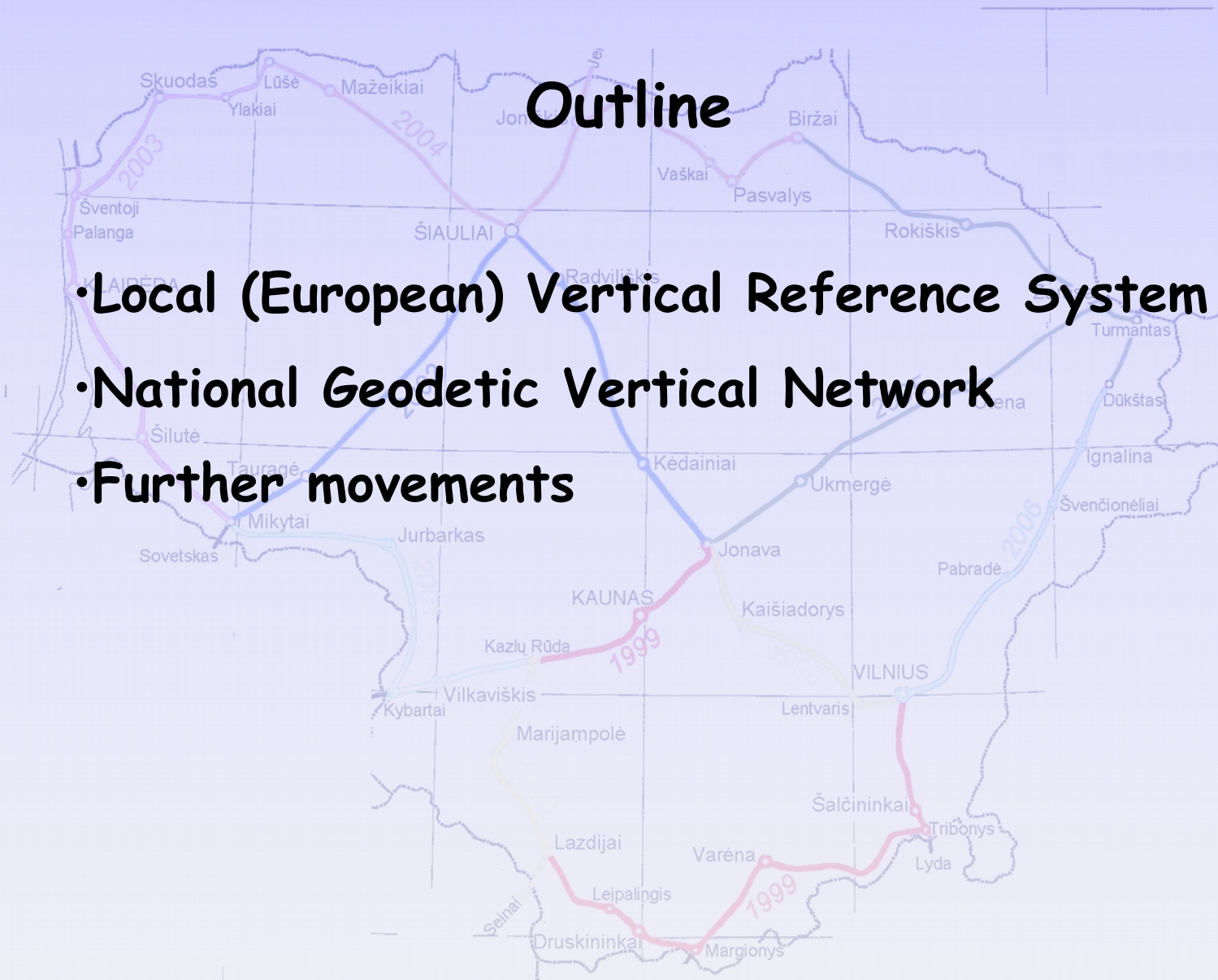


EUROPEAN VERTICAL REFERENCE SYSTEM IN LITHUANIA

Tomas Ladukas, Jurgita Spuraite, Jolita Aldoniene, Robertas Aleliunas, Renata Traceviciene, Eimuntas Parseliunas,
Boleslovas Krikstaponis

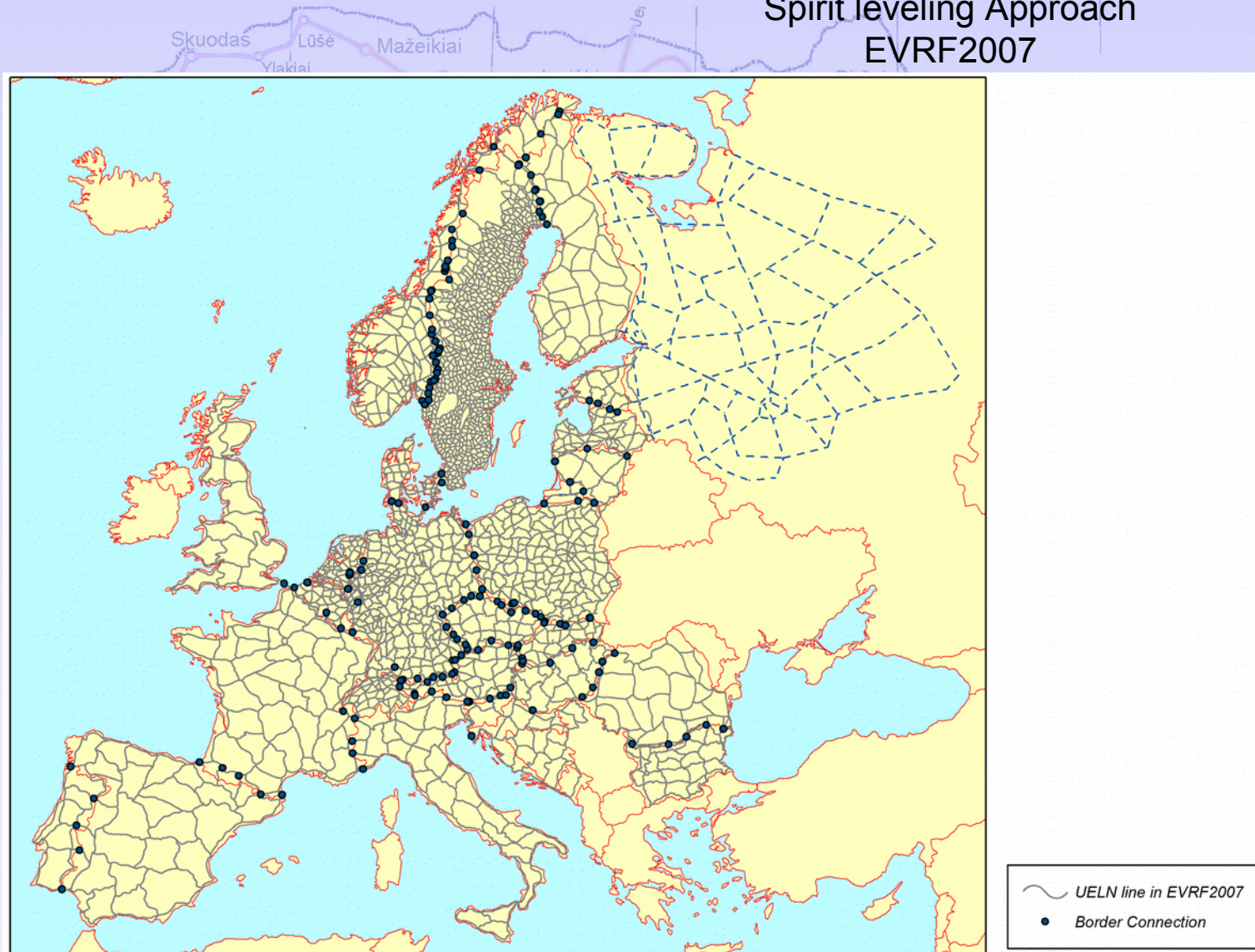
Outline

- Local (European) Vertical Reference System
- National Geodetic Vertical Network
- Further movements



European Vertical Reference System

Spirit leveling Approach
EVRF2007

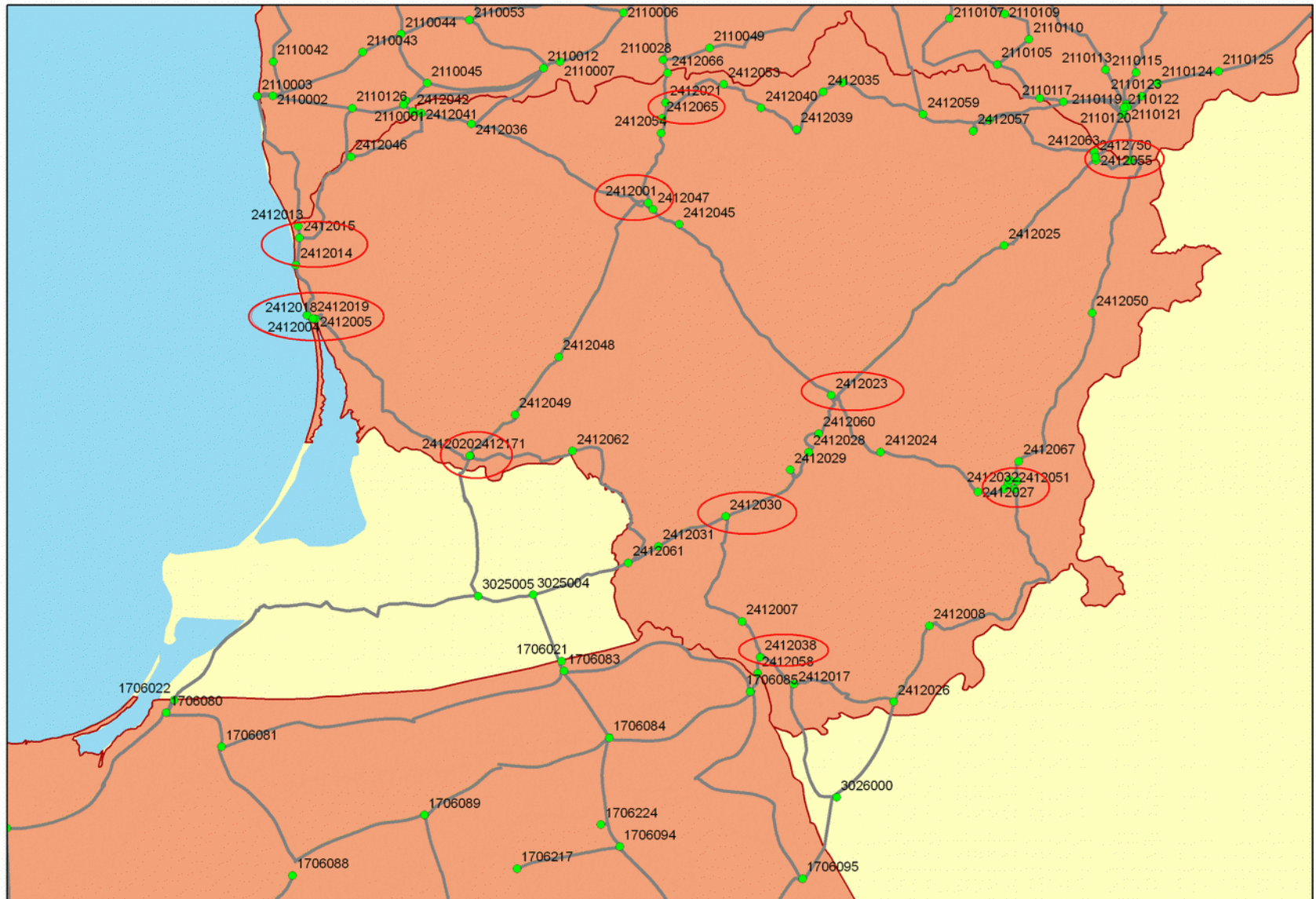


Local (European) Vertical Reference System

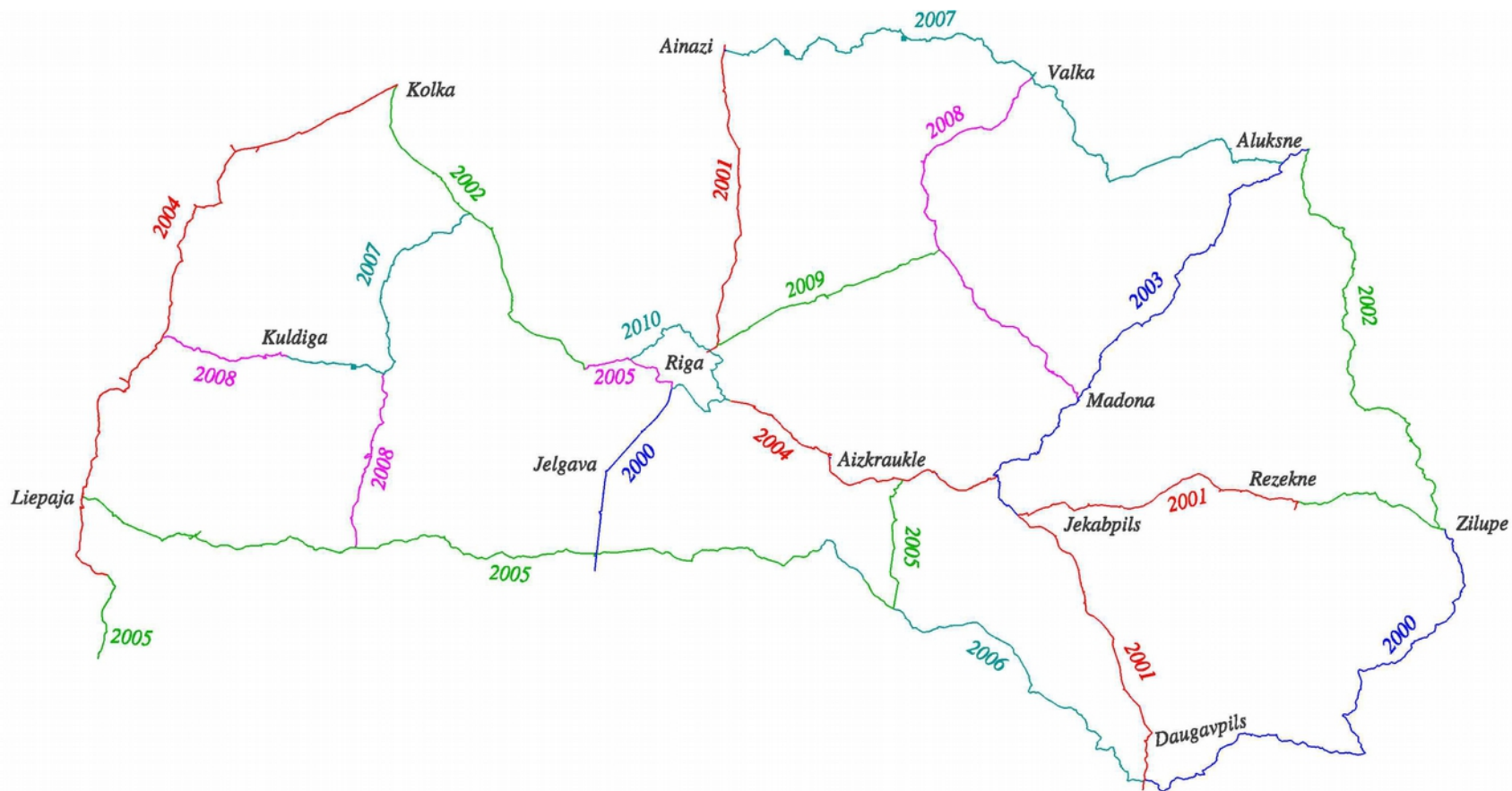
Loop around the Baltic Sea



- 358 lines from DK(13), SE (212), FI(38), RU(13), EE(13), LV(30), LT(9), PL(17), DE(13) reduced to epoch 2000 (by NKG2005LU)
- Perimeter **7052 km**, Misclosure **45.5 kgal·mm**
- permissible value $Z_U = \pm 2 \cdot \sqrt{U}$ (Z_U in mm, U perimeter in km):
168 mm
(ca. 164.6 kgal·mm)



National Geodetic Vertical Network (11)



National Geodetic Vertical Network (12)

Data on height differences of the connecting lines

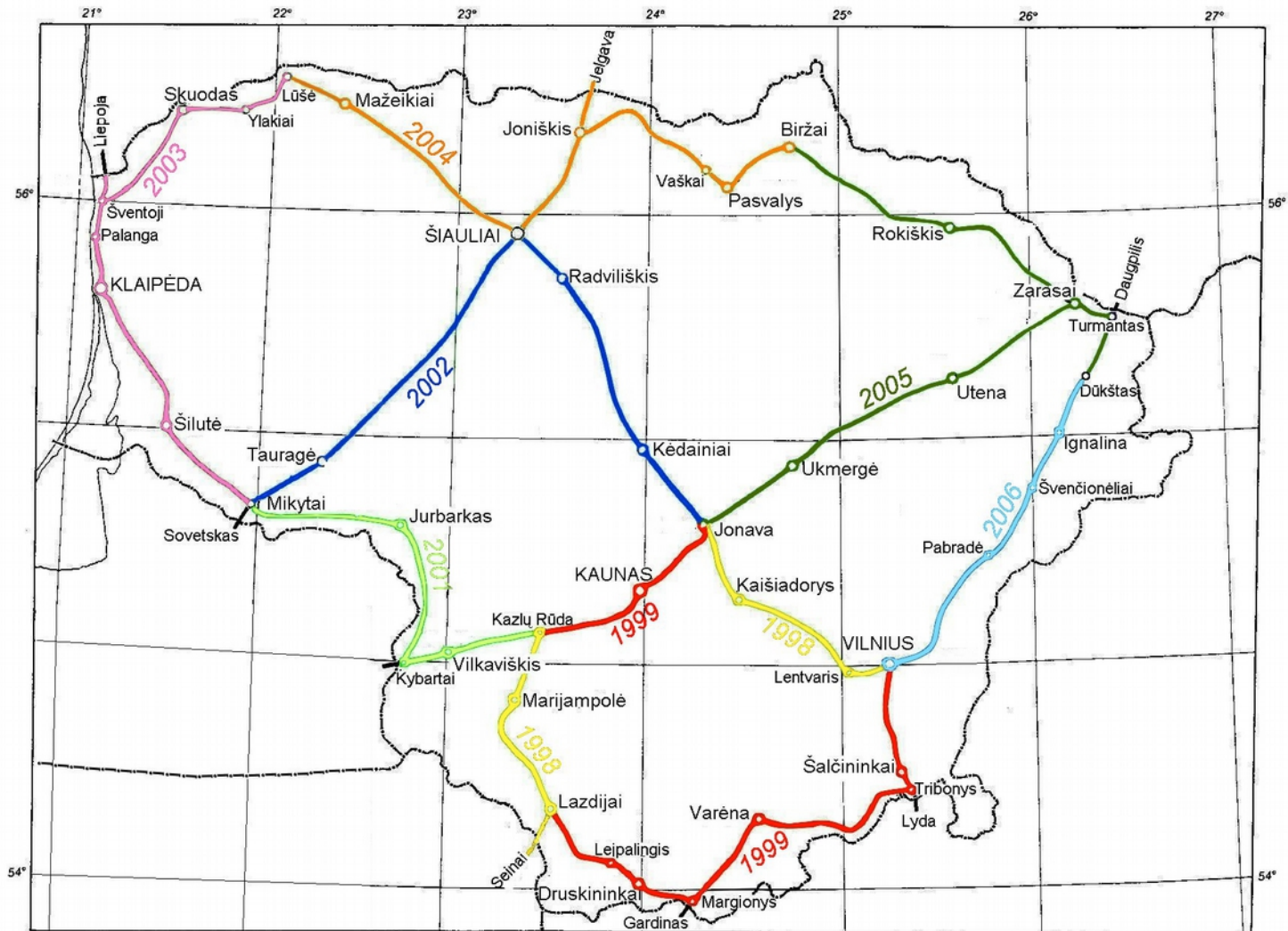
Start point	End point	D , km	h , m (Lithuanian measurements)	h , m (Latvian measurements)	Geopotential number, kGal×m (Lithuanian measurements)
Būtingė–Rucava					
26V-1561	26V-6237	1.76	+3.20416		+3.14513
26V-6237	26V10238	2.08	+2.39474	+2.3948	+2,35063
26V10238	21L-1684				
Joniškis–Eleja					
56V10049	56V10051	1.43	0.56092		+0,55060
56V10051	56S--335	1.88	-1.00096	-1.00014	-0,98255
56S--335	02L-0718	1.50		-0.3766	
Turmantas–Demene					
03L-0331	03L-2285	1.21		+0.98737	
03L-2285	95V-0053	1.60		+0.31740	
95V-0053	95S--295	0.35	+1.54210	+1.5421	+1,51363

National Geodetic Vertical Network (13)

Loop No.	Actual misclosure, $\text{kGal} \times \text{mm}$	Loop perimeter, km	Allowable misclosure, $m_0 = 1.0 \text{ mm}$
1	+4.29	491.500	43.45
2	+6.76	640.700	49.61
3	+2.47	548.200	45.89
4	-14.65	525.400	44.93
5	-32.83	576.300	47.05
6	+11.66	510.000	44.26
7	+3.04	452.000	41.67
8	+17.67	569.500	46.77
9	+5.22	53.300	14.31
10	-2.44	36.800	11.89
11	-7.66	35.500	11.68
12	-18.86	429.800	40.63

13	-15.62	353.300	36.84
14	-16.69	97.000	19.30
15	-11.76	363.200	37.35
16	+1.82	42.700	12.81
17	-5.90	49.300	13.76
18	-7.72	36.400	11.83
19	-15.33	342.400	36.27
20	+4.10	366.900	37.54
21	-7.49	362.800	37.33
22	+33.50	501.600	43.90
23	+12.25	548.500	45.90
24	+11.66	423.800	40.35
25	-9.10	420.600	40.20

National Geodetic Vertical Network (1)



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.

IAG SC1.3a EUREF

EVRS Conventions V5.1



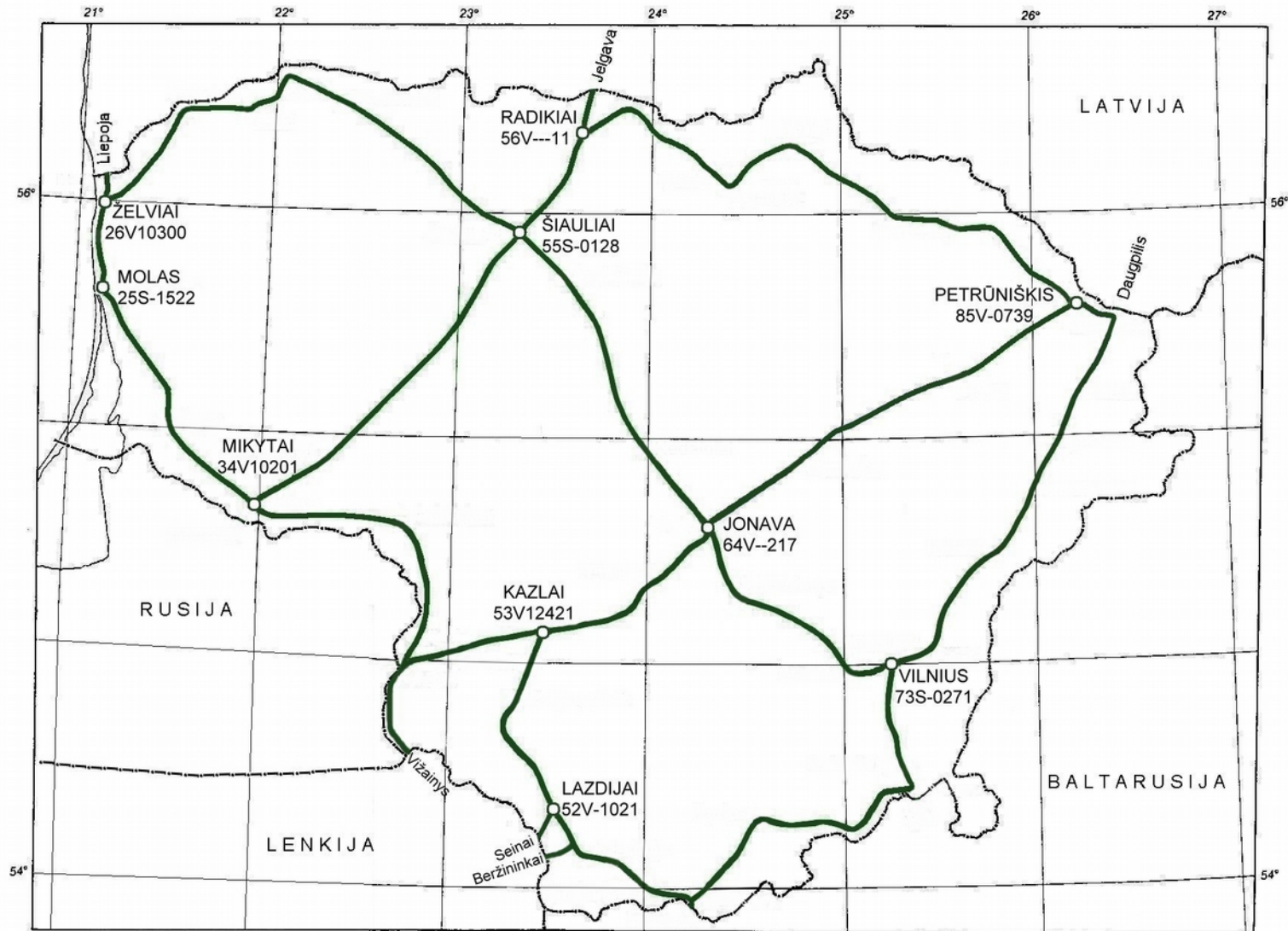
IAG Sub-commission 1.3a EUREF

**Conventions for the Definition and Realization of a
European Vertical Reference System (EVRS)**

– EVRS Conventions 2007 –

Johannes Ihde¹, Jaakko Mäkinen², Martina Sacher¹,

National Geodetic Vertical Network (1)



10 datum points

National Geodetic Vertical Network (1)

Data of datum points

No.	Name	National code	UELN code	LKS94 coordinates	Geopotential number, $\text{m}^2 \cdot \text{s}^{-2} \cdot 10^{-1}$	Accuracy of geopotential number in UELN network, $\text{m}^2 \cdot \text{s}^{-2} \cdot 10^{-1}$	Normal height, m	LSS07 gravity acceleration, $\text{m} \cdot \text{s}^{-2}$
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 (14)

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	Kursėnai	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	

Vertical network (1st and 2nd order)



Red lines – foreseen 2nd order lines



Red lines – foreseen 2nd order lines

Vertical network - numbers

Characteristics of projected 2nd order Network

Region	Average length of line, km	Area, thousand km ²	Perimeter of projected network, km	Projected lines			Density of projected network, km/1000 km ²
				Number of lines	Runs which coincide with lines of old levelling, km	New runs, km	
South	27,4	12,6	958	35	692	266	76,0
East	32,8	11,5	854	26	276	578	74,3
North	29,6	15,3	1094	37	635	459	71,5
West	27,5	15,2*	1154	42	812	342	75,9
Centre	31,5	10,2	818	26	708	110	80,2
	29,4	64,8	4878	166	3123	1755	75,3

Total length of lines - 3100 km:

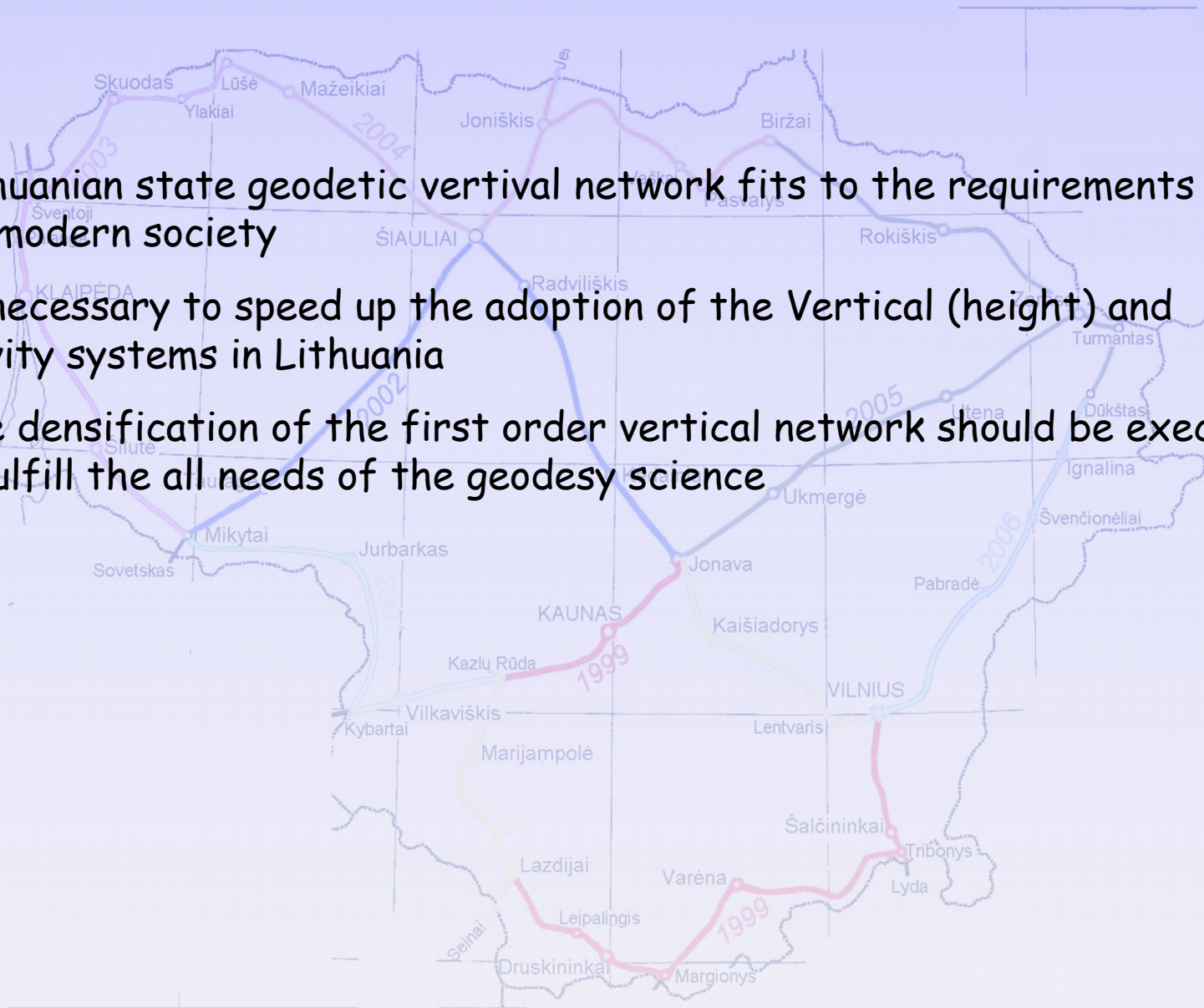
Ready - 300 km (in 2007) + 300 km (in 2012)

Foreseen – 2200 km (in 2013-2015)

Total number of points - 3300 (new -2800)

Conclusions

- Lithuanian state geodetic vertical network fits to the requirements of the modern society
- It necessary to speed up the adoption of the Vertical (height) and Gravity systems in Lithuania
- The densification of the first order vertical network should be executed to fulfill the all needs of the geodesy science



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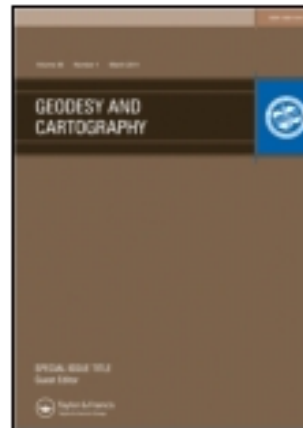
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