

41st ISEE/CICR colloquium

Speaker: Dr. Takanobu Yamaguchi (CIRES University of Colorado Boulder / NOAA ESRL, USA)

ISEE Coordinator: Hirohiko Masunaga (Division for Meteorological and Atmospheric Research)

Title: Role of vertical wind shear in aerosol-cloud interactions in marine shallow cumulus clouds

Date and Time: Nov 20 (Tue), 2018, 15:30-17:00

Place: Research Institutes Building I (ISEE), 6th floor meeting space (617)

Abstract:

The microphysical suppression of drizzle in precipitating shallow cumulus clouds has recently been shown to be buffered by cloud deepening as a dynamical response to increased droplet number. In this study, we employ large eddy simulations with a newly implemented two-moment bin microphysics model to revisit the buffering and explore the role of vertical wind shear in aerosol-cloud interactions in trade cumuli. An idealized case with steady large scale forcing and nudged mean wind and aerosol concentration is developed based on a ship measurements over the Sulu Sea of the Philippines in 2012 and corresponding reanalysis data. Quasi-steady state is reached after 30-40 h for all 6 simulations (3 different aerosol concentrations with / without vertical wind shear). Consistent with a previous study, our simulations show a deepening of cloud top and a reduction of cloud fraction for higher aerosol loadings and that the buffering expresses itself in surface precipitation. Simulations with

vertical wind shear produce shallower clouds as well as shallower boundary layers than those without vertical wind shear, resulting in a reduction in surface rain rate as aerosol amount increases. Vertical wind shear imposes two effects: clustering of clouds and evaporation of thin cloud elements. The differences between these simulations are reasonably understood as a competition between these two effects.