System and service for management of space weather risk in Korea

2020. 2. 4.

YUN, JONG-YEON
The primary action agency of emergency measure to severe SWx, and the RWC Korea as a member of ISES (International Space Environment Service)
Operational Flow

Observation
- Ionosondes (x2) & TEC (x5) & VIPIR (x2)
- Mag (x3)
- SRS (30MHz~2.5GHz)
- F10.7 Meter
- IPS
- RIMS (30MHz~18GHz)
- GIC Monitor (x3)
- Space
  - ACE, DSCOVR, STEREO Tracking

Products
- 3-hourly Condi. & Forecast
- 3-day Forecast (daily)
- 27-day Forecast (weekly)
- HF prediction (monthly)
- ISES URSigram (daily)
- Alerts
- Warnings

Communication Link
- ISES RWCs
- Inter Agency

Customers
- Satellite
- Comm.
- Defense
- Aviation
- Research
- 4,000+ Subscribers
Forecasting Office
All ministries followed predefined procedures based on KSWC’s SWx information!
We take actions according to NOAA SWx scales

If level 3+ event occurs, we provide the press release for public

<table>
<thead>
<tr>
<th>R.S.G.</th>
<th>KSWC level</th>
<th>Ministry level</th>
<th>National level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Send alert messages (SMS/email/fax, automatic)</td>
<td>Report to the Ministry Press release</td>
<td>Issue a national space weather disaster alert (by Space Weather Disaster Management Manual)</td>
</tr>
<tr>
<td>2</td>
<td>Notify to key customers (phone call, forecaster)</td>
<td>Status updates at website</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>Notify to related Ministries (Defense, Transport, Communication, Energy, Meteorological, Security…)</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
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</tbody>
</table>
Migration to Customer Oriented Services

Alerts & Warnings for Global Disturbance

Customized Alerts & Warnings to Each Customer

Ionospheric Disturbance Effect Prediction

Solar Radio Noise Effect Prediction

Solar Activity Prediction using Image Processing

GEO Satellite Environment

Comic radiation Prediction Model
Customer Oriented Web Services

Customer Services

- Satellite
- Aviation
- navigation
- Electric Power
- radio
- defense
## R & D - SW Forecast Models

<table>
<thead>
<tr>
<th>Forecast Model</th>
<th>Radio Blackouts</th>
<th>Solar Radiation Storms</th>
<th>Geomagnetic Storms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify solar active regions, filament channels and coronal holes</td>
<td>- ASSA (Automatic Solar Synoptic Analyzer)</td>
<td>- Solar Proton Event Prediction</td>
<td>- Enlil, IPS, IPS-driven Enlil</td>
</tr>
<tr>
<td><strong>Upgrade Plan (Future)</strong></td>
<td>+ Tracing filaments using SDO 304</td>
<td>+ Predicting the peak time and the end time of the solar proton event</td>
<td>+ CME analysis improvement using data of STEREO and L5 satellite</td>
</tr>
<tr>
<td></td>
<td>+ Analyzing the magnetic field configuration of sunspots</td>
<td></td>
<td>+ Predicting IMF Bz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+ Automatic CME analysis</td>
</tr>
</tbody>
</table>
## R & D - SW Effect Analysis Models

<table>
<thead>
<tr>
<th>Analysis Model</th>
<th>Satellite</th>
<th>Aviation</th>
<th>Navigation</th>
<th>Power Grid</th>
<th>Comm.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- DREAM</td>
<td>- SAFE</td>
<td>- GNSS signal monitoring analysis</td>
<td>- GIC measurement</td>
<td>- Real time HF Mapping</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>Calculate high energy particles on the radiation belts</td>
<td>Calculate cosmic radiation does during aviation flight</td>
<td>Monitor GNSS signal status according to solar activity</td>
<td>Measure GIC induced by Space Weather disturbance</td>
<td>Predict usable HF based on ionospheric assimilation</td>
</tr>
<tr>
<td><strong>Upgrade Plan (Future)</strong></td>
<td>+ predict electron density distributions for 3 days using deep-learning</td>
<td>+ predict cosmic radiation doses on flight routes</td>
<td></td>
<td>+ predict GIC and K index for 3 days in Korea</td>
<td>+ accuracy improvement using portable observational devices for ionosphere</td>
</tr>
</tbody>
</table>
Activities for ionosphere research

- Ionospheric joint observation
- Ionospheric prediction model
✓ Progress of Joint Observation of East Asia Ionosphere and MOU
✓ Expansion of ionospheric observation area through Oblique sites
✓ Use the VIPIR system
✓ Vertical Sites
  + Oblique Sites on the sea
Oblique to Vertical

- White line: extracted data from oblique sounding data
- Red line: translated data from oblique to vertical
- Green line: scaled data
Final concept of KIPM (Korean Ionospheric Prediction Model)

- GPS-TEC
- Ionosonde (vertical & Oblique)
- COSMIC

Ionospheric initial conditions

IDA4D
- Ion densities

Solar flux (F10.7 or HEUVAC)
- Geo mag. condition (AP)

KIPM (SAMI2)

TIE-GCM
- Neutral O density
- Neutral winds

Final results
- (NmF2, hmF2, TEC)

Ionospheric general drivers

Ionospheric main drivers

t = 0

t = every 15 min.
Big data & AI system construction

2020: hardware + Infrastructure
2021: Software + Applications
Thank you!

www.facebook.com/rwcjeju

App : RRA Space Weather