GLONASS
Status and Progress

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21 September 2010

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- GLONASS Architecture and Status
- Modernization Plan
- SDCM
- Summary

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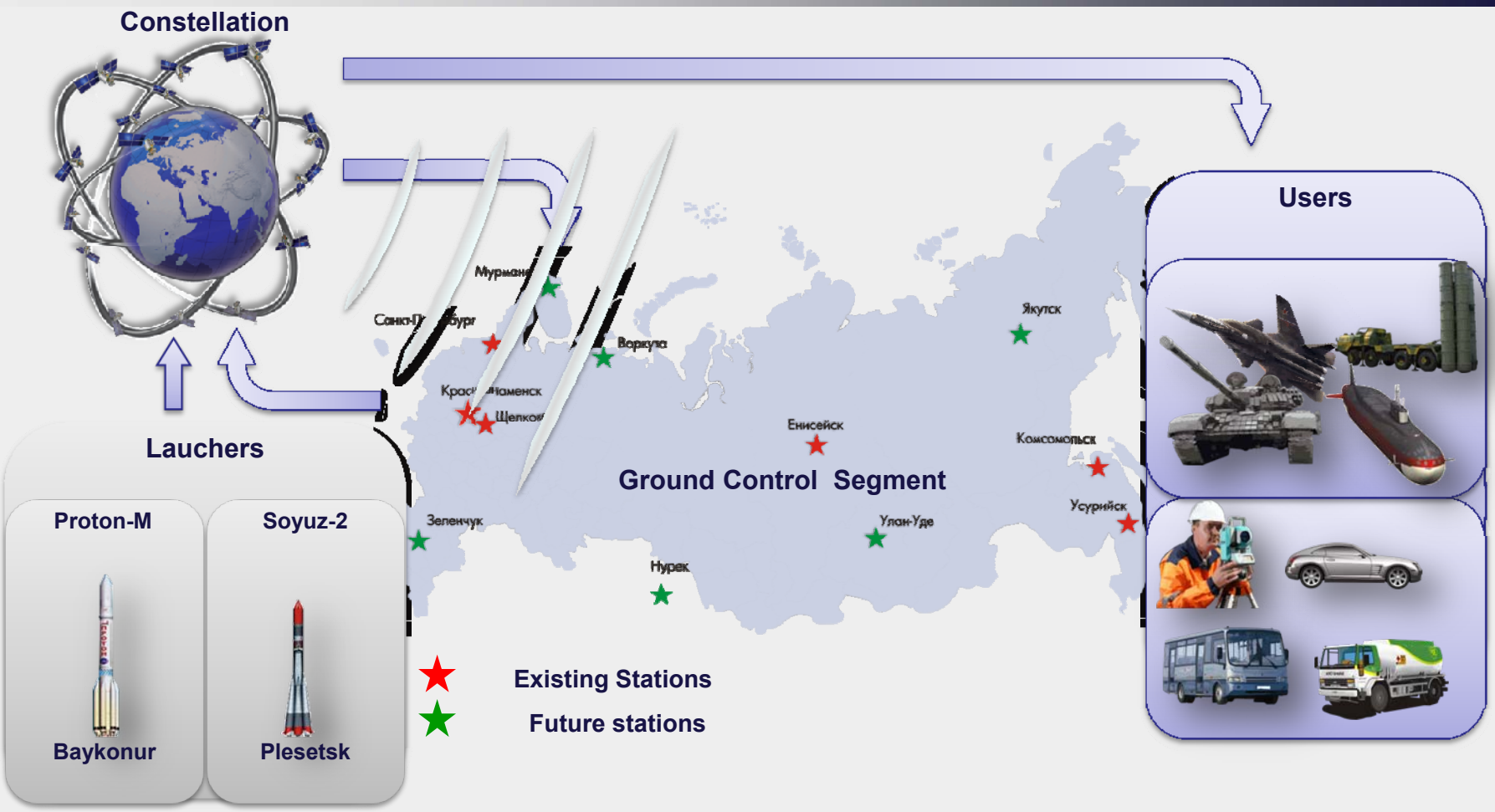
GLONASS Architecture



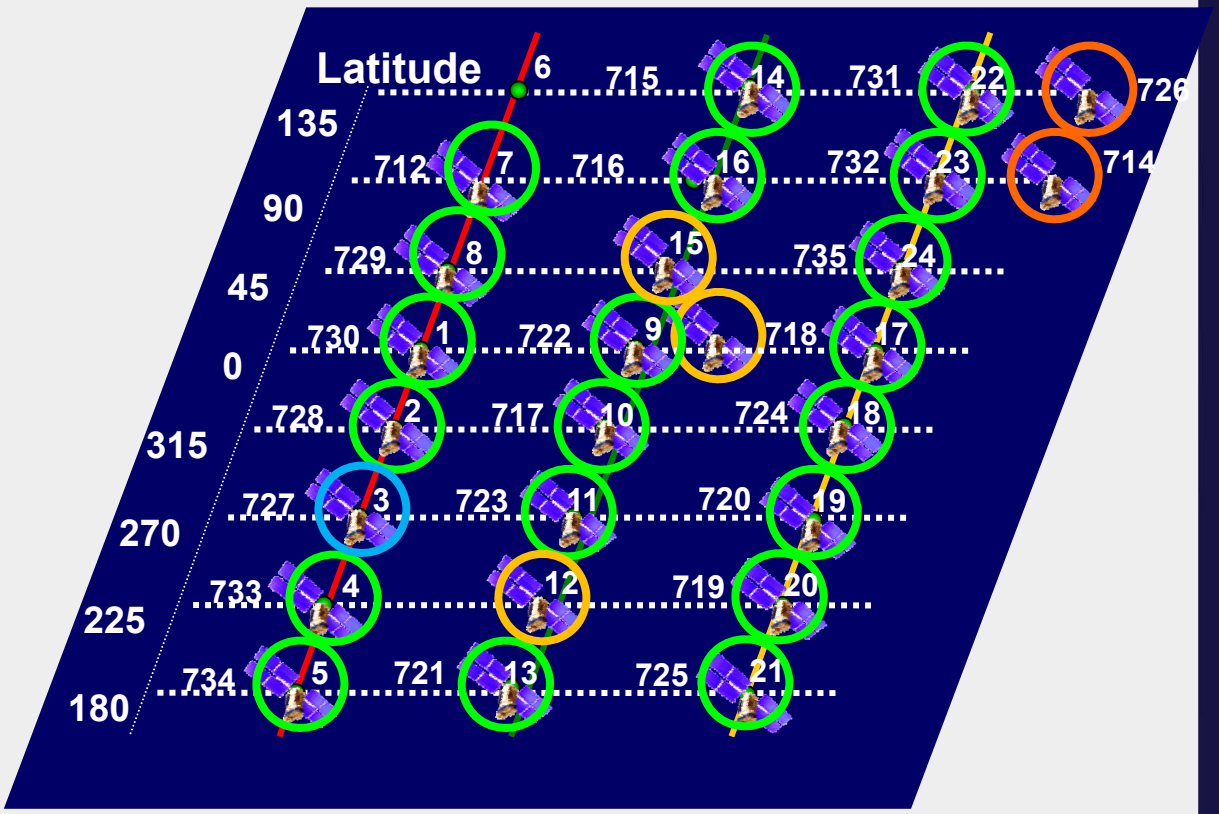
Block 42 launch at 02.09.2010

Next Launches:

- Block 43 (3 SV «Glonass-M»,
  December 2010
- Flight Test Begin of «Glonass-K»
  December 2010

Constellation Status

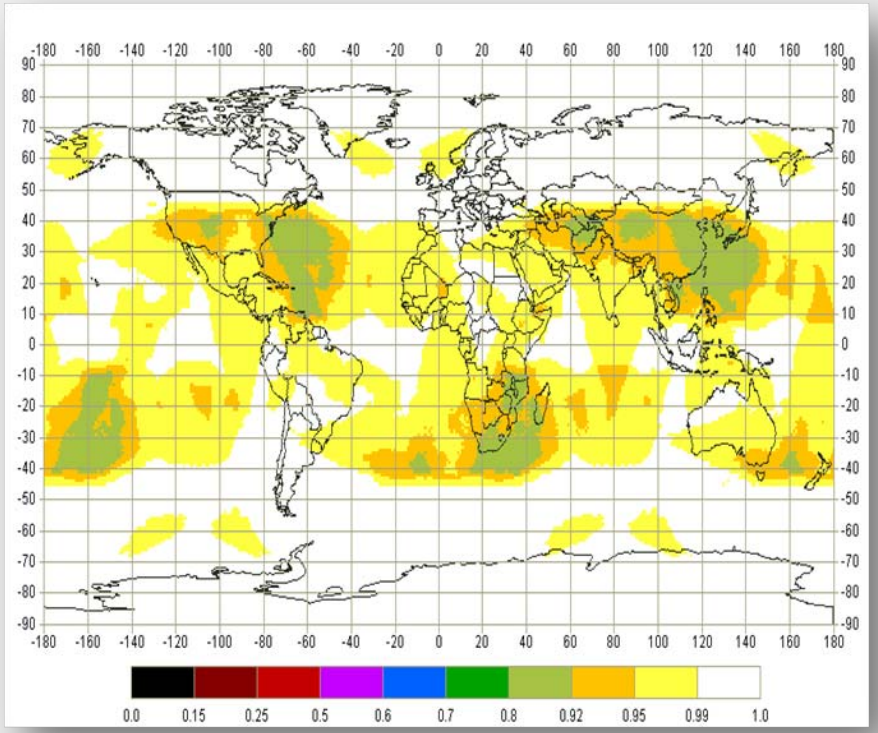
In orbit:	**26 SV**
Operational:	**20 SV**
Spares:	**2 SV**
In commission:	**3 SV**
In maintenance:	**1 SV**

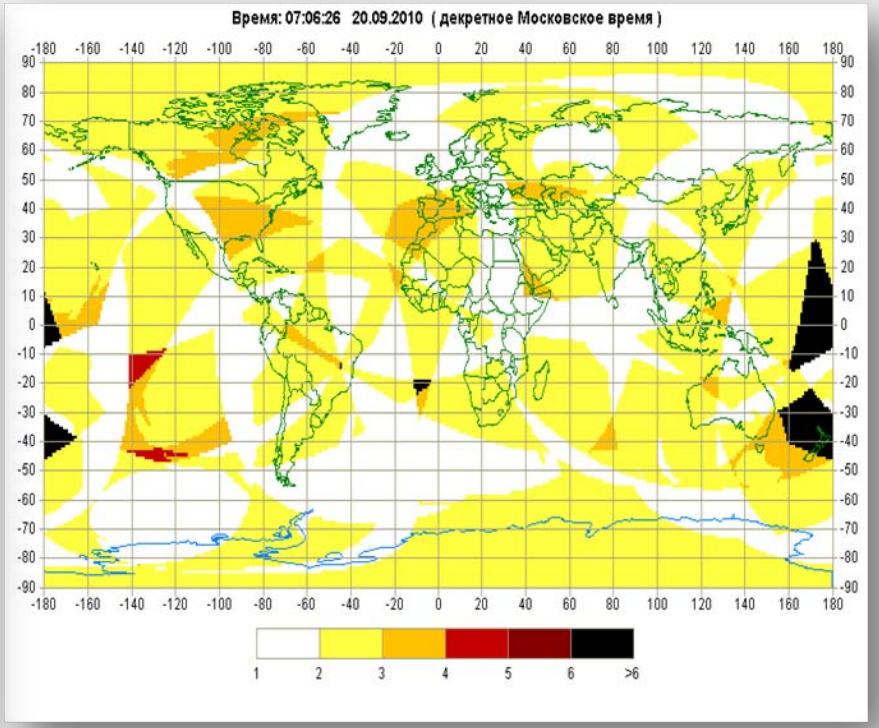


The constellation provides:

- ❑ Continuous navigation over Russia
- ❑ Practically global continuous navigation

GLONASS Availability
(20.09.2010)





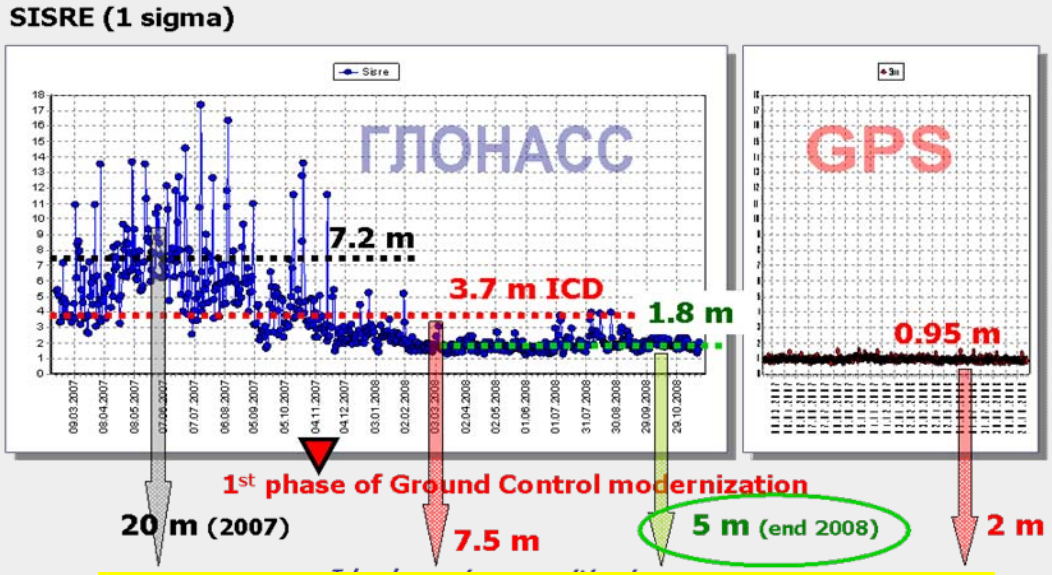
Mean availability for a day

Instant availability (PDOP)

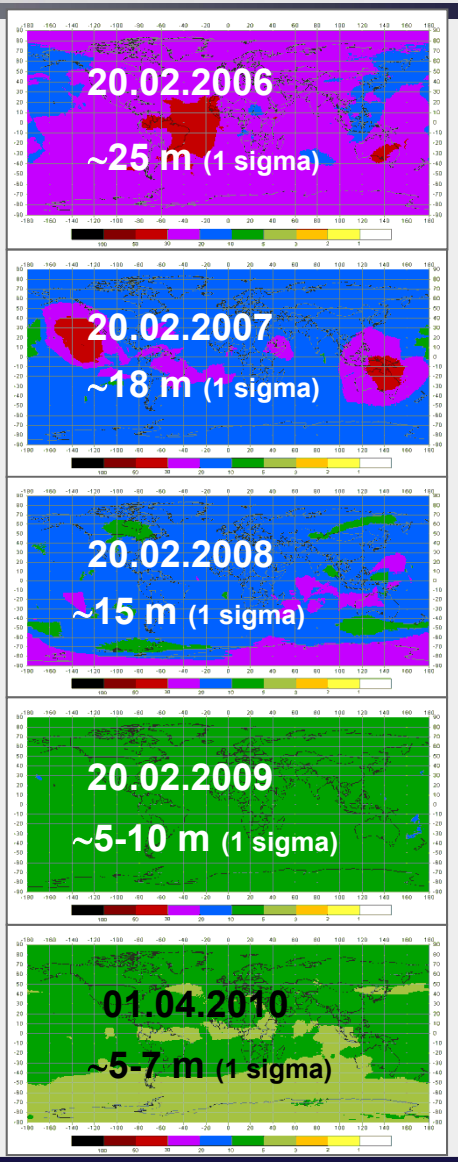
Global availability is 98 % (PDOP < 6, γ > 5°)

GLONASS Accuracy

- GLONASS accuracy has 5 time improved for last three years
- Now it is the same order of GPS
- Next improvement phase is expected by 2011

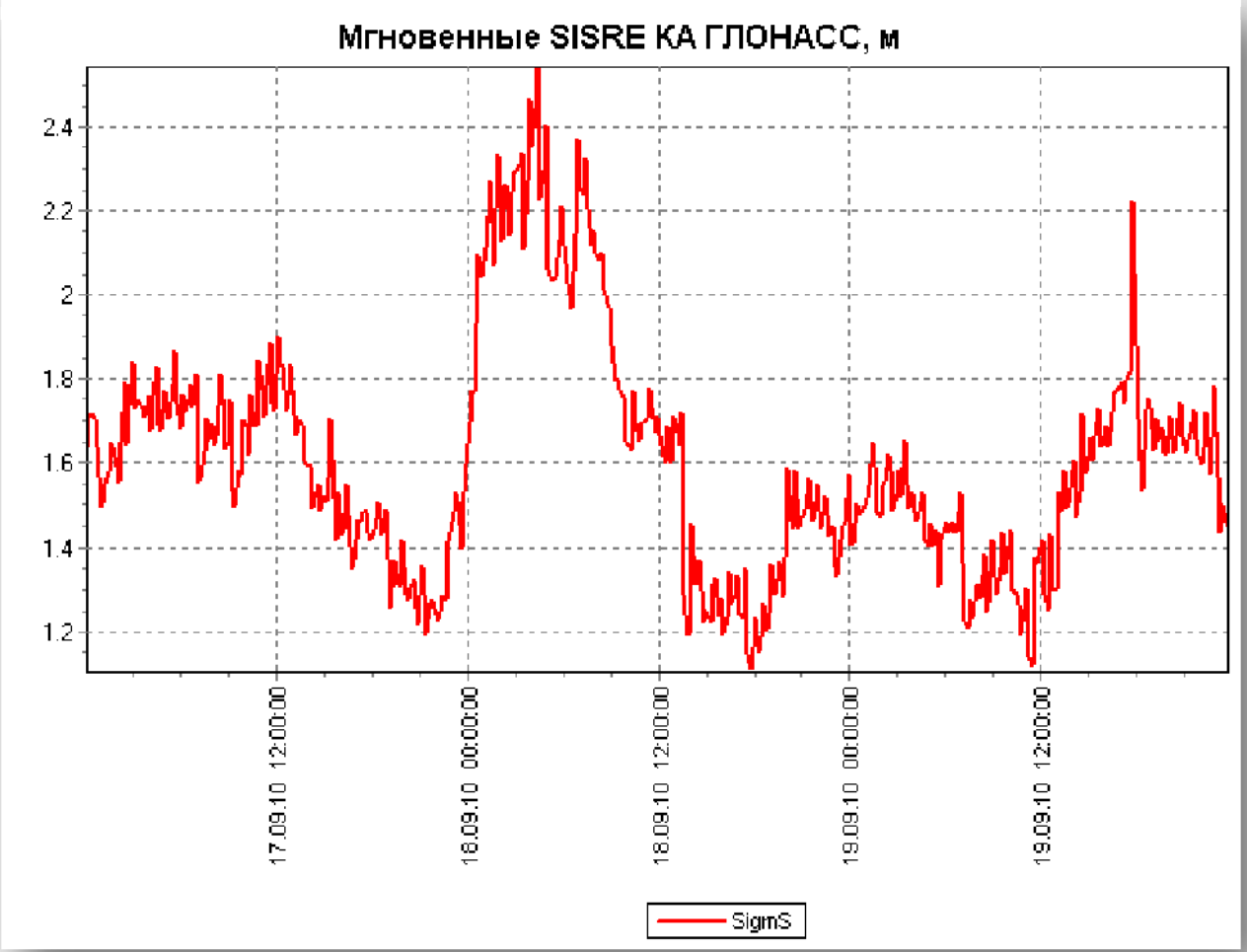


Ideal receiver positioning accuracy



GLONASS Accuracy
17 - 19.09.2010

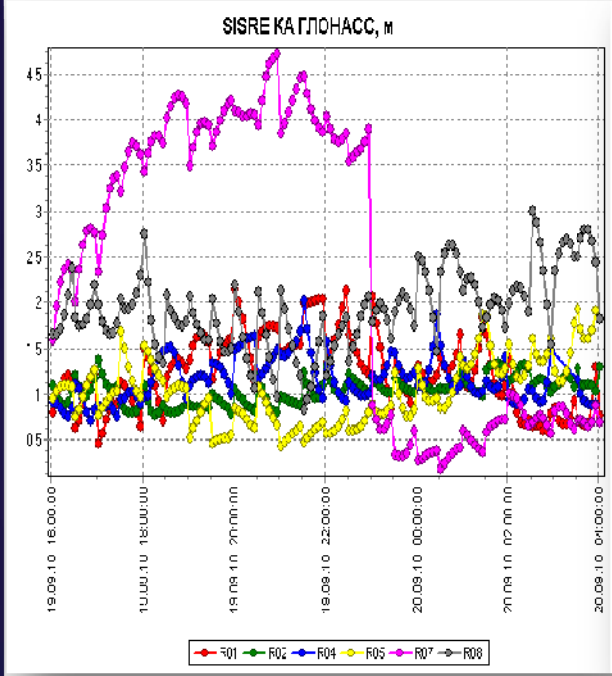
Signal In Space Range Error, m



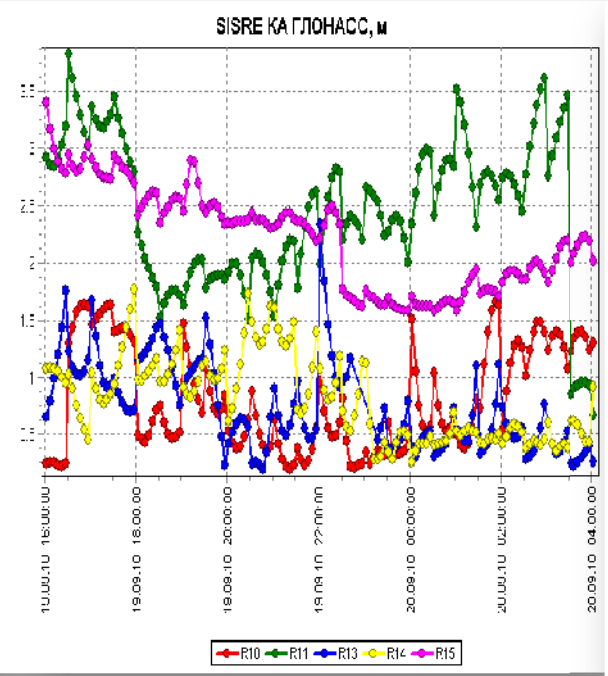
GLONASS Accuracy by Satellite 17 – 19.09.2010

Signal In Space Range Error, m

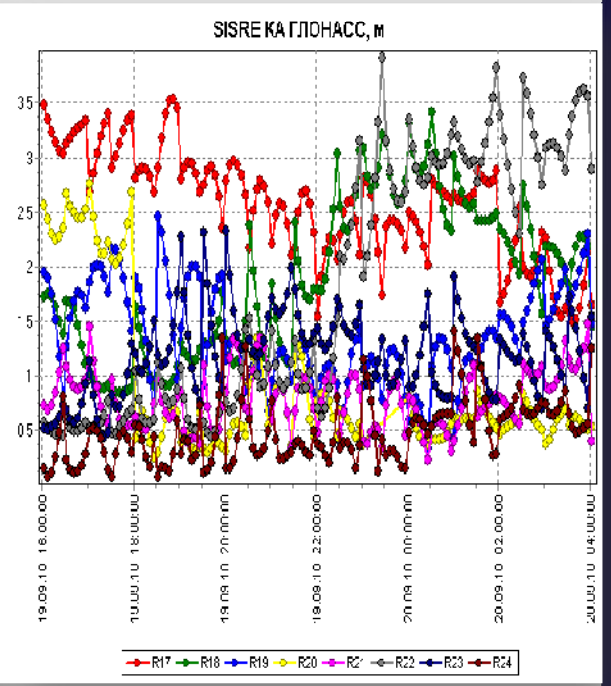
I plane



II plane



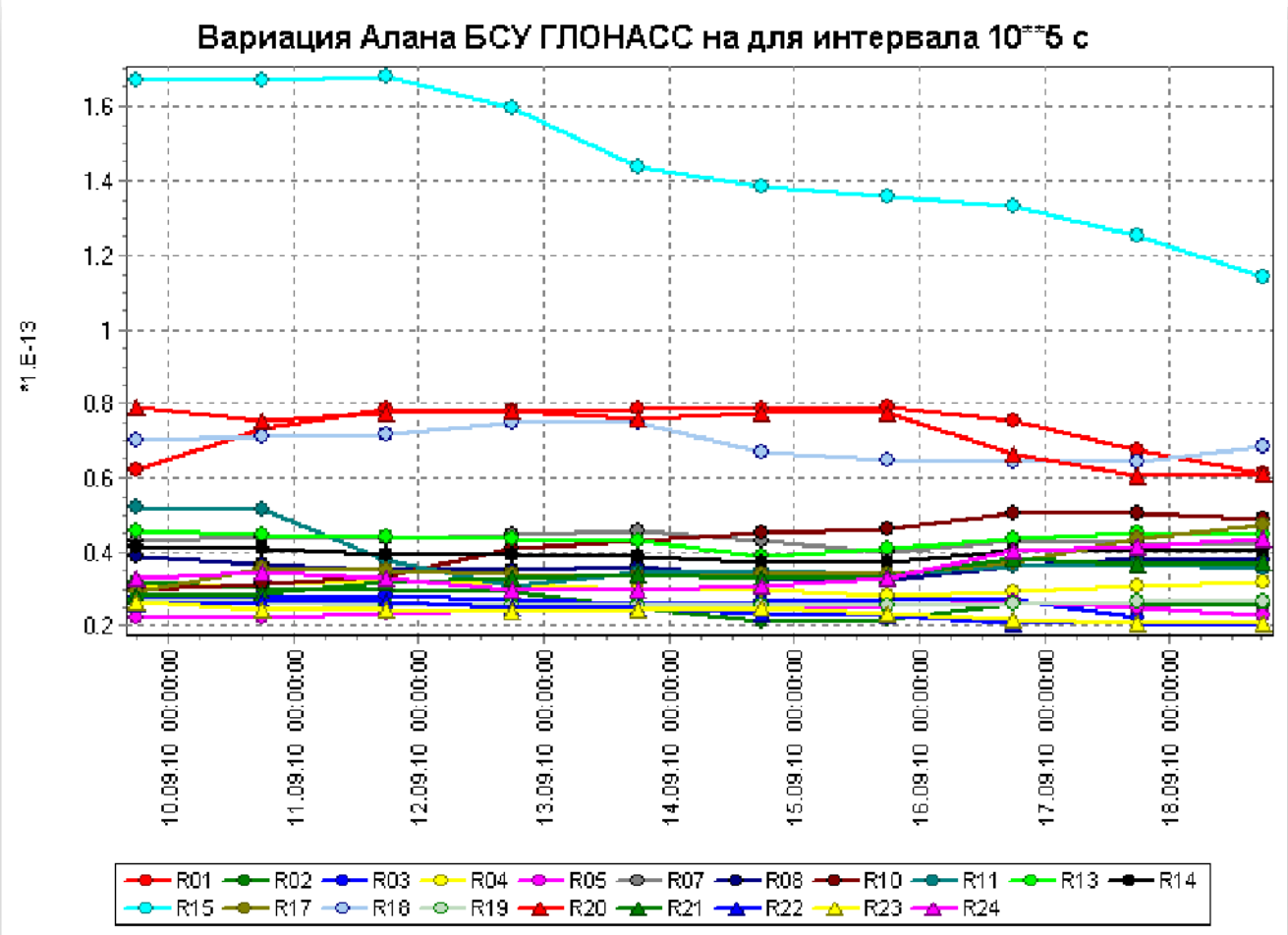
III plane



On-Board Clock Stability 10 – 18.09.2010

Alan variation

(interval 100000 sec)



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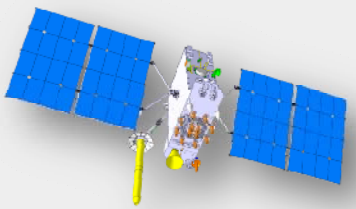
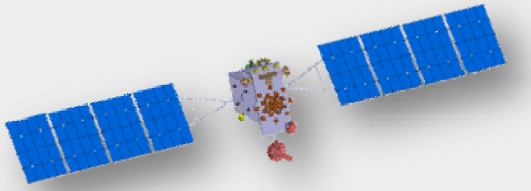
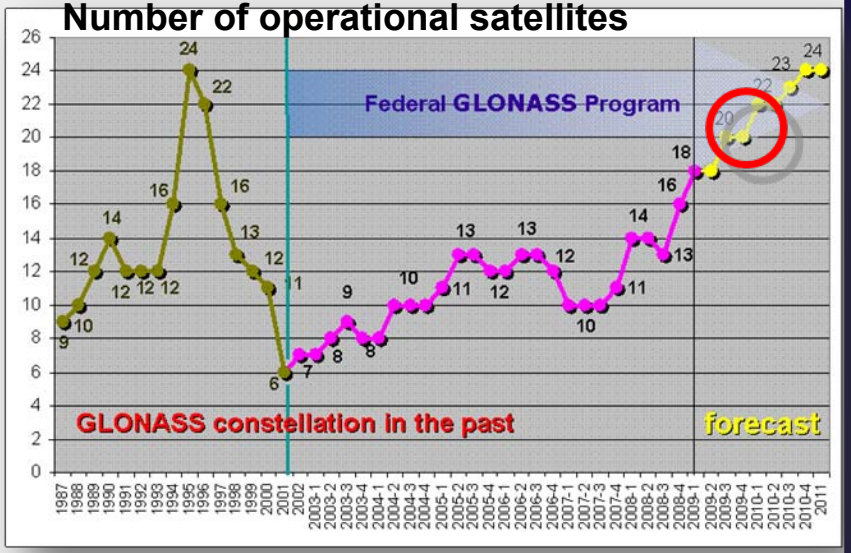
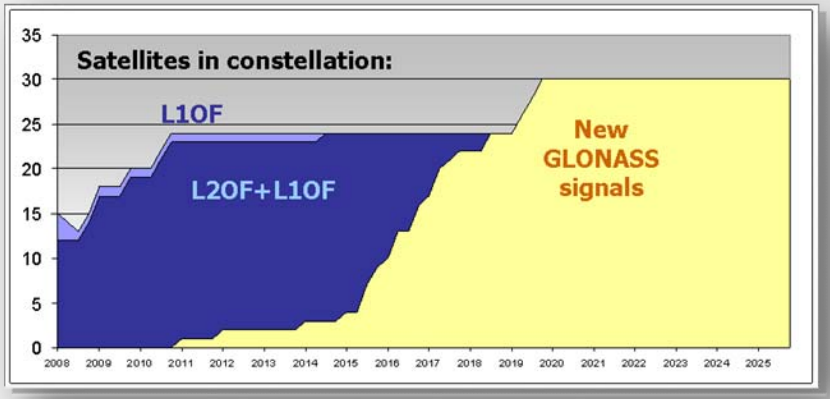
1982	2009	2010	2013
Glonass	**Glonass-M**	**Glonass-K1**	**Glonass-K2**
			
• 3 year design life • Clock stability - $5*10^{-13}$ • Signals : L1SF, L2SF, L1OF, (FDMA) • Totally launched 81 satellites ▪ Real operational life time 4.5 years	• 7 year design life • Clock stability 1*10-13; • Signals : L1SF, L2SF, L1OF, L2OF (FDMA) • Totally launched 28 satellites and going to launch about 11 satellite until to end 2012	• 10 year design life; • Clock stability 5*10-14; • Signals L1SF, L2SF, L1OF, L2OF (FDMA) • L3OC (CDMA) - test :	• 10 year design life; • Clock stability 1*10-14; • Signals L1SF, L2SF, L1OF, L2OF (FDMA) • L1OC, L3OC, L1SC, L2SC (CDMA) :

GLONASS Planning

- Full constellation deployment in 2010
- Ground Control Segment modernization
- New GLONASS-K satellite (with improved performance) IOV start by 2010
- GLONASS will continue transmitting existing FDMA signals
- Additional new CDMA signals since GLONASS-K deployment
- GLONASS performance competitive ability provision plan
- GLONASS Federal Program extension until 2020





Constellation Update based on GLONASS-K

GLONASS-K Flight Tests

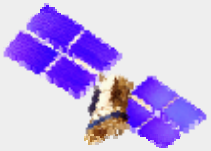
The direction of GLONASS navigation signals modernization

- Provide better potential accuracy for pseudorange and phase measurements
- Provide a better interference and multipath resistance of GLONASS signals
- Provide of greater interoperability with GPS and future GALILEO and other GNSS

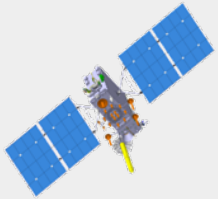
Introduction of new CDMA signals since GLONASS-K deployment

GLONASS signals modernization

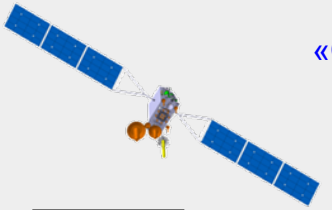
«Glonass»



«Glonass-M»



«Glonass-K1»



«Glonass-K2»

«Glonass-KM»

L1	L2	L3	L1, L2	Future	Status
L1OF, L1SF	L2OF, L2SF	-	-		Done
L1OF, L1SF	L2OF, L2SF	-	-		Done
L1OF, L1SF	L2OF, L2SF	L3OC test	-		From first test sat (2010 г.)
L1OF, L1SF	L2OF, L2SF	L3OC	L1OC, L1SC, L2SC		From #3 sat Glonass-K
L1OF, L1SF	L2OF, L2SF	L3OC	L1OC, L1SC, L2SC	L3SC, L1OCM, L2OC, L5OC	Under developm. After 2015 г.

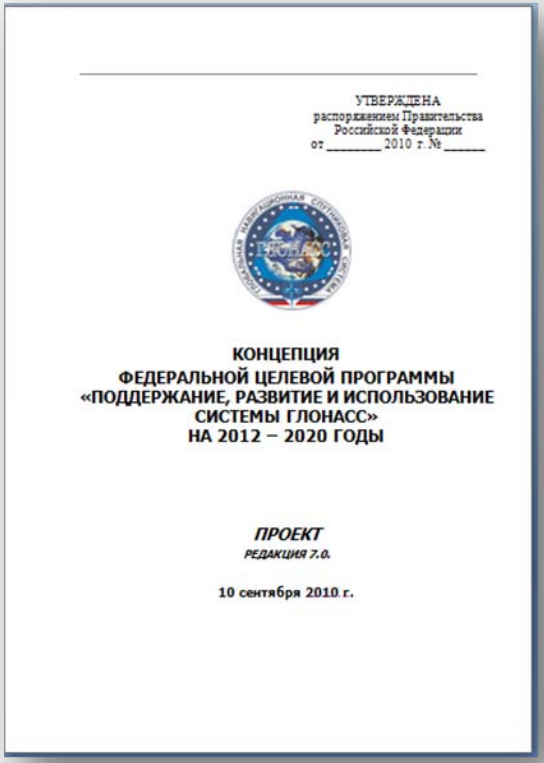
FDMA signals

CDMA sbgnals

Major positions of the GLONASS-2020 Concept

Sustainment, Development, Use

- **Sustainment**
  - ***State commitments*** on performance (constellation, availability, accuracy, stability of performance)
    - Launch program until 2020 with spares in-orbit and on the ground
- **Development**
  - Constellation improvement
  - New signals implementation
  - Accuracy and availability improvement
  - Interference protection improvement
  - New functions implementation
  - Service area widening
- **Use**
  - Governmental use support
  - Private activity encouraging
  - Make [illegible]



УТВЕРЖДЕНА
распоряжением Правительства
Российской Федерации
от _____ 2010 г. № _____

КОНЦЕПЦИЯ
ФЕДЕРАЛЬНОЙ ЦЕЛЕВОЙ ПРОГРАММЫ
«ПОДДЕРЖАНИЕ, РАЗВИТИЕ И ИСПОЛЬЗОВАНИЕ
СИСТЕМЫ ГЛОНАСС»
НА 2012 – 2020 ГОДЫ

ПРОЕКТ
РЕДАКЦИЯ 7.0.

10 сентября 2010 г.

Extended PNT Architecture of Russia

Precise Ephemeris and Clock System

Wide Area Augmentation SDCM

Regional Augmntns

Earth Attitude and Rotation System

Time Reference System UTC (SU)

Geodesy Reference and Maps

Special User Equipment

Civil Users Equipment

Synergy of performance and requirements

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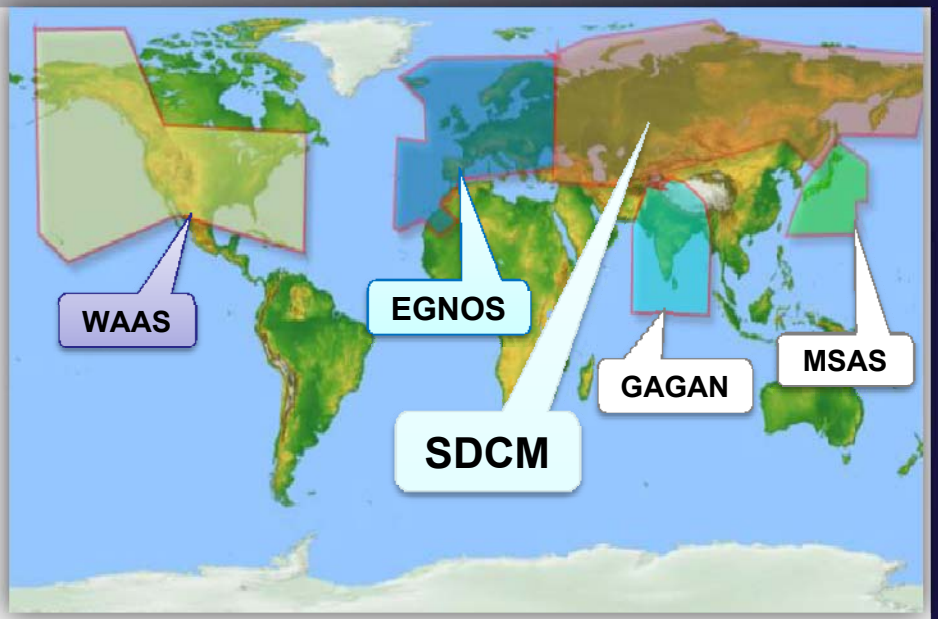
SDCM (SBAS Augmentation)

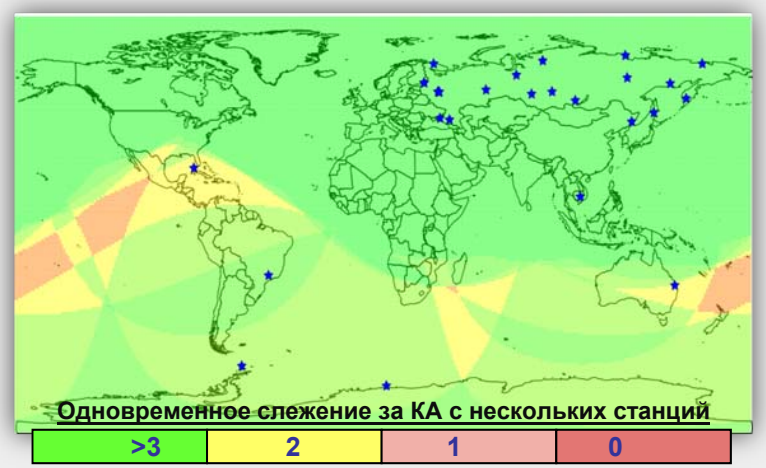
Objectives

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



Current status of monitoring stations

- **Operational network**
  - **12 stations in Russia**
  - **1 station in Antarctic**
- **Future development**
  - **8 stations more in Russia**
  - **5 stations more outside**



Перспективная сеть станций

SSI-01 monitoring station installation and commissioning (Bellingshausen, Antarctica, 2010)

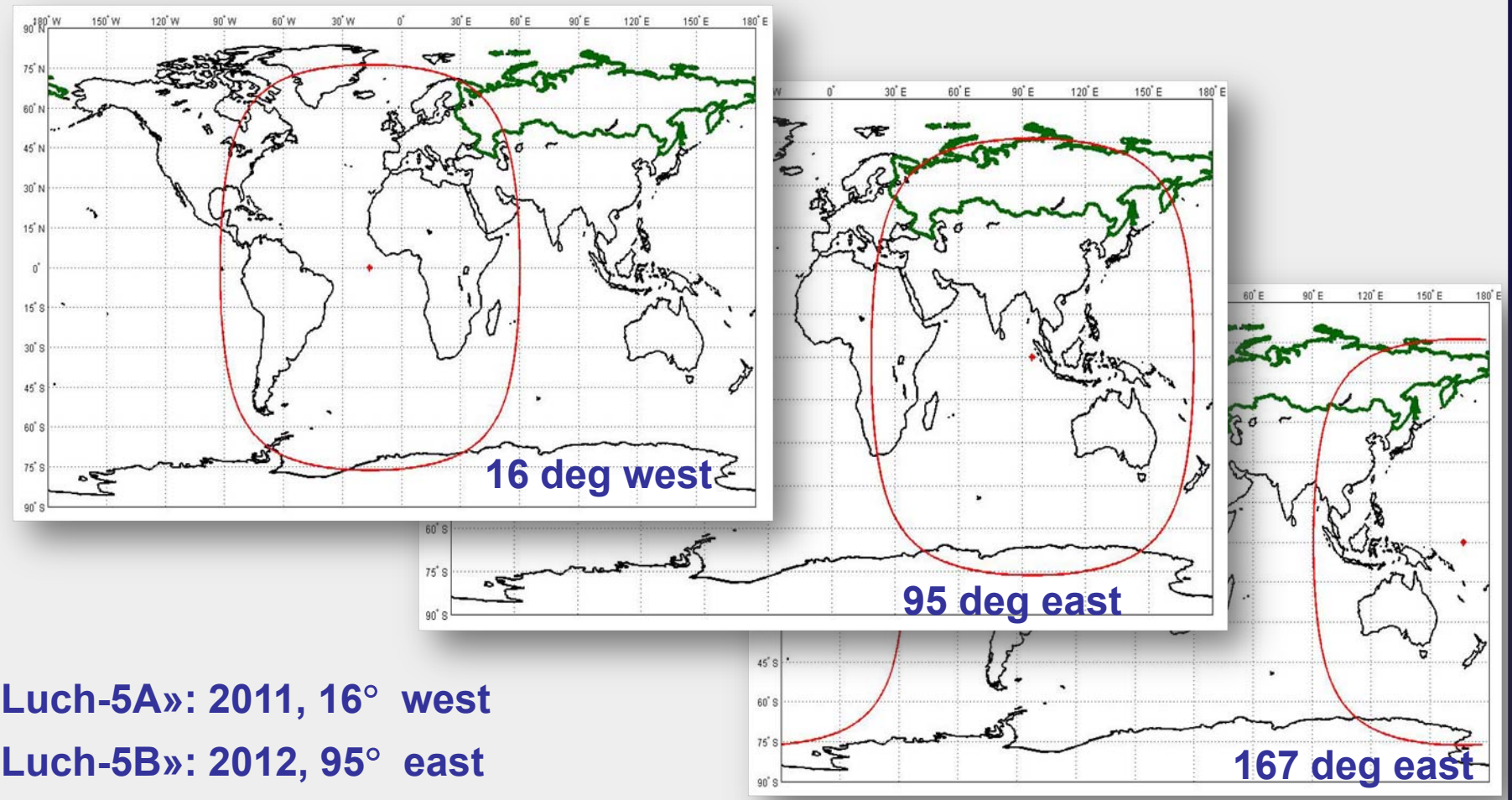
Main view of the SSI-01

Off-site equipment

GLONASS/GPS antenna + Vaisala weather station

Satellite communication channel antenna

Envisaged locations for GEOs “Luch” with SDCM payload (2011-2013 timeframe)



«Luch-5A»: 2011, 16° west

«Luch-5B»: 2012, 95° east

«Luch-4»: 2013, 167° east

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Summary

- GLONASS Program is the high priority of the Russian Government policy
- GLONASS Program is in a progress
- 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 2010
- GLONASS will continue
  - Keeping the GLONASS traditional frequency bands
  - Transmitting existing FDMA signals
  - Introducing new CDMA signals
- New GLONASS Program is under development
  - State committments for major performance
  - GLONASS sustainment, development, use
- International cooperation – make GLONASS as one of key elements of the international GNSS

Thank you for your attention!