Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences

Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic

Committee of Geodesy, Polish Academy of Sciences

14th CZECH–POLISH WORKSHOP

ON RECENT GEODYNAMICS OF THE SUDETY MTS. AND ADJACENT AREAS

ABSTRACTS

Jarnołtówek, Poland
October 21-23, 2013

Organizing Committee
of the

14th Czech–Polish Workshop

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The 14th Czech–Polish Workshop is co-sponsored from the Polish National Science Centre (NCN), grant No. N526 278940.

Typesetting – Wojciech Dach, MSc. | Graphics – Stanisław Rogowski, MSc.
Wrocław University of Environmental and Life Sciences, Poland, Institute of Geodesy and Geoinformatics
Print in 50 copies

ABSTRACTS

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SURFACE ANALYSIS SUB-CARBONIFEOURUS NE PART OF THE BOHEMIAN MASSIF AND THE CONSEQUENT IMPLICATIONS FOR THE ANALYSIS OF NEOTECTONIC MOVEMENTS

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ABSTRACT

Fore-Sudetic Block to the concept of tectonic forms together with the Sudetic one tectonic unit broken into two parts by the Sudetic Marginal Fault (SMF). In the north, Sudetic Block ends in the Middle Odra Dislocation System. The eastern boundary is contacted with a of Upper Silesia Block and the western is not clearly defined. Mainly due to Neogene age of the SUB, it was assumed that Fore-Sudetic Block is a young tectonic structure. On the other hand, it was aware that it is much more deeply eroded than the Sudetic Block.

Surface analysis sub-Carbonifeourus very clearly shows the differences in the structure and tectonic Sudetic and Fore-Sudetic Block. The Fore-Sudetic Block does not have the deep Carboniferous sedimentary basins. The bottom of the basins: Intra-Sudetic Depression, Bardo Units, North Sudetic Depression are located from 2 to more than 4 km deeper than the sub-Carbonifeourus surface of the Fore-Sudetic Block. Assuming initially a greater diffusion of Carboniferous sediments in the NE part of the Bohemian Massif we can conclude that since Permian the Fore-Sudetic Block developed differently than the current Sudetic Block.

The Fore-Sudetic Block in the geological time scale is extremely stable and rigid. Deeper dislocations are indicated only on its surface, in the zone of SMF. The rest of the are almost not indicates visible faults of the deeper assumptions. On the other hand, on the the Fore-Sudetic Block the most young dislocations were found indicating a weak tectonic activity in that part of the Bohemian Massif. The current sub-Carbonifeourus surface map pays attention to the increasing role of weathering processes on its configuration than tectonic processes, which have been postulated in many tectonic analyzes.

ACKNOWLEDGMENTS: This research is financed by the Polish National Science Centre, grant No. N526 278940.

APPLICATION OF GEOPHYSICAL METHODS TO RESTORE THE SUB-CRETACEOUS SURFACE OF THE UPPER NYSA KŁODZKA GRABEN

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ABSTRACT

As a part of an ongoing study on the contemporary tectonic movements taking place in the region of the Śnieżnik Massif and the NE part of the Upper Nysa Kłodzka Graben, for many years the open question is the nature of Wilkanów (NS) and Krosnowice (NW–SE) faults. Few unveiling indicate that the Wilkanów fault is at least the partially reverse steep fault. The morphotectonic analysis and electrical resistance measurements indicate that this is a normal fault. This problem has been raised in the project NN 526 223335 „Geodetic monitoring of the Waliszow–Morawa tectonic zone recent activity" by gravimetric profiling. Gravimetric measurements were made using Autograv Scintrex CG-5 in two profiles (Idzików and Wilkanów profiles), intersecting Wilkanów fault. The measurement points in the both profiles were taken every 100 m. The resulting density distributions allowed to clarify the image of the surface of semi-detailed gravimetric and magnetic images contained in the work of Jodłowski (1999). In the picture the limit of density between the Upper Nysa Kłodzka Graben and Śnieżnik Massif gneisses doesn't appear. Changing the density of the rock is visible between Gierałtów gneisses, and a range of slate-gneisses of the Stronie unit.

The attempt to explain the surprising lack of contrast of density between such different lithological centers was the reason of developing the shape of the surface of the sub-Cretaceous Upper Nysa Kłodzka Graben. Earlier drafts of the substrate developed by Jodłowski (1999) for the reasons of poor printing techniques were illegible.

Sketches of the study area are based on drilling and electro-sounding. The resulting image of the bottom surface of the trench fossil reveals his considerable height differences. The deepest sub-basins occur in parts of the north and south graben. A

ridge oriented NW–SE is marked in the middle. The picture of the basin indicates that the tectonic framework are associated with steep normal faults. Distribution of resistive indicates that in the east side prevailed delivery of material with a high resistance while the resistance in the western part of the chalk cliffs were often smaller. Lack of gravimetric contrast between the Massif gneisses and sedimentary rocks in the trench of Upper Nysa Kłodzka Graben explains very detailed study of the drill core fragments from the borehole Potoczek. This borehole depth exceeding 700 m was completed in gneisses. Samples were taken from each lithological layer. The average density of gneiss was 2.61 $Mg \cdot m^{-3}$, the same averaged value (2.61 $Mg \cdot m^{-3}$) was obtained for the upper Cretaceous sediments (Rosowiecka et al., PGI-NRI, 2013).

Initial study of marl samples density taken from an exploratory borehole has shown that they have a density greater than 2.50 $Mg \cdot m^{-3}$, which would confirm the above-described medium density. At present, attempts were made to build a gravimetric model, which takes into account a similar average bulk density of gneisses and Cretaceous formations.

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INFLUENCE OF LOCAL AND GLOBAL HYDROLOGICAL CHANGES IN THE ABSOLUTE GRAVITY OBSERVATIONS – THE CASE OF JÓZEFOSŁAW AND KSIĄŻ OBSERVATORY

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ABSTRACT

Geodynamical use of epoch gravimetric relative and absolute observations requires the elimination of one from the most significant effect related to local and global changes of hydrological conditions. It is understood that hydrological effect is associated with changes in groundwater levels and soil moisture around the gravimetric station. In Poland, the quasi-permanent observations of gravity changes by absolute method carried out since 2005 on gravity station located in the Astronomical – Geodetic Observatory in Józefosław. Additionally, the non-cyclical gravimetric observations of this type are carried out on thestation in a Geodynamical Laboratory in Książ. In presentation will be shortly described measurement strategy of absolute observations and different approaches to the elimination of the local and global effects associated with changes in hydrology. This paper will discuss the results of the analysis of tidal observations relevant to the development of absolute observations – seasonal changes in barometric correction factor and differences in the locally designated tidal corrections model. Analysis of the possibility of elimination the impact of global hydrological influence is based on the model GLDAS a spatial resolution of 0.25 degree independently on a local scale and global. Józefosław Observatory is equipped with additional sensors linked to the monitoring of local hydrological conditions. It gives a possibility to verify the quality of modeling of hydrological changesusing global models in local and global scale.

ASSESSMENT OF THE CONTROL POINTS' DISPLACEMENTS IN THE AREA OF THE OPEN PIT MINE KOŹMIN BASED ON DEFORMATION MONITORING GPS NETWORK

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ABSTRACT

Ground deformation monitoring in the area of the open pit mine Koźmin (KWB Adamów) has been carried out since 2008. The principles of the precise determination of the three dimensional displacements with the use of GPS technology developed at the University of Warmia and Mazury in Olsztyn has been presented in this paper. In specific, establishment of the control network, patented technology of the field measurements, the post-processing strategy in the Bernese 5.0 software, as well as obtained displacements of the control network with their accuracy analysis has been presented.

The research carried out with the developed technology indicates the high accuracy of the determined displacements of the control points.

ANNUAL SIGNALS IN GPS TIME SERIES

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ABSTRACT

It is very well known that GPS time series contain strong annual and semiannual signals in the frequency domain. They may be induced by the hydrological and atmospheric loading, but also could be the artefacts of the GPS system (aliasing of mismodelled effects in diurnal bands, draconitic year etc.). The annual signals could efficiently bias the geodetic velocities determined from the permanent GPS observations. We have used data from permanent sites incorporated to the ASG-EUPOS and EPN networks. ASG-EUPOS data covered the period from 2008 to 2013 (more than 130 stations from Poland and surrounding areas), EPN data come from EPN Reprocessing project, the longest time series cover even 12 years of daily solutions (more than 230 stations distributed evenly over the Europe). Power spectrum of the data confirms that GPS time series contain significant power at annual and semiannual harmonics. Amplitudes and phase shift (number of days related to the beginning of the year) were determined using TSView software and the spatial relations were discovered.

ACTIVITY OF TECTONIC FAULTS IN THE SUDETY MTS. OBSERVED WITH TM-71 CRACK GAUGES

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ABSTRACT

The present-day geodynamic activity of the Sudety Mts. in Poland and in the Czech Republic in the past 60 years has been confirmed with epoch national precise levelling measurements and periodic satellite GPS/GNSS and gravimetric observations in research networks. Results of these studies have been published on many occasions and concerned several parts of the Sudety Mts. covered by regional and local geodynamic areas. Monthly, relative observations of more than a dozen TM-71 crack gauges located on tectonic faults consists another source of information about this activity.

In the paper location of this equipment on the main and minor tectonic faults in the Sudety Mts. will be presented. The results of the monthly crack gauge observations will be presented as graphs. These characterise relative, temporal changes of geological structures on both sides of the faults in local x, y, z space. An attempt to relate these results with epoch levelling and satellite GPS observations will also be made.

APPLICATION OF GEOPHYSICAL AND GEODETIC METHODS TO DETERMINE THE POTENTIAL SLIP SURFACES AND THEIR RELATIONSHIP WITH TECTONIC ZONES ON AREA OF LANDSLIDE IN JANOWIEC – PRELIMINARY RESULTS

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ABSTRACT

In 1997, on the slope of Mount Kurzyniec (528 m) in the Janowiec area, which is part of the band of Bardo Mts., a landslide occurred. Research object is located on the edge of the foothills of the Sudeten tectonic foreland and the Bardo Mts. The boundary between the mountain and foreland part of the area in the vicinity of the landslide slopes are a highly transformed thresholds tectonic stretching between Bardo and Srem. On the landslide there are extensive areas piedmont cones that fall on a high terrace surfaces. These are the variable thickness of the cover mud-rubble accumulated over mountain streams on their foreland.

In 2010, the area of the landslide was inventoried by Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences. Survey was carryout by 3D terrestrial laser scanner along the valley of Nysa Kłodzka, and part of a slope of Mount Kurzyniec. On landslide were established a network of control points and periodically measurements are performed. These data provide information on the geodynamics of the landslide, which in some areas continue to show moderate activity.

In 2013, was started a research project in collaboration with the Polish Geological Institute – National Research Institute. The objective of the project is to test geophysical methods to determine the spatial extent and style of deformation processes taking place at the landslide. This project is in addition to complement the work already conducted by the NRI research within the landslide protection program SOPO.

The main aim of the work is to test geophysical methods to develop a spatial model of the landslide. The most important feature of this model will determine slip surface, the extent and shape of the rock mass undergoing movements and to determine the internal structure of the landslide in relation to the surrounding areas. It has become well established link with the location of landslides the Sudeten Marginal Fault and its accompanying sub-tectonic zones. To assess the degree of risk is also necessary hydrogeological analysis of the landslide area. For this purpose will be conducted hydrogeological holes. The analysis of groundwater flow in conjunction with meteorological data will allow the geological model developed to predict landslides continue to run the mass movements.

THE APPLICATION OF OPTOELECTRONIC SET FOR MEASURING RELATIVE MOVEMENTS OF ROCK BLOCKS

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ABSTRACT

Keywords: laser, camera CCD/CMOS, deformation measurement, close-range mono-photogrammetry

The cracking and displacement of rock blocks are processes that occur in natural objects, whereas on the technical objects (e.g. dams, weirs) occur displacement and deformation of their structures. The effect of these processes are the risks of human life, the environment and catastrophes or failure of technical objects. The places where these risks are expected, should be monitored with an appropriate control-measurement equipment.

This paper presents a new method for measuring the relative displacement of rock blocks using optoelectronic techniques. The widespread availability of optoelectronic components with high class technical parameters allows you to design a set of various measuring instruments. The proposed set-up consists of: a set of lasers arranged in a certain project configurations and CCD / CMOS camera, which is the measuring receiver.

Designed and developed by the authors measuring set can be successfully used to implement monitoring activities relative displacements over short distances, such as: blocks and rocky island mountains, in the corridors of rock caves, mining adits and galleries dams. The basis of the measuring method is the implementation of the angular intersection with the use of laser beams, which are recorded by CCD/CMOS camera. Preliminary experimental research, using a prototype measuring set, performed by the authors in the laboratory, allowed to obtain designation of simulated displacements with submillimetre accuracy.

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SOCIAL FUND

This work is co-financed by the European Union as part of the European Social Fund

CO-SEISMIC DISPLACEMENTS OBTAINED FROM INDEPENDENT PPP ANALYSES OF GPS AND GLONASS OBSERVATIONS

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ABSTRACT

The Precise Point Positioning (PPP) processing algorithm in kinematic mode is applied for detection of short-term displacements related to seismic phenomena. The input data – the 1-Hz records of GPS and GLONASS observations before and during the earthquake are analyzed separately to obtain coordinate variations independently from two GNSS. Data processing is realized with ABSOLUTE software package developed at the Department of Theoretical Geodesy, Slovak University of Technology in Bratislava. The potential of PPP for monitoring co-seismic displacements independently by GPS and by GLONASS is demonstrated by analysis of GNSS observations during the Van, Turkey M 7.3 earthquake.

THE STABILITY OF THE GEODESIC POINTS IN CONNECTION WITH GEODYNAMIC PROCESSES IN AZERBAIJAN

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ABSTRACT

The State Geodetic Networks, if it is not systematically updated and do not improve, gradually aging, loses part of points, loses accuracy in its individual parts, especially due to the modern movements of the earth crust. Main centers of modern movements of the earth crust on the territory of the Azerbaijan Republic (AR) are the phenomena of the tectonic character, high seismic activity, caused by technogenic and anthropogenic processes.

Tectonic position of Azerbaijan in the General structure of the Caucasus and adjacent folded regions is determined by the main structural complexes: megantiglinory the Greater and Lesser Caucasus (east end) and separating them Kur River between mountain deflection. These patterns go under the latest deposits meridional depression of the Caspian Sea. The Caspian Sea is located at the junction of large, heterogeneous geostructural elements of the Northern Caspian, the Caucasus, Central Asia (Kazakhstan, Turkmenistan and Northern Iran. Caspian depression consists of two basins: the Mid-Caspian and South Caspian separated by the Absheron-Balxan area of young highs.

Analysis of the geological structure of Azerbaijan shows that now observed faults deep-have a considerable length and extending mainly from North–West to South–East and North–East to South–West divide the whole territory of the Republic. In the Small Caucasus modern movements are differentiated and, if in extreme mountain zones occur raising with a speed of 4–5 mm/year, in the inland areas, on the contrary, lowering of 0.1–1 mm/year. In Kura-Araz lowland in General is sinking, and its speed reaches 0.5–5 mm/year, in Mil-Karabakh an inclined plain overall speed is 2–3 mm/year. In Adjinour zone differential rising with a speed of 4–6 mm/year. Ganykh-Agrichay zone, located between Adjinour and the Greater Caucasus is also an area of uplift (4 mm/year).

The results of repeated leveling show that on the Absheron Peninsula there are significant movements of the earth's surface. Analysis of instrumental data, morph structural features and geodynamics of the Peninsula has allowed establishing, that these movements have tectonic nature. At the same time lowering the areas connected with the oldest oil fields in Sabunchi, Surakhani, Ramana and Bibieybat (for the period from 1912 until 1962, the General lowering of the earth's surface Surakhani oil field has reached 2450 mm), have been interpreted as the result of long-term oil and gas production, i.e. as a manifestation of anthropogenic factor on the background of purely tectonic movements.

Azerbaijan with the adjacent water area of the Caspian Sea presents a vast range of distribution of mud volcanoes. In the South–Eastern Caucasus, there are over 200, including about 30 active mud volcanoes.

The territory of Azerbaijan has long differs high seismic activity. So, district, Shamakhi – most seismic active item Caucasus. Pockets of earthquakes in AR scattered almost on the whole territory of the Republic.

For Baku and some regions (Khizi, Shamakhi and other) Azerbaijan is characterized by recurrent landslide processes covering significant area (in Baku in 1998 landslides occurred with the area of about 100 ha and depth of about 30 m), leading to the deformation of geodetic networks in these areas. In order to study the geodynamic regime in the most seismically active zones AR created six geodynamic polygon (GPA): Absheron special network –80, Shamakhi geodynamic polygon, the Caspian Civic Democrats, GDP «Sheki-Kurdamir», Technogenic polygon Apsheron, GDP Azerbaijan NPP.

POSITION AND VELOCITY OF GLONASS SATELLITE BASED ON ANALYTICAL THEORY OF MOTION

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ABSTRACT

Positioning of GLONASS satellites based on broadcast ephemerides differs in several aspects from that of GPS. The GLONASS broadcast ephemerides provide initial conditions every 30 minutes. They contain coordinates and velocities of the satellite (state vector) in Earth-centered, Earth-fixed ECEF (PZ-90.02) coordinate frame and the lunar-solar accelerations. According to GLONASS Interface Control Document (ICD 2008), to obtain satellite coordinates at a time different from that reference time, the satellite's equations of motion have to be numerically integrated.

In presented work motion of the GLONASS satellite is described using osculating elements of the intermediate, non-Keplerian (Eulerian) orbit. This intermediate Eulerian orbit corresponds to the exact solution of the generalized problem of two fixed centers. The analytical algorithm embraces the disturbing acceleration due to the coefficients to the second J_2 and third J_3, and partially fourth zonal harmonics in the expansion of the Earth's gravitational potential. Other main disturbing accelerations – due to the Moon and the Sun gravitational attraction – are also partially computed analytically, where the geocentric position vector of the Moon and the Sun are obtained by evaluating known analytical expressions for their motion.

The given numerical examples show that the presented method is more efficient and can improve the accuracy of satellite coordinates and velocities calculation for GLONASS satellites on the base of their broadcast ephemerides.

IGS REAL-TIME PRODUCTS VERIFICATION

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ABSTRACT

Until recently, real time GNSS users were limited in the sources of precise data, since only predicted part of ultra-rapid products was available in real-time, so the prior download of orbit and clock data was necessary. In 2013 Real-time IGS service officially started, which provides GPS and GLONASS high-rate corrections to broadcast orbits and clocks in real-time. Products are disseminated by Internet streams, standardized on RTCM-SC 104 formats, and available through NTRIP (Networked Transport of RTCM via Internet Protocol).

The target performance of combined product is 0.3ns for satellite clock accuracy and orbit accuracy at the level of the IGS Ultra predictions with maximum latency of 10s. To verify the current quality of the available RTIGS products, one week series of the resulting real-time orbits and clock were compared with the CODE final products. The accuracy and availability of the products were investigated, proving the high quality of real-time service.

The critical parameter for the real-time products is the correction age, that can be defined as the latency between the time of input data and the time of their application during the positioning. Therefore, the quality degradation over time of each parameter was investigated, to indicate the maximum latency of applied corrections. The studies show also the possibility of short-time forecast of orbit corrections in case of the interruption of the connection with the stream caster, which might cause problems especially for in-field real-time applications.

MONITORING OF TERRAIN RELIEF AND HYDROLOGICAL CONDITION CHANGES WITH THE USE OF GIS TOOLS ON EXAMPLE OF PODHALE AREA

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ABSTRACT

Monitoring of recent dynamics of geosystems carried out for research purposes in last years provides practical sense as well. Analysis of temporal changes of some environmental parameters is essential for undertaking of administrative decisions for minimization of negative effects of anthropogenic influences.

Thus frequently researches are carried out for distinguish or determination of real, undoubted environmental effects of human activity. But there are other situations: e. g. in observed rivers morphology only effects of geological processes (tectonic activity) neglecting influence effects of human activity.

In the paper a combination of both approaches on the example of changes in hydrogeological regime in the area of Podhale is discussed. The channel incision process of the Czarny Dunajec river alike in the case of other Carpathians rivers is strongly conditioned by changes in policy of spatial development (decreasing acreage of arable areas), regulation of the river and development of hydrotechnical structures. As a consequence it often leads to uncover the bed-rocks below quaternary sediments. In that case estimation of river's condition and prognosis of its changes requires as well detailed analysis of structure of bed-rocks including resistance and discontinuities in outcrops or neotectonic problems.

In analysis of the mentioned process GIS tools are helpful. They allow monitoring of anthropopression and evaluation of morphostrctural parameters or their temporal changes. The changes in the river morphometry evaluated from archival cartographical elaborations from 1878, 1901, 1933, 1992 and the changes evaluated from aerial images from 1964, 1977, 1983, 1994 i 2009 are compiled with geological and hydrogeological background of the area, derived from geological and hydrological maps, elaborated in 1964–1967 and 1997–2005. The analysis was compared with the data of spatial development of the basin of Czarny Dunajec River, and data from water gauge of Nowy Targ.

The authors point significant diversities of changeability of the channel in areas of various outcrops which are compared with changes resulted from human impact. The most intensive (about 0.5 m for 10 years) incision process of the Czarny Dunajec channel was noticed in period 1965–1975 that coincides to intensive human activity:

substantial river regulation and gravel mining in the riverbed. It confirms mechanism of inducing deep-seated erosion by unloading water mass from water debris.

Derived results bring to conclusion that reliable study on geological activity of an area evaluated from river channel morphology requires changes in spatial development as a factor controlling the intensity of hydrological regime. In that case a database of complex geodata information is a need.

MIDDLE-HIGH FREQUENCY SIGNALS REGISTERED BY WATER-TUBE TILTMETERS IN THE GEODYNAMIC LABORATORY OF SRC IN KSIAZ. PERMANENT EXCITATION OF THE EARTH

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ABSTRACT

Keywords: Water-tube tiltmeters, plumb line variations measurements, Earth free oscillations, mechanism of excitation of the Earth, infrasounds, natural sources of infrasounds, atmospheric resonance, interaction between ionosphere and atmosphere, interaction ocean-atmosphere

Scientific program of the Geodynamic Laboratory in Ksiaz comprises investigations of various middle-high frequency signals of 5 to 100 minute long periods. Research of middle-high frequency signals can be processed owing to the water-tube tiltmeters measurement parameters. The observed signals consist of two classes associated with two kinds of phenomena: Earth free oscillations and extremely low frequency atmospheric infrasounds.

Both of them have harmonic characteristics, but they differ in their amplitudes. Infrasounds signals reach maximally several percent of tidal signals (several mili-arc seconds) while Earth free oscillations signals reach one fraction of mili-arc seconds just after extremely strong seismic events and then diminish to dozen or so micro-arc seconds.

Harmonic oscillations of several micro-arc seconds amplitudes were observed on all measure channels of water tubes three weeks before Sumatra–Andaman (26-12-2004) seismic event and earlier. Similar situation was repeated before Japan (11-03-2011) seismic event.

Fourier analyses of time series of free oscillations phenomenon show strong replacement of energy between harmonic modes. It was well visible in comparison between Fourier analyses of dozen or so hours wide windows of data. Harmonic modes almost vanish in the time and next they increase again. But generally after strong earthquake for whole spectrum energy of oscillation diminishes until energy corresponding to dozen or so micro-arc second amplitude of oscillations. For this level permanent signals are observed on all channels of the water tubes. The measurements of middle-high frequency signals from opposite ends of the tubes provide us with observations that these signals are not exactly asymmetric as in the case of tidal signals and sometimes they become symmetric.

In the case of infrasound signals observed on channel 01, oscillations decrease in the several hours or several days in general. Between the epochs of phenomena no signals are observed.

VERIFYING THE POSSIBILITIES OF USING A 3D LASER SCANNER IN THE MINING UNDERGROUND

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ABSTRACT

Laser scanning systems excel at ability to contactless determine the spatial coordinates of any spatial objects, such as buildings, structures, interiors, space, terrain, etc. and with exceptional speed, accuracy, comlexity and safety. The scanned object is then visualized using a specialized software in the form of clouds of points on which it is subsequently possible perform a wide range of analytical tasks and also generate models of these objects.

The basic principle on which this device works is similar to radar. The device emits a pulse and captures his reflection. From the time between sending the pulse and taking his reflection is possible to calculate the distance to the point of reflection. Due to pulse transmission of the narrow laser beam in different directions in a relatively short period of time (thousands to hundreds of thousands emit per second), it is possible to target individual space scene with high spatial precision and resolution. The spatial position of each point is thereafter calculated using spatial polar method.

Presented contribution has to introduce our current knowledge of the use of pulsed scanner Leica ScanStation C10 *in situ* mining works. It is a device with a long-range laser beam that has excellent positional, length and angular accuracy and a very high speed laser scanning, with opportunity of photographic documentation of scanned scene.

The possibility of its use *in situ*, were tested in mine works of already closed polymetallic deposit of Zlaté Hory (Olomouc region, Czech Republic). Within realized surveying campaigns were verified the possibilities of using this technology especially for documentation of the current technical condition of the mines and their real spatial definition. Furthermore, the possibilities for monitoring of spatial changes in mine features (movements and deformations).

Based on the undertaken scanning campaigns, subsequent analysis of the data and also with regard to the physical and technical constraints that we encountered, were subsequently refined technological procedures of each type of scanning carried out in such specific conditions.

THE IMPACT OF INTRODUCING ASG-EUPOS STATIONS COORDINATES AND VELOCITIES TO LOCAL GEODYNAMIC NETWORK – GEOSUD NETWORK CASE-STUDY

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ABSTRACT

Geodynamic measurements using GPS technology began in the area of Sudety Mts. in the 90s of the twentieth century. Annual measurement campaigns carried out in the network GEOSUD (GEOdynamic of SUDetes) from 1996 to 2012 made it possible to determine the ITRF2008 coordinates and velocities of observed points. GBAS (Ground Based Augmentation System) network of permanent GPS stations called ASG-EUPOS was established on Polish territory in 2008. The ASG-EUPOS stations located in the south–western Poland were included in annual campaigns of GEOSUD network during 2009–2012 period.

The latest solution of GEOSUD network sites coordinates and velocities was performed using seven EPN (EUREF Permanent Network) stations (BOR1, GRAZ, GOPE, PENC, POTS, WROC, WTZR) as fiducial, during the minimum-constrained solution. Cumulative solution of the ASG-EUPOS network (February 3, 2008 – November 3, 2012) provided the coordinates and velocities of stations in SW Poland that were added as fiducial ones to the GEOSUD network solution in the second scenario. This change of the reference frame has an impact on the resulting coordinates and velocities (global and intraplate). Paper presents the comparison of coordinates and velocities in ITRF2008 datum, between the two scenarios. The impact of changes between presented solutions on potential geodynamic interpretations is also discussed.

ACKNOWLEDGMENTS: This research is financed by the Polish National Science Centre, grant No. N526 278940. The author thank also to Dr Karolina Szafranek and Prof. Mariusz Figurski from the Military University of Technology in Warsaw for the results of cumulative ASG-EUPOS solution.

THE DAMAGES OF KSIAZ CASTLE ARCHITECTURE IN RELATION TO ROUTS OF RECOGNIZED TECTONIC FAULTS AND INDICATIONS OF RECENT TECTONIC ACTIVITY OF SWIEBODZICE DEPRESSION OROGEN

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ABSTRACT

Recent tectonic activity in the area of Swiebodzice Depression is recorded by the instruments of Geodynamic Laboratory SRC PAS (GL). Irregular in time tectonic events lasting dozen or so hours or several days have been watched by pendulums tiltmeters since 1974. Similarly, indications of tectonic activity such as tiltings of foundation and vertical motions were repeatedly observed by water-tube tiltmeters (WT). Effects of tectonic displacements on faults are visible in the geological structure of Ksiaz orogen as well as deformations of Pelcznica Valley meander.

On the basis of determined routs of faults and visible damages of castle architecture faults were chosen activity of which was expressed in the form of damages of elements of castle architecture.

Fault trends and dips in the area of investigations were determined by accurate geological and structural identification in the GL underground corridors, in environment and in Ksiaz castle objects.

For this purpose in the corridors of the GL geodetic horizontal network was established which helps to determine the localization of faults and their projection on local geodetic map. Faults were measured by geodetic methods to determine their trends and dips.

Alarming cracks of the castle architectural objects can be seen in the structure of wall of St. George Tower, in the wall of Chestnut Terrace, in sequences of cracks of window stone elements, in the windows sills above the Chestnut Terrace as well as in the western wall of terraces (fragments repeatedly repaired). Listed damages are situated approximately in one plain. Cracks are also visible from the southern side of castle complex in the stone wall and stairs leading to the terraces (concreted cracks quickly open again).

The influence of recent tectonic activity on Ksiaz architectural objects will be evaluated on the basis of two sources of geo-information – local from GL and field information from measurements on scientific geodetic network. Local sources of geo-information are represented by time sequences of WTs, horizontal pendulums tiltmeters and the extensometer. The results of elaborations of observations from GL provide information about characteristics of tectonic events such as: moment of initiation and time of duration, value of tiltings of foundation as well as vertical motions.

The investigations of recent tectonic activity in the area of Swiebodzice Depression will be applied to assess their influence on the architecture elements of the Ksiaz castle and Ksiaz Herd of Stallions.

UNCERTAINTIES OF GEODETIC VELOCITIES FROM PERMANENT GPS OBSERVATIONS

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ABSTRACT

Velocities determined from permanent satellite observations play more and more significant role nowadays. They are used for instance in reference frame realization and estimation of lithospheric deformations. Each of the topocentric component (North, East, Up) of GPS permanent station can be described as the sum of its initial value, station's velocity, the amplitudes and phase shifts of seasonal components that occur in time series, the outlying values, offsets and the noise component. It is widely desired that the time series behave like white noise only and all effects would be then fully understood. Therefore most of the GPS processing software do not consider existence of coloured noise in time series. A direct consequence of this assumption is the over-optimistic estimation of both the coordinate component and velocity uncertainties. Presentation deals with noise analysis of time series from permanent sites incorporated to the ASG-EUPOS and EPN networks. ASG-EUPOS data covered the period from 2008 to 2013, EPN data come from EPN Reprocessing project, the longest time series cover even 12 years of daily solutions. Authors will show how the amplitudes and type of noise existing in GPS time series influence the estimation of stations velocities and their uncertainties. Spatial dependencies are also examined.

INTEGRATION OF PERMANENT AND PERIODIC GNSS MEASUREMENTS FOR LOCAL AND REGIONAL GEODYNAMIC RESEARCH ON THE EXAMPLE OF THE POLISH–CZECH NETWORK SUDETEN – DESCRIPTION OF THE RESEARCH PROJECT

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ABSTRACT

All current local geodynamic researches led with GPS technique in the area of the Polish part of Sudeten and the Sudetic Foreland from 1996 were carried out based on measuring periodic campaigns repeated every year (so-called "epoch-making measurements"). At first they were several hours sessions, at most over twelve hours, later 2–3 day, 24-hour observations. Experience collected by an international research teams carrying out geodynamic research with GPS technique in active areas seismically (USA, Japan) are pointing, that much more information it is possible to obtain from permanent measurements. Time series of coordinate changes of permanent GPS stations let not only for thorough appointing the value of the linear velocity of motion of points, but also for the detection of cyclical signals and the detection of sporadic jumping changes, caused by tectonic phenomena. But in Poland, regarded universally as area about the weak tectonic activity, installing thick chains of permanent GPS stations only for needs of geodynamic research is finding no grounds, above all from economic reasons. Hence rational using existing permanent GPS stations is revealed, located in studied area or in his immediate vicinity, for the detection of these parameters of coordinate changes which aren't possible to appoint based on periodic measurements, and which have wide surface, rather than local character. It is regarding cyclical signals caused by factors disrupting the measurement above all (atmosphere, activity of the Sun, changeability of a frame of reference). The possibility of creating the spatial model of these disrupting signals would allow on "improvement" of periodic results of measurements.

In this project authors have proposed to use measurement data of chosen permanent GPS stations, located on the area of research (the EPN stations, ASG-EUPOS stations, GEONAS stations) and all archival observation data of periodic measurements made as part of research projects carried out earlier, in 1996–2009 years, as well as new supplementing measurements, planned for years of duration of the project 2011–2012. They have proposed reprocessing of all monitoring data with the latest version Bern software (BERNESE v. 5.0) in a standardized frame of reference and with exploiting new, absolute models of phase variation centre of the antennas and the latest models of parameters of the Earth motion model and new models of the atmosphere. Standardized and corrected results of processing the aggregated GPS network, including all local area networks on the area of research, will serve for

conducting new geodynamic interpretation. It is regarding the stage of the estimation of parameters of the linear model of changes of test points coordinates based on results of permanent and epoch-making measurements and the identification of the model of surface deformations of the area based on calculated velocity vectors. Results of this interpretation will constitute the base for due recognizing real character of tectonic changes of the area and the evaluation of potential hazards caused by them.

The project is being conducted in cooperation with scientists from the Institute of Rock Structure and Mechanics of the Czech Academy of Sciences in Prague and from the Polish State Geological Institute – Lower Silesia Branch in Wrocław.

ACKNOWLEDGMENTS: This research is financed by the Polish National Science Centre, grant No. N526 278940.

COMPARATIVE ANALYSIS OF THE VELOCITY AND DEFORMATIONS MODELS OF THE SUDETEN AREA DEVELOPED ON THE BASIS OF DATA OF THE LOCAL RESEARCH NETWORKS AND THE ASG-EUPOS DATA

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ABSTRACT

The combination of GNSS epoch observations carried out in local geodynamic networks in the period 1997–2012 in the Sudety Mts. and in their surroundings made it possible to develop a model of velocity and strain fields of the local tectonic units including the Sudety Mts. and the Fore-Sudetic Block. Adding to the solutions observations from the ASG-EUPOS permanent stations covering the tectonic units in the whole of the country allows the assessment of the behavior of the research area in relation to the trends of the overriding tectonic unit that is the Bohemian Massif and adjacent units including the Fore-Sudetic Monocline and the Carpathians.

As part of the research, interpolation of velocity and calculation of deformation parameters have been made in regular grid and in irregular triangular mesh. Velocity and strain models were developed using modified least-square approach and models based on triangular elements with the assumption of homogeneous linear strain model. Statistical evaluation of the significance of the obtained parameters have been also made in relation to the assessment of major tectonic faults activity.

The models developed on the basis of a network with different coverage permit detection of the trends occurring on a regional scale and their changes on a local range. The deformation models developed on the basis of the ASG-EUPOS sites velocity and sites velocity in local network differ in values, however principal directions of the strains are consistent and related to regional directions of the tectonic dislocations.

This research is financed by the Polish National Science Centre, grant No. N526 278940 “Integration of the GNSS permanent and epoch measurements for local and regional geodynamic research on the example of the Polish–Czech network SUDETY” and by the The National Centre for Research and Development, grant No. N R09 0010 10 “The supporting modules for ASG-EUPOS system real-time services”.

SITE MOVEMENT FIELDS ASSESSED FOR THE SUDETEN AREA IN THE LAST DECADE

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ABSTRACT

Since 1997 annual GPS campaigns have been carried out on the Sudeten area. The GPS signals monitoring were performed mainly simultaneously on sites of existing Czech and Polish geodynamical networks and, naturally obtained data were processed and geologically interpreted. Data processing had been applied liable to knowledge of that time. Therefore, for a comparison of so far determined site movement fields two aspects were taken: (a) changes in methodological steps applied in the field assessments, and (b) a reliability of the fields for geodynamical studies of the area. An influence of fiducial stations and terrestrial reference frames in computations as well as software improvements will be delivered. Impacts of methodological changes to assessed movement fields will be also considered.

ACKNOWLEDGMENTS: This research is financed by the Polish National Science Centre, grant No. N526 278940.

AN APPROACH TO ASSIMILATION OF LEVELLING DATA AND GPS PERMANENT MEASUREMENTS FOR CREATING MODEL OF VERTICAL CRUSTAL MOVEMENTS IN POLAND

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ABSTRACT

The ASG-EUPOS established in 2008 provides permanent information about height changes (vertical velocities) of the system's stations which are evenly located on the area of Poland. Precise levelling campaigns gave very consistent data, but only residual information on the changes in time. The goals of this presentation are to elaborate the method of GPS height data verification and to combine it with data from precise levelling campaigns in order to obtain more reliable description of the modern vertical movements of the area of Poland. We have used the Delaunay triangulation to obtain optimal tessellation with GPS stations as vertices. On each of the side of the triangle the relative vertical movements were calculated. Such constructed network was analysed and results were evaluated statistically. The adjustment of the relative vertical movement network with one stable point was performed. As a nodal the point in central Poland was adopted. Afterwards the results were compared with interpolated data taken from precise levelling. To the interpolation the InterVertic software elaborated at the University of Warmia and Mazury in Olsztyn was used. The results give an outlook on the joint use of GPS and precise levelling data to create the kinematic vertical reference frame in Poland.

GNSS PRECISE POINT POSITIONING IN GEODYNAMIC RESEARCHES

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ABSTRACT

Based on the results of research on GNSS positioning techniques can be concluded that both methods – relative and absolute – can be an adequate tool for the detection and monitoring of the Earth's crust vibration caused by earthquakes. In the paper, PPP technique on the GNSS stations network was used to identify and determine the parameters of the Earth's crust vibration caused by earthquakes.

DYNAMICS OF BENCHMARK VERTICAL MOVEMENTS IN THE INTERIOR AND SURROUNDINGS OF JASKINIA NIEDŹWIEDZIA IN KLETNO

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ABSTRACT

Paper presents the analyse height dynamic changes of controlled benchmark, located both inside and in vicinity of Jaskinia Niedźwiedzia in Kletno. These changes will be comparatively presented for two periods: during the exploitation carried out in nearby quarry and after exploitation. Results of measurements carried out using various of precise levels, will be presented in relation to the determined reference benchmarks. The results are the basis to assessment of the object safety.

NEW RESULTS AT MORAVA GPS NETWORK

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ABSTRACT

Among the first GPS geodynamics projects in Czech Republic the MORAVA network was founded in 1994 with aim to determine the positional changes at border zone between the Bohemian Massif and the Carpathians. Initial project included three successive GPS campaigns in period 1994–1996, but was not continued because of lack of support. It had been possible to carry out new measurements in southern part of the MORAVA network including five stations, after gap of 15 years (2009). In this year another seven points have been re-measured. In the paper comparison of previous and contemporary results of epoch GPS measurements is presented, which indicates block movement tendencies at the Bohemian Massif and the Western Carpathians border, thus confirming activity of the area up to present days.

THE GRAVITY EXPERIMENT AT MINE SHAFT STONAVA (STO-SU-1, KARVINÁ DISTRICT, CZECH REPUBLIC)

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ABSTRACT

Underground gravity measurements can be utilized to the mean density of the Earth estimation, interval (block) density estimation as well as to the determination of the vertical gradient of gravity inside the Earth.

We performed the experiment in the Stonava shaft Sto-Su-1 within the Ostrava–Karviná Mine District with two gravity meters, namely LaCoste & Romberg model G and Scintrex CG-3M. These meters are normally accurate to 0.01 mGal or even slightly better. The measuring stand heights had to be accurately determined which was performed by special measuring belt.

The experiment was aimed specifically at estimation of the mentioned parameters of gravity and its vertical gradient including the block densities but also generally at examining the accuracy requirements in searching for the density anomalies provided that the measured data are topographically corrected within all the measured vertical profile.

CAN THE GNSS/GPS OBSERVATIONS ACCOMPLISHED AT CRATOGENIC STRUCTURES DETECT RELIABLE SITE MOVEMENTS INDUCED BY LOCAL GEODYNAMIC PROCESSES?

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ABSTRACT

Reliable detection of ongoing local geodynamic movements depends not only on a density coverage of area by GNSS/GPS stations and an accuracy of data processing but also on a type of geological structures and their ability mutually move to each other in time. In central European area the Bohemian Massif dominates mostly with cratogenic structures of solid rocks. Moreover, their contacts can be still additionally healed. At present, there are in the Massif a few areas and/or zones with evident dynamic mobility. One of them is the West Bohemian region where these activities are accompanied by earthquake swarms and by gas and fluid emissions. In 2004 the GNSS time series of the POUS station proved anomalous position changes lasting two weeks. They were correlated with a weak earthquake swarm (ML≈1.4) occurred simultaneously in the region [Schenk et al. 2007]. Four years later, in October 2008, relatively strong swarm occurred in this region with some events of ML≈3.7~3.8 and during its pre-, co- and post-seismic activities different horizontal and vertical position changes of GPS network sites were detected and interpreted [Schenk et al. 2012]. To verify reliability of such short-term site position changes caused by local geodynamical processes enacting in upper crust, we analyzed 2011–2012 time series of five GNSS stations situated in West Bohemia. In this period lengthy earthquake swarm occurred which consisted of a few sub-swarms. The obtained results will be presented and compared with the previous interpretations of 2004 and 2008 periods.

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ANALYSIS OF VECTORS VELOCITY OF ASG EUPOS NETWORK POINTS DISPLACEMENTS

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ABSTRACT

The ASG-EUPOS reference stations network operating in the territory of Poland since 2008 is in constant development. In the network permanent GNSS observations are carried out. System covers an area of country by points (stations of the system and additional points) on average distance about 70 kilometers. Such amount of data and their resolution allows to using them in geodynamic researches on the area of whole country.

Paper presents analysis of the velocity vectors of selected ASG-EUPOS points. Authors present graphical and statistical interpretation of vectors velocity of network points displacements. They using ITRF2005 model as well as tectonic plate model calculated by authors. Analysis take into account localization of the points – especially points in the mining areas and located on different tectonic structures.

Based on the analysis authors attempts to identify the main direction and character of movements.

GRAVIMETRIC SURVEY OF ACTIVITY OF SALT DOME MONITORED BY GEODETIC METHODS

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ABSTRACT

Inowrocław salt dome is considered as one of the most geologically active area in Poland, where geodetic observations are supported by other research methods. The problem of displacements estimated from results of leveling, GNSS, PS InSAR data in combination with seismic surveys and geomorphostructural analysis was discussed in several papers. Displacements reveal effects of erosional or halotectonic process. The processes involve local gravity changes as a result of mass redistribution – due to uplift process or subrosion. Erosional deposition of sediments was confirmed by geological surveys in situ during old shallow mining. Mining activity is no longer in the area and gravimetric surveys carried out there in 2002–2004 provided results showing gravity changes both effects of mining and natural processes. There were two types of gravimetric surveys carried out in the area of the city: microgravimetric networks for detection of local anomalies and network measurements in geodetic points for monitoring of changes in the salt dome area. Determined anomalies in western part of the city are related to old excavations and sinkholes resulted mostly from mining activity in the past. Their relative negative amplitudes of gravity anomalies suggest that some of liquidated before old excavations and sinkholes are still hazardous for terrain surface. Authors discuss the negative gravity changes in the network points in the aspect of salt dome activity. Authors conclude that geodetic and gravimetric survey are complementary in monitoring of salt dome activity.

ASSESSMENT OF ACCURACY OF LOCAL QUASIGEOID MODELLING BY GGI METHOD – CASE STUDY FOR THE AREA OF POLAND

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ABSTRACT

"GGI method" is the abbreviated name of local quasigeoid modelling method which uses geophysical gravity data inversion technique. The analysed method is based on the construction of a local three-part disturbing potential model. The first part provides the potential produced by topographic masses which lay above the geoid. The second part is a potential produced by disturbance masses occurring under the geoid, down to the compensation level (the Moho surface). The third part is a residual potential model. The two first mentioned parts of the disturbing potential model are written in discrete form of searched density distribution functions of topographic masses and masses lying below the geoid surface. The third part is written as a low degree harmonic polynomial with searched its coefficients. The unknown parameters of the model are determined using least squares method based on surface gravity data (gravity anomalies or disturbances) and GNSS/levelling height anomalies. This paper presents the results of analyses related to estimation of accuracy of the approach on the basis of precise GNSS/levelling test data from the area of Poland.

GEOPHYSICAL EXCITATION OF NUTATION – COMPARISON OF DIFFERENT MODELS

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ABSTRACT

We use the most recent models of excitations by geophysical fluids (atmosphere, oceans) to derive their impact on the motion of the Earth spin axis in space – nutation. Celestial pole offsets (i.e., the differences between the observed nutation and the adopted IAU model) due to these geophysical excitations are computed for a non-rigid Earth model to account for the realistic Earth's response. The results, corresponding to excitations provided by different agencies, are compared with the celestial pole offsets observed by Very Long-Baseline Interferometry.

INFLUENCE OF A GEOLOGICAL FAULT ON THE CHOICE OF MINING METHOD IN KGHM POLISH COPPER "RUDNA" MINE

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ABSTRACT

Key words: geological fault, stress, deformation, mining method

Any discontinuity in the rock mass such as existence of a geological fault, produces additional change in the distribution of stresses resulting from the mining operation. The presents of the fault affects the redistribution of stresses and have effect on deformations with in and on the surface of the rock mass. Therefore, the presence of a fault must be taken under consideration when designing the mining method in order to meet a-priori criteria accepted for the design. The magnitude of stress changes is a function of the geometry of the fault and of the rock parameters in the fault. The determination of fault's parameters is based on rock mass classification systems. The proposed methodology for the inclusion of geological faults in the mining design is illustrated on an example of Biedrzychowa fault in the area of KGHM Polish Copper Rudna mine operation.

ZENITH TOTAL DELAY SHORT-TERM STATISTICAL FORECASTS

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ABSTRACT

Troposphere delay values may be applied either in positioning and meteorology. Several troposphere delay empirical models are available as a functions of meteorological parameters (temperature, air pressure and relative humidity), the Zenith Total Delay (ZTD) values are also available as NRT (near real-time) product of GNSS processing (in Double Differencing and Precise Point Positioning (PPP) processing). To provide fully operational service for real-time PPP it is essential to provide real-time ZTD estimates or a short-term forecasts from near real-time estimation.

GNSS and METEO group of the Institute of Geodesy and Geoinformatics (IGG), Wrocław University of Environmental and Life Sciences, Poland provides ZTD estimates with 1 hour interval for Poland. The GNSS data is acquired from over 100 stations included in GBAS (Ground Base Augmentation Systems) network called ASG-EUPOS. IGG had created permanent NRT service of ZTD estimation from GPS observations for the area of Poland called IGGHZ-G. To provide real-time ZTD, one possibility is to perform short-term predictions of IGGHZ-G.

This paper presents statistical approach to predict short-term ZTD from long time series. Several time-series models have been used, such as autoregressive model (AR) or autoregressive moving average model (ARMA). Depending on purpose for forecasts, different time-series lengths and various prediction horizons have been considered (form 5 to 24 hours). Predictions are included in both global and local model. The global model term means that one statistical model is used for all stations and the local one that each station has its own statistical model.

Methods of ZTD prediction have been verified by two independent validators: deterministic Global Pressure and Temperature (GPT) model and the Numerical Weather Prediction model COAMPS (Coupled Ocean/Atmosphere Mesoscale Prediction System). The ZTDs were calculated from meteorological parameters and compared with predictions obtained by authors.

PERIODIC COEFFICIENTS IN COORDINATE TIME SERIES OF GPS PERMANENT STATIONS LOCATED ON THE AREA OF SUDETEN AND ITS FORELAND

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ABSTRACT

Keywords: time series analysis, periodicity, jumping signals

Compontents (N,E,U) of GPS coordinate time series, which are presenting actual point movement, are composed of three main coefficients, that is: linear trend, periodic components and possible jumps, which are the outcome of sudden changes in point position. In this work the computation results that were targeted mostly for periodic movements and possible jumps detection are presented.

There were batch of 17 stations taken for computations locate on the area of Sudeten and Foreland: four EPN points with the longest period of active measurements (DRES, GOPE, TUBO WROC), four Czech GEONAS points started in 2006 for Bohemian Massif study (BEZD, UPIS, STAM, VIDN), three points of CZEPOS GPS Ground Based Augmentation System (CBRU, CSUM, CTRU) and rest taken, with least amount of data, from ASG-EUPOS – Polish GBAS (JGLR, KLDZ, LEGN, NYSA, OPLE, WLBR).

Two methods were used to obtain periodic coefficients from the data; Fast Fourier Transform (FFT) as well as continuous Wavelet transform (Morlet in all cases). For both methods all power peaks were compared with red noise power spectrum for significance, and both cases showed significant match. In all but one case one year period was found significant. For EPN stations other, longer, periods were discovered.

For jumps detection moving average and moving median was used and two cases only showed considerable but minor jump.

ACKNOWLEDGMENTS: This research is financed by the Polish National Science Centre, grant No. N526 278940.

PRELIMINARY INTERPRETATION OF DETERMINED MOVEMENTS OF KSIA GPS STATION IN THE CONTEXT OF COLLECTED KNOWLEDGE ABOUT ŚWIEBODZICE DEPRESSION TECTONICS

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ABSTRACT

***Keywords*:** non-tidal signals, non-periodic geodynamic signals, GPS measurements, tectonic motions, station velocity, crustal movements, local faults.

The new contribution is continuation and extension of the investigations associated with GPS permanent station of the Geodynamic Laboratory in Ksiaz (LGK), which were presented during Jugowice and Wrocław workshops and published in Acta Geodynamica et Geomaterialia. The GPS Station in Ksiaz was established in 2010 to support research of neo-tectonic activity of Świebodzice Depression. Since autumn 2010 until middle of 2013 the KSIA GPS station was working without defects, provided us interrupted interval of data. This time the instruments of Geodynamic Laboratory noticed increase of tectonic activity expressed by strong tiltings and vertical movement effects. In the period 2010 to 2013 the tectonic signals partially changed their characteristics in time and amplitude domains. On the basis of results of 2.5 year long series of GPS data processing, KSIA station velocity vector was determined and compared with velocity vectors of selected reference stations, which are distributed in different azimuths and different distances from the KSIA station. The selected reference stations possessing sufficient quality and length series of observations are established on different tectonic units. Determined velocity vectors of all stations were compared with vectors obtained from other solutions and calculated on the basis of existing geodynamic and satellites plate tectonic models. On account of further interpretation, geodetic network was established in order to determine trends and dips of recognized faults in the LGK corridors. Results of elaboration of 2.5 years long GPS data show small differences between movement of the Świebodzice Depression Ksiaz block and GPS reference stations. Visible deformation of the Pełcznica river meander, determined trends and dips of recognised faults as well as development of kinematic model of deformation allow us on preliminary interpretation of the reasons of KSIA GPS station velocity anomaly.

FILTERING OF AIRBORNE LASER SCANNING DATA IN LANDSLIDE AREAS

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ABSTRACT

In the process of Digital Terrain Model (DTM) generation on the basis of Airborne Laser Scanning data there is a requirement of exclusively extracting points from the raw point cloud, which are reflection of the laser beam from the ground. This task is mainly realised by commercial, specialist software for classification and filtration of laser scanning data. Over the past years, several filtering algorithms have been developed to extract bare-Earth points from point clouds. Most of this filters perform well in smooth rural landscapes, in complex urban areas and terrain with vegetation.

The specific morphology of the terrain in landslide areas is a challenge for the filtering algorithms. The actuality of the topic influenced on the author obtaining the main goal of this research as an examination of filtering methods of laser scanning data for landslides data filtering. Set of numerical tests on landslide's dataset were done, qualitative and quantitative analyses of used methods were carried out.

As an result of this research the degrees of filtration efficiency have been performed for each of used methods. The research showed that most efficient methods for ALS-data filtering in landslide areas are adaptive TIN models and linear prediction. Apart of that the most effective algorithms were pointed out and the increase of their effectiveness was attempted.

Program of the 14th Czech–Polish Workshop

ON RECENT GEODYNAMICS OF THE SUDETY MTS. AND ADJACENT AREAS

Jarnołtówek, October 21-23, 2013

Monday, October 21, 2013	
10:00 – 13:00 **Registration of the participants**	
13:00 – 14:00 **Lunch**	
14:00 – 14:15 **– Opening Session** **Chairmen: Cacoń S., Schenk V.**	
Session I – Global and regional geodynamics Chairmen: Schenková Z., Barlik M.	
14:15	Vondrák J., Ron C.: GEOPHYSICAL EXCITATION OF NUTATION – COMPARISON OF DIFFERENT MODELS
14:30	Barlik M., Olszak T., Pachuta A., Próchniewicz D.: INFLUENCE OF LOCAL AND GLOBAL HYDROLOGICAL CHANGES IN THE ABSOLUTE GRAVITY OBSERVATIONS – THE CASE OF JÓZEFOSŁAW AND KSIĄŻ OBSERVATORY
14:45	Pospíšil L., Švábenský O., Černota P., Novosad M., Weigel J., Witiska M.: NEW RESULTS AT MORAVA GPS NETWORK
15:00	Kowalczyk K., Bogusz J., Rapiński J., Figurski M.: AN APPROACH TO ASSIMILATION OF LEVELLING DATA AND GPS PERMANENT MEASUREMENTS FOR CREATING MODEL OF VERTICAL CRUSTAL MOVEMENTS IN POLAND
15:15	Schenk V., Schenková Z.: CAN THE GNSS/GPS OBSERVATIONS ACCOMPLISHED AT CRATOGENIC STRUCTURES DETECT RELIABLE SITE MOVEMENTS INDUCED BY LOCAL GEODYNAMIC PROCESSES?
15:30	Kudrys J.: GNSS PRECISE POINT POSITIONING IN GEODYNAMIC RESEARCHES
15:45 – 16:15 **Coffee break**	
Session II – GNSS Techniques development Chairmen: Vondrak J., Góral W.	
16:15	Gerhátová L., Hefty J.: CO-SEISMIC DISPLACEMENTS OBTAINED FROM INDEPENDENT PPP ANALYSES OF GPS AND GLONASS OBSERVATIONS
16:30	Góral W., Skorupa B.: POSITION AND VELOCITY OF GLONASS SATELLITE BASED ON ANALYTICAL THEORY OF MOTION
16:45	Kłos A., Bogusz J., Figurski M., Kosek W.: UNCERTAINTIES OF GEODETIC VELOCITIES FROM PERMANENT GPS OBSERVATIONS

17:00	Bogusz J., Figurski M., Kłos A.: ANNUAL SIGNALS IN GPS TIME SERIES
17:15	Hadaś T., Kapłon J., Wilgan K., Bosy J., Sierny J.: IGS REAL-TIME PRODUCTS VERIFICATION
17:30	Wilgan K., Rohm W., Bosy J., Kapłon J., Hadaś T., Sierny J.: ZENITH TOTAL DELAY SHORT-TERM STATISTICAL FORECASTS
17:45– 18:15 **Coffee break**	
Session III – Deformation measurement techniques I Chairmen: Pospíšil L., Badura J.	
18:15	Hajdukiewicz M., Szczerbowski Z.: MONITORING OF TERRAIN RELIEF AND HYDROLOGICAL CONDITION CHANGES WITH THE USE OF GIS TOOLS ON EXAMPLE OF PODHALE AREA
18:30	Szczerbowski Z., Porzucek S., Madej J.: GRAVIMETRIC SURVEY OF ACTIVITY OF SALT DOME MONITORED BY GEODETIC METHODS
18:45	Badura J.,Jamroz O.,Farbisz J., Łój M., Porzucek S.: APPLICATION OF GEOPHYSICAL METHODS TO RESTORE THE SUB-CRETACEOUS SURFACE OF THE UPPER NYSA KŁODZKA GRABEN
19:00	Cacoń S.: INTRODUCTION TO THE FIELD SESSION I
19:15	Guest from RZGW: INTRODUCTION TO THE FIELD SESSION II
20:00 – 23:00 **Dinner party**	

Tuesday, October 22, 2013	
7:30 – 8:30 **Breakfast**	
Field session	
8:30 – 14:00	VISIT ON THE NYSA LAKE DAM AND NYSA CITY TOUR
14:00 – 15:00 **Lunch**	
Session IV Chairmen: Schenk V., Kontny B.	
15:00	Kontny B.: INTEGRATION OF PERMANENT AND PERIODIC GNSS MEASUREMENTS FOR LOCAL AND REGIONAL GEODYNAMIC RESEARCH ON THE EXAMPLE OF THE POLISH–CZECH NETWORK SUDETEN – DESCRIPTION OF THE RESEARCH PROJECT
15:15	Zając M.,Kontny B.: PERIODIC COEFFICIENTS IN COORDINATE TIME SERIES OF GPS PERMANENT STATIONS LOCATED ON THE AREA OF SUDETEN AND ITS FORELAND

15:30	Kapłon J.: THE IMPACT OF INTRODUCING ASG-EUPOS STATIONS COORDINATES AND VELOCITIES TO LOCAL GEODYNAMIC NETWORK – GEOSUD NETWORK CASE-STUDY
15:45	Kontny B., Grzempowski P., Bogusz J., Figurski M.: COMPARATIVE ANALYSIS OF THE VELOCITY AND DEFORMATIONS MODELS OF THE SUDETEN AREA DEVELOPED ON THE BASIS OF DATA OF THE LOCAL RESEARCH NETWORKS AND THE ASG-EUPOS DATA
16:00	Kontny B., Schenk V., Schenková Z.: SITE MOVEMENT FIELDS ASSESSED FOR THE SUDETEN AREA IN THE LAST DECADE
16:15	Badura J.: SURFACE ANALYSIS SUB-CARBONIFEOURUS NE PART OF THE BOHEMIAN MASSIF AND THE CONSEQUENT IMPLICATIONSFOR THE ANALYSIS OF NEOTECTONIC MOVEMENTS
16:30 – 17:00 **Coffee break**	
Session V – Regional and local geodynamics Chairmen: Švábenský O., Aleksandrowski P.	
17:00	Sowa W., Bogusz J., Grzempowski P.: ANALYSIS OF VECTORS VELOCITY OF ASG EUPOS NETWORK POINTS DISPLACEMENTS
17:15	Kaczorowski M.: MIDDLE-HIGH FREQUENCY SIGNALS REGISTERED BY WATER-TUBE TILTMETERS IN THE GEODYNAMIC LABORATORY OF SRC IN KSIAZ. PERMANENT EXCITATION OF THE EARTH.
17:30	Zdunek R.: PRELIMINARY INTERPRETATION OF DETERMINED KSIA GPS STATION MOVEMENTS IN THE CONTEXT OF COLLECTED KNOWLEDGE ABOUT TECTONICS OF SWIEBODZICE DEPRESSION
17:45	Kasza D.: THE DAMAGES OF KSIAZ CASTLE ARCHITECTURE IN RELATION TO ROUTS OF RECOGNIZED TECTONIC FAULTS AND INDICATIONS OF RECENT TECTONIC ACTIVITY OF SWIEBODZICE DEPRESSION OROGEN
18:00	Pospíšil L., Mikuška J., Černota P., Volařík T., Papčo J., Pospíšil J., Záhorec P.: GRAVITY EXPERIMENT AT MINE SHAFT STONAVA (STO-SU-1, KARVINÁ DISTRICT, CZECH REPUBLIC)
18:15	Trojanowicz M.: ASSESSMENT OF ACCURACY OF LOCAL QUASIGEOID MODELLING BY GGI METHOD – CASE STUDY FOR THE AREA OF POLAND
19:30 – 23:00 **Grill dinner**	

Wednesday, October 23, 2013	
8:00 – 9:00 **Breakfast**	
Session VI – Deformation measurement techniques II Chairmen: Cacoń S., Kaczorowski M.	
9:00	Ćmielewski K., Gołuch P., Kuchmister J. Wilczyńska I.: THE APPLICATION OF OPTOELECTRONIC SET FOR MEASURING RELATIVE MOVEMENTS OF ROCK BLOCKS
9:15	Gojamanov M.: THE STABILITY OF THE GEODESIC POINTS IN CONNECTION WITH GEODYNAMIC PROCESSES IN AZERBAIJAN
9:30	Cacoń S., Košťák B., Stemberk J.: ACTIVITY OF TECTONIC FAULTS IN THE SUDETY MTS. OBSERVED WITH TM-71 CRACK GAUGES
9:45	Ziaja M., Borkowski A.: FILTERING OF AIRBORNE LASER SCANNING DATA IN LANDSLIDE AREAS
10:00 – 10:30 **Coffee break**	
Session VII – Deformation measurement techniques III Chairmen: Stemberk J., Kajzar V	
10:30	Baryła R., Paziewski J., Wielgosz P., Stępniak K., Krukowska M.: ASSESSMENT OF THE CONTROL POINTS' DISPLACEMENTS IN THE AREA OF THE OPEN PIT MINE KOŹMIN BASED ON DEFORMATION MONITORING GPS NETWORK
10:45	Mąkolski K., Kaczałek M.: DYNAMICS OF BENCHMARK VERTICAL MOVEMENTS IN THE INTERIOR AND SURROUNDINGS OF JASKINIA NIEDŹWIEDZIA IN KLETNO
11:00	Szostak-Chrzanowski A., Warchala E.: INFLUENCE OF A GEOLOGICAL FAULT ON THE CHOICE OF MINING METHOD IN KGHM POLISH COPPER "RUDNA" MINE
11:15	Ćmielewski B.,Urbański K., Różański P., Kontny B.: APPLICATION OF GEOPHYSICAL AND GEODETIC METHODS TO DETERMINE THE POTENTIAL SLIP SURFACES AND THEIR RELATIONSHIP WITH TECTONIC ZONES ON AREA OF LANDSLIDE IN JANOWIEC – PRELIMINARY RESULTS
11:30	Kajzar V. Kukutsch R.: VERIFYING THE POSSIBILITIES OF USING A 3D LASER SCANNER IN THE MINING UNDERGROUND
11:45 – 12:15 **Final Discussion and Closing Ceremony** Chairmen: Cacoń S., Schenk V.	
12:30 – 13:30 **Lunch**	