Ambient single scattering albedo at the high alpine site Jungfraujoch

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Keywords: Single scattering albedo, tropospheric aerosol, absorption coefficient, atmospheric aerosol, long-term trend.

Continuous measurements of aerosol optical properties have been performed since 1995 at the high alpine research station Jungfraujoch (JFJ) situated at 3580 m asl. The JFJ is prevalently situated in the free troposphere (FT), but is often influenced by thermal convection of planetary boundary layer (PBL) air during the warmer months. Consequently all measured aerosol parameters show a clear annual cycle with maximum values in summer and minimum values in winter. The JFJ is therefore well suited to measure the background aerosol above a continental area.

Due to the hard weather conditions, the inlet is heated and the measured optical properties relate therefore to dry aerosol. Nessler et al. (2005a and b) gave an RH correction for the scattering and backscattering coefficients and showed that the correction of the absorption coefficient for ambient humidity can be neglected for the calculation of the single scattering albedo (SSA). Taking into account the ambient relative humidity at the JFJ, these corrections were applied to obtain ambient scattering and backscattering coefficients. The absorption coefficient measured by the multiwavelength aethalometer was corrected for the shadowing effect and for the scattering offset according to Arnott et al. (2005) and Schmid et al. (2006):

\[ B_{\text{abs,t}} = \frac{SG(\lambda) BC - cB_{\text{wet,n}}}{C*R} \]

(1)

where \( SG(\lambda) \) is the multiplying factor used by the manufacturer, \( BC \) is the measured black carbon concentration, \( \alpha(\lambda) \) depends on the scattering exponent and the filter properties, \( C(\lambda) \) depends on the SSA and on a \( C_{\text{ref}} \) value, and \( R(\lambda) \) depends on the filter loading, the flow rate, the spot area and filter properties. Since April 2003, a MAAP (Multiangle Absorption Photometer) has also been used to measure the absorption coefficient at the JFJ. \( C_{\text{ref}} \) value was therefore determined from Weingartner et al. (2003), taking the MAAP as reference. The RH correction has a greater impact on the SSA than the aethalometer correction. With both corrections the 5-year means of the SSA vary between 0.943 and 0.916 depending on the wavelength.

Even if the cycle amplitude is smaller, the corrected seasonal cycle becomes clearer, the SSA being highest with the maximum PBL influence from May to August, and lowest at the end of February, the coldest month. A diurnal cycle of the SSA is clearly visible only in spring, when the FT or PBL influence is well defined. A trend analysis with the seasonal Kendall method and with a least-mean square fit will be performed on the SSA and all other corrected parameters.

<table>
<thead>
<tr>
<th>( \lambda ) [nm]</th>
<th>370</th>
<th>520</th>
<th>660</th>
<th>950</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 percentile</td>
<td>0.888</td>
<td>0.876</td>
<td>0.855</td>
<td>0.809</td>
</tr>
<tr>
<td>Mean SSA</td>
<td>0.943</td>
<td>0.939</td>
<td>0.932</td>
<td>0.916</td>
</tr>
<tr>
<td>90 percentile</td>
<td>0.992</td>
<td>0.992</td>
<td>0.992</td>
<td>0.993</td>
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</tbody>
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