Geophysical Research Abstracts, Vol. 7, 00226, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00226

Influence of small-scale drop size variability on the estimation of cloud optical properties

Y. Knyazikhin (1), A. Marshak (2), M. L. Larsen (3,4), W. J. Wiscombe (2), J. V. Martonchik (5) and R. B. Myneni (1)

(1) Boston University, Boston, USA, (2) NASA/GSFC, Greenbelt, USA, (3) Michigan Technological University, Houghton, USA, (4) Goddard Earth Science and Technology Center, USA, (5) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA

Most cloud radiation models and conventional data processing techniques assume that the mean number of drops of a given radius is proportional to volume. The analysis of microphysical data on liquid water drop sizes shows that, for sufficiently small volumes, this proportionality breaks down; the number of cloud drops of a given radius is instead proportional to the volume raised to a drop-size-dependent non-unit power. The coefficient of proportionality, a *generalized drop concentration*, is a function of the drop size. For abundant small drops the power is unity as assumed in the conventional approach. However, for rarer large drops, it falls increasingly below unity. This empirical fact leads to drop clustering, with the larger drops exhibiting a greater degree of clustering. The generalized drop concentration shows the mean number of drops per cluster, while the power characterizes the occurrence frequency of clusters. With a fixed total number of drops in a cloud, a decrease in frequency of clusters is accompanied by a corresponding increase in the generalized concentration. This initiates a competing process missed in the conventional models: an increase in the number of drops per cluster enhances the impact of rarer large drops on cloud radiation while a decrease in the frequency suppresses it. Because of the non-linear relationship between number of clustered drops and volume, these two opposite tendencies do not necessarily compensate each other. The data analysis suggests that clustered drops likely have a stronger radiative impact compared to their unclustered counterpart; ignoring it results in underestimation of the contribution from large drops to cloud horizontal optical path.