Facts and findings: Sea level rise and storm surge threats for Florida

See the full report, *Surging Seas*, for methods used and national findings: surgingseas.org/report

Storms and the rising sea

Even small amounts of sea level rise make rare floods more common by adding to tides and storm surge. Climate Central has analyzed data and made projections at water level stations in Florida. For a representative station[1]:

1. Odds of a 100-year flood or worse by 2030, with sea level rise from global warming[2]: **25%**
2. Odds without global warming[3]: **10%**
3. Bottom line: global warming multiplies the odds by **2.6X**
4. Historic local sea level rise rate[4]: **1.1 inches/decade**
5. Projected new sea level rise by 2050[5]: **13 inches**

People, homes and land at risk

Climate Central has developed maps and statistics for Florida areas less than 1-10 feet above the local high tide line, including searchable results for every coastal town, city and county, accessible via surgingseas.org/states/FI. A summary of vulnerability[6] at less than 4 feet[7]:

1. Population at risk: **2.4 million**[8]
2. Homes at risk: **1.3 million**
3. Land area at risk[9]: **1.8 million acres**
4. Towns and cities where at least half the population is at risk: **107**
5. Counties where at least 10% of the population is at risk: **8**
6. Cities with the largest total exposed populations, ranked most to least: Hialeah, Pembroke Pines, Cape Coral, Miami Beach, Plantation, Miramar, Fort Lauderdale, Davie, St. Petersburg, Miami
7. Counties with the largest total exposed populations, ranked most to least: Miami-Dade, Broward, Lee, Pinellas, Collier, Hillsborough, Monroe, Charlotte, St. Johns, Brevard
8. Miami-Dade and Broward Counties each have more people living on land below 4 feet than any US *state* except Florida itself and Louisiana.

Special considerations for Florida

1. The porous limestone underlying much of Florida makes the state particularly vulnerable to sea level rise. So seawalls can't block seawater from infiltrating underground, and the ocean is already contaminating freshwater aquifers.
2. Development is more concentrated in the first few feet above high tide than it is at higher elevations. For almost all other coastal states, the reverse is true.
3. Southeast Florida uses canals to drain storm runoff into the ocean. A recent report finds just six more inches of sea rise would cripple almost half the area's flood control capacity.

Impacts already happening

1. Saltwater contamination of freshwater aquifers
2. Flooding at extreme high tides
3. Diminishing effectiveness of Southeast Florida canal system for rainstorm runoff

Preparations already underway

1. Southeast Florida Regional Climate Change Compact and its Climate Action Plan
2. Municipal adaptation to sea-level rise: City of Satellite Beach, Florida
3. City of Punta Gorda Adaptation Plan

Table: Sea level and high water projections throughout Florida

Sea level rise projections take into account global and local effects, and vary by site due to differences in local effects, most importantly different rates of sinking or rising land. Scenarios without global warming remove only global effects, both historical and projected. Differences in storm surge patterns and sea level projections together lead to different flood level exceedance odds in different places.

Water level station	Reference 100-year flood level (feet)[2]	Odds of exceeding reference flood level by 2030		Measured historic sea level rise[4]		Projected sea level rise by 2050[5]	
		With global warming[2]	Without global warming[3]	Inches rise	Period of record	Inches rise 2009-2050	90% range
Fernandina Beach - Amelia River	3.3	55%	1%	9	1897-2006	12	5-22
Vaca Key - Florida Bay	3.0	25%	10%	4	1971-2006	13	6-23
Key West	3.1	24%	10%	8	1913-2006	12	5-22
Naples - Gulf Of Mexico	3.9	25%	7%	3	1965-2006	11	4-22
St. Petersburg, Tampa Bay	6.5	20%	14%	6	1947-2006	12	5-23
Clearwater Beach - Gulf Of Mexico	6.6	20%	14%	3	1973-2006	12	5-22
Apalachicola - Apalachicola River	15.0	19%	17%	2	1967-2006	10	3-20
Pensacola - Pensacola Bay	14.0	19%	17%	7	1923-2006	11	4-21

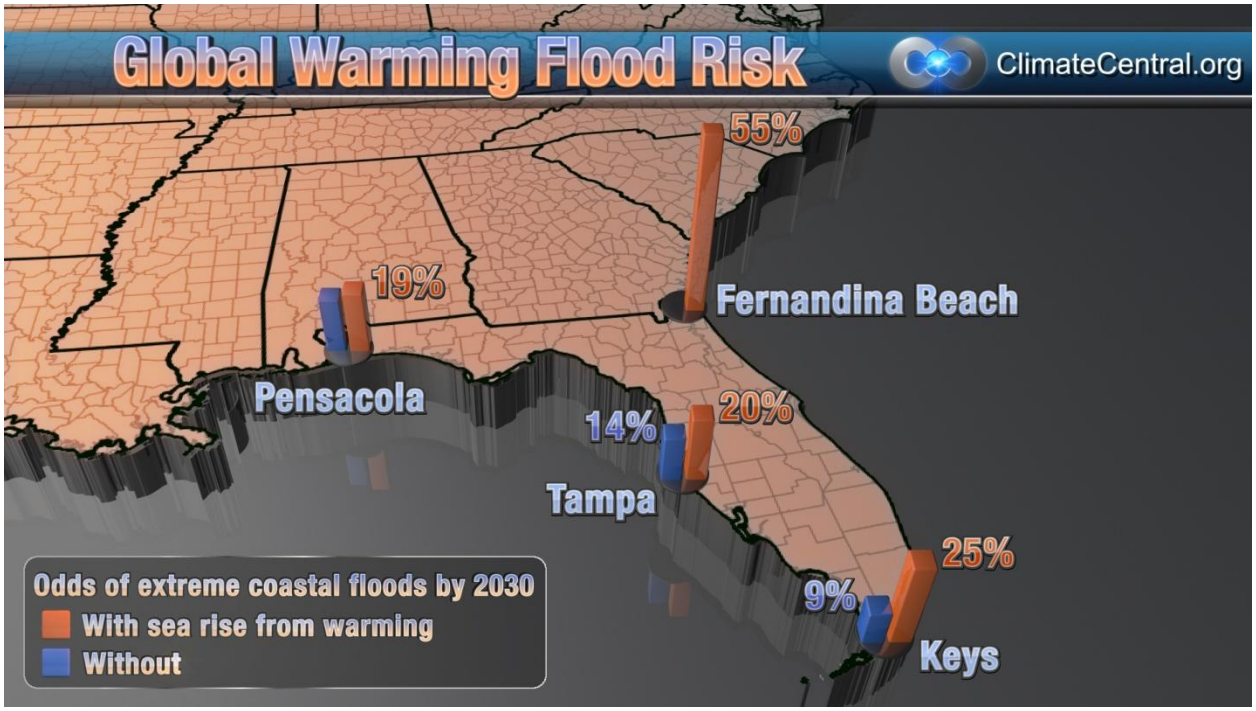

Figure 1. Odds of reference 100-year floods[2] when factoring in sea level rise from global warming, versus when not. See Table for source data.

Figure 2. How Florida's population on low-lying land compares to other states.

Limitations

All values presented here are best estimates based on Climate Central's peer-reviewed analysis. Actual values may vary. For discussion of methods, assumptions and limitations, see the full report *Surging Seas* and its citations.

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Notes

[1] Vaca Key, in southeast Florida. A table near the end of this sheet gives findings for other Florida area stations. All values in this list and in the table represent best estimates within wider possible ranges.

[2] A 100-year flood is defined as a flood reaching a fixed elevation so high that it is expected to take place with only a 1% chance in a year, here assuming a water elevation baseline at 2009 sea level. But because sea level is rising, the odds of floods reaching any fixed elevation become higher over time.

[3] This value comes from calculations assuming no past or future sea level rise from melting ice sheets and glaciers, or from ocean expansion due to warming. (Global average sea level has already risen about 8 inches since 1880, known to be mostly or all from warming. This analysis assumes 90% was from warming.) The calculation also assumes global warming has not affected nor will affect storms, surges or tides.

[4] Zervas, C. 2009. Sea Level Variations of the United States, 1854-2006, NOAA Technical Report NOS CO-OPS 053.

[5] Projections take into account multiple possible 1) future scenarios of heat-trapping gas emissions; 2) relationships between emissions and global warming; and 3) relationships between warming and sea level rise. See table for confidence ranges, and the full report Surging Seas for 2030 projections and further details.

[6] Many areas may be protected, to some degree, by sea walls, levees, forced drainage, or other features – for example, much of New Orleans already lies below the high tide line. This analysis presents vulnerability considering elevation only.

[7] A height near the middle of the range of 100-year flood levels calculated for Florida area stations.

[8] This is 50% of the coastal contiguous US population living less than 4 feet above the high tide line, and 13% of Florida's total population living at any elevation.

[9] Includes freshwater wetlands as classified by the National Wetlands Inventory, but not marine or estuarine ones. Excluding freshwater wetlands as well, the total dry land area at risk is 618,000 acres.

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