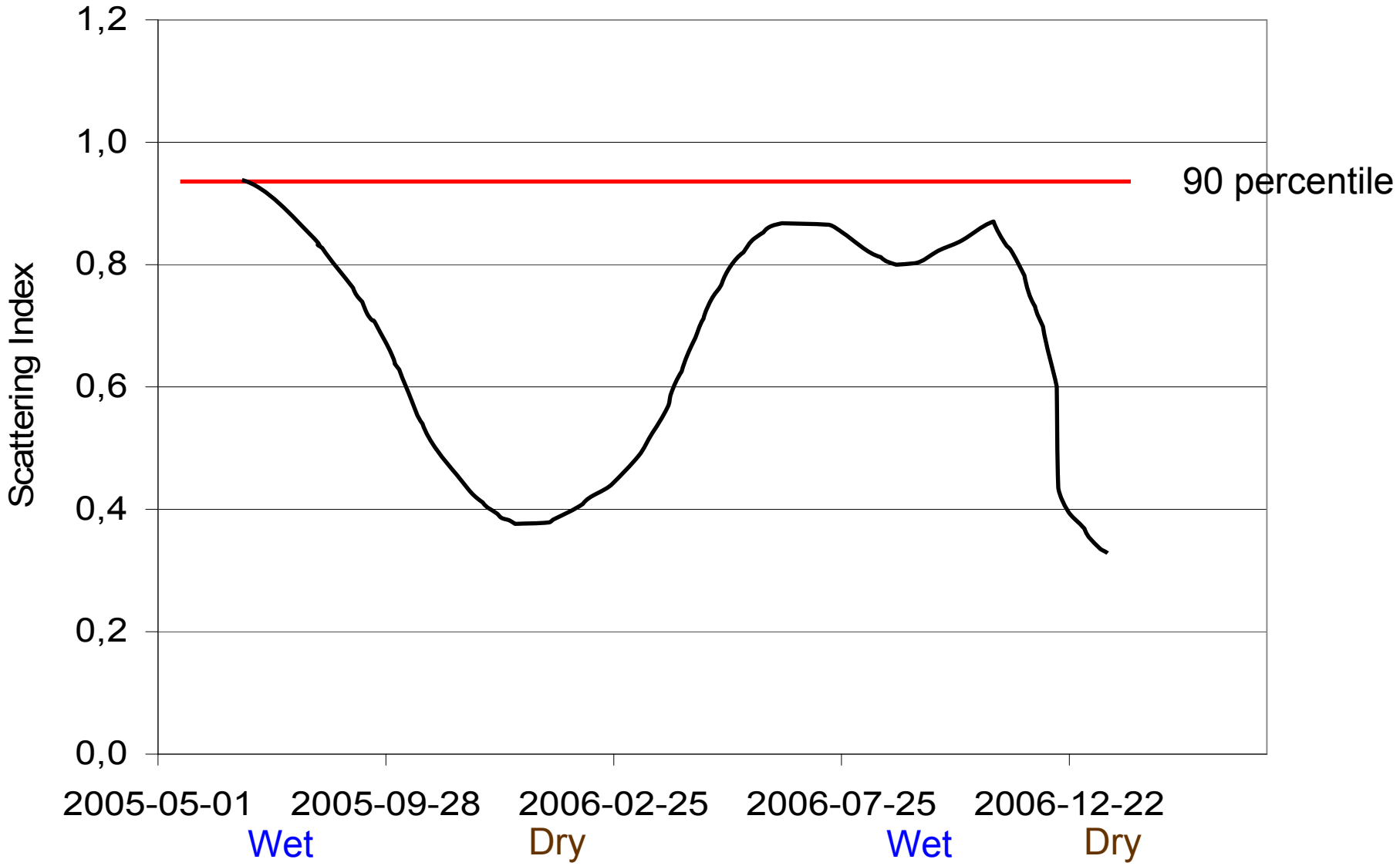

Trajectories for samples with the highest scattering influence

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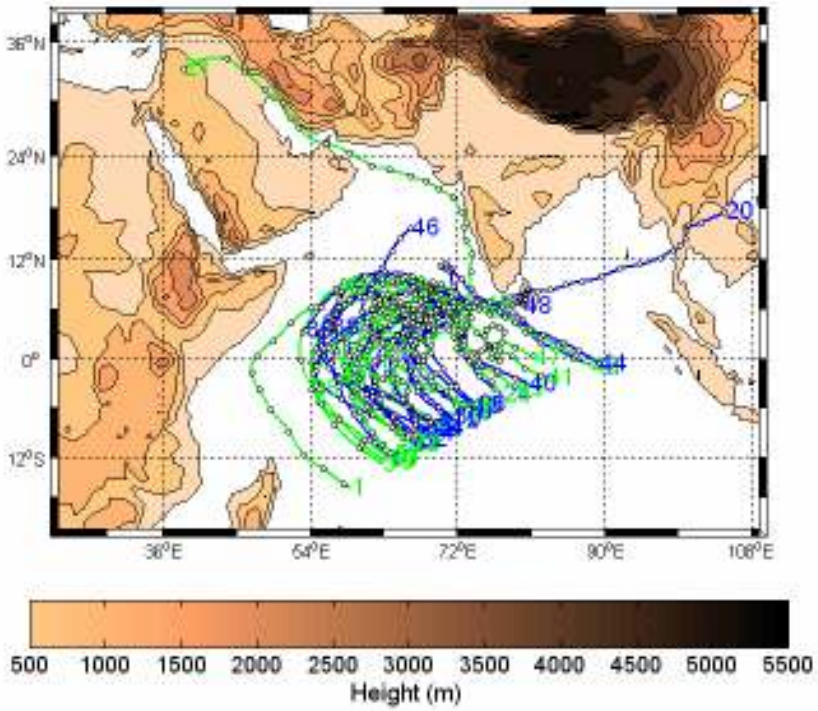
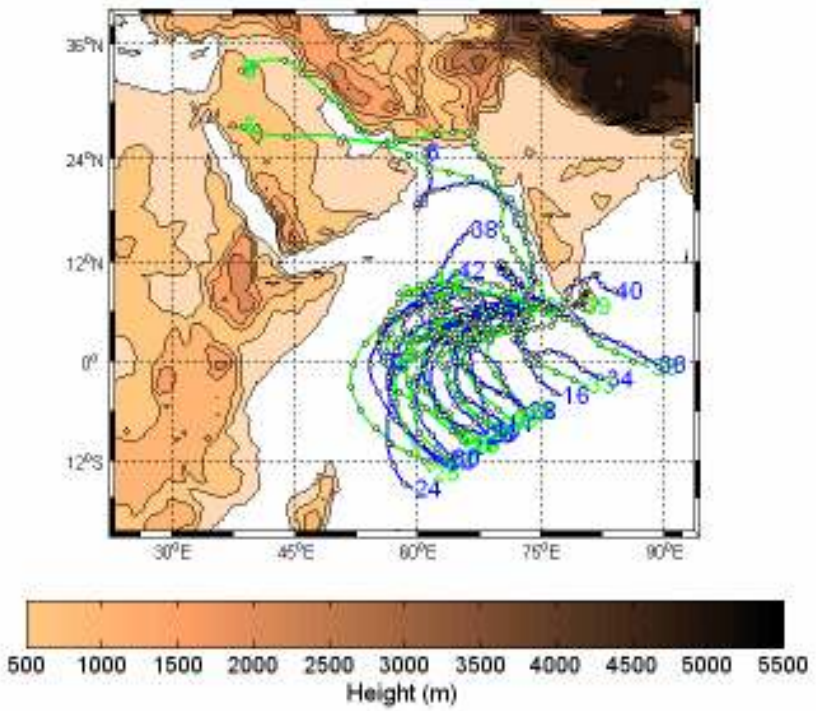


Highest scattering
(90 percentile)



Lowest absorption
(10 percentile)

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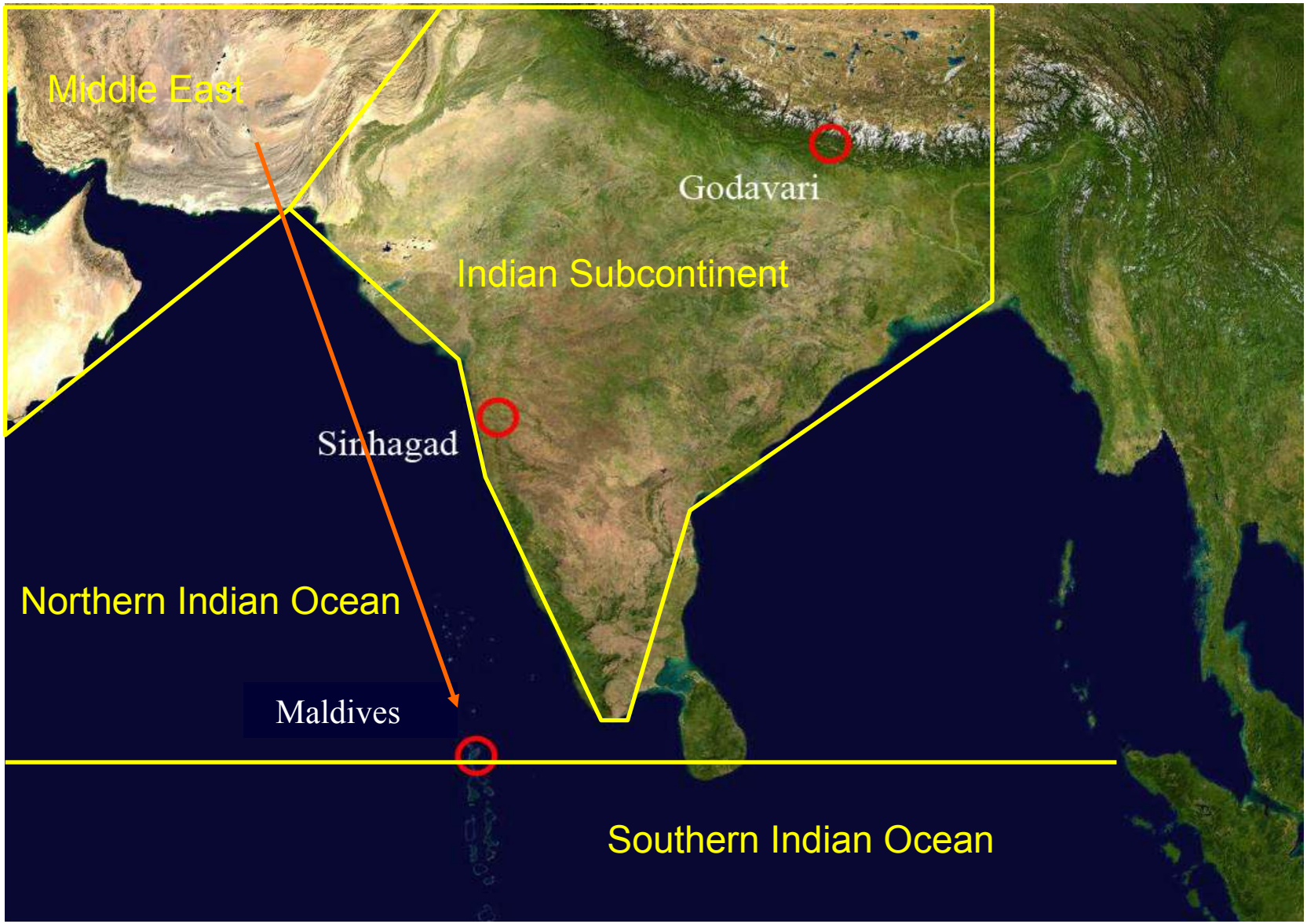
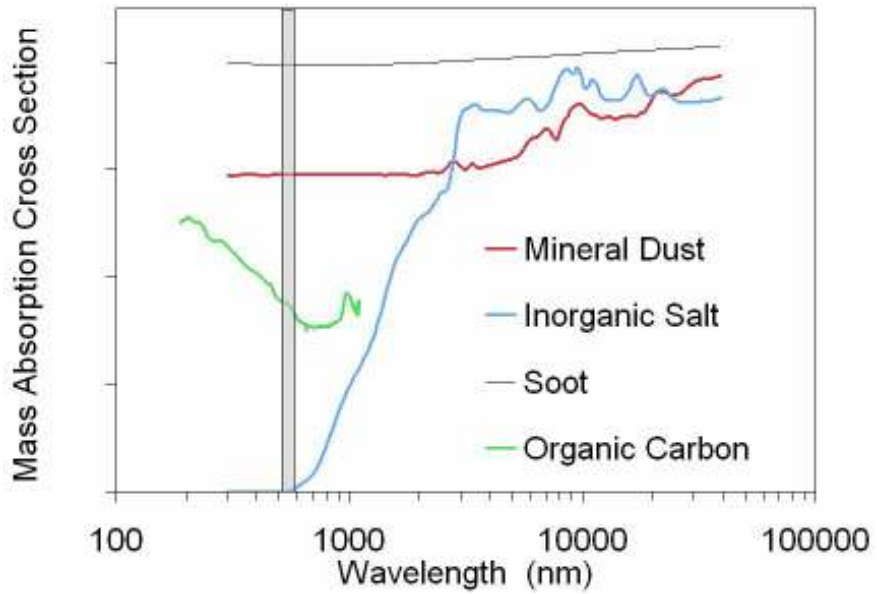
Source regions



Dust influence - Dust Index (Di)

$$\mathring{A}_{abs} = -ln\left[\frac{Od_{\lambda 1}}{Od_{\lambda 2}} - \frac{\lambda 1}{\lambda 2}\right]$$

$$Di = \frac{\mathring{A}_{450-550}}{\mathring{A}_{750-1000}}$$



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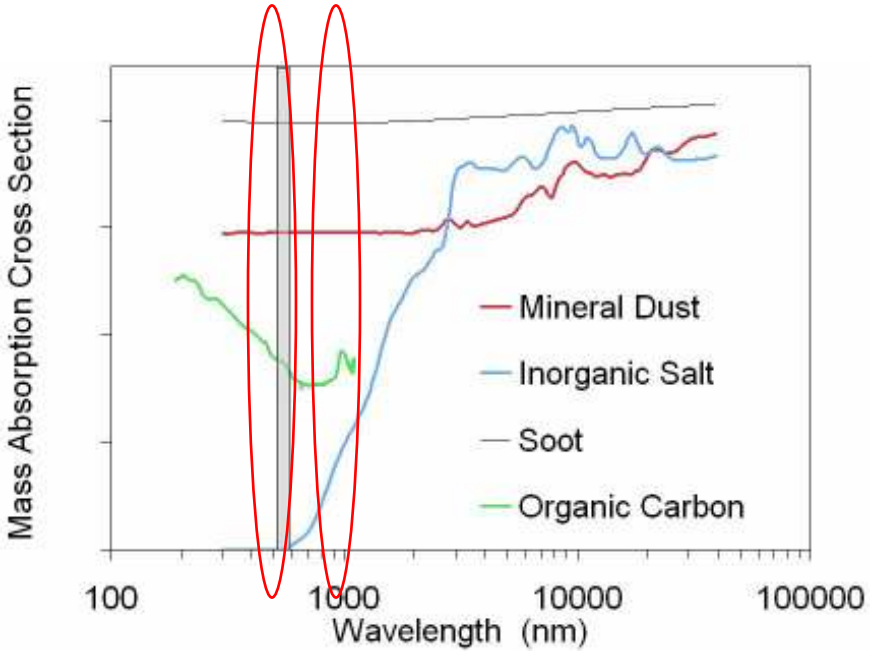
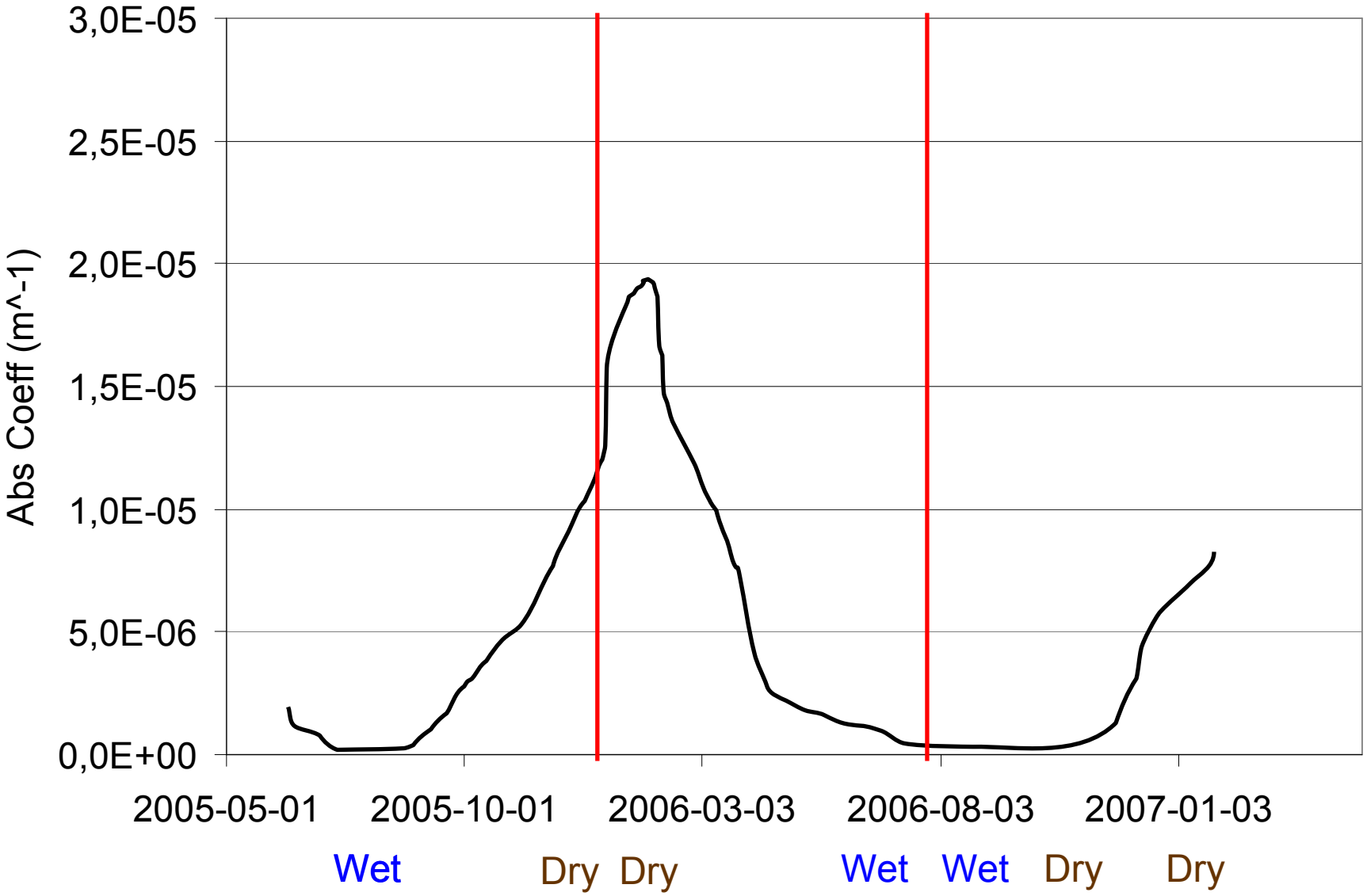
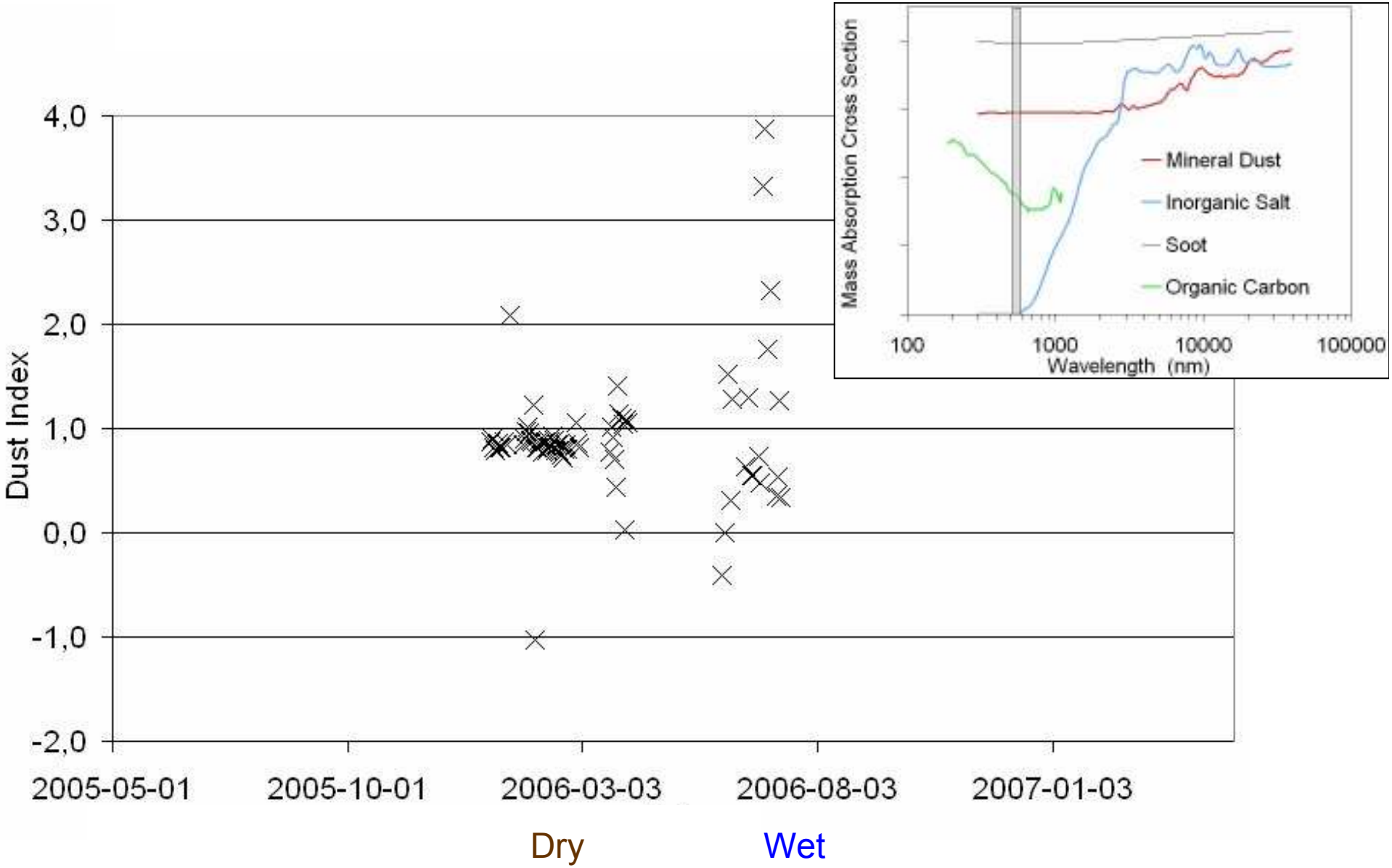


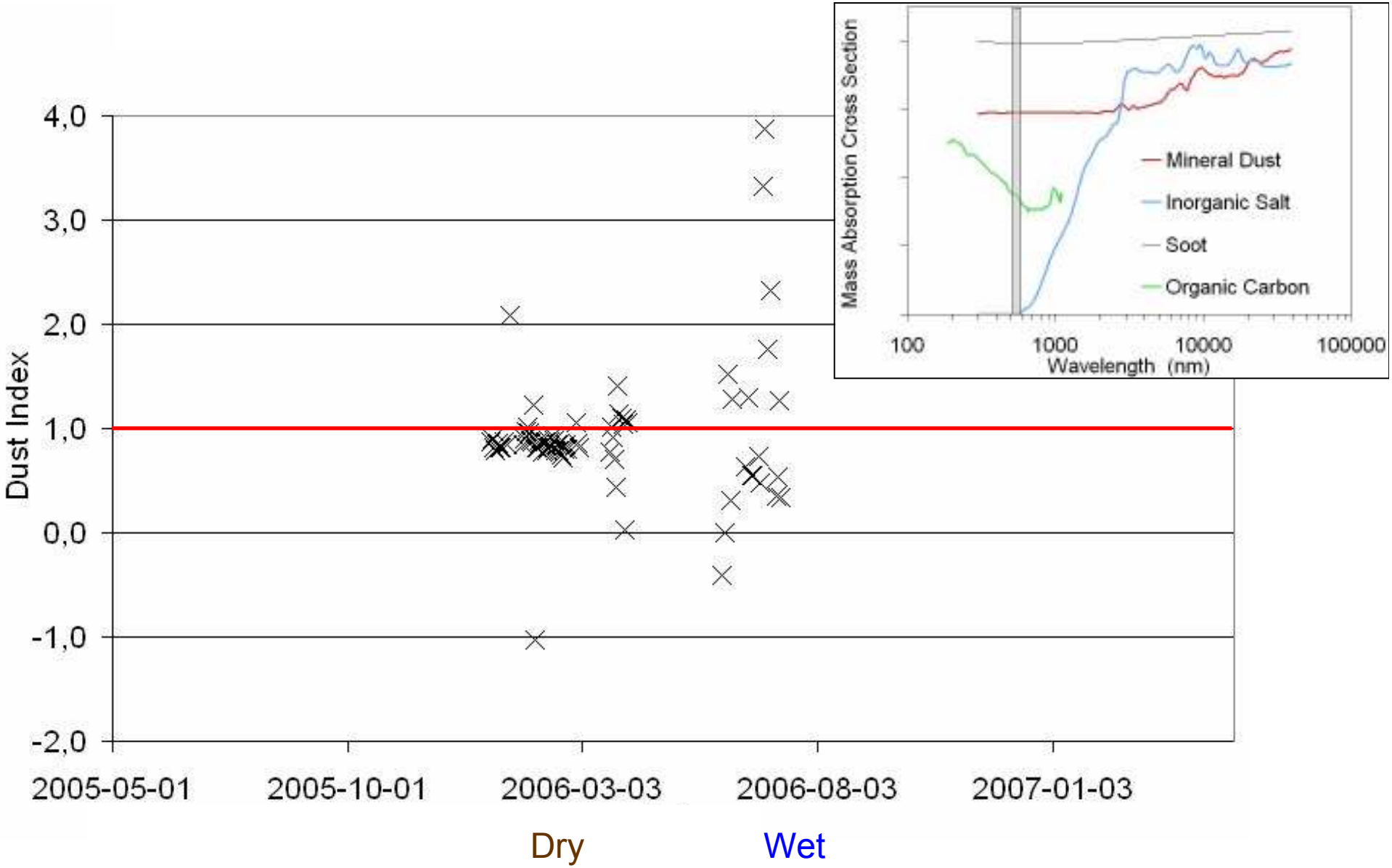
Dust influence - Dust Index (Di)



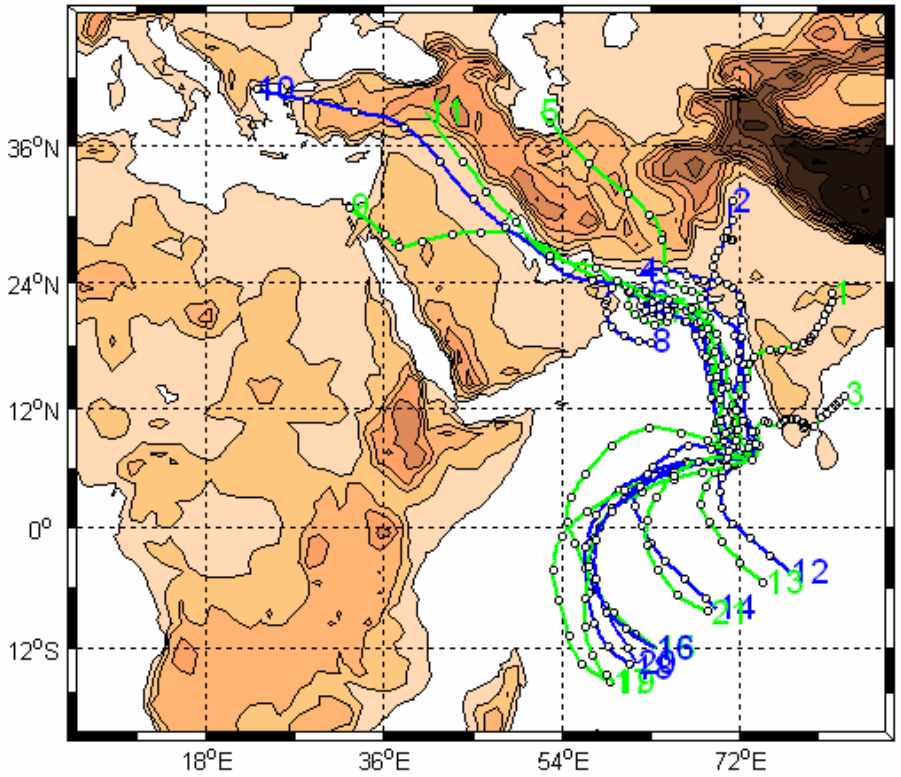
Dust influence - Dust Index (Di)

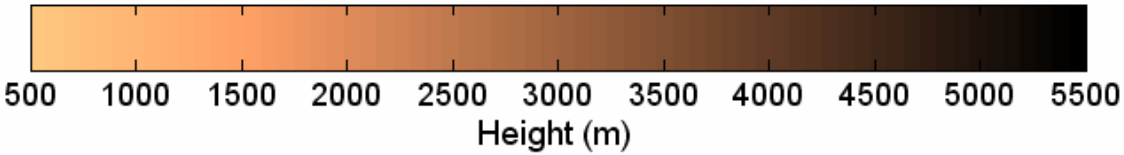


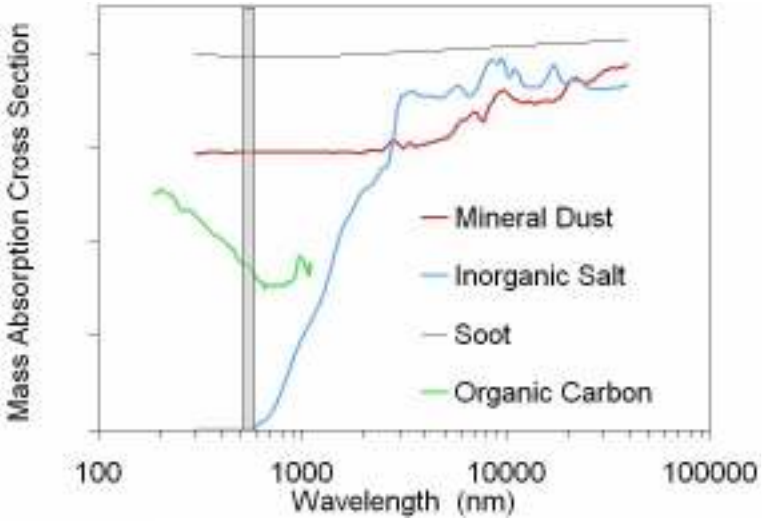
Dust influence - Dust Index (Di)



Trajectories for samples with a Di of 1 or higher







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Summary

- BC air concentration shows a seasonal variation with the shifting of monsoon and source region.
- High concentrations in continental influenced air from fossil fuel and biomass burning.
- Low concentrations in marine influenced air from natural sources.
- Detected absorption in marine air mostly due to scattering.

What's next?

- PSAP scattering correction
- Soot in rain
- Integrate chemistry
- Model simulation
- Visit stations

Acknowledgment

- **Supervisors**
Caroline Leck and Henning Rodhe.

- **Colleagues**
Lennart Granat, Leif Bäcklin, Jost Heintzenberg and Thomas Müller.

- **Synthetic soot**
Brenntag-Nordic AB and the Degussa Company

- **Financial support**
Swedish International Development Cooperation Agency (Sida)
Swedish Science Foundation (SVR)
Marie Curie scholarship from the EU Commission
Helge Ax:son Jonsson foundation
Accent and IGAC
Bert Bolin Climate Center

Take home messages

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- Organic coatings on pre-existing aerosol particles can change the chemical and optical properties of the particle.

- Organic aerosols can be distinguished from other aerosols by it’s optical properties.

- Organic aerosols are mainly less absorbing than soot particles and less scattering than inorganic salt, but there is a large variety.


Thank you for your attention.