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Characterization of optical and micro-physical properties of cirrus clouds using a wideband thermal infrared spectrometer

Luca Palchetti (1), Gianluca Di Natale (2,3), and Giovanni Bianchini (1)

(1) Istituto Nazionale di Ottica - CNR, Florence, Italy (luca.palchetti@ino.it), (2) Department of Information Engineering University of Pisa, Italy, (3) Istituto di Fisica Applicata "Nello Carrara" - CNR, Sesto Fiorentino, Italy

High-altitude ice clouds such as cirrus clouds play a key role in the Earth's radiation budget since they cover permanently about 20-30% of the surface of the planet, reaching even to 60-70% in the tropics. The modulation of the incoming solar radiation and the outgoing Earth's thermal emission due to cirrus can contribute to heat or to cool the atmosphere, according to their optical properties, which must be characterised with great accuracy and over the whole spectral range involved in the scattering and emission processes.
Here we present the infrared measurements over the wide spectral range from 9 to 50 micron performed by the Fourier transform spectrometer REFIR-PAD (Radiation Explorer in Far InfraRed – Prototype for Application and Development) during many field campaigns that have taken place since 2007 from different high-altitude ground-based stations: Testa Grigia Station, Cervinia-Italy, (3480 m asl), Cerro Toco, Atacama-Chile, (5380 m asl), Concordia Base, Dome C-Antarctica (3230 m asl). These measurements show for the first time the spectral effect of cirrus clouds in the long-wave part of the emission spectrum above 15 micron of wavelength.
To characterise these measurements over the wide spectral range as a function of the optical properties of ice particles, a model of the radiative transfer, that integrates the well known numerical code LBLRTM, which simulates the radiative transfer in the atmosphere, with a specific code which simulates the propagation of the radiation through the cloud, was developed. The optical properties of clouds have been modelled using the δ-scaled Eddington approximation for a single layer and the Ping Yang's database for the single-scattering properties of ice crystals.
The preliminary results of the fit procedure used for the determination of the micro-physical parameters of ice crystals, such as the effective diameter, ice water path, effective temperature and optical thickness will be shown in the presentation. The sounding of the long-wave part of the spectrum, where the signal is higher than in the other infrared regions, will allow to increase the accuracy of the fit calculation and therefore improving the quality of the remote sensing of cirrus clouds.