



# LAND SURVEY OFFICE

**C Z E P • S**

*EUPOS 2023*

**Land Survey Office, Department of Geodetic Control**

**Jan Řezníček**

# Administration of CZEPOS network

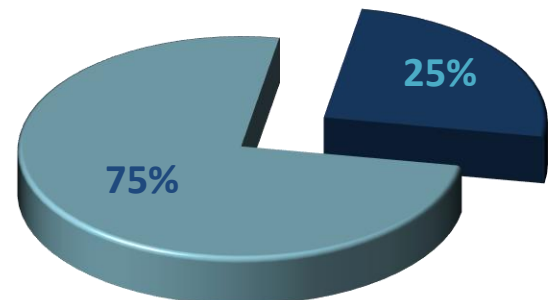
- 28 Czech stations
- 27 neighboring stations
- real-time services
- post-processing products



**2023/11: 2610 users**  
**+270 since last year**

since 2023: support in legislative  
 (Act No. 200/1994 on land surveying)  
 CZEPOS is legally part of geodetic control

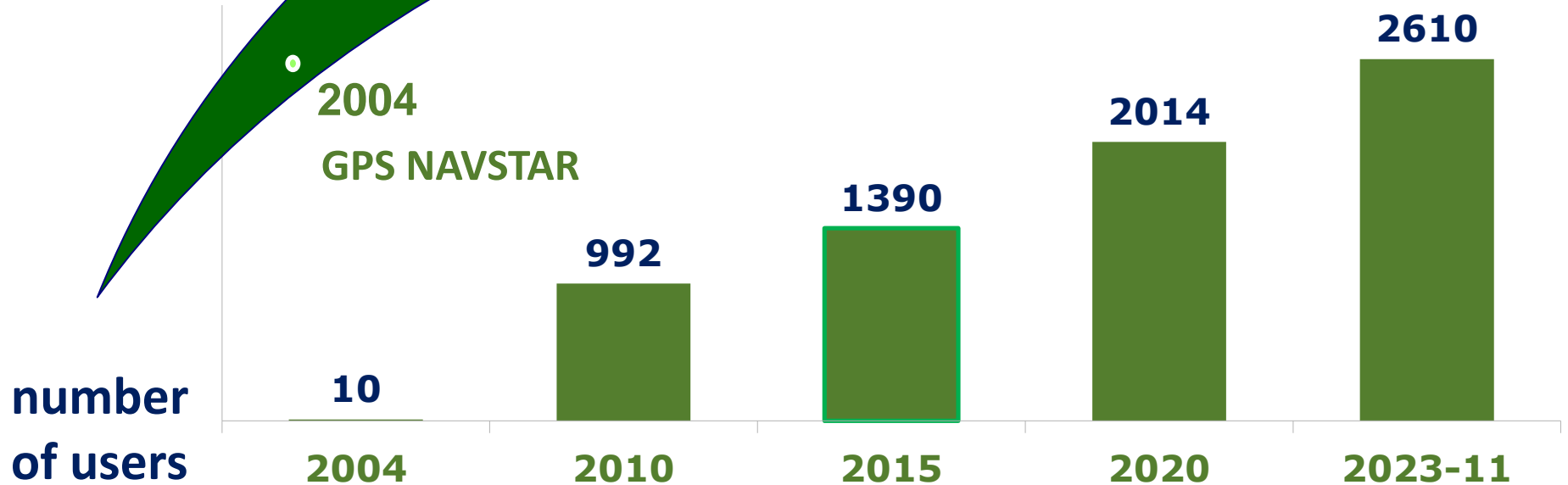
- private sector
- public sector



# Administration of CZEPOS network



compatibility of CZEPOS services with  
global navigation satellite systems



2004

GPS NAVSTAR

10

2004

992

2010

1390

2015

2014

2020

2610

2023-11

2012

GLONASS

2017/18/19

GALILEO

BeiDou

# Receivers and Antennas

## Leica GR30

- 2018 first 8 stations
- 2019 remaining 17 stations



## Leica AR25

- since 2012





# Firmware Upgrade in 2023




since april 2023 – receiving new GNSS frequencies after a firmware upgrade (BeiDou III. generation)

GR30 - 4.61.290 | CPRG | 2023-05-23 14:05:14

[Domů](#) | [Stav](#) | [Správa GNSS](#) | [Nastavení přijímače](#) | [Pomoc](#) | [Podpora](#)

Správa GNSS

## Příjem

Obecné	GPS	GLONASS	GALILEO	BEIDOU	QZSS	
<b>Družicové systémy</b>						
GPS	Aktivní <input type="checkbox"/>	<input checked="" type="checkbox"/> L1	<input checked="" type="checkbox"/> L1C	<input checked="" type="checkbox"/> L2P(Y)	<input checked="" type="checkbox"/> L2C	<input checked="" type="checkbox"/> L5
GLONASS	Aktivní <input type="checkbox"/>	<input checked="" type="checkbox"/> L1	<input checked="" type="checkbox"/> L2P	<input checked="" type="checkbox"/> L2C	<input checked="" type="checkbox"/> L3	
GALILEO	Aktivní <input type="checkbox"/>	<input checked="" type="checkbox"/> E1	<input checked="" type="checkbox"/> E5a	<input checked="" type="checkbox"/> E5b	<input checked="" type="checkbox"/> AltBOC	<input checked="" type="checkbox"/> E6
BEIDOU	Aktivní <input type="checkbox"/>	<input checked="" type="checkbox"/> B1I	<input checked="" type="checkbox"/> B1C	<input checked="" type="checkbox"/> B2a	<input checked="" type="checkbox"/> B2b	<input checked="" type="checkbox"/> B2I <input checked="" type="checkbox"/> B3I
QZSS	Aktivní <input type="checkbox"/>	<input checked="" type="checkbox"/> L1	<input checked="" type="checkbox"/> L1C		<input checked="" type="checkbox"/> L2C	<input checked="" type="checkbox"/> L5
NavIC	Neaktivní <input type="checkbox"/>					<input type="checkbox"/> L5
SBAS	Aktivní <input type="checkbox"/>	Přij. druž. syst.: <input type="checkbox"/>		Automaticky <input type="checkbox"/>		

so far included only in RINEX files



# Software

**GNSS Spider**

File View Management SkyPlot Tools Window Help

Management

- C1d
- Sites
- Brno
- Ceske Budejovice
- Domazlice
- Frydek - Mistek

Elevation mask 0°

Last change 23:37:17 / Receive data / Orbits

Tracking Sensor RTCM

Sat	G02	G05	G08	G16	G18	G20	G25	G26	G27	G29	G31	R01	R02	R03	R09	R10	R17	R18	R19	R20	E04	E13	E15	E21	E27	E30	E34	E38	C02	C05	C08	C11	C12	C13	C19	C21	C22	C23	C24	C25	C34	C38	C43	C44	C80					
SNR(L1)	51	49	39	48	51	43	45	50	40	50	39	48	45	51	44	39	49	39	37	37	42	50	53	49	53	52	52	34	39	43	49	48	47	45	43	46	50	48	52	52	47	49	50	43	-	-	-	-	-	
L1/B1/E1	48	44	36	40	53	34	41	51	36	46	46	32	40	39	51	-	38	49	47	35	33	45	54	45	54	51	53	31	38	42	45	53	52	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
L2/B2/E2	-	-	37	-	57	-	47	55	40	-	-	-	-	-	-	-	-	-	-	-	37	48	57	48	57	53	55	33	34	41	44	51	51	46	42	38	43	49	45	51	51	43	46	48	40	-	-	-	-	-
L5/E5a/B3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E5ab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	48	57	48	57	53	55	33	34	41	44	51	51	46	42	38	43	49	45	51	51	43	46	48	40	-	-	-	-	-
Elev[1]	58	27	0	29	65	10	15	59	8	51	32	4	14	4	69	27	1	47	78	18	1	20	71	23	74	43	49	0	5	20	34	81	83	45	7	3	13	38	18	58	83	21	32	39	5	-	-	-	-	-
Az[1]	64	65	338	305	176	33	136	292	267	70	222	348	40	88	280	324	50	40	281	235	348	217	189	310	275	145	55	44	105	127	41	249	66	57	24	120	73	304	170	231	268	37	248	64	111	-	-	-	-	-

Content	Date/Time	User	Category	Text
All	12.11.2022 23:34:38	Spider Server	Sensor	Site 'Polom' Log message: Position received with incoming RTCM data stream differs from site position.
All Sites	12.11.2022 23:34:58	Spider Server	General	Ephemeris data updated. BDS Satellite: 26, IODE: 9, Time: 11-12-2022 21:00:14, Unhealthy (1).
Query (Offline)	12.11.2022 23:35:46	Spider Server	General	Ephemeris data updated. BDS Satellite: 26, IODE: 9, Time: 11-12-2022 21:00:14.
	12.11.2022 23:36:18	Spider Server	Sensor	Site 'Polom' Log message: Position received with incoming RTCM data stream differs from site position.
	12.11.2022 23:36:58	Spider Server	General	Ephemeris data updated. BDS Satellite: 26, IODE: 9, Time: 11-12-2022 21:00:14, Unhealthy (1).

For Help, press F1

0/55 Remote User level: Administrator NUM Local time : 23:37:11 OK

## Leica GNSS Spider

- Primary installation – 12 months a year
- Secondary installation – 1 month a year

# Galileo/BeiDou RINEX3 services since 2021

The screenshot shows the CZEPOS RINEX Data interface. At the top, there is a navigation bar with 'Home / Post Processing / RINEX Data'. A sidebar on the left contains icons for home, user, and search. The main content area displays 'RINEX Data' and a progress indicator 'DOSTUPNOST DAT 17.47%' for a 30-day period. A text block explains the service: 'Tato služba umožňuje požadovat data ve formátu RINEX v. 3.x. Původní interval observací je 1 s a původní délka souboru je 15 min. Přizpůsobení výstupního intervalu observací a slučování souborů je podporováno. Maximum 960 souborů může být stahováno nebo (pokud je možno) slučováno v rámci jednoho požadavku.' Below this is a date range selector from '2021-04-07 8:30' to '2021-04-07 09:00' and a '00:30 h' duration. A search bar contains '(Název projektu)' and 'Hledání Stanic'. A 'Virtuální RINEX' checkbox is present. A table lists station data with columns for station name, equipment, and file count. A red arrow points to the checked checkbox for the CSVI station.

Station	Equipment	Files	Completion	Selected
CRAK	LEIAR25.R4 LEIT	2 Soubory	(100.00%)	<input type="checkbox"/>
CSUM	LEIAR25.R4 LEIT	2 Soubory	(100.00%)	<input type="checkbox"/>
CSV I	LEIAR25.R4 LEIT	2 Soubory	(100.00%)	<input checked="" type="checkbox"/>

till 2021: Leica SpiderWeb software:

since 2021: Leica X-Pos software:

only RINEX2 (GPS+GLO)

only RINEX3 (GPS+GLO+GAL+BDS)

# Administration of CZEPOS network

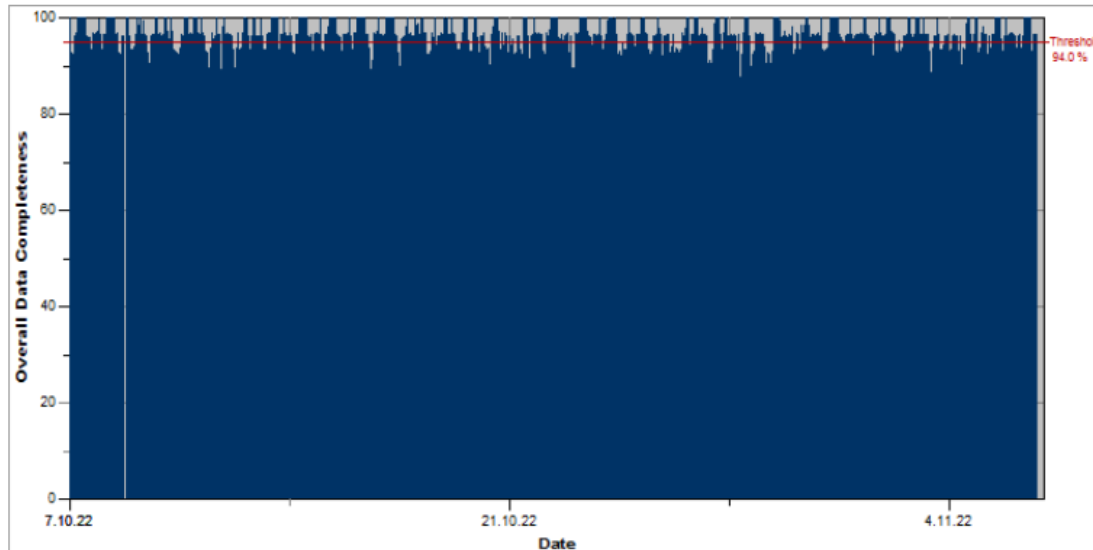


Home / Kvalita stanice

## Praha Quality Plots

[Site Overview](#) | [Quality Plots](#) | [File Summary](#) | [File Availability](#)

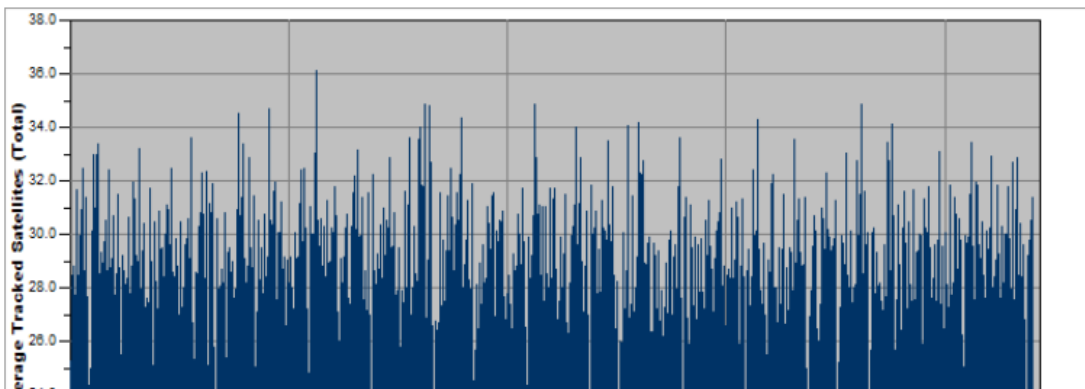
**Overall Data Completeness:** More than 94% complete epochs/observations indicates normal operation.



• monitoring of quality

part of  
Leica X-Pos software

**Number of Satellites (Total):** The number of satellites should be 5 or greater for high accuracy positioning.





# New prices since 2017

DGPS Differential GPS	<ul style="list-style-type: none"><li>• DGPS</li></ul>	<i>20 Kč (0.78 €) / 1 hour</i>
RTK Real Time Kinematic	<ul style="list-style-type: none"><li>• RTK</li><li>• RTK3-GG</li><li>• RTK3-NS-GG</li></ul>	<del>80 Kč (3.13 €) / 1 hour</del> <b>60 Kč (2.35 €) / 1 hour</b>
VRS Virtual Reference Station	<ul style="list-style-type: none"><li>• RTK-PRS</li><li>• RTK-FKP</li><li>• VRS3-MAX, VRS3-iMAX</li><li>• VRS3-MAX-GG, VRS3-iMAX-GG</li><li>• VRS-MAX-GG_L4G</li><li>• VRS-iMAX-GG_CMR, VRS-iMAX-GG_CMR+</li><li>• VRS3-VirtualRS-GG</li></ul>	<del>80 Kč (3.13 €) / 1 hour</del> <b>60 Kč (2.35 €) / 1 hour</b>

# New prices since 2017

## Real-time services:

### - fixed monthly payment

RTK-PRS, RTK-FKP, MAX, iMAX, MAX-GG, iMAX-GG,  
RTK, RTK3-NS, RTK3-GG,  
DGPS

~~6 000 Kč (234.74 €)~~

**1 000 Kč (39.12 €)**

### - fixed annual payment

RTK-PRS, RTK-FKP, MAX, iMAX, MAX-GG, iMAX-GG,  
RTK, RTK3-NS, RTK3-GG,  
DGPS

~~25 000 Kč (978.09 €)~~

**10 000 Kč (391.24 €)**

## Post-processing products:

data interval: 1 – 4 seconds

~~80 Kč (3.13 €)~~ **50 Kč (1.96 €)**

5 – 9 seconds

~~16 Kč (0.63 €)~~ **10 Kč (0.39 €)**

10 – ... seconds

~~8 Kč (0.31 €)~~ **5 Kč (0.20 €)**

computation service

**free of charge**

till 2023: prices listed in the price list of Land Survey Office

since 2023: prices implemented in legislative

(„land surveying“ decree 31/1995 Coll.)

# CZEPOS – cooperation with dealers since 2021

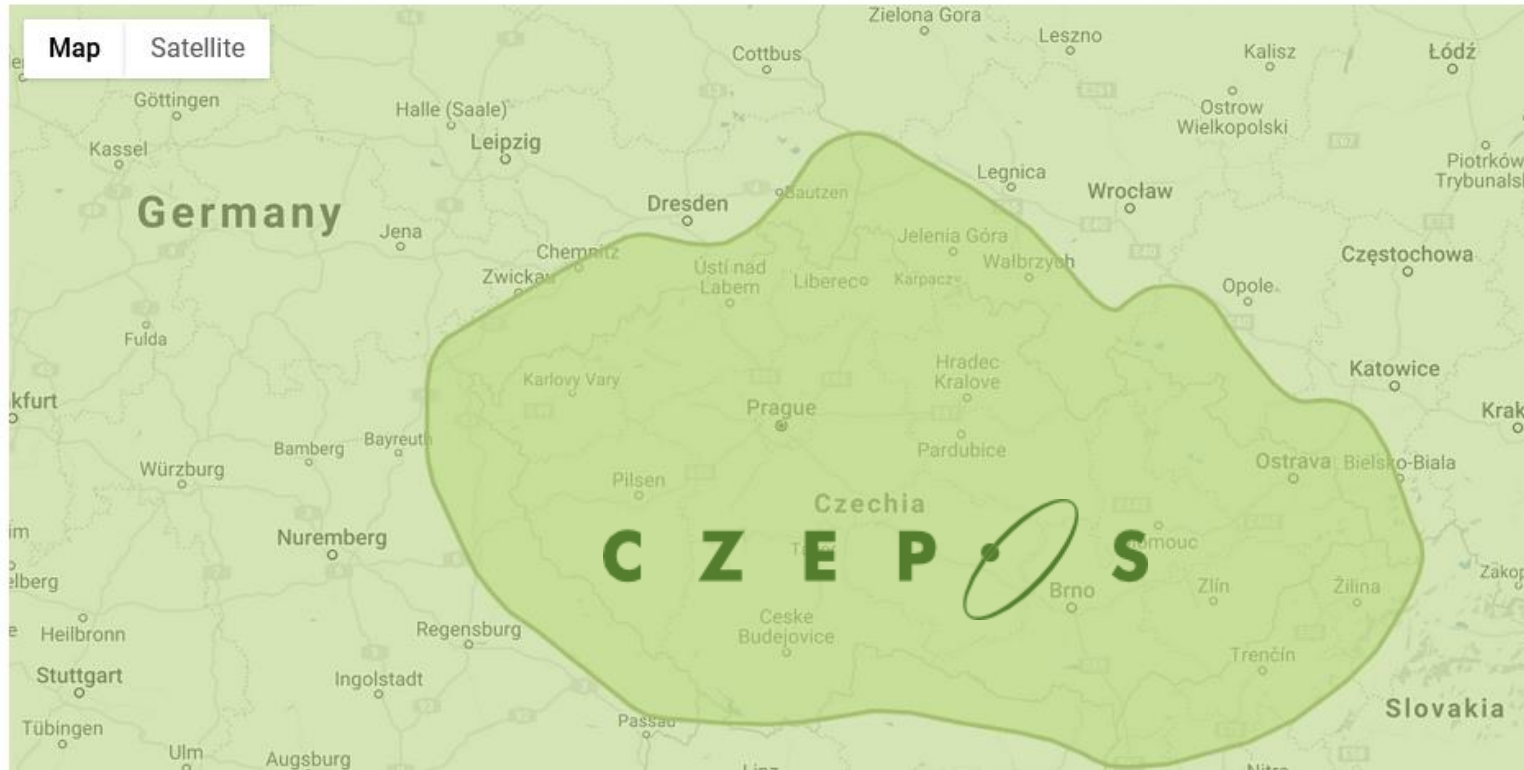


HxGN SmartNet

Služby Podniky Aplikace Jak to fu


Domů > Pokrytí

## Pokrytí



# CZEPOS data within CzechGeo/EPOS project

- 28 Czech stations
- 27 neighboring stations

- 7 stations involved in EUREF - EPN 
- cooperation within projects: EUPOS, EPOS, GISCAD-OV





# CZEPOS data within CzechGeo/EPOS project



Logged in as (jan.reznicek@cuzk.cz)



## GNSS data portal

This web portal provides access to

- GNSS station metadata ("site-logs")
- GNSS measurement data files
- GNSS data quality monitoring

**data flow from CZEPOS  
interrupted in 2023**



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## GNSS data

The [GNSS data portal](#) is used to provide data measured by permanent GNSS stations (Global Navigation Satellite System). It contains:

- Metadata about GNSS stations ("site-logs")
- GNSS measurement files
- GNSS data quality control

Access is provided for permanent GNSS stations from four networks that are connected to the CzechGeo infrastructure (GEONAS, PPGNet, VESOG and WEBGEODYN) and one network cooperating with CzechGeo (CZEPOS). The data is available in daily files in the standard RINEX format (version 2.11 or 3.x) with a recording interval of 30 seconds. For data with a shorter recording interval (1 second, for some stations 10 Hz), please contact the responsible person. The data are available only for research and academic purposes within the CzechGeo/EPOS infrastructure. Information on the use of data is collected, including links to relevant publications.

# CZEPOS data within GISCAD-OV project



Co-funded by the Horizon 2020 programme of the European Union



European Global Navigation Satellite Systems Agency

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## Scope and Objectives

The main scope of the GISCAD-OV is to design, develop and validate an innovative and cost-effective High Accuracy Service for Cadastral Surveying applications, based on GPS+Galileo High Accuracy Services (HAS) and Precise Point Positioning-Ambiguity Resolution quick convergence (PPP-AR) advanced techniques.



Work Plan



Work Packages



GANTT Chart

2022/09 – field campaign



# CZEPOS data within GISCAD-OV project

## PPP-RTK - RTK surveyors / control points

place	point number	type	method	dN  {cm}	dE  {cm}	dp {cm}	dH  {cm}
Prague	101, 885-3	DP	PPP-RTK	0,2	1,1	1,1	1,0
Prague	102(0179)	DP	PPP-RTK	4,7	1,4	4,9	3,8
Prague	1000	GP	PPP+HAS	1,0	3,0	3,1	3,0
Prague	103(184)	DP	PPP-RTK	1,4	0,1	1,4	5,8
Prague	1001	GP	PPP-RTK	3,0	1,0	3,1	7,5
Prague	29(V zahorskem)	TP	PPP-HAS	2,1	1,0	2,4	0,6
Prague	201(0010)	DP	PPP-HAS	2,8	1,7	3,3	9,4
Prague	202(0037)	DP	PPP-RTK	0,9	2,4	2,6	9,0
Prague	203(0003)	DP	PPP-RTK	1,3	6,1	6,2	9,9
Prague	205(0021)	DP	PPP-RTK	4,5	0,7	4,6	7,3
Prague	204(4576-11)	DP	PPP-RTK	4,5	0,0	4,5	2,6
Prague	206(4576-2)	DP	PPP-RTK	13,4	4,1	14,1	12,1
Prague	2001	GP	PPP-RTK	1,0	2,2	2,5	4,0
Hradec	4004	GP	PPP-RTK	0,9	5,6	5,6	11,1
Hradec	4001	GP	PPP-RTK	1,4	2,3	2,7	246,6
Hradec	2	DP	PPP-RTK	11,1	6,6	12,9	9,2
Hradec	1	DP	PPP-RTK	0,2	0,8	0,8	34,3
Hradec	3	DP	PPP-RTK	0,6	6,8	6,8	28,0
Hradec	4003	GP	PPP-HAS	3,9	4,0	5,6	13,7

## all points excluding the error ones:

n	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
35	4,2	3,2	3,7	12,9

Hi							11,2
Hi							8,9
Rol							17,8
Rol							22,4
Rol							23,4
Rol							12,4
Rol							9,0
Rokytnice	4	DP	PPP-RTK	1,2	4,8	5,0	12,0
Rokytnice	6	DP	PPP-RTK	8,8	1,4	8,9	14,1

Accuracy:

all points:

n	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
36	24,9	11,0	19,2	38,3

all points excluding the error ones:

n	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
35	4,2	3,2	3,7	12,9

only trigonometric points:

n	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
4	3,3	2,3	2,9	7,5

advantage:

- sparser network of permanent stations

disadvantage:

- so far 10 min fixation on 1 point
- specially modified GNSS receiver

# CZEPOS data within GISCAD-OV project

## PPP-HAS - RTK surveyors / control points

place	point number	type	method	dN  {cm}	dE  {cm}	dp {cm}	dH  {cm}
Prague	1000	GP	PPP+HAS	1061,6	713,8	1279,2	52,5
Prague	1001	GP	HAS	40,0	51,5	65,2	455,7
Prague	1001	GP	PPP-HAS	3,7	17,4	17,8	130,0
Prague	1000	GP	PPP-HAS	28,0	2,2	28,0	70,2
Prague	29(V zahorskem)	TP	PPP-HAS	14,1	42,2	44,5	167,6
Prague	201(0010)	DP	PPP-HAS	15,6	5,0	16,4	29,9
Hradec	4003	GP	PPP-HAS	4,0	1,3	4,3	113,4
Hradec	4002	GP	PPP-HAS	20,0	88,3	90,6	341,9
Hradec	50(U procharny)	TP	PPP-HAS	9,1	65,9	66,5	36,2
Rokytnice	4001	GP	PPP-HAS	24,6	52,6	58,0	37,0
Rokytnice	4002	GP	PPP-HAS	82,4	68,0	106,9	8,4
Rokytnice	5 (Rokytnice n/J, s)	TP	PPP-HAS	20,5	18,7	27,8	91,6
Paka	1066	GP	PPP-HAS	2,8	24,9	25,1	95,6
Paka	4001	GP	PPP-HAS	2,3	8,5	8,8	52,0
Paka	27(1501 U krize)	TP	PPP-HAS	39,0	10,1	40,3	99,6

DP - detail point (ETRS89 coordinates originally measured by surveyors - RTK method)  
 GP - reference point (ETRS89 coordinates originally measured by surveyors - RTK method)  
 TP - trigonometric point (given catalogue ETR89 coordinates)

## **all points excluding the error ones:**

n	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
14	30,1	42,6	36,9	124,3

## Accuracy:

### all points:

m <sub>N</sub> {cm}	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
15	275,6	188,9	236,3	168,1

### all points excluding the error ones:

m <sub>N</sub> {cm}	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
14	30,1	42,6	36,9	124,3

### only trigonometric points:

m <sub>N</sub> {cm}	m <sub>N</sub> {cm}	m <sub>E</sub> {cm}	m <sub>NE</sub> {cm}	m <sub>H</sub> {cm}
4	23,6	40,5	33,2	109,2

## advantage:

- no network of permanent stations needed

## disadvantage:

- so far 10 min fixation on 1 point
- specially modified GNSS receiver





**thank you for your attention**