



# **OBSERVED CLIMATE CHANGE IN THE CARIBBEAN: *CURRENT STATUS AND PAST STUDIES***

Climate Studies Group, Mona  
Department of Physics  
University of the West Indies, Mona



*‘Climate change is an issue of our times – one that  
Caribbean cannot avoid contending with . . . . .’  
– CSGM 2011*



# CLIMATE CAN CHANGE

## Climate Change

- Distinct changes in measures of climate lasting for a long period of time

Natural Variations	Volcanic Eruptions	Human Activity
<ul style="list-style-type: none"><li>• Changes in the earth's orbit</li></ul>	<ul style="list-style-type: none"><li>• Alter aerosols in the atmosphere (block sunlight) ... not long term effect.</li></ul>	<ul style="list-style-type: none"><li>• Changing land cover (reflective properties of earth).</li></ul>
<ul style="list-style-type: none"><li>• Changes in solar intensity</li></ul>	<ul style="list-style-type: none"><li>• Alter carbon dioxide concentrations (CO<sub>2</sub>)</li></ul>	<ul style="list-style-type: none"><li>• Altering aerosol concentrations.</li></ul>
<ul style="list-style-type: none"><li>• Pre-industrialized era e.g. Ice Age</li></ul>		<ul style="list-style-type: none"><li>• Post Industrial Revolution (~1750). Burning of fossil fuels and biomass has altered the composition of the atmosphere primarily through the addition of greenhouse gases.</li></ul>



# CLIMATE CAN CHANGE

IPCC (2007):

It is **extremely unlikely** (<5%) that the global pattern of warming during the past half century can be explained without external forcing, and **very unlikely** that it is due to known natural external causes alone.



# CLIMATE HAS CHANGED



# CLIMATE HAS CHANGED: GLOBAL TRENDS

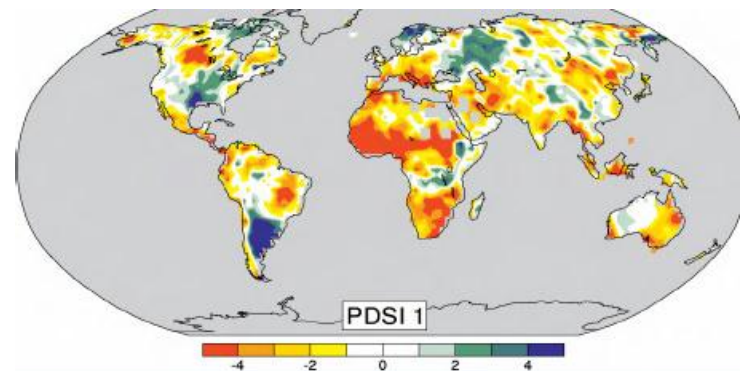
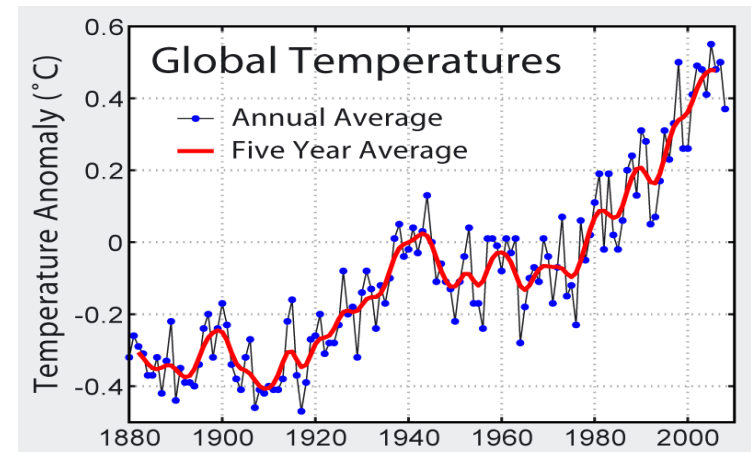
IPCC (2007):

## *Temperature*

- ⊙ Rise of  $0.74^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$  during the period 1906 - 2005
  - > 1998 and 2005 were the warmest years
  - > More warm days, fewer cold nights
  - > Lower diurnal temperature range

## *Rainfall*

- ⊙ Northern latitudes are wetter, Tropics are drier
  - > Droughts more common
  - > Heavier rainfall events
  - > More intense – dangerous – hurricanes

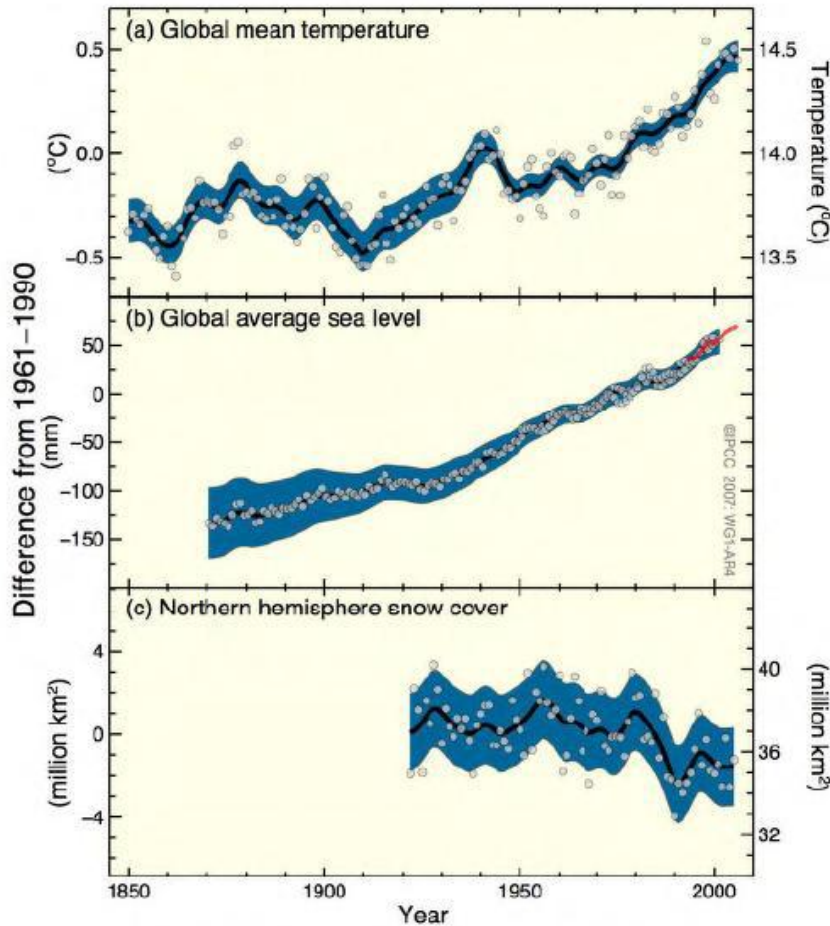


The most important spatial pattern of the monthly Palmer Drought Severity Index (PDSI) for 1900 to 2002.



# CLIMATE HAS CHANGED: GLOBAL TRENDS

Changes in Temperature, Sea Level  
and Northern Hemisphere Snow Cover



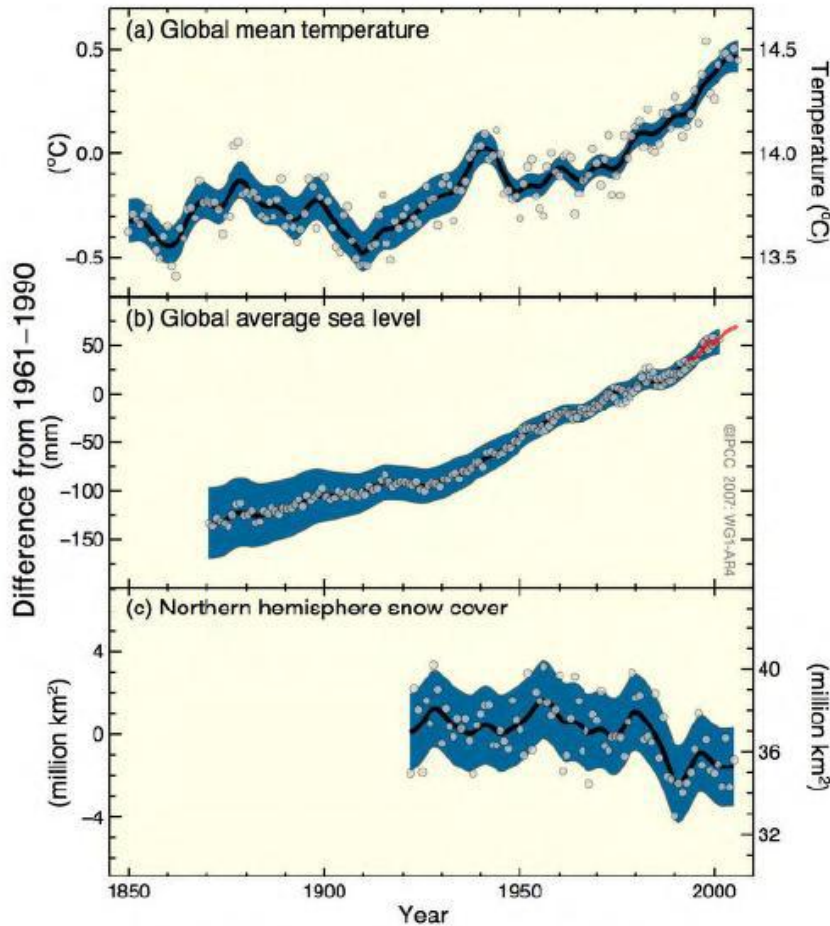
IPCC (2007):

- Primary factors driving current *sea level rise* include:
  - the expansion of ocean water caused by warmer ocean temperatures
  - melting of mountain glaciers and small ice caps
  - (to a lesser extent) melting of the Greenland Ice Sheet and the Antarctic Ice Sheet



# CLIMATE HAS CHANGED: GLOBAL TRENDS

Changes in Temperature, Sea Level  
and Northern Hemisphere Snow Cover



IPCC (2007):

## ● Sea Level rise

- > Sea levels have risen across the globe over time
- > Rise is due to thermal expansion and melting of glaciers and ice sheets

## ● 20th century rate of 4.8 to 8.8 inches per century (1.2-2.2 mm/year)





# Climate has changed

## Caribbean Trends

Trends presented are for the mean Caribbean



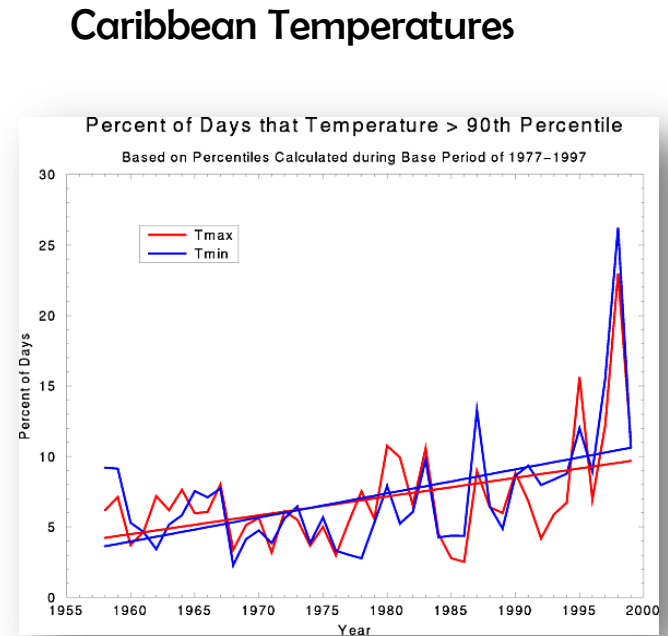
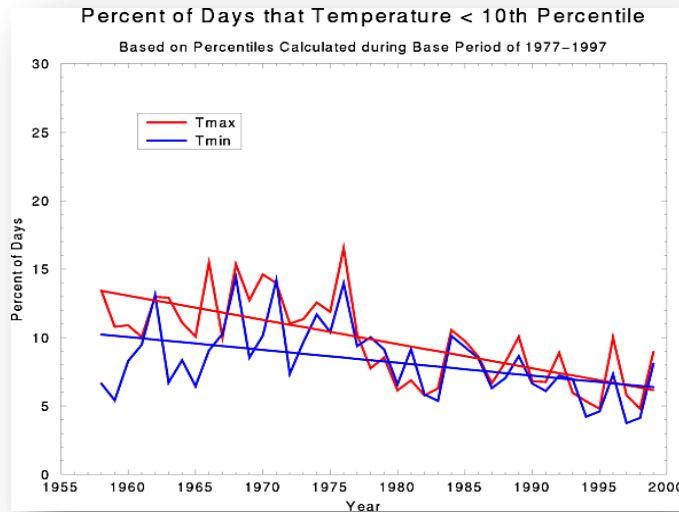


# CLIMATE HAS CHANGED: CARIBBEAN TRENDS

Peterson et al (2002):

- 1950-2000
- More warm days, More warm nights
- Fewer cool days, Fewer cool nights

Temperatures





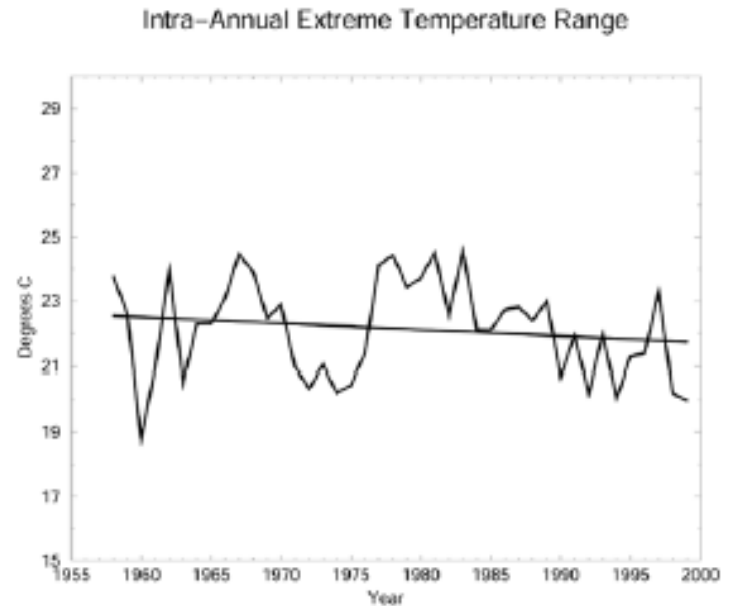
# CLIMATE HAS CHANGED: CARIBBEAN TRENDS

Peterson et al (2002):

- 1950-2000
- Intra-Annual extreme temperature range (ETR) is steadily decreasing.

ETR = warmest maximum temperature minus coldest minimum temperature reading for year

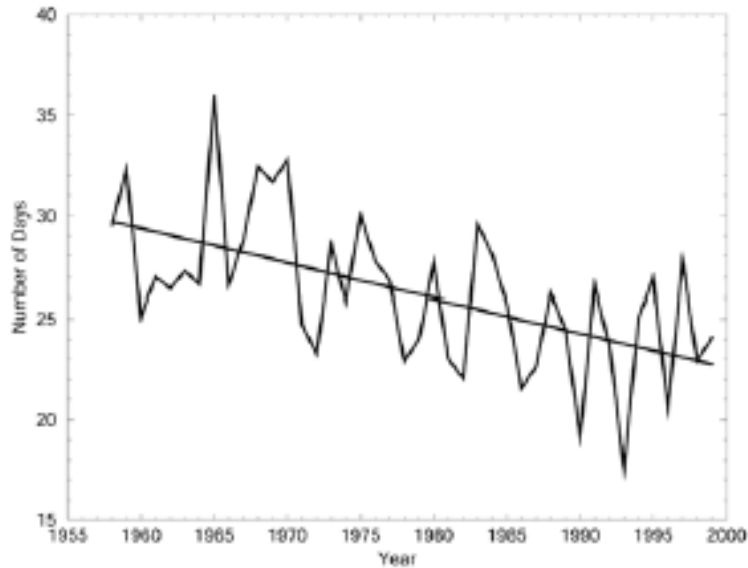
Caribbean Temperatures





# CLIMATE HAS CHANGED: CARIBBEAN TRENDS

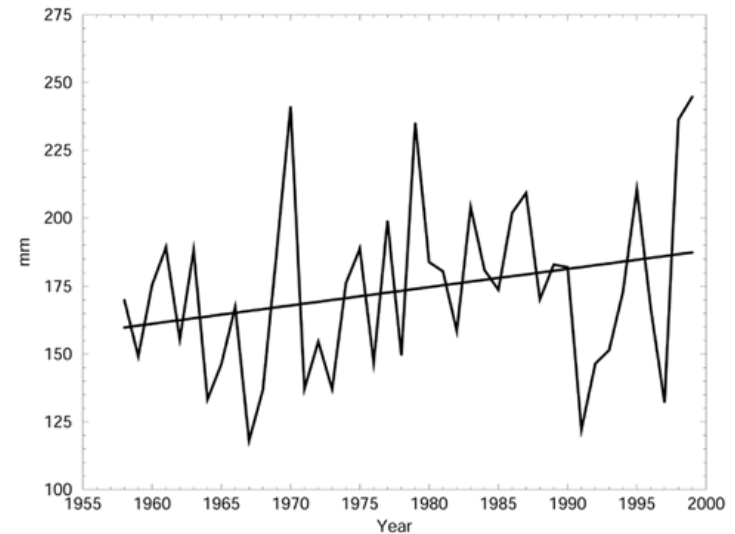
Maximum Number of Consecutive Dry Days



- Maximum number of consecutive dry days is decreasing (Peterson, et al. 2002)
- dry day = day where precipitation is less than 1 mm

- Highly variable
- Greatest 5-day rainfall total is increasing.  
i.e. more heavy rains and flooding
- Increased frequency of *droughts* (Taylor et al. 2007)

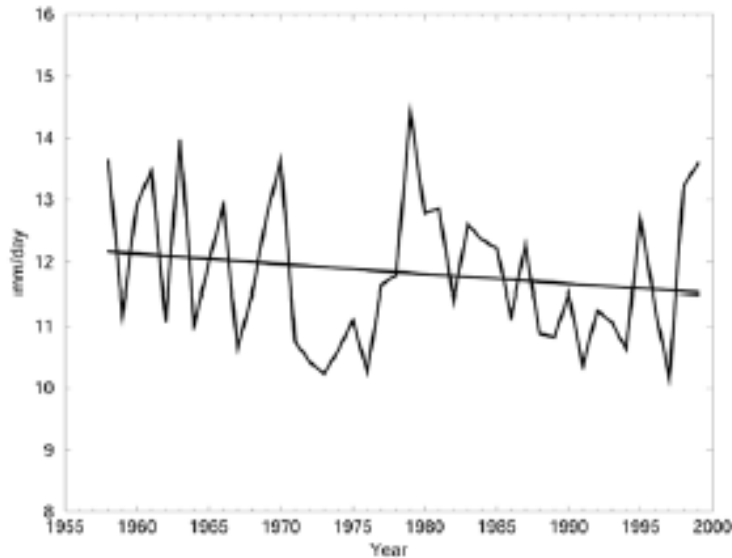
Greatest 5-day Rainfall Total





# CLIMATE HAS CHANGED: CARIBBEAN TRENDS

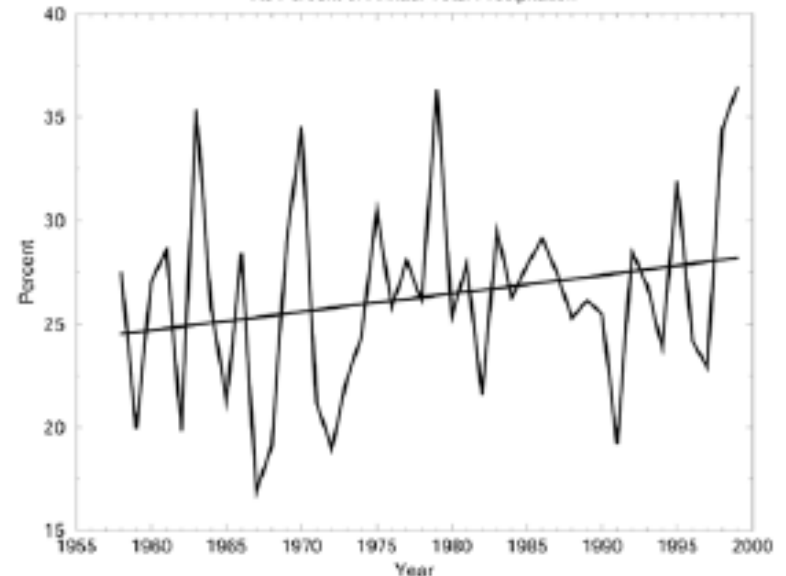
Simple Daily Precipitation Intensity Index



- Simple daily intensity is decreasing.
- Trend is not statistically significant

- Percent of total annual rainfall coming from heavy rainfall events is increasing.
- Trend is not statistically significant.

Precipitation due to Events Above the 95th Percentile  
As Percent of Annual Total Precipitation

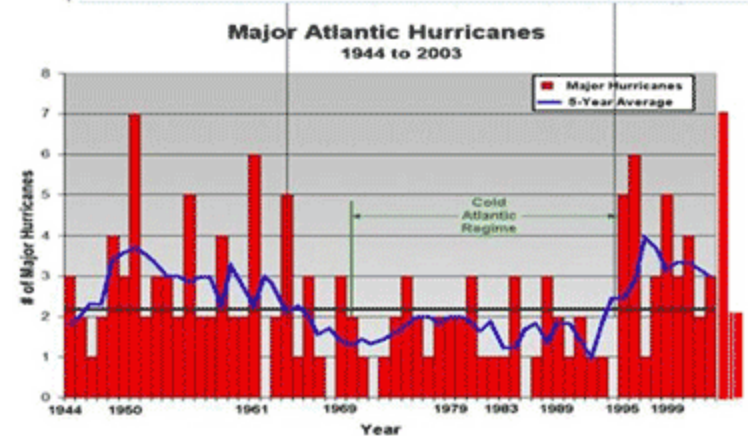
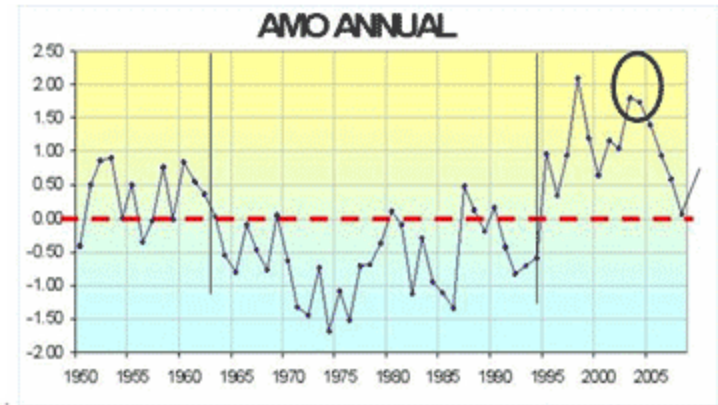




# CLIMATE HAS CHANGED: CARIBBEAN TRENDS

CSGM (2011):

- **Tropical storm and hurricane** frequencies vary considerably from year to year, but evidence suggests **increases in intensity and duration** since the late 1990s.





# CLIMATE HAS CHANGED: CARIBBEAN TRENDS

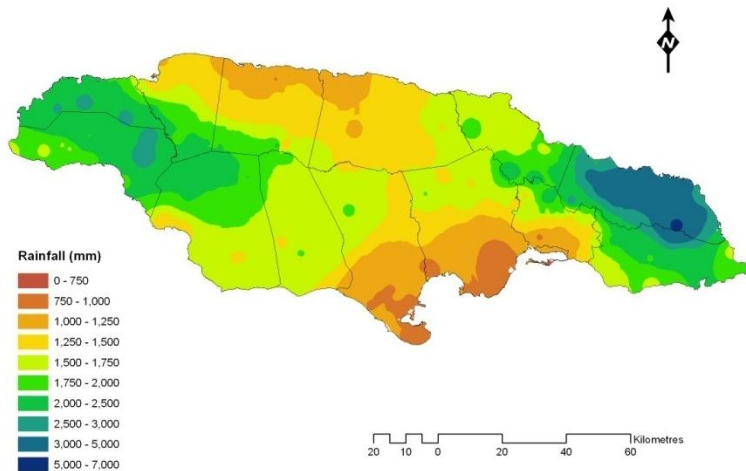
## *Sea Level Rise (SLR)*

- Most of the Pacific and Atlantic basins are experiencing average to above-average sea level rise (IPCC 2007)
- Caribbean sea level rise appears to be near the global mean (Church et al. 2004)
- Not uniform across the Caribbean Basin (Hendry 1993, Gamble 2009)

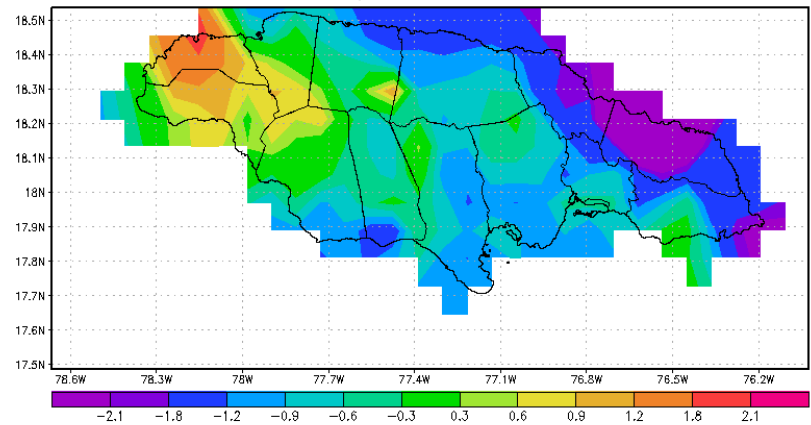


# JAMAICA: RAINFALL

Jamaica: Distribution of Mean Rainfall (1971-2000)



Slope 1992-2010



- Rainfall distribution shows greatest intensity in easternmost and westernmost parishes, and lowest across the southern plains

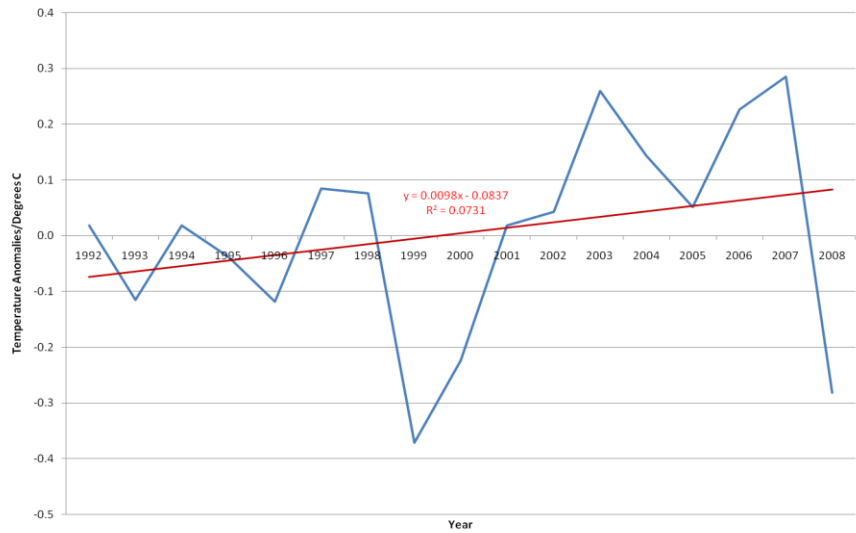
- Change since 1992 has been greatest in wettest areas
  - East seems to be drying as west gets wetter



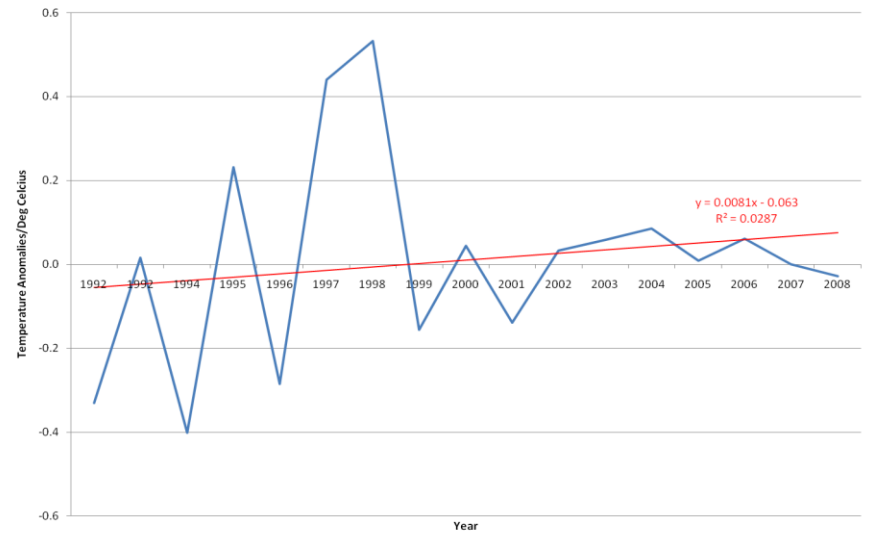


# JAMAICA: TEMPERATURE

Manley Intl Airport  
Annual Temperature Anomalies wrt 1992-2008



Sangster Intl Airport  
Annual Temperature Anomalies wrt 1992-2008



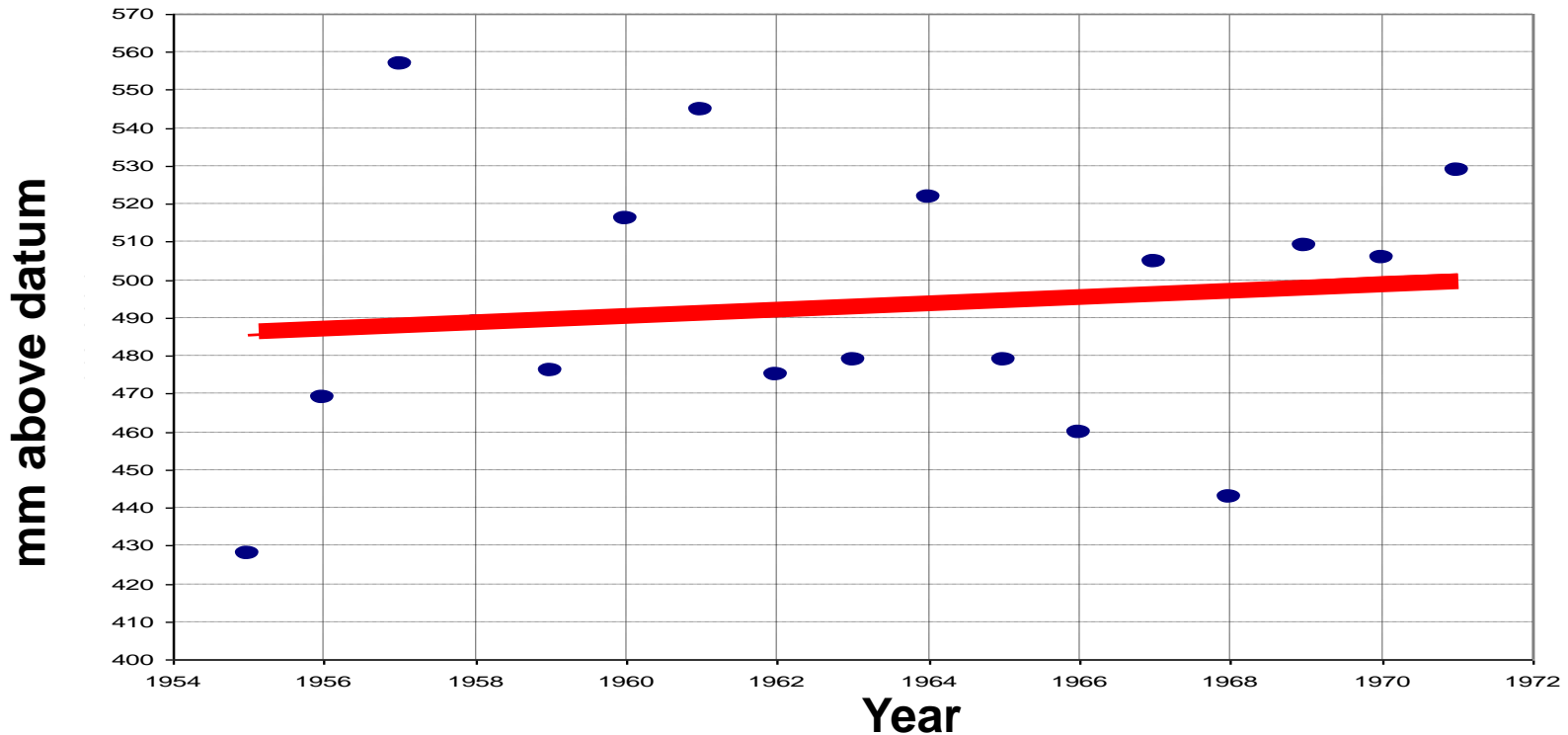
- Apparent warming trend- from airport temperature data



# JAMAICA:

## SEA-LEVELS AT PORT ROYAL 1955 – 1971

(REDRAWN FROM CAMBRAY 1973, LINEAR TREND INSERTED)



Mean annual sea levels-

- Fluctuation maximum at 88 mm, and minimum at 3 mm
- Trend line indicates mean rise for 1955-1971 is 15 mm

Courtesy of The Marine Geology Unit, UWI Mona



# CLIMATE HAS CHANGED: CARIBBEAN TRENDS - SUMMARY

- Caribbean Climate has changed
- General tendency between 1950-2000 is:
  - Hotter
  - Drier
    - Longer dry spells
    - More intense rainfall events
  - More intense hurricanes with longer durations
  - Rising sea levels





**THANK YOU**

