Coastal land change due to tectonic processes and implications for relative sea-Level rise in the Samoan Islands

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November 24, 2022

Abstract

Of the major coastal land change mechanisms responsible for relative sea-level change, tectonic subsidence is generally quoted as ranging from < mm/yr to 1 cm/yr. However, we documented coseismic and ongoing post-earthquake surface displacements from continuous GPS and tide gauge/altimetry data that indicated rapid subsidence on two of the major Samoan Islands of 12 - 20 cm during and following the 8.1 2009 Tonga-Samoa earthquake. Earlier results and our modeling of GRACE-derived gravimetric data provided a preliminary forecast of future relative sea-level rise through rapid land subsidence [Han et al., 2019]. Of course these numerical forecasts of time-dependent deformation are only as good as our input observations and our assumed rheological models. As part of our current NASA Earth Surface and Interior study, we are obtaining a wider range of data to constrain and test alternate models of ongoing postseismic deformation across American Samoa and Upolu, Samoa: (1) times series of altimetry plus tide gauge data processed to complement the cGPS data available to provide high-temporal resolution, point measurements of uplift/subsidence, (2) InSAR derived observations of surface deformation across the highly vegetated Samoan Islands, (3) evaluating and using NASA satellite lidar data (ICESat-I & ICESat-II, GEDI) for fusion with multi-source topographic data sets and for estimating topographic change on the decadal time scale. We are evaluating and using these new observations to better understand and separate out local, island-wide, and multi-island subsidence patterns and to evaluate the high impact of rising sea-level in a tectonically active region.

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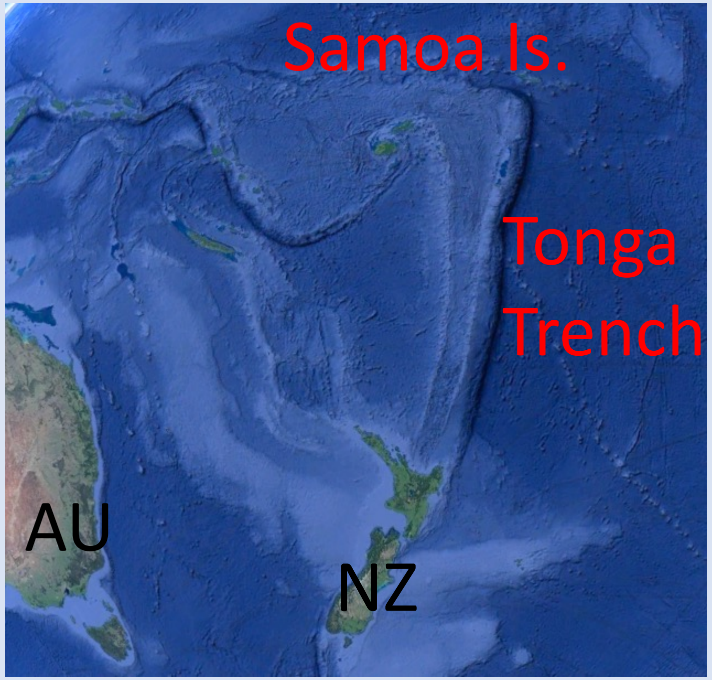
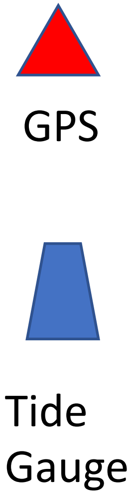
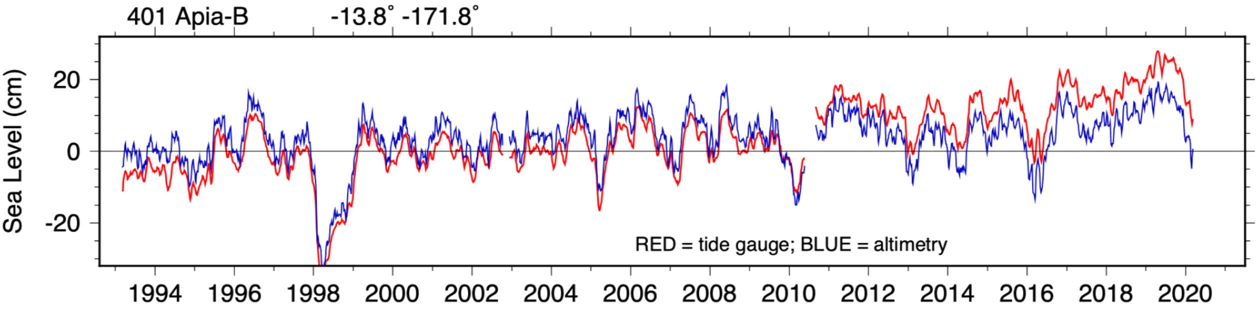
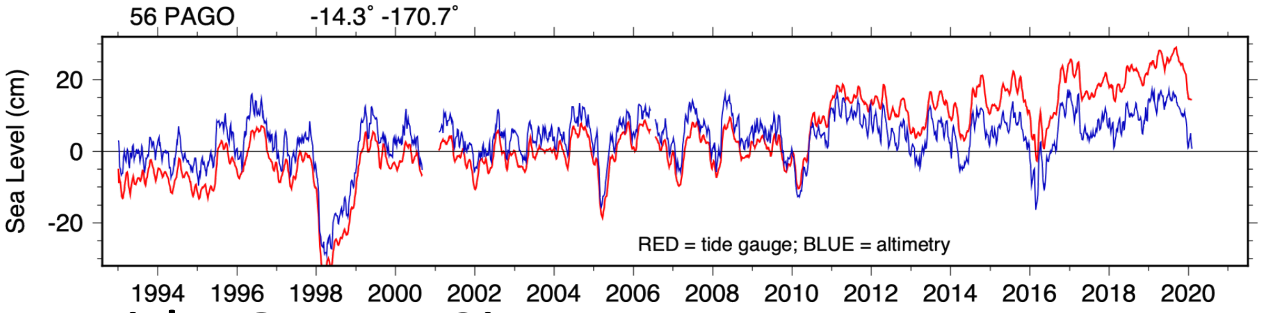


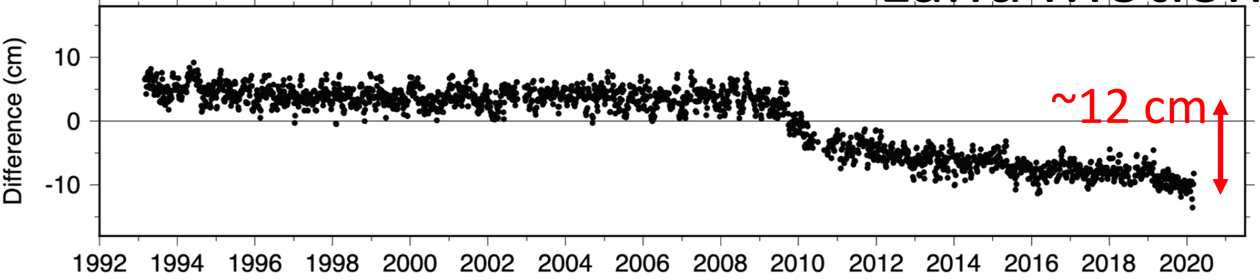
How much is the sea-level rising versus the land subsiding?

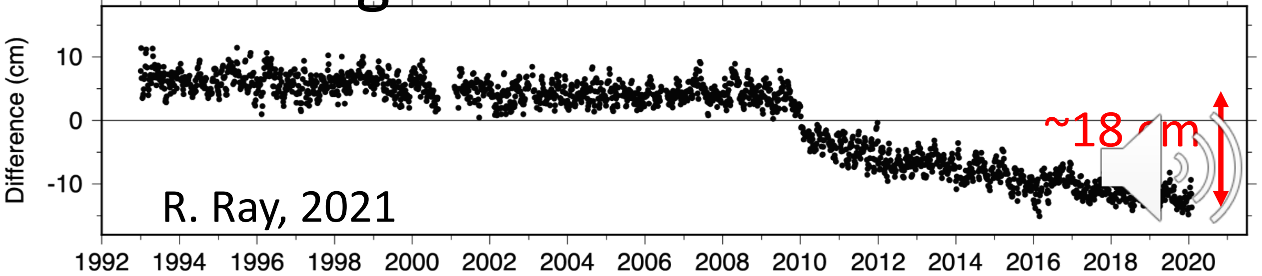




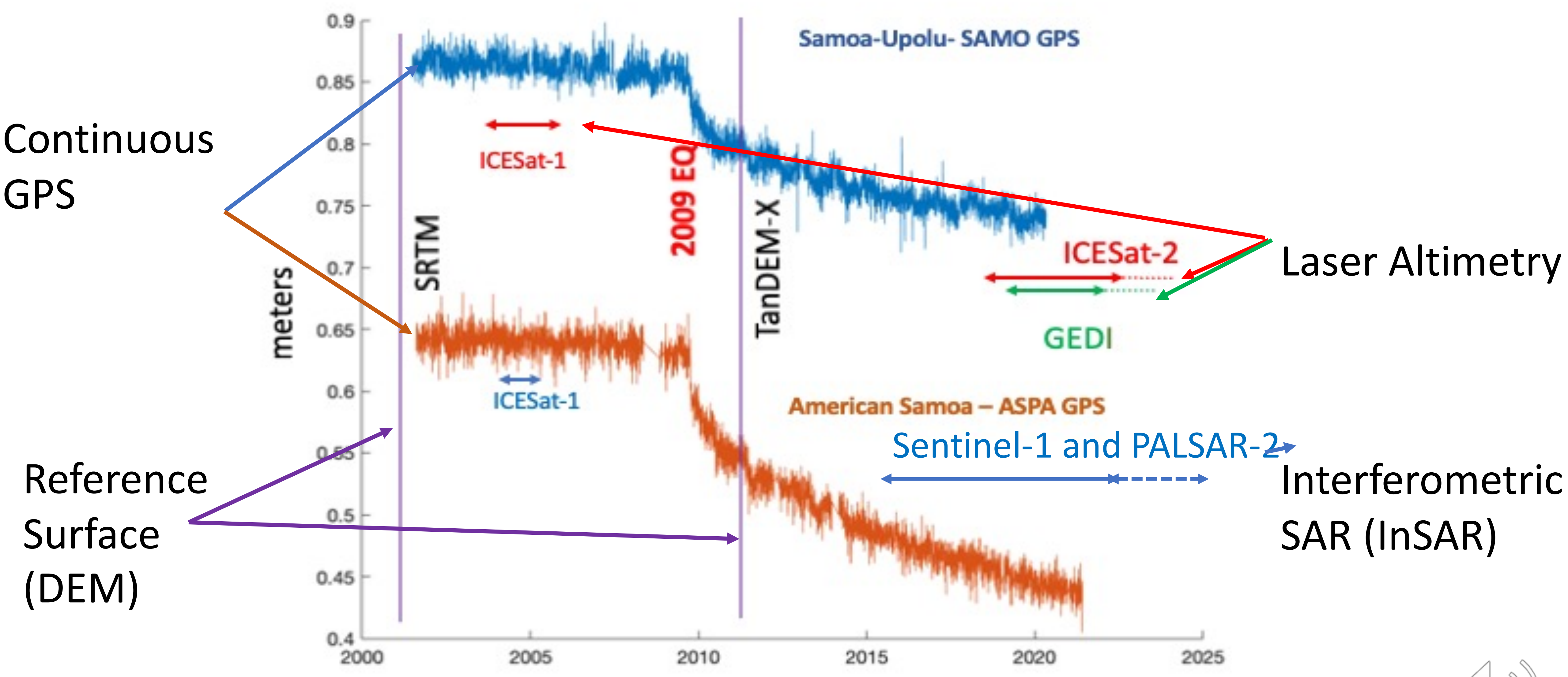


Land Motion at Tide Gauge Site

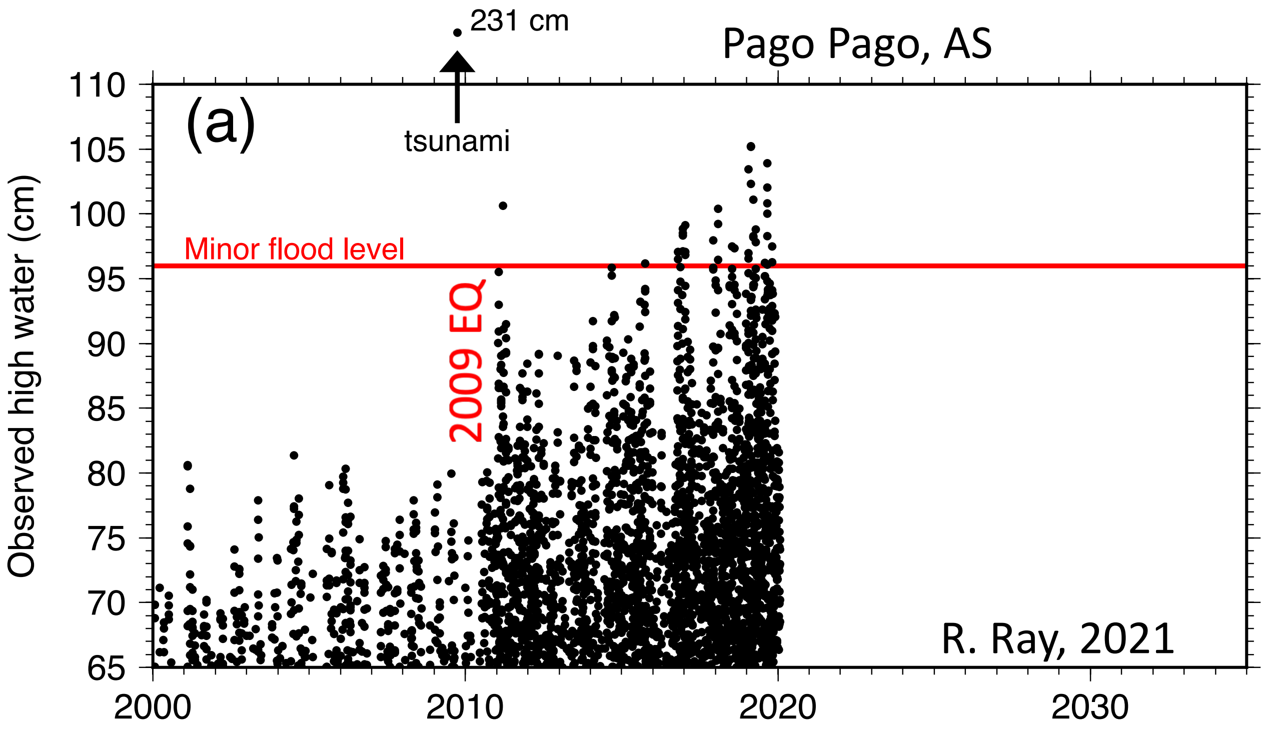




Constraining the temporal and spatial variability of land motion component of RSL



Accounting for land motion has practical consequences:



Minor flooding level surpassed

Observed high water levels at Pago Pago harbor relative to mean sea level (1983-2001).

Highway shore protection, Tutuilla, AS

Questions?

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