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REPORT ON THE STATUS OF CURRENT AND FUTURE RUSSIAN SATELLITE SYSTEMS

This document addresses the current status of the Russian satellite systems: Meteor-M N2 polar-orbiting meteorological satellite (launched on July 8th, 2014), Electro-L N1 & N2 geostationary meteorological satellites (launched on January 20th, 2011 & December 11th, 2015 respectively).

Future Russian geostationary meteorological constellation will consist of three Electro-L series satellites. The satellites will be placed at 14,5W, 76E and 166E orbital positions. The mission objectives, payload and ground segment details are presented.

Working paper provides an overview of future Meteor-3M polar-orbiting satellite system, which will comprise of three meteorological and one oceanographic satellites; the next generation series of Meteor-MP satellites is briefly described.

Arctica-M constellation of highly elliptical orbit satellites is now under development. The system consists of two spacecrafts. These satellites will provide continuous observations over the Arctic region. The launch is scheduled for 2017–2019. An overview of the mission objectives, payload and ground segment details are presented.

STATUS OF CURRENT AND FUTURE RUSSIAN SATELLITE SYSTEMS

1 INTRODUCTION

According to the Russian Federal Space Program (2016–2025) the space system for hydrometeorological and environmental monitoring will consist of three polar-orbiting meteorological and one oceanographic satellites, three geostationary meteorological satellites and two highly elliptical orbit satellites. Currently, two spacecrafts of Meteor-M and Electro-L series have been already launched – Meteor-M N1, N2 (2009 and 2014) and Electro-L N1, N2 (2011 and 2015).

Meteor-M N1 satellite have reached the end of designed lifespan (5 years), but not yet finally decommissioned. Some instruments are still functioning and the restricted exploitation of the satellite is now being continued. Meteor-M N2 satellite is fully operational. Electro-L N1 satellite now operates in the degraded mode due to technical issues onboard. Electro-L N2 satellite performance is now being evaluated during the commissioning phase. Ground segment matters as well as data transmission details, projects and services are also presented.

Details on the next satellites of Meteor-M series and their payload, including oceanographic satellite Meteor-M N3, together with forthcoming next generation Meteor-MP series satellites are provided.

A constellation of Electro-L geostationary satellites to be located at 14.5W, 76E and 166E is presented.

Arctica-M project of two highly elliptical orbit satellites is also presented. It will provide observations similar to geostationary satellites, but over the Arctic region. The payload of Arctica-M satellites should be similar to Electro-L series.

2 CURRENT SATELLITE SYSTEMS

There are three meteorological satellites currently in orbit (disregarding deficient Meteor-M N1, which is out of the lifespan): one polar-orbiting and two geostationary. The satellite status in the WMO tables is updated below.

Current GEO satellites contributing to the GOS

Sector	Satellite in orbit	Operator	Location	Launch date	Details on near real time access	Instrument payload
Indian Ocean (36°E-108°E)	Electro-L N1	Russian Federation /Roshydromet	76E	20/01/2011	HRIT/LRIT specification	MSU-GS, HMS (GGAK), DCS, GeoSAR. Direct broadcast HRIT, LRIT

Indian Ocean (36°E-108°E)	Electro-L N2	Russian Federation /Roshydromet	77.8E	15/12/2015	HRIT/LRIT specification	MSU-GS, HMS (GGAK), DCS, GeoSAR. Direct broadcast HRIT, LRIT

Current LEO satellites contributing to the GOS

Orbit type	Satellite in orbit	Operator	Equator Crossing Time	Mean Alti-tude	Launch date	Details on near real time access	Instrument payload
Sun-synchronous "Morning" orbit ECT between 19:00-24:00 and between 07:00-12:00	Meteor-M N2	Russian Federation /Roshydro met	09:30	820 km	08/07/2014	Signal structure	MSU-MR, MTVZA, IKFS-2, KMSS, Severjanin, GGAK-M. Dissemination: HRPT, LRPT

2.1 Status of current GEO satellite systems

According to the Russian Federal Space Program the Electro-L N1 geostationary meteorological satellite has been located at 76E. Due to technical issues onboard (orientation system partial malfunction), the satellite now operates in the degraded mode. In order to provide the coverage of the Indian Ocean region the newly launched Electro-L N2 geostationary meteorological satellite has been placed at 77.8E orbital position (now the satellite undergoes the commissioning phase).

2.1.1 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;
- The development and maintaining the national data collection system (DCS), collection of the hydrometeorlogical data from national and international platforms (DCPs);
- 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 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;
- 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.

2.1.2 Status of spacecraft

The current status of Electro-L N1 satellite:

- The MSU-GS instrument operates in the degraded mode;
- The DCS is fully functional (300 national channels and 33 international channels);
- The COSPAS-SARSAT system is functional;
- The GGAK instrument operates with significant limitations;
- The HRIT/LRIT channels are functional, but data dissemination is now suspended;
- When available, the data in HRIT format is distributed via SRC Planeta FTP server.

Electro-L N2 is now undergo the commissioning phase. Further details will be available after thorough evaluation.

2.1.3 Impact on spacecraft due to space weather

Impact on spacecraft due to space weather was not positively established.

2.1.4 Ground segment matters

Roshydromet ground segment is based on three SRC Planeta regional 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.

Roshydromet ground segment for Electro-L series satellites is located at SRC Planeta facilities. The receiving stations together with retransmission systems are located in European center (Moscow-Dolgoprudny) and Siberian center (Novosibirsk). The deployment of the receiving system in the Far-Eastern center (Khabarovsk) is underway. The scheduling for MSU-GS instrument operations is performed at SRC Planeta, Moscow, and depends severely on the status of various service systems onboard Electro-L N1. As a result, the MSU-GS data is available mostly during the daytime now.

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

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

2.1.5 Data transmission

Electro-L N1 HRIT/LRIT channels are functional, but data dissemination is currently suspended due to various reasons onboard.

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

When available, the MSU-GS data in HRIT format is distributed to users via SRC Planeta FTP server.

2.1.6 Projects, services

The list of services currently provided by Electro-L N1 satellite:

- Visible and IR imagery of MSU-GS instrument (when available, mostly daytime);
- DCS;
- COSPAS-SARSAT system.

2.1.7 User statistics

MSU-GS data (when available) is now used internally by Russian Hydrometeorological and Environmental Monitoring Service.

The DCP platforms in Roshydromet (over 560 by now, number growing rapidly) relies mostly on Electro-L N1 services. 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. After the quality control procedures, the data is used for NWP purposes as well as for calibration and validation of various satellite data and products (where appropriate).

2.2 Status of current LEO satellite systems

The second spacecraft of Meteor-M series of new Russian polar-orbiting meteorological satellites, Meteor-M N2 was launched on July 8th, 2014. It is located in a sun-synchronous orbit (820 km, ascending, equator crossing time ~ 9:30, inclination 98.79°). The satellite was designed and built by JSC “VNIIEM Corporation”.

2.2.1 Mission objectives, payload/instruments, products

The main objective of Meteor-M N2 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 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);
- Severjanin 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);
- IRFS-2 - IR Fourier-transform spectrometer (IR atmospheric sounder, spectral range 5-15 μm, spectral resolution ~ 0.5 cm^{-1});
- GGAK-M Heliogeophysical Measurements Suite;
- Data collection system (DCS).

Meteor-M N2 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;
- 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).

2.2.2 Status of spacecraft

Meteor-M N2 is operational.
Instrument status:

- MSU-MR instrument is fully functional;
- MTVZA-GY instrument is fully functional;
- KMSS instrument is fully functional;
- IRFS-2 instrument is fully functional;
- Severjanin SAR instrument is functional with limitations (due to low signal/noise ratio);
- DCS is functional;
- LRPT transmission is functional;
- GGAK-M is functional.

2.2.3 Impact on spacecraft due to space weather

Impact on spacecraft due to space weather was not positively established.

2.2.4 Ground segment matters

Roshydromet ground segment is based on three SRC Planeta regional 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.

Roshydromet 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.

Meteor-M N2 ground segment has been developed jointly by Roshydromet and Roscosmos.

2.2.5 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.

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

MTVZA-GY instrument data, declared as Essential according to Roshydromet-EUMETSAT bilateral Agreement, is available in HDF format to EUMETSAT third party service in near-real-time via FTP channel. Test distribution of preprocessed IRFS-2 data is to be started soon.

2.2.6 Projects, services

The list of services currently provided by the Meteor-M N2 satellite:

- Visible and IR imagery (MSU-MR instrument);
- Moderate resolution visible imagery (KMSS instrument);
- Temperature and humidity sounding (MTVZA-GY);
- Atmospheric sounding (IRFS-2).

Meteor-M N2 data is used for atmospheric sounding, disaster monitoring such as floods and forest fires, as well as sea ice and water pollution monitoring, and etc.

2.2.7 User statistics

Meteor-M N2 satellite data is currently used internally by Russian Hydrometeorological and Environmental Monitoring Service, and also provided to EMERCOM – Ministry of Civil Defence, Emergencies and Disaster Relief of the Russian Federation, Ministry of Natural Resources and Environment of the Russian Federation and other federal and regional institutions of Russia.

All MTVZA-GY data available in near-real-time to EUMETSAT is free to be redistributed to the EUMETSAT users.

3 FUTURE SATELLITE SYSTEMS

Sector	Satellite in orbit	Operator	Location	Planned launch date	Instrument payload
Indian Ocean (37°E -109°E)	Electro-L N2	Russian Federation/ Roshydromet	77.8°E	2015	MSU-GS, HMS (GGAK), DCS, GeoSAR. Direct broadcast HRIT, LRIT
TBD	Electro-L N3	Russian Federation /Roshydromet	TBD	2017	MSU-GS, HMS, DCS, GeoSAR. Direct broadcast HRIT, LRIT
TBD	Electro-L N4	Russian Federation /Roshydromet	TBD	2019	MSU-GS, HMS, DCS, GeoSAR. Direct broadcast HRIT, LRIT
TBD	Electro-L N5	Russian Federation /Roshydromet	TBD	2024	MSU-GS, HMS, DCS, GeoSAR. Direct broadcast HRIT, LRIT
Indian Ocean (37°E -109°E)	Electro-M N1-1	Russian Federation /Roshydromet	TBD	2025	MSU-GSM, IRFS-GS, ERBR, LM, GGAK-E/M, BRTK-M
	Electro-M N1-2			TBD	

Orbit type	Satellite in orbit	Operator	Orbit	Planned launch date	Instrument payload
Highly Elliptical Orbit (non-geo-stationary)	Arctica-M N1	Russian Federation /Roshydromet	Molnya Orbit	2017	MSU-GS, DCS, HMS(GGAK)
	Arctica-M N2	Russian Federation /Roshydromet	Molnya Orbit	2019	MSU-GS, DCS, HMS(GGAK)
	Arctica-M N3	Russian Federation /Roshydromet	Molnya Orbit	2020	MSU-GS, DCS, HMS(GGAK)
	Arctica-M	Russian	Molnya Orbit	2024	MSU-GS, DCS,

	N4	Federation /Roshydromet			HMS(GGAK)
	Arctica-M N5	Russian Federation /Roshydromet	Molnya Orbit	2025	MSU-GS, DCS, HMS(GGAK)

Orbit type	Satellite in orbit	Operator	Time	Orbit	Planned launch date	Instrument payload
Sun-synchronous orbit ECT 15.00 (The ascending unit)	Meteor-M N2-1	Russian Federation /Roshydromet	TBD	820 km	2017	MSU-MR, MTVZA, IRFS-2, KMSS, DCS, COSPAS-SARSAT. Dissemination: HRPT, LRPT
Sun-synchronous orbit ECT 09.00 (The descending unit)	Meteor-M N2-2	Russian Federation /Roshydromet	TBD	820 km	2017	MSU-MR, MTVZA, IRFS-2, KMSS, DCS, COSPAS-SARSAT. Dissemination: HRPT, LRPT
Sun-synchronous orbit ECT 15.00 (The ascending unit)	Meteor-M N2-3	Russian Federation /Roshydromet	TBD	820 km	2020	MSU-MR, MTVZA, IRFS-2, KMSS, MeteoSAR, GGAK-M2, DCS. Dissemination: HRPT, LRPT
Sun-synchronous orbit ECT 09.00 (The descending unit)	Meteor-M N2-4	Russian Federation /Roshydromet	TBD	820 km	2021	MSU-MR, MTVZA, IRFS-2, KMSS, MeteoSAR, GGAK-M2, DCS. Dissemination: HRPT, LRPT
Sun-synchronous orbit ECT 15.00 (The ascending unit)	Meteor-M N2-5	Russian Federation /Roshydromet	TBD	820 km	2022	MSU-MR, MTVZA, IRFS-2, KMSS, MeteoSAR, GGAK-M2, DCS. Dissemination: HRPT, LRPT
Sun-synchronous orbit ECT 12.00 (The ascending unit)	Meteor-M N3	Russian Federation /Roshydromet	TBD	650 km	2021	CZS, SCAT, OCS, Radiomet, SAR-X, Dissemination: LRPT

3.1 Status of future GEO satellite systems

According to the Russian Federal Space Program Electro-L constellation of the geostationary meteorological satellites should consist of three similar satellites.

The satellites are designed and built by Lavochkin Association and have a three-axis stabilized platform.

The payload of Electro-L constellation is similar to Electro-L N1 spacecraft but with improved instrument performance. The payload will consist of MSU-GS imager, standard meteorological communication package (DCS and retransmitters), data retransmission channel for hydrometeorological data exchange between Roshydromet centers, and GGAK Heliogeophysical Measurements Suite.

3.1.1 Mission objectives, spacecraft, payload/instruments, products

Primary objectives of Electro-L 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. JSC "Russian Space Systems" is a developer of this instrument. 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.

3.1.2 Ground segment matters

Electro-L N3, N4 & N5 ground segment will be jointly developed by Roshydromet and Roscosmos. Roshydromet main 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.

3.1.3 Data transmission

Electro-L N3, N4 & N5 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.

3.2 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.

Meteor-M N2-1 hydrometeorological satellite is scheduled to be launched in 2017. It is planned to launch five similar satellites with the same payload as Meteor-M N2, i.e. Meteor-M N2-1, Meteor-M N2-2, Meteor-M N2-3, Meteor-M N2-4, Meteor-M N2-5. The goal is to create a constellation of identical operational meteorological satellites in morning and afternoon orbits. These satellites will be developed by JSC "VNIIEM Corporation". The payload of Meteor N2-1 and Meteor N2-2 will be modified to exclude Severjanin X-band Side-Looking Radar and Heliogeophysical Measurements Suite and to include COSPAS-SARSAT Search & Rescue system. For Meteor N2-3, Meteor N2-4 and Meteor N2-5 there will be MeteoSAR and modified Heliogeophysical Measurements Suite GGAK-M2 instead.

Meteor-M N3 oceanographic satellite is currently under development. Its payload will consist of:

- Multimode radar based on Active Phased Array Antenna (APAA) technology (X-band, spatial resolution from 1 to 500 m, swath 10 - 750 km);
- Scatierometer (Ku-band; 25x25 km spatial resolution, swath 1800 km);
- Coastal Zone Scanner (4 channels, visible range, 80 m spatial resolution, swath 800 km);
- Ocean Color Scanner (8 channels, visible range, 1 km spatial resolution, swath 3000 km);
- Radio-occultation instrument (Radiomet).

Meteor-M N3 is scheduled for launch in 2020.

Forthcoming Meteor-MP meteorological satellites' payload will be basically similar to Meteor-M series payload, but with improved instrument performance.

Meteor-MP payload will consist of:

- Scanning radiometer (low-resolution multichannel scanning unit);
- Visible spectrum scanning imager (Moderate resolution multispectral imaging system);
- Infra-red Fourier-transform spectrometer;
- Moderate resolution multispectral infra-red scanner;
- Atmospheric composition spectrometer;
- Microwave imager-sounder (module for temperature and humidity sounding of the atmosphere);
- Scatterometer;
- Side-looking radar system;

- Radio-occultation instrument;
- Data collection system;
- Heliogeophysical Measurements Suite;
- 137 MHz data downlink system;
- 1.7 GHz data downlink system;
- X- band data downlink system.

First satellite in the series, Meteor-MP N1, is scheduled for launch in 2024.

3.2.1 Mission objectives, spacecraft, payload/instruments, products

The main objective of Meteor-MP mission is to provide global observations of the Earth's surface, the ocean and the atmosphere. The data acquired by the satellite can be used for the following purposes:

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

3.2.2 Ground segment matters

The future Meteor-MP ground segment based on the existing facilities will be developed jointly by Roshydromet and Roscosmos.

Roshydromet ground segment consists of three SRC Planeta regional centers, responsible for receiving, processing, disseminating and archiving of satellite data: European (Moscow-Obninsk-Dolgoprudny), Siberian (Novosibirsk) and Far-Eastern (Khabarovsk). These centers together should provide Roshydromet and its users with full operational coverage of all the Russian Federation and neighboring territories with the lowest possible latency.

Roshydromet ground segment for Meteor-MP series satellites will be located at SRC Planeta facilities. It will also include the network of DCS, LRPT and HRPT stations.

3.2.3 Data transmission

Global data X-band downlink will be used for Roshydromet purposes only.

The direct broadcast will work in L-band in AHRPT and in a band of 137 MHz in LRPT format. The detailed format description will be updated and published at SRC Planeta website after the commissioning phase.

3.3 Status of future HEO [or other] satellite systems

At CGMS-34 the Russian project of Arctic region monitoring from the "Molnya" highly elliptical orbit was announced for the first time. Now this project evolved into mission of two HEO satellites called Arctica. The work has been started in 2011 and the first satellite is planned to be launched in 2017.

3.3.1 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 24 hours a day each of two 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 allowing adding various types of complementary instruments, including international ones if agreed upon. The launch of the first Arctica satellite is scheduled in 2017.

3.3.2 Ground segment matters

The ground segment for Arctica constellation will be based on SRC Planeta/Roshydromet facilities in Moscow, Novosibirsk and Khabarovsk. Also it is planned to deploy the network of small data acquisition centers in the coastal zone along the Northern Sea Route.

3.3.3 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;
- Meteorological data retransmission in L-band.

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

The geostationary Electro-L N1, N2 satellites located over the Indian Ocean at 76E and 77.8E have international DCS channels, which may be used to collect the information from the remote areas located within its footprint. Thus, CGMS could recommend its members to use this opportunity.

As the second recommendation, it is suggested to make an additional effort into channels inter-calibration for the geostationary and polar-orbiting satellites, especially in regard to the infrared and microwave channels.

5 CONCLUSION

Russian Federation is currently developing a national constellation of both geostationary and polar orbiting meteorological satellites. It will be complemented by the satellites at highly elliptical “Molnya” type orbits. Two satellites in HEO, the first spacecraft is scheduled for launch in 2017, will provide the continuous monitoring of the atmosphere, ocean and land in the northern Polar Regions.