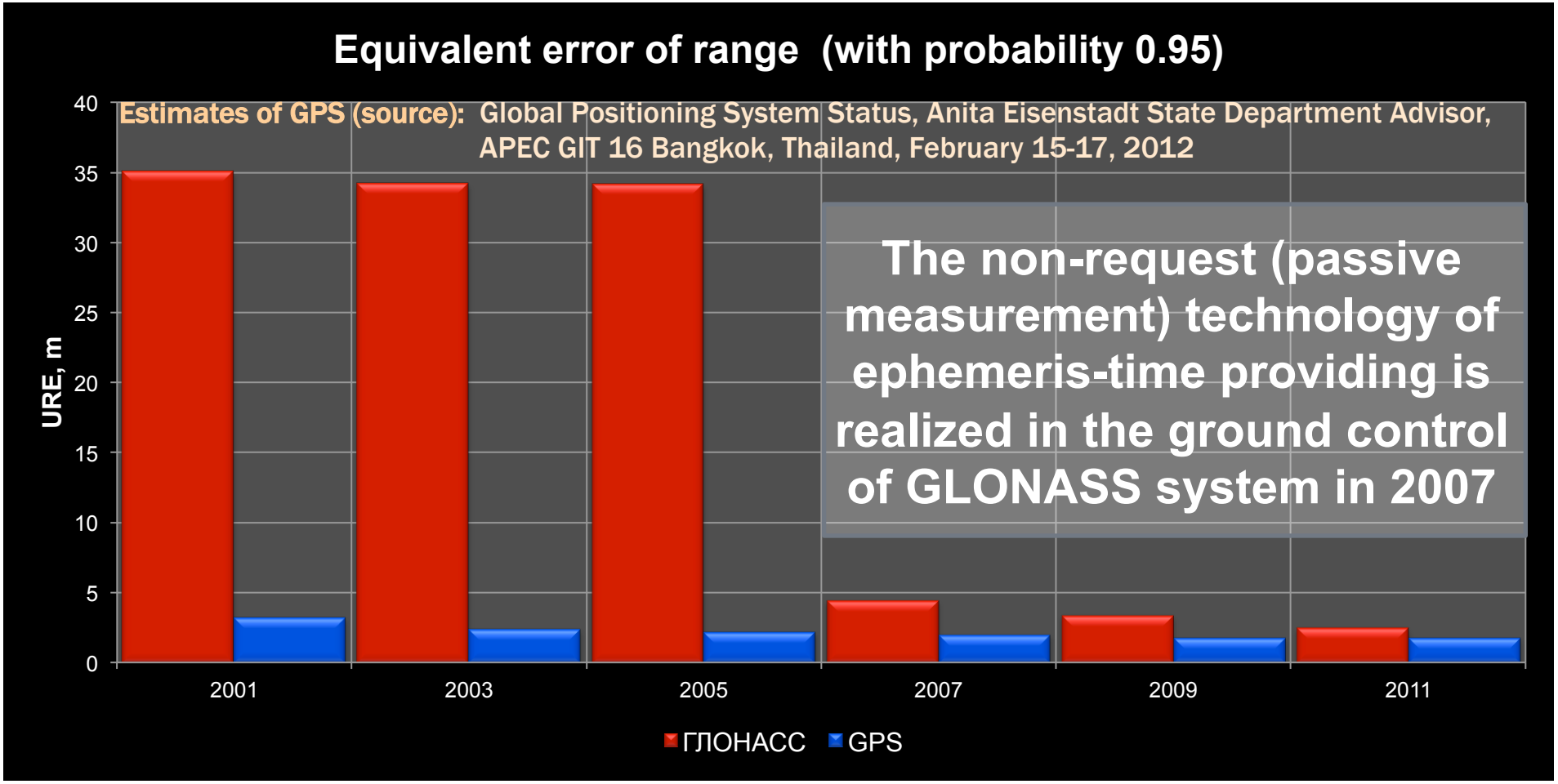
Open Joint-Stock Company
"Research-and-Production Corporation
"Precision Systems and Instruments"

Improving the accuracy of GLONASS in the interests of operational and aposteriori applications

Vladimir Pasynkov

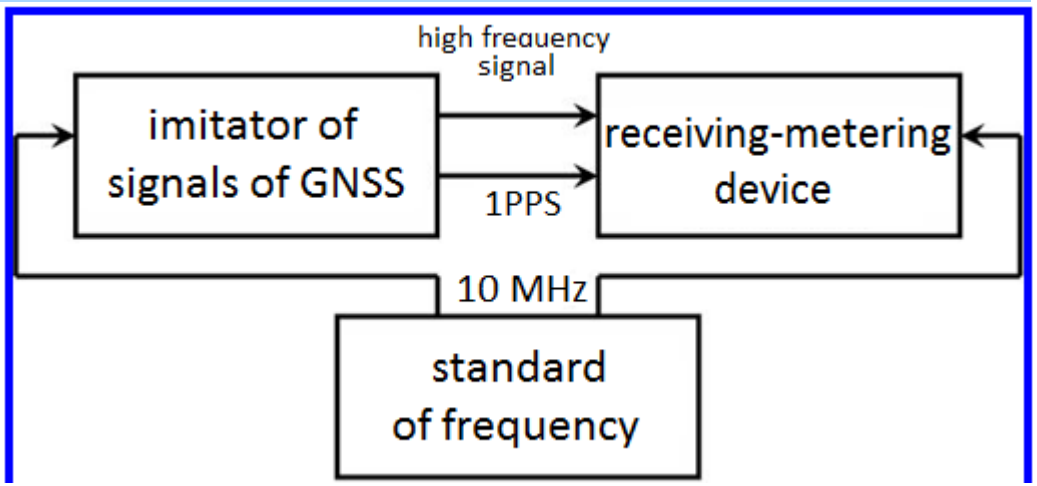
United Nations/Russian Federation Workshop on Applications
of Global Navigation Satellite Systems
18–22 May, 2015
Krasnoyarsk, Russia

The achieved level of accuracy of the space GLONASS segment



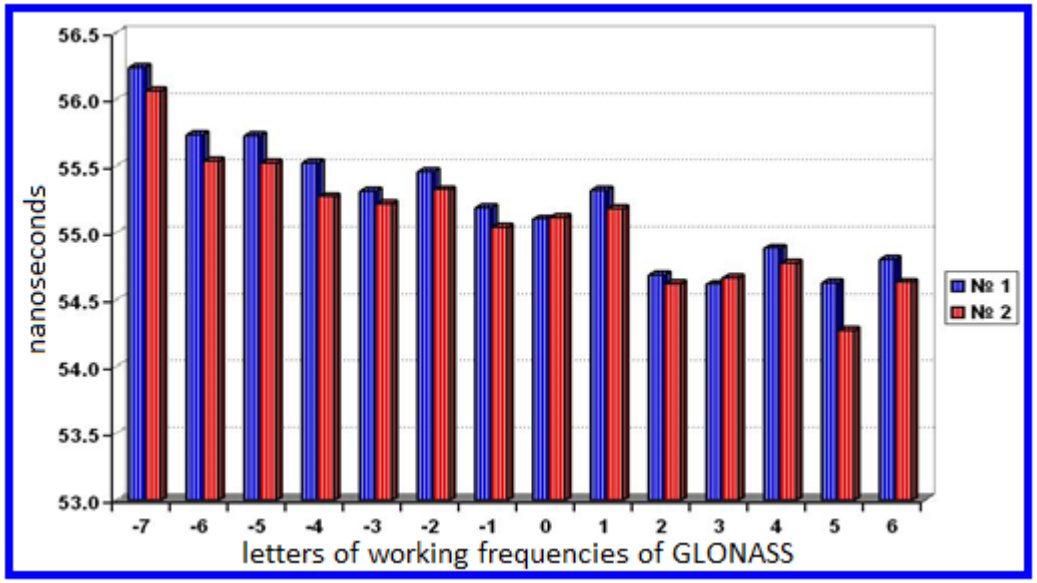
Conclusion: As a result of the executed actions of the program GLONASS 2002-2011, accuracy of a space segment has improved several times and amounted to approximately 2.8 m (with probability 0.95) by the end of 2011, that corresponds to the competitive level of the GLONASS system

Calibration of the navigation equipment of consumers



The imitator of signals of navigation satellite systems of GLONASS and GPS GSS8000 (No. 48730-11 in the State registry of measuring instruments):

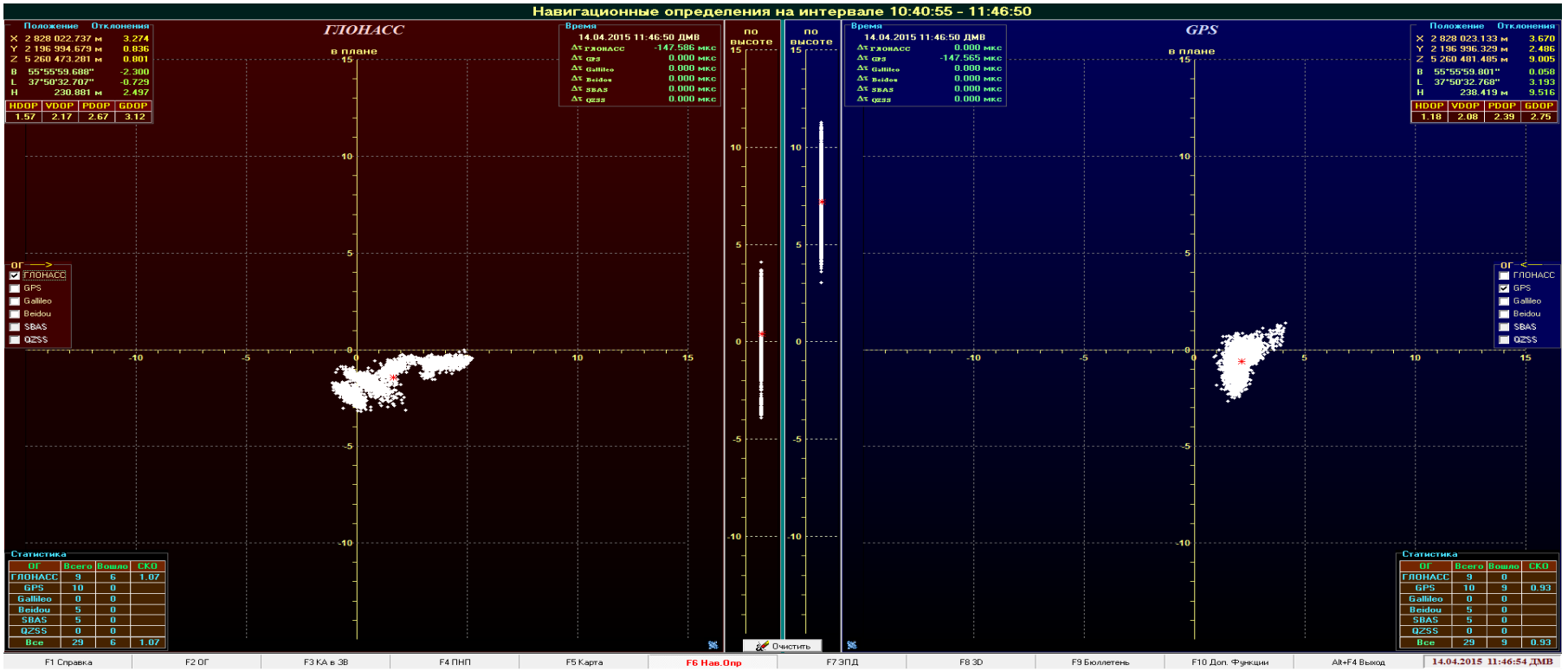
error of transfer of time between a pulse signal of time of 1 Hz and the event corresponding to it in a navigation signal no more than 0.2 nanoseconds (with probability 0.95)



Conclusion: Decrease of a contribution of an error of the receiving equipment to an error of navigation of consumers is provided to the level of 1-3 cm

Navigation on GLONASS signals (ephemeris-time information from structure of a navigation frame)

Current level of accuracy



Characteristic Q_2	2011	Program GLONASS 2012-2020					
		2015	2016	2017	2018	2019	2020
Error of determination of location in real time in GGSK at the expense of a space segment, m	2.8	1.4	1.1	0.9	0.9	0.75	0.6

Conclusion: Maintaining of competitive level of accuracy of GLONASS system is provided for 2015-2020.

GLONASS aposteriori technologies

Method No. 1

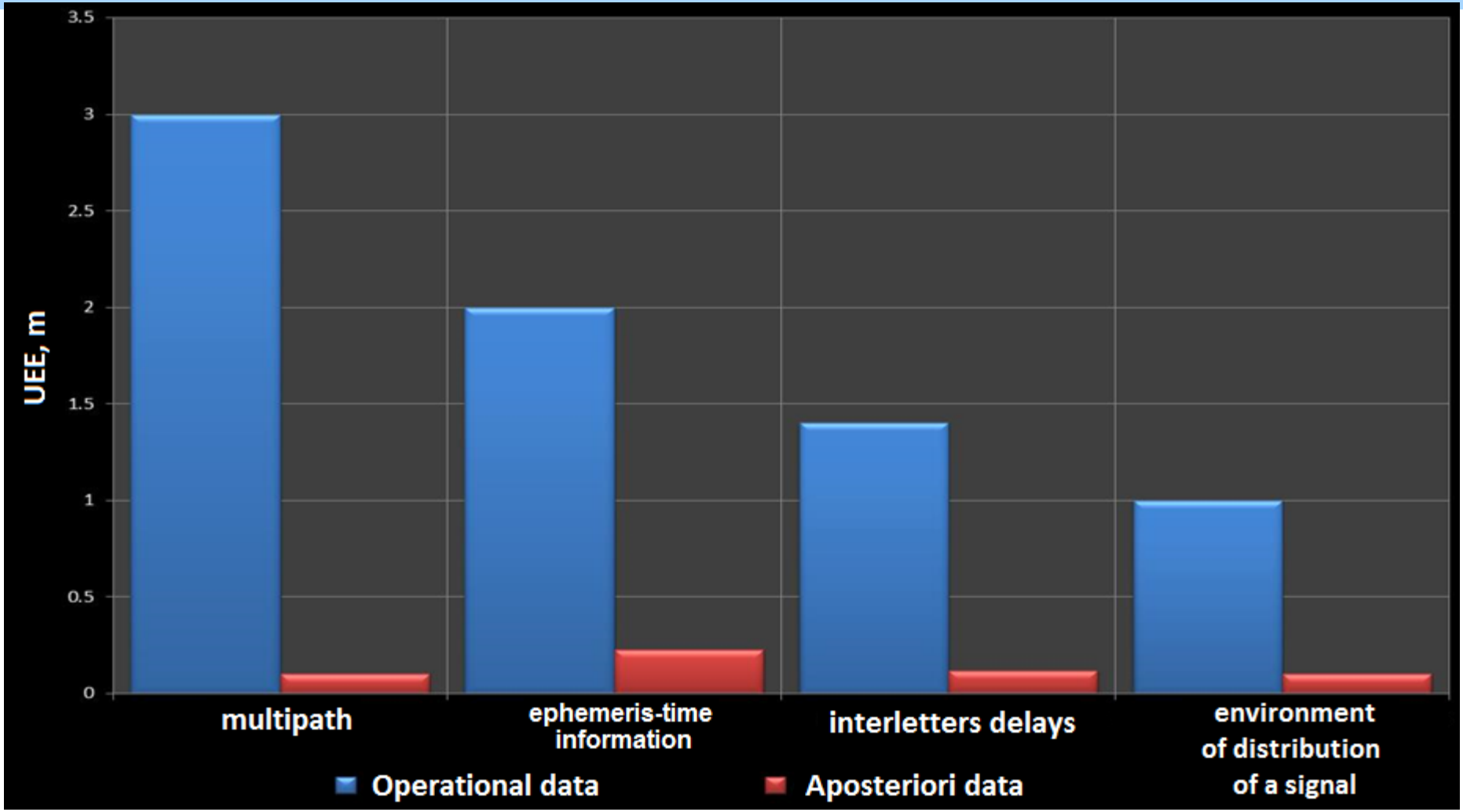
Parrying of the main components of an error of measurements in the aposteriori mode.

Method No. 2

Direct high-precision collateral processing of code and phase measurements.

Conclusion: The main lack of aposteriori technologies is obtaining the decision with the essential delay, exceeding 1 days

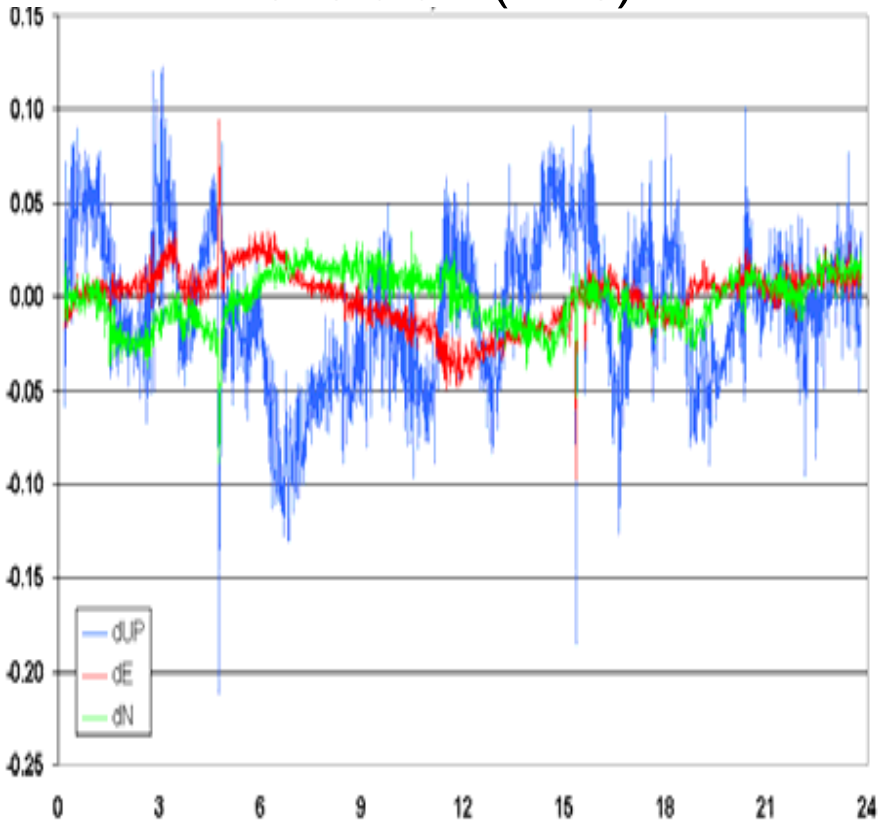
GLONASS aposteriori technologies: method No.1



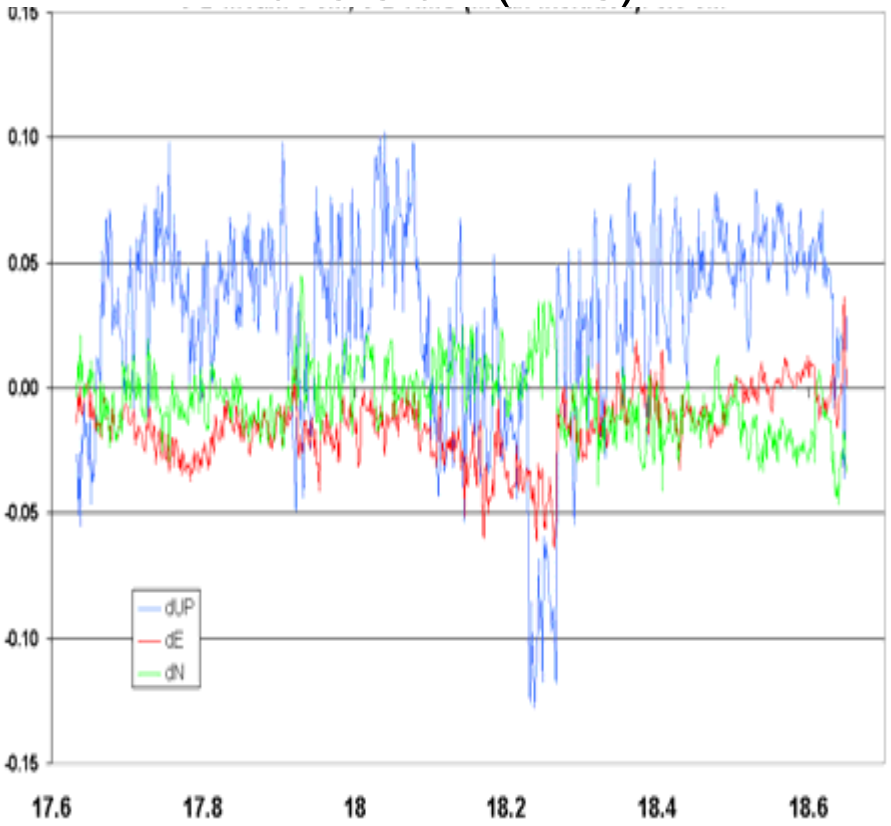
Conclusion: Accuracy of navigation at the decimeter level – is provided problem solving of applied geodesy

GLONASS aposteriori technologies: method No.2

Static consumer, kinematic solutions of 5.0 cm (RMS)

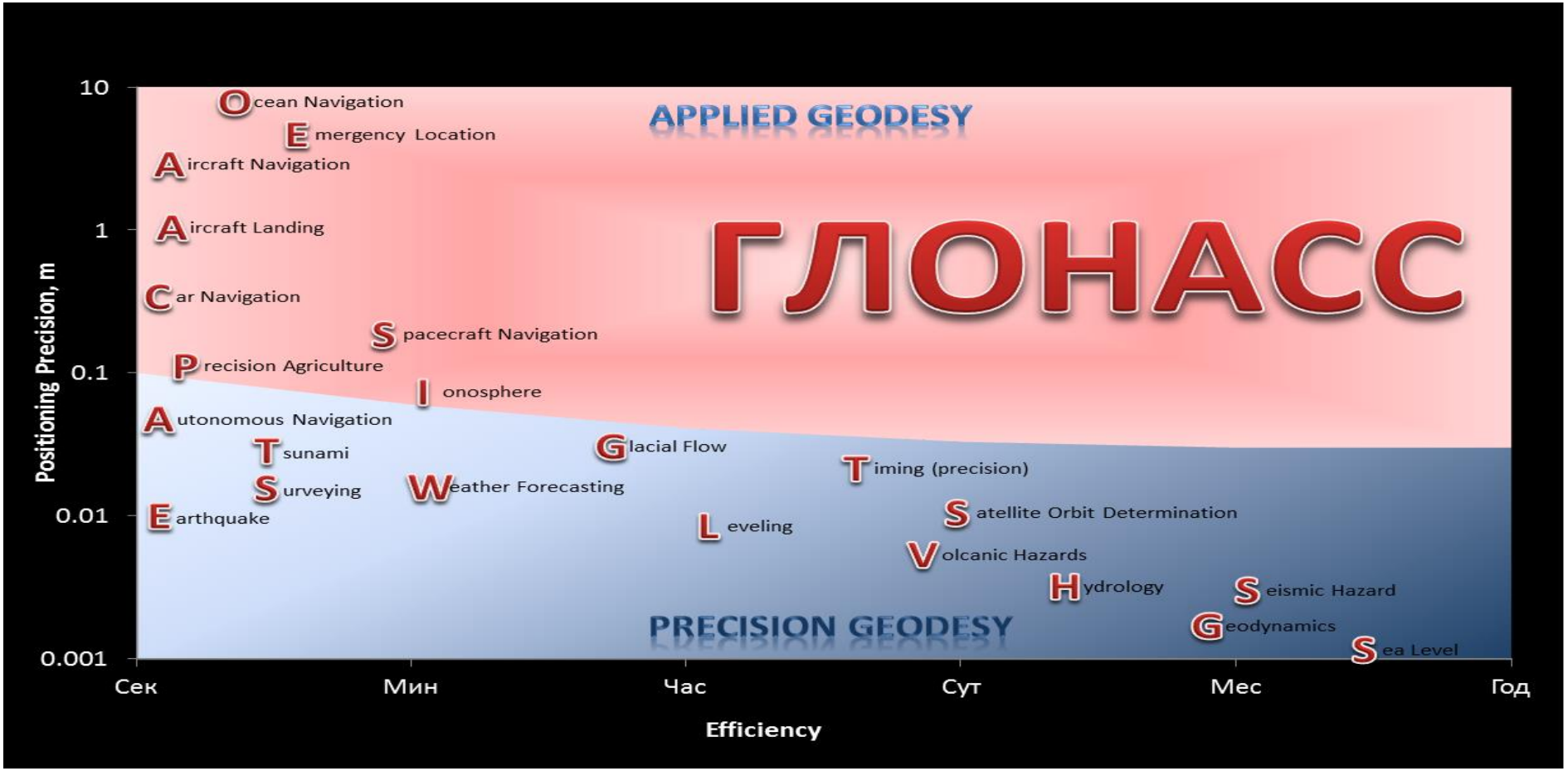


Dynamic consumer, kinematic solutions of 5.5 cm (RMS)



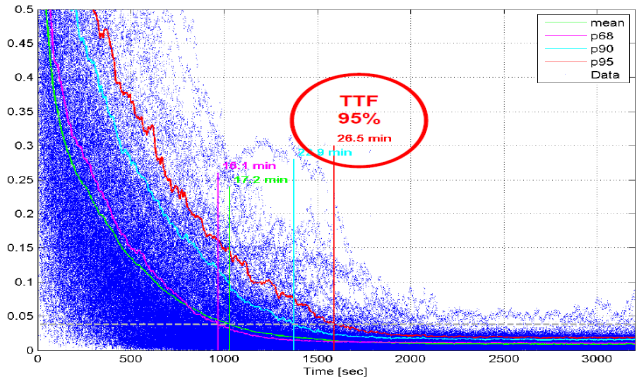
Conclusion: Accuracy of navigation at the centimetric level – prerequisites are created for problem solving of fundamental geodesy

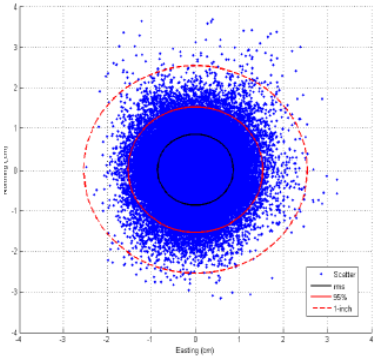
Operational and aposteriori applications of GLONASS



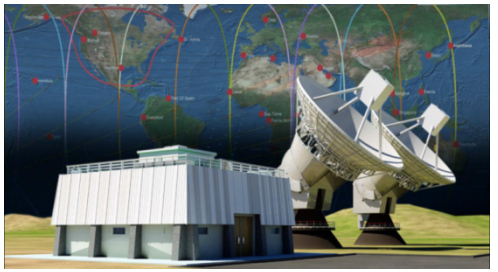
Conclusion: The solution of a wide range of issues is provided of navigation and geodesy with use of GLONASS, however introduction of GLONASS technologies interferes with the organizational and technical restrictions generated by the competing systems of geodetic support

High-precision navigation on GLONASS signals





Global network of measurements stations in real time (50 stations)



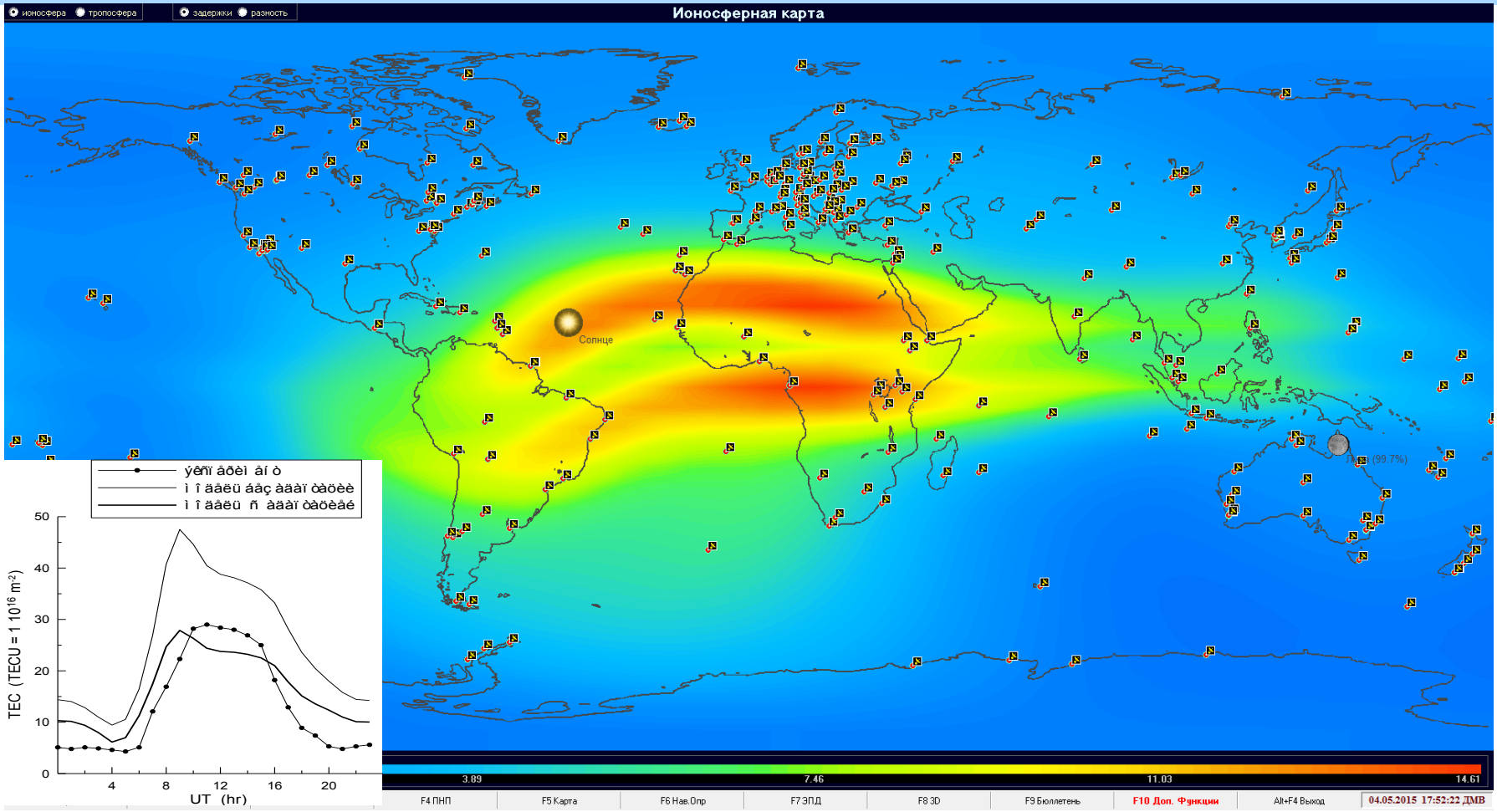
Global informational covering on means of a satellite segment

Positioning accuracy 5–10 cm (P = 0.95) at the time of the first solution (TTF) no more than 30 minutes

Characteristic Q_3	2011	Program GLONASS 2012-2020					
		2015	2016	2017	2018	2019	2020
Error of determination of location in real time in GGSK at the expense of a space segment, m							
Operational mode (Q_{31})	-	**0.5**	**0.5**	**0.5**	**0.3**	**0.3**	**0.1**
Operational mode with initial initialization (Q_{32})	-	**0.3**	**0.3**	**0.3**	**0.1**	**0.1**	**0.05**
Aposteriori mode (Q_{33})	**0.3**	**0.1**	**0.05**	**0.05**	**0.05**	**0.05**	**0.03**

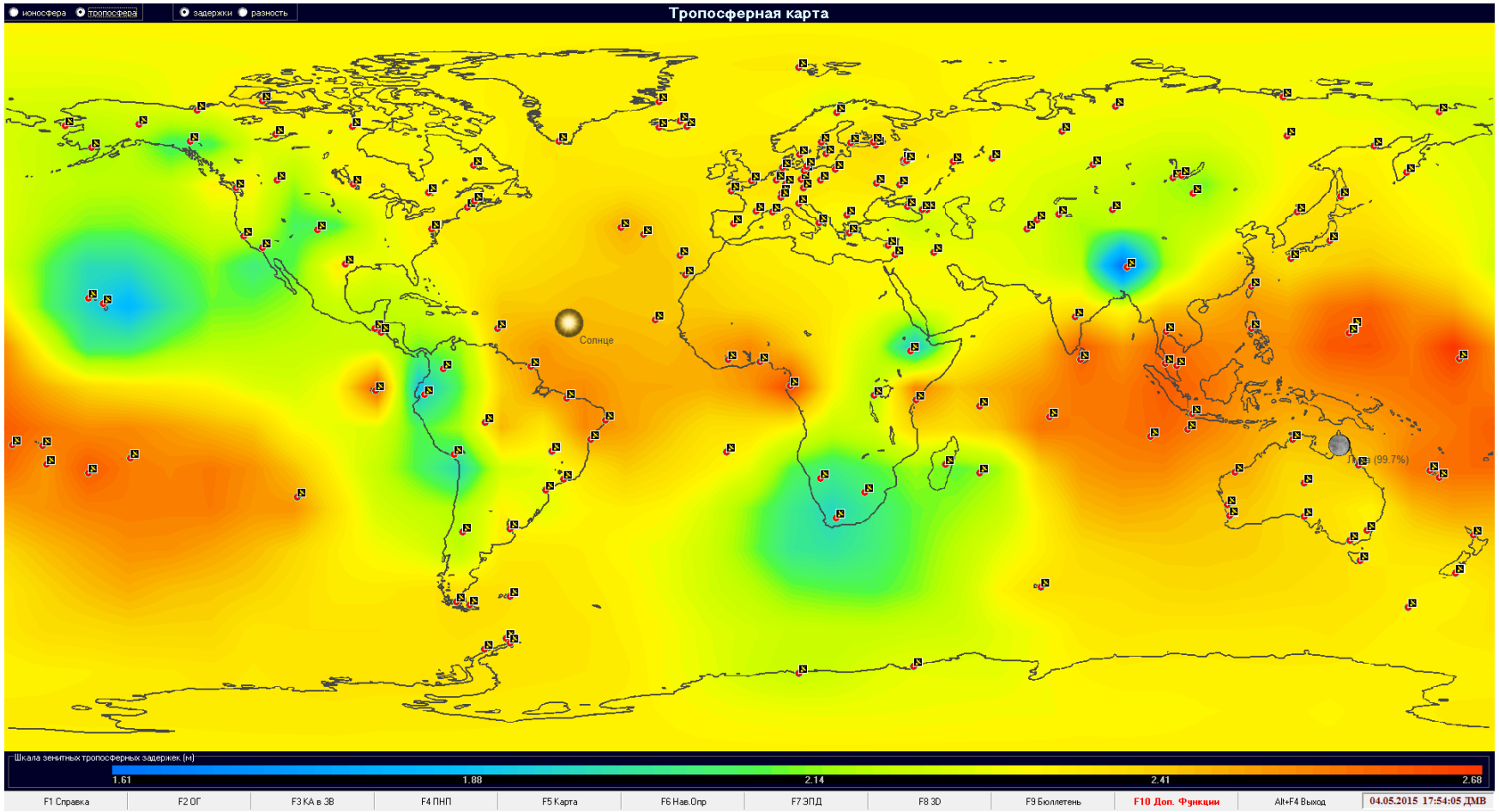
Conclusion: Perspective level of accuracy is provided of navigation of consumers of GLONASS with use of high-precision ephemeris-time information in real time

Monitoring of an ionosphere (www.glonass-svoevp.ru)



Conclusion: Transfer of the GAMI (Global Adaptive Model of an Ionosphere) parameters as a part of digital information of the navigation message L3OS. Increase of accuracy of the accounting of effect – to 2 times in comparison with known models

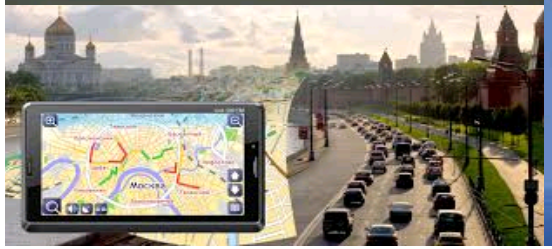
Monitoring of the troposphere (prospect)



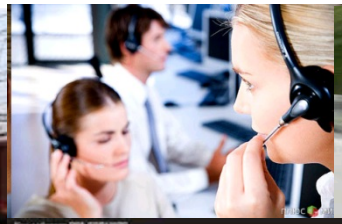
Conclusion: It is planned to transfer of parameters of global adaptive model of the troposphere for consumers of GLONASS as a part of digital information of the navigation message (L3, L5, …)

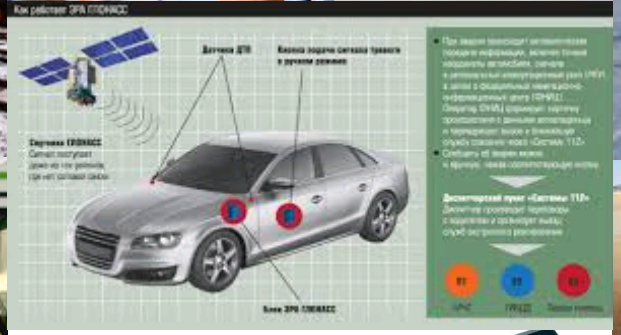
GLONASS - an integral part of the Russian economy

Transport



Rescue

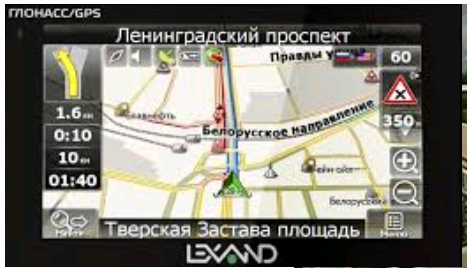




Autonomous navigation

Resource exploitation

Navigation, monitoring and many other things

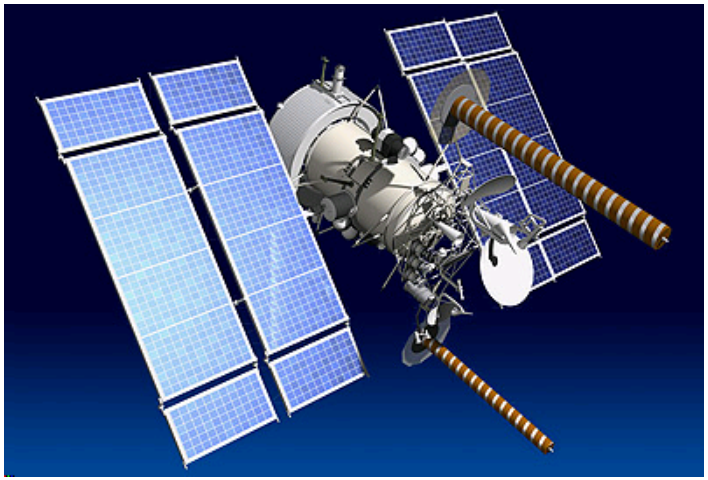


Conclusion: Intensity of development of the Russian economy depends on development of the GLONASS navigation technologies

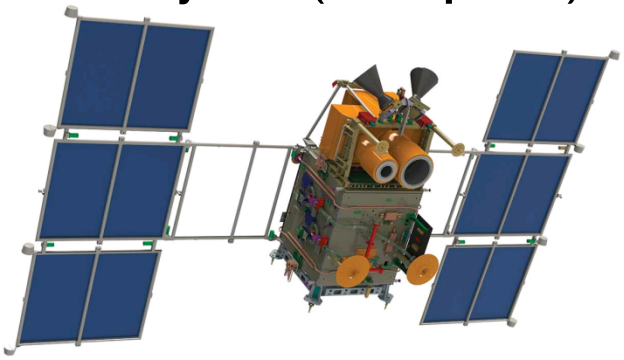
Orbital consumers of GLONASS

Ресурс-П (Resurs-P)

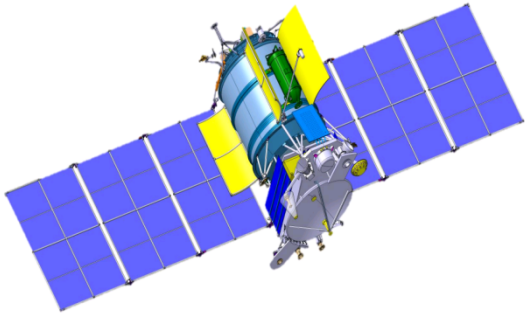
Радуга-1М (Raduga-1M)



Канопус-В (Canopus-V)

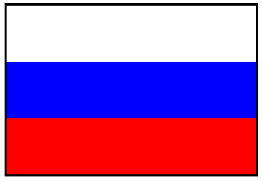


ГЕО-ИК-2 (GEO-IK-2)

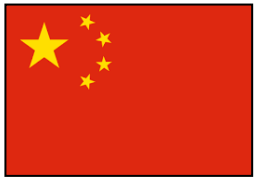


Conclusion: The navigation equipment of GLONASS system has become a key element of the onboard equipment of perspective satellites

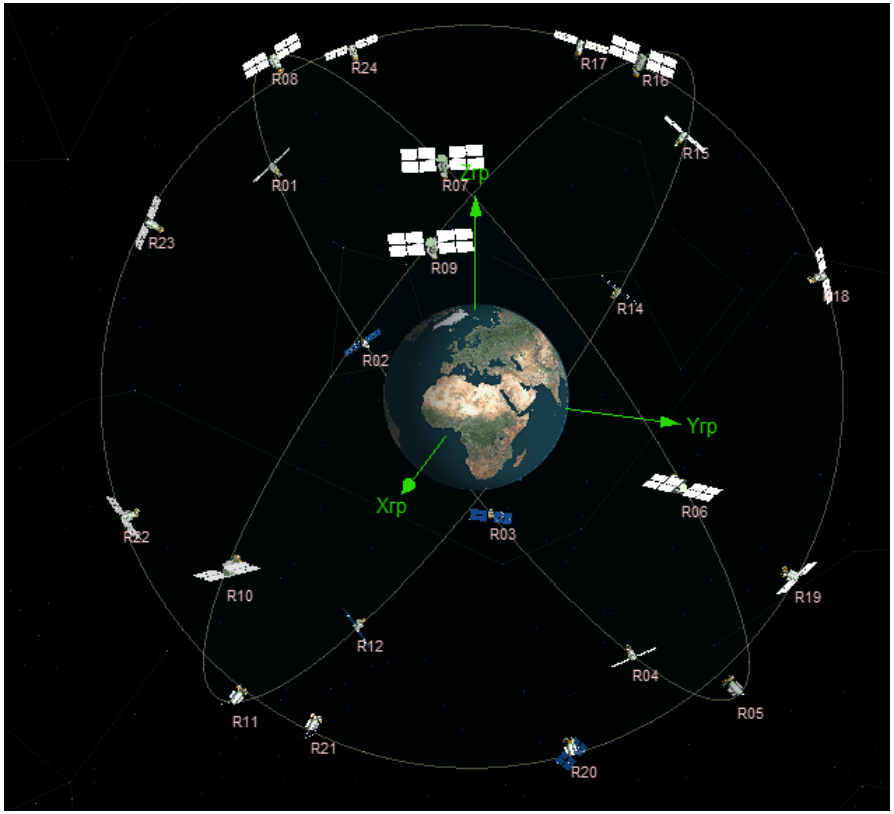
International integration of GLONASS

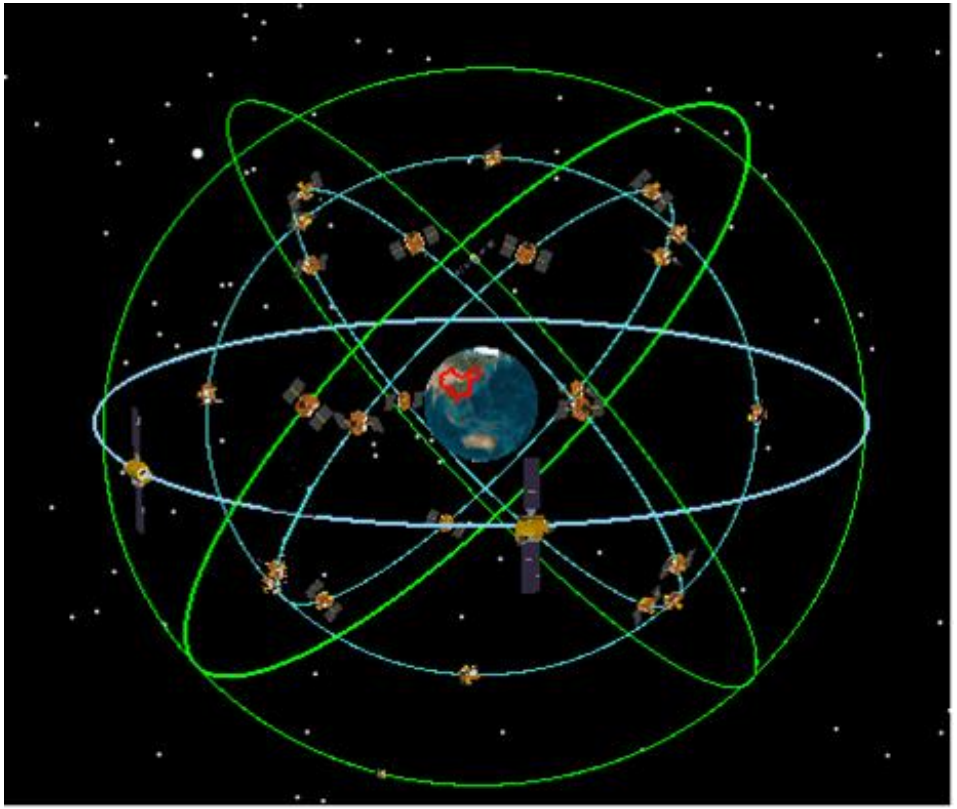


GLONASS



BeiDou





Conclusion: Increase of accuracy and efficiency not less than by 1.5 times, decrease in investment risks when creating of the combined equipment

Conclusions

1. Improvement of operational and aposteriori accuracy of GLONASS system provided entire range of navigation and surveying applications, and also its introduction in all sectors of the Russian economy.

2. Perspective development of the GLONASS system is realization of system of real time high-precision navigation, which will provide the decimeter level of accuracy without use of basic differential stations, including its introduction in practice of orbital flights.

3. The perspective direction of development of the international cooperation is combined use of GLONASS and BEIDOU with potential increase of accuracy and efficiency of navigation providing consumers not less than by 1.5 times, and also decrease of investment risks in creating of the combined equipment.

4. The significant progress in the accuracy of GLONASS creates a conflict of interests of the established corporate groups, which openly interfere with introduction of GNSS-technologies in aircraft, the sphere of low-orbital flights, geodesy, etc. These artificial restrictions must be overcome organizationally and technically.

Open Joint-Stock Company

"RESEARCH-AND-PRODUCTION CORPORATION "PRECISION SYSTEMS AND INSTRUMENTS"

(RPC "PSI", OJSC)

address: 53, Aviamotornaya Str.,
111024, Moscow, Russia

phone: +7 (495) 234-9847

fax: +7 (495) 234-9859

web: www.npk-spp.ru