Sea-Level Rise for the Coasts of California, Oregon, and Washington:

Past, Present, and Future

Committee on Sea Level Rise in California, Oregon, and Washington

Board on Earth Sciences and Resources and Ocean Studies Board

Division on Earth and Life Studies

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Mendocino, the committee projects that sea level will rise 4–30 cm by 2030 relative to 2000, 12–61 cm by 2050, and 42–167 cm by 2100. For the Washington, Oregon, and California coasts north of Cape Mendocino, sea level is projected to change between -4 cm (sea-level fall) and +23 cm by 2030, -3 cm and +48 cm by 2050, and 10–143 cm by 2100. Major sources of uncertainty in the regional projections are related to assumptions about future ice losses and a constant rate of vertical land motion over the projection period. Uncertainties are larger for the regional projections than for the global projections because more components are considered and because uncertainties in the steric and ocean dynamic components are larger at a regional scale than at a global scale.

The combination of land uplift and gravitational and deformational effects reduces the threat of future sea-level rise for Washington and Oregon. However, the land is rising along the Washington and Oregon coasts likely because interseismic strain is building in the Cascadia Subduction Zone. A great earthquake (magnitude larger than 8), which has occurred in the area every few hundred to 1,000 years, would cause some coastal areas to immediately subside and relative sea level to suddenly rise. If this occurs, relative sea level could rise an additional meter or more over projected levels.

The committee's projections for the California coast are slightly higher than its global projections, primarily because much of the coastline is subsiding. The California projections are somewhat lower but have wider ranges than the Vermeer and Rahmstorf (2009) global projections, which are being used by California on an interim basis for coastal planning.

The projections of future sea-level rise have large uncertainties resulting from an incomplete understanding of the global climate system, the inability of global climate models to accurately represent all important components of the climate system at global or regional scales, a shortage of data at the temporal and spatial scales necessary to constrain the models, and the need to make assumptions about future conditions (e.g., greenhouse gas emissions, large volcanic eruptions) that drive the climate system. As the projection period lengthens, uncertainty in the projections grows. At short timescales (2030 and perhaps 2050), when the models more closely represent the future climate system, confidence in the global and regional projections is relatively high. By 2100, however, projections made using process-based numerical models, extrapolations, and semi-empirical methods all have large uncertainties. The actual sea-level rise will almost surely fall somewhere within the wide uncertainty bounds, although the exact value cannot be specified with high confidence.

SEA-LEVEL RISE AND STORMINESS

Most of the damage along the California, Oregon, and Washington coasts is caused by storms—particularly the confluence of large waves, storm surges, and high astronomical tides during a strong El Niño. The water levels reached during these large, short-term events have exceeded mean sea levels projected for 2100, so understanding their additive effects is crucial for coastal planning.

Changes in Storm Frequency and Magnitude

Climate change has been postulated to induce changes in storm frequency, magnitude, and direction. To date, there is no consensus among climate model simulations about whether the number and severity of storms will change in the northeast Pacific. A number of climate models predict a northward shift in the North Pacific storm track over the course of the 21st century, which could lessen the impact of winter storms in southern California and possibly increase their impact in Oregon and Washington. However, these changes may not emerge for a few decades, and most observational records are not yet long enough to determine conclusively whether storm tracks are moving north.

Several observational studies have reported that the largest waves have been getting higher and that winds have been getting stronger in the northeastern Pacific over the past few decades. Interpretation of these trends is controversial because wave and wind records are short, extending back only about 35 years. At least part of the observed increase likely reflects natural climate variability of the Pacific atmosphere-ocean system, particularly the occurrence of large El Niños and interdecadal fluctuations. If some or all of the increase represents a long-term trend, the frequency and magnitude of extremely high coastal wave events will likely increase.