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Modelling contemporary GIA signals in northern Europe and Scandinavia

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GPS-measured rates of vertical crustal motion and GRACE-derived gravity change rates are incorporated into a semi-empirical model to constrain better the present-day glacial isostatic adjustment (GIA) signal associated with the former Fennoscandian Ice Sheet. The study area extends from northern Europe just south of the LGM ice margin to the load-central regions of Scandinavia. The observational data are combined with a suite of forward GIA model predictions which allow for variation in both ice sheet history and Earth model characteristics, with the best-fit posterior model simultaneously minimizing the misfit between both the observational and model constraints. When only the GPS data are incorporated into the prior model a good fit is obtained ($\chi 2 < 1$), with the most prominent post-fit residuals predicted to the north and east of the Gulf of Bothnia. The result is similar when only the GRACE data are used as constraint, and the best overall fit is obtained when both datasets are inverted. Both the GPS and GRACE datasets are corrected a priori for the effect of hydrological loading using the PCR-GLOBWB hydrology model, a correction which can, at least at the local scale, significantly impact the fit of model predictions to the observational data. Within formerly glaciated regions, the methodology provides a realistic prediction of the uncertainty associated with the glacial isostatic adjustment process; for example, for rates of vertical land motion, predicted uncertainties range from $\sim$0.2-1 mm/yr, with the largest rates present in the northern Gulf of Bothnia. The GIA predictions can be used in sea-level studies to better constrain the magnitude and uncertainty of the GIA contribution to the regional sea-level budget. Also assessed is the sensitivity of the model predictions to variations in ice sheet and Earth model combinations, and the ability of the method to resolve preferred values for these parameters.