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Imaging of polar cap patches with small airglow cameras

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In the last two decades, 630.0 nm airglow measurements with cooled CCD cameras have been widely used to observe various kinds of ionospheric phenomena such as plasma bubble and MSTID. Recently, similar airglow observations at high-latitudes have enabled us to visualize the dynamical behavior of polar cap patches, which are regions of high density plasma propagating in the central polar cap region. In this sense, now the all-sky airglow measurement is one of the essential tools for monitoring ionospheric phenomena at all the latitude regions. However, it is still very difficult to make a dense network of airglow imagers and capture the large-scale structure in the ionosphere because the system is relatively large and high cost.

In this paper, we have employed a cheap and small CCD camera (Watec Co.Ltd.: WAT-910HX) to observe airglow in the polar cap region and check if such a camera can be used for observations of polar cap patches. We prepared two sets of small airglow camera, one with a fish-eye lens and the other with a wide field-of-view lens. They are combined with an optical filter whose central wavelength is 632.0 nm, FWHM is 10 nm and transmittance is 85%. The two airglow cameras were installed in Longyearbyen (78.1N, 15.5E), Norway in October 2013 and operated continuously during the 2013/2014 winter season. In Longyearbyen, airglow measurements with an EMCCD all-sky airglow imager (ASI) and the auroral spectrograph (ASG) have been carried out; thus, we were able to compare the images from the small airglow cameras with those from the conventional airglow observation systems.

On the night of December 4, 2013, a series of polar cap patches was observed by the EMCCD all-sky imager in Longyearbyen. The optical intensity of the patches was as large as 500 R. At the same time, the small airglow cameras also detected regions of enhanced airglow intensity passing through their fields-of-view. The quality of the images was slightly lower than those from the EMCCD-ASI, but it was high enough for capturing the 2D structure of the patches. This indicates that the small CCD camera of Watec Co.Ltd. can be used for observations of ionospheric phenomena such as polar cap patches. However, there is some sort of difference in the optical intensity between the EMCCD-ASI and the small airglow camera. We suppose that this is due to the difference in the FWHM of the optical filters. In the presentation, we will discuss this difference in a quantitative manner by using airglow spectra from ASG.

Keywords: Polar cap region, Polar cap patches, Airglow measurements