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**WORLD METEOROLOGICAL ORGANIZATION**

**COMMISSION FOR BASIC SYSTEMS**

**JOINT CBS-CCL INTER-PROGRAMME EXPERT TEAM ON OPERATIONAL PREDICTIONS FROM SUB-SEASONAL TO**

**LONGER-TIME SCALES**

**(IPET-OPSLS)**

**BARCELONA, SPAIN, 2 JUNE AND 4 TO 6 JUNE 2018**



**FINAL REPORT**

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**EXECUTIVE SUMMARY**

The meeting of the Inter-Programme Expert Team on Operational Predictions from Sub-seasonal to Longer-Time Scale (IPET-OPSLS), a WMO Joint Commission for Basic Systems (CBS)-Commission for Climatology (CCl) took place at the Barcelona Supercomputing Center (BSC), Spain, 2 to 4 June 2018, back to back with the second WMO Workshop on Operational Climate Prediction (OCP-2) which was held on 30 May - 2 June 2018.

The IPET-OPSLS reviewed decisions of the WMO constituent bodies relevant to its work including those from CBS-TECO (Technical Conference) and CBS-MG (Management Group) which were held in March 2018 in preparation of the EC-70, and of CCl-17 which also took place in April 2018. Key decisions include, from CBS: a) the agreement with the idea to explore the opportunity to consider inclusion of new class of RSMCs into the Manual on GDPFS namely, a centre for climate reanalysis, a centre for climate monitoring on global scale and GPC covering sub-seasonal forecasts on the global scales; and from CCl, the invitation to the IPET-OPSLS to take on the coordination responsibility of operational production of the Global Seasonal Climate Update (GSCU) and to assist with the development of the CSIS Technical Reference and the identification of activities relevant to CSIS functions yet to be defined in the Manual on GDPFS to provide authentic and well-coordinated sources of global information to Members.

The team reviewed progress made since its last meeting in Beijing, China (2016) by reviewing the action items. Key achievements include:

* the approval of the designation criteria for Global Producing Centers for Annual to Decadal Climate Prediction (GPC-ADCP), and its inclusion in the GDPFS Manual;
* the approval of designation criteria for Lead Center for Annual to Decadal Climate Prediction (LC-ADCP), and its inclusion in the GDPFS Manual;
* successfully organizing WMO workshops on Operational Climate Prediction (OCP-1) and (OCP-2);
* development of a research requirements document from operations perspective;
* development of a draft outline for the guidelines on procedures for generating regional seasonal forecasts.

In addition, the team noted with satisfaction the work of LC-LRFMME which has:

* updated the GPC-LRF seasonal forecast systems from GPC-ECMWF, GPC-Seoul, GPC-Offenbach;
* included seasonal forecasts from GPC-Offenbach;
* provided graphics on NH polar projection (to support ArcRCC);
* taken on responsibilities for verifications (that formally were the responsibility of LC-SVSLRF);
* developed the pilot phase for sub-seasonal forecasts;
* provided continued support for GSCU;
* opened the access of the graphical products at the LC-LRFMME website.

 In reviewing its actions, the Team considered the work of its seven Sub-Teams (STs), namely: ST1 - Workshops on Operational Climate Prediction; ST2 - Develop revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to GSC ; ST3 - On scoping/implementation of sub-seasonal forecasts; ST4 - Scoping/implementation of longer than seasonal forecasts; ST5 - New approaches for distribution of GPC hindcast and forecast data; ST6 - Guidelines on procedures for generating regional seasonal and ST7 - Amendments to the GPC-relevant sections of the Manual on the GDPFS. The Team decided to disband ST-4 and ST-7 as their work had been completed.

The team reviewed the status of LC-LFRMME and of LC-SVSLRF. It noted that with the designation of GPC Offenbach as GPC-LRF, there are now 13 GPC-LRF contributing data to LC-LRFMME. The current status of data provided by GPCs-LRF and the upgrade history of seasonal forecast systems can be viewed in Annex 3. Regarding the LC-SVSLRF which has been operational for over 12 years, the team came to an agreement that the level of use of its information by WMO Members has been on the low side. The case in point is that since 2014, none of the GPC has updated its forecast verification results, therefore, in a practical sense, the LC-SVSLRF has functionally ceased to be of much use. The team, therefore, supported the decommissioning of the LC-SVSLRF website, with verification to sit, in the future, alongside GPC forecasts hosted by the LC-LRFMME.

The Team discussed information related to its work and contained in the revised Manual on GDPFS (WMO-No. 485). It noted some inconsistency in the placement of the designated RSMCs, in particular the GPC for Annual to Decadal Climate Prediction (ADCP) which should be in the list of “General Purpose Activities” instead of “Specialized Activities”. In addition the Team felt that the definition of sub-seasonal and climate prediction would gain from revisiting the definitions for their time scale specification. These issues will be brought to the attention of the CBS for consideration.

The Team reviewed the currently applicable GSCU schedule worked out by CCl TT-GSCU (Annex 4) and its practical implications for operationalization. The team noted the recommendation of CCl-17 inviting the LC-LRFMME to take the responsibility for operational production of GSCU. However, the Team recognized that the LC-LRFMME would need assistance to cover all the required elements of GSCU, a key part of which is monitoring information. The Team further noted that, at present, the prediction part is summarized by the International Research Institute for Climate and Society (IRI) based on the graphical products generated by LC-LRFMME, and that the monitoring part is contributed by National Centers for Environmental Information (NCEI). Therefore, the Team recommend the establishment (or assign to) an ST to assess the considerations related to operational GSCU and to propose options to address them for implementation.

On the CSIS guidance for the implementation of CSIS, the team was engaged to review the prediction section of the technical reference on CSIS with particular attention to the alignment with the Manual on GDPFS.

The team discussed key activities for the future in particular:

1. the support to GSCU (to guide the future development of the GSCU including recommendations on operational arrangements for its routine production and dissemination;
2. the support to the ArcRCC (provision of additional products of special interest for the Arctic region including sea ice, ice freeze up/break dates, snow water equivalent etc.);
3. the support RCOFs (alignment of regional domains for forecast and verification, development of specialized products by GPCs-LRF);
4. opening of hindcast data from 9 GPCs-LRF currently allowing open data access and password protect 4 GPCs-LRF that do not allow free access;
5. annual assessment of seasonal forecasts;
6. designation of new class of RSMCs: Global Climate Reanalysis and Global Climate monitoring. CCl and CBS to reexamine how to implement the proposal on the global scale. The team felt that this is not in its remit. To address the issue, it may be necessary to establish a Task Team composed of representatives of IPET-OPSLS, WCRP, Data Advisory Council (WDAC) and expertise from CCl;
7. the production of standards verification methods and guidance for ADCP;
8. address the outcome of OCP-2 related to the production of a paper on operational climate prediction.

Annex 8 provides the list of actions, recommendations and decisions resulting from this IPET-OPSLS meeting.

**1. OPENING**

Mr Arun Kumar, Chair of IPET-OPSLS, welcomed IPET-OPSLS members to the meeting. He indicated that, although the meeting is, this time, limited to four days, he was confident that the team would have fulsome discussions resulting in clear decisions and actions to continue supporting and evolving WMO operational climate prediction infrastructure and activities. He also highlighted the fact that the team is growing with now 13 GPCs for LRF and upcoming four additional GPCs for Annual to Decadal Climate Prediction (ADCP). In that context, the team would need to review how the IPET-OPSLS membership would be defined to ensure efficient participation. Mr Kumar added that generally the Team is not very proactive in making its work known and efforts should be made to change the situation leading to an enhancement of the utilization of the LRF infrastructure within WMO. He concluded his opening remarks by thanking the Government of Spain and Barcelona Supercomputing Center (BSC) for agreeing to host the meeting, and Mr Francisco Doblas-Reyes, and his team for making all the necessary arrangements.

Mr Abdoulaye Harou, Chief of WMO Data Processing and Forecasting Systems, welcomed the Experts and also thanked the Spanish government and BSC for hosting the meeting. He extended his thanks to Mr Francisco Doblas-Reyes and Mrs Gabriela Tarabanoff of BSC, for the organization of the meeting as well as of the Second WMO Workshop on Operational Climate Prediction (OCP-2) that preceded the IPET-OPSLS meeting in Barcelona. He added that this meeting is perhaps the last one in this form considering the possible changes being prepared for WMO governing structure. Nonetheless, the work of the Team is very important in the development of the long-range forecast infrastructure and it will find a home under the new structure.

Mr Rupa Kumar Kolli, Chief of WMO World Climate Applications and Services Division, welcomed the participants and highlighted that the IPET-OPSLS is a joint team between the Commission for Basic Systems (CBS) and the Commission for Climatology (CCl). He recalled that originally the team was a CBS based team but the need to become a joint team with CCl was quickly recognized to better serve WMO members with operational climate prediction services. He also highlighted that the WMO governance/structure is changing and this might have some implications for plans for future activities, but that the current activities may not be affected. However, these forthcoming changes need to be kept in mind when formulating the work plan and future activities. He also highlighted that IPET-OPSLS supports the Climate Services Information System (CSIS) pillar of the Global Framework of Climate Services (GFCS) in a comprehensive way, which is also a major focus for CCl.

Mr Francisco Doblas-Reyes from BSC welcomed all participants, provided information on the local arrangements and expressed appreciation for having the opportunity to host the IPET-OPSLS meeting at BSC.

The opening session concluded with a *tour de table* self-introduction of all participants.

**2. ORGANIZATION OF THE MEETING**

**2.1 Adoption of the agenda**

The agenda was adopted without change. The Chair informed the participants that he had assigned names of IPET-OPSLS members for note-taking for specific agenda items to facilitate drafting of the final meeting report. The agenda is available at Annex 1 to this report.

**2.2 Working arrangements**

The Participants agreed on the working arrangements. The meeting participants and their contact details are listed in Annex 2. Tabled documents for the meeting are available at the link below.

<http://www.wmo.int/pages/prog/www/DPFS/Meetings/ET-OPSLS_Barcelona2018/DocPlan.html>

**3. INTRODUCTION**

**3.1** **IPET-OPSLS – Overview**

Mr Arun Kumar (Chair, IPET-OPSLS) briefed on the structure of WMO, identifying where the IPET-OPSLS fits within the CBS and CCl including its scope and task teams, for the benefit of new members. He highlighted that there are 8 Technical Commissions (TCs), 6 Regional Associations (RAs) and that the IPET-OPSLS functions as a joint CCl-CBS Expert Team. A question was raised as to where the climate projection activities fit? In this context, it was noted that WMO Regional Climate Centre (RCC) designation criteria include mandatory functions on long-range forecasts and highly recommended functions for climate projection. Although, RCCs may be responsible with climate projection but the team’s engagement, at present, will reamain confined to operational climate prediction. It was also noted that the current operational infrastructure for climate predictions is better developed than it is for climate projections which currently have a significant research component.

**3.2 WMO infrastructure for operational prediction on sub-seasonal to longer-time scales**

Mr Caio Coelho (Co-Chair IPET-OPSLS) described the operational infrastructure for prediction on sub-seasonal to longer time scales. He explained the designation process of GPC-LRF which is governed by the [Manual on the GDPFS (WMO-No. 485)](https://library.wmo.int/opac/doc_num.php?explnum_id=4246) and was included in the Manual in 2006. The designation criteria are based on a set of standards, such as a fixed forecast production cycle, a standard set of seasonal forecast products and implementing WMO-defined verification standards for retrospective forecasts. He went on to also describe the designation criteria and operational activities of the Lead Centre on Long Range Forecast Multi-Model Ensemble (LC-LRFMME), and of Lead Centre for Annual to decadal Climate Prediction (ADCP) and of Regional Climate Centres (RCCs). More detailed information on these aspects can be found in the Manual on GDPFS available at the above link.

**3.3 Relevant decisions from CBS-TECO (Technical Conference) and CBS-MG (Management Group)**

Mr Harou presented on IPET-OPSLS relevant decisions from CBS-TECO and CBS-MG meeting which were held in Geneva from 26 to 29 March 2018. He recalled that a decision was made to not hold CBS Extraordinary Session every two years (one should have been scheduled in 2018) but hold only Regular Session every four years. Considering that the 18th Session of Congress (Cg-18) is planned in June 2019, WMO Executive Management decided to hold a Technical Conference (TECO) Session followed by CBS Management Group meeting to decide on issues to bring forward to the 70th Session of WMO Executive Council (EC-70) and to Cg-18.

The key decisions related to IPET-OPSLS, agreed by CBS-MG to be proposed for consideration by EC-70, are the following:

1. endorsement of the outlines of the Guide (WMO-No. 305) to the Manual on the GDPFS (WMO-No. 485);
2. endorsement of the approach taken by the EC Steering Group on the development of the Implementation Plan (IP) for the Seamless GDPFS. Final plan to be tabled at Cg-18. Guidance from EC-70 on the draft IP is required;
3. endorsement of the collaborative efforts between CBS and CCl to integrate operational functions of CSIS into GDPFS with IPET-OPSLS taking the lead;
4. agreement with the idea to explore the opportunity to consider inclusion of new class of RSMCs into the Manual on GDPFS namely (i) centre for climate reanalysis, (ii) centre for climate monitoring on global scale and (iii) GPC covering sub-seasonal forecasts on the global scales.

The Team agreed to discuss how to address the decision (d) above under agenda item 6.

**3.4 Relevant outcomes of CCl-TECO and decisions of CCl-17**

Mr Kolli presented a summary of CCl-17[[1]](#footnote-1) (10 and 13 April 2018, Geneva) decisions and the Technical Conference on Climate Services for Policy and Decision Support (11-12 April 2018, Geneva) outcomes. He noted that the CCl-TECO was mainly used as a venue to report back on key achievements of CCl during the sixteenth intersessional period, followed by panel discussions on future perspectives and priorities for CCl. The main focus of CCl-17 session was on future work, under three core themes: (i) Basic systems for climate prediction, (ii) Climate Service Delivery and (iii) Capacity development. CCl-17 has reaffirmed its joint responsibility with CBS of IPET-OPSLS as part of its new working structure, and also invited the IPET-OPSLS to take on the coordination responsibility of operational production of the Global Seasonal Climate Update (GSCU).

Mr Kolli also brought to the attention of the participants the (CCl-relevant) deliverables for IPET-OPSLS identified by CCl-17: (i) Guidance on operational Seasonal Forecasting; (ii) Technical coordination of Workshop series on Operational climate Prediction; (iii) Operationalization and further development of the GSCU including development of Guidance of the use of GSCU; and (iv) Recommendation on CSIS functionality of operational prediction and its integration with the GDPFS. The participants discussed the implication of these CCl requirements to its work, and noted with satisfaction that a large part of the deliverables is in close alignment with the ongoing work of IPET-OPSLS, though the participants also recognized the additional responsibility of leading the GSCU operationalization and the need for possible adjustments in the description of the deliverables. Further, the participants agreed that the IPET-OPSLS mission as provided in CCl-17 working structure for IPET-OPSLS needed to be changed slightly as noted under recommendations below.

**Recommendations:**

* **Revise the mission for IPET-OPSLS to “Provide guidance on operational climate prediction on global scale to enable optimal utilization at regional and national scales” (CCl-MG; Secretariat to communicate).**
* **Review the CCl proposed deliverables for the IPET-OPSLS and recommend necessary changes to the CCl-MG (All members; Jean-Pierre Ceron to consolidate suggested changes to communicate with CCl-MG).**
* **Include a focal point from IPET-OPSLS to be a member of the ICT-CSIS (CCl-MG; Secretariat to communicate).**

**3.5 New GDPFS Manual and Seamless GDPFS**

Mr Harou provided general introduction to the Manual and Mr Kumar focused the discussion on the sections relevant to IPET-OPSLS. He noted that there are five designations of RSMCs in the GDPFS Manual that are coordinated by IPET-OPSLS. He noted some inconsistency as to the placement of the designated RSMCs in the Manual. The designation of one of the five RSMCs, i.e., the Annual to Decadal Climate Prediction is currently listed under “Specialized Activities,” but to be consistent, could be under the “General Purpose Activities” (similar to the GPCs for LRF). He also noted the title of Appendix 2.2.20 would benefit from adding “ADCP” after “Centres” for clarity.

Regarding the Appendix 1.1 - Definitions of meteorological forecasting ranges - the participants held considerable discussions as to its current relevance, in particular around the definitions of sub-seasonal and climate prediction which lack time scale specifications.

After discussions, the team decided on the following recommendations and actions:

**Recommendations (to CBS-MG):**

* **Appendix 1.1 on “Definitions for the Meteorological Forecasting Ranges” be reviewed by the appropriate Expert and Task Teams under the OPAG-DPFS and, if necessary, appropriate updates/revisions be incorporated in the GDPFS Manual.**
* **Invite CCl ICT-CSIS, through CCl president, to provide input to the evolution of the operational functions (that may become part of the GDPFS Manual) in the CSIS***.*

**Actions:**

* **IPET-OPSLS to review the relevant sections in the GDPFS manual and propose necessary changes to the ICT-DPFS for follow-up.**

**3.6 IPET-OPSLS relevant items and recommendations from RCOF Review 2017**

The Team was apprised that RCOFs have completed 20 years of operations around the world. To mark the occasion, WMO organized a workshop on global review of RCOFs (September 2017, Guayaquil, Ecuador) to identify best practices, innovative approaches, potential expansion of RCOF products and to propose ways to make more effective delivery and communication for decision making. The workshop facilitated analysis of strengths and weaknesses, opportunities and threats, which resulted in future plans for relevant activities.

The Team was informed that the workshop had generally expressed satisfaction on seasonal forecasts provided by GPCs-LRF and welcomed increased visibility of the RCOF activity. The Team noted IPET-OPSLS relevant recommendations from the RCOF Review including improvement of the access of GPC-LRF data from the LC-LRFMME to support RCCs to produce objective forecasts, support of subseasonal forecasting activity, development of the guidance documents to support operational forecasting, introduction of climate change component to RCC products (in terms of observed trends and attribution of extreme events). Associated with the RCOF activity, the Team also pointed out that establishing a coordination mechanism between RCOFs and the research (WGSIP) is important for sustained engagement of the research community. The Team requested the Secretariat to facilitate forwarding future RCOF announcements to the Team co-chairs to enhance involvement of GPCs-LRF. The IPET requested the LC-LRFMME to consider the possibility of adding functionality to the website to create regional consistency maps, and further, to enable users to download data behind the displayed maps to produce, on their own, maps of their choice. Some technical discussions on optimization of multi-model ensemble, hindcast periods to compute climatology and data horizontal resolution took place.

The Team noted that the overall conclusion of the RCOF Review was to bring a quantum change in the way the forecasts are currently prepared at the RCOFs (i.e., move towards objective methods). It was noted that GPCs-LRF were responding favorably to invitation from RCOFs and some of them were attending RCOF sessions, which was seen as an excellent outcome. The Team also noted that there is an interest to add climate change information in RCOFs. The Team was informed that a guidance document is in development to facilitate good practices in RCOF operations, taking into account the outcomes of the RCOF Review workshop.

**Action:**

* **In collaboration with CCl/CBS Inter-Programme Expert Team on Regional Climate Activities (IPET-RCA), develop a mechanism whereby research needs from RCCs and RCOFs on prediction aspects can be communicated to WCRP/WGSIP (IPET-OPSLS Co-Chairs).**

 **3.7 Relevant items for EC-70**

CBS items for EC-70 were discussed at the agenda item 3.3. Mr Kolli also briefed the meeting on CCL-17 recommendations relevant to IPET-OPSLS going to EC-70. The recommendations from CCl-17 include the request to CBS to support:

1. the development of the CSIS Technical Reference Manual;
2. identification of activities relevant to CSIS functions yet to be defined in the Manual on GDPFS to provide authentic and well-coordinated sources of global information to Members;
3. further development and operational coordination of the GSCU through the IPET-OPSLS, and integration of GSCU production and dissemination into the LC-LRFMME operational schedule;
4. capacity development for CSIS implementation, including outreach.

 **3.8 Outcomes of OCP-2 and follow-up actions for IPET-OPSLS**

The Second WMO Workshop on Operational Climate Prediction (OCP-2) was held on 30 May - 2 June 2018 in Barcelona. Mr Coelho reported that the OCP-2 discussed different aspects of operational predictions, research-operations linkages, current challenges and limitations of climate prediction at time scales ranging from sub-seasonal to decadal time-ranges. Three groups were formed for a breakout session, to focus on subseasonal, seasonal and decadal predictions aspects and to discuss gaps and recommendations. A summary report of the three groups discussions was shared with the Team so that each sub-group could take comments and recommendations into account in planning of its future activities. It was decided that the summary report, after consideration by the team members, will be discussed under agenda item 9 (AOB).

**4. STATUS REPORTS**

**4.1 Technical specifications of GPCs-LRF (Washington, Seoul, Tokyo, Exeter, Pretoria, CPTEC Brazil, Melbourne, Moscow, ECMWF, Beijing, Toulouse, Montreal, Offenbach)**

Mr Caio Coelho (the co-chair) presented a review of the seasonal forecast configurations used by the 13 GPCs-LRF. Currently there are 11 GPCs-LRF using coupled systems and 2 GPCs-LRF using the two-tier approach. Since the last meeting in April 2016 (Beijing), ECMWF upgraded their system with higher horizontal resolution in both the atmospheric (~36 Km) and oceanic component (0.25 degree). The new system includes updated versions of the atmospheric and interactive ocean models and an interactive sea ice model LIM2. Forecasts show substantial improvements in the tropics, in particular for sea-surface temperature in the equatorial Pacific.

Although the ECMWF hindcast period for the new system is 36 years (1981-2016), the products are calibrated using the most recent 24 years period (1993-2016). This is to ensure that the anomalies remain relevant in the context of climate change. Characteristics of temperatures and other atmospheric variables have changed sufficiently over the last 36 years for seasonal mean values to be almost always warm compared to the early years of the hindcast period. The result is that all too often the temperature forecasts are warm everywhere, relative to an increasingly distant past. This may be a correct probabilistic statement about next season’s expected weather relative to a distant climatological period, but it is of limited use to a typical user who wants to know what to expect relative to a more recent past. The length of the most recent reference period (24 years) is still sufficient to avoid sampling issues. Constructing seasonal forecast products in a period with strong trend is a challenge, and although the warming climate is an important affect that should not be discarded in the development of seasonal outlooks, although some users are more interested on the prediction of the year-to-year variability. The meeting agreed that the climate community and RCCs could provide useful feedbacks on this issue.

Although a number of GPCs have extended their hindcast period, the common hindcast period, available from the LC-LRFMME remains limited to 1993-2009 as it was in 2016. Only GPC–Exeter produces the hindcast on the fly and this is made available at the same time as the real-time forecasts. GPC-Montreal GPC-Melbourne and GPC-Offenbach are working towards a system update within the next two years. GPC-Melbourne and GPC-Offenbach are working on improving the land surface representation.

The updated technical specification of the GPCs is available at the following website: <http://www.wmo.int/pages/prog/www/DPFS/Meetings/ET-OPSLS_Barcelona2018/DocPlan.html>

and the historical evolution of seasonal forecast systems at different GPCs is included in Annex 3.

**4.2 IPET-OPSLS achievements since April 2016 meeting in Beijing; Action items from the last meeting**

Mr. Kumar took the responsibility of chairing the IPET-OPSLS in November 2016. The Chair expressed his sincere thanks to Mr Richard Graham, the former chair of the IPET-OPSLS, for his leadership during the previous eight years. Mr Kumar, together with the rest of the team, expressed immense gratitude to Mr Graham for all his effort in advancing WMO LRF infrastructure during his years as ET-OPSLS chair. He then presented a review of the achievement and pending actions following the Beijing meeting in 2016. Since April 2016, a long list of achievements and contributions was noted. The list included:

* the designation of GPC-Offenbach;
* the approval of the designation criteria for Global Producing Centers for Annual to Decadal Climate Prediction (GPC-ADCP), and its inclusion in the GDPFS Manual;
* the approval of designation criteria for Lead Center for Annual to Decadal Climate Prediction (LC-ADCP), and its inclusion in the GDPFS Manual;
* the approval of UKMO as the LC-ADCP;
* organizing WMO workshops on Operational Climate Prediction (OCP-1) and (OCP-2);
* development of a research requirements document from operations perspective;
* a draft outline for guidelines on procedures for generating regional seasonal forecasts.

The meeting noted that the LC-LRFMME is providing an excellent climate service to the WMO users. Since April 2016 the LC-LRFMME has:

* updated the GPC-LRF seasonal forecast systems from GPC-ECMWF, GPC-Seoul, GPC-Offenbach;
* included seasonal forecasts from GPC-Offenbach;
* provided graphics on NH polar projection (to support ArcRCC);
* taken on responsibilities for verifications (that formally were the responsibility of LC-SVSLRF)
* developed the pilot phase for sub-seasonal forecasts;
* provided continued support for GSCU;
* opened the access of the graphical products at the LC-LRFMME website.

It was noted that following the decision to open the access to the LC-LFRMME products, significant increase of number of users has not been yet noted. To increase the visibility of LC-LRFMME products, WMO Secretariat proposed to make the link to the LC-LRFMME more prominent on its web-site. In order to enhance the use of LC’s products a facility that informs the users when the new forecast products are available, the use of social media was suggested. For example, the use of WMO twitter was proposed.

In order to encourage the GPCs to check the integrity of their individual products published at the LC-LRFMME website, the Chair suggested that the LC-LRFMME create a script that can produce a PowerPoint with the appropriate set of plots to each GPC every month the forecasts are updated.

During the meeting the Team also discussed the implementation of the sub-seasonal forecast products, including the establishment of sub-seasonal GPCs and possibly an associated lead center. A pilot phase of sub-seasonal forecasts has already been established at LC-LRFMME and would facilitate the future operational phase of sub-seasonal forecasts.

Currently the sub-seasonal products are only accessible to the GPCs. CCl representative and RCC can request the access to such products, however, since the development of the pilot phase depends on a special agreement with Subseasonal to Seasonal (S2S) Project, and relies on the S2S project archive and its policies, participants of forecast producers in the S2S Project need be consulted regarding any change to the access of the sub-seasonal products at LC-LRFMME. The Team also discussed the optimal mechanisms for WGSIP and S2S project communities to provide feedback on LC-LRFMME products, and access GPC data to advance research efforts.

Among other actions discussed was the development of a revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to GSCU.

IPET-OPSLS will continue to review applications for new GPC candidates for WMO designation and monitor the updates in the LC-LRFMME products by incorporating newly designated GPCs in the multi-model forecast product. To support emerging requirements of Polar RCCs, IPET-OPSLS discussed revisiting the mandatory and highly recommended data requirements for GPCs to develop a capability to provide forecast information relevant to Polar Regions, and revise GPDFS as necessary.

The Chair noted that for the long-range forecast infrastructure, and coordination among operational centers is still far behind the practices in weather prediction. Towards continued improvements in development and evolution of long-range forecast infrastructure, the IPET-OPSLS team needs to be more active between face-to-face meetings in advancing the action items of IPET-OPSLS and its Sub-Teams. The use of teleconference could help the team to work more efficiently. The following actions were identified:

**Actions:**

* **WMO Secretariat make the link to the LC-LRFMME surface temperature and precipitation forecast products on its web-site to increase the LC visibility and also promote uptake of its products. To facilitate this, LC-LRFMME will make the necessary changes to establish a permanent link to the latest forecasts.**
* **LC-LRFMME to create a script to generate a PowerPoint and send the appropriate set of plots to each GPC every month the seasonal forecast is updated to ensure GPC check the integrity of the data they send to the LC-LRFMME and how it is represented.**
* **WMO Secretariat to use their social media handles to regularly issue alerts whenever LC-LRFMME forecast is updated.**
* **The Team should elaborate optimal mechanisms for WGSIP and S2S project communities to provide feedback on LC-LRFMME products, and access GPC Data to advance research efforts.**

**4.3 Status of LC-LRFMME**

Mr Kuh Hee Chodescribed the data configuration supplied by 13 GPCs-LRF. All GPCs-LRF provided hindcast and ensemble forecast to the LC-LRFMME. Current status of GPCs-LRF, along with the evolution of seasonal forecast systems, is provided in Annex 3. A question was raised about the availability of hindcast data from the Copernicus Climate Change Service (C3S). Ms Ferranti confirmed that via the C3S data portal, the hindcast data (for a limited number of GPCs-LRF including ECMWF) is freely available.

Mr Cho also addressed the LC-LRFMME efforts on sub-seasonal time scale whereby he reminded the Team members about how the data exchange between the S2S data portal and the LC-LRFMME is taking place. Some discussion took place on the requirement of having these sub-seasonal forecasts under password or not. It was agreed that because of some GPCs-LRF data policy, and following the S2S Project protocols, the LC-LRFMME subseasonal products should stay password protected for the moment. It was noted that currently only the GPCs-LRF were allowed to access the sub-seasonal section of the LC-LRFMME web site.

Mr Cho also described the result of the survey the LC-LRFMME conducted in 2017 in order to improve the service. 53 Countries responded to the survey sent out to 362 registered users in 82 countries. It appears that more than a single person use the same password access (within NMHSs), implying that the total number of members accessing the data is likely to be much higher. It was noted that the majority of users (56%) prefer NetCDF over GRIB format for their gridded data download. Also, probabilistic forecasts are preferred over deterministic forecasts. Of the six forecast variables available, precipitation is the most in demand, followed by 2m temperature. When asked which aspects of the services should be improved, the importance of spatial resolution over time resolution came first. The desire for the availability of 850-hPa wind data was also expressed: 32 out of 53 respondents indicated that 850 hPa wind data are needed.

The IPET-OPSLS recalled that exchange of 850-hPa wind was recommended at the last meeting but was not successfully implemented because it was not a mandatory requirement. The Team decided to take on an action to make it a mandatory requirement which will need an amendment of the Manual on GDPFS.

Mr. Cho concluded his presentation by underlining the resources that the LC requires for processing the data, maintaining the web site, etc. He mentioned that KMA has limited resources for meeting the requirements of the LC responsibilities. He thanked APCC for their support to the LC operations. The Team recognized the essential role of LC and the resources deployed by KMA and APCC and thanked them for their efforts.

**Actions:**

* **Make a proposal to include 850-hPa wind as part of the mandatory products to be provided by GPCs-LRF (will need an amendment of the Manual on GDPFS).**
* **Propose amendments to Appendix 2.2.1.5 of the Manual on GDPFS to include additional variables and add providing data in real time to the LC-LRFMME a mandatory requirement for the designation of GPCs-LRF.**

**4.4 Status of LC-SVSLRF**

Mr Jones provided updated information on the status of the Lead Centre for the Standardized Verification System for Long-Range Forecasts (LC-SVSLRF). The Lead Centre has been running for more than 12 years but now has a very low level of use by WMO members. It would appear that no GPC has updated forecast verification results since the ET meeting held in April 2014, meaning that the LC-SVSLRF has functionally ceased to be used.

The ET-OPSLS in the 2014 Exeter meeting agreed to adopt a centralized approach to verification, with the LC-LRFMME taking on the responsibilities of the SVSLRF diagnostics (using submitted hindcasts). It was concluded that this approach has the advantage that verification can readily be accomplished using the same code, verification dataset and reference baseline. It also allows harmonization with the verification activities undertaken for the GSCU.

As part of the development of GSCU for which the forecast component is provided by the LC-LRFMME, a centralized verification has been implemented at LC-LRFMME. This facilitates provision of historical skill along with the real-time forecasts as part for the GSCU. This is done both for forecast from individual models and the forecast based on the multi-model ensembles.

The Team supported the decommissioning of the LC-SVSLRF website, with verification in future to sit alongside GPC forecasts hosted by the LC-LRFMME. It was also decided that the Sub-Team 2 to undertake a review of GPC verification activities with a view to ensuring that user needs are met while allowing a realistic work load on GPCs (ultimately leading to a better compliance).

**Decision:**

* **For the SVSLRF functionality to move to the LC-LRFMME and the LC-SVSLRF to be decommissioned. However, for the time being, keep the web-site of SVSLRF active, and aim for disbanding it by Cg-18.**

**Actions:**

* **Finalize the phasing out of LC-SVSLRF.**
* **Review the documentation of SVSLRF, retain pertinent information, including codes and port to the LC-LRFMME website.**
* **Explore, through IPET-RCA, whether an RCC can take the lead on requirements for regional verification needs and liaise (provide expertise to) with other RCCs. For the sake of consistency, LC-LRFMME can provide the verification codes..**
* **Explore whether the verification computer codes could be included in the Climate Services Toolkit (CST).**

**4.5 Status of GPC-ADCP & LC-ADCP**

Mr. Jeff Knight briefed on the status of the LC-ADCP. He reported that work is underway for the establishment of the LC-ADCP website and requested comments and suggestions as to how make the website further useful to the users. Initial comments/suggestions included that the maps over regions would be useful in addition of the current global maps. It was also noted that the role of LC-ADCP and GPCs-ADCP will extend beyond CMIP6 that will provide the real-time data only until 2019, i.e., until the end of the CMIP6 project, and further, GPC-ADCPs may have no objections for freely distribution their data.

Mr Knight reported that all four centres which submitted their applications for designation as GPCs-ADCP (Offenbach, Germany; Exeter, UK; Montreal, Canada; Bacelona, Spain) have met the designation criteria as per the Manual on GDPFS (WMO-No-485) and will be considered for designation at EC-70.

**Actions:**

* **Link ADCP products with CCl and WCRP and establish a mechanism for collaboration with WCRP and IPET-RCA in relation to ADCP activities.**
* **Review compliance of GPC-ADCP and LC-ADCP.**
* **Review list of exchange of mandatory variables. If forecasts of new variables are to be added, verifications should also be done.**
* **Review the designation criteria for GPC-ADCP and LC-ADCP, and recommend changes in the GDPFS manual, as necessary.**

**4.6 Status of GSCU**

Mr Kolli briefed on the GSCU initiative. It was initiated in 2010 to address the need for authentic real-time assessment of the global-scale aspects of seasonal climate with the trial phase initiated in 2015. There is an increased interest of humanitarian agencies for this information. The GSCU provides the community with an expert assessment and global consensus on the status of the climate for the current and the upcoming season along with information on robustness and uncertainty of the predictable signals, thereby contributing to an effective application of science-based climate information in climate risk management. The team was informed that the prototype of GSCU was submitted for expert review to IPET-OPSLS, WGSIP, ET-RCCs, TT-RCOFs and TT-NCMP.

He reported on recent development, in particular the CCl-17 inviting CBS to consider further development and operational coordination of the GSCU to be taken up under the responsibility of IPET-OPSLS. The Team noted that the CCl Task Team on GSCU is no longer a part of the CCl-17 working structure, and that this brings an additional responsibility to its work. Elements for consideration in moving forward included:

* The provision of guidance on addressing some challenges that were pointed out through the trial phase;
* Guide further development and operational implementation of GSCU;
* Support the development of the user guide of the GSCU;
* The establishment of a sub-task team on GSCU Operationalization.

The Team reviewed the currently applicable GSCU schedule worked out by the while CCl TT-GSCU (Annex 4) and its practical implications for operationalization. The team noted the recommendation of CCl-17 inviting the LC-LRFMME to take the responsibility for operational production of GSCU. However, the Team recognized that the LC-LRFMME would need assistance to cover all the required elements of GSCU, a key part of which is monitoring information. The Team further noted that, at present, the prediction part is summarized by the International Research Institute for Climate and Society (IRI) based on the graphical products generated by LC-LRFMME, and that the monitoring part is contributed by National Centers for Environmental Information (NCEI).

**Actions:**

* **Establish (or assign to) an ST to assess the considerations related to operational GSCU and to propose options to address them for implementation. Include members from CCl.**
* **WMO Secretariat to include IPET-OPSLS members in the distribution list of GSCU.**

**4.7 Guidance documents for the implementation of CSIS**

Mr Kolli informed the team that CSIS implementation is led by a CCl Implementation Coordination Team CSIS (ICT-CSIS) which has been working on the development of a technical reference document on the functions and dissemination of the products. He requested the IPET OPSLS review the prediction part of the technical reference on CSIS. A draft version of the technical reference is available on the WMO website ( <http://www.wmo.int/pages/prog/wcp/ccl/documents/CSIS_TechRefDoc_DRAFT_06_26Mar18.pdf> ) *.* The Technical reference document is, however, still in early stages of development and will need to be reviewed and revised. In due course, it will also need to be integrated and aligned with the Manual on GDPFS. The following actions were agreed on following discussions:

**Actions:**

* **The Team to review the prediction section of the technical reference on CSIS, with particular attention to the alignment with the Manual on GDPFS (** [**http://www.wmo.int/pages/prog/wcp/ccl/documents/CSIS\_TechRefDoc\_DRAFT\_06\_26Mar18.pdf**](http://www.wmo.int/pages/prog/wcp/ccl/documents/CSIS_TechRefDoc_DRAFT_06_26Mar18.pdf) **).**

**5. REPORTS FROM RELEVANT TASK TEAMS**

**5.1 ST1 - Workshops on Operational Climate Prediction (Chair – Caio Coelho)**

Mr Caio Coelho reported that the OCP workshop was the result of a workshop in Brasilia (Brazil) in 2013. The first OCP workshop took place in Pune (India) in Nov 2015. A number of people from the IPET-OPSLT, WMO and BSC supported the ST1 for the organization of the OCP-2 workshop which was held successfully in Barcelona 30 May to 1 June 2018. It was noted that some of the ST1 members have moved on and that an updated member list for ST1 needs to be established for OCP-3. It was also noted that a survey at the end of the workshop would be useful to gather participant’s perspectives on the usefulness, format and adequacy of the workshop. The following actions were agreed on:

**Actions:**

* **Continue with ST1 for developing the OCP-3 and entrain CCl members within the IPET-OPSLS. Also approach Richard Graham (UK) and Raizan Rahmat (Singapore) for membership on ST1.**
* **Send a feedback survey template to the participants of OCP-2.**

**5.2 ST2 - Develop revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to GSCU (Chair - Arun Kumar)**

On further discussions after the IPET-OPSLS meeting in Beijing in 2016, ST2 recommended termination of the LC-SVSLRF website transferring the information and the necessary functions to the LC-LFRMME and remove its reference from the Manual on GDPFS. The team also discussed the need to revisit the recommended verification metrics in the current SVSLRF document and revise it to be more in line with what is currently being done. These activities need to be completed in order to take the recommendation for the LC-SVSLRF to Cg-18 (through ICT-DPFS and CBS-MG). The team membership needs to be updated with the removal of Suhee Park and Anca Brookshaw as the members. New replacement will be identified.

**Decision: ST2 needs to stay active to finalize the task of preparing recommendations for the removal of the LC-SVSLRF and associated action items.**

**Actions:**

* **ST2 to identify replacement of Suhee Park and Anca Brookshaw on ST2.**
* **Follow up on the steps to terminate LC-SVSLRF.**
* **Recommend changes that need to be updated in the GDPFS Manual.**

**5.3 ST3 - On scoping/implementation of sub-seasonal forecasts Chair (Suhee Park)**

IPET-OPSLS recognized the significant progress made by ST3 on the pilot for the subseasonal forecast exchange, drawing on the infrastructure put in place as part of the S2S project. Forecasts are currently available at <https://www.wmolc.org/> for GPCs to review etc., and as per agreed on requirements put forth by the S2S project, are password protected. A demonstration of the website was provided to IPET-OPSLS by the ST3.

It was agreed that the IPET-OPSLS should take on the responsibility for developing criteria for the designation of GPC for Subseasonal Forecasts (GPC-SSF). These criteria could be recommended to the WMO Congress in 2019 for approval. Currently 10 GPCs-LRF are contributing to S2S project and may be candidates for future designation. Rather than expanding the mandatory requirements of GPCs-LRF, the preference of IPET-OPSLS members was for the creation of a new class of RSMC centre (GPC-SSF), but the ST3 will explore options further. It was also noted that consultation with CBS-MG and CCL-MG would also be necessary.

**Decisions:**

* **ST3 will continue with replacement of Richard Graham by Jeff Knight and Suhee Park by Kuh Hee Cho, and additional members of Arun Kumar, Abdoulaye Harou and Vladimir Kryjov.**
* **Keep the designation of GPC LRF separate from the designation of GPC Sub-seasonal.**
* **Mr Yuhee Takaya kindly agreed to take on the responsibility to Chair ST3.**

**Actions:**

* **Develop designation criteria for GPC and LC for SSF; Aim for submitting the recommendations to Cg-18.**
* **Consider alternate proposals if SSF could be part of existing LRF designation (although the majority of IPET-OPSLS leaned towards a separate designation);**
* **Clarify model climatology procedure currently used by LC-LRFMME for computing anomalies.**
* **Recommend** **verifications for sub-seasonal forecasts.**

**5.4 ST4 - Scoping/implementation of longer than seasonal forecasts (Chair – Richard Graham)**

The sub-team has overseen very good progress towards its goal of establishing an operational WMO framework for prediction on annual to decadal timescales, to mirror the existing structures for long-term prediction on seasonal timescales.

An amendment to the GDPFS Manual was tabled and agreed at EC-69 (May 2017) to include recognition of a Lead Centre for Annual to Decadal Climate Predictions (LC-ADCP) and Global Producing Centres for Near Term Climate Prediction (GPC-ADCP). A resolution agreed to the Met Office (the UK NMHS) to be a LC-ADCP.

The LC-ADCP is responsible for assessing whether candidate centres demonstrate the capability to meet the requirements of a GPC-ADCP as specified in the manual. Full applications for GPC-ADPC designation have been received from Barcelona, Canada, Offenbach and Exeter. Having considered these applications, LC-ADCP recommended each of these for endorsement by IPET-OPSLS, as previous non-compliances have been remedied. The IPET-OPSLS agreed with the endorsement for the four centres as GPC-ADCP.

**Decision:**

* **Following completions of its tasks, IPET-OPSLS agreed to disband the ST4.**

**5.5 ST5 - New approaches for distribution of GPC hindcast and forecast data (Chair – David Jones)**

ST5 sent out a request to the GPC representatives in the IPET-OPSLS to get an update on the data dissemination practices at their respective operational centers. The purpose of the survey was to sample data dissemination practice that are followed, and from the input received, develop recommendations for the distribution of the LC-LRFME data.

ST5 also noted that as the future scope of the LC-LRFMME moves towards developing products on sub-seasonal time-scales, latency of the data transfer becomes more important (because of a faster decay in skill with lead-time). ST5 also noted that due to the evolving expertise of C3S in delivering data, participation of a representative from C3S on ST5 will be relevant.

Discussion also noted that downloading the hindcast data from LC-LRFMME by RCCs and RCOFs is not an issue. The underutilization of LC-LRFMME data is likely more due to issues with the data format (i.e., Grib2) and efforts should be made to provide the software to convert Grib2 data to different format. Jeff Knight from GPC-Exeter noted that UKMO has developed public domain software – IRIS – that is written in Python and is purposed to accomplish data format conversion tasks. It was also noted that the underutilization of the LC-LRFMME data and products may be due to a lack of appropriate guidance on development of seasonal forecasts, and the proposed guidance document for seasonal climate outlooks will help rectify this issue.

It was recommended that ST5 continue and its membership be amended to include representative from C3S, and also include Jeff Knight from GPC-Exeter. The proposed actions of ST5 will also be updated.

**Decision:**

* **Jeff Knight to join the ST5. Anca Brookshaw (C3S) proposed as an additional member (awaiting consultation or was this conformed).**

**Action:**

* **Include a representative from C3S in ST5.**

**5.6 ST6 - Guidelines on Procedures for generating regional seasonal forecasts (Chair – Arun Kumar)**

It was noted that the proposed guidance document was discussed at the OCP-2 workshop. It was recommended that a survey be sent to all participants and get feedback and to assess their interest in contributing to the guidance document. It was discussed that a draft version of the guidance document be completed by the end of 2018. A decision was made to keep ST6 until the guidance document is completed. IPET-OPSLS members were requested to look at the list of content and see if they can offer to write part of the text. The key target audience for the guidance document will be NMHSs in developing countries. A target of middle of July 2018 was set to develop a timeline and complete the guidelines with the goal to have the draft of the document by the end of 2018. The team reviewed the outlines and arrived at the following decision and actions:

**Decision:**

* **Keep the ST6 but with a revised title: “Guidance on Operational Practices for Seasonal Climate Forecasting.”**

**Actions:**

* **Building on the consultations at OCP-2, establish a writing team consisting of members from both operational and research communities.**
* **Prepare a time-limited work plan for the development of the guidance document by the middle of July, 2018.**
* **Complete the full draft by the end of December 2018.**
* **Review the examples of the guidance documents on Verification and Nowcasting.**
* **Organize a peer review of the draft Guidance document, revise and finalize the draft for endorsement by CBS, CCl and Cg-18.**

**5.7 ST7 - Amendments to the GPC-relevant sections of the Manual on the GDPFS (Chair – Richard Graham)**

It was noted that revised GDPFS Manual has been completed and has been approved by the relevant WMO constituent bodies. ST7 made important contributions to OPSLS specific items in the revised GDPFS Manual.

**Decision:**

* **Phase out ST7 as the Manual on GDPFS (WMO-No.485) is published.**

**6. IPET-OPSLS POTENTIAL FUTURE ACTIVITIES**

**6.1 Future support for GSCU**

IPET-OPSLS discussed future support for the operationalization of GCSU as a new responsibility for itself following the recommendation of CCl-17. It was clarified that this responsibility does not mean that IPET-OPSLS will be responsible for operational work but that IPET-OPSLS needs to guide the future development of the GSCU including recommendations on operational arrangements for its routine production and dissemination. The Team agreed that a new sub-team on GSCU should be formed to provide this guidance. It was suggested that Ernesto Rodriguez (or his possible replacement as a CCl representative on the IPET-OPSLS, following finalization of CCl-17 working structure currently under consideration by CCl MG), another person from CCl (to be determined) and Arun Kumar, Anahit Hovsepyan, Atsushi Goto (both from WMO Secretariat), JP Ceron or Akihiko Shimpo (Co-Chairs of CCl-17 Focus Area 2 on CSIS Operations) are proposed as members of the new ST.

**Decision:**

* **Create a new sub-team on GSCU.**

**6.2. Revisiting the exchange to meet requirements for emerging needs**

Discussion on this topic was about looking forward in changing the list of mandatory variables for GPCs-LRF to submit to LC-LRFMME and how to go about implementing this change. A change in the mandatory variables for GPCs-LRF means (a) GPCs-LRF may need to go back in time and resubmit the data for new variables, (b) necessary changes need to made to the GDPFS Manual.

**6.2.1 Support for ArcRCC**

Mr Bertrand Denis presented the ArcRCC-Network as a hybrid implementation of the RCC concept, with a combination of geographical as well as functional distribution of responsibilities among the constituent nodes. Canada has assumed the responsibility for LRF component of the ArcRCC-Network, Norway for Operational Data Services and Russia for Monitoring, with a pan-Arctic coverage. He presented consensus maps produced objectively using LC-LRFMME and the Forecasting Regional Arctic Sea Ice from Month to Season (FRAMPS) project.

After discussing the content of the ArcRCC-Network web portal (www.artic-rcc.org) and current needs, the IPET-OPSLS encouraged GPCs-LRF to generate and provide additional products of special interest for the Arctic region, such as forecasts of sea ice, ice freeze up/break dates, snow water equivalent, etc. The team decided on the following actions:

**Actions:**

* **Review the Manual and propose highly recommended functions related to sea ice to go into the Manual on GDPFS (Bertrand as the lead).**
* **Develop a proposal for the exchange of sea ice forecasts (as a mandatory or recommended variable); an alternative strategy could be to provide directly to Canada as the Lead Node for pan-Arctic LRF function within the ArcRCC-Network.**

**6.2.2 Support for RCOFs**

Mr Caio Coelho reviewed the conclusions of the WMO Workshop on Global Review of RCOFS held from 5 to 7 September 2017 in Guayaquil, Ecuador, with regard to the roles and operations of GPCs-LRF in support of RCOFs. He mentioned the following issues: (i) improve access to GPCs-LRF data, mainly through the LC LRFMME; (ii) enable RCCs and NMHSs staff in processing GPC-LRF data outputs via training and capacity building programs; (iii) expedite the technical guidance on operational seasonal predictions under development by the IPET-OPSLS; (iv) encourage GPCs-LRF to adopt some RCOFs in regions of their particular interest for sustained support; (v) encourage the extension of the current verification procedures for individual GPCs-LRF to the MME forecasts produced by the LC-LRFMME, and development of verification products for pre-defined RCOF regions.

After discussing the proposal from the Global Review of RCOFs, the IPET-OPSLS agreed on the following:

**Recommendations:**

* **LC-LRFMME to align the regional domains for forecast and verification.**
* **Encourage RCCs to work with GPCs-LRF to develop specialized products and verification (e.g., sea ice, monsoon onset date).**

**Actions:**

* **Invite GPCs-LRF to adopt some RCOFs for sustained support and mentoring. To facilitate this WMO Secretariat to initiate letters to PRs of Members with WMO hosting GPCs-LRF, to encourage them to twin their GPCs-LRF with selected RCOFs of their interest.**
* **GPCs-LRF to develop a catalogue of data and products available on their website and post it as a downloadable document on the LC-LRFMME website for easy accessibility and future reference.**
* **GPCs-LRF to inform the Secretariat of training activities in order to facilitate participation of RCCs and NMHSs.**

**6.3 Data access and exchange policy**

GPCs-LRF provide hindcast and real-time forecast data to the LC-LRFMME. The access to the data is password protected, and generally, on request, access can be provided to GPCs-LRF, NMHSs, RCCs etc.

In the operational context of RCCs and RCOFs, access to digital data can be useful at regional level, for example, (a) for developing statistical downscaling/calibration techniques with methods available as part of the Climate Prediction Tool (CPT); (b) understanding sources of predictability at regional level; (c) optimizing seasonal forecasts at regional level, for example, as part of RCC and RCOF activities; (d) use of hindcast data in support of training courses; (e) tailoring graphical products to suit regional needs (e.g., requirements for polar projection for products associated with ArcRCC-Network) etc.

A similar password protected access also existed for graphical products at the LC-LRFMME website until recently. Only in March 2018, following the concurrence from all GPCs-LRF, the password restriction was removed. To enhance wider utilization of GPCLRF and LC-LRFMME products and infrastructure, unrestricted access is desired, as other players like C3S and APCC make their data freely available, and could potentially marginalize WMO infrastructure for LRF, primarily on easy-access basis.

IPET-OPSLS recognized that it also needs to consider an eventual open access to the hindcast and forecast data residing on the LC-LRFMME, noting that C3S already has plans to open data of some GPCs-LRF. In that case a proposal was made to make open access to GPCs-LRF data except for those GPCs-LRF that have policy restriction (i.e., continue password access for data from specific GPCs-LRF). Another option is to create a database of MME data and make them available freely. The following actions were agreed on:

**Actions:**

* **Open the hindcast data for 9 GPCs-LRF (that currently allow open access), password protect data 4 GPCs-LRF (that currently do not allow free access). No open access to MME at this time because all members need an agreement for it, while such work on obtaining agreement is under process.**
* **WMO Secretariat to write to PRs of Members with WMO hosting GPCs-LRF for their agreement to provide open access to the MME data.**
* **Confirm that 9 GPCs-LRF agree to open access to real time data with at least one month delay.**

**6.4 Changing the release of forecast time**

At present, the final seasonal forecast by the LC-LRFMME is released around 25th of the month, the forecast period covering the next three months. The release date is determined by (a) when GPCs-LRF submit forecasts to the LC-LRFMME, (b) time to process the data, and (c) possible restrictions due to seasonal forecast release date by GPCs-LRF themselves (in their respective roles as NMHSs or other capacities). An earlier forecast release date will be beneficial for many of the users, e.g., RCCs.

In general, based on the statistics available at the LC-LRFMME website, it seems seasonal forecasts from all 13 GPCs-LRF, in general, become available around 20th of the month (Fig. 1).

LC-LRFMME also seems to be following the practice of updating the seasonal forecasts as the seasonal forecast data from GPCs-LRF come in. Following this, the forecast of next season keeps getting updated, for example, on 10th of the month the seasonal forecast displayed at the LC-LRFMME website may be based on forecast data from five GPCs while on 15th of the month the seasonal forecast maybe based on data from eight GPCs.

It is proposed that the IPET-OPSLS review the submission dates of seasonal forecasts from various GPCs-LRF and investigate the feasibility of (a) formally advancing the date for providing an interim version of the seasonal forecast. This “interim” version may be based on forecasts from a sub-set of GPCs-LRF, and (b) subsequently, this interim forecast will be replaced by the final seasonal forecast when the forecast data from all 13 GPCs-LRF become available.

IPET-OPSLS should also explore the possibility of advancing the submission date of seasonal forecasts from GPCs-LRF. Depending on the seasonal forecast schedule at different GPCs-LRF, this may not be feasible but will be a worthwhile attempt.

The following actions were agreed on:

**Actions:**

* **Explore the feasibility of 15th of the month as the cutoff date for data from GPCs-LRF to LC-LRFMME and 18th of the month as the release of MME products. Any centre sending in their data after the 15th of the month will only be included in the final MME Products release on 25th of the month.**
* **LC-LRFMME to maintain a record of the arrival time of GPC-LRF data to the LC and share it at least once a year with the IPET-OPSLS.**

**6.5 Hindcast data to support research (along the lines of CHFP)**

Following repeated requests from the research community to gain access to the LRF data from current operational systems to further research and lead improvements in long-range forecasts, this discussion focused on the availability of hindcast data from LC-LRFMME. Mr David Jones raised two issues related to the Climate-System Historical Forecast Project (CHFP) and shared a document providing the background on the CHFP. CHFP was initiated by the World Climate Research Programme’s (WCRP) Working Group on Subseasonal to Interdecadal Prediction (WGSIP) to facilitate the availability of hindcast data suite for research pertaining to seasonal prediction and predictability. The CHFP invites leading centers to contribute their hindcast suite on a voluntary basis to a common database hosted at Centro de Investigaciones del Mar y la Atmósfera (CIMA) in Argentina. The two issues raised for the Team consideration were:

(a) The duplication in data provision to the CHFP by LC-LRFMME and Copernicus, for example. A related question was could the LC-LRFMME be the vehicle for complementing the CHFP archive (e.g., for serving hindcasts from those GPCs-LRF that are not in the CHFP archive or for which model has been updated)?

(b) Not all GPC models are part of CHFP archive. Missing from the potential contributors are: Pretoria, CPTEC, Moscow, Seoul and Beijing, and cases where the hindcasts from the GPCs that have updated their forecast systems

The team concluded the discussion on this agenda item with the following actions:

**Actions:**

* **When LC-LRFMME data access policy has been revised and hindcast data from some GPCs is freely available, inform WGSIP of the opening of hindcast data;**
* **Provide the link to LC-LRFMME data in CHFP website.**
* **Work with C3S, UKMET and other GPC centres to come up with solution for the transfer of GRIB to NetCDF format and develop the implementation of the solution (GRiB to NetCDF and vice versa). These codes could be part of CST and/or could be provided at the LC-LRFMME.**

**6.6 Annual summary of seasonal forecasts**

Proposal to develop an annual assessment of how seasonal forecasts performed over past year was put forward. Such an annual assessment will facilitate documenting what was the skill levels over different regions, identifying possible issues with the forecasts submitted to the LC-LRFMME. It was felt that the annual assessment of seasonal forecasts will also complement efforts of Global Seasonal Climate Update (GSCU) and will enhance the visibility of coordinated efforts within WMO. Similar efforts are also part of Annual review of Global Climate (led by WMO) and Bulletin of American Meteorological Society (BAMS) on “Explaining Extreme Events from Climate Perspective.” The team was supportive to the proposal and agreed to the following action:

**Action:**

* **ST2 to develop the mechanism/concept for annual assessment of seasonal forecasts.**

**6.7 Designation of new class of RSMCs for additional global products**

The team was briefed that the Manual on GDPFS (WMO-No. 485) contains specification for various Regional Specialized Meteorological Centers (RSMCs). The RSMC specification in the GDPFS Manual includes designation criteria that RSMC shall perform (i.e., the mandatory functions). In the context of the IPET-OPSLS, the RSMCs of interest are GPC-LRF, LC-LRFMME, LC-SVSLRF, GPC-ADCP and LC-ADCP. Another RSMC of interest will be on the Sub-seasonal forecasts. The team was also informed that the idea to expand the role of GDPFS to include RSMC for

* Global Climate Reanalysis
* Global Climate monitoring

was been discussed during CBS and CCl TECO. Such RSMCs will provide support for climate monitoring activities at regional level that currently are part of mandatory function for RCCs. The team was also briefed that a recommendation for designation of new class of RSMCs for climate reanalysis and climate monitoring were discussed during CBS and CCl TECO and recommendations were put forward to respective MGs and to the EC-70. After a long discussion on the pros and cons of moving in the direction of designating new class of RSMCs and considering the expertise of team, it was agreed to recommend:

**Recommendation:**

* **CCL and CBS to reexamine how to implement the proposal for RSMC for Climate Reanalysis and Climate monitoring on the global scale, as it is not within the remit or expertise of this team. Mechanism could include establishing a limited time-horizon Task Team. Such a TT may include members from IPET-OPSLS, WCRP Data Advisory Council (WDAC) and expertise from CCl.**

**6.8 Future status of SVSLRF**

See agenda item 4.4

**6.9 Guidance document for operational forecasting**

The Chair recalled that currently, the LC-LRFMME provides seasonal forecast on global scale. These forecasts are provided as guidance for use by NMHSs, RCCs, RCOFs etc. for developing seasonal forecast information at the regional level. Similarly, GPC-LRFs also generate global scale seasonal forecast guidance based on dynamical models. The Chair also noted that at the regional level, NMHSs, RCCs, RCOFs follow a variety of practices to provide seasonal forecast information to the stakeholders. For example, development of seasonal forecasts practices range from model based objective methods to largely subjective methods for generating seasonal forecasts. To promote the use of best practices in seasonal forecasting, a need for guidance document for operational practices for seasonal climate forecasting has been recognized. The Chair presented outlines of a guidance document for comments and the Team agreed to the following action:

**Action:**

* **This guidance is under ST6, the Chair needs to establish a drafting team to develop the draft guidance by end of year.**

Outlines of the guidance document is available at Annex 5.

**6.10** **Landscape of LRF activities**

Ms Laura Ferranti briefed on various Multi model seasonal forecast operational systems that also exist. The APCC multi-model system includes eight models from GPCs-LRF; currently the C3S multi-model collection consists of those from three GPC-LRF, although this number is likely to increase in the near future. The North American Multi-Model Ensemble (NMME) includes two GPC-LRF models while the WMO LC LC-LRFMME system is made up of 13 GPC-LRF models. The NMME issues the forecast on the 8th, C3S on the 10th and APCC on the 20th of each month. The multi-model digital data and the data from individual models are freely available from C3S, NMME and APCC with different space and time resolutions. Further, the user can choose the data format in GRIB or netCDF. NMME in addition offers CPT and GrADS format. The team concluded that it is important that the LC-LRFMME makes available the digital data to enhance the level of its service to RCCs and NMHSs. It is also important that the collaboration between GPCs-LRF and the Lead Centre to be strengthened. The communities need to work more closely together. Annual evaluation on the performance would be useful and could be facilitated through a sustained collaboration.

**6.11 The production of standards, verification methods and guidance for Annual to Decadal Climate Predictions (ADCP)**

Mr Francisco Doblas-Reyes presented the working document on “Standards for Production and Verification of Annual to Decadal Climate Prediction” produced as a contribution to one of the so-called Grand Challenges identified by the WCRP. The document collects the views of the research community aiming at organizing an ordered transfer of knowledge from research to operations for these time scales. The draft document is available at the following website:

https://docs.google.com/document/d/1tjZxtn0bzwzQ4QtGquL-PPIYUtR-w\_1Wp\_Miy3OijBc/edit#

After discussing the document, the IPET-OPSLS agreed on the following actions:

**Actions:**

* **In future, revise the corresponding parts of the GDPFS Manual (related to the LC-ADCP) to ensure consistency with the research community.**
* **Evaluate this standards document to seek consistency with the “Guidance on Operational Practices for Seasonal Climate Forecasting” document under development by IPET-OPSLS.**
* **Once the document on Standard for production and verification of Annual to Decadal Climate Predictions is completed, ensure that it is made available on LC-ADCP website**.

**6.12 Development of compliance** **document under the GDPFS**

Mr Harou briefed the Team that with the publication of the new Manual on GDPFS (WMO-N0. 485) comes the requirement for the regular audit of designated centres. OPAG DPFS has a Task Team led by the Chair of OPAG-DPFS (Yuki Honda, JMA) to develop the audit mechanism. It is expected that document will be ready for Cg-18 consideration.

**7. OTHER RELEVANT ITEMS**

**7.1** **Discussion on membership with increasing designation of GPCs**

The team discussed the issue of the number of its memberships, in particular with the increased number of GPCs that will fall under its purview. For examples four new GPCs-ADCP will most likely be designated at EC-70. The question is whether or not the number of members should be increased, in consideration of the additional cost this would generate for the Team meetings. The Team concluded that it may not be necessary to increase the number of members as some (or most) of the current GPCs-LRF will also be GPCs-ADCP, and therefore, at this point the membership is not a critical issue.

**7.2 Observational needs**

Mr Yuhei Takaya presented a document on the “statement of guidance for sub-seasonal to longer time scale predictions” which outlines observational data requirements for the sub-seasonal to longer predictions and provides a gap analysis between the requirements and current status of the observations. He noted that the observational requirements and the gap analysis of sub-seasonal to longer forecasts are based on a consensus of the coupled ocean–atmosphere modelling community. The gap analysis between user requirements and current observing system capability is provided in the document. The focus is on elements, which are particularly important for initialization, validation and calibration of the sub-seasonal to longer time scale predictions, and for the development of related systems.

The Team concluded after some discussion that the following actions need to be taken:

**Actions:**

* **Consult GPC experts in data assimilation for the spatial and temporal requirements. [**Arun - Not sure how we are going to achieve this and should this be kept as an action item.]
* **Team members to review the document provided by Yuhei and provide comments by 29 June 2018.**
* **The list of Ocean data requirements must be updated (current list was developed in 2009).**

The Team concluded that it is hard to come up with spatial and temporal requirements and that consultation with other experts such as WDAC will may be necessary.

**7.3 O2R document and collaboration with WGSIP including contribution to the Boulder Conference**

The Chair reported that In September 2017, in attempts to enhance collaboration between operations and research, a list of potential research requirements was submitted from the Chair and Co-Chair of the IPET-OPSLS to the Co-Chairs of the Working Group on Subseasonal to Interdecadal Prediction (WGSIP). The document was discussed in the WGSIP session during the “Pan-WCRP Modelling Groups” meeting in October 2017, Exeter, UK. Some members of Team have already provided comments/suggestions.

He suggested there is a need to explore pathways to develop collaborative partnerships for operational requirements to guide research and that few specific case studies can be selected to demonstrate the efficacy of the concepts. He added that IPET-OPSLS further consider the strategies to further interactions between operations and research, and if necessary, consider forming a task team to advance this concept in collaboration with the WGSIP. This concept was also presented by Bill Merryfield (Co-Chair, WGSIP) to the WCRP Joint Steering Committee (JSC) meeting in April 2018.

**Action:**

* **Act on the recommendation of the WGSIP to form a joint Task Group to enhance interaction between Operation and Research.**

The team also commented that the opening of hindcast data set will facilitate more interactions between Operation and Research.

**7.4 Position Paper on Operational Prediction**

The Team discussed producing a paper on operational climate prediction drawing on the outcomes of OCP-2. There are two options that may be considered; a short and sharp paper which might be published in a journal such as Nature Climate Change and will describe outstanding (operational) issues in extended-range predictions that community can focus on. The second option is for a longer position paper that will summarize the current status and practices for climate prediction across different time-scales and will identify gaps and research priorities to advance the operational extended-range prediction infrastructure. These papers are in addition to the Guidance Document for Operational Forecasting (see Agenda item 6.9) and the possible update of the Graham et al., 2011 which was shared with the Team and available at the following link: <https://www.int-res.com/abstracts/cr/v47/n1-2/p47-55/>.

**Action:**

* **Drafting team for various position papers and their respective timelines need to be established with initial members comprising of Arun Kumar, Francisco Doblas-Reyes and Caio Coelho.**

**8. REVIEW OF THE IPET-OPSLS TERMS OF REFERENCE INCLUDING SUB-TASK TEAMS**

IPET-OPSLS considered the terms of reference for the IPET-OPSLS. It was noted that the terms of reference of the team needs to reflect the expansion of scope of the Teams remit into the subseasonal and longer range. Suggested modifications were made and will be provided to the ICT-DPFS for their consideration and concurrence.

The sub-teams were revised to reflect discussions during the course of the meeting and are included in the IPET membership see Annex 6.

The list of Action items is available in Annex 7.

**Action:**

* **Obtain the concurrence of the ICT-DPFS on changes to Terms of Reference for IPET-OPSLS**

**9. ANY OTHER BUSINESS (AOB)**

Mr Denis demonstrated a website (<http://collaboration.cmc.ec.gc.ca/cmc/saison/indices/site_web>) for Ocean indices by the Canadian SIPS (CanSIPS- Canadian Seasonal to inter-annual Prediction System). The site provides calculated ocean indices. The link of the site can be shared with RCCs. Intention is to make it public once NAO index is included in the fall.

Mr Denis also showed the Canadian website on seasonal forecast.

Mr Kumar Kolli briefed on a draft white paper for collaboration between C3S and WMO describing a framework for the use of C3S products in CSIS operations.

Mr Kumar discussed the formal paper led by R. Graham (Long-range forecasting and global framework for climate services) and published in *Climate Research* 2011. Given the advances in extended-range predictions since 2011 (e.g., establishment of GPCs for ADCP, pilot for sub-seasonal predictions, GSCU etc.) it might be timely to provide an update on the paper. In general, the team concurred with the idea and will follow up via email discussions to develop a plan for action.

**Action:**

* **Engage in follow up discussion on providing an update on the paper by Graham et al. (2011).**

**10. CLOSING**

The Chair thanked the participants for their engagement in the meeting and closed it at 12:45, on June 6, 2018.

**Annex 1**

**PROVISIONAL AGENDA**

*(Submitted by the Secretariat)*

**1. OPENING**

**2. ORGANIZATION OF THE MEETING**

2.1 Adoption of the agenda

2.2 Working arrangements

**3. INTRODUCTION**

3.1 IPET-OPSLS – structure within CBS & CCl; scope; TTs (for the benefit of new members)

3.2 WMO infrastructure for operational prediction on sub-seasonal to long-time scales

3.3 Relevant decisions from CBS-TECO and CBS-MG

3.4 Relevant decisions from CCL-TECO and CCl-MG

3.5 New GDPFS Manual and Seamless GDPFS

3.6 IPET-OPSLS relevant items and recommendations from the RCOFs review

3.7 Relevant items for EC-70

3.8 Outcomes of OCP-2 and follow-up actions for IPET-OPSLS

**4. STATUS REPORTS**

* 1. Washington, Seoul, Tokyo, Exeter, Pretoria, CPTEC Brazil, Melbourne, Moscow, ECMWF, Beijing, Toulouse, Montreal, Offenbach
	2. IPET-OPSLS achievements since April 2015 meeting in Beijing; Action items from the last meeting
	3. Status of LC-LRFMME
	4. Status of LC-SVSLRF
	5. Status of GPC-LDCP & LC-ADCP
	6. Status of GSCU
	7. Guidance documents for the implementation of CSIS (verification; CSIS technical reference manual; …)

**5. REPORTS FROM RELEVANT TASK TEAMS**

5.1 ST1 - Workshops on Operational Climate Prediction (Chair – Caio Coelho); DONE (OCP-2 took place before the IPET-OPSLS)

5.2 ST2 - Develop revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to GSCU (Chair – Arun Kumar)

5.3 ST3 - On scoping/implementation of sub-seasonal forecasts (Chair – Suhee Park)

5.4 ST4 - Scoping/implementation of longer than seasonal forecasts (Chair – Richard Graham)

5.5 ST5 - New approaches for distribution of GPC hindcast and forecast data (Chair – David Jones)

5.6 ST6 - Guidelines on Procedures for generating regional seasonal (Chair – Arun Kumar)

5.7 ST7 - Amendments to the GPC-relevant sections of the Manual on the GDPFS (Chair – Richard Graham)

**6. IPET-OPSLS POTENTIAL FUTURE ACTIVITIES (these discussions could lead to new TTs); Discussion leads are identified next to the items**

 6.1 Future support for GSCU

 6.2 Revisiting the exchange of variables to meet requirements of :

 6.2.1 Support for ArcRCC

 6.2.2 Support for RCOFs

6.3 Data access and exchange policy

6.4 Changing the release of forecast time

* Preliminary version
* Final version

6.5 Hindcast data to support research (along the lines of CHFP)

6.6 Annual summary of seasonal forecasts

6.7 Designation of new class of RSMCs for additional global products (GPCs)

* Sub-seasonal forecasts
* Climate Reanalysis
* Climate monitoring

6.8 Future status of SVSLRF

6.9 Guidance document for operational forecasting

6.10 Landscape of LRF (C3S;…)

6.11 The production of standards, verification methods and guidance for near-term climate predictions (NTCP)

6.12 Development of compliance document under the GDPFS

**7. OTHER RELEVANT ITEMS**

7.1 Discussion on membership with increasing designation of GPCs

7.2 Observational needs

7.3 O2R document and collaboration with WGSIP including contribution to q Boulder Conference

7.4 Position Paper on Operational Prediction

**8. REVIEW OF THE ET-OPSLS TERMS OF REFERENCE INCLUDING SUB-TASK TEAMS**

**9. ANY OTHER BUSINESS (AOB)**

**10. CLOSING**

Annex 2

**Workshop on Operational Climate Prediction (OCP-2)**

**Barcelona, Spain, 30 May – 1 June 2018**

**Meeting of Expert Team on Operational Predictions from Sub-seasonal to Long Time-scales**

**(ET-OPSLS)**

**Barcelona, Spain, 2-6 June 2018**

|  |  |  |
| --- | --- | --- |
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**Annex 3**

**Information on the data configuration supplied by the 13GPCs**



**Record of the GPC system upgrades**

**GPC’s system specifications (updated 2018)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GPC name (last update)** | **Centre** | **System****Configuration****(ensemble size****of forecast)** | **Resolution****(atmosphere)** | **Hindcast****period used** |
| Beijing (2005, 2016)  | Beijing ClimateCentre  | Coupled (48) Coupled (24) | T63/L16T106/L26 | 1983-20041991-2013 |
| CPTEC (2009) | Centre forWeatherForecasts andClimate Studies | 2-tier (15)  | T62/L28  | 1979-20011979-2010 |
| ECMWF (2010,2017) | European Centrefor Medium rangeWeather Forecasts | Coupled (41)Coupled (51) | T159/L62T255/L91T319/L91 | 1981-20051981-20101981-2016 |
| Exeter (2010, 2012, 2015)  | Met OfficeHadley Centre  | Coupled (42)  | 1.85ºx1.25º/L38/L85 0.83ºx 0.56º/L85  | 1989-20021996-20091993-2015 |
| Melbourne(2010, 2015) | AustralianBureau ofMeteorology | Coupled (30)Coupled (99)Coupled (165)  | T47/L17  | 1980-20061961-20101981-2010 |
| Montreal (2011) | MeteorologicalService ofCanada | 2-tier (40)Coupled (20) | T32/T63/T95/2.0°x2.0°(4model combination)CanCM3+CanCM4T63/L31 and T63/L35 | 1969-20041981-2010 |
| Moscow (2007, 2010. 2012)  | Hydromet Centreof Russia  | 2-tier (10) 2-tier (20) | 1.1°x1.4°/L28  | 1979-20031981-2010  |
| Offenbach (2016) | Deutscher Wetterdienst | Coupled (30) | T63L47 | 1981-2015 |
| Pretoria (2007, 2014) | South AfricanWeather Service  | 2-tier (6)Coupled (40) | T42/L17 | 1983-20011982-2009 |
| Seoul (1999, 2010, 2012,2014, 2016) | KoreanMeteorologicalAdministration | 2-tier (20) Coupled (42) | T106/L210.83ºx 0.56º/L85 | 1979-20071979-20101979-20121996-20091991-2010 |
| Tokyo (2010, 2012, 2015) | JapanMeteorologicalAgency | Coupled (51)  | T95/L40 T159/L60 | 1979-20081979-20101979-2014 |
| Toulouse (2008) (2013, YEAR?,2016) | Météo-France | Coupled (41)Coupled (51)  | T63/L91T127/L31 T255L91?T359/L91 | 1979-20071991-20101993-2016 |
| Washington(2004, 2011) | National Centresfor EnvironmentalPrediction | Coupled (40)  | T62/L64T126/L64 | 1981-20041981-2010 |

Table 1: System changes reported at the 2012 (Geneva) meeting (red), at the 2014 (Exeter) meeting (blue), at the 2016 (Beijing) meeting (green), and at the 2018 (Barcelona) meeting (orange). Note: latest configurations may be viewed at <http://www.wmolc.org>

Annex 4

**Global Seasonal Climate Update (GSCU) Schedule**



**Annex 5**

**Guidance on Operational Practices for Seasonal Climate Forecasting**

08 December 2017

Revised: 19 April 2018

1. **Seasonal predictions – Some background**
	1. Introduction
		1. Societal context
		2. Historical overview
		3. Elements of interannual climate variability
	2. Scientific basis for seasonal forecasting
		1. Role of slowly varying boundary conditions in modulating seasonal atmospheric variability – SSTs (ENSO), land surface (soil moisture), …
		2. Teleconnections and key drivers of seasonal to interannual variability of climate (global/regional/national/local)
		3. Role of low-frequency trends (e.g., warming trends) in seasonal forecasts.
	3. Predictability issues, including the associated space-time aspects; predictability limits and its spatial dependence
	4. Probabilistic nature of seasonal predictions – why seasonal predictions need to be probabilistic? Discussion of forecast lead-time and growth of forecast uncertainty (cone of uncertainty diagram).
	5. Seasonal prediction methods (including a discussion of their pros and cons)
		1. Empirical seasonal prediction methods.
		2. Dynamical seasonal prediction methods.
			1. Some basic aspects of climate models
		3. Combining seasonal forecasts from multiple seasonal prediction tools.
		4. Target variables and their space-time aggregation.
2. **Expression of seasonal prediction**
	1. Reference period and prediction of seasonal anomalies.
	2. Deterministic seasonal outlooks.
	3. Probabilistic seasonal outlooks.
	4. Seasonal outlooks and dividing/slicing the PDF of seasonal mean variability into forecast categories, e.g., terciles (pros and cons).
	5. Predicting PDF of seasonal mean outcomes and probability of exceedance approach (pros and cons).
	6. Interpreting probabilistic seasonal outlooks, e.g., if probabilistic seasonal outlooks are reliable then they will fail [the probabilities for seasonal outlooks also carry the information about the chance how often seasonal outlooks will fail (in the context of categorical forecasts)].
	7. Attributes for building credibility as the seasonal forecast provider (use of objective methods; transparency of forecast process; provide the track record…).
3. **Components of a seasonal prediction system**
	1. Real-time forecasts.
	2. Hindcasts – purpose
		1. establishing skill of seasonal prediction system.
		2. bias correction and calibration.
		3. Observed climate data requirements (quality, density, length, etc.)
	3. Optimizing multimodel ensemble approaches for geographic domains of interest
		1. Selection of most appropriate model(s)
	4. Bias correction and calibration of real-time prediction.
		1. Tools
		2. Tailoring
	5. Blending forecasts from different prediction tools.
	6. Statistical downscaling; issues with dynamical downscaling
	7. Outlook verification
	8. Forecast reliability and its implications for seasonal outlooks.
4. **Guidance on operational practices for developing seasonal climate forecasts**
	1. Catalog and document regional drivers of climate variability
		1. Seasonal climatology (e.g., onset/withdrawal dates of rainy season; variability of NAO).
		2. Spread in the “drivers of climate variability” from year-to-year - based on observational data, i.e., document what is the expected range for seasonal mean outcomes?
		3. Document recent trends (if any).
	2. Establish a publicly available schedule for seasonal outlooks.
	3. Provide a postmortem of the most recent verifying seasonal outlook and its performance.
	4. Provide a discussion of the current state of climate to set the context for the outlook for the coming season(s).
	5. Follow probabilistic guidance for seasonal outlooks.
	6. Provide a text discussion for a possible physical basis for the forecast/Reasons for shift in probabilities.
	7. Establish feedback mechanisms from the users (web; periodic face-to-face meetings/workshops).
	8. Start from an objective guess for seasonal outlook (e.g., from LC-LRFMME), and if altered, then as part of the text discussion provide reasons for altering the first guess objective forecast.
	9. Keep an archive for objective seasonal outlook guidance and the final seasonal outlooks to document the improvements.
	10. Guidance on communicating forecasts
		1. Provide information about past skill (based on hindcasts and/or if a long history of track record of real-time forecasts exists).
		2. Provide guidance on the interpretation of forecast probabilities (could be the same statement each time and refer to the probabilistic aspect of the seasonal outlook).
		3. User engagement
	11. Guidance on establishing credibility
		1. Keep the forecast process (methodology) transparent.
		2. Keep a track record.
		3. Keep documentation of the evolution of forecast practices.
		4. Keep/highlight regional relevancy in seasonal outlooks (by referring to regional drivers of climate variability and their climatology).
5. **Use of WMO infrastructure (and resources) for seasonal prediction**
	1. GPCs for LRF
	2. LC-LRFMME
	3. GSCU
	4. RCCs
	5. RCOFs
6. **Other potential sources of seasonal prediction products**
	1. NMME
	2. C3S
	3. APCC
	4. Others ?
7. **Other aspects of seasonal predictions and variability**
	1. Connection between attribution (forecast postmortem) and predictability.
	2. Connections with research
	3. Exploring historical data (data mining to extend historical data record).

**Annex 6**

**Terms of Reference of IPET-OPSLS**

1. On the basis of requirements from Regional Climate Centres (RCCs), Regional Climate Outlook Forums (RCOFs) and NMHSs, and in the context of the Climate Services Information System (CSIS) of the Global Framework for Climate Services (GFCS), guide future development, outputs including, for example, the Global Seasonal Climate Update (GSCU) and coordination of components in the production of global prediction from sub seasonal to longer time scales.
2. Support CCl and CBS to collaboratively promote the use of GPC and LC forecast and verification products by RCCs, RCOFs and NMHSs, develop interpretation guidance to facilitate their use, and encourage feedback on usefulness and application;
3. Support CBS in the implementation of a seamless GDPFS;
4. Report on production, access, dissemination and exchange of sub seasonal to longer time scales prediction products and provide recommendations for future consideration and adoption by CAS, CCl, CBS, WCRP and other appropriate bodies;
5. In consultation with relevant experts in CAS and CCl and with the CBS Expert Team on Operational Weather Forecasting Process and Support (ET-OWFPS), review developments in verification scores and practices with a view to updating the Standardized Verification System for Long-range Forecasts (SVSLRF);
6. Assess applications for GPC status against the designation criteria and make recommendations on designation to CBS;
7. Review the rules regarding user access to GPC and LC forecasts products;
8. Review the status of sub-seasonal forecasting activities, and promote the availability and exchange of sub-seasonal forecasts and verification products;
9. In close collaboration with WCRP, promote international cooperation and research on initialized predictions from sub seasonal to longer-time scales and report on potential for operational predictions to CBS and CCl;
10. Review the *Manual on the GDPFS* (WMO-No. 485) and propose updates as necessary concerning sub-seasonal to longer-time scales predictions.

**Annex 7**

**Sub-Teams and their Work Plans**

**ST1: Workshops on Operational Climate Prediction – to be held in** **2020**

Proposed tasks:

a) November 2018: Organising committee in place; review OCP-2 experience and survey results.

b) February 2019: Theme, scope and aims, workshop mode (open vs. invited), identification of key participants, funding, dates and venue of next workshop.

c) July 2019: First circular and save the dates call issued; pre conference tasks allocated (e.g. questionnaires)

d) September 2019: near-final conference programme available

e) June 2020: workshop held and report completed

*Membership: Caio Coelho (Chair), Richard Graham (to be confirmed), Jean-Pierre Ceron,, Rupa* *Kumar Kolli, Abdoulaye Harou, Anahit Hovsepyan, Raizan Rahmat (to be confirmed)*

**ST2: Develop revised strategies for verification exchange, including for LC-LRFMME**

**multi-model products, real-time verification and support to GSCU.**

Proposed tasks:

a) February 2019: Assess LC-LRFMME portfolio of verification activities to ensure LC-SVSLRF functionalities are covered

b) April 2019: Revise SVSLRF manual to further simplify the verification requirements on GPCs; keep verifications requirements that have more practical relevance

c) June 2019: Ensure necessary documents from the LC-SVSLRF are placed on the LC-LRFMME website

d) Make a proposal to the Cg-18 or EC-71 on the termination of LC-SVSLRF designation in the GDPFS

e) Finalize phasing out of LC-SVSLRF

*Membership: Arun Kumar (Chair), David Jones, Bertrand Denis, Kristina Frohlich, Caio Coelho*

**ST3: On scoping/implementation of sub-seasonal forecasts**

Proposed tasks:

a) February 2019: Clarify on the climatology used for the sub-seasonal forecasts at LC-LRFMME

b) February 2019: Consider alternate proposals if SSF could be part of existing LRF designation (although the majority of IPET-OPSLS leaned towards a separate designation).

c) March 2019: Develop designation criteria for GPC-SSF

d) June 2019: Recommend verifications for sub-seasonal forecasts.

*Membership: Yuhei Takaya (Chair), Kuh Hee Cho, Laura Ferranti, Vladimir Kryjov, Abdoulaye Harou, Caio Coelho, (Paolo Ruti)*

**ST4: GSCU**

Proposed tasks:

a) February 2019: Move towards operationalization of GSCU

b) March 2019: Review operational version of GSCU

c) Provide guidance further refine and develop the operational version of GSCU (as needed)

*Membership: Arun Kumar (Chair), Jean-Pierre Ceron/Aki Shimpo, Ernesto Rodriguez (or alternate CCl member within IPET-OPSLS), Atsushi Goto, Anahit Hovsepyan, CCl (TBD).*

**ST5: New approaches for distribution of GPC hindcast and forecast data**.

Proposed tasks:

a) March 2019: Grib2 to NetCDF conversion codes/software (IRIS…)

b) May 2019: Placing the conversion software on the LC\_LRFMME website with examples

c) When the LC-LRFMME hindcast is available without password, connect with CHFP and WGSIP

*Membership: David Jones (Chair), Kuh Hee Cho, Anca Brooshaw (C3S rep), Jeff Knight, Bertrand Denis*

**ST6: Guidelines on procedures for generating regional seasonal forecasts.**

Proposed tasks:

a) July 2018: Set the time line for the drafting the guidance document and establish core writing contributors.

b) December 2018: Complete the 1st drat of the guidance document.

c) Other tasks: (i) review by relevant bodies; (ii) go to Cg-18 or EC-71?

*Membership: Arun Kumar (Chair) and the members of the writing Team.*

**Annex 8**

**List of Recommendations, Decisions and Actions**

|  |  |  |
| --- | --- | --- |
| **Agenda Items** | **Recommendations** | **Lead** |
| 3.4 Relevant decisions from CCL-TECO and CCl-MG | * Revise the mission for IPET-OPSLS to “Provide guidance on operational climate prediction on global scale to enable optimal utilization at regional and national scales.”
* Review the CCl proposed deliverables for the IPET-OPSLS and recommend necessary changes to the CCl-MG (All members; Jean-Pierre Ceron to consolidate suggested changes to communicate with CCl-MG).
* Include a focal point from IPET-OPSLS to be a member of the ICT-CSIS.
 | To CCl-MG (question – what are the mechanisms for recommendations)To CCl-MG |
| 3.5 New GDPFS Manual and Seamless GDPFS | * Appendix 1.1 on “Definitions for the Meteorological Forecasting Ranges” be reviewed by appropriate Expert and Task Teams under the OPAG-DPFS, if necessary, changes be incorporated in the GDPFS Manual.
* Invite CCl ICT-CSIS to provide input to the evolution of the operational. functions (that may become part of the GDPFS Manual) in the CSIS.
 |  To CBS-MGTo CCl-MG & ICT-CSIS |
| 6.2.2 Support for RCOFs  | * LC-LRFMME to align the regional domains for forecast and verification;
* Encourage RCCs to work with GPCs-LRF to develop specialized products and verification (e.g., sea ice, monsoon onset date).
 | To LC-LRFMMETo IPET-RCC |
| 6.7 Designation of new class of RSMCs for additional global products  | * CCL and CBS to reexamine how to implement the proposal for RSMC for Climate Reanalysis and Climate monitoring on the global scale, as it is not within the remit or expertise of this team.
 | To CCl and CBS MG |
|  |  |  |
| **Agenda Items** | **Decisions** |  |
| 4.4 Status of LC-SVSLRF | * For the SVSLRF functionality to move to the LC-LRFMME and the LC-SVSLRF to be decommissioned. However, for the time being, keep the web-site of SVSLRF active, and aim for disbanding it by Cg-18.
 |  |
| 5.2 ST2 - Develop revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to GSCU (Chair – Arun Kumar) | * ST2 needs to stay active to finalize the task of preparing recommendations for the removal of the LC-SVSLRF and associated action items.
 |  |
| 5.3 ST3 - On scoping/implementation of sub-seasonal forecasts (Chair – Suhee Park) | * ST3 will continue with replacement of Richard Graham by Jeff Knight and Suhee Park by Kuh Hee Cho, and additional members of Arun Kumar, Abdoulaye Harou,Vladimir Kryjov and Caio Coelho.
* Keep the designation of GPC LRF separate from the designation of GPC Sub-seasonal.
* Mr Yuhei Takaya kindly agreed to take on the responsibility to Chair ST3.
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| 5.4 ST4 - Scoping/ implementation of longer than seasonal forecasts (Chair – Richard Graham) | * Following completions of its tasks, IPET-OPSLS agreed to disband the ST4.
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| 5.5 ST5 - New approaches for distribution of GPC hindcast and forecast data (Chair – David Jones) | * Jeff Knight to join the ST5. Anca Brookshaw (C3S) proposed as an additional member (awaiting consultation).
 |  |
| 5.6 ST6 - Guidelines on Procedures for generating regional seasonal (Chair – Arun Kumar) | * Keep the ST6 but with a revised title: “Guidance on Operational Practices for Seasonal Climate Forecasting.”
 |  |
| 5.7 ST7 - Amendments to the GPC-relevant sections of the Manual on the GDPFS (Chair – Richard Graham) | * Phase out ST7 as the Manual on GDPFS (WMO-No.485) is published.
 |  |
| 6.1 Future support for GSCU | * Create a new sub-team on GSCU.
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|  |  |  |
| **Agenda Items** | **Actions** | **Lead** |
| 3.5 New GDPFS Manual and Seamless GDPFS | * IPET-OPSLS to review the relevant sections in the GDPFS manual and propose necessary changes to the ICT-DPFS for follow-up.
 | Arun Kumar |
| 3.6 IPET-OPSLS relevant items and recommendations from the RCOFs review | * With the CCl, develop a mechanism whereby research recommendations from RCCs and RCOFs on prediction aspects can be communicated to the IPET-OPSLS for review and their communication to the WCRP/WGSIP.
 | Caio Coelho |
| 4.2 IPET-OPSLS achievements since April 2015 meeting in Beijing; Action items from the last meeting | * WMO Secretariat make the link to the LC-LRFMME surface temperature and precipitation forecast products on its web-site to increase the LC visibility and also promote uptake of its products. To facilitate this, LC-LRFMME will make the necessary changes to establish a permanent link to the latest forecasts. WMO Secretariat to make the link to the LC-LRFMME more prominent on its web-site to increase the LC visibility.
* LC-LRFMME to create a script to generate a PowerPoint and send the appropriate set of plots to each GPC every month the seasonal forecast is updated to ensure GPC check the integrity of the data they send to the LC-LRFMME and how it is represented.
* WMO Secretariat to use their social media handles to regularly issue alerts whenever LC-LRFMME forecast is updated. (Lead: Secretariat).
* The Team should elaborate optimal mechanisms for WGSIP and S2S project communities to provide feedback on LC-LRFMME products, and access GPC Data to advance research efforts.
 | Rupa Kumar KolliArun Kumar & Kuhhee ChoRupa Kumar KolliArun Kumar |
| 4.3 Status of LC-LRFMME  | * Make a proposal to include 850-hPa wind as part of the mandatory products to be provided by GPCs-LRF (will need an amendment of the Manual on GDPFS).
* Propose amendments to Appendix 2.2.1.5 of the Manual on GDPFS to include additional variables and add providing data in real time to the LC-LRFMME a mandatory requirement for the designation of GPCs-LRF.
 | Arun KumarArun Kumar |
| 4.4 Status of LC-SVSLRF | * Finalize the phasing out of LC-SVSLRF.
* Review the documentation of SVSLRF, retain pertinent information, including codes and port to the LC-LRFMME website.
* Explore whether an RCC can take the lead on requirements for regional verification needs and liaise (provide expertise to) with other RCCs. For the sake of consistency, LC-LRFMME can provide the verification codes.
* Explore whether the verification computer codes could be included in the Climate Services Toolkit (CST).
 | ST2 ChairST2 ChairLiaise with IPET-RCCLiaise with CST lead |
| 4.5 Status of GPC-ADCP & LC-ADCP | * Link ADCP products with CCl and WCRP and establish a mechanism for collaboration with WCRP and RCCs in relation to ADCP activities.
* Review compliance of GPC-ADCP and LC-ADCP.
* Review list of exchange of mandatory variables. If forecasts of new variables are to be added, verifications should also be done.
* Review the designation criteria for GPC-ADCP and LC-ADCP, and recommend changes in the GDPFS manual, as necessary.
 | Jeff KnightJeff KnightJeff KnightJeff Knight(see action under 3.5 also) |
| 4.6 Status of GSCU | * Establish (or assign to) an ST to assess the considerations related to operational GSCU and to propose options to address them for implementation. Include members from CCl.
* WMO Secretariat to include IPET-OPSLS members in the distribution list of GSCU.
 | ST4 ChairRupa Kumar Kolli |
| 4.7 Guidance documents for the implementation of CSIS (verification; CSIS technical reference manual; …) | * The Team to review the prediction section of the technical reference on CSIS, with particular attention to the alignment with the Manual on GDPFS ( <http://www.wmo.int/pages/prog/wcp/ccl/documents/CSIS_TechRefDoc_DRAFT_06_26Mar18.pdf> ).
 | Arun Kumar |
| 5.1 ST1 - Workshops on Operational Climate Prediction (Chair – Caio Coelho); DONE (OCP-2 took place before the IPET-OPSLS) | * Continue with ST1 for developing the OCP-3 and entrain CCl members within the IPET-OPSLS. Also approach Richard Graham (UK) and Raizan Rahmat (Singapore) for membership on ST1.
* Send a feedback survey template to the participants of OCP-2.
 | ST1 ChairWMO Secretariat |
| 5.2 ST2 - Develop revised strategies for verification exchange, including for LC-LRFMME multi-model products, real-time verification and support to GSCU (Chair – Arun Kumar) | * ST2 to identify replacement of Suhee Park and Anca Brookshaw on ST2.
* Follow up on the steps to terminate LC-SVSLRF.
* Recommend changes that need to be updated in the GDPFS Manual.
 | ST2 Chair(see also actions under 4.4) |
| 5.3 ST3 - On scoping/implementation of sub-seasonal forecasts (Chair – Suhee Park) | * Develop designation criteria for GPC and LC for SSF; Aim for submitting the recommendations to Cg-18.
* Consider alternate proposals if SSF could be part of existing LRF designation (although the majority of IPET-OPSLS leaned towards a separate designation).
* Clarify model climatology procedure currently used by LC-LRFMME for computing anomalies.
* Recommend verifications for sub-seasonal forecasts.
 | ST3 ChairST3 ChairST3 ChairST3 Chair |
| 5.5 ST5 - New approaches for distribution of GPC hindcast and forecast data (Chair – David Jones) | * Include a representative from C3S in ST5.
 | ST5 Chair |
| 5.6 ST6 - Guidelines on Procedures for generating regional seasonal (Chair – Arun Kumar) | * Building on the consultations at OCP-2, establish a writing team consisting of members from both operational and research communities.
* Prepare a time-limited work plan for the development of the guidance document by the middle of July, 2018.
* Complete the full draft by the end of December 2018.
* Review the examples of the guidance documents on Verification and Nowcasting.
* Organize a peer review of the draft Guidance document, revise and finalize the draft for endorsement by CBS, CCl and Cg-18.
 | ST6 ChairST6 ChairST6 ChairST6 ChairST6 Chair |
| 6.2.1 Support for ArcRCC | * Review the Manual and propose highly recommended functions related to sea ice to go into the Manual on GDPFS (Bertrand as the lead).
* Develop a proposal for the exchange of sea ice forecasts (as a mandatory or recommended variable); an alternative strategy could be to provide directly to Canada as the Lead Node for pan-Arctic LRF function within the ArcRCC-Network.
 | Bertrand DenisBertrand Denis |
| 6.2.2 Support for RCOFs  | * Invite GPCs-LRF to adopt some RCOFs for sustained support and mentoring. To facilitate this WMO Secretariat to initiate letters to PRs of Members with WMO hosting GPCs-LRF, to encourage them to twin their GPCs-LRF with selected RCOFs of their interest.
* GPCs-LRF to develop a catalogue of data and products available on their website and post it as a downloadable document on the LC-LRFMME website for easy accessibility and future reference;
* GPCs-LRF to inform the Secretariat of training activities in order to facilitate participation of RCCs and NMHSs.
 | Rupa Kumar KolliArun KumarGPC members in IPET-OPSLS |
| 6.3 Data access and exchange policy | * Open the hindcast data for 9 GPCs-LRF (that currently allow open access), password protect data 4 GPCs-LRF (that currently do not allow free access). No open access to MME at this time while JMA works on obtaining agreement for MME.
* WMO Secretariat to write to PRs of Members with WMO hosting GPCs-LRF for their agreement to provide open access to the MME data.
* Confirm that 9 GPCs-LRF agree to open access to real time data with at least one month delay.
 | Arun KumarAbdoulaye & Arun (note: this is about MME data)Arun Kumar |
| 6.4 Changing the release of forecast time | * Explore the feasibility of 15th of the month as the cutoff date for data from GPCs-LRF to LC-LRFMME and 18th of the month as the release of MME products. Any centre sending in their data after the 15th of the month will only be included in the final MME Products release on 25th of the month.
* LC-LRFMME to maintain a record of the arrival time of GPC-LRF data to the LC and share it at least once a year with the IPET-OPSLS.
 | Arun KumarKuhhee Cho |
| 6.5 Hindcast data to support research (along the lines of CHFP) | * When LC-LRFMME data access policy has been revised and hindcast data from some GPCs is freely available, inform WGSIP of the opening of hindcast data;
* Provide the link to LC-LRFMME data in CHFP website.
* Work with C3S, UKMET and other GPC centres to come up with solution for the transfer of GRIB to NetCDF format and develop the implementation of the solution (GRiB to NetCDF and vice versa). These codes could be part of CST and/or could be provided at the LC-LRFMME.
 | ST5 ChairST5 ChairST5 Chair |
| 6.6 Annual summary of seasonal forecasts | * ST2 to develop the mechanism/concept for annual assessment of seasonal forecasts.
 | Arun Kumar |
| 6.7 Designation of new class of RSMCs for additional global products (GPCs) | * CCL and CBS to reexamine how to implement the proposal for RSMC for Climate Reanalysis and Climate monitoring on the global scale, as it is not within the remit or expertise of this team. Mechanism could include establishing a limited time-horizon Task Team. Such a TT may include members from IPET-OPSLS, WCRP Data Advisory Council (WDAC) and expertise from CCl.
 | Arun Kumar |
| 6.9 Guidance document for operational forecasting | * This guidance is under ST6, the Chair needs to establish a drafting team to develop the draft guidance by end of year.
 | ST6 Chair |
| 6.11 The production of standards, verification methods and guidance for near-term climate predictions (NTCP) | * In future, revise the corresponding parts of the GDPFS Manual (related to the LC-ADCP) to ensure consistency with the research community.
* Evaluate this standards document to seek consistency with the “Guidance on Operational Practices for Seasonal Climate Forecasting” document under development by IPET-OPSLS.
* Once the document on Standard for production and verification of Annual to Decadal Climate Predictions is completed, ensure that it is made available on LC-ADCP website.
 | Jeff KnightJeff KnightJeff Knight |
| 7.2 Observational needs | * Consult GPC experts in data assimilation for the spatial and temporal requirements.
* Team members to review the document provided by Yuhei and provide comments by 29 June 2018 (Yuhei will place the document in Google drive to facilitate contributions).
* The list of Ocean data requirements must be updated (current list was developed in 2009).
 | If not doable then removeYuhei TakayaYuhei Takaya |
| 7. 3 O2R document and collaboration with WGSIP including contribution to Boulder Conference | * Act on the recommendation of the WGSIP to form a joint Task Group to enhance interaction between Operation and Research.
 | Arun Kumar |
| 7.4 Position Paper on Operational Prediction | * Drafting team for various position papers and their respective timelines need to be established with initial members comprising of Arun Kumar, Fancisco Doblas-Reyes and Caio Coelho.
 | Arun Kumar/Caio Coelho |
| 8. Review of the IPET-OPSLS Terms of Reference including Sub-Task teams | * Obtain the concurrence of the ICT-DPFS on changes to Terms of Reference for IPET-OPSLS
 | Abdoulaye/Arun |
| 9. Any other business | * Engage in follow up discussion on providing an update on the paper by Graham et al. (2011).
 | Arun Kumar |

1. Final report of CCl-17 is available at <https://library.wmo.int/doc_num.php?explnum_id=4611>. [↑](#footnote-ref-1)