

SuperDARN HOKkaido Pair of (HOP) radars: accomplishments, present status and future perspectives

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Super Dual Auroral Radar Network (SuperDARN) is a network of HF radars deployed in both hemispheres. The SuperDARN Hokkaido West radar, one of SuperDARN HOKkaido Pair of (HOP) radars, is the newest SuperDARN radar located in Rikubetsu, Hokkaido, Japan, which began its operation in October 2014, in addition to the SuperDARN Hokkaido East radar which started working in November 2006. Longitudinal coverage of subauroral ionosphere over several hours of magnetic local time by the SuperDARN HOP radars, together with other midlatitude SuperDARN radars, will enable us to study the detailed characteristics of magnetosphere-ionosphere-thermosphere coupling phenomena in the subauroral and midlatitude areas, such as Sub-Auroral Polarization Streams (SAPSs) and Traveling Ionospheric Disturbances (TIDs). In this paper scientific accomplishments, present status and future perspectives of the SuperDARN HOP radars will be presented. The paper also presents initial results from the radar wave remote receiver in Nagoya, which enable us to study ionospheric disturbances equatorward of the radar site in Hokkaido.

SuperDARN HOP HF radars and northern SuperDARN radars (as of 24 Oct 2014)

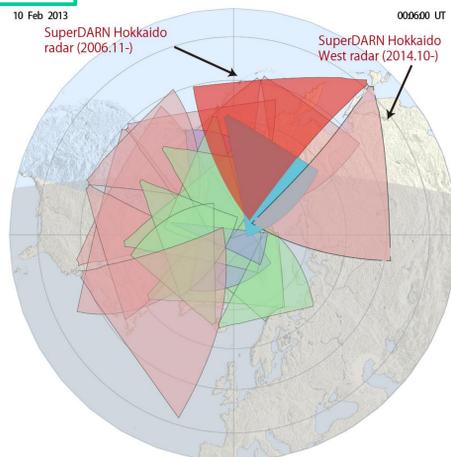


HOP East radar antenna, transmitters and receivers

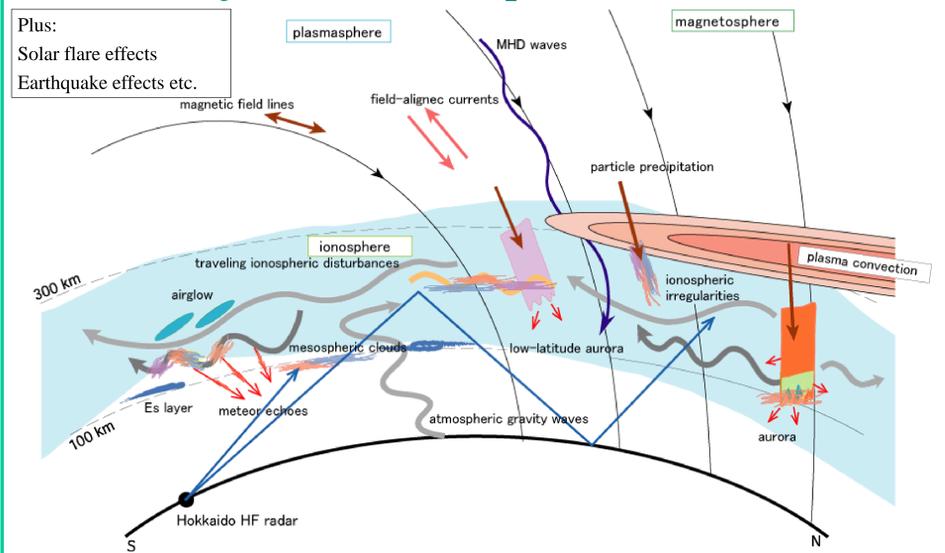


HOP West radar antenna

Number of the papers published using Hokkaido radar :25



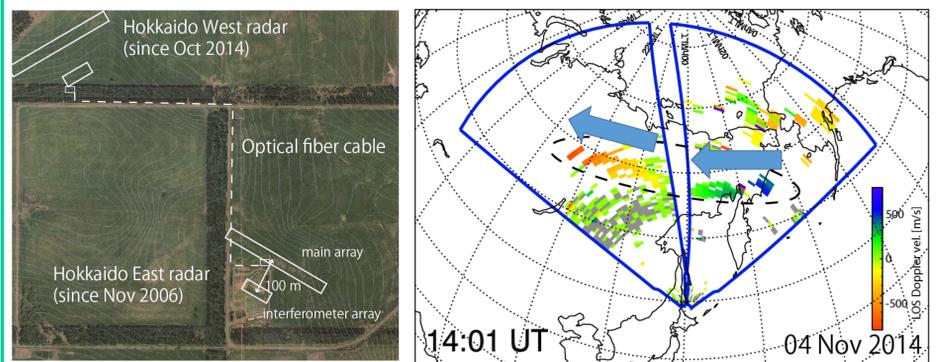
Scientific objectives of the SuperDARN HOP radars



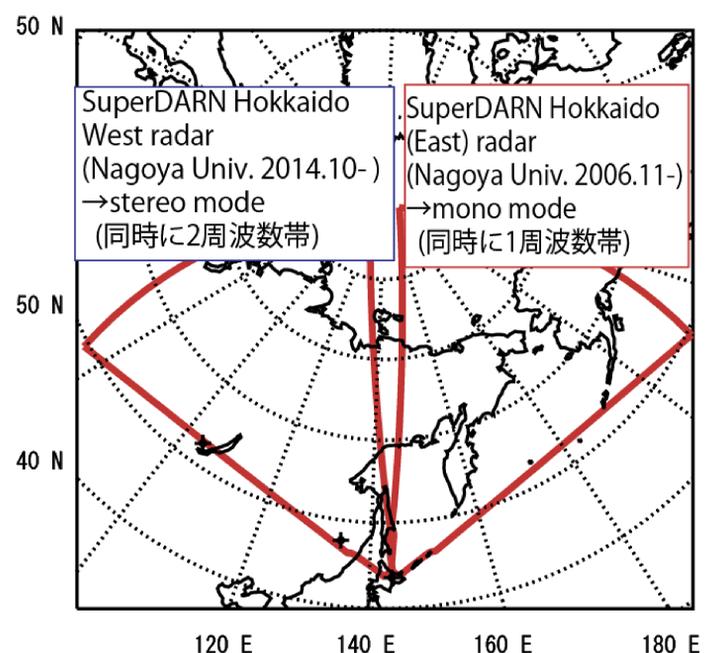
- So far we have published 25 papers in the refereed international journals mainly using the SuperDARN Hokkaido East radar data.

Initial result of the SuperDARN Hokkaido West (HOP West) radar

- We completed the construction, installation, license testing of the HOP West radar on 24 Oct 2014, and began receiving echoes.
- The HOP West radar is located about 1.1 km northwest of the HOP East radar (see bottom left figure). Both radars are connected with optical fiber cable, in order to send blanking signals to each other to protect receivers.
- So far we made observation of several storm time disturbance events, including the one on 4 Nov 2014 (see bottom right figure: details will be presented at the STE Space Weather Event Report Workshop on Wednesday).
- We still have some minor problems such as the maximum range gates (present: 70 -> should be 110), but otherwise have been successfully taking the data continuously.
- Distribution of the data to the SuperDARN community will begin soon.



New scientific objectives using HOP East / West radars



Hokkaido West radar: stereo mode

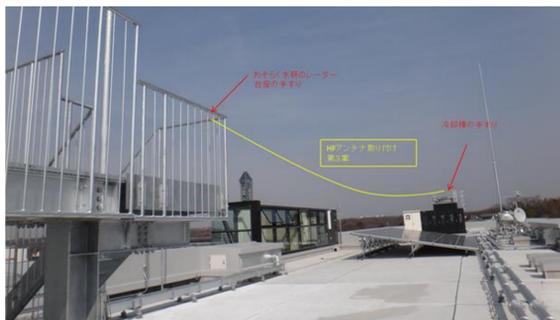
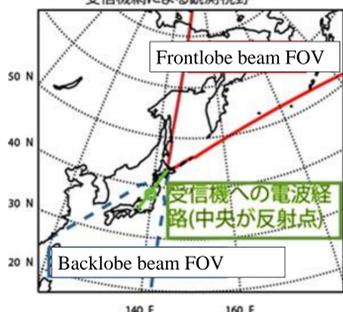
- Sampling two beams simultaneously: simultaneous observation of 1m 2D data and 1-3 s one beam data
- Useful for the studies of spatial / temporal characteristics of ULF waves, short time scale phenomena such as SCs / substorms and coseismic disturbances
- Three beams in the field of view of Hokkaido East / West radars can study Pc3 / Pi2 longitudinal wave number (m number) in detail
- It might be possible, by using raw data samples, to study ULF waves with periods shorter than 3 s
- Conjunction studies with ERG and other spacecraft are highly anticipated

West radar: possible to use 2 frequencies simultaneously

- 3 freq observation with 2 radars
- Useful for the studies of altitude dependence
- Studies of TIDs, solar flare effects, coseismic disturbances etc. are promising

Study of ionospheric disturbances using remote HF wave receiver

北海道-陸別短波レーダー及び受信機網による観測視野



- In 2014 we installed remote receiver of the HF radio wave emitted from the backlobe beam of the SuperDARN Hokkaido East radar in Nagoya to monitor the upward-downward motion of the ionospheric reflection point.
- We also install another receiver in the vicinity of the radar site in order to obtain information of the timing of the HF radar pulses and the precise radar frequency. Both receivers are synchronized to each other using the GPS.
- As initial results, we succeeded in obtaining daily variation of Doppler velocity (upward-downward motion of the ionosphere).
- We are planning to monitor shorter scale disturbances generated by the earthquakes, typhoons, volcano eruptions etc.
- In the near future we are planning to install received in Russia to monitor the front lobe beams to obtain detailed information of the radar wave paths.