

Tufts Civil Engineer Predicts Boston's Rising Sea Levels Could Cause Billions of Dollars in Damage

March 2003

*Climate Change Presentation to the American Association for the Advancement of Science Describes
City's Options, Consequences*

DENVER— A team of civil engineers and geographers today presented their research on the impact of rising sea levels due to climate change on the Boston metro area – and it's a serious threat to Bostonians.

The team, led by Tufts University civil and environmental engineering Research Professor Paul Kirshen, presented their findings at the annual meeting of the American Association for the Advancement of Science (AAAS), the world's largest general scientific society.

Their research shows that over the next century, damage to residential, commercial and industrial buildings and their contents in metropolitan Boston (an area stretching from Ipswich to Duxbury) could exceed \$20 billion, depending on how the city responds to rising sea levels. Costs could run as high as \$94 billion, if climate weather conditions are more severe than expected.

"We just celebrated the 25th anniversary of Boston's notorious Blizzard of '78, which created enough damage across coastal Massachusetts to cost \$550 million in today's dollars," said Kirshen. "Because of the rising sea level and increased waterfront development, a storm of that magnitude would cause far more damage if it occurred today," he added.

The research was funded by a \$900,000 grant from the U.S. Environmental Protection Agency to study climate change in metropolitan Boston. Kirshen and his team examined current local coastal flood data, the impact of rising sea levels and the continuing commercial and residential development along metro Boston's coastline.

Kirshen explains that global climate change - with its melting glaciers, melting polar ice caps and thermal expansion of the oceans, coupled with the natural "sinking" of land - has raised sea levels, which are threatening Boston, New York City, Los Angeles, New Orleans and other coastal cities around the country.

As part of efforts to protect life and property from flooding, The Federal Emergency Management Agency has mapped out a "100-year floodplain" throughout the country, i.e, the coastal area that would be flooded by a violent storm on the average once every 100 years. FEMA's 500-year floodplain encompasses a larger area and would be damaged by a storm so violent that it would just occur an average of every 500 years. Floodplains are measured in the land area that would be flooded in the storm, as well as in the height of the storm surge that would flood the area.

"Because of rising sea levels, the same-sized wave that normally would swamp the 100-year floodplain in Boston will soon become high enough to overtake the 500-year floodplain," explained Kirshen. "Sea level rise will have a drastic impact on metropolitan Boston and other similar coastal cities if steps aren't taken to address the issue."

The team of civil engineers and geographers, which includes experts from the University of Maryland and Boston University, presented three scenarios of how Boston could respond to the change of sea level, and calculated both the cost of the response and the cost of repairing subsequent damage. The three options are:

"Ride-It-Out" Scenario

This approach would mean that over the next 100 years Boston would continue development in flood plains as it does now, and would repair storm damage as it occurs to return buildings to their original condition. Using the team's economic model of development along the waterfront and expected flood damage over the next century, this response would cost \$20 billion in repairs. Due to sea level rise, the size of the area flooded will more than triple over the next 100 years in this scenario. The \$20 billion in damages - as well as the estimates in the other scenarios - are based on the estimate that sea level rise will reach .62 meters

(2 feet) over the next 100 years, and that the area will be damaged by a maximum of one storm per year. If the sea level rises to one meter and Boston properties are damaged by more storms than the team estimates, the total property and emergency costs could easily reach \$94 billion.

“Build-Your-Way-Out” Scenario

This approach would also allow the current development to continue without flood proofing buildings, but would mean that after a second storm at the level of a 100-year storm, the city would construct seawalls and bulkheads to protect coastal development.

Because so much flooding will be prevented, the damages from this scenario would be \$5.9 billion over the next 100 years instead of \$20 billion in the Ride-It-Out scenario. However, the structural construction could cost up to \$3.5 billion, and maintenance costs will be high. Seawalls would also have a negative impact on the environment, separating the beachfront from the dunes and increasing vulnerability to erosion.

“Green” or Planned Adaptation Scenario

As the name suggests, this scenario would be much better for the environment. All new development in the 100-year and 500-year floodplains would need to be totally flood proofed, as would currently existing homes and commercial and industrial buildings before being sold. Retrofitting these buildings to be flood-proofed is assumed to be 80 percent effective, so these structures would only suffer 20 percent of the expected flood damage. Retrofitting homes would cost between \$3,500 and \$17,000, depending on location. The Green scenario would require a \$1.8 billion expenditure for flood-proofing, but damages would decrease to \$4.7 billion.

Scenario	Preventative construction costs	Damages over the next 100 years
Ride It Out	\$0	\$20 billion
Build-Your-Way-Out	\$3.5 billion	\$5.9 billion
Green (Planned Adaptation)	\$1.8 billion	\$4.7 billion

“It is up to governments in the metropolitan Boston area to decide how to deal with the issue of the rising sea level and its impact on coastal development,” said Kirshen. “But it would be in the region's best interest to take this threat very seriously. As Ben Franklin once said, ‘An ounce of prevention is worth a pound of cure.’”