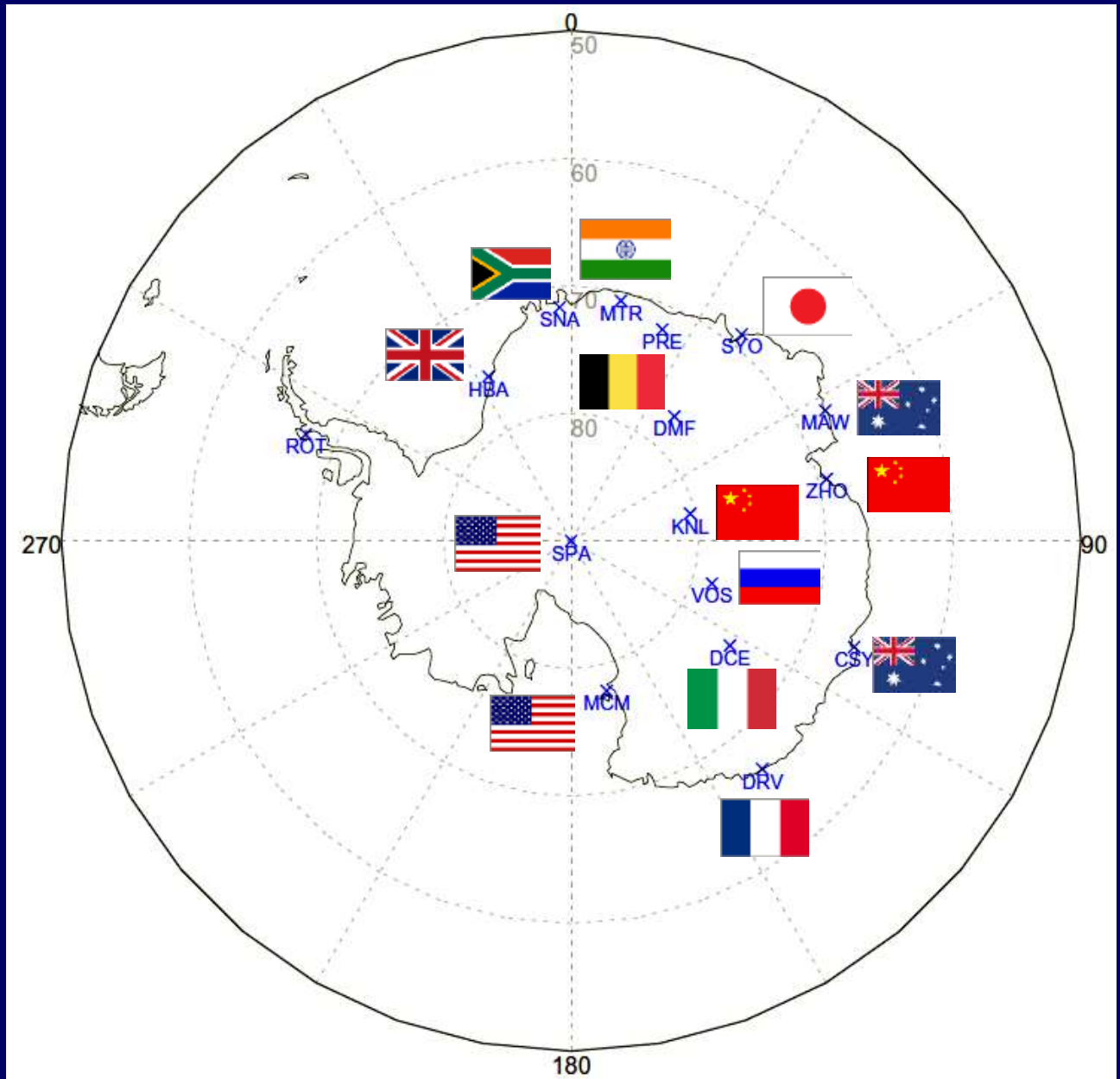


Asian and international collaboration
in the polar region for space and upper
atmospheric sciences study
in association with Japanese activities

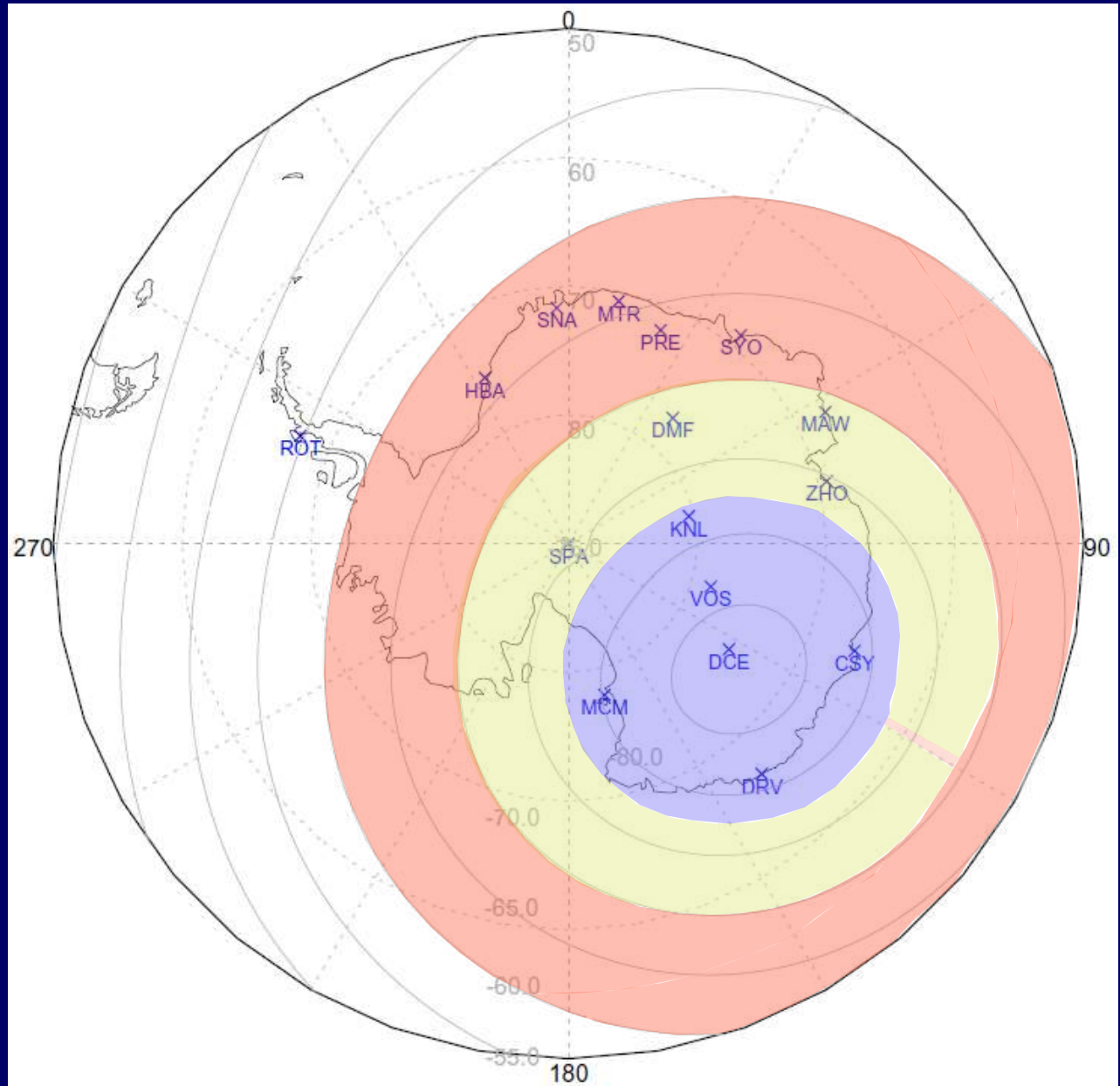
Akira Kadokura

*Upper Atmospheric Sciences group
National Institute of Polar Research, Japan*

International Collaboration in Antarctica



Geomagnetic Location ~ Magnetospheric Region



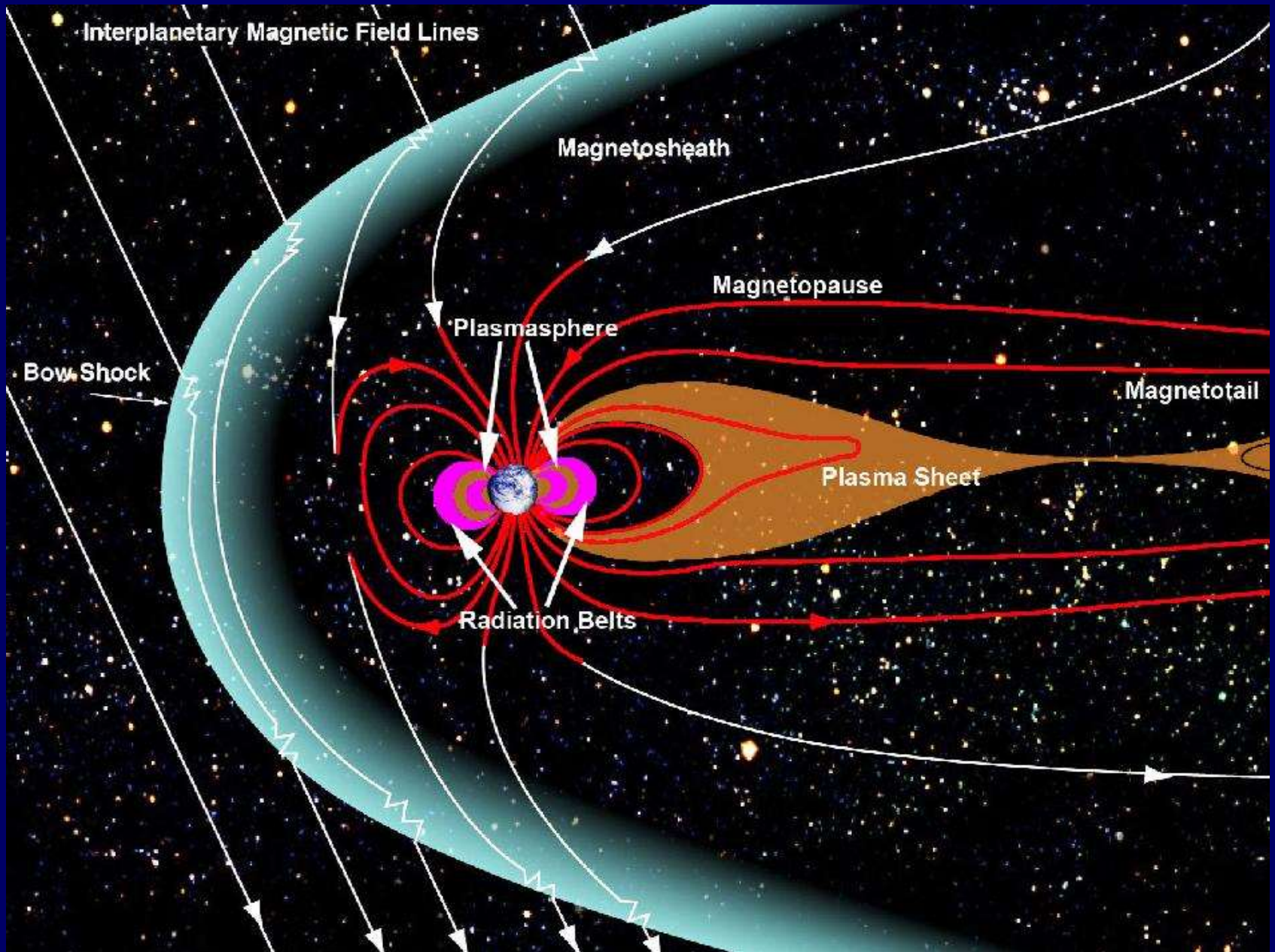
Polar Cap
Tail Lobe

Cusp, LLBL, HLBL,
PSBL

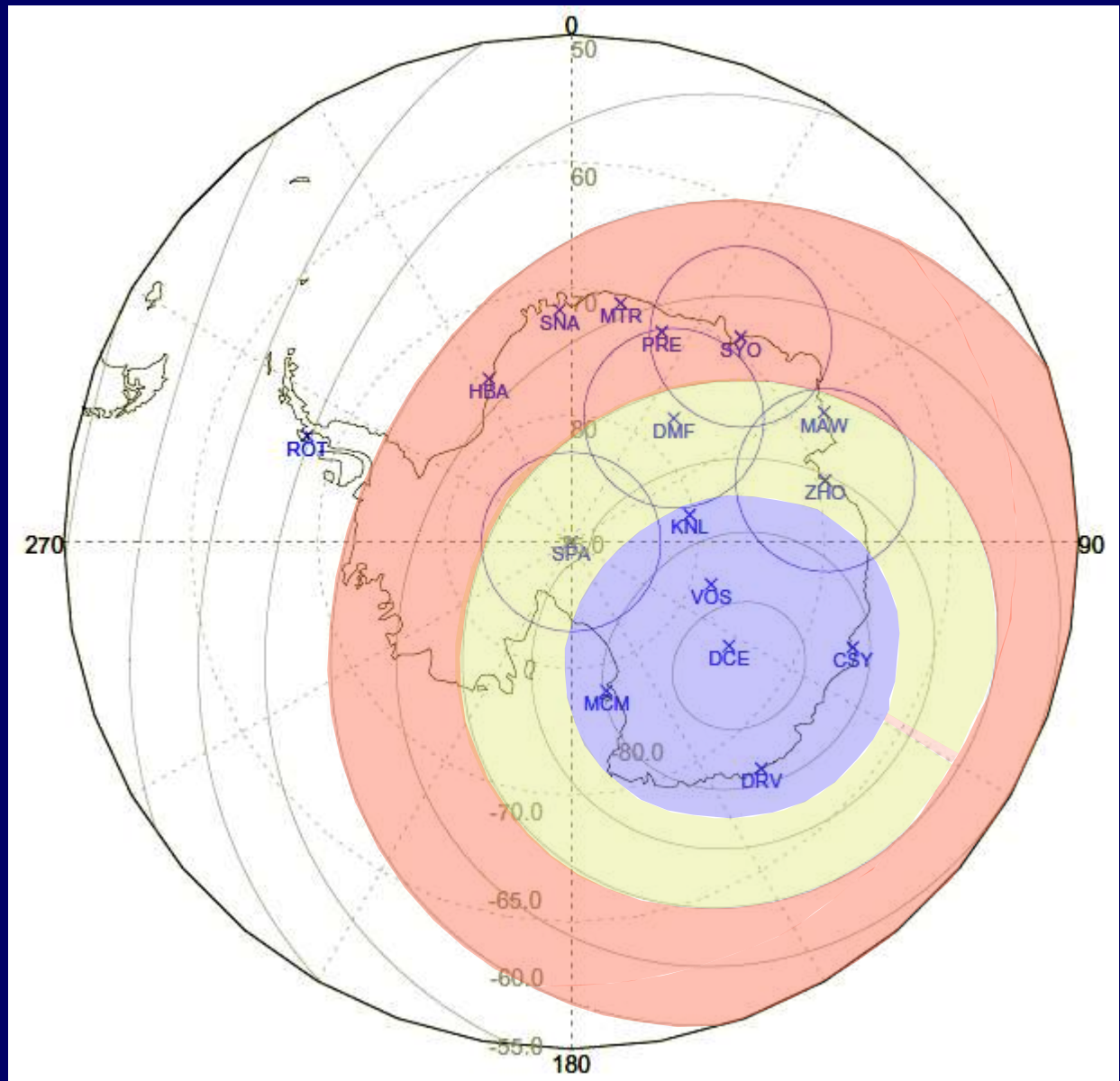
Auroral zone
Plasma sheet

Plasmasphere
Radiation belt

Geomagnetic Location ~ Magnetospheric Region



Auroral Optical Observation



Polar Cap
Tail Lobe

Cusp, LLBL, HLBL,
PSBL

Auroral zone
Plasma sheet

Plasmasphere
Radiation belt

Syowa 



Dome-F 



South Pole 



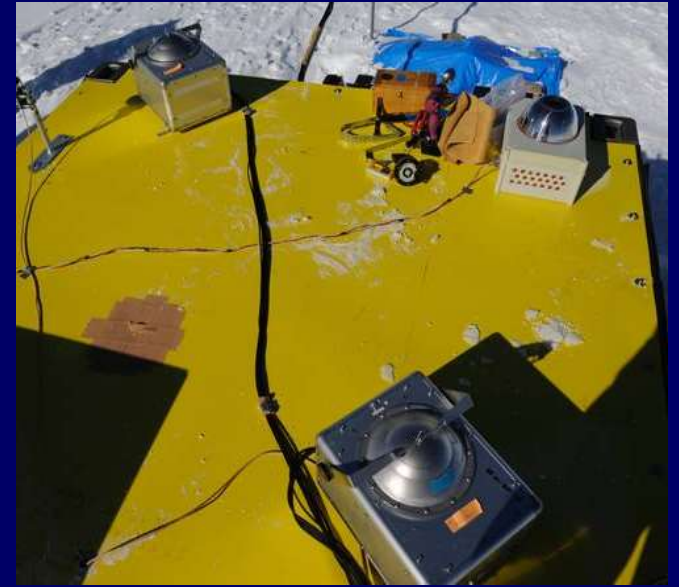
Zhongshan 



Syowa



Dome-F



South Pole

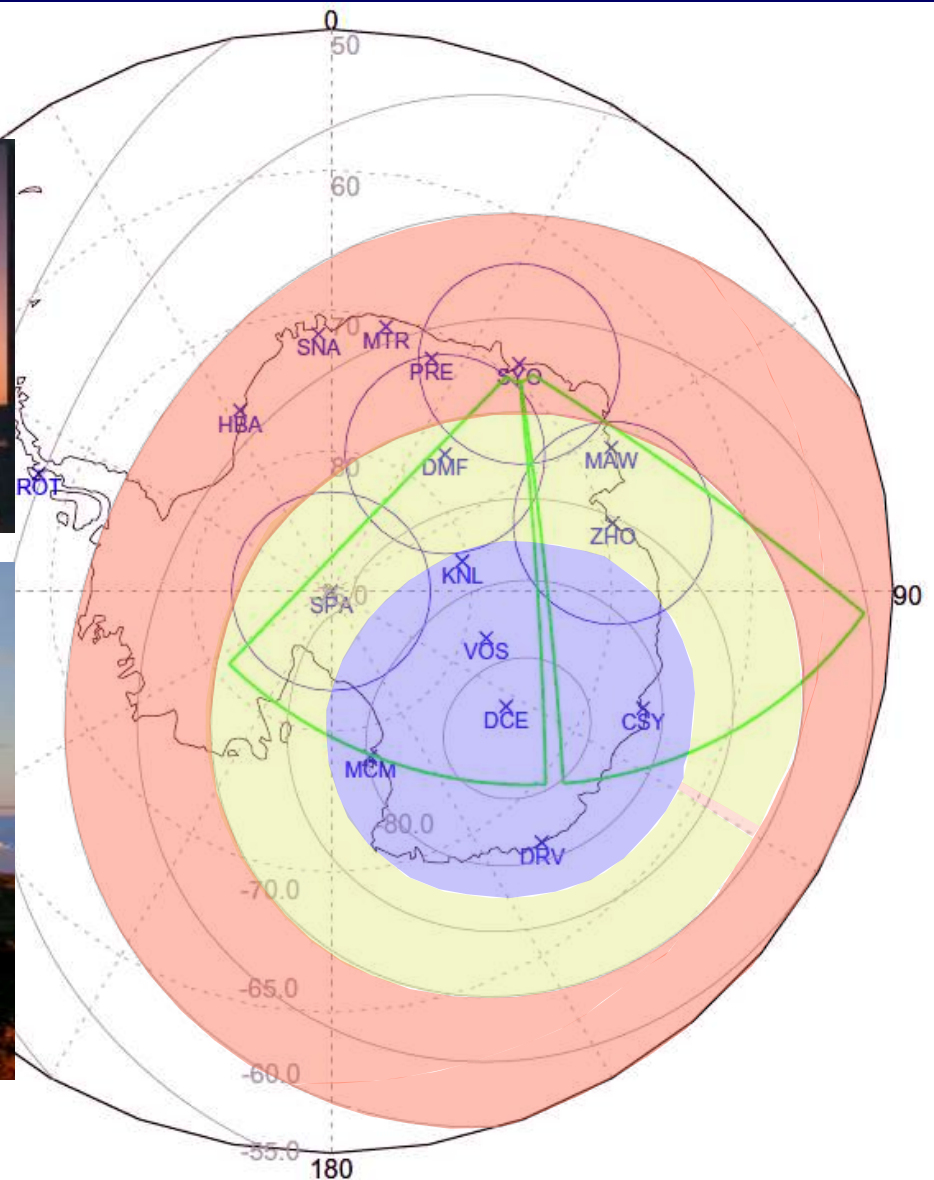


Zhongshan



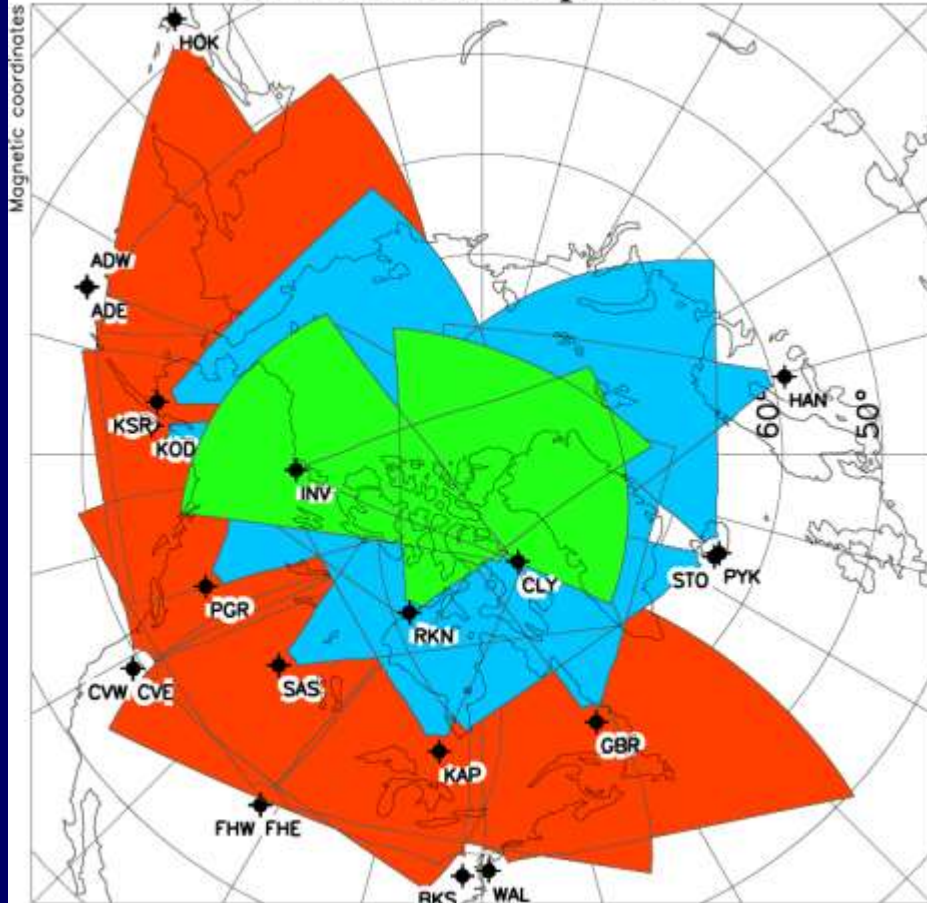
Auroral Optical + SuperDARN radar

Syowa Radar

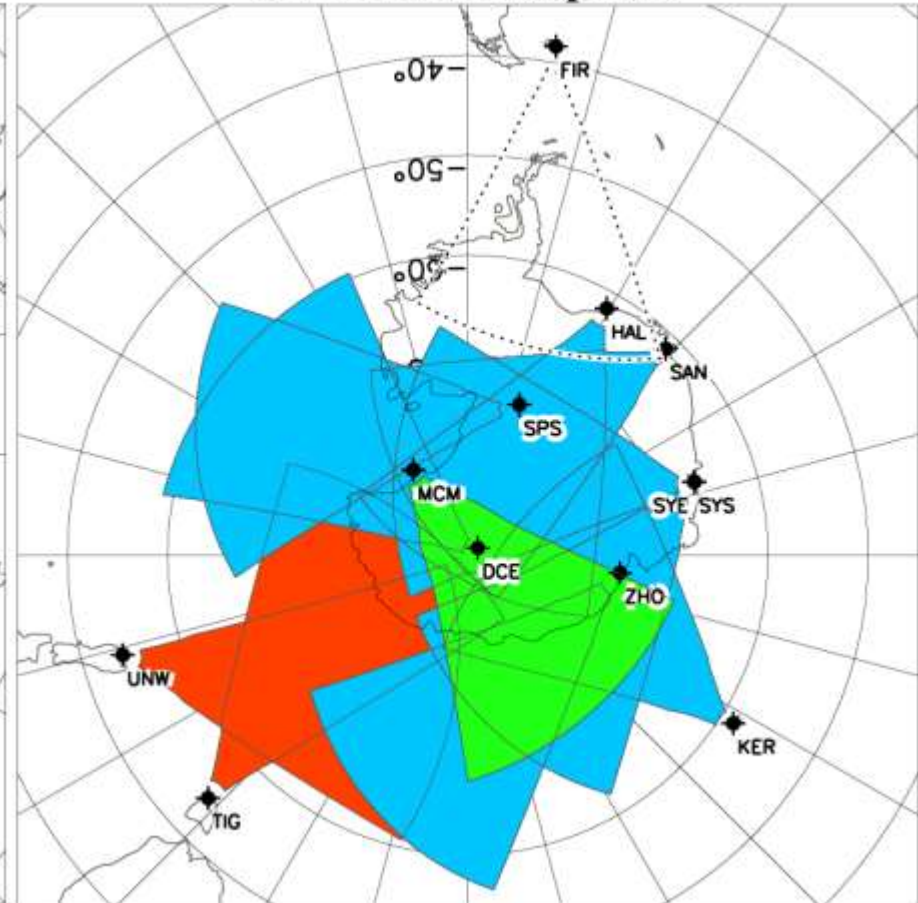


SuperDARN network in Both Hemispheres

Northern Hemisphere

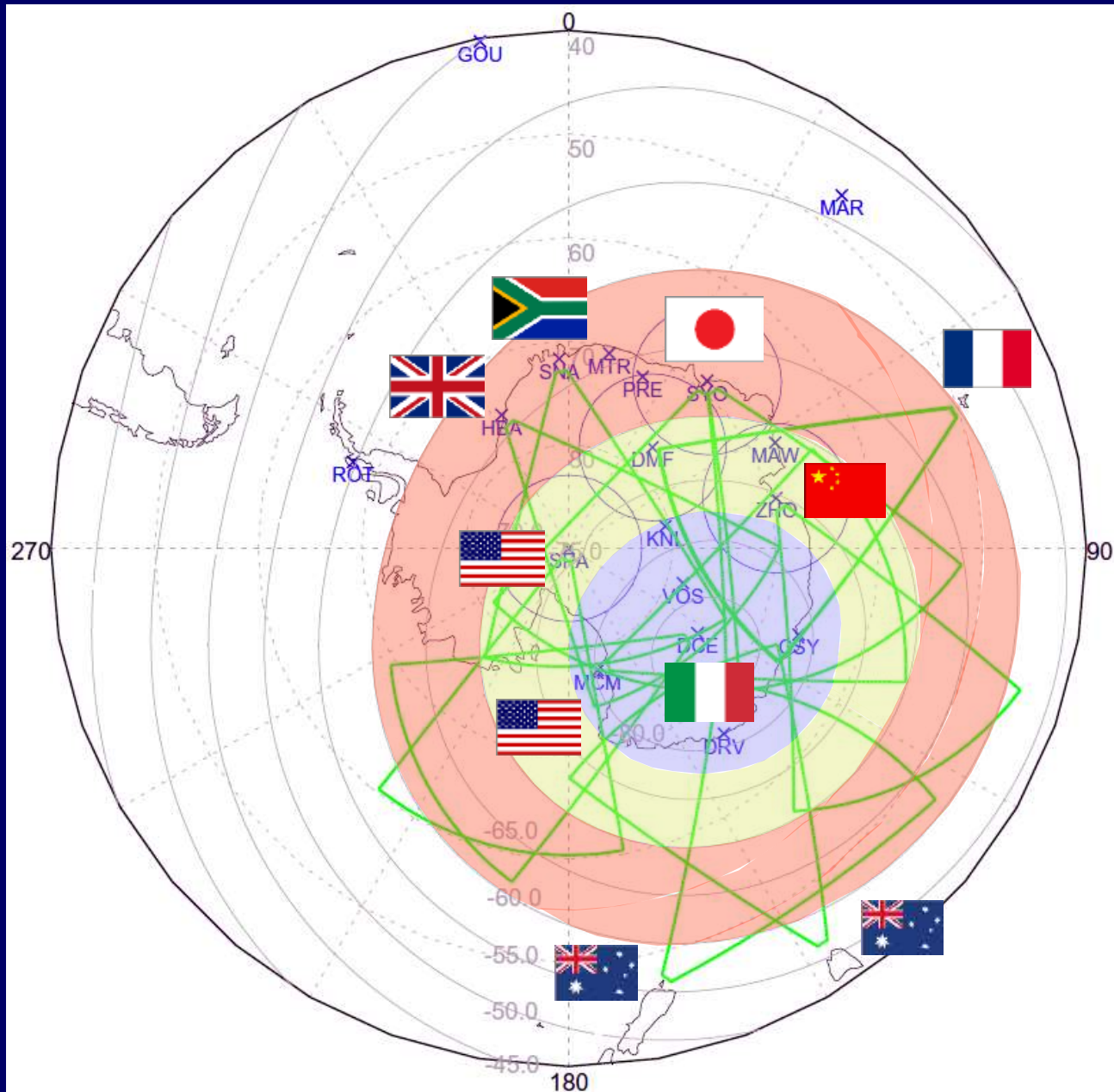


Southern Hemisphere

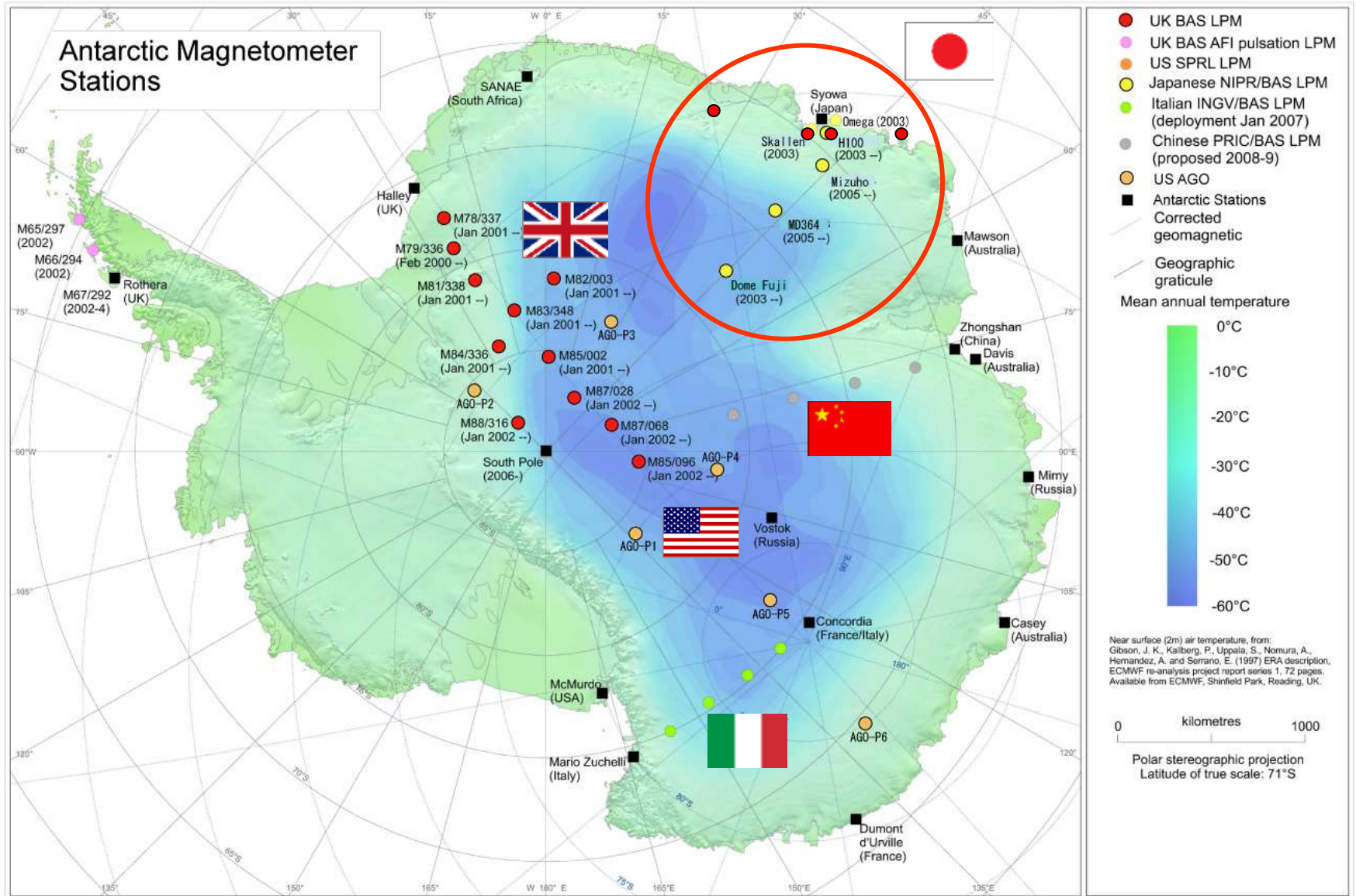


 Polar Cap  High-Latitude  Mid-Latitude  Out-of-Service

SuperDARN radar Network in Antarctica: All now



Unmanned Station Network in Antarctica



Unmanned Station in Antarctica



U.S. AGO (Automatic Geophysical Observatories)

- Imaging Riometer
- Fluxgate Magnetometer
- Search Coil Magnetometer
- All-sky Auroral Imager
- ELF/VLF Radio Receiver
- LF/HF Radio Receiver



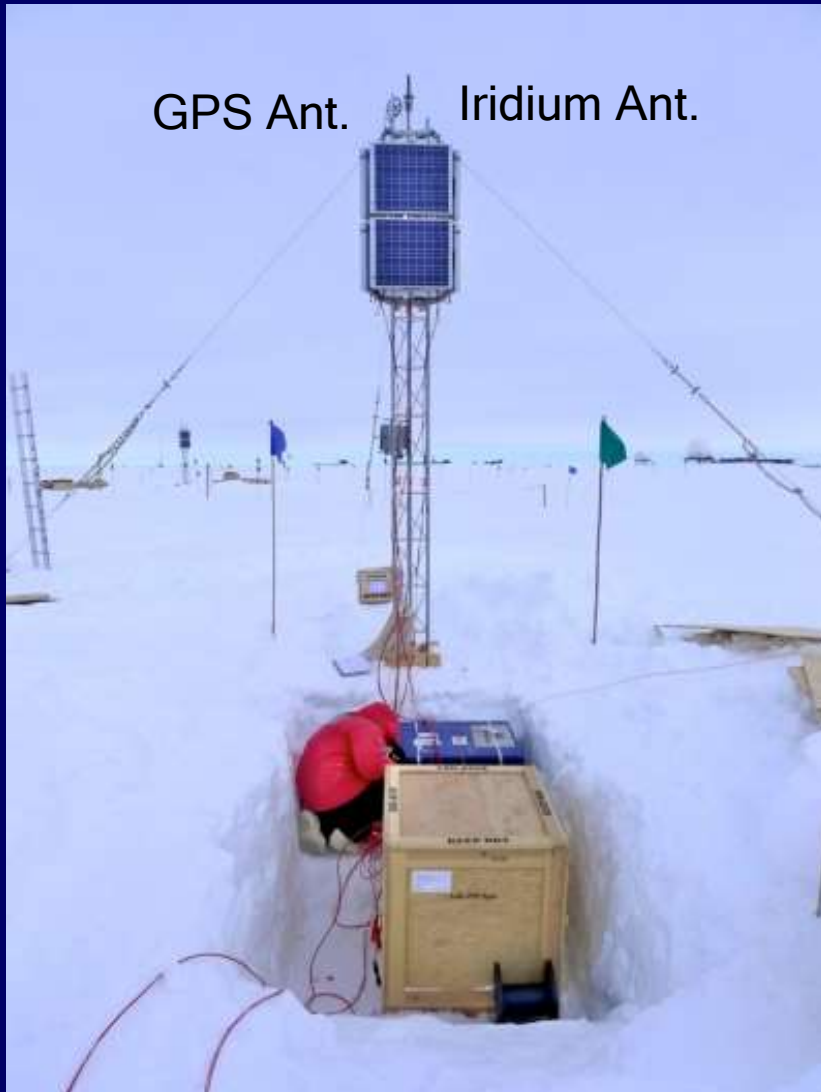
BAS LPM (Low Power Magnetometer)

- Fluxgate Magnetometer
- Low Power : 0.42 / 0.08 / 0.05 W
- Sampling: 1 / 10 / 60 sec
- Resolution: 1 nT
- Operating Temperature: -78°C min
- Data collection : 1/year



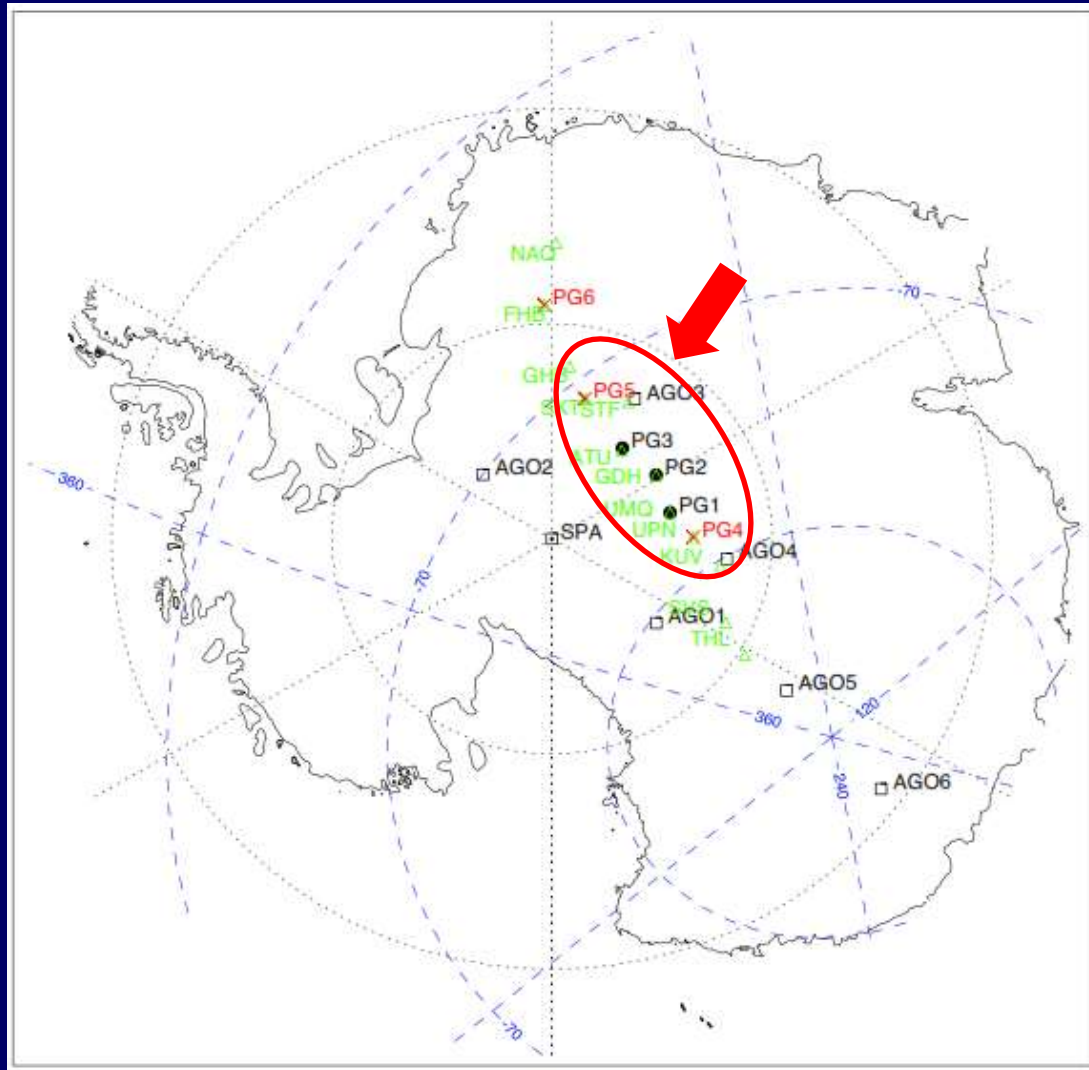
Autonomous Adaptive Low-Power Instrument Platform (AAL-PIP)

Virginia Polytechnic Institute and State University, U.S.A.



Autonomous Adaptive Low-Power Instrument Platform (AAL-PIP)

Virginia Polytechnic Institute and State University, U.S.A.



BAS type Low Power Magnetometer in JARE

Mizuho

2005.08/23

Mizuho

2012.10/15

MD364

Dome Fuji

NIPR type Low Power Magnetometer

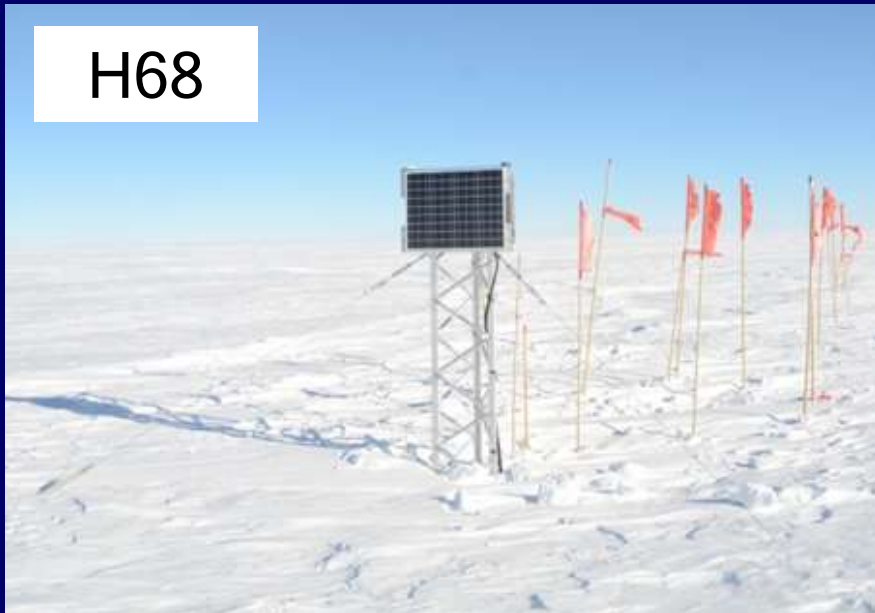
Utsteinen



Amundsen Bay



H68



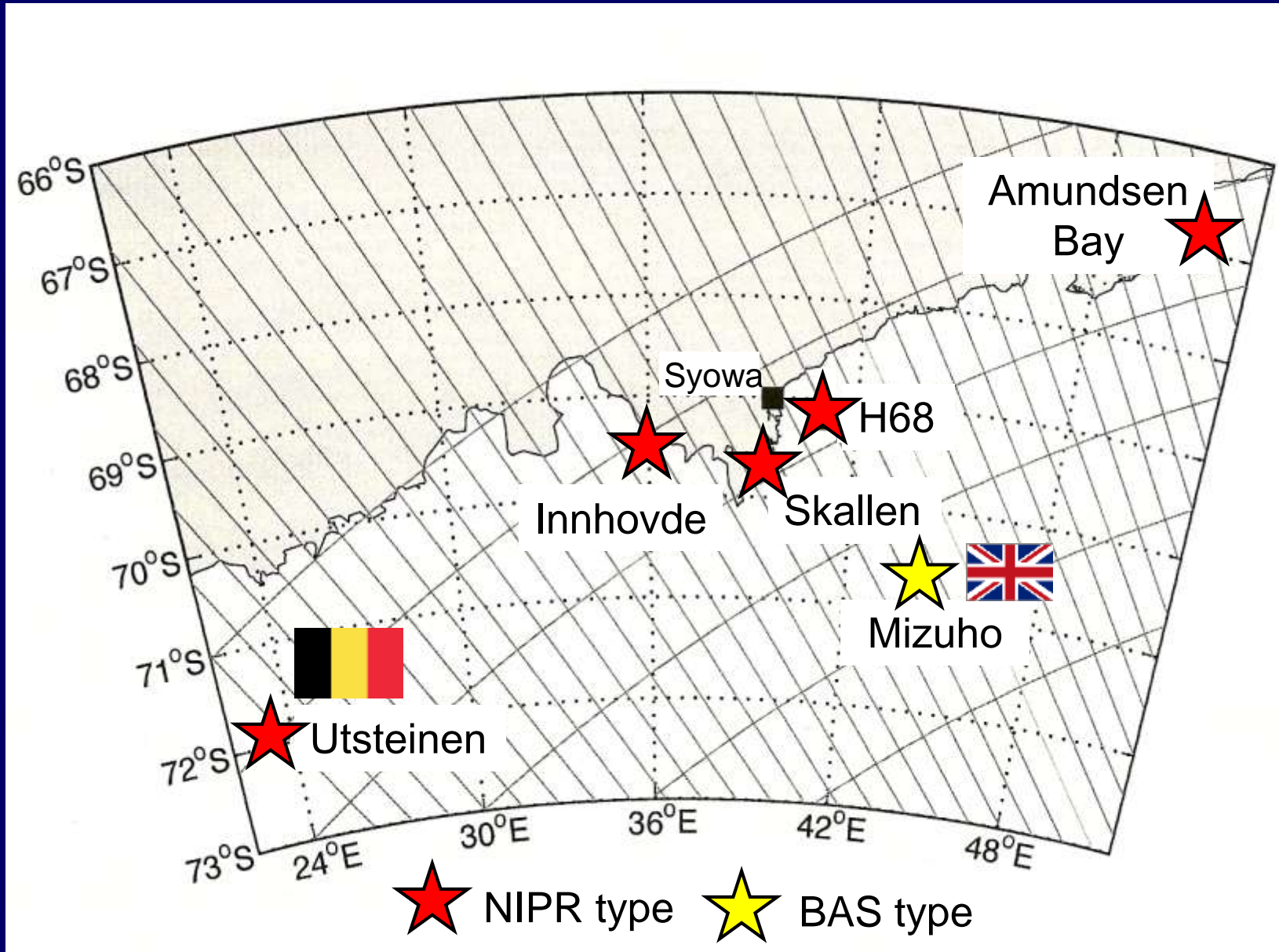
Skallen



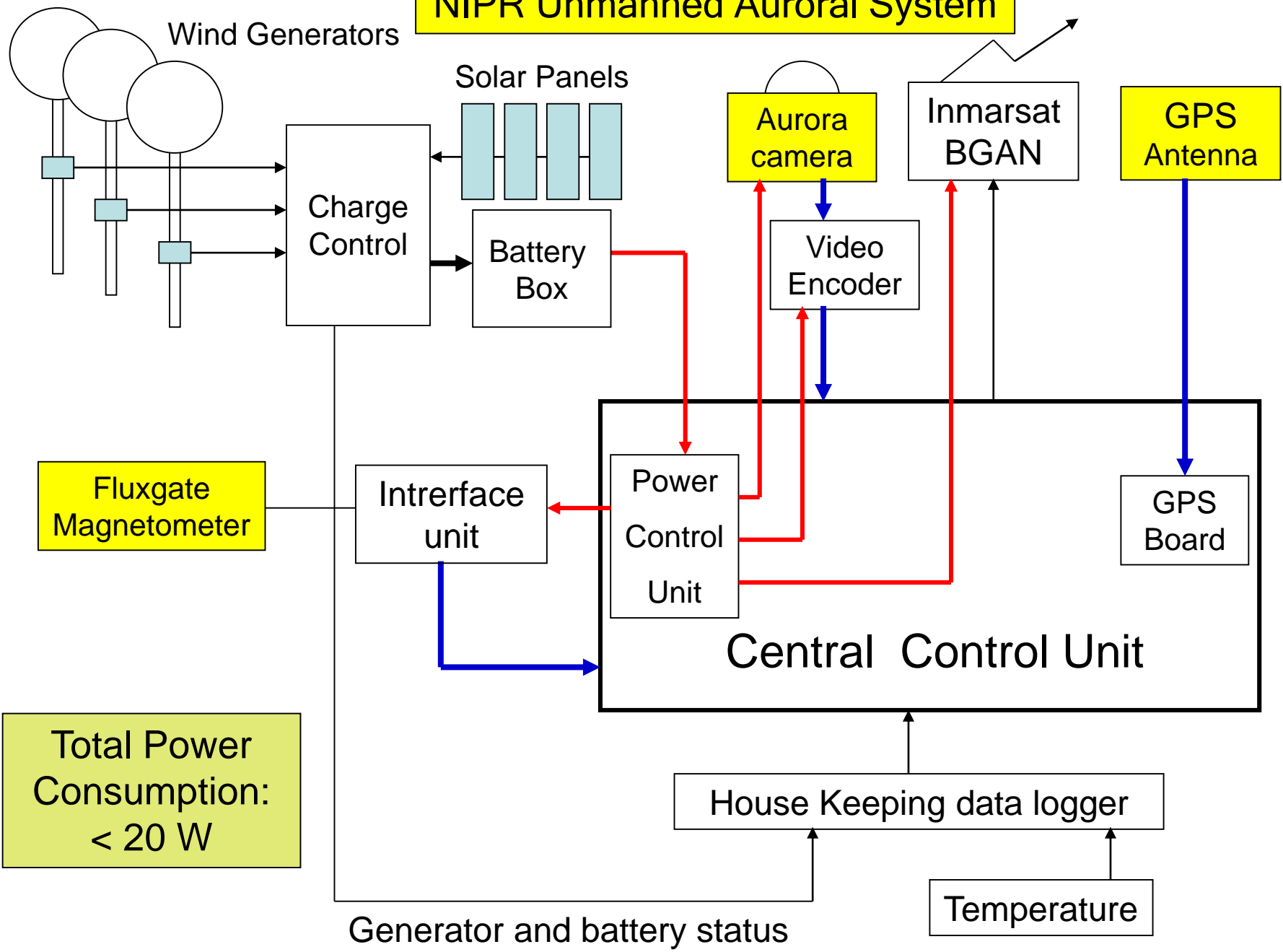
BAS type and NIPR type

	BAS-LPM	NIPR-LPM
Magnetometer	MAG-03MC	MAG-03MC
Resolution	16 bit	16 bit
Noise level	1 nT	0.2 nT
Low Pass Filter	100 Hz	15 Hz
Power consumption (1 sec sampling)	0.42 W	0.16 W
Data acquisition	Flash memory card	Iridium satellite Flash memory card
Command sending	×	○

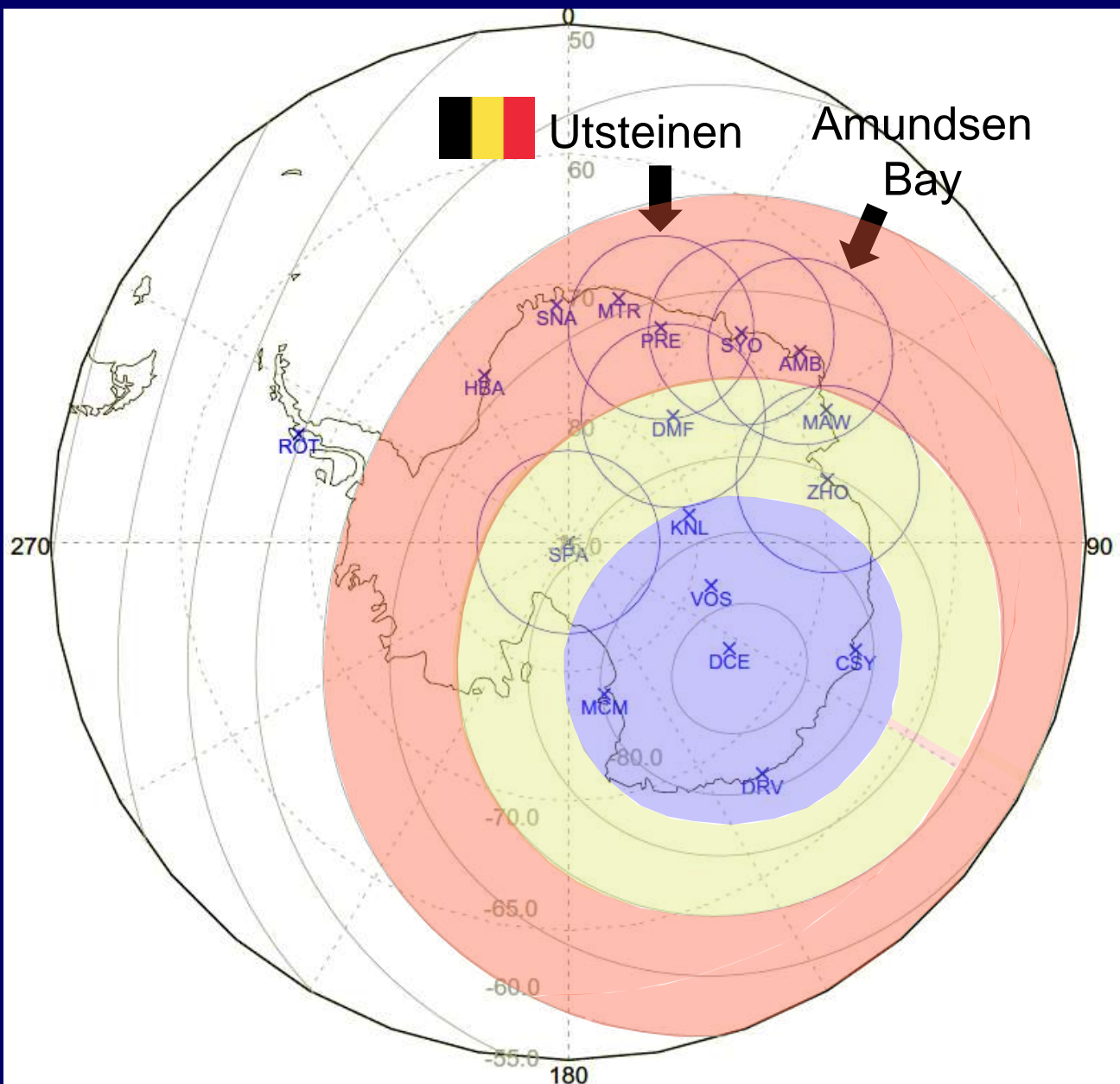
Unmanned Magnetometer Network in JARE



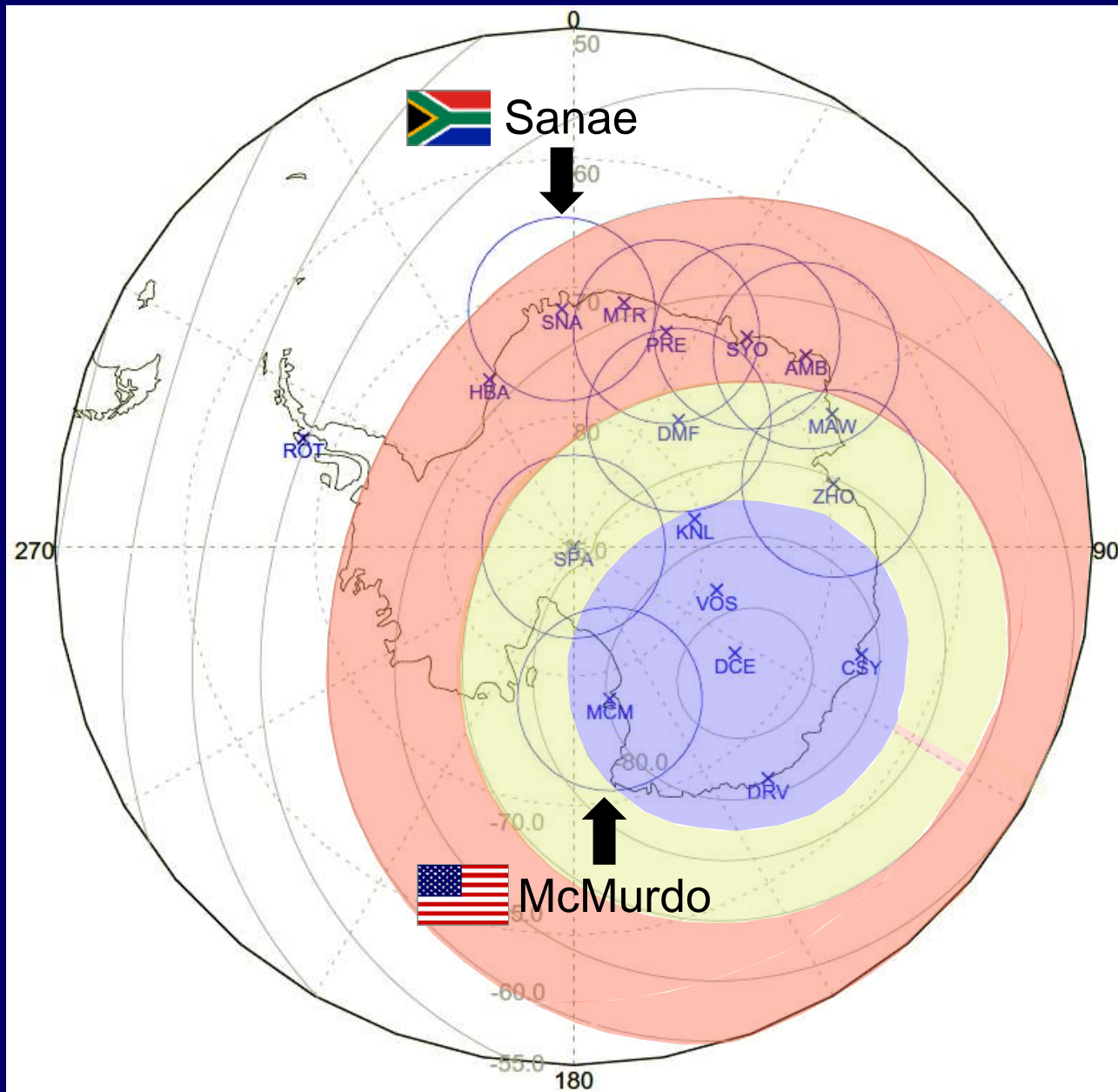
NIPR Unmanned Auroral System



Deployment of Unmanned Auroral System in near future

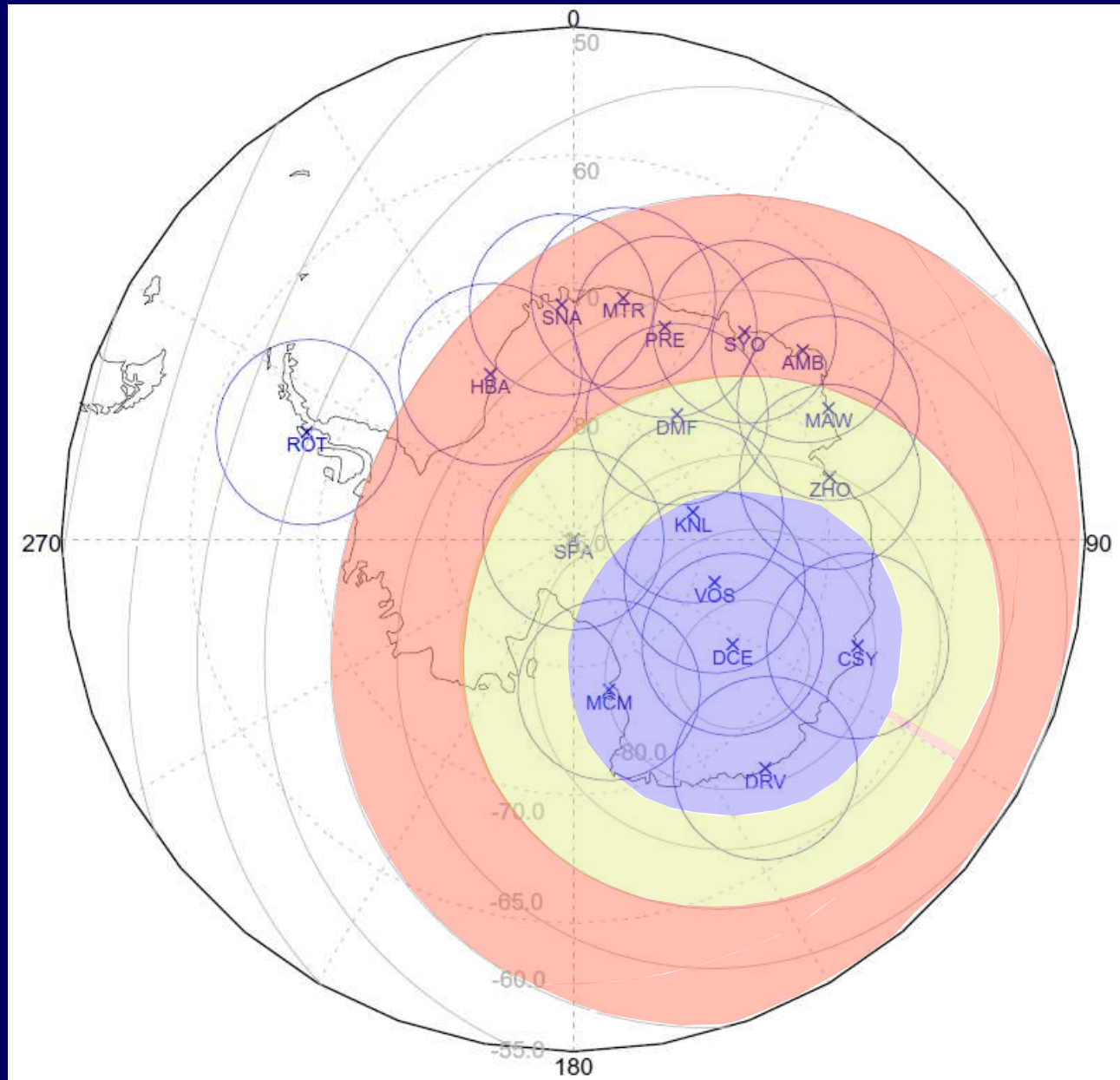


Expansion of Auroral Optical network in near future



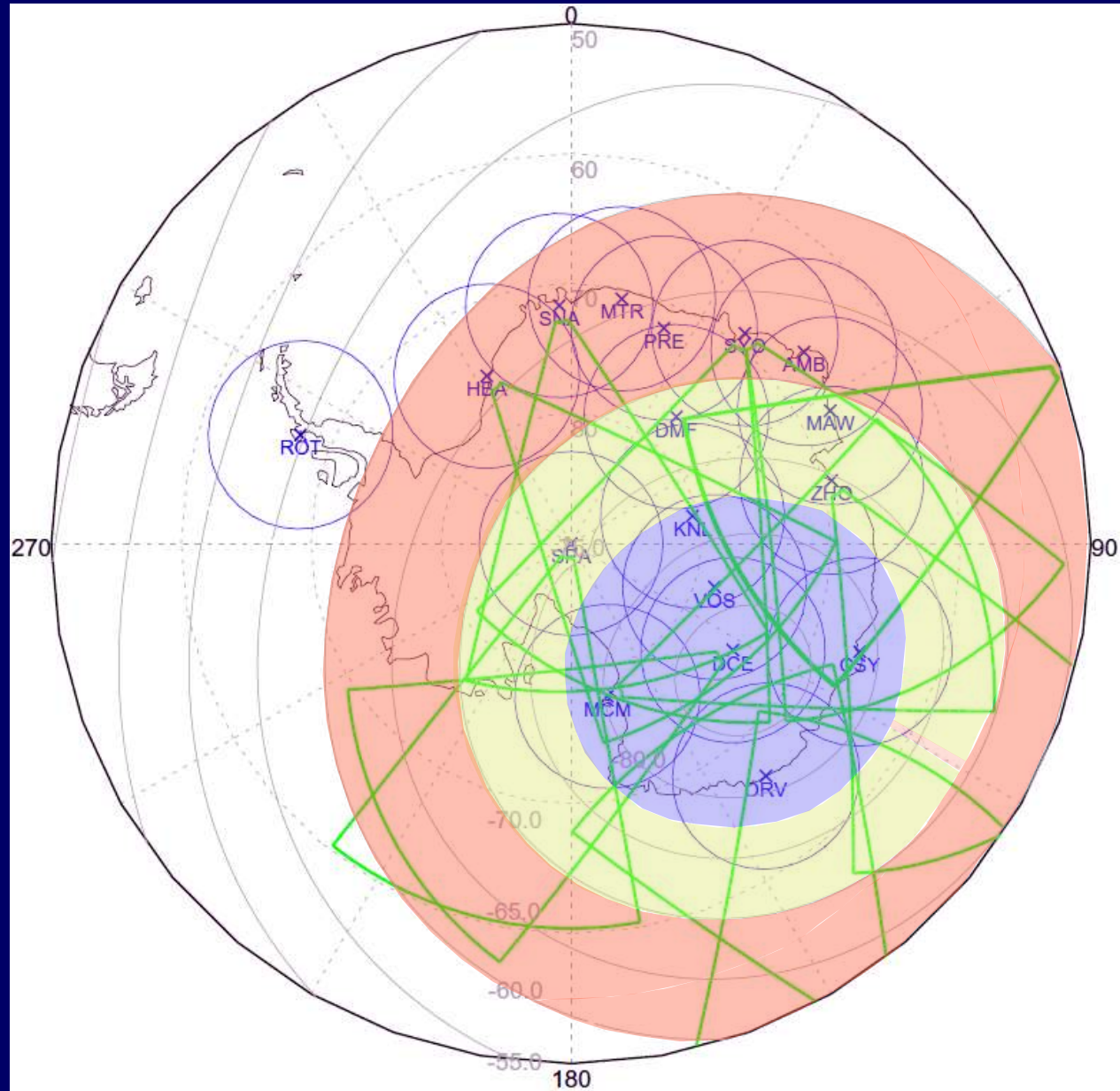
Auroral Optical Observation Network in Antarctica

Future
Dream

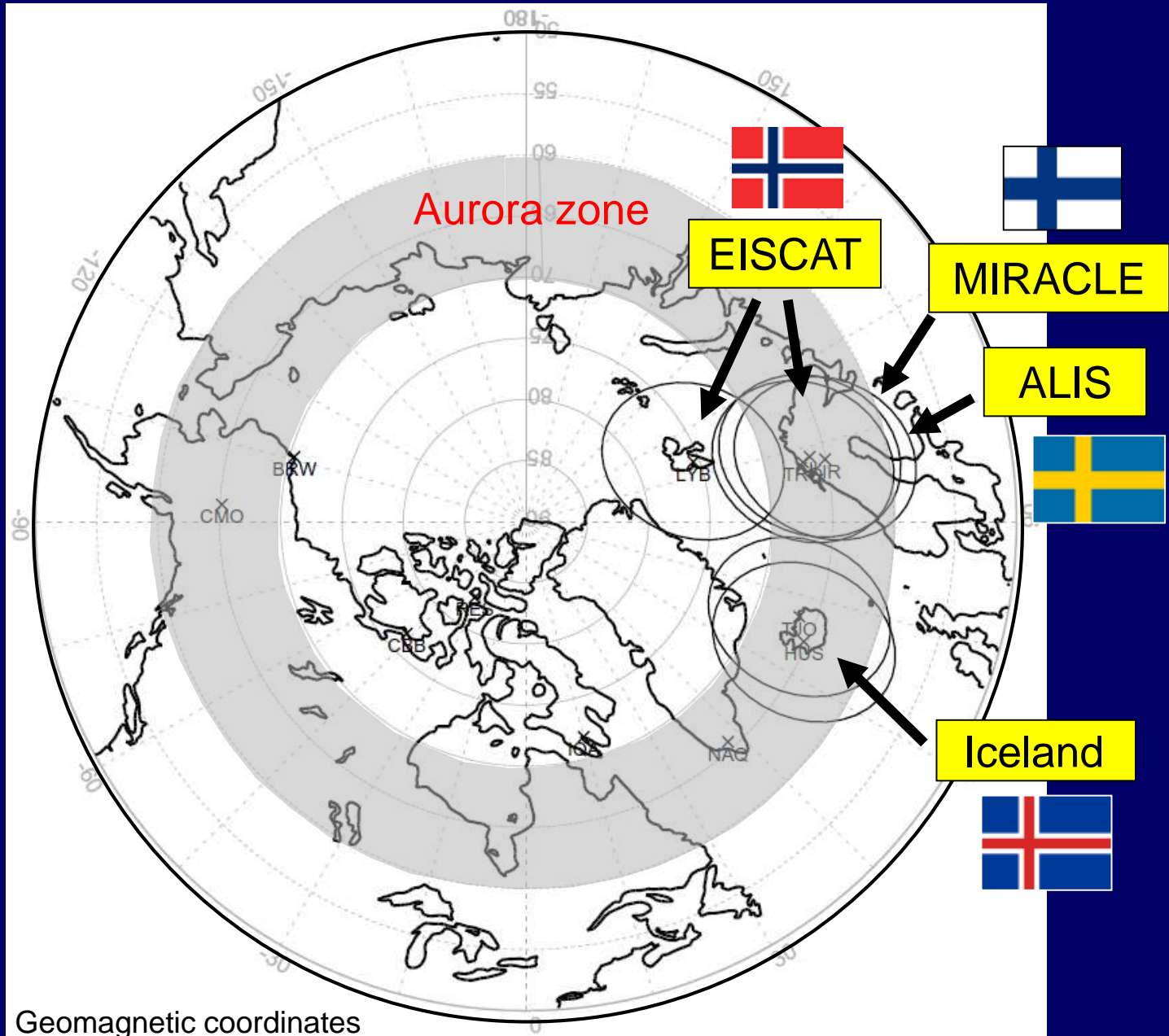


Optical Auroral & SuperDARN & Unmanned Station

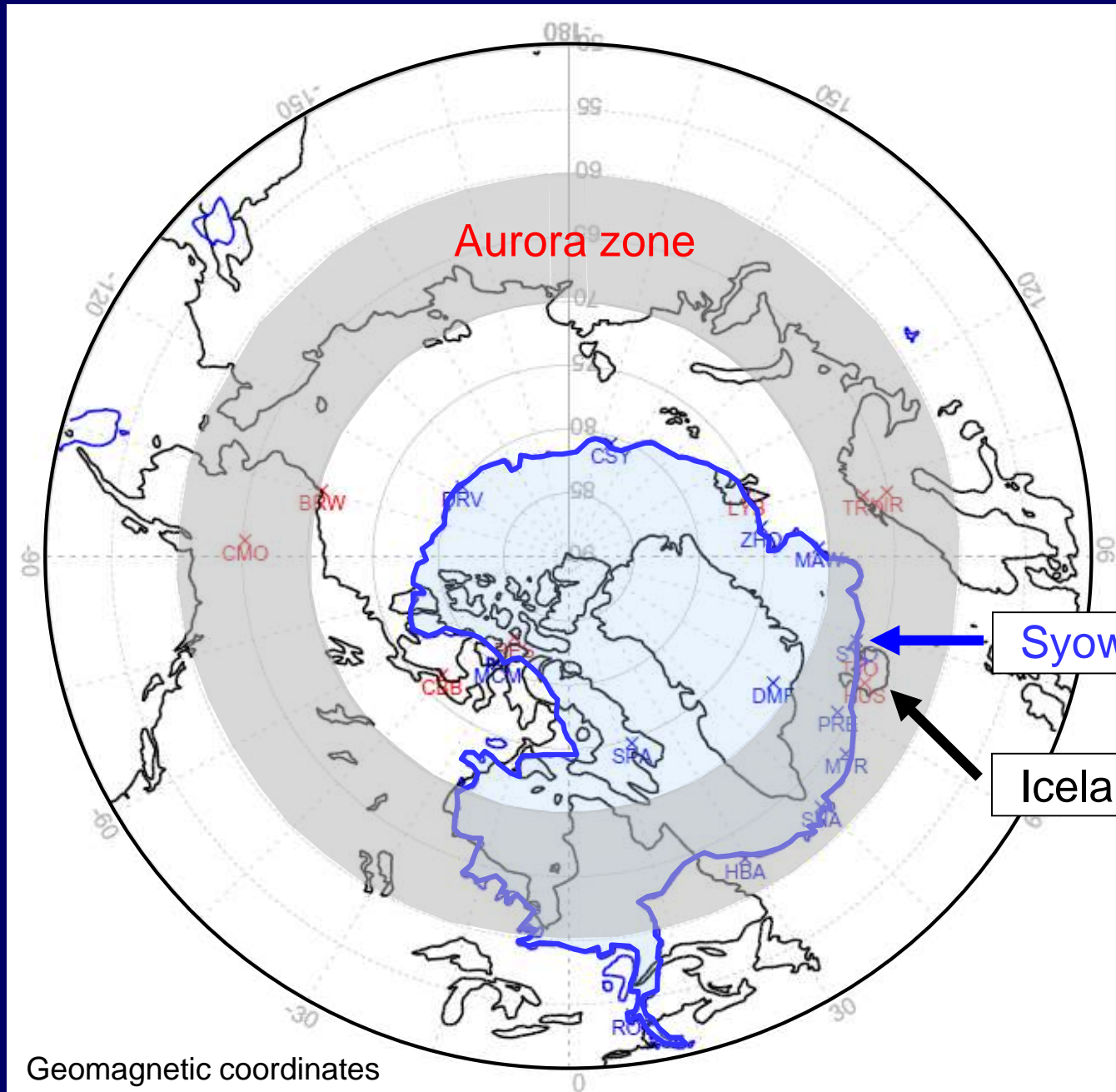
Future
Dream



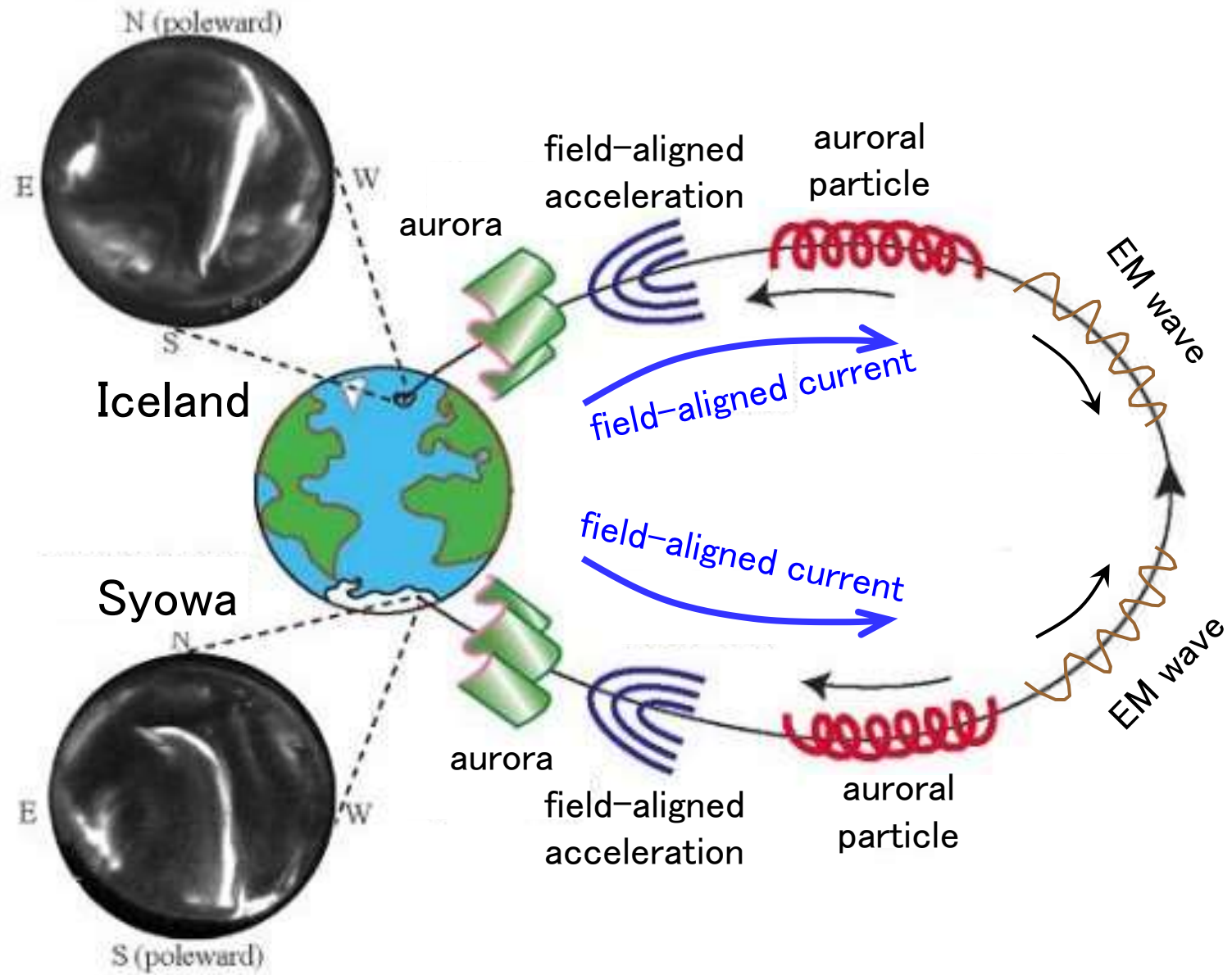
International Collaboration in northern hemisphere



Geomagnetic conjugate locations



Syowa-Iceland Auroral Conjugate Observation



Conjugate point of Syowa Station in Iceland (IGRF)



Conjugate Stations

Husafell



Tjornes



Syowa



Collaboration among Univ. Iceland, NIPR, and UKM (Universiti Kebangsaan Malaysia)



UKM GPS instruments at Husafell, Iceland



EISCAT Scientific Association

Associates



Time buyer



Tromsø VHF radar

EISCAT Svalbard Radar



Tromsø UHF radar

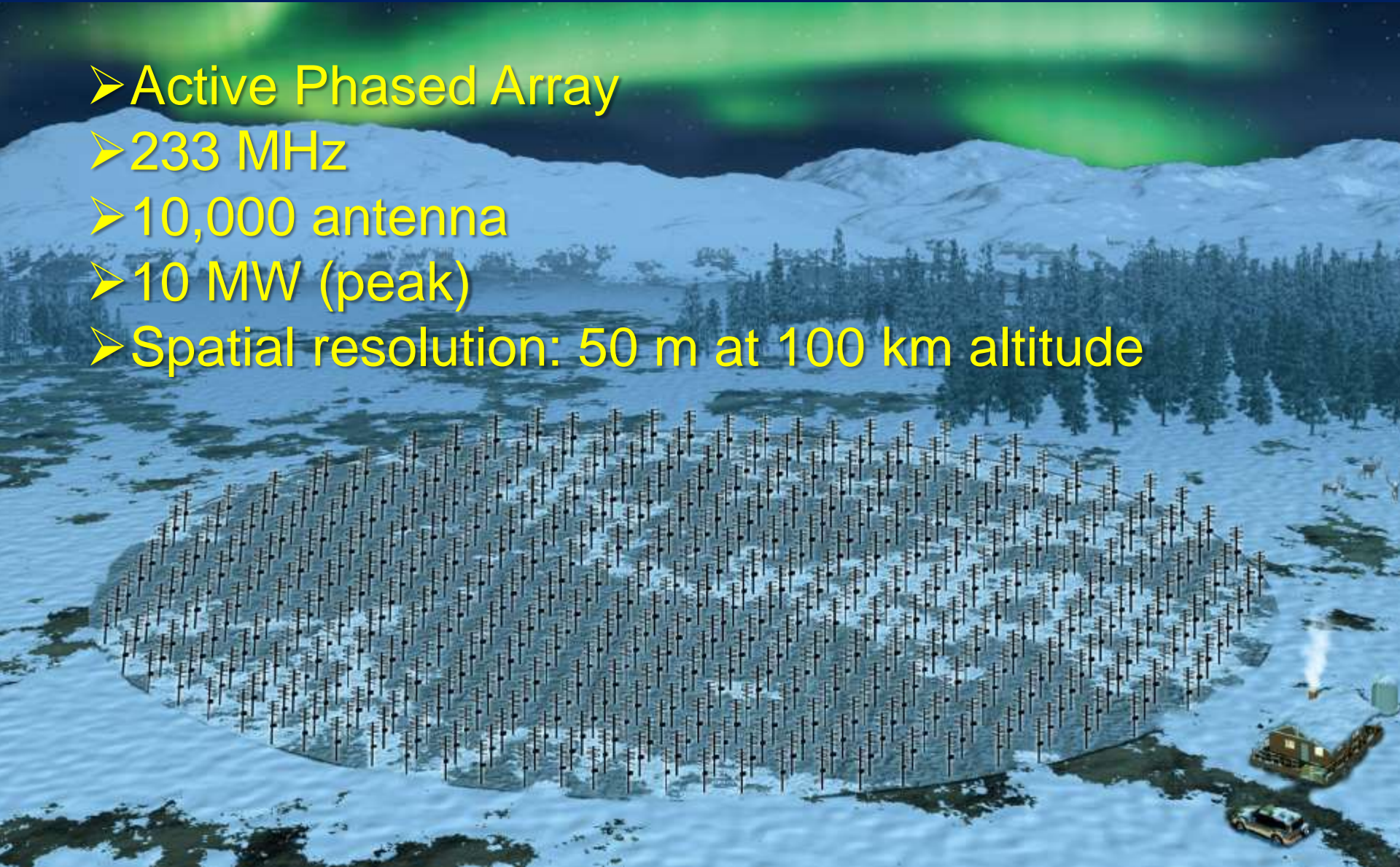
Kiruna VHF radar

Sodankyla VHF radar



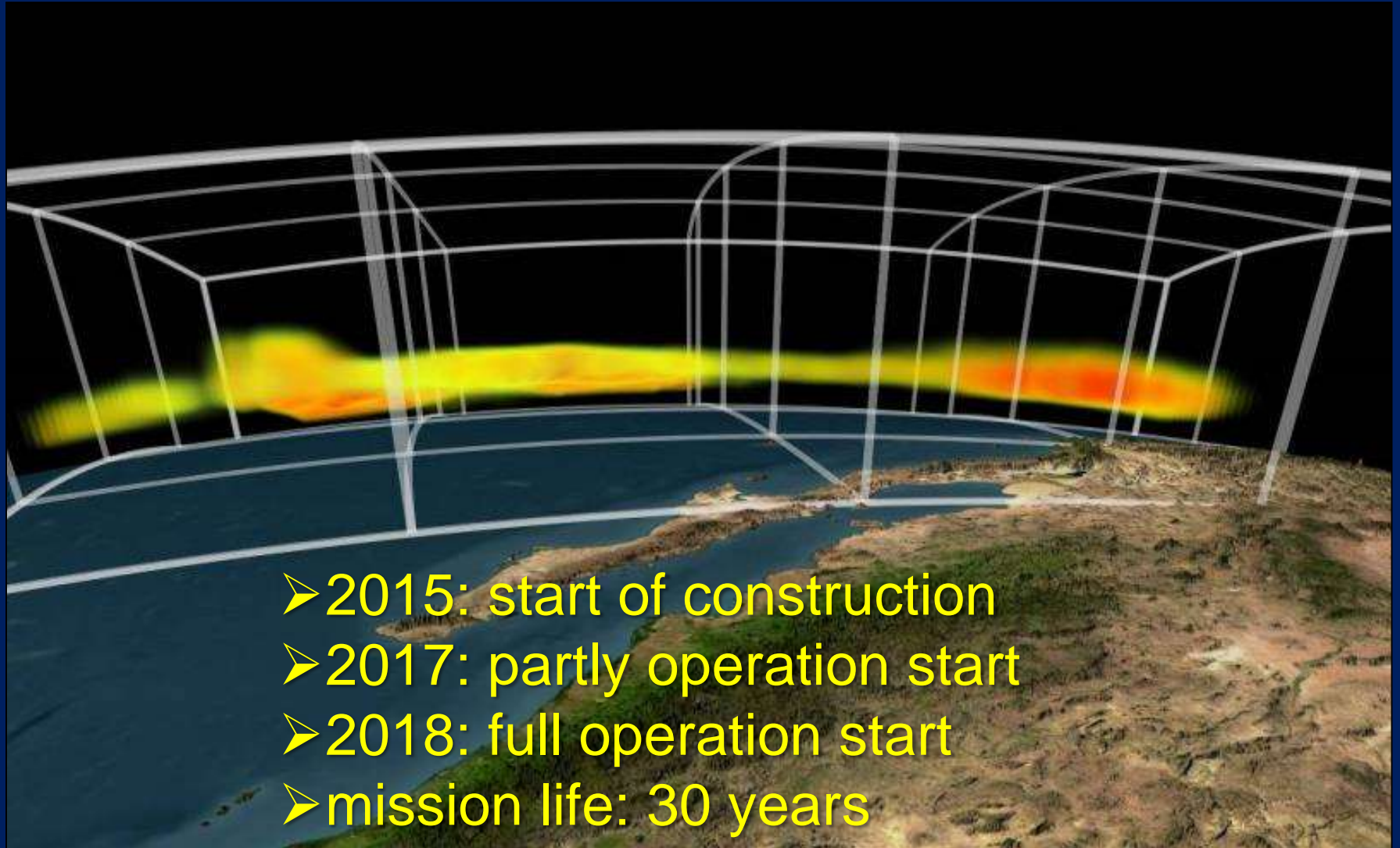
EISCAT next generation: EISCAT_3D

- Active Phased Array
- 233 MHz
- 10,000 antenna
- 10 MW (peak)
- Spatial resolution: 50 m at 100 km altitude

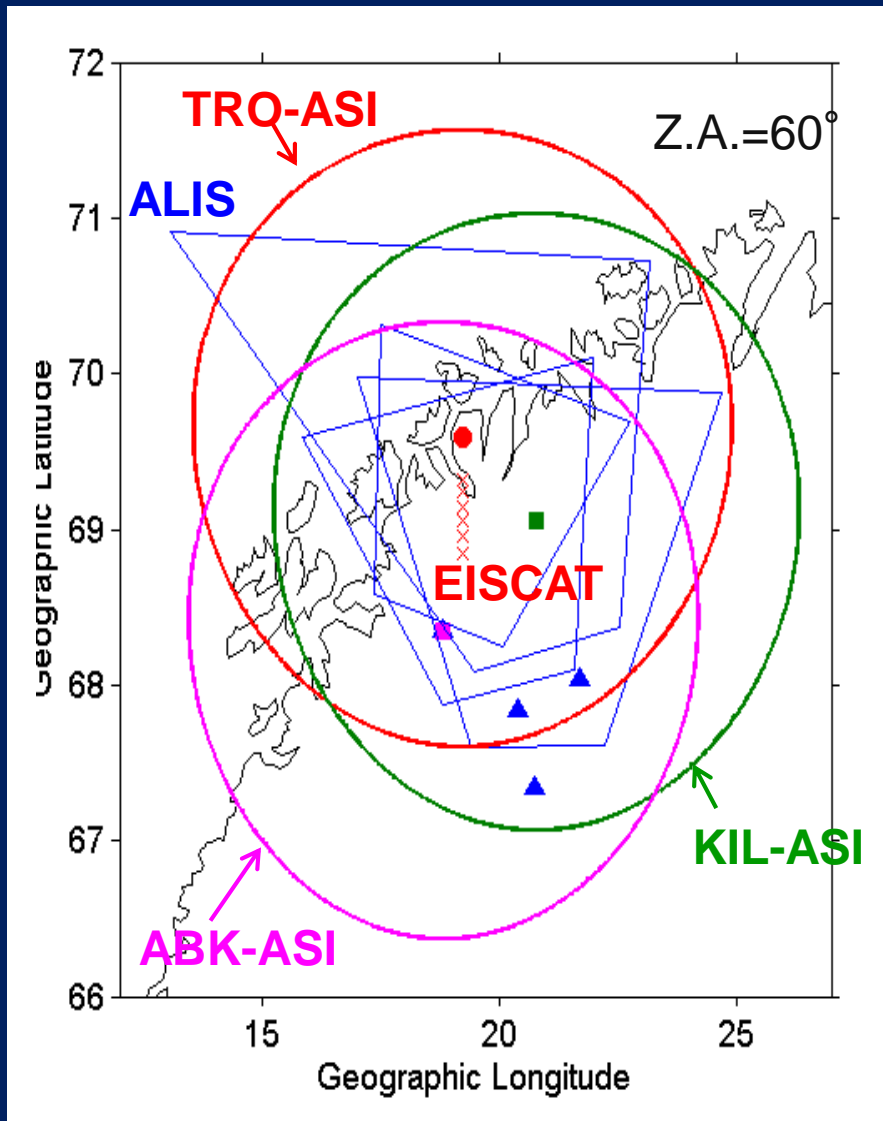


EISCAT next generation: EISCAT_3D

3D imaging of ionosphere within 10 sec



Auroral Tomography study with ALIS, MIRACLE, EISCAT



All-sky EMCCD imagers

■ Stations:

- Tromso (NIPR)
- Kilpisjarvi (FMI, MIRACLE)
- Abisko (FMI, MIRACLE)
- Kiruna (IRF, ALIS)
- Silkkimuotka (IRF, ALIS)
- Tjautjas (IRF, ALIS)

■ Wave length: 427.8 nm

■ Exposure: 2 sec

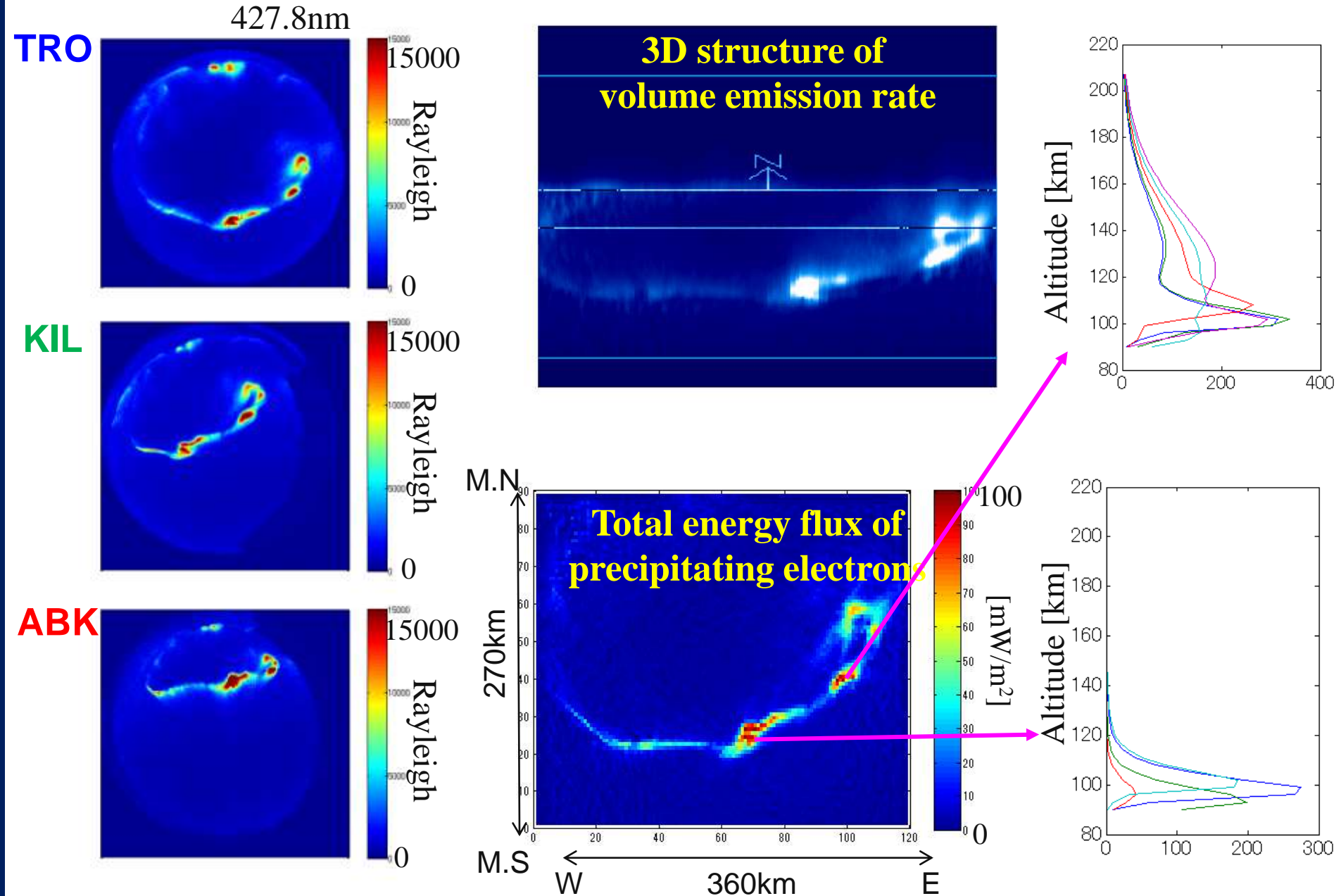
■ Cadence: 2sec

EISCAT radar

■ Meridional scan (Elev.=56-80°)

■ Cadence: 30sec

Auroral Tomography study with ALIS, MIRACLE, EISCAT



Summary

- International collaboration in both polar region is essentially important for the space and upper atmospheric sciences study because of its global characteristics.
- Further international collaboration in both polar region, especially in Antarctica should be proceeded in the future to obtain further scientific outputs.