

Data analysis of permanent GPS network in Mongolia

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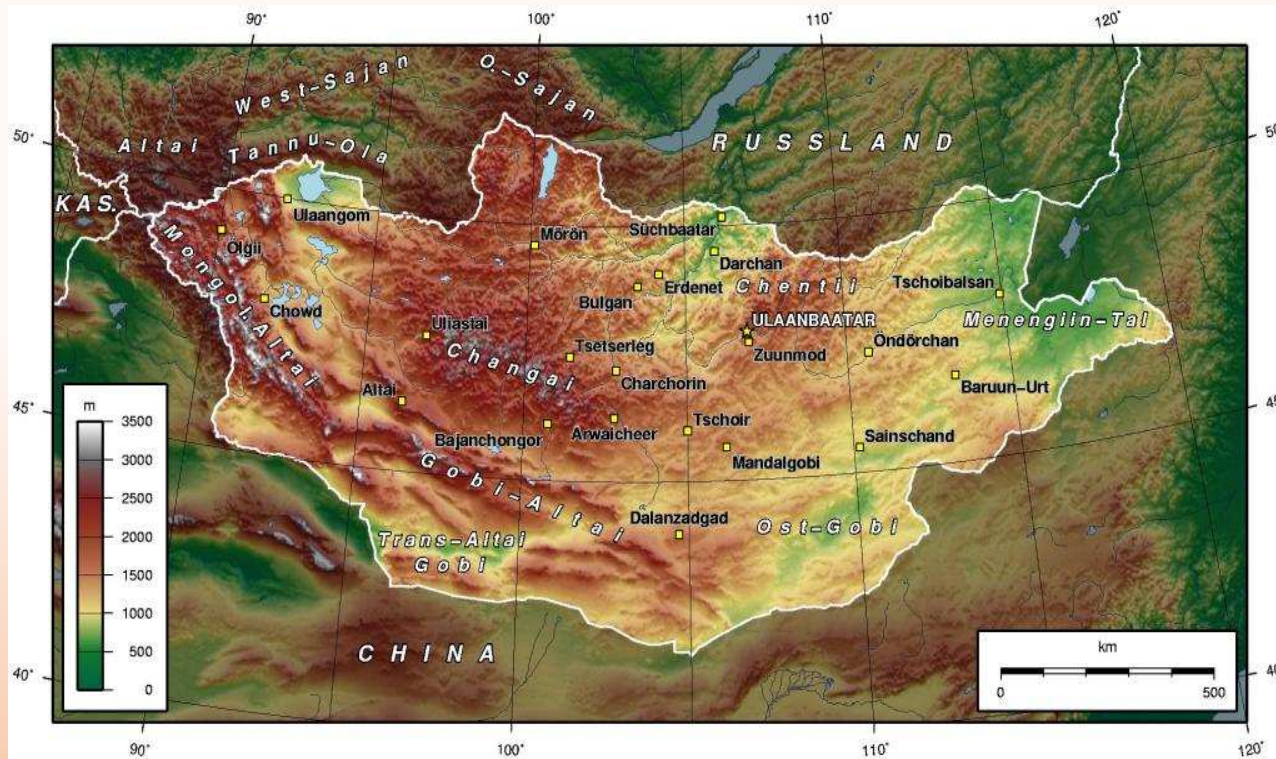
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Country background



Geography:

Location: Northern Asia,
between China and
Russia.

Area: 1,564,100 km²

Climate:

Highest in summer: +30°C

Lowest in winter: -45°C

Elevation extremes:

lowest point 518 m, Highest point 4374 m, average 1500 m from the sea level

Steppe : 41.3%;

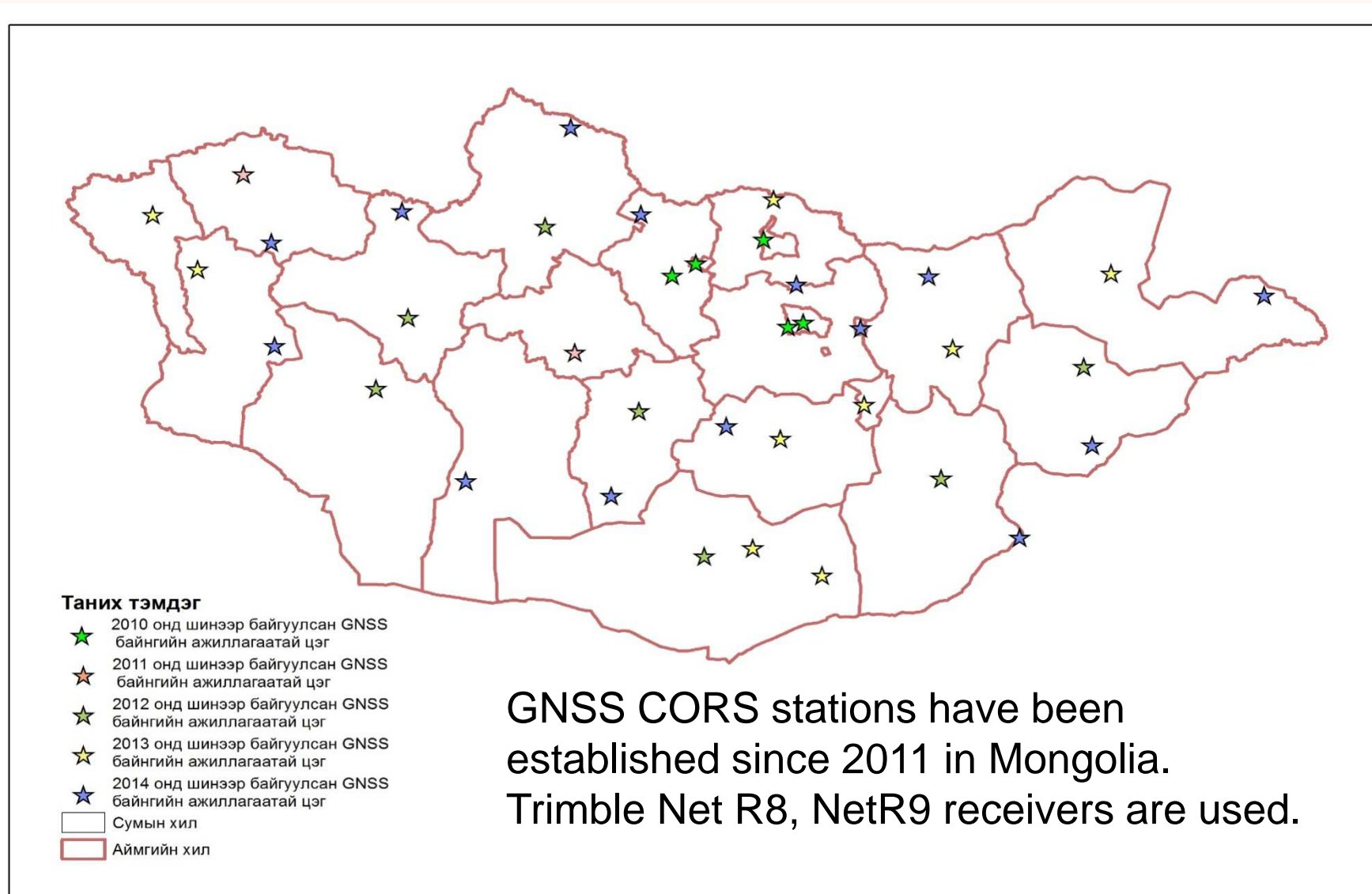
Gobi dessert : 17.3%

Forest : 11.4%;

GNSS Networks in Mongolia

- GNSS network operated by **Agency of Land management, Geodesy and Cartography of Mongolia**
- Continuous GPS (CGPS) network operated by **Seismological Department of Institute of Astronomy and Geophysics (IAG), Mongolian Academy of Science (MAS)**
- GNSS network includes 4 sites HOVD, MURN, CHOI, DALN operated by University of Tokyo (Prof. Teruyuki Kato)
- GNSS-CORS operated by some private company such as geodetic and mining company
- ULAB - IGS

GNSS-CORS network operated by Agency of Land management, Geodesy and Cartography of Mongolia





Data products

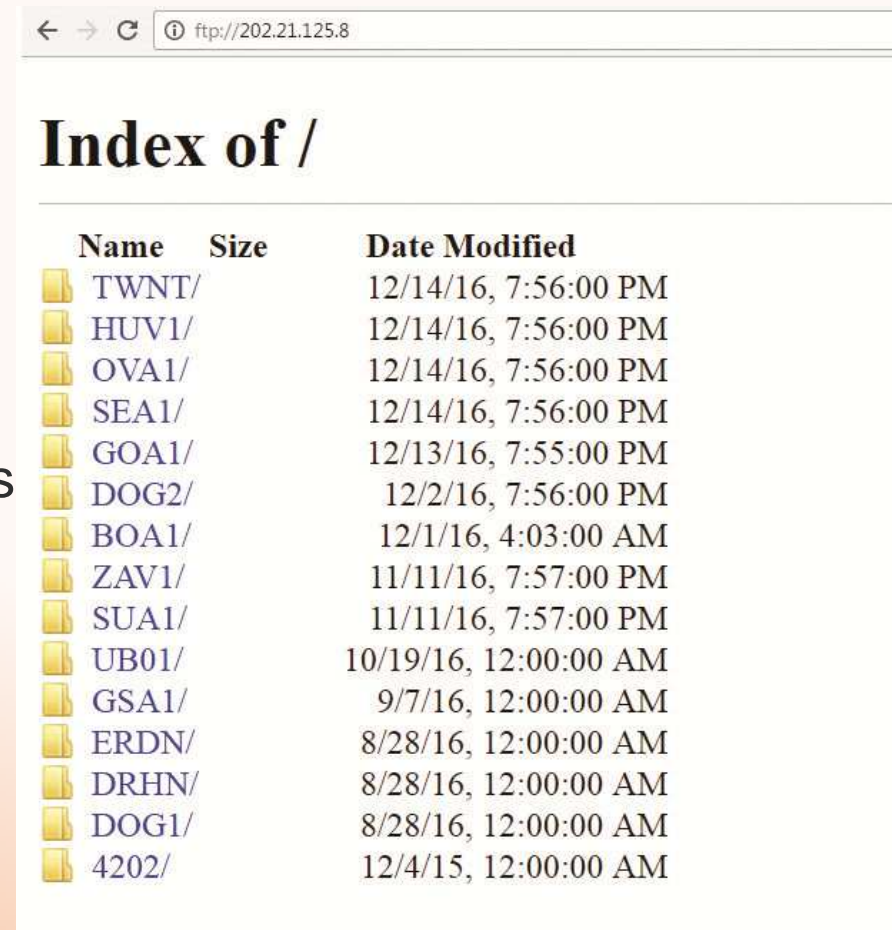
CORS network provides:

- daily files with a sample rate of 30 seconds
- Hatanaka compressed files

The GNSS data collected at these Sites are made available to the public in the Receiver Independent Exchange (RINEX) format.

Rinex files available:

<ftp://202.21.125.8>



| Name | Size | Date Modified |
|-------|------|-----------------------|
| TWNT/ | | 12/14/16, 7:56:00 PM |
| HUV1/ | | 12/14/16, 7:56:00 PM |
| OVA1/ | | 12/14/16, 7:56:00 PM |
| SEA1/ | | 12/14/16, 7:56:00 PM |
| GOA1/ | | 12/13/16, 7:55:00 PM |
| DOG2/ | | 12/2/16, 7:56:00 PM |
| BOA1/ | | 12/1/16, 4:03:00 AM |
| ZAV1/ | | 11/11/16, 7:57:00 PM |
| SUA1/ | | 11/11/16, 7:57:00 PM |
| UB01/ | | 10/19/16, 12:00:00 AM |
| GSA1/ | | 9/7/16, 12:00:00 AM |
| ERDN/ | | 8/28/16, 12:00:00 AM |
| DRHN/ | | 8/28/16, 12:00:00 AM |
| DOG1/ | | 8/28/16, 12:00:00 AM |
| 4202/ | | 12/4/15, 12:00:00 AM |

GNSS network-operated by Seismological Department of IAG, MAS

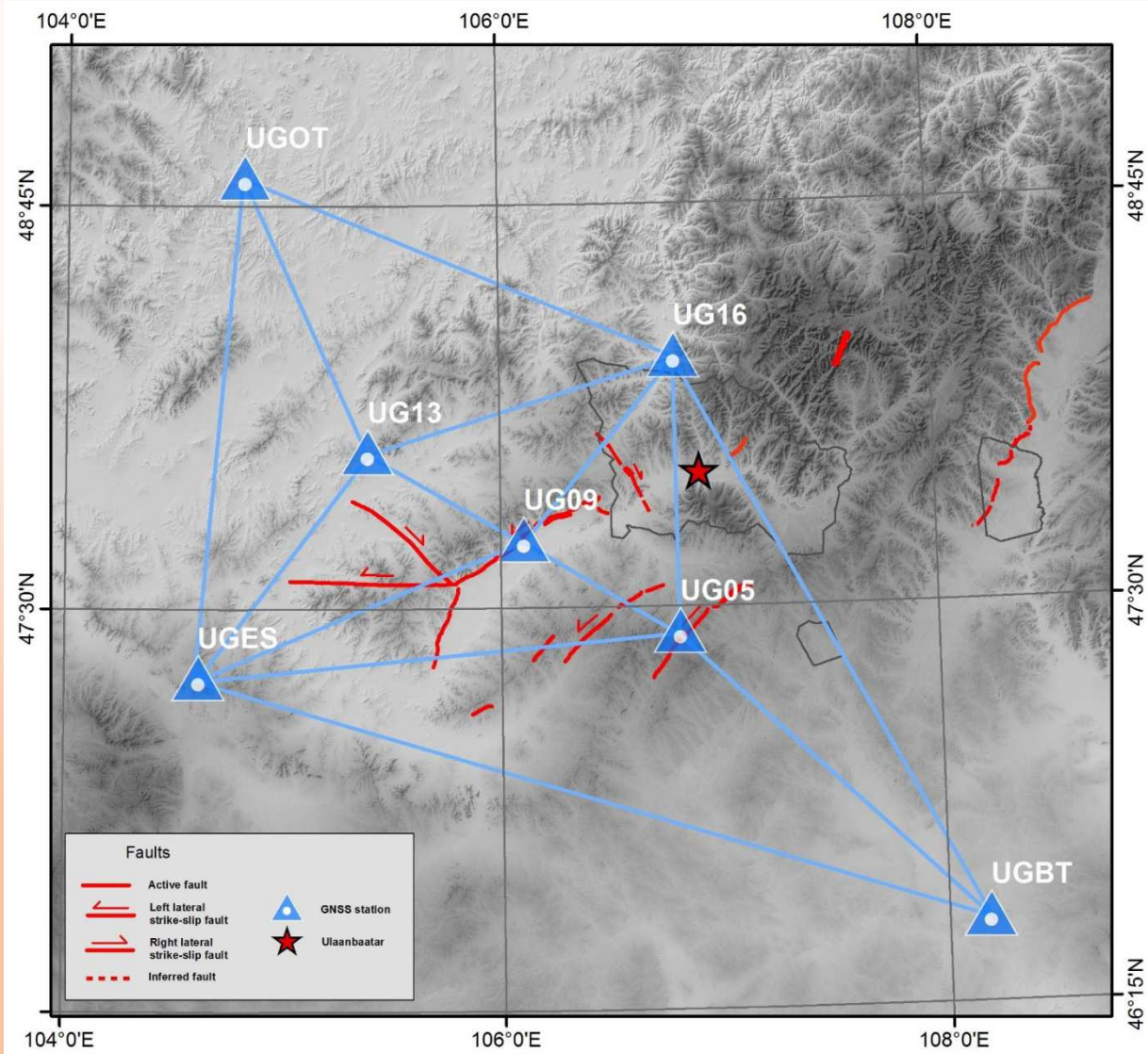
Continuous GPS network:

- 7 permanent sites
- Focus scientific interest for seismic hazard aspects

The main objective:

- monitoring
- investigation of the contribution of GNSS seismology
- characterization and quantification of earthquake parameters

Position of stations



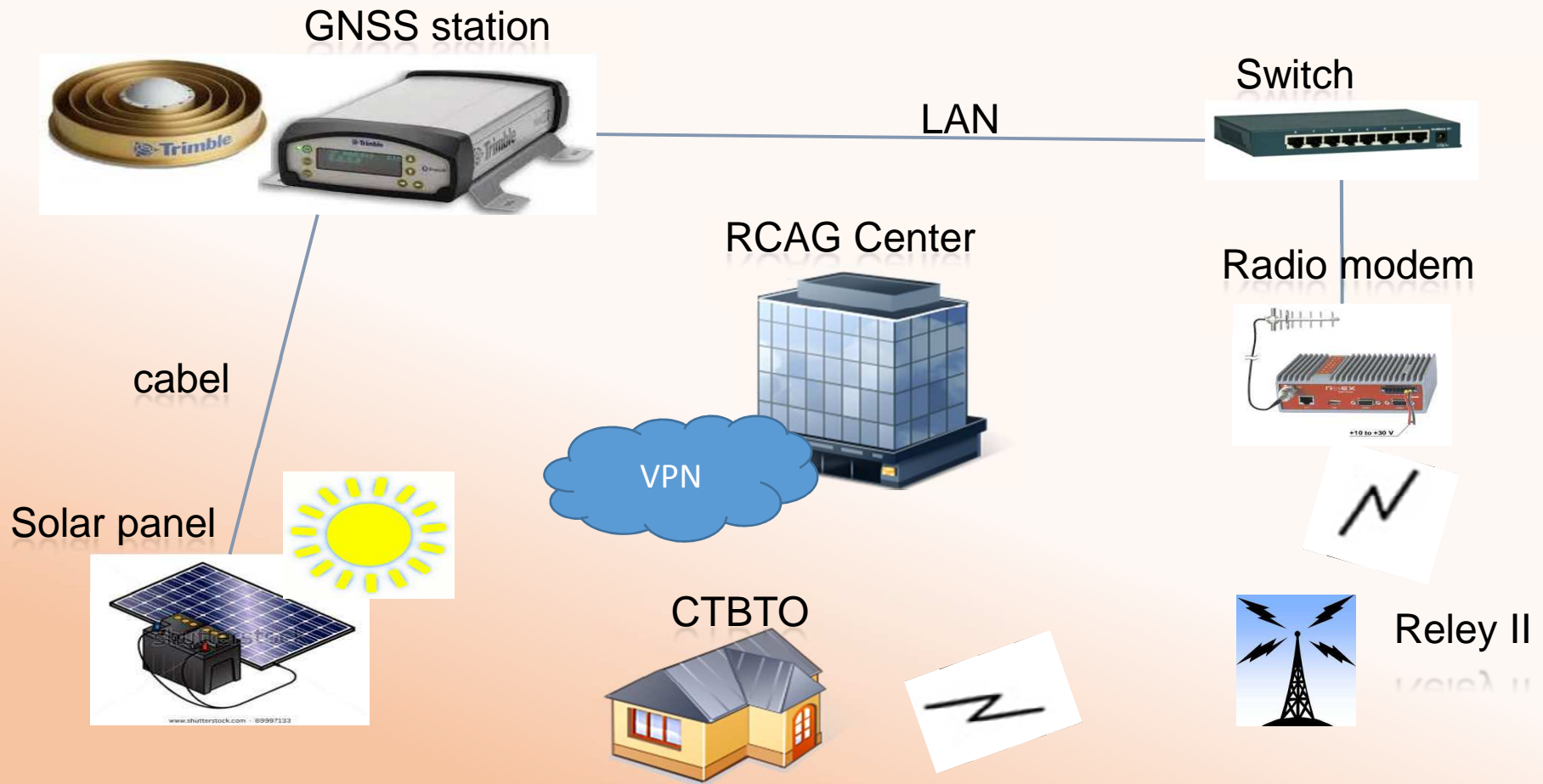
Configurations of polygons and quantities of permanent sites are determined with regard to the geological and geomorphological structure of the areas, locations and orientations of active faults, and paleo-and-recent seismicity indicators.

Equipment



The CGPS network fully equipped by Trimble NetR9 receiver and Choke ring antenna with radome.

Data stream

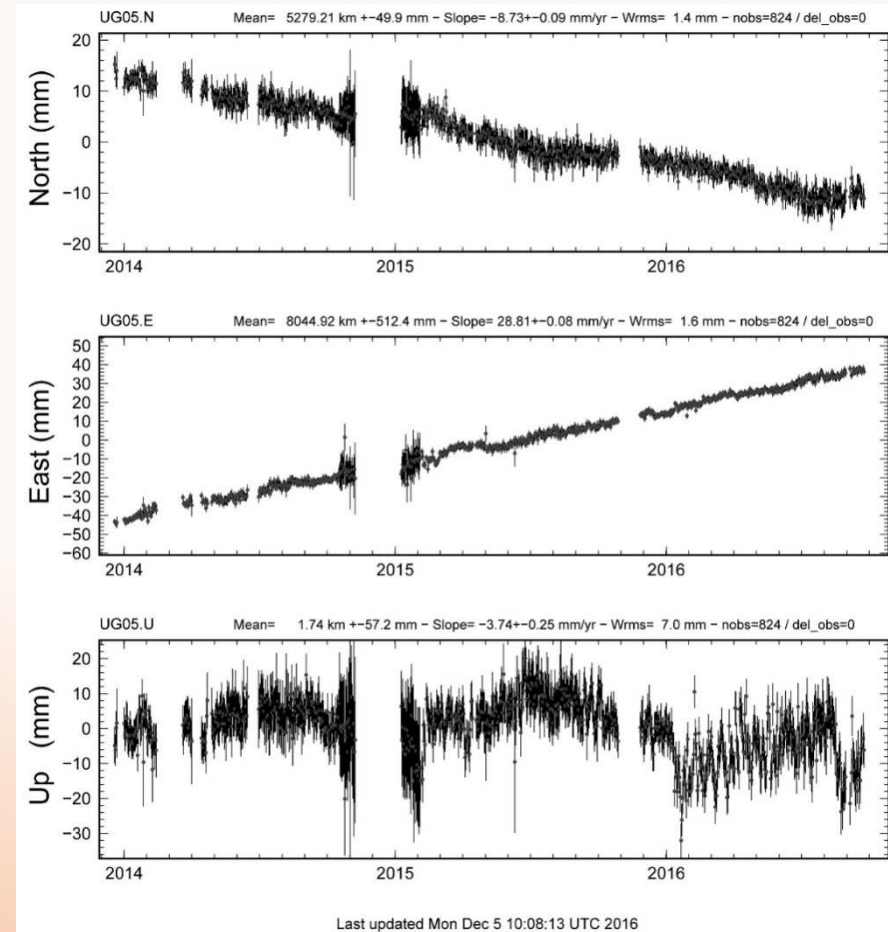


Data accumulation

The network provides GNSS data at two sample rates:

- Daily files with a sample rate of 30 seconds
- High-rate and real-time data with a sample rate of 1 seconds

Long-term, continuous sets of data responds to get mm level of crustal movement.



The Geodynamic study in Mongolia using GNSS

Study area of modern horizontal velocities of displacement and deformation in Mongolia started in 1997. As a result of the international program was established as part of the international network IGS - ULAB.

The first results of GNSS data analysis were obtained by scientists (*Calais and Amarjargal, 2000*). It was revealed that the velocity of the Amurian/North China block's movement in the ESE direction was by a factor of 3 to 6 faster than the movement rate predicted by models based on the hypothesis that deformation in Central Asia is entirely driven by the India/Eurasia collision.

Active development of the study for GPS observations in Mongolia began in 2010.

Analysis and preliminary result of GNSS measurement

Software:

- GAMIT (King & Bock, 2000),
- GLOBK (Herring et al., 1990),



Developed by:

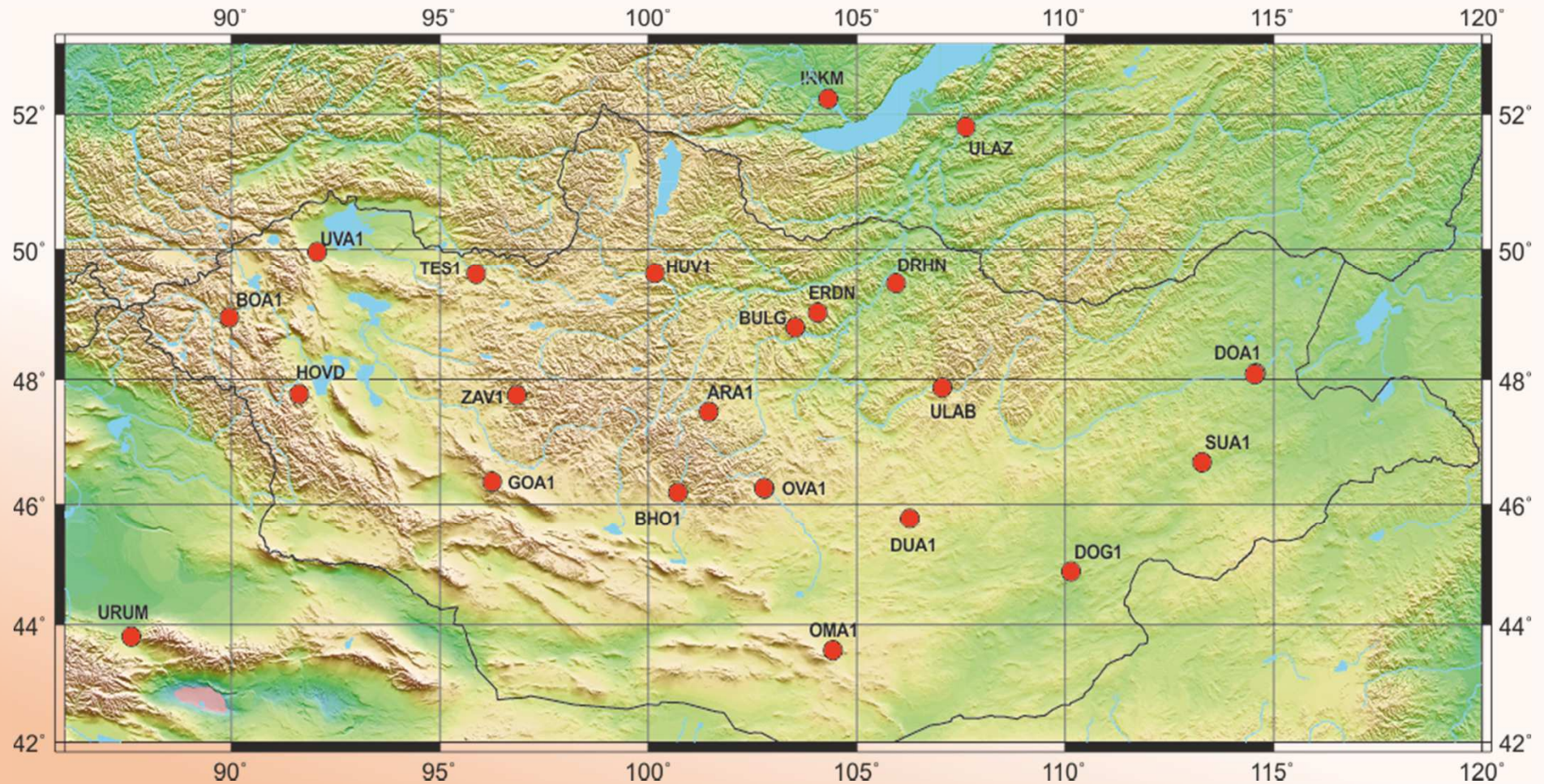
- Massachusetts Institute of Technology,
- Scripps Institution of Oceanography,
- Harvard University,

Calculated with:

- ITRF2014
- IGS stations (ARTU, BADG, BJFS, CHUM, FAIR, GRAZ, IISC, IRKT, KHAJ, KIT3, KOKB, KUNM, LHAZ, MAG0, NRIL, NVSK, ONSA, PETP, PETS, POL2, SELE, SHAO, TIDB, TIXI, TSKB, ULAB, URUM, USUD, WUHN, XIAN, YAKT)

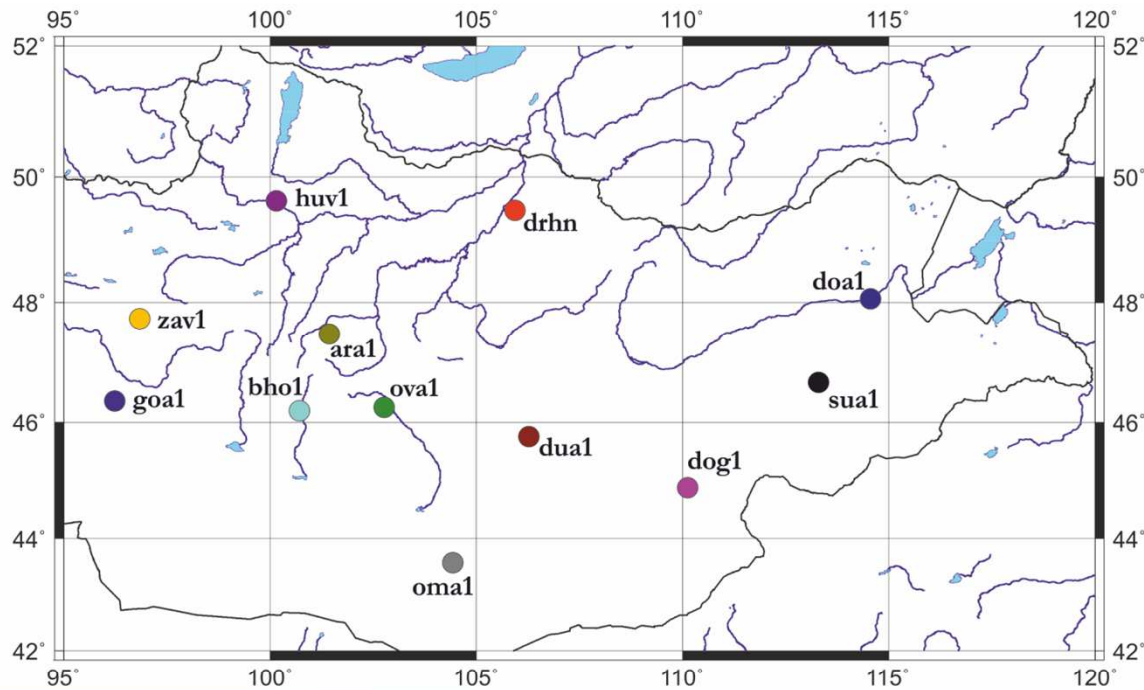

Relative Positioning

Selected sites from ALMGC



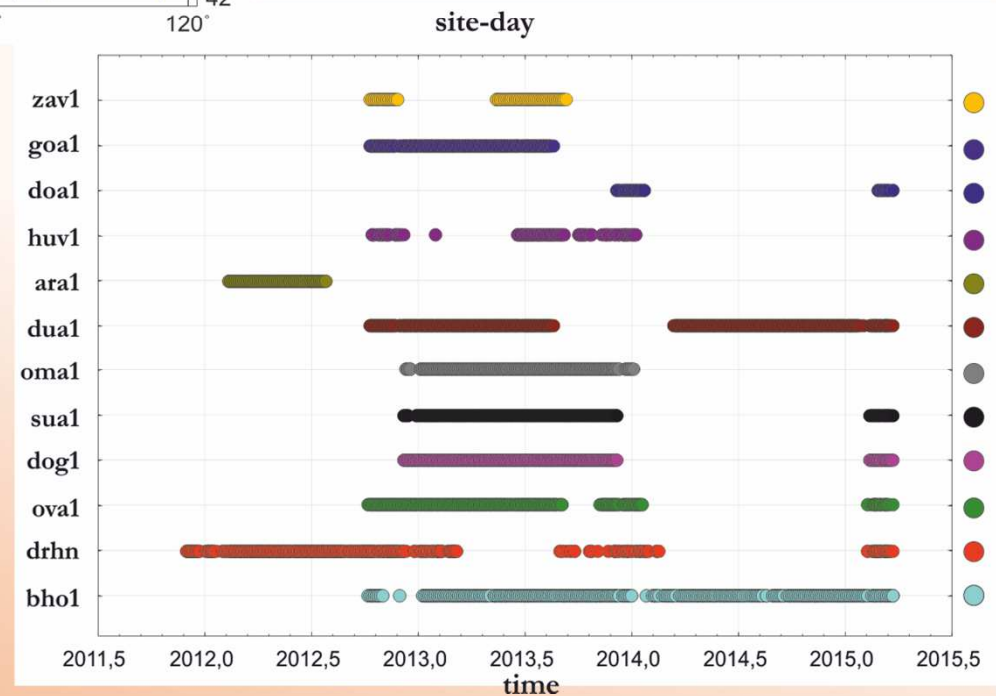
Selected by:

- data availability through time
- their monumentation quality.

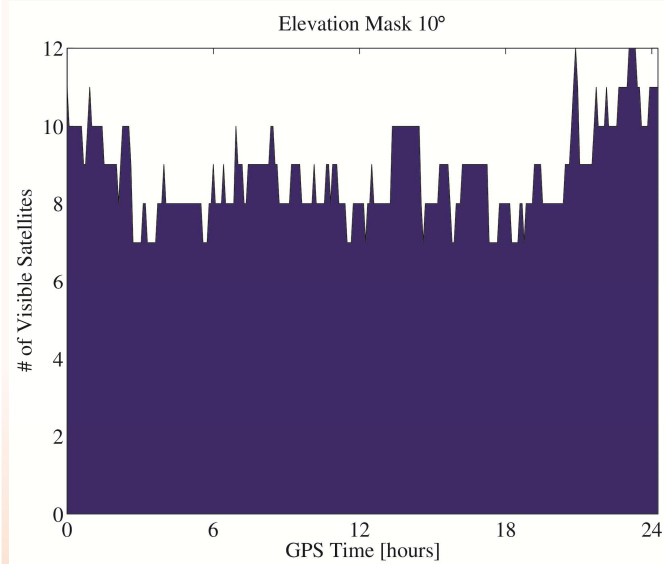


A major shortcoming of the obtained permanent GPS-data points, is the presence of large breaks in the measurements.

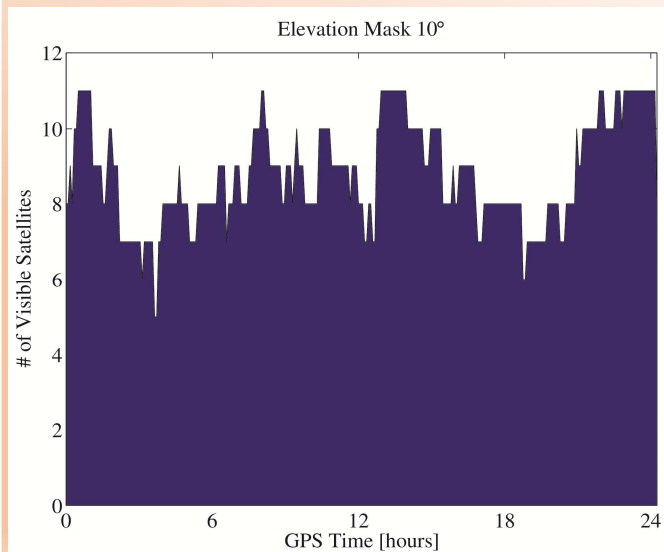
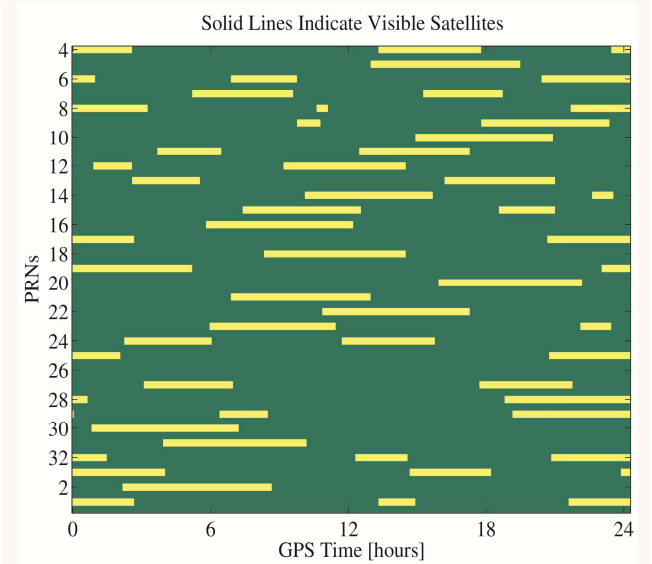
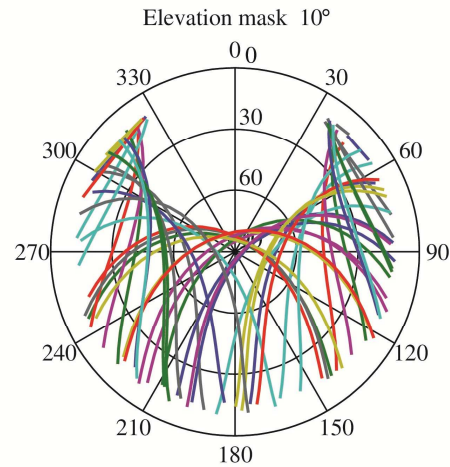
Here shows the time series of measurements for a number of permanent stations of Mongolian regional network. Clearly visible significant time breaks in measurements almost at all stations.



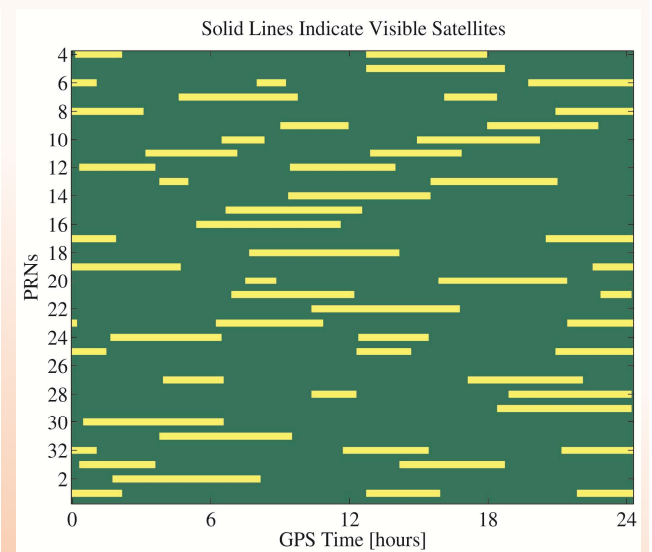
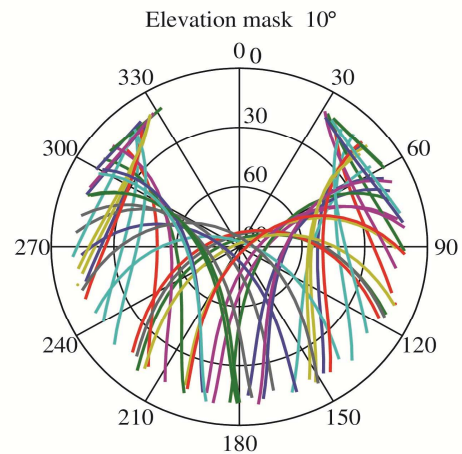
Satellite visibility

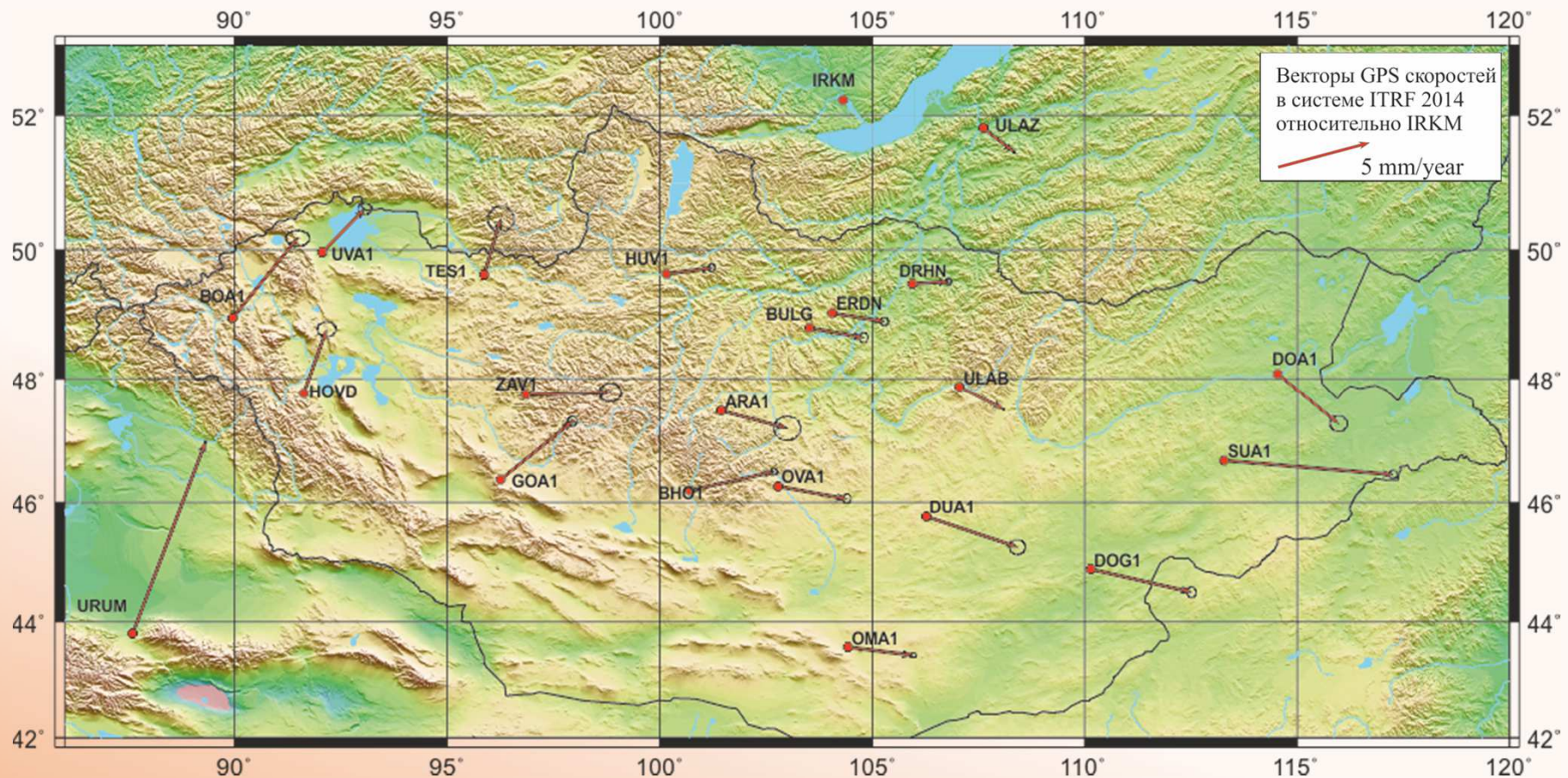


Skyplot for the position DOA1 (ϕ, λ) = (48.0751°, 114.5456°)

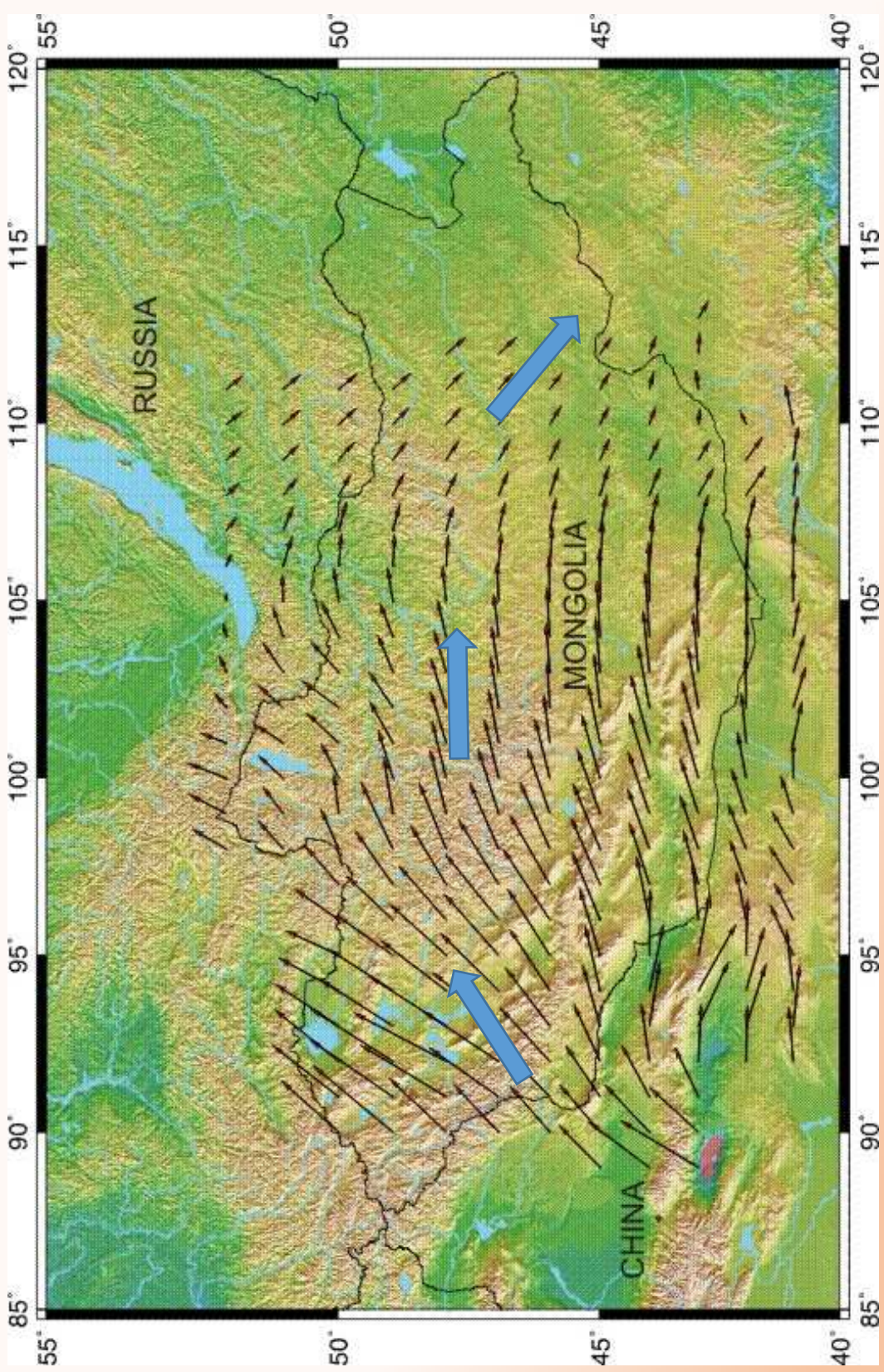


Skyplot for the position UVA1 (ϕ, λ) = (49.9642°, 92.0622°)





Speed of modern horizontal movements by GPS-measurement data for permanent sites, Mongolian landfill for the period 2011-2015. ITRF2014 in the system relative to Eurasia. Ellipses show 95% confidence intervals.



Conclusions

- ✓ The GNSS/CGPS networks have been designed and established in the territory of the Mongolia. Regular observations were conducted at 21 sites from 2011 to 2015.
- ✓ The result of the data analysis of permanent stations has confirmed the rate of movement in the territory of Mongolia, while retaining features of deformation observed in China is divided into two streams. One of them can be traced from the region of India-Eurasia collision to the southern districts of Tuva, and decreasing to low levels in the Siberian platform. The second stream is deflected to the east in central Mongolia, then to the south-east in the territory of Trans-Baikal and North China.
- ✓ The method of research of geodynamic parameters fulfilled in plate tectonics of active regions of Mongolia, and numerical values of modern deformations received from these methods. It will be used for an assessment of environmental, social and economic risks of development of Mongolia and will be implemented for assessment of deformation of the Earth's surface.
- ✓ Thank to the Agency of Land management, Geodesy and Cartography of Mongolia for sharing their GNSS data.

Thank you for your attention