Analysis of long-term extensometric data of Sopron and Budapest geodynamical observatories

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Abstract

Long quartz-tube extensometric measurement systems are monitoring rock deformations in two geodynamical observatories in Hungary. The Sopronbánfalva Geodynamical Observatory (SGO) is situated in Sopron, at the border of the Alps, in metamorphic (gneiss) environment. The Mátyáshegy Gravity and Geodynamical Observatory (MGGO) is created in the karstic environment of Mátyás-Hill in W-Budapest. The 8 year-long time series of continuous measurements are processed and examined, attending to geologic and topographic features of the measurement sites. Tidal and coherence analysis were performed to determine the tidal deformation parameters as well as to study the sensitivity at both locations. The stability of the geodynamical measurement places was investigated by means of signal to noise values derived from the processing of higher frequency variations in both observatories. The long-term deformation rates measured by the extensometers are compared with the strain rates inferred from GPS measurements of the Hungarian GPS Geodynamic Reference Network (HGRN).

Keywords: extensometer, tidal analysis, long-term data processing

1. EXTENSOMETRIC MEASUREMENT SYSTEMS

Monitoring of long period deformations of the upper Earth crust is mostly performed by extensometry using equipments with different principles, capable for observing variations in 10^{-11} order (nm-scale displacements). The observations are used to study tidal and non-tidal rock deformations, as well as to monitor recent geodynamic processes. Application possibilities are to analyse the natural (wide spectrum of the Earth's physical processes, e.g. tides, self-oscillation of solid Earth, pole motion, variation of Earth's rotation, mass rearrangements, tectonics, climatic changes) and man-made (e.g. mining, water accumulation, industrial activity) deformations. In order to characterise global processes in

continental range, datasets earned from network of observatories should be used.

2. APPLIED INVESTIGATIONS

Properties and signal transfer characteristics of the local deformation field were examined by means of tidal analysis in the short wavelength band of variations. Tidal calculations were carried out by ETERNA 3.40 'Earth Tide Data Processing Package' applying Wahr-Dehant model and HW95 tidal potential catalogue. For tidal investigations data were high-pass filtered with a cut-off frequency 0.8 cycles per day. Spectral analysis was carried out by FFT (Fast Fourier Transformation). The signal transfer characteristics and tidal parameters of the two stations were examined by tidal and coherence analysis. Long term variations (with geodynamical contents) and admittances of strain and outer temperature variations were also studied (Eper-Pápai et al., 2014). Strain rates measured in the Hungarian GPS Geodynamic Reference Network (HGRN, Grenerczy et al., 2000) and in the Central European GPS Reference Network (CEGRN) were compared to the measured rates at both sites. (Eper-Pápai et al., 2014)

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References

EPER-PÁPAI, I., MENTES, GY., KIS, M., KOPPÁN, A. (2014): Comparison of two extensometric stations in Hungary. Journal of Geodynamics (in print).

GRENERCZY, GY., KENYERES, A., FEJES, I. (2000): Present crustal movement and strain distribution in Central Europe inferred from GPS measurements. J. Geophys. Res. 105 (B9), 21835–21846