Geodynamic studies in the Pieniny Klippen Belt in 2004-2020

Dominika Staniszewska
Warsaw University of Technology, Geodesy and Cartography, Warsaw, Poland (dominika.staniszewska@pw.edu.pl)

The Pieniny Klippen Belt is located in the middle part of the zone between the Inner Carpathians and Outer Carpathians. Researches at the Pieniny Geodynamic Test Field dates back to the 1960s. Previous geodynamic studies in the area of the Pieniny Klippen Belt have indicated neotectonic activity. Currently, starting in 2004, a GNSS survey campaign is held annually in early September.

The subject of the study was to check whether the Pieniny Klippen Belt (PKB) shows neotectonic activity in the relation to the surrounding structures - the Podhale Flysh (FP) and the Magura Nape (MN).

This study was based on the survey of the movement of stations located in the area of the aforementioned three structures, which create the Pieniny Geodynamic Test Field.

The Pieniny Geodynamic Test Field consists of 15 GNSS stations, including 6 stations inside the PKB, 5 stations within the MN and 4 stations within the FP. The whole geodynamic test field is supplemented by 4 GNSS stations located in the Tatra Mountains.

To determine the horizontal movements of the geodynamic units, the results of satellite measurements made between 2004 and 2020 were processed. The coordinates and velocities of the stations were determined in two reference systems - IGb08 and IGb14.

To define the IGb08 and IGb14 systems, 24 EUREF stations (Euref Parmanent GNSS Network) were used. The stations were selected based on the following criteria: location, length of available data and the fewest number of discontinuities. The stations were basing to be located at the shortest distance from the Pieniny Geodynamic Test Field, as well as to be distributed evenly. Data from the CODE Analysis Center was used to process the GNSS data. GNSS datasets were processed using Bernese 5.2 GNSS Software. The adjustment was prepared in two variants due to inconsistencies between the orbits of the satellites and the IGb14 system. The differences between the ITRF2008 and ITRF2014 are quite small and are due to new or updated antenna calibrations.

Then, the obtained velocities were converted to ETRF2014. Station velocities were determined in two ways-analytically, using transformation parameters between the ITRF and ETRF2014 systems for the 2010.0 epoch, and using the EPN CB Coordinate Transformation Tool shared by the EUREF Permanent Network (EPN).

Horizontal coordinates were determined in both short-period solutions - daily and long-period
solutions - covering sixteen measurement epochs.

To check the validity of the adjustment, a comparison of the velocities calculated for the reference stations with the EUREF model was performed.

The velocities of stations located in the Pieniny Geodynamic Test Field were also compared with those obtained in a study done in 2016.

The realized comparison of calculations allowed us to conclude that the performed alignment does not deviate from the solutions presented in the model and in the previous study.

The obtained results shows the tectonic activity of the Pieniny Klippen Belt and surrounding units. Horizontal point movements are small, i.e. 0.2 - 0.7mm/year, although changes in the position of points show a linear character. The trend in the direction of these changes and their magnitude is also preserved.