Cloud characteristics 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).

Japan Aerospace Exploration Agency (JAXA) launched a polar orbiting satellite, Global Change Observation Mission – Climate (GCOM-C), in 23 December 2017 (http://suzaku.eorc.jaxa.jp/GCOM_C), which carries Second Global Imager (SGLI). The whole-sky camera was originally mounted on R/V *Shirase* for the purpose of the validation of cloud products from GCOM-C/SGLI. There were four days at least when GCOM-C overpassed R/V *Shirase* in 27 March, 2 April, 6 April, and 10 April 2018. However, the standard products of clouds are not available currently. On the other hand, 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). Therefore we tried to investigate the cloud characteristics from Himawari-8 observation along the track of R/V *Shirase* at this stage.

Figure 1 shows a map of cloud optical thickness from Himawari-8/AHI along the ship track of R/V *Shirase*. It is found that the cloud optical thickness in the wavelength of 500 nm was retrieved only at the east coast of Australia in 27 March 2018. We will estimate cloud fraction based on the cloud optical thickness and compare it with the R/V *Shirase* observation in future.

In this study, cloud characteristics from Himawari-8 observations is investigated along the ship track of R/V *Shirase* observation for the validation at this stage. Furthermore, cloud properties from GCOM-C/SGLI observation will be also investigated and validated along the track of R/V *Shirase* after the standard products are available.

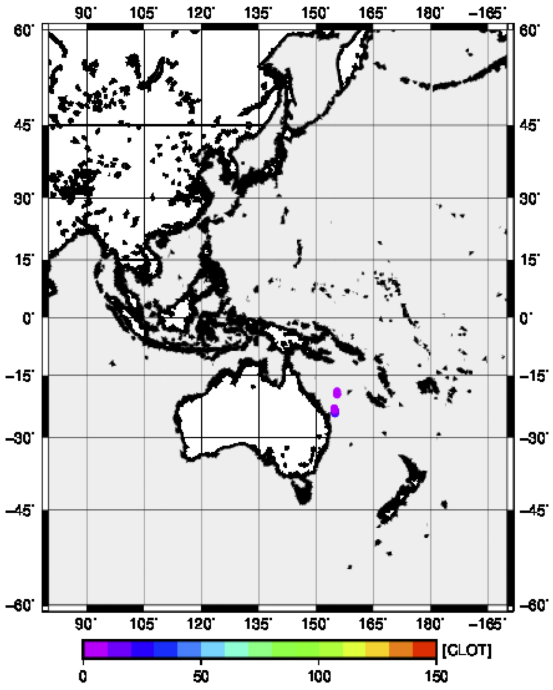

Figure 1. Map of cloud optical thickness (CLOT) at the wavelength of 500 nm from Himawari-8 along the track of R/V *Shirase* in every 10 min in 27 March 2018. It is noted that the cloud product is preliminary before the validation.

References

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