

Modelling climate change in the Caribbean Region

An overview of activities to generate climate scenarios

Why model?

Modeling?

Carib Effort

Some results

So what?

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3 Reasons for Modelling...

Why model?

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So what?

1. The Caribbean is climate **sensitive**...

Our lives and livelihood revolve around or are closely linked to climate.

- Economic: E.g. Tourism, agriculture, mining, fishing
- Infrastructure: E.g. Location of major cities, water quality and storage
- Recreation
- Wellbeing/health

Size and topography enhances sensitivity: E.g. Hilly backbone, limited landspace, infrastructure few miles from coast.

3 Reasons for Modelling...

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2. The Caribbean is therefore **vulnerable**...

Changes in climate (short term or long term) can and do alter Caribbean existence.

Droughts and floods;
Hurricanes;
Hot days, nights,
Long term climate change etc.

Impact felt throughout many areas of Caribbean life directly or indirectly:

Agriculture, Health, Water, Tourism, Disaster Management/Infrastructure, Sport, Finance

3 Reasons for Modelling...

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So what?

2. The Caribbean is however **not helpless...**

If we could anticipate the change in climate then we could better plan for it.

Modelling gives us a clue into the long term changes in climate.

So why model?

To build climate resilience by:

- offering insight into likely ways the climate might change in our region
- enabling the use of this knowledge for planning purposes.



Premise...

Why Model?

Modeling?

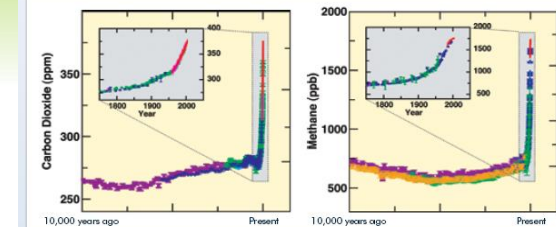
Carib Effort

Some results

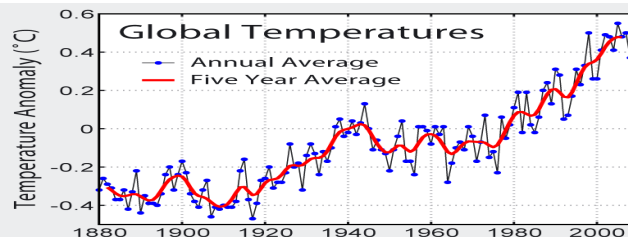
So what?

1. Climate has been changing due primarily to human activity – primarily **through** the addition of **greenhouse gases**.

Carbon Dioxide and Methane Concentrations Over the Last 10,000 Years

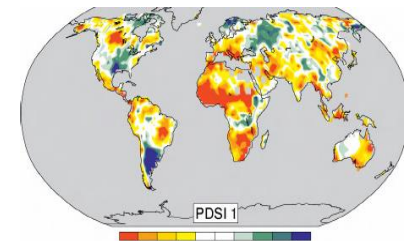
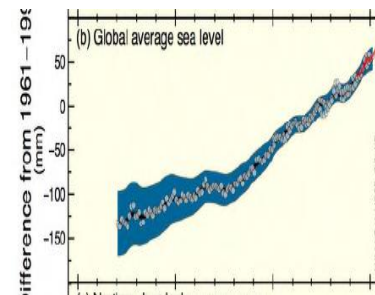


Atmospheric concentrations of carbon dioxide (in parts per million) and methane (in parts per billion) over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colors for different studies) and atmospheric samples (red lines). Source: IPCC, 2007



2. The result is the earth has warmed over the last century - Earth is **0.75 degrees warmer** than in 1860.

3. Rising temperatures result in other effects e.g. sea level rise and changing rainfall patterns



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



Premise...

Why Model?

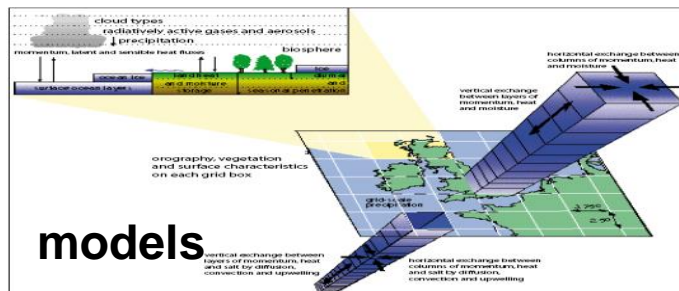
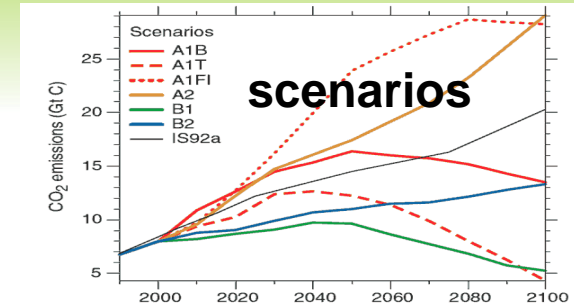
Modeling?

Carib Effort

Some results

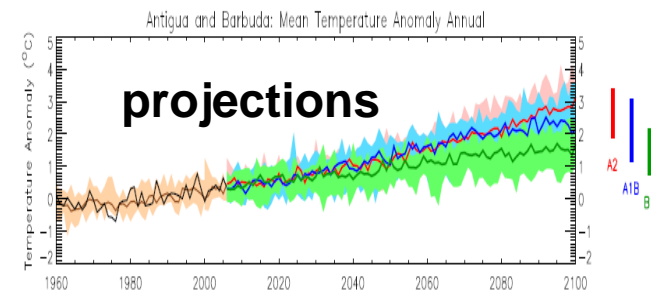
So what?

1. Suppose we could guess how the concentrations of **greenhouse gases will change** going into the future



2. Put these concentrations in computer models that simulate all the physical processes of the earth.

3. Generate pictures of how the climate of the earth, or region on the earth will look in the future.



Modelling...

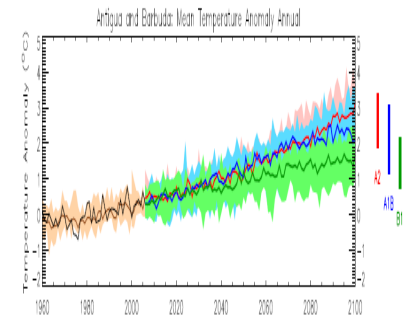
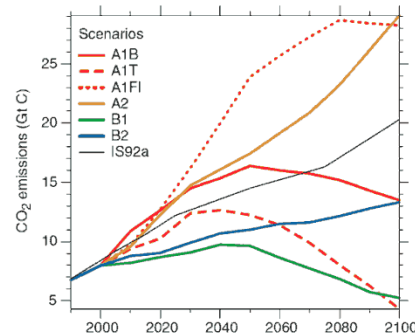
Why Model?

Modeling?

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Some results

So what?



Models

+

Scenarios

=

Future Climate

Computer simulations of future climates given conjectures of how the greenhouse gases will change going to the end of the century.

Caribbean Modelling Initiative

Why Model?

Modeling?

Carib Effort

Some results

So what?

In 2003 a group of modellers got together in Havana Cuba.

- 4 Countries: Jamaica, Cuba, Babados, Belize
- 4 Institutions: UWI (Cave Hill), UWI (Mona), INSMET, CCCCC
- Disheartened that no model projections existed for Caribbean and at scale of Caribbean.
- Deliberate collaborative effort to produce Caribbean climate projections at scale of Caribbean.
- Premised on shared workload to get results out quickly.
- Premised on building of capacity in the region.

Caribbean Modelling Initiative

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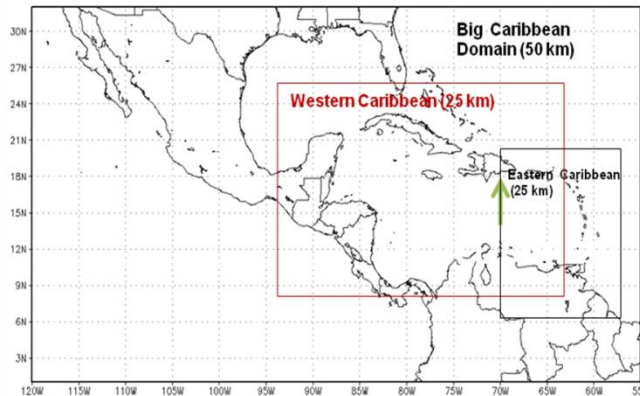
So what?

Chose a DOMAIN

- All of Caribbean
- Run at 50 km
- Smaller domains at 25 km

Chose a MODEL

- **PRECIS - Providing REGIONAL Climates for Impact Studies**
 - Hadley Centre, UK



- Dynamical Downscaling Model (RCM)
- Driven by the HADAM3P GCM and ECHAM but can be forced at its boundaries by other GCM's
- Has a resolution of up to 25km
- Built by UK Hadley Centre but run locally
- Can be used for any part of the Globe

Caribbean Modelling Initiative

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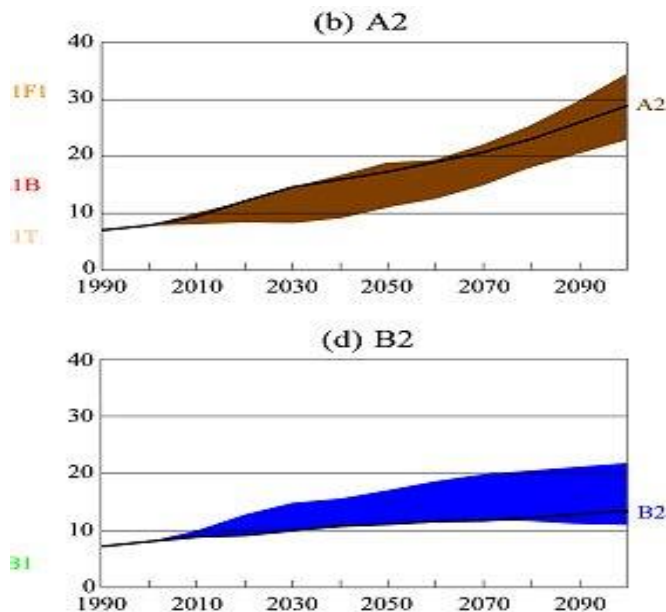
So what?

Chose SCENARIOS

- IPCC SRES Scenarios
- A2 (high emissions) and B2 (low emissions)

Divided up the runs

- Considered capacity
- Considered available computing power
- Considered interest



Cuba (INSMET)	Carib basin 50 x 50 km	B1 (30 yrs) & A2 (30 yrs) Baseline (30 yrs) Reanalysis (15 yrs)
Jamaica – UWI (Mona)	Carib Basin 50 x 50 km	A2 (30 yrs) & B2 (30 yrs) Baseline (30 yrs)
Barbados – UWI (Cave Hill)	Eastern Caribbean 25 x 25 km	A2 (30 yrs) & B2 (30 yrs) Baseline (30 yrs)
Belize - 5C's	Caribbean and Eastern Caribbean	Multiple runs

Caribbean Modelling Initiative

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Modeling?

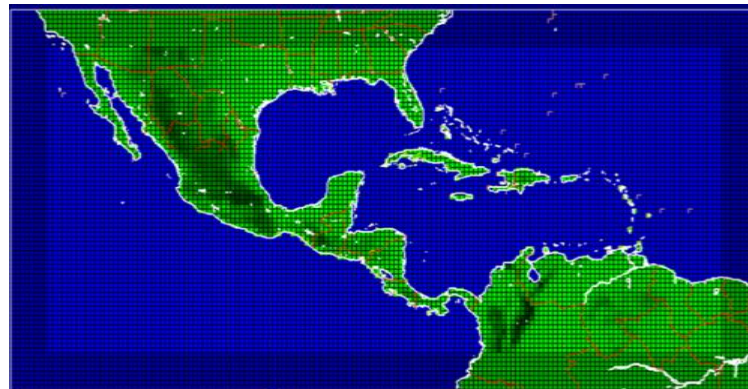
Carib Effort

Some results

So what?

Chose Methodology

- Simulate historical conditions (e.g. 1970-present)
- Simulate future conditions under scenarios (end of century)
- **Determine absolute or percentage change between future and present.**



Caribbean Modelling Initiative

Why Model?

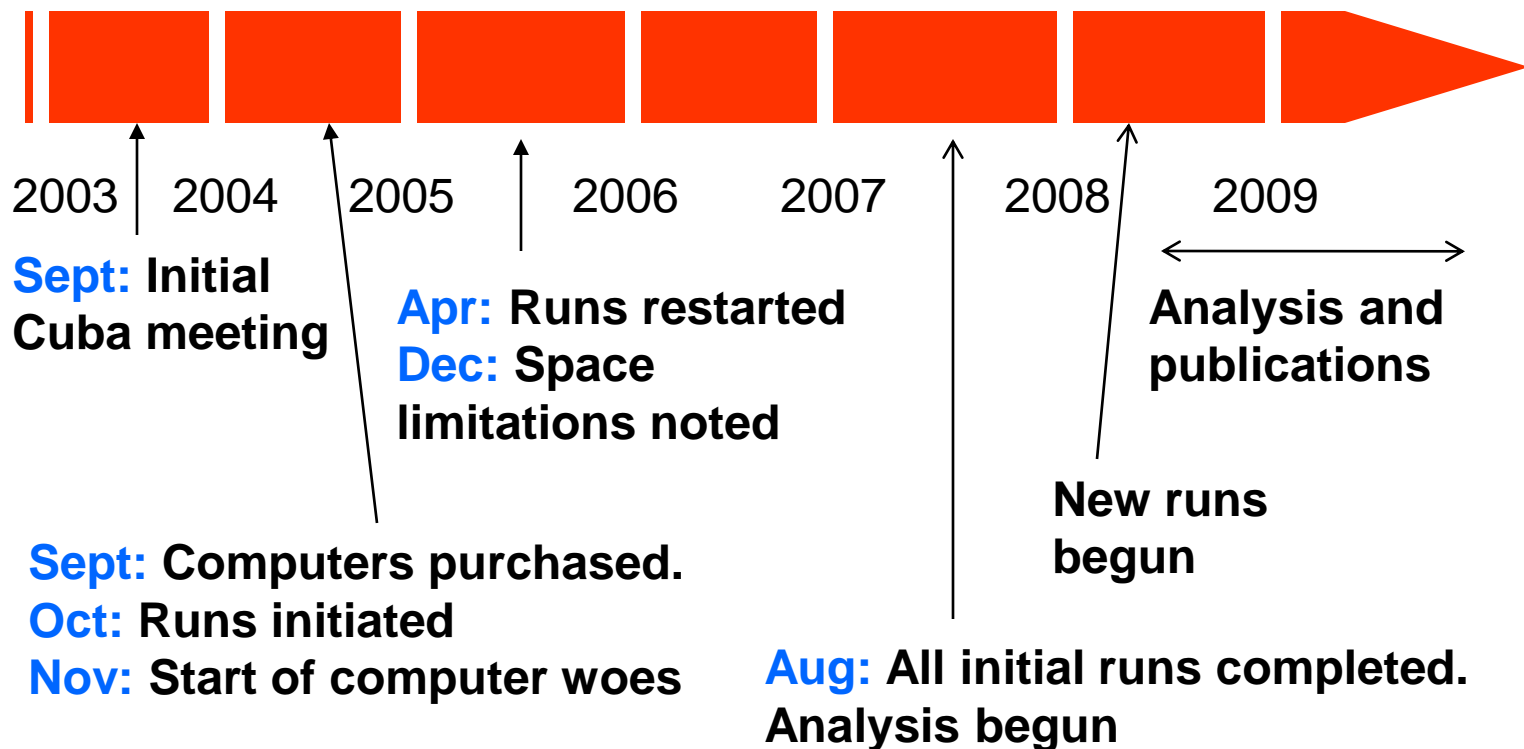
Modeling?

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Some results

So what?

PRECIS Project Timeline



Temperatures

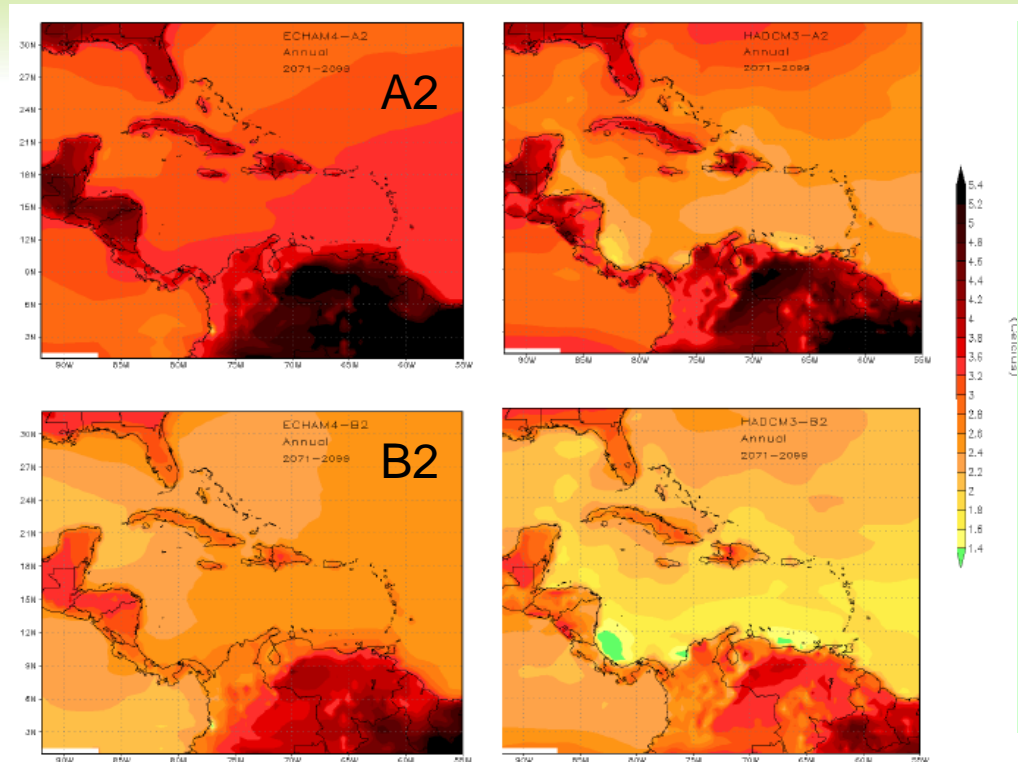
Why Model?

Modeling?

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Some results

So what?



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.

Temperatures

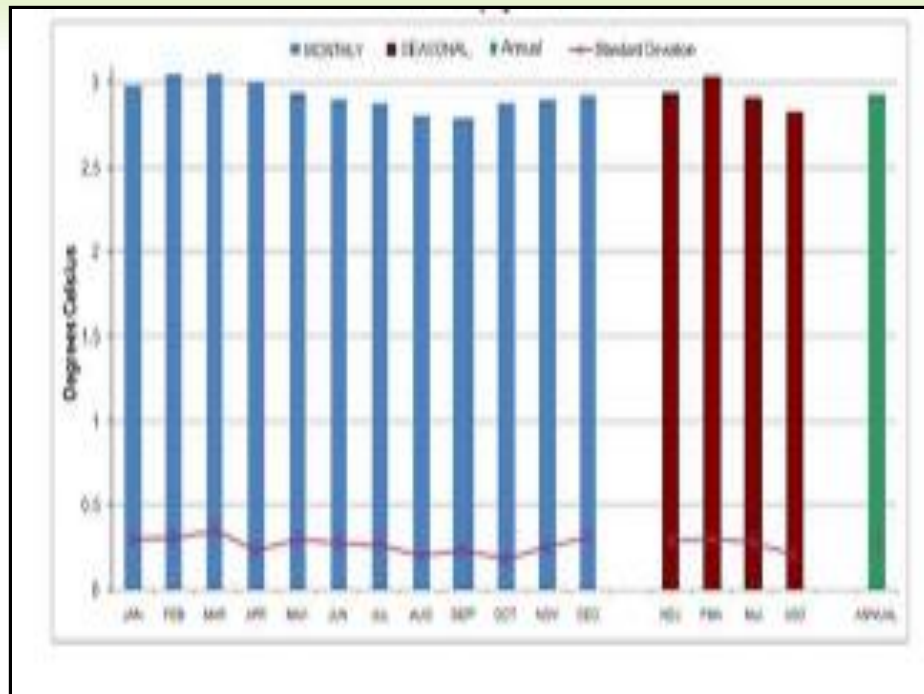
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Rainfall

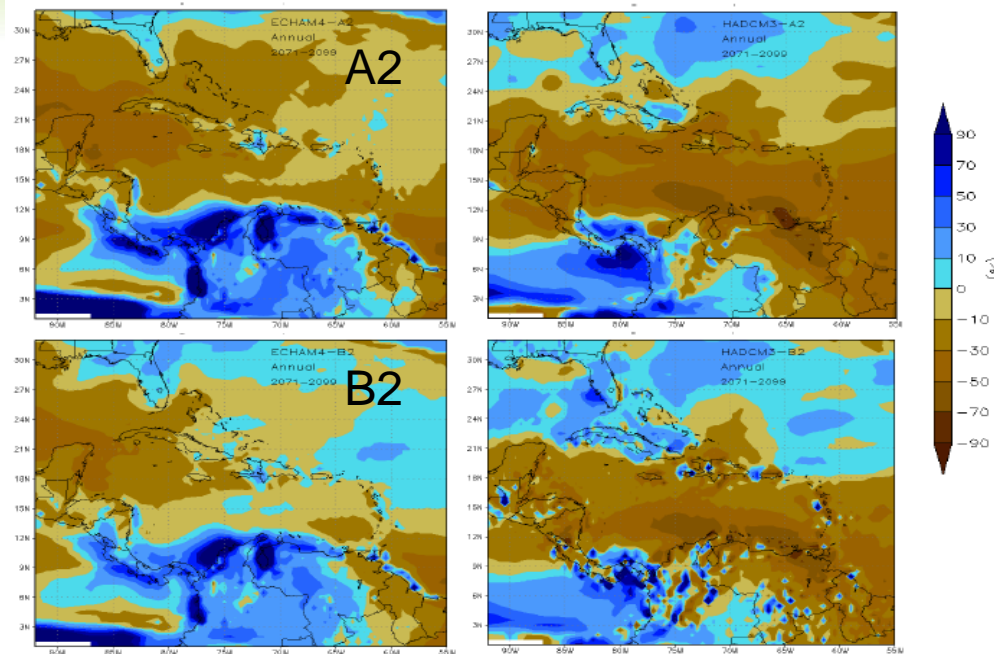
Why Model?

Modeling?

Carib Effort

Some results

So what?



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.

Rainfall

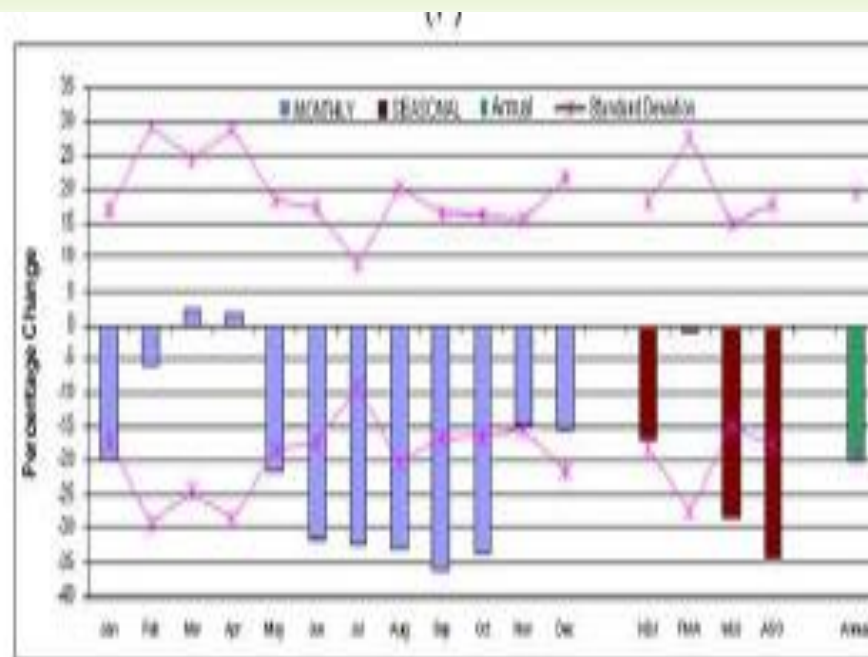
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Some results

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How certain?

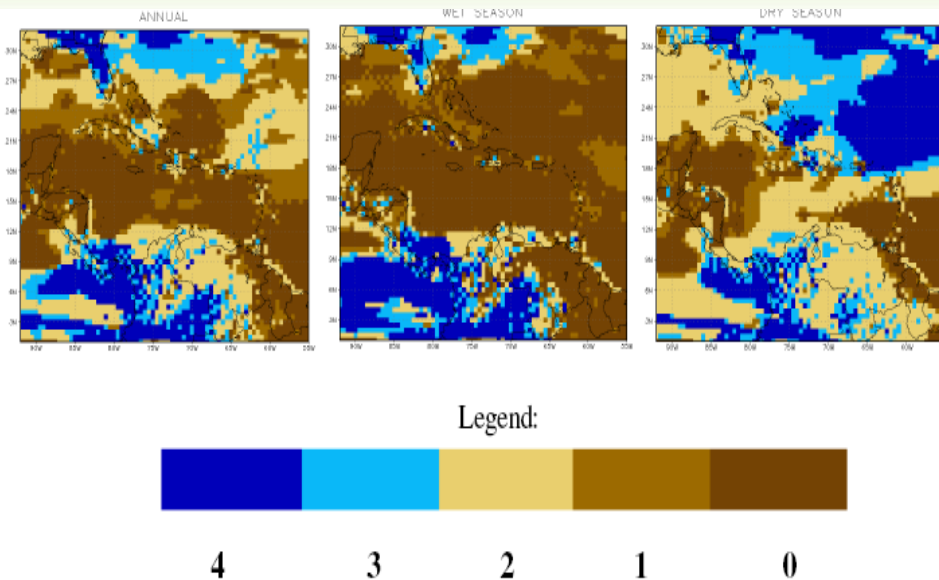
Why Model?

Modeling?

Carib Effort

Some results

So what?



Multiple uncertainties in models

Consensus diagrams useful

In some regions, all scenarios predict drier.

In some regions all simulations predict wetter.

Number of simulations projecting precipitation increase for 2080s.

Other parameters...

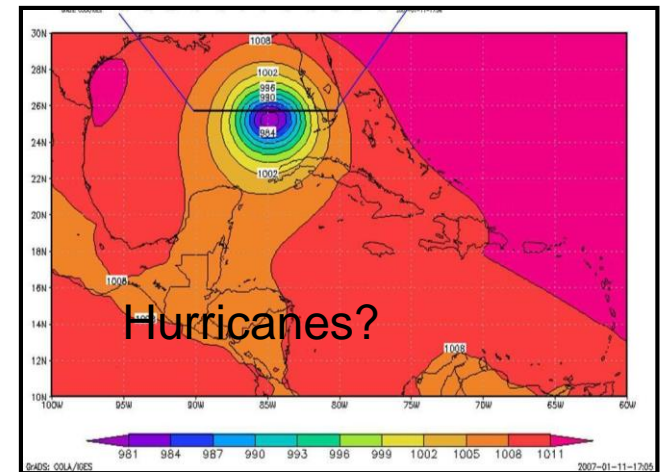
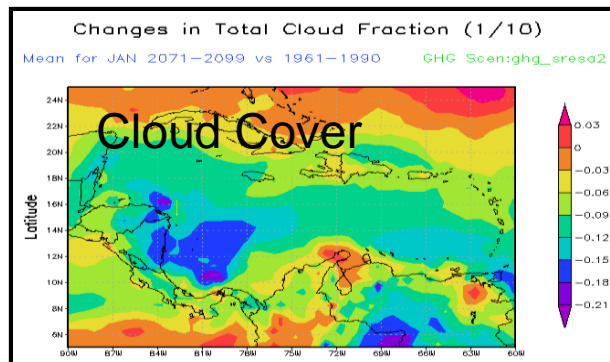
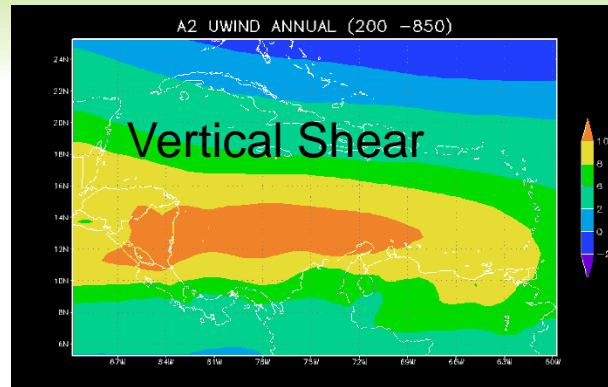
Why Model?

Modeling?

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Some results

So what?



All results...

Why Model?

Modeling?

Carib Effort

Some results

So what?

The screenshot shows the homepage of the PRECIS Caribe website. The header includes the INSMET logo and the text 'PRECIS Caribe' and 'PROYECTANDO EL CAMBIO CLIMÁTICO EN EL CARIBE CON EL MODELO CLIMÁTICO REGIONAL HADLEY'. Below the header is a navigation menu with options: 'Español | English | Français', 'Acceso en Línea a Escenarios de Cambio Climático para el Caribe', and a list of menu items: 'INTRODUCCIÓN', 'ACCESO A LOS DATOS', 'DESCRIPCIÓN DE ESCENARIOS', 'REPORTES Y TALLERES', 'OTROS ENLACES', and 'PREGUNTAS FRECUENTES'. The main content area is titled 'Introducción' and contains text about the website's purpose and the PRECIS project.

The screenshot shows the 'Online Access to Caribbean Climate Change Scenarios' interface. It features a navigation menu with options: 'Español | English | Français', 'Online Access to Caribbean Climate Change Scenarios', and a list of menu items: 'INTRODUCTION', 'ACCESS TO THE DATA', 'SCENARIO DESCRIPTIONS', 'REPORTS AND WORKSHOPS', 'OTHER LINKS', and 'FAQ'. The main content area is titled 'Enter the coordinates of the desired area' and includes a map of the Caribbean region with a crosshair. Below the map are input fields for 'Northernmost latitude', 'Westernmost longitude', 'Easternmost longitude', and 'Southernmost latitude'. There are also dropdown menus for 'GCM scenario' (set to A2), 'Month' (set to 1), 'Year' (set to 2011), 'Variable' (set to Surface pressure (hPa)), 'Level' (set to Surface), and 'Type of graph' (set to isopleths). 'SEND' and 'RESET' buttons are located at the bottom right.

User friendly website

All results

User specify desired variables and future period.

Multiple plot types. predict wetter.

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

Using the results...

Why Model?

Modeling?

Carib Effort

Some results

So what?

Reporting Purposes

Compiling projections for use in 2nd National Communications

St. Lucia

	RCM
	2070s
JAN	1.6 - 1.9
FEB	1.8 - 2.3
MAR	1.9 - 2.5
APR	1.9 - 2.8
MAY	2.2 - 2.7
JUN	2.1 - 2.7
JUL	1.9 - 2.5
AUG	1.9 - 2.2
SEP	2.0 - 2.2
OCT	1.9 - 2.3
NOV	1.8 - 2.1
DEC	1.8 - 2.1
ANNUAL	1.9 - 2.4

Temps

	RCM
	2070s
JAN	-46.91 --25.90
FEB	-78.37 - -50.04
MAR	-86.14 - -50.95
APR	-81.80 - -57.79
MAY	-69.91 - -47.49
JUN	-77.10 - -47.26
JUL	-57.86 - -29.02
AUG	-36.29 - -21.95
SEP	-39.94 - -21.95
OCT	-33.13 - -3.76
NOV	-30.37 - +18.58
DEC	-48.69 - -8.32
ANNUAL	-57.21 - -27.94

Rainfall

Using the results...

Why Model?

Modeling?

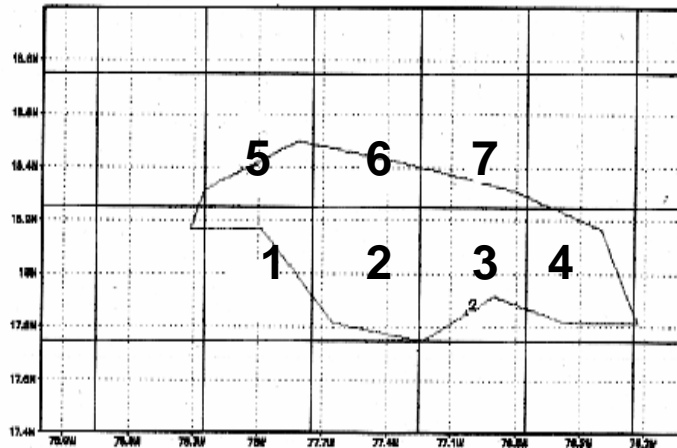
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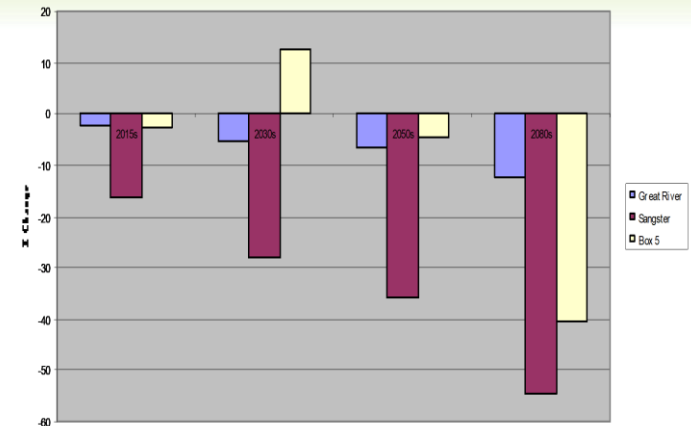
So what?

Impact Studies

E.g. Analysis of impact of climate change on water sector in Jamaica



Avg A2B2 Annual % Change for Box 5 area



Average of A2 and B2 projected changes in *streamflow* at Great River and *precipitation* at Sangster and in *region 5* for 2015s, 2030s, 2050s and 2080s.

Discernible impacts

Why Model?

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Some results

So what?

Transforming our talk:

Modelling in the Caribbean is moving us from general, hypothetical conversations on climate change premised on studies not done in or for the Caribbean to **more contextually relevant science language**.

Access Answers

Modelling in the Caribbean is enabling us to **answer our own impact and vulnerability questions** (e.g impact of climate change on dengue fever, or sugar cane crops, or river streamflows in eastern Jamaica, etc.)

Or...

Modelling enabling region to **address our sustainable development issues**.

Discernible impacts

Why Model?

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Some results

So what?

Creating Capacity

The more we do climate modelling **within the Caribbean** is the greater our ability to pose and answer Caribbean science questions **in the Caribbean** i.e. Caribbean setting its own Caribbean science agenda!

Learning we can do it in the Caribbean for the Caribbean!!!

Valuable Lessons about Collaboration...

Why Model?

Modeling?

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Some results

So what?

Collaborations work

when...

Collaborators own the problem

Collaborators are willing to share a piece of the problem.

Collaborators are equipped to solve their piece of the problem.

There is joint ownership of the results amongst collaborators.

Collaborators do not lose sight of the wider purpose for their work.

Next steps?

Why Model?

Modeling?

Carib Effort

Some results

So what?

More Analysis

Lots of data generated over the years. Get it out there.

Analysis left to be done:

Validation Extreme Analysis Dynamics Hurricanes

Haven't begun to look at impacts on other sectors.

More Models and Modeling

Must offer multiple realisations of the future.

One way is to use different regional models. PRECIS but one option.

More Partnerships

Too difficult, time consuming for any one country or institution.

Collaboration heightens efficiency for producing usable results.

Builds synergies/support groups across institutions.

Collaborate with non-English speaking Caribbean

IMPACT WILL BE WIDELY FELT...

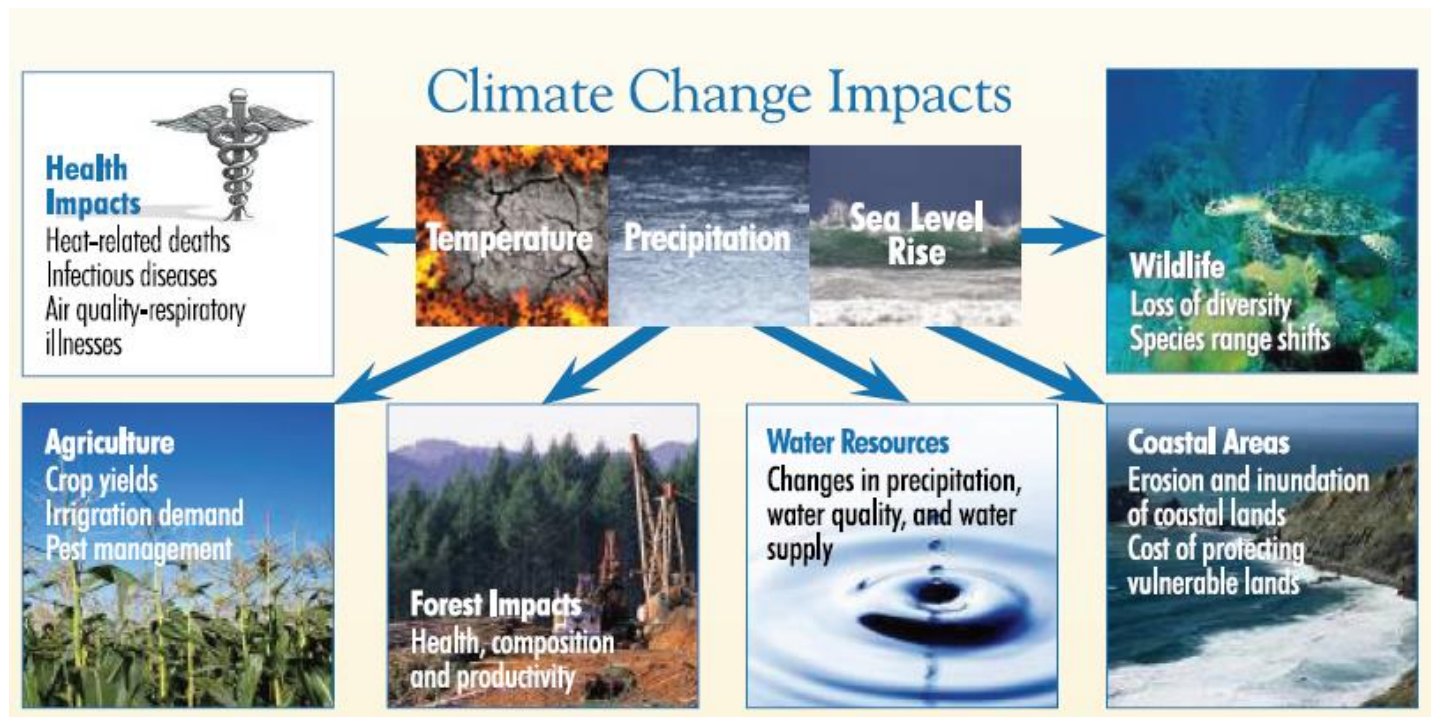
Why Model?

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So what?



END

Why Model?

Modeling?

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So what?

Thank You