

Lantmäteriet's input: NKG activity to develop a GIA model for Fennoscandia & more

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LANTMÄTERIET



NKG and land uplift/GIA models

- Existing land uplift model NKG2005LU will be substituted with a new one (test model circulated)
- NKG land uplift workshop in Reykjavik 2013 with a wish to support development of a GIA model for Fennoscandia
- Moral support to bring “modellers” of the NKG community together to work on such a model
- Participating modellers: Valentina Barletta (DK, USA), Matt Simpson (N), Maaria Nordman (FIN), Karin Kollo (EST), Per-Anders Olsson & Holger Steffen (S) + help by Glenn Milne
- Ice model support by Lev Tarasov

The NKG GIA model for Fennoscandia

A reference of/for

- Vertical motion (Present-day rate of uplift)
 - GPS, tide gauges, altimetry, levelling
- Horizontal motion
 - GPS, VLBI, DORIS(?)
- Gravity change
 - AG, RG, GRACE, GRACE-FO, GOCE(?)
- Geoid change
- Topography/bathymetry, sea level, uplift, geoid change at several times since the last glacial maximum

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- Uncertainty estimates
- Last but not least: GIA refers to a certain process, but is all land uplift GIA? Therefore: determine differences due to tectonic and/or other effects(!)

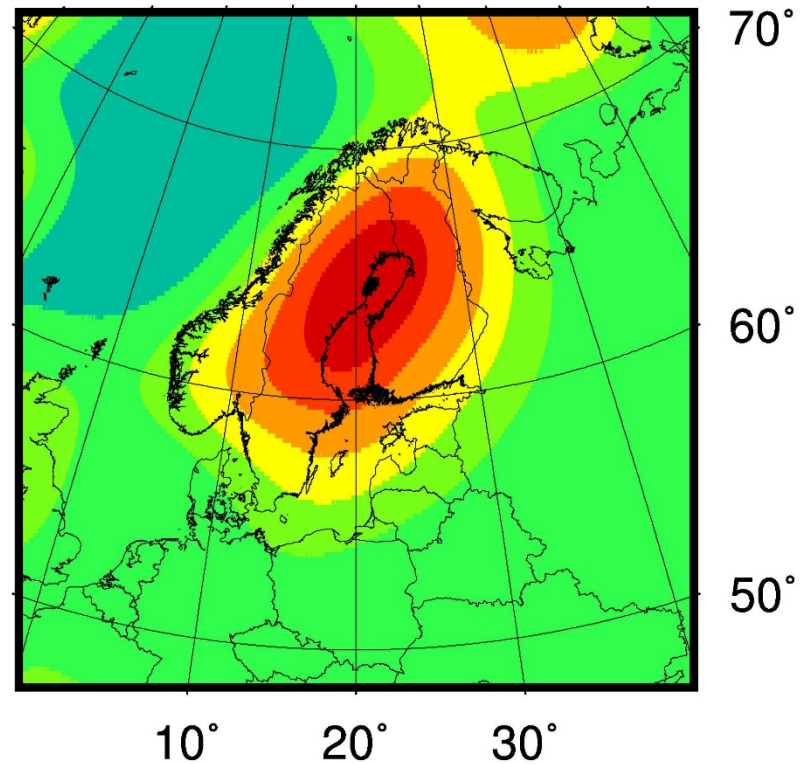
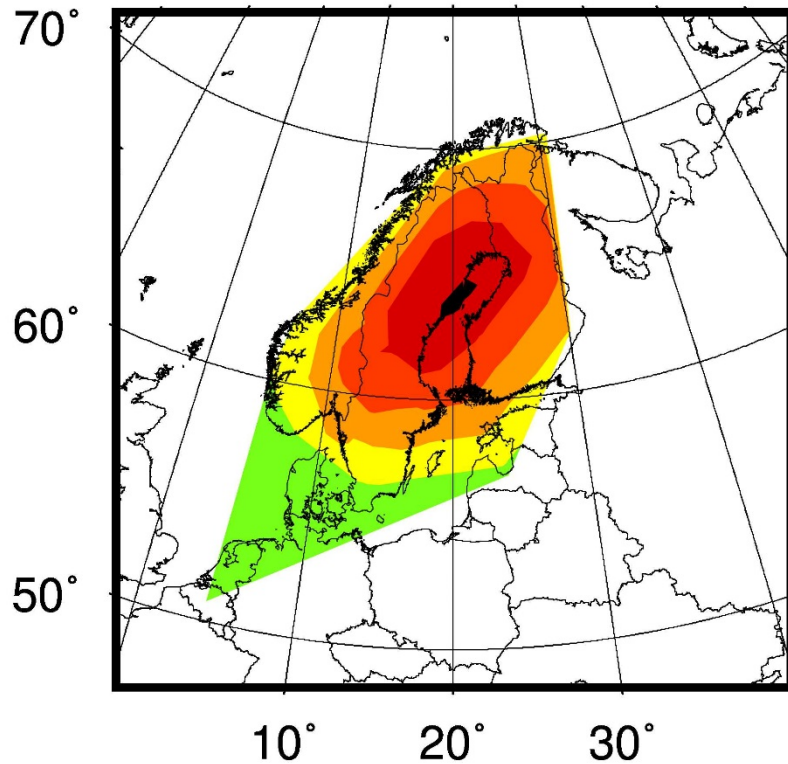
Model set-up for first test model

- Ice model:
 - Decision to use GLAC (Lev Tarasov & co-workers) for Fennoscandia and Barents Sea, other parts of the world from ICE-5G (Peltier) and tuned to fit sea-level equivalent; ICE-5G was multiplied by 1.02
- Earth model:
 - Close to VM5 in terms of lithosphere thickness (90 km) and mantle viscosity (7×10^{20} Pa s upper mantle; 2×10^{21} Pa s lower mantle), Maxwell rheology
 - Other model parameters (ice/water density, Earth radius, moments of inertia, π , etc.) as used in COST benchmark activity (see Spada et al. 2010)
- Observations:
 - BIFROST 2013 results as presented at IAG in Potsdam
 - Global RSL data (e.g. Barbados etc.) and Fennoscandian RSL data
 - Also comparison to latest tide gauge results from Per Knudsen (DTU Space) & GPS GIA-frame solution by Kierulf et al. (2014, JGR)

Comparison to recent GPS observations

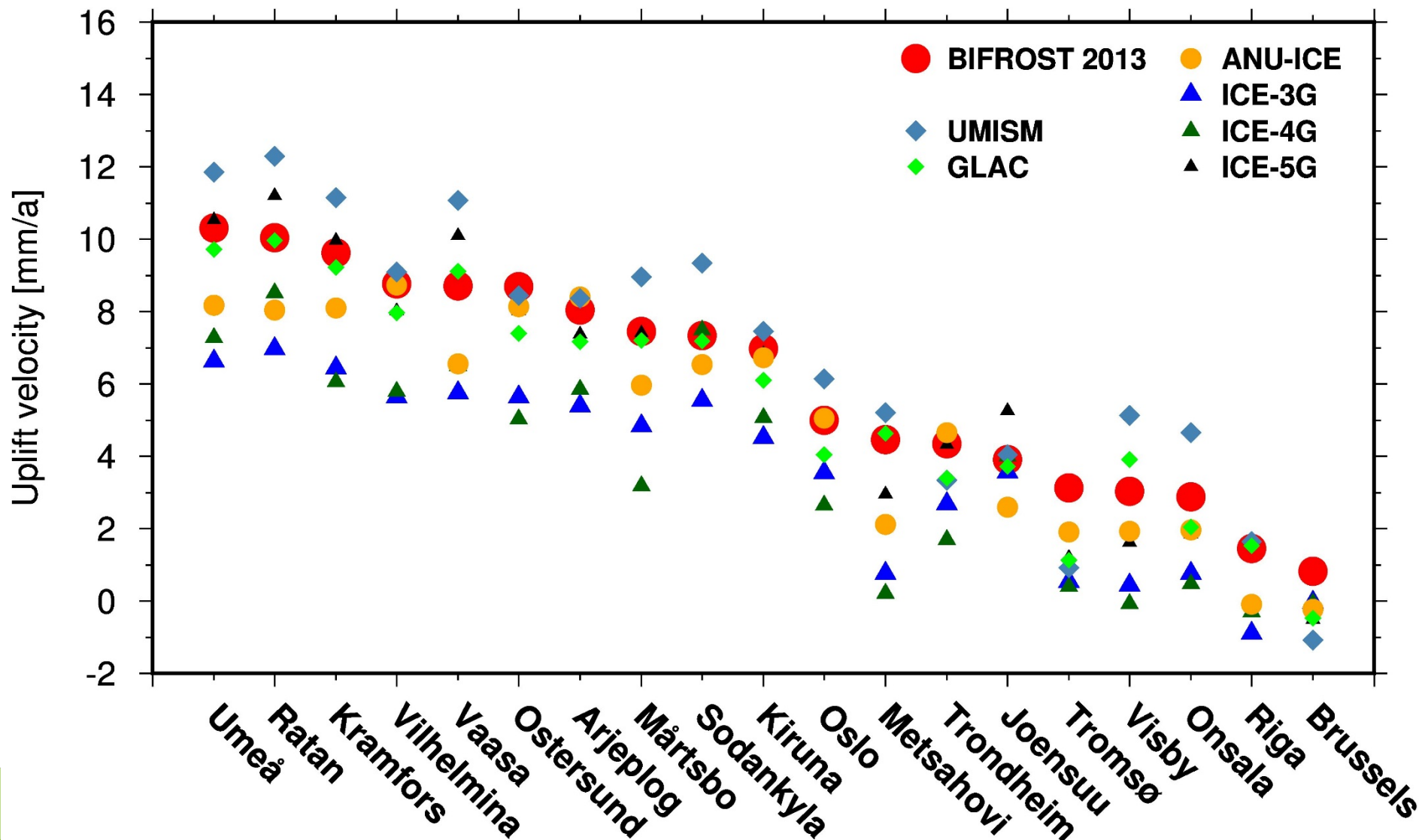
BIFROST 2013 (IAG pres.)

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Observations vs. GIA model results

Different ice models with the same VM5-like earth model



Model set-up for second test generation

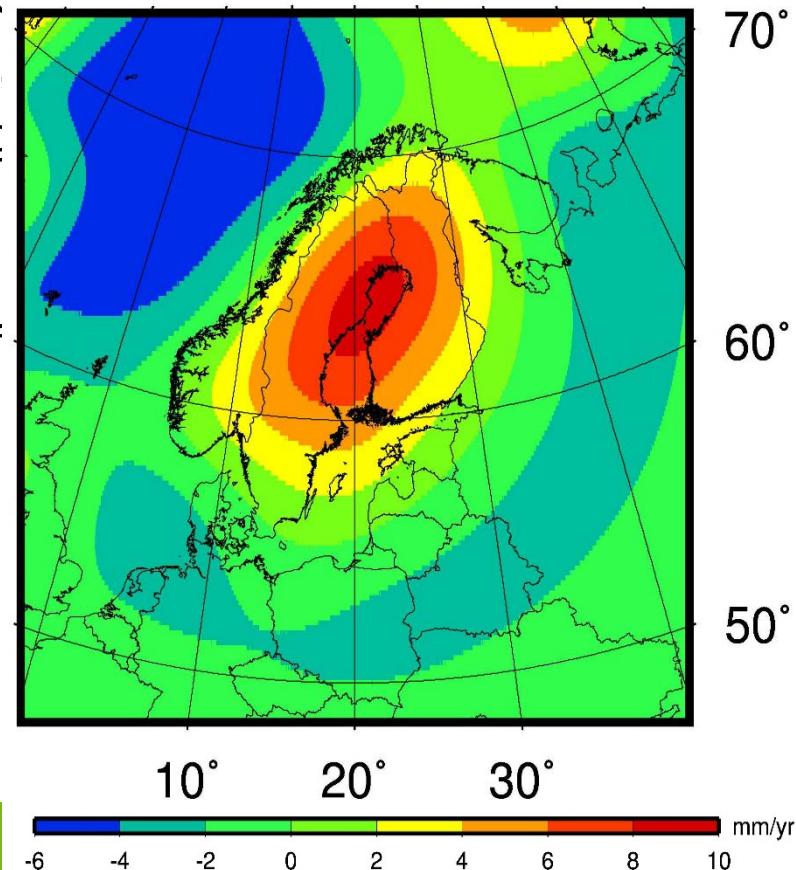
- Ice models:
 - 35 different GLAC ice histories for Fennoscandia and Barents Sea, other parts of the world from ICE-6Gc (Peltier et al., in press) and tuned to fit sea-level equivalent; ICE-6G factor to be determined for each ice history
 - Also test ICE-6Gc
- Earth model:
 - Close to VM5a, perhaps more layers than first generation, Maxwell rheology
 - Other model parameters as used in COST benchmark activity
- Observations:
 - New BIFROST 2015/16 release (currently in preparation with 100+ GPS stations)
 - Global RSL data (e.g. Barbados etc.) and Fennoscandian RSL data
 - Also GRACE, tide gauge, geologic information

Suggested model set-up for first EGSiEM GIA correction

- Ice models:
 - Best GLAC for Fennoscandia/Barents Sea, ICE-6GC/GLAC/Gowan for North America, Updated W12 for Antarctica, Lecavalier et al. (2014) for Greenland, rest from RSES (Kurt Lambeck), but no Tibet
- Earth model:
 - Dedicated earth model for each region, Maxwell rheology, using Wu (2004) 3D spherical FE model approach
 - Other model parameters (ice/water density, Earth radius, moments of inertia, π , etc.) as used in COST benchmark activity (see Spada et al. 2010)
- Observations:
 - New BIFROST 2015/16 release (currently in preparation with 100+ GPS stations)
 - EGSiEM GRACE result
 - Global RSL data (e.g. Barbados etc.) and Fennoscandian RSL data

Further cooperations

- Alar Rosentau (U Tartu, Estonia), RSL data in Estonia & Russia
- Andrei Panin (U Moscow, Russia), forebulge analysis near Smolensk
- Annemiek Vink (BGR, Germany), RSL data North Sea
- Anders Fischer (Danish Agency for Culture), global archaeological RSL data
- Lars Nielsen (GEUS, Denmark), GPR RSL data Denmark
- Lou Schmitt (U Gothenburg, Sweden), RSL S
- Thomas Hammarklint et al. (SMHI, Sweden)
- Sönke Dangendorf, Thomas Wahl (TU Sieg
Sea
- Rebekka Steffen (U Uppsala, Sweden), GIF
- Christian Brandes (U Hannover, Germany), f
- Patrick Wu (U Hong Kong), 3D GIA models
- Kvarken Council & Naturum Skuleberget, pu
- FAMOS
- EUREF & NKG contacts (Diana Haritonova,



Thank you for your attention!

