



Space Weather Prediction Research and Services for China Manned Space Mission

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Outline

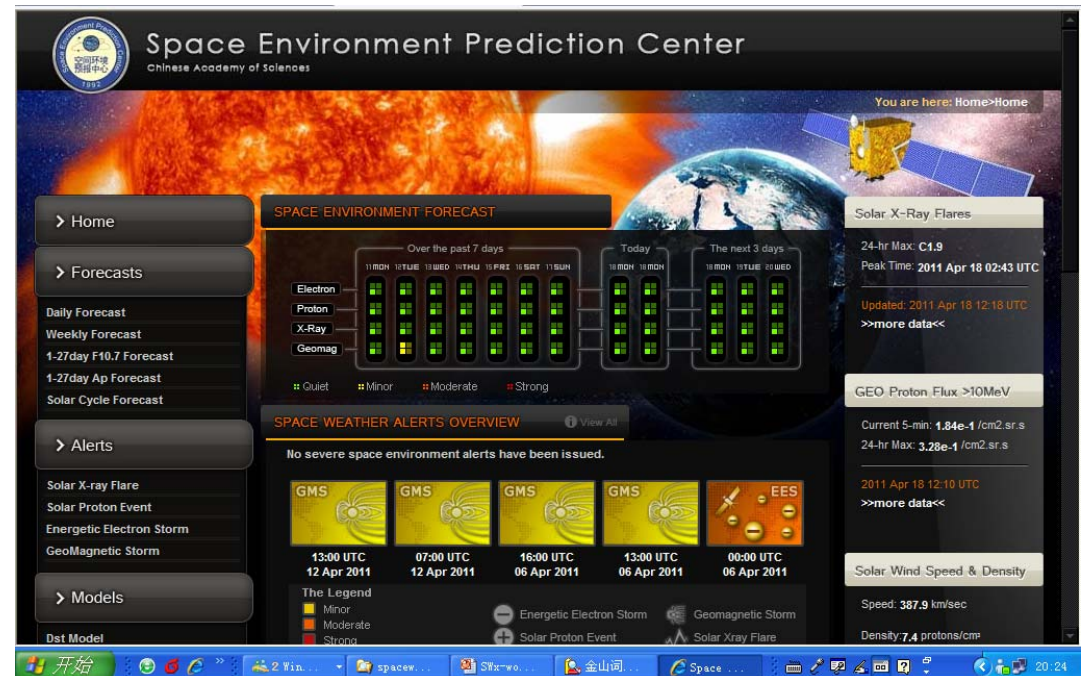
- I. General information of Space Environment Prediction Center (SEPC)**
- II. Services for China Manned space missions**
- III. Researches on Space Weather**

I. SEPC – Foundation

- To support China manned space missions, SEPC was established in 1993 in NSSC,CAS;
- Set up its space environment operational system and forecasting team in 1998.
- Started to issue space environment prediction all over the world in 1998 via internet.

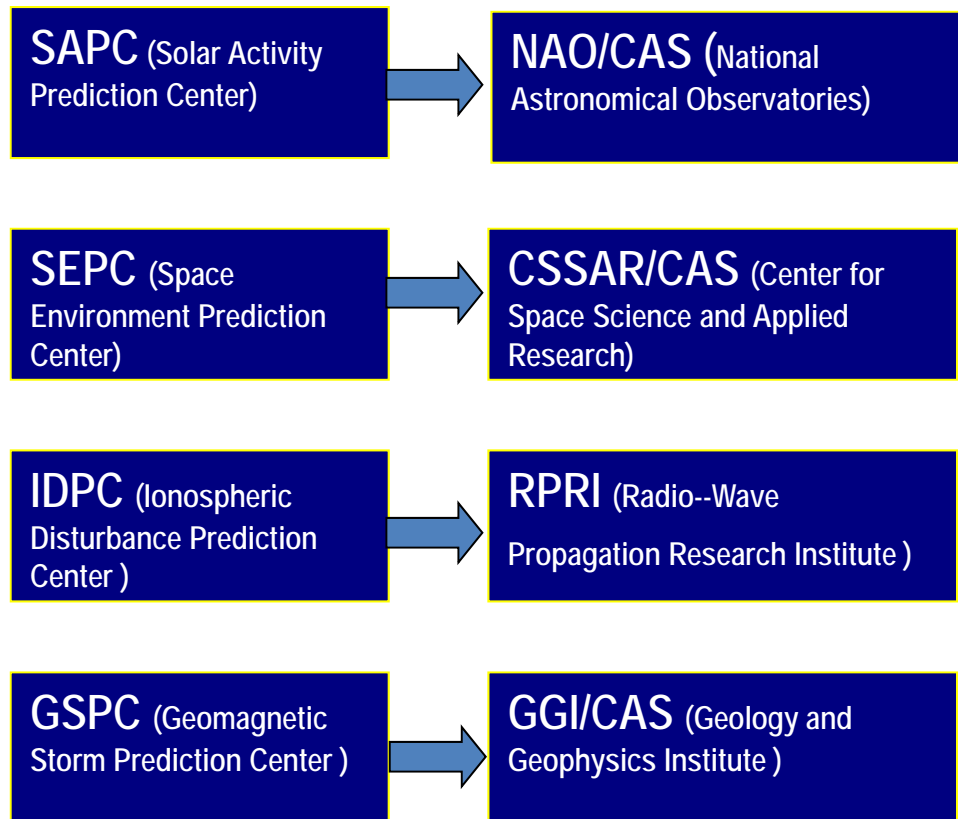
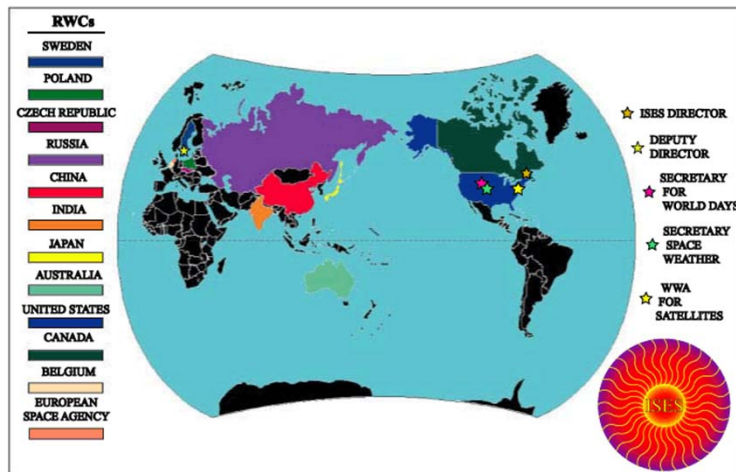
❖ 7days/week, 365days/year

<http://www.sepc.ac.cn>



RWC-China

- SEPC is one of the four sub-centers of Regional Warning Center-China (RWC-China, ISES).



I. SEPC – Organization

- SE forecast group
- SE forecast research group
- SE model research group
- SE effects research group
- SE operation system developing group
- Space debris group

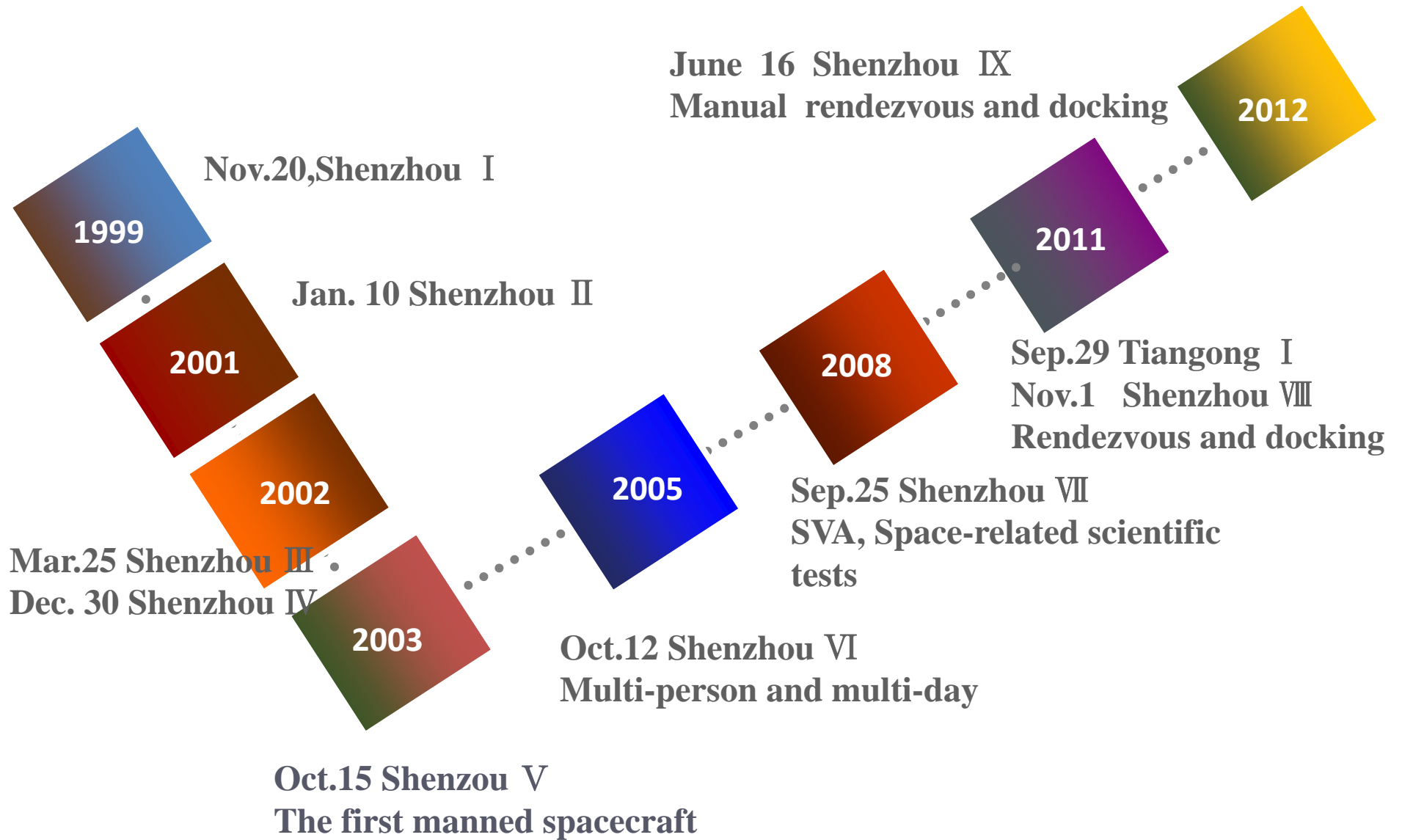


- 16 forecasters come from different groups

Outline

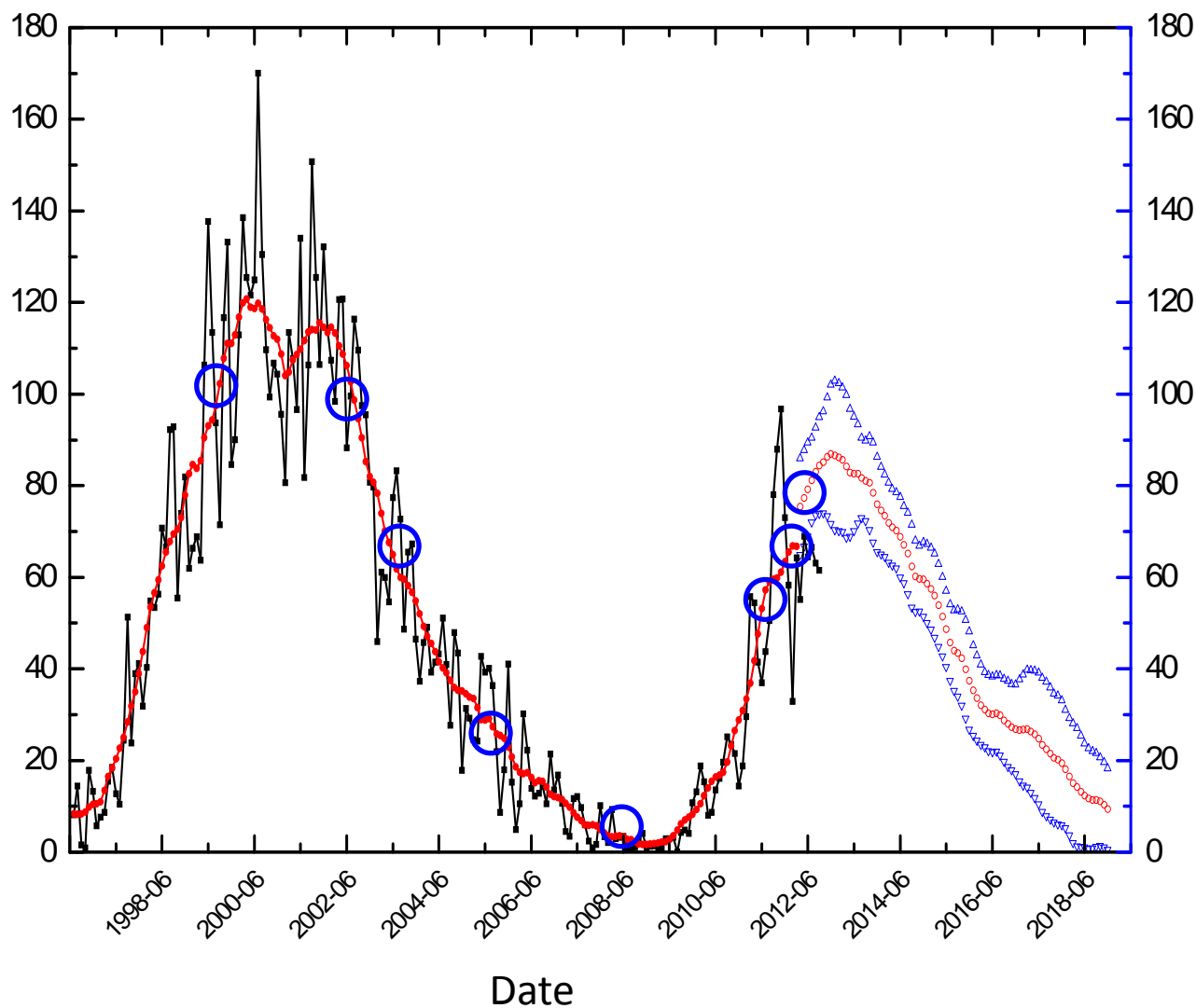
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China Manned Space Engineering



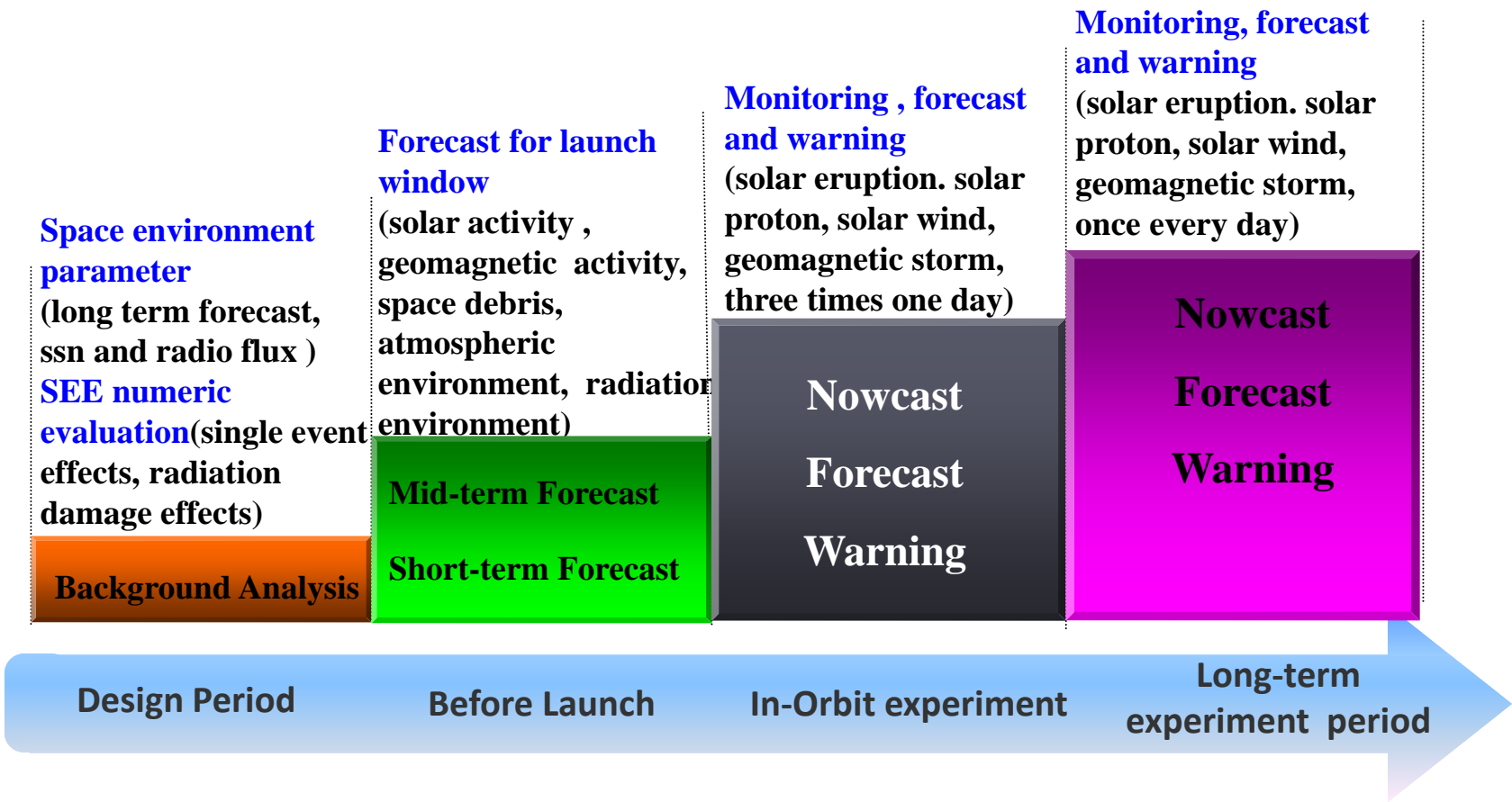
As a subsystem of space application system in China manned space engineering, SEPC has supplied space weather service in each step of China Manned Space Engineering

Missions during Solar Cycles



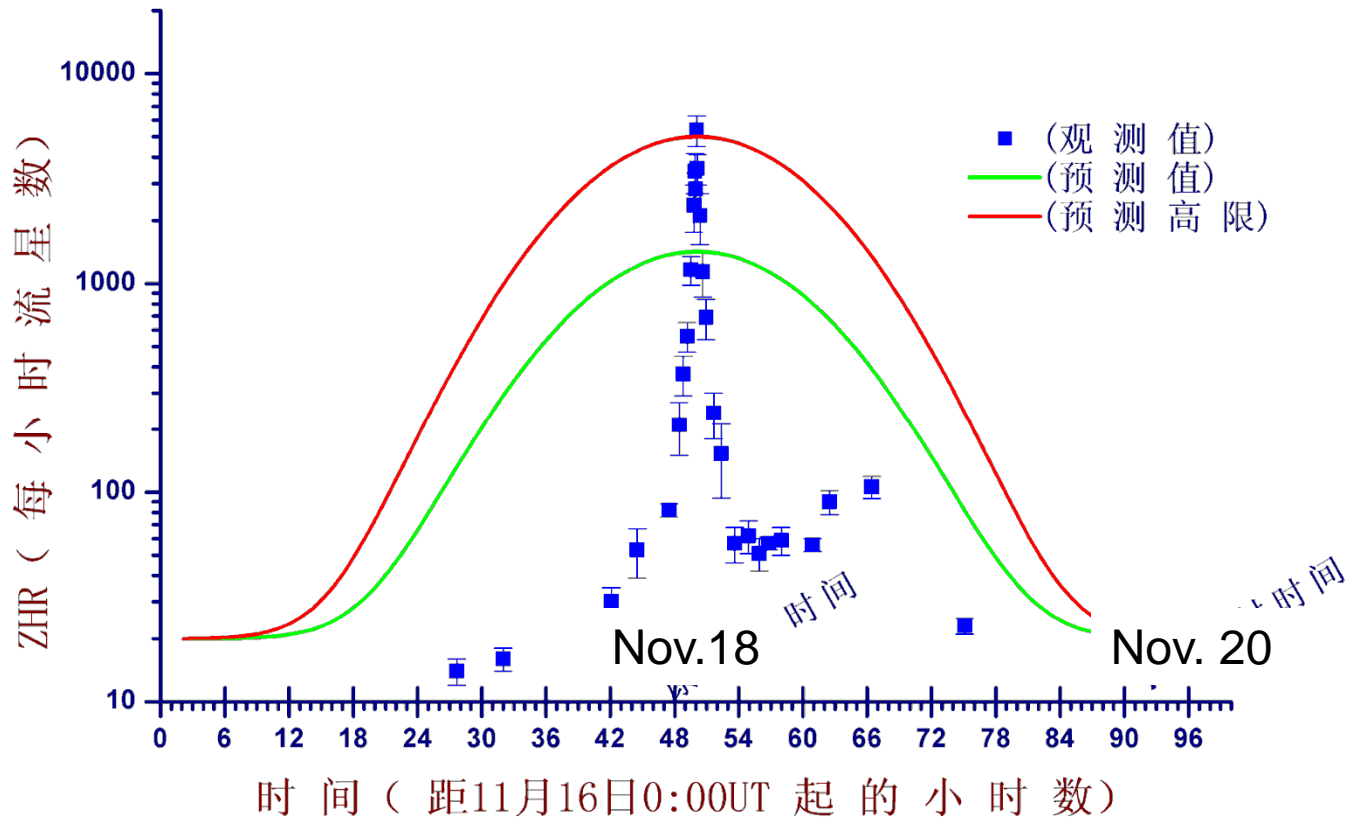
- **Nov.20, 1999 Shenzhou I**
- **Jan. 10, 2002 Shenzhou II**
- **Mar.25, 2002 Shenzhou III**
- **Dec. 30, 2002 Shenzhou IV**
- **Oct.15 , 2003 Shenzhou V**
The first manned spacecraft
- **Oct.12 , 2005 Shenzhou VI**
Multi-person and multi-day
- **Sep.25 , 2008 Shenzhou VII**
SVA
Space-related scientific tests
- **Sep.29, 2011 Tiangong I**
- **Nov.1, 2011 Shenzhou VIII**
Rendezvous and docking
- **June 16, 2012 Shenzhou IX**
maned rendezvous and docking

Service for China manned missions

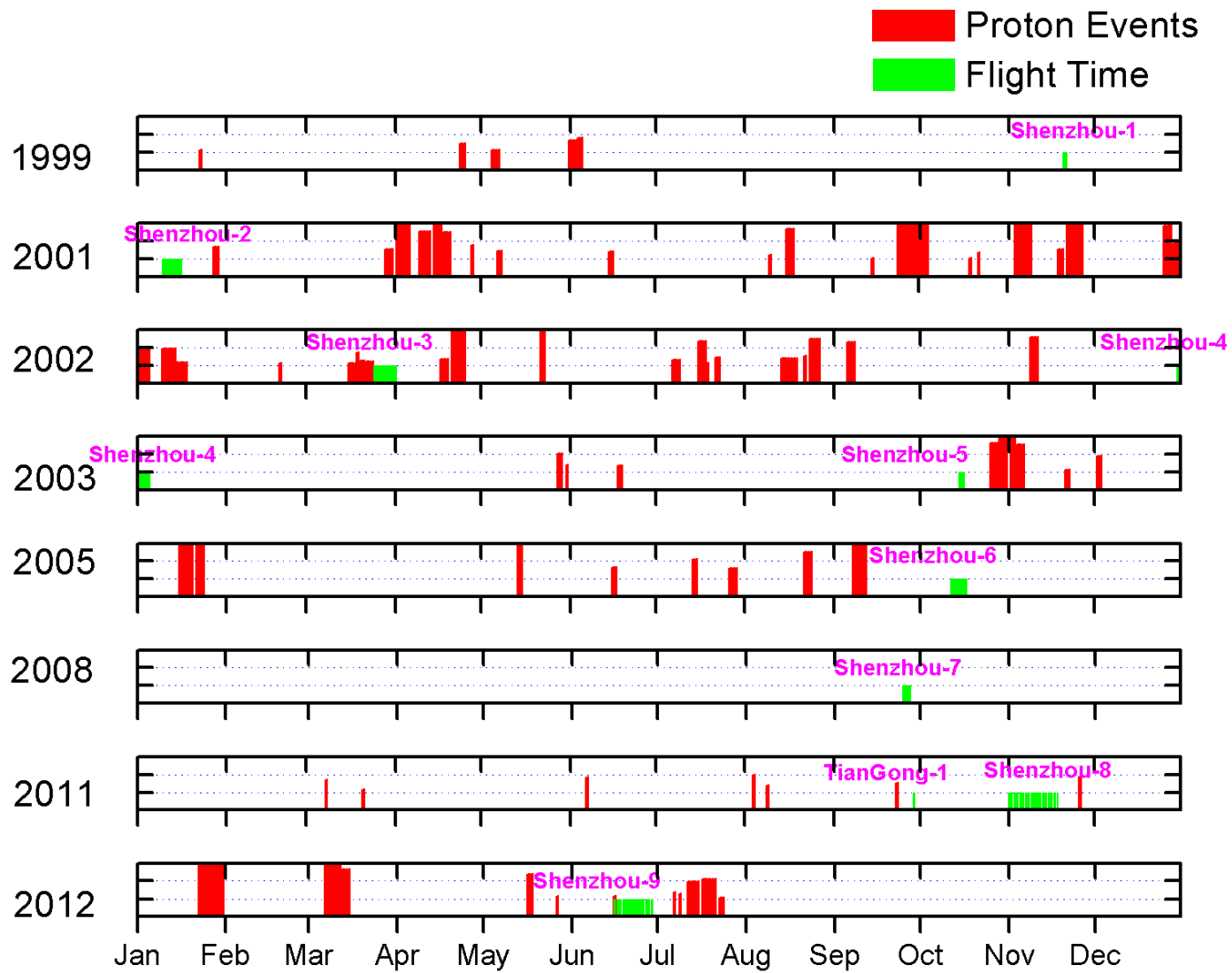


Process of Space Weather Forecast Service

Leonid Burst Prediction for Shenzhou-1

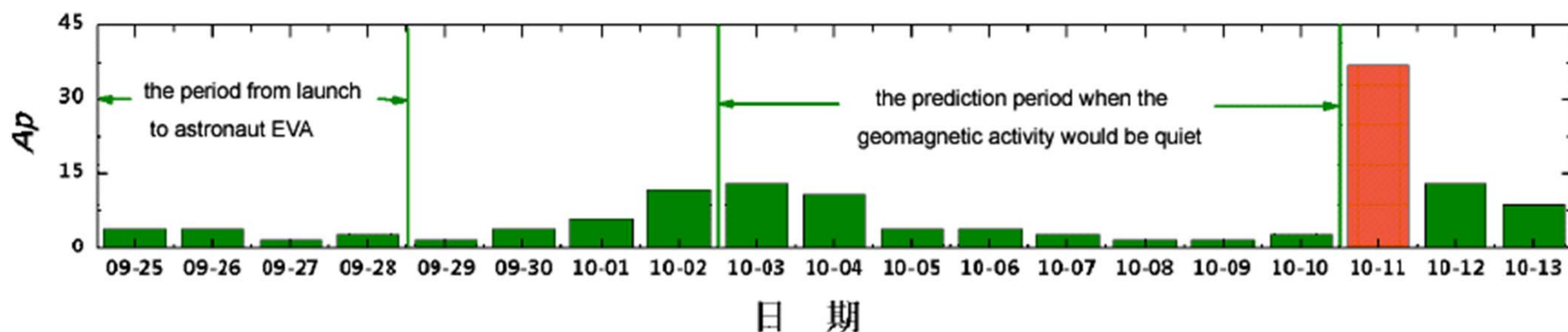


- In 1999, in order to avoid Leonid burst, Shenzhou-1 postponed its launch time from Nov.18 to Nov. 20 for 48 hours . This is the first time of changing launch plan due to space environment in China.
- According to the observation, Meteoroid flux had declined to the safe level at the launch time.



- Successfully avoided the severe space environment event—Solar Proton Event.

Geomagnetic field quiet period prediction for Shenzhou VII

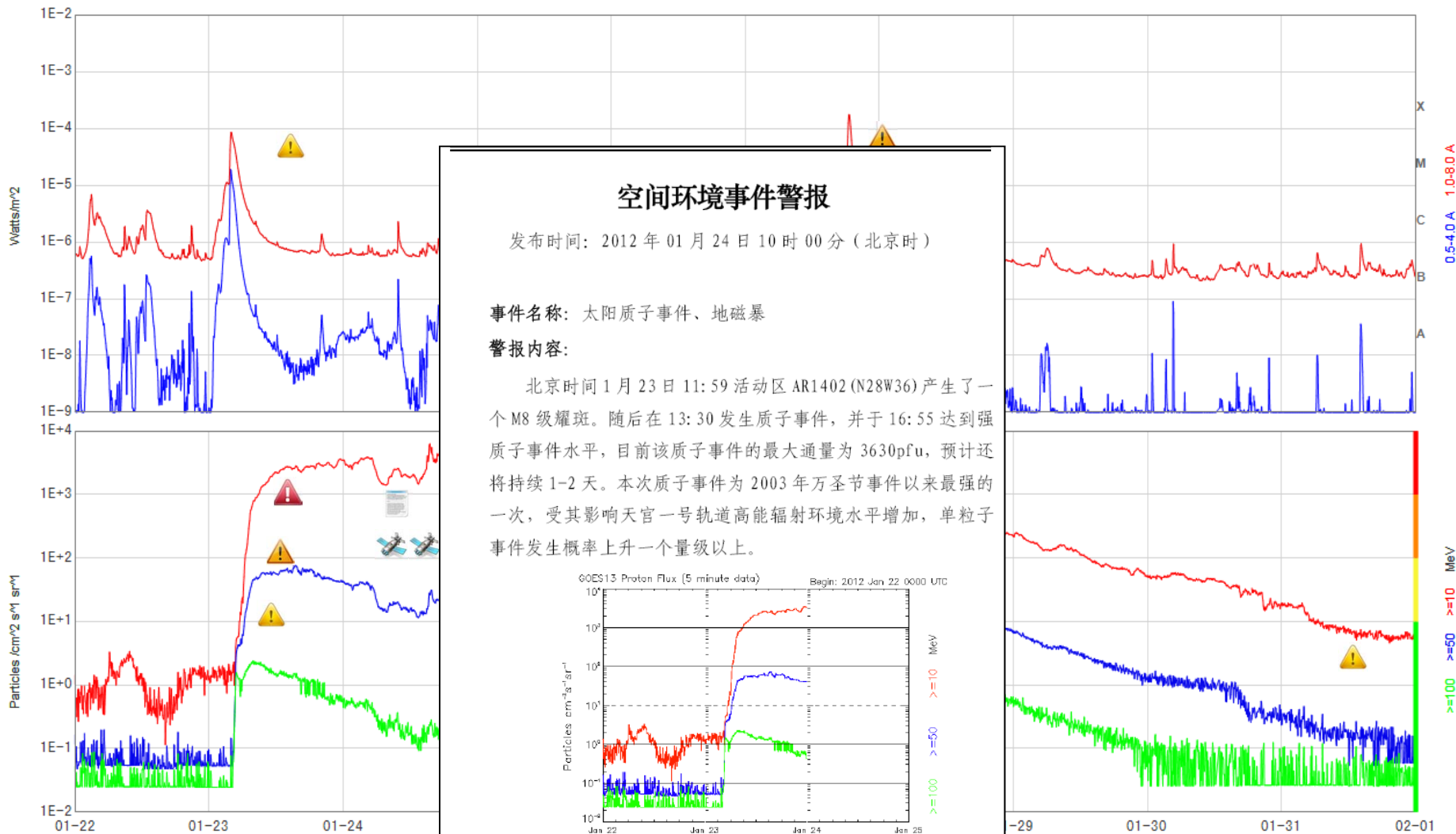


The geomagnetic Ap index during SZ-7 launch, EVA and companion microsatellite experiment

2012 China dragon event

GOES Xray Flux & Proton Flux(5 Min data)

Begin:2012 Jan 22 0000 UTC



空间环境事件警报

发布时间：2012年01月24日10时00分（北京时）

事件名称：太阳质子事件、地磁暴

警报内容：

北京时间1月23日11:59活动区AR1402(N28W36)产生了一个M8级耀斑。随后在13:30发生质子事件，并于16:55达到强质子事件水平，目前该质子事件的最大通量为3630pfu，预计还将持续1-2天。本次质子事件为2003年万圣节事件以来最强的一次，受其影响天官一号轨道高能辐射环境水平增加，单粒子事件发生概率上升一个量级以上。

GOES13 Proton Flux (5 minute data) Begin: 2012 Jan 22 0000 UTC

Updated 2012 Jan 24 00:11:03 UTC NOAA/SWPC Boulder, CO USA

Space environment detectors on Tiangong I

- Energetic particle radiation detector

- Proton

- 2.5~5MeV

- 5~10MeV

- 10~18.5MeV

- 18.5~40MeV

- 40~80MeV

- 80~150MeV

- >150MeV

- Electron

- 0.2~0.4MeV

- 0.4~0.5 MeV

- 0.5~0.6MeV

- 0.6~0.8MeV

- 0.8~1.0MeV

- 1.0~1.2MeV

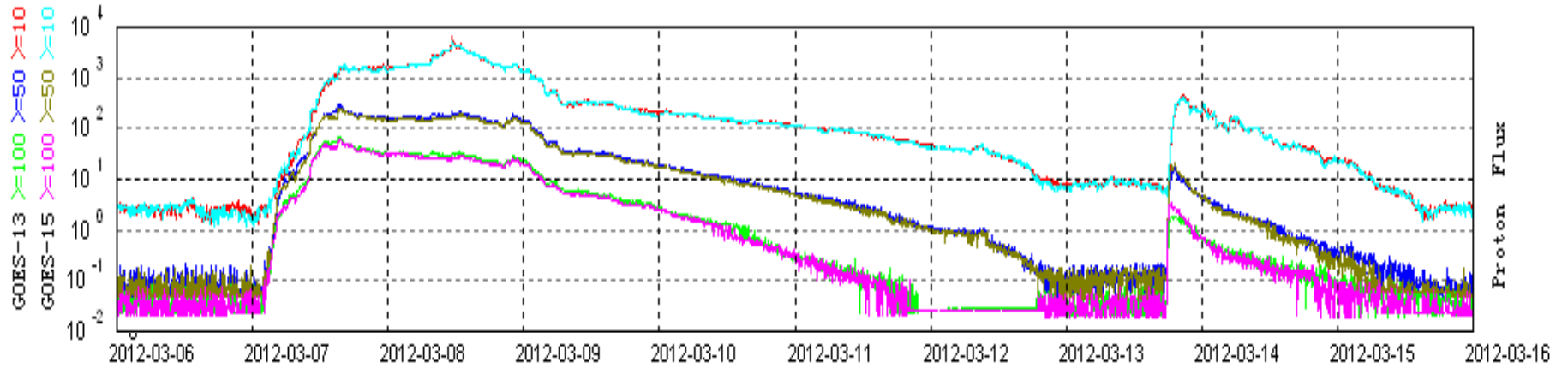
- 1.2~1.5MeV

- >1.5MeV

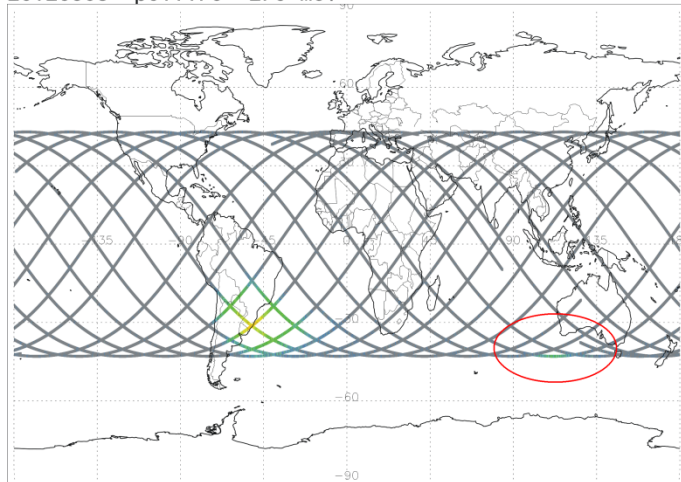
- Orbital atmospheric environment detector

- Density, composition

Solar proton event on March 7, 2012

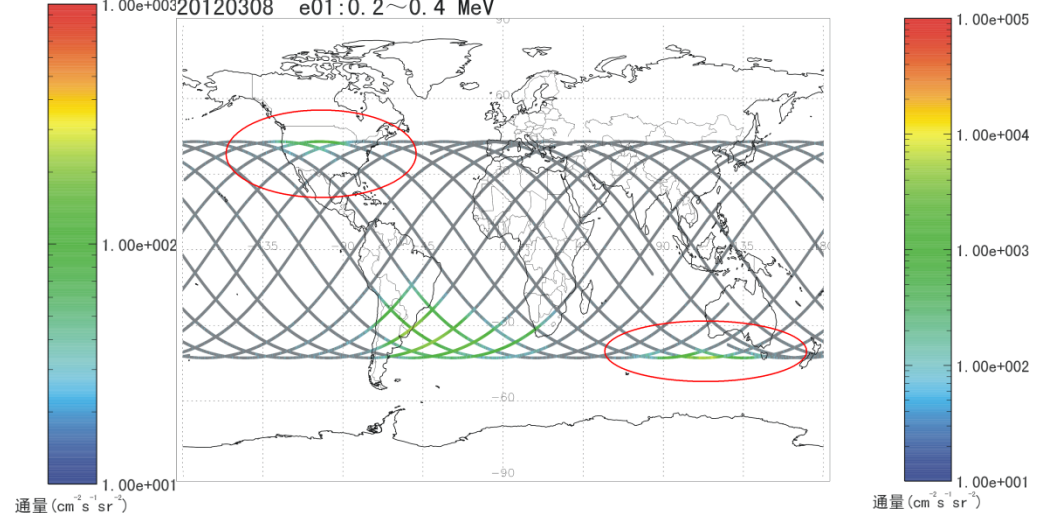


20120308 p01:1.5~2.5 MeV



proton

1.00e+003 20120308 e01:0.2~0.4 MeV



electron

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- I. General information of Space Environment Prediction Center (SEPC)
- II. Services for China Manned space missions
- III. Researches on Space Weather

Model Research Review in SEPC

Sun

- Sunspot and solar F10.7 long-term and 27-day forecast
- Solar eruptive event forecast study

Solar wind

- Solar wind velocity during low CME periods model research

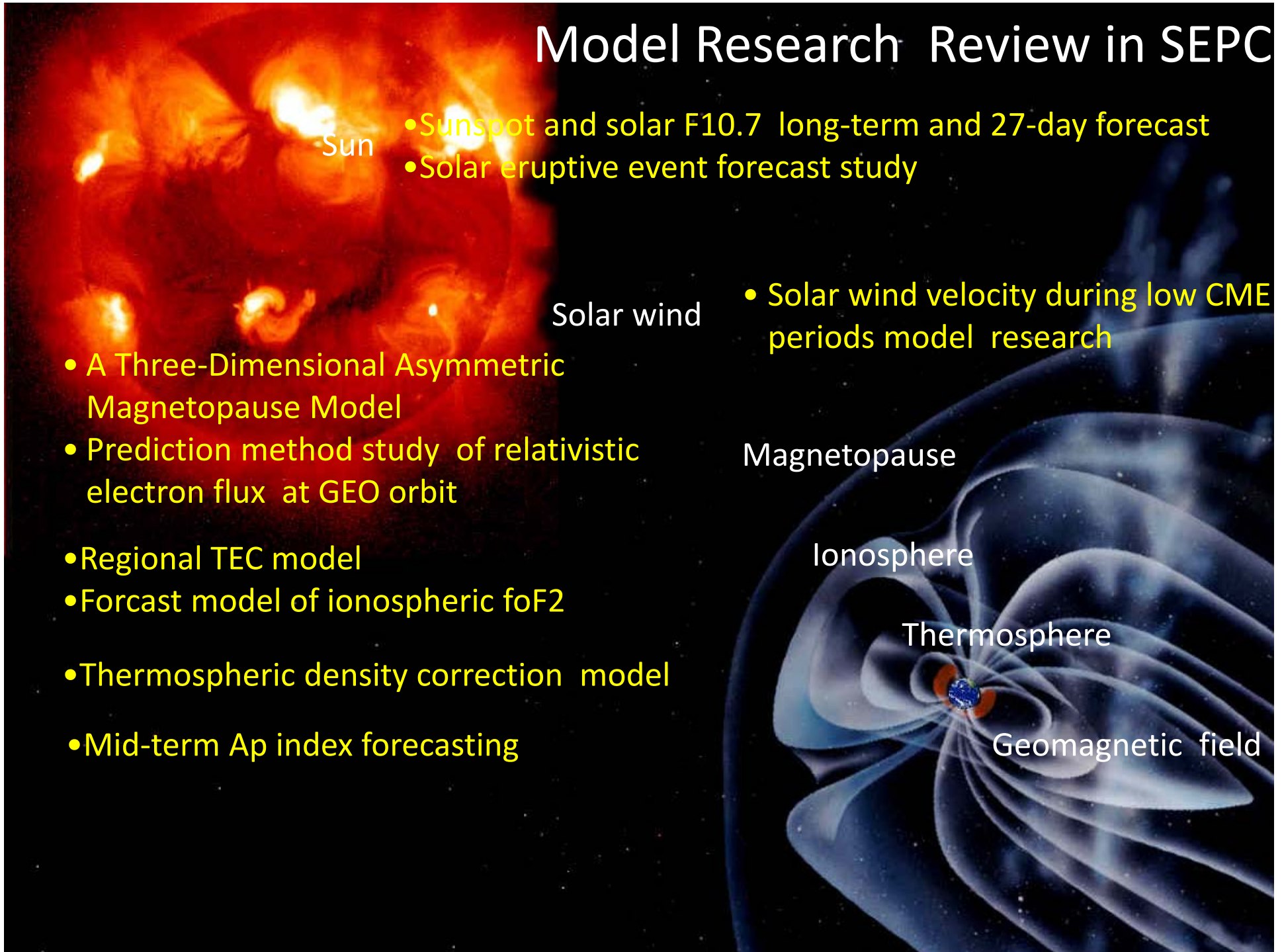
- A Three-Dimensional Asymmetric Magnetopause Model
- Prediction method study of relativistic electron flux at GEO orbit
- Regional TEC model
- Forecast model of ionospheric foF2
- Thermospheric density correction model
- Mid-term Ap index forecasting

Magnetopause

Ionosphere

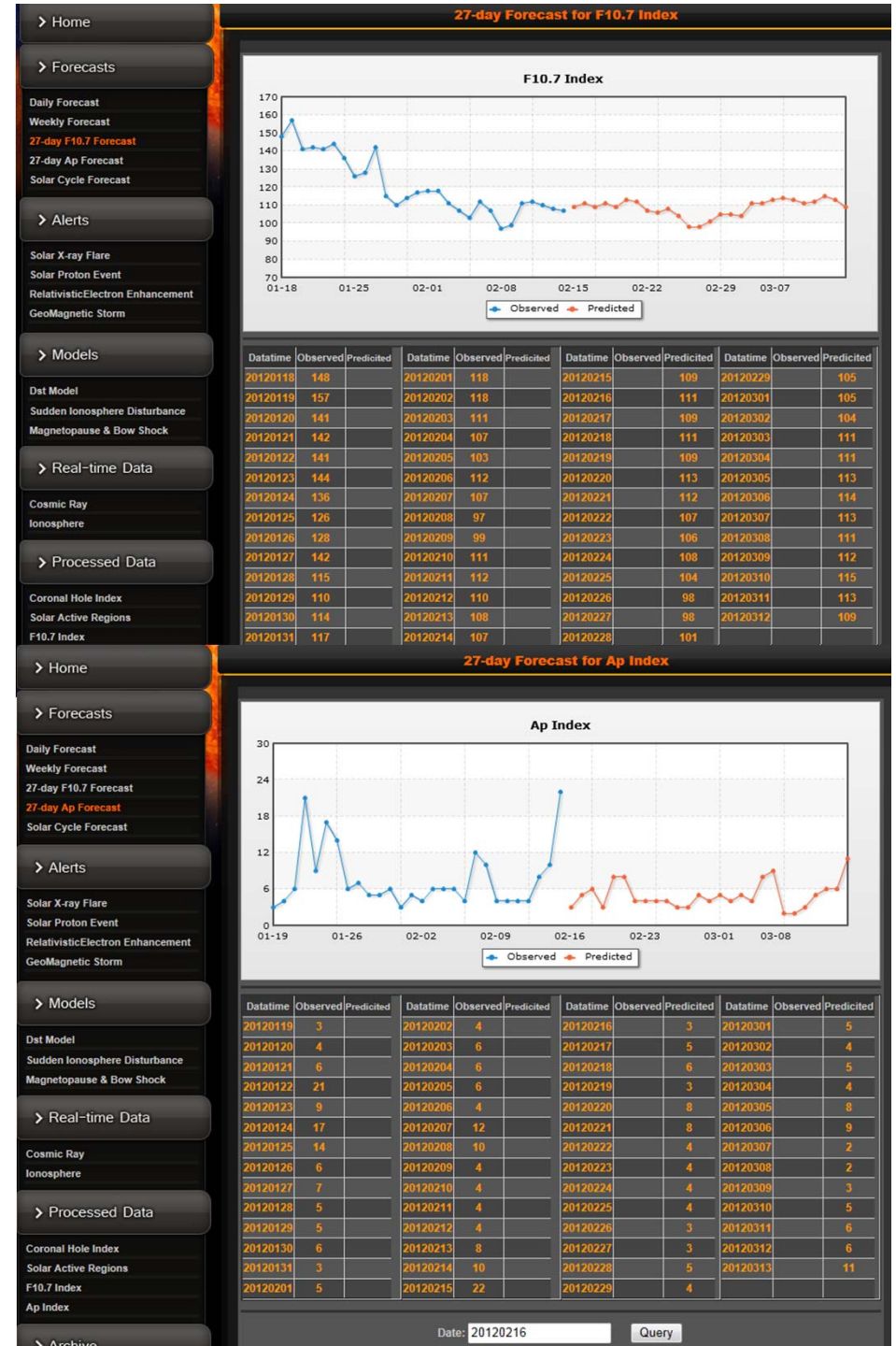
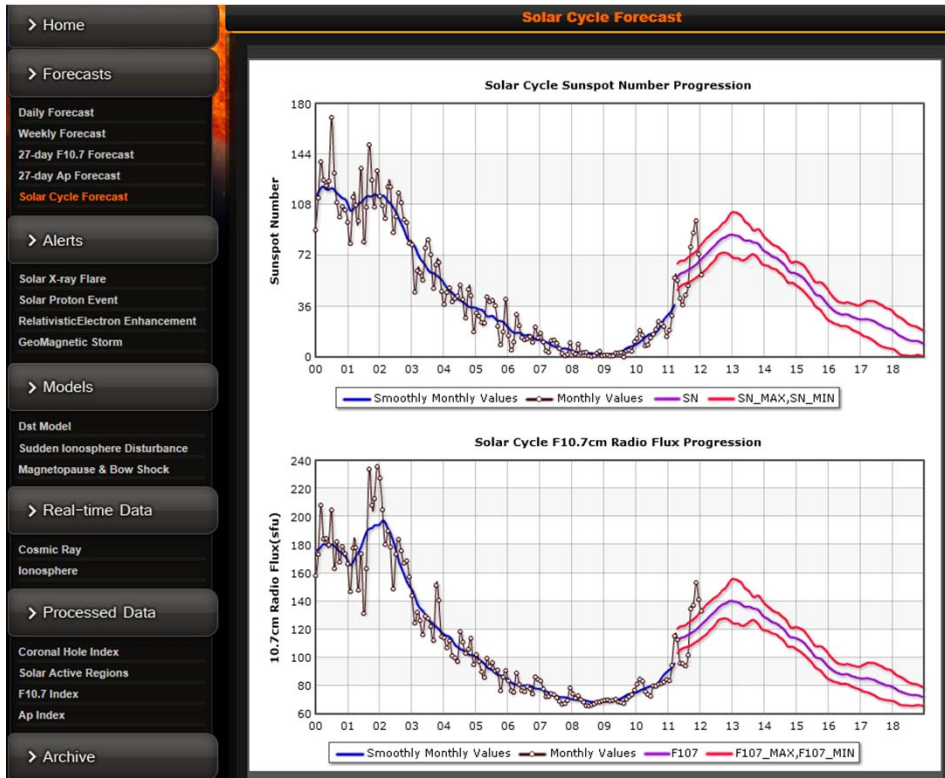
Thermosphere

Geomagnetic field

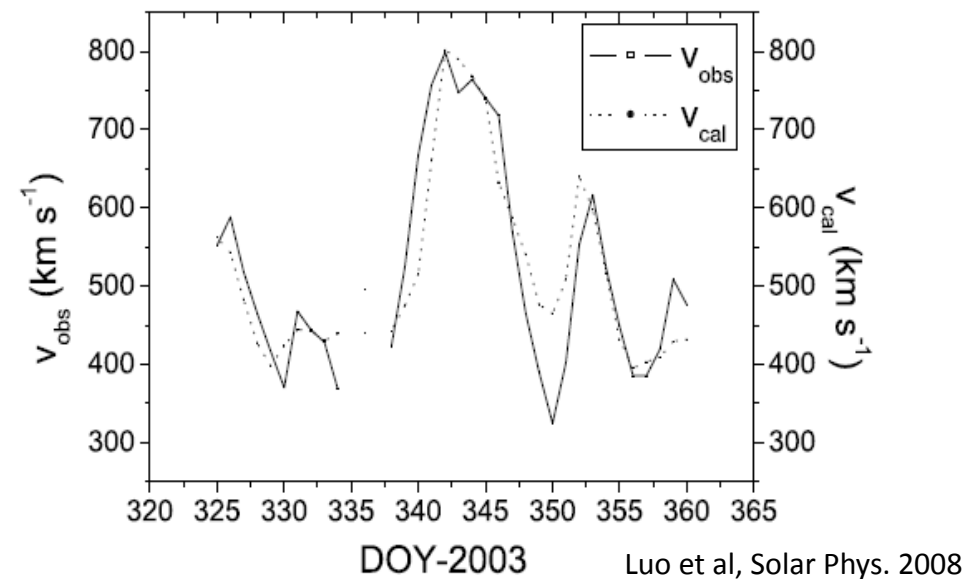
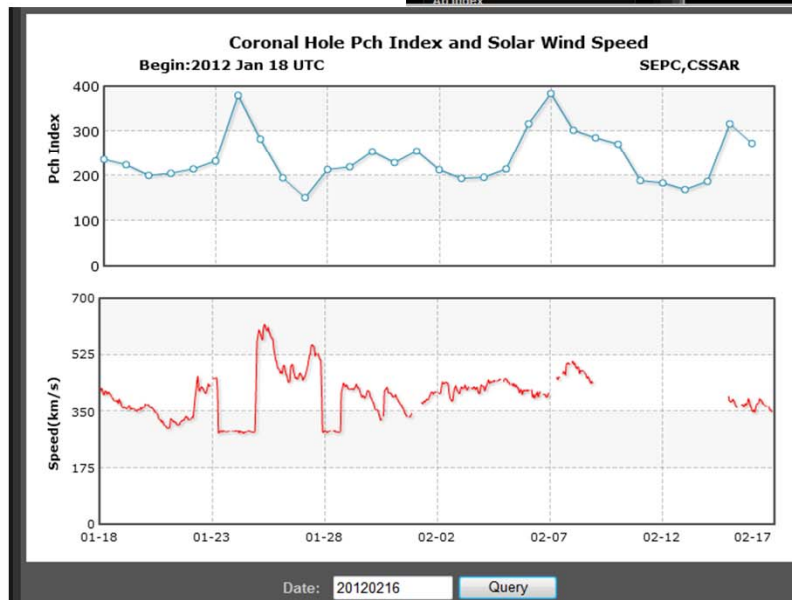
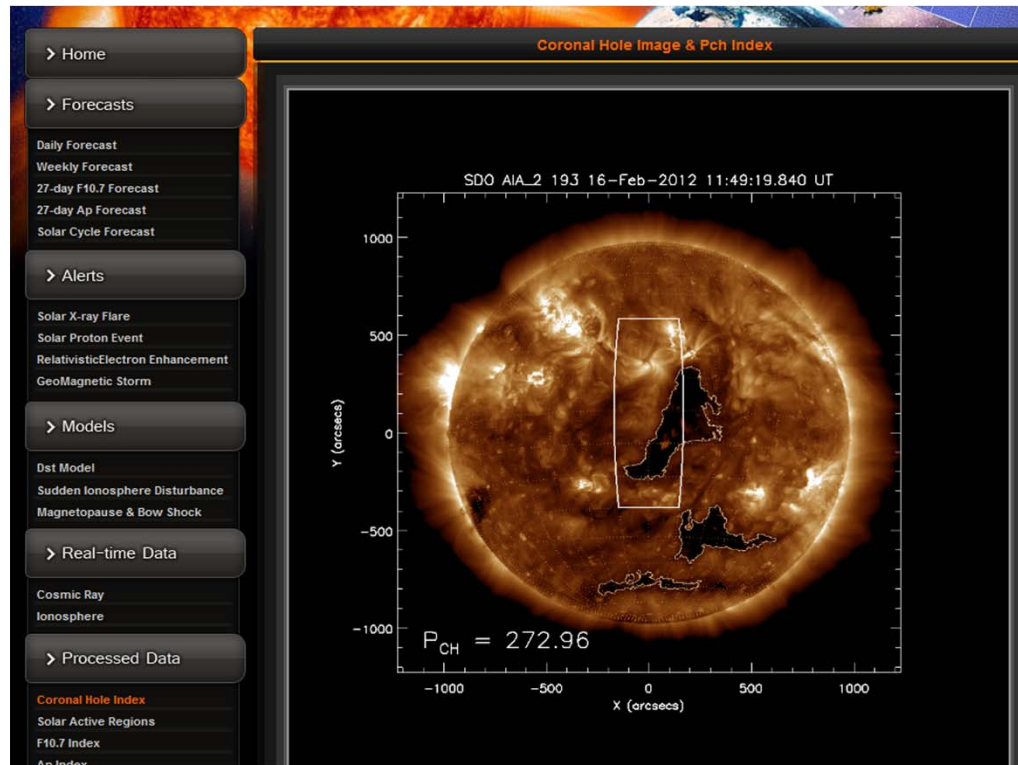


• Mid-term Forecast

• Solar Cycle Forecast



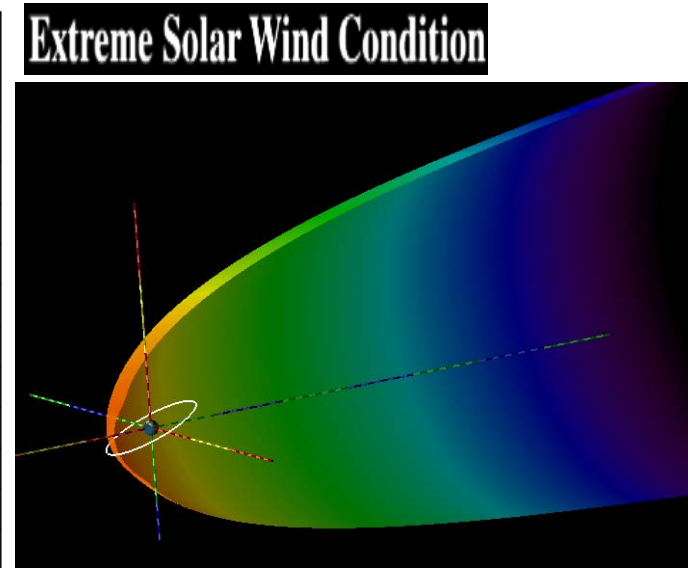
Pch index and solar wind speed forecast

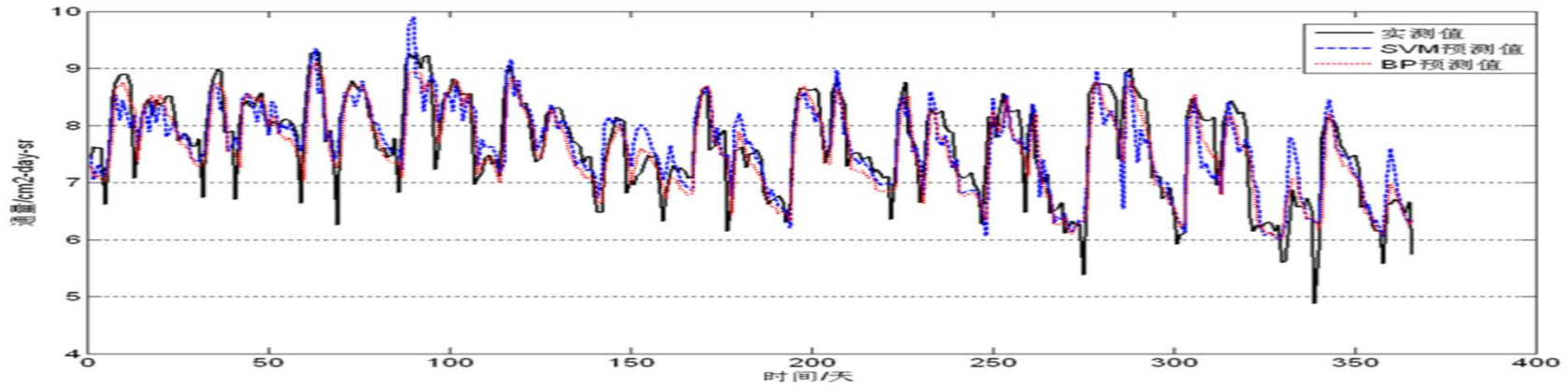


Three Dimensional Asymmetric Magnetopause Empirical Model (Lin et al. 2010, JGR)

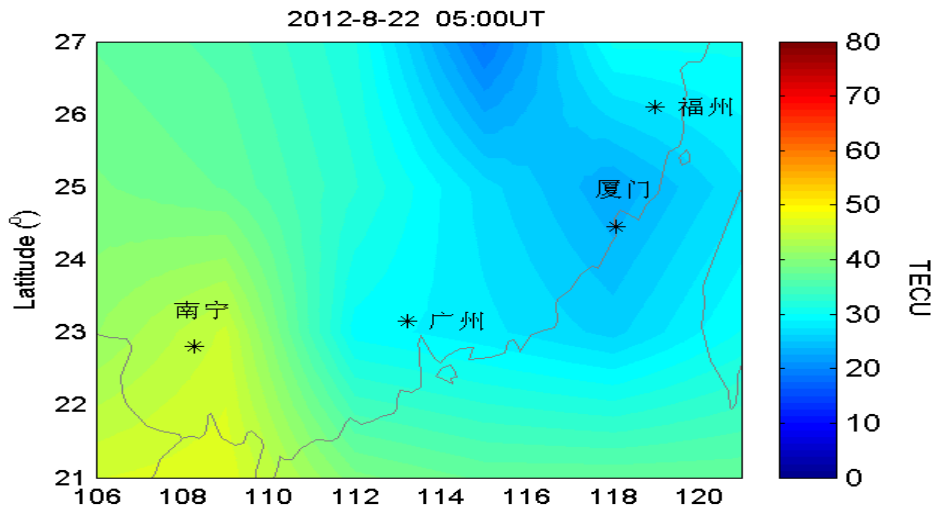
- ◆ In comparison with previous magnetopause empirical models, this model **reduces the standard deviation of prediction greatly.**
- ◆ Parameterized by solar wind dynamic and magnetic pressures, IMF Bz, and the dipole tilt angle. **It's appropriate for the near-Earth magnetopause prediction under both normal and extreme solar wind conditions.**
- ◆ Can describe the 3D magnetopause, including **the asymmetries and the indentations near the cusps.**

Region Model	θ			Z		All
	$\theta \leq 30^\circ$	$30^\circ < \theta < 90^\circ$	$\theta \geq 90^\circ$	$ z \leq 3R_E$	$ z > 3R_E$	
	309	680	237	530	696	
Roelof and Sibeck [1993]	1.298	1.351	2.822	1.489	1.886	1.725
Petrinec and Russell [1996]	0.788	1.210	1.371	0.792	1.367	1.154
Shue et al. [1997]	0.863	1.219	1.397	0.822	1.390	1.178
Shue et al. [1998]	0.829	1.236	1.407	0.795	1.411	1.185
Kuznetsov and Suvorova [1998]	0.663	1.150	2.048	0.947	1.494	1.287
Kawano et al. [1999]	1.093	1.237	1.510	1.029	1.413	1.261
Kalegaev and Lyutov [2000]	1.477	1.601	3.208	1.698	2.187	1.990
Chao et al. [2002]	0.789	1.242	1.375	0.783	1.400	1.174
New model	0.582	0.727	1.054	0.642	0.855	0.770
$\delta\sigma(d)\%$	12.0%	36.8%	23.1%	18.0%	37.5%	33.3%

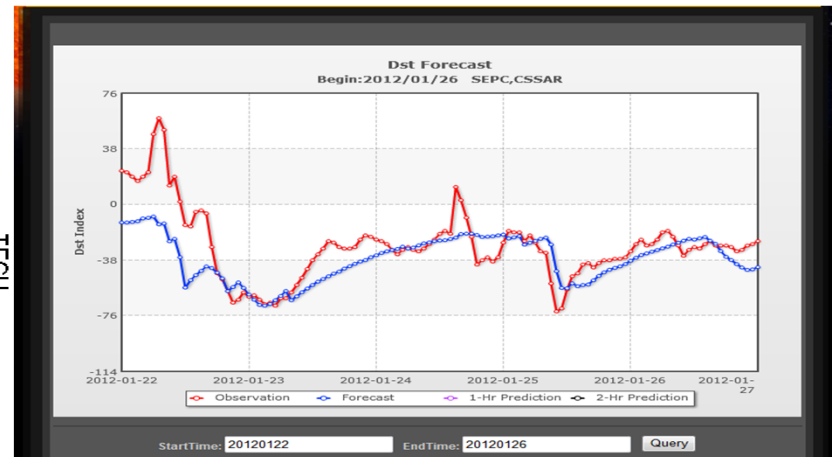




GEO relativistic electron flux forecast model



regional TEC



Dst index forecast model

http://eng.sepc.ac.cn

Space Environment Prediction Center
Chinese Academy of Sciences

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SPACE ENVIRONMENT FORECAST

Over the past 7 days

	11 MON	12 TUE	13 WED	14 THU	15 FRI	16 SAT	17 SUN
Electron	Quiet	Minor	Minor	Minor	Minor	Minor	Minor
Proton	Quiet	Minor	Minor	Minor	Minor	Minor	Minor
X-Ray	Quiet	Minor	Minor	Minor	Minor	Minor	Minor
Geomag	Quiet	Minor	Minor	Minor	Minor	Minor	Minor

Today

	18 MON	18 MON
Electron	Minor	Minor
Proton	Minor	Minor
X-Ray	Minor	Minor
Geomag	Minor	Minor

The next 3 days

	18 MON	19 TUE	20 WED
Electron	Minor	Minor	Minor
Proton	Minor	Minor	Minor
X-Ray	Minor	Minor	Minor
Geomag	Minor	Minor	Minor

■ Quiet ■ Minor ■ Moderate ■ Strong

SPACE WEATHER ALERTS OVERVIEW [View All](#)

No severe space environment alerts have been issued.

Alert Type	Time (UTC)	Date
GMS	13:00	12 Apr 2011
GMS	07:00	12 Apr 2011
GMS	16:00	06 Apr 2011
GMS	13:00	06 Apr 2011
EES	00:00	06 Apr 2011

The Legend

- Minor
- Moderate
- Strong
- ⊖ Energetic Electron Storm
- ⊕ Solar Proton Event
- ☄ Geomagnetic Storm
- ☀ Solar Xray Flare

Solar X-Ray Flares

24-hr Max: C1.9
Peak Time: 2011 Apr 18 02:43 UTC
Updated: 2011 Apr 18 12:18 UTC
>>more data<<

GEO Proton Flux >10MeV

Current 5-min: $1.84e-1$ /cm².sr.s
24-hr Max: $3.28e-1$ /cm².sr.s
2011 Apr 18 12:10 UTC
>>more data<<

Solar Wind Speed & Density

Speed: 387.9 km/sec
Density: 7.4 protons/cm³

Windows: 开始, 2 Win..., spacew..., SWx-wo..., 金山词..., Space ...

20:24

> Home

> Forecasts

Daily Forecast

Weekly Forecast

27-day F10.7 Forecast

27-day Ap Forecast

Solar Cycle Forecast

> Alerts

Solar X-ray Flare

Solar Proton Event

Relativistic Electron Enhancement

GeoMagnetic Storm

> Models

Dst Model

Sudden Ionosphere Disturbance

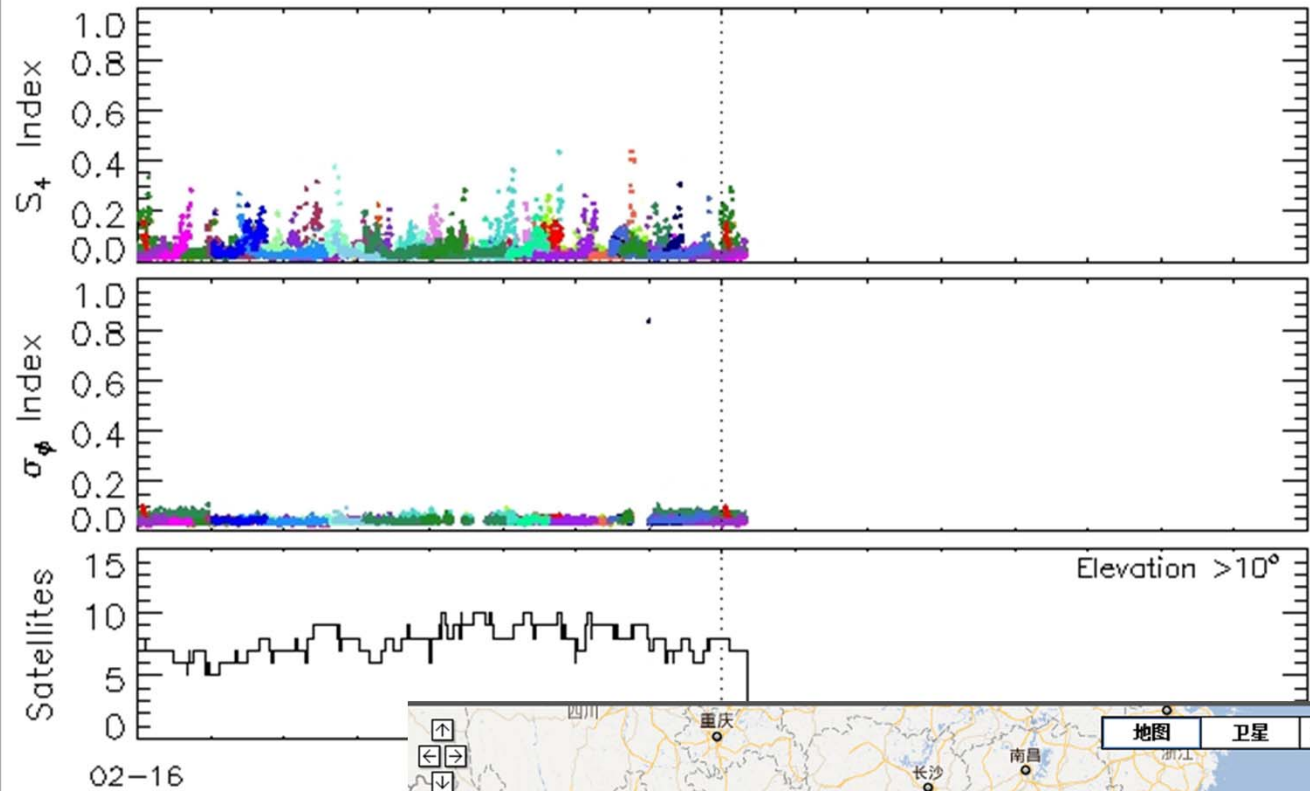
Magnetopause & Bow Shock

> Real-time Data

Cosmic Ray

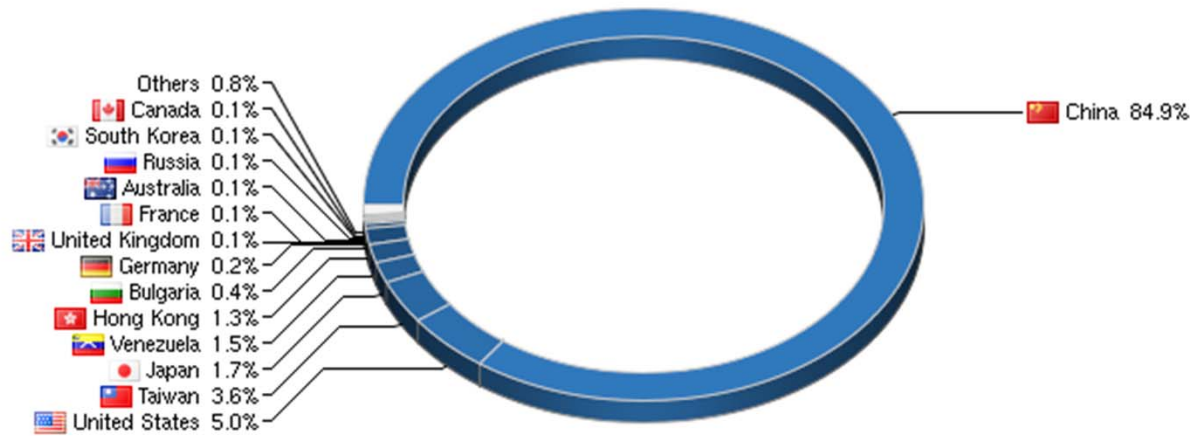
Ionosphere

Xiamen Scintillation Monitoring



Real-time Data

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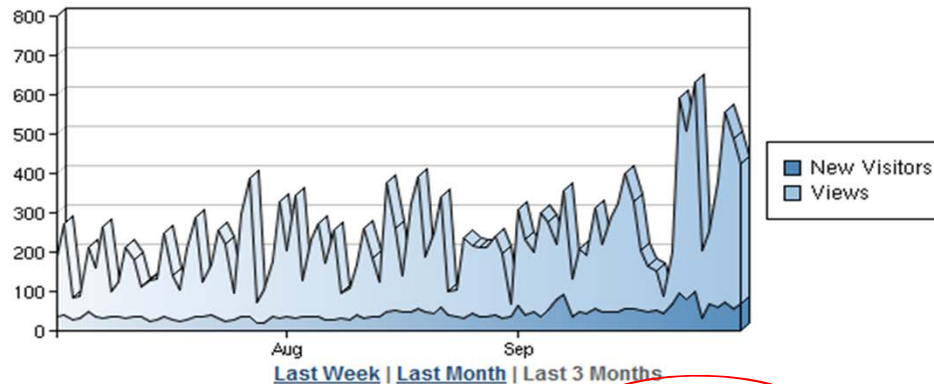
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 30 day average: 57
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Yesterday: 424 ↓
 30 day average: 295
 Record: 1,007 on June 25, 2012
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Date	New Visitors	Flag Counter Views
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October 16, 2012	69	424
October 15, 2012	58	488
October 14, 2012	73	556
October 13, 2012	62	382
October 12, 2012	67	252
October 11, 2012	34	203
October 10, 2012	99	631

Thanks for your attention!

