Characteristics of cloud fraction and shortwave downward radiation at Syowa Station with ground-based observations

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Cloud has warming and cooling effects on the Earth's climate: it absorbs earth radiation and reflects solar radiation, respectively. Their magnitudes depend on shape, height and amount of clouds, and so on. However, it is not easy to observe clouds precisely because of their spatial and temporal variability, e.g., wide variety of shapes and distributions. Cloud is one of the greatest sources of error in estimating radiative forcing and temperature in the future [IPCC 2013]. In addition, polar regions have a crucial impact on global climate through the existence of sea ice and ice sheet. Therefore, it is required to comprehend cloud behavior in polar regions.

In this study, we investigated the characteristics of three types of cloud fraction: all-sky camera, Micro Pulse LIDAR (MPL) and visual observations at Syowa Station, Antarctica. The all-sky camera continuously observes the whole sky every 10 min with a fisheye lens. We estimated cloud fraction from all-sky camera images based on a cloud detection method [Yabuki et al., 2014]. Using the all-sky camera, cloud has been detected only during the daytime period. MPL emits micro-pulse laser beams into the atmosphere and receives the backscattered light from cloud. Consequently, MPL can detect the presence of clouds, and thus, cloud fraction is estimated as the occurrence frequency. The visual cloud fraction was available from the Baseline Surface Radiation Network (BSRN). The visual observations are conducted every 3 h. We also investigated the relationship between these cloud fractions and shortwave downward radiation. The shortwave downward radiation observed by a pyranometer were also available every 1 min.

We investigated the variation of monthly-mean cloud fractions from all-sky camera, MPL and visual observations from 2005 to 2018. As a result, cloud fraction from the three observations generally showed similar variations. In addition, as a result of the correlation analysis of cloud fractions, all correlation coefficient is very high of 0.8 or higher. We are also going to discuss the results of correlation between cloud fractions and shortwave downward radiation.

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References

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