# A Lagrangian Approach for Deriving Cloud Characteristics from Satellite Observations and Its Implication to Cloud Parameterization

*V. Ramanathan and E. Boer*
*Center for Atmospheric Sciences &*
*Center for Clouds, Chemistry and Climate*
*Scripps Institution of Oceanography*
*University of California, San Diego*
*San Diego, California*

## Introduction

A Lagrangian view is adopted for establishing spatio-temporal cloud statistics and the scale-dependent radiative properties using satellite data. Individual clouds are identified using a newly developed scheme (Boer and Ramanathan 1997). With this scheme, all clouds are sorted by

- cloud type
- cloud area
- number of clouds in each area bin
- associated radiative properties.

These analyses provide diurnal variability, lifetimes, and evolution of cloud systems as a function of their spatial scales.

For seven different cloud types, our analyses provide radiative properties, such as albedo and cloud top temperature, as a function of the cloud spatial scale. These scale-dependent cloud properties can be objectively used in guiding the development and evaluation of cloud parameterization in general circulation models (GCMs) (see Zhang and Ramanathan 1998). Particularly, we show how our Lagrangian approach can be used to establish the relative importance of resolvable and fully parameterized clouds to the total cloudy area and to the total amount of reflected visible irradiance.

Our focus is on the convective-stratiform cloud systems over the western and tropical Pacific. We show that for the convective-stratiform systems in this region, 95% of the radiatively important clouds are of the scales resolvable by a GCM of about 50 km x 50 km. On the other hand, a GCM of 250 km x 250 km will only be able to resolve 50% of the radiatively important clouds. This, however, does not mean that the processes responsible for the formation and maintenance of these systems are also resolvable. The low clouds that are unattached to convective-stratiform systems are mostly resolvable by available GCMs.

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## References

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