



**The 3rd AOSWA Workshop**  
Asia Oceania Space Weather Alliance

# Space Weather Operations and Research Activities at the IGGCAS

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**Mar. 2nd, 2015**

# Outline

- 1. Observation Chain**
- 2. Developed Instruments**
- 3. CAS Cooperation**
- 4. International Cooperation**
- 5. Models**

# Observation Chain of IGGCAS

Data Center in IGGCAS



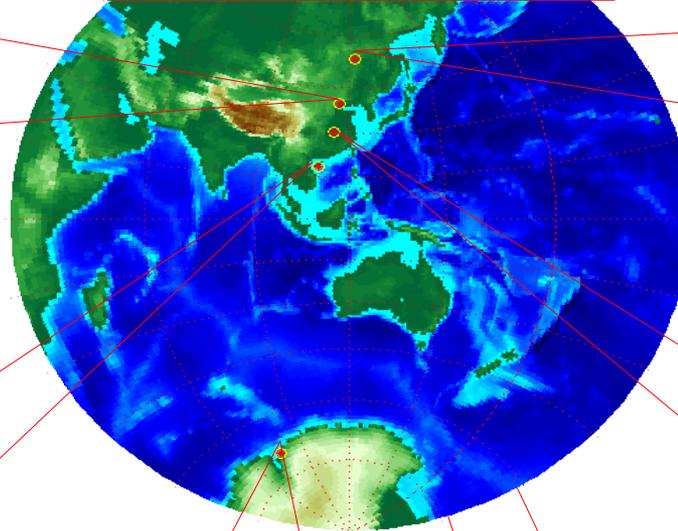
Beijing Station  
(40.3°N , 116.2°E )



Mohe Station  
(53.5°N 122.3°E)



Sanya Station  
(18.3°N 109.6°E)



Zhongshan Station  
(69.4°S 76.4°E )

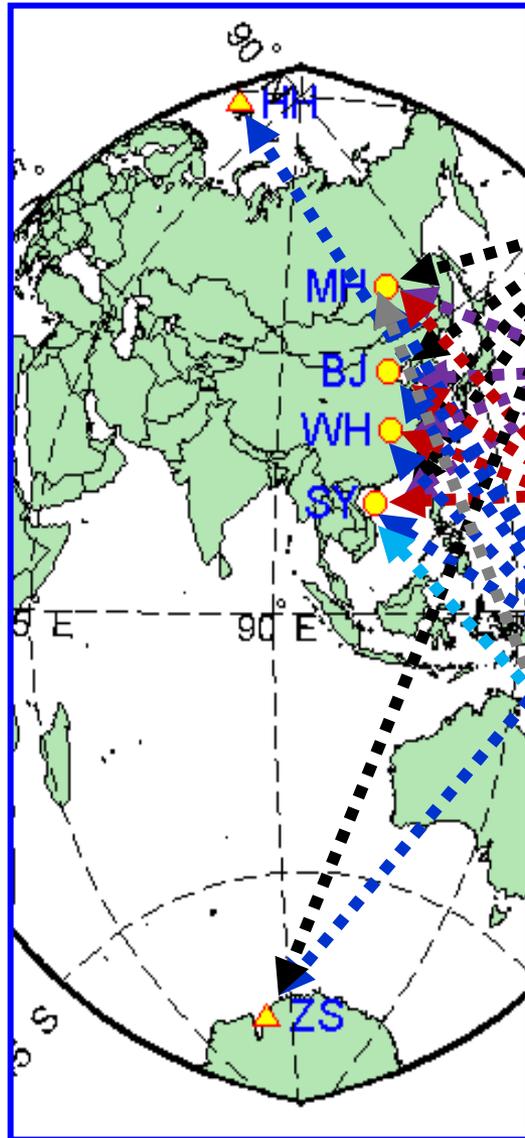


Yellow River Station  
(78.9°N 11.9°E )



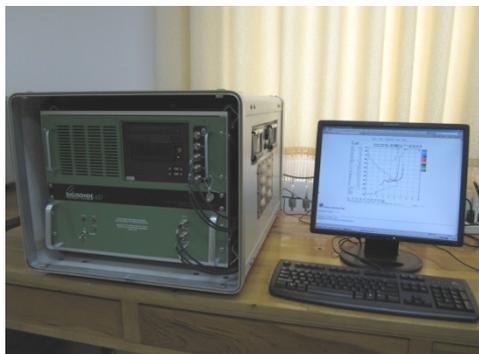
Wuhan Station  
(31.0°N, 114.5°E)

# Observation Instruments

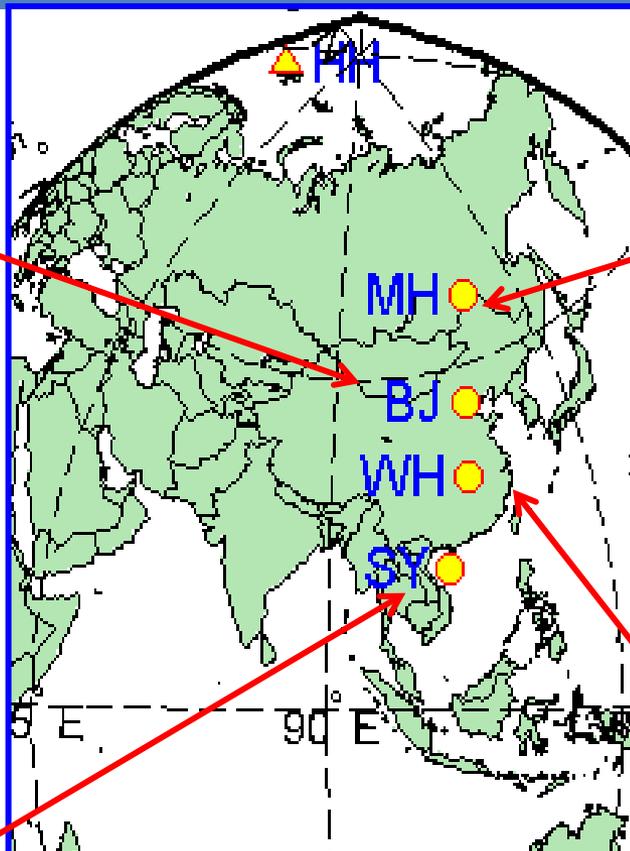


- Magnetometer ( 4 x 6+6=30 set )
- Meteor Radar ( 4 set )
- Ionosonde ( 4+2 set )
- GPS TEC and Scintillation ( 8 set )
- VHF Radar ( 1 set )
- Atmospheric electric field mill ( 1 set )

# Ionosonde Chain of IGGCAS



Beijing (40.3°N, 116.2°E)  
DPS4D since Dec. 2009



Mohe (53.5°N, 122.3°E)  
DPS4D since Sep. 2010



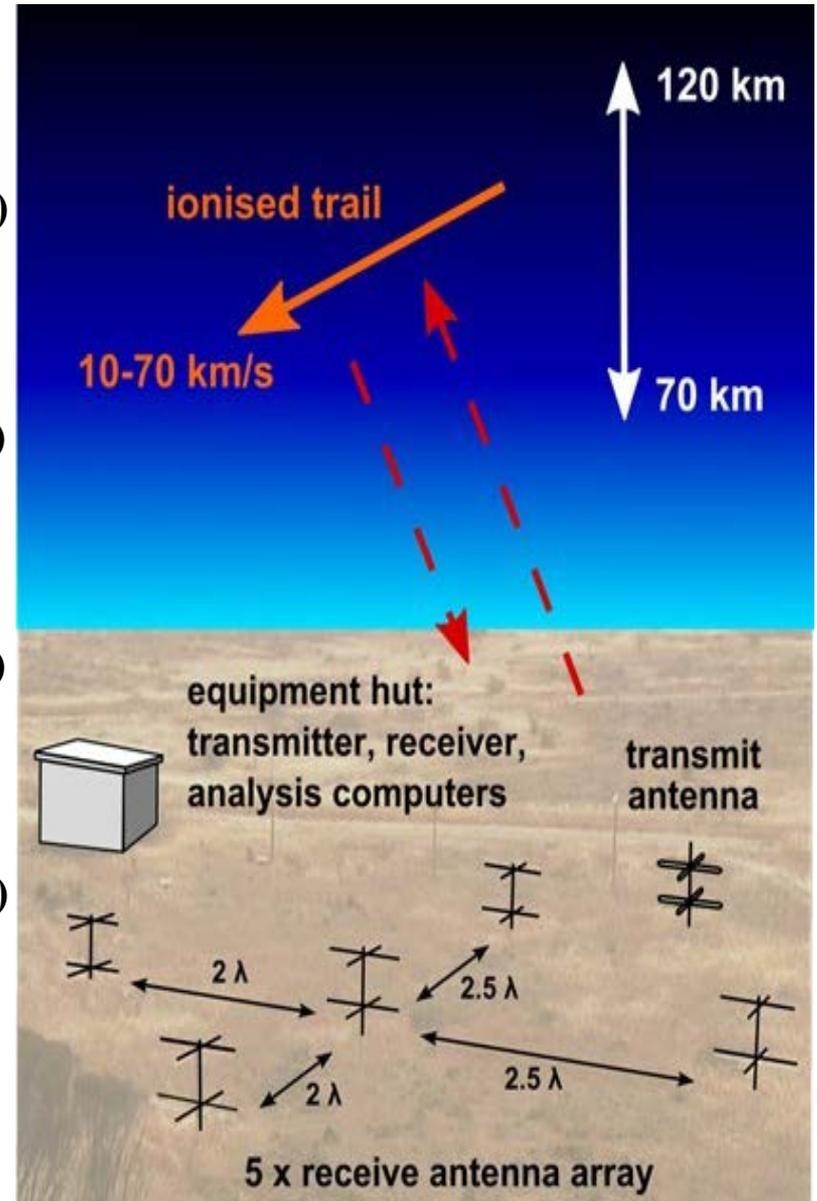
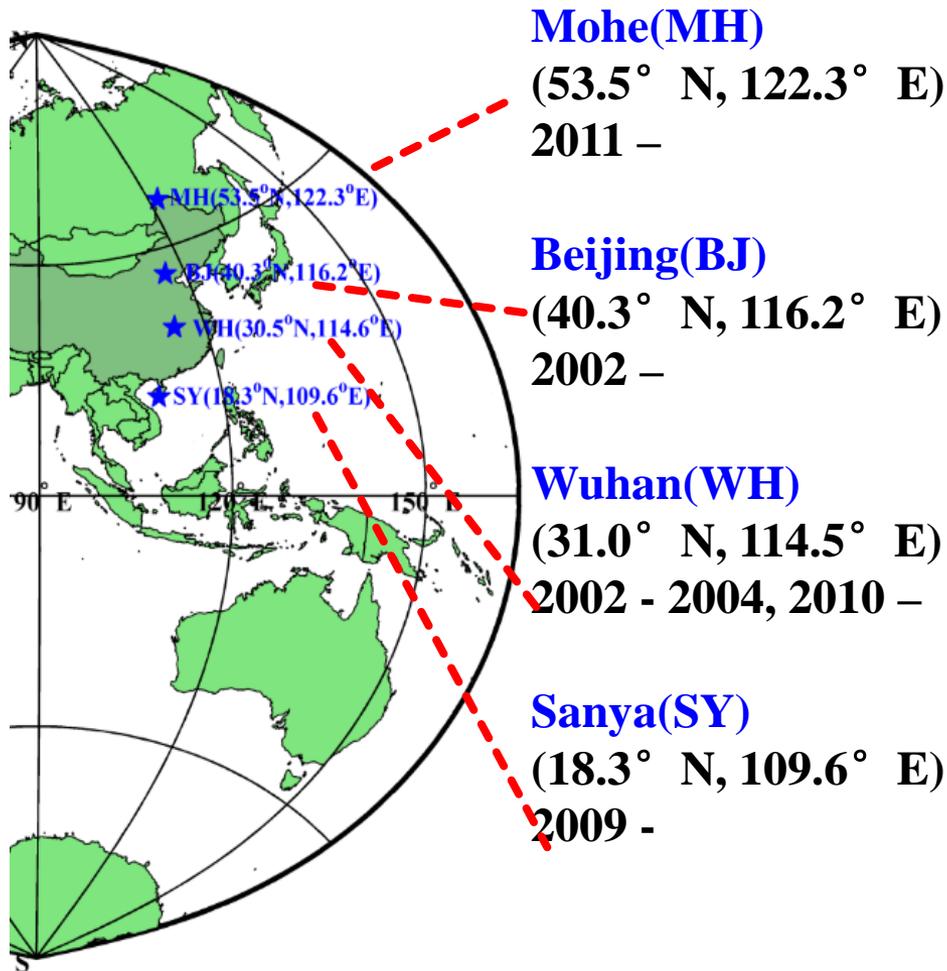
Sanya (18.3°N, 109.6°E)  
DPS4D since May 2011

Four stations in a chain  
along 120° E meridian are  
equipped with DPS4D  
digisondes



Wuhan (31.0°N, 114.5°E)  
Vertical sounding since 1946  
DPS4D since Apr. 2010

# IGGCAS meteor radar chain (all sky meteor radar)



# IGGCAS meteor radar chain (all sky meteor radar)

## ■ Observables:

$u$ : zonal wind

$v$ : meridional wind

## ■ Altitude range:

70 – 110 km

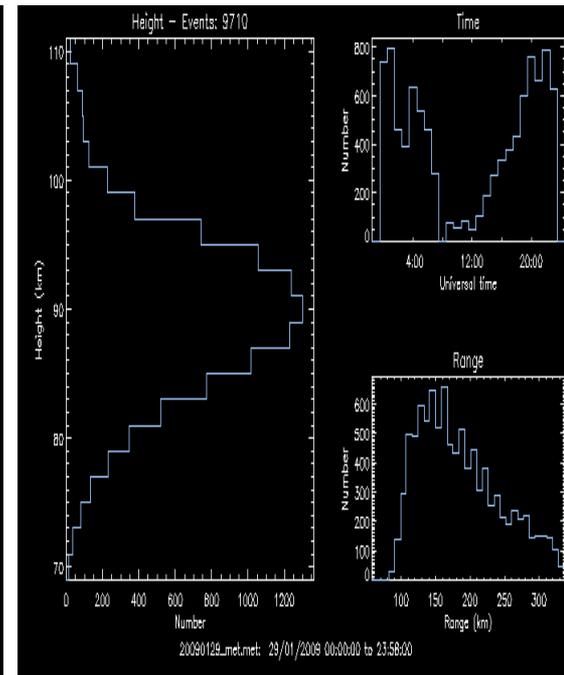
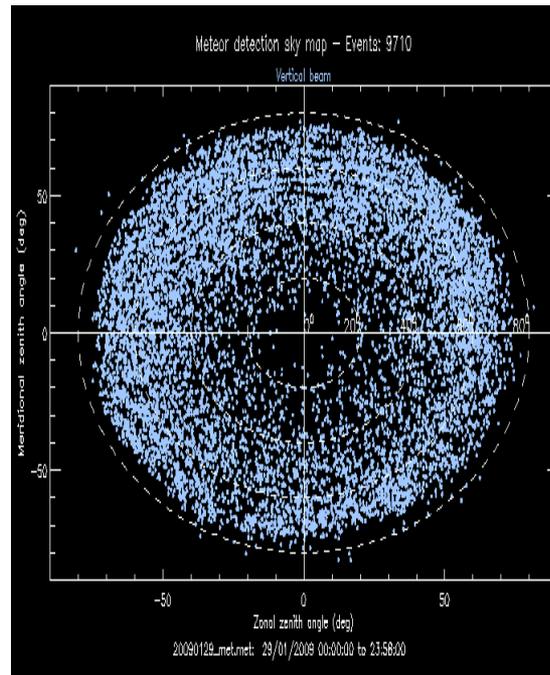
## ■ Altitude resolution:

2 km

## ■ Time resolution:

1 hr

✓ Suitable for study tides  
in MLT region



# IGGCAS meteor radar chain (wind observation)

■ **Sample observations:**  
(2012.11.21-2012.11.28)

◆ **Period**

1, 1/2, 1/3..., day

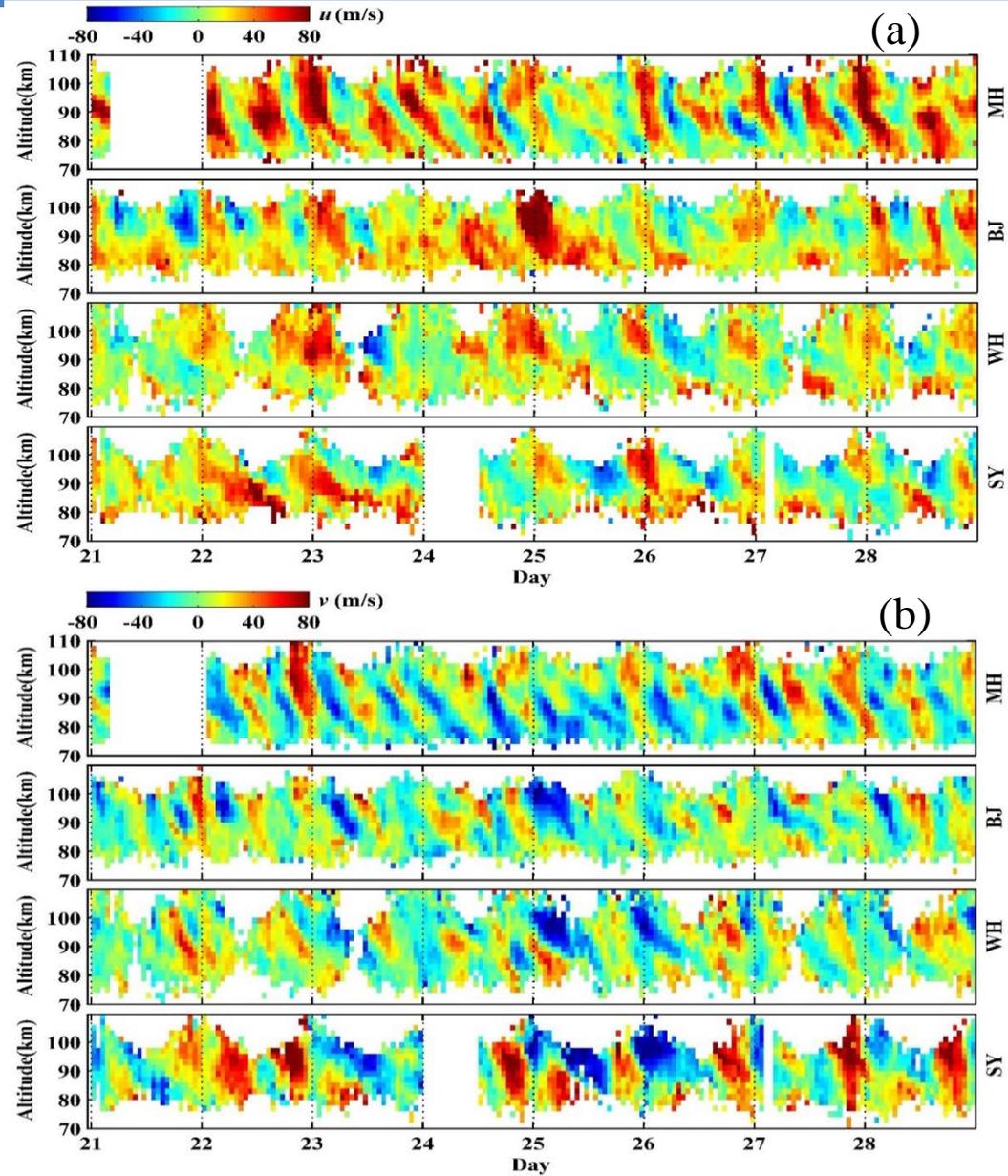
◆ **Latitude variation**

diurnal (semidiurnal)  
variation dominates at  
low (mid)-latitude  
stations

◆ **Altitude variation**

peak in MLT region

◆ **Day-to-day variability**



# GPS & Magnetometer Chain of IGGCAS

- GPS TEC and Scintillation

- Yellow River since 2007
- Mohe since 2006
- Beijing since 2004
- Wuhan since 2001
- Sanya since 2004
- Zhongshan since 2012

- Magnetometer

- Mohe since 2000
- Beijing since 2000
- Sanya since 2006
- Zhongshan since 2010

北京

漠河

三亚

南极中山

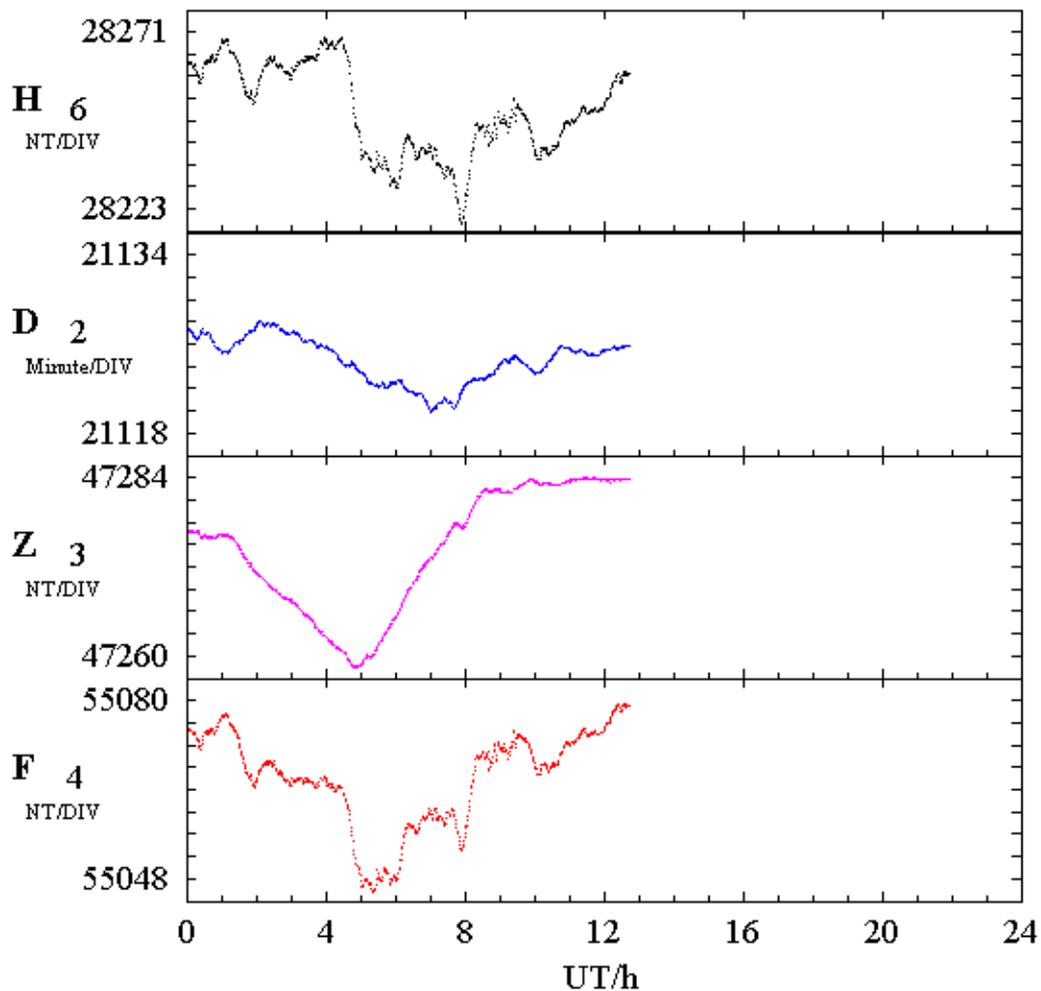
返回首页

观测站: 北京 (40.30°N, 116.19°E)

[前一天地磁场](#)

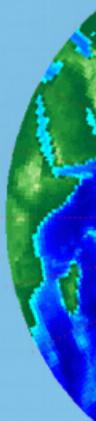
[当前地磁场](#)

BEIJING-GEOMAG 2015-03-01 UT  
Institute of Geology and Geophysics Chinese Academy of Sciences



电离层TEC长期预报

利用中国科  
间环境综合  
到三亚的4个  
时处理与传  
域分布算法,  
现报,以每15  
140° (东经)

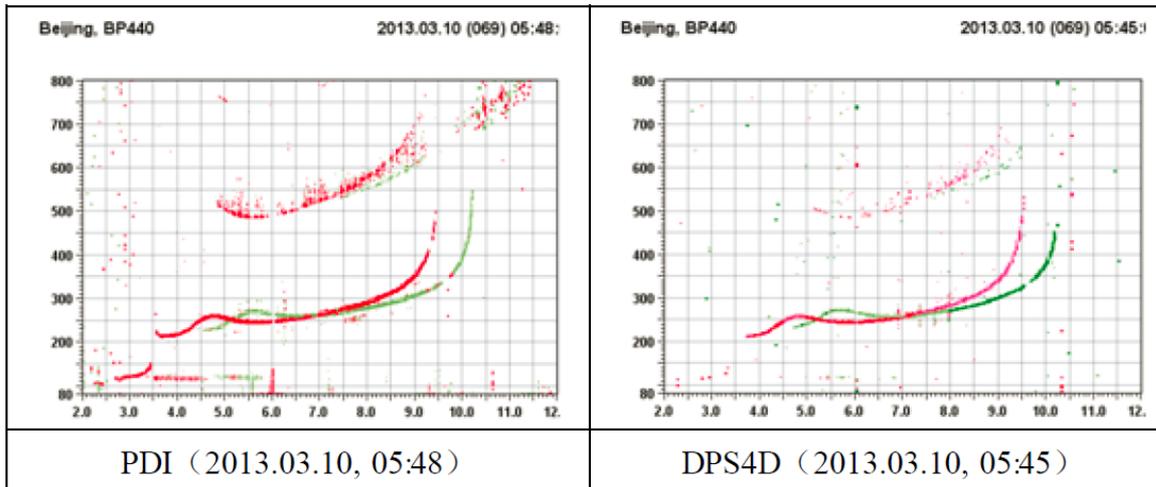


# Outline

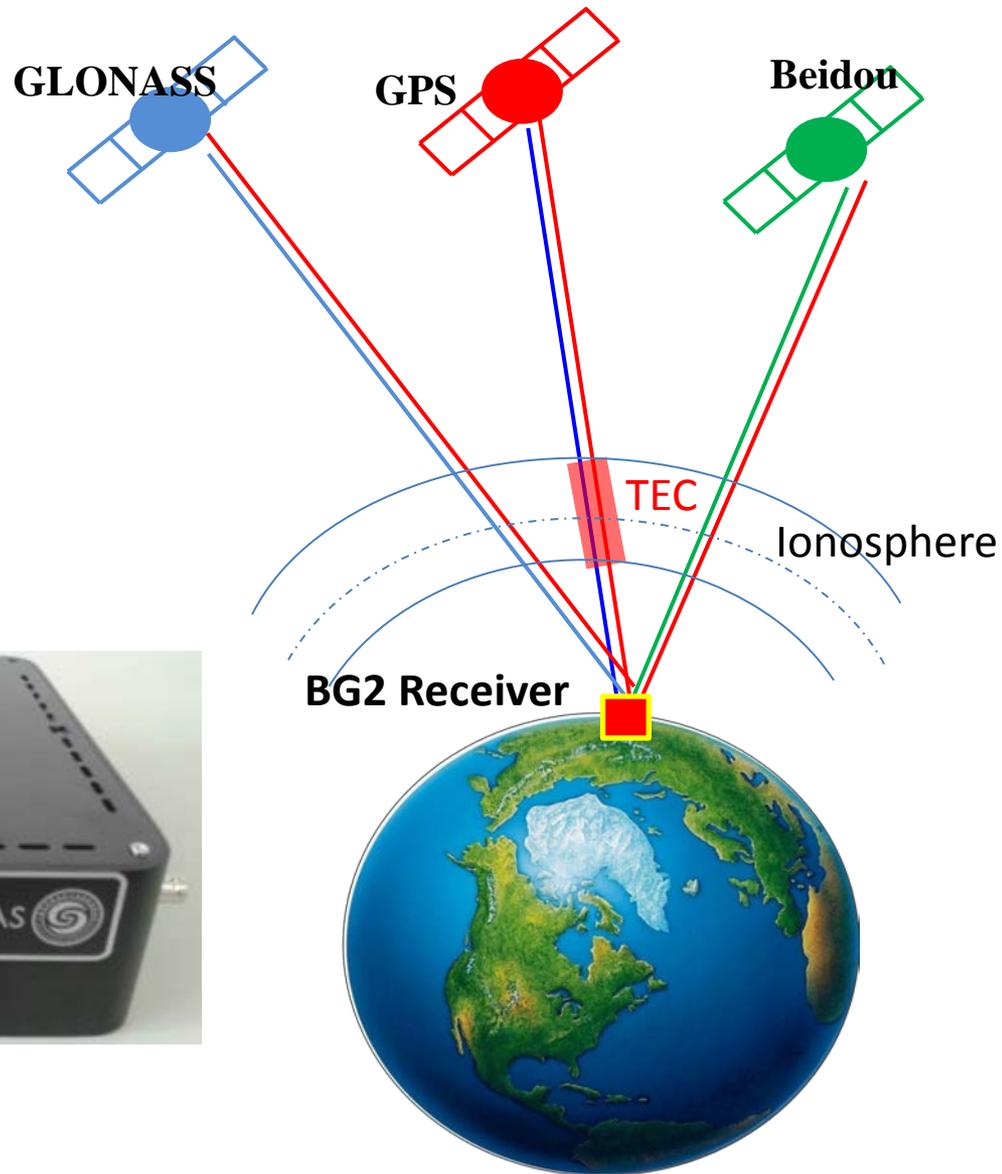
1. **Observation Chain**
2. **Developed Instruments**
3. **CAS Cooperation**
4. **International Cooperation**
5. **Models**

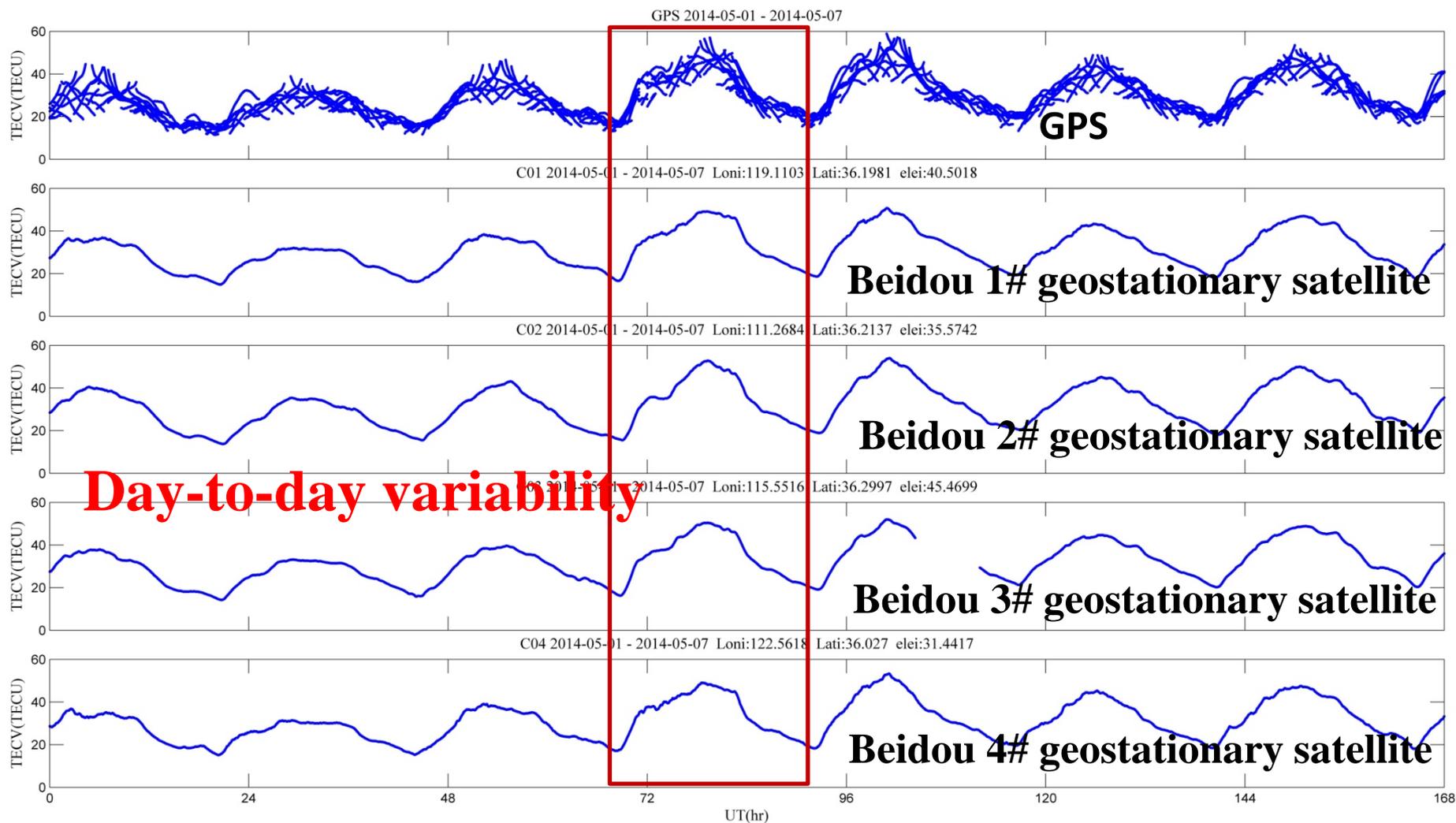
# Portable Digital Ionosonde (PDI)

- Sending antenna 4m\*27m
- Receiving antenna 3m\*27m
- Shaoyang (111.5E, 26.9N) since 2012



# Multiple GNSS Receiver





**TEC in May 1-7, 2014 at Beijing Station**

# VHF Radar in Sanya

- Ionosphere coherent
  - irregular structure of ionosphere
- All sky meteor radar
  - wind observation

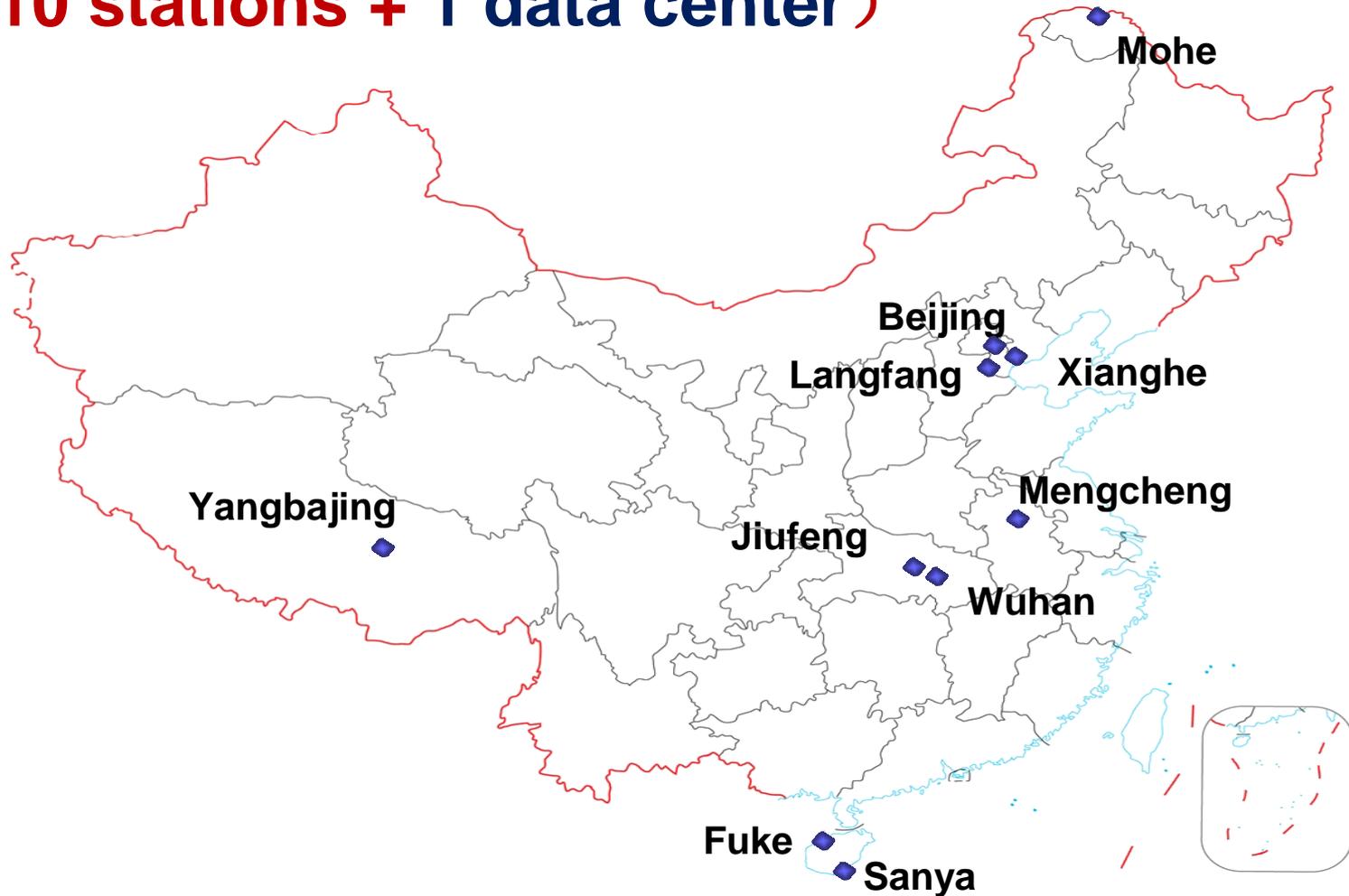


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# Solar-Terrestrial Environment Research Network (STERN)

**(10 stations + 1 data center)**

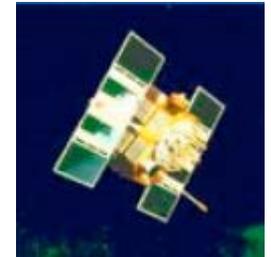


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# Madrigal database

- The Madrigal database stores data from a wide variety of upper atmosphere research instruments
- Number of instruments in Madrigal (summer 2013):
  - Incoherent scatter radars: 22
  - MST radars: 3
  - MF radars: 16
  - Meteor radars: 7
  - FPI: 23
  - Michelson Interferometers: 6
  - Lidars: 4
  - Photometers: 4



Incoherent Scatter Radar TEC via GPS

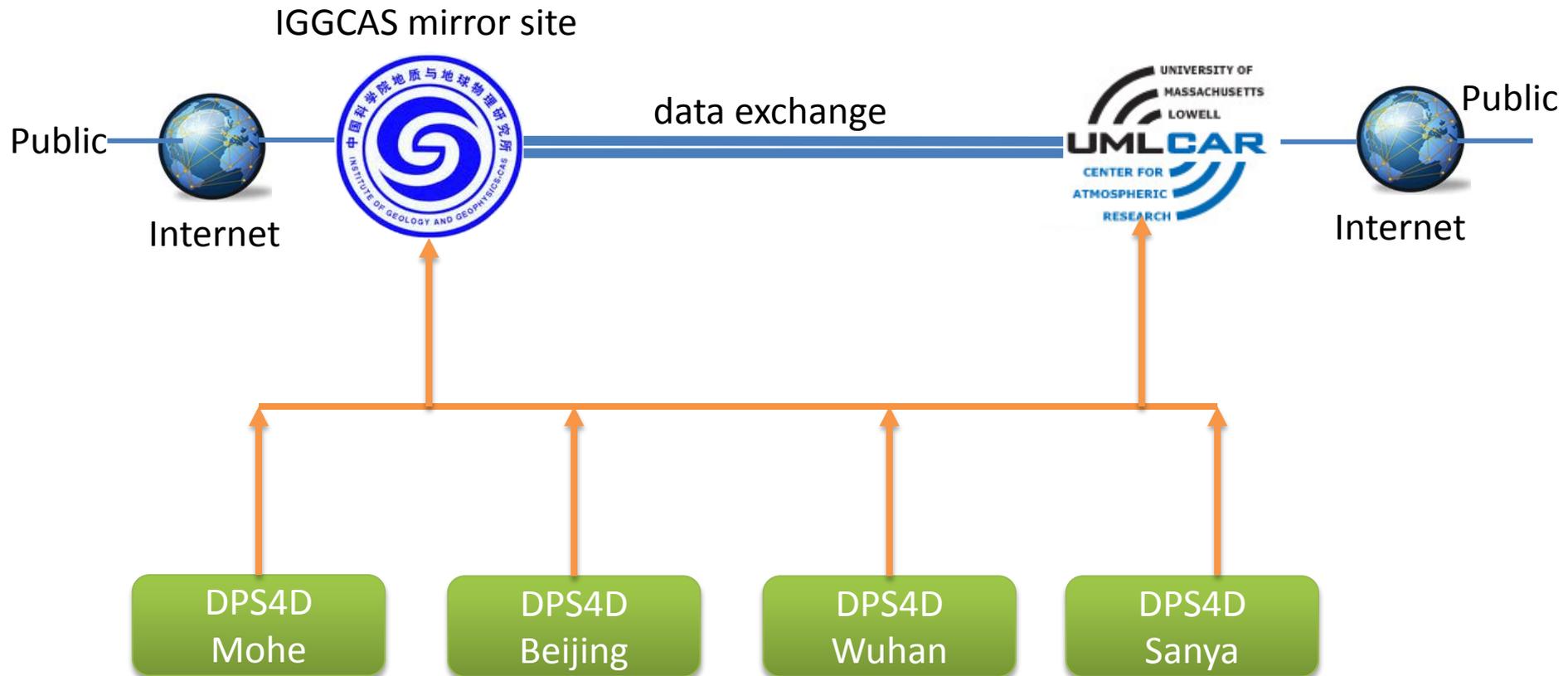


MF Radar

# Mirror site of Madrigal

The image shows a screenshot of a web browser displaying the Madrigal Database website. The browser's address bar shows the URL `madrigal.iggcas.ac.cn`. The page content includes the heading "Welcome to the Madrigal Database" and text describing the database as a "World Wide Web based system" for ionospheric data. A red oval highlights the heading. Below the text, there is a photograph of two men standing in a server room. To the left, a smaller photograph shows a man in a green shirt speaking at a podium. A presentation slide is overlaid on the bottom left, titled "How to download data from the Madrigal Database" and providing the URL `http://madrigal.iggcas.ac.cn/madrigal_igg.pdf`. The slide also mentions "MIT Harvard" and "brideo". The bottom right of the slide features the "NELL" logo and a globe icon. The browser's taskbar at the bottom shows various application icons.

# Mirror site of GIRO



Four digisondes of IGGCAS send data to UMLCAR

# Real-time DPS4D data in IRTAM from IGGCAS

## IRI Real-Time Assimilative Mapping (IRTAM)

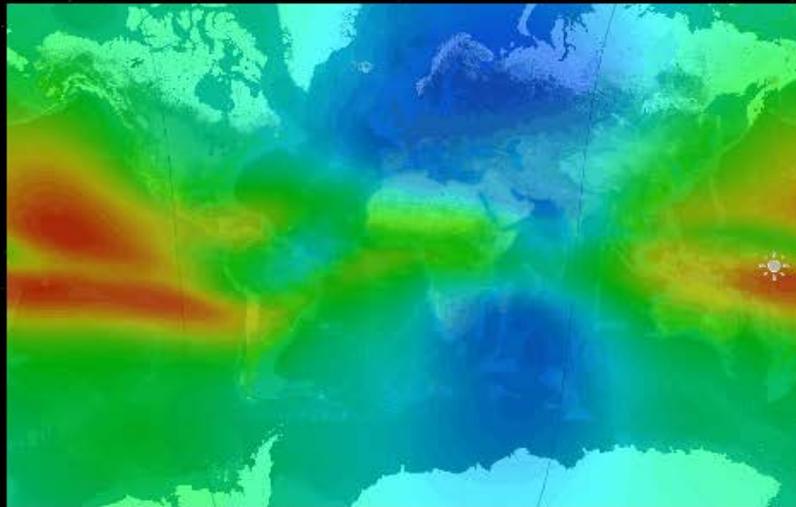
Global Near-Real-Time F2-layer Critical Frequency



foF2: 24-hour Latest Weather

IRTAM v0.1B

Time UT - 2013.10.05 00:37:00



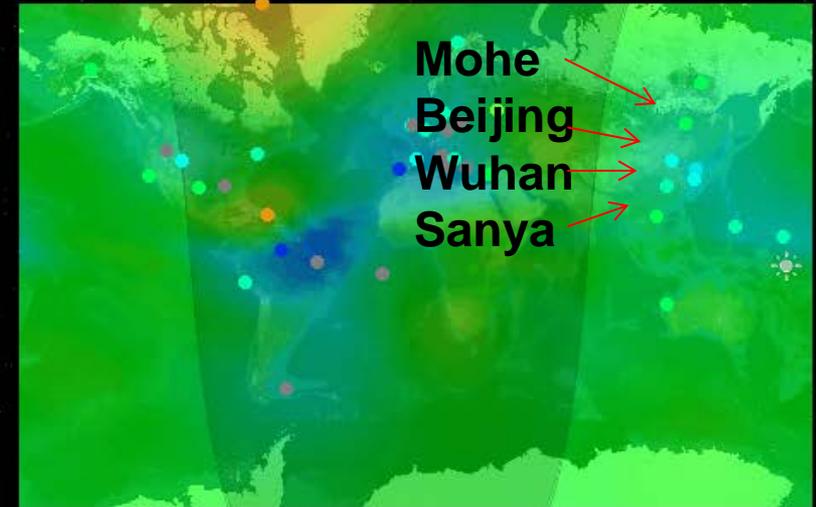
Map: foF2 (RTAM) MHz



foF2: Deviation from Climate

IRTAM v0.1B

Time UT - 2013.10.05 00:37:00



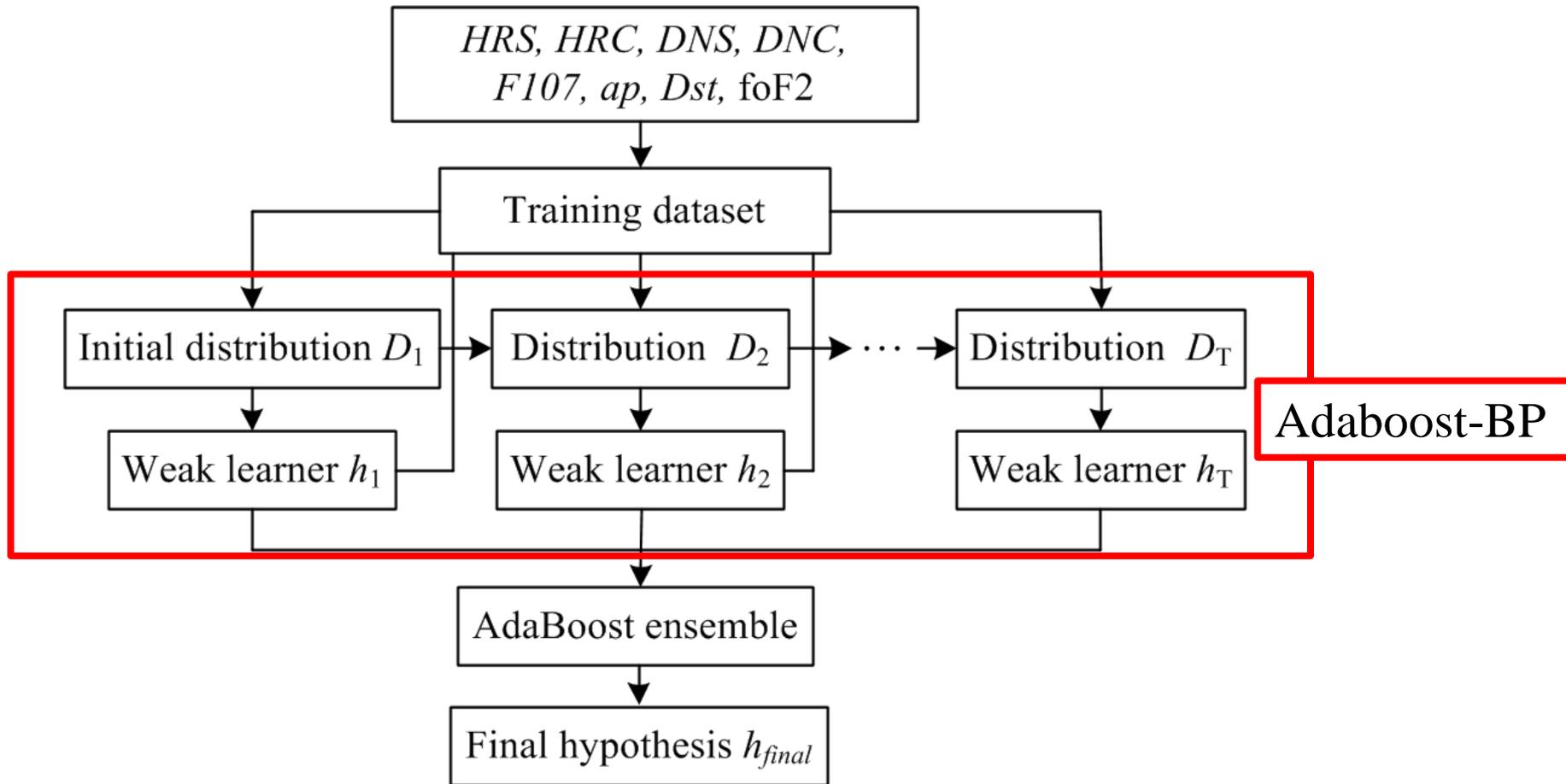
Map: foF2 (RTAM-IRI)/IRI % Circles(sites): foF2 (GIRO-IRI)/IRI %



# Outline

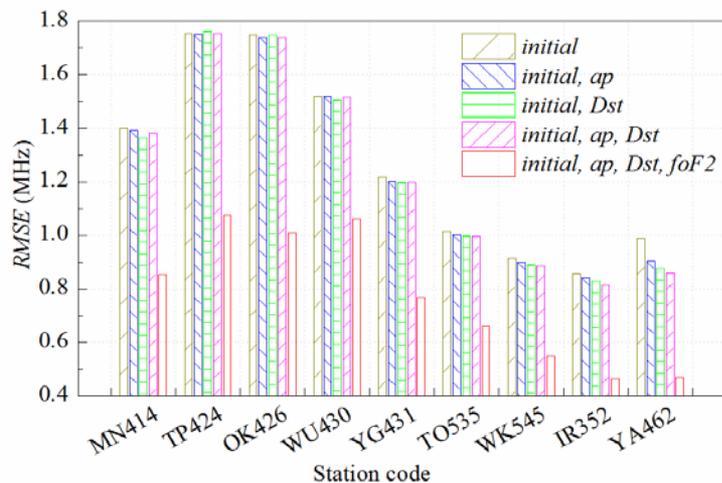
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# Prediction model of short-term ionospheric foF2

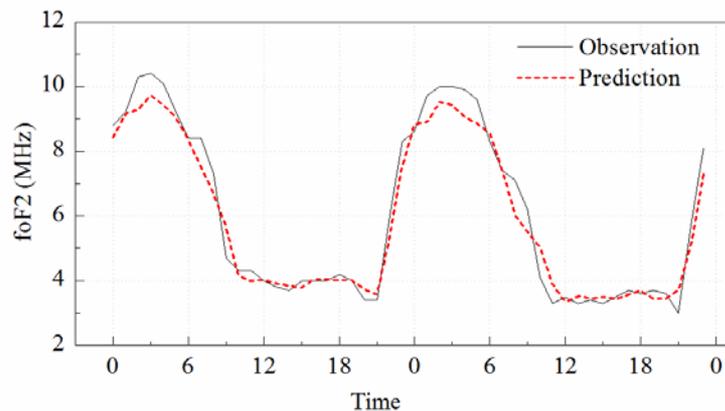


# Prediction model of short-term ionospheric foF2

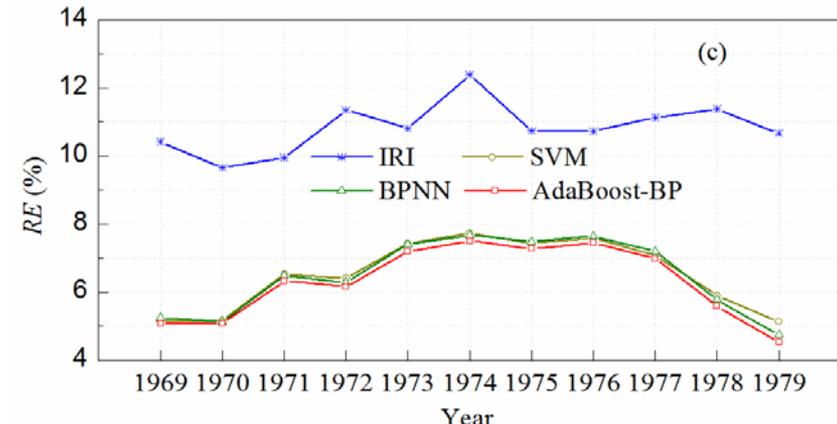
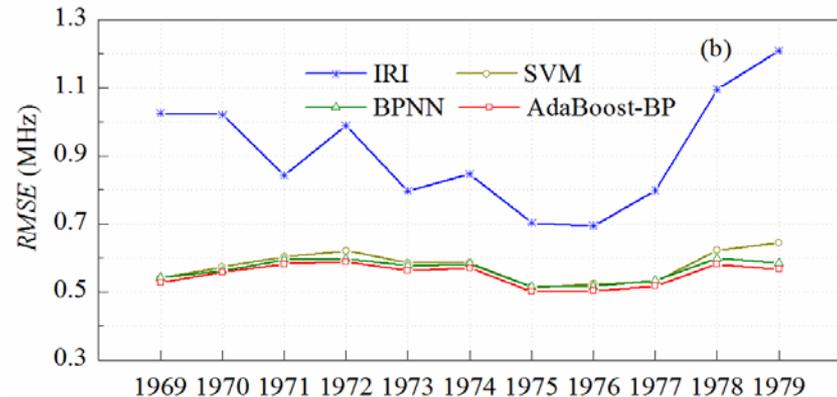
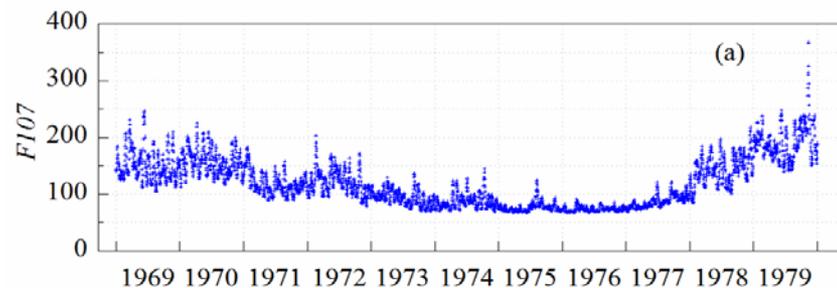
## The contribution of input parameters



The initial parameters are *HRS*, *HRC*, *DNS*, *DNC* and *F107*



## Comparison of different methods for Wakkanai data versus F107 values



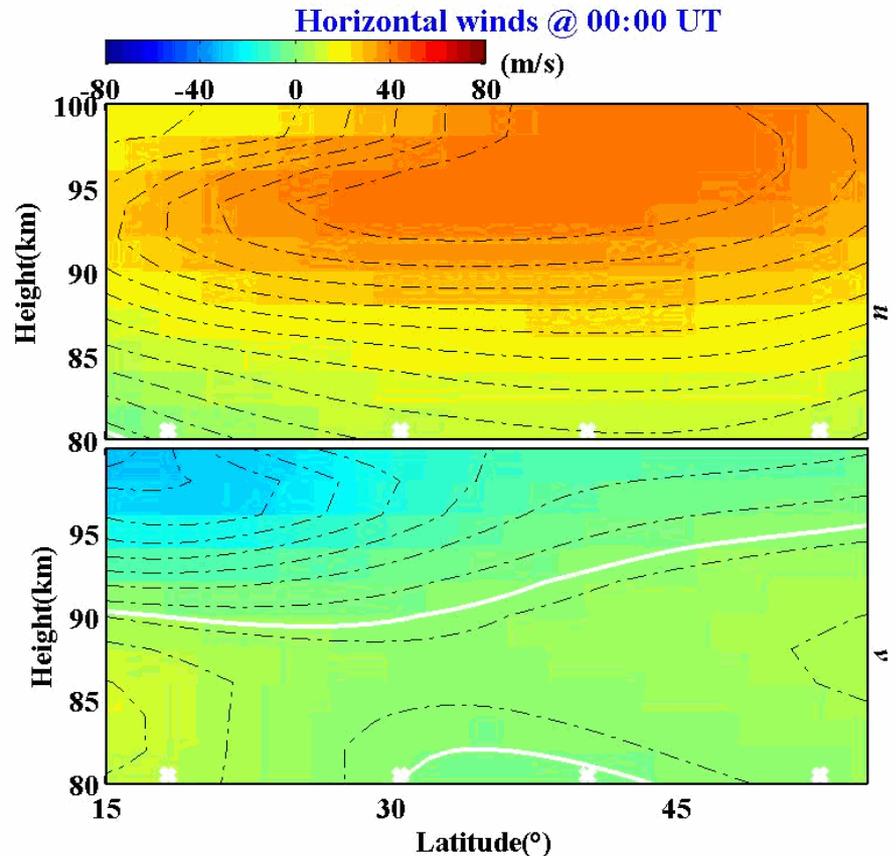
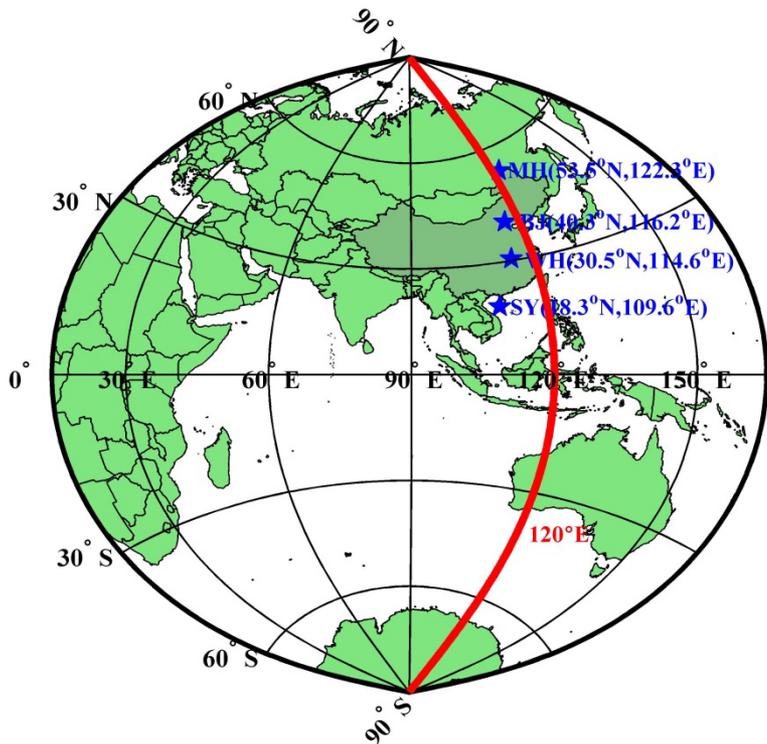
## ✓ 120° E meridional chain

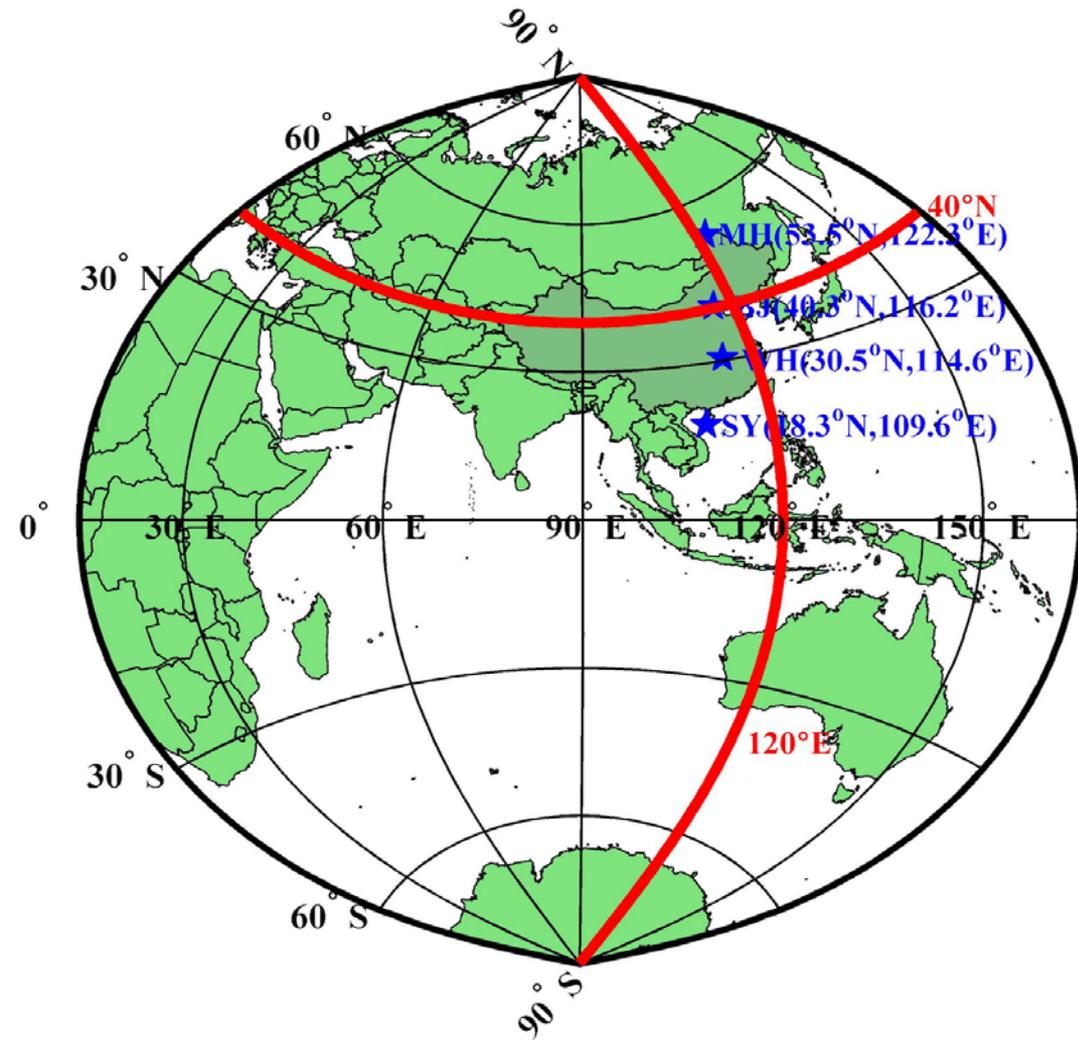
four meteor radars at  
Mohe(MH), Beijing(BJ),  
Wuhan(WH), Sanya(SY)



## ✓ 3D distribution of winds

longitude: 120° E  
latitude: 15-55° N  
altitude: 80-100 km  
local time: 0-23 LT





## ? 40° N zonal chain

Need wind observations from the stations around 40° N to extract the **non-migrating tidal component**

## ? 120° E meridional chain

Need wind observations from the stations (especially in the S. Hemisphere) along the 120° E meridian to decompose the **tidal modes in both Hemispheres**



**Thank you for your attention!**

**Dr. Xiukuan Zhao (Kevin)**

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