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Impact of Modelling Improvements on POD for TOPEX/Poseidon and Jason

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The TOPEX/Poseidon and Jason-1 now provide an invaluable time series of 16 years to analyze synoptically changes in the state of the oceans. One of the most challenging applications of altimeter data from these missions is the determination of global mean sea level. Many factors intervene in this calculation, and an extreme stability of the entire altimeter measurement system is required to obtain a reliable estimate of the global rate of change of mean sea level. The stability of the satellite orbits, and the reference frame within which the geodetic measurements are situated directly map into the global MSL rate estimate. The global uncertainty includes about 0.4 mm/year from the uncertainty in the knowledge of vertical motion at the tide gauge sites (Mitchum, 2000), and about 0.3 mm/year due to the uncertainty in the ITRF (Beckley et al., 2007). In this paper we examine the impact of several effects on the mean sea level orbit time series not presently included in the present-day POD analyses and ascertain what their impact would be on MSL rate determination: (1) Direct forward modelling of the Center-of-Mass variations (2) Modelling of secular changes in the Earth gravity (other than the zonal terms already included in the static field); (3) Modelling of atmospheric loading at the geodetic sites. We quantify the impact on the orbits, the data residuals, and the mean sea level rate.