Space Weather Services in China

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Outline

- **1. Increasing Need for SpaceWx**
- 2. Successful SpaceWx Services
- 3. Improvement of Operational SpaceWx Forecasting Framework



1. Increasing Need for SpaceWx





- To meet the space weather requirements for China's space missions, the Space Environment Prediction Center (SEPC) was established in 1992 in NSSC,CAS.
- In 1998, SEPC set up the first generation of an operational space weather forecast system, and built up a professional forecasting team.
- Since then, SEPC has been issuing space weather prediction via internet 365 days/year and providing space weather services for customers .





SpaceWx Services for the Entire Process of a Space Flight Mission

Space environment parameter (long term forecast, ssn and radio flux) SEE numeric evaluation(single event effects, radiation damage effects) Background Analysis	Forecast for launch window (solar activity , geomagnetic activity, space debris, atmospheric environment, radiation environment) Mid-term Forecast Short-term Forecast	Monitoring , forecast and warning (solar eruption. solar proton, solar wind, geomagnetic storm, three times one day) Nowcast Forecast Warning	and warning (solar eruption. solar proton, solar wind, geomagnetic storm, once every day) Nowcast Forecast Warning
Design Period	Before Launch	In-Orbit experiment	Long-term experiment period



Monitoring, forecast

Services for Manned Space Flight Missions



As a subsystem of space application system, SEPC has supplied space weather services in each step of China's Manned Space Program for 10 Shenzhou space ships and Tiangong 1.

Leonid Burst Prediction for Shenzhou I



- In 1999, in order to avoid Leonid burst, the launch of Shenzhou-1 was postponed for 48 hours, from Nov.18 to Nov. 20. This is the first time a launch plan was changed due to a space environment event in China.
- According to the observation, meteoroid flux had declined to safe levels at launching time.



Geomagnetic field quiet period prediction for Shenzhou VII







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







No solar proton event, a kind of severe space environment event, occurred during the missions.



3. Improvement of SpaceWx Forecasting Framework

(1) SpaceWx forecast system
 (2) Product capability expansion
 (3) Extension of service means
 (4) Development of operational SpaceWx models
 (5) Improvement of SpaceWx data capability



(1) Space weather forecast system





(2) Product capability expansion

Space weather event alerts

- Solar Flare
- Solar Proton Event
- Geomagnetic Storm

Fundamental spaceWx parameters observation

- SSN
- F10.7
- Ap

More SpaceWx Parameters, prediction

- SSN
- F10.7
- Ap
- Kp
- AE
- Dst
- Electron Flux



- Radiation belt
- Middle-upper atmosphere
- Magnetopause



Space Environment Effects Evaluation

- Single event effect
- Surface Charging
- Internal dielectric charging
- Total radiation evaluation



(2) Product capability expansion

General Public : forecasts, models,data Contents : space weather parameters (SSN, F10.7, Ap, Dst, Kp, AE, GEO >2MeV Electron Flux) space weather events (Solar Flare, SPE, Geomagnetic Storm, Relativistic Electron Flux Enhancement) Publish : Website, Text message, email, App, Wechat, Weibo

Customers : Manned Space Mission, Lunar Exploration ... Contents : according to user needs, space environment specification, space environment effect evaluation

Publish : according to user needs (fax, email, document)





(3) Extension of service means

DWebsite

Text message
App (IOS + Android)
Microblog (Twitter)
Wechat

1992		
		You are here: Hor
A MARCEN		
> Home	OVERVIEW & FORECAST	Solar X-Ray Flares
> Forecasts	Over the past 7 days	The next 3 days - 24-hr Max:C1.3 In mon acrue alueo Peak Time 2015 Jan 19 10:13
7 Torceases	Electron - 11 11 11 11 11 11 11 - 11 11	
Dally Forecast	Proton II II II II II II II II II	>>more data<<
Veekly Forecast	X.Ray	
7-day F10.7 Forecast		
7-day Ap Forecast	II Quiet II Minor II Moderate II Strong	
Solar Cycle Forecast		GEO Proton Flux >10MeV
> Alerte	Daily Review Day 1 To 3 Weekly Review W	Veekly Forecast Current 5-min:1.740e-1 /cm ² .
Alerts	During the past 24 hours enlar activity was low with two C-class flares produ	24-hr Max:3.410e-1 /cm ² .sr.s
Solar X-ray Flare	active regions on the visible disk, simple and stable. The solar wind speed n	naintained at about Undated 2015 Jan 19 13:30 L
iolar Proton Event	350km/s. The geomagnetic field was quiet.	>>more data<<
RelativisticElectronEnhancement	Published: 2015-01-19 0	0:12 UTC
GeoMagnetic Storm	Forecaster: 022/031	
	AI EDTS Brown	Solar Wind Speed & Dens
> Models	ALERIO	Speed:330.5 km/sec
AE Model	No space environment alerts have been issued today.	Density:1.0 protons/cm ³
Ost Model	SXR SXR GMS GMS	GMS Updated:2015 Jan 19 13:44 L
udden lonosphere Disturbance		>>more data<<
Aagnetopause & Bow Shock		
(p Model	13:08 UTC 03:38 UTC 10:00 UTC 07:00 UTC	01:00 UTC
SEO relativistic electron flux	14 Jan 2015 13 Jan 2015 07 Jan 2015 07 Jan 2015	Planetary K-Index
	The Legend	
Real-time Data	Windo Generation Generation Generation Generation	eomagnetic Storm Currenc Kp=1 Star Xrav Elara 24-hr Max:Kp=3
Cosmic Ray	Strong Goal Proton Event W So	Lindeted 2015 Jan 10 12:00 J
onosphere	LATEST DATA	>more data<
	HS05 Stoles L5	
> Processed Data	2015-01-17 03:05:22 History 202	GEO Electron Eline S2Mal
		GLO LICUIOI FILX SEMEN
Coronal Hole Index		
Coronal Hole Index Solar Active Regions		Current 5-min:2.780e+1 /cm ²
Coronal Hole Index Solar Active Regions P10.7 Index		Current 5-min:2.780e+1 /cm ² . Integral Flux:2.573e+6 /cm ² .sr



(3) Extension of service means



Space weather information are pushed to customers by: (Left) text message; (Middle) mobile App; (Right) Wechat



(4) Operational models





(4) Operational models



http://eng.sepc.ac.cn



(5) Space weather data

Ground Based

<image>

Meridian Space Weather Monitoring Project



Two ground based space weather monitoring networks have been constructed. The first one, Space Environment Monitoring Network (SEMnet), is to support operational forecasting works in Space Environment Prediction Center (SEPC). The other one, Meridian Space Weather Monitoring Project, is to supply data for space weather integrated modeling that will be translated into operational frameworks through SEPC-China.



(5) Space weather data

Space Based



Space environment data from satellites, either from meteorological satellites such as Fengyun series, or from applied satellites such as China Beidou's navigation satellite system, are used to support space weather services and modeling.



Thank you for your attention!



Space Environment Prediction Center, NSSC/CAS



National Space Science Center, CAS