What is happening to the Jamaican climate?
Climate Change and Jamaica: Why worry?

Climate Studies Group, Mona (CSGM)
Department of Physics
University of the West Indies, Mona
Part 1

RAIN A FALL, BUT DUTTY TUFF

Climate Context
1. CLIMATE CONTEXT

- Climatology
  Average behaviour of weather

- Examine values of a number of climate variables
  - Temperature
  - Rainfall
  - Solar Radiation
  - Wind
  - Relative Humidity
1. **Climate Context**

- Temperature
  - Varies with earth’s orbit about the sun
- Hotter in summer (July-August)
- Range of 3°C

- Spatial variation in mean temperature across island

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**Graph: Temperature Climographs of Jamaica, Norman Manley Airport, and Donald Sangster Airport for 1992-2008**

- Jamaica
- Norman Manley International Airport
- Donald Sangster International Airport

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**Rainfall**
1. **Climate Context**

- Rainfall
  - Bimodal

- Early season: May-July
- Late season: August – November
  - coincides with peak hurricane season

- Mean no. of rain days: 60-200 days
1. **CLIMATE CONTEXT**

- Rainfall
- Spatial variability across the island.
- Max in Portland (Centre of max is only approximate)
1. CLIMATE CONTEXT

- Solar

- Estimated average of 177 MJ/m² per year of direct solar radiation.

- Very slight variation from north to south

- Indication of slightly higher values in the far eastern tip of Jamaica.

Mean global radiation across Jamaica
1. **Climate Context**

- Wind
- Combination of prevailing winds, sea breezes and mountain and valley winds

- Prevailing winds from east or northeast is strongest influence

- Driest months = larger wind speeds
- Wettest month = smaller wind speeds

Modelled wind speed over Jamaica based on data collected at Manley and Sangster Airports and at Munro
1. **CLIMATE CONTEXT**

- Other Variables
- Relative humidity does not vary significantly throughout the year.

- Sunshine hours vary little throughout the year, ranging between 7 and 9 hours per day.
  - More sunlight hours in the dry season and less in the main rainy season

- Evaporation values peak approaching July

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1. **Climate Context**

- Hurricanes
- Easterly waves frequently mature into storms and hurricanes
- June - November

Hurricane tracks for 1851-2010
Quick Review

Which 4 of the following are features of Jamaica’s climate?

- Hotter in summer
- Hurricane in April
- Same amount of rainfall over entire island
- Greater wind speeds in drier months
- Relative Humidity does not vary a lot
- Early & Late rainfall seasons
Quick Review

Which 4 of the following are features of Jamaica’s climate?

- Hotter in summer
- Greater wind speeds in drier months
- Relative Humidity does not vary a lot
- Early & Late rainfall seasons
Climate Change Observed
2. **Climate Change Observed**

- **Higher Temperatures**
  - Globe
  - Caribbean
  - Jamaica
    - 0.1 degrees Celsius/decade for airports
    - 0.27 degrees Celsius/decade for island

- Percent of very warm days and very warm nights observed annually increasing

Yu nebba see sumoke. . . . .
2. CLIMATE CHANGE OBSERVED

- Variable Rainfall

- Significant interannual (year to year) variability

- Decadal variability
  - Last decade shows rainfall trending upwards

- Mean Jamaica rainfall record shows no statistically significant trend

Jamaican rainfall (blue) with decadal trends (red)
2. Climate Change Observed

- **Variable Rainfall**

- Significant decrease in the proportion of total rainfall that occurs in ‘heavy’ events

- Increasing rainfall over the centre of the island and decreasing rainfall over the eastern and western parishes

Map showing Rainfall trends slope. Positive slope suggest increasing rainfall, and negative slope suggest decreasing rainfall.
2. **Climate Change Observed**

- **Higher Sea Levels**
  - Global sea level rise over the 20th century is estimated to have been $0.17 \pm 0.05$ m.

- Caribbean appears to be near the global mean

- Port Royal between 1955 and 1971 also indicate a 0.9 mm/year rising trend (Horsfield, 1973).

![Graph showing mean annual sea levels at Port Royal between 1955 and 1971.](image)
2. **Climate Change Observed**

<table>
<thead>
<tr>
<th>Tidal Gauge Station</th>
<th>Observed Trend (mm/yr)</th>
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<td>2.04 ± 0.47</td>
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<td>1.65 ± 0.52</td>
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<td>Vaca Key, Florida</td>
<td>2.78 ± 0.60</td>
<td>1971 – 2006</td>
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</table>
2. **Climate Change Observed**

- **Higher Hurricane Frequency** since 1995.

- May be attributed to Atlantic multidecadal oscillation and not necessarily due to global warming (Goldenburg et al., 2001).

- Additionally, El Niño and La Niña events influence the location and activity of tropical storms across the globe.
2. Climate Change Observed

- Other Variables
  - Significant increases in the annual and seasonal values of wind speed around Jamaica in all seasons over the period 1960-2006
  - No significant trend in Relative Humidity (RH) over Jamaica

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<tr>
<th>Variable</th>
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<th>MAM</th>
<th>JJA</th>
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Observed trends for 1960-2006
2. **Climate Change Observed**

- Other Variables
- Statistically significant increases in sunshine hours in MAM and JJA for Jamaica over recent years (1983-2001).
- Statistically significant increasing trends in JJA and SON sea surface temperatures

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Observed trends for 1960-2006
QUICK REVIEW: CLIMATE CHANGE
OBSERVED

- Temperature  ➤ Getting Higher
- Rainfall
- Sea Level
- Hurricane Frequency
- Sunshine Hours
- Wind speed
- Relative Humidity

No significant Trend
Part 3

A nuh same day leaf drop
A river bottom it rotten

More Climate Change Expected
CLIMATE CHANGE EXPECTED

Reminder of how we get projections

Models
GCMs or RCMs

Scenarios
A2
A1B
B2

Future Climate
Temperature
Rainfall
Sea Level Rise, etc.
MORE CLIMATE CHANGE EXPECTED

Key take home points

- **GCMS**
  - Lots of GCMs (21 ensemble) – good for range
  - GCMs have lots of climate variables
  - GCMs give one value for Jamaica

- **RCM**
  - One RCM – PRECIS but forced by 2 GCMs and 2 scenarios – still have range
  - Has 12 grid boxes for Jamaica (50 km)
  - Lots of climate variables
  - Right now end of century only
PROJECTIONS OF TEMPERATURE...

Caribbean context from GCMs

21 member ensemble
- Caribbean expected to warm 1.4 - 3.2 degrees by 2100
- Greatest in SON
- 100% of days at end of century warmer than present

A nuh same day. . . . .
PROJECTIONS OF TEMPERATURE...
Jamaica from GCMs

15 member ensemble

- Mean warming
  - 1.1 - 3.5 degrees by the 2090s
- Extremes
  - 30-98% of days annually will be considered ‘hot’ by the 2090s
- Only 2% ‘cool’ by the 2080s
- Most change in summer months (JJA)

McSweeney et al. 2008
### PROJECTIONS OF TEMPERATURE...

**Jamaica from RCMs**

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**CSGM 2012**

- Warming by 12 grid boxes
- Warming by month, season and annually

*A nuh same day.....*
## PROJECTIONS OF TEMPERATURE...

### Jamaica from RCMs

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### CSGM 2012

- Warming by west (grid boxes 2, 3, 8, 9); centre (1, 4, 5, 10, 11); east (6)
- Warming by month, season and annually

* A nuh same day...
**PROJECTIONS OF TEMPERATURE...**

Jamaica from RCMs

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**Figure 7.2.1**
- Warming expected across the island 2.9°C and 3.4°C by the 2080s
- Greatest warming in JJA (up to 5 degrees warmer than present)
- Some areas may warm faster than others e.g. south and east
Quick Review

- What do we expect to happen to temperatures over Jamaica towards the end of the century?

1. Increase
2. Decrease
3. No change
4. Still unsure (No consensus)
Quick Review

- What do we expect to happen to temperatures over Jamaica towards the end of the century?

1. Increase
PROJECTIONS OF RAINFALL...
Caribbean context from GCMs

21 member ensemble

- Drying across the Caribbean Basin
  - Most models agree
  - -39% to +11% by end of century
- Minimal interannual variability
-44% to +18% by the 2050s and -55% to +18% by the 2080s

Drier JJA (early wet season) and SON (late wet season)
15 member ensemble

Rainfall extremes:
- Mixed across the ensemble.
- Tendency for decreases in rainfall extremes.

McSweeney et al. 2008
PROJECTIONS OF RAINFALL...
Jamaica from RCMs

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CSGM 2012

- % changes by 12 grid boxes
- % changes by month, season and annually
PROJECTIONS OF RAINFALL...

Chapter 7: Jamaica from RCMs

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CSGM 2012

- May onward projected to get drier, irrespective of scenario or area
  - Models agree that JJA will get drier by end of century
  - East- throughout the year
- Toggle between west and east in dry months and wet months
Most severe in the west and least severe in Portland in annual
Quick Review

What do we expect to happen to summer rainfall over Jamaica towards the end of the century?

1. Increase
2. Decrease
3. No change
4. Still unsure (No consensus)
QUICK REVIEW

What do we expect to happen to summer rainfall over Jamaica towards the end of the century?

2. Decrease
PROJECTIONS OF OTHER VARIABLES...
Relative Humidity for Jamaica from RGCMs & RCMs

- May not be representative of Jamaica in GCMs
  - Small increases- DJF, MAM

- RCMs
  - General decrease throughout the year- greatest in JJA
  - -1.1 to -1.7% by the 2080s under A2
PROJECTIONS OF OTHER VARIABLES…
Wind speeds for Jamaica from RGCMs & RCMs

- GCMs
  - No consensus
  - May increase

- RCMs
  - Decreases in wind speed by 2080s under A2
  - Greatest in SON by -0.3 to -0.5 ms\(^{-1}\)
PROJECTIONS OF OTHER VARIABLES...
Sunshine hours and sea surface temperatures for Jamaica from RGCMs & RCMs

- GCMs
  - Most models suggest increase in sunshine hours under A2
    - -0.2 to +0.9 hours per day
    - Greatest in JJA
  - Higher sea surface temperatures (SSTs)
    - +0.9°C and +2.7°C by the 2080s
    - Greatest in SON

- RCMs
  - Changes in sunshine hours surpass GCM projections
    - Increase by +1.4 hours per day by 2080s under A2
  - No SST projections from RCMs
PROJECTIONS OF OTHER VARIABLES…
Hurricanes and Sea Level Rise from GCMs

- Difficult to project for the region
- Increase in rainfall intensity associated with tropical storms
- Storm surges could intensify if hurricanes become more intense and sea levels rise
- 0.18-0.59m by 2100 relative to 1980s to 1990s
QUICK REVIEW

Which of the following variables are expected to increase towards the end of the century?

1. Sunshine Hours
2. Relative Humidity
3. Sea Level Rise
4. Rainfall intensity associated with tropical storms
5. Sea Surface Temperatures
6. Wind speeds
QUICK REVIEW

Which of the following variables are expected to increase towards the end of the century?

1. Sunshine Hours

3. Sea Level Rise

4. Rainfall intensity associated with tropical storms

5. Sea Surface Temperatures
**PROJECTIONS...**

Jamaica from GCMs and RCMs

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THE TAYLOR TRUTH (SUMMARIZED)

Jamaica’s climate has changed.
Jamaica’s climate will continue to change.
Jamaica’s climate demands change