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RUSSIAN EARTH OBSERVATION MISSIONS: satellites, ground segment and data access evolution

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Prospective Development Dep.

WGISS-40
UKSA, Harwell, UK
September 28 – October 2, 2015

THE RUSSIAN EARTH OBSERVATION SATELLITE CONSTELLATION

Russian EO satellite constellation is designed for informational support in solving a wide range of tasks of various spheres of government economic activities

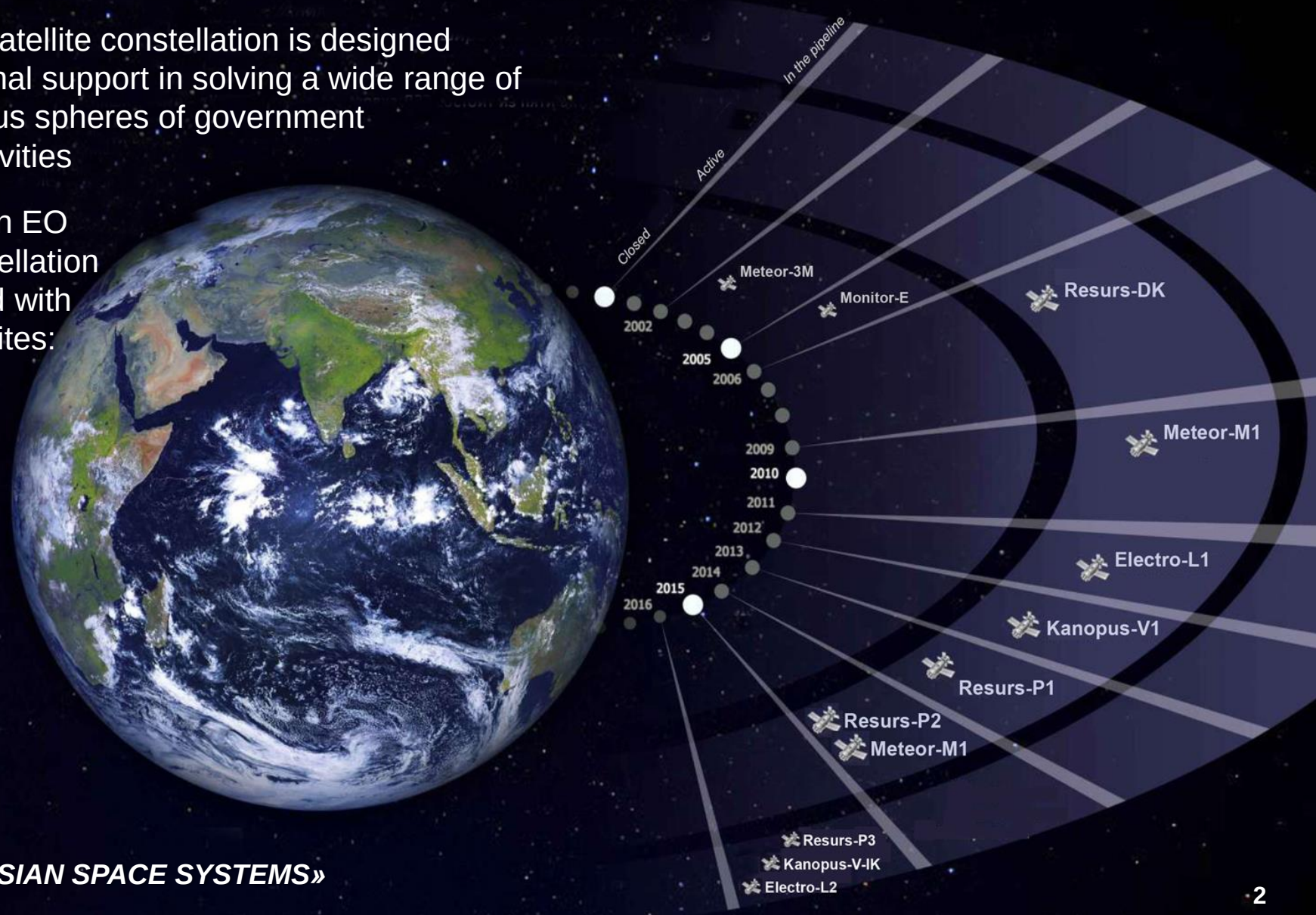
Today Russian EO satellite constellation is represented with 7 active satellites:

Resurs-DK
Resurs-P1
Resurs-P2

Kanopus-V1

Meteor-M1
Meteor-M2

Electro-L1



INFORMATION CAPABILITIES OF RUSSIAN EARTH OBSERVATION SATELLITE CONSTELLATION

Satellite / Characteristics	Resurs-DK	Resurs-P				Kanopus-V		Meteor-M			Electro-L
Launch Date (dd-mm-yyyy)	15.06.2006	25.06.2013 (Resurs-P1) 26.12.2014 (Resurs-P2)				22.07.2012		17.09.2009 (Meteor-M1) 08.07.2014 (Meteor-M2)			20.01.2011
Active Lifetime (years)	3	5				5…7		5			10
Instrument	Geoton	Geoton	GSA	ShMSA		PSS	MSS	KMSS*		MSU-MR*	MSU-GS*
				VR	SR*			MSU-50*	MSU-100*		
Swath Width (km)	28 / 16**	38	25	97	441	23	20	900	900	2800	Entire disk of the Earth
Spatial Resolution (m): • Panchromatic (PAN) • Multispectral (MS)	1 / 3** 2–3 / 3–5**	1 3	– 30	12 23.8	60 120	2.1 –	– 12	– 60	– 120	– 1000	VIS – 1000, IR – 4000
Spectral Bands	4	6	96–255	6	6	1	4	3	3	6	10
Revisit Period (days)	6–10	3–4				16		1–3			15–30 minutes

* Open access data; ** Before / after September 2011

Satellite / Thematic Tasks	Cartography	Ecological Monitoring	Infrastructure Object Monitoring	Environmental Management	Natural Resources Monitoring	Monitoring of Man-Made and Natural Disasters
Resurs-DK	1:10,000 and smaller	+	+	+	+	+
Resurs-P	1:10,000 and smaller	+	+	+	+	+
Kanopus-V	1:25,000 and smaller	+	+	+	+	+
Meteor-M	1:500,000 and smaller	+	–	+	–	+
Electro-L	–	–	–	+	–	Large-scale +

RESURS-DK

MISSION PURPOSE

Near real-time acquiring of highly informative data in visible and near-IR spectral range for ecological monitoring, natural resources inventory, mineral exploration, and mapping

Launch date – June 15, 2006

ONBOARD INSTRUMENT

Highly Detailed-Resolution Optical Sensor [Geoton]

Resolution PAN (0. –.80μm)	– 1m / 3m*
Resolution MS (3 bands, 0.5–0.8μm)	– 2–3m / 3-5m*
Swath width	– 28km / 16km*

* Before / after September 2011

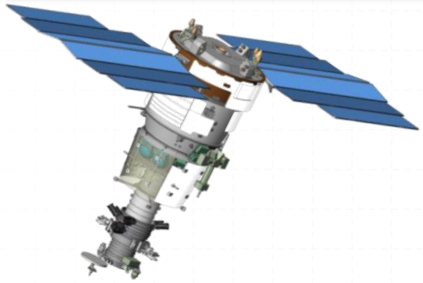
CURRENT TASKS

- Inventory of natural resources, topographic and thematic mapping
- Monitoring of the biosphere pollution sources
- Monitoring of emergencies
- Research activities

RESURS-P

MISSION PURPOSE

Near real-time acquiring of highly informative data in visible and near-IR spectral range for ecological monitoring, natural resources inventory, mineral exploration, and mapping



Launch date – 25 June, 2013 (Resurs-P1)
26 December, 2014 (Resurs-P2)

Next launch – the end of 2015 (Resurs-P3)

CURRENT TASKS

- Maps creation and update (scale 1:10,000 and smaller)
- Environmental ecological monitoring
- Operational emergencies monitoring
- Respond to agriculture and forestry challenges
- Socio-economic infrastructure monitoring

ONBOARD INSTRUMENTS

Highly Detailed-Resolution Optical Sensor [Geoton]

Resolution PAN (0.58–0.80μm)	– 0.9m
Resolution MS (5 bands, 0.45–0.90μm)	– 3m
Swath width	– 38km

2 Wide-Swath Optical Sensor s [ShMSA]

High Resolution Sensor [ShMSA-VR]

Resolution PAN (0.58–0.80μm)	– 12m
Resolution MS (5 bands, 0.43–0.90μm)	– 23.8m
Swath width	– 97km

Medium Resolution Sensor [ShMSA-SR]

Resolution PAN (0.58–0.80μm)	– 60m
Resolution MS (5 bands, 0.43–0.90μm)	– 120m
Swath width	– 441km

Hyperspectral Sensor [GSA]

Resolution (96-255 bands, 0.4–1.1μm)	– 30m
Swath width	– 25km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RESURS-P
Vatican, Rome
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RUSSIAN SPACE SYSTEMS
RESURS-P
New York
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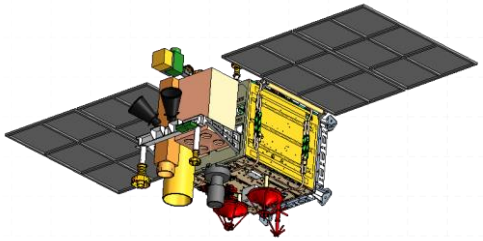
KANOPUS-V

MISSION PURPOSE

Near real-time acquiring of highly informative data in visible and near-IR spectral range for ecological monitoring, natural resources inventory, mineral exploration, and topographic mapping



Launch date – July 22, 2012 (Kanopus-V1)

Next launch – the end of 2015 (Kanopus-V-IK)

ONBOARD INSTRUMENTS

PAN Optical System [PSS]

Resolution (0.54–0.86μm)	– 2.1m
Swath width	– 23km

MS Optical System [MSS]

Resolution (4 bands, 0.46–0.84μm)	– 12m
Swath width	– 20km

CURRENT TASKS

- Maps creation and update (scale 1:25,000 and smaller)
- Environmental ecological monitoring
- Operational emergencies monitoring
- Respond to agriculture and forestry challenges
- Socio-economic infrastructure monitoring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RUSSIAN SPACE SYSTEMS
KANOPUS-V
St. Petersburg
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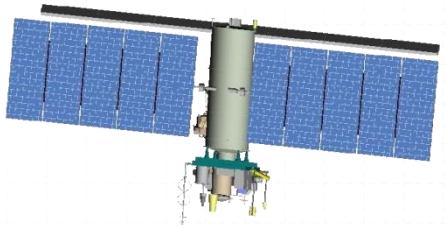
METEOR-M

MISSION PURPOSE

Operational acquiring of cloudiness and the Earth's underlying surface data, hydrometeorological data acquisition, heliogeophysical measurements, Earth's resources study, and ecological monitoring



Launch date – 17 September, 2009 (Meteor-M1)
Launch date – 8 July, 2014 (Meteor-M2)

Next launch – the beginning of 2016 (Meteor-M2.1)

CURRENT TASKS

- Environmental monitoring
- Ice conditions monitoring
- Operational emergency monitoring
- Monitoring of radiation and heliogeophysical conditions in near-Earth space

ONBOARD INSTRUMENTS

2 Medium-Resolution Optical Sensor s [KMSS]

Land-Using Sensor [MSU-100]

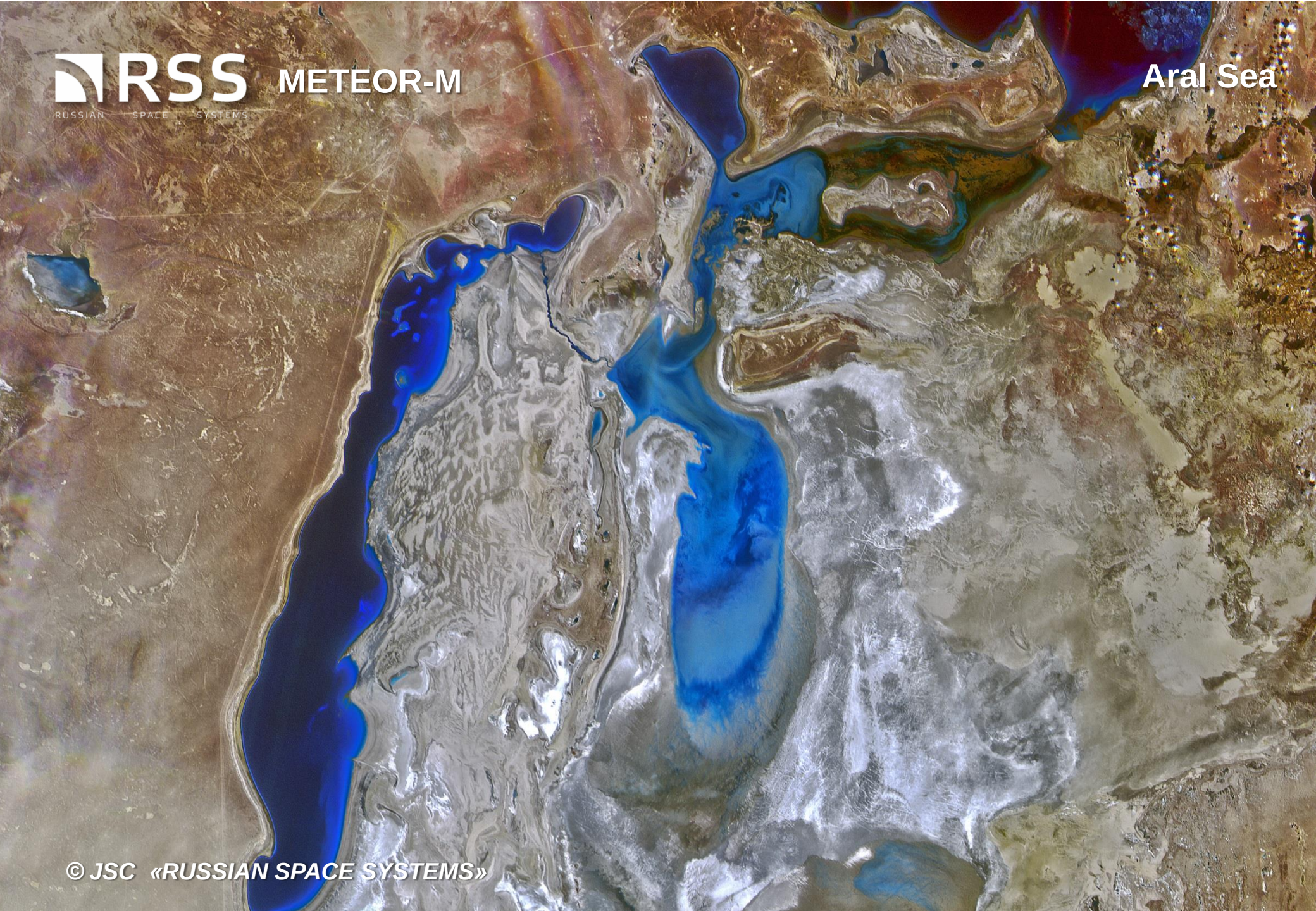
Resolution MS (3 bands, 0.53–0.90μm)	– 60m
Swath width	– 900km

Marine-Using Sensor [MSU-50]

Resolution MS (3 bands, 0.37–0.69μm)	– 120m
Swath width	– 900km

Low-Resolution Optical Sensor [MSU-MR]

Resolution MS (6 bands, 0.5–12.5μm)	– 1000m
Swath width	– 2800km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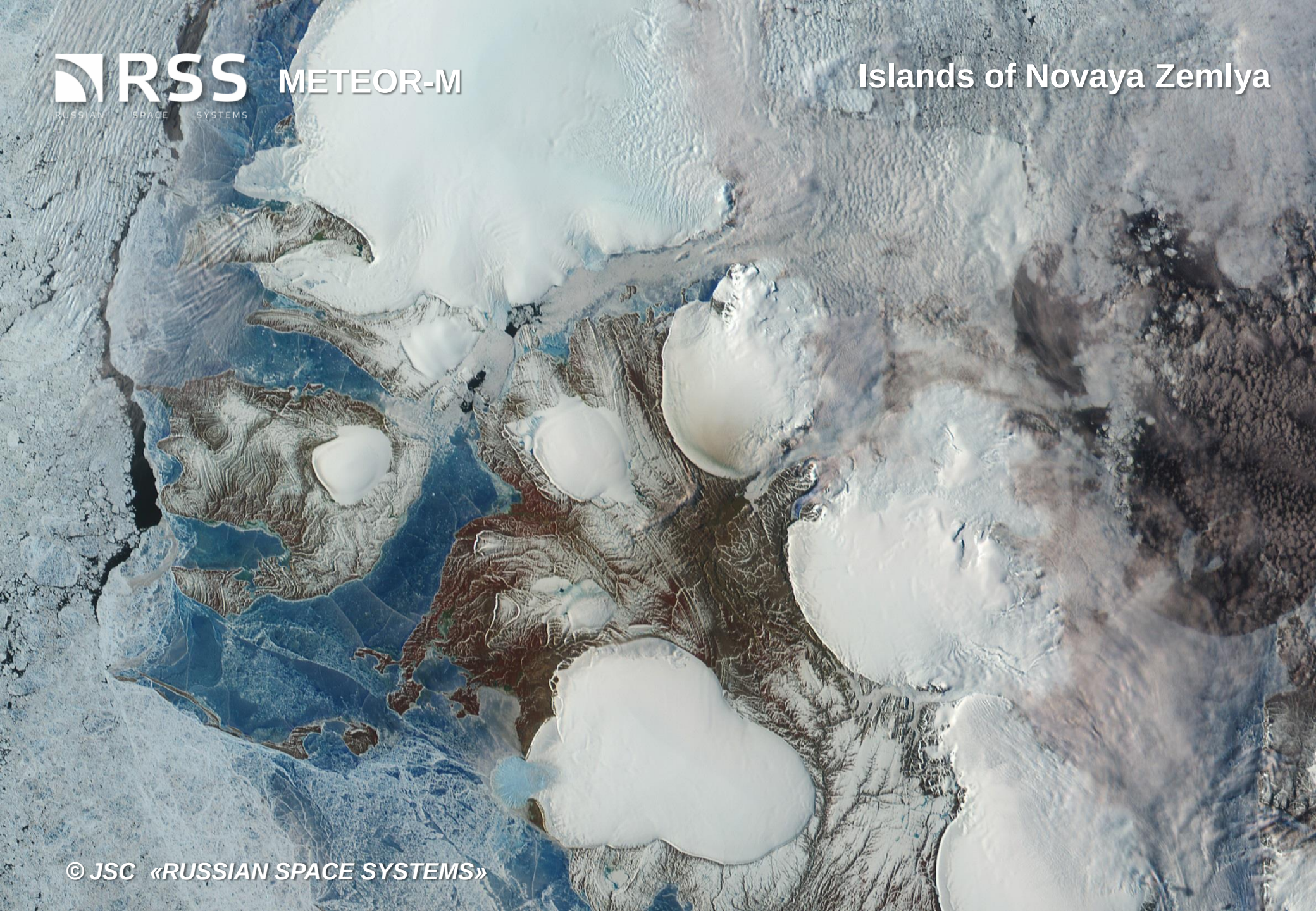
METEOR-M
Aral Sea
© JSC «RUSSIAN SPACE SYSTEMS»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RUSSIAN SPACE SYSTEMS
METEOR-M
Islands of Novaya Zemlya
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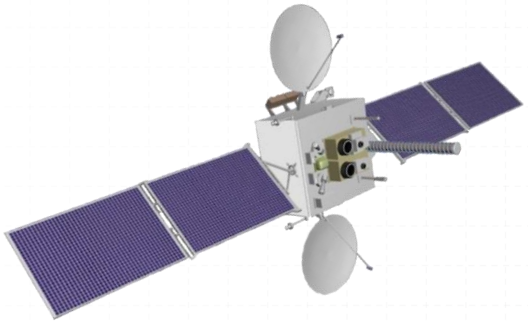
ELECTRO-L

MISSION PURPOSE

Operational acquiring of cloudiness and the Earth's underlying surface data, hydrometeorological data acquisition, heliogeophysical measurements



Launch date – January 20, 2011 (Electro-L1)

Next launch – the end of 2015 (Electro-L2)

CURRENT TASKS

- Operational imaging of the Earth's underlying surface
- The World Ocean state monitoring
- Global monitoring of emergencies

ONBOARD INSTRUMENT

Geostationary MS Optical Sensor [MSU-GS]

Coverage area	– the entire disk of the Earth
Resolution VIS (3 bands, 0.5–0.9μm)	– 1000m
Resolution IR (7 bands, 3.5–2.5μm)	– 4000m
Swath width	– 900km
Revisit period in 24h	– 30min (as scheduled) / – 15min (on ground commands)

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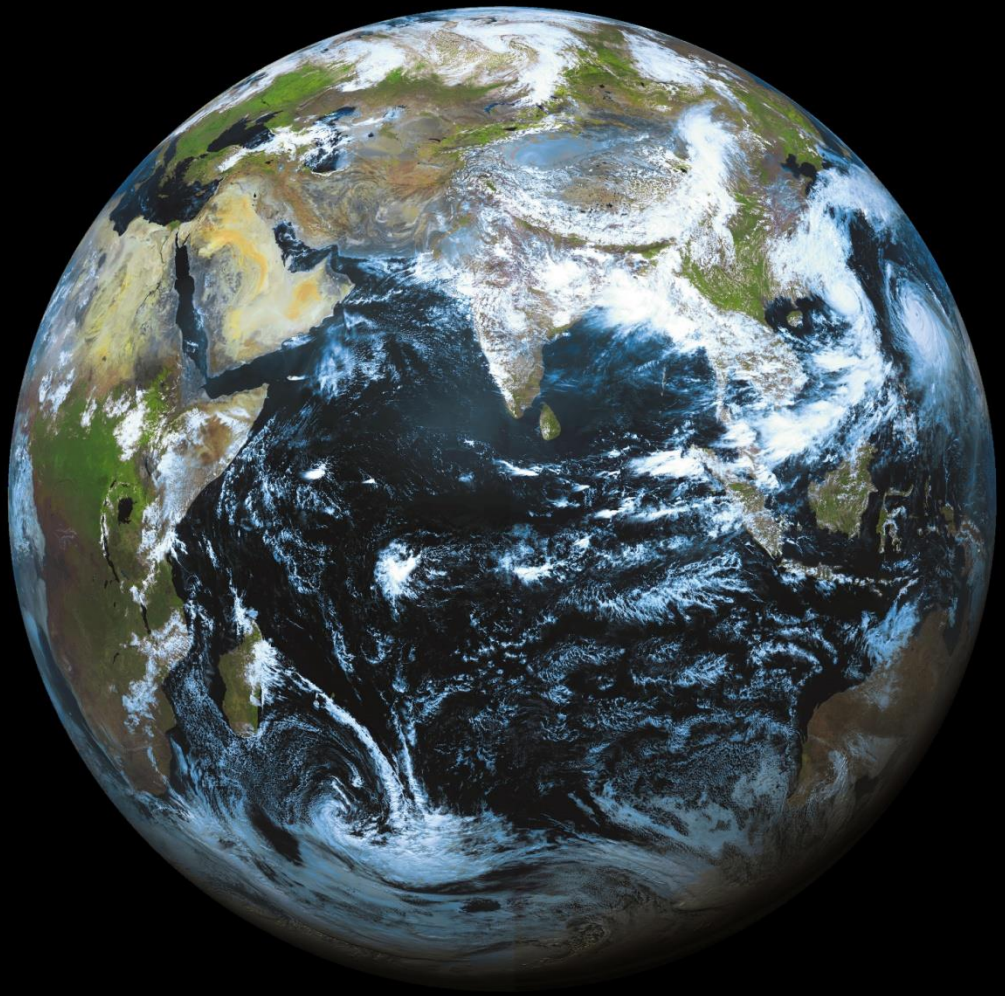
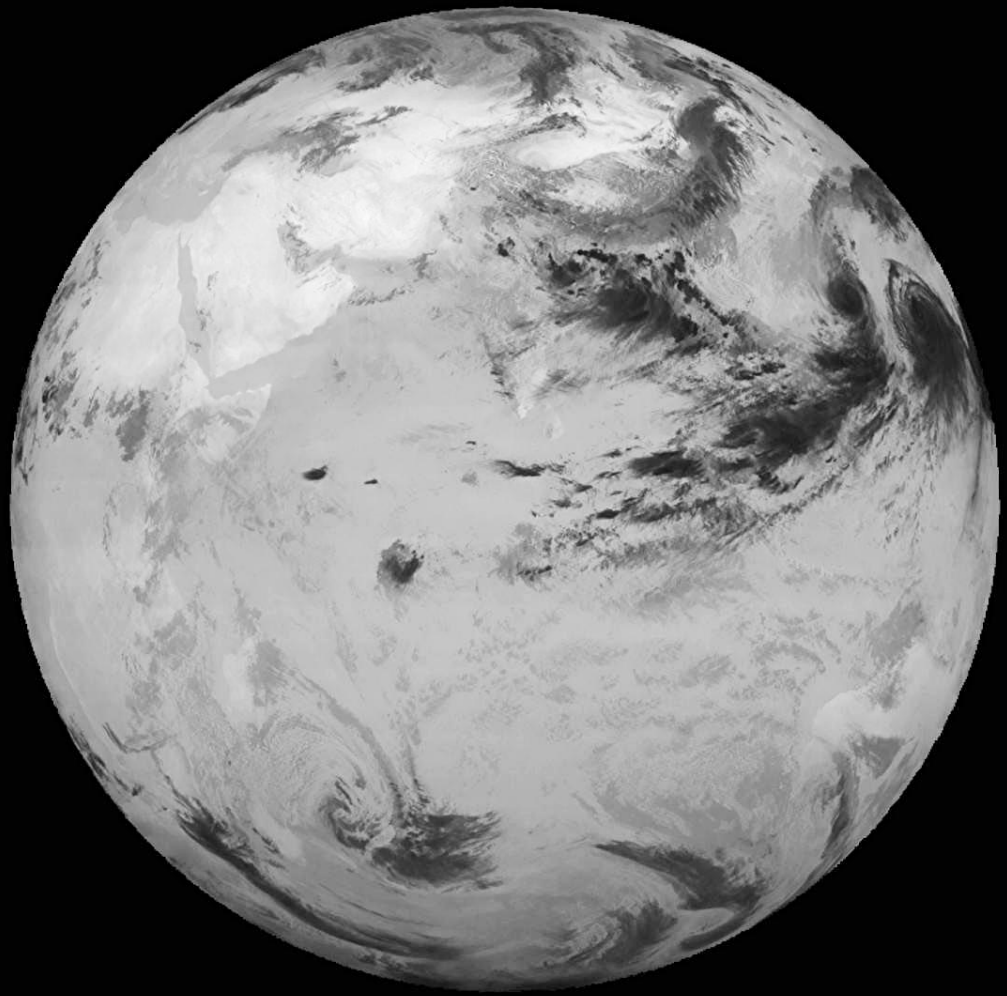
ELECTRO-L



Visible bands (RGB)



IR band (10,2-11,2μm)

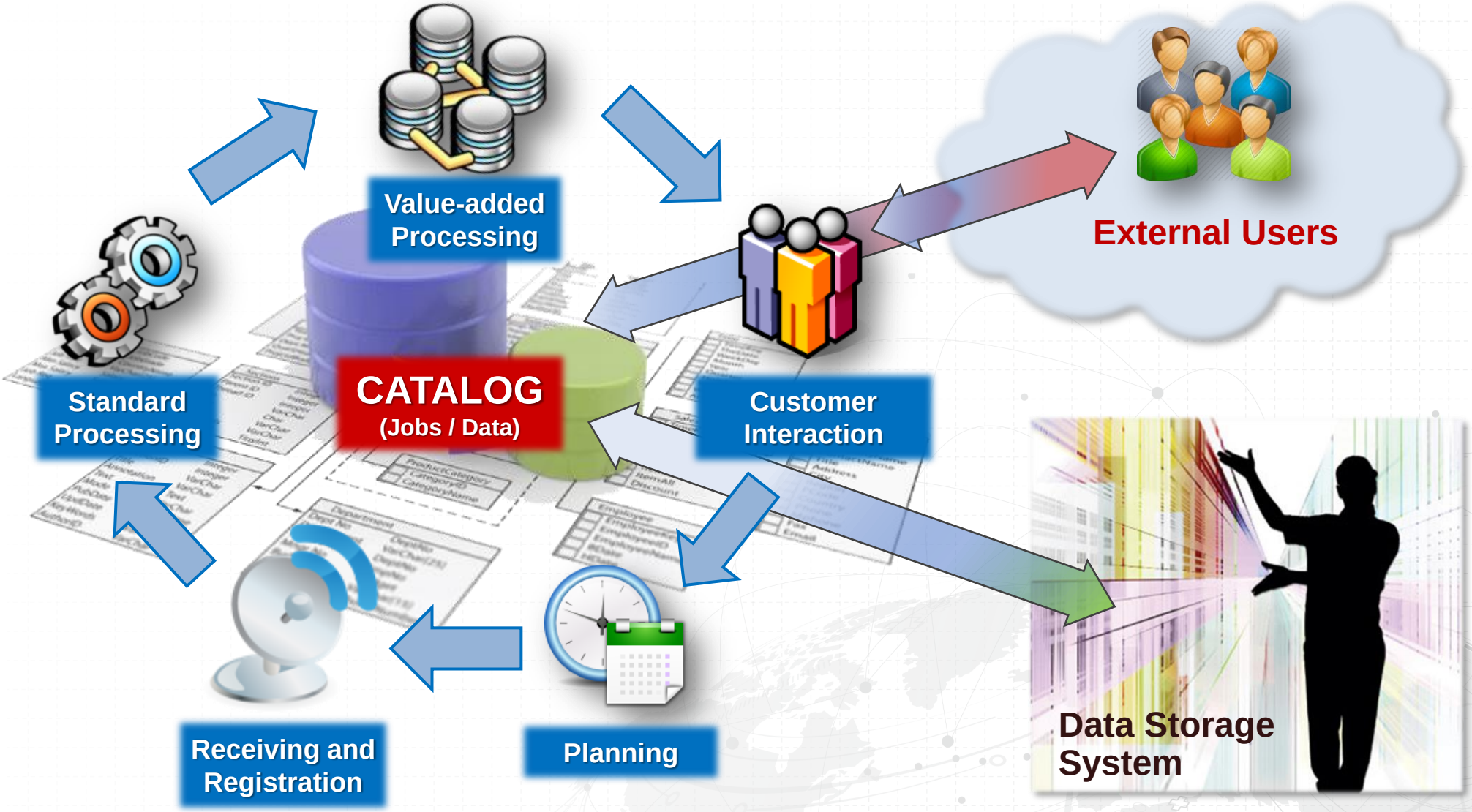
RESURS-P DATA COVERING DIAGRAM

The area of the Russian territory coverage by Resurs-P1 and -P2 (PAN and MS data) is more than 30 million sq. km since 2013

KANOPUS-V DATA COVERING DIAGRAM

The area of the Russian territory coverage by Kanopus-V1 (PAN and MS data) is more than 50 million sq. km since 2013

TECHNOLOGICAL SCHEME OF RUSSIAN OPERATOR'S CYCLE



RUSSIAN AND FOREIGN EARTH OBSERVATION DATA RECEIVING AND RECORDING FACILITIES

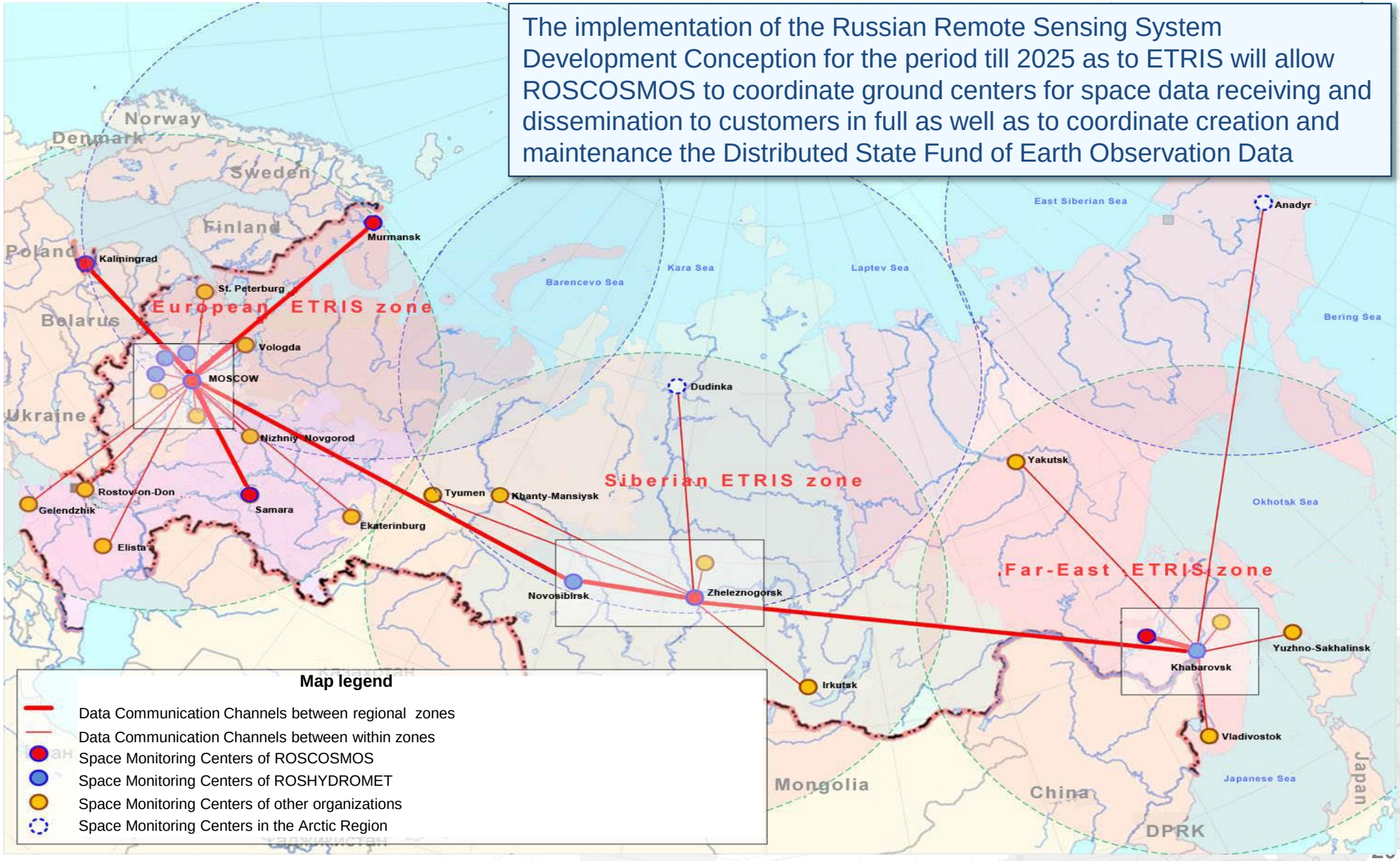
EO Data Receiving and Recording Complex

Space Communication Station

The antenna complexes provide data receiving at the rate between 5 and 320 Mbps of X-band with left and right polarization, for 24 hours – up to 30 satellites

INTEGRATED GEOGRAPHICALLY DISTRIBUTED INFORMATION SYSTEM OF EARTH REMOTE SENSING (ETRIS)

The implementation of the Russian Remote Sensing System Development Conception for the period till 2025 as to ETRIS will allow ROSCOSMOS to coordinate ground centers for space data receiving and dissemination to customers in full as well as to coordinate creation and maintenance the Distributed State Fund of Earth Observation Data



Map legend

- Data Communication Channels between regional zones
- Data Communication Channels between within zones
- Space Monitoring Centers of ROSCOSMOS
- Space Monitoring Centers of ROSHYDROMET
- Space Monitoring Centers of other organizations
- Space Monitoring Centers in the Arctic Region

GEOINFORMATION SERVICES OF THE OPERATOR

Unprocessed EO data

Ground complex of reception, processing and distribution of space information
(Research Center for Earth Operative Monitoring, JSC "RSS")

Unprocessed EO data

The unified bank of geodata

Joint catalog and archive of standard EO data

from 2010

The bank of EO data interdepartmental use – BBP

Catalog and archive of basic EO products

From 2016

Being developed

Open data portal
Data with spatial resolution of 60 m and lower
(Electro-L, Meteor-M, Resurs-P)

ROSCOSMOS Geoportal

DEPARTMENTAL AND REGIONAL INFORMATION SYSTEMS

JOINT STATE SYSTEM OF INFORMATION ON THE SITUATION IN THE WORLD OCEAN

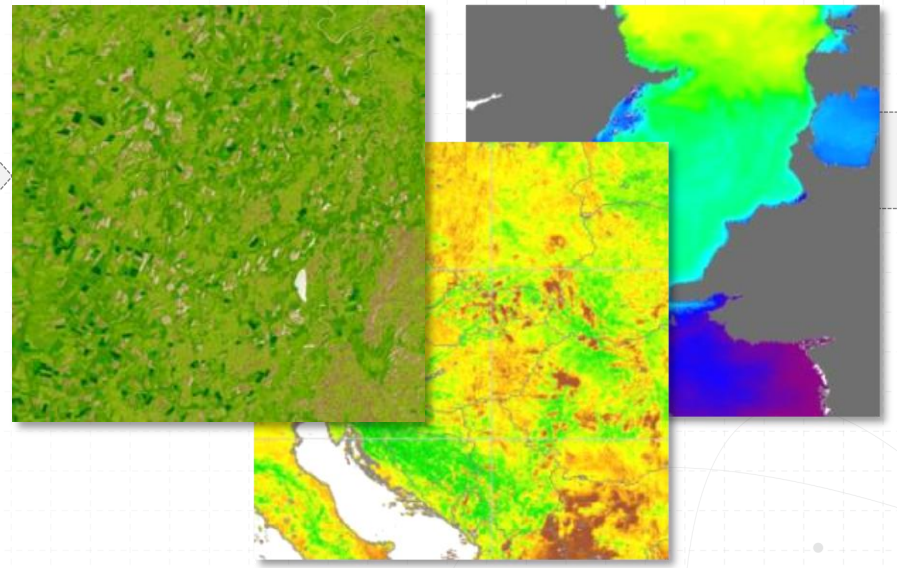
ЕСИМ

INTERNATIONAL COOPERATION PROGRAMS

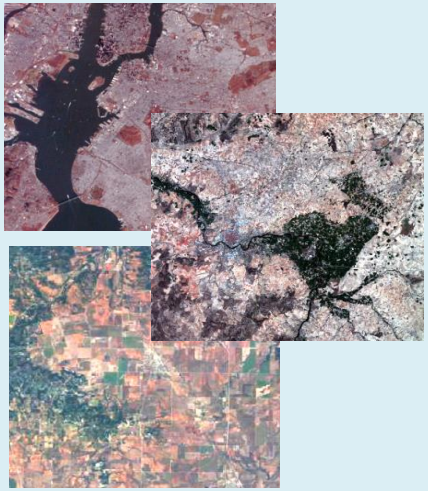
CEOS – CWIC

Maintaining regional EO data banks require their informational and technology connection (support) with a central data bank of Russian EO Satellites Operator

CONCEPT OF BASIC EO DATA PRODUCT

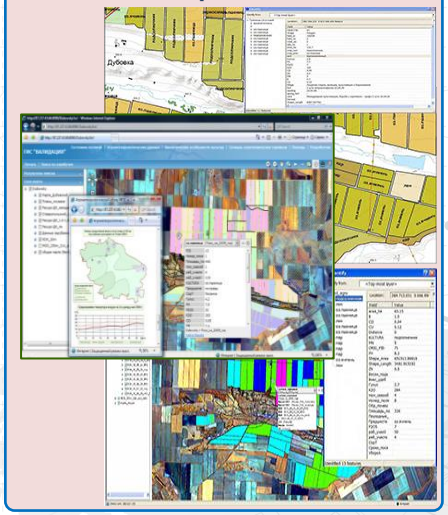


EO Data Products of Standard Processing Level (L1C, L1D CEOS)

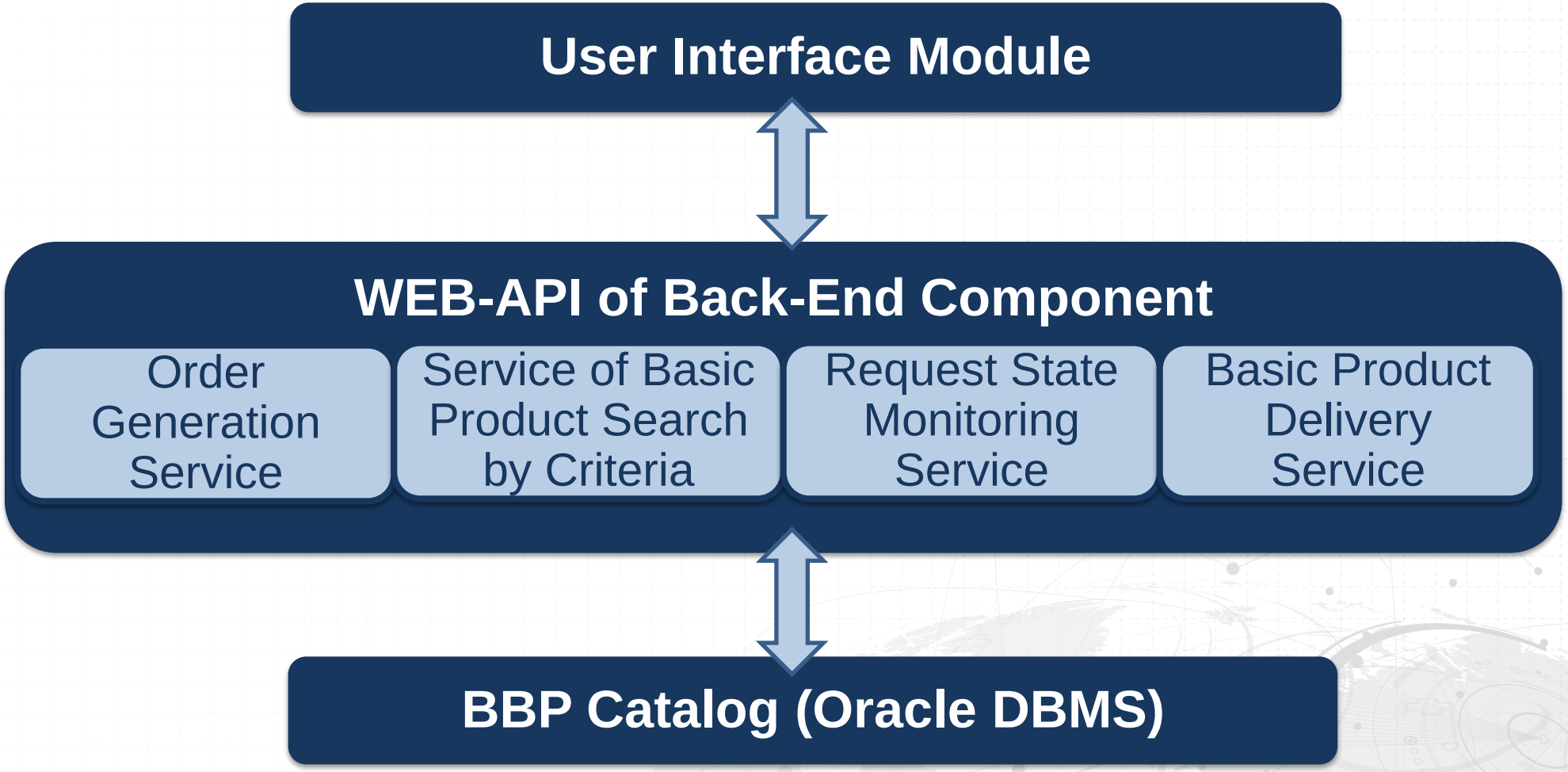


Basic EO data products provide the basis for multipurpose thematic interpretation for solving the tasks of interagency and regional customers with no use of additional measuring material

Thematic GIS – Results of Basic Products Interpretation



BLOCK-DIAGRAM OF BASIC PRODUCTS BANK (BBP) DISTRIBUTION COMPONENT



PROGRAMM INTERFACE FEATURES OF BBP WEB SERVICE

1. API access to BBP resources is implemented on the basis of the HTTP protocol with support of cryptographic encryption protocols TLS/SSL (HTTPS).

2. Support of various ways of access to service resources (data search without order).

3. Data service is provided by api-key (a signature of the access to resources) composed after successful authorization.

4. Capability of varied search options (interest zone geometry, weather conditions, remote sensing conditions, etc.).

5. Implemented method of messages exchange – JSON (Javascript object notation).

PROGRAMM INTERFACE FEATURES OF BBP WEB SERVICE

1. Support of a geographical basis for a search of primary basic products.
2. Multilingual use.
3. Mechanisms of cross-platform and cross-browser formation of the interface.
4. Capability of saving of basic products criteria set search, as well as of conditions of an interactive map during a change of client's sessions (LocalStorage technology).
5. Support of search engines and loading of pre-set user's regions of interest in accordance with the GeoJSON format.
6. Support of dynamic information mechanisms updates in accordance with the Ajax technology.
7. Support of the images selection mechanisms corresponding to the set search criteria, mechanisms of sorting and grouping of found images.

SEARCH DATA

oscow

Ru
En

SEARCH DATA

Search area:

User layers

LineString [ID: 5491521807]

Static layers

Polygon [ID: 73593736]

Date range:

from: 01.01.2014 to: 22.09.2015

Satellites:

- EO-1 (Earth Observing-1)
- Kanopus-V 1
- Landsat-7
- Landsat-8
  - OLI-TIRS
- Meteor-M 1
- Meteor-M 2
  - KMSS_MSU50
  - KMSS_MSU101
  - KMSS_MSU102
  - MSU-MR
  - BRLK
- Resurs-DK 1
  - GEOTON
- Resurs-P 1
- Resurs-P 1

Cloudiness:

no more than *(percentage, %)*: 35

Camera angles:

Search

lat: 37.579
lon: 98.789

SNAPSHOTS

Search...

Ru
En

Satellite name:	Landsat-8
Sensor name:	OLI-TIRS
Orbit pass:	0
Route:	25233
Frame:	2015233

SNAPSHOTS

High 0 | Medium 20 | Low 0

Total: 216

MEDIUM RESOLUTION

LS8.OLI-TIRS.000LC81320232015233LGN00				27.08.2015 19:56:42
10%	α: 0° β: 0°	α: 156° β: 43°		
MM2.MSU101.10000586001011				25.08.2015 11:24:28
14%	α: -82° β: 14°	α: 121° β: 44°		
MM2.MSU101.10000585801006				25.08.2015 07:56:05
33%	α: -82° β: 14°	α: 140° β: 54°		
MM2.MSU101.10000585801005				25.08.2015 07:54:55
64%	α: -82° β: 14°	α: 144° β: 57°		
MM2.MSU101.10000584501009				24.08.2015 10:01:55
46%	α: -82° β: 14°	α: 125° β: 46°		
MM2.MSU101.10000584501008				24.08.2015 10:00:44
11%	α: -82° β: 14°	α: 129° β: 48°		
MM2.MSU101.10000584401009				24.08.2015 08:17:06
24%	α: -82° β: 14°	α: 137° β: 52°		
MM2.MSU101.10000584401008				24.08.2015 08:15:56
56%	α: -82° β: 14°	α: 141° β: 54°		
MM2.MSU101.10000584201009				24.08.2015 04:56:47
24%	α: -82° β: 14°	α: 128° β: 47°		
MM2.MSU101.10000584201008				24.08.2015 04:55:36
14%	α: -82° β: 14°	α: 132° β: 49°		

1

lat: 67.067
lon: 226.41

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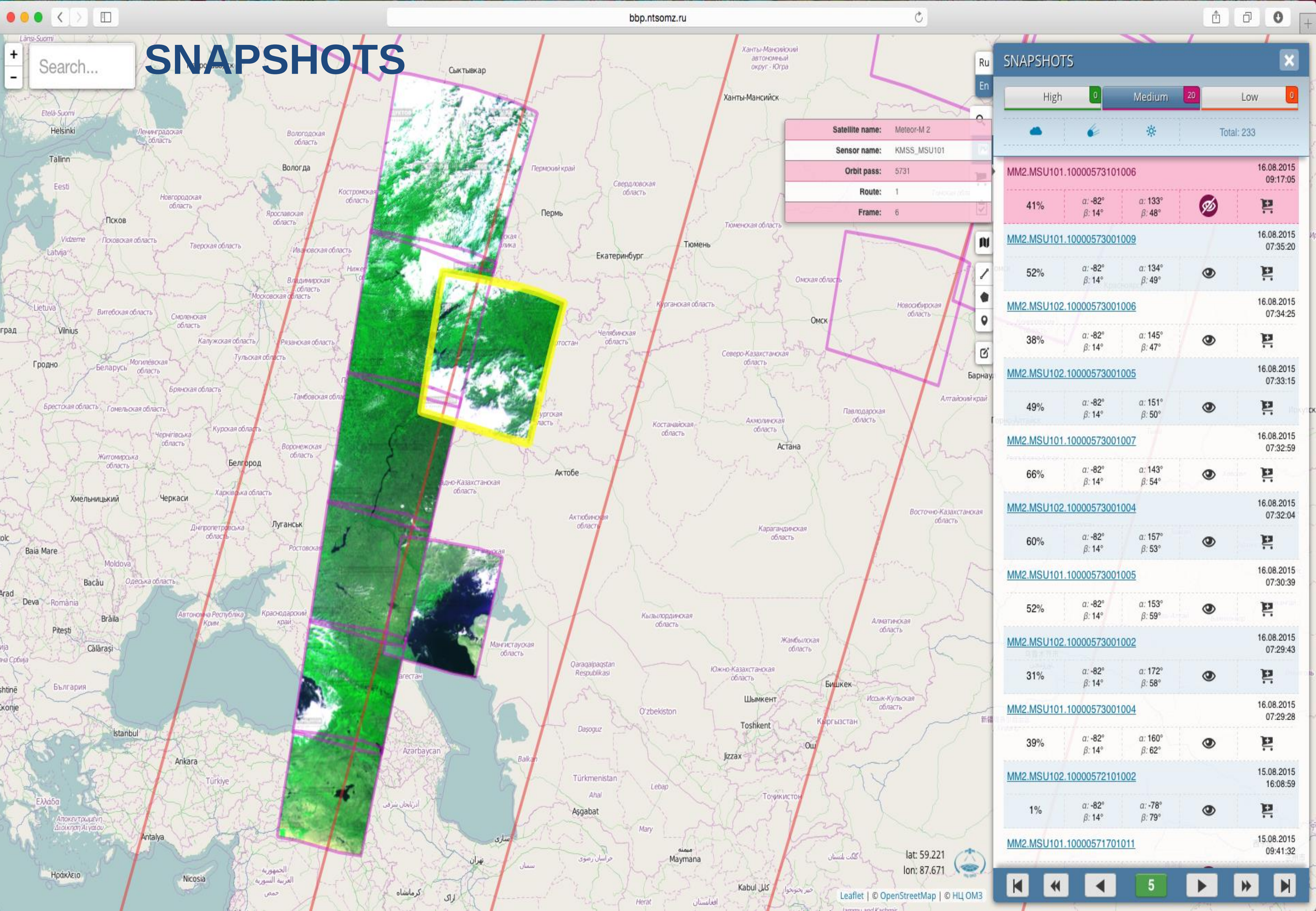
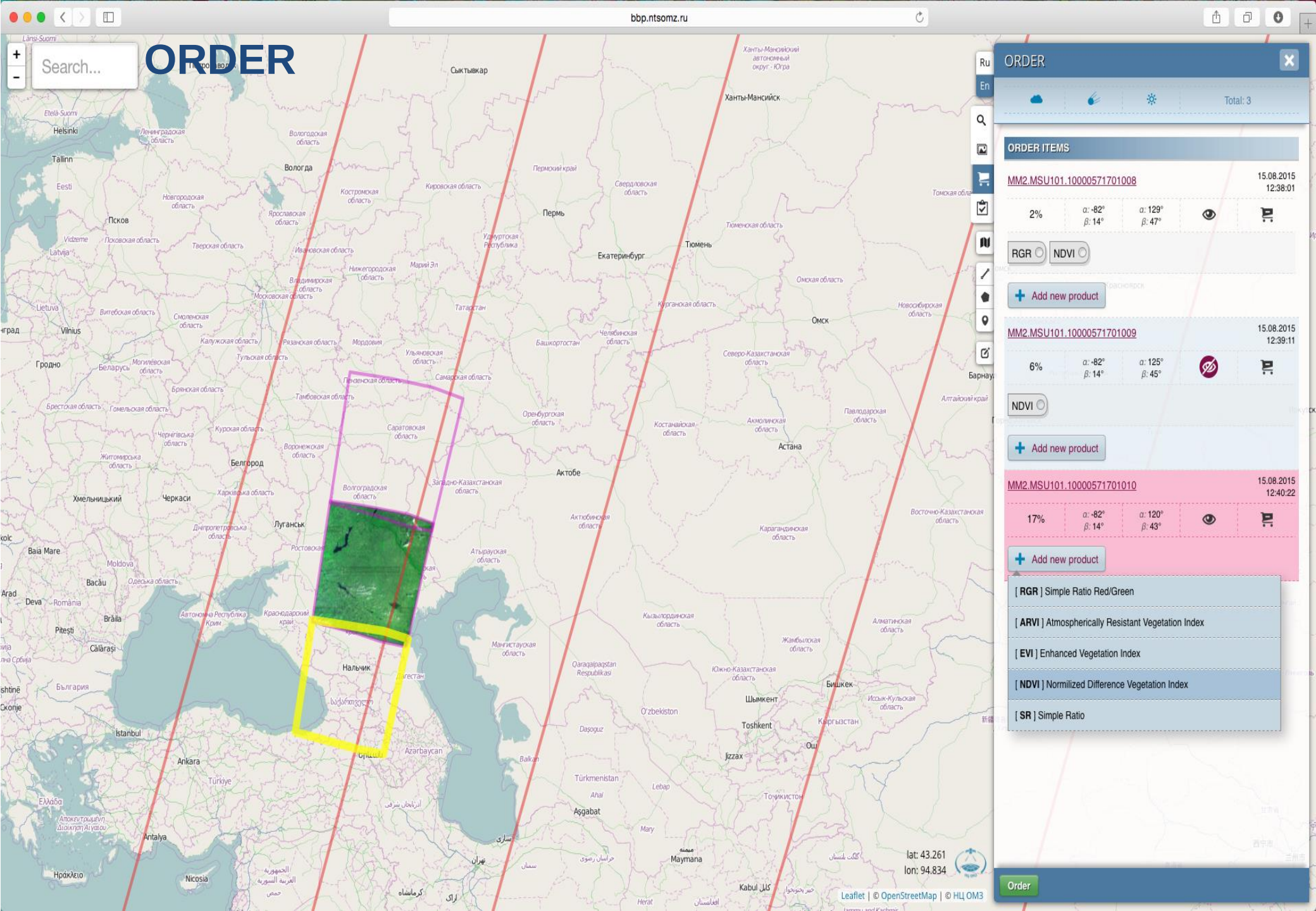
Message: Total: **216**; Page: **1** / 11; Showed: ***1 – 20***

SNAPSHOTS



bbp.ntsomz.ru
Search...
SNAPSHOTS
High 0
Medium 20
Low 0
Total: 233
Satellite name: Meteor-M 2
Sensor name: KMSS_MSU101
Orbit pass: 5731
Route: 1
Frame: 6
MM2.MSU101.10000573101006 16.08.2015 09:17:05
41% α: -82° β: 14° α: 133° β: 48°
MM2.MSU101.10000573001009 16.08.2015 07:35:20
52% α: -82° β: 14° α: 134° β: 49°
MM2.MSU102.10000573001006 16.08.2015 07:34:25
38% α: -82° β: 14° α: 145° β: 47°
MM2.MSU102.10000573001005 16.08.2015 07:33:15
49% α: -82° β: 14° α: 151° β: 50°
MM2.MSU101.10000573001007 16.08.2015 07:32:59
66% α: -82° β: 14° α: 143° β: 54°
MM2.MSU102.10000573001004 16.08.2015 07:32:04
60% α: -82° β: 14° α: 157° β: 53°
MM2.MSU101.10000573001005 16.08.2015 07:30:39
52% α: -82° β: 14° α: 153° β: 59°
MM2.MSU102.10000573001002 16.08.2015 07:29:43
31% α: -82° β: 14° α: 172° β: 58°
MM2.MSU101.10000573001004 16.08.2015 07:29:28
39% α: -82° β: 14° α: 160° β: 62°
MM2.MSU102.10000572101002 15.08.2015 16:08:59
1% α: -82° β: 14° α: -78° β: 79°
MM2.MSU101.10000571701011 15.08.2015 09:41:32
5
lat: 59.221
lon: 87.671
Leaflet | © OpenStreetMap | © НЦ ОМЗ


bbp.ntsomz.ru
ORDER
Search...
ORDER
Total: 3
ORDER ITEMS
MM2.MSU101.10000571701008
15.08.2015
12:38:01
2%
α: -82°
β: 14°
α: 129°
β: 47°
RGR
NDVI
Add new product
MM2.MSU101.10000571701009
15.08.2015
12:39:11
6%
α: -82°
β: 14°
α: 125°
β: 45°
NDVI
Add new product
MM2.MSU101.10000571701010
15.08.2015
12:40:22
17%
α: -82°
β: 14°
α: 120°
β: 43°
Add new product
[RGR] Simple Ratio Red/Green
[ARVI] Atmospherically Resistant Vegetation Index
[EVI] Enhanced Vegetation Index
[NDVI] Normilized Difference Vegetation Index
[SR] Simple Ratio
Order
lat: 43.261
lon: 94.834
Leaflet | © OpenStreetMap | © НЦ ОМЗ

BBP INFORMATION INTEROPERATION

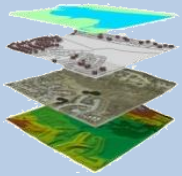
BASIC PRODUCTS BANK
www.bbp.ntsomz.ru

Satellite Services Centers

VEGA Satellite Service

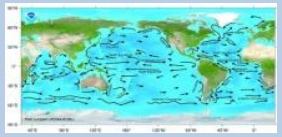
VEGA-Science

VEGA-PRO



ETRIS Integrated Bank of Geo-Information Data

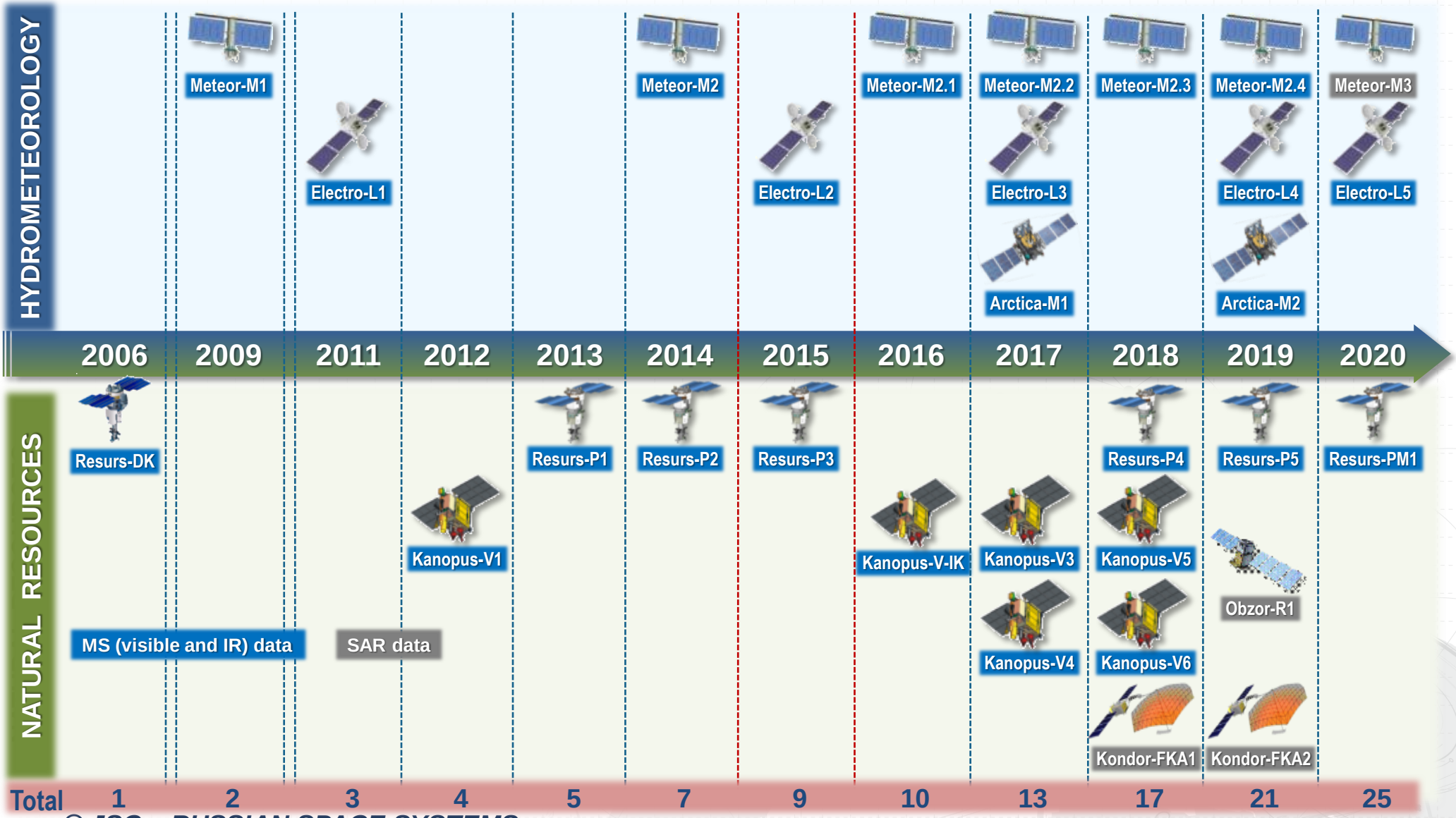
ROSCOSMOS GEOPORTAL
www.gptl.ru



Sea To Sea
Satellite Service Of World Ocean Monitoring

VolSatView
System for Remote Monitoring of Volcanic Activity of Kamchatka and the Kurile Islands

THE RUSSIAN EARTH OBSERVATION SATELLITE CONSTELLATION 2006–2020



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United
Rocket and Space Corporation

THANK YOU FOR ATTENTION!

Tamara Ganina

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www.ntsomz.ru

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UKSA, Harwell, UK
September 28 – October 2, 2015