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SK*POS* CONTRIBUTION TO GEOKINEMATICS RESEARCH

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Introduction

Selected stations or whole networks of GNSS permanent stations are used worldwide in variety of real time or post-processing applications. Scientific part of world is focused especially on post-processing because it allows the possibility to achieve millimeter accuracy. One of those applications is geokinematics – research of Earth surface motions (tectonic motions). From geodetical point of view it is a direction and amplitude determination of sites motions via GNSS platform, where sites are represented by suitable installed observation antenna. Geokinematics is very sensitive for lot of site dependent details such as monumentation or connection with ground, which can degrade the quality of interpretation. Only from suitable and correctly monumented sites with distinct mounted antennas can be achieved truthful results

Geokinematics research in Slovakia

Geodetic and Cartographic Institute Bratislava (GKU) has more than 10 years of experience in the field of accurate coordinate and velocity site determination. Aim of those accurate determinations was the necessity of the establishment of the high precise ETRS89 representative in Slovakia which will be also reliable for evaluation of country stability from tectonic motion point of view. For that purpose was during 1993-95 established across the whole country a network of points (fig.1) with sufficient quality of monumantation (mainly on bedrocks with module for forced centering) with denomination Slovak geodynamic reference network (SGRN).

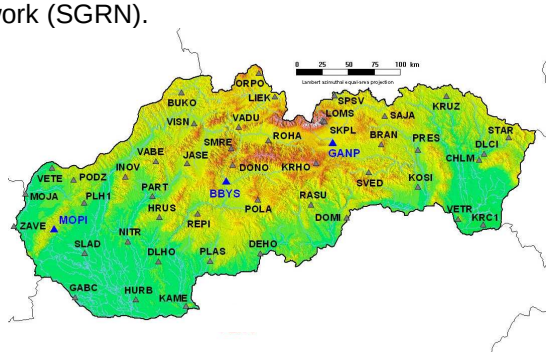

Fig.1 Distribution of SGRN points

On those SGRN points are bi-yearly carried out epoch observation campaigns taking about 5 days of simultaneous observations. Processing of those campaigns are performed by scientific software according strictly procedures. Results are represented by precise coordinates and velocities with their confidential characteristics. Velocities achieved from time series analysis are usually used for vector maps creation.
Always when the new campaign is performed, the new set of coordinates and velocities are estimated with consideration of previously campaigns and created new kinematics vector map is compared to previous one (fig.2). Note that from vectors on figure 2 was the motion of Eurasian tectonic plate (model ITRF2000) eliminated so the result represents only the local stations motions.

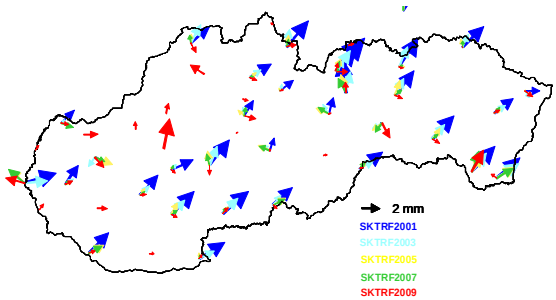

Fig.2 Geo-kinematics chronology in Slovakia from epoch measurements

With permanent stations expansion to all GNSS fields of applications, epoch measurement usage started to be obsolete and useless. Vision of crustal movement determination from time series was really fantastic. But it is important to have on mind that not all of estimated motions refer to tectonic movements, thus it is important to know how to distinguish what is or is not the real tectonic motion.
Also the factor of station monumentation, which is in detail analysed in lot of guidelines for station design e.g. (*EUPOS* guidelines, 2008) has to be taken into account.

Foundation of SK*POS* stations

Before SK*POS* service had been realized (2006 year) its future usage was discussed in detail. Primary scope of SK*POS* was focused on DGNSS and RTK service. Because GKU representatives would like to continue works on geo-kinematics monitoring activities they decided to stabilize with quality monumentation as many SK*POS* stations as it will be possible (budget limitation).
Two stations (GANP, BBYS) which had been established with deep pillar monumentation earlier could be included into the SK*POS* immediately. Next two stations (LIE1, PAR1) according to budget possibility were founded with the same type of monumentation (deep pillar) during phase of SK*POS* establishment. Pictures from LIE1 station realization with its final status is in figure 3.

Fig.3 Permanent station Lie1 (Liesek) – realization and final status

Later in 2008 was the new permanent station MOP2 stabilized by pillar on rock. Station owner - Slovak University of Technology signed a contract with GKU and MOP2 GNSS permanent station became a part of SK*POS*. Now 5 from all 23 SK*POS* reference stations serve not only for DGNSS, RTK and post-processing applications but also for geokinematics research. All of those stations were included into SGRN network too. Theirs distribution across Slovakia are depicted on fig.4.

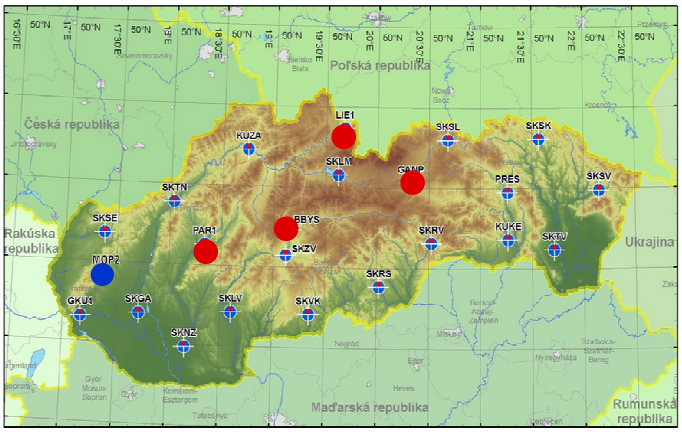

Fig.4 Distribution of SK*POS* stations with pillar stabilization

Permanent stations velocity determination

On GKU is routinely performed processing of all SK*POS* permanent stations with Bernese software 5.0 (Dach et al., 2001). Time series composed from resulted coordinates undergoes to analysis for local (velocity of Eurasian plate are eliminated) and global velocity determination. Both velocities are estimated with applying simple linear regression on particular time series components (fig.5).

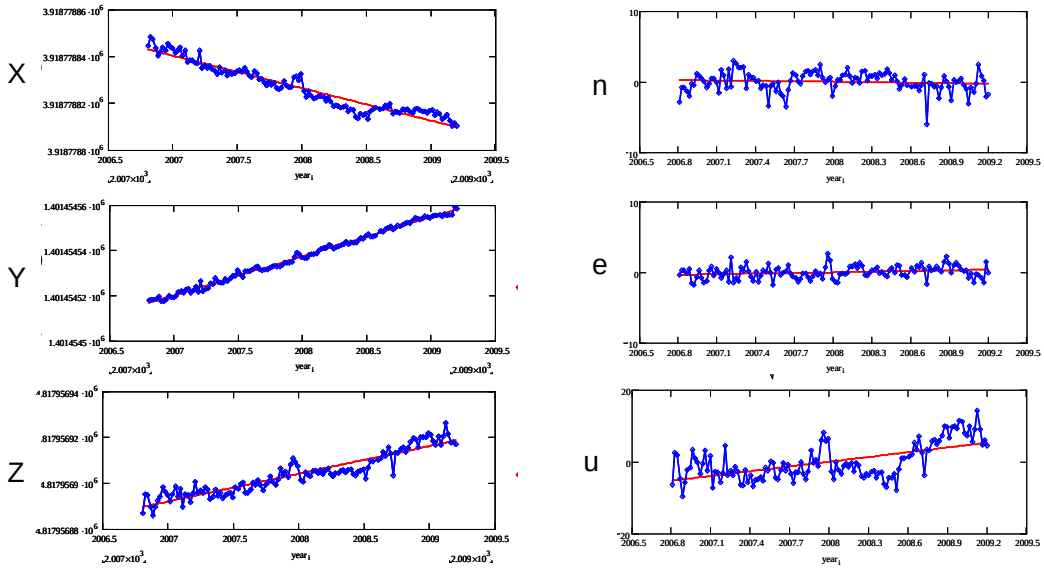

Fig.5 Global (left) and local (right) velocity estimation on station LIE1

Time series from SK*POS* permanent stations are now not long enough (just 2.5 year) hence the estimated velocities can not be used for reliable interpretations or to comparison with results achieved from epoch campaigns. This will be the task for future.

Benefits from geo-kinematics monitoring methodology

There are some benefits for permanent station network administrator if geokinematics methodology (scientific software usage, precise approach to coordinate determination, accurate velocity estimation) is used for routinely permanent stations monitoring:

- Accurate stations coordinates and velocities with characteristics
- Information about stations behaviors - from coordinates quality evaluation and from time series analysis we can decide to offer or not to offer station/whole service for precise application
- Long term stability maps – from vector maps can be created long-term stability maps which can serve for evaluation of expected lifetime of the station coordinates (fig.6)

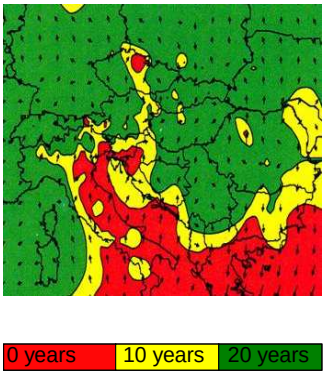

Fig. 6 Color map for coordinate lifetime evaluation (source (Caporali and Turturici, 2008))

Future plans

Our future plans touched with geo-kinematics research can be divided into:

- To carry on in routinely monitoring of SK*POS* pillar stations.
- To offer reliable stations to regional geokinematics/geodynamics projects.
- To monitor also other SK*POS* roof monumented stations for suitability for contribution to geokinematics research.

Conclusion

It is clear that future of GNSS geo-kinematics is just in velocities estimation from permanent stations. Time factor is also very important to get truthful interpretations. We are still only at the beginning from that point of view so full potential of GNSS permanent stations on the field of geo-kinematics research is for us still uncovered.

References

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