# Simulation of marine stratocumulus off the west coast of California

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## 1. Introduction

Marine stratocumulus (Sc) plays a prominent role in the climate system by affecting radiation, heat, and water budget. Nakajima and Nakajima (1995) (NN95) observed the cloud microphysical properties of Sc off the west coast of California from satellite. They found out the growth stage of cloud from satellite observed results. However there are only a few previous studies (Suzuki et al. 2010, Su10) to represent the results by numerical model. In this study, we tried to represent the satellite observed results by nesting simulation and investigate the sensitivity of aerosol and dynamical condition to cloud microphysical properties.

## 2. Model description and Numerical simulation

We conducted the multi nesting simulation using two types of regional cloud resolving models (Saito et al., 2006 and Iguchi et al. 2008). The former is bulk microphysical model, and the latter is spectral bin microphysical (SBM) model. Dynamics framework of both models is based on JMANHM (Saito et al. 2006). We only calculate the warm phase cloud. The detail of experimental set is shown in Figure 1. Initial and boundary condition of aerosol is nested from SPRINTARS (Takemura et al. 2005). We carried sensitivity experiments with changing the amount of aerosol and lapse rate of temperature.

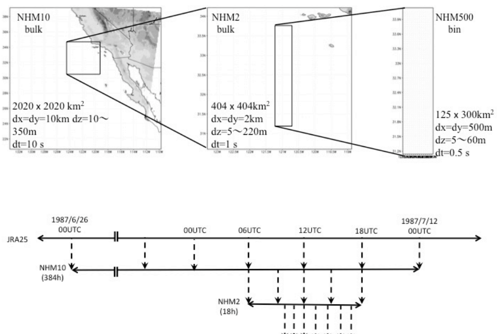


Figure1: Experimental design

## 3. Result

Figure 2 shows the optical thickness represented by our model. This figure suggests two things. One is that cloud optical thickness is extremely thin without regeneration process of aerosol, and regeneration process is important. The other is that aerosol has large sensitivity to cloud microphysical property. Figure 3 shows scatter plot of optical thickness (horizontal axis) versus effective radius (vertical axis) of cloud obtained from idealized studies (Su10), this study, and observation (NN95). The sensitivity experiments reproduced the tendency of cloud microphysical changes with a CCN change as proposed by the past idealized studies.

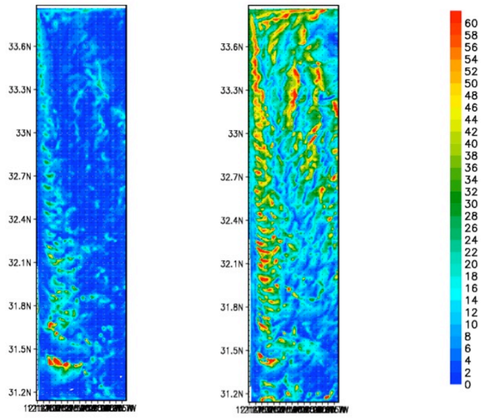


Figure 2:Optical thickness represented by model (left) without regeneration process, (right) with regeneration

## 4. Discussion

Sensitivity experiments of this study can represent the characteristics of scatter plot by Su10. However, our model can't represent the shape of scatter plot obtained from observation by NN95, which is high-heel-like plot. One of the reasons of this discrepancy is problem of regeneration process. In future study, we will improve this problem, and validate our model by comparison of aircraft data.

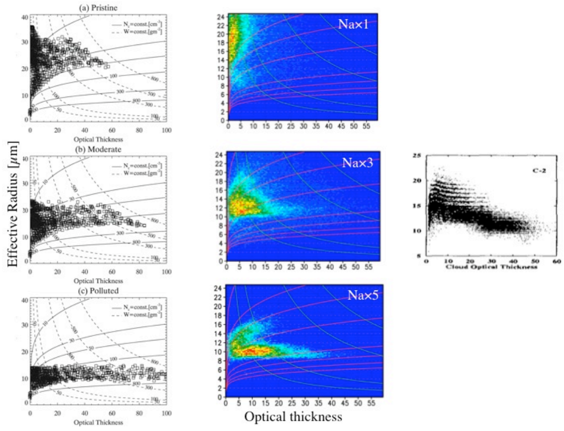


Figure 3: Scatter plot of optical thickness versus effective radius obtained from sensitivity study with changing aerosol amount, by idealized study (Su10) (left), this study (center), and observation by NN95 (right). Upper, middle, and bottom figures of left and center row show the scatter plot obtained by the experiment with pristine, moderate, and polluted aerosol condition respectively.

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