Retrieval of cloud optical depth from ground based measurements of solar radiation in broad and photosynthetic bands

S. Matamoros, J.A. González, J. Calbó

Physics Department, University of Girona, Spain (jose.gonzalez@udg.es / Fax +34 972418098)

Cloud optical depth is the main optical variable to treat the atmospheric radiative transfer for overcast skies. Here, a method based on an iterative algorithm has been applied to estimate cloud optical depth at 550 nm. First, a guess value for optical cloud depth is introduced in a radiative model to obtain an estimation of the selected irradiance. After comparing this with measured irradiance, a new guess for the cloud optical depth is derived and introduced in a new run. This process is successively applied until the desired agreement is reached.

Ground based measurements of solar horizontal irradiances in broad and photosynthetic bands have been used. Broadband irradiance has been measured by a pyranometer, whereas photosynthetic photon flux density has been measured by a quantum sensor. Measurements have been taken in Girona (NE of the Iberian Peninsula) every second, and then averaged over 1-minute intervals. Modelling of the irradiances has been performed with SBDART, a plane-parallel radiative transfer model that uses the discrete ordinate code.

The method has been applied to overcast conditions, which have been selected a posteriori from the whole database by visual inspection of the time evolution of measured irradiances. This selection has been confirmed by inspection of images taken every minute by a whole sky camera.The sensitivity of the retrieval method to physical (effective radius of cloud droplets) and geometrical (cloud base height, thickness) cloud features, and also to solar altitude and ground albedo has been studied. Also, the effect of atmospheric conditions has been considered in the sensitivity study. The usefulness of the considered bands has been compared, by modelling, to that of the 415 nm band of the MultiFilter Rotating Shadowband Radiometer. Results show that the intrinsic accuracy of the method increases with the narrowness of the band.