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The impact of the annual hydrological cycle on tide gauge data

M. E. Tamisiea (1), E. M. Hill (2), R. M. Ponte (3) and J. L. Davis (2)

(1) Proudman Oceanographic Laboratory (mtam@pol.ac.uk), (2) Harvard-Smithsonian Center of Astrophysics (ehill@cfa.harvard,edu, jdavis@cfa.harvard.edu), (3) Atmospheric and Environmental Research, Inc. (rponte@aer.com)

While tide gauge (TG) data are often used to determine long-term variations in sea level, shorter-term variability in the data can make interpretation difficult. Hill et al., 2007, demonstrated that sea-level time series based upon a global ocean model and the static inverted barometer effect significantly reduce the observed variability at TG stations. However, the residual time series at many stations contain an annual signal. One possible non-oceanographic mechanism for an annual signal is the crustal motion and gravitational changes caused by continental water storage. Previous studies have shown that the mass exchange between the oceans and the continents is primarily responsible for the non-steric, globally-averaged, annual sea-level change. Large geographic variations in this annual signal will result, however, due to the relative phase between the globally-averaged cycle and the local water storage. When the increase in the mean ocean water volume is in phase with the local water storage on land, the amplitude of the sea-level cycle observed at TG stations can be as large as 20 mm. While the magnitude of this water-storage signal is not large enough to account for the majority of the residual signal in the Hill et al. analysis, it demonstrates the importance of accounting for non-oceanographic variations prior to assimilating TG data into ocean models.