

# National report of Ukraine

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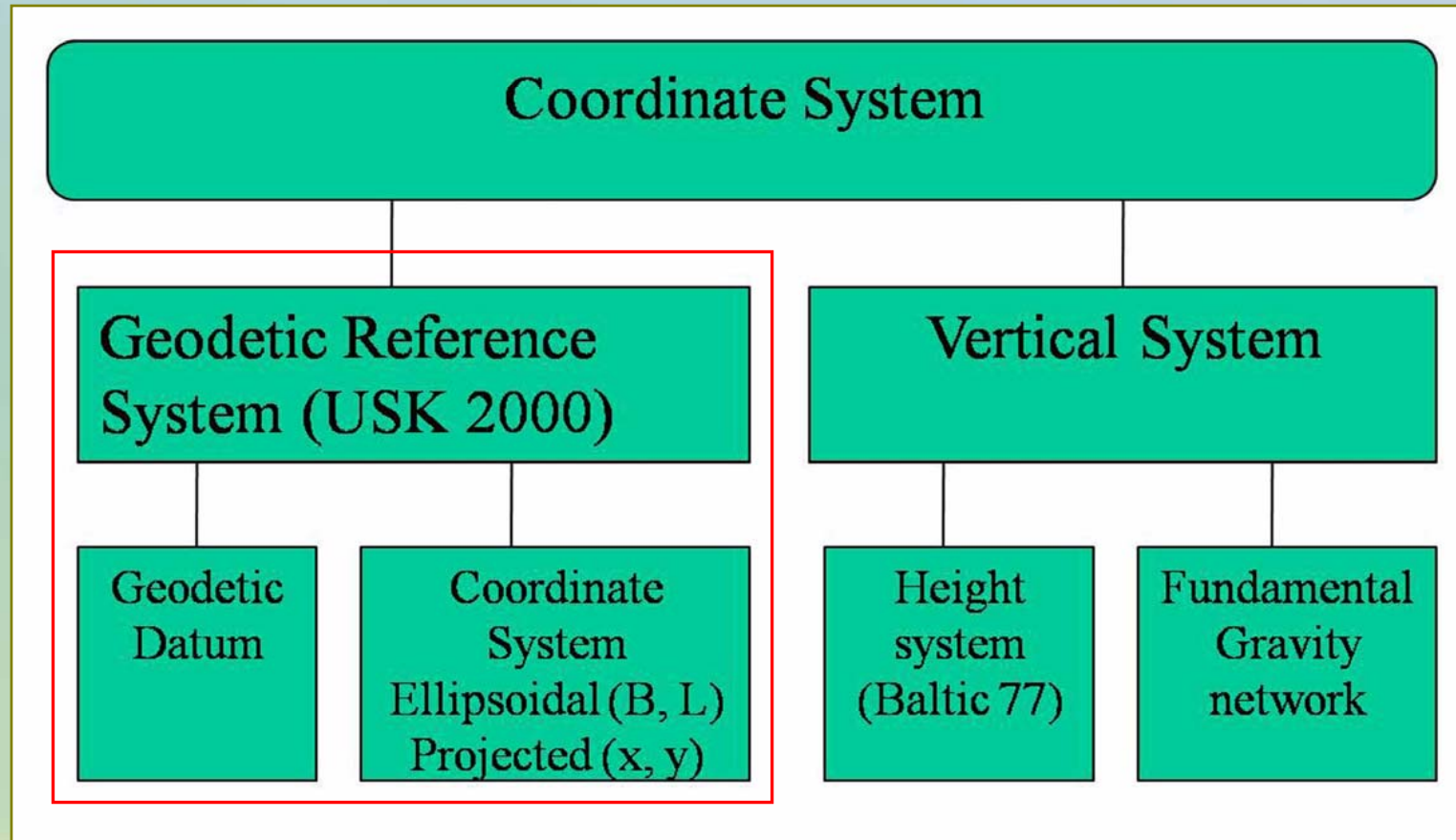
# *Introduction*

The following activities during last years should be mentioned:

- development of the permanent GNSS network,
- initiation of the reference coordinate system USK-2000,
- new quasigeoid solutions,
- preparations to the readjustment of the State vertical network,
- common adjustment of GNSS observations and classic terrestrial data of the combined geodetic network consisting of 24562 points.

*As a result, the Ukrainian part of the horizontal network of USSR is given now in USK-2000, ITRS and ETRS89 systems with accuracy on the level from 1 to 3 cm.*

# Reference system

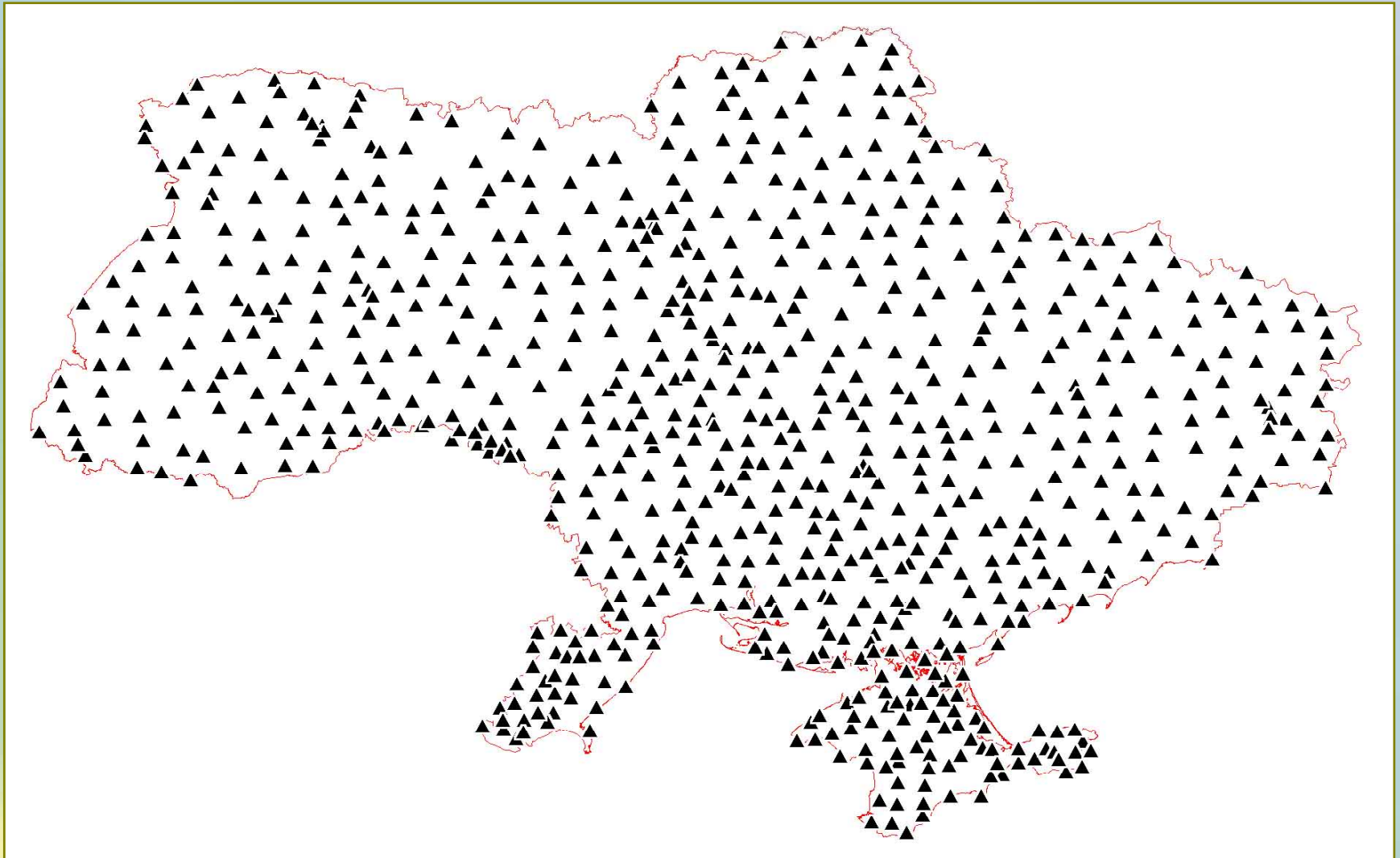


# Adopted criteria for USK-2000:

- 1) it is eccentric, the center of USK-2000 selected as the center of Krassowsky's ellipsoid is defined under the standard condition of minimal deviation between reference ellipsoid and quasigeoid in the Ukraine area;
- 2) its orientation is given initially by the orientation of ITRF2000 at epoch 2005.0 (scale is identical to the ITRF2000 scale at the same epoch);
- 3) its realization is based on the Ukrainian permanent network and preferred stations of the State network of 1<sup>st</sup> order via common adjustment of GNSS observations and classic terrestrial data;
- 4) USK-2000 should be close to the horizontal system S-42 (Pulkovo).

*After practical realization of these requirements the new system keeps old maps of the scale 1:10000 or smaller given in the S-42 system. In addition the accurate connection between the reference system USK-2000 and the coordinate systems ITRS/ITRF2000 and ETRS89 was derived.*

# Ukrainian 3D geodetic network of the 1<sup>st</sup> order



*Combining GNSS observations and classic terrestrial data was started in 2004-2005 from long-term GNSS measurements*

# Accuracy estimation of the position of geodetic stations given in USK-2000

Statistics	Accuracy estimation (in m) of geodetic stations of different orders				
	1 <sup>st</sup> order, 813 points	2 <sup>nd</sup> order, 5586 points	3 <sup>rd</sup> order, 10084 points	4 <sup>th</sup> order, 8174 points	Total: 24657 points
Min	0.001	0.001	0.001	0.003	0.001
Max	0.026	0.112	0.099	0.143	0.143
Mean	0.003	0.020	0.032	0.032	0.028

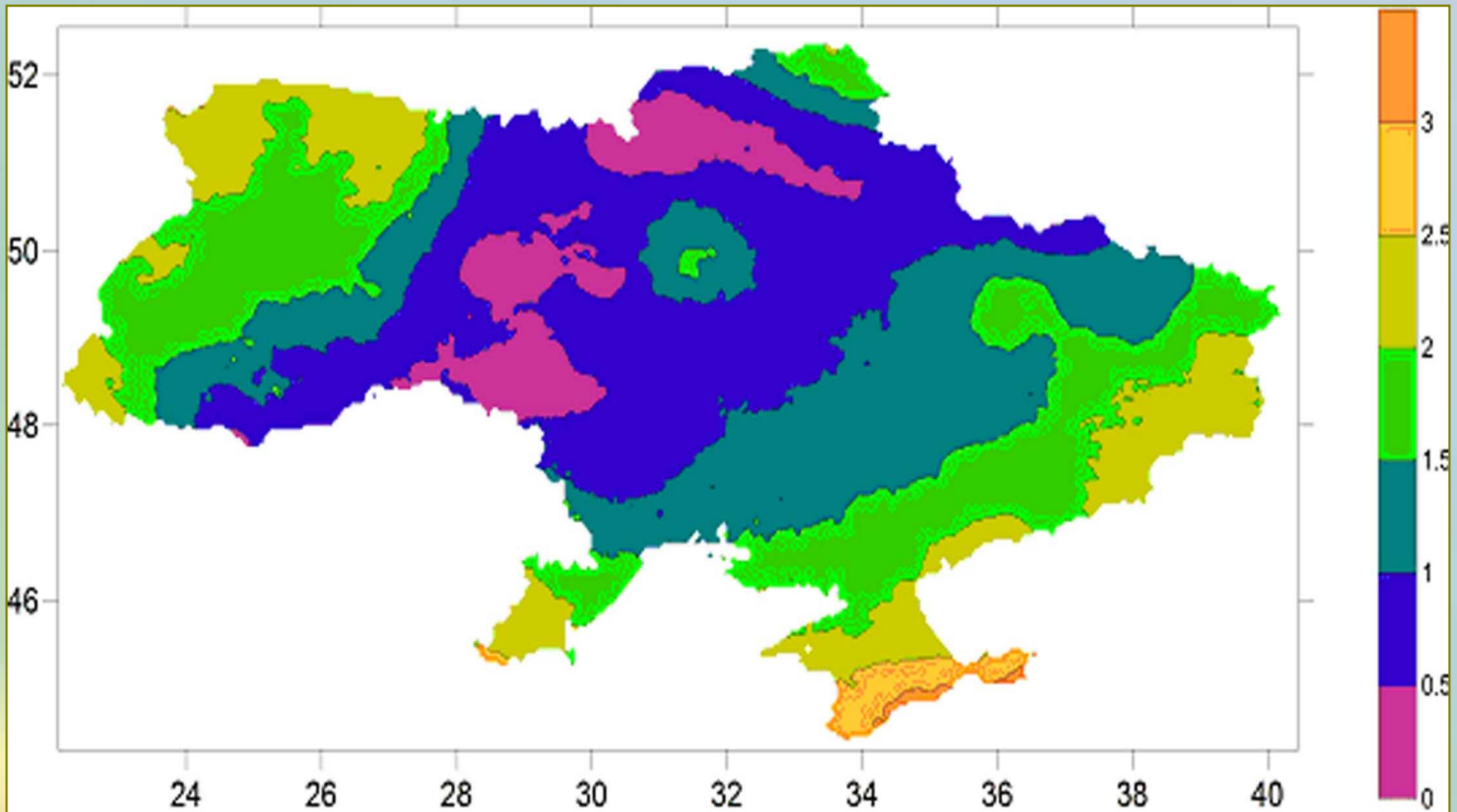
Range of accuracy	Number of stations				
	1 <sup>st</sup> order	2 <sup>nd</sup> order	3 <sup>rd</sup> order	4 <sup>th</sup> order	Total
0 to 1 cm	803	316	841	7	1967
1 to 2 cm	8	2738	622	658	4026
2 to 3 cm	2	2219	3119	3074	8414
3 to 4 cm	0	189	3143	2883	6215
4 to 5 cm	0	80	1722	1256	3058
5 to 6 cm	0	30	493	236	759
6 to 10 cm	0	13	144	58	215
More than 10 cm	0	1	0	2	3

## Differences of coordinates given in S-42 and USK-2000 systems

Range of coordinate differences (in m)	Number of stations	%
0.0 – 0.5	1 292	5.26
0.5 – 1.0	5 589	22.75
1.0 – 1.5	5 808	23.65
1.5 – 2.0	6 548	26.66
2.0 – 2.5	4 438	18.07
2.5 – 3.0	750	3.05
>3.0	137	0.56
Total:	24 562	100

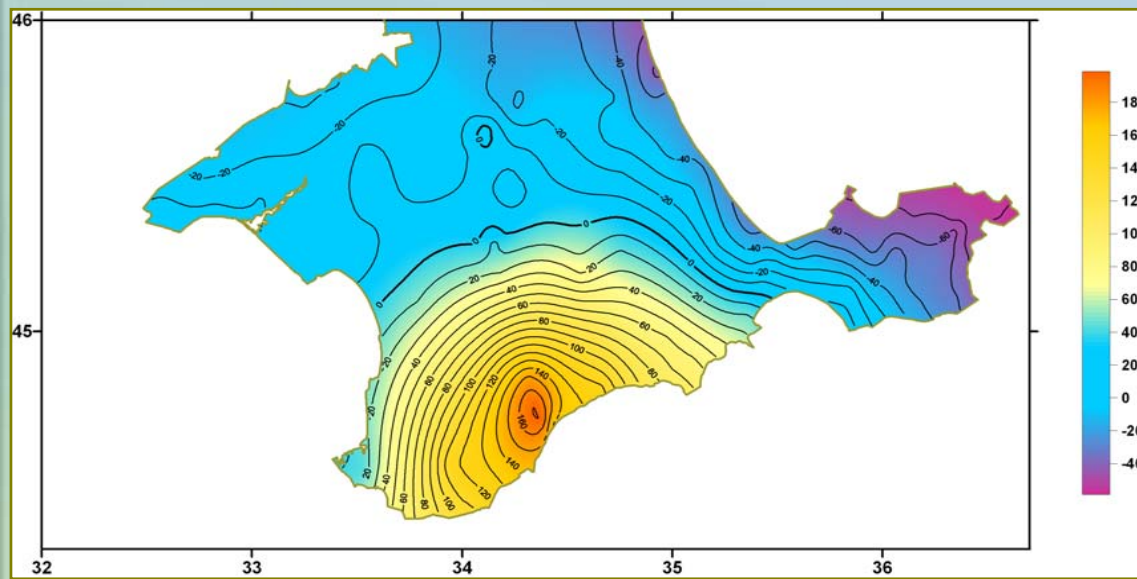


## Distribution of coordinate differences (m) given in S-42 and USK-2000 systems



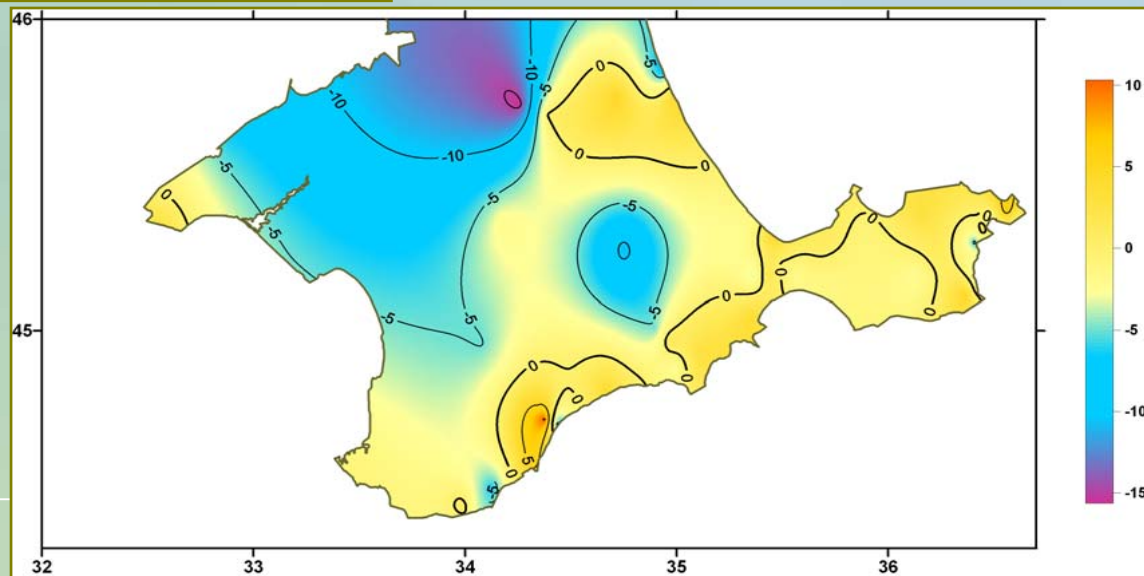


Differences (cm) between the measured normal heights  $H^\gamma$  and GPS-derived  $H^\gamma = H - \zeta$  based on the gravimetric EGG97 and UQG2006 quasigeoids  $\zeta$  in the Crimea area

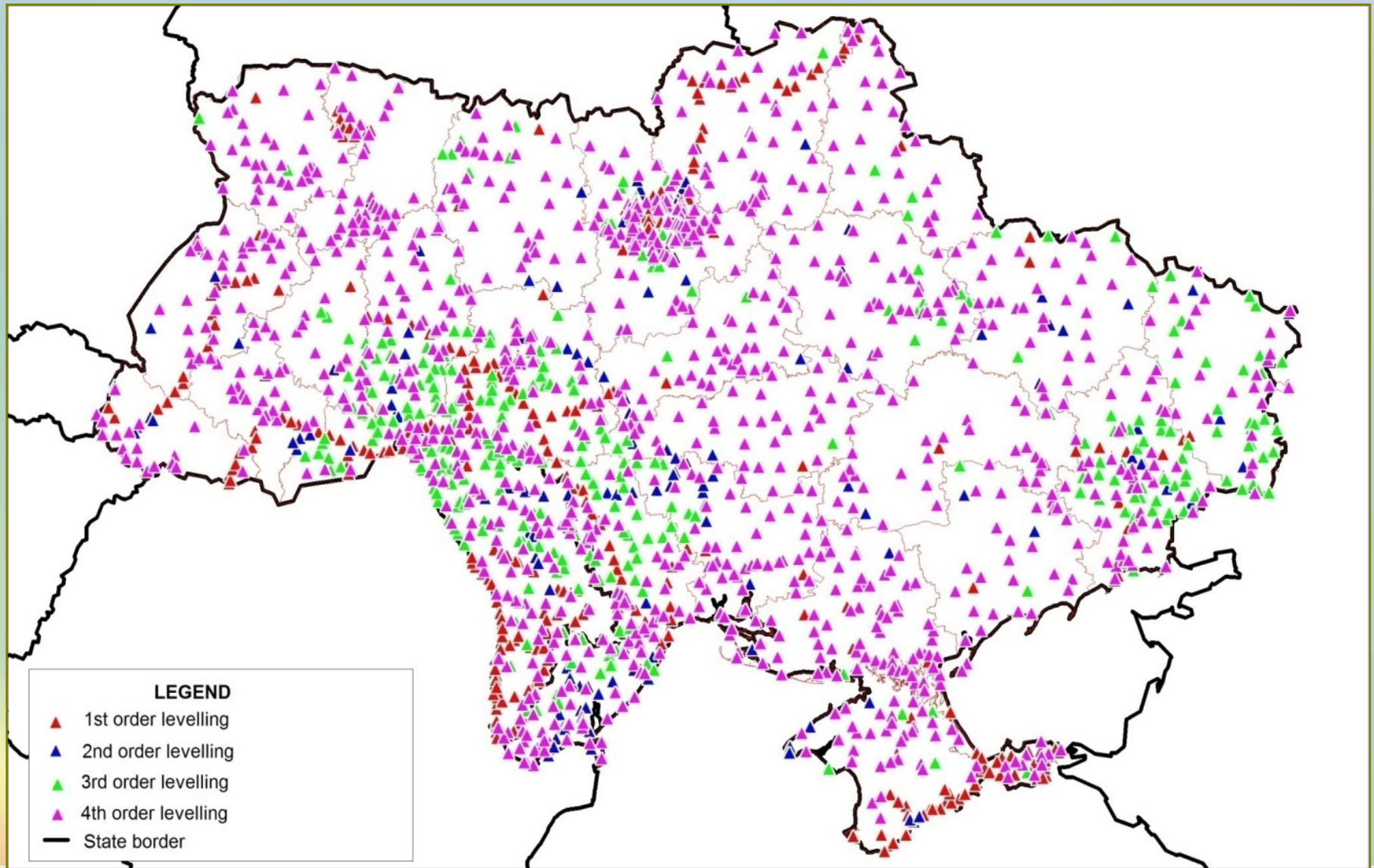


← EGG97

UQG2006⇒

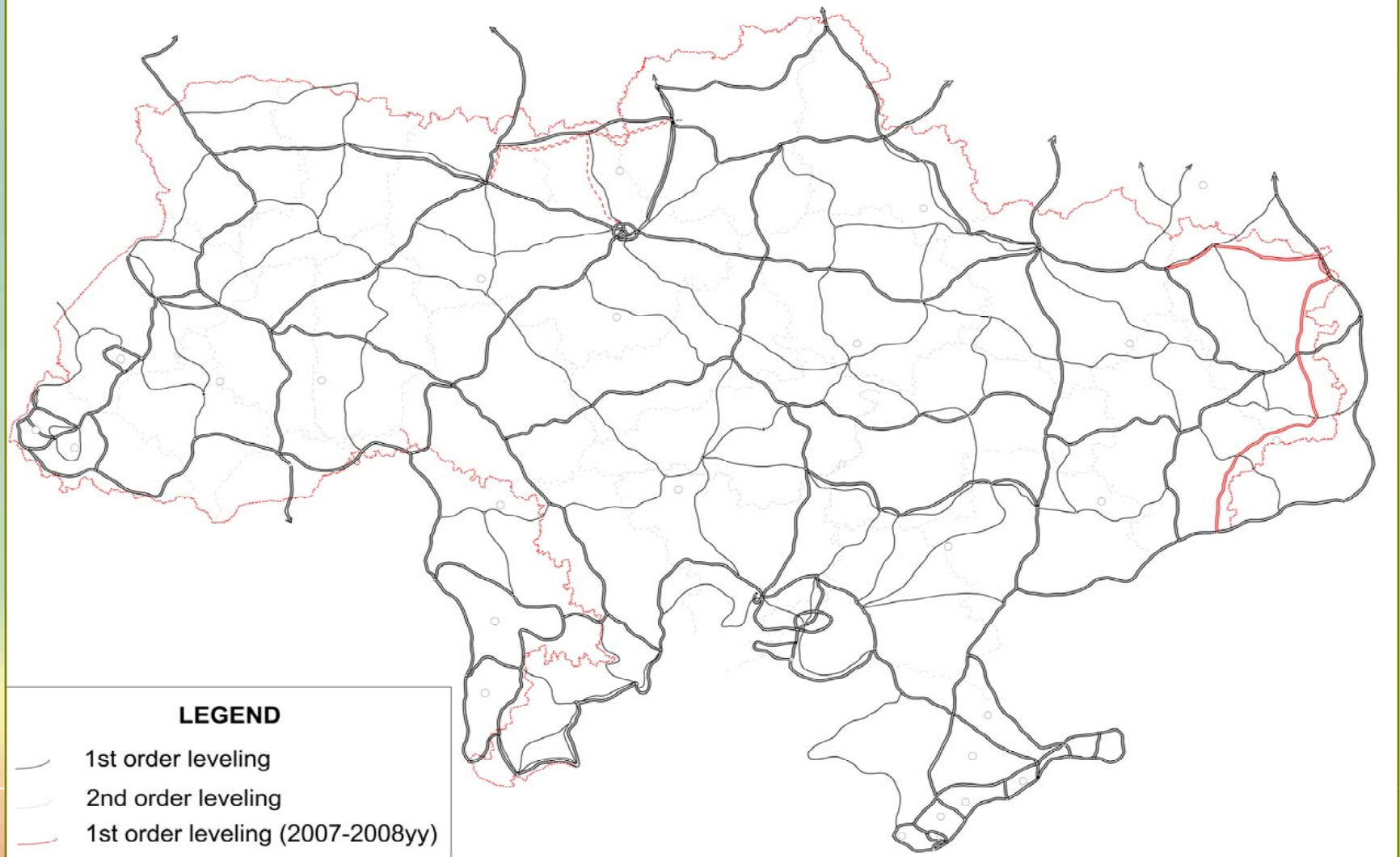


# Distribution of GPS-leveling data



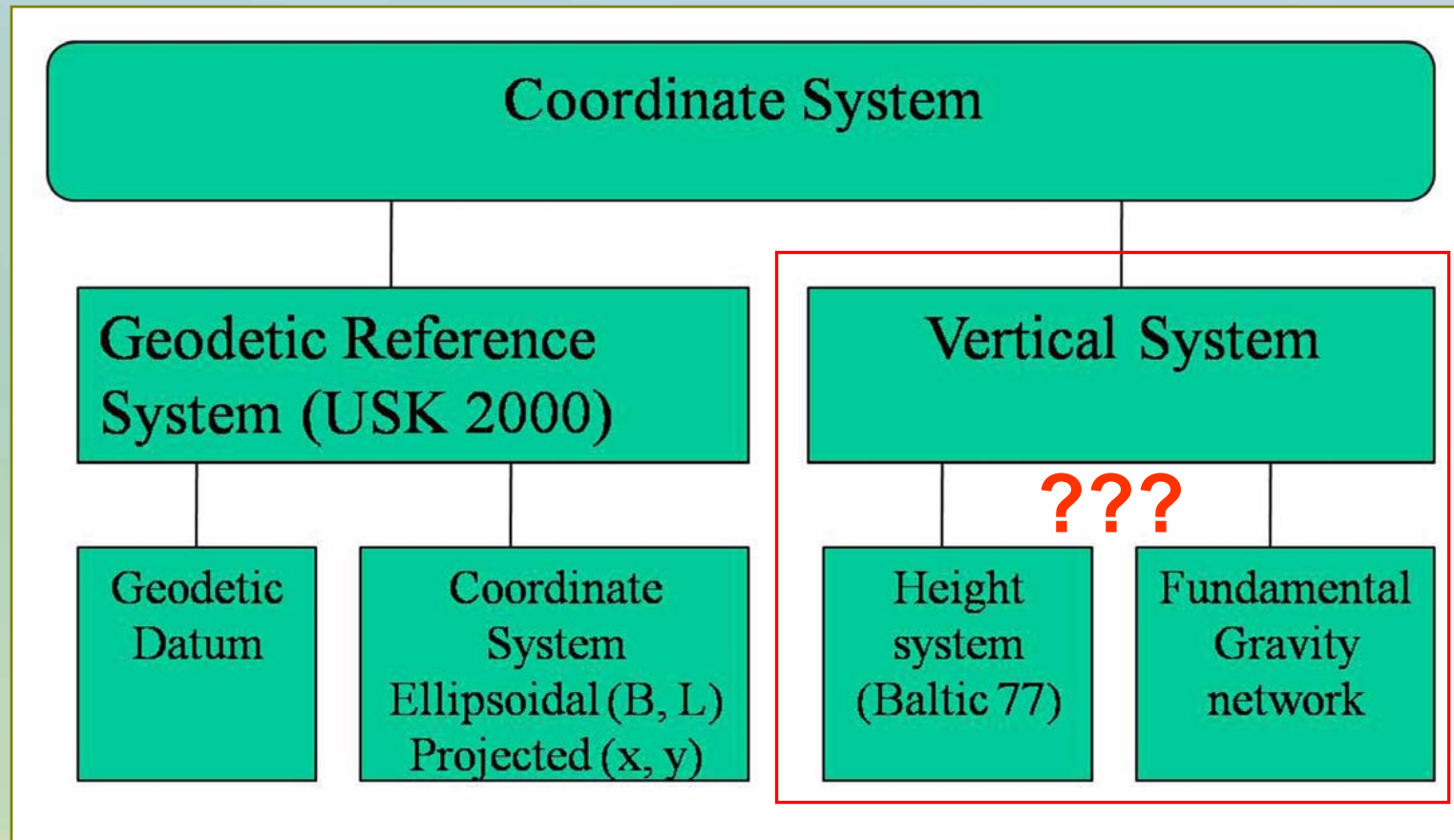
# Vertical networks of 1<sup>st</sup> and 2<sup>nd</sup> orders

Order	Number of lines	Length of lines, km			Number of polygons	Perimeter, km	
		Min	Max	Total		Min	Max
I	29	70.7	1301.9	11975.0	18	135.5	2234.9
II	62	37.5	383.9	11179.5	72	218.0	883





# Reference system



# ***Conclusions***

- **Common adjustment of GNSS observations and classic terrestrial data led to the construction of the State geodetic network consisting of 24562 points given in the USK-2000, ITRS and ETRS89 systems with accuracy from 1 to 3 cm.**
- **The USK-2000 reference system has accurate parameters of transformation with the ITRS and ETRS systems and their realizations.**
- **In view of accuracy the first component or the horizontal system USK-2000 becomes homogeneous (in contrast to the S-42 system).**
- **The second component or completely geometrical Baltic 1977 system requires the readjustment via geopotential numbers to get a consistent gravity-related height system having a correct connection with EVRF.**
- **Redefinition of the Baltic 1977 system will lead to the recompilation of GPS/leveling data and new quasigeoid solutions associated with a reference level of a common gravity-related height system covering Europe.**

**Thank you  
for your attention!**