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Indications of Acceleration in Glacier Melting: Recent Changes in the Dynamic Oblateness (J2) of the Earth's Gravity Field

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Earth's dynamic oblateness (J2) has been decreasing due to post-glacial rebound (PGR). However, an increase began in 1997 (Cox and Chao, Science, 2002) indicating a pronounced change in global-scale mass redistribution processes. Dickey et al. (Science, 2002) found that the observed increases in J2 were caused primarily by a surge in sub-polar glacial melting and mass shifts in the Southern Pacific, and Indian Oceans. Recently, the geodetic J2 series has been decreasing rather than increasing, which motivates further study. Data series have been extended, in particular ocean loading derived from ECCO bottom pressures and hydrology (Milly, pers. comm.). The sums of the glacial, oceanic, atmospheric and continental hydrological contributions to J2 are compared with geodetic observations (Cox and Chao, 2002; Cox, pers. comm., 2003). The modeled excitation captures the rise of J2 in the late 1990's as well as its subsequent decrease, even though J2 contributions due to glacial melting maintain a positive slope. Thus it is not necessary for the glaciers to switch to a net positive mass-balance, in order to match the decrease in the observed J2. Special emphasis will be placed on the recent glacier results and the impact of their geographical distribution.