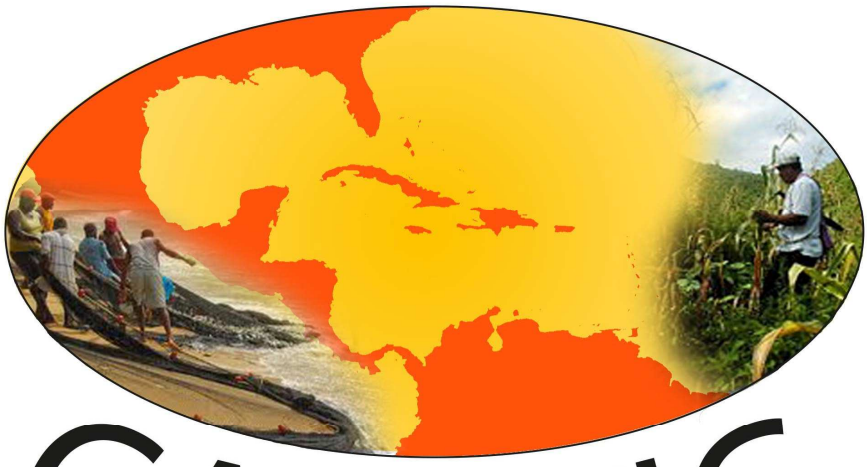
Caribbean Weather Impacts Group

Supporting risk based decision making



CARIWIG

Scientific Publications

May 2015

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Contents

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1 Summary of deliverable

Dissemination of the CARIWIG project results was achieved through a number of routes to various audiences: a stakeholder workshop, a stakeholder technical staff capacity building event, the web service, the project web site, and scientific and policy dissemination through submissions to scientific journals, policy publications and presentations to international conferences and workshops.

This deliverable summarizes the scientific dissemination of the CARIWIG project through submissions to scientific journals. First, the historical climatic context is considered, then a model based on present-climate storms and hurricanes is presented, finally approaches to modelling the future climate are considered.

Setting the historic climatic change context of the region, Jones et al. (submitted$_a$) investigated observed trends in precipitation and temperature in the Caribbean region, and considered the implications of data scarcity on these results.

For infrastructure and emergency planning, a methodology to investigate the hazard from hypothetical tropical storms and hurricanes was presented by Mandal (in preparation), and demonstrated through a flood hazard application in Jamaica.

Considering projections of future climate change in the region, Centella-Artola et al. (2015) evaluated the sensitivity of regional climate model simulations to the model domain. Results suggested how best to make use of limited computational resources for climate model runs for the region.

In a more local context, Jones et al. (submitted$_b$) presents a combined dynamical and statistical downscaling technique of the outputs of regional climate model runs. This approach bias corrects the climate model projections and generates ensembles of simulations that represent the present day and future climate for a number of locations across the region.

1.1 List of publications

Following is a list of scientific publications arising from the CARIWIG project:

Centella-Artola, A., Taylor, M.A., Bezanilla-Morlot, A., Martinez-Castro, D., Campbell, J.D., Stephenson, T.S., and Vichot, A., (2015) Assessing the effect of domain size over the Caribbean region using the PRECIS regional climate model, *Climate Dynamics*, 44:1901–1918, doi: 10.1007/s00382-014-2272-8

Jones, P.D., Harpham, C., Harris, I., Goodess, C.M., Burton, A., Centella-Artola, A., Taylor, M.A., Bezanilla-Morlot, A., Martinez-Castro, D., Campbell, J.D., Stephenson, T.S., Joslyn, O., Nicholls, K., and Baur, T, (submitted$_a$) Long-term trends in precipitation and temperature across the Caribbean, submitted to *International Journal of Climatology*.

Mandal, A., Stephenson, T., Taylor, M., Brown, A., and Campbell, J., (in preparation) Rainfall-Runoff simulations using the CARIWIG Simple Model for Advection of Storms and Hurricanes and HEC HMS Tools – the Hurricane Ivan and Jamaica Hope River watershed case study, for submission to *Natural Hazards*.

Jones, P.D., Harpham, C., Burton, A., and Goodess, C.M., (submitted$_b$) Downscaling regional climate model outputs for the Caribbean using a weather generator, submitted to the *International Journal of Climatology*.

2 Details of each publication

The following sub-sections of this report provide further details of each publication.

2.1 Centella-Artola et al. (2015)

Title

Assessing the effect of domain size over the Caribbean region using the PRECIS regional climate model

Abstract

This study investigates the sensitivity of the one-way nested PRECIS regional climate model (RCM) to domain size for the Caribbean region. Simulated regional rainfall patterns from experiments using three domains with horizontal resolution of 50 km are compared with ERA reanalysis and observed datasets to determine if there is an optimal RCM configuration with respect to domain size and the ability to reproduce important observed climate features in the Caribbean. Results are presented for the early wet season (May–July) and late wet season (August–October). There is a relative insensitivity to domain size for simulating some important features of the regional circulation and key rainfall characteristics e.g. the Caribbean low level jet and the mid summer drought (MSD). The downscaled precipitation has a systematically negative precipitation bias, even when the domain was extended to the African coast to better represent circulation associated with easterly waves and tropical cyclones. The implications for optimizing modelling efforts within resource-limited regions like the Caribbean are discussed especially in the context of the region's participation in global initiatives such as CORDEX.

Citation

Centella‐Artola, A., Taylor, M.A., Bezanilla-Morlot, A., Martinez-Castro, D., Campbell, J.D., Stephenson, T.S., and Vichot, A., (2015) Assessing the effect of domain size over the Caribbean region using the PRECIS regional climate model, *Climate Dynamics*, 44:1901–1918, doi: 10.1007/s00382-014-2272-8

2.2 Jones et al. (submitted$_a$)

Title

Long-term trends in precipitation and temperature across the Caribbean

Abstract

This study considers long-term precipitation and temperature variability across the Caribbean using two gridded datasets (CRU TS3.21 and GPCCv5). We look at trends across four different regions, for three different seasons (May to July, August to October and November to April) and for three different periods (1901-2012, 1951-2012 and 1979-2012). There are no century-long trends in precipitation, although some regions show decade-long periods of wetter or drier conditions. Temperature in contrast shows statistically-significant warming everywhere for the period 1901-2012, 1951-2012 and for most areas during 1979-2012. Data availability is a limiting issue over much of the region and we discuss the reliability of the series we use in the context of what is known to be available in the CRU TS3.21 dataset. More station data have been collected but have either not been fully digitized yet or not made freely available both within and beyond the region.

Citation

Jones, P.D., Harpham, C., Harris, I., Goodess, C.M., Burton, A., Centella-Artola, A., Taylor, M.A., Bezanilla-Morlot, A., Martinez-Castro, D., Campbell, J.D., Stephenson, T.S., Joslyn, O., Nicholls, K., and Baur, T, (submitted$_a$) Long-term trends in precipitation and temperature across the Caribbean, submitted to the *International Journal of Climatology*.

2.3 Mandal et al. (in preparation)

Title

Rainfall-Runoff simulations using the CARIWIG Simple Model for Advection of Storms and Hurricanes and HEC HMS Tools – the Hurricane Ivan and Jamaica Hope River watershed case study

Abstract

Rainfall – runoff modelling for tropical watersheds of Small Island Developing States (SIDS) is essential in town planning and planning of infrastructures. The SIDS of the Caribbean are vulnerable to flooding from high intensity rainfall often associated with tropical storms and hurricanes resulting in loss of life and livelihood. Jamaica, the third largest island in the Caribbean is also significantly affected by hydrometeorological hazards. While predictions of these hazards are available on a climate scale, sub-daily rainfall and wind data in relation to hurricanes traversing a given Caribbean island over multiple tracks, and with different speeds and strength do not exist. In this study rainfall data is simulated in relation to the Hope River watershed in eastern Jamaica to investigate implications for peak discharge. The rainfall data is obtained at 25km spatial resolution using a new tool known as the Simple Model for Advection of Storms and Hurricane (SMASH) that provides rainfall and wind speeds over Caribbean islands under varying tracks, speeds and categories of a select group of hurricanes. Tropical storm Ivan is explored using three user defined tracks (south of Jamaica; over the watershed on a south-east to north-west trajectory; over the watershed on a south-south-east to a north-north-east trajectory) and speeds (17 and 25 km/hr).The rainfall data is conditioned over a new hydrological model created using HEC HMS for the watershed to derive peak discharges at significant sections. Results show higher intensity of discharge for the track south of the island(as opposed to a direct hit) and a shorter lag time to peak discharge with increase in speed of the hurricane. The potential to use the two tools for the creation of awareness to flooding from different types of tracks and speeds of hurricanes, and therefore as aids in better planning to avoid loss of life and property is also briefly discussed.

Citation

Mandal, A., Stephenson, T., Taylor, M., Brown, A., and Campbell, J., (in preparation) Rainfall-Runoff simulations using the CARIWIG Simple Model for Advection of Storms and Hurricanes and HEC HMS Tools – the Hurricane Ivan and Jamaica Hope River watershed case study, for submission to *Natural Hazards*.

2.4 Jones et al. (submitted$_b$)

Title

Downscaling regional climate model outputs for the Caribbean using a weather generator

Abstract

Locally relevant scenarios of daily weather variables that represent the best knowledge of the present climate and projections of future climate change are needed by planners and managers to inform management and adaptation decision making. Information of this kind for the future is only readily available for a few developed country regions of the world. For many less-developed regions, it is often difficult to find series of observed weather data to assist in planning decisions. This study applies a previously developed Weather Generator (WG) to the Caribbean, using examples from Belize in the west to Barbados in the east. The purpose of this development is to provide users in the region with generated sequences of possible future daily weather that they can use in a number of impact sectors. The WG is first calibrated for a number of sites across the region and the goodness of fit of the WG against the daily station observations assessed. Particular attention is focussed on the ability of the precipitation component of the WG to generate realistic sequences of extremes. For the future weather sequences, a Regional Climate Model (RCM) simulation is used to develop Change Factors (CFs) between the control period of the RCM and future 30-year periods centred on the 2020s, 2050s and 2080s. Changes between the control period and the three futures are illustrated not just by changes in average temperatures and precipitation amounts, but also by a number of well-used measures of extremes (very warm days/nights, the heaviest 5-day precipitation total in a month, counts of the number of precipitation events above specific thresholds and the number of consecutive dry days).

Citation

Jones, P.D., Harpham, C., Burton, A., and Goodess, C.M., (submitted) Downscaling regional climate model outputs for the Caribbean using a weather generator, submitted to the *International Journal of Climatology*.

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