Recent Activities on Space Weather in China and Perspectives on International Collaboration

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Space Weather: Solar-Earth Connection

- Sun
- Solar Wind/Interplanetary
- Geospace Environment
  - Magnetosphere
  - Ionosphere
  - Thermosphere

Credit: NASA/GSFC
01. The ASO-S (Kuafu) Mission

02. International Meridian Circle Program

03. Regional Warning Center-China in ISES
ASO-S, China's first comprehensive solar exploration satellite, was launched in October last year.

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Observations of ASO-S (Kuafu-1)

**FMG Magnetogram**

**HXI Observations**

**LST Images**

- ASO-S/HXI 15-20 keV
- LST/SCI + SCI
- LST/SCI
- LST/SCI
- LST/SCI
- LST/WST
- White-light flare
- Lyra prominence
- Lyra CME
- Lyra wave
- Lyra filament
- Lyra flare

National Space Science Center, CAS
A data release and training conference on how to use the observation data was held online (April 11-12, 2023), which was attended by nearly 400 solar physics experts from 25 countries.

Data Website: http://aso-s.pmo.ac.cn/sodc/imageBrowser.jsp
International Collaborations

- ASO-S International Guest Research Program
- 3 ISSI or ISSI-Beijing International Research Team
- Collaborations Established with Solar Orbiter Payload teams
- China NSF: Key International Cooperation Projects
- Ministry of Science and Technology (MOST): High-end Foreign Experts Recruitment Plan
- Sino German Science Center Mobility Programme
Multi band analysis of high temporal and spatial resolution HXI imaging

Magnetic field extrapolation and analysis

Data driven MHD simulation

(1) HXI Reveals the Detailed Motion of Hard X-ray Foot Points and the Mechanism of Flare QPP Production
Preliminary Scientific Results

(2) SDI observed for the first time Wave (Source area: 20230303 X2.1 class flare)
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Chinese Meridian Project

1 Chain
From Sun to Earth

3 Networks
M, I, A

4 Focuses
High-latitude: Polar regions
Mid-latitude: North area of China
Low-latitude: South of China (Hainan)
High-land: Tibetan Plateau

- 295 instruments will be deployed at 31 stations across China and polar regions
- 1.3 billion CNY (or $200 M dollars)
- Completed and put into operation by the end of 2023

Data website: https://data2.meridianproject.ac.cn/
Solar Radio Telescope

- Frequency: 150MHz - 450MHz
- No. of antenna: 313
- Array Diameter: 1000m

SOHO EUV-eit284 Image
LOFAR Image
DSRT Solar-Image
DSRT Image

Observations During the Dec 1, 2023 Storm

SYISR log10(Ne m⁻³) @ SY, 2023-12-01, Az=178°, Ele=45°, 030s

Te (K)

Ti (K)

Vo (m/s)
IMCP is an outgrowth of the Chinese Meridian Project

- Integrate ground-based observatories along the 120° E and 60° W Great Meridian Circle
Facilities under joint construction

2017, China-Brazil Joint Laboratory for Space Weather

Ionospheric Digisonde

Dual-Wavelength Lidar

GPS-TEC

South America Data Center

Fluxgate magnetometer
North Polar Region (Canada, Europe, Chinese Polar Stations)

Canada High Arctic Ionosphere Network (CHAIN)
- 25 GNSS receivers
- 6 Digisondes
- ...

University of Oslo Network
- 4 GNSS receiver
- 4 All sky imagers
- ...

Add > 3 All sky imagers, >3 photometers
Partially filling the coverage gap, but not enough
Ionospheric observational network in East/Southeast Asia

- GNSS TEC/scintillation receivers
- Ionosondes
- HF and VHF radars
- Airglow Imagers

Observing background ionosphere and plasma bubbles over a wide longitude from Indian ocean to west Pacific

International cooperation:
- Pakistan
- Thailand
- Laos
- Cambodia
- Indonesia
IMCP 2023 → 2024

IMCP 2024, August 6, Brazil
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Regional Warning Center – China in ISES

- **Establishment:** In 1992, RWC-China was established and joined in the ISES. The Space Environment Prediction Center (SEPC) in National Space Science Center (NSSC, CAS) was one of the subcenters in RWC-China. Another center is Solar Activity Prediction Center (SAPC) in National Astronomical Observatories (NAOC, CAS).
In 2023, SAPC moved to NSSC from NAOC, and merged with SEPC. According to the consortium of ISES, NSSC becomes the RWC-China.
Products and Services

General Public: forecasts, models
space weather events (Solar Flare, SPE, Geomagnetic Storm, Relativistic Electron Flux Enhancement)
Issue: Website, Text message, email, App, Wechat, Weibo

Specific Users: Manned Space Mission, Lunar Exploration, Strategic Priority Program on Space Science...
Contents: according to user needs, space environment specification, space environment effect evaluation...
Issue: according to user needs (fax, email, document)
Share Forecasts with ISES Members

Latest Forecasts

RWC Locations

©ISES Regional Warning Centers
If you want to post your forecasting services on this portal, contact Webmaster.
Summary

- Space weather monitoring, forecasting, and services has made significant development in China.
- We welcome usage of China mission data for space weather study.
- We welcome collaborations and contributions in the International Meridian Circle Program (IMCP).
- We will contribute to global space weather collaborations through space- or ground-based missions, and continue to exchange data and forecast in ISES and other international organizations.