

AEROSOL-CLOUD INTERACTIONS AND INDIRECT AEROSOL EFFECTS

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March 2005

For presentation at the  
International Association of Meteorology and  
Atmospheric Sciences (IAMAS) Conference  
Beijing, China  
August 2-11, 2005

**ABSTRACT**

Much effort has been devoted to specification of the cloud droplet number concentration in terms of pre-cloud aerosol properties under adiabatic and uniform dynamical conditions in investigating indirect aerosol effects. However it is known that cloud microphysical properties in addition to the droplet concentration also affected by pre-cloud aerosol properties. One such property is the relative dispersion of the cloud droplet size distribution, which is shown to also increase with aerosol loading and the enhanced dispersion diminishes the effect of increased droplet concentration. Here we derive an analytical expression that relates the relative dispersion of the cloud droplet size distribution to pre-cloud aerosol properties and cloud updraft velocity under adiabatic conditions, and discuss the relationship of relative dispersion to the cloud droplet number concentration and to the specific liquid water content (ratio of the cloud liquid water content to the droplet number concentration). We then extend the results to consider some “non-adiabatic effects” on the relationships, including effects of turbulent fluctuations, entrainment and mixing, and drizzle formation. We also discuss the implications of these findings for evaluation of the first and second indirect aerosol effects.