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Sea Level Rise für the U.S. West Coast

SEA LEVEL RISE FOR THE U.S. WEST COAST

Robert A. Dalrymple[1] and NRC Committee[2]

This paper presents the results of a National Research Council study on present and future sea levels for California, Oregon, and Washington, carried out in 2011. The committee of twelve scientists and one engineer studied historical and existing sea levels there and made projections of global and regional sea levels to the year 2100.

After the publication of the Intergovernmental Panel on Climate Change report in 2007, Governor Arnold Schwartzenegger issued an Executive Order that agencies of the State of California plan for future sea level rise and that a committee of the National Research Council be formed to provide estimates of the potential sea level rise for three different future times: 2030, 2050, and 2010. Ultimately 10 state (5 in California, one each for Oregon and Washington) and 3 federal agencies (NOAA, U.S. Geological Survey, and the U.S. Army Corps of Engineers) participated in funding the project. The following will review the findings of the committee, including global and regional projections.

The major contributors to sea level rise are thermosteric sea level rise due to the warming of the oceans (and concomitant expansion of water) and the melting of land ice, including ice sheets, ice caps, and glaciers. While the Intergovernmental Panel on Climate Change in 2007 believed that the contributions of these two effects were equal, currently ice melt plays a much larger role in rising sea levels. Other factors, such as water storage/extraction and changing meteorological phenomena (El Niño, La Niña), play smaller roles.

There are two measures of sea level rise: the first is the global sea level, which is primarily due to the change in volume of water that comprises the oceans, and the second also includes the vertical movement of the land with respect to that of the oceans. This latter measure is the relative (or local) sea level rise and it is the one that is of vital importance to coastal planners.

Globally there are thousands of tide gages to measure the change in water level many times a day. The best of this data, with reasonable record lengths, have been used by a number of researchers to determine the global sea level rise. However, tide gages also record the local vertical land motion, a signal that then has to be removed from the tidal record. Further tide gages are associated primarily with coast lines, with only a few gages located on islands in mid-ocean. Another tool, satellite altimeters, available nearly 20 years, provides synoptic global coverage of sea level.

For the west coast, the geology varies dramatically from southern California to Washington, with differing tectonic behavior. In Oregon and Washington, plate tectonics are causing the land to rise, as the North American plate flexes as the Juan de Fuca tries to go under it. This vertical land movement is on the order of 1-3 mm/year. Unfortunately a major earthquake will cause a nearly instantaneous drop of the land of 1-2 m, equivalent to more than 100 years of sea level rise.

Water melting from large ice masses is not evenly distributed around the globe. Due to the large, but decreasing, mass of ice, sea level near the ice, which was elevated due to the gravitational attraction of the ice, falls locally, while it is becomes higher elsewhere. This gravitational effect on

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the melt water is referred to sea-level fingerprint due to modern ice melt and we included this effect in our computations of west coast sea level rise.

At the end of the presentation, the predictions from the committee will be presented. These predictions use GCM predictions for various greenhouse gas scenarios for the thermosteric effect, and recent ice data is used to make prediction into the future (with ice dynamics). Sea-level fingerprinting will be applied for nearby Alaskan glaciers and Greenland and Antarctic Ice Sheets. Regional differences in local sea level will be discussed.

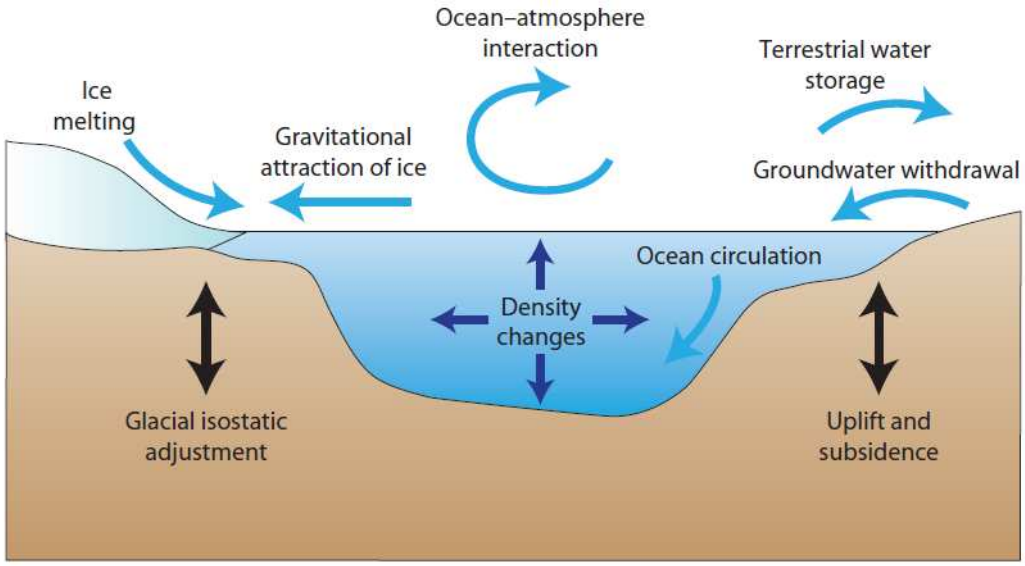

Figure 1 Processes involved in global and local sea level rise. (Modified from Milne et al., 2009)

REFERENCES

Milne, G.A., W.R. Gehrels, C.W. Hughes, and M.E. Tamisiea (2009) "Identifying the Causes of Sea-level Change, Nature Geoscience, Vol. 2, pp. 471-478.

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