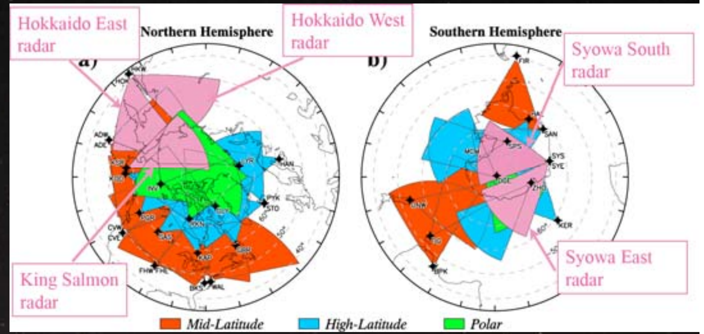
Current status of the SuperDARN Hokkaido Pair of radars



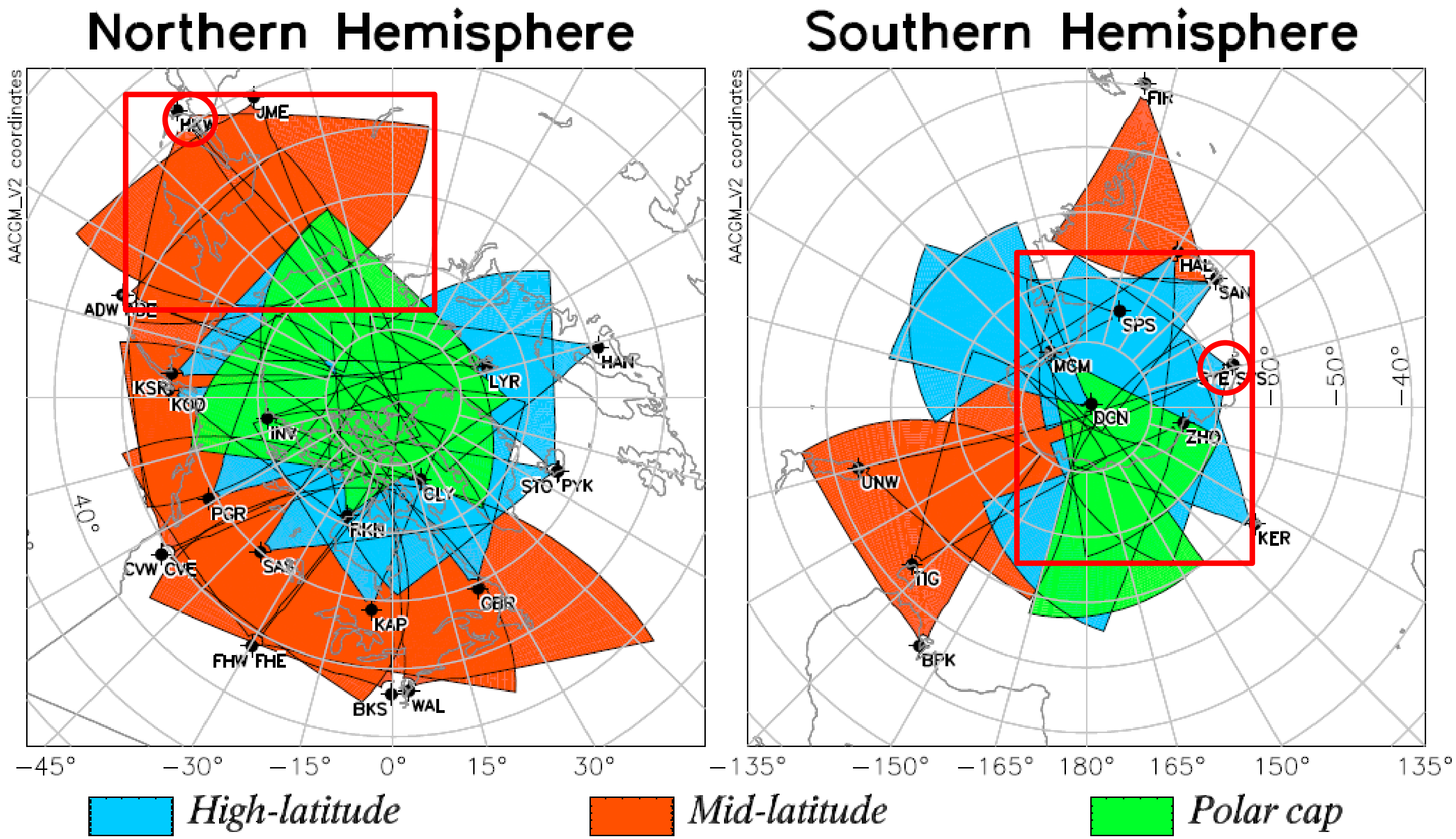
Nozomu Nishitani[1]

[1] ISEE, Nagoya University

Low latitude aurora behind the SuperDARN HOP East radar (2015.3.18 0110 JST)

Super Dual Auroral Radar Network (SuperDARN)

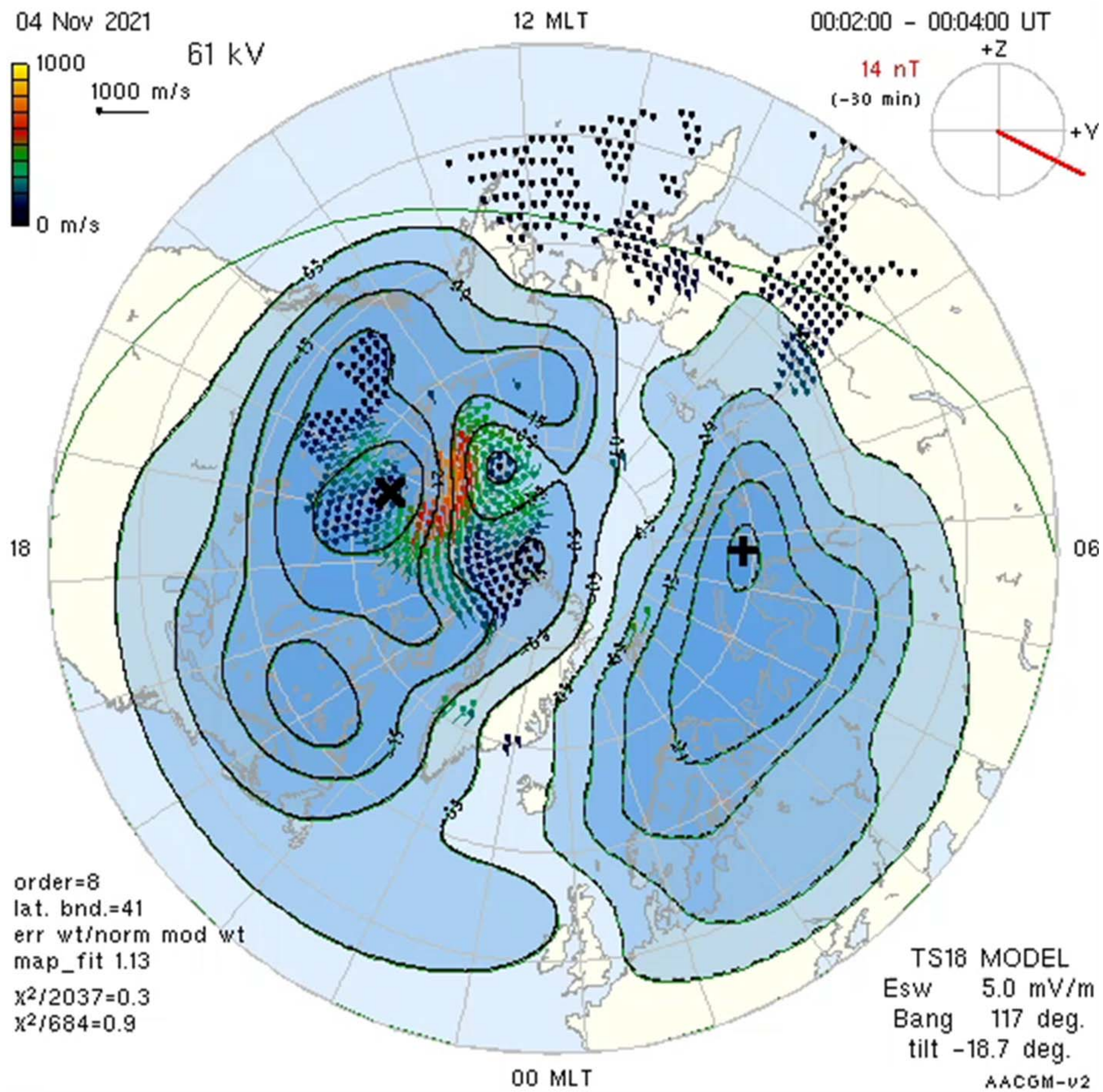
Standard temporal resolution: 1-2 min



Number of operating HF radars: 38 (24 in the northern and 14 in the southern hemi-spheres) as of Feb 01, 2023, operated under the cooperation of about 10 countries

The radars use basically the same hardware architecture, same operation software, same schedule, same data format and same data analysis software, provide important information for the space weather / geospace dynamics studies.

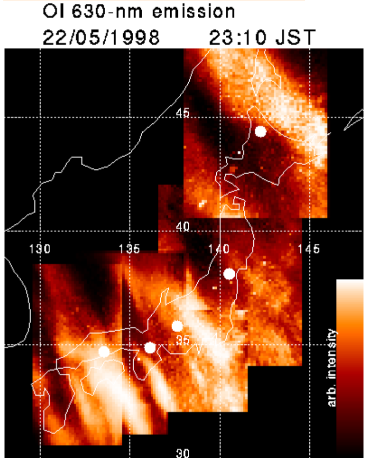
Global convection map movie on 04 Nov 2021



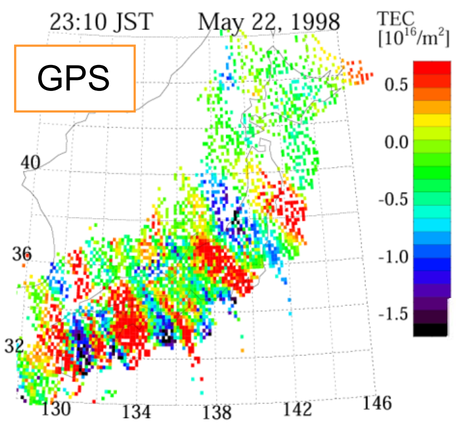
提供:
名古屋大B4
大森君

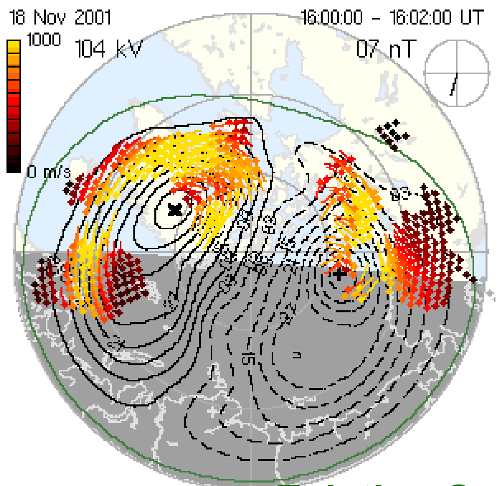
SuperDARN Hokkaido Pair of (HOP) radars (2006.11-)

Airglow imagers

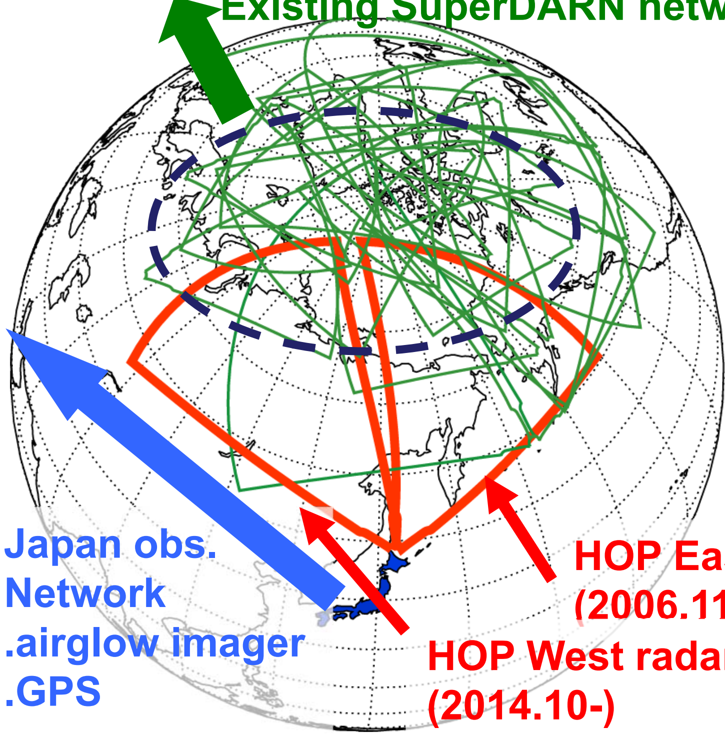


GPS





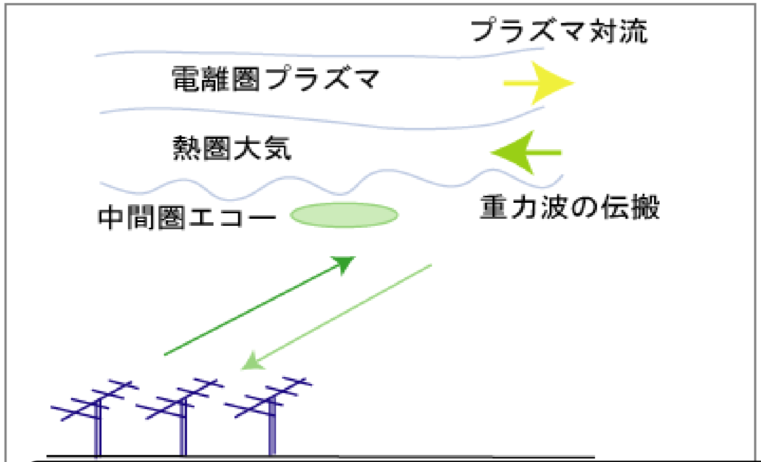
Existing SuperDARN network



Japan obs. Network
.airglow imager
.GPS

HOP East radar (2006.11-)

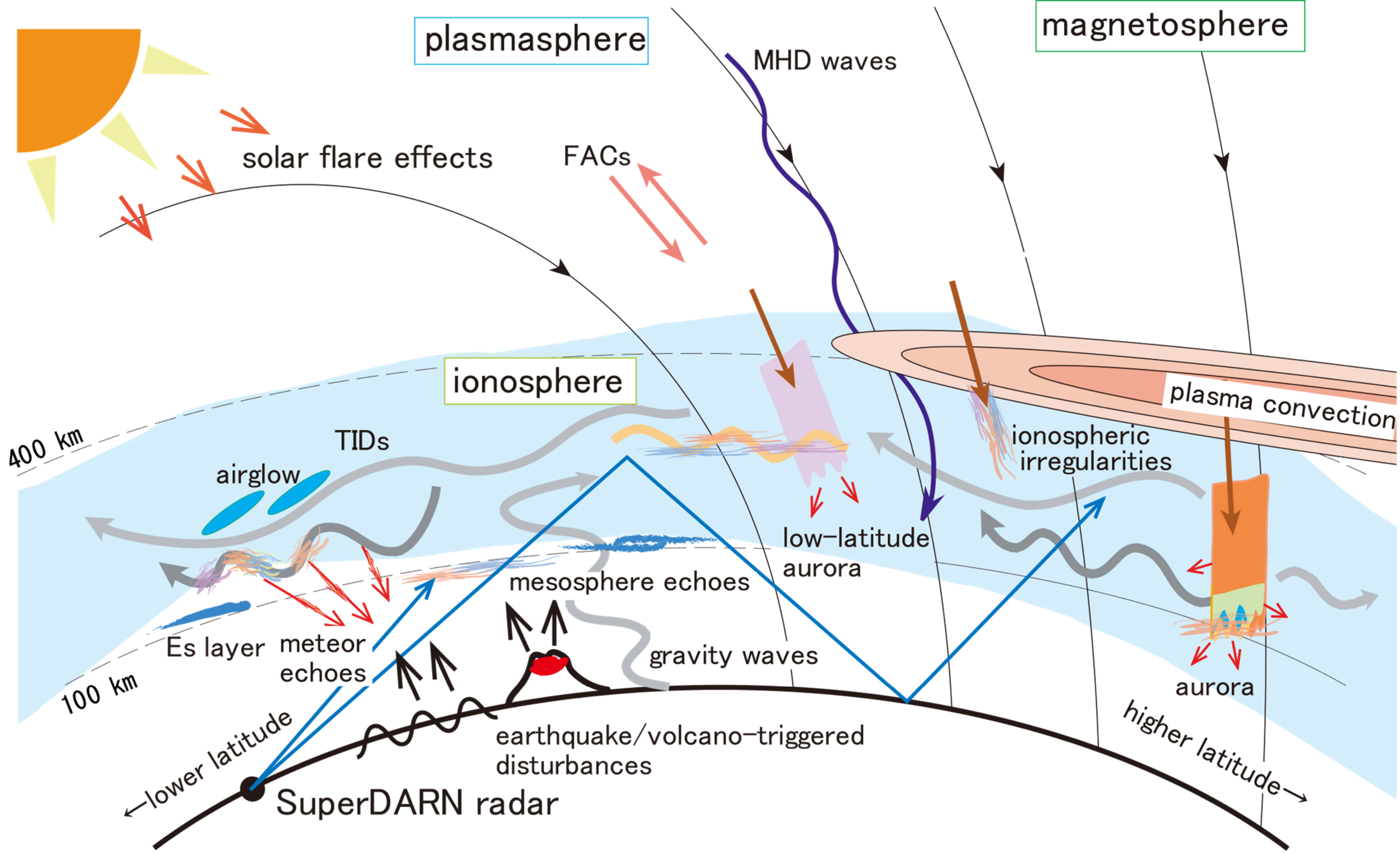
HOP West radar (2014.10-)



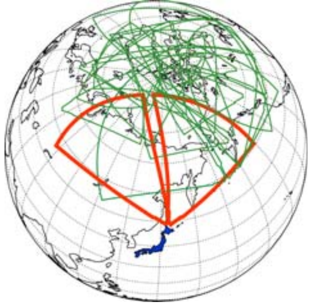
Study of ionosphere, thermosphere and upper mesosphere

Unified understanding of the dynamics of the high- to mid-latitude ionosphere / upper atmosphere

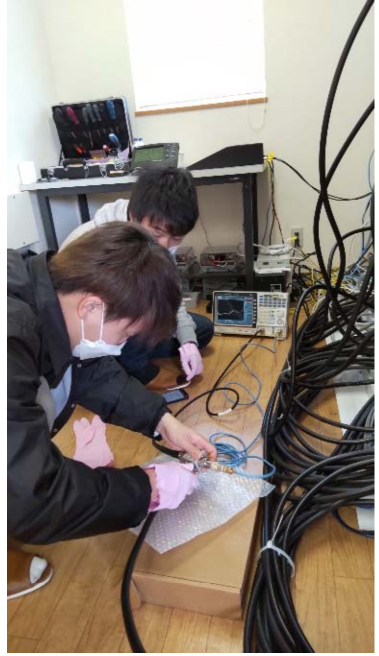
g



Schematic objectives of the SuperDARN radars
Adapted from Nishitani, Ruohoniemi, Lester et al., Mid-latitude SuperDARN review paper (PEPS, 2019, PEPS most cited award 2021, latest citation #: 128, google scholar)

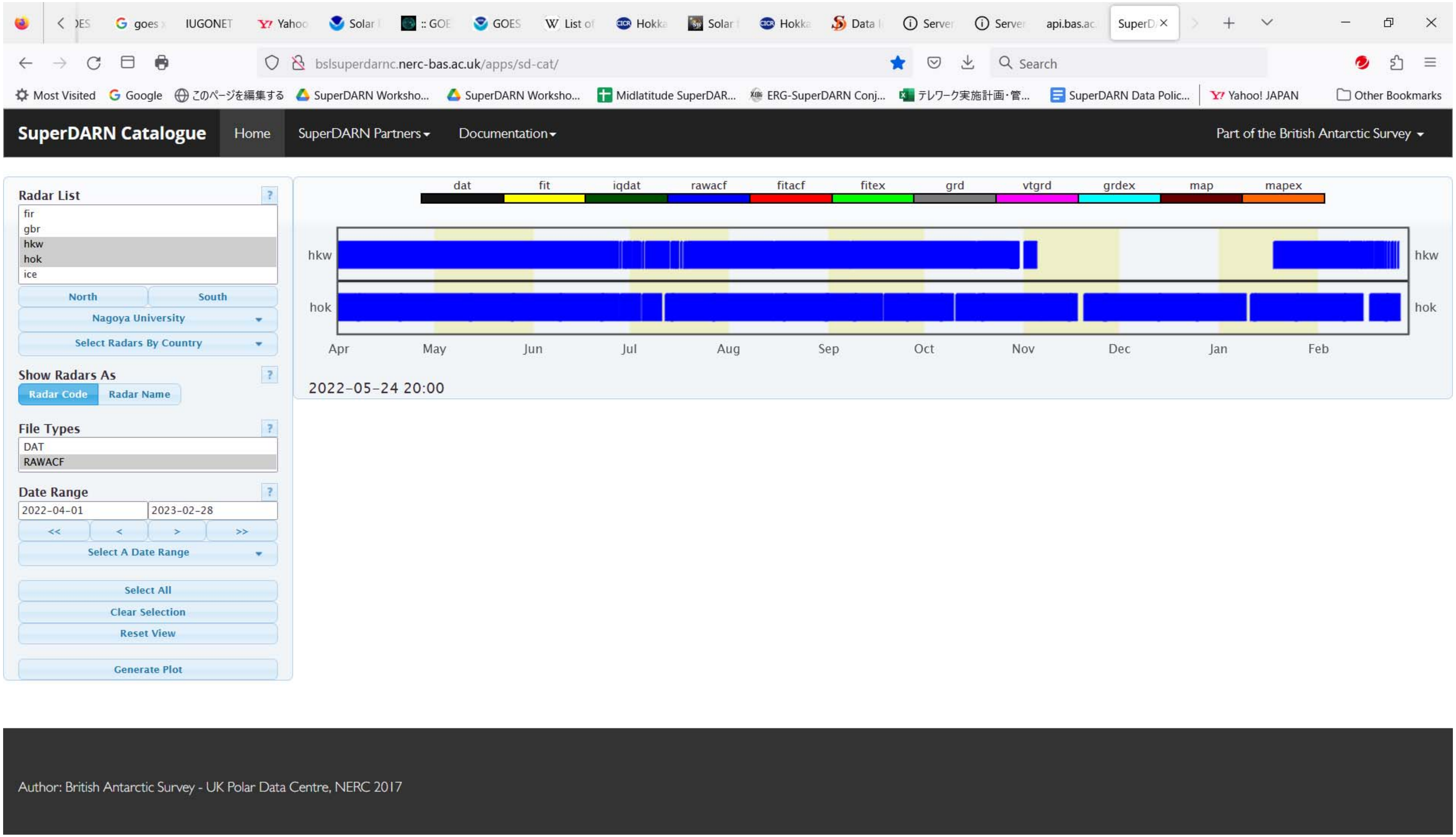


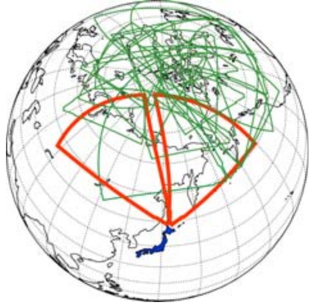
Recent updates of the SuperDARN HOP radars



- Radar system check (2022.10.16-18)
- Repair of Antennas (2021.11.1) (HOP East F13)
- Synth Unit problem at HKW (2022.10.28-11.1) – recovered by switching off/on the Synth Unit and the timing computer.
- BASBOX problem at HKW (2022.11.5-2023.1.18) – the faulty BASBOX was sent to Univ. of Leicester for repair and was sent back to Rikubetsu in January. The problem was due to the faulty power supply unit, which was replaced with a new one. Spare power supply unit was also purchased from Univ of Leicester.
- Timing computer problem at HOK (2023.2.15-17) –It stopped working because of a faulty PC cooling fan. We visited the site and fixed the problem by replacing with the spare PC's cooling fan.
- Mid-latitude SuperDARN review paper (Nishitani et al., PEPS 2019) – now the number of citation is 128 (ref. google scholar) -> PEPS Most Cited Paper Award 2021
- Nikon camera D610 for monitoring auroras/NLCs and the Window10 PC got faulty and were replaced in October.
- The plan of implementing a full imaging capability at the HOK radar started from 2022 FY (we get Kakenhi funding from 2022 FY).
- The network to the radar site often becomes faulty. We are planning a repair work or complete replacement of the whole system this year.

HOP radars archive (2022.04-2023.02)





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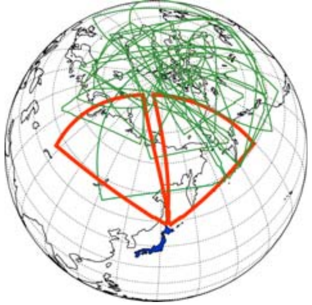

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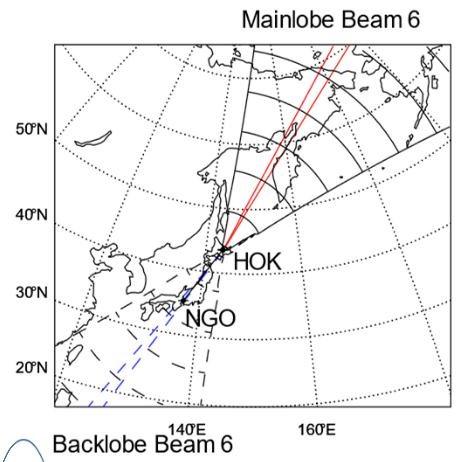
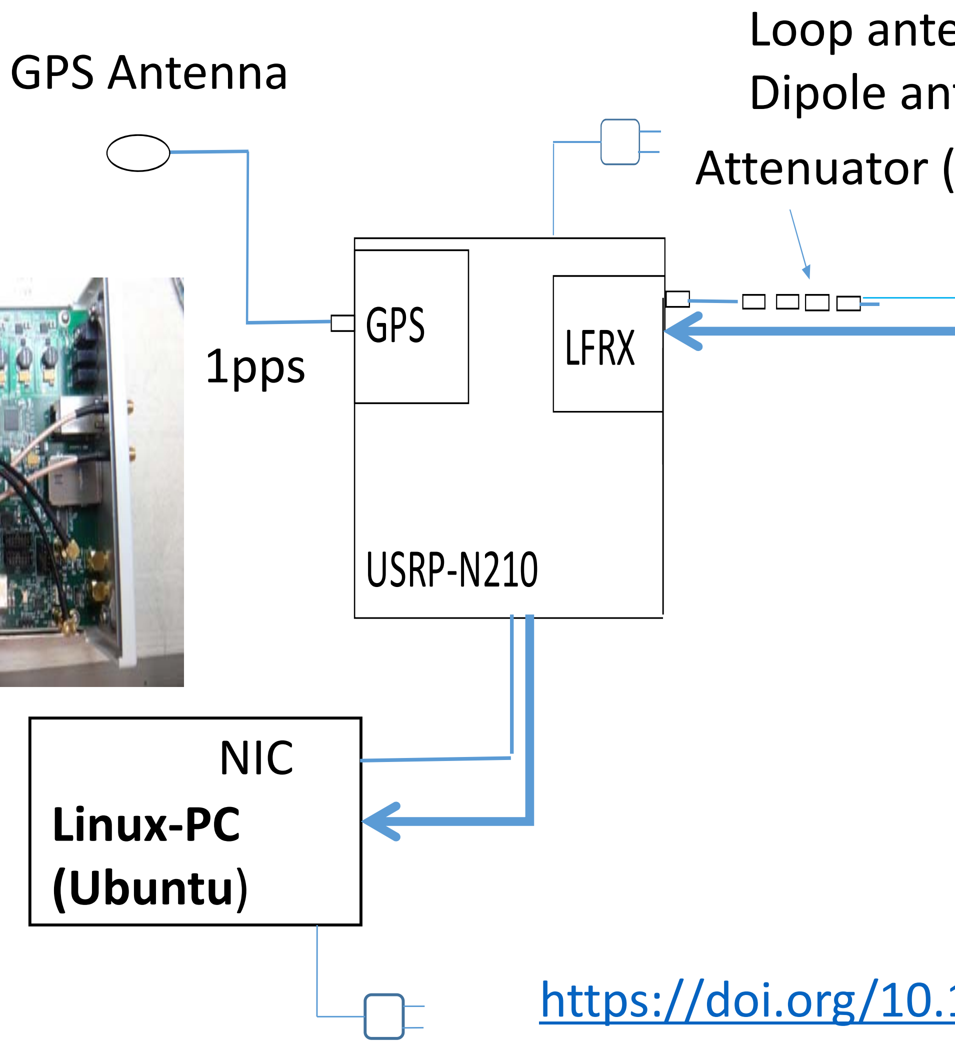
Fig. 2a

SuperDARN remote receiver in Nagoya (2014–)

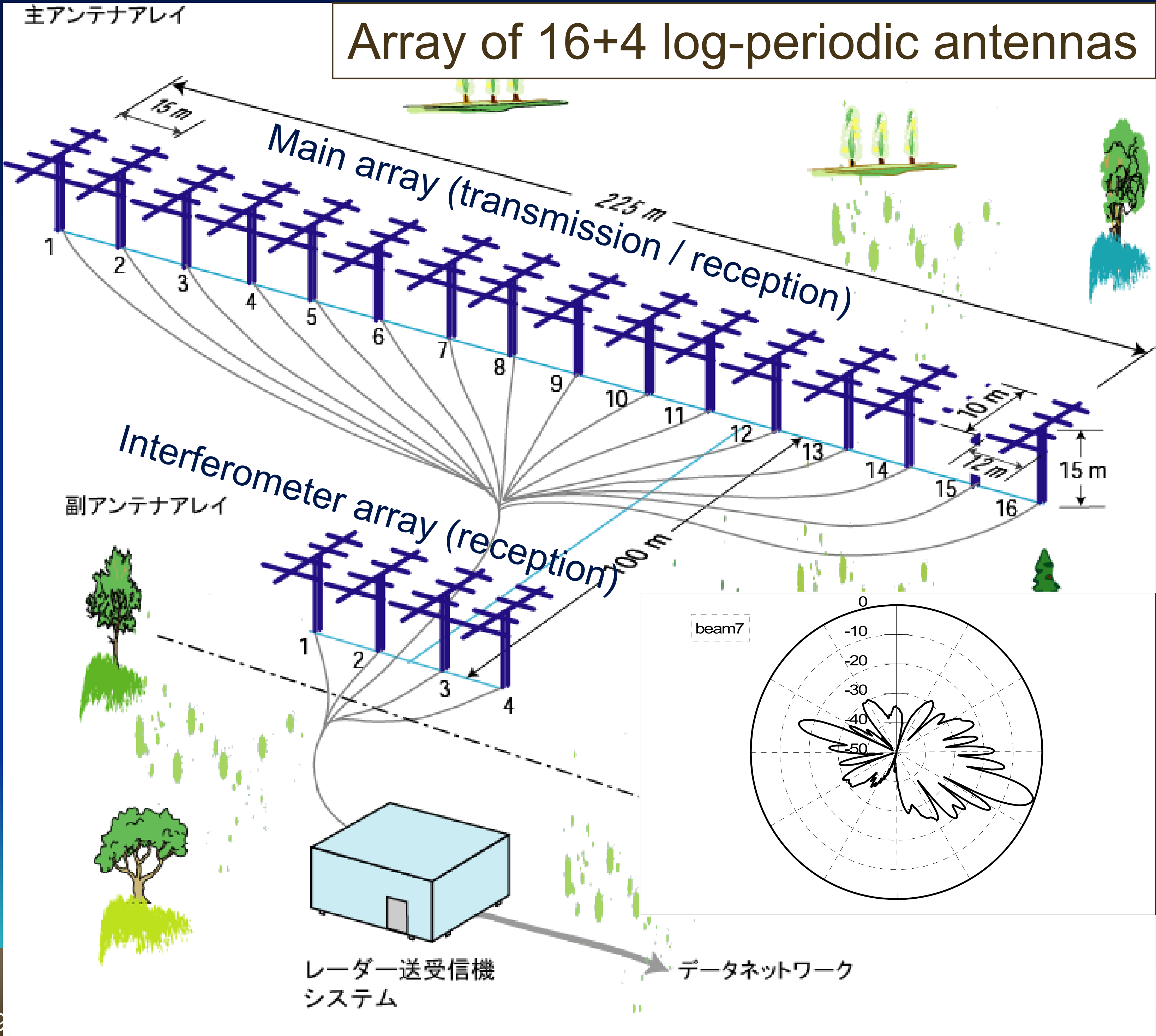




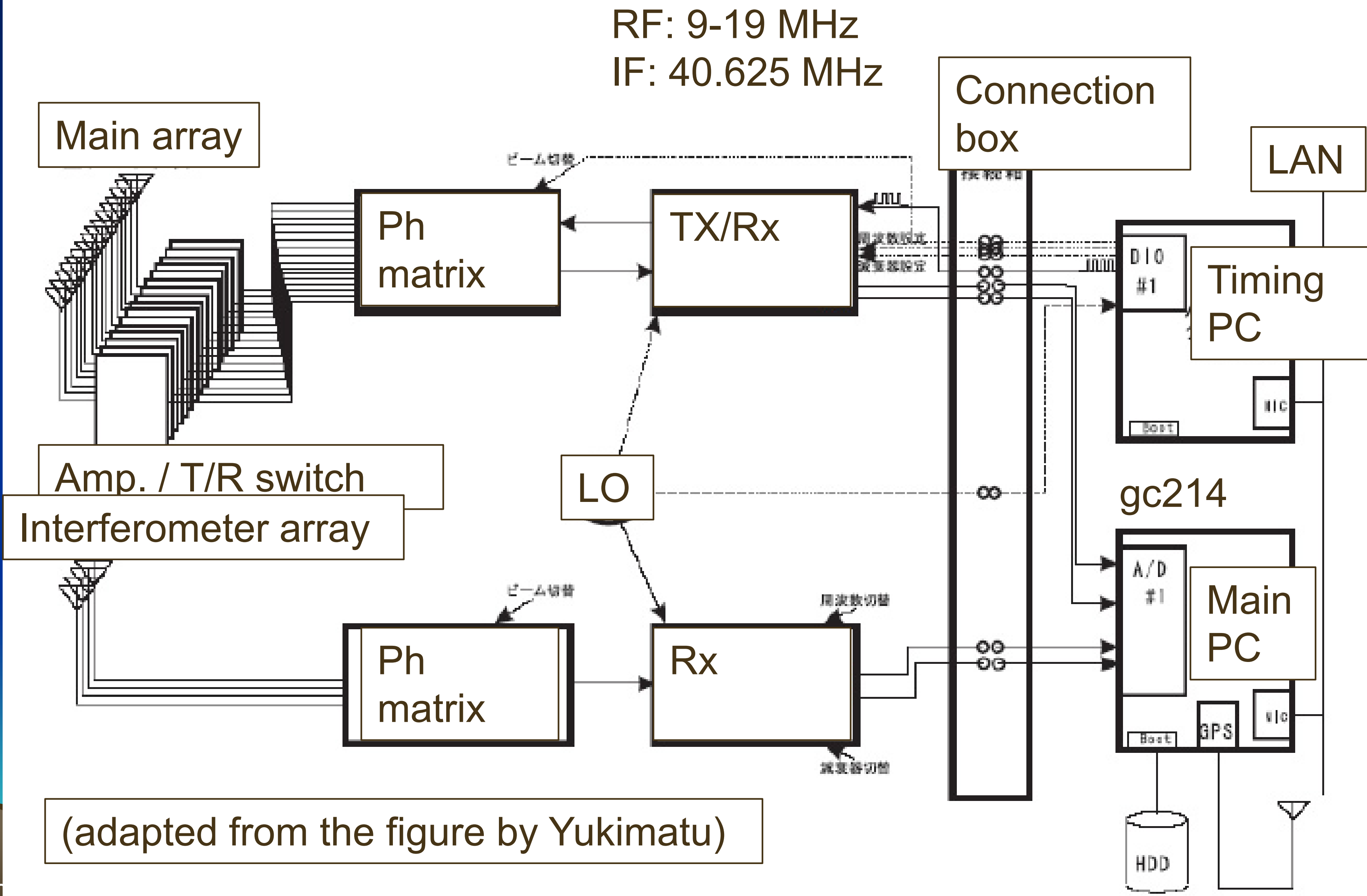
https://doi.org/10.1016/j.polar.2021.100669

Nishitani et al. (2021), Polar Sci. SuperDARN special issue

Array of 16+4 log-periodic antennas

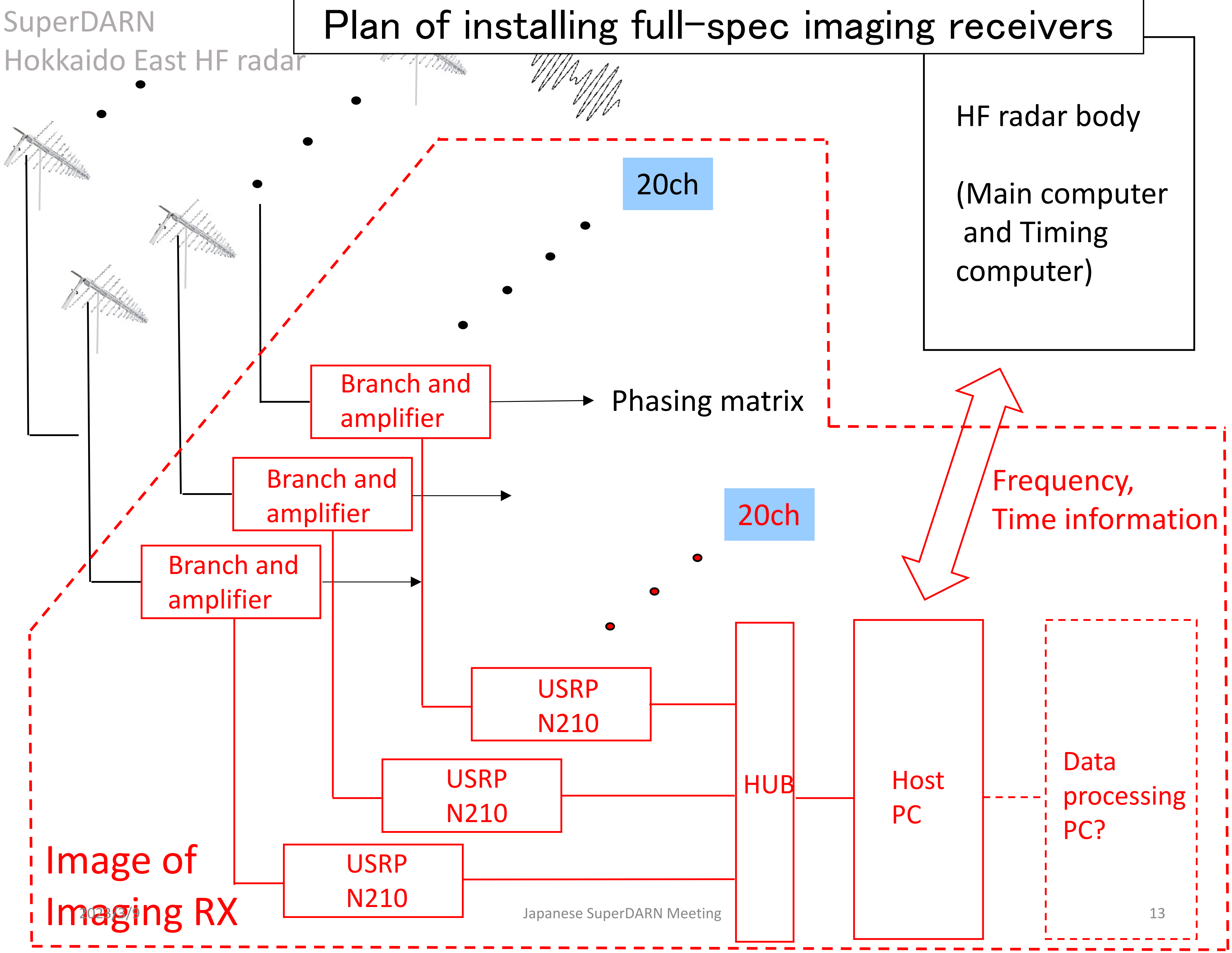


Current Hokkaido East / West radar Tx/Rx system

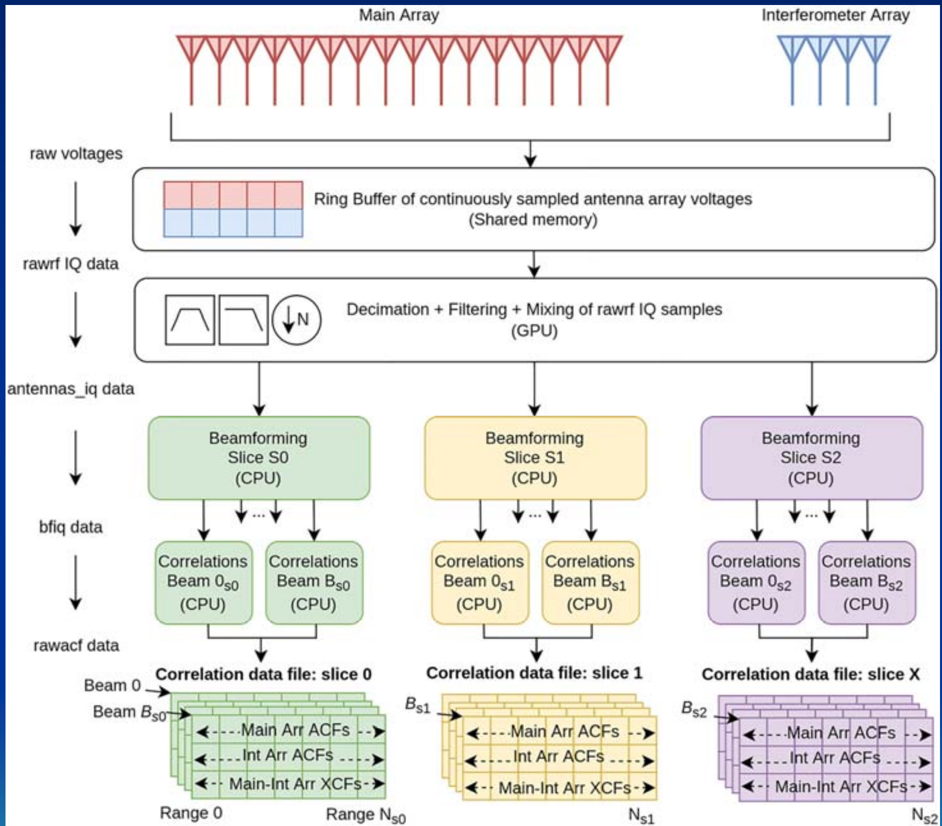


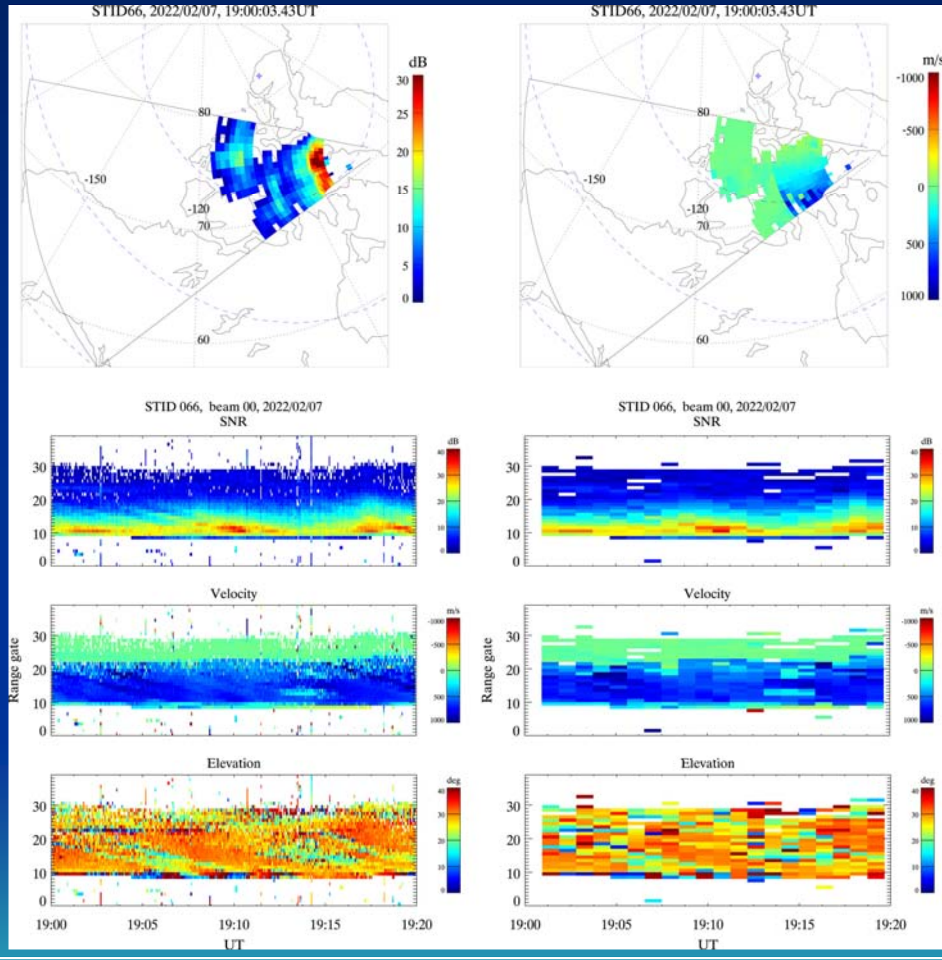
(adapted from the figure by Yukimatu)

Plan of installing full-spec imaging receivers



Borealis system at University of Saskatchewan: addition of imaging capability to the SuperDARN (McWilliams et al., Radio Sci., 2023)





The imaging capability increases the temporal resolution of the data by several times, as well as the spatial resolution

ISEE international technical exchange meetings (2/21, 2/24)

Summary

- SuperDARN Hokkaido East / West radars have been operating, although there have been several problems (both radars were down for a few days to a few months).
- We are funded for the development of the imaging receiver system (2022-2027FY).
- The network to the radar site (Wifi relay system) often becomes unstable (sometimes as slow as a few 10kB/s). A fundamental solution is desirable.
- Recent topics:
  - **Shinbori et al., Tonga earthquake effect (this meeting)**
  - **Morita, ULF wave characteristics (this meeting)**
  - **Omori, mid-latitude ionospheric convection (this meeting)**
  - **Furuhashi, F-region echo characteristics (this meeting)**
  - **Nishitani, SAPS latitude characteristics (this meeting)**

HOP Publication list in 2022FY

1. Atsuki Shinbori, Yuichi Otsuka, Takuya Sori, Michi Nishioka, Septi Perwitasari, Takuo Tsuda & Nozomu Nishitani, Electromagnetic conjugacy of ionospheric disturbances after the 2022 Hunga Tonga-Hunga Ha'apai volcanic eruption as seen in GNSS-TEC and SuperDARN Hokkaido pair of radars observations. Earth Planets Space 74, 106 (2022). https://doi.org/10.1186/s40623-022-01665-8.
2. Jiaojiao Zhang, Jiyao Xu, Wei Wang, Guojun Wang, J. Michael Ruohoniemi, Atsuki Shinbori, Nozomu Nishitani, Chi Wang, Xiang Deng, Ailan Lan, Jingye Yan, Oscillations of the Ionosphere Caused by the 2022 Tonga Volcanic Eruption Observed With SuperDARN Radars, Geophysical Research Letters, Volume 49, Issue 20, https://doi.org/10.1029/2022GL100555, 2022.
3. W. Hazeyama, N. Nishitani, T. Hori, T. Nakamura, S. Perwitasari, Statistical Study of Seasonal and Solar Activity Dependence of Nighttime MSTIDs Occurrence Using the SuperDARN Hokkaido Pair of Radars, Journal of Geophysical Research: Space Physics, Volume 127, Issue 4, https://doi.org/10.1029/2021JA029965, 2022.
4. P. V. Ponomarenko, E. C. Bland, K. A. McWilliams, N. Nishitani, On the Noise Estimation in Super Dual Auroral Radar Network Data, Radio Science, Volume 57, Issue 6, https://doi.org/10.1029/2022RS007449, 2022.
5. W. Wang, J. J. Zhang, C. Wang, N. Nishitani, J. Y. Yan, A. L. Lan, X. Deng, H. B. Qiu, Statistical Characteristics of Mid-Latitude Ionospheric Irregularities at Geomagnetic Quiet Time: Observations From the Jiamusi and Hokkaido East SuperDARN HF Radars, Journal of Geophysical Research: Space Physics Volume 127, Issue 1, https://doi.org/10.1029/2021JA029502, 2022.
6. A. A. Sinevich, A. A. Chernyshov, D. V. Chugunin, A. V. Oinats, L. B. N. Clausen, W. J. Miloch, N. Nishitani, M. M. Mogilevsky, Small-Scale Irregularities Within Polarization Jet/SAID During Geomagnetic Activity, Geophysical Research Letters, Volume 49, Issue 8, https://doi.org/10.1029/2021GL097107, 2022.
7. Xueling Shi, Dong Lin, Wenbin Wang, Joseph B. H. Baker, James M. Weygand, Michael D. Hartinger, Viacheslav G. Merkin, J. Michael Ruohoniemi, Kevin Pham, Haonan Wu, Vassilis Angelopoulos, Kathryn A. McWilliams, Nozomu Nishitani, Simon G. Shepherd, Geospace Concussion: Global Reversal of Ionospheric Vertical Plasma Drift in Response to a Sudden Commencement, Geophysical Research Letters, Volume 49, Issue 19, https://doi.org/10.1029/2022GL100014, 2022.

Visiting SuperDARN scientists from foreign countries in 2022 FY

- Shibaji Chakraborty (Virginia Tech, USA)
  - 2022.9.13-11.10 Solar flare effect on the ionosphere
- Pavlo Ponomarenko (U of Saskatchewan, Canada)
  - 2023.2.1-4.30 ULF waves characteristics etc.
- Hermann Opgenoorth (U of Umea, Sweden)
  - 2023.2.13-3.10 Sub-auroral dynamics (magnetic / electric fields and effects on GIC /)
- Kevin Krieger (U of Saskatchewan, Canada)
  - 2023.2.16-27 SuperDARN technical exchange
- Remington Rohel (U of Saskatchewan, Canada)
  - 2023.2.16-27 SuperDARN technical exchange
- Matthias Foerster (GFZ, Germany)
  - 2023.2.20-3.3 Storm-time electric field / particle precipitation

Another recent topic – detection of low-latitude aurora during the Feb 2023 storm event

Newspaper reporting on the aurora observation at Rikubetsu Astronomical observatory

（19）　2023年（令和5年）3月1日（水曜日）　（第3種郵便物認可）　十勝毎日新聞

津田館長が銀河の森天文台で撮影した低緯度オーロラ（赤線で囲った部分。2月28日午前2時1分、露出30秒）

陸別に8年ぶり低緯度オーロラ

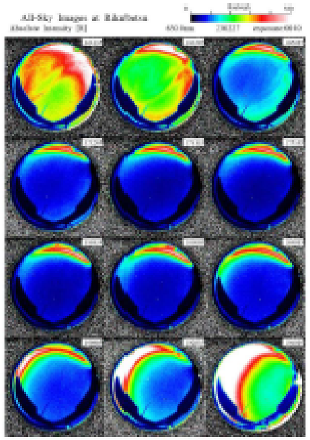
天文台撮影

【陸別】陸別町内で2月28日午前1時半ごろから同4時半ごろにかけて、低緯度オーロラが出現した。りくべつ宇宙地球科学館・銀河の森天文台の津田浩之館長と中島克仁主査が写真に収めたほか、同天文台に設置している名古屋大学の機器でも撮影。解析した同大宇宙地球環境研究所の塩川和夫教授は「波長の関係で街明かりではなく、弱い低緯度オーロラとはっきり分かった。いつも見るような赤色よりも緑色の方が強い」と結論付けた。

同日は太陽の大きめの爆発現象（フレア）が発生し、米国などでは中緯度のオーロラが見られると騒ぎに。日本でも肉眼では見られないが写真に収められる可能性があるとみて、津田館長が準備していた。

同天文台でのオーロラ撮影の成功は2015年12月以来となる。同天文台と私設陸別天体観測所（町上陸別）でカメラを構えていた津田さんは「8年ぶりに捉えられて良かった」と喜ぶ。

今後、太陽の表面に黒点の数が増え活動も活発化することから、「オーロラのシーズンが始まったという感じ。3、4月は気が抜けない」と話している。（北雅貴）



写真上部にオーロラが写る画像。1段目は月の影響で明るくなっているが、時間の経過とともにはっきりとした形になっている。最下段の右端は夜明けの時間帯の写真（名古屋大提供）

野塚岳、不明の男性死亡

市内の68歳

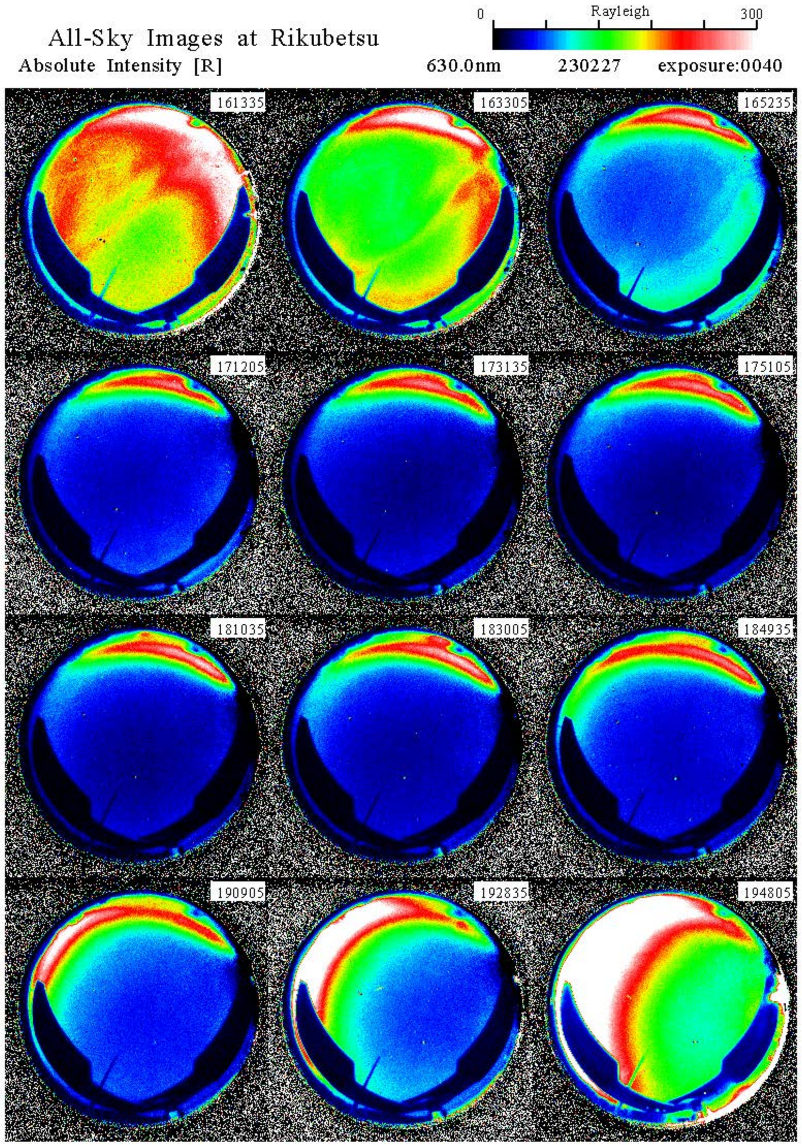
【広尾】野塚岳（1353㍍）で2月27日から行方不明になり、28日に心肺停止状態で発見された男性は、間もなく死亡が確認された。広尾署の調べで、男

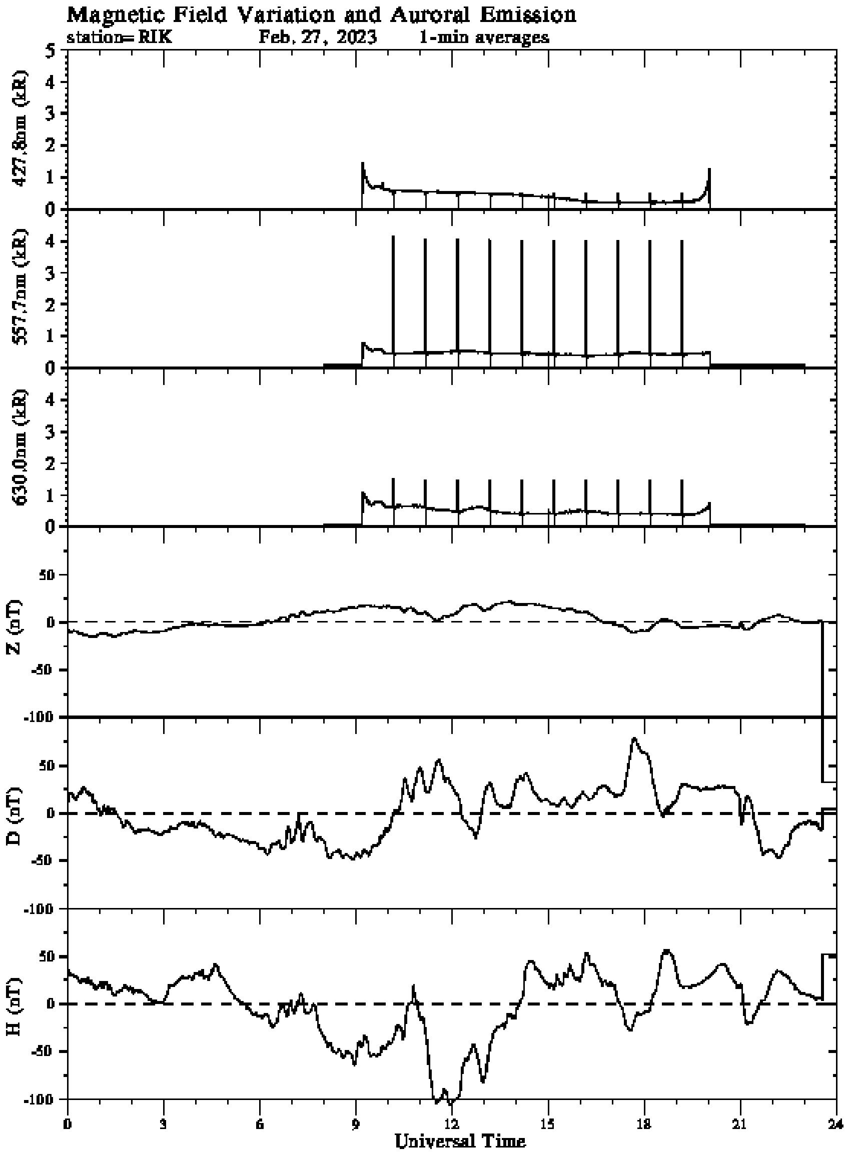
八鍬

帯広出身の

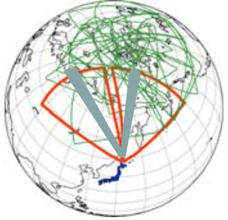
630 nm auroral Imager data (left) and magnetic field / photometer data (right)

https://stdb2.isee.nagoya-u.ac.jp/member/shiokawa/aurora_230227.html





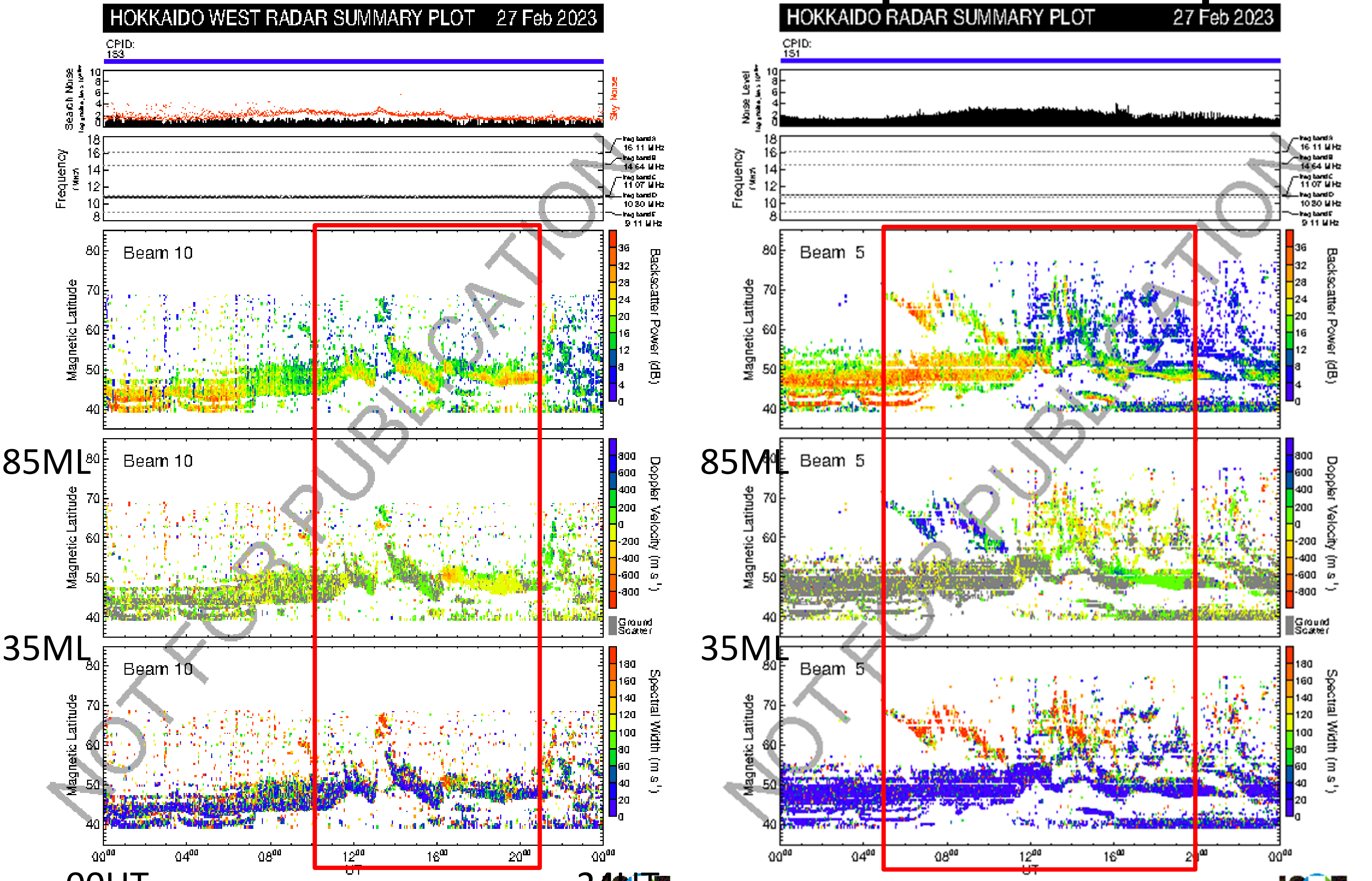
Northern sky images taken by Nikon N610 camera@HOK radar site



Feb 27, 2023

LT=UT+9 hrs

Hokkaido West / East quicklook plots



SuperDARN Quicklook plots at: http://cicr.isee.nagoya-u.ac.jp/hokkaido/