Geophysical Research Abstracts, Vol. 8, 06163, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06163

Satellite microphysical signature of severe convective storms and its application to early tornado warning

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The evolution of cloud particle effective radius (Reff) with decreasing cloud top temperature (T) of convective elements is the product of the updraft intensity profile and of the aerosols on which cloud droplets nucleate and freeze. Stronger updrafts nucleate larger number of smaller drops at cloud base for a given aerosol population. The rate of increase of Reff with decreasing T depends, among other things, on the available time for the advancement of coalescence processes. At the supercooled levels the development of the ice phase is slower for smaller cloud drops and would occur at greater heights for stronger updrafts.

The T-Reff profiles therefore reflect the vigor of the convection. The signal is sufficiently strong to be detected with the geostationary MSG and GOES satellites, which provide time resolution of up to 15 minutes. Application to known cases of tornados and the adjacent non severe areas shows a distinctive "severe storm signature" appearing in the pre-tornadic clouds as early as 90 minutes before the actual occurrence of the tornado. This observation lends itself to the development of an early warning system of severe convective storms, which has certain important advantages when integrated with the existing warning systems.