NATIONAL REPORT OF LITHUANIA TO EUREF 2018

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Atkurtai Lietuvai 100

EUREF 2018 SYMPOSIUM

AMSTERDAM 30 May – 1 June 2018

Amsterdam, Netherlands, 2018

Outline

- CORS Network LitPOS
- LitPOS Reprocessing
- Gravity survey
- Geomagnetic observatory

LitPOS(1):

LitPOS (**Lit**huanian **P**ositioning **S**ystem), the network of permanent reference GNSS stations, became operational in July 2007. It provides data both for real-time and post-processing applications.

LitPOS stations cover the whole territory of Lithuania. Total number of LitPOS GNSS stations is **31**. LITPOS includs also **3** ASG-EUPOS Polish stations and **6** LATPOS Latvian stations

CORS Network - **LitPOS**

LitPOS(2)

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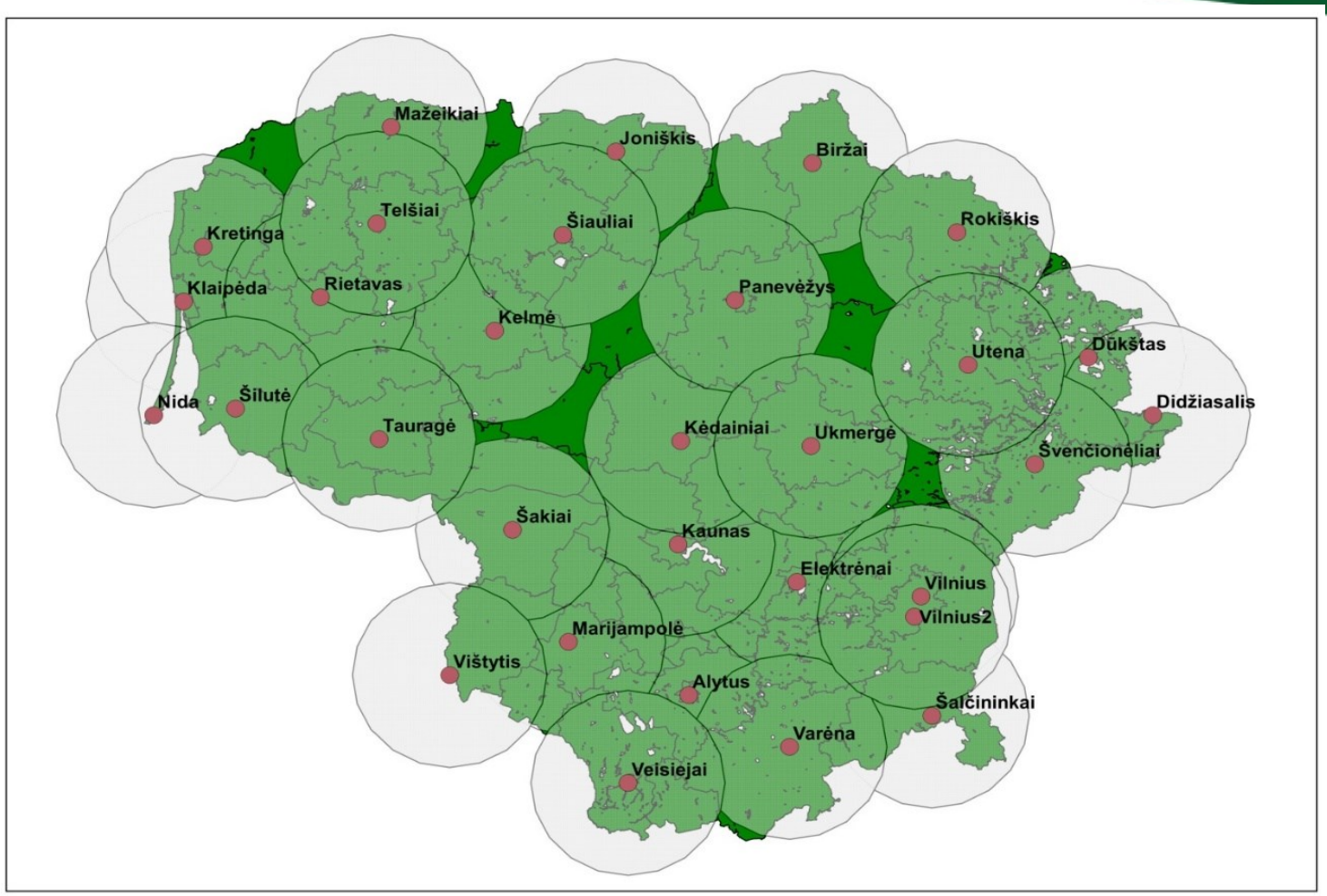
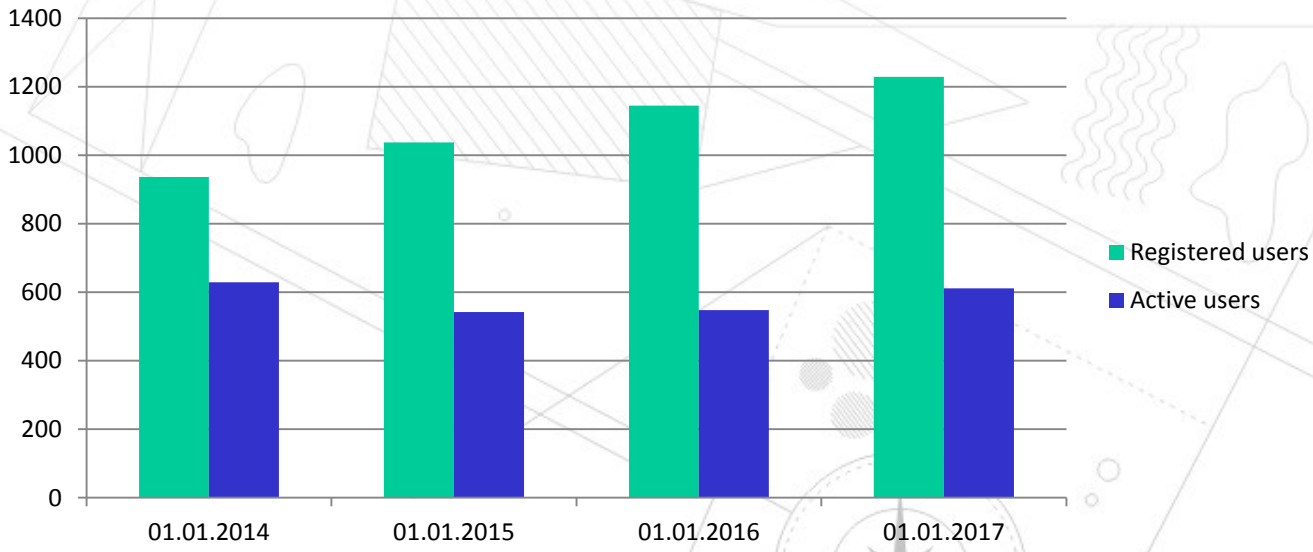


Coverage of LitPOS stations (R=35 km)

LitPOS(3)

Users statistics (2018-05-01):

- **Number of LitPOS registered users: 1345 (+116)**
- **Numbers of active users: 652 (+41)**



LitPOS(4)

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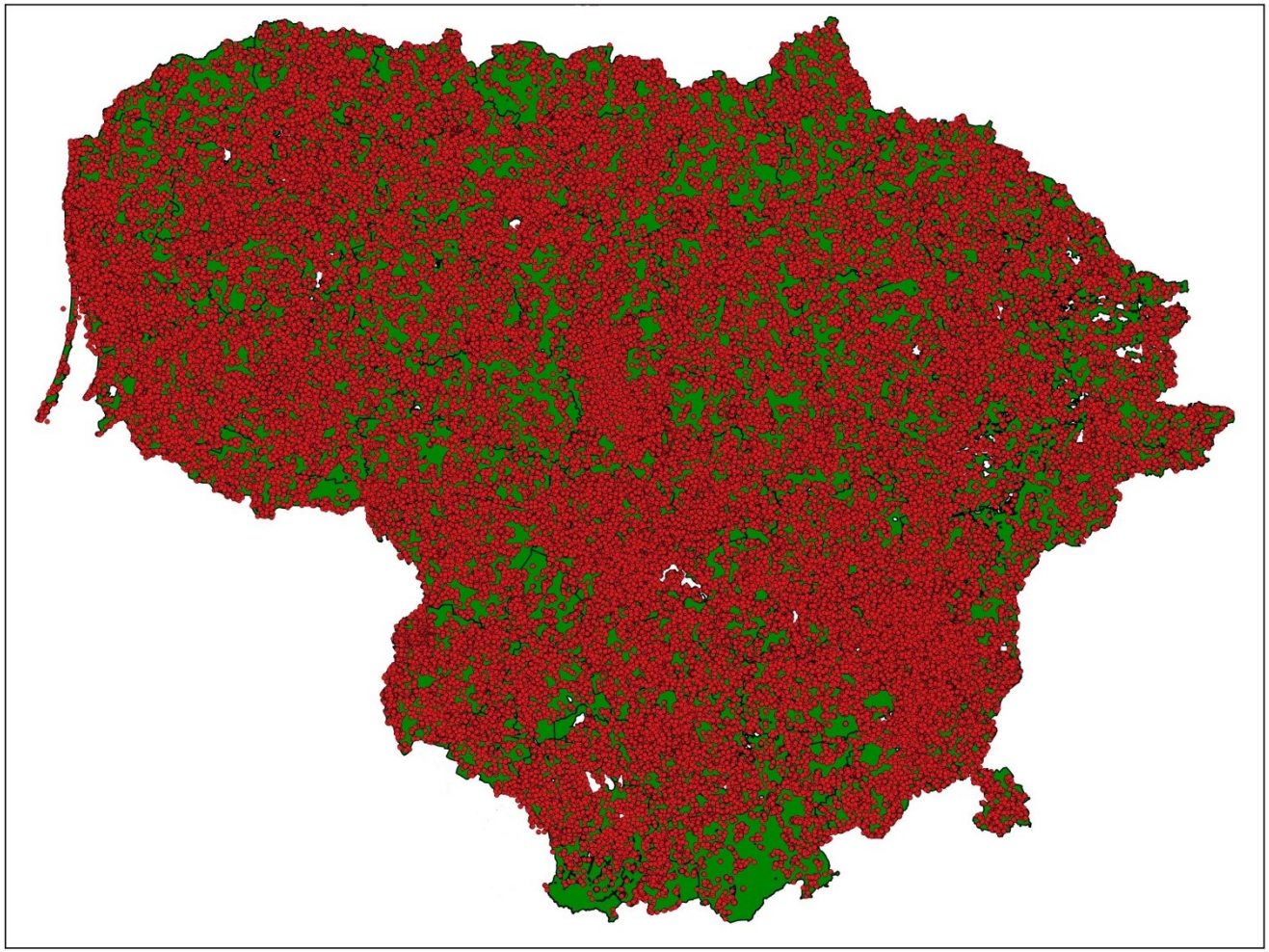

Users connections during 2017 year (red dots)

LitPOS(5)

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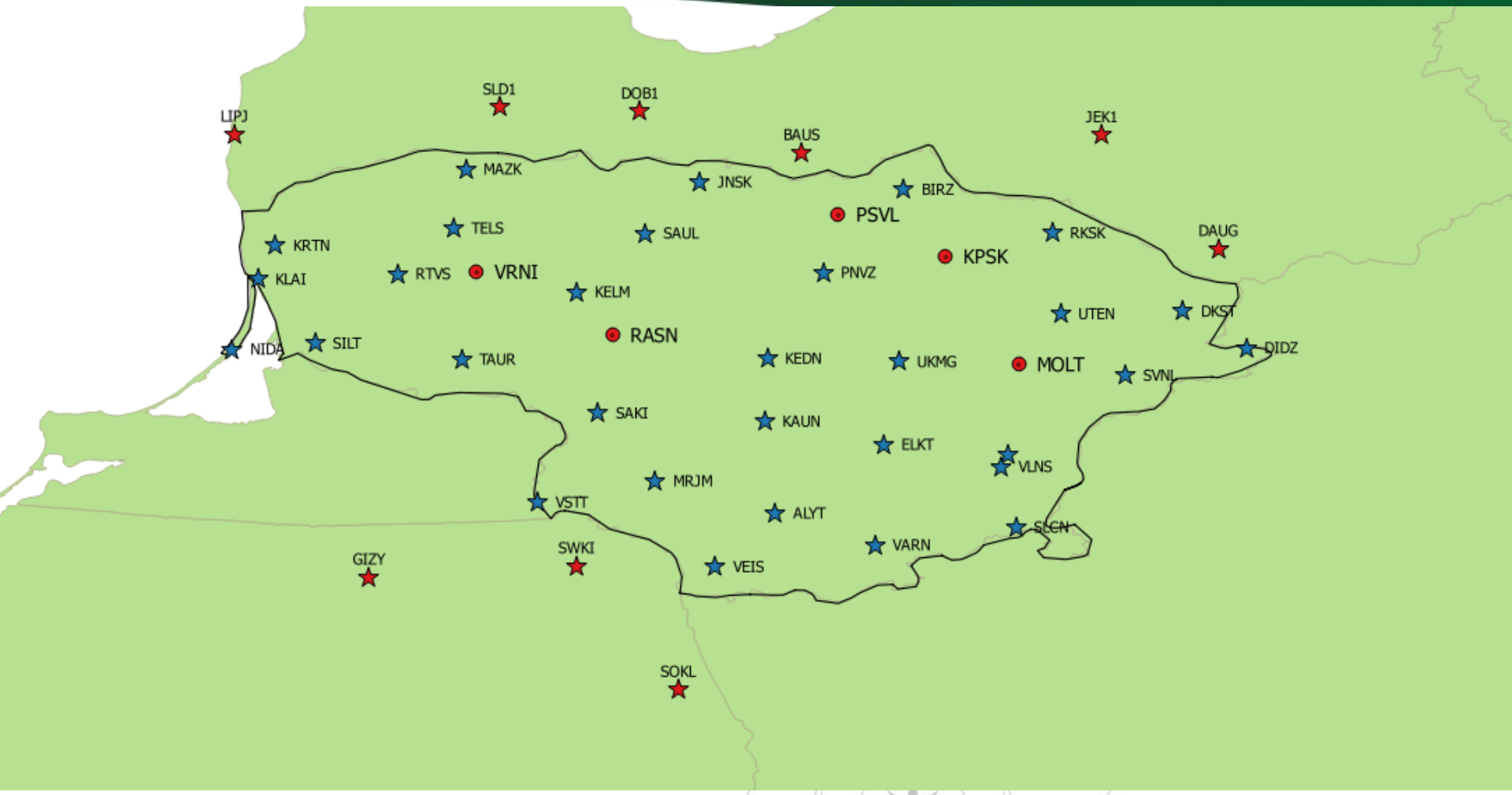
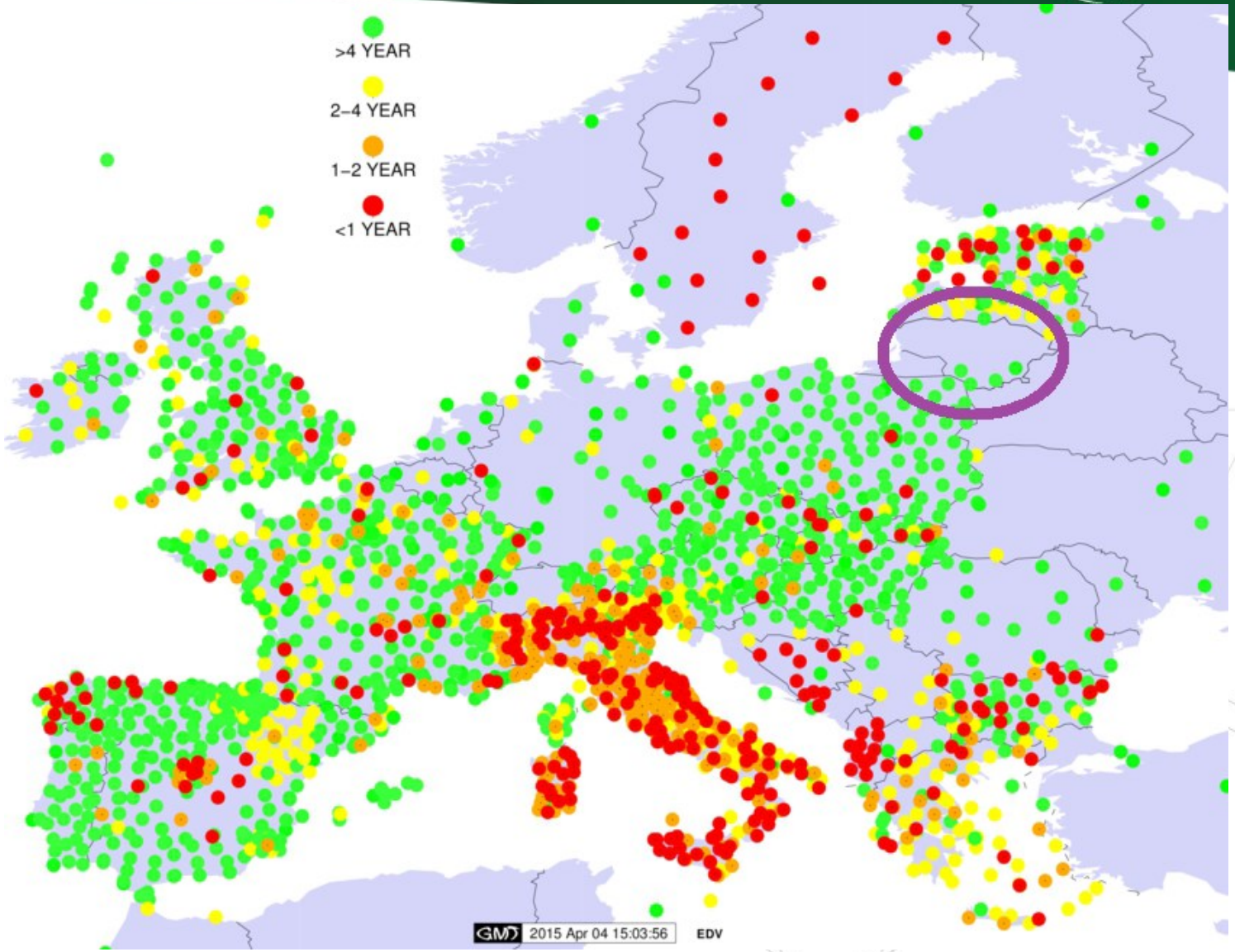


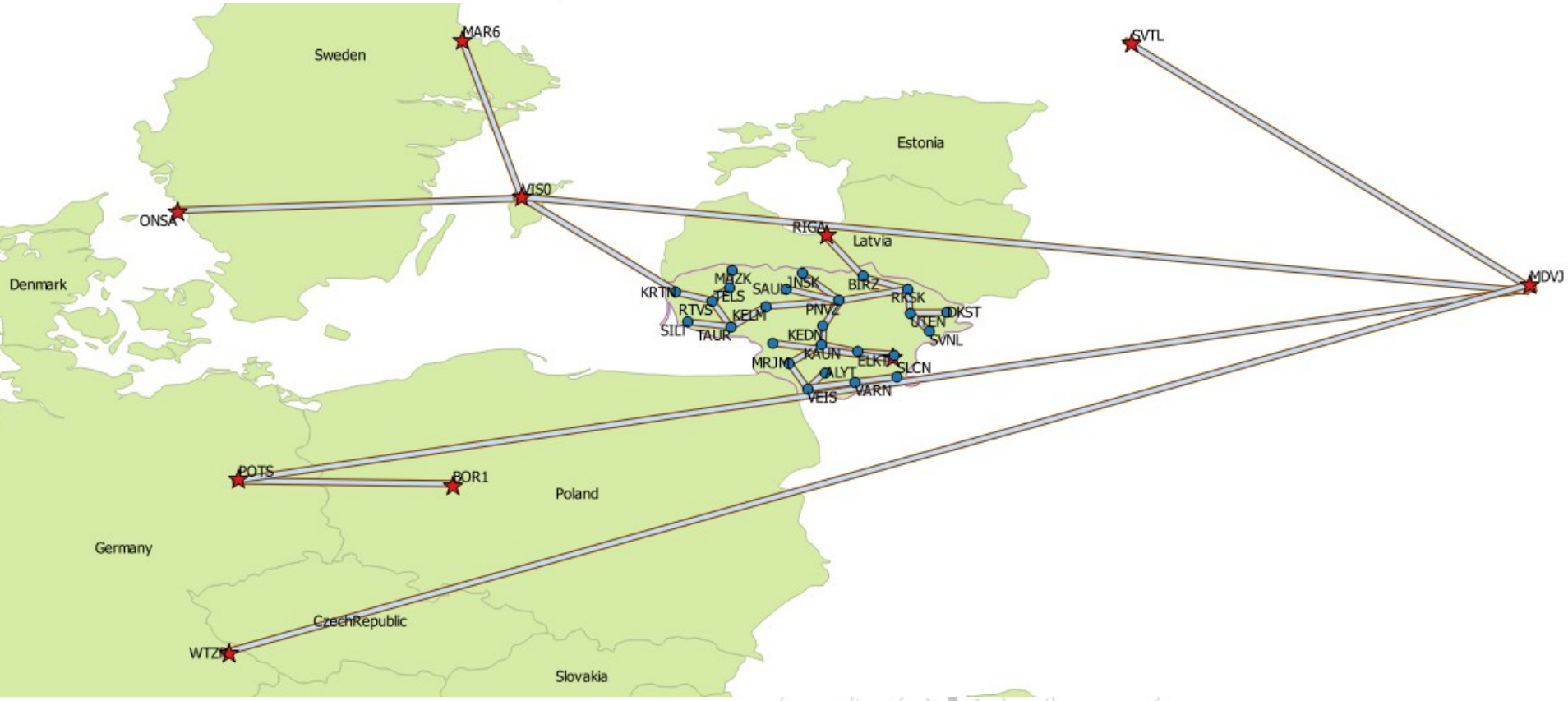
LitPOS densification 5 new stations during 2018 year (red dots)

- LitPOS Reprocessing

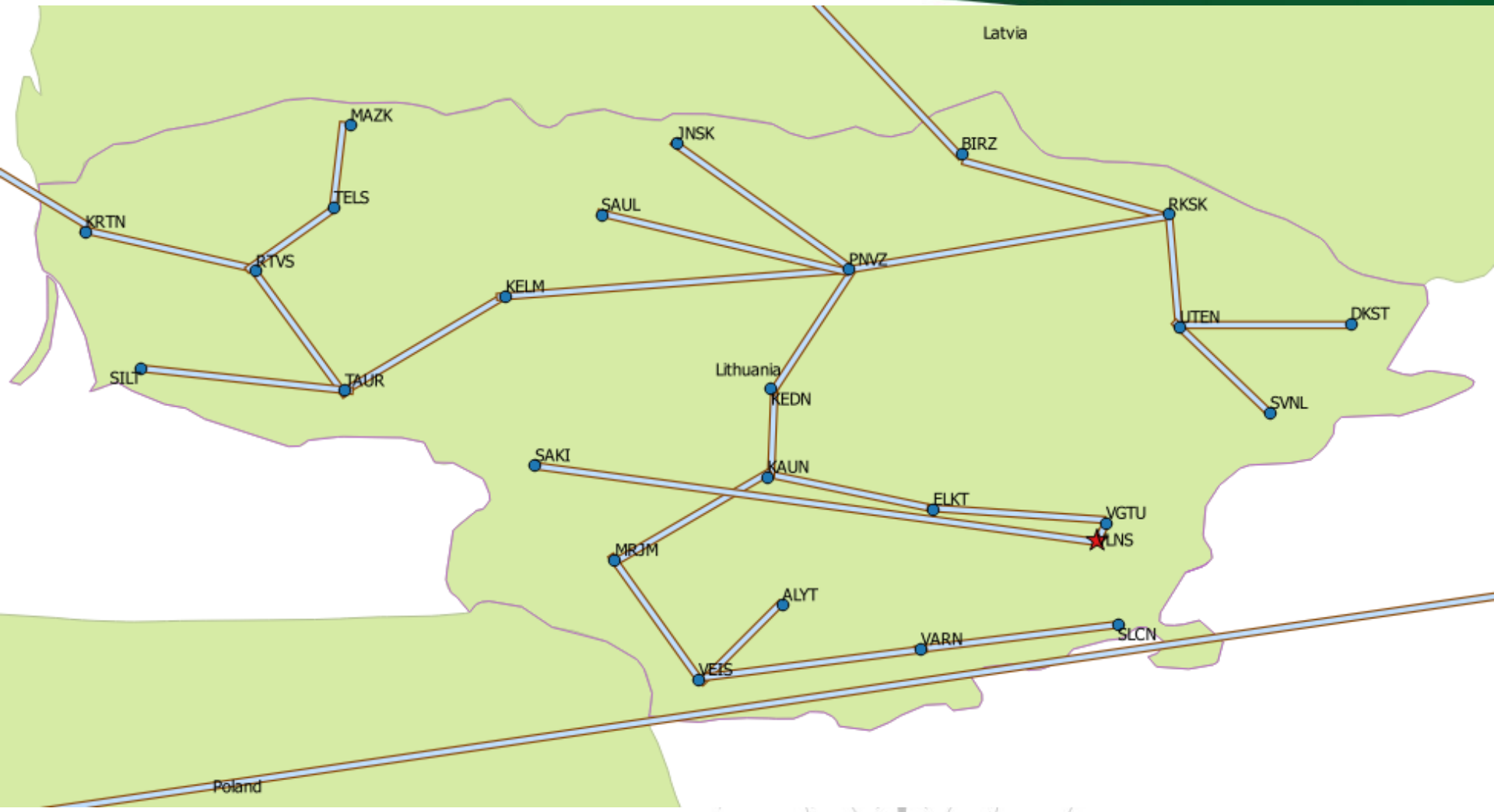
LitPOS_Repro(1):



LitPOS_Repro(2):



LitPOS_Repro(3):



LitPOS_Repro(4):

Main characteristics:

- Software: **BSW5.2** update 2016 01 08
- Network: **25+6+3** LitPOS stations +**10** IGS/EPN fiducial stations
- GNSS: **GPS**
- Antennas PCV: **absolute** and **individual calibration**
- Precise orbits, etc.: **CODE**
- Tropospheric refraction: **VMF**
- Ocean tide model model: **FES2004**
- Baselines processing strategy: **OBS-MAX**
- Ambiquities resolution strategy: **QIF**
- ITRF realisation: **IGb08** (EPN_A_IGb08_C1845.SNX) (ITRF2014 -GPS week 1934 (29 January 2017)
- Cut-off angle: **3, 10, 25**
- Period: **2008-2014**; (2015-2018 GPS week 2000)
- Products: **Daily** and **weekly SNX** (**NEQ + COV**)
- Coordinates Time Series: analysis by **GITSA, FODITS, TSview**

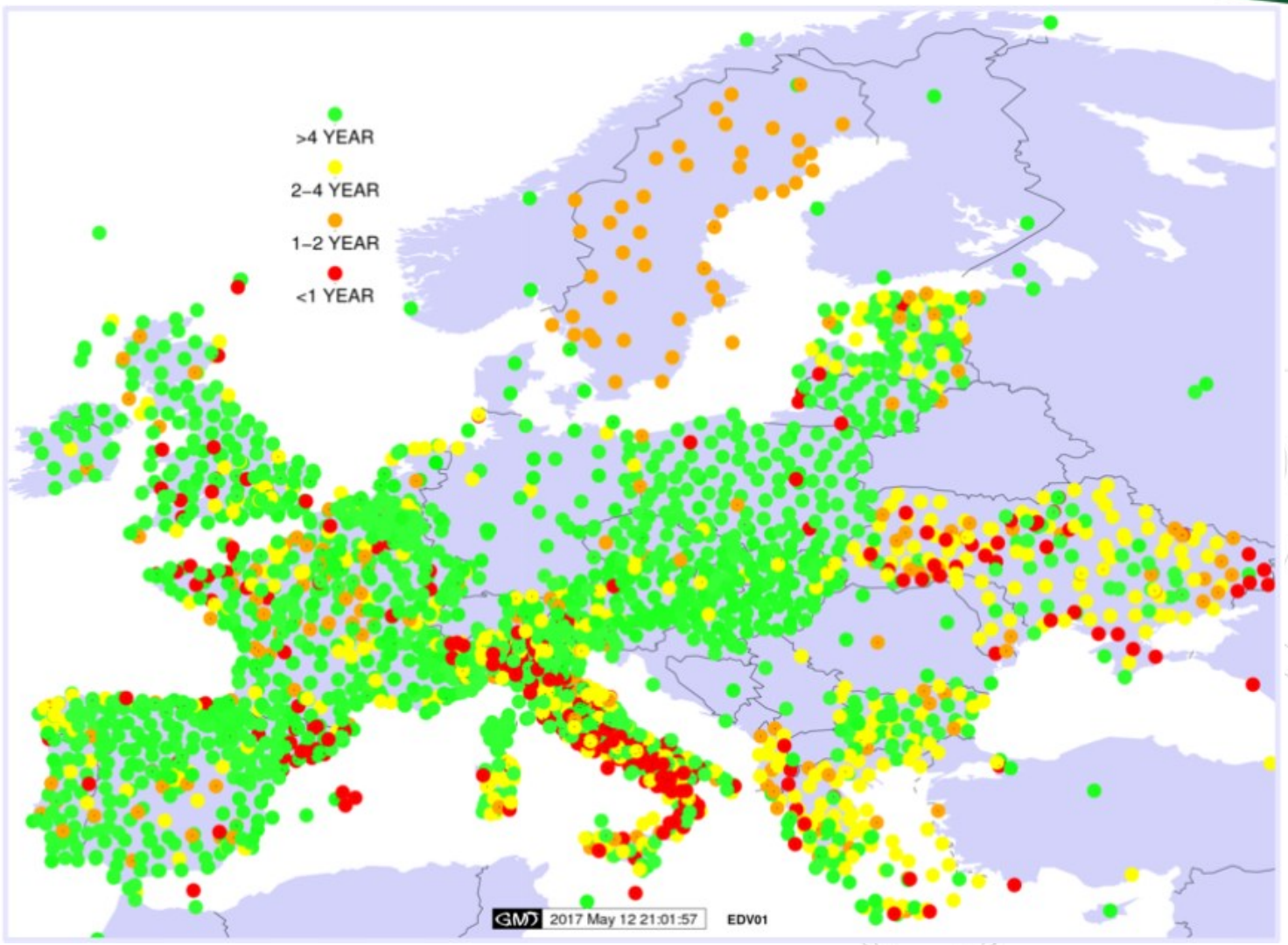
LitPOS_Repro(5):

- **2008-2017 weekly SINEX** files (with **COV matrix**) was uploaded to **EPN ftp server** with intention to fill the gap of Lithuania in European dense velocity field.

- Reprocessing of **2008-2017 daily solutions** is finished and **weekly solutions** (with **NEQ matrix**) was uploaded to **NKG ftp server**.

- **Operational processing** started from **GPS week 1934.**

LitPOS_Repro(6):



LitPOS_Repro(7):

Parameters used in FODITS analysis

FODITS 1.2: General Variables

PARAMETERS FOR THE SELECTION OF RELEVANT EARTHQUAKES

Earthquake factor A	-5.60	
Earthquake factor B	+2.17	
Minimal time span between earthquakes	60	days

RECONSTRUCT TIME SERIES OF STATION COORDINATES

by applying the coordinate input file	☐
by applying the velocity input file	☐

ALGORITHM PARAMETERS

Maximal number of iteration steps	20
Maximal number of screening steps	50

NEW ELEMENTS

Maximal number of outliers per iteration	40
Overall threshold for outlier detection	200

FODITS 5: Statistical tests

SIGNIFICANCE TEST

Threshold for relative improvement	0.005
N*sigma criterion for outliers	3.0

MINIMAL DISPLACEMENT

	Horizontal	Vertical	3D	Coordinate
Discontinuities (meter)	0.008	0.01		
Velocity changes (meter/year)				
Outliers (meter)	0.005	0.01		
Periodic functions (meter)				

LitPOS_Repro(8):

TSview and FODITS comparison (benchmark test)

Stations	Epochs	TSview outliers LM	Rejected data %	FODITS outliers	Rejected data %
HFS4	2514	126	5	84	3
ISAF	2444	146	6	200	8
KEVO	3027	381	13	349	12
NYA1	3263	114	3	147	5
ONSA	3223	175	5	36	1
RIGA	3260	112	3	124	4
SMID	3278	230	7	80	2
SUN0	3287	108	3	60	2
TOIL	3206	107	3	79	2
VLNS	2961	339	11	177	6
WTZR	3270	126	4	186	6

Input: CRD files, period from 2008 to 2016.

LitPOS_Repro(9):

Velocity estimation differences between TSview and FODITS results

Station name		No assessment Velocity [mm/yr]	TSview LM Velocity [mm/yr]	FODITS Velocity [mm/yr]	Velocity difference [mm/yr]
HFS4	X	15,13	**15,29**	**15,25**	**0,04**
	Y	15,48	**15,36**	**15,39**	**0,03**
	Z	4,79	**5,83**	**5,62**	**0,21**
ISAF	X	20,19	**20,13**	**20,20**	**0,07**
	Y	-11,40	**-11,44**	**-11,39**	**0,05**
	Z	-1,20	**-1,25**	**-1,28**	**0,03**
KEVO	X	13,52	**13,52**	**13,52**	**0,00**
	Y	17,04	**17,02**	**17,03**	**0,01**
	Z	4,01	**4,11**	**4,05**	**0,06**
NYA1	X	14,60	**14,60**	**14,61**	**0,01**
	Y	10,45	**10,45**	**10,46**	**0,01**
	Z	8,41	**8,41**	**8,43**	**0,02**
ONSA	X	14,75	**14,76**	**14,75**	**0,01**
	Y	17,21	**17,23**	**17,21**	**0,02**
	Z	2,67	**2,73**	**2,66**	**0,07**

Station name		No assessment Velocity [mm/yr]	Tsview LM Velocity [mm/yr]	FODITS Velocity [mm/yr]	Velocity difference [mm/yr]
RIGA	X	13,07	**13,48**	**13,48**	**0,00**
	Y	20,56	**20,31**	**20,28**	**0,03**
	Z	0,68	**0,74**	**0,78**	**0,04**
SMID	X	15,62	**15,55**	**15,61**	**0,06**
	Y	17,26	**17,25**	**17,26**	**0,01**
	Z	0,16	**0,24**	**0,16**	**0,08**
SUN0	X	14,33	**14,34**	**14,33**	**0,01**
	Y	17,20	**17,18**	**17,20**	**0,02**
	Z	9,66	**9,67**	**9,65**	**0,02**
TOIL	X	13,02	**13,00**	**13,02**	**0,02**
	Y	20,48	**20,50**	**20,47**	**0,03**
	Z	2,31	**2,31**	**2,32**	**0,01**
VLNS	X	14,08	**13,75**	**13,73**	**0,02**
	Y	21,22	**20,95**	**20,92**	**0,03**
	Z	-0,30	**-0,46**	**-0,44**	**0,02**
WTZR	X	15,77	**15,68**	**15,74**	**0,06**
	Y	20,41	**20,25**	**20,26**	**0,01**
	Z	-0,41	**0,30**	**-0,20**	**0,50**

LitPOS_Repro(10)

Differences with official coordinates

ETRF2000(R14) - LitPOS_officials					
name	dome	ΔX	ΔY	ΔZ	soln
ALYT	10803M001	-0.0343	-0.0197	-0.0524	1
ALYT	10803M001	-0.0298	-0.0182	-0.0524	2
ALYT	10803M001	-0.0273	0.0002	-0.0530	3
BIRZ	10804M001	-0.0237	-0.0116	-0.0394	1
BIRZ	10804M001	-0.0349	-0.0069	-0.0446	2
DIDZ	10805M001	-0.0268	-0.0077	-0.0602	1
DIDZ	10805M001	0.0474	0.0196	0.0268	2
DIDZ	10805M001	0.0195	0.0250	0.0373	3
DKST	10806M001	-0.0138	-0.0107	-0.0423	1
DKST	10806M001	-0.0167	-0.0062	-0.0391	2
DKST	10806M001	-0.0207	-0.0740	0.0894	3
DKST	10806M001	-0.0276	-0.0724	0.0834	4
ELKT	10807M001	-0.0302	-0.0134	-0.0490	1
ELKT	10807M001	-0.0283	-0.0083	-0.0472	2
JNSK	10808M001	-0.0251	-0.0069	-0.0338	1
JNSK	10808M001	-0.0240	-0.0116	-0.0416	2
KAUN	10809M001	-0.0359	-0.0132	-0.0497	1
KAUN	10809M001	-0.0284	-0.0100	-0.0428	2
KEDN	10810M001	-0.0316	-0.0243	-0.0492	1
KEDN	10810M001	-0.0371	-0.0183	-0.0539	2
KELM	10811M001	-0.0252	-0.0143	-0.0471	1
KELM	10811M001	-0.0310	-0.0121	-0.0464	2
KELM	10811M001	-0.0296	-0.0099	-0.0491	3
KLAI	10802M002	-0.0262	-0.0096	-0.0361	1
KRTN	10812M001	-0.0189	-0.0178	-0.0324	1
KRTN	10812M001	-0.0241	-0.0164	-0.0311	2
KRTN	10812M001	-0.0228	-0.0165	-0.0383	3
MAZK	10813M001	-0.0196	-0.0119	-0.0323	1
MAZK	10813M001	-0.0298	-0.0062	-0.0403	2
MRJM	10814M001	-0.0297	-0.0245	-0.0456	1
MRJM	10814M001	-0.0367	-0.0188	-0.0501	2
NIDA	10815M001	-0.0442	-0.0320	-0.0475	2
PNVZ	10816M001	-0.0290	-0.0154	-0.0486	1
PNVZ	10816M001	-0.0372	-0.0133	-0.0503	2
RKSK	10818M001	-0.0150	-0.0109	-0.0406	1
RKSK	10818M001	-0.0269	-0.0060	-0.0386	2
RTVS	10817M001	-0.0293	-0.0116	-0.0401	1
RTVS	10817M001	-0.0241	-0.0060	-0.0359	2

LitPOS_Repro(11):

Differences with official coordinates

SAKI	10819M001	-0.0433	-0.0214	-0.0606	1
SAKI	10819M001	-0.0402	-0.0176	-0.0546	2
SAUL	10820M001	-0.0319	-0.0136	-0.0520	1
SAUL	10820M001	-0.0256	-0.0123	-0.0385	2
SILT	10821M001	-0.0208	-0.0110	-0.0486	1
SILT	10821M001	-0.0343	-0.0095	-0.0595	2
SLCN	10822M001	-0.0270	-0.0167	-0.0442	1
SLCN	10822M001	-0.0244	-0.0133	-0.0456	2
SVNL	10823M001	-0.0273	-0.0114	-0.0496	1
SVNL	10823M001	-0.0217	-0.0067	-0.0413	2
TAUR	10824M001	-0.0196	-0.0233	-0.0378	1
TAUR	10824M001	-0.0286	-0.0211	-0.0426	2
TAUR	10824M001	-0.0373	-0.0183	-0.0454	3
TELS	10825M001	-0.0143	-0.0001	-0.0219	1
TELS	10825M001	-0.0052	0.0001	-0.0111	2
UKMG	10826M001	-0.0266	-0.0163	-0.0521	1
UKMG	10826M001	-0.0202	-0.0092	-0.0473	2
UTEN	10827M001	-0.0182	-0.0105	-0.0425	1
UTEN	10827M001	-0.0227	-0.0145	-0.0396	2
UTEN	10827M001	-0.0272	-0.0087	-0.0426	3
VARN	10828M001	-0.0310	-0.0193	-0.0496	1
VARN	10828M001	-0.0212	-0.0118	-0.0379	2
VEIS	10829M001	-0.0262	-0.0222	-0.0371	1
VEIS	10829M001	-0.0307	-0.0201	-0.0407	2
VEIS	10829M001	-0.0242	-0.0109	-0.0371	3
VGTU	10830M001	-0.0201	-0.0181	-0.0392	1
VGTU	10830M001	-0.0196	-0.0133	-0.0437	2
VGTU	10830M001	-0.0318	-0.0151	-0.0501	3
VLNS	10801M001	-0.0114	-0.0085	-0.0181	1
VSTT	10831M001	-0.0470	-0.0269	-0.0680	1

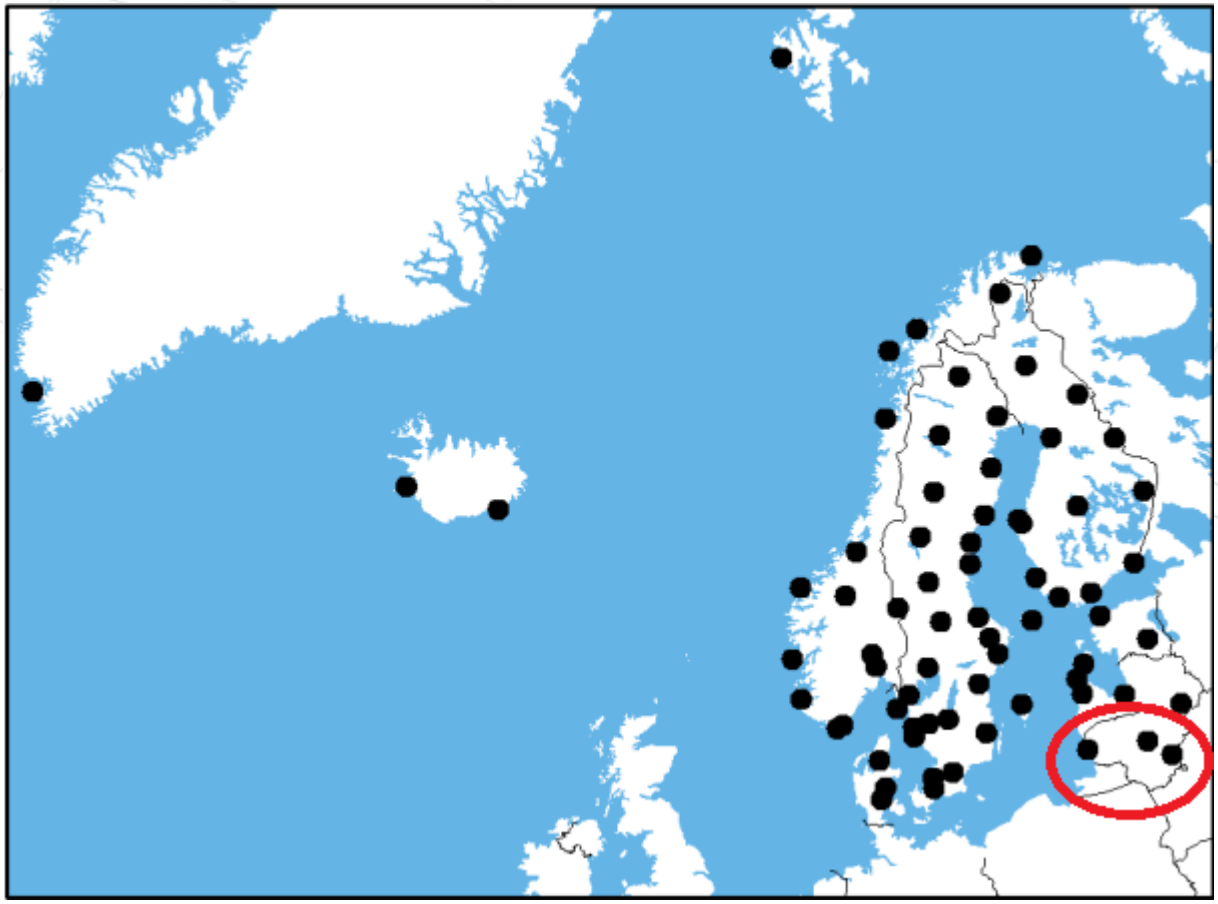
Gravity survey

- Gravity survey

Gravity survey (1)

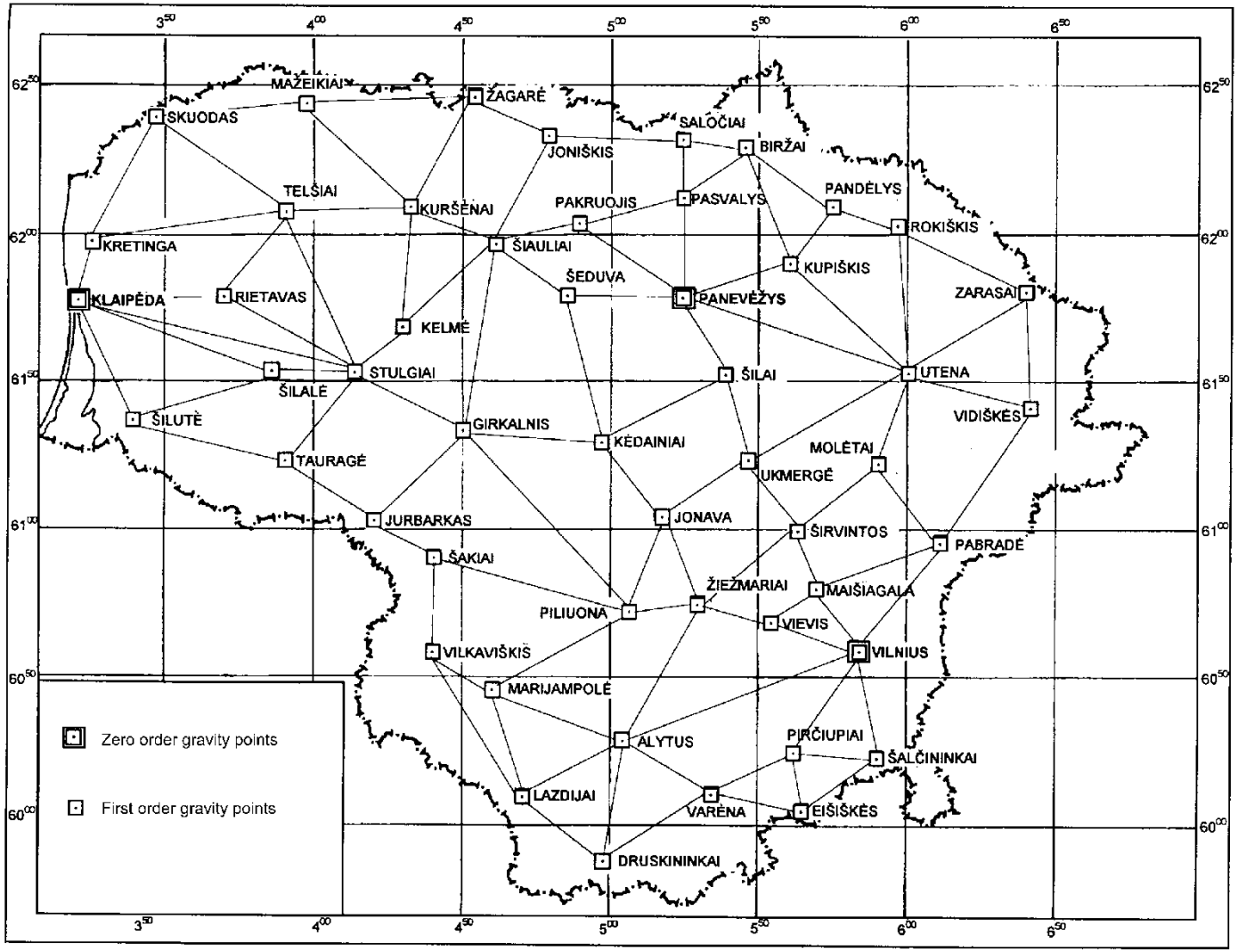
ABSOLUTE GRAVITY OBSERVATIONS IN SEPTEMBER, 2017

Observations were executed by Mirjam Bilker-Koivula employing gravimeter FG5X-221 of the Finnish Geospatial Research Institute.



Gravity survey (2)

Gravimetric network of Lithuania



Gravity survey (3)

ABSOLUTE GRAVITY OBSERVATIONS IN LITHUANIA

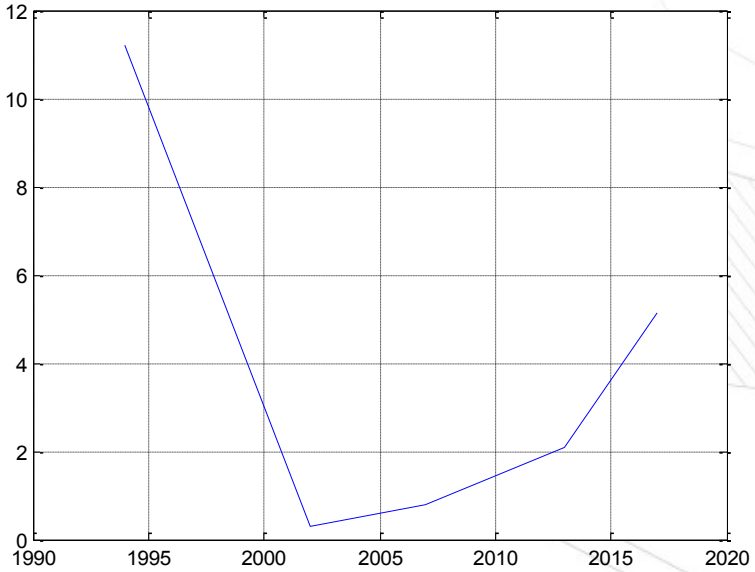
```
%Observers:
%
% 1994 JILAg-5 Jaakko Makinen
% 2002 JILAg-5 Jaakko Makinen
% 2007 FG5-221 Jaakko Makinen
% 2013 FG5X-221 Jaakko Makinen
% 2017 FG5X-221 Mirjam Bilker-Koivula
%
% Observation transfer height 120 cm.
%
%
```

% CODE	EPOCH(yr)	Instr.#	g(uGal)	tot.uncert.(uGal)	set.scatter(uGal)	#drops
VLNS	1994.539	5	981458750.2	5.	0.	4200
VLNS	2002.594	5	981458739.3	5.	0.	2550
VLNS	2007.944	221	981458739.8	2.5	1.91	1525
VLNS	2013.868	221	981458741.1	2.5	3.12	2000
VLNS	2017.722	221	981458744.14	2.5	0.96	3989
KLPD	1994.562	5	981547400.3	5	0.	3500
KLPD	2002.605	5	981547395.8	5	0.	3550
KLPD	2017.710	221	981547395.22	2.5	1.98	3696
PNVZ	1994.579	5	981526713.8	5.	0.	2750
PNVZ	2002.616	5	981526709.5	5.	0.	3600
PNVZ	2017.702	221	981526705.80	2.5	1.12	3541

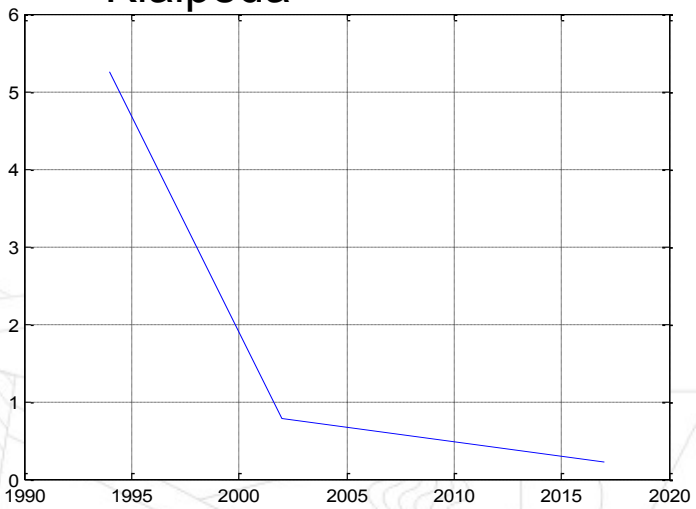
Gravity survey (4)

GRAVITY ACCELERATION CHANGES

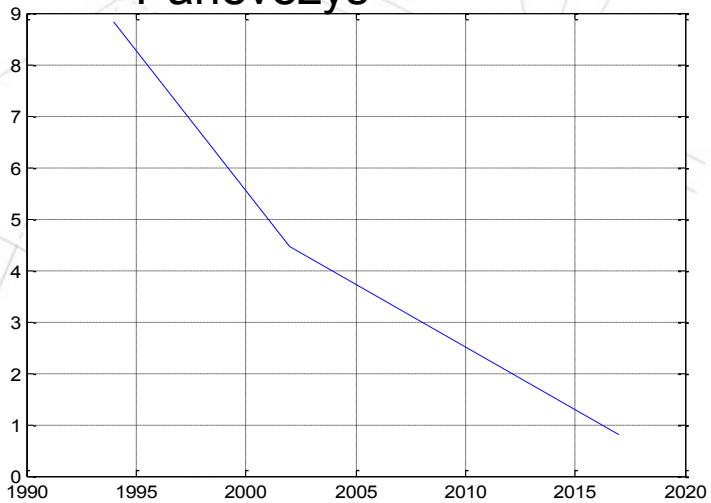
Vilnius



Klaipeda



Panevezys



Gravity survey (5)

Project "GRAVIMETRIC SURVEY OF THE LITHUANIAN TERRITORY"

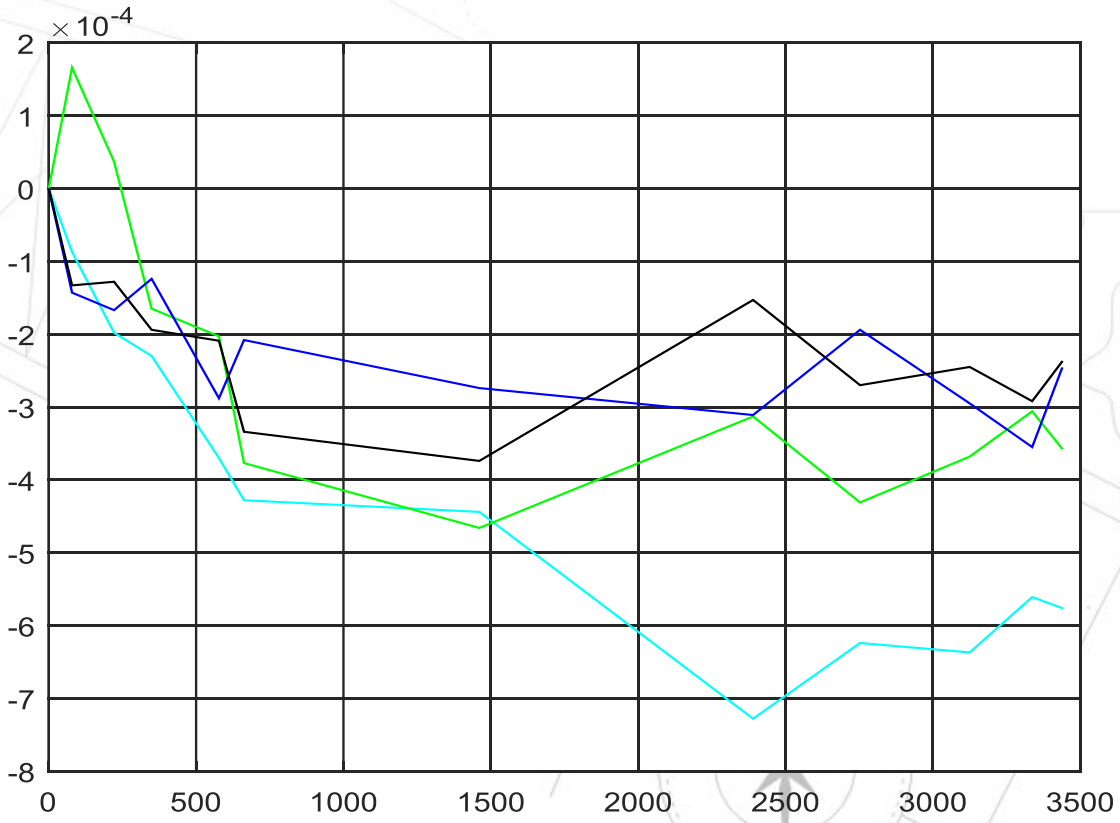
- The gravity survey is based on the Lithuanian state gravity control network, which consists of **686** points. The standard deviations of the gravity acceleration at these points are not bigger than **10 µGal**.
- **5** Scintrex CG-5 gravimeters employed.
- Total number of gravity points: **30 000**.
- Density of gravity points: **1 point in 2 km^2**.
- The average distance between gravity points should be about **1.5 – 2 km**.
- RMS error of the gravity acceleration at the gravity survey points < **60 µGal** (20 µGal)
- RMS error of Bouguer anomalies < **80 µGal** (23 µGal).
- RMS error of interpolated values of Bouguer anomalies <**100 µGal (**30 µGal**).**
- The accuracy of the gravity points coordinates < **0.20 m**, the accuracy of the normal heights, applying geoid model LIT15G, < **0.15 m**.

Gravity survey (6)

ABSOLUTE GRAVITY OBSERVATIONS IN SEPTEMBER, 2017

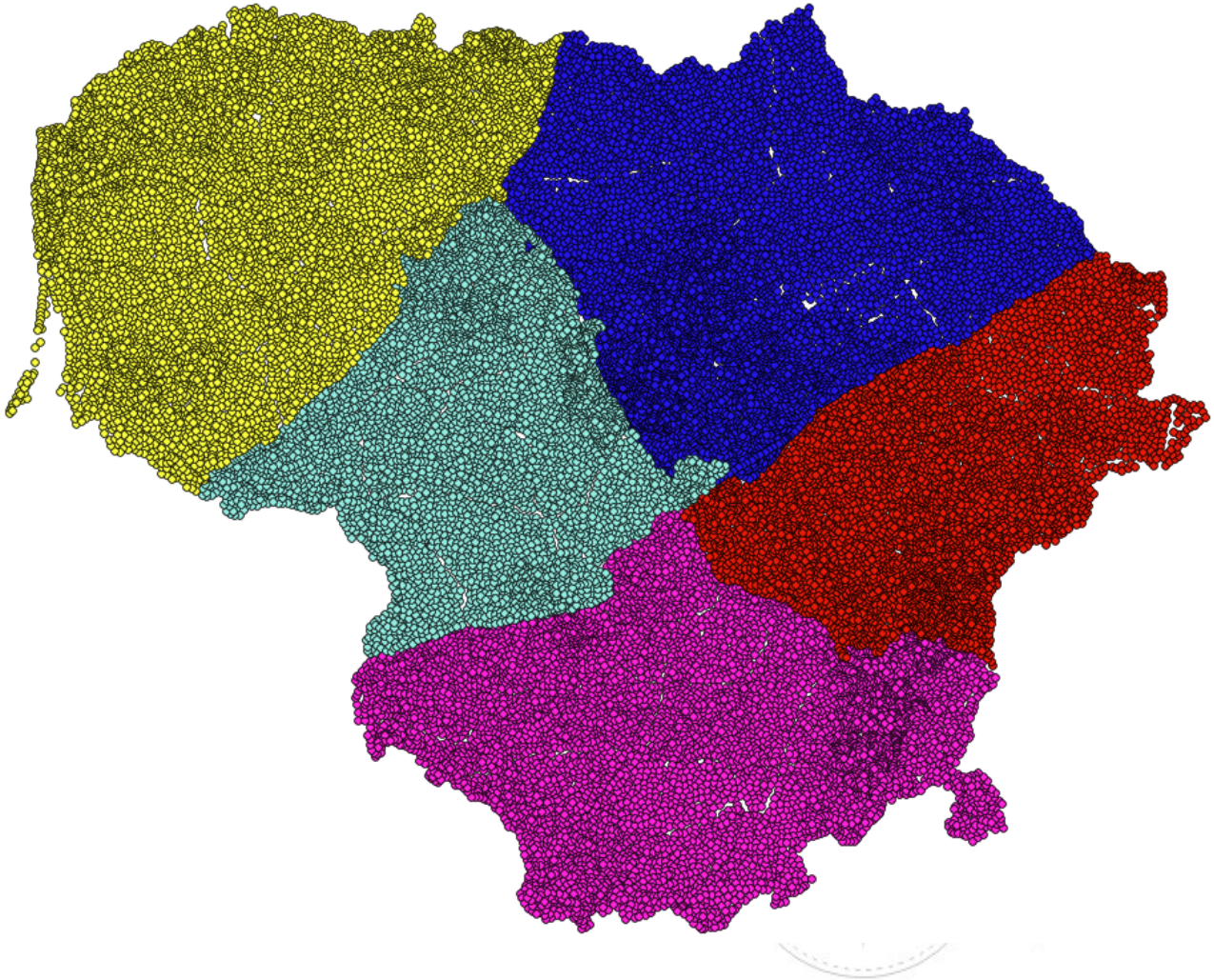
Gravity survey (7)

Changes of calibration coefficients

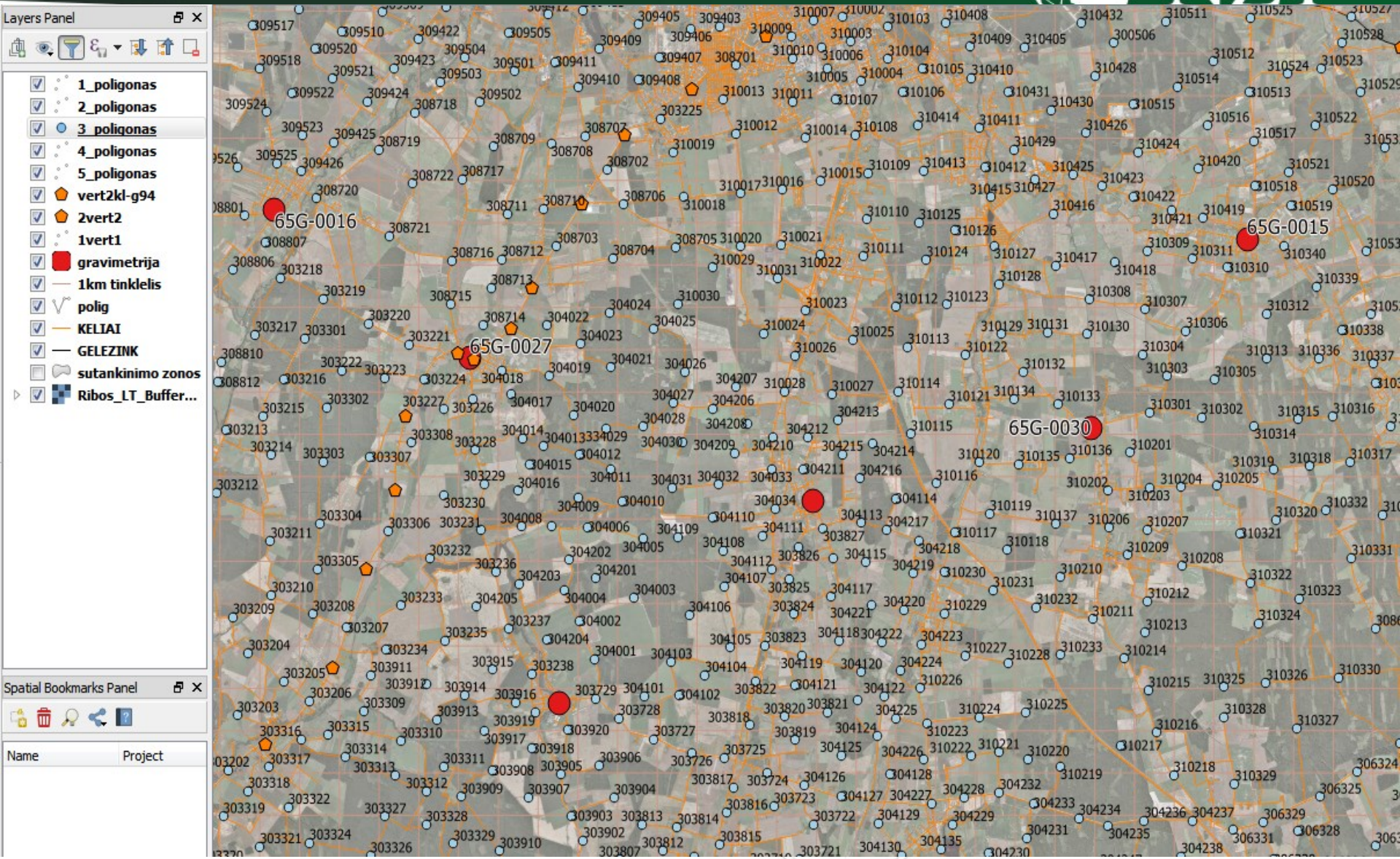


Gravity survey (8)

Gravity points coverage



Gravity survey (9)



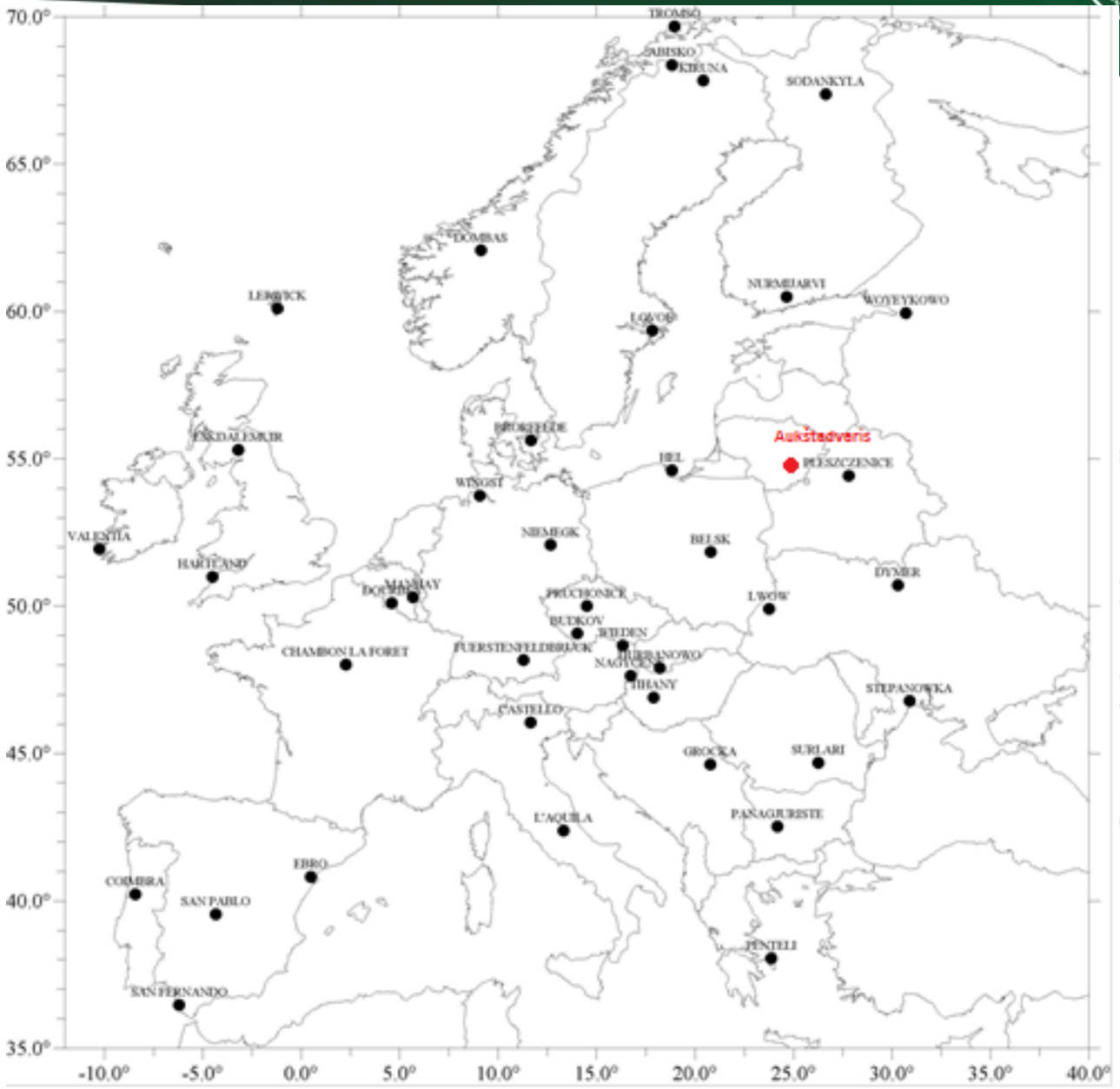
The points of gravity survey are coded by **six digits identifier**

Geomagnetic observatory

- Geomagnetic observatory

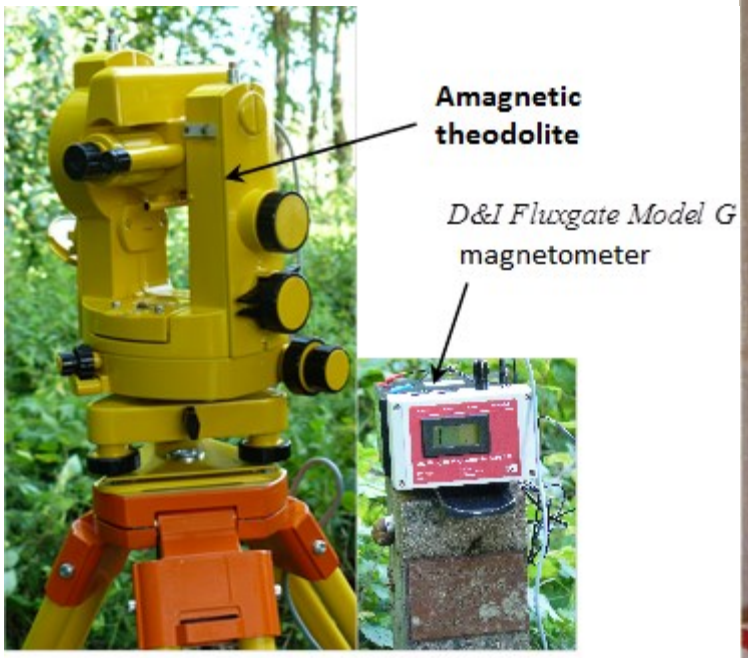
Geomagnetic observatory (1)

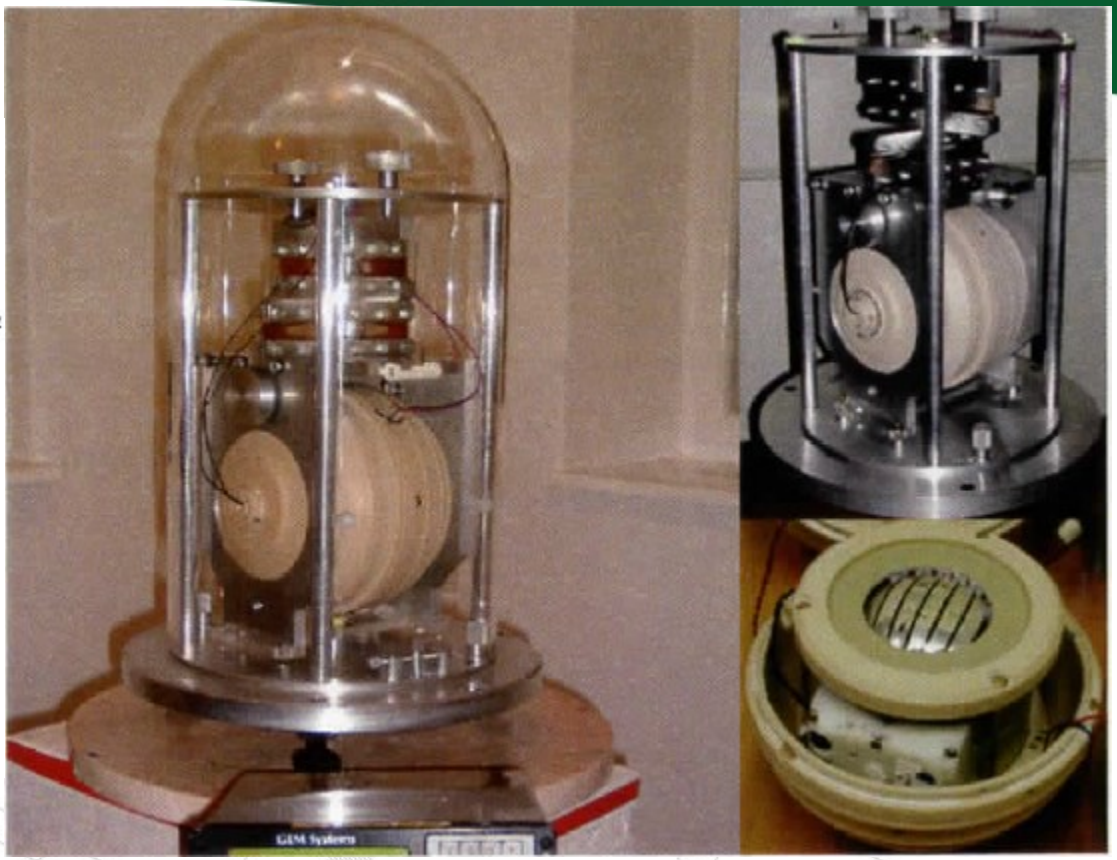
NŽT



Geomagnetic observatory (2)

Geomagnetic observatory (3)





Magnetometer dIdD

At present the data flow is under testing!

NŽT

THANKS FOR YOUR ATTENTION !

www.gi.ap.vgtu.lt

www.nzt.lt

www.geoportal.lt

www.litpos.lt

www.zis.lt