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Retrieval of fast changes in apparent optical depth in cloud edges: a sensitivity analysis.

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Modern CCD spectrometers allow measuring spectral fluxes at high time rates. Changes in solar flux and consequently in apparent optical depth can then be retrieved for relatively fast processes, as those involved when the solar ray is intercepted by a cloud edge. A sensitivity study using radiative modeling in the visible and the NIR range has been performed to assess the potential of CCD spectrometers for the description of changing physical conditions (as water vapor content and particle properties) in the transition zone between low, liquid cloud and cloud-free areas. In particular, we have studied how changes in the optical depth in the visible spectral range are related with changes in optical depth in the water absorption bands at 940 nm and 1.4 um. Several hypotheses about water condensation/evaporation processes in the cloud boundary and its radiative effects in the visible and NIR bands are considered in the analysis, beside the role of other variables, as air mass, atmospheric profile, and aerosol load and characteristics. Whereas the optical depth in the water absorption band at 940 nm is related with the total column of precipitable water in the atmosphere, the strong absorption band at 1.4 um could be suitable for studying the fast, and expectedly small, relative changes in the water conditions in the vicinity of the cloud edge. A first comparison with retrievals from solar direct flux measurements taken at a high frequency with a system integrating three CCD spectrometers to cover the range from 350 to 1700 nm is also presented. Special attention is paid to the use of the ratio among spectra acquired very close in time, with the aim of reducing the effects of instrument instabilities.