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# Appendix 2: Investigation of GIA models with various ice-melt reconstructions

This supplementary material aims to investigate the impact of our choice of GIA models on our results.

## 1 VLM PREDICTIONS FROM ICE-5G (VM2) AND ICE-6G (VM5A)

VLM predictions due to PIM (Past Ice Mass) changes are computed as the average of two GIA models taking into account two different ice-load reconstructions (ICE-5G and ICE-6G), two different viscosity profiles (VM2 and VM5a) and two different numerical modelling methods (Peltier 2004; Purcell et al. 2016). We choose the solution from Purcell et al. (2016) for the ICE-6G (VM5a) model, because anomalous uplift rates were reported in the computations of Argus et al. (2014) and Peltier et al. (2015).

Total VLM predictions are computed as the sum of surface loading, PDIM and GIA predictions (Figure 1a). The GIA prediction is the average of the ICE-5G (VM2) and ICE-6G (VM5a) predictions. The error rate on the total VLM prediction is computed by adding the error rates on surface loading, PDIM and GIA predictions in quadrature (Figure 1b). The error rate on GIA prediction is the absolute difference between the ICE-5G (VM2) and ICE-6G (VM5a) predictions.

The total VLM predictions (Figure 1) are in good agreement with the main manuscript (Figure 6). The largest (up to $\pm 3$ mm/yr) differences in VLM predictions are observed in North America. With this approach, higher uplift rates are indeed predicted in Greenland and northern Canada than in the main manuscript. This is to be expected, given that new data were included in the ICE-6G model to reconstruct the ice load history over North-America (Engelhart et al. 2011). The uplifts predicted in Fennoscandia are lower by about 1.5 mm/yr with this approach than in the main manuscript. Elsewhere, VLM predictions differ by less than 1 mm/yr. Besides, the error rates achieved with this approach are generally lower (on average by 50 %) than in the main manuscript. The range of viscosity values explored in the main manuscript is indeed very large (probably too large), so that the range of resulting GIA predictions is probably too large to. The approach chosen in the main manuscript may therefore be considered as an upper limit on the GIA uncertainties associated with our lack of knowledge of the mantle structure.

## 2 COMPARISON OF ADDITIONAL VLM PREDICTIONS WITH OBSERVATIONS

The goodness of fit between VLM observations and predictions are equivalent for both approaches. With this approach, the VLM predictions can explain about half of the variance observed at scales larger than 300 km when considering the full dataset ($R^2$= 0.5). When excluding the most isolated stations ($w_{min}$ = 7), the determination coefficient goes up to values around 0.8 considering wavelengths greater than 400 km. Besides, with this approach, the differences between VLM observations and predictions (Figure 2) follow very similar patterns than in the main manuscript (Figure 8). As expected, the major differences between two approaches appear for North America and Fennoscandia, while it is relatively consistent elsewhere. Also, cumulative error rates (Figure 2b) are a bit lower than in the main manuscript (Figure 8b). As a consequence, the significance ratio (Figure 3) is higher than in the main manuscript. In addition to the nine regions identified in the main manuscript (Figure 9), high SR ratios pop up around the Baltic Sea (Figure 3). SR ratios are also higher along the San Andreas fault and Florida. On the opposite, SR ratios are lower in the south of the Gulf of Mexico and in Malaysia. SR ratios are somewhat lower over Australia, but still reach values ranging from 5 to 9 in the East of the country.

## 3 CONCLUSIONS

The choice of different GIA models does not affect significantly VLM predictions, but has a strong impact on the estimated error rates. The error rates express the range of variability of VLM predictions given some uncertainties on a priori models accounting for the Earth's rheology and the evolution of ice loads since the LGM. In the main manuscript, we choose the upper-bound approach: it maximises the error rates to isolate the most significant residual signals. A better knowledge of regional GIA patterns may help to better constrain the sources of VLM in North America and in Europe and eventually to isolate significant residual VLM in these regions.

## REFERENCES

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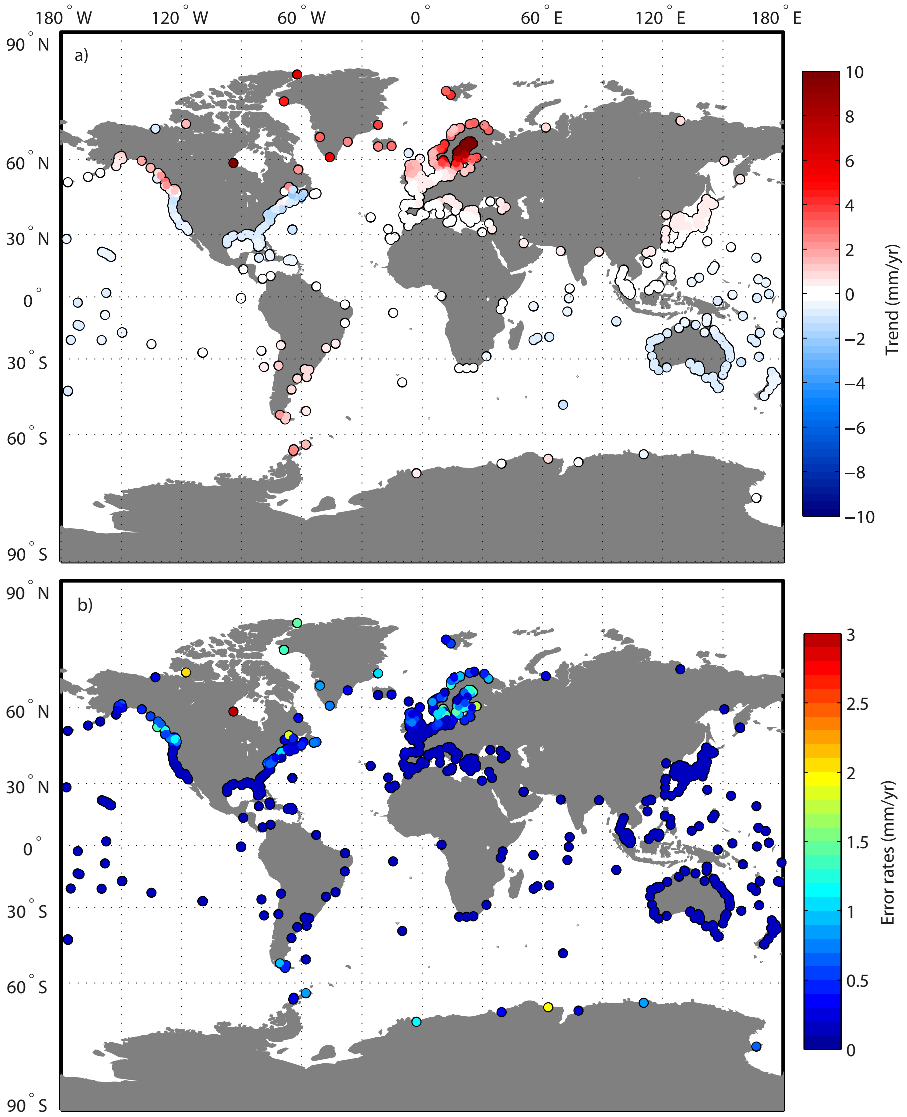


**Figure 1.** VLM predictions: trend (a) and error rates (b).

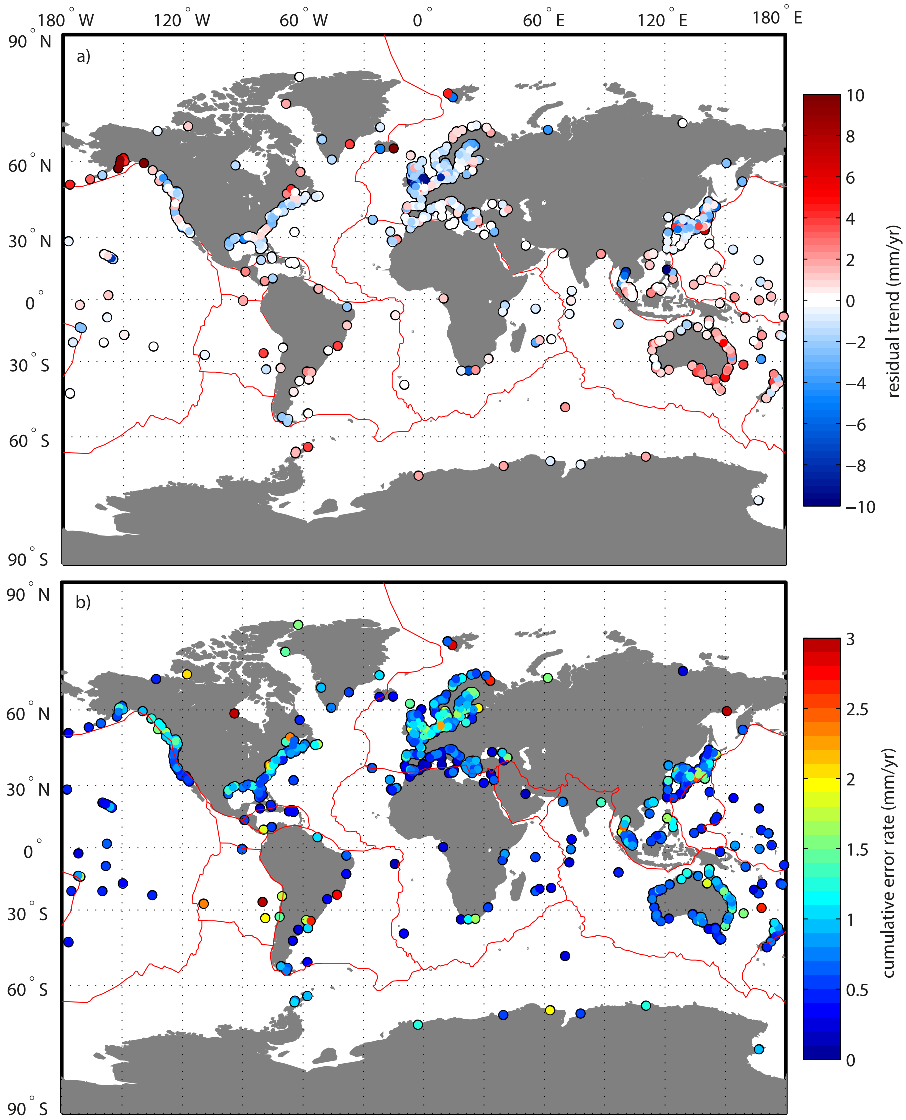


**Figure 2.** Difference between VLM observations and predictions: residual trends (a) and cumulative error rates (b).

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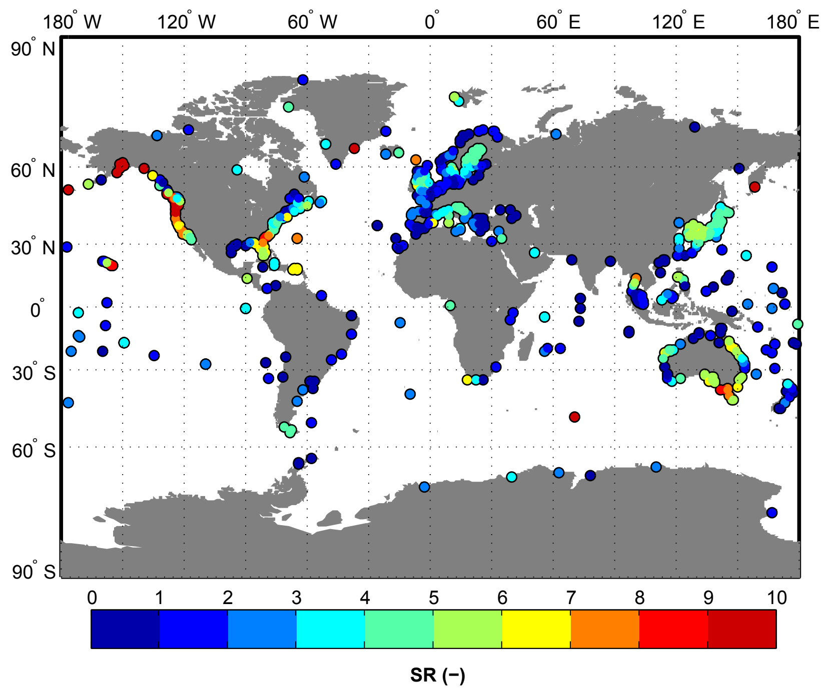


**Figure 3.** Non-dimentional significance ratio (SR).