

# MY COMMUNITY, OUR EARTH

## MIAMI

### The effects of sea level rise on the Turkey Point nuclear power plant, Florida, USA

Project Director: Catherine Laroche

Team Leader: Cristian Rodriguez

Team: Daniela Hernandez, Fernando Poschl

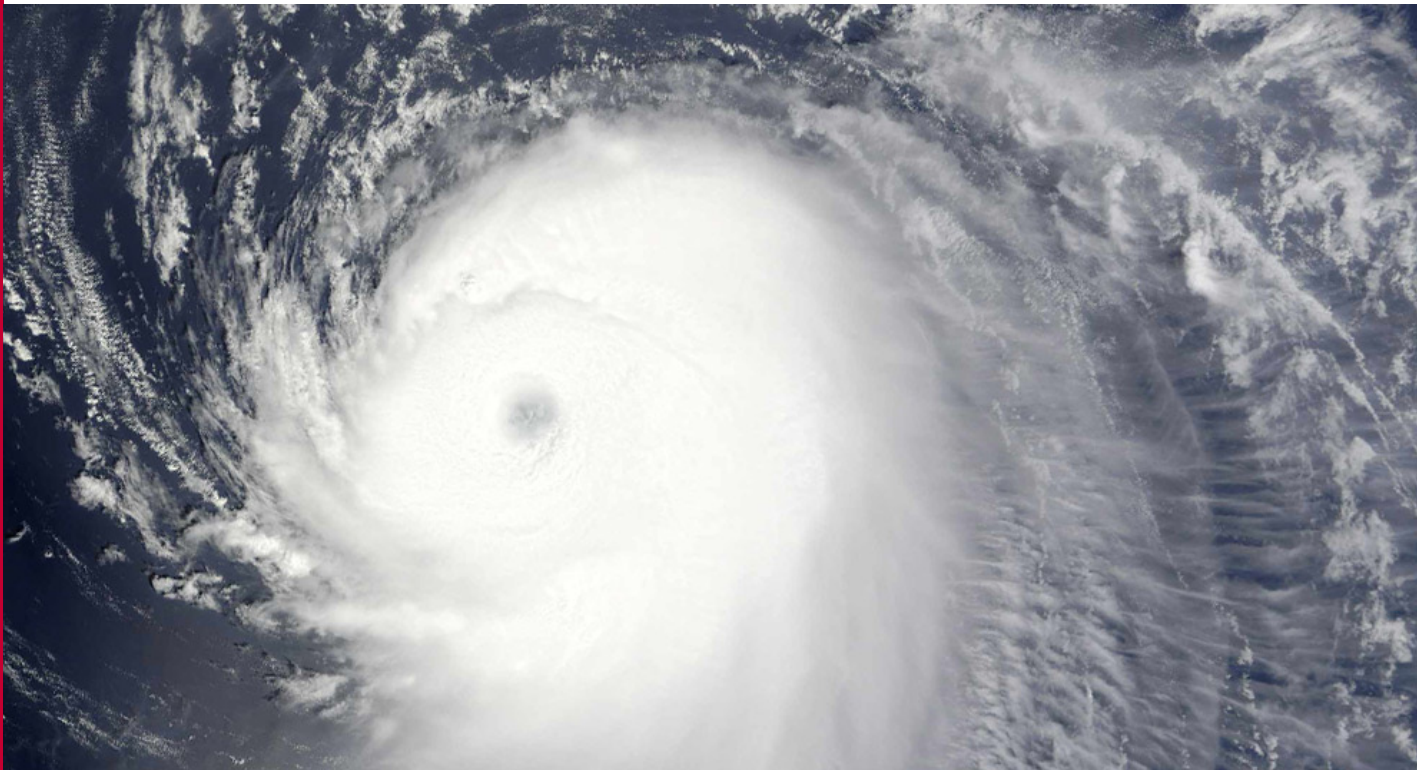
**Problem Statement:** How would a nuclear power plant be affected by a substantial increase in sea level as a result of global warming?

#### Abstract

South Florida is topographically flat and is therefore threatened by an increase in sea level rise and storm surges from hurricanes. South Florida receives 15% of its electrical energy needs from the Turkey Point Nuclear Generating Station. Turkey Point needs water for its 168 miles of cooling canals, therefore it is located next to the ocean. A rise in sea level or a high storm surge can interfere with pump stations which control the water in the canals. Interference with this cooling water can result in a nuclear meltdown similar to the one that occurred in Fukushima Daiichi, Japan.

#### Global Warming

Global warming is happening and it poses a very real threat to south Florida, a threat that pressures south Floridians to act, or risk mass infrastructure failure. When discussing global warming it is necessary to understand and recognize the impacts and dangers of sea level rise to the south Florida population and to its already-near-sea-level infrastructure. The world's mean temperature has risen 1.4oF during the last 100 years, and most of it has occurred during the last few decades. Although there are many consequences of global warming including changes in local climate, the spread of vector-borne diseases, and ocean acidification, the most immediate concern to south Florida is rising sea level.



Global warming is the rise in the Earth's average temperature due to an increase in greenhouse gases in the atmosphere preventing warm solar radiation from exiting earth and moving into space. This causes the earth to warm up, much like the way a car warms up when sitting in the sun, even on a cold day. This increase in the earth's temperature causes the sea level to rise by constantly melting polar ice caps located all across the world. The water from the melted ice caps leaks into the sea and, in turn, causes the surface of the ocean to rise. Worldwide, sea level rise is occurring and per recent satellite imagery, it appears the speed at which the sea level is rising is increasing. Some scientists are predicting that by 2100, the worldwide sea level could rise between 3 feet and 6 feet. Higher sea level rise might occur if the Greenland and West Antarctica ice sheets, which are responsible for most of the world's fresh water reserves, melt more quickly than originally thought.

## South Florida

Florida is a peninsula located in the southeast "corner" of the United States. It is surrounded on three sides by water, the Atlantic Ocean on the east, the Gulf of Mexico on the west and the Caribbean Sea on the south. Because of it being almost surrounded by water it is a prime target for the effects of sea level rise.

The area locally referred to as "South Florida" includes the cities from Homestead to Palm Beach, the



archipelago of islands to the south called the "Florida Keys," and the interior portions of swampland called the "Everglades." As of the 2000 census, all of South Florida has a population of almost 4 million people. The area along the east coast is particularly threatened by sea level rise due to its high population. Below is a map showing where most of the cities with the largest populations are located in Florida; the largest concentration of major cities is in South Florida.

All of Florida is susceptible to the impacts of sea level rise due to its flat terrain. In fact about 9 percent of the state is within 5 feet of the current sea level. But South Florida has an elevation average that is lower than the rest of the state - only about 6 feet above the surface of the coastal waters. This low elevation poses a major problem when dealing with the effects of sea level rise. As the sea level increases, the ocean will seep into South Florida land. According to Surging Seas - a sea level rise analysis research group - a sea level increase of about three feet will flood ap-

proximately 10% of the homes and buildings located on the coastal shores of Homestead, Fort Lauderdale and Boca Raton, leaving 5.9% of the South Florida population homeless. At six feet, 31.7% of South Florida infrastructure will be flooded and 27.4% of the population will be homeless.

## Turkey Point Nuclear Generating Station

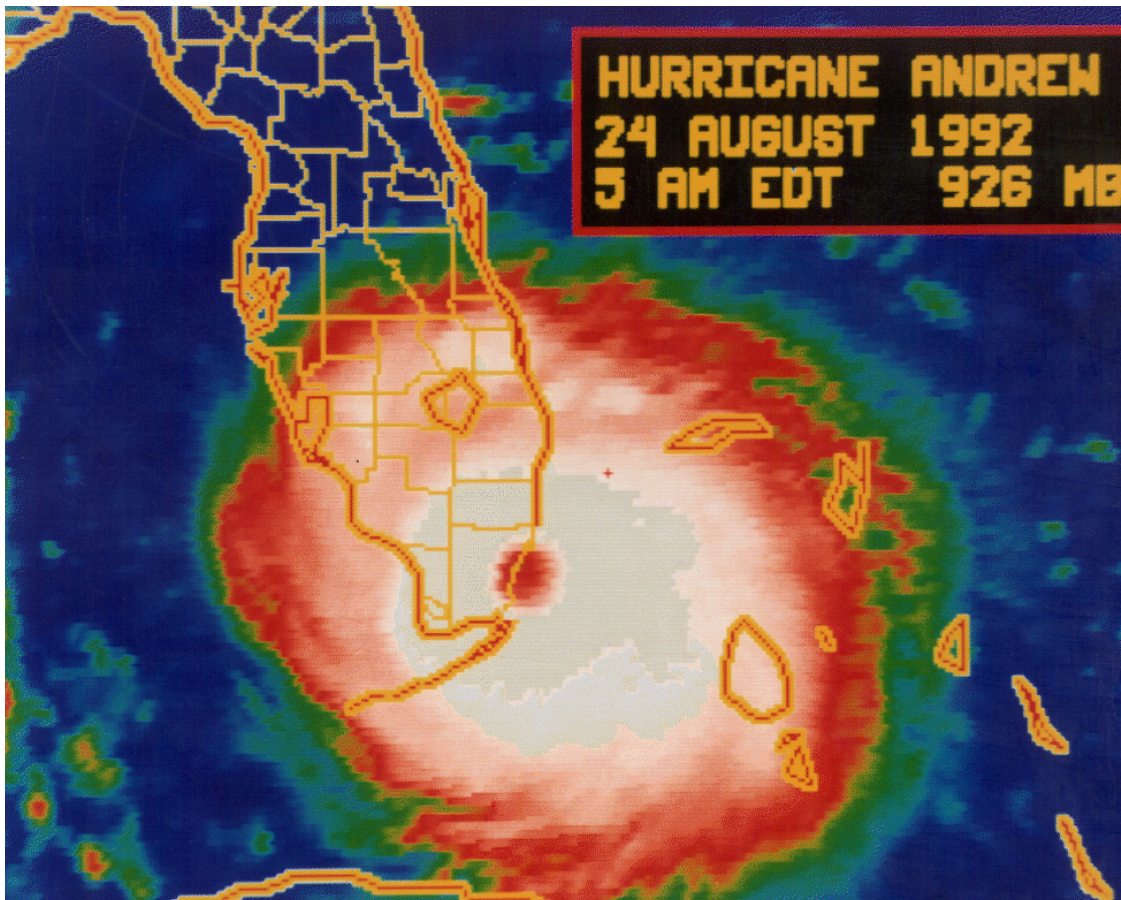
Most of the energy consumed in the United States comes from power plants that burn fossil fuels, and South Florida is no exception. About 74% of the electrical needs for South Florida comes from burning petroleum or coal, both of which are types of fossil fuels. However, about 15% of South Florida's electrical needs is provided by nuclear power. To provide this 15%, South Florida maintains several nuclear power facilities. One of them is Turkey Point Nuclear Generating Station. Turkey Point is the largest nuclear plant in Florida and is the sixth largest power plant in the United States. Below is a MyCOE ArcGIS map showing the location of Turkey Point Power Plant.

Turkey Point started producing energy in 1972 with 2 separate units. Since then 3 more have been added. Together they currently supply enough electricity to provide about half a million homes with their power needs for a full year.

## The Ocean, Wind, and Turkey Point

Most nuclear plants are near a water source because water is used a coolant in the nuclear plant process. Turkey Point is no different. As seen in the map above, the power plant is located on the edge of the ocean. The water that is used inside the reactor, however, does not come from the ocean. That water comes from the city's water supply. The ocean water helps supply a series of 36 interconnected canals that are used to cool the turbine steam. Basically the water flows through a 168-mile canals system before it is circulated back to the power plant for reuse. Although the reactor buildings are elevated, the canal system is not. Rather it sits fairly low to allow the flow of water to occur.

Officials have always been aware of the threat the ocean poses to Turkey Point, in fact, the reactors were built at an elevation of about 20 feet to avoid problems with winter storms and with storm surges from hurricanes. Turkey Point got tested for real in 1992 when it suffered a direct hit from Hurricane Andrew. Andrew tested Turkey Point with category 5 force winds and a 16-foot storm surge. There was some damage to one of the smoke stacks, which eventually had to be demolished and replaced. Fortunately, the reactors survived Andrew's 160 mile-per-hour winds, but there was some damage to other parts of the property. The fire-safety system, security system, and communication stations took damage, but the reactors' containment buildings were fine. Even with relatively minor damage, the plant was closed for 6 months. Below is a satellite image of Andrew coming on shore. The eye went over Turkey Point.



## Global Warming and Turkey Point

Although built to withstand storm surges and hurricane force winds, the Turkey Point Nuclear Generating Station cannot endure a rising ocean. In the future, when sea level rises only 3 feet, Turkey Point will be under water as well, posing major nuclear threats to the people of South Florida. If Turkey Point were to fail, it would release a large amount of radiation to the surrounding area, contaminating the environment. If it does fail, radiation will leak into the surrounding waters and will quickly result in mass radioactive exposure similar to what happened in the Fukushima Daiichi, Japan, nuclear disaster.

The earthquake and tsunami disaster that struck Japan has provided Florida with some insight into what might happen with sea level rise at Turkey Point. The fear is that water from storm waves, either super storms caused by global warming, or from passing hurricanes, would damage the pump sta-

tions that control the water flowing into the cooling canals. As a result of sea level rise, the ocean itself might disrupt the flow of the canal water or damage the pump stations. If the water pump stations fail then the plant will experience a meltdown as it did in Japan. It is important to realize that the backup pump stations failed in Japan as a result of the increase in water level from the tsunami. The inability to pump the cooling water back into the plant is what ultimately caused the meltdown in Fukushima.

Radiation causes extreme damage to water sources through mere contact. As nuclear radiation makes contact with water, it breaks the bond of the water molecule, creating different fragments, like hydrogen and other particles called hydroxyls. These fragments and particles can recombine to form back into water or can form back into poisonous substances like hydrogen peroxide. The poison given off from the contaminated water easily puts the lives of both sea life and the people of South Florida in danger.

## References

<http://sealevel.climatecentral.org/surgingleas/place/cities/FL/Miami#show=cities&center=9/25.7528/-80.1793&surge=3>

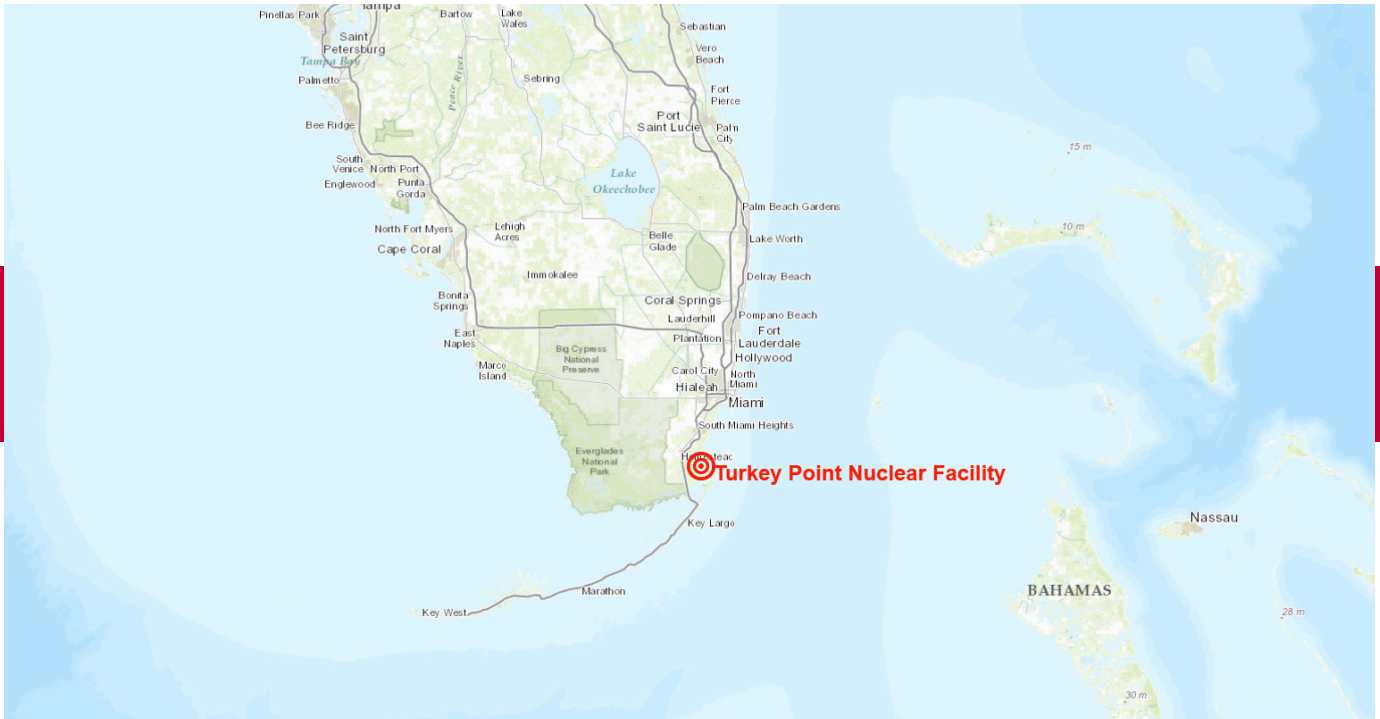
<http://www.eia.doe.gov/neic/rankings/plantsbycapacity.htm>

<http://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/1993/in93053s1.html>

<http://www.nrc.gov/reading-rm/basic-ref/teachers/09.pdf>

[http://www.eia.gov/pub/oil\\_gas/natural\\_gas/analysis\\_publications/ngpipeline/southeast.html](http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/southeast.html)

<http://www.climatecentral.org/news/sea-level-rise-brings-added-risks-to-coastal-nuclear-plants>



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo and the GIS User Community

