ONE YEAR WITH OUR ABSOLUTE GRAVIMETER

Mikael Lilje, Jonas Ågren, Andreas Engfeldt,
Per-Anders Olsson

Lantmäteriet, Sweden

LANTMÄTERIET

Introduction

- In Sweden, a new generation of reference systems has been introduced.
- Due to post glacial rebound, reference systems need to have an epoch
- To be able to guarantee their sustainability over time, post glacial rebound need to be modelled.
- The post glacial rebound also effect the gravity field of the Earth.
- Repeated gravity measurement can therefore be used for the development of the model.

LANTMÄTERIET

One year with our absolute gravimeter - FWW Stockholm, TS 5F, Tuesday 17th June, 2008

Why does Lantmäteriet need to determine gravity?

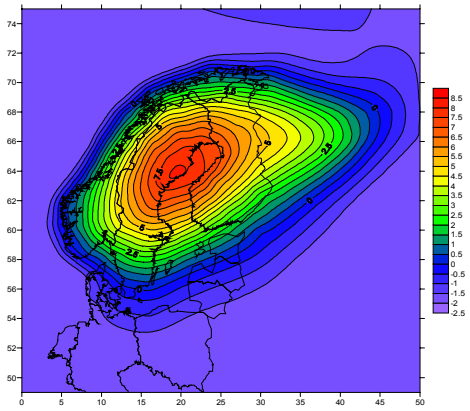
Lantmäteriet are responsible for our national reference systems

Three main areas:

- The change in gravity at a location is important information to understand the mechanism behind post glacial rebound
- Geoid determination
- Height determination (e.g. for our new height system RH 2000)

LANTMÄTERIET

An example of a Land Uplift Model



NKG2005LU

NKG2005LU used for the adjustment of ours (and others) height system

Vertical: 0 to 1 cm/year

Horizontal: 1 mm/year.

Mathematical model determined using

- Repeated levelling
- tide gauge observations
- repeated levelling
- Geophysical model

LANTMÄTERIET

One year with our absolute gravimeter - FWW Stockholm, TS 5F, Tuesday 17th June, 2008

Buildings for boats

LANTMÄTERIET

Discussion

- Post glacial rebound can be determined with repeated gravity measurement.
- Gravity measurements gives valuable extra information about interior Earth mass changes so that improved models of the geoid changes can be computed.
- The best is to combine various geodetic observations as GNSS, gravity and tide gauges
- Demands on high accuracy => absolute gravity to prefer.

LANTMÄTERIET

One year with our absolute gravimeter - FWW Stockholm, TS 5F, Tuesday 17th June, 2008

Various types of gravity meters


LaCoste & Romberg

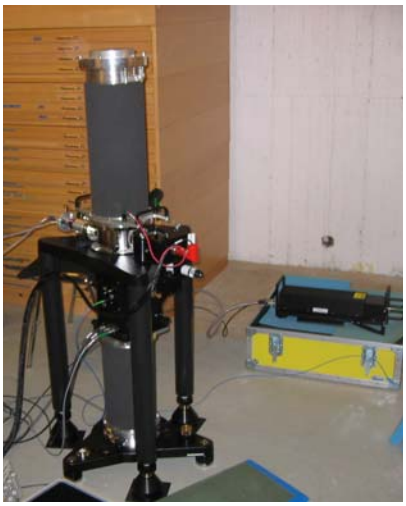

Scintrex


A10


FG5

LANTMÄTERIET

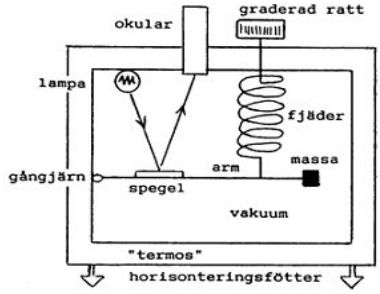
Absolute gravity measurement


FG5

- Gravity is determined relative the physical standards for length and time.
- Today, more or less only ”free fall” is used.
- Position and time determined many times of an object falling in vacuum.
- Time determined using an atomic clock and position using a laser with stable wave length.
- Accuracy (1 sigma): ≈ 2 μGal

LANTMÄTERIET

Relative gravity measurement



- Difference in gravity determined between two or more points.
- Usually keeping a mass in equilibrium using an elastic spring.
- Accuracy (1 sigma):

  5 – 10 μGal over short distances with reasonable gravity variations

LANTMÄTERIET

Best option for us:
Micro-g LaCoste FG 5-233 and Scintrex CG5

LANTMÄTERIET

Consequences of the investment

-You need to secure that you have enough personnel who are dedicated, interested and skilful enough

-Never underestimate the need to work with the instrument. Maintenance is needed both at office, on field and at Micro-g (USA)

-Important to use opportunities for calibration and comparisons of your instrument

-Absolute and relative gravity

LANTMÄTERIET

Gravity measurements at Lantmäteriet

Traditionally:

Two LaCoste&Romberg relative gravimeters

- Determination of reference systems/frames as our height systems.
- Important information to understand post glacial rebound.

Since October 2006:

Micro-G LaCoste FG-5 as well as a new Scintrex CG-5 relative gravimeter. We are now able to:

- Guarantee enough observations to develop models for post glacial rebound.
- Determine gravity change over time as well as the geoid variation over time.

LANTMÄTERIET

Nordic and German co-operation

- Project started 2003.
- Gravity observations together with other geodetic observations as CGNSS.
- Observations needed from the whole area => International co-operation important.
- The changes are needed to be determined very accurately (at least 0.1 μGal/year) to be able to be used. Long time series needed. We must start now!

LANTMÄTERIET

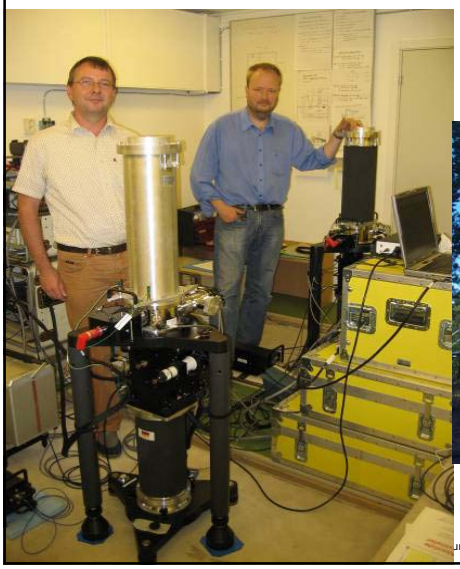
Combined CGNSS and gravity

LANTMÄTERIET

Stations measured in the Nordic Area 2007

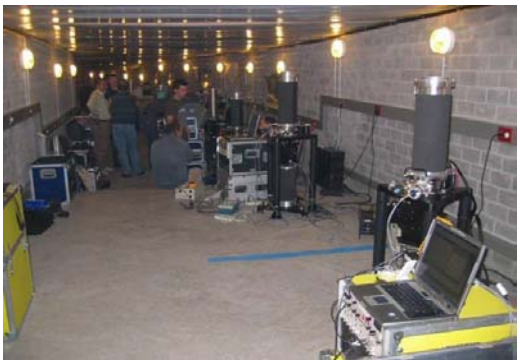
LANTMÄTERIET

Example of comparison, Mårtsbo 2007



LANTMÄTERIET

Intercomparison, Luxembourg November 2007



LANTMÄTERIET

Serbia in October, 2007

Grgeteg

Gradac

Sicevo

LANTMÄTERIET

Summary

About 10-15 stations per year

The instrument must be treated carefully. High precision!

Never underestimate the need of

- Dedicated and interested personnel
- Services and Maintenance

LANTMÄTERIET

Thank You

Questions?

Contact: Mikael Lilje, mikael.lilje@lm.se

One year with our absolute gravimeter - FWW Stockholm, TS 5F, Tuesday 17th June, 2008

LANTMÄTERIET