AN APPLICATION OF THE MULTI-MODEL TECHNIQUE IN ENSEMBLE WEATHER FORECASTING AT CPTEC/INPE

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Summary: *The goal of this work is to evaluate a prototype system of ensemble weather forecasting based on the multi-model technique. The multi-model system is based on integrating a numerical model using different parameterizations of physical processes, such as deep convection and radiation. The model used was the Atmospheric General Circulation Model (AGCM) from the Centre for Weather Forecast and Climate Studies (CPTEC). The evaluation consisted of two stages: first, the calculation of statistical scores to the northern and southern Hemispheres and Tropical Region; second, the evaluation of a rainy event occurred in late November 2008 in the coastal region of the State of Santa Catarina (SC). The configuration of the Ensemble Prediction System (EPS) used as reference is configured identically to the version currently in operation in CPTEC. The results show that the multi-model was able to anticipate some characteristics of the event that occurred in SC and statistical indices presented results slightly above the reference configuration.*

Introduction

Ensemble forecasting is a numerical prediction method that is used to attempt to generate a representative sample of the possible future states of a dynamical system. An ensemble system can be constructed using several methodologies. In a traditional way, perturbations are applied only for initial conditions (IC). In modern systems, perturbations at IC are combined with perturbations in model physics. In this work we have constructed and performed a preliminary evaluation of a multi-model ensemble version for CPTEC-EPS. The objective is to get a first evaluation of this prototype system of ensemble of physics.

METHODOLOGY

EXPERIMENT DESIGN

1.Integrate several 15-members ensembles
2.Each 15-members ensemble is generated through random perturbation of the initial conditions, following a method for the operational ensemble
3.Each 15-members ensemble is differentiated by changes in some physics parameterization
4.The combined parameterizations were short and long wave radiation, and deep convection
5.In total, a set of 126 ensembles was produced
6.Here we evaluate the initial conditions from 11/12/2008 to 11/16/2008

ASSESSMENT APPROACH

To compare the we have made use of anomaly correlations and root mean squared error (RMSE) scores.

Exp40	Exp41	Exp42	Exp43	Exp44	Exp45
ISWRAD= 'LCH'	ISWRAD= 'CRD'	ISWRAD= 'LCH'	ISWRAD= 'CRD'	ISWRAD= 'LCH'	ISWRAD= 'CRD'
ILWRAD= 'HRS'	ILWRAD= 'UKM'	ILWRAD= 'HRS'	ILWRAD= 'UKM'	ILWRAD= 'HRS'	ILWRAD= 'UKM'
ICCON= 'KUO'	ICCON='KUO'	ICCON= 'ARA'	ICCON='ARA'	ICCON= 'GRE'	ICCON='GRE'
ISCON= 'TIED'	ISCON='TIED'	ISCON= 'TIED'	ISCON='TIED'	ISCON= 'TIED'	ISCON='TIED'
10/11/2008	10/11/2008	10/11/2008	10/11/2008	10/11/2008	10/11/2008
11/11/2008	11/11/2008	11/11/2008	11/11/2008	11/11/2008	11/11/2008
12/11/2008	12/11/2008	12/11/2008	12/11/2008	12/11/2008	12/11/2008
13/11/2008	13/11/2008	13/11/2008	13/11/2008	13/11/2008	13/11/2008
14/11/2008	14/11/2008	14/11/2008	14/11/2008	14/11/2008	14/11/2008
15/11/2008	15/11/2008	15/11/2008	15/11/2008	15/11/2008	15/11/2008
16/11/2008	16/11/2008	16/11/2008	16/11/2008	16/11/2008	16/11/2008
17/11/2008	17/11/2008	17/11/2008	17/11/2008	17/11/2008	17/11/2008
18/11/2008	18/11/2008	18/11/2008	18/11/2008	18/11/2008	18/11/2008
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25/11/2008	25/11/2008	25/11/2008	25/11/2008	25/11/2008	25/11/2008
26/11/2008	26/11/2008	26/11/2008	26/11/2008	26/11/2008	26/11/2008
27/11/2008	27/11/2008	27/11/2008	27/11/2008	27/11/2008	27/11/2008
28/11/2008	28/11/2008	28/11/2008	28/11/2008	28/11/2008	28/11/2008
29/11/2008	29/11/2008	29/11/2008	29/11/2008	29/11/2008	29/11/2008
30/11/2008	30/11/2008	30/11/2008	30/11/2008	30/11/2008	30/11/2008

Table 1 – Experiments performed organized by combination of parameterizations (columns) and initial condition date (lines).

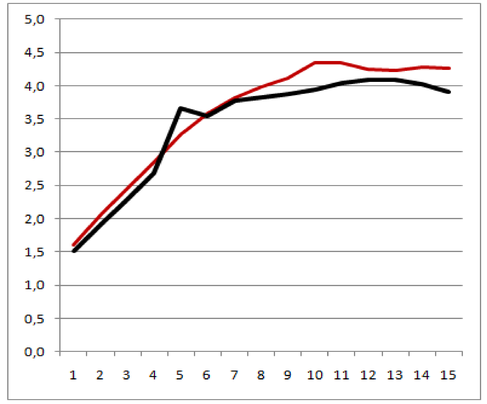


Figure 1 – RMSE for temperature at 850 hPa in the Southern Hemisphere. Average of 6 integrations. Black (red) line indicates Ensemble of Physics (reference Ensemble).

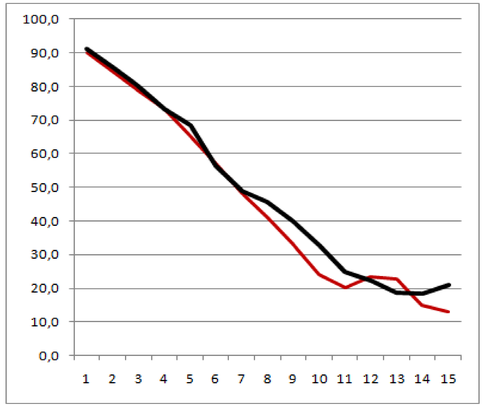


Figure 2 – Anomaly correlations for temperature at 850 hPa in the Southern Hemisphere. Average of 6 integrations. Black (red) line indicates Ensemble of Physics (reference Ensemble).

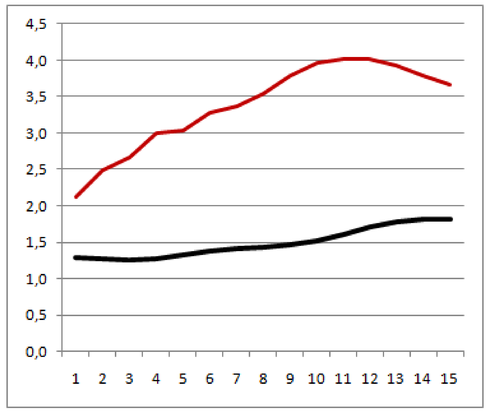


Figure 3 – RMSE for temperature in the tropics at 850 hPa. Average of 6 integrations. Black (red) line indicates Ensemble of Physics (reference Ensemble).

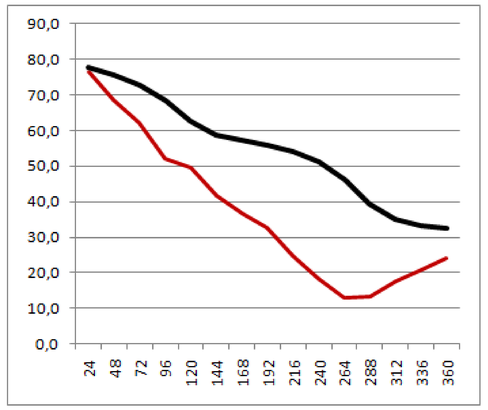
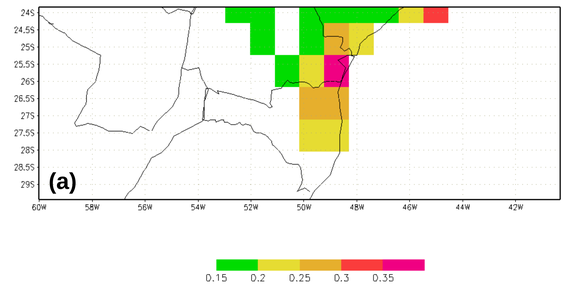


Figure 4 – Anomaly correlations for temperature in the tropics at 850 hPa. Average of 6 integrations. Black (red) line indicates Ensemble of Physics (reference Ensemble).



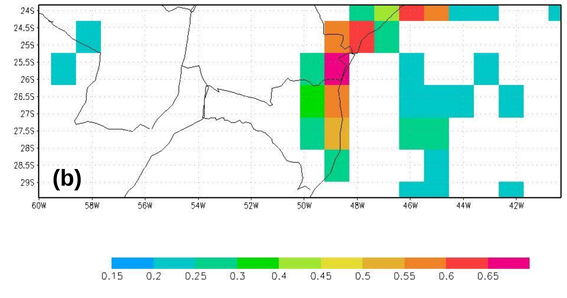


Figure 5 – Probability of precipitations with a rate greater than 10mm/24h. (a) Ensemble of Physics. (b) Reference Ensemble. Integrations initiated from 11/10/2008. Forecast date is 11/22/2008.

Concluding remarks:

- The present results showed that the Ensemble of Physics did not improves significantly the scores for geopotential height at 500 hPa and Sea Level Pressure in the Northern Hemisphere;
- In the Southern Hemisphere there was a detectable, though slight, improvement concerning the prediction of temperature at 850 hPa. Forecasts of geopotential height and Sea Level Pressure did not show substantial improvements in the scores.
- The best progress was achieved for the absolute temperature in the tropical region. The enhancement in the scores was substantial;
- The Ensemble of Physics was able to estimate some probabilities for the severe event occurred in Santa Catarina, in November 2008. However, compared to the reference Ensemble the probabilities were underestimated.

1,42 x 0,9m