Operations summary of the Russian segment of the China-Russia Consortium

V. Burov, K. Kholodkov
The International space weather service for international civil aviation was developed by ICAO with the participation of WMO to address the risks associated with space weather disturbances.

**Four** ICAO-designated Global Space Weather Centers perform routine operations of monitoring the space weather phenomena and issuing advisories: ACFJ, CRC, PECASUS, SWPC.

CRC (China-Russia Consortium) — a Global Space Weather Center is of these centers. It comprises the efforts and expertise of space weather specialists of the two countries.
Every SWxC under the International space weather service for international civil aviation monitor for three major space weather phenomena:

• Radiation risk for crew and passengers
• Degradation of GNSS precision
• Unavailability of over-the-horizon radiocommunication

Degradation of bi-directional aircraft-satellite communication is under consideration.
Russian and Chinese National Centers for Space Weather

The China and Russian Federation Consortium for ICAO global space weather centers
The implementation of space weather center services is a set of interconnected software components that receives and processes the observational data, calculates space weather parameters in accordance with the embedded models and provides conclusions based on specified criteria and threshold values.

The system is built in such a way that each data stream is processed in independent and isolated way, so no single failure could affect multiple components. Analysis tool and detectors automatically switch similar data sources to remain active in case of measurements outage. When effective, the forecaster is also presented with data from multiple sources.
Recent significant space-weather event as seen on forecaster's dashboard. Staff was notified by an automated system.
When indicators show signs of moderate or severe events, the system populates the corresponding list, prepares advisory and presents it to several backup space weather forecasters, who approve or reject the advisory.
CRC utilizes multiple instruments and models to assess the magnitude of the ongoing phenomena and provide forecasts (where available). For example:

- forecasting strong magnetic storms caused by coronal mass ejections storms with a lead time from 10 hours to several days (the most likely sources of such disturbances are Halo-type CMEs with a coronal mass ejection velocity of more than 1000 km/s, accompanied by X-ray bursts and injection of proton fluxes);

- calculation of the radiation situation on air routes during strong solar flares at various altitudes from 5 to 18 kilometers in increments of about a thousand meters for all regions, seasons and local time with calculation of background values for each altitude.
Comparison of the radiation models for ICAO Space Weather Services

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In 2023, our consortium completed 6 two-week operational cycles. Since January 1, 2023, global space weather centers of The International space weather service for international civil aviation have issued 582 advisories regarding potentially hazardous space weather disturbances for air travel. Of them:

350 is potentially harmful to GNSS positioning accuracy;
232 are potentially dangerous for over-the-horizon radio communications.
Thank you for your attention!
Для ответов на возможные вопросы
The threshold values for moderate and severe intensities for advisory generation

<table>
<thead>
<tr>
<th>Effect</th>
<th>Sub-effect</th>
<th>Parameter used</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNSS</td>
<td>Amplitude Scintillation</td>
<td>S4 (dimensionless)</td>
<td>0.5</td>
<td>0.8</td>
</tr>
<tr>
<td>GNSS</td>
<td>Phase Scintillation</td>
<td>Sigma-phi (radians)</td>
<td>0.4</td>
<td>0.7</td>
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<tr>
<td>GNSS</td>
<td>Vertical Total Electron Content (TEC)</td>
<td>TEC units</td>
<td>125</td>
<td>175</td>
</tr>
<tr>
<td>RADIATION</td>
<td></td>
<td>Effective dose rate (micro-Sieverts/hour)</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>HF COM</td>
<td>Auroral Absorption (AA)</td>
<td>Kp</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>HF COM</td>
<td>Polar Cap Absorption (PCA)</td>
<td>dB from 30MHz riometer data</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>HF COM</td>
<td>Shortwave Fadeout (SWF)</td>
<td>Solar X-rays (0.1-0.8 nm) (W-m⁻²)</td>
<td>1x10⁻⁴ (X1)</td>
<td>1x10⁻³ (X10)</td>
</tr>
<tr>
<td>HF COM</td>
<td>Post-Storm Depression</td>
<td>MUF**</td>
<td>30%</td>
<td>50%</td>
</tr>
</tbody>
</table>
ICAO performs operational oversight and provides for inter-SWxC collaboration via Meteorology Panel. SWX Work Stream of the METP and SWxC Coordination Group hold regular meetings addressing issues, discussing development, harmonization and overall service improvement.

CRC provides harmonized and compliant products that meet all ICAO criteria. Specialists from Roshydromet, AMC and KMA participate in various technical and regulatory subgroups.
The primary instrument of the duty officer is the situation dashboard.
Russian segment of the CRC utilizes multiple data sources, models and data preprocessing to provide in-depth information to duty officers and forecasters.