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Characterization of cirrus heterogeneities: optical depth, effective radius and variation of surface albedo.

C. Fricke (1), M. Wendisch (1), A. Ehrlich (1), B. Bohn (2), and M. Wirth (3)

(1) University of Leipzig, Institute for Meteorology, Stephanstraße 3, 04103 Leipzig, Germany, (2) Forschungszentrum Jülich Gmbh, Insitut für Energie und Klimaforschung, 52428 Jülich, Germany, (3) DLR Oberpfaffenhofen, Institut für Physik der Atmosphäre, 82234 Wessling, Germany

For the effect on the climate cirrus clouds are of special importance, but they are complicated to handle mostly due to the complex non-spherical shape of the particles and their spatial inhomogeneity which causes major problems in remote sensing of cirrus from satellite platforms. Therefore spectral measurements of solar radiation are applied on the new Research Aircraft for atmospheric research and earth observation of the German Science Community named HALO (High Altitude and Long Range Research Aircraft). With its maximum flight altitude of 14 km combined with times of flight up to 10 hours it provides the opportunity to study spatial radiation fields all over the world. Aboard of the first HALO flight with operational scientific instruments (Techno-Mission in October/November 2010) the spectrometer system for measurements of the upward radiance was operated by the University of Leipzig together with an instrument for measurements of actinic radiation in cooperation with the Forschungszentrum Jülich (HALO-SR). The data is currently used in combination with 1-dimensional radiative transfer calculations (1D) to derive information on the shape and spatial distribution of cirrus cloud ice crystals based on the retrieval of Nakajima & King (King et al., 1990), supported by Lidar data gathered by the DLR instrument WALES during the Mission. Due to the investigation of optical thin cirrus clouds ($0.2 < \tau < 2$) the effect of the reflected radiation by the surface has to be considered. In this regard, the major topic of the presentation will be the influence of the heterogeneity of the surface albedo (measurement area over land/southern Germany) on the retrieval which is investigated in addition to the cloud property retrieval. Based on the albedo derived from satellite-data (MODIS), the retrieval is performed in a statistic approach to determine the effect of the albedo variation of the ground on the retrieved cloud properties. Mean values and standard deviations (σ) of optical thickness and effective particle diameter are derived depending on frequency distributions of the surface albedo. For the cloud optical thickness the results are additionally compared with LIDAR data derived from the DLR instrument WALES. Methodology and first results will be presented.