

A vibrant space-themed background featuring a bright yellow sun on the left, emitting golden rays and solar flares. A small blue and white Earth is visible in the center-right, surrounded by swirling blue and purple magnetic field lines. The background is filled with numerous small white stars and streaks of light.

# **Space weather service and collaborations in NAOC**

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National Astronomical Observatories, Chinese  
Academy of Sciences (NAOC)**

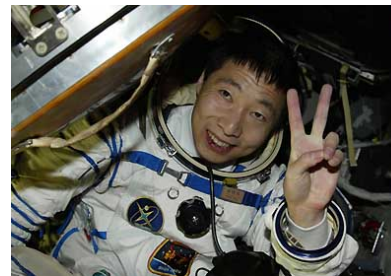
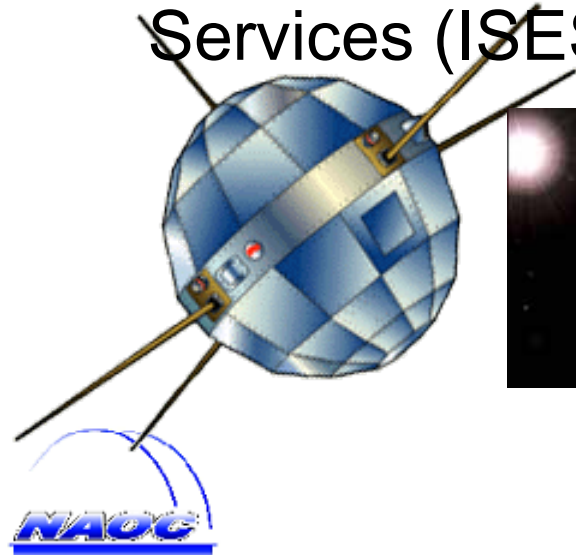
# **Outline**

- 1. History**
- 2. Solar observations**
- 3. Solar activities forecasting services**
- 4. Perspective**

# 1. History

Solar activity prediction center of RWC-China has long-term domestic and oversea collaborations in solar observations and forecasting serves.

- Begin in 1969
  - short wave communication
  - space missions
- Services for Chinese first satellite mission in 1970
- Member of International Space Environment Services (ISES) in 1990



# Regional Warning Center of China (RWC-China)

- Setup in 1991
- Four sub-centers
  - **Solar Activity Prediction Center (SAPC) at NAOC (headquarters of RWC-China)**
  - Space Environment Prediction Center (SEPC)
  - Ionospheric Disturbance Prediction Center (IDPC)
  - Geomagnetic Storm Prediction Center (GSPC)
- RWC-China's tasks:
  - (1) Data collection
  - (2) User services
  - (3) Information exchange with other RWCs



<http://www.ises-spaceweather.org/>



The International Space Environment Service (ISES) is a permanent service of the Federations of Astronomical and Geophysical Data Analysis Services (FAGS) under the support of the International Union of Radio Science (URSI) in association with the International Astronomical Union (IAU) and the International Union of Geodesy and Geophysics (IUGG).



## 2. Solar observations



Domestic solar observation sites

# Observations at NAOC



**Huairou Solar Observing Station (Huairou Reservoir, Beijing )**



**Solar Tower and Solar Telescope (Fuxian Lake, Yunnan)**



**China Solar Radio Heliograph (Mingantu, Inner Mongolia )**

# Round-the-clock and high resolution full disk H $\alpha$ images (collaborations among solar observatories )

**1500 - 0000 UT**

**BBSO (USA)**



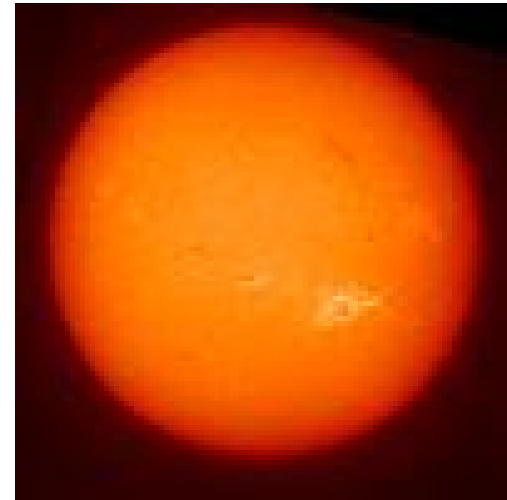
**0600 - 1500UT**

**KSO (Austria),  
CAO (Italy)**



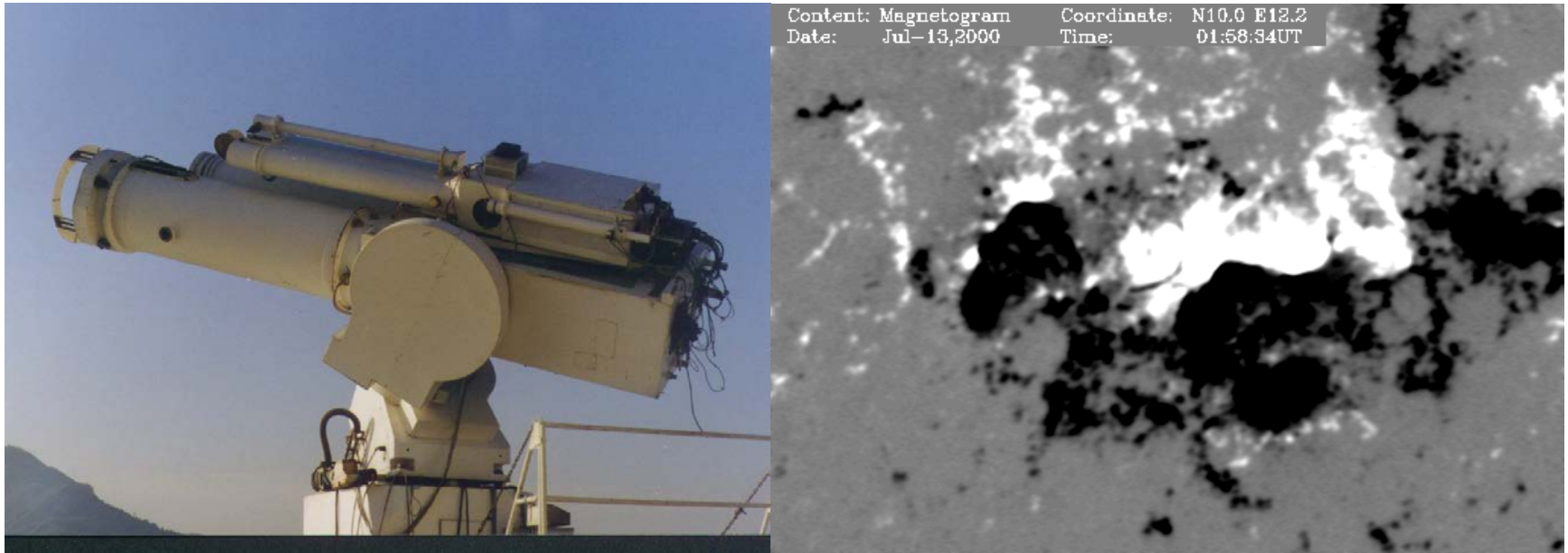
**0100 - 0800 UT**

**YNAO, HSOS  
(China)**



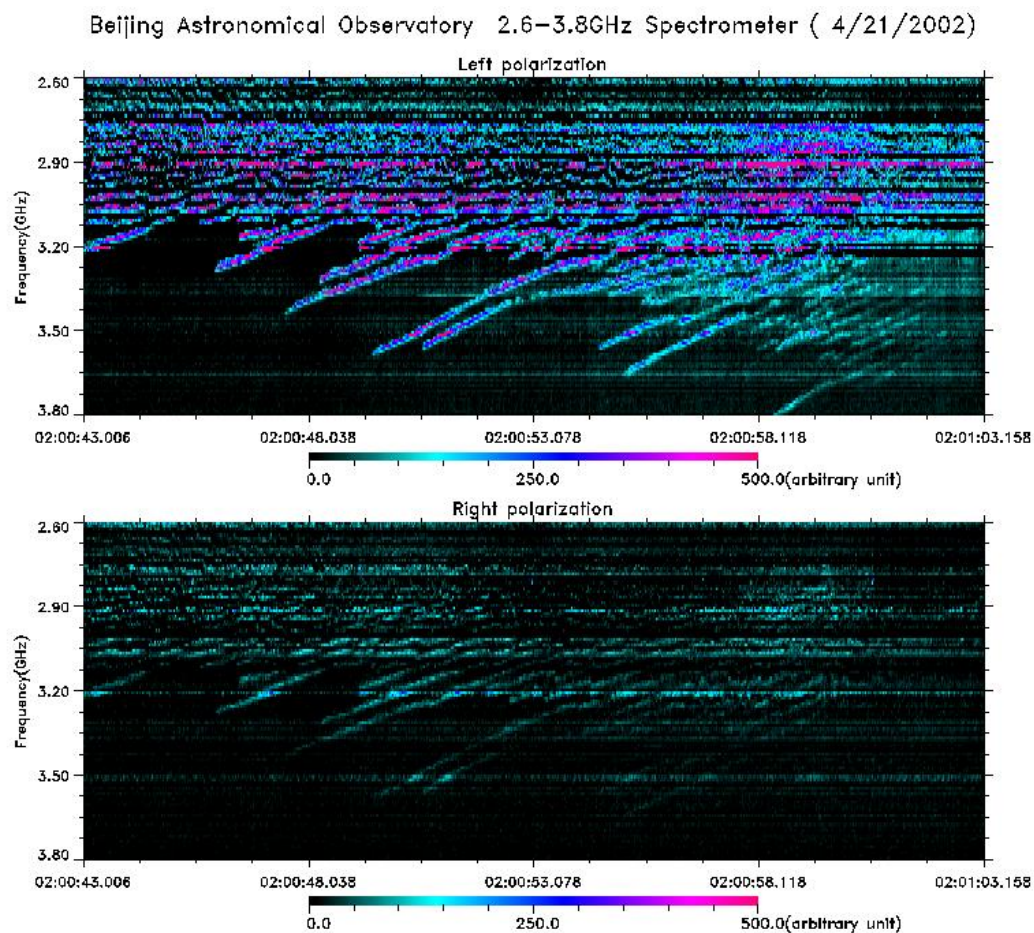


# Solar Multi-Channel Telescope at Huairou, Beijing



Solar Multi-Channel Telescope and the observed magnetogram

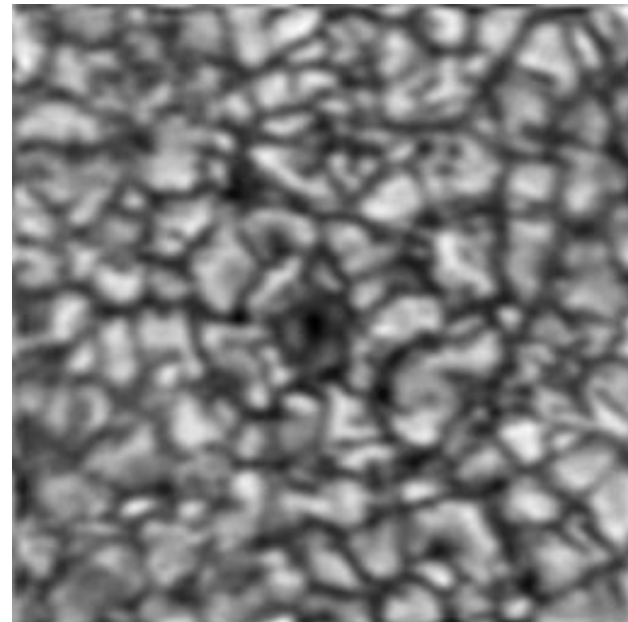
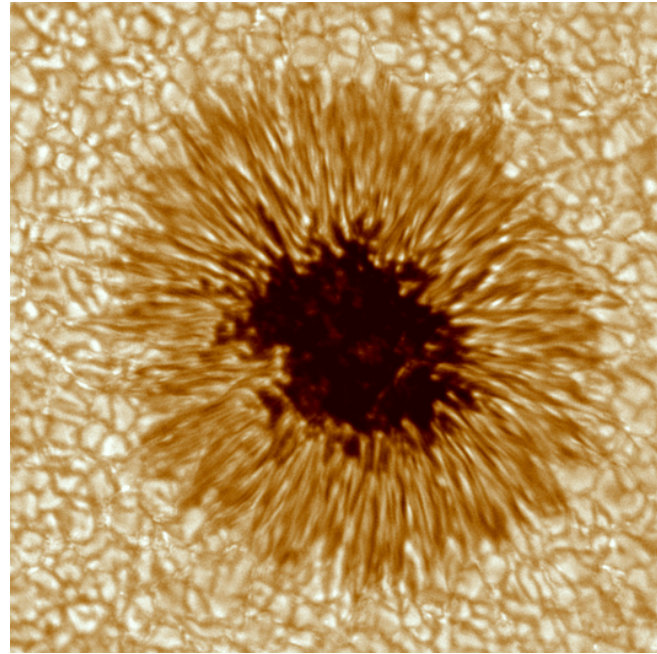




Data Observed by 0.7-7.6GHz broadband radio-spectrometers at  
Huairou, Beijing



Solar Tower at Huxian Lake



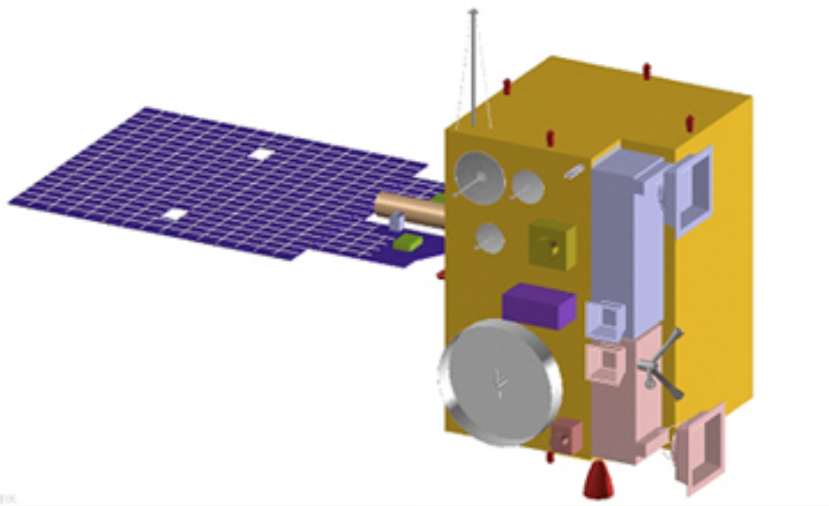




## China Solar Radio Heliograph (Mingantu, Inner Mongolia )



# Sharing observational data with other institutes



Solar flux and imaging  
observations from payloads on  
FY series and other satellites



Shidao solar observatory  
(Shandong )



### 3. Solar activities forecasting services



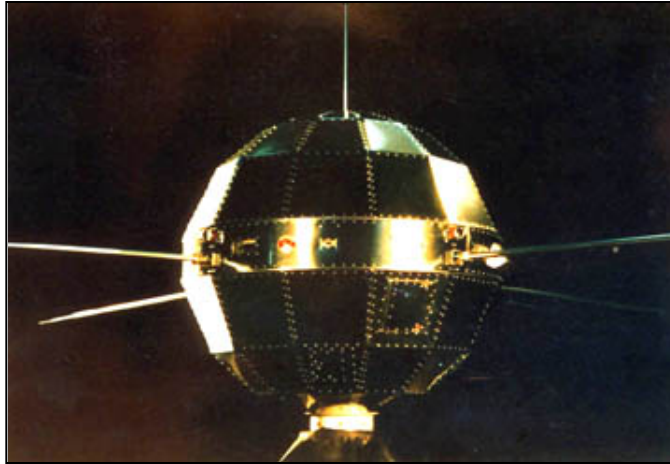
# Solar weather forecasting services at NAOC

- Short-term prediction (within 2 or 3 days)
  - solar X-ray flare class within 2 days  
(none, C, M, X)
  - solar proton event probability within 3 days
  - solar 10.7cm radio flux daily values within 3 days
- Medium-term prediction (within 1 or 2 weeks)
  - monthly mean sunspot number
  - solar X-ray flare activity level
- Long-term prediction (in time scale of solar cycle)
  - maximum value and phase of sunspot number

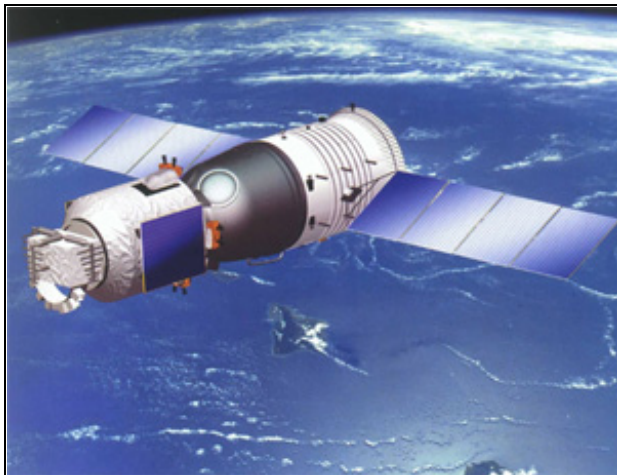
The daily solar activity forecasts are distributed both by web pages (<http://rwcc.bao.ac.cn>) and emails



# Special services



Chinese first satellite mission (1970)



Shenzhou series of manned space flight



Chang'e series of moon exploration spacecraft

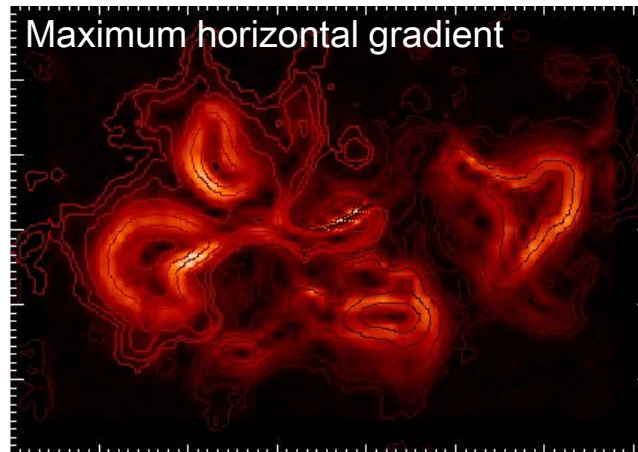
# Researches on solar weather forecasting

- Currently available prediction models:
  - **solar flare short-term prediction models**
  - **solar proton event short-term prediction model**
  - solar 10.7cm radio flux prediction model
  - solar active longitude prediction model
  - solar active level quantitative assessment model
  - solar 3-D coronal magnetic field NLFFF extrapolation model
- Forecasting models in development:
  - **coronal mass ejection (CME) prediction model**

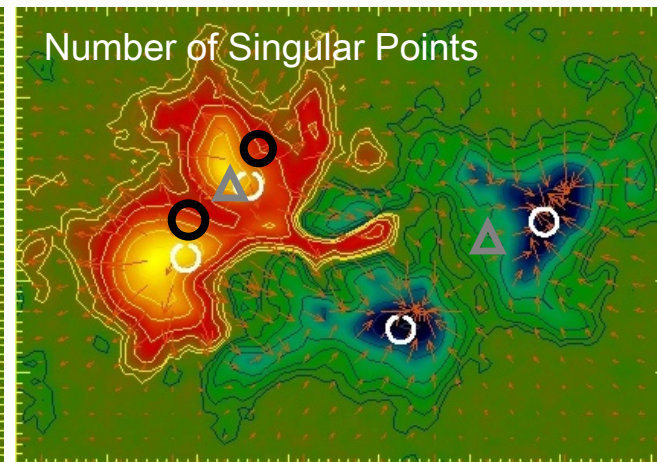
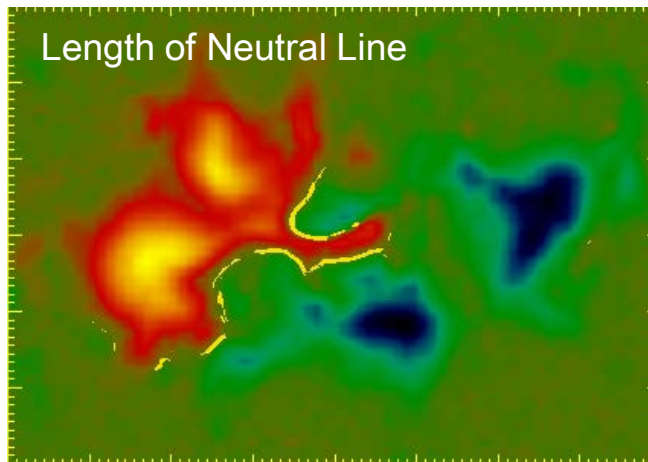




# New physical measures of magnetic field as input factor for the flare and proton event prediction models

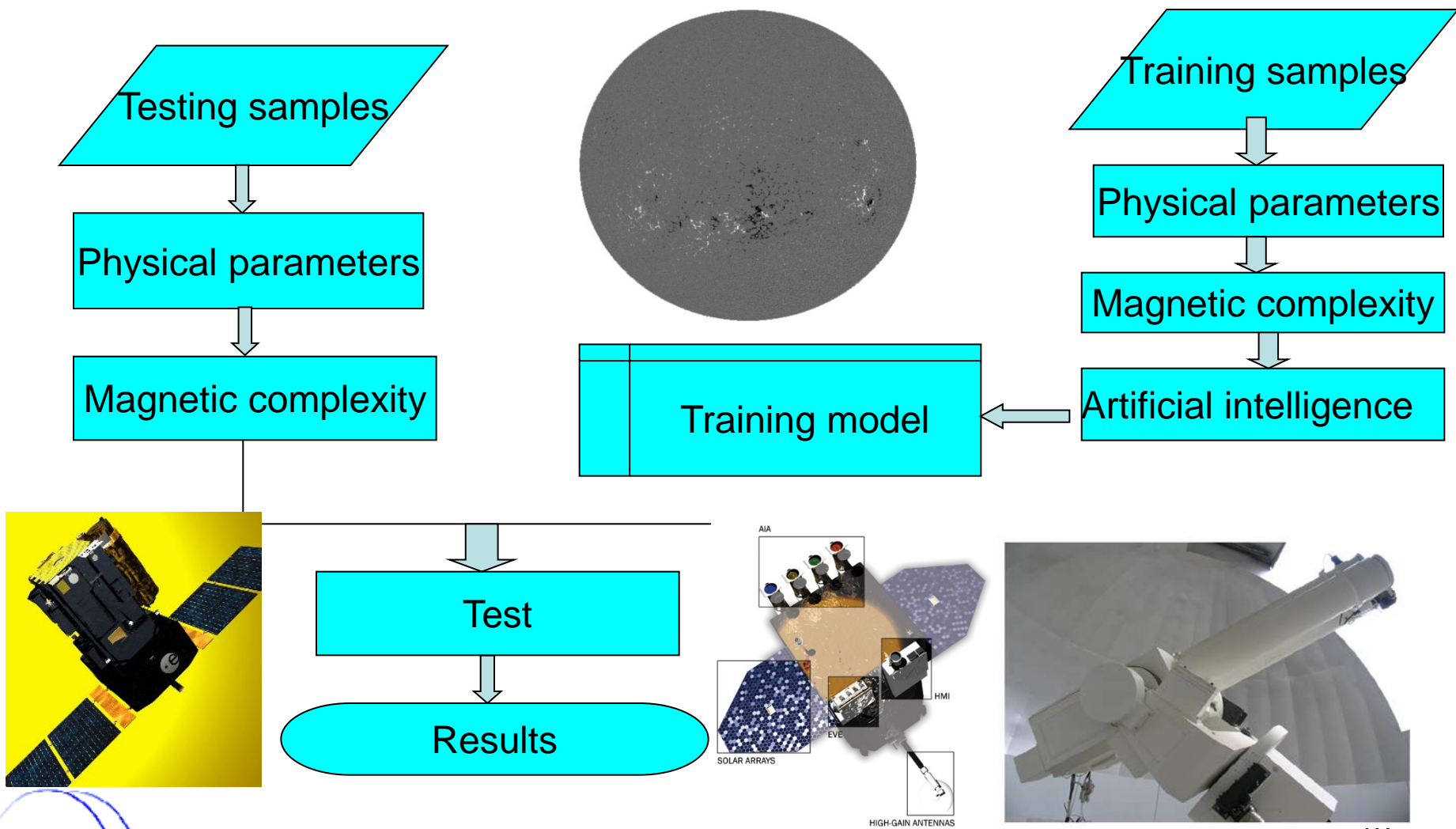


Active Region  
NOAA 9574  
2001-08-11 UT



Physical measures reflect the complexities of the photospheric magnetic field

# New artificial intelligence classifying algorithm for flare and proton events prediction models



# Operational platforms for solar weather forecasting and distribution at NAOC

Operational Platform	Application time	Distribution media	Supporting computer system
First generation	2001 – 2006	Web page	Simple database system and data table; input observation data by hand; run prediction model by hand
Second generation	2006 – 2011	Web page; simple English language page	Simple database system; complex data table; grab observation data semi-automatically; prediction model can be controlled by platform
Third generation (being developed)	2011 -	Dynamic and Interactive web pages; Complete English language pages; <b>3-D computer simulation interface</b>	Dedicated database server; Mass storage devices; grab and extract observation data automatically; run prediction model automatically; 3-D virtual reality (VR) technique

# Web interface of the 2nd generation operational platforms ( in Chinese language)

中国科学院国家天文台  
太阳活动预报中心

中国科学院国家天文台  
太阳活动预报中心

Home News Team Knowledge History data English  
首页 中心新闻 团队介绍 科普园地 历史数据 英文版

今日预报  
发布时间: 2010年11月19日

过去24小时太阳活动综述  
2010年11月19日 在過去24小时  
中, 太阳活动很低。日面上有2颗  
黑子, 编号为3044 1124 1128  
1127 0814 S31 X05, L172 108  
(05), 面积为: 0150 0040 0060,  
磁分类为Beta Beta Alpha+  
McIntosh分类为Eso Eso Max。设  
期间无C级及以上耀斑发生。地球  
磁场平静。

未来48小时太阳+射线耀斑和地  
磁活动预报  
发布日期: 20101119 预报日期: 20101119  
无 无 平静

未来三天太阳F10.7cm射电流量预报  
第一天 第二天 第三天  
89 89 89

未来24/48/72小时太阳质子事件  
发生概率  
24hr 48hr 72hr  
01 01 01

过去三天太阳活动状况  
时间 11-10 11-17 11-16  
X射线  
耀斑 无 无 无  
质子事件 无 无 无  
地磁  
活动 平静 平静 平静  
白冕  
物两两时 白冕物 白冕物 白冕物  
热两两时 热两两时 热两两时 热两两时  
黑子  
相对数 57 55 60  
新生  
黑子群数 1 1 0  
总群数 4 4 4  
10cm  
射电流量 / / /  
射电小爆  
发事件数 0 0 0  
射电大爆  
发数 (峰值  
>100sfu) 0 0 0

中国日地物理过程

太阳活动预报中心  
1991年中国科学院和中国科学院  
北京成立世界太阳中心北京日地物  
理预报中心。日地物理预报中心  
(SWC-Beijing)下设四个分中  
心: 地球物理预报中心、空间环境  
预报中心、电离层预报中心和太阳  
活动预报中心。总部设在国家天文  
台。2000年根据国际空间环境服务  
组织的请求, 更名为中国区域预报  
中心 (RWC-CHINA), 其宗旨是: 提  
高日地物理预报水平, 扩大服务范  
围, 推进日地物理研究与国际的合  
作, 开展日地物理研究与应用, 为  
国内和国际合作与交流, 与国际地  
球物理中心进行数据资料交换,  
为本地区服务。

滚动新闻  
20100207  
2010-02-07  
太阳第24活动周最新报道  
20101021  
2010-01-21

相关链接  
Space Weather Prediction Center  
(NOAA)  
SDO - Solar Dynamics  
Observatory  
空间环境预报中心  
Hinode Solar Observing Station  
Big Bear Solar Observatory  
SCOOPT  
Solar Physics Division  
SDO  
TSCS  
TRACE on-line  
YOHIOH SXT SCIENCE MESSAGES  
BATSE Solar Flare Server  
Space Weather (AGU Journal)

全日面色球单色像 (资料获取顺序: 国家天文台怀柔太阳  
观测基地, SDO, SOHO)

全日面色球单色像 (资料获取顺序: 国家天文台怀柔太阳  
观测基地, SDO, SOHO)

Home page: <http://rwcc.bao.ac.cn>

NAOC Solar Activity Prediction Center National Astronomical Observatories, CAS

太阳活动预报中心管理后台

数据操作 (开启中)

预报操作  
非常发布  
管理后台

网上取文件 收邮件 Halpba 图 星子图 CME 磁图

前一活动事件:  
日期: 20090610 CME: 查看 地磁活动: 查看  
X射线耀斑: 查看 质子事件: 查看 小爆数: 查看 大爆数: 查看

日期: 20090611 编号: 查看 磁位形: norm 查看

当前活动事件:  
日期: 20090611 黑子相对数: 查看 新生群数: 查看 总群数: 查看  
射电流量: 查看 小爆数: 查看 质子流量: 0 查看

大爆开始时间: 20090611001927 大爆开始: 查看 极大: 查看  
结束: 查看 峰值流量: 查看

大爆开始时间 大爆开始 极大 结束 峰值流量 操作

确认并保存

日期: 20090611 资料类型: 9 查看

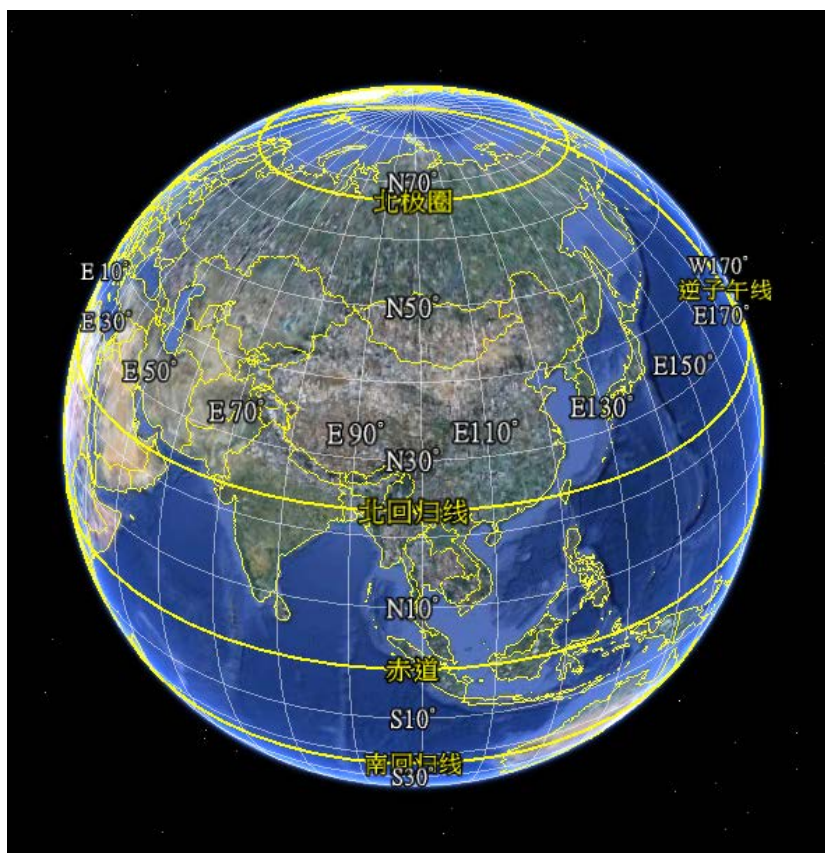
未来48小时太阳+射线耀斑和地磁活动预报  
日期: 20090611 X射线耀斑: 0 地磁活动: 0  
未来三天太阳F10.7cm射电流量预报  
第一天: 第二天: 第三天:  
未来24/48/72小时太阳质子事件发生概率  
24hr: 48hr: 72hr:  
未来24/48小时太阳质子事件概率  
24hr: 48hr: /

IDL表十九的查询

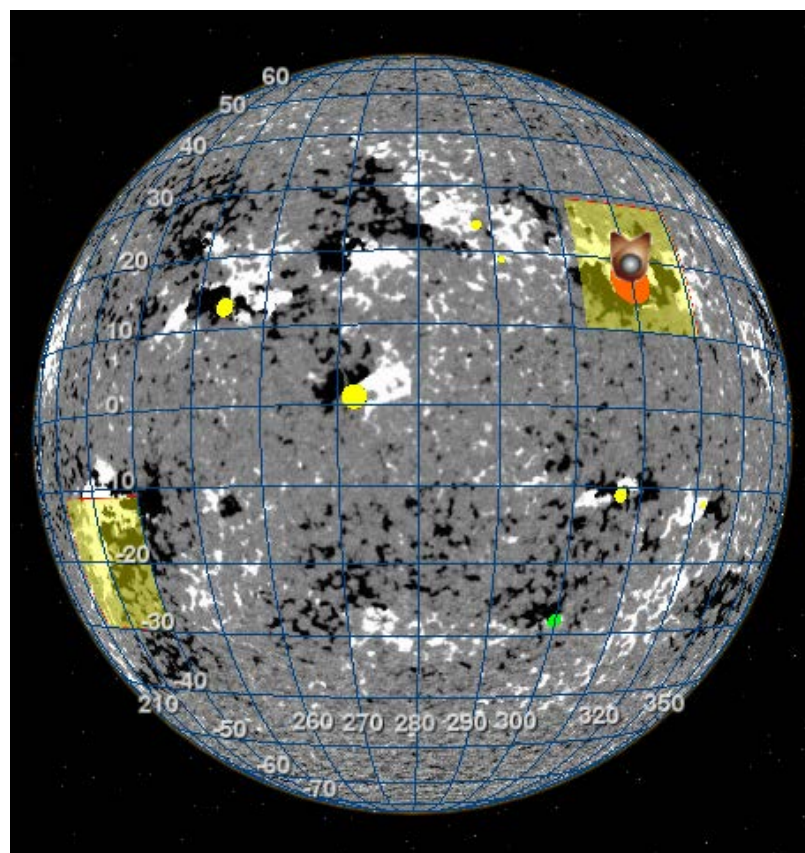
Admin Interface



# 3-D computer simulation – Virtual-Sun

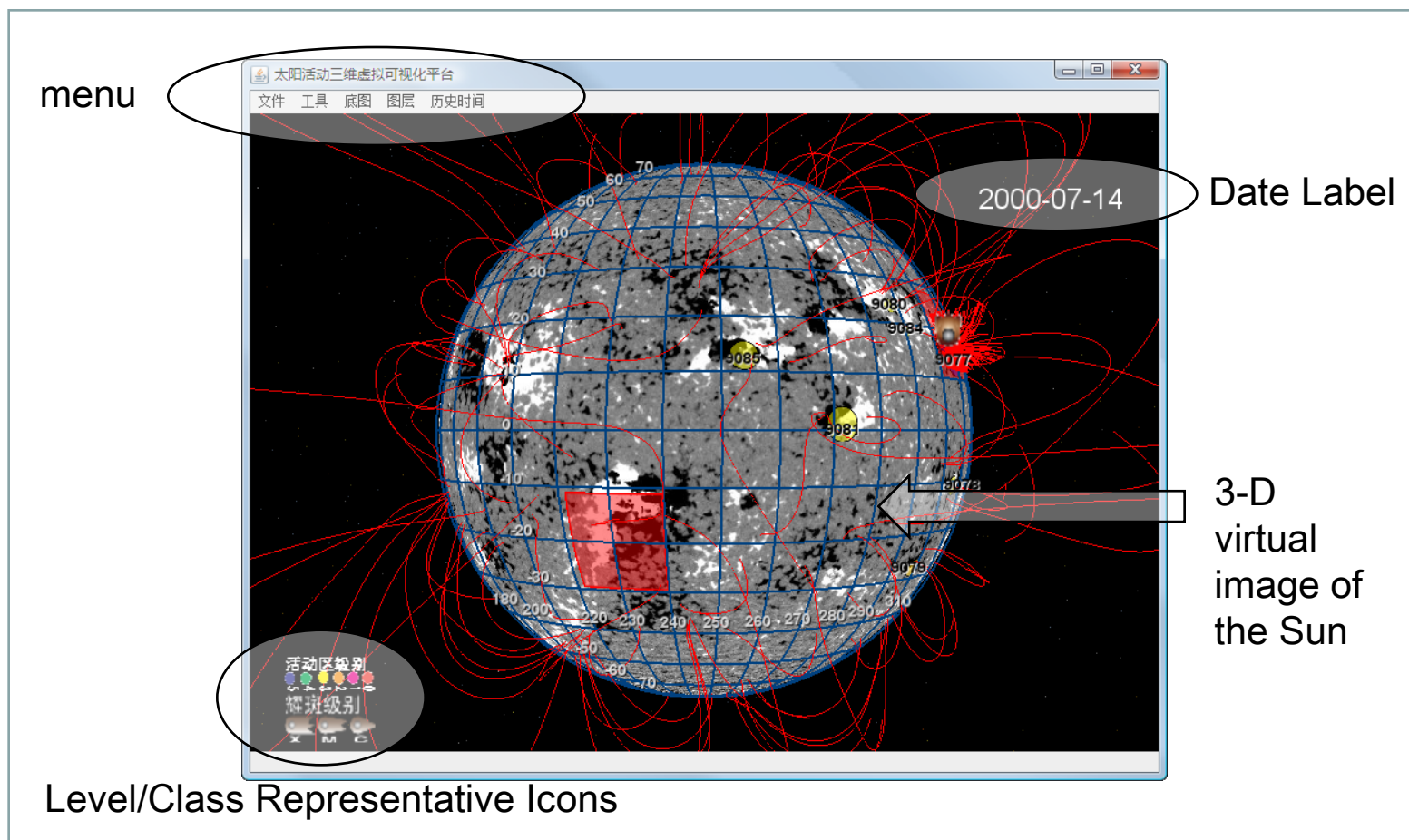


3-D Virtual Earth(Google Earth)



3-D Virtual Sun

# Virtual-Sun Client interface



For online experience (1996-2009 historical data), please visit: <http://159.226.170.65/virtual-sun/>



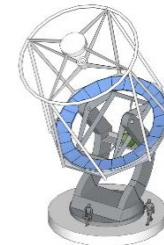
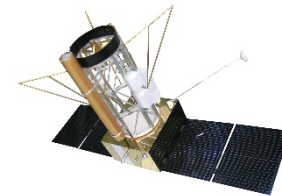
## 4. Perspective

### ➤ Virtual-Sun

- Monitoring real time solar activities
- Running prediction models
- Presenting forecasting results

### ➤ New observations (possible)

- Deep-space solar observatory (DSO)  
1 meter solar telescope at L1
- China Giant Solar Telescope (CGST)  
8 meter ring mirror solar telescope



A new generation operational solar weather monitoring and forecasting system is expected to be constructed in the near future at NAOC.

*Thanks !*