THE EFFECT OF ANTARCTIC ICE MASS CHANGES ON CRUSTAl . MOTION AND GLOBAL GEODETIC OBSERVABLES

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Glaciological estimates of the present-day ice mass balance of Antarctica vary widely, indicating the need for additional data to constrain mass-balance models. For example, recent studies find both a positive mass balance (up to 1.1 mm/a equivalent sea-level fall [Bentley and Giovinetto, 1991]) and a negative mass balance (up to 1.3 mm/a equivalent sea-level rise [Jacobs et al., 1992]) of the Antarctic ice sheet. The elastic crustal response to 4 realistic, but contrasting, scenarios of present-day Antarctic ice mass change constructed from these studies shows peak vertical rates less than 10 mm/a, and with one exception, less than 5 mm/a. In comparison, the ICE-3G glacial rebound model of Tushingham and Peltier [1991], which features substantial ice mass loss (equivalent to ~25 m sea-level rise) between 9 ka and 4 ka, yields peak rates well in excess of 20 mm/a. If deglaciation begins 3 ka earlier, peak rates still attain values in excess of 15 mm/a, This suggests that observations of present-day crustal motion in Antarctica, such as could be obtained from a future GPS survey, could assist in placing constraints on the timing and magnitude of deglaciation. Sites in the trans-Antarctic Mntns would be well situated to test some deglaciation models. In interpreting these observations, however, it may be necessary at some sites to consider the effect of inter-annual and seasonal variations in precipitation, as these variations could potentially lead to vertical crustal motions of the order of a few mm. In contrast to the rather small crustal velocities found for most of the present-day scenarios, the predicted secular variation in the zonal harmonics and drift of the Earth's rotation axis are found to be substantial fractions of the observed rates, in agreement with earlier studies. Present-day ice mass changes must be included when constructing budgets for these global geodetic observable.