Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 4613-4623, 2007
www.atmos-chem-phys.net/7/4613/2007/

Technical Note: Improved total atmospheric water vapour amount determination from near-infrared filter measurements with sun photometers

F. Mavromatakis[1], C. A. Gueymard[2], and Y. Franghiadakis[1]
[1]Department of Sciences, Technological Education Institute of Crete, Estavromenos, P.O. Box 1939, 710 04 Heraklion, Crete, Greece
[2]Solar Consulting Services, P.O. Box 392, Colebrook, NH 03576, USA

Abstract. In this work we explore the effect of the contribution of the solar spectrum to the recorded signal in wavelengths outside the typical 940-nm filter's bandwidth. We employ gaussian-shaped filters as well as actual filter transmission curves, mainly AERONET data, to study the implications imposed by the non-zero out-of-band contribution to the coefficients used to derive precipitable water from the measured water vapour band transmittance. Published parameterized transmittance functions are applied to the data to determine the filter coefficients. We also introduce an improved, three-parameter, fitting function that can describe the theoretical data accurately, with significantly less residual effects than with the existing functions. The moderate-resolution SMARTS radiative transfer code is used to predict the incident spectrum outside the filter bandpass for different atmospheres, solar geometries and aerosol optical depths. The high-resolution LBLRTM radiative transfer code is used to calculate the water vapour transmittance in the 940-nm band. The absolute level of the out-of-band transmittance has been chosen to range from 10^{-6} to 10^{-4}, and typical response curves of commercially available silicon photodiodes are included into the calculations.

It is shown that if the out-of-band transmittance effect is neglected, as is generally the case, then the derived columnar water vapour is mainly underestimated by a few percents. The actual error depends on the specific out-of-band transmittance, optical air mass of observation and water vapour amount. Further investigations will use experimental data from field campaigns to validate these findings.

Final Revised Paper (PDF, 771 KB) Discussion Paper (ACPD)

Citation: Mavromatakis, F., Gueymard, C. A., and Franghiadakis, Y.: Technical Note: Improved total atmospheric water vapour amount determination from near-infrared filter measurements with sun photometers, Atmos. Chem. Phys., 7, 4613-4623, 2007. Bibtex EndNote Reference Manager