WORLD CLIMATE PROGRAMME

WORLD CLIMATE SERVICES PROGRAMME

WMO WORKSHOP ON GLOBAL REVIEW OF REGIONAL CLIMATE OUTLOOK FORUMS

5-7 September, 2017
Guayaquil, Ecuador

MEETING REPORT

WORLD METEOROLOGICAL ORGANIZATION

November 2017

The **World Climate Programme (WCP)** implemented by WMO in conjunction with other international organizations consists of the following major components as per decision of the seventeenth World Meteorological Congress (Cg-17) in 2015:

Global Climate Observing System (GCOS)
World Climate Research Programme (WCRP)
World Climate Services Programme (WCSP)
Global Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA)

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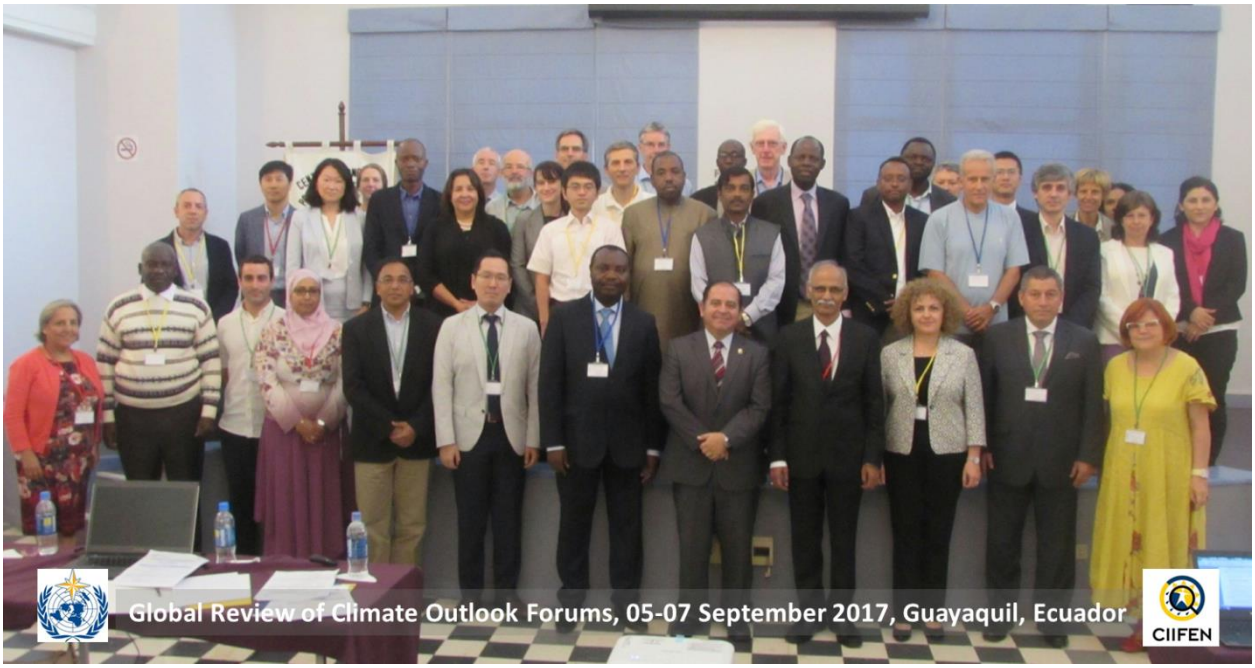

Participants of the WMO International Workshop on Global Review of RCOFs, 5 - 7 September 2017, Guayaquil, Ecuador

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Executive Summary

Since the establishment of Regional Climate Outlook Forums (RCOFs) in late 1990s, the World Meteorological Organization (WMO) has been actively supporting their operations, and conducting periodic expert review of RCOFs operation in order to identify gaps and challenges and propose way to improve and standardize the RCOF process. On the occasion of the RCOF concept completing two decades of successful implementation, WMO undertook a comprehensive review of the RCOF process, a Global RCOF Review 2017, to examine all aspects of the interpretation, creation and dissemination of regional climate outlooks as handled through the RCOFs, particularly in the light of the recent achievements and given the higher expectations and requirements of stakeholders in more actionable climate information tailored to their needs, and to agree on the way forward towards the improved and sustained RCOF processes. The RCOF Review was guided by the Commission for Climatology Task Team on RCOFs (TT-RCOF) in close collaboration with the Subject Matter Experts (SME) from international institutions involved in RCOF process.

The WMO International Workshop on Global Review of RCOFs, was held from 5 to 7 September, 2017, in Guayaquil, Ecuador, hosted by the International Research Center on El Niño (CIIFEN). The Workshop was well attended by the Technical/Organizational Leads from all the existing RCOFs worldwide, representatives from WMO RCCs, GPC-LRFs and the associated Lead Centres, other regional and international institutions involved in and/or coordinating RCOF operations and capacity building activities, invited climate experts, the members of TT-RCOF.

Participants in the workshop reviewed the activities of individual RCOFs, analyzed the different aspects of current operational practices at RCOFs, including the development of consensus outlook, verification, capacity development, user engagement and so on. Furthermore, they discussed the opportunities for improved and sustained RCOF process, that was discussed in more details in the breakout groups.

In conclusion, participants unanimously recognized the progress achieved, particularly on the contributions of RCOFs in promoting wider use and better interpretation of seasonal forecasts at the national levels and agreed on the way forward towards the new generation of RCOFs (RCOF v2.0), including:

- ✓ Mainstreaming of objective seasonal climate forecasting underpinning RCOF products,
- ✓ New approaches including expanded product portfolio, based on standardized operational practices identified during the workshop,
- ✓ Follow-up integration of seasonal outlooks in decision-making process at country level
- ✓ Improved Partnership and User Engagement in RCOF process
- ✓ Organization of "centralized" training workshops to better target capacity development efforts associated with RCOFs

Furthermore, the following specific recommendations were made on the way forward for improved RCOF operations:

- Promote greater access and utilization of WMO LC -LRFMME data to enable RCCs to produce objective forecast for RCOF operations/RCCs to optimize skills for the region of interest
- RCCs to continue guiding/coordinating the RCOF process, including the responsibilities of RCCs to play a role in resource mobilization for RCOFs
- Build feedback mechanisms at RCOF sessions to propose improving RCC activities to better address RCOFs needs
- Expand RCOF product portfolio to include:
    - Climate Monitoring
    - Verification
    - Remote climate anomalies
    - Sub seasonal products
    - Introduce Climate Change component, in terms of observed trends, attribution of extreme events in climate change context, etc.
    - Replace the pre-COF training sessions with "centralized" training workshops that address specific competencies across regions
- Promote stronger linkages of RCCs, RCOFs with research community
- Establish/Implement regular NCOFs (and other similar mechanisms) at national (and sub-national) levels, with the primary aim of sharing seasonal products and their updates on a regular basis to support sector-driven climate risk management
- National Frameworks for Climate Services (NFCS) linked to high-level cross-cutting objectives, will provide mechanisms for sustainability to the national climate forums
- Ensure joint provider-user ownership of RCOF process, demonstrating the value of forecast and advocating with the governments the usability/value of the RCOF/NCOF products

OPENING SESSION

The WMO Workshop on Global Review of Regional Climate Outlook Forums opened at 09.00 am on Tuesday, 5 September 2017 at the International Research Center On El Niño (CIIFEN), Guayaquil, Ecuador. The opening session was addressed by Mr José OLMEDO MORÁN, the Permanent Representative of Ecuador. He warmly welcomed the participants of the Workshop, highlighting the importance of the event, and some major milestones and achievements in Ecuador, including successful and sustained implementation of Western South American Climate Outlook Forums (WSACOF). He noted the importance of provision of reliable and high quality climate services for managing climate risks, and that RCOFs play a critical role in this process. Dr Rupa Kumar Kolli, on behalf of the Secretary General of WMO, expressed gratitude to the government of Ecuador, the PR of Ecuador, and the CIIFEN for hosting this important event. He highlighted the central role of the Commission for Climatology (CCl) Task Team on RCOFs (TT-RCOFs) in the review process, particularly in following up on the recommendation of the Workshop. Mr Rodney Martinez, the international director of CIIFEN, introduced the role of CIIFEN in implementing climate services at regional level as a WMO Regional Climate Centre (RCC). On behalf of the CIIFEN team he welcomed the participants of the Workshop and wished them a very successful meeting.

The opening was followed by a tour de table of self-introduction of participants. Participants were also informed by the host about logistical arrangements during the Workshop. The rapporteurs were requested to provide draft summaries of their assigned sessions to the WMO Secretariat to facilitate development of the Workshop report.

SETTING THE SCENE

Workshop Concept, Goals and Objectives, along with a recap of previous reviews

Through a keynote presentation, Rodney Martinez provided the workshop with an overview on the overall concept of RCOFs, and the progress since the RCOFs were established following a Meeting in Victoria Falls, Zimbabwe in 1996. RCOFs have demonstrated such benefits as broad awareness and acceptance of seasonal forecasts, improvements in Members' capacities to develop and interpret such forecasts, and the provision of useful information for decision-making.

Mr Martinez recalled previous reviews of RCOFs, the first held in 2000 in Pretoria, South Africa, the second in 2008 in Arusha, Tanzania, and the progress made since then by following some of their recommendations, and from analyzing the lessons learned concerning how to ensure that the recommendations are successfully fulfilled. In particular, a number of recommendations highlighted at the Global RCOF Review 2008, such as closer integration between GPCs, RCC, NMHSs, support to national meteorological services, improved capacity building, better understanding of user-level decision processes to make RCOF products user driven, and so on, still need further attention. Mr Martinez mentioned the position papers developed as an important outcome of the RCOF Review 2008, emphasizing that most of the issues raised in these papers are still valid.

Building up on the previous events, Mr Martinez presented the scope, the overall objectives of the Global RCOF Review 2017, stressing that the current review aims at examining carefully the processes currently in vogue at various RCOFs in order to:

- Identify the lessons learnt, and good practices in RCOFs
- Identify opportunities and innovative approaches for RCOFs
- Explore possibilities to enhance/improve the capacity development benefits of RCOFs
- Consider possible expansion of the RCOF product portfolio, and

- Propose ways to make more effective delivery and communication of climate products and services for decision making in a sustainable manner.

RCOF operational practices: Towards objective seasonal forecasting

Mr Rupa Kumar Kolli recalled the current practices of developing the consensus approach through consolidating forecast information and products from multiple sources, which is mainly subjective and hinges on confirming or challenging the statistical results – which may influence final predicted probabilities - and the blending of individual national forecasts into a spatially coherent regional outlook. Mr Kolli also highlighted a number of key limitations of RCOF outlooks, such as unsuitability of the format for applications in decision making, forecast skill not routinely evaluated, absence of a systematic approach to provide regular updates as the target season evolves, very limited use of RCOF products at national scale, lack of user tailored product packages.

Based on a recent White Paper developed, and EC-69 decision, he argued that these and many other known limitations of the current RCOF forecast process could be addressed by the adoption of objective approaches to regional seasonal forecasts, and make RCOF outputs more reliable and user-targeted. The participants were informed on a number of initiatives/activities underway that will inform the way forward to take up objective approaches for operational regional seasonal forecasting, both under the auspices of the WMO CCl. The first is the joint development, with the Commission for Basic Systems (CBS), of a Technical Guidance on Operational Predictions from Sub-seasonal to Longer-time Scales (OPSLS), which is expected to establish a basis for the future development of long-range forecasts, associated outputs, and the coordination of the ingredients necessary to produce them. The regular global workshops on Operational Climate Prediction, as well as following up the current Global RCOF Review recommendations, are expected to facilitate the implementation of objective forecasting concept in RCOF practice, which is initially anticipated to be done through the piloting of development and institutionalization of objective seasonal forecasting schemes in selected regions. Implementation of such pilots will have three dimensions:

1) Identifying skillful seasonal forecast methodologies for specific regions,
2) Identifying and accessing the necessary resources for developing and operationalizing such methodologies, and
3) Assembling and coordinating the cooperation among the institutions that would be involved in further developing and operationalizing skilful seasonal forecast systems.

GPC-LRFs, RCCs and their role in RCOF operations

Mr Caio Coelho informed participants about the current status of Global Producing Centres for Long Range Forecasts (GPC-LRF) and RCCs as operational mechanisms for producing forecasts at global, regional levels. GPC-LRFs are established through a designation process. They provide a minimum set of required products, delivered in the form of maps and/or digital data, that can be downloaded from a GPC-LRF or the Lead Centre for LRF Multi-Model Ensemble (LC LRFMME) web site.

Mr Coelho briefed participants about activities of the LC LRFMME and the Lead Centre for Standardised Verification of Long Range Forecasts (LC SVSLRF). The LC LRFMME, jointly operated by Korean Meteorological Administration (KMA) and NOAA NCEP, collects retrospective and real-time forecasts from GPCs and produces multi-model ensemble (MME) forecast from the collected GPCs. More recently, the LC LRFMME started: 1) production of verification products from the collected GPCs' retrospective forecasts, for GPCs that delegate

score computation to the LC, and 2) dissemination of all forecast and verification products listed above to NMHSs, RCCs and RCOFs. The LC LRFMME also contributes to the Global Seasonal Climate Update (GSCU), providing forecast and verification products. Recently, the LC LRFMME also started the development of pilot sub-seasonal forecast products.

The LC SVSLRF is jointly run by the Australian Bureau of Meteorology (BOM) and the Meteorological Service of Canada, and provides access to the verification software and relevant documentation of the system, as well as access to final verification scores both in digital and graphical format. If required the Centre also provide technical support.

WMO RCCs are centres of excellence, designated based on the set of criteria and requirements. RCCs provide regional climate products in support of regional and national climate activities, performing mandatory and often also some of highly recommended functions.

Mr Coelho suggested that RCOFs could serve as a platform for collecting RCC/RCC-Network feedback from NMHSs and sector specific users. The CCl Expert Team on RCCs (ET-RCC) has recommended considering to include RCC feedback questionnaires in the agenda of RCOFs.

Mr Coelho informed on the current status of utilization of GPC-LRFs and RCC products by RCOFs, challenges faced, as well as future prospects to improve their input to RCOFs operation. The latter include ensuring easy and free access to the required data, and generation of pre-processed products for RCOF target regions. In particular, he mentioned that currently available forecast and verification products (maps) disseminated either directly by GPC-LRFs or via the LC-LRFMME are being successfully integrated by RCCs into the RCOF process for producing consensus forecasts based on expert assessment of all available information. He underscored that, for moving towards objective seasonal forecasts in RCOF regions, the use of both hindcast and real time forecast datasets disseminated either directly by GPCLRFs or via the WMO LC-LRFMME need to be further encouraged and facilitated.

In terms of future prospects for improving RCOF practice, Mr Coelho highlighted the need of close collaboration between GPCs, RCCs, and NMHSs. These centres could support in addressing a number of additional challenges in RCOFs, such as moving beyond tercile categories, forecast interpretation and communication, particularly uncertainty aspects, tailoring and downscaling, as well as incorporation of multiannual/decadal and climate change information in RCOFs.

In the follow up discussion, answering a question about the usability of RCOF products at regional level, participants were informed that many United Nations agencies and humanitarian organizations need and use RCOF products for their decision making. However, many RCOF products have limited applicability for specific decisions particularly at smaller (national and local) scale. This aspect needs to be addressed at national level.

REPORTS OF RCOF OPERATIONS AROUND THE WORLD

In this section, status reports of existing 19 RCOFs and one new RCOF (Pan – Arctic Climate Outlook Forum, or PARCOF), to be established in 2018, were presented. Each of the speakers presented a brief report on various aspects of the RCOF such as background behind the establishment of the respective RCOF, various process involved in the COF meeting, associated training workshop for the participants and user forum meetings, a

SWOT analysis of the RCOF, and the way forward. Among the various processes of these RCOFs, preparation of the consensus forecast outlook for the relevant season is the most important activity. A notable common feature of all RCOFs was that current use of dynamical forecasts is mainly subjective and hinges on confirming or challenging the statistical results – which may influence final predicted probabilities - and the blending of individual national forecasts into a spatially coherent regional outlook. It was also observed that consensus forecast outlook statements issued by various RCOFs are well structured and in general consist of a summary of the statement, introduction, current status and the forecast outlook of the large global climate anomalies like ENSO, IOD, snow cover over NH etc., and a consensus forecast outlook along with a probability forecast map and a climatology map, as well as the verification of consensus forecast issued for the previous year. Meanwhile, there were some differences in the presentation of the consensus forecast maps, such as text used in the tercile categories, color codes used for representing tercile categories, spatial scales at which probability forecasts are issued, etc.

Greater Horn of Africa Climate Outlook Forum (GHACOF)

Mr Guleid Artan presented the GHACOF, which was initiated in 1998. GHACOF has been sustained and currently is being organized under the coordination of IGAD Climate Prediction and Applications Centre (ICPAC) on a regular basis three times a year, generally with resources from various projects at ICPAC. In order to meet users' requirements, GHACOF moves towards generating actionable information. Among the recommendations for improving the process Mr Artan mentioned: utilization of online platforms, access to GHACOF products through on-line maprooms and geo-portals; introducing a high level forum after every GHACOF dedicated to policy makers; co-design and co-produce tailored climate services with users; implementation of an objective method for developing consensus regional climate outlooks, expansion of GHACOF products to include climate monitoring, sub-seasonal information including onset and cessation, rainfall distribution, climate advisories, impact-based outlooks, and climate change information for adaptation.

Climate Outlook Forum for Central Africa (PRESAC)

Climate Outlook Forum for Sudan-Sahelian Africa (PRESASS) and

Climate Outlook Forum for the Gulf of Guinea countries (PRESAGG)

Mr A. Kamga Foamouhoue presented the Climate Outlook Forum for Central Africa (PRESAC), the Climate Outlook Forum for Sudan-Sahelian Africa (PRESASS) and the Climate Outlook Forum for the Gulf of Guinea countries (PRESAGG) which take place annually in April or May under the coordination of the African Center of Meteorological Application for Development (ACMAD) and AGRHYMET, a specialized agency of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS). In terms of developing capacities, irregular training workshops on seasonal forecasts and climate services are being organised prior to PRESAC, PRESASS and PRESAGG sessions, subject to the project budget availability. Mr Kamga mentioned users' sessions which are used to collect feedback on the use of last forecasts, tailoring forecasts, and preparing for potential impacts and early action. As an example he mentioned the case in Kenya, when the seasonal outlook warning for drought was used by the IFRC to provide aid. To improve the PRESAC, PRESASS and PRESAGG, he proposed to expand current seasonal forecasting procedures to sub-seasonal forecasts and climate change scenarios for impact assessment and resilience policies and plans; train NMHS and RCC experts on forecast and scenarios provision; produce more

tailored forecast products to meet needs of practitioners, policy and decisions makers; as well as technical notes, bulletins or reports for practitioners; and syntheses or statements for policy and decision making, to be systematically provided as elements of climate services as contributions to the GFCS.

Mr Seydou B. Traore presented the role of AGRHYMET in the PRESASS and PRESAGG processes. AGRHYMET was created in 1974 to contribute to achieving sustainable food security and rational management of natural resource through provision of information to various decision makers as well as capacity building of member States meteorological, hydrological, crop protection and agricultural statistics agencies. Among the AGRHYMET Agricultural Campaign Monitoring products, Mr Traore mentioned: seasonal forecasts of rainfall, onset and cessation dates of the rainy season, dry spell durations and maximum river discharges; and Monthly and Special alert bulletins. AGRYMET has been involved in the RCOF process in West Africa since the inception of Climate Outlook Forums for West Africa (PRESAO) in 1998 (currently PRESASS). AGRHYMET is involved in a number of projects, e.g. MESA, and pilot projects to communicate RCOF results to agricultural extension staff and farmer associations (CCAFS, ACCIC, BRACED), SERVIR and SAWIDRA (with involvement of national DRR agencies).

Climate Outlook Forum for North Africa (PRESANORD)

Ms Khadija Kabidi presented PRESANORD, which was initiated in January 2012, led by ACMAD. Currently, PRESANORD is organized at least once a year under the umbrella of the Mediterranean Climate Outlook Forum (MedCOF) with financial contributions from Agencia Estatal de Meteorología (AEMET-Spain). At PRESANORD sessions the seasonal outlooks are developed based on understanding and analysis of predictability sources. Participants attend training sessions and workshops on seasonal climate prediction associated with MedCOF. Among the opportunities Ms Kabidi highlighted were conducting more research on ocean-land-atmosphere modeling to improve regional model outputs for region, providing regular monthly updates, demonstrating the value and usefulness of the seasonal forecast for different socioeconomics sectors through pilot projects and design annual synthesis report, and enhancing the collaboration and contributions of all the five North African countries.

Southern African Regional Climate Outlook Forum (SARCOF)

SARCOF activities were presented by Ms Nsadisa Faka. In the frame of capacity development activities, an annual training programme focuses on the seasonal forecast system prior to the consensus building. An attachment programme is used to respond to the capacity development needs in NMHSs. Ms Nsadisa underlined that SARCOF, as part of its process, collects user "feedback", but the response to the needs is insufficient due to lack of manpower to perform more analysis as requested by users. In order to improve climate services, the Climate Services Centre (CSC) of the Southern Africa Development Community (SADC) developed a strategy with the following elements: (1) understand users' needs, current use of climate services (LRF), and sector specific vulnerability response; (2) improve decision-relevant scales and decision-relevant parameters; and (3) engage and demonstrate climate service prototypes, delivery and engagement. Among the examples of tool and services development Ms Nsadisa mentioned a streamlined seasonal forecast process, user-friendly tools on downscaling, and tools for climate services applications.

South West Indian Ocean Climate Outlook Forum (SWIOCOF)

Mr François Bonnardot, while presenting the SWIOCOF, mentioned that it was initiated in 2012 in the framework of ACCLIMATE project (IOC). Currently is being held annually in September under technical coordination of Météo-France (La Réunion) and ACMAD; with logistical support of Indian Ocean Commission and no sustainable funding (WMO for SWIOCOF in 2016 and 2017). In order to advance SWIOCOF capacity development, the following training activities were mentioned: basic understanding of global and regional climate variability; facilitating access to the essential inputs on large scale and regional scale drivers and jointly interpreting their potential influences; and downscaling large scale data to derive local scale information. To address the capacity gaps, Mr Bonnardot underlined "the lack of continuity in NMHSs representatives; experts are different every year and frequently have very poor experience in seasonal forecast". Among the opportunities and recommendations for the SWIOCOF next session are strengthening capacities from different NMHSs, and links with national or regional stakeholders to identify key services that could be provided for the region; defining regional homogeneous data sets of observed precipitation and temperature; developing tailored products for users; and possible partnership with RIMES.

East Asia winter Climate Outlook Forum (EASCOF)

EASCOF was introduced by Mr Yasushi Mochizuki. The EASCOF aims to share recent understanding of phenomena related to seasonal prediction of the East Asian winter monsoon and provide a seasonal outlook for the coming winter. During the forum, five sessions take place: Current Status and Future Plan of Seasonal Forecasting Service, Understanding of the Mechanism on East Asian Winter Monsoon, Overview of recent East Asian Monsoon and ENSO current status, Seasonal outlook for each country from NMHSs and Discussion. After the forum, the EASCOF process is followed by further value addition and dissemination of outlooks to stakeholders at national scale. Mr Mochizuki highlighted the roles of Regional Climate Centers (RCC) for sustainability of EASCOF, such as contribution to the development of the consensus outlook, exchange of expertise for climate outlooks through follow-up activities, active communication with the research community, and the promotion of information sharing on state-of-the-art expertise and techniques for climate services in the forum. Among the recommendations for further EASCOF development, Mr Mochizuki mentioned promotion of meteorological understanding of the East Asian monsoon system, promotion of continuous involvement of research community and sharing of the current status of utilization of long range forecasts in each participating country and their activities for promotion of use of the forecasts, and interaction with user communities. In this regard, it is planned to invite user representatives to the next session of EASCOF to obtain feedback about the usefulness of the products.

Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRAII)

Mr Zhiqiang Gong presented the FOCRAII, which takes place annually and covers all the countries in Asia, most being Members of WMO Regional Association II. The FOCRAII activities are coordinated by the Beijing Climate Centre (BCC) of the China Meteorological Administration (CMA) with sources of funding provided by the Regular International Cooperation Fund of CMA. The FOCRAII mainly works on the summer prediction of precipitation and temperature. Among the FOCRAII capacity development activities, Mr

Gong mentioned: establishing the mechanism and workflow in the areas such as improving data sharing and collaborative release of products, deepening the cooperation and exchange between different sectors, strengthening cooperative R&D activities and joint training, and optimizing the operational service system and distribution. Mr Gong highlighted that engagement, feedback, monitoring and evaluation are essential for capturing the user's experience and hence improving services.

South Asian Climate Outlook Forum (SASCOF)

Mr D. S. Pai presented SASCOF, which is coordinated by India Meteorological Department and financially supported mainly by WMO through its various funding agencies, including the United States Agency for International Development (USAID), Department of the Environment, Government of Canada, and others. The SASCOF physical sessions take place in April for the SW Monsoon and in September for the NE Monsoon. A SASCOF online session is organised in November for the winter season (December to February). The consensus outlook is based on the prevailing large scale global climatic patterns (like ENSO, IOD, Snow Cover etc.) and seasonal forecasts for the relevant season from both statistical and dynamical models. Mr Pai mentioned that a capacity development workshop, as a part of the main forum meeting, was introduced in response to a recommendation of the SASCOF-1, in 2010, to provide an updated overview on current research on seasonal prediction; dedicated lessons and the opportunity to develop simple empirical prediction schemes for the national scale or homogeneous region-wide rainfall; and training to prepare country-based seasonal forecast outlooks. Among the issues faced during the capacity development workshops, Mr Pai mentioned: no continuity in the training due to new participants each year, some participants lack required background in the subject, and lack of good quality gridded climate data. For further acceptability and usability of the SASCOF products, the following points were underlined by Mr Pai: make the process of preparing the consensus forecast map from various forecast inputs as objective as possible; standard tools for verification of consensus forecasts; the seasonal forecast to be supplemented by sub-seasonal/monthly climate forecasts; increased interaction with the user community and generation of tailored climate products for the users.

Southeast of South America Climate Outlook Forum (SSACOF)

Ms Laura Aldeco presented the SSACOF, which started in 1997 under the guidance of WMO, with the co-sponsorship of the International Research Institute for Climate and Society (IRI) and the National Oceanic and Atmospheric Administration (NOAA). Since 1999, the forums have been organized twice a year by the National Meteorological and Hydrological Services (NMHSs), with the financial support from WMO and, in recent years, also the State Agency for Meteorology of Spain (AEMET). The SSACOF process has two main steps: the diagnosis of the global and regional climate conditions of previous months, including the evaluation of the key drivers of the region's climate; and the use of forecasting tools (both statistical and dynamical) for preparing the final forecast outlook. Among the main recommendations for the near future, Mme Aldeco highlighted: calibration and verification of seasonal climate numerical models; verification and integration of the consensus forecasts; development of additional products for monitoring and forecast and tailoring forecast. It was noticed that an integration of the numerical models in the regions of South of South America is not easy due to the poor skill that most models have in many regions. This makes it more evident that calibration and a study to decide which models should be integrated based on their performance are needed.

Western Coast of South America Climate Outlook Forum (WCSACOF)

Mr Rodney Martinez informed participants that since WCSACOF establishment in 2003 by the NMHSs of Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela, under the auspices of WMO and with the coordination of CIIFEN, the sessions are organized on an annual basis, generally at the end of the year. Specialized training courses are being held to strengthen capabilities for the provision of climate services. Mr Martinez noted that the RCOF has enabled the implementation of regional projects, which had enhanced technical cooperation, mutual assistance, and sustained capacity building efforts.

Among the WCSACOF weaknesses, Mr Martinez mentioned: employment instability and lack of technical personnel in most of NHMS, and limited interaction between research community and NMHSs. In order to enhance the WCSACOF, it was proposed, *inter alia,* to support NMHSs to implement NCOFs or Sector User COFs; to develop capacities including the fundamentals of sub-seasonal prediction; to foster research on regional and sub-regional atmospheric processes critical for improving the seasonal prediction; to review and document experiences on the use of specific predictors/domains for the different sub-regions and seasons; to harmonize the verification systems in the NMHSs from the region; and to develop and apply tools for tailoring seasonal forecasts for agriculture, water resources and risk management.

Central America Climate Outlook Forum (CACOF)

Participants were briefed by Ms Berta Olmedo on the operation of the CACOF, which was initiated in 2000. Since then it is being organized 2-3 times a year under the coordination of the Regional Committee of Hydraulic Resources (CRRH-SICA), with financial and expert support from the Office of Global Ocean and Atmospheric Administration Programs (NOAA). The process of development of a seasonal outlook in general is similar to other RCOFs. In addition, an analysis of similar (analogue) years using the Central American Climate Database (BDCAC) is being conducted. The outputs from a dynamical modelling system, SAMPRE 3, are also used as an input for the seasonal outlook. An interactive portal, Centro Clima, has been established through which information is collected, published, shared and distributed to support decision making. Another important feature of CACOF is the Application Forums held back to back with CACOF. These were initiated in 2007 by the organization in charge of Food and Nutrition Security of the Central American Integration System (SICA). A few challenges and needs were highlighted, such as the improvement of the skill of forecasts, inclusion of new variables, and reaching out wider users' communities.

Caribbean Climate Outlook Forum (CariCOF)

Mr Adrian Trotman informed participants that CariCOF is being held twice per year under the coordination of the Caribbean Regional Climate Centre hosted by the Caribbean Institute for Meteorology and Hydrology (CIMH), with financial contributions through projects funded by NOAA, USAID, ECC Canada, PPCR, and others. CIMH produces regular monthly updates between the CariCOF sessions, using the Caribbean Outlook Generator (CAROGEN), an automation platform integrated with the IRI Climate Predictability Tool (CPT). Some important features of CariCOF: it is sector driven, and helps sectors to take decisions by providing a number of thematic or hazard-specific outlook products (e.g. wet spells, heatwave days). CIMH also regularly produces regional bulletins and supports the NMHSs in developing the national ones through capacity building, and working along with them through the development, if requested. Participating countries disseminate the outlooks through NCOFs, currently being held in Trinidad & Tobago, Belize, Guyana, Suriname. The

adequate user engagement gives also an opportunity for collecting feedback which leads to producing more tailored products. Mr Trotman indicated that there are still some challenges and needs, such as to enhance skills in CDMS, GIS, to assess and illustrate an economic value of products. In the future measures are anticipated to enhance user engagement, use of online tools, platforms for remote COFs, and training sessions. More research will also be required to better understand the processes influencing the climate in the region.

ASEAN Climate Outlook Forum (ASEANCOF)

The activities of ASEANCOF (Association of Southeast Asian Nations COF), a forum initiated in 2013, were presented by Ms Thea Turkington. ASEANCOF is conducted twice a year with one physical session (DJF Boreal Winter Monsoon) and one online session (JJA Boreal Summer Monsoon). While the physical sessions, as well as pre-COF training, allow for more in-depth discussion among the participants, having one of the sessions online is thought of as a more sustainable approach. Each session has a theme and the relevant regional end-users are invited to attend The main strengths of ASEANCOF is the model predictability for the region. Sessions also provide the platform for NMHSs and GPCs to exchange experience and best-practices in the different techniques, tools and skills of seasonal predictions. Challenges come from inconsistent methodologies across national predictions, and the lack of continuity in national representation at the meetings. There is potential for model and observational data to become more accessible (including sharing of data), as well as to improve participants' understanding of uncertainties in the outlook and the associated skill of products. The South East Asian RCC-Network will soon start its demonstration phase, which will provide an opportunity for regularly producing more regional products and services in support of ASEANCOF. An important initiative at ASEANCOF is a workshop on Climate Change Projections and their Applications in ASEAN Countries proposed to be convened in early 2018. The workshop will review the existing local climate change projections in a regional context, enhance regional networking, and ensure better integration of regional actors for utilization of regional and national scenarios. The workshop will serve as a Best Practice and could be replicated in other regions.

Pacific Islands Climate Outlook Forum (PICOF)

Mr Alexander Montoro informed participants that PICOF was initiated in 2015 and is being held annually in September-October prior to South West Pacific Cyclone season, with funds coming through different projects. Each session has a specific sector focus, e.g. the upcoming PICOF-3 will target the health sector. The Regional Statement is the main output of PICOF, which is being developed based on the seasonal forecasts from different models, tropical cyclone and ENSO forecasts with consideration of model verification skill scores. Following the PICOF session a number of countries disseminate the outlook to the national stakeholders through national COFs (NCOF). One of the advantages of PICOF is that users' needs are properly captured and addressed at the following sessions by providing more actionable information. The proposed WMO RA-V Pacific Island Regional Climate Centre Network (PI-RCC Network) is moving towards the demonstration phase. Among the needs and challenges, Mr Montoro mentioned the need for additional training in seasonal climate forecasting and increased technical modeling capacity. A challenge is to ensure sustainability of PICOFs and NCOFs.

North EurAsian Climate Outlook Forum (NEACOF)

Ms Valentina Khan informed participants about activities of the NEACOF, mentioning that since its establishment in 2013 NEACOF sessions are being held twice per year, a physical and an on-line at the end of spring and at the end of autumn to issue outlooks for the boreal summer and winter, under North EurAsian Regional Climate Centre (NEACC) coordination, and funding from the government of Russia and through various projects. Ms Khan emphasized that one of the main achievements is that NEACOF is the most effective mechanism for coordination and cooperation of NHMSs of former Soviet Union countries in climate services provision. There is also a visible progress in capacity building of NHMSs experts. However there is a risk for sustainability of organization of physical sessions of NEACOF and training courses. Among future prospects, Ms Khan mentioned conducting more research within scientific projects, proper training courses focusing on different aspects of seasonal forecasting, enhanced user engagement, and applying efficient evaluation of consensus forecasts.

Mediterranean Climate Outlook Forum (MedCOF)

The MedCOF, as introduced by Mr E. Rodriguez-Camino, covers the whole Mediterranean region and operates as an overarching entity in support of two other RCOFs existing in the region (SEECOF and PRESANORD). The RA VI RCC and Northern Africa RCC Networks, as well as the AEMET, play a paramount role supporting MedCOF activities, along with other institutions, such as ACMAD and the South East European Virtual Climate Change Center (SEEVCCC). MedCOF sessions focus on the large-scale forcings (e.g., NAO), that are shared by the whole basin, the subregional RCOFs focus on smaller-scale forcings refining and adapting the consensus forecasts provided by MedCOF. So far, the main funding mechanism for MedCOF has been WMO and AEMET support, meanwhile new possibilities of funding are envisaged based on agreements with C3S, MEDSCOPE and other EU initiatives. Mr Rodrigues underlined the following steps forward for MedCOF: improvement of evaluation and verification procedures pointing to the implementation of objective verification methods, following the recommendations of the WMO Commission for Climatology (CCl); development and implementation of tools for online working to facilitate the organization of remote MedCOF sessions; development of tools (toolkit) for Forecast Calibration, Verification and Information Synthesis; capacity building and transfer of knowledge; progress on user involvement; and close link with the MEDSCOPE (ERA4CS) project aiming to produce tools and support MedCOF activities.

South-East European Climate Outlook Forum (SEECOF)

Mr B. Bijelic presented activities of SEECOF, which was initiated in 2008 under coordination of the RA VI RCC-SEEVCC/RHMS of Serbia. Since 2010, two sessions are being held every year, an online and a physical session. The SEECOF sessions (both virtual and face-to-face) consist of three steps: the qualitative verification of the past SEECOF Consensus Statement on the Climate Outlook for the winter or summer season; an assessment of the current state of the climate, including large-scale climate patterns worldwide, assessments of the likely evolution of climate in the course of the following months, prepared by the RCC on CM (DWD) and LRF (Meteo-France); and development of the Consensus Climate Outlook for the following season (summer or winter). Mr Bijelic highlighted that the SEECOF Climate Outlook Bulletins are issued with additional sector specific climate information, e.g. for the water resource management and the electric power industry of Serbia. On the other hand, for agriculture, due to the small-size farms, the Climate Outlooks for the upcoming summer

season are not been used in an adequate way. Among the principle weaknesses of the SEECOF Forum, Mr Bijelic mentioned: lack of funding mechanisms to ensure sustainability of SEECOF; lack of feedback from the NHMS on the follow-up and utilization of SEECOF outlook at national level; and lack of prompt feedback during on-line meetings in delivering of NHMS contributions for the evaluation of the previous climate outlook and during preparation of the outlook for forthcoming season.

Pan-Arctic Regional Climate Outlook Forum (PARCOF)

Mr Bertrand Denis informed participants about PARCOF, which is planned to take place for the first time in spring of 2018. The PARCOFs will coincide with the launch of the Polar RCC (PRCC) demonstration phase and will be highly dependent on the PRCC products and services. The PARCOF involves all Arctic Council Member States, and is a unique COF that covers 24 time zones. Canada will support the implementation of the inaugural session of PARCOF. Among the PARCOF objectives, Mr Denis mentioned a review of recent Arctic climate conditions and their possible impacts on the coming season, assessment and interpretation of monthly and seasonal forecast products for the region (temperature, precipitation as well as various operational and experimental sea ice products), and development of outlook statements to communicate the outlook as well as anticipated risks. PARCOF will engage key users, decision makers and indigenous knowledge holders in a dialogue to better understand their needs and for them to explore how they can integrate the information, and to discuss with the polar scientific community how to translate advances in science into improvements in regional-scale services delivered through the PRCC. As, in the Arctic, the break-up/freeze up of sea ice drives the dates of the PARCOFs, it is anticipated to take place twice a year: a face-to-face meeting in Spring (April or May) and virtual meeting in Fall (September). Main expected outcomes of PARCOFs will be communication of risks and opportunities via an integrated bulletin, exploring the use of Indigenous Knowledge, improving understanding of users' needs, and understanding research needs to improve predictions.

In a summary, a **number of recommendations** were made by various speakers:

- The RCOF process and format of the forecast outlook should continue to be uniform or standardized.
- There is a need for development of high resolution and quality data bases for better climate monitoring as well as bias correction and verification of climate model forecasts.
- The process of preparing the consensus forecast map from various forecast inputs should be objective as much as possible.
- Skill maps of objective methods need to be made available for improving confidence in using the consensus forecast products
- Standard tools for verification of consensus forecasts
- Mechanism to update the consensus forecast regularly
- The seasonal forecast to be supplemented by sub-seasonal/monthly climate forecasts.
- Conduct capacity training workshops on other topics such as the construction of long time series of gridded climate data over the region, extended range prediction, climate applications and climate impact assessment

- Increased interaction with the user community and generation of tailored climate products for the users.
- Specialized capacity building workshops for user community.

Target seasons

All the combinations of seasons during the year have been reported as targets of seasonal forecasting. Some RCOFs are targeting three months seasons when a few areas have four to six months seasons. Models outputs for seasons lasting between three to six months are therefore relevant. Most RCCs and RCOFs are preparing forecasts valid for these seasons in their area of responsibility.

Funding partners

A set of financial stakeholders are identified: WMO, USAID and other development aid organizations, such as World Bank and Regional Development Banks, target countries, NGOs and UN organizations including UNICEF, UNDP, UNOCHA, FAO.

Forecasting process

Presentations highlighted persistence, analog, composite, variability and trends analysis, statistical and dynamical modeling, model outputs statistics as forecasting methods used by different RCOFs. In most RCOFs, forecasting involves verification of the last seasonal forecast, analysis and diagnostics on the current state of climate with emphasis on drivers of climate variability for the target region and seasons, and collection, processing, tailoring and interpretation of forecasts products leading to discussions to generate consensus. Sea Surface, land and atmospheric temperatures, ice and permafrost, circulation and precipitation fields, related phenomena and patterns including indices from NMHSs, RCCs, GPCs and LCs are main inputs to the process. Input Data and indices are processed to generate products which are interpreted, leading to climate outlooks disseminated to users in different formats. Sub-seasonal and climate scenario products and information are increasingly being considered as RCOF outputs. Some RCOFs are extending technical support as required to NMHSs to further generate detailed local information for users through National Climate Outlook Forums.

Capacity Development

One or more regional training events are organized every year to strengthen networks, share experiences and exchange on advances in forecasting methods, tools and new products as well as products interpretation guidance. Data rescue and management, seasonal prediction, climate services, understanding climate variability and change, sub-seasonal forecasting are the major topics of training events.

User involvement

Some RCOFs do not interact with users but rely on NMHSs to involve users mostly only at the national level. However, most RCOFs organize dialogue and discussions with users who

attend the forums to collect feedback, tailor climate information, understand user decision systems and practices, establish trust and credibility between climate information providers and users. Emailing lists, social media, radio and TV interviews are additional channels used by RCOFs to better involve users. Agriculture and water, Disaster Risk Management and humanitarian communities are the main user sectors of most RCOFs.

SWOT

Almost in all regions, RCCs or developing RCCs are operating. RCOFs are established and operational in all except the polar regions where the RCOF will become operational in 2018. Technical capacity on climate forecasting is established over most of the regions where RCOFs have about a decade of operation.

Weaknesses presented include lack of long periods of historical high quality climate data, limited staff, data processing and communication infrastructure in developing countries involved, no or weak interactions with universities to address seasonal to sub-seasonal forecasting research and development questions.

Among the threats presented, high staff turnover, little institutionalization of climate services as operational/regular activities in developing NMHSs, the overlaps on missions and mandates with climate change institutions and emerging alternative providers of climate information from the private sector are major constraints posing a challenge to sustainability of RCOFs.

The recognition of climate change as a global challenge to be addressed at the highest level and enshrined in SDGs, Paris Agreement and the Sendai Framework for DRR, the availability of climate and disaster funds dedicated to building disaster and climate resilience are opportunities for RCOFs.

The presenters made suggestions to shape the future of RCOFs. To improve credibility and trust in the user community, downscaling, tailoring with thresholds; forecasts verification and harmonization are essential. Regional efforts in collaboration with GPCs should be supported to undertake research on regional processes, phenomena and patterns driving climate variability and change from regional to local levels. High quality historical data, regional verification best practices, sub-seasonal and decadal forecasts, climate scenario generation and impacts assessments, more engagement of users, indigenous knowledge experts and community leaders to build trust and ensure relevance of climate information provided are proposed as ways forward.

During the open discussion the following main issues were raised for discussion: i) user involvement, ii) the number of RCOFs and adequacy of geographical coverage, iii) the current content/portfolio of RCOFs and future perspectives.

i) The participants highlighted that NMHSs are main users for RCOFs, which serve as a mechanism for strengthening capacities. However, participation of regional stakeholders and users is critical to learn about the usefulness, users perspectives. The humanitarian agencies, international organizations, e.g. FAO could be potential users of seasonal outlooks, which may help them to plan humanitarian aid to impacted regions.

ii) In terms of the number of RCOFs and geographical coverage, it was stressed that the most recent RCOFs are established based on needs from the region, while for the earlier

RCOFs it was rather prescriptive. While it may not be feasible to standardize RCOFs, due to a variety of specifics for different regions. One of the main strengths of multiple RCOFs was to empower as many NMHSs as possible, given that countries with similar challenges are involved in an RCOF.

iii) Participants questioned whether or not there is too much focus on forecast, and suggested that perhaps a description of current state of climate would be as important as the forecast, and even more so in areas with low predictability. It was highlighted that it is critically important to understand sources of predictability, analyze large scale circulation patterns, to have clear idea of the current state of the climate system in order to interpret its possible development in the coming season, particularly in regions where skill is very poor. A good knowledge of climatology is also very important, particularly in case of low predictability. While looking at predictability of dynamical models, and assessing predictability at regional scale, it is important to consider specific patterns, as there might be skill at smaller scales.

The issue of communication of climate information was also raised. While considering ways to improve the forecast skill, on the other hand, it is still required to adequately communicate it to users and provide them tailored, actionable information.

In conclusion it was stressed that there is a need to question whether the best of science is being used, given the recent development of models, methodologies. One should be able to trace back the forecast, and to be careful in developing the forecast. Another aspect is to strongly argue for objectivity. Second issue is to consider standardized approach, e.g. for reference periods. **It was agreed that, based on the discussions and outcomes of the review, an approach will be framed on the way forward with a new RCOF concept.**

SYNTHESIS OF RCOF OPERATIONAL PRACTICES

Development of consensus based outlook including data/forecast inputs

Mr Rodney Martinez addressed current approaches in developing consensus-based outlooks including data/forecast inputs from GPC-LRFs, RCCs and NMHSs. He first recalled a commonly applied forecast preparation process in RCOFs, which includes the review of the past and present state of the global sea surface temperature anomalies with emphasis on ENSO, the review of existing knowledge on teleconnections and impacts of sea surface temperature (SST) anomalies over the target region, analysis of atmospheric and oceanic patterns, use of expert knowledge of global/regional climate variability to summarize the current state of sea surface temperature anomalies and estimate the expected evolution during the target season and related impacts on seasonal temperature and precipitation of the target region, use of national statistical models developed and validated during the RCOF training phase to provide a second estimate of expected seasonal temperature and precipitation patterns over each country of the region, use of downscaling tools to prepare local seasonal forecasts, and use of seasonal forecasts from each of the existing GPC-LRFs, to provide a third estimate of the expected climate outlook using consistent patterns between models.

Mr Martinez highlighted problems in the forecast preparation process identified in the Global RCOF Review of 2008 (GRCOF 2008), including the fact that little effort has been devoted to skill analysis in addition to consistency checks between models outputs used in RCOFs operations. However, despite the availability of some verification products giving information on historical performance of statistical and dynamical models for seasonal

forecasting, interpretations of models outputs in some regions consider only consistency signals between models.

One of the GRCOF 2008 highlights was that the consensus discussion is held in different ways in different regions. The combination of large scale, regional and national information is sometimes quite subjective and questionable. This leads to problems in interpreting national products, and in inter-comparing and consolidating RCOFs products from different regions.

In conclusion Mr Martinez highlighted the problems and opportunities identified in GRCOF 2008 in terms of forecast presentation, impact assessments, and communication, including the following: Users from all sensitive sectors are usually not represented in the forums. The knowledge base on the impacts of past climate conditions and actions, decisions or policy options available for adaptation is usually missing. All RCOFs provide the climate outlooks, some add impacts outlooks (e.g. Food security, malaria), and very few provide actions or decision options for end users. These elements are fragmented and can be integrated to make RCOFs more useful, with a transformation of expected climate conditions to impacts and coping actions or decisions. The most likely category is usually considered as the expected condition by many users. The level of correctness of such interpretation is not always known and should be assessed with the verification community to prepare well informed messages on uncertainties. Current use of dynamical forecasts in developing seasonal climate outlooks at RCOFs is mainly subjective. These consensus-based approaches pose challenges for the usability of forecasts, particularly at the national level, as well as for evaluation of forecast skill. Further progress on operational seasonal forecasting, and associated tailored products for decision support, will entail more widespread adoption of objective seasonal forecasting schemes that readily facilitate the tailoring of forecast products to support specific end uses. Since the last RCOF Review, there have been considerable developments and scientific advances in sub-seasonal to seasonal forecasting methodologies, downscaling techniques, impact based forecasts, and communicating tailored climate information to users. CCl experts have developed a number of guidance documents, such as the Guidance on Verification of Seasonal Climate Forecasts, Guidelines on Good Practices for Climate Services User Engagement, Guidelines on Climate Risk Management. He concluded indicating that it is important to find ways to integrate these approaches into the RCOF process.

Understanding sources of predictability

Ms Anca Brookshaw addressed the issue of understanding sources of predictability. She started with a description of practices in RCOFs, which starts from the list of drivers, examining current state, predicting evolution, deriving teleconnections of individual drivers, including this info in consensus forecast in subjective manner, and finally communicating the information on the sources of predictability in a final document. She highlighted that some variations to this process exist in different RCOFs.

Next she looked at the question of why it is important to look at sources of predictability, indicating that it is important for assessing the 'predictability' of the situation, to qualify the level of confidence in the model predictions and to anticipate the likely scale of the predictive signals.

Further Ms Brookshaw addressed the question of how best to achieve this analysis of source of predictability in the RCOF context, suggesting to conduct research on understanding regional variability and predictability, rather than relying on existing studies, and, before

modifying model outputs, to examine if the effect is already represented by the model in question. Some issues were also highlighted including how does the information on skill coexist with information on predictability, what value do these analyses have when several independent factors influence predictability, and what are the best tools to combine the individual influences.

In terms of predicted drivers of predictability, Ms Brookshaw indicated the need to know the skill of (all) models in predicting the modes of variability. She also highlighted that predictability of drivers of predictability may not operate on seasonal timescales (e.g. shorter lead time than desired, shorter influence than the period of interest) (e.g. stratospheric warmings), and finally the need for integrating information from several sources – multi-model combination for modes of variability.

Furthermore, she looked at the issues of interpreting drivers of sources of predictability, whether the prediction should follow the canonical teleconnections, as well as the verification of RCOF forecasts, raising a question of whether a forecast should be considered as failed in case if high confidence predictions do not match reality.

Then she looked at the issue of sources of predictability and users, raising the questions: Should information on predictability be incorporated in the probabilities of the definitive forecast? Is it helpful to convey the information on predictability in subjective terms to non-specialist users? Or better to tailor the products to take this into account?

Ms Brookshaw concluded her presentation by indicating that the analysis of sources of predictability adds information of value to forecasters and to some users (predictability, scale of patterns), and that understanding the sources of predictability is not the same as having a clear path to using them.

Downscaling techniques and tools

Mr Jean-Pierre Ceron addressed the issue of downscaling techniques and tools. He indicated that downscaling is a well-known problem of bringing large scale information to local scales in order to be useful in application areas such as agriculture, water resources and health using sector specific models. He highlighted two key questions: until which scale one can expect to downscale the large scale information, and how to get the best compromise between the limits of seasonal predictability and the needs for applications?

Mr Ceron also indicated that the main goals of downscaling is to take into account mean local effects of the large scale forcing and to adapt the seasonal forecasting information to the relevant scale for the user (at least to get better resolution generally needed both in space and time). Additionally he mentioned that downscaling should reflect the mean effect of sub-grid processes forced by large scale conditions and take into account physical processes at the local scales, bringing more added information than a simple interpolation. He also indicated that downscaling brings some artificial increase in the resolution, contains uncertainty which must be evaluated and information which is part of the ensemble/probabilistic forecast. Additionally, he emphasized that downscaling has some chance to succeed if, and only if, the smaller scales are significantly forced by the large scale signal.

Mr Ceron then introduced three downscaling methods, starting with purely statistical methods, which are based on the analysis of Large Scale Conditions (e.g. SST, SOI). These methods assume that the large scale climate conditions have a slow evolution and a

significant influence on the local climate and are mostly based in linear statistical models including auto-regressive models and analogs, which are the common approach used in RCOFs. The advantages of these methods include the low computing cost, and facility to implement operationally. The disadvantages include the generation of forecast with possible artificial scores, the weak representation of interactions within the climate system, the difficulty of using these models for complex relationships and the need for regular recalibration due to multi-decadal variability and climate change.

Next Mr Ceron introduced hybrid (dynamical/statistical) methods, which use the forecasted large scale conditions (from GCMs). These methods assume that the large scale condition, which have a significant influence on the local climate, are well represented in the GCM. The advantages of these methods include the reasonable (affordable) computing cost for the downscaling, the complexity of the climate system is represented in the large scale conditions of the GCM, the potential predictors are physically based, uncertainty sampling is naturally assessed (ensemble forecast, multi-model), and the facility to implement operationally (provided GCM outputs are accessible). The disadvantages include GCM limitations and biases, generation of possible artificial scores and robustness problems, and issues of symmetric/non symmetric impact of large scale forcing (e.g. Niño / Niña impacts).

In terms of statistical methods used for the two downscaling approaches introduced above he highlighted linear methods such as regression, discriminant analysis, CCA, SVD, and modes of variability (examination of model versus observed modes), as well as nonlinear methods such as neural networks, analogues/anti-analogues, circulation regimes/weather types, regression trees and logistic regression.

The third (dynamical) downscaling method is based on limited area models (or RCMs) taking as input GCM forecasts. This method assumes that large scale condition forces the local climate which is better represented in a limited area model. The advantages of this method include the fact that the complexity of the climate system is represented in the large scale condition and in the limited area model, extreme events forecasts can potentially better represented, uncertainty sampling is naturally assessed (ensemble forecast, multi-model), and that there is no needs of observations over the region of interest. The disadvantages include the difficulty to implement operationally (need to have access to a large volume of GCM forecast files), the GCM limitations and biases, the huge computational resources required, boundary effects, limited area model limitations and error propagation and the risk of using as a black box.

Mr. Ceron concluded his presentation indicating that the success in downscaling depends on the predictability over the targeted region, the local part of the signal which is large scale forced, the parameter being downscaled, the targeted categories and the period, availability of good quality observations for calibration when necessary (both at the climate and users' domain), and the use of the downscaled information produced.

Climate monitoring, Climate Watch Advisory

The practice, and the importance of inclusion of climate monitoring as a regular practice, at some of the RCOFs (e.g. MedCOF, SEECOF), and utilization of climate monitoring products in issuing the Climate Watch Advisories at the regional level as an operational practice in the RA VI, were presented by Mr Ernesto Rodriguez. He highlighted the climate monitoring products that the WMO RA VI RCC-Network produces, including the elements of climate monitoring in terms of a catalogue of products, bulletins/reports, monthly maps of various

variables (e.g. temperature, precipitation, mean sea level pressure, etc.), a drought index, reference climatology, station based products (maps, graphs, trends), event monitoring, gridded data, and specific products requested by RCOFs.

In terms of conducting climate monitoring as part of the RCOF process Mr Rodriguez showed the example of MedCOF process, that consists of three steps: the verification of the previous seasonal forecast, an assessment of the current state of the climate system, including the relevant large-scale climate patterns, that serves as a starting point for the, third step, the consensus process. The discussions on the main relevant drivers and model outputs allow RCOF meeting participants to reach a common view in terms of evolution of climate variability patterns affecting the region. In step 3 the consensus based seasonal outlook is produced. In addition, MedCOF produces two documents, one on climate monitoring, with a detailed description of the state of climate including ocean analysis, atmospheric analysis, other forcings, such as sea ice, SST, snow cover, temperature and precipitation anomalies; the other report is on verification.

Mr. Rodriguez informed that Climate Watch System (CWS) provides advisories and statements to inform NMHSs about slowly evolving and/or foreseen extreme climate anomalies. He mentioned that Climate Watch Advisories, as a complement to RCOF outlooks, are routinely issued at regional level by the RA VI RCC-network, in case of anticipated climate extreme events, and disseminated through national focal points, and also posted on the dedicated web page. He showed an example of climate watch advisory for RA VI, which is a short, one page document containing any foreseen climate extreme, the concerned area, the validity of the advisory, and a short description of the climate event.

Mr. Rodriguez discussed the need to improve links between RCCs, RCOFs and NMHSs, indicating that many RCOFs are not exploiting the full potential of the climate monitoring component of RCCs, the need to improve access of RCCs to national data, to improve feedback from NMHSs, and having the RCCs production schedule in accordance with RCOFs and national needs. He also highlighted the need for improving interaction/harmonization with other RCCs. This is because of the wide diversity among RCC and RCOFs despite their compliance with the basic requirements from the GDPFS Manual, and therefore better harmonization is needed. He also indicated the need to clarify the **time scales** (weather versus climate warnings), as there is frequent overlap of scales (e.g., medium range vs monthly range), so clarification between weather and climate extremes is needed.

Mr. Rodriguez in conclusion proposed as way forward the need to rethink RCC-CM products and services and their use by RCOFs, the need of harmonization among different climate monitoring practices in different RCCs, and the need of online tools to select/manipulate information relevant for RCOFs and NMHSs.

Forecast Verification

This session highlighted the necessity for systematic verification of seasonal forecasts, drawing attention to a guidance document developed by Commission for Climatology experts and the recommended techniques. Qualitative evaluation of seasonal outlooks of the previous season being implemented in some RCOFs was also considered.

Mr Simon Mason addressed the issue of forecast verification. He indicated that the procedures for the verification of WMO Global Producing Centres (GPCs) model outputs are defined and described in the WMO Standardized Verification System for Long Range

Forecasts (SVSLRF) document. He highlighted that these procedures are of only limited applicability to RCOF forecasts, being of some use for model selection, but not for interpreting a specific forecast.

He then illustrated three RCOF forecast formats. In the first format probabilities are issued by grid or fixed area (i.e. the forecasts are spatially-averaged rainfall accumulations). He indicated that this type of forecast can be verified by comparing with observations averaged over the same area. In the second format, probabilities are issued by region and the forecasts are not regionally-averaged rainfall accumulations. He indicated that this type of forecast can be verified by station if made that way. He indicated that this forecast format is verifiable (and verified) only by reinterpreting the forecast. In the third format, probabilities are issued by station, therefore forecasts are location-specific and verified by comparing with station observations.

Mr Mason then looked at two verification questions: How good are the RCOF forecasts? How good was this RCOF forecast? He indicated that the first question can be addressed by SVSLRF **but has not been addressed in any of the RCOFs**. He next indicated that skill addresses the question which of the two sets of forecasts (A) and (B) is better than another. The skill is generally poorly defined and that is not an attribute of forecasts, calling the attention for the need to clearly indicate what is meant by "better".

Then Mr Mason introduced some of the probabilistic forecast attributes such as reliability, resolution and discrimination, and indicated that reliability diagrams are used for assessing the first two, the ROC curve as per the WMO SVSLRF is used to assess discrimination and that the CCl guidance describes all these attributes for RCOF seasonal forecast verification.

In terms of the use of SVSLRF for interpreting the forecasts, and converting a model probability in addition to a score to a forecast, Mr Mason indicated that the SVSLRF is often being misused to reinforce the subjectivity of the forecast production process.

Next he highlighted that the sampling errors on all scores are *enormous* exemplifying that the standard error of a 0.3 correlation with $n = 30$ forecasts is 0.18, and pointed out that identifying the "best" model, or weighting models by skill is just silly. Then he indicated that the best models are the ones that are most accessible and best-supported in each region.

He then moved on to talk about the verification of RCOF forecasts and highlighted a loud and clear result, which is hedging on normal category and asked the question: Do we genuinely think that normal is almost always the most likely category, or do we think it is the safest forecast? He stressed that this problems is present is several RCOFs and need to be stopped because high probabilities being attributed to normal category is inconsistent with the current correlation skill levels. For example 40% probability for "normal" requires a correlation higher than 0.52 and 45% probability for "normal" requires a correlation higher than 0.66.

He next indicated that there is no satisfactory way of verifying single probabilistic forecasts, but that the CCl guidance on verification of RCOF forecasts provides some possible ways for assessing single probabilistic forecasts including the so called hit score.

He finally concluded his presentation offering some radical suggestions. First: hedging on normal needs to stop, and a possible solution is training in reliable calibration. However, that assumes that the problem is technical. The second suggestion is to scrap the terciles as many RCOFs are effectively trying to forecast two categories. And the third suggestion is to scrap the probabilities in place of hit scores, indicating that the forecast probability, if reliable, is the hit score.

Capacity development activities in RCOFs: current practices and forecast possibilities for centralized training workshops

The participants were briefed on the current status of capacity development activities in RCOFs. Furthermore, the possibility was discussed to de-link the capacity development training sessions from RCOFs, and instead to conduct more "centralized" training workshops, where representatives from same or different RCOF regions would be brought together and trained, depending on their skill and needs for capacity development.

Mr Wassila Thiaw addressed capacity development activities in RCOFs, current practices and recommendations for centralized training workshop. He started with a summary of current practices including the conduct of a Pre-COF training workshops – usually a two-to-five day training workshop generally on seasonal forecasting, where participants run seasonal forecast experiments, prepare seasonal outlooks to feed into the regional consensus outlooks using various methods including linear regression, canonical correlation analysis (CCA) with observed SST, CCA with dynamical model predicted SST and statistical downscaling of dynamical models. He indicated some issues with this training, such as no continuity in terms of attendance. He also indicated that despite many training workshops, there are still gaps in the understanding of the science behind the forecasts (e.g. modes of climate variability), as there usually little emphasis on the interpretation of the forecasts and their verifications. The quality of the local data used in the workshops is also often times a problem. He also outlined some competences required for producing operational seasonal forecasting, including: knowledge of statistics and climatology; knowledge of the physical parameters that impact outlooks, trends, physical modes and impacts (ENSO, IOD, AO, AAO, etc.); understanding of environmental modeling (statistical and dynamical); the ability to think through what goes into the forecast; the ability to use GIS to map outlooks; the ability to communicate the outlook in writing and orally; and the ability to verify forecasts and to communicate uncertainty.

For improving the seasonal forecasting production process he suggested that Pre-COF training workshops must entice participants to be enthusiastic about continuously conducting diagnostics studies, essential to document sources of predictability and to improve forecasts, emphasizing that SSTs are excellent predictors but they are not the only predictors that can be useful. He suggested exploring other variables that sometime might be connected to SST such as winds, geopotential height and stream function and could add value to the forecasts.

Mr Thiaw also indicated that an operational seasonal forecasting system must include the writing of forecast bulletins with discussion of the current state of the climate and the tools used for the forecasts, an update of the forecasts on a monthly basis, continuous verification of the forecasts and keeping an archive of forecast verification results, and sharing forecasts and forecast verifications with the user community via a website and through other outreach activities.

Next he addressed the new paradigm for pre-COF capacity development, indicating that more effective training workshops should include a combination of hands-on exercises and lectures, with the hands-on exercises focused on the use of tools for seasonal forecasting, and lectures with focus on climate basic state and variability, including a review of monsoon systems, modes of variability (ENSO; MJO; NAO, AO, AAO, etc), impacts of modes of variability on regional climate, and practical exercises on deriving indices.

He also indicated the need to reflect if sub-seasonal forecasting should be addressed in RCOFs, highlighting that knowledge about the MJO and the associated impacts on regional rainfall need to be well understood. Mr. Thiaw also emphasized the importance of climate

monitoring is essential for effective delivery of climate services and to provide timely and relevant information related to climate hazards, and that the development of impact based forecasts requires work in collaboration with the user community.

Mr Thiaw concluded with some recommendations indicating that pre-COF training workshops must be structured to meet the needs of the scientists with emphasis on tools for seasonal forecasting, understanding of sources of predictability, use of GCM in seasonal forecasts, interpretation of results from seasonal forecast experiments, building consensus seasonal outlooks, communication of seasonal forecasts to the users, forecast verifications, with institutional engagement in order to sustain the training and operationalize seasonal forecasts.

Regional user engagement, sector-focused RCOF sessions, user applications and evaluation

The engagement of regional user representatives in the RCOF process, and organization of sector-focused sessions will be explained on the example of Central America COF (CACOF), specifically mentioning the outlook application and evaluation by the users.

Ms Patricia Ramirez addressed the aspects of regional user engagement, sector focused RCOF sessions, user evaluation and application in the Central America RCOF (CA-RCOF) sessions. She reported on the risk analysis based on RCOF forecasts in central America through a forum of regional institutions. After the end of the RCOF session, various application sectors (health, water and sanitation) have a virtual working table meeting, where experts of these sectors discuss the impacts of the seasonal forecast produced in the RCOF on each sector. A short summary report is produced with the potential risks indicated and recommendations are provided for each sector. A strategy for dissemination of this information at various governmental/ministerial levels has also been implemented. In terms of lessons learned, she reported that the continuity of this virtual working table meeting showed its great value in transferring knowledge and experiences between climatologists and interested users in terms of understating forecast limitations and uncertainties, leading to increased trust in the forecast products. This practice also led to the increased interest in use of seasonal climate outlooks in various application sectors of the government and also strengthened the outreach of the RCOF seasonal forecasts in application areas.

In terms of challenges and opportunities Ms Ramirez highlighted the need to increase CA-RCOF capacity for regular delivery of other products in addition to tercile probability forecasts, such as rainy season onset and end dates, midsummer drought onset and length, dry spells probabilities, among others, the need to gather and organize sectorial information about climate hazards and impacts of climate variability within sectors, the need to provide capacity development for user to enhance their capacity to understand climate forecast an products, the need for the inclusion of RCOF verification information in public bulletins, the need to adequately monitor the use of sector specific products/bulletins by end–users, and the need to promote further involvement of users in this process in order to have long term sustainability of the RCOFs and sector specific virtual working table meetings.

Coordination mechanisms: role of Regional Climate Centres

Mr Andre Kamga addressed the role of RCCs as coordination mechanisms. He started with a rationale indicating that RCOFs require action by stakeholders at global, regional and national levels, both within and outside of the climate community, and that coordination

helps to address duplication/gaps and can create economies of scale. Next he addressed the functions of coordination by RCCs including the assessment and identification of priorities, the establishment and maintenance of operational relationships/partnerships between stakeholders, information sharing, raising awareness and monitoring stakeholders, managing joint decisions and actions, and innovation using user feedback (e.g. move to impacts/risk assessments, partnerships for preparation/response). He concluded his presentation proposing the following ways forward: To identify collaborative endeavors with GPCs, LCs and NMHSs, to establish horizontal activities with other RCCs, to identify regional users and establish required interfaces, creation of a help desk, support for establishment and operation of NCOFs and NFCSs, regional collaborative research and training, regional projects and programmes, and resource mobilization for implementation.

Sub-seasonal updates to RCOF products

The importance of producing regular updates during the course of the target season and in between the sessions was highlighted by Mr Adrian Trotman, who talked about the approaches to developing and disseminating them to the countries of the region (building on the practice at CariCOF), as well as on the usefulness of these updates for th countries.

Mr Trotman indicated that soon after establishment of CariCOF, in response to the 1997-98 El Niño, 0-month lead, 3 month tercile rainfall forecasts have been produced every two months by CIMH. However, there was a desire to provide tercile rainfall products and information every month to update NMHSs and other users across the region. Additionally, to cover a typical Caribbean season of six months, CIMH has commenced preparation of 0- and 3- month lead three month tercile rainfall forecasts, as of 2013. Outlook products have been developed using an automation tool (CAROGEN) that is integrated with CPT, in 2015, making the man-hours spent less intensive as the suite of forecast products expanded. These include both tercile-based and more tailored forecast products produced from a fixed set of pre-determined CCA experiments into an ensemble which are run every month to produce monthly updates. In addition to the traditional tercile probability seasonal forecasts, SPI and heat wave forecast are also produced. The dissemination of forecasts is made through various bulletins, including sector bulletins produced with regional sector users in collaboration with CIMH .

He also indicated that outside of the two annual CARICOF forums/assemblies, updates are discussed remotely, mainly via email, after initial regional output maps are released to NMHSs for consensus (though they are mainly objective). CIMH now has a video-conferencing facility thanks to the American People through USAID via the BRCCC Programme (in collaboration with WMO as executing agency). In the near future, between the forums/assemblies, discussions on the forecasts (including consensus) will be through video-conferencing.

During the discussion session the following points were raised by the workshop participants:

When selecting models that are able to represent the main sources of predictability it is important to include those models that incorporate the representation of the processes behind the sources of predictability, for example for polar regions models must have a sea ice component.

Care with excessive standardization is a concern as RCCs have been established to address specific regional needs and may require particular kinds of information and procedures. There is the danger that excessive standardization may affect mechanisms of cooperation between RCCs, NMHSs and users.

It has also been mentioned that regional downscaling with dynamical regional climate models on operational scales is not a feasible proposition due to the large computational resources required and considerable amount of time required for running these models for producing seasonal forecasts. The increasing availability of higher resolution global climate models now makes it less necessary the use of regional dynamical climate models for seasonal forecasting.

Another point that was raised during the discussion was that if user communities are not complaining about the current forecast products generated in RCOFs this probably means that these communities are happy with the products.

The need to harmonize RCOFs and RCCs was highlighted.

An important issue concerning possible discrepancies in seasonal forecasts of countries that take part of various different RCOFs providing different outlooks has also been raised. Can a recommendation be made to avoid discrepancies? In response to this question it was noted that having multiple sources of forecast information is not a problem, this is rather a choice for countries to have multiple sources. What is important is to have all forecasts properly documented and countries could take decision how and which forecast to use. Additionally, it was highlighted that there is a need for good communication between RCCs and NMHSs concerning conflicts of information. The positive side of dealing with different sources of information is that it contributes to the learning process regarding uncertainty.. It was also added that all available information, even from other RCOFs, is considered when producing RCOF forecasts.

It has been suggested that verification of spatial structures (features) in seasonal forecasting could be exploited with object-oriented verification approaches currently used in meso-scale forecast verification. Another forecast verification aspect raised in the discussion was verification of other types of forecasts, such as tropical storm tracks. It was noted that methods for verifying this type of forecasts are currently not described in SVSLRF.

TOWARDS IMPROVED AND SUSTAINED RCOF PROCESSES

This section identified gaps and challenges, both in terms of human and infrastructure capacities, as well as technical and methodological aspects of RCOF operations, and proposed ways to improve and standardize the RCOF process to make delivery and communication of climate products and services for decision-making more effective and sustainable.

Good practices in RCOFs, summarizing the SWOT analysis

Responses to a survey on the current status of RCOF process enabled Mr Andrew Tait to perform an analysis of SWOT pertinent to each RCOF, both on regional and national scales. The RCOFs have been revealed to be very useful for building and sustaining regional networking and a well-connected community of learning, encouraging the sharing of experiences across the region, interaction and collaboration with experts from various fields

and the development of climate capacity in the NMHSs. The RCOFs also substantially contribute to establishing a link between global, regional and national activities and processes and enable to develop tailored products used by a wide variety of stakeholders.

One of the principal weaknesses is the staff turnover attending the RCOF sessions which are likely to compromise the learning and capacity development of national and regional climate scientists. In addition, potential users of climate products are not always aware of the seasonal outlooks produced during the RCOF sessions and there is an incomplete understanding concerning the usage of probabilities. A lack of tools and high-quality data and data access constraints impede forecast verification. There is a need for improved forecasting and downscaling tools to meet specific regional needs and concerns. The lack of ability to demonstrate the value of the forecasts has also been identified as a weakness in the RCOF status report.

Mr Tait mentioned that the RCOFs offer the opportunity for performing a standardized regional product suite, including sector-specific tailored products in the concerned region. The RCOFs could go beyond seasonal outlooks by providing sub-seasonal and inter-annual forecasts and focus more on the priority climate information needs of the countries in each region. The ongoing improvements to forecast skill could enhance the usefulness of RCOF products. The RCOFs provide more evidence of the value of the forecasts. They enable to foster linkages to research organizations and capitalize on climate adaptation funding opportunities. They represent an opportunity to make more linkages to policy, strategy and actions.

Lack of reliable sources of sustainable funding poses a genuine threat for the RCOF process. The low or varied technical capability of participants and the low technical capacity of NMHSs (infrastructure, hardware, and software) may also impact the proper progress of the RCOFs. The non-standard and unproven services provided by private sector operators, the lack of sufficient funding to maintain climate station networks and databases, as well as the low importance of seasonal forecasts in terms of political perception are other crucial threats.

The Role of Co-production in RCOFs: Toward Usable Climate Services

The participants were briefed on the RCOF objectives from the user community perspective with respect to developing and co-producing actionable climate information/services in support of decision making processes.

Ms Meaghan Daly (ULeeds) defined co-production as an ongoing interaction and collaboration between actors possessing different types of knowledge (scientific and non-scientific), experience or perspectives. It has the intention to create usable knowledge, i.e. perceived as credible, salient and legitimate by key stakeholder groups and influential in decision-making. Ms M. Daly presented an overview of research that seeks to examine the co-production of knowledge in RCOFs. A first phase of study consisted of scoping the RCOFs globally, through interviews with individuals involved in implementation or coordination of the RCOFs, to identify goals, processes, actors and the role of users. A phase 2, which is currently ongoing, consists of a comparative study between three RCOFs (SASCOF, SARCOF and MedCOF), undertaken through interviews and an online survey to identify efforts to co-produce climate information.

Co-production in RCOFs is specific to the regional context, because what might be appropriate in some locations will not be relevant, and will not work, in others. Co-production needs to build relationships and communication, authentic dialogue and mutual understanding among participants. However, co-production may not be necessary in all

cases. For this reason, it is important to understand when and where co-production is truly needed, through the analysis of roles of producers and users, a transparent communication of processes and products, setting clear and realistic expectations, and defining intended goals and outcomes.

Improved/standardized format of seasonal outlook statements

Mr D. S. Pai focused particular attention to the consensus statements issued during the RCOF sessions. He noted that in general, the RCOF consensus statements include the present climate conditions, a probabilistic forecast map, a description of the outlook, as well as a summary of the outlook statement. Only a few RCOFs provide the verification of the previous outlook and describe the methodology for the development of the outlook. Only three RCOFs out of 19 provide impact warnings and advisories for specific sectors (e.g. CariCOF and ICU provide drought outlooks and PRESASS statement includes impact warning advisories for many sectors).

Concerning the seasonal forecast maps, most of the RCOFs used color shaded areas for most likely tercile categories over the region, along with the probabilities for each. However, the colors depicting the different tercile categories are not uniform among the RCOFs. Some RCOFs use fourth color to indicate areas of climatological probabilities. FOCRAII and EASCOF indicate only the most likely tercile categories over broad areas, without color shaded areas.

For the sake of readability and clarity, Mr D. S. Pai (IMD) suggested a standardization of consensus statements among all the RCOFs, consisting in adopting a similar format with the following components:

- *Summary* providing highlights of the consensus forecast outlook in a brief;
- *Probability forecast map and maps* showing recent seasonal anomalies and climatology;
- *Status and forecast outlook* of global climate anomalies;
- *Verification* of consensus forecast issued for the relevant season of previous year;
- *Methodology* describing the development processes involved in the preparation of the consensus outlook.

The probability forecast maps need to be harmonized and designed in a common format for all the RCOFs, with a uniform color code. It would be useful to consider whether a separate color has to be used to highlight areas of climatological probability. The rainfall forecast map needs to clearly indicate dry regions.

CCl Expert Teams' guidance to help improving RCOF process

In recent years, expert teams of the Commission for Climatology have developed a number of guidance documents that are relevant to different aspects of RCOFs, and which could potentially help improve the RCOF process.

Mr R. Martinez presented several such guidelines. The forthcoming WMO report *Good Practices for Climate Services User Engagement* provides guidance on how to undertake effective engagement between users of climate information for decision-making and providers of climate services. The *Guidance on Verification of Operational Seasonal Climate Forecasts* (S. J. Mason, 2015) describes and recommends procedures relevant to the verification of forecasts presented as probabilities of three categories (similar to the RCOF

consensus probabilistic forecasts). The forthcoming *Guidance on the concept of Climate Risk Management (CRM)* identifies and describes examples of best practices in CRM for strengthening NMHSs capacities. Additional guidelines have been, or are being, developed by the CCl experts which are of great interest for sustaining and improving the RCOF process.

Global Seasonal Climate Update: Current status and future prospects for RCOF applications

Ms A. Brookshaw introduced the Global Seasonal Climate Update (GSCU). The GSCU is an extension of WMO El Niño/La Niña Update. It summarizes the current and the expected future state of the seasonal climate, including major atmospheric general circulation features and large-scale oceanic anomalies around the globe and their likely impacts on surface temperature and precipitation patterns, as predicted by the Global Climate Models (GCMs) from the GPCLRFs. The GSCU is proposed to be issued every three months, a few days ahead of each of the standard meteorological seasons. Although the graphical products from the GSCU may be not appropriate for RCOF regions and may not meet the timeliness criteria or target suitable periods, the GSCU can offer useful information on the sources of predictability other than ENSO and the skill of individual prediction systems.

LC LRFMME operation, access to products for RCOFs

Mr K. H. Cho presented the role of the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (WMO LC-LRFMME). The WMO LC-LRFMME is jointly managed by KMA and NOAA's National Centre for Environmental Prediction (NCEP). It aims to collect and share long-range forecasts data from the 13 WMO designated GPCLRFs each month and maintains a central portal of GPCLRFs output in digital (forecast and hindcast of monthly mean anomalies) and graphical (individual forecast, deterministic and probabilistic MME, verification maps) formats accessible to users after registration on the website.

Following the request of the WMO Cg-XVI (2011), the LC-LRFMME is planning to expand its role to include exchange of extended-range predictions and to provide Multi-Model Ensemble forecasts and its verification results through the website.

Copernicus Climate Change Service (C3S): potential role in RCOF process

Ms A. Brookshaw introduced the Copernicus Climate Change Service (C3S). The C3S is a service based on a multi-system framework aiming at providing an open access portal to climate information. The heart of its infrastructure is the Climate Data Store (CDS). The CDS provides information about past, present and future climate (observations, global and regional analysis, global and regional climate projections) in terms of Essential Climate Variables (ECVs) and derived climate indicators. C3S is also developing seasonal forecast products, based on the best information available, with a target publication date of 15th of each month. The current proof-of-concept phase includes a set of atmospheric and ocean variables (air temperature, sea surface temperature, precipitation, radiation, etc.), with a spatial resolution of 1 degree at daily or sub-daily temporal resolution. The CDS will also provide a comprehensive set of software tools (CDS Toolbox) allowing the users to develop applications to make use of the content of the CDS.

The wealth of climate information provided by the C3S aims at supporting adaptation and mitigation policies in a number of sectors which are, but not limited to water management, agriculture and forestry, tourism, insurance, transport, energy, health, infrastructure, disaster risk reduction and coastal areas.

Regional approach for implementation of Climate Services Information System

Mr R. Kolli emphasized the importance of implementing the Climate Services Information System (CSIS) at regional level. A focused regional effort would facilitate systematic strengthening of early warning services in a comprehensive manner that would help countries to be more resilient. Some institutions (e.g. RCCs and RCC-Networks) have already made considerable investments for seamless multi-hazard early warning and the extra-budgetary funding from climate-related initiatives, such as the Climate Risk Early Warning Systems (CREWS) and the Green Climate Fund (GCF), and additional investments could be also available in related projects. The implementation of CSIS at regional level requires some additional efforts, notably in terms of data, prediction and service delivery activities.

- For data:
  - Strengthen observing systems and encourage data rescue activities to improve understanding of historical climate change and variability;
  - Strengthen climate data management systems to offer improved data and products access for users and facilitate climate analyses and data exchanges;
  - Integrate data, tools and products among global, regional and national centers, using WMO Information System (WIS) and the Global Data Processing and Forecasting System (GDPFS) to facilitate data and products exchange.

- For prediction:
  - Adopt objective sub-seasonal to seasonal forecasting systems (EC-69, Decision 4.5/4) at regional level;
  - Downscale and tailor sector applications in countries with potential CREWS funding availability;
  - Strengthen severe weather, typhoon and flood warning systems;
  - Develop sub-seasonal forecast bundles;
  - Downscale regional projections of key variables.

- For service delivery:
  - Increase systematic provision of monitoring products;
  - Strengthen alerting systems using the Common Alerting Protocol (CAP);
  - Tailor products for risk management in sensitive sectors, including marine services (e.g. coastal inundation, fisheries).

NCOF concept: scaling down RCOF outlooks for decision making at national scale

In recent years there has been significant progress in the implementation of National Climate Outlook Forums (NCOFs) in different parts of the world, guided by CCl and with support of WMO and other organizations. Mr G. Srinivasan presented the National Climate Outlook Forums (NCOFs) concept. NCOFs are considered to be important operational elements for the implementation of the Global Framework for Climate Services (GFCS). Indeed, they constitute an institutional platform for provision of reliable climate information, at relevant timescales, through a regular and sustained dialogue between climate provider

and users, at national level. Large and regional scale forecasts are adapted to the national context and products are tailored in order to deliver key messages for public and decision-makers from climate-sensitive sectors like agriculture, irrigation, disaster risk reduction and health. The NCOFs therefore represent an opportunity to discuss user views and ensure that climate products, along the risks and opportunities arising from these products, are interpreted and understood by end-users, and to make the climate information accessible, user-friendly and applicable. NCOFs also serve as starting points for closer interaction with user agencies to develop decision support tools based on weather and climate information products from NMHSs.

Mobilizing resources to sustain the RCOFs through funding mechanisms

A common challenge for many RCOFs is still to identify and mobilize resources for convening physical sessions. Mr R. Martinez recalled some major climate policies, such as the Sendai Framework for Disaster Risk Reduction and the Paris Agreement, but also some UN-led initiatives, such as the Sustainable Development Goals (SDGs) and the GFCS which are all a universal call for the mitigation of, and adaptation to climate change and variability, in order to protect the planet and ensure the protection of life and property. The potential financing sources are the GCF, the Disaster Risk Reduction funds (e.g. Global Facility for Disaster Risk Reduction (GFDRR)), the development financial agencies (e.g. World Bank and other development banks, etc.), regional cooperation agencies, national governments and private sector.

Regarding the RCOF funding, it is increasingly difficult to fund international meetings to discuss climate outlooks, despite their crucial importance. To limit expenditure, Mr R. Rodney suggested using regional meetings for technical and scientific discussions or training workshops to improve climate predictions and to send the final RCOF outcomes to regional users via videoconference or e-mail. The visibility of NMHSs needs to be raised to get the necessary funding from government to try to entrench the RCOFs. Concerning the NCOFs, these latter should become relevant for DRR and assimilated as important information resources for adaptation.

BREAKOUT SESSIONS

Participants in break-out groups discussed the current status and opportunities to introduce innovative approaches and standardized operational practices for generating RCOF outputs including, *inter alia*, the development of objective sub-seasonal and seasonal regional forecasts, tailoring forecast products to specific user-requirements, and mechanisms for the provision of regular sub-seasonal updates between the RCOF sessions.

To facilitate the discussions, participants were provided with the introductory information on the purpose, and expected outcomes of the discussions, as well as with a set of questions to answer.

The participants then split into five groups to discuss the following topics:

BG-1. Roles and operations of GPC-LRFs in support of RCOFs and in introducing Objective approaches to RCOF products

The GPC-LRF infrastructure is well established, but the provision and uptake of usable information to the RCOFs/NMHSs remains sub-optimal. From the perspective of the RCOFs, too much focus has been put on generating map products from the GPCs, which can only

serve to reinforce subjective forecast production at the RCOFs. The GPC-LRFs and LC representatives discussed how to ensure that their outputs are available to the RCOFs as input to objective forecasting schemes.

BG-2. Roles and operations of RCCs in support of RCOFs, including capacity development and updates between RCOF sessions

The RCCs play a coordinating role in the majority of RCOFs, providing technical guidance and contributing to generation of seasonal outlooks as well as to capacity development activities. In some regions, RCCs/RCC-Networks are also generating updates between RCOF face-to-face sessions, including Climate Watch Advisories. Based on these experiences, the members in this group proposed concrete recommendations on the provision of regular updates between sessions, and how to make sure that these updates are usable at country level.

BG-3. Role of NMHSs in the follow-up integration of seasonal outlooks in decision making process at country level

RCOFs play an important role in bringing different forecasting groups together to facilitate the assessment of available seasonal predictions and the development of consensus-based outlooks for the region. There is very little feedback on the follow-up actions at national scale, while there is clearly a merit in extending this concept to the national level by establishing operational NCOFs, and National Meteorological and Hydrological Services (NMHS) play a central role in this process. The participants in this group developed recommendations on the follow-up actions by NMHSs representatives for establishing national mechanisms for integration of climate information in decision-making process.

BG-4. User engagement in RCOFs

With the background information provided through the presentations on this topic in the earlier sessions, the members of this group focused on the quality and usefulness of seasonal forecasts from the user perspective. They proposed ways for addressing users requirements, e.g., through developing tailored climate information and impact based forecasts.

BG-5. Expanding the RCOFs portfolio

During last two decades of operation, regional seasonal outlooks have been predominantly the main RCOF outputs. The availability of reliable climate monitoring information could provide better impacts forecasts than the seasonal forecasts, particularly in the regions where the skill of forecast is poor. Furthermore, to date no attempt has been made at regional scale to compare and contrast the various studies on climate change projections for the region. It will be beneficial for countries in the regions to share their experience, with a view to define best practices and to develop guidelines for in the generation of climate change scenarios. These, and other potential products/functions were considered by the group, which provided recommendations on additional products to be included in the portfolio of next generation RCOFs.

CONCLUSIONS AND RECOMMENDATIONS FOR THE FUTURE GENERATION RCOFS

Reporting back from break-out groups

The moderators or rapporteurs of the break-out groups provided a brief summary of the discussions, highlighting the main findings, decisions and recommendations on the way forward.

BG-1. Roles and operations of GPC-LRFs in support of RCOFs and in introducing Objective approaches to RCOF products

Mr Coelho summarising the discussions highlighted two main aspects: 1. how do we make sure that GPC outputs can be input to RCOF objective forecasting schemes, and 2. whether an extension to the SVSLRF could be proposed to include additional information that might be useful to the RCOFs. A number of recommendations were made, in particular:

- To improve access to GPCLRF data, mainly through the LC LRFMME
- Encourage RCCs to take the lead in accessing these data and disseminating to members
- Capacitate RCCs and NMHSs staff in processing GPC data outputs via training programs
- Expedite the technical guidance on operational seasonal predictions under development by the IPET-OPLSLS
- Encourage GPCs to adopt some RCOFs in regions of their particular interest for sustained support; and to contribute with climate monitoring information to RCOFs
- Encourage the extension of the current verification procedures for individual GPCs to the MME forecasts produced by the LC-LRFMME, and development of verification products for pre-defined RCOF regions.

BG-2. Roles and operations of RCCs in support of RCOFs, including capacity development and updates between RCOF sessions

Mr Trotman summarized the following recommendations on the role of RCCs in support of RCOFs:

- RCCs should lead RCOFs and facilitate regular updates between RCOFs in close consultation with NMHSs of Member countries
    - As a part of the standardized process, RCCs can provide updated regional based consensus forecast even if only for reference
- Recommend strongly that NMHSs consider RCOF forecasts and updates,
- Pursue capacity building for NMHSs through national training workshops
- Pursue co-designing, and co-producing communications packages – moving toward impacts based forecasts
- RCCs should contribute to data management, data rescue, QC
- Develop a methodology for downscaling (techniques) - to be part of capacity development of NMHSs
- Demonstrate the value of both regional (RCOF) and national products
- Should at least play a significant role on resource mobilization for RCOFs

- Recommend that sub-seasonal forecast be a part of RCC and RCOF along with training would be necessary
- Provide tools or methodology for sub-seasonal forecasting, along with capacity building.

BG-3. Role of NMHSs in the follow-up integration of seasonal outlooks in decision making process at country level

Ms Maria Etala summarized the current practice of NCOFs worldwide, highlighting some challenges in the national context and good practices in the reigons, such as adding values to regional products, downscaling, understanding predictability, also shifting the ownership such that the sectors which are engaged lead the production process.

The following recommendations were made to strengthen the role of NMHSs:

- Institutionalization into existing governmental structures (such as for DRR)
- Co-productions (at planning level): demonstration projects to lead to final agreements

Rcommendations to RCOF/RCC:

- Convert maps into objective impact products for input to sector models
- Build information on regional scale - to address needs of regional users
- Improved communication: train users, develop communication strategy to communicate tailored info, moderate users expectations, provide information on risks.

BG-4. User engagement in RCOFs

Ms M. Daly highlighted the following recommendations:

- RCOFs develop deliberate and targeted partnerships,
- New approaches to feedback – mechanisms for continous feedback, more creative ways to collect feedback involving social experts
- Relations building, trust, and ownership that includes communication, mutual capacity building, and building climate services teams
- Technical recommendations: tailored products, reconsidering probabilities linking with confidence, data availablity (not only climate)

BG-5. Expanding RCOFs portfolio

Ms T. Turkington briefed that the group discussed future functions for RCOFs, and identifed those functions that should be prioritised (training, verification, and climate monitoring). It was recommended:

- Climate monitoring
    - Need to have proper understanding of what should be included in the monitoring (e.g. variability patters, current predictability of the system)

    - Introduce templates for climate monitoring
- Verification
    - Use to look back and try to understand where and why the outlook went wrong/right
    - Broaden the reflection to consider atmospheric and ocean structures, any impact based forecast, as well as verify how the information was used.
- Remote climate anomalies (climate anomalies for other regions)
    - Need a research/survey on which climate anomalies are of interest
    - Easy sollution to have a link to the relevant RCOFs on the RCOF website
- Capacity development
    - Could be in form of centralized training, grouping different regions a good approach (separate to RCOFs)
    - Online training could be widely used;;
    - Training of NMHS personnel; also training sessions for user groups (separate and joint), introducing climatological aspects in training for users
- The following were recommended to have a lower priortiy, due to lack of knowledge on the subject (more research required), or limited benefits compared to the previous suggestions:
    - Subseasonal products
    - Due to slow reaction time of RCOFs, not feasible to have subseasonal outlooks completely within RCOFs. Some RCOFs can have specific products (e.g. monsoon onset date)
    - Can provide capacity building/training and promote the use of sub-seasonal forecasts
    - The issue of usability of subseasonal Climate Watch advisories – could be one possibility
- Annual to multidecadal scale outlooks:
    - Based on NMHSs and users, can highlight topics for future research
    - Start with attribution to climate change as part of monitoring,
    - Can use as a topic for a particular COF (e.g. monitoring products in the context of projections).
- Impact based forecasts
    - In many instances, the research has not been done. The responsible party for impact modelling may also not be the NMHSs.
    - Focus on the most relevant sectors and tailor the outlook and monitoring accordingly
    - Can use for comissioning research
- Demonstrate Value (can support NMHSs who struggle in demonstrating value of outlooks)
    - Provide preliminary look at the potential value (e.g. cost-benefit analysis)
    - Include in reflection section of the COF (was the previous forecast of value)
    - Prepare more actionable products

Open Discussion

Following the reporting session, the participants were invited to the final discussion session moderated by Mr Andrew Tait, to synthesize the findings of break-out discussions, and propose concrete recommendations to be included in the Roadmap towards improved concept of future generation RCOFs. The participants also had an opportunity to raise any other issues for discussion that are pertinent, but not included in the agenda.

Participants discussed about the features of the next generation RCOF (2.0). One of the possibilities to sustain RCOFs is moving to impact based forecast, that is to understand the impact of forecast, to interpret the impact of forecast on a specific sector. Although issuing advisories is responsibility of NMHS, and is not RCOF mandate, nevertheless RCOF could help countries and develop capacity of developing impact based forecast.

There is also a requirement to demonstrate the value of seasonal forecasts in particular to the governments, which could be done as a pilot in some RCOFs. This could lead to political support to RCOFs, and will help raising funds to support RCOF sustainability

There is also a clear need for close nexus of global, regional, national experts and users, and responsibility of RCCs in this process is a critical element of this chain.

RCOFs give an excellent opportunity to share experiences, good practices that are already in place.

Some challenges were mentioned in terms of adding new products in RCOF portfolio, e.g. attributions to climate change, adding sub-seasonal scale, which cannot be done once a year, and need regular update. There is a need of stronger linkage with research community, that may held address research requirements of RCOFs, such as impact based forecast, assessment of the value. One possibility was to identify RCOFs research and to communicate to the research community (WCRP), to address these needs.

Review of actions, conclusions and recommendations on way forward for improved RCOF operations

Summarizing the outcomes of the meeting, each of the breakout group was invited to highlight one priority recommendation:

- **BG 1:** RCCs to access digital forecast and hindcast data from the WMO LC-LRFMME and produce an objectively consolidated forecast product combining information of various GPCs-LRF to be used as a first estimate for RCOF discussions
-
- **BG 2:** RCCs to continue guiding RCOF process; including the responsibility to play a role in resource mobilization RCCs for RCOFs. Build mechanisms at RCOF sessions to propose improving RCC activities to address RCOFs needs.
- **BG 3:** Establish/Implement regular NCOFs (and other similar mechanisms) at national levels, and where required at sub-national levels with the primary aim of sharing seasonal products and their updates on a regular basis to support sector-driven climate risk management;

- National Frameworks for Climate Services (NFCS) linked to high-level cross-cutting objectives, will provide mechanisms for sustainability to the national climate forums
- **BG 4:** Ensure joint provider-user ownership of RCOF process, demonstrating the value of forecast and advocating with the governments the usability/value of the RCOF/NCOF products
- **BG 5**: Expand RCOFs portfolio to include (focusing on the top 3):
    - Climate Monitoring
    - Verification
    - Remote climate anomalies
    - Sub seasonal products
    - Introduce Climate Change component, in terms of observed trends, attribution of extreme events in climate change context, etc
    - Continued development of training activities
- Promote stronger linkages of RCCs, RCOFs with research community.

In conclusion participants unanimously recognized the progress achieved, particularly on the contributions of RCOFs in promoting wider use and better interpretation of seasonal forecasts at the national levels and agreed on the way forward towards the new generation of RCOFs, including:

- ✓ the introduction of objective seasonal climate forecast schemes,
- ✓ new approaches including expanded product portfolio, based on standardized operational practices identified during the workshop,
- ✓ follow-up integration of seasonal outlooks in decision-making process at country level
- ✓ Improved Partnership and User Engagement in RCOF process
- ✓ introduction of the new concept of "centralized" training workshops to better target capacity development efforts associated with RCOFs

Any Other Business

Mr Rodney Martinez informed participants about the upcoming IV International Conference on El Niño Southern Oscillation: ENSO in a warmer Climate, which is being co-organized by CLIVAR and CIIFEN, and will be held on 16-18 October 2018 in Guayaquil, Ecuador.

Closure

In conclusion, the representatives from CIIFEN and WMO summarized the workshop outcomes. Mr Martinez mentioned that the current Workshop had quite significant achievements, compared with RCOF 2008, everything is now in place to build a new concept. He highlighted that CIIFEN had a privilege to host this historical event.

Mr. Kolli expressed gratitude to the government of Ecuador, the Permanent Representative of Ecuador with WMO, and the CIIFEN, for the willingness to host this event, the hard work and wonderful hospitality. In terms of technical guidance he thanked all the experts and

particularly Mr. Simon Mason, and CCl TT-RCOFs, helping with the preparations and RCOF related issues, as well as all the chairs and rapporteurs. He stressed that we will be able to take it forward with valuable contribution from all participants. This review doesn't stop here, the synthesis report, and recommendations for the way forward will be developed after the workshop, and will be made available to the participants for their follow up on the recommendations at their concerned RCOFs.

The WMO Workshop on Global Review of Regional Climate Outlook Forums was closed at 17:00 Hrs on Thursday, 7 September 2017.

ANNEX 1 Provisional Agenda

WMO WORKSHOP ON GLOBAL REVIEW OF REGIONAL CLIMATE OUTLOOK FORUMS

5-7 September, 2017
Guayaquil, Ecuador

PROVISIONAL AGENDA

Day 1: 5 September 2017 (Tuesday)		
08:30 – 09:00	**REGISTRATION**	
1. Opening session		
09:00 – 09:30	• Opening Remarks by the PR of Ecuador • Statement on behalf of the WMO Secretary-General (R.K. Kolli) • Remarks by CIIFEN (R. Martinez) • Tour de table (All) • Logistic briefing (CIIFEN)	
2. Setting the scene Chair: J.-P. Ceron Rapporteur: A. Hovsepyan		
09:30 – 10:00	Global RCOF Review: • *The concept, goals and objectives of the RCOF Review;* • *Recap of previous reviews*	R. Martinez (CIIFEN)
10:00 – 10:15	RCOF operational practices: *Towards objective seasonal forecasting*	R. Kolli (WMO)
10:15 – 10:30	GPC-LRFs, RCCs and their role in RCOF operations: *Current status and future prospects*	C. Coelho (CPTEC)
10:30 – 11:00	HEALTH BREAK & GROUP PHOTO	
3. Reports of RCOF operations around the world *Summary of activities of individual RCOFs, particularly focusing on operational aspects (based on the template provided, 10 min each)* Chair: S. Mason (IRI) Rapporteur: D.S. Pai (IMD)		
	RA I (Africa)	
11:00 – 11:10	▪ Greater Horn of Africa Climate Outlook	G. Artan (ICPAC)

	Forum (GHACOF)	
11:10 – 11:40	▪ Central Africa (Prévisions Climatiques Saisonnières en Afrique Centrale : PRESAC) ▪ Sudano-Sahelian Africa (Prévisions Climatiques Saisonnières en Afrique Soudano-Sahélienne : PRESASS) ▪ Gulf of Guinea (Prévisions Climatiques Saisonnières pour les pays du Golfe de Guinée : PRESAGG)	A. Kamga (ACMAD) S.Traore (AGRHYMET)
11:40 – 11:50	▪ Northern Africa (Prévisions Climatiques Saisonnières en Afrique du Nord : PRESANORD)	K. Kabidi (DMN, Morocco)
11:50 – 12:00	▪ Southern African Regional Climate Outlook Forum (SARCOF)	F. Nsadisa (SADC-CSC)
12:00 – 12:10	▪ South West Indian Ocean Climate Outlook Forum (SWIOCOF)	F. Bonnardot (Meteo France/La Reunion)
	RA II (Asia)	
12:10 – 12:20	▪ East Asia winter Climate Outlook Forum (EASCOF)	Y. Mochizuki (TCC, Japan)
12:20 – 12:30	▪ Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRAII)	Z. Gong (BCC, China)
12:30 – 14:00	LUNCH BREAK	
3. Review of RCOFs around the world (continued) Chair: S. Mason (IRI) Rapporteur: A. Kamga (ACMAD)		
	RA II (Asia) contd.	
14:00 – 14:10	▪ South Asian Climate Outlook Forum (SASCOF)	D.S. Pai (IMD, India)
	RA III (South America)	
14:10 – 14:20	▪ Southeast of South America Climate Outlook Forum (SSACOF)	L. Aldeco (Argentina)
14:20 – 14:30	▪ Western Coast of South America Climate Outlook Forum (WCSACOF)	R. Martinez (CIIFEN)
	RA IV (Northern America, Central America and the Caribbean)	
14:30 – 14:40	▪ Central American Climate Outlook Forum (CACOF)	B. Olmedo (RCHR)
14:40 – 14:50	▪ Caribbean Climate Outlook Forum (CariCOF)	A.Trotman (CIMH)
	RA V (South-west Pacific)	
14:50 – 15:00	▪ Association of South East Asian Nations Climate Outlook Forum (ASEANCOF) (RAII+RAV)	T. Turkington (MSS, Singapore)
15:00 – 15:10	▪ Pacific Islands Climate Outlook Forum	A. Montoro (SPREP)

	(PICOF)	
	RA VI (Europe)	
15:10 – 15:20	▪ North Eurasian Climate Outlook Forum (NEACOF) (RAII+RAVI)	V. Khan (NEACC)
15:20 – 15:30	▪ Mediterranean Climate Outlook Forum (MedCOF) (RAVI+RAI)	E. Rodriguez (AEMET, Spain)
15:30 – 16:00	HEALTH BREAK	
3. Review of RCOFs around the world (continued) Chair: S. Mason (IRI) Rapporteur: A. Kamga (ACMAD)		
	RA VI (Europe) contd.	
16:00 – 16:10	▪ South-East European Climate Outlook Forum (SEECOF)	B. Bijelic (SEEVCCC)
	Arctic (RAII/RAIV/RAVI)	
16:10 – 16:20	▪ Pan-Arctic Climate Outlook Forum (PARCOF)	B. Denis (ECCC, Canada)
16:20 – 17:30	Open Discussion: Elements of RCOF operations, common practices, successes, challenges, gaps	Moderated by M. Coughlan (BoM)
17:30	CLOSURE OF DAY 1	

Day 2: 6 September 2017 (Wednesday)		
4. Synthesis of RCOF Operational Practices Chair: M. Coughlan (BoM) Rapporteur: C. Coelho (CPTEC)		
09:00 – 09:15	Development of consensus based outlook including data/forecast inputs	R. Martinez (CIIFEN)
09:15 – 09:30	Understanding sources of predictability	A. Brookshaw (ECMWF-C3S)
09:30 – 09:45	Downscaling techniques and tools	J.P. Ceron (CCl)
09:45 – 10:00	Climate monitoring, Climate Watch Advisory	E. Rodriguez (AEMET)
10:00 – 10:15	Forecast Verification	S. Mason (IRI)
10:15 – 10:30	Discussion	All
10:30 – 11:00	HEALTH BREAK	
11:00 – 11:15	Capacity development activities in RCOFs: curent practices and possibilities for centralized training workshops	W. Thiaw (NOAA)
11:15 – 11:30	Regional user engagement, sector-focused RCOF sessions, user applications and evaluation	P. Ramirez (CCl)
11:30 – 11:45	Coordination mechanisms: role of Regional Climate Centres	A. Kamga (ACMAD)
11:45 – 12:00	Sub-seasonal updates to RCOF products	A. Trotman (CIMH)

12:00 – 12:30	Discussion	All
12:30 – 14:00	LUNCH BREAK	
5. Towards improved and sustained RCOF processes Chair: J.P. Ceron (CCl) Rapporteur: S. Diouf (NOAA)		
14:00 – 14:15	Good practices in RCOFs, summarizing SWOT analysis	A.Tait (NIWA)
14:15 – 14:45	The Role of Co-production in RCOFs: Toward Usable Climate Services	M. Daly (ULeeds)
14:45 – 15:00	Improved/standardized format of seasonal outlook statements	D.S. Pai (IMD)
15:00 – 15:15	CCl Expert Teams' guidelines to help improving RCOF process	R. Martinez (CIIFEN)
15:15 – 15:30	Global Seasonal Climate Update: *Current status and future prospects for RCOF applications*	A. Brookshaw (ECMWF-C3S)
15:30 – 16:00	HEALTH BREAK	
16:00 – 16:15	LC LRFMME operation, access to products for RCOFs	K.H. Cho (KMA)
16:15 – 16:30	Copernicus Climate Change Service (C3S): potential role in RCOF process	A. Brookshaw (ECMWF-C3S)
16:30 – 16:45	Regional approach for implementation of Climate Services Information System	R. Kolli (WMO)
16:45 – 17:00	NCOF concept: scaling down RCOF outlooks for decision making at national scale	G.Srinivasan (RIMES)
17:00 – 17:15	Mobilizing resources to sustain the RCOFs through funding mechanisms	R. Martinez (CIIFEN)
17:15 – 17:45	Open Discussion: integrating new approaches in RCOF operation	All
17:45	CLOSURE OF DAY 2	

Day 3: 7 September 2017 (Thursday)

6. Breakout Sessions

Participants in break-out groups will discuss the current status, and opportunities to introduce innovative approaches and standardized operational practices for generating RCOF outputs including, *inter alia*, the development of objective sub-seasonal and seasonal regional forecasts, tailoring forecast products to specific user-requirements, and mechanisms for the provision of regular sub-seasonal updates between the RCOF sessions.

09:00 – 09:10	Introduction to breakout discussion session	S.Mason (IRI)
09:10 – 10:30	Break-out group discussions on key topics *(Moderator/Rapporteur):* 1. Roles and operations of GPCLRFs in support of RCOFs and in introducing Objective approaches to RCOF products *(C.Coelho/Z.Gong);* 2. Roles and operations of RCCs in support of RCOFs, including capacity	

	development and updates between RCOF sessions *(A.Trotman/V.Khan)*; 3. Role of NMHSs in the follow-up integration of seasonal outlooks in decision making process at country level *(G.Srinivasan/M.Etala)*; 4. User engagement in RCOFs *(M.Daly/P.Luganda)*; 5. Expanding RCOFs portfolio (e.g. adding climate monitoring, climate change projections, etc.) *(J.P.Ceron/T.Turkington)*	
10:30 – 11:00	HEALTH BREAK	
11:00 – 12:30	Break-out Group Discussions continued	
12:30 – 14:00	LUNCH BREAK	
7. Conclusions and Recommendations for the future generation RCOFs Chair: R. Martinez (CIIFEN) Rapporteur: A. Hovsepyan (WMO)		
14:00 – 15:00	Reporting back from break-out groups (10 min each)	Moderators/Rapporteurs
15:00 – 15:30	Open Discussion: findings of break-out discussions as recommendations for future development of RCOFs	Moderated by A. Tait
15:30 – 16:00	HEALTH BREAK	
16:00 – 16:30	Review of actions, conclusions and recommendations on way forward for improved RCOF operations	Moderated by A. Tait
16:30 – 17:00	Closing remarks	CIIFEN, WMO
17:00	END OF WORKSHOP	

ANNEX 2 List of Participants

WMO WORKSHOP ON GLOBAL REVIEW OF REGIONAL CLIMATE OUTLOOK FORUMS

5-7 September, 2017
Guayaquil, Ecuador
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