National report of LITHUANIA

Status of the geodetic control of Lithuania and further movements

Eimuntas Parseliunas
Geodetic Institute of Vilnius Technical University
eimis@vgtu.lt

NKG WG for geoid determination and geodynamics meetings, 2010, Masala, Finland

Outline

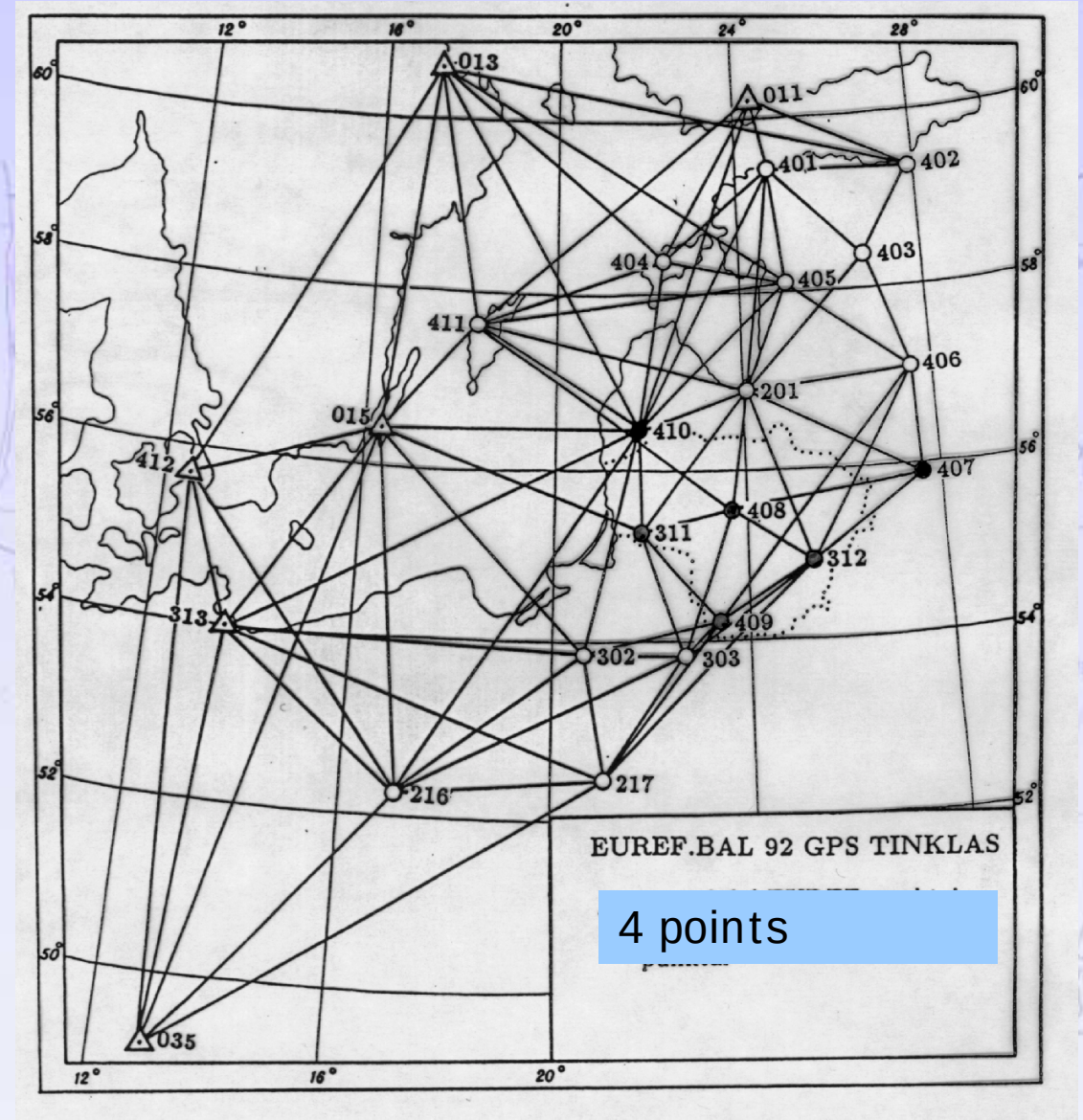
- EUREF2009 implementation (LitPOS)
- NKG2008 GPS campaign
- National Geodetic Vertical Network
- National Gravimetric Network
- Gravimetric database
- BTR+Sveksna basis celebration

EUREF2009 implementation

Lithuanian National Geodetic Coordinate System (LKS94) based on common **European Terrain Reference System ETRS89**
And, taking into account recommendations of International Association of Geodesy, was accepted by the
Resolution No. 936 of Government of Lithuania in September 30, 1994.

Lithuanian vertical (height) system and **Lithuania gravity system** are still not adopted, but Governmental decisions are on the way.

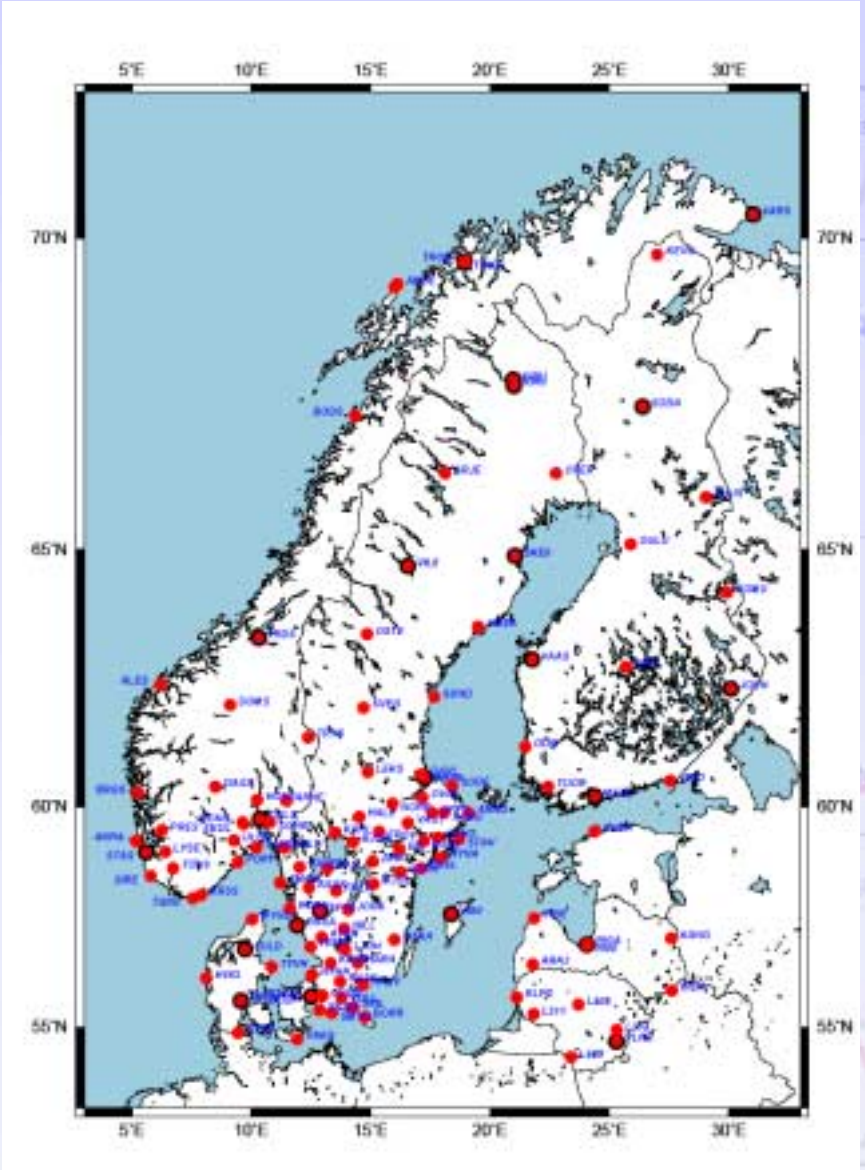
EUREF2009 implementation



EUREF BAL'92 GPS Network (Class "C")

EUREF2009 implementation

NKG 2003 campaign (Class “B”)



6 points

Resolutions

of the EUREF Symposium in Riga, 14 – 17 June 2006

Resolution no. 1

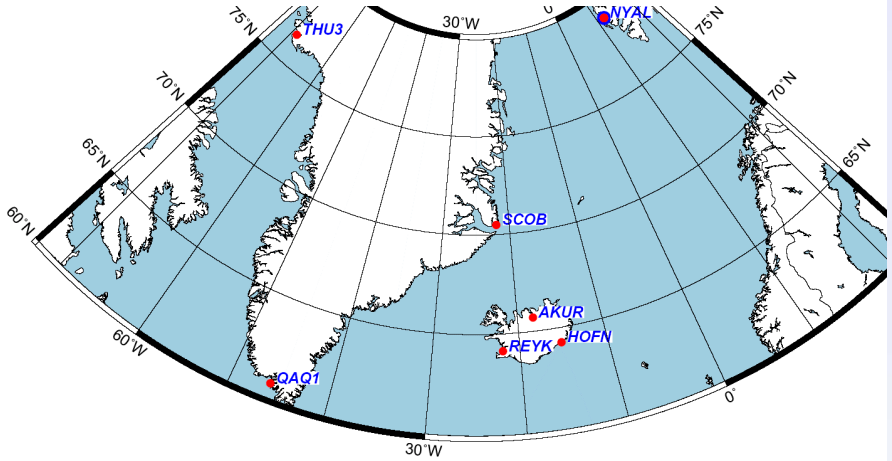
The IAG Reference Frame Sub-commission for Europe (EUREF)

recognising that

- in October 1993 the EUREF-BG-93 campaign in Bulgaria was observed and was reprocessed in 2005,
- in August-September-October 2004 the EUREF-BG-2004 campaign was observed,
- in September-October 2003 the EUREF-NKG-2003 in Scandinavia and the Baltic countries was observed, including points in Latvia and Lithuania, and

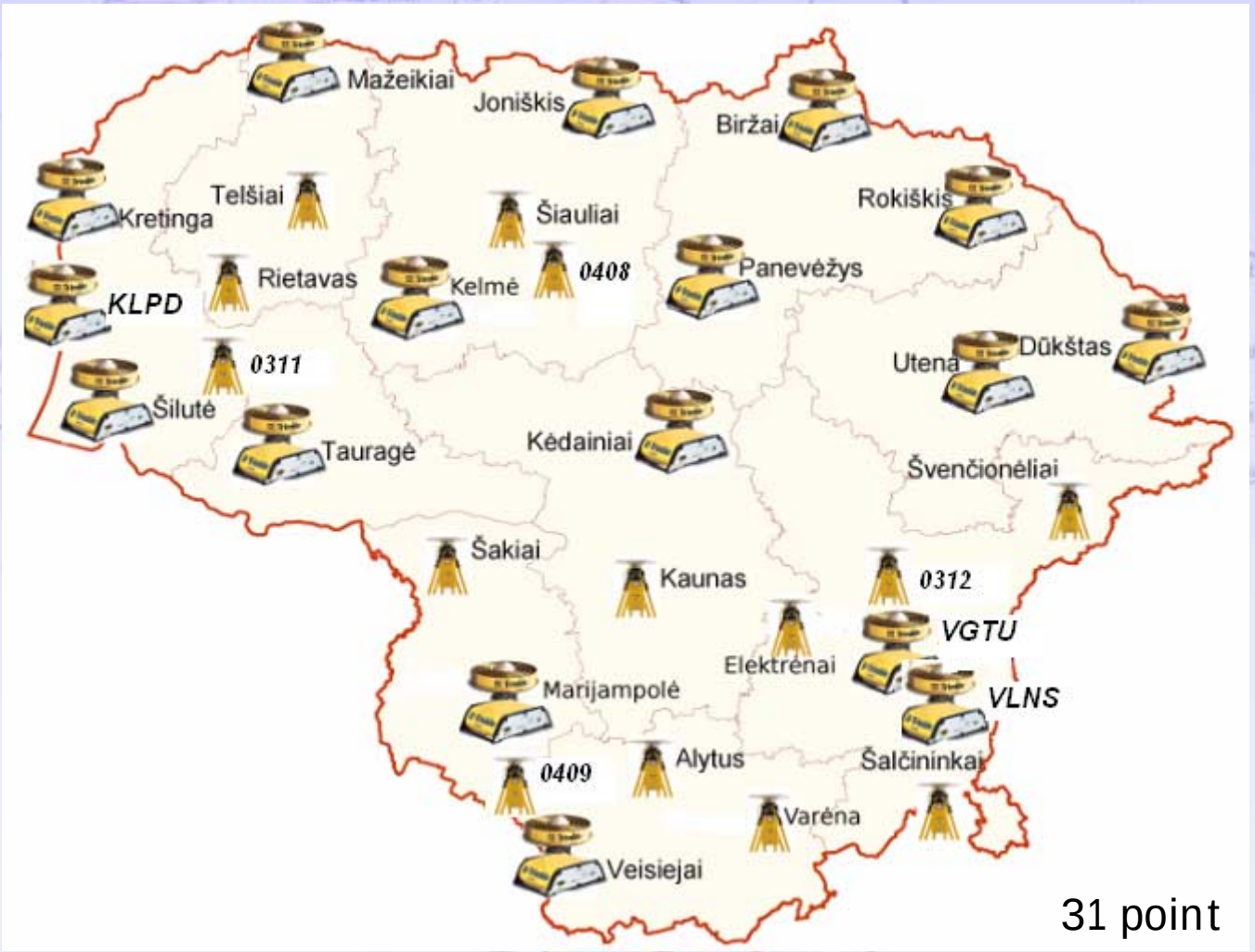
all the results were submitted to the EUREF technical working group, where they were accepted as Class B standard (about 1 cm at the epoch of observation)

endorses the subset of points submitted to the EUREF Technical Working Group as extensions to the current realisation of ETRS89



EUREF2009 implementation

NKG 2008 campaign (maintenance)

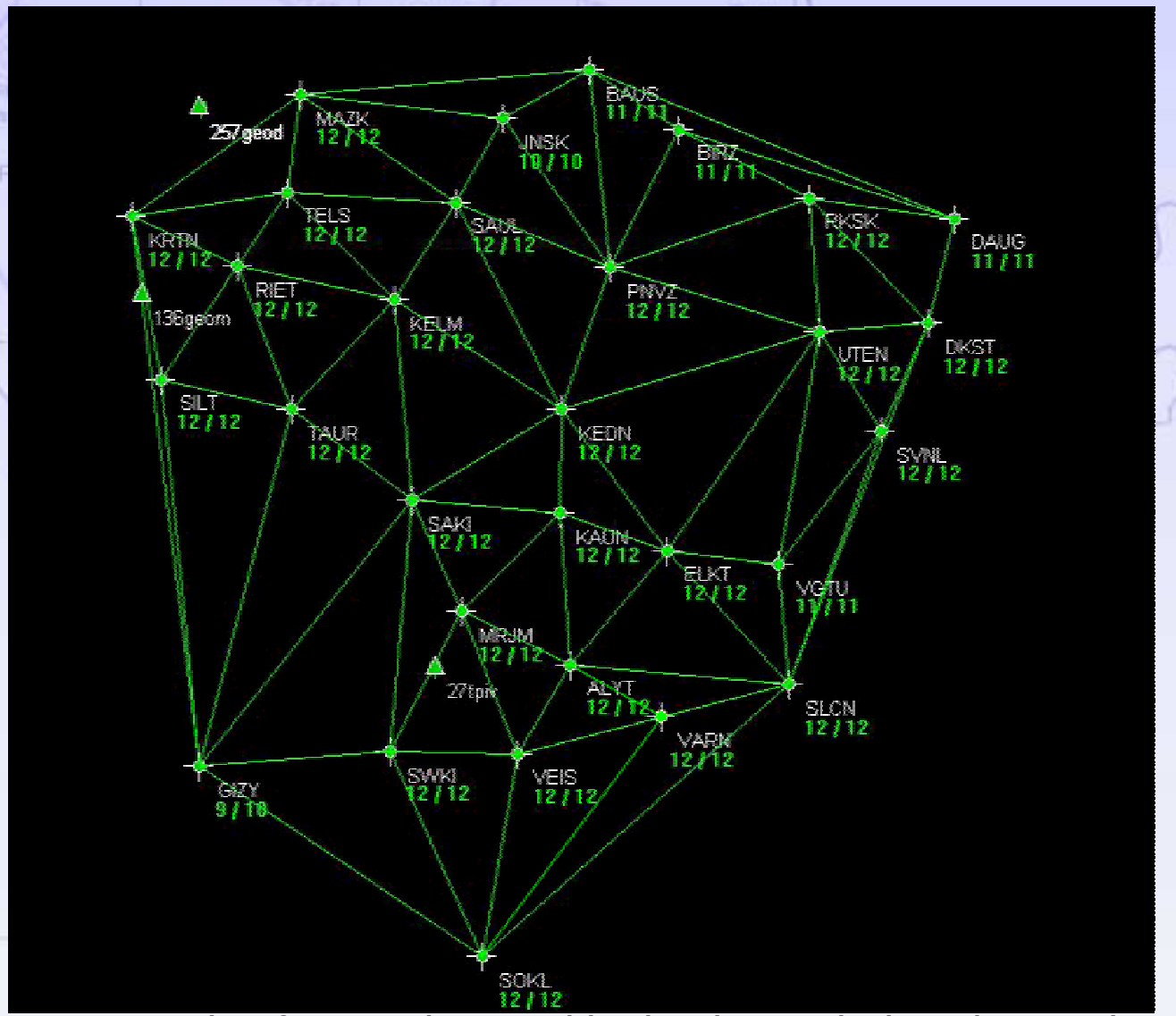


LitPOS - A Service for Precise Positioning in Real Time (25 stations)

EUREF2009 implementation

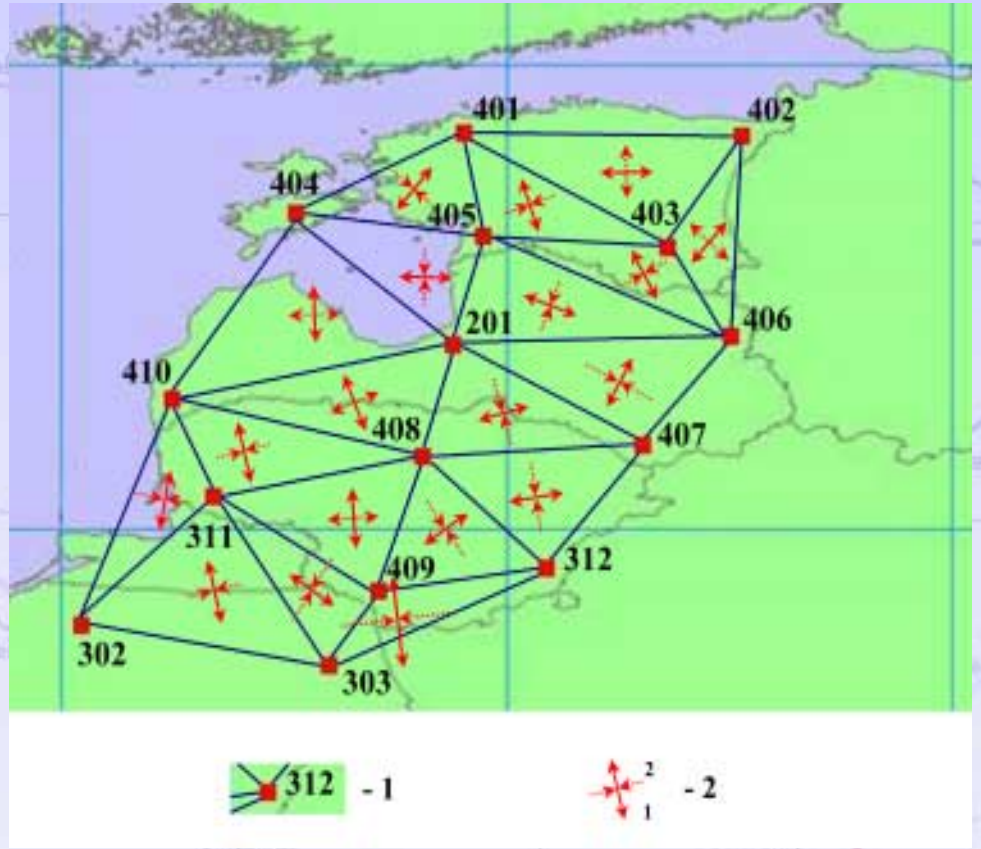
INSPIRE: INfrastructure for SPatial InfoRmation in Europe

EUPOS® (European Position Determination System)



LitPOS - A Service for Precise Positioning in Real Time (25 stations)

DEFORMATION OF GEODETIC NETWORK BASED ON GPS DATA IN THE BALTIC REGION



GPS network and orientation of the horizontal principal strain axis: 1 – GPS benchmark, 2 – principal strain direction (1 – maximum principal strain (extension), 2 – minimum principal strain (compression)

DEFORMATION OF GEODETIC NETWORK BASED ON GPS DATA IN THE BALTIC REGION

Parameters of horizontal deformations

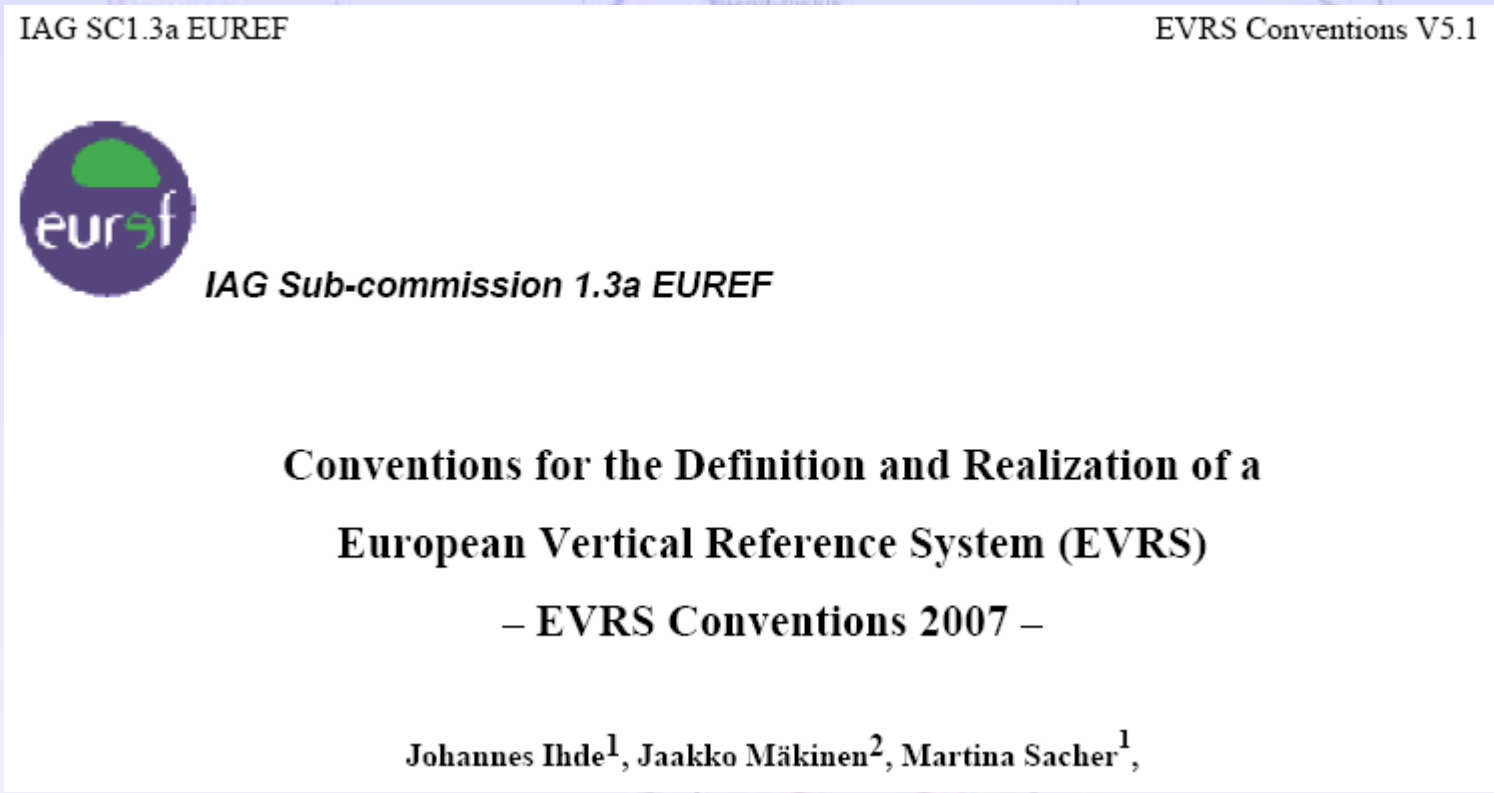
Node of finite element			$\varepsilon_1 \cdot 10^{-6}$	$\varepsilon_2 \cdot 10^{-6}$	φ°	$\Delta \cdot 10^{-6}$
GPS benchmark	GPS benchmark	GPS benchmark				
401	402	403	0.05	0.01	89	0.06
404	401	405	0.06	–0.04	41	0.02
401	403	405	0.04	–0.02	–19	0.02
403	402	406	0.04	0.03	42	0.07
405	403	406	0.06	–0.02	–28	0.04
404	405	201	0.05	–0.01	91	0.05
405	406	201	0.10	–0.02	111	0.08
404	201	410	0.07	0.02	–2	0.10
201	406	407	0.04	–0.36	28	–0.32
410	201	408	0.11	0.02	–22	0.13
201	407	408	0.03	–0.24	75	–0.21
410	408	311	0.15	–0.08	–13	0.07
408	407	312	0.08	–0.22	81	–0.15
410	311	302	0.11	–0.08	11	0.04
311	303	302	0.18	–0.02	–13	0.16
311	409	303	0.06	–0.31	124	–0.24
311	408	409	0.12	0.01	–4	0.13
408	312	409	0.05	–0.17	56	–0.12
409	312	303	0.58	–0.93	–7	–0.35

National Geodetic Vertical Network (1)

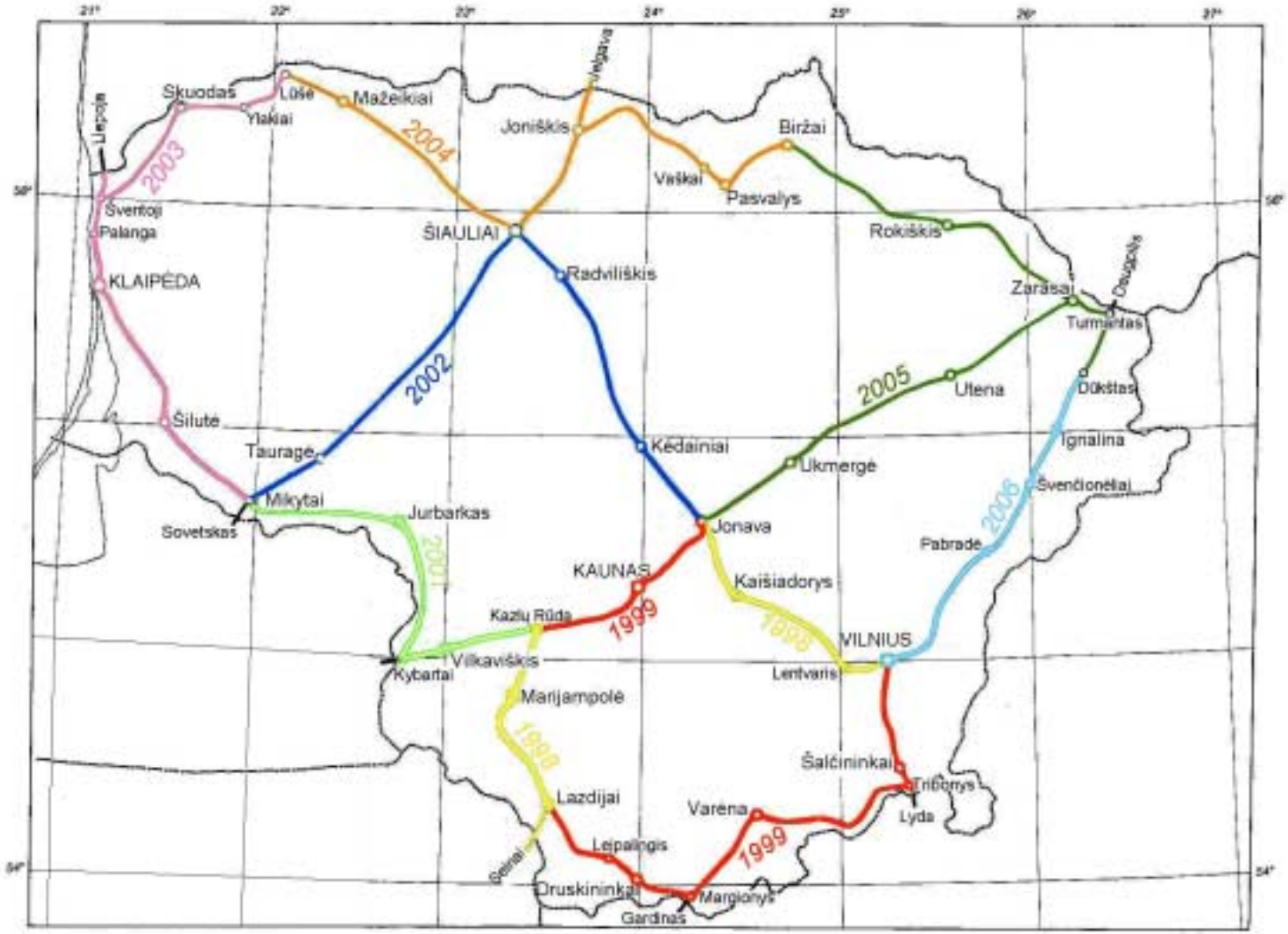
Lithuanian vertical (height) system is still not adopted.

The project of **The Resolution of the Government of Lithuania is prepared!**

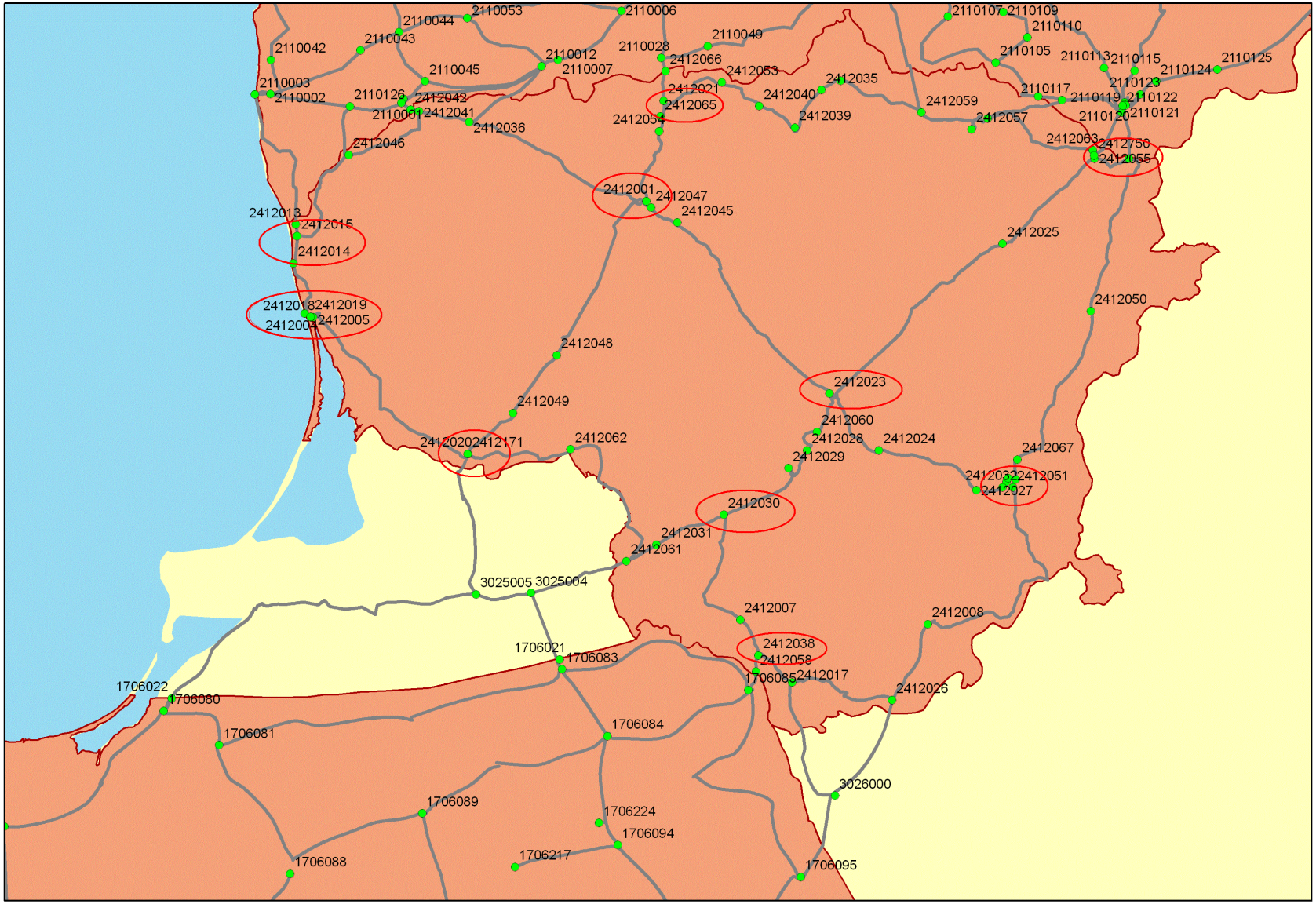
It is based on **EVRS Conventions 2007.**



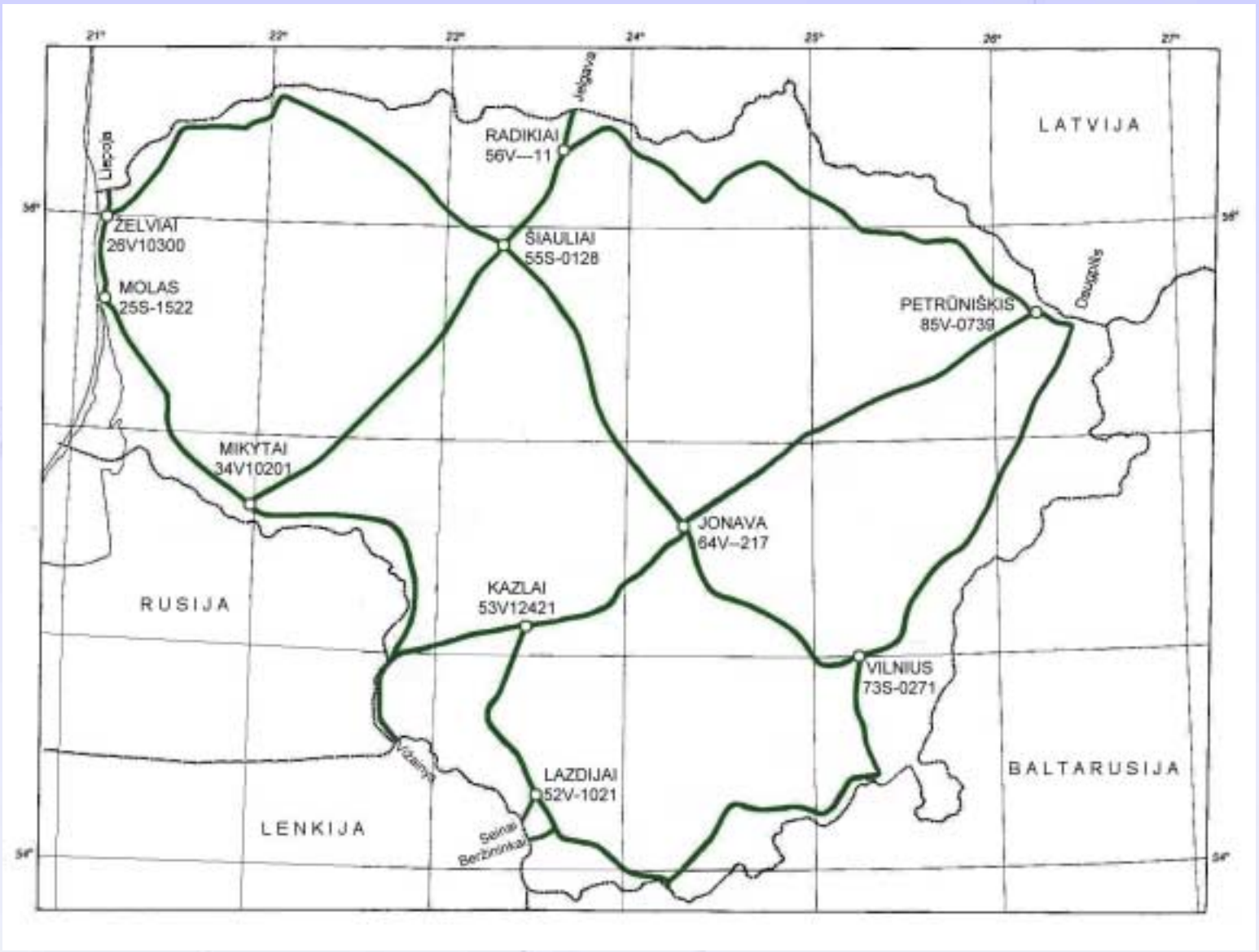
National Geodetic Vertical Network (1)



National Geodetic Vertical Network (3)



National Geodetic Vertical Network (4)



10 datum points

National Geodetic Vertical Network (5)

Data of datum points

No.	Name	National code	UELN code	LKS94 coordinates	Geopotential number, $m^2 \cdot s^{-2} \cdot 10^{-1}$	Accuracy of geopotential number in UELN network, $m^2 \cdot s^{-2} \cdot 10^{-1}$	Normal height, m	LSS07 gravity acceleration, $m \cdot s^{-2}$
1	ŠIAULIAI	55S-0128	2412001	55°54'48,78202" 23°22'17,18605"	138,795	0,0127	141,402	9,815339
2	VILNIUS	73S-0271	2412002	54°39'11,30417" 25°17'55,19158"	211,797	0,0128	215,801	9,814334
3	MOLAS	25S-1522	2412004	55°43'47,23801" 21°04'58,88606"	4,590	0,0136	4,676	9,815498
4	ŽELVIAI	26V10300	2412015	56°00'41,96954" 21°06'51,86654"	9,126	0,0138	9,297	9,815762
5	MIKYTAI	34V10201	2412020	55°07'54,06812" 21°57'34,81749"	16,370	0,0116	16,678	9,814947
6	JONAVA	64V--217	2412023	55°05'55,95392" 24°16'20,64503"	67,575	0,0122	68,848	9,814745
7	KAZLAI	53V12421	2412030	54°44'43,61659" 23°28'14,25382"	63,884	0,0112	65,090	9,814756
8	LAZDIJAI	52V-1021	2412038	54°13'18,96189" 23°30'43,65627"	129,529	0,0105	131,981	9,814077
9	PETRŪNIŠKIS	85V-0739	2412055	55°43'08,70335" 26°14'41,29362"	142,250	0,0136	144,924	9,815321
10	RADIKIAI	56V---11	2412065	56°12'13,21889" 23°34'03,21221"	59,636	0,0134	60,754	9,815793

National Geodetic Vertical Network (6)

Differences between some height systems

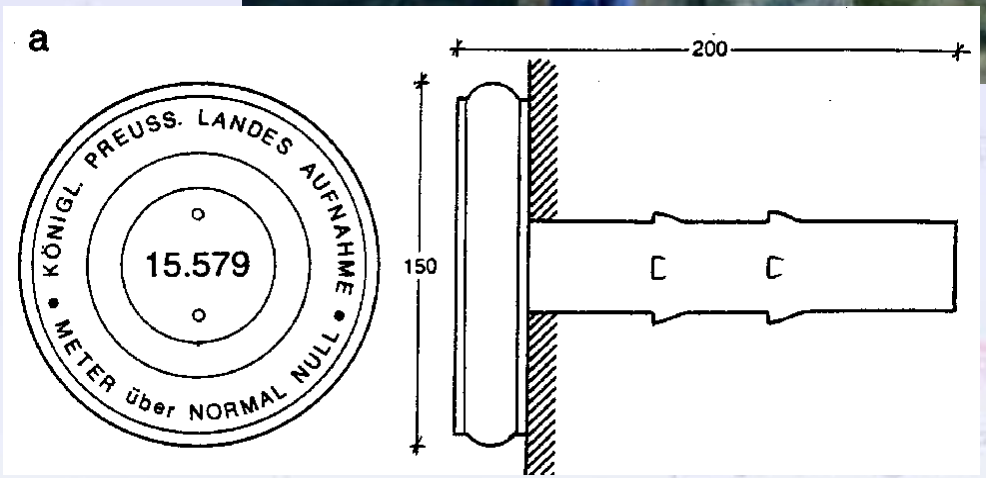
KODAS	KAM 39	BAS77	LVS07	BAS77-KAM39	LVS07-KAM39	LVS07-BAS77
26V-1406	20,737	20,662	20,774	-75	37	112
26V-1423	22,716	22,651	22,764	-65	48	113
34V-4016	36,822	36,651	36,769	-171	-53	118
37V-1609	106,765	106,700	106,813	-65	48	113
44V-4035	17,521	17,382	17,503	-139	-18	121
44V-4041	19,996	19,851	19,972	-145	-24	121
46V-1804	99,090	98,996	98,113	-94	23	117
46V-1810	98,866	98,777	98,894	-89	28	117
52V-4302	120,544	120,419	120,554	-125	10	135
52V-4319	71,653	71,455	71,586	-198	-67	131
53V-4101	70,061	69,933	70,060	-128	-1	127
53V-4228	60,121	60,002	60,128	-119	7	126
53V-4325	63,254	63,133	63,262	-121	8	129
55V-1110	130,436	130,301	130,418	-135	-18	117
55V-2007	131,810	131,710	131,827	-100	17	117
55V-2210	93,120	93,014	93,135	-106	15	121
63V-3723	105,967	105,845	105,974	-122	7	129
63V-3913	69,044	68,926	69,052	-118	8	126
63V-3919	70,203	70,082	70,208	-121	5	126
64V-2233	70,282	70,160	70,285	-122	3	125
64V-2239	71,935	71,811	71,936	-124	1	125
64V-3510	90,486	90,371	90,496	-115	10	125
74V-3101	168,558	168,471	168,591	-87	33	120
74V-3523	74,499	74,400	74,525	-99	26	125
74V-3540	157,093	156,996	157,116	-97	23	120
76V-2416	131,601	131,537	131,656	-64	55	119
85V-3109	111,356	111,263	111,386	-93	30	123
85V-3217	159,005	158,920	159,039	-85	34	119

National Geodetic Vertical Network (7)

Differences between some height systems

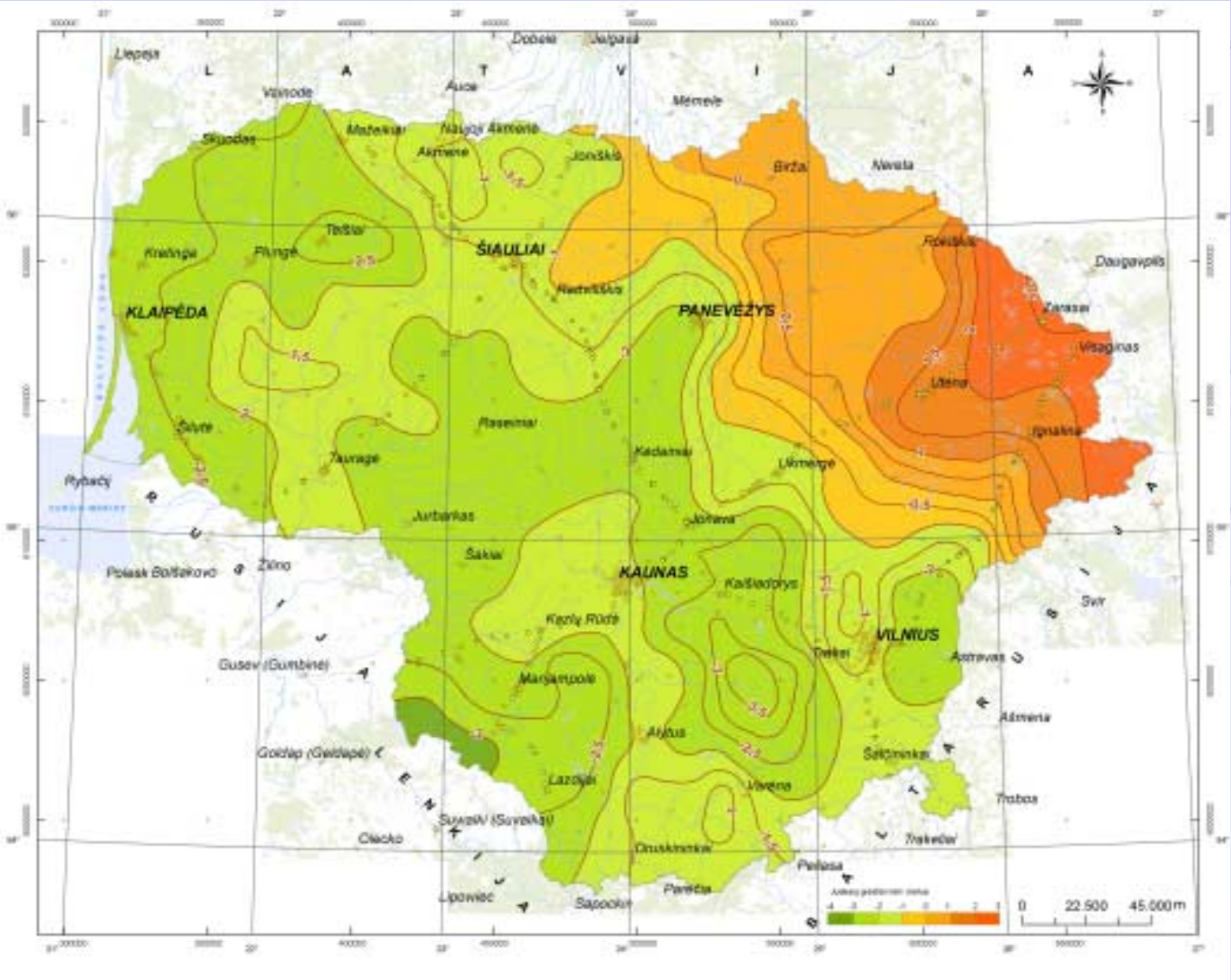
Benchmark code	Place	Year of establishing	H initial	H 1930	H 1939	H 1951	H 1980	H 2000	H LVS07
55N-1110	Šiauliai	1889	130,328				130,277	130,398	130.418
64N-1234	Žeimiai	1889	70,765		70,895	70,751	70,748	70,907	
46N-0003	Kuršėnai	1889	103,149		102,251	-	103,098	103,222	103.277
36V-1609	Lūšė	1889	106,603		106,765	-	106,543	106,758	106.813
43N-4221	Pilviškis	1888	46,190		46,111			46,127	
43N-1570	Vilkaviškis	1890	55,868				55,837	55,952	
53N-1603	Mauručiai	1888	94,464				94,452	94,581	94.571
95N—315	Žemgalė	1930	-	138,436	-	-	138,415	138,486	
84N--139	Ignalina	1872	163,212	163,137	163,137	-	163,099	163,172	
73N-7036	Naujoji Vilnia	1899	153,032	153,091	-	152,984	152,956	153,098	
34V-0004	Lauksargiai	1888	52,079	-	52,076	-		52,046	52.048
26N-0001	Palanga	1881	7,841	-	7,923	7,800	7,798	7,884	7.928
26N-7381	Nemirseta	1881	11,925	-	12,024	11,900	-	11,985	
72N-0007	Rūdiškės	1888	159,480				159,646	159,786	
62N-0010	Valkininkai	1888	142,279				142,539	142,674	
62N—345	Matuizos	1888	127,002				127,046	127,178	
61N-0001	Marcinkonys	1888	124,848				124,903	125,032	

National Geodetic Vertical Network (8)



National Geodetic Vertical Network (9)

National Geodetic Vertical Network (10)

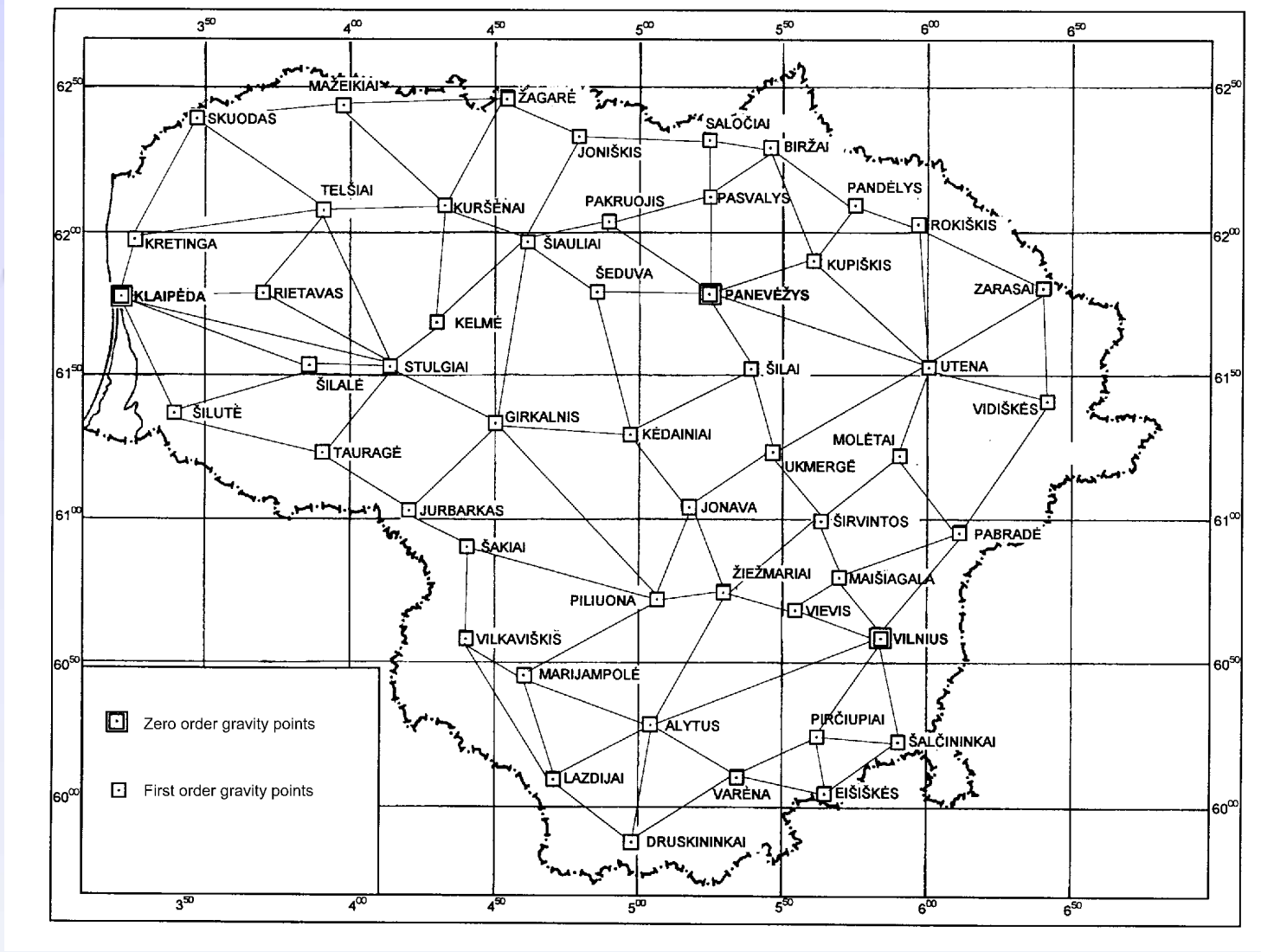


Map of Lithuania current Earth crust vertical movements

Gravimetric Networks – current works and future plans

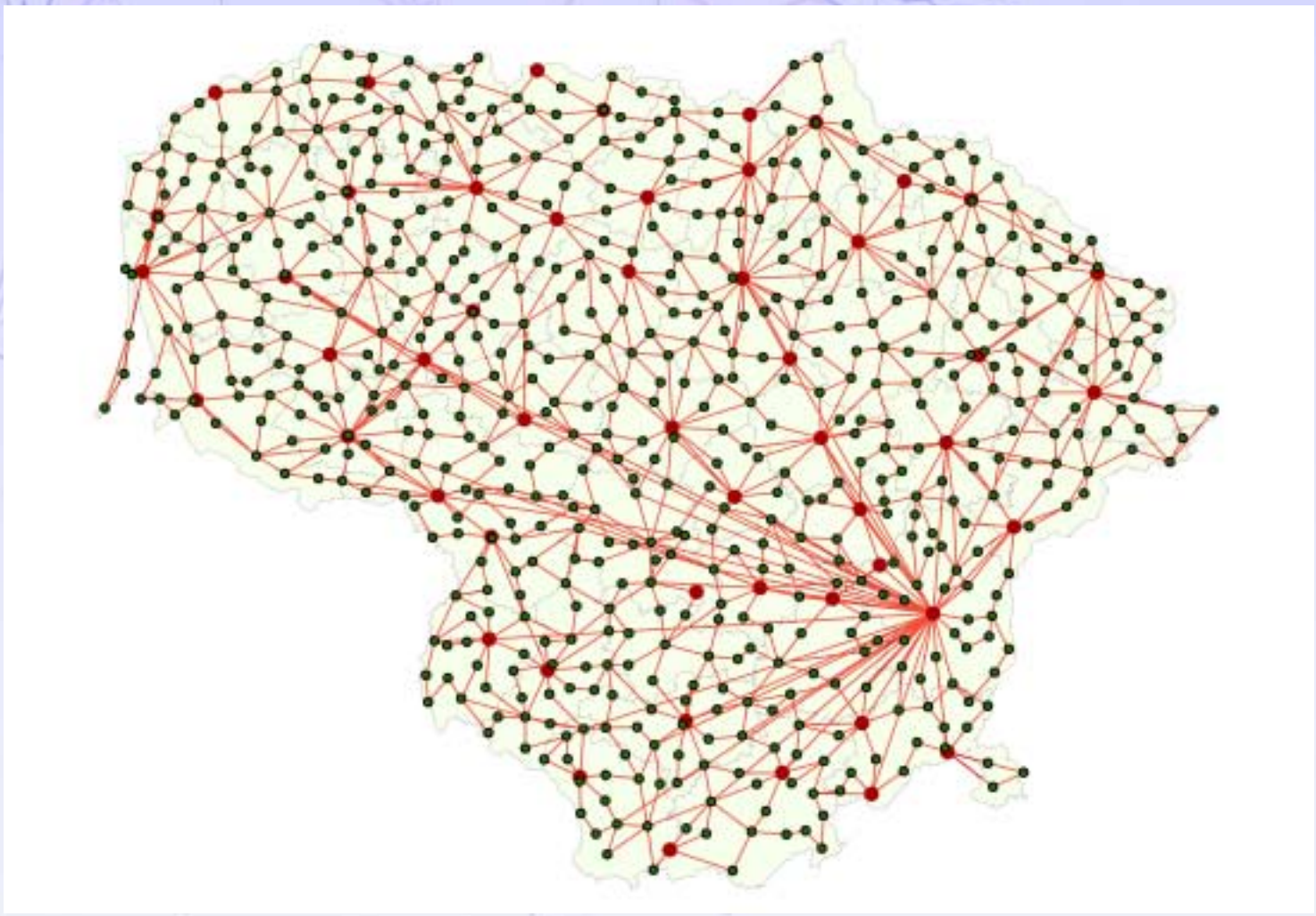
Lithuanian National Gravity First Order Network (48 points)

(1998-2001)



Gravimetric Networks – current works and future plans

Lithuanian National Gravity Second Order Network (about 635 points)
(2007-2009)



Gravimetric Networks – current works and future plans

Gravity acceleration corrections at the first order gravimetric points, µGal

Punkto kodas	Punktas	Pataisa, µGal
24G-0001	ŠILUTĖ	15
25G-0002	KRETINGA	25
26G-0005	SKUODAS	5
34G-0001	TAURAGĖ	0
35G-0001	ŠILALĖ	10
35G-0002	RIETAVAS	11
36G-0003	TELŠIAI	–10
36G-0004	MAŽEIKIAI	3
43G-0005	ŠAKIAI	0
43G-0006	VILKAVIŠKIS	5
44G-0005	JURBARKAS	21
44G-0006	GIRKALNIS	22
45G-0003	STULGIAI	21
45G-0004	KELMĖ	–3
46G-0005	KURŠĖNAI	0
51G-0001	DRUSKININKAI	2
52G-0009	LAZDIJAI	–3
52G-0010	MARIJAMPOLĖ	2
54G-0006	KĖDAINIAI	0
55G-0006	ŠEDUVA	5
55G-0007	ŠIAULIAI	5
56G-0005	PAKRUOJIS	4
56G-0006	JONIŠKIS	–14
56G-0007	ŽAGARĖ	–7
62G-0008	VARĖNA	–11
62G-0009	ALYTUS	0
63G-0004	ŽIEŽMARIAI	14
63S-1435	PILIUONA	5
64G-0006	UKMERGĖ	–4
64G-0007	JONAVA	7
65G-0006	ŠILAI	–11
66G-0002	SALOČIAI	–2
66G-0003	BIRŽAI	–2
66G-0004	PASVALYS	8
72G-0008	ŠALČININKAI	–6
72G-0009	EIŠIŠKĖS	0
72G-0010	PIRČIUPIAI	6
73G-0006	MAIŠIAGALA	22
73G-0007	VIEVIS	9
74G-0004	ŠIRVINTOS	5
74G-0005	MOLĖTAI	9
75G-0005	KUPIŠKIS	3
76G-0003	PANDĖLYS	8
76G-0004	ROKIŠKIS	2
83G-0003	PABRADĖ	4
84G-0003	VIDIŠKĖS	–1
85G-0005	UTENA	1
85G-0006	ZARASAI	0

Gravimetric Networks – current works and future plans

ure plans

GRAVIMETRINIO ANTROSIOS KLASĖS TINKLO PUNKTAS

KERNAVĖ

73G-0018

LSS 07 sunkio pagreitis
(2007 m. gravimetriniai matavimai)
g = 981 470,629 mGal

LKS 94 geodezinės koordinatės
(2007 m. GPS matavimai (LitPOS RTKNet paslauga))
B = 54°53'05,583" **x = 6 083 531,10 m**
L = 24°51'07,897" **y = 554 679,79 m**

LAS 07 normalinis aukštis
(2004 m. geoido modelis)
H_n = 111,56 m

Elipsoidinis aukštis
(2007 m. GPS matavimai (LitPOS RTKNet paslauga))
H_e = 136,49 m

PUNKTO VIETA (70-74/35-39)

PASTATO FASADAS

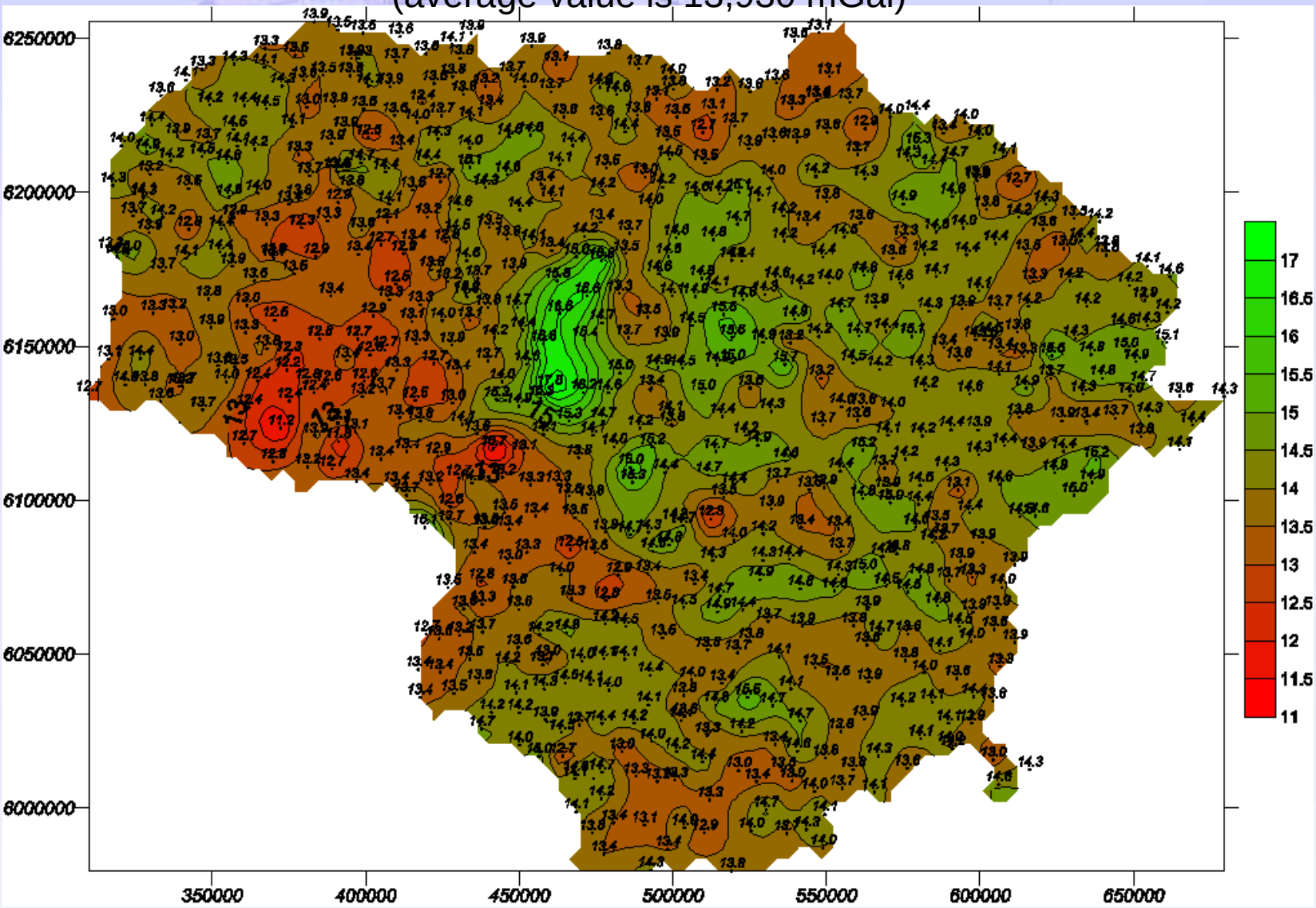
ZENKLO VIETA

Svc. Mergelės Marijos Skaplierinės bažnyčios kairiojo įėjimo dešiniąja puse.
Kernavės g. 6, Kernavė, Širvintų r. sav.

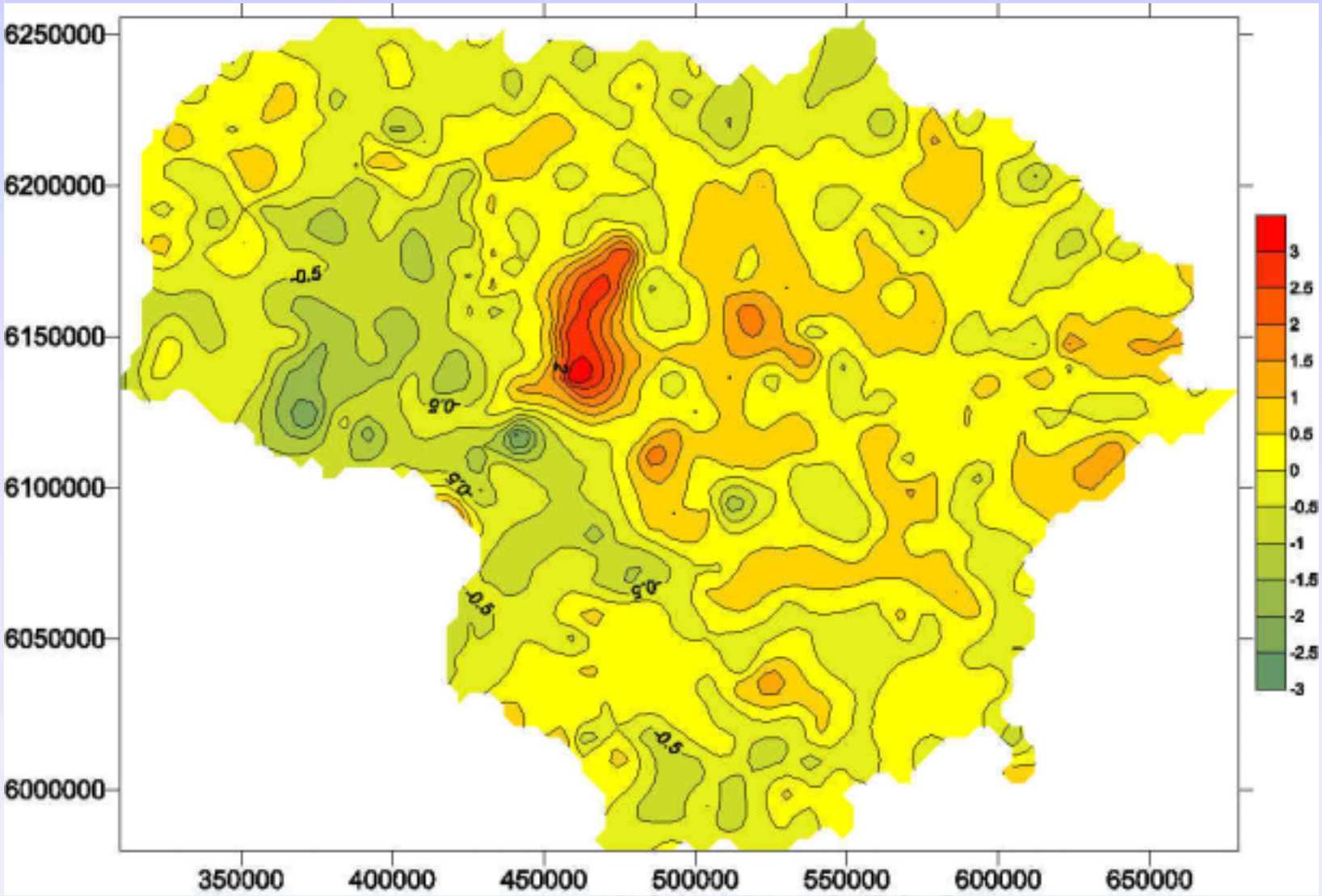
Punkto vietą aprašė P. Valiontas, 2007 09

Gravimetric Networks – current works and future plans

Differences between Potsdam and IGSN71 systems
(average value is 13,930 mGal)

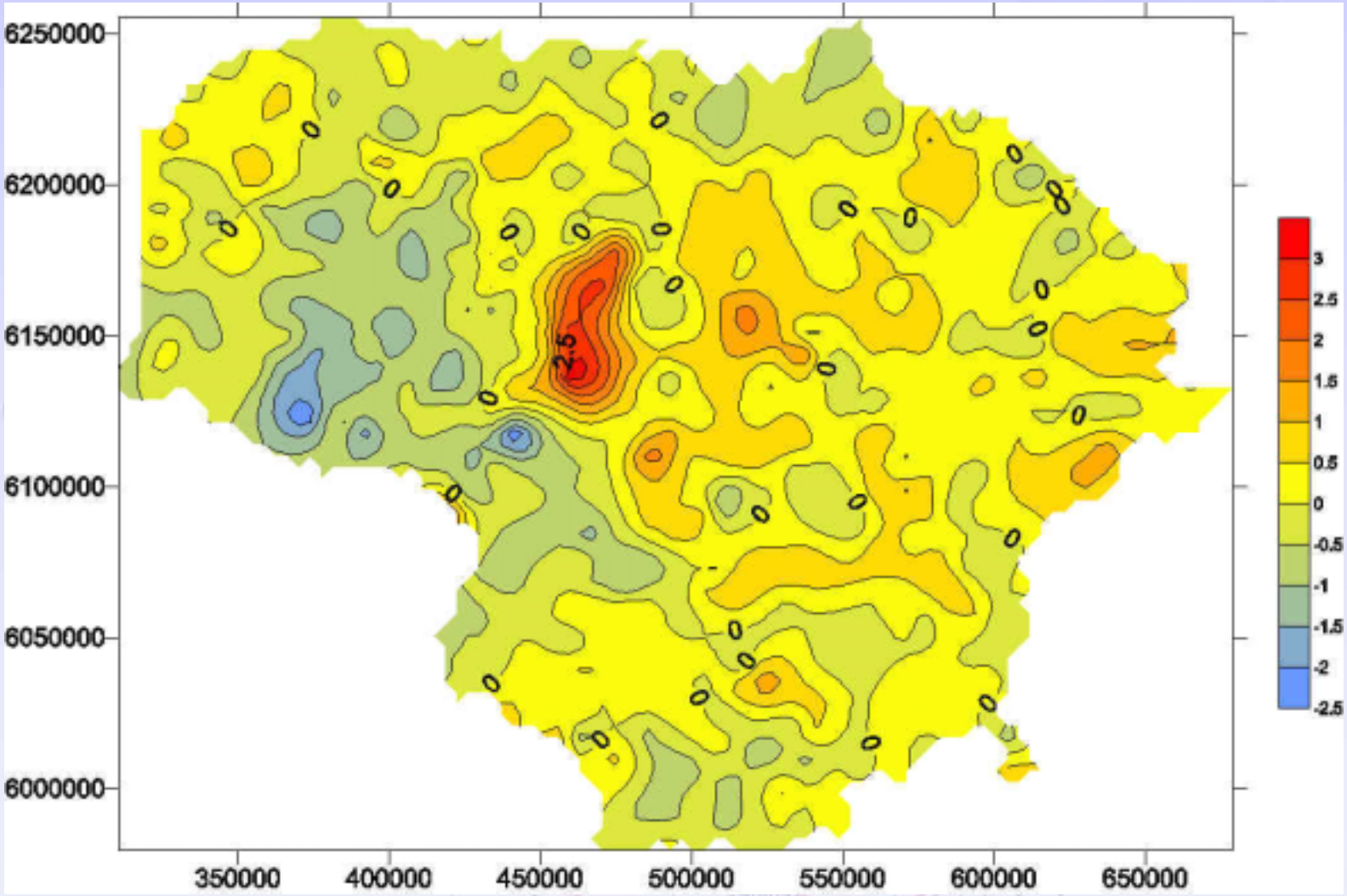


Gravimetric database



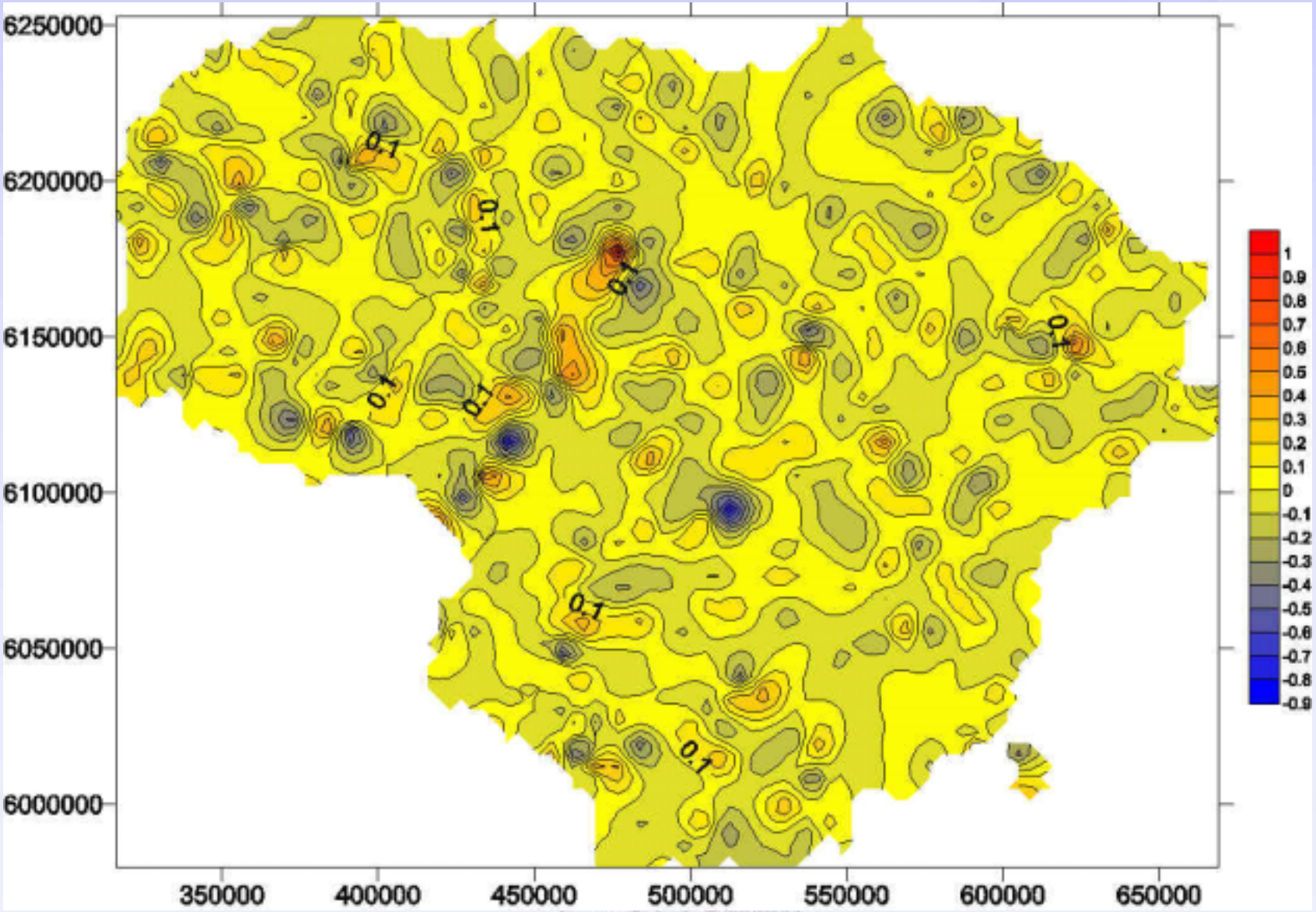
Differences of Bouguer anomalies at 686 points (Bmap-Bnew)

Gravimetric database



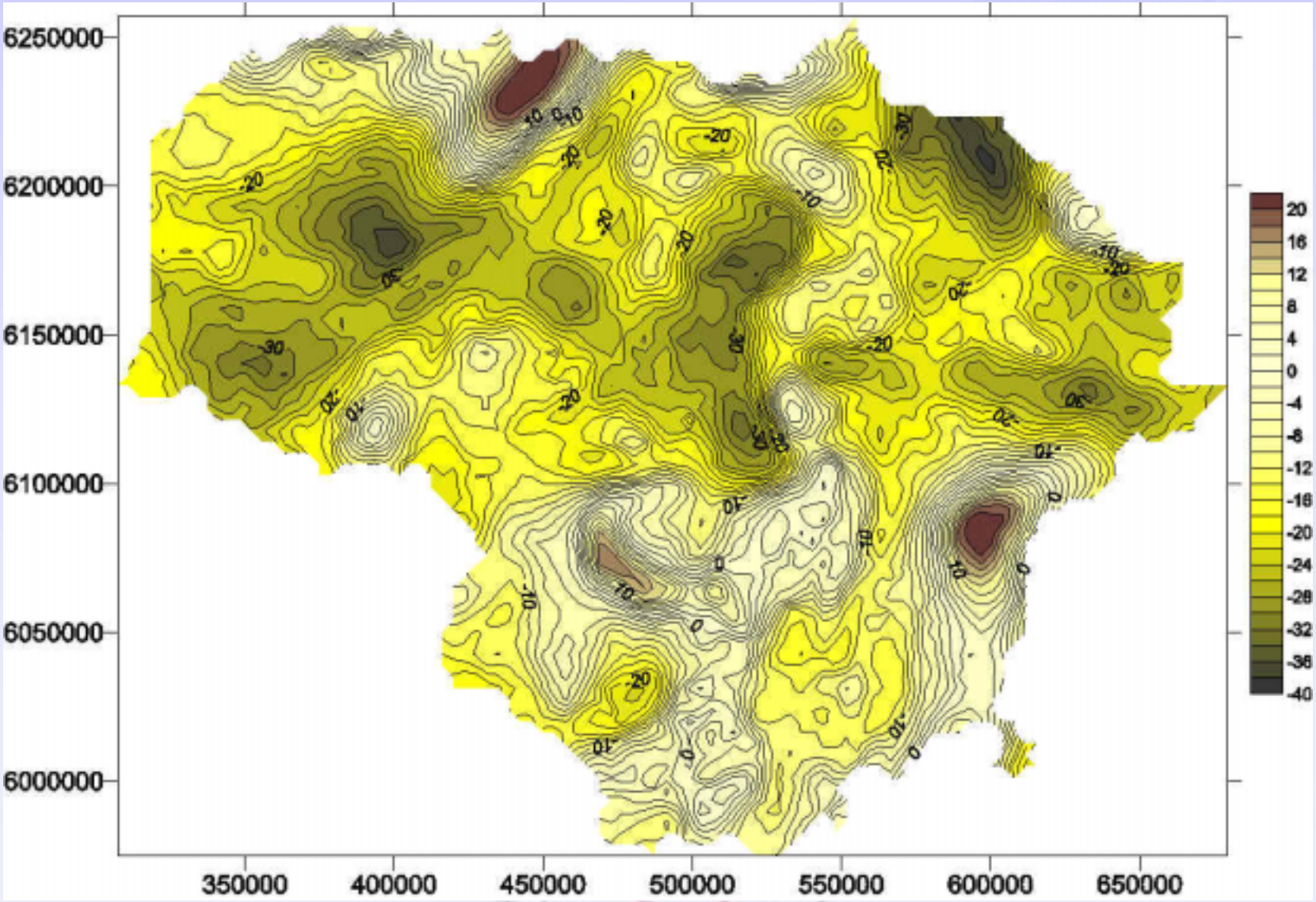
Differences of Bouguer anomalies at 10645 points (Bmap-Bmodel)

Gravimetric database



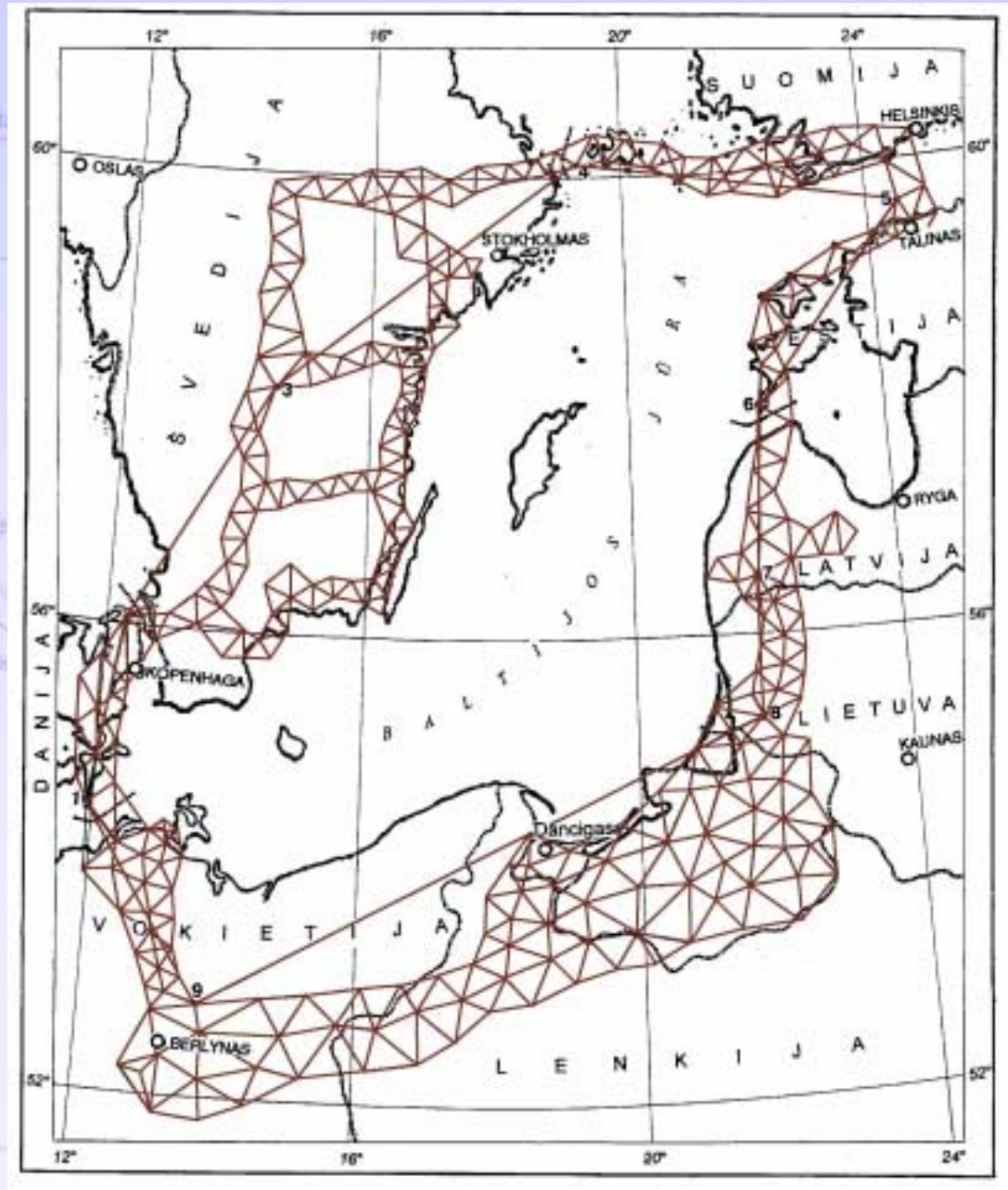
Residuals of Bouguer anomalies at 10645 points

Gravimetric database



Bouguer anomalies based on 686+10645 points

Baltic Triangulation Ring



Baltic Triangulation Ring

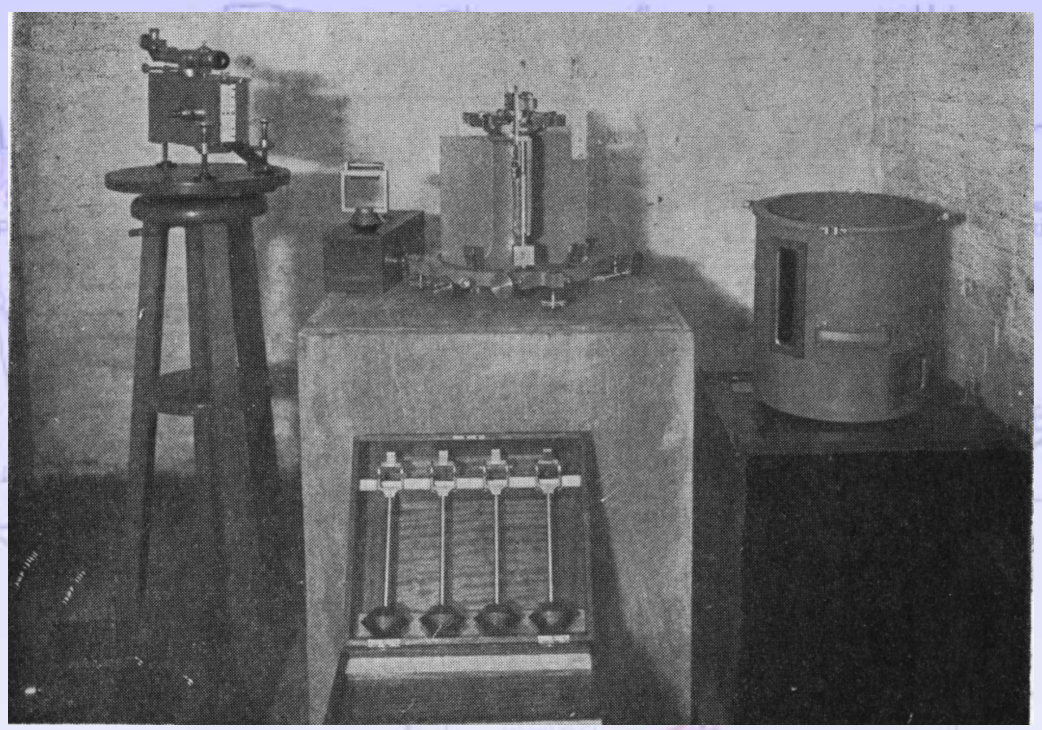
Sveksna basis was measured in **June 3–9, 1929**.
The measurements were carried out by the international team of the Baltic Geodetic Commission:
Dr. U. Pesonen (Finland) – team leader;
MsC. Ö. Burrau (Denmark);
Asist. N. Jonsson (Sweden);
Eng. T. Szymanski (Poland);
Local specialists.

Length of Sveksna basis

***B* = 6466 m + 345,30 mm ±0,74 mm.**

1:8 700 000

Baltic Triangulation Ring

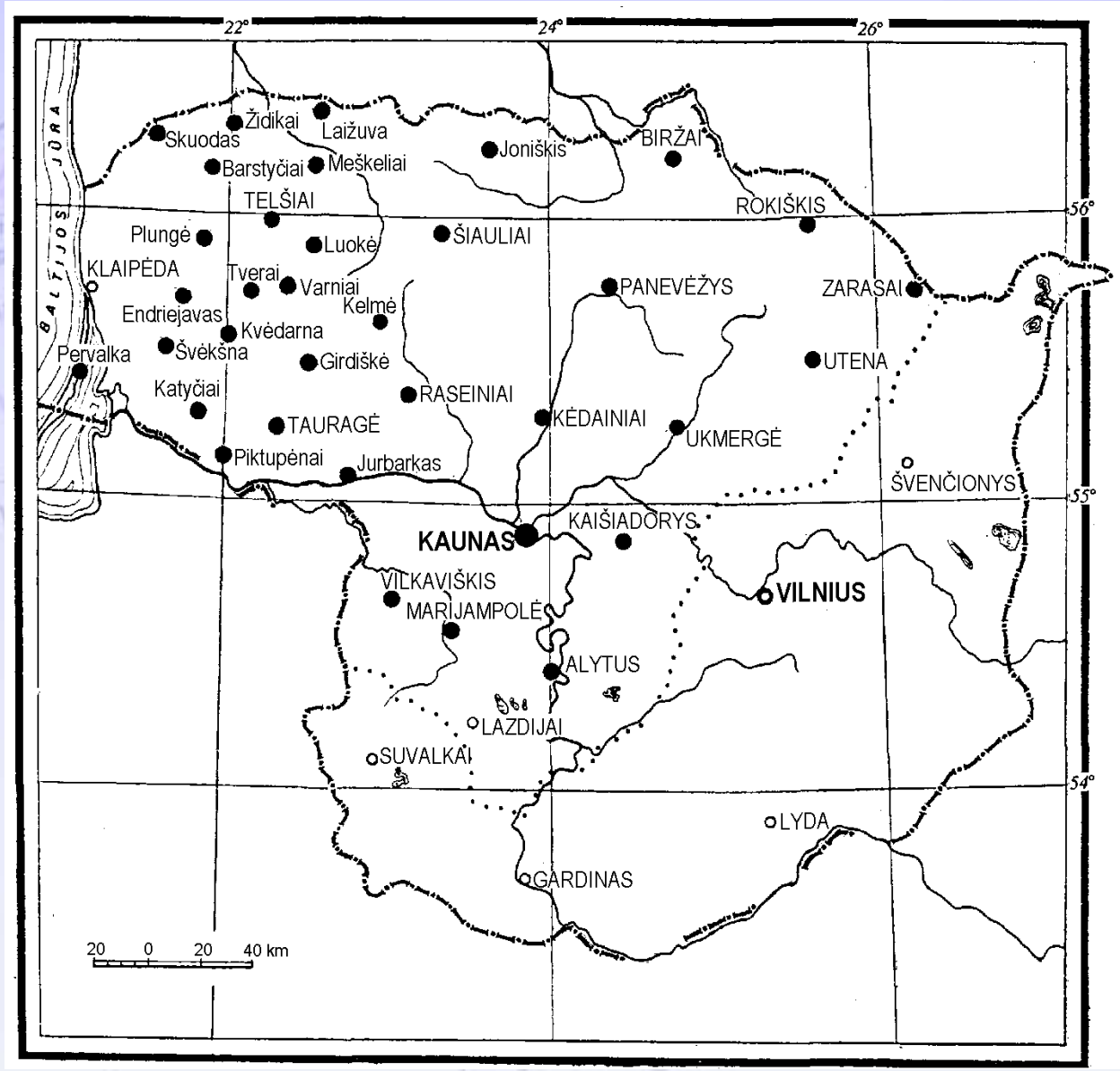


1930 m. liepos. 8 d. ***Šterneko svyruokliniu prietaisu*** *punkte ŠVĖKŠNA, įrengtame Švėkšnos pašto pastato rūsyje, atlikti gravimetriniai matavimai. Sunkio pagreitis gravimetriniame punkte gautas*

g=981529 mGal ± 3–4 mGal.

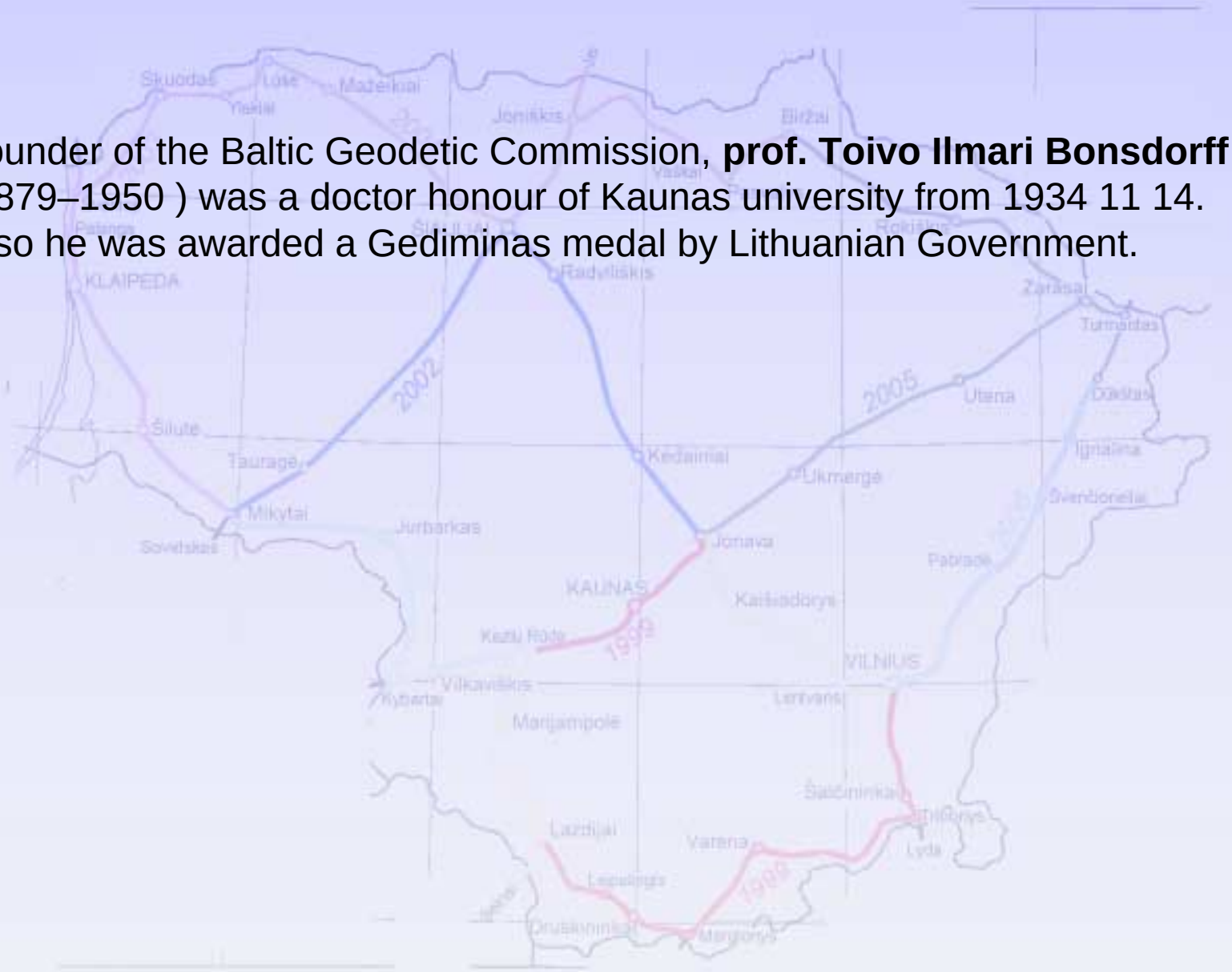
Matavimus atliko Vytauto Didžiojo universiteto Geofizikos ir meteorologijos katedros vedėjas profesorius Kazys Sleževičius (1890–1953). Jam padėjo kap. Žiaurys.

Baltic Triangulation Ring



Baltic Triangulation Ring

Founder of the Baltic Geodetic Commission, **prof. Toivo Ilmari Bonsdorff** (1879–1950) was a doctor honour of Kaunas university from 1934 11 14. Also he was awarded a Gediminas medal by Lithuanian Government.



Baltic Triangulation Ring

Punkto pavadinimas	1929–1935 m. trianguliacijos matavimų rezultatai		1992–1996 m. GPS matavimų rezultatai			Koordinačių nesutapimai m	
	X_1	Y_1	GPS tinklo klasė	X_2	Y_2	X_1-X_2	Y_1-Y_2
AKMENIŠKIAI	6133140,48	4552964,15	nulinė	6133140,418	4552964,050	+0,06	+0,10
SKOMANTAI	6159168,39	4533867,65	antroji	6159168,424	4533867,503	–0,03	+0,15
ŠVĖKŠNA	6155009,97	4538819,64	antroji	6155009,984	4538819,484	–0,01	+0,16
ŽVIRBLAIČIAI	6205757,00	4552955,90	pirmoji	6205756,933	4552956,073	+0,07	–0,17

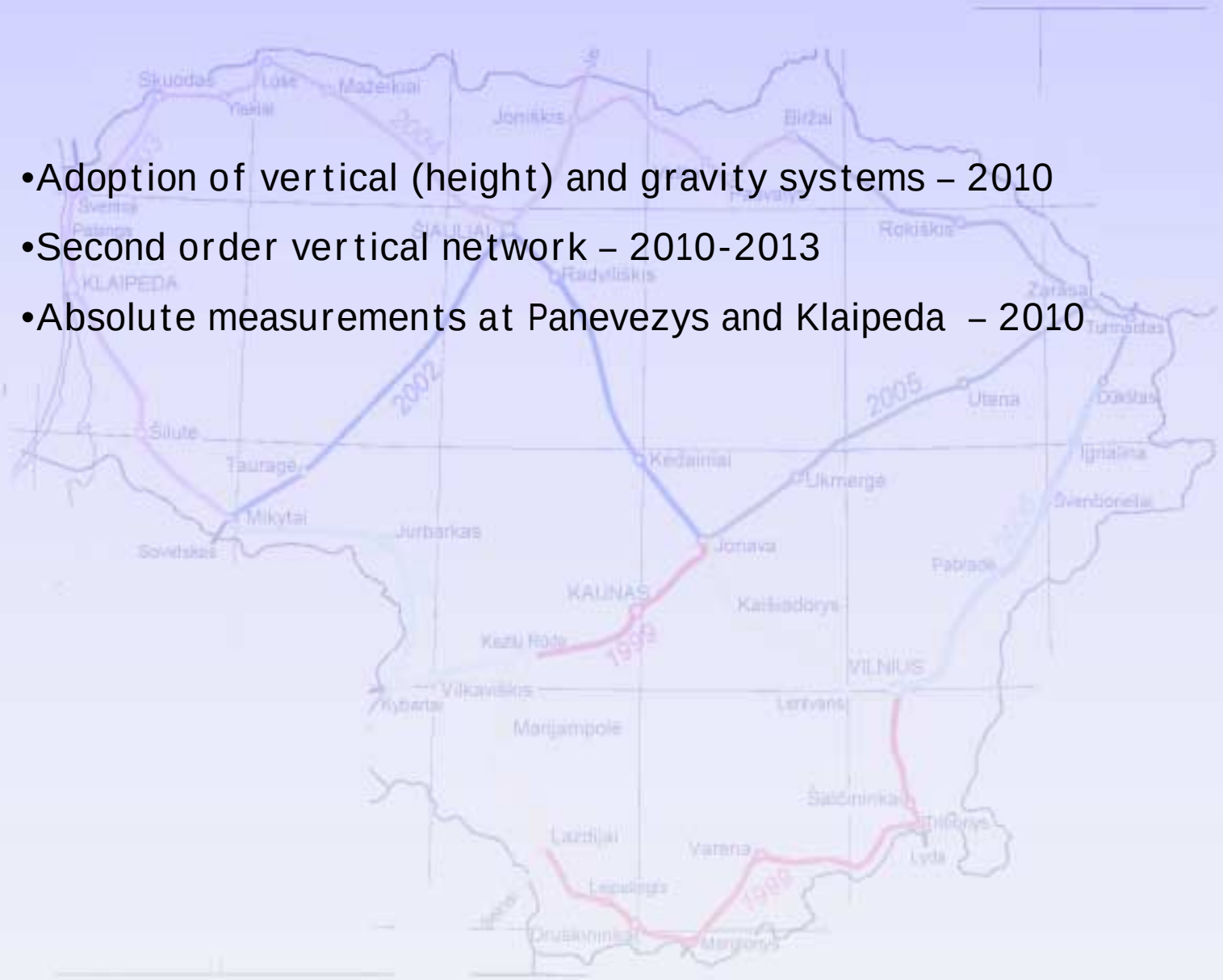
Baltic Triangulation Ring

Two end-points of Sveksna basis are in the list of the Culture heritage of Lithuania from 2004.

Baltic Triangulation Ring

Conferences, dedicated to the Baltic Triangulation Ring Sveksna basis geodetic measurements, were held in Sveksna gymnasium in June 5, 2009 and in Vilnius technical university in October 23, 2009!

Future plans



- Adoption of vertical (height) and gravity systems – 2010
- Second order vertical network – 2010-2013
- Absolute measurements at Panevezys and Klaipeda – 2010

Thanks...

Thank you for your attention!