



Regional Workshop on Hydrological Seasonal Forecast in Western South America

10th – 11th November 2010

Quito - Ecuador

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1. Opening session

Mr. Carlos Naranjo, Permanent Representative of Ecuador to WMO welcomed to participants and remarked the importance of this workshop for the region. He recalled the expectations of the RA III to implement this first initiative on Hydrological Seasonal Forecasts and encouraged to all participants to pursue the objectives of this regional activity.

Dr. Claudio Caponi from the WMO Secretariat, explained by videoconference, the progress on fulfilling the Regional Action Plan agreed in Guayaquil in January 2010. He requested to take actions regarding the pendent activities and expressed the support from WMO to this regional process.

Finally, Mr. Rodney Martínez from CIIFEN, introduced the objectives of the workshop and the importance of this activity within the Regional Action Plan which requires to be adjusted and refined with the close coordination between the climatologists and hydrologists in each country.

The training workshop was attended by 15 participants from the National Meteorological and Hydrological services from Bolivia, Chile, Ecuador, Peru and Venezuela. Colombian representatives could not attend because clearance issues. Dr. Andrew Robertson (IRI), Dr. Waldo Lavado (SENAMHI-Perú) and Mr. Juan José Nieto (CIIFEN) participated as trainers. The agenda is in the Annex "A" and the list of participants in the Annex "B".

2. Objectives of the Training workshop

- a) To review analysis tools for operational seasonal hydrology forecasts
- b) To introduce CPT and explore applicability to seasonal hydrology forecasts
- c) To introduce an Hydrological Model (GR2M)
- d) To introduce methodologies fro stochastic realizations such as HMM, KNN and their applicability in seasonal hydrological forecasts

3. Introduction to climate forecasts (Dr. Andrew Robertson)

This session consisted of a lecture on seasonal climate prediction and downscaling approaches for hydrologic forecasts. The physical basis for seasonal prediction, ENSO, and atmospheric teleconnections were reviewed. Seasonal forecast models and the need for probabilistic forecasts were then covered. Downscaling approaches for hydrology were then discussed, making a basic distinction between 2 types of approach. In the first, a purely statistical approach is taken, based on regressing various predictors (antecedent and SST conditions, or GCM seasonal forecast fields) against historical streamflow time series. In the second, statistical methods are used to downscale seasonal forecasts of rainfall/temperature, and to disaggregate them in time, in order to drive a

hydrologic model (lumped or distributed). Examples of the first approach were then discussed using CPT. The second approach was treated on the second day.

Recommendations:

- a) CPT can be used very effectively, provided sufficiently long historical streamflow time series (20–30yrs minimum) are available.
- b) The existing COF process coordinated by CIIFEN provides an excellent basis for using the predictors identified for seasonal climate outlooks, and testing them for hydrology.
- c) GCM retrospective forecast fields (precipitation, wind fields) should also be tested as potential predictor fields in CPT.
- d) CPT can be used to combine multiple predictor fields, including antecedent streamflow.
- e) Monthly flow can be used as a predictand, and it is important to compare the skill levels obtained against 3-monthly ones. The latter provide the well-established benchmark from seasonal climate forecasting. Sub-seasonal variability tends to add noise and decreases skill in seasonal climate forecasts. This may be less of an issue for streamflow because it is an integrated quantity. This impact needs to be tested and verified.

4. Introduction to CPT (Mr. Juan José Nieto)

During the session, participants were introduced to CPT in order to show them the possibilities of making hydrological forecast from flow time series and a predictor such as rainfall or Sea Surface Temperature.

An example of how CPT works was made to show the particularities of the software. After the presentation, participants works on their own data, most of them used rainfall average in the pilot basin to make flow forecast. The preliminary results were quite poor except for Chile and Venezuela were the model showed a relative good skill.

Recommendations

- a) Use the expertise of the Meteorological services using CPT to improve the skill of the model
- b) Explore several predictors in different time scales
- c) Predict in a seasonal time scale and then apply some method for monthly and daily realizations
- d) Develop user friendly tools to apply daily sequences approach
- e) Improve the communication of tercile categories to users
- f) Develop some examples on how the probabilities and categories forecast can be applied to the hydrological management

5. Hands on Demo of CPT

Participants developed a training exercise .

6. Introduction to hydrology forecast and GR2M hydrological model (Dr. Waldo Lavado Casimiro)

In this session we introduced the participants in the hydrological model for forecasting purposes. This model is a monthly step, thus the forecasting will be seasonal. A explanation of the model is given in <http://www.cemagref.fr/webgr/indexgb.htm> . The model need like input rainfall,

evapotranspiration and discharge, the two firsts at basin scale. In this session we work in Excel (Microsoft Office) and is necessary know use the Solver module of Excel. We run the model in several basins of South America specifically in Bolivia, Ecuador, Venezuela, Peru and Chile. The results of the models were acceptable except in the basin of Ecuador, in fact the statistical shown goods performances of the model in the others countries. So, GR2M can be used for forecasting purposes.

Recommendations:

- a) Try GR2M model in the select pilot basins in the WS region for hydrological purposes and if possible use CPT output or ensembles for seasonal forecasting.
- b) My principal observation is the data quality. We need rainfall and evapotranspiration at basin scale, so the inputs for the interpolation should be goods. Data quality and Homogenization analysis is necessary for use the hydrological models.
- c) We work only for two days in this training. So for the limited time several topics about hydrological models were avoided like sensibility of parameters, of input data and other topics.
- d) In some countries (e. g. Chile) work with hydrological models several years ago but the principal problem is that don't have relation with the climatologist. We need improve this relationship Hydrology-Climatology indispensable for seasonal hydrological forecasting.
- e) For the experience in the training we need start first with hydrological models at monthly step and then try the hydrological models at daily step.

7. Hands on Demo GR2M

Participants developed a training exercise.

8. Introduction to HMM, KNN (Andy)

This session introduced three methods for deriving daily weather sequences from seasonal forecasts, to be used as inputs to hydrologic models run at daily step: (1) Resampling past years based on seasonal forecast categories, (2) Resampling based on nearest analog years (KNN), and (3) Monte Carlo weather generation, such as HMM. Method (1) is the simplest, and could be based directly on the COF-produced forecasts. Method (2) is a generalization of the analog method, and it requires indices (such as ENSO or forecasted regional average seasonal precip.) on which to condition. Method (3) is based on stochastic weather generators, rather than resampling as in 1 & 2. In the lecture, the most time was spent on discussing method (1) which is attractive as a simple place to start

Recommendations:

- a) Create a simple Excel-based tool to implement tercile-category bootstrap resampling (method 1).
- b) Test the skill of method 1. This will require a long set of retrospective tercile-category hindcasts. These could be generated from CPT if they are not yet available from the COF process.

- c) Carry out an inter-comparison of the 3 methods in research mode for a chosen basin where seasonal predictability is high.

9. Presentations of countries

As final practical exercise, teams from each country prepared a complete exercise starting with CPT applied to hydrological variables and then combine it with the use of an Hydrological model. The results, difficulties and further work in each country was presented by participants.

10. Next Steps and Review of Regional action Plan agreed in Guayaquil (January, 2010)

ACTIVITY	RESPONSIBLE	DATE
1. Workshop Report	CIIFEN-OMM	30-Nov-2010
2. Development of wiki site on CIIFEN	CIIFEN	30-Dic-2010
3. National Training course on CPT for Hydrologists	NMHSs	January 2011- March 2011
4. Design a document on Guidelines to use CPT on Hydrological Forecasts	IRI- CIIFEN-Regional trainers	January 2011
5. National meetings between Focal points to discuss details and information requirements for CPT application, agree on designation of pilot basins (Inventory and validation of required data) and prepare a programe of activities.	NMHSs	30-January-2011
6. Design of a methodological guide for data preparation.	IRD	March -2011
7. Experiments with CPT and Hydrological Modeling using stochastic realizations and including verification	NMHSs-CIIFEN-Regional Trainers	April 2011-June 2011
8. Regional Training on stochastic realizations (KNN and HMM)	WMO-CIIFEN	July – 2011
9. Experiments with KNN and HMM including verification	NMHSs-CIIFEN-Regional Trainers	August-October 2011
10. Review of experiments in each country during COF XI-WCSA	WMO-NMHSs – CIIFEN-IRI-IRD	November – 2011

Annex “A”

Regional Workshop on Hydrological Seasonal Forecast in Western South America

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Objectives

- a) To train participants in analysis tools for operational seasonal hydrology forecasts
- b) To introduce participants to CPT and explore applicability to seasonal hydrology forecasts
- c) To introduce participants to GR2M
- d) To introduce participants to HMM, KNN and their applicability in seasonal hydrological forecasts

Requirements

In order to fulfill the objectives of the workshop, participants are strongly encouraged to bring their own data with the following characteristics:

Definition of a pilot basin

Monthly discharge data

Monthly rainfall data in the selected basin

Monthly max and min temperature in the selected basin

Monthly evapotranspiration data

November 10

(Morning session)

Introduction to climate forecasts (Andy)

Introduction to CPT (Juan José)

Hands on Demo of CPT (Andy, Juan Jose, Waldo, participants)

(Afternoon session)

Introduction to hydrology forecast (Waldo)

Introduction to GR2M (Waldo)

Hands on Demo GR2M (Participants, Waldo, Juan José)

November 11

(Morning session)

Using daily data: Introduction to HMM, KNN (Andy)

Presentations of results obtained during the training workshop in the IRI (Waldo, Juan Jose)

(Afternoon session)

Discussion: Next Steps and Review of Regional action Plan agreed in Guayaquil (January, 2010)

Other recommendations

Annex “B”

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