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CPTEC/INPE FUTURE ACTIVITIES AND COORDINATION

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CPTEC/INPE-Future activities and coordination

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Long-range forecasts (LRF) are being issued from CPTEC and several other Centres/Institutes and are being made available in the public domain. Forecasts for specific locations may differ substantially at times, due to the inherent limited skill of long-range forecast systems. This LRF can be Monthly outlook, or three-month or 90-day outlook (Seasonal outlook). CPTEC issues Deterministic Long-Range Forecasts presented as maps of anomalies (non categorical forecasts) and Probabilistic categorical forecasts (equiprobable terciles). Deterministic LRF is produced from the grand mean of the members of an Ensemble Prediction System (EPS) from the CPTEC AGCM. The seasonal forecast issued one month before the beginning of the validity period is said to be of one-month lead.

I. Research requirements on seasonal climate prediction

We have identified the following topics that deserve especial attention:

1 Identification of *"environmental forecasts"* activities in other centers around the world. In particular: Seasonal forecasts of risks of fire in South America, seasonal soil moisture content and soil moisture storage; and Seasonal river streamflow forecasts. These activities are been developed regionally in Brazil.

2 *Stratification according to the state of ENSO* should be made based on reasonably representative model climatology (30 years?). This has been done at CPTEC for a 10-year 9-member ensemble (1982-91) and will re-done for a 50-years model climatology (1949-2000) being currently run at IRI and CPTEC. This will allow for a better stratification since sufficient ENSO events are contained within this hind cast period. Scores are to be provided for each of three categories: All hind cast seasons, Seasons with El Niño active, Seasons with La Niña active. IRI has done this for the model it runs, and it would be great for them to share experiences and software with other centers.

3 Perform studies on the *"optimum size of the ensemble"* for seasonal climate forecasts on global and regional basis. CPTEC runs 25 realizations for two sets of SST anomalies. Studies developed by CPTEC have shown that for regions with higher climate predictability (e.g. Northeast Brazil) a smaller size ensemble can be enough, while for regions such as Southeastern South America, a region with lower climate predictability and where the most important cities in South America are located (São Paulo, Buenos Aires, Rio de Janeiro) even with a ensemble size larger than 25 members, the models do show skill in predicting regional rainfall anomalies.

4 Develop *Hydrological seasonal forecasts*, using seasonal climate forecasts from regional and global models for agriculture and hydroelectric generation purposes. Experiences from CPTEC show some use of modeled rainfall from a global model for seasonal river discharge prediction in southern Brazil (region with high-medium predictability). On this region (as well as in the Amazon basin), the model systematically underestimates rainfall and corrections can be made using statistical adjustments (linear regression type) to obtain a "corrected" rainfall in order to obtain "corrected" streamflow values.

II. Data sets for model validation

CPTEC has used for the validation of the CPTEC COLA AGC the following "observational" data sets":

1. NCEP/NCAR reanalyses for circulation, humidity and air temperatures.
2. Xie-Arkin –CMAP for Precipitation anomaly.
3. OLR data sets from NCEP

There are other data sets that can be included in any model validation that have been used in other centres: GPCP rainfall, CRU rainfall and air temperature data sets, Legates-Willmott rainfall, ERA reanalyses, the Oort winds and temperature, ISCCP cloud products as well as other GEWEX generated products. (www.gewex.org). There is a need for a set of observations that centres can use for their model validation and verification. As an example, one of the topics of a cooperative project between INPE and ECMWF is data exchange for purposes of seasonal prediction.

III CPTEC suggestions for future research activities on modelling activities (seasonal climate forecasts)

Here we propose some activities that are or will be developed at CPTEC and that can also be worked out together with other institutions:

1 *To improve the boundary conditions in AGCMs*: SST prediction in the tropical Pacific Ocean, Tropical Pacific and Indian Oceans: SST anomalies in the tropical Pacific all year long is generated by the NCEP coupled model and provided by NCEP; SST anomalies in the tropical Atlantic Ocean during the period November to May generated by the SIMOC statistical model and provided by CPTEC; SST anomalies in the Indian Ocean generated by an statistical model and is provided by IRI. CPTEC's SIMOC model is made available to many numerical centres, and we suggest that IRI provides the Indian Ocean SST model to other centres. Our suggestion is too look into possibilities to develop statistical seasonal forecast of SST anomalies in extra tropical areas.

2 *To exchange parameterisation schemes from different models*, in order to improve the models performance. Example, the CPTEC AGCM and several other models exhibits a systematic underestimation of rainfall in the Amazon basin during the rainy season. Several experiments using different parameterisation schemes (clouds, convection, land surface processes, Planetary Boundary layer, among others) should be tested to improve the seasonal climate prediction.

3 *To exchange information on seasonal prediction activities among the different numerical (operational and research) centres during the year*. This will provide new information and new insight on methodologies to study and assess predictability in subtropical and extra tropical regions. INPE has a colaboration project with ECMWF in seasonal prediction, and this allows for exchange of experiencies, interaction among researchers of both centres and collaborative studies. Colaboration agreement also exists between INPE and IRI in seasonal prediction. Informal or formal agreements can be done with other centres in order to exchange seasonal prediction experiences.

4 *To make available global digital results of several models* to perform a multi-model ensemble similar to those from IRI. We envision a *global multimodel ensemble* including all models used by the IRI plus from other centres (ECMWF, JMA, UK Met Office, BMRC, CPTEC and other centres that do not have models run at IRI) to be implemented either by IRI or any other institution with support from WMO.

5 *To propose and develop methodologies in order to study climate extremes* (dry spells, days with intense rainfall using) global and regional models, for composites of ENSO (El Niño and La Niña years) and for normal years.

6 To propose and explore the benefits (usefulness and limitations) of *dynamical and statistical downscaling in seasonal climate prediction,* including assessments of skill of the model (successful experiences in Northeast Brazil: CPTEC-IRI-FUNCEME).

IV Dissemination and exchange of seasonal climate force: How can we reach a technical language that can be understood by several levels of users?

The dissemination of forecasts is mainly *by Internet or printed bulletins*, showing maps of rainfall anomalies, model skill assessments and probability maps, as well as maps with areas with 3 levels of probabilities (rainfall above normal, normal, and below normal). In our experiences in Brazil and in South America, users have problems in understanding what "normal" mean, or with terms such as "slightly below the normal", or with meaning of the probabilistic forecast, or why a region shows a lower model skill, or why predictability is low in one region. There should be a common language, single and concise enough for a farmer, a journalists or a policy or decision maker.
Another efficient way of dissemination of products on seasonal time scales are the *Climate Diagnostic Forum meetings*, that normally take place almost everywhere on the planet. The positive side of this kind of meetings is that the forecasts products can be disseminate to wider spectrum of users and by the press, while the downside is that the regionalization of the forecasts is made using climate model outputs and a strong component of subjectivity, that is different from region to region, and that at the end makes almost impossible intercomparisons between consensus forecast maps.

V Contribution of global producing centres for future activities

1 Provide *multimodel ensembles (such those produced by IRI)* together with skill score measurements to mask regions with lower model skill may be one way to solve the problem of subjectivity typical of Regional Climate Diagnostic Forum meetings, in order to improve the quality of seasonal climate consensus maps, as well as a systematic validation and verification of previous consensus forecasts.
2 Suggest an effort to implement a *multimodel ensemble for global and climate regional models* (from different centres all around the planet).
3 Reach a *consensus on a common data set of observations for model validation* and verification and for calculations of model skill scores.
4 Establish a minimum *list of skill scores (ROC, RMS, Brier Skill, just to mention some)* used to validate models to assess model skill.
5 Propose studies to *determine a minimum number of years to build a consistent model climatology*, considering computing limitations of the different centres.
6 Propose studies to *determine a minimum number of members of an ensemble*, considering computing limitations of the different centres.
7 To explore *the potential and benefits of empirical/statistical–stochastic seasonal rainfall forecasts* and to propose coordinated efforts to implement such models in tropical and subtropical regions (examples of success: Northeast Brazil, Southern Brazil, Mexico).