



SKPOS® – NOT ONLY POSITIONING SERVICE R&D PROJECTS SUPPORTER



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International scientific and methodological conference KOLOS 2014

The 1st conference within the project Space emergency system

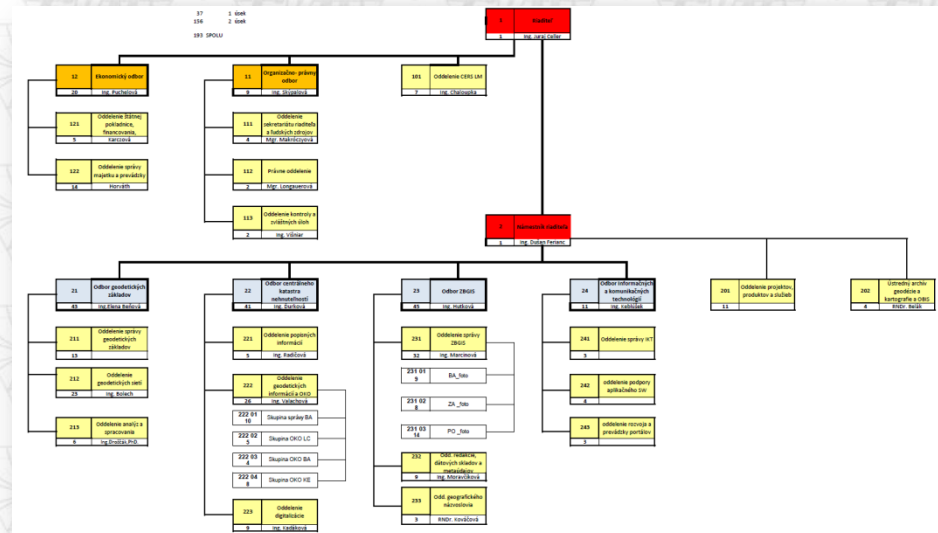
December 4-6 2014, Stakčín & Kolonica saddle, Slovakia



Agenda

- Geodetic and Cartographic Institute Bratislava
 - Geodetic controls department
- **SKPOS**[®]
 - what is it
 - infrastructure status in December 2014
 - information about number of users, type of users etc.
- Contribution with **SKPOS**[®] data to research and development projects
 - Own activities
 - Collaboration with other institutions
 - Planned activities
- Conclusion

Geodetic and Cartographic Institute (GKÚ)



- **Budget organisation**
- **Under patronate of Geodetic, Cartographic and Cadastral authority of the Slovak republic (ÚGKK SR)**
- **193 employees**
- **6 departments and 20 sections**

Geodetic controls department Structure



Geodetic controls department

Ing. Branislav Droščák, PhD.

Geodetic controls administration

Ing. Elena Beňová

ISGZ group

SKPOS group

Maintenance
Group 1

Maintenance
Group 2

Levelling
Group 1

Levelling
Group 2

Levelling
Group 3

Geodetic controls networks

Ing. Václav Bolech

Border maintenance
Group 1

Border maintenance
Group 2

Border maintenance
Group 3

Gravimetry
Group 1

Geodetic controls analysis

Ing. Emília Havlíková

GNSS a SKPOS data
processing

Levelling
processing

Geodetic controls department

Main tasks



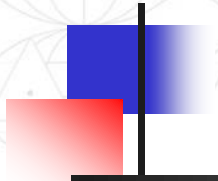
Geodetic and Cartographic Institute Bratislava
Geodetic controls department

1. Administration and realization of the geodetic reference systems in Slovakia

2. Providing of the reference base for correct work in geodetic reference systems

Reference base

- Geodetic controls points of National spatial, National levelling, National gravimetric and National trigonometric networks
- Services which enable to work in or transform data between geodetic reference systems (**SKPOS**[®] service, transformation service)



SKPOS[®]

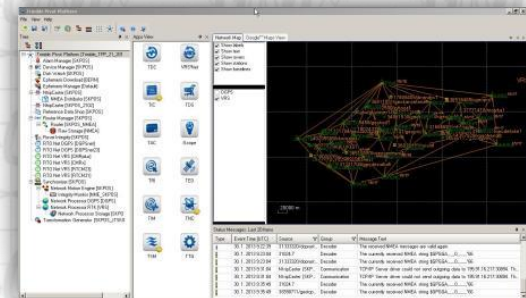
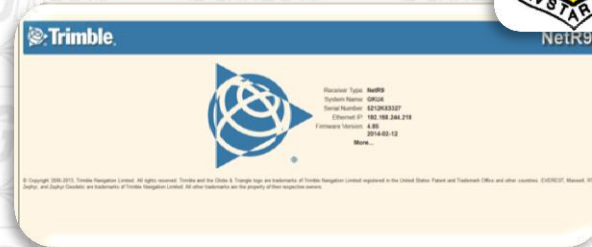
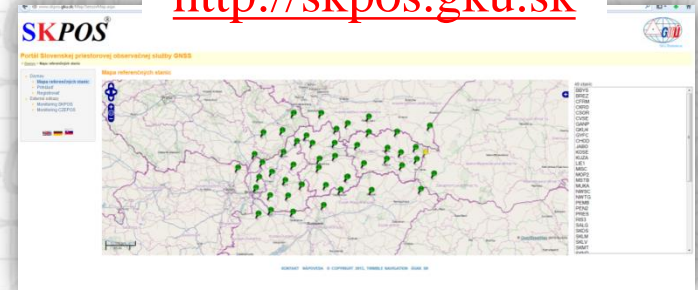
Slovak real-time positioning service

SKPOS®

Slovak real-time positioning service

- **SKPOS®** is Slovakian public real time positioning service which enables registered users to correctly work in ETRS89 and S-JTSK systems via
 - transmitted corrections in RTCM or CMR data formats
 - RINEX data files (for postprocessing)

<http://skpos.gku.sk>

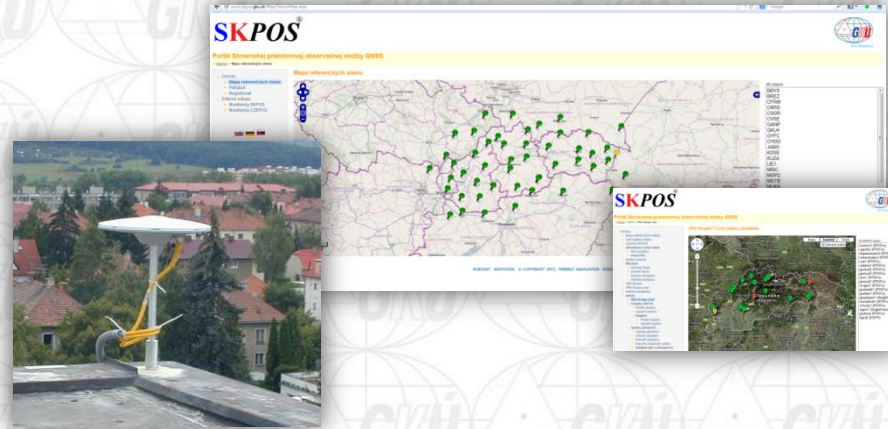




SKPOS[®]

Fundamentals (main elements)

- **SKPOS[®]** composed of
 - **GNSS permanent stations**
 - **National service center with service control software**
 - **Private WAN network** which joins permanent stations with National service center



SKPOS[®] permanent stations

Types of monumentation



SKPOS®

National service center and its activities

- National service centre
 - Situated on GKÚ Bratislava
- Web
 - www.skpos.gku.sk
- Routine activities
 - Service administration
 - Service quality monitoring
 - Data archivation and service backups
 - Users administration and contracts managment



SKPOS®

Control software

Trimble Pivot Platform ver. 3.1.5

The screenshot displays the Trimble Pivot Platform software interface. The main window shows a network map with various stations connected by lines. The map includes labels for stations and baselines. A sidebar on the left contains a tree view of the system components, including Alarm Manager, Device Manager, and various RTKNet and DGPS modules. A status messages window at the bottom shows a log of events, including NMEA messages being received and decoded.

Type	Event Time [UTC]	Source	Group	Message Text
i	28. 5. 2014 7:19:33	35729023/remingcons...	Decoder	The received NMEA messages are valid again.
i	28. 5. 2014 7:19:33	31029.29	Decoder	The received NMEA messages are valid again.
i	28. 5. 2014 7:19:33	35729023/remingcons...	Decoder	The currently received NMEA string \$GLGGA,.....0.....7A
i	28. 5. 2014 7:19:33	31029.29	Decoder	The currently received NMEA string \$GLGGA,.....0.....7A

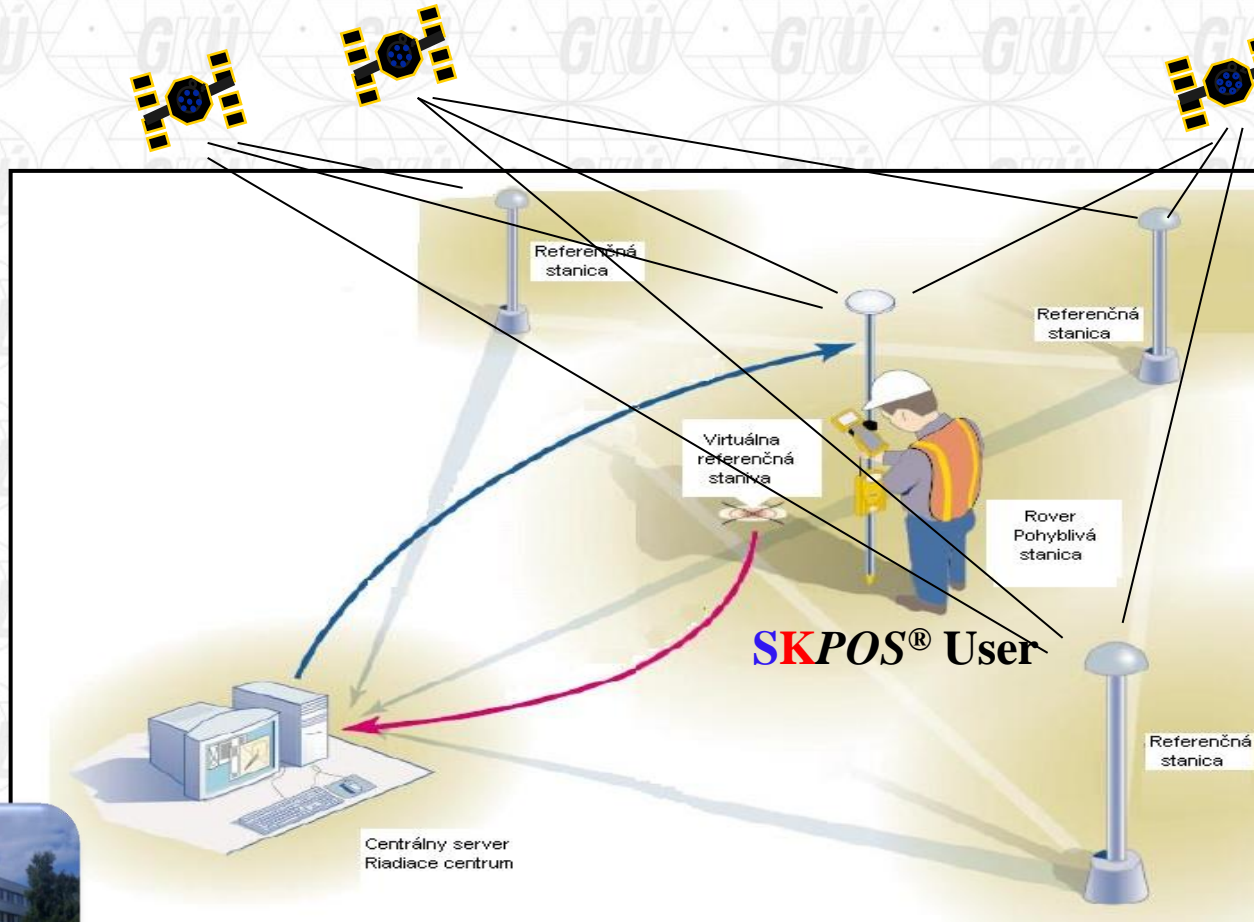
The screenshot shows the SKPOS web portal interface. The main content area displays a map of Slovakia with several VRS (Scope) Livel stations marked with green dots. The map includes a legend and a list of station names. The portal title is "Portál Slovenskej priestorovej observačnej služby GNSS".

I-Scope modul

The screenshot displays the I-Scope modul software interface. The main window shows a detailed map view of a specific location, likely a construction site or industrial area. The map includes a legend and a list of station names. The interface is designed for detailed monitoring and management of the I-Scope system.

SKPOS[®]

Service principle



SKPOS[®] National service center

Only network solution (Network RTK in VRS concept) is provided!
No single station!

Service (mountpoint) name	Accuracy	Data format	Interval
SKPOS_MM for post-processing (VRS or permanent station data)	mm - cm	RINEX: 2.10, 2.11, 3.0 DAT, TGD, T01, T02	1 sec. – x sec.
SKPOS_CM_23 SKPOS_CM_31 SKPOS_CM_CM_RX SKPOS_CM_CM_R+ for RTK	2 – 4 cm	RTCM 2.3 RTCM 3.1 CMRX CMR+	1 sec.
SKPOS_DM_SVK SKPOS_DM_SVK_23 for DGNS	0,3 – 1 m	RTCM 2.1 RTCM 2.3	1 sec.



SKPOS[®]

Charges



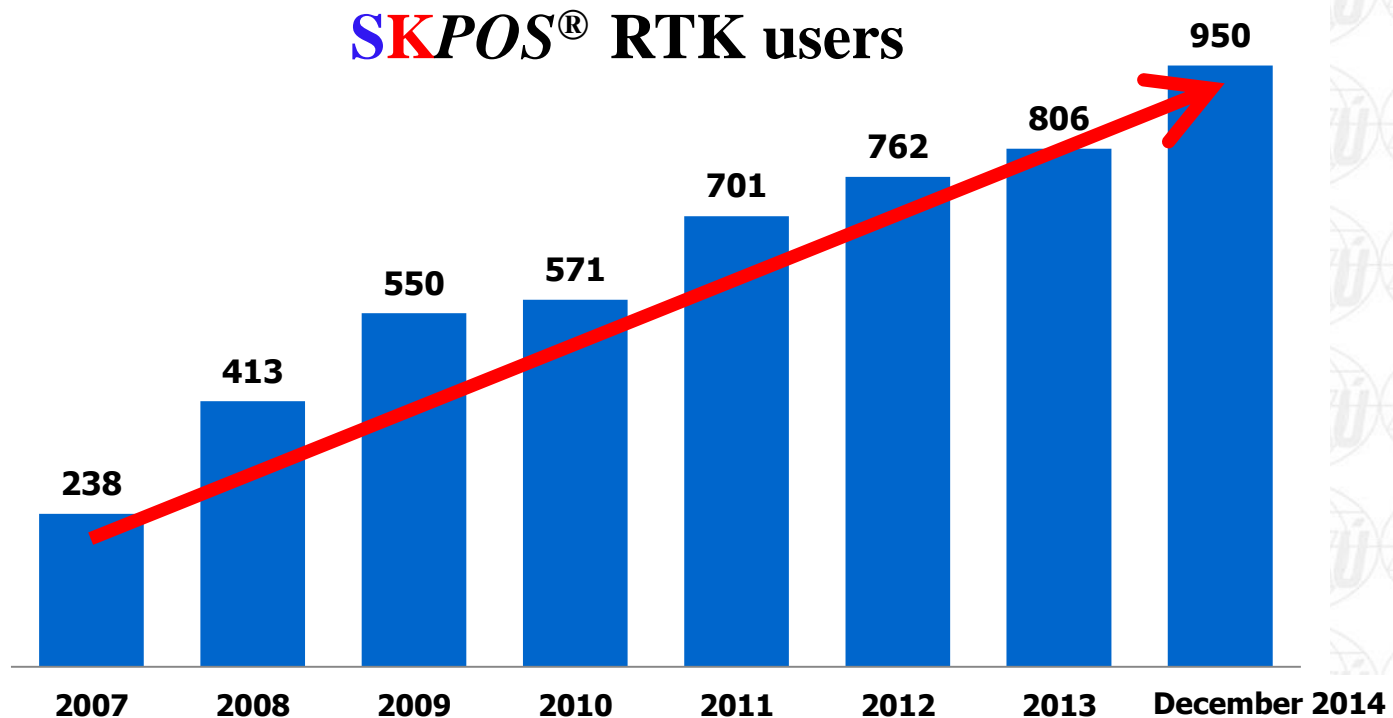
Post processing 1000 hours RINEX files	RINEX 2.x, 3.x	50 € / 365 days
Network RTK (year) 1000 hours network RTK 50 hours RINEX files	RTCM 2.3, 3.1, CMR _x , CMR ₊	50 € / 365 days (from 1.5.2014)
Network RTK (month)	RTCM 2.3, 3.1, CMR _x , CMR ₊	19 € / 30 days
DGNSS	RTCM 2.1	20 € / 365 days



SKPOS®

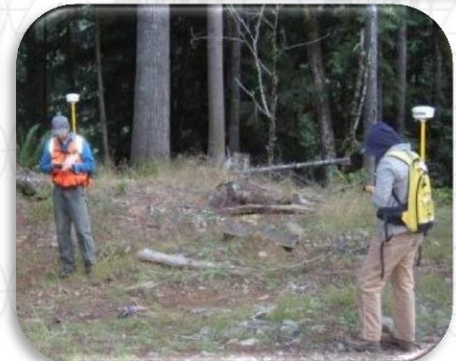
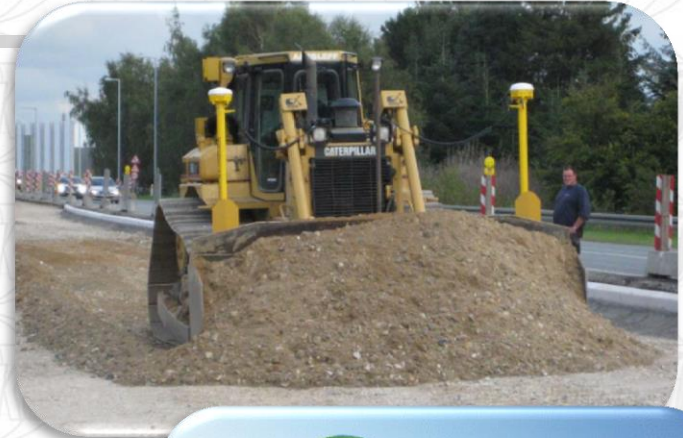
Number of users (December 2014)

- over 950 users
- number is still increasing



SKPOS[®]

Type of users



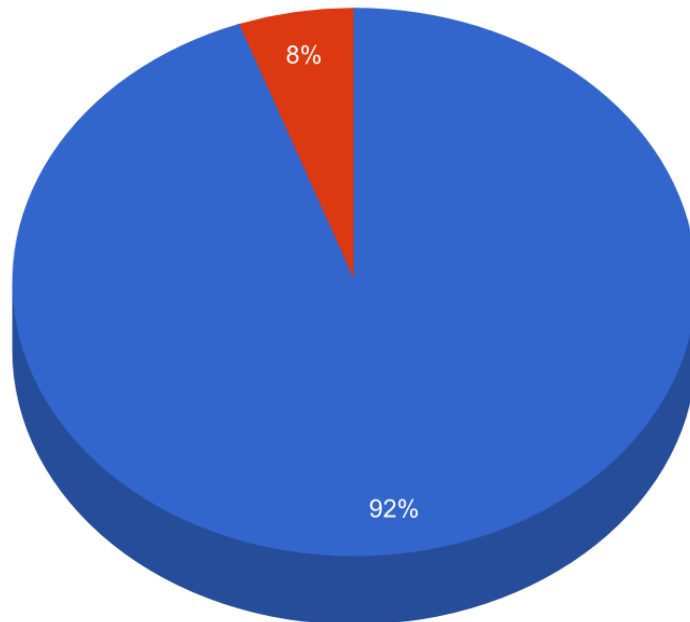


SKPOS[®]

Usage

- SKPOS[®] usage

- Surveying fields (cadastre, surveying, mapping, GIS) - **92%**
- Other fields - **8%**



- surveying, cadastral, cartography geodesy and GIS
- other than surveying, cadastral, cartography geodesy and GIS

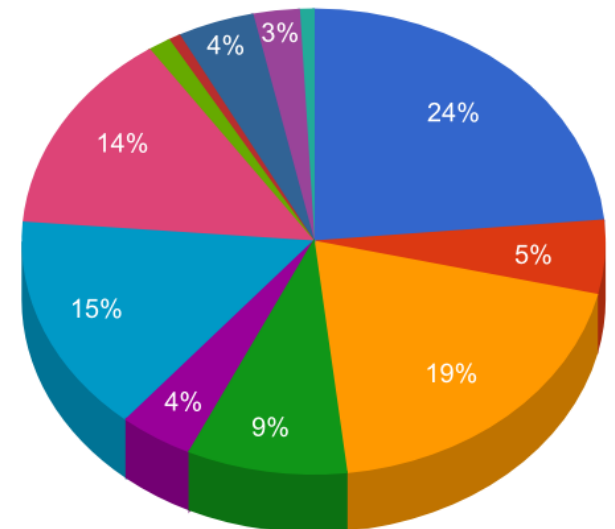
SKPOS®

Usage

■ SKPOS® usage

■ Surveying fields (cadastre, surveying, mapping, GIS) - 92%

■ Cadastre	24%
■ Engineering - construction	19%
■ Mapping – thematic maps	15%
■ Mapping – different activity	14%
■ Engineering – road construction	9%
■ Land consolidation	5%
■ GIS – data collection	4%
■ Engineering – control and deformation measurements	4%
■ GIS - thematic maps	3%
■ Terrestrial photogrammetry and scanning	1%
■ Aerial photogrammetry and scanning	1%
■ Other	1%



SKPOS[®]

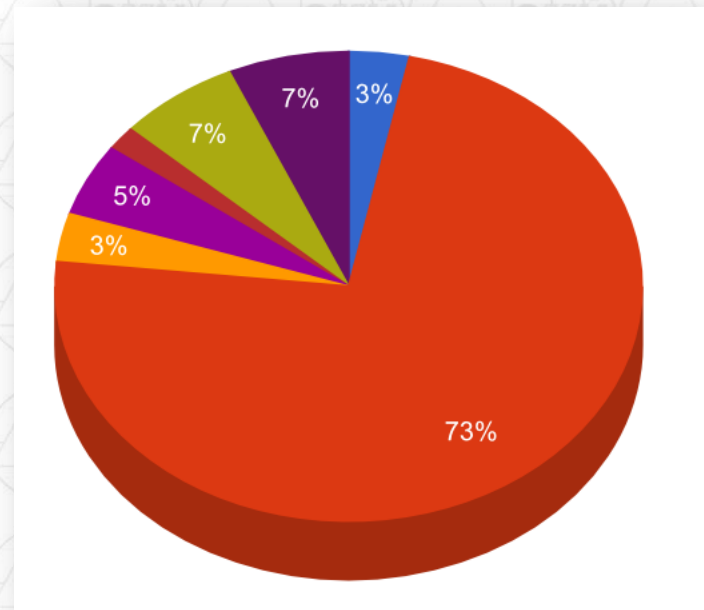
Usage

■ SKPOS[®] usage

- Other fields - 8%

Other than surveying, cadastre, cartography, geodesy, GIS etc.

■	Precise farming	73%
■	Other	7%
■	Pipeline transport	7%
■	Mining	2%
■	Construction – control of machines	3%
■	Air transport	3%



SKPOS®

Portal and registration to the service

<http://skpos.gku.sk/RegisterAccount.aspx>

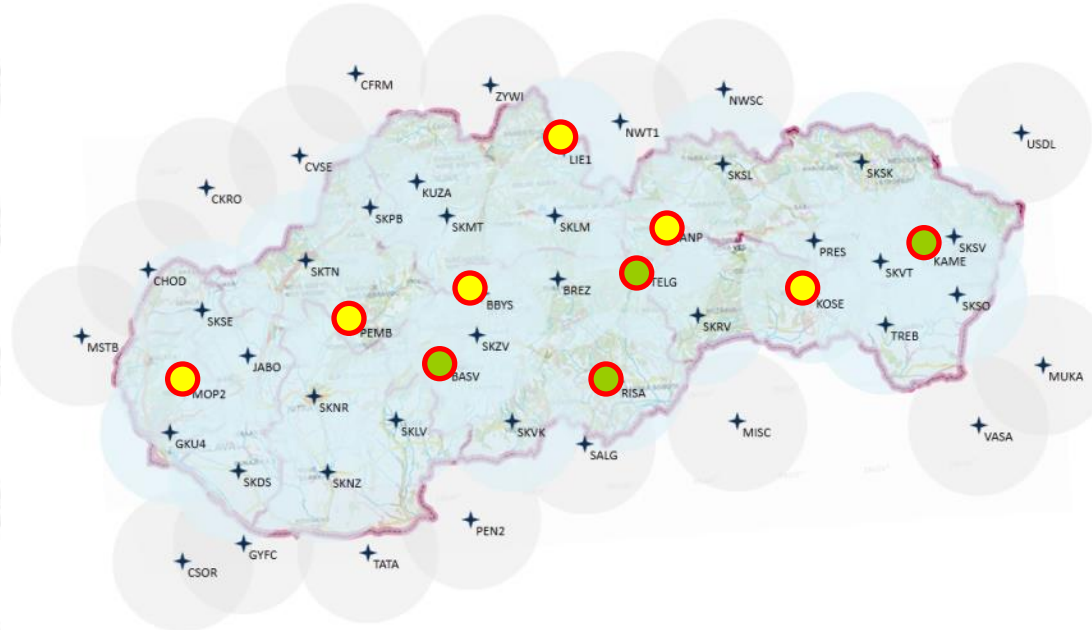
The screenshot shows a web browser window displaying the SKPOS registration page. The browser's address bar shows the URL `skpos.gku.sk/RegisterAccount.aspx`. The page features the SKPOS logo at the top left and the GKÚ Bratislava logo at the top right. A yellow banner below the logos reads "Portál Slovenskej priestorovej observačnej služby GNSS". On the left side, there is a navigation menu with a red box highlighting the "Registrovať" (Register) option. The main content area is titled "Vytvoriť účet" (Create account) and "Registrovať nový účet" (Register new account). It contains a form for "Osobné údaje" (Personal data) with the following fields: Meno (Name), Priezvisko (Surname), Adresa (Address), PSC (Postal code), Mesto (City), Kraj (Region), Štát (Country), E-mail, Ďalší e-mail (Additional email), Tel. číslo domov (Home phone number), Tel. číslo do práce (Work phone number), Číslo mob. telefónu (Mobile phone number), GSM číslo pre TNC (GSM number for TNC), and Jazyk (Language) set to "<Nič/Implicitné>". A "Ďalší" (Next) button is located at the bottom right of the form. The footer of the page includes the text "KONTAKT NÁPOVEDA © COPYRIGHT 2014, TRIMBLE NAVIGATION". The Windows taskbar at the bottom shows the system clock as 10:57 on 15. 9. 2014.



Contribution with **SKPOS**[®] data to research and
development

Own (GKÚ) activities

GKU run **SKPOS**[®] stations for geodynamics purposes



10 special Pilier/pier & deep drilled braced monumentation



Routine precise **SKPOS**[®] data processing on GKÚ

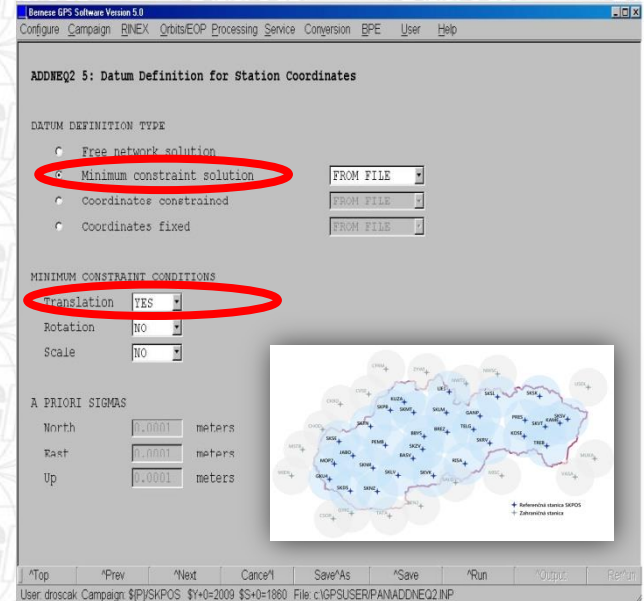
- Precise GNSS data processing
 - Scientific Bernese GNSS software v5.2
 - ITRS (ITRF2008)
 - Antenna absolute phase center models
 - Precise IGS ephemerids
 - GPS+GLONASS

■ Adjustment

- Minimal Constraint – no net translation condition on the selected EPN stations

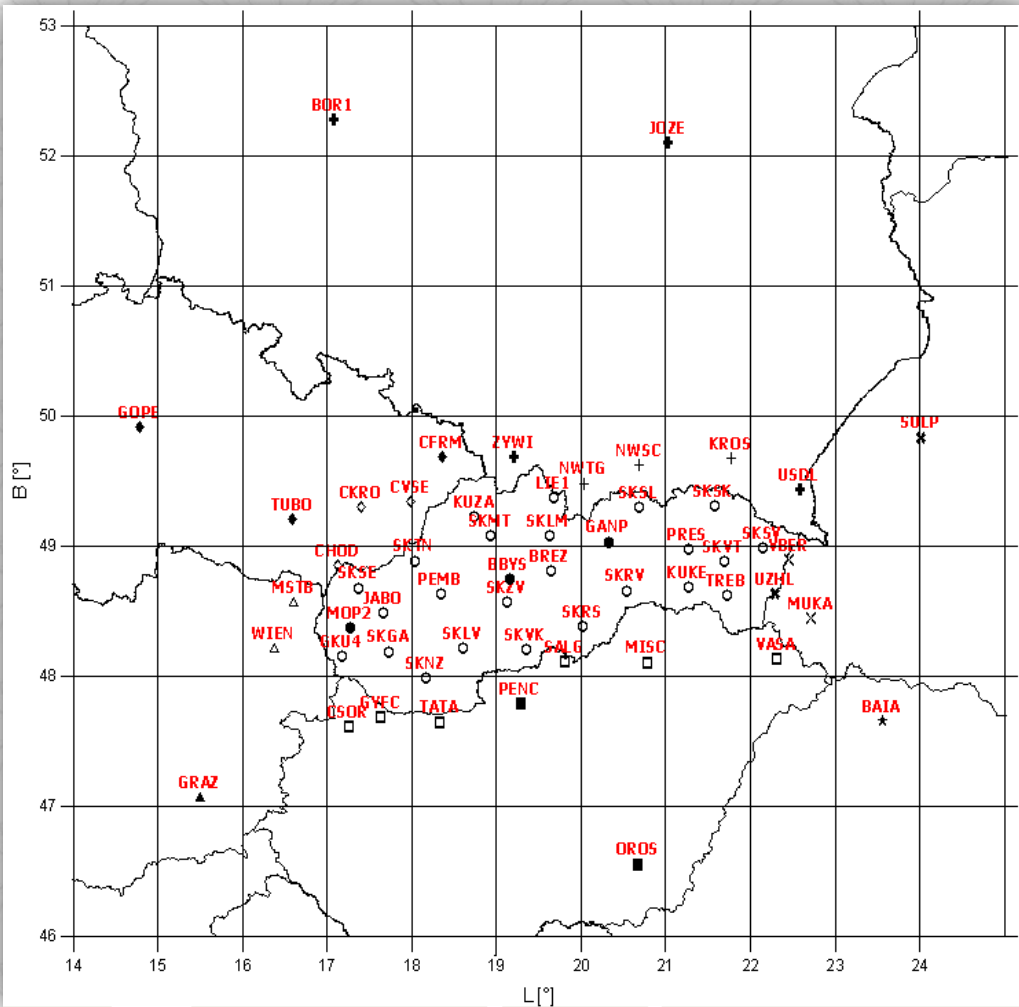
■ Results

- SINEX files
- XYZ coordinates + covariancies



Precise **SKPOS**[®] data processing

Processing network

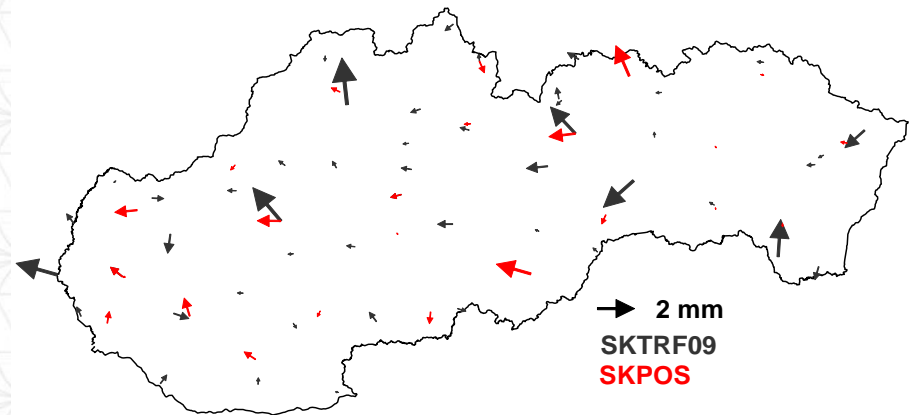


■ SKPOS int	30/1 EPN
◆ SKPOS ext	2/2 EPN
▲ APOS	3/1 EPN
■ GNSNet.hu	8/2 EPN
● CZEPOS	6/3 EPN
■ ASG-EUPOS	7/4 EPN
▲ ZAKPOS	3/1
■ EPN	2
<hr/>	
Total	61 stations

Contribution to geokinematics of Slovakia

Scheme of processing

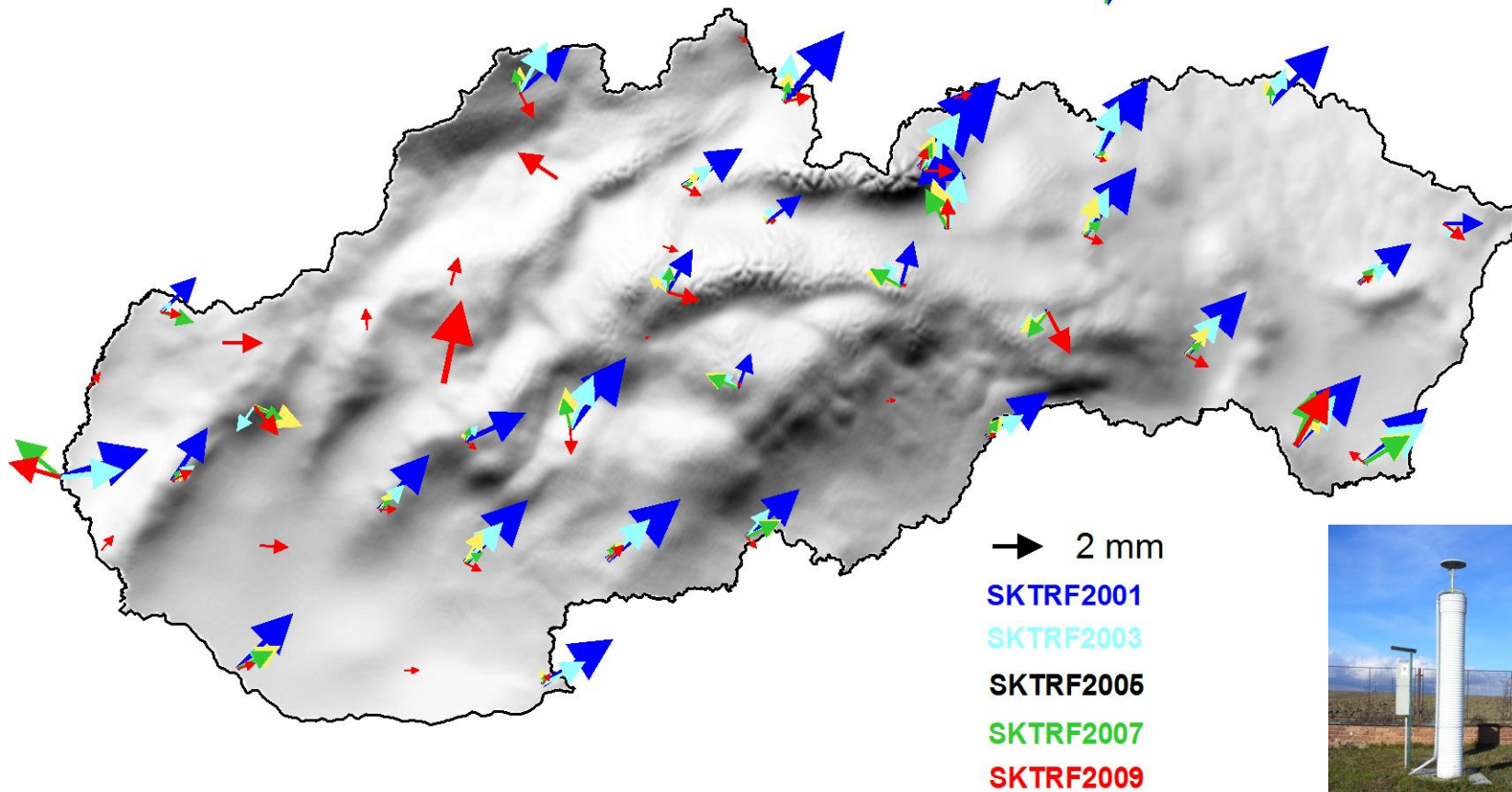
- **1. Trend estimation** = interplate velocities estimation
(Estimated station velocities represents motions of particular)
- **2. Velocities visualization via vector field**
 - Hz plane
 - V plane
- **3. Motions interpretations**



Slovakia geodynamics

Example of the result

Development of Interplate velocities (Horizontal)





Contribution with **SKPOS**[®] data to research and development

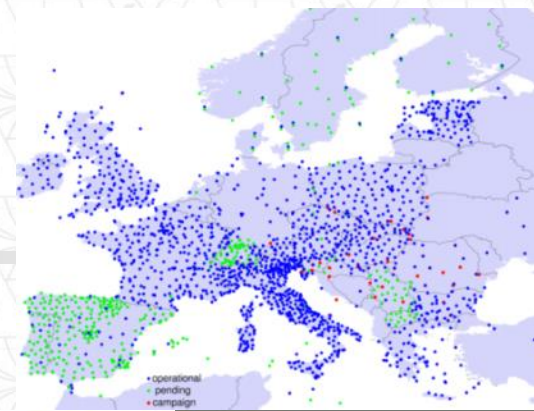
Collaboration with other institutions

SKPOS®

active part of **EUPOS®**

European Position Determination System

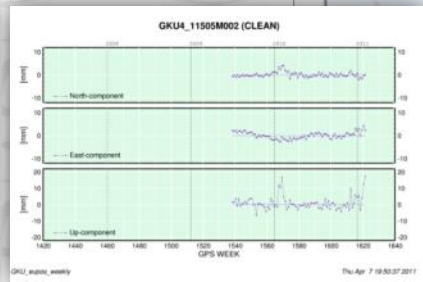
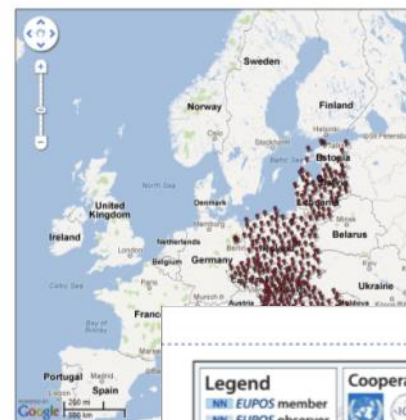
- Follows *EUPOS* initiative standards
- Keeps information in *EUPOS* station database
- Contributes to *EUPOS* combination centre (SINEX GKU)
- Leads EUPOS working group on service monitoring



EUPOS®
European Position Determination System

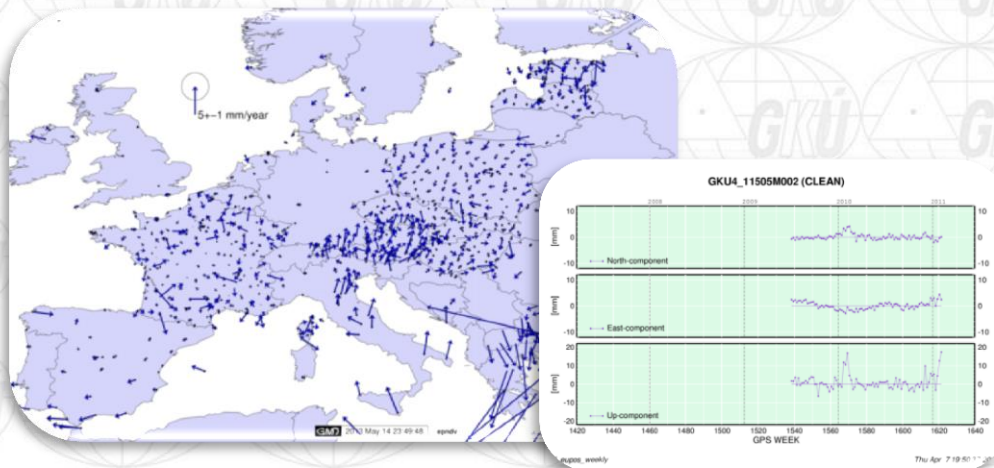
Station Database

Map of EUPOS Reference Stations



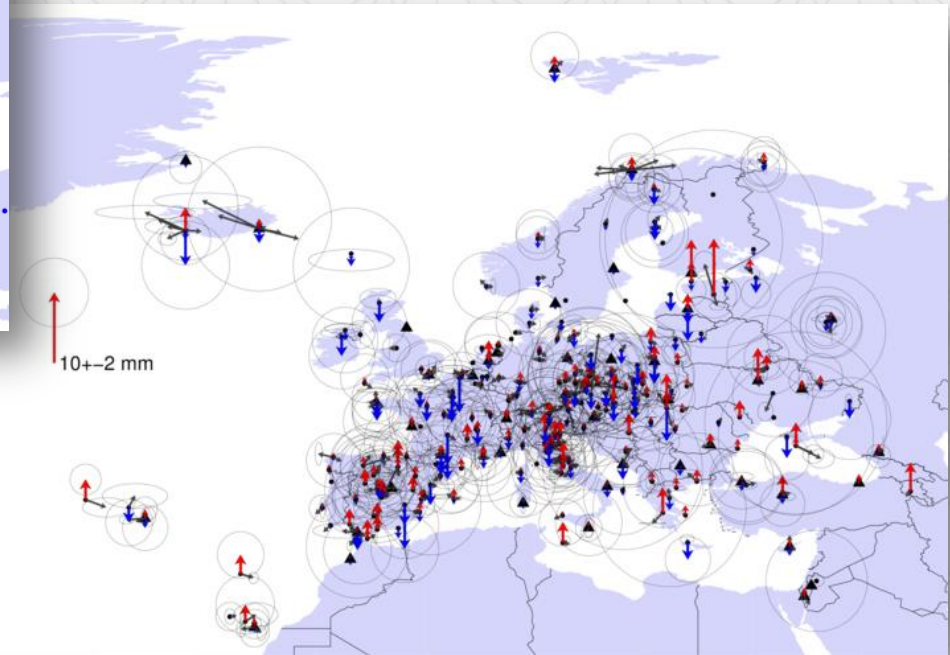
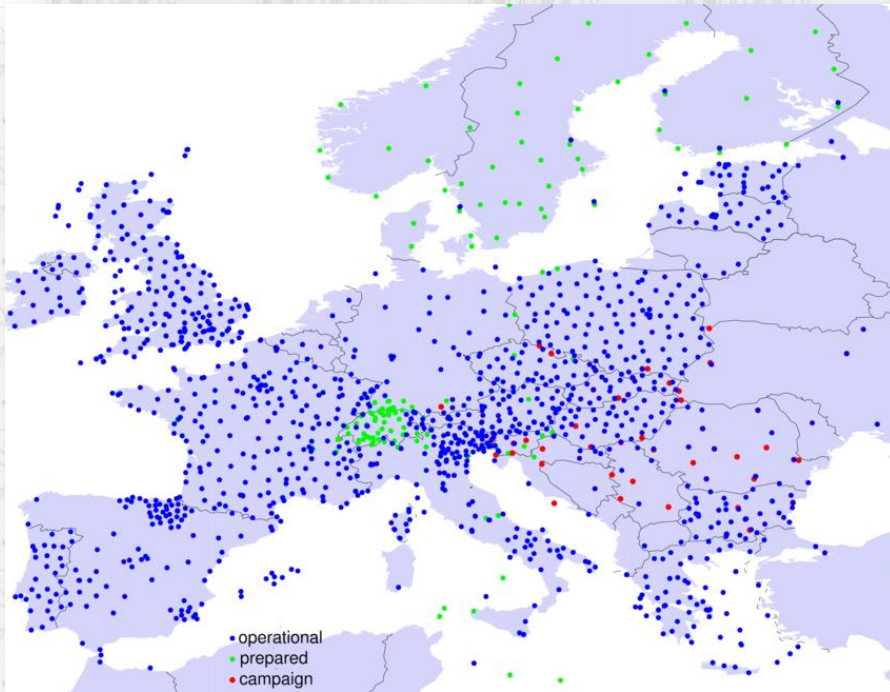
Contribution to „European“ geokinematics

- GKU contributes to ECC = *EUPOS* Combination Center
 - SINEX files with GKU acronym: **GKUwww7.SNX**
- ECC aim
 - Creation of European interplate velocity model = base for the new ETRS89 definition
- ECC leader: Ambrus Kenyeres (FOMI - Hungary)



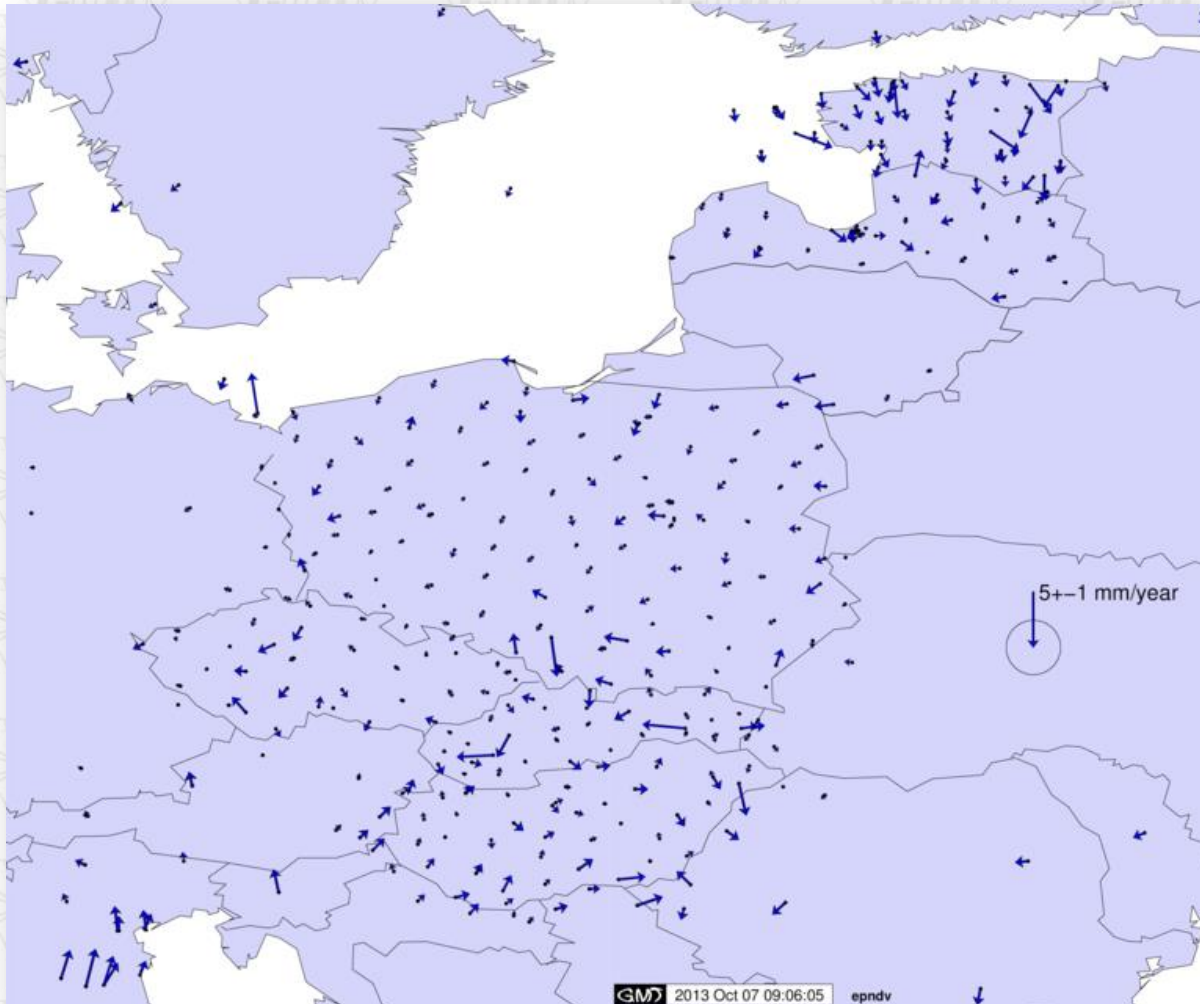
Contribution to „European“ geokinematics

A.Kenyeres (from status report – October 2013)



Contribution to „European“ geokinematics

A.Kenyeres (from status report – October 2013)



- ECC results:
 - agreed with GKÚ solution
 - confirm that permanent stations on buildings can help to European geokinematics
 - confirm that central Europe is stabile part of Eurasian tectonic plate

Activities related to EUREF Permanent Network

SKPOS[®] contribution to EPN and IGS

EPN CB
HOME

EUREF PERMANENT NETWORK

ROB *****
GNSS RESEARCH GROUP *****
EUREF 

Contribution to EPN, IGS

Daily and hourly observation and navigation data - RINEX 2.11 including L5, RINEX 3.02

EUREF-IP project

Observation data from GANP in Real-time – NTRIP protocol, RTCM 3.1.

GANP

- Od: 2003
- GPS, GLONASS,
- Galileo, BeiDou
- EPN, IGS, EUREF-IP
- Admin: GKÚ



Locate station on map

- Select a station -

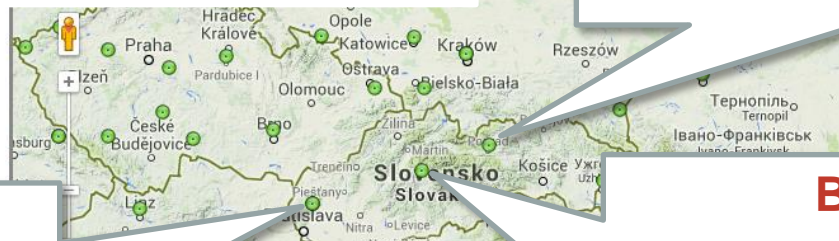
Station criteria selection

Receiver manufacturer:

AOA
ASHTECH
JAVAD

Antenna manufacturer:

3S NAVIGATION
AOA
ASHTECH



MOP2

- Od: 2008
- GPS, GLONASS,
- Galileo, BeiDou
- EPN
- Admin: STU



BBYS

- Od: 2007
- GPS, GLONASS,
- Galileo, BeiDou
- EPN
- Admin: GKÚ + TOP



SKPOS[®] contribution to „National center for diagnosing the earth surface deformations in Slovakia“ project

<http://www.geokinematika.sk>

The screenshot displays the website for the National Center for Diagnosing the Earth Surface Deformations in Slovakia. The page includes a navigation menu, a header with logos of supporting organizations (Ministry of Education, Science and Sports, and the European Union), and a main content area with a sidebar. The sidebar lists sections: ABOUT THE PROJECT, MONITORED SITES NETWORK, SATELLITE AND GRAVIMETRIC MEASUREMENTS ANALYSIS, PROJECT OUTPUT, and CONTACT. The main content area provides details about the project's aim, output, and measurement methods. A map titled "Sieť monitorovaných bodov" (Network of monitoring points) shows the geographical distribution of 9 monitoring stations in Slovakia, with labels for Liesek, Lomnický štít, Gánovce, Telgárt, Kamenica n. Cirochou, Partizánske, Banská Bystrica, Banská Štiavnica, and Rimavská Sobota. The map uses a coordinate system of latitude and longitude.

WE SUPPORT RESEARCH ACTIVITIES IN SLOVAKIA
THE PROJECT IS CO-FINANCED FROM THE EU
SOURCES

Agentúra
Ministerstva školstva, vedy, výskumu a športu SR
pre štrukturálne fondy EÚ

NATIONAL CENTER FOR DIAGNOSING THE EARTH SURFACE
DEFORMATIONS IN SLOVAKIA

ITMS: 2622020108

START OF THE PROJECT: 1 DECEMBER 2010 / END OF THE PROJECT: 30 NOVEMBER 2013

ABOUT THE PROJECT

MONITORED SITES NETWORK

SATELLITE AND GRAVIMETRIC MEASUREMENTS ANALYSIS

PROJECT OUTPUT

CONTACT

ABOUT THE PROJECT

The aim of the National Center For Diagnosing the Earth Surface Deformations in Slovakia is to identify the Earth surface deformations on the basis of research results by applying the satellite, gravimetric and tropospheric measurements.

The output of the national center is a permanently updated database of earth crust dynamics in Slovakia focused on determination of risk areas for construction and monitoring of large structures.

The national center carries out the measurements of geometric and physical variations on the Earth's surface on 9 reference stations of the monitoring network.

The position variations at all sites of the monitoring network and absolute and relative gravimetric measurements are carried out vertical deformation information.

Sieť monitorovaných bodov

Zemepisná šírka (°)

Zemepisná dĺžka (°)

Liesek, Lomnický štít, Gánovce, Telgárt, Kamenica n. Cirochou, Partizánske, Banská Bystrica, Banská Štiavnica, Rimavská Sobota

Copyright © 2014 Národné centrum diagnostikovania deformácií zemského povrchu na území Slovenska



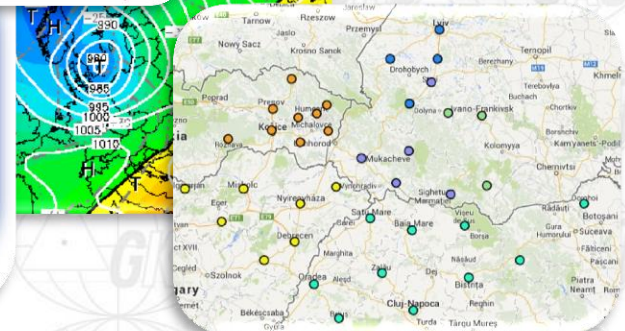
Contribution with **SKPOS**[®] data to research and
development

Planned activities

Planned collaboration with Vihorlatská hviezdáreň

SES project

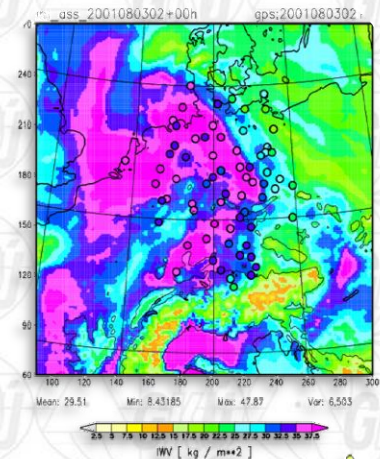
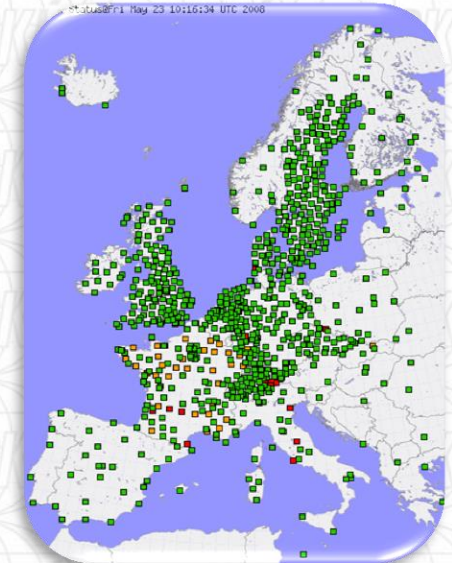
- Collaboration between GKÚ and Vihorlatska hviezdareň
- Agreement prepared for signature
- KOLS permanent station will be part of **SKPOS**[®]
- GKU plan to support SES project with:
 - KOLS permanent station data provision
 - 8 **SKPOS**[®] permanent stations



<http://www.meteognss.net/>

Planned contribution to E-GVAP programme

- E-GVAP = The EUMETNET GNSS water vapour programme
- GKU plan to
 - contributes with **SKPOS**[®] data to computation of water vapour above the **SKPOS**[®] sites in NRT
 - computes and sends ZTD data to E-GVAP centers for water vapour computations



EUMETNET

The Network of European Meteorological Services

Planned contribution to MGEX project

- GKU plan to
 - contributes with **SKPOS**[®] station GANP to MGEX (Multi GNSS experiment project)
- MGEX
 - IGS scientific project to track, collate and analyze all available GNSS signals. Analysis centers will attempt to estimate inter-system calibration biases, compare equipment performance and further develop processing software capable of handling multiple GNSS observation data

The MGEX Network

An overview of the current MGEX network is shown in the map below. For detailed information on individual stations see the [IGS station list](#). The latest MGEX site logs are available from the [IGS MGEX site log archive](#).





Conclusion

- As you could see in the slides before, **SKPOS**[®] is not only the positioning service for Slovakian land surveyors but with its data from permanent stations also contributes to different research and developments projects and activities
- It is planned to continue in those activities, because there is no other public network in Slovakia which will be able to do this
- From this point of view we can said, that GKU (with **SKPOS**[®] data) is successful supporter of different useful R&D projects and programmes



**Thank you for your
attention**

Geodetic and Cartographic Institute BRATISLAVA

branislav.droscak@skgeodesy.sk