

ROSHYDROMET/ROSCOSMOS updates since CGMS-51 and report on the medium to long-term future plans on earth observation

Presented to CGMS-52 plenary session, agenda item 3

Executive summary

Since CGMS-51 the Russian hydrometeorological satellite constellation has been increased by highly elliptical orbit meteorological satellite Arktika-M N2 launched on 16 December 2023 and 2 polar-orbiting meteorological satellites of Meteor-M series launched on 27 June 2023 (N2-3) and 29 February 2024 (N2-4).

Overview - Planning of ROSHYDROMET/ROSCOSMOS satellite systems



CURRENT GEO SATELLITES

- Elektro-L constellation standing points:
 - 14,5°W – Elektro-L N2
 - 76°E – Elektro-L N3
 - 165,8°E – Elektro-L N4

- Instrument payload:
 - MSU-GS imager
 - Heliogeophysical complex GGAK-VE
 - Data collection system
 - COSPAS-SARSAT system
 - direct broadcast HRIT/LRIT

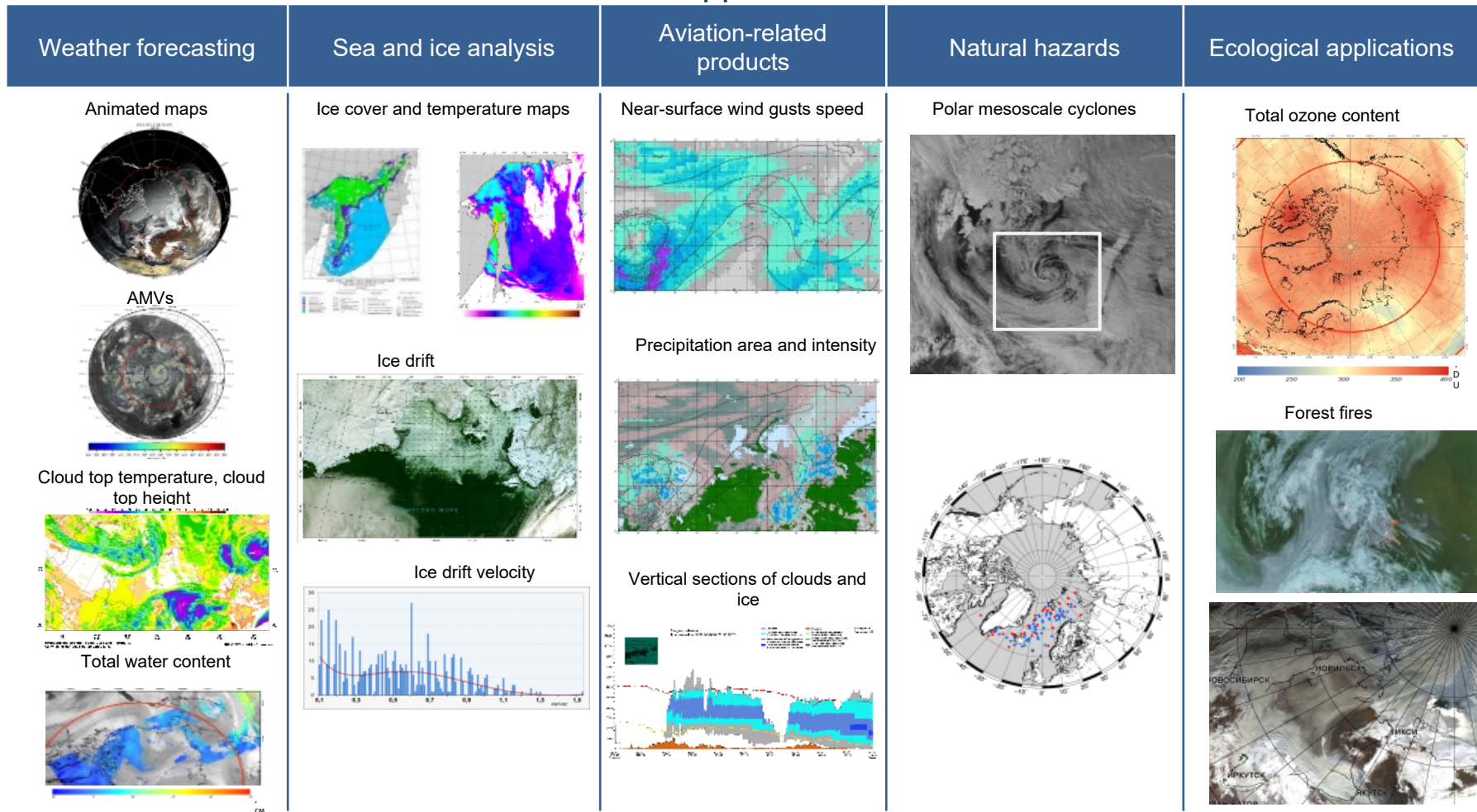
- Objectives of Elektro-L mission:
 - Continuous observation of the Earth disc within a radius of 55-60 degrees centered at the sub-satellite point;
 - Simultaneous images of cloud cover and the Earth's surface in 3 visible and 7 infrared channels;
 - Heliogeophysical measurements at geostationary orbit altitudes;
 - Collection and retransmission of the hydrometeorological data from national international platforms (DCPs);
 - Retransmission of the data from Roshydromet regional centers;
 - Data dissemination in HRIT/LRIT formats to national and foreign users

CURRENT HEO SATELLITES

- The main purposes of the mission Arktika-M are meteorology, oceanography, including ice cover monitoring and disaster monitoring in the Arctic 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
- Primary objectives of Arktika-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 (Elektromagnetic solar radiation, corpuscular radiation and terrestrial magnetic fields)
 - The development and maintaining the national data collection system, collection of the hydrometeorological data from national and international platforms
 - Two-way radio communication with stations of Roshydromet hydrometeorological network

CURRENT HEO SATELLITES

Arktika-M applications

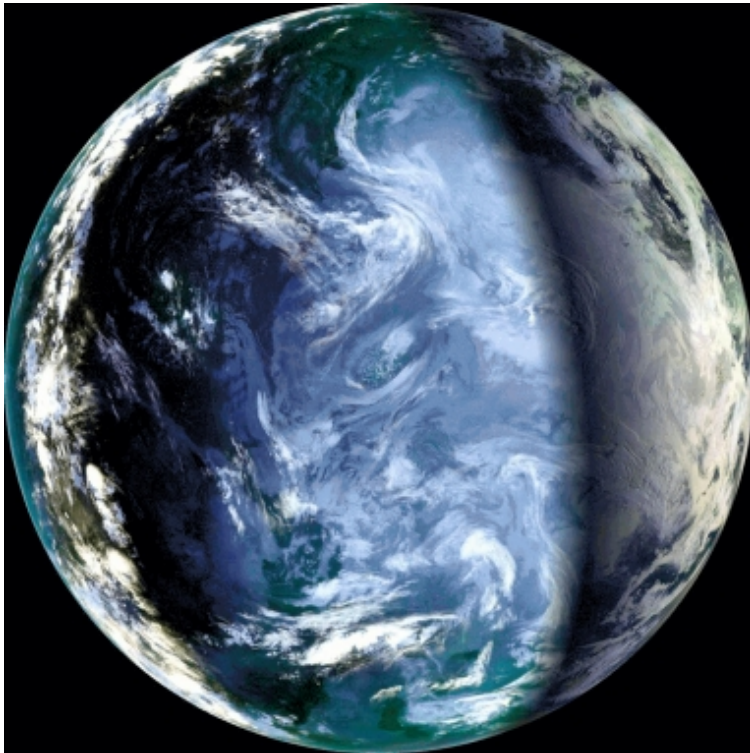


CURRENT HEO SATELLITES

- Arktika-M N1 and N2 payload is similar to those of Russian geostationary satellites and includes:
 - MSU-GS/VE imager in 3 visible channels (1 km spatial resolution) and 7 IR channels (4 km spatial resolution)
 - GGAH-VE Heliogeophysical Measurements Suite
 - Data collection system (DCS)
- Both Arktika-M N1 and N2 satellites are functional without limitations
- The ground segment for Arktika-M 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)

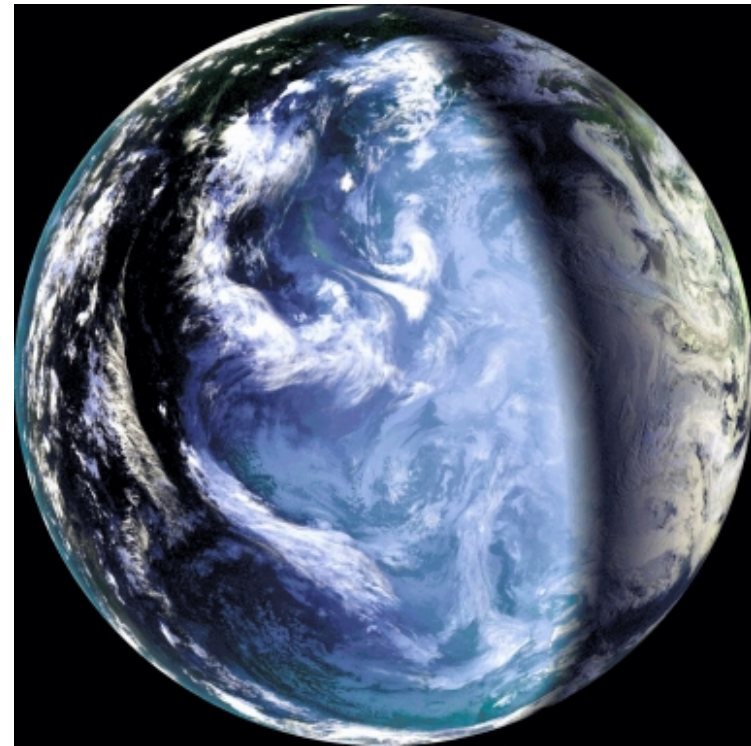
CURRENT HEO SATELLITES

Animated maps in VIS/IR based on Arktika-M N1 & N2 data allows to track the evolution of clouds in the day and night zones



"Western" pass

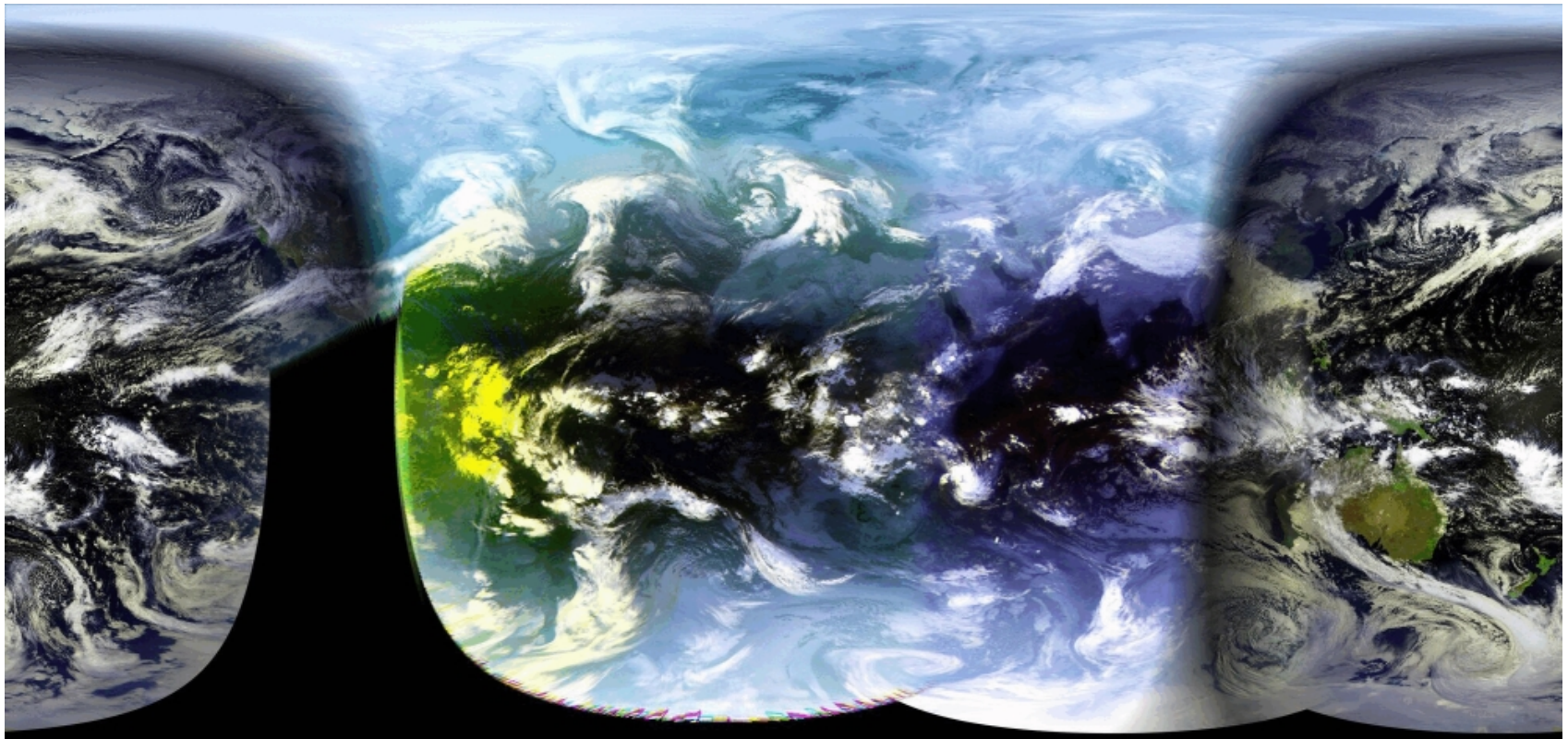
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"Eastern" pass

CURRENT GEO/HEO SATELLITES

Global cloud animation combined of 3 Elektro-L and 2 Arktika-M VIS & IR data.

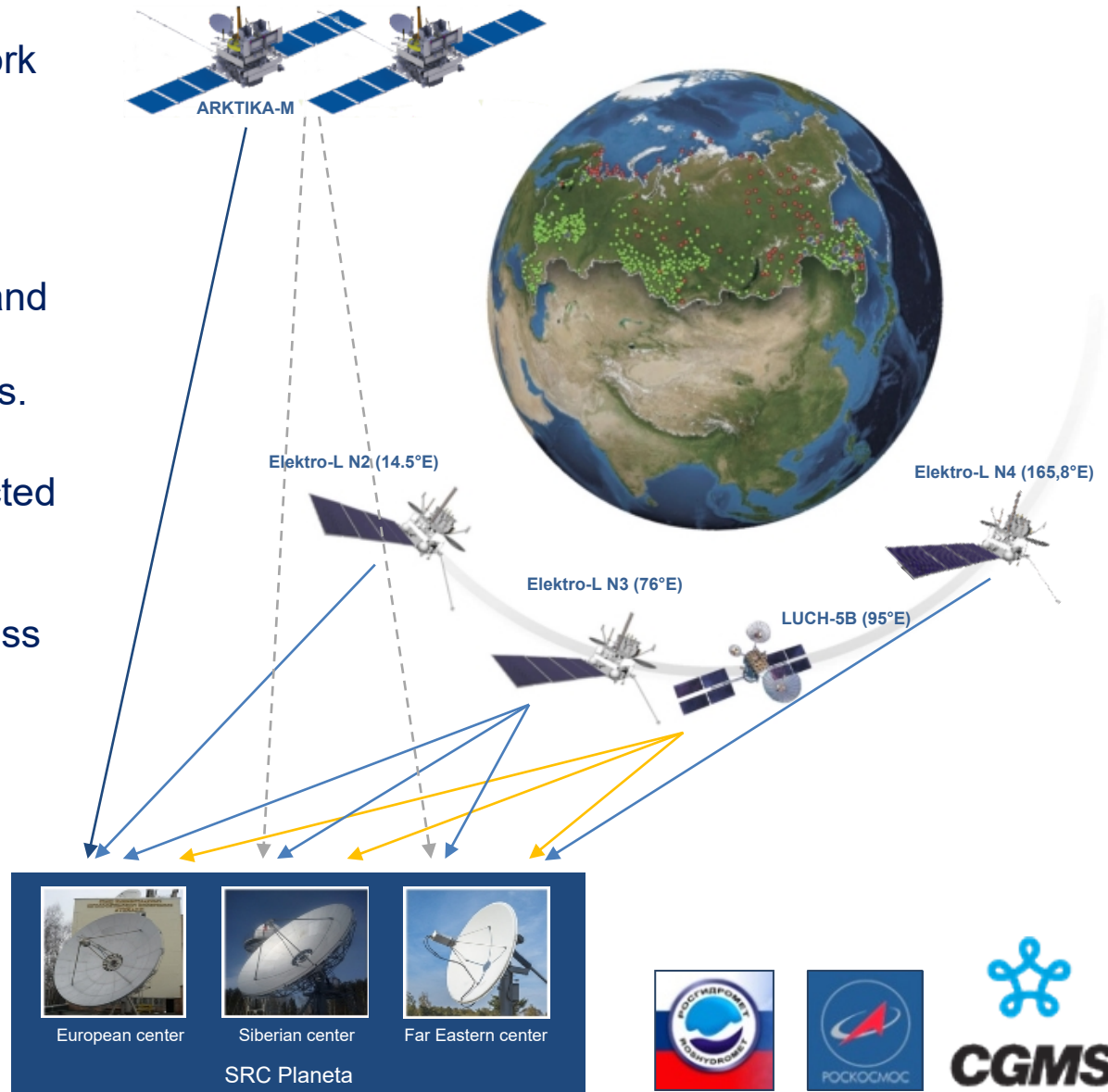


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CURRENT GEO/HEO SATELLITES

DCS comprises of the network of DCPs at Roshydromet's observational sites, relay transponders at Russian satellites of 3 Elektro-L, 2 Arktika-M and Luch series, and ground receiving stations at SRC Planeta satellite centers.

Data is currently being collected from 696 Roshydromet's observation network (●●●), including 141 difficult to access stations (●).



CURRENT LEO SATELLITES

- Two Meteor-M series satellites are now operational on sun-synchronous orbit with ~820 km height, 98.8° inclination:
 - Meteor-M N2-2 - “afternoon” orbit, ascending equator crossing time ~ 15:00
 - Meteor-M N2-3 - “morning” orbit, ascending equator crossing time ~ 9:30
 - Meteor-M N2-4 - “afternoon” orbit, ascending equator crossing time ~ 15:00
- Instrument payload operational for now:
 - 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);
 - 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);
 - MeteoSAR X-band Synthetic Aperture Radar (onboard only Meteor-M N3 and N2-4);
 - GGAK-M Heliogeophysical Measurements Suite;
 - Data collection system (DCS)
 - COSPAS-SARSAT system

CURRENT LEO SATELLITES

- The main objective of Meteor-M mission is to provide global observations of the Earth's surface and the atmosphere 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 N2-2, N2-3, N2-4 has 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 (not operational on Meteor-M N2-3)
 - 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).

CURRENT LEO SATELLITES

➤ Status of spacecraft:

Meteor-M N2-2 is operational with limitations. MSU-MR, KMSS and GGAK-M (with limitations) are functional. MTVZA-GY, IKFS-2 and DSC are not functional.

Meteor-M N2-3 is operational with limitations. Due to failure of X-band radio link the transmission of global data and SAR data is not carried out.

Meteor-M N2-4 is under commissioning phase

➤ Meteor-M LEO constellation is planned to consist of 4 spacecrafts to provide meteorological data over Russian Federation at least 8 times per day at synoptic time

FUTURE GEO SATELLITES

Mission	Operator(s)	Orbit	Launch planned	Instruments
Elektro-L N5	ROSHYDROMET /ROSCOSMOS	GEO, standing point 119E	2025	<ul style="list-style-type: none"> - MSU-GS, - GGAK-VE, - DSC, - COSPAS-SARSAT, - direct broadcast HRIT/LRIT
Elektro-L N6	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	2029	
Elektro-L N7	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	2033	
Elektro-M N1-1	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	>2031	<ul style="list-style-type: none"> - 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
Elektro-M N1-2	ROSHYDROMET /ROSCOSMOS	GEO, standing point TBD	>2032	

- Elektro-L N5, 6 and 7 are the serial satellites planned to maintain the current constellation
- New generation GEO satellite series Elektro-M with extended useful payload is planned to start after 2031

FUTURE LEO SATELLITES

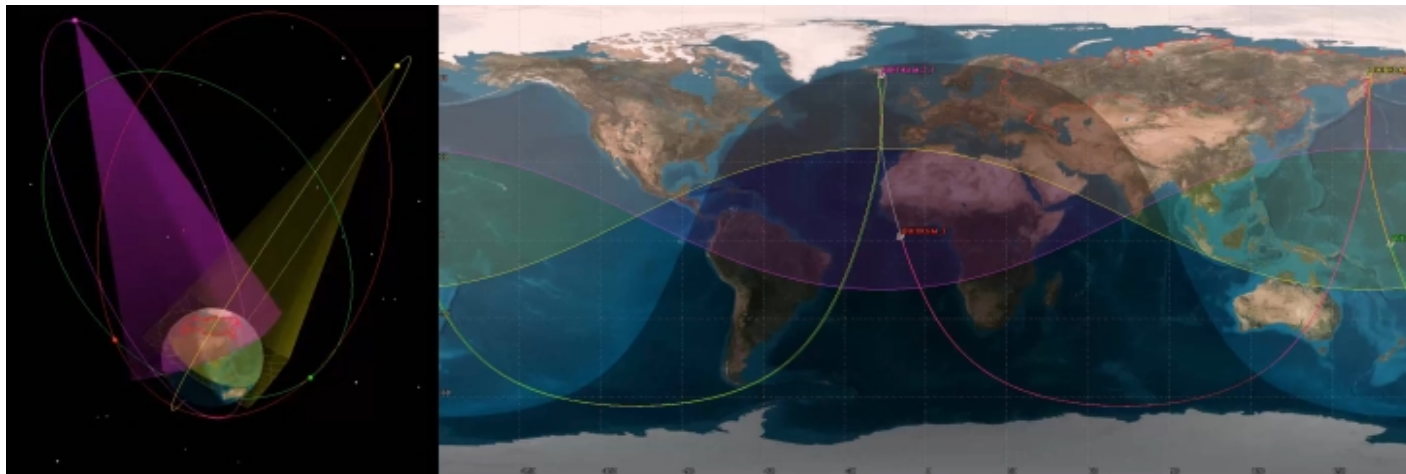
Mission	Operator(s)	Orbit	Launch planned	Instruments
Meteor-M N2-5	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	2025	<ul style="list-style-type: none"> • MSU-MR • MTVZA-GY • IKFS-2 • KMSS • DCS
Meteor-M N2-6	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	2025	<ul style="list-style-type: none"> • MeteoSAR • GGAK-M2 • dissemination HRIT/LRIT • COSPAS-SARSAT
Meteor-MP N1	ROSHYDROMET /ROSCOSMOS	LEO, ECT TBD	>2032	<ul style="list-style-type: none"> • MSU-MR-MP (20 channels) • MTVZA-MP • IKFS-3 • SA-MP • SCAT-MP • ARMA-MP • KGI-MP • DCS • dissemination HRIT/LRIT • COSPAS-SARSAT

- Meteor-M N2-5, N2-6 will be serial identic satellites to form LEO constellation
- Meteor-MP will start next generation LEO constellation with improved characteristic and new payload incl. scatterometer, radio occultation sounding, greenhouse gas spectrometer

FUTURE HEO SATELLITES

Mission	Operator(s)	Orbit	Launch planned	Instruments
Arktika-M N3	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit	TBD	<ul style="list-style-type: none"> • MSU-GS/HE • GGAK-VE • DSC
Arktika-M N4	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit	TBD	
Arktika-M N5	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit	TBD	
Arktika-M N6	ROSHYDROMET /ROSCOSMOS	HEO Molnya Orbit	TBD	

- The HEO constellation of 4 spacecraft will allow to double the periodicity of observation from two angles



Thanks for attention!

