A Coastal Nation
Beginning with just one meter of sea level rise, our nation would be physically under siege, with calamitous and destabilizing consequences.

The US is a coastal nation with over 12,000 miles of coastline. With 53% of all Americans living in and around coastal cities and towns, it is important to understand the impact of climate-induced sea level rise on our nation. Previous studies have focused on a six-meter rise. The following study takes a more conservative approach, beginning with a sea level rise of just one meter.
NATION UNDER SIEGE
Sea Level Rise at Our Doorstep

A Coastal Impact Study Prepared by The 2030 Research Center

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September 2007
ACKNOWLEDGEMENTS

2030, Inc. / Architecture 2030

Vincent Martinez
Teal Bowes
Peter Chapman

We would like to acknowledge the help and contributions to this project made by the following people and organizations:

The Redfish Group, Santa Fe, New Mexico

Stephen Guerin
Joshua Thorp

Washington State Department of Transportation

Michelle Blake

San Francisco Bay Conservation and Development Commission

Tim Doherty
(Coastal Planner and GIS Analyst)

Puget Sound LIDAR Consortium

Environmental Studies Laboratory, Department of Geosciences
The University of Arizona

Jeremy Weiss

Mapping Data Sources:

US Geological Survey Digital Elevation Models (USGS DEM)
NOAA National Geophysical Data Center (NGDC)
International Hurricane Research Center, Laboratory for Coastal Research (IHRC)
Massachusetts Geographic Information System (MassGIS)
San Francisco Bay Conservation and Development Commission (BCDC)
Forward

We are at the crossroads of the most significant crisis of modern times. Two profound, life changing events are converging to create this crisis – the warming of the earth’s atmosphere by burning fossil fuels, and the rapid depletion of global petroleum and natural gas reserves. We have all heard about the alarming planetary events that will occur if we fail to take decisive action to dramatically reduce greenhouse gas emissions, from species extinction and intensified weather events, to food and water shortages and rising sea levels. What we have failed to acknowledge is the severity with which this crisis will impact the United States.

Architecture 2030's mission is to examine the Building Sector, the single largest contributor to global warming, to construct and offer real, achievable, measurable solutions to the climate change crisis. Therefore, this study begins with a sober look at the impact of sea level rise on the US, and then provides a two-pronged solution that, if begun immediately, would avert dangerous climate change.

Edward Mazria
Executive Director
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Introduction

We have only to look at one event in just one city, hurricane Katrina and its impact on New Orleans, to understand what may soon be upon us...

There have been recent and very clear warnings from the US scientific community that we are perilously close to a climate change tipping point, and that unless we begin reducing greenhouse gas (GHG) emissions, we will soon pass this point with widespread undesirable consequences. Scientists estimate that continued growth of GHG emissions for another 10 years would make it impractical, and most likely impossible, to avert dangerous climate change [1].

With a business-as-usual approach, where fossil fuel consumption and GHG emissions continue to increase, we will likely see a warming of 2 °C to 3 °C this century with a planetary energy imbalance sufficient to melt enough ice to raise sea level by several meters [2]. During the last interglacial period, 125,000 years ago, when the earth was this warm, sea level was four to six meters higher than today [3].

Because 53 percent of all Americans live in and around coastal cities and towns [4], it is important to understand the point at which sea level rise creates an untenable situation in the US. We have seen and heard much about the catastrophic global consequences of six meters of sea level rise, and the effects of a much smaller rise on low-lying countries, like Bangladesh and island states in the South Pacific. What has not been made clear is the possible timing and effect of smaller increments of sea level rise on the US.

The following study of the US coasts reveals that, beginning with just one meter of sea level rise, our nation will be physically under siege, vulnerable to catastrophic property and infrastructure loss with large population disruptions and economic hardship. We have only to look at one event in just one city, hurricane Katrina and its impact on both New Orleans and our country, to understand what may soon be upon us if firm and immediate action to reduce GHG emissions to acceptable levels is not taken.

The most recent scientific study, issued by 47 scientists from many of our most respected institutions (from NASA on the East Coast to Lawrence Berkeley National Laboratory on the West Coast), indicates that, at approximately 450 parts per million (ppm) carbon dioxide (CO2) in the atmosphere (a greenhouse gas), we will reach a tipping point and trigger “dangerous climate change” with potentially irreversible glacial melt and rapid sea level rise “out of humanity’s control” [5]. We are currently dangerously close to this threshold at 383 ppm, and are now increasing atmospheric concentrations of CO2 at about 2 ppm annually [6].

The one inexpensive fossil fuel in plentiful supply that, if consumed at its present and/or an expanding rate, will push the planet past the 450 ppm threshold, is coal. If we are to avert this tipping point, we will need to call for an immediate halt to the construction of any new conventional coal-fired power plants and the phasing out of existing and aging coal plants over time. If we fail to take this action, there is no doubt we will soon reach the 450 ppm threshold.
Sea Level Rise

In order to accurately determine sea level rise along the US coast, base maps were constructed using United States Geological Survey - National Elevation Datasets (NED) for selected areas of interest. The NED is a seamless raster dataset of US elevations. Within the NED, the US is divided into 10 meter-by-10 meter squares, whose elevations correspond to the average elevation within a square. The NED is a compilation of elevation data from many sources, including LIDAR and USGS digital elevation models.

The Sea Level datum within the NED does not necessarily coincide with local mean sea level (MSL) along the US coastline. The elevations in the NED are based on the North American Vertical Datum, 1988 (NAVD88). The NAVD88 fixes Sea Level (zero elevation) at a particular point in Quebec, Canada. All US elevations within the NED are calculated relative to that zero point (adjusted for the curvature of the earth). For most purposes, the NAVD88 represents an acceptable standard for deciding elevations above Sea Level. Along a coastline, however, the level of the sea does not everywhere correspond to zero on the NAVD88. A correction was applied to the NED to bring it in line with actual local tidal conditions.

Once corrected sea levels were established, a flood-fill algorithm was used to determine contiguous inland access from the coastline for increased sea levels. For each area studied, the land-water edge, based on corrected sea level, was determined. The algorithm used this edge as the starting point of the flood-fill and moved inland. From each flooded point, the algorithm selected neighboring pixels that were at, or below, the corrected sea level. The algorithm continued from these neighboring points until no new points were selected.

Flood maps generated using the flood-fill algorithm were then superimposed over Google Earth images to illustrate in detail how localities will be flooded on a calm, rain-free day at high tide at various increments of sea level rise [7].

Visual Imaging

It can be difficult to visualize and grasp the implications of sea level rise. This is due in part to the way mapping is presented, i.e. as a two-dimensional image. Two-dimensional maps provide little, if any, visceral connection for the viewer. To overcome this disconnect, we chose to present our data in a familiar format, that of looking out an airplane window at a city or town when making the approach for landing. By illustrating sea level rise mapping as an aerial, three-dimensional snapshot of a city or town, the images take on a sense of familiarity and immediacy, and by connection, gives the viewer a more realistic understanding of the physical impacts of sea level rise.
A total of 31 coastal cities, towns and areas were studied: Atlantic City, NJ, Boston, MA, Brigantine, NJ, Cape Coral, FL, Coronado, CA, Cypress Lake, FL, East Boston, MA, Fort Lauderdale, FL, Foster City, CA, Freeport, TX, Galveston, TX, Hampton, VA, Hollywood, FL, Honolulu, HI, Lavalette/Dover Beaches, NJ, Marina Del Ray/Santa Monica, CA, Miami, FL, Miami Beach, FL, Naples/East Naples, FL, Newport Beach, CA, New Orleans, LA, New York City, NY, Oakland Airport, CA, Point Pleasant, NJ, Point Shirley, MA, Port Aransas, TX, San Diego, CA, San Francisco, CA, Savannah, GA, Seattle, WA and Silverton Area, NJ.

One Meter Sea Level Rise... and Rising

Beginning with just one meter of sea level rise, the impact on the US would be calamitous, having the potential to destabilize many areas of the country.

The US populace has been somewhat complacent thus far in aggressively confronting global warming. There is the notion, advanced by both the media and the many studies on the impacts of climate change, that the wealthier countries in the West will be best able to adapt, and the underdeveloped countries will bear the brunt of the impacts. As illustrated here, this is clearly not the case; the US is vulnerable at very small increments of sea level rise.

Starting in East Boston and moving down along the East Coast, around Florida and over to the Gulf of Mexico, then up along the West Coast and ending with the city of Honolulu, Hawaii, a picture of inundation, population displacement and catastrophic property loss develops.
With a business-as-usual approach, where fossil-fuel consumption and GHG emissions continue to increase, we will likely see a warming of 2 °C to 3 °C this century with a planetary energy imbalance sufficient to melt enough ice to raise sea level by several meters.
Once the process of ice sheet disintegration begins, the impact on the US is unremitting, and at each additional increment, additional cities and towns will be adversely affected.
During the last interglacial period, 125,000 years ago, when the earth was this warm (2 °C to 3 °C warmer), sea level was four to six meters higher than today.
A Lesson Learned?

Scientists forewarned of the consequences of a hurricane hitting New Orleans. The above image illustrates the counties affected by Hurricane Katrina (in gray). A single catastrophe in just one city, in one way or another, affected the entire country. The cost to avert this tragedy was approximately two billion dollars. It will cost taxpayers 200 to 300 billion dollars to rebuild this one city.

Below is an excerpt from the article Gone With the Water, published in National Geographic Magazine in October, 2004, one year before Hurricane Katrina struck New Orleans:

“The next day the storm gathered steam and drew a bead on the city… more than a million people evacuated to higher ground. Some 200,000 remained, however—the car-less, the homeless, the aged and infirm, and those die-hard New Orleanians who look for any excuse to throw a party.

The storm hit … pushing a deadly storm surge into Lake Pontchartrain. The water crept to the top of the massive berm that holds back the lake and then spilled over … it reached 25 feet (eight meters) over parts of the city, people climbed onto roofs to escape it.

Thousands drowned in the murky brew that was soon contaminated by sewage and industrial waste… It took two months to pump the city dry, and by then the Big Easy was buried under a blanket of putrid sediment, a million people were homeless … It was the worst natural disaster in the history of the United States.

When did this calamity happen? It hasn’t—yet …“

Current Trends

Scientists are now forewarning that, at approximately 450 ppm CO₂ in the atmosphere, we will trigger potentially
irreversible glacial melt and sea level rise “out of humanity’s control”. The amount of CO₂ in the atmosphere affects our planet’s temperature. With concentrations of CO₂ currently at 383 ppm, the planet is now approximately 0.8 °C warmer than pre-industrial levels. Concentrations of 450 ppm corresponds to approximately 2 °C global warming above pre-industrial levels [8].

**Timeline**

Atmospheric concentrations of CO₂ are increasing at 2 ppm each year [9]. At this growth rate, we will reach 450 ppm in 2035.

Continued growth of CO₂-producing infrastructure and emissions for another 10 years will make it impractical, and most likely impossible, to avert exceeding this threshold [10].

**Fossil Fuels and Climate Change**

During the “fossil fuel era”, from ca. 1750 to the present, enough coal, oil and natural gas have been burned to increase CO₂ concentrations in the atmosphere from 260 ppm to 383 ppm. We are now reaching the peak in global oil production (US oil production peaked in 1970, natural gas in 1973). The global static lifetime of conventional oil is approx. 40 years, natural gas 60 years. As oil and gas peak their price will increase dramatically and alternatives will become more economically attractive. Oil and gas consumption will decline after the peak, being consumed more sparingly with their depletion rate stretching out over many years.

Because it is plentiful and inexpensive, the current trend is to meet the projected and increasing global demand for energy with coal. The US alone has 151 new conventional coal plants in various stages of development [11]. Globally, at least one new conventional coal-fired power plant is being added each week.
The CO₂ power plant emissions from burning coal, per unit of energy produced, is greater than any other fossil fuel; for example, it is double that of natural gas.

The Silver Bullet: A Moratorium on Coal

The one fossil fuel positioned to push the planet beyond 450 ppm, and trigger dangerous climate change, is coal.

It has become common today to declare that there is no ‘silver bullet’ for solving the global warming crisis. This, in fact, is not correct. The one fossil fuel positioned to push the planet beyond 450 ppm, and trigger dangerous climate change, is coal. This fact, coupled with the fact that a coal plant built today has a life expectancy of 50 years or more, mandates that the time for positive preventive action is now, and that this action must be a moratorium on coal.

The decisions we make today about energy production and infrastructure will determine whether, or how fast, we reach 450 ppm. Unless the US initiates an immediate halt to the construction of any new conventional coal-fired power plants, gradually phases out existing plants, and then uses its global and economic influence to call for an international moratorium as well, our country and major population centers will be at serious risk.

Those who invoke China’s emissions as an insurmountable obstacle to emissions reductions, fail to understand that the US, Japan and the European Union consume 78% of all Chinese exports, fueling China’s economic growth. If we collectively call for a global halt to the construction of any new conventional coal-fired power plants, China will follow to ensure its continued growth.

Replacing Coal

Without an increased demand for electrical energy, there is no need for additional coal-fired power plants.

- As the single largest contributor to global warming, buildings account for approx. 48% of total annual US energy consumption (40% for building operations, 8% for building construction). Globally, the percentage is even greater.
- Building operations (heating, cooling, ventilation, hot water, etc.) account for 43% of total annual US greenhouse gas emissions [12].

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These efforts, and many others, are critical in our attempt to address global warming. They are wasted if we do not also come to terms with the damaging effects of burning coal.
Each year, we build approximately five billion square feet of new buildings, renovate approximately five billion square feet and demolish approximately 1.75 billion square feet of existing buildings. By the year 2035, three-quarters of the built environment in the US will be either new or renovated. This transformation of the built environment over the next 30 years represents a historic opportunity to dramatically reduce the Building Sector’s CO₂ emissions.

To take advantage of this opportunity, Architecture 2030 issued ‘The 2030 Challenge’, calling for an immediate 50% fossil-fuel energy consumption reduction for all new and renovated buildings, incrementally increasing the reduction for new buildings to carbon neutral by 2030. Specifically, the Challenge calls for the following:

- All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.
- The fossil fuel reduction standard for all new buildings shall be increased to:
  - 60% in 2010
  - 70% in 2015
  - 80% in 2020
  - 90% in 2025
- Carbon-neutral in 2030 (using no fossil-fuel GHG-emitting energy to operate)

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy and/or certified renewable energy credits.

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buildings to consume 50% less fossil fuel energy allows for new efficient buildings to be built without increasing the sector’s energy demand.

If we stop building conventional coal-fired power plants, phase out existing coal plants and simultaneously reduce the emissions of the Building Sector, we can avert the worst consequences of climate change. If we begin now, we make it; the numbers are on our side. If we wait, even 10 years, this window of opportunity is lost.

**Been There, Done That**
The US has accomplished similar tasks before. During the 1970’s oil crisis (an 11-year period from 1973 to 1983), this country, drawing on American determination and ingenuity, increased its real GDP by over one trillion dollars (in Year 2000 dollars) and added 30 billion square feet of new buildings and 35 million new vehicles, while decreasing total US energy consumption and CO₂ emissions. This was accomplished with increased efficiency and with cost-effective, readily available, off-the-shelf materials, equipment and technology.

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**Conclusions and Recommendations**

**Conclusions:**
- Sea level rise due to climate change poses a great threat to the US. Even small increments of sea level rise will result in serious property and infrastructure loss, population displacement and economic hardship.
- Coal is positioned to push the planet beyond the ‘dangerous climate change’ threshold of 450 ppm.
- The sheer volume of CO₂ released by conventional coal plants completely negates current efforts to mitigate climate change.
- There is a ‘silver bullet’ to the global warming crisis. A moratorium on coal would immediately stabilize the amount of CO₂ being released into the atmosphere, while simultaneously allowing the current efforts to mitigate climate change to make a difference.
- The US’s increasing electrical energy demands can be met without coal by implementing The 2030 Challenge. Without increased demand, there is no need for additional coal-fired power plants.
- This crisis can be mitigated with existing, proven design principles, materials and technologies.

**Recommendations:**
- 2030 recommends calling for an immediate moratorium on coal, i.e. a halt to the construction of any new conventional coal-fired power plants and the phasing out of existing and aging coal plants.
- 2030 recommends calling for all new and renovated federal, state and local government buildings to exceed The 2030 Challenge targets.
- 2030 recommends immediately updating the National Model Building Energy Codes (residential and commercial) to incorporate The 2030 Challenge targets, and mandating their implementation.
- 2030 recommends supporting federal, state and local legislation to encourage the adoption of the Challenge targets.
Katrina Revisited

The global warming discussion must now center on the question "How much are we willing to risk?"
Do we do what it takes to solve this crisis, or do we push the planet to 450 ppm?
ENDNOTES


7. Maps are based on LIDAR data and USGS 10m NED. Maps are illustrative; areas in blue depict various potential inundation scenarios. Map accuracy is dependant on the accuracy of the geospatial data.


METHODOLOGY USED TO DETERMINE COASTAL FLOODING DUE TO SEA LEVEL RISE

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Summary
The goal of this project was to provide an accurate estimate of coastal flooding due to sea level rise. Elevation data from the USGS National Elevation Dataset were used and augmented with higher resolution LIDAR data where available. Baseline high tide levels were established by incorporating measurements from the closest NOAA tide gauges. A flood-fill algorithm was developed to determine the extent of coastal inundation. The resulting data were imported into Google Earth to provide detailed images of coastal flooding for selected US cities and towns.

Methodology For Predicting Coastal Flooding
The technical methodology developed to predict coastal flooding is comprised of five steps: 1) compile the best available national elevation data, 2) augment flood data with additional Light Detection and Ranging (LIDAR) and ground-based sources 3) establish mean sea level (MSL) with respect to available elevation data, 4) execute the flood-fill algorithm, and 5) integrate flood maps with Google Earth [1].

Compile Available Elevation Data
The National Elevation Dataset (NED) was obtained from the United States Geological Survey (USGS) [2] for selected areas of interest. The NED is a seamless raster dataset of US elevations. Within the NED, the US is divided into 10 meter-by-10 meter squares whose elevations correspond to the average elevation within a square. The NED is a compilation of elevation data from many sources, including LIDAR and USGS digital elevation models. The NED is maintained by the USGS to contain the most accurate, up-to-date elevation of US landforms.

Augment National Datasets With Local LIDAR Studies
Any attempt to assess the potential damage to coastline interests from sea level rise will require knowledge of how high the coastline is in relation to the water. Despite enormous strides that have been made in technology of elevation determination in recent decades, the quality of data maintained in the national databases remains uncertain. In 1998, the National Geodetic Survey provided Congress with a report detailing the woeful lack of coordination between various sources of information concerning elevation [3]. The national datasets used in this study, therefore, were supplemented with local LIDAR data where available.

The NED provides estimates of land elevation, which in most cases are clearly validated by aerial photography of the marks left on coastal zones by the ebb and flow of tides. It also, however, provides estimates that are clearly wrong. An example of the uncertainty in the NED is illustrated using the city of Long Beach, NY, a barrier island off the coast of Long Island. The NED elevation of an intersection near the center of town differs by approximately 2.25 m from the elevation listed on the US Army Corps of Engineers flood plain map [4]. Thus, a flood-fill map generated using the NED data would show the island routinely flooded at high tide, which does not occur.

The reason that this situation has not already produced chaos is that city, county and state engineering departments have their own databases for the purposes of designing roads, sewage lines, drainage systems and flood control structures and for granting building permits. Some of these data are publicly available [5], but much is available for a cost.

LIDAR data at approximately 3-m resolution typically improves the horizontal resolution 9-fold over 1/3 arc-second (~10 m) data. Figure 1 illustrates differences in resolution.
To validate and augment elevation data for this study, an effort was made to acquire additional LIDAR datasets in areas where visual inspection led to lower confidence with USGS NED data. Sources of LIDAR data were obtained using phone interviews with local governments’ Geographic Information System (GIS) users and Internet surveys. A summary of the locations investigated, along with the data sources used for this study, is shown in Table 1.

In addition to supplementing with LIDAR data, a survey team was sent to take actual spot elevations in lower-confidence areas. These measurements consisted of determining the elevations of sea walls, berms, roads and piers relative to actual or apparent high tide. The local surveying allowed us to conservatively validate the amount of sea level rise required to breach a given area and result in significant flooding. Spot elevation data was gathered for the following locations: San Francisco, Boston, East Boston, Point Shirley, New York City, Brigantine, Point Pleasant, Atlantic City, Miami Beach and Miami, shown in Fig. 2. Example maps of survey points are in Fig. 3.

Establish Local Mean Sea Level
The elevations in the NED and LIDAR datasets are based on the North American Vertical Datum, 1988 (NAVD88). NAVD88 uses one base monument located at Father Point, Quebec in Canada as its zero elevation level. Elevations within the NED are calculated relative to that zero point (adjusted for the curvature of the earth). For general purposes, the NAVD88 represents an approximate standard for establishing elevations above mean sea level. Along a coastline, however, the level of the sea does not everywhere correspond to zero on the NAVD88. This discrepancy can range from a few centimeters in Florida to a few meters in the northwest United States. Thus, local tidal conditions must be established using local tide gauges. United States National Oceanic and Atmospheric Administration (NOAA) [6] datum tables were obtained from tide gauges. These datum tables included zero-level NAVD88 marks and the measured MSL and Mean Higher High Water (MHHW) levels. The MSL and the MHHW on these datum tables are averaged over the 19-year period from 1983 to 2001 (National Tidal Data Epoch). In cases where multiple gauges were available within a specified radius, the adjustment was calculated based on a simple average. The following equation was used to establish MSL with respect to the NAVD88-based elevation models:

\[
EMSL = MSL_{Gauge} - NAVD88_{Gauge}
\]  

A Coastal Impact Study: Nation Under Siege
Table 1. Locations Presented and Data Sources Used

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<th>Location</th>
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<th>Population</th>
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<td>Coronado, CA</td>
<td>3-5 meter</td>
<td>24,100</td>
<td>USGS 10M NED</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>3-5 meter</td>
<td>1,223,400</td>
<td>USGS 10M NED</td>
</tr>
<tr>
<td>Marina Del Rey/Santa Monica, CA</td>
<td>3-5 meter</td>
<td>84,084</td>
<td>USGS 10M NED</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>3-5 meter</td>
<td>563,374</td>
<td>USGS 10M NED (LIDAR verified)</td>
</tr>
</tbody>
</table>

+International Hurricane Research Center, Florida International University
+National Geophysical Data Center
#Massachusetts Geographic Information System

Figure 2. Map of Survey Locations

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Figure 4. Example NOAA tide gauge station datum table.

where EMSL is the local MSL, MSLGauge is the MSL from the datum table, and NAVD88Gauge is the height of the zero-level NAVD88 mark from the datum table. To assess the impact of high tide, the elevation of the local MHHW can be established with the following equation:

\[
EMHHW = MHHWGauge - NAVD88Gauge
\]  

where EMHHW is the elevation of local MHHW and MHHWGauge is the MHHW from the datum table.

An example NOAA datum table is shown in Fig. 4. This table was obtained from the New York tide gauge station shown in Fig. 5. In this table, the zero-level NAVD88 benchmark is 1.849 m high on this gauge. The MSL and the MHHW are 1.785 and 2.543 m, respectively. Using Eq. 1, the local MSL is -0.064 m with respect to NAVD88. The local MHHW is 0.694 m with respect to NAVD88 (Eq. 2).
Execute Flood-Fill Algorithm
Once local MHHW levels were established, the flood-fill algorithm was used. This algorithm determines contiguous inland access from the coastline for increased sea levels. The algorithm was executed for the following values of sea level rise: 0, 0.25, 0.5, 0.75, 1.0, 1.25, 1.5, 1.75, 2.0, 3.0, 4.0, 5.0 and 6.0 m. (A sea level rise of 0 m was evaluated as an algorithm check and a validation of elevation data.) For each area studied, the land-water edge, based on local MHHW, is determined. The algorithm uses this edge as the starting point of the flood-fill and moves inland. From each flooded point, the algorithm selects neighboring pixels that are at, or below, the local MHHW plus the amount of simulated sea level rise. The algorithm continues recursively from these neighboring points until no new points are selected.

Integrate Flood Maps with Google Earth
The flood maps generated by the flood-fill algorithm were saved as portable network graphics (PNG) images. The PNG is a bitmap image format that uses lossless data compression. From these PNG images, KML files were generated for direct import into Google Earth. The KML format is used to display geographic data in Google Earth and is based on the XML (extensible markup language) standard file format. At its best, Google Earth imagery is sufficiently detailed to show a bird's eye view of buildings, streets, parks, waterways, and even individual automobiles. The resulting, superimposed flood maps show in detail how localities will be flooded on a calm, rain-free day. An example of a flood map for Miami, FL is shown in Fig. 6 for a 1.25-m sea level rise above MHHW.

Figure 5. Tide gauge station in New York Harbor ("The Battery", ID-8518750).

Figure 6. Miami flood map for a 1.25-meter sea level rise above MHHW.
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REFERENCES

6. National Oceanic and Atmospheric Association’s Center for Operational Oceanographic Products and Services, Silver Spring, MD.
Katrina Revisited

The global warming discussion must now center on the question, "How much are we willing to risk?"

Do we do what it takes to solve this crisis, or do we push the planet to 450 ppm?