Appendix E: Supplemental Information for Analyses in Flooding Chapter

This appendix describes methods, data sources, and assumptions for the flooding analyses presented in Chapter 6 of the main report. First is the information for our detailed analysis of coastal flooding and children's homes. Second is information required for the discussion of emerging literature linking inland flooding with analogous effects on children's homes.

Detailed Analysis of Coastal Flooding and Children's Homes

This section provides supporting information for the detailed analysis of coastal flooding impacts to children's homes presented in Chapter 6 of the main report. It starts with a discussion of the National Coastal Properties Model (NCPM) and recent research that has relied on its methods and functionality. Then, the analytic steps in the report's future projection of coastal flooding risks to children are described in detail. After presenting the results of the analysis, this section concludes with limitations of the approach.

NATIONAL COASTAL PROPERTIES MODEL AND RELATED RESEARCH

The NCPM is a well-established tool for evaluating site-specific risks to coastal properties in the contiguous United States associated with sea level rise and storm surge. The model determines inundated areas at the 150 m grid resolution for each coastal county and estimates property losses and expected damage, considering local characteristics like elevation and proximity to tidally influenced waterbodies. Permanent inundation associated with sea level rise is modeled using a "modified bathtub" approach that ensures a hydraulic connection as sea levels rise. It assumes complete loss of structure value once the mean high or higher water level reaches the property, or if repeated storm surge damage reaches a threshold of a persistent 10% annual economic damage. Storm surge is modeled using historical tide gauge measurements from NOAA. Details and relevant data sources are provided in Table 1 below and in Neumann et al., referenced below.

The model also differentiates between "with" and "no additional" adaptation scenarios. Under the "with adaptation" scenario, properties are protected (e.g., via sea walls, beach nourishment, and elevating properties) when the avoided property damages associated with protection outweigh the costs of implementing the mitigation measures. Alternatively, the "no additional adaptation" scenario assumes no protective measures beyond those currently in place. More information about the NCPM can be found in Neumann et al., particularly the supplemental materials; and at www.epa.gov/cira, particularly the impacts by units of sea-level rise in Appendix B of the FrEDI documentation and in Technical Appendix H of EPA's report, *Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts*.

Over the last decade, several published studies have used the NCPM to analyze coastal flooding risks, including Lorie et al.,[1] Martinich et al.,[2] and Neumann et al.[3, 4, 5] Most recently, Neumann et al.[6] employed the NCPM to estimate the monetary value of damages to existing coastal infrastructure under different climate change scenarios. The authors found that the average annual damages to coastal properties could reach $44.1 billion (2018 dollars) by 2090 relative to a 2005 baseline with high emissions (RCP8.5) and no additional adaptation. The analysis in this report revisits the NCPM parameters used in Neumann et al. to identify the census blocks susceptible to flooding impacts and estimates the number of children in those census blocks that may experience the various risks associated with flooded homes.

ANALYSIS STEPS

Table 1 details the analytic steps, data sources, and assumptions used to estimate the number of children at risk of "temporary home damage and displacement" and "complete home loss" associated with coastal flooding (see Chapter 6 for details). As described in the table, this analysis summarizes impacts by increments of global mean sea level (GMSL) rise. For more information on how the analysis applies thresholds of GMSL, see methods described in Chapter 2 of the main report or Appendix A.

This analysis is limited to coastal counties. The report defines a county as "coastal" using the National Oceanic and Atmospheric Administration's (NOAA) definition of Coastal Watershed Counties.[7] However, this definition is limited in this analysis to the contiguous U.S. and excludes those counties incorporated in NOAA's list solely based on proximity to or bordering on the Great Lakes. 302 counties meet this definition.

Table 1: Analytic Steps in Climate Change Impacts on Coastal Flooding and Children's Homes Analysis

	Step	Data	Methods, Assumptions, and Notes
Baseline Risks	1. Establish the number of children living in homes experiencing damage from coastal flooding conditions in the baseline	Various property value, property type (e.g., residential) and undeveloped land data housed in NCPM and used in Neumann et al. (2021)	The baseline represents coastal flooding impacts to children without sea level rise and is centered on the year 2000. Temporary displacement: based on annual expected damage from storm surge that exceeds 2% (see Step 3a below for more detail) without changes in mean sea level. Home loss: based on an annual expected damage from storm surge that exceeds 10% (see Step 3a for more details) based on 2005 era mean sea level. The baseline excludes loss of home when the grid cell area is below the mean high or higher water (MHHW) in 2005 (that is, if the cell has been inundated already at the start of the simulation)
Future Climate Stressor	2. Forecast future coastal flooding from sea level rise and storm surge exceedance curves assuming "no additional adaptation" and "with adaptation"	Sweet et al.[8] for local relative rise in sea level to 2100, and Lorie et al. for historical storm surge exceedance curves. Both data sources are used in Neumann et al. and incorporated into the NCPM.	Local sea level rise accounts for local factors such as vertical land movement and effects of climate on ocean currents among others (see Sweet et al.). Storm surge height portfolios are estimated from tide gauge data. A distance weighting procedure for interpolating between individual tide gauges is employed to attribute tide gauge-level results to each coastal county. The NCPM simulates flooding in 302 coastal counties at the 150 m square grid between 2000 and 2100 assuming "no additional adaptation" and "with adaptation." Sea walls and beach nourishment protect areas in the landward direction, while the action of elevating buildings within a grid only protects the elevated building itself. Using the annual model output, the methodology averages across the six climate change projections around 11-year windows centered on arrival years of sea level points (25 cm to 125 cm, at 25 cm increments), as described in Chapter 2 of the main report and Appendix A.
Future Effects on Children	3a. Evaluate the number of homes at risk of temporary damage and displacement or complete loss	Various data housed in NCPM and used in Neumann et al.	Temporary displacement: This scenario assumes an annual expected property damage threshold of 2%.[*] This would mean annual repair costs would be roughly equivalent to the cost of the residential structure after a 50-year period. This level of damage is designed to represent a significant, but not necessarily fully threatening, level of risk; 2% average

Step		Data	Methods, Assumptions, and Notes
			expected damages (AED) is roughly twice the standard procedure for maintenance used by property managers as the expected routine maintenance cost for a structure. <u>Home loss:</u> Consistent with assumptions in Lorie et al. and Neumann et al., which recently revised and updated the adaptation and property at risk of exclusion from adaptation decision rules for the NCPM, this scenario assumes an individual 150 m grid cell is at high risk of complete loss if either (i) once it reaches an annual expected damage threshold of 10%, which indicates the cost of repair is higher than the value of the residential structure over a 10-year period or (ii) the property is below the MHHW level driven by sea level rise.
	3b. Estimate the number of children living in homes at risk of temporary damage and displacement or complete loss	See Chapter 2 of the main report and Appendix A for details on our population projection methods and data sources used throughout the analysis.	To determine the number of children living in the homes identified in Step 3a, this analysis maps each 150 m to census block groups, then applies the population at the census block group level (see Chapter 2 and Appendix A). There are roughly 220 grids per census block group in the coastal counties. The intermediate SLR scenario (1 meter of global mean rise by end of century) is used to determine the year from the population projection to use for the 50 cm and 100 cm scenarios. Within a census block group, the data do not distinguish between residential and non-residential structures, or determine which homes include children. To address this, the analysis assumes the number of children impacted relates to the proportion of property impacted within the census block group. This process assumes an even spatial distribution of children living across the census block group. For the temporary displacement analysis, the number of children affected are displayed in annual terms. For the home loss scenario, the analysis presents the cumulative number of children affected at or below the sea level rise threshold.
Notes: *1% and 3 % AED thresholds were also considered. At 100 cm of global mean sea level rise, the number of children impacted by a 1% AED is about 10% higher than at a 2% AED. At a 3% AED, the number of children impacted is about 15% fewer than at a 2% AED.			

EFFECTS ON CHILDREN RESULTS

Table 2 describes the overall results, assuming population growth consistent with EPA's ICLUSv2 population tool (see Chapter 2 and Appendix A). Table 3 demonstrates the influence of climate change by assuming a consistent U.S. population size using 2010 levels.

For coastal flooding, which is driven by sea-level rise, a GCM-specific approach to uncertainty analysis (i.e., high- and low- end estimates to accompany the average across climate models) used for other analyses is not applicable. Therefore, the uncertainty estimates for this analysis rely on Sweet et al. that reports global mean projections as well as the 17th and 83rd percentiles. This "likely range" of sea level rise is used in the flooding analysis to estimate the number of children impacted in the contiguous United States (U.S.) for each increment of sea level rise from 25 cm to 100 cm. The technique works well for the "Home Loss" scenario because the estimates are permanent and cumulative, and therefore increase as sea level rises increases. However, uncertainty bounds are not included for the "Temporary Displacement" scenario. This is because temporary displacement represents a shifting zone of influence that migrates landward as sea levels rise but excludes the zone where homes have already been lost. For this reason, the number of children impacted by temporary displacement fluctuates as seas rise by about +/- 20% but generally does not increase with higher sea levels.

Table 2: Total Number of Children Living in Coastal Areas with Homes Projected to Be Affected by Flooding (with Population Growth)

Global Mean Sea Level Rise Scenario	Temporary Displacement		Home Loss	
	No Additional Adaptation	With Adaptation	No Additional Adaptation	With Adaptation
25 cm	1,070,000	705,000	121,000 *(106,000 to 136,000)*	119,000 *(105,000 to 131,000)*
50 cm	1,014,000	629,000	185,000 *(159,000 to 437,000)*	169,000 *(149,000 to 216,000)*
75 cm	1,129,000	833,000	517,000 *(358,000 to 1,082,000)*	230,000 *(201,000 to 294,000)*
100 cm	1,079,000	956,000	1,133,000 *(477,000 to 2,962,000)*	300,000 *(223,000 to 603,000)*
125 cm	818,000	696,000	1,724,000	392,000

Notes: Number of children impacted relative to baseline risks: 662,600 children for temporary displacement and 48,800 children for home loss. The number of children affected by temporary displacement are annual estimates whereas the number of children affected by home loss are cumulative (i.e., once a home is lost, the number of affected children is included in the affected population in all subsequent sea level rise thresholds). The low and high estimates for home loss are characterized by uncertainty bounds from Sweet et al. that reports global mean projections as well as the 17th and 83rd percentiles. All other estimates in the table reflect averages across climate models.

Table 3: Total Number of Children Living in Coastal Areas with Homes Projected to be Affected by Flooding (2010 Population)

Global Mean Sea Level Rise Scenario	Temporary Displacement		Home Loss	
	No Additional Adaptation	With Adaptation	No Additional Adaptation	With Adaptation
25 cm	948,000	630,000	108,000 *(95,400 to 119,000)*	107,000 *(94,300 to 115,000)*
50 cm	758,000	502,000	151,000 *(134,000 to 298,000)*	138,000 *(126,000 to 171,000)*
75 cm	804,000	613,000	345,000 *(252,000 to 661,000)*	181,000 *(161,000 to 227,000)*
100 cm	795,000	699,000	690,000 *(322,000 to 1,886,000)*	231,000 *(176,000 to 469,000)*
125 cm	589,000	500,000	1,062,000	302,000

Notes: See Table 2.

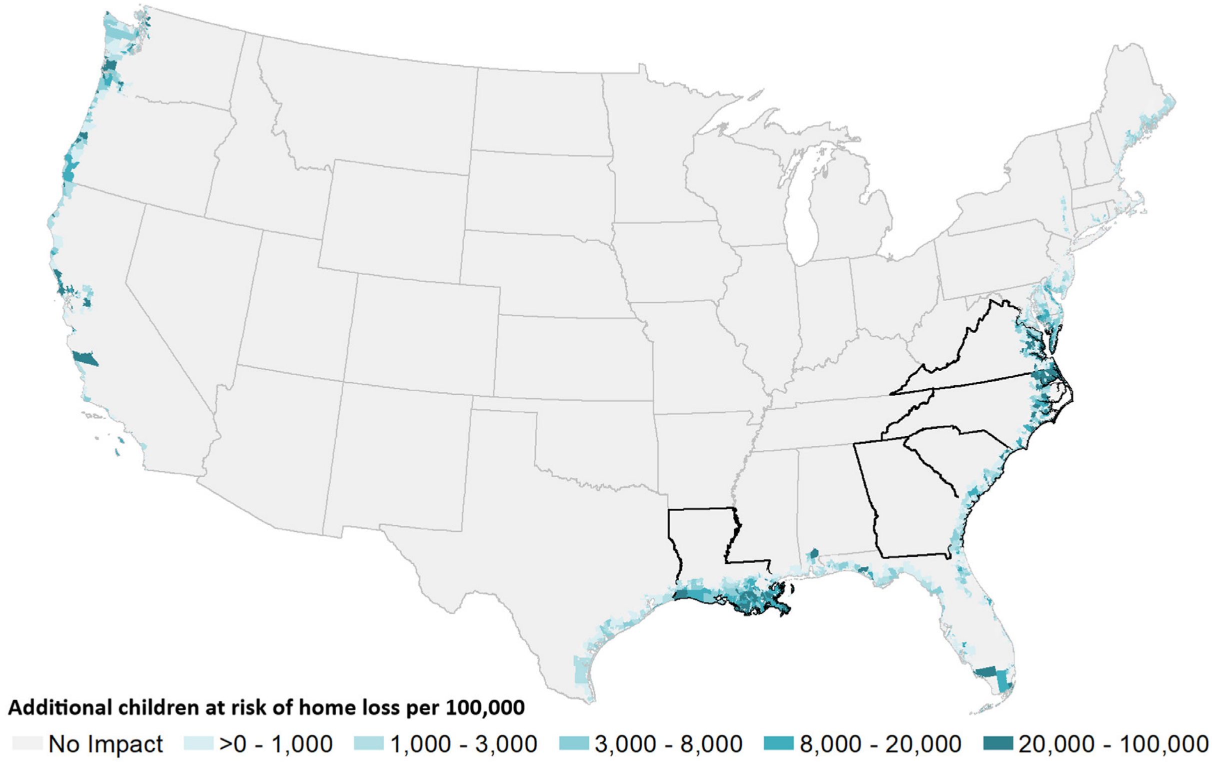
The next several tables and figures describe the spatial distribution of these impacts on children. Table 4 summarizes the number of children affected and the number of children per 100,000 living in coastal counties for both flooding impact severity, assuming no additional adaptive action. There is substantial variation across and within states in part because of differences in topography, and in part because of differences in the location of homes relative the projected future coastal flood plain. Figures 1 through 5 that follow highlight the distribution aggregated to census tracts from census block groups, recognizing this heterogeneity within and between states.

Table 4: Number of Children Living in Coastal Areas with Homes Projected to Be Affected by Flooding by State, Assuming No Additional Adaptation at 100 cm of Global Sea Level Rise

State	Expected Annual Temporary Displacement		Cumulative Home Loss	
	Total Children	Per 100,000	Total Children	Per 100,000
Alabama	5,000	3,100	2,000	1,600
California	61,000	500	70,000	600
Connecticut	21,000	2,600	2,000	300
Delaware	2,000	1,000	8,000	3,300
Washington, DC	1,000	500	0	0
Florida	263,000	4,700	731,000	12,900
Georgia	14,000	5,500	10,000	4,000
Louisiana	134,000	19,600	67,000	9,900
Maine	3,000	2,200	4,000	2,900
Maryland	21,000	2,100	16,000	1,600
Massachusetts	34,000	2,500	6,000	400
Mississippi	40,000	27,100	5,000	3,300
New Hampshire	1,000	900	2,000	1,500
New Jersey	90,000	3,100	21,000	700
New York	180,000	3,500	4,000	100
North Carolina	47,000	15,000	55,000	17,600
Oregon	7,000	2,200	6,000	1,700
Pennsylvania	1,000	100	1,000	100
Rhode Island	4,000	1,600	1,000	500
South Carolina	26,000	9,700	17,000	6,500
Texas	28,000	1,000	42,000	1,500
Virginia	76,000	5,800	45,000	3,500
Washington	21,000	1,500	18,000	1,200

Notes: Total number of children affected, and number of children affected per 100,000 children, living in coastal counties for each state. These assume no additional adaptation at 100 cm of global sea level rise.

Figure 1: Children Projected to Be Affected by Home Loss Per 100,000 Living in Coastal Counties Affected at 50 cm of Global Sea Level Rise (Assuming No Additional Adaptation)

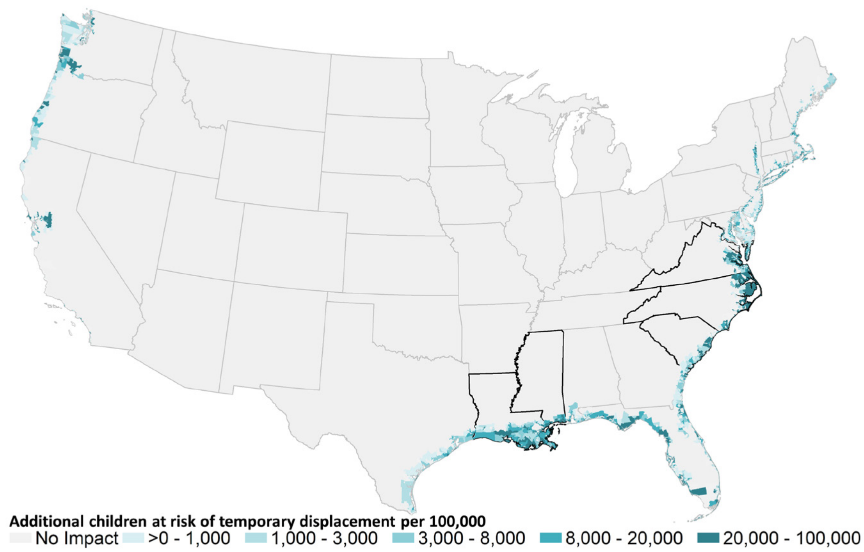


Top five states: NC (13,000), LA (4,000), SC (3,000), VA (2,000), and GA (1,000)

Note: This map describes the number of children per 100,000 projected to be affected by complete home loss from coastal flooding at 50 cm of global sea level rise assuming no additional adaptation measures are taken. Darker shading conveys higher impacts. The five states with the highest average impacts per 100,000 children are outlined in black. Only coastal counties are considered in this analysis, see Table 1.

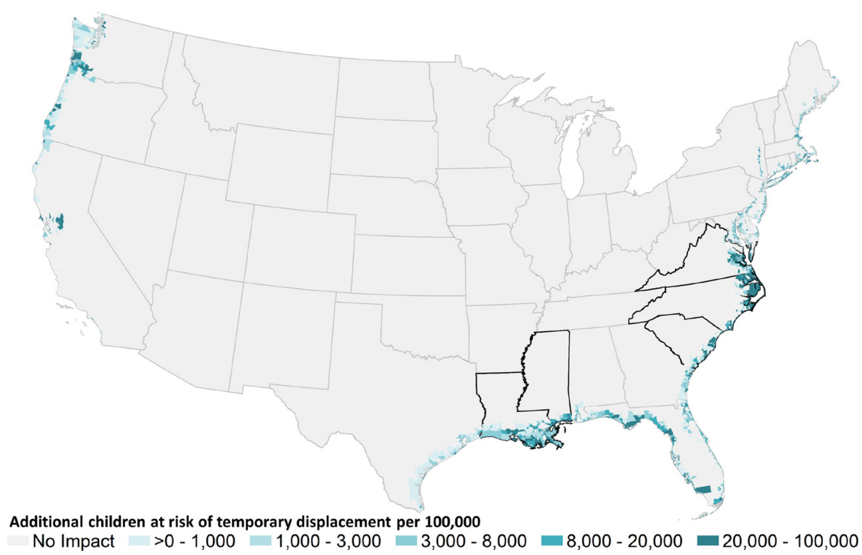
Figure 2: Children Projected to be Affected by Temporary Home Displacement Per 100,000 Living in Coastal Counties Affected at 100 cm of Global Sea Level Rise

No Additional Adaptation



Top five states: MS (27,000), LA (20,000), NC (15,000), SC (10,000), and VA (6,000).

With Adaptation

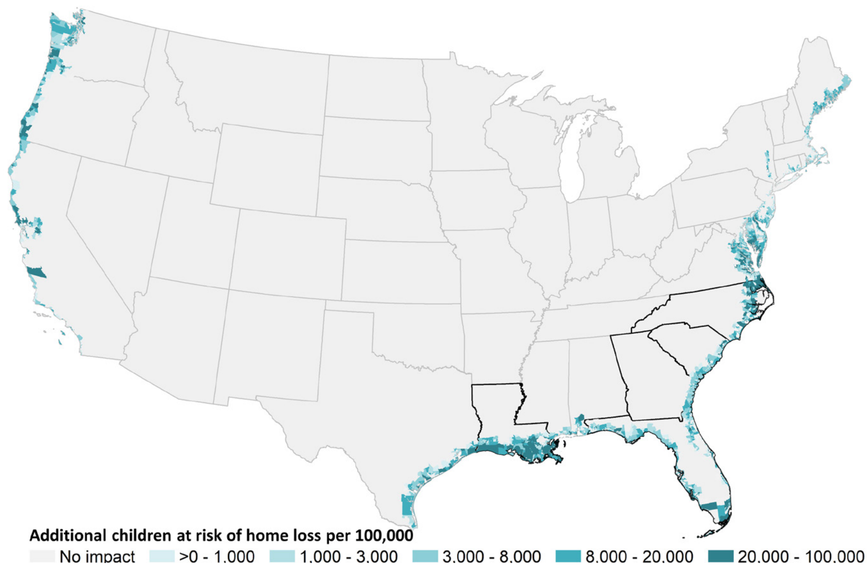


Top five states: MS (25,000), LA (18,000), NC (15,000), SC (9,000), and GA (5,000).

Note: These maps describe the number of children per 100,000 projected to be affected by temporary home displacement from coastal flooding at 100 cm of global sea level rise assuming both "no additional adaptation" and "with adaptation" scenarios. Darker shading conveys higher impacts. The five states with the highest average impacts per 100,000 children are outlined in black. Only coastal counties are considered in this analysis, see Table 1.

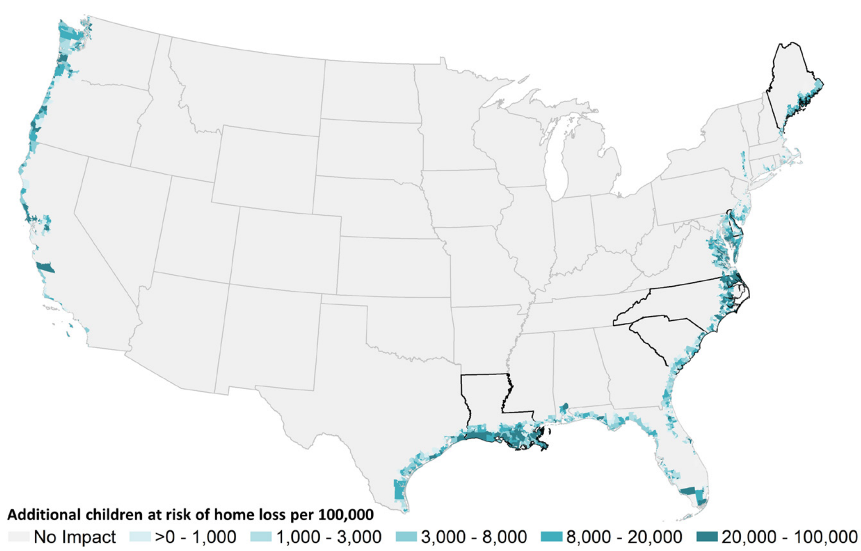
Figure 3: Children Projected to be Affected by Home Loss Per 100,000 Living in Coastal Counties Affected at 100 cm of Global Sea Level Rise

No Additional Adaptation



Top five states: NC (18,000), FL (13,000), LA (10,000), SC (7,000), and GA (4,000).

With Adaptation

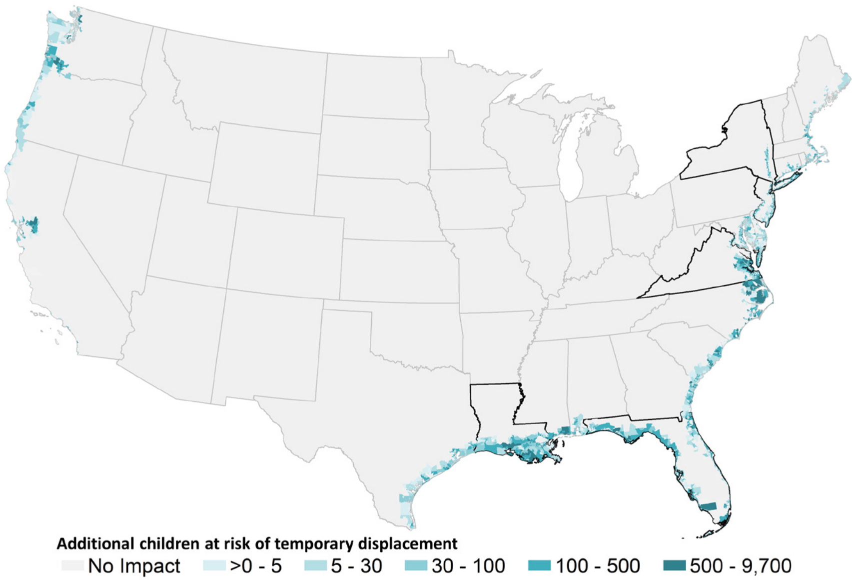


Top five states: NC (15,000), LA (6,000), SC (4,000), DE (3,000), and ME (3,000).

Note: These maps describe the number of children per 100,000 projected to be affected by complete home loss from coastal flooding at 100 cm of global sea level rise assuming both "no additional adaptation" and "with adaptation" scenarios. Darker shading conveys higher impacts. The five states with the highest average impacts per 100,000 children are outlined in black. Only coastal counties are considered in this analysis, see Table 1.

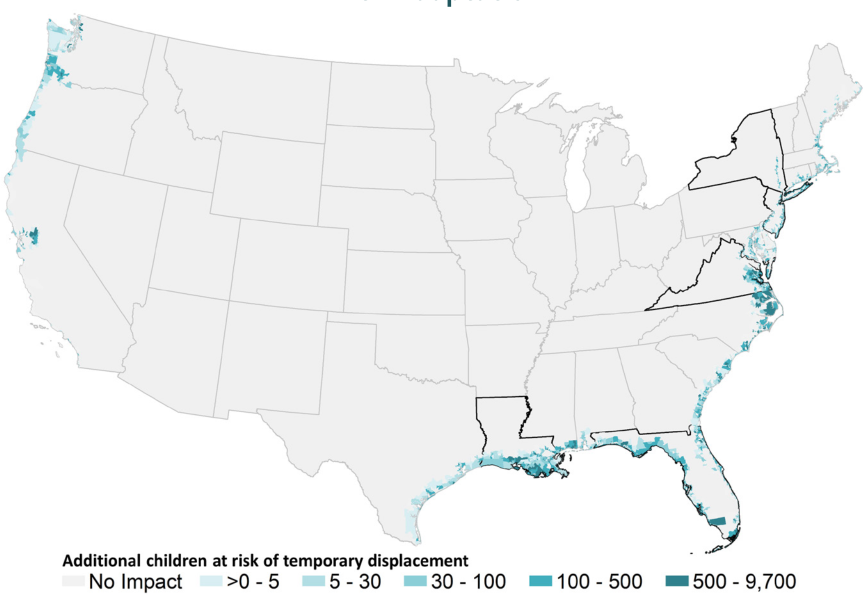
Figure 4: Total Number of Children Projected to be Affected by Temporary Home Displacement in Coastal Counties at 100 cm of Global Sea Level Rise

No Additional Adaptation



Top five states: FL (263,000), NY (180,000), LA (42,000), NJ (90,000), and VA (96,000).

With Adaptation

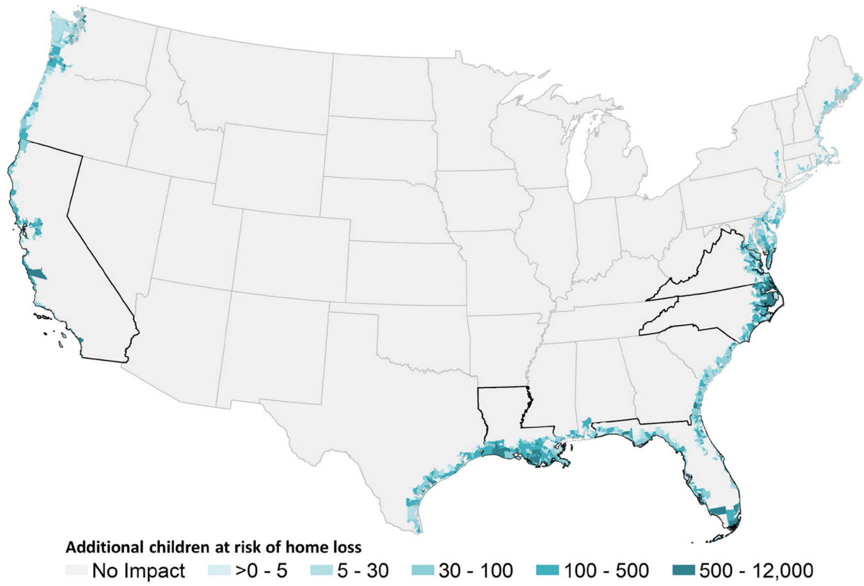


Top five states: FL (221,000), NY (176,000), LA (120,000), NJ (86,000), and VA (63,000).

Note: These maps describe the total number of children projected to be affected by temporary home displacement from coastal flooding at 100 cm of global sea level rise assuming both "no additional adaptation" and "with adaptation" scenarios. Darker shading conveys higher impacts. The five states with the highest total impacts are outlined in black. Only coastal counties are considered in this analysis, see Table 1.

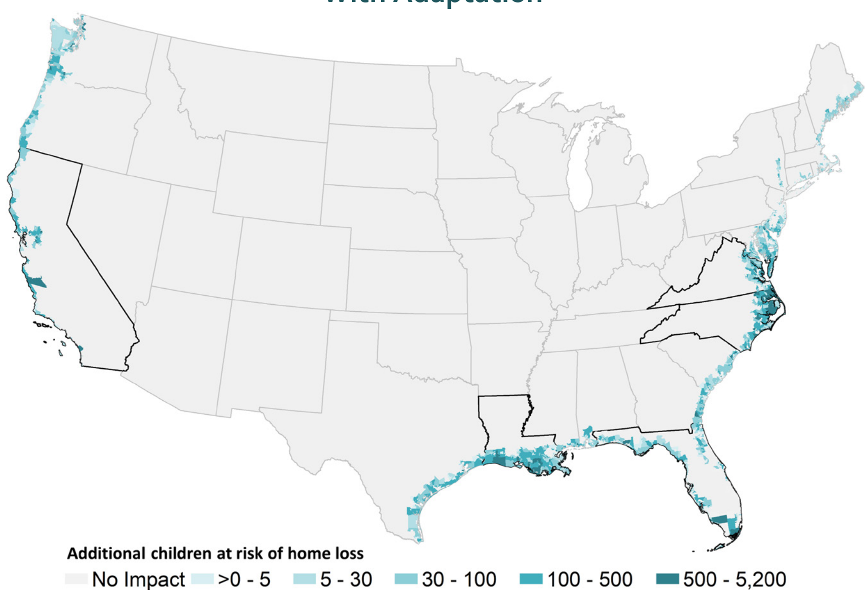
Figure 5: Total Number of Children Projected to be Affected by Home Loss in Coastal Counties at 100 cm of Global Sea Level Rise

No Additional Adaptation



Top five states: FL (731,000), CA (70,000), LA (67,000), NC (55,000), and VA (45,000).

With Adaptation



Top five states: FA (52,000), NC (48,000), LA (42,000), CA (32,000), and VA (32,000).

Note: These maps describe the total number of children projected to be affected by complete home loss from coastal flooding at 100 cm of global sea level rise assuming both "no additional adaptation" and "with adaptation" scenarios. Darker shading conveys higher impacts. The five states with the highest total impacts are outlined in black. Only coastal counties are considered in this analysis, see Table 1. Each map in this figure includes a different legend.

Figures 6 through 9 describe the results of the social vulnerability analysis (see Chapter 2 and Appendix A for methods, data sources, and assumptions). These results are presented for the "Complete Home Loss" and "Temporary Home Displacement" scenarios at both 50 cm and 100 cm of global sea level rise assuming both "no additional adaptation" and "with adaptation" for comparison. The estimated risks for each socially vulnerable group are presented relative to each group's "reference" population, defined as all individuals other than those in the group analyzed. Positive numbers indicate the group is disproportionately affected by the referenced impact. Negative numbers indicate the group is less likely to live in the areas with the highest projected impacts.

Figure 6: Social Vulnerability Analysis Results for Children Projected to be Affected by Temporary Home Displacement from Coastal Flooding

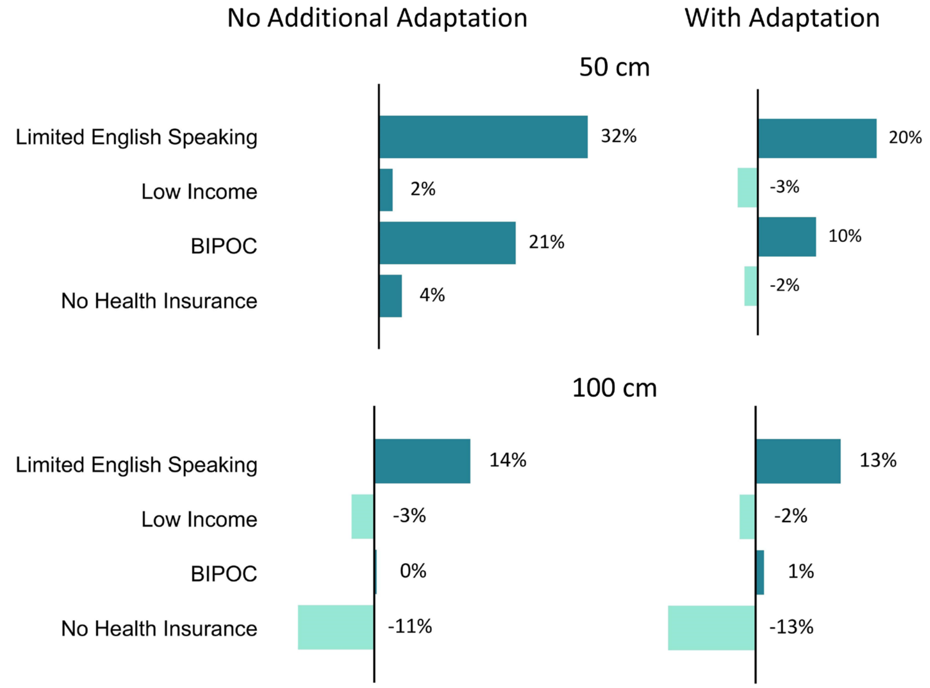


Figure 7: Social Vulnerability Analysis Results for Children Projected to be Affected by Temporary Home Displacement from Coastal Flooding, by Racial and Ethnic Group

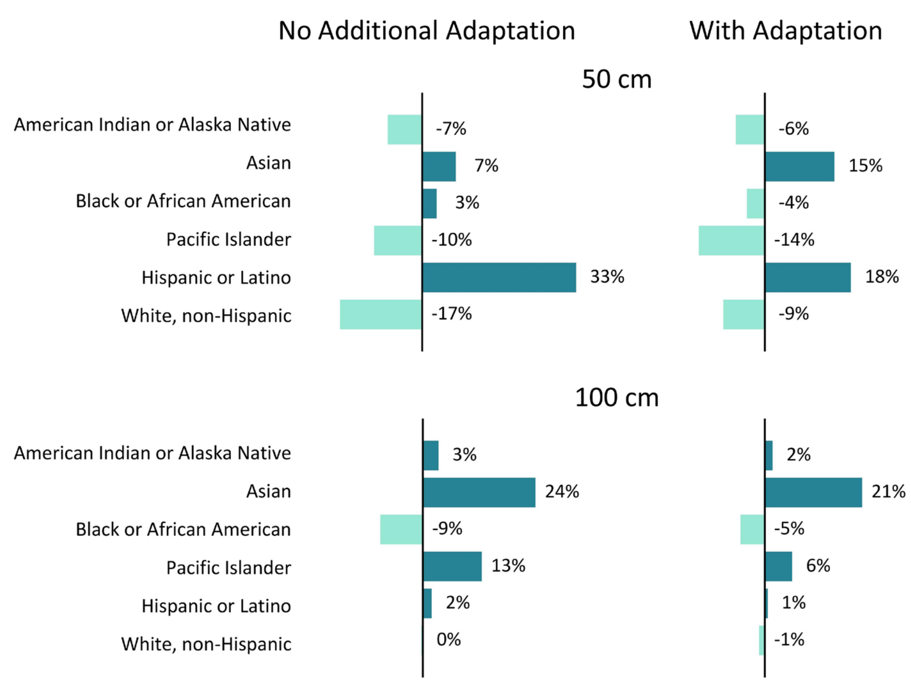


Figure 8: Social Vulnerability Analysis Results for Children Projected to Be Affected by Home Loss from Coastal Flooding

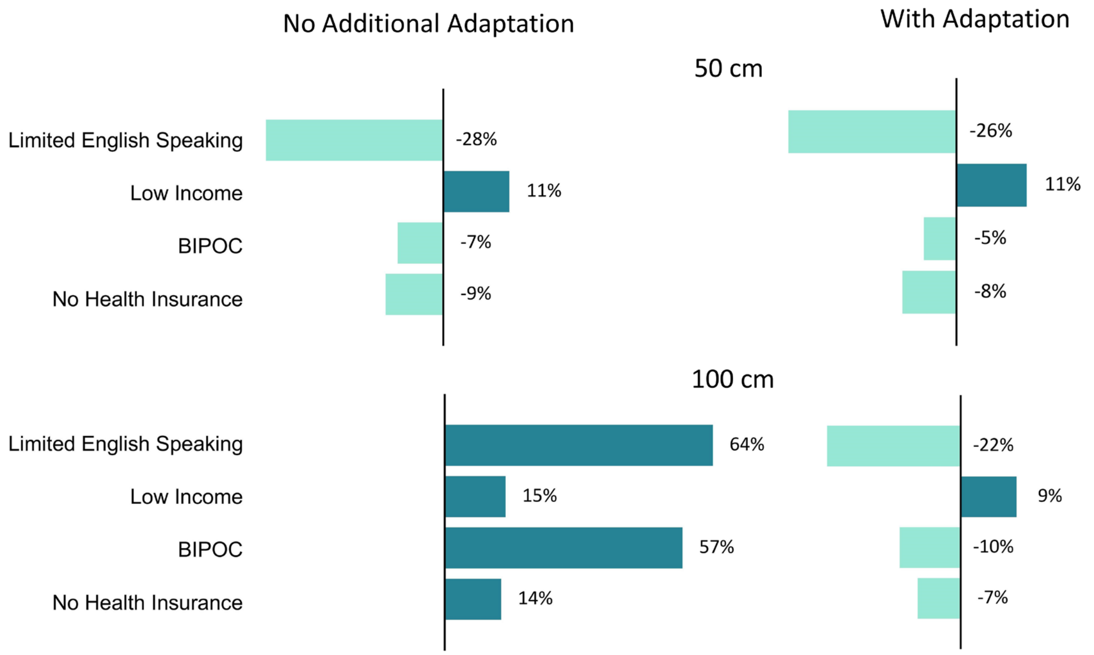
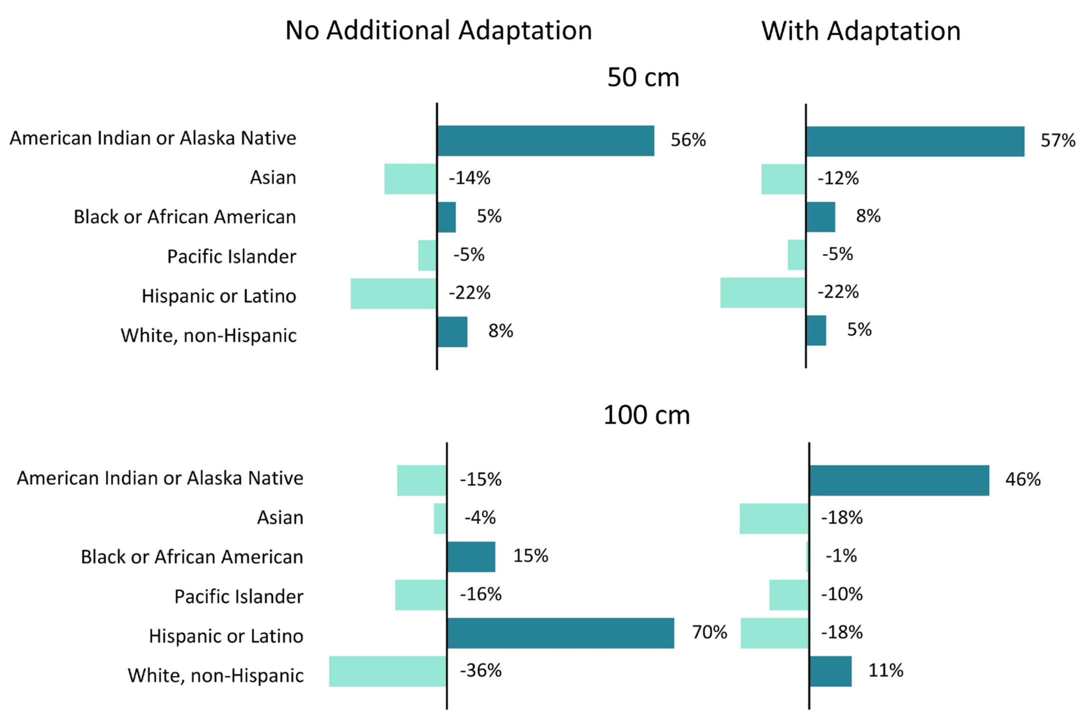


Figure 9: Social Vulnerability Analysis Results for Children Projected to Be Affected by Home Loss from Coastal Flooding, by Racial and Ethnic Group



LIMITATIONS

Below are several limitations of our analysis. See Neumann et al. and Lorie et al. for additional descriptions of limitations of the NCPM.

1. ***Although the NCPM evaluates impacts at grid cells that are 150 m square, the property characteristics in the NCPM are at the census block group level and not at the parcel level.*** Because of this, the methodology approximates the population affected by taking the portion of upland property area that is impacted and multiplying that by population for the block group. As such, the analysis does not consider different lot sizes within the block group, vacant lots, or houses with solely seasonal occupation.
2. ***The NCPM models risks to infrastructure, and the methodology makes several assumptions to link those risks to potential impacts on children.*** For instance, all 150m grids are assumed to contain residential structures and an even spatial distribution of children living in the 150m grids overlapping census blocks, the level at which population information is available.
3. ***Uncertainty surrounding the less-severe flooding scenario.*** As described in Table 1, the "temporary damage and displacement" flooding scenario is defined using an AED threshold of 2% with a 10-year planning horizon. This level was chosen based on expert judgment among the referenced study authors researchers well-acquainted with the NCPM, although it is not necessarily data-driven (see earlier in this Appendix for results of sensitivity analysis on this parameter).
4. ***Adaptation is a complex process and difficult to forecast.*** Many adaptation response decisions of this type in the coastal zone are not made with strict cost-benefit decision rules, particularly at local levels. Other factors may include local zoning bylaws or similar policies, future land-use plans, the presence of development-supporting infrastructure, or proximity to sites with high cultural value. However, the analytical framework of the NCPM provides a simple, benefit-cost decision framework that can be applied consistently for regional and national-scale analyses.
5. ***Increasing degrees of sea level rise and storm surge risks over time are likely to trigger changes in the demographics of populations at risk of facing flooding effects.*** For example, the owners of properties that are repeatedly damaged by storm surge may choose to sell. Those who have limited access to information regarding risks of purchasing near-coast property, who have strong sociocultural ties to a location, or who value coastal property may move into these areas once the property values drop, changing the demographics of the properties at risk, especially at higher rates of sea level rise. Such demographic changes are not accounted for in the modeling approach used in this analysis.
6. ***The distribution of demographics (e.g., age, race or ethnicity, income/poverty status, etc.) within the census block groups are not considered because that information is not available.*** However, there likely are differences in demographics for which this analysis is unable to account, and which may be relevant. For instance, the data may include the presence or absence of children in the households of shore-front property-owners and property-owners a few streets away from the beach.

7. *Storm modeling in the NCPM is simplified.* The NCPM uses a modified bathtub approach for simulating sea level rise-related inundation and storm surge flood zones and depth. While this was the only feasible approach at the national scale, local dynamic flood modeling techniques may show different patterns and depths of inundation and storm surge flood. Additionally, changes in topography, ground cover, and hydrology over time likely will alter flood and inundation patterns, especially later in the century. These details are not captured in the NCPM modeling featured in this section of the report.
8. *Children will experience the impacts of flooding differently.* This analysis highlights the number of children at risk of losing their home permanently and temporarily but cannot extend to how loss of home affects other aspects of public health.

DATA SOURCES

Table 5: Summary of Data Sources Used in the Coastal Flooding and Children's Homes Analysis

Data Type	Description	Data Documentation and Availability
Sea level rise and tide gauge levels	Sea level rise projections and tide gauge levels used to develop storm surge heights and probabilities.	National Oceanographic and Atmospheric Administration. 2017. Global and regional sea level rise scenarios for the United States. NOAA Center for Operational Oceanographic Products and Services, Technical Report NOS CO-OPS 083.
Domestic economic growth	Projection of future gross domestic product (GDP) from the Emissions Predictions and Policy Analysis (EPPA, v6) model. The projection of GDP growth through 2040 was taken from the 2016 Annual Energy Outlook reference case, combined with EPPA-6 baseline assumptions for other regions and time periods.	Chen, Y.-H. H., et al. The MIT EPPA6 Model: Economic Growth, Energy Use, and Food Consumption. MIT Joint Program on the Science and Policy of Global Change, Report 278, Cambridge, MA 2015. Available online at http://globalchange.mit.edu/research/publications/2892 U.S. Energy Information Administration, 2016: Annual Energy Outlook. Available online at https://www.eia.gov/outlooks/aeo
Infrastructure inventory data	Property value for each 150 m X 150 m coastal county grid cell is derived from compiled tax assessment values for land and structure, and address residential, commercial, industrial, institutional, and most categories of public land (excluding military installations).	Updates from Neumann et al. 2010.Available by county at CIRA2.0 sectoral impact data repository. Available at: https://www.indecon.com/projects/benefits-of-global-action-on-climate-change/
Elevation, land cover, land use, mean tidal levels	Various land and tidal characteristics for all coastal areas including elevation, land cover, land use, MHHW historical levels, compiled for use in the NCPM.	Neumann, J.E., P. Chinowsky, J. Helman, M. Black, C. Fant, K. Strzepek, and J. Martinich. 2021. Climate effects on US infrastructure: The economics of adaptation for rail, roads, and coastal development. Climatic Change, 167(44), doi:10.1007/s10584-021-03179-w. Available online at

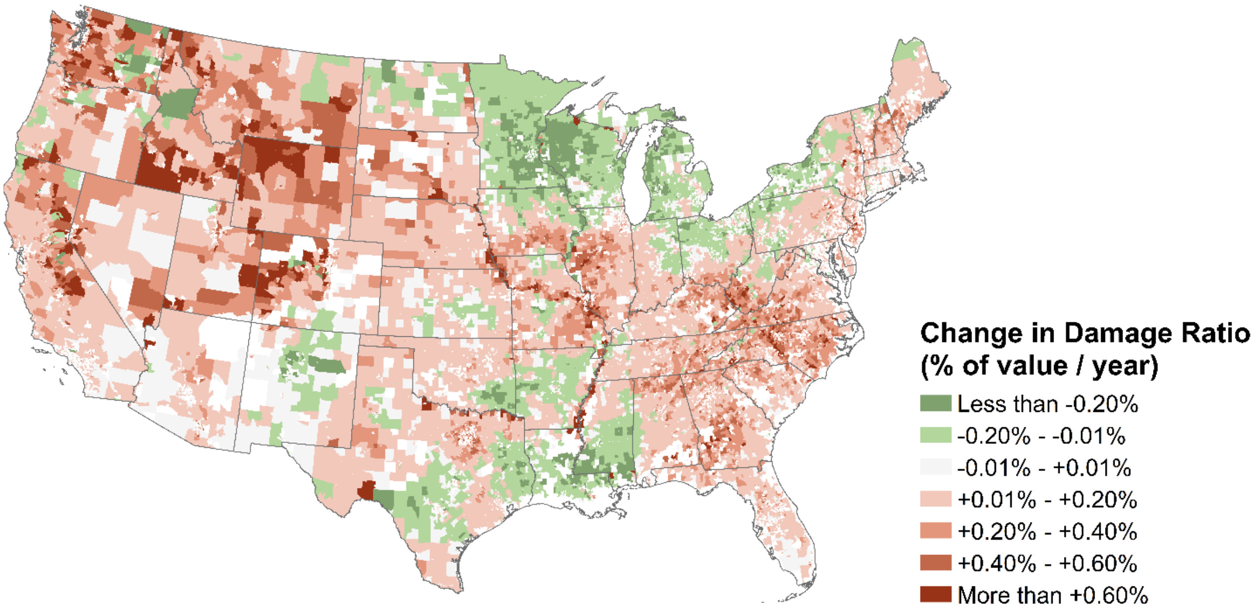
Data Type	Description	Data Documentation and Availability
		https://link.springer.com/article/10.1007/s10584-021-03179-w
Global sea level rise scenarios	*See Appendix A for data sources*	
Future population of children	*See Appendix A for data sources*	
Demographics for social vulnerability analysis	*See Appendix A for data sources*	

Inland Flooding and Children’s Homes

Chapter 6 highlights research about the possible effects of inland flooding on children’s homes. As outlined in the chapter, the method relies on results from Wobus et al.[9] and data by census tract and block group developed for U.S. EPA[10]. Note that the study also considered adaptation to flood risk in the form of floodproofing, property elevation, and property acquisition, but overall did not find a strong effect between climate change and the uptake of these measures relative to the present day. Figures 10 and 11 show impacts by census tract, but the analysis of children at risk was performed at the finer block group level. Block-group-level analysis is less precise than the National Coastal Property Model 150m grid analysis, which is the focus of the Chapter 6 detailed analysis, as flood zones tend to be smaller than block groups. The analysis of inland flooding nonetheless is informative of the number of children who might be affected by this additional stressor.

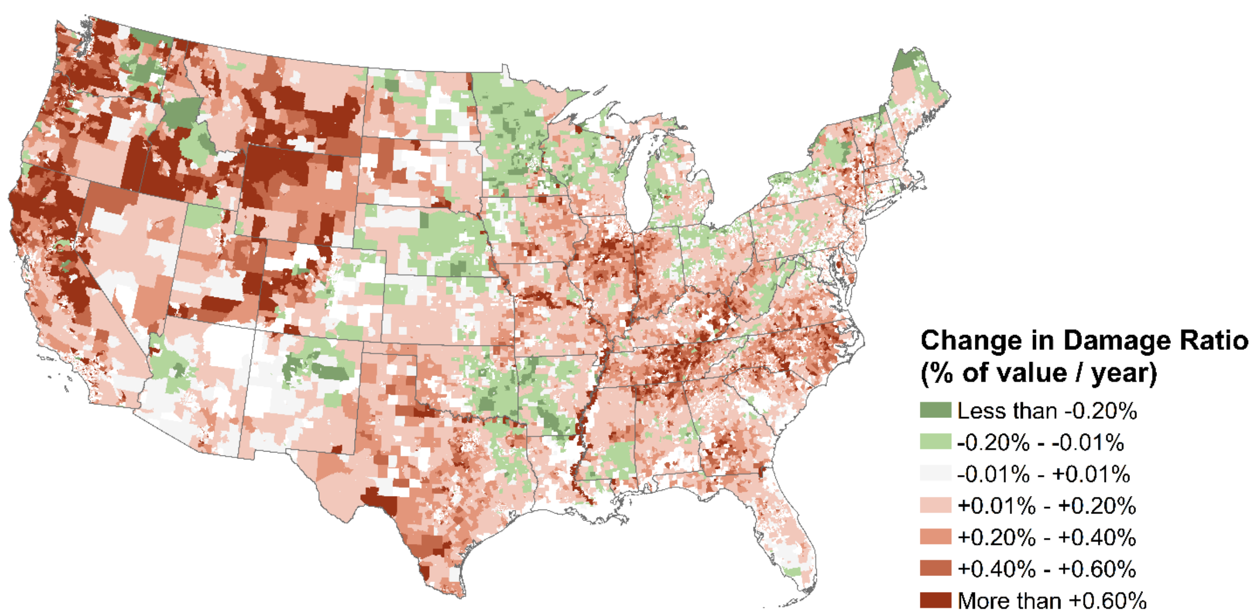
For temporary evacuation, the analysis uses a threshold 2% AED ratio for the block group. For more severe residential damage, a threshold 5% AED for the block group is applied. The use of lower thresholds for the inland flooding analysis compared to coastal flooding analysis reflects the high likelihood that not all homes in a block group may be affected by the same flood, and that more concentrated areas (of unknown dimensions) may be affected acutely at a property or neighborhood level. It also reflects that damages may represent a smaller proportion of the total block group structure value. Table 6 provides further details on the number of affected children at various AED thresholds for degrees of global warming.

Figure 10: Projected Annual Expected Damage Ratios for Inland Flooding at 2°C of Global Mean Temperature Rise



Source: Analysis of data from Wobus et al. (2021) and data by census block group

Figure 11: Projected Annual Expected Damage Ratios for Inland Flooding at 4°C of Global Mean Temperature Rise



Source: Analysis of data from Wobus et al. (2021) and data by census block group

Table 6: Projected Number of Children Potentially Affected by Inland Flooding at Varying AED Thresholds

Annual Expected Damage (AED) Ratio Threshold	Number of Children Affected at 2°C of Global Warming	Number of Children Affected at 4°C of Global Warming
Greater than 0.5%	156,000	880,000
Greater than 1%	237,000	894,000
Greater than 2%	199,000	569,000
Greater than 3.5%	97,000	233,000
Greater than 5%	17,000	56,000
Greater than 10%	0	876

Notes: These are the additional number of children affected as a result of increased global mean temperatures, relative to a 1986-2005 baseline. These are characteristically different from the coastal flooding analysis above which relies on more spatially resolved flood depths and therefore flood damage to estimate the number of children that experience these flood damage thresholds. The AED expressed here is an average across the entire census block group, where it's likely that many homes are unaffected, i.e., not in the floodplain.

DATA SOURCES

Table 7: Summary of Data Sources Used in the Coastal Flooding and Children's Homes Analysis

Data Type	Description	Data Documentation and Availability
Downscaled Hydrology Dataset	Daily routed flows at approximately 57,000 stream reaches across the CONUS for an ensemble of GCMs downscaled using the bias correction and spatial disaggregation method.	Reclamation: Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections: Release of Hydrology Projections, Comparison with Preceding Information, and Summary of User Needs, Prepared by the US Department of the Interior, Bureau of Reclamation, Technical Services Center, Denver, CO, 2014. Documentation and VIC hydrology data are available at ftp://gdo-dcp.ucllnl.org/pub/dcp/archive/cmip5/hydro/BCSD_daily_VIC_nc/
Property Flood Risk Data	Property-level flood risk dataset and model for the U.S.	First Street Foundation, 2020. First Street Foundation Flood Model (FSF-FM): Technical Documentation. Brooklyn, NY. Published 06/17/2020. https://assets.firststreet.org/uploads/2020/06/FSF_Flood_Model_Technical_Documentation.pdf Bates, P.D., Quinn, N., Sampson, C., Smith, A., Wing, O., Sosa, J., Savage, J., Olcese, G., Neal, J., Schumann, G. and Giustarini, L., 2020. Combined modelling of US fluvial, pluvial and coastal flood hazard under current and future climates. Water Resources Research, p.e2020WR028673. Armal, S., Porter, J. R., Lingle, B., Chu, Z., Marston, M. L., & Wing, O. E. (2020). Assessing Property Level Economic Impacts of

Data Type	Description	Data Documentation and Availability
		Climate in the US, New Insights and Evidence from a Comprehensive Flood Risk Assessment Tool. Climate, 8(10), 116. First Street data can be accessed on the Foundation's website: https://firststreet.org/flood-factor/
Depth-damage curves	Depth-damage curves for different occupancy classes of properties	Federal Emergency Management Agency. 2016. Multi-hazard Loss Estimation Methodology Flood Model HAZUS®MH MR3 Technical Manual. Developed by: Department of Homeland Security, Federal Emergency Management Agency -Mitigation Division. Washington, D.C. Under a contract with: National Institute of Building Sciences Washington, D.C. https://www.hsdl.org/?abstract&did=480580

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