Analyzing the impact of changes in flood risk on housing value: Evidence from a coastal county

Travis LaHue

FERC

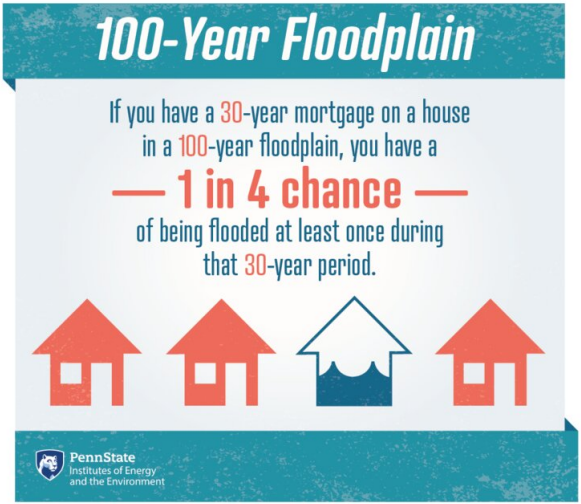
October 3, 2023

Disclaimer: I am speaking here today on behalf of myself, and not the Federal Energy Regulatory Commission (FERC). Anything presented reflects my own views and opinions and do not reflect the views of FERC.

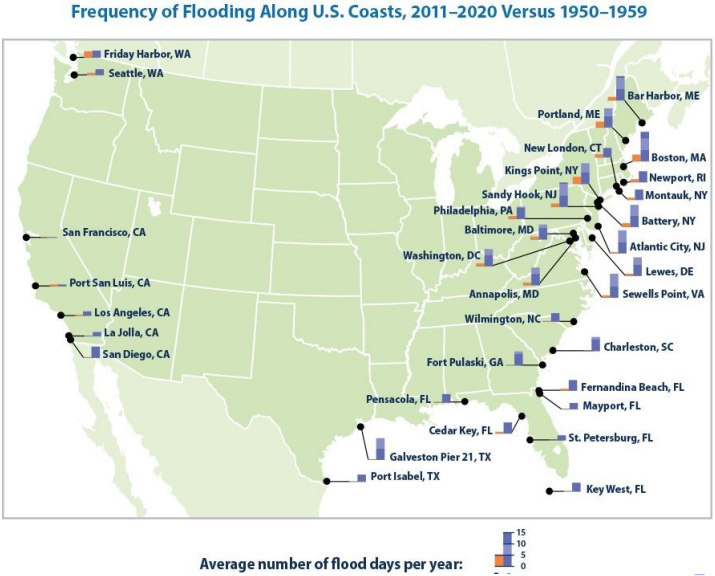
Research Question

- How does a change in flood zone status impact housing value?
- How do consumers respond to changes in stated risk and environmental amenities?
- Using the final property tax rolls from the Florida Department of Revenue, I create a repeat-sales sample covering 1995 - 2019.

Introduction: Flood Risk



Introduction: Coastal Flooding



Introduction

- Flooding causes the most property damage in the U.S. and is the most common natural disaster.
- One likely outcome of climate change and sea-level rise is an increase in 100-year flooding events.
- Some argue that for many coastal communities, the increase in severity and frequency of flooding events will be the most economically damaging component of climate change.

Previous Research: Flood Risk and Housing Value

Most studies have found evidence of some risk discount associated with a home being located inside of a 100-year floodplain. (Harrison et al., 2001);(Beltran et al., 2018)

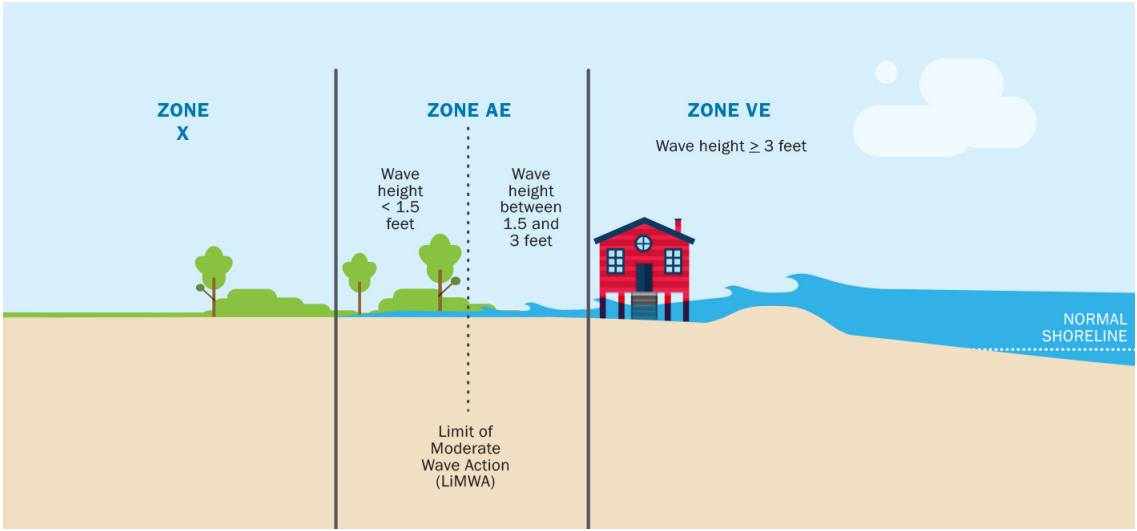
- FEMA does not archive old flood maps, presenting a challenge to analyzing how flood risk status changes over time.

Shr and Zipp (2019) estimate a price discount of 11% associated with a house being mapped into a flood zone, but no change in sales price when a house is mapped out of a flood zone.

FEMA's Flood Maps

- The National Flood Insurance Program began in 1968 to help reduce the impact of flooding on private and public properties by providing affordable flood insurance.
- FEMA, the administrator of the program, developed Flood Insurance Rate Maps (FIRMs) to help implement the program's requirements.
- The FIRMs define the location of the different flood zones and risk associated with each zone.

FEMA's Flood Zones



FEMA's Flood Maps

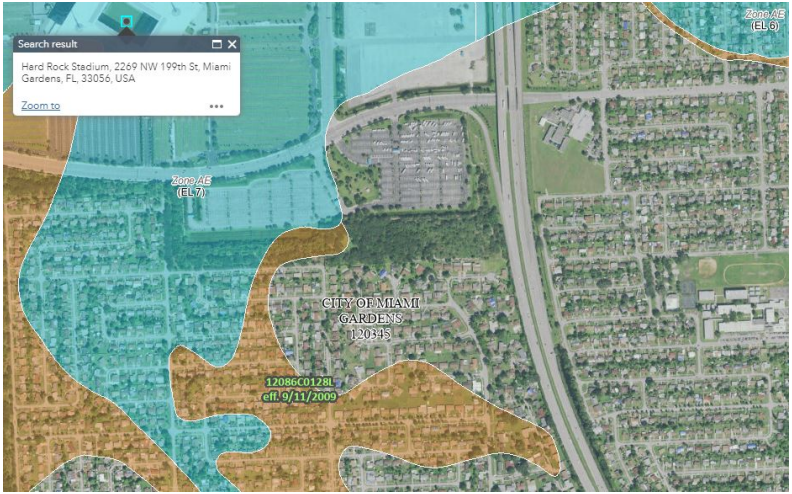
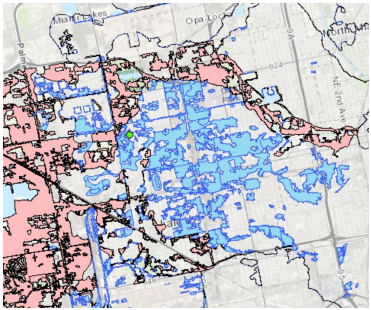


Figure: Flood zones around the Hard Rock Stadium in Miami Gardens

2009 Miami-Dade Flood Map Update



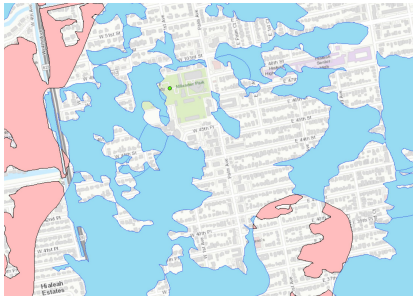


Figure: Changes in Miami-Dade's flood zones after the September 2009 update, the green dot is Ted Hendricks Stadium in Milander Park, Hialeah

Reforms to the NFIP

- The Flood Disaster Protection Act of 1973 instituted the mandatory purchasing requirement.
- In 1994, Congress passed the National Flood Insurance Reform Act.
- Part of this Act gave FEMA a mandate to review and update all flood insurance rate maps at least once every five years.
- However, due to funding constraints, many counties have flood maps that are older than five years.

Flood Map Revision Process

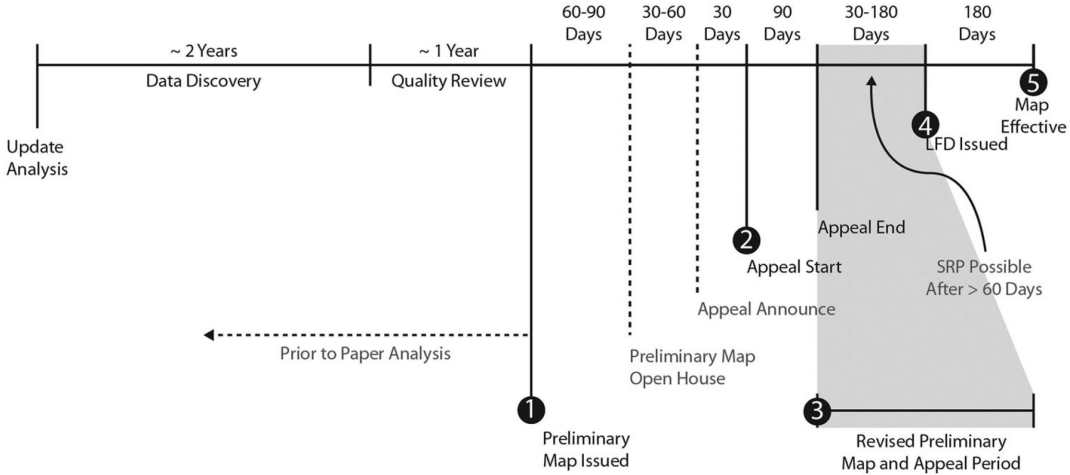
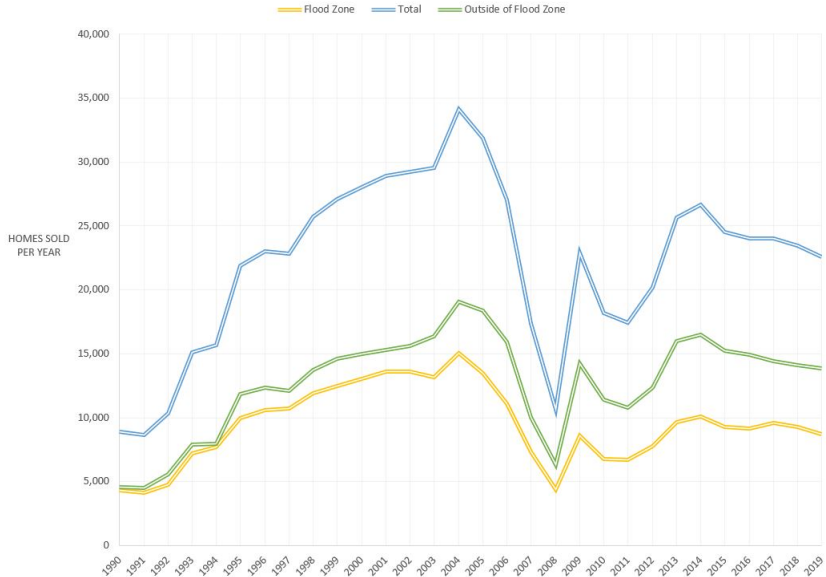


Figure: Standard Flood Insurance Rate Map Adoption Process Source: (Wilson and Kousky, 2019)

Brief Overview of the Hedonic Method

- The hedonic price method is often utilized to investigate the economic value of non-market amenities, such as environmental quality.
- The hedonic model estimates marginal implicit prices of different housing characteristics.
- When estimating this type of model, one of the primary concerns is omitted variable bias from unobserved housing characteristics, such as the slope of the terrain of the property.
- To overcome any potential omitted variable bias, I employ parcel-level fixed effects.

Sales Over Time By Flood Zone Status



Primary Estimating Equation

To estimate the impact of being mapped into or out of a flood zone, I estimate the following hedonic property model:

$$\begin{aligned} lnSP_{it} = \beta_0 + \beta_1 mapped\ in_{it} + \beta_2 mapped\ out_{it} \\ + \beta_3 X + \tau_t + \delta_i + \varepsilon_{it} \end{aligned} \tag{1}$$

Where

- $\beta_1 mapped\ in_{it}$ is a dummy variable equal to one if house i is mapped into a flood zone and the transaction occurs after the flood map update.
- $\beta_2 mapped\ out_{it}$ is a dummy variable equal to one if house i is mapped out of a flood zone and the transaction occurs after the flood map update.
- δ_i represents the parcel-level fixed effects.

Table 1: Primary Results

Outcome variable: ln sales price	
Mapped in	-0.1473***
	(.0091)
Mapped out	-0.0583***
	(.0062)
Adj.R^2	0.8230
Observations	606,424
Groups	164,727
Fixed effects	parcel
Sample	repeat sales

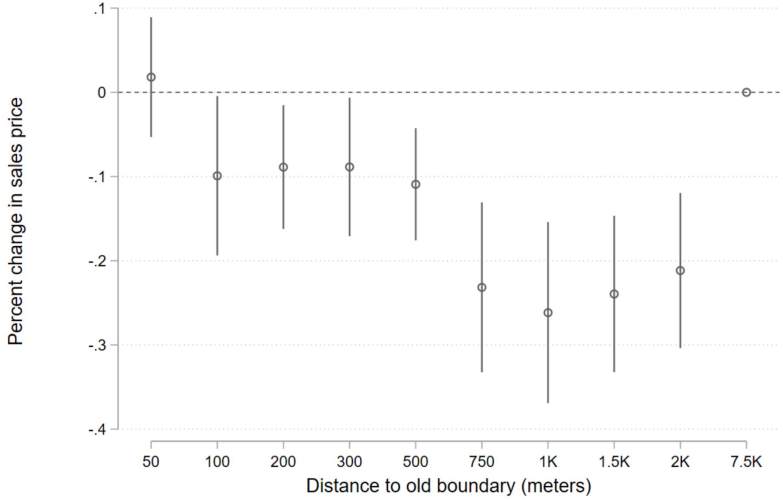
[1] ***, **, ** represent significance at the 1%, 5%, and 10% levels. [2] errors are clustered at the block group level.

Additional Specifications: Distance to Old Flood Zone Boundary

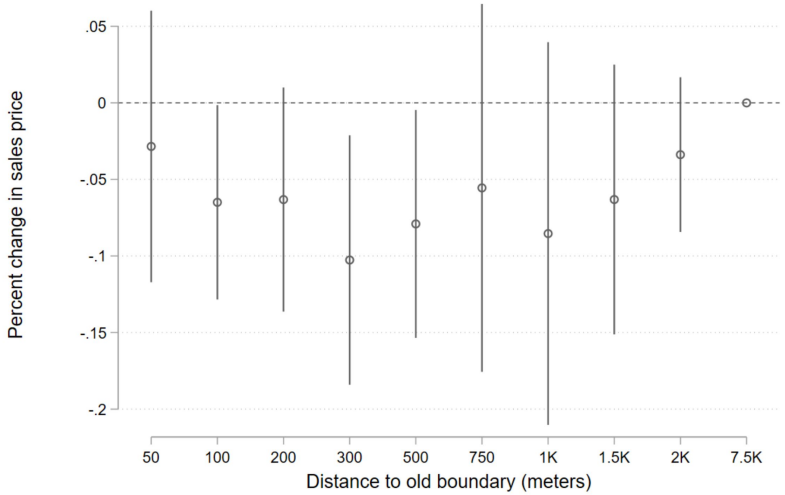
$$\begin{aligned} lnSP_{it} =& \theta_0 + \sum_{\tau=0}^{T} \beta_\tau map\ in_{i\tau} * distance\ bin_{i\tau} \\ &+ \sum_{\tau=0}^{T} \phi_\tau map\ out_{i\tau} * distance\ bin_{i\tau} + \gamma X + \tau_t + \delta_i + \varepsilon_{it} \end{aligned} \tag{2}$$

- The coefficients of interest are β_τ and ϕ_τ; they estimate the impact distance to the old flood zone boundary has on sales price.
- They are constructed by first creating a series of dummy variables equal to one if the house is within a certain distance from the old flood zone boundary.
- Then, these dummy variables are interacted with the dummy variables for being mapped into and out of a flood zone.

Proximity to Old Flood Zone Boundary: Mapped In



Proximity to Old Flood Zone Boundary: Mapped Out



Additional Specifications: Heterogeneous Effects

$$\begin{aligned} lnSP_{it} =& \beta_0 + \beta_1 map\ in_{it} + \beta_2 Minority\ *\ map\ in_{it} + \beta_3 map\ out_{it} \\ &+ \beta_4 Minority\ *\ map\ out_{it} + \beta_5 X + \tau_t + \delta_i + \varepsilon_{it} \end{aligned} \tag{3}$$

Where *Minority* is a dummy variable = 1 if the percent minority in the parcel's block group is higher than the sample average, and zero otherwise (using 1990 Census data).

Heterogeneous Effects: Results

Model	
	1
Variable	ln sales price
Map in	-0.0343**
	(.0138)
Map in x Minority block group	-0.1565***
	(.0173)
Map out	-0.0137
	(.0085)
Map out x Minority block group	-0.0807***
	(.0113)
Adj. R-squared	0.8231
Observations	606,424
Groups	164,727
Fixed effects	parcel

[1] ***, **, ** represent significance at the 1%, 5%, and 10% levels. [2] errors are clustered at the block group level.

Conclusion

- Given Florida's large exposure to current and future flood risk, it is important that its residents have the most accurate information about the level of flood risk they face.
- Back of the envelope calculations indicate the property values for all impacted transactions declined by as much as $1.2 billion, which has many implications for local government policy.
- Since 2016, Florida has experienced more devastating hurricanes, and with the recent rise in housing prices, it's becoming more costly to rebuild after these storms.

Thank you!

You can reach me at travis.lahue@ferc.gov

You can find my most recent draft here:

www.travislahue.net/research

Appendix

Flooding in Miami-Dade

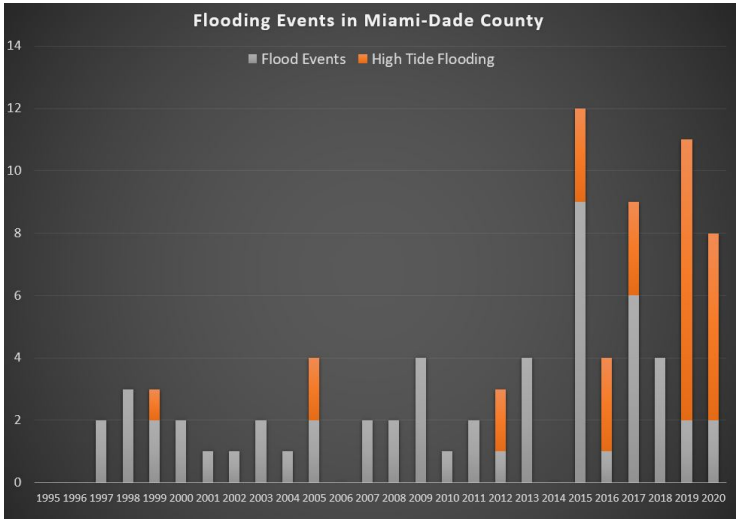


Figure: Source: NOAA's Storm Events Database, Virginia Key Tide Station

Identification

- The primary identification assumption is that absent flood zone status, homes on either side of the flood zone boundary have similar characteristics and thus have similar housing value.
- This congressional mandate generates plausibly random variation in flood zone status near the boundary of the 100-year floodplain when a new flood map is issued.

Data

I incorporate three primary datasets:

1. The final property tax data files from the Florida Department of Revenue.
2. Newly digitized FIRMs.
3. Decennial census data from 1990, 2000, and 2010.

- I include only residential, arms-length transactions of single family homes greater than \$5,000.
- I drop all parcels that only have one transaction during the time period, resulting in 606,424 transactions from 164,727 parcels.
- Every sale price is indexed to the fourth quarter of 2012 for the Miami-Dade MSA.

The Insurance Effect vs. the Saliency Effect

- The average annual flood insurance premium in Miami-Dade County is approximately $1,000, and the net present value of this premium in perpetuity (assuming a 5% discount rate) is $20,000.
- The estimate from Table 1 indicates that a home mapped into a flood zone experiences an average decrease in sales price of $45,779 (using the average transaction value of $310,791).
- This suggests the saliency of flood risk is negatively affecting sales price following a flood map update.
- The estimate from Table 1 implies that approximately 44 percent of the total flood risk discount can be attributed to the insurance effect, while 56 percent of the overall effect can be attributed to the saliency effect.

Distance Bin Construction

The distance bins were constructed as follows:

- (0m-50m], (50m - 100m], (100m - 200m], (200m - 300m], (300m - 500m],
- (500m - 750m], (750m - 1000m], (1000m - 1500m], (1500m - 2000m], (2000m - 7500m]
- Average distance: 770.8 meters
- 10% of sample $<$ 67 meters
- 25% of sample $<$ 181 meters
- 50% of sample $<$ 455 meters
- 75% of sample $<$ 1066 meters
- 90% of sample $<$ 1959 meters

Robustness Checks

- I dropped every transaction within 50 meters of the old flood zone boundary and then replicated Table 1; the coefficient estimates were significant and similar in magnitude.
- The primary results are robust to using a winsorized sample, as well as a sample that drops the top and bottom fifth percentile groups according to sales price.
- The distance results from equation (3) are robust to different distance bin cutoffs.