# Preliminary results on Quasi-geoid of Latvia using Vertical Deflection observations

The research is funded by ESF Project: 1.1.1.1/16/A/160

# Overall Information

In terms of “Development of the high accuracy gravity field model for Latvia including sea territory” project main task is to compute gravity field and precise quasi-geoid model up to 1 cm accuracy using all available data.

In the year of 2016 quasi-geoid model for Eastern part of Latvia has been computed using DFHRS (Digital Finite-element Height Reference Surface) software v.4.2., which allowed the combination of GNSS/leveling data together with global geopotential models.

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# Overall Information

At the moment Institute of Geodesy and Geoinformatics (GGI) is dealing with new kind of measurement – vertical deflection (VD) observations – which are possible to use in DFHRS v4.3.

DFHRS v.4.3. allows to use GNSS/levelling data together with geopotential models and field vertical deflections measurements and/or vertical deflections derivatives from geopotential models.

Vertical deflection measurements allow to check independently the places that have inconsistencies and improve quasi-geoid model.

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# Digital Zenith Camera

Zenith camera consists of a rotating platform, on which is mounted a small telescope, equipped with imaging device, tiltmeter, leveling mechanism, rotation gear and control equipment.

Similar platform bellow is used as base of levelling and rotation, it is mounted on field tripod.

The CCD camera is attached in direct focus, below the telescope.

A 203 mm catadioptric telescope equipped with CCD camera is used for image acquisition.

The camera has 8 Mpix sensor with 4.5 µm pixels; at 2 m focus distance resulting field of view is 0.5x0.39 deg with resolution close to 0.5 ’’/pix


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# Digital Zenith Camera

Digital-Zenith camera and processing software was developed by GGI and these observations are actively done in Latvia now. The current amount of VD observations is more than 115 and precision of these measurement are evaluated as 0.10 arcsec mostly for all observations.

In terms of a project, 230 GNSS/Levelling points were observed by GGI. 1st and 2nd order levelling data and 147 GNSS/Levelling points were provided by LGIA.

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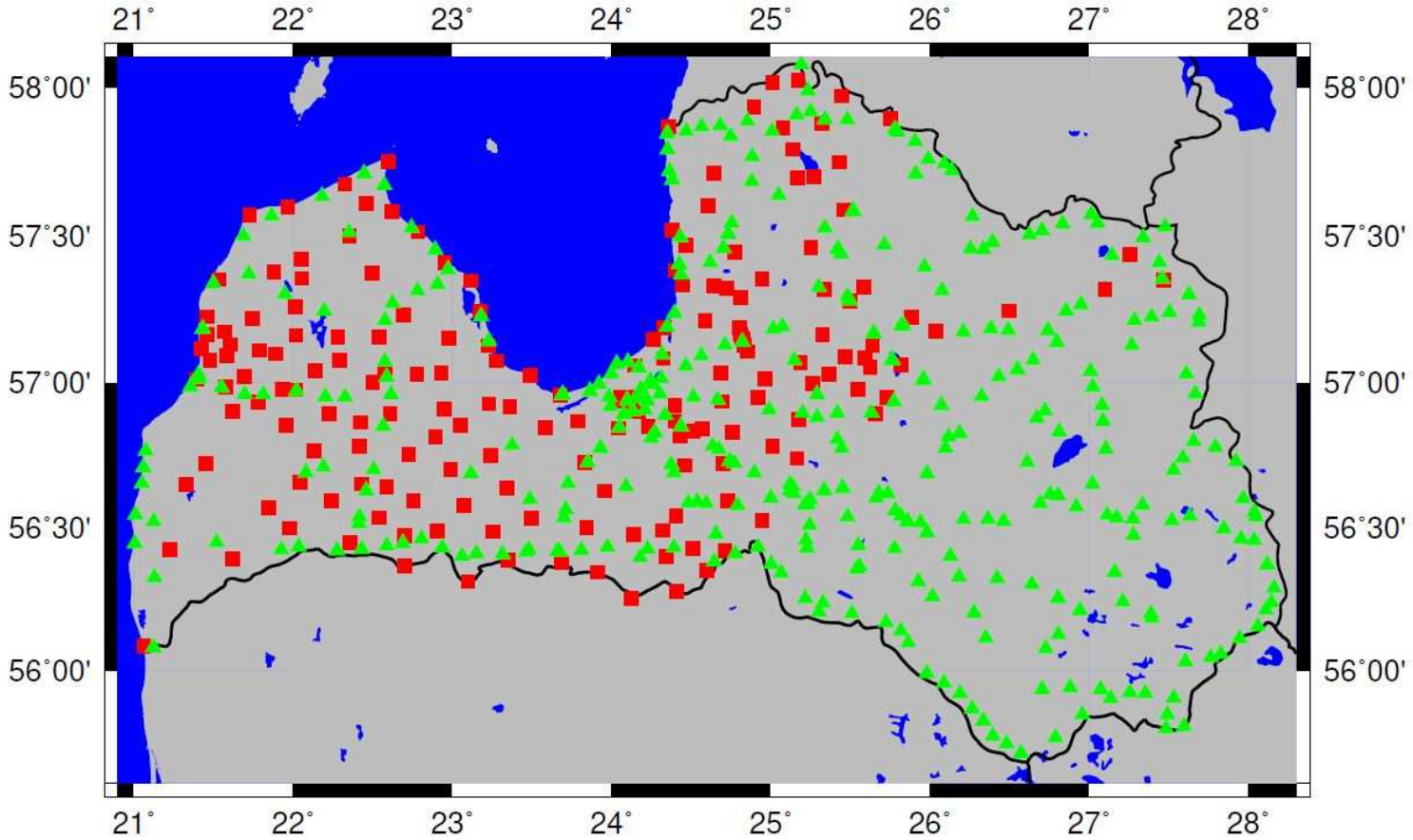
# The scheme of GNSS/levelling and VD observations

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# Gravity measurements with CG-6

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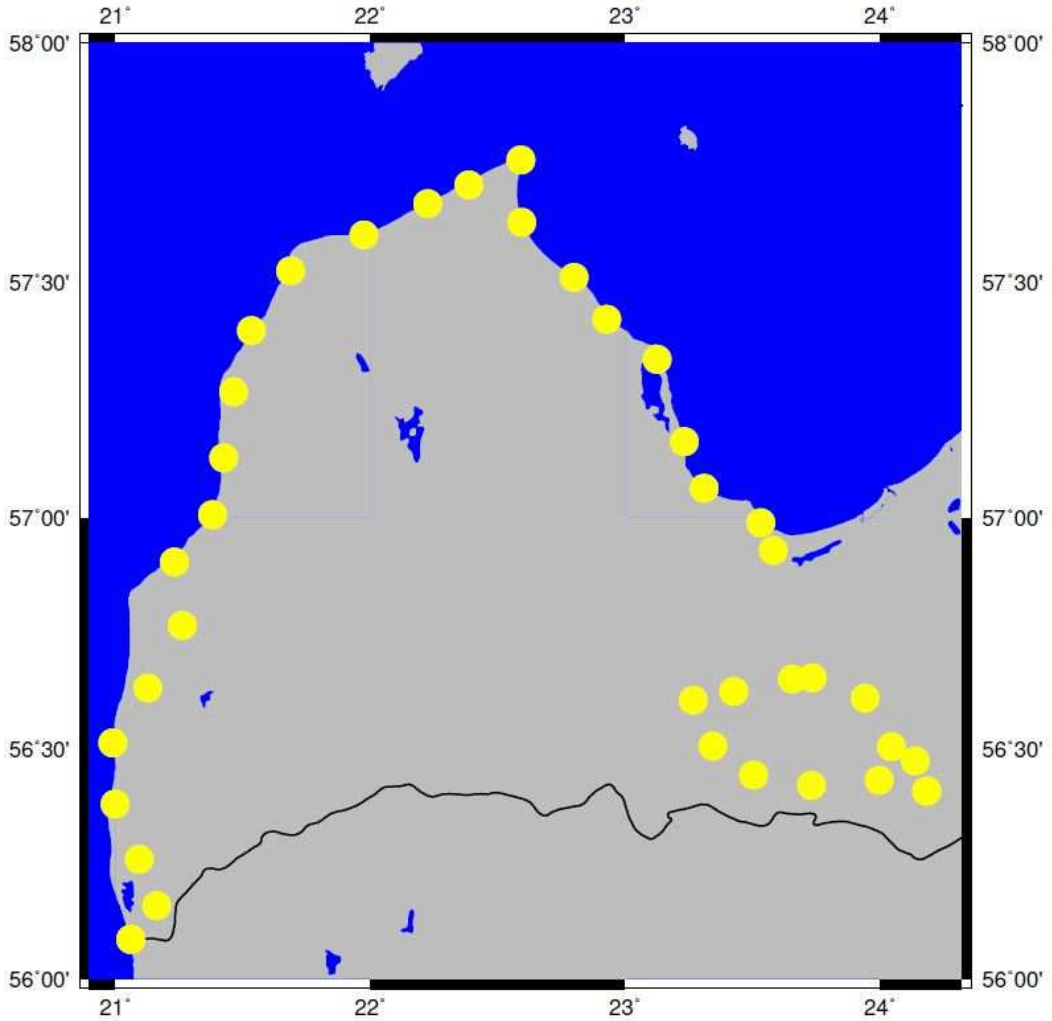
# Gravity measurements

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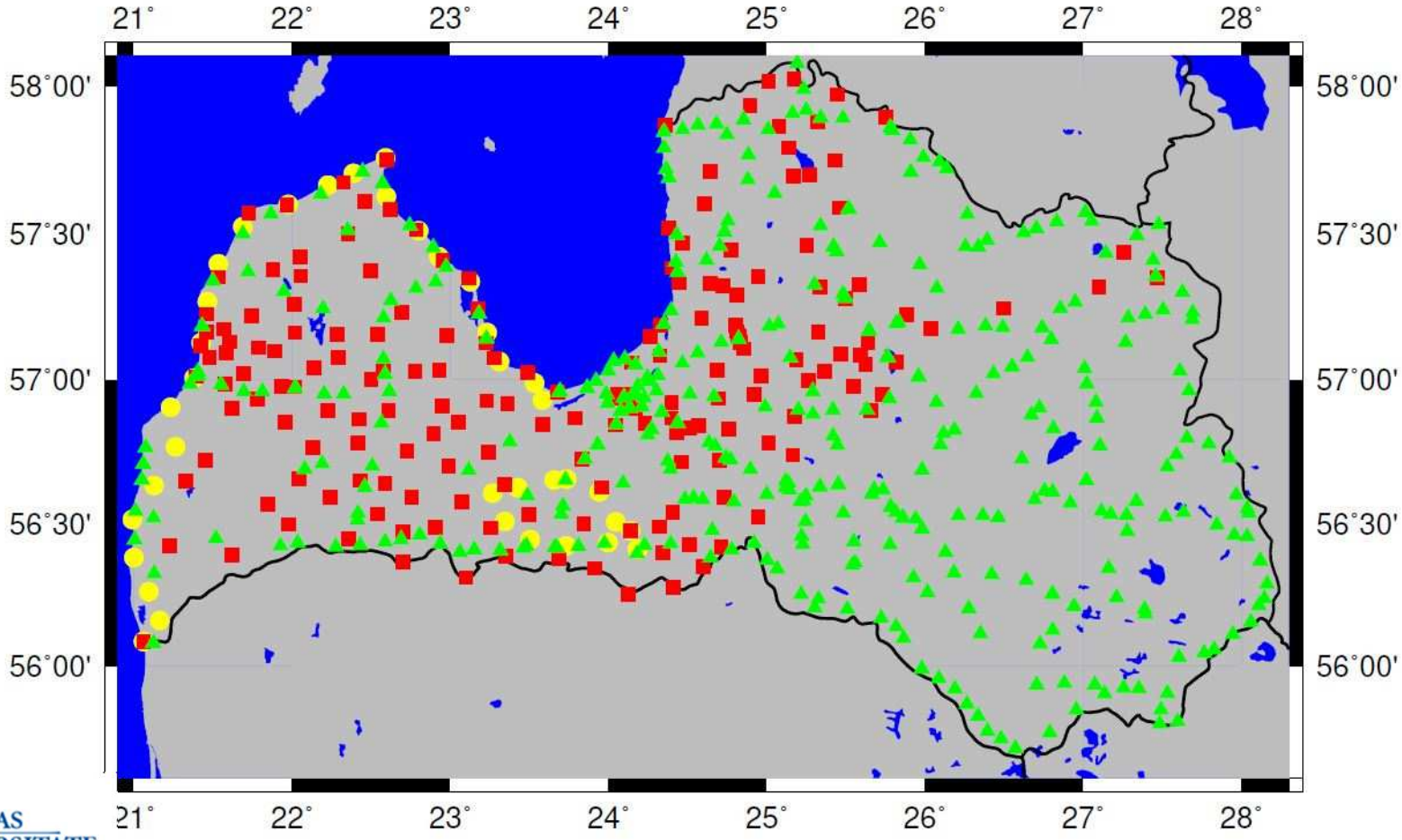
# All data

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# GNSS reference data improvement


| | Tracked | | Constellation | |
|---|---|---|---|---|
| | # | Satellites | # | Satellites |
| GPS | 11 | 1, 3, 11, 14, 17, 18, 19, 22, 23, 31, 32 | 32 | 1, 2, 3, 5...32<br>Unhealthy: 4 |
| GLONASS | 8 | 1, 2, 3, 10, 11, 17, 18, 24 | 24 | 1...24 |
| Galileo | 6 | 2, 7, 12, 19, 20, 26 | 22 | 1...5, 7, 8, 9, 12, 14, 19, 24, 25, 26, 30, 31<br>Unhealthy: 11, 18, 20, 21, 22, 27 |
| QZSS | 1 | 194 | 4 | 193, 194, 195, 199 |
| BeiDou | 3 | 5, 9, 16 | 26 | 1...14, 16, 19<br>Unhealthy: 17, 20...24, 27...30 |
| IRNSS | 1 | 6 | 7 | 6<br>Unhealthy: 1...5, 7 |
| SBAS | 3 | 128:GAGAN - GSAT 10<br>127:GAGAN - GSAT 8<br>136:EGNOS - SES-5 | | |
| MSS | 1 | ESAT_ | | |

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# Thank You

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