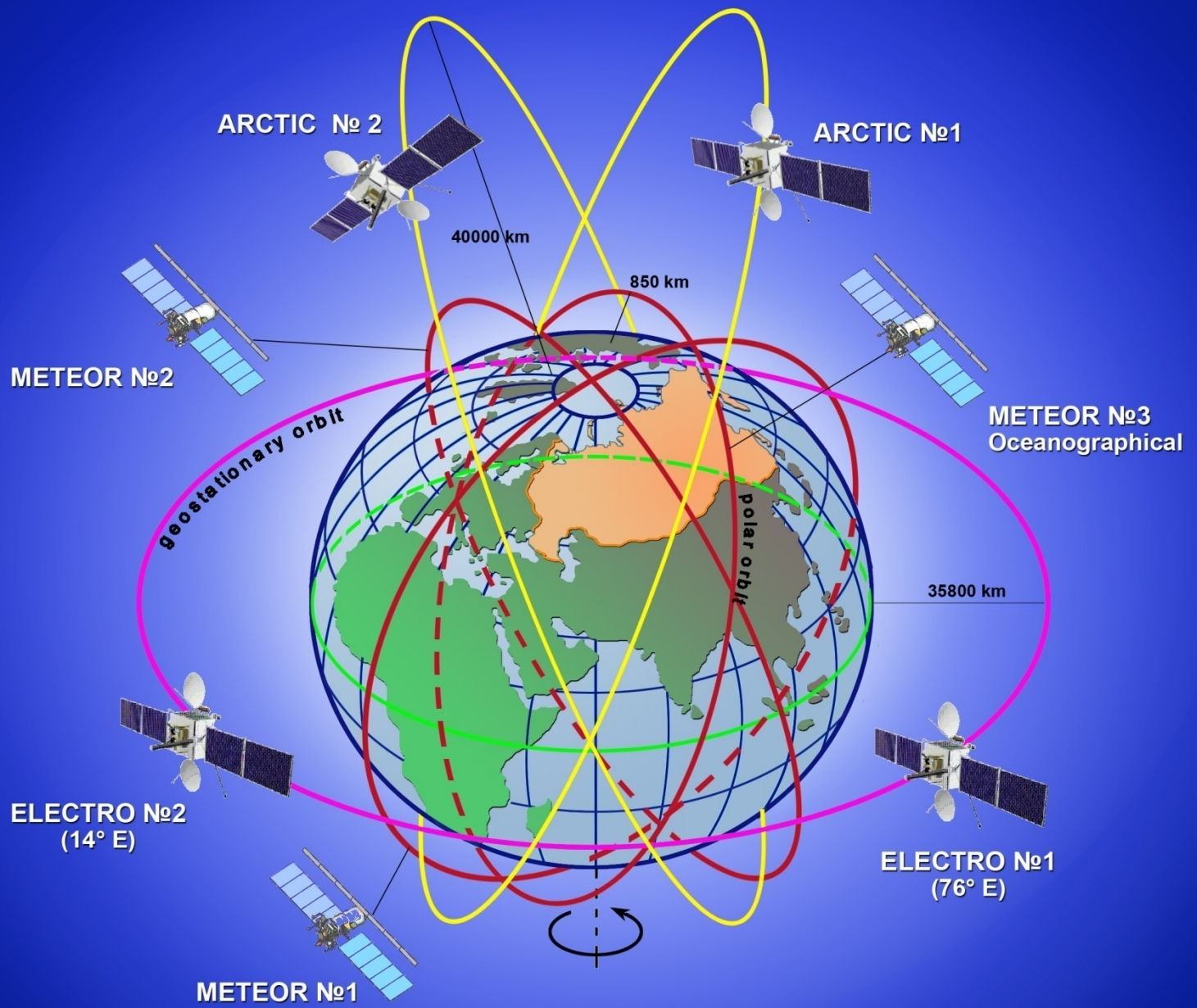
ITSC-17

Monterey, CA, USA, April 14 –20, 2010

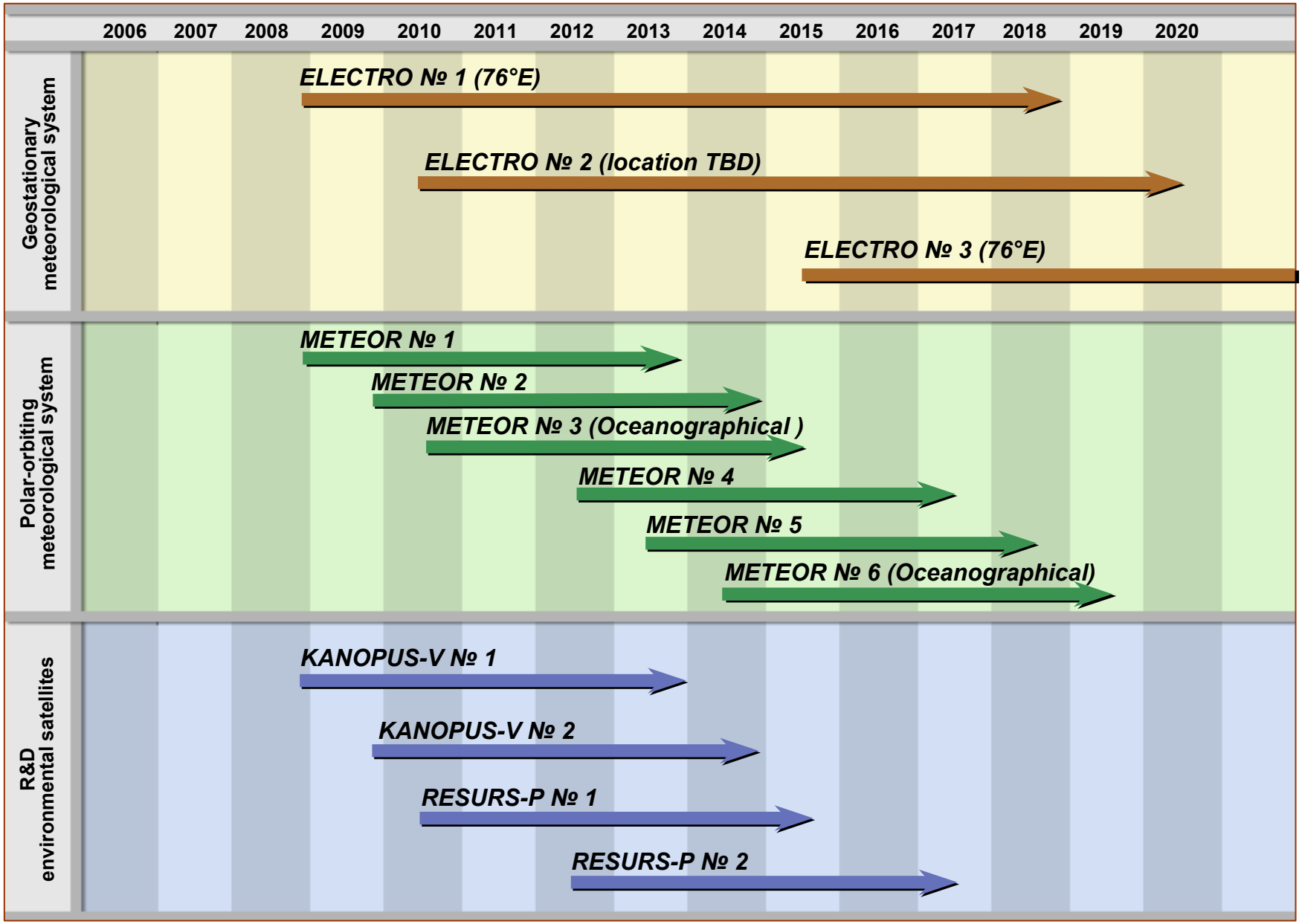
Status of current and future Roshydromet satellite programmes

State Research Center on Space Hydrometeorology PLANETA, Moscow, Russia

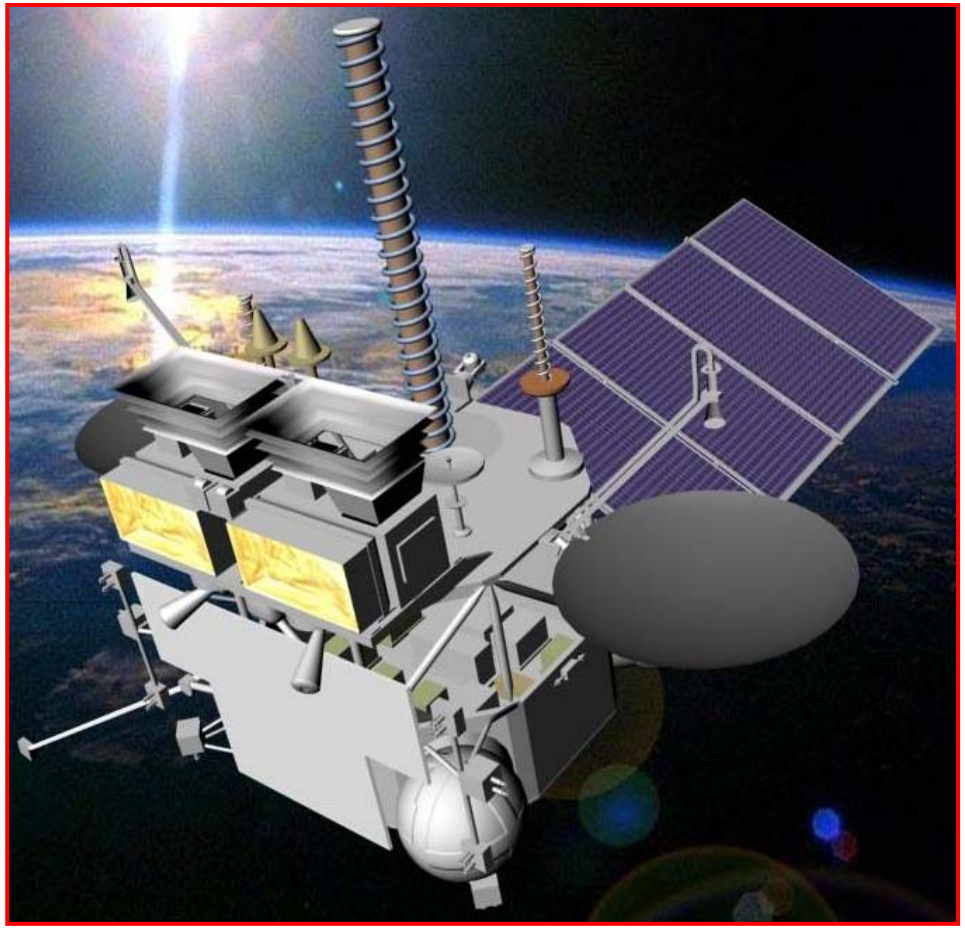
RUSSIAN HYDROMETEOROLOGICAL SATELLITE SYSTEM



Russian Earth Observation Satellites Program 2006-2015



ELECTRO-L General Design



- Three-axis high-precision stabilization
- In-orbit mass - 1500 kg
- Payload mass - 370 kg
- Lifetime - 10 years
- Longitude - 76E
- Data dissemination format - HRIT/LRIT
- Image repeat cycle – 30/15 min

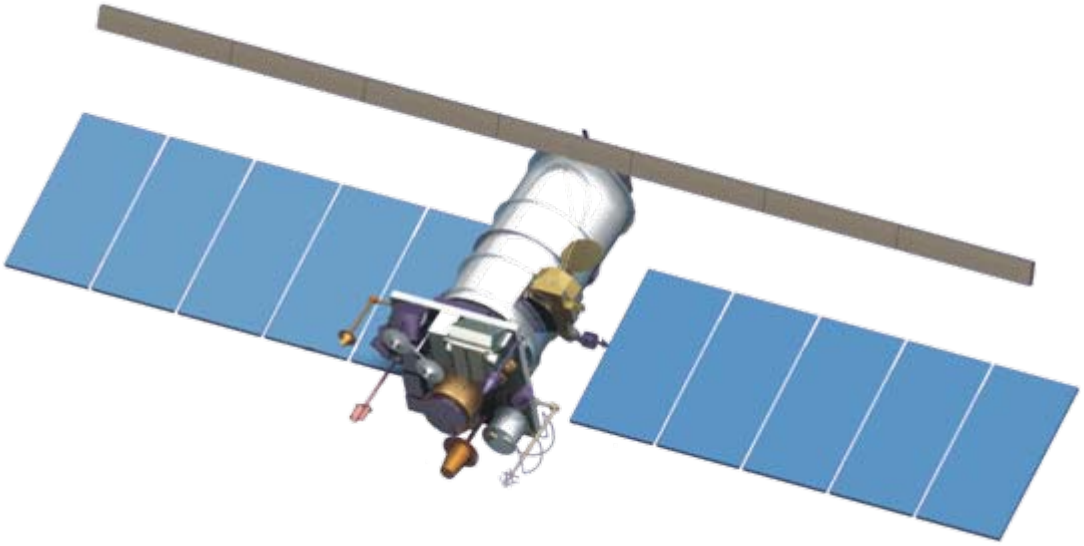
Mission objectives

- Operational observation of the atmosphere and the Earth surface (MSU-GS)
- Heliogeophysical measurements
- Maintaining Data Collection System and COSPAS/SARSAT Service

MSU-GS Basic Performance Characteristics

1.	Number of channels • VIS • IR	10 3 7
2.	Spectral range at half maximum of spectral response function (μm)	0.5-0.65; 0.65-0.80;0.8-0.9; 3.5-4.0; 5.7-7.0; 7.5-8.5;8.2-9.2; 9.2-10.2; 10.2-11.2; 11.2-12.5
3.	Image frame (deg x deg)	20 ± 0.5 x 20 ± 0.5
4.	HRIT ground resolution in subsatellite point (km)	1.0 (VIS); 4.0 (IR)
5.	S/N ratio for VIS channels	≥ 200
6.	NEΔT at 300K (K) • in the band 3.5-4.0 μm • in the band 5.7-7.0 μm • in the band 7.5-12.5 μm	 0.8 0.4 0.1-0.2
7.	Power (W)	≤ 150
8.	Weight (kg)	≤ 88
9.	Lifetime of basic and reserve units (years)	10

METEOR-M General Design



- In-orbit mass – 2700 kg
- Payload mass – 1200 kg
- Lifetime – 5 years
- Orbit – Sunsynchronous
- Altitude – 830 km
- Data dissemination format – HRPT/LRPT

METEOR-M Mission Objectives and Basic Instruments

Instrument	Application	Spectral Band	Swath-width (km)	Resolution (km)	Instruments for interca-libration
MSU-MR	Global and regional cloud cover mapping, SST, LST, …	0.5 – 12.5 μm (6 channels)	3000	1 x 1	AVHRR/NOAA
KMSS multichannel scanning unit	Earth surface monitoring	0.4-0.9 μm (3 channels)	100	0.06/0.1	
MTVZA imager/ sounder	Atmospheric temperature and humidity profiles, sea surface wind	10.6-183.3 GHz (26 channels)	2600	12 – 75	SSMIS/DMSP AMSR/EOS-AQUA AMSU/NOAA
IRFS-2 advanced IR sounder *	Atmospheric temperature and humidity profiles	5-15 μm	2000	35	
Severjanin (SAR)	Ice monitoring	9500-9700 MHz	600	0.4 x 0.5	
Radiomet* (radio occulation unit)	Atmospheric temperature and pressure profiles.				

*** - to be launched on board METEOR-M №2**

Basic performance characteristics of IRFS-2

№	Parameter	Units	Value
1	Spectral range: wavelength wave number	μm cm^{-1}	5-15 2000-665
2	Reference channel wavelength	μm	1.06
3	Maximum optical path difference (OPD)	mm	17
4	Angular size of FOV	mrad	40 x 40
5	Spatial resolution (at subsatellite point)	km	35
6	Swath Width and spatial sampling	km	2500, 110 2000, 100
7	Aperture angle of beams reaching the detector	degree	63
8	Duration of the interferogram measurement	s	0.5
9	Dynamic range		2^{16}
10	Number of reference points in two-sided interferogram		2^{15}
11	Frequency band of measuring channel	kHz	4.5-13.5
12	Reference signal frequency	kHz	65.5
13	Frequency band of reference channel	kHz	61-70
14	Weight	kg	45-50
15	Power	W	50

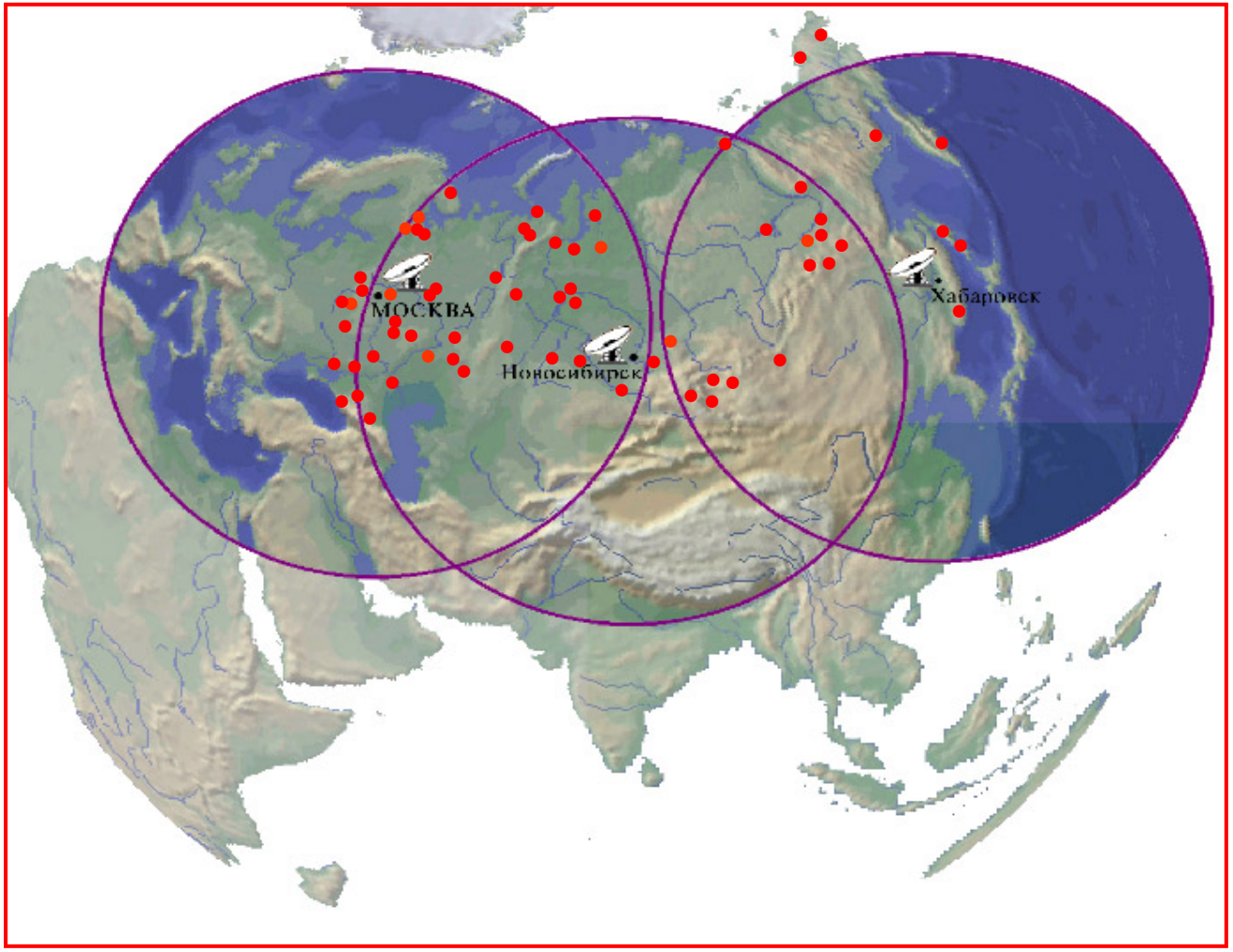
Roshydromet Satellite Ground Segment

3 Main centers:
Europe
(Moscow-Obninsk-Dolgoprudny)

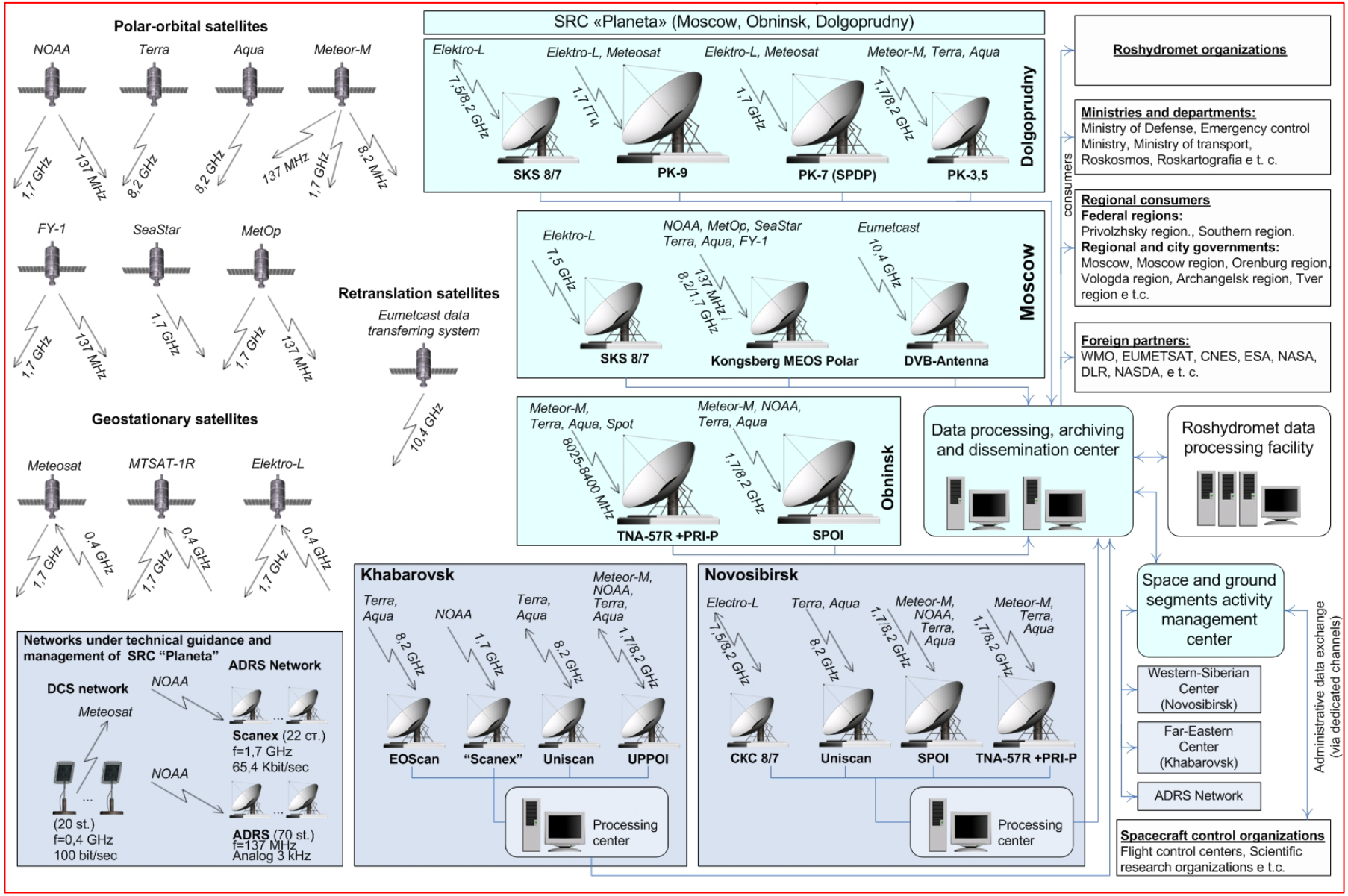
Siberia
(Novosibirsk)

Far-East
(Khabarovsk)

- **- 68 Local centers**

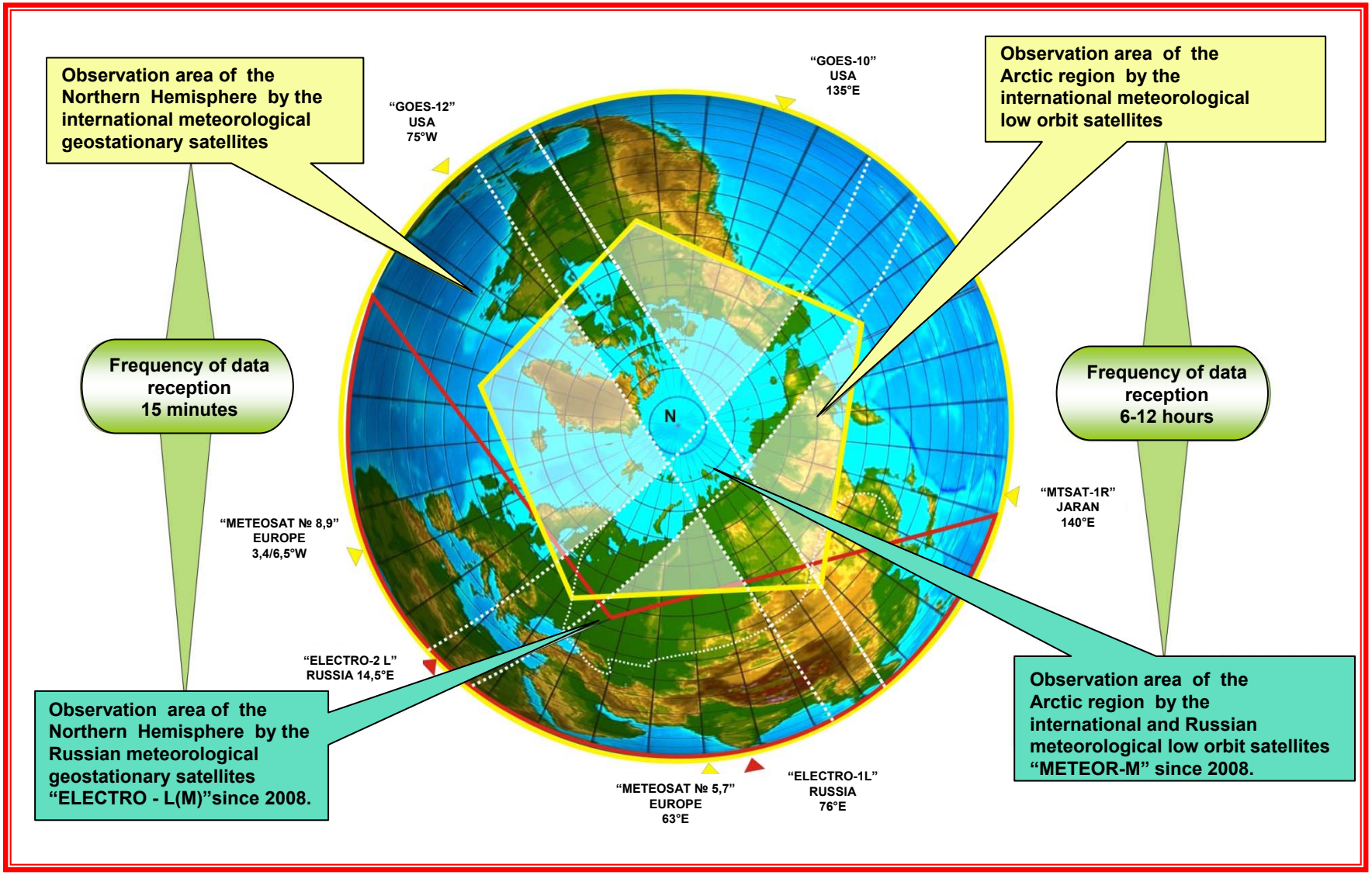


Status of Roshydromet Ground Segment




Federal Service for Hydrometeorology
and Environmental Monitoring
Russian Federal Space Agency
High-elliptical Orbits Satellite
System "Arctica"
State Centre on Space Hydrometeorology
"Planeta"
Lavochkin Association

Earth observation by the international meteorological satellite system



Mission objectives

Monitoring of the Earth atmosphere and surface in Arctic region (inaccessible for observation from geostationary orbit) on the base of multispectral imaging with high temporal resolution (15 – 30 min).

Providing heliogeophysical information in polar areas.

Maintaining data collection system, telecommunication service for data exchange and retransmission.

Search & Rescue service (COSPAS-SARSAT).

Main Tasks and Applications

Utilization for analysis and forecasting :

- weather in the regional (Arctic) and global scales
- ice cover in Arctic
- flight conditions for aviation (cloudiness, wind, jet-streams etc.)
- snow cover
- heliogeophysical conditions in the near Earth Space

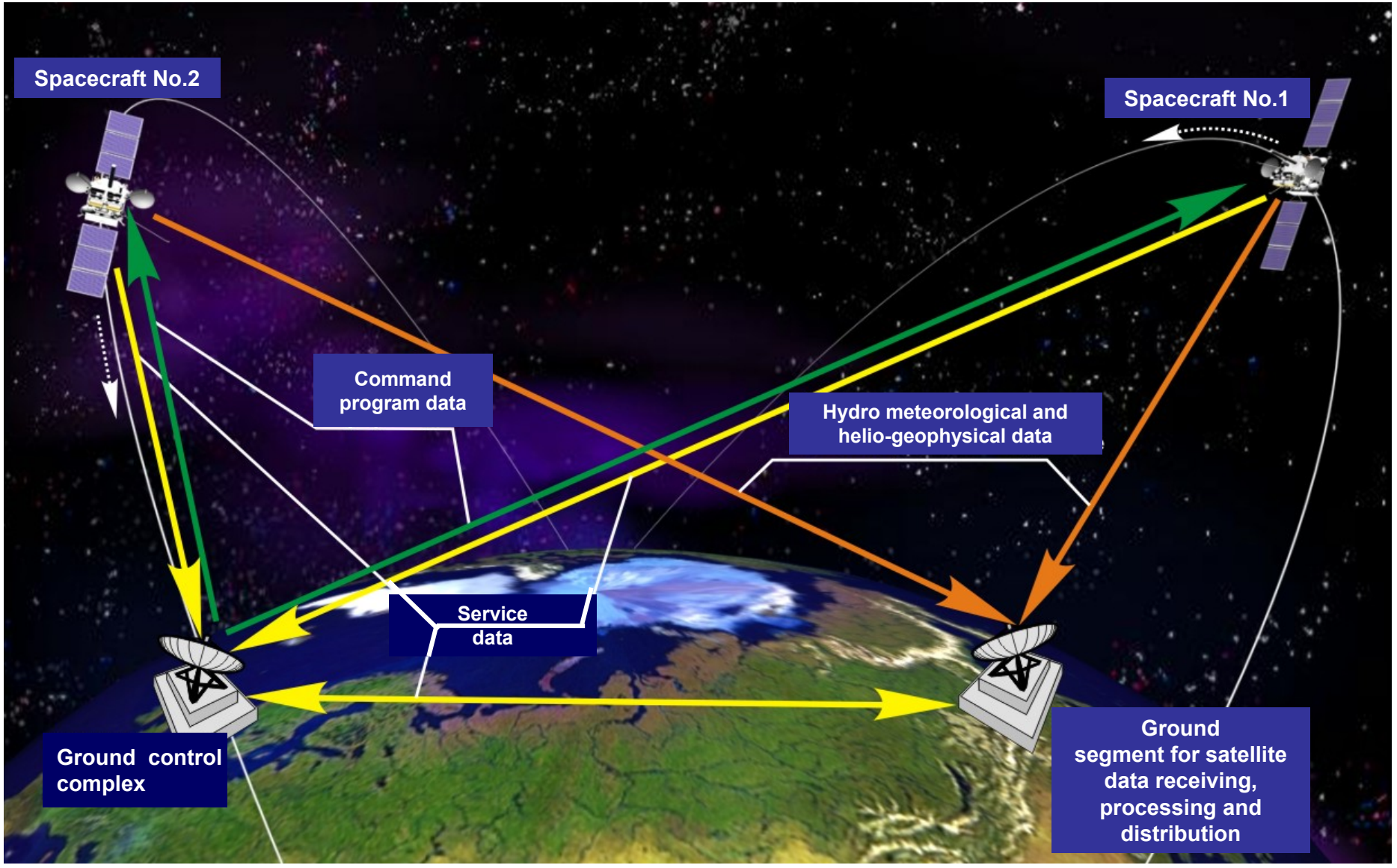
Monitoring of disasters (fires, floods, volcanic eruptions etc.)

Monitoring of climate changes

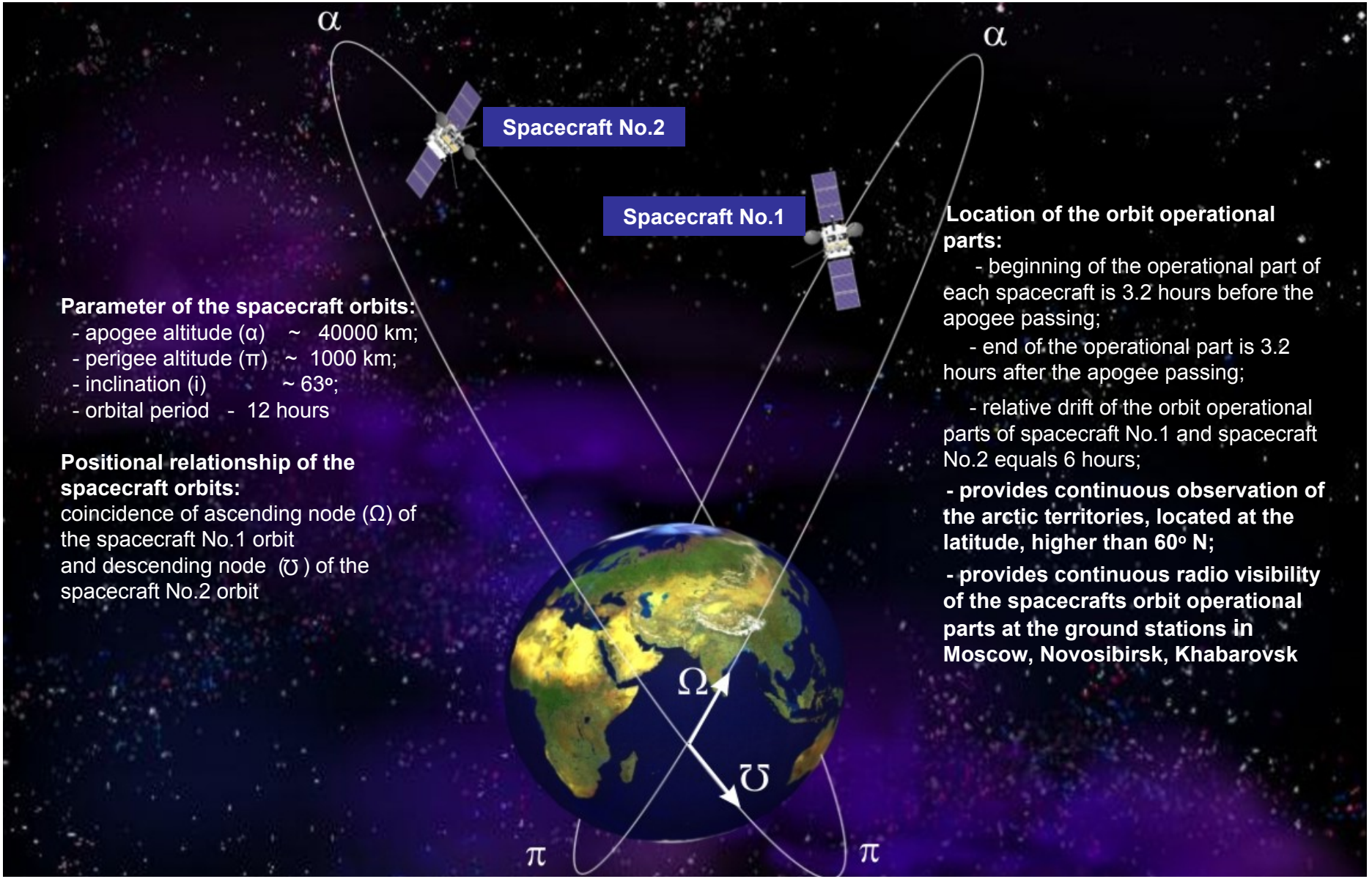
Data collection and relay from land-, sea- and air-based observing platforms

Exchange and dissemination of processed satellite, meteorological and heliogeophysical data

"Arctica" System General Design



Ballistic configuration of the space system



Parameter of the spacecraft orbits:
- apogee altitude (α) ~ 40000 km;
- perigee altitude (π) ~ 1000 km;
- inclination (i) ~ 63°;
- orbital period - 12 hours

Positional relationship of the spacecraft orbits:
coincidence of ascending node (Ω) of the spacecraft No.1 orbit
and descending node (℧) of the spacecraft No.2 orbit

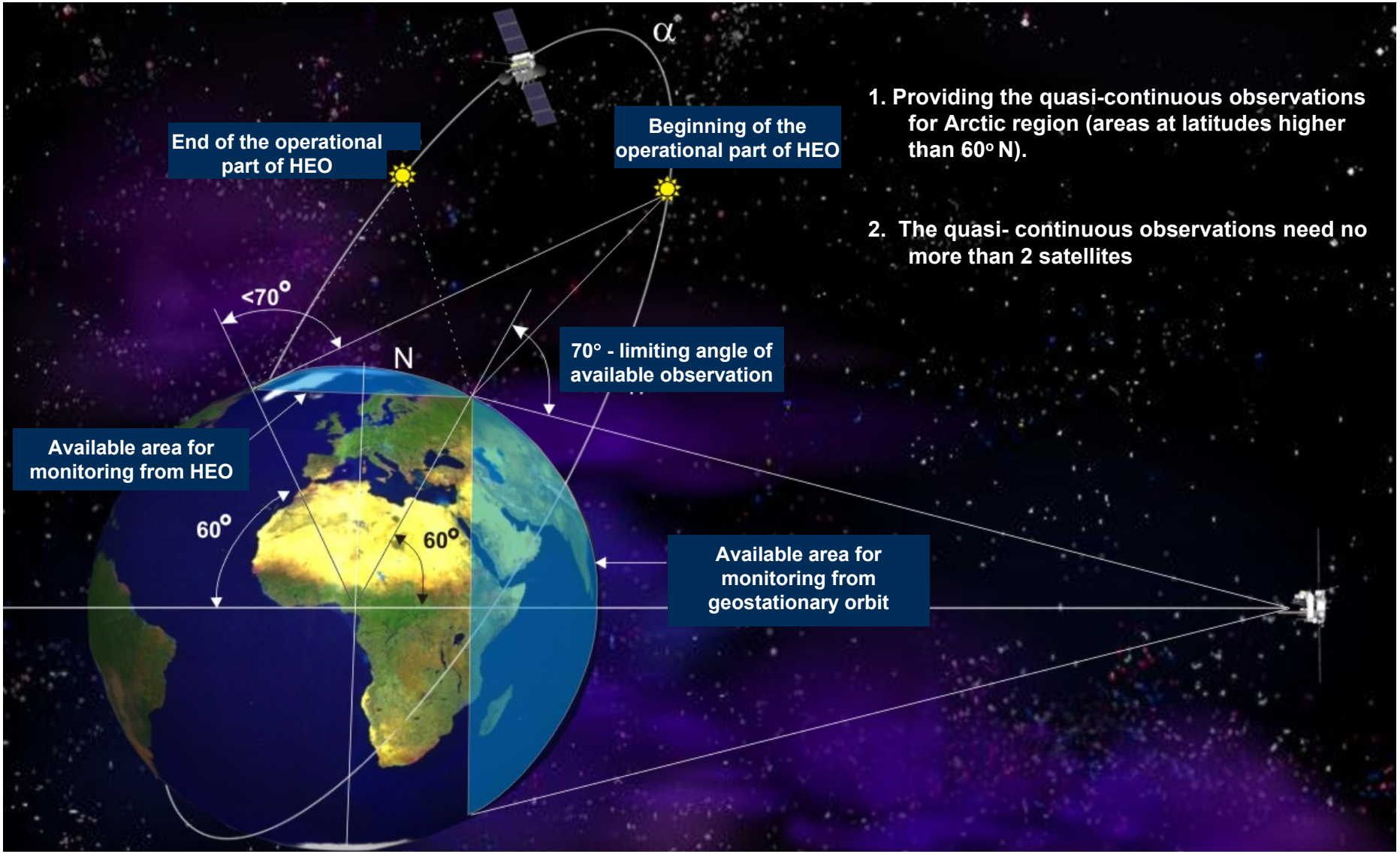
Location of the orbit operational parts:

- beginning of the operational part of each spacecraft is 3.2 hours before the apogee passing;
- end of the operational part is 3.2 hours after the apogee passing;
- relative drift of the orbit operational parts of spacecraft No.1 and spacecraft No.2 equals 6 hours;

- provides continuous observation of the arctic territories, located at the latitude, higher than 60° N;

- provides continuous radio visibility of the spacecrafts orbit operational parts at the ground stations in Moscow, Novosibirsk, Khabarovsk

Advantages of the high- elliptic orbits (HEO) over geostationary orbits for Arctic observations



1. Providing the quasi-continuous observations for Arctic region (areas at latitudes higher than 60° N).

2. The quasi- continuous observations need no more than 2 satellites

Conclusions

1. To a great extent the progress of global and regional numerical weather forecasting, as well as providing safety navigation along Northern Sea Route together with many other Earth monitoring problems depends on the capabilities to provide hydrometeorological information for the Arctic region (at the latitudes higher than 60 deg. N) in quasi-continuous mode with high temporal resolution.

2. Geostationary meteorological satellites cannot provide such information and therefore the proposed "Arctica" system should supplement existing global satellite observation system.

3. Russia has great experience on design and exploitation HEO satellite systems, as well as the technical stock on the development of "Electro-L" and "Spectr-R" type spacecrafts. Based on this Roscosmos and Roshydromet (as responsible Russian governmental bodies) propose to realize "Arctica" project in the frame of wide international cooperation.

THANK YOU !