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Modern geodynamical motion of the Northern Caucasus from data of GPS/GLONASS observations

Vadim Milyukov, Vladimir Zharov, Alexey Mironov, Andrey Myasnikov, and Mark Kaufman
Moscow University, Sternberg Astronomical Institute, Moscow, Russian Federation (milyukov@sai.msu.ru, +7 495 9328841)

The northern part of the Greater Caucasus is one of the most geodynamically active regions of Russia. This is a zone of complex tectonics resulting from interaction between two of the Earth's major lithospheric plates, Arabia and Eurasia. Therefore, the region as a whole is characterized by a complex system of faults, with meridional and diagonal structures. The first GPS and absolute gravity campaign in the Black Sea and Northern Caucasus regions was carried out between 1993 and 1994 as part of the SELF project. One of the points of the GPS measurements was transformed in the stationary station. This station is located in Karatchay-Cherkessia Republic of the Russian Federation. Since 1997 the Zelenchukskaya station has been part of the European Reference Frame (EUREF) GPS network with a code ZECK. Within the last few years we have established three new stationary GPS/GLONASS stations in the Northern Caucasus. The first (site code TRSK) is located in the Kabardino-Balkaria Republic, near the Elbrus volcano. It began to operate in 2005. The second one is located in Karatchay-Cherkessia Republic (site code KISL). This station has been in operation since 2006. The third is located in Vladikavkaz, the capital of North Ossetia Republic (site code VLAD). The continuous GPS measurements began in 2008. These four stationary stations form the base for the regional Northern Caucasus GPS network, which can be called the Northern Caucasus Deformation Array (NCDA).

We analyse the GPS data using BERNESE 5.0 GPS software. As a reference site we use the Mendeleevo station, located in the Moscow region (IGS site code MDVJ).

The striking aspect of the velocity field of the Northern Caucasus derived from the NDCA stations is the rapid motion in the north–east direction with almost equal velocities of about 28 mm/yr. The motion of the feducial site MDVJ (Moscow region) is characterised by a similar velocity value (25 mm/yr) in the same direction. Therefore the motion of the Northern Caucasus region is mainly defined by the general tectonic movement of the Eurasian plate with respect to ITRF. At the same time the analysis defines excess NE movement of stations in the NCDA with respect to Eurasia (as defined here by the Moscow station) at rates of 3-4 mm/yr. Apparently the excess velocities of NCDA reflect tectonic activity of this region.

With respect to the uplift of the Northern Caucasus region, the situation is ambiguous. The uplift of the ZECK site derived from the GPS data coincides with an estimation obtained on the basis of absolute gravity measurements over a thirteen-years period (2 mm/yr). The station Terskol shows the greatest uplift (9 mm/yr). The local effect connected with inflation of magmatic chambers of the Elbrus volcano may be one of the possible explanations of the uplift value of the TRSK site. Nevertheless the question of the uplift estimate for the Northern Caucasus region demands further study.

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