CGMS-53-ROSHYDROMET-WP-03
5 June 2025

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Agenda Item 3
Discussed at Plenary

Subject	**ROSHYDROMET UPDATES SINCE CGMS-52 AND REPORT ON THE MEDIUM TO LONG-TERM FUTURE PLANS ON EARTH OBSERVATION**
In response to CGMS action/recommendation	
HLPP reference	
Executive Summary	This document addresses the current status of the Russian satellite systems for hydrometeorology and heliogeophysics. Since CGMS-52 the Russian hydrometeorological satellite constellation has been increased by 2 polar-orbiting heliogeophysical satellites Ionosphere-M N1 and Ionosphere-M N2 launched on 5 November 2024 by group launch
Action/Recommendation proposed	

1 INTRODUCTION

The Russian hydrometeorological satellite constellation has been changed during the last year. Two polar-orbiting heliogeophysical satellites Ionosphere-M N1 and Ionosphere-M N2 were launched on 5 November 2024 by group launch from Vostochny cosmodrome.

According to the Russian Federal Space Program (2016–2025) the space system for hydrometeorology and environmental monitoring will consist of 4 polar orbit meteorological satellites, 3 geostationary meteorological satellites, 4 highly elliptical orbit satellites and 4 polar orbit heliogeophysical satellites destined for study of upper atmosphere, ionosphere and near-earth space.

The report shall cover the relevant ROSHYDROMET/ROSCOSMOS satellite systems of current and future GEO, LEO, HEO, satellite systems.

2 CURRENT SATELLITE SYSTEMS

Seven Russian meteorological satellites are now operational: Meteor-M N2-3, N2-4, Electro-L N2, N3, N4, Arctica-M N1, N2. Meteor-M N2-2 has been decommissioned since January 2025.

The satellite status in the WMO tables is updated below.

Mission	Operator(s)	Orbit	Launch	Instruments	Details
Arctica-M N1	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit, apogee longitude 25W, 155E	28/02/2021	MSU-GS, GGAK-VE, DSC	
Arctica-M N2	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit, apogee longitude 25W, 155E	16/12/2023	MSU-GS, GGAK-VE, DSC	
Electro-L N2	ROSHYDROMET /ROSCOSMOS	GEO, 14,5W	15/12/2015	MSU-GS, GGAK-VE, DSC, COSPAS-SARSAT, direct broadcast HRIT/LRIT	operating with limitations
Electro-L N3	ROSHYDROMET /ROSCOSMOS	GEO, 76E	24/12/2019	MSU-GS, GGAK-VE, DSC, COSPAS-SARSAT, direct broadcast HRIT/LRIT	
Electro-L N4	ROSHYDROMET /ROSCOSMOS	GEO, 165,8E	05/02/2023	MSU-GS, GGAK-VE, DSC, COSPAS-SARSAT, direct broadcast HRIT/LRIT	

Meteor-M N2-3	ROSHYDROMET /ROSCOSMOS	LEO, ECT 9:30 asc	27/06/2023	MSU-MR, MTVZA-GY, IKFS-2, KMSS, DCS, COSPAS-SARSAT, GGAK-M, METEOSAR	operating with limitations
Meteor-M N2-4	ROSHYDROMET /ROSCOSMOS	LEO, ECT 15:00 asc	29/02/2024	MSU-MR, MTVZA-GY, IKFS-2, KMSS, DCS, COSPAS-SARSAT, GGAK-M, METEOSAR	operating with limitations
Ionosphere-M N1, N2	ROSHYDROMET /ROSCOSMOS	LEO	5/11/2024	Instrument complex for study of upper atmosphere, ionosphere and near-earth space	

3 STATUS OF CURRENT GEO SATELLITE SYSTEMS

Now the Russian constellation of GEO meteorological satellites is fully deployed. Three satellites of Electro-L series are placed in 3 points 14,5W, 76E and 165,8E, approved by WMO in order to provide the coverage of the Atlantic, Indian and Pacific Ocean region.

3.1 Mission objectives, payload/instruments, products

Primary objectives of Electro-L mission:

- Continuous observation of the Earth within a radius of 55-60 degrees centered at the sub-satellite point;
- Simultaneous images of cloud cover and the Earth's surface in 10 visible and infrared channels;
- Heliogeophysical measurements at geostationary orbit altitudes;
- The development and maintaining the national data collection system (DCS), collection of the hydrometeorlogical data from national and international platforms (DCPs);
- Two way radio communication with DCPs;
- Retransmission of the data from Roshydromet regional centers;
- Data dissemination in HRIT/LRIT formats to national and foreign users.

Besides standard meteorological communication package (DCS and re-transmitters) the key payload consists of MSU-GS imager that provides data in three visible and seven IR channels. The spatial resolution at sub-satellite point is 1 km for visible and 4 km for IR channels. The period between scanning sessions for all channels is 30 min (regular operation) or 15 min (frequent mode). The MSU-GS instrument is manufactured by JSC "Russian Space Systems". The 7.5 GHz channel with of 30.72 Mbps data rate is used for raw data downlink.

GGAK Heliogeophysical Measurements Suite provides monitoring of the electromagnetic solar radiation, corpuscular radiation and terrestrial magnetic fields. The 1.7 GHz channel (5 Kbps data rate) is used for GGAK data transmitting.

Besides general downlink for the raw hydrometeorological data, there are also following retransmission channels onboard:

- DCP network data collection and retransmission channel;
- Two way radio communication with DCPs;
- Retransmission channel for hydrometeorological data exchange between regional Roshydromet centers;
- Channels for MSU-GS data dissemination in HRIT and LRIT formats;
- COSPAS-SARSAT Search & Rescue system.

3.2 Status of spacecraft

Electro-L N2 satellite is functional with limitation (12 mkm channel is absent).

Electro-L N3 satellite is functional without limitations.

Electro-L N4 satellite is functional without limitations.

3.3 Ground segment matters

Geographically Distributed System for Earth Monitoring from Space of Roshydromet as a part of Integrated Geographically Distributed Information System of Earth Remote Sensing (IGDIS ERS) is based on three SRC Planeta satellite centers, responsible for receiving, processing, disseminating and archiving of satellite data: European (Moscow-Obninsk-Dolgoprudny), Siberian (Novosibirsk) and Far-Eastern (Khabarovsk). These centers together provide Roshydromet and its users with full operational coverage of all the Russian Federation and neighboring territories.

The ground segment for Electro-L series satellites also includes the network of DCP, LRIT and HRIT stations.

Satellite data are also being received at Roscosmos facility in Moscow for the quality control purposes.

3.4 Data transmission

The Electro-L N2, N3 and N4 HRIT/LRIT data is being distributed via the land channels, including Internet channels, and also provided to EUMETSAT in near real time.

Additionally, the satellite is used for COSPAS-SARSAT Search & Rescue signal retransmission at 0.4/1.54 GHz waveband.

Russian DCS relies on Electro-L N3, N4 services and backed up by Luch-5B communication satellite. There are 698 DCPs currently deployed by Roshydromet. Those DCPs are being used at both manned and unmanned hydrometeorological stations all over Russian Federation, each usually operates 8 times a day, with an option for frequent mode (a message each 2 minutes, so called “storm” mode). Messages contain standard meteorological and hydrological measurements. Usage statistics for DCS is being accumulated and analysed at SRC Planeta, Moscow.

3.5 Projects, services

The list of services currently provided by Electro-L series satellites:

- Visible and IR imagery of MSU-GS instrument;
- DCS including 2-way communication with DCPs;
- GGAK Heliogeophysical Measurements Suite;
- COSPAS-SARSAT system.

3.6 User statistics

Electro-L N2, N3, N4 satellite data is currently used internally by Russian Hydrometeorological and Environmental Monitoring Service and also provided to EMERCOM, Ministry of Natural Resources and Environment and other federal and regional institutions of Russia.

4 STATUS OF CURRENT LEO SATELLITE SYSTEMS

Now the Russian constellation of LEO meteorological satellites consists of three Meteor-M series satellites. has been decommissioned since January 2025. Meteor-M N2-3 is located in a sun-synchronous “morning” orbit (820 km, ascending, equator crossing time ~ 9:30, inclination 98.8°). Meteor-M N2-4 is also located in a sun-synchronous “morning” orbit (820 km, ascending, equator crossing time ~ 9:30, inclination 98.8°). Both satellites are operational with limitations.

4.1 Mission objectives, payload/instruments, products

The main objective of Meteor-M mission is to provide global observations of the Earth’s surface and the atmosphere. The data acquired by the satellite is used for the following purposes:

- Weather analysis and forecasting on global and regional scales;

- Global climate change monitoring;
- Sea surface observations;
- Space weather analysis and prediction (solar wind, ionosphere research, Earth's magnetic field, etc.).

Meteor-M N2-3, N2-4 payload includes:

- MSU-MR Scanning Radiometer (1 km spatial resolution multichannel scanning unit, 6 channels, VIS/IR);
- KMSS VIS Scanning Imager (6 channels implemented by 3 cameras, 50 m and 100 m spatial resolution);
- METEOSAR X-band Synthetic Aperture Radar;
- MTVZA-GY Imaging/Sounding Microwave Radiometer (module for temperature and humidity sounding of the atmosphere, 26 channels, 10.6-183 GHz);
- IKFS-2 - IR Fourier-transform spectrometer (IR atmospheric sounder, spectral range 5-15 mkm, spectral resolution ~ 0.5 cm^{-1});
- GGAK-M Heliogeophysical Measurements Suite;
- Data collection system (DCS).

Meteor-M N2-3, N2-4 have three downlink radio lines:

- 2-channel X-band radio link (8.192 GHz and 8.320 GHz) with 122.88 Mbps data transmission rate in each channel;
- L-band radio link (1.7 GHz) with 665.4 Kbps data transmission rate (HRPT data transmission);
- VHF-band radio link (137 MHz) with 80 Kbps data transmission rate (LRPT data transmission).

4.2 Status of spacecraft

Meteor-M N2-3 and N2-4 are operational with limitations. METEOSAR on Meteor-M N2-4 is operational only separately of other payload.

4.3 Ground segment matters

Geographically Distributed System for Earth Monitoring from Space of Roshydromet as a part of IGDIS ERS is based on three SRC Planeta satellite centers, responsible for receiving, processing, disseminating and archiving of satellite data: European (Moscow-Obninsk-Dolgoprudny), Siberian (Novosibirsk) and Far-Eastern (Khabarovsk). These centers together provide Roshydromet and its users with full operational coverage of all the Russian Federation and neighboring territories with the lowest possible latency.

Core ground segment for Meteor-M series satellites is located at SRC Planeta facilities. It also includes the network of DCS, LRPT and HRPT stations. Data acquisition and processing are also performed by Roscosmos operational facility in Moscow.

4.4 Data transmission

Global data X-band downlink is used for Roshydromet purposes only (raw data dumps over the SRC Planeta centers).

The direct broadcast is operational in L-band in HRPT-like format. The detailed format description is published at SRC Planeta WEB-site.

The preprocessed data is also distributed to Roshydromet users via SRC Planeta FTP server.

4.5 Projects, services

The list of services currently provided by the Meteor-M N2-3 and N2-4 satellites:

- Visible and IR low resolution imagery (MSU-MR);
- Moderate resolution visible imagery (KMSS);
- METEOSAR radar imagery;
- Heliogeophysical data (GGAK-M).

Meteor-M N2-3, N2-4 data is used for cloudiness mapping, disaster monitoring such as floods and forest fires, as well as sea ice and water pollution monitoring, space weather monitoring etc.

4.6 User statistics

Meteor-M N2-3, N2-4 satellite data is currently used internally by Russian Hydrometeorological and Environmental Monitoring Service and also provided to EMERCOM, Ministry of Natural Resources and Environment and other federal and regional institutions of Russia.

5 STATUS OF CURRENT HEO SATELLITE SYSTEMS

Arctica-M N1 satellite is successfully functioning since its input in regular operation in September 2021 and provides observations over the Arctic and contiguous region every 15 min daily within two six-hour time frames successively from eastern (over Kamchatka) and western (over Iceland) orbit working sections. Arctica-M N2 satellite was set in regular operation in April 2024 and operates within other six-hour time frames, thus providing continuous observations of Arctic region from 2 HEO satellites.

5.1 Mission objectives, payload/instruments, products

The main purposes of the mission are meteorology, oceanography, including ice cover monitoring and disaster monitoring in the Arctic and contiguous region. To perform operational monitoring of polar regions 24 hours a day each of two satellites is covering

the area for ~6 hours and then step back for the next one. The repeat cycle time for each satellite is exactly 12 hours. The payload and general design of the satellites are similar to those of Russian geostationary satellites.

The essential feature of Arctica system spacecraft is their mass and power reserves, potentially allows adding various types of complementary instruments.

Primary objectives of Arctica-M mission:

- Continuous observation of Arctic and contiguous region;
- Simultaneous images of cloud cover and the Earth's surface in 10 visible and infrared channels;
- Heliogeophysical measurements at orbit altitudes (electromagnetic solar radiation, corpuscular radiation and terrestrial magnetic fields);
- The development and maintaining the national data collection system (DCS), collection of the hydrometeorlogical data from national and international platforms (DCPs);
- Two-way radio communication with stations of Roshydromet hydrometeorlogical network;

Arctica-M N1 and N2 payload includes:

- MSU-GS imager in 3 visible channels (1 km spatial resolution) and 7 IR channels (4 km spatial resolution);
- GGAK-VE Heliogeophysical Measurements Suite;
- Data collection system (DCS).

5.2 Status of spacecraft

Both Arctica-M N1 and N2 satellites are functional without limitations.

5.3 Ground segment matters

The ground segment for Arctica constellation is based on SRC Planeta/Roshydromet satellite centers, responsible for receiving, processing, disseminating and archiving of satellite data: European (Moscow, Obninsk), Siberian (Novosibirsk) and Far-Eastern (Khabarovsk).

5.4 Data transmission

Data transmission system of Arctica satellites will consist of:

- X-band downlink with data transmission rate of 30.72 Mbit/s;
- L-band downlink especially for the GGAK instrument with data transmission rate of 5000 bit/s;
- DCS retransmission support at 401-403 MHz / 1.7 GHz.

5.5 Projects, services

The list of services currently provided by Arctica-M N1, N2 satellites:

- Visible and IR imagery of MSU-GS instrument;
- GGAK Heliogeophysical Measurements Suite;
- DCS;
- Two-way radio communication with stations of Roshydromet hydrometeorlogical network;

5.6 User statistics

Arctica-M N1 satellite data is currently used internally by Russian Hydrometeorological and Environmental Monitoring Service and also provided to EMERCOM, Ministry of Natural Resources and Environment and other federal and regional institutions of Russia.

6 FUTURE SATELLITE SYSTEMS

Mission	Operator(s)	Orbit	Launch planned	Instruments
Arctica-M N3, N4	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit, apogee longitude 25W, 155E	2029	MSU-GS/HE, GGAK-VE, DSC
Acktica-M N5, N6	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit, apogee longitude 25W, 155E	2030	
Arctica-M N7, N8	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit, apogee longitude 25W, 155E	2034	
Electro-L N5	ROSHYDROMET /ROSCOSMOS	GEO, standing point 77E	2025	MSU-GS, GGAK-VE, DSC, COSPAS-SARSAT, direct broadcast HRIT/LRIT
Electro-L N6	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	2030	
Electro-L N7	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	2032	
Electro-M N1	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	2033	MSU-GSM imager with ~20 channels, hyperspectral sounder IKFS-GS, lightning detector, radiation balance radiometer, heliogeophysical complex KGI, DSC, COSPAS-SARSAT, direct broadcast HRIT/LRIT
Electro-M N2	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	2034	
Meteor-M N2-5	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	2027	MSU-MR, MTVZA-GY, IKFS-2, KMSS, DCS, METEOSAR, GGAK-M2, COSPAS-SARSAT
Meteor-M N2-6	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	2028	

Meteor-M N2-7	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	2032	
Meteor-M N2-8	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	2033	
Meteor-MP N1	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	>2033	MSU-MR-MP, MTVZA-MP, IKFS-3, atmosphere gas content spectrometer SA-MP, scatterometer SCAT-MP, radio occultation sounder ARMA-MP, heliogeophysical complex KGI-MP, DCS, COSPAS-SARSAT
Ionosphere-M N3, N4	ROSHYDROMET /ROSCOSMOS	LEO	July 2025	Instrument complex for study of upper atmosphere, ionosphere and near-earth space

7 STATUS OF FUTURE GEO SATELLITE SYSTEMS

7.1 Mission objectives, spacecraft, payload/instruments, products

Primary objectives of GEO satellite missions:

- Continuous observation of the Earth within a radius of 55-60 degrees centered at the sub-satellite point;
- Simultaneous images of cloud cover and the Earth's surface in 10 visible and infrared channels;
- The development and maintaining DCS, collection of the hydrometeorological data from national and international platforms;
- Retransmission of the data from Roshydromet regional centers;
- Heliogeophysical measurements at geostationary orbit altitudes;
- Data dissemination in HRIT/LRIT formats to national and foreign users.

Besides standard meteorological communication package (DCS and retransmitters) the key payload will consist of MSU-GS imager which provides data in three visible and seven IR channels. The spatial resolution at the sub-satellite point is 1 km for visible and 4 km for IR channels. The regular period between scanning sessions for all channels is 30 min or 15 min in frequent mode. The instrument is manufactured by JSC "Russian Space Systems". The 7.5 GHz channel with data rate of 30.72 Mbps is used for raw MSU-GS data downlink.

GGAK Heliogeophysical Measurements Suite provides monitoring of the electromagnetic solar radiation, corpuscular radiation and terrestrial magnetic fields. The separate 1.7 GHz channel (5 Kbps data rate) is used for GGAK data downlink.

Besides general downlink for the raw hydrometeorological data, there are also following retransmission channels onboard:

- DCP network data collection and retransmission channel;

- Retransmission channel for hydrometeorological data exchange between regional Roshydromet centers;
- Channels for MSU-GS data dissemination in HRIT and LRIT formats;
- COSPAS-SARSAT Search & Rescue system.

7.2 Ground segment matters

Electro-L N5, N6 and N7 ground segment will be jointly developed by Roshydromet and Roscosmos. Core ground segment for Electro-L satellites will be based on SRC Planeta facilities. The ground segment will also include the network of DCP, LRIT and HRIT stations.

7.3 Data transmission

Electro-L N5, N6 and N7 HRIT/LRIT channels will be used for the data transmission in L-band every 30 min. Additionally, the satellite will support COSPAS-SARSAT Search and Rescue system at 0.4/1.54 GHz.

8 STATUS OF FUTURE LEO SATELLITE SYSTEMS

According to the Russian Federal Space Program (2016–2025) the polar-orbiting satellites system should consist of three hydrometeorological and one oceanographic satellites.

It is planned to launch serial Meteor-M N2-5, N2-6, N2-7, and N2-8 satellites with the same payload as Meteor-M N2-3 and N2-4. The goal is to create a constellation of identical operational meteorological satellites in morning and afternoon orbits. These satellites are to be manufactured by JSC “VNIIEM Corporation”. Starting from Meteor N2-3 among the payload there will be METEOSAR and modified Heliogeophysical Measurements Suite GGAK-M2.

8.1 Mission objectives, spacecraft, payload/instruments, products

The main objective of Meteor-M mission is to provide global observations of the Earth’s surface and the atmosphere. The data acquired by the satellite is used for the following purposes:

- Weather analysis and forecasting on global and regional scales;
- Global climate change monitoring;
- Sea surface observations;
- Sea ice observations;
- Disaster monitoring;
- Space weather analysis and prediction (solar wind, ionosphere research, Earth's magnetic field, etc.).

Meteor-M N2-5 – N2-8 payload will be similar to Meteor-M N2-3 and N2-4. For next generation Meteor-MP series it is planned to add scatterometer, radio-occultation sounding unit, atmosphere gas content spectrometer and increase the number of MSU-MR channels to 20.

8.2 Ground segment matters

The ground segment for Meteor-M constellation should be based on SRC Planeta/Roshydromet facilities in Moscow, Novosibirsk and Khabarovsk and Roscosmos facility in Moscow.

8.3 Data transmission

Global data X-band downlink will be used for Roshydromet purposes only (raw data dumps over the SRC Planeta centers). The direct broadcast will be operational in L-band in HRPT-like format.

9 STATUS OF FUTURE HEO SATELLITE SYSTEMS

The launch of the next Arctica-M satellites is scheduled in 2029 and later. The system of 4 spacecrafts will provide 24-hour frequent observations similar to geostationary satellites, but over the Arctic region simultaneously from 2 viewpoints.

9.1 Mission objectives, spacecraft, payload/instruments, products

The main purposes of the mission are meteorology, oceanography, including ice cover monitoring and disaster monitoring in the Arctic region. To perform operational monitoring of polar regions from 2 viewpoints 24 hours a day each of four satellites will be covering the area for 6.4 hours and then step back for the next one. The repeat cycle time for each satellite is exactly 12 hours. The payload and general design of the satellites are similar to Electro-L series.

The essential feature of Arctica system spacecraft is their mass and power reserves, potentially allows adding various types of complementary instruments, including international ones if agreed upon.

9.2 Ground segment matters

The ground segment for Arctica constellation should be based on SRC Planeta/Roshydromet facilities in Moscow, Novosibirsk and Khabarovsk.

9.3 Data transmission

Data transmission system of Arctica satellites will consist of:

- X-band downlink with data transmission rate of 30.72 Mbit/s;
- L-band downlink especially for the GGAK instrument with data transmission rate of 5000 bit/s;
- DCS retransmission support at 401-403 MHz / 1.7 GHz.

10 ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION BY CGMS PLENARY SESSION

No actions and/or recommendations for consideration by CGMS plenary session are proposed.

11 CONCLUSIONS

Russian Federation is currently developing a national constellation of both geostationary and polar orbiting meteorological satellites. It is complemented by the satellites at highly elliptical “Molnya” type orbits for frequent coverage of the northern areas.