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# On Objectives and Some Results of Russian Satellite Laser Ranging Network Operation in 2013

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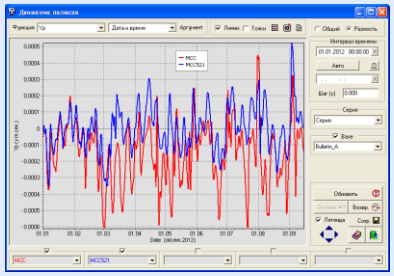
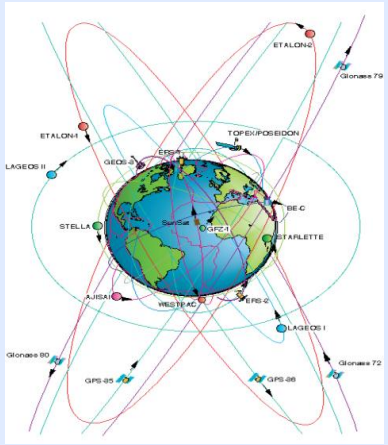
11-15 Nov 2013 , Fujiyoshida, Japan

# Goals of Russian Satellite Laser Ranging Network

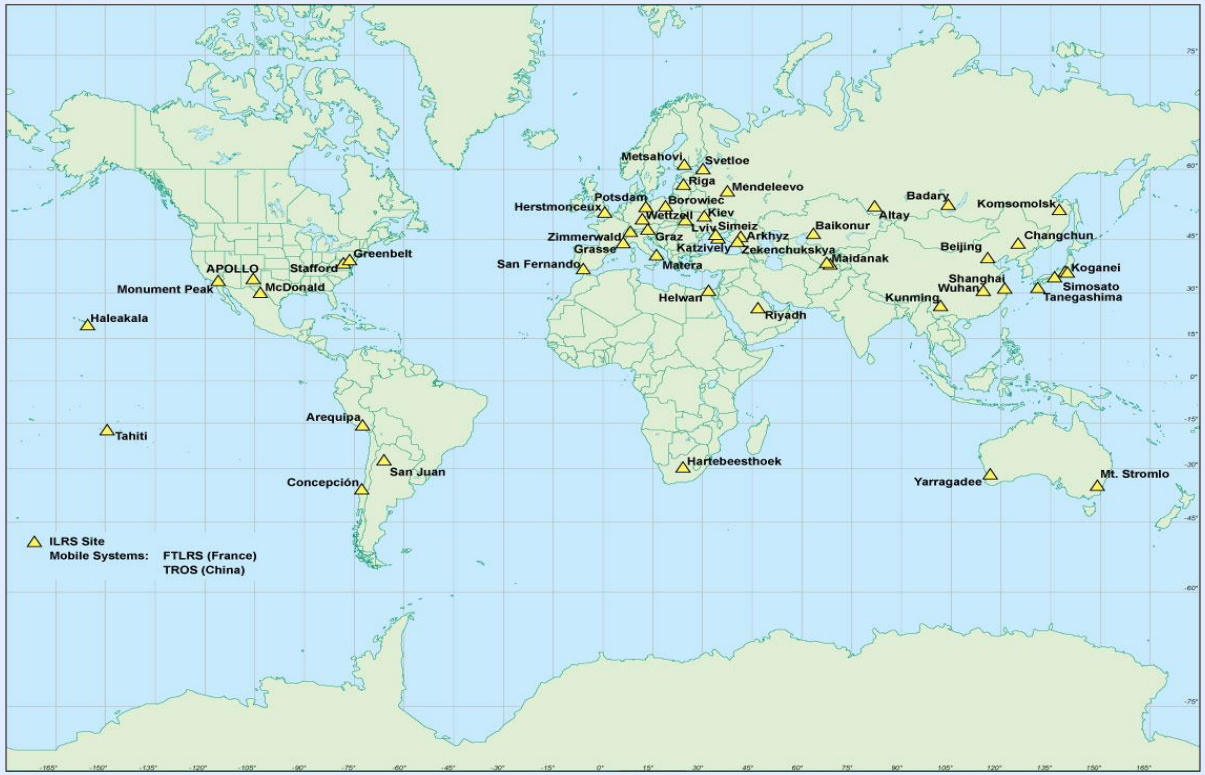
## Main Goals of the Russian SLR Network

- Creating and monitoring of the high-precision geodetic reference system for GLONASS base on the measurements from collocated SLR, VLBI and one-way measuring stations (to the availability with ITRF, GPS/GALILEO/COMPASS/… reference systems)
- Estimation of delivering errors of the state geocentric reference system by GLONASS navigation field
- Precise monitoring of the calculating Glonass satellites' orbit and clock data (onboard and others)
- Measurement of time scale differences at remote stations using differences between the stations and the onboard time scales of the same Glonass S/C
- Calibration of one-way/two-way radio and technical systems
- National and ILRS missions support



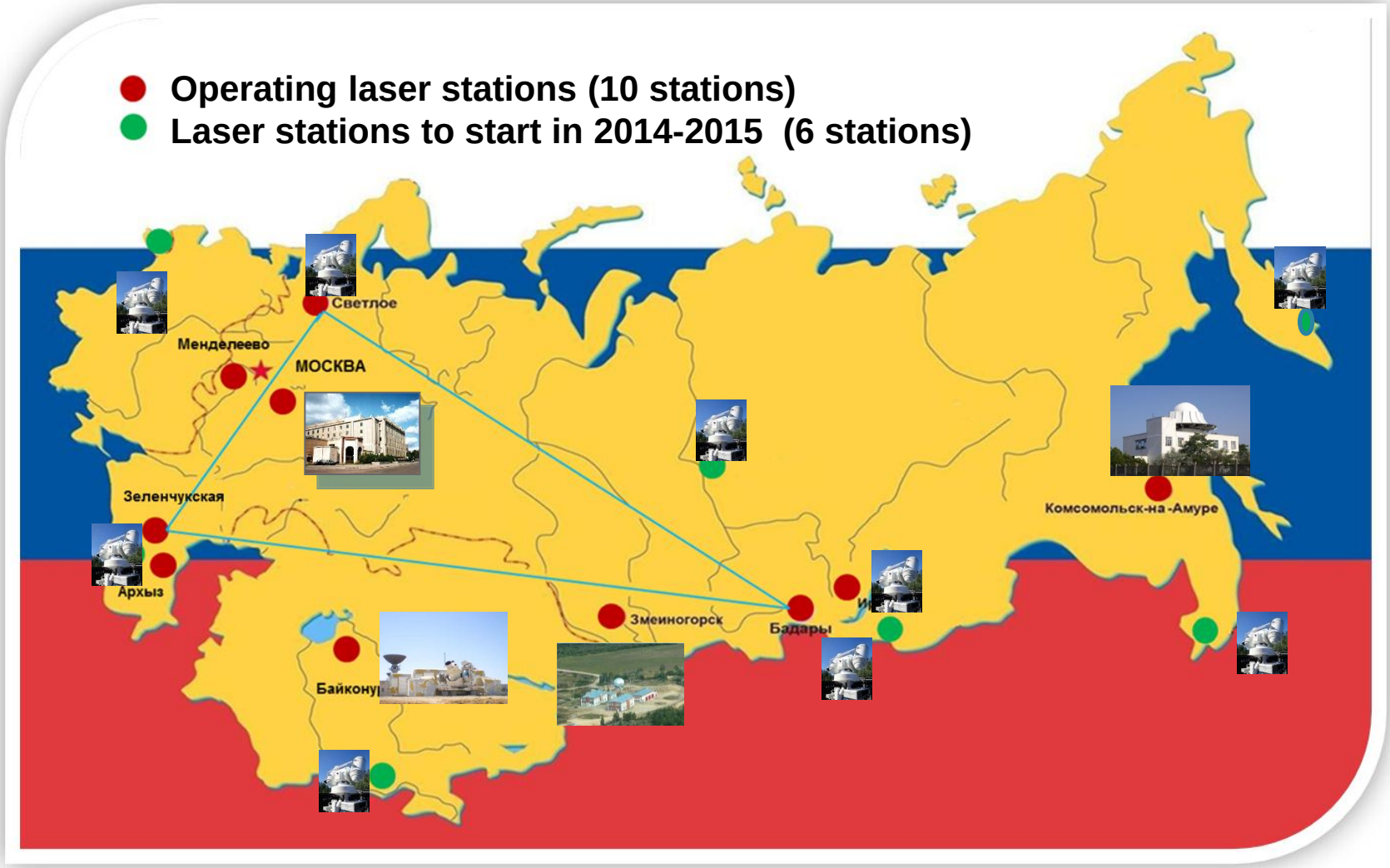


# ILRS Global Network



Currently measurements are obtained from 39 stations of the ILRS Network including stations of the Russian Network – Altay, Komsomolsk, Arkhyz, Baikonur, Svetloe, Zelenchukskaya, Badary as well as Mendeleevo and Irkutsk (experimental mode)

# Russian SLR Network



# New Russian SLR stations

***RUSSIAN DoD***

- Altay
- Komsomolsk

***RUSSIAN SPACE AGENCY***

- Arkhys
- Baikonur

***RUSSIAN ACADEMY OF SCIENCES***

- Badary
- Svetloe
- Zelenchukskaya

***RUSSIAN AGENCY OF STANDARDIZATION***

- Mendeleevo
- Irkutsk

***RUSSIAN AGENCY OF GEODESY***

- ***New stations***

# Information and Analysis Center for PNT

**Information and Analysis Center for Positioning, Navigation and Timing**
***(Previous/other name – Mission Control Center- MCC)***

## Experience and Current Status
***(operation with SLR data in the form of permanent service)***

- **Russian SLR Network Operational Center since 1990**
- **IERS Analysis Center since 1994**
- **In frame of ILRS activity since 1997**
- **In frame of IGS activity since 2005 (as IAC – microwive data processing for Precise Orbit&Clock Determination)**

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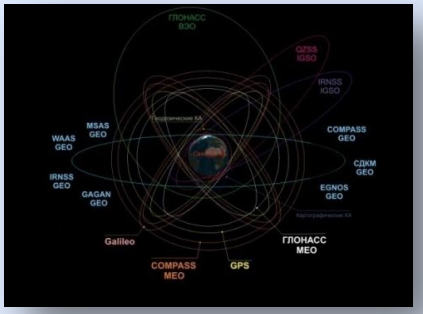
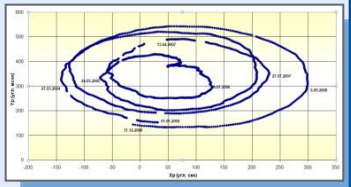
# Information and Analysis Center for PNT

## Within Russian SLR Network :

- Operations planning of Russian SLR stations based on the priorities
- CPF format calculation for Russian missions
- Collecting and storing SLR data obtained from the stations
- “Normal points” generating according to CRD
- Precise quality control of Russian SLR stations
- Measurement data delivering to Russian users and international centers for data collection, storage and analysis



## Within ILRS operations:

- Processing of the obtained measurements including Earth orientation parameters determination and Glonass satellites’ precise orbit and clock determination
- Precise monitoring of ILRS Network measurement accuracy
- Information interaction between ILRS, IERS, EDC, HTSI Centers of SLR data collection, storage and analysis

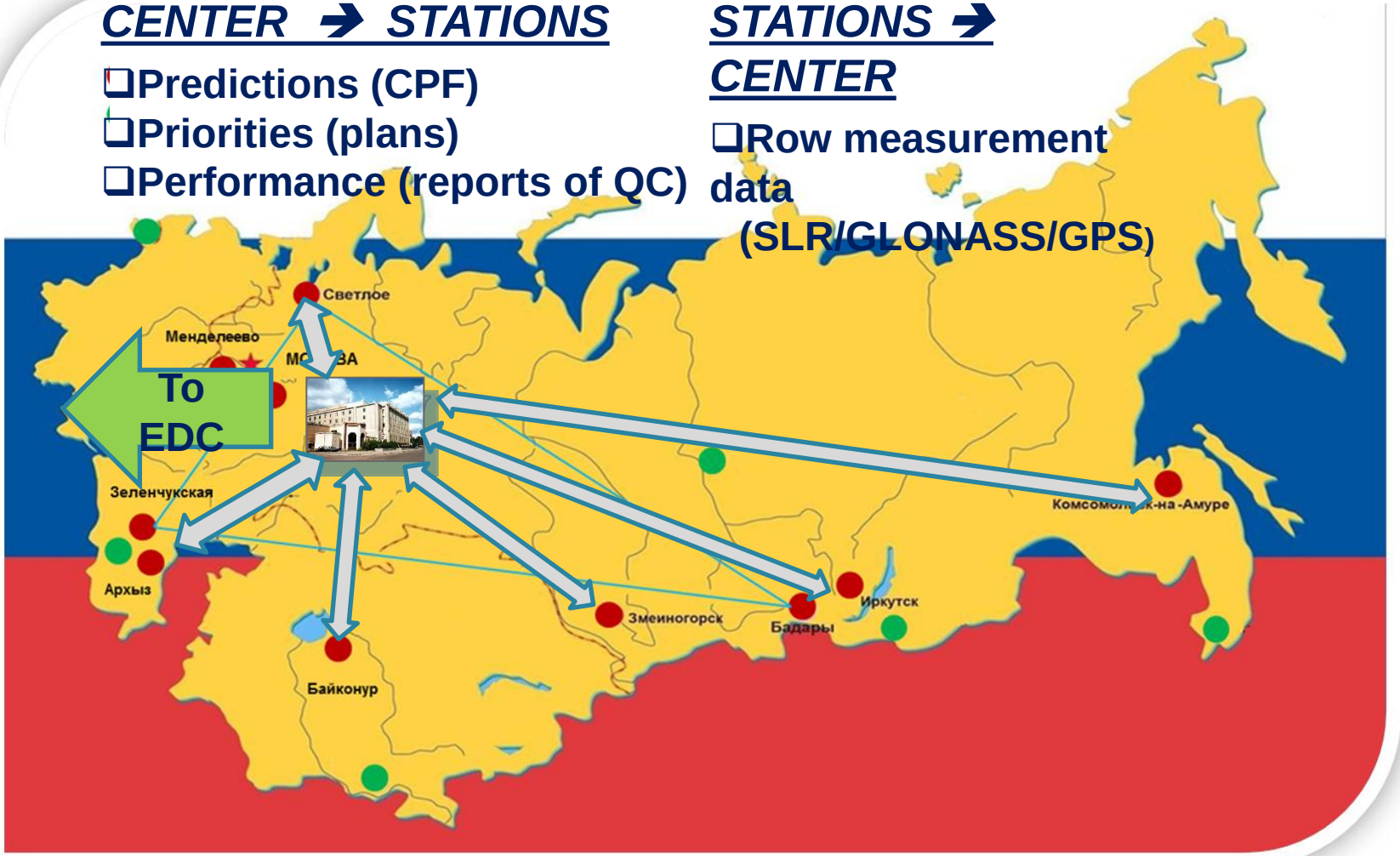
# Data flow

***CENTER ➔ STATIONS***

- Predictions (CPF)
- Priorities (plans)
- Performance (reports of QC)

***STATIONS ➔ CENTER***

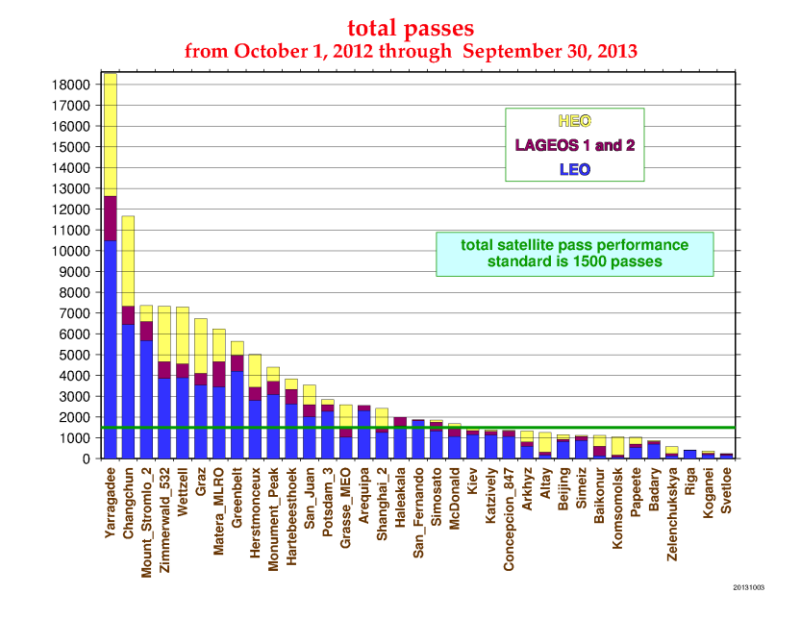
- Row measurement data (SLR/GLONASS/GPS)



# Results Obtained in 2013

## Current observation statistics for 2013

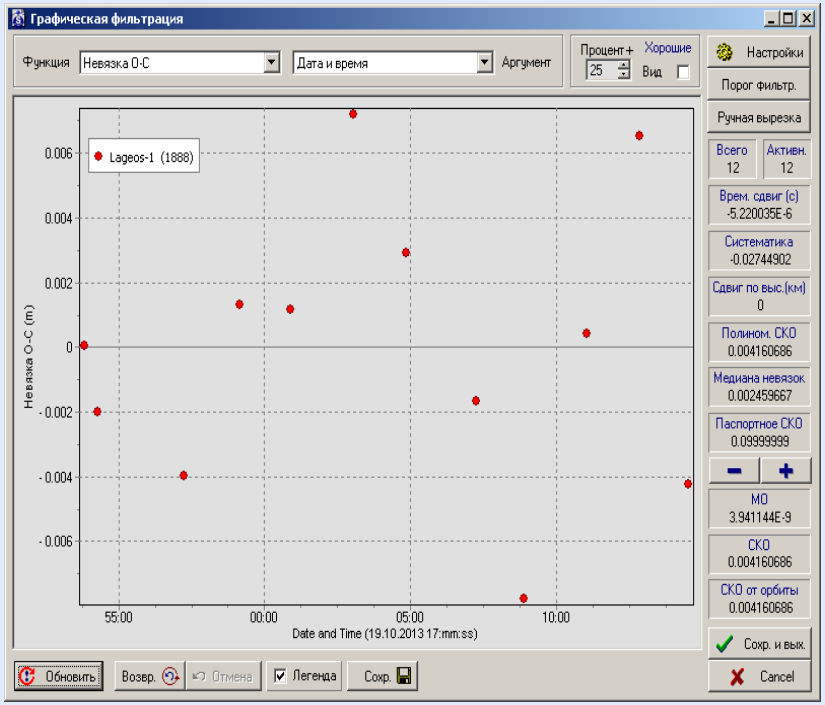
| | | | |
|---|---|---|---|
| **Komsomolsk:** | **1252 passes** | **Zelenchuksksya:** | **486 passes** |
| **Altay:** | **1389 passes** | **Badary:** | **981 passes** |
| **Arkhyz:** | **1551 passes** | **Svetloe:** | **321 passes** |
| **Baikonur:** | **1128 passes** | **Mendeleevo:** | **67 passes** |
| | | **Irkutsk:** | **103 passes** |




***From ILRS web-page***

# Operational Center of the Russian Network

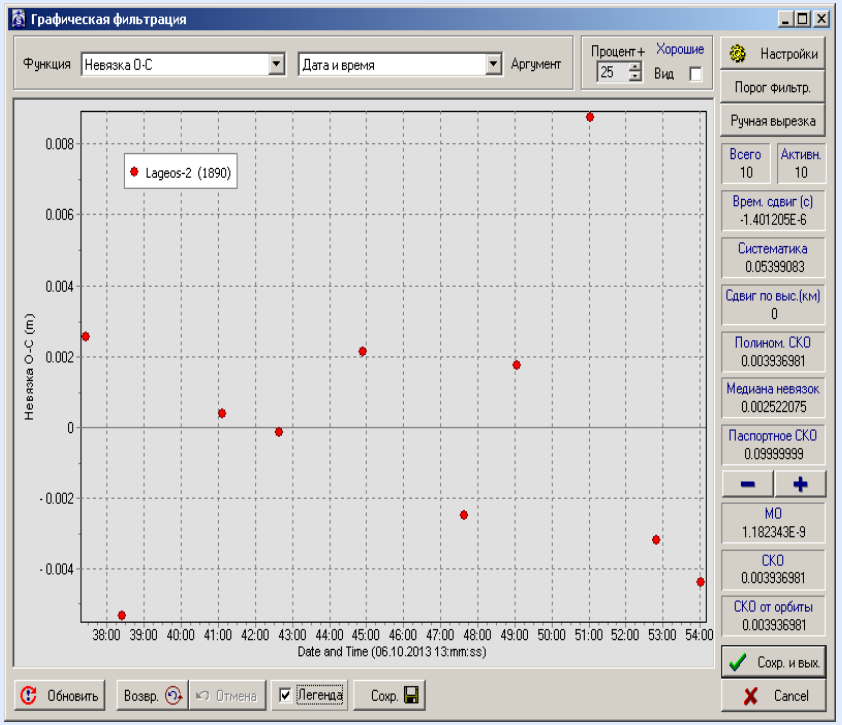
## Detailed estimation of measurements made by Svetloe station




**Error (rms)= 4-6 mm**

# Operational Center of the Russian Network

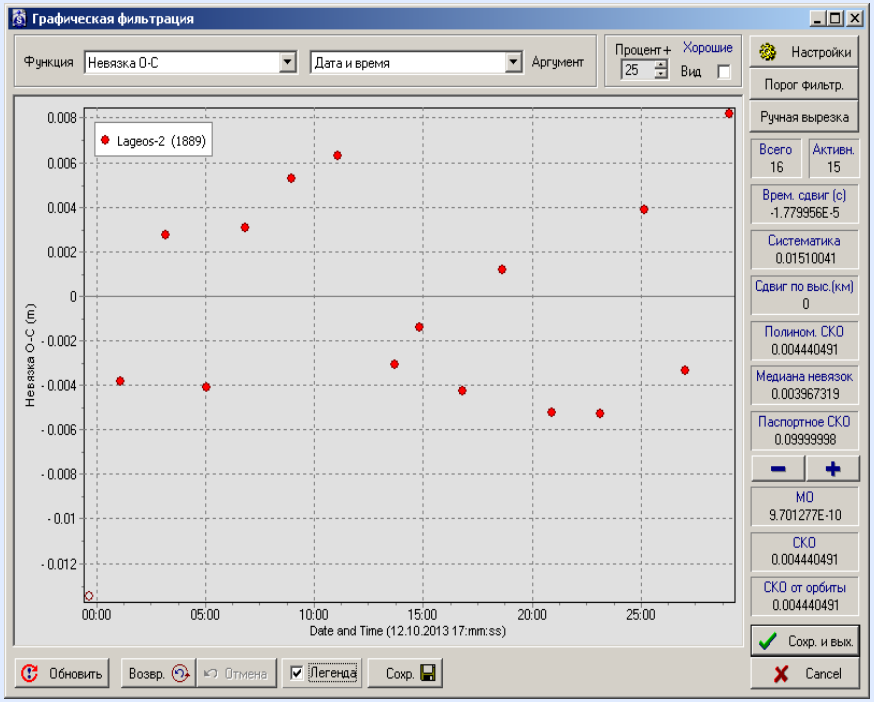
## Detailed estimation of measurements made by Badary station




**Error (rms)= 2-6 mm**

# Operational center of the Russian Network

## Detailed estimation of measurements made by Zelenchukskaya station

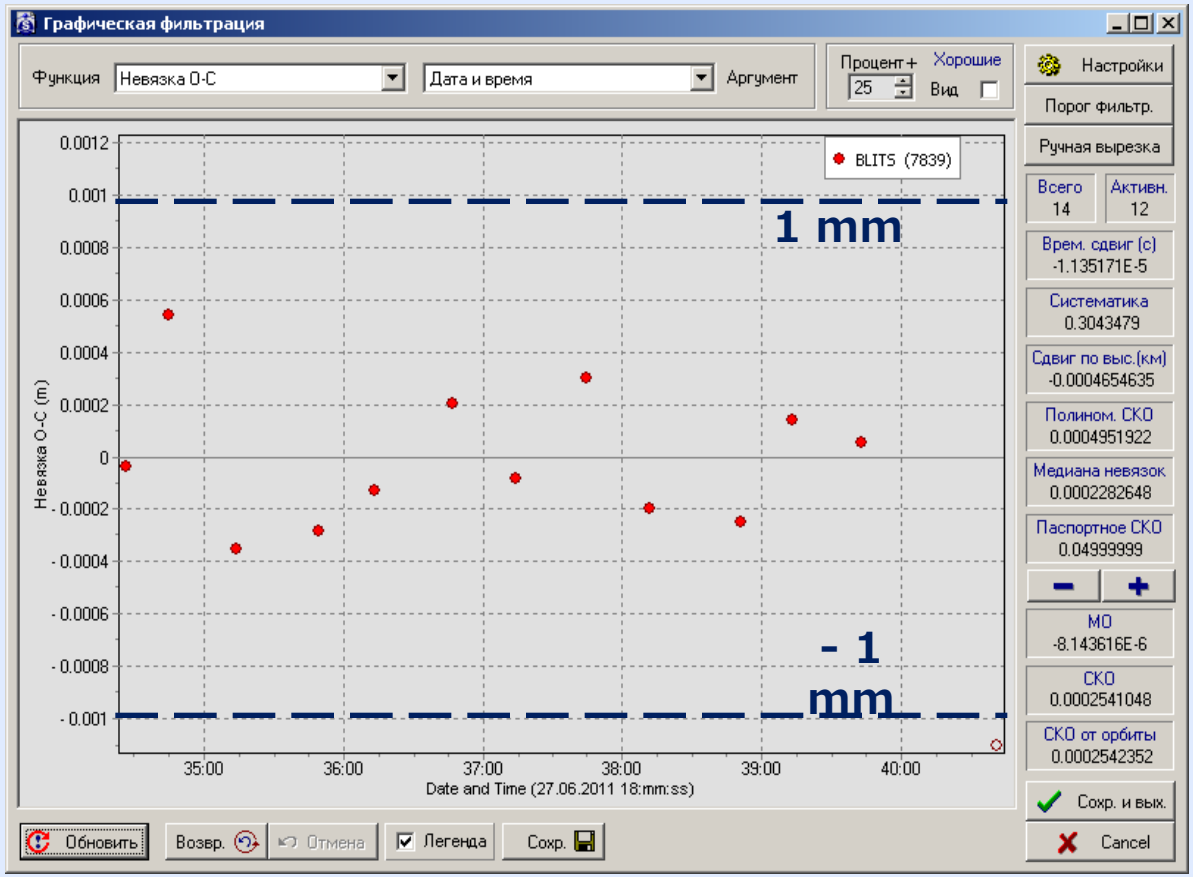



## Error (rms)= 4-6 mm

# Measurement passes Quality Estimation

## Diagram of Graz station (Austria) measurement deviations from smoothing orbit using Blitz satellite

**(Error (rms)= 0,50 mm; Error (rms) of the session with two filtered points = 0,25 mm)**



# Future plans

## Support of the GNSS performance:

- *GLONASS is* fully loaded Global Navigation Satellite System
- All GLONASS satellites have retroreflectors
- Many future GNSS satellites (Compass, GALILEO, GPS, …) will be equipped with retroreflector arrays
- Necessity to the improvement of the time, frequency, reference system and ephemeris data products from GNSS
- Necessity to support of GGOS project and multi-constellation GNSS receivers (Glonass, GPS, Compass, etc)

**The increasing importance of SLR to the improvement of GNSS performance**

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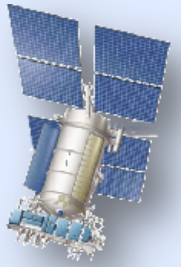
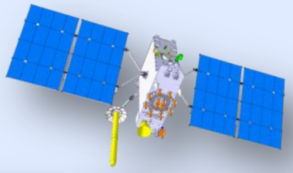
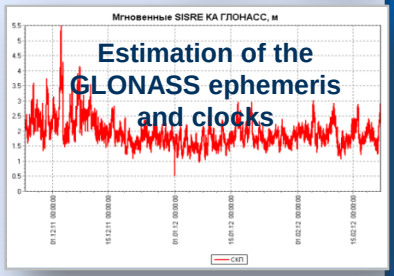
"Glonass-M"



"Glonass-K1"





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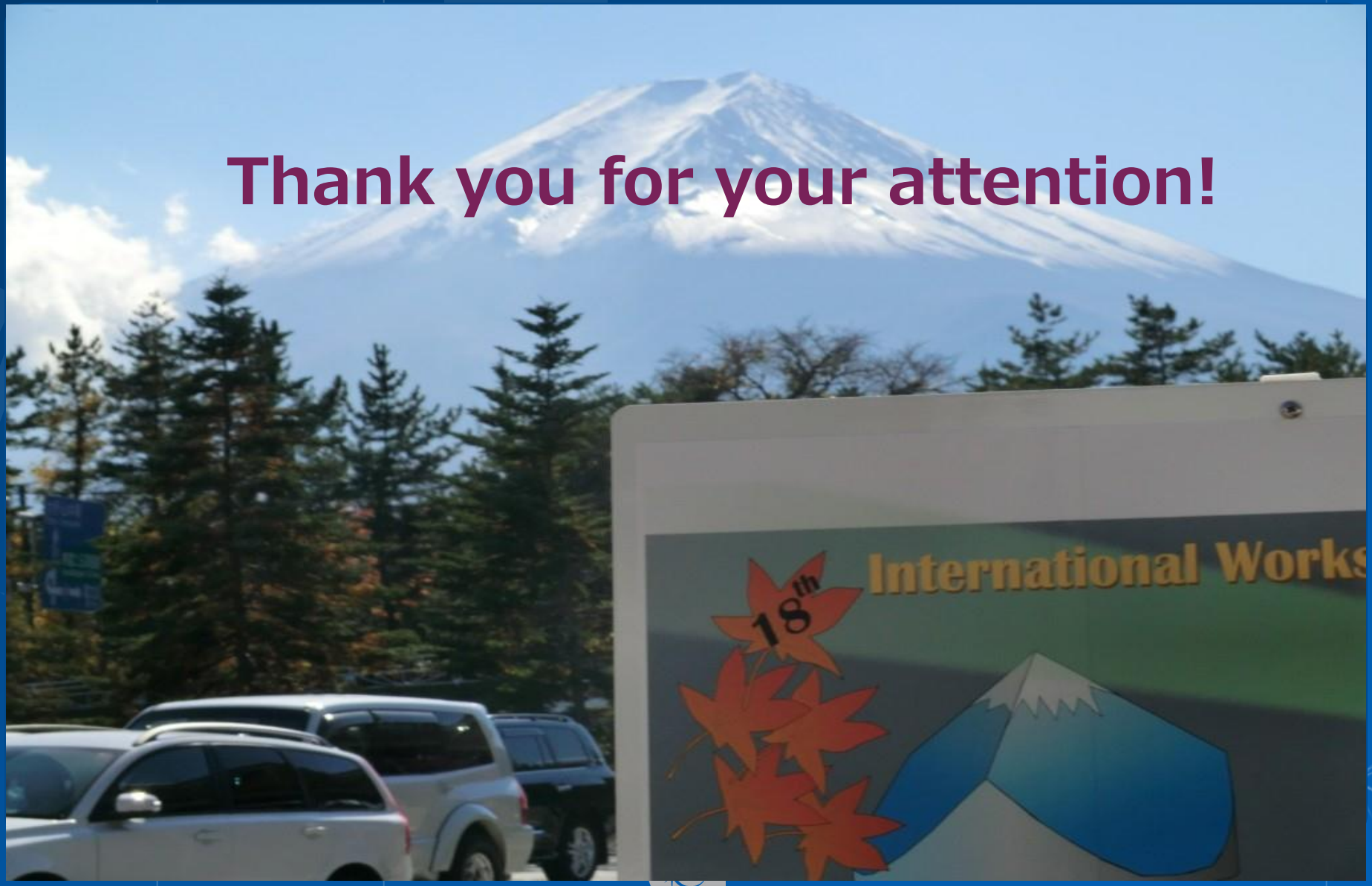
# Thank you for your attention!