Space Weather Operations in China

XiaoXin Zhang

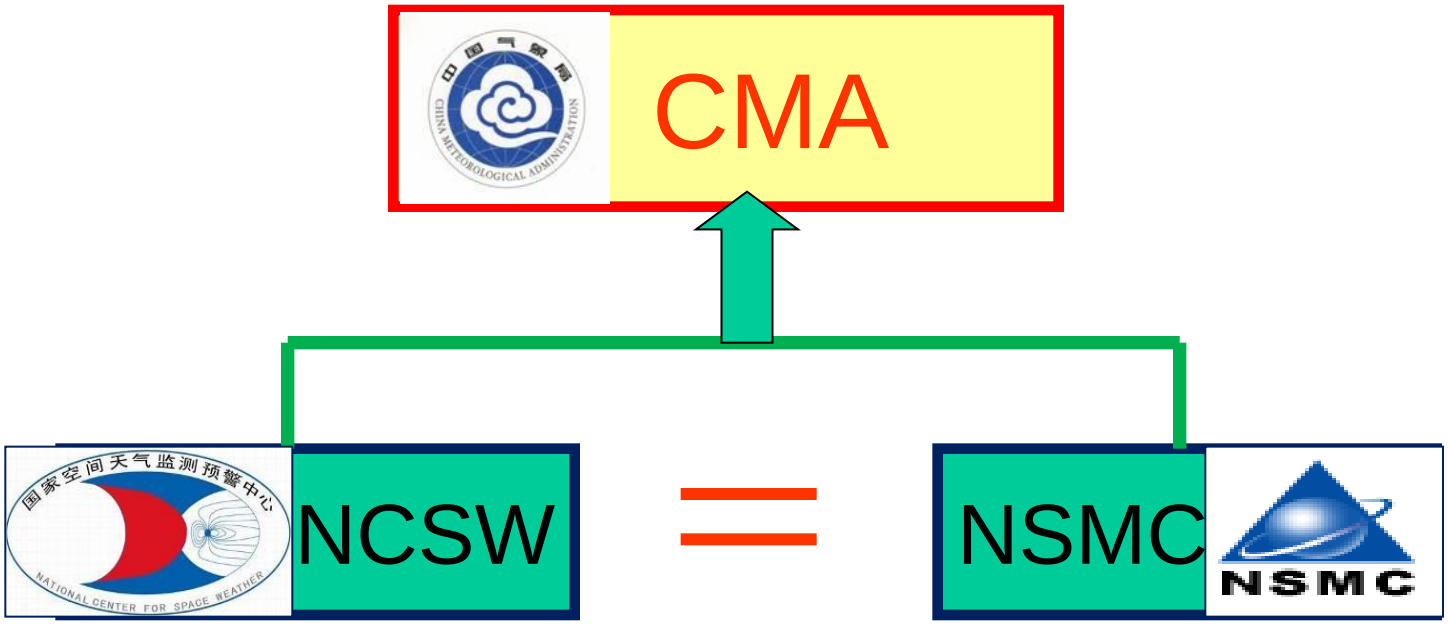
National Center for Space Weather
China Meteorological Administration

Outline

1. ***New Space weather center in CMA***
2. **Space Weather Activities in CMA**
3. **Related Activities in WMO**
4. **Future Projects**

1. Introduction to National Center for Space Weather

China Meteorological Administration



National Center for Space Weather　　National Satellite Meteorological Center

One institute, two names

NSMC

- NSMC was founded in 1971
- NSMC is a scientific research and operational facility under CMA

NCSW

- NCSW was founded in 2002
- NCSW acts as the national level center authorized by the National Council, to carry out the space weather operation and provide space weather services.

On July 1, 2004

CMA declared that NCSW began to provide space weather operational service

Missions of NCSW

I. To study and draft strategy and development programs for China's Space weather operations.

II. To build up space-based and ground-based monitoring systems for China's space weather operations.

III. To be responsible for receiving, processing, distributing and studying space weather data.

IV. To provide space weather monitoring and warning operations and services

Daily Operation of NCSW

A. Data acquisition and collection

B. Space weather analysis and forecast

C. Space weather events evaluation

D. Providing products and services

Outlook of National Center for Space Weather

Welcome to visit our Center
when you go to Beijing !

Outline

1. New Space weather center in CMA
2. *Space Weather Activities in CMA*
3. Related Activities in WMO
4. Future Projects

Meteorological satellites & Space Weather

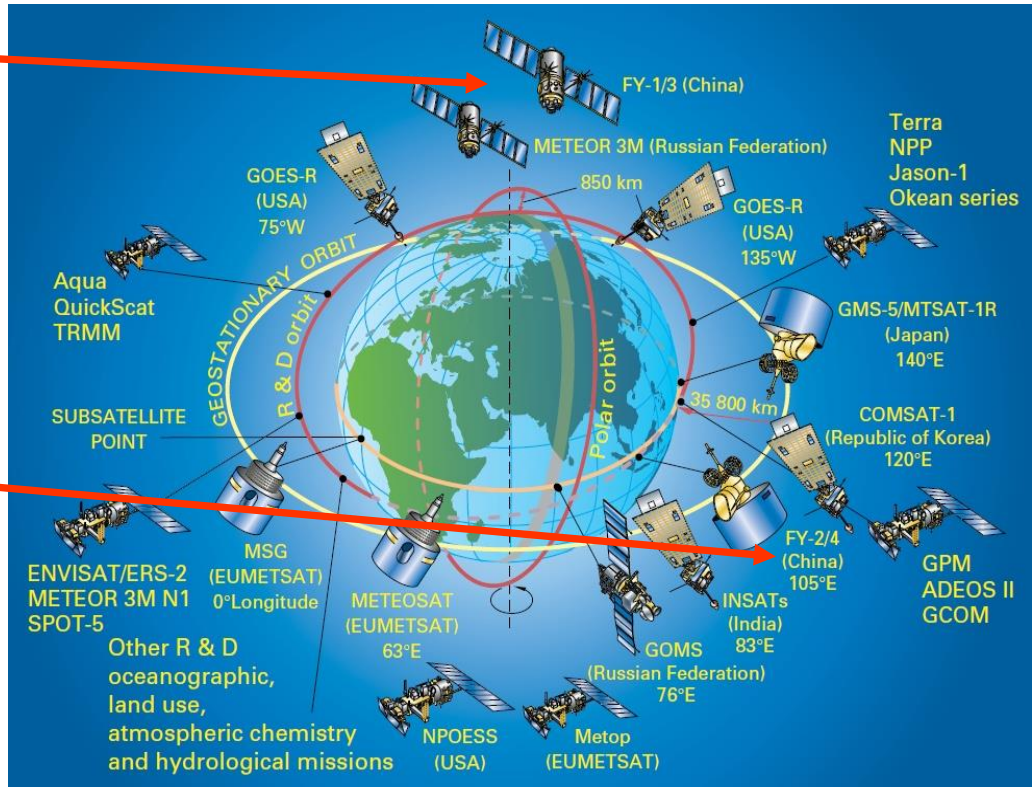
- The space environment data from Meteorological satellites are critical for developing, driving, and validating space weather models.
- The space environment measurements from Meteorological satellites are a critical component of Space Weather Operations and Services.
- Meteorological satellites would advance our understanding of the space environment.

2.1 Observations & Operations

□ FENGYUN (FY) Meteorological satellites:

I. FY Polar Satellites
- FY-1（D）
- FY-3（A)
- FY-3 （B)
- FY-3 02 series

II. FY geostationary Satellites
- FY-2（C、D、E）
- Coming soon:
  FY-2 （F、G、H）
  FY-4 (A) ……



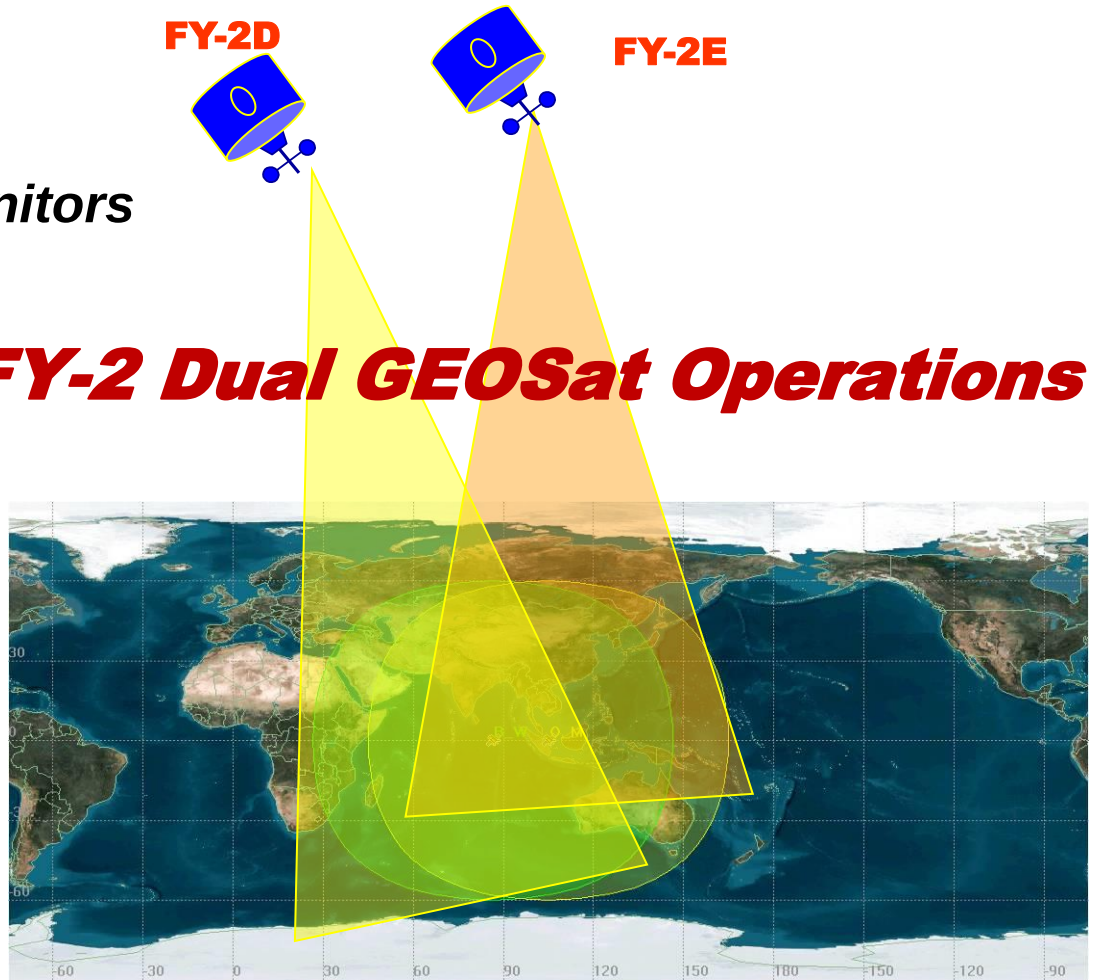
Status of FY

Current SWx Sensors : FY-1/FY-3

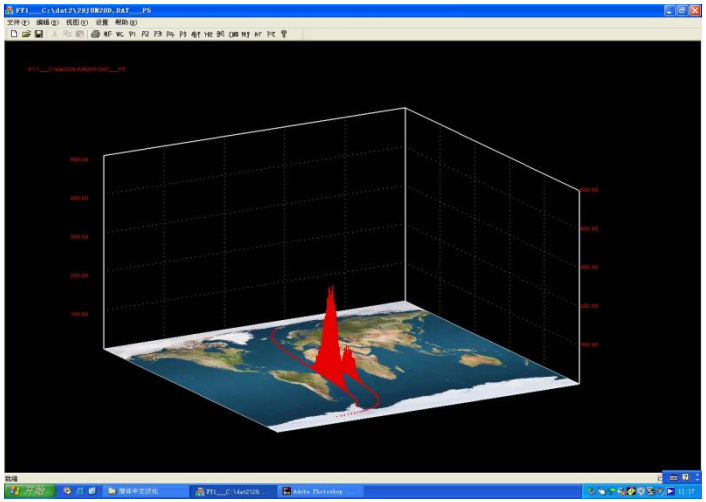
- **FY-1（D）**
  - ✓*Sun-synchronous orbit ~ 870km*
  - ✓*energetic particle detectors*
- **FY-3（A/B/C/D/E/F）(A/B launched)**
  - ✓*Sun-synchronous 830km*
  - ✓*Space Environment Monitor Unit*
    - *high energy particle detector*
    - *single-events-upsets monitor*
    - *satellite surface charging potential detector*
    - *space radiation environment monitor*

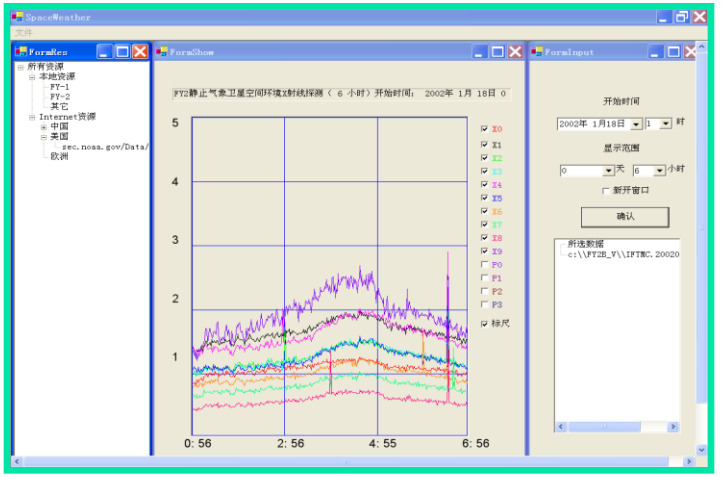
Current SWx Sensors : FY-2 D/E

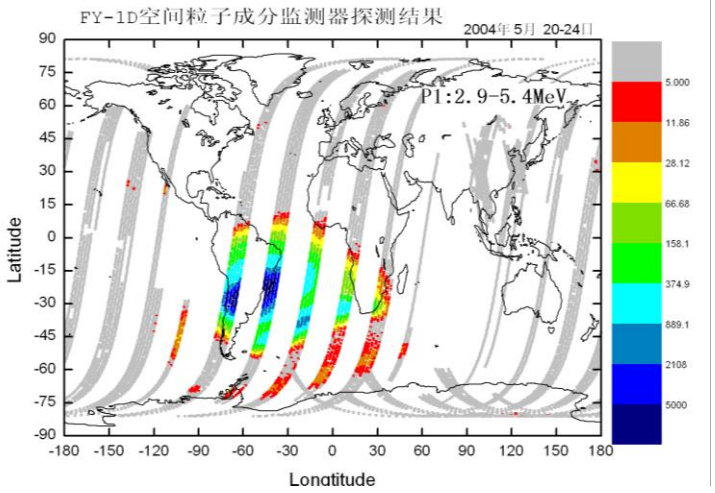
- FY-2（D/E, C still there, F/G/H 2011~2016）
  - ✓ ***Space Environment Monitors***
    - ◆ *electrons*
    - ◆ *protons*
    - ◆ *Heavy particles*
  - ✓ ***X-ray flux Monitor***

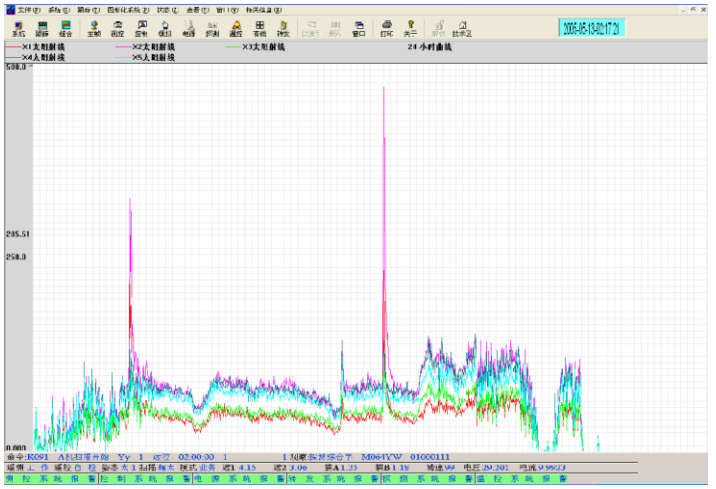


Spwx monitor and analytic system





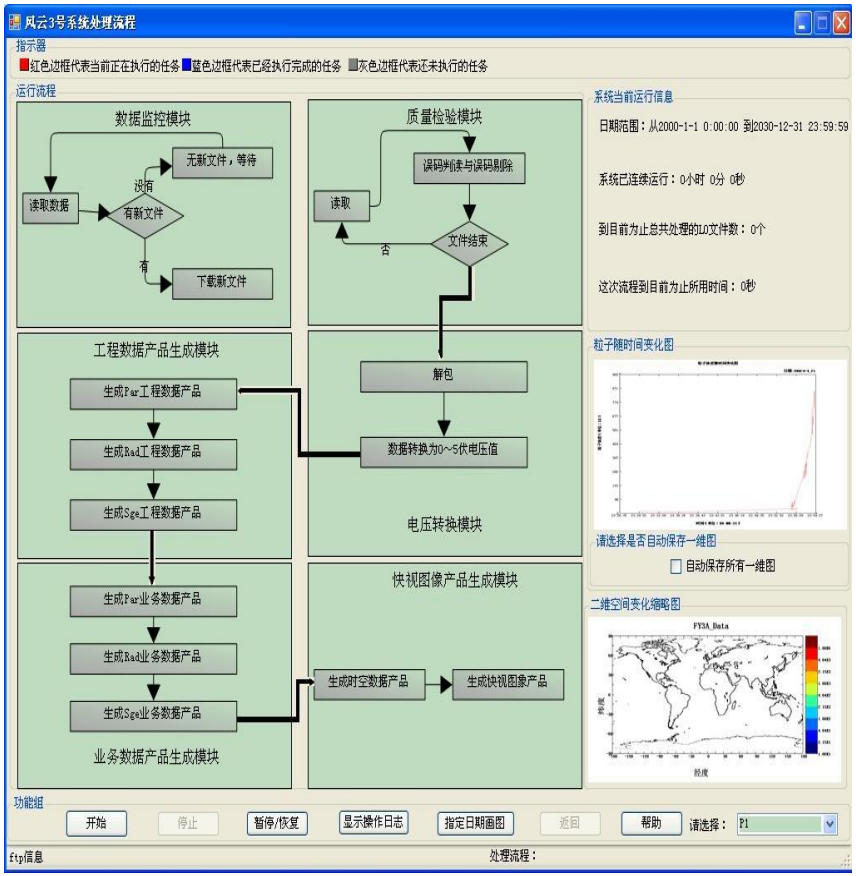




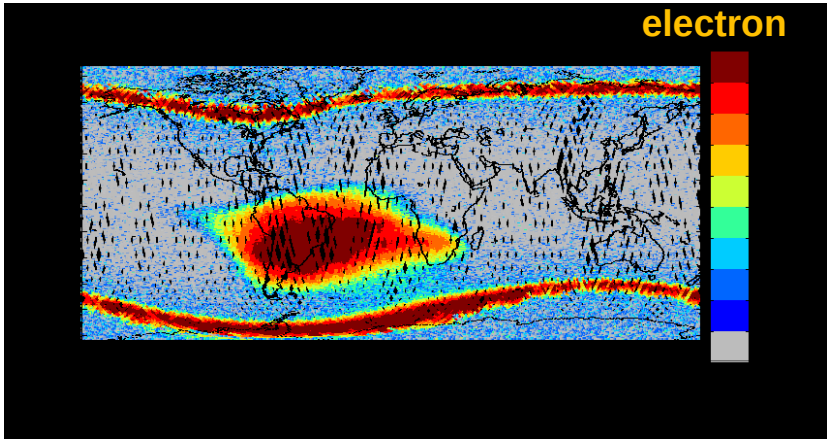
FY-1D High energy Particle Monitoring

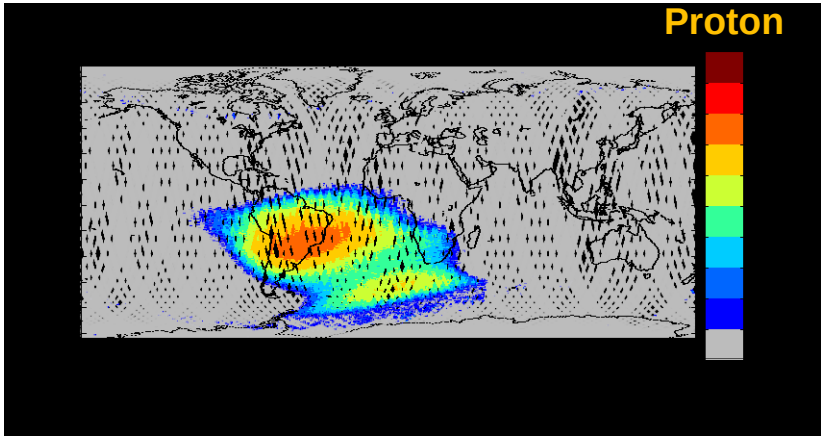
FY-2 High energy Particle Monitoring

FY-3A/B Satellites: Operation and products

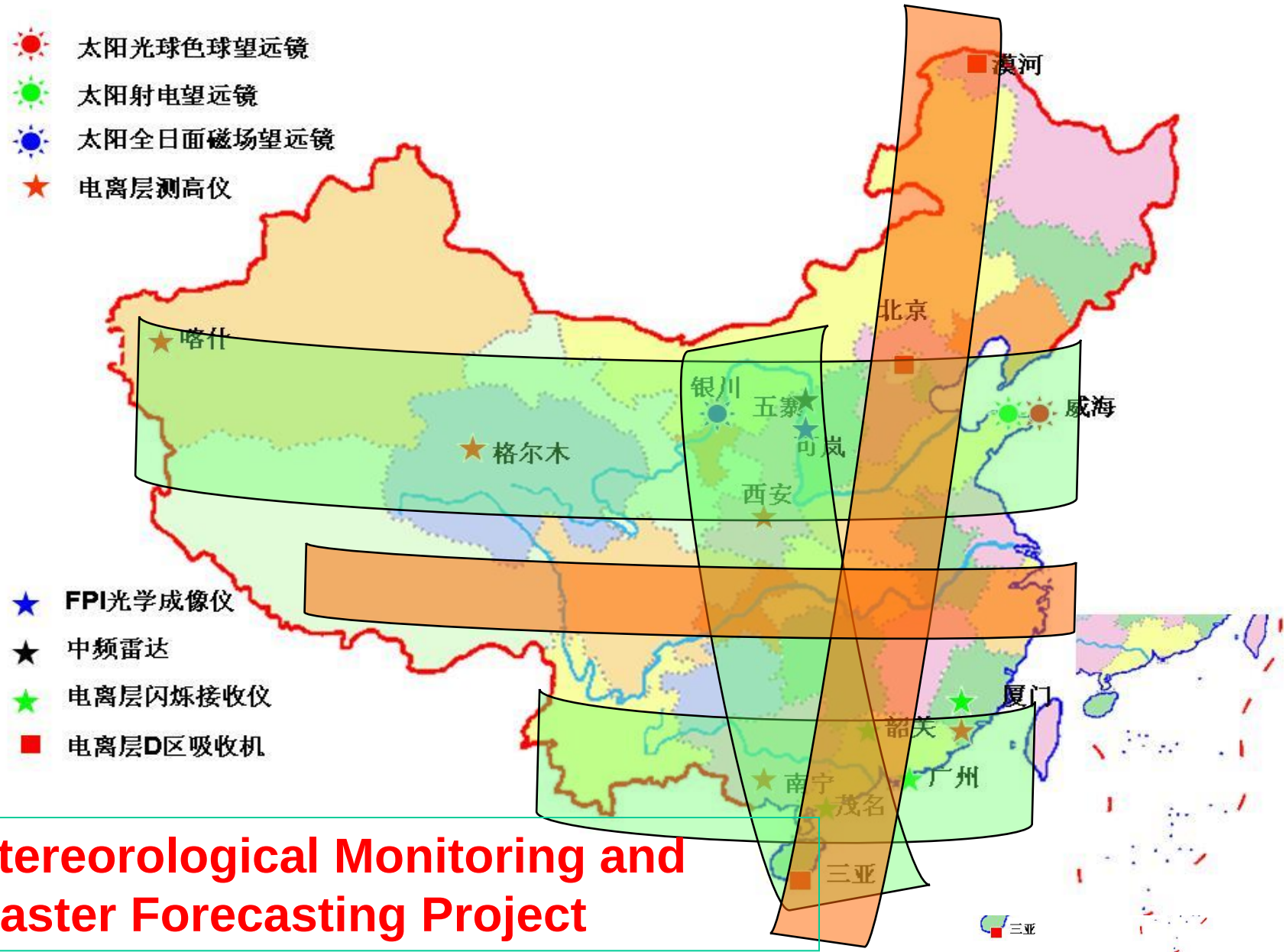


Operation System



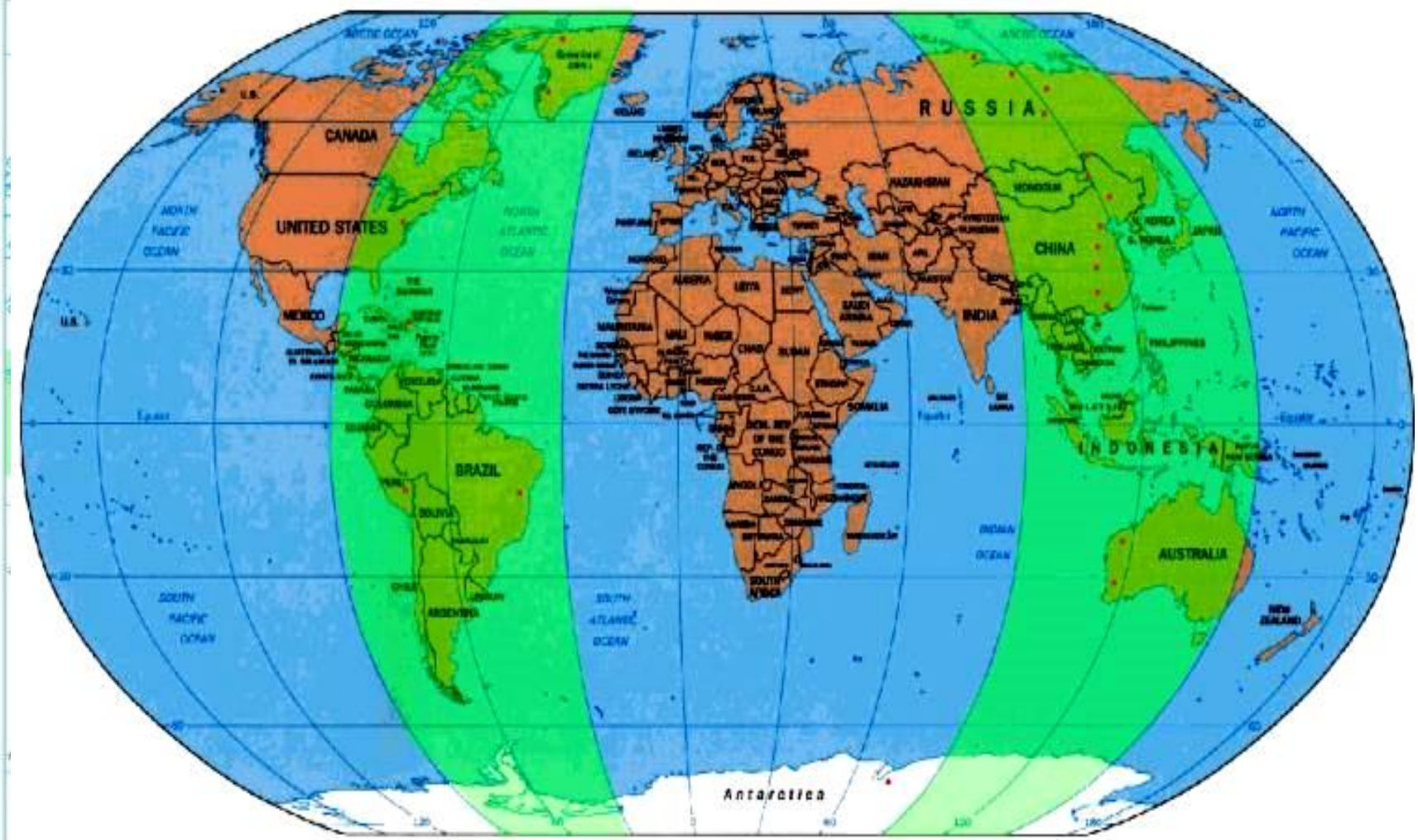


Monitoring Products



Metereorological Monitoring and disaster Forecasting Project

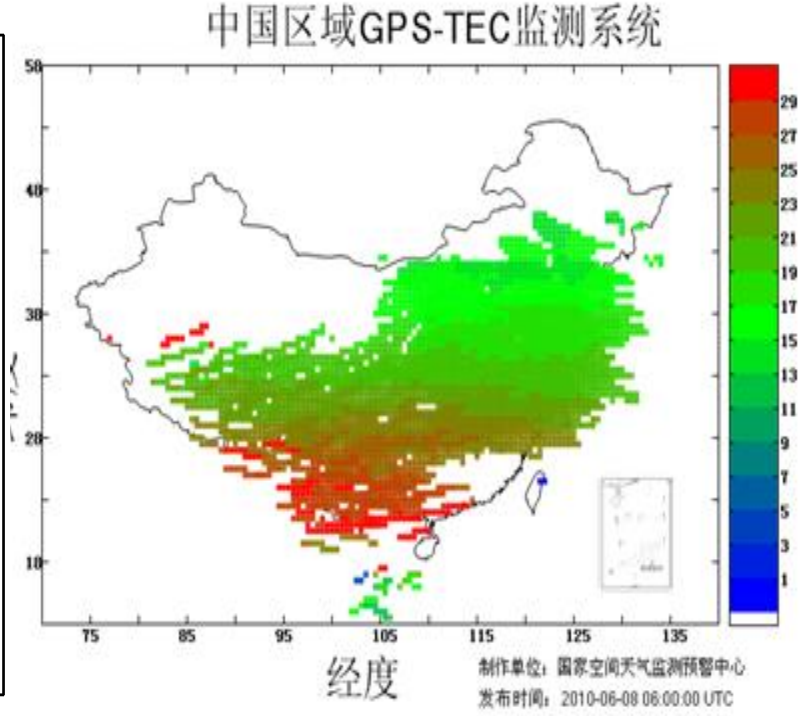
- **Meridian Project (Meridian Circle Program)**

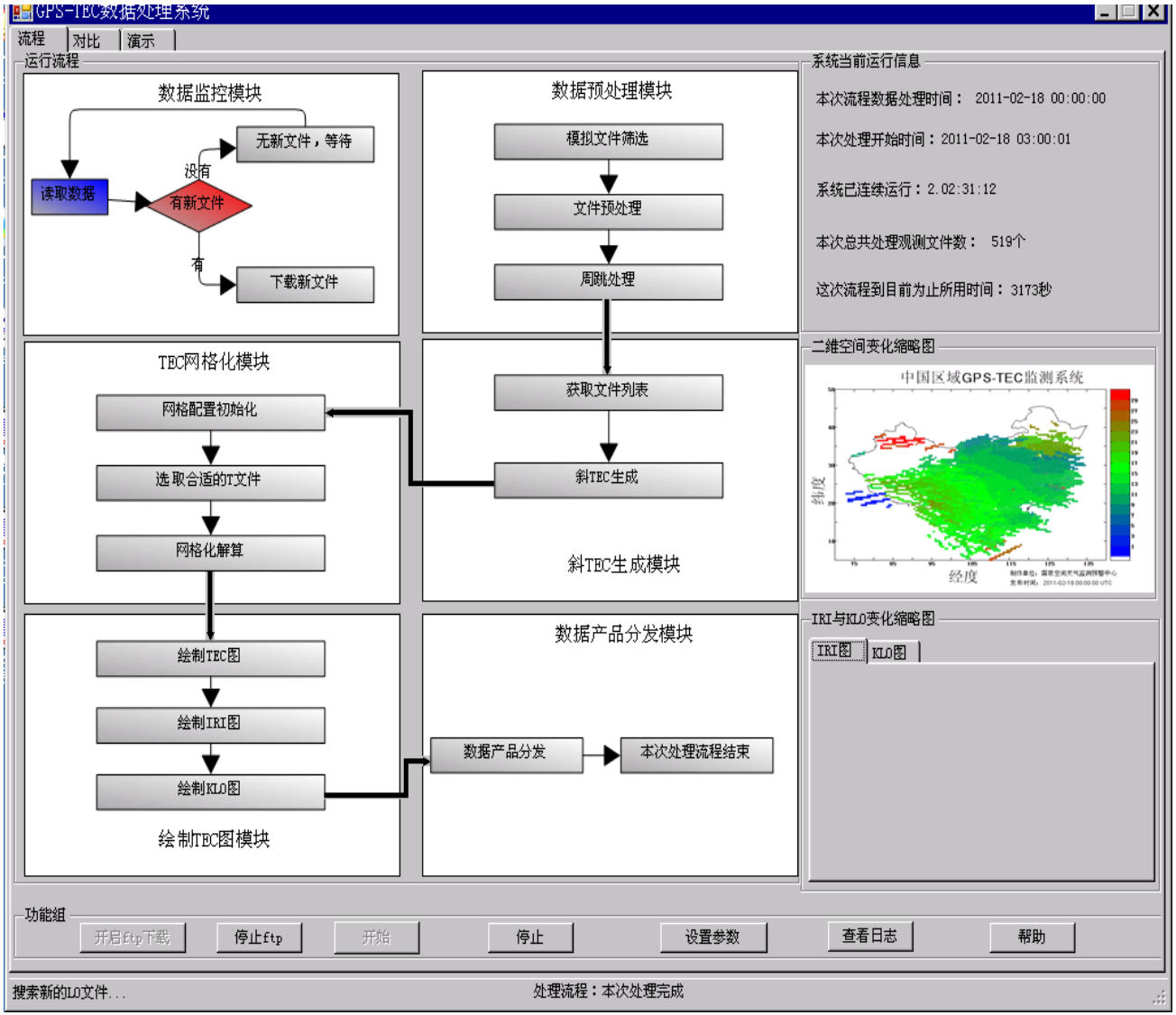


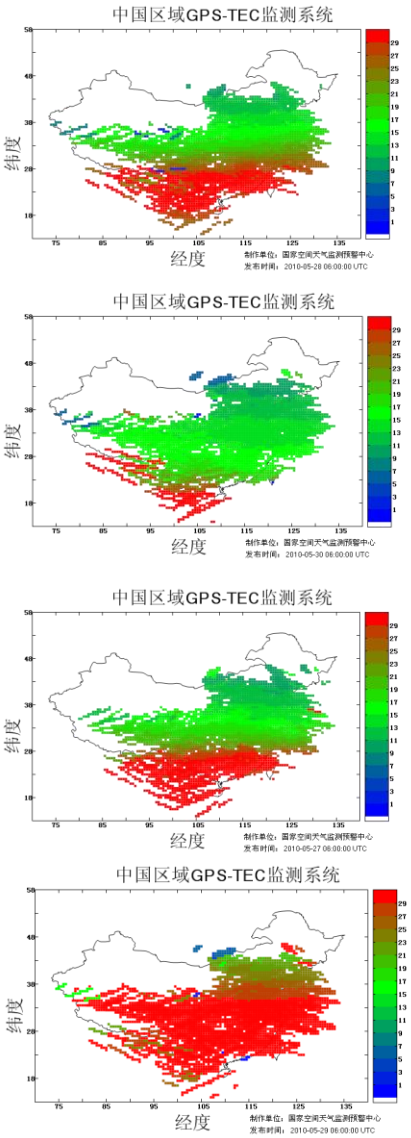
Ground-based Sensors (cont.)

GPS/MET network

– TEC data (maps) over China from more than 400 GPS/MET stations are available now for routine operation in CMA. In near future (by 2015), the number of GPS stations will increase to about 2500 stations.




GPS-TEC数据处理系统
流程
对比
演示
运行流程
数据监控模块
无新文件，等待
没有
读取数据
有新文件
有
下载新文件
数据预处理模块
模拟文件筛选
文件预处理
周跳处理
获取文件列表
斜TEC生成
斜TEC生成模块
TEC网格化模块
网格配置初始化
选取合适的T文件
网格化解算
绘制TEC图
绘制IRI图
绘制KLO图
绘制TEC图模块
数据产品分发模块
数据产品分发
本次处理流程结束
系统当前运行信息
本次流程数据处理时间： 2011-02-18 00:00:00
本次处理开始时间：2011-02-18 03:00:01
系统已连续运行：2.02:31:12
本次总共处理观测文件数： 519个
这次流程到目前为止所用时间：3173秒
二维空间变化缩略图
中国区域GPS-TEC监测系统
纬度
经度
IRI与KLO变化缩略图
IRI图
KLO图
功能组
开启ftp下载
停止ftp
开始
停止
设置参数
查看日志
帮助
搜索新的LO文件...
处理流程：本次处理完成


中国区域GPS-TEC监测系统
纬度
经度
中国区域GPS-TEC监测系统
纬度
经度
中国区域GPS-TEC监测系统
纬度
经度
中国区域GPS-TEC监测系统
纬度
经度

2.2 Operational Products

Forecast type	Forecast time	Operation products	
Long term	A year	Solar activity index	Yearly Solar Spot Number
			Solar F10.7cm flux
Mid-term	A month	Solar activity index	Monthly Solar Spot Number
			Solar F10.7cm flux
Short term	1-3 days	Solar activity indices	SSN、F10.7cm flux、flares、SPE、CME
		Geomagnetic activities	Storm、Ap index、Dst index
		Ionospheric weather	Ionospheric background, disturbances, storms、scintillations etc.
Warning	Several minutes to 3 days	Solar activities	Solar flares、SPE、CME
		Geomagnetic activity	Geomagnetic storms
		Ionospheric weather	Ionospheric storm、disturbances、Scintillations
Nowcast	Events	Solar activities	Solar flares、SPE、CME
		Geomagnetic activity	Geomagnetic storms
		Ionospheric weather	Ionospheric storm、disturbances、

Prediction for Solar Cycle 24

- We predict that the peak of solar activities will occur between 2013 and 2015, and the maximum of smoothed monthly mean sunspot number is expected to be 64 ± 5.

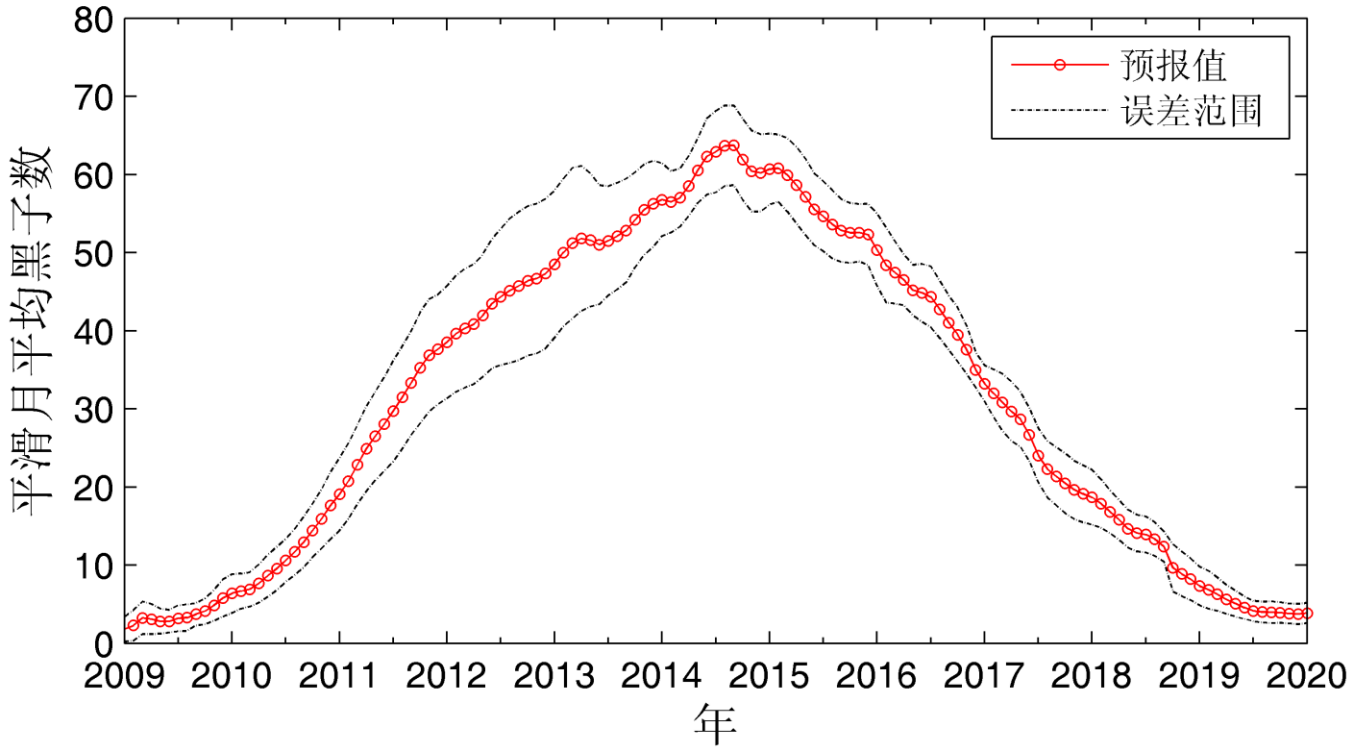
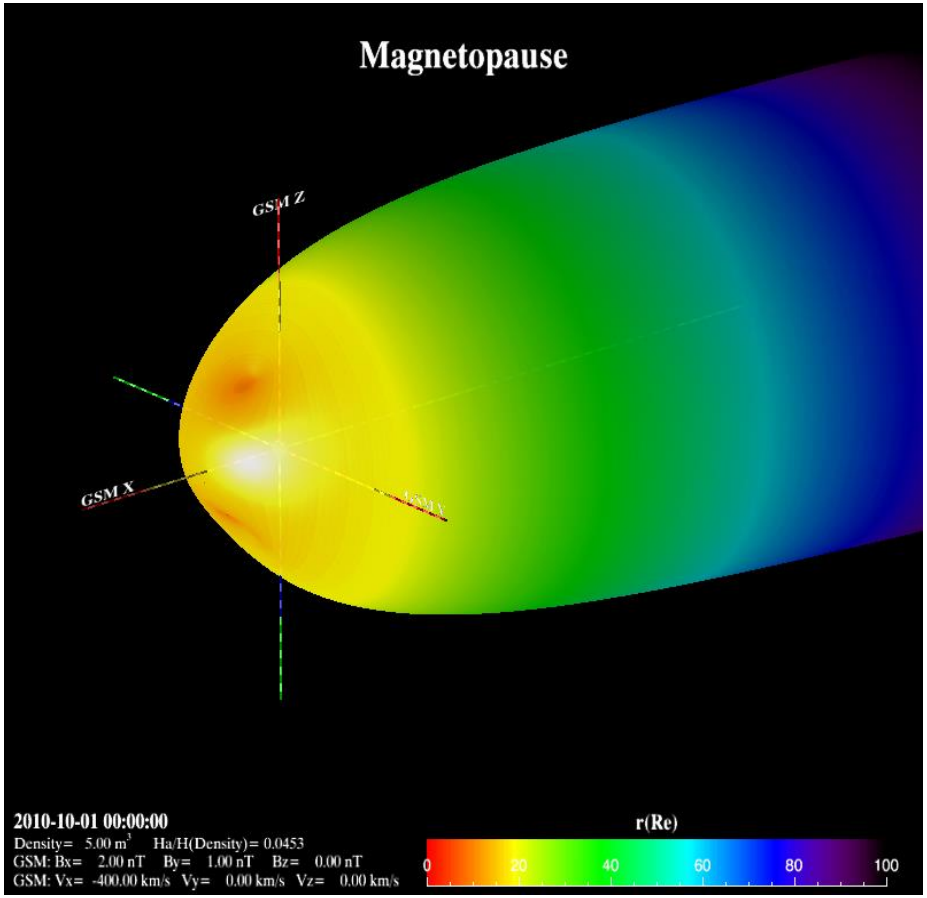
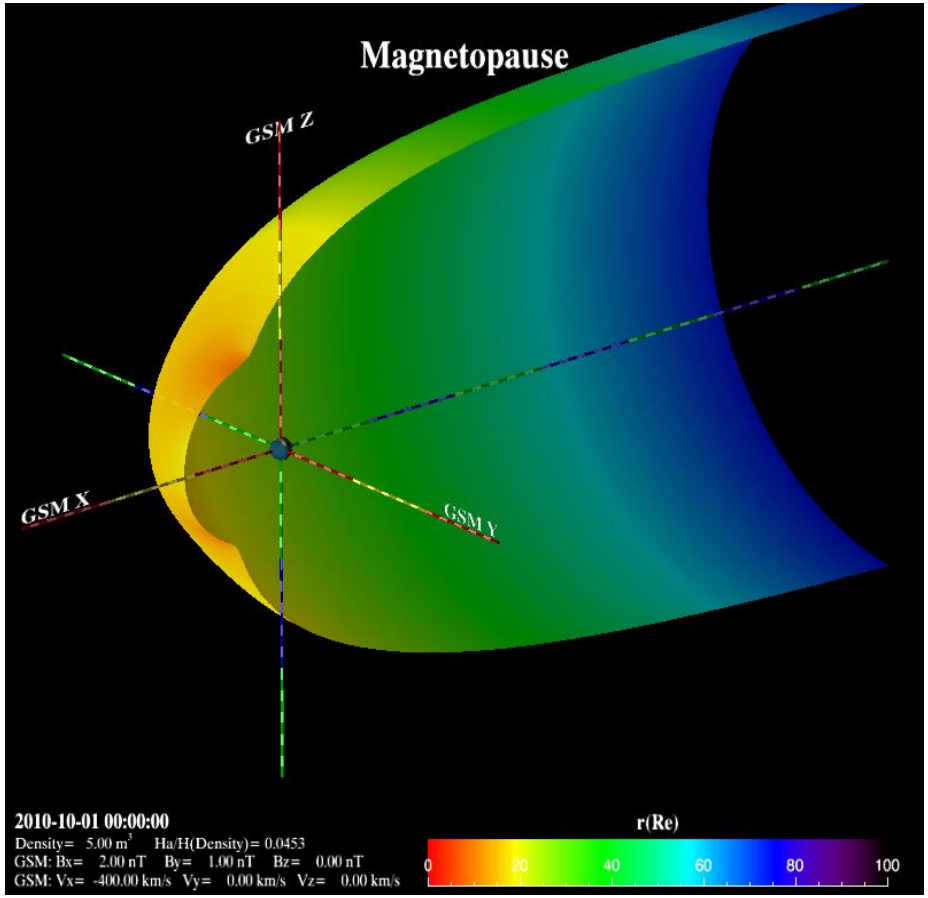


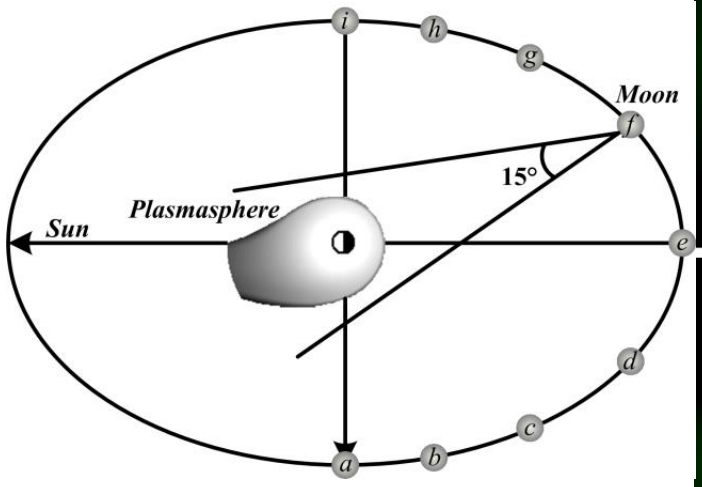
Figure 1 the prediction of sunspot number for solar cycle 24

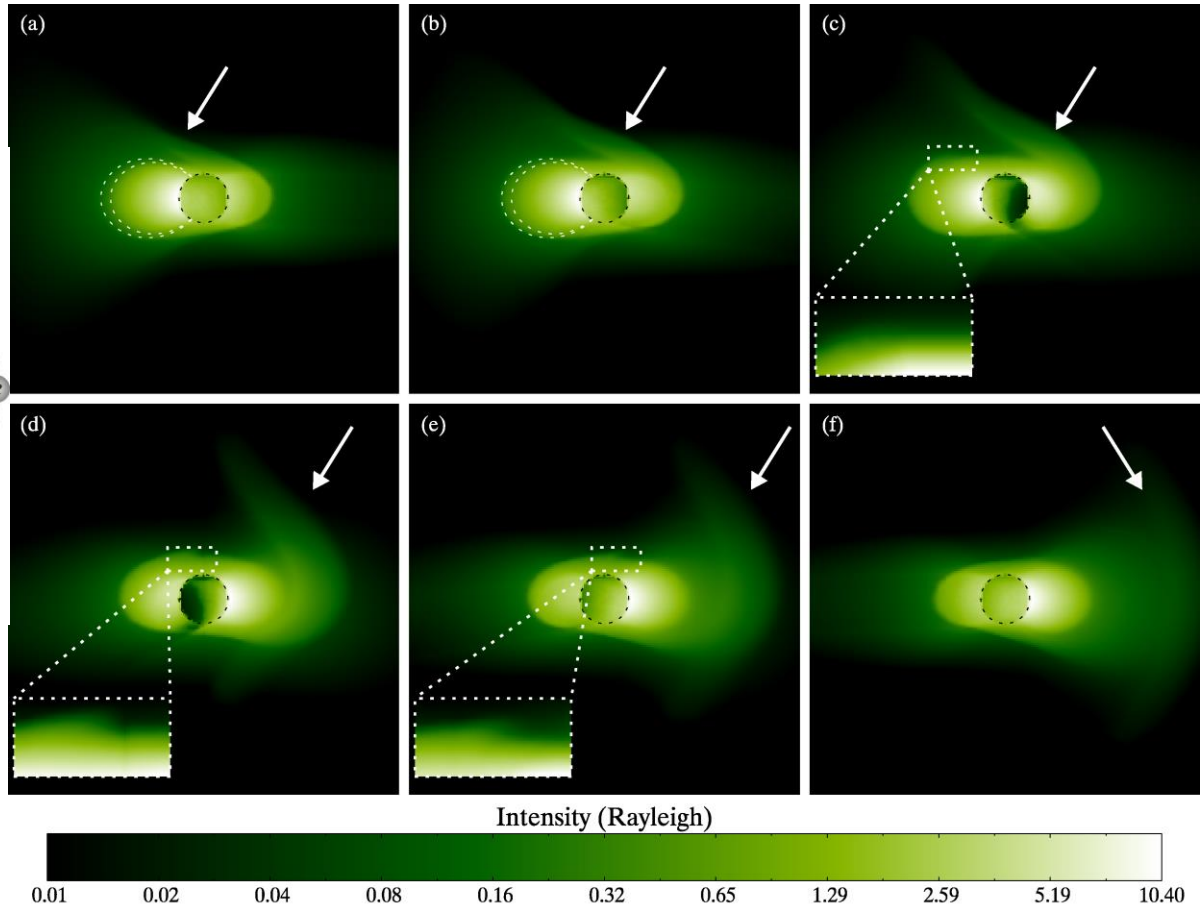
2.3 Research and modeling (a)
A new 3-D asymmetric magnetopuase model



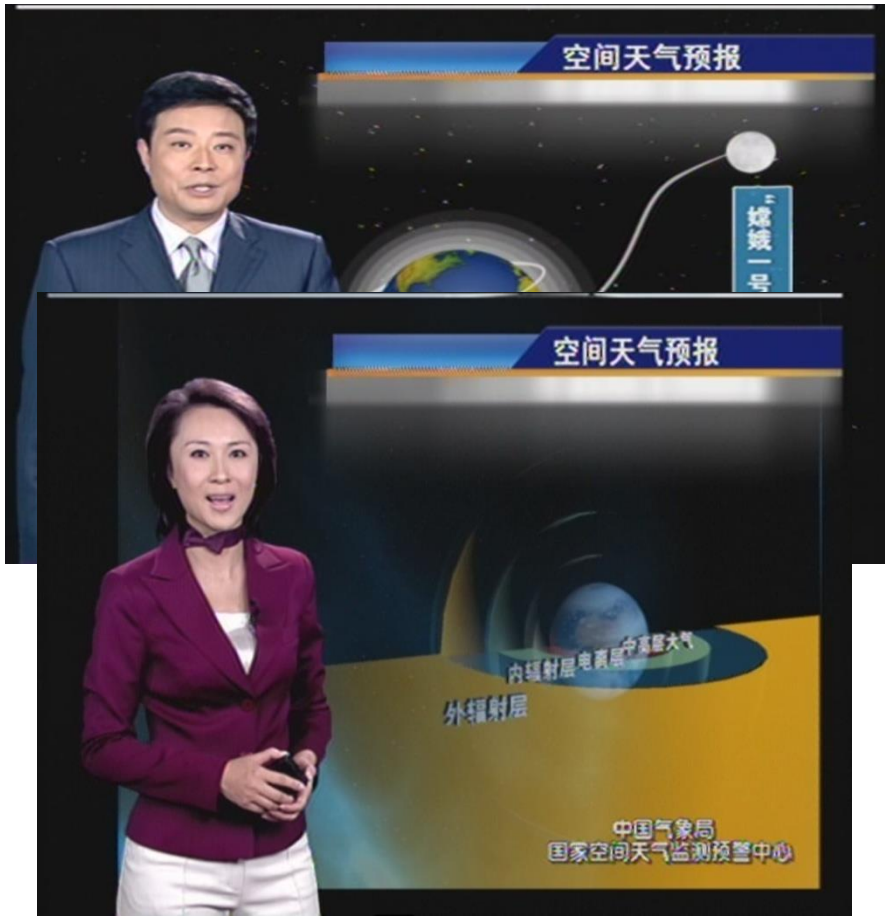


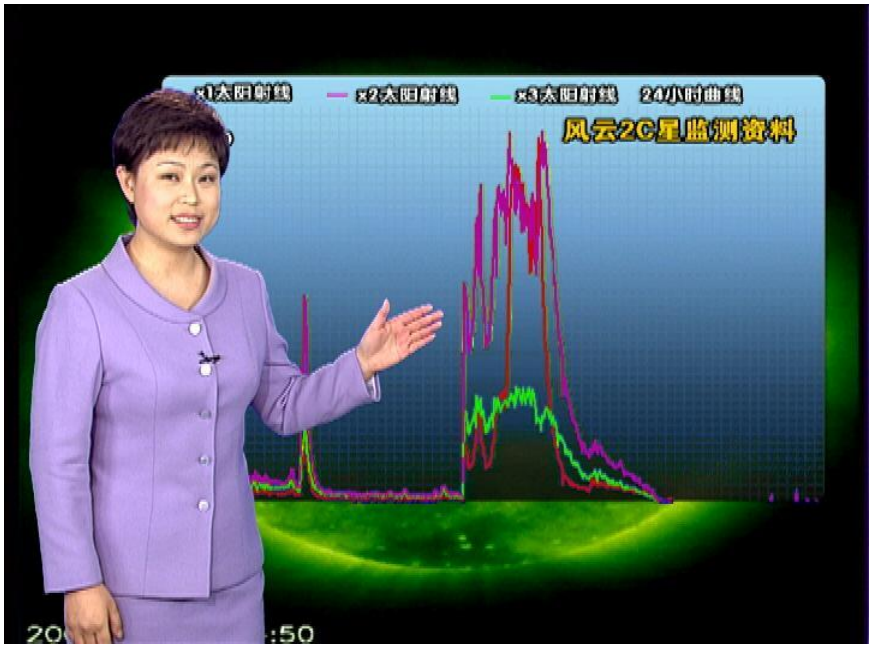
2.3 Research and modeling (b)
Moon-based plasmasphere image simulation





2.4 Education and Outreach Program
News & Media





国家空间天气监测预警中心
National Center for Space Weather

NSMC

www.spaceweather.gov.cn

http://www.spaceweather.gov.cn/

国家空间天气监测预警中心

首 页 INDEX | 中心简介 INTRODUCTION | 产品与数据 PRODUCT AND DATA | 监测预警 MONITOR FORECAST | 对外合作 CORPORATION | 科学研究 RESEARCH | 科 普 SCIENTIFIC

过去24小时空间天气综述

综述时间：[2010-6-23 9:01:53]
过去24小时，太阳活动水平极低，没有C级耀斑爆发；太阳风速度从350公里/秒下降至320公里/秒左右。
过去24小时，地磁活动平静到微扰；地球同步轨道能量大于2MeV的高能电子流量维持在较高水平。
过去24小时，电离层天气平静。

未来三天空间天气预报

预报时间：[2010-6-23 9:01:53]
预计未来三天，太阳活动水平低，不会爆发M级以上耀斑。
预计未来三天，地磁活动以平静到微扰为主，受冕洞高速太阳风影响，24-25日可能出现短时的地磁活跃。
预计未来三天，电离层天气平静。

未来72小时概率预报

太阳耀斑概率		地磁暴发生概率		太阳质子事件概率	
M级耀斑 24小时	1%	小磁暴概率 24小时	1%	24小时	1%
X级耀斑 24小时	1%	大磁暴概率 24小时	1%		
				48小时	1%
M级耀斑 48小时	1%	小磁暴概率 48小时	10%		
X级耀斑 48小时	1%	大磁暴概率 48小时	1%	72小时	1%
M级耀斑 72小时	1%	小磁暴概率 72小时	1%		
X级耀斑 72小时	1%	大磁暴概率 72小时	1%		

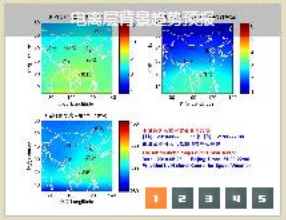
未来72小时指数预报

太阳10.7厘米射电流量		地磁AP指数	
24小时流量	73	24小时指数	5
48小时流量	73	48小时指数	10
72小时流量	73	72小时指数	8

最新消息

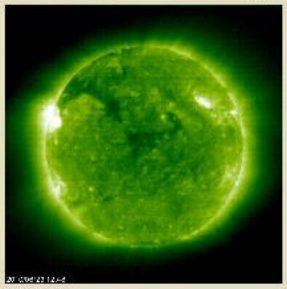
中国明年一月可见日环食 大理或成沪市民最佳观测点

预报图 MORE



SOHO卫星MDI观测图

外国监测图 MORE



相关单位链接

Space Weather forecast Symbols & Classfication（V1.0）

空间天气预警符号

1．太阳活动

共分为 4 个级别，具体级别及标志如下：

极低　低　中　高

Solar activity indicator

2．地磁活动

共分为 4 个级别，具体级别及标志如下：

平静　小磁暴　大磁暴　特大磁暴

Geomagnetic activity Indicator

3．地球同步卫星轨道辐射环境

共分为 4 个级别，具体级别及标志如下：

低　中　强　极强

GEO Orbit radiation Level

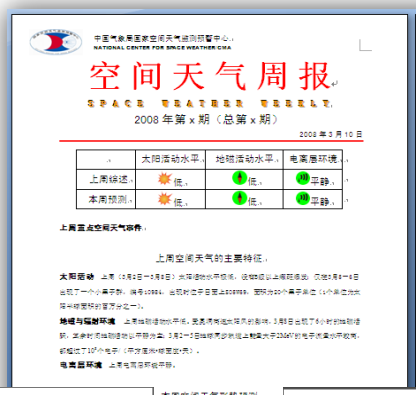
4．电离层电波传播环境：

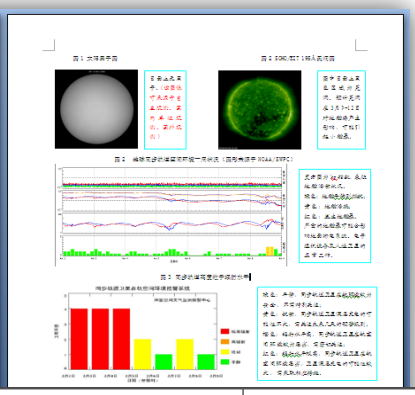
共分为 4 个级别，具体级别及标志如下：

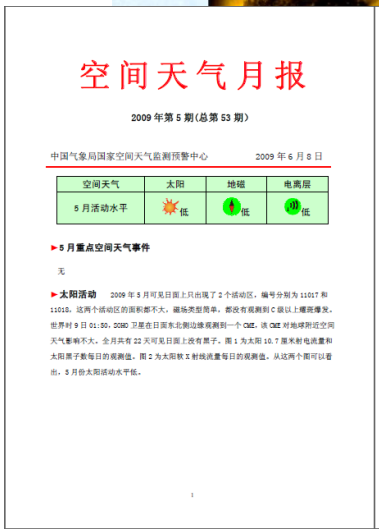
好　一般　差　极差

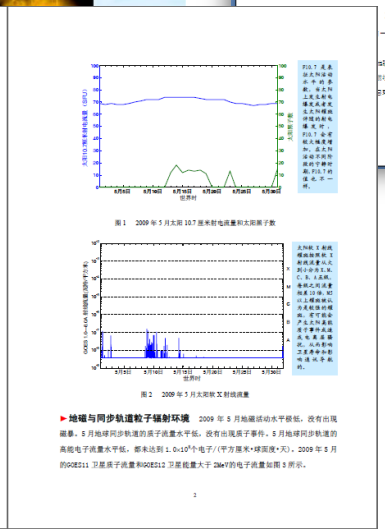
Ionospheric communication Level

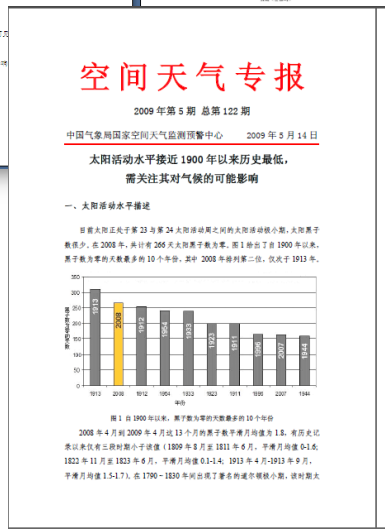
Space Weather Bulletins

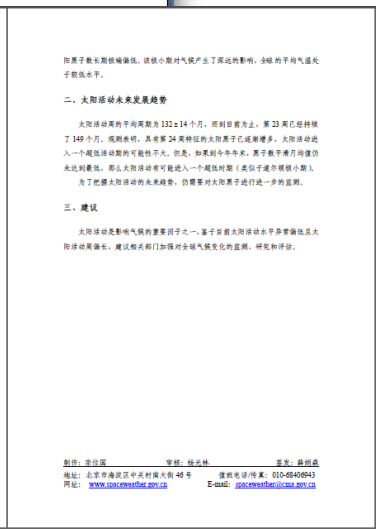












Issue to public daily, weekly, and monthly.

- Cooperation and Supports in China

中国科学院
电子学研究所

中国科学院
空间科学与
应用研究中心

中国电波传
播研究所

国家天文台

中国空间
技术研究院

中国科学院高能
物理研究所

中国科学院地
质地球
物理研究所

中国极地
研究中心

中国科学院大气
物理研究所

云南天文台

紫金山天文台

中国科学
技术大学

北京大学

解放军理工大学

武汉大学

山东大学

南昌大学

中南民族大学

南京大学

北京航空
航天大学

长沙理工大学

南京信息
工程大学

...

Outline

1. New Space weather center in CMA
2. Space Weather Activities in China
3. ***Related Activities in WMO***
4. Future Projects

3.1 Space Weather activities in WMO

- Executive Council endorsed principle of WMO activities in support of Space weather
- In May 2010, the Inter-programme Coordination team on Space Weather (ICTSW) was established, with focus on:
  - **Harmonizing observations**
  - **Exchange of data and products through the WMO Information System**
  - **Definition of products, warning procedures**
  - **Linkage between research and operational communities**

- **Cooperation with ICAO, IMO, ITU, ISES, OOSA/COPUOS etc.**

Inter-Programme Coordination Team for Space Weather

- Australia – Phil Wilkinson
- Belgium – Ronald Van der Linden
- Brazil – Hisao Takahashi
- Canada – Larisa Trichtchenko
- China (Co-chair) – Xiaoxin Zhang
- Colombia – Jaime Villalobos Velasco
- Ethiopia – Yitaktu Tesfatsion
- Finland – Kirsti Kauristie
- Japan – Ken Murata
- South Korea (will nominate soon)
- Russian Federation – Vyacheslav Burov
- United Kingdom – David Jackson
- United States (Co-chair) – Terry Onsager, Jim Head, Joe Davila, Kelly Hand

- European Space Agency – Alain Hilgers
- International Civil Aviation Organization – R. Romero
- International Space Environment Service – David Boteler
- International Telecommunication Union – Sergio Buonomo
- UN Office of Outer Space Affairs – Hans Haubold
- WMO – Jerome Lafeuille

3.2 CMA-NOAA

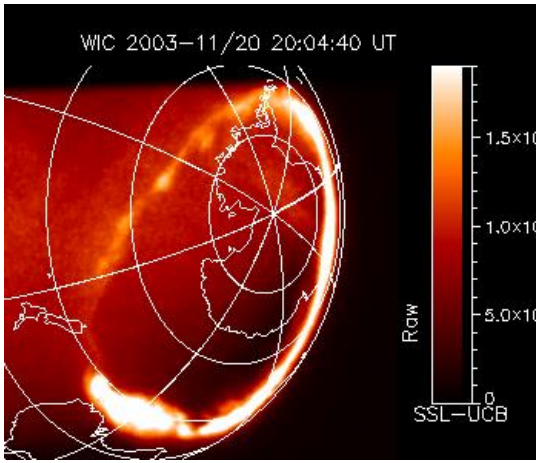
- The Joint Working Group meeting (JWG-17) between the CMA and NOAA.
- Focusing on: Data exchange and Instrument calibration in space weather activities

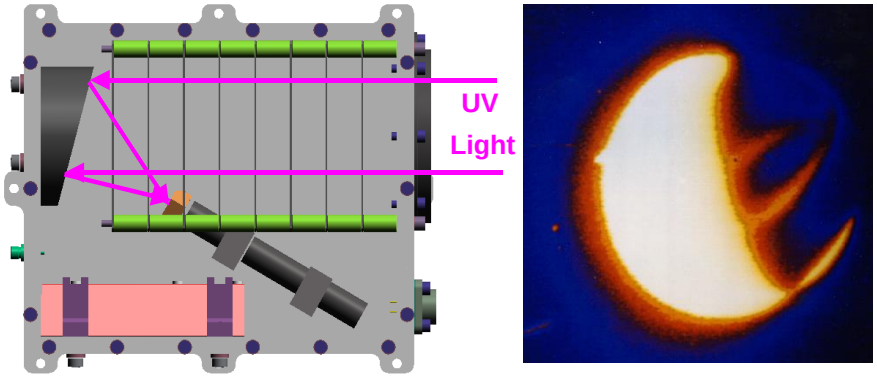
Outline

1. New Space weather Center in CMA
2. Space Weather Activities in China
3. Related Activities in WMO
4. ***Future Projects***

4.1 FY-3 02 : New Payloads (2012-2018)
(C/D/E/F satellites)

- Ionospheric Photometer (IPM)
- Wide-angle Aurora Imager (WAI)
- GNSS Occultation Sounder (GNOS)





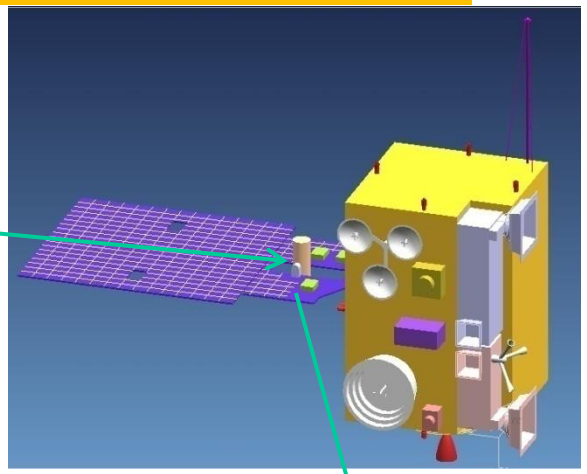
4.2 FY-4 : New Payloads (2014-2015)

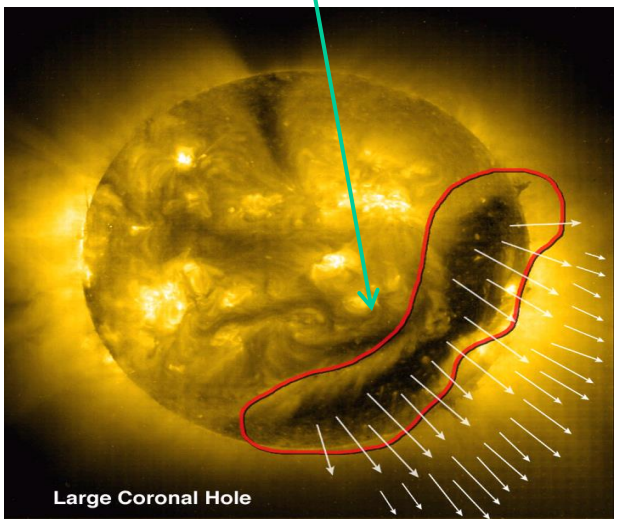
- Geomagentic field detector: FGM
- Solar X-ray & EUV Imager (SXEI)

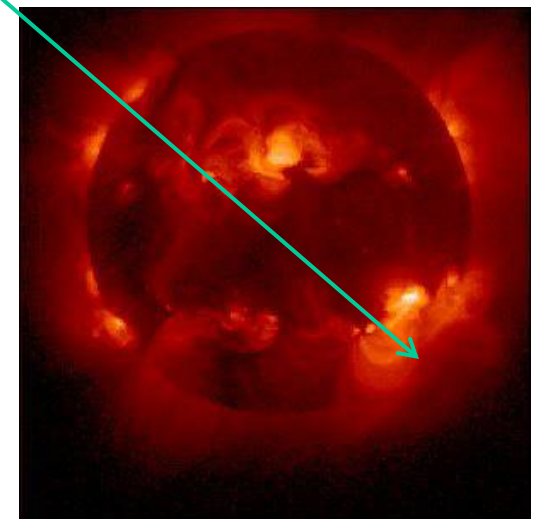
☐ *Solar Flare*

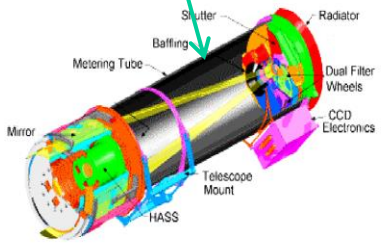
☐ *CME*

☐ *Coronal Hole*



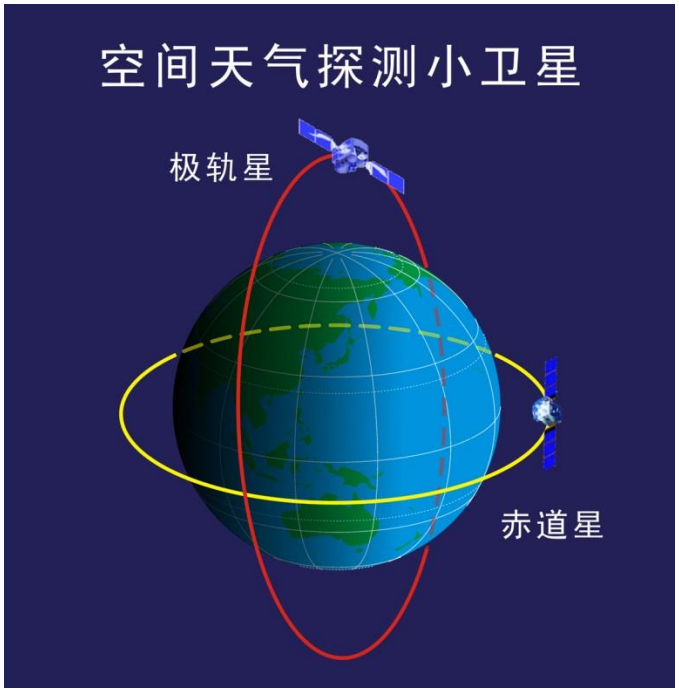




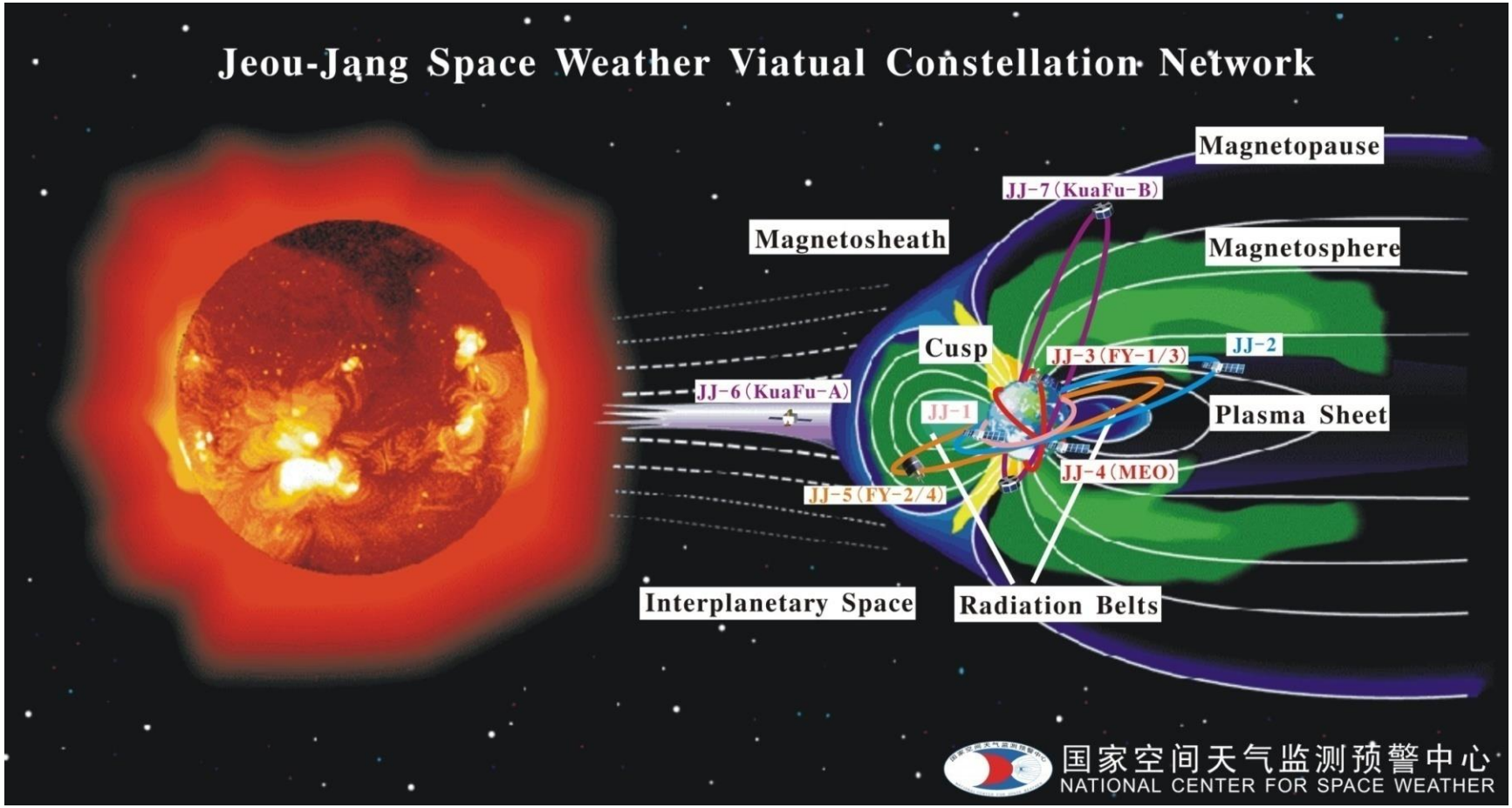


4.3 Special operational satellites for ionospheric weather

- With the dawn-dusk polar orbit of 800-1500 km, the satellite could get the ionospheric images and solar activities (Sun-synchronous obit -> FY-3)
- The equator satellite is in low Earth orbit 300-800 km and could in-situ monitor the small scale structure of ionosphere.



4.4 Space weather Virtual Constellation



Thanks !