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Sea level changes along the east coast of United States: links to the Florida Current transport and temperature

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The goal of this study is to assess attributions of sea level changes in areas along the east coast of US. Analysis of sea level records derived from 42 tide gauges along the east coast of the United States shows that during 2010-2015 accelerated sea level increase has been observed south of Cape Hatteras at rates exceeding 25 mm per year (approximately 5 times the global average of ~5 mm per year for the same period). To examine potential mechanisms causing observed changes of the regional sea level, a suite of ocean observations is analyzed including XBT transects, hydrographic surveys across the Florida Straits, telephone cable-derived Florida Current transports, and sea level data from satellite altimetry and tide gauges. During 2010-15, the Florida Current transport was slightly below the long-term average, contributing to higher than mean sea level along the U.S. coast, since due to geostrophic balance, higher (lower) Florida Current transport is generally linked with lower (higher) sea level along the U.S. coast. However, changes in Florida Current transport does not account for the observed rates of sea level increase during 2010-2015. Analysis of XBT and CTD profiles, on the other hand, has revealed substantial warming of waters carried by the Florida Current during the period. The entire water column in the Florida Straits shifted from a cold regime during 2010-2013 to a warm regime during 2014-2017, with larger temperature anomalies observed between the surface and 300 m. **The main finding** of this study is that during 2010-2015 warming of the Florida Current accounts for a thermosteric sea level increase of 19 mm per year, which explains most of the sea level trend observed by tide gauges south of Cape Hatteras, where the Gulf Stream detaches from the coast.

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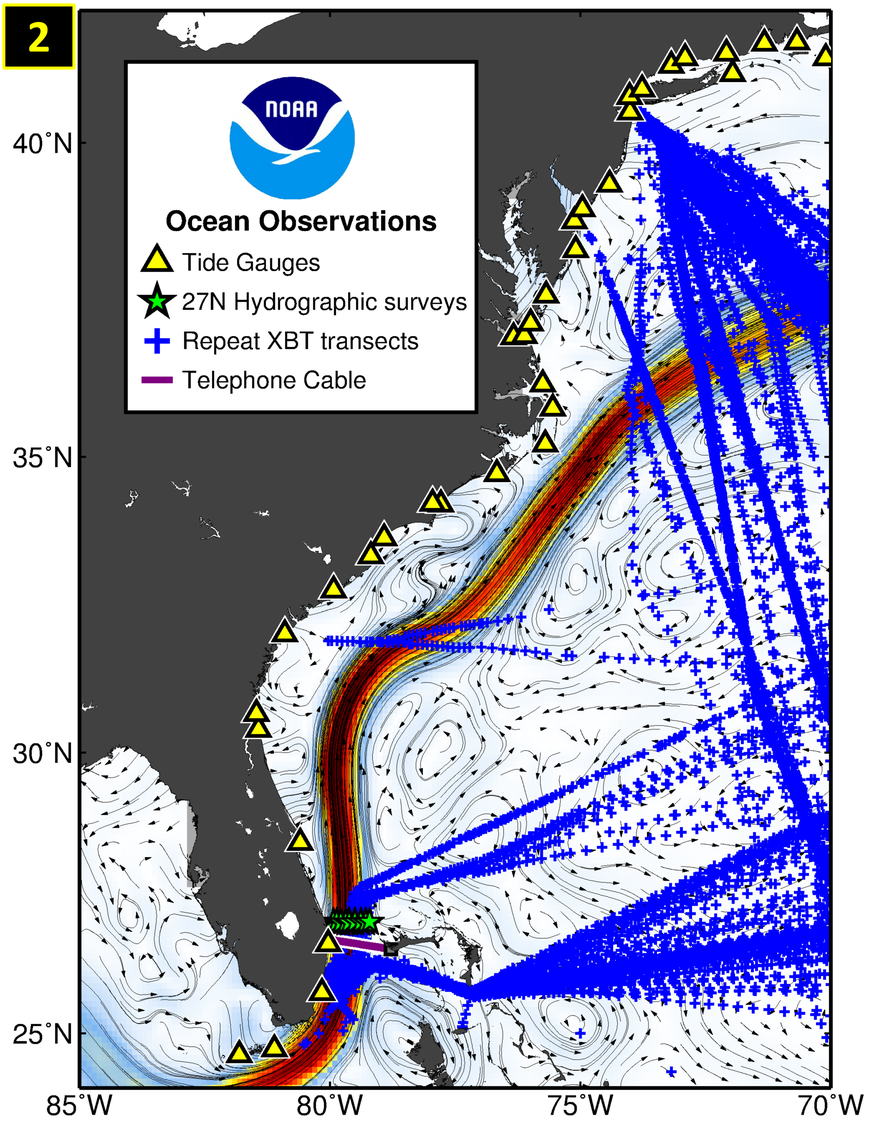
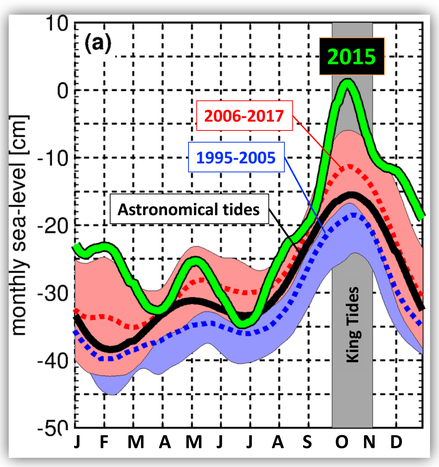
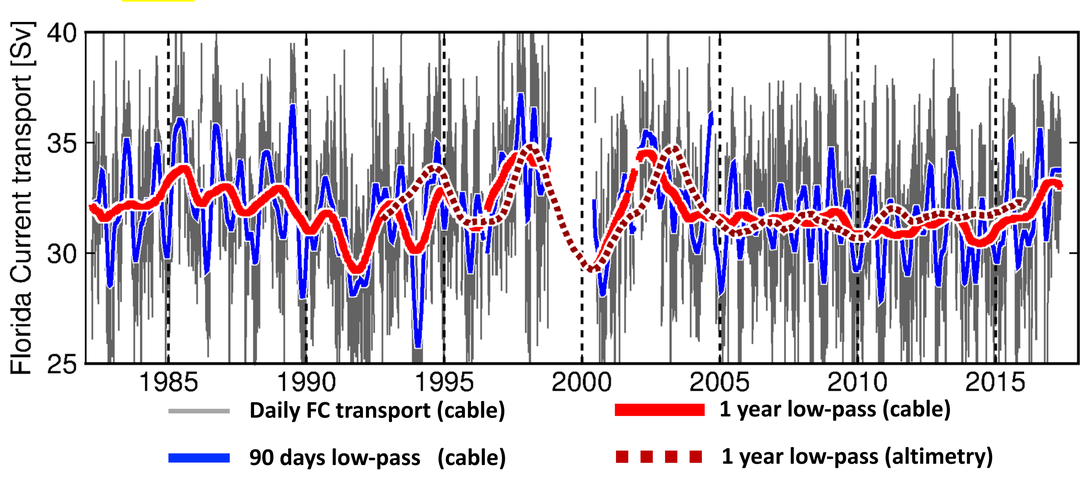


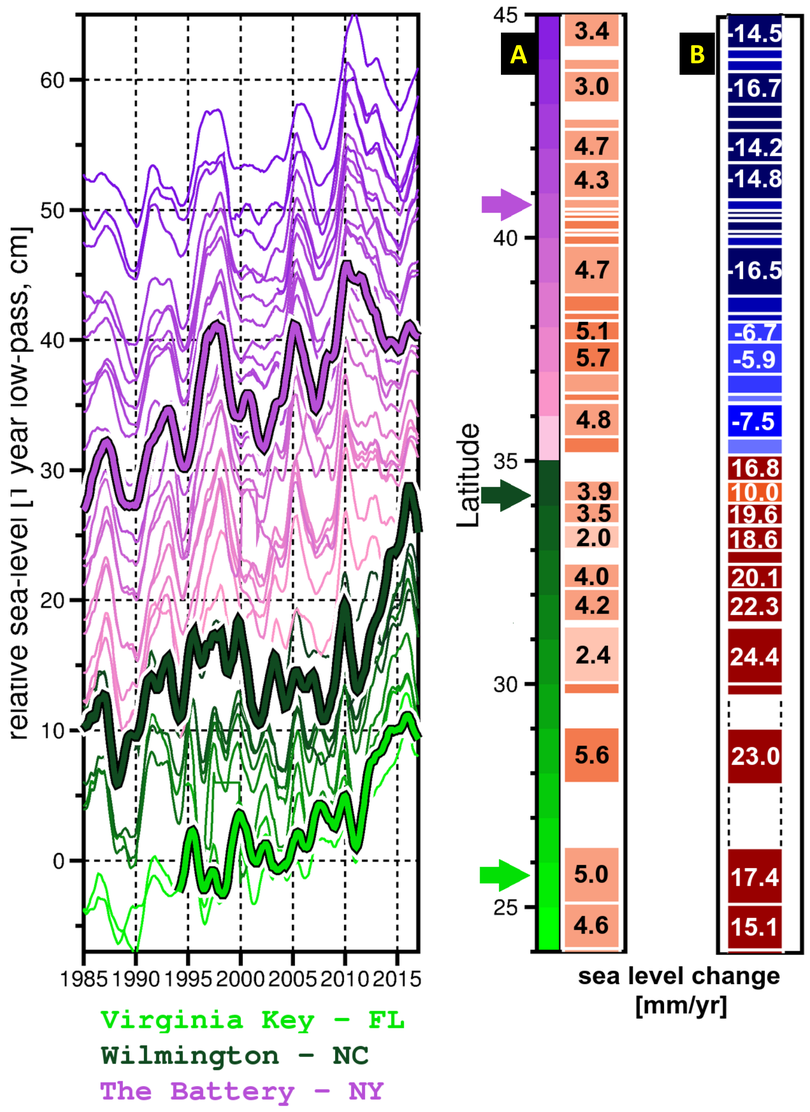
3 Monthly sea level in Miami



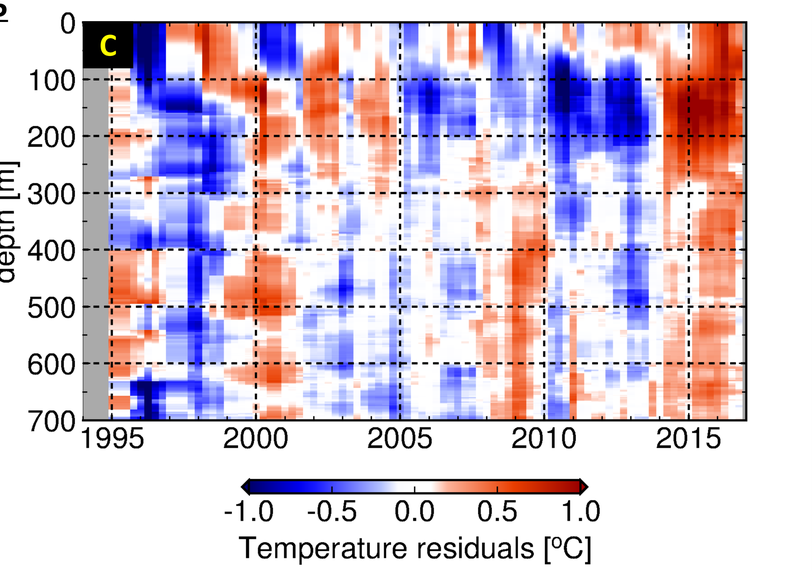
5 Daily record of the Florida Current flow since 1982

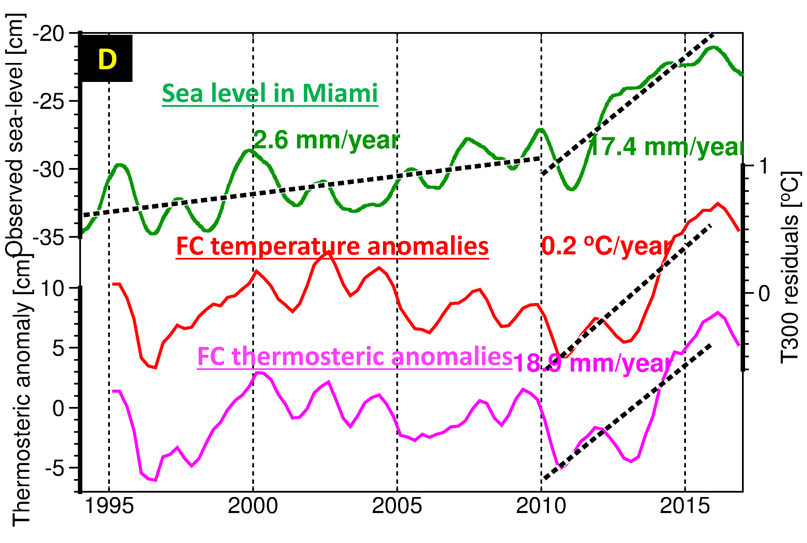


4 Sea level recorded along the east coast of U.S.



6 Changes in the Florida Current temperature





1. Several locations along the east coast of U.S. are affected by recurrent tidal flooding that have been increasing in frequency and intensity
2. NOAA maintains an ocean observing system based on tide gauges and periodic hydrographic surveys that is currently being used to investigate attributions of coastal sea level changes
3. Sea level recorded in Miami shows that flooding events observed in fall of 2015, the largest on the record, were not accounted by astronomical tides
4. Observations from tide gauges along the east coast of U.S. show that:
   A. Sea level has been steadily increasing over the record
   B. During 2010-2015, accelerated sea level changes were observed along the east coast of U.S., with sea level increasing rapidly south of Cape Hatteras (~35N), and decreasing to the north
5. A continuous and daily record of the Florida Current transport since 1982 shows that its flow remained relatively stable during 2010-2015, and do not account for observed sea level changes
6. Analysis of the hydrographic data in the Florida Straits, on the other hand, revealed that:
   C. Waters carried by the Florida Current exhibit substantial temperature variability over the record
   D. Changes in Florida Current temperature account for a relevant component of regional sea level changes larger than 10 cm through thermal expansion (contraction) of the water column, and largely account for observed sea level increase during 2010-2015

Conclusion: Water column temperature changes can account for accelerated sea level changes along the east coast of U.S., and correspond to a key component causing recent flooding events. Results reported here illustrate the importance of the different components of the global ocean observing system, such as repeat XBT transects and hydrographic surveys, for improving our knowledge on the different drivers of sea level changes.

Acknowledgments

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Reference

Domingues et al. (2018). Accelerated sea level changes along the east coast of United States: links with recent changes in the Florida Current and Gulf Stream temperature. Under review

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