Massie

USGS
science for a changing world

Prepared in cooperation with the Department of the Interior Southeast Climate Science Center

Sea-Level Rise Modeling Handbook: Resource Guide for Coastal Land Managers, Engineers, and Scientists

Professional Paper 1815

U.S. Department of the Interior
U.S. Geological Survey

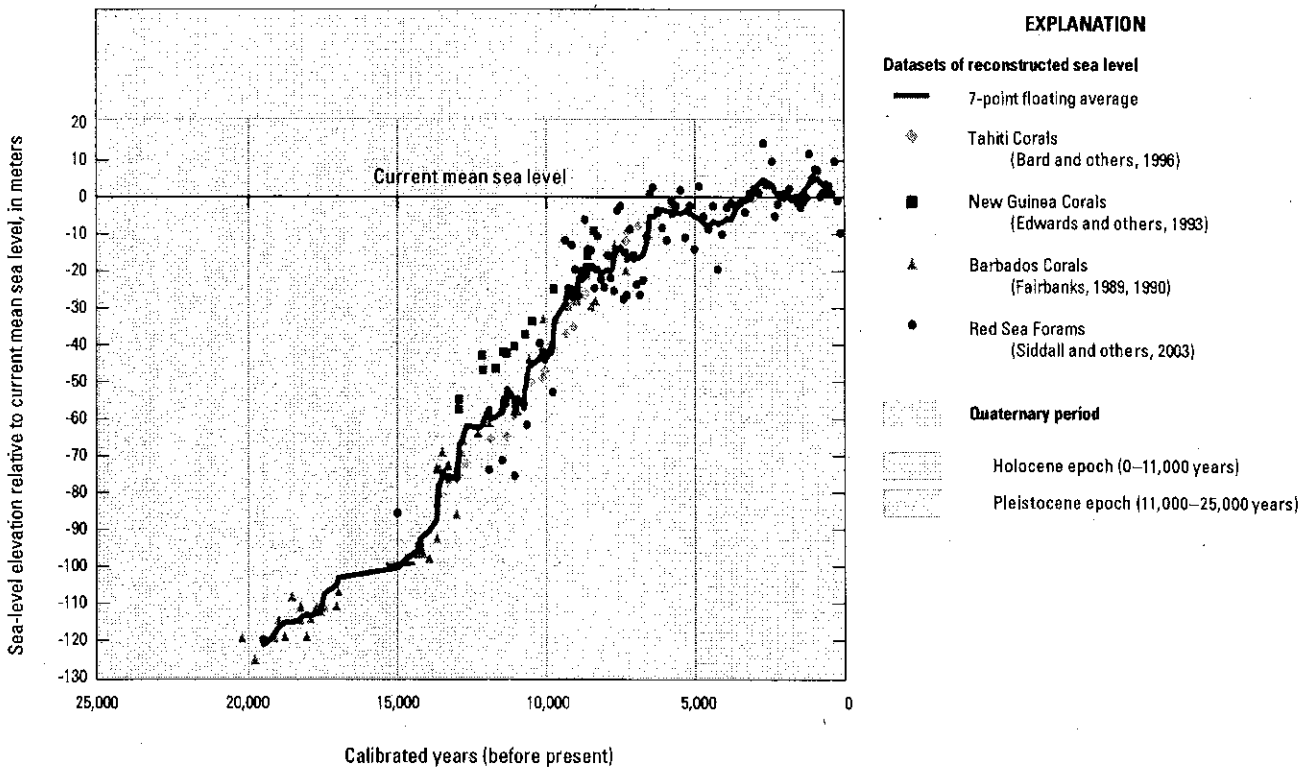

Figure 4. Holocene and Pleistocene sea-level reconstruction from composite studies and fossil dates illustrating a general sea-level curve that is more or less universally accepted and applicable worldwide (modified from Balsillie and Donoghue, 2004; used with permission).

88), are commonly used and referenced to assign a location and elevation, respectively, that are not interchangeable but can be easily rectified to one or the other by use of conversion software. Satellite navigation systems are likewise based on geoid and ellipsoid models of space that can be expressed or converted to a specified datum. The distinction of datums is an important aspect of all of the different kinds of models of land and water that will be discussed hereafter in this handbook.

Modeling sea-level rise is a challenge because both the land and sea are moving vertically and differentially by location, spatially and temporally. We easily envision how the ocean moves with the ebb and flow of tides, but it is more difficult to observe how the ground beneath our feet moves on a daily or seasonal basis or laterally in geological time. Land and sea motion together account for the relative sea-level rate at a given coastal location. While ocean volume (eustasy) is currently increasing and sea level is rising on a global scale, some coastal environments and communities are actually experiencing uplift of land surface (for example, in the Pacific Northwest) and drop in sea level both locally and regionally.

To effectively model the process and impacts of sea-level rise, models of both land surface and sea surface are required. Land surface and sea floors are measured and referenced differently, but all are part of the same landform that is covered or exposed with rising and falling sea levels spatially and temporally. The use of geodetic networks and tidal benchmarks provides a basis for referencing height or depth in relation to the sea surface. The intersection of land and sea may appear obvious (such as a beach), but it is much more difficult to ascertain when, where, and how much flooding occurs in and across the intertidal zone with the changing tide. This intertidal zone is where tide gages are so important and why the data are so valuable. Tide gage observations are used to predict tide behavior, to establish tidal datums of the different tide phases, and to determine mean sea level for a period of record. Predictive tide models require this information to reliably predict the astronomical timing and height of low and high tides. Tidal datums are also important for boundary determinations of private and public land, navigational aids and infrastructure, coastal development ordinances, and other political and economic uses.

A number of factors control the types and range of tides for a given coastal reach, and these factors are important for sea-level rise models and applications. First and foremost, every coastal reach has a unique tidal behavior and magnitude that are taken into account in more robust sea-level rise