Beyond 2100: Committed Sea Level Rise in South Florida Produced by 21st Century Global Temperature Rise

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‘It’s tough to make predictions, especially about the future.’

Yogi Berra, NY Yankees.
Temperature is Increasing because of human activities which introduce greenhouse chemicals into our atmosphere.
Temperature Anomaly

Predictions by the IPCC suggest that we will reach a temperature anomaly of +2° to 4° Centigrade by the end of the 21st Century. The temperature is dependent on our behavior.

Current predictions for 2100 range from 0.5 to 2 meters of sea level rise.

But SLR does not stop at the year 2100. Because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

We have already created an anomaly of +0.8 degrees C.
Temperature Anomaly vs. Sea Level Rise Commitment

Commitment levels are achieved when the ocean equilibrates to the combined effects of an expanding warming ocean, melting of land ice primarily at the poles, methane release, and numerous other smaller drivers.

Levermann et al. in 2013 calculated that the commitment level relationship is:

1° C = 2.3 meters (7.5 feet) of committed SLR

- 1° C (1.8° F) = 2.3m (7 ft.)
- 2° C (3.6° F) = 4.6m (14 ft.)
- 3° C (5.4° F) = 6.9m (21 ft.)
- 4° C (7.2° F) = 9.2m (28 ft.)
Southern Florida Future Sea Level Rise Maps

The maps on the following slides show 1 ft. level inundation layers. They cover the commitment levels for up to 4° C of warming.

When looking at them, remember the rate of temperature rise is much faster than the rate at which the ocean responds with higher sea levels.

The timing between layers is likely variable because we expect SLR jumps instead of smooth increases.

Higher levels will take much more than a century to be realized.
Southern Florida Topography

All lands above 0 feet shown (NAVD88 datum).

Currently, the lowest elevations along the coast (2 ft. or less) are at risk for Spring Tide flooding. These “nuisance tides” occur approximately once a month now, but will become more frequent with time.

Topo data source: SFWMD, 2015
Southern Florida with 1 foot of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.1 degrees C which already occurred in the late 1970s.

This level will be realized between 2018 and 2024: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
Southern Florida with 2 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.3 degrees C which occurred at the end of the 1980s.

This level will be realized between 2031 and 2042: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University
2015
Southern Florida with 3 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.4 degrees C which occurred in the mid-1990s.

This level will be realized between 2048 and 2066: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.
Southern Florida with 4 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.5 degrees C which occurred around 2000.

This level will be realized between 2074 and 2100: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.
Southern Florida with 5 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.7 degrees C which occurred in the early 2010s.

This level will be realized between 2084 and 2112: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
Southern Florida with 6 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.8 degrees C which occurred in the mid-2010s.

This level will be realized sometime between 2094 and 2122: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University
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Southern Florida with 7 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 0.9 degrees.

This level will be realized in the late 21st or early 22nd Century: the exact timing is uncertain because warming (expanding) the ocean and melting of polar ice to equilibration are slow non-linear processes.
Southern Florida
with 8 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.1 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 9 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.2 degrees C.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 10 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.3 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 11 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.5 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
Fix the maps which have upside down legends.

harlemp, 10/13/2015
Southern Florida with 12 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.6 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 13 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.7 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 14 feet of Sea Level Rise

This is the approximate commitment level for a temperature rise of 1.9 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 15 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.0 degrees C.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 16 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.1 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
Southern Florida with 17 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.3 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University
2015
Southern Florida with 18 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.4 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
Southern Florida with 19 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.5 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 20 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.7 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 21 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.8 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University
2015
Southern Florida with 22 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 2.9 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University
2015
Southern Florida with 23 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.1 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University
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Southern Florida with 24 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.2 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 25 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.3 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 26 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.5 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 27 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.6 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
Southern Florida with 28 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.7 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 29 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 3.9 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.
Southern Florida with 30 feet of Sea Level Rise

This is the estimated commitment level for a temperature rise of 4.0 degrees.

This level will take a long time to realize because warming (expanding) the ocean and melting of polar ice to equilibration are much slower processes.

Map by Peter W. Harlem
GIS-RS Center and SLSC, Florida International University 2015
The End?
“The Future is an ever-changing place, a point of transition between what is and what will be. Obscured by a veil of possibilities, it contains all the joys of heaven, and all the terrors of hell.

From: A Solder’s Duty by Jean Johnson

Remember we are already at 0.8 degrees C!