Ice Microphysical Properties in Stratiform Region of a Baiu Frontal Convective System Observed by Hydrometeor Videosonde

T. Ohigashi[1], S. Miyai[1], K. Tsuboki[1], and E. Nakakita[2]

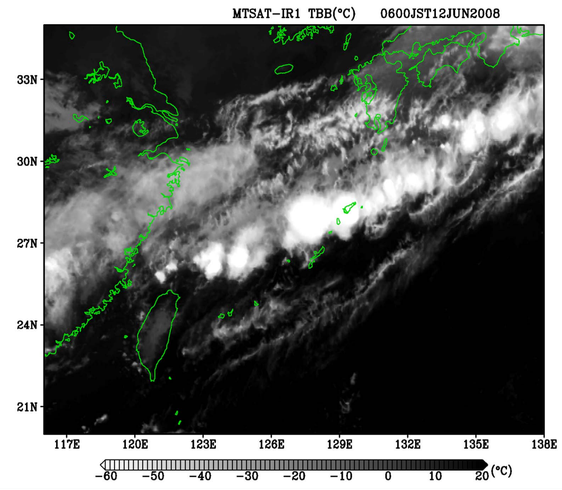
[1]*Hydrospheric Atmospheric Research Center, Nagoya University, Nagoya, Japan*
[2]*Disaster Prevention Research Institute, Kyoto University, Kyoto, Japan*
E-mail: ohigashi@rain.hyarc.nagoya-u.ac.jp

Introduction

Mesoscale convective systems (MCSs) developed in the Baiu frontal zone frequently form clusters of upper-level clouds with low brightness temperature. The deep clouds extending from convective regions form stratiform precipitation. The upper-level clouds cool cloud-top layers through radiation, which can intensify or develop convections.

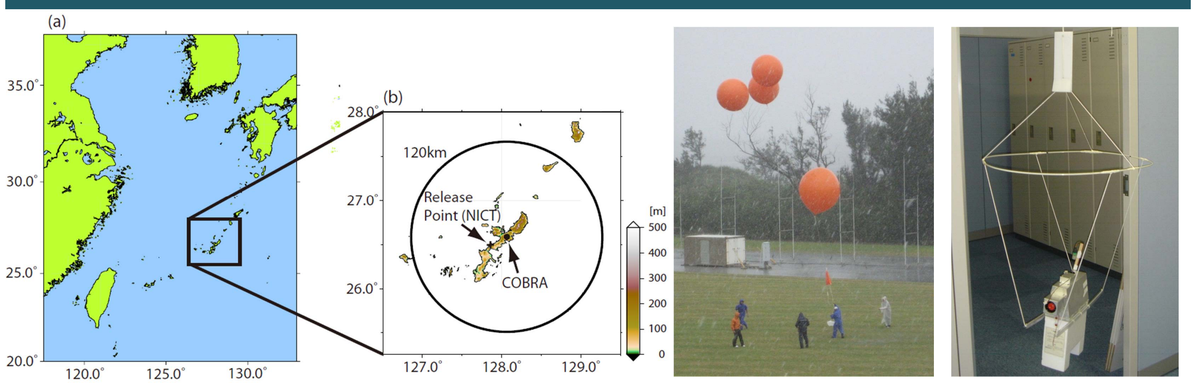
A numerical model which incorporates detailed cloud microphysical processes is a powerful tool to understand the processes such as precipitation formations and dynamics of MCSs in the Baiu frontal zone. Although simulation results should be validated by observations, observations of microphysical properties of upper-level ice clouds, which are related with precipitation formation and dynamical processes, are insufficient for MCSs in the Baiu frontal zone.

To examine microphysical quantitative properties of ice clouds of the Baiu frontal MCSs, we performed an observation at the Okinawa Island in Japan during a Baiu season using hydrometeor videosondes (HYVIS).

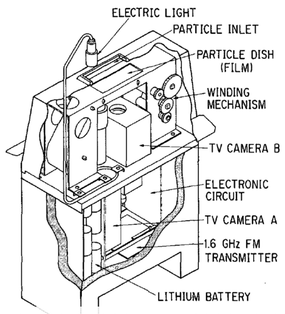


Hydrometeor videosonde (HYVIS) observation

Observation



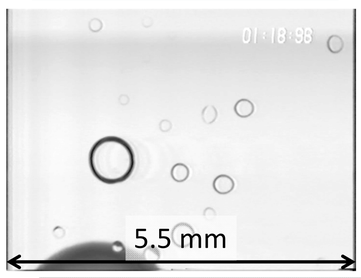
HYVIS and two camera images



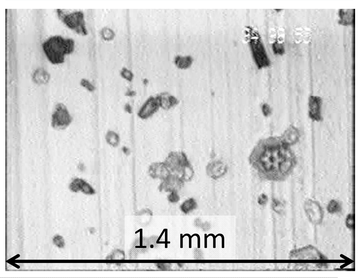
(Murakami and Matsuo 1990, JTECH)

Made by Meisei Electric Co., Japan

closeup camera image



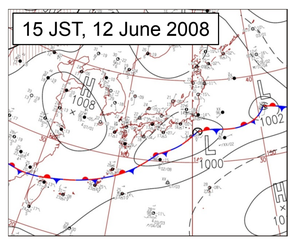
microscope camera image



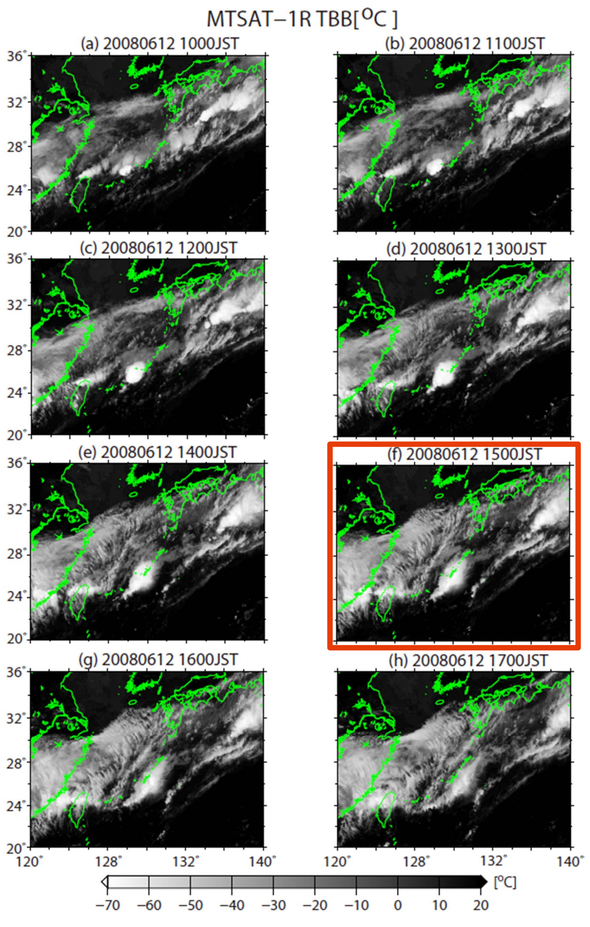
Particles more than ～10 μm on a film can be measured.

Convective system observed by HYVIS

Baiu front and development of a MCS

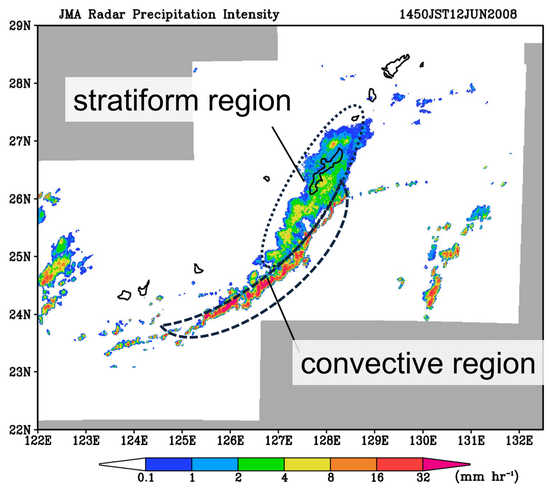


A MCS developed at 12 June 2008 in the Baiu front. Around 15 JST, the MCS was at a mature to decaying stage.

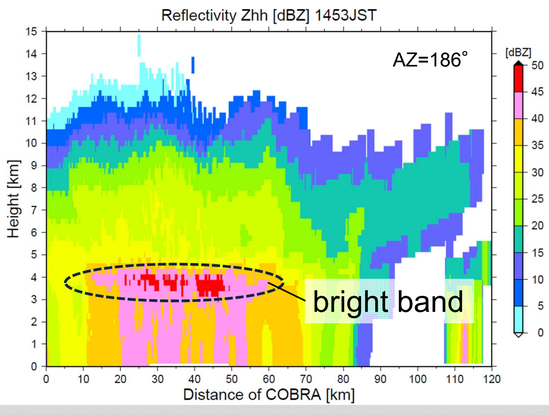


Radar image

horizontal display of precipitation intensity (JMA radar)



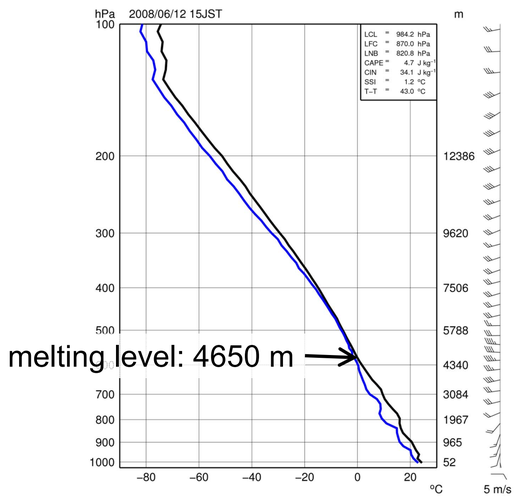
vertical cross section (COBRA radar)

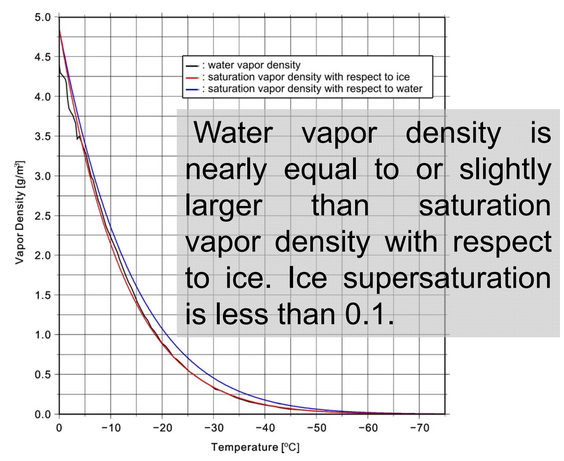


A HYVIS was released in the stratiform region at 1426 JST, 12 June 2008. The ascending velocity was about 5.5 m s^{-1}.

Microphysical quantitative properties

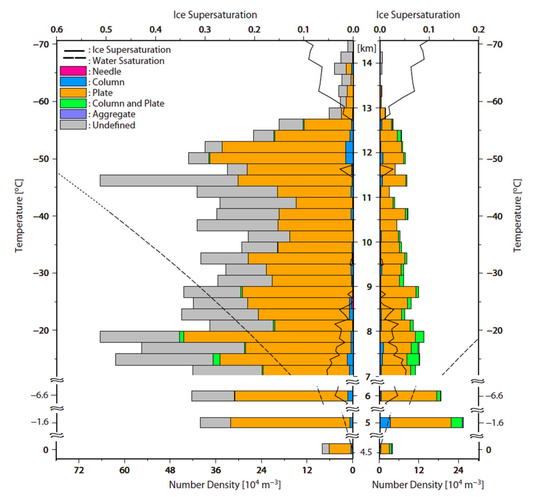
Sounding





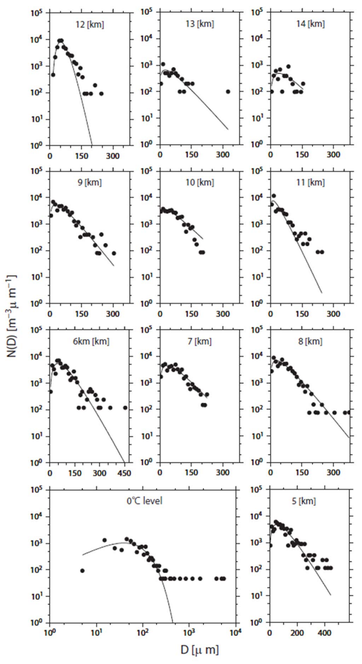
Water vapor density is nearly equal to or slightly larger than saturation vapor density with respect to ice. Ice supersaturation is less than 0.1.

Number concentration



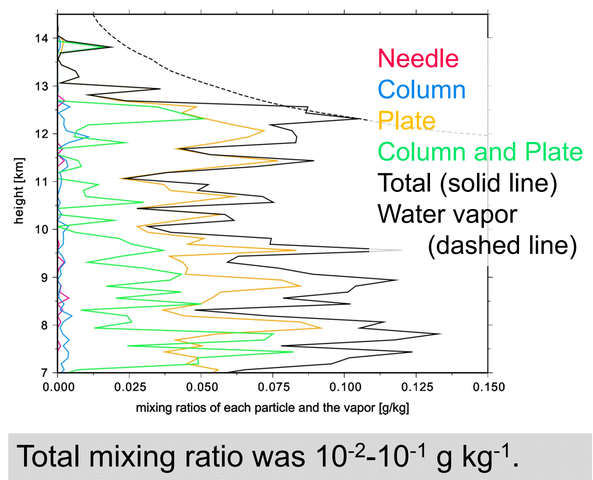
Number concentrations of the particles less than and more than 100 μm are 10^5-10^6 m^{-3} and 10^4-10^5 m^{-3}, respectively. “Plate” and “unknown” particle types were predominant.

Particle size distribution



The modified gamma distributions are more suitable than the exponential distributions. Its shape parameter showed positive values, which indicate the PSDs are convex upward.

Mixing ratio



Total mixing ratio was 10^{-2}-10^{-1} g kg^{-1}. “Plate” and “Column and Plate” types significantly contribute to the total mixing ratio.

Summary

A MCS developed at 12 June 2008 in the Baiu frontal zone. A HYVIS was released in the stratiform region of the MCS which was at a mature to decaying stage. The layer above a melting layer was examined.

- Orders of **number concentrations** of ice particles less than 100 μm and more than 100 μm were 10^5-10^6 m^{-3} and 10^4-10^5 m^{-3}, respectively.
- **Mixing ratio** was 10^{-2}-10^{-1} g kg^{-1} except for the cloud top.
- **Particle size distributions (PSDs)** are approximated by the modified gamma distribution. The PSDs’ shapes are convex upward.
- The dominant **habit** was “Plate” through the ice clouds with low ice supersaturation.

These facts provide references for future numerical simulations.