Recent geodynamic processes in a central part of Europe, its geological and tectonic developments and knowledge of geophysical fields help us to understand better mutual interactions between old and young European geological units. Old units in this area are represented by the East European Precambrian Platform and the Central and West European Paleozoic Platforms and young units by the Alps and the Carpathians belonging to the Alpine-Himalayan Orogen. Studies of motion origins and interactions between the old resistant and the young mobile units contribute reasonably to understanding of Central European geodynamics.

The Department of Geodesy and Photogrammetry, Agricultural University of Wroclaw, in collaboration with the Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, organized the 4th Czech – Polish Workshop on Recent Geodynamics of the Sudety Mts. and Adjacent Areas in Lubawka (Poland) on November 7 – 9, 2002. The workshop was held under the auspices the Section of the Geodynamics of the Committee of Geodesy, Polish Academy of Sciences, the Section of Satellite Geodesy and Geodynamics, Academy of Engineering in Poland and the Czech Center for Earth Dynamic Research. Forty-eight participants from nineteen Czech and Polish research institutions and universities attended the Workshop. The scientific programme of the Workshop was focused on topics concerning the recent mobility of the Sudety Mts. and adjacent geological units. The field session to the "Dobromierz" geodynamic network and "Ksiaz" seismologic observatory was included into the programme. Delivered contributions allowed a broad community of geologists, geophysicists and geodesists to be mutually informed. Even if many of them had an interdisciplinary character, their topics were directed mostly to the following items:

(a) regional and local geodynamic networks,
(b) GPS data monitoring and processing, and
(c) analyses of geological and geophysical data relating to geodynamic activities.

The 4th Workshop on Recent Geodynamics of the Sudety Mts. and Adjacent Areas gave a good opportunity to present new results of all geodetic and geodynamic projects realized under national and/or international co-operations. A total of thirty-two papers were presented. This special issue of the journal Acta Montana, Series A contains seventeen papers.

The organizers wish to express their satisfaction that the 4th Workshop as well met with a great response among geo-scientists being interested in this area. Their warm thanks go to all participants of the Workshop and to all authors, who submitted their contributions for a presentation in this way. Particular thanks are due to the Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic for printing this special issue of the journal Acta Montana, Series A. The supports granted by the Grant Agency of the Czech Republic, research project No. 205/01/0480 and by the Ministry of Education, Youth and Sport of the Czech Republic, project LN00A005 "Center for Earth Dynamic Research" are highly appreciated and acknowledged.

PREFACE

Zdeňka SCHENKOVÁ and Vladimír SCHENK,
Editors of this special issue

Abstract
Recent geodynamic processes in a central part of Europe, its geological and tectonic developments and knowledge of geophysical fields help us to understand better mutual interactions between old and young European geological units. Old units in this area are represented by the East European Precambrian Platform and the Central and West European Paleozoic Platforms and young units by the Alps and the Carpathians belonging to the Alpine-Himalayan Orogen. Studies of motion origins and interactions between the old resistant and the young mobile units contribute reasonably to understanding of Central European geodynamics.
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Prague, June 2003

IERS AND ITS IMPORTANCE FOR GLOBAL GEODYNAMICS

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Abstract

The International Earth Rotation Service (IERS) was created jointly by the IAU and IUGG in 1987 (and operating since 1988), with the main goals to establish and maintain the International Celestial Reference System (ICRS), the International Terrestrial Reference System (ITRS), and to monitor their mutual orientation via the Earth Orientation Parameters (EOP). To this end, several modern techniques of observation are used, such as VLBI, GPS, SLR, LLR and DORIS. Because the ever changing Earth's orientation is substantially affected by the motions of the non-solid parts of the Earth (atmosphere, oceans, core...), the IERS established a Global Geophysical Fluids Center (GGFC). Thus the IERS evolved into a rather complicated international structure, consisting of many Technique Centers, Product Centers and Combination Research Centers, all serving to one ultimate goal, global geodynamics. The most recent version of the International Terrestrial Reference Frame – ITRF2000 – is characterized, and the velocities of European GPS permanent stations are demonstrated. Examples of mutual interactions between the geophysical processes and rotating Earth are shown and the most important results obtained recently are discussed, namely the polar motion and variations of the Earth’s speed of rotation.

MORPHOTECTONIC PROPERTIES OF THE SUDETIC MARGINAL FAULT, SW POLAND

Janusz BADURA [1)], Witold ZUCHIEWICZ [2)], Adam GÓRECKI [3)], Waldemar SROKA [4)], Bogusław PRZYBYLSKI [1)] and Marta ŻYSZKOWSKA [3)]

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Abstract

The southern portion of the Sudetic Marginal Fault (SMF) in Poland, nearly 77 km long, has been studied using morphometric analysis of both scarp and small drainage basin parameters, as well as due to construction of digital elevation models and digital processing of topolineaments. From among six segments distinguished in the investigated fault fragment, that situated in the Sowie Mts., i.e. segment 3, shows the highest amount of recent uplift of the footwall, testified to by very well-preserved triangular facets showing a two-tier arrangement. Morphometric analyses allow us to infer that the most useful parameters to characterise the SMF scarp are the mountain front sinuosity and valley floor width/valley height ratio, whereas the maximum basin relief, relief ratio (i.e., mean basin slope), and basin elongation ratio describe best small drainage basins located at the foot of the scarp. All these parameters clearly indicate that segment 3 of the SMF reveals properties that do not differ much from those typical for young, moderately active normal fault scarps described from elsewhere. This hypothesis is supported by the results of studies of both topolineament pattern, and digital elevation models of the fault zone. The latter portray very well a two-tier arrangement of triangular facets, resulting from at least two episodes of fairly recent uplift.

THE UPPER MORAVA AND NYSA PULL-APART GRABENS - THE EVIDENCE OF NEOTECTONIC DEXTRAL TRANSTENSION ON THE SUDETIC FAULTS SYSTEM

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Abstract

The genesis, sedimentary development and neodynamic activity of the Nysa and Upper Morava pull-apart grabens are linked to dextral strike-slip kinematics and dynamic evolution on WNW-ESE and NW-SE striking Sudetic faults system, namely Intra-Sudetic Fault Zone, Bušín-Temenice Fault Zone and Nectava-Konice Faults. Offsets and/or sidesteps in the main Sudetic strike-slip faults produce a zone of extension (pull-apart basins) at releasing sidesteps. The Nysa Pull-Apart Graben is genetically related to offset in-between the Intra-Sudetic Fault Zone and the Bušín Fault and represents conspicuous asymmetrical (half-graben) and hinge-like structure (with pivot hinge near Štíty town in the area of its southern termination) with Turonian-Santonian sedimentary filling. The Upper Morava Pull-Apart Graben represents illustrative example of complex pull-apart basin not only based on its perfect rhombic-shaped outline geometry. Tectonically induced subsidence of the graben started in the Lower Badenian and was related to offset of the Bušín-Temenice Fault Zone with the Nectava-Konice Fault Zone. The transtension was also synchronized with the Alpine-Carpathian Orogeny parallel stretching (NE-SW extension tensor), which impact likewise its foreland represented by Moravosilesian area of the Bohemian Massif. The overall framework and arrangement of both pull-apart grabens, so as their gradual (from both time and space migration point of view) SE-ward opening, support concept sinistral rotation of West Carpathian plate in relation to Eastern Alps.

GEODYNAMICS OF THE KRÁLICKÝ SNĚŽNÍK MTS.

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Abstract

The study area is situated along the border of the Czech republic and Poland between Králíky and Staré Město towns. Geodynamic analysis is based on detail geological mapping and its correlation with geophysical and morphostructural data. The main fault are oriented here in the NNE-SSW and in „Sudetic“ NW-SE directions. Many of them are indicated by distinct gradient in the gravity field. Some of them are clear visibble in the digital terrain model. The border between West and East-Sudets or Lugicum and Silesicum is located just in the Králický Sněžník Mts., Rychleby Mts. and the Jeseníky Mts. region. The global of the analysis is to find main geological units, important tectonic lines, the relationship between geological pattern and gravity and relief.

Tectonic earthquakes registered in this area in the past years can have been a manifestation of recent movements. The seismic activity is concentred to the concact of the Králický Sněžník Mts. and Staré Město crystalline complex. Recently precise GPS measurements of „SUDETEN“ network (Schenk et al. 2000) can bring new data about direction of movements. The correlation with geological analysis can help to the geodynamic research of the Králický Sněžník Mts. area.

RECENT CRUSTAL MOBILITY OF THE UPPER NYSA KŁODZKA GRABEN, SW POLAND

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Abstract

The Upper Nysa Kłodzka Graben is an area where Late Alpine faults have been recognized relatively early. Tectonic activity of this region commenced in Late Cretaceous times when the graben was formed. The graben is surrounded by the Śnieżnik Massif on the east, the Bystrzyckie and Orlickie Mts. on the west, and the Krowiarki range on the north. The cumulative throw on the eastern side of the graben exceeds 1,700 m. The most intensive vertical motions took place in Late Turonian, at the turn of Cretaceous/Tertiary, as well as in Tertiary times. Late Neogene and Quaternary activity of this structure is, however, poorly constrained. Some pieces of indirect evidence, e.g. the presence of volcanic caps and dykes near Lądek Zdrój spa, occurrence of thermal and mineral waters, minor historical seismicity, and variable heights of terrace risers, point to ongoing tectonic mobility of this region. This activity is also indicated by the results of recent geodetic surveys and microseismic monitoring in the neighbouring Eastern Sudetes Mts.

SEISMICITY OF THE EAST SUDETEN AS RECORDED BY SOLITARY TRIGGERED STATIONS OF UGN

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Abstract

Seismic activity in the East Sudeten area, Northern Moravia, is studied in the context of the project of GACR No. 205/01/0480 solved in 2001-2003. The area is characterized by a complex structural setting and very low seismic activity. Three permanent seismic stations (Raduň, Javorník and Slezská Harta) equipped with digital seismic recorder PCM3-EPC were installed to monitor seismic activity in this region. The installation of these stations allowed to improve the magnitude detection level of events down to 0 for hypocentral distance about 9 km.

Seismic stations operate under triggered regime of record. The used trigger levels are usually 5.10-6 m.s-1. The most of seismic events registered by solitary stations may be selected into following groups: local natural seismic events (very weak intensity), events induced by quarry blasts and/or other human activities in monitored area, events induced by mining activities in the Czech and Polish part of the Upper Silesian Coal Basin (hard coal mines) and in the Lubin area (Polish cooper mines), and unidentified parts of teleseismic events, as well. Location of local events is based on procedure of S-P times and polarization analysis because, generally, events are recorded at one station only.

More than 2000 triggered records were recorded in 2002 by stations of UGN and about 300 from these are seismic events. Only one sequence of three natural earthquakes was recorded in this period. It was in May 5, epicenters are near from Litultovice (W of Opava), local magnitude up to 0.1.

RECENT GEODETIC ACTIVITIES OF BRNO UNIVERSITY

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Abstract

Brno University of Technology has been carrying out geodetic measurements in the Sudety Mts. region for more than ten years. The activities include in the first place the long term monitoring of surface geometric changes in Czech part of the Králický Sněžník massif. Several kinds of measuring techniques are employed here – GPS, EDM, astronomic and gravimetric measurements.

In the last three years a new activity in the western parts of the Krkonoše Mts. has started with the aim to monitor the displacements of boulders on high mountain ridges. Three small geodetic monitoring networks were established in this area and subsequently repeatedly measured by GPS, precise levelling and classical distance and angle measuring methods.

The paper presents actual state of these activities, preliminary results covering last period are also discussed.

TO GEODYNAMIC INTERPRETATIONS OF GPS DATA MONITORED ON THE EAST SUDETEN NETWORK

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Abstract

Main goals of the GPS data monitored in the six annual campaigns and their processing were directed to geodynamic interpretations. Since a reliability of movement vectors calculated for individual network sites is after the six-year period relatively high, it was possible to start with their geodynamic interpretation and obtained results to consult with known geological materials and geophysical data. Movement vectors, their total values and geographical azimuths were analyzed with respect to tectonic structures of the Sudeten area and probable geodynamic terranes were delineated as well as probable stress and strain fields were compiled and discussed.

GEODYNAMIC NETWORK KARKONOSZE -- RESULTS OF THE 2001

AND 2002 CAMPAIGNS*

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Abstract

KARKONOSZE geodynamic network has been established in the Western Sudetes. GPS network consist of 19 points located on the area of Karkonosze Mts. and its foreland. The KARKONOSZE network is connected with geodynamic networks GEOSUD and SUDETES and state the western part of them. Two measuring campaigns (2001 - 2002) of the local geodynamic network KARKONOSZE covering Karkonosze Mts. and its foreland, were done. Permanent observations on the main point of the network Śnieżka (SNIE) were carried out during measurement campaigns. The meteorological parameters (temperature, pressure, humidity) were also measured in order to determine the field of refraction. Data from GPS observations were processed using Bernese v.4.2 software. In the paper the preliminary result of comparison of GPS data processing of the two campaigns KARKONOSZE 2001 and 2002 have been presented.

THE CONCEPT OF UTILIZING THE SILESIAN ACTIVE GEODETIC NETWORK FOR DETERMINATION OF CURRENT PARAMETERS OF LOCAL DIFFERENTIAL TROPOSPHERIC REFRACTION

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Abstract

In 2001 the Head Office of Geodesy and Cartography in Poland decided on establishing permanent GPS reference stations in Silesian area. The pilot project of the Active Geodetic Network (ASG-PL), consisting of six GPS stations distributed throughout Upper Silesian Coal Basin, has been in operation since February 2003.

Moreover, in Krakow the KRAW permanent GPS station has started operating. It is installed in the premises of the University of Mining and Metallurgy, Faculty of Mining Surveying and Environmental Engineering. Silesian active GPS stations as well as KRAW station are equipped with the receivers - Ashtech μZ – CGRS (Continuous Geodetic Reference Station) and geodetic antennas. It is noteworthy that Silesian GPS network is situated between permanent stations KRAW and WROC giving the opportunity to undertaking research on the variety of high precision positioning applications. We are particularly interested in the improvement of a better modelling of the atmosphere in an improved estimation of the heights. A special software is created for this purpose. First the theoretical background of data processing operation of determining total tropospheric zenith delay in the layer between the endpoints of the baseline is presented. In the presented model two tropospherical parameters are estimated. The presented approach enables the estimation of differential tropospheric delay with no information on meteorological conditions.

RESULTS OF THE GEODYNAMIC INVESTIGATIONS

IN THE STOŁOWE MTS. RESEARCH AREA

Stefan CACOŃ [1)], Jiři KOPECKÝ [2)], Mirosław KACZAŁEK [1)],
Krzysztof MĄKOLSKI [1)], Jan KAPŁON [1)], Bernard KONTNY [1)] and Jarosław BOSY [1)]
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Abstract

The present-day orographic picture of the Stołowe Mts. was shaped as a result of geological and tectonic processes, climatic and atmospheric changes, as well as seismic events. These processes have started in Late Cretaceous Period. Repeated geodetic, satellite GPS and gravimetric measurements indicate ongoing changes of the lithosphere's upper layer.

Deformation studies of the upper lithosphere layer in the Stolowe Mts. began in 1972. Geodetic network was established in the upper part of the Szczeliniec Wielki — in front of PTTK mountain shelter. Periodic observations in this rather small research network combined with relative measurements using TM–71 crack gauges were aimed to estimate present–day mass movements of cretaceous sandstone blocks. The following years brought extension of these observations on to the whole of the Szczeliniec Massif including the "Piekiełko" rift. Periodic geodetic and relative (TM–71) observations confirmed the Massif's instability in the early 90–ties of the last century. The greatest changes were recorded in "Piekiełko" (~0.5 mm/year). In 1989 similar observations were started on the "Ostaš" object in the former Czechoslovakia. Both objects were linked in 1993 by an 8–point geodynamic satellite and gravimetric network. Satellite, gravimetric, geodetic and relative (TM–71) measurements carried out with varying frequency on local objects (Szczeliniec and Ostaš), as well as in the geodynamic network prove present–day mobility of geologic and tectonic structures. Recent measurements, conducted in 2002 allow quantitative assessment of the changes relating to tectonic and mass movements.

"DOBROMIERZ" GEODYNAMIC NETWORK

— RESULTS OF 2001 AND 2002 CAMPAIGNS

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Abstract

"Dobromierz" geodynamic research area has been established on one of the profiles belonging to the "GEOSUD II" regional geodynamic network. The profile cuts across the following tectonic structures: Sudety Mts. Horst, Roztoka–Mokrzeszów Graben and Strzegom Horst. The region lies in an area of tectonically engaged metamorphic and sedimentary rocks, which were subjected to two orogeny periods: older Variscian and younger Late Alpine. The Sudetic Marginal Fault, with known amplitude of tectonic movements of more than 250 m, originated during the Late Alpine Orogeny. In this complex tectonic structure, on the edge of Sudety Mts., the "Dobromierz" ground dam on Strzegomka River has been located.

It must be noted that earthquakes have been recorded in historic times, in adjacent regions, e.g.. Złotoryja — 1599, Staszowice — 1855. Seismic activity connected with copper mining in nearby Legnica–Głogów Copper Basin (LGOM) is on the rise. Above–mentioned facts indicate possible threat to the dam, that furthermore substantiated organisation of detailed geodynamic investigations in this area.

The geodynamic research network, established in 2001, consists of 5 points located on both sides of the Sudetic Marginal Fault and near the dam. Periodic observations performed in the network have been correlated with the 4–segment control-measurement system. Satellite GPS and gravimetric measurements, performed once a year, make up the system's foundations (I and II segment). Geodetic measurements (Total Station) carried out every six months form the III segment with relative observations (monthly cycle) using TM–71 crack gauges augmenting theses measurements.

Two years of observations (2001–2002), in individual segments, confirm mobility of geological structures in the area. Superposition of registered changes, endogenous and exogenous in character, makes impossible to separate them. This particularly relates to the gravity measurements and observations with crack gauges installed in the dam's adit and below its right abutment in the crystalline zone of Sudetic Marginal Fault.

MOBILITY OF LOCAL TECTONIC STRUCTURES IN WESTERN PART OF THE

PACZKÓW GRABEN (SUDETIC FORELAND) ON THE GROUNDS OF PRESENT INVESTIGATIONS

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Abstract

The paper presents preliminary comparison of relative height changes between benchmarks of the 1st order national levelling lines from 1953 to 2002 and results of gravimetric observations in 1993-2002 period. This research was performed with the intention of determining vertical movements of earth's crust surface layers and is connected with the planned construction of an embankment dam on the Nysa Kłodzka River (Sudetic Foreland, SW Poland). The area of investigations is characterised by complex geological structure and documented cases of tectonic activity in historical times. Analyses take into consideration geological, tectonic and hydrogeological settings of the site. Results show residual but ongoing crustal processes indicated by movements of benchmarks at particular fault zones and significant variations of gravitational acceleration. The observed varying vertical movements within the structures confining western part of the Graben and in subsidence zones, together with analysis of available geological data could indicate either oscillating character of these processes or superposition of tectonic and residual glacial rebound processes.

Attention is drawn to the need of setting up additional reference points with the intention to continue geodynamic observations and control measurements of the dam. A plan of their location has been proposed.

NATURAL TECTONIC HAZARD FOR ENGINEERING STRUCTURES IN LOWER SILESIA*

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Abstract

Lower Silesia was broken into numerous tectonic blocks, graben and horsts during late Alpine orogeny. These movements were at its peak in the Neogene. Throughout the Quaternary till the present times this activity wakened, nevertheless their existence is still felt as local earthquakes. The area of SW Poland is characterised by dense settlement and development resulting from favourable climatic and soil conditions and abundant mineral resources. Numerous engineering objects: water dams, mines, city agglomerations have been built. Some of them have been located in tectonic zones, whose activity was confirmed by geological studies. This creates possible threat for people living there. Within successive KBN projects a geodetic monitoring system, based on satellite GPS, geodetic, gravimetric and relative (feeler gauge) observations, in "geodynamic profiles" connected by means of GPS network, has been developed. Multiple measurements indicate differentiated crustal movements in the investigated area, particularly in young tectonic graben. Analysis of changes determined from geodetic observations will help selecting objects with potentially greatest degree of hazard.

ANALYSIS AND INTERPRETATION OF VERTICAL GROUND

MOVEMENTS IN WROCŁAW*

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Abstract

In the paper the vertical changes of benchmarks in local networks and precise levelling lines of the 1st and 2nd order, passing across Wrocław for the 1968-1998 period are presented. Wrocław is characterized by diversified geological, groundwater and dwelling density conditions. Ground reactions due to increased loads resulting from development and growth of housing district and industrial activity are also varied. W and SW parts is subjected to elevations while the remaining areas experience subsidence. Wrocław is located in the Odra river basin, at a boundary of two large pre - Cenozoic units: Fore – Sudetic Block and Fore – Sudetic Monocline separated by middle Odra fault zone. Tertiary and Quaternary deposits reach combined thickness of 150-170 m. Tertiary sediments are 170 m thick in SW part and decrease in the SE direction to about 85 m. Quaternary deposits are thickest in the centre of the city (57 m) and decrease to the W and SW to around 10 m. Central part of the city lies in a zone of alluvial deposits accumulated by Odra river. Analysis of Wrocław –Ząbkowice levelling line (1st order) measured in 1956, 1975, 1992 and 1999 indicates that the most significant changes (-70 mm subsidence) occured between 1975 and 1992 in the period of greatest housing development and increase of road transport. Basing on the analysis of vertical movements of benchmarks a map with isolines of elevations changes has been developed. It shows that the zone of negative to positive change of benchmark movements is consistent with the direction of dense built up area of the city (SE-NW). Growth of housing developments has probably the greatest effect on vertical variations of benchmarks. However mobility of above – mentioned tectonic units cannot be ruled out as these also extend in the SE-NW direction. In the paper attempt has been made to interpret the process of vertical motion of the ground and indicate its possible causes.

TECTONIC SETTING AND NEWLY ORGANISED MONITORING OF RECENT TECTONIC DEFORMATION IN THE RYCHLEBSKÉ HORY MTS.

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Abstract

First year results of microdeformation measurements in Na Pomezí Cave are analysed in view of Quaternary development of the Rychlebské Hory Mts. near Jeseník Spa, Czech Republic. Basic information is given about the installation of monitoring instrumentation in Na Špičáku Cave where measurements started as late as at the end of 2002. The measurement is carried out with the use of a verified, very stable and sensitive deformeter TM71. Four instruments were installed either directly in or in the close vicinity of Sudetic Marginal Fault. First results of the measurement confirm good stability of the instruments regarding their setting in the investigated joints. Deformations registered by deformeters show very low or no influence of the climatic cycle. Analysis into correlation between registered microdeformations and atmospheric precipitation or seismic phenomena in the region did not prove any significant effects.

NOTE TO REMOTE CONTROL OF GPS OBSERVATORY USING GSM MODEM

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Abstract
In principle to check a regular and flawless operation of any far off recording device it is possible to apply GSM technology. Such a device can be any permanent GPS observatory that is placed on far and uneasy accessible locality. This contribution gives information on the remote control of the GPS observatory SNEZ situated on the top of the Czech highest mount, the Sněžka Mt.