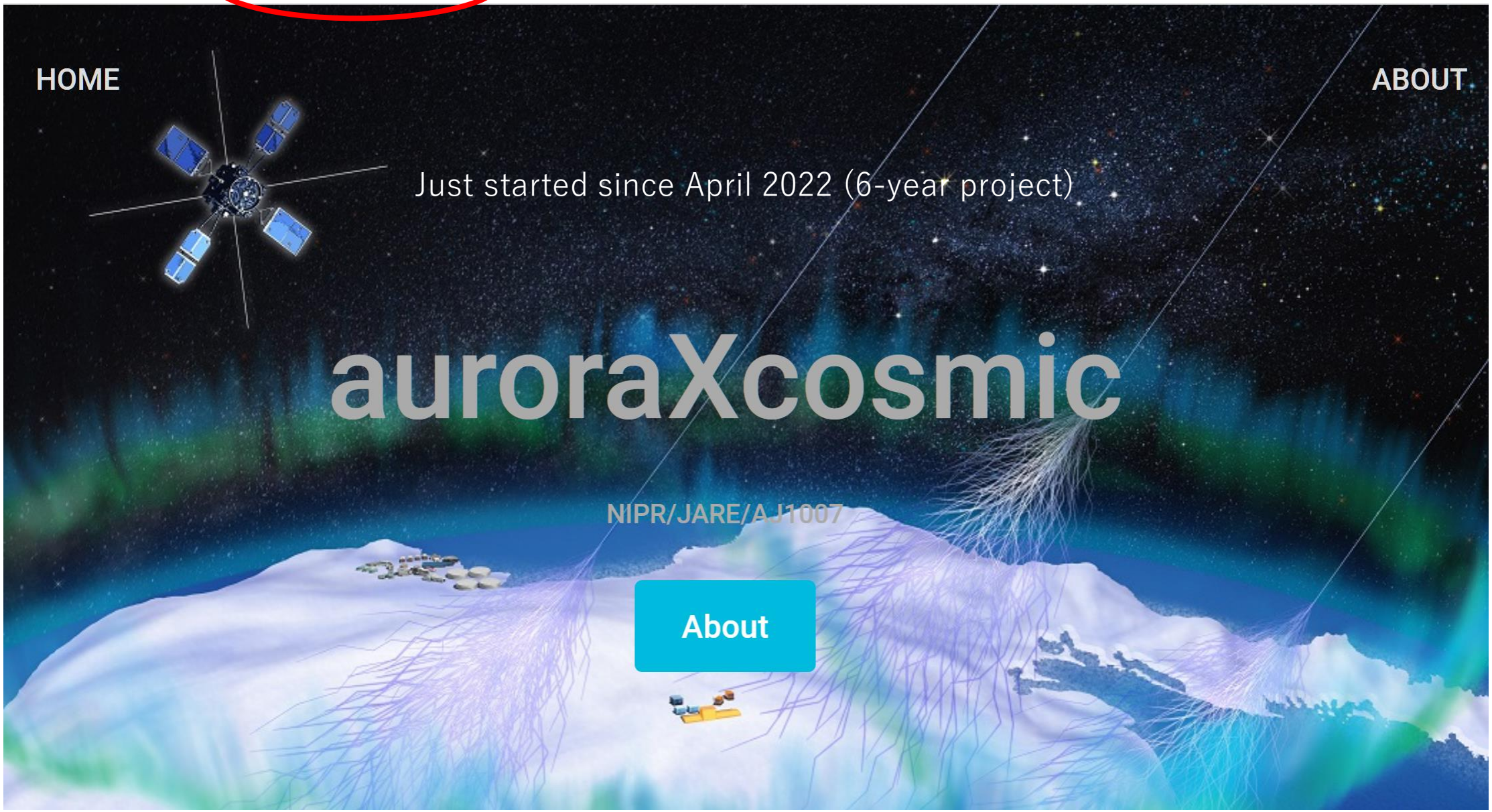
保護されていない通信 | polaris.nipr.ac.jp/~aurorax/



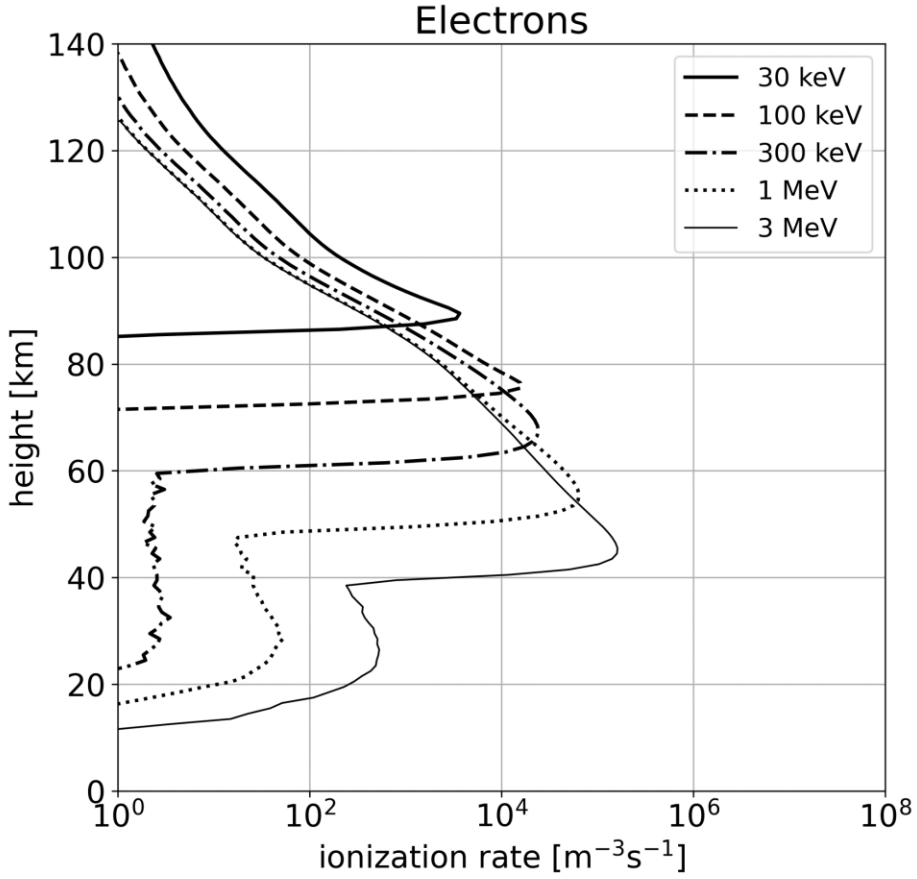
>25 all-Japan preparation team member

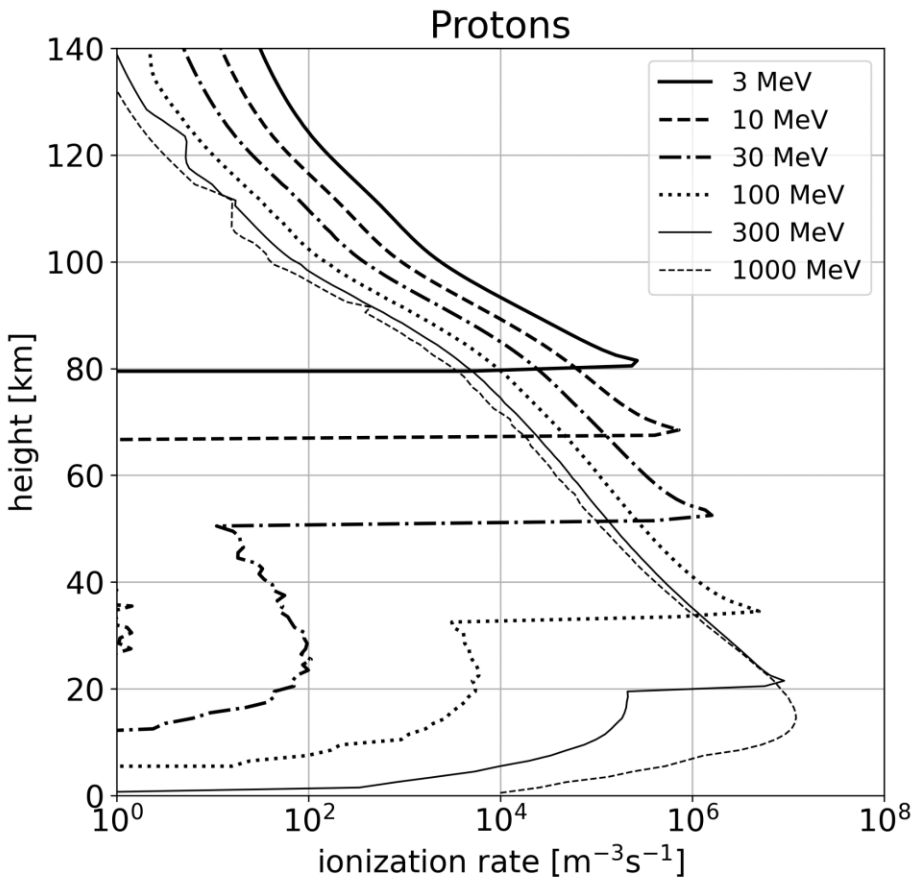
- PI: Ryuho Kataoka (National Institute of Polar Research, Speaker of this talk)
- System development: Takeshi Sakanoi, Keisuke Hosokawa, Takanori Nishiyama, Yasunobu Ogawa
- Radio at Syowa: Akira Mizuno
- Riometer at Syowa: Yoshimasa Tanaka
- Cosmic rays at Syowa: Chihiro Kato, Masayoshi Kozai, Shoko Miyake
- U.S. collaboration (South Pole/McMurdo): Yusuke Ebihara
- SuperDARN collaboration: Akira Sessai Yukimatu
- REPPU simulations: Shigeru Fujita, Masakazu Watanabe
- Arase collaboration: Yoshizumi Miyoshi
- PhD Students: Yuki Nakamura, Hiroyasu Kondo, Kiyoka Murase
- Support members: Mitsumu Ejiri, Takashi Minoshima, Naoki Terada
- Advisors: Akira Kadokura, Kazuo Shiokawa, Kazuoki Munakata, Hisao Yamagishi, Takashi Tanaka

Space weather and space climate as seen from Antarctica

- New JARE Prioritized Research Project AJ1007 (Space environmental changes and their effects on the Earth's atmosphere explored from the polar cap region, 2022-2027), “auroraXcosmic project” in short, is supported by NIPR. We will study space weather and space climate from Antarctica to understand how the Earth system is open to space.
- The polar cap (magnetic latitude >75 deg) is a special region where geomagnetic field is mostly open to the solar wind, and therefore the atmosphere is directly affected by various types of energetic particles from space.

Atmospheric ionization by energetic particles



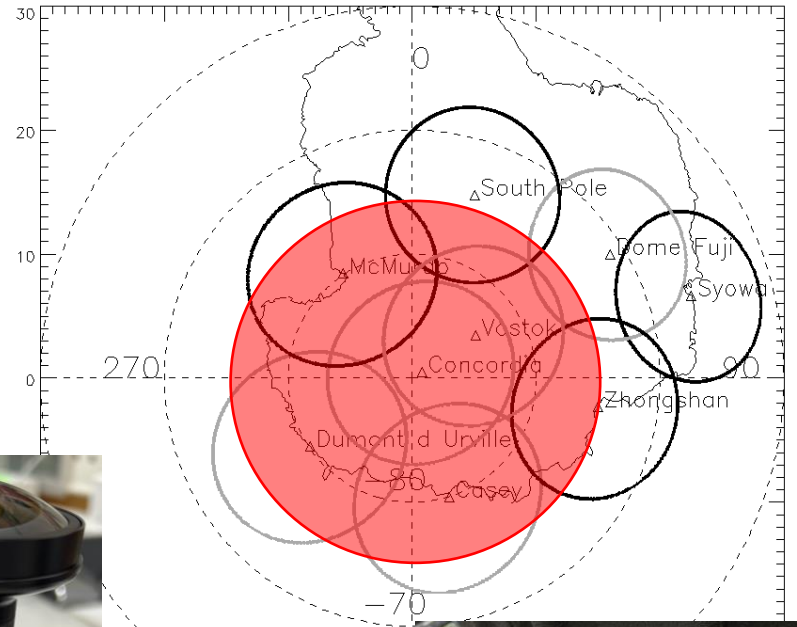


PHITS simulation: Textbook “Extreme Space Weather” by Ryuho Kataoka (2022)

International Collaboration Plan

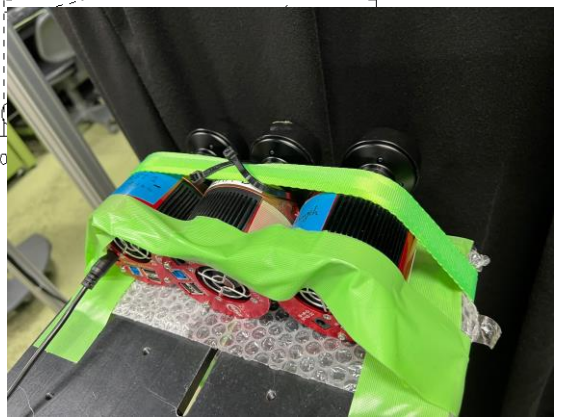
- Auroras can visualize the atmospheric impact from auroral electrons and solar protons. However, the auroras in the polar cap are less understood because of relatively poor coverage of imaging observations.
- We will be able to solve the technical problem by developing and distributing new imagers by international collaborations. We will also contribute to real-time cosmic-ray observation network.
- We will then contribute better understanding of the outer boundary of Earth system, via close collaborations with simulations and data science (data will be open to public).
- We are developing a small auroral imager system, including a tough housing bearable for Antarctica. The system will be low-cost, low-power, portable, and the data will be obtained real-time. The first model will be tested in new Dome-Fuji station in 2023, and then be provided or distributed for future international collaboration in Antarctica.
- We identified two good wavelengths: High-altitude red aurora at 630.0 nm and low-altitude polar glow at 391.4 nm. (The red aurora has been used to identify the open/closed boundary of geomagnetic field.)

Gray circles: future possible FOVs by international collaborations

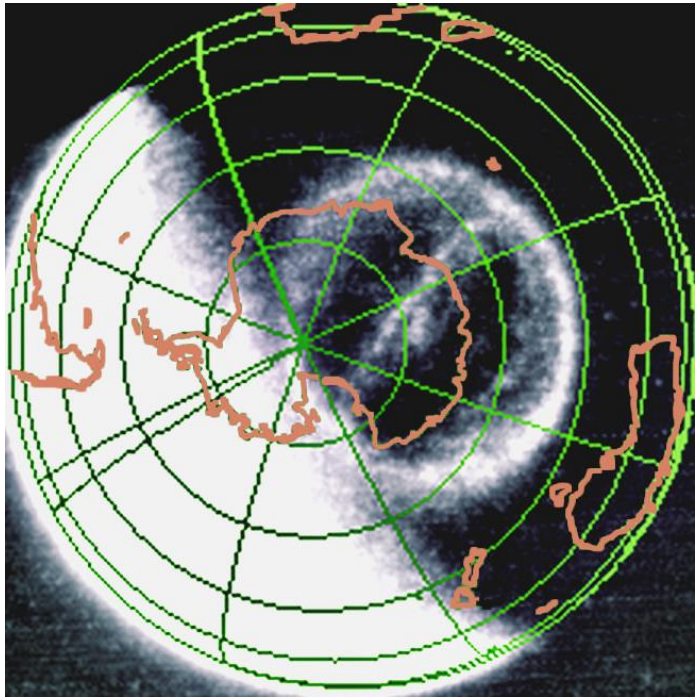


optical filter inside

multi wavelengths

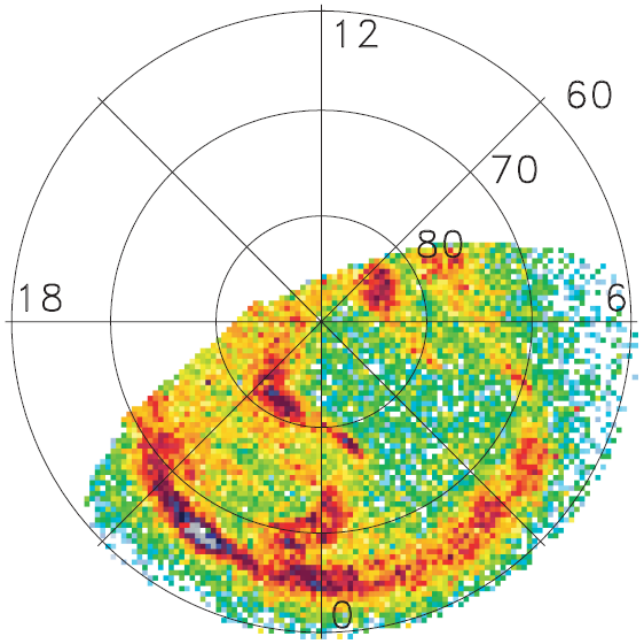


Extreme auroras during low-Mach solar wind



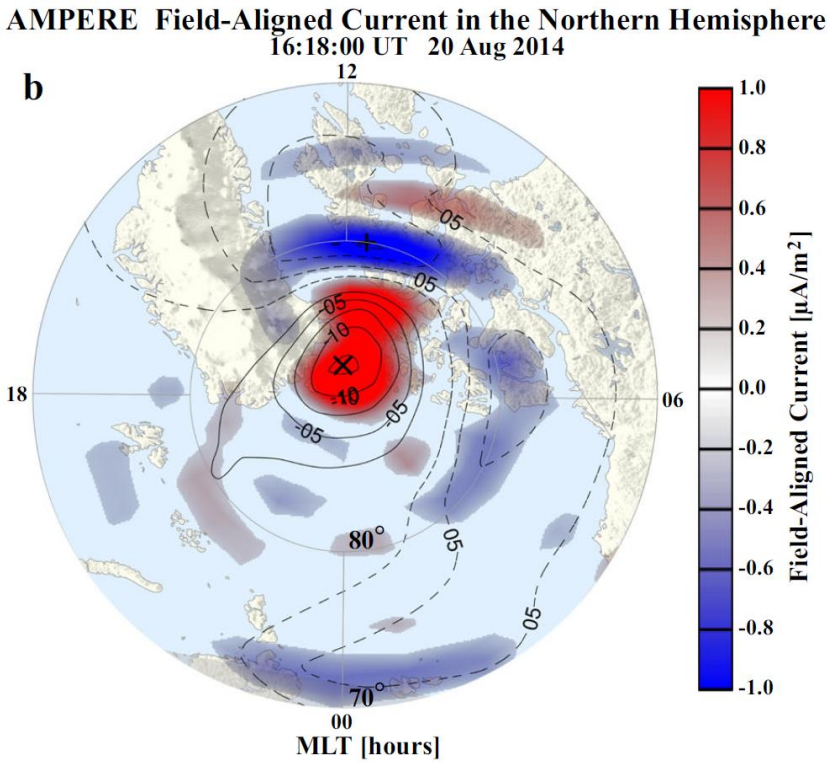
Theta aurora (Credit: NASA/SWRI)

Strong IMF-BY aurora?



Giant spiral (Rosenqvist et al., 2007)

Strong SBZ aurora?

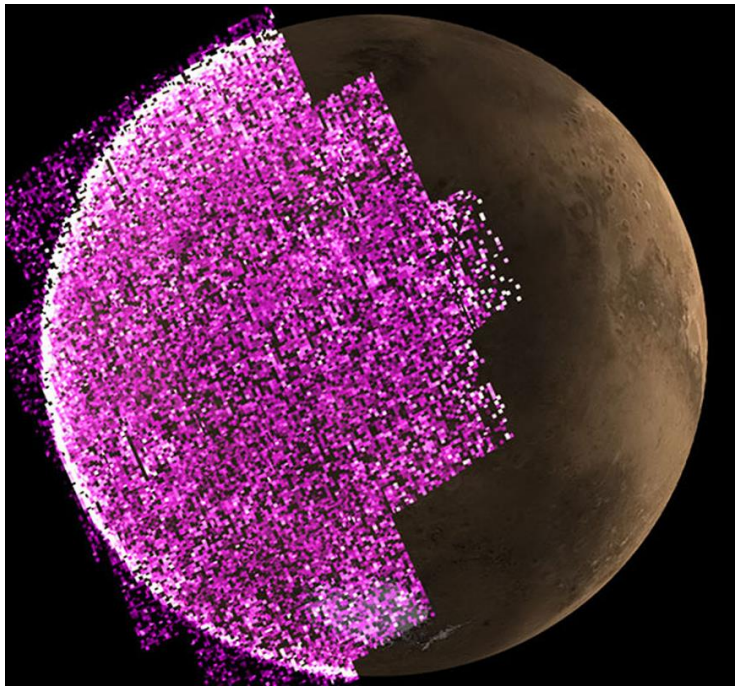


Space hurricane (Zhang et al., 2021)

Strong NBZ aurora?

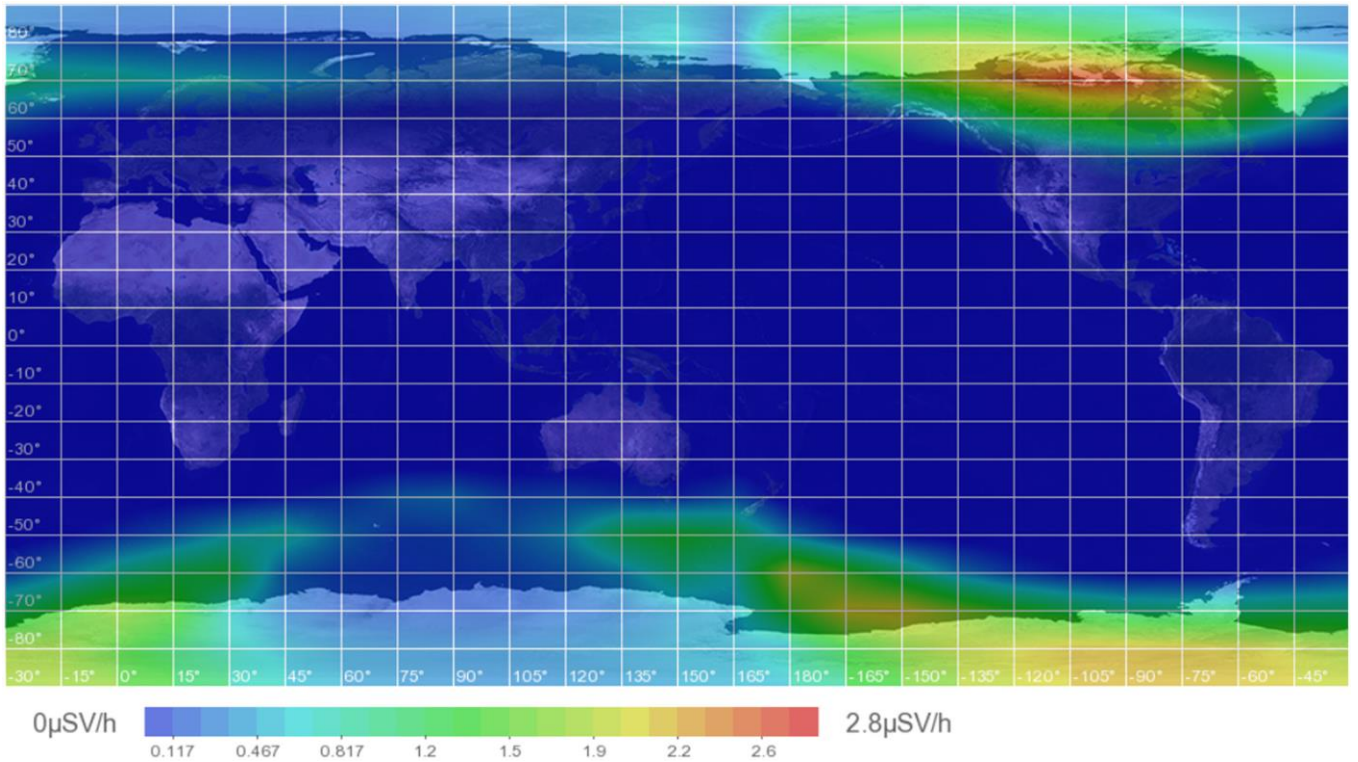
Polar-cap glow due to solar energetic protons

~polar glow aurora at Earth



Mars aurora (Schneider et al., 2018)

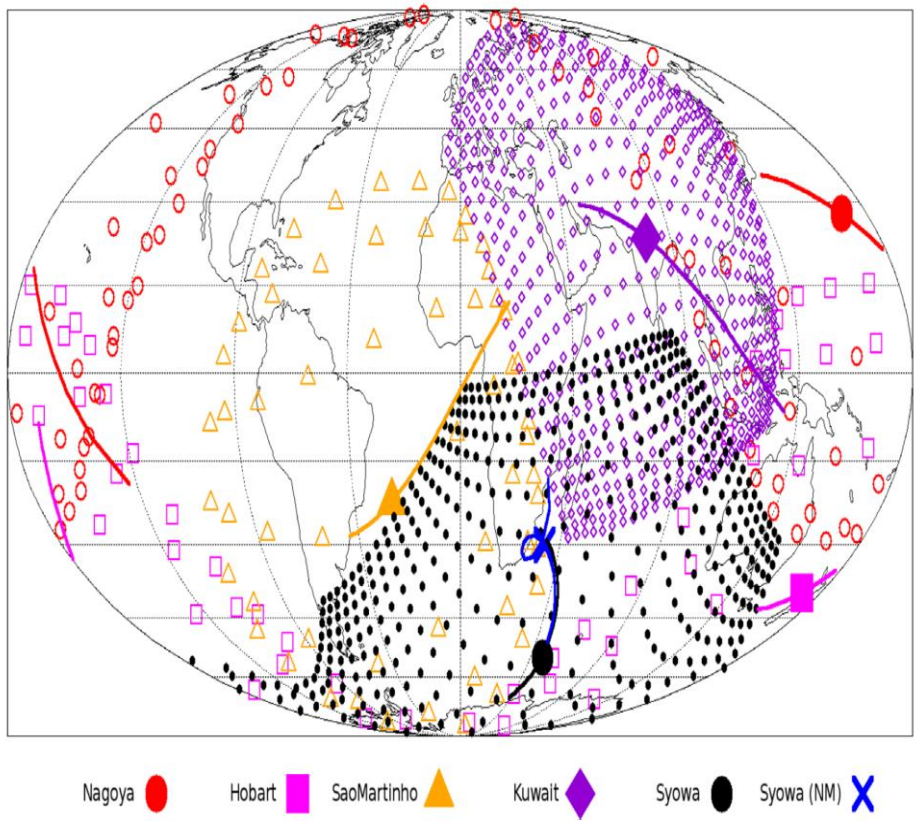
MeV protons



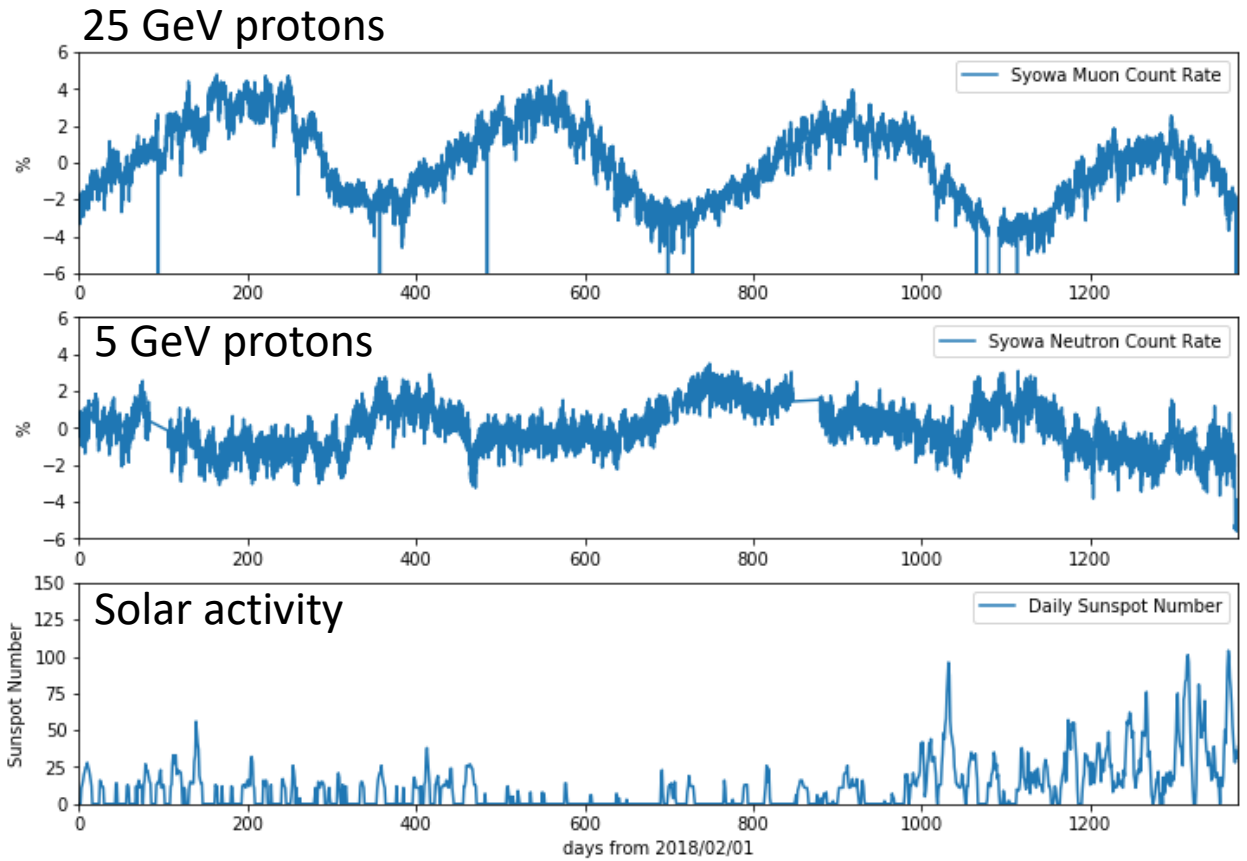
Radiation dose map of Earth (Kataoka et al., 2018)

GeV protons

Cosmic ray variations due to solar activity

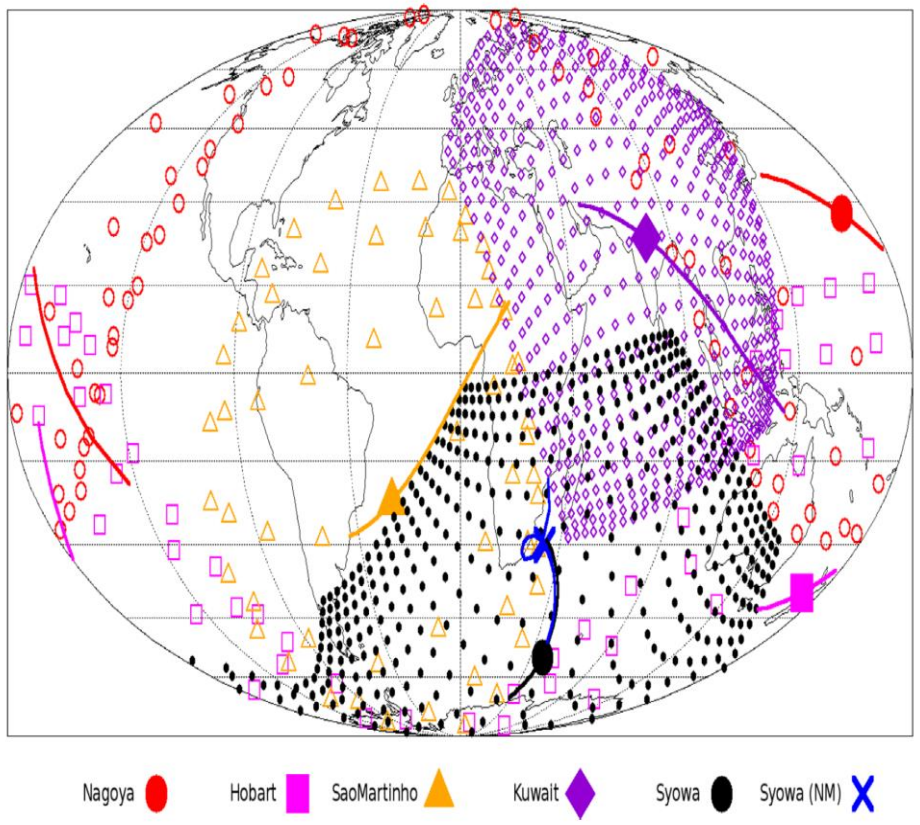


Global Muon Detector Network (Kato et al., 2021)

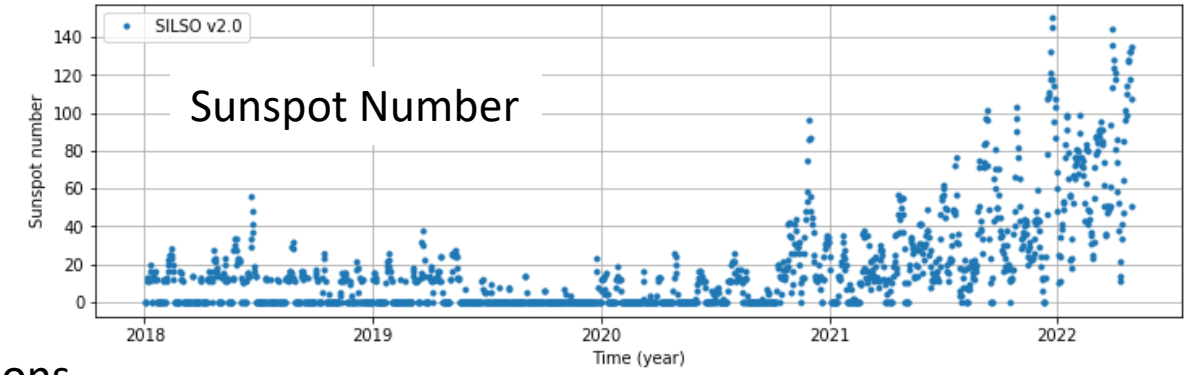


New solar cycle 25 started from 2020 (day ~700)

Solar modulation of cosmic rays

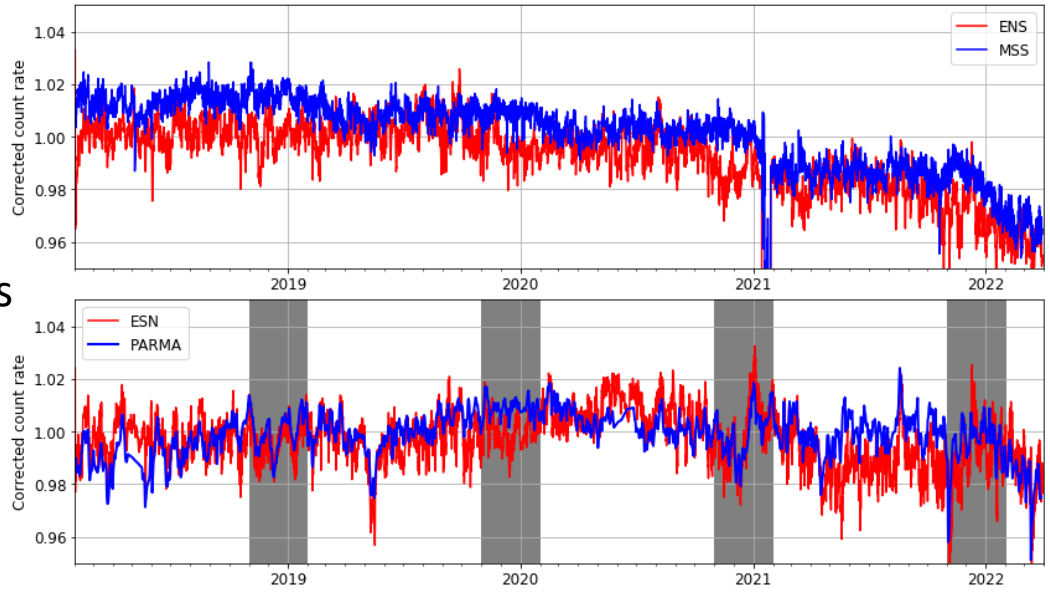


Global Muon Detector Network (Kato et al., 2021)



Muons

Neutrons



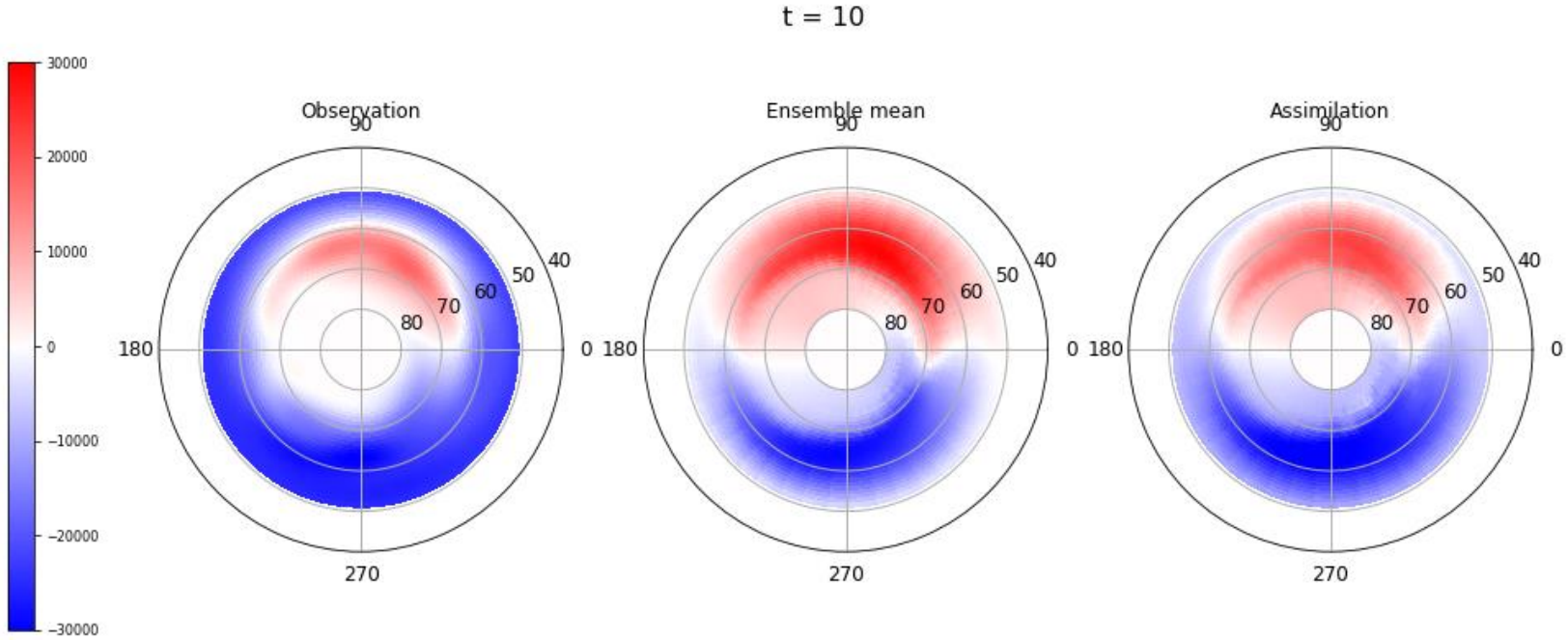
Four-year data accumulated (Kataoka et al., 2022)

Syowa observation suits

- The high-energy solar protons will be observed by neutron monitor and muon detector at Syowa Station
  - During the auroraXcosmic, the cosmic ray observation at Syowa will be full-system in 2024 and real-time data will be obtained every 10 min.
- Further, we will fully use our heritages: A suit of comprehensive geophysical observations is ongoing at Syowa Station, including SuperDARN, PANSY radar, radio, riometers, high-speed auroral imagers, and magnetometers.
  - Unmanned network observations are also ongoing along the auroral oval via international collaborations.
  - AuroraXcosmic will make many kinds of observation data open to public.

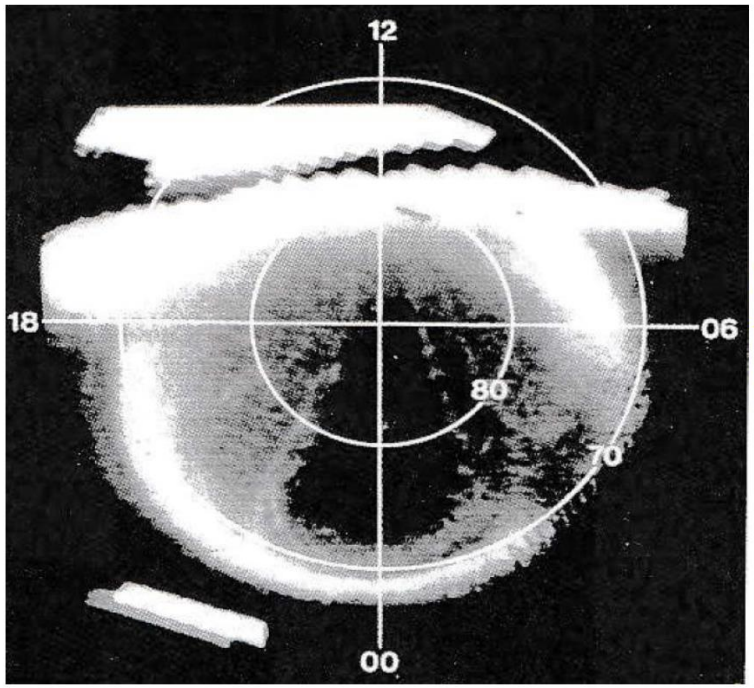
Reanalysis Space Weather Data Study

- Global MHD simulation (REPPU) is used as the physics-based model for the reanalysis data study. AuroraXcosmic will provide the observation data set.
  - PI: Shinya Nakano, collaboration among ISM, NICT, and NIPR.

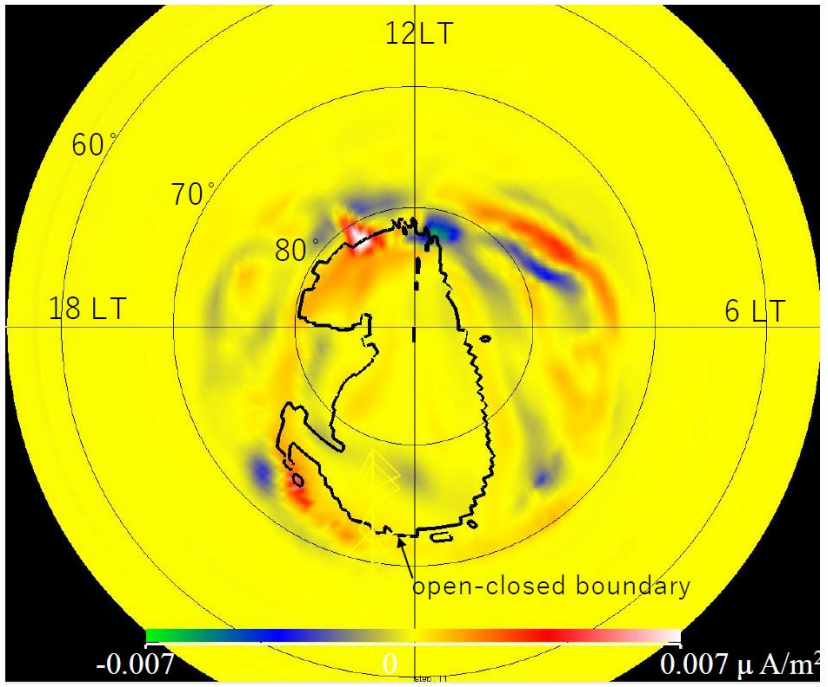


Complexity of NBZ polar cap?

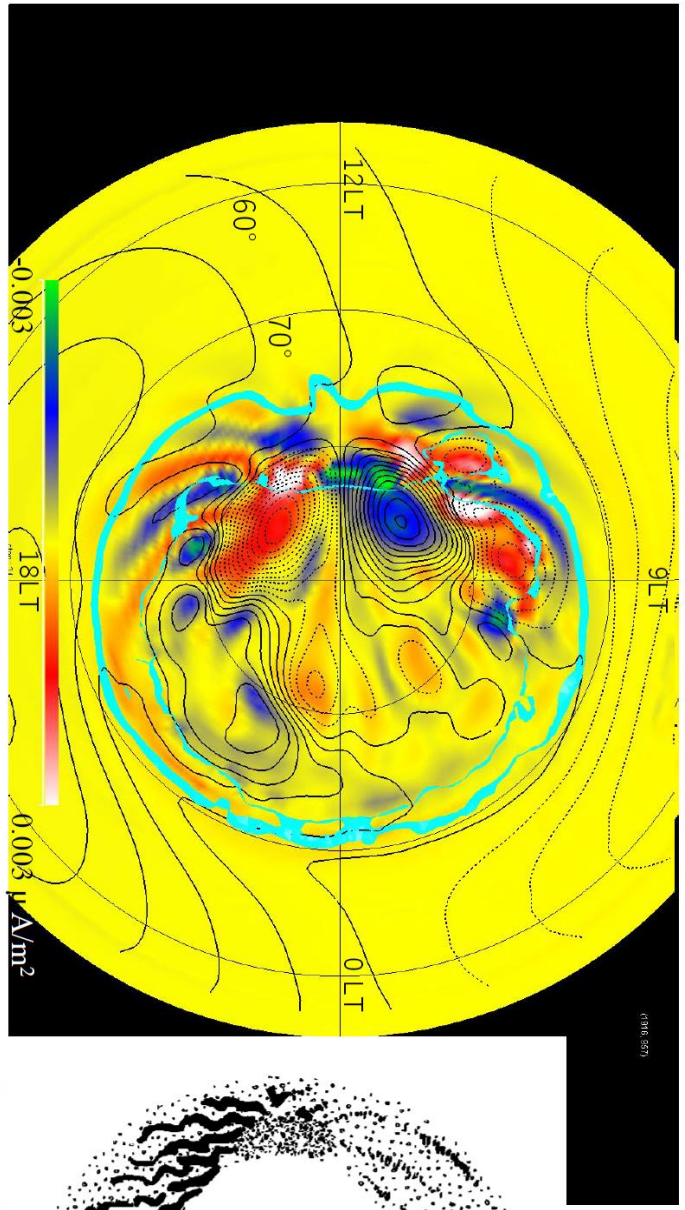
- Comparison with REPPU Lv7 simulation
  - Tanaka et al. (2022 JGR, accepted)

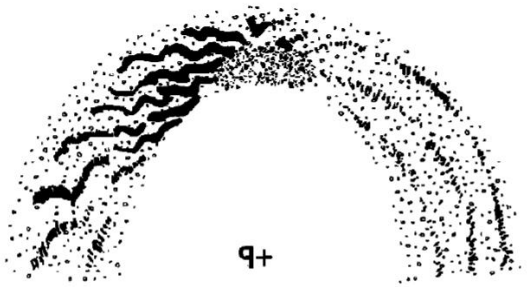


ISIS2 (Murphree et al., 1982)



NBZ By<0 sun-aligned arcs





Meng and Lundin, 1986

NBZ fan arcs

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HOME

ABOUT

Thank you. I hope to collaborate with you in coming 6 years!

If any question, please contact: kataoka.ryuho@nipr.ac.jp

auroraXcosmic

NIPR/JARE/AJ1007

About

Acknowledgment:

- This study is a part of the Science Program of Japanese Antarctic Research Expedition (JARE) Prioritized Research Project (Space environmental changes and atmospheric response explored from the polar cap), supported by National Institute of Polar Research (NIPR) under MEXT.