Introduction

The economic consequences of climate change and sea level rise have not been adequately studied. Even under conservative models for sea level rise, coastal areas can expect to see flooding increase both in severity and frequency. Moreover, areas previously immune to flooding will become vulnerable. Many urban economies in the US with coastal locations have extensive shorelines with significant concentrations of businesses. Flooding events may disrupt businesses for days to months at a time. The Center for the Blue Economy at the Middlebury Institute of International Studies investigated these economic vulnerabilities under the San Diego Regional Climate Collaborative. By modeling both the extent and the depth of flooding, the Center was able to develop a detailed economic assessment of economic disruption to economy of the ten coastal cities in San Diego County resulting from storm events under low, moderate, and high sea level rise scenarios. This work shows that significant and cumulative disruptions will occur throughout the region as sea level rises.

Methods

San Diego’s economic vulnerability to sea level rise was estimated by combining estimates of possible flooding under different climate change rates using the Coastal Storm Modeling Systems (CoSMoS) from the United States Geological Survey (USGS) with economic information at specific locations from Info-USA and from San Diego County property tax records. Estimates of flood extent and depth were made for both low intensity (storms occurring every year) and high intensity (storms occurring every 100 years). Storm intensity was combined with possible sea level rise scenarios of 1(39") and 2 (78") meters. Vulnerability was defined as a business location within the estimated flood zones. Employment and contribution to regional GDP were measured, as well as contributions to the property tax base of each of ten cities. Possible impacts to these values were estimated both with and without adjustments for the projected depth of flooding.

Economic Impacts

Vulnerabilities adjusted for projected flood depths are much smaller than unadjusted estimates, but still significant in both severe and moderate intensity storms.

**Figure 4**

**Comparison of Depth Adjusted and Unadjusted Employment Vulnerabilities by SLR Scenario and Storm Intensity**

**Figure 5**

Owing to its size, the City of San Diego is the most economically vulnerable, with the City of Chula Vista second. However, the jobs at risk would affect residents from throughout the county.

**Figure 6**

Employment vulnerabilities by industry in San Diego County (not adjusted for flood depth) in 100-year storm and 1 meter of Sea Level Rise for industries in all CoSMoS scenarios; The tourism and recreation sector is by far the most vulnerable, but the range of potentially affected industries is large.

Major Findings

- The cities of San Diego, Chula Vista, and Coronado face special risk to their tourism and recreation industries from flooding due to sea level rise.
- Flooding from 100-year storm events under a 2 meter sea level rise scenario will disrupt over 49,000 jobs, $6.1 billion in GDP, and cause at least $2.2 billion in property damage.
- With a single meter of sea level rise, 100 year storms will disrupt as many as 15,000 jobs, $1.1 billion to $2 billion in GDP.
- Although the tourism, recreation, and hospitality sectors face the greatest risk, impact will be widespread, affecting at least 16 distinct regional industries in all scenarios. Ship Building and associated businesses are particularly vulnerable.
- The largest cities (San Diego and Chula Vista) will have the highest economic vulnerability.

Discussion

Estimates of economic vulnerability have tended to focus primarily on the risks of property damage. Little attention has been paid to the effects on the functioning of regional economies. This study demonstrates that sea level rise of 1 meter (39") creates significant risks for a major urban economy. The vulnerabilities rise more than proportionately with 2 meters of SLR. Key industries such as tourism and recreation are particularly vulnerable, but scope of industries is quite broad.

The largest vulnerabilities are, not surprisingly, in the largest cities of San Diego and Chula Vista. While much attention is often directed at the vulnerabilities associated with the largest changes in sea levels and the most intense storms, this analysis indicates that the economic effects of less intense but frequent storms will do significant cumulative damage to firms and the regional economy. The real vulnerability comes not from the flood but from the recurring floods.

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