



GLONASS Status and Modernization

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Applications of Global Navigation Satellite Systems
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РОСКОСМОС





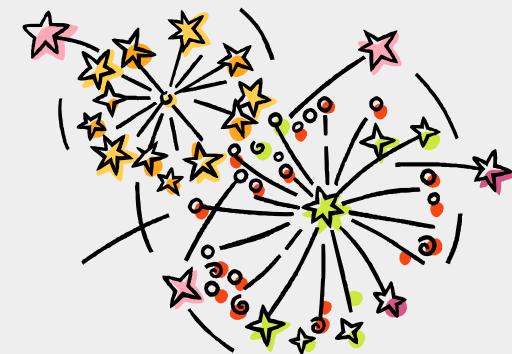
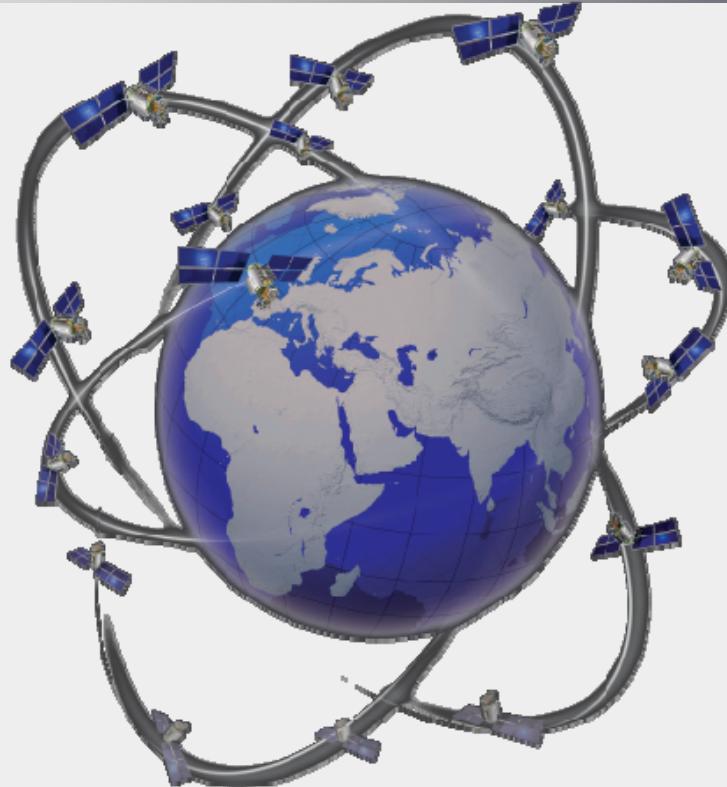
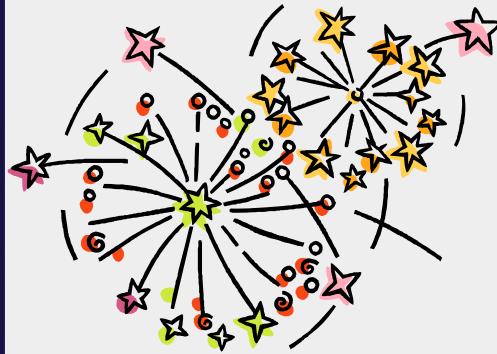
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- GLONASS Program Results
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- International Cooperation
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РОСКОСМОС



**Since December 8, 2011, 8:00 Moscow Time
GLONASS is a full operational system
with 24 satellites in constellation!**



State Policy Basic Principles

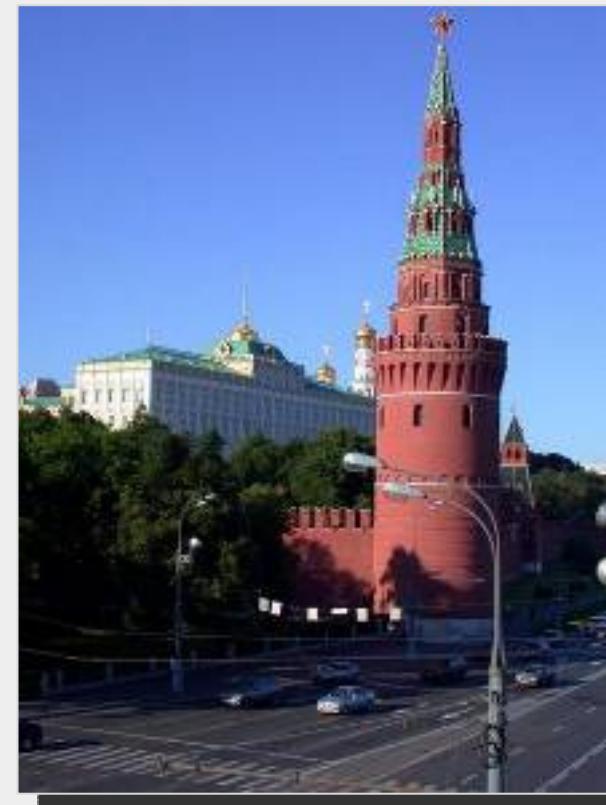


Basic Documents:

- Presidential Decree, May 17, 2007
- GLONASS Federal Program
 - 2002 – 2011
 - 2012 – 2020 (under preparation)

Basic Principles

- GLONASS is a dual use system
 - GLONASS free of charge worldwide
 - GLONASS mandatory use for Russian critical infrastructure and governmental applications
 - Promotion of GLONASS commercial use
 - GNSS compatibility and interoperability



Federal GLONASS Program is a basis for GLONASS State Policy implementation



GLONASS Segments



GLONASS Space Complex (core)

- Open basic navigation service
- Authorized basic navigation service

SDCM Ground based augmentations

- SBAS service
- Accuracy improvement
- Integrity

Precise Orbit and Clock Determination System

- Post processed data
- Real time data (in development)

Fundamental Segment

- Geodesy reference system
- System time scale steering to UTC
- Earth rotation and attitude parameters

User Segment

- Governmental segment
- Civil segment



GLONASS Constellation Status

11.12.2011



Total satellites in constellation		31 SV
Operational		24 SV
In commissioning phase		3 SV
In maintenance		2 SV
Spares		1 SV
In flight tests phase		1 SV

Orb. slot	Orb. pl.	RF chnl	# GC	Launched	Operation begins	Operation ends	Life-time (months)	Satellite health status	Comments
								In almanac	In ephemeris (UTC)
1	1	01	730	14.12.09	30.01.10		23.9	+	+ 06:01 11.12.11
2	1	-4	728	25.12.08	20.01.09		35.5	+	+ 06:00 11.12.11
3	1	05	744	04.11.11	08.12.11		1.2	+	+ 04:59 11.12.11
4	1	06	742	02.10.11	25.10.11		2.3	+	+ 04:59 11.12.11
5	1	01	734	14.12.09	10.01.10		23.9	+	+ 04:59 11.12.11
6	1	-4	733	14.12.09	24.01.10		23.9	+	+ 04:59 11.12.11
7	1	05	712	26.12.04	07.10.05		83.5	+	+ 04:59 11.12.11
8	1	06	729	25.12.08	12.02.09		35.5	+	+ 05:45 11.12.11
9	2	-2	736	02.09.10	04.10.10		15.3	+	+ 06:00 11.12.11
10	2	-7	717	25.12.06	03.04.07		59.6	+	+ 04:59 11.12.11
11	2	00	723	25.12.07	22.01.08		47.6	+	+ 04:59 11.12.11
12	2	-1	737	02.09.10	12.10.10		15.3	+	+ 04:59 11.12.11
13	2	-2	721	25.12.07	08.02.08		47.6	+	+ 04:59 11.12.11
14	2	-7	715	25.12.06	03.04.07		59.6	+	+ 05:29 11.12.11
15	2	00	716	25.12.06	12.10.07		59.6	+	+ 06:00 11.12.11
16	2	-1	738	02.09.10	11.10.10		15.3	+	+ 06:00 11.12.11
17	3	04	714	25.12.05	31.08.06		71.6	+	+ 06:01 11.12.11
18	3	-3	724	25.09.08	26.10.08		38.5	+	+ 06:00 11.12.11
19	3	03	720	26.10.07	25.11.07		49.5	+	+ 06:01 11.12.11
20	3	02	719	26.10.07	27.11.07		49.5	+	+ 04:59 11.12.11
21	3	04	725	25.09.08	05.11.08		38.5	+	+ 04:59 11.12.11
22	3	-3	731	02.03.10	28.03.10		21.3	+	+ 04:59 11.12.11
23	3	03	732	02.03.10	28.03.10		21.3	+	+ 04:45 11.12.11
24	3	02	735	02.03.10	28.03.10		21.3	+	+ 06:01 11.12.11
2	1	-4	743	04.11.11		1.2			Commissioning Phase
7	1	05	745	04.11.11		1.2			Commissioning Phase
17	3	04	746	28.11.11		0.4			Commissioning Phase
21	3	03	701	26.02.11		9.5			Flight Tests
14	2		722	25.12.07	25.01.08	12.10.11	47.6		Spares
3	1		727	25.12.08	17.01.09	08.09.10	35.5		Maintenance
22	3		726	25.09.08	13.11.08	31.08.09	38.5		Maintenance



The constellation provides global continuous navigation



POCKOCMOC

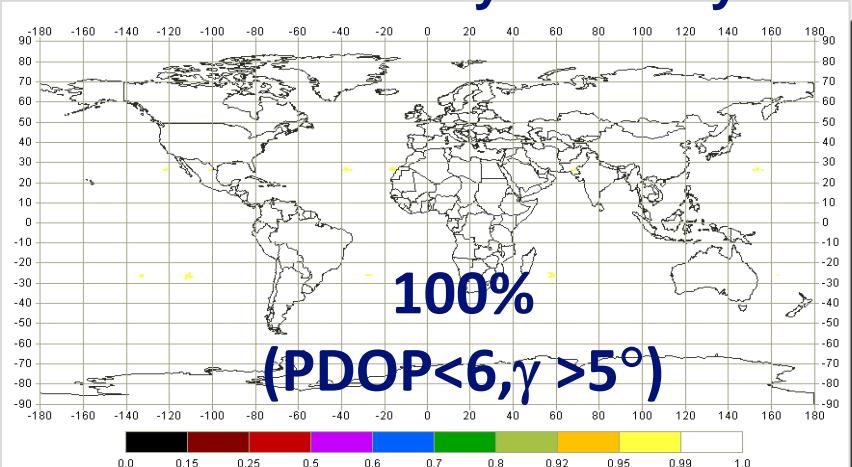
GLONASS Performance

(11.12.2011)

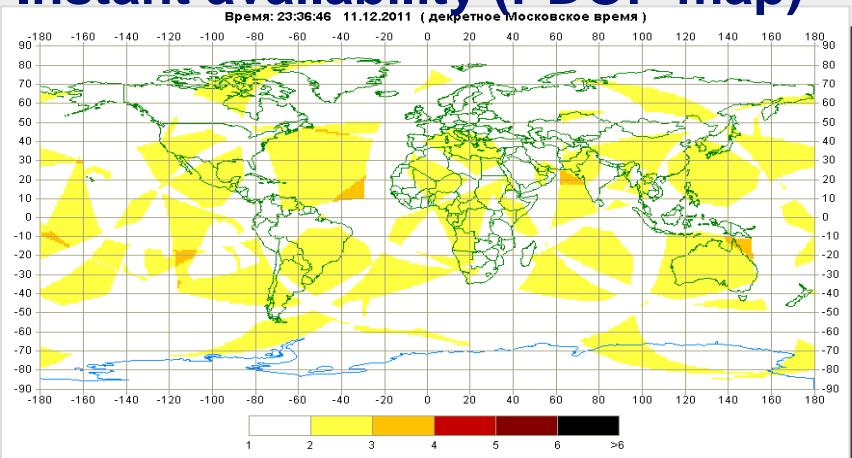


AVAILABILITY

Mean availability for a day

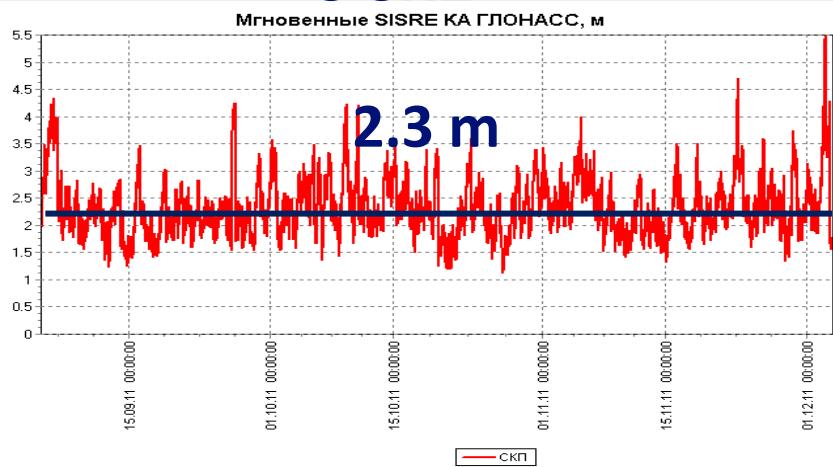


Instant availability (PDOP map)

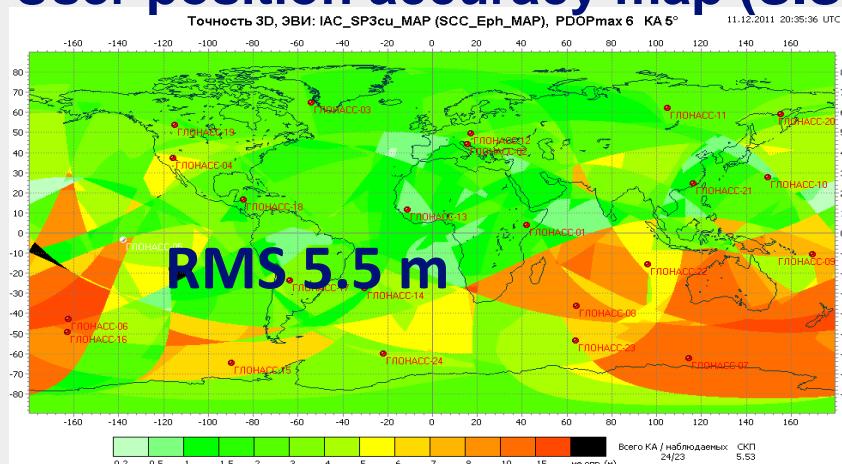


ACCURACY

SISRE



User position accuracy map (SIS)

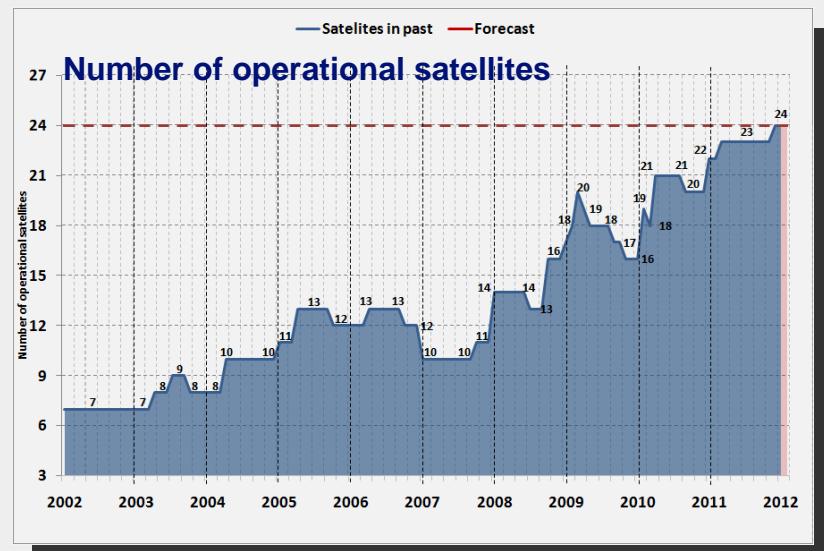




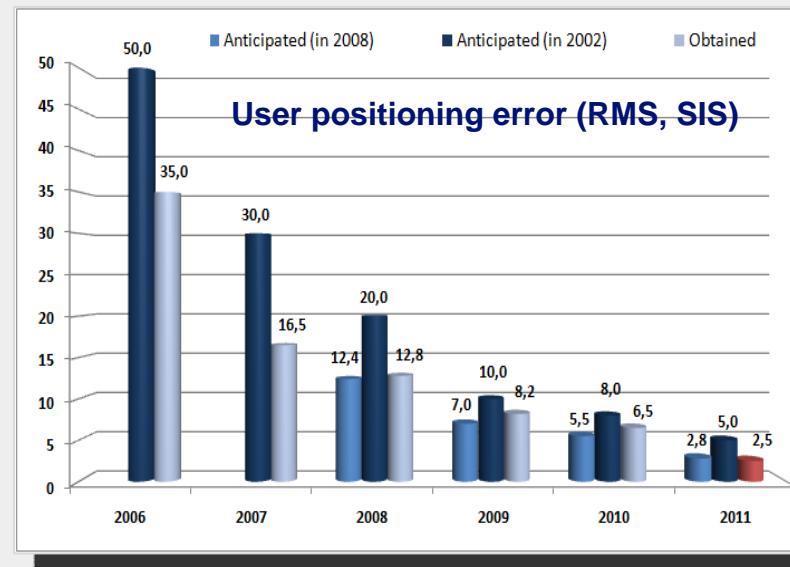
GLONASS Program Results



Constellation recovery



Accuracy improvement



Main program objective – GLONASS recovery – achieved!

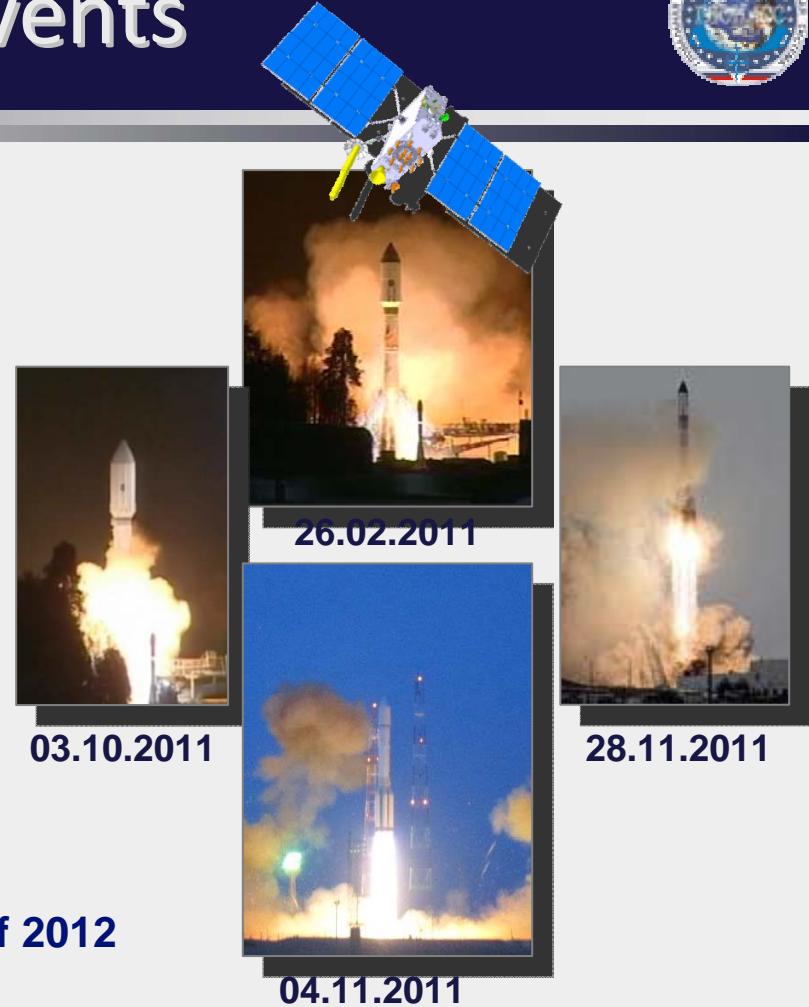


Recent Events



Launches in 2011:

- 26.02.2011 the first GLONASS-K launch
(Flight test begins)
- 03.10.2011 – 1 SV GLONASS-M
- 04.11.2011 – 3 SV GLONASS-M
- 28.11.2011 – 1 SV GLONASS-M



Next launches:

- 2nd GLONASS-K (test) at the beginning of 2012

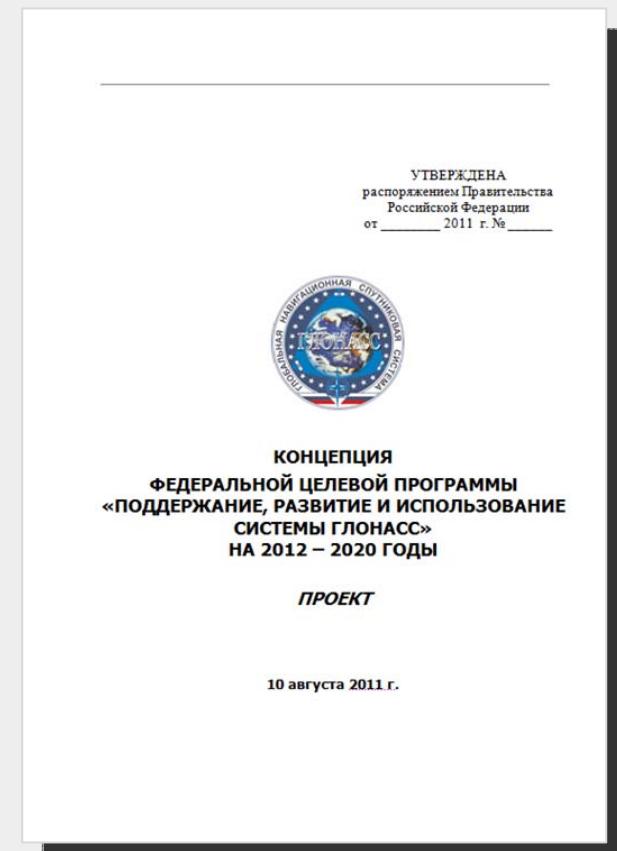
With the launch program of 2011 the full constellation deployment completed. Basis for further sustainment and development created



New GLONASS Program Status



- **GLONASS Program Concept prepared**
- **The Program objective defined:**
 - make the GLONASS service
 - more **available**
 - more **accurate**
 - more **reliable**
 - more **robust**
 - in the multi GNSS world
- **Budget for 9 years defined**
- **Approval is to be done by the end of 2011**



GLONASS Sustainment, Development and Use



Main GLONASS Program Directions



- **Constellation sustainment (24 sats with spares)**
 - Glonass-M launches
 - Glonass-K launches (after flight test completion)
 - 24 CDMA+FDMA satellites expected by 2020
- **GLONASS improvement**
 - Constellation (availability)
 - Accuracy of the core system
 - Augmentations development (accuracy, integrity, availability, assisting technology...)
 - References improvement (geodesy, time, Earth rotation and attitude data...)
- **User segment development**
 - Governmental applications
 - Chips and chipsets, navigation maps
 - Commercial applications encouraging



GLONASS Modernization



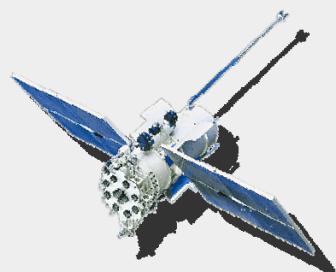
1982

2003

2011

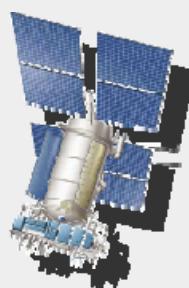
2014

“Glonass”



- 3 year design life
- Clock stability - 5×10^{-13}
- Signals: L1SF, L2SF, L1OF, (FDMA)
- Totally launched 81 satellites
- Real operational life time 4.5 years

“Glonass-M”



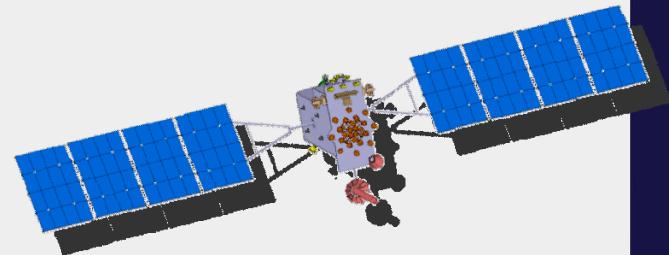
- 7 year design life
- Clock stability 1×10^{-13}
- Signals: Glonass + L2OF (FDMA)
- Totally launched 36 satellites and going to launch 3 satellite by the end 2012

“Glonass-K1”



- 10 year design life
- Unpressurized
- Expected clock stability $\sim 10 \dots 5 \times 10^{-14}$
- Signals: Glonass-M + L3OC (CDMA) – test
- SAR

“Glonass-K2”

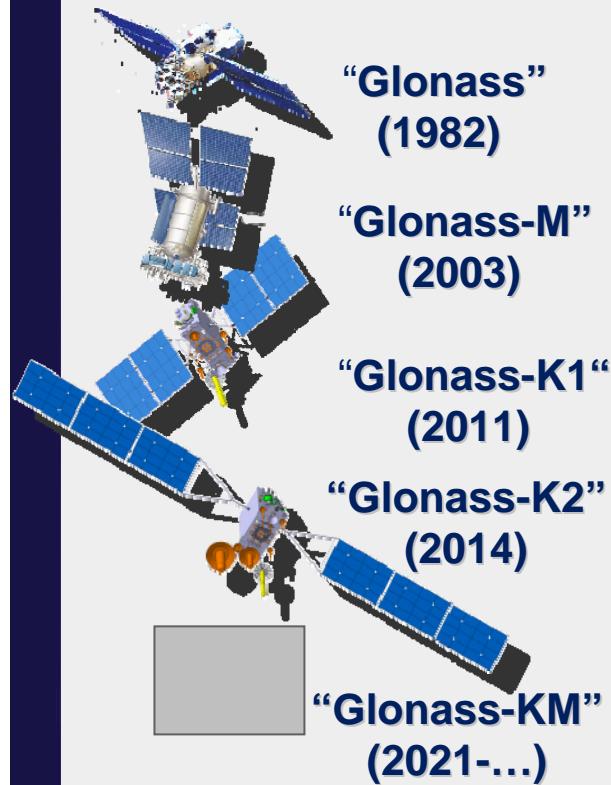


- 10 year design life
- Unpressurized
- Expected clock stability $\sim 5 \dots 1 \times 10^{-14}$
- Signals: Glonass-M + L1OC, L3OC, L1SC, L2SC (CDMA)
- SAR

CDMA signals general structure already designed



GLONASS Signals Modernization



L1	L2	L3	L1, L2	other	Status
L1OF, L1SF	L2OF, L2SF	—	—		Done
L1OF, L1SF	L2OF, L2SF	—	—		Done
L1OF, L1SF	L2OF, L2SF	L3OC test	—		Done
L1OF, L1SF	L2OF, L2SF	L3OC	L1OC, L1SC, L2SC		2014
L1OF, L1SF	L2OF, L2SF	L3OC	L1OC, L1SC, L2SC	L1OCM, L2OC, L5OC	Under development after 2015



FDMA signals



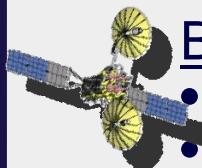
CDMA signals

GLONASS will introduce new CDMA signals
GLONASS will continue transmitting existing FDMA signals



ROKKOMOOC

SDCM (SBAS Augmentation)



Broadcasting facilities

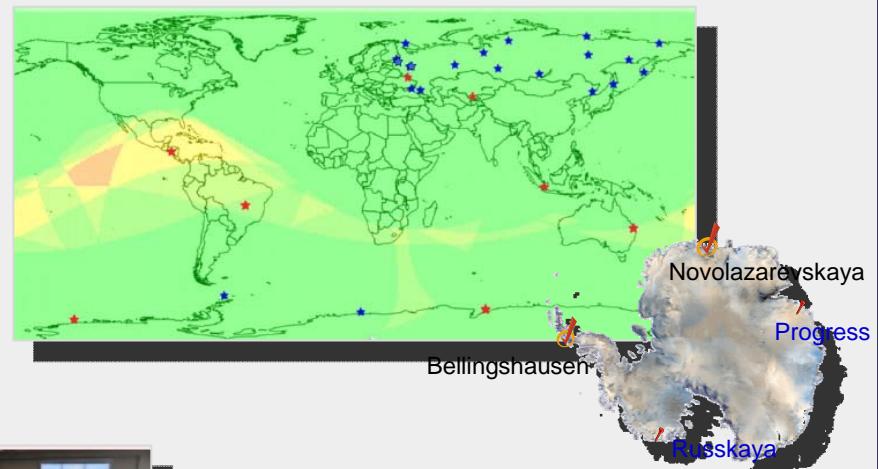
- 3 + 1 GEO satellites
- SiSnet server

Objectives

- GNSS monitoring
 - Integrity
 - Differential corrections
 - Deep analysis in postprocessing
- Service area – Russian territory

Reference stations network

- 19 station in Russia
- 6-8 station abroad



Central Processing Facilities

- Main (Moscow)
- Reserve (TBD)





Precise Orbit and Clock Determination System



Precise GNSS orbit & clock data

- Ultra rapid – 1-2 hours delay
- Rapid – 1-2 days delay
- Final – < 15 days delay

The screenshot displays the official website for the SVO EVP Glonass system. The main header reads "СИСТЕМА ВЫСОКОТОЧНОГО ОПРЕДЕЛЕНИЯ ЭФЕМЕРИД И ВРЕМЕННЫХ ПОПРАВОК". The left sidebar includes links for "Главная", "О системе", "Данные", "Новости", "Статьи", and "Контакты". The central content area features a banner with an image of Earth and satellites, titled "СВОЭВП ГЛОНАСС". Below the banner, there is descriptive text about the system's purpose and a link to "Подробнее...". The right sidebar contains sections for "Новости" and "Распоряжение", with a note from the Government of the Russian Federation dated June 20, 2007, and a link to "Продолжение...". A large white box at the bottom left shows the file index: "Индекс «ftp://ftp.glonass-ianc.rsa.ru/SVOEVP/2011/»" with a link to "Перейти в каталог на уровень выше". It lists files by name ("clock", "efem", "ion", "rep", "trop") and their last modification dates (all 05.01.2011).

www.glonass-svoevp.ru



International Cooperation



- GLONASS is an element of the global GNSS infrastructure
- Compatibility and Interoperability provision
- Development of common GNSS standards
- Promotion of GLONASS worldwide use for all user benefit



Multilateral cooperation in the framework of ICG and Working Groups,
Bilateral working contacts with USA, EU, India, China and other countries on
GNSS compatibility and interoperability and global use



GLONASS Information Service



www.glonass-center.ru
[\(www.glonass-iac.ru\)](http://www.glonass-iac.ru)

The screenshot shows a map of the Northern Sea Route (NSR) from Murmansk to the Far East. A red line traces a specific route through the Arctic. The map includes labels for various ports and regions like Chukotka, Kamchatka, and the Far East. Below the map, there is a brief description of the experiment and a note about the PS-824 panel ship navigation track.

News

This screenshot displays the 'The Northern Sea Route 2011' experiment page. It features a map of the NSR, a summary of the experiment's objectives, and a chart showing the number of satellites in various operational phases. The chart indicates 27 in orbit, 21 in commissioning, 4 in maintenance, and 2 in decommissioning.

GLONASS Status &
Feedback

This screenshot shows the 'Evaluation of GLONASS characteristics' page. It includes a table of satellite status (operational, decommissioned, etc.) and a detailed form for users to input their own data for analysis. The form fields include 'Name', 'Email', 'Subject', 'Message', and 'Submit'.

This screenshot shows the 'Detailed analysis of the GNSS characteristics service' page. It features a login form for users to access detailed performance data. The page also includes a graph showing GNSS signal strength or performance over time.

GLONASS Performances₁₇



Summary



- GLONASS Program is the high priority of the Russian Government policy
- GLONASS open service is free for all users
- Present GLONASS Program is being completed, objective to be achieved by 2011
 - Performance to be comparable with GPS by the end of 2011
 - Full constellation (24 sats) already done!
- GLONASS will continue
 - Keep the GLONASS traditional frequency bands
 - Transmit existing FDMA signals
 - Introduce new CDMA signals
- New GLONASS Program (2012 – 2020) is under development to be approved by the end of 2011
 - State commitments for major performance
 - GLONASS sustainment, development, use
- International cooperation – make GLONASS as one of key elements of the international GNSS infrastructure for worldwide user benefits



Thank you for your attention!

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