Development of an imager specialized in an observation of noctilucent clouds in high latitude regions.

Yuriko Nakamura[1], Hidehiko Suzuki[1]
[1]*Department of physics, Meiji university*

Polar mesospheric clouds (PMCs) are the Earth's highest clouds which appear in upper mesosphere during summer season in both sub-polar regions. PMCs are considered to be the one of the proxies to monitor global atmospheric variations since their occurrence is highly sensitive to the mixing ratio of the water vapour and atmospheric temperature at the mesopause region. Thus, it is important to monitor the global occurrence of PMCs in polar region in both hemispheres. PMCs are visible even by naked eyes from ground when sky is under deep twilight condition. This is because PMCs are in extremely high altitude and can be illuminated by sunlight even after Sunset for ground observers. This geometric condition makes PMCs luminous in a dark sky condition. This visualized PMCs are known as noctilucent clouds (NLCs) and frequently reported by many observers in subpolar regions (50 – 60 degrees in latitude) in summer season of north hemisphere (e.g. http://spaceweathergallery.com/nlc_gallery.html). However, in contract, reports of NLCs observations are extremely rare in southern hemisphere. This is apparently due to scarcity of populated cities or habitable lands in subpolar region of southern hemisphere. Survey stations near the coast of Antarctic continent are possible locations for NLCs observations. However, most of them are still too high in latitude and thus under the midnight sun condition in almost entire season of NLCs. Nevertheless, there is one report which successfully photographed faint NLCs from Syowa Station (69S) on the end of summer season (Feb 11) in 2009 [Takeda et al., 2013]. They captured very faint signature of NLCs by using a commercial colour digital camera. Signal to noise ratio of NLC signature in colour image is mostly dominated by brightness of NLCs and background sky. NLCs are typically photographed in low elevation from horizon during twilight period. Thus, background sky behind the NLCs typically shows bright and brilliant reddish colour [e.g. Suzuki et al., 2017]. On the other hands, spectral radiance of NLCs shows blueish shape in typical [Tsuda et al., 2018]. Thus, it is possible to design the suitable bandpass of a colour camera which can detect NLC with higher SNR by supressing strong signal from background sky. For example, a red channel of ordinal digital cameras less contribute to obtain signal from NLC but from background sky. So high-pass filtering to supress signals from twilight sky could improve SNR of NLCs images. Observable period by colour digital cameras would be also extended by supressing background signals. This can increase the opportunity to detect NLCs by the cameras in high latitude region. In this talk, progress of a development of the colour camera specialized for NLCs observation and an observation plan in high latitude region of southern hemisphere is presented.

References

Hosokawa K., Y Takeda, T Ogawa, A Kadokura, Simultaneous observations of noctilucent clouds and polar mesosphere summer echoes at Syowa Station, Antarctica, Antarctic Record, 57(3), 317-328, 2013

Suzuki, H., Sakanoi, K., Nishitani, N., Ogawa, T., Ejiri, M. K., Kubota, M., Kinoshita T., Murayama Y. and Fujiyoshi, Y., First imaging and identification of a noctilucent cloud from multiple sites in Hokkaido (43.2–44.4° N), Japan. Earth, Planets and Space, 68(1), 182, 2016

Tsuda, T. T., Hozumi, Y., Kawaura, K., Hosokawa, K., Suzuki, H., and Nakamura, T., Initial report on polar mesospheric cloud observations by Himawari-8. Atmospheric Measurement Techniques, 11(11), 6163-6168., 2018