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Investigations of gravity and plumb line variations in Geodynamic Laboratory of Space Research Center in Ksiaz

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The Geodynamic Laboratory of Space Research Centre exists in Ksiaz since 1974 year. The Laboratory is placed in horizontal galleries built in slope of valley. Underground galleries are situated 340 meters above sea level and 50 meters below the Earth surface. Stability of bedrocks and good propagation of geodynamic signals by orogen were confirmed by long-standing seismic and tiltmeter measurements. In 1974 in laboratory there were begun measurements carried with help of two quartz horizontal pendulums equipped with photographic system of registration. Photographic system of registration was applied until 2002. In 2006 we resumed pendulums measurements with help of new system of electronic registration. Since 1974 the pendulums measurements are carried out at the fixed place in azimuths closed to fundamental directions NS and EW. In 2002 in geodynamic laboratory there appeared long water-tube tiltmeter. Instrument consists of two perpendicular tubes 65 and 83 meters-long, partially filled with water. The idea of measurements bases on phenomenon of hydrostatic equilibrium. Tilting of tubes in relation to gravity field produces variations of water level inside the hydrodynamic system of the instrument. Variations of water level are measured with the help of interference technique. This technique allowed us to achieve internal sensitivity of tiltmeter close to 1 microarcsecond. Furthermore, stability of length of the He-Ne lasers light and application of differential method for data elaboration caused elimination of the instrumental drift. In 2007 in laboratory we installed relative gravimeter LaCoste&Romberg G-648 of tidal resolution. Initiation of gravity measurements was possible after construction in underground gravimetric room equipped with thermostatic system and pillar for relative gravimetry. Long-standing series of plumb line variations obtained with help of horizontal pendulums allowed us to lead investigations of tidal signals.
Permanent observations carried out using horizontal pendulums suggest also existence of strong, irregular non-tidal signal of plumb line variations. During tens of years of pendulums measurements several times we observed epochs of instability of pendulums equilibrium position. Almost every year the azimuths of equilibrium of the pendulums have been changing rapidly. Existence of strong non-tidal signals was also confirmed by plumb line measurements carried out with help of long water-tube tiltmeter. Special peculiarities of new tiltmeter such as high resolution and possibility of reduction of instrumental drift opened possibility of investigation of the long period or systematic plumb line variations. In 2004 property of water–tube tiltmeter allowed us to observe phenomenon of the Earth free oscillation caused by extremely strong seismic event which took place near the coast of Sumatra-Andaman Islands. Introduction to laboratory gravimetry opens for us perspective of investigation of Love'a numbers h and k for Sudeten Mountain area.