Climate Change: Jamaica and the Caribbean:

Really, what must we expect?

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Really, what must we expect?

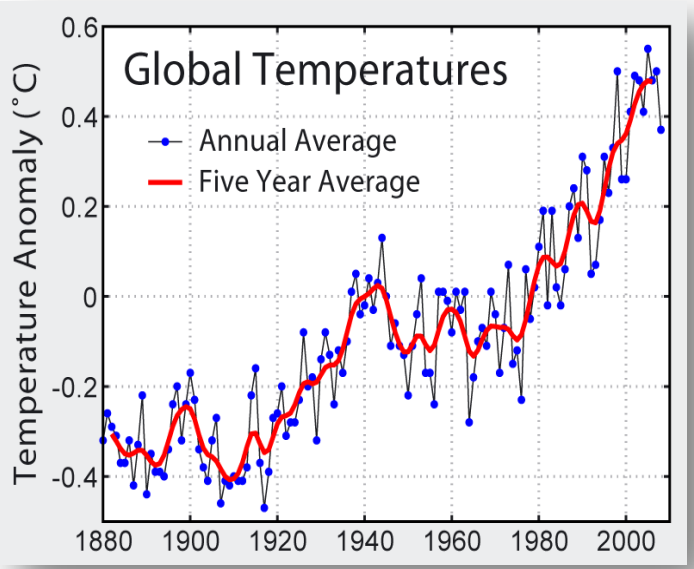
- Temperature
- Rainfall
- Sea Level Rise

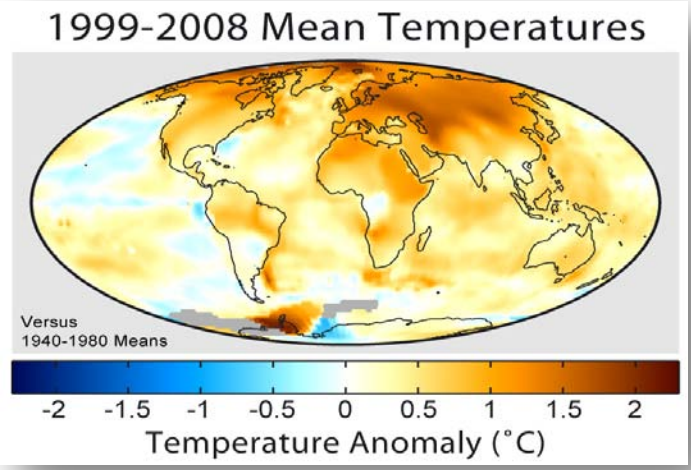
ANSWER 1: "MUCH OF THE SAME BUT…"

Temperatures

Global Observed data (IPCC (2007)):

- Rise of 0.74 C 0.18 C during the period 1906 – 2005
- More warm days, fewer cold nights
  - Lower diurnal temperature range



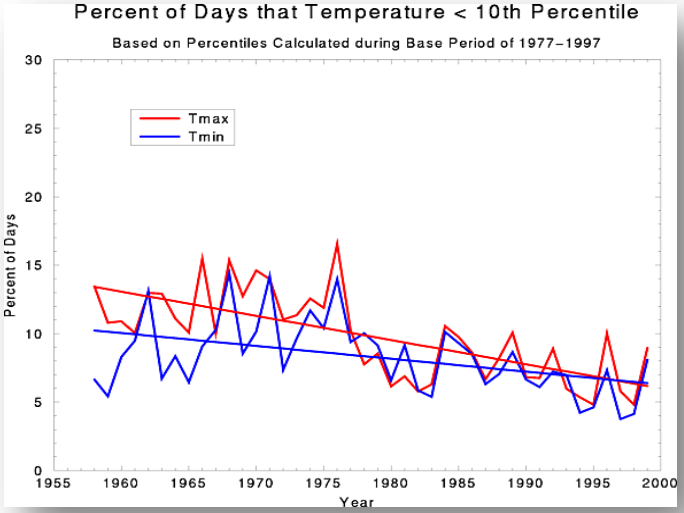


ANSWER 1: "MUCH OF THE SAME BUT…"

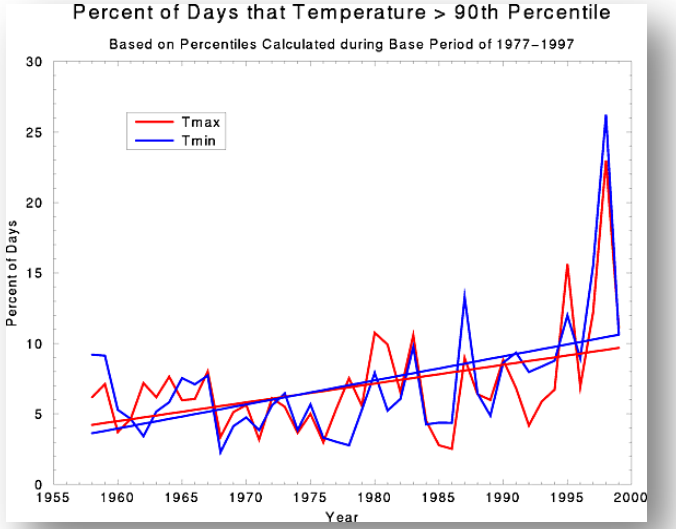
Temperatures

Caribbean Observed data (Peterson et al (2002)):

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



Caribbean Temperatures



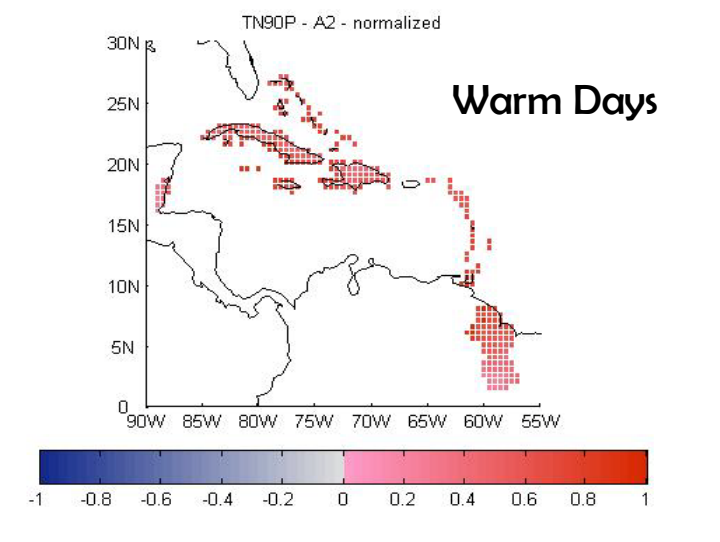
ANSWER 1: "MUCH OF THE SAME BUT…"

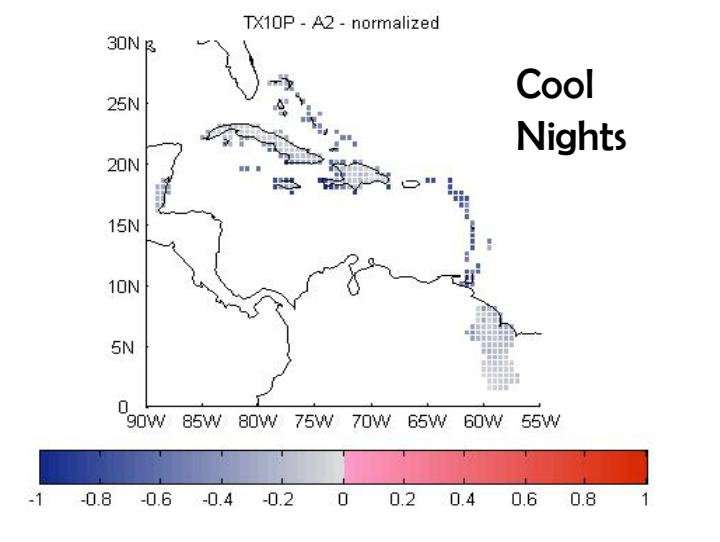
Temperatures

Caribbean Observed data
(CSGM (2011))

- Warmer days and nights

Caribbean Temperatures

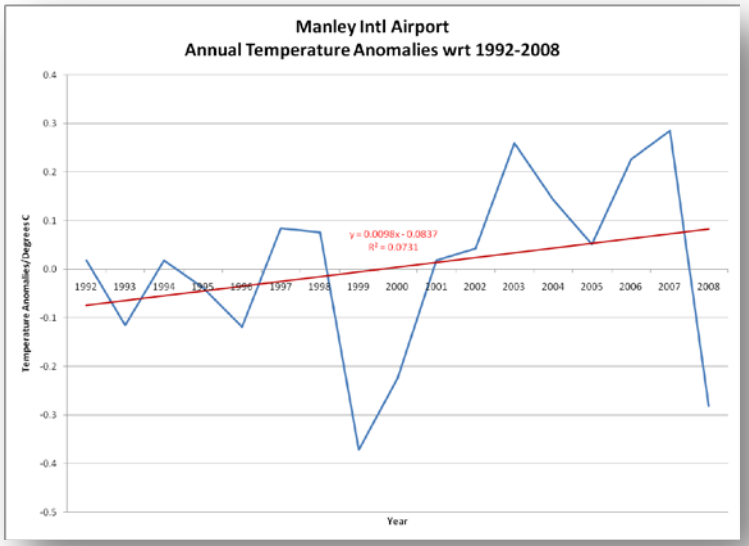




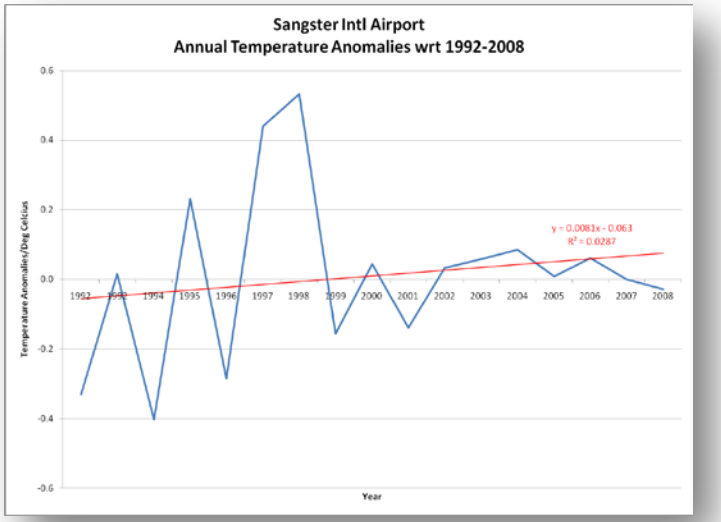
ANSWER 1: "MUCH OF THE SAME BUT…"

Jamaica observed data (CSGM (2011)):

- 1992-2008
- Rise in temperature
- 0.08-0.09 degrees/decade



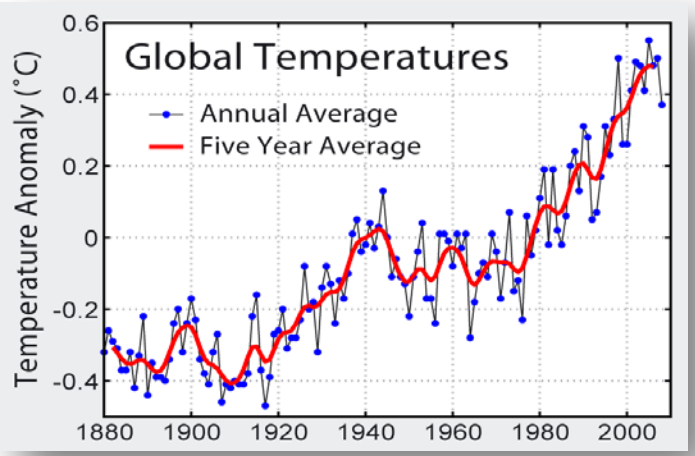
Jamaican Temperatures

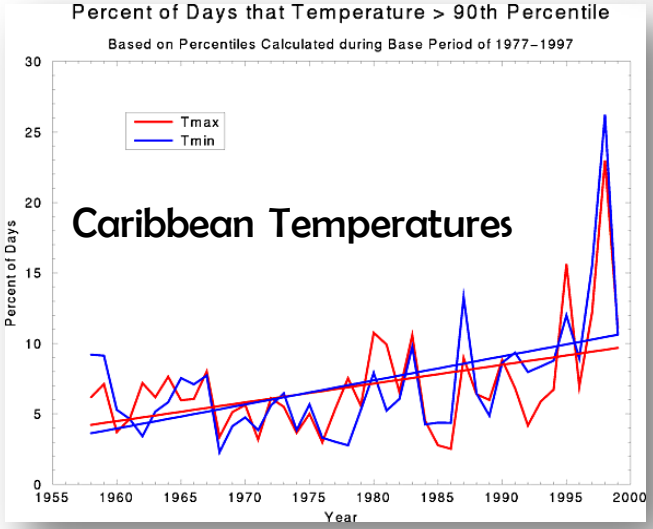


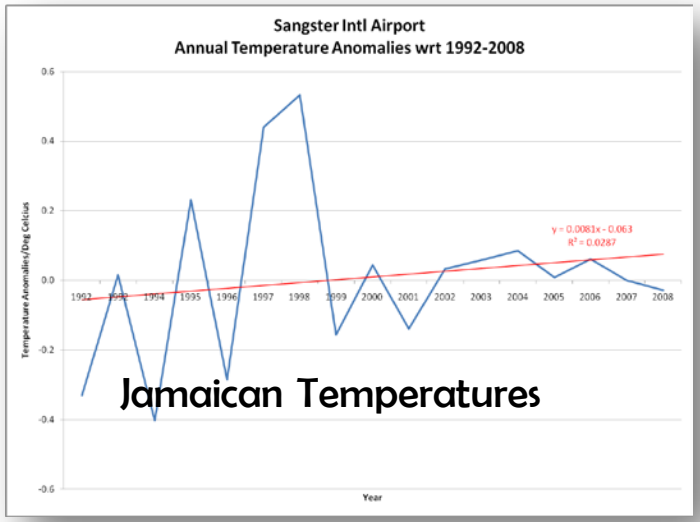
ANSWER 1: "MUCH OF THE SAME BUT…"

Temperatures

Recent Trend: Hot







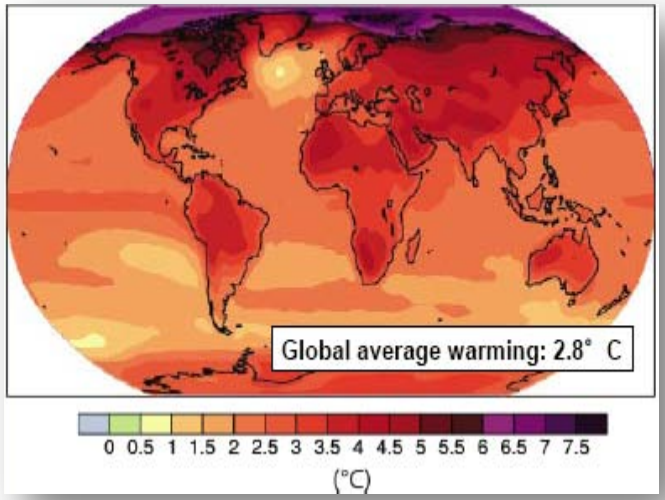
ANSWER 1: "MUCH OF THE SAME BUT…"

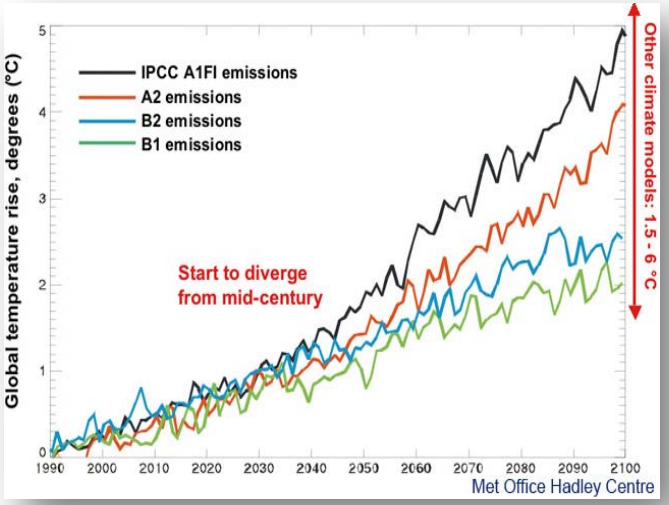
Temperatures

Global Projections (IPCC (2007)):

- End of Century (2100)
- Climate models under various scenarios predict 1.4 – 5.8°C
- Larger than any century scale increase ever seen before!

Global Temperatures



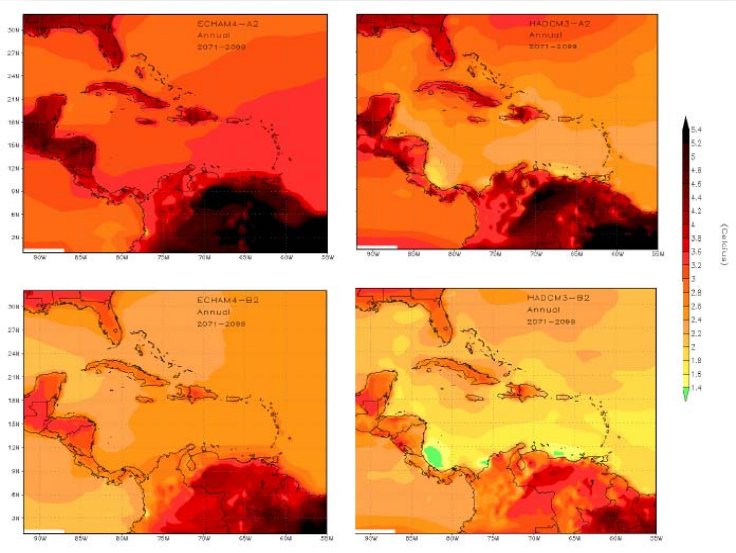


ANSWER 1: "MUCH OF THE SAME BUT…"

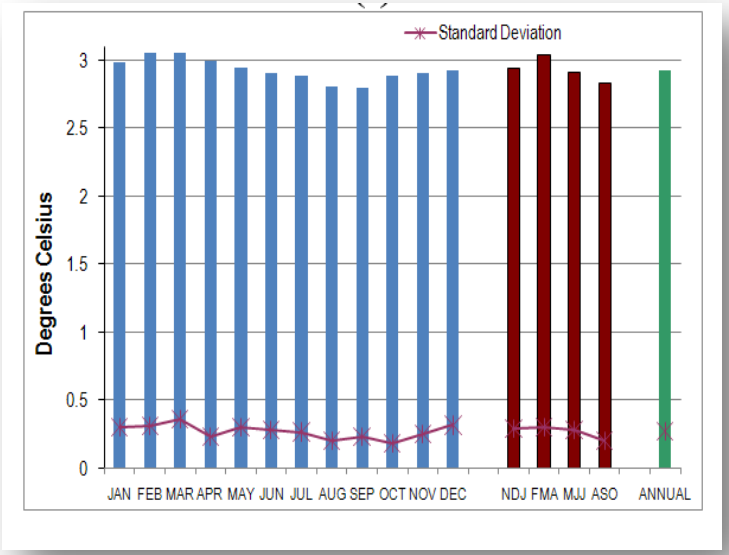
Temperatures

Caribbean Projections using Precis
Campbell et al (2010):

- End of Century (2100)
- Climate models under various scenarios predict 1 – 3.5°C
- Larger than any century scale increase ever seen before!



Caribbean Temperatures



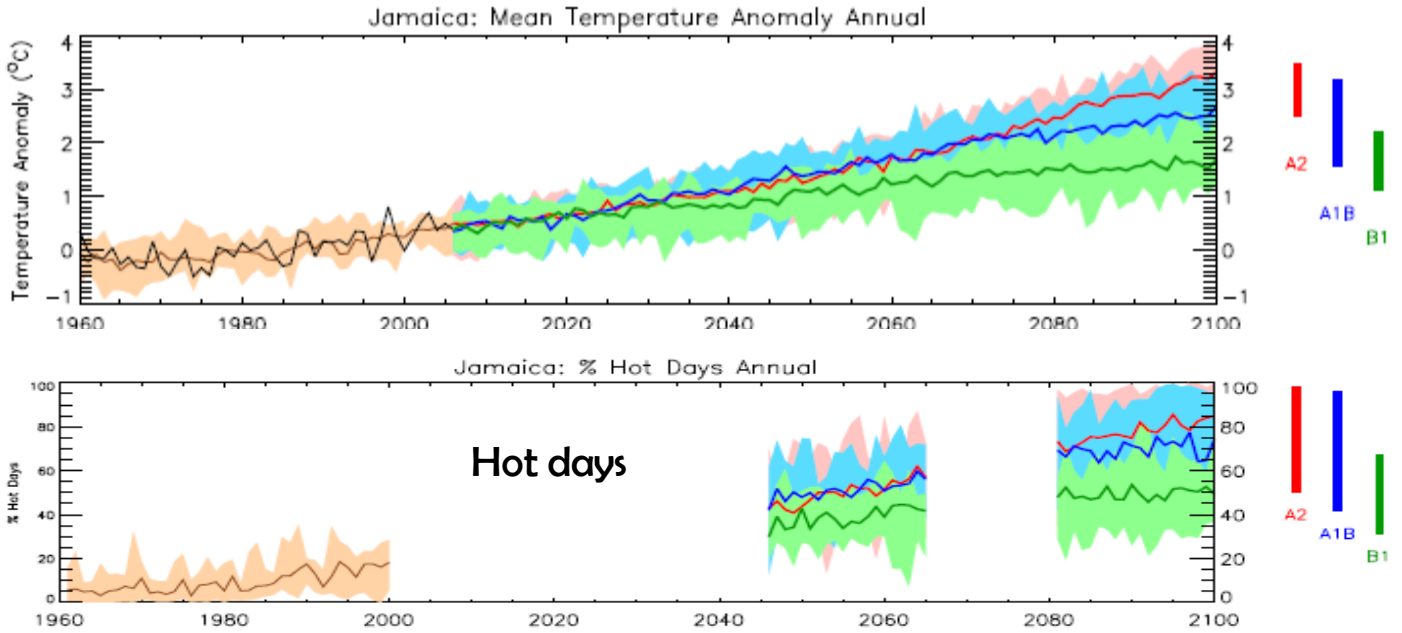
ANSWER 1: "MUCH OF THE SAME BUT…"

Temperatures

Jamaica using GCM
(McSweeney et al. (2008))

- End of Century
- Climate models project 1-3.5°C increase.

Jamaican Temperatures



Climate Change: Jamaica and the Caribbean:

Really, what must we expect?

Temperatures

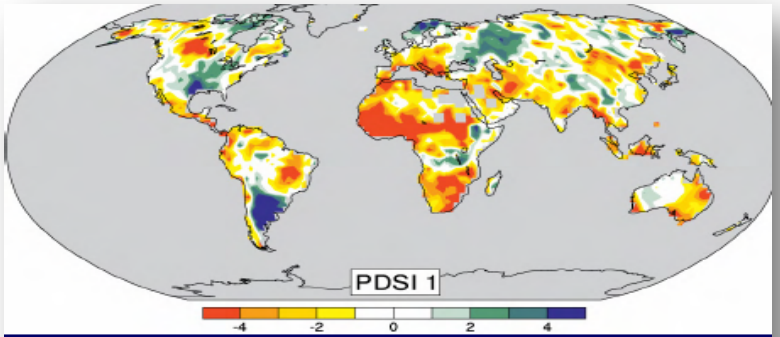
ANSWER 1: "MUCH OF THE SAME BUT…MORE!"

ANSWER 2: "SOME OF THE SAME BUT…"

Rainfall

Global observed data (IPCC (2007)):

- Changes in **amount, intensity, frequency and type** of precipitation.
- Trends vary widely by region and over time.
- **Precipitation strongly modulated by variability** e.g. ENSO.
- Globally there has been no statistically significant overall trend in precipitation over the past century…
- **Tropical storm and hurricane** frequencies vary considerably from year to year, but evidence suggests substantial **increases in intensity** and **duration** since the 1970s.



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

ANSWER 2: "SOME OF THE SAME BUT…"

Rainfall

Jamaica observed data

CSGM (2011):

- **Precipitation strongly modulated by variability** interannual and decadal e.g. ENSO, AMO
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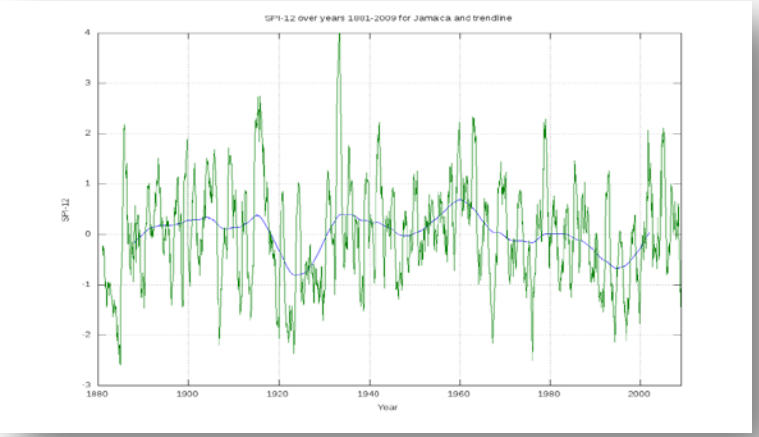

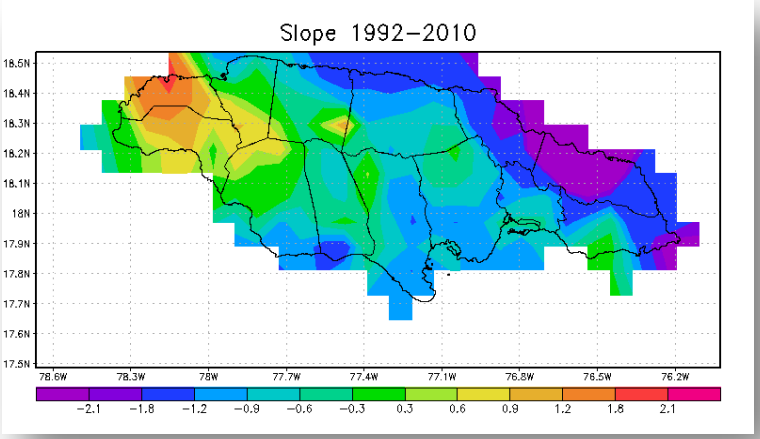

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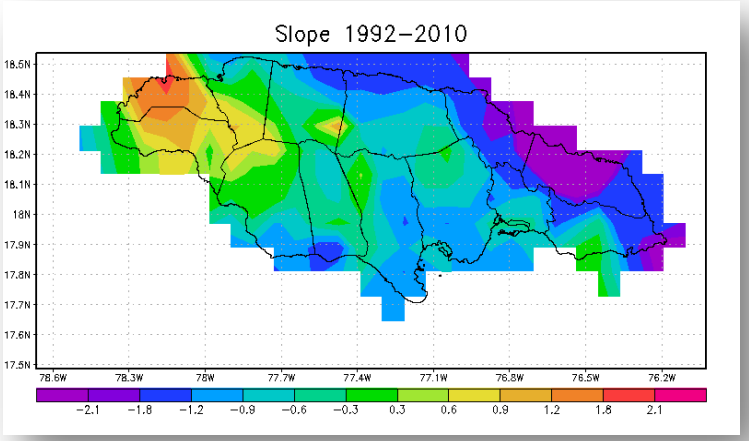

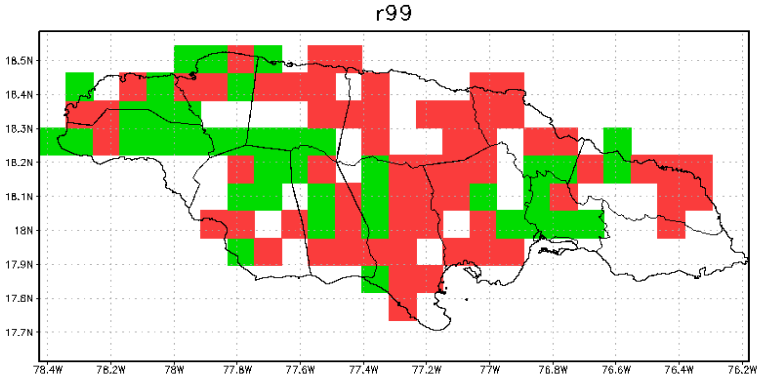

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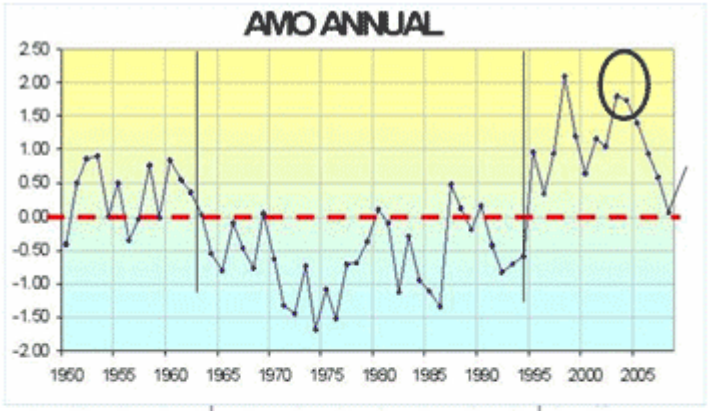
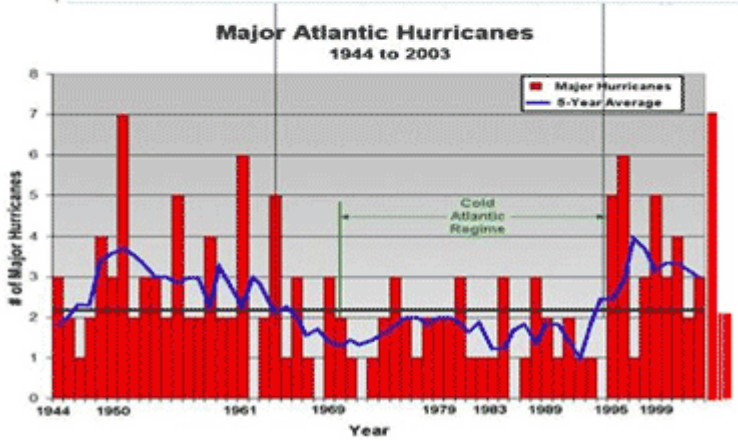


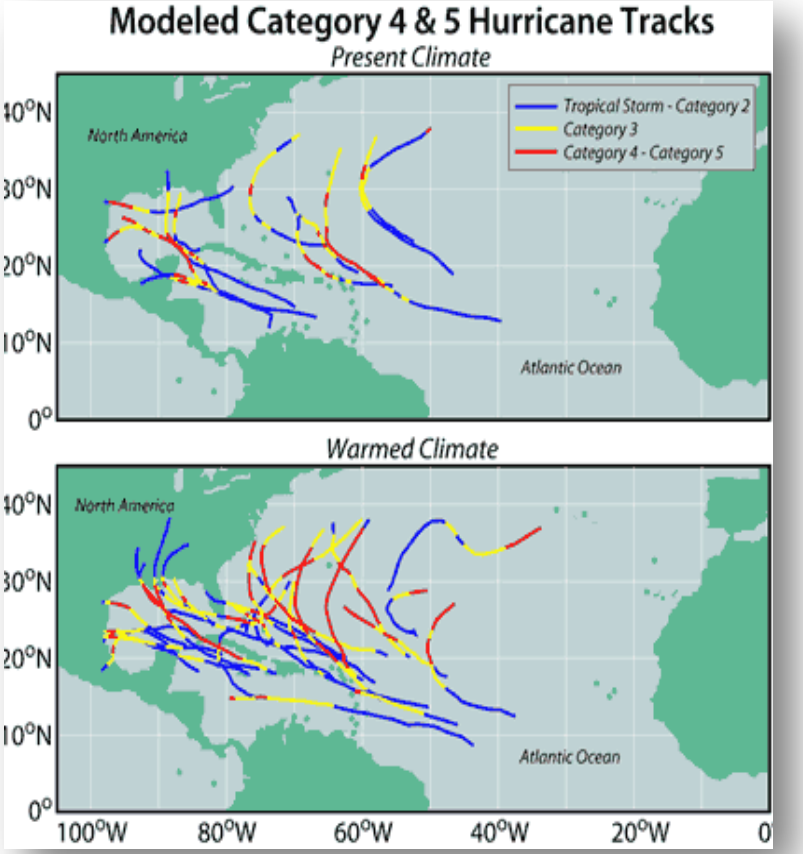


ANSWER 2: "SOME OF THE SAME BUT…"

Rainfall

Bender et al (2010):

- **Climate Models**
- Overall number of simulated storms in warming scenario decreases but storms that do occur tend to be more intense, with higher rainfall rates and increased maximum winds.



ANSWER 2: "SOME OF THE SAME BUT…"

Rainfall

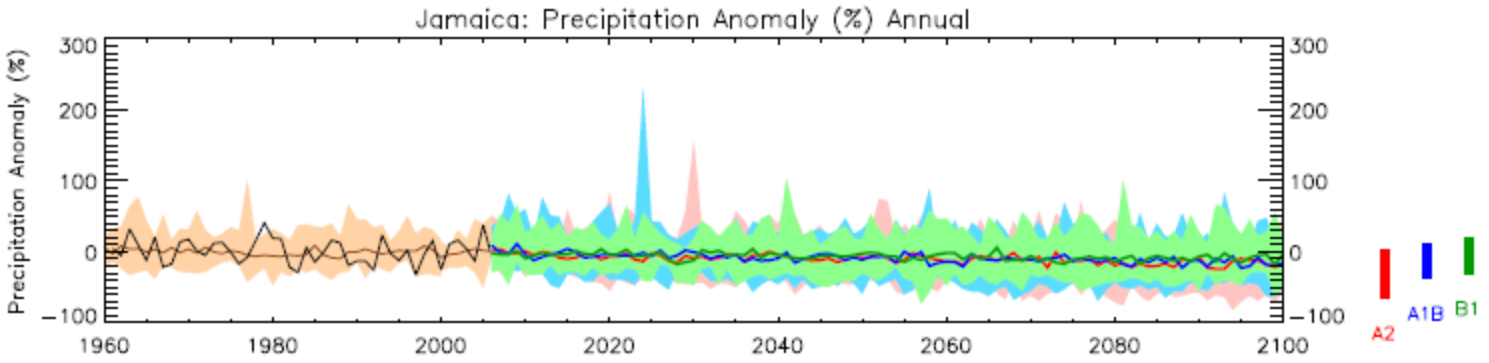
McSweeney et al (2008)

GCM Projections of Jamaica rainfall

- **Precipitation strongly modulated by variability** interannual and decadal e.g. ENSO,AMO
- **BUT** Tendency toward drying by end of century

•A reduction by 7-8% in the length of the rainy season and an increase of 6-8% of the length of the dry season.

•Largest end of century decreases projected for MJJ (~60%) and ASO (~66%) – worst case scenario.



ANSWER 2: "SOME OF THE SAME BUT…"

Rainfall

Projection of Caribbean rainfall by Precis

Campbell et al (2010):

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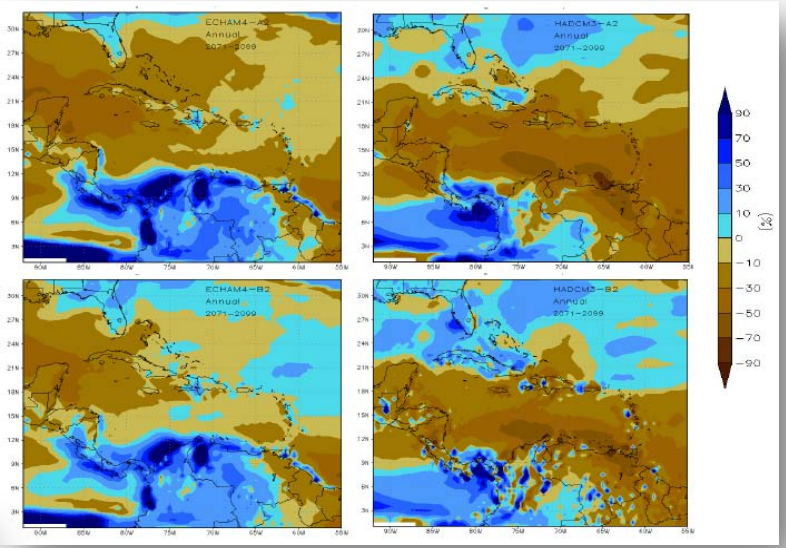

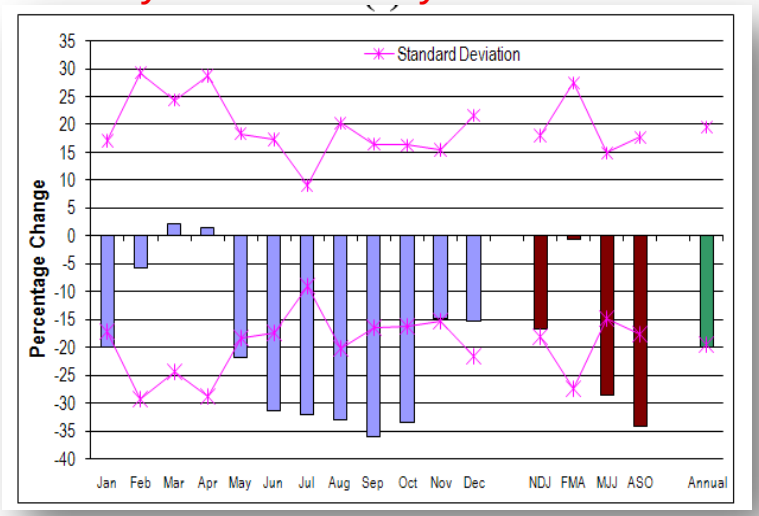

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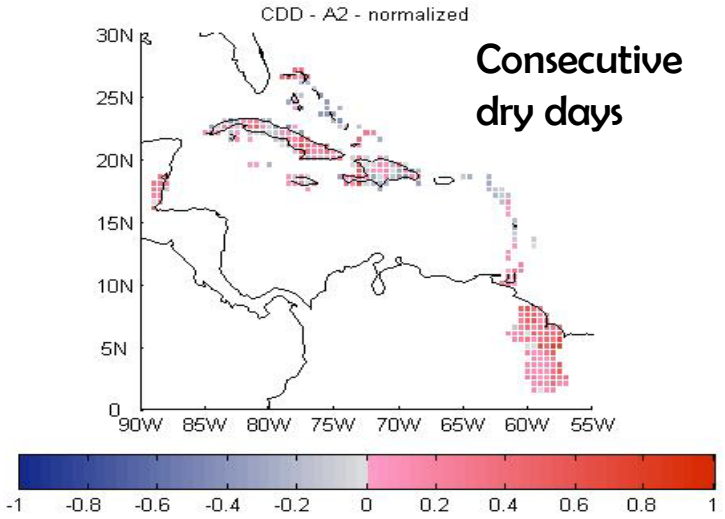
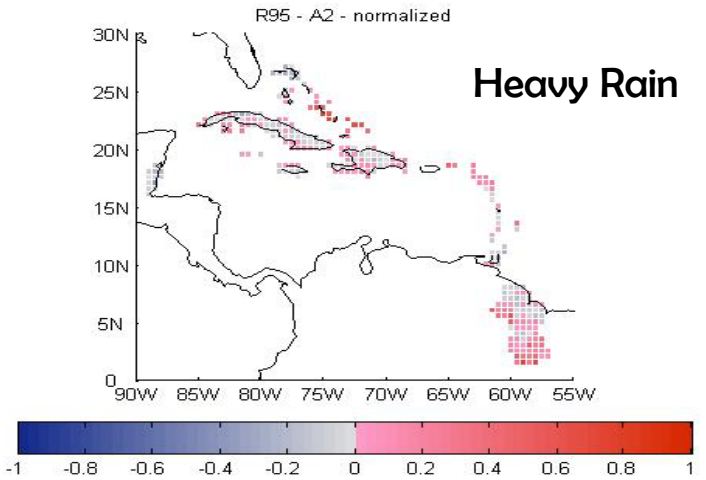




Climate Change: Jamaica and the Caribbean:

Really, what must we expect?

Temperatures

ANSWER 1: "MUCH OF THE SAME BUT… MORE!"

Rainfall

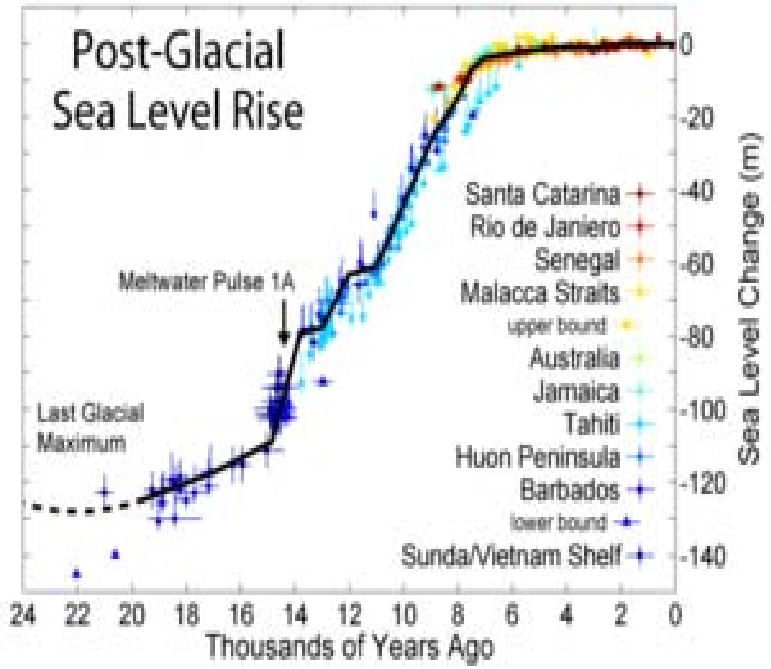
ANSWER 2: "SOME OF THE SAME BUT…SOME DIFFERENCES"

ANSWER 3: "LIKELY THE SAME BUT…"

Sea level Rise

IPCC (2007):

- Rise in the Caribbean appears to be near the global mean (Church et al. 2004). Pacific and Atlantic basins are experiencing average to above-average sea level rise.
- During the 20th century, sea level rose at an average rate of 4.8 to 8.8 inches per century (1.2-2.2 mm/year)
- More recent examinations of satellite measurements, however, estimate at an even more alarming rate of 9 to 15 inches per century (2.4-3.8 mm/yr) since 1993 (Bindoff et al. 2007).



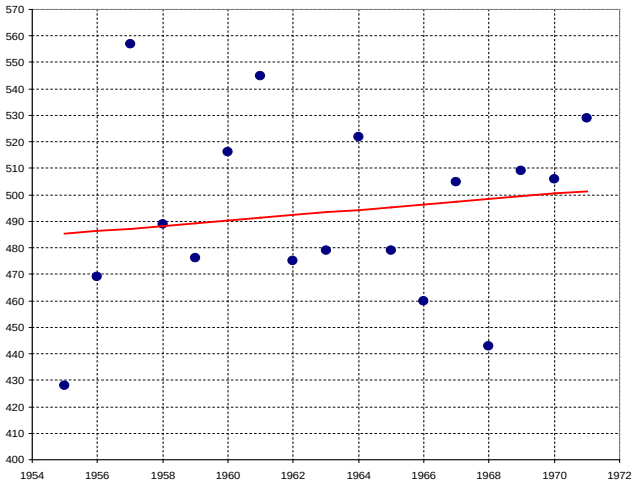
ANSWER 3: "LIKELY THE SAME BUT…"

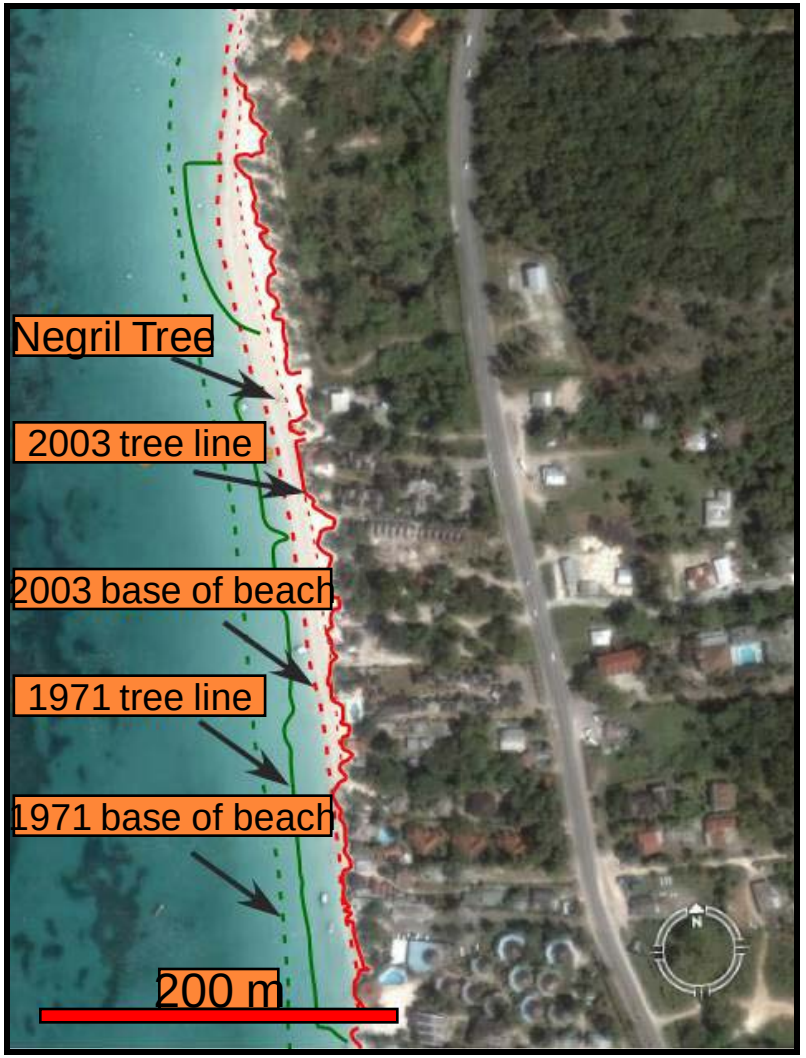
Sea level Rise

Marine Geology Unit, UWI:

- Fluctuation maximum at 88 mm, and minimum at 3 mm
- Trend line indicates mean rise for 1955-1971 is 15 mm or 0.9 mm/year

Sea-Levels at Port Royal (1955 – 1971 (redrawn from Cambray 1973, linear trend inserted)





ANSWER 3: "LIKELY THE SAME BUT…"

Sea level Rise

Table 3: Summary of Global Sea Level Rise Projections for 21st Century [63,64,65,66,67]

	2050*	2100		
		Low Range	Central Estimate	High Range
Continuation of current trend (3.4mm/yr)	13.6 cm	-	30.6 cm	-
IPCC AR4 (2007)	8.9 cm to 23.8 cm	18 cm	-	59 cm
Rahmstorf (2007)	17cm to 32 cm	50 cm	90 cm	140 cm
Horton et al. (2008)	~ 30 cm		100 cm	
Vermeer and Rahmstorf (2009)	~40 cm	75 cm	124 cm	180 cm
Grinstead et al. (2009)	-	40 cm	125 cm	215 cm
Jevrejeva et al (2010)	-	60 cm	120 cm	175 cm

- Caribbean sea level rise may be more pronounced than in other regions because of its proximity to the equator (Bamber et al. 2009, Hu et al. 2009)
- Simpson et al. (2010)- "The question is not **if** the Caribbean will face SLR of 1m or 2m under either a 2.0 C or 2.5 C global warming scenario, but rather **when**"

Predicting Sea Level Rise

- IPCC (2007) Based on models that do not include ice dynamics
  - Melting of ice shelves
  - Accelerated flow of ice streams

LOOK AT ACTUAL DATA (HANSEN & SATO 2011)

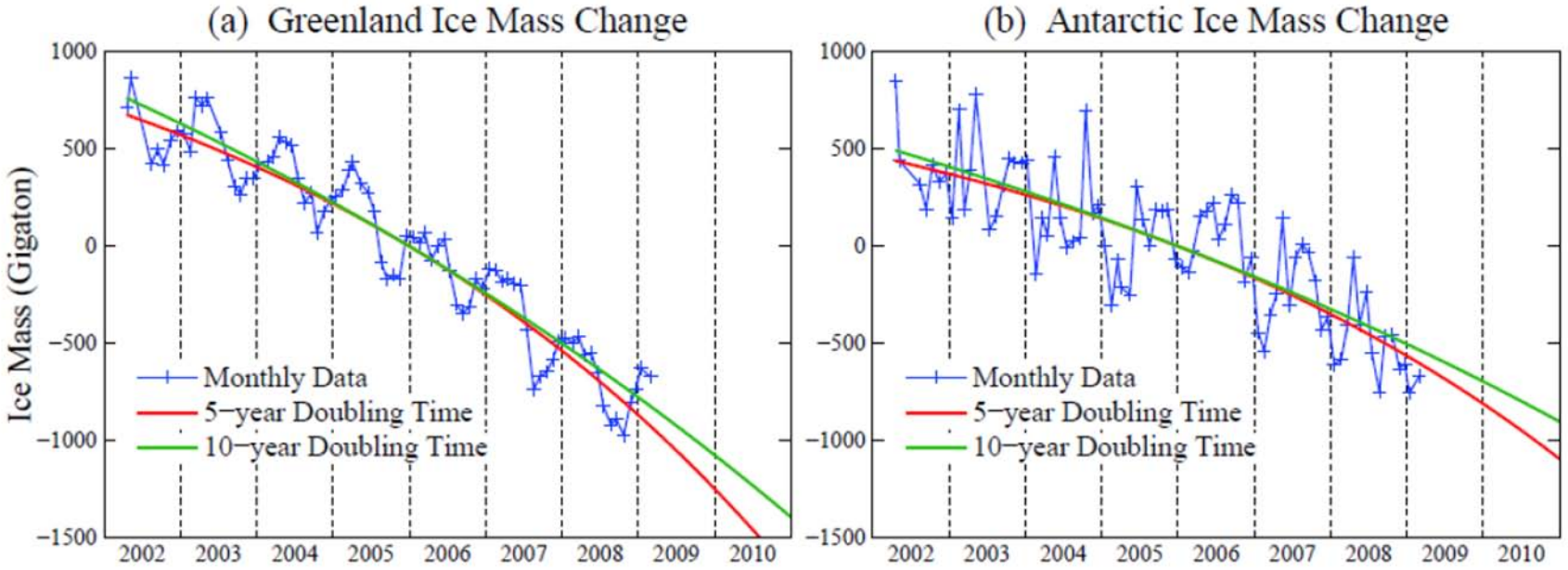


Fig. 8. Greenland (a) and Antarctic (b) mass change deduced from gravitational field measurements by Velicogna (2009) and best-fits with 5-year and 10-year mass loss doubling times.

WILL THE MASS OF ICE MELTING DOUBLE IN 5 OR 10 YEARS TIME?

IF THE MASS OF ICE MELTING DOUBLES IN 10 YEARS:

- **UP TO 5 METERS RISE IN SEAL LEVEL BY END OF THIS CENTURY**

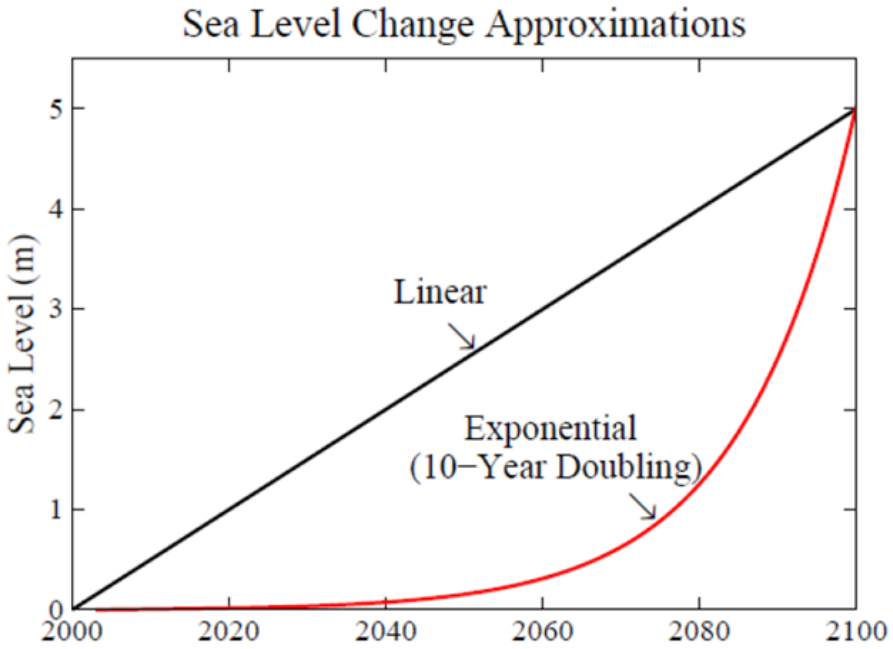


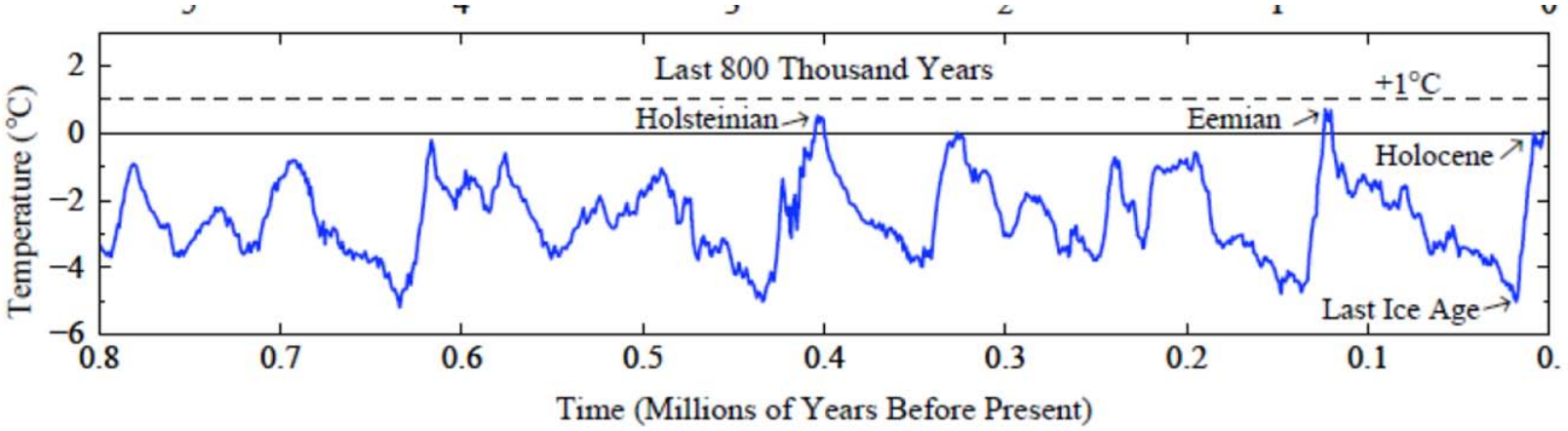
Fig. 7. Five-meter sea level change in 21st century under assumption of linear change and exponential change (Hansen, 2007), the latter with a 10-year doubling time.

Very possible because of Positive Feedbacks

- Albedo (reflection of solar radiation) decreases
- Warmer ocean gives off CO2
- Additional methane due to
  - Meting of permafrost
  - Continental shorelines releasing methane from methane hydrate

PALEOCLIMATOLOGY

- tools or proxies to determine past temperatures, sea level rise and CO2 concentrations
- Our Present temperature is near the peak Holocene
- It is ≤ 1ºC below that of the Eemian period (based on new more accurate methodology)
- Sea level at Eemian peak was probably 4 to 6m (13 to 20 feet) higher than today



Possibility of extreme sea Level rise by end of century

- Paleoclimate data and observed data (too short to be significant) tells us that a 5 meter rise by the end of the century is possible if temperatures rise more than 1ºC above the present value

ANSWER 3: "LIKELY THE SAME BUT…"

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Temperatures

ANSWER 1: "MUCH OF THE SAME BUT… MORE!"

Rainfall

ANSWER 2: "SOME OF THE SAME BUT…SOME DIFFERENCES"

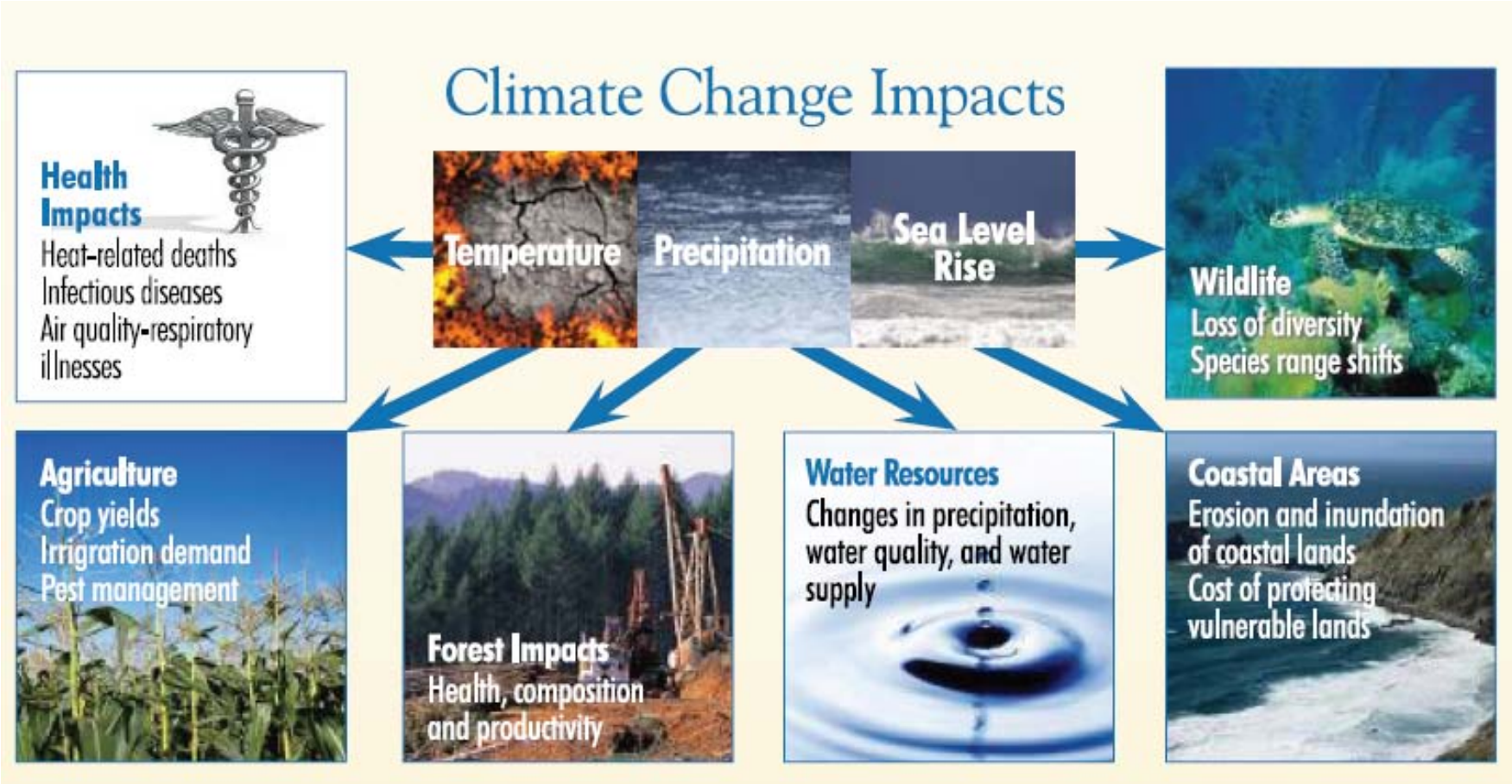
Sea Level Rise

ANSWER 3: "LIKELY THE SAME BUT… HOW MUCH…?"

CONCLUSION

	REALLY, WHAT MUST WE EXPECT?	*SO AS WE CONSIDER…*
Temperatures	**Much of the same but… more!** • Increase to end of century • 1-4 degrees • Warmer nights and days	**Predictability** Priorities and actions need not be timid or wait forever
Rainfall	**Some of the same but… some differences** • Variability • More intense storms • Drying by end of century	**Variability** Priorities and actions must account for extremes
Sea Level Rise	**Likely the same but… how much…?** • Rising sea levels • Erosion, inundation and storm surge • 1 m or 2 m…Hmmm?	**Uncertainty** Priorities and actions must recognize there is still unknown

JAMAICA IS CLIMATE SENSITIVE...



'Climate change is an issue of our times – one that Caribbean cannot avoid contending with - preferably through voluntary action, now as opposed to later, and with a paradigm shift in thought and action equivalent to the shift necessitating it.' – CSGM 2011

THANK YOU