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Accelerated Thinning of Pine Island Glacier Between 1995 and 2006

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We have derived the acceleration in elevation change over Pine Island Drainage Basin from ERS-2 and Envisat radar altimetry. Elevation differences were found at orbit crossover points to generate time-series on the 35-day orbit repeat cycle. The difference between altitude and range, and each of the electromagnetic and tidal correction fields, were examined over the overlap period in order to ensure that both satellites were providing similar measurements. The ERS-2 dry-tropospheric correction was replaced by a new correction derived from NCEP, because the ERS-2 correction was found to be inconsistent with both the Envisat correction and the ECMWF and NCEP pressure fields. Each time-series was then individually cross calibrated between the two satellites and edited to remove outlying data to produce continuous time-series over the period 1995 to 2006. We then fitted, using the Levenberg Marquardt method, a model (Equation 1) to each time-series and derived the acceleration from the second derivative of the polynomial part of the model. Δe is the elevation difference from a reference cycle at a crossover location, and t is time.

$$\Delta e = \alpha_1 \cos(\alpha_2 t + \alpha_3) + \alpha_4 t^2 + \alpha_5 t + \alpha_6 \quad (1)$$

The main trunk of Pine Island Glacier is showing accelerated thinning, and thinning in the largest tributary to Pine Island Glacier is now measurable. Thinning is now contributing to mass loss that is approximately 8 percent of the mass lost through the grounding line. Accelerated thinning is spatially correlated with InSar ice flow velocity measurements in the main trunk and the tributaries to the South of the main

trunk of the glacier. The implication of this is that the acceleration is due to dynamical changes in the flow. Accelerated thinning suggests that the events taking place at Pine Island Glacier are due to an ongoing, external forcing. If the acceleration continues at its present rate, the main trunk of PIG will be afloat in less than 150 years.