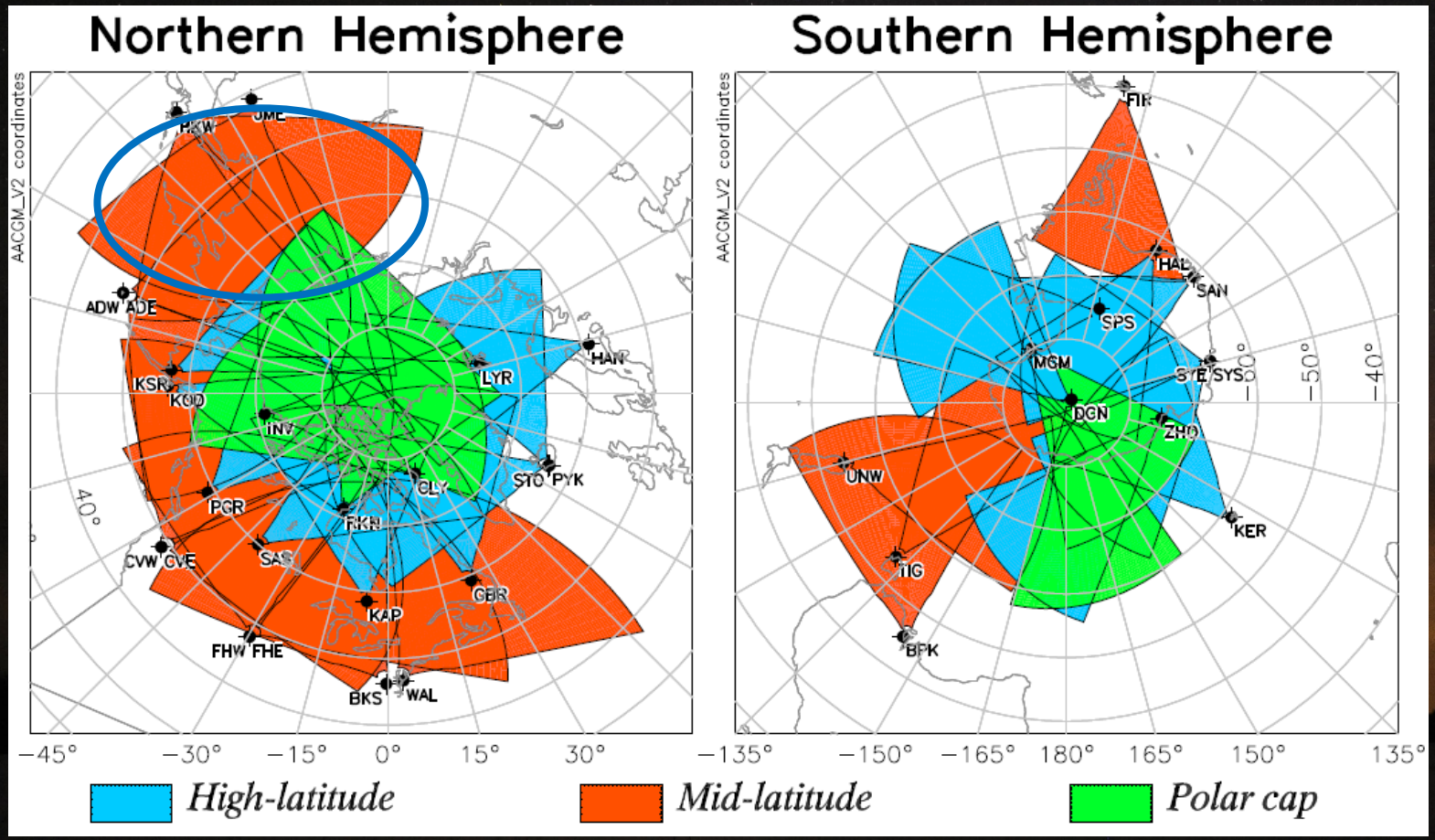
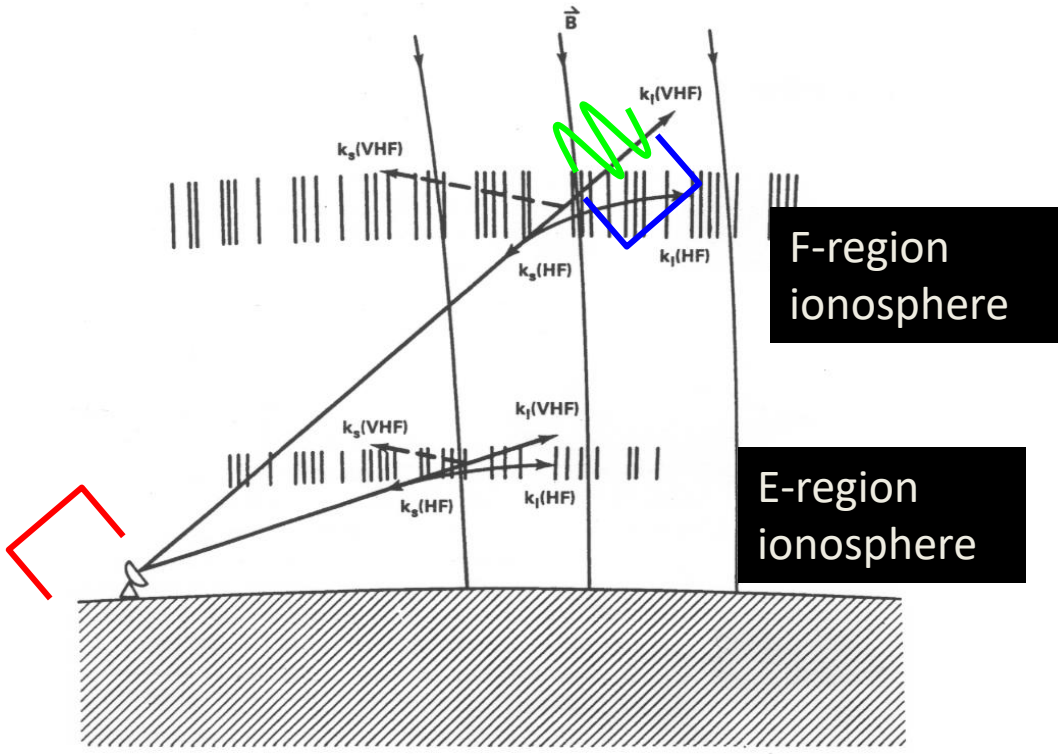
SuperDARN HOPレーダーの現況報告



西谷　望・堀　智昭(名大ISEE)

Low latitude aurora behind the SuperDARN HOP East radar (2015.3.17 1610 UT)

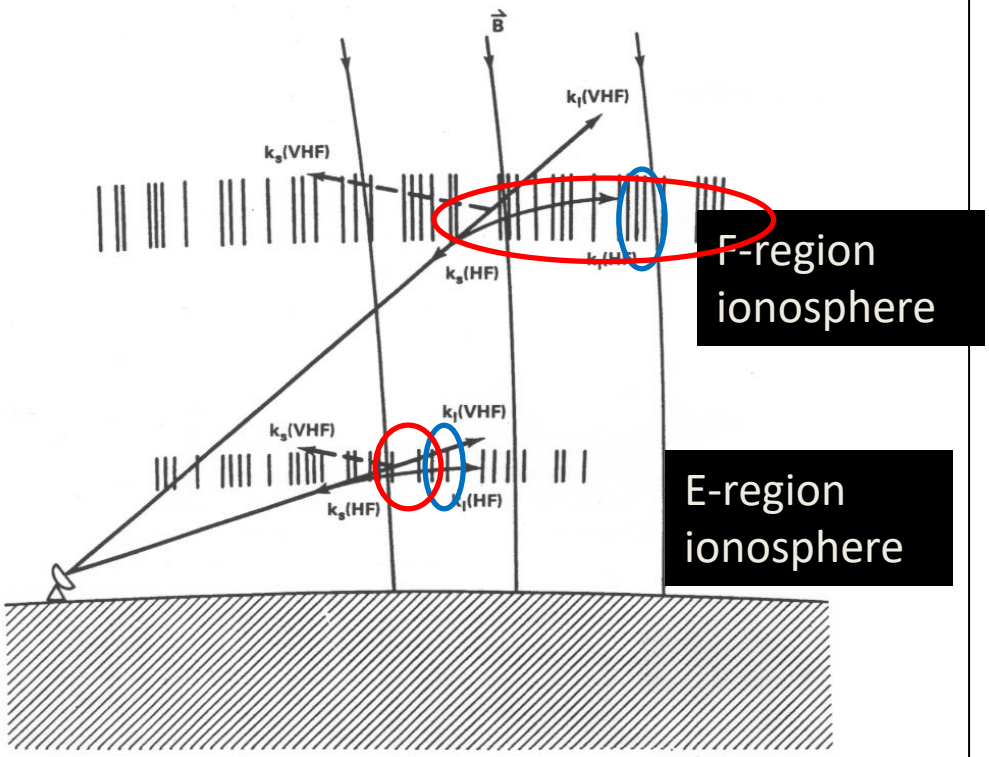
High Frequency (HF) radar: measurement of ionospheric convection velocity using Ionospheric scatter



Adapted from Greenwald et al., SSR, 1995.

- Emit the radar wave toward the ionosphere.
- Waves are backscattered by ionospheric irregularities.
- Using Doppler shifts, ionospheric convection velocities can be measured.

High Frequency (HF) radar: measurement of ionospheric convection velocity using Ionospheric scatter



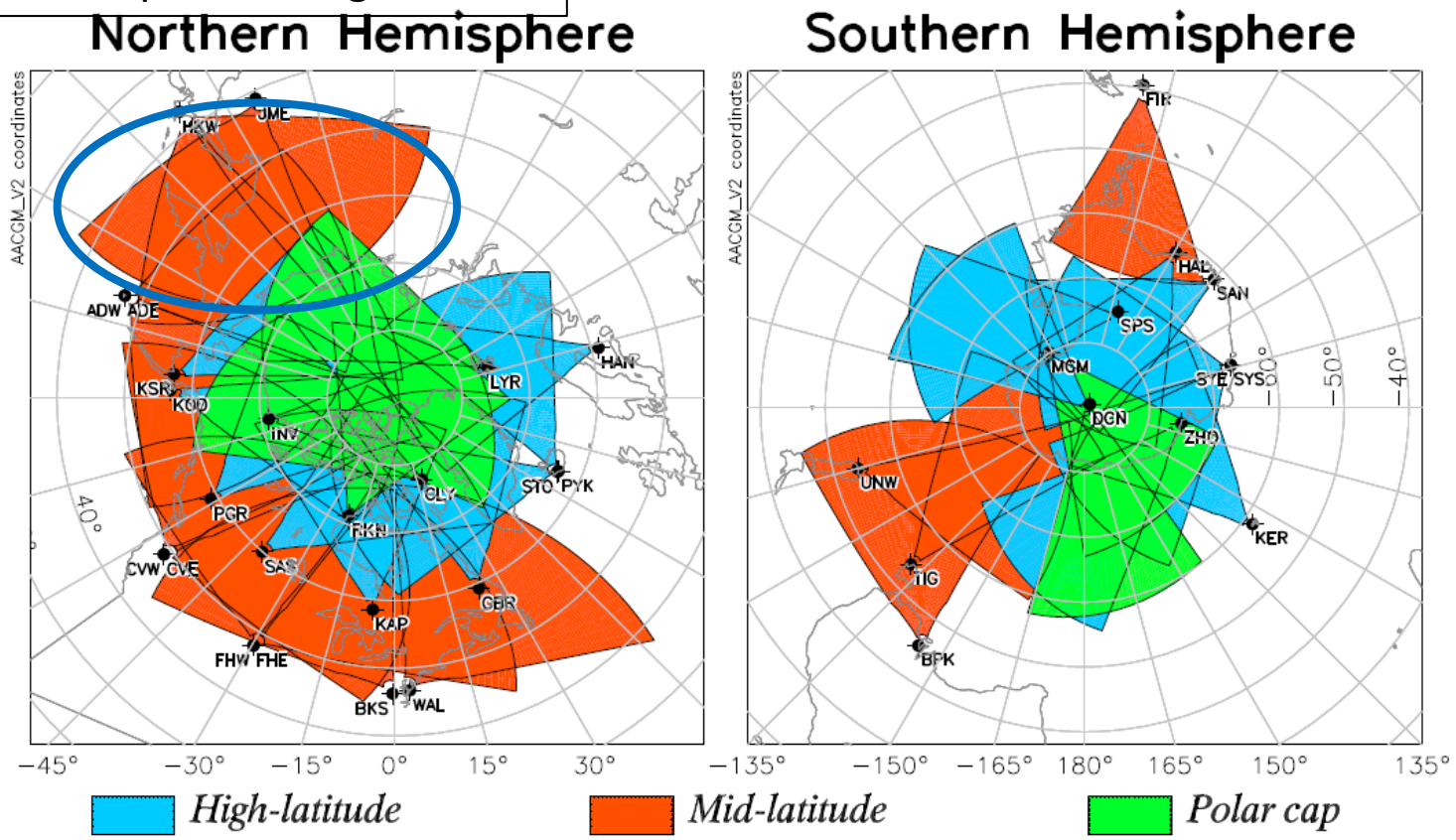
Adapted from Greenwald et al., SSR, 1995.

- Note: at the backscatter region, the radar wave vector should be perpendicular to the ambient geomagnetic field
- Thank to the reflection at ionospheric height, HF radars can cover much wider regions than VHF radars, so that it is possible to monitor ionospheric dynamics over much larger areas – Ray Greenwald magic

Super Dual Auroral Radar Network (SuperDARN)

From vt.superdarn.org website

Standard temporal resolution: 1-2 min



Number of operating HF radars: 38 (24 in the northern and 14 in the southern hemispheres) as of Nov 01, 2020, 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.

Thomas and Shepherd (JGR, 2018): SuperDARN in 2004 (left) and in 2016 (right)

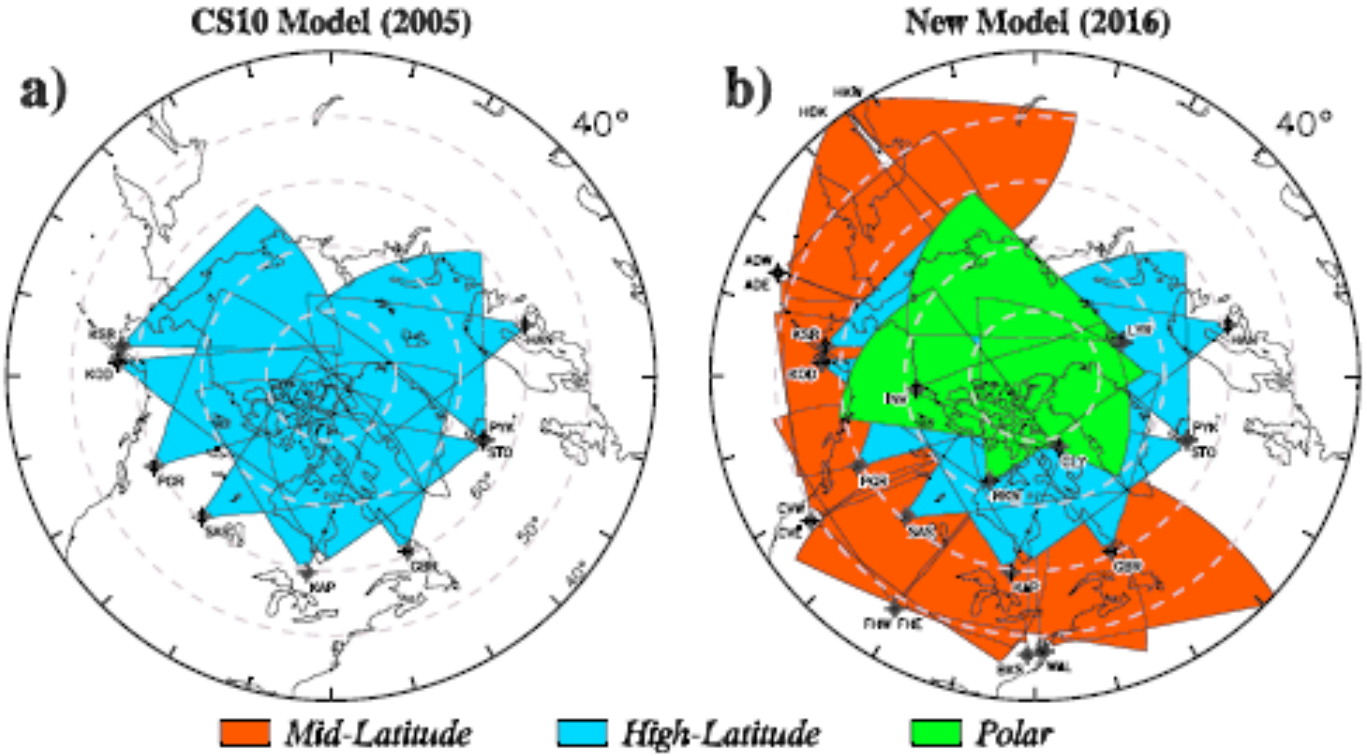


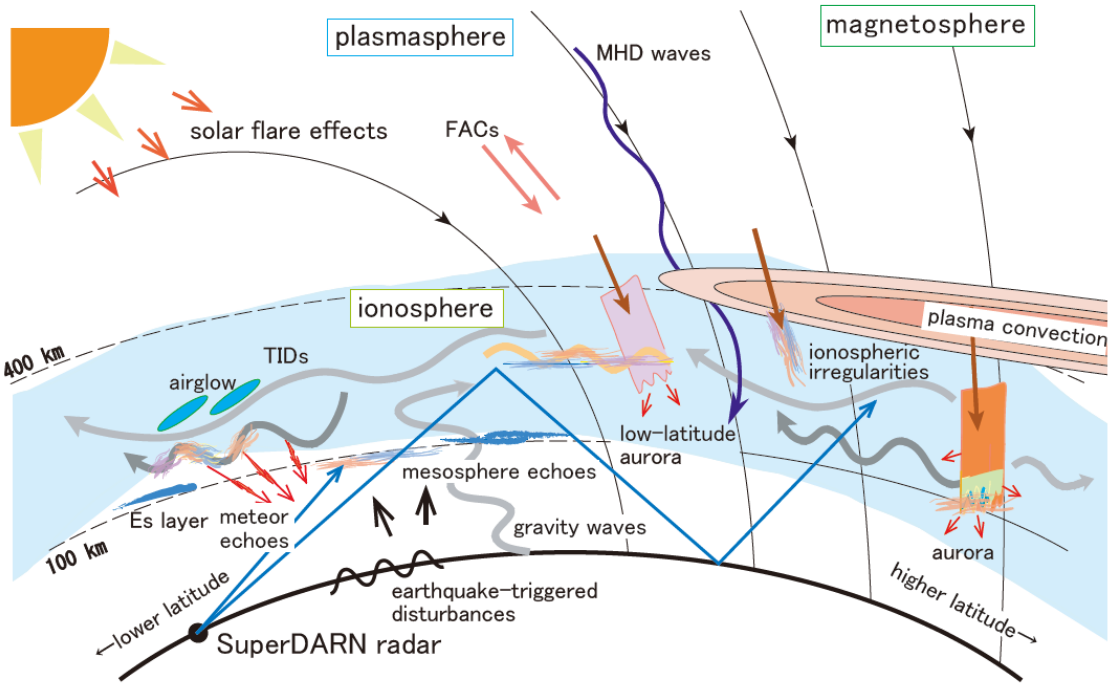
Figure 2. Fields of view of the Northern Hemisphere Super Dual Auroral Radar Network radars contributing to the (a) CS10 model and (b) new statistical model in geomagnetic coordinates. Dates in parentheses indicate the final year considered by each model. Mid-latitude, high-latitude, and polar radar fields of view are shaded orange, blue, and green, respectively. Detailed information regarding each radar site is provided in Table 1.

Review of the accomplishments of mid-latitude SuperDARN

(Nishitani et al., 2019, https://doi.org/10.1186/s40645-019-0270-5)

1. Introduction
2. Convection
3. Ionospheric Irregularities
4. HF Propagation Analysis
5. Ion-Neutral Interactions
6. MHD waves
7. Future directions

Suppl. Historical overview

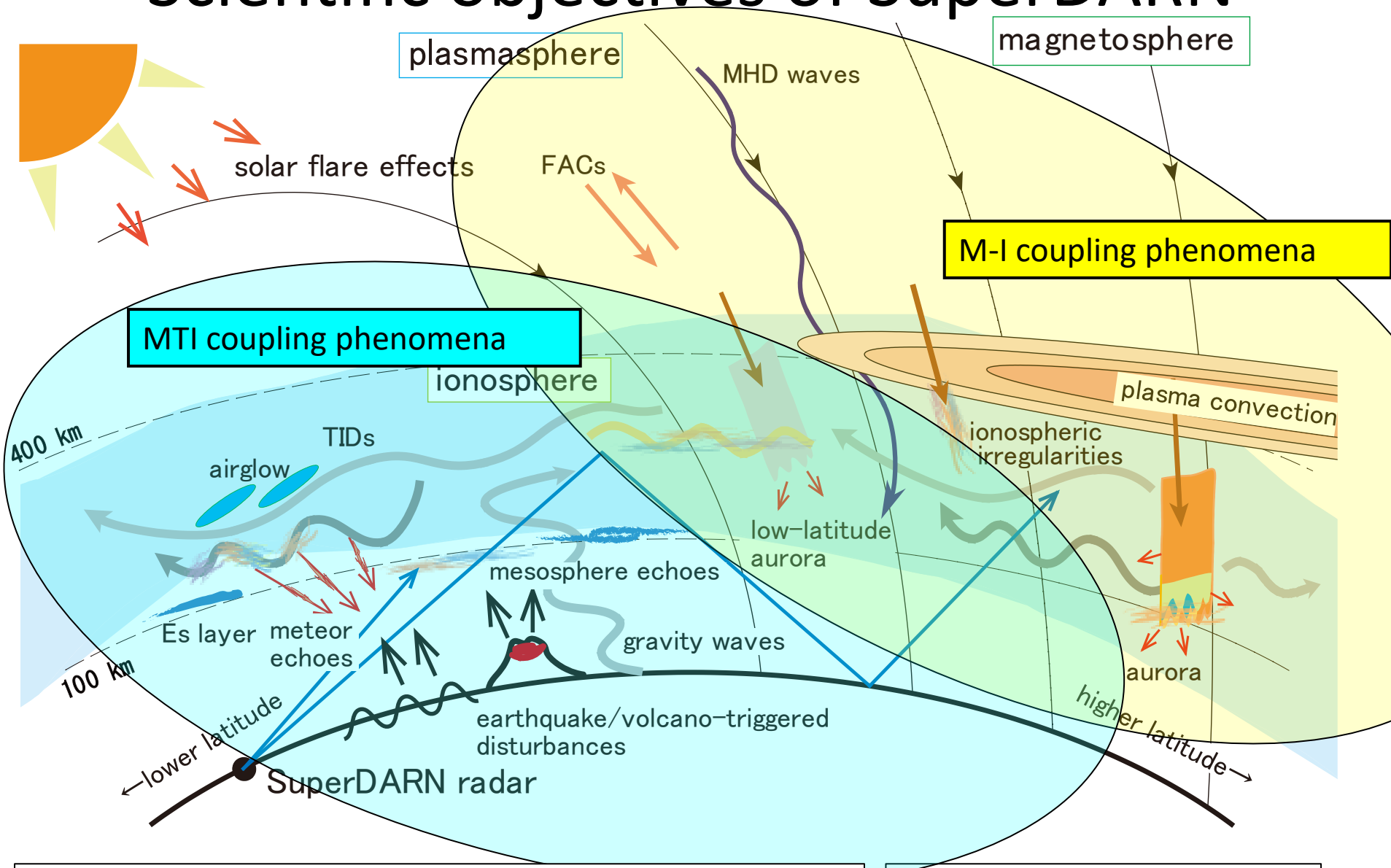


PEPS Most Cited Paper Award 2021 -
9279 downloads (SpringerOpen),
156 citations (google scholar)

2024/02/07

Published: 18 March 2019, correction published: 30 July 2019

Scientific objectives of SuperDARN



It is important to identify the effects both from above and below the ionosphere.

Modified from Nishitani et al. (PEPS, 2019)

Ionospheric scatter (a,b) and ground / sea scatter (c) echoes

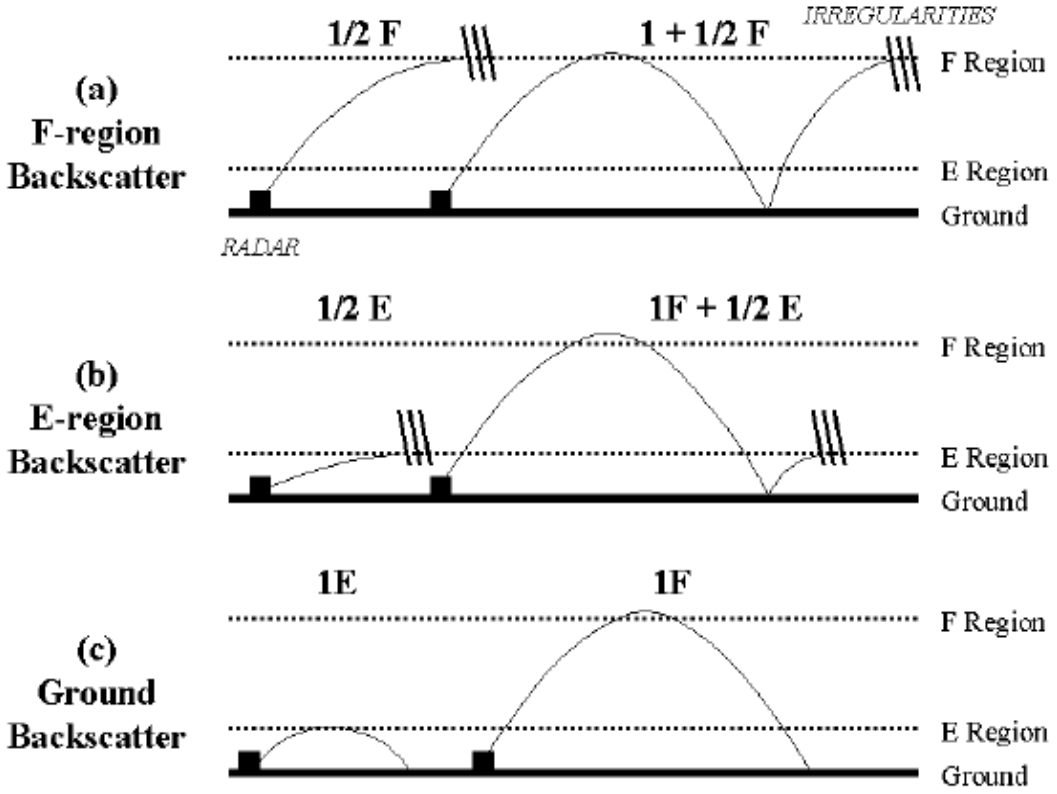
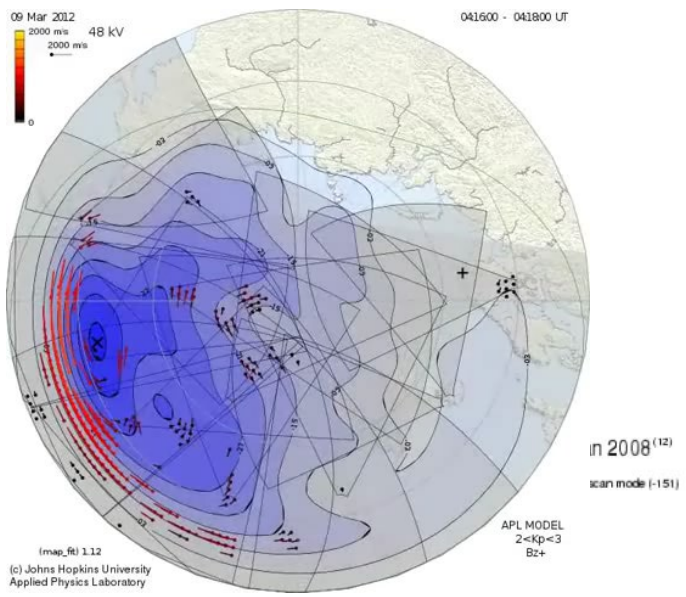


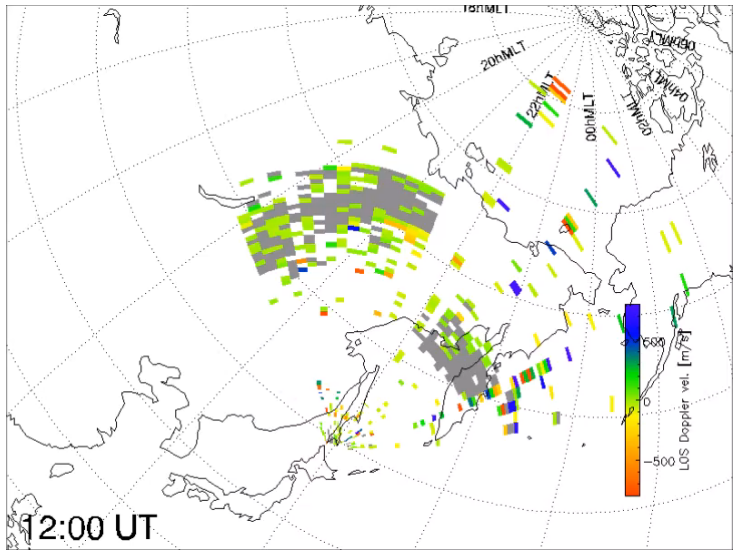
Fig. 1. Schematic diagram representing the typical propagation modes of SuperDARN HF radar signals backscattered from **(a)** F-region irregularities, **(b)** E-region iregularities, and **(c)** the ground.

Chisham and Pinnock, Ann. Geo., 2002

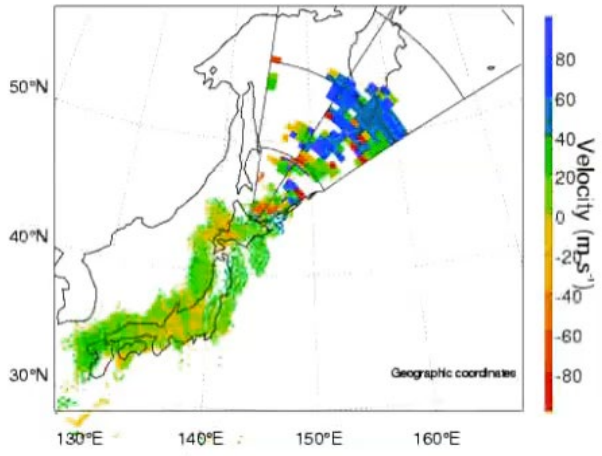
Examples of SuperDARN radars observations



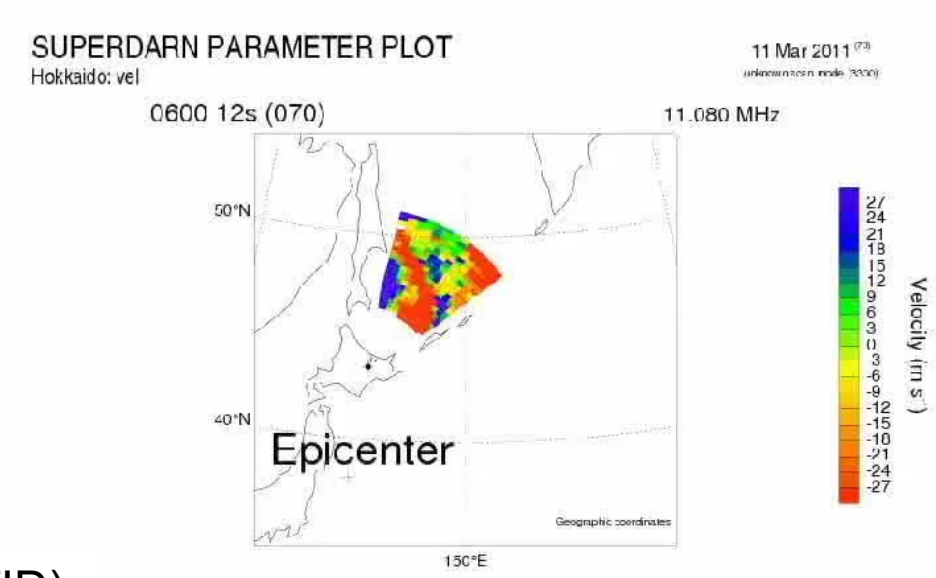
Global convection (SuperDARN)



Sub-Auroral Polarization Streams



Traveling Ionospheric Disturbances (TID) (+GEONET)

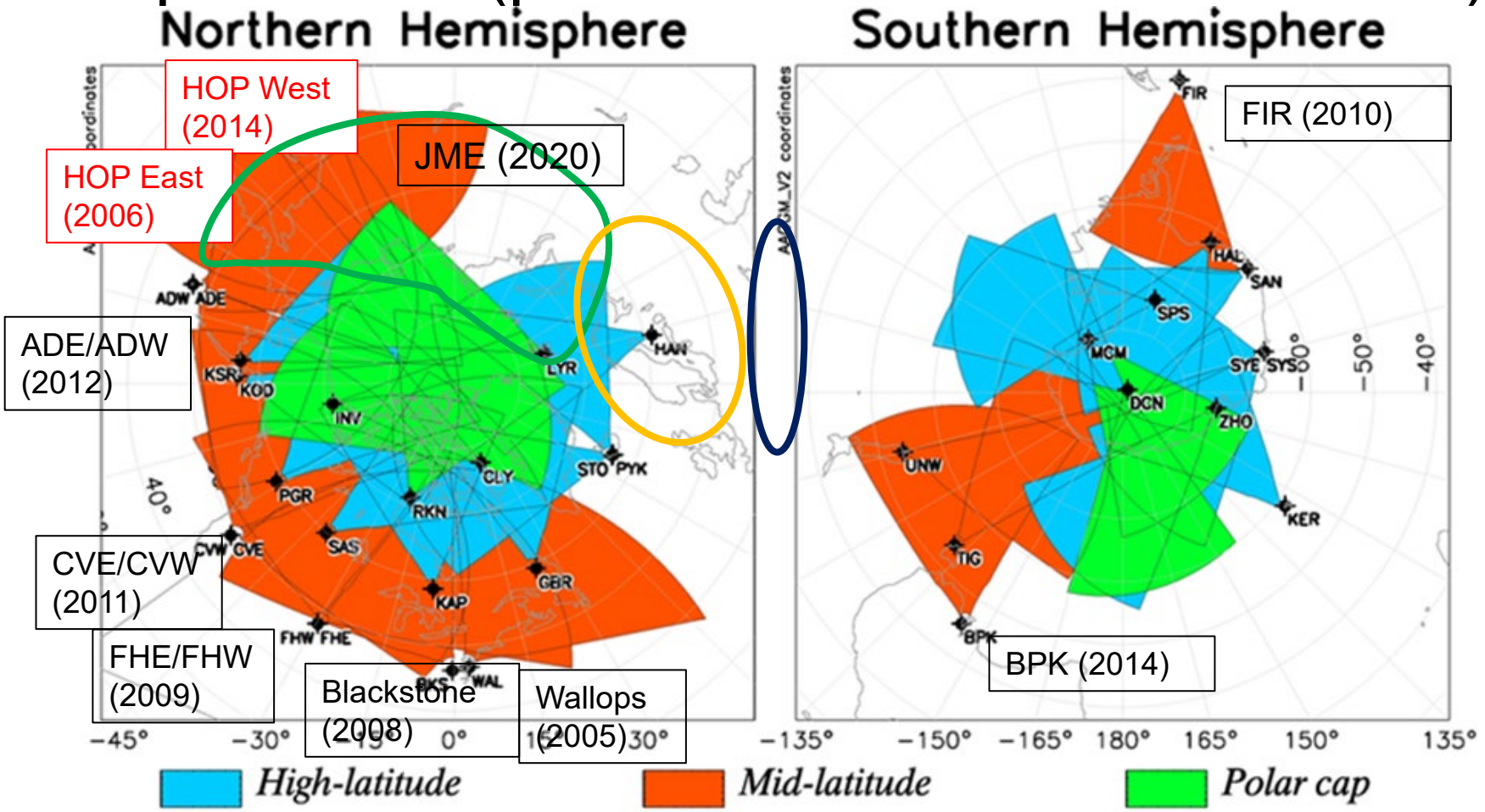


Coseismic Ionospheric Disturbances

SuperDARN history: high-, mid- and low/equatorial latitudes

Region	Auroral lat.	Mid-lat.	Polar lat.	Low / eq. lat.
1980s	First HF radar at Goose Bay (1983) Greenwald et al. (1985) – design			
1990s	Official beginning of SuperDARN (1995) Greenwald et al. (1995) – Overview of SuperDARN			
2000s	Chisham et al. (2007) – review of (mainly high-lat.) SuperDARN	First mid-latitude SuperDARN at Wallops (2005)	First PolarDARN at Rankin Inlet (2007)	
2010s		Nishitani et al. (2019) – review of mid-latitude SuperDARN		
2020s -				First equatorial SuperDARN in early 2020s?

Further Expansion of (mid- and low-latitude) SuperDARN (planned or under construction)

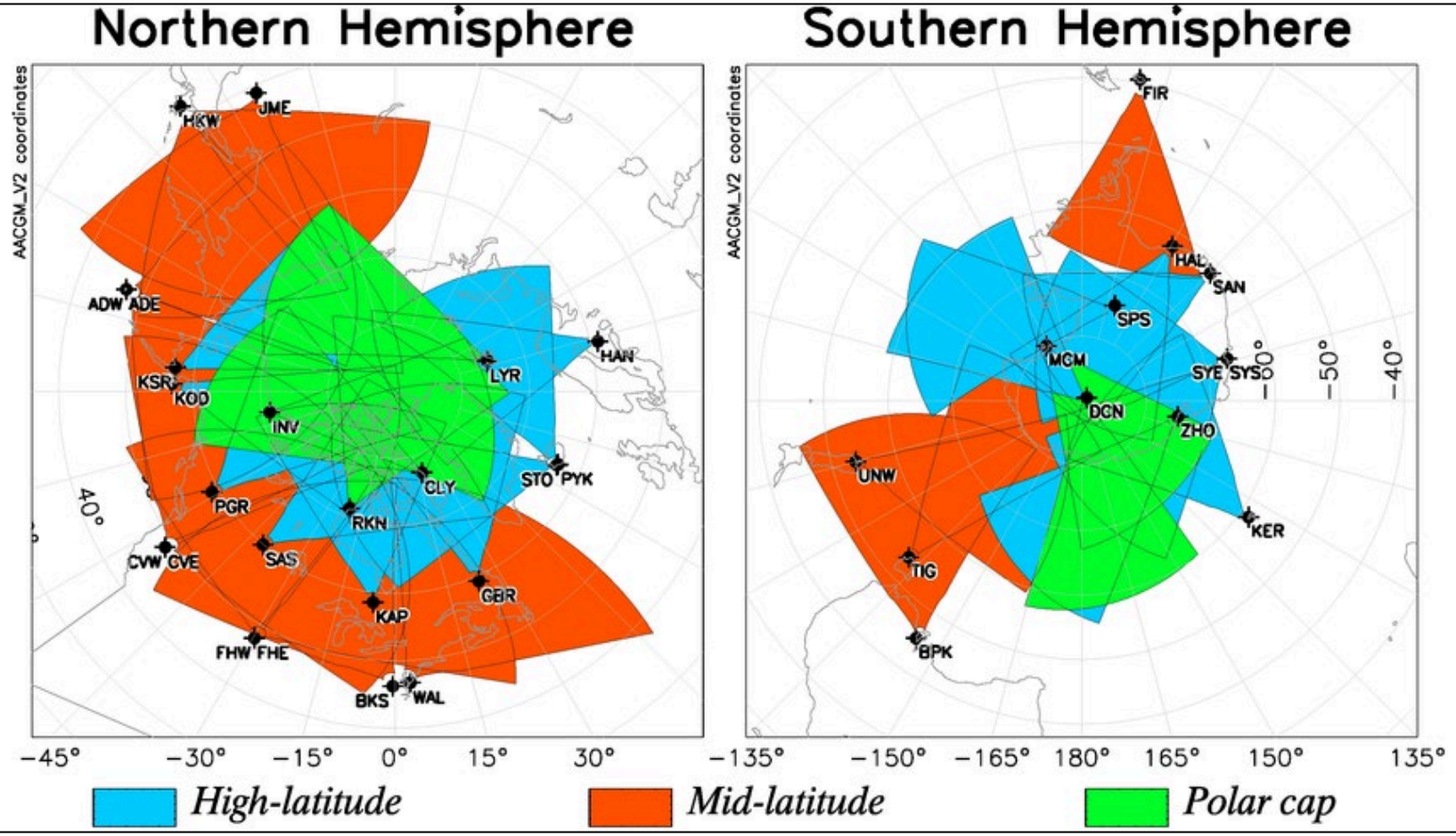


China

Europe

USA-Nigeria

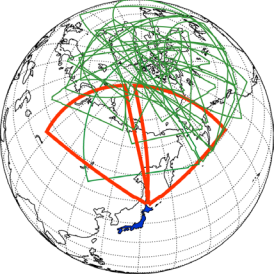
Super Dual Auroral Radar Network (SuperDARN)



Number of operating HF radars: 38 (24 in the northern and 14 in the southern hemispheres) as of Jul 01, 2020, operated under the cooperation of about 10 countries

Standard temporal resolution: 1-2 min (Nyquist freq.: 4-8 mHz)

The radars use basically the same hardware architecture, same operation software, same schedule, same data format and same data analysis software



Recent updates of the SuperDARN HOP radars

- Visit to the radar site (Aug 27-29). The HKW F14 antenna was found to be faulty. It was fixed by Abe Tsuushinsetsubi on November 6. The regular maintenance of the whole antenna system was conducted during the week of Nov 6-10.
- There was no error in the transmitter / receiver filter units during the August visit.
- URSI GASS 2023 optional tour visitors visited the HOK site (Aug 28).
- The plan of implementing a full imaging capability at the HOK radar is in progress (we get Kakenhi funding from 2022 FY).
- The network to the radar site often becomes faulty. We are planning to switch to the mobile network connection (a mobile phone relay antenna nearby the radar site is now under construction).

URSI GASS 2023の陸別観測所・

https://www.isee.nagoya-u.ac.jp/news/2023/20230908.html

Most Visited | Google | このページを編集する | SuperDARN Worksho... | SuperDARN Worksho... | Midlatitude SuperDAR... | ERG-SuperDARN Conj... | テレワーク実施計画・管... | SuperDARN Data Polic... | Yahoo! JAPAN | Other Bookmarks

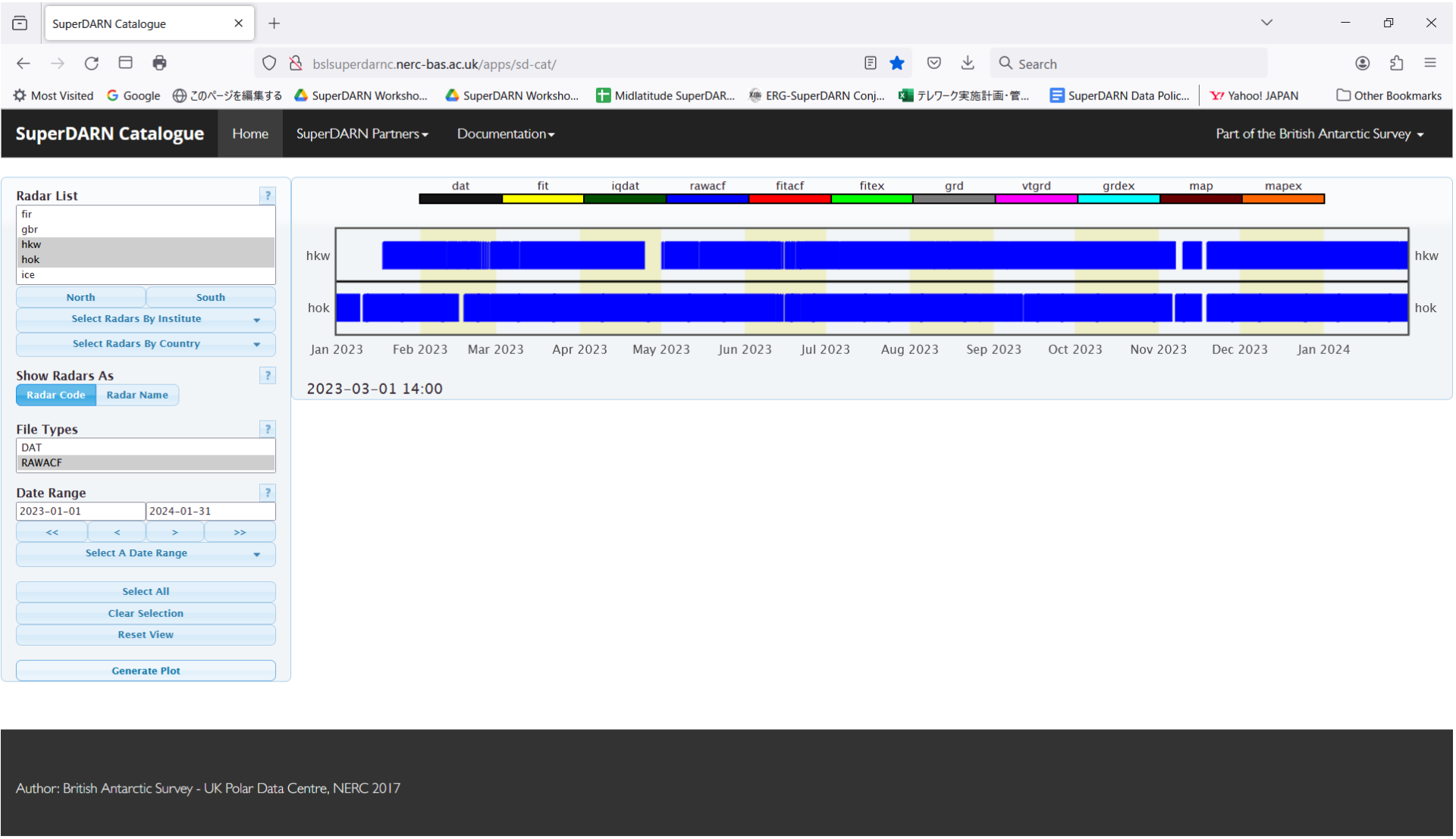
URSI GASS 2023の陸別観測所・レーダーサイトへの見学ツアーが実施される

2023-09-08

札幌コンベンションセンターにて8月19-26日に開催された第35回国際電波科学連合総会（URSI GASS 2023）に引き続き、北海道足寄郡陸別町の名古屋大学宇宙地球環境研究所陸別観測所・同観測所附属SuperDARN短波ドップラーレーダーサイトにおける見学ツアーが8月28日に開催されました。SuperDARNレーダーは世界中に南北合わせて35基以上あり、陸別町には2基のレーダーが設置されています。ツアーには引率者を含めて計39名の参加者があり、午前中に陸別観測所および併設のりくべつ宇宙地球科学館を見学し、町中心部で昼食を取ったのち、そこから約20 kmの距離にあるSuperDARNレーダーサイトを見学しました。ツアー参加者はレーダー装置及びアンテナを興味深く見学し、活発に質問を行っていました。

ページトップ

HOP radars archive (2023.02-2023.01)



Implementation of imaging capability on some of the SuperDARN radars

- Several SuperDARN groups, including Nagoya Univ. (HOP East), are working on the plan of implementing a receiver on each antenna input and making post beam forming, so that temporal and spatial resolutions are improved by several times.
- There is still no standard way to achieve this.
- After the completion of such implementation, a new issue arises – how to handle / distribute a huge amount of data?

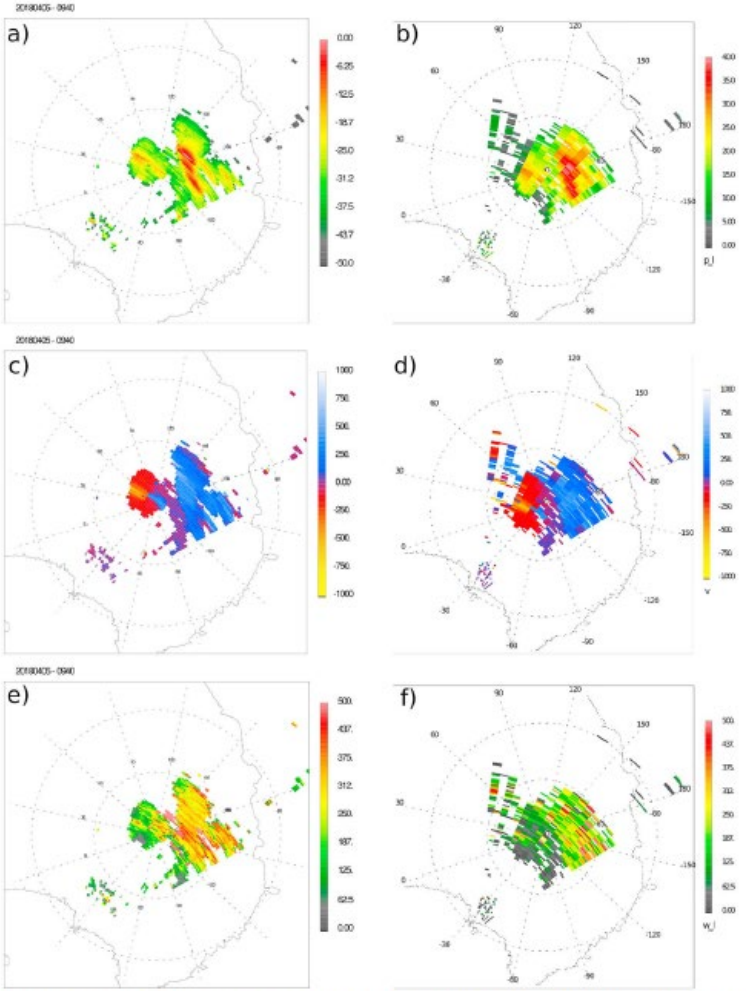
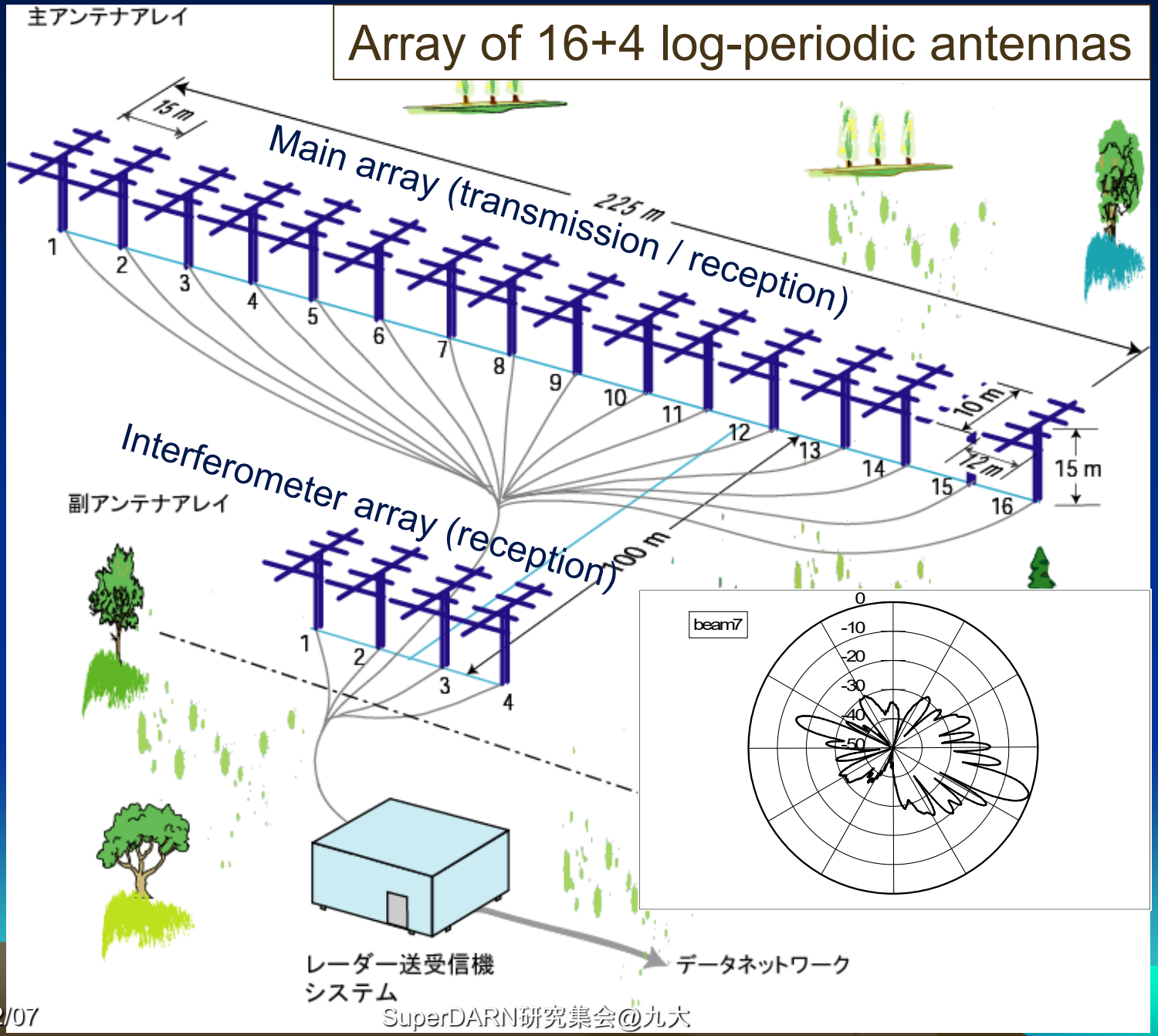


Figure 9. Left column shows imaging analysis, and right column shows standard Super Dual Auroral Radar Network processing of the same observations from the McMurdo radar at 0940 UT on 5 April 2018. The top row (panels a and b) shows signal-to-noise ratio, the middle row (panels c and d) shows velocity in meters per second, and the third row shows spectral width in meters per second.

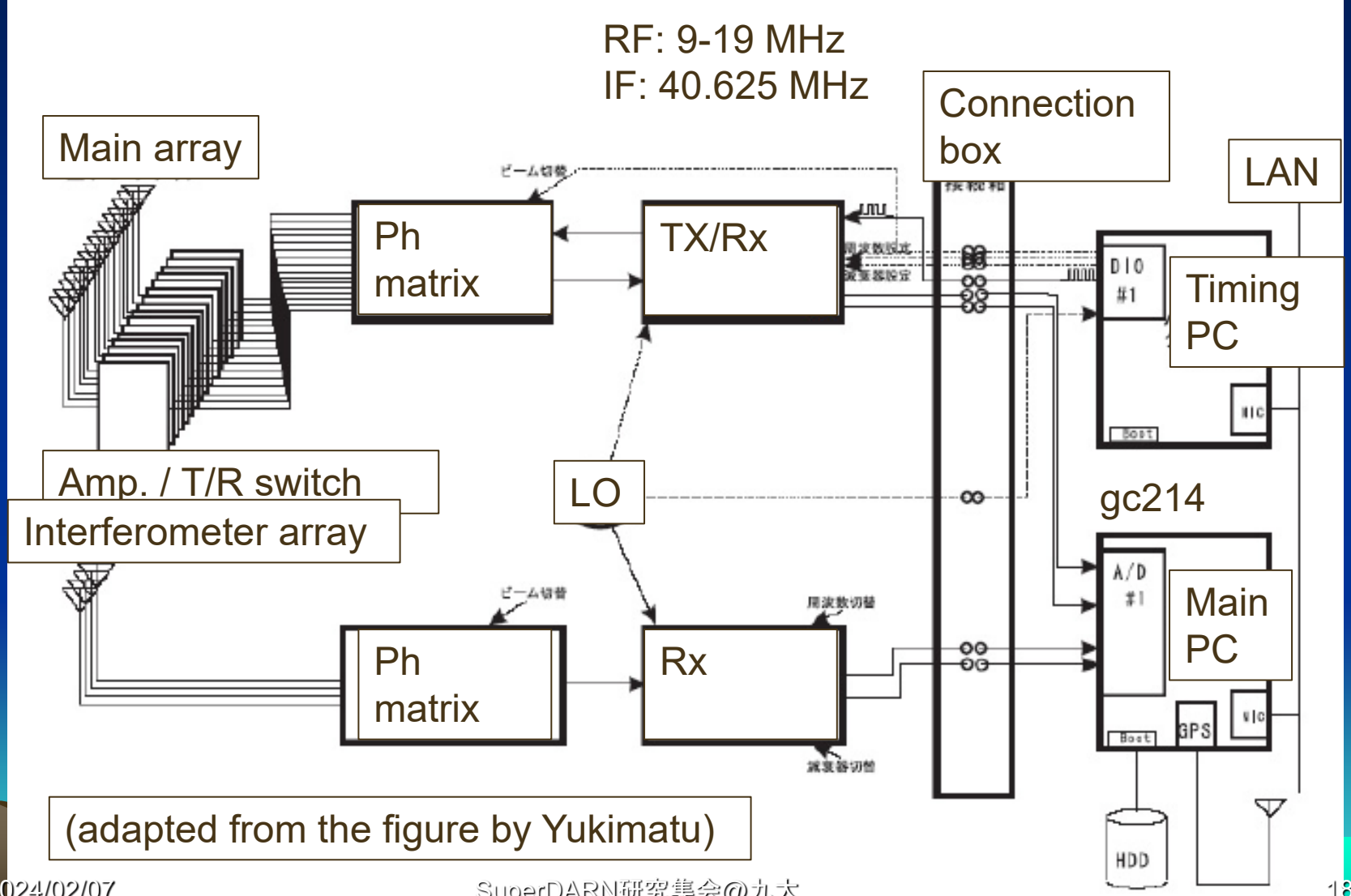
See Nishitani et al., SGPESS 2023, R011-P05

Bristow et al., RS, 2019

Array of 16+4 log-periodic antennas



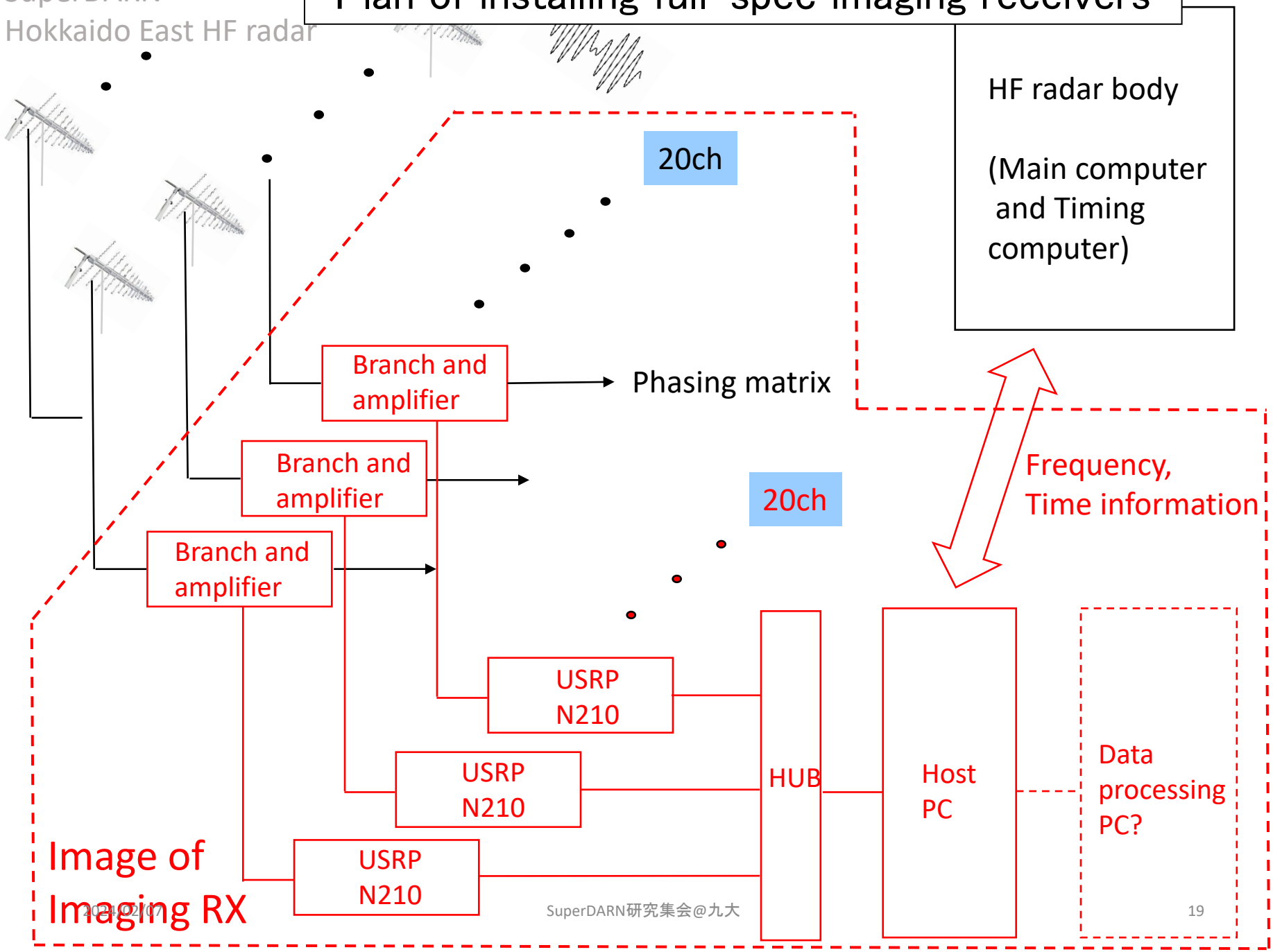
Current Hokkaido East / West radar Tx/Rx system



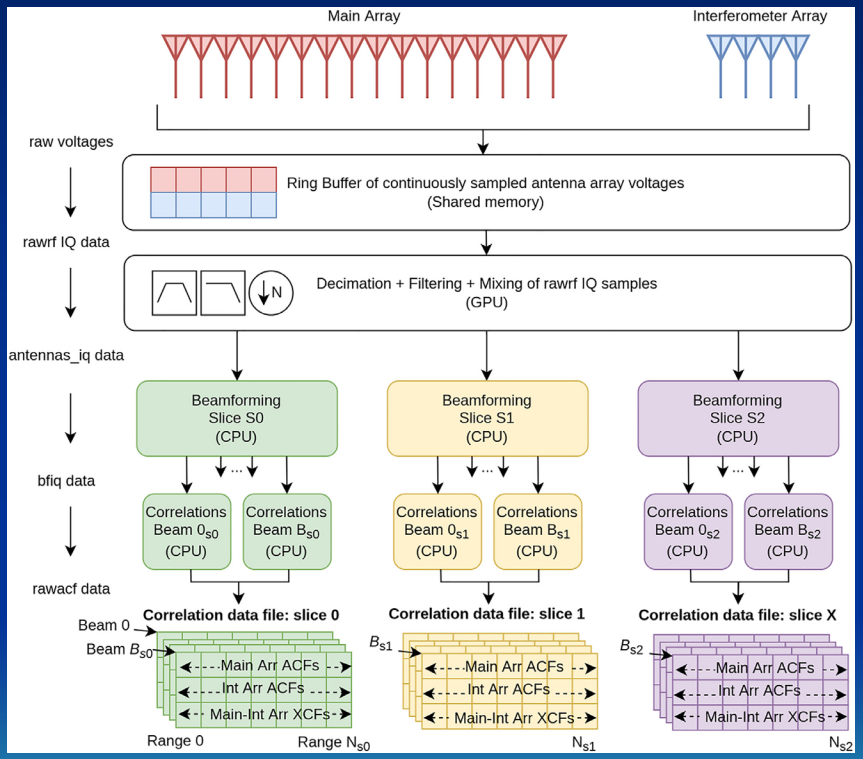
(adapted from the figure by Yukimatu)

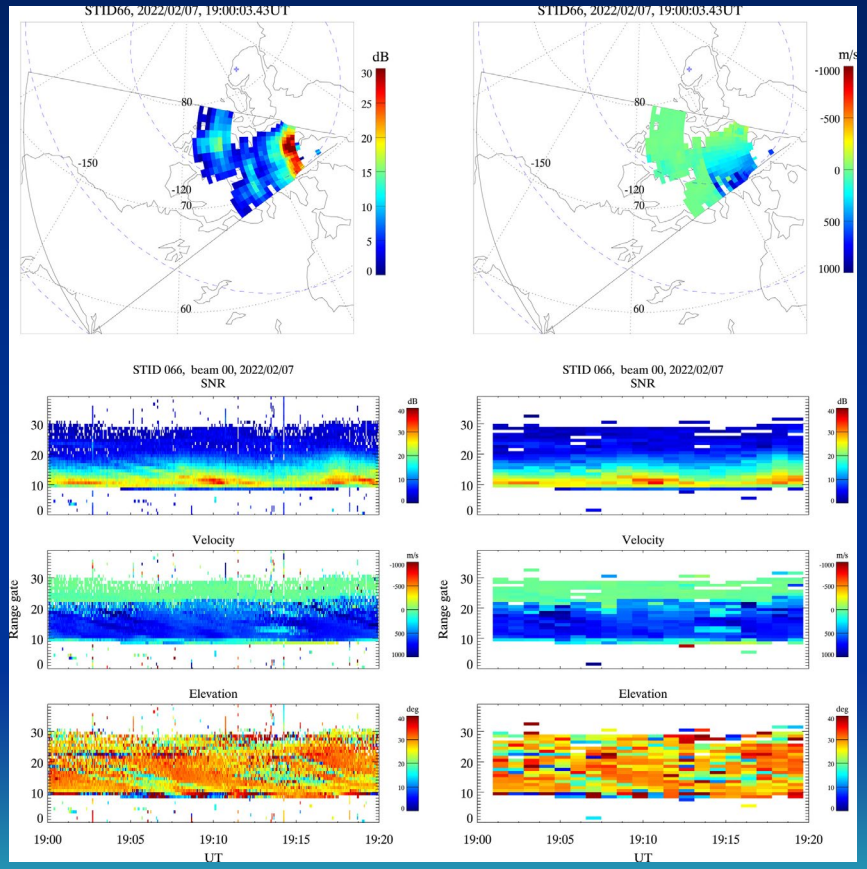
SuperDARN
Hokkaido East HF radar

Plan of installing full-spec imaging receivers



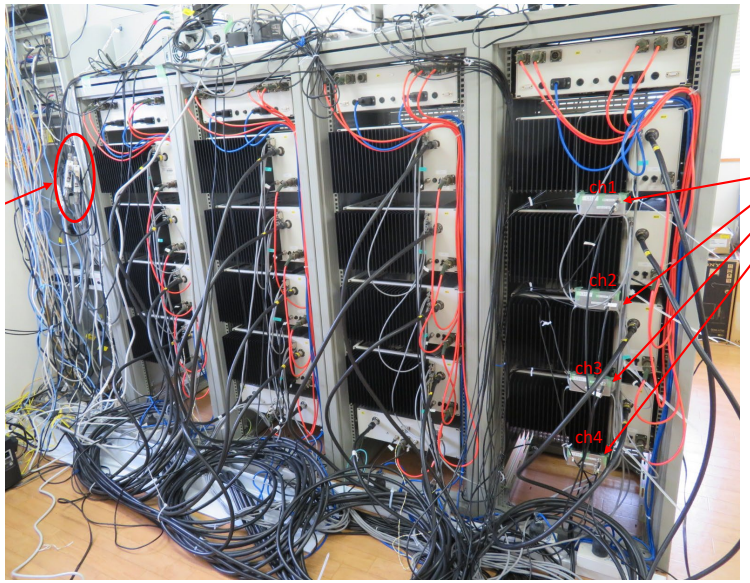
Borealis system at University of Saskatchewan: addition of imaging capability to the SuperDARN (McWilliams et al., Radio Sci., 2023)

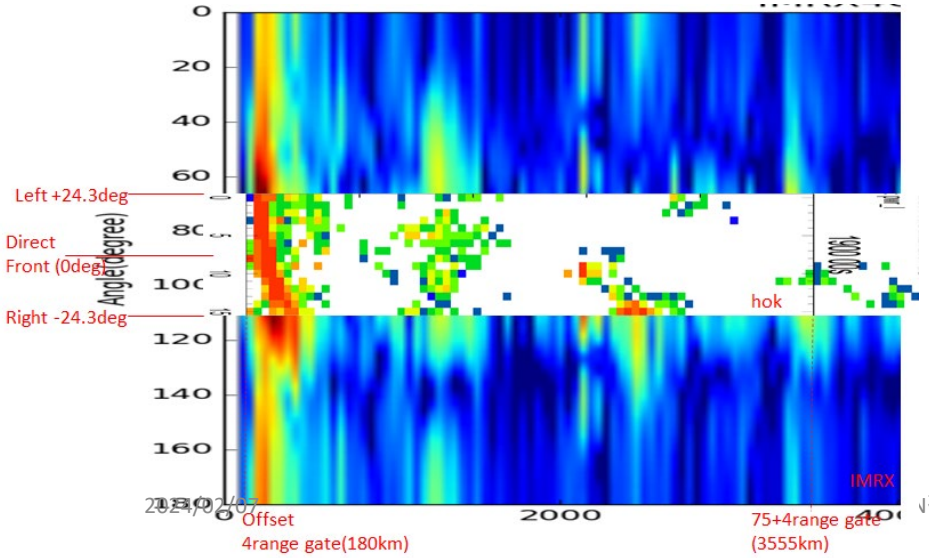


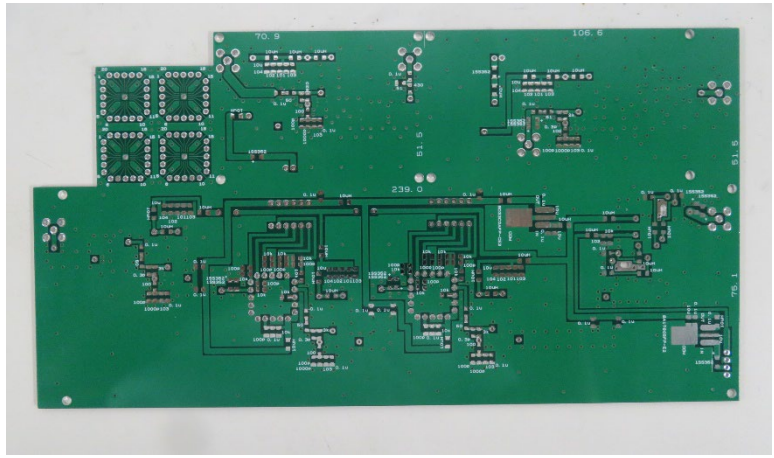


The imaging capability increases the temporal resolution of the data by several times, as well as the spatial resolution

Test of 4-ch imaging subset system (2020.07) design of the receiver board for 20-ch fullset

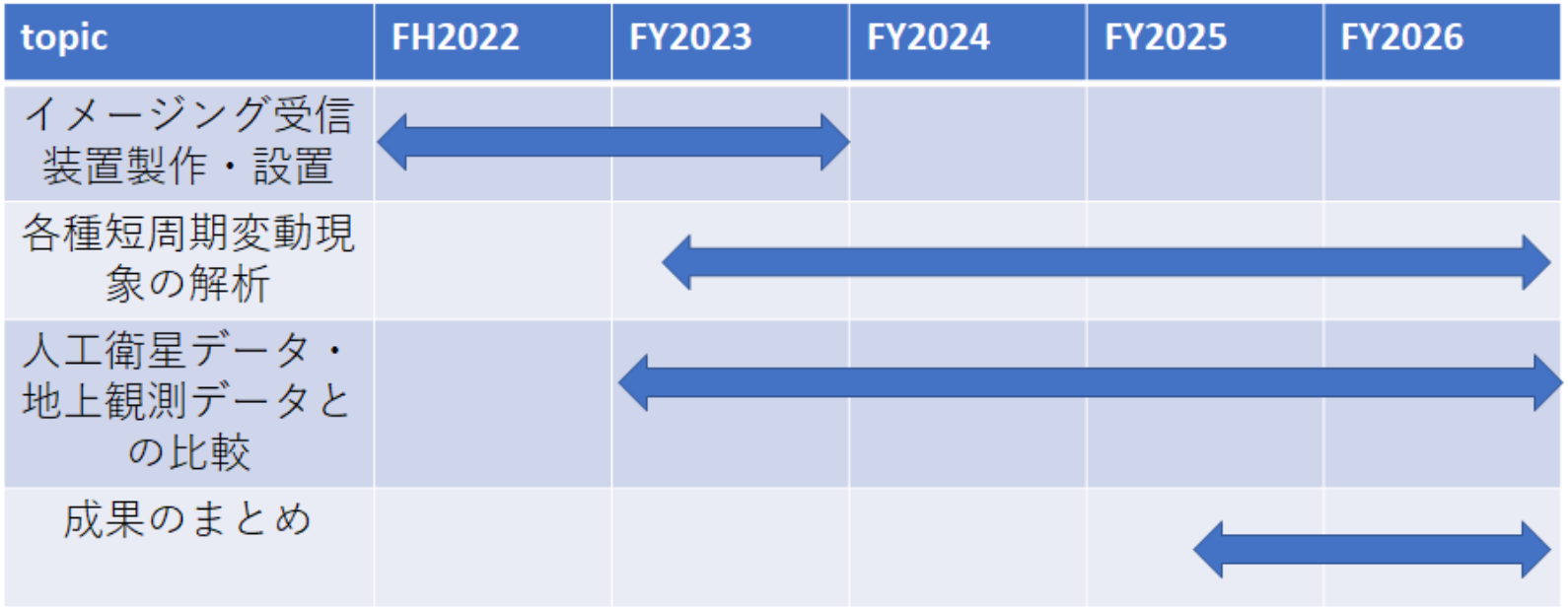






Production of the full 20-ch system

- We obtained Kakenhi Kiban-B (22H01284, 2022-2026 FY) for producing and operating the full 20-ch (16 main array + 4 interferometer array)imaging system at HOK (SuperDARN Hokkaido East).



Latest status of the HOP East imaging system

Progress of the imaging system

- We almost completed the production of:
  - Head amplifier x20
  - Main amplifier box x1
  - Signal splitter box x1
  - Interface box x1
  - Etc.

Progress of the imaging system -Future (near-range) plans

1. Implementation of the units onto the 19-inch rack, prepare connection cables and attach to the units, and then complete the whole hardware system.
2. Repair the preexisting radar simulator (Direct Digital Synthesizer – DEDS), to prepare for the testing of the system (facing many difficulties!)
3. After completing 1 and 2, connect the system with the radar simulator, test the system using the preexisting 4-ch imaging receiver PC. Then test the operation of the amplifiers, and conduct the calibration of the gain, phasing, and delay.
4. If 3 is ok, purchase the PCs for the whole 20-ch operation.
5. Test the system using the PCs purchased in step 4.
6. Conduct the calibration of the system for the 20-ch data.
7. If 6 is ok, then make plans for processing the 20-ch data (compression, storage, etc.).
8. If 7 is ok, then consider the radar beam pattern (wide beam? Fixed beam 7?)

Summary

- SuperDARN Hokkaido East / West radars have been operating pretty well.
- 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). We are planning to switch to a mobile connection.
- Topics during this meeting:
  - **Hosokawa et al., Overview of 2023 Arase-SD campaign**
  - **Hori et al., SAPS signature during 2022 Arase-SD campaign period**
  - **Shinbori et al., GNSS TEC-SD LOS relation during 2022 caterpillar event**
  - **Nishitani et al., Introduction of the 20222 caterpillar event**
  - **Watanabe et al., Dungey reconnection during northward IMF**
  - **Nishitani et al., Convection associated with low-latitude aurora events**
  - **Omori et al.,, Statistics of mid-latitude ionospheric convection**
  - **Matsuoka et al., Statistical characteristics of nightside MSTIDs**
  - **Yukimatu, -**

2/1 東京新聞記事

〉社会

昭和基地で越冬交代式　第６４次隊から第６５次隊へ

2024年2月1日 23時54分（共同通信）

記念撮影する第６４、６５次越冬隊＝１日、南極・昭和基地（南極観測隊同行記者撮影）

【昭和基地＝南極観測隊同行記者】南極・昭和基地の管理、運営を第６４次越冬隊から第６５次隊に引き継ぐ「越冬交代式」が１日、同基地で行われた。厳しい環境下で１年を過ごした第６４次隊をねぎらい、これから基地を守る第６５次隊を激励した。

「２月から新しい１年が始まる」と言われるほど、越冬隊にとって大切な節目。交代式で第６４次隊の樋口和生越冬隊長は「誰ひとり欠けることなくこの場に立っていることをうれしく思う」とあいさつ。第６５次隊の行松彰越冬隊長は「さまざまな問題が生じても一致団結して乗り越えたい」と決意を新たにした。

第６５次隊のフィールドアシスタントを務める山岸慎英さん（４７）＝国立極地研究所南極観測センター、長野県白馬村＝は「これから長い１年が始まる。第６６次隊が来るまでしっかりと基地を守り、引き渡せるように頑張りたい」と意気込んでいた。

関連キーワード

https://www.youtube.com/watch?v=qv3PmG-wpek

Summary of the SuperDARN

- The SuperDARN is a powerful tool for studying space weather phenomena (both from above and below) using both ionospheric scatter and ground / sea backscatter echoes (in collaboration with other observation and modeling):
  - **Ionospheric scatter**: global / medium-scale convection dynamics, dynamo processes including the effect of lower atmospheric disturbance
  - **Ground / sea scatter**: Traveling Ionospheric Disturbances, solar flare effect on the ionosphere, ionospheric disturbances triggered by earthquakes / volcano eruptions
- The SuperDARN is making a progress in various ways even now - including the expansion of the coverage into the mid- / low-latitude regions, and the implementation of the multichannel (imaging) capability to improve the spatial / temporal resolution several times.

SuperDARN International Workshop 2023@Beijing

- May 20-24, 2024@Beijing International Convention Center (the week just before JPGU)
- Hosted by National Space Science Center, Chinese Academy of Sciences
- Followed by the onsite school at the Siziwang Observatory of Space Weather in Inner Mongolia Province (new SuperDARN radar site), May 25-27
- More information please go to the conference website: https://superdarn2024.casconf.cn
- Registration deadline: 5 May 2024 (early bird: 20 April)
- Abstract submission deadline: 31 March 2024
- Please contact the LOC chair as soon as possible so that you can obtain visa to enter China!