Full-scale spatial characteristics of pulsating aurora derived from color digital camera images from the International Space Station

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Astronauts have been taking a large number of photographs of the Earth from the International Space Station (ISS) using digital single lens reflex (DSLR) cameras. Images obtained from this observation often contain upper atmospheric phenomena such as airglow and aurora. We have introduced a method for projecting the photographs of aurora from ISS onto the geographic coordinate system using night city lights in the images as markers [Nanjo et al., 2020, submitted]. The temporal resolution of the ISS photography is less than 1 sec with a wide field-of-view (FOV) coverage (as wide as the FOVs of multiple ground-based all-sky imagers). Besides, the FOV of the ISS photography sweeps for a long distance (4-5 hours in local time) in a short time interval (~10 min). Since the typical pulsating period of pulsating aurora (PsA) is 2-40 sec and their spatial scale ranges from a few tens to a few hundreds of km, we are able to employ the ISS photographs for investigating large-scale characteristics of spatio-temporal variations of PsA. First, we analyzed the MLT dependence of pulsating period. However, it was difficult to claim that there is a clear dependence of period on MLT for all the intervals of interest. Next, we focused on the color of aurora in the ISS image. The DSLR camera has three color channels (i.e., R, G and B). Typical greenish aurora (557.7 nm) could correspond to the G channel and the bluish band emission of nitrogen molecule (e.g., 427.8 nm) could correspond to the B channel. The electrons, responsible for the band emission of nitrogen, are known to have relatively higher energy than those causing greenish aurora. Therefore, the intensity ratio of B and G channels (B/G ratio) can be used as a proxy for the characteristics energy of precipitating electrons. We analyzed the B/G values from the ISS images for multiple events and found that the B/G value is higher 1) in the morning sector, 2) within PsA rather than within discrete aurora, 3) during ON-time of PsA than during OFF-time. These characteristics are consistent with previous findings regarding the energy of PsA electrons, which implies the feasibility of using the B/G ratio as a proxy for the energy of precipitating electrons.

Keywords: International Space Station, Digital Single Lens Reflex camera, aurora, pulsating aurora

