Supplementary material

For manuscript “Look−up tables of complex refractive index corrections of particle size measured by common research−grade optical particle counters”

Representation of model size distribution according to Seinfeld and Pandis (2006)

lognormal three−modal number size distribution, where each mode is represented as

\[
\frac{dN}{d\log D_p} = \frac{N_{\text{tot}}}{\sqrt{2\pi \log \sigma_g}} e^{\exp \left[ -\frac{(\log D_p - \log D_{p,g})^2}{2(\log \sigma_g)^2} \right]} \tag{2}
\]

where \(N_{\text{tot}}\) is the integrated number concentration, \(D_{p,g}\) the median diameter and \(\sigma_g\) the geometric standard deviation.

Parameters are listed in Table S1.

<table>
<thead>
<tr>
<th>Mode</th>
<th>(N_{\text{tot}})</th>
<th>(D_{p,g})</th>
<th>(\log \sigma_g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode 1</td>
<td>726</td>
<td>2</td>
<td>0.247</td>
</tr>
<tr>
<td>Mode 2</td>
<td>114</td>
<td>37</td>
<td>0.777</td>
</tr>
<tr>
<td>Mode 2</td>
<td>0.178</td>
<td>21.6</td>
<td>0.438</td>
</tr>
</tbody>
</table>

Table S2. Second−degree polynomial function (generic form \(y=a_0+a_1x+a_2x^2\)) used to fit the CDP−representation of the nominal dust size distribution from Seinfeld and Pandis (2006)

<table>
<thead>
<tr>
<th>Diameter range</th>
<th>Polynomial function</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;16.85 µm</td>
<td>(y = 0.06x^2 + 3.8793x + 12.593)</td>
<td>0.99</td>
</tr>
<tr>
<td>2.43−16.85 µm</td>
<td>(y = -0.0521x^2 + 2.2899x - 0.202)</td>
<td>0.96</td>
</tr>
<tr>
<td>&lt; 2.43 µm</td>
<td>(y = 0.0436x^2 + 0.1779x + 9.2514)</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Formulae

- Particle extinction, scattering and absorption coefficient (\(\sigma_{\text{ext}}, \sigma_{\text{sca}}\) and \(\sigma_{\text{abs}}\); units \(\text{Mm}^{-1}\); \(1 \text{ Mm}^{-1} = 10^{-6} \text{ m}^{-1}\))

\[
\sigma_{\text{ext}}(\lambda) = \int \frac{\pi D^2}{4} Q_{\text{ext}}(\lambda, D, \text{CRI}) \frac{dN}{d\log D} d\log D \tag{1.a}
\]

\[
\sigma_{\text{sca}}(\lambda) = \int \frac{\pi D^2}{4} Q_{\text{sca}}(\lambda, D, \text{CRI}) \frac{dN}{d\log D} d\log D \tag{1.b}
\]
\[
\sigma_{abs}(\lambda) = \int \left( \frac{\pi D^2}{4} \right) Q_{abs}(\lambda, D, CRI) \frac{dN}{d\log D} d\log D
\]  

(1.c)

where

- \(D\) is the diameter (\(\mu\)m)
- \(Q_{ext}, Q_{sca}, Q_{abs}\) are the single particle extinction, scattering and absorption efficiencies (unitless) as functions of wavelength (\(\lambda\)), diameter, and complex refractive index (CRI)
- \(dN/d\log D\) is the particle number size distribution (cm\(^{-3}\))

- Mass concentration

\[
M = \rho_p \int \left( \frac{\pi D^3}{6} \right) \frac{dN}{d\log D} d\log D
\]

(2)

where

- \(\rho_p\) is the particle density (g cm\(^{-3}\)), set equal to 2.65 for mineral dust

- Mass extinction and absorption efficiency (MEE and MAE, units m\(^2\)/g)

\[
MEE(\lambda) = \frac{\sigma_{ext}(\lambda)}{M}
\]

(3.a)

\[
MAE(\lambda) = \frac{\sigma_{abs}(\lambda)}{M}
\]

(3.b)

- Angstrom extinction and absorption exponent (AEE and AAE, unitless)

\[
AEE(\lambda) = - \frac{\log \left( \frac{\sigma_{ext}(\lambda)}{\sigma_{ext}(\lambda_0)} \right)}{\log (\lambda/\lambda_0)}
\]

(4.a)

\[
AAE(\lambda) = - \frac{\log \left( \frac{\sigma_{abs}(\lambda)}{\sigma_{abs}(\lambda_0)} \right)}{\log (\lambda/\lambda_0)}
\]

(4.b)

In this paper \(\lambda = 870\) nm and \(\lambda_0 = 440\) nm
Figure S1. Contour plots of \(\frac{d\log C_{\text{sc}}}{d\log D}\) as functions of the bin midpoint diameters and the real and imaginary parts of \(\text{CRI}\).