Sea Level Rise Indicators in Broward County: A Quick Look at Tidal Records and Recurring Flood Events

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1. Introduction

Numerous authors ([1], [2], and [3]) report sea level rise along the South Florida Atlantic Coast. Sea level rise is occurring locally, but is hard to quantify since it is caused by a number of factors including melting glaciers, thermal expansion of water, subsidence or the compaction from sediment loads, and localized depression from the extraction of ground water. The long-term NOAA tide gages provide the necessary information to determine vertical datums such as Mean Sea Level (MSL) and Mean Lower Low Water (MLLW) and rates of sea level rise through the analysis of water level fluctuations referenced to benchmarks. For these reasons, we took a quick look at water level fluctuations occurring at NOAA Tide Station 8723214 located in Virginia Key, FL This station was established in 1994 and provides the closest water level gage to associate observed and predicted tides with recurrent floods in Broward County, Fl. MLLW is 3.1 m.

2. Methods

Water level fluctuations at Virginia Key, FL were compared to some available photographs taken by the Broward County Environmental Planning and Community Resilience Division (Fig. 1). The photograph depicts a period of recurring flooding that occurred during spring high tides at Mola Avenue and Isle of Capri Drive off of Las Olas Boulevard, one of the lowest areas in Fort Lauderdale.

Periods of King tides (i.e., perigean spring tides) bring even higher water levels several times per year, and they can cause local tidal flooding.

3. Conclusions

Tides vary on timescales ranging from hours to years due to astronomical forces. To make accurate records, tidal reference stations measure the water level over long periods of time. Tide gauges ignore variations caused by waves with periods shorter than minutes. While tides are usually the largest source of short-term water level fluctuations, sea levels are also subject to forces such as wind and barometric pressure changes, resulting in storm surges, and subsidence, especially near the coast.

Images of flooding along with the graphs showing the excess water levels above astronomical tides suggest that non-tidal factors contribute to recurring flooding. Owing to sea level changes that we see in the residual record there is a relative rise in sea level surrounding Mola Avenue in Fort Lauderdale, Fl. High tides following the New Moon at 08:00 AM on October 7, 2010 were 1.134m above MLLW. The corresponding tidal predictions were 0.928m. The difference between observed and predicted tides was 0.21 m.

Since average daily water levels are rising, flood tides are extending further inland than in the past. King tides accentuate the impact of sea level rise in coastal regions such as Fort Lauderdale. This directly impacts quality of life and property value for residents living in low lying areas. We can estimate the amount of flooding that will occur by looking at the tidal and non-tidal forces that impact sea level. These factors are occurring at different temporal scales and include sea level rise, storm surge even from the passage of favorable fronts, and the timing of astronomical higher high tides. Factors such as inadequate sea walls further exacerbate the flooding. Tide synchronized photographs also provide useful calibration and validation data for numerical model studies.

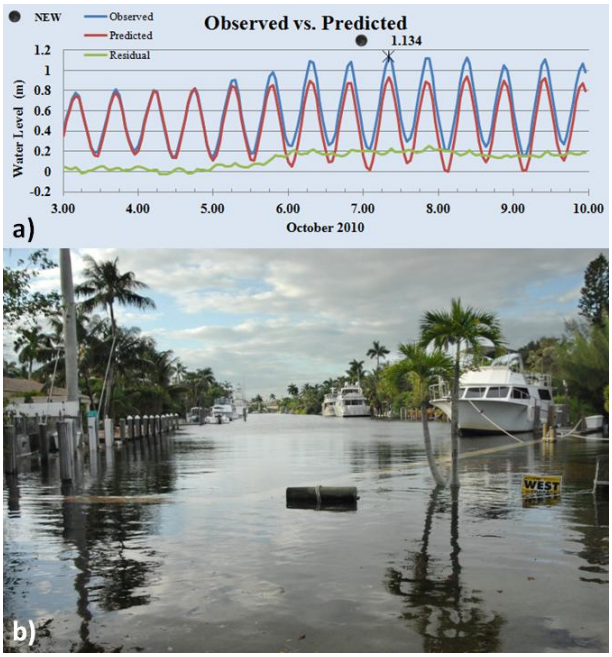

Figure 1. Mola Avenue under extreme high tide. a) Water levels from October 3-10, 2010. b) Picture of flooding at 8:18 AM EDT on October 7, 2010

4. References

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