The secular, postglacial gravity change in Fennoscandia

– observations and findings -

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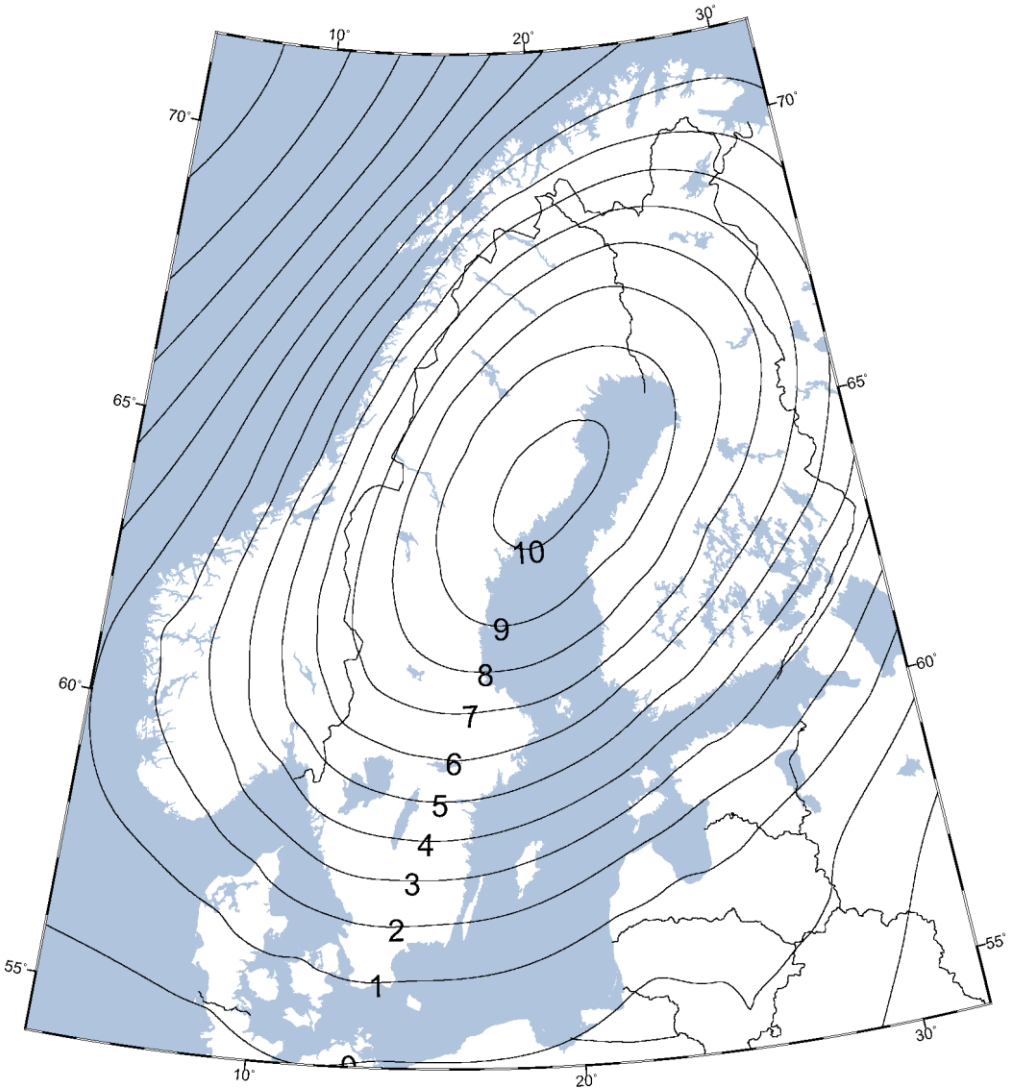
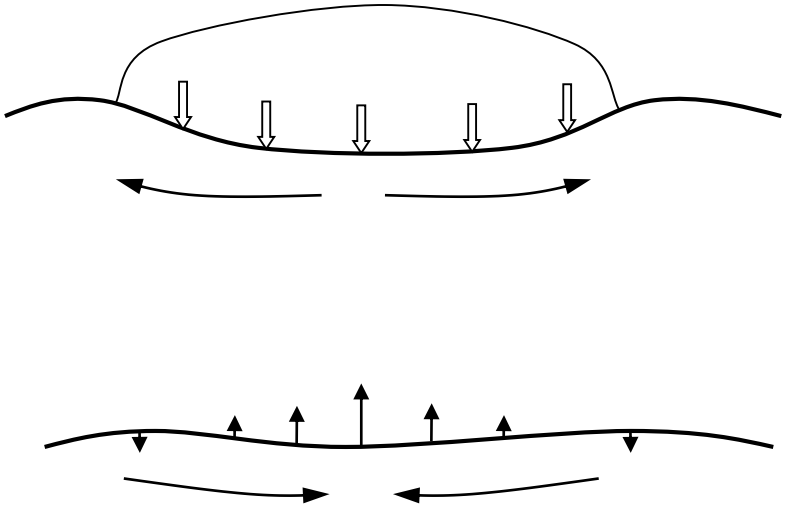
The Fennoscandian postglacial land uplift region



NKG2016LU_abs
[mm/yr]



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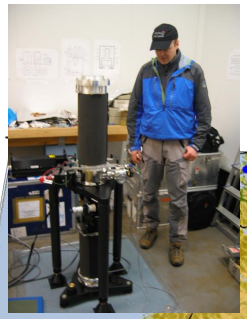
GIA observables



Sea level observations

Gravity observations

Deformation of the crust

Lidberg (2010)

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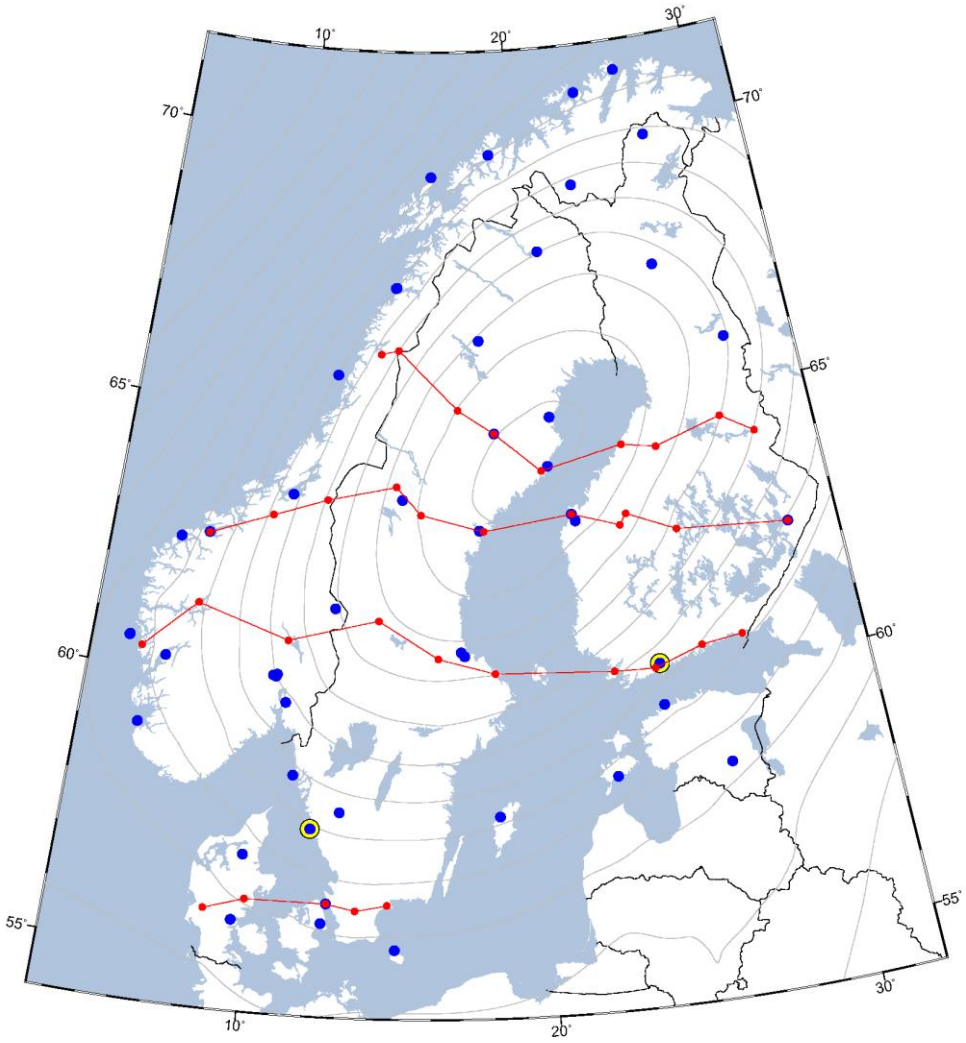
The gravity signal

Gravity change
=
Vertical displacement
+
Redistribution of masses within the Earth
+
Redistribution of masses on the surface of the Earth

Observations of the GIA-induced gravity rate of change in Fennoscandia



- Land uplift gravity lines, since 1960s
- Repeated AG observations since late 1980s
- 53 AG stations (often co-located with GNSS)
- ~700 AG observations
- 10 organizations
- 13 instruments (81% FG5)

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A Fennoscandian $\dot{g}$-model

Why?

- Epoch reduction of geodetic observations
- Ground trouth for satellite missions
- Tuning of GIA models

How?

- Observed $\dot{g}$
- GIA modelling
- $\dot{h}$ model with relation to $\dot{g}$
- Combination

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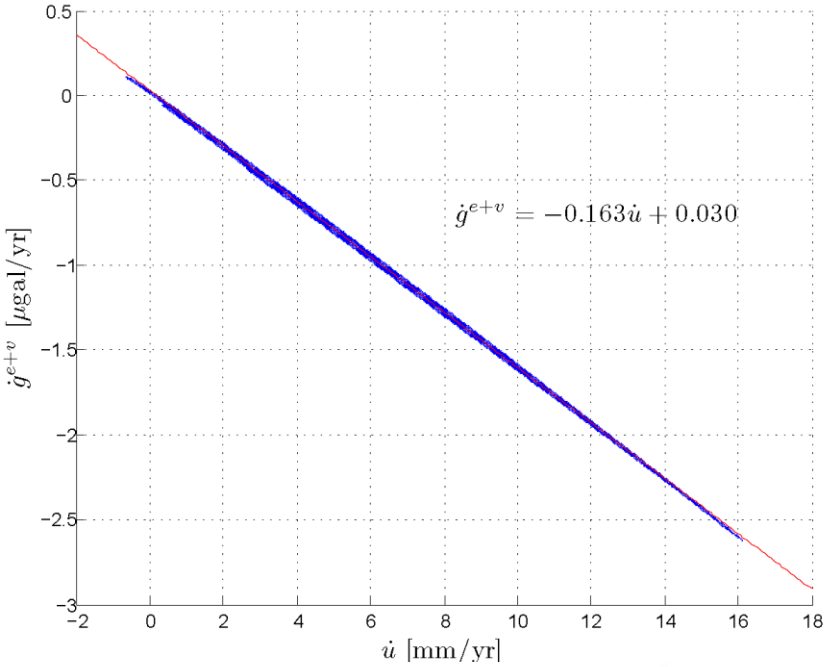
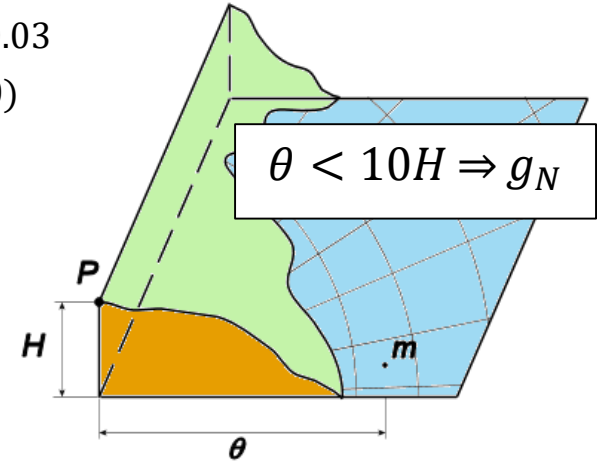
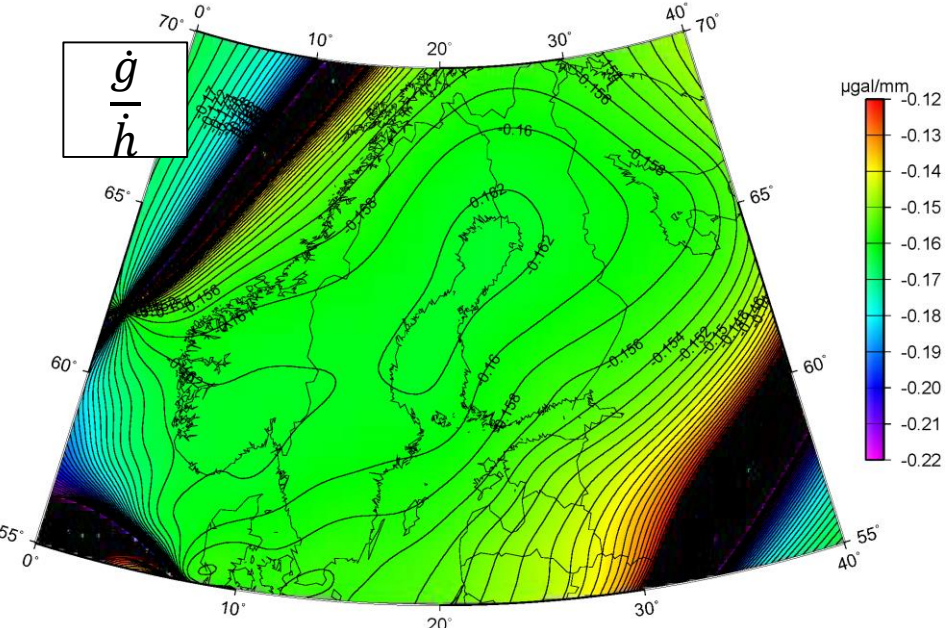
The relation between $\dot{g}$ and $\dot{h}$

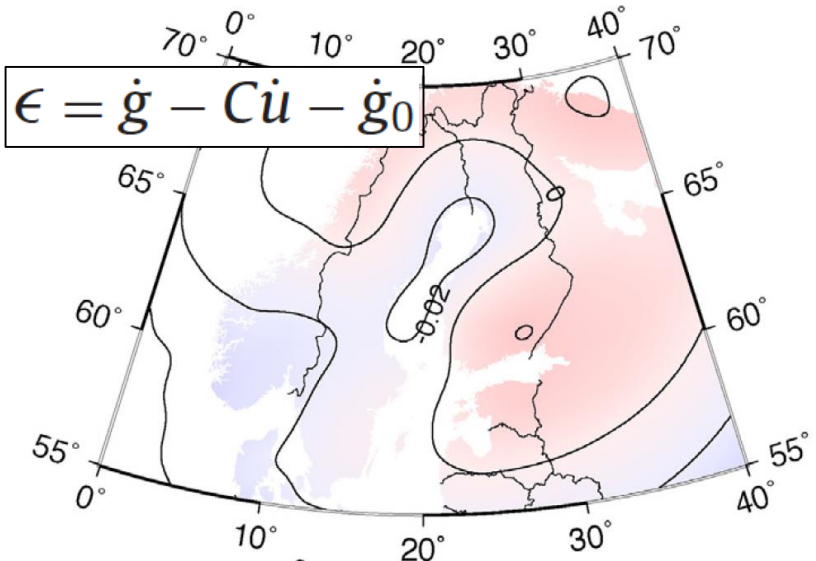


From GIA modelling (1D) we know that in Fennoscandia the relation is:

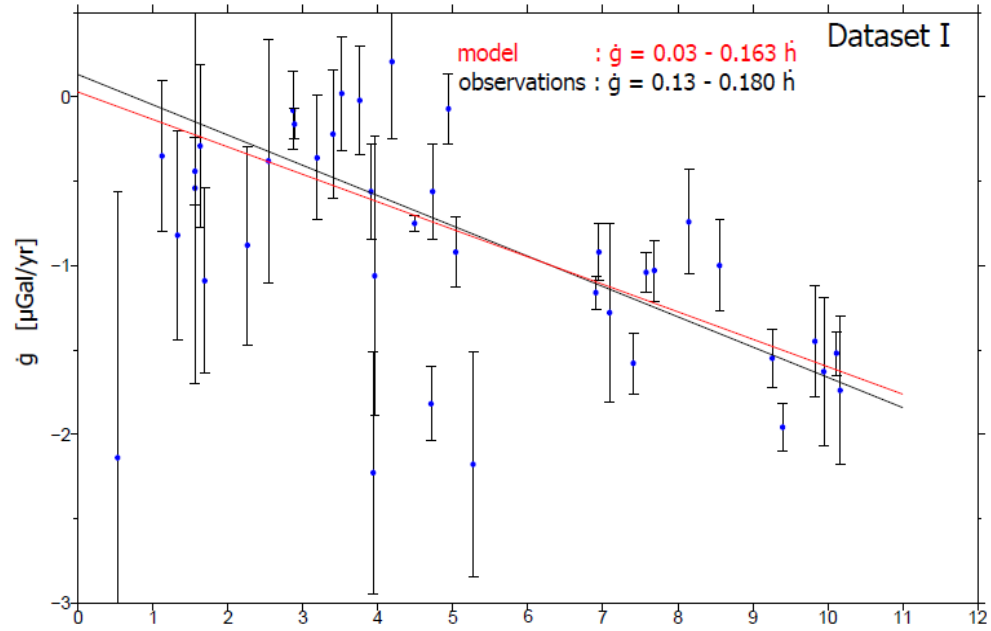
- ~linear
- $\dot{g} = -0.163\dot{h} + 0.03$
- $(\dot{g} = 0) \neq (\dot{h} = 0)$
- ~constant
- valid on land



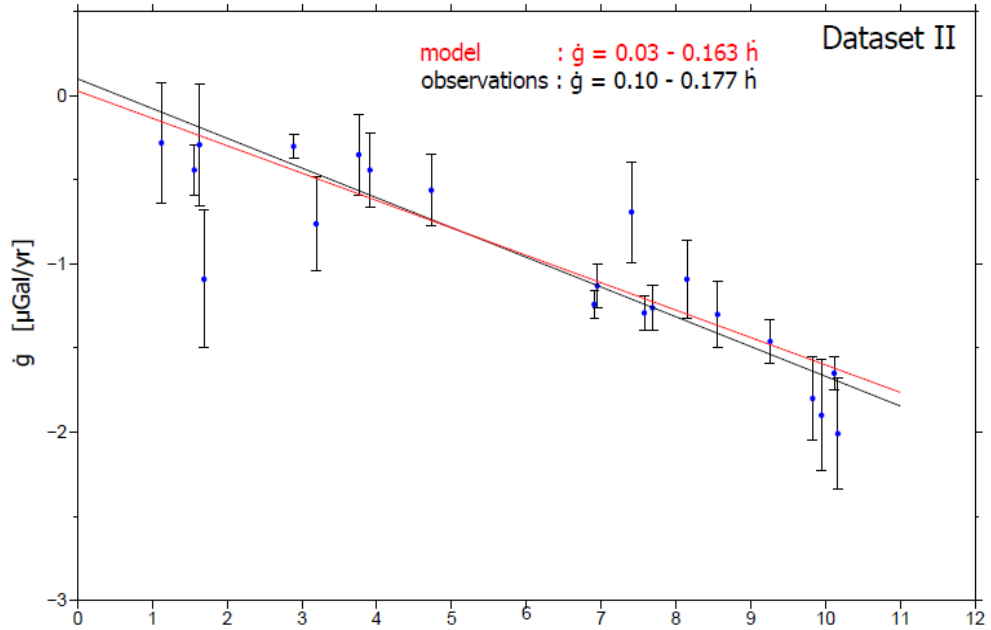


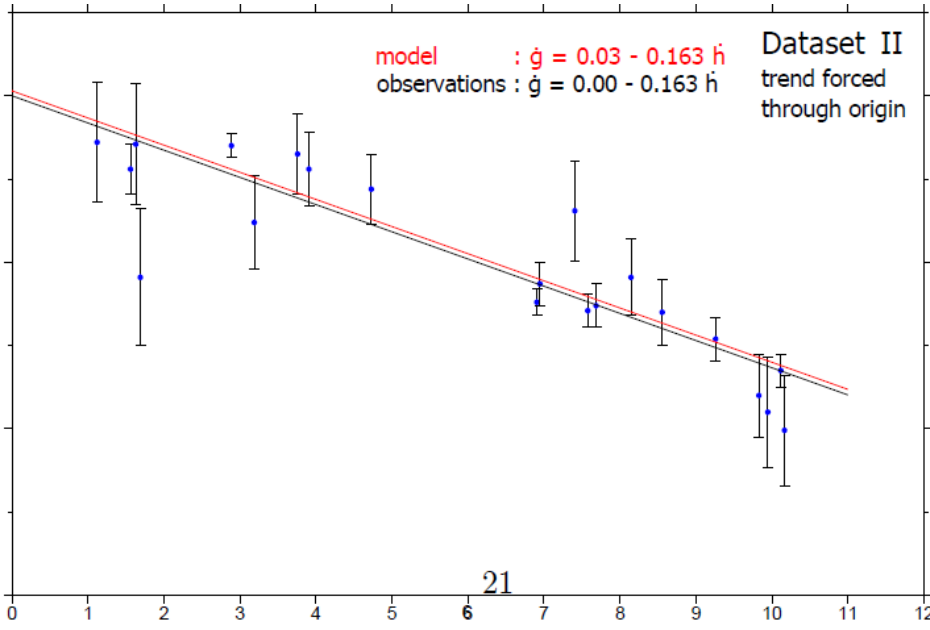


Observations confirms the modelled relation (WLSA)

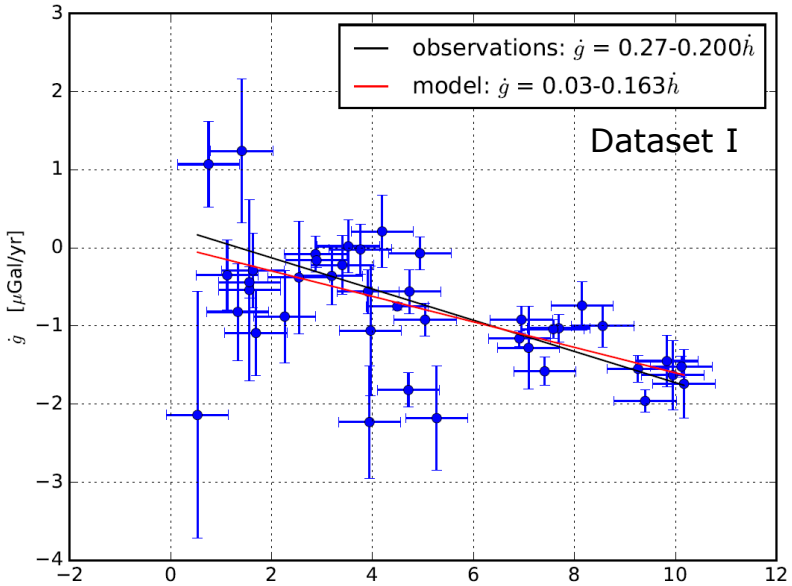


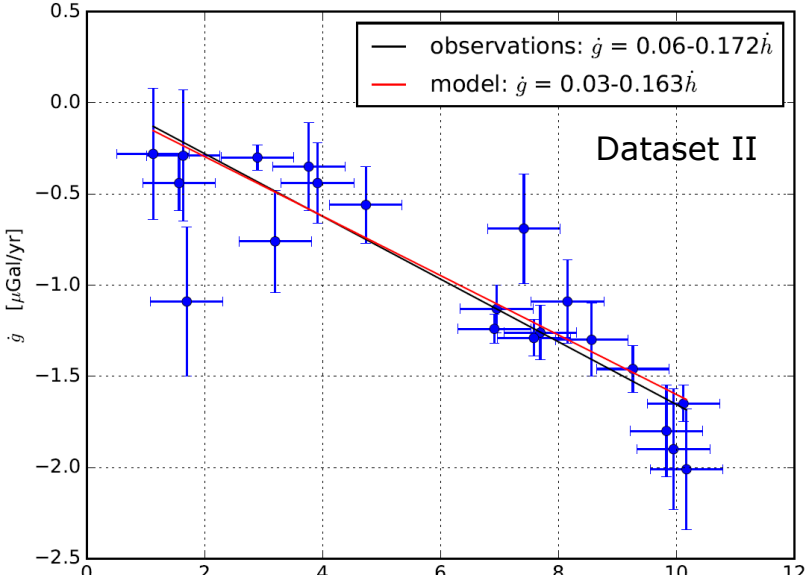
Dataset I = all AG observations
Dataset II = only FG5, suspected systematic errors and large uncertainties removed

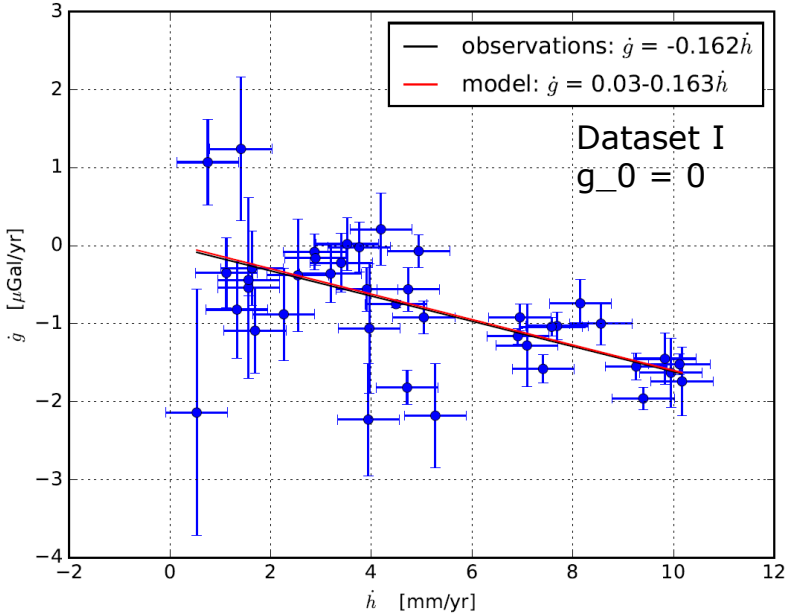


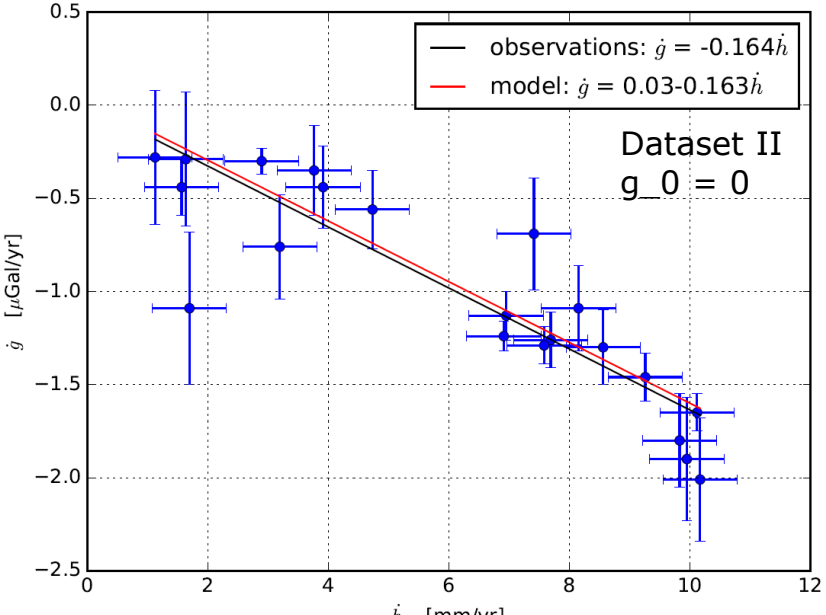


Observations confirms the modelled relation (WODR)





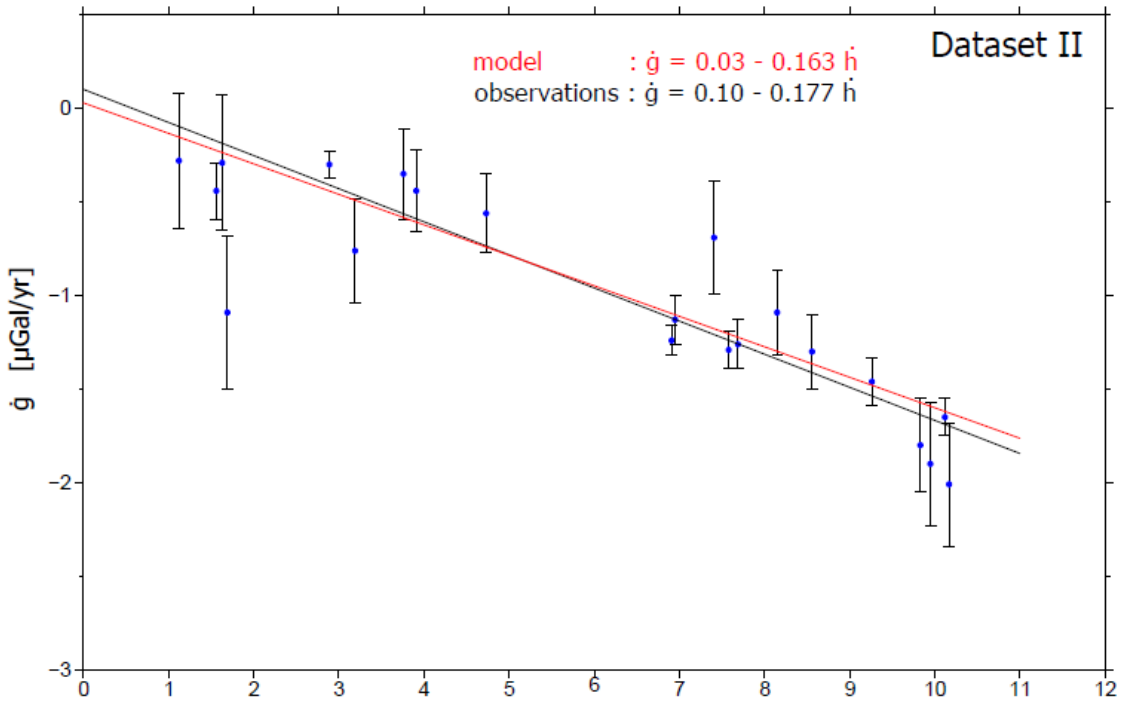


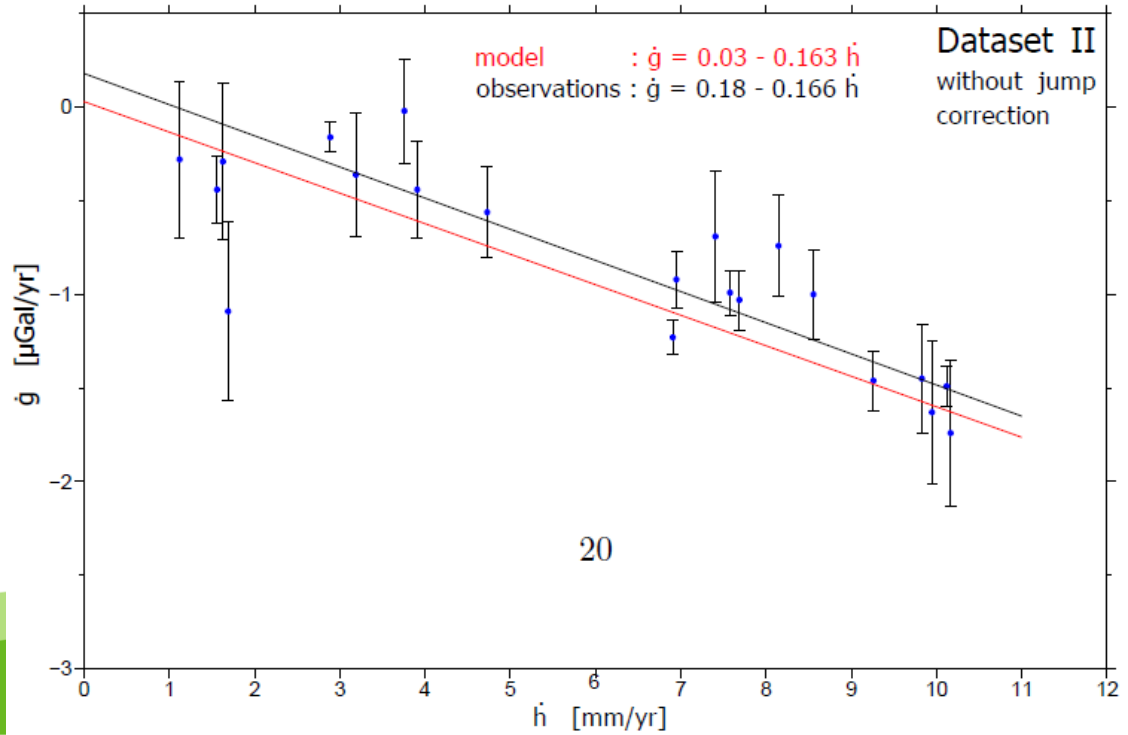


Observations confirms the modelled relation (summary)

Relation	g_0	C	Estimator
Geophysical	0.03	-0.163±0.016	GIA model
Dataset I	0.14±0.13	-0.180±0.021	WLSA
Dataset II	0.10±0.09	-0.177±0.013	WLSA
Dataset II	0.06±0.10	-0.172±0.015	WODR
Dataset II, GNSS	0.04±0.12	-0.168±0.017	WODR
Dataset I, g_0=0		-0.164±0.007	WLSA
Dataset II, g_0=0		-0.163±0.005	WLSA
Dataset II, g_0=0		-0.164±0.006	WODR
DII, GNSS, g_0=0		-0.163±0.007	WODR

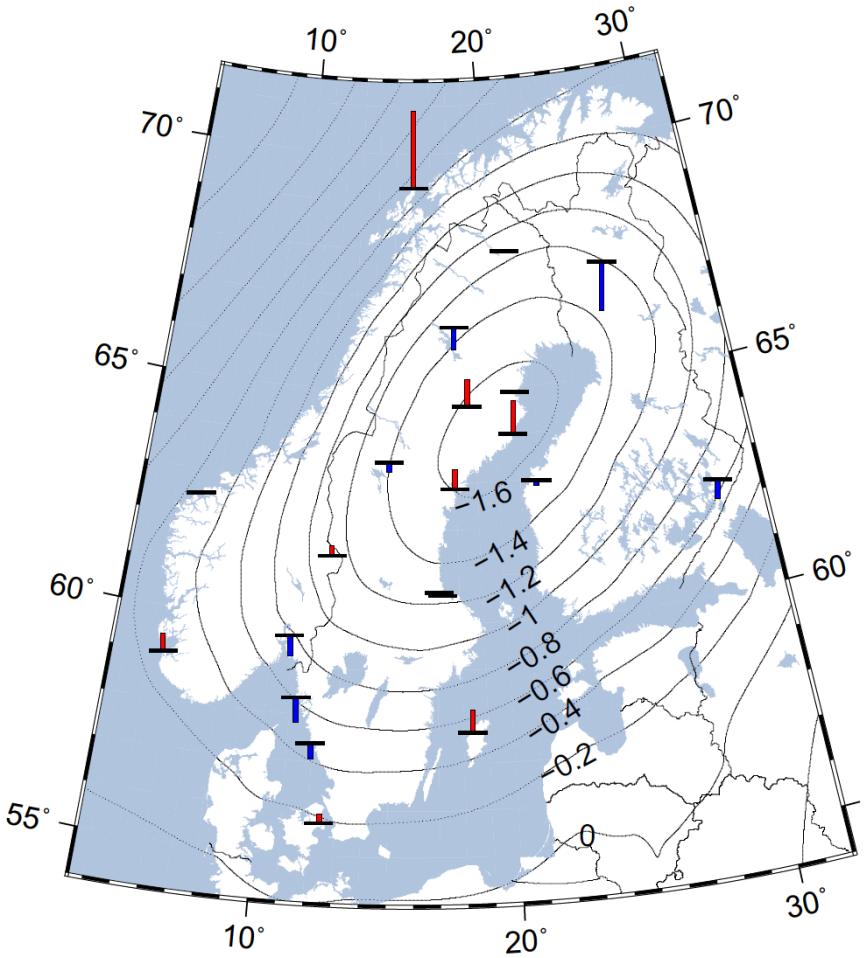
Without correction for jump

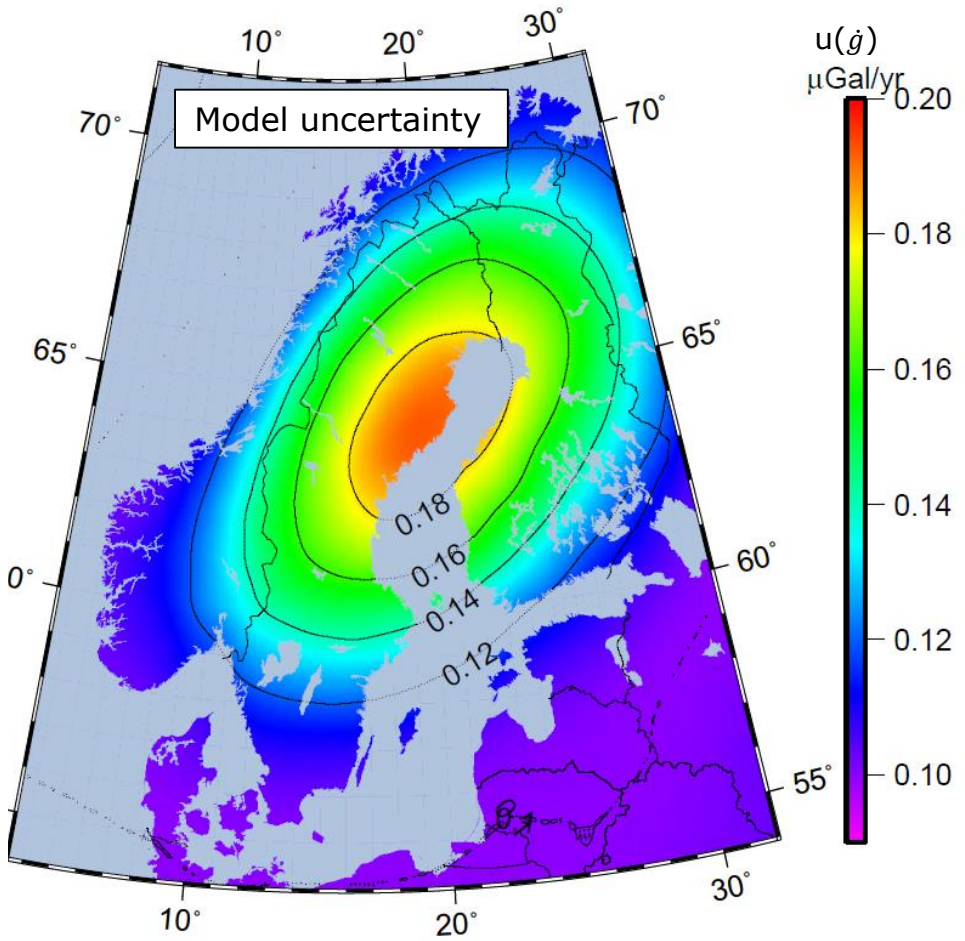




P.-A. Olsson, A. Engfeldt, and J. Ågren. *Investigations of a suspected jump in the Swedish repeated absolute gravity time series.* International Association of Geodesy Symposia, 2016. doi: 10.1007/1345 2016 250.

NKG2016LU_gdot = -0.163*NKG2016LU_abs





ġ uncertainties from observations [µGal/yr]
Max : 1.58
Min : 0.05
Mean : 0.41

u(NKG2016LU_abs)	= 0.2 mm/yr
u(ITRF2008_CM)	= 0.5 mm/yr
u(ITRF2008_scale)	= 0.3 mm/yr
u(C)	= 0.016 µGal/mm

Summary, conclusions and outlook

- We have compiled ~700 repeated AG observations in Fennoscandia spanning over three decades
- Observations confirm the geophysical relation $\dot{g} = -0.163\dot{h} + 0.03$
- AG observations
  - Discrete points
  - Heterogeneous uncertainties, due to e.g.
    - Few observations/short timespans
    - Local/external unmodelled effects
- Combining the geophysical relation with a land uplift model gives
  - A continuous $\dot{g}$ surface
  - More homogeneous and (in general) lower uncertainties
- All AG data will be published in an Open Access journal
- All (?) AG data will be uploaded to AGrav