f. A number of GPCs have developed advanced web presentations for their forecasts (in some cases delivered by associated RCCs) in which forecast maps are “clickable” to reveal point probability forecasts and associated verification (examples are GPCs Tokyo, Montreal and Melbourne).

g. Dynamical downscaling of global model seasonal forecasts is being explored by a number of GPCs. CPTEC is perhaps the most advanced in the operational use of dynamically downscaled products, with experimental use of dynamical downscaling being investigated by others (e.g. Exeter with RCC-IGAD; ECMWF with RCC-Network Europe). The strong requirement for downscaled forecasts, reinforced by the questionnaire, was noted. It was recognised, though, that with different regional domains applying to different RCCs it would not be practical to formulate an operational infrastructure for GPCs to serve all RCCs with dynamically downscaled products. Moreover, because of regional focus downscaling is more naturally a function of RCCs than of GPCs. It was agreed that provision/development of statistical downscaling tools for use by RCCs should be accelerated (using experience from RCCs that have already implemented such tools), while continued research on dynamical downscaling by individual GPC-RCC collaborations and in collaboration with WGSIP should be encouraged.

h. Several GPCs are active in capacity development training often through an associated RCC (e.g. Tokyo, Beijing) or through formal/informal relationships with RCCs. A few GPCs also regularly attend and provide training at RCOFs. A number of experimental educational aids have been developed to assist this training, including tools to gain hands-on familiarity with evaluating, interpreting and using GPC ensemble hindcast and forecast data. A compendium of such tools could be compiled to assist in making them more generally available.

i. Dissemination of hindcast and forecast data: A few centres are exploring the use of open data platforms (using OPeNDAP technology) for both access and visualisation to climate data (including GPC forecast output). The IRI data library is the most established (see paragraph 7.4), while GPCs Exeter and Montreal are currently developing such systems. The potential use of open data platforms to serve GPC-RCC data exchanges is discussed further in paragraph 7.5.

6. Relevant seasonal forecast research and development initiatives

6.1 The meeting was presented with information on the developing Global Seasonal Climate Update (GSCU). The GSCU is being developed by the CCl TT-GSCU. It includes a monitoring component in which the state of the climate over the 3-months prior to issue are summarised and a predictive component in which the expected evolution for the next 3 months is presented (based on GPC products and multi-model products generated by the LC-LRFMME). For both components the variables addressed are 2m temperature, precipitation and a range of climate indices (Niño1+2, Niño3.4, IOD, NTA and STA for the prediction component). The GSCU is evolving as a practical way to facilitate the use of GPC and related Lead Centres’ products by RCCs and other regional entities, RCOFs, and NMHSs. It is directly relevant to the GFCS implementation and has been included as a priority project under the Climate Services Information System pillar of GFCS Implementation Plan. It was noted that the GSCU also faces the challenges of timeliness and leadtime discussed in paragraph 5.2e. A further challenge includes the large resource commitment required to prepare and compile and review the GSCU graphics and texts.

6.2 The meeting was briefed on the activities of the WCRP Working Group on Seasonal to Interannual Prediction (WGSIP). WGSIP’s aims include development of a programme of numerical experimentation for seasonal-to-interannual variability and predictability,

statistically-based seasonal forecasting and also for advanced correction of model forecast output through Model Output Statistics (MOS) methods. Strengthened support for RCCs to use CPT in calibration of GPC output was requested and included provision of GPC forecasts and hindcasts in the data format required by CPT (some GPCs are already doing this via the IRI data library and other means). In this context it was noted that the potential of making GPC forecasts available in CPT format on the LC-LRFMME website should be explored. New functionality in the latest version of CPT was described: including a facility for generating Standardised Precipitation Index (SPI) forecasts to assist assessment of the drought implications of rainfall forecasts; a facility for verifying sets of probabilistic forecasts (e.g. as might be generated by RCCs or NMHSs) using a set of scores that includes the Standard Verification System measures; and a new presentation option for probability forecast maps. In discussion it was noted that while CPT was a very versatile and valued tool, application of some facilities such as Canonical Correlation Analysis (CCA) was not always trivial and benefited from substantial understanding of the principles involved – in particular the choice of geographical input domain for the model being calibrated is not always straightforward. This pointed again to a need for enhanced written guidance material and training to be developed and made available to RCCs.

7.4 The meeting was briefed on the IRI data library. The IRI data library allows free access to climate data and forecasts for download, manipulation and visualisation. Data may be downloaded in a wide variety of formats including CPT, Google Earth and GIS. Forecast visualisation includes a facility for the user to select the percentile of interest (e.g. to view, for the IRI multi-model, the forecast probability of rainfall exceeding the 90^{th} percentile). In discussion it was noted that the steps to retrieve data were currently quite complex and that these were being made more user-friendly. It was also noted that other centres (e.g. Exeter) were also developing open data platforms for their GPC forecasts and hindcasts and other climate data along with tools to manipulate, visualise and download the data (the Exeter system will also allow users to contribute applications to perform specialised data processing). If these OPeNDAP systems are linked together and steps are taken to include the LC-LRFMME forecast/hindcast data repository, the combined data sources and processing tools would make a powerful resource for RCCs.

7.5 In the above context, and given the expected demands of the GFCS for large increases in the flow of data to support climate forecasts and monitoring, it was noted that a new collaborative effort to enhance and link open data platforms, using e.g. OPeNDAP technology and working within the WIS system, will likely be a more effective way forward than incremental improvements in data access based on existing IT infrastructure.

8. Use of GPC products by RCCs – including methods of preparing regional outlooks

8.1 The participants were briefed on the activities of 10 RCCs represented at the meeting (comprising both designated RCCs as well as RCCs at different stages of development). Representatives from nodes in RCC Networks with LRF responsibilities for subregions also briefed on their activities (the South East Europe Virtual Climate Change Centre and the Eastern Mediterranean Climate Centre). Discussion covered all functions including climate monitoring and training provided by some RCCs, but focussed on long-range forecasting activities and particularly RCC use of GPC products. In general there is a very large diversity in activities, products and forecast procedures, as might be expected from the differing climate characteristics of the

predicted rainfall totals, however experimental dynamical predictions of onset timing, available from e.g. GPC Exeter, are beginning to be used by some African RCCs.

d. *Downscaling*: A few RCCs are providing operational downscaled seasonal forecast products, using statistical methods. Other RCCs use the results of downscaling in the generation of regional forecast maps. For example, where CPT is used with station observation predictands, the resulting downscaled forecasts are often considered in generation of the final map products and, though some smoothing is typical, a degree of geographical detail may be retained in the final product. A few RCCs are experimenting with dynamical downscaling and in some cases results are included in RCC operational bulletins.

e. *Forecast verification*: Most RCCs and developing RCCs are providing verification of their issued forecasts. Where RCCs forecasts are based on objective processing of GPC output verification may include assessments, using the SVS, over the full (multi-decadal) GPC-model hindcast period (e.g. RCC Tokyo). Frequently, operational forecasts synthesised by expert assessment of a number of prediction methods are presented in map format only and are not held in gridded digital form. In such cases verification is more of a challenge and is possible only over the timeseries of real-time forecasts. Nevertheless verification measures such as ROC, RPSS, and hitrate scores are being used.

f. *Needs of RCCs*: The needs of RCCs are diverse and depend on region, stage of development and capacity. However needs highlighted in the discussion are listed below and are generally consistent with the questionnaire results.
   - o much improved access to GPC hindcast and forecast data in digital format, and guidance on its use;
   - o provision of digital data in required formats (e.g. CPT);
   - o tools for statistical downscaling of GPC forecasts and training in their use (there was general agreement that downscaling was more naturally the role of RCCs than GPCs – and that RCCs have best access to the necessary station data);
   - o tools for objective combination of the results of different forecast methodologies;
   - o there is a need for recommended procedures in generation of regional forecasts, including downscaling – with a move towards standardisation;
   - o more information on the relative skills of GPC models for each RCC region (e.g. in the form of a technical guidance document);
   - o better communication of the products and services that are available from GPCs;
   - o software tools for verification of RCC forecasts and guidance in their use (the new verification facility available from CPT was noted in this context);
   - o new GPC outputs, including: longer lead time forecasts (a reference mainly to LC-LRFMME products); higher order categories (e.g. quintiles, percentiles); drought related indices (e.g. SPI); forecasts for rainy season onset and cessation; risk of consecutive dry days; reduced timeframe (e.g. monthly means in addition to 3-monthly-means (note: monthly means are available from the LC-LRFMME and climagram products generated by some GPCs are based on monthly values); diagnostic variables (e.g. 200hPa stream function and velocity potential).
   - o Capacity development: this was a cross cutting need that has been mentioned several times in the above. Additional aspects to this theme include: need for trained personnel and the need to share ideas and experiences between RCCs. RCC sharing of common issues and operational experience might best be served by an annual workshop on operational long-range prediction.

Day 2

(Continuation of 1: identify new or modified gaps in GPC output in light of discussion on available tools for interpreting GPC output and the discussions on RCC/RCOF forecast methodology).

4) How does the process/methodology of using GPC output in preparation of regional/national forecasts need to be strengthened? How can GPCs assist?
5) How do interactions between GPCs and RCCs/RCOFs need to be enhanced to strengthen the forecast process.

Responses to these questions, consolidated in plenary sessions, are in Annex V and formed input to develop draft recommendations on day 3.

On day 3 participants divided into 2 groups, a GPC group and an RCC/RCOF/NMHS group. Each group was given the task of drafting workshop recommendations – using results of the consolidated information in Annex I and the subsequent discussion on NMHS activities. The different perspectives of each group were then harmonised in plenary. In addition, the GPC group was tasked with developing suggested revisions to the GPC designation criteria and mandatory products, consistent with the recommendations. Similarly, the RCC/RCOF/NMHS group was tasked with reviewing the RCC mandatory requirements for LRF activities. Recommendations from this final plenary session have been further harmonised through post-meeting correspondence and are elaborated in the following sections.

11.2 Recommendations of the GPC group on revision of the GPC designation criteria and minimum products requirement are copied below:

Designation criteria (GDPFS Manual Appendix II-8):

- Issue frequency should be monthly.
- A date of submission of outputs to the LC should be agreed upon.
- A distinction between variables and products needs to be made.
- The forecast period should be kept to 3-months for two-tiered systems, but could be extended for coupled models.
- The requirements for publication of verification information will need to be revised in response to recommendations from the ET-OPSLS Task Team on Revised Verification Strategies (TT2).

Minimum products (GDPFS Manual Appendix II-6 4.2):

- A list of atmospheric and oceanic indices should be defined, and become mandatory products of GPCs. The indices should be disseminated through the GPC´s website, and a smaller list of products made available by the LC.
- Probabilities for the outer quintiles (or other higher order categories, to be agreed by the ET-OPSLS) should become highly recommended products of GPCs.
- The sentence on product accessibility requires clarification. Mandatory variables should be submitted to the LC, but there also needs to be a mandatory set of products that the GPCs should make available on their own website.
- SST forcing used in two-tiered systems should be a mandatory variable.
- The list of variables needs revision – 500 hPa is useful, but MSLP and T850 may require revision. Other variables should be added.
- GPCs should be encouraged to use standard formatting for display of their products.

11.3 Recommendations of the RCC/RCOF/NMHS group on potential review of the RCC mandatory functions for LRF are provided below:

- The current criteria (GDPFS Manual Appendix II-11) are not currently in need of updating, however it was noted that regular reviews of the criteria should be made as

Annex I

LIST OF PARTICIPANTS

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Wed 27 Nov	**Day3 – Break out groups - plenary session on RCC and GPC needs – action plan**
Report on sessions 4, 5a and 5b	
09:00 – 09:20	Rapporteur's summary of sessions 4 and 5a&b and associated discussion
09:20 – 09:30	Questions/further discussion
Session 5c: Use of RCC and GPC products by NMHSs	
Chair: Andre Kamga	**Rapporteur:** Janita Palahad
09:30 – 09:35	Tanzania
09:35 – 09:40	Bangladesh
09:40 – 09:45	Paraguay
09:45 – 09:50	Costa Rica
09:50 – 09:55	Fiji
09:55 – 10:00	Turkey
10:00 – 10:15	Discussion
10:15 – 10:30	Preparation for break out groups
10:30 – 11:00	Break
Session 6: Break out groups	
11:00 – 13:00	1: Needs of RCCs from GPCs and Lead Centres 2: Needs of GPCs and Lead Centres from RCCs (including feedback mechanisms) 3: Standard procedures for use of GPC and Lead Centre products and support needs
13:00 – 14:00	Lunch
Session 7: Plenary	
14:00 – 14:20	Group 1: report back on RCC needs and recommended ways of meeting needs
14:20 – 14:40	Group 2: report back on GPC/LC needs and recommended ways of meeting needs
14:40 – 15:00	Group 3: Recommendations on procedures and support needed to implement standard procedures for forecast preparation
15:00 – 15:30	Discussion
15:30 – 16:00	Break
16:00 – 16:30	Discussion continued
16:30 - 17:30	Draft report on recommendations and implementation action plan
17:30	Close

Q3. Please describe your centre's links with NMHSs other than that of your own country

	Q3 **Which of the following (a, b, c or d) best describes your GPC's links to NMHSs other than that of your own country**	Please select one only (enter "Y")	In the row that you have entered "Y" please give number of NMHSs linked with
a	Apart from our GPC products visualised on websites, provided as part of my organizations WMO GPC commitment, my GPC has no well established links with any NMHSs		
b	My GPC has well established informal agreements to provide tailored services to one or more NMHSs		
c	My GPC has well established formal agreements to provide tailored services to one or more NMHSs (e.g. project contracts, MoUs)		
d	My GPC has informal collaborations with one or more NMHSs, however our service supply is not yet regular or well established.		

If needed, clarify or comment on your responses or add other information below:

Supply of visualised forecast maps on GPC/LC websites

Q4. Content of new forecast products: GPCs and the LC-LRFMME currently provide visualised forecast maps for 3-month-mean values of the following variables: 2m temperature, precipitation, pmsl, temperature at 850hPa and 500 hPa geopotential height. Forecasts are provided in terms of ensemble mean values and probabilities of tercile categories. Below is a (non-exhaustive) list of additional products that RCCs have expressed interest in. Please indicate the status of development of such products at your centre (NB: "in principle" implies "given resources").

	Q4 **Status/potential for "new" GPC products**	Operational now or, in principle, could be made operational within 1 year	Experimental products could, in principle, be made ready for trialling with RCCs within 1 year	Research topic, expected ready for trialling in 2-5 years	No current plans to research or develop this sort of product
a	More variables: e.g. u and v wind components; upper level divergence…				
b	More information on climate indices: More SST "plume" products (as currently available for Nino regions) e.g. for IOD and Atlantic regions. Also other indices such as NAO and monsoons				
c	Probabilities for higher order categories (e.g. seasonal average temperature in outer quintile or outer decile categories)				
d	Regionalised and tailored products e.g. probabilities of exceeding absolute thresholds (e.g. seasonal rainfall > 400mm)				
e	Regionalised products tailored to specific seasons: eg. addressing 4 month seasons				

	such as Sept-Dec and June-September
f	Probability of more/less than the typical number of subseasonal events (e.g. heatwaves, heavy rain events, dry spells)
g	Timing of subseasonal events e.g. start/cessation of rainy season
	Please add more items of product development below if not covered above.

If needed, clarify or comment on your responses or add other information below:

Provision of digital forecast and hindcast data

Q5. Please indicate (enter "Y") if and where your forecast and hindcast data (monthly and seasonal averages) are freely available to all RCCs.

		Freely available on case-by-case request	Freely available through our GPC website or ftp	Freely available through LC-LRFMME website	Freely available through IRI data library	Freely available through other means	Not freely available
Q5	**Availability of your GPC forecast and hindcast data**						

If needed, clarify or comment on your responses or add other information below:

Q6. Tools for post-processing GPC forecasts.

Q6	**Please indicate tools that you have developed for regional post-processing of GPC forecasts that could be shared with RCCs**	Available now or, in principle, could be made available within 1 year	Could, in principle, be made available within 2-5 years	No current plans to develop these tools
a	Advanced forecast calibration (using the hindcast skill track record)			
b	Multi-model combination methods			
c	Dynamical downscaling (Regional Climate Model systems)			
d	Dynamical downscaling (statistical methods)			
	Please add more items below if other tools not covered above are being developed			

If needed, clarify or comment on your responses or add other information below:

Verification

Q7: The interpretation and use of GPC products heavily rely on the performance of forecasting systems used to prepare these products over a country or region. GPCs have been providing standard verification products to the WMO LC-SVSLRF. What additional verification products are available and can be exchanged between GPCs and RCCs to further facilitate optimal use of GPC products?

Q7	Status of information on forecast verification and software tools for verification	Available now or, in principle, could be made available within 1 year	Could, in principle, be made available within 2-5 years	No current plans to develop these tools
a	Availability of forecasts maps with a superimposed skill mask?			
b	If you are developing new, additional forecast products (see Q3) do you have information on their skill?			
c	Do you generate a "skill summary" bulletin for your forecast products, commenting on e.g. prediction skill for ENSO and for temperature and precipitation (global coverage)			
d	Do you have verification software packages that can be shared with RCCs and NMHSs for use over their region of interest? *Please add other verification products and tools being developed if not covered above.*			

If needed, clarify or comment on your responses or add other information below:

Capacity development

Q8: Training materials and courses

Many GPCs have developed training materials and courses to provided capacity building events both for climate service providers and users. Please answer the following questions on the status of materials/courses.

Q8	AVAILABILITY OF CAPACITY DEVELOPMENT MATERIALS/COURSES	Available now or, in principle, could be made available within 1 year	Could, in principle, be made available within 2-5 years	No current plans to develop these materials/courses

a	General climate science foundational courses
b	Specific training on the use and interpretation of GPC products including verification
c	Provision of tools (e.g. CPT) for processing and downscaling GPC forecasts and hindcasts and specific training in using them, including regular updates
d	Assistance with establishing dynamical downscaling (i.e., Regional Climate Models) including training
e	Access to documentation, literature and on-line modules relevant to GPC products, and development of technical reference manuals oriented for operational LRF
	Please add more items if you are have or are developing capacity development tools not covered above

If needed, clarify or comment on your responses or add other information below:

Feedback to GPCs

Q9: Reporting to GPCs

RCCs and NMHSs should guide future development of GPC products to meet national or regional needs. Quarterly or annual reports from RCCs and NMHSs could be useful to exchange information, share experiences and make suggestions to facilitate targeted developments of GPC products leading to better products and services at regional and national levels. Please rank elements of content you would like to have in a report on the use of your product by RCCs and NMHSs.

From the list below please enter "1" for the highest priority down to "7" for your lowest priority. Each number should be used only once (i.e. no equal ranking please).

Q9	**POTENTIAL CONTENTS OF FEEDBACK REPORTS TO GPCs**	Rank
a	Service standards. i.e. ease of access to desired products	
b	Description of observed features/phenomena over the region during the season or year	
c	The range of GPC products available to the RCC	
d	Statistics on the degree of use of different GPC products	
e	RCC regional products derived by processing of GPC's products	
f	Long-term predictive skill of GPCs over the region (comparison of different GPCs)	
g	Real-time (recent) performance of GPCs over the region (comparison of different GPCs)	
	Please add more items below if the most important ones for your organisation are not included	

If needed, clarify or comment on your responses or add other information below:

Annex IV

QUESTIONNAIRE FOR RCCS, DEVELOPING RCCS AND LRF NODES IN RCC-NETWORKS

You have received this questionnaire as a participant in the WMO workshop: Operational Long-range Forecasting: GPCs and RCCs, in support of NMHSs and RCOFs, to be held 25-27 November 2013, Brasilia, Brazil.

The intention of the questionnaire is to introduce some topics to be addressed at the workshop and to gather information to help the organisers and chairpersons of the sessions. Its focus is on your current use and future needs for GPC products in preparation of forecasts for your region. A companion questionnaire has also been sent to GPCs.

In order to allow timely processing of responses, please return your completed questionnaire as soon as possible and no later than 25 October 2013.

Please return to: jean-pierre.ceron@meteo.fr; with copy to akamgaf@yahoo.com and richard.graham@metoffice.gov.uk

Many thanks in advance for completing the questionnaire.

Questionnaire

Note:
1. In the following, "RCC" is used to cover both designated and developing RCCs as well as LRF nodes in RCC-Networks.
2. GPC=Global Producing Centre for Long-range Forecasts
3. Unless stated otherwise, "LC" refers to the Lead Centre for Long-range Forecast Multi-model Ensembles https://www.wmolc.org/

Q1. Identification and information on your RCC

Country
Name of your organisation
Name of the RCC you are responding for?
Please state if a fully functional RCC or LRF node in RCC-Network?
My organisation is both an RCC and also a GPC? (Y or N)
Your name (optional)
Your email address (optional)

Q2. Please describe your centre's links with GPCs

Q2	Which of the following (a, b, c or d) best describes your RCC's links to GPCs	Please select one only (enter "Y")	In the row that you have entered "Y" please give the number of GPCs linked with
a	Apart from our use of GPC products visualised on websites, my RCC has no well established links with any GPCs		
b	My RCC has well established informal agreements for services from one or more GPCs		
c	My RCC has well established formal agreements for services from one or more GPCs (e.g. project contracts,		

MoUs)

d My RCC has informal collaborations with one or more GPCs, however service supply is not regular or well established.

If needed, clarify or comment on your responses or add other information below:

Q3. Please indicate the degree to which you use GPC and or LC products in preparation of the following mandatory RCC outputs

Q3	Degree of use of GPC/LC forecasts in your RCC's products	GPC/LC forecasts are main source of information	GPC forecasts important but secondary	Little current use of GPC output in this product
a	Consensus regional and sub-regional seasonal forecasts issued ahead of main seasons (e.g. as produced at RCOFs)			
b	Seasonal forecast updates (e.g. issued every month)			
c	Climate watches			
d	*Please add here (in new rows) similar information for other key forecasts products your centre issues that are not covered above.*			

If needed, clarify or comment on your responses or add other information below:

Use of visualised forecast maps on GPC/LC websites

Q4. How important are the following (mandatory) GPC outputs in your preparation of the forecasts your RCC generates for relevant regions/NMHSs?

Q4	Please indicate the degree of importance to you of the mandatory products from GPCs	Essential	Useful, but not essential	Not much used
a	Tercile probabilities of 3-month-mean 2m temperature			
b	Tercile probabilities of 3-month-accumulated precipitation			
c	Tercile probabilities of 3-month-mean Sea Surface Temperature			

If needed, clarify or comment on your responses or add other information below:

Q5. How important are the following additional GPC outputs in preparation of the forecasts your RCC generates for relevant regions/NMHSs?

Q5	Please indicate the importance to you of these additional products from GPCs	Essential	Useful, but not essential	Not much used / or not found
a	Mean sea level pressure			
b	500 hPa geopotential height			
c	850 hPa temperature			
d	Regional SST forecasts (e.g. SST "plumes" for Nino3.4)			

e Specific GPC forecast bulletins
f *Please add here (in new rows) similar information for other GPC products your centre uses that are not covered above*

If needed, clarify or comment on your responses or add other information below:

Q6. Please indicate your approach when using forecasts from multiple GPCs

Q6	**Preferred ways of using forecasts from multiple GPCs**	Frequently used	Sometimes used	Rarely or never used
a	Judgement based on forecast from an individual, preferred GPC			
b	Judgement based on comparing individual forecasts from several individual GPCs			
c	Multi-model products combining forecasts from several preferred GPCs			
d	Multi-model products combining forecasts from all available GPCs			

If needed, clarify or comment on your responses or add other information below:

Q7. Please indicate the internet source for GPC forecasts that you use most

Q7	**Preferred ways of using the output from up to 12 GPCs and other sources**	Frequently used	Sometimes used	Rarely or never used
a	Websites of one or more individual designated GPCs			
c	Websites of other prediction centres, not designated as a GPC			
d	LC-LRFMME website			
e	APCC website			
f	EUROSIP website			

If needed, clarify or comment on your responses or add other information below:

Q8 Which lead times are the most important for preparation of your regional forecasts?

Q8	**WHICH LEADTIMES OF GPC FORECASTS ARE MOST IMPORTANT**	Essential	Useful, but not essential	Not useful (as lead time too short)
a	0-month lead time			
b	1-month lead time			
c	2-month lead time			
e	3-month lead-time			

If needed, clarify or comment on your responses or add other information below:

Verification

Q9. Please indicate your degree of use of GPC hindcast verification products. (Verification products for GPCs are available on the website of the Lead Centre for the

Standard Verification System for Long-range Forecasts (LC-SVSLRF) and on individual GPC websites)

Q9	Please indicate your use of verification products	Frequent use	Occasional use	Rarely or never used.
a	Verification available on the LC-SVSLRF website http://www.bom.gov.au/wmo/lrfvs/			
b	Verification available on individual GPC websites			

If needed, clarify or comment on your responses or add other information below:

Q.10 Do the above websites provide sufficient information on the forecast skill of the GPCs for your region?

Q10	SUITABILITY OF CURRENT VERIFICATION INFORMATION	Strongly agree	Agree	Disagree	Strongly disagree	Products not used so far
a	The current verification information provided by GPCs and the LC-SVSLRF http://www.bom.gov.au/wmo/lrfvs/ is sufficient for my needs					

If needed, clarify or comment on your responses or add other information below:

Q11. Please indicate which of the SVSLRF verification measures you make most use of

Q11	Please indicate your use of verification products	Frequent use	Occasional use	Rarely or never used	Not found
	"Bulk" scores for regions				
a	ROC curves and ROC "scores" for tercile categories calculated for geographical regions				
b	Reliability and sharpness diagrams calculated for geographical regions				
c	Mean Square Skill Score (MSSS) calculated for geographical regions				
d	Decomposition component of the MSSS (e.g. correlation) calculated for geographical regions.				
	Scores plotted in map format				
d	ROC "scores" for tercile categories calculated at gridpoints and plotted in map format				
e	Mean Square Skill Score calculated at gridpoints and plotted in map format				
	Decomposition component of the MSSS (e.g. correlation) plotted in map format				
	Scores for Nino3.4				
f	ROC scores for tercile categories of the Nino3.4 index				
g	Reliability and sharpness diagrams				

	for the Nino3.4 index	
h	Mean Square Skill Score for the Nino3.4 index	
i	Decomposition component of the MSSS (e.g. correlation) for the Nino3.4 index	

Please expand on how the information on GPC forecast quality should be improved.

Use of digital forecast/hindcast data from GPCs

Q12. Please compare your degree of use of visualised forecast maps on GPC/LC websites with that of digital forecast data (as well as hindcast data)

Q12	**Please indicate your frequency of use of the following**	Frequent use	Occasional use	Rarely or never used, or not available
a	Visualised forecast maps on GPC and LC websites			
b	Digital forecast and hindcast data downloaded or provided by GPCs			

If needed, clarify or comment on your responses or add other information below:

Q13. Downscaling of GPC data

Q13	**If you downscale the digital data from GPCs please indicate your degree of use of the two methods below.**	Frequent use	Occasional use	Rarely or never used.
a	Statistical methods			
b	Dynamical methods (Regional Climate Model systems)			

If needed, clarify or comment on your responses or add other information below:

Barriers to using GPC products

Q14. In your opinion, what are the key barriers that can hinder your use of GPC products?

From the list below please enter "1" for the biggest barrier down to "8" for the smallest. Each number should be used only once (i.e. no equal ranking please). If you add barriers to the list please include them in your ranking. For example if you include 2 further barriers your ranking should be 1 to 8, again with no equal ranks.

Q14	**Please rank the barriers encountered in use of GPC products (1=biggest barrier)**	Rank
a	Difficulties in accessing GPC graphical forecast products on websites	
b	Difficulties with accessing or lack of availability of digital forecasts and hindcasts	
c	Difficulties in interpreting/understanding the forecast products	
d	Quality/skill of forecasts not as good as existing statistical forecasts	
e	Insufficient verification information to assess the quality/skill of forecasts	
f	Lack of information on the details of the GPCs forecast systems	

g	Format of the forecasts is unsuitable (e.g. tercile information is not sufficient)	
h	Lack of downscaling/tailoring to the sub-regional/national scale	
	Please add more barriers below if the most important ones for your organisation are not included	

If needed, clarify or comment on your responses or add other information below:

Priorities for the enhancement of GPC services to RCCs

Q15. **Delivery of forecast products:** currently, GPCs are required to deliver forecasts through visualised products on websites and/or by supply of digital data. Which of these methods are most important to develop in the future? Please answer below.

Q15	**WHICH OF THE BELOW SHOULD BE HIGHEST PRIORITY FOR GPCs TO WORK ON?**	Please select one only (enter "Y")
a	An expanded range of rendered images for RCCs to view on GPC and Lead Centre (LC-LRFMME) websites	
b	Improved access to forecast and hindcast data and tools to analyse them (so that RCCs can develop their own bespoke products)	

If needed, clarify or comment on your responses or add other information below:

Q16. Content of new forecast products: GPCs and the LC-LRFMME currently provide visualised forecast maps for 3-month-mean values of the following variables: 2m temperature, precipitation, pmsl, temperature at 850hPa and 500 hPa geopotential height. Forecasts are provided in terms of ensemble mean values and probabilities of tercile categories. What are the priorities for expanding this list of products?

From the list below please enter "1" for the highest priority down to "7" for your lowest priority. Each number should be used only once (i.e. no equal ranking please). If you add variables to the list please include them in your ranking. For example if you include 2 further variables your ranking should be 1 to 9, again with no equal ranks.

Q16	**PRIORITY VISUALISED FORECAST MAP PRODUCTS FOR GPCs TO DEVELOP AND EVALUATE**	Rank
a	More variables: e.g. u and v wind components; upper level divergence…	
b	More information on climate indices: More SST "plume" products (as currently available for Nino regions) e.g. for IOD and Atlantic regions. Also other indices such as NAO and monsoons	
c	Probabilities for higher order categories (e.g. seasonal average temperature in outer quintile or outer decile categories)	
d	Regionalised and tailored products e.g. probabilities of exceeding absolute thresholds (e.g. seasonal rainfall > 400mm)	
e	Regionalised products tailored to specific seasons: eg. addressing 4-month seasons such as Sept-Dec and June-September	
f	Probability of more/less than the typical number of subseasonal events (e.g. heatwaves, heavy rain events, dry spells)	
g	Timing of subseasonal events e.g. start/cessation of rainy season	
	Please add more variables below if the most important ones for you organisation are not included	

If needed, clarify or comment on your responses or add other information below. For example if you have listed 2, 3 or 4 as having high priority, add the indices, categories and thresholds of interest.

Q.17 Please respond to the following questions on standards for GPC services.

Q17	SERVICE STANDARDS	Strongly agree	Agree	Disagree	Strongly disagree
a	It is important for me to know in advance the exact day of issuance of GPC and LC forecasts				
b	It is important for me to know details of the modelling systems used by GPCs (e.g. parameterisation schemes used)				
c	It is important for me to be given advance warning of changes to the modelling system that generates the forecast products				
d	It is important for me to have detailed technical documentation of the GPC products including forecast skill summary, caveats on performance etc.				
e	It is important for me to have a Help Desk or similar forum available for real-time technical assistance in using GPC products and discussion of their interpretation.				

Please briefly expand your answers by stating for example the main information you need on the modelling system specification and the amount of advance warning you need ahead of model changes.

Q.18 Capacity development: **Please rank the capacity development requirements of your RCC. (If your capacity in these areas is already well developed please state that and move to question 19.)**

From the list below please enter "1" for the highest priority down to "5" for your lowest priority. Each number should be used only once (i.e. no equal ranking please). If you add categories to the list please include them in your ranking. For example if you include 2 further categories your ranking should be 1 to 7, again with no equal ranks.

Q18	CAPACITY DEVELOPMENT NEEDS FOR YOUR ORGANISATION	Rank
a	General climate science foundational courses	
b	Specific training on the use and interpretation of GPC products including verification	
c	Provision of tools (e.g. CPT) for processing and downscaling GPC forecasts and hindcasts and specific training in using them, including regular updates	
d	Assistance with establishing dynamical downscaling (i.e., Regional Climate Models) including training	
e	Access to documentation, literature and on-line modules relevant to GPC products, and development of technical reference manuals oriented for operational LRF	
	Please add more categories below if the most important ones for your organisation are not included	

Please expand your answers in the space below. For example if you have listed 2 or 3 has high priority add the indices and thresholds of interest.

Q.19 Capacity development: **Please rank the capacity development requirements of NMHSs in the (sub-)region for which your RCC is responsible**.

From the list below please enter "1" for the highest priority down to "5" for your lowest priority. Each number should be used only once (i.e. no equal ranking please). If you add categories to the list please include them in your ranking. For example if you include 2 further categories your ranking should be 1 to 7, again with no equal ranks.

Q19	**CAPACITY DEVELOPMENT NEEDS FOR YOUR (SUB-) REGION**	Rank
a	General climate science foundational courses	
b	Specific training on the use and interpretation of GPC products including verification	
c	Provision of tools (e.g. CPT) for processing and downscaling GPC forecasts and hindcasts and specific training in using them, including regular updates	
d	Assistance with establishing dynamical downscaling (i.e., Regional Climate Models) including training	
e	Access to documentation, literature and on-line modules relevant to GPC products, and development of technical reference manuals oriented for operational LRF	
	Please add more categories below if the most important ones for your organisation are not included	

Please expand your answers in the space below. For example if you have listed 2 or 3 has high priority add the indices and thresholds of interest.

Annex V

Results of breakout groups and plenary sessions on days 1 and 2

Theme 1: What are the main gaps/barriers to RCC/NMHS/RCOF use of GPC output (include LC-LRFMME and LC-SVSLRF)?

- Lack of tools to verify GPC products and assess model limitations to predictability
- Lack of tools to downscale the GPC outputs
- Lack of ready access to GPCs' digital forecast and hindcast data from a single portal
- Lack of tools to convert GPC data into the format desired
- Lack of human resource capability
- Lack of guidance on how to use the GPC output
- Lack of information on the range of available GPC products (i.e. a catalogue)
- Poor timeliness of forecast issuance, relative to RCCs' committments in timing of regional forecast issuance
- LC-LRFMME lead-time too short (next 3-months forecast) – need longer lead forecasts
- Lack of software to aid interpretation of GPC output
- Lack of service standards: i.e. Advance notification of changes to GPC model configuration
- Guidance on converting GPC outputs into regional probability forecasts
- Lack of subseasonal information (onset timing, dry spells etc)
- Need for high frequency output e.g. daily output for diagnosing number of rain days.
- Lack of guidance on how to verify consensus forecasts

Theme 2: From additional products/activities available or developing, what should be adopted more widely? – anything else?

- Subseasonal information (eg. MJO indices; key variables for next 1,2,3 and 4 weeks ahead; season onset and cessation);
- Tailored forecast products including: higher order categories (e.g. quintiles), "extremes", products for 4-month seasons (e.g. African and Indian monsoon);
- Circulation parameters: e.g. streamfunction and velocity potential;
- More climate (SST teleconnection) indices: IOD, Atlantic Ocean, NAO and Monsoon Indices
- Arctic sea ice extent and depth
- Drought forecasts, including use of SPI
- Tropical Cyclone forecasts (all ocean basins)
- Soil moisture moisture forecasts
- Products for diagnosis of ocean models
- Best possible spatial and temporal resolution for all products

Theme 3: Ideas/recommendations on how to close gaps and improve use of GPC output. Implications for LCs

- GPCs to coordinate strengthened capacity development (including downscaling – which is primarily an RCC responsibility)
- Modify (expand) the list of mandatory GPC products
- Promote improved communication and formal cooperation between RCCs and GPCs (including regular technical workshops)
- GPCs to "push" forecast and hindcast data, rather than depending on RCC's to "pull" it
- Development of coherent forecast and observation products (same formats)
- Revisit the timeliness of issue of forecasts.

- Relax current data policies which inhibit sharing of data for some GPCs.
- Develop tools and expertise for diagnosis of GPC output on regional to national levels)
- Lead Centre to display GPC forecasts relative to a common hindcast period (e.g. 1983-2001)
- Add requirement for longer lead forecasts on LC-LRFMME website
- GPC collaboration on OpeNDAP sharing of forecasts

Theme 4: How does the process/methodology of using GPC output in preparation of regional/national forecasts need to be strengthened? How can GPCs assist?

- Improved mechanism for coordination between global, regional and national forecasts – to reduce inconsistencies
- Hindcasts and forecasts from GPCs to be made available on IRI data library and other OpeNDAP systems
- GPCs to assist in downscaling methodology
- Collaboration with WGSIP to address methodologies for assessment of predictability through diagnostic analysis of seasonal climate processes
- Develop guidance on best practice and procedures for preparing regional predictions – backed by training
- Guidance on how to produce regional/national probabilities using all forecasts methods (particularly MME) in a more objective way

Theme 5: How do interactions between GPCs and RCCs/RCOFs need to be enhanced to strengthen the forecast process.

Establish group in which all RCC/RCOFs are represented to discuss common issues and communicate jointly to GPCs and LCs via the ET-OPSLS

- Organise regional training activities jointly between GPCs/LCs and RCCs/RCOFs/NMHSs, including on improved use of GPC output
- Formal arrangements for feedback between GPCs and RCCs to be strengthened
- More systematic participation of GPCs in RCOFs including development of technical guidance
- GPC/RCC collaboration to produce new joint forecast demonstration products
- Advertise existing facility of GPC contact points (as in GDPFS manual)

Annex VI

PARTICIPANT ABSTRACTS

STATUS OF THE GLOBAL PRODUCING CENTRES FOR LONG-RANGE FORECASTS (GPCS) AND MANDATORY GPC PRODUCTS

Richard Graham

WMO CBS designated the first Global Producing Centres for Long-range Forecasts (GPCs) in 2006. There are now 12 GPCs, with at least one in every WMO Regional Association area. The criteria for designation and the definition of mandatory products have not changed since that time. However, there have been significant advances in the development and designation of Regional Climate Centres (RCCs) and the development and spread of Regional Climate Outlook Forums (RCOFs) and their activities - bringing an increased requirement on GPCs that is backed by an imperative for strengthened international collaboration through the Global Framework for Climate Services (initiated by World Climate Conference-3 in 2009). It is therefore timely to review the roles and functions of GPCs at this workshop with a view to developing their outputs to better meet the needs of RCCs, NMHSs and RCOFs. The current designation criteria, mandatory and recommended products are reviewed below. Currently, to be designated a GPC, a centre must:

- Have a fixed production cycle and time of forecast issuance. The issue frequency must be at least quarterly;
- Provide a minimum set of mandatory forecast products (see below). The forecast range must cover at least the 3-month period following the month of issue;
- Provide verification information as per the WMO Standardised Verification System for Long-range Forecasts (SVSLRF) – see below;
- Provide up-to-date information on the prediction methodology used by the GPC;
- Make products accessible through visualised images on the GPCs website and/or through dissemination through the GTS and/or the internet.

The mandatory forecast products are:

- Calibrated probability forecasts for three (tercile) categories for:
    - 2-metre temperature (with global coverage);
    - Sea Surface Temperature (applies only for GPCs using coupled ocean-atmosphere prediction systems);
    - Total precipitation (with global coverage).

In addition, the following recommended products are now generated by all GPCs and displayed (at least on the LC-LRFMME website (see below)).

- Calibrated probability forecasts for three (tercile) categories for:
    - Pressure at mean sea level;
    - Temperature at 850 hPa;
    - 500 hPa height.

Ensemble mean forecasts for both mandatory and recommended products are also generated.

To assist the work of GPCs, 2 Lead Centres have been established: a Lead Centre for Long-range Forecast Multi-Model Ensemble prediction (LC-LRFMME http://www.wmolc.org) and the Lead Centre for SVSLRF (LC-SVSLRF http://www.bom.gov.au/wmo/lrfvs). Briefly, the LC-LRFMME collects forecast data from GPCs and displays individual GPC forecasts in a standardised format, as well as generating and displaying multi-model forecasts. The LC-SVSLRF collects and displays verification information on GPC forecasts and is a repository for verification datasets, documentation and software for verification diagnostics.

Reference:

Graham, R.J., Yun, W-T., Kim, J., Kumar, A., Jones, D., Bettio, L., Gagnon, N., Kolli, R.K. and Smith, D. 2011: Long-range forecasting and the Global Framework for Climate Services. Clim Res, 47, 47-55. http://www.int-res.com/abstracts/cr/v47/n1-2/p47-55/

STATUS OF RCC DESIGNATION, RCC MANDATORY AND HIGHLY RECOMMENDED PRODUCTS, AND RCOF ACTIVITIES

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Regional Climate Centres (RCCs) are being established in all WMO Regional Associations (RAs). The status of designation differs from region to region, i.e. from RCCs already being designated to RCCs which are still in the developing phase. In some regions the discussion just started how to design and establish a RCC. Also Regional Climate Outlook Forums (RCOFs) are continued to be established. The process to establish RCOFs is based on regional needs and involvement, and formalised to a lesser extent.

RCCs have to go through a process which involves regional level coordination at the outset, to agree that a RCCs shall be developed, and then to agree on which are the specifics of the functions to be provided to the member countries of the region through their respective NMHSs. The guiding principle are to build on existing activities, and not to duplicate or replace national activities. The approached taken in the regions can differ, from a single RCC at one institution offering all mandatory and highly recommended products from a single source, a network of individual nodes collectively fulfilling the RCC functions, several full functional RCCs or several sub-regional RCCs with one centre taking care of the overall coordination.

The WMO publication “How to establish and run a WMO Regional Climate Centre (RCC) “(WCASP - No. 80 or WMO/TD - No. 1534) provides guidance for each RCC being established. It describes in a general way the mandatory operation functions for long-range forecasting, climate monitoring and data services, to support operational LRF and climate monitoring. Training in the use of operational RCC products and services is another mandatory function of a RCC. Additional ‘highly recommended’ RCC functions in the domains of ‘climate prediction and climate projection’, ‘non-operational data services’, ‘coordination’, ‘training and capacity building’ and ‘Research and Development’ are listed and specified in the Manual on the GDPFS. The specifics of such highly-recommended functions can vary from region to region. WMO RCCs and WMO RCC Networks are encouraged to deliver as much ‘highly recommended’ functions as possible.

After a demonstration or pilot phase, the Pilot RCCs or RCC Networks are being evaluated by a joint CCL-CBS expert team and the establishment of a RCC or RCC Network is proposed to CBS for approval. After consideration by CBS, the WMO EC, and eventually by the World Meteorological Congress, the designation process is formally completed.

RCOFs are being established to discuss and communicate climate information including long-range forecasting with users and develop consensus forecasts in order to facilitate uptake and application of climate information in a coherent way. RCOFs typically look at those seasons which are of most importance to the region concerned. Based on monitoring information and by using long-range forecasts accessible to participants, the situation is analysed, teleconnections identified, predictive skill discussed and a consensus outlook being formulated. As of today 14 RCOFs have been established and had at least one meeting.

Though RCCs and RCOFs are regional scale elements of the Climate Services Information System (CSIS) of the GFCS, much needs to be done to communicate the potential of the hugh amount of information provided by NMHSs to communities outside the traditional meteorological community, e.g. those engaged in development planning at national and regional levels.

STATUS AND FUTURE PLANS OF LC-LRFMME

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The Korea Meteorological Administration (KMA) and NOAA/NCEP have organized a joint effort to sustain and develop the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME) activities. The goals of the WMO LC-LRFMME are to provide a conduit for sharing of model data for long-term climate predictions and to develop a well-calibrated MME system for mitigating the adverse impact of unfavorable climate conditions and maximizing benefits under favorable conditions.

At present, the forecasts from 12 GPCs for 2-meter air temperature, precipitation, mean sea level pressure, 850hPa air temperature, 500hPa geopotential height and sea surface temperature (if available) are collected at the LC-LRFMME between the 1st to 20th of each month, and the forecast data are used in displaying various seasonal forecast products in terms of the digital and graphical products in standard format. Members of GPCs, RCC, NMHSs and related institutions that produce LRF forecasts can download forecast and hindcast data products for the GPCs that allow redistribution of their digital data in the LC-LRFMME website (www.wmolc.org). Also, the graphical products including monthly and seasonal mean anomalies from individual GPCs and MME forecast are displayed in website.

The WMO LC-LRFMME makes efforts to provide high-quality climate prediction products and to develop more advanced climate prediction technology for WMO Members. The products of LC-LRFMME are currently used in various RCOFs (e.g., FOCRAII, EASCOF, SASCOF, GHACOF, ASEANCOF). The WMO LC-LRFMME plays important roles in WMO's Global Seasonal Climate Updates (GSCU) publication and will serve as a Data Collecting and Producing Centre (DCPC) of Global Information System Centre (GISC-Seoul). Also, the WMO LC-LRFMME are preparing to develop the new MME service for sub-seasonal forecast from next year.

LEAD CENTRE FOR THE LONG-RANGE FORECAST STANDARD VERIFICATION SYSTEM

Bertrand Denis and David Jones
and the CBS/ET-OPSLS TT2 (verification)

The main objective of the Lead Centre for the Long-Range Forecast Standard Verification System (LC-LRFSVS) is to provide seasonal forecast users with the GPCs forecast expected skills. To do so, the LC-LRFSVS collects from the GPCs the verification statistics based on their respective hindcast. These statistics are displayed online using a common look and feel approach. It is part of the LC-LRFSVS responsibility to maintain the web site (http://www.bom.gov.au/wmo/lrfvs/) where the hindcast verification maps are displayed. The verification statistics which GPCs must submit to the LC-LRFSVS are defined in the WMO Manual on the Global Data-Processing System. Other LC-LRFSVS responsibilities include the maintenance of verification software and recommendations of specific observational dataset for use in the assessments of the forecasts.
Use of the LC-LRFSVS web site has been lower than expected. Many reasons may explain that fact, amongst them:

- Potentially outdated verification statics displayed on the LC-LRFSVS web site (http://www.bom.gov.au/wmo/lrfvs/) for the systems actually available from LC-LRFMME web site https://www.wmolc.org/
- Verification statistics are only for hindcasts. No verification is displayed for the most recent seasonal forecasts
- No verification statistics for the LC-LRFMME Multi-Model Ensemble hindcast/forecasts are provided
- The display of GPC forecasts and verification information is on two different websites; The look and feel of LC-LRFVS and LCLRFMME products tends to be different;
- After significant investment in the early days, the LC-LRFVS has progressed rather little and uses somewhat outdate web technologies. This relates to a lack of resources at the co-hosts (GPC Melbourne and GPC Montreal);

Recently a CBS/ET-OPSLS Task Team on verification has been established. Its first task is to come up with revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to Global Seasonal Climate Update (GSCU). This presentation might be an excellent opportunity to get feedbacks from the forecast users about some proposals.

SUMARY RESULTS ON ANALYSIS OF RESPONSES TO QUESTIONAIRE BY GPCs

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One third of Global Producing Centres (Beijing, Toulouse, Moscow and Tokyo) are both GPCs and RCCs. More than half (7/12) these centres have well established informal arrangements to provide products to RCC/RCOFs and NMHSs. All Centres have plans to develop and provide more climate indices and most of them have materials or courses on general climate science and other specific training. This provides a basis to prioritize standardization of new climate indices and training materials for future exchanges between GPCs and RCCs/RCOFs/NMHSs.

With the myriad of evidences on increase in climate variability and extremes, seasonal forecasts of extremes have become a regularly requested product. Most GPCs have plans and could provide operational or experimental products on extremes during the coming years.

Regionalized products for specific seasons are operational or are part of research and development in 5 out of 12 GPCs. More than half of GPCs have plans for new products on timing and frequency of sub seasonal features/phenomena. Collaboration to trial and further refine these products could be recommended between those GPCs and RCCs as a step toward defining new standard products for real time exchanges.

Most GPCs do not make available data upon request. They provide data through the LC-LRFMME site not IRI data Library and have no plans for dynamical downscaling. However, they are working on forecasts calibration using hindcast skill, multimodel combination methods and statistical downscaling. Most GPCs have verification products including forecast with skill mask, skill summary reports. A recommendation to exchange theses products and available verification software with RCC/NMHSs through GPCs websites or LC-SVSLRF could be made.

Most GPCs have material and courses on general climate science, specific training materials on the interpretation and use of GPC products including tools for verification, post processing and statistical downscaling. Having this documentation accessible online to RCCs and other training centres and Institutes could be a high priority endeavor.
Many GPCs would like to have information on regional products derived from global outputs, regional performance of GPC products as well as their long term predictive skill. Having commitments from RCCs to prepare and provide such a report could be suggested.

RCC QUESTIONNAIRE : SYNTHESIS

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The RCC profiles :

Looking to potential RCCs, on can quote a total of 18 RCCS; namely :

- RA I : 6 identified candidates covering **East**, South, Central, **West** and North Africa (plus the **continental** scale), demonstration phase in progress for 2.
- RA II : 3 RCCs acting ; **BCC**, **TCC** and **NEACC** already designated; 3 more candidates (**India**, Iran and Saudi Arabia)
- RA III : 3 identified candidates covering **Western coast of SA**, Northern SA, and **Southern SA.** All 3 Intended to start the demonstration phase.
- RA IV : One candidate identified (for the **Caribbean**) intending to start the demonstration phase. 2 more RCC-networks under discussion (North and Central America)
- RA V : Assessment of the related functions performed in the region in progress
- RA VI : **RCC network** designated and acting

10 contributions (indicated in bold above) were received and thus helped to have a better view of the RCC landscape, needs and expectations. Among the responding RCCs, 4 are acting both as GPC and RCC.

The questionnaire was addressing several topics (for a total of 19 questions) ; the answers are synthesized hereafter :

The use of GPC Products :

- *Linkage RCCs/GPCs*
  - The linkage is mostly well established (whatever formal or informal)
  - GPCs are the main source of information for Consensus and Seasonal Forecast updates
  - For Climate Watches GPCs are the main or an important source of information

- *Products*
  - The Mandatory products are mostly essential (or useful)
  - Some additional products are important ; especially a strong demand for Regional SST, an important need of SLP and Z500, some interest in Specific GPCs Bulletins. In addition, there is little use of T850 while some very specific products can be used by individual RCCs

- *Use of Products*
  - The use of several GPCs is privileged through the use of individual GPCs or MMEs from several GPCs. There is less use of all GPC MME.
  - There is a frequent use of both graphics and digital products while for downscaling, the statistical methods privileged (and performed) vs a little use of dynamical downscaling

- *Access to products*
  - The access to GPC products is done through individual GPCs web sites, the LC-MME web site or the Euro-SIP web site. There is a little use of APCC and other prediction centres web sites

- *Lead-Time*
  - The 1 month Lead Time (LT) mainly used but some interest in other LT

The Verification :

- *Verification information*
  - The Access is done most frequently through the GPC web sites and only (?) using the LC-SVS web site
  - In term of interest the major outcomes is that this information is not sufficient.

- *Verification Products*
  - For Bulk Scores for regions : there is some use of ROC and reliability information while the MSSS and its decomposition is poorly used.
  - For Score map representations : the use is quite frequent use fo ROC scores and MSSS decomposition to some extent
  - For Niño 3.4 scores : the most frequent use is for the ROC and the reliability ; there is less use of MSSS and its decomposition

The GPC services : **Services Standard, Barriers and Improvements**

- *Importance of Standard Services*
  - They are mostly all are important. The strongest agreement is on the timely provision of forecasts (issuance date) and then on the warning of changes.

- *Barriers to use*
  - The biggest barrier refer to the access to digital data and Downscaling/tailoring ; the Skill and Verification are also to be considered.
  - To be quoted the little concern with the access to Graphics

- *Priority for the enhancement of GPCs services*
  - The domain to work on is related to the improved access to forecast, hindcast data and tools
  - For the visualized forecast maps; there is a large spread in the priorities however, the greatest priority should be for on more Climate Indices (plumes, monsoon, …)

The Capacity developments

- *Capacity development needs in the organisations*
  - The biggest needs refer first to the tools for processing GPC forecasts and to the use and interpretation of products. Dynamical downscaling is also to be considered
  - The less important needs are related to the General Climate Science and Documentation

- *Capacity development needs in the sub-regions*
  - The biggest needs refer still to the tools for processing GPC forecasts and then to the use and interpretation of products.
  - The less important needs are related to Dynamical downscaling, the General Climate Science and Documentation

As a tentative conclusion, some questions to address

- The main domain to work on is related to an improved access to forecast, hindcast data and tools
- For the products, there is needs for more Climate Indices (plumes, monsoon, …) and regional products
- About the services, some developments are asked for in Downscaling/Tailoring (especially Tools). However, the respective role of RCCs and GPCs should be discussed and clarify.
- For the verification, there is a clear need of a better information on verification (may be a sign for revisiting the SVS ?).
- On capacity developments, a common need is about the training offer and the necessary coordination. Here again, the respective role of GPCs, RCCs and RCOFs should be clarify.

GPC-BEIJING IN SUPPORT OF RCCs, NMHSs AND RCOFs

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GPC Beijing conducted both extended and long range forecast (ERF & LRF) operationally based on its atmospheric general circulation model (AGCM T63L16) driven by persisted SSTA and coupled general circulation model (CGCM), which has the same atmospheric component AGCM T61L16 as in ERF and a ocean component of same horizontal resolution as T63 with 30 levels in depth, respectively.

The products of ERF and LRF come from the ensemble prediction of GPC Beijing models including the mandatory variables such as precipitation, 2-meter temperature, sea surface temperature (for seasonal forecast), 500hPa geopotential height and other upper levels circulation variables (200/700/850hpa wind, height, temperature, etc) in determined way by ensemble means and probabilistic way by terciles. Graphical and digital products of GPC-Beijing are disseminated freely available on BCC website and the digital data of seasonal forecast and hindcast of GPC-Beijing could be download by registered user from BCC website. The digital forecast and hindcast outputs are also sent to the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME) and APCC for the operational forecasts every month.

The new operational climate model system for ERF and LRF are under construction based on the coupled ocean-land-atmosphere-ice model (BCC_CSM1.0) which consists of increased resolution of component models and improved physical processes including the cloud, radiation, precipitation and PBL, taking into account climate characteristics in East Asia. The new version of BCC AGCM (T106) driven by the persisting SSTA has be launched into experimental operation at the end of 2012 to provide ERF products. And new version of coupled model for seasonal forecast will be launched into experimental operation at the end of 2013.

GPC Beijing serves the RCC, NHMSs and RCOFs (FOCRAII, EASCOF) especially in RA II with its ERF and LRF products to support relevant operational activities of seasonal prediction and assist the decision-making of governmental agencies, for instant for agriculture and risk management of flood and drought in China and Pakistan. GPC Beijing will continue engaging in improving its capability in response to needs of NMHSs, RCCs and RCOFs.

GPC CPTEC ACTIVITIES AND PRODUCTS ADDITIONAL TO MANDATORY

Caio Coelho
CPTEC/INPE, Brazil

This presentation will highlight the following activities and products developed by GPC CPTEC that are additional to the mandatory functions:

1) The Brazilian multi-model seasonal forecast system: CPTEC in partnership with the Brazilian Meteorological Service (INMET) and Ceará State Meteorology and Water Resources Foundation (FUNCEME) recently developed a multi-model ensemble seasonal forecast system for Brazil. The system is composed by: 90 ensemble member forecasts produced by CPTEC global atmospheric climate model run with both forecast and persisted sea surface temperatures (SSTs) [forecast SSTs are obtained from NCEP/CFSv2]; 20 ensemble member forecasts produced by FUNCEME by running ECHAM4.6 global atmospheric climate model with persisted SSTs; and an ensemble of forecasts produced by three models run at INMET (Brazil) including circulation and SST based forecasts produced with the Climate Predictability Tool (CPT) developed by the IRI, and two time series models that take into account the recently observed climate conditions. All models of this multi-model system produced retrospective forecasts (hindcasts) for the period 1989-2008 using exactly the same procedure used in real-time forecasting. A liner regression calibration procedure using this 20-year retrospective multi-model ensemble mean forecasts and corresponding precipitation observations is used for producing objectively the probabilistic tercile probability forecast for Brazil. The procedure takes into account the forecast anomaly of the multi-model ensemble system and the corresponding retrospective multi-model system skill (based on past performance) to determine the width of the final forecast probability distribution.

2) EUROBRISA multi-model system: CPTEC leads the EURO-Brazilian Initiative for improving South American seasonal forecasts, a collaborative research effort between CPTEC, University of Exeter, ECMWF, UK Met Office, Météo-France, Federal University of Paraná (UFPR), University of São Paulo (USP) and INMET. The key motivating idea of this effort is giving the availability of both empirical (statistical) and dynamical model predictions, why not combining all available state-of-the-art forecast information for improving seasonal forecasts in South America - a region where the forecasts have skill and useful value. A state-of-the art procedure known as forecast assimilation is used for combining and calibrating dynamical coupled ocean-atmosphere precipitation forecasts for South America produced by 3 European models (ECMWF System 4, UK Met Office GloSea 5 and Météo-France System 4) and by an empirical model that used SSTs over the Pacific and Atlantic as predictors for seasonal precipitation over South America. The final EUROBRISA combined and calibrated (hybrid) forecast aggregating the forecasts of these 3 dynamical models and the empirical model is known as the integrated forecast. The EUROBRISA system has been last updated in July 2013 for incorporating the updated versions of UK Met Office, Météo-France and empirical models. Both forecast and verification products for each individual model and also for the integrated forecasts are made available at the EUROBRISA webpage http://eurobrisa.cptec.inpe.br.

3) Regionally downscaled forecast products: CPTEC runs operationally the ETA model for producing regionally downscaled seasonal forecasts for South America at 40 km x 40 km spatial resolution. The ETA model is run with persisted SSTs using boundary conditions from CPTEC global atmospheric model at T62L28 resolution, which is also run with persisted SSTs. CPTEC is currently also developing a new regional seasonal forecast system for South America using a model framework known as the Brazilian Developments on the Regional Atmospheric Modelling System (BRAMS). This new system is being developed for producing downscaled seasonal forecasts for South

America at 30 km x 30 km spatial resolution. The BRAMS model for seasonal forecasting is being evaluated with persisted SSTs and using boundary conditions from CPTEC global atmospheric model at T62L28 resolution, which is also run with persisted SSTs.

The Brazilian (CPTEC/INMET/FUNCEME) multi-model, EUROBRISA and ETA forecast products are routinely produced and used in monthly national climate outlook forums in Brazil and in regional climate outlook forums in South America, demonstrating healthy national and international regional cooperation in providing access to a number of additional to mandatory GPC forecast products. Improved cooperation could be achieved by formalized agreement (e.g. MoU) between GPC CPTEC and RCCs/RCOFs (e.g. SSARCC and SSACOF) to help developing additional tailored seasonal forecast services.

GPC EXETER: ACTIVITIES AND PRODUCTS THAT ARE ADDITIONAL TO MANDATORY

Richard Graham

The GloSea5 system: GPC Exeter's current prediction system, GloSea5, was implemented in June 2013 and is described in MacLachlan et al. (2014). Relative to the previous system, GloSea5 has improved resolution (atmosphere: 0.83°E-W; 0.56° N-S; 85 vertical levels: ocean: 0.25°; 75 vertical levels). GloSea5 shows unprecedented high skill for the DJF North Atlantic Oscillation (r = 0.62) and Arctic Oscillation (r = 0.64). Notable improvements in skill are also found for ENSO and variability in the Western North Pacific Subtropical High – important for prediction of the East Asian monsoon. GloSea5 is configured for both seasonal and subseasonal forecasting. GPC Exeter and GPC Seoul are developing a joint seasonal forecasting system that will become operational in late 2014. The joint system is based on the GloSea5, which will be run operationally at both the UK Met Office the Korea Meteorological Agency (KMA). Major advantages of the joint system will be increased ensemble size and hindcast period.

Products: GPC Exeter continues to provide mandatory and recommended visualised forecast and verification products at: http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/gpc-outlooks. Forecasts are updated each month and are for 3-month means at 1, 2 and 3 month leadtime. As well as global maps, forecast maps for regions are also provided, including regions tailored for the RCOFs in West, East and southern Africa. All requested forecast/hindcast data and verification data is provided to the LC-LRFMME and LC-SVSLRF.

Further additional real-time products currently available include:

- SST "plumes" showing the predicted monthly evolution of Nino3/3.4/4;
- Probability forecasts and SVSLRF verification for outer-quintile categories
- Tailored forecasts, including for specific regions, available at: http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/long-range/forecasts
    - Precipitation prediction for tropical North Africa; East Africa and NE Brazil;
    - North Atlantic tropical storm forecasts;
    - Arctic sea ice extent;
    - Experimental decadal predictions including next 5-year means (global
    - coverage) and real-time verification.

Experimental products: new experimental real-time products include probabilistic forecasts of rainy season onset. These have been developed for West, East and southern Africa and are being trialled at RCOFs. Forecast skill depends on region, but is generally similar to the skill for seasonal totals. The methodology used could be applied to other regions.

Multi-model decadal prediction: The Met Office is hosting an international exchange of initialised decadal predictions (Smith et al. 2012) and is developing multi-model products for display on the Met Office website.

Forecast data package: a GloSea5 forecast/hindcast data package is freely available for non-commercial uses on request, and is accessed by an ftp link. The package, which is updated each month, consists of forecast and hindcast members for monthly means of 2m temperature, precipitation, sea surface temperature, PMSL, 850hPa temperature and 500hPa geopotential height.

Capacity training: a 2-week seasonal forecast capacity development curriculum has been developed and delivered in collaboration with ICPAC, Nairobi and ACMAD, Niger and the Rwanda Meteorology Agency. The programme includes a week of basic familiarisation with output from dynamical ensemble prediction systems. An interactive spreadsheet tool is used to study ensemble characteristics, measure hindcast skill of GPC systems for the region concerned (using SVSLRF skill measures) and generate regional real-time forecasts. This is followed by a module in which IRI's Climate Predictability Tool (CPT) is used to carry out advanced statistical post processing of GPC output – to correct for systematic biases in GPC output. See: http://www.metoffice.gov.uk/media/pdf/8/m/Workshop2011.pdf

Seasonal forecast downscaling with Regional Climate Models (RCMs): In collaboration with ICPAC, Nairobi, a new RCM (based on HadGEM3) has been installed at ICPAC and used in a "proof of concept" workshop to examine potential benefits of dynamically downscaled GPC seasonal forecasts to RCC and RCOF products.

Communicating seasonal forecasts: A new suite of graphical seasonal forecast products has been developed to visualise seasonal forecasts for the UK. The new products, which have been developed with UK government customers, go beyond the traditional tercile representation. In particular, the bias corrected forecast ensemble spread is compared that of observed climate in both the 1981-2010 period and the most recent 10 years (see links to pdf files at: http://www.metoffice.gov.uk/publicsector/contingency-planners). The presentation format is re-locatable and has been used, experimentally, to generate corresponding graphics for other parts of the world.

The "ClimateCloud": The Met Office is developing an OPeNDAP cloud-based system (ClimateCloud) that will enable external and internal users to view and download climate data based on variable, period, and geographical area. Users may contribute applications to the set of tools available to process and retrieve climate data. Other centres (e.g. IRI) have developed OPeNDAP systems with associated processing tools. If these OPenDAP systems are linked together and steps are taken to include data repositories such as the LC-LRFMME, the combined data sources and processing tools will make a powerful resource for RCCs, NMHSs and RCOFs.

References:

MacLachlan, C. and co-authors, 2014: Description of GloSea5: the Met Office high resolution seasonal forecast system. Q.J.R. Meteorol. Soc. Submitted

Smith, D. and co-authors, 2012: Real-time multi-model decadal predictions. Clim. Dyn. DOI 10.1007/s00382-012-1600-0

GLOBAL PRODUCING CENTRE MELBOURNE: ACTIVITIES AND PRODUCTS THAT ARE ADDITIONAL TO MANDATORY

David Jones and Janita Pahalad
(presented by J. Pahalad)

GPC Melbourne implemented an updated version of the Predictive Ocean Atmosphere Model for Australia (POAMA) in 2013 leading to the implementation of POAMA Multiweek 2.4 system. The major focus for model improvement has been in the area of assimilation across both the ocean and atmosphere, with model skill, model reliability and applicability of forecasts across a range of timescales significantly improved.

POAMA2 now includes a state-of-the-art ocean data assimilation system called the POAMA Ensemble Ocean Data Assimilation System (PEODAS; Yin et al. 2011). Further, because the PEODAS assimilation is based on an ensemble technique, an ensemble of perturbed ocean initial conditions is naturally provided for use in ensemble forecast generation.

POAMA M2.4 includes realistic atmospheric initial conditions, and is run twice-weekly nine months into the future with a 33 member ensemble. This means the system can be used seamlessly across intraseasonal and seasonal prediction, with the former having significant skill, particularly for temperatures. A summary of the current model configuration is provided in Table 1 below, while more detailed information on the model can be found at http://poama.bom.gov.au/ (see also Lin et al. 2012). The modelling system has been found to provide skilful and reliable forecasts for rainfall and temperature, and is used without calibration for operational seasonal prediction in Australia, and experimentally across a number of countries in the South Pacific.

A new GPC website has been developed by the Bureau to support the use of forecasts products http://poama.bom.gov.au/experimental/pasap/ . This provides access to rainfall, temperature, mean sea level pressure and ocean forecasts through a rich user interface which adopt Open Standards for data and graphics. Access to all forecast and hindcast data (across all model variables) is available through the Bureau's OpenDap server accessible through http://poama.bom.gov.au . With a focus on small island states, tailored applications of POAMA have been developed for the prediction of coral bleaching, sea level variability and tropical cyclone risk.

Capacity building remains a priority for the Bureau of Meteorology (GPC Melbourne), with a focus on the southwest Pacific. The Bureau has a major new program of work called the Climate and Oceans Support Program for the Pacific (COSPPac) which is providing assistance to states in the southwest Pacific to develop climate services, with a particular focus on seasonal prediction. This has seen a number of training workshops, pilot projects, and mentoring activities undertaken with WMO Member States.

Table 1: Summary of the POAMA M2.4 Model Configuration

Real-time configuration: Forecasts run for 9 months, twice weekly
Atmospheric model: Bureau of Meteorology Atmospheric Model (BAM) v3
Horizontal resolution ~250km (T47)
17 vertical levels
Ocean model: Australian Community Ocean Model (ACOM) v2
Zonal resolution ~220 km
Meridional resolution ~55km (tropics) to ~165 km (poles)
25 vertical levels

References

Lim, E-P., Hendon, H.H., Langford, S. and Alves, O., 2012. Improvements in POAMA2 for the prediction of major climate drivers and south eastern Australian rainfall. *CAWCR Technical Report No. 051*

Yin, Y., O. Alves, and P. R. Oke, 2011. An ensemble ocean data assimilation system for seasonal prediction. *Mon. Wea. Rev.,* 139, 786-808.

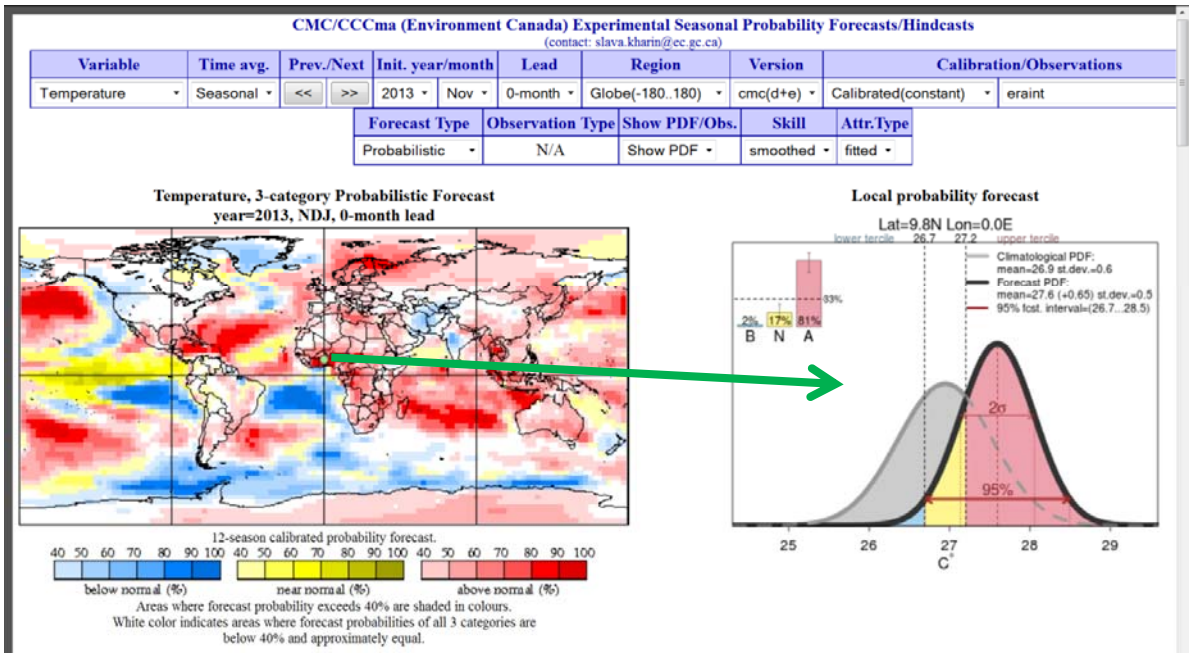
MONTREAL GLOBAL PRODUCING CENTRE (GPC)

Bertrand Denis

GPC-Montreal has implemented in December 2011 its new Canadian Seasonal to Interannual Prediction System (CanSIPS). It is based on two versions of the CCCma's coupled climate model. It is therefore a Multi-Model Ensemble (MME) system that relies on 2 sets of 10 members for a total of 20. Forecast initial conditions are provided through a set of assimilation runs, one for each ensemble member, in which atmospheric temperature, specific humidity and horizontal winds are constrained by values from six-hourly gridded analyses through a simple assimilation procedure. The forecasts are produced every month and go up to 12 months. We plan to increase in 2014 the forecast frequency from one to two issuances per month.

In addition to the mandatory WMO forecast variables, CanSIPS is capable to forecast additional variables as soil moisture, water equivalent snow depth, sea ice and other potentially useful quantities.

The presentation will give you a summary of the experimental products that we are currently testing as well as a quick demonstration of a web-base tool used to display probability forecasts from a mouse 'click'.



GPC PRETORIA: ACTIVITIES AND EMERGING PRODUCTS

Asmerom F. Beraki

GPC Pretoria has been providing limited dataset to Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC_LRFMME) since 2009. Following the substantial expansion and new developments in its forecasting system recently, GPC Pretoria has replaced the existing operational forecasting system with a more robust global ensemble climate prediction system. As a result of this enhancement, the centre is in the process of updating its mandatory data and skill scores exchange. The new forecasting system, which comprises an ocean-atmosphere coupled global climate model, enables GPC Pretoria to extend its mediatory contribution to the prediction of El-Niño Southern Oscillation (ENSO) and (near-global) Sea Surface Temperature (SST). The atmospheric-only component model is also concurrently running in a seamless fashion with a flexibility to increase the frequency of forecast issuance within a month. This essentially means that the forecasting system is able to support the sub-seasonal (extended-range) and seasonal timescales for various climate variables in addition to its mandatory variables (if requested). The forecasting system may also support among others the prediction of climate drivers such as the Indian Ocean Dipole (IOD) and Southern Annual Mode (SAM) as documented in resent publications. This forecasting system positively contributes toward the implementation of the Climate Service Information System (CSIS) pillar of Global Framework for Climate Services (GFCS) through the GPC network (and perhaps the South African Weather Service (SAWS) website). The presentation would also emphasize the challenges and constraints of seasonal forecasting from the southern African context. In addition, current and future research activities at the centre would also briefly be highlighted.

STATUS AND FUTURE PLANS OF GPC-SEOUL

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The operational long-range forecasting system of GPC-Seoul is based on the global atmospheric spectral model, GDAPS (Global Data Assimilation and Prediction System), with horizontal resolution of T106 and 21 vertical levels of hybrid sigma-pressure coordinate. For the Ensemble prediction, we utilize 20 ensemble members by lagged average method with about 3 week lead-time. To predict the global SST and provide the boundary conditions for GDAPS, a statistical global SST prediction system is being developed by combining Coupled Pattern Projection Model (CPPM), Lagged Linear Regression Method (LLRM), dynamical El Nino prediction model, and persistence method. In the tropical Pacific, predictions produced by El Nino prediction model are used, and in other regions the best results between CPPM, LLRM, and persistence are used. The El Nino prediction system is based on the intermediate ocean and statistical atmosphere model.

Three-month forecasts for 2m air temperature, precipitation, mean sea level pressure, 850hPa air temperature, 500hPa geopotential height and sea surface temperature are provided to the WMO LC-LRFMME and the APEC Climate Center (APCC) for multi-model ensemble forecast, and Nino 3.4 Indices supplied to International Research Institute for Climate and Society (IRI).

The operational forecasting system of GPC-Seoul will be replaced by the KMA-UKMO Joint Seasonal Forecasting System. The joint system, GlosSea5, is the fifth version of the Met Office ensemble prediction system for seasonal forecasting, which has been built based on the latest version of HadGEM3. Although both GPC-Seoul and GPC-Exeter are using same forecasting model, they use different initial conditions (ICs) for the atmospheric and land surface model. Different ICs lead to the significant regional-scale diversity in products between GPC-Exeter and GPC-Seoul. From June 2014, all products of GPC-Seoul will be provided with GloSea5 to the WMO LC-LRFMME and the APCC for multi-model ensemble forecast.

GPC TOKYO IN SUPPORT OF NMHSS, RCCS AND RCOFS

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The Japan Meteorological Agency (JMA) was officially designated as one of the Global Producing Centres (GPCs) for Long Range Forecasts in May 2007, in recognition of pioneering operational long-range forecast activity. JMA has been operating a One-month Ensemble Prediction System (EPS) since 1996, and a Seasonal EPS since 2003. GPC Tokyo makes these forecast information (graphical and gridded binary products with hindcasts and their verifications) available from a website of the Tokyo Climate Center (TCC, designated as a Regional Climate Centre) on a routine basis, along with its seasonal forecast data accessible from a website of the WMO Lead Center for Long-Range Forecast Multi-Model Ensemble. A total amount of model integrations corresponds to more than 750 (1100) years for the one-month (seasonal) real-time forecasts per year and 32-year hindcasts provided through the TCC website. These data are utilized to support seasonal forecast activity at National Meteorological and Hydrological Services (NMHSs) and Regional Climate Outlook Forums (RCOFs).

GPC Tokyo makes a lot of efforts in addition to mandatory roles of GPCs. As noted above, GPC Tokyo has emphasized sub-seasonal forecasting since its designation and disseminated one-month forecast data. The full sets of both one-month and seasonal hindcasts are also freely available for registered NHMSs to enable users to calibrate and verify their own products. Ample graphical products provided on the TCC website were developed and maintained in close collaboration of GPC Tokyo (a numerical modeling team) and RCC Tokyo. The products include tailored regional probabilistic products for the Asian region (RA II) by means of statistical downscaling techniques. Lecturers from GPC Tokyo take part in annual training seminars organized by TCC to enhance capacity development in RA II. GPC Tokyo supports RCOFs in Asia as well as other regions by sending its experts or providing materials with explanations and perspectives. Expert visits for supporting statistical downscaling at NMHSs are another collaborative activity of GPC Tokyo and RCC Tokyo. We recognize that these steady efforts are essential to build a technical/scientific capacity for operational seasonal forecasting at NMHSs, especially in RA II. GPC Tokyo will continue and extend above-mentioned supportive activity in response to needs of NMHSs, RCCs and RCOFs.

GPC TOULOUSE: ACTIVITIES AND PRODUCTS

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The Operational forecasting suite

Composed with a distributed suite between Toulouse and ECMWF, the forecasting suite is run on a monthly base. The oceanic assimilation is located in Toulouse (Mercator project) and is providing the Initial Conditions for the ocean. We use the operational ECMWF analysis for the atmosphere and the continental surface conditions (including soil moisture). The coupled model runs in Reading (on our own computing resources). Then at the very beginning of each month the grib files (monthly means) are sent to Toulouse using the operational dissemination; namely a secured link between ECMWF and our operational database. Final production and Graphical tasks are performed in Toulouse within our secured forecast production environment. If necessary (e.g. for Circulation Regimes) all daily post processing is done in Reading; the final result is sent to Toulouse. (Note that the model task is not considered as a Critical Time Application).
The resolution of the atmospheric model (Arpège) corresponds to a T127L31 while it is a 1° grid for the ocean (NEMO). The Hindcast period cover 20 years (1991-2010) with 15 members and for operations, we are issuing a 7 month range forecast with 51 members sampling both different atmospheric and oceanic initial conditions.

The Products

The products are issued at the beginning of each month with commitment for the 8th at the latest. GPC Toulouse provides mandatory and recommended visualised forecast and verification products at: http://elaboration.seasonal.meteo.fr (password protected – access granted on request under the WMO umbrella). To be quoted that we are acting under the triple cap of GPC, Node leader of the LRF Node of the RA VI RCC Network and obviously as NMHS. As a consequence, we are especially supporting RCCs and RCOFs without forgetting some GPCs and the Euro-SIP MME.
Further additional real-time products currently available include:

- SST “plumes” showing the predicted monthly evolution of Niño boxes and OOPC boxes over the Tropical Atlantic (North and South) and Indian Ocean (West and East) ; including IOD and TASI indexes.
- Probability forecasts and associated verification for extreme categories (mean +/- 1std)
- Probabilistic and deterministic forecasts for U and V in Low and High troposphere
- Probabilistic and deterministic forecasts for velocity Potential and Stream Function in high troposphere
- Climagrams for 25 land boxes (identical to ECMWF) for precipitation and temperature,
- Anomaly frequency of occurrence of Circulation regime over the North Atlantic sector
- Verification for monthly values (especially useful for climagrams interpretation)

Expertised products

Once a month, we are editing a Global Climate Bulletin (GCB) in collaboration with the RA VI RCC LRF Node. The expected lead-time is 1 month for forecasts and it is edited by the end of the current month (for next 3 month forecasts). It contents a review of the state of the climate system and an overview of seasonal forecasts from individual GPCs and MMEs (LC and Euro-SIP). In addition through a multidisciplinary discussion, a guidance is proposed for the most likely scenario over the RA VI region. This bulletin is also adapted to support some COFs including the newly developed MedCOF.

Experimental products
New experimental products are expected in the next, especially the development of new circulation regimes (using Velocity Potential and Stream Function) and an assessment of the current predictability. The use of such information has shown a large improvement in the prediction of the years with a high number of High Precipitation Events (>100mm/day) at fall over the Mediterranean Basin. Then, the Velocity Potential gives insight into the atmospheric response in terms of Hadley-Walker circulation anomalies while the Stream Function gives complementary insight into the atmospheric response to tropical forcing (especially in terms of teleconnections with mid-latitudes) which is very relevant for the assessment of the current predictability.
In addition for France we are developing Hydrological Seasonal Forecasts (Soil Wetness Index and River Flow forecasts).

Capacity training
A 1-week seasonal forecast training is available in Toulouse (presently in French but which could be extended to english) and we are participating to several training to the benefit of COFs. Especially in 2012, we set up a full training session for the implementation of a new COF for the South West Indian Ocean (training both in English and French).

GPC perspectives
Currently we are developing the new version of our coupled model (system 5). This version will be close to the IPCC-AR5 version (and so consistent with Decadal Forecasts)
The resolution should be close to T127L91 allowing a better representation of the Stratosphere effects which is especially relevant for the improvement of the mid-latitude circulation; the ocean model (still Nemo) staying at a 1° resolution. The Mercator Ocean analysis and Reanalysis: will cover the 1979 – 2010 period. As scheduled improvements, one can quote the implementation of the Stochastic Dynamic which should improve the scores especially over the mid-latitudes and Africa, a new SVAT model (Surfex), and likely the implementation of a state of the art sea-ice model (Gelato). Some options still remain open. The availability for operations is targetted for 2015 (possibly end of 2014 as most of the developements are in progress). The post-processing will be likely done at the full resolution.

Some recommendations
Some specific points seem to be quite important; they include :

- The security of operations by using a QMF-like approach and integrating operations within a fully operational system (supervision, post-processing, …)
- The provision of relevant data for RCC sub-regional products,
- The provision of verifications associated to all provided products (including Climagrams, Monthly values, …)
- To preserve some flexibility in MME combinations (with respect of the current analysis of individual models and of the predictability),
- To invest in the post-processing of daily values (and associated operations),
- To investigate and use relevant parameters to assess the current predictability,
- To work on the verification of the current forecasts (especially with respect of the current predictability and the difference between Tropics vs mid or high latitudes).
- To work on the Climate trend vs Seasonal anomaly (characteristic in the hindcast, relative weight in the scores, filtering or not in the post-processing, …)
- Last, in the light of our experience, the issuance date of GPC products is critical for the operations of the RCCs and RCOFs and the linkage to and feedback from users is of particular importance.

GLOBAL PRODUCING CENTER – WASHINGTON: SEASONAL AND SUBSEASONAL FORECAST SYSTEM AND PRODUCTS

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National Center for Environmental Prediction (NCEP) is one of the WMO recognized Global Producing Centers (GPC) for long-range forecasts. Seasonal forecasts from NCEP are submitted to the WMO Lead Center for Long-Range Forecasts Multi-Model Ensembles (LC-LRFMME) on a monthly basis. The operational long-range forecast suite maintained in real-time at NCEP is following:

- A set of four 9-month lead forecast once a day; and
- A set of 16 45-day lead forecasts once per day.

Real-time forecasts are complemented by an extensive set of hindcasts: (a) seasonal 9-month lead forecasts from 1981-2010 with four forecasts every 5th day of the calendar month, (b) 45-day lead forecasts from 2001-2010 with four forecasts every day. The set of hindcasts is used for calibration and skill assessment of the extended-range forecast system. Further details about the forecast configuration can be found at:

https://www.wmolc.org
http://origin.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fcst/

GPC Washington forecast products are also displayed at it website and can be found at:

Seasonal Forecasts:
http://origin.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fcst/
Monthly Forecasts:
http://www.cpc.ncep.noaa.gov/products/people/mchen/CFSv2FCST/monthly/
Weekly Forecasts:
http://origin.cpc.ncep.noaa.gov/products/people/sweaver/cfs_fcst/

Above websites also maintain a comprehensive verification of real-time forecasts, and also of skill assessments based on hindcasts.

THE DEVELOPING GLOBAL SEASONAL CLIMATE UPDATE (GSCU)

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Following the success of the WMO-coordinated El Niño/La Niña Updates, the Fifteenth Session of World Meteorological Congress (2007) recommended that the Updates be extended to include other large-scale climate indices having important regional impacts on seasonal climate. In this context, the Global Seasonal Climate Update (GSCU) has been designed through a dedicated scoping meeting of climate monitoring and prediction experts led by a WMO Commission for Climatology (CCl) Task Team, and it is currently under development through a trial implementation phase. The objective of the GSCU is to provide the world community with an expert consensus on the state of the global climate with an outlook for the upcoming season along with information on robustness of the available forecast signals. The GSCU is also a means to strengthen international collaboration and information flow between global, regional and national level operational climate monitoring and prediction centres – thereby contributing to the goals of the GFCS. The GSCU is intended primarily for use by Regional Climate Centres (RCCs), Regional Climate Outlook Forums (RCOFs) and National Meteorological and Hydrological Services (NMHSs) for assistance in preparation of regional and national climate Updates; however, requirements of global user communities will also be considered and in this context the GSCU will contribute to application of science-based climate information in climate risk management. GSCU has been included as a priority activity in the implementation plan for the Global Framework for Climate Services (GFCS).

GSCU Implementation Strategy

- Monitoring: Information will be contributed by global data centres. Example products from the NOAA National Climate Data Center to be incorporated into Mark 1 are shown.
- Outlook: Information will be contributed principally by the 12 WMO Global Producing Centres for Long-range Forecasts (GPCs) with data collected, processed and displayed by the WMO Lead Centre for Long-range Multi-Model Ensembles (LC-LRFMME).
- Monitoring and prediction information will also be included on selected climate indices such as the Indian Ocean Dipole (IOD).
- Trial phase: GSCU will be trialed with selected target users and relevant experts for a suitable period. Feedback on the content and usefulness will be used to develop a final version to be considered for implementation.

Challenges

The science and practice of seasonal forecasting is a developing area, and this gives rise to a number of challenges for the GSCU, these include (not an exhaustive list):

- Production schedule: text input will be generated through an international consensus – this will need to be done on a very tight production schedule;
- Developing consistency in presentation: forecast products typically use a tercile format: monitoring centres typical use an absolute anomaly format;

- Converging on a consistent climate reference period: for monitoring the 1961-1990 and/or 1971-2000 periods are typical. Seasonal forecasts are expressed relative to the period covered by the retrospective forecast set (hindcasts) - and this can vary quite widely between GPCs;
- Priority Climate indices: The GSCU cannot be completely comprehensive. We must identify a limited set of climate indices which provides a sufficient description of the past and future global climate state;
- Geographical variations in prediction skill: Regions and indices for which prediction skill is generally low (e.g. extratropics) must be made clear;
- Expert interpretation: Experience has shown that expert interpretation of forecast information (e.g. predicted seasonal circulation patterns) can improve on direct model predictions of temperature and rainfall. It is a challenge to determine how and to what extent this semi-subjective information can be incorporated into the GSCU.

WORKING GROUP ON SEASONAL-TO-INTERANNUAL PREDICTION: SEASONAL AND SUB-SEASONAL RESEARCH ACTIVATES

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Under the purview of World Climate Research Programme (WCRP), the Working Group on Seasonal-to-Interannual Prediction (WGSIP) is tasked to:

- Develop a programme of numerical experimentation for seasonal-to-interannual variability and predictability, paying special attention to assessing and improving predictions;
- Develop appropriate data assimilation, model initialization and forecasting procedures for seasonal-to-interannual predictions, considering such factors as observing system evaluation, use of ensemble and probabilistic methods and statistical and empirical enhancements, and measures of forecast skill;
- Advise on the on the status of seasonal to interannual forecasting and on the adequacy of the CLIVAR observing system, and liaise with other WCRP panels on modeling and numerical experimentation.

Activities of WGSIP focus on research to advance seasonal-to-interannual (SI) prediction and can be thought to complement the operational activities of Global Producing Centers (GPCs) of long-range predictions. Research advances made as an outcome of WGSIP efforts should inform operational activities, while research needs of operational community should be communicated to the research community via WGSIP.

One of the core projects coordinated by WGSIP is the Climate Historical Forecast Project (CHFP). The aim of CHFP is to collect seasonal hindcast data from different operational and research forecast system, and to make it available to research community to advance efforts in understanding and sources of predictability; skill assessments; understanding interactions among various components of the Earth System; and to develop seamless prediction capability from weekly-to-decadal time-scales. WGSIP also coordinates focused numerical experiments to understand predictability associated with individual components of the Earth System, e.g., interaction between stratosphere and troposphere.

More information about WGSIP can be found at:
http://www.wcrp-climate.org/wgsip/index.shtml

THE GFCS TRAINING CURRICULUM

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It is recognized that the capacity-development strategy for the Global Framework for Climate Services (GFCS) should include a complete management of the human resources development process. This should be approached at the national and regional levels adopting a process which allows to satisfactorily manage the full training process, including:

- Analysis of the organizational context: implies the understanding of the new requirements imposed by the implementation of the GFCS and the increasing influence of climate variability and change over society.
- Identification of the training/learning needs: requires the determination of the competencies which the personnel involved in the provision of the climate services at the different institutions should demonstrate or acquire. An evaluation of the number of people to be trained and the required and potential resources is necessary.
- Determination of the training solution to be applied: given the competences to transmit, the number of people to train and the resources available, a training solution must be designed, including different forms of training (face-to-face, distance, on-line, on-the-job, self-learning etc.)
- Design of the training activities and production of the training resources: once the training solution is determined, individual training activities should be designed and the necessary resources – such as guidance material, software, etc. – must be produced.
- Training management and delivery: training activities must be driven by a management cycle which includes its scheduling, the drafting of the adequate trainers and trainees and the preparation of a suitable venue and infrastructural resources for its delivery.
- Assessment and and evaluation the training process: the whole process described should undergo an evaluation process to assess its overall quality.

This process should place emphasis on updating climate curricula at WMO Regional Training Centers (RTCs) to incorporate the new advances in climate sciences, applications and services. Sustained efforts are required to ensure that the personnel in charge of the management, production, interpretation and dissemination of the climate services meets certain top level competencies (as well as their associated performance criteria and knowledge requirements) suitably identified for the purpose, such as:

1. Create and manage climate data sets.
2. Derive products from climate data;
3. Create and interpret climate forecasts and model output;
4. Ensure the quality of climate information and services;
5. Communicate climatological information to users.

The topics in the primary-level training to build GFCS-relevant competencies could include:

- Basics, (to provide the background to the science as well as information on relevant Programmes and Projects, including CLIPS)
- Introductory Atmosphere-Ocean Dynamics

- Modelling (both empirical and numerical modelling, noting that at least one-third of the WMO Membership has seasonal forecast capabilities, most of this being based on empirical techniques)
- Predictability and Prediction (to include ensembles, probability approaches, verification and downscaling)
- Applications (to a wide range of socio-economic sectors)
- Presentation (includes contact issues with users, including the media) and
- Management (basic training on project management).

Members need to optimally utilize education and training resources within their countries such as universities, research institutes and other academia, as well as accessing WMO RTCs. National Meteorological and Hydrological Services (NMHSs) need effective mechanisms to obtain practical techniques to generate climate information and products in alignment with products of GPCs and RCCs as well as expertise in climatology. At the regional and global levels, collaboration on developing e-learning facilities needs to be encouraged and expanded. Further development of CLIPS curriculum and also regular updates of its components are of particular importance in this regard. This will allow a sustained mechanism for advanced training and complement the face-to-face regular training with focus on the specific domain of climatology.

Users also require education and real-time assistance to better understand their own vulnerability to climate, climate services and how to effectively use and derive benefits from these. Therefore, the need for provider-user platforms, particularly at the national level, for example, national forums, is to be adequately addressed.

REGIONALIZED OPERATIONAL NATIONAL MULTIMODEL ENSEMBLE FORECASTS FOR REGIONAL CLIMATE CENTERS

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The paper presents seasonal forecasts from the NCEP Climate Forecast System version 2 (CFSv2) and the US National Multimodel Ensemble (NMME) staged for several regions of the globe. The NMME forecasts include: the NCEP CFS, the Canadian models CCM3 and CCM4, the NOAA/GFDL, the NASA/GISS, the NCAR model, and the ensemble mean. These forecasts are displayed on the NOAA's Climate Prediction Center (CPC) International Desks website as part of NOAA's contribution to Regional Climate Outlook Forums (RCOFs) and to facilitate humanitarian relief decision systems at various US and international agencies.

The CPC International Seasonal Forecasting website features outlooks of sea surface temperature (SST) covering the globe with a zoom into the Pacific, the Indian Ocean, and the Atlantic. Outlooks for surface air temperature and precipitation cover the globe, Africa, the Americas, Asia, Europe, and the Maritime continent. These forecasts are presented in the form of anomalies, standardized anomalies, and skill-masked standardized anomalies. For precipitation, the forecasts are also presented in terms of departures from climatological probabilities of the three equiprobable categories of above, near-average, and below-average rainfall. The forecasts are made available to the public on the CPC website in graphic format via clickable and easy to download maps. Forecasts examples for the CFSv2 and for the NMME are shown. For both CFSv2 and NMME, outputs through the next seven months after the initial condition month are post processed and displayed. For NMME updates on the CPC International Desks website are once per month, while for the CFSv2, updates are three times a month.

The CFSv2 and NMME global forecast data expressed in terms of standardized anomaly of SST, precipitation, and temperature are also made available in binary form and can be downloaded through the CPC International Desks website. This data along with the hindcasts are also available in Climate Predictability Tool (CPT) format and ready for use in prediction experiments.

The US NMME precipitation skill assessment in the form of anomaly correlation between observed and predicted precipitation for selected sub-regions of Africa is presented. Canonical correlation analysis (CCA) is applied to correct the models. The results are presented. Finally, possible applications in food security outlooks are discussed.

USE OF GPCs PRODUCTS BY African RCC and the LRF Node for ECOWAS-RCC

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The WMO/RA I at its 15th session in November 2010 in Marrakech-Morocco expressed the need for one RCC in each of the five Regional Economic Communities in Africa and a pan African RCC at ACMAD with a coordinating role among all WMO RA I RCCs. ACMAD was also assigned the role of LRF Node for ECOWAS RCC-Network.

Since January 2012, ACMAD has been assessing and interpreting GPCs and LCs products. The centre provides Long Range forecast products for all Africa, undertakes verification of tailored products, generates consensus outlook statements across African sub regions through Regional Climate Outlook Fora. Communication of climate products and information is done by emails and online through the African RCC website. The African RCC LRF products are ACMAD's inputs to RCOFS in West, Central, North, East, Southern Africa and South West Indian Ocean region.

This presentation describes LRF function activities at ACMAD, methods and tools, inputs data and output products generated. GPCs products including forecasts and associated models performance are interpreted. Statistical forecasting systems using global analysis, GPCs hindcasts and forecasts data as inputs are run and related outputs interpreted. Analysis based on historical station observations and global analyses and reanalyses is made to detect and understand climate variability, trends, analog years and persistence signals. Other scientific and indigenous knowledge derived from literature review and interactions with users are pivotal for generating African long range forecasts every month. A continental consensus statement involving all developing RCCs in Africa is planned to start in 2014.

For the LRF node of ECOWAS-RCC, regional SST and atmospheric indices, global tropical SSTs, precipitation, velocity potential, precipitable water and winds analysis, hindcasts and forecasts are used as predictors for precipitation, number of heavy rain days, monsoon onset, sub-seasonal distribution of precipitation over West Africa. The consensus outlook statement products are generated for West Africa every year in May for July-August-September season. Verification products generated with country stations observations and regional to global analyses are being provided for forecasts assessment and improvement of confidence in these products.

Based on user requirements, future consensus outlook statements are expected to cover four months seasons and be made a month or two in advance to become more useful. The needs for better and simple products well disseminated on time are putting pressure on service providers to use new scientific advances and scientists to identify new sources of predictability, understand and represent them in predictions systems, upgrade and transfer better forecasting systems for operations.

THE USE GPC MULTIMODEL ENSEMBLES AND DOWNSCALED MODEL FORECASTS FOR REGIONAL CLIMATE SERVICES IN EASTERN AFRICA AT THE EMERGING REGIONAL CLIMATE CENTRE FOR IGAD REGION

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The Greater Horn of Africa (GHA) countries Ethiopia, Somalia, Sudan, South Sudan, and Djibouti, alongside the typical East Africa countries Kenya, Uganda, Tanzania, Rwanda and Burundi is a region where socio-economic welfare of the national governments and local communities are severely affected by climate extremes, especially droughts and consequent famine crisis, such as the recent Horn of Africa drought and famine crisis of 2011. Indeed, it is climate stress and its adverse impacts within and across the national borders that catalyzed the Horn of Africa country governments to form the regional economic grouping: IGAD, currently recognized and renamed as Intergovernmental authority on development following its predecessor the Intergovernmental authority on drought and development.

Thus climate stress over the region must be addressed by provision of mandatory climate services including real time monitoring and forecasts to information critical sectors such as agriculture, water resources and disaster risk management to enhance regional resilience to adverse climate extremes which are predictable. This is the core mandate of the IGAD climate Prediction and Applications Centre climate services for the whole region. The climate services within the framework of Regional Climate Centre forecast capability has greatly improved with inclusion of Global Producing Centre (GPC) model products and GPC derivatives in form of multimodel ensembles and downscaling of the individual model products in support of consensus regional climate outlooks (RCOFs). *Using the example of GPCs and downscaling for two rainfall seasons, namely March-May (MAM) and October-December (OND) seasons in Equatorial East Africa, it is apparent that the GPC derived climate signals/indicators are most powerful for some seasons in the region. Thus GPCs and derived products though potentially most comprehensive source of global forecast information for downscaling to regional and local scales, in operational application, GPC model forecast information should supplemented with careful inclusion of regional and local scale climate drivers which might be below the scope of global climate model physics and dynamics.*

USE OF GPC PRODUCTS BY REGIONAL CLIMATE CENTRE (RCC), PUNE – INCLUDING METHOD OF USE IN PREPARING REGIONAL OUTLOOKS

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National Climate Centre (NCC), Pune was established in 1995 by India Meteorological Department (IMD) for providing various climate related services to the country (India). The centre has been carrying out many India specific climate related activities like Climate Monitoring and Analysis, Climate Data Management, Climate Research and Climate Prediction (Seasonal Forecasts). NCC is bringing out climate diagnostic bulletins regularly and different climate data products are prepared for the user community. Operational Seasonal forecast for rainfall over the country is another important activity of the NCC. As a part of widen the activities of the centre, recently, NCC started to work towards taking up the role of WMO recognised RCC for south Asia. In this regard, NCC has started to prepare several climate monitoring and long range forecast products for south Asia. The long range forecasts (monthly and seasonal forecasts of rainfall and 2m temperature anomalies) for south Asia are prepared based on two sources. One is based on IMD's seasonal forecast model (SFM), which is an atmospheric global circulation model. The SFM uses the CFSV2 forecasted SST as the boundary conditions. The model is initiated in the first 10 days of each month (January to May) and run up to end of September (end of monsoon season). Similarly for June to December model is run for 5 months. The second source is the forecast from 6 GPCs (Melbourne, Washington, Seoul, Tokyo, Moscow & Beijing) available in the digital form through WMO –LC for LEF MME. Currently, the centre prepares regional outlook for the SW Monsoon Season only as a part of a South Asian Climate Outlook Forum (SASCOF). One of the main difficulties in using all the GPCs forecasts is the non-availability of the products particularly the hindcasts and verification scores in the digital form. Another difficulty is the availability of the products with enough lead time (say lead time of at least 2 months).

THE RCC SOUTHERN SOUTH AMERICA

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The creation of a RCC dedicated to the Southeastern South American region was decided upon in a WMO meeting held in Brasilia, in April, 2011. At that opportunity it was agreed upon that, considering the climate characteristics, as far as Regional Climate Centers are concerned, the WMO Regional Area III should be subdivided in three distinct sub-regions:

1. a Western Region, encompassing countries whose climates are more directly affected by the Pacific Ocean and by the Andes;
2. a Southeastern Region, including Argentina, Uruguay, Paraguay and part of Brazil, whose climates are specially affected by cold fronts originated at the Antarctic region and the Southern Atlantic Ocean; and
3. a Northern Region, including part of Brazil, Venezuela, the French Guiana, Suriname and perhaps Colombia – areas which climate is particularly affected by the Tropical Atlantic Ocean and the AmazonRain Forest.

In subsequent meeting of the AR III Climate Working Group it was decided that Chile and Bolivia should make part of both the Western SA and Southeastern SA RCCs. In view of that it became more adequate to rename the Southeastern SA RCC to simply Southern SSA RCC.

The process of joint organization of the RCC-SAS remained dormant until June 2013, when a meeting was organized involving the Directors of the NMHS of Argentina, Brazil, Paraguay and Uruguay, besides other representatives of the NMHS and of collaborating institutions from Brazil, such as CPTEC and Simepar. At that opportunity it was discussed and signed a document on “basic principles for the organization and operationalization” of RCC SSA, including an initial working plan for the start-up of the center. Among the several points agreed upon three deserve special highlight, namely:

- the concept of an independent profile for the RCC, which should be perceived of a new entity, a virtual center formed with the contribution of the NMHS and collaborators, but not to be confused with any of those;
- the creation of an Executive Committee, formed by the director of the NMHSs of the member countries, responsible, among other issues, to approve the products and services to be offered by the RCC SSA;
- the creation of four permanent working groups, formed by representatives of the member countries, to conduct the activities of the RCC, in particular those related to the development and production of new products and services.

Currently those groups are working on the set-up of a Regional Meteorological Data Base, on the construction of a Web Portal and on the definition of an initial set of products to be offered at the Portal.

At this early demonstration stage of RCC SSA, it is possible to identify only a few demands to the GPCs, particularlyto CPTEC/INPE which is the local GPC in South America. Those are listed below:

1. Access to forecast and hindcast data on pre-established grid points over South America for the generation of regional products for Southern South America.
2. Assistance with generation of verification products, particularly for the SESA RCOFs consensus forecasts produced in the region since 1998.
3. Assistance with establishing dynamical downscaling (i.e., Regional Climate Models) including training.

REGIONAL CLIMATE CENTER FOR WESTERN SOUTH AMERICA: LINKAGE OF GPCs WITH RCCs

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Regional Climate Centers implementation is one of the components within the overall Global Framework of Climate Services (GFCS), recently approved by WMO Congress in October 2012. The NMHSs from South America agreed in 2010 to propose to the International Research Center on El Niño (CIIFEN) as potential RCC for Western South America (WCSA). Since March 2013, CIIFEN started the demonstration phase in close coordination with the National Meteorological and Hydrological Services (NMHSs) of Bolivia, Colombia, Chile, Ecuador, Peru and Venezuela. The RCC-WCSA monitors ENSO regional impacts, manage a regional climate data base with daily data from more than 400 climatological stations, and produces information derived from long range forecast and data products from the Global Production Centers (GPCs), and associated prestigious research and operational centers around the world. This information is processed to generate products such as the Seasonal Forecast for WCSA, which remains operational in a monthly basis since 2004 and has the active participation of NMHSs from Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela. CIIFEN also delivers bulletins with a regional perspective about ENSO evolution, ocean analysis and estimated impacts. The RCC also keeps a portal with data products, model outputs, information and educational resources mainly oriented to assist to the technical staff of NMHSs and other regional sectoral organizations. The RCC-WCSA also is responsible to coordinate with NMHSs the Seasonal Prediction efforts for the region where, the sea surface temperature and other atmospheric variables are critical to ensure better accuracy despite the existent uncertainties.

The RCC-WCSA Portal is available on http://ac.ciifen-int.org/rcc/.The products and services available are growing while the portal is increasingly accessed for benefit of a wide range of users.

Since one of the RCC mandatory functions is related with regional climate prediction at different time scales, and due to the strong linkages with operational meteorological and oceanographic institutions in the region, is highly recommended to establish the formal cooperation with some of the closest GPCs to keep an operational scheme with the GPCs and to access to very useful products such as monthly prediction. In return, RCC-WCSA can contribute with data assimilation within GPCs Models and providing the feedback about the seasonal prediction in the region.

THE USE OF GPC DATA AND PRODUCTS IN THE CARIBBEAN RCC

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In 2007, the Caribbean Institute for Meteorology and Hydrology established the Section in Applied Meteorology and Climatology (AM&C), to develop weather and climate related products that will provide important information for decision and policy making for the economic and social sectors and Disaster Risk Reduction in the Caribbean region; including, *inter alia*, water resources management, agriculture, disaster management, health, tourism and energy.

The AM&C Section assumed responsibility for producing the Caribbean Seasonal Precipitation Outlook, and assumed responsibility for the Caribbean Climate Outlook forum with its re-launch in 2012. In 2009, the Caribbean Drought and Precipitation Monitoring Network (CDPMN) was launched, with its interest in agricultural and hydrological drought, in particular. After one of the worst droughts in Caribbean history in 2009-2010, the Government of Brazil provided financial support for the Caribbean to boost its Drought Early Warning and Planning, with CIMH supporting the three pilot countries in developing Draft Plans for Drought Early Warning Information Systems, one of which have already been approved as part of the National Disaster management Plan of that country. The Section also assumed the roles of hosting regional meteorological and climatological data archives, with the added role of dissemination, and to provide climate summaries for stations in its Member States. Since the Caribbean Agrometeorological Initiative (CAMI), funded by the European Union, it produces and disseminates a regional monthly agroclimatological bulletin, with the assistance of Member States; and assists them in developing their own National Bulletins.

The regional SPI and Decile maps produced under the CDPMN, combine local station data from numerous Caribbean countries with NCEP Reanalysis data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at http://www.esrl.noaa.gov/psd/. CIMH also produces a SPI Outlook based on the seasonal rainfall forecast. However, it is expected that an experimental application of the Climate Predictability Tool (CPT), which will be launched and demonstrated at the Third International Conference on Climate Services in Montego Bay, Jamaica in December 2013, will be used in the very near future. Early in 2014, CIMH will be providing information and products that aid in monitoring temperature monitoring (including anomalies), as well as temperature forecasts, with the forecast following a process similar process to that of the Precipitation Outlook. Currently forecast information on temperature is provided through the analysis of output maps from GPCs, such as ECMWF, EuroSIP, UK Met Office, WMO LC for LRF-MME, and a non-GPC in IRI.

BEIJING CLIMATE CENTRE'S ACTIVITIES AS RCC OF RAII

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Beijing Climate Centre (BCC), established on the basis of National Climate Center of China Meteorological Administration in 2003, was designated as a WMO RCC in RA II at EC-LXI in June 2009. BCC has served as RCC and carried out its obligations in order to meet user requirements since 2009.

According to RCC mandatory functions defined in the Manual on Global Data Processing and Forecasting System (GDPFS), BCC delivers data and products of climate monitoring and monthly to seasonal forecasts to NMHSs through its website. BCC incorporates the WMO East Asian Monsoon Activity Centre (EAMAC) and the Centre for Extreme Events Monitoring in Asia (CEEMA), providing information service of East Asian monsoon and extreme events to the neighboring and surrounding countries in Asia.

BCC also played a leading role in initiating, sustaining and assisting the Regional Climate Outlook Forum (RCOF) process in Asia. The Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRAII) has been organized by BCC every year since 2005 in order to provide tailored climate prediction products and services and became an important platform of sharing experience and knowledge and benefited to NHMSs in Asia. And BCC will make great efforts to enhance its capabilities further as RCC to contribute to the Climate Services in Asia.

TOKYO CLIMATE CENTER'S ACTIVITIES AS RCC TOKYO IN THE SCOPE OF OPERATIONAL LONG-RANGE FORECASTING

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The Tokyo Climate Center (TCC) of the Japan Meteorological Agency (JMA) has served as a designated RCC, RCC Tokyo (RA II), since 2009.

TCC's main activities include (1) the provision of climate data and products to NMHSs through the TCC website and (2) the assistance with capacity development at NMHSs so that they can provide required and appropriate climate services to meet user requirements in user sectors such as agriculture, health, energy and disaster risk reduction. TCC's activities are well in line with RCC mandatory functions defined in the Manual on Global Data Processing and Forecasting System (GDPFS).

As to one of RCC mandatory functions, Operational Activities for Long-Range Forecast, TCC provides various products relevant to long-range forecast using outputs of the numerical prediction model generated by GPC Tokyo. As to tailored regional products, TCC provides one-month probabilistic forecasts (for seven-day averaged surface temperature and 14-day averaged precipitation) at station points in Southeast Asia (http://ds.data.jma.go.jp/tcc/tcc/products/guidancetst/). To generate the products, the statistical downscaling techniques are used with the hindcast results, which are also made available on the TCC website, and historical climate data. Another example is probabilistic forecasts for three-month-averaged surface temperature and precipitation (http://ds.data.jma.go.jp/tcc/tcc/products/model/probfcst/4mE/index.html) for Asia. Verification results of these products are also made available on the TCC website. TCC also provides El Niño outlook including indices on its website.

In order to promote the use of products generated by GPC Tokyo and provided by RCC Tokyo for operational climate services at NMHSs, RCC Tokyo, in collaboration with GPC Tokyo, holds annual training seminars inviting experts engaged in operational climate services at NMHSs in the Asia-Pacific region. The training seminar focuses on practical exercises so that participants could apply what they learned to their operational climate services soon after returning home.

Furthermore, JMA's reanalysis data are also accessible through its web-based analysis tool (Interactive Tool for Analysis of the Climate System on the TCC website, or ITACS).

RA VI RCC NETWORK – LRF NODE : ACTIVITIES AND PRODUCTS

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The RCC Network

The RA VI RCC is a RCC Network. It is composed by 3 Nodes, one for the data, o,e for the monitoring and one for the Long Rage Forecasts. The LRF Node is led jointly by Meteo-France and RosHydromet. In addition, the Norwegian Meteorological Institute; the Republic Hydrometeorological Service of Serbia (RHMSS) and the Turkish State Meteorological Service Composed are also contributing to this consortium. A dedicated web site was set up; http://www.rccar6.org ; and all the Nodes are providing a catalog of products and services including the description, main characteristics and examples. These catalogs are currently available in English; they should be also available in Russian in the next. The operations are conducted on a monthly base nevertheless, the main season of interest are the Winter (DJF) and Summer (JJA) periods (referring to seasons in the Northern Hemisphere).

The use of GPC Products

The LRF Node provides products relevant and/or tailored for the RA VI ; some being directly provided by GPCs (and especially GPC Toulouse which have privileged and linkage with the RCC network).

The main GPC products which are currently used are first some Global monitoring products ; the regional view being provided by the Monitoring Node. Then for the forecasting part, the LRF node use SST forecasts (mostly from ECMWF, Meteo-France and Euro-SIP), Plumes in the 3 Tropical oceanic basins (ECMWF and Meteo-France), General Circulation Forecasts (Velocity Potential, Stream Function and Geopotentiel Heigh from ECMWF and Meteo-France). The LRF node is also using the temperature and rainfall forecasts from 5 individual GPCs (the 4 contributing to EuroSIP plus GPC_Tokyo) and MMEs (EuroSIP and LC-MME), some regional forecast (land boxes from ECMWF and Meteo-France). Last, the consistency maps from the LC-MME is also used as support for the outlooks provided for the different sub-regions of RA VI.

The outlooks are provided monthly. Some insight into the uncertainty and an added expert judgment is given through a multidisciplinary discussion. All these information are provided via a Bulletin (Global Climate Bulletin – see also GPC Toulouse talk) which is edited on a monthly base (in English). A synthetic recap is done at the end, presenting insight into most likely individual model scenarios dispersion, synthesis of individual models, insight into most likely multi model scenarios dispersion and a proposed guidance using additional expert judgment.

The LRF Node provides also products relevant and/or tailored for sub-regions in RA VI like Statistical Adaptation of LRF to Scandinavian regions (using ECMWF forecasts) or Regional dynamical downscaling using fully coupled atmosphere-ocean Regional Climate Model for South-Eastern regions (and ECMWF fields as boundary conditions).

Some perspectives

First of all, our plan is to develop relevant Sub Regional Products by downscaling GPCs forecasts at a relevant scale for sub-regional goals (very likely 0°5 resolution). In support to

that, we will likely use some already existing dataset like the E-Obs dataset (or other) or GPCG. The products will be developed both in monitoring and forecasting mode including the design of relevant Sub-Regional Boxes (better than those provided by GPCs). In support, we will promote corresponding studies (CG Indices, Circulation Regimes, …).
In addition, we plan to develop the use of Velocity Potential and Stream Function (High Troposphere) in forecasting mode, especially in relationship with the diagnosis of the current predictability over RA VI sub-regions.

Last but not least, we are developing a wiki page in order to be able to share our analysis on monitoring and prediction of the climate system. This wiki page is automatically updated (for most of the figures of the Global Climate Bulletin) and allow to share the draft of the bulletin and to support the expert discussion. In the next, GPCs will be very welcome for sharing their expertise on their models and their forecasts.

Some recommendations

On the RCC side, we have some specific points to highlight :

- To work on Sub-regional information / Downscaling
- To work on MME issues (especially in relationship with the previous point)
- The use of Circulation regimes vs Variability modes
- To cope with the Climate trend vs Seasonal forecast
- To investigate some other parameters like Extreme Events (especially related to Climate Watches), Drought related information (e.g. Soil Wetness Index) or Velocity Potential and Stream Function in the high troposphere.
- To work on the assessment and prediction of the current predictability
- To work on the use of the Intraseasonal information (including MJO, monthly desegregation of LRF, …)
- To promote the sharing of expertise on operational climate models

USE OF GPCs PRODUCTS BY RCOFs

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ACMAD and partners have been organizing Regional Climate Outlooks (RCOFs) in Africa since 1998. Sixteen RCOFs have been organized in West Africa including Chad and Cameroon (PRESAOs), seven RCOFs in Central Africa (PRESACs), four in North Africa (PRESANORDs) and two in the South West Indian Ocean (SWIOCOFs) region. Given the importance of the March-April-Mai season for African countries along the Gulf of Guinea, a new RCOF for the Gulf of Guinea (PRESAGG) is planned to start in 2014.

Seasonal precipitation and temperature, drought and heavy precipitation, monsoon onset, cyclone frequency and tracks, number of cyclone days, seasonal discharge are the main products of RCOFs.

Dynamical approaches with outputs of GPCs and IRI forecasting systems, statistical seasonal prediction tools, analog years, variability, trends, persistence analysis as well as other scientific and indigenous knowledge of regional climate are used for generating RCOFs products.

Input data for RCOFs includes in situ precipitation datasets, global analysis, hindcasts and forecasts from GPCs and IRI of sea surface temperature, precipitation, geopotential, humidity, winds, velocity potential, stream function, precipitable water, indices representing features, phenomena and patterns driving regional climate. Global maps for these parameters are downloaded and interpreted by regional and national experts. Some datasets (SSTs, Precipitation, winds, humidity …) are applied as predictors in statistical prediction tools. Historical global, regional and national stations and gridded datasets are useful for variability, trends, persistence, and analog year analysis. Other scientific and indigenous knowledge and understanding of regional climate derived from literature review and interactions with users contribute to consensus outlook production.

Major challenges for climate services include the simplification of the probabilistic and uncertainty language used to communicate seasonal outlooks, data rescue and management needed to develop, calibrate and validate forecasting systems at local scales, thresholds definitions required to develop local and sector specific outlooks including advices.

ICPAC REGIONAL CLIMATE SERIVECS TO THE GHA/E.AFRICA: COLLABORATION WITH GPCS TO ADVANCE ROLE OF GPCS AND RCCs FOR EFFECTIVE REGIONAL CLIMATE OUTLOOK SERVICES.

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The Greater Horn of Africa (GHA) countries Ethiopia, Somalia, Sudan, South Sudan, and Djibouti, alongside the typical East Africa countries Kenya, Uganda, Tanzania, Rwanda and Burundi are in a sub-region of Africa where socio-economic welfare is severely affected by climate extremes, especially droughts and consequent famine crisis. A good recent example is the Horn of Africa drought and famine crisis of 2011. Indeed, it is climate stress and its adverse impacts within and across the national borders that catalyzed the Horn of Africa national governments to form the current regional economic grouping referred to as IGAD (Intergovernmental authority on development) following its predecessor the Intergovernmental authority on drought and development.

Thus, the IGAD Climate Prediction and Applications Centre (ICPAC), started as a UNPD project in 1989 and adopted as a technical institution for IGAD/Eastern Africa region in 2007 has spearheaded regional climate service and guidance with interactive involvement of users from sectors which are most vulnerable to climate anomalies. These are the Greater Horn of Africa Climate Outlook Forums (GHACOFs). ICPAC, which is currently running as a WMO RA-I demonstration phase Regional Climate Centre (RCC) in collaboration with GHA/E. Africa National Meteorological and Hydrological Services (NMHSs), the World Meteorological Organization (WMO) and other partners has conducted and disseminated a total of 35 GHACOFs, some of which are available at http://rcc.icpac.net/

GHACOFs have witnessed a successive increase in user-interest and involvement in the formulation of climate forecast implications on critical sectors like agriculture and food security, water resources and disaster risk reduction (DRR) among others. During the GHACOFs, users from regional, national and international organizations review and assess the previous outlook impacts on their sectors and then work with climate scientists to formulate the implementation strategies for the current GHACOF forecast in form sector action plans.

The ICPAC regional climate information processing and forecasts has developed steadily from use of simple-linear type of predictive modeling using indicators such as ENSO and sea surface temperature (SSTs) evolutions with linkage with regional rainfall, which were the main methods used during the late 1990s/early 2000s to the current advanced modeling methods including use of oceanic and atmospheric regional climate indicators, circulation processes and coupled patterns, regional and local scale climate derivers alongside the dynamical model ensembles provided by GPCs through the WMO lead centres for long range prediction and regional climate model for downscaling.

- As a demonstration phase RCC moving towards full accreditation, ICPAC has a track record in providing mandatory RCC climate services to all the 11 National Meteorological Services (NMSs) of the Greater Horn of Africa (GHA). To date, 35-Regional climate outlooks with an interactive user involvement for the GHA, called GHACOFs have been done. In each GHACOF, there has been a notable increase in the user participation, with users from agriculture and food security, water resources, disaster risk reduction managers including international organizations and health among others.
- No single global climate model can capture all the regional climate aspects which fully explain and satisfy the scientific details and user information needs. Scale limits of models and methods have to be addressed in the information processing. Thus integrating “multi-model multi-method” data sources as provided by the various GPCS is

a robust basis of climate information processing and service delivery within the frame work of regional climate outlooks (ROCs).

- Downscaling will usually improve the quality and skill of the GPC model products. Statistical downscaling nearly guarantees user-skill improvement (East Africa downscaling shown above is good example) unlike dynamical downscaling with use of regional climate models, which requires in-depth research and resources to implement.
- Emerging RCCs should partner with GPCs to generate baseline information guide on the usefulness of each GPC in each region. Since GPCs can share their model hindcasts and real time forecast data sets with RCCs, RCCs can also share regional climate observed data sets with GPCs to generate the information for the various operational regions of the RCCs. ICPAC as the GHA/E.A RCC will generate sample products in partnership with CPC-International desks, Africa desk who have already availed the full CFS model hindcasts and real-time forecasts for this type of regional application in the GHA.
- ICPAC will work with each individual GPC to prepare the particular model user climate information products relevant to the major socio-economic challenges over the GHA/E. Africa. The GHA/E. Africa is climatically stressed; Socio-economic and welfare activities especially agriculture, water resources, and livestock herding are all sustained by seasonal rainfall. Thus predictions of at least 2-months lead time are crucial and as developing RCC in collaboration with GPCs, we must provide this climate information with improved and higher-accuracy for GHA/E. Africa to enable decision makers and contingency planners use the information in advance of the onset the climatic conditions.
- This collaboration has mutual advantage. GPCs and RCCs will greatly advance climate information service delivery to inform decisions in “climate sensitive socio-economic sectors” as envisaged within the Global Frame Work of Climate Services (GFS).
- Continuation of research to improve physics and dynamics of the regional climate controls and drivers as well as development of next generation experts and operational techniques must be continued and enhanced. Thus operational climate centres, GPCs and RCCs must have strong linkage with national and international institutions for applied climate research. For the GHA/E. Africa, ICPAC relies strongly on the academic weather and climate training and research in the Department of Meteorology, the University of Nairobi, Kenya.

FORUM ON REGIONAL CLIMATE MONITORING, ASSESSMENT AND PREDICTION FOR ASIA (FOCRAII)

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Found in 2005 as a RCOF in Asia, the Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRAII) was annually hosted at April by BCC and sponsored by WMO and CMA. In recent years, State Foreign Experts Affairs of China and WMO Training Center Nanjing also cosponsored FOCRAII. FOCRAII is a response to addressing the needs of the RA II region for climate monitoring, assessment, prediction and applications (CliMAP). The main objectives of FOCRAII are:

- To review the progress made in the CliMAP programs and the activities both within RA II and the world with a specific focus on the challenges and opportunities in seasonal to inter-annual climate prediction methodologies and systems unique to the RA II region.
- To provide a platform for the members of RA II to share experience and training on CliMAP.
- To build collaborations and partnerships among the members of RA II in the CliMAP programs as well as other international partners and activities.
- To discuss collaborations among the members of RA II and other international partners to build an Asia-Pacific network of climate extreme events monitoring and assessment.

As an important outcome of FOCRAII, a consensus prediction of the summer climate in the RA II region was produced to assist NHMSs in RA II for their climate services during summer season.

Each year, experts from tens climate operation and research centers, universities or international organizations contribute to this RCOF. More than 360 NMHSs staffs from 50 countries/territories or regional groupings attend the FOCRAII since 2005.

EAST ASIA WINTER CLIMATE OUTLOOK FORUM (EASCOF)

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The East Asia winter Climate Outlook Forum (EASCOF) is a new RCOF, of which establishment was formally agreed at the fifteenth session of the Regional Association II (RA II) held in Doha, Qatar in December 2012. EASCOF is coordinated by four participating NMHSs (CMA, JMA, KMA and NAMEM-Mongolia) and its first session was held in Ulaanbaatar, Mongolia from 4 to 6 November 2013.

Meanwhile, in recognition of the importance of influence of the East Asian winter monsoon on East Asian countries, there already existed a sub-regional cooperation among the above-mentioned four NMHSs in the form of the Joint Meeting for Seasonal Prediction of the East Asian Winter Monsoon, which started in 2000.

The Joint Meeting aimed to exchange information on and the latest knowledge of the diagnosis of the current climate conditions, Asian winter monsoon and seasonal forecast for the coming winter. The participating NMHSs brought together their own seasonal forecasts using the GPC products and a statement was summarized at the end of the meeting containing individual forecasts of the Asian winter monsoon and seasonal outlooks. The meeting also gave an opportunity to further strengthen meteorological cooperation among the participating NMHSs.

While the name of the meeting changed to EASCOF, the basic concept and meeting procedure remains the same. EASCOF will continue to provide a good opportunity for information exchange about the Asian winter monsoon and seasonal forecast as well as to enhance collaboration among the participating NMHSs.

USE OF GPC PRODUCTS BY RCOFS (SASCOF) – INCLUDING METHOD OF USE IN PREPARING REGIONAL OUTLOOKS

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The idea of establishing a South Asian Climate Outlook Forum (SASCOF) was originated in a meeting convened by WMO, the Directors General of the National Meteorological and Hydrological Services (NMHSs) in South Asia and Permanent Representatives (PRs) of the respective countries with WMO, at the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy, on 6 August 2009. The PRs of south Asian nations with the WMO had unanimously agreed to implement SASCOF for southwest monsoon season from 2010 onwards. The first 3 meeting of SASCOF (SASCOF-1) was hosted by India Meteorological Department and held at Pune. The latest and fourth session of the SASCOF was held at Kathmandu, Nepal. SASCOFs are generally conducted during the 3rd week of the April month each year. The main activity during all the SASCOFs was the preparation and issuing of a consensus outlook for the southwest monsoon rainfall over South Asia. Associated with last three SASCOFs, Training workshops on seasonal prediction were also held.

Consensus outlook was prepared based on the expert assessment of prevailing large scale global climate indicators, experimental models developed during capacity building workshops conducted for South Asian countries by IMD in association with SASCOF-2 and SASCOF-3, and experimental as well as operational long range forecasts based on statistical and dynamical models generated by various operational and research centers including GPCs. A table showing forecasts for the 2013 southwest monsoon season (June-September) rainfall over south Asian countries derived from forecast maps of various GPCs and other centers is given below along with the final consensus forecast achieved during the SASCOF-4 meeting at Kathmandu, Nepal during April 2013 is given below.

COUNTRY	FORECAST												
	MR Model	IITM CFSV2	NCEP CFS-2	IRI MME	APEC	EURO SIP	JMA	ENSO NEUTR AL	CM C	BOM	UKM O	MF	FINAL FCST BN N AN
AFG	--	BN	-20	CP	N	N	BN	N	CP	N	N	BN	N 30 40 30
BAN	6	BN	-3	CP	CP	N	BN/N	N	CP	N	N	BN	N 25, 45, 25
BHU	11	N	-6	CP	CP	N	N	N/AN	CP	N	AN	N/AN	N/AN 25 35 40
MYA	-8	N	-2	CP	AN	AN	N/ AN	N	CP	N	N	AN	N/AN 25 45 30
SRI	-2	N	-11	CP	BN	N	BN	N	CP	BN	BN	BN	BN/N 40 35 25
NEP	15	N (-)	-3	CP	CP	N	BN	AN	CP	N	AN	AN	N/AN 25 35 40
PAK	-40	N (-)	-14	CP	N	N	BN/N	N	CP	N	BN	AN/CP (N/S)	BN/N 40 35 25
MAL	10	BN	AN	CP	CP	N	N/ AN	N	CP	AN	AN	BN/CP (N/S)	N/AN 25 40 35
IND	BN/ N	AN	2	CP	N	N+	N	N	CP	N	N/A N	AN/BN (N&C/S)	N/AN 25 45 30

BN – Below Normal N – Normal AN – Above Normal CP – Climatol. Prob.

SOUTHEAST OF SOUTH AMERICA CLIMATE OUTLOOK FORUM (SSACOF)

Caio Coelho

CPTEC/INPE, Brazil

Presented on behalf of SMN (Argentina), INMET (Brazil), DINAC (Paraguay) and DNM (Uruguay)

The aim of the Southeast South America Climate outlook forum (SSACOF) is to produce the seasonal climate outlook forecast for the Southeast South America region for the upcoming season. This region, defined as the area between 20ºS and 40ºS east of Andes Mountains, is important for both societal and economic reasons. The region contains the La Plata Basin, where one of the world largest hydropower dams is located, and is one of the main cereal and oilseed producing regions in the world.

The SSACOF started in December 1997 with the first forum held in Montevideo, Uruguay, where the seasonal forecast outlook for January-February-March (JFM) 1998 was produced. Since then a total of 35 forums have been organized. Nine forums were organized in Argentina, nine in Brazil, eight in Paraguay and nine in Uruguay. Experts from National Meteorological Services, Universities and other institutions of these four countries participated in these forums. A larger number of forums were organized before 2004 (average of about three forums per year). After 2004 the number of organized forums reduced to about two per year. The last forum was help in Porto Alegre, Brazil, in June 2013. The most forecast target seasons were: January-February-March (JFM), with six issued forecast outlooks, July-August-September (JAS), with 7 issued forecast outlooks, and November-December-January (NDJ) also with six issued forecast outlooks.

The methodology used in the SSACOF for preparing the seasonal forecast outlook has two components:

1) Diagnostics of the global and regional climate conditions of previous months, including the evaluation of the El Niño-Southern Oscillation (ENSO) status, by examining the ENSO quick look bulletin produced by the International Research Institute for Climate and Society (IRI), the ENSO diagnostic discussion bulletin produced by the Climate Prediction Centre (CPC/NOAA), the Niño plume forecasts produced by the European multi-model Seasonal to Interannual prediction system (EUROSIP), and the wrap up bulletin produced by the Bureau of Meteorology (BOM/Australia).

2) Use of forecasting tools (both statistical and dynamical models) for preparing the final forecast outlook. It is estimated that the final outlook is produced based on about 30% statistical models information and 70% dynamical models information.

As for statistical models the following forecasts are considered in the discussion for preparing the outlook:

1) An ensemble of forecasts produced by three models run at INMET (Brazil) including circulation and sea surface temperature (SST) based forecasts produced with the Climate Predictability Tool (CPT) developed by the IRI, and two time series models that take into account the recently observed climate conditions.
2) SST based CPT forecasts run at the Meteorological Services of Argentina, Paraguay and Uruguay.
3) SST based forecasts run at INTA (Argentina), Pelotas University (Brazil) and as part of EUROBRISA (A Euro-Brazilian Initiative for improving South American seasonal forecasts)

As for dynamical models the following forecasts are considered in the discussion for preparing the outlook:

1) Global and regionally downscaled forecasts produced by the local Global Producing Centre for Long-Range Forecasts (GPC), CPTEC (Centre for Weather Forecasts and Climate Studies), Brazil
2) Forecasts produced by CENPAT-CONICET, Argentina
3) The multi-model ensemble forecast of the 12 WMO GPCs
4) The multi-model ensemble forecast produced by EUROSIP
5) The multi-model ensemble forecast produced by the IRI
6) The hybrid (statistical-dynamical) multi-model ensemble forecast produced by EUROBRISA

After presenting all the content above, including diagnostic, forecasts and associated verification products, all participants contribute to the final discussion for elaborating the upcoming seasonal forecast by consensus agreement among climate experts attending the forum. The forecast is expressed in 3 categories (terciles probabilities) for both temperature and precipitation, with categorical probabilities assigned subjectively by the group of experts attending the forum. The forecast most likely category is generally less than 45%.

THE USE OF GPC DATA AND PRODUCTS IN THE CARIBBEAN CLIMATE OUTLOOK FORUM (CARICOF)

Adrian Trotman, CIMH, Barbados

Though established in 1998, a true Climate Outlook Forum for the Caribbean was not realised until 2012, as for more than a decade the Caribbean Institute for Meteorology and Hydrology (CIMH) created regional Precipitation Outlooks on its own. However, joined by regional National Meteorological Services from the English-, French-, Spanish- and Dutch-speaking Caribbean in February 2012, a consensus forum (the Caribbean Climate Outlook Forum, CariCOF) developed that provides seasonal climate outlook information for rainfall and temperature with zero and three month lead times.

After analysing diagnostics of the global and regional climate conditions of previous months, particularly using information from NOAA CPC, the production of the Seasonal Rainfall Forecast is primarily driven by experiments using the Climate Predictability Tool (CPT) established and maintained by the International Research Institute for Climate and Society (IRI). A number of experiments are run by individuals from across National Meteorological Services and CIMH primarily using:

- Observed SST over the tropical Atlantic and Pacific (data source: NOAA ERSSTv3b);
- Observed SST over the tropical North Atlantic over September (data source: NOAA ERSSTv3b)
- Predicted SST over the tropical Atlantic and Pacific (data source: NOAA CPC CFSv2)
- Predicted SST over the tropical North Atlantic (data source: NOAA CPC CFSv2)
- Predicted rainfall totals over the Caribbean (data source: ECHAM4.5 ensemble24 ensemble mean)

The CFSv2 model prediction data sets are sourced via the NOAA CPC International Desk's ftp site. The other data sets are all sourced via the IR Data library.

Results from CPT experiments are then compared and interpreted in conjunction with seasonal rainfall predictions and other products from a number of Global Producing Centres (including Multi-centre multi-model products), in particular:

- NOAA CPC – probabilistic rainfall forecast
- ECMWF Predicted Tropical SSTs and precipitation
- Météo France Predicted SSTs and precipitation
- EUROSIP – multi-model probabilistic rainfall forecast
- WMO LC for LRF-MME – Multi-model rainfall forecast
- UK Meteorological Office precipitation forecasts
- CPC/IRI ENSO Forecast
- NOAA CPC NAO index monitoring/forecasting
- *IRI – multi-model probabilistic rainfall forecast (not a GPC)*

The final consensus rainfall forecasts are then produced using all this information and agreed upon through online discussions with all forecast parties.

Due to a training workshop in May 2013 in Port of Spain, Trinidad, forecast verification is becoming more important for CariCOF. There is some concern over the skill of the AMJ forecasts.

In its newsletter CariCOF also provides information on seasonal temperature (2m) forecasts, which at the moment is determined by outputs from GPC (as those mentioned for rainfall above). CariCOF will be producing its own temperature forecast through an approach similar to that used for the rainfall forecast. The newsletter, as well as the more canonical tercile 3-montly precipitation forecast maps can be downloaded from http://cimh.edu.bb/?p=precipoutlook.

PACIFIC ISLANDS ONLINE CLIMATE OUTLOOK FORUM (PICOF)

Elisabeth Thompson, Grant Beard and Janita Pahalad
(*Presented by J. Pahalad*)

Climate and Oceans Support Program in the Pacific (COSPPac)

The World Meteorological Organization (WMO) Pacific Islands online Climate Outlook Forum (PICOF), also known regionally as the Online Climate Outlook Forum (OCOF), began during the second phase of the Pacific Islands Climate Prediction Project (PICPP) in 2007. In July 2012, PICPP merged with another regional project (the South Pacific Sea Level and Climate Monitoring Project) to become the Climate and Oceans Support Program in the Pacific (COSPPac). COSPPac is a 4-year climate services capacity building program, assisting fourteen partner Pacific Island Countries (PICs) through the Australian Agency for International Development (AusAID) funding. Administered by the Australian Bureau of Meteorology (Bureau), COSPPac is an outcome-based program focussed on benefiting Pacific communities through improved climate services. The continued support and facilitation of the PICOF is an important focus of COSPPac's contribution to improved climate services in the Pacific region.

The participants of the PICOF include eleven Pacific Island Countries and staff from the Australian Bureau of Meteorology. The forum covers the current ENSO status and forecasts, the Islands' most recent one and three month rainfall observations, and their latest seasonal climate outlooks using the Seasonal Climate Outlooks for Pacific Island Countries (SCOPIC) statistical forecast model. The OCOF also provides an opportunity for the Pacific Islands to give feedback, share any relevant experiences they have had with their stakeholders, and to ask questions of their Australian colleagues.

Over the life of the forum, the PICOF has shown to be a platform for the positive reinforcement of training and climate information understanding. In addition, the COSPPac team has noticed a definitive improvement in the quality of the outlooks produced as a result of the PICOF.

USE OF GPC PRODUCTS BY SEECOF

Branko Bijelić

South East Europe Virtual Climate Change Center (SEEVCCC)
RHMS of Serbia

The functions of the South East European Virtual Climate Change Center (SEEVCCC) hosted by the RHMS of Serbia (RHMSS) as a contributing member of the WMO RA VI RCC-Network include support to the Southeast Europe Climate Outlook Forum (SEECOF) process. This includes the provision of technical, scientific, and other relevant support to the SEECOF process. SEECOF-1 is the first Regional Climate Outlook Forum (RCOF) on the territory of RA VI, organized in Zagreb, Croatia in June 2008. 19 NMHSs of the countries of the South-East Europe and Caucasus region take part in SEECOF, namely Albania, Armenia, Azerbaijan, Bosnia and Herzegovina/Federation of Bosnia and Herzegovina, Bosnia and Herzegovina/Republic of Srpska, Bulgaria, Croatia, Cyprus, Georgia, Greece, Hungary, Israel, Republic of Moldova, Montenegro, Romania, Serbia, Slovenia, The Former Yugoslav Republic of Macedonia and Turkey. The latest session of SEECOF-10 was held in Belgrade, Serbia, in November 2013. SEECOF normally conducts two sessions per year, one through online discussions, and the other face-to-face.

WMO WORKSHOP ON OPERATIONAL LONG-RANGE FORECAST:GPCs AND RCCs, IN SUPPORT OF NMHSs AND RCOFs,

Brasilia, Brazil, 25-27 November 2013

USE OF GPCs AND RCCs PRODUCTS BY TANZANIA METEOROLOGICAL AGENCY (TMA)

ABSTRACT

Dr Hashim Ng'ongolo

Tanzania Meteorological Agency (TMA) is the designated official sources for the provision of meteorological information and early warning services including alerts and advisories to the public in Tanzania. It also provides seasonal weather forecast information to different users such as Disaster Management Department; Agriculture and food security; Hydro power generation sector; Environment department ; Health sector and among others. The development of seasonal climate outlook in Tanzania involves three phases: First phase, TMA climate experts' seat for some days to develop a preliminary seasonal climate outlook for the country. TMA climate experts reviewed the state of the global climate system and its implication to the upcoming season in the country. Among the principal factors taken into account are the observed and predicted Sea Surface Temperatures (SSTs) in the Global Oceans and precipitation in global scale, these products obtain from WMO-GPCs (Melbourne, ECMWF, Tokyo, Seoul, Exeter, Washington, Beijing, CPTEC , Tolouse, Montreal, Moscow). Second phase involves regional Climate Outlook Fora (RCOF) based in SADC (SARCOF and IGAD (GHACOF) regional centers. TMA experts participate in both regional centers in preparing and issuing the seasonal climate outlook for the region. Third phase involves downscaling of regional seasonal climate outlook to national level by TMA scientists taking into consideration the results from the preliminary forecast and micro-climatic features in various climatological zones.In collaboration with GHACOF and SARCOF Tanzania Meteorological Agency is continuing generating and disseminating climate information to a variety of users and stakeholders through knowledge sharing platforms such as capacity building workshops and providing seasonal climate outlooks.

USE OF RCC AND GPC PRODUCTS BY NMHSs: BANGLADESH

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Dhaka

Bangladesh is an agriculture-based country with agricultural production comprising about 18.6% (data released on November, 2010) of the country's GDP and employs around 45% of the total labor force. To strengthen this sector, better planning and cost effective methods should be taken up, which in turn requires more accurate and reliable agro-meteorological information and forecasts or in fact seasonal and long-range forecasts. For this, the Bangladesh Meteorological Department (BMD) needs to enhance its forecasting abilities.

With this end in view, BMD utilizes products from a number of GPCs and RCCs of Tokyo and Beijing along with the developing RCC of India. BMD utilizes raw data more effectively than graphical representations. The BMD is yet to acquire capability to prepare or run models on its own or validate those received from the GPCs and RCCs to make them more time and location specific. BMD is striving hard to enhance its medium and long-range forecasting capability but relevant technical support and training is required.

USE OF RCC AND GPC PRODUCTS BY NMHSs: PARAGUAY

Max Pasten

Meteorological and Hydrologic National Direction
Paraguay

The Meteorological and Hydrologic National Direction (DMH) of Paraguay works with different sectors of society, especially whit Agriculture, Health and Hydrologic, this sectors use our seasonal forecast that we made using the CPT (Climate Predictability Tools). Furthermore the seasonal forecast is published jointly whit other NMHSs of Latin America by the CIIFEN (Centro de Investigacion Internacional del Fenomeno de El Niño).

To improve the seasonal forecast the DMH needs to enhance its forecasting skill to give better products adjusted to different sectors, especially for the agriculture because Paraguay depend on it and the impact reflect especially in the GDP.

USE OF RCC AND GPC PRODUCTS BY NMHSs: COSTA RICA

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According with the Germanwatch Global Climate Risk Index[2], Costa Rica and the rest of Central American countries were the most vulnerable and affected region by hidrometeorological ynamical between 1992 and 2012. Our countries are already taking action to prepare for climate-related disasters and to promote as well as implement adaptation. However, adequate financial and institutional support provided by developed countries is required to further increase disaster preparedness and resilience.

In this sense, Climate threat to water and food security (FS) in Central America is a matter of concern for authorities and FS program managers; Information for climate risk management is recognized and in demand in the region. In response, since 2000 the Central American Climate Outlook Forum (CA-COF), coordinated by Regional Water Resources Committee of the Central America Integration System (CRRH-SICA), has consolidated a process to issue Seasonal Climate Outlooks(SCO), bringing together the capacities of all seven Nacional Weather Services (NWS) in the Central American region (http://www.recursoshidricos.org/productosserviciosinformacion). So far, there have been 41 continuously meetings of the CA-COF.

Currently CA-COF uses ynamical climate seasonal forecast products from global centers (GPC) like IRI, BoM, ECMWF, MetOffice, CPTEC, NCEP, among others, jointly with national data, statistic tools (analogous years, CPT, contingency analysis) and seasonal climate variability researches to ensemble seasonal climate outlook 3 times a year (May-July, 1st part of rainy season and "Little Summer", August-October ,2nd part of rainy season-peak of hurricane season and, December-February, the "winter" season).

Starting in 2006, CA-COF joined the Central America Regional Program for Food and Nutrition Security (PRESANCA) to stablish the Central American Climate Outlooks Application Forum (CA-COF) for the purpose of interpreting climate outlooks in terms of climate hazards relevant to the sectors involved in food security (agriculture, water and sanitation, health and nutrition, fisheries, and disasters management).

The process to establish this climate service have helped the NMHSs in Central America to better understanding the demand for climate information in their own countries, the type of risk associated with climate users face, the type of decision they may take based on climate outlooks and information. It also has a created a roster of climate risk aware sectoral experts in the region and in the countries, that will be key in advancing the development of climate services at national level. The knowledge is helping the NMHSs to improve their relation with users, focus their efforts and find synergies for climate product development with interested parties or users in specific sectors.

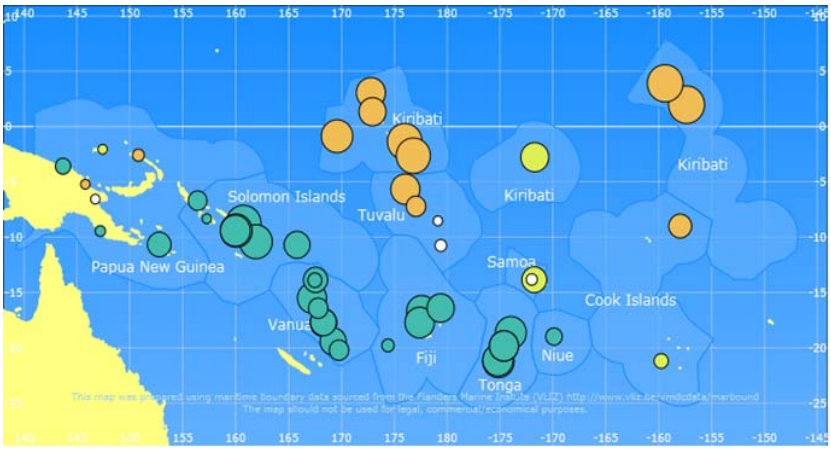
[2] Harmeling, S. and D. Eckstein, 2013. GLOBAL CLIMATE RISK INDEX 2013. GermanWatch.

USE OF RCC and GPC PRODUCTS BY NMHSs: FIJI

Bipendra Prakash,

Senior Scientific Officer (Climate), Fiji Meteorological Service

Fiji's climate varies significantly from year to year, with hydro-meteorological disasters and tropical cyclones impacting the country every now and then. The country was affected by two severe floods and a tropical cyclone in 2012 alone, causing damages and losses amounting to hundreds of millions of dollars and loss of several lives. In consideration of the above and Fiji's heavy economic reliance on the climate sensitive primary and service based industries, seasonal climate prediction can go a long way in helping decision makers and planners to cope with undesirable effects of climate variability and to also maximize on the opportunities. Fiji Meteorological Service (FMS) has been issuing seasonal climate outlook for the Fiji region for quite sometime now. FMS also produces special sector climate outlook for the Fiji's sugar industry and the Fiji Electricity Authority. The main guide for FMS's seasonal climate outlook at present is a statistical climate model called 'SCOPIC' (Seasonal Climate Outlook for the Pacific Island Countries), developed by the Australian Bureau of Meteorology as an aid of the Australian Government to the Pacific Island countries. Global climate models also provide useful broader climate perspective, however, their outputs are too coarse to give any area or region specific prediction. There are two Regional Climate Outlook Forums in which FMS participates and this further aids in the seasonal climate prediction. While FMS has been issuing seasonal climate outlook every month for several years now, it has its challenges and there remains a lot of room for improvement.



SCOPIC Outlook for the Pacific Island Countries
Source: Australian Bureau of Meteorology

USE OF RCC AND GPC PRODUCTS BY NMHSs: TURKEY

Fazilet Camalan

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Turkish State Meteorological Service (TSMS) has been carried out monthly, seasonal, annual and long term climate assessment and publish these studies at their web site (http://www.mgm.gov.tr). These assessments have also been contributed to the WMO's and NOAA's State of the Climate Report. TSMS is using GIS software to produce Climate Atlas and climate monitoring. TSMS has been running two regional climate models (RegCM3-4 and PRECIS) for future projections in the region.

TSMS contributes to the RCC-Network of WMO Region VI (Europe) and is delivering climate monitoring, seasonal forecast and data products to the Eastern Mediterranean countries (EMCC will be given services to countries including Turkey, Cyprus Greece, Syria, Israel, Lebanon, Jordan and Egypt) through EMCC web site (http://emcc.mgm.gov.tr). These climate prediction and information services contribute to enhanced social and economic resilience and decision making in many climate-sensitive sectors such as water, agriculture, fisheries, health, forestry, transport, tourism, energy and disaster risk management in the region.

Eastern Mediterranean Climate Center (EMCC) will be conducted in the following manner studies:

1) To perform monitoring for 2m surface temperature and total precipitation at the end of each month for the previous month. NOAA, NCEP and TSMS data will be used for monitoring processes.
2) To interpret GPCs products and assess of their forecast performance for 2m temperature and rain rate anomaly prediction at the end of each months for the coming three months.
3) To provide monitoring and prediction data set for the Eastern Mediterranean region.