

CariCOF 2021 Wet/Hurricane Season – Forecasters’ training workshop / SDCR Sub-Seasonal Climate Prediction Model Validation Workshop

31st May – 4th June, 2021

Workshop Report

The 2021 Wet/Hurricane Season CariCOF forecasters’ training was held online via ZOOM videoconferencing on May 31st, June 1st, June 3rd and June 4th from 11:00 AM to 1:00 PM EDT/Eastern Caribbean Time. This was done as part of biannual Caribbean Climate Outlook Forum (CariCOF) activities. The training workshop followed after 3 CariCOF activities organised the previous week, including the regular Wet/Hurricane Season Climate Outlooks Discussion meeting among meteorologists and climatologists held on May 25th, and two stakeholder sessions held on May 26th – where the climate outlooks were presented and discussed – and on May 28th, a Climate Services webinar entitled “Towards improved heat early warning information systems in the Caribbean: Research and Applications”. The CariCOF was organised by the Caribbean Institute for Meteorology and Hydrology (CIMH). The training workshop was facilitated by Dr. Simon Mason of Columbia University’s International Research Institute for Climate and Society (IRI), and Dr. Cédric Van Meerbeek of the World Meteorological Organization (WMO) Caribbean Regional Climate Centre (Caribbean RCC) at CIMH, as well as with the support from the U.S. National Oceanic and Atmospheric Administration (NOAA) through the RCC-Washington in the person of Ms. Sarah Diouf. Furthermore, session 2 was co-facilitated by Ms. Agathe Bucherie (IRI). The training workshop consisted of a validation exercise for the research and development work implemented by the IRI for the CIMH under the Strengthening Disaster and Climate Resilience (SDCR) project, which was made possible thanks to the generous support of the American People through the United States Agency for International Development (USAID). It should be noted that, in view of the participation of persons from different language groups and upon request of the French speakers, summaries of all presentations were made in French to ensure efficient capacity building across the region. The workshop agenda is found in [Appendix 1](#).

Under activity 2.4.2 of the SDCR project, the IRI Consultants work with the relevant CIMH staff to conduct an assessment of the predictability of extreme wet spells and their relationship with flash floods, and to develop a forecast modelling framework to forecast flash flood potential at sub-seasonal timescale. Along-side CIMH the consultants will develop a forecast modelling framework for operational sub-seasonal dry spell forecasts to support the agriculture sector. This CariCOF Forecasters’ Training Workshop evolved around Activity 2.4.3 of the SDCR project entitled “Sub-seasonal forecast models for flash flood & dry spells validated” in which the two modelling frameworks developed in the consultancy with IRI (Columbia University) is validated by the NMHSs.

Collaborators:

Day 1: Monday May 31st, 2021 – Session 1 – *Sub-seasonal to seasonal climate predictability and prediction: the basics on theory and operations*

After a word of welcome and opening remarks by Mr. Adrian Trotman (CIMH) and Dr. Mason, the training workshop's objectives were introduced by Dr. Cédric Van Meerbeeck. Dr. Van Meerbeeck that this training workshop was one of the activities undertaken by the IRI as part of a consultancy under the SDCR project (Output 2.4 - Sub-Seasonal Climate Information Products to Improve Decision-Making in the Caribbean region Established). The first day would focus on bringing workshop participants, consisting of 37 Meteorologists and Climatologists from National Meteorological and Hydrological Services across the region.

In this technical session, Dr. Mason presented a lecture on the basics of the theory of sub-seasonal to seasonal climate variability, and on the experimental and operational model runs that are available. The following key messages were presented:

- The MJO is the main feature of sub-seasonal variability.
- The MJO phases are described by the location of the main area of strong convection.
- Wheeler – Hendon diagrams are used to track the phase and intensity of the MJO, and can be used both for monitoring and forecasting; different indices can be used for these diagrams, but the Real-Time Multivariate MJO Index (RMMI) is preferable for real-time monitoring.
- The impact of the MJO on climate over the Caribbean is complex, and there are other influences, so the only viable way to make a forecast is to use a dynamical climate model rather than to look for simpler empirical relationships between MJO phases and rainfall, for example.
- There are two main sources of sub-seasonal forecasts from climate models:
 - WWRP/WCRP-coordinated Sub-seasonal to Seasonal Prediction Project;
 - NOAA-coordinated Sub-seasonal Experiment (SubX).

Of these two sources, the SubX model outputs are more suitable for operational forecasting in the Caribbean because real-time forecasts are freely accessible, and forecasts from different models are made using a common standard. However, not all the SubX models are operational, and so only a subset of SubX models should be used.

Questions were fielded and discussions about how to account for other sources of predictability were held. An important conclusion is that simple statistical models (such as MJO phase composites), while informative for diagnostic analysis, are likely to be unreliable for forecasting purposes. Analysis of dynamical model outputs are likely to be the only viable well of producing forecast products since, in principle, they should be able to model the multiple forcing mechanisms and non-linear interactions that are present in the real world.

Day 2: Tuesday June 1st, 2021 – Session 2 – *Towards building a modelling framework for operational subseasonal forecasting of flash flood potential and dry spells: research and development under the SDCR Project*

In this second session, Dr. Mason summarised the key messages from the first day and then presented a brief background to the research being conducted on rainfall as an indicator of flash-flood potential. Dr Bucherie presented these research results in more detail. The research has focussed on flash floods in Grenada as a case study. Progress on the flash-flood research, and recommended additional analyses, include:

- Flash-flood data quality control is an important step that can lead to immediate improvements in estimates of rainfall-flood relationships. Additional datasets for flash floods have been identified that could be explored for other islands, and by combining data from different sources a more comprehensive record can be developed.
- Comparisons of flash floods with daily (as opposed to three-daily) extreme precipitation indicates improved detection compared with the incomplete flash-flood records for floods near to the one available rain gauge in Grenada.
- Collaboration with Grenada Met is encouraged. Additional rain gauge data may be available, and/or satellite data could be used. CHIRPS data are the most logical option, although there are known to be problems in their estimates of rainfall intensity.
- The participants encouraged the researchers to explore using the 95th rather than the 99th percentile as a definition of heavy rainfall.
- For consistency with existing CIMH practices, the researchers were encouraged to explore using 3-day rather than 1-day rainfall totals. There was considerable discussion around the question of the most appropriate time period to use, and theoretical arguments do not point obviously to a preferred period.

Day 3: Thursday June 3rd, 2021 – Session 3 – *Towards building a modelling framework for operational subseasonal forecasting of flash flood potential and dry spells: Demonstration and validation of the modelling framework*

and

Day 4: Friday June 4th, 2021 - Session 4 – *Towards operational S2S forecasting in the CariCOF regional and Caribbean SIDS context: discussion on the potential benefits and limitations, as well as next steps*

Before the third and fourth sessions were started and upon the request of Dr. Mason and the audience, Ms. Diouf presented on the range of sub-seasonal prediction products offered by the RCC-Washington, including week 1 and week 2 forecasts of temperature, precipitation (totals and probability of exceedance), wind, precipitation and heatwave days.

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The third and fourth sessions were interwoven into one focusing on validating the IRI's proposed modelling framework and discussion its benefits, limitations and the next steps to be taken under SDCR Activity 2.4.2. The mode of delivery of the joint session was a powerpoint presentation of the research results on sub-seasonal predictability of extreme rainfall across the Caribbean interwoven with Q&A and discussions.

The main results and preliminary recommendations for implementation of a sub-seasonal forecasting system were:

- Skill for week 2-3 forecasts from each dekad of the year have been calculated for the period 1999 – 2020 using a range of CPT's GCM options. Skill was calculated separately for mainland South America on the one hand, and for Belize and the Caribbean Islands on the other.
- Cross-validation appears to be negatively biased, and so retroactive skill assessment is recommended instead.
- The predictability of total rainfall for Belize and the Caribbean Islands is weak throughout the year, but there may be some promise for South America from about October to May. Initial results for the predictability of extreme rainfall occurrence (> 100 mm in one day) are also promising.
- The General Circulation Model (GCM) option within the Climate Predictability Tool (CPT) is recommended rather than the usual spatial pattern correction procedures adopted for seasonal forecasting. The spatial pattern correction procedures (such as canonical correlation analysis) are suitable for correcting systematic spatial errors but may be unsuitable for the more complex problem of forecasting from initial conditions rather than from boundary forcing.

Some work has also been conducted on one-month forecasts, with promising skill evident for June. However, because of a lack of time, this topic was not covered in the workshop and will be taken up at a later opportunity.

The recommended next steps for research under SDCR Activity 2.4.2 arising from the discussion are...

- Further results should be calculated for a 50 mm threshold, and for dry spells.
- An analysis of the predictability of the rainfall threshold that is the best indicator of flash-flood potential would be beneficial.
- Some consideration of the spatial scale of predictability would be valuable

Finally, recommendations were also made on continued work beyond the SDCR project, to be funded by the European Union through two initiatives led by the Organisation for African, Caribbean and Pacific States. The modelling framework developed through the SDCR project will require further refinement to enable operational production of sub-seasonal flash flood potential and dry spell forecasts, including in terms of software tool development – i.e. integration of daily station data functionality into the Climate Predictability Tool (CPT) –, in terms of output visualisation in tailored map forms, as well as in terms of inclusion of CPT functionality to integrate multi-model ensemble prediction members. These integrations and

Collaborators:

implementations will then enable the development of a sub-seasonal heatwave prediction modelling framework largely following the same approach but using different prediction parameters and outputs.

The workshop was closed with a vote of thanks and closing remarks given by Dr. Van Meerbeek.

APPENDIX 1 – Workshop Agenda

CariCOF 2021 Wet/Hurricane Season – Forecasters’ training workshop / SDCR Sub-Seasonal Climate Prediction Model Validation Workshop

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Workshop Agenda

Day 1: Mon 31 May

- 11:00 – 11:15 *Opening Remarks* (Mr. Adrian Trotman, Head of the Caribbean RCC, and Dr. Cédric Van Meerbeeck, CIMH; Dr. Simon Mason, IRI)
- 11:15 – 13:00 *Session 1 – Sub-seasonal to seasonal climate predictability and prediction: the basics on theory and operations* (Dr. Mason, IRI)

Day 2: Tue 1 June

- 11:00 – 13:00 *Session 2 – Towards building a modelling framework for operational sub-seasonal forecasting of flash flood potential and dry spells: research and development under the SDCR Project* (Dr. Mason and Ms. Agathe Boucherie, IRI)

Day 3: Thu 3 June

- 11:00 – 11:20 *Presentation of sub-seasonal climate prediction products offered by the RCC-Washington* (Ms. Sarah Diouf, NOAA CPC / RCC-Washington)
- 11:20 - 13:00 *Session 3 – Towards building a modelling framework for operational subseasonal forecasting of flash flood potential and dry spells: Demonstration and validation of the modelling framework*
and
Session 4 – Towards operational S2S forecasting in the CariCOF regional and Caribbean SIDS context: discussion on the potential benefits and limitations, as well as next steps (Dr. Mason, IRI; and Dr. Van Meerbeeck, CIMH)

Day 4: Fri 4 June

- 11:00 – 12:50 *Session 5 – Monthly, initialised forecasts: a demonstration* (Dr. Mason, IRI; and Dr. Van Meerbeeck, CIMH)
- 12:50 – 13:00 *Vote of Thanks and Closing Remarks* (Dr. Van Meerbeeck, CIMH)

END OF WORKSHOP