



CITIES AT RISK: A FORWARD-LOOKING VIEW OF WIND-DRIVEN STORM SURGE, 2010 - 2100

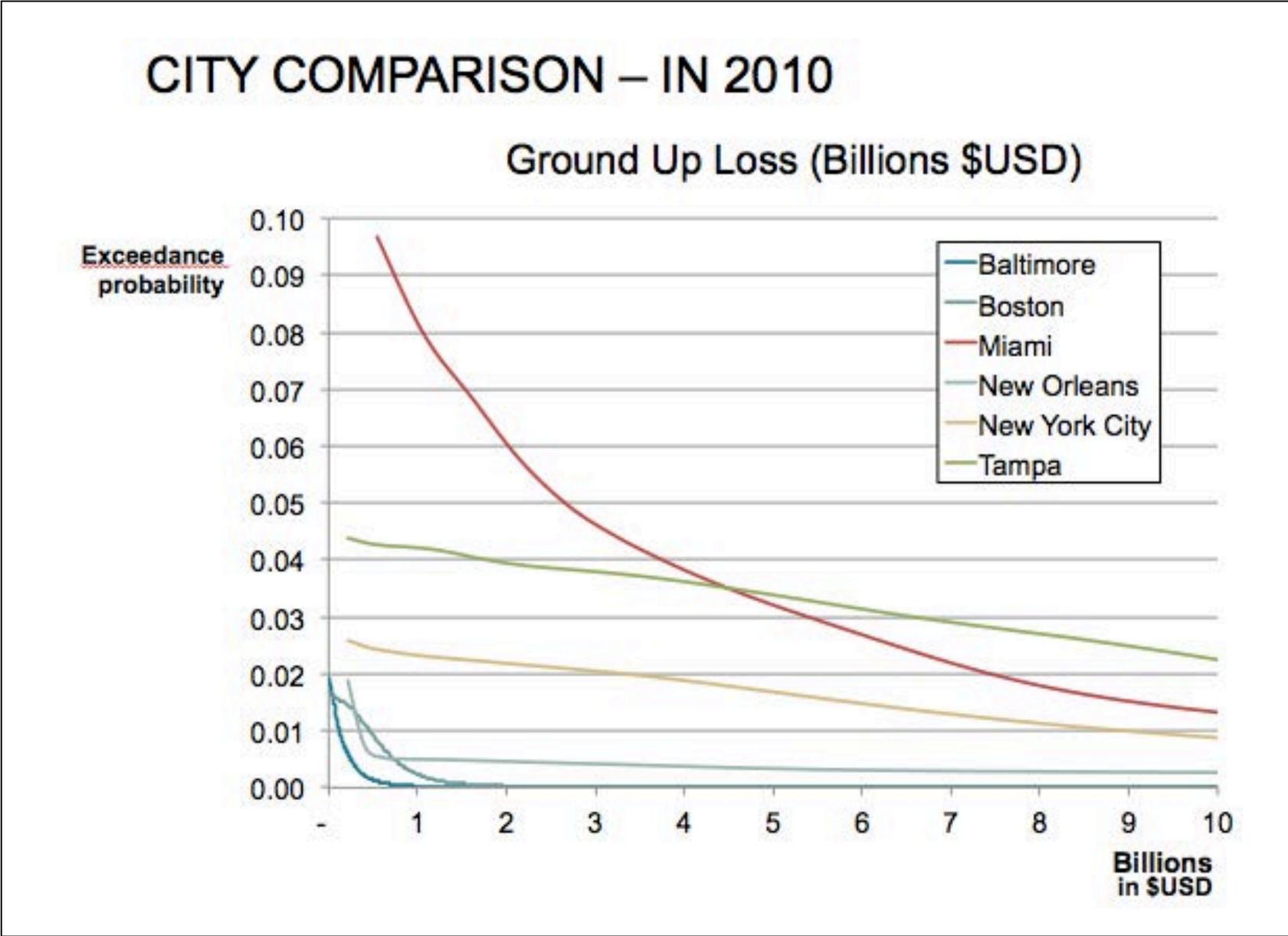
Potential economic losses from storm surge on six key U.S. coastal cities



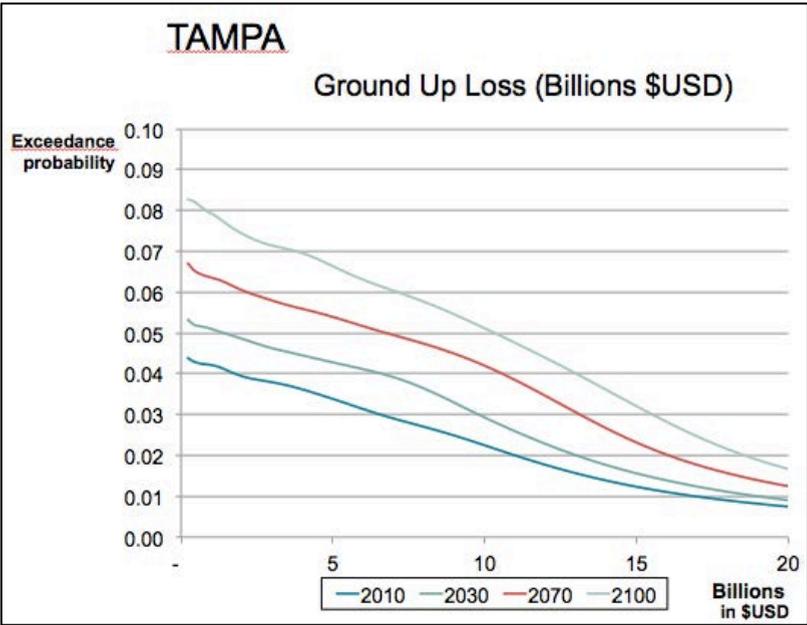
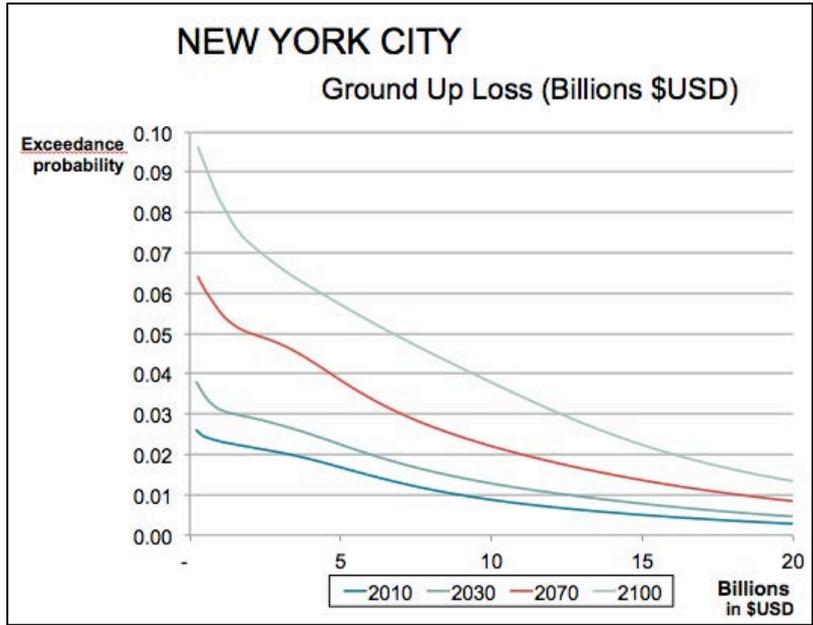
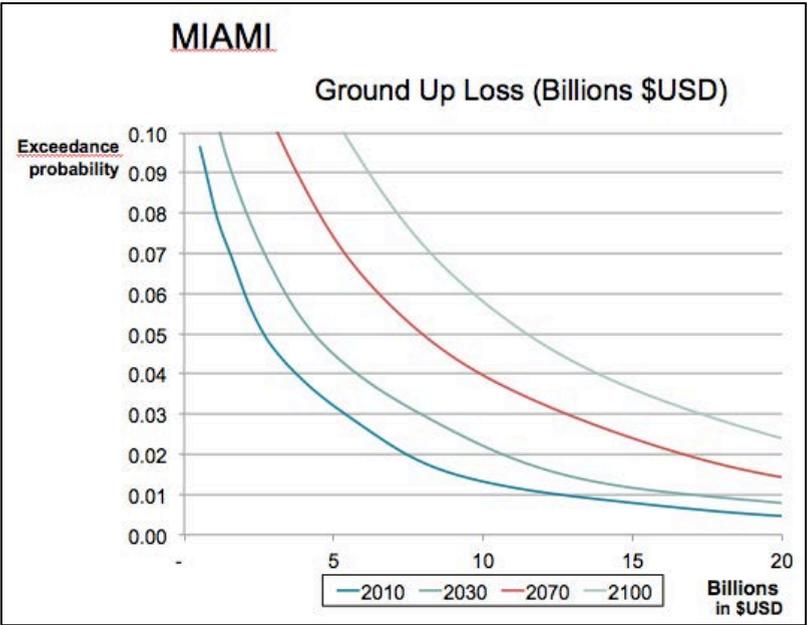
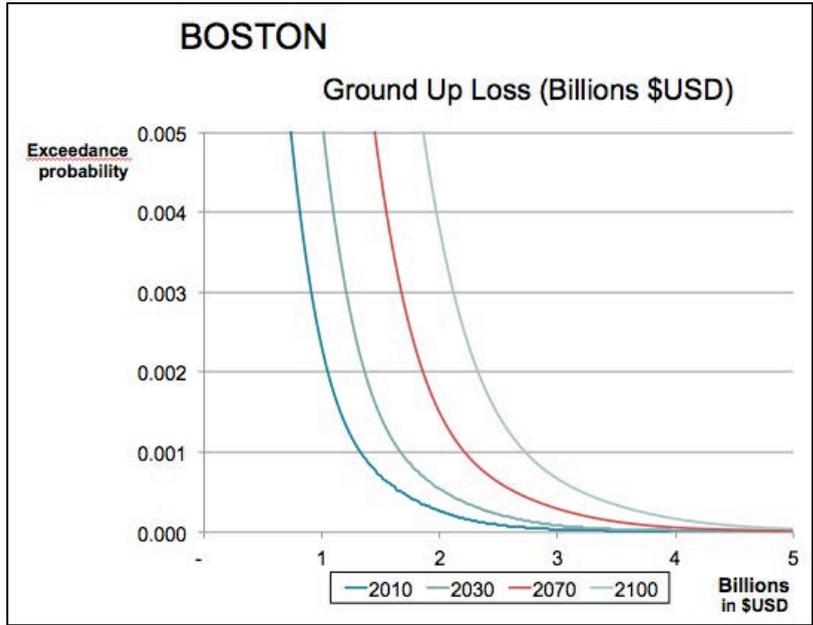
ECONOMIC LOSSES FOR HURRICANE-DRIVEN STORM SURGE

A city-by-city comparison of economic losses from storm surge:

- Today, Miami is most at-risk of storm surge losses.
- Beyond roughly the 30-year return period, Tampa becomes the most risk prone, followed by Miami and New York City.
- New Orleans is the fourth most risk-prone city, except in a 65- to 200-year return period window, where Boston surpasses it.
- Baltimore is the least risk-prone city.



GROUND-UP HURRICANE-DRIVEN STORM SURGE LOSS



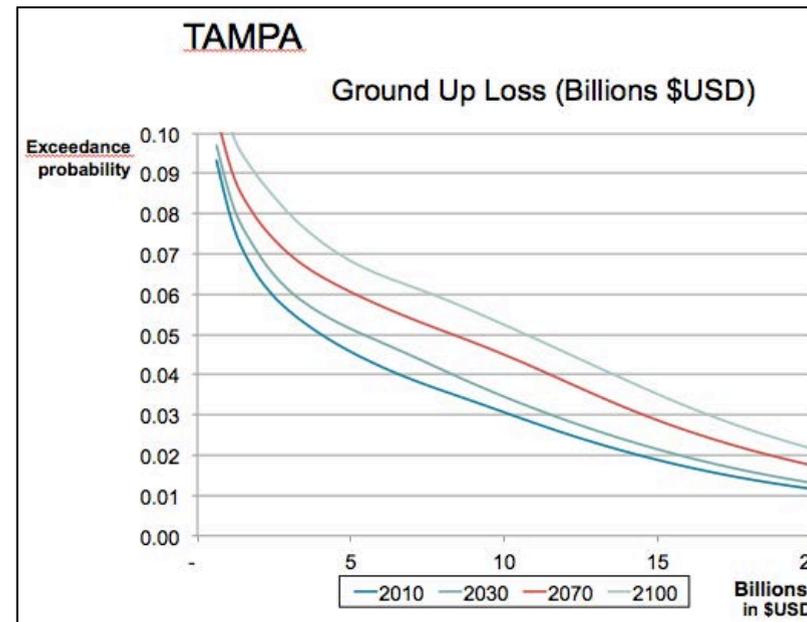
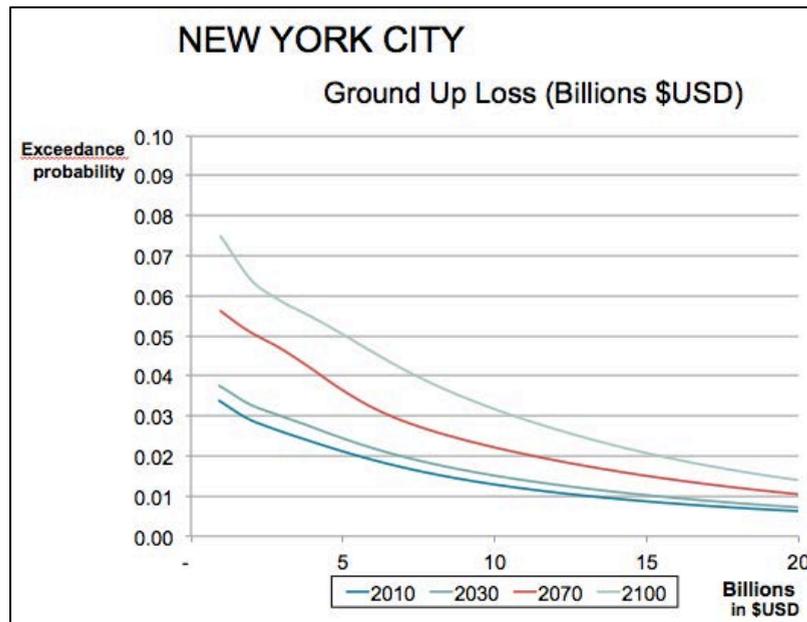
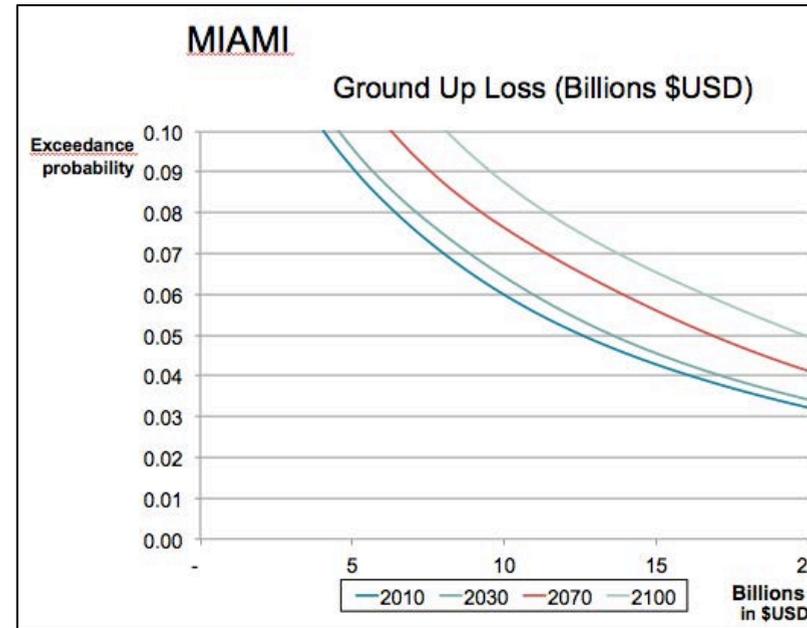
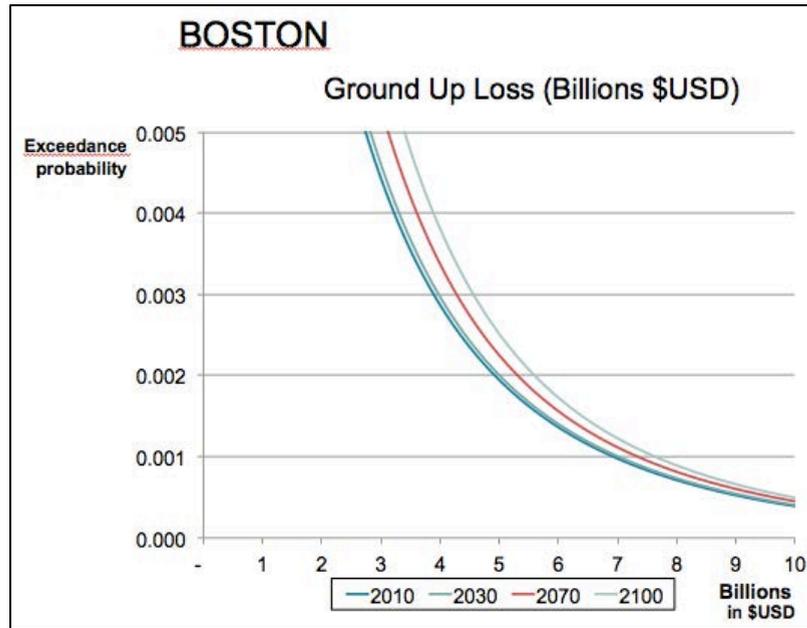
Annual exceedance probability curves, highlighting the total potential industry economic loss due to storm surge, taking into account the impact of rising sea levels between present day (2010) and three future climate scenarios (2030, 2070, 2100)

Miami and Tampa are the most risk-prone cities in terms of annual likelihood of storm surge loss. Presently (2010), Miami possesses an annual likelihood of 1.28% (78-year return period) of an event causing at least US\$10 billion in storm surge losses, while Tampa possesses an annual likelihood of 2.22% (45-year return period). By 2100, this increases to 5.88% (17-year return period) for Miami and 5.26% (19-year return period) for Tampa.

New York City displays the most sensitivity to sea-level rise. The annual likelihood of the city suffering a US\$5 billion storm surge loss increases by 3.4 times from 2010 to 2100, reducing the return period from 60 years to 17 years. The likelihood of a loss event of \$US10 billion increases by 4.3 times, reducing the return period from 115 years to 27 years.

Baltimore, which had the lowest full storm surge losses, is not displayed.

ECONOMIC LOSSES FOR WIND + STORM SURGE

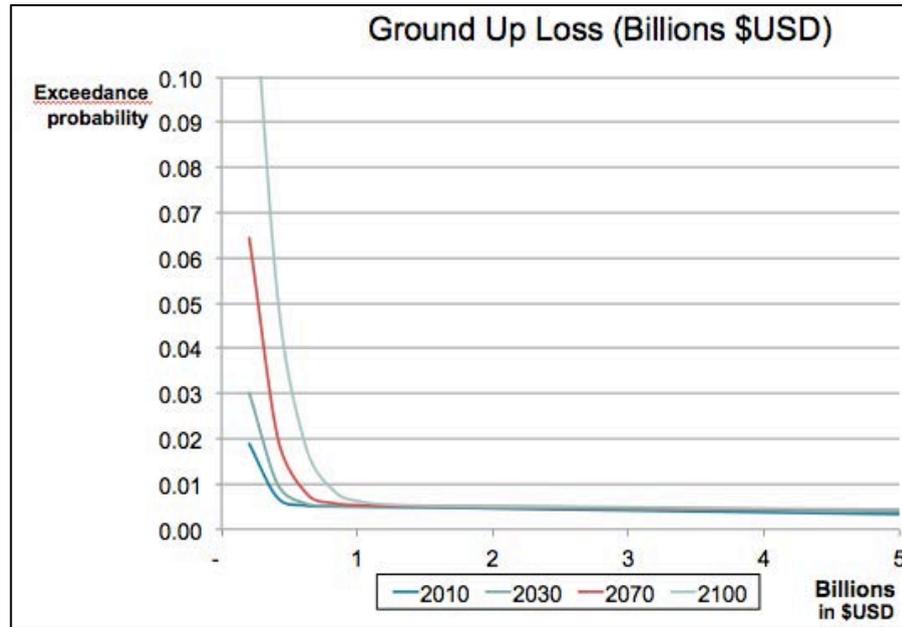


Annual exceedance probability curves, highlighting the total potential industry economic loss due to wind and full storm surge, taking into account the impact of rising sea levels between present day (2010) and three future climate scenarios (2030, 2070, 2100)

Miami remains the most risk-prone city in terms of economic loss, with return periods for at least US\$10 billion in economic losses under 20 years (annual likelihood of 5% or better) for all four time periods (17 year in 2010, 16 year in 2030, 13 year in 2070, 12 year in 2100).

New York City still displays the most sensitivity to sea-level rise, with the likelihood of a loss event of US \$10 billion increasing by 2.5 times from 2010 to 2100.

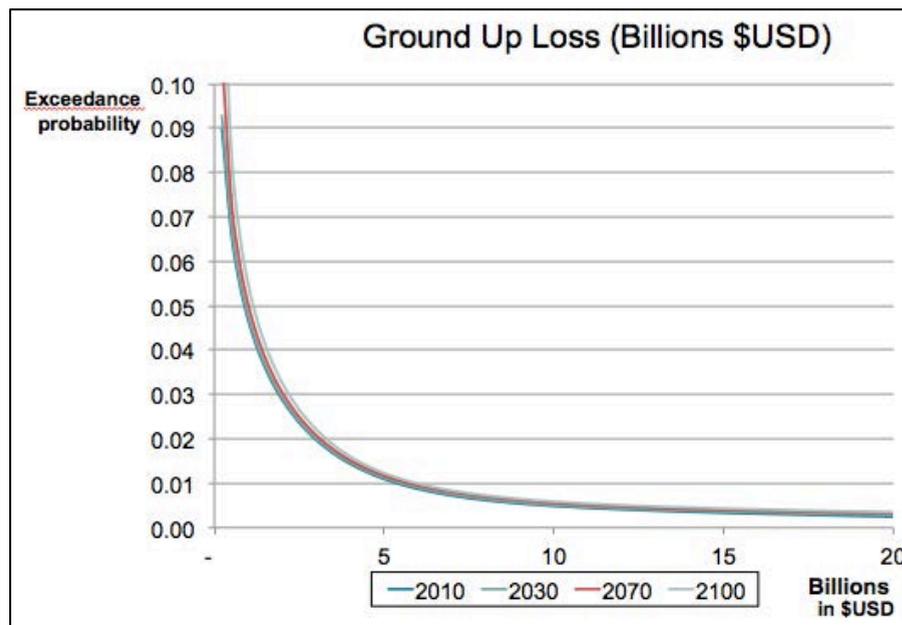
HOW NEW ORLEANS WOULD FARE TODAY FROM ANOTHER KATRINA



Annual exceedance probability curves for New Orleans, highlighting the total potential industry economic loss due to storm surge (left) and wind plus full storm surge (right), taking into account the impact of rising sea levels between present day (2010) and three future climate scenarios (2030, 2070, 2100).

All exceedance probability curves calculated for New Orleans have implicitly assumed that flood defenses will be continuously upgraded to keep pace with rising sea levels.

If the city's levees are not maintained accordingly, a one-meter rise in sea levels increases the likelihood of levee failure in New Orleans by 3 times, and a two-meter rise multiplies that likelihood by nearly 9 times. The sections most likely to fail for both a one-meter and a two-meter sea-level rise are sections 10-13, which protect against flooding from Lake Pontchartrain.



If another Hurricane Katrina were to hit New Orleans again, total economic losses due to ground-up full storm surge are estimated around US\$15 billion — a 440-year return period event. By including wind, the economic losses increase to US \$16.7 billion, and the return period drops slightly to 330 years.

RETURN PERIOD SURGE LOSSES

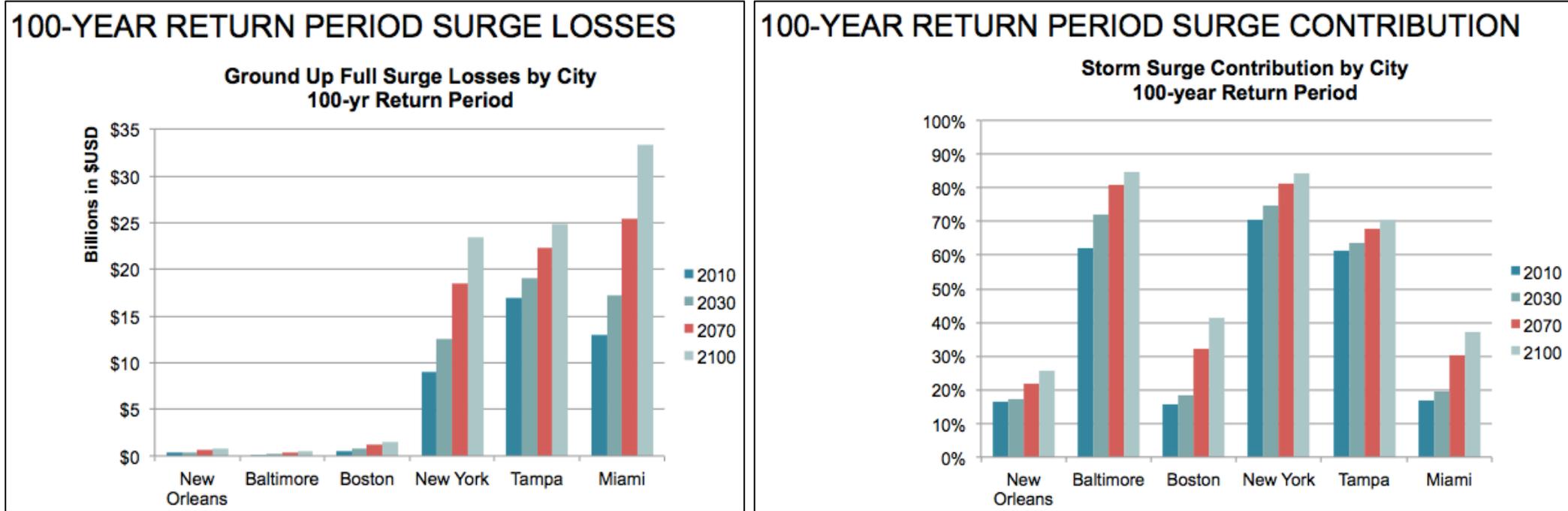
If another Hurricane Katrina were to strike New Orleans today but with the 2005 levee system, total ground-up full surge losses for Orleans Parish alone would equal around US\$15 billion — the equivalent of a 440-year return period event.

However, of the six cities we analyzed, New Orleans is not the city at most risk of a Katrina-like event. Three other cities — Tampa, Miami, and New York City — have higher likelihoods, especially when the impacts of sea level rise are considered

For example, a US\$15 billion storm surge event today in Tampa has an 80-year return period, which drops to 30 years by 2100.

Miami has a 125-year return period for a US\$15 billion storm surge event today. However, the risk is projected to be much higher by 2100, when the return period shrinks to just 30 years.

In New York City, the likelihood of a US\$15 billion surge loss today is relatively low with a 200-year return period — but that drops dramatically to 45 years by 2100.



One hundred-year return period (1% annual likelihood) of the total economic loss due to storm surge (left) and the contribution of storm surge losses to the total wind plus full storm surge losses (right), taking into account the impact of rising sea levels between present day (2010) and three future climate scenarios (2030, 2070, 2100).

One hundred-year return period storm surge losses are projected to increase from 50% to nearly 300% between 2010 and 2100 for all cities.

Storm surge is expected to contribute to more than half of the total wind plus full storm surge losses in Baltimore, New York City, and Tampa by 2100 and at least 25% for New Orleans, Boston, and Miami.