Understanding Sea Level Variations from Space Geodetic Measurements and Global Geophysical Fluid Modeling

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Today more than 100 million people worldwide live on coastlines within one meter of mean sea level; any short-term or long-term sea level change relative to vertical ground motion is of great societal and economic concern. As paleo-environment and historical data have clearly indicated the existence and prevalence of such changes in the past, new scientific information regarding to the nature and causes and a prediction capability are of utmost importance for the future. The 10-20 cm global sea-level rise recorded over the last century has been broadly attributed to two effects: (1) the steric effect (thermal expansion and salinity-density compensation of sea water) following global climate; (2) mass-budget changes due to a number of competing geophysical and hydrological processes in the Earth-atmosphere-hydrosphere-cryosphere system, including water exchange from polar ice sheets and mountain glaciers to the ocean, atmospheric water vapor and land hydrological variations, and anthropogenic effects such as water impoundment in artificial reservoirs and extraction of groundwater, all superimposed on the vertical motions of solid Earth due to tectonics, rebound of the mantle from past and present deglaciation, and other local ground motions. As remote-sensing tools, a number of space geodetic measurements of sea surface topography (e.g., TOPEX/Poseidon, Jason), ice mass (e.g., ICESat), time-variable gravity (e.g. GRACE), and ground motions (SLR, VLBI, GPS, InSAR, Laser altimetry, etc.) become directly relevant. The strive to the goal of understanding sea level changes "anywhere, anytime" in a well-defined terrestrial reference frame in terms of climate change and interactions among ice masses, oceans, and the solid Earth, and being able to predict them.