Development of the imaging receiver system for the SuperDARN Hokkaido East radar

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The Super Dual Auroral Radar Network (SuperDARN) is a network of High-Frequency (HF) radars located at the high- and mid-latitude regions in both hemispheres, operated under the international collaboration by more than 10 countries (e.g., Nishitani et al., 2019). Among the total of 38 SuperDARN radars (as of October 2020), the Hokkaido Pair of (HOP) radars, consisting of Hokkaido East (2006-) and West (2014-) radars, are located at the lowest geomagnetic latitude and have been acquiring data at auroral, sub-auroral and mid-latitude regions with unique characteristics. After the operation and data accumulation for 14 and 6 years, it has been clear that sub-auroral and mid-latitude ionospheric phenomena, such as Sub-Auroral Polarization Streams (SPAS), sometimes have inner structures with a temporal scale of one to a few minutes. It is also found that the standard temporal (~ 1 min) and spatial (~ 45 km) resolution of the present system is not sufficient to fully monitor two-dimensional characteristics of these phenomena. To overcome the current difficulties, we have developed a prototype (4-channel subset out of total 20-channel array) of the SuperDARN imaging receiver system consisting mainly of USRP-N210 receiver units, which is attached to the SuperDARN Hokkaido East radar. Based on the results of this prototype, we are planning to develop a full set (20 channel) imaging receiver system. Installation of the imaging receivers can significantly improve the spatial-temporal resolution of the radar data, and make it possible to monitor several phenomena such as SAPS wave structures, Pc3 pulsations, and coseismic ionospheric disturbances, which have not been captured with sufficient spatial-temporal resolution with the preexisting receiver system. Details of the latest status of the development and scientific objectives of the imaging receiver system are presented.

References

Nishitani, N., et al., Review of the accomplishments of mid-latitude Super Dual Auroral Radar Network (SuperDARN) HF radars, Prog. Earth Planet. Sci., 6, 27, https://doi.org/10.1186/s40645-019-0270-5, 2019..