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Optimal locations of sea-level indicators in glacial isostatic adjustment investigations

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This poster presents the results of Steffen et al. (2014).

Fréchet (sensitivity) kernels are an important tool in glacial isostatic adjustment (GIA) investigations to understand lithospheric thickness, mantle viscosity and ice-load model variations. These parameters influence the interpretation of geologic, geophysical and geodetic data, which contribute to our understanding of global change.

We discuss global sensitivities of relative sea-level (RSL) data of the last 18 000 years. This also includes indicative RSL-like data (e.g., lake levels) on the continents far off the coasts. We present detailed sensitivity maps for four parameters important in GIA investigations (ice-load history, lithospheric thickness, background viscosity, lateral viscosity variations) for up to nine dedicated times. Assuming an accuracy of 2 m of RSL data of all ages (based on analysis of currently available data), we highlight areas around the world where, if the environmental conditions allowed its deposition and survival until today, RSL data of at least this accuracy may help to quantify the GIA modeling parameters above.

The sensitivity to ice-load history variations is the dominating pattern covering almost the whole world before about 13 ka (calendar years before 1950). The other three parameters show distinct patterns, but are almost everywhere overlapped by the ice-load history pattern. The more recent the data are, the smaller the area of possible RSL locations that could provide enough information to a parameter. Such an area is mainly limited to the area of former glaciation, but we also note that when the accuracy of RSL data can be improved, e.g., from 2 m to 1 m, these areas become larger, allowing better inference of background viscosity and lateral heterogeneity. Although the patterns depend on the chosen models and error limit, our results are indicative enough to outline areas where one should look for helpful RSL data of a certain time period. Our results also indicate that as long as the ice-load history is not sufficiently known, the inference of lateral heterogeneities in mantle viscosity or lithospheric thickness will be interfered by the uncertainty of the ice model.

Reference:
Steffen, H., Wu, P., and Wang, H.: Optimal locations of sea-level indicators in glacial isostatic adjustment investigations, Solid Earth, 5, 511-521, doi:10.5194/se-5-511-2014, 2014.