

Russian Space Infrastructure applied in the Arctic: sea ice application within Roshydromet

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Satellite sea ice applications :

- Operative tasks:
 - 24/7 sea ice operative analysis & monitoring
 - Sea ice charting
 - General and customized hydrometeorological services (support)
- Climatic monitoring of sea ice parameters
 - Sea ice boundary, extent, MYI variability
 - Long-term planning and informing of federal bodies
- Research applications
 - NP and other field activities support
 - development of algorithms for Arctic sea & land ice, atmosphere and ocean monitoring

Institutions:

Arctic and Antarctic Research Institute (AARI): <http://www.aari.ru>

<p>19.10.2009 XIV международный научный симпозиум имени академика М.А. Усова студентов и молодых ученых "Проблемы геологии и освоения недр" NEW</p> <p>16.10.2009 Информация о СП – 37 за период 09-15.10.09</p> <p>16.10.2009 «175 лет гидрометеорологической службе России МЕТЕО-ЭКСПО 2009»</p>	<p>ГУ "Арктический и антарктический научно-исследовательский институт" (ГУ ААНИИ)</p> <p>Федеральная служба по гидрометеорологии и мониторингу окружающей среды Российской Федерации (Росгидромет)</p>	<p>[Галерея фотографий] [Издания]</p> <p>[Лед. карты текущие] [Прогноз]</p> <p>[Геофизика] [Прогноз Волнения]</p> <p>[проект ВМО ГБЦДМЛ] [ЕСИМО]</p> <p>[СП-37] [Погода Арктики и СПБ]</p> <p>[Антарктика-РАЭ] [Вакансии]</p> <p>[Лаборатория ОШЛ] [им.Фрама]</p> <p>[Проект ПАЛЕКС]</p>
<p>Евразийский подорфис МПГ Россия в МПГ Полярные океаны и морская криосфера</p>		
		
<p>[Далее на русском] [Гостевая книга] [More in English]</p> <p>Фото-ресурсы</p>		
<p>Адрес ААНИИ: 199397, Россия, Санкт-Петербург, ул.Беринга, 38 тел.:(812)3521520 факс:(812)3522688 e-mail:aaricoop @ aari.ru</p>		
<p>[English version] Пресс-служба: тел./факс. (812) 352-2735 - press @ aari.ru Полярные FAQ: info @ aari.ru </p>		

Planeta Research Center for Space Hydrometeorology:
<http://planet.iitp.ru>

- Core Ground Segment
- Satellite Data Products
- Satellite Systems
- Applied Projects
- Partners

Scientific Research Center "Planeta" is a state organization that was founded in 1974.

SRC "Planeta" is a leading organization of the Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) in exploiting and development of national satellite Earth observation systems of hydrometeorological (Meteor, Electro) and environmental (Resurs) purpose and also in receiving and processing data from NOAA, EOS (Terra, Aqua), METEOSAT, GOES, MTSAT and other satellites.



SRC "Planeta" is executing operative control and guidance management of ground system for receiving and processing satellite data and includes three regional receiving and processing centers (Obninsk-Moscow-Dolgoprudny, Novosibirsk & Khabarovsk) and a network of almost 70 stationary and mobile autonomous receiving stations located in Russia, Antarctica, or mounted on ships. They provide satellite data that covers all the territory of Russian Federation and Europe.

Each day SRC "Planeta" receives and processes vast amounts of data (more than 80 Gigabytes) and issues more than 100 types of satellite information products for federal, regional and local level users - Roshydromet organizations, Department of Defense, Emergency Control Ministry, Ministry of Environmental Resources and other ministries and departments (total - more than 300 users). Efficient data dissemination is ensured by a developed network of specialized communication links.



SRC "Planeta" is participating on regular basis in major national and international programs concerned with use of Earth remote sensing data: operative hydrometeorology, ecology, global climate research and monitoring, disaster monitoring etc. Center possesses vast experience in realization of various applied projects (including international projects in collaboration with leading world organizations) and in building of territorial and task-oriented informational systems that use satellite data.

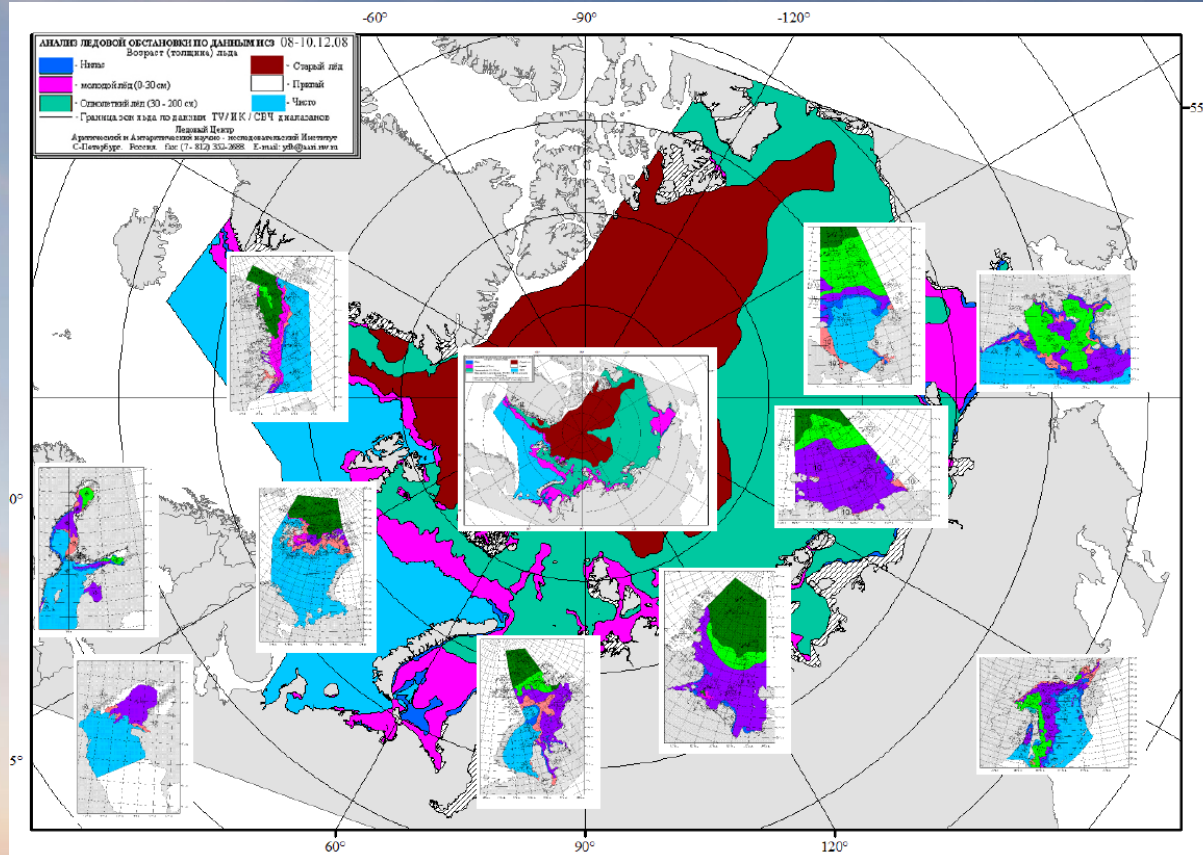
All received space data is stored in archives of State Information Fund of Russian Federation (since 1979), as well as dedicated archives of informational production.

Catalogues of satellite images are available at internet-servers:

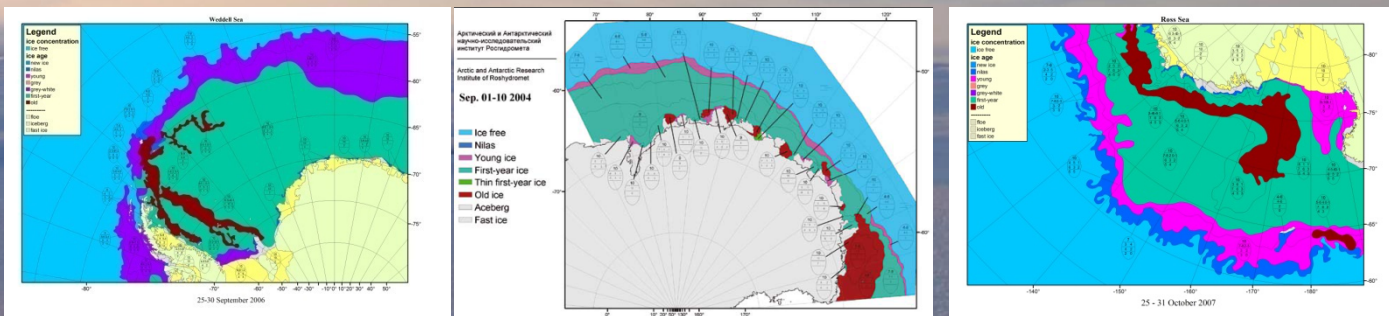
<http://sputnik1.infospace.ru>
<http://planet.iitp.ru>
<http://planet.rssi.ru>



Ice-covered regions operationally monitored by AARI

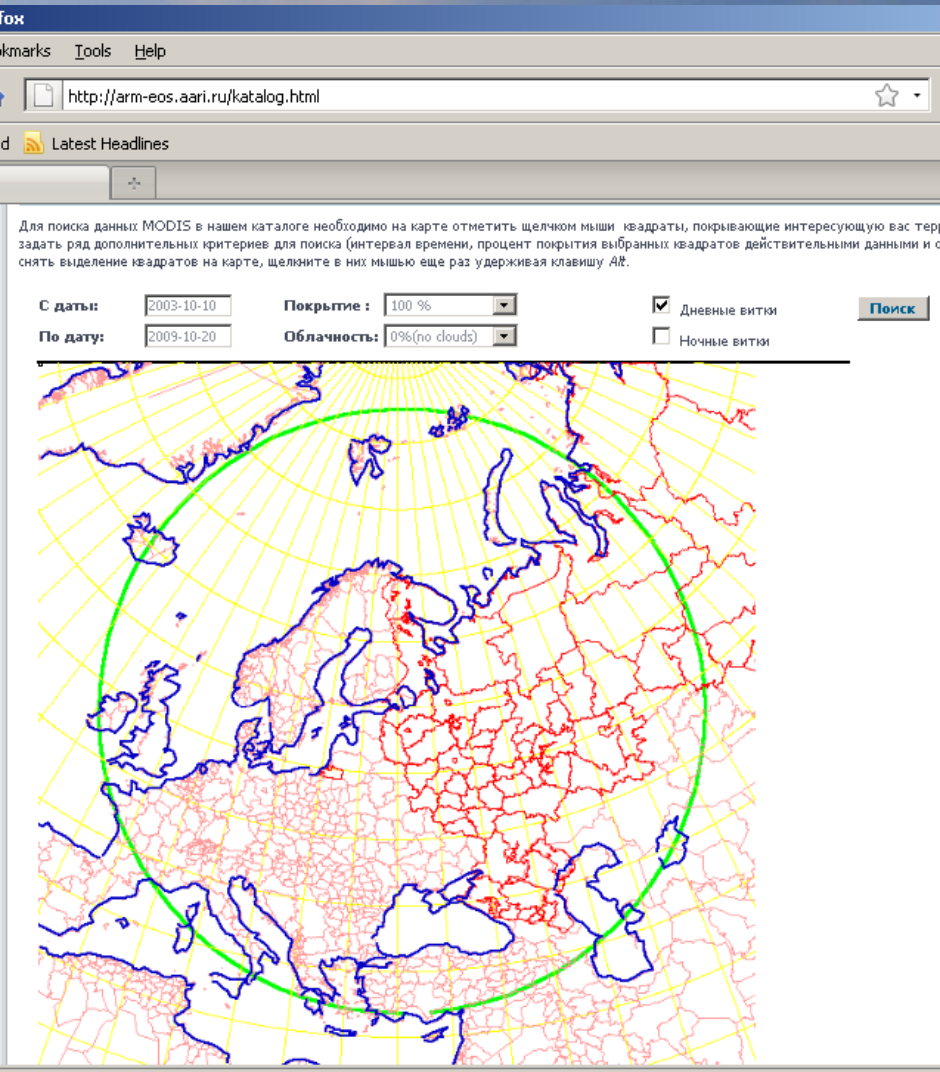


Arctic Ocean and
shelf seas: 1-7 days
periodicity



Antarctic sectoral
analysis on
bi-weekly scale

AARI "SEVER" system satellite reception station



Keypoints:

- from 1992 satellite imagery is the prime source of initial data for sea ice parameters
- satellite imagery wherever possible is complemented by ground-truth obs from ships, drifting platforms and coastal stations
- analysis is validated upon history
- multi-sensor approach is always used

Imagery	Approx no. scenes per month
Radarsat	Infrequently, in winter season 30-50
Envisat	30 GMM/WSM
MODIS	300
AVHRR	450
SSM/I, AMSR	approx 30 per month
QuikScat	approx 30 per month

Services provided by the AARI:

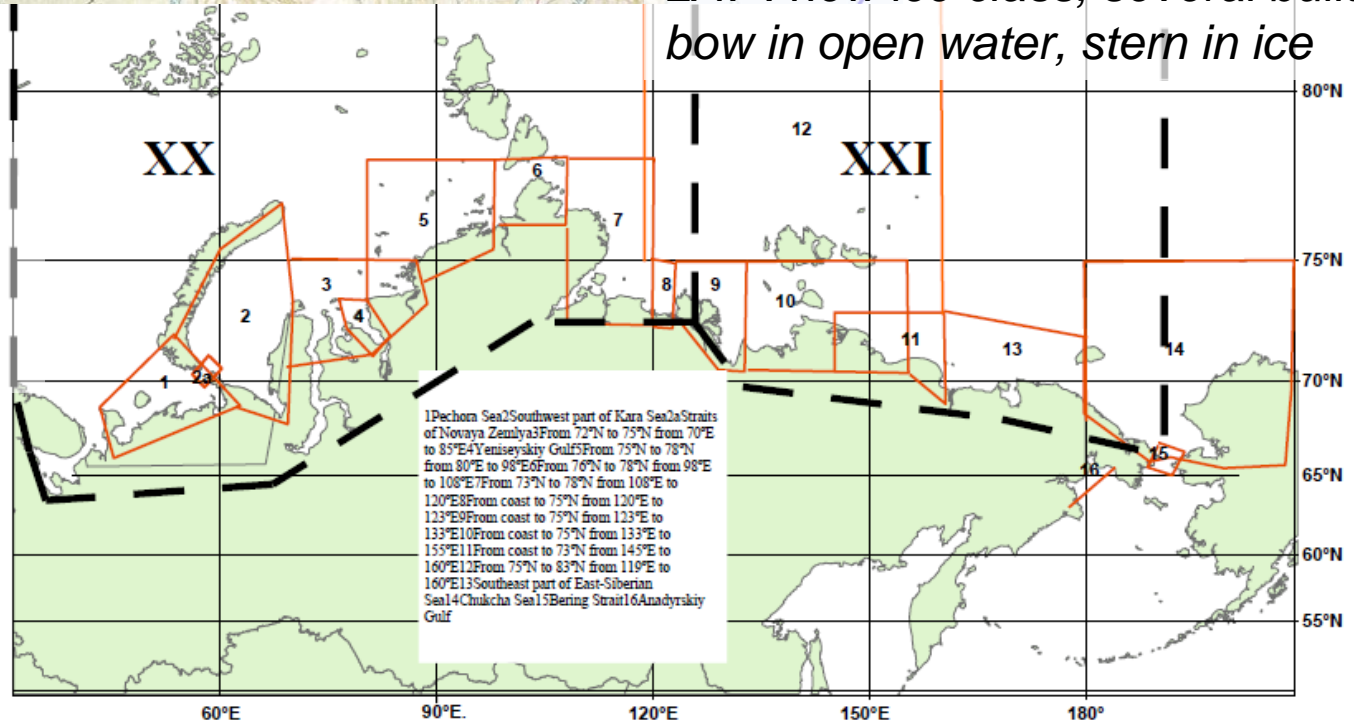
- Service 1: *navigation support to shipping – repetitive coverage in areas and sections that change seasonally (daily...weekly imagery, analysis and prognostic ice charts)*
- Service 2: *routine monitoring of Eurasian Arctic & other Russian ice covered waters and Antarctic to produce weekly and be-weekly analysis of ice conditions*
- Service 3: *tailored support for offshore activities in points (daily...weekly charts and imagery)*
- Service 4: *infrequent spot coverage in response to specific incident*
- Service 5: *infrequent spot coverage in response to tourist activities*

Services are provided within the NSR and new IHO/WMO NAVAREAS/METAREAS



Bulker “Noril’skii Nikel”, ice class LA7 : new ice class, several built, bow in open water, stern in ice

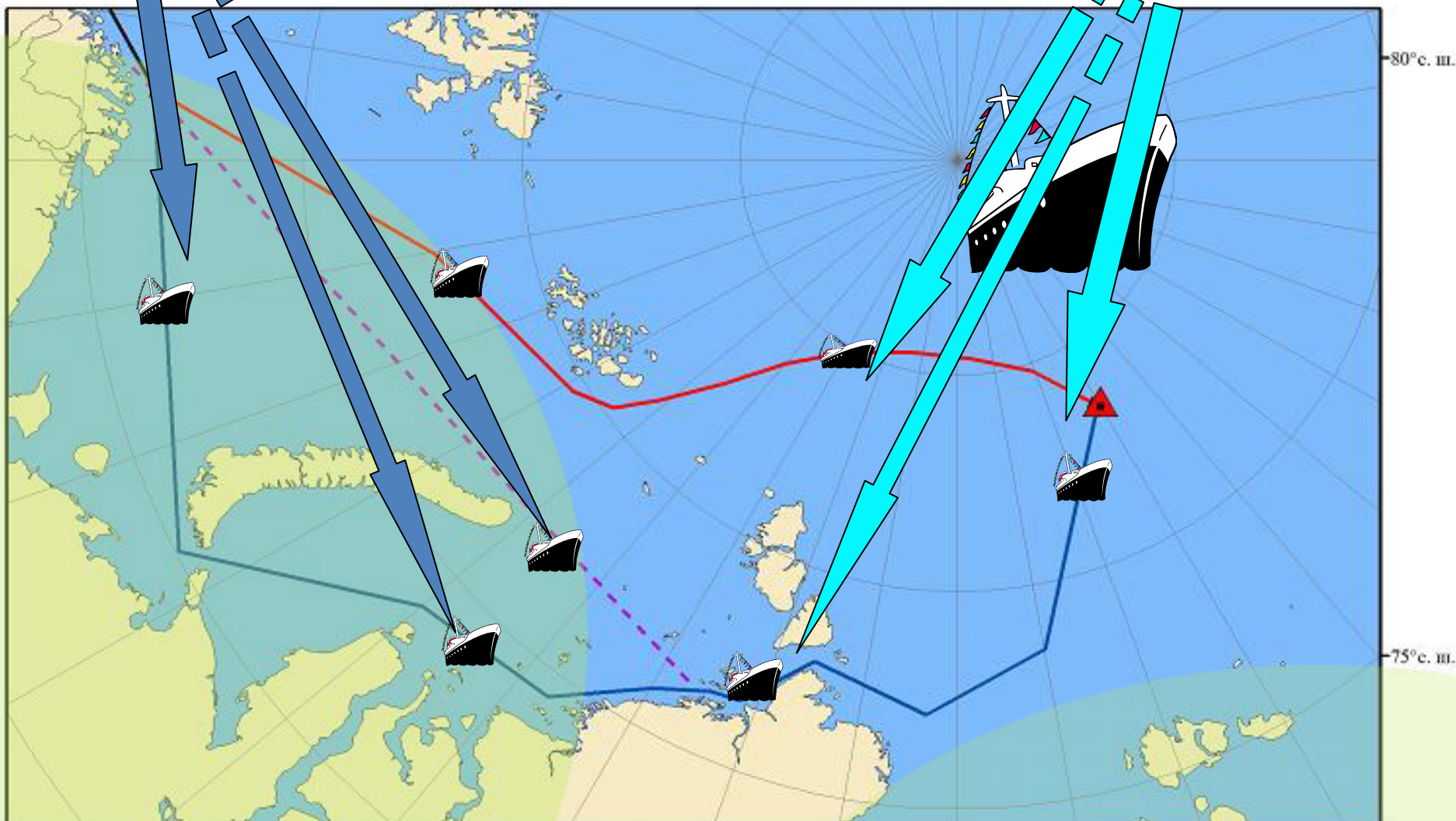
1 general and 4 destination or customer-oriented services



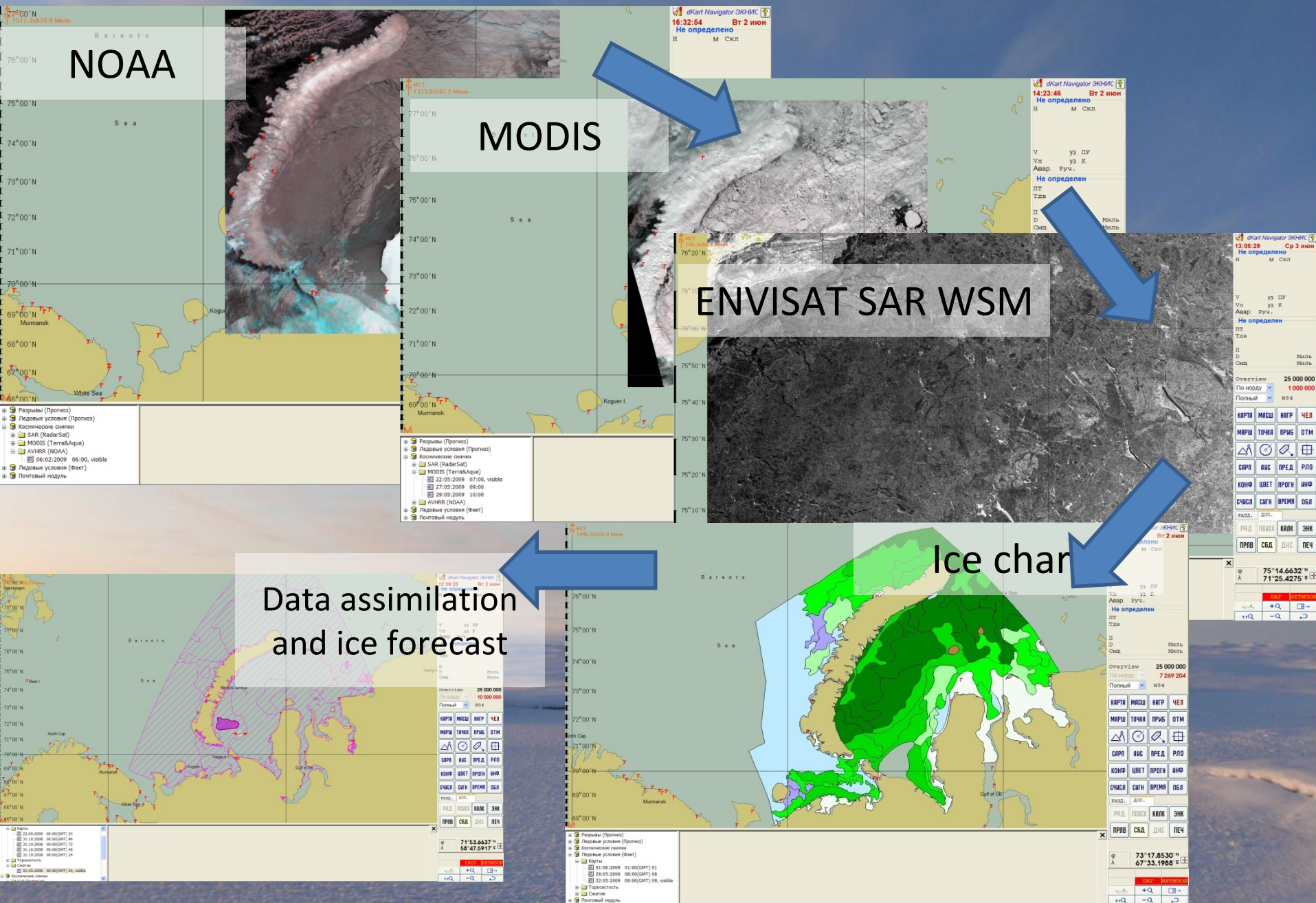
Унмарсат

Main satellite communication facilities in the western sector of NSR

Уридиум



AARI operational satellite based ice products

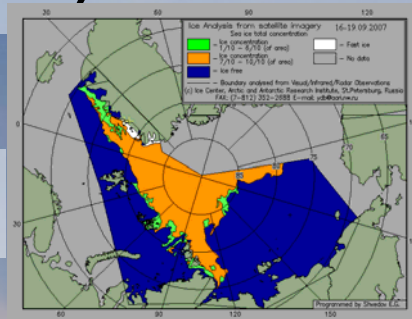
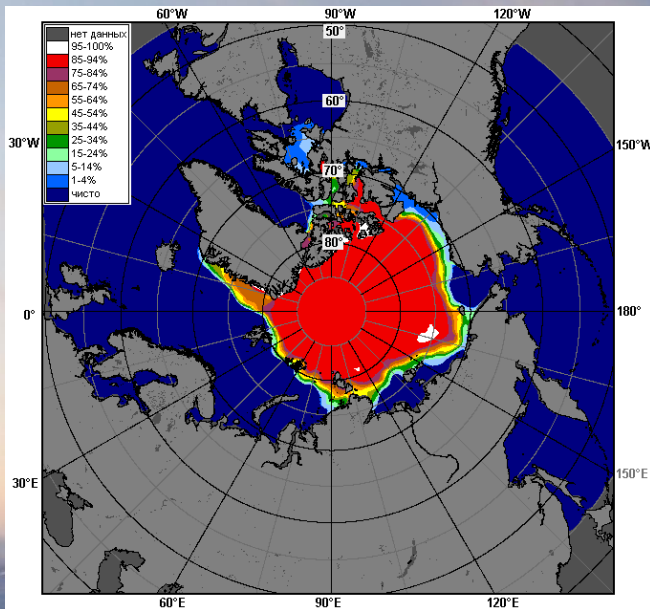


Northern Sea Route in August – September 2009

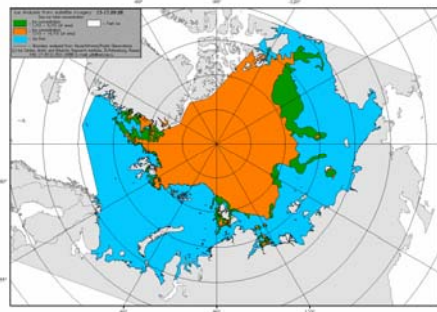


Arctic sea ice conditions – monitoring from 1933...2009 (charts)

Robust mean sea ice total concentration in September



Ice chart for 16-19 Sep'07

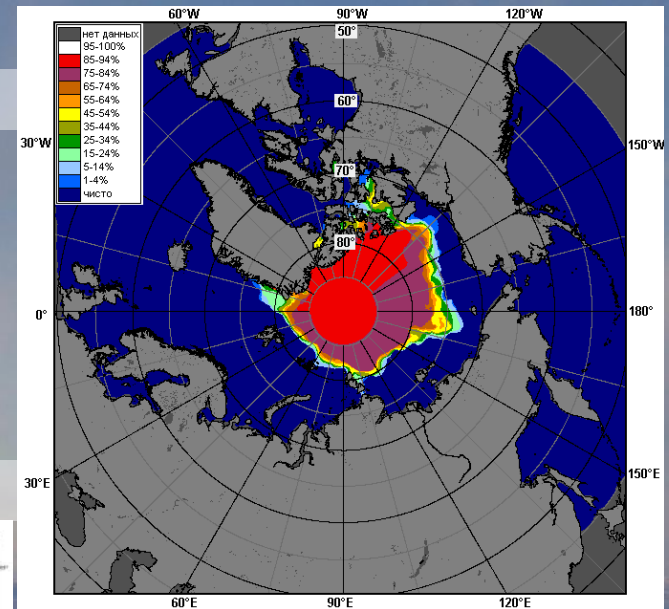


Ice chart for 15-17 Sep'08

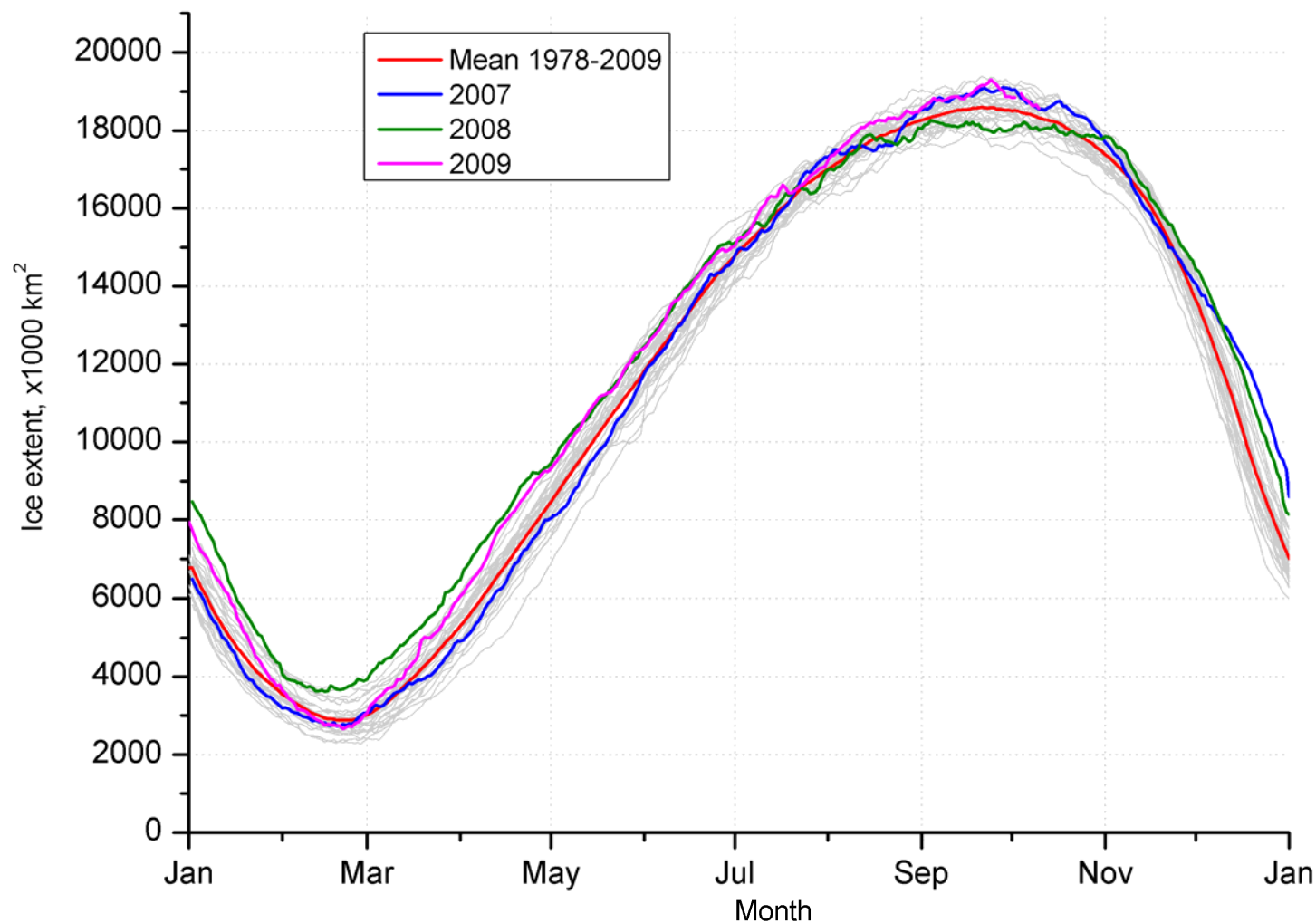


Ice chart for 13-15 Sep'09

5% quantile sea ice total concentration in September



Daily estimates of the Southern Hemisphere ice extent based on NSIDC NRT SSMR-SSM/I NASATEAM algorithm total concentration patterns



Planeta and non-specialized Roshydromet Satellite Ground Segment

3 Main centers:

Europe

(Moscow-Obninsk-Dolgoprudny)

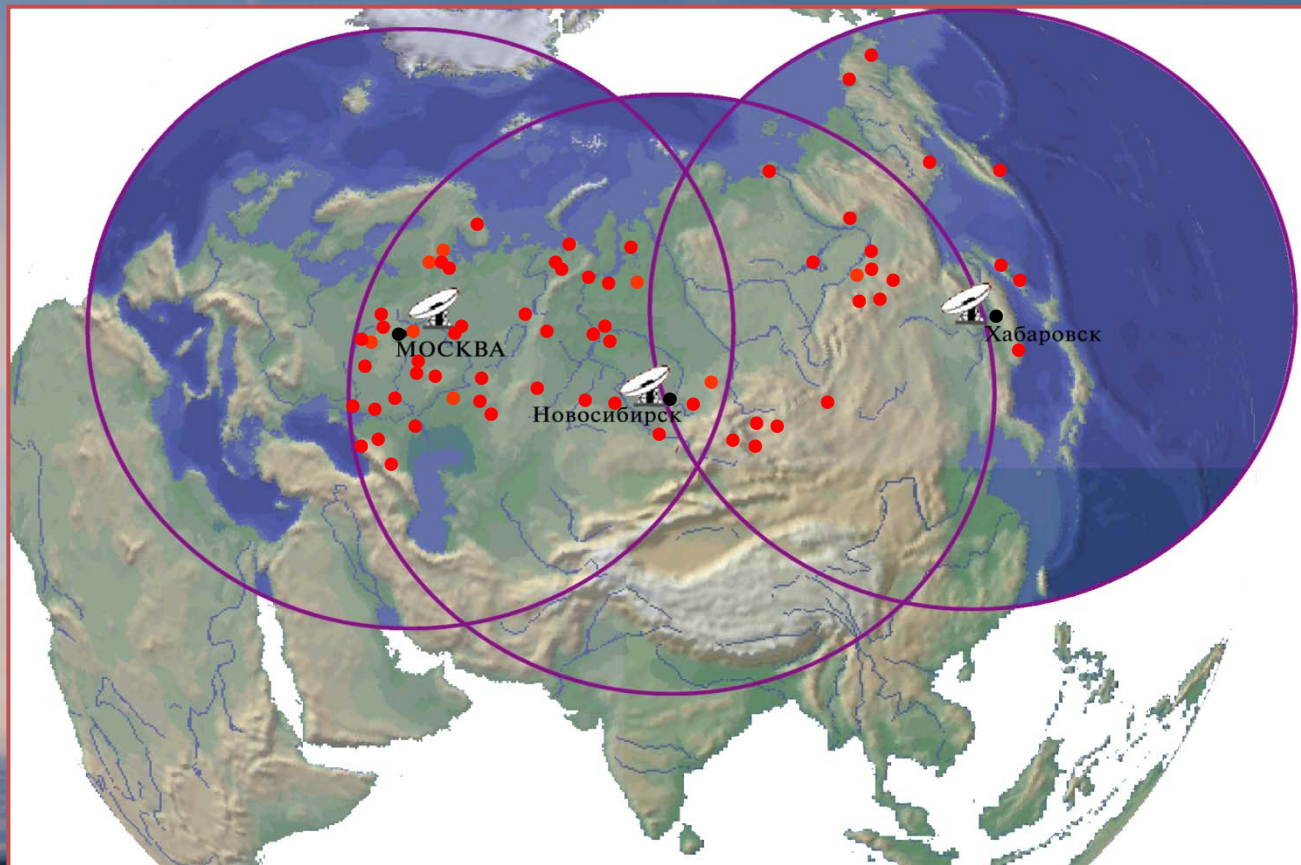
Siberia

(Novosibirsk)

Far-East

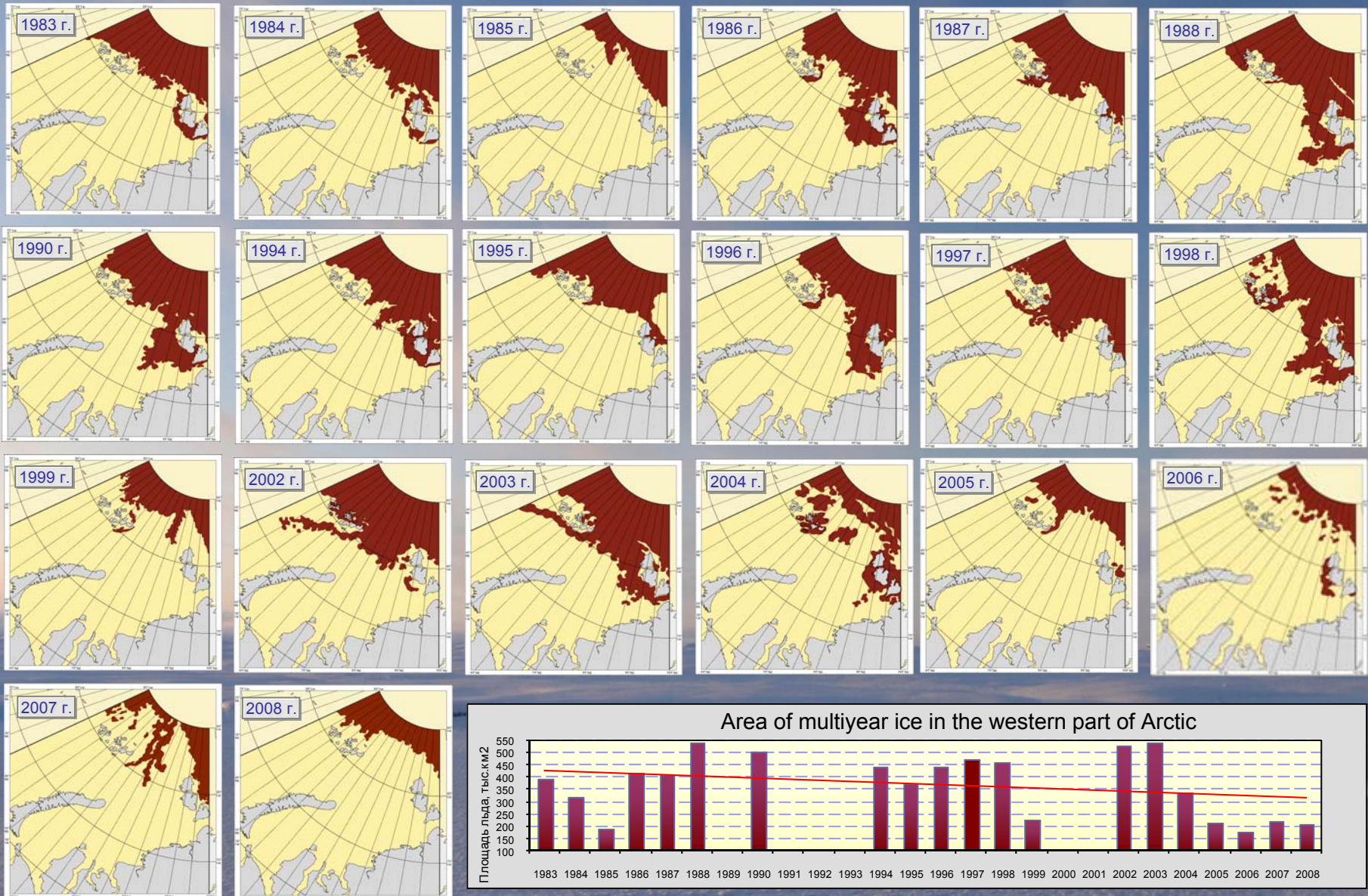
(Khabarovsk)

• 68 Local centers

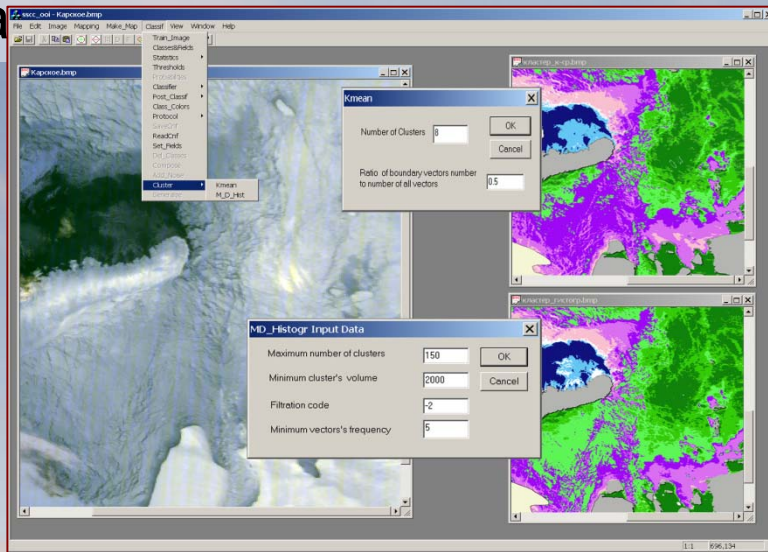


Multiyear Arctic ice dynamics in the western part of Arctic

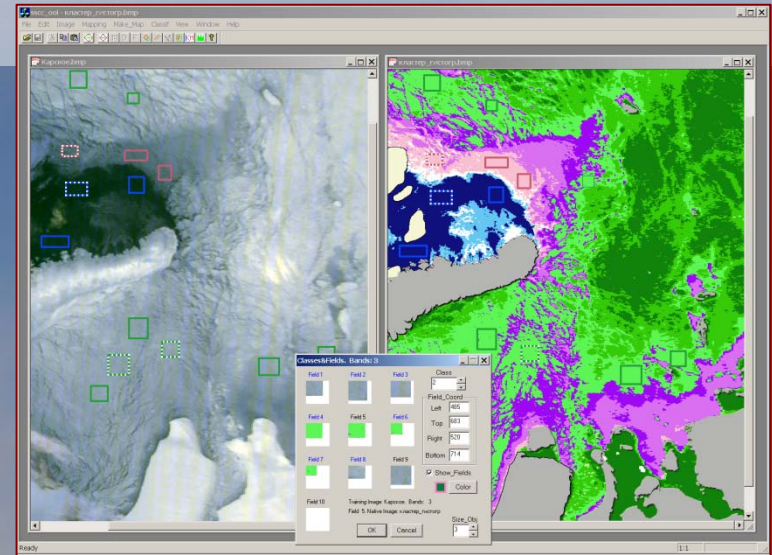
(OKEAN satellite, side-looking radar, 1,5 – 2 km, December 1983 -1999,
QuikSCAT satellite, Sea Wind NRT, 35–40 km, December 2002-2008)



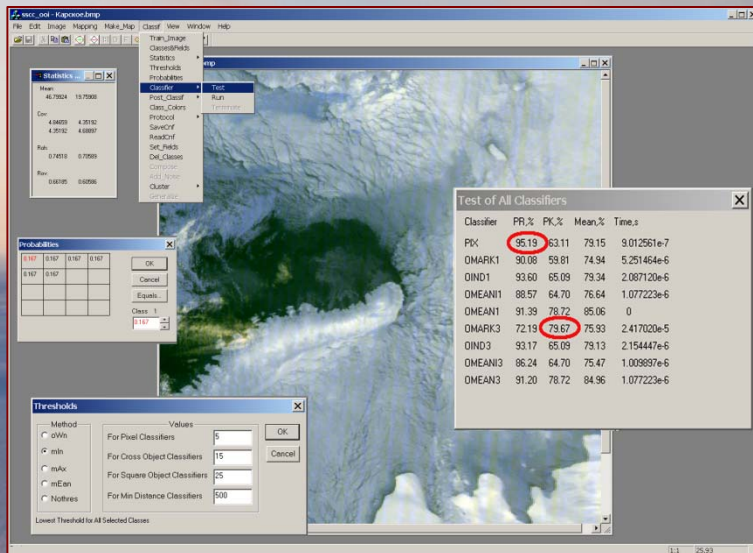
Planeta Automated classification ice objects in multispectral satellite data



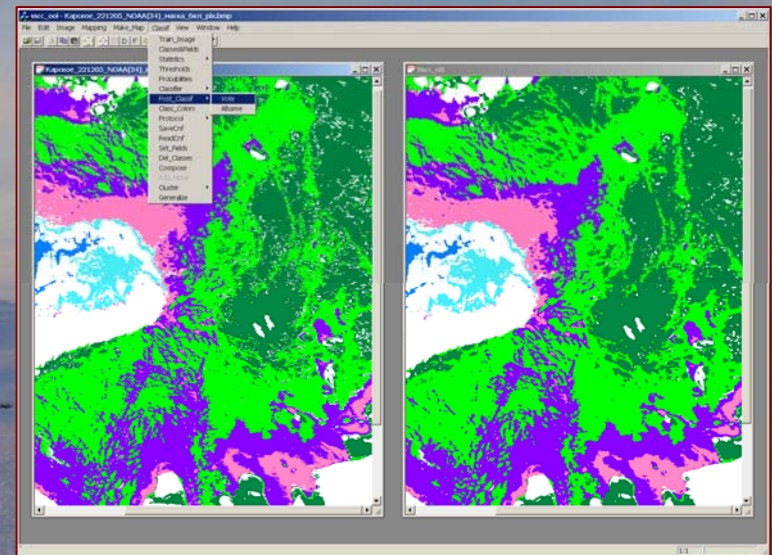
Cluster analysis



Test polygons choosing

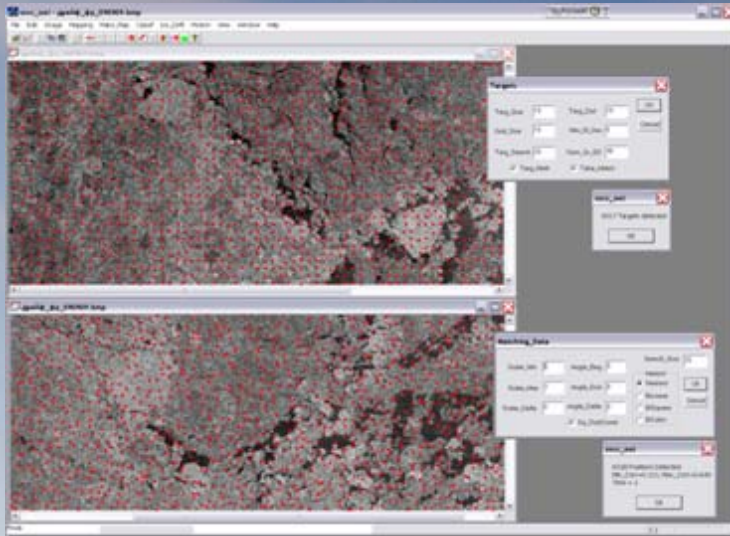


Recognizing method definition

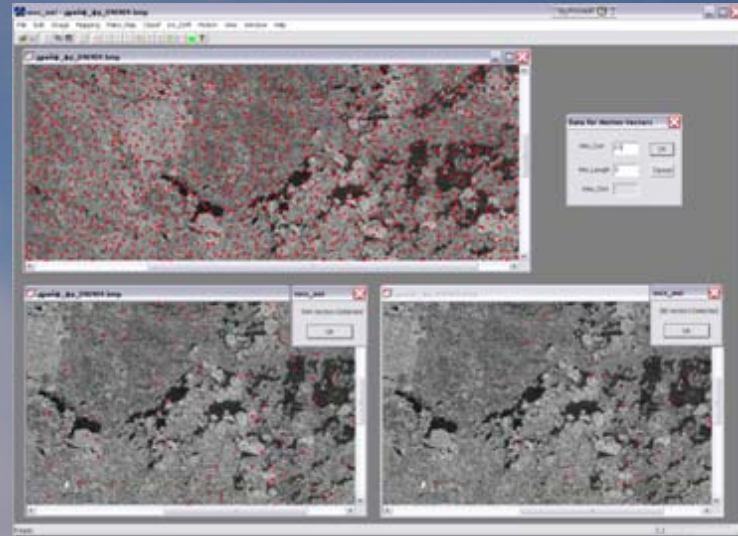


Classification and result smoothing

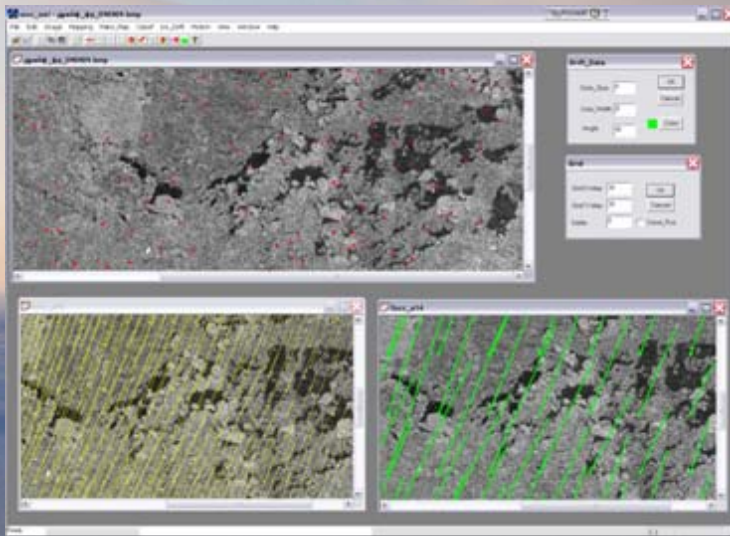
Planeta ice drift maps creation



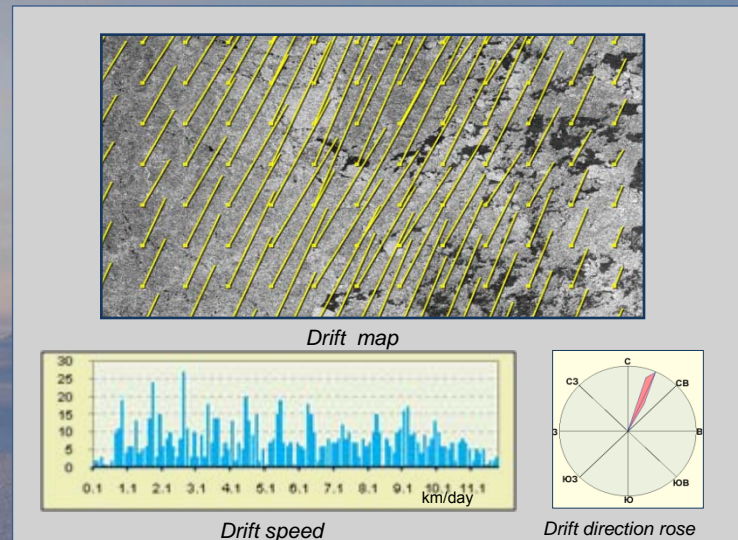
1. Searching for etalons in the current image and in the next time step image



2. Searching for optimal vector

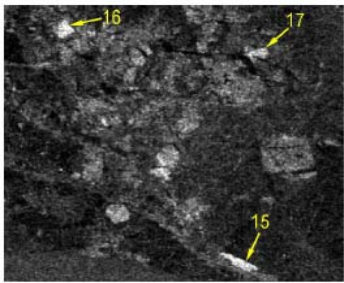


3. Object drift map creation

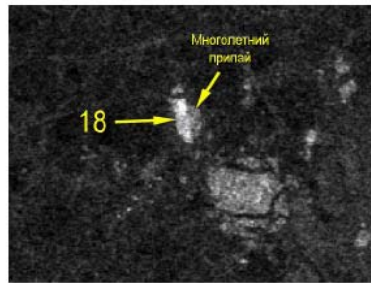


4. Creation of the objects drift maps and wind speed and direction diagrams

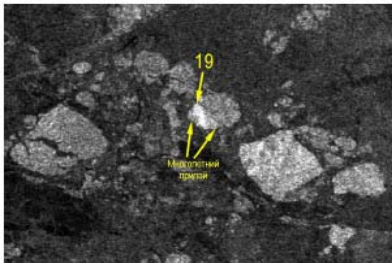
AARI North Pole drifting station logistics support



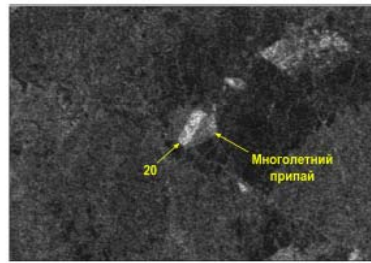
Radar imagery of ice objects #15 (560 x 3010 m), 16 (1190 x 1500 m) and 17 (470 x 1470 m). ENVISAT WSM 23:02 UTC 19 March 2008 (150 m).



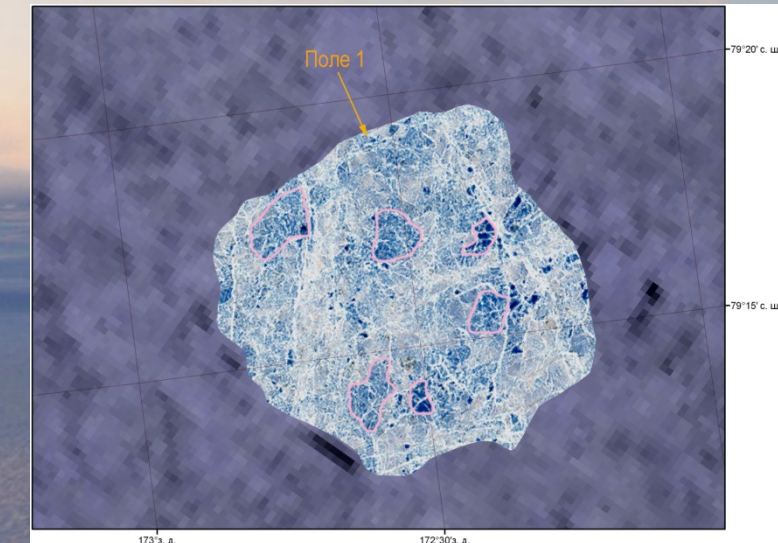
Radar imagery of ice objects #18 (600 x 2360 m). ENVISAT WSM 23:02 UTC 19 March 2008 (150 m).



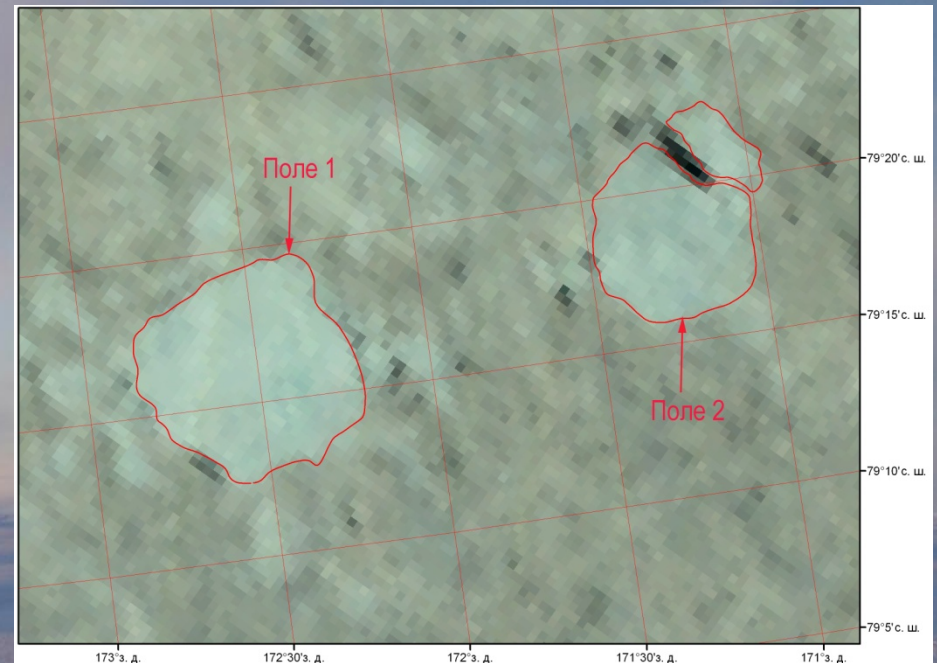
Radar imagery of ice objects #19 (600 x 2340 m). ENVISAT WSM 23:02 UTC 19 March 2008 (150 m).



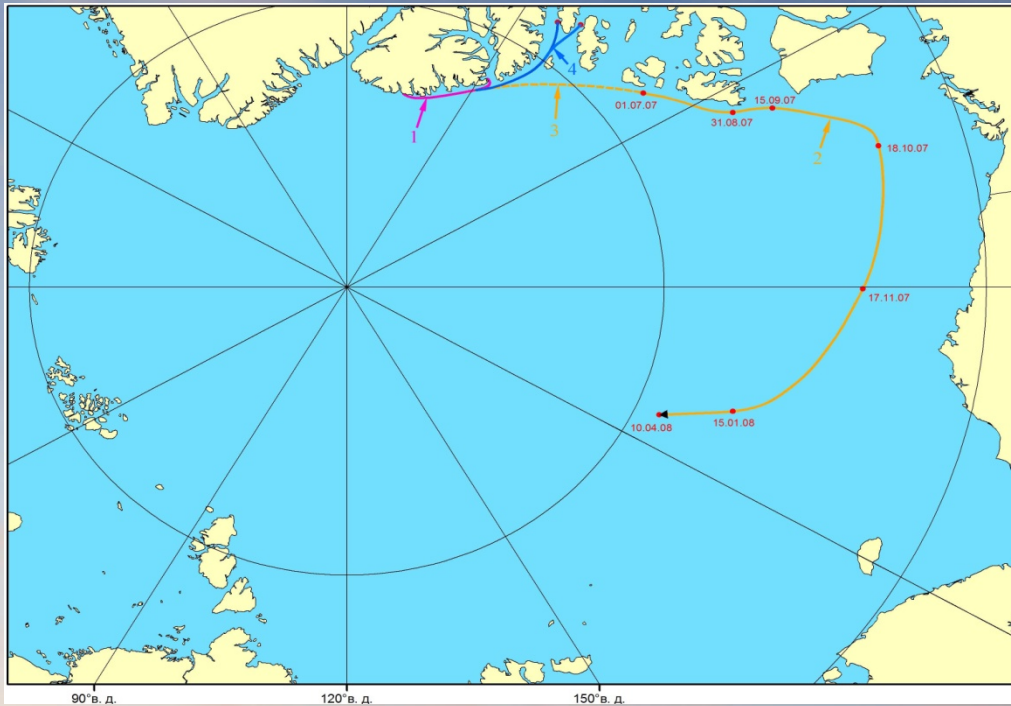
Radar imagery of ice objects #20 (820 x 2840 m). ENVISAT WSM 23:02 UTC 19 March 2008 (150 m).



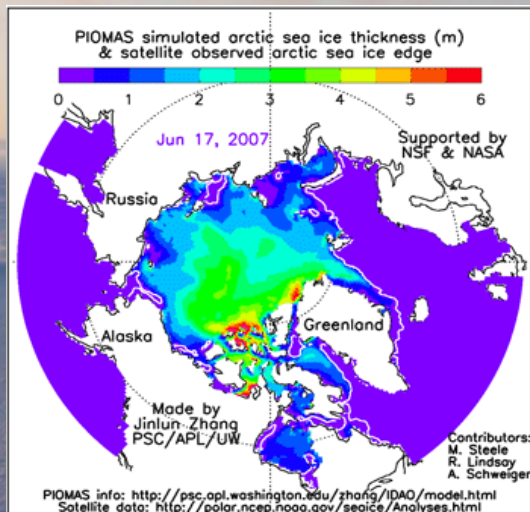
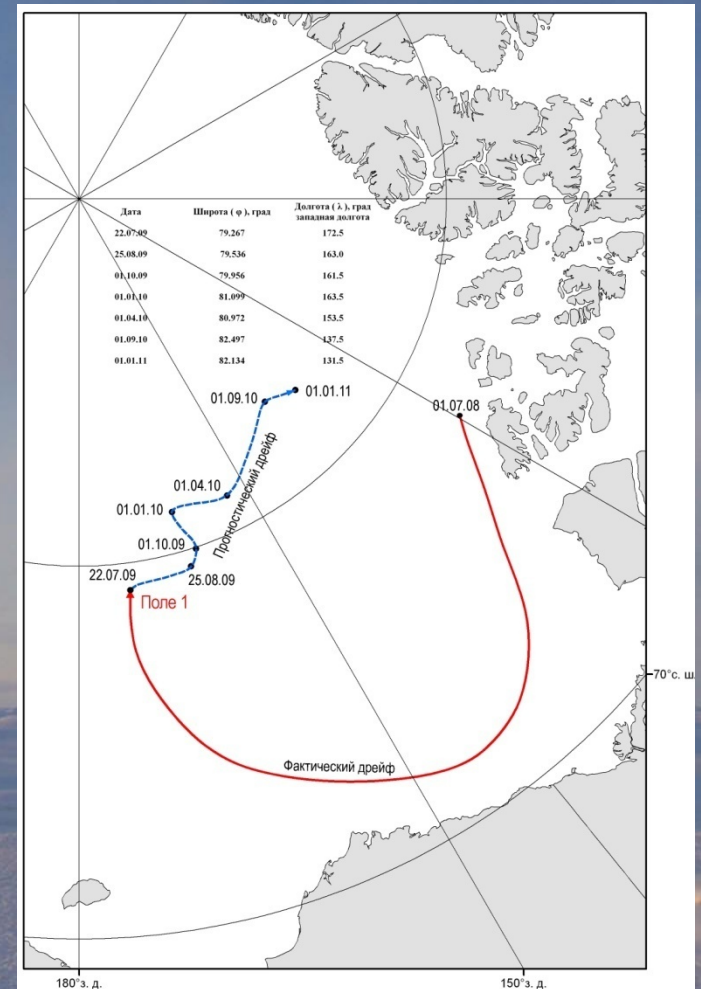
1) Search for potential objects
Multi-sensor approach
Envisat WSM, MODIS, Landsat



North Pole drifting station logistics support

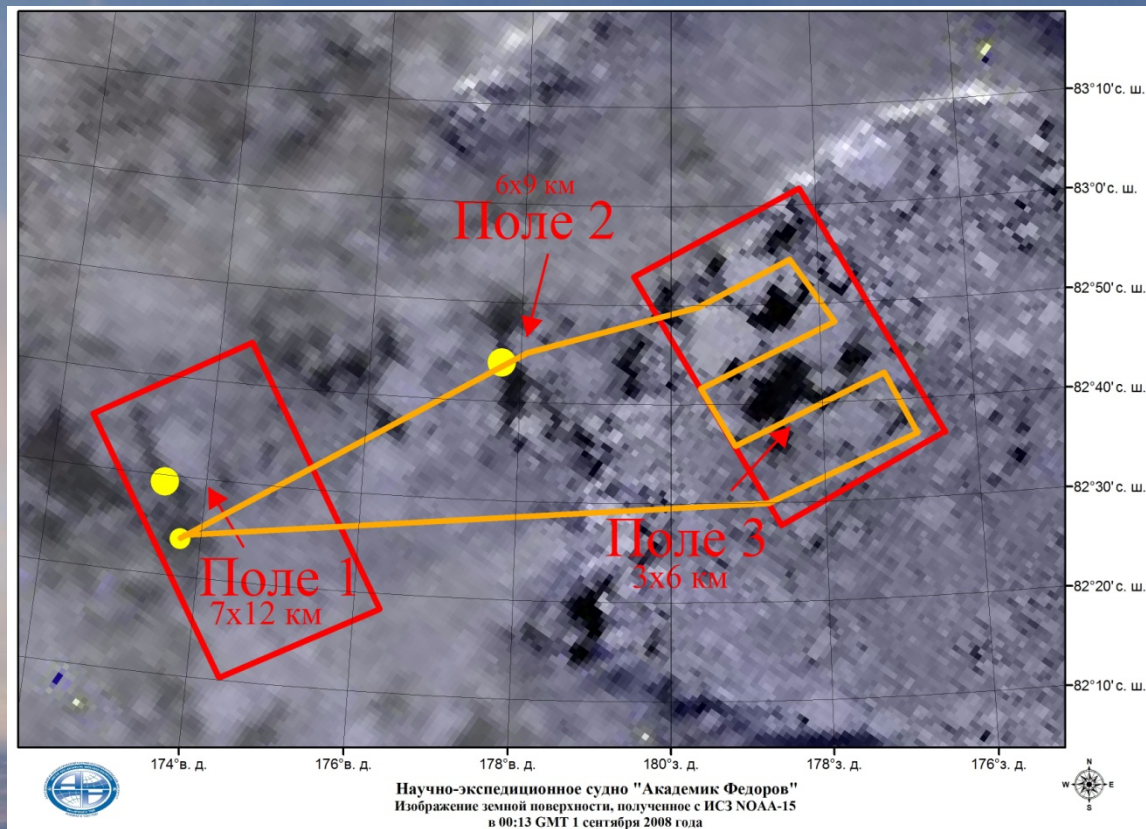
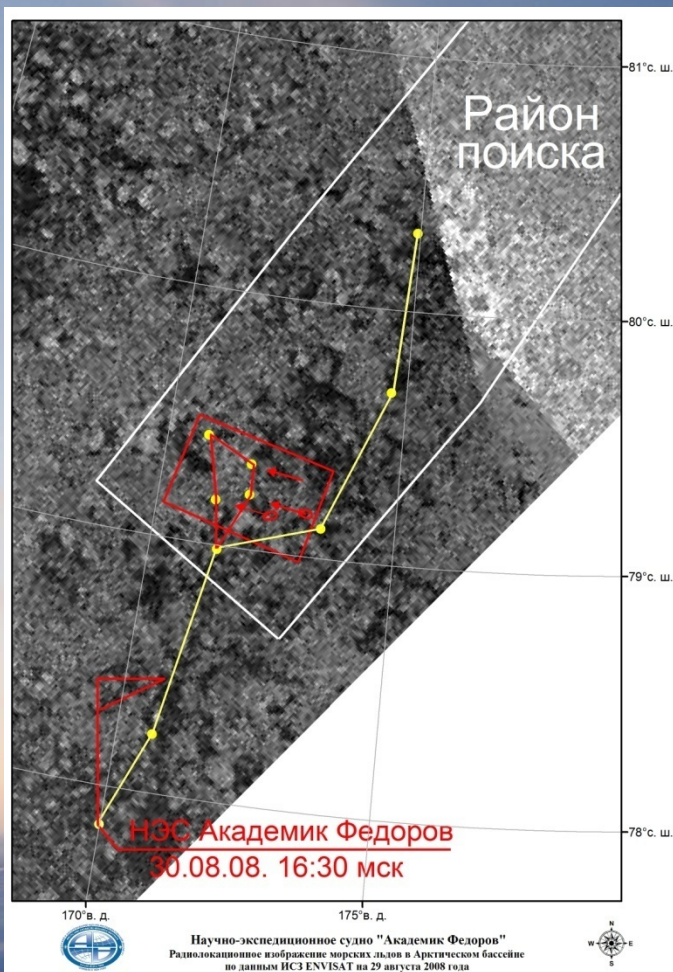


2) Tracking origin

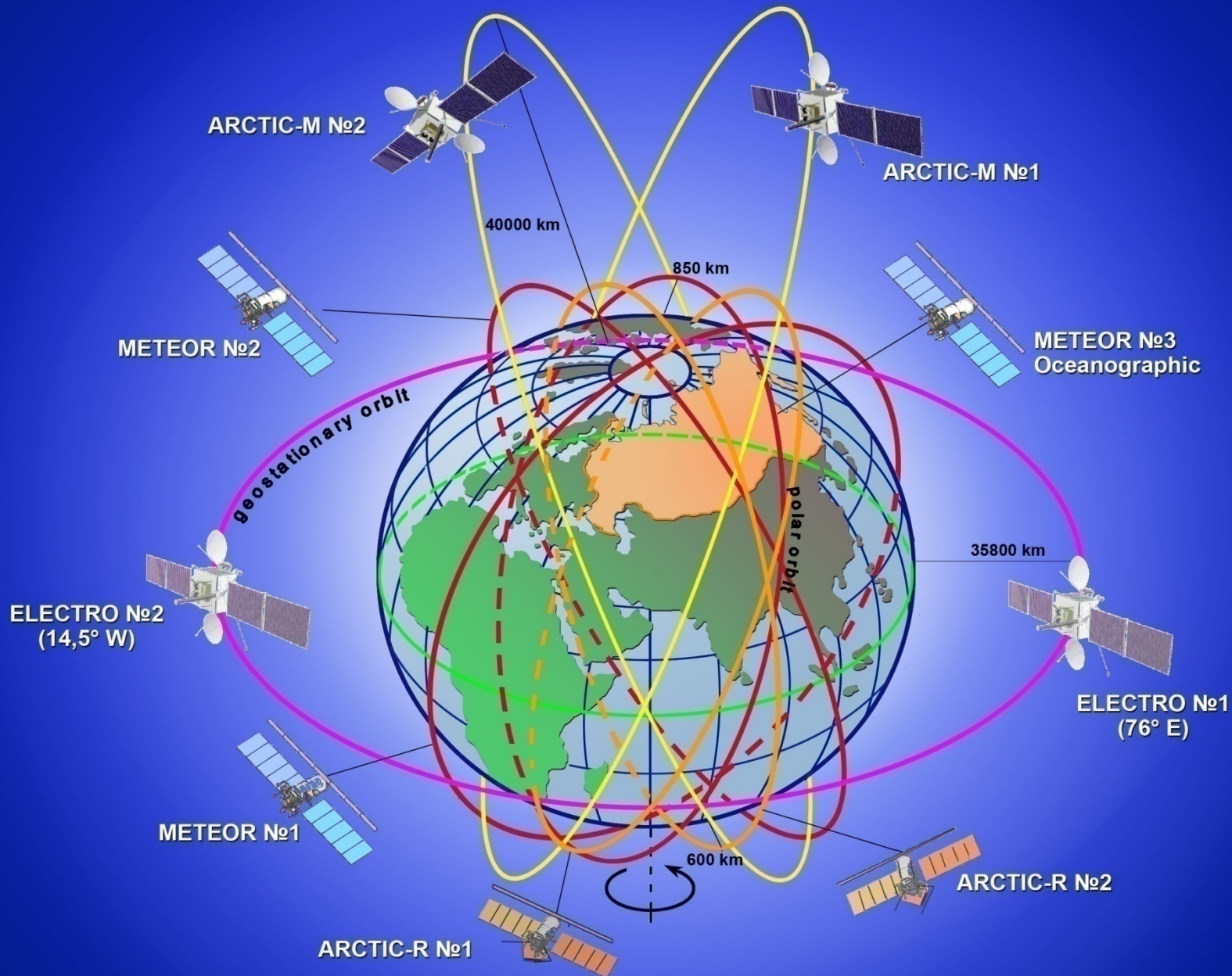


North Pole drifting station logistics support

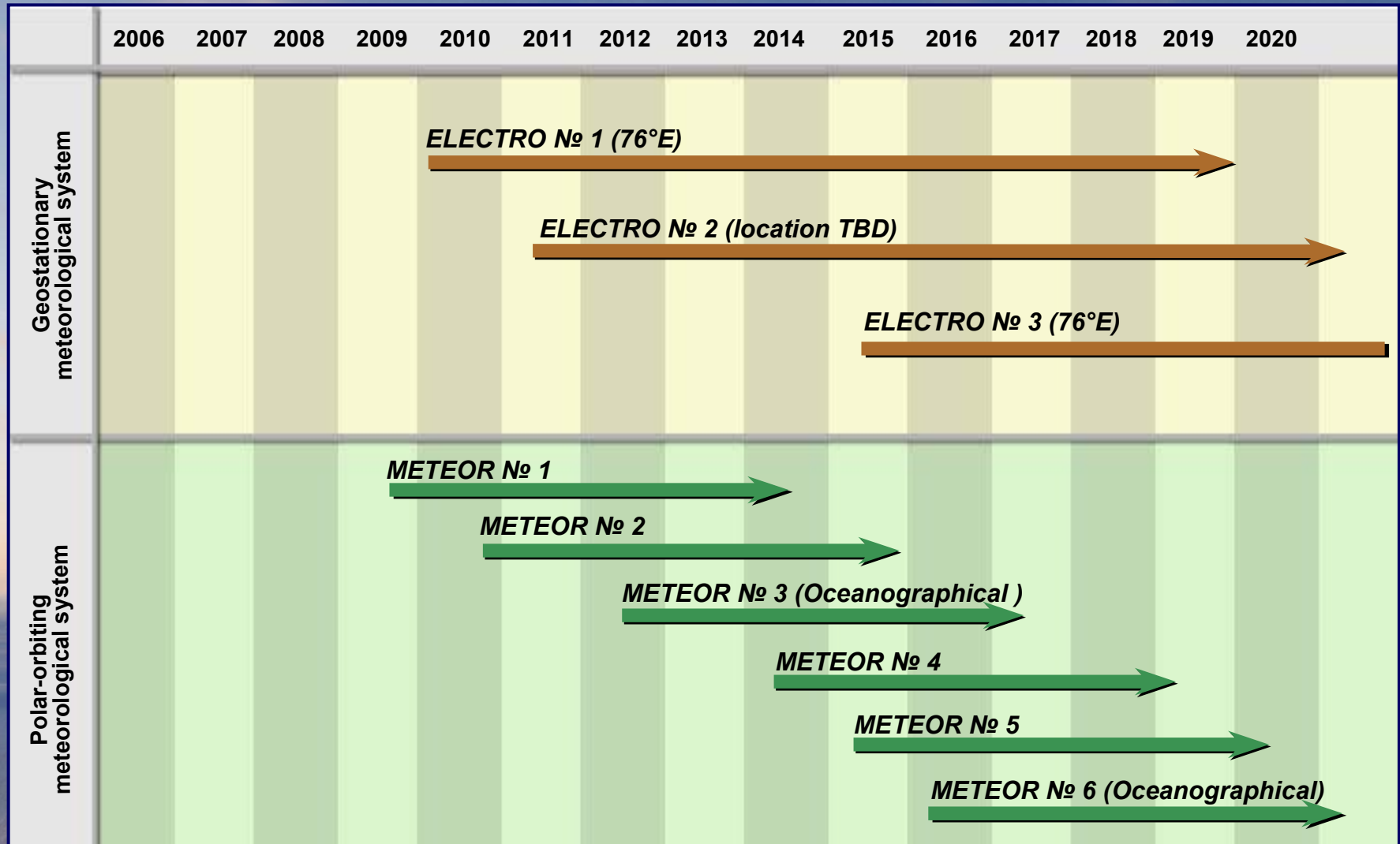
3) Deployment and support during life cycle



RUSSIAN HYDROMETEOROLOGICAL SATELLITE SYSTEM



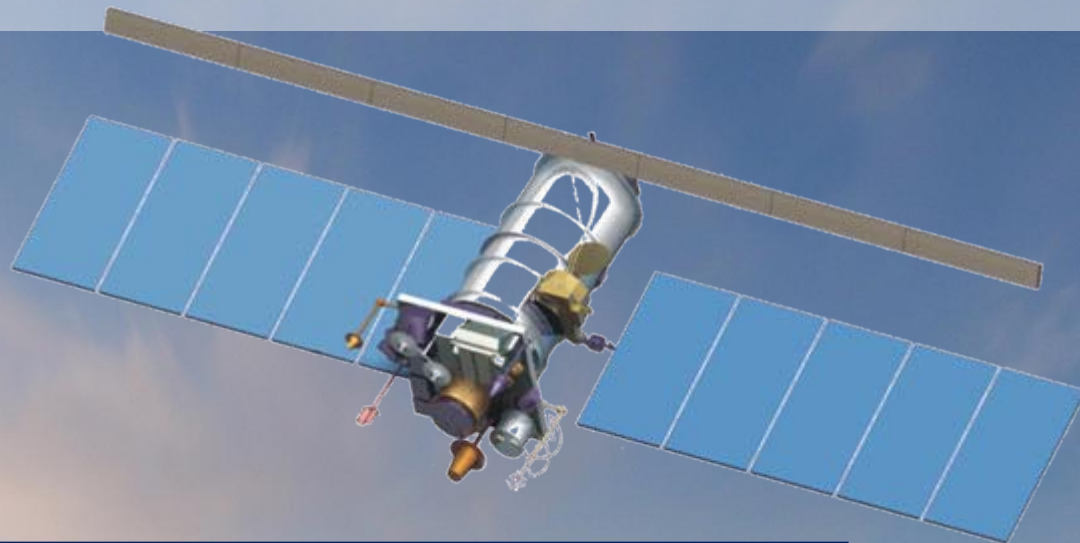
Russian Earth Observation Satellites Program 2006-2015





Polar-orbital “Meteor-M” №1 weather satellite»

September 17 2009 Russia had launched a new meteorological satellite on board a Soyuz 2.



General characteristics “Meteor-M” №1:

Launch date:	17 September 2009
In-orbit mass :	~2700 kg
Payload mass	~1200 kg
Lifetime	5 years
Data dissemination format	HRPT, LRPT

Orbit parameters:

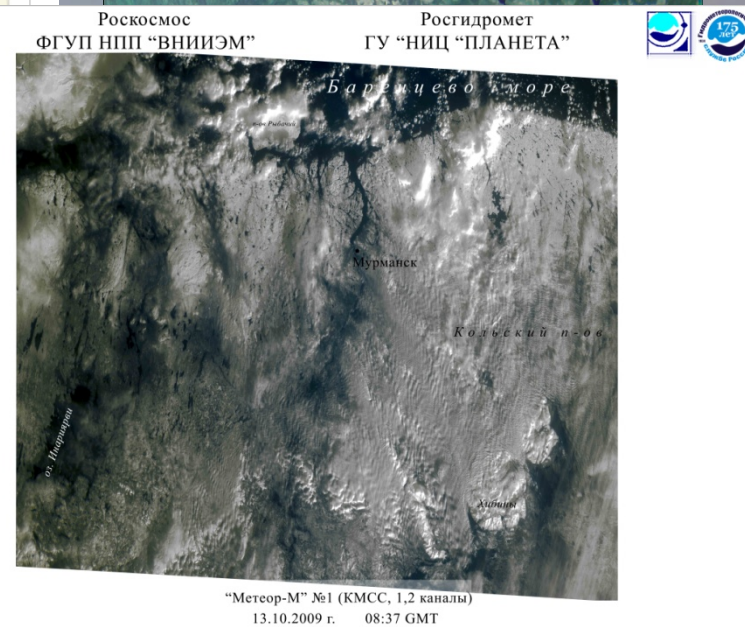
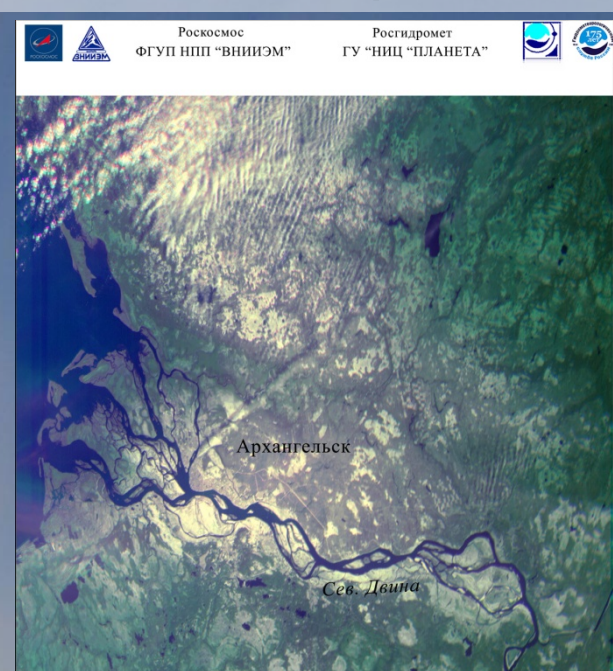
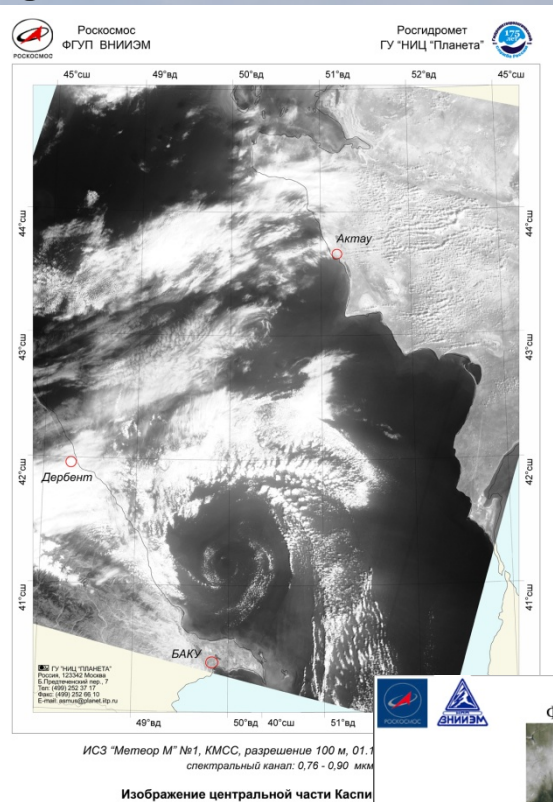
Orbit:	Sun synchronous (near polar)
Altitude	830 km
Period:	101,45 min
Inclination:	98,72°
Time of equator crossing (descending)	9:30 a.m.

METEOR-M Mission Objectives and Basic Instruments

Instrument	Application	Spectral Band	Swath-width (km)	Resolution (km)
MSU-MR multi-channel scanner for meteorological purposes	Global and regional cloud cover mapping, SST, LST, ...	0.5 – 12.5 μm (6 channels)	3000	1 x 1
KMSS multi-channel Earth surface observation complex	Earth surface monitoring	0.4-0.9 μm (6 channels)	400	0.06/0.1
MTVZA atmosphere temperature and humidity sounding module	Atmospheric temperature and humidity profiles, sea surface wind	10.6-183.3 GHz (26 channels)	2600	12 – 75
IRFS-2 advanced IR sounder (Meteor-M №2)	Atmospheric temperature and humidity profiles	5-15 μm	2000	35
Severjanin (SAR) synthesized aperture radar	Ice monitoring	9500-9700 MHz	450	0.4 x 0.5
GGAK-M helio-geophysical complex	Near-Earth space environment monitoring	Helio-geophysical complex is designed for analysis of the following parameters: electron flux density with 0.03 - 15.0 megaelectron-volt energy; proton flux density with 0.5 - 30.0 megaelectron-volt energy; ions concentration in the upper atmosphere in range 1-20 atomic mass units		

The satellite is also capable of acquiring information from ground data collection platforms using international frequency band (401,9 - 402,0 MHz) at 400 bit/sec rate.

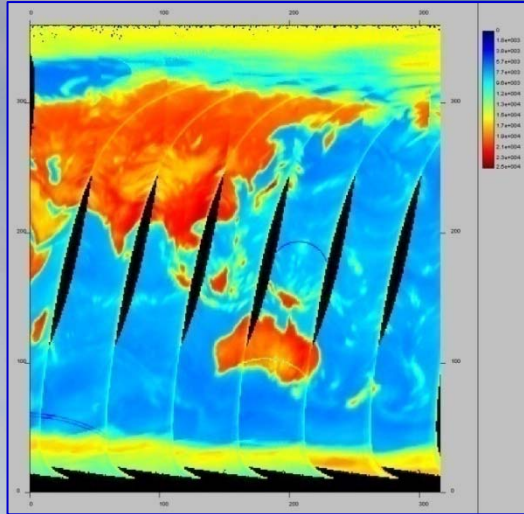
Sample false color images from KMSS instrument for Sep-Oct'09



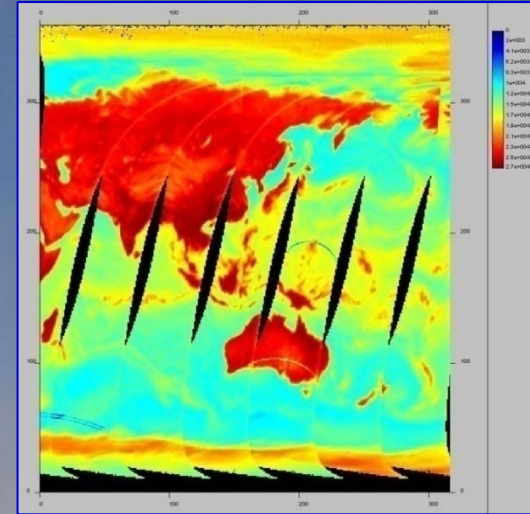
KMSS multichannel scanning unit

channel	swath	resolution
0,370-0,450 мкм	450, 900 км	60 м/100 м
0,450-0,510 мкм		
0,535-0,575 мкм		
0,580-0,690 мкм		
0,630-0,680 мкм		
0,760-0,900 мкм		

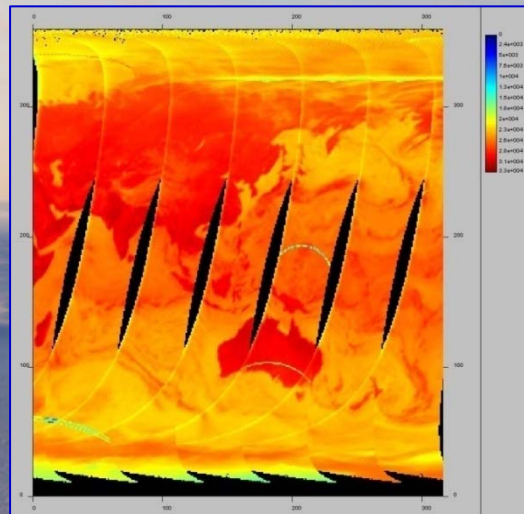
Sample global data received from the Meteor-M №1 MTVZA microwave scanning unit



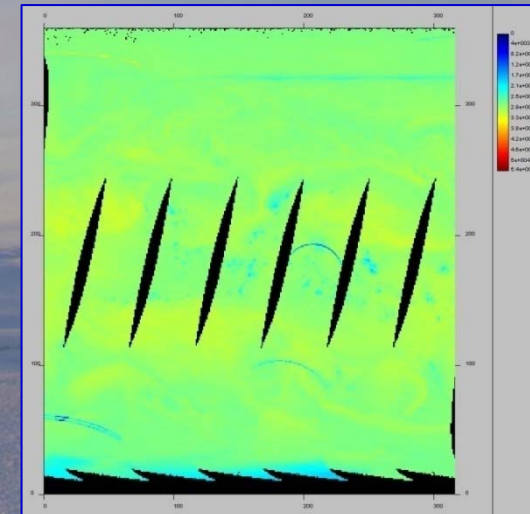
10,6 GHz – data on sea surface temperature



18,7 GHz – data on water vapor content in the atmosphere over the sea surface and module of surface wind



36,7 GHz – data on integral water vapor content Over the sea surface and module of surface wind



183 GHz – data on water vapor content in the troposphere

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



**Federal Service for Hydrometeorology
and Environmental Monitoring**



Russian Federal Space Agency

High-elliptical Orbits Satellite System "Arctica"



**State Research Center
for the Space Hydrometeorology
"Planeta"**



Lavochkin Association

Perspectives of Russian satellite sea ice applications:

- Wider and more timely (1-6 hours) access to multi-sensor data, in particular dual polarization radar (within national and international agreements)
- More timely and wider-band relay of products to customers (Iridium, HFAX, Inmarsat)
- Development of standards and formats for ice charts and imagery presentation and delivery for new generation of marine and MSS systems (ENC, GMDSS, within WMO/IHO)
- Closer and further level cooperation (and harmonization) between Russian and international ice services towards seamless ice products and services within the polar Arctic and Antarctic METAREAS within WMO, IICWG, EIS etc

Perspectives of Russian satellite sea ice applications:

- Organization of training facilities for navigators and other customers for proper interpretation of ice charts and imagery
- Organization of feed-back between customer at sea and provider (AARI, Planeta) (we shall know when, what and how much information was received and used by the customer)
- Extension of a list of provided information in a part of more efficient usage of satellite information with full ground resolution and regular request and reception of radar imagery
- Development of the new algorithms and techniques of satellite-based products creation and assimilation including ice charts, into numerical models
- Implementation of the next generation Russian satellite system including HEO Arctica system

Thank you for attention and questions ?

