Basic gravity network of the Republic Croatia in function of controlling and improving national and European geoid models

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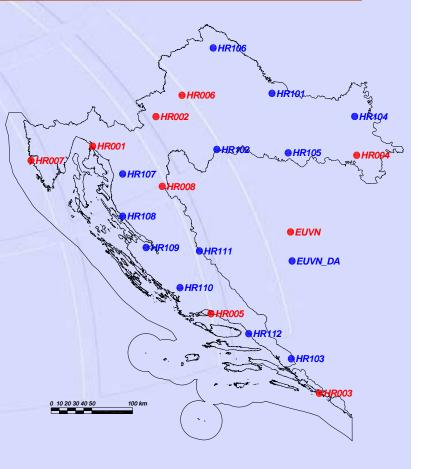CROATIAN GEODETIC INSTITUTE

1. Introduction

EUVN project

- ✓ establishing of uniform European referent height system,
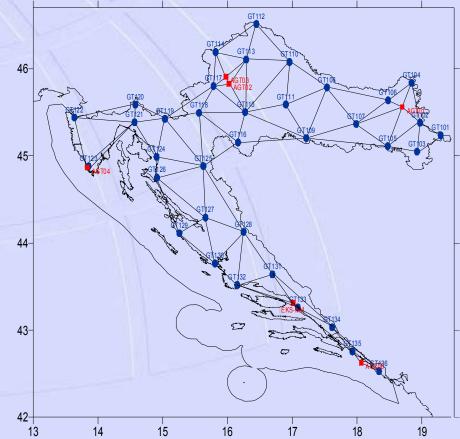- ✓ connecting different national height systems,
- ✓ acquiring of new data for continental geoid model testing and calculating,
- ✓ connecting European tide gauges.

EUVN1997 GPS campaign in Croatia - 8 sites

EUVN_DA campaign (2005-2006) – 12 sites

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2. Croatian gravity network

- UNIGRACE project – 6 absolute gravity points

- revision of the old gravity network

- 25 of 84 old gravity points could be used

- installation of 11 new points

- First phase of the project neglected precise position and height determination

- Unsolved differences of some EUVN points and different geoid models – determination of 1st order gravity points in same way like as in EUVN (DA)

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3. Works on the project of fundamental gravity network

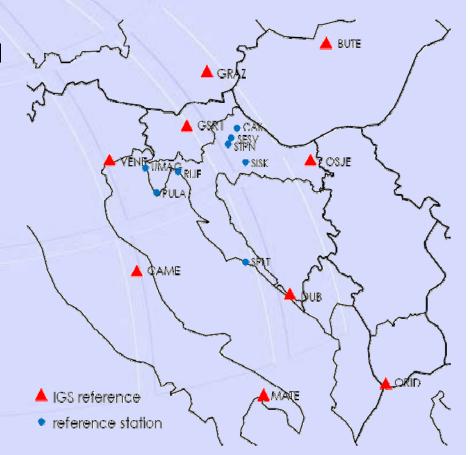Conducted activities in context of finishing 1st order gravity network:
- Project preparation,
- Assembling of site descriptions and topographic maps of related benchmarks, gravity and control GPS points,
- Adaptation of database necessary for planning and completing the project,
- Finishing of the "Plan of 1st order gravity network - positional and vertical determination"
- Extra stabilization of gravity points,
- GPS measurements in the points, data processing and adjustment,
- Vertical connection to official benchmarks by precise spirit levelling, data processing and adjustment of levelling lines,
- Determination of absolute gravity points positions by combination of GPS and terrestrial methods,
- Processing and adjustment of terrestrial measurements,
- Calculation of geopotential heights,
- Calculation of normal heights in UELN95/98,
- Finishing of site descriptions for all fundamental gravity points,
- Final report of 1st order gravity network - positional and vertical determination.

4. Positional determination of gravity points

- dual-frequency instruments,
- same antenna type,
- 15 second interval registration,
- elevation mask above 10°,
- obtain GPS measurements for 2-4 hours per point, depending on levelling time
- set antenna to north, and measure height before and after measurement.

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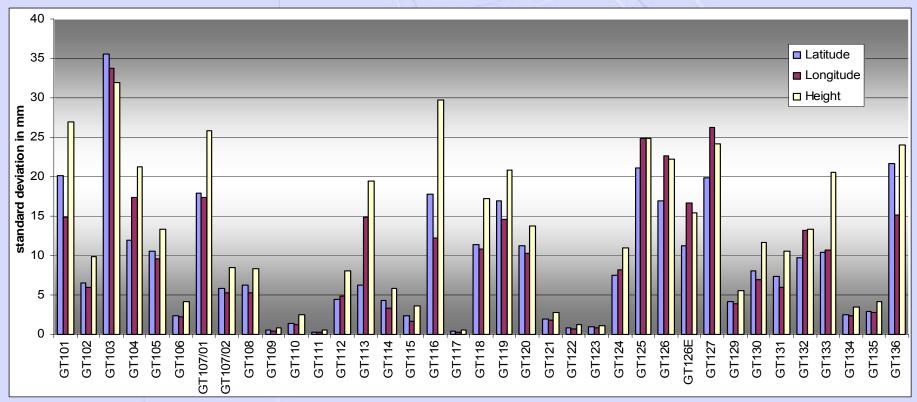CROATIAN GEODETIC INSTITUTE

4.1. Processing of GPS measurements

■ GPS measurements were processed using commercial TTC software,

■ IGS final orbits were used,

■ data were processed in actual ITRF2005 reference frame,

■ elevation mask was set to 10°,

■ registration interval was 15sec,

■ troposphere model was standard (NEILL),

■ processed data were adjusted using IGS stations in Dubrovnik and Osijek and IGS stations around Croatia.

▲ IGS reference
● reference station

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4.2. Adjustment of GPS measurements - IGS and Croatian reference station are fixed

For GPS measurement adjustment all reference stations coordinates were fixed in coordinate system ITRF'2005, 2007.24.
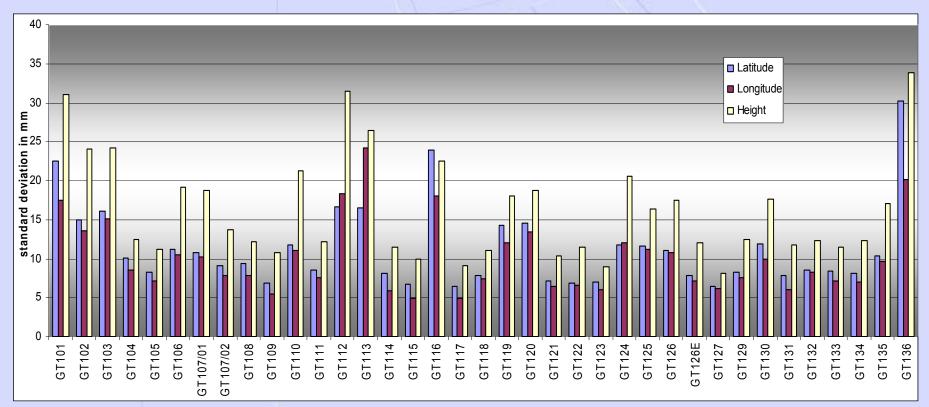

Position and height standard deviations

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4.2. Adjustment of GPS measurements - IGS are fixed
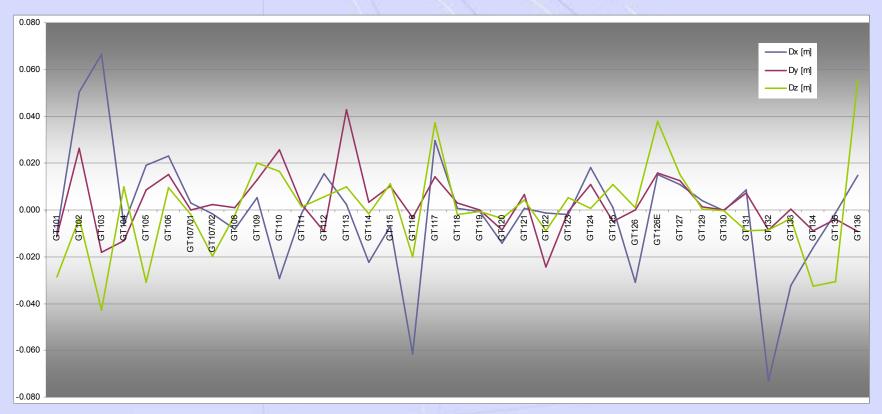
For GPS measurement adjustment all reference stations coordinates were fixed in coordinate system ITRF'2005, 2007.24.

Position and height standard deviations

4.2. Adjustment of GPS measurements - comparison of two calculated models

Gravity point coordinate comparison from two calculated models

Coordinates of gravity points ITRF2005 were transformed in ETRS89 1989.0 and new Croatian datum HTRS96 (ITRF96 for epoch 1995.55).

5. Levelling measurements

- Gravity points were connected to closest benchmark
- Using method of spirit precise levelling
- Where it was possible control measurements were taken
- Height differences were corrected with normal orthometric corrections

Information about levelled gravity points

total distance in one direction:	39020 m
average distance:	1060 m
min. distance:	0 m
max. distance:	9650 m
min. height difference:	0 m
max. height difference:	293.298 m

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6.1. Analysis of geoid model differences: EGG06 - EUVN

■ Difference between preliminary geoid model EGG_06 and EUVN

■ based on 20 EUVN points with expanded set of 34 first order gravity points

■ evident shift in height direction for EGG06 geoid model

■ eliminated 43cm shift

■ slightly better characteristics then national model

+ 10 cm

- 10 cm

0 10 20 30 40 50   100 km

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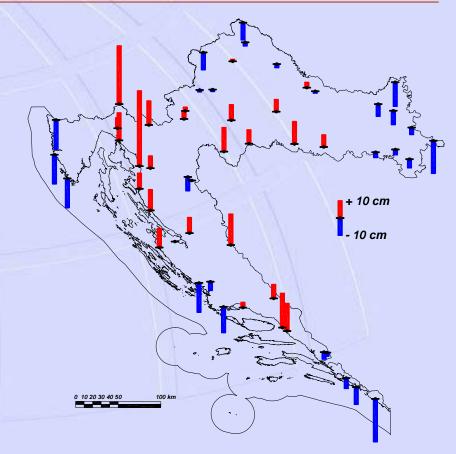# 6.2. Analysis of geoid model differences: HRG2000 - EUVN

■ Difference between HRG2000 and EUVN

■ based on 20 EUVN points with expanded set of 34 first order gravity points

■ no shift in height direction for HRG2000 geoid model

■ some problematic zones

■ GT120 near the border with Republic of Slovenia

+ 10 cm

- 10 cm

0 10 20 30 40 50   100 km

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6.3. Statistical analysis of differences of geoid models

EUVN and EGG_06 and HRG2000 geoid model differences

	n=54 points		n-1 points	n-2 points
	EGG_06 - GPS/levelling (EUVN, GT) [cm]	HRG2000 - GPS/levelling (EUVN, GT) [cm]	EGG_06 - GPS/levelling (EUVN, GT) [cm]	HRG2000 - GPS/levelling (EUVN, GT) [cm]
STDEV	9	13	8	11
AVERAGE	-43	1	-44	0
MIN	-60	-25	-60	-25
MAX	-15	45	-19	20
RANGE	45	70	41	45

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7. Conclusion

- After finalization of Fundamental Gravity Network and results interpretation, all measurements on basic gravity network are finished. All conditions for densification with second order gravity network are fullfiled.

- Project realization and newly defined points provide data for systematic quality control of different geoid models for Croatian territory.

- New set of GPS/levelling/gravity points also provides new input for future models and good base for solving different practical and scientific geodetic problems.

- Achieved results confirm appropriate participation of Croatia in international projects.

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Thank you for your attention