



**Letting Science Tell The Story  
FSA Pre-Conference Workshop  
June 19, 2019**



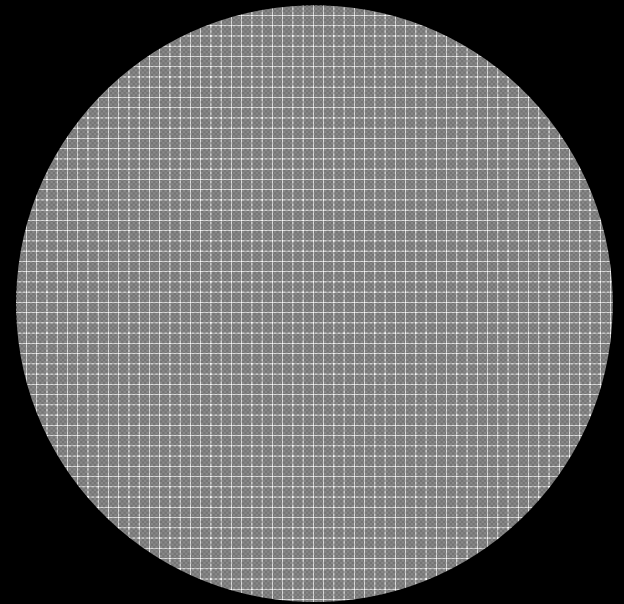
**Elizabeth Perez  
Opening Comments**



- FSA has been a center for excellence for stormwater management since 1993 so we will focus a lot on stormwater and analysis today. However, your speakers acknowledge that we are a part of the entire community of professionals that will be needed to address this issue.

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Thanks To FSA!  
Thanks for Attending!



# The **Boring** Agenda Slide

- Introduction - Liz
- Hydrologic Baselines – Brett/Steve
- Water Quality - Tony
- Threat Interaction - Jeff
- Closing Interactive Discussion

# Now Let's Earn our PDHs for a Few Slides

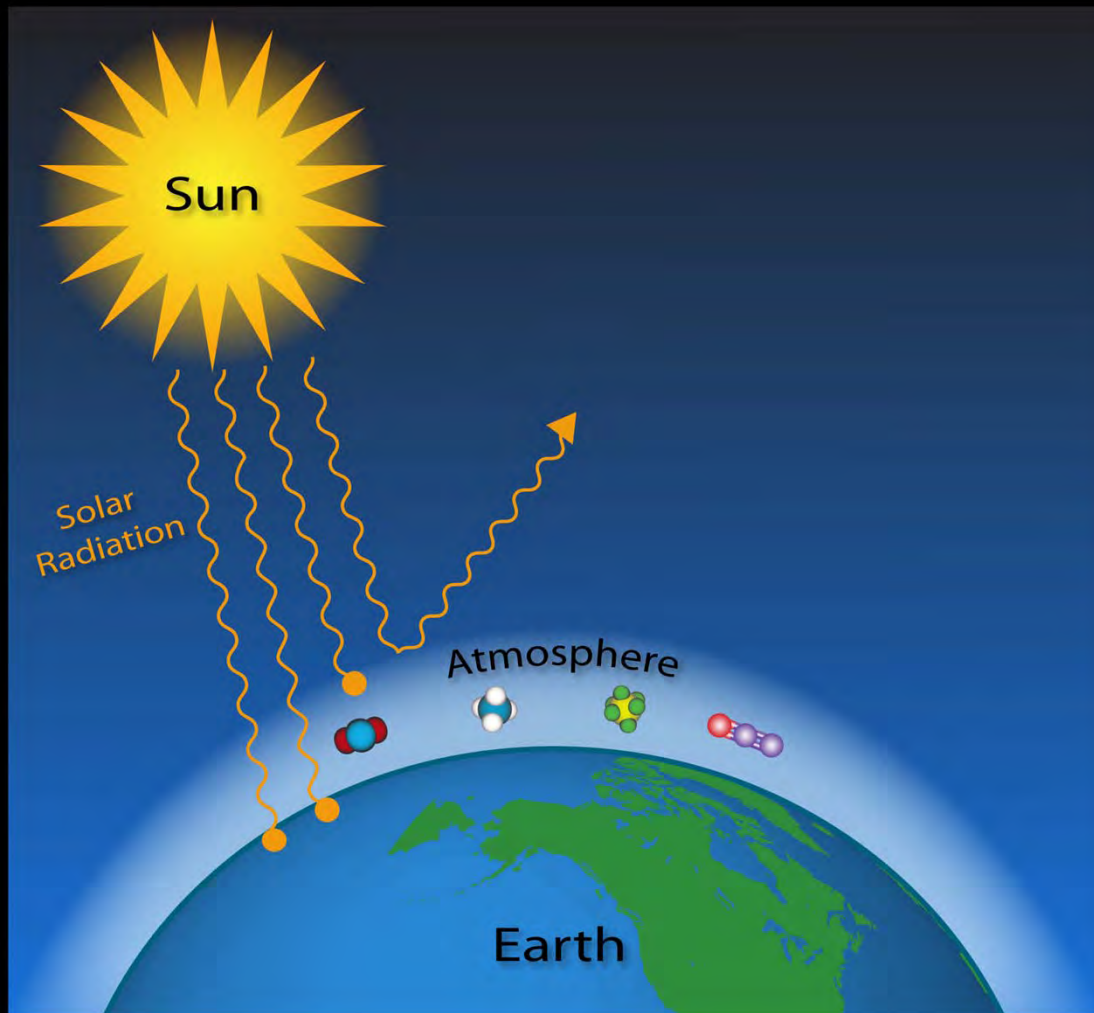
aka – a brief message from our friendly  
climate scientists



**“Scientific evidence for warming of the climate system is unequivocal.”**

-Intergovernmental Panel on Climate Change

[https://climate.nasa.gov/climate\\_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/](https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/)



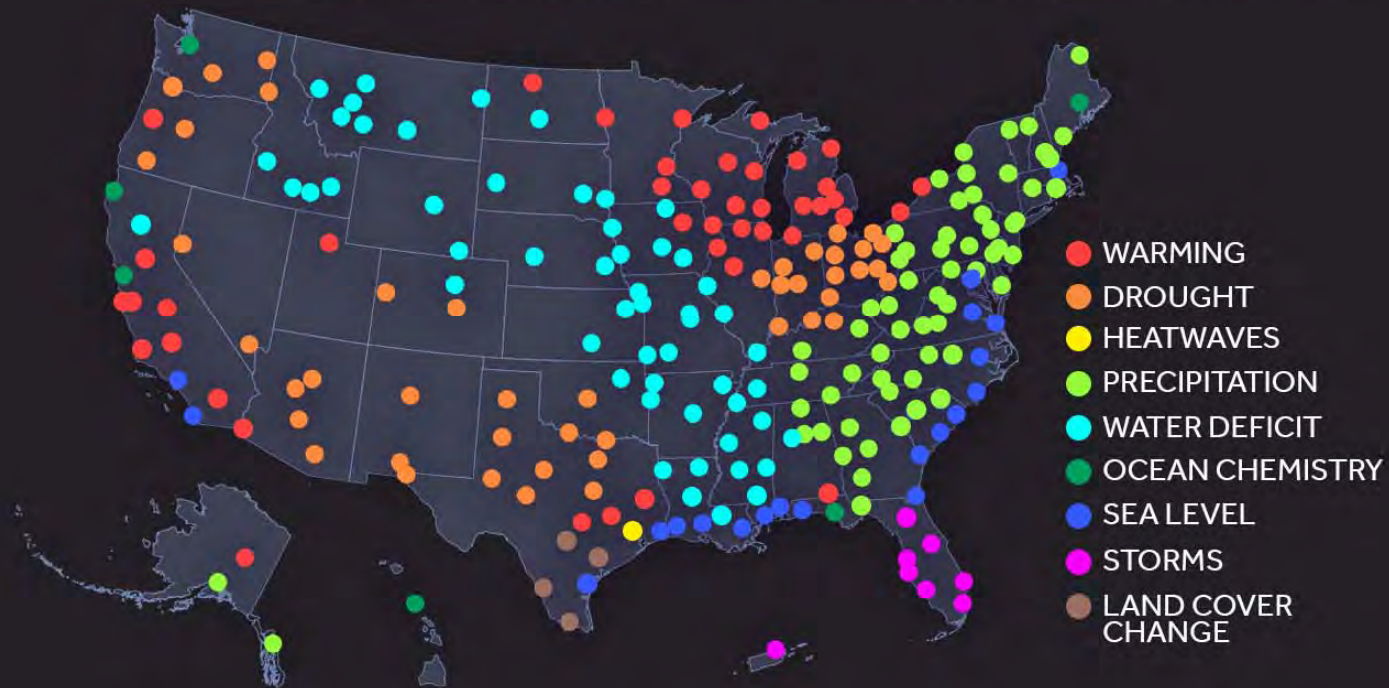
## • The Major Greenhouse Gases

- CO<sub>2</sub>
- Methane (CH<sub>4</sub>)
- Nitrous Oxide (N<sub>2</sub>O) – aka laughing gas
- Sulfur hexafluoride (SF<sub>6</sub>)

[https://www.esrl.noaa.gov/gmd/outreach/carbon\\_toolkit/basics.html](https://www.esrl.noaa.gov/gmd/outreach/carbon_toolkit/basics.html)



# UNITED STATES TOP CLIMATE HAZARDS IN 2050



Produced: 2/20/2019. Source: Mora et al. 2018. Projected hazards under RCP 8.5. Climate Central removed sea level & ocean impacts at locations with fewer than 0.1% structures exposed to annual flooding in 2050 under RCP 8.5, using 95th percentile sea level projections from Kopp et al. 2017.

# Multiple Lines of Evidence

- Across Many Scientific Disciplines
  - Temperature Rise Globally
  - Warming Oceans
  - Shrinking Ice Sheets
  - Glacial Retreat
  - Decreased Snow Cover
  - Sea Level Rise
  - Drought
  - More Frequent Severe Storms
  - Ocean Acidification
  - Numerous Ecological Changes



# TEN SIGNS OF A WARMING WORLD

## Arctic Sea Ice

Satellite images show that the area covered by sea ice in the Arctic at the end of the summer is getting smaller. Ice-free shipping routes and newly established access to oil resources increase the risk of damage to this sensitive environment, and habitat for marine animals is threatened.

## Ocean Heat Content

Temperature sensors on thousands of floats that move through the ocean show an increase in heat energy stored in the top half-mile of water. Warmer ocean waters damage coral reefs and change marine ecosystems, disrupting fisheries and the people who depend upon them.

## Air Temperature Over Ocean

Thermometers on ships and floating buoys show that air near the ocean's surface is getting warmer, increasing its ability to evaporate water. In turn, we see an increase in heavy precipitation events and flooding on land.

## Sea Surface Temperature

Satellite sensors and thermometers on ships and buoys show that the temperature of water at the ocean's surface is rising. Warmer surface waters can increase the destructive potential of tropical cyclones and hurricanes.

## Global Sea Level

Satellites that measure the distance from their orbit to the ocean's surface show that global sea level is getting higher. Rising waters threaten ecosystems, freshwater supplies, and human developments along coasts.

## Air Temperature Over Land

Weather stations on land show that average air temperature at the surface is going up. Consequently, we see an increase in the number of heat wave events, and the area affected by drought.

## Humidity

Measurements from weather stations over land and water show increasing humidity—more water vapor in the air. The air feels stickier when it's hot, and air conditioners have to work harder for us to feel comfortable.

## Temperature of the Lower Atmosphere

Measurements from satellites show that the lowest layer of the atmosphere—where we live, airplanes fly, and weather occurs—is warming. Greenhouse gases build up in this layer, trapping heat radiated from Earth's surface and raising the planet's temperature.

## Snow

Satellite images show the area of land covered by snow during spring in the Northern Hemisphere is getting smaller. Snow is melting earlier, changing when and how much water is available for nature and people.

## Glaciers

Historical paintings and photographs show that most mountain glaciers are melting away. People who depend on water from melting glaciers for their living roads, crops, and livestock are facing shortages.



All statements refer to trends in measurements observed over a period of 30 years or longer.

Sources:  
 BMwS Annual State of the Climate, 2009  
 USGCRP Global Change Impacts in the United States, 2008  
 USGCRP Climate Library: The Essential Principles of Climate Science, 2009

Climate change will have consequences for the Earth system and human lives.

Explore further information and the data sets that support each of these statements at:

[www.climate.noaa.gov/warmingworld](http://www.climate.noaa.gov/warmingworld)



# Impacts

*We don't talk about  
enough*

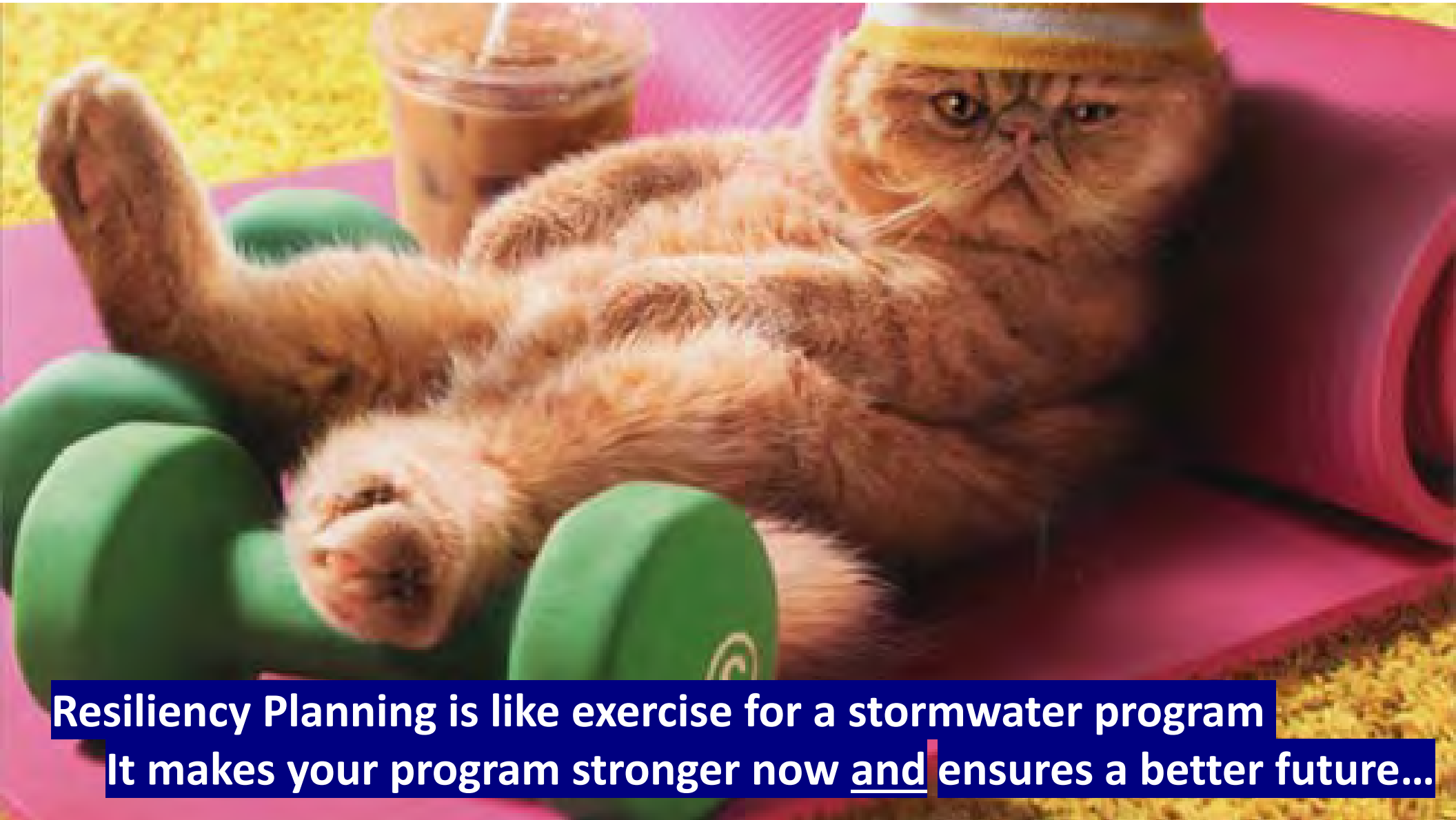
- Conflicts and Wars Over Water
  - Agricultural and Food Supplies
  - Longer Allergy Seasons
  - Human and Ecological Migrations
  - Disease Migration
  - Real Estate and Economic
- Disproportional Impacts Based on Socioeconomics

# Analysis: The Right Thing to Do

*(Regardless)*

- Data and analyses have always been important
  - Proactive responses to regulations
    - CRS Program
    - FEMA Maps
    - Water Quality Regulations
  - More responsive to inquiries and challenges
  - Informed decision making
  - Greater transparency
  - Makes operating a stormwater program more cost effective





**Resiliency Planning is like exercise for a stormwater program  
It makes your program stronger now and ensures a better future...**

# Engineers Cannot Do This Alone

- No “silo” alone is enough
  - The complexity is mind boggling – scientifically, socially, politically, etc.
  - Our cookbooks were built on old observations (that are no longer variable enough)
  - We cannot use Federal datasets to answer all of our questions
  - We cannot move our cities out of all threat areas
  - We’ve never been faced with global issues of this magnitude

# But we also need to be the best version of engineers and scientists...

- Who better to communicate the issues?
- We are comfortable with scientific method and understand the importance of public discourse
- Science should inform decision makers and politicians



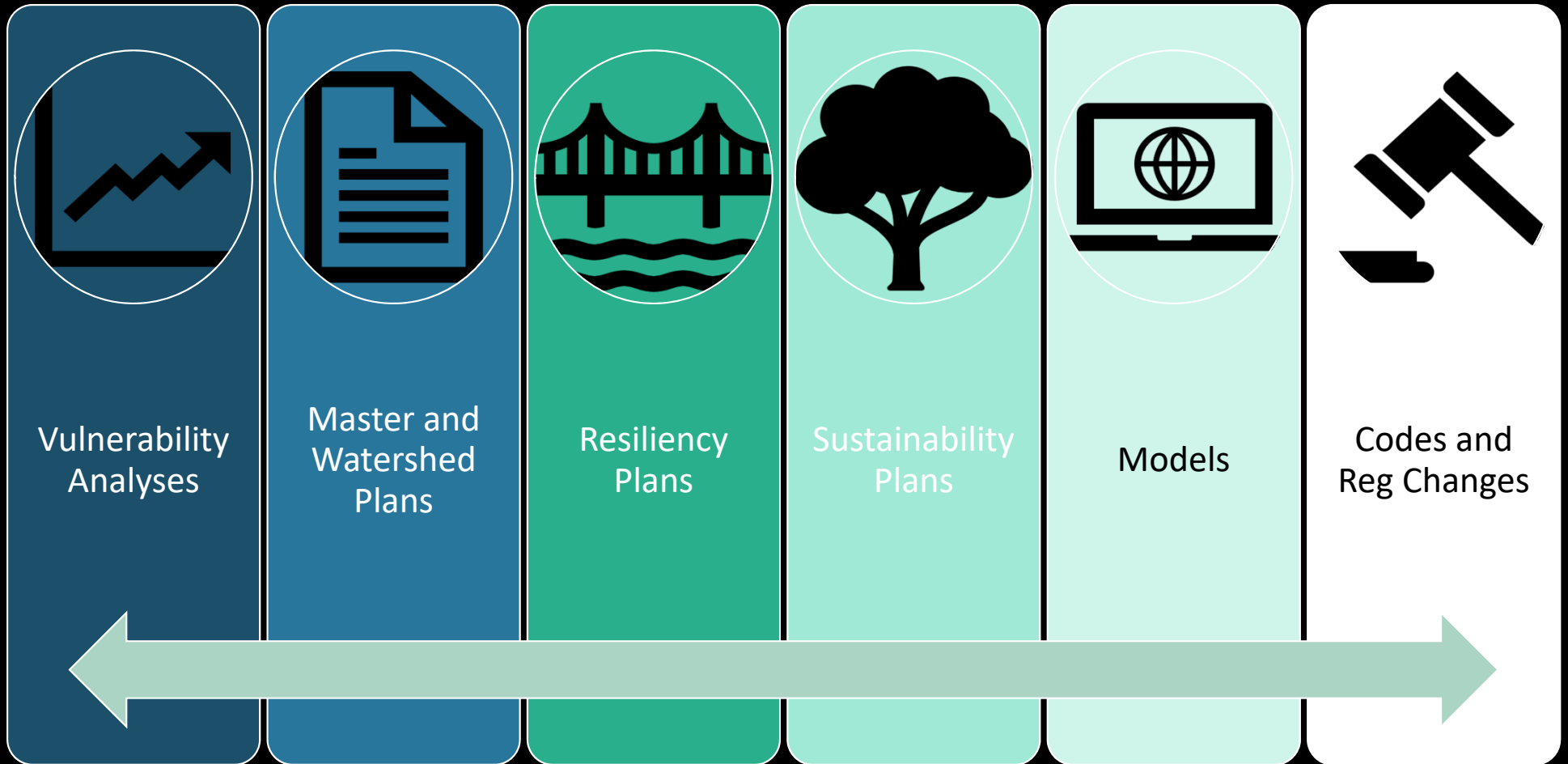


Why is  
**INTEGRATED**  
Analysis  
Important?

# What Do Blind Spots Look Like?

- Financial (#fightingfires)
- CIP Programs not balanced socio-economically (#squeekywheelsyndrome)
- CIP Programs only focused on water quantity and civil engineering
- Temporal blind spots – i.e. large storms are occurring more often in many parts of Florida
- Overly simplistic analyses that we can't use to make decisions
- Variability (#offthecurve)
- Psychological (#veryscaryfuture)
- Any many, many more...

# What Are Floridians Doing?







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