# SEASONAL PRECIPITATION PREDICTION OVER SOUTH AMERICA WITH THE ETACLIM

*Julio Pablo Reyes Fernández[1], Igor A. Pisnichenko[1] and Tatiana A. Tarasova[1]*

**RESUMO** As previsões sazonais da precipitação e temperatura são úteis para as regiões afetadas por eventos extremos como secas e enchentes, os quais normalmente são associados a fenômenos globais (El Niño). O objetivo deste trabalho é aumentar o desempenho das previsões regionais sazonais dos eventos extremos sobre América do Sul usando para isto a técnica de previsão por conjunto de física. A versão climática do modelo regional ETA (ETACLIM) do Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) foi utilizada para simular a estação de verão de 1997/1998 (El Nino). Os esquemas de convecção e microfísica disponíveis no modelo serão utilizados para constituir os membros do conjunto. Resultados preliminares usando os esquemas de convecção (Betts-Miller-Janjic, Kain-Fritsch and RAS) mostraram-se promissores para previsões climáticas sobre América do Sul.

**ABSTRACT** The seasonal forecasts of precipitation and temperature on a regional scale are very useful, mainly for the regions affected by extreme events: such as droughts and floods. These events are commonly associated to global scale phenomena (e.g.: El Niño/South Oscillation). The aim of this work is to improve the performance of seasonal regional forecasts of extreme events over South America using a mixed physics ensemble approach. For this purpose, seasonal simulations using the ETA regional climate model (ETACLIM) of the Center for Weather Forecasting and Climate Studies (CPTEC) were carried out for austral summer 1997/98 (El Niño). The microphysics and convection schemes available in the model will be used to constitute the members of the ensemble. The preliminary results using the convective schemes (Betts-Miller-Janjic, Kain-Fritsch and RAS) showed encouraging perspectives for climate predictions over South America region.

**Palavras-chaves:** Modelos climáticos regionais, conjunto, física misturada.

## INTRODUCTION

The seasonal forecast of precipitation and temperature on regional scale are very useful, mainly for the regions affected by extreme events, such as droughts and floods. Sometimes these events are associated to global scale phenomena (e.g. El Niño/Southern Oscillation). Recent studies, using General Circulation Models (GCM) and Regional Climate Models (RCM), over the South America region have shown that only in some specific areas the predictability is high (Marengo et al., 2003; Chou et al. 2005). The use of RCMs is necessary because of the limitations in GCM to describe sub-grid scale phenomena and as a rule more poor parameterization of physical processes in GCM comparing with RCM. Roads et al. (2003) concluded that regional climate models do not yet provide a substantial improvement over GCMs, although the regional climate models can provide predictions for specific regions. Their results suggest the use of the ensemble approach as a way to improve the model predictability.

[1]Center for Weather Forecasting and Climate Studies – CPTEC/National Institute for Space Research - INPE, Brazil Rodovia Presidente Dutra, km. 40, 12630-000, Cachoeira Paulista, São Paulo, Brasil. Telefono: (12) 31868532, e-mail: pablo@cptec.inpe.br

Arritt et al (2004) described four ensemble methods for seasonal limited area forecast: a) lagged-averaged; b) perturbed physics; c) mixed physics and d) multi-model. At CPTEC/INPE the mixed physics ensemble approach is used to improve the predictability with the ETA regional climate model (ETACLIM). This method uses different schemes of the model's physics, it is expected that the ensemble mean improve the forecast over large part of South America continent.

The aim of the current research is to improve the performance of seasonal regional forecast, mainly extreme events, over South America in particular over Brazil using the mixed physics approach. The ETACLIM is used to simulate the austral summer of 1997/98. This season was affect by the most intense ENSO event of the XX century.

**METHODOLOGY**

The ETACLIM is basically a modified version for climate studies of the ETA operational model of NCEP version 2003. Developed at CPTEC as described by Fernandez et al (2006a) and Tarasova et al. (2006) and used to studies of climate variability and climate change (Fernandez et al, 2006b; Pisnichenko et al., 2006). This version has been many physical options such as microphysics: Zhao, Ferrier and Ferrier modified; convective schemes: Betts-Miller-Janjic (BMJ), Kain-Fritsch (KF) and Relaxed Arakawa-Schubert (RAS), and solar radiation schemes: original (GFDL) and new (CLIRAD-SW-M).

The domain includes a large part of the South American continent. The model is integrated from 00Z 16 November 1997 till 00Z 1 March 1998, with initial and boundary conditions from the National Center for Environmental Predictions (NCEP) / Department of Energy (DOE) reanalysis II (Kanamitsu et al., 2002) data each 6 hours and daily update of SST from Reynolds et al. (2002). In this paper is used different convection schemes to test the mixed physics ensemble approach. The horizontal resolution of this version of ETA model is 40 Km approximately.

**PRELIMINARY RESULTS**

Figure 1 shows the monthly mean precipitation for January 1998 of Climatic Research Unit (CRU), Global Precipitation Climatology Project (GPCP) and ETACLIM ensemble mean simulation. The different precipitation patterns can be noted in observed data (CRU and GPCP);

mainly over Central and Southeastern Brazil, but in general the ensemble mean simulation captures these patterns and improves the predictability over some regions.

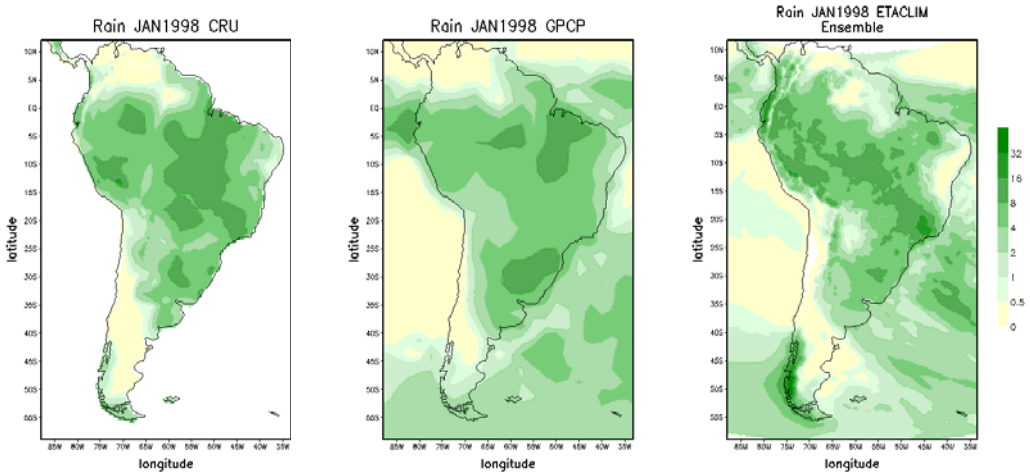


Figure 1 Monthly mean precipitation for January 1998: a) CRU; b) GPCP and c) ensemble mean simulation. Units: mm day$^{-1}$.

In the individual runs of members of the ensemble, using the BMJ, KF and RAS convective schemes, it is noted that each model simulation differs regionally (figure not showed). This spread in scatter is a positive indication to obtain better predictability. Also in these simulations the systematic bias may increase or decrease over some regions. This is a drawback of this approach.

## SUMMARY AND FUTURE WORK

This study uses the mixed physics ensemble approach to improve the predictability over South America, mainly in austral summer. The different convective schemes of ETACLIM model were used as members of ensemble. The preliminary results showed that individual members have more predictability over some regions than others. This ensemble approach shows an increment of predictability over some regions of South America. Also this technique can improve the predictability of extreme events (drought, floods) when forced by a GCM. The results of RCM, of course, in simulation and/or forecast mode depend on the quality of forcing, for this CPTEC's GCM improvements are being attempted. The last version of ICTP RegCM3 and WRF NNM will also be used for this task to build a mixed-physics and multi-model ensemble. The drawbacks and advantage of these models and parameterizations will be tested.

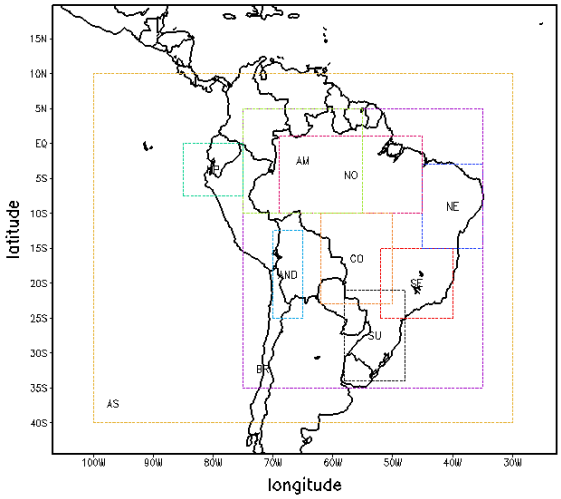


Figure 2 Regions of evaluation over South America.

Further studies must be done to evaluate the performance of ensemble mean, spread and probability. Comparisons between the simulations and GPCP and CRU data will be done, for precipitation and air surface temperature, respectively, over specific regions (Figure 2), mainly for homogeneous climate characteristics, which are of economic importance (Fernandez et al., 2006a).

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