Tufts UNIVERSITY
Earth and Ocean Sciences

How Climate Change Threatens Water Security

Mapping Sea Level Rise in Myrtle Beach, South Carolina

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Introduction

Myrtle Beach, South Carolina has been cited as an area where sea level rise poses a significant threat to a large coastal population that has been growing rapidly in the past decade and continues to strain coastal resources. According to the U.S. Decennial Census, Horry County (encompassing the Myrtle Beach metro area) grew from 144,000 residents in 1990 to an estimated 289,000 residents in 2013 [3]. This rapidly growing population, of course, needs access to freshwater, putting a strain on water resources along the coast.

Providing fresh water this population as sea level rises is of particular concern. A significant portion of freshwater in this coastal area is provided by surface water intakes that are extremely close to the coast; in fact some **freshwater intakes have been taken out of commission as salt water intrudes further in coastal estuaries**.

Methodology

To determine the **surface water intakes most at risk at different levels of inundation**, a high resolution digital elevation model of the Myrtle Beach coast was used, provided by the National Geophysical Data Center. The DEM importantly was referenced to a vertical datum of mean high water (MHW) local to Myrtle Beach. Calculating inundation extent was achieved by increasing elevation values on the DEM a fixed amount at all values less than 0. This ultimately yielded the three inundation scenarios shown in the maps at right.

In this method, any areas that sit below sea level but have no channel to the ocean were removed so that no false inundation results were returned during the raster calculation. After calculating an inundation scenario, at risk surface water intakes could be identified.

Workflow

- Obtain DEM and calculate difference between MHW and vertical datum shift (=0)

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- Create Inundation scenarios using "bathtub fill" methodology

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- Remove "false inundations" of inland, low-lying areas

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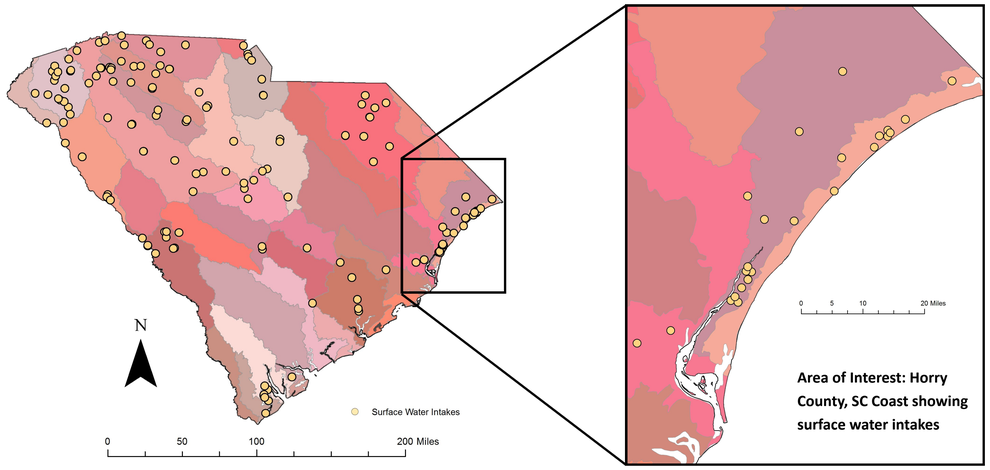
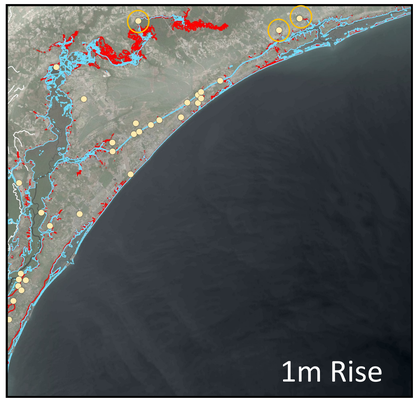
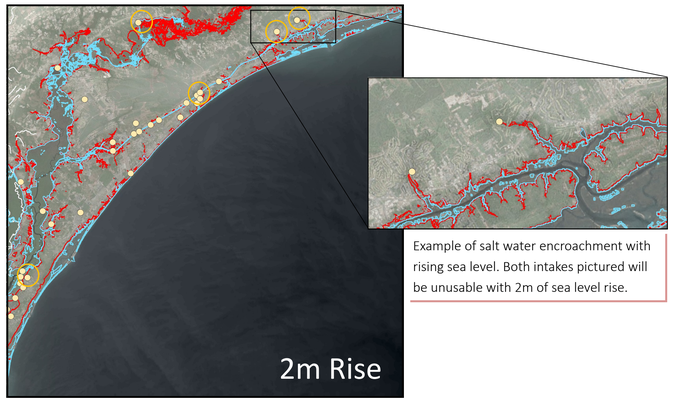
- Determine freshwater intakes most at risk from salt water encroachment by creating a contour at the new MHW

Major Freshwater Intakes in South Carolina River Basins



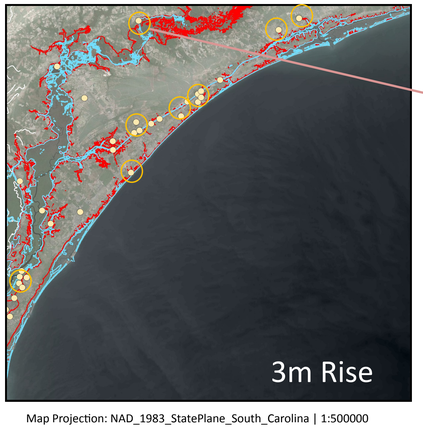
Inundation Scenarios Highlighting At-Risk Freshwater Intakes





Example of salt water encroachment with rising sea level. Both intakes pictured will be unusable with 2m of sea level rise.

Surface Water Intakes | Sea Level Rise | Present Sea Level



Note salt water encroachment in Winyah bay. Surface water intakes in the bay are the first to be affected by sea level rise although they are further inland.

Map Projection: NAD_1983_StatePlane_South_Carolina | 1:500000

Circled areas show most at risk water intake stations. Given 1m of sea level rise, 3 important intakes lie in inundation zones. **With 3m of sea level rise, a significant portion of coastal intakes are at risk.** Ultimately, these intakes will become unusable with rising sea level. Sea level rise for this section of beach has averaged 4.09mm per year over the past 50 years. **At this rate, the 1m sea level rise will be reality in 240 years**. However, the rate of sea level rise is also expected to increase, thus these inundation scenarios may in fact represent more near-future conditions. Predictions accounting for accelerated sea level rise put the 1m scenario less than 80 years out.

Conclusion

As shown by the inundation maps, there are a significant number of surface water intakes that are in danger due to sea level rise. **Reliance on coastal fresh water intakes should be reevaluated**.

It is important to address the limitation of the methodology used in this inundation model. As sea level rises, coastal geomorphology will change as base level increases. As erosion patterns respond to this change in base level, the course of coastal rivers and streams will be altered. This model assumes that the geomorphology remains constant, and sea level rise follows a "bath tub fill" scenario. This is idealized; thus the methodology used here is helpful in determining only approximate inundation scenarios. It is not applicable in situations which require high resolution estimates of future inundation. However, it is helpful in identifying areas that are at particularly high risk.

As shown, there are several surface water intakes that are at an increased risk for salt water intrusion. Particularly, surface water intakes near Winyah bay, as pointed out on the inundation maps, are at a high risk for salt water contamination.

Understanding how sea level rise will affect the availability of fresh surface water is extremely important for coastal communities. Encroachment of salt water is expected to increase in both surface and ground water as sea level increases; thus understanding sea level rise is vital to insure water security for these highly populated regions.

References

Data Sources

National Geophysical Data Center
South Carolina Department of Health and Environmental Control
United States Geological Survey
National Hydrography Data Set

Publications

[1] Conrads, P.A., Roehl, E.A., Jr., Daamen, R.C., and Cook, J.B., 2013, Simulation of salinity in trusion along the Georgia and South Carolina coasts using climate-change scenarios: U.S. Geological Survey Scientific Investigations Report 2013–5036

[2] "Saltwater Intrusion Puts Drinking Water at Risk." Saltwater Intrusion Puts Drinking Water at Risk. National Oceanic and Atmospheric Administration, n.d. Web. 28 Mar. 2015.

[3] US Decennial Census

Methodology

Mapping Coastal Inundation Primer (NOAA)
Simulation of salinity intrusion along the Georgia and South Carolina coasts using climate-change scenarios (USGS)

Image

Myrtle Beach Chamber of Commerce