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Aerosol characteristics at the Alpine site of Innsbruck, Austria

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Aerosol optical depth (AOD) is being measured in Innsbruck, Austria. Since 2007 a precision filter radiometer (PFR) is set up at 620 m above sea level in order to characterise the aerosol conditions at this Alpine site. The five year time series is analysed with respect to AOD, the Angstrom coefficient α and the curvature of the ln(τ)-ln(λ) relationship γ. Information on the fine mode particle fraction and its modal radius is obtained with a graphical method. For special cases such as Saharan dust events the King inversion algorithm is applied. The PFR measures direct irradiance at 368 nm, 412 nm, 500 nm and 862 nm. It is also employed as a network instrument in the Global Atmosphere Watch (GAW) Programme of the World Meteorological Organisation.

The Innsbruck annual aerosol pattern reveals monthly mean AOD at 500 nm in winter between 0.05 and 0.1 and up to 0.22 in summer. Daily AOD at 500 nm remains below 0.5 for all measurement days. This seasonality in AOD is typical for mid-latitude sites. The AOD in Innsbruck is only slightly higher than at the GAW/PFR site Hohenpeissenberg, Germany (989 m above sea level; $\sim$75 km north of Innsbruck). The Hohenpeissenberg minimum AOD in winter (daily means around 0.01) are not observed in Innsbruck. There, the wintertime minimum daily means are three to five times higher with 0.03 to 0.05. In contrast to Innsbruck the Hohenpeissenberg measurement site is above the wintertime inversion layer trapping boundary layer aerosols. These wintertime boundary layer aerosols from local sources such as domestic wood burning and traffic pollution are part of the (columnar) AOD in Innsbruck situated in the Inn valley.

The overall mean α is 1.53+/-0.29 and the overall mean γ is -0.53+/-0.26. These parameters indicate submicron aerosols prevailing in Innsbruck. On 93% of the days a fine mode fraction of more than 70% is detected. A fine mode radius between 0.1 μm and 0.15 μm is observed on 90% of the days. Saharan dust events with α $<$1 and γ $>$0 are identified three to four times per year by the Innsbruck PFR. The ash plume from the eruption of the Icelandic Eyjafjallajökull was detected in Innsbruck on April 17, 2010. On this day α equalled 0.9 and γ was -0.17. The fine mode fraction ranged between 50% and 70% indicating the volcanic ash aerosols being superimposed on the regular aerosol conditions. Inversion results show the coarse mode volcanic ash particles have radii around 0.8 μm.

Comparing the Innsbruck aerosol parameters to other Alpine sites leads to a geographic distribution in a complex terrain. This enables a comparison of ground-based with satellite-derived aerosol parameters. Satellite-derived aerosol products over mountainous terrain reveal higher uncertainty than over homogeneous ground.