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An Integrated Study of Sea Level Change Using Altimetry, Gravity, and In Situ Measurements

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The TOPEX/Poseidon (T/P) and Jason satellite altimeter missions have provided a 12-year record of sea level change, which show an increase of global mean sea level of 2.8 +/- 0.4 mm/year, with considerable geographic variation. An important question for climate studies is to determine the cause of this change - specifically how much of the change is due to steric (heating) versus eustatic (runoff, melting ice, etc.) contributions? One method for answering this question is to analyze ocean temperature measurements to estimate the steric contribution, which when differenced with the altimetry leaves the eustatic component. These studies suggest that the steric and eustatic contributions are roughly equal over the last decade. The launch of the GRACE satellite gravity mission in 2002 now provides a method to directly measure the eustatic contribution through the changes it causes in the Earth's gravity field. GRACE measurements of monthly eustatic variations over the ocean are balanced by changes over the land that GRACE also measures, thus the GRACE dataset provides a unique opportunity to interpret global sea level variations in the context of the global water cycle. Current efforts have focused on interpreting the annual signals, but the analysis of interannual and secular variations is also being attempted. We will review the latest results from T/P, Jason, GRACE, and the in situ measurements, and place them in context with an overall evaluation of our current knowledge of sea level change in the altimetric era, and how this relates to changes in water storage over the continents.