Characteristics of cloud fractions from satellite observations along the ship track of R/V *Shirase*

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Clouds have an important role in the earth climate system in terms of radiation budget. They have cooling and warming effects on solar and terrestrial radiations, respectively. Their radiative impacts depend on the cloud amount, optical thickness, particle size, top and bottom heights, and so on. Satellite observation is one of the most suitable approaches to understand the cloud properties on a global scale. However, it is not easy to observe cloud properties because their spatiotemporal variations are very large, and then the reliability on the cloud products from satellite is not necessarily high (IPCC 2013). It is therefore required to validate the cloud products retrieved from satellites. There are a lot of validation sites over land, but we do not have enough validation sites over ocean, even though ocean extends about 70% of the earth surface. Therefore, shipborne observation is one of the possible counterparts for the spaceborne platforms over the oceans.

R/V *Shirase* performed the Antarctic cruise between Japan and Antarctica from 12 November 2017 to 12 April 2018 during the 59th Japanese Antarctic Research Expedition (JARE 59). Cloud fractions were estimated from R/V *Shirase* observations with whole-sky camera, ceilometer and eye after JARE 55 (Kuji et al. 2018).

JAXA retrieves cloud properties using Advanced Himawari Imager (AHI) onboard Himawari-8, which is a geostationary meteorological satellite launched by Japan Meteorological Agency (JMA) in 2014 (Bessho et al. 2016). The cloud products such as cloud optical thickness and cloud types are available in every 10 min in Himawari Monitor (http://www.eorc.jaxa.jp/ptree/index.html). The product level ver. 1 was used in this study.

Therefore we tried to investigate the cloud characteristics from Himawari-8 observation along the track of R/V *Shirase* . We estimated cloud fraction based on the cloud optical thickness and compared it with the R/V *Shirase* observation. A pixel is considered cloudy when the cloud optical thickness above R/V *Shirase* is greater than 0. The cloud fraction was defined as a frequency of cloud appearance, that is, the ratio of cloudy to total effective pixels. Figure 1 shows a scatter plot of daily-averaged cloud fractions estimated with Himawari-8 versus the whole-sky camera in JARE 59. The correlation coefficient of Himawari-8 versus the whole-sky camera were high with 0.77.

In this study, cloud characteristics from Himawari-8 observations is investigated along the ship track of R/V *Shirase* observation for the validation. We are going to improve the estimation of the cloud fraction. In future, the cloud properties from GCOM-C/SGLI observation will be also investigated and validated along the track of R/V *Shirase* .

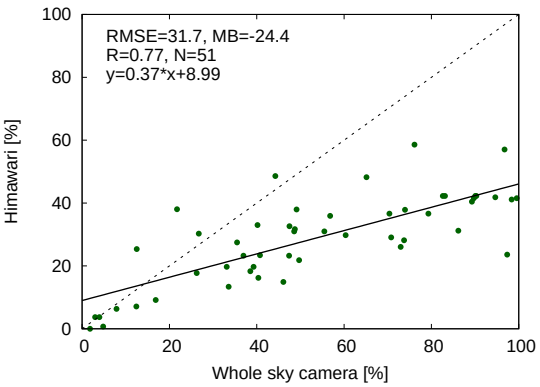

Figure 1. Scatter plot of daily- averaged cloud fractions estimated with Himawari-8 versus the whole-sky camera in JARE 59. Solid and dotted line are regression and one-to-one line, respectively. RMSE, MB, R and N represent root-mean-square-error, mean bias, correlation coefficient and total number, respectively.

References

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