Estimating the Impact of Catastrophic Sea Level Rise in Maine

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Introduction

Global climate change is increasingly recognized as a certainty (IPCC 2001). Associated with increasing temperatures, sea levels are expected to rise as a result of thermal expansion and the melting of polar ice caps. Mean high tide is predicted to rise one meter by the end of the century (IPCC 2001). Long-term models indicate the possibility of sea level rise up to six meters (Hamilton cited in Richardson 2006). If these predictions are realized, the loss of land and the associated economic impacts will change the face of the Maine coastline. Long term financial and spatial planning will help to alleviate the impact of climate change. This study is a spatial analysis of the areas most likely to be affected by rising sea levels in Maine.

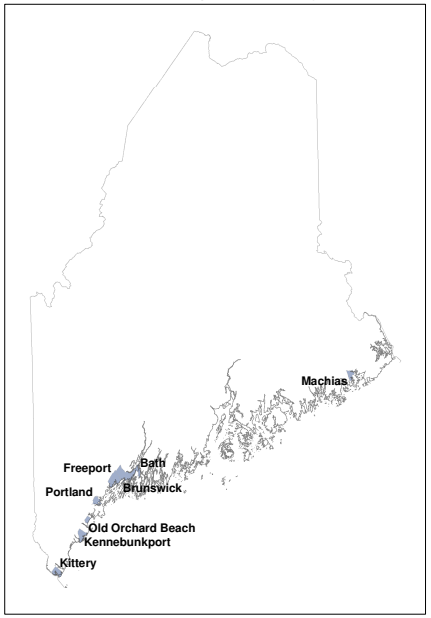
Methods

Digital Orthophoto Quadrats (DOQs) were downloaded from the Maine Office of GIS (MEOGIS) to visualize existing infrastructure in 16 Maine towns. In addition to the eight towns shown, data for Bar Harbor, Biddeford, Boothbay Harbor, Bristol, Brunswick, South West Harbor, Waldoboro, and York were included in our analysis. Data layers containing information on fire and police stations, schools, hospitals, libraries and roads were obtained from MEOGIS. Maine township data were used to determine the borders of each town. We used the mask function to identify the infrastructure located in our study sites. Digital Elevation Model (DEM) tiles of 10 or 30 meters were then downloaded, merged, and reclassified into five elevation classes: ≤0m, 0-1m, 1-6m, 6-20m, and >20m. These elevation classes represent projected sea level rise scenarios. We then determined the total amount of infrastructure located within each class. The road miles analysis was only calculated for the eight towns shown. A similar analysis was conducted for the whole coastline, however DOQs were not included.

Discussion

Maine will experience the economic impacts of sea level rise within this century. The cost of replacing coastal infrastructure as well as private property will be high. Overall, in the 1-meter scenario 3 municipal buildings and in the 6-meter 35 building were submerged. In the 16 towns analyzed, no municipal buildings included in our study were affected. In the 6-meter scenario 2 schools and libraries, 3 fire and police stations, and 1 hospital were submerged. Few roads were affected by the 1-meter scenario, with less than 4 kilometers of road damaged in each town. Within the 16 towns, the largest land loss in a 1-meter scenario was in Kennebunk, where 3.24% of the town would be inundated.

The six meter rise scenario had the largest land impact on Old Orchard Beach, where 26.45% of the land and 21.36 kilometers of road were submerged. The Maine Municipal Association performed a study estimating a cost of $25,000 to $40,000 per mile to replace coastal roads (2006). With a 1-meter rise the cost to the state, counties and municipalities would be $4 to 7 million. A 6-meter rise would cost between $16 and 26 million. This analysis does not include the cost of damage to private and residential property. By planning ahead and building in low risk areas the state of Maine can help to lessen the economic impact of future changes in sea level.



Predicted losses of land and infrastructure resulting from increases in sea level for the coast of Maine.

	1 Meter	6 Meter
Area (km^2)	166.46	654.28
Roads (km)	73.56	541.05
Schools / Libraries	2	17
Police Stations	0	3
Fire Stations	1	14
Hospitals	0	1