R005-59
Zoom meeting C ：11/3 AM2 (10:45-12:30)
11:00〜11:15

Estimation of cloud base height and cloud cover from all-sky cloud imagers

#Atsuya Nemoto[1],Hiroyo Ohya[2],Toshiaki Takano[3],Tamio Takamura[4],Alessandro Damiani[4],Hiroyuki Nakata[5]
([1]Science and Engineering, Chiba University,([2]Engineering, Chiba Univ.,([3]Chiba Univ.,([4]CEReS Chiba Univ.,([5]Grad. School of Eng., Chiba Univ.

Cloud base height has been observed by radiosondes, radars, and lidars (ceilometer). Radiosonde observation is carried out only twice a day at 00:00 and 12:00 UT over the world, and observation sites are limited (for example, 16 sites in Japan). 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. Lidars can be obtained relatively accurate cloud base heights locally [Takano and Takamura, 2014]. However, they detect only the overhead cloud base height. The advantage of satellites is that two-dimensional distributions of the microphysical and macrophysical properties of clouds may be retrieved on a global scale with high resolution [Huang et al., 2006]. However, the acquisition of cloud base height cannot be obtained directly from satellite observations. On the other hand, column resistance of global electric circuit increases by 10 % with increasing cloud cover based on simulation[Zhou and Tinsley, 2010], although quantitative verification has not been performed by observations yet. In this study, we propose a method for estimating cloud base height and cloud cover using all-sky imagers at two sites. The advantage of all-sky imagers is that they are cheaper than radars and lidars. Cloud observations have been performed by the two all-sky imagers 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. 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 of RGB and binarized values between the two maps. The height that the cross-correlation coefficients show maximum value is adopted as the cloud base height. We verified the estimation accuracy of the cloud base height by simulation. When we made several pseudo-cloud images in the cloud base height range of 500 - 3000 m with a step of 500 m, the estimation errors were 0 - 30 m. The errors are very low, because spatial resolutions of visible spectra for the Himawari-8 satellite and X-band radar network are 1 km and 250 m, respectively. Applying our estimation method for observation data, the cloud base height was estimated to be 1987 m and 1937 m in the cases of the RGB and binarized values at 11:45:13 JST on 16 March, 2020, respectively. 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 11:45:00 JST. On the other hand, we improved an automatic procedure to estimate nighttime cloud cover from cloud optical images using the RGB color values. The nighttime judgement conditions of the RGB values for clouds were changed from daytime one. In the session, we will show the results of verification for the accuracy of the estimation method and relationship between cloud cover and atmospheric electric field in details.