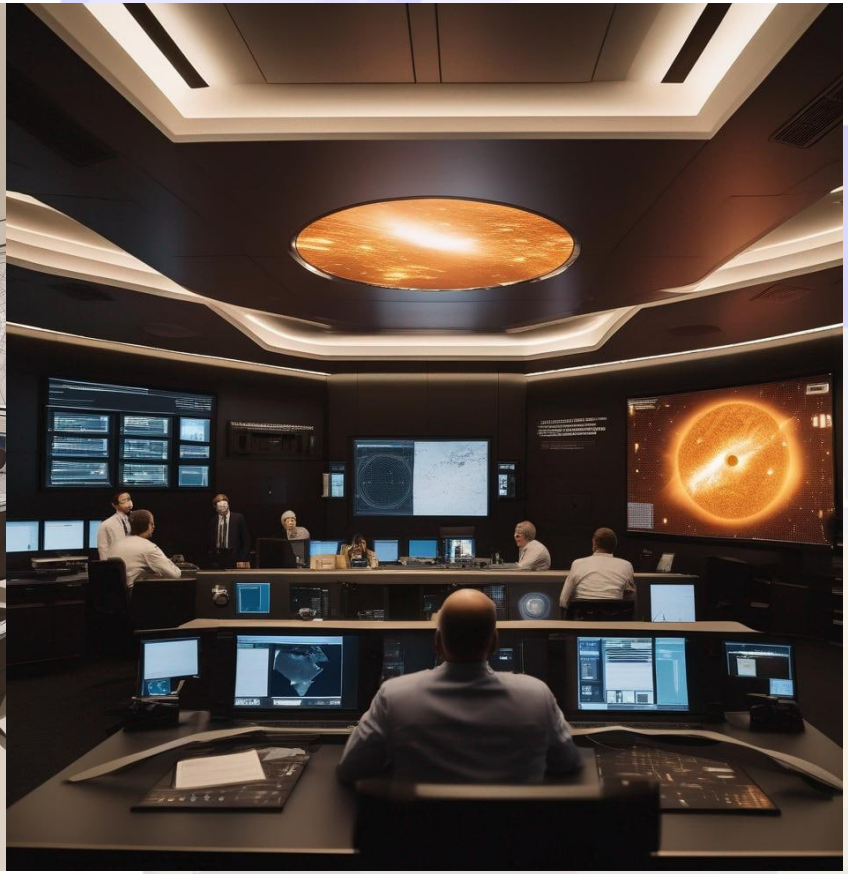
Operations summary of the Russian segment of the China-Russia Consortium

V. Burov, K. Kholodkov



Technical Session Presentation for the 61th Session of the Scientific and Technical

Images by Stable Diffusion

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

中俄联合体全球空间天气中心
Российско-китайский консорциум
Глобальный центр космической погоды
China-Russia Consortium
Global Space Weather Center

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.

РОСГИДРОМЕТ

CAAC

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

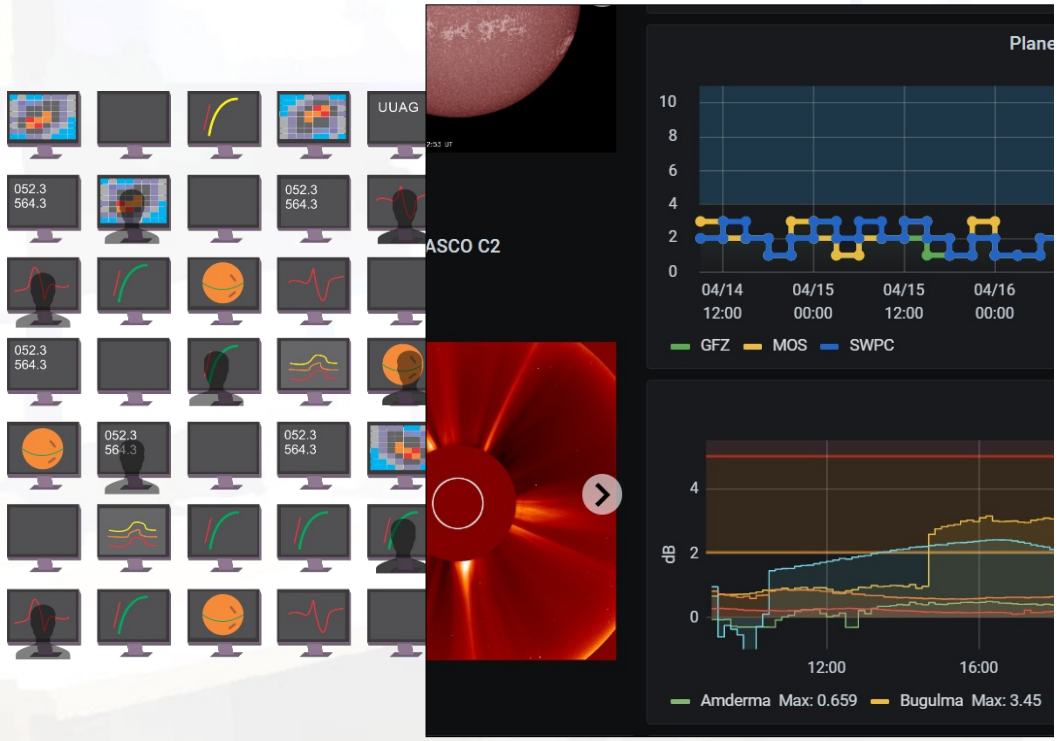
The implementation of space weather center services is a set of interconnected software components that receives and processes the observational data, calculates space weather parameters in accordance with the embedded models and provides conclusions based on specified criteria and threshold values.

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

Robot warning about the beginning of the X-ray burst on December 31, 2023

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.



Настройка сводки

Status: Operative | Test | Exercise

Report: First | Correction | Amendment

Effect: GNSS | HF Communication | Radiation **Severity:** Moderate | Severe

DTG: 20231031/1118Z

Nr: 2023/185 **FYI последние номера:** GNSS: 171 HF: 184 RAD: 10

Nr Rplc: *Оставить пустым если не используется*

Obs: 31/1118Z DAYLIGHT SIDE *Справка*

Forecast +6: 31/1718Z NO SWX EXP

Forecast +12: 31/2318Z NO SWX EXP

Forecast +18: 01/0518Z NO SWX EXP

Forecast +24: 01/1118Z NO SWX EXP

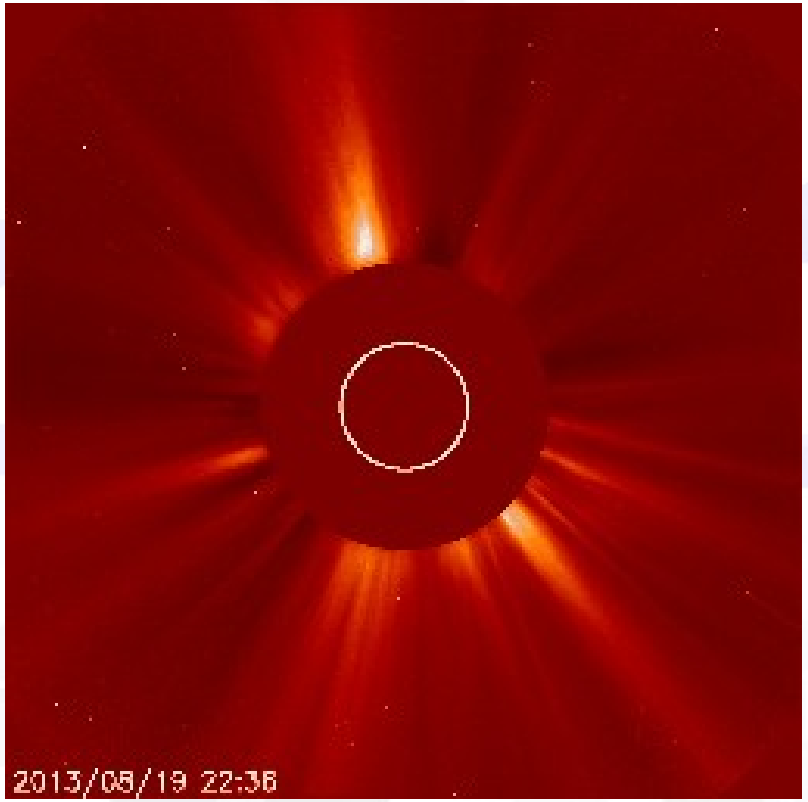
Rmk: SWX EVENT (SOLAR FLARE) INPR IMPACTING LOWER HF COM FREQ BAND ON THE DAYLIGHT SIDE

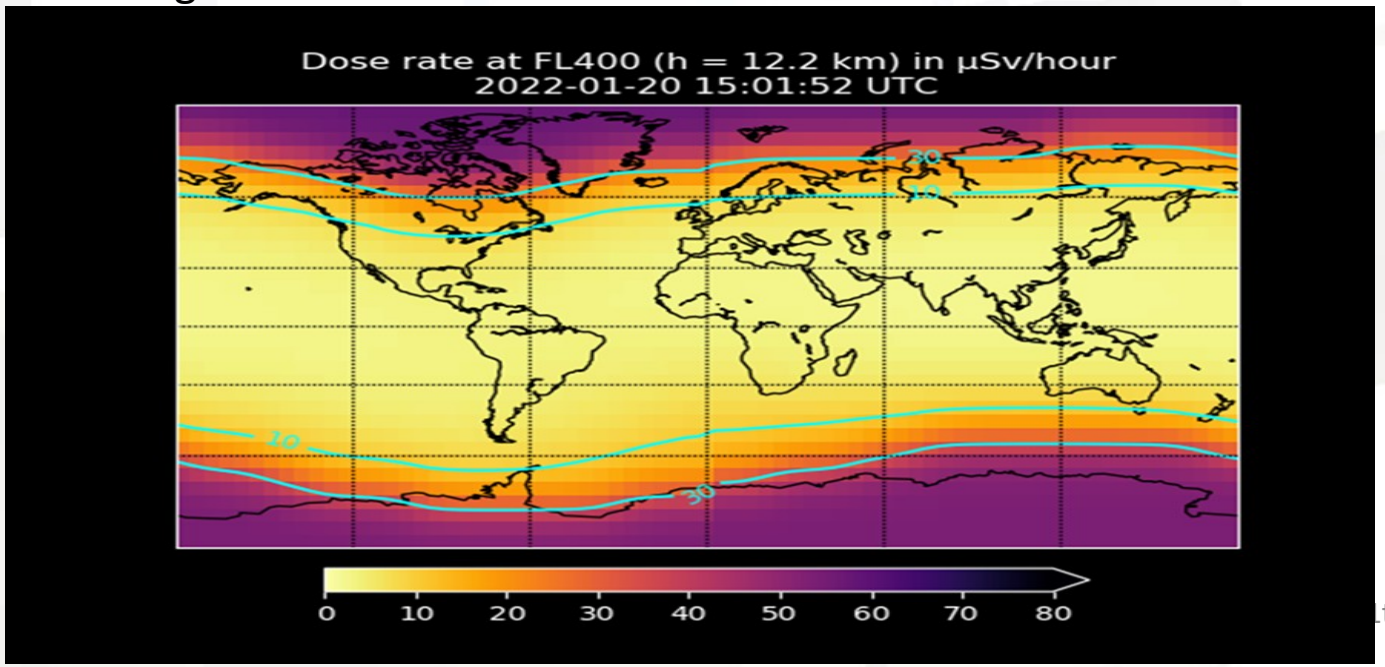
Nxt: WILL BE ISSUED BY 20231031/1718Z *YYYYMMDD/HHMMZ* NO FURTHER ADVISORIES

Составить сводку

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

Mamoru Ishii[1], Marcin Latocha[2], Peter Beck[2], Hazel Bain[3], Kyle Copeland[4], Yuki Kubo[1], Daikou Shiota[1], Philippe Yaya[5], Nicolas Fuller[6], Karl-Ludweg Klein[6], Vyacheslav Burov[7], Kirill Kholodkov[7], Yuri Ochilkov[7], Weiguo Zong[8], Machin Simon, Krista Hammond, Christopher Davis, Fan Lei, Ryden Keith

[1]National Institute of Information and Communications Technology, Japan

[2]Austrian Institute of Technology, Seibersdorf, Austria

[3]CIRES, Univeristy of Colorado Boulder, Boulder, Colorado, United States

[4]FAA Civil Aerospace Medical Institute, Oklahoma City, Oklahoma, United States

[5]Collecte Localisation Satellites , Saint-Agne, France

[6]Observatoire de Paris, LESIA, Meudon, France

[7]Fedorov Institute of Applied Geophysics, Moscow, Russia

[8]National Center for Sapce Weather, CMA, Beijing, China

Space weather service output in 2023

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

Effect	Sub-effect	Parameter used	Moderate	Severe
GNSS	Amplitude Scintillation	S4 (dimensionless)	0.5	0.8
GNSS	Phase Scintillation	Sigma-phi (radians)	0.4	0.7
GNSS	Vertical Total Electron Content (TEC)	TEC units	125	175
RADIATION		Effective dose rate (micro-Sieverts/hour)	30	80
HF COM	Auroral Absorption (AA)	Kp	8	9
HF COM	Polar Cap Absorption (PCA)	dB from 30MHz riometer data	2	5
HF COM	Shortwave Fadeout (SWF)	Solar X-rays (0.1-0.8 nm) ($W\text{-}m^{-2}$)	$1x10^{-4}$ (X1)	**$1x10^{-3}$ (X10)**
HF COM	Post-Storm Depression	MUF**	30%	50%

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.

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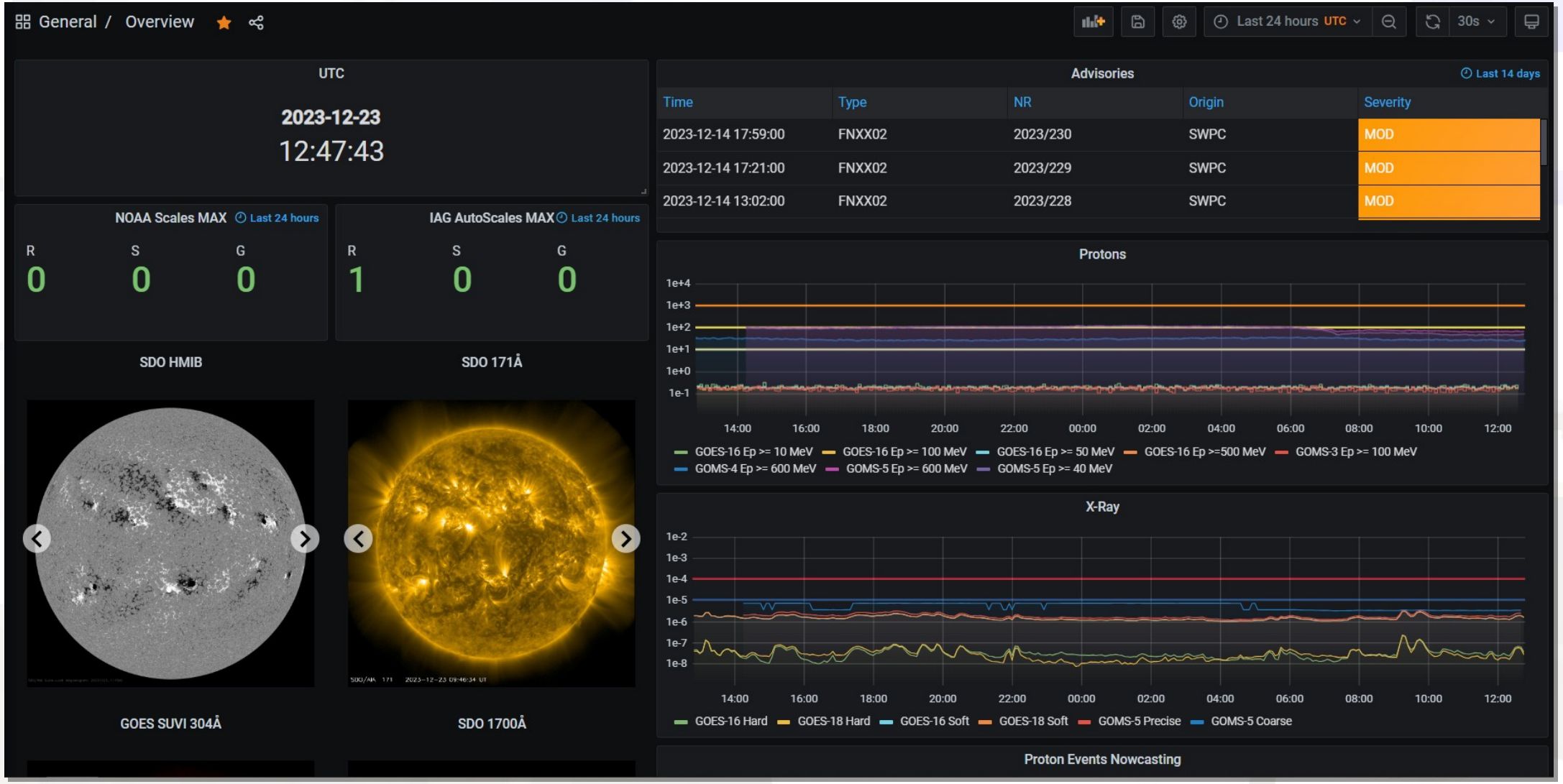
CRC provides harmonized and compliant products that meet all ICAO criteria.Specialists from Roshydromet, AMC and KMA participate in various technical and regulatory subgroups.

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