UN/US International Space Weather Initiative Workshop

Monitoring and investigation of geospace disturbances along the 120E/60W longitudes: International Meridian Circle Project

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International Space Weather Initiative ISWI

Massachusetts Institute of Technology

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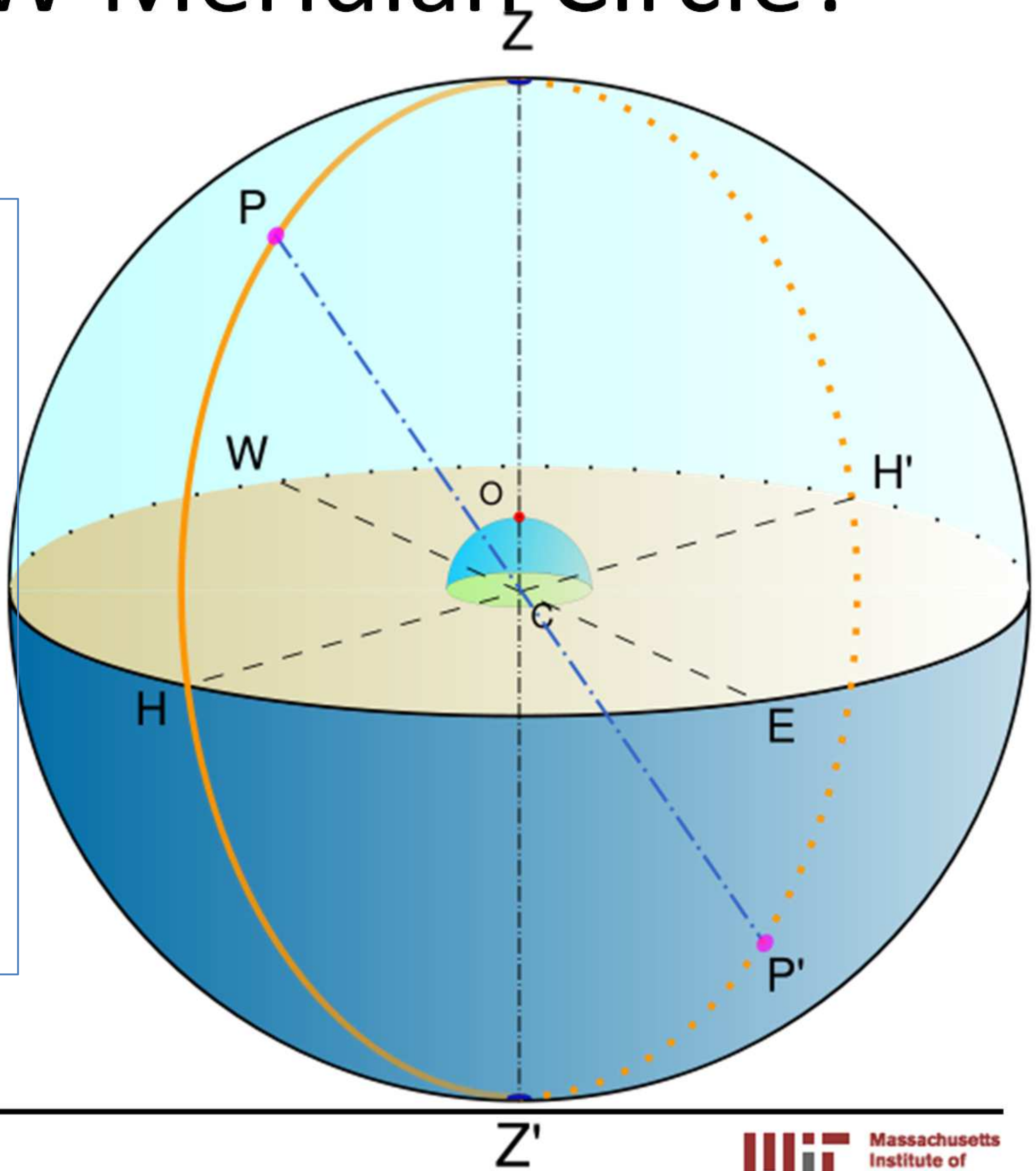
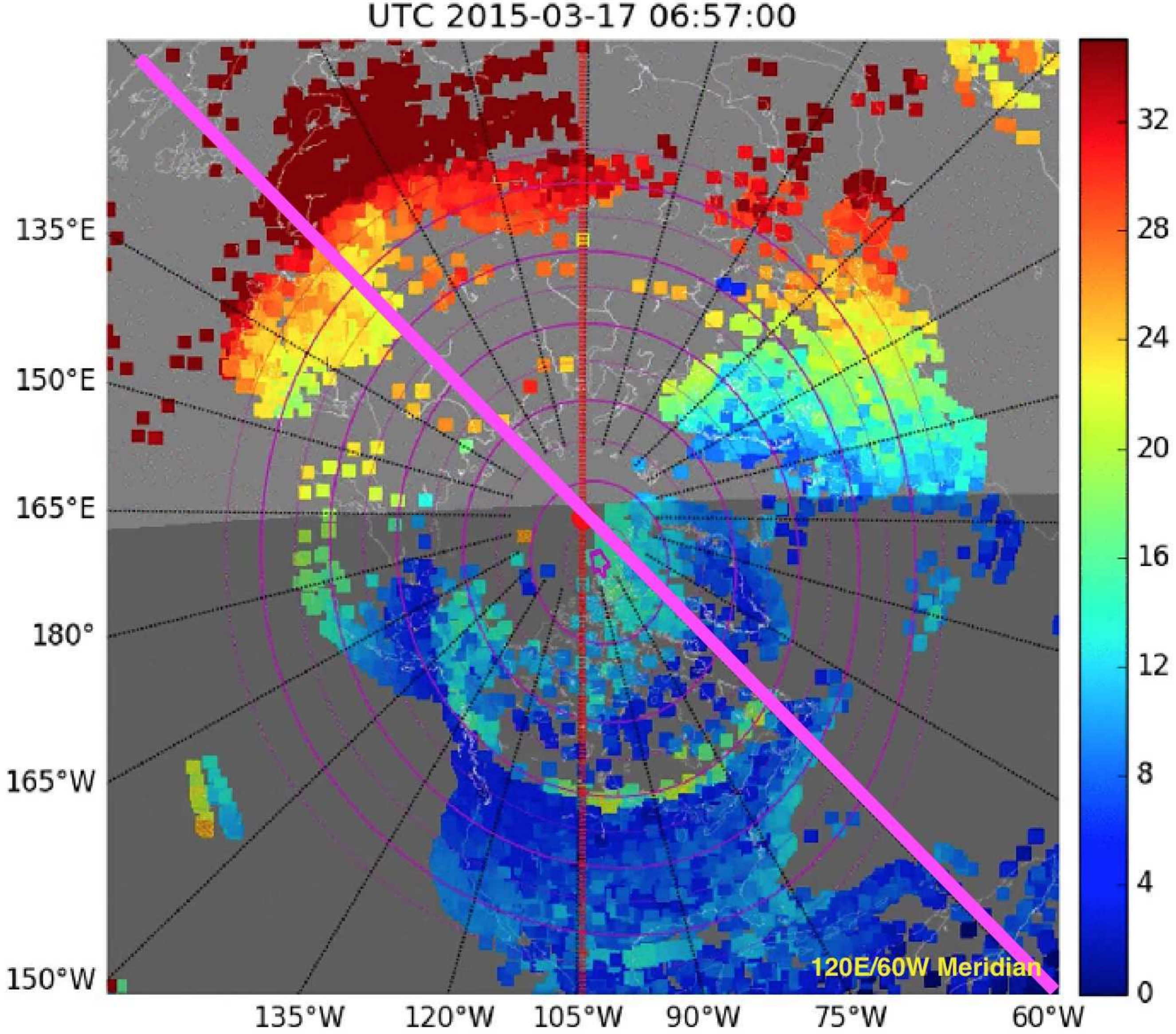
Why 120E/60W Meridian Circle?

- Local time is 12 hr off
  - Noon ←→ Midnight
  - Darn ←→ Dusk
- East Asia and North America Sectors
  - Geomagnetic latitude – geographic latitude = +/- 10 degrees



GNSS TEC MAP



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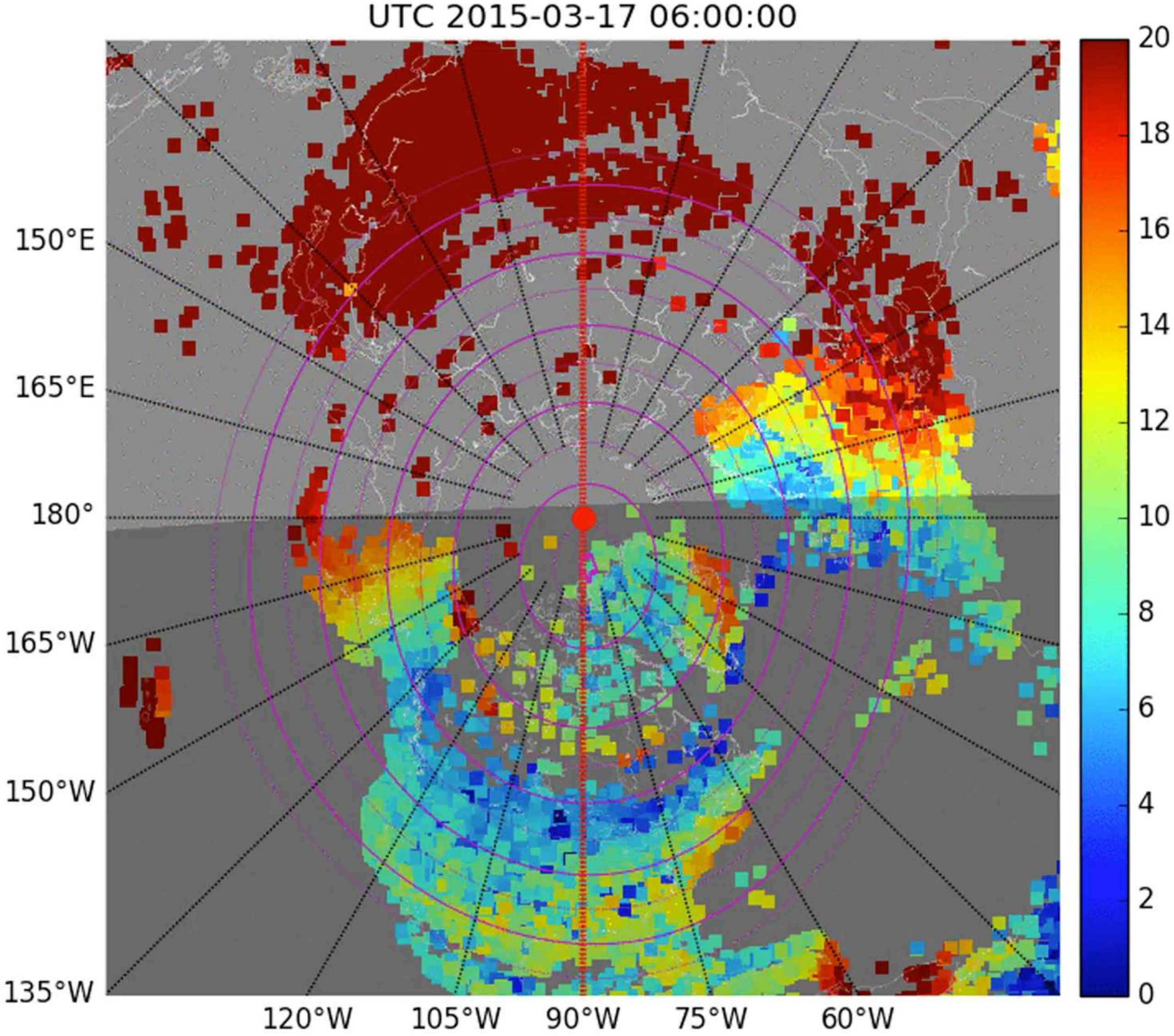
GNSS TEC MAP (movie)



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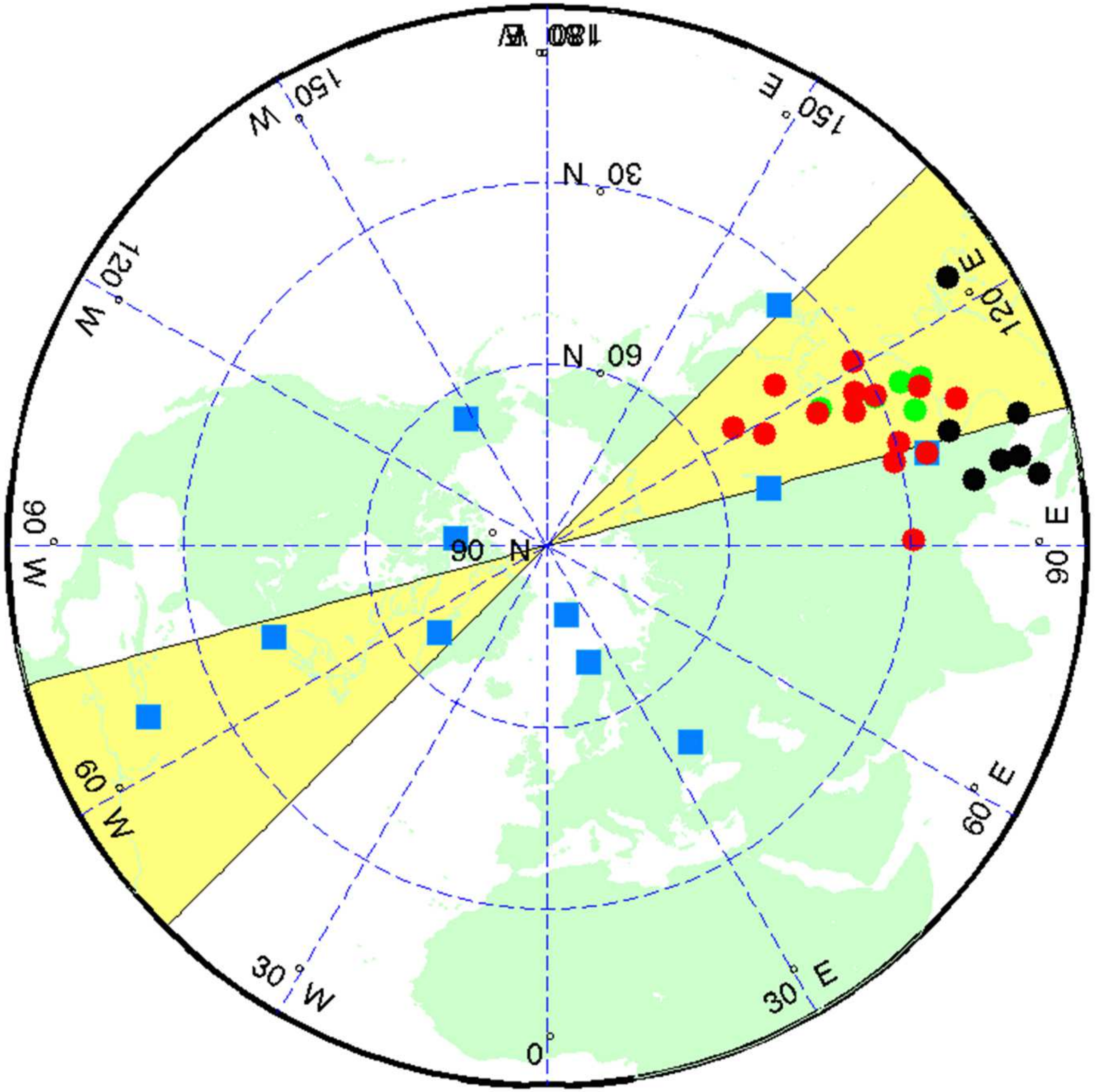
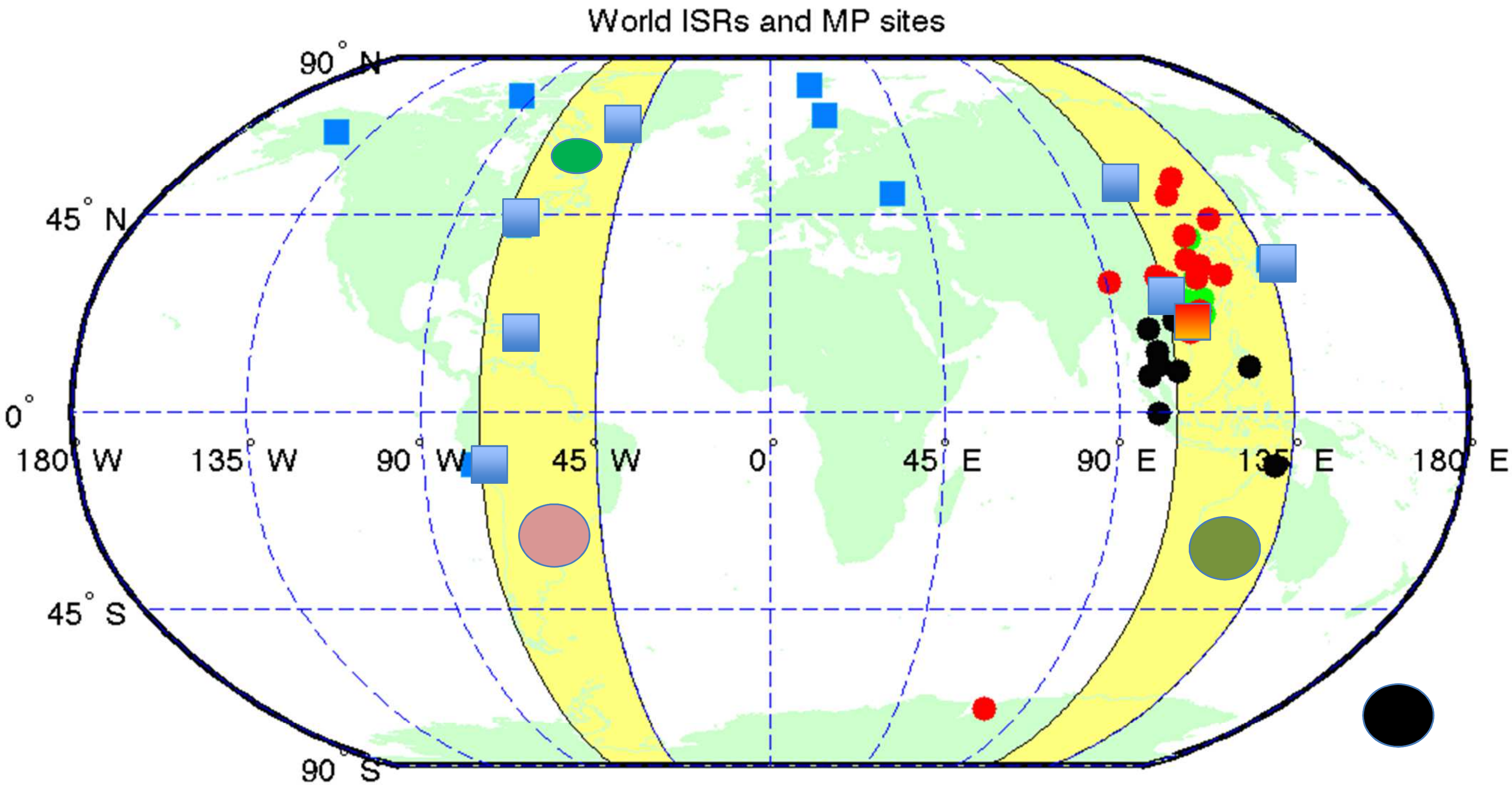
Meridian Circle International Observation: A **Partial** Network (polar view)



Meridian Circle International Observation: A **Partial** Network



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Soundrestrom ISR

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Millstone Hill ISR

N_e

T_e

T_i

V_0

Ion composition

$T_n \leftarrow\rightarrow T_{ex}$

EX**B**

U

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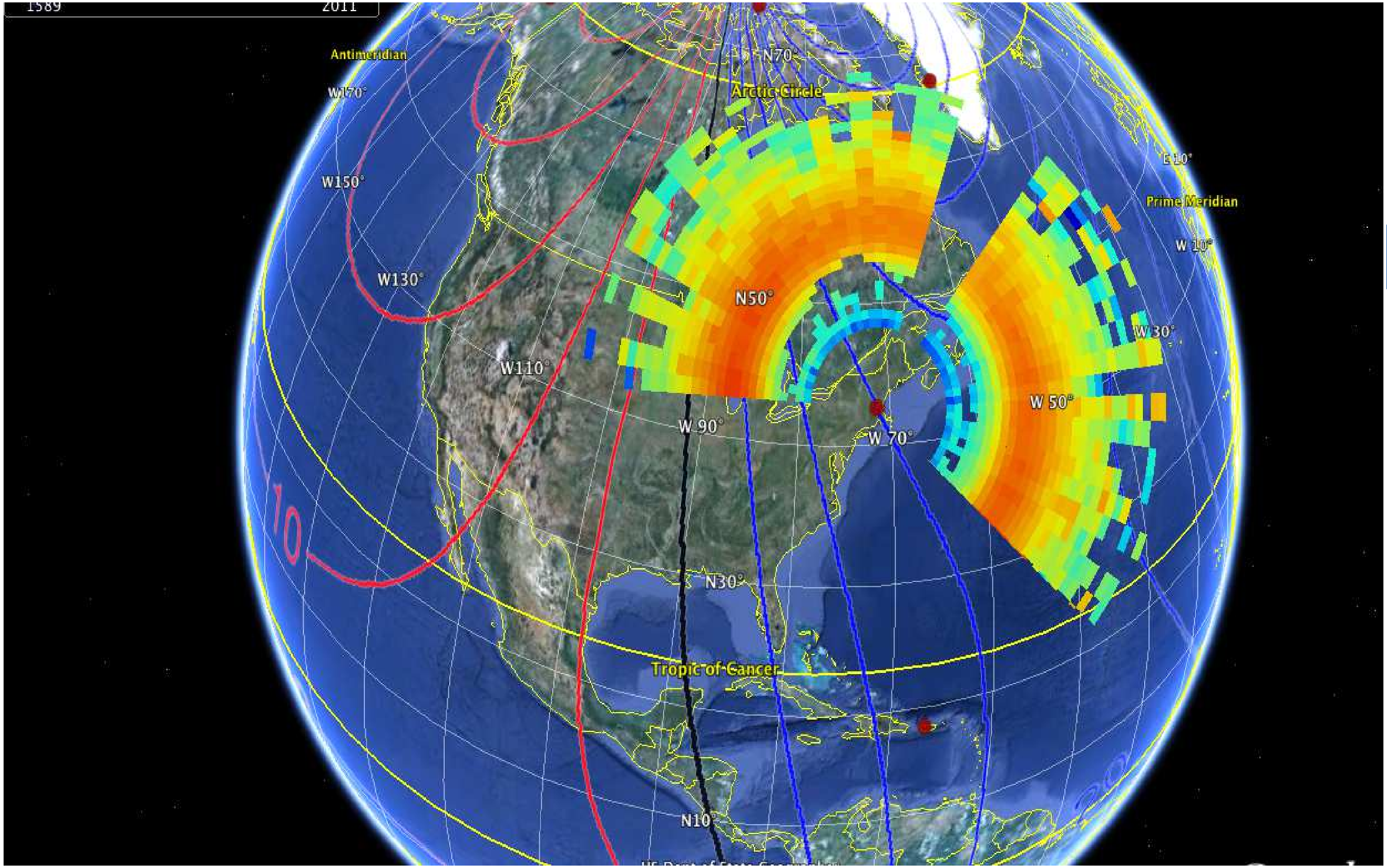
MISA: Super-wide Coverage

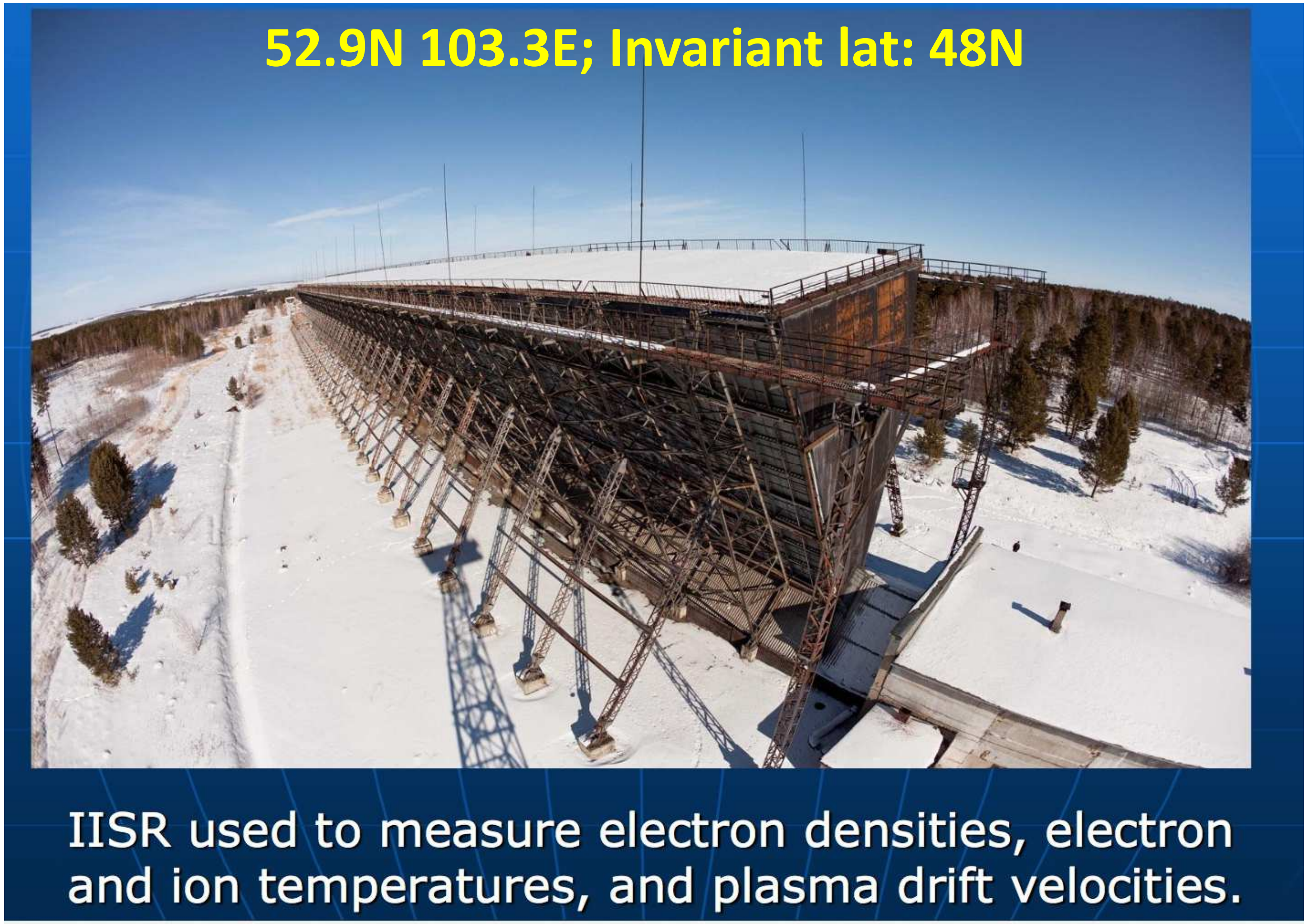


Arecibo ISR

Jicamarca ISR

Irkutsk Incoherent Scatter Radar (IISR)

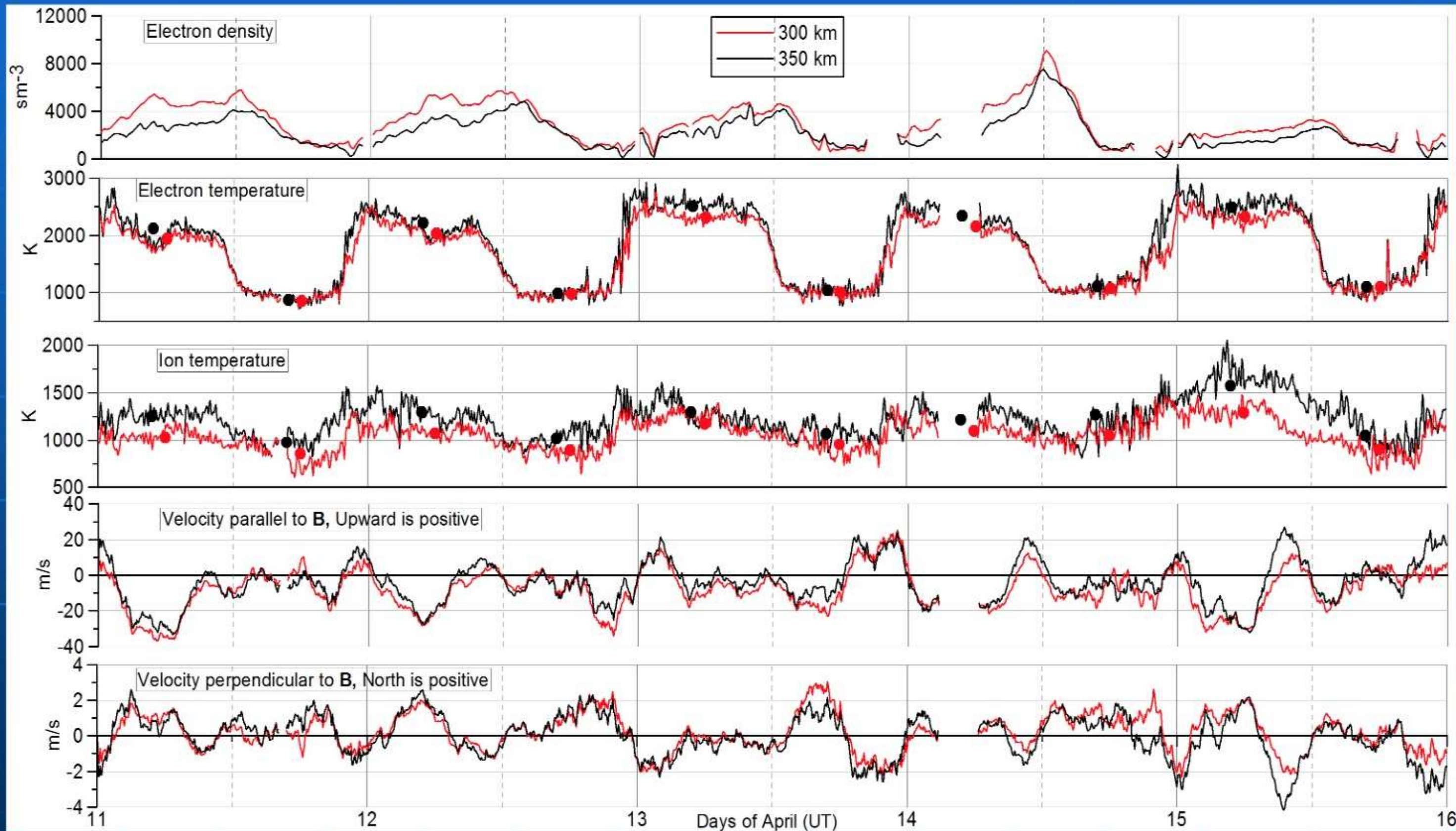
- **Horn Antenna 246x12 m**
- 2 sub-horns
- **f=154-162 MHz**
- Frequency beam steering
- **Polarization filter**
- Pt <3MW
- **Beam 0.5x10 deg**



Medvedev et al. (ISTP)

IISR Observation

Day-to-day variations of electron density, electron temperature, ion temperature, and drift velocities at 300 and 350 km (Irkutsk ISR data)

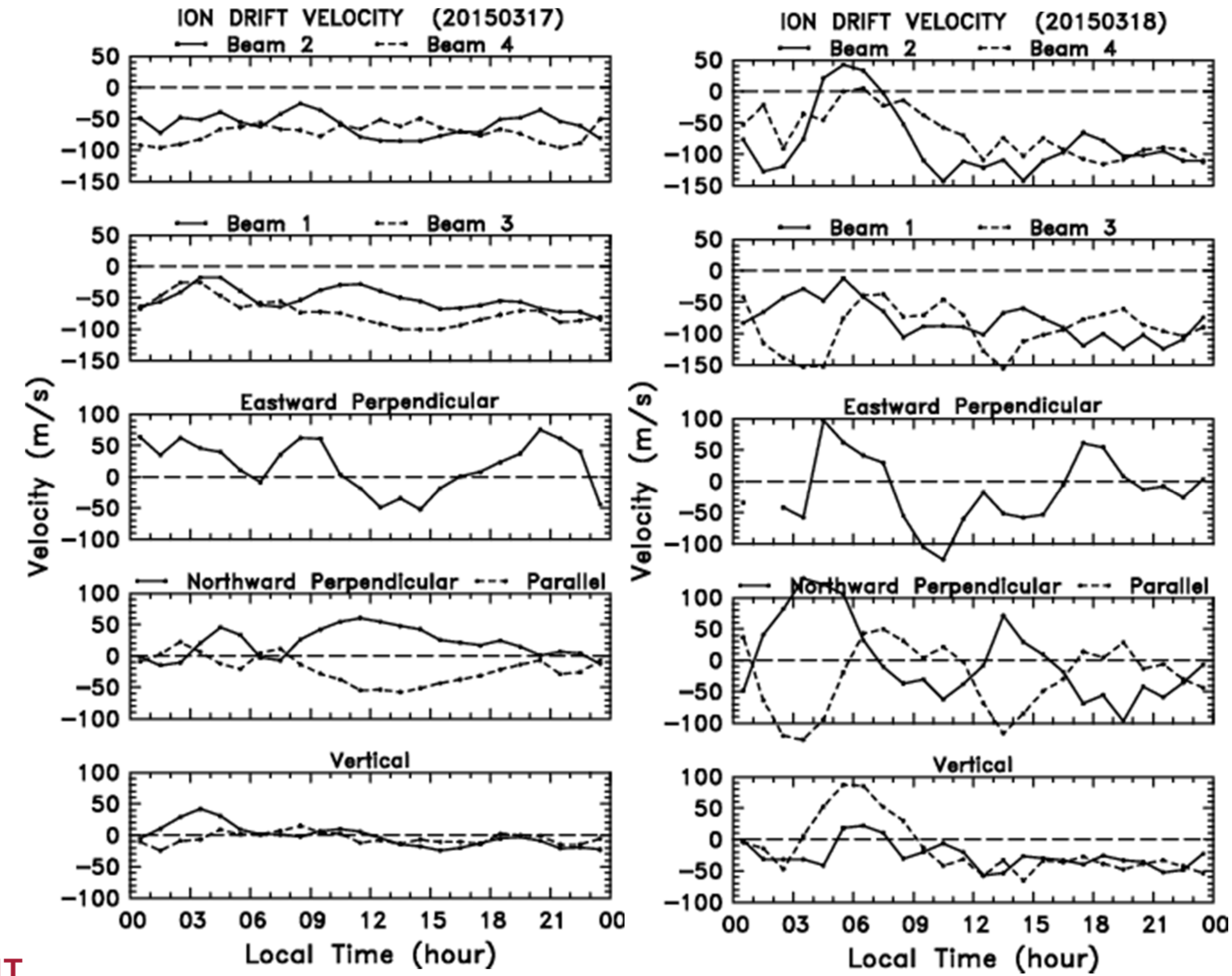


Dusk effect is seen in (1) electron density enhancement, (2) decrease (relative to other days at 12 UT) in electron temperature, and (3) increase in upward drift velocity.

Medvedev et al. (ISTP)

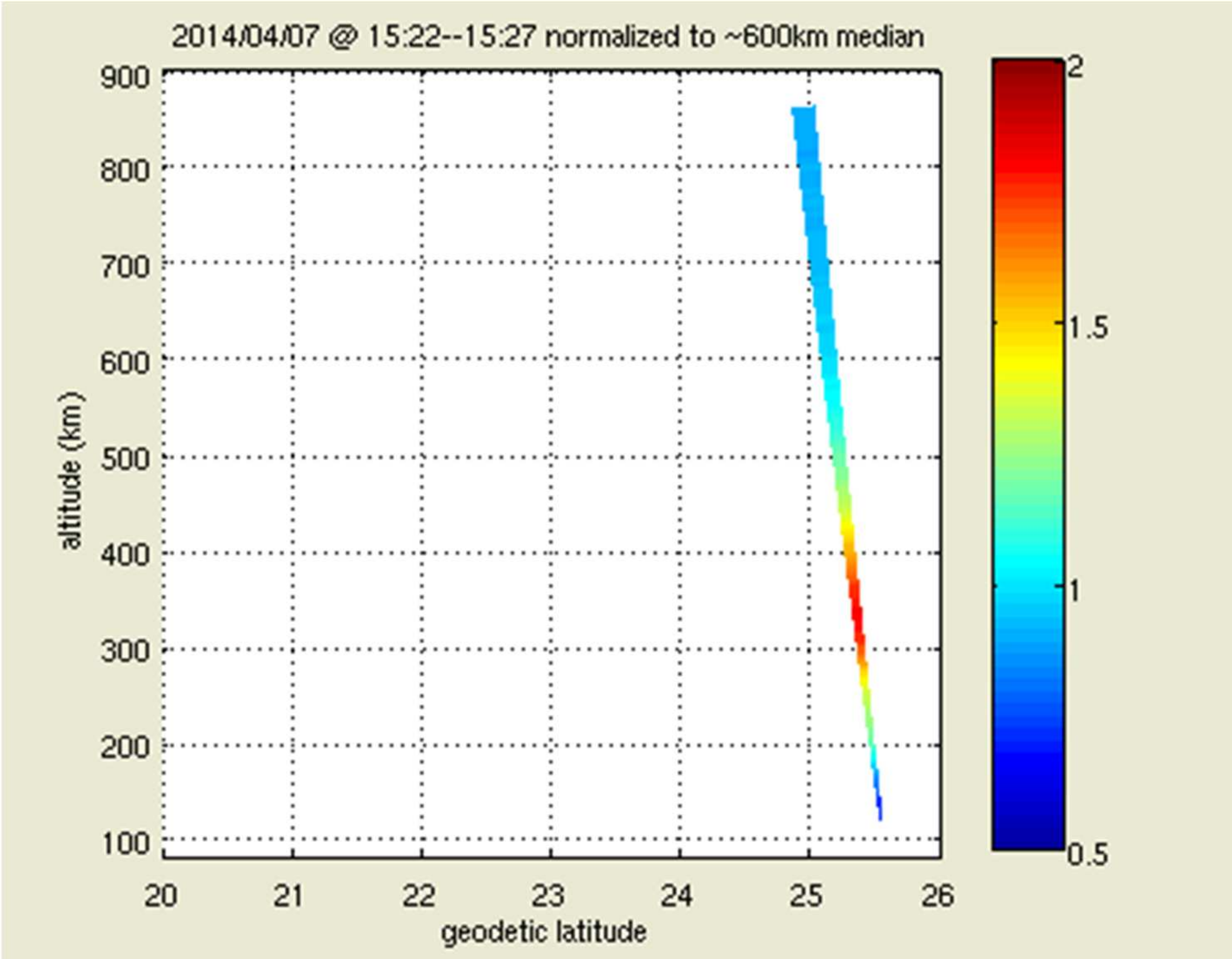
MU radar (Japan)

MU Radar plasma drifts during 2015 St Patrick's Day



Qujing Incoherent Scatter Radar

Qujing ISR elevation scans



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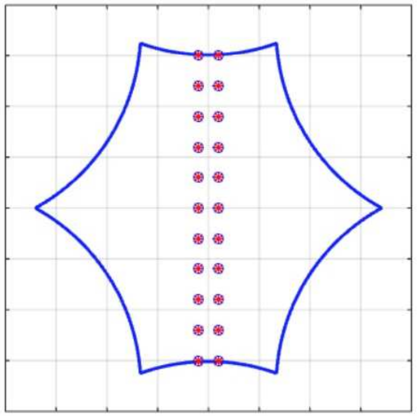
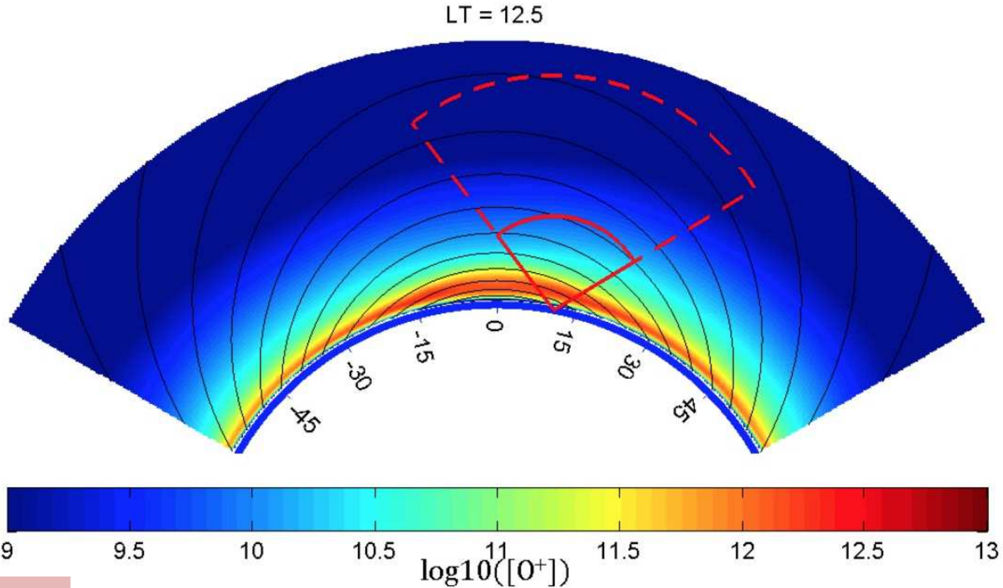
Sanya ISR, under construction

- **Scan zenith:** ±48°
- **Altitude Range:** 50-2000 km (possible 5000 km)
- **Observables:** $[O^+]$, T_i, V_i

Meridian Mode



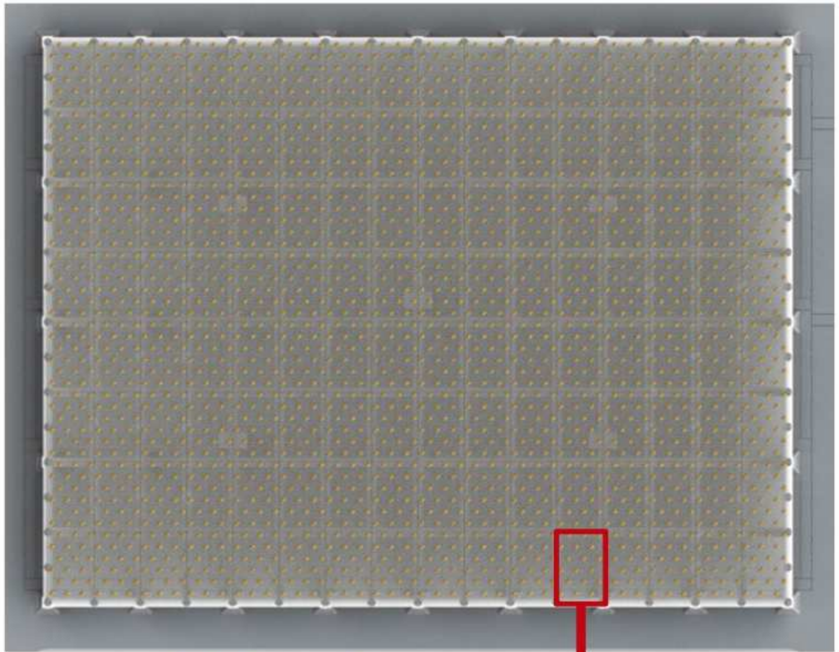


Operational in 2018

Simulated super fountain: O^+ Upflow

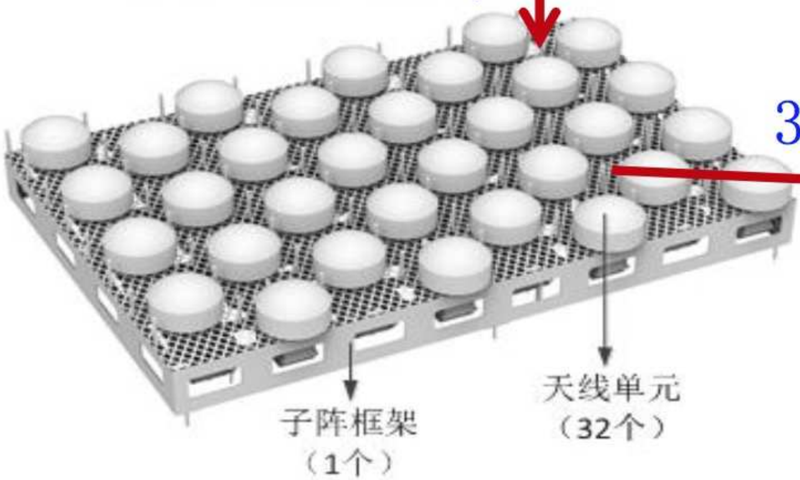
SYISR Phase Array

Totally 4096 units, 2 MW

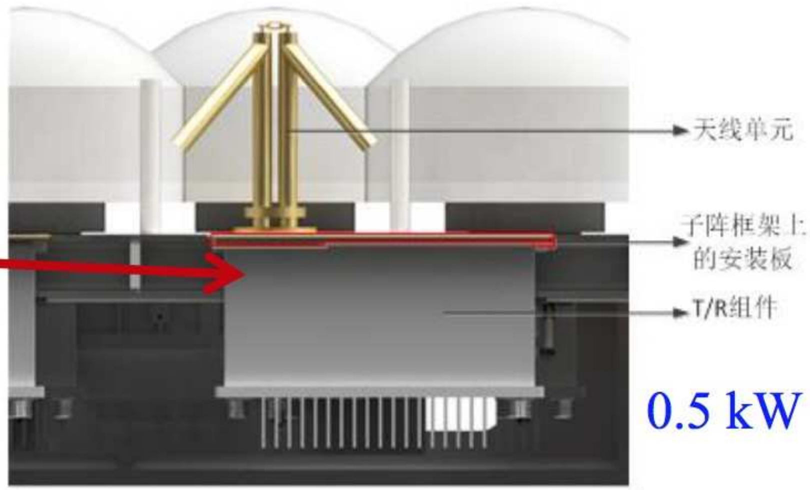


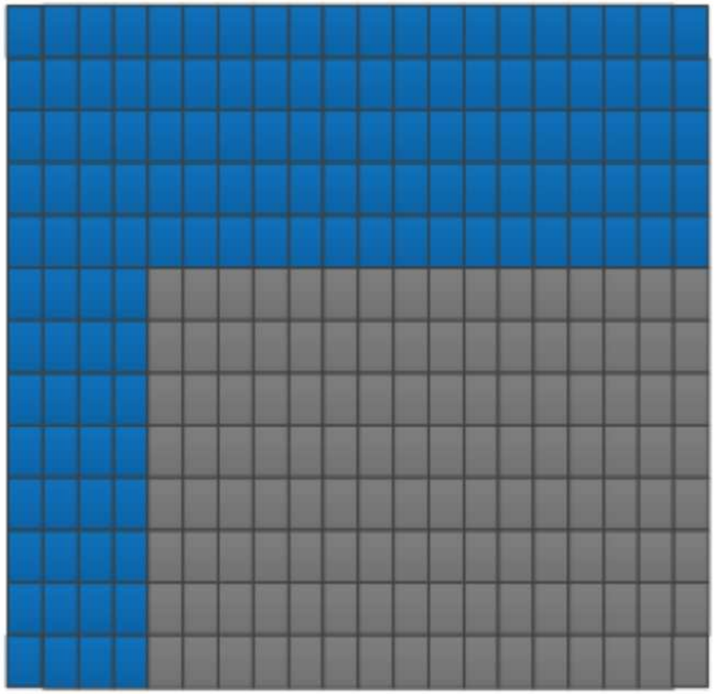
Frequency	440 MHz
Peak Power	2 MW
Antenna Gain	43 dB
Scan (azimuth)	0 ~ 360°
Scan (zenith)	0 ~ 48°
Max Range	2000 km

128 sub-arrays



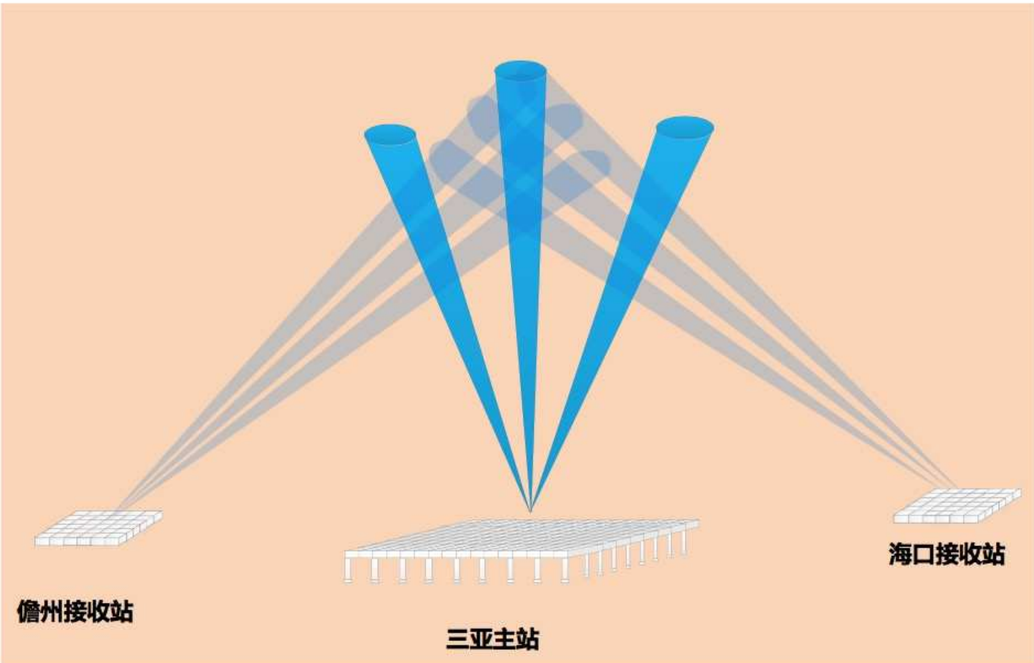
32 units





SYISR Extension in
Meridian Project Phase 2 (MP2)

- Double the phase array
  - 4096 → 8192 units
  - 2 MW → 4MW total power
- Setup additional 2 receive stations



MP2: Hainan Key Monitoring
子午工程二期之海南低纬重点监测

Stations:

- ◆SanYa (SY)
- ◆FuKe (FK)
- ◆HaiKou (HK)

Instruments:

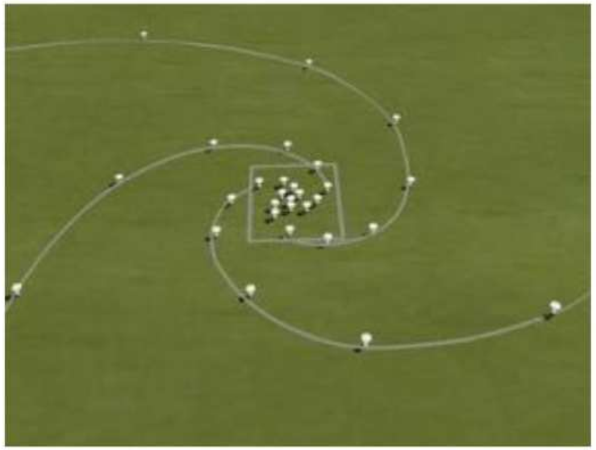
- ◆ISR (ISR-T/R)
- ◆HF radar (HF)
- ◆VHF radar (VHF)
- ◆Digisonde (DPS)
- ◆GNSS-TEC (TEC)
- ◆He Lidar array (HeL)
- ◆Rocket

Key Instruments

Advanced Modular ISR

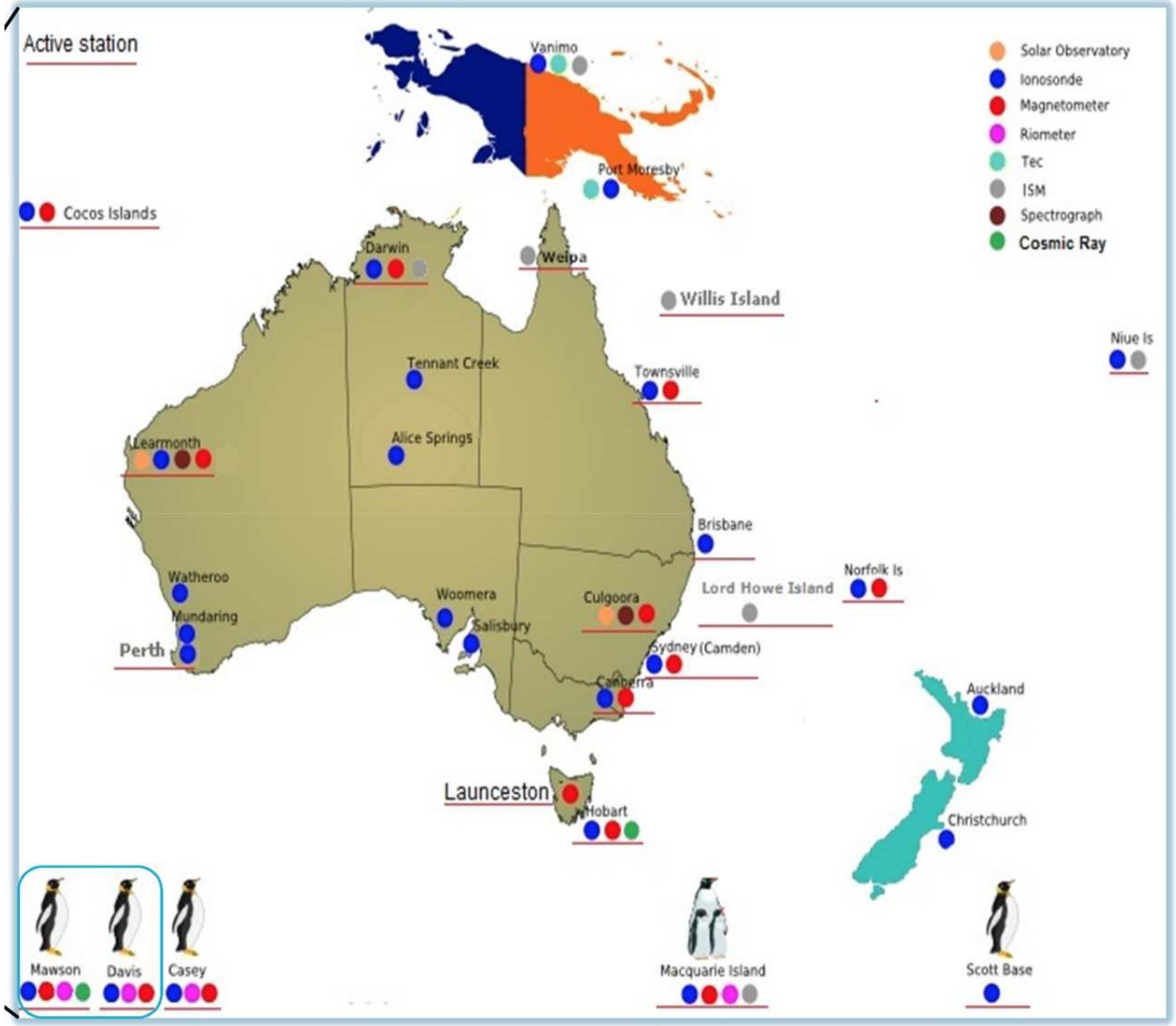
Multi-function LIDAR

SuperDAWN Radar



Solar Radio Heliograph

Australia ionospheric stations



Wang (Australia Space Weather Service)

Australian Government
Bureau of Meteorology

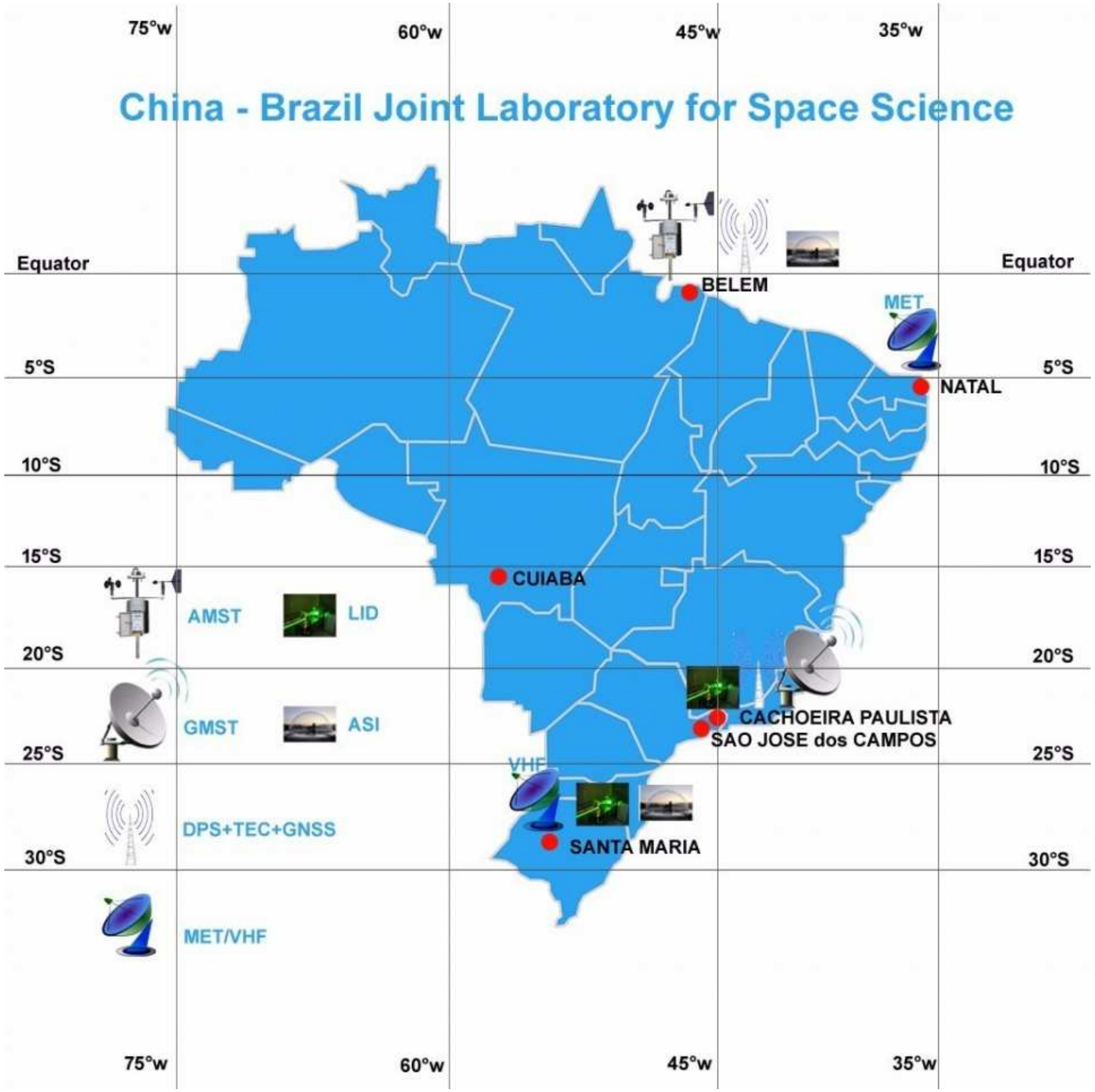
Australia's Space Weather Stations Located in IMCP Belt

Table 1. Australia's space weather stations list and observations

	Station	Latitude (°)	Longitude (°)	Observation
1	Cocos Islands	12.20 S	96.80 E	Ionosonde, magnetometer
2	Darwin	12.45 S	130.95 E	Ionosonde, magnetometer, ISM*
3	Weipa	12.63 S	141.88 E	ISM*
4	Townsville	19.63 S	146.85 E	Ionosonde, magnetometer
5	Learmonth	22.25 S	114.08 E	Ionosonde, magnetometer, solar, spectrograph
6	Culgoora	30.28 S	149.58 E	Magnetometer, solar, spectrograph
7	Perth	31.94 S	115.95 E	Ionosonde
8	Camden	34.05 S	150.67 E	Ionosonde, magnetometer
9	Canberra	35.32 S	149.00 E	Ionosonde, magnetometer
10	Launceston	41.44 S	147.15 E	Magnetometer
11	Hobart	42.92 S	147.32 E	Ionosonde, magnetometer, cosmic ray
12	Casey	66.30 S	110.50 E	Ionosonde, magnetometer, riometer

*ISM=ionospheric scintillation monitor

China-Brazil Joint Lab for Space Science



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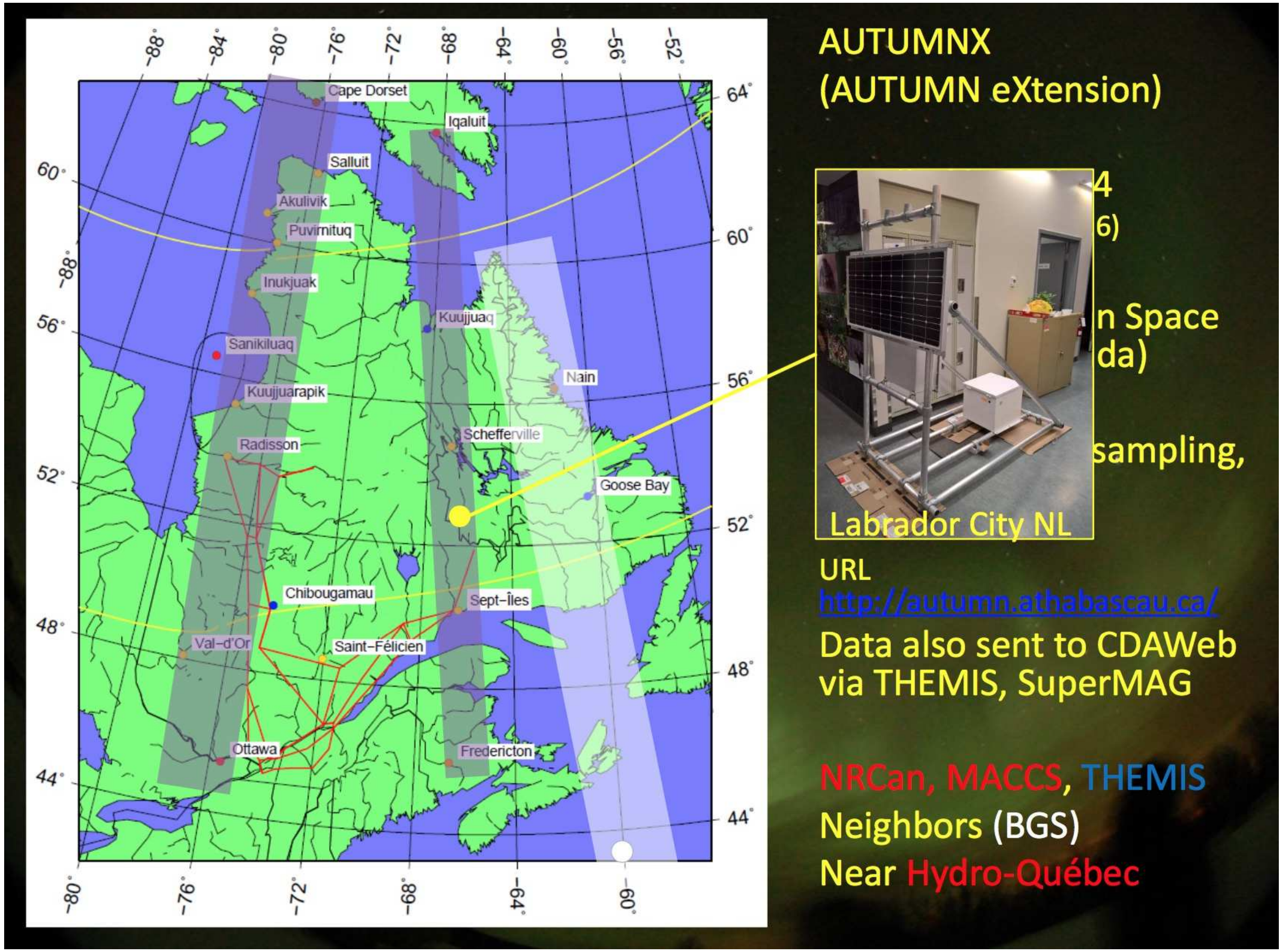
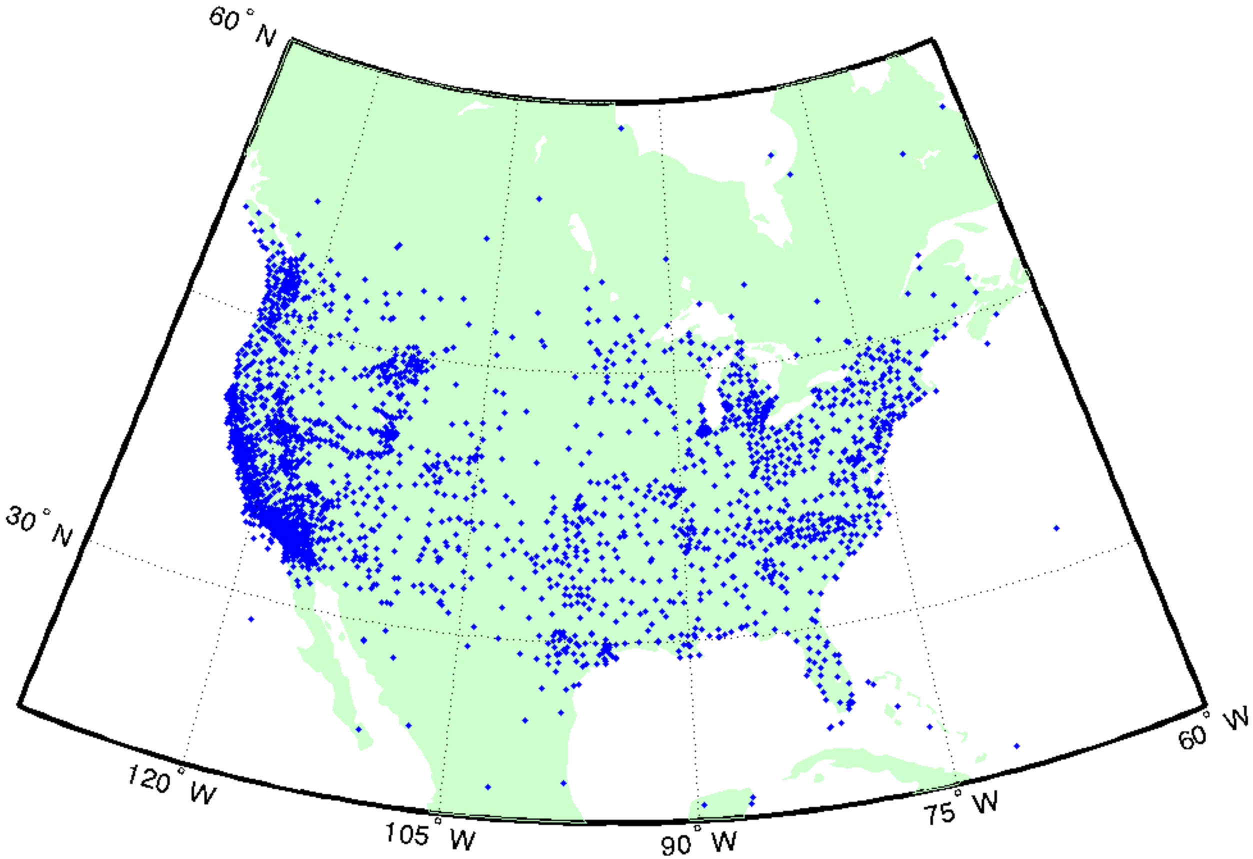
Candian Magnetometers



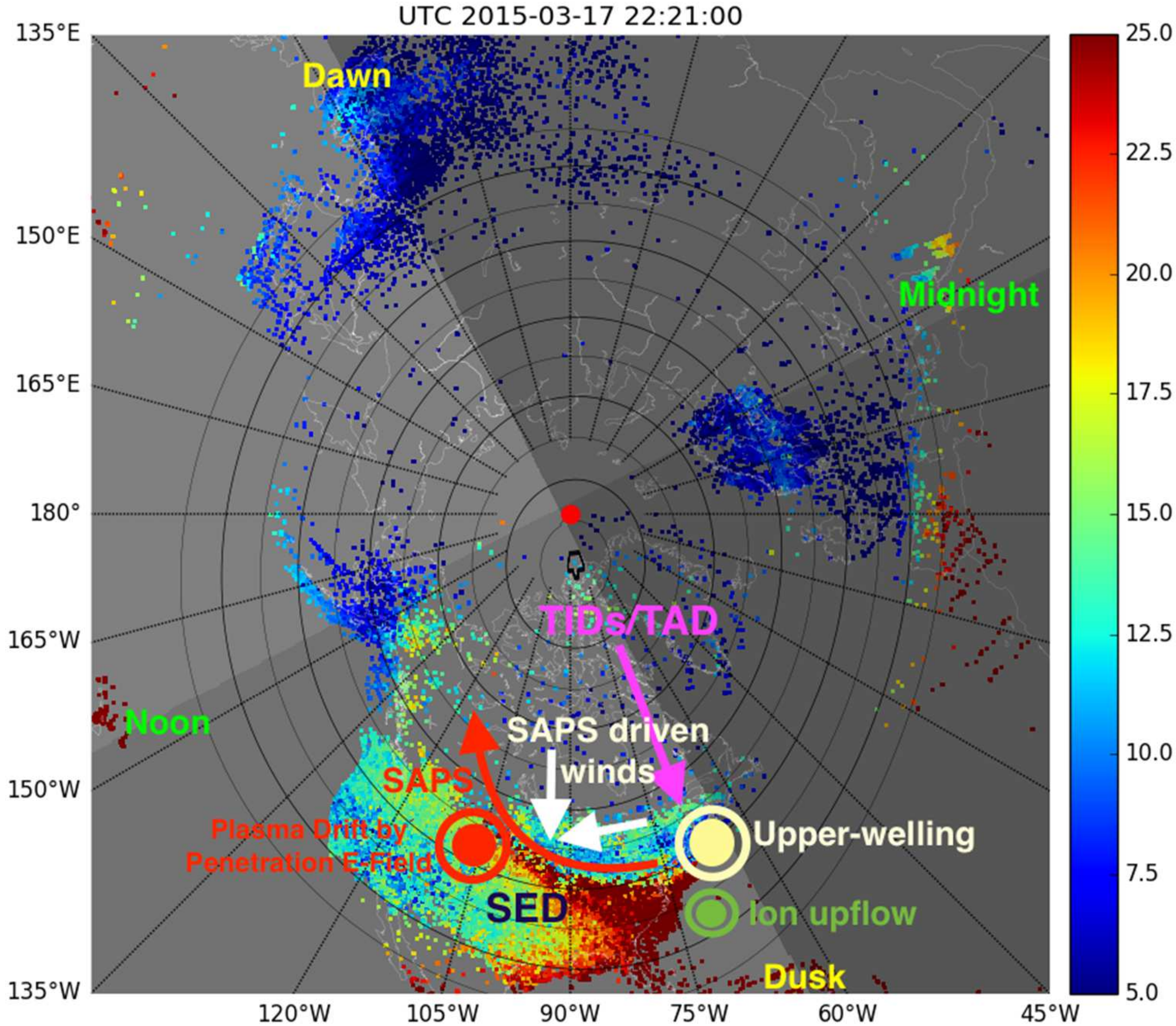
Conners (Athabasca U.)

MIT GPS TEC system



Meridian Circle Campaigns

- 2014
  - March 31 – April 4
  - September 24 – 29
- **2015**
  - **March 17-22, 2015 (St Patrick's Day)**
- 2016
  - March 13 — March 18, 2016
- 2017
  - Sept 13-24, 2017 (window)
- 2018 (June 2018)



Zhang et al. JGR, (2017)

International Meridian Circle Project Workshop, Feb 2011

International Meridian Circle Project Workshop, May 2017

SA007:
Solar Eclipse Effects on the Upper Atmosphere

Submit an Abstract to this Session

DEADLINE: today in 10 hours

Session ID#: 26657
Session Description:
For the first time in 26 years, a total solar eclipse will occur in the North American on 21 August 2017. During the eclipse-induced sudden interruption in solar illumination, the upper atmosphere will undergo significant changes beyond what a normal sunset and sunrise process would generate. Although eclipse effects have been studied for many decades, recent major advances in modern observational techniques can provide timely new information on eclipse upper atmospheric system response. Global numerical models have become more capable of capturing important coupling processes on various scales. This session will review existing theories and knowledge of eclipse upper atmospheric effects, examine these against modern eclipse observations, in particular during 21 August 2017, and identify unresolved and challenging problems for future research. We welcome contributions addressing scientific questions of the ionospheric, thermospheric and mesospheric variations during a solar eclipse using ground-based and in situ measurements as well as numerical models.
Please note, the regular AGU abstract submission deadline comes before the 2017 eclipse. Submissions related to this event must be submitted by the 2 August deadline, however for this session, revision to the submitted abstracts will be possible until September 15, allowing the latest results to be incorporated into the submitted abstracts.

Primary Convener:
Shunrong Zhang, MIT Haystack Observatory, Westford, MA, United States
Conveners:
Larisa P Goncharenko, Massachusetts Institute of Technology, Cambridge, MA, United States
and **Libo Liu**, IGG Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China