

Caribbean MAGIC: Enhancing Collaboration in Research and Education

April 12, 2017

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Caribbean MAGIC: Enhancing Collaboration in R and E

Caribbean Climate Modelers Group:

- ◆ **Climate Studies Group Mona, Department of Physics, UWI, Mona, Jamaica.**
- ◆ **Dept. of Computer Science, Mathematics and Physics, UWI, Cave Hill, Barbados.**
- ◆ **Instituto de Meteorología de la República de Cuba, (INSMET) Habana, Cuba.**
- ◆ **Department of Infrastructure, Anton de Kom University of Suriname**
- ◆ **Caribbean Community Climate Change Centre, Belize**

Newer partners:

- ◆ **Université des Antilles, Guadeloupe.**
- ◆ **UWI, St Augustine, Trinidad.**

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Objective :

Downscale global and regional climate model outputs to local level.

Generate future climate scenarios at the regional and local-scale through downscaling, using the Special Report on Emission Scenarios (SRES**) and Representative Concentration Pathways (**RCPs**) data with other downscaling techniques.**

Conclusion from Climate Modeling

Broad agreement with IPCC-WG1 assessment report.

Temperature:

- ▶ **Annual temperature increases by end of the 21st century: range from 1.4°C to 3.2°C (median of 2.0°C);**
- ▶ **Increase in SSTs;**
- ▶ **Increase in number of very warm days.**

Rainfall:

- ▶ **Models project decreases in annual precipitation but increase in intensity (up to 20% by 2050);**
- ▶ **Reduced length of rainy season 7 - 8% by 2050;**
- ▶ **Increased length of dry season 6 - 8% by 2050.**

Conclusion from Climate Modeling

- **General drying across the Caribbean basin:**

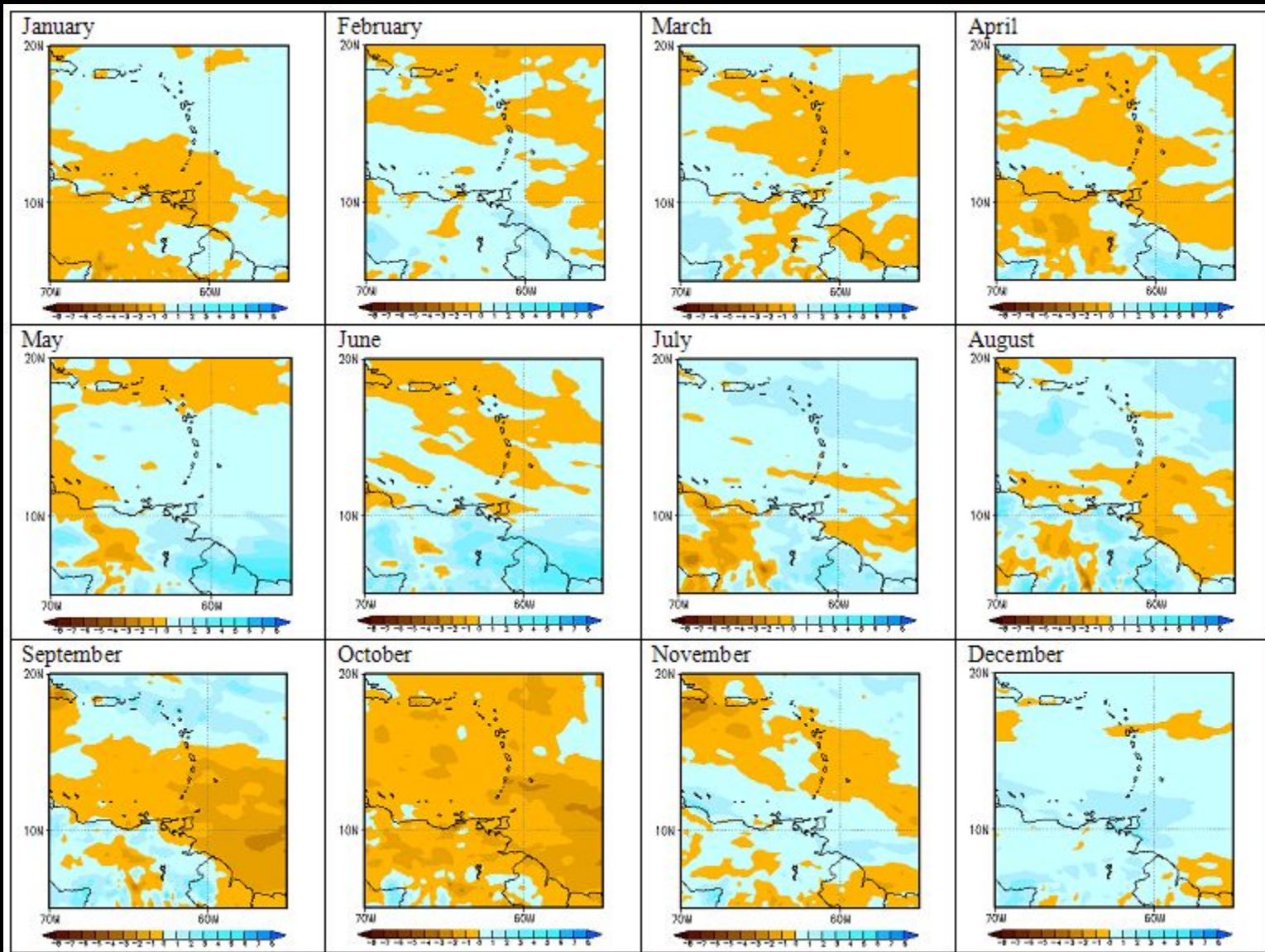
The decreases in rainfall range from **25 to 50%** depending on the scenario and section of the Caribbean basin

The exception to the overall drying trend is in the far northern Caribbean, including western Cuba and the southern Bahamas – **all are up to 25% wetter under the scenarios.**

Conclusion from Climate Modeling

- **The effect of climate change appears to enhance the existing climatic pattern:**
 - Making the wet and dry zones wetter and drier respectively, during the first 4 – 6 months of the year.
 - In May to October the entire Caribbean is up to **25% drier**.
 - The changes in average rainfall show a pronounced north-south gradient in rainfall change during the January to April dry season.
 - Indicates summer drying to become more severe during the wet season.

Rainfall change over the Eastern Caribbean



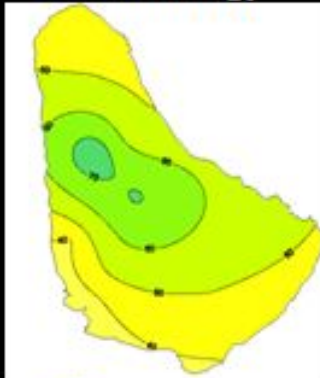
Month

Observed
Climatology

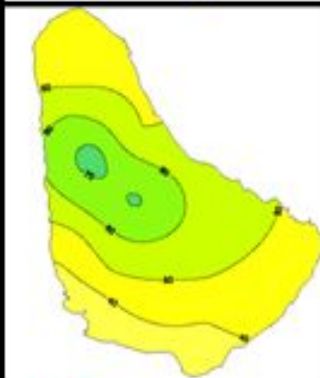
A2

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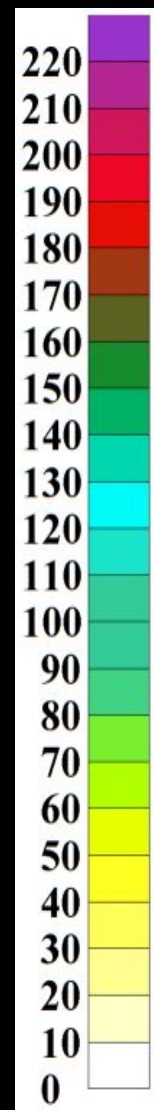
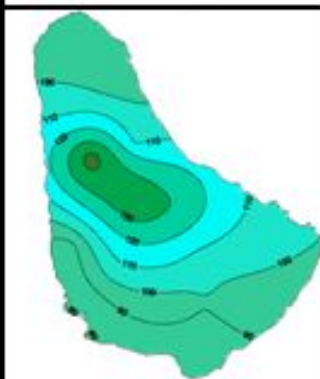
Feb



Mar



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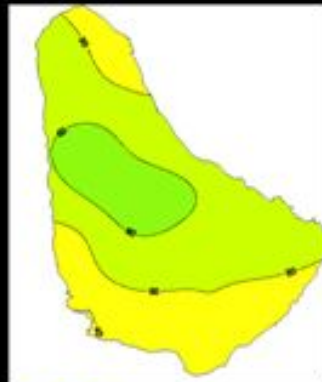
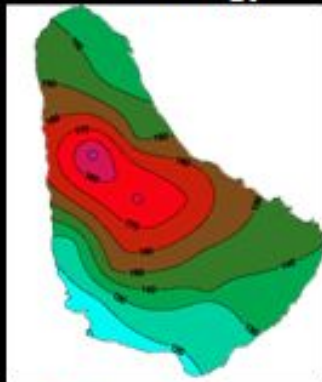
Month

Observed
Climatology

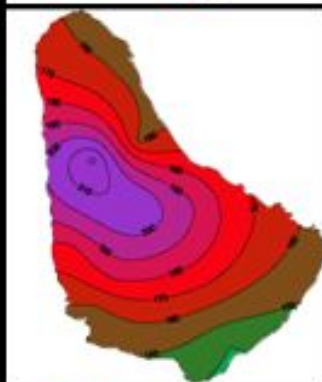
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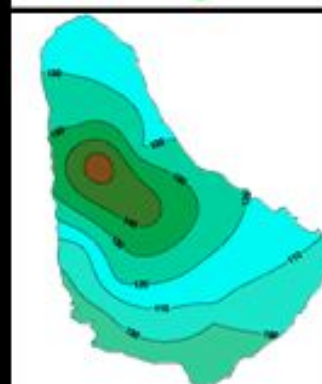
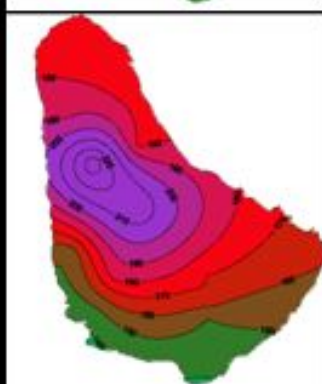
Jul



Aug



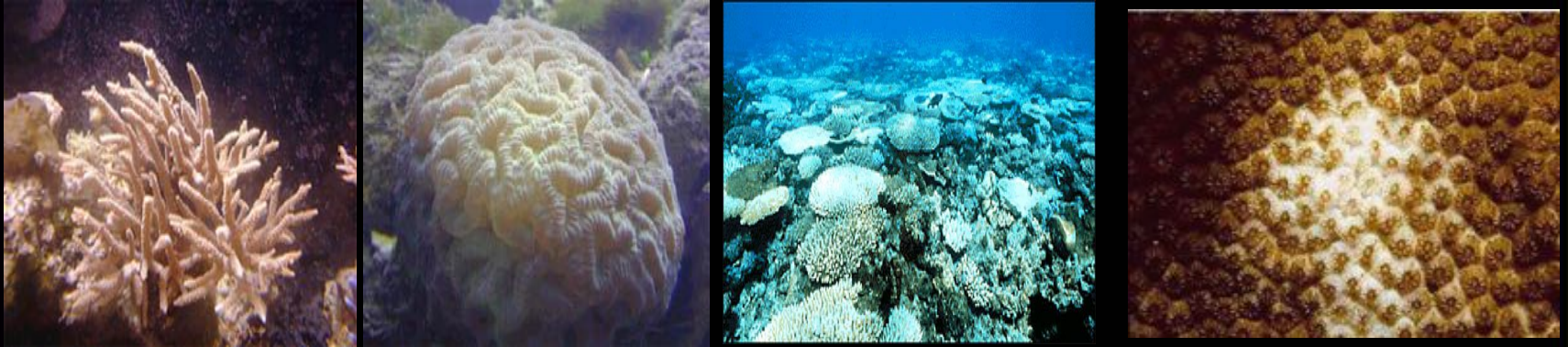
Sep



Conclusion from Climate Modeling

- ◆ More intense and longer droughts observed since the 1970s.
- ◆ Statistically significant summer drying trend for the Caribbean during **June - August**, based on the observed data.
- ◆ Very likely occurrence of more intense rainfall events, but decreases in annual precipitation.
- ◆ Trend is projected to continue throughout the 21st Century.

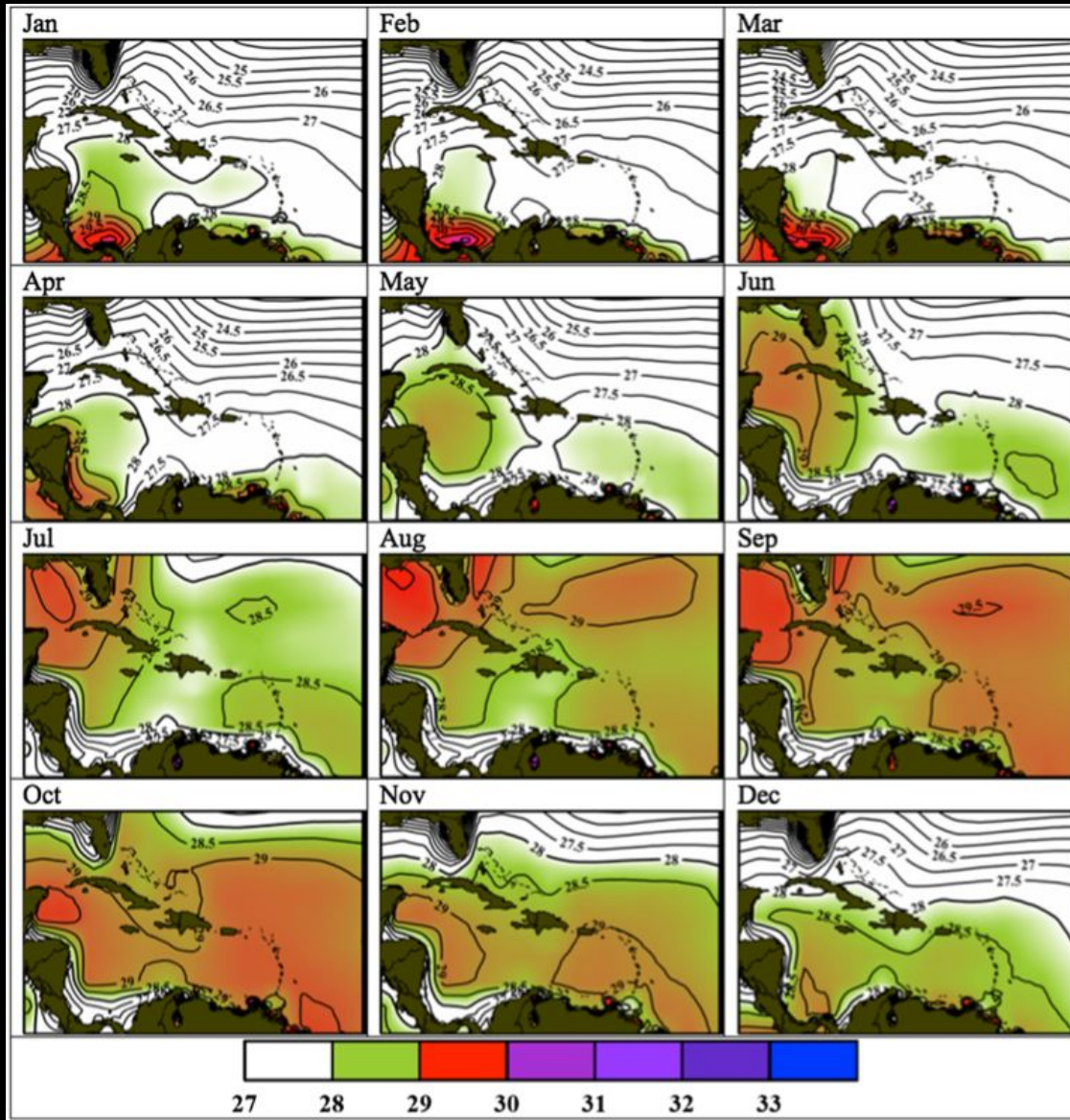
Warmer Sea Temperatures Result In Coral Bleaching And Mortality



- ◆ **In 1998 coral reefs around the world suffered the most extensive and severe bleaching and subsequent mortality in modern record.**
- ◆ **In the same year, tropical sea surface temperatures were the highest in modern record, topping off a fifty year trend for some tropical oceans.**
- ◆ **The repercussions of the 1998 mass bleaching and mortality events will continue to be far reaching in time and space.**

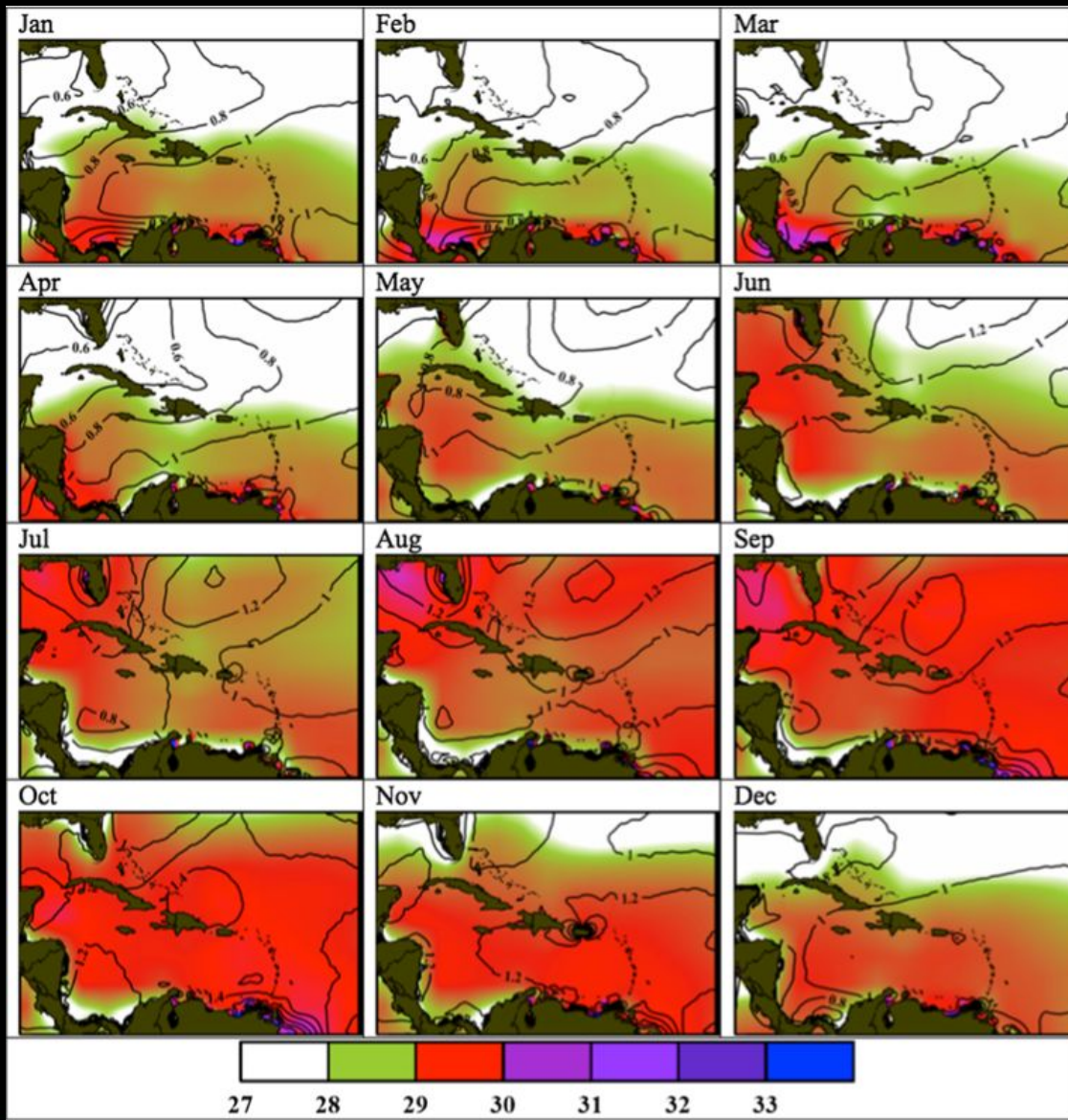
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Sea Surface Temperature
1985 – 2000
(AVHRR)



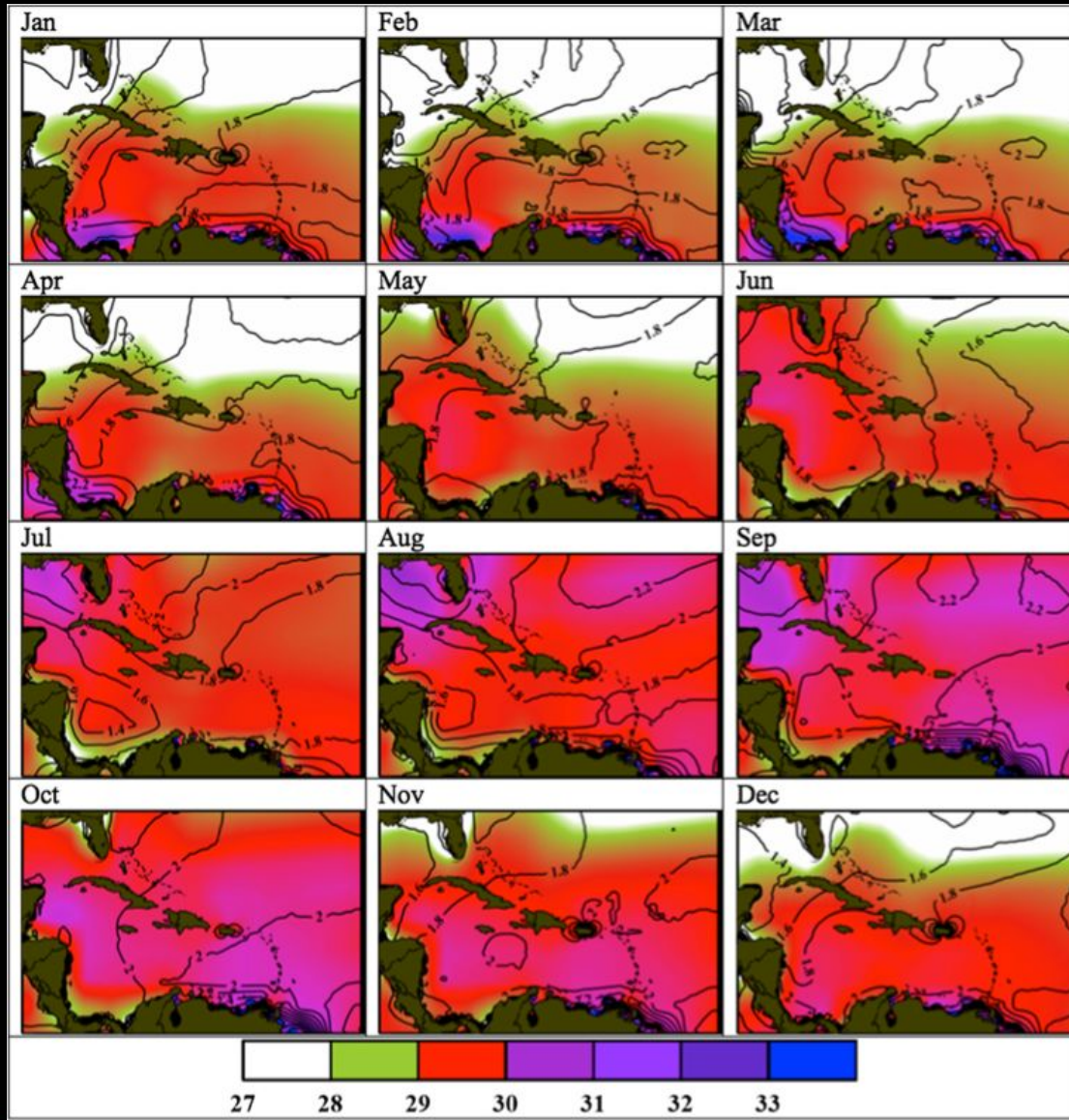
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Projected
Sea Surface
Temperature
2050 – 2059

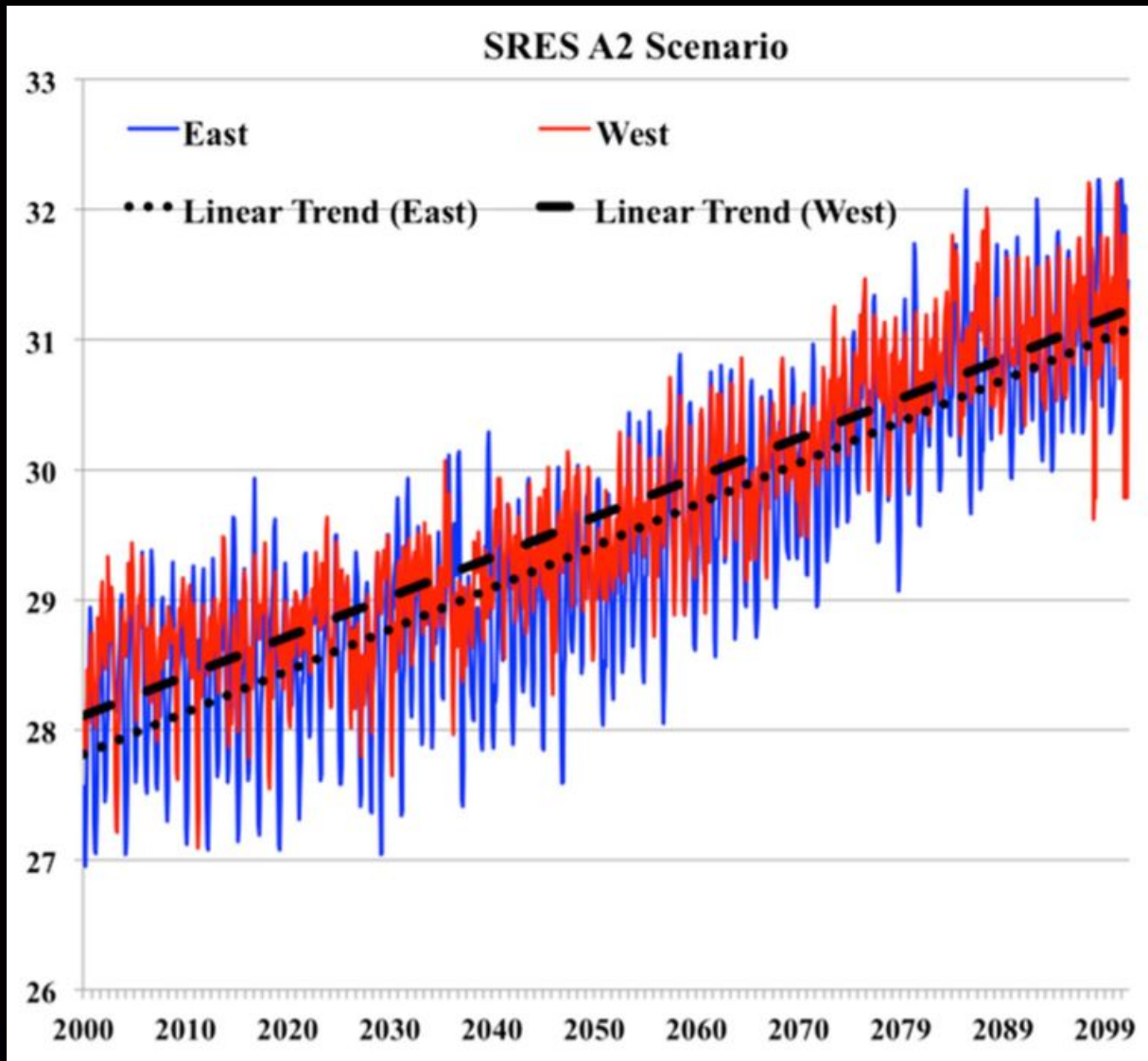


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Projected
Sea Surface
Temperature
2090 – 2099



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**Projected
Sea Surface
Temperature
2000 – 2100**

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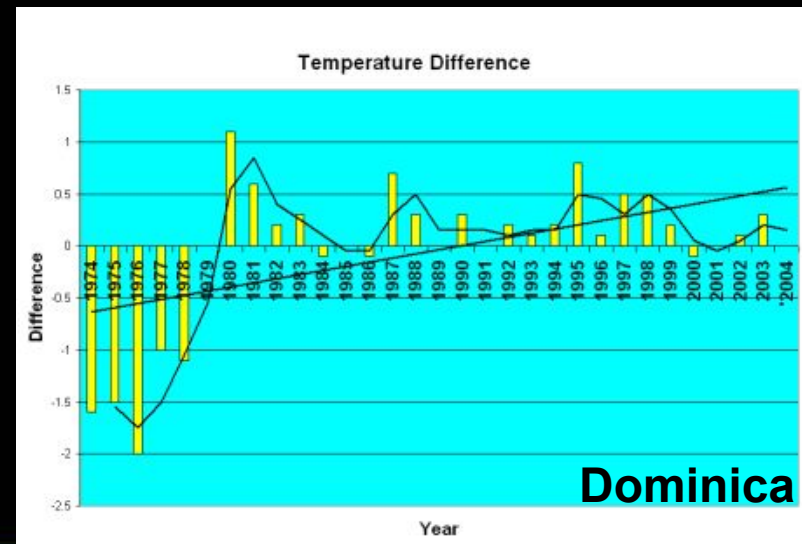
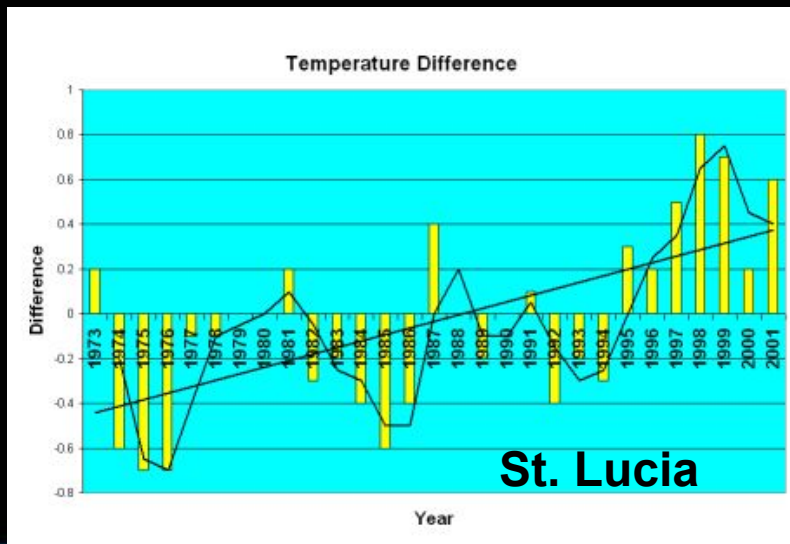
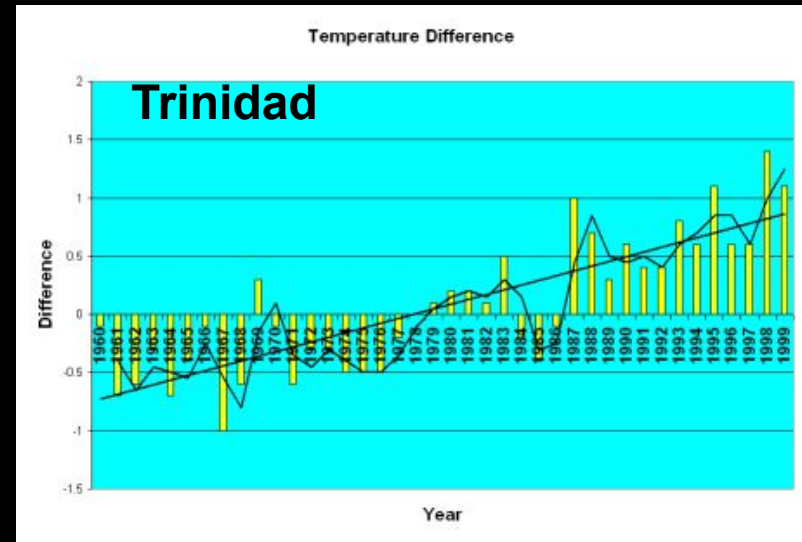
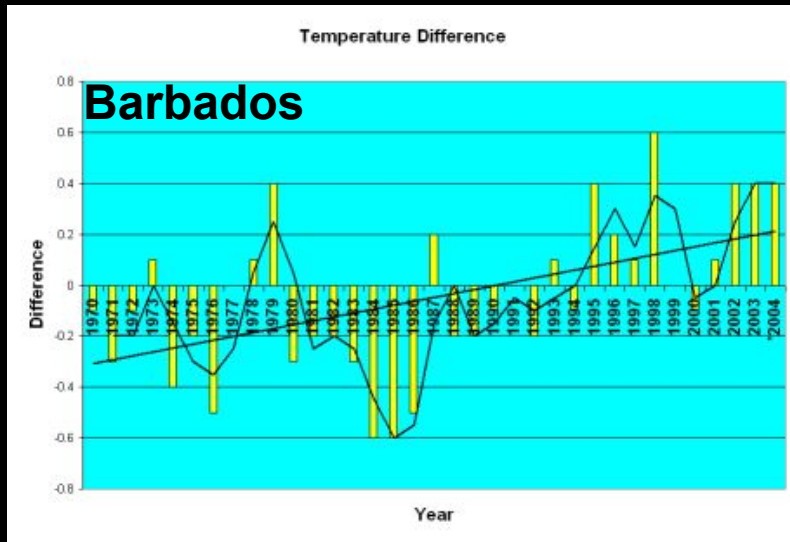
- ▶ **Temperature** observations and model projections for the caribbean are consistent with global trends.
- ▶ In 19th Century, air and sea surface temperature changes in the Caribbean have followed the global trend, though the rate of increase was slightly lower than global mean.
- ▶ Very high probability that Caribbean air and SSTs will continue to increase. *Rate/amount* of increase depends on GHG emissions.

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Temperature Projections:

- ▶ **Higher max and min temperatures.**
- ▶ **Number of very warm days and nights increasing.**
- ▶ **Number of very cool days and nights decreasing.**

Annual Mean Temperature Anomaly



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Sea Level Rise

Higher H₂O Levels → Higher Wave Amplitude

→ Increased Wave Energy

Coastal vulnerability assessments for Barbados, Guyana and Grenada (CPACC Project) show that **elevated sea level amplifies coastal erosion.**

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Sea Level Rise

- ▶ In Trinidad, sea level has been rising at rate of **8-10 mm/yr.** during the past 20 years.

Some beaches are retreating by approx. **1.0 m/yr.**

- ▶ Model runs and observed data project that ***accelerated beach erosion*** will be a major challenge in the Caribbean.

While some present-day erosion is man-induced (*sand mining, reef degradation, etc.*), empirical studies show that SLR is a significant contributory factor.

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Sea Level Rise



**Banana Bay Beach,
Southeast Peninsula,
after Hurricane Luis, 1995**

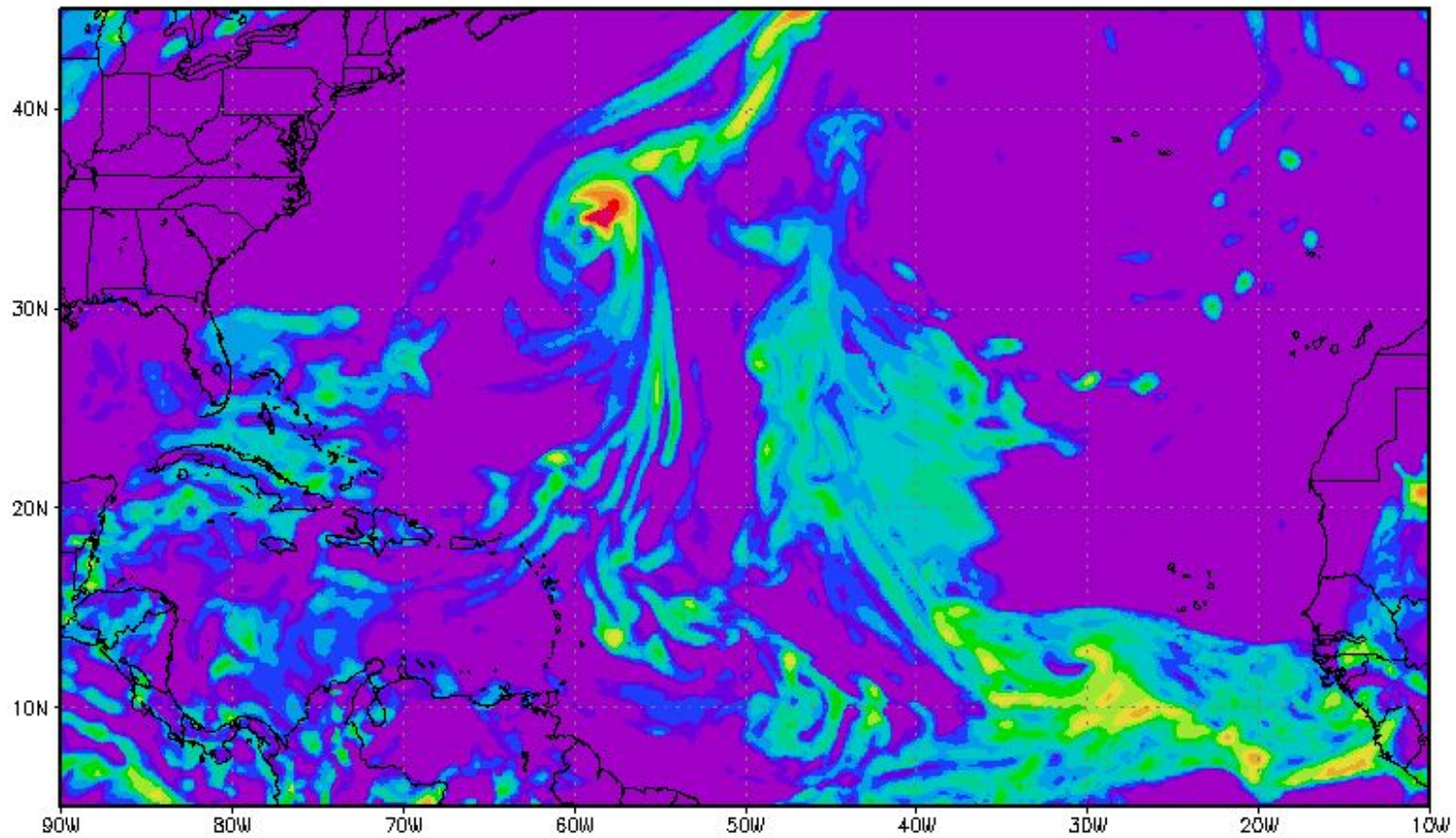
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Key Observations from the IPCC's AR

- **Temperature trend from actual observations:**
 - "Warming of the climate system is **“unequivocal”**."
- **Changing rainfall patterns:**
 - Increases of **both** drought and heavy precipitation events.
- **Sea level rise:**
 - Sea level rose at an average rate of about **1.8** mm/year during the years 1961-2003. **Since 2003, the average rate of annual increase has almost doubled.**

Key Observations from the IPCC's AR

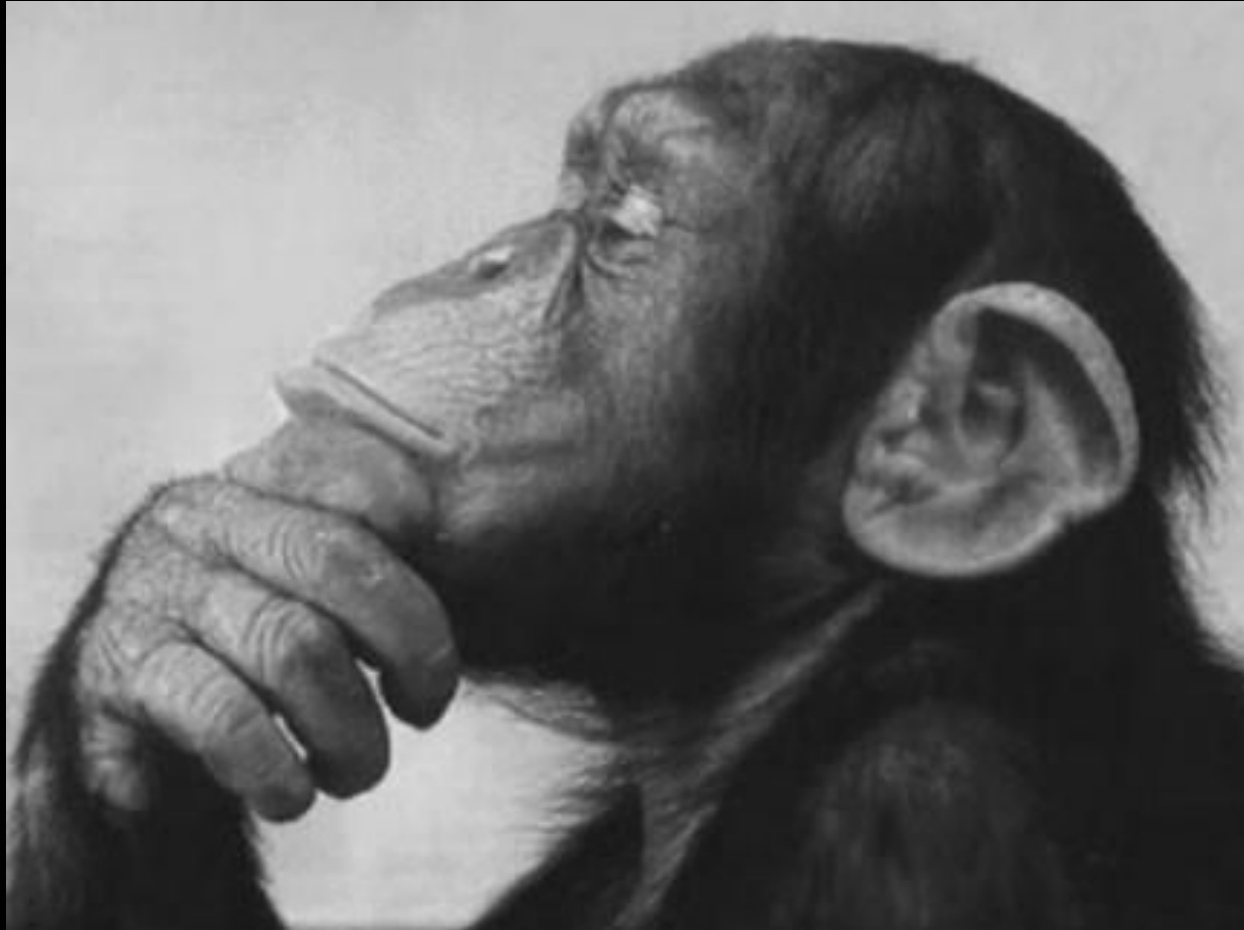
■ Hurricane Activities

- There has been an increase in **hurricanes** in the **North Atlantic** since the 1970s, and that increase correlates with increases in sea surface temperature.
- The observed increase in hurricane intensity is larger than **climate models** predict for the sea surface temperature changes we have experienced.

■ Cause

- Unmistakable evidence that the earth's temperature is rising and attributable to anthropogenic activities – **Green House Gases**

So where does that put us?



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Proposal for Collaboration :

- ◆ **Techniques for climate data reconstruction;**
- ◆ **Models' testing and comparison (errors, biases, etc);**
- ◆ **Rainfall distribution and behavior. Identifying where exceptions and special cases seem to be developing. Trends, variability, intensities, etc.**

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Proposal for Collaboration :

- ◆ **Hazard potentials (flooding, desertification, etc);**
- ◆ **Development of indices;**
- ◆ **Temperature (everything about it);**
- ◆ **Caribbean SSTs – impacts on marine life;**
- ◆ **Projected return periods of events' types;**

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Proposal for Collaboration :

- ◆ **Identification of new developing behaviors;**
- ◆ **Caribbean responses in the new climate (very broad – multiple questions);**
- ◆ **Projected Impacts! (very broad – multiple sectors, multiple questions);**

The New player:

Sargassum Moss (Sea Weed)



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**Thank
You!**