A plan for ground-based observation of noctilucent clouds in Antarctic region.

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Noctilucent cloud (NLC) images often contain very fine wavy structures ranging from several kilometers to several tens of kilometers. These are thought to reflect small scale local atmospheric disturbances in the upper atmosphere. Satellite imaging data cannot resolve these fine structures, and thus, ground-based imaging is an effective method to study the relationship between fine structures in NLC and background disturbances in the upper mesosphere. However, previous NLC observations have been conducted mainly in the Northern Hemisphere, as represented by Northern Europe [e.g. Dalin et al.,2020] and the North American continent [e.g. Russell III et al.,2014]. In contrast, there are very few observations in the Southern Hemisphere. The reason for this asymmetry is that most of the best observation latitudes (50 - 60°S) in the Southern Hemisphere are in the ocean, and most of the land area of Antarctica is under the influence of the midnight sun, which makes it difficult to detect NLCs because of a bright background sky condition. Therefore, opportunities for NLC observations in the Southern Hemisphere are quite limited. We have examined the feasibility to overcome this problem by developing an optical imager specialized for noctilucent cloud observations [Nakamura et al.,2021]. Noctilucent clouds are known to have a spectral peak at 400-500 nm in their radiance [Lange et al.,2022]. On the other hand, the background spectrum in twilight sky attenuates in wavelengths shorter than 680nm. Therefore, there is the optimum wavelength band for noctilucent cloud observation with the best signal-to-noise ratio (SNR) in shorter wavelength region. In this study, the most suitable bandpass for NLC observations is proposed based on the ground spectral data acquired in the polar region in twilight period.

As a result, we conclude that an imaging observation by using a cooled CMOS camera equipped with the bandpass filter which has the center wavelength at 405nm and 10nm bandwidth can give enough SNR(SNR>10) for NLC even under a bright sky condition corresponding to a local solar zenith angle ~91°.

The new imager can expand the observation period in the high-latitude region. For example, the observation period would increase +18 days to the conventional period of 10 days in Syowa Station (69.00°S, 39.58°E) (See Figure).

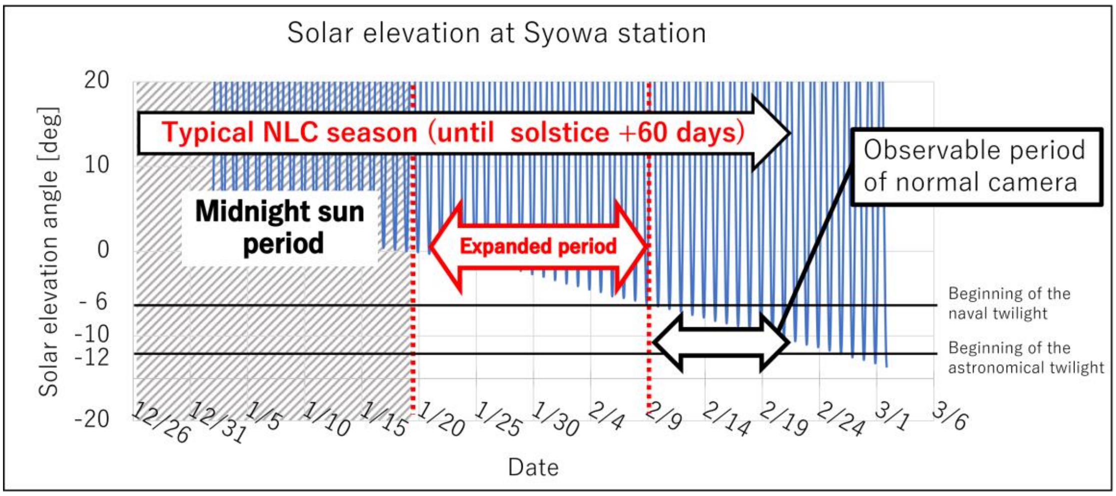

Figure. The opportunity of NLC observation in Syowa Station

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