|  |  |  |
| --- | --- | --- |
| **WORLD METEOROLOGICAL ORGANIZATION**COMMISSION FOR BASIC SYSTEMSOPAG on DPFS**MEETING OF THE CBS (DPFS) EXPERT TEAM ON OPERATIONAL PREDICTIONS FORM SUB-SEASONAL TO LONGER-TIME SCALES (ET-OPSLS)**BARCELONA, SPAIN, 2 AND 4 TO 6 JUNE 2018 |  | DPFS/ET-OPSLS/Doc. 6.9(15.V.2018)\_\_\_\_\_\_\_Agenda item : 6.9ENGLISH ONLY |

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

*(Submitted by Arun Kumar)*

##### Summary and purpose of document

This document contains the draft outline for “Guidance on Operational Practices for Seasonal Climate Forecasting”

##### Action Proposed

The meeting is invited to review the document and recommend steps for advancing the completion of the document forward (including possible action for the relevant sub-team)

**Annex(es):** - The current version for the guidance document

**Reference(s):** - …….

**GUIDANCE ON OPERATIONAL PRACTICES FOR SEASONAL CLIMATE FORECASTING**

**1**. Currently, Lead Center for Long-range Forecasts Multi-Model Ensembles (LC-LRFMMF) provides seasonal forecast on global scale. These forecasts for 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.

**2.** At the regional level, NMHSs, RCCs, RCOFs follow a range of spectrum 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.

**3.** Advantages of objective methods (as opposed to subjective seasonal forecasting practices) for seasonal forecasts range from traceability, improved credibility for forecast providers, quantification of forecast skill, archival of digital data of forecast tools and final forecasts. To promote the use of best practices in seasonal forecasting, a need for guidance document for operational practices for seasonal climate forecasting is recognized. Best practices as part of seasonal forecasting will also be applicable for forecasts for other time-scales in the extended-range: sub-seasonal and decadal.

**4**. One of the core functions of the Climate Services Information System (CSIS), a foundational pillar of the Global Framework for Climate Services (GFCS) is to provide operational climate predictions, with a particular focus on the seasonal scales. CCl has developed a draft Technical Reference document for CSIS, in which CSIS is envisioned to provide an integrated platform for advancing international climate services through accelerated information exchange on new science and technologies, shared data and products, tools, and best practices for service delivery to end-users and partners (<http://www.wmo.int/pages/prog/wcp/ccl/documents/CSIS_TechRefDoc_DRAFT_06_26Mar18.pdf>). WMO Executive Council, through Decision 18 (EC-69) on Sub-seasonal and Seasonal Forecasting Systems, requested CCl (i) to develop Technical Guidance, in collaboration with

CBS, on Operational Predictions from Sub-seasonal to Longer-time Scales, (ii) to support the development of operational practices of RCOFs based on objective sub-seasonal and seasonal forecasts, and (iii) to provide information on how best to advance objective use of data from GPCLRFs in forecast preparation. The recent CCl-17 session adopted a new working structure, in which it identified Guidance on Operational Seasonal Forecasting as a CCl-relevant deliverable assigned to CBS/CCl IPET-OPSLS (see Annex 2 to Resolution 6/1(CCl-17)).

**5**. A draft version of a similar guidance document for the best practices for the verification of seasonal forecasts has been developed is being finalized for publication as part of CCl contributions the CSIS (<http://www.wmo.int/pages/prog/wcp/ccl/documents/GuidanceonVerificationofOperationalSeasonalClimateForecasts-final-draft.pdf>).

**6.** An outline of guidance on operational practices for seasonal climate forecasting has been developed (Annex 1). The document has been reviewed by IPET-OPSLS, WGSIP and by few at WMO secretariat. Comments from IPET-OPSLS and WGSIP are included in Annex 2.

**7.** IPET-OPSLS is invited to further review the draft guidance document and develop a plan for its completion (including a proposed time-line as well as writing task assignments).

**Annex 1**

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

08 December 2017

Revised: 19 April 2018

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

**Annex 2**

**Comments on the draft outline of the guidance documents from IPET-OPSLS and WGSIP**

Following is a summary of comments provided by IPET-OPSLS members and by the WGSIP:

* Under role of low-frequency trends in seasonal predictions one can also include role of all external factors, e.g., solar, volcanic forcing etc.
* Under predictability sub-section also include a discussion of (a) signal-to-noise, (b) distinction between predictability and prediction skill.
* Under discussion of predictability also include a discussion about why deterministic single-day weather predictions beyond a few days are not feasible, whereas seasonal or other temporal averages can be forecast usefully due to the averaging out of ~unpredictable weather noise.
* Under probabilistic nature of seasonal prediction also include a discussion of need to quantify forecast uncertainty.
* Include a discussion on current capability and future prospects of seasonal predictions.
* Under basic aspects of climate models, touch on initialization also.
* Under the discussion related to the reliability of probabilistic seasonal forecasts, include a discussion that reliability needs to be assessed in the contest of large set of forecasts. Stress the fact that for reliable probabilistic outlooks the observed category will occur with a similar frequency or likelihood to the forecast probabilities.
* Section on “Components of seasonal prediction system” could be before the “Expression of seasonal prediction” section.
* In the context of observational data requirement stress that forecasts can only be usefully verified (and historical skill established) to the extent that observations meeting these requirements are available.
* Feedback mechanism are required not just to ensure clear communication and proper use/interpretation of forecasts, but to ascertain needs for tailored products that meet specific user needs (in which case underpinning R&D may be needed to establish best practices for producing such forecasts and whether they can be sufficiently skillful to benefit users).
* User engagement and feedback is required to establish how best to communicate the forecast and uncertainties.
* Under other aspects include a discussion about the important applications of the hindcast data.
* Include some examples of best practices.
* An example on the use of seasonal forecasts is <https://weather.gc.ca/saisons/info_prev_e.html#howto> (from Environment Canada).
* “Expression for seasonal prediction” could also be “Presentation of seasonal prediction.”
* Include a section on “managing expectations – what is predictable; what not predictable.”
* Include a possible need for prognostics discussion associated with seasonal predictions, e.g., what were relevant patterns of climate variability.
* Under “Guidance on communicating forecasts” could also discuss how to communicate limited skill of forecasts.