Geophysical Research Abstracts, Vol. 7, 00174, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00174

Remote sensing of optically thick ice clouds from space

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Water exists in clouds in liquid, gaseous, and crystalline forms. Remote sensing of water clouds from space is simplified due to the spherical shape of droplets and relative homogeneity of water clouds. On the other hand, crystalline clouds are very inhomogeneous both in vertical and horizontal directions. Also they consist of ice crystals having very complex forms. This complicates retrievals of cloud parameters such as the size of crystals and the optical thickness of a cloud. Due to this fact effects of inhomogeneity are ignored in operational ice cloud retrievals and ice crystals are defined in terms of some a priori assumed specific particle size/shape distribution functions. Therefore, a general approach used for liquid water cloud retrievals is closely followed with the substitution of the spherical particle model by models of crystalline media (e.g., hexagonal cylinders and plates). It means that the retrieved effective size parameter of ice crystals depends on the assumed model of crystals used in the retrieval. The task of this paper is to introduce a new parameter - the particle absorption length - for the ice cloud remote sensing problems. This parameter is habit-independent and can be used instead of the loosely defined ice grain size in the ice cloud retrieval procedures. We also adapt the SemiAnalytical Cloud Retrieval Algorithm (SACURA) (see www.iup.physik.uni-bremen.de) to the special case of ice cloud remote sensing. This algorithm is based on the asymptotic solution of the radiative transfer equation valid for optically thick random media. The modified SACURA is applied to remote sensing of hurricane properties using Moderate Resolution Imaging Spectrometer data.