CLIMATE STUDIES IN THE CARIBBEAN

Climate Studies Group, Mona (CSGM)

Department of Physics

University of the West Indies, Mona

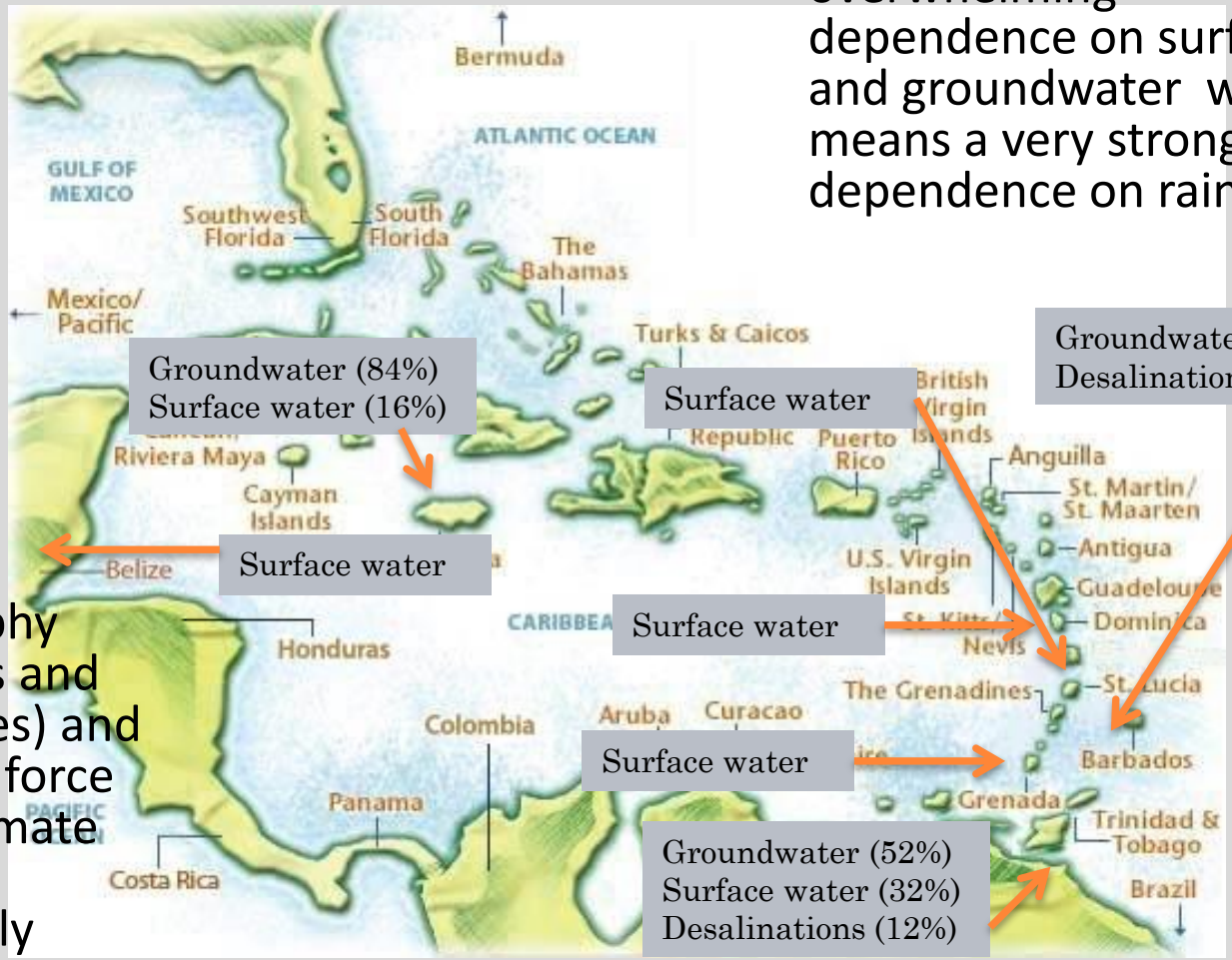
About the CSGM

Mandate: Climate Science Research for the Caribbean

- To investigate and understand the mechanisms responsible for a) the mean climate and b) extremes in climate in the Caribbean
- To investigate climate change and it's historical, current and future manifestations in the Caribbean.
- To promote climate data capture and sound data management principles.
- To investigate and promote the advantageous uses of climate information for the development of the Caribbean region.
- To build capacity (data, human and technical) to do climate science within the Caribbean region and respond to climate science demands within the region

‘Rainfall is King’

“There is an overwhelming dependence on surface and groundwater which means a very strong dependence on rainfall”



“ The size, topography (steep hilly interiors and narrow coastal zones) and economic activities force consideration of climate as an issue for the Caribbean, especially rainfall…”

Climate Research + Drought

4 Areas of concentration

CARIBBEAN RAINFALL CLIMATOLOGY

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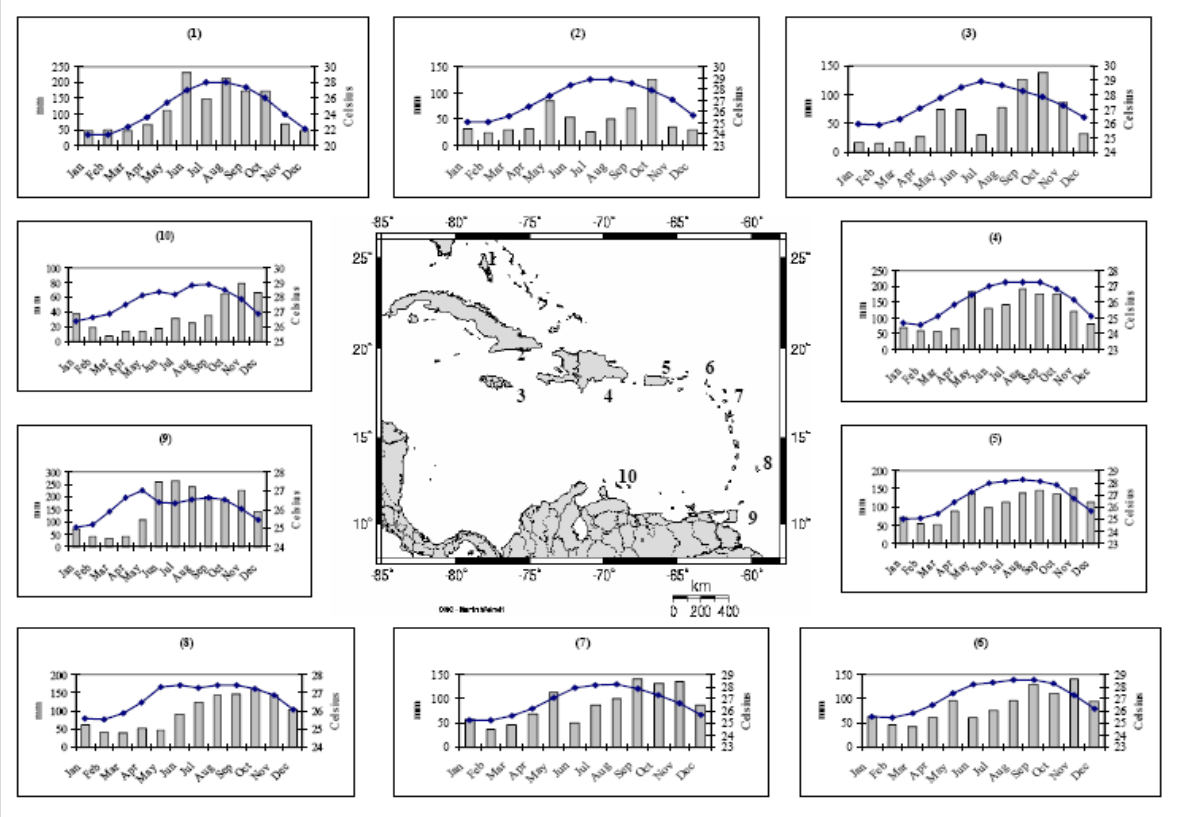

CARIBBEAN RAINFALL CLIMATOLOGY

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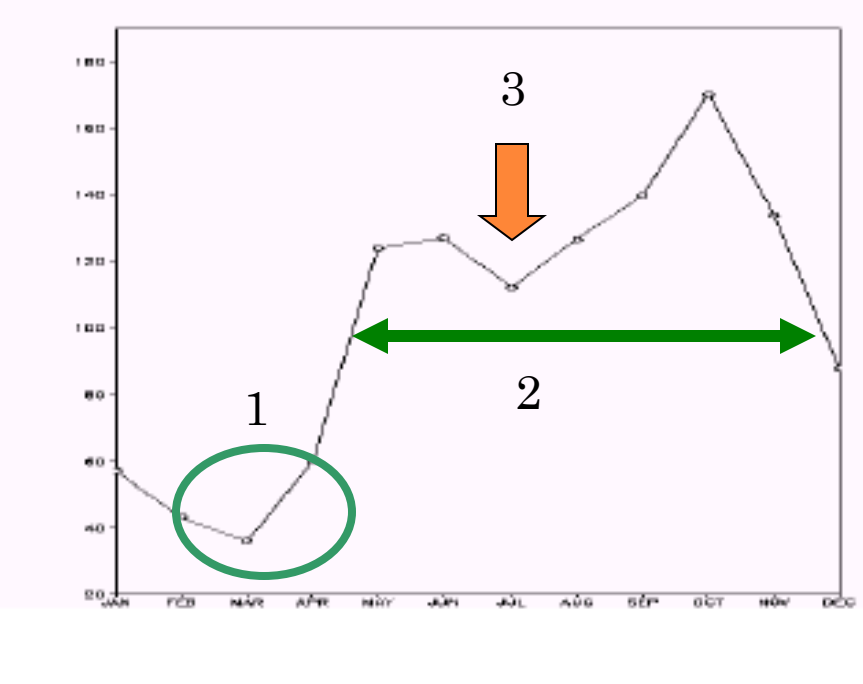

1. Dry Season

December - April

2. Rainfall Season

May - November
Peaks in September/October

3. Bimodal - MSD

Early season - May-July
Late Season - Aug –Nov

Interest:

What dives this pattern…

CARIBBEAN RAINFALL CLIMATOLOGY

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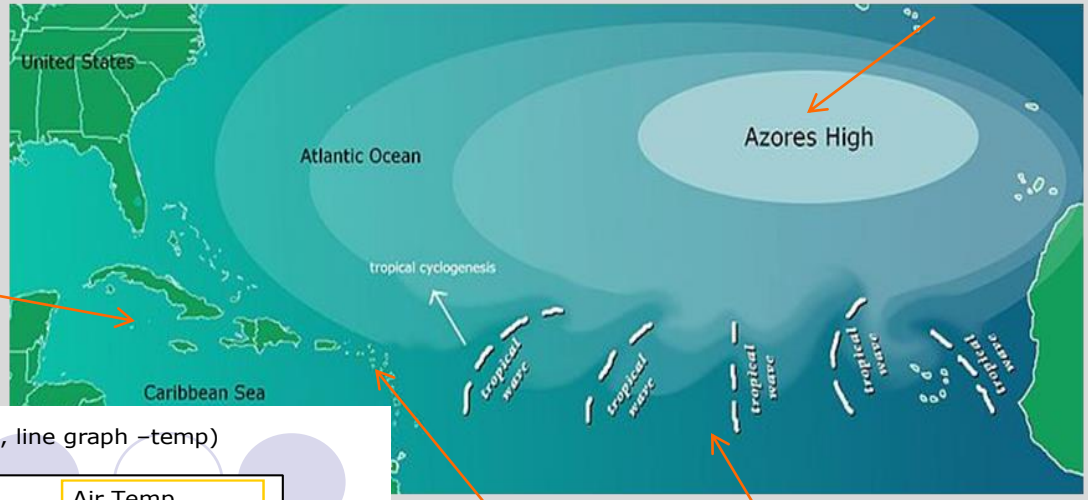
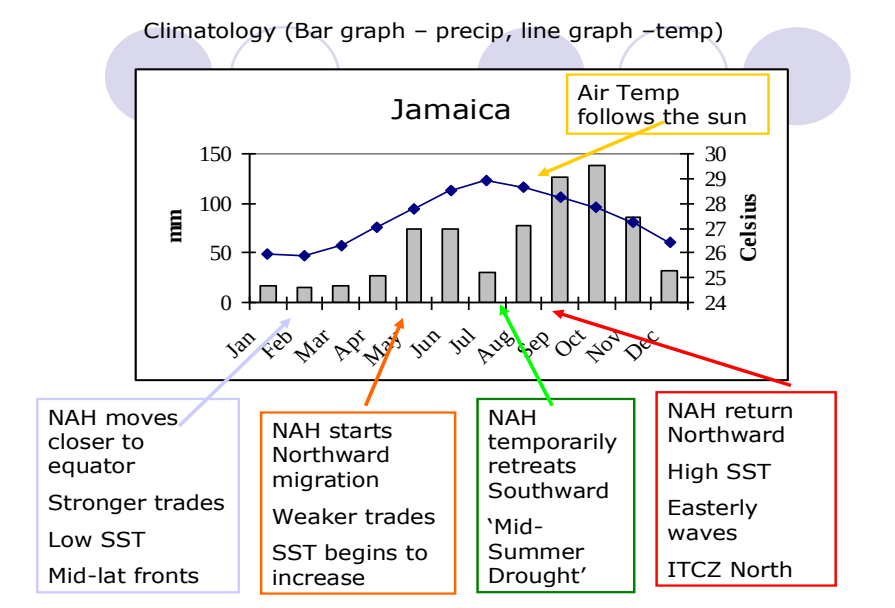
High Pressure



SSTs

Easterly Waves

Trade Wind Strength
+ vertical shear



Drivers of Variability

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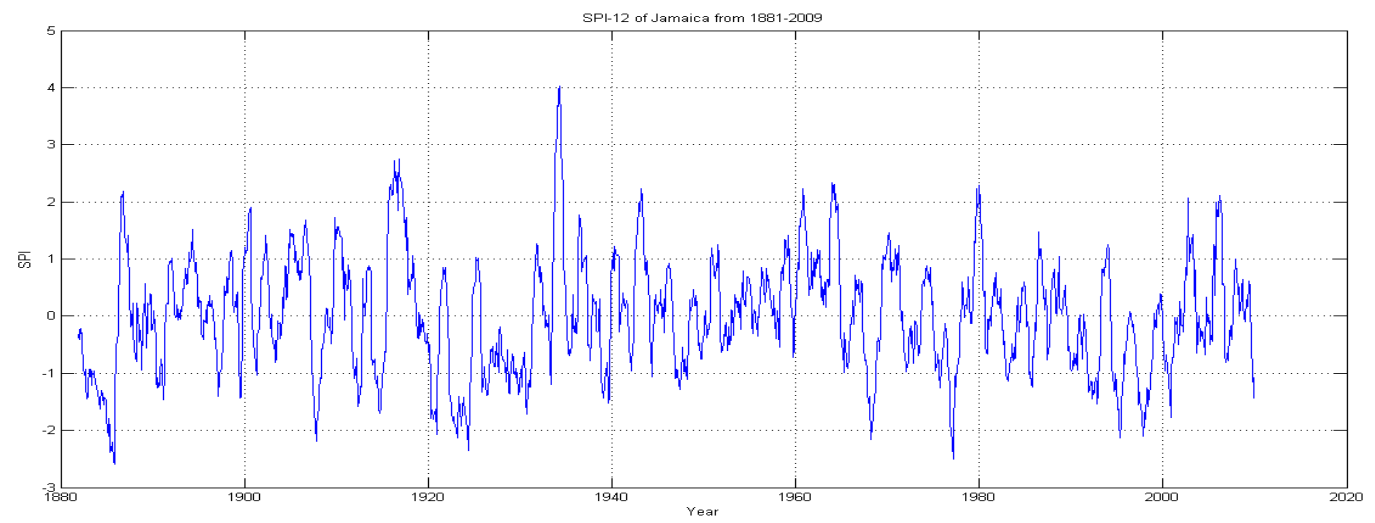

Drivers of Variability

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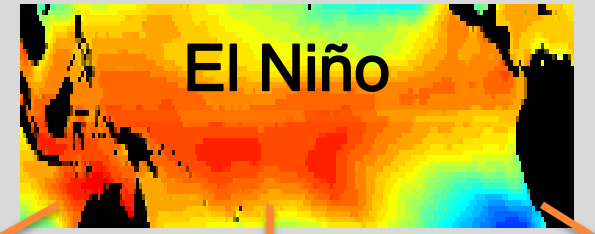
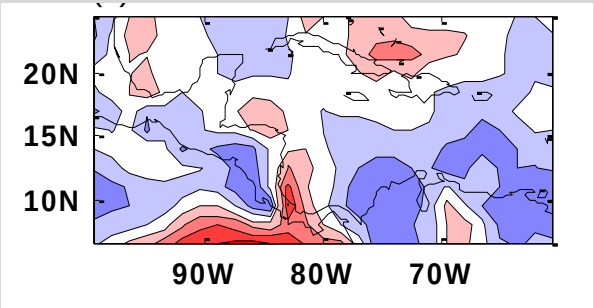
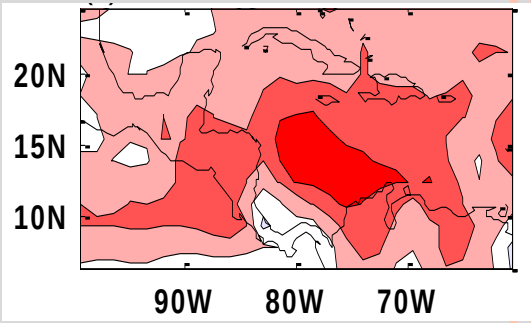
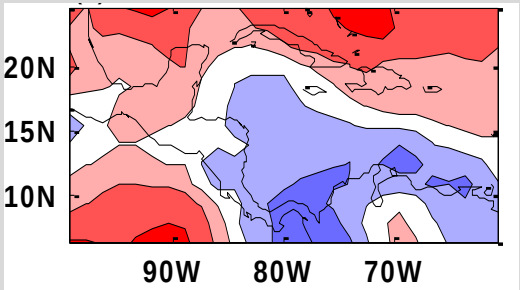




1. Late wet season drier in most of the Caribbean

2. Dry season drier in south Caribbean





3. Early Wet season drier in most of the Caribbean

Drivers of Variability

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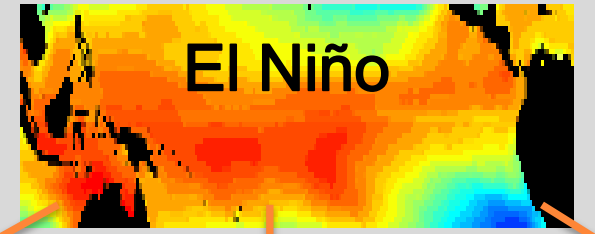
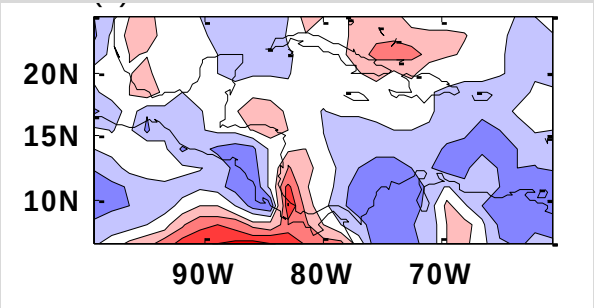


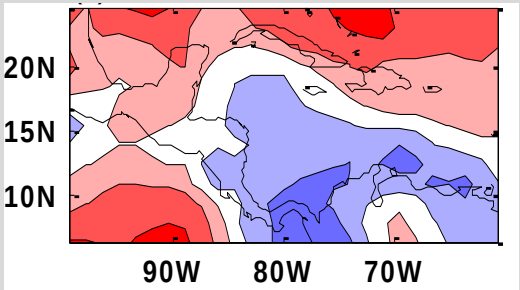


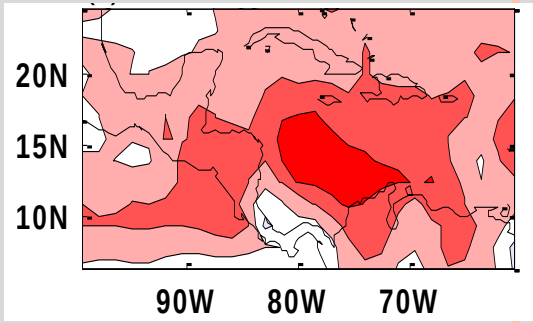
1. Late wet season drier in most of the Caribbean

Increases shear

2. Dry season drier in south Caribbean

Changes large scale circulations





3. Early Wet season drier in most of the Caribbean

Warms Caribbean Sea

Drivers of Variability

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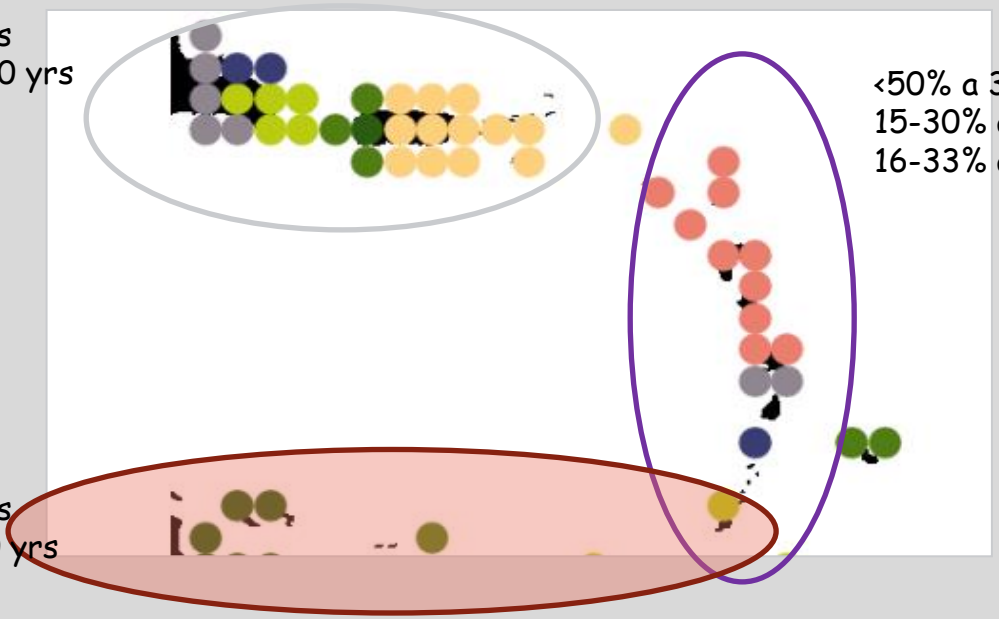
NAO+ ENSO

+50% a 3-5 yrs
+15-30% a 5-10 yrs
20% a >10 yrs



<50% a 3-5 yrs
15-30% a 5-10 yrs
16-33% a >10 yrs

+60% a 3-5 yrs
15-30% a 5-10 yrs

- Combinations of Patterns of variability

Gouirand et al. (2011)

Drivers of Variability

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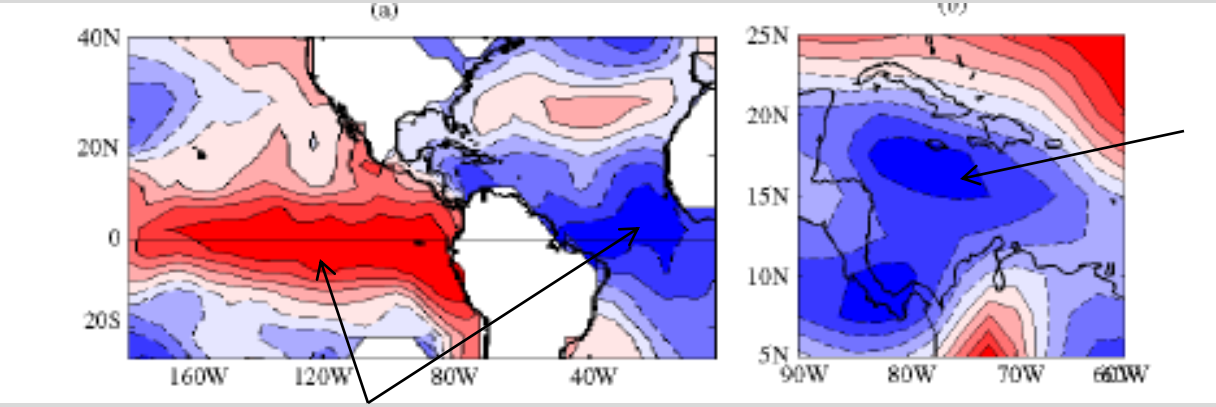
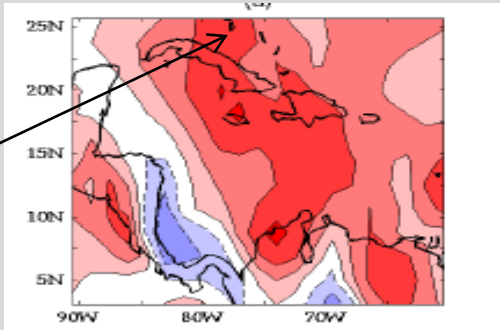
Gradient Indices



Low level wind strengths (CLLJ)

Gradients in SSTs between Equatorial Pacific and Tropical Atlantic

Drier than normal Caribbean basin during midsummer drought



Drivers of Variability

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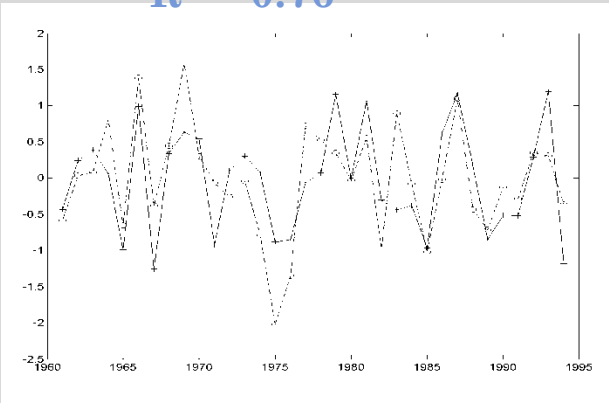
Caribbean Rain/Drought Models

MJJ RAIN =

- – 0.0610 + 0.3111 NINO3(FMA)
- – 0.0675 SLP2(FMA)
- – 0.0299 SLP4(FMA)
- + 0.1187 VSH4(FMA)

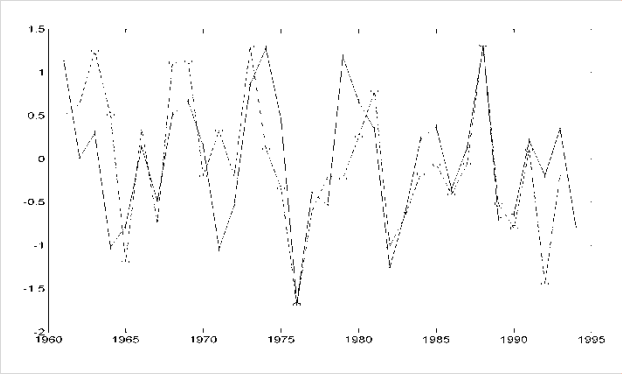
$R^2 = 0.76$



ASON RAIN =

- – 0.0280 + 1.5822 CSST(MJJ)
- – 0.7227 PACEq(MJJ)
- – 0.5739 PACTNA(MJJ)

$R^2 = 0.70$



Historical Drought

Indices of Drought

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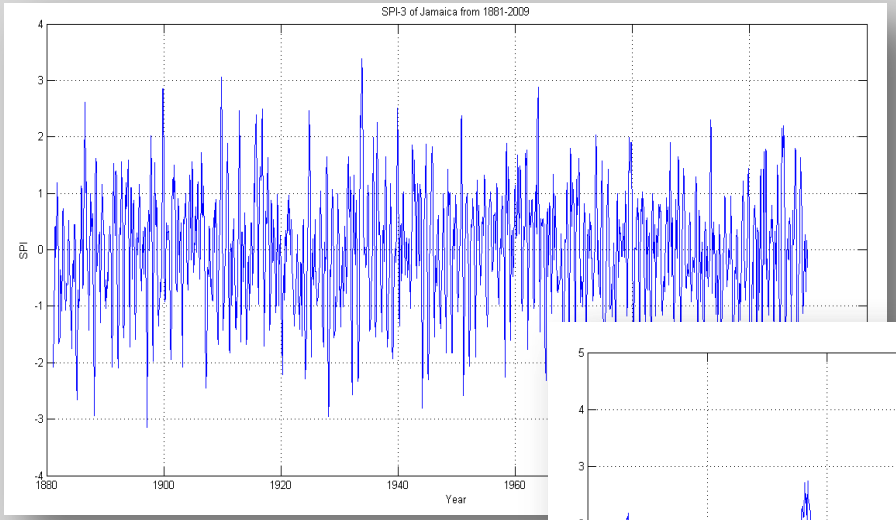
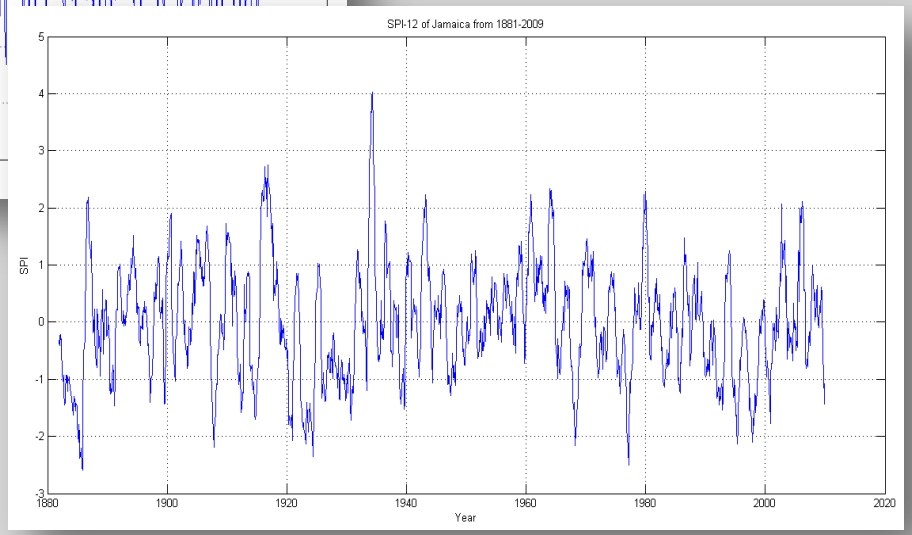


3 month SPI Jamaica



6 month SPI Jamaica

Historical Drought

Drought Influences

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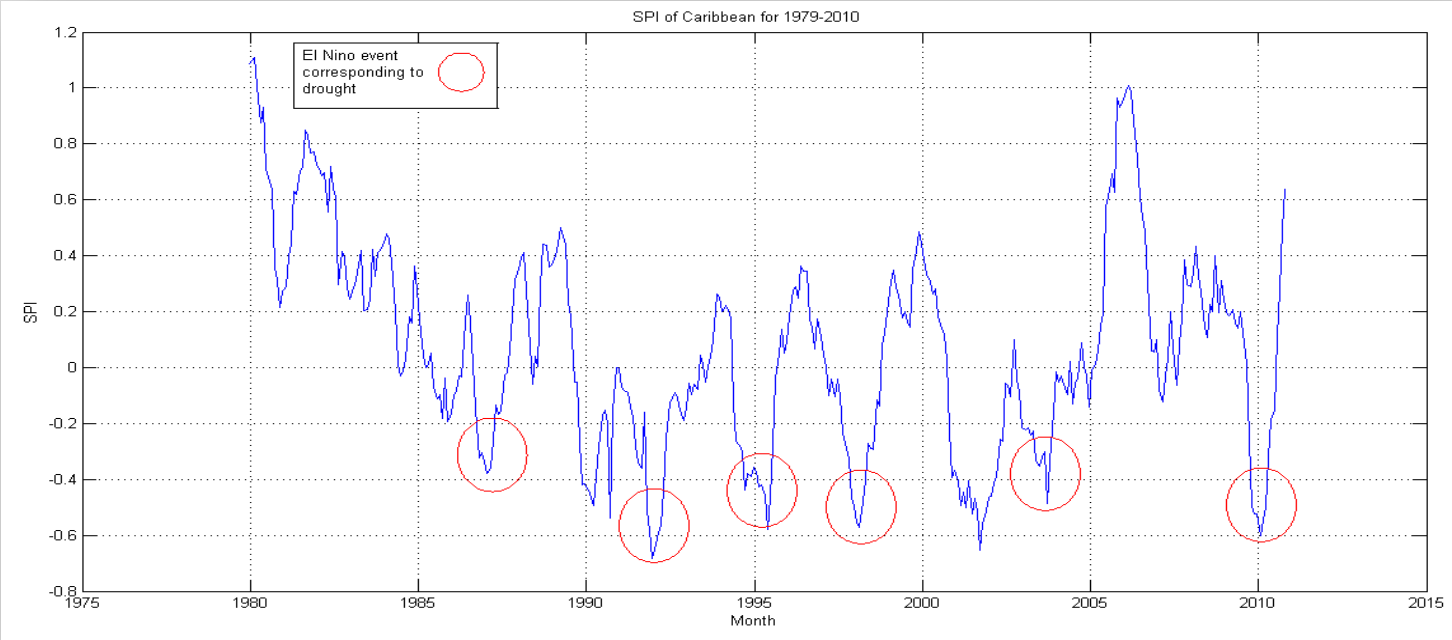
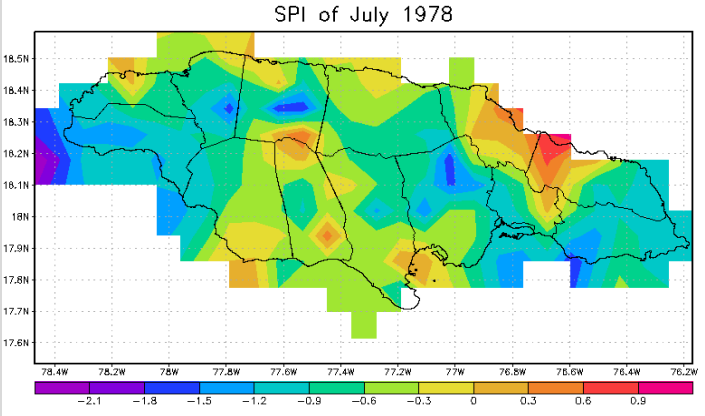
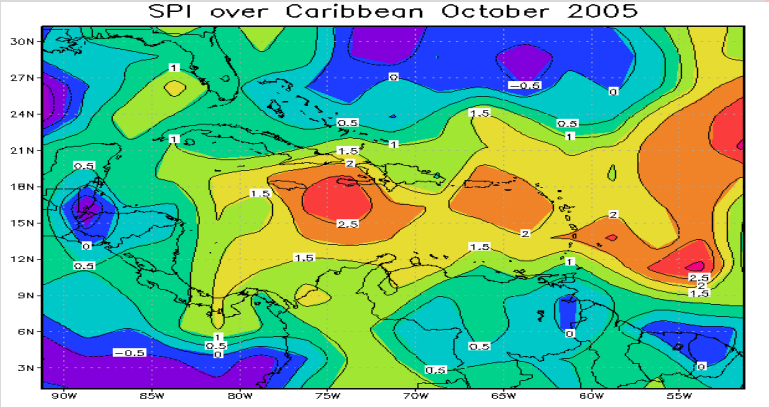


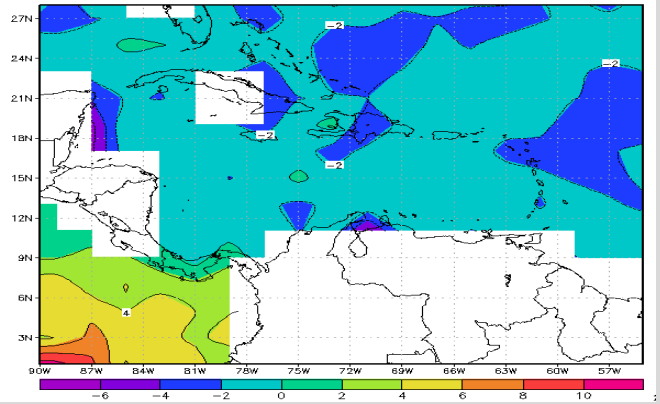
12 month SPI Jamaica

Historical Drought

Significant Drought and Drought Influences







SST composite:

Flood minus Drought

HISTORICAL DROUGHT

Other Indices of Rainfall/Drought

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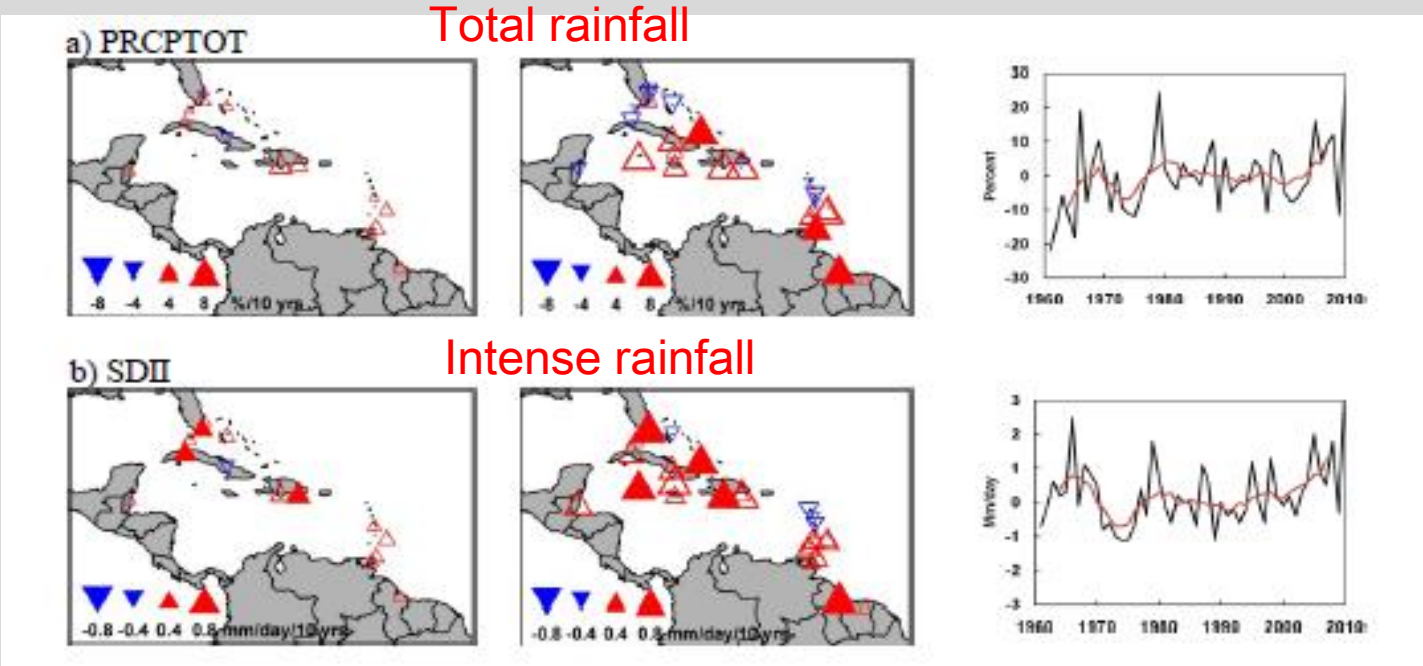

1961-2010 1986-2010 Stephenson et al (2002)

Future Drought

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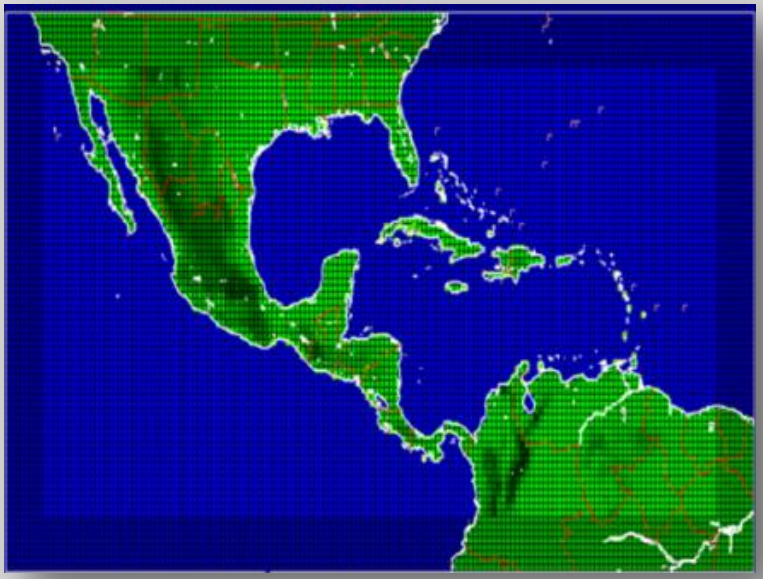

Regional Climate Model

- **PRECIS, UK**
- Caribbean
- Scale ~50 km

Future Drought

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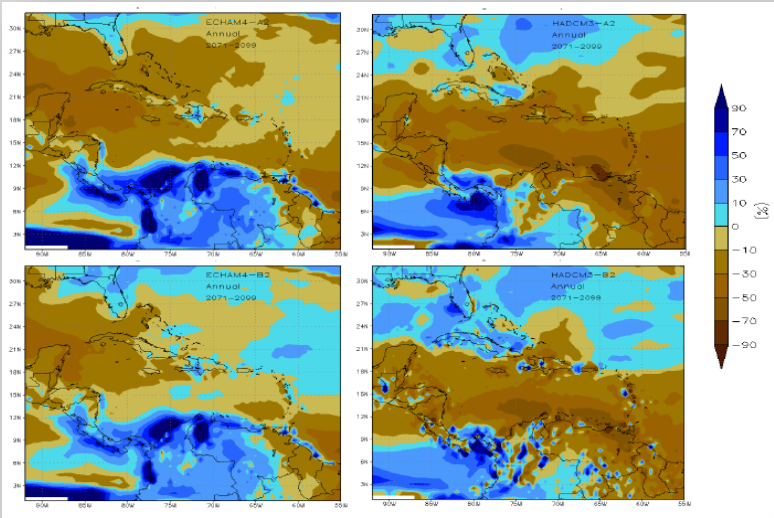


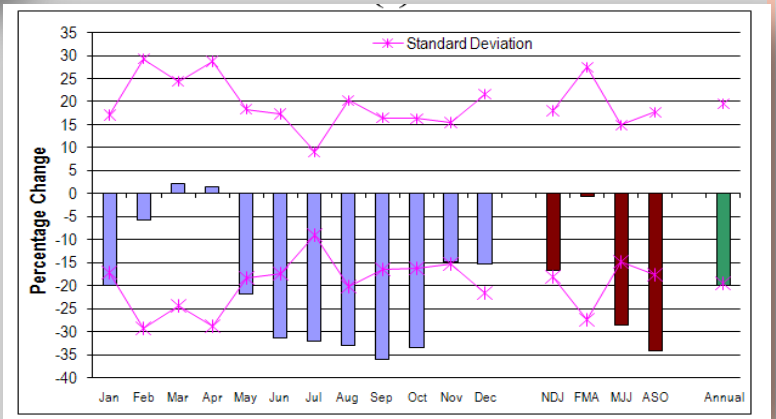
Mean changes in the annual rainfall for 2071-2099 with respect to 1961-1989, as simulated by PRECIS_ECH and PRECIS_Had for SRESA2 and SRESB2.

General tendency for drying (main Caribbean basin) by end of the century.

Drying between 25% and 30%

Possibly wetter far north Caribbean NDJ and FMA.

Drying exceeds natural variability June-October – wet season dryer!



Future Drought

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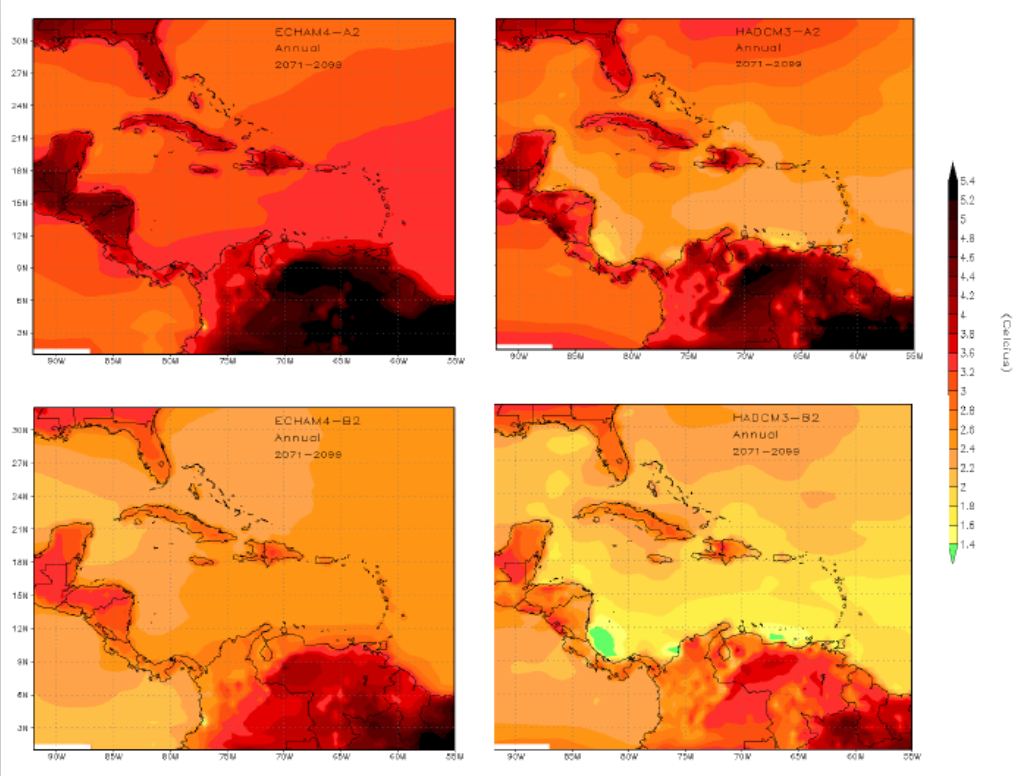

Irrespective of scenario the Caribbean expected to warm.

Warming between 1 and 5°C

Warming greater under A2 scenario.

Warming consistent with projections for other parts of globe.

Warming far exceeds natural variability

Mean changes in the annual mean surface temperature for 2071-2099 with respect to 1961-1989, as simulated by PRECIS_ECH and PRECIS_Had for SRESA2 and SRESB2.

Future Drought

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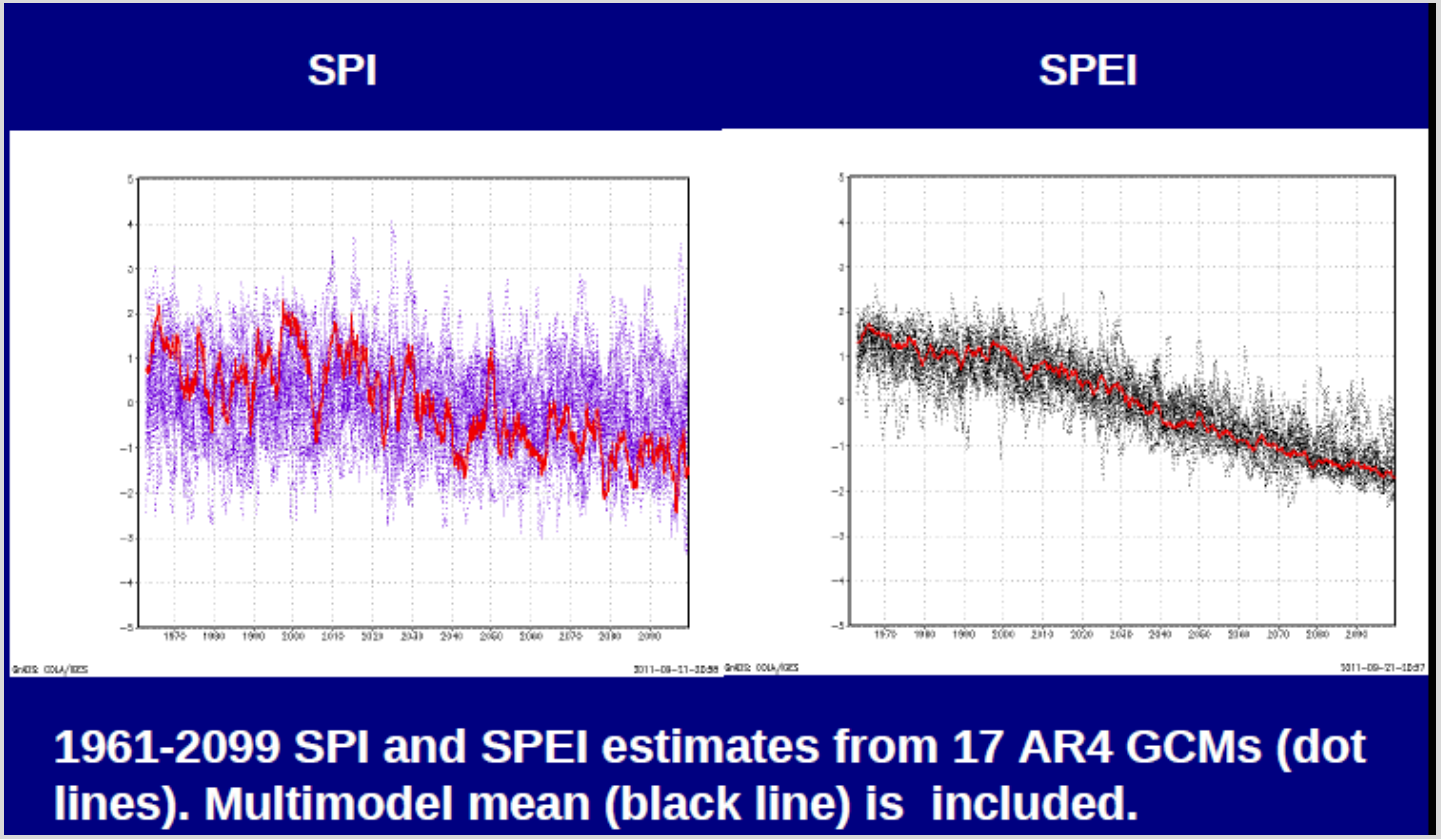

INSMET (2011)

Future Drought

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Why?

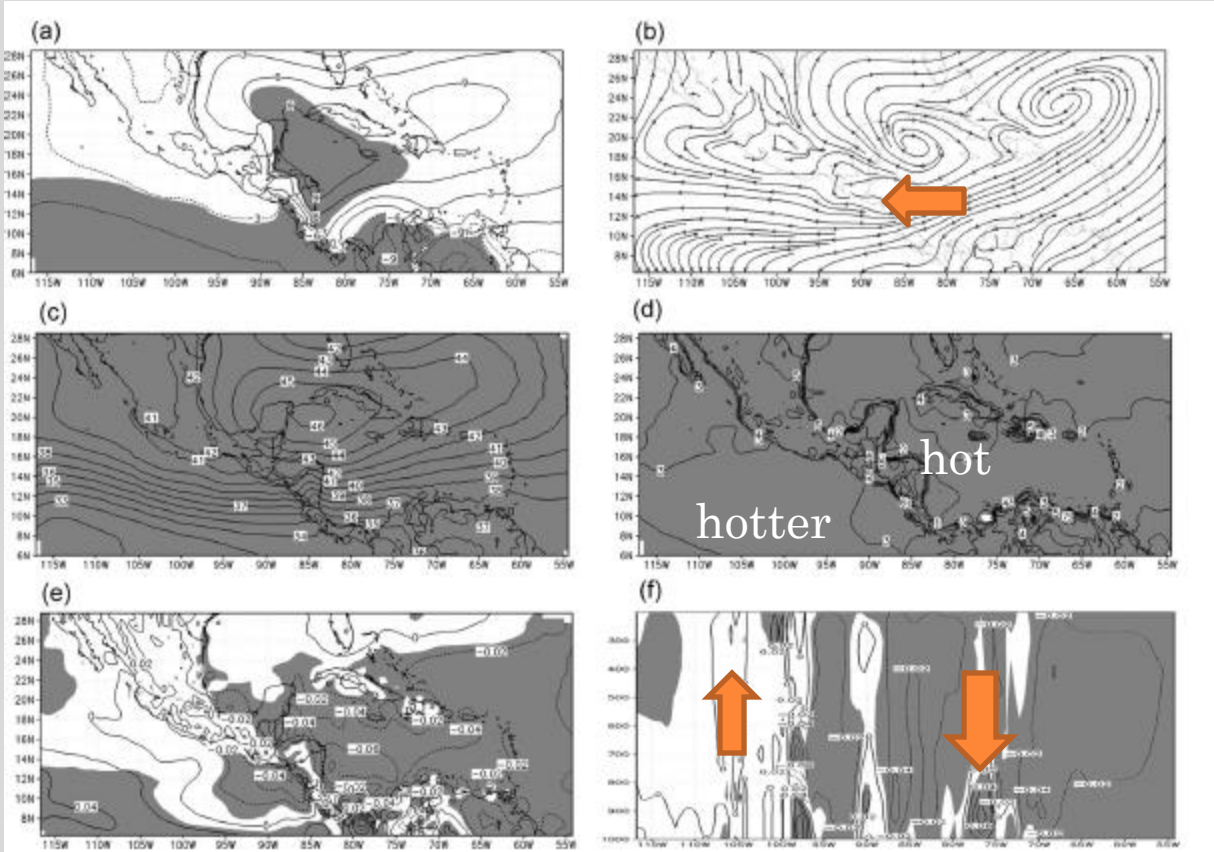

Figure 7. Climatological maps for the mean Caribbean wet season (May–November) for 2071–2100 relative to 1961–1990. (a) Geopotential (gpm) at 1000 hPa. (b) Streamlines at 925 hPa. (c) Geopotential (gpm) at 700 hPa. (d) Surface temperature (°C). (e) Vertical velocity (Pa/s) at 500 hPa. Signs are reversed so positive indicates ascent. Shading in Figures 7a, 7e, and 7f indicates differences statistically significant at the 90% level. In Figures 7c and 7d the entire domain is significantly different.

Taylor et al. (2011)

Summary of Climate Research + Drought

1. Caribbean Rainfall Climatology
2. Drivers of Variability
3. Historical Drought
4. Future Drought

Thank You