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Examining spatial variability in relative sea-level in the New York City/New Jersey region during the Common Era

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Relative sea-level (RSL) reconstructions extend the 20th century instrumental record (tide gauge and satellite measurements) of spatial and temporal sea-level variability to provide a much longer context for recent trends and projected RSL rise. Common Era (last 2000 years) RSL reconstructions illustrate patterns of natural variability and include natural phases of climate and sea-level which will improve our knowledge basis for sea-level responses to climate changes.

The northeast U.S. has exhibited varying rates in relative sea-level rise through the Common Era, primarily due to glacial isostatic adjustment. However, other factors such as ocean/atmosphere dynamics, sediment compaction, and the static equilibrium response to land ice changes, further influence the evolution of relative sea-level. The spatial variability is manifest in the tide gauge records. The tide gauge at the Battery, New York City (1856 to 2015) records a relative sea-level rise of 2.8 mm/yr whereas the tide gauge at Sandy Hook, New Jersey (1932 to 2015), 25 km southeast, records 4.1 mm/yr.

Here we present a new reconstruction of RSL in northern New Jersey using geological and tide gauge data. A Common Era sea-level record from northern New Jersey fills in the spatial gap between records completed in southern New Jersey, New York City, and Connecticut. Our field study site is in Cheesequake State Park, where we observed sedimentary sequences dating back 2000 cal. yrs. BP. We use microfossil indicators preserved in salt-marsh sediments as a proxy to reconstruct RSL with decimeter precision. Salt-marsh foraminifera act as reliable RSL indicators because their modern distribution is strongly linked to tidal elevation. The recent application of microfossil-based transfer functions has enabled continuous records of RSL, extending centuries before the modern instrumental period, to be produced with a full consideration of uncertainty. We use a composite chronology of AMS 14C, pollen chrono-horizons, pollution histories, and a 137Cs spike (AD 1963) to achieve multi-decadal temporal precision. The RSL record for northern New Jersey shows a 2.4 m rise during the past 2000 years at a mean rate of $\sim$1.2 mm/yr. This compares to rates from a database of Holocene relative sea-level observations for the U.S. Atlantic coast which found a rise of $\sim$1.4 mm/yr for New Jersey and $\sim$1.3 mm/yr for New York from 4 ka BP to AD 1900 (Engelhart and Horton, 2012).