Stereoscopic determination of all-sky altitude map of aurora using two ground-based Nikon DSLR cameras

Ryuho Kataoka[1], Y. Miyoshi[2], K. Shigematsu[2], D. Hampton[3], Y. Mori[4], T. Kubo[5], A. Yamashita[5], M. Tanaka[6], T. Takahei[7], T. Nakai[8], and H. Miyahara[9]

[1]*National Institute of Polar Research, 10-3, Midoricho, Tachikawa, Tokyo 190-8518*

[2]*Solar-Terrestrial Environment Laboratory, Nagoya University*

[3]*Geophysical Institute, University of Alaska, Fairbanks*

[4]*Department of Mechanical Engineering, Shizuoka University*

[5]*Department of Precision Engineering, Graduate School of Engineering, The University of Tokyo*

[6]*Department of Mechanical and Control Engineering, Tokyo Institute of Technology*

[7]*Orihalcon Technologies, Inc., Japan*

[8]*Hydrospheric Atmospheric Research Center, Nagoya University*

[9]*Musashino Art University*

A new stereoscopic measurement technique is developed to obtain an all-sky altitude map of aurora using two ground-based digital single-lens reflex (DSLR) cameras. Two identical full-color all-sky cameras were set with an 8 km separation across the Chatanika area in Alaska (Poker Flat Research Range and Aurora Borealis Lodge) to find localized emission height with the maximum correlation of the apparent patterns in the localized pixels applying a method of the geographical coordinate transform. It is found that a typical ray structure of discrete aurora shows the broad altitude distribution above 100 km, while a typical patchy structure of pulsating aurora shows the narrow altitude distribution of less than 100 km. Because of its portability and low cost of the DSLR camera systems, the new technique may open a unique opportunity not only for scientists but also for nightsky photographers to complementarily attend the aurora science to potentially form a dense observation network.

References:

Kataoka, R., Y. Miyoshi, K. Shigematsu, D. Hampton, Y. Mori, T. Kubo, A. Yamashita, M. Tanaka, T. Takahei, T. Nakai, H. Miyahara, and K. Shiokawa, Stereoscopic determination of all-sky altitude map of aurora using two ground-based Nikon DSLR cameras, Ann. Geophys, 31, 1543.1548, 2013.

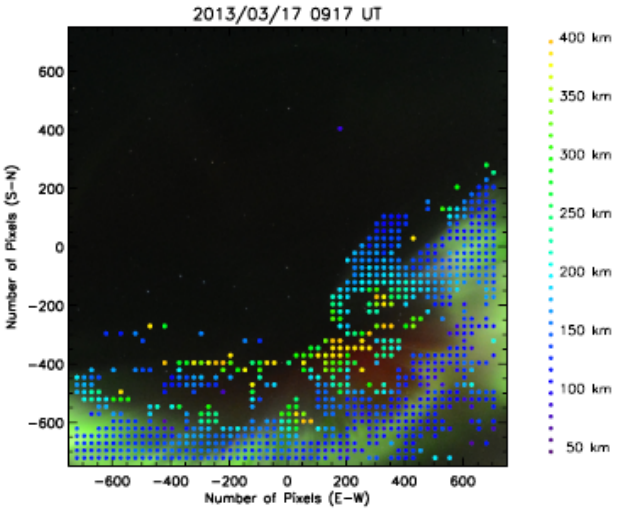

Fig. 4. Altitude map of a ray structure of a discrete aurora as obtained from all-sky images in Fig. 1. The superposed dots show the estimated emission altitudes, and the blue to yellow colors indicate low (50 km) to high (> 400 km) altitudes. The full-color original image is also shown in the background.

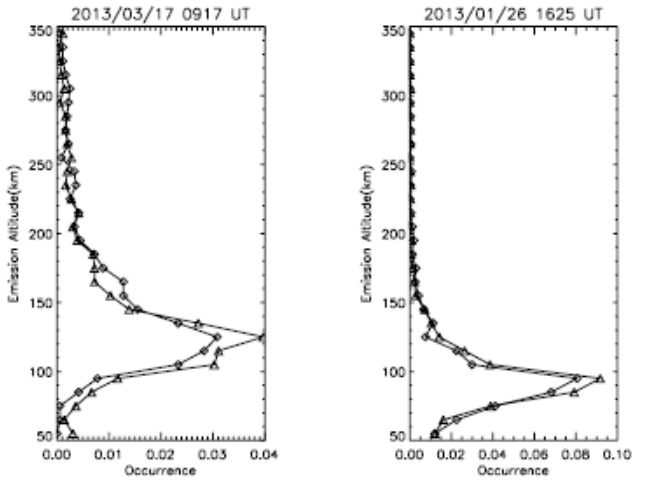

Fig. 6. The occurrence distributions of the emission altitudes for (left) the ray structure, and for (right) the patchy structure, as also shown by the dots in Figs. 4 and 5, respectively. Diamonds are from the altitude map as calculated starting from the base window in PI1, and triangles are from the altitude map as calculated starting from the base window in PI2.