RWC China- SAPC 2014 Annual Report

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Outline

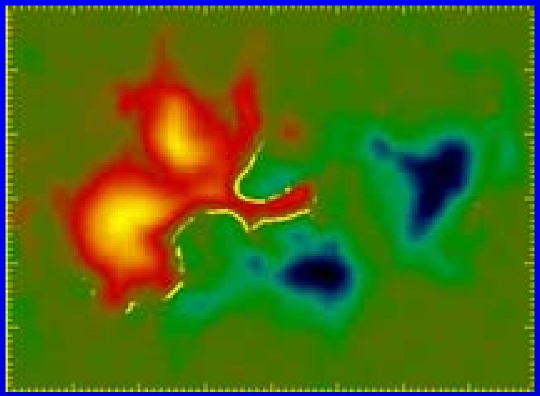
1. Recent Accomplishments
2. High Priority Product Goals
3. High Priority Data Needs
4. Forecast Verification

1. Recent Accomplishments

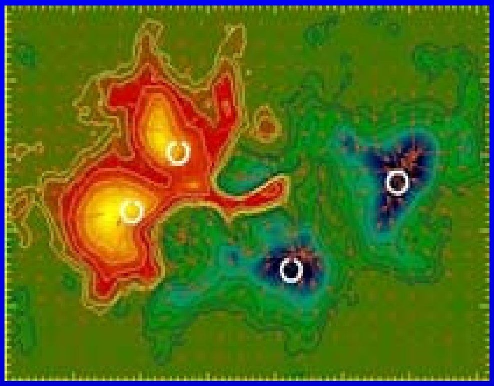
1.1 New artificial intelligence classifying algorithm for flare and proton events prediction models

In order to setup artificial intelligence classifying algorithm, a series of new measures from solar magnetic observations are suggested. For example, we extract some measures, such as , maximum horizontal gradient, length of neutral line, number of singular points from full disk solar magnetograms as predicting factors. Decision tree method is employed to replace the traditional statistics method for prediction modeling.

maximum horizontal gradient



length of neutral line

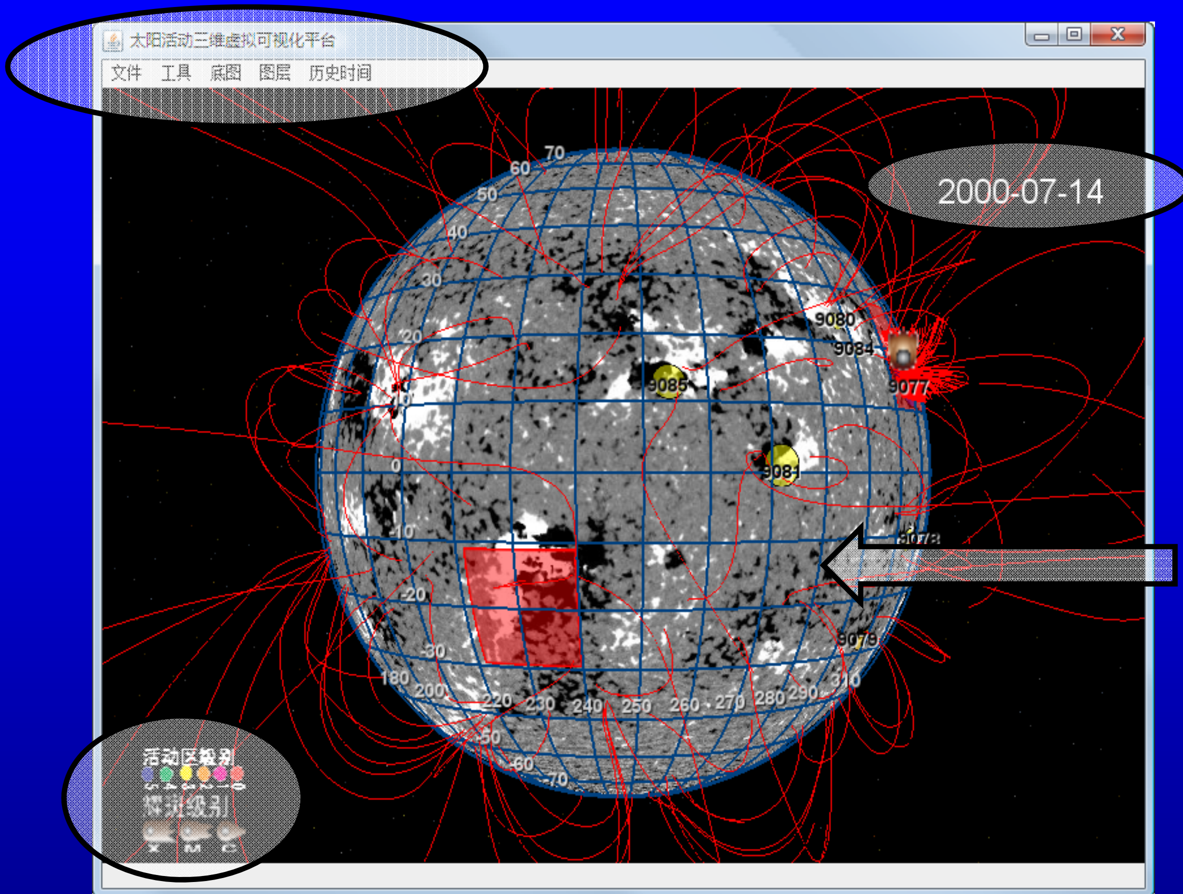


number of singular points

1.2 3-D computer simulation – Virtual-Sun

A new-generation computer platform with 3-D interface for operational space weather service (from solar perspective) is developed at National Astronomical Observatories, Chinese Academy of Sciences (NAOC). This platform is named as Virtual-Sun. The Virtual-Sun is a Client-Server (C-S) system, the Server part keeps the data of solar activity, the Client part is installed on the user's computer. The Virtual-Sun Client obtains the solar data from the Server through Internet connection, constructs the 3-D virtual image of the Sun, and displays various solar activity components on the virtual sun (e.g., sunspots, magnetograms, active region numbers, flare classes, active levels, etc). The 3-D virtual sun can be rotated and zoomed freely by using computer mouse or keyboard. A test version of the Virtual-Sun Client is available on the website of the platform.

menu



Date Label

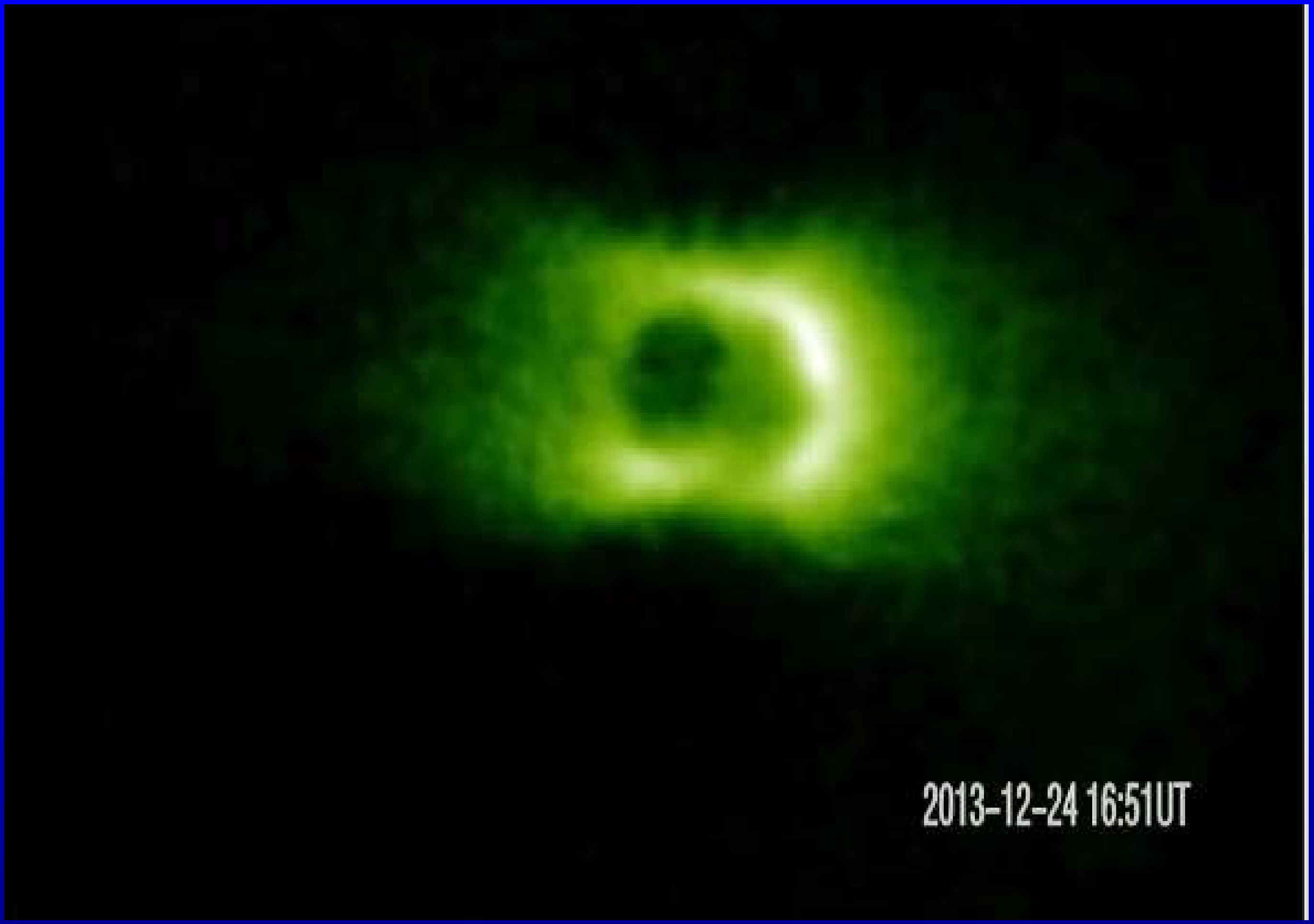
3-D virtual image of the Sun

Level/Class Representative Icons

Virtual-Sun Client interface

1.3 EUV Observations from Chang'e 3

In order to observe the Earth's plasmasphere in a global scale meridian view, a moon based EUV camera (EUVC) has been making observations at a wave band of 30.4nm and with a field of view of 15 degrees since December of 2013. On the top deck of Chang'e 3, this camera provides images of the Earth's plasmasphere with a high angular resolution of 0.1 degrees and a temporal resolution of 10 minutes within some time intervals of moon's day during the life time of Chang'e 3 mission (probably more than one year). For this reason ,we shall have many good opportunities to observe how the plasmasphere responses to solar activity and investigate behaviors of plasma in the megnetosphere.



EUV image obtained by EUVC of Chang’e 3

2. High Priority Product Goals

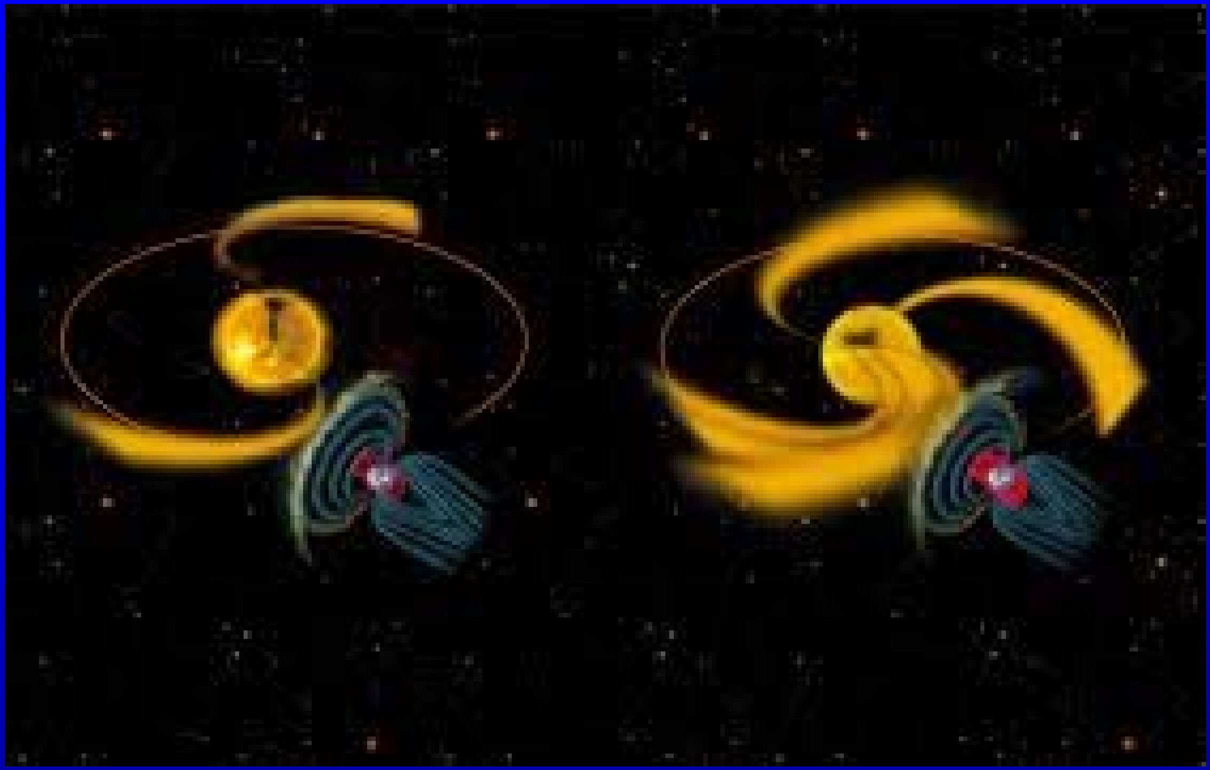
A new concept of solar activity forecast

Disturbances caused by solar eruptions, such as major solar flares and coronal mass ejections, propagate through interplanetary space, and create shock waves in the solar wind interacting with the geomagnetosphere. There exist two problems in forecasting solar eruption: (1) when and how will it happen? (2) will it has effect on the Earth?

The information of solar eruptions impacting on the Earth cannot be fully provided with the normal solar activity forecast focusing on probability of solar flares and solar energetic particle events. For this reason, we suggest a new concept of solar activity forecast:

the erupting frequency and the main attack direction of major solar eruptions should be included in forecasting contents.

The erupting frequency and the main attack direction are determined by physical properties and location of source region, solar global magnetic field. The main attack direction finally toward the Earth depends on solar rotation, IMF, and orbit motion of the Earth.

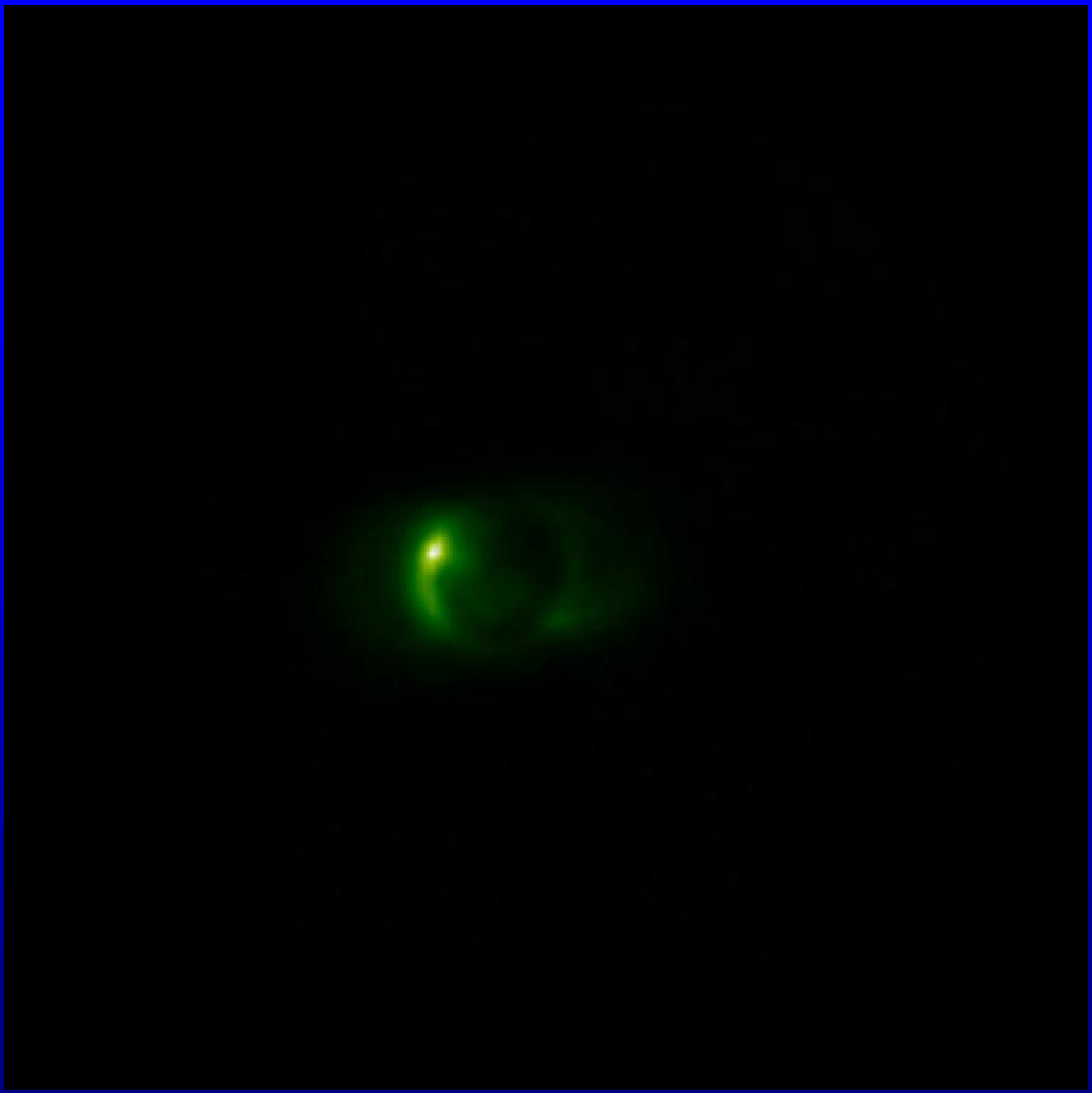


The erupting frequency and the main attack direction of major solar eruptions

3. High Priority Data Needs

Moon based EUV observational data

The EUVC of Chang’e 3 provides EUV observational data of the Earth’s plasmasphere in a global scale meridian view, which is very useful for the monitoring of space environment nearby the Earth. However, the EUVC cannot continuously provide observational data . We tend to proposal a space mission to setup an EUV observational station based on the Moon to monitor the Earth’s plasmasphere and ionosphere under the help of future missions for lunar explorations. If this proposal is made by the ISES, we might have a very good collaboration for manufacturing the payload among ISES members.



EUVC Data on 2014年2月21日（movie）

4.Forecast Verification

RWCC-SAPC toke part in the second flare-forecasting comparison workshop hosted by Northwest Research Associates at Colorado Boulder during April, 2-4 , 2013. As one of nine models proposed by authors from different institutes in the world, Our flare-forecasting model supported with a new artificial intelligence classifying algorithm was used to deal with the data source provided by the workshop organizer and realized a good mark in this comparison. However, this model should be improved further.

Comparison among flare-forecasting models

The Second Flare-Forecasting Comparison Workshop

hosted by
NorthWest Research Associates
Boulder, CO, 2—4 April 2013

Methods, Data, and Methodology

KD Leka, G. Barnes and the FFC2 attendees:

V Abramenko (Big Bear Solar Observatory)
C Balch (NOAA/SWPC)
S Bloomfield (Trinity College, Dublin)
D Falconer (MSFC/University of Alabama/Huntsville)
M Georgoulis (Academy of Athens)
X Huang (National Astronomical Observatories, Chinese Academy of Sciences)
P Higgins (Trinity College, Dublin; now LMSAL)
M Kazachenko (University of California, Berkeley)
M Alomari (ASU/Jordan, formerly University of Bradford, UK)
R T J McAteer (New Mexico State University)
S Wang (New Jersey Institute of Technology)

Funding for the workshop and the data analysis was provided by NASA/Living with a Star contract NNH09CE72C (Dr. Graham Barnes, PI) and NASA/Guest Investigator contract NNH12CG10C (Dr. KD Leka, PI).

Data collection for comparison

Data Tar-Ball	Data Listing	Event Lists:	
		C1.0 + , Latency: 0hr, Validity: 24hr	M1.0 + , Latency: 0hr, Validity: 24hr
201108.tgz (7.0Gb)	hmi_201108_contents	events_C10min_Z00max_lat0hr_val24hr_201108.txt	events_M10min_Z00max_lat0hr_val24hr_201108.txt
201109.tgz (11Gb)	hmi_201109_contents	events_C10min_Z00max_lat0hr_val24hr_201109.txt	events_M10min_Z00max_lat0hr_val24hr_201109.txt
201110.tgz (15Gb)	hmi_201110_contents	events_C10min_Z00max_lat0hr_val24hr_201110.txt	events_M10min_Z00max_lat0hr_val24hr_201110.txt
201111.tgz (18Gb)	hmi_201111_contents	events_C10min_Z00max_lat0hr_val24hr_201111.txt	events_M10min_Z00max_lat0hr_val24hr_201111.txt
201112.tgz (17Gb)	hmi_201112_contents	events_C10min_Z00max_lat0hr_val24hr_201112.txt	events_M10min_Z00max_lat0hr_val24hr_201112.txt
201201.tgz (13Gb)	hmi_201201_contents	events_C10min_Z00max_lat0hr_val24hr_201201.txt	events_M10min_Z00max_lat0hr_val24hr_201201.txt
201202.tgz (6Gb)	hmi_201202_contents	events_C10min_Z00max_lat0hr_val24hr_201202.txt	events_M10min_Z00max_lat0hr_val24hr_201202.txt
201203.tgz (8.8Gb)	hmi_201203_contents	events_C10min_Z00max_lat0hr_val24hr_201203.txt	events_M10min_Z00max_lat0hr_val24hr_201203.txt
201204.tgz (9.4Gb)	hmi_201204_contents	events_C10min_Z00max_lat0hr_val24hr_201204.txt	events_M10min_Z00max_lat0hr_val24hr_201204.txt
201205.tgz (10Gb)	hmi_201205_contents	events_C10min_Z00max_lat0hr_val24hr_201205.txt	events_M10min_Z00max_lat0hr_val24hr_201205.txt
201206.tgz (8Gb)	hmi_201206_contents	events_C10min_Z00max_lat0hr_val24hr_201206.txt	events_M10min_Z00max_lat0hr_val24hr_201206.txt
201207.tgz (15Gb)	hmi_201207_contents	events_C10min_Z00max_lat0hr_val24hr_201207.txt	events_M10min_Z00max_lat0hr_val24hr_201207.txt

Models/ Index	Huang	Foconer	Leka
HSS (C flare)	0.47		0.48
TSS (C flare)	0.68		0.41
HSS (M flare)	0.22	0.38	0.35
TSS (M flare)	0.65	0.48	0.25

Observed	*Predicted* flare	no flare
flare	**TP**	**FN**
no flare	**FP**	**TN**

Heidke skill score: HSS = (TP + TN – random) / (N – random)

True skill statistic (*aka* Hanssen and Kuipers discriminant, *aka* Peirce skill score) : TSS = POD – POFD = TP/(TP+FN) – FP / (FP + TN)

Thanks!