

Recent Progress of Research and Operational Activities of Solar Weather Forecasting at NAOC

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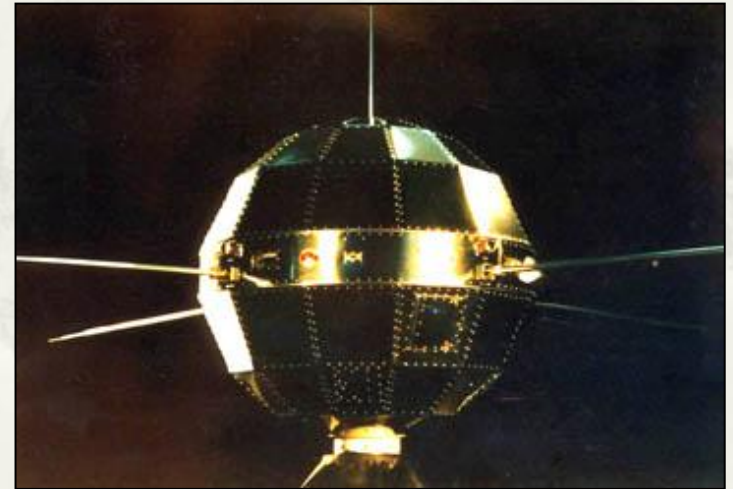
National Astronomical Observatories, Chinese
Academy of Sciences, Beijing, China

Solar weather - Origin of the space environment disturbances

- Conditions or activities on the Sun that can influence or disturb the space environment
 - solar active regions (sunspot groups)
 - solar flare
 - coronal mass ejection (CME)
 - solar energetic particle (SEP)
 - EUV, X-ray and radio radiation
 - filament (prominence)
 - coronal hole (origin of high speed solar wind)
 - solar cycle

History of solar weather forecasting activities at NAOC

- 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



The first satellite of China (1970)

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).

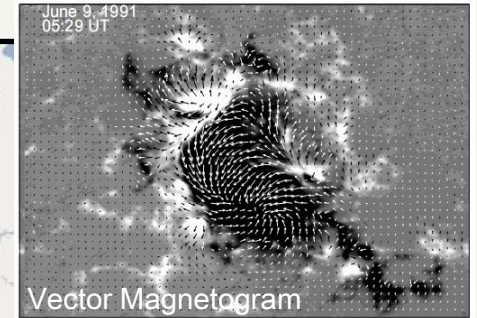
Observations at NAOC



Huairou Solar Observing station



Fuxian Lake, Yunnan Observatory

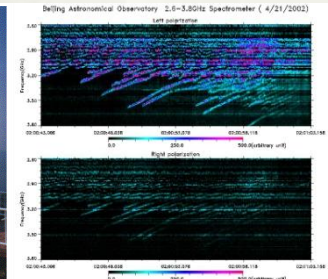


June 9, 1991
05:29 UT

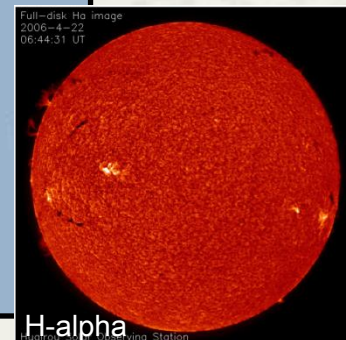
Vector Magnetogram



radio-spectrometers



Beijing Astronomical Observatory 2.6-3.8GHz Spectrometer (4/21/2002)



Full-disk H α image
2006-4-22
06:44:31 UT

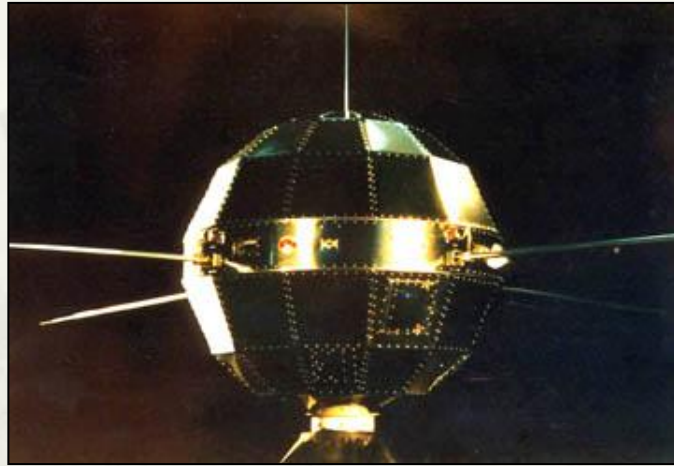
H-alpha

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



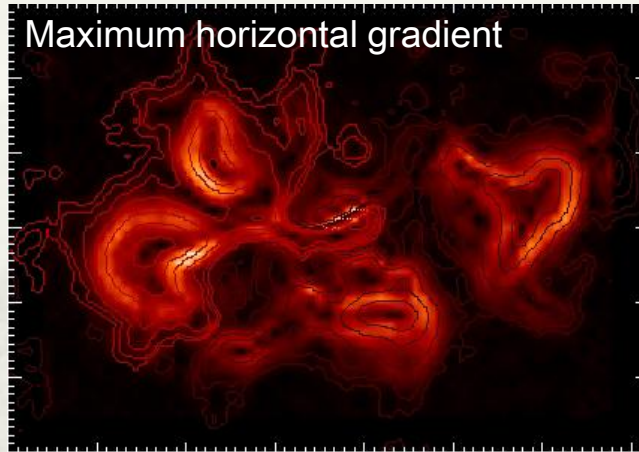
Chang'e series of moon exploration spacecraft

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**

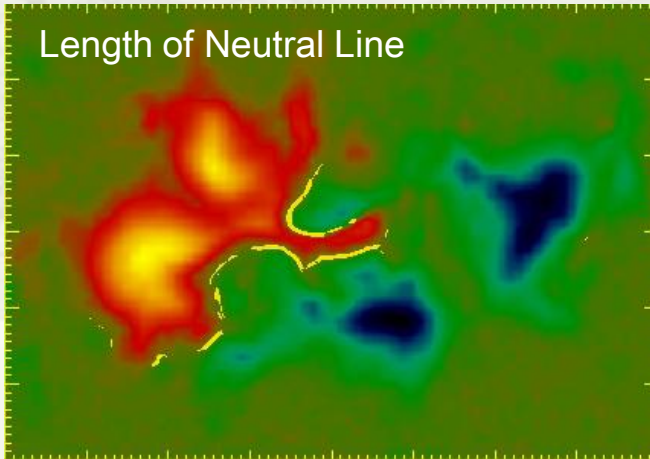
New physical measures of magnetic field as input factor for the flare and proton event prediction models

Maximum horizontal gradient

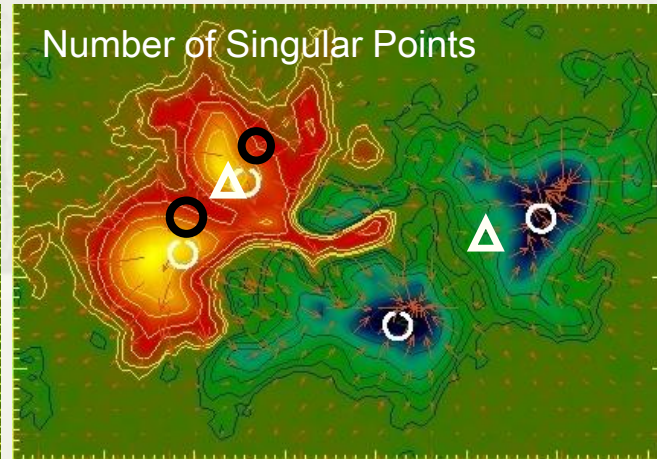


Active Region
NOAA 9574
2001-08-11 UT

Length of Neutral Line

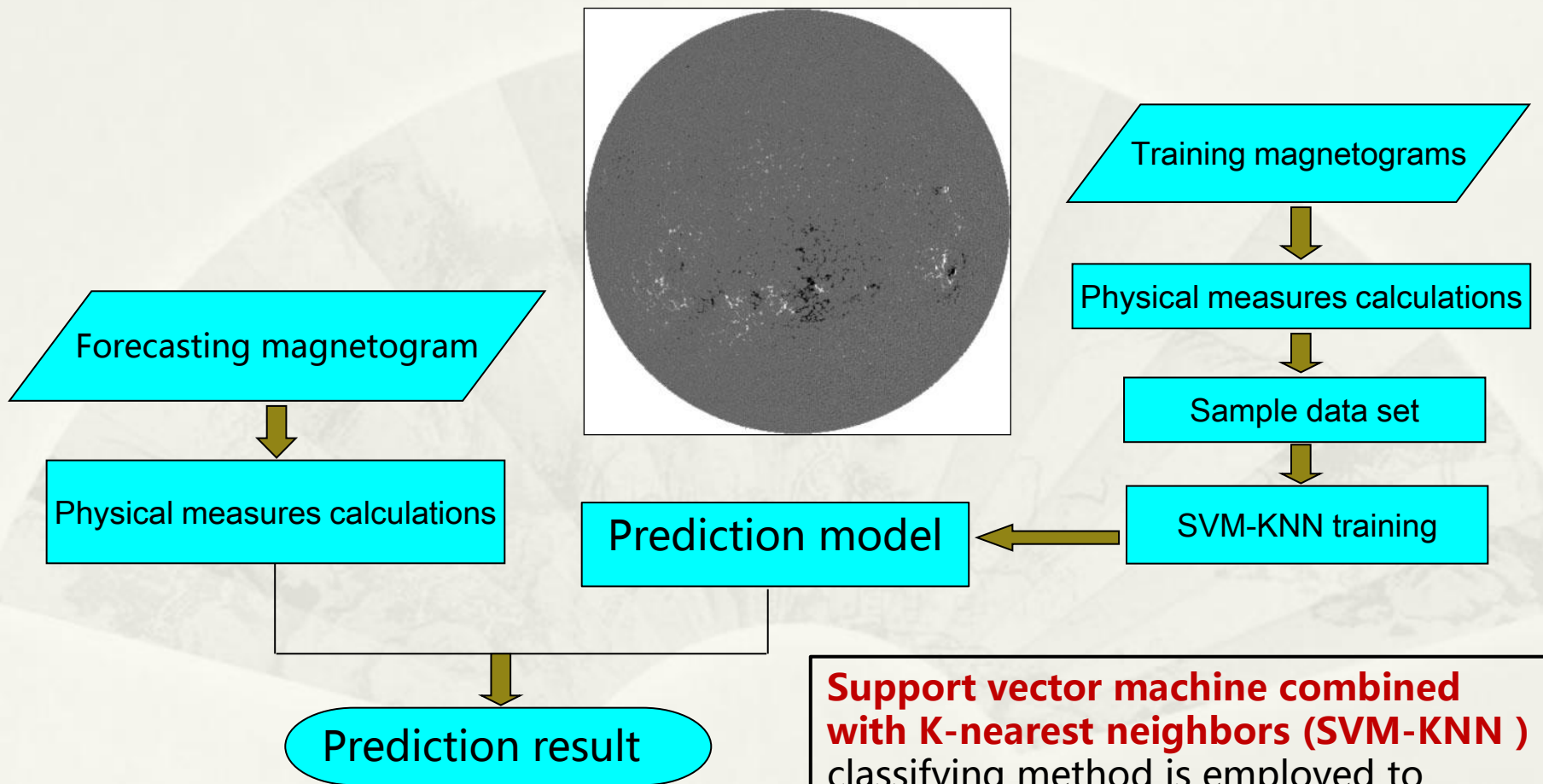


Number of Singular Points



Physical measures reflect the complexities of the photospheric magnetic field

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

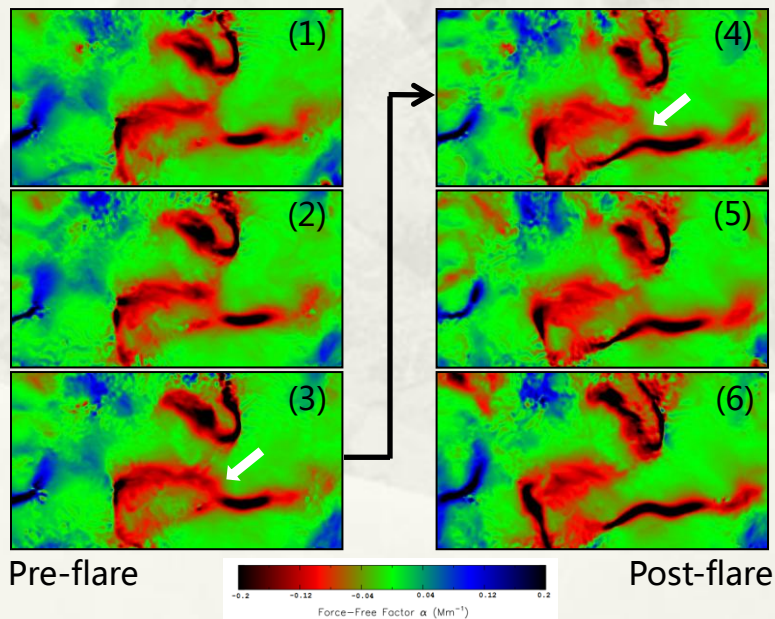


Support vector machine combined with K-nearest neighbors (SVM-KNN) classifying method is employed to replace the traditional statistics method for prediction modeling

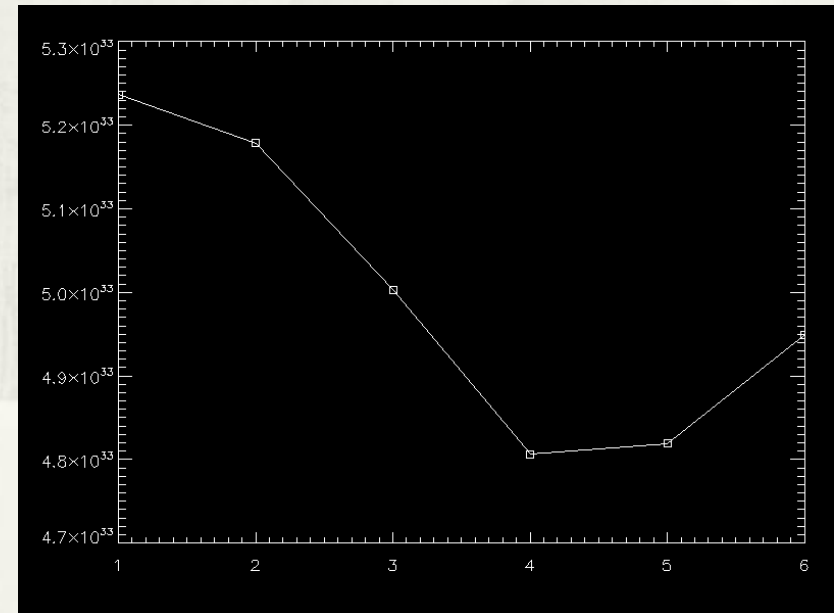
Quantitative analyses of 3-D coronal magnetic fields for solar eruptive event prediction (being developed)

Quantitative analyses of the 3-D coronal magnetic fields associated with the X3.4 flare event of the solar active region NOAA 10930

- Six magnetograms: 3 for pre-flare, 3 for post-flare
- Resolution: 1arcsec/pixel; grid number: 300x160x160
- Projection effect is corrected and the six magnetograms are co-aligned



Alpha distribution at layer 11 of modeling grid



Total magnetic energy evolution

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; 3-D computer simulation interface	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

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

http://rwcc.bao.ac.cn

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 在过去24小时中, 太阳活动很低。日面上有3群黑子, 编号为NOAA 1124 1126 1127 014 S31 N25, L172 108 058。面积为: 0150 0040 0060, 磁分类为Beta Beta Alpha。Mintesh分类为Eso Dso Max。该期间无C级及以上耀斑发生。地磁场平静。

未来40小时太阳、射线耀斑和地磁活动预报

发布日期	射线耀斑	地磁活动
20101119	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	11-18	11-17	11-16
射线耀斑	无	无	无
质子事件	无	无	无
地磁活动	平静	平静	平静
日冕物质抛射	日冕物质抛射	日冕物质抛射	日冕物质抛射
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

中国日地物理资料

太阳黑子像 (资料获取顺序: 国家天文台怀柔太阳观测基地, SDO, SOHO)

太阳黑子像 (资料获取顺序: 国家天文台怀柔太阳观测基地, SDO, SOHO)

太阳黑子像 (资料获取顺序: 国家天文台怀柔太阳观测基地, SDO, SOHO)

太阳活动预报中心
1991年国家科委和中国科学院批准成立世界预报中心北京日地物理预报中心。日地物理预报中心 (RWC-Beijing) 下设四个分中心: 地磁物理预报中心、空间环境预报中心、电离层预报中心和太阳活动预报中心。总部设在北京天文台。2000年根据国际空间环境服务组织的要求, 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, 推进日地空间环境的研究和预报, 开展日地物理研究与预报的国内和国际合作与交流, 与国际其他区域预报中心进行快速资料交换, 以获得全球日地物理资料和预报, 为本地区服务。

滚动新闻
20100207
2010-02-07
太阳强24活动局最新报道
20100121
2010-01-21

相关链接
Space Weather Prediction Center (NOAA)
SDO - Solar Dynamics Observatory
空间环境预报中心
Huairou Solar Observing Station
Big Bear Solar Observatory
SCOSTEP
Solar Physics Division
SOHO
ISCS
TRACE on-line
YOHKOH SXT SCIENCE MUGGETS
BATSE Solar Flare Server
Space Weather (AGU Journal)

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

IAOCC 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

非常规发布

管理后台

网上取文件 收邮件 Halpaha 图 黑子图 CME 磁图

查看 查看 查看 查看

前一日活动事件:

日期: 20090610 CME: 地磁活动: 射线耀斑: 质子事件: 小耀发数: 大耀发数: 保存

日期: 20090611 编号: 磁位形: norm 保存

当前活动事件:

日期: 20090611 黑子相对数: 新生群数: 总群数: 射电流量: 小耀发数: 质子流量: 0 保存

大耀发开始时间: 20090611001927 大耀发开始: 极大: 结束: 峰值流量: 保存

大耀发开始时间 大耀发开始 极大 结束 峰值流量 操作

确认并保存

日期: 20090611 资料类型: 9 保存

未来40小时太阳、射线耀斑和地磁活动预报

日期: 20090611 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

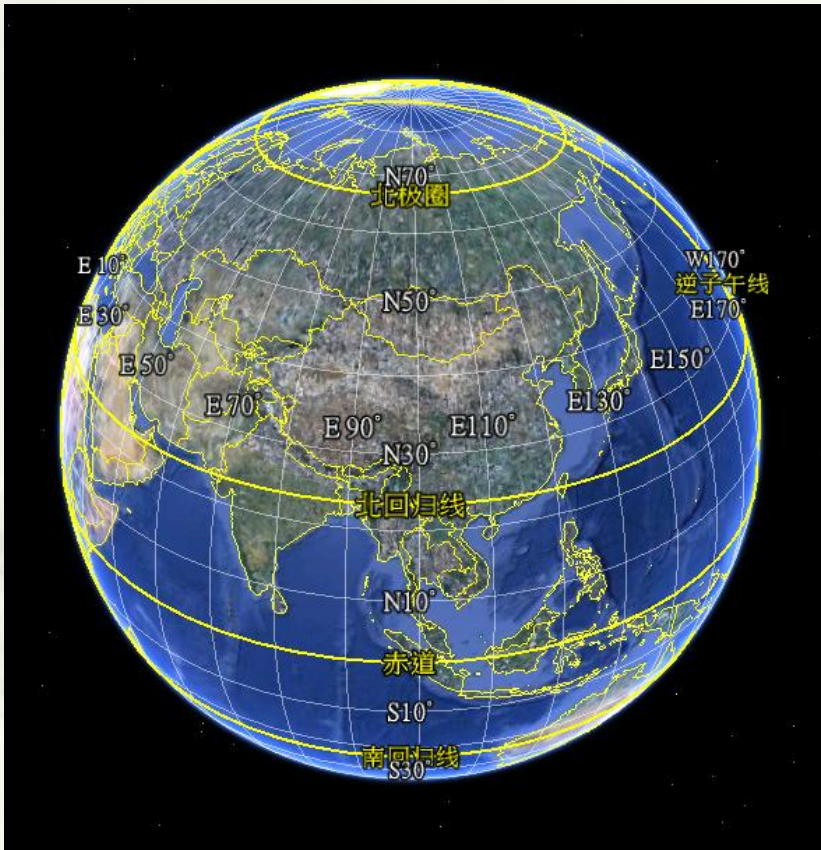
24hr: 48hr: /

保存

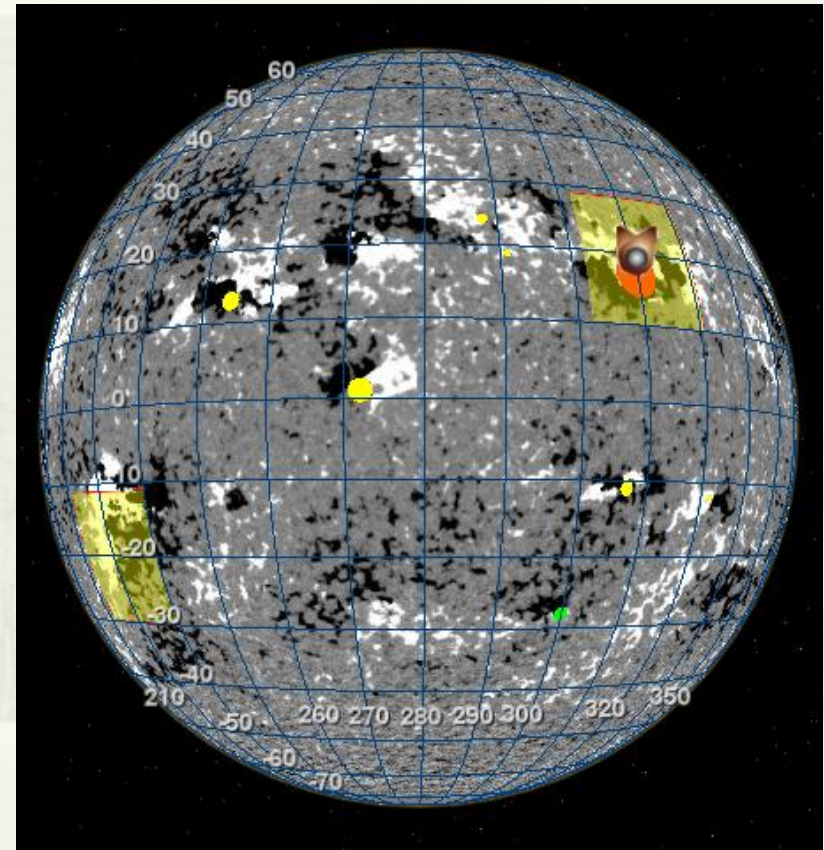
IDL表十九的查询

Admin Interface

3-D computer simulation – Virtual-Sun

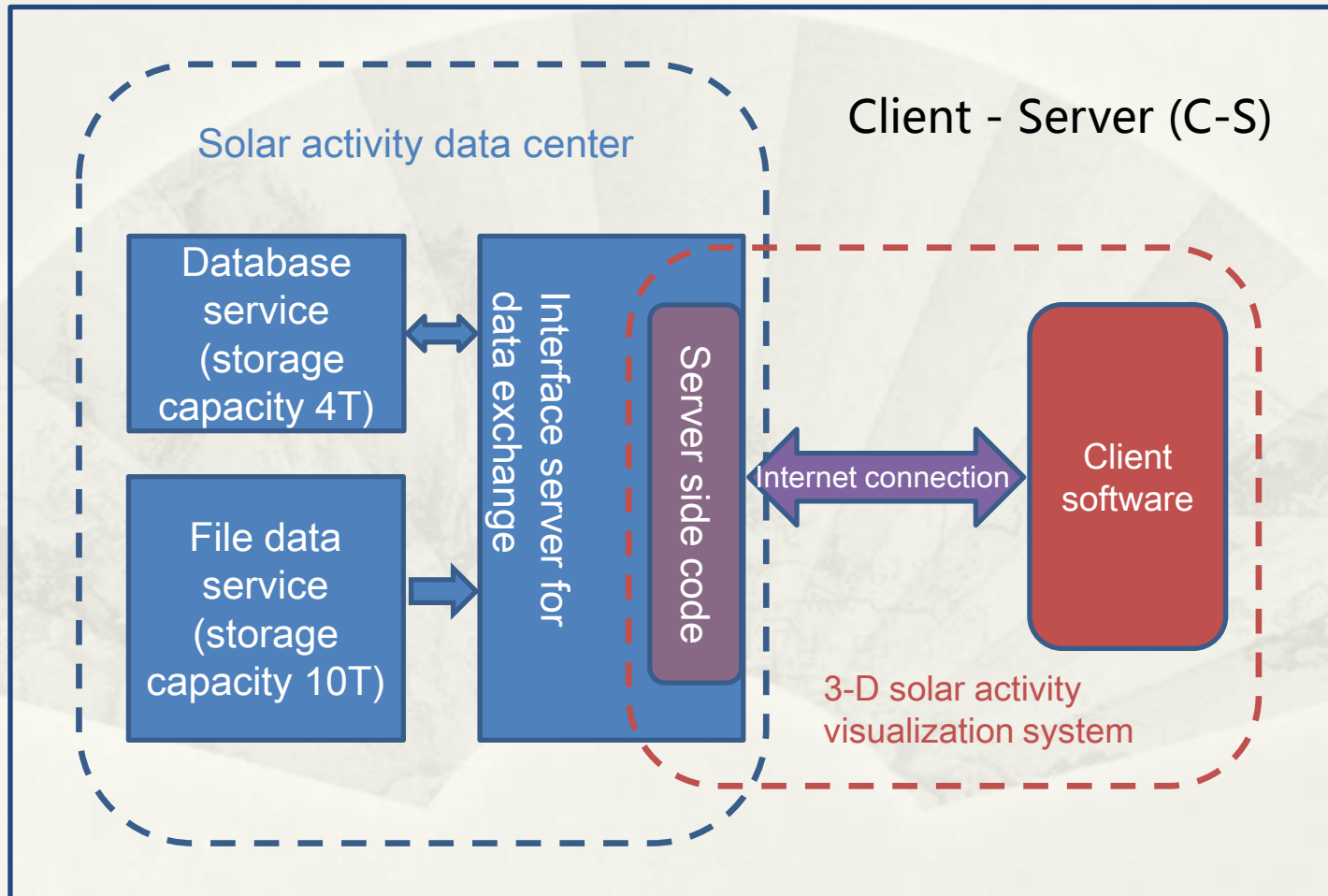


3-D Virtual Earth(Google Earth)

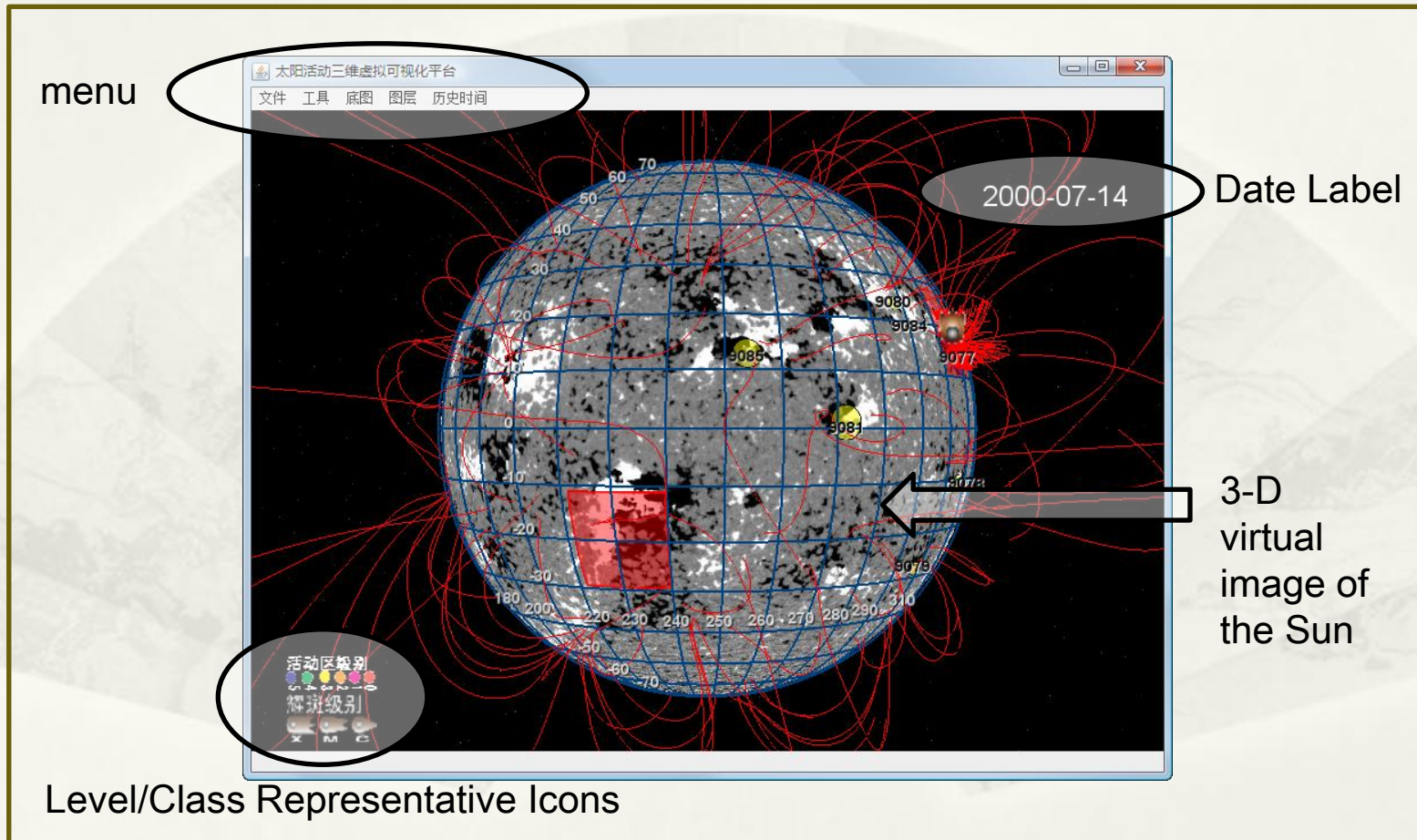


3-D Virtual Sun

Computer system architecture of the 3-D solar activity visualization system



Virtual-Sun Client interface



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

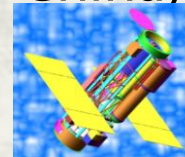
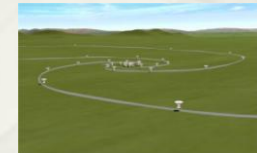
Perspective

➤ Virtual-Sun

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

➤ New observations

- 1-meter Infrared Solar Telescope
(Location: Yunnan Province, Fuxian Lake)
- Chinese Spectral Radio-Heliograph (CSRH)
(Location: Inner Mongolia of China)
- Space-based solar telescope



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



Thanks !