



# A QUICK OVERVIEW OF REGIONAL CLIMATE MODELLING EFFORTS IN THE CARIBBEAN

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**The PRECIS-Caribbean Story: Lessons and Legacies. *Bull. Amer. Meteor. Soc* (July 2013)**



## 4 Questions

### **Why?**

*Why do regional climate modelling in the Caribbean?*

### **How?**

*How did the region approach the task?*

### **What?**

*What has been the overriding benefit?*

### **So?**

*So what happens next?*



# Context

*Extremely climate sensitive and very vulnerable*

Why?

How?

What?

So?



Size and location ensures climate influence always present & inescapable.



Small islands surrounded by Caribbean Sea with hilly interiors.



All major infrastructure located on limited coastal plains. Narrow economic zone.





# Context

*Extremely climate sensitive and very vulnerable*

Why?

How?

What?

So?



Extremely climate sensitive and very vulnerable to changes in climate.



**Economy** (Agriculture including fisheries & Tourism)  
**Health and Wellbeing** (dengue and asthma) and  
**Critical livelihood sectors** (Water, Energy) bound up with climate





# Context

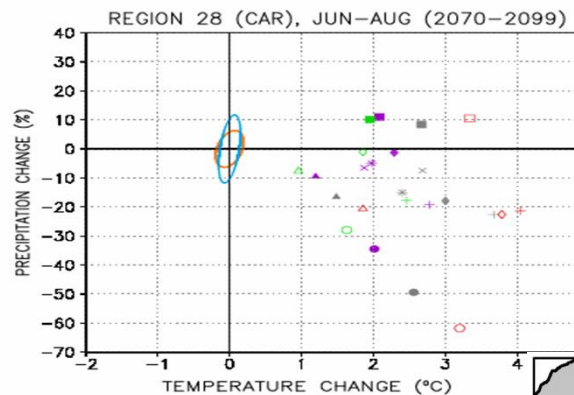
*Little information on climate change within Caribbean domain and at the scale of the Caribbean.*

Why?

How?

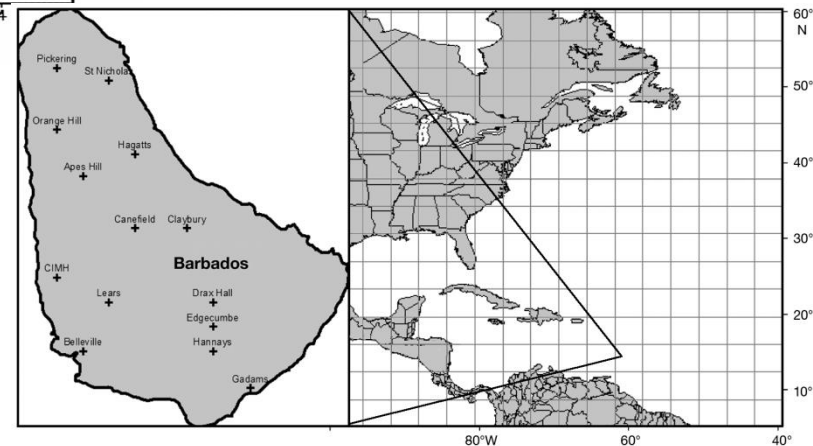
What?

So?



Model-simulated temperature/ precipitation response to forcing scenario. Scenario is depicted by colour of the point (A1FI - red, A2 - grey, B1 - green and B2 - violet). Ovals show 95% Gaussian contour ellipses of the natural internal tridecadal variability.

**Left:** Island of Barbados.  
**Right:** HadCM3 grid boxes and where Barbados should be located.





# Context

*Increasing demand from stakeholders for more information as climate extremes become more frequent.*

Why?

Estimated economic impact of recent climate extreme events on Jamaica. Source: PIOJ

How?

What?

So?

EVENT	Year	Category	Impact (% GDP)
Hurricane Michelle	2001	4	0.8
May/June Flood Rains	2002		0.7
Hurricane Charley	2004	4	0.02
Hurricane Ivan	2004	3	8.0
Hurricanes Dennis & Emily	2005	4	1.2
Hurricane Wilma	2005	5	0.7
Hurricane Dean	2007	4	3.4
Tropical Storm Gustav	2008		2.0
Tropical Storm Nicole	2010		1.9





# Context

**Why?**

Extremely climate sensitive and very vulnerable



**How?**

Little information on climate variability and change within Caribbean domain and at the scale of the Caribbean.



**What?**

Increasing demand from stakeholders for more information as climate extremes become more frequent.

**So?**



**Case for RCM in Caribbean**





Why?

# Context

How?

What?

So?







# Collaboration

Why?

Caribbean consists of territories with limited and unequally distributed resources and capacities. Effectively responding to the crisis of climate change needs coordination and collaboration.

How?

## Coordinated Science approach

### PRECIS – Caribbean Project

What?

- Born in Havana in 2002.
- Deliberate collaborative modelling effort premised on shared workload.
- **Focus:** Produce quickly a picture of how the Caribbean's climate was likely to change (at the scale of the Caribbean islands) through the end of the century for use in developmental planning at national and regional levels.
- Tool: PRECIS RCM

So?





# Collaboration

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Why?

How?

What?

So?

## Coordinated Science approach

### PRECIS – Caribbean Project

- Cuba – Instituto de Meteorologia
- Jamaica – University of the West Indies
- Barbados – University of the West Indies
- Belize – Caribbean Community Climate Change Centre





# Collaboration

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## Coordinated Science approach

### PRECIS – Caribbean Project

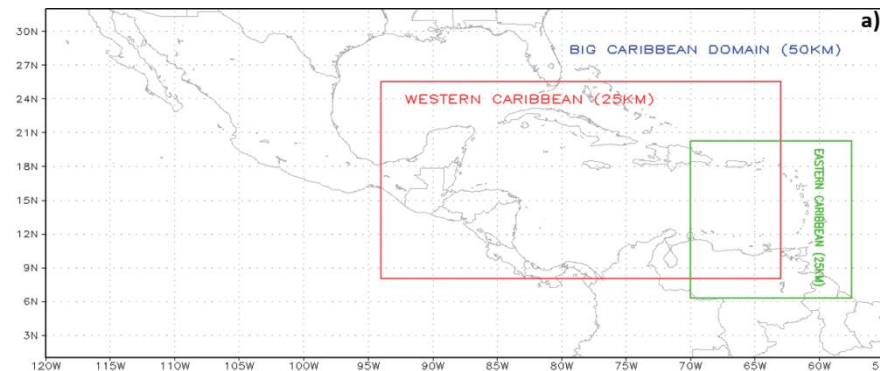


TABLE I. Initial division of runs.

Cuba (INSMET)	Caribbean basin, 50 × 50 km <sup>2</sup>	B1 (30 yr) and A2 (30 yr), baseline (30 yr), reanalysis (15 yr)
Jamaica, UWI (Mona)	Caribbean basin, 50 × 50 km <sup>2</sup>	A2 (30 yr) and B2 (30 yr), baseline (30 yr)
Barbados, UWI (Cave Hill)	Eastern Caribbean, 25 × 25 km <sup>2</sup>	A2 (30 yr) and B2 (30 yr), baseline (30 yr)
Belize, 5Cs	Caribbean and eastern Caribbean	Multiple runs





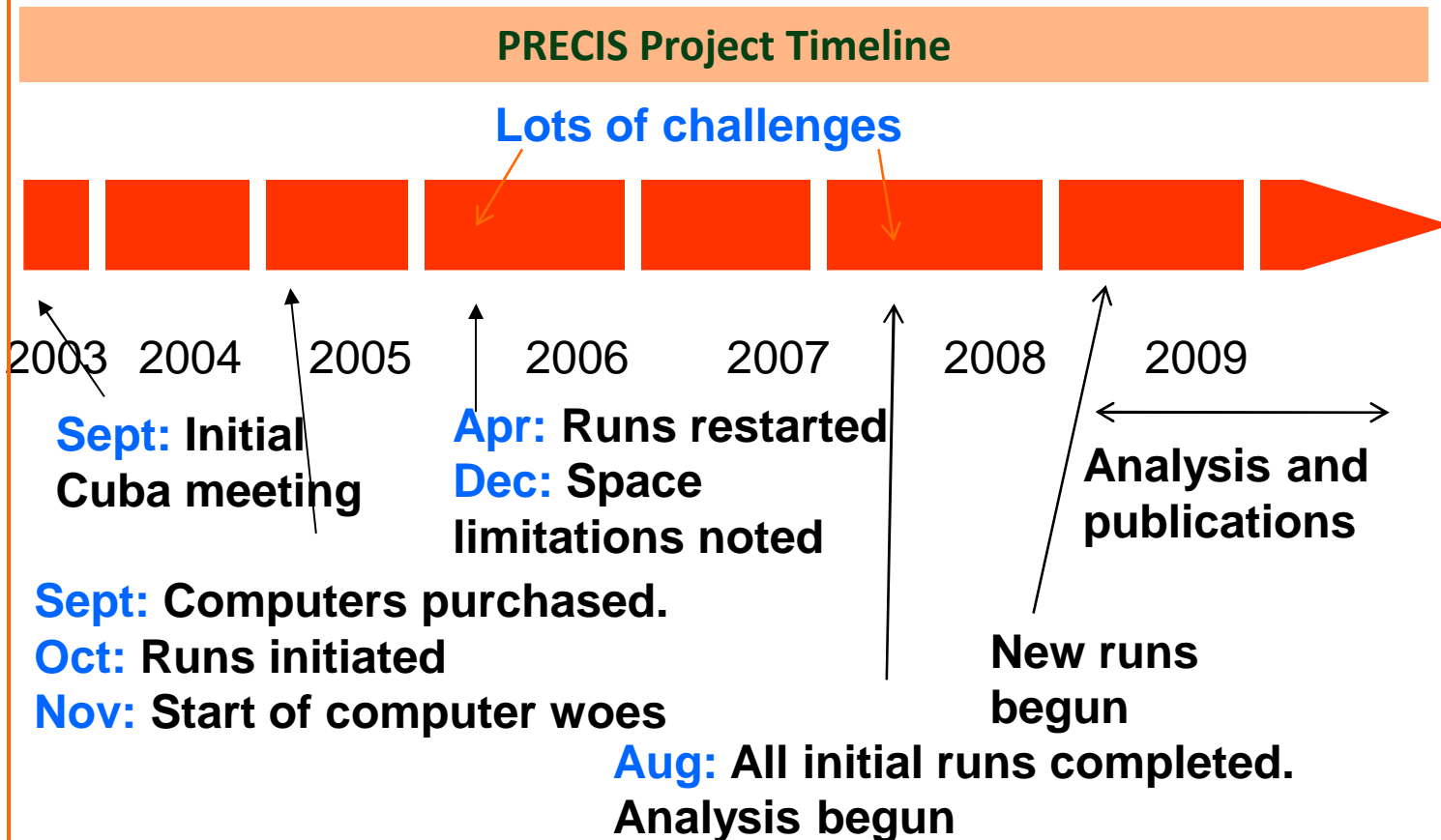
# Collaboration

Why?

How?

What?

So?





# Collaboration

Why?

Caribbean consists of territories with limited and unequally distributed resources and capacities. Effectively responding to the crisis of climate change needs coordination and collaboration.

How?

## Coordinated Science approach

Since 2009...

What?

“ A new picture of Caribbean climate has emerged closer to the scale of the Caribbean. Published in peer reviewed papers.

So?

“ Capacity has been significantly enhanced to do modelling within the region . new modelling centres added: Antom de Kom University of Suriname; UAG French West Indies.

“A regional climate change science framework has been articulated and is being pursued with respect to modelling still premised on the shared workload.



<b>Mandate</b>	<b>What Science?</b>	Climate Has Changed	Climate Will Change	Climate Demands Change
		<b>Any Science that enables critical evaluation of the Core Climate Change Message above</b>		

<b>Data Priorities</b>	<b>Historical Climate Data</b>	<b>Future (Projected) Climate Data</b>	<b>Sector-Relevant Data</b>
	Baseline climatologies Patterns of historical variability	Deviations from Baseline New patterns of variability	Linked to the climate sensitivities of important sectors

<b>Methods</b>	<b>Data Mining and Monitoring</b> Past, current data . real & proxy	<b>Agenda</b>	<b>Sensitivity and Attribution</b> <i>We are climate sensitive societies</i>
	<b>Data Modelling</b> Future Data . regional, station,		<b>Vulnerability and Risk</b> Our sensitivity makes us vulnerable
	<b>Data Meaning</b> Implications & Uncertainties		<b>Resilience - M &amp; A</b> Vulnerability k Helplessness



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## Coordinated Science approach

Since 2009...

**PRECIS**

**RegCM4**

Resolution (Km)	Coverage	Boundary Data	SRES
50	1960 - 1990	HadAM3P	A2
50	2070 - 2100	HadAM3P	A2
50	2070 - 2100	HadAM3P	B2
50	1960 - 2100	ECHAM4	A2
50	1990 - 2100	ECHAM4	B2
50	1989-2002	ERA-INTERIM	
50	1979-1993	ERA15	
25	1960 - 2040	HadCM3Q0	A1B
25	1960 - 2040	HadCM3Q3	A1B
25	1960 - 2040	HadCM3Q4	A1B
25	1960 - 2040	HadCM3Q10	A1B
25	1960 - 2040	HadCM3Q14	A1B
25	1960 - 2040	HadCM3Q11	A1B
25	1960 - 2100	ECHAM5	A1B
50	1989-2002	ERA-INTERIM	
50	1960. 2000	ERA40	

<http://precis.insmet.cu/Precis-Caribe.htm>



Why?

# Context

How?

# Collaboration

What?

So?







Why?

**Context**

How?

**Collaboration**

What?

**Clarity** (a bit more...)

So?





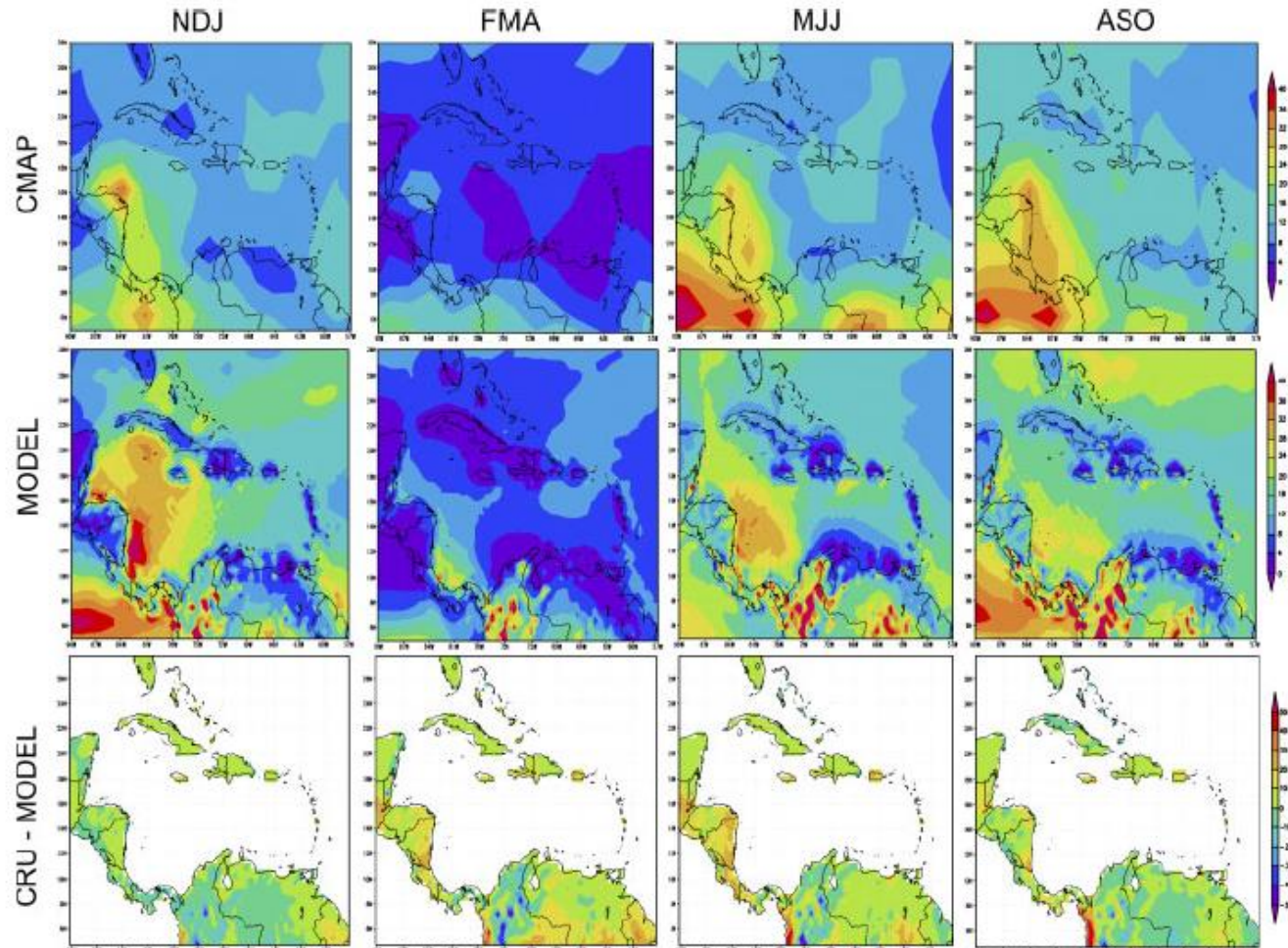
# 1. A bit more spatial detail...

Why?

How?

What?

So?



Campbell et al. (2010)

**Present day - Rainfall**





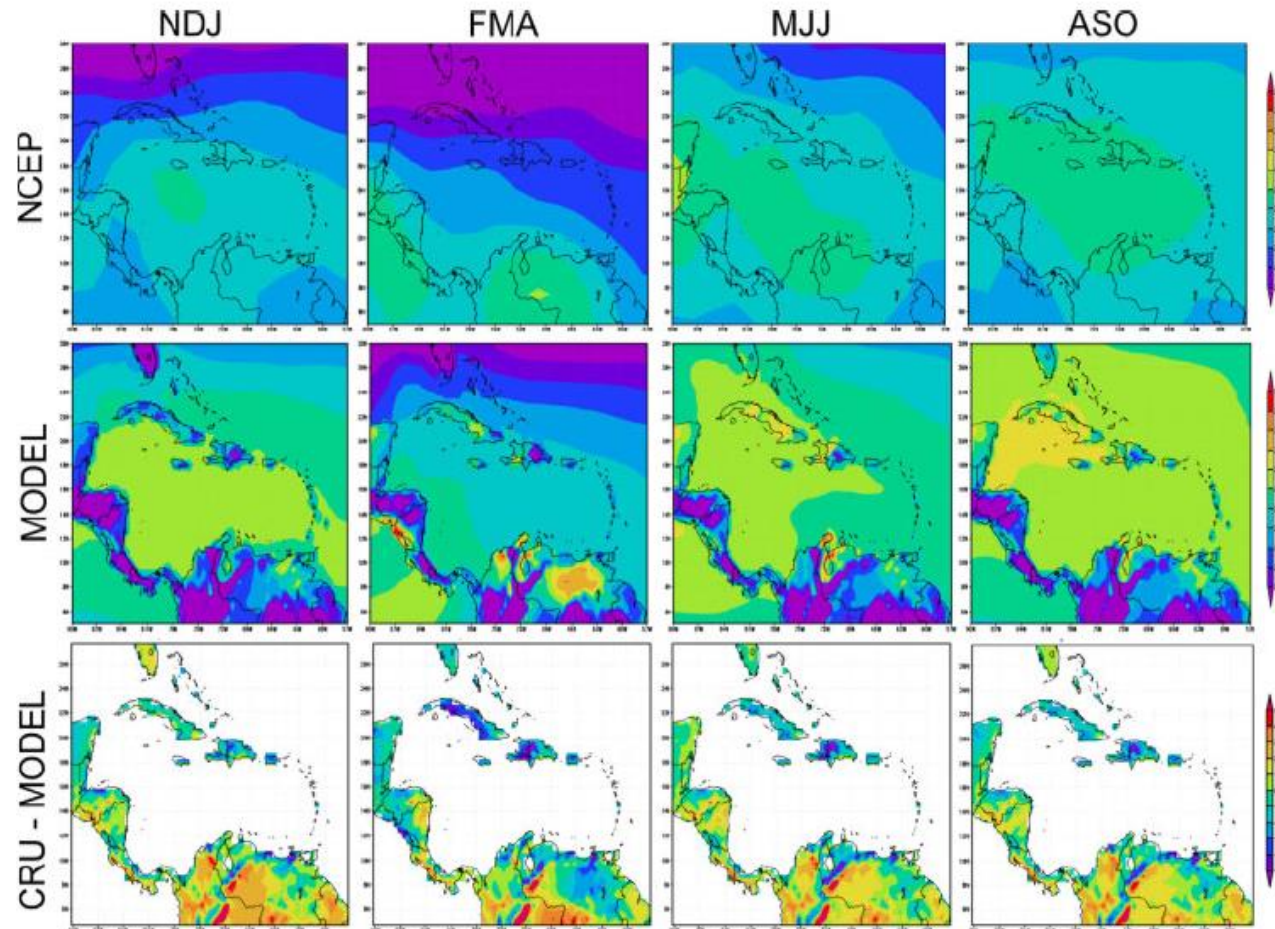
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So?



Campbell et al. (2010)

**Present day - Temperature**





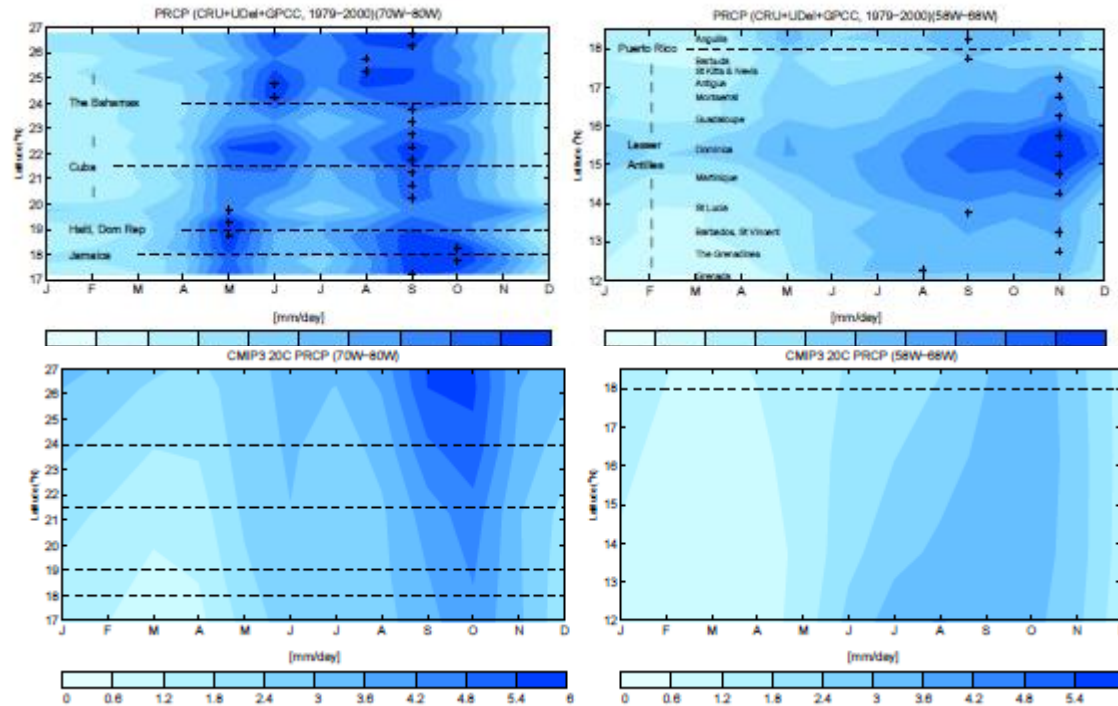
## 2. A better representation of key metrics...

Why?

How?

What?

So?



**CRU  
(observed)**

**CMIP3  
GCMs**

**Present day rain**

Karmalkar et al. (2013)





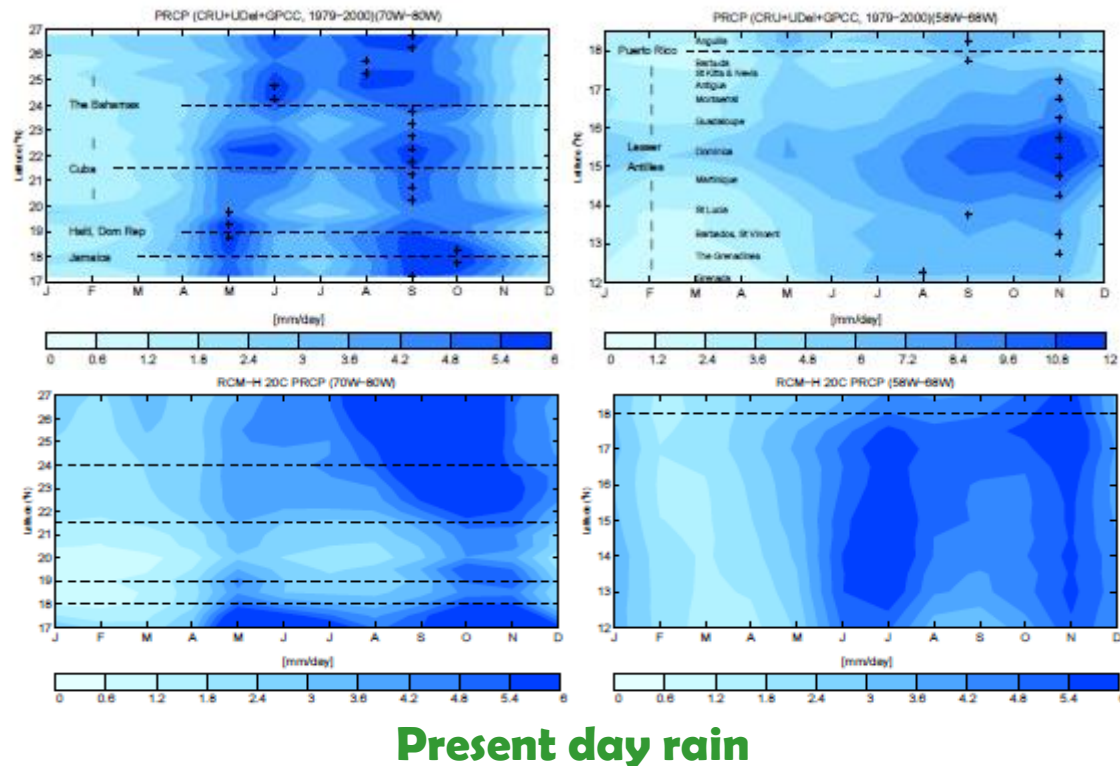
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Karmalkar et al. (2013)





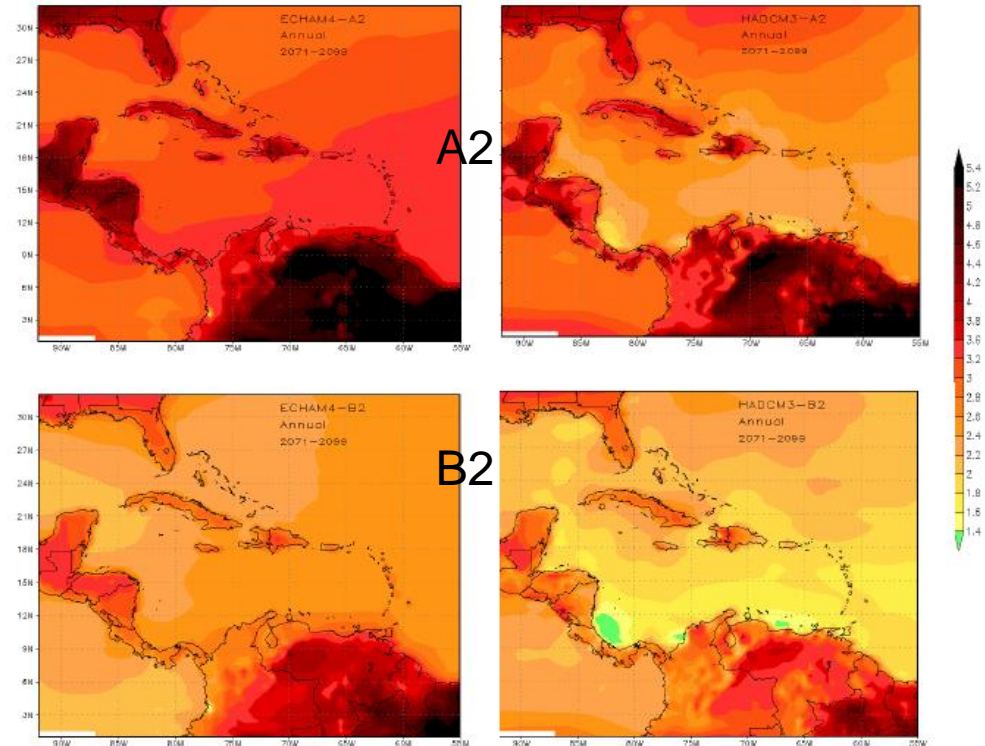
### 3. A glimpse into a Caribbean future...

Why?

How?

What?

So?



**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 historical variability

Taylor, Centella et al. (2013)

*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.*

**End of century temperature anomalies**





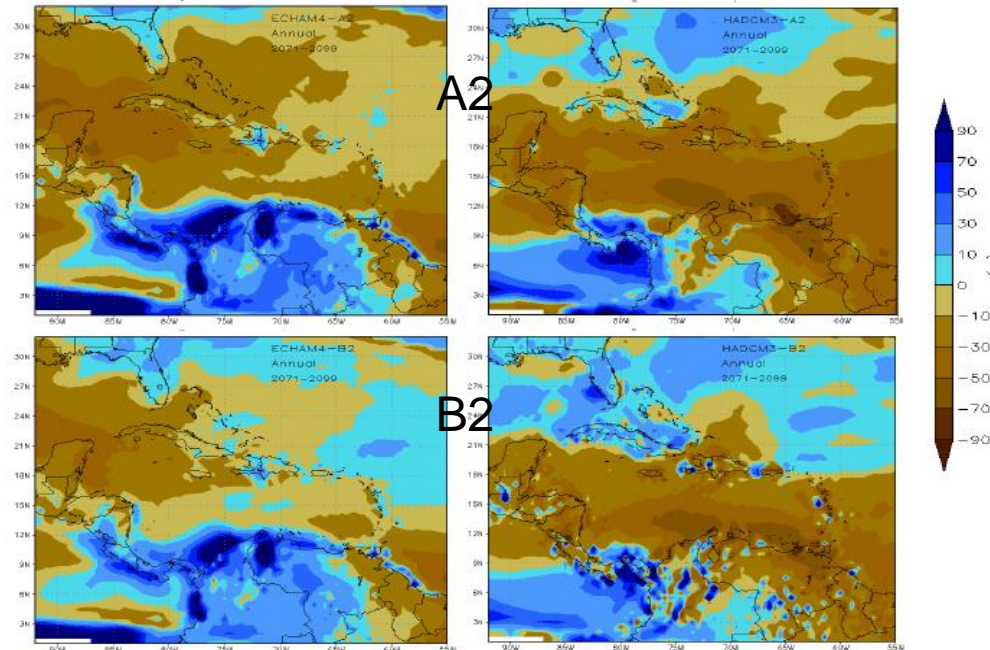
### 3. A glimpse into a Caribbean future...

Why?

How?

What?

So?



Taylor, Centella et al. (2013)

**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!

*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.*

**End of century rainfall change**





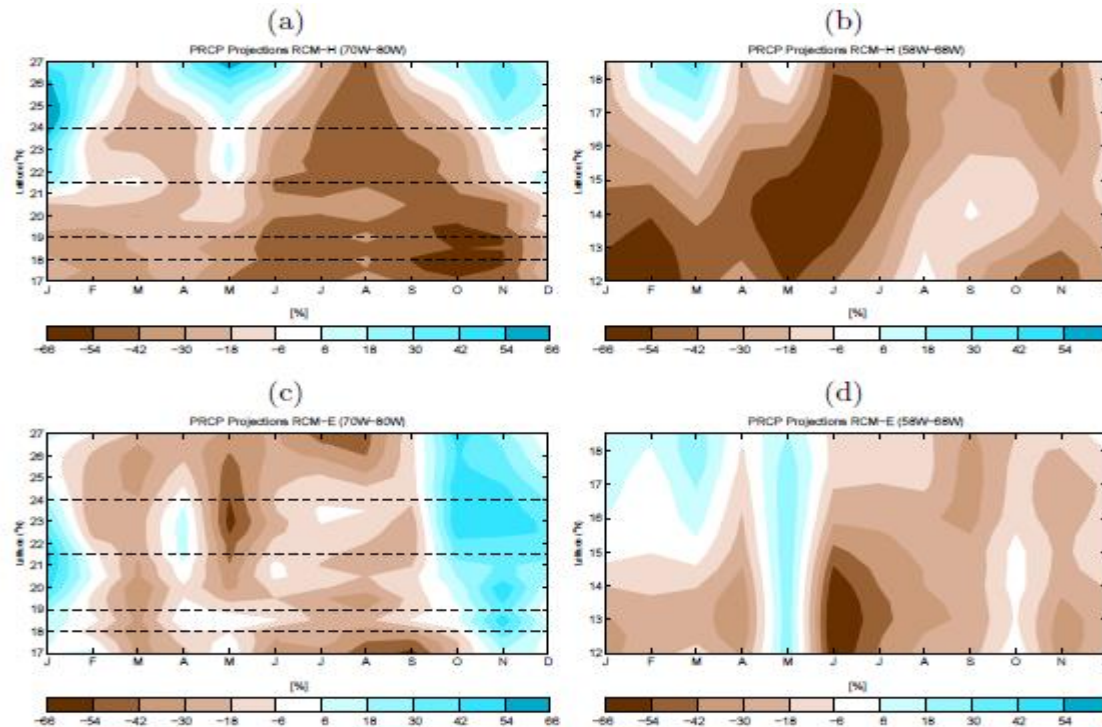
### 3. A glimpse into a Caribbean future...

Why?

How?

What?

So?



**PRECIS  
Hadley**

**PRECIS  
Echam**

**End of century rain change**

Karmalkar et al. (2013)







## 4. An opportunity to pursue impact studies...

Why?

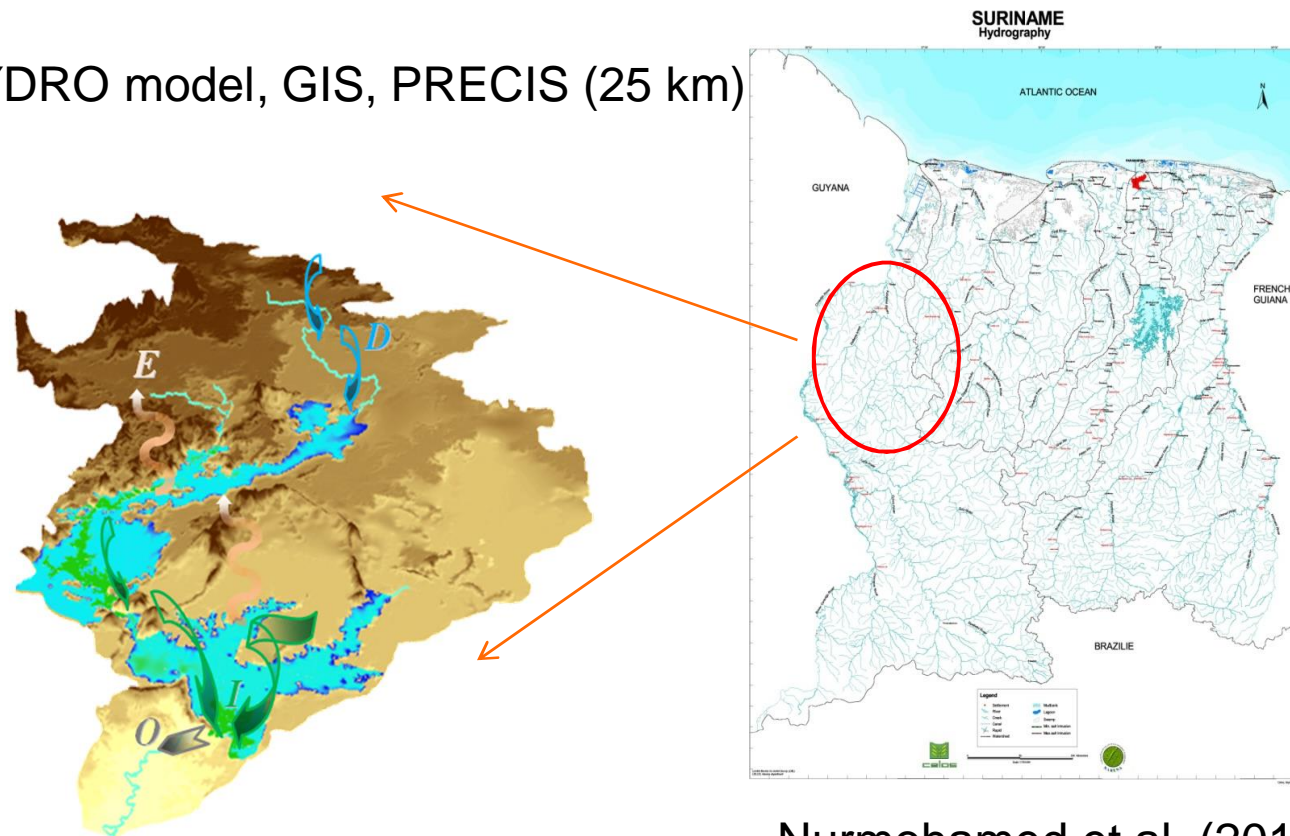
Modeling the impact of climate change on the hydropower potential of Suriname . A study of the Kabalebo river basin

How?

HYDRO model, GIS, PRECIS (25 km)

What?

So?



Nurmohamed et al. (2013)



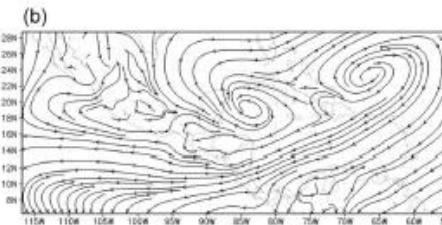
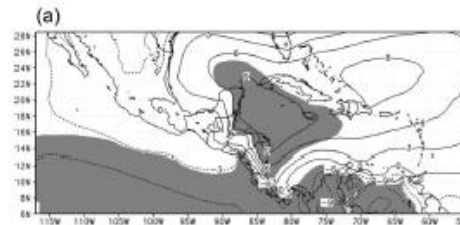


## 5. A chance to explore regional dynamics especially of an altered future...

Why?

### Dynamics of the future climate – why warmer = drier?

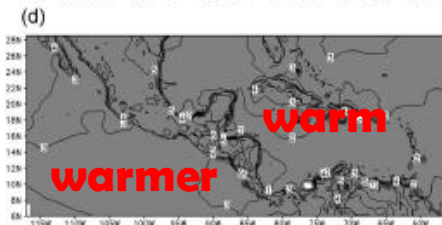
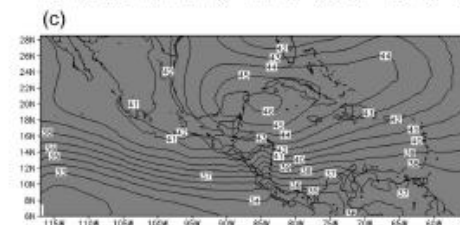
1000 hPa  
Geopot



925 hPa  
Streamlines

How?

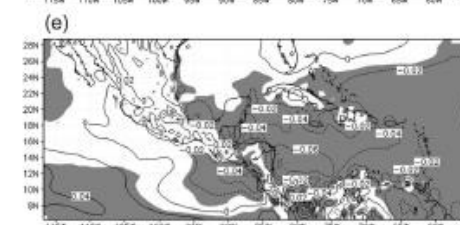
700 hPa  
Geopot



Surface  
temps

What?

500 hPa  
Vertical  
velocity



Vertical  
velocity

So?

### End of century dynamics

Taylor et al. (2011)





Why?

1. A bit more spatial detail...

How?

2. A better representation of key metrics...

What?

3. A glimpse into a Caribbean future...

So?

4. An opportunity to pursue impact studies...

5. A chance to explore regional dynamics especially of an altered future...

**Clarity** (a bit more...)





Why?

**Context**

How?

**Collaboration**

What?

**Clarity** (a bit more...)

So?





# Challenges (New)

The RCM work done to date within the Caribbean has suggested that there are more scientific challenges to be pursued.

Why?

How?

What?

So?

**Extracting Caribbean climate relevant features from the models e.g. hurricanes, low level jets, vertical shear, bimodal patterns, etc.**

**Determining how model characteristics may impacts results e.g. model physics, domain size, resolution, driving model etc.**

**Determining value added by doing regional modelling beyond scale.**

**How climate models are to be linked to sector models to provide future scenarios of impact.**

**Transforming science into action and policy.**





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Why?

**Context**

How?

**Collaboration**

What?

**Clarity** (a bit more...)

So?

**Challenges**





**THE UNIVERSITY OF THE WEST INDIES**  
AT MONA, JAMAICA

**Thank you**