РОСКОСМОС

GLObal Navigation Satellite System (GLONASS)

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- **GLONASS Modernization**
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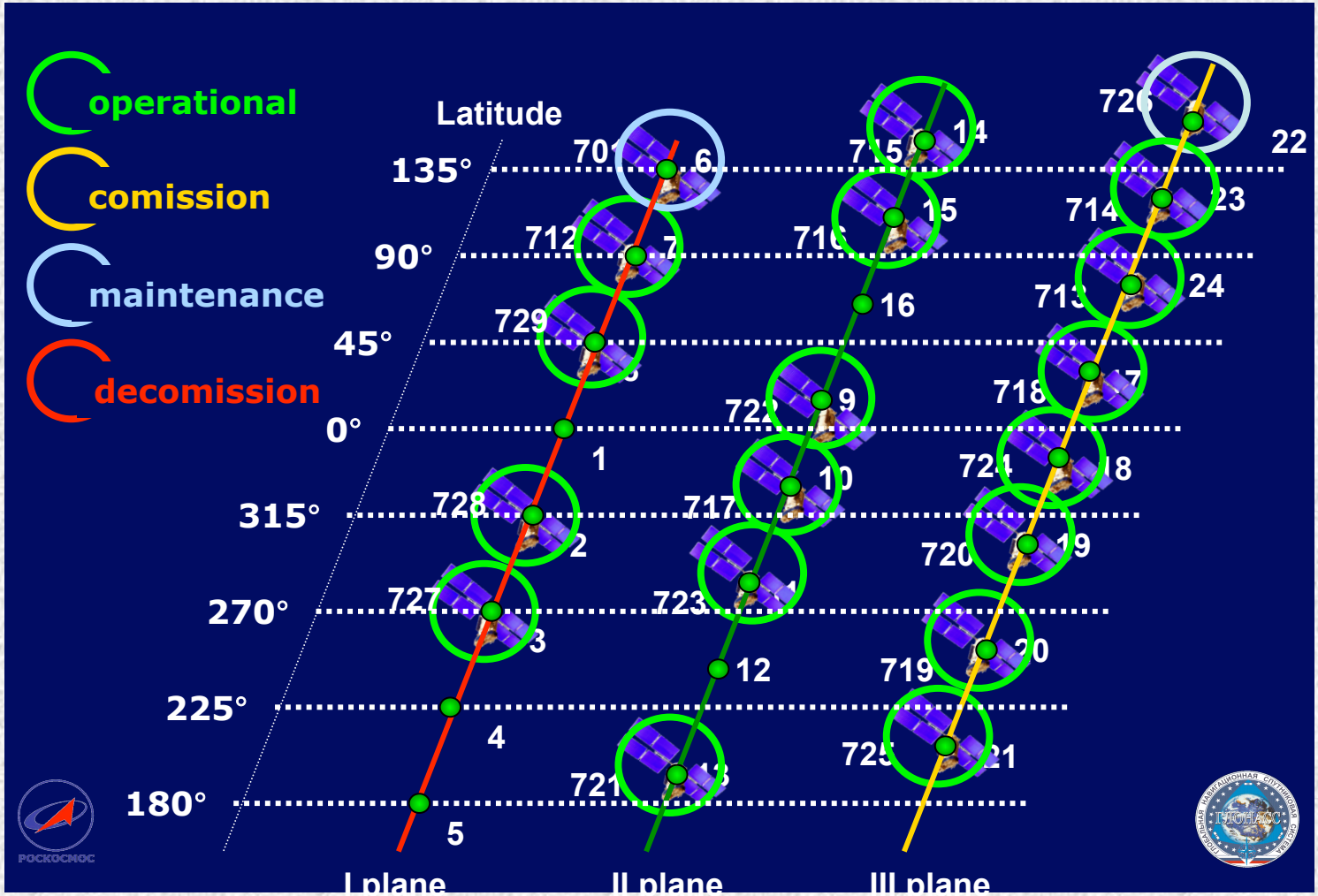
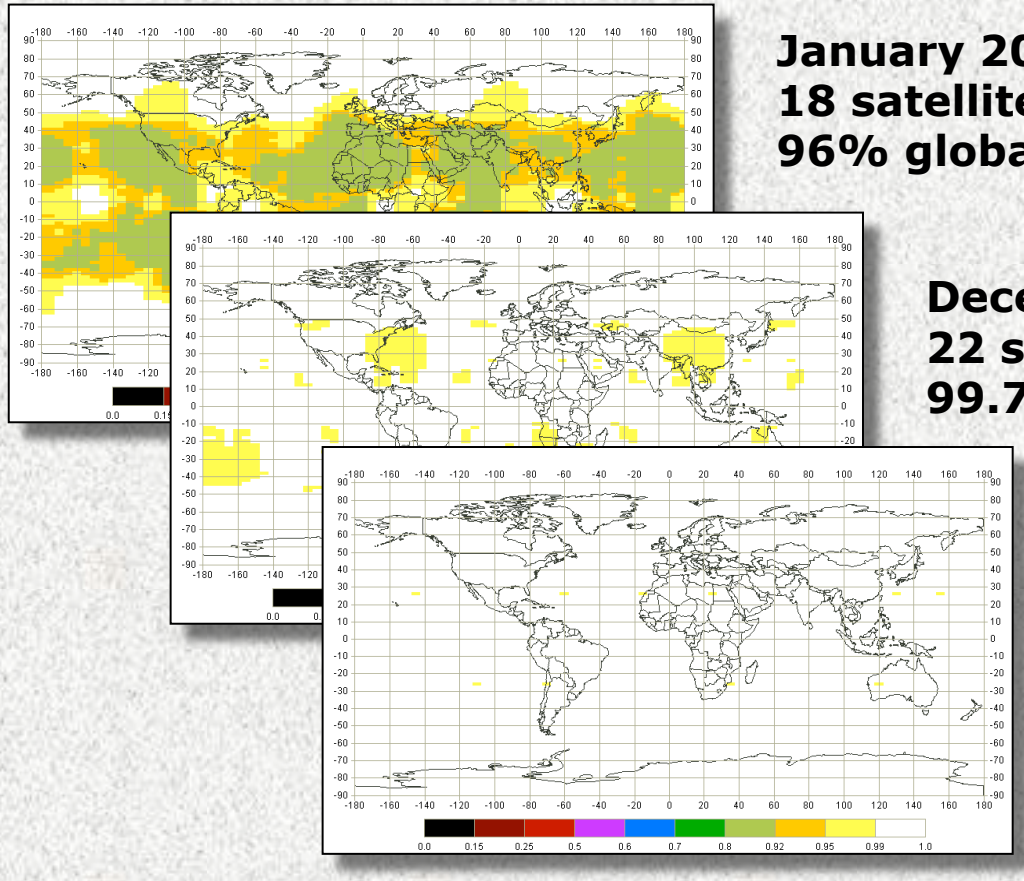
GLONASS Improvement Events

- In 2007-2008 12 GLONASS-M satellites launched
- 1st phase of Ground Control modernization
- Refined geodesy reference implemented (PZ-90.02)
- 19 Satellites "GLONASS-M" on Orbit
- 18 GLONASS-M satellites are transmitting two civil signals in L1 и L2
- Next launches:
  - September 2009 – 3 "Glonass-M" sats
  - December 2009 – 3 "Glonass-M" sats

GLONASS Constellation Status (12.09.2009)



GLONASS Deployment Program



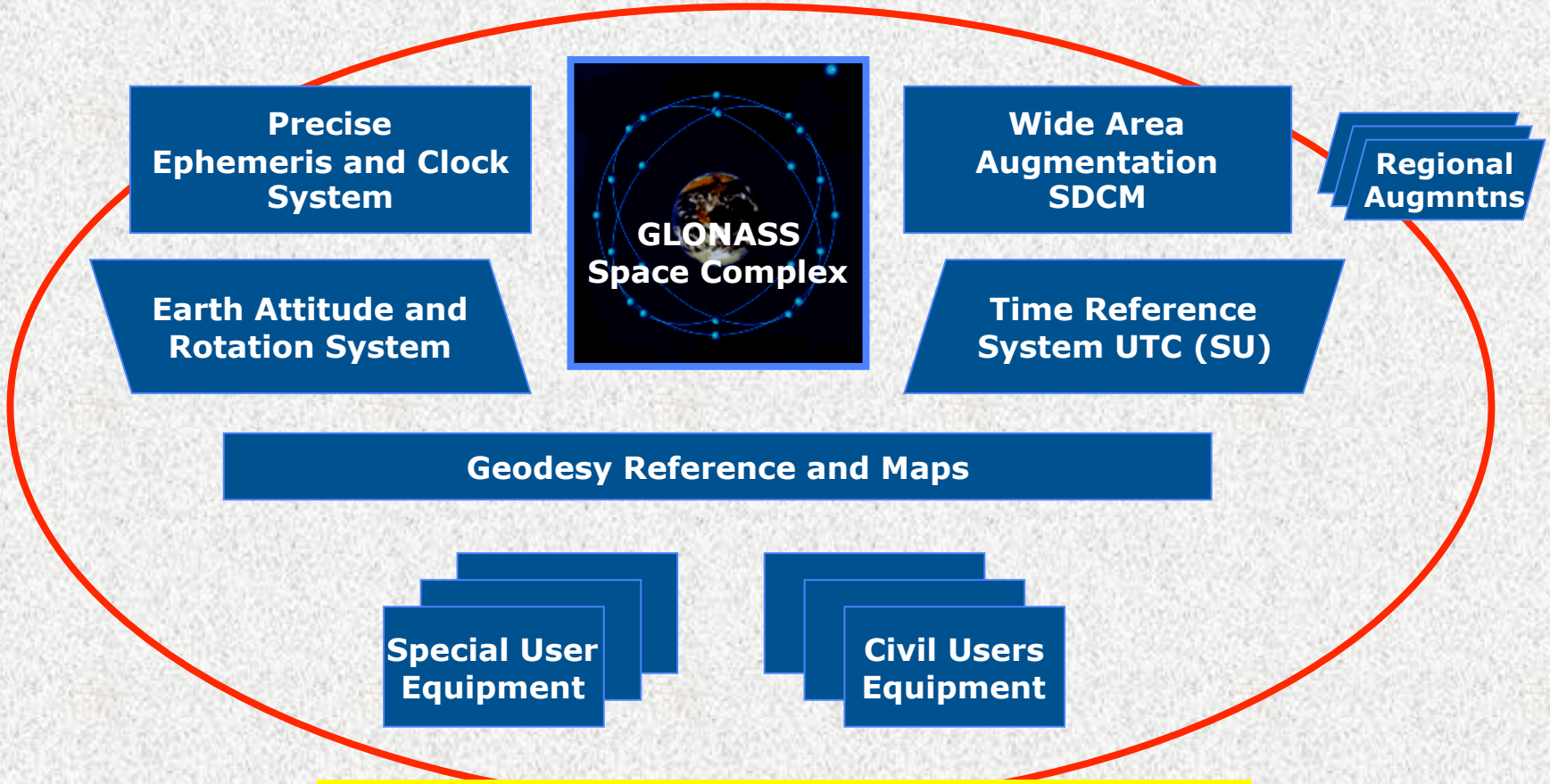
January 2009
18 satellites.
96% global availability

December, 2009
22 satellites.
99.7% global availability

December, 2010
24 satellites.
99.9% global availability

Extended PNT Architecture of Russia

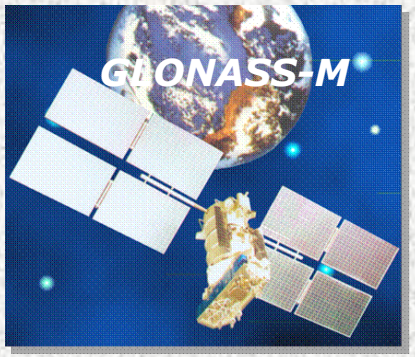
New GLONASS Technical Requirements

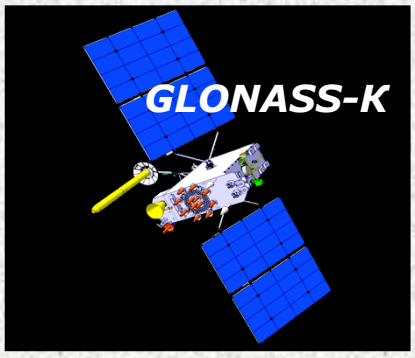


Synergy of performance and requirements

GLONASS Development Program

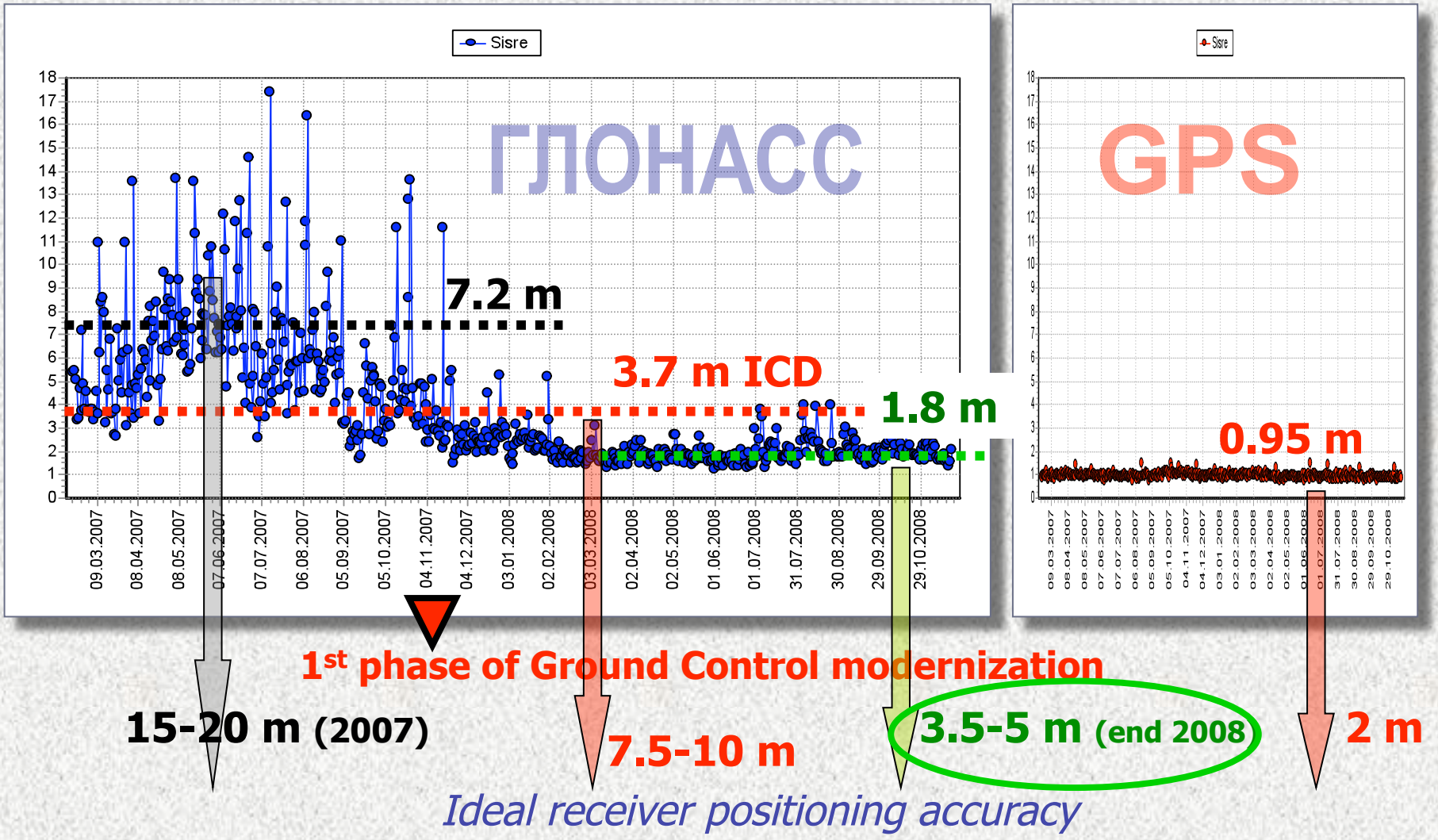
- "Glonass-K" flight test (2010)
- Continuous global navigation provision plan
  - Modernization of the orbital constellation
- GLONASS accuracy improvement plan
- Ground control segment modernization
  - Ground control network extension
  - System time and orbit improvement
  - Monitoring network extension
- Signal modernization
  - New signals in "Glonass-K" (including CDMA)
- Interoperability with GPS and future GALILEO
  - Signals
  - Geodesy reference
  - Time reference
- Further modernization of GLONASS based on new satellite





GLONASS Accuracy Improvement

SISRE (1 sigma)



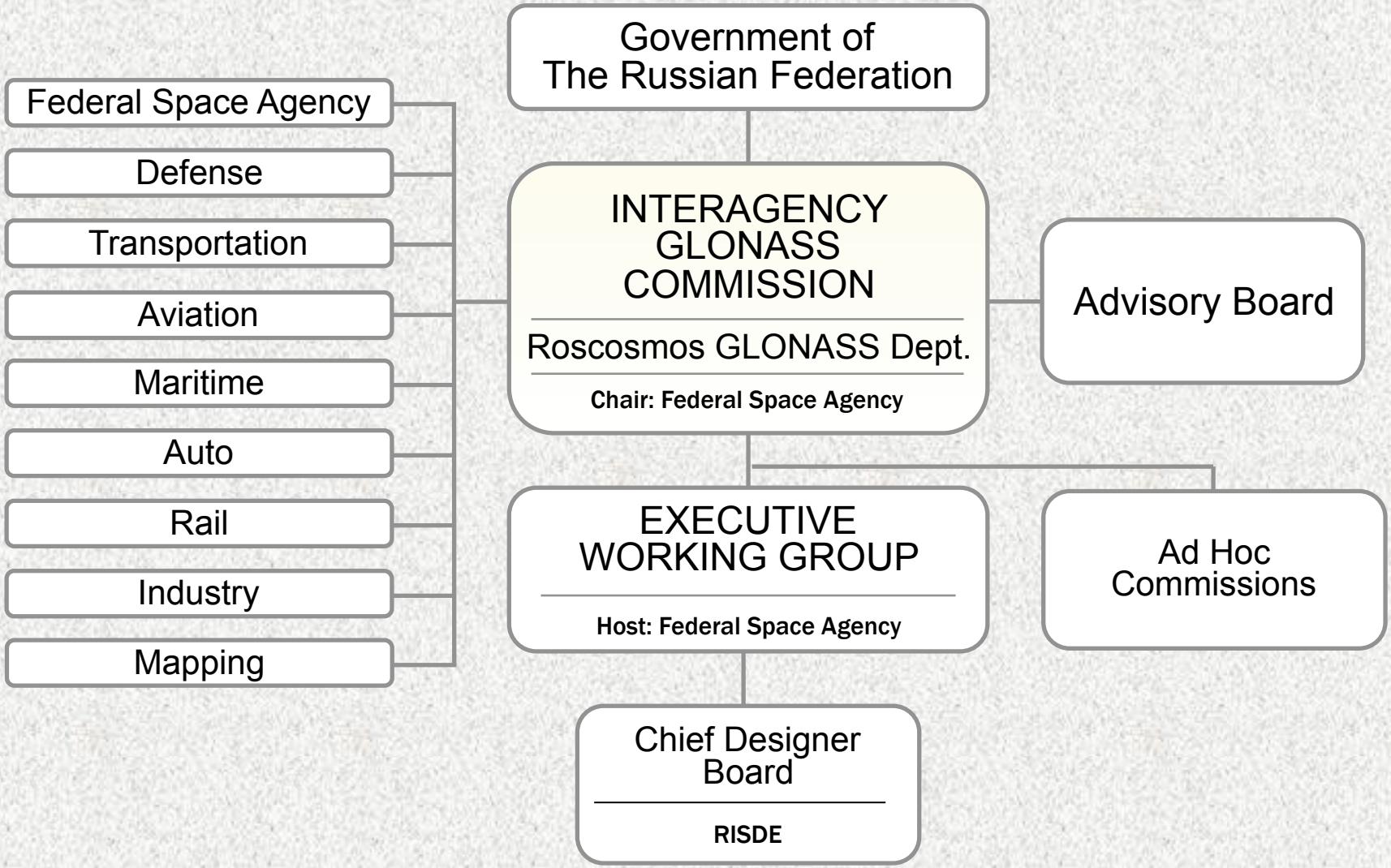
State Policy Basic Principles

- **GLONASS is a part of the critical state PNT infrastructure providing national security and economy development**
- **Creating, developing and sustaining the PNT infrastructure is a State responsibility**
- **No direct user fees for civil GLONASS services**
- **Open, free access to GLONASS information necessary to develop and build user equipment**
- **GLONASS is used in combination with other GNSS, terrestrial radio navigation, other navigation means to increase reliability of navigation**
- **International cooperation on GNSS compatibility and interoperability**

Presidential Decree on GLONASS (May 17, 2007)

- **Main statements:**
  - Free access to the civil signals
  - GLONASS binding use for governmental and critical applications
- **Recommended:**
  - GLONASS use for regional authorities and commercial companies
- **General coordination of GLONASS sustainment, development and application**
  - Federal Space Agency
- **To the Government:**
  - GLONASS promotion, including international cooperation
  - Digital maps issue to be resolved asap
  - Preparation of the new GLONASS Program for 2012 – 2020.

GLONASS Organization



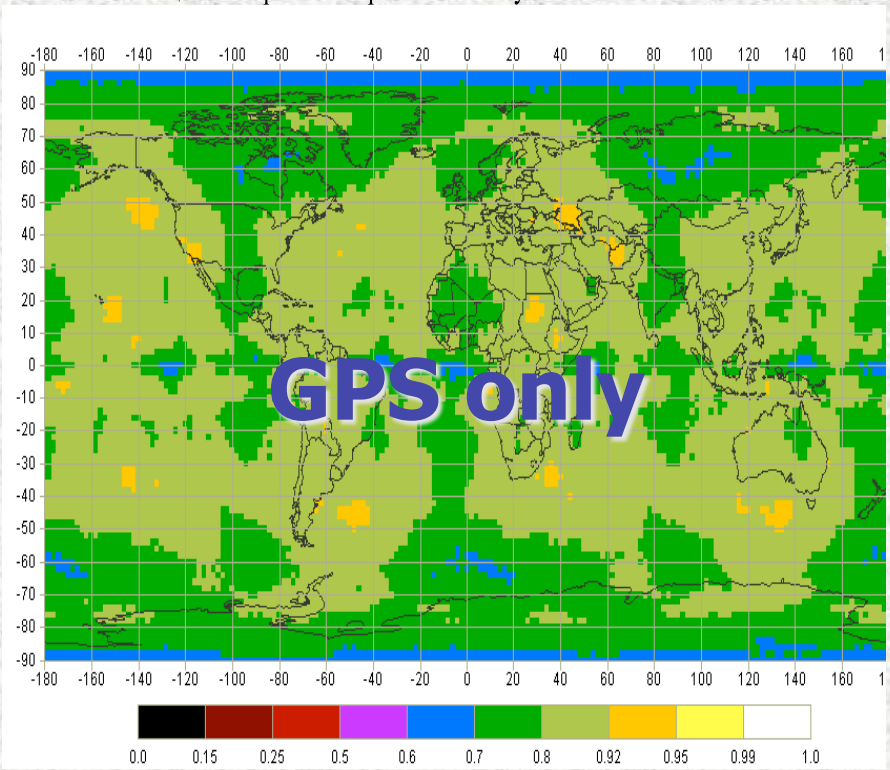
International Cooperation

- **Goals:**
  - Promote GLONASS worldwide use
  - Provide GNSS compatibility and interoperability
  - Integrate GLONASS into the Global GNSS Infrastructure
- **Cooperation with GNSS providers**
  - The United States – GPS/GLONASS compatibility and interoperability
  - European Union – Galileo/GLONASS and augmentations compatibility and interoperability
  - India – GLONASS deployment support, augmentations interoperability
  - UN GNSS Providers Forum
- **GLONASS Use Cooperation**
  - Former USSR countries
  - Middle East, Australia, Latin America…
  - UN ICG

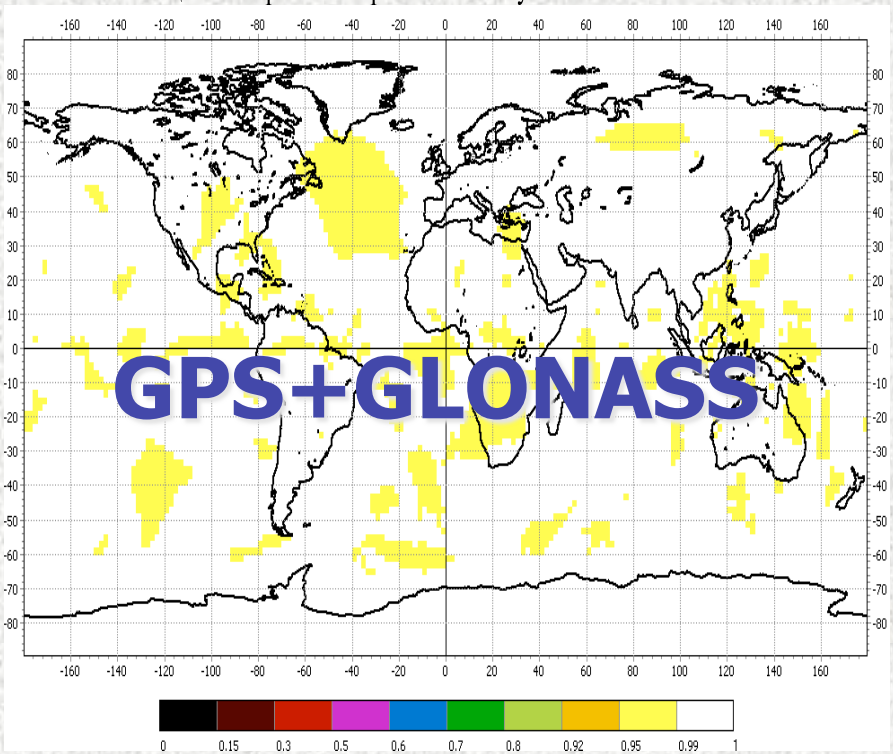
Availability: GPS, GLONASS

25° mask angle

Доступность навигации ГНСС на поверхности Земли
(средняя доступность по Земле: 0.821)
Перспективная ОГ GPS 32 КА
Условие навигации: Pdop<=6. Ограничение на угол места: 25°



Доступность навигации ГНСС на поверхности Земли
(средняя доступность по Земле: 0.996)
Перспективная объединенная ОГ: GPS 32 КА+GLONASS 24 КА
Условие навигации: Pdop<=6. Ограничение на угол места: 25°



Availability: GPS, Galileo

25° mask angle

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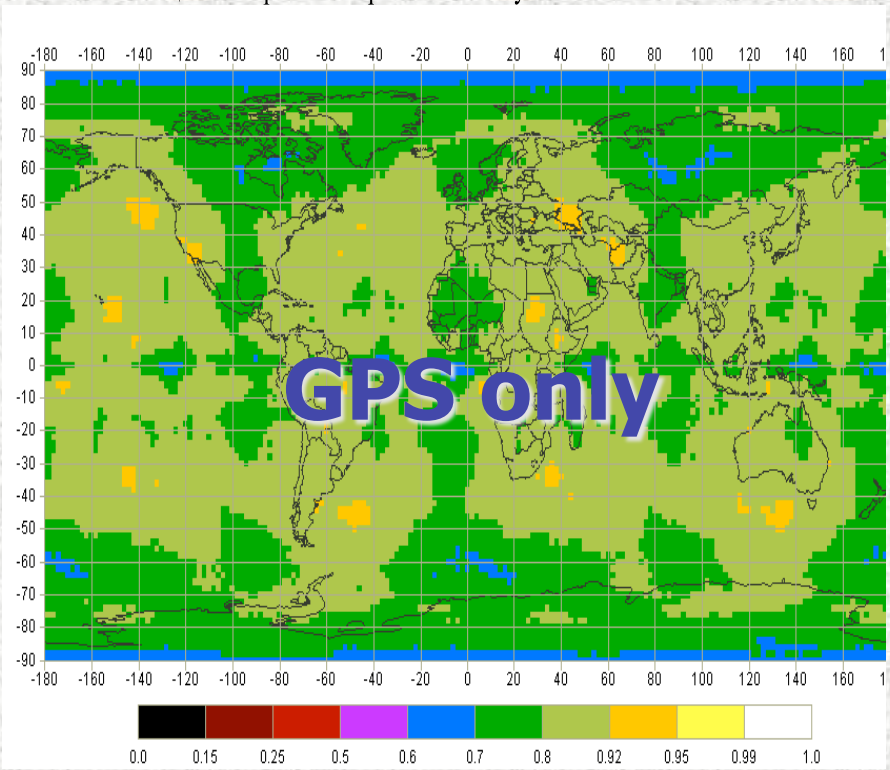

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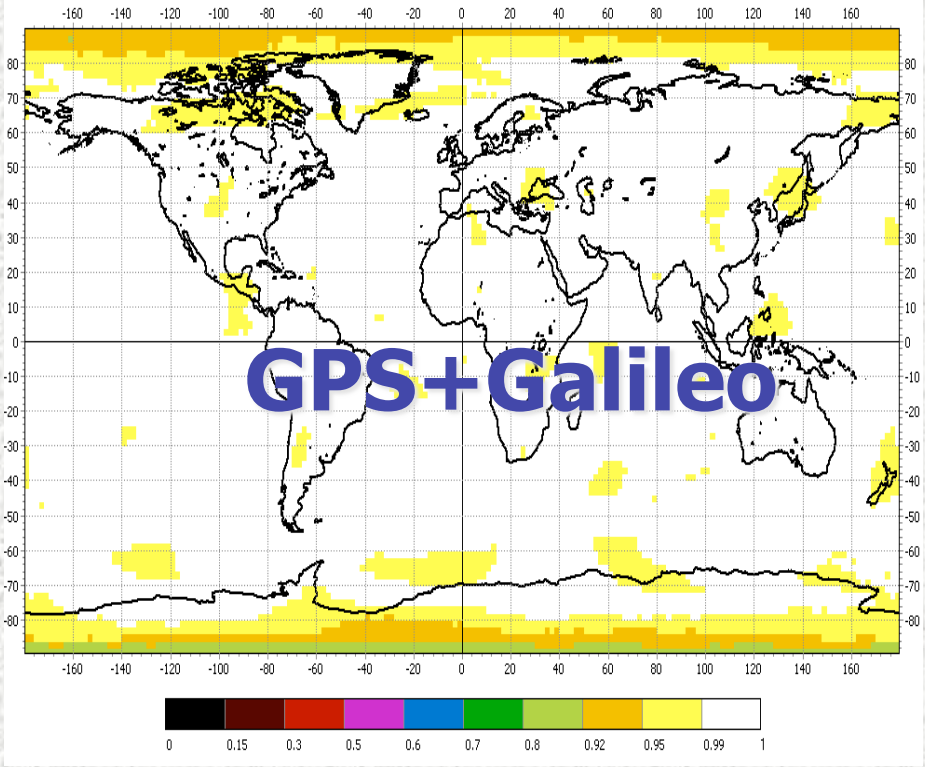


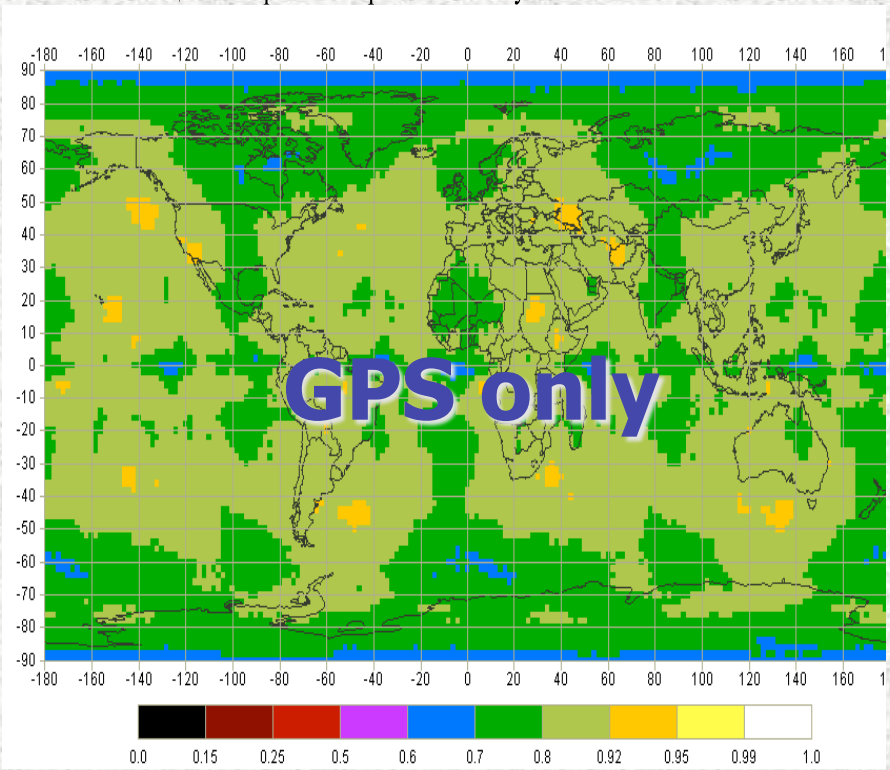
Availability: GPS, GLONASS, Galileo

25° mask angle

Доступность навигации ГНСС на поверхности Земли
(средняя доступность по Земле: 0.821)

Перспективная ОГ GPS 32 КА

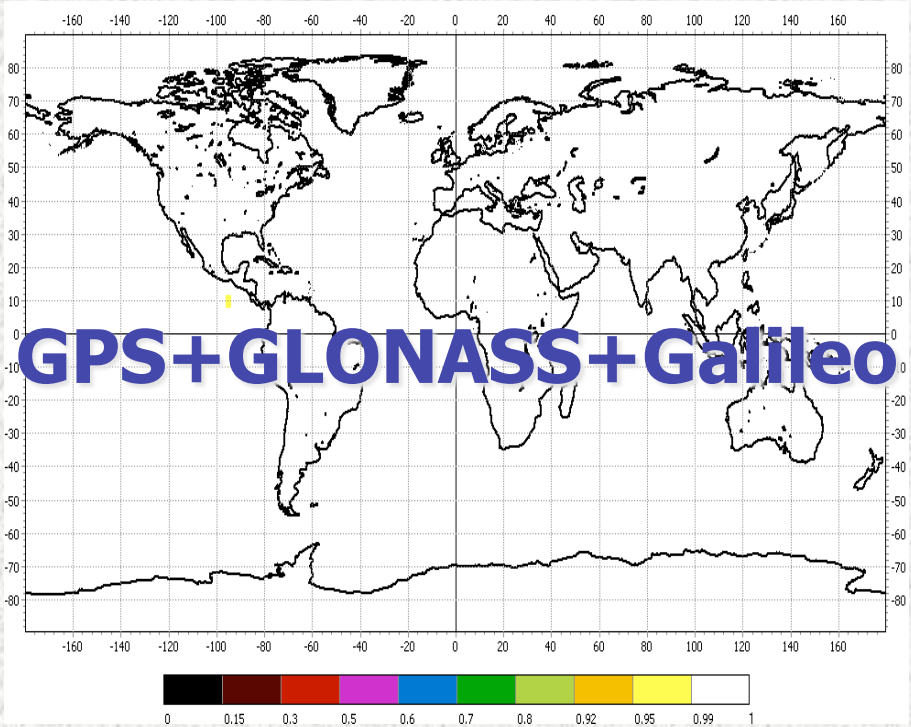
Условие навигации: Pdop<=6. Ограничение на угол места: 25°



Доступность навигации ГНСС на поверхности Земли
(средняя доступность по Земле: 0.999)

Перспективная объединенная ОГ: GPS 32 КА+GALILEO 27 КА+GLONASS 24 КА

Условие навигации: Pdop<=6. Ограничение на угол места: 25°



Summary

- **GLONASS Program is the high priority of the Russian Government policy**
- **GLONASS Program is in progress, will be extended to 2020**
- **GLONASS improvement is a major objective:**
  - **Performance to be comparable with GPS and Galileo by the end of 2011**
  - **Full constellation (24 sats) by the end of 2010**
  - **New signals implementation to improve the service for both military and civil users**
- **Compatibility and interoperability are the goals of international cooperation, as well as the GLONASS worldwide use, and integration it into World GNSS**

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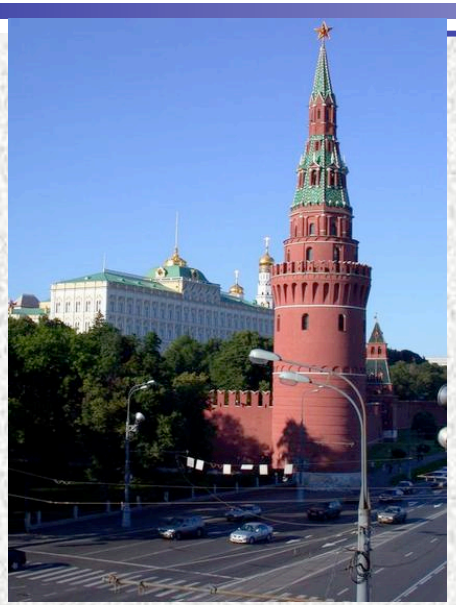
Thank you!

History of the GLONASS Policy



- 1976: Decree of the Soviet Union Communist Party Central Committee and Council of Ministers of the USSR №.1043-361 from 16.12.1976 on the creation of GLObal NAvigation Satellite System system
- 1982: First launch of GLONASS SV
- 1986: Decree of the CPSU Central Committee and CM of the USSR №. 136-46 from 27.01.1986 on GLONASS modernization
- 1993: Russian Federation (RF) Presidential Instruction №.658 RPS from 24.09.1993 started the system operational with IOC
- 1995: The RF Governmental Decree №. 237 from 07.03.1995 to start GLONASS operation with FOC
- 1998: RF Presidential Order to the Government of Russia on the GLONASS development plan
- 2001: RF Governmental Decree №. 587 from 20.08.2001 adopted the Federal Program "Global Navigation System"
- 2007: Decree of the President of the Russian Federation on GLONASS development and use

Future GNSS – Convergence of Interests

Interests

- **Providers:**
  - Global use of their own systems
- **Users:**
  - Simultaneous use of all systems available

Requirements

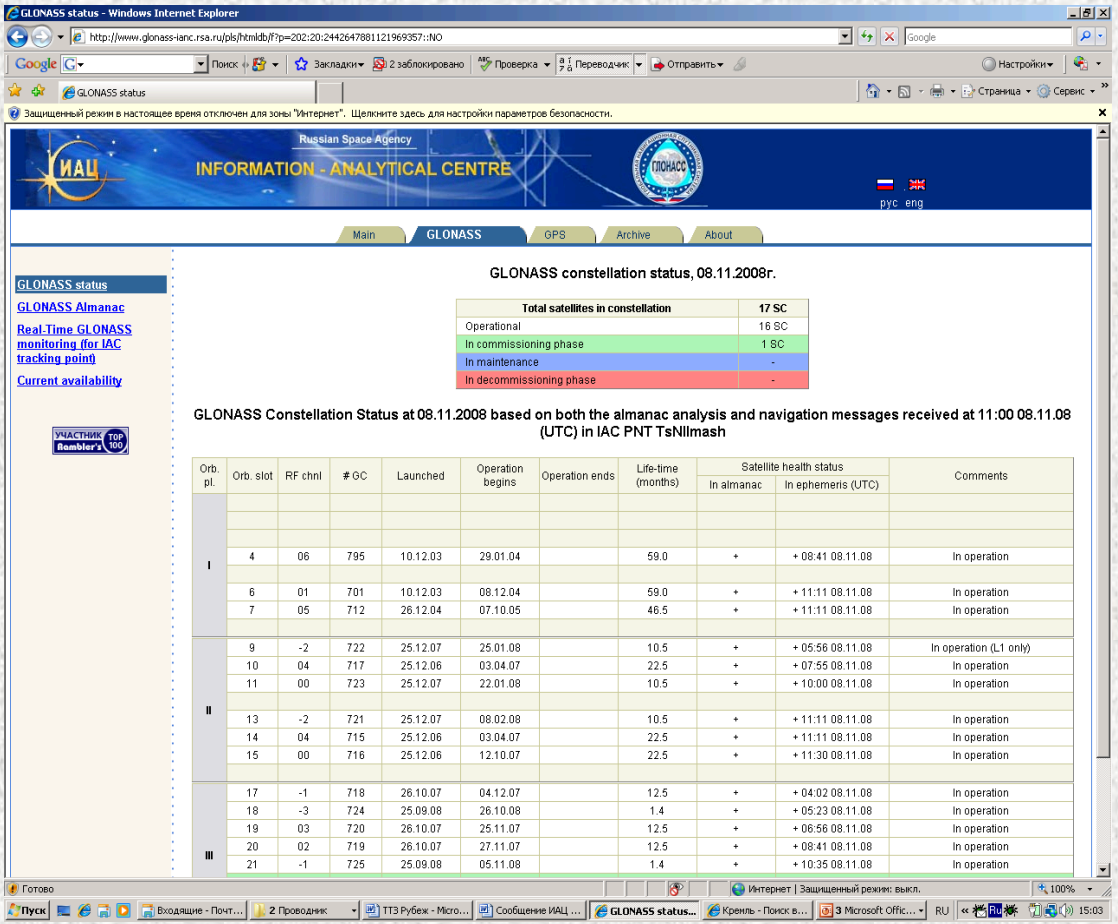
- **Positioning accuracy improvement**
- **Navigation service availability improvement in the canyons with restricted visibility**
- **Integrity service**

Solution

GNSS Compatibility and Interoperability

GLONASS Status User Interface

- GLONASS Constellation Status
- GLONASS Performance
- GLONASS ICD
- Federal Official Documents
- GLONASS News

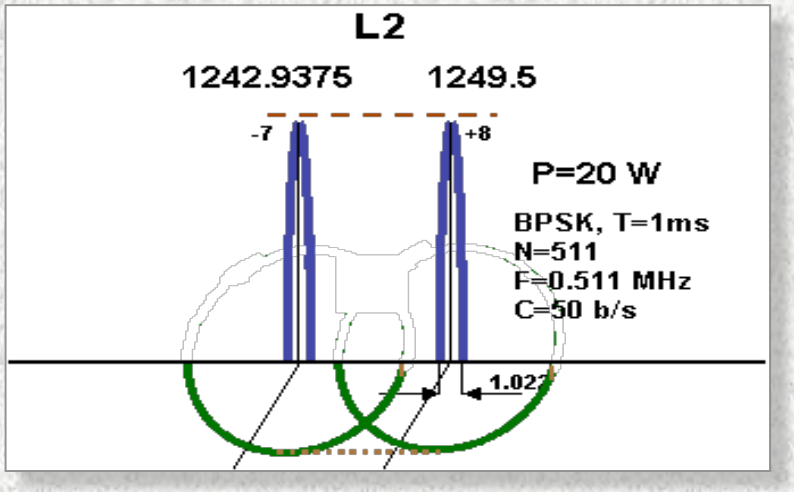


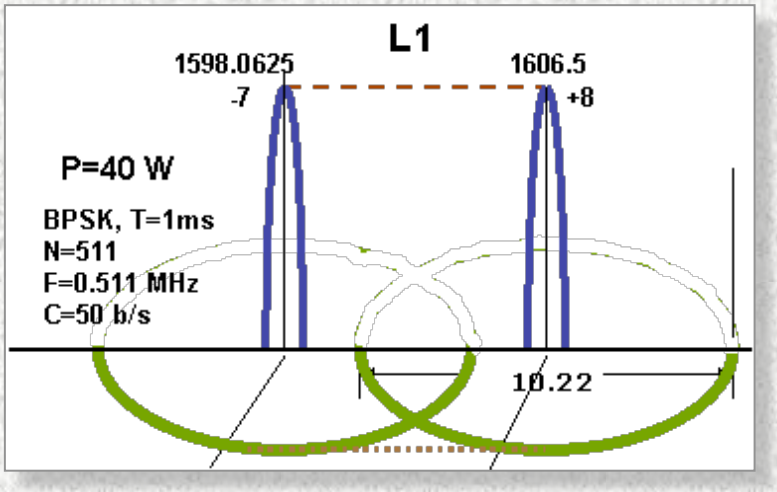
Orb. pl.	Orb. slot	RF chnl	# GC	Launched	Operation begins	Operation ends	Life-time (months)	Satellite health status: In almanac	Satellite health status: In ephemeris (UTC)	Comments
I	4	06	795	10.12.03	29.01.04		59.0	+	+ 08:41 08.11.08	In operation
	6	01	701	10.12.03	08.12.04		59.0	+	+ 11:11 08.11.08	In operation
	7	05	712	26.12.04	07.10.05		46.5	+	+ 11:11 08.11.08	In operation
II	9	-2	722	25.12.07	25.01.08		10.5	+	+ 05:56 08.11.08	In operation (L1 only)
	10	04	717	25.12.06	03.04.07		22.5	+	+ 07:55 08.11.08	In operation
	11	00	723	25.12.07	22.01.08		10.5	+	+ 10:00 08.11.08	In operation
	13	-2	721	25.12.07	08.02.08		10.5	+	+ 11:11 08.11.08	In operation
	14	04	715	25.12.06	03.04.07		22.5	+	+ 11:11 08.11.08	In operation
	15	00	716	25.12.06	12.10.07		22.5	+	+ 11:30 08.11.08	In operation
III	17	-1	718	26.10.07	04.12.07		12.5	+	+ 04:02 08.11.08	In operation
	18	-3	724	25.09.08	26.10.08		1.4	+	+ 05:23 08.11.08	In operation
	19	03	720	26.10.07	25.11.07		12.5	+	+ 06:56 08.11.08	In operation
	20	02	719	26.10.07	27.11.07		12.5	+	+ 08:41 08.11.08	In operation
	21	-1	725	25.09.08	05.11.08		1.4	+	+ 10:35 08.11.08	In operation

www.glonass-ianc.rsa.ru

Existing GLONASS FDMA Signals

- **L2**
  - L2 open FDMA
  - L2 authorized FDMA
- **L1**
  - L1 open FDMA
  - L1 authorized FDMA

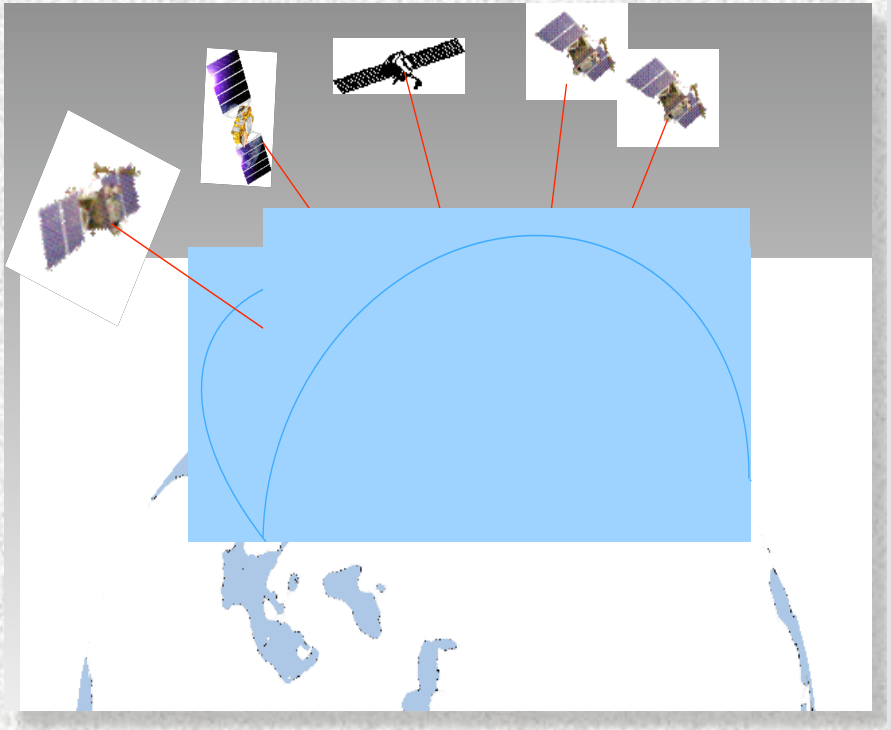


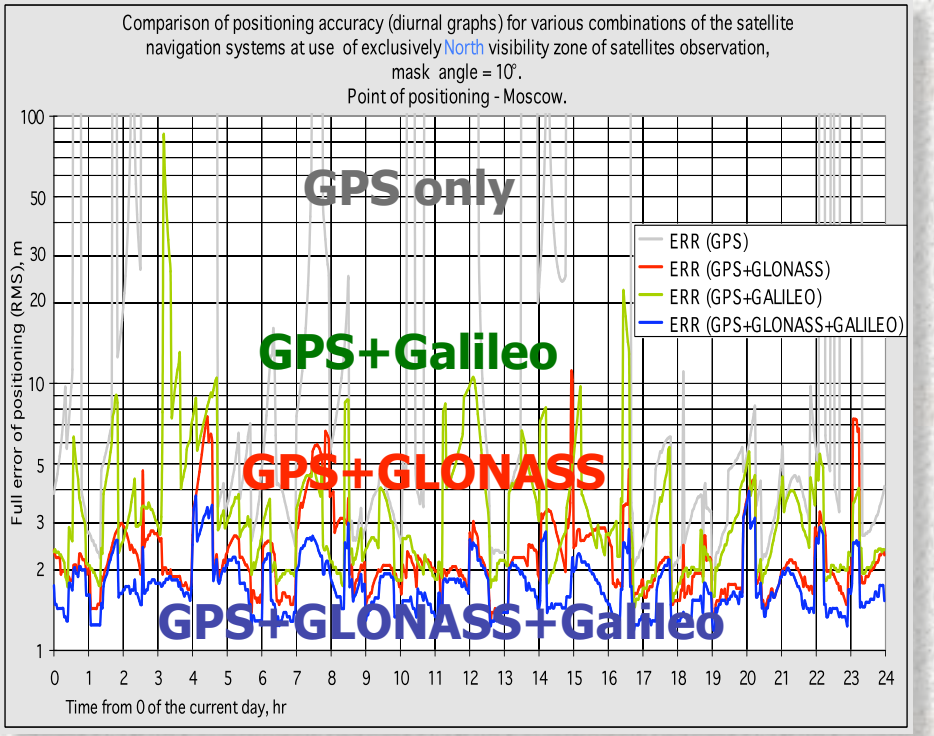


GLONASS will continue transmitting existing FDMA signals for the future

GNSS Accuracy: North Hemisphere

Positioning accuracy for North hemisphere visibility zone. Combination of GPS, GLONASS, Galileo





GNSS Accuracy: West Hemisphere

Positioning accuracy for West hemisphere visibility zone. Combination of GPS, GLONASS, Galileo