R005-01
Zoom meeting C ：11/1 AM1 (9:00-10:30)
09:00-09:15

Estimation of cloud base altitude using cloud images captured by all-sky imagers

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Clouds can significantly affect the Earth's radiation budget and water cycle by changing its various properties. In addition to cloud microphysical properties, cloud bottom height, which is one of the macrophysical structures of clouds, has a particularly important meaning for infrared radiation on the surface of the Earth. Cloud base height is also extremely important in air safety, airborne military operations and surveillance [Vislocky and Fritsch, 1997]. Thus, an accurate method of estimating the cloud base altitude may provide a better understanding of the effects of clouds on the Earth's radiative balance, and may provide useful information for improving aviation safety. The following ground-based instruments can be used to accurately estimate cloud base heights. Radar and lidar can be used to obtain relatively accurate cloud-bottom heights locally [Takano and Takamura, 2014]. However, they cannot provide the cloud base height information in wide area. The advantage of satellites is that high-resolution, two-dimensional distributions of the microphysical and macrophysical properties of clouds may be retrieved on a global scale [Huang et al., 2006].However, the acquisition of cloud-bottom heights is quite complex and cannot be obtained directly from satellite observations. Wilheit and Hutchison [2000] also proposed a method to retrieve the cloud base height by combining passive microwave brightness temperature and infrared cloud top temperature. However, these methods are mainly useful for special cloud types (e.g., relatively thin clouds, stratocumulus clouds, convection clouds, etc.). In this study, we propose an estimation method of the cloud base height using a pair of cloud images observed by all-sky imagers at two sites. The advantage of all-sky imagers is to be cheaper than radars and lidars. The two all-sky imagers were installed on the roofs of Engineering Research Building 1 (35.6246N, 140.1037E) and 2 (35.6266N, 140.1040E) in Nishi-Chiba campus in Chiba University, Japan. The distance between the two all-sky imagers is 216 m. The all-sky imagers have equisolid angle projection method. The estimation method of the cloud base height is described below. When the cloud base height is assumed in the range of 500-2500 m with step of 50 m, the two cloud images are projected to each map. Then we calculate cross-correlation between the two maps. The cloud base height is determined when the cross-correlation coefficients are at their maximum in all cases. In a recent case study, the cloud base heights were estimated to be 1850 m at 11:45:13 LT on 16 March, 2020. The cloud base height was observed to be 1860 m by a lidar installed by the National Institute for Environmental Studies (NIES) in the same campus in Chiba University at 11:00 LT. The difference of cloud base height between our method and lidar was 10 m. We verified the accuracy of the cloud base height estimation by simulation. When cloud base heights of pseudo-cloud were set to be 1000 m and 2000 m, the estimated heights were higher by 100-250 m than the true one. In the session, we will show the results of verification of the accuracy of the estimation method in details.