Cloud top height, optical thickness, and effective particle radius of cirrus retrieved from NOAA AVHRR data.

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Cloud top height, optical thickness, and effective particle radius of cirrus around Japan were obtained by using three infrared channels of NOAA AVHRR. Split window technique has been used for many years to retrieve the optical thickness and effective particle radius. However, cloud height is critical to determining them. Cirrus cloud height changes particularly in the mid-latitude because cirrus in the mid-latitude is generated by various mechanism such as typhoon, strong convective cloud and warm front. Therefore cloud height has to be determined simultaneously with the other two parameters.

In the present study ch.3, ch.4, and ch.5 of AVHRR were used to retrieve cloud top height, optical thickness, and effective particle radius of cirrus. Infrared radiances to be observed from satellite were calculated with plane-parallel atmosphere model including cloud. Although cloud particles were assumed to be sphere, the effects of the non-sphericity seems to be small because the emission and absorption are isotropic, a nd scattering is weak. The cloud geometrical thickness wasassumed to be 1 km by using lidar measurement statistics obtained at National Institute for Environmental Studies in Tsukuba, Japan. The lidar data were also used to validate the satellite remote sensing results. The comparison between satellite remote sensing and lidar measurement showed that both cloud top heights agreed with each other within 1 km. By applying the developed algorithm to AVHRR data during the night in July and October of 1996 and January and April of 1997, cirrus cloud properties around Japan were revealed. The results will be discussed in the presentation.

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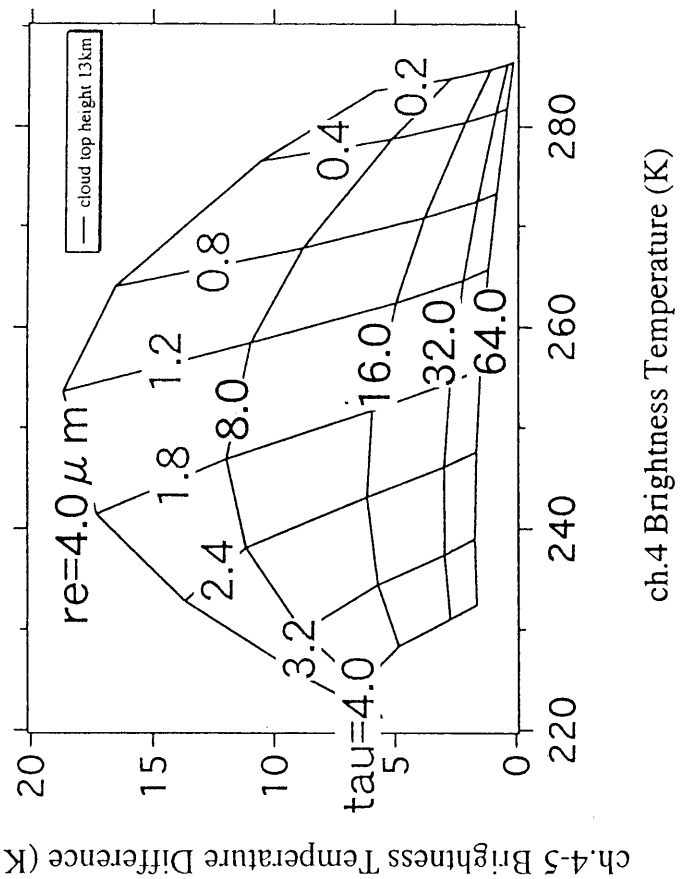
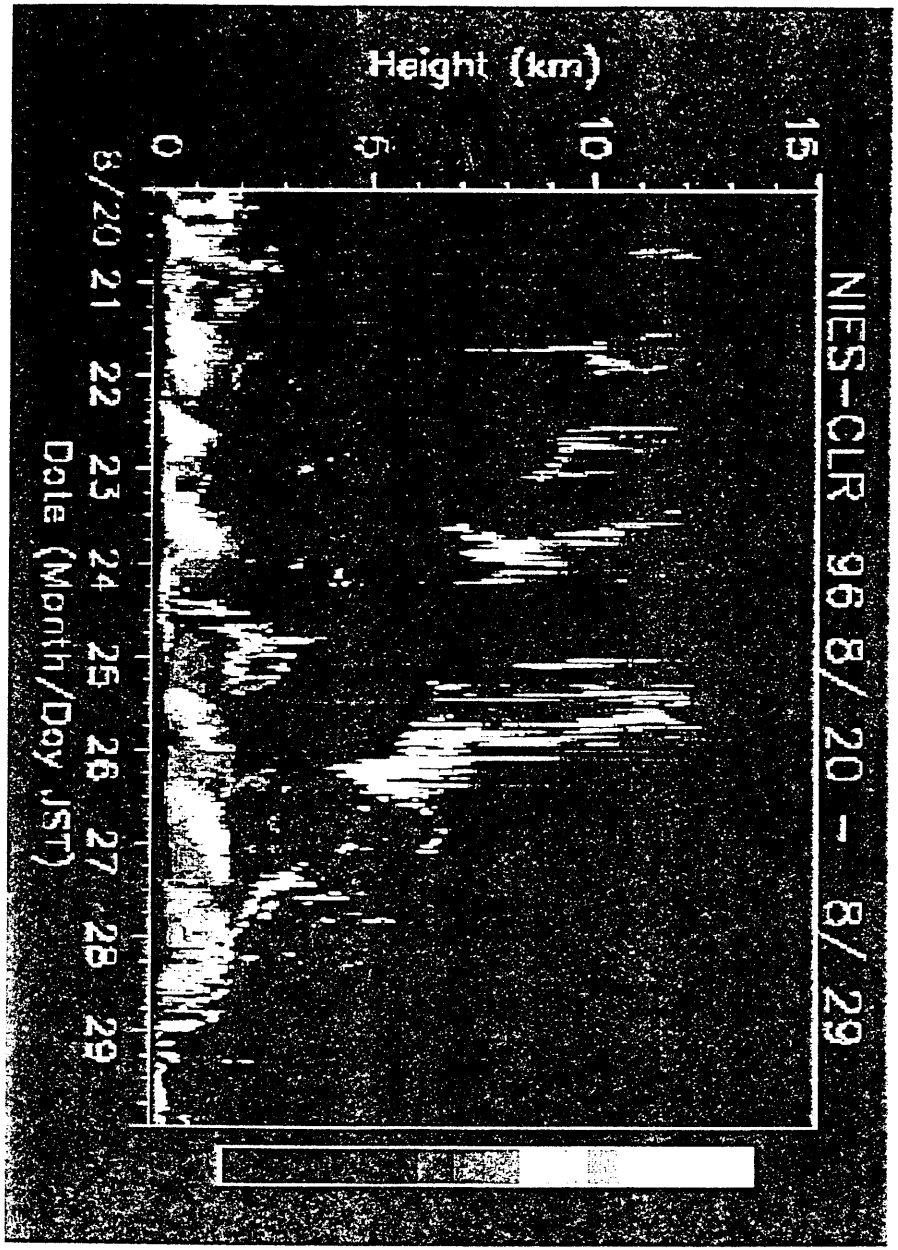
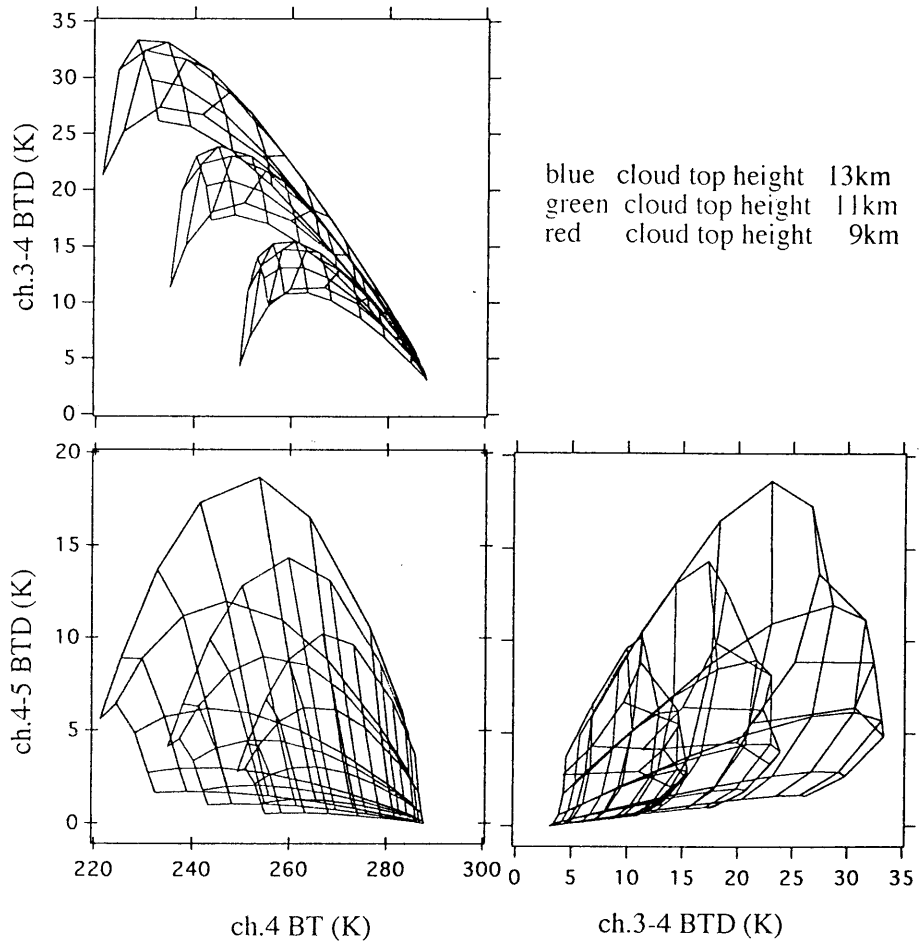
- NOAA/AVHRR ch3, ch4, and ch5 data were compared with theoretical calculations to retrieve cloud height, optical thickness, and effective particle radius.
- Cloud top height obtained from AVHRR data were compared with that obtained from lidar measurement.



wave length
ch.4 10.8μm
ch.5 12.0μm

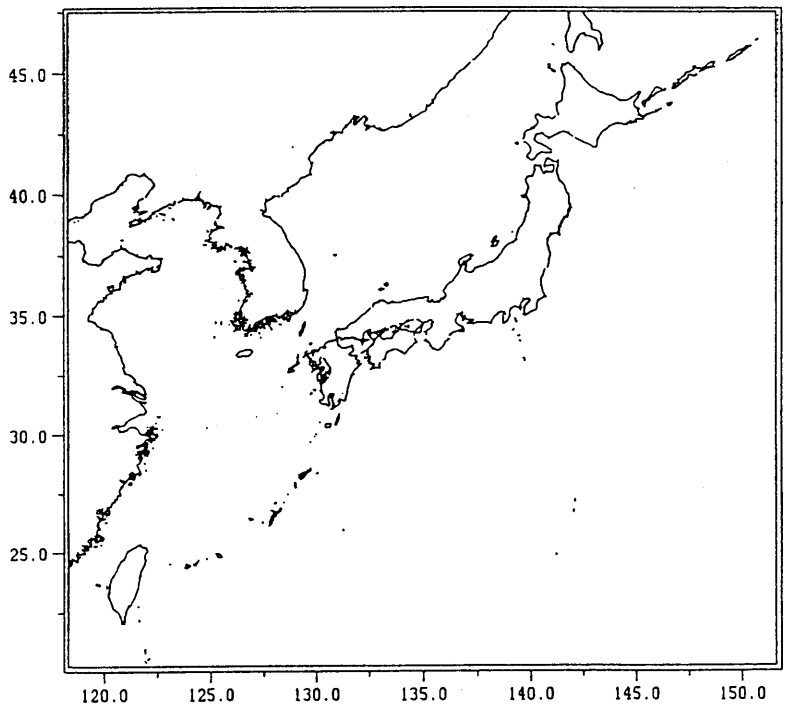
Relationship among optical thickness,effective radius of Cirrus and Brightness Temperature, Brightness Temperature Difference





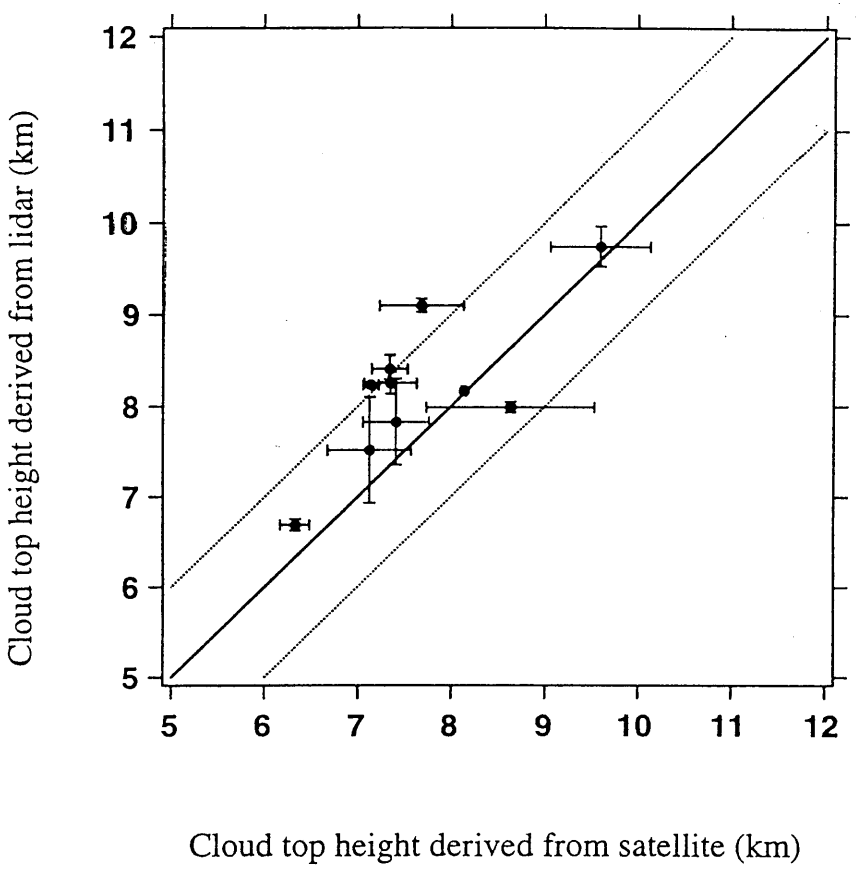
Relationship among optical thickness,effective radius of Cirrus and Brightness Temperature, Brightness Temperature Difference

Area of data analysis



Latitude(North)　　Longitude(East)

２０.１０～４７.６０　　１１８.２１～１５１.７９



Comparison of cloud top height derived from satellite and lidar

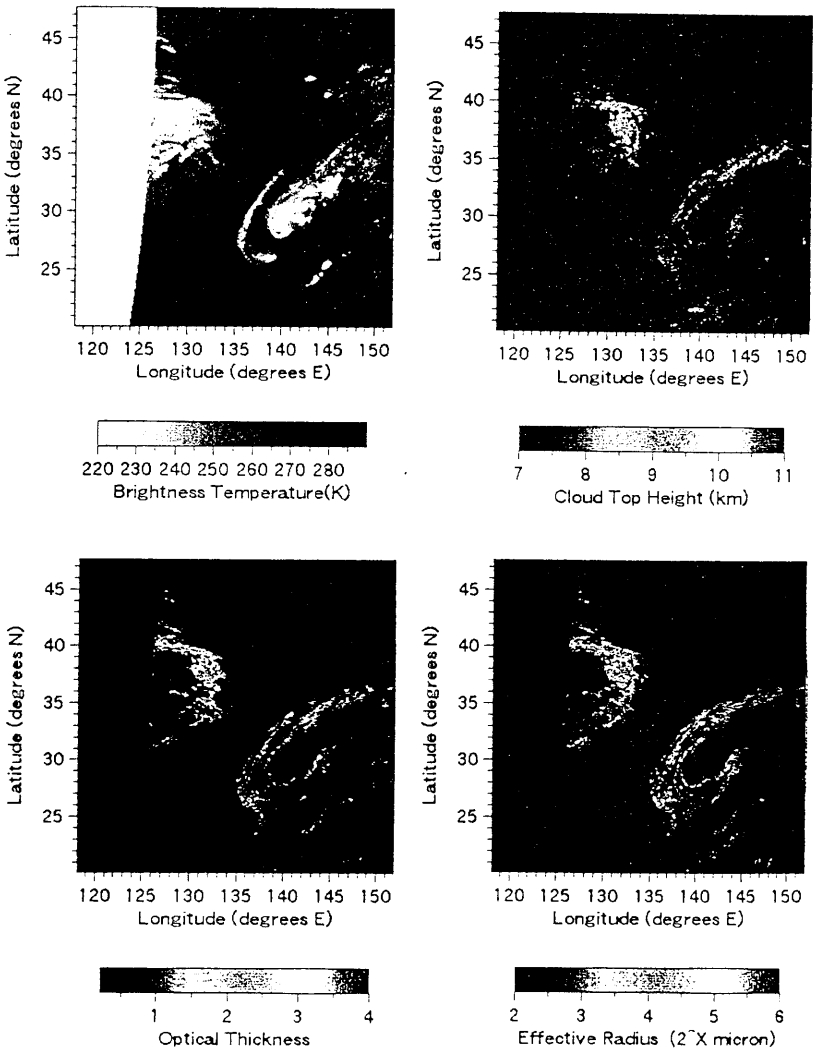


Image of IR and retrieved results of cirrus

1/10/1996 Low pressure

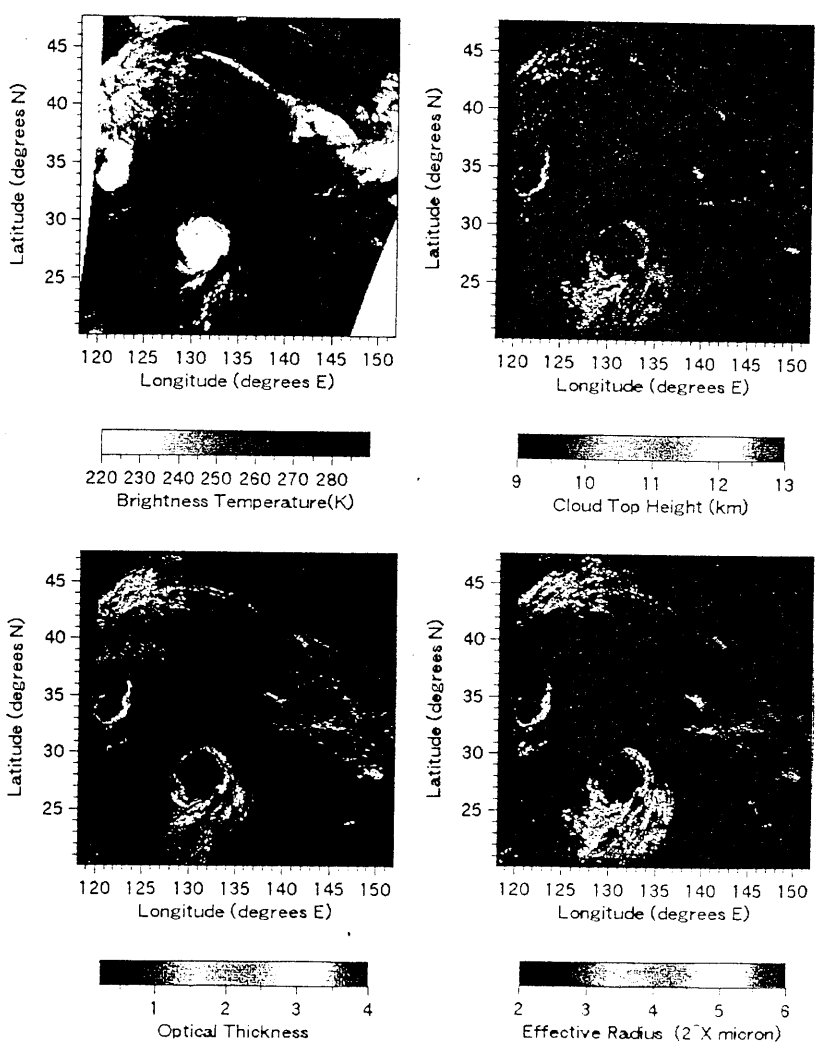
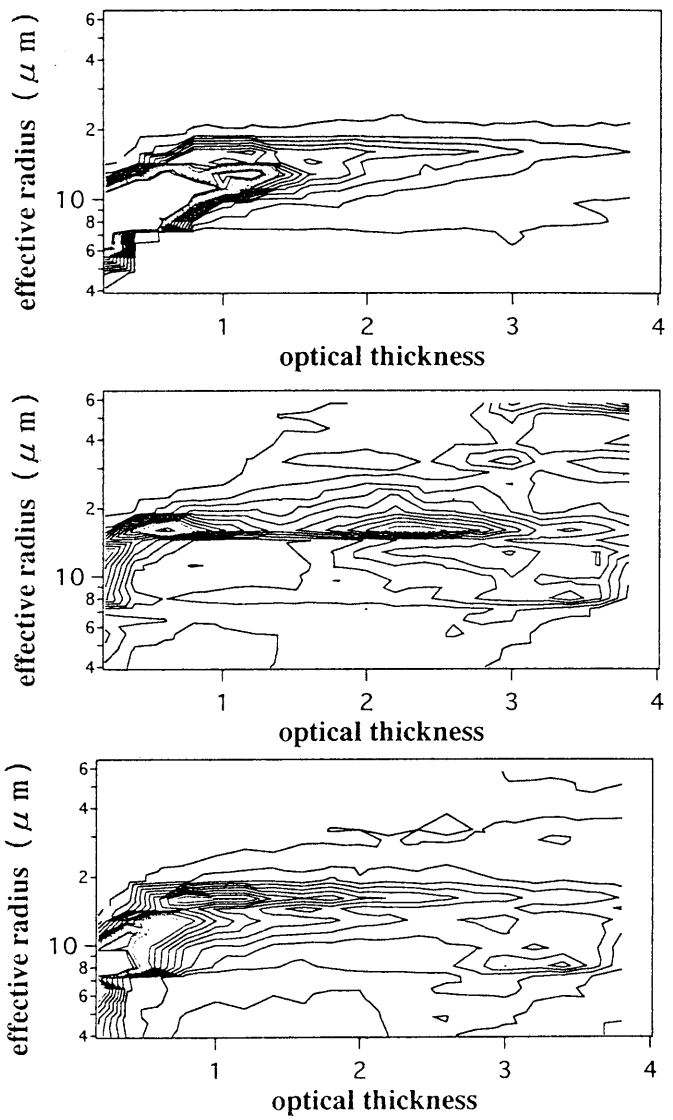


Image of IR and retrieved results of cirrus

17/7/1996 Typhoon



Relationship between distributions of optical thickness and effective radius

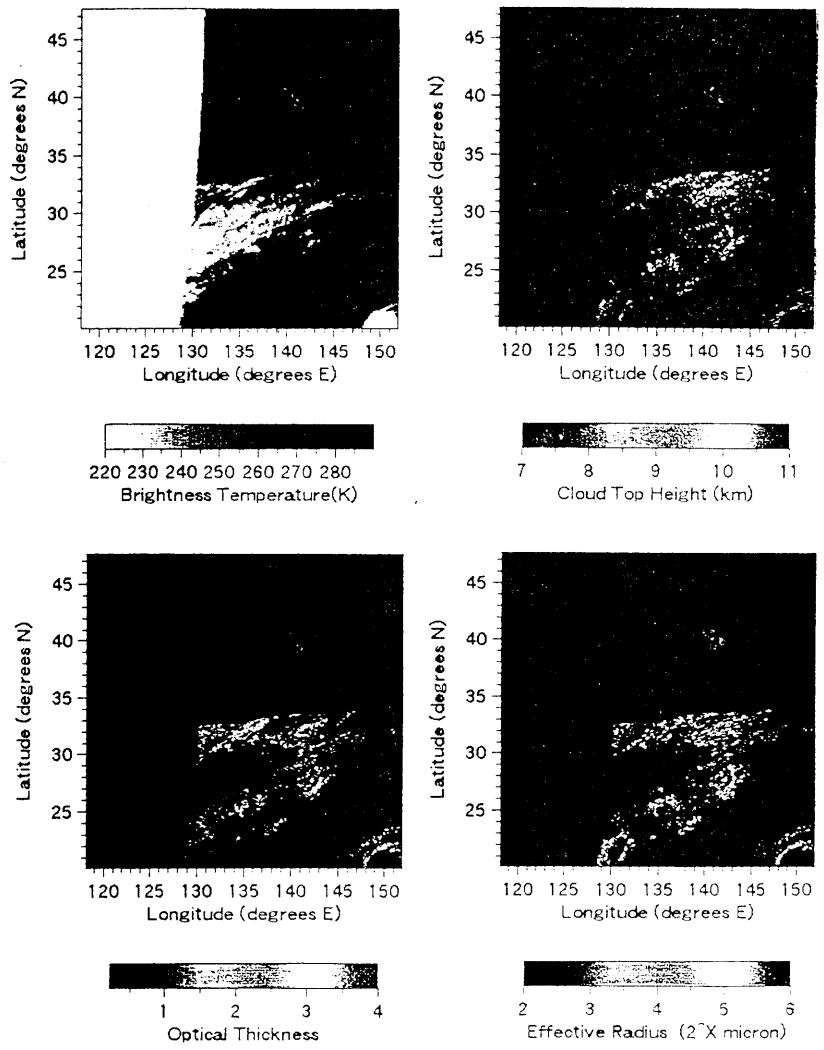


Image of IR and retrieved results of cirrus

21/10/1996 Warm front

Statistics of results

Cirrus accompanied with typhoon (7/15~7/19)

optical thickness= 1.21± 0.95

effective radius = 11.87± 4.87 μm

Cirrus accompanied with low pressure (10/1~10/3)

optical thickness= 1.78± 1.10

effective radius = 17.41±13.05 μm

Cirrus accompanied with warm front (10/20~10/23)

optical thickness= 1.93± 1.08

effective radius = 14.03± 9.88 μm

Summary

- Cloud top height, optical thickness, and effective particle radius of cirrus were retrieved from NOAA AVHRR IR data.
- The comparison between satellite remote sensing and lidar measurement showed that both cloud top heights are consistent.
- Cirrus cloud properties retrieved from AVHRR suggests that those properties correspond to various cloud types such as typhoon, warm front, etc.