Geophysical Research Abstracts, Vol. 9, 03694, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03694

Isolating the PGR signal in the GRACE data: impact on mass balance estimates in Antarctica and Greenland.

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Redistribution of mass over the Earth and within the mantle changes the gravity field whose variations are monitored at high spatial resolution by the presently flying GRACE space gravity mission from NASA or, at longer wavelengths, by the SLR (Satellite Laser Ranging) constellation. GRACE data allow in principle to study the time evolution of Earth phenomena through their gravitational effects. The correct identification of the gravitational spatial and temporal fingerprints of the individual hydrologic, atmospheric, oceanographic and solid Earth phenomena is thus extremely important, but also not trivial. In particular, it has been widely recognized that the gravitational estimates of present day ice mass loss in Greenland and Antarctica, and the related effect on sea level changes, depend on an accurate determination of the Post Glacial Rebound after Pleistocene deglaciation, and this in turn depends on the assumed solid Earth parameters and the deglaciation model. We investigate here the effect of the uncertainty of the solid Earth parameters (viscosity, litospheric thickness) and of different deglaciation models on the PGR in Greenland and Antarctica. We find that realistic constraints to the trend in ice mass loss derived from GRACE data determine a range of variation substantially wider than commonly stated, namely ranging from an important ice loss of -210 Gt/yr to an accumulation of +81 Gt/yr in Antarctica, and with Greenland loosing mass at a rate between -120 and -49 Gt/yr. However, if we adopt the set of most probable Earth parameters, we obtain definitely a substantial mass loss in both regions, -172 $\pm$39 and -99 $\pm$29 Gt/yr for Antarctica and Greenland respectively.