The Institute of Astronomy & Geophysics
of Mongolian Academy of Sciences

Book of Extended Abstracts

The International Conference on Astronomy and Geophysics in Mongolia, 2017

Ulaanbaatar, Mongolia
20-22 July, 2017

1957-2017
60 YEARS

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ASTRONOMY & GEOPHYSICS IN MONGOLIA, 2017

20-22 JULY, 2017, ULAANBAATAR, MONGOLIA

Extended Abstract Volume

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Ulaanbaatar
2017

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INSTITUTE OF ASTRONOMY AND GEOPHYSICS OF MONGOLIAN ACADEMY OF SCIENCES (IAG, MAS)

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Print design: Mungunshagai Mendbayar

ISBN 978-99978-1-236-0

Published by Mongol Altay printing Co.ltd

PRESENT-DAY MOVEMENTS OF THE EARTH'S CRUST OF MONGOLIA FROM GPS MEASUREMENTS AT THE PERMANENT SITES

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GPS survey in the Baikal region and Mongolia was initiated in 1994 in the framework of a collaboration between the Research Center for Astronomy and Geodesy of the Mongolian Academy of Sciences (Ulaanbaatar, Mongolia), the Institute of the Earth's Crust, Siberian Branch of the Russian Academy of Sciences (Irkutsk, Russia), and Géosciences Azur, National Center for Scientific Research (Sophia Antipolis, France). To date, more than 50 GPS sites have been installed in this territory. The main results of the measurements have been reported in (Calais et al., 1998, 2003, 2006, Sankov et al., 2009, Lukhnev et al., 2010).

A new stage of the GPS network development in Mongolia started in 2010 when more than 30 new campaign sites were installed during the next 6 years. These sites were organized as three networks of different scales. Moreover, since 2011 the Agency of Land management, Geodesy and Cartography of Mongolia has carried out periodic measurements at the permanent sites which had been installed in almost all aimag centers. Fig.1 shows location of all GPS sites in the territory of Mongolia.

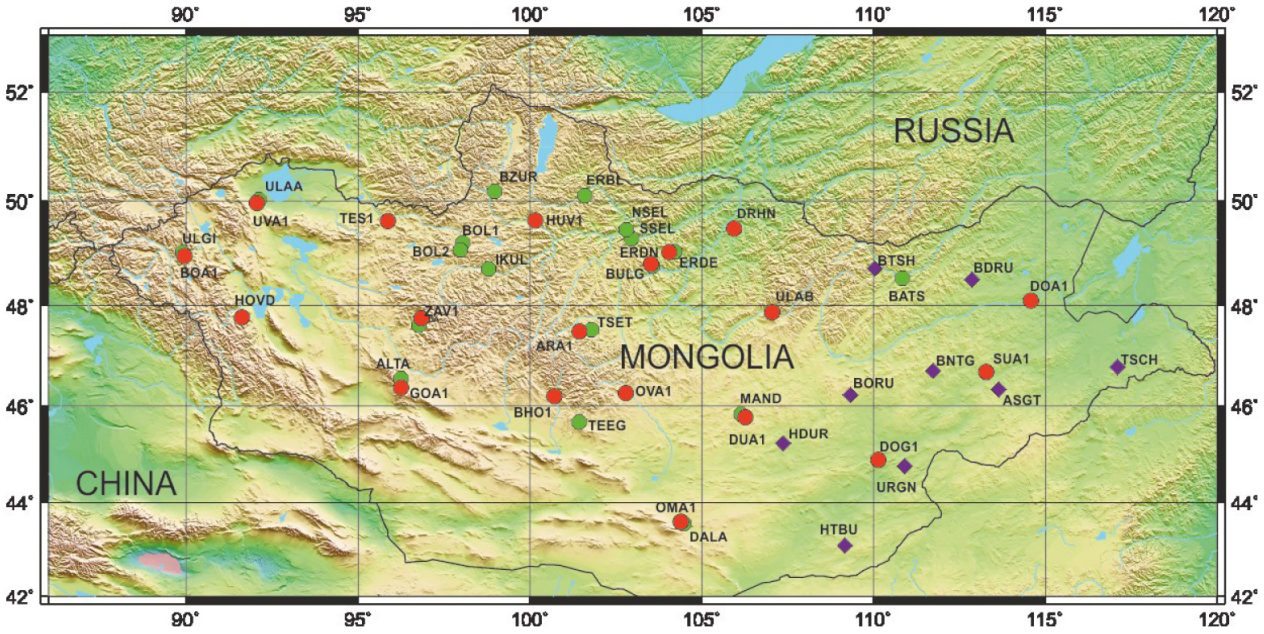

Figure 1: Location of both permanent and campaign GPS sites in Mongolia. Green circles show the campaign sites, red circles show the permanent sites, purple diamonds show the campaign sites of the network "East", and purple circles are campaign sites of the Baikal-Mongolia network which are incorporated in the network "East".

A significant drawback of the data obtained at the permanent sites is the presence of time gaps in measurements. Time series for some sites are shown in Fig.2 where large time gaps can be seen for nearly all sites.

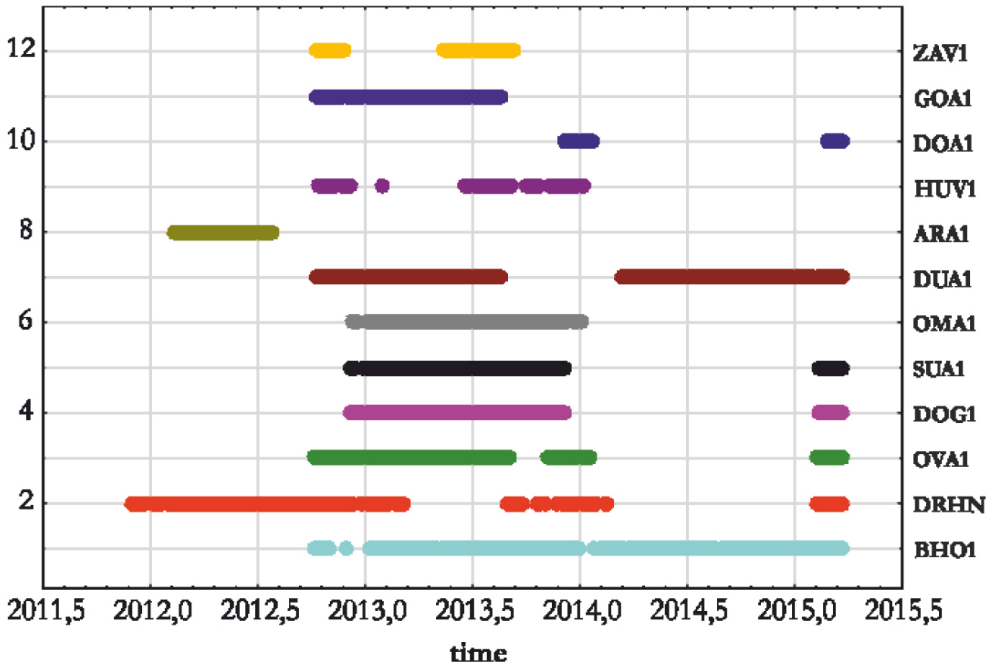

Figure 2: Time-series of GPS measurements at the permanent sites of Mongolia.

The GPS data obtained at the permanent sites were processed by A.V.Lukhnev according to the procedure described in (Lukhnev et al., 2010). Site coordinates, velocities and their uncertainties were estimated in ITRF2014. The velocity vectors obtained are shown in Fig.3.

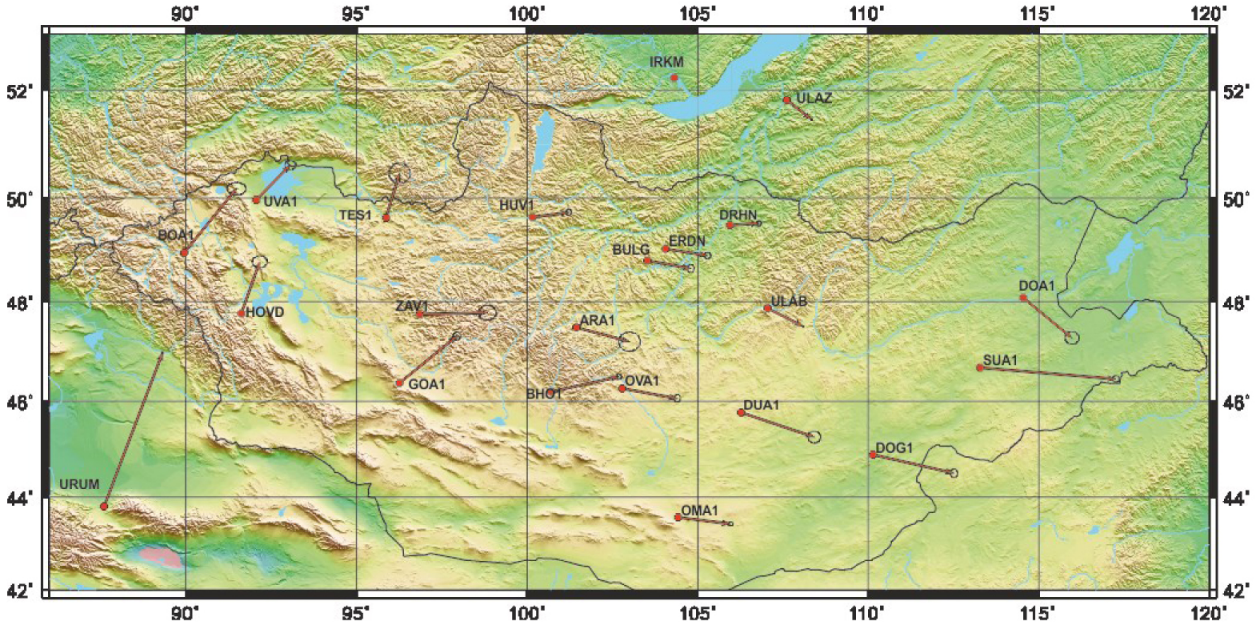

Figure 3: GPS-derived velocities of the permanent sites of Mongolia in the ITRF2014 system with respect to Eurasia for 2011-2015. Ellipses are 95% confidence.

The maximum values of the movement velocity were found for south-west (URUM – 10.8 mm/yr) and south-east (SUA1 – 9 mm/yr) parts of the study territory. In Central Mongolia, velocities are decreased up to 3-3.5 mm/yr (ARA1, DULG). In general, there is a decrease in the velocity of the horizontal movements of the permanent sites from south to north. As to the vector direction, it is turning from nearly S-N in the western part, to the W-E orientation in the central part, and then to E-S-E in the eastern part of Mongolia.

When analyzing the time series for some sites, we revealed a significant variation of velocity

increment of site coordinates for the W-E and N-S directions. This variation seems not to be caused by seasonal fluctuations, and it has a pulsation mode. Annual variations are clearly distinguished in the vertical component of the movements (Fig.4).

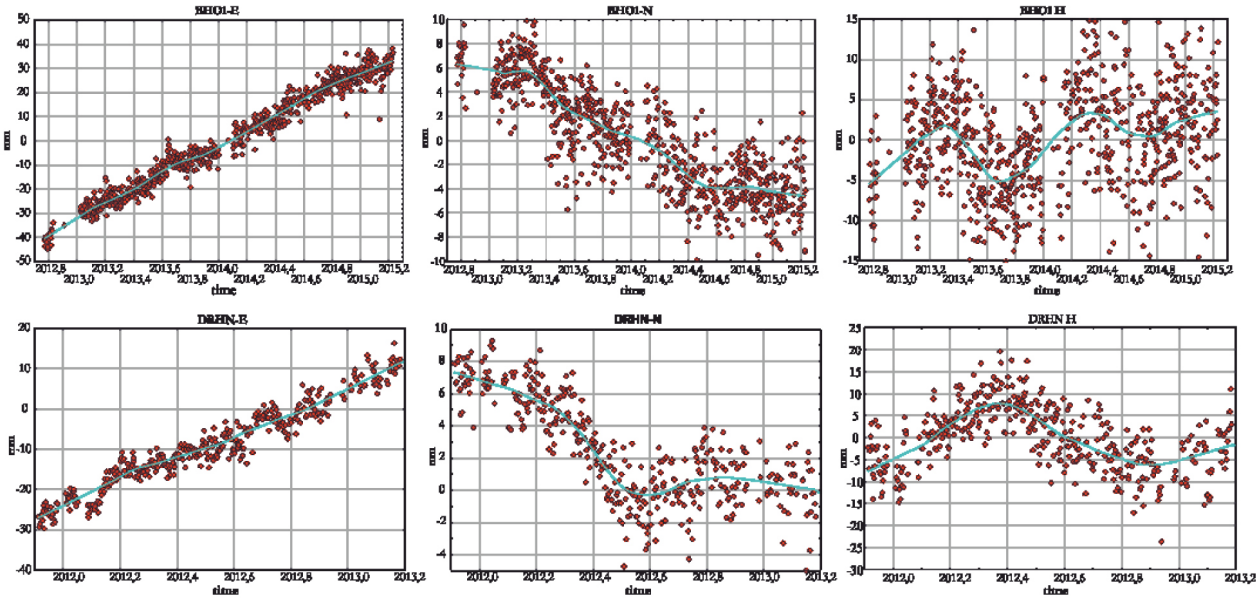

Figure 4: Coordinate increment of the permanent sites BHO1 (A-C) a DRHN (D-F) along the West-East direction (A, D), North-South direction (B, E), and Up-Down direction (C, F).

The field of the relative horizontal strain rate estimated on the base of the velocity vectors for the permanent sites is shown in Fig.5.

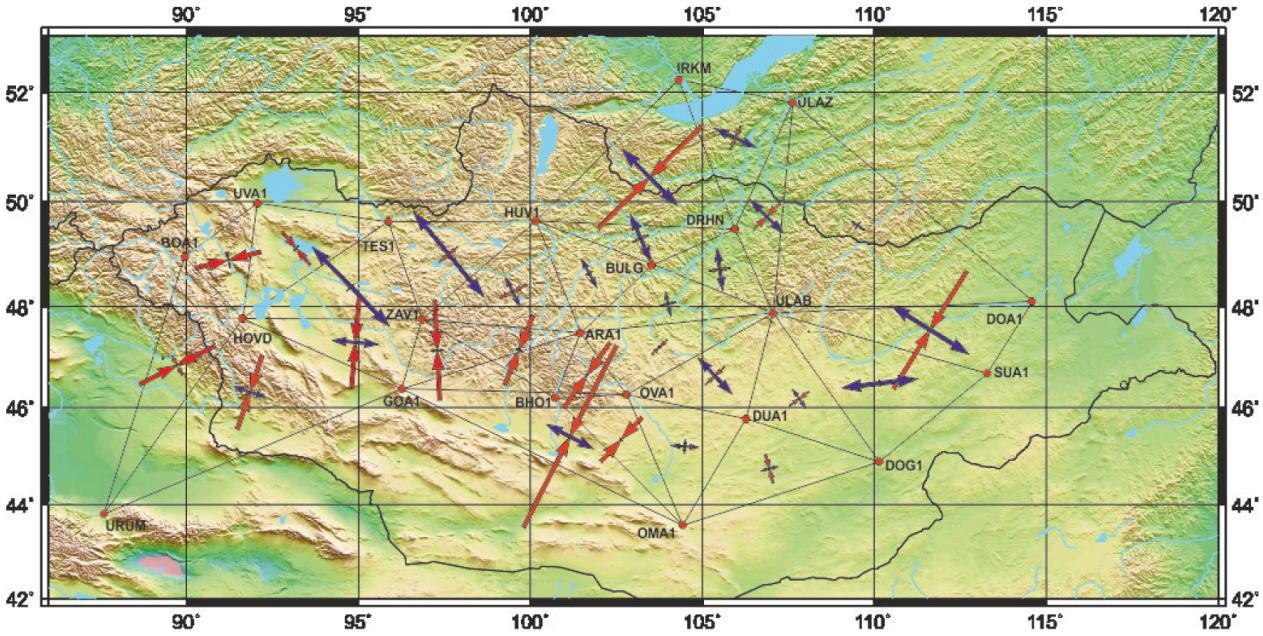

Figure 5: Relative horizontal crust strain patterns of the territory of Mongolia derived from velocities of the permanent GPS sites for 2011-2015. Red and blue arrows are principal shortening and elongation rate axes, respectively.

The high values of the maximum shear strain rates (10-15*10-9 yr^{-1}) have been found for the zone of variable width which runs along the southern, south-western, and western margins of the Khangay dome. The southern and western parts of the dome are characterized by crust shortening, whereas the crust of the northern part is under elongation.

The strain rate for the northern and eastern parts of the Khangay dome as well as the western part of the Khentei upland are much lower and they are up to 2-4*10-9yr^{-1}. The orientation of the elongation axis here is NW-SE. In the area of the middle reaches of the Kerulen, the strain rates have the values comparable to those for the western Mongolia (16-18*10-9yr^{-1}). Here, a shear type of strain is observed with the NW-SE and NE-SW orientation of the axes of elongation and shortening, respectively. A considerable area of manifestation of strain of extension is observed to the south, with a sublatitudinal orientation of the axis of elongation.

The work was carried out with the partial financial support of the Russian Foundation for Basic Research (grant 17-05-00826_a).

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