



Climate Modellers' Consortium Meeting

Full Report

September, 2018

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Climate Modellers' Consortium Meeting 2018

1. Welcome, Introductions and Opening Remarks

The 2018 Climate Modellers' Consortium Meeting began with remarks from Abel Centella of INSMET, Ainsley Henry of the PPCR Management Unit, and Jeremy Collymore, who is the Resilience Consultant and Advisor to the University of the West Indies. Participants were welcomed and encouraged to give their input in making the meeting productive. Through Component 3 of the PPCR, the modellers' consortium has been able to increase its technical capacity and the volume of work produced to further define the region's climate. Recent events show that the unprecedented nature of the current climate is creating new ears for the need for resilient climate states that are effectively equipped for adaptation and mitigation. There has, therefore, been an increase in political acceptance of the need for climate considerations in development. The consortium is critical in that task, as it can provide the necessary climate data and information, particularly in the efforts of the UWI to build resilience in the university and the region.

The 37 participants in attendance introduced themselves to the group at the end of this session.



Figure 1. Attendees of the 2018 Climate Modellers' Consortium Meeting.

2. Overview of Modellers Consortium

Michael Taylor

The goal of the meeting is to show that there is a community of climate science users and producers in the region and to get everyone involved talking. This includes updates from all modelling entities, a look at how climate science is being implemented under the PPCR and how the modellers' group can be of use, and the setting of new 5 year goals for the group. For example, the group must respond to the complaint that IPCC assessment reports do not adequately describe the climate dynamics of small islands, and apply the large funding available (such as GCF) to progressing Caribbean climate science.

The Caribbean region is inherently and deeply sensitive to climate, which means any changes in climate will affect it and the region has to respond to this by building resilience through mitigation, adaptation, and education. This can be summarised in three sums:

Seasonality + size/sector = sensitivity

Sensitivity + variability = vulnerability

Vulnerability + action = resilience

The challenge to be addressed is moving towards resilience. We have responded well as a science community by pursuing four kinds of science:

1. Science that sets the parameters for action
2. Science that supports the planning process
3. Science that serves the policy agenda
4. Science shows the possibilities

There is a lot more climate science that needs to be done to contribute to the response of the region and increasing its resilience.

Comments/Questions:

- *Where can information be found in one space?*

It depends on what you want to find. There are various portals that can be explored, e.g. Caribbean climate portal from the 5Cs, IMPACT Project creating a database of the climate scientists in the region.

- *Regarding the geographic scope, there is a focus on island states, but the CARICOM position would need mainland countries such as Guyana. These mainland countries should be considered going forward to have a better geographic spread.*

The initial domain did not include the mainland, but newer work deliberately includes Guyana and Belize. Prof. Bynoe brings the University of Guyana into the consortium, and efforts to be inclusive will expand further.

- *Advocacy to get climate information out to the Caribbean public is missing, and most individuals do not understand what is involved to get the information.*

There is certainly a gap and addressing it is a struggle, because scientists are not considered to be good communicators. However, is that the group's primary role? The PPCR has a pillar dealing with

communication of project results, so whatever is done under the project must be publicised. A number of initiatives across the region are including that sort of component, but the primary role of the consortium is to ensure that the Caribbean keeps up with the rest of the world in having the level of climate science it needs to support whatever positions it is taking.

3. Current Research Updates and Planned Activities

Moderator: Abel Centella

3.1 Cuba- INSMET

Arnoldo Bezanilla

The current climate dynamics research being conducted at INSMET is largely geared towards completion of key climate science publications for the region. These include:

- 1.5°C vs 2°C vs 2.5°C dynamical paper- This study evaluates not only the changes that can occur in the region under temperature change of 1.5°C vs 2°C, but also what drives those changes and the difference in local and non-local systems. Much of this analysis has already been completed using similar models to those used in previous studies, and will be done for a new set of variables including wind components, pressure, precipitation, geopotential, vertical velocity, sea surface temperature and moisture profiles.
- Drought study using SPI and SPEI-12- This study explores the dynamics of drought across the region to determine differences in existing observed drought datasets, the influence of spatial resolution, and the value of gridded vs weather station datasets. Analyses will extend beyond sea surface temperatures to include other large scale systems, such as the CLLJ, and will include an assessment of the value of regional climate models (RCMs) in representing drought.
- RegCM 4.6.1- Multiple RegCM4 publications are being prepared. The first is an “Assessment of the ability of RegCM4 to reproduce drought in the Caribbean region and future projections under climate change conditions”. Results have shown that the model represents droughts reasonably well for most of the region, and projects an increase in the number of drought years into the future. The second assesses “The performance of RegCM4 over the Central America and Caribbean region using different cumulus parameterizations”. Results showed that, although the Tiedtke scheme had the most balanced performance, no configuration of the model was best performing for all analysis criteria used. The third is “Added value of RegCM4 simulations over Central America and the Caribbean”. This study showed that there was substantial added value of RCM downscaling in all experiments.

The Caribbean Reanalysis Initiative is primarily focussing on precipitation using the WRF model at 15x15Km resolution, with initialization done with Era-Interim Reanalysis 1979-2018 and data assimilation with WRFDA of TRMM and Surface Met Stations. First delivery is expected by March 2019 (Cuba, Jamaica, and Haiti) and evaluation of precipitation and other fields by September 2019.

Future research plans include a Caribbean ensemble of RCM, CARIDRO web page improvements, incorporation of new analysis into the output of RCM, assessment of the future of renewable energy in the Caribbean, and new links to study the TCLV under a warmer future climate.

Comments/Questions:

- *There may be concern that the reanalysis project is limited to the larger islands.*

The idea was to conduct the study for Cuba, but Jamaica was incorporated in order to pool the resources of the two groups. Weather station across the region will need to be formatted to be compatible with the methodology. Once the preliminary work is done, we will know how to scale the reanalysis for the entire region. There is also an issue of resolution of the model for the small islands. We need to determine how resolution needs vary depending on the size of the island, which will require a lot of computing power.

- *For a large island like Cuba, there may not be that much of a difference from existing reanalysis, but there could be a large difference for small islands.*
- *How will Haiti be included given the lack of data?*

Haiti was mainly included because of the shape of the domain, but data do exist for the country. Data from Haiti will not be used. This will allow for assessment of how well reanalysis performs in the absence of data. It will also cut down on noise in the model. More computer power would help to expand the reanalysis to the Eastern Caribbean (e.g. CIMH).

3.2 Jamaica- CSGM

Tannecia Stephenson

Research being conducted by the Climate Studies Group, Mona (CSGM) covers a number of areas. These include:

- Dynamics- Drivers of rainfall and fires, climate features represented by PRECIS, change in hurricane risk
- Impacts- Vulnerability of Caribbean countries, sea level rise and storm surge, impact on hydropower and biodiversity

Under the PPCR, the group's activities aim to improve regional processes of climate relevant data acquisition, storage, analysis, access, transfer and dissemination and to pilot and scale up innovative climate resilient initiatives. Progress has been made in increasing human and technical capacity for research in climate dynamics, including numerous publications, presentations, and partnerships. Four more simulations using the RegCM model driven by ERA Reanalysis have been completed. Two other sets of model runs are still in progress. Three historical and future simulations with PRECIS model driven by HadGEM have been completed. One additional run is in progress. One simulation with MPI is still in progress. A platform for accessing model data is currently under development.

Future work by the group will address the following research questions:

- How will future gradients in sea surface temperatures influence extreme rainfall variability in the Caribbean?
- What changes in the characteristics of the main development region of Atlantic hurricanes have been observed and can be anticipated under climate change?
- How will a 1.5 or 2 degree global warming above pre-industrial levels impact on landslides and flood risks?

Comments/Questions:

- *The work that has been done by the group is impressive, particularly the division of activities among researchers in the group.*

3.3 Barbados - UWI Cave Hill

a. Isabelle Gouirand

Current research on “Transition from dry to wet and wet to dry conditions over the Caribbean Region and Central America 1979-2017” is underway to determine the date, sensitivity, and drivers of the transition based on the occurrence of the Weather Types (WTs), as well as the influence of the transition on the rainy season and overall climate. This work will include an update of Moron et al. (2016), using updated WTs recalculated over the 1979-2017 period to identify the transition date based on combined “summer” and “winter” WTs from NCEP and ERA. Results to date have shown that there is synchronicity in the transition from dry to wet conditions over the Caribbean and Central American region, and the transition is rapid. Rainfall is not directly triggered by SST or CLLJ, but is triggered by a combination of many factors, such as a slow CLLJ and SST greater than 27°C, and the start of the rainy season is somewhat predictable. Future research will focus on the drivers of the transition, rainfall seasonality, WTs and extreme events in Central America, and potential ecological indicators of rainfall and transition dates.

Comments/Questions:

- *One of the things that we clearly need to do is try to use wavelet analysis, because frequency is a big component of this and many current studies and it would be useful to decompose these patterns.*

Prior publications have used wavelet analysis to assess frequency at different time scales to show the responses of different islands to signals, such as ENSO. Wavelet analysis would be useful to further identify signals being seen in current analyses.

- *The study showed that rainfall is not triggered by SST or the CLLJ, but rather by a combination of SST greater than 27°C, a slow CLLJ, and a reasonable amount of precipitable water. In terms of the precipitable water, did results show a threshold?*

No such link was found in this study, but a previous Caribbean paper found a link to precipitable water of 30kg/m². Multiple components are required to be in balance to trigger the rainfall, and these are still being investigated.

NB. CSGM is investigating ENSO transition from warm to cool phase and the influence of that transition on the start of the rainfall season in the Eastern Caribbean.

b. John Charlery

The modelling consortium has done a remarkable job in producing data and generating analyses in its 15 years of existence. UWI Cave Hill is pursuing two additional objectives in keeping with the goals of the consortium:

- Focus more on vulnerability and risk analysis- This can be aided by collaboration between students at Cave Hill and Mona.
- Data visualisation- Two students will be looking into using virtual reality and other visualisation methods to show projected climate change.

Visualisation activities will contain an element to expand the SMASH and CARIWIG programmes to translate storm activity for the region, hopefully using simulated storms from Prof. Kerry Emanuel at MIT. Cost is uncertain, but funding can hopefully be identified if necessary (Prof. Taylor or Dr. Charlery). Prof. Leonard Nurse, who was part of the group, will be retiring at the end of this month. It was through him that the link with Prof. Emanuel was made. Cave Hill obtained topographical data from Dominica after the 2017 hurricane season in the form of low resolution digital elevation maps and will be conducting analyses similar to those done for St. Lucia. 5C's will be deploying the LIDAR project, which should start operation later this year and will provide very high resolution elevation data that can enhance virtual reality and other visualisation methods. This is an area in which we will need to interface with engineers and others to expand our understanding of the data being generated.

NB. A demonstration of a virtual reality simulation developed by Dr. Charlery students with the help of Dr. David Farrell of CIMH was shown to the group.

3.4 Trinidad- UWI St. Augustine

Xsitaaz Chadee

The update from UWI St. Augustine covered climate variability at the local scale and impacts of climate change on renewable energy resources (wind resources for Trinidad and Tobago). Main results from postgraduate students were presented as summarised below:

Influence of the Atlantic and Pacific Ocean on rainy season rainfall for a Caribbean Small Island State, Trinidad and Tobago- Nkese McShine

Main Result: SST in parts of the south Pacific play a role in modulating rainfall in Trinidad and Tobago, particularly in the late rainy season.

Future Work: Improve simple predictive models for seasonal rainfall in Trinidad and Tobago

Variations in extreme temperature and precipitation for a Caribbean island: Barbados (1969 – 2010)- Shridevi Mohan

Main Result: Consistent warming signal in warm and cool nights, particularly in April and May

Future Work: Extend local scale historical analyses for heat indices - impact on energy use for cooling and the tourism sector

Impact of global temperature increases of 1.5 to 2.5°C on Renewable Energy Resources within the Caribbean: A Case Study Analysis of wind resources for Trinidad and Tobago– Climate Modeller’s Group

Main Results: Reasonable confidence in moving forward using downscaled RegCM with CNRM GCM as driving boundary conditions (coincides with MERRA) for investigating impact on wind resources in the future; wind power density increases across Tobago and decreases across Trinidad under 1.5°C; decrease in energy content of wind under 2 and 2.5°C; results will affect energy harvested by wind turbines and energy related government policy.

Future Work: Extend the climate change impact analyses on wind resources to incorporate the downscaled data of more GCMs and assess the GCM data itself for suitability for capturing the historical winds

Other Ongoing Postgraduate Research Studies:

- Impact of sea level rise on land availability in Trinidad and Tobago under climate change – Shane Baldeosingh
- Impact on water reservoir capacity at the Navet Dam, Trinidad – Sharlene Beharry
- Solar resource assessment for Trinidad – baseline – Nalini Dookie
- Sectoral impacts at the local scale

Comments/Questions:

- *In the case of wind energy assessment, were the change estimates made with respect to MERRA?*

The change is with respect to the downscaled GCM then applied to MERRA, from which wind density and energy outputs were calculated.

- *INSMET recently completed a wind assessment for Cuba using interesting techniques. There may be potential for dialogue with the INSMET team about their recent publications.*

Yes, that would be appreciated. Contact will be made and publications shared.

4. Caribbean Community Climate Change Centre (CCCCC) Regional Updates

Albert Gilharry

The Caribbean Community Climate Change Centre (CCCCC) is the official repository and clearinghouse for climate change related data and information in the Caribbean. It provides an important knowledge base by functioning as a proactive information exchange facility. It also aids and supports stakeholders in accessing and sharing climate change related information. The clearinghouse can be accessed at <http://clearinghouse.caribbeanclimate.bz/>. The information resources available are digital documents (case studies, vulnerability and capacity analyses, economic assessments, national/regional strategy documents, project reports, etc.), CDs, books, links, and peer reviewed publications. The following are available for climate projections:

Models: RCP 2.6, RPC 4.5, RCP 8.5, ECHAM5, AENWH, AEXSA,, AEXSC, AEXSK, AEXSL, AEXSM

Outputs: CSV, Charts, Maps, & GIS Rasters

Time Interval: Daily, Monthly, Yearly, Multi-year Means

Variables: 36

Next steps will involve incorporating anomalies and change factors, research facilitating analysis, a data sharing protocol, and user registration. There may also be an opportunity to leverage the HPC to improve performance, and to input RCPs into Weather Generator (in CARIWIG Portal).

In the last quarter of 2017, the Centre acquired its own LiDAR equipment through funding from the USAID CCAP program. The LiDAR allows for both bathymetric and topographic scanning. It is equipped with a camera for aerial imagery and is high-powered (will be mounted on an airplane). The CDB has approved US\$1.5 million in grant funding to facilitate a 3-year project to:

- Map almost 10,000 km² of vulnerable Caribbean coastline
- Provide resources for the preparation of an Intellectual Property Policy (IPP)
- Create a product development and marketing strategy for the Centre
- Train 38 end-users from the BMCs in the use of LiDAR data

Comments/Questions:

- *The domain of the clearinghouse extends from the southern states of the US to South America, so it covers the entire Caribbean.*
- *Regarding climate projections, what variables are available and for what use?*

The projected data provide scenarios of what the climate will be like across the region, and can be used in decision-making. The resolution is 25km and includes 36 variables.

- *Can a user look for a specific island?*

A user can get data for a specific island because they are all included in the dataset. For a specific location, more work may need to be done depending on the scope of the consortium.

- *Are these data being used and does the 5C's keep track of that use?*

The data are being used. At least eight organisations have approached the 5C's in 2018 for data and other local and international users have accessed the data as well. This is why it is necessary to get a climate data policy in place and obtain appropriate funding to allow for provision of these datasets to a wide range of users.

- *When you provide data, do you provide the limitations of use?*

Yes, the data are provided with instructions on how they can be used, circulation limitations, and a request that any output such as publications be shared with the 5C's. However, it is imperative that these limitations become legal binding.

- *How do you ensure that they share all output with the 5C's?*

There is not much we can do outside of our own due diligence. The eight organisations that were previously mentioned were provided with a form to complete and the disclaimer and instructions were included. A key point was that sharing information must be submitted on the form.

- *Have the 10,000 km² of vulnerable Caribbean coastline been identified?*

The Centre will consult the countries to identify the ideal sites.

- *Would the LiDAR be able to assess groundwater?*

No, because it cannot penetrate the ground. It works well in clear water, but not murky water. It penetrates forest over as well. However, it does not work for underground.

- *We can try to do an inventory of how much computing capacity we have available in the group to help with planning. Jay, Arnoldo, and Albert can do this assessment. Recommendation*
- *The clearinghouse is user friendly. ECHAM-5 was run under the A1B scenario, but RCPs were recently uploaded. What models were used for these scenarios?*

PRECIS was downscaled using HADGEM-ES GCM. The portal states scenarios and not models, so this information can possibly be added.

- *The issue of model uncertainty was also raised. Contact information for the entities in the consortium was provided to the users who requested more information on that.*
- *Is 5C's liaising with PPCR in the LiDAR initiative to minimise overlap?*

5C's is aware of the initiatives under the PPCR, but AG is uncertain of exactly what synergies exist.

- *5C's will need to improve public awareness of the portal. The modelling group can submit publications and other materials to be included in the clearinghouse to the 5C's documentation specialist, as information acquisition is done regularly. Data can be included as long as there is space.*
- *Will undergraduate students be able to register individually or will they have to register through an institution?*

That has not yet been discussed, but ideally everyone would register individually. The goal is to get more information on users for control purposes, to avoid anyone taking advantage of the group, and for funding purposes.

5. PPCR Updates

5.1 Caribbean Institute for Meteorology and Hydrology (CIMH)

The CIMH is involved in Component 2 of the PPCR, which is 'Consolidating and expanding the regional climate network and global platform linkages' (US\$975,000). The objective of the component is to "strengthen regional and national structures and mechanisms for the delivery of climate products and services at the national level through enhancements to the regional climate data monitoring networks and complementary linkages with global climate information centres/platforms." The core activities being conducted by the CIMH under this component will be as follows:

- (i) improvements in the acquisition weather data across Caribbean PPCR countries;

- (ii) the development of priority climate products and services for some PPCR countries, complementing ongoing initiatives under the Global Framework for Climate Services (GFCS);
- (iii) six capacity building workshops of the national meteorological offices to deliver on their expanded role as national climate centres; and
- (iv) increase in the capacity of backup storage of regional climate data.

The activities under the project will directly support building climate change resilience in priority national sectors, the reduction of climate change impacts in such sectors, and safeguarding the region's valuable climate data. CIMH will be carrying out these activities in all the PPCR pilot countries, and already has work underway in Grenada, St. Lucia, and St. Vincent and the Grenadines.

Activity i: In-country training workshops lasting for two weeks to build capacity of Meteorological Offices, including training in monitoring products, seasonal climate forecasting, translating information to stakeholders, and a stakeholders' meeting.

Activity ii and iii: Familiarising country representatives with the Caribbean's programmatic approach to the design, development, and delivery of sector specific climate services. Strategising the formation of a national sectoral early warning information system across climate time scales committee (EWISACTs, now NSEC).

PPCR has sent a Sector Climate Product Development Specialist to work with CIMH (Ms. Jodi-Ann Petre) to assist with support of capacity building, translation of information, and other duties. CIMH also has a methodological approach to providing services under the PPCR Component 2. Phase 1 of this was the in-country training workshop, and phase 2 will be meetings with stakeholders to determine what they need, which is being conducted by Ms. Petre. This approach is applied in each country. CIMH is exploring options for formulation of National Sectoral EWISACTs Committees (NSECs), which will adapt the regional approach of CIMH at the national level.

Comments/Questions:

- *Is the sector specialist available for the consortium to consult?*

Yes, she is with PPCR and working out of CIMH.

- *What is the timeframe for the NSEC to be developed in Jamaica?*

The project has already been done in Grenada, but nothing in Jamaica just yet. Uncertain of reason.

- *Is the capacity building limited to human capacity or does it also extend to technical capacity?*

There is a lot done to build human capacity, but the PPCR also funded automatic weather stations in a number of countries (technical).

- *Does the training include servicing and maintenance of the weather stations? This is a very big problem across the region.*

This is an issue. Uncertain of any discussion with PPCR on future maintenance.

- *How does CIMH monitor success in terms of services provided?*

Engagement with stakeholders is modelled after the regional roadmap. Success was measured using surveys of stakeholder satisfaction, which will be applied to the national level. Countries are being encouraged to enhance their sector specific met. products, but there will be an assessment of how this works.

- *Given impacts of climate change on agriculture, are extension workers included? It is important to get farmers to use the data indirectly through the extension officers.*

Uncertain. A previous project sent extension officers to be trained by CIMH.

5.2 Caribbean Regional Fisheries Mechanism (CRFM)

The CRFM is involved in Component 4 of the PPCR, which covers Applied adaptation initiatives (US\$3,127,388), specifically Section (ii) Marine. Two projects are to be co-implemented by the CRFM under component 4:

Project #1: Development of an Early Warning and Emergency Response System for Fishers (ICT-based)

- Objective: to reduce fishers' vulnerability to the impacts of climate change/variability and to facilitate sharing of local ecological knowledge to inform climate-smart fisheries planning and management decision-making, as well as risk management in the fisheries sector.
- Countries: Dominica, Grenada, Saint Lucia, St Vincent and the Grenadines (one selected fishing community in each country)
- Update: The Project was executed by the ICT4Fisheries Consortium and officially ended on 31 May 2018, and the final set of contract deliverables have been submitted to the CRFM Secretariat.
- Product: FEWER - Fisheries Early Warning and Emergency Response (ICT Based Product)
- Next step: CRFM is seeking CDEMA support for FEWER and determining the best formula of inter-agency relations for long-term FEWER administration and usage support

Project #2: Fishery-related ecological and socio-economic impact assessments and development of a monitoring system

- Objective: to conduct Fishery-Related Ecological and Socio-economic Assessments of the Impacts of Climate Change and Variability and Development of an associated monitoring system.
- ESSA Technologies Limited, which was recently contracted to carry out a fishery assessment and monitoring study for the CRFM.
- One ongoing activity is to develop a fisheries and environment database and the associated meta-database, as well as the supporting database manual and data and information policy and provision of training on database management/usage.

Comments/Questions:

- *Is there a component in which climate data is to be fed into some assessments?*

The activities have just begun, so those aspects are still being discussed.

- *Are there any limitations to climate data being fed into the system, e.g. resolution?*

There should be no such limitations. The meteorological office in St. Vincent and the Grenadines has already been contacted for weather data.

- *Is there any scope for further mitigation in the fisheries sector, e.g. solar systems that have already been installed by fishers?*

Yes, each country will determine their best plan for mitigation, once the technology is available for them. E.g. Technology to move boats away from shore before a storm.

- *There should be more of an effort to centralise data acquisition to ensure consistency and accuracy. The CIMH receives monthly climate data from meteorological services across the region.*

The Director of Fisheries gave directions on the best way to acquire the data, so she would have directed her appropriately.

5.3 Caribbean Public Health Agency (CARPHA)

CARPHA is involved in Component 4 of the PPCR, which covers Applied adaptation initiatives, with specific focus on Early Warning Systems to Reduce Climate Related Risks on Health and Enhancement of Rainwater Harvesting System Enabling Environment (Policy and Capacity Building). The broad implementation activities of CARPHA under the PPCR focus on health and water. For the area of health, terms of reference have been developed for activities on vector-borne diseases, a health audit tool, and a gender study. For water, the activities being planned are:

- Development of water vulnerability maps
- Draft codes for rainwater harvesting (RWH) for climate change adaptation and water security
- Training on RWH
- Financial instruments to identify gaps and opportunities for financing RWH
- Analysing price structures for the range of professional services, commodities and materials associated with rainwater collection and supply of collected content

Planned activities for 2019 include:

- Water:
 - Identifying three (3) projects in RWH to be implemented or refurbished with enshrined sustainability measures in pilot countries building on previous initiatives where possible
 - Designing new financial instruments or formulating recommendations for modification of existing financial instruments including duty waivers and tax rebates to support investment in RWH and water conservation
 - Designing an appropriate Private Sector Participation mechanism to promote the provision of goods and services in RWH and water conservation
- Health:
 - There is a limited pool of expertise in the area

- Given that the resource pool is limited, possible selection of consultants for both the health audit tool and gender study
- Convene a smaller meeting with CIMH to discuss the methodological approach to modelling vector-borne diseases and to avoid overlap with the PPCR proposed methodology
- Develop study protocol for conduct of vector borne diseases and gender dynamics studies
- Draft and finalise pilot study instrument in consultation with CARPHA and participating countries
- Conduct study in 3 PPCR Pilot countries – Haiti, Jamaica, St Lucia
- Activities will be based on the rate at which activities roll out once a consultant is selected and activities start.

There is great potential for use of modelling data, which can support:

Modelling data can support:

- Early warning system for vector-borne disease- planning to generally improve health sector planning and resilience
- Identifying areas that can benefit from decentralising water access and storage such as RWH- general planning for integrated water resources management

Comments/Questions:

- *What is the implementing agency for this component in Jamaica?*

Work will be conducted through PPCR for this. Agriculture may be the area of focus in Jamaica, so relevant agencies will be engaged when plans are finalised.

- *Might there be overlap with RWH projects currently underway?*

No, there will be assessments beforehand to avoid duplication, e.g. using rooftop capture instead of ponds.

- *Will vector-borne disease modelling be done for the chikungunya and zika viruses as well?*

Yes. The only time dengue will become more important is when evaluations focus more on influence of climatic factors.

- *Expand on how rainwater quality will be evaluated. UWI Department of Physics is currently working on water quality monitors. Is there a way for users to assess water quality?*

Quality assessment will depend on use of the water, e.g. filtration for agriculture or treatment for domestic use. Users can only assess pH. The Ministry of Health has the responsibility to assess water quality for domestic use, so if the user takes on that responsibility then the two methods that can be implemented are identifying a system for monitoring or dual plumbing system to use rainwater in select ways.

- *UNICEF has been focussing on the impact of climate change on children, particularly their health. E.g. heat stress in indigenous schools in Guyana due to construction. Children should be part of the focus.*

Agreed. Issues relating to children should be added.

5.4 Caribbean Agricultural Research and Development Institute (CARDI)

The main strategic programmes and cross cutting issues being addressed by CARDI are shown in Figure 2. The specific strategic programmes are as follows:

- Strategic Programme 1: Value Chain Services- includes crop modelling using DSSAT, drought tolerance experiments through work with PPCR and CSGM
 - Examples of parameters used: number of plants harvested, weight of vines, main stem length (cm plant-1), root yield: commercial and non-commercial (g plant-1), root dry weight (g plant-1)
- Strategic Programme 2: Policy and Advocacy- includes communication of research and policy guidance
- Strategic Programme 3: Institutional Strengthening- includes training of young CARDI scientists in climate change and crop modelling and training of management in research methods
- Strategic Programme 4: Partnerships and Strategic Alliances- climate related partnerships of CARDI have expanded and the institution can be a good facilitator in collecting data around the region because of the number of countries in which it is established

The goal is to embed climate change into the activities of CARDI, and to communicate its climate relevant research to the wider public. The main partners in these efforts have been the CSGM and the IDB funded PPCR.

The way forward for CARDI is to have scientists doing more climate related field research and feeding the data gathered and analyses conducted back to the CSGM, which has already begun. The institution does not have the resources to work in isolation. Regardless, valuable partnerships have been developed. It is the hope that, in the near future, more publications will be produced by CARDI. It is not always easy to describe to an extension officer how climate change information translates for the farmer, and it is going to be a challenge to ensure that they are able to communicate this with practice.



Figure 2. Strategic goals, strategic programmes, and cross-cutting issues being addressed by CARDI under the PPCR (Presented by G. Robin).

5.5 Climate Data Platform (UWI CSGM)

This tool was created to facilitate access to state of the art regional climate projections to the wider public. The contribution is to constrain the information to some basic graphics that can easily be interpreted and reused for reports involving climate change. Some limitations of the platform are:

- Small Ensemble
- Precipitation Projection biases
- Performance of models to reproduce extreme events

Details on the data platform

Data sources:

- Observed and reanalysis using EWEMBI
- Bias correction applied to RCM projections
- Emission scenario RCP4.5

Climate Indicators:

- Monthly mean temperature
- Monthly cumulated precipitation
- Climate change indices

- Hot extremes TXx, Monthly maximum value of daily maximum temperature
- Wet extremes Rx1day, Monthly maximum 1-day precipitation
- 5-day wet extremes Rx5day, Monthly maximum consecutive 5-day precipitation

Presentation of climate projections:

- Reference period map
- Projection map
- Regionally Averaged Transient
- Regionally Averaged Annual Cycle

Work completed:

- Display of reanalysis data
- Calculation of Change
- Bias Correction

To be completed:

- Calculation of Extremes
- Web domain purchase
- Official Launch

Further details can be found at <http://regioclim.climateanalytics.org/documentation>.

The project is a merger of two ongoing projects in the region:

- Climate IMPACT being conducted by Climate Analytics through the 5Cs- data and policy tools for small islands in the Eastern Caribbean
- PPCR work on increasing availability of climate modelling data

The goal of the project is to leverage the similar goals of both and to make a link with the other entities in the consortium. High resolution maps have been developed for all the countries included, which allows for acquisition of data for parishes in each country. The tool is customisable because it was written in python. It also defines a domain for the Caribbean and the tool can be accessed through the 5Cs clearinghouse.

Comments/Questions:

- *Farmers will want to know the accuracy of forecasts for their planning.*

There is a distinction between short term forecasts and long term projections. Seasonal forecasts are provided and verified by CIMH. Long term projections are provided as a range of possibilities.

6. Caribbean Initiatives and Funding Opportunities

Sharon Lindo

The 5Cs was accredited to the Green Climate Fund (GCF) in 2015 and is legally capable of executing projects on behalf of the fund (AMA was signed). The Centre is accredited as a regional implementing entity for small projects between 10 - 50 million dollars, and can implement projects that are of medium or low environmental risk (see Table 1). The CDB is also accredited and can implement projects of higher environmental risk.

Table 1. Environmental and social risk categories of the GCF (Presented by S. Lindo).

Risk level	Funding proposals	Intermediation*
High	Category A Activities with potential significant adverse environmental and/or social risks and/or impacts that are diverse, irreversible, or unprecedented.	Intermediation 1 (I-1) When an intermediary's existing or proposed portfolio includes, or is expected to include, substantial financial exposure to activities with potential significant adverse environmental and/or social risks and/or impacts that are diverse, irreversible, or unprecedented.
Medium	Category B Activities with potential mild adverse environmental and/or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.	Intermediation 2 (I-2) When an intermediary's existing or proposed portfolio includes, or is expected to include, substantial financial exposure to activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally-site specific, largely reversible, and readily addressed through mitigation measures; or includes a very limited number of activities with potential significant adverse environmental and/or social risks and/or impacts that are diverse, irreversible, or unprecedented.
Low/No	Category C Activities with minimal or no adverse environmental and/or social risks and/or impacts	Intermediation 3 (I-3) When an intermediary's existing or proposed portfolio includes financial exposure to activities that predominantly have minimal or negligible adverse environmental and/or social impacts.

* Activities involving investments through financial intermediation functions or through delivery mechanisms involving financial intermediation.

The GCF manages its relationship with member states in the following ways:

- Readiness proposals
- National adaptation plans
- Project preparation facility proposals
- Simplified funding proposal (requires fewer inputs than full funding proposal)
- Full funding proposal

The six investment criteria of the GCF are:

- Country Ownership
- Impact Potential
- Efficiency and Effectiveness
- Sustainability
- Paradigm shift
- Needs of Recipients

The information required to formulate projects and full proposals requires a strong role of researchers to build the case for climate change, e.g. The 1.5 Initiative. This is particularly necessary at the community and sector levels. Research and monitoring is also important for post project implementation. There is space for the CSGM and other groups in the climate consortium to contribute to their countries' NDAs and national adaptation plans, as well as to the 5Cs information gathering process as the implementing agency. It is important that a core team is established for the entirety of the project. The GCF is intent on co-financing, so the region must provide some amount of financing for projects. The GCF will not fund purely research based projects, but will fund the project if that research is applied in a practical way.

There is a genuine need to help in the development of bankable programmes/projects both nationally and regionally. CCCCC also recognises that greater engagement with sector level experts and researchers is necessary to move project from concepts to full funding proposals. Through collaboration between CCCCC, researchers, and government/national entities, adaptation and mitigation actions will be concretely grounded in science. CCCCC remains committed to acting as a conduit in the dissemination of climate change information. Through the IMPACT project, a regional research plan that is currently being developed, and the 5-year plan of the climate consortium, the 5Cs has the goal of ensuring that there is a strong climate link and foundation for the region.

Comments/Questions:

- *Are there any immediate funding opportunities for the research needed to provide the science background for these projects?*

The goal is that the funding of the science becomes a component of the larger proposal, so that there is not just isolated funding for either component. However, that can be explored with bi-lateral donors. There are ways to do that.

- *How do we move forward?*

The interest of moving forward with the IMPACT project and the regional research plan is one of the primary and easiest ways forward, complemented by the 5-year plan of the consortium. It would be useful to have a more detailed conversation with Mr. Donnell Cain at the 5Cs for more information on how to get climate science into current and future projects and plans of the 5Cs.

- *It is good to know that the Centre is moving in this direction and the consortium is committed to being part of the effort, in the hopes that a portion of the funding coming from GCF will be apportioned for climate research.*

There is a way to do it and the staff at the Centre can find a way to get it done.

7. IPCC AR6 Caribbean Climate Science Needs and 2018-2019 Plans- The 8-7-6 Plan

Top EIGHT Dynamics

1. Expanded treatment of extremes: Exploring the characteristics and driving dynamics for droughts [INSMET]
 - a. Multi-hazards (in partnership with Bristol) [Mona]

2. Examination of drivers of rainfall onset and end dates and how these may change in the future under climate change [Cave Hill]
3. An initial look at the implications of Geo-engineering on Caribbean climate. [Mona]
4. Attribution of select extreme events/hurricanes impacting the Caribbean
 - a. In partnership with Bristol [Mona]
5. Change in characteristics of hurricanes (intensity, frequency, track density) for the Caribbean region [Mona + INSMET]
6. Application of algorithms to identify tracks in Reanalysis and RCM data from CCMC runs + HAPPI
 - a. In partnership with Bristol [INSMET + Mona]
7. Short lived climate forcers, in particular for the region black carbon, methane, hydrofluorocarbons, tropospheric zones.
8. Value Added – RCM + ESD

Top SEVEN Impacts

1. Expansion of Climate Change Impact and Implications Studies (perhaps under Caribbean 1.5 Phase II)
 - a. Engineering/Infrastructure/Cities/Urban Areas; Health [Mona + CARPHA]; Tourism; Gender; Policy Implications [UG]; Vulnerability Studies [Cave Hill]; Renewable Energy [Mona + St. Augustine]; Marine environment [Mona + CRFM]; Air Quality; Migration [CRFM + Adelle Thomas + Mona]; Heat
 - b. Landslides (In partnership with Bristol) [Mona]
2. Cost of Climate Change: A look at the historical and future economic impact on the Caribbean under a changing climate– investigation for sectors and regions [Mona]
3. Assess Loss and Damage in relation to oceans, storm surge (coral reefs and fisheries) impact; ocean acidification and oxygen loss and inter-linkages; species invasion (possible)
4. Assess Loss and damage in relation to extremes and slow onset event (drought)
 - a. In partnership with Bristol
5. Impact of sea level rise and storm surge on low lying coastal villages, cities, communities, whole low lying islands [Cave Hill]
6. Impact of climate change, extremes and variability on land degradation (including mountain areas) (This is related to food security and trade and might be very important to Jamaica)
 - a. [UG] and sargassum (possible) [CRFM + Jeremy Collymore]
7. Mitigation studies – Nationally Determined Contributions Review [UG]

Top Data Priorities for 2018-2019

1. Creation, validation and use of Caribbean Reanalysis Data Products
2. Undertake simulations of regional climate model driven by Shared Socioeconomic Pathways (SSPs) and examination of outputs.
3. Model simulations under RCP1.9 and examination of outputs
4. Generation of sector products from impacts modelling under agriculture
5. Launch of online platform with model data and products, sector model products
 - a. Water vulnerability maps (CARPHA)
 - b. Agricultural yield products for different crops under a number of scenarios

- c. Perhaps partnership possible with climate services through CIMH and other organizations
- 6. Uploading existing CORDEX runs on the ESGF so they can be included in AR6
- 7. HiResMIP and CMIP6 Data Acquisition over the next year

IPCC AR6 Timelines

Literature submission cut off: 31 December 2019

Literature acceptance cut off: 30 September 2020

Future Conferences, Meetings and Communications

- Annual Meeting of the Mexican Geophysical Union (RAUGM 2018)
 - October 28 – November 2 2018
 - Puerto Vallarta, Jalisco, Mexico
- American Geophysical Union (AGU) – December 10 – 14, 2018;
 - Abstract submission: August 1, 2019; Early submission deadline is today
 - New Orleans
- Co-Ordinating Regional Downscaling Experiment (CORDEX) MEETING in 2019
 - October 14-18, 2019

Summary of Assignments from 5-Year Plan

5 Pillars	Lead Institutions
1. New Data - Model - Caribbean Reanalysis	INSMET & CSGM CIMH & INSMET
2. Science Questions (a) Modelling studies - Sensitivities, Bias Correction, Uncertainties, Weather Types (b) Drivers to enhance prediction - Seasonal interannual, decadal, multidecadal, multidecadal (c) Sectors - Agriculture - Fisheries - Water - Energy - Health - Biodiversity - Engineering	INSMET & CSGM, UWI St. Augustine, UWI Cave Hill INSMET, UWI Cave Hill, CSGM CARDI CRFM UWI Mona Geo, CERMES, UWI St. Augustine Suriname, UWI Mona, UWI St. Augustine CARPHA, UWI Mona UWI Cave Hill CSGM
2. Science Questions (d) Extremes - Drought - Extreme rainfall - Temperature - ETCCDI - Heat extremes - Historical and projected extremes - Urban air quality	INSMET, CSGM, UWI Cave Hill INSMET, CSGM INSMET, CIMH INSMET, CSGM CARPHA, UWI Mona UWI, St. Augustine CSGM UWI Mona Geo

- Wind extremes - Hurricanes - Flood Risks	
(e) Ocean related studies - Storm surge, waves, currents - Coastal vulnerability - Sea level rise - Sea surface temperatures	UWI Mona Geo, UWI St. Aug Geo, CERMES UWI Cave Hill
(f) Tools	
3. Data availability -Storage & Backup - Transfer of large data - Accessibility	INSMET, CSGM, 5Cs
4. Dissemination & Communication	5Cs
5. Capacity Building, Sustainability, Visibility - Identify conferences, meetings and workshops	CSGM

1. Each lead institution will develop a plan for executing their component.
2. Funds to develop (a) five-year plan and (b) convert plan to proposal to be provided (in principle) by the 5Cs.

Comments/Questions/Topic suggestions (Decisions in red):

- *i) INSMET has done some work on wind and there is a lot of potential in renewables. It may be useful to apply this work. Perhaps we need to have a review of the nationally determined contributions, e.g. Antigua, because what most countries have articulated may not be adequate to respond to the projected changes in climate. This should include the importance of renewables. For example, the NDC of Guyana is focused on energy and forests. ii) The issue of assessing loss and damage is also critical, particularly given its importance to AOSIS. iii) There are synergies among the three Rio conventions that are not being adequately explored. iv) University of Guyana's involvement in both policy and vulnerability would be good, given the low-lying terrain of Guyana.*
- *Has any research been done on climate induced migration, e.g. Dominica after last year's hurricanes? This would be useful in planning.*

One of the things that the group has been trying to do is to widen the scope of the work being done, which is why it is important for people to come on board to champion these issues. The group is currently composed of climate scientists, but scientists in other fields will need to join and integrate their strengths. One of the areas recently identified as a possible interest is climate induced migration, for which two researchers in the region have been identified, given their work on migration.

- *Do we have the data for a migration study?*

We will know once we have discussed it with the specialists.

- *This time around, we need to raise the view of SLR. Most of the work done by the group so far has been atmospheric. However, much of the region is already experiencing the effects of*

SLR. Actions have been taken that have not been wholly appropriate and perhaps more work needs to be done to provide the science to better inform such activities.

John Charlery volunteered to lead work on SLR.

- *The impact of sargassum has been an important issue for the Caribbean countries, which is impacting our coasts. Modelling has been done in this area, and this should be included somehow for the consortium, perhaps through provision of links to recent research. This is a major area for research in fisheries right now.*

Link will be made with sargassum modelling researchers through CRFM. Jeremy Collymore will make contact with the UWI team that is also exploring this issue.

- *Mention of drought and loss and damage to slow onset hazards, but heat is not mentioned.*

Heat is included in the 5-year pillar, but it can also be added to the AR6 plan.

- *Addition of invasive species*

This would need a climate link.

- *Coral bleaching*

Included under marine environment- currently being explored in 1.5 study.

- *The current plan is adequate. There is a danger of expanding it too widely and not achieving as much. Unless a glaring gap is identified, this is more than sufficient.*
- *It would be good for the Caribbean region to be responsible for placing more attention on social sciences, e.g. food security, health, livelihoods. This would be less of an addition and more of a way of making the work of the group more rounded.*
- *1) Other projects are happening in the region that can be integrated, e.g. food and nutrition- Prof. Nicholas Samuels at UWI Cave Hill. 2) How is membership established in the climate consortium?*

By the presence of the institution at the meeting, that institution is automatically a member.

- *The consortium has not been effective in communication to the broader public and this should be included in the 5-year plan.*

Agreed.

- *The work of the consortium should be made more visible to regional climate negotiators, e.g. for COP25.*

Agreed, but the group will need to carefully devise a plan to handle communication appropriately.

8. Way Forward and Next Meeting

- In the coming year, the consortium will need to determine what will be done about data sharing and storage. There are many new initiatives that need high resolution modelling.

- There are some developments that the group needs to plan for, such as the release of CMIP6 and higher resolution models.
- Some areas of the original 5-year plan have been achieved and other necessities have arisen, e.g. 1.5 initiative.
- Meeting summary will be sent to EOS.
- Caribbean climate series can be used to publicise more papers from the group in summary.

Suggested strategy for way forward:

1. Integrate new 8-7-6 plan into 5-year plan
2. Clearly identify new things that need to be done versus gaps that still exist
3. Identify necessary linkages to move ahead, e.g. University of Guyana
4. Set a short term goal with teams and team leads, e.g. AR6
 - a. Use the leadership of Caribbean IPCC lead authors to better plan for relevant chapters
 - b. Determine what chapters need a Caribbean contribution
 - c. Get more Caribbean authors involved in the IPCC process

Suggestion for next meeting: Climate Change Congress in Cuba- July 2019