

# GLONASS Status and Modernization

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РОСКОСМОС





# Content



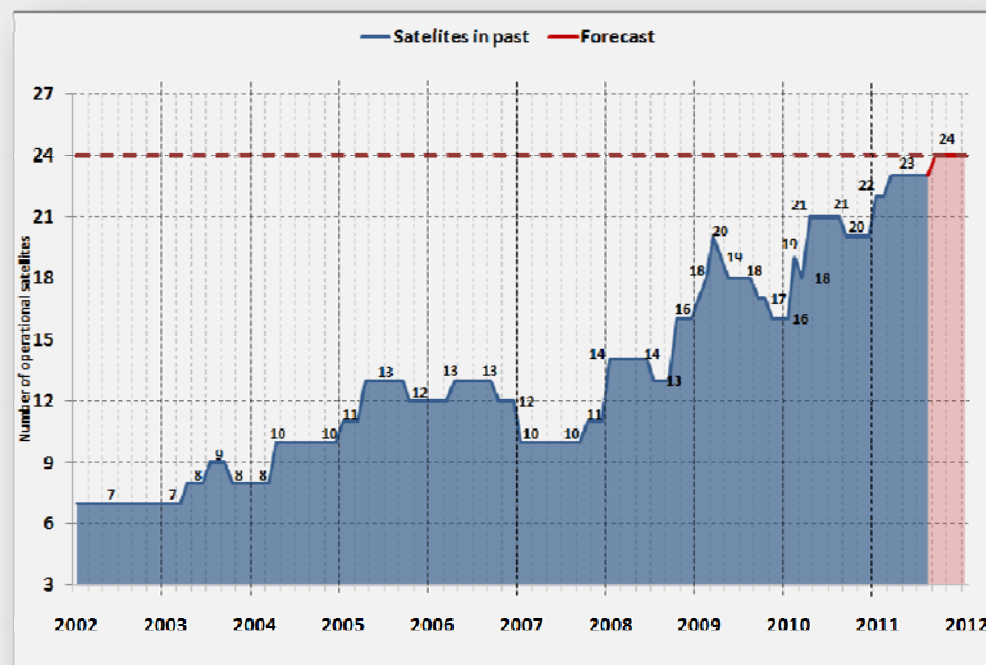
- GLONASS Overview
- Recent Events
- Modernization Improvements
- GLONASS State Policy
- International Cooperation
- Summary

# Constellation Status

## 19.09.2011



### Number of operational satellites history



Total in orbit	27 SV
Operational	23 SV
In maintenance	3 SV
Flight Test	1 SV

### The constellation provides:

- Continuous navigation over Russia
- Practically global continuous navigation



# Recent Events

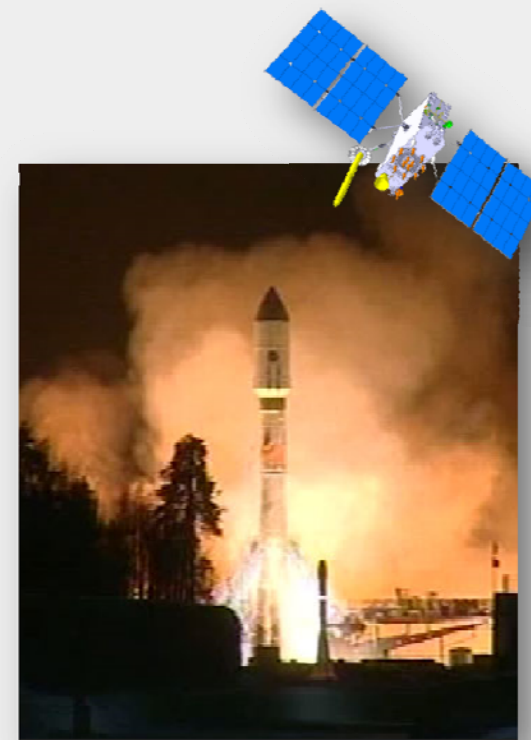


## Last launches:

- 26.02.2011 the first GLONASS-K launch

## Next Launches in 2011:

- 1 GLONASS-M at October 1
- 3 GLONASS-M at the end of October
- 1 GLONASS-M in November-December
- 1 GONASS-K by the end of the year



26.02.2011

**Launch program of 2011 will ensure full constellation deployment and sustainment**

# GLONASS Control Segment



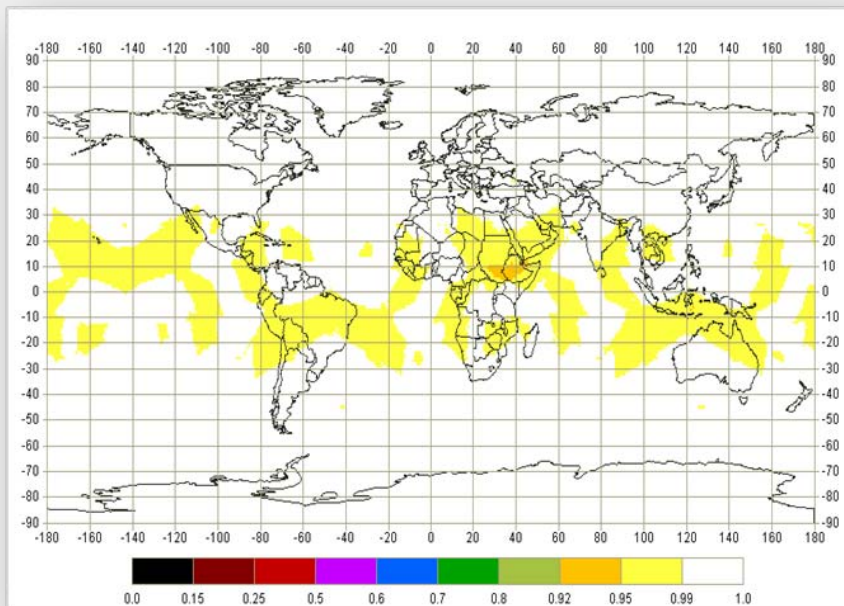
## Ground Control Segment Architecture



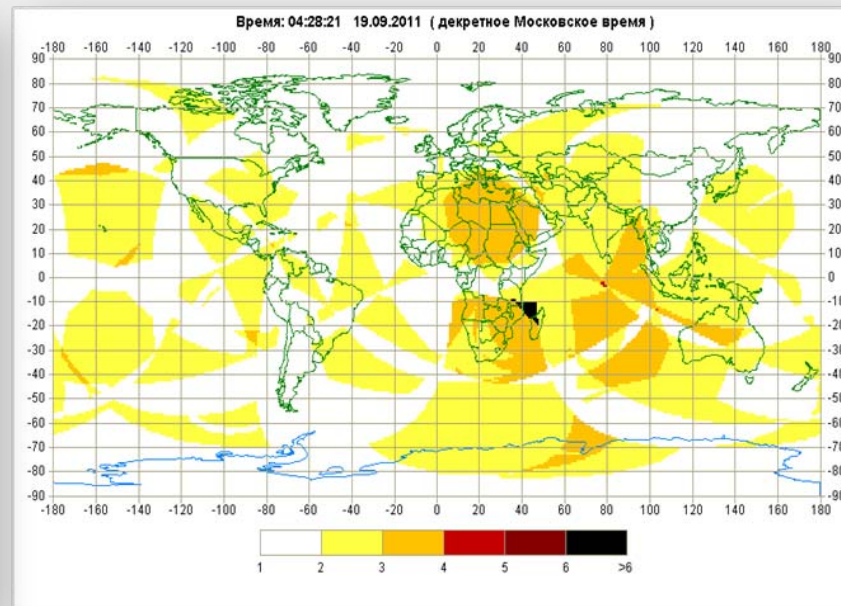
- ★ Existing Stations
- ★ Future stations



# GLONASS Availability (19.09.2011)



**Average availability for a day**



**Instant availability (PDOP)**

**GLONASS global availability: 99.5% (PDOP<6,  $\gamma$ >5°)**



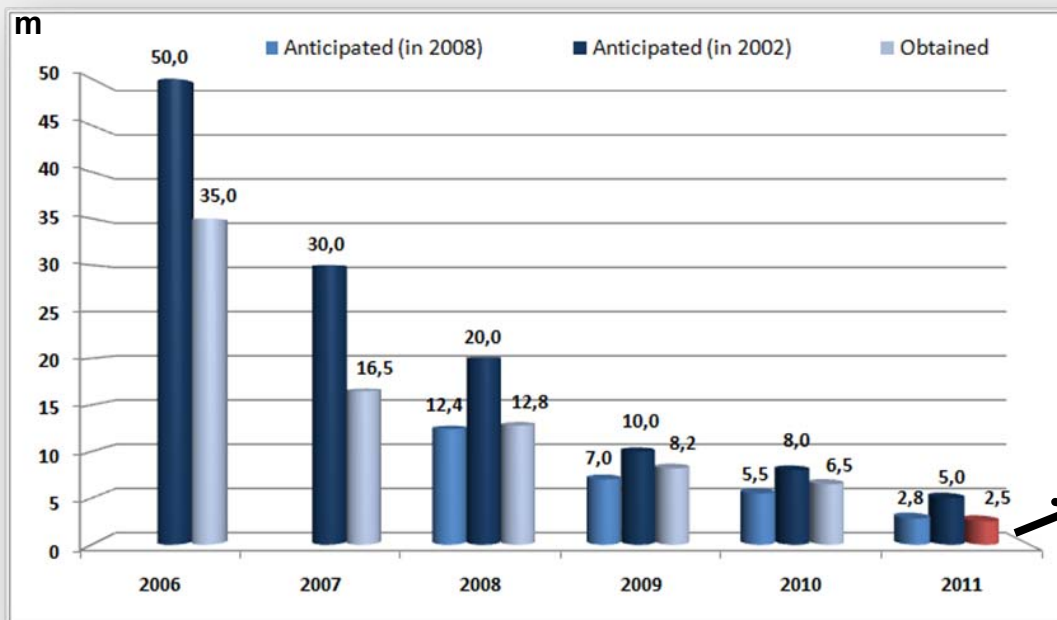


# GLONASS Accuracy

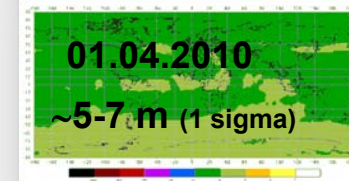
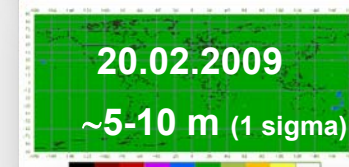
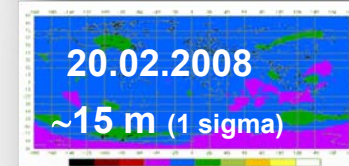
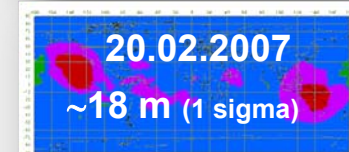
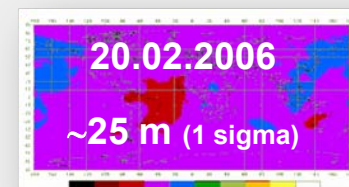


➤ **GLONASS accuracy has significantly improved over last five years**

➤ **Next improvement phase is expected by the end of 2011**



**GLONASS position accuracy map**



**GLONASS Accuracy**

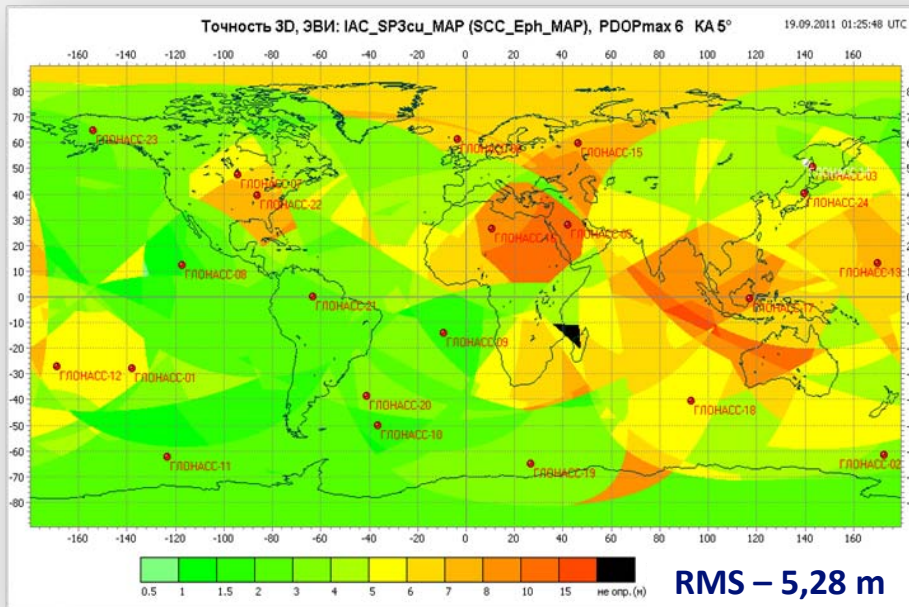


# GLONASS Accuracy

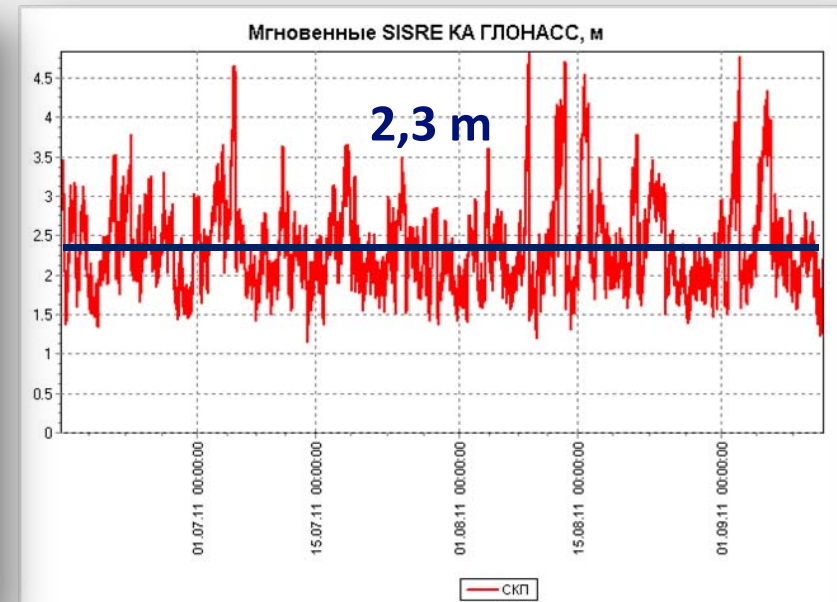
## 19.09.2011



Instant accuracy (PDOP < 6,  $\gamma > 5^\circ$ )  
19.09.2011



Instant GLONASS SISRE (1 sigma), m  
15.06.2011 – 15.09.2011



[stat.glonass-iac.ru](http://stat.glonass-iac.ru)





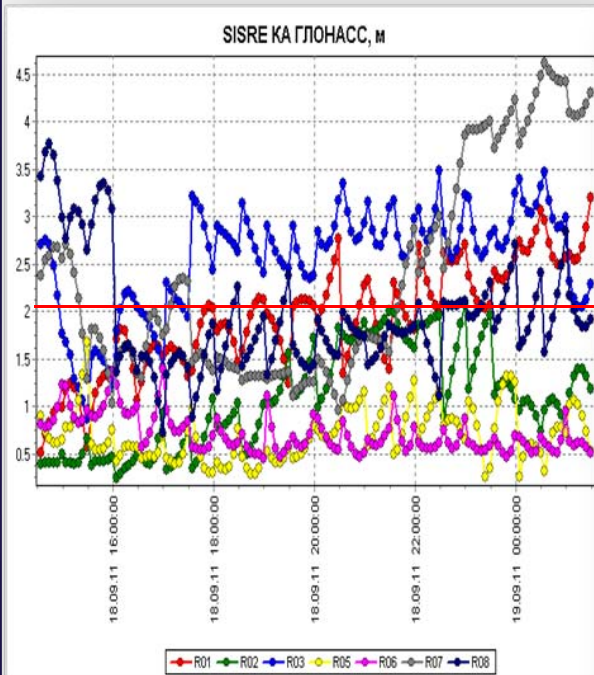
# GLONASS Accuracy by Satellite

## 19.09.2011

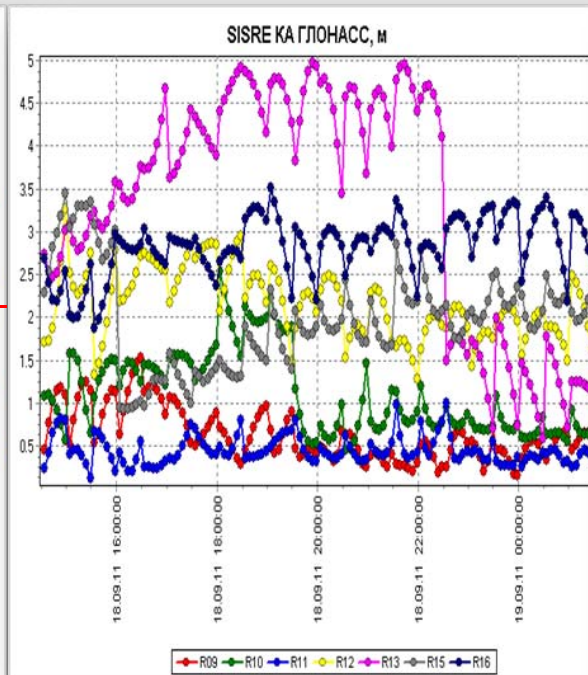


### Signal In Space Range Error, m

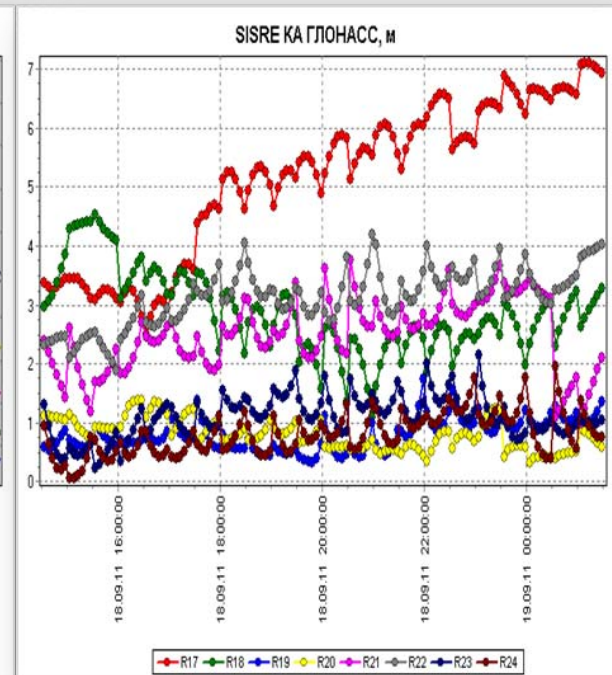
I plane



II plane



III plane

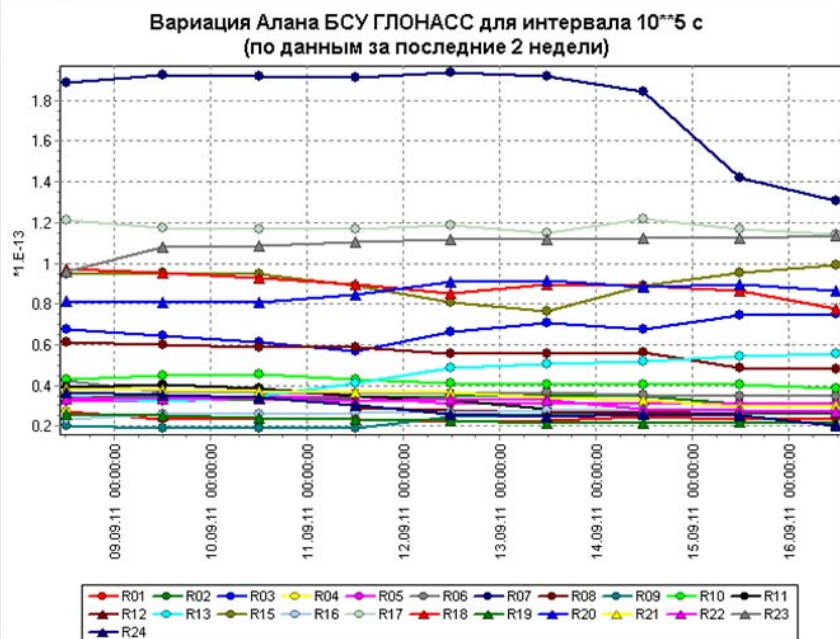




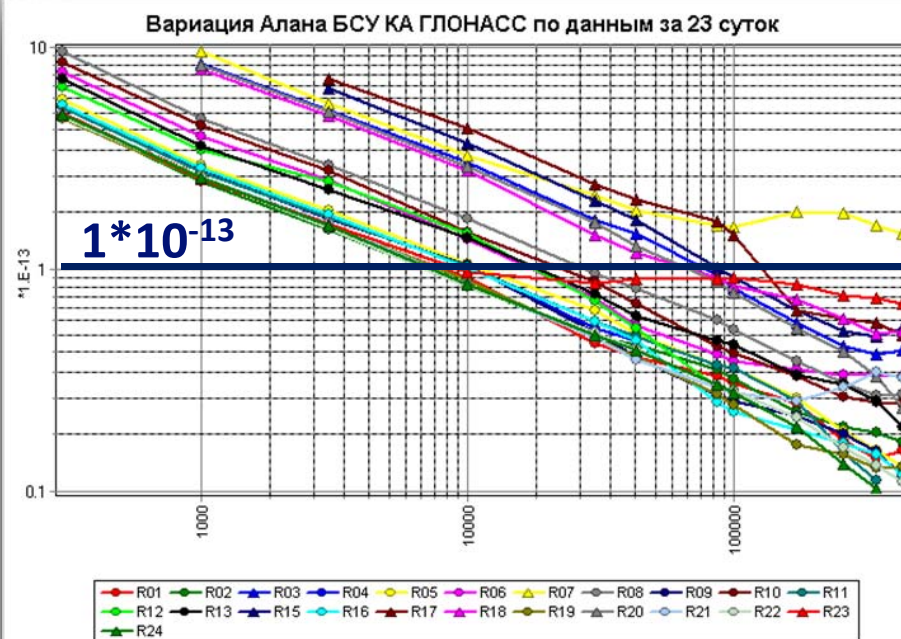
# On-Board Clock Stability



## Alan variation (interval 100000 sec)



## Alan variation (interval 23 days)





# GLONASS Modernization Plan



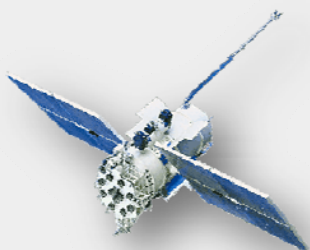
1982

2003

2011

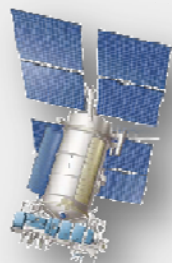
2013-2014

## “Glonass”



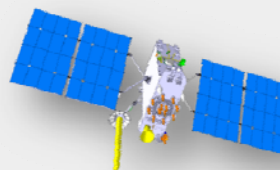
- 3 year design life
- Clock stability -  $5 \cdot 10^{-13}$
- Signals: L1SF, L2SF, L1OF, (FDMA)
- Totally launched 81 satellites
- Real operational life time 4.5 years

## “Glonass-M”



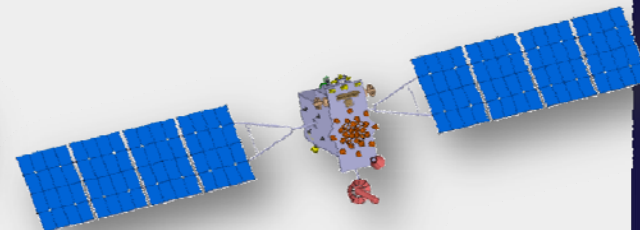
- 7 year design life
- Clock stability  $1 \cdot 10^{-13}$
- Signals: Glonass + L2OF (FDMA)
- Totally launched 28 satellites and going to launch 8 satellite by the end 2012

## “Glonass-K1”



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

## “Glonass-K2”



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

**CDMA signals general structure already designed**



# GLONASS Signals Modernization



“Glonass”



“Glonass-M”



“Glonass-K1”



“Glonass-K2”



“Glonass-KM”

	L1	L2	L3	L1, L2	Future	Status
“Glonass”	L1OF, L1SF	L2OF, L2SF	–	–		Done
“Glonass-M”	L1OF, L1SF	L2OF, L2SF	–	–		Done
“Glonass-K1”	L1OF, L1SF	L2OF, L2SF	L3OC test	–		Done
“Glonass-K2”	L1OF, L1SF	L2OF, L2SF	L3OC	L1OC, L1SC, L2SC		From №3 sat “Glonass-K”
“Glonass-KM”	L1OF, L1SF	L2OF, L2SF	L3OC	L1OC, L1SC, L2SC	L1OCM, L2OC, L5OC	Under development after 2015



FDMA signals



CDMA signals





# State Policy Basic Principles

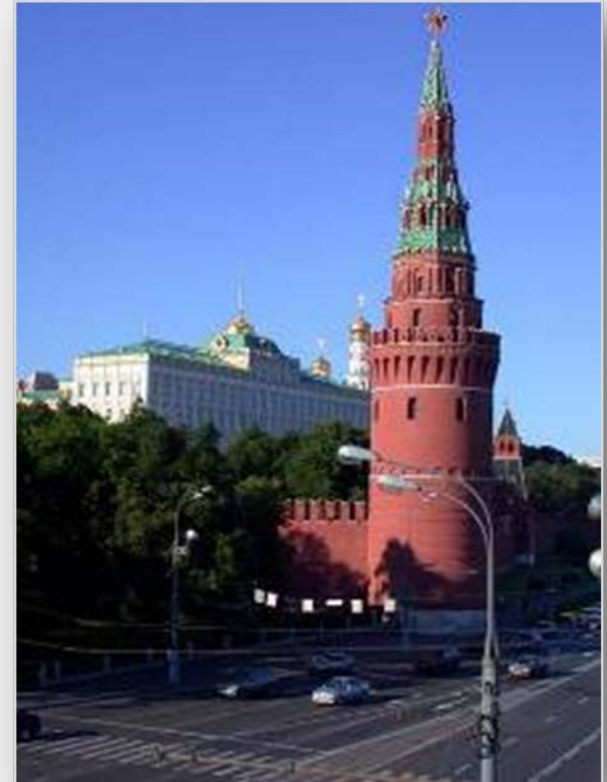


## Basic Documents:

- 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**





# New GLONASS Program Status



- GLONASS Program Concept prepared
- GLONASS Program for 2012 – 2020 to be approved by the end of 2011
- The Program objective is to make the GLONASS service
  - more **available**
  - more **accurate**
  - more **reliable**
  - more **robust**in the multi GNSS world



**GLONASS Sustainment, Development and Use**

# International Cooperation

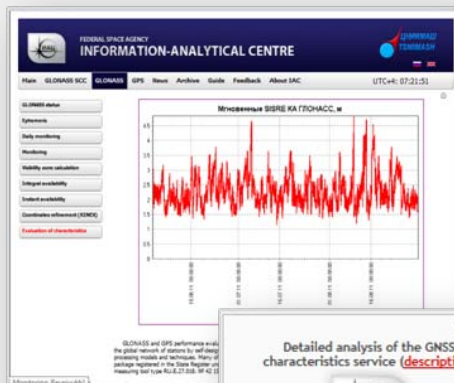
- GLONASS is an element of the global GNSS infrastructure
- Compatibility and Interoperability provision
- Development of common GNSS standards
- Promotion of GLONASS worldwide use for all user benefit







# GLONASS Performance Estimates



The screenshot shows a login page titled 'Detailed analysis of the GNSS characteristics service (description)'. It features the IAЦ logo and a login form with the following fields and options:

- Login (Email): sergey.revniyykh@mcc.rsa
- Password: [masked]
- Remember me?
- Log in button
- Forgot password? Request for registration
- Feedback email: ianc@glonass-iac.ru

- SIS Accuracy
- User Accuracy
- Availability
- Orbit accuracy
- Clock accuracy and stability
- Time scale difference estimates
- Geodesy reference difference estimates







# Summary



- GLONASS Program is the high priority of the Russian Government policy
- GLONASS open service is free for all users
- GLONASS Program is in a progress, objective to be achieved by 2011
- GLONASS improvement is a major objective:
  - Performance to be comparable with GPS by the end of 2011
  - Full constellation (24 sats) by the end of 2011
- 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 for worldwide use



# Thank you for your attention!

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