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NEW IPCC Report and What it Means for Florida

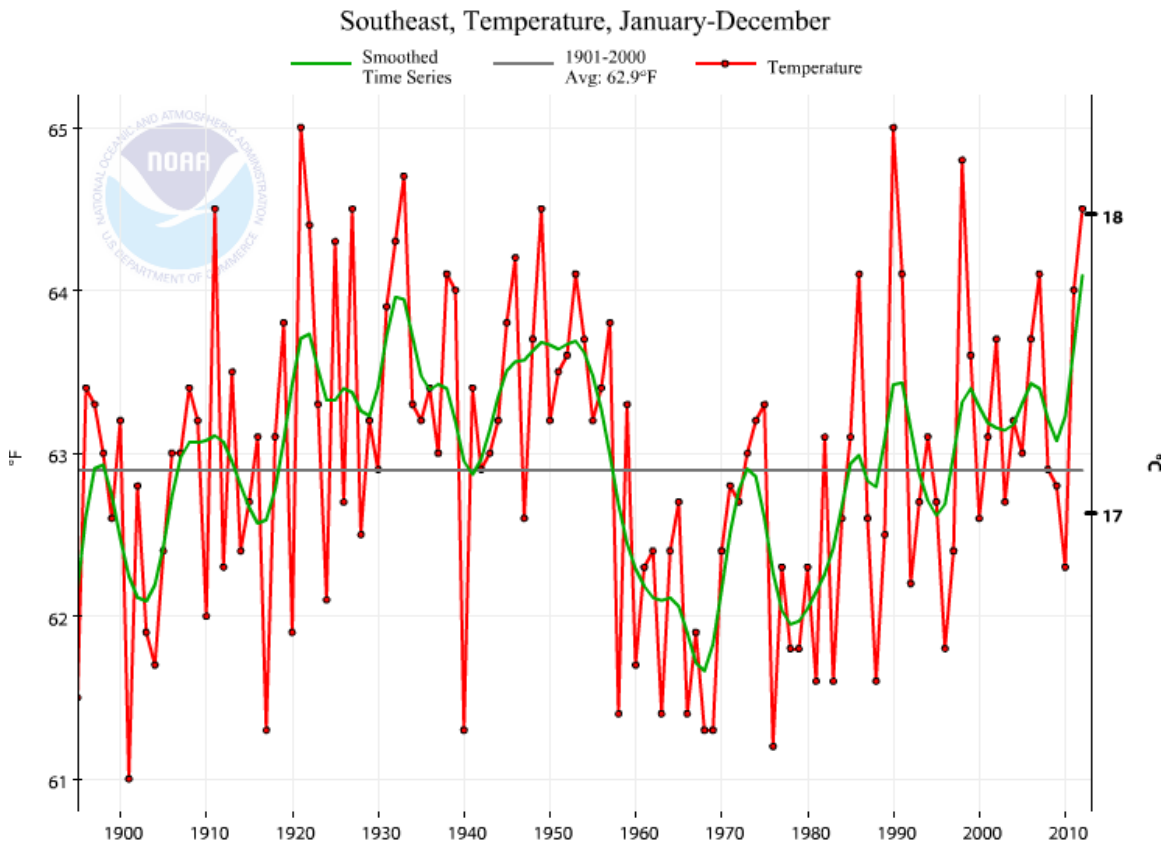
The United Nations sponsored Intergovernmental Panel on Climate Change (IPCC) released a summary of its latest report last Friday, September 27, on the state of the earth's climate and how it is changing. The IPCC consists of hundreds of leading climate scientist from around the world and they have issued assessment reports every 5-6 years since 1988. These reports are widely considered to be the most comprehensive and authoritative summary of current climate science. The 5th Assessment Report is to be released this year in three parts consisting of thousands of pages. The report released on September 27th is the "Summary for Policy Makers", around a 30-page summary of the most important conclusions.

The main headline of the last report is that it is now considered *extremely likely* that human activity and greenhouse gases are responsible for more than half of the observed rise in global temperatures. *Extremely likely* means at a confidence level of 95%, an increase in confidence over the 90% level given in the last assessment in 2007. Averaged around the globe, the earth's surface has warmed an estimated 0.85°C (1.5°F) between 1880 and 2012. They predict that global temperature will rise 1.5°C to 4.5°C by 2100, depending on the amount of carbon dioxide and other greenhouse gases that humans continue to put into the air.

The Summary for Policy makers also includes statements on other aspects of climate change including drought, extreme events, hurricanes, and sea level rise. We would like to briefly look at some of these conclusions and how they apply to changes we have seen in Florida and the Southeast and their associated risks.

Rising Temperatures

The earth as a whole has warmed approximately 0.85°C over the last century and a half with the greatest warming in the higher latitudes of the northern hemisphere and the Arctic. The Southeast U.S., including northern and central Florida, is one region of the globe that has not experienced any appreciable warming from greenhouse gases. Our historic data records show that the climate of the Southeast was characterized by relatively warm decades in the 1920's, 1930's, and 1950's and cooler decades in the 1960's through 1980's. In northern Alabama and northern Georgia, some of the hottest years on record and many daily heat records occurred in the 1930's.



Average annual temperature for the Southeast U.S. since 1895 (Courtesy NOAA NCDC)

In the State of Florida, the greatest impact that man has had on climate is through changing the land surface. Temperatures have risen along the southeast Florida coast by over a degree F in the last 40 years, especially in the summer months. Much of this can be attributed to urban development, where cities built of concrete and asphalt now absorb and hold more heat than the natural environment they replaced. Similar trends are observed in other urbanized areas like Jacksonville, Tampa, Orlando, and the I-4 corridor. Other changes to the land surface have also impacted the local climate, like the draining of vast wetlands and their conversion to sugar cane fields around Belle Glade on the south shore of Lake Okeechobee. To see historical temperature and precipitation patterns at your location, visit our climate visualization tool at the Florida Climate Center website.

<http://climatecenter.fsu.edu/climate-data-access-tools/climate-data-visualization>

It is difficult to determine if the Southeast will continue to lag behind the rest of the globe with respect to rising temperatures. While global climate models have some skill at predicting changes to the global average temperature, they have much harder time predicting regional or local changes. Our geography and being surrounded by the Gulf of Mexico and Atlantic Ocean would suggest that temperature changes will be less here in Florida.

Hurricanes

Perhaps the greatest weather and climate related risk to the people and property in the state is from hurricanes, where Florida can be considered the most vulnerable state. The IPCC report states there is a “low confidence” (less than 20%) that we have seen a human-caused increase in intense hurricanes, which is even less confident than the 2007 assessment. Influencing this conclusion is a widely cited 2010 review paper published by ten of the leading hurricane experts, "[Tropical Cyclones and Climate Change](#)". These authors found there was no significant increase in landfalling storms and that it is uncertain whether the changes observed in past hurricane activity were outside the variability expected from natural causes.

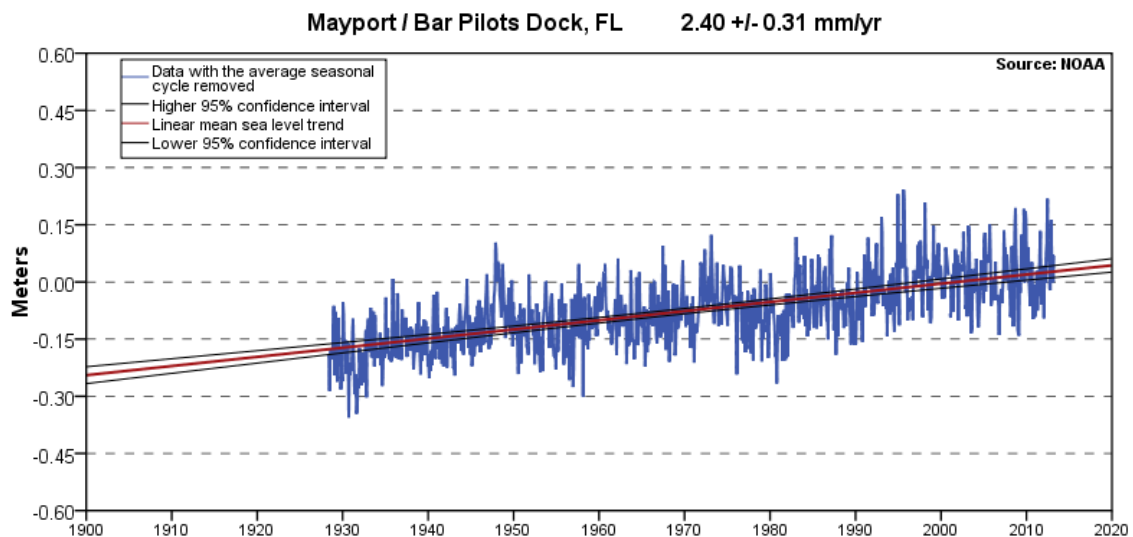
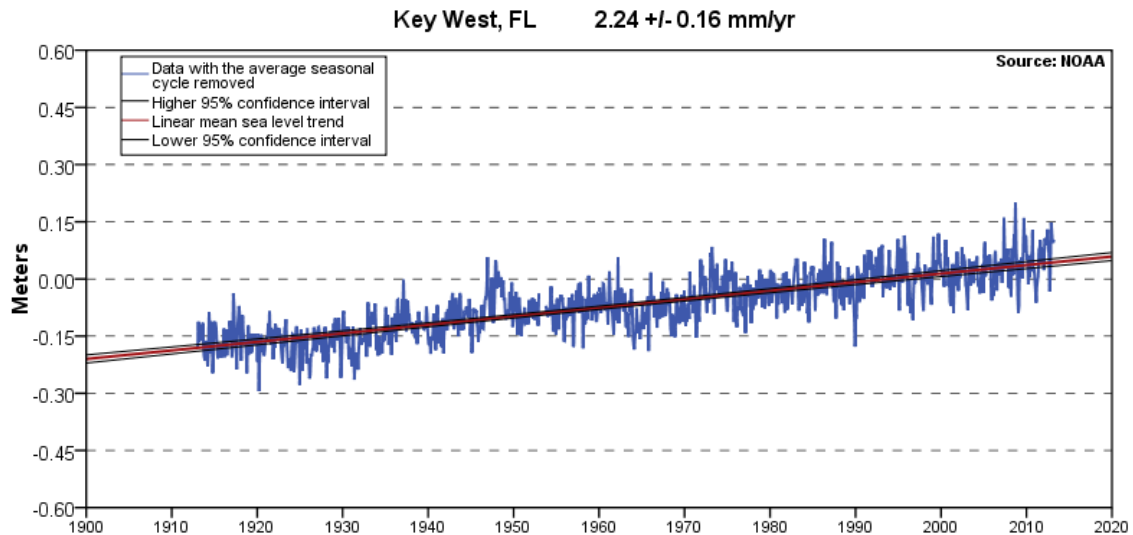
In the future, the IPCC report states that it is more likely than not (greater than 50% confidence) that there will be a human caused increase in intense hurricanes by 2100 in some regions. This is less confidence than in the 2007 assessment (66%). Common sense would dictate that warmer ocean temperatures would lead to more strong storms, but reality is not that simple. In addition to the heat and moisture from the oceans surface that is needed to feed hurricanes, there also needs to be a favorable atmospheric environment with moist air and little wind shear. It is unclear from the climate models how these environment factors may change in the future. A recent study from Kerry Emanuel at MIT using global climate model output driving a high-resolution hurricane model indicates that intense hurricanes will increase by 2100. Another study using similar methods by a different model showed a decrease. Bottom line, there is more uncertainty than is known about how climate change will affect the number of strong hurricanes.

Sea Level Rise

With hundred of miles of low-lying coasts, Florida is highly vulnerable to rising sea level as a result of the changing climate. Miami-Dade is considered one of the most at risk locations in the country and has teamed up with three other counties to form the [Southeast Florida Climate Compact](#), where they assess the risk of rising sea levels and make planning and policy decisions on how to react. Even a modest amount of sea level rise there will cause tremendous problems with water storage, stormwater, and saltwater intrusion into the Biscayne Aquifer. The latest IPCC report states that global sea level has risen 19 cm (7.5 inches) between 1901 and 2012, and that the rate has accelerated to a rate of 3.2 cm/decade in the last 20 years, matching tide gauge and satellite observations.

Local sea level rise can be either higher or lower than the global average due to differences in prevailing winds and ocean currents and underlying geologic processes like crustal rebound. Florida is fairly stable, geologically speaking, and measurements from tide gauges on both coasts are in line with the global

values, perhaps rising at a slightly lower rate. Shown are tide gauge records from Key West and Mayport (near Jacksonville). They both show a very steady rate of sea level rise at a little over 2 mm per year (2 cm/decade).



*Mean sea level, trend, and 95% confidence levels at Key West and Mayport, FL
(Courtesy NOAA/NOS)*

In the future, the IPCC report projects that global sea level will rise another 26 to 98 cm by 2100. This represents a modest increase from the 2007 projections. There is also a chance that sea level could rise an even greater amount than the higher limit, but higher estimates were not included due to the primitive understanding of glacier and ice sheet dynamics and their potential rate of melt. There are a number of new studies predicting an even greater rate of sea level

rise whose results were not included in the IPCC report. For an easily read primer on the mechanisms of sea level rise, see University of South Florida's [Gary Mitchum report](#) from the Florida Climate Institute.

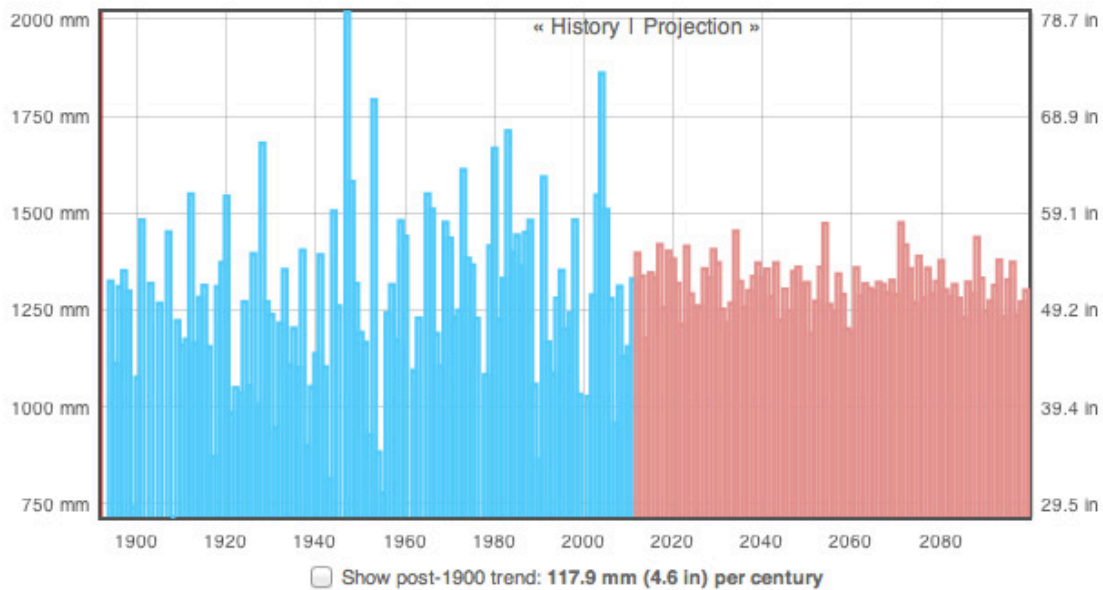
Changes in Precipitation

The underlying theory is that as the atmosphere warms, it can hold more moisture and that will lead to more extreme rainfall events. Conversely, warmer temperatures will cause greater evapotranspiration rates leading to more periods of drought. In short, we could be looking at both more drought and extreme rainfall events in a warming climate. However, the IPCC report only gives “low confidence” (20% chance) that we have already observed a human-cause change in the intensity or frequency of drought, less than the 50% confidence in the 2007 report. The report also states it is *likely* that the frequency of heavy rain events has increased in some regions, including North America.

Here in Florida, the climate is subject to both drought and heavy precipitation. Because of the nature of our summer convective rainy season and the influence of El Niño/La Niña cycle, the year-to-year variability of rainfall overwhelms other trends or patterns. Florida will continue to be vulnerable to drought, especially when dryness in winter and spring extends into the summer season. Florida is also subject to heavy precipitation events, whether from tropical systems, mid-latitude lows and fronts that tap the Gulf Moisture, or slow-moving summer thunderstorms.

As difficult as it is to make a definitive statement about changing precipitation patterns in the past, projections of the future are even more uncertain. Global climate models lack the resolution (size of the grid used for calculations) to represent important local and regional processes important to rainfall such as the afternoon seabreeze. Because of limited physics of cloud and rainfall formation, even when downscaled, these models struggle to accurately represent the correct day-to-day variations of rainfall, diurnal cycle, or even the seasonal cycle. As an example, the graph below shows yearly rainfall for Lake City, Florida with the historical observed rainfall in blue, and projected rainfall from a downscaled climate model in red. It is clear that the modeled rainfall lacks the year-to-year variability seen in the historic observations.

Data sources: GHCN; Maurer et al. (2009)

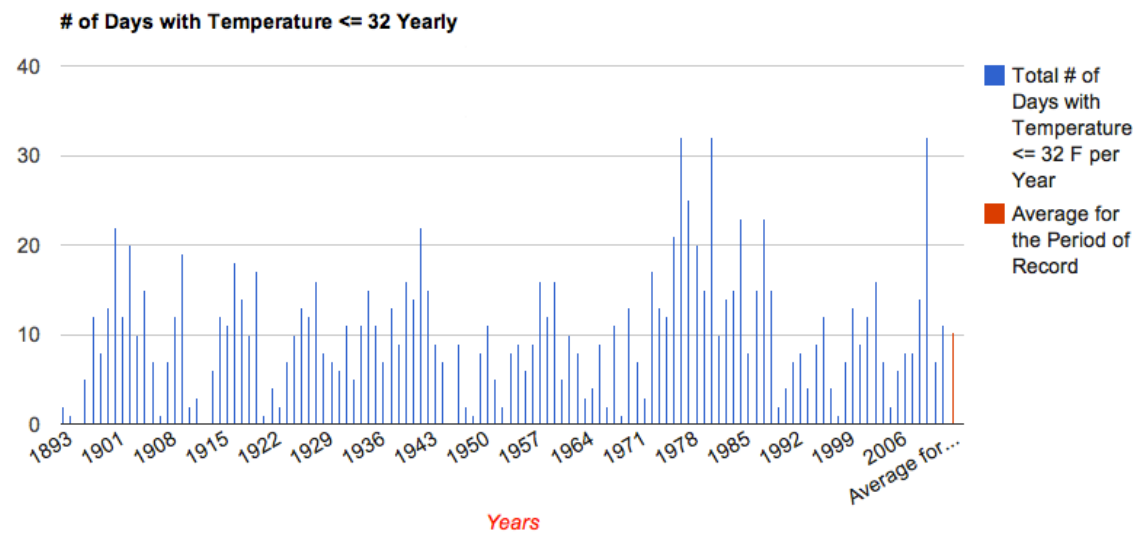
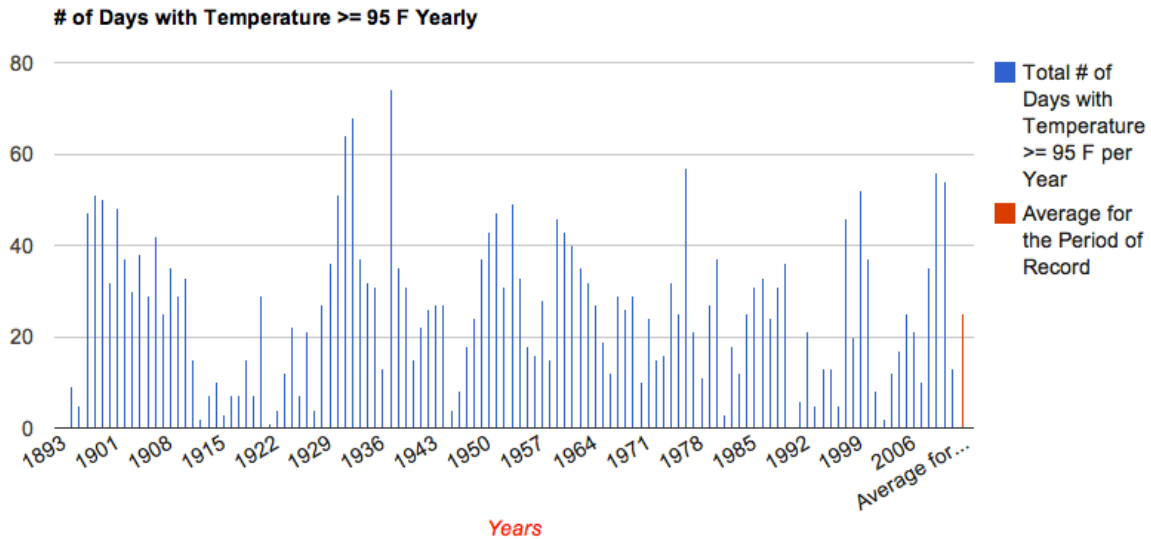


Yearly rainfall for Lake City, Florida from historic GHCN (blue) and high emissions scenario model (red). Courtesy of WeatherUnderground.

Extreme Temperatures

The IPCC report states that we are already seeing an increase in the number of hot days and a decrease in the number of cold days. "Changes in many extreme weather and climate events have been observed since about 1950. It is *very likely* that the number of cold days and nights have decreased and the number of warm days and nights has increased on the global scale." Again, this statement may be true for many regions and for the globe as a whole, but Florida is not following suit. Below are graphs of the total number of days at 95 degrees or higher and 32 degrees or lower at a central location of Ocala, Florida.

These graphs actually show more 95 degree days in the 1930's and more freezing days in the 1980's. Florida experienced a string of devastating freezes from 1997 through 1989, and the winter of 2010 as a whole (January – March) was the coldest on record.



Annual number of days at 95 degrees or higher (top) and 32 degrees or less (bottom) at Ocala, FL. (Florida Climate Center)

Other Aspects of Our Climate System

While this statement went into a little depth on some of the changes to the climate system that affect Florida the most, the IPCC Summary for Policy Makers includes a whole list of observed and anticipated changes to the earth's climate system as a result of human activity and greenhouse gas emissions. The list includes declining snow cover, arctic sea ice extent, thawing permafrost, ocean warming, ocean acidification, shrinking ice sheets and glaciers, among other impacts. The full report is available here:

http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf

In spite what changes may or may not be happening in our own back yard, the list of observable and predictable impacts on the global environment is sobering.

Weaknesses of the IPCC report

Even though the IPCC assessments are regarded as the authoritative voice on climate science, this current report and the process as whole has recognized weaknesses. First, it is a cumbersome process to compile the thousands of publications and experiments into a coherent document, and newer research and findings can be left out. In some ways, the report is outdated before it is published.

One particular criticism is how the IPCC report addresses the current 15-year “hiatus” of global warming. The global average temperature, as tracked by four major centers, has almost leveled off since a record warm year in 1998 that was caused by a strong El Niño. The IPCC explains this leveling off as, “due to natural variability, trends based on short records are very sensitive to the beginning and end dates and do not in general reflect long-term climate trends.” This statement is true and most scientists believe that the recent slowdown in warming is just a temporary speed bump. However, the climate models used in the 2007 assessment all failed to predict this slowdown in warming. At best that means the models are failing to reproduce internal variability at important time scales, at worst that the models are not properly representing an important physical process.

Commentary

The state of Florida may or may not feel the magnitude of changes that other part of the world are experiencing or are likely to experience in the future. However, that does not mean that we can sit back without taking action. With a nearly tropical climate, a small increase in temperature or changes in rainfall patterns could have a profound influence on natural and man made systems. South Florida is already struggling with the reality of sea level rise. Human health and disease is and will be affected.

In addition, many of the climate-related risks including drought, heavy rainfall, hurricanes, and extreme temperatures have been with us for decades and even centuries and our vulnerability to them is still very high. Decision makers need the highest quality, accurate, and scientifically sound climate information to help prepare for and anticipate climate risks and opportunities to build a more climate resilient society. The Florida Climate Center is dedicated to making that happen.

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