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Modelling the glacial isostatic adjustment of the British Isles using continuous GPS measurements of 3-D crustal motion.

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A number of previous studies have considered the glacial isostatic adjustment (GIA) of the British Isles with the aim of constraining a variety of model parameters, including: viscoelastic Earth structure, local ice sheet history and the global meltwater (eustatic) signal. All of these studies used, as their primary observable, the high quality relative sea level (RSL) data set for this region [Shennan & Horton, J.Quat.Sci., 17, 2002] and have demonstrated the power of these data in GIA applications. However, the data are notoriously difficult to fit in their entirety due to the highly non-monotonic nature of the observed sea-level changes and the large spatial variation in this signal across the region. In addition, the model predictions display a strong sensitivity to both local ice and Earth model parameters, as well as the global meltwater history, resulting in a high degree of non-uniqueness [e.g. Shennan et al., J.Quat.Sci., 21(6), 2006], which is a further obstacle to arriving at a robust model solution for this region.

This study considers a data set of present-day, 3-D crustal motion at up to 42 GPS stations across the UK mainland. These data provide new constraints on GIA models of the British Isles that complement those imposed by the RSL observations. Our results indicate that the site-differenced GPS data are relatively insensitive to plausible variations in both local and global ice models and, as such, can be used to provide a robust constraint on earth structure. A forward modelling analysis based on 3-layer (lithosphere, upper mantle, lower mantle), 1-D Earth models indicates that the data prefer a lithospheric thickness of $\sim$70 km and an upper mantle viscosity of 2-5 $\times$ 10^{20} Pas. The predictions were less sensitive to variations in lower mantle viscosity but prefer a value that is greater than $\sim 1 \times 10^{22}$ Pas. These results will be compared

to those from previous analyses that adopted the RSL data only.