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**Title: Bayesian estimation of global glacial isostatic adjustment for sea level rise re-evaluation**

Glacial isostatic adjustment (GIA) has a crucial contribution to sea level rise. In general, estimates of the GIA process have been obtained from physical model simulations with assumptions about the Earth structure and ice loading history. These models often lead to significant regional discrepancies due to incomplete information of the lower mantle viscosity, ice loading histories, and the 3-D structure of the Earth. In this study, we propose a data-driven approach to provide GIA estimates which synthesises global model solutions with GPS observations made at a subset of the global station network. GIA is treated as a time invariant Gaussian process on the sphere, with a local Matern covariance function. Following a full Bayesian approach and the principle of stable inference, we use the GIA estimate derived from the ICE-6G (VM5a) model as the prior mean, and parameterise the covariance function in terms of a variance and a correlation length. For computational feasibility, we use a sparse matrix representation induced by a Gaussian Markov random field (GMRF) approximation, and a parallel updating algorithm which exploits the conditional independence structure of the GMRF. The result is a new global GIA reconstruction, with a full assessment of uncertainty.