

INTERIM REPORT

Caribbean Institute for Meteorology and Hydrology

Caribbean Regional Climate Centre (in Demonstration Phase)

September 2015

Overarching Statement – All mandatory functions will be in place by December 2015/January 2016.

Mandatory Functions

1. Operational Activities for Long Range Forecasts (LRF)

Interpret and assess relevant LRF products from Global Producing Centres (GPCs), distribute relevant information to RCC Users; and provide feedback to GPCs

Interpretation of GPC products are done routinely and in support of the regional RCC LRF products. Essentially the mapped products are used to provide guidance on the confidence in the statistically downscaled LRF products produced at the RCC and at the NMHS's involved within the Caribbean Climate Outlook Forum (CariCOF). Information on the CariCOF can be found on <http://rcc.cimh.edu.bb/caricof/>.

As such, the CariCOF uses guidance from:

- 1) UK Met Office GCM (UKMO) probability forecast;
- 2) European Center for Mid-range Weather Forecast GCM (ECMWF) and EUROSIP (multi-model) probability forecasts;
- 3) APEC Climate Center (APCC) multi-model probability forecasts;
- 4) WMO Lead Centre for LRF – MME on the intermodal consistency, spread and average signal.
- 5) NOAA-CPC CFSv2 model
- 6) MétéoFrance Arpège model.
- 7) JMA model
- 8) Environment Canada CMC model

- 9) IRI multi-model probability forecast (though IRI is not a GPC, it provides the only multi-model forecast that recalibrates & weights the models based on past performance);

While the GPC information is not made available to RCC users via the RCC website, links to GPC information has been made available to Meteorological Services for their access. In addition, with each monthly update of the operational LRF products, a technical presentation including most well performing GPC LRF outlook maps for precipitation and mean two meter temperature is distributed amongst all forecasters and climate scientists within the CariCOF. Any person wishing to subscribe to the mailing list can obtain all information, so long as they participate in the CariCOF. Subscription can be done by a simple email request to caricof@cimh.edu.bb.

In part because of this, as well as through training workshops in seasonal climate forecasting being held before each CariCOF stakeholder meeting, most NMHSs in the Caribbean already refer to GPC products.

Generate regional and sub-regional tailored products, relevant to RCC User needs, including seasonal outlooks etc.

Rainfall and temperature-related seasonal forecasts are provided for three month rainfall totals and mean, maximum and minimum temperature at 0- and 3- month lead times, with a coverage including the geographic Caribbean. While the maximum and minimum temperature outlooks are currently in experimental stages (operationalisation expected by December 1st, 2015), all other forecasts are updated monthly and available at:

<http://rcc.cimh.edu.bb/long-range-forecasts/caricof-climate-outlooks/>

The standard operational LRF products provided by CariCOF at present are:

- 1) Seasonal rainfall outlook map (0-month lead). Latest at: http://rcc.cimh.edu.bb/files/2015/09/caricofson_precip1.png
- 2) Seasonal rainfall outlook map (3-month lead). Latest at: http://rcc.cimh.edu.bb/files/2015/09/caricofdjf_precip1.png
- 3) Seasonal mean temperature outlook map (0-month lead). Latest at: http://rcc.cimh.edu.bb/files/2015/09/caricofson_temp1.png
- 4) Seasonal mean temperature outlook map (3-month lead). Latest at: http://rcc.cimh.edu.bb/files/2015/09/caricofdjf_temp1.png

In addition, there are also operational forecasts catering to information demands and co-developed by CariCOF's user network on:

- 1) drought that are accompanied by alert information. Latest at: http://rcc.cimh.edu.bb/files/2015/09/caricof_drought_end_November2015.pdf

- 2) extreme rainfall within the 0-month lead, three month forecast period, a range of operational products that quantify forecast frequencies of wet days and increasingly extreme wet spells. While these products are operational, they are still undergoing further development. In the near-future, the suite will also be expanded beyond wet spells to dry spells and heatwaves. Latest at:
http://rcc.cimh.edu.bb/files/2015/09/CariCOF_SON_2015_wetdays_wetspells_outlooks_.pdf

Furthermore, in an effort to (i) contextualise the LRF information with recent climate and impacts observations, the reference climatologies for the forecast period, (ii) provide GPC guidance on recent and forecast climate conditions that drive seasonal variability in the Caribbean, as well as (iii) to provide it in a structured, simplified language for the users, CariCOF issues a monthly Caribbean Climate Outlook Newsletters. Latest at:
<http://rcc.cimh.edu.bb/files/2015/09/caricofsondjf.pdf>

Similarly, the CariCOF drought alert outlooks are further contextualised by the Caribbean Drought and Precipitation Monitoring Network with drought and drought impacts monitoring information, and issued each month in the Caribbean Drought Bulletin. Latest at:
http://rcc.cimh.edu.bb/files/2015/09/CaribbeanDroughtBulletin_September_Vol2_Issue4.pdf

Finally, with particular relevance to the Caribbean and in response to a request by a wide range of CariCOF stakeholders, operational LRF information for coral bleaching potential are made available by CIMH in collaboration with NOAA's Global Coral Reef watch. Latest at:
http://rcc.cimh.edu.bb/files/2015/09/Caribbean-CRW-Vol1_Issue_4_Sept.pdf

Generate consensus statement on regional or sub-regional forecasts

Statements are made available through a CariCOF Caribbean Climate Outlook Newsletter (see above for a description). Latest issue available at:
<http://rcc.cimh.edu.bb/files/2015/09/caricofsondjf.pdf>

In addition, a summary statement of the latest 0-month lead, 3-month consensus rainfall outlook is available at <http://rcc.cimh.edu.bb/long-range-forecasts/caricof-climate-outlooks/>.

Perform verification of RCC quantitative LRF products, including the exchange of basic forecasts and hindcast data

Verification exercises have been carried out in terms of ROC, Hit Rate Skill Score and other, related scores as part of a number of research internships.

The work has been / is in the process of being published:

- 1) S. Bedward and C. Van Meerbeeck: Assessing the skill of seasonal rainfall outlooks for the Caribbean. Geophysical Research Abstracts Vol. 15, EGU2013-5968, 2013

- 2) S. Bedward and C.J. Van Meerbeeck: Researching the Development of a Colour Coded Alert system for Flooding events in the Caribbean Region. CERMES Technical Report No. XX, pp. xx, *accepted for publication*.

The most recent assessment incorporated verification of CariCOF's consensus seasonal precipitation outlooks as well as the objective statistically downscaled forecasts from the moment that the forecast methodology was standardized. An update is expected to be made available after sufficient time has passed to ensure robustness of the verification exercise. The outcome of that update will be published on the RCC website. However, verification information is presently not made available routinely.

Provide on-line access to RCC products/services to RCC Users

All operational LRF products, as well as seasonal climatologies are available at rcc.cimh.edu.bb

Please see above for direct links to the latest LRF products. In terms of reference monthly and seasonal climatologies for rainfall, mean, minimum and maximum temperature, as well as extended climatologies, please refer to <http://rcc.cimh.edu.bb/climate-monitoring/caribbean-climatology/>

This page gives an overview of seasonal average precipitation and links to Caribbean weather station-based climatologies made available by the RCC and by CariCOF. The climatologies include tabled and graphed record annual, seasonal and monthly high and low records, 10th and 90th percentiles, terciles and median values. In addition, the long-term annual mean values are given for each station. This is done for both the 1981-2010 reference period (for all stations with no more than 20% missing monthly values within this time interval) as well as for the entire period of record made available by CariCOF.

Assess use of RCC products and services through feedback from RCC Users

Historically, feedback is gained through organised face-to-face meetings with stakeholders, for example, through CariCOF meetings, and sectoral meetings. Feedback is also gained after dissemination to stakeholders via email and surveys.

In an effort to strengthen the systematic assessment of the delivery and usability of RCC products and services, in June 2015, the CIMH initiated a baselining exercise to assess existing CIMH and NMHS performance/capacity on the five pillars of the GFCS, as well as, user perceptions of their use and needs for climate products and services. On the user side, survey questions asked sectoral users to assess their general use of climate information; their level of awareness of CIMH climate products and tools; the usability of these climate products and tools, as well as, the quality of their interaction with climate information providers such as CIMH. Full questionnaire templates that captures user feedback are available. It is expected that the results of this process, which will be available online, will further inform product tailoring and

development for climate sensitive sectors in the near to medium term. In the long-term, the baseline questions will become an integral part of a regular evaluation process that formally captures feedback through various avenues, including the bi-annual CariCOF evaluation process, as well as, more adhocly with the convening of regional and national sectoral workshops. In each case, results will feed into an annual synthesis report.

With the addition of a Communications Specialist to the team, CIMH has also begun to track, compile and analyse the number of users who access our products online. Current efforts to distribute and promote products are focused on email and social media. When a new issue of a product is released, CIMH highlights its content in an email or social media post and provides users with a unique URL for the product that is generated by an application (Bitly.com) that measures the clicks on the link. The application allows CIMH to gather data on how many people are reading the product, when they read the product and where they clicked from. This approach has worked particularly well with new products such as the Caribbean Coral Reef Watch (CCRW) which was first issued in June 2015. After three issues, we have measured close to 800 clicks that connect users to the CCRW. Although a proxy measure of use, the Institute is now in a position to quantify user clicks as a proxy of end-user interest. This information is key to understanding online trends and behaviours of our audiences on an ongoing basis, so we can effectively cater to their needs.

There are also plans for interactive portals that would allow engagement, including feedback. The first, for agriculture, is currently being developed for the Caribbean, as we seek to launch what will be the Caribbean Society for Agrometeorology (CariSAM) in early 2016. Similar interactive platforms are being proposed for other sectors. Feedback would be used by the CIMH/RCC for product improvement and the development of new products.

2. Operational Activities on Climate Monitoring

Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales

This is done for rainfall, but mainly using the SPI and Deciles indices to indicate variability. SPI and Deciles are produced relative to the reference period 1981-2010.

SPI discussions and maps are provided on a web page dedicated to the Caribbean Drought and Precipitation Monitoring Network (CDPMN - <http://rcc.cimh.edu.bb/cdpmn/>), a separate SPI Monitor page (<http://rcc.cimh.edu.bb/climate-monitoring/spi-monitor/>), and via the Caribbean Drought Bulletin (<http://rcc.cimh.edu.bb>). There is also a dedicated Deciles page, with Deciles maps. Text information on the Deciles page was temporarily halted and will recommence in late 2015. CIMH also manages a multi-hazard platform (Dewetra), developed under the project Enhancing Resilience to Reduce Vulnerability in the Caribbean (<http://www.cimh.edu.bb/erc/home/>) that also displays these products.

In collaboration with the National Oceanic and Atmospheric Administration (NOAA) of the USA, Caribbean Sea Surface Temperatures are monitored for potential coral reef impacts and disseminated via the Caribbean Coral Reef Watch (<http://rcc.cimh.edu.bb/>).

Though the priorities of the Caribbean RCC was for the development of its LRF and CDPMN products (because of the importance of rainfall in the Caribbean), other rainfall monitoring products, along with temperature that include absolute and anomaly information would go on-line from December 2015/January 2016. The CIMH/RCC is also experimenting with products to indicate the monthly change in the SPI.

Establish an historical reference climatology for the region and/or sub-regions

Climatologies are available on the CIMH/RCC page for both rainfall and temperature that are updated every year (<http://rcc.cimh.edu.bb/climate-monitoring/caribbean-climatology/stations/>). Reference climatologies for rainfall and maximum, minimum and mean 2m temperature for the period 1981-2010 (the reference period currently being used for other Caribbean RCC products) can be viewed on-line (<http://rcc.cimh.edu.bb/climate-monitoring/caribbean-climatology/1981-2010/>).

Implement a Regional Climate Watch

This is already provided for rainfall and drought using SPI and Deciles (as described above). For drought particularly, an alerting mechanism is made also available that raises concerns on drought at various levels, with the most recent alerts being viewed in the Caribbean Drought Bulletin. In collaboration with regional and national stakeholders and accompanies the drought outlook products (<http://rcc.cimh.edu.bb/long-range-forecasts/caricof-climate-outlooks/>; see also Table 1).

With the advent of the Temperature Monitor in December 2015/January 2016, and a proposed heat wave product, the temperature analogy of the extreme-rainfall-within a season series of outlook products, a regional heat wave watch will be developed in 2016. The experimental methodology for extreme rainfall will be replicated using temperatures.

For agriculture a separate Agroclimatic Bulletin provide advisories for agriculture and are updated monthly. Similar tailored bulletins are being discussed with the user-community through the Early Warning Information Systems Across Climate Timescales (EWISACTS) and its consortium¹ work. When necessary, advisories are also communicated to the National Meteorological and Hydrological Services (NMHS) for them to communicate to their national stakeholders. Advisories are also made through the CariCOF newsletter, which also has a climate summary embedded. With the advent of the temperature monitor in December 2015/January

¹ A formalized sectoral mechanism in which regional sectoral partners support CIMH to co-design, co-develop and co-deliver tailored climate products and services in the agriculture and food security, water, disaster risk management, health, energy and tourism sectors.

2016 similar would eventually be done for heat advisories, once heat wave information is operationalised.

Table 1 Drought Alerting Levels and recommended actions

ALERT LEVEL	MEANING	ACTION LEVEL
NO CONCERN	No drought concern	<ul style="list-style-type: none"> ✓ monitor resources ✓ update and ratify management plans ✓ public awareness campaigns ✓ upgrade infrastructure
DROUGHT WATCH	Drought possible	<ul style="list-style-type: none"> ✓ keep updated ✓ protect resources and conserve water ✓ implement management plans ✓ response training ✓ monitor and repair infrastructure
DROUGHT WARNING	Drought evolving	<ul style="list-style-type: none"> ✓ protect resources ✓ conserve and recycle water ✓ implement management plans ✓ release public service announcements ✓ last minute infrastructural repairs and upgrades ✓ report impacts
DROUGHT EMERGENCY	Drought of immediate concern	<ul style="list-style-type: none"> ✓ release public service announcements ✓ implement management and response plans ✓ enforce water restrictions and recycling ✓ enforce resource protection ✓ repair infrastructure ✓ report impacts

3. Operational Data Services, to support operational LRF and climate monitoring

Develop quality controlled regional climate datasets, gridded where applicable

This has been one of CIMH's mandates from its establishment. Most quality control commences in the counties themselves by the NMHS. Further quality checking takes place at CIMH/RCC, as well as for any data submitted by sources other than NMHS. A customised/synchronising database (see also next section) that will be released in late 2015, incorporates quality checking and will continue and even upgrade this process. Gridded data, however, is not yet pursued. Monthly weather summaries are also made available post-processing, and can be viewed at <http://www.cimh.edu.bb/?p=home#monthly.summaries>.

Provide climate database and archiving services, at the request of NMHSs

This has been one of CIMH's mandates from its establishment. The NMHSs of the CMO Member States regularly send their data to CIMH to be archived. CIMH/RCC staff perform quality checks on this data before storing it in the CIMH database. CIMH Staff also fulfill requests for data from the public.

Currently, a new version of the CIMH climate database is under production and is slated to be completed by late 2015. Its proposed design was influenced by recommendations in the WMO draft document "Climate Data management System Specifications Version 1.2". This database will be supported by a number of satellite 'lightweight' databases, one in each of the CMO Member States. Each of these smaller databases is intended to store the local data of its respective country and will push any recently entered data to the main database at CIMH for verification by CIMH Staff.

The main database will offer a web portal which will allow visitors to determine what data is available and to make requests for data sets. Currently data queries and data provision must be made by contacting CIMH/RCC via e-mail.

4. Training in the use of operational RCC products and services

Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use

There has not yet been a manual compiled, but some of the products, for example SPI and Decile maps, Caribbean Climatologies, tercile forecasts, and others, have on-line explanatory notes, and work has commenced on building manuals for producing the climate outlooks.

Under the Sectoral EWISACTs component of the CIMH implemented BRCCC Programme, CIMH is in the process of developing a communication package of multi-media materials for decision-makers in six climate sensitive sectors (agriculture and Food Security, water, disaster risk management, health, tourism, energy). One of the initial outputs of this initiative is the development of product information sheets for the range of CIMH products. The sheets are intended to give stakeholders an overview of each product, the type of data they offer, how they benefit climate sensitive sectors, when they are published and how to access them. A draft generic template for the product information sheet is available and is currently being tested. It is expected that the first dissemination of the information sheets will take place in November 2015 at the Dry Season CariCOF.

Coordinate training for RCC Users in interpretation and use of mandatory RCC products

This is done during CariCOF for both regional and national providers and users; as well as through other workshops held for specific sectors.

The results of the provider baseline survey will provide insights on performance and capacity gaps in the five pillars of the GFCS, namely: 1) Monitoring and Observation; 2) Research, Modelling and Prediction, 3) the Climate Services Information System, 4) the User Interface Platform and 5) Capacity Development. Identified capacity gaps are likely to translate into concrete training needs. Provider survey results should be available by December 2015.

Highly-Recommended Functions

1. Climate Prediction and Projection (beyond 2 years timeframe)

Provide information to RCC Users for use in development of climate adaptation strategies

Such information are made available through CariCOF, Sector-specific meetings/workshops and email lists. Support in recent years have been in developing strategy toward drought resilience, with the support of the climate-related drought products, including the alerting system.

Perform verification on consensus statements for forecasts

Verification exercises on both objective forecasts and consensus seasonal climate outlooks have been carried out in terms of ROC, Hit Rate Skill Score and other, related scores, however routine verification information not made available routinely. CIMH's rainfall tercile forecast verification has been performed by an MSc student of the University of the West Indies for satisfaction of the thesis. To be published (Bedward and C. Van Meerbeeck referred to earlier) either in peer reviewed or as a Technical Report of the university.

2. Non-operational Data Services

Assist NMHSs in the rescue of climate data from outmoded storage media

This has been done through projects funded by the Caribbean Development Bank and the European Union. The data has been embedded into the CIMH archives. CIMH/RCC will review the needs for further data rescue.

Assist NMHSs to develop and maintain historical climate datasets

This is already being done as it comes with our mandate for sixteen Member States of the Caribbean Meteorological Organization (CMO). Providing a synchronising version of the

customised CIMH/RCC database that will soon be completed is an extension of this. Also through the RCC process, data from other Caribbean and Central American States are submitted to CIMH specifically for the use of climate monitoring and forecasting analyses.

Assist RCC Users in the development and maintenance of software modules for standard applications;

As per the CIMH/RCC customised, synchronised database above.

Advise RCC Users on data quality management

This is already being done as it comes with our mandate. This is done in our training programmes as mandated, along with other short courses, along with collaboration with other regional and international institutions through other initiatives.

Develop and manage databases, and generate indices, of climate extremes;

The management of databases for the region was already part of the mandate of CIMH since establishment. The customised database with synchronising application for NMHS is in its final stage of development. Development of indices has commenced at CIMH/RCC and in collaboration with other institutions and initiatives; one of these is through the use of RCLIMDEX. This resulted in a study that has been published in peer-reviewed journal on trends of observed climate extreme indices in collaboration with other academic institutions and NMHSs of the region. This work is scheduled to continue in early 2016 through further analyses of seasonal extremes, Climpacts training for specific sectors, and work on monthly climate indices is completed and being compiled for publication.

Perform Quality Assurance, Quality Control on regional datasets

Already a part of our mandate on establishment

3. Coordination Functions

Strengthen collaboration between NMHSs on related observing, communication and computing networks including data collection and exchange

This is being done in collaboration with CIMH's Instruments and IT centre. One of the strategies is to create a homogenous network of instruments, which will go a long way in lowering the costs through bulk purchases, the cost of training as instruments would have the same technology

across the region, and have a stockpile of spares that can support multiple locations and countries. Recently installed instruments in Caribbean transfer real-time data to the CIMH/RCC.

Develop systems to facilitate harmonisation and assistance in the use of LRF products and other climate services

An automated system for production of LRF products CariCOF Outlook Generator (CAROGEN) is near completion and will be delivered in November 2015, and will harmonise the delivery of these products. Training will be conducted for NMHS in November 2015 in the use of the automated system. It will be easier for users to make comparisons across the region as all displayed information will be based on the same experiments and approaches.

Assist NMHSs in user liaison, including the organisation of climate and of multidisciplinary workshops and other forums on user needs

This is already being done under a number of initiatives and alongside the GFCS programme as national consultations and NCOFS are supported by CIMH/RCC. The CIMH/RCC has already supported this cause in Belize, Trinidad and Tobago, Dominica and Suriname. Through the Caribbean Agrometeorological Initiative that ended in 2013, agricultural sector workshops were held in ten Caribbean States. Through other initiatives, national sector workshops are slated to commence in late 2015

Assist NMHSs in the development of a media and public awareness strategy on climate service

CIMH/RCC has employed its first communications specialist to support strategy development particularly at the CIMH/RCC, and to also support the NMHSs. Training for NMHSs began in 2013 and another WMO-sponsored training session is planned for November 2015.

The November 2015 media training will promote the value of climate services for island nations and build capacity in communicating climate information. Well-known BBC journalist and presenter, Mr. David Eades, will provide participants with specific skills required to understand what journalists are looking for and to how to frame effective messages for print and broadcast media. The training will include reviews of good and bad stories about other science-based organisations. It will also include practical radio and on-camera experience to help the participants understand how to: construct and keep to a message; take control of a situation; use language and body language effectively. At the conclusion of the training selected participants will be invited to participate in a simulated panel discussion in front of live cameras.

4. Training and Capacity Building

Assist NMHSs in the training of users on the application and on implications of LRF products on users

This is done through CariCOF and other regional sector-specific workshops through a number of projects and initiatives. National workshops are also supported by CIMH when possible. These workshops serve to adapt the regional scale forecasts to the national context. They also facilitate the tailoring of products and translating key messages for users (through multidisciplinary working groups). Moreover, user-provider interaction and feedback is enhanced as well as impact evaluation of expected weather conditions (given existing vulnerabilities).

Assist in the introduction of appropriate decision models for end-users, especially as related to probability forecasts

This has begun with a drought alerting system that was developed alongside the stakeholders at various regional workshops.

Promote technical capacity building on NMHS level (e.g. acquisition of hardware, software, etc.), as required for implementation of climate services.

This has already begun under a number of initiatives where hardware and software are acquired (including instruments, computers, software on GIS, statistical packages and others) for use by both CIMH/RCC and NMHS, and is supported through a number of workshops that train on their use and application.

Assist in professional capacity building (training) of climate experts for generating user-targeted products

This has already begun under a number of initiatives and continues through a number of workshops, including pre-CariCOF training. Other examples of training for NMHS was through the CAMI project (e.g. using DSSAT and FAO AquaCrop models, pests and diseases models) for agriculture, with this currently being expanded (including for other sectors) through the establishment of the EWISACTS initiative; training on statistical applications; drought monitoring and planning; and the building and application of the Caribbean Climate Impacts Database.

5. Research and Development

Develop a climate Research and Development agenda and coordinate it with other relevant RCCs

This is primarily done through several internship programmes supporting research within the RCC and through collaborative research with other regional and international research institutions. However, there is no collaboration with other RCCs at this time.

Promote studies of regional climate variability and change, predictability and impact in the Region

Promoting impacts studies has already commenced, particularly with impacts through the development of EWISACTS and the launching of the Caribbean Climate Impacts Database (CID). The impact research on sectors is supported by an internship programme at CIMH/RCC. Current research is being done on climate predictability, climate change monitoring and projections, in collaboration with other institutions. In the case of CIMH/RCC, there is a greater focus in the area of climate variability.

Develop consensus practices to handle divergent climate information for the Region

This has been commenced with the building of historical reference climatologies for the CariCOF participating territories derived by an in-house built automated generator (CAROGEN) – so therefore developed through the same processes. This automated system, when finally released in November 2015 in time for the dry season pre-CariCOF training, will also homogenise the data management and experiments for seasonal forecasts across the different CariCOF NMHS.

Promote application research, and assist in the specification and development of sector specific products

This has already commenced through CAMI for agriculture and continues with research and development in Early Warning Information Systems across Climate Timescales (EWISACTs) for multiple climate sensitive sectors. For example, the User Baseline survey which was conducted under the sectoral EWISACTs component of the BRCCC Programme, is expected to inform product tailoring and development for climate sensitive sectors in the near to medium term.

As a precursor to conducting future applied research, CIMH has conducted searches of the academic and grey literature on the relationship between sectoral productivity outcomes and climate for six climate sensitive sectors. A centralised Mendeley referencing system has been

developed and annotated bibliographies for six climate sensitive sectors are available. Archived soft copy scientific and grey literature articles and reports are also available.

In addition, new R&D relationships have been brokered through the recently formulated (May 2015) Consortium of Regional Sectoral EWISACTs Coordination Partners. As sectoral partners on the climate services agenda, regional sectoral technical agencies have agreed to facilitate the climate R&D agenda by specifically: 1) supporting the formalisation of data sharing arrangements; 2) facilitating the identification and sharing of historical climate-related sectoral impact data; 3) supporting the conduct of research or a review of research that examines associations between climatic variables and relevant sectoral productivity outcomes, and 4) providing technical input that contributes to the validation and tailoring of tourism climatic bulletins produced by CIMH. These sectoral responsibilities have been formalised through sectoral partner Terms of Reference documents.