GNSSnet.hu – Experiences and developments

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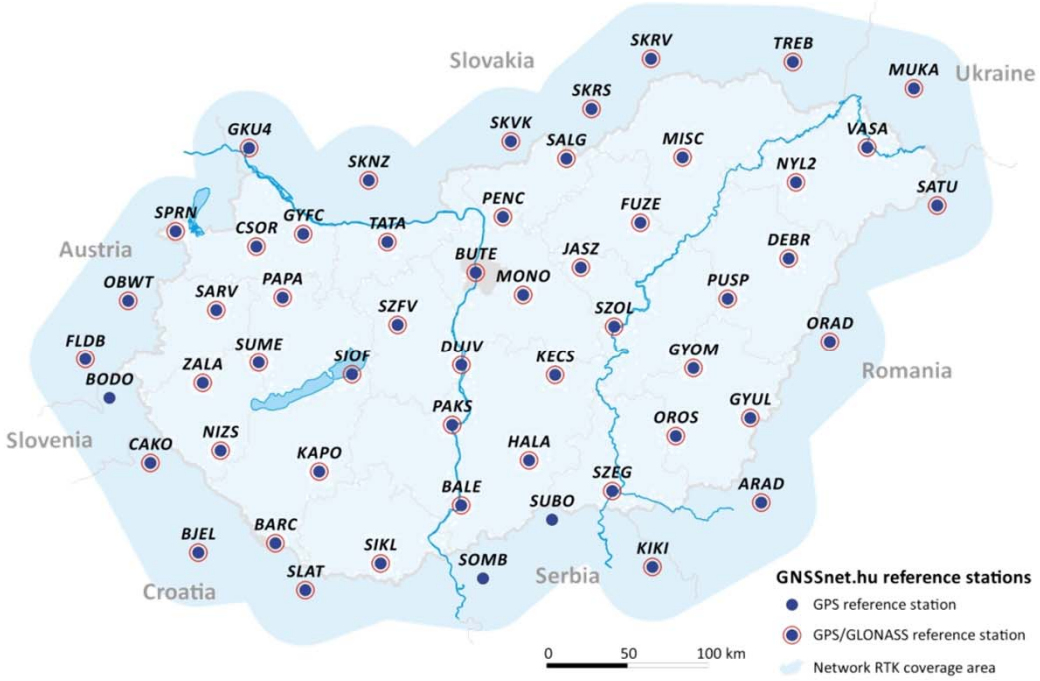
GNSSnet.hu - Stations

- **54 reference stations - 35 inland + 19 integrated from the neighbouring countries**
- **Inland stations: GPS+GLONASS + equipped with individually calibrated (PCV) antennas**

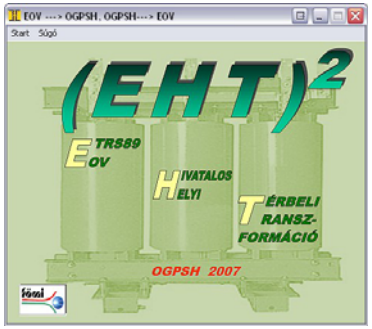


GNSSnet.hu - Services

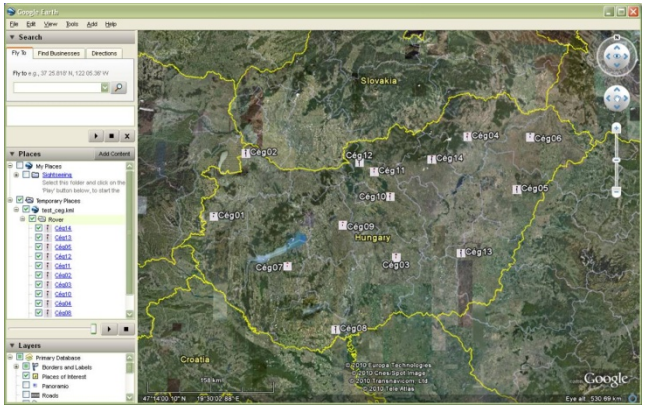
- **Data for post-processing**
  - RINEX data of the operating permanent stations with adjustable record interval and time period
  - Virtual RINEX data for the position defined by the user, with adjustable record interval and time period
- **autopostGNSS service**
  - The autopostGNSS service carries out the automatic, central post-processing of the data uploaded by the user
- **Real time services**
  - DGPS, DGNSS corrections with dm accuracy
  - RTK and network RTK corrections with cm accuracy

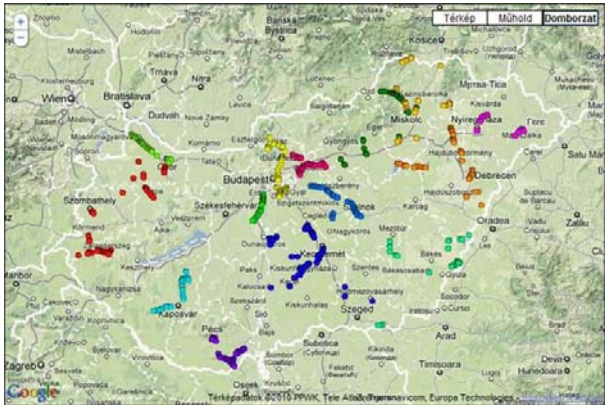
GNSSnet.hu – Services II.

- **Transformation**
  - Real time – VITEL or RTCM based VITEL
  - Posterior – EHT² free on PC



- **Fleet tracking**
  - Real time or posterior
  - Bigger companies (eg. Hungarian State Railways)





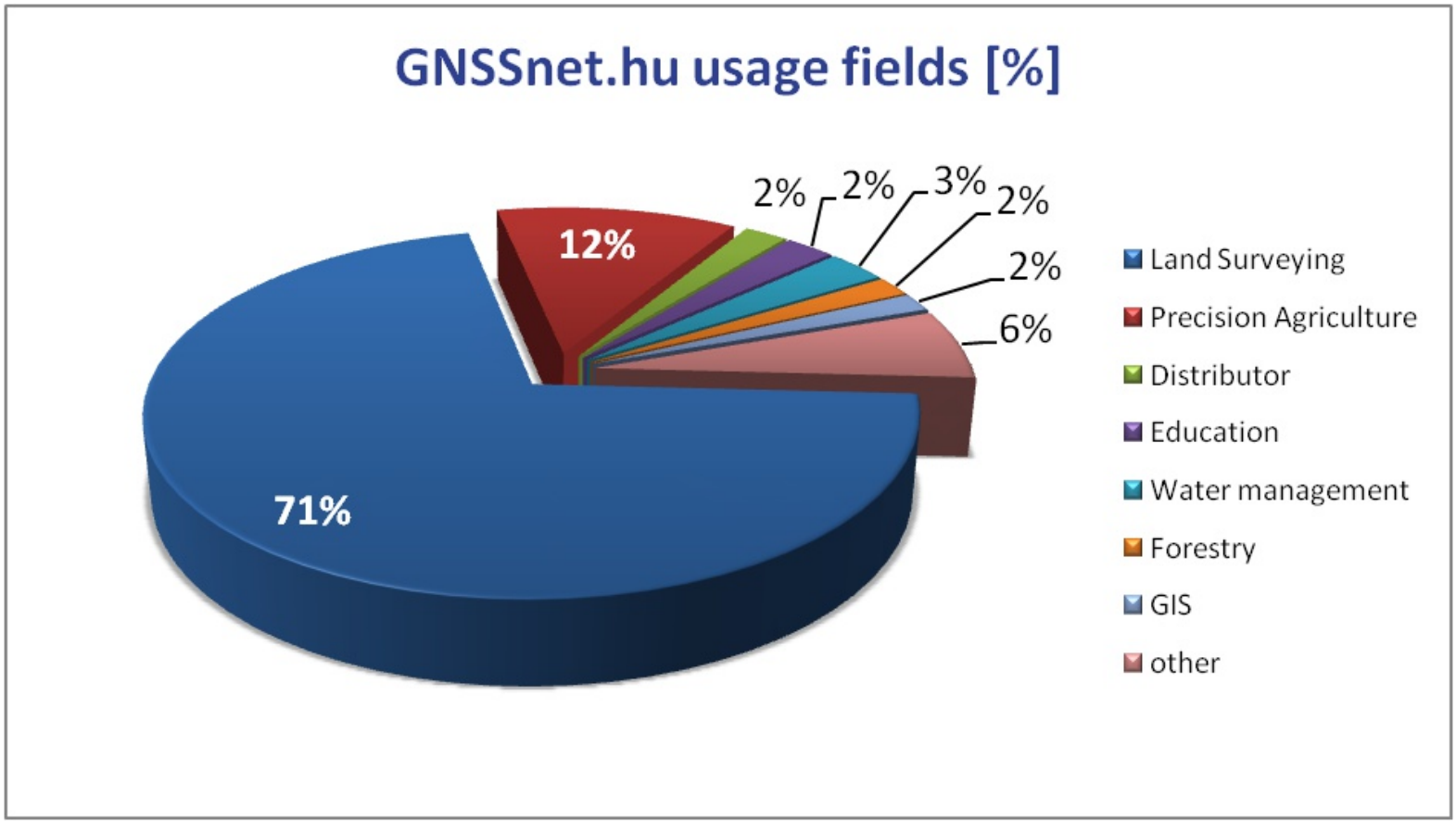
Company users

Username:	Comp01
NTRIP Mountpoint:	SGO_VRS-RTCM3.1-GLO
Quality indicator:	RTK fix
Numer of satellites:	11
Latitude [°]	047°51'20.94600"E
Longitude [°]	20°12'42.01800"N
Height [m]	184.000000
HDOP:	1.7
Age of correction [°]	1.0
Time since login [sec]	4h 37' 36"
Reference date [UTC]	09.10.05
Nearest station [UTC]	(JASZ)

Username:	Comp02
NTRIP Mountpoint:	SGO_VRS-RTCM3.1-GLO
Fix state:	RTK fix
Numer of satellites:	12
Latitude [°]	046°49'24.21600"E
Longitude [°]	20°39'43.29600"N
Height [m]	130.100000
HDOP:	0.8
Age of correction [°]	1.0
Time since login [sec]	4h 16' 39"
Reference date [UTC]	09.10.05
Nearest station [UTC]	(GYOM)

GNSSnet.hu – User segment

- **Land surveyors, precision agriculture, etc.**

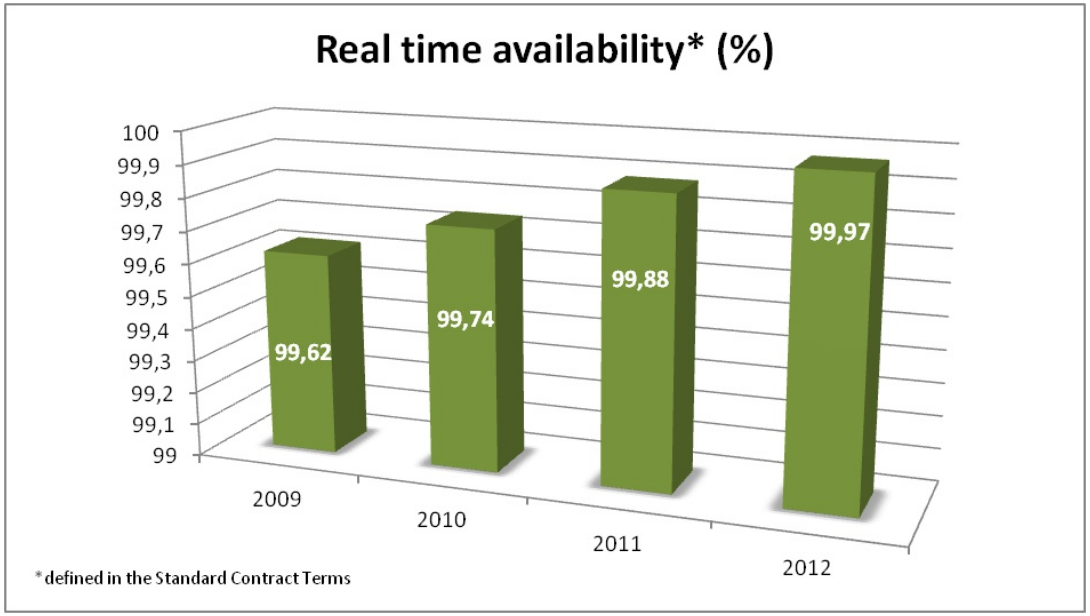


GNSSnet.hu – User segment

- Number of users still increasing, just like the usage
- Agricultural usage:
  - More than doubled last year
  - All over the country
  - Some further growth expected

New central data processing system

- *„Minimalize the outage, maximalize the availability”*
- **Installed at November 2012**
- **New, fully backed up hardware**
- **Automatic reaction for errors**



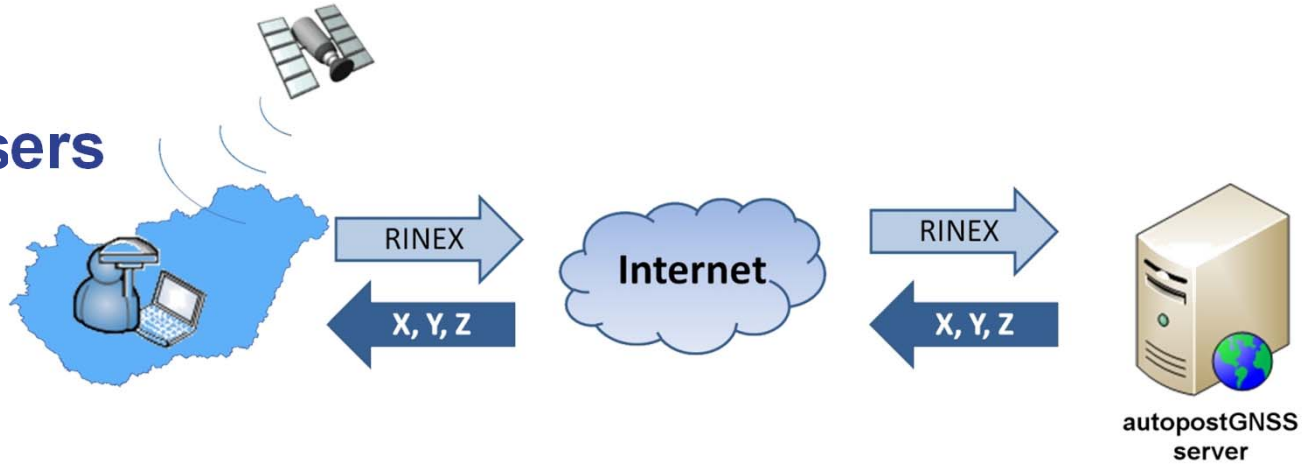
New central data processing system

- **Outage at the switch: only ~30 minutes**

ÁLLOMÁS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
ARAD	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
BALE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
BARC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
BJEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BODO	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
BUTE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CAKO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CSOR	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DEBR	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DUJV	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
FLDB	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
FUZE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GKU4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GYFC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GYOM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GYUL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
HALA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.3	99.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
JASZ	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
KAPO	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
KECS	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
KIKI	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MISC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MONO	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MUKA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	100.0
NIZS	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NYL2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
OBWT	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ORAD	100.0	100.0	100.0	99.9	99.6	99.4	99.5	99.9	99.8	99.9	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	99.6	99.9	99.9	99.9
OROS	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
PAKS	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
PAPA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
PENC	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
PUSP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SALG	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SARV	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SATU	99.9	100.0	99.9	98.2	99.8	99.8	99.9	100.0	100.0	100.0	100.0	100.0	100.0	50.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.1	100.0	100.0
SIKL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SIOF	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	100.0	100.0	100.0	100.0	100.0	49.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

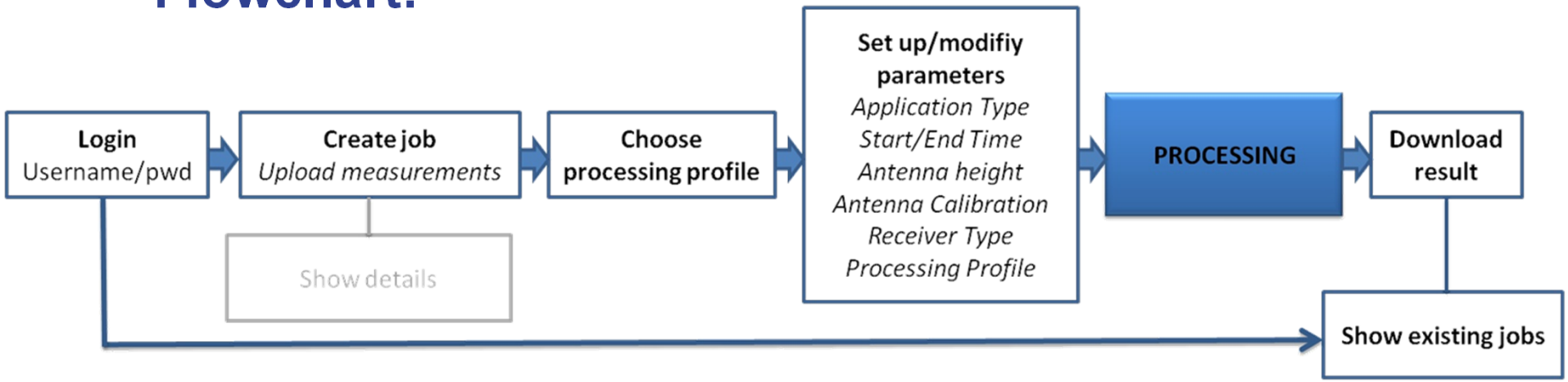
New service: autopostGNSS

- Carries out the automatic central post-processing of the measurement data uploaded by the user
  - Static and Kinematic (plus Stop&Go measurements in the future)
  - Result: ETRS89 coordinates (plus Hungarian Unified Projection – EOV in the future)
- 2 % of the users

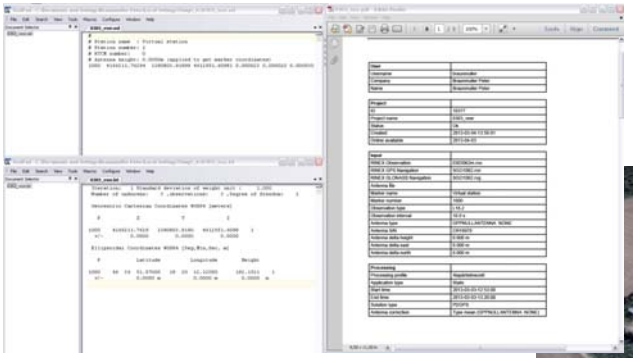


New service: autopostGNSS

- **Flowchart:**



- **Output:**
  - **Summary pdf**
  - **Coordinate list**
  - **Google Earth file**



New service: autopostGNSS

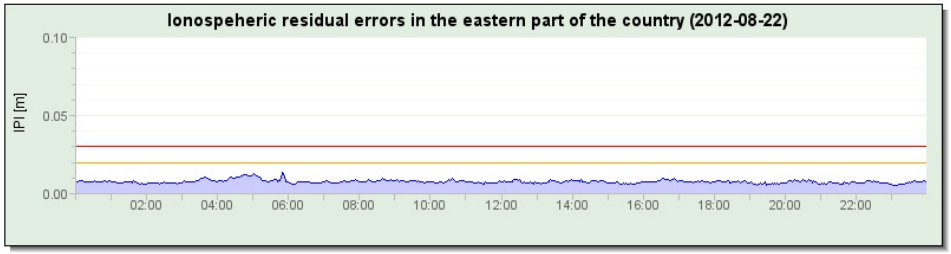
- **Validation of precision based on a monitor station (Nyírbátor) – ideal circumstances**

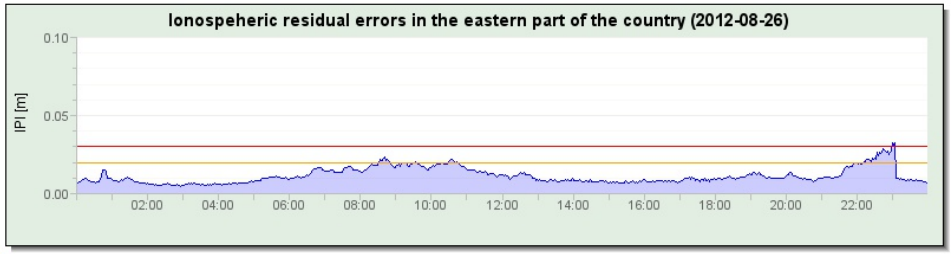
Low ionosperic activity

Int.	Duration	dy	dx	dH	dT
1 sec	20 min.	0,000	-0,017	-0,011	**0,020**
15 sec	20 min.	0,000	-0,016	-0,010	**0,019**
15 sec	10 min.	0,002	-0,013	-0,011	**0,017**
15 sec	5 min.	0,004	-0,013	-0,010	**0,017**

Increased ionospheric activity

Int.	Duration	dy	dx	dH	dT
1 sec	20 min.	-0,006	-0,002	0,025	**0,026**
15 sec	20 min.	-0,001	-0,002	0,020	**0,020**
15 sec	10 min.	-0,008	-0,001	0,033	**0,034**
15 sec	5 min.	-0,009	-0,006	0,027	**0,029**





New service: autopostGNSS

- **Validation of precision in urban territory with greater multipath effect**

Int.	Duration	dy	dx	dH	dT
15 sec	60 min.	0,001	-0,017	-0,015	**0,023**
15 sec	30 min.	0,024	-0,038	-0,025	**0,051**
15 sec	15 min.	0,018	-0,032	-0,038	**0,053**
15 sec	8 min.	0,017	-0,029	-0,033	**0,047**

- **Possible to achieve geodetic accuracy, but (maybe) longer observation time and measurements should be done more carefully**

New permanent station: PEN2

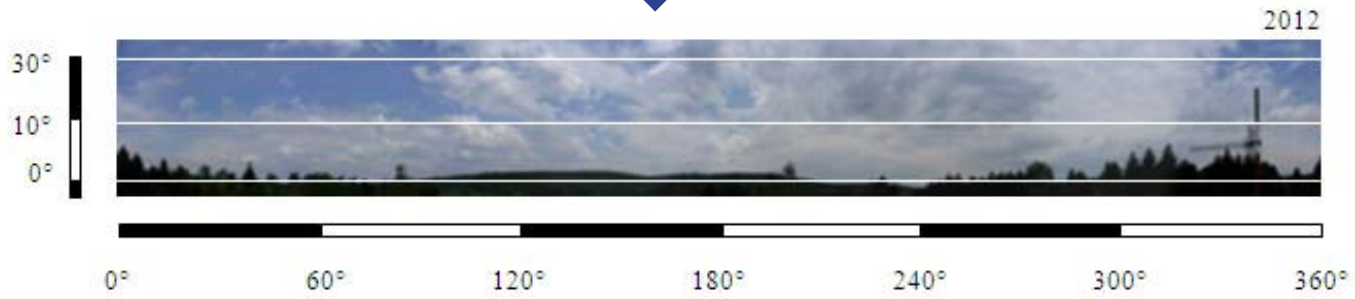
- Testing since the summer of 2012
- GPS + GLONASS + Galileo
- New, higher place – less obstacles, smaller multipath effect
- Will soon substitute PENC

New permanent station: PEN2

- **Less obstacles**

PENC

PEN2

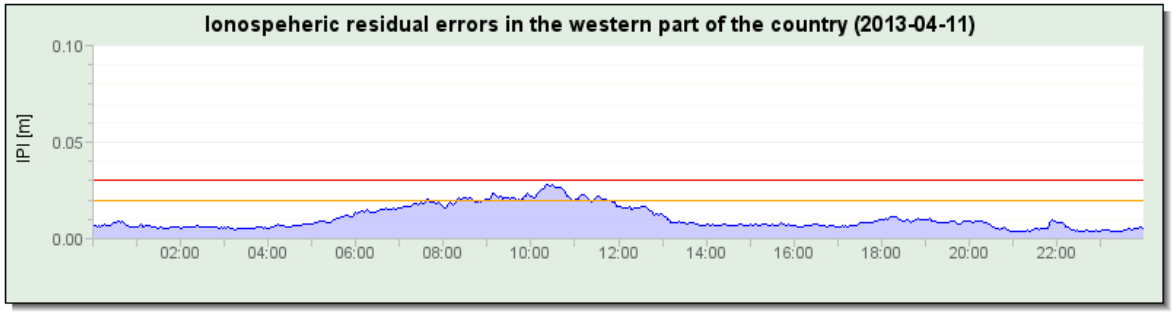


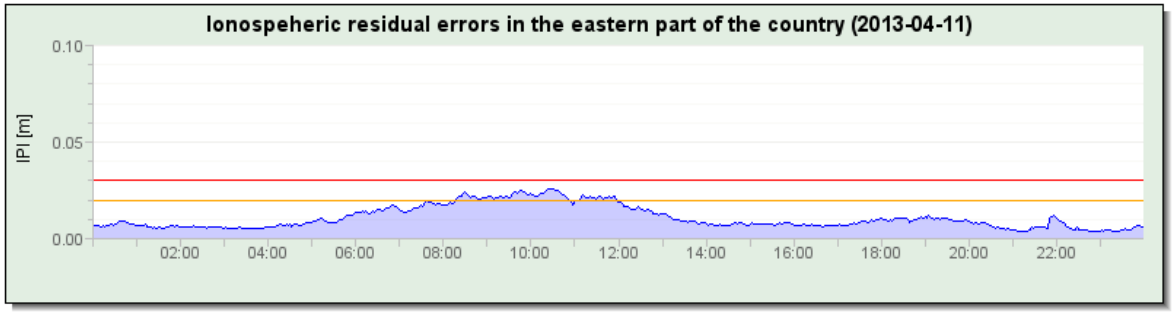
New permanent station: PEN2

- **Proposed to EPN**
  - **14 % of the operating stations is Galileo capable**
  - **25 % of the proposed stations is Galileo capable**

Ionosphere monitoring solution

- Posteriorly throught our webpage
- The state of the ionosphere can be checked
- Several visualization forms (chart, timeline, table)
- Separately for the Western and Eastern part of the country





Ionosphere monitoring solution

- **Introduced in March 2012**
- **Now available in English**

Operation of monitorizing system of ionospheric activity:

The software takes the values of the estimated ionospheric residual errors from the real time network adjustment in every second minute and stores the results in a database. The purpose of the webpage is to visualize and get available the rate of the ionospheric residual errors for the users.

The use of the webpage:

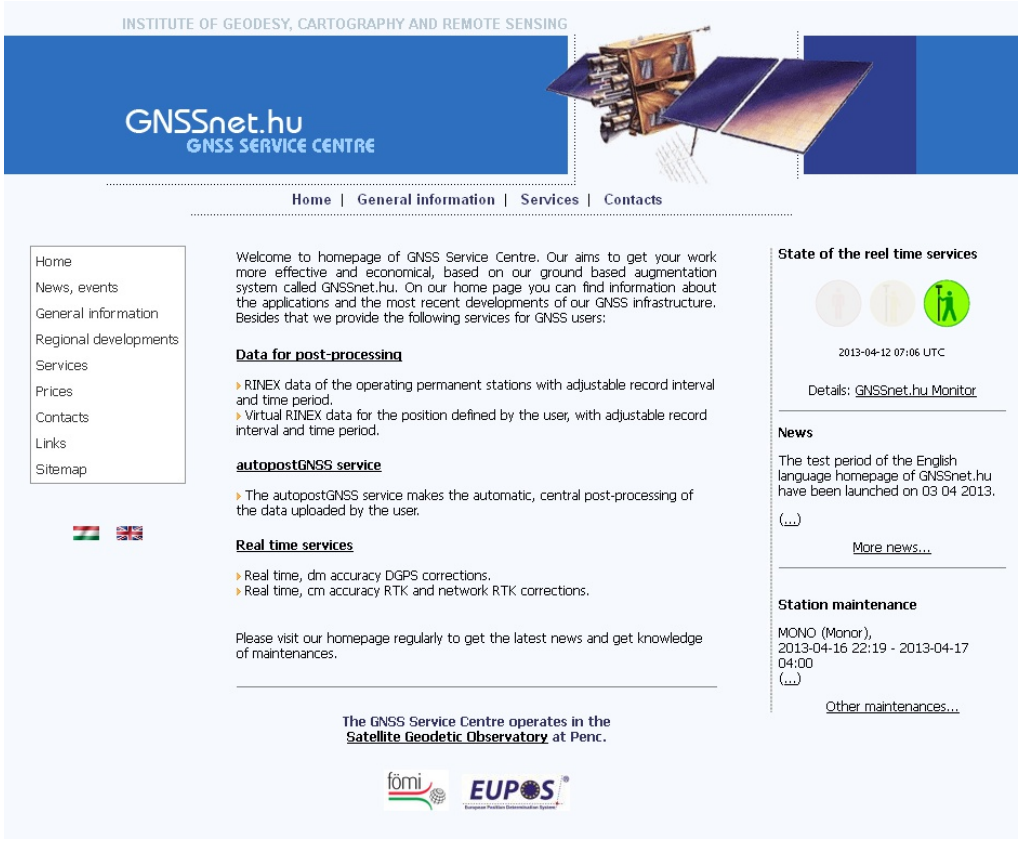
Three different visualizations can be chosen on the webpage which are available through roll down menu *"Visualization:"*.

- **graph** - it shows the value of the ionospheric residual errors in form of a graph in the western and in the eastern part of the country. The yellow line indicates the 2 cm, and the red line indicates the 3 cm alert threshold.
- **timeline** - in this case not the exact values are visualized, but we show in which period was the ionosperic residual errors less than 2 cm (green), between 2 and 3 cm (yellow) or over 3 cm (red) by applying the traffic light colours also used in the **monitoring system for cellular phones**.
- **table** - here the average of the ionosperic residual errors can be seen in yearly, monthly, daily or hourly resolution.

If you have any question or comment in reference to the effect of ionosphere to the RTK positioning or to the operation of monitorizing system, please contact our colleagues throught the contacts listed **here**.

English language homepage

- **Not finished yet, in test phase, not official**
- **All monitoring page also (real time and posterior)**



Future

- **Some further developments of autopostGNSS**
- **Finish the English language homepage + new design**
- **Updated transformation solution (real-time and posterior)**

- **Upgrade/change of the Hungarian permanent stations → Galileo capability**

Thank you for your attention!

Contacts of the GNSS Service Centre:

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