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Predictions of the Vertical Land Motions (VLM) due to the Present-Day Ice Mass (PDIM) changes for each glaciated region

This supplementary material shows the predicted VLM due to PDIM changes over each glaciated region. Please note that the colour scale changes for each map to fit the signal range.

1 VLM PREDICTIONS DUE TO PDIM CHANGES

In Greenland, Alaska and Canada, the main contributor to the predicted VLM is the elastic rebound associated with the PDIM changes. The PDIM changes encountered over these 3 regions explain 89 % of the variance of the total predicted signal (R^2 = 0.89, Figure 1a). Considering just the PDIM changes over Greenland, the predicted uplift can reach 2 mm/yr. Because the ice-melt rate is large (142 +/- 49 Gt/yr), significant uplift (> 1 mm/yr) is predicted at large distances ($\leq$ 1500 km) from the ice sheet. Subsidence (0.2 mm/yr) is predicted in the far field (at 15 000 km from the ice sheet) due to the elastic flexure of the lithosphere. The PDIM changes in Alaska generates significant uplifts (ranging from 0.5 to 1.9 mm/yr) at large distances ($\leq$ 700 km) from the glaciers. The melt of the Canadian glaciers also produces uplifts ranging from 0.1 to 0.9 mm/yr over a large region extending from the Alaska to the Arctic. Elsewhere, predicted VLM can be significant, but only in the direct vicinity of the glaciers. For example, significant uplift rates (up to 1.8 mm/yr) are predicted in Svalbard, but sole two stations are significantly affected. The predicted VLM over Antarctica are small ($\leq$ 0.35 mm/yr), due to the lack of stations in this region. At global scale, the effects of PDIM changes on predicted VLM are limited from -0.3 to 2.7 mm/yr, because there is few monitoring stations in the vicinity of the glaciers (Figure 2 in the main manuscript).

2 UNCERTAINTY ON THE PDIM CHANGES

The errors on predicted VLM are significant (up to 0.8 mm/yr), which is linearly due to the uncertainty on the PDIM changes. Large error rates are exhibited for Greenland and Antarctica (Table 2 in the main manuscript) because (i) the ice-melt rate is not linear over the period studied (1992-2011) and (ii) there are discrepancies between the various methods of observations. The error rates on predicted VLM (up to 0.7 mm/yr for Greenland and 0.3 mm/yr for Antarctica) take these uncertainties into account. For smaller glaciers, the uncertainty on the PDIM changes may be underestimated because they are representative of a shorter period of time (2003-2009). One should be extremely careful when interpreting the vertical deformation observed over Alaska and western Canada, because large uncertainties (possibly reaching 1 mm/yr) may be encountered over these regions due to unaccounted effects of the PDIM changes. For these near-field sites, PDIM predictions would probably benefit smaller-scale regional modelling. For the large majority of stations considered, the effects of PDIM changes are however predicted with enough accuracy (a few 0.1 mm/yr at most), considering the range of the observed VLM signal (+/- 15 mm/yr in Figure 3 in the main manuscript) and the VLM signal expected from other geophysical effects (Table 4).

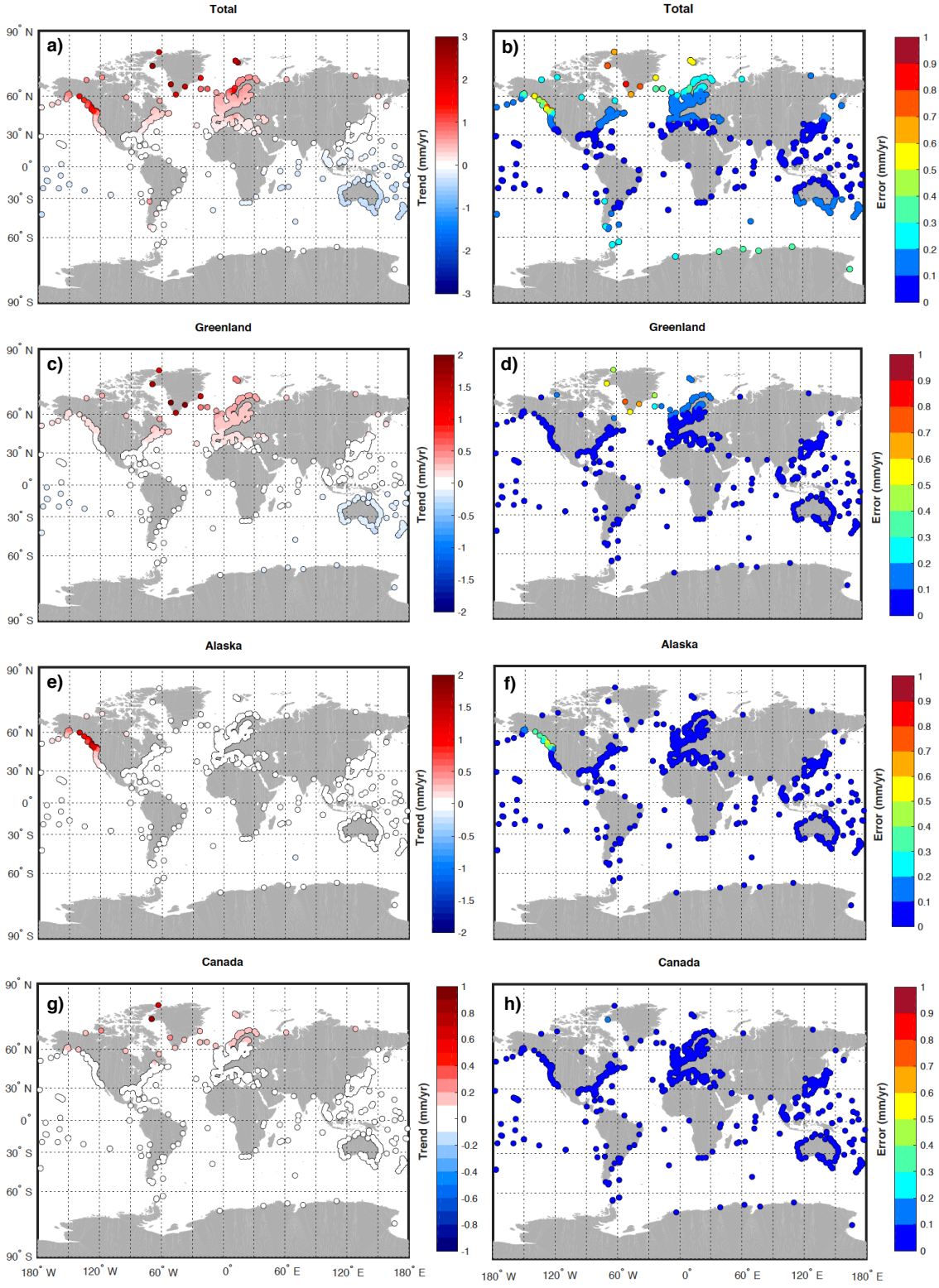

Figure 1. VLM predictions due to the PDIM changes estimated for the sum of all glaciated regions (a-trend and b-error rates) and for Greenland (b-trend and c-error rates), Alaska (d-trend and e-error rates) and Canada (f-trend and g-error rates) individually.

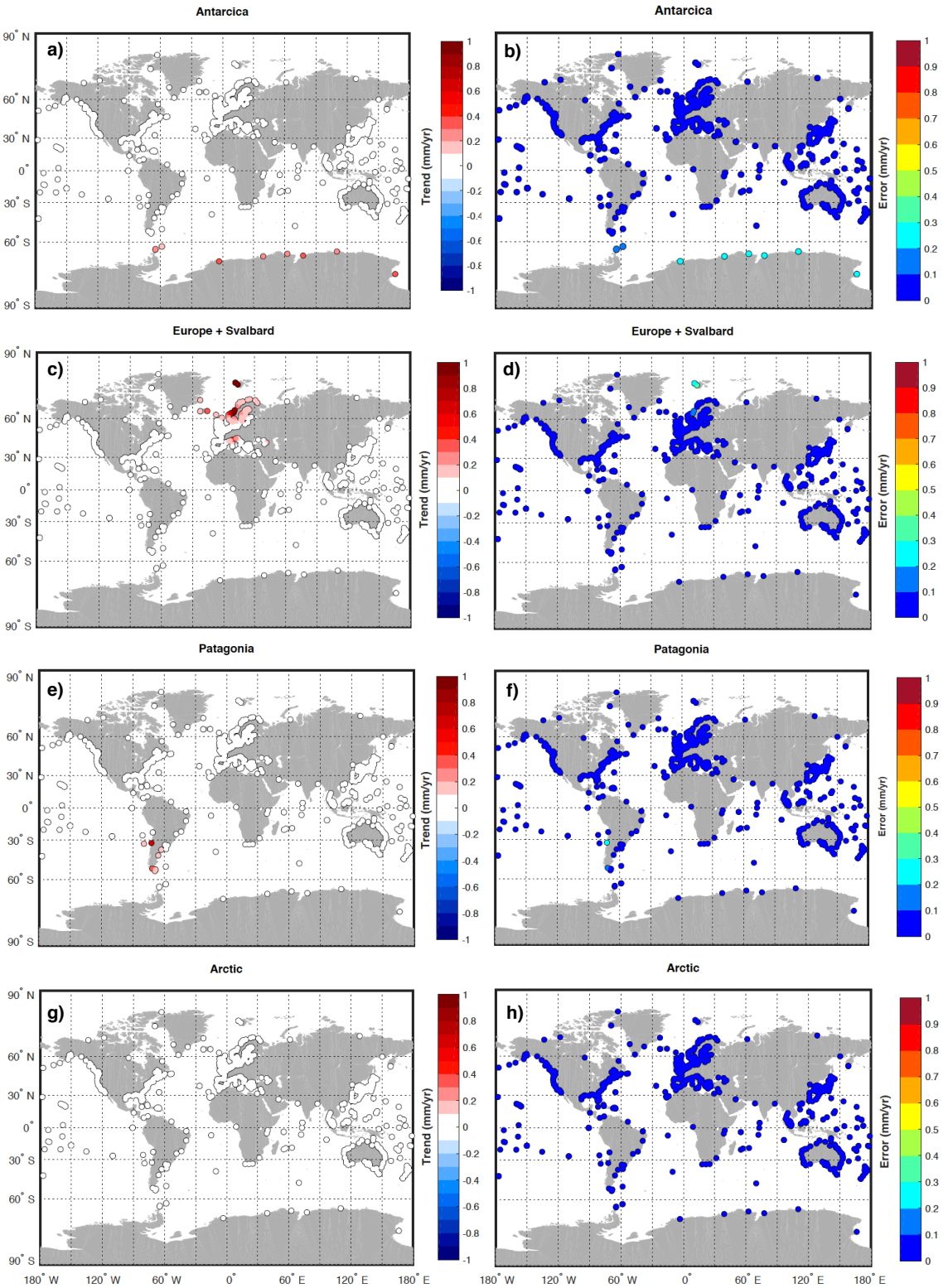

Figure 2. VLM predictions due to the PDIM changes estimated over Antarctica (a-trend and b-error rates), Europe and Svalbard (b-trend and c-error rates), Patagonia (d-trend and e-error rates) and Arctic (f-trend and g-error rates).