

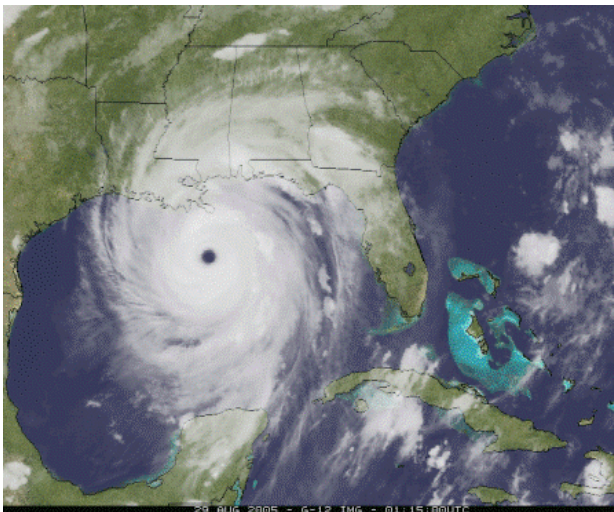


NCAR is Sponsored by NSF

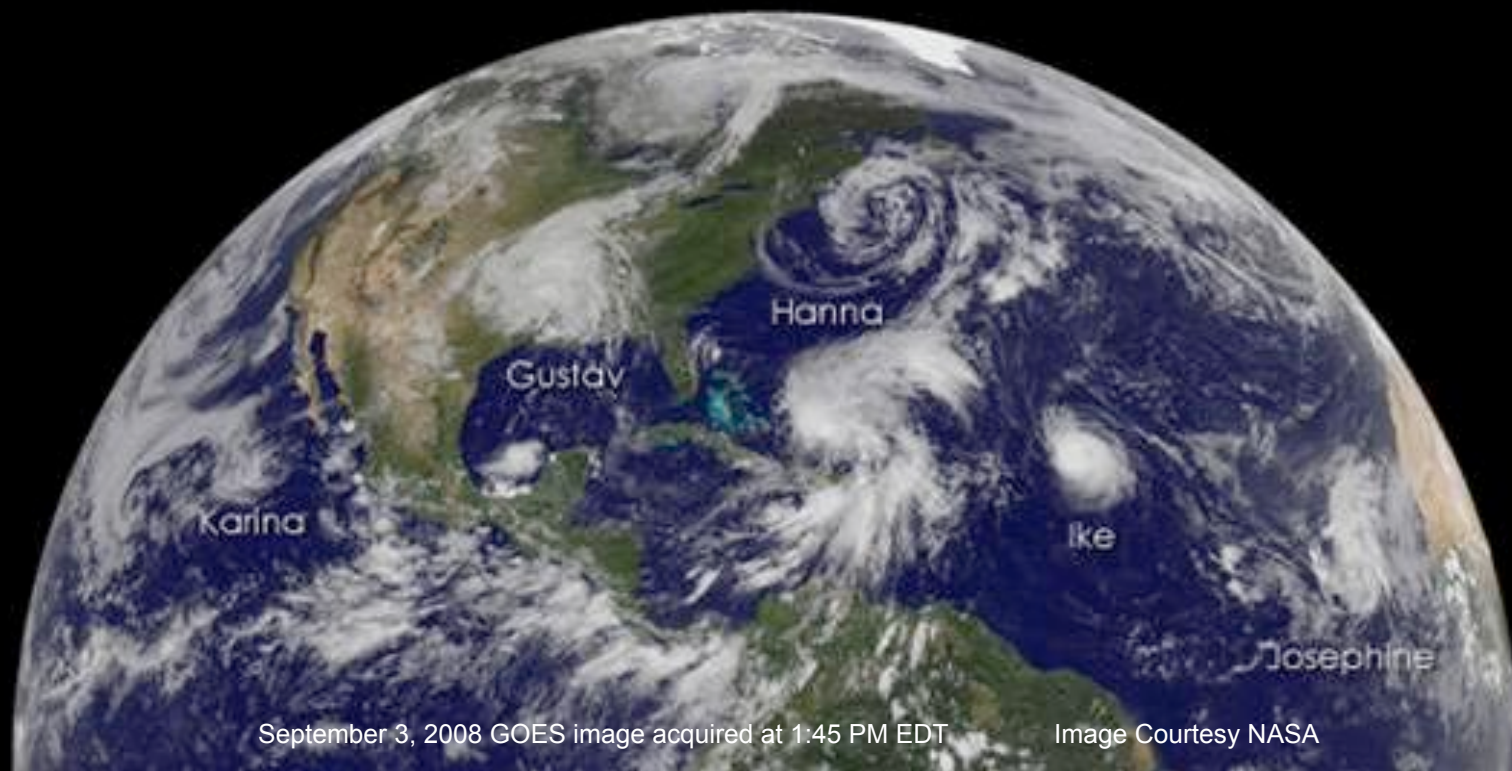


Zooming in on Future Hurricanes

James Done



The future?



September 3, 2008 GOES image acquired at 1:45 PM EDT

Image Courtesy NASA



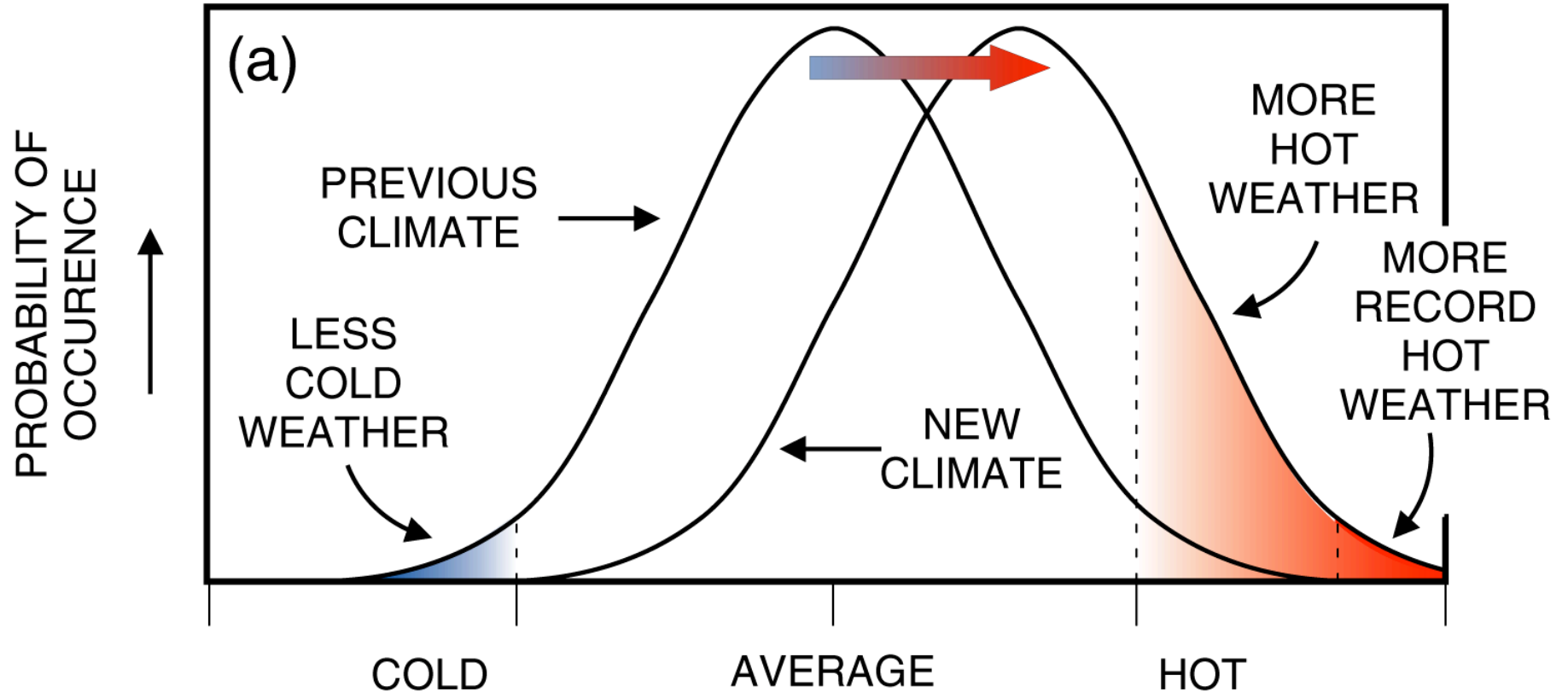
Climate Change and Extremes

Changes in extremes matter most for society and the environment

- ◆ With a warming climate:
 - ◆ More high temperatures, heat waves
 - ◆ Wild fires and other consequences
 - ◆ Fewer cold extremes
- ◆ More extremes in hydrological cycle:
 - ◆ Drought, heavy rains, floods
 - ◆ Intense storms



Increase in the Average . .



. . . leads to much bigger changes in extremes

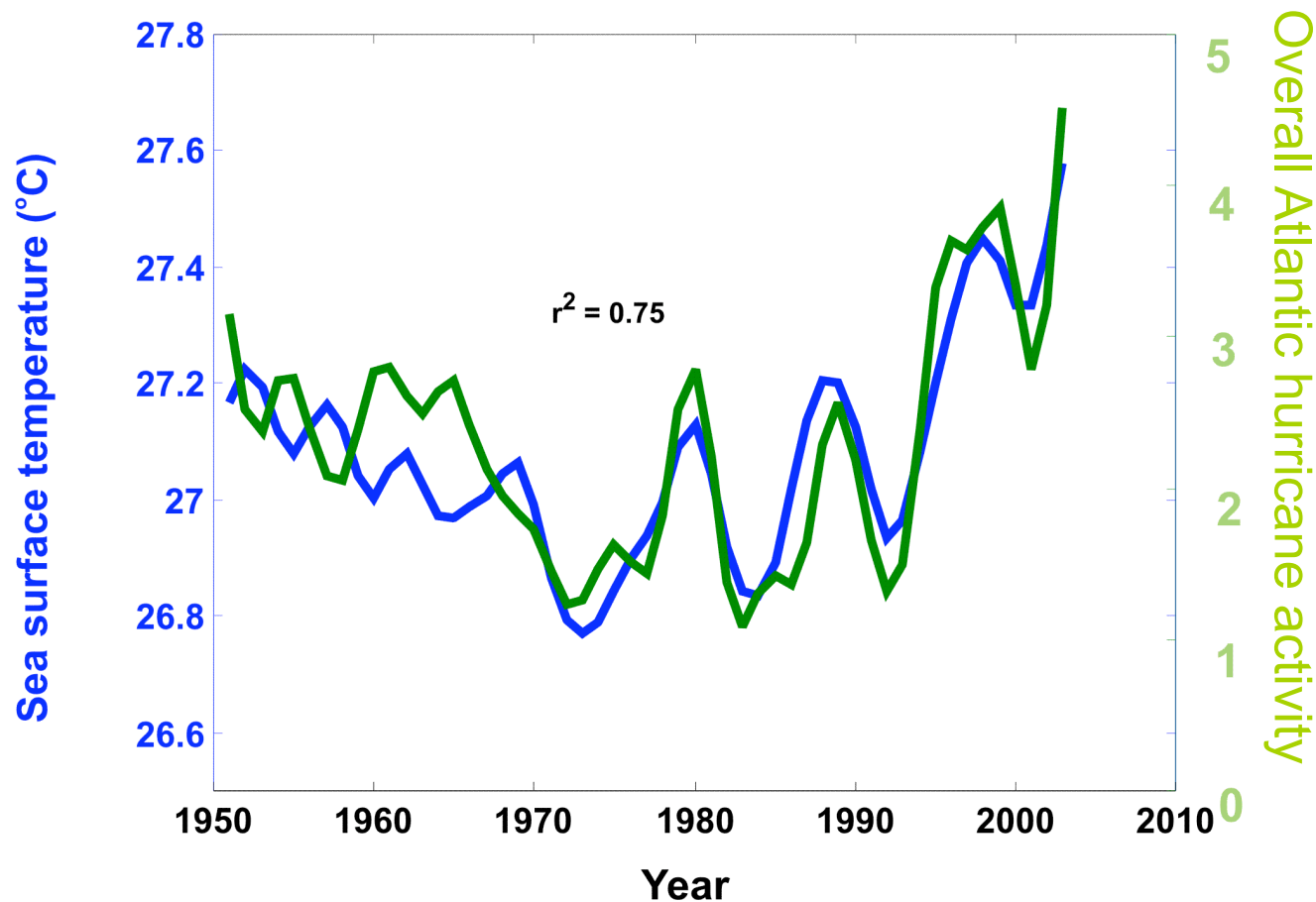
Are Hurricanes Changing? Why are they Changing?

What will happen in the future?





The Recent Past

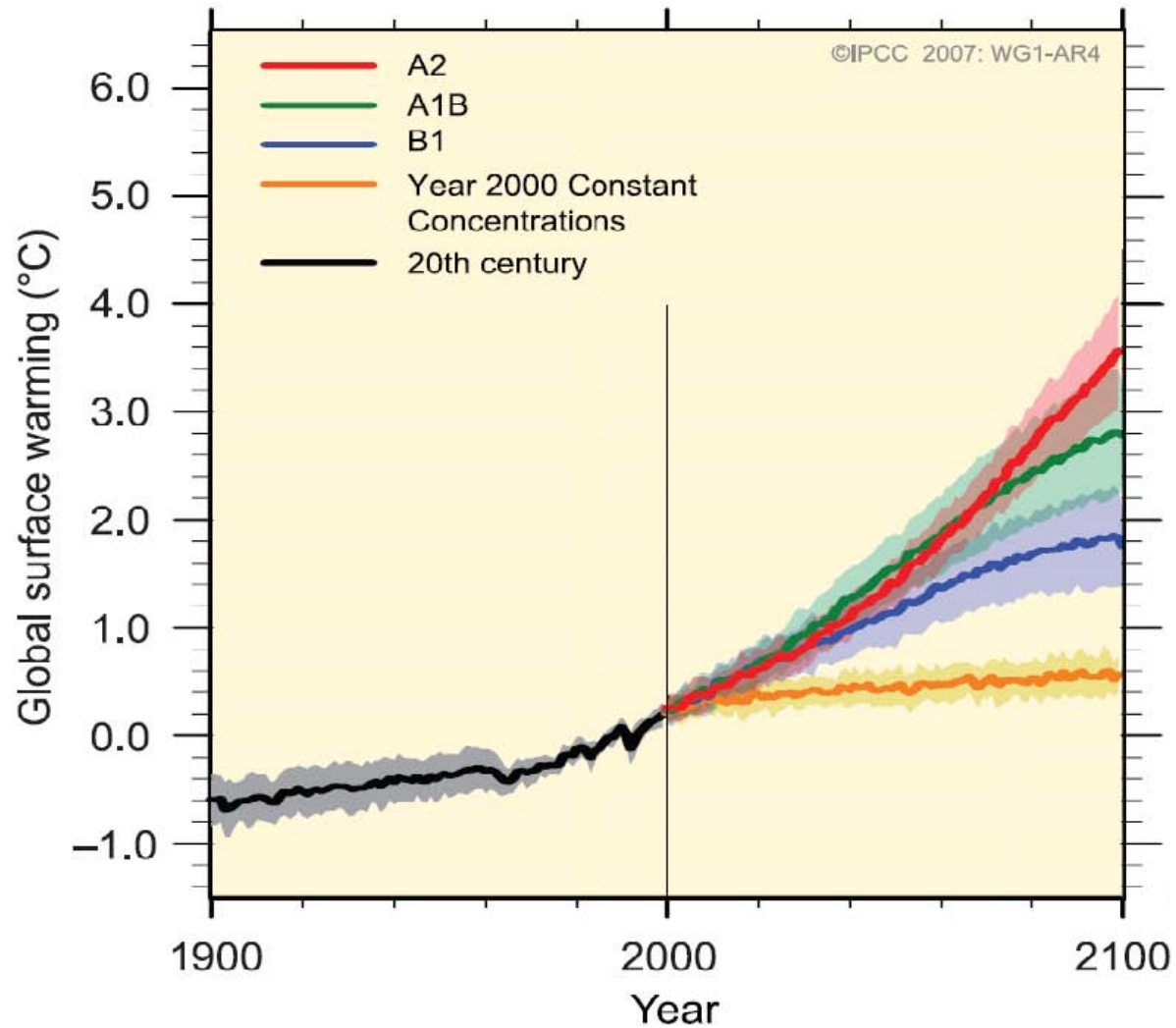


Hurricane activity and sea surface temperatures have changed in step with each other.

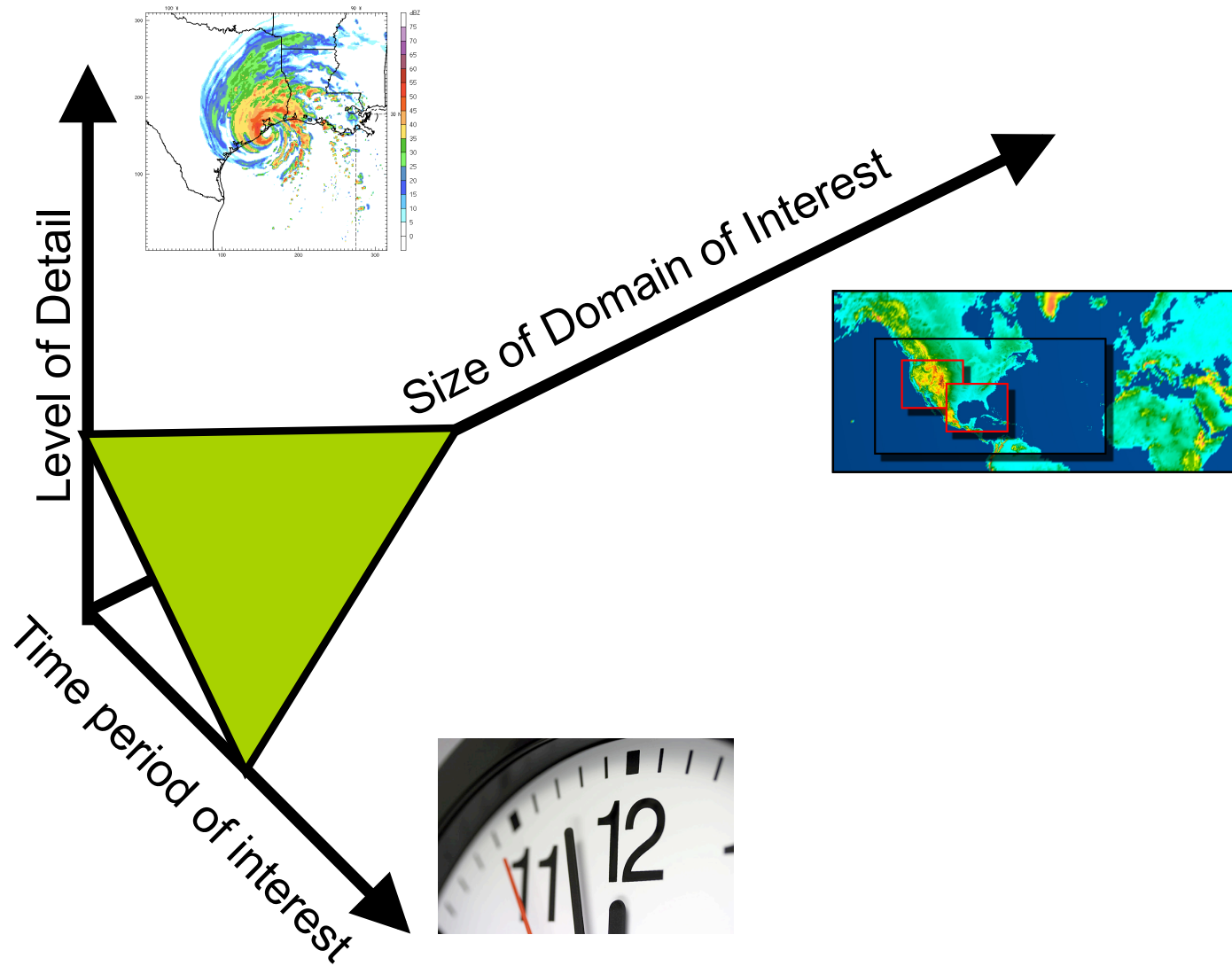
Source: Kerry Emanuel, J. Climate (2007).



Future Temperature

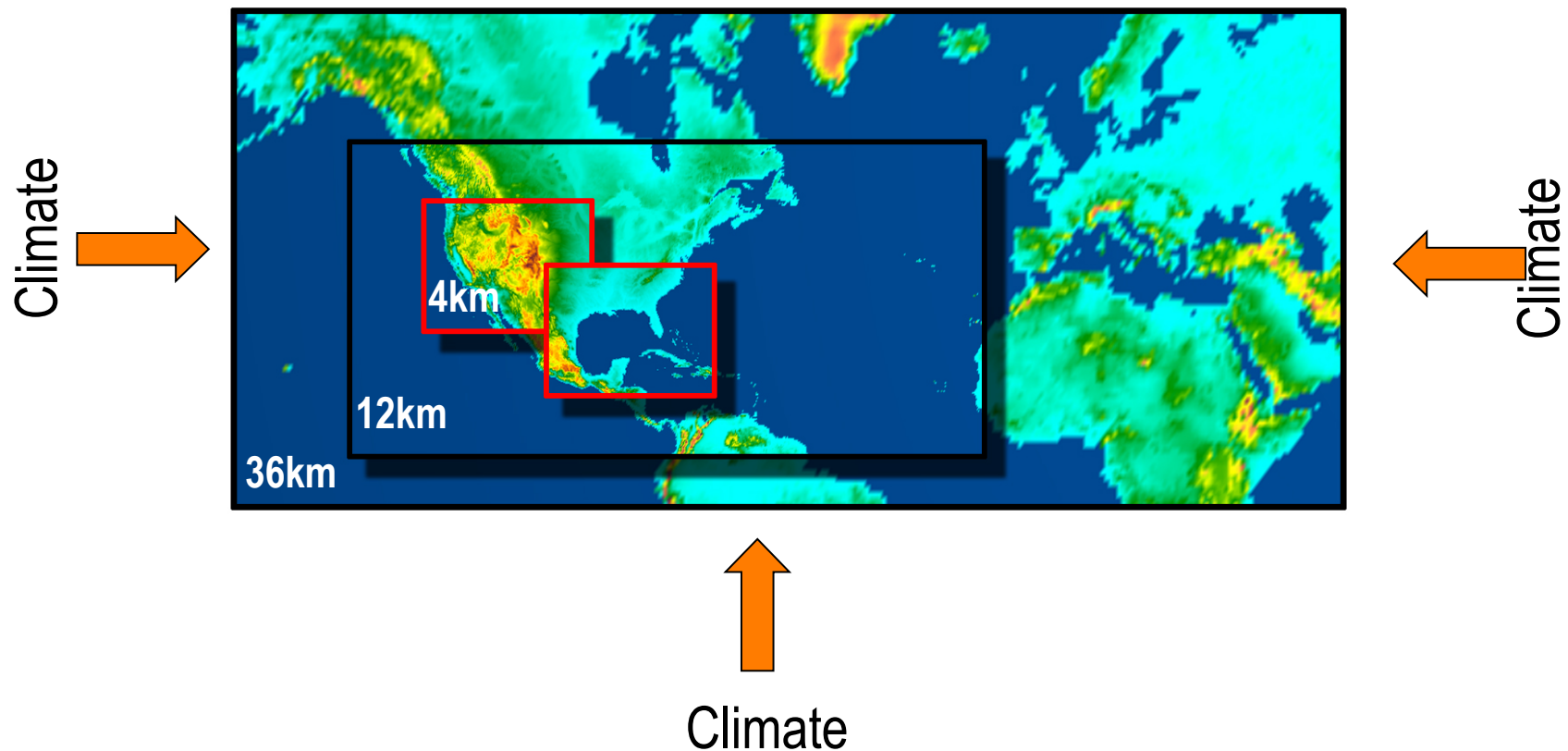


Finite Computer Power





Weather and Climate Simulations: A Powerful Combination

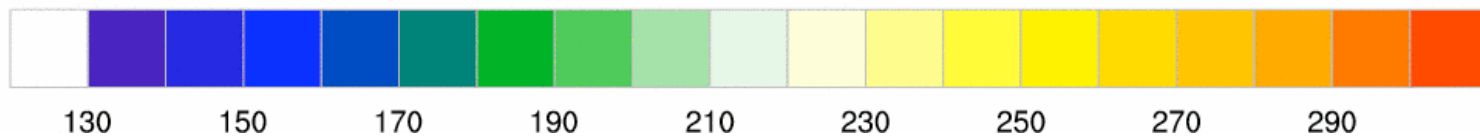
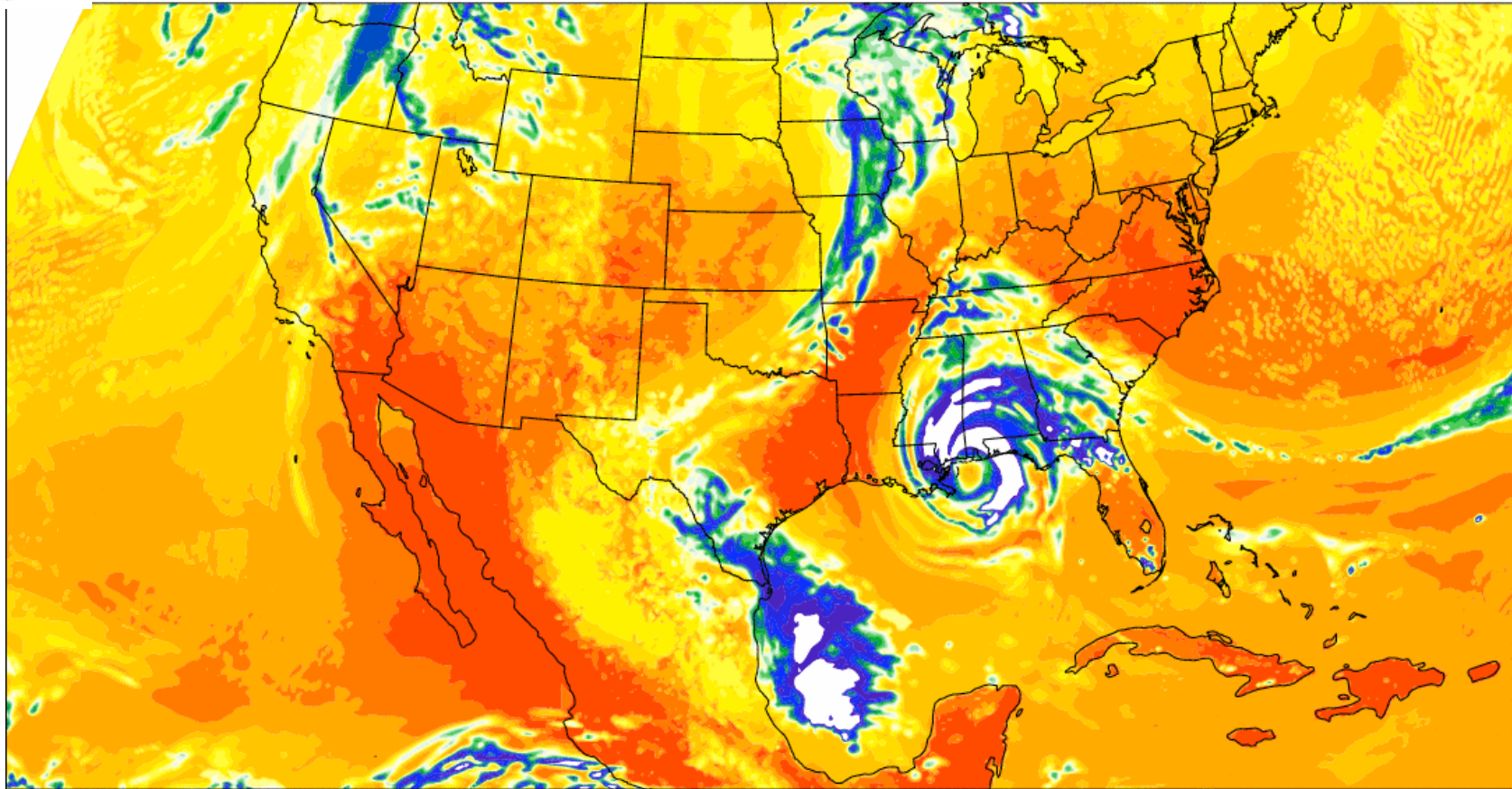




Category 3 Hurricane October 2046

OUTGOING LONG WAVE

W m⁻²



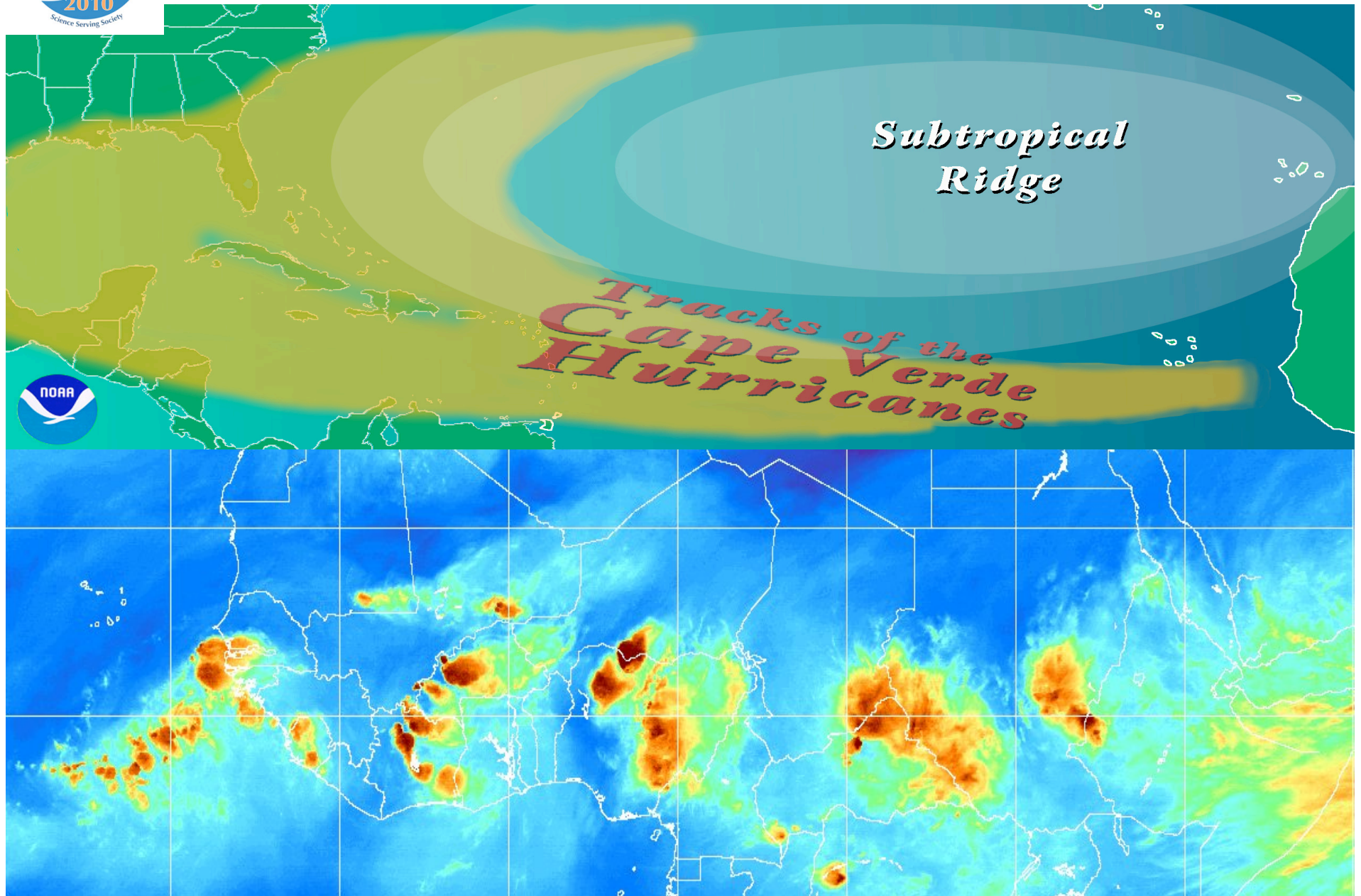
Hurricanes of the Future

	Simulated 2000s	Simulated 2020s	Simulated 2050s
	7.6	8.5	10.4

- More Hurricanes
- Stronger Hurricanes



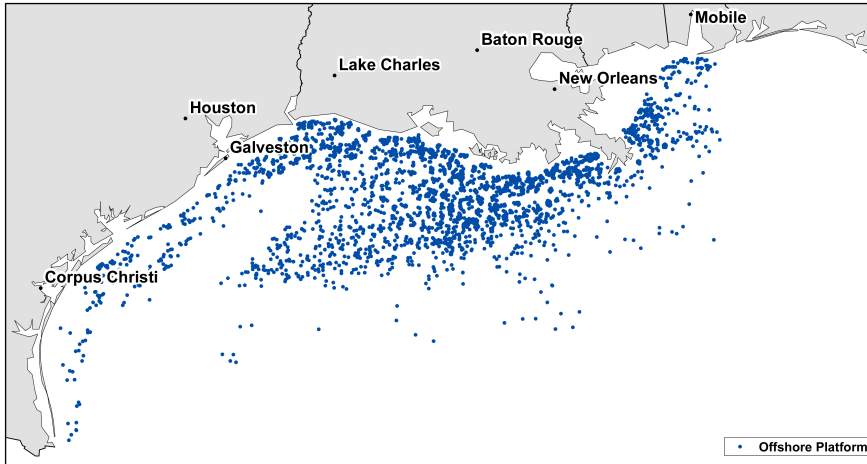
- Southeast shift in storm track location





Assessing Hurricane Damage Potential

Active Gulf of Mexico Offshore Platforms



Source: Minerals Management Service (MMS) data as interpreted by API. Data current as of 08/07/08.



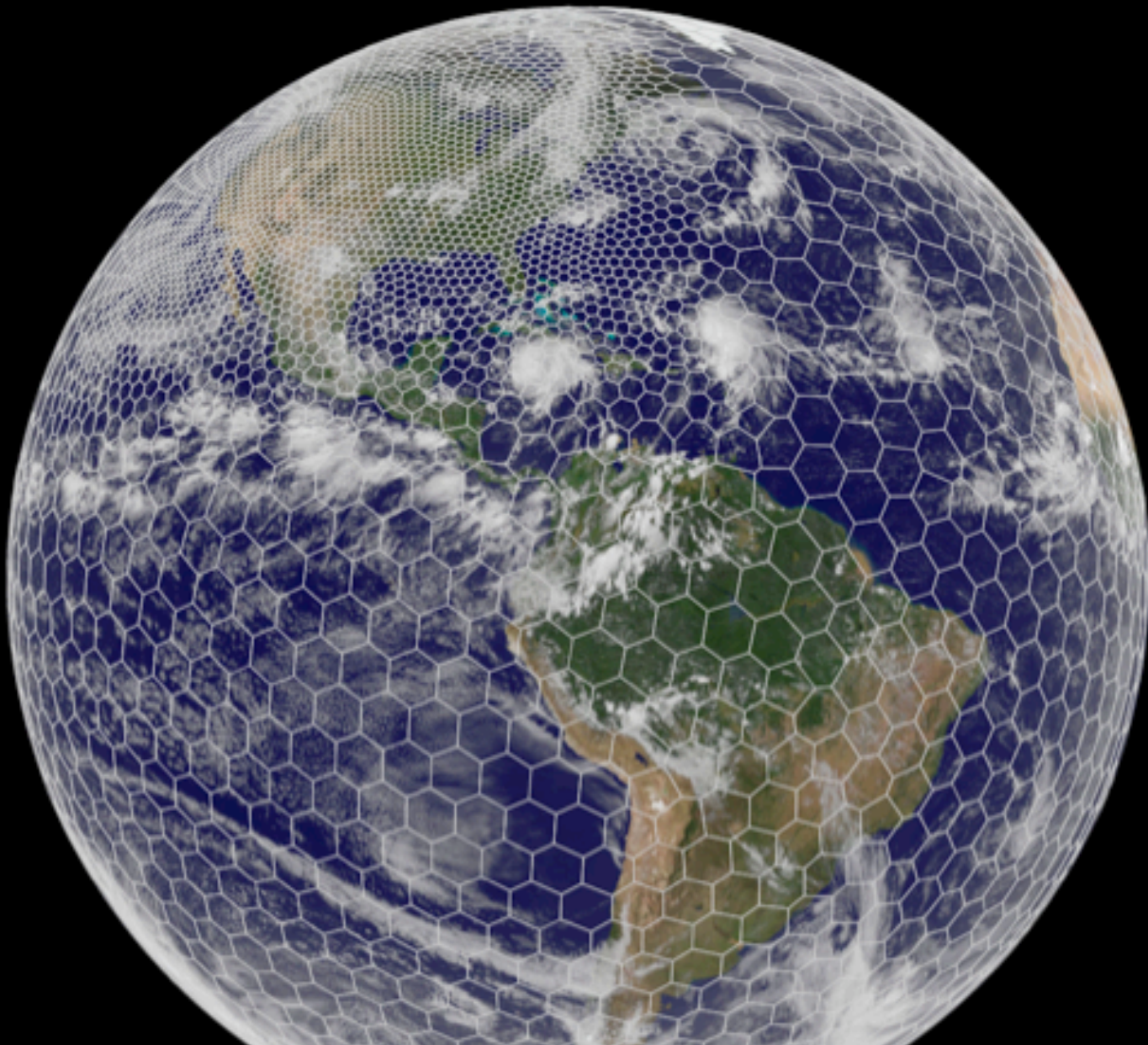
Relate Hurricanes characteristics to damage.

$$Damage = (WindSpeed)^3 + Size + (ForwardSpeed)^{-1}$$

- real-time damage prediction
- impact of climate change on damage

Future Directions

New and efficient methods to simulate hurricanes and climate





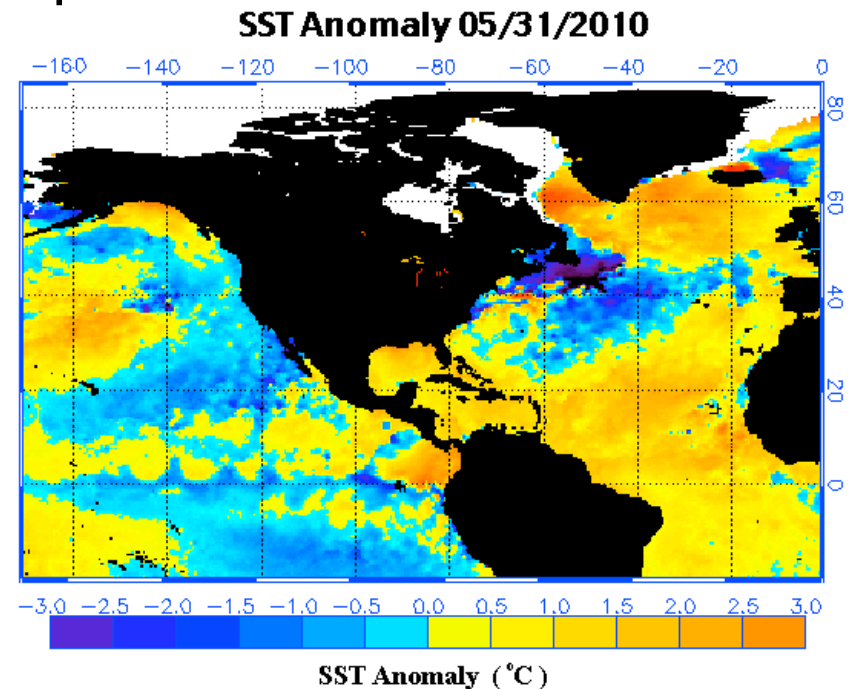
The 2010 Hurricane Season?

Colorado State University (CSU): 18 named storms
(Issued June 2) 10 hurricanes
5 intense hurricanes

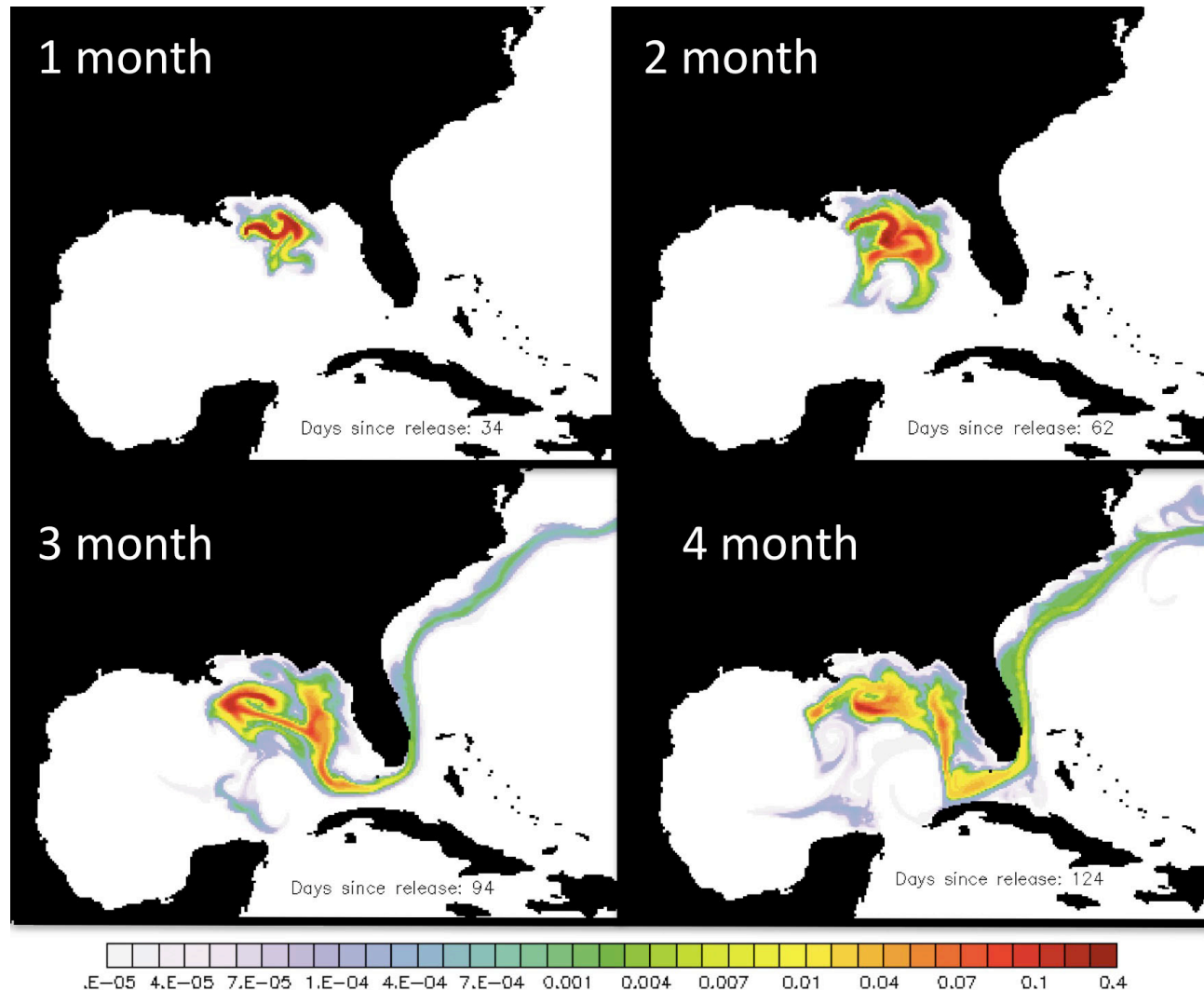
- Record high ocean temperatures
- Favorable conditions in the atmosphere

Should be believe it?

June forecasts are
better than guessing



Oil Spill Projection



Simulation of a passive dye injected at the location of the oil leak over 20m depth and advected by an ocean model for different run times for one likely ensemble. The dilution factor is colored.



Some Remaining Science Questions

- Why are there 80 - 90 hurricanes worldwide each year?
- What is the impact of human activity on hurricanes?
- How do hurricanes form?



Hurricane Tracks

