CPTEC
Centro de Previsão de Tempo e Estudos Climáticos

MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

ENSEMBLE FORECAST SYSTEM CPTEC/INPE

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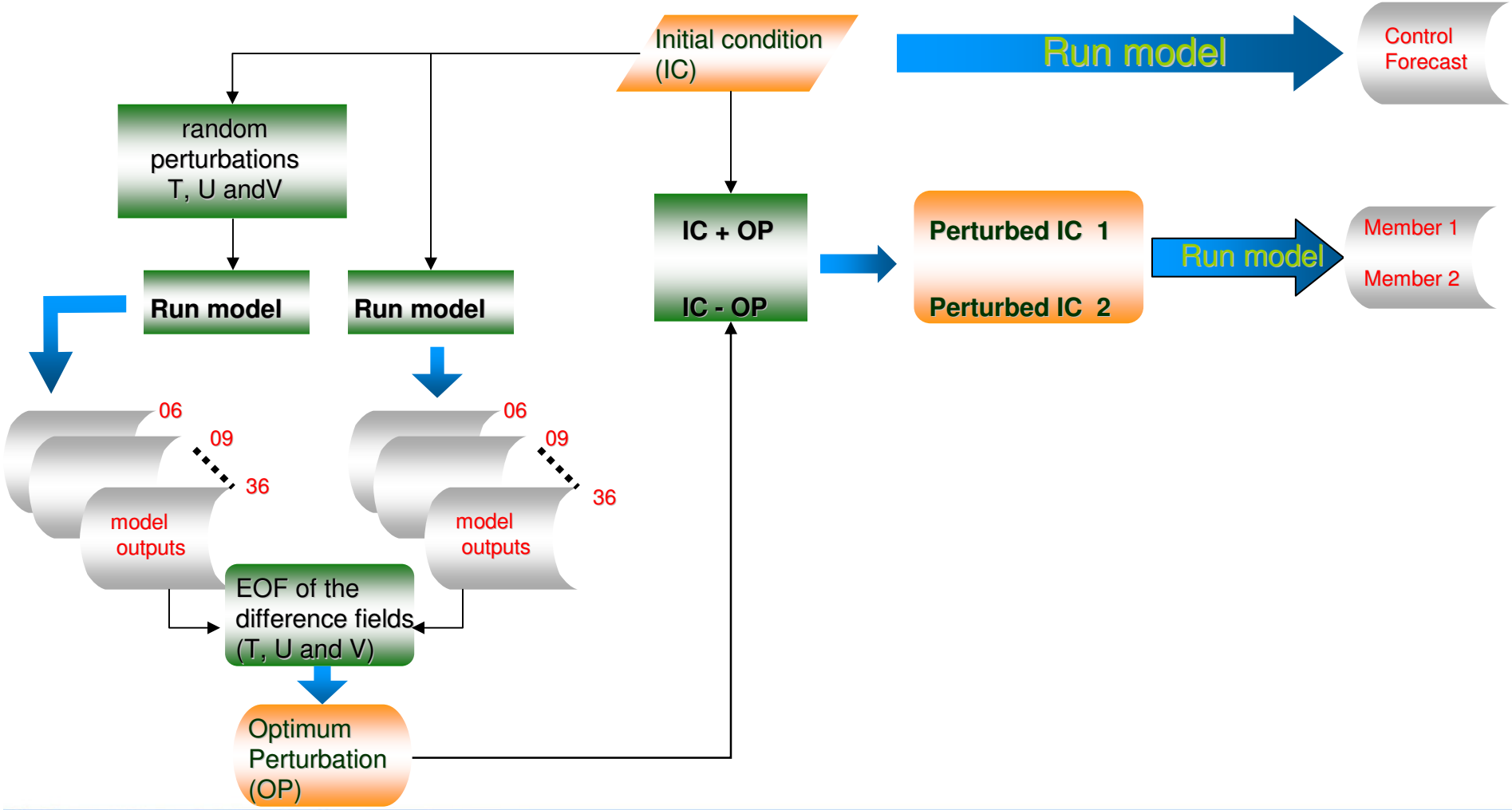
Main Characteristics

- Started operationally in October 2001
- Two runs are performed starting from 00 and 12 UTC analysis
- Each run represents a set of 15 forecasts (1 control plus 14 perturbed) up to 15 days
- Domain: Global
- Resolution: T126L28
- Perturbed region: 45S-30N/0-360E
- Perturbed fields: T, U and V;

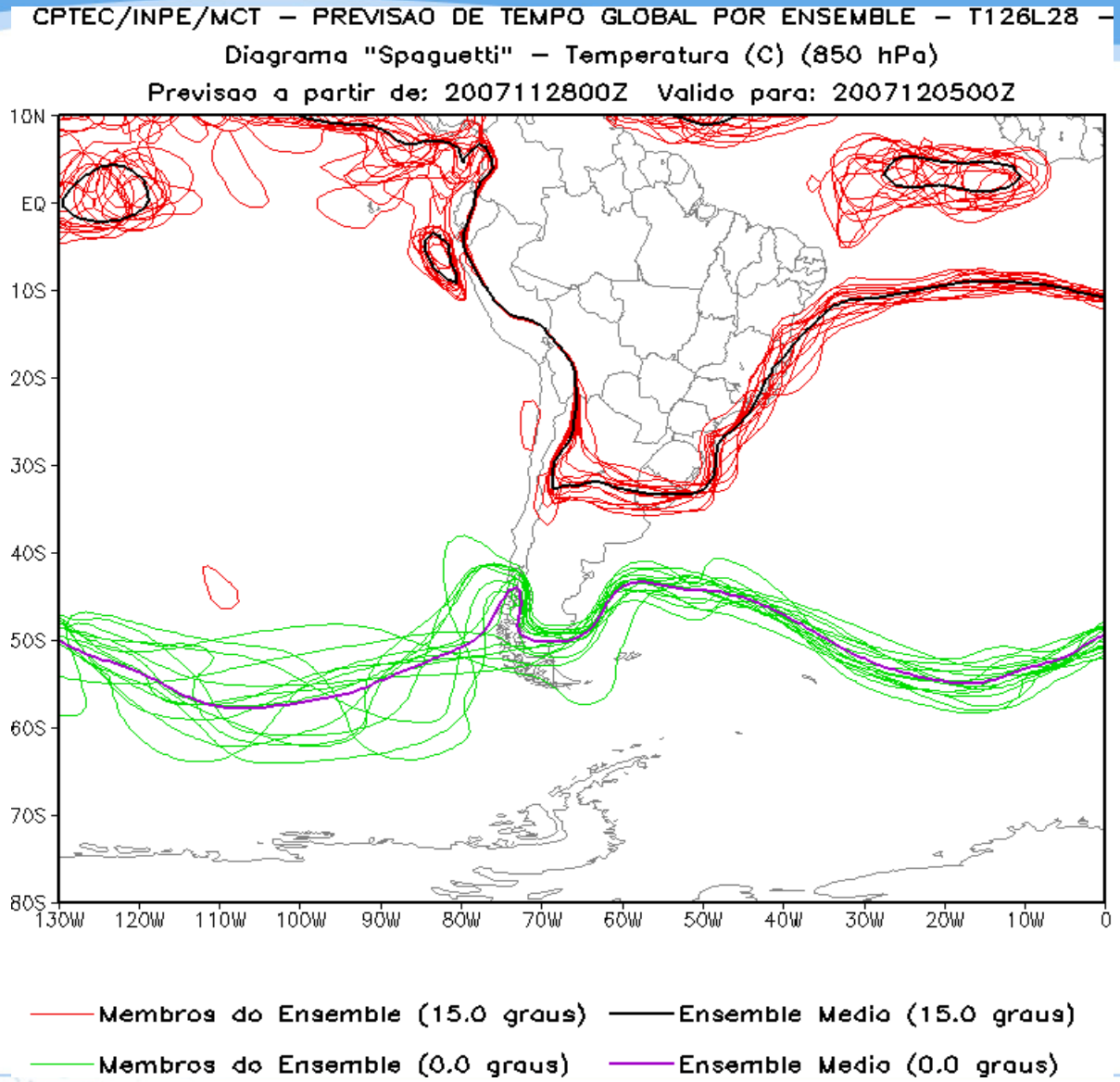
Perturbation Method

- It is based on the method developed by Zhang and Krishnamurti (1999) and modified by Coutinho (1999);
- It is supposed that model is perfect;
- A set of perturbed initial conditions are generated using the “EOF-Based Perturbation” method;
- The model is integrated starting from each perturbed initial condition to produce an ensemble forecasting;

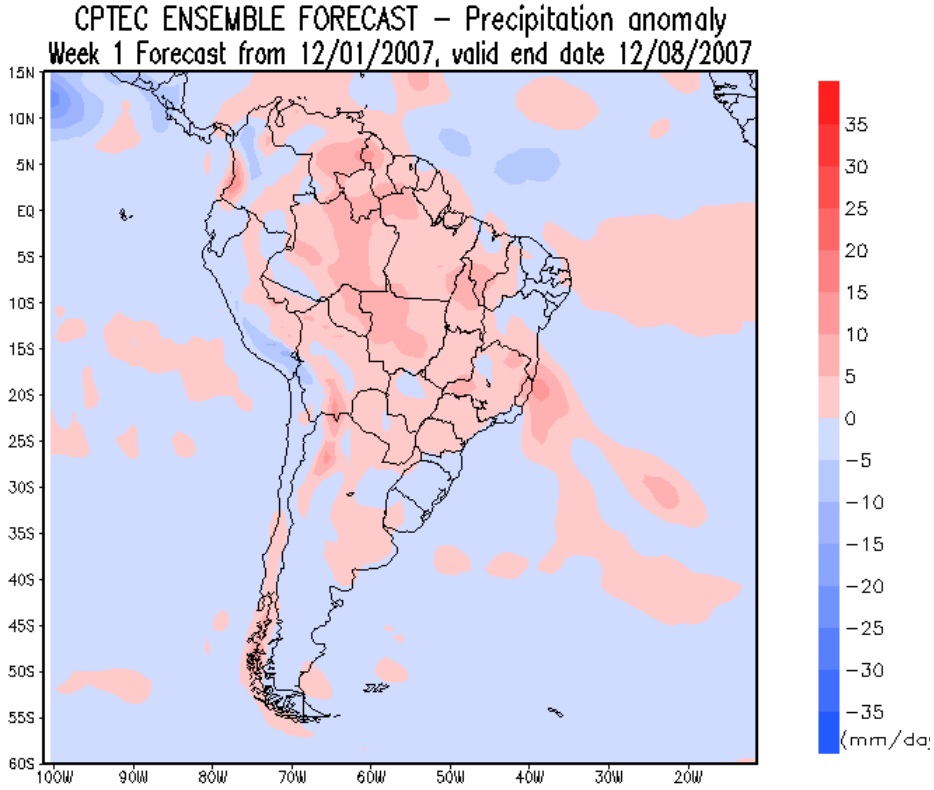
Schematic Diagram

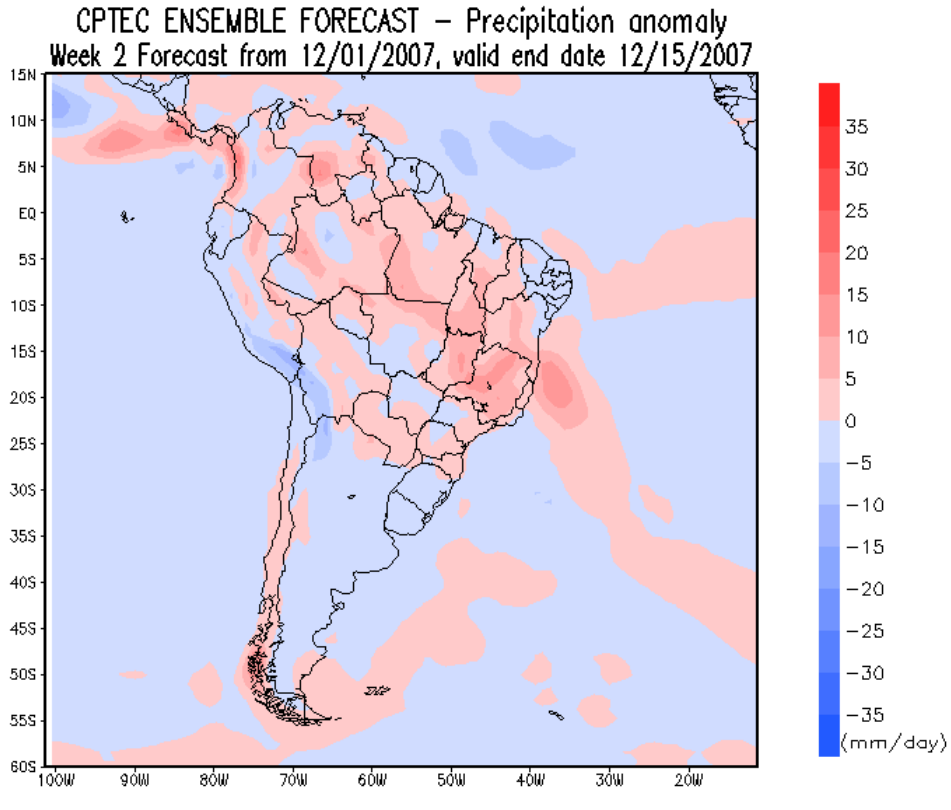


Spaghetti Diagram



Week Mean Precipitation Anomaly





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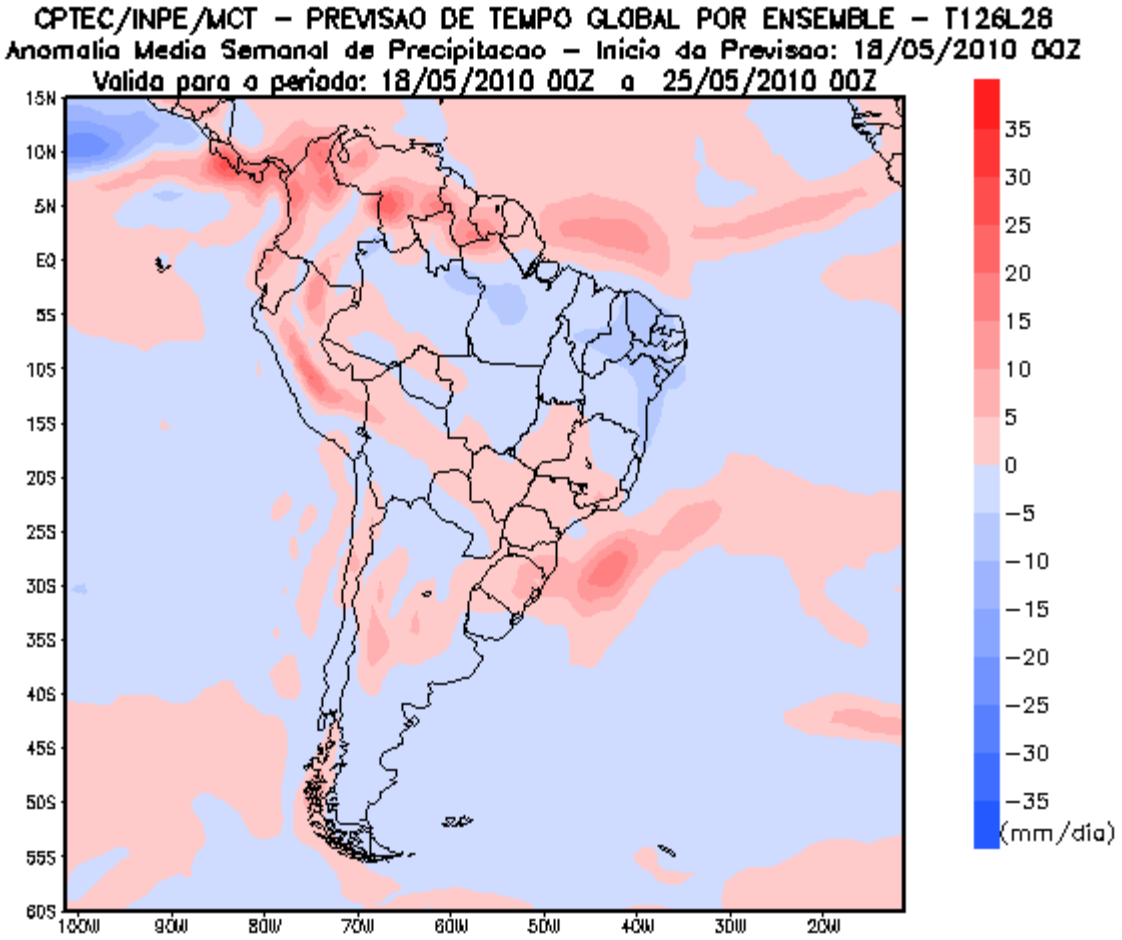
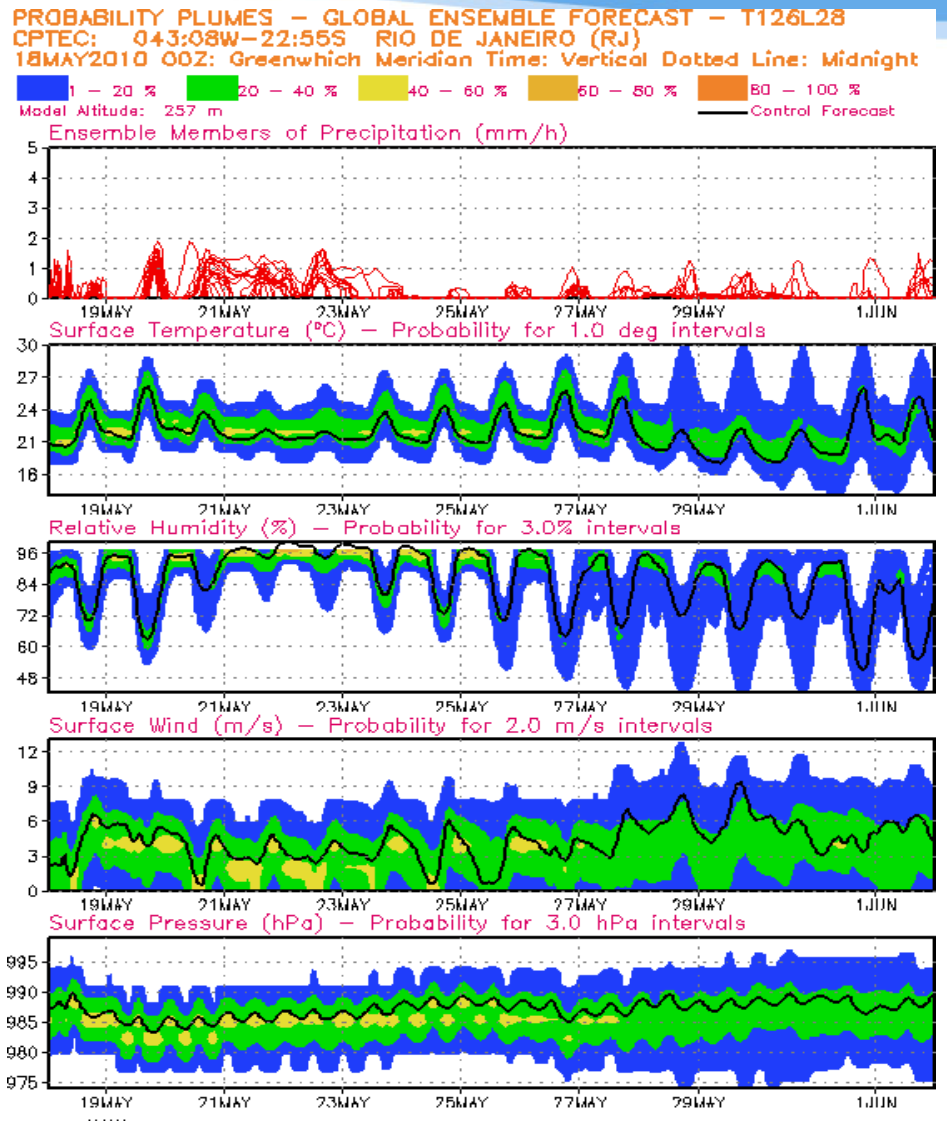
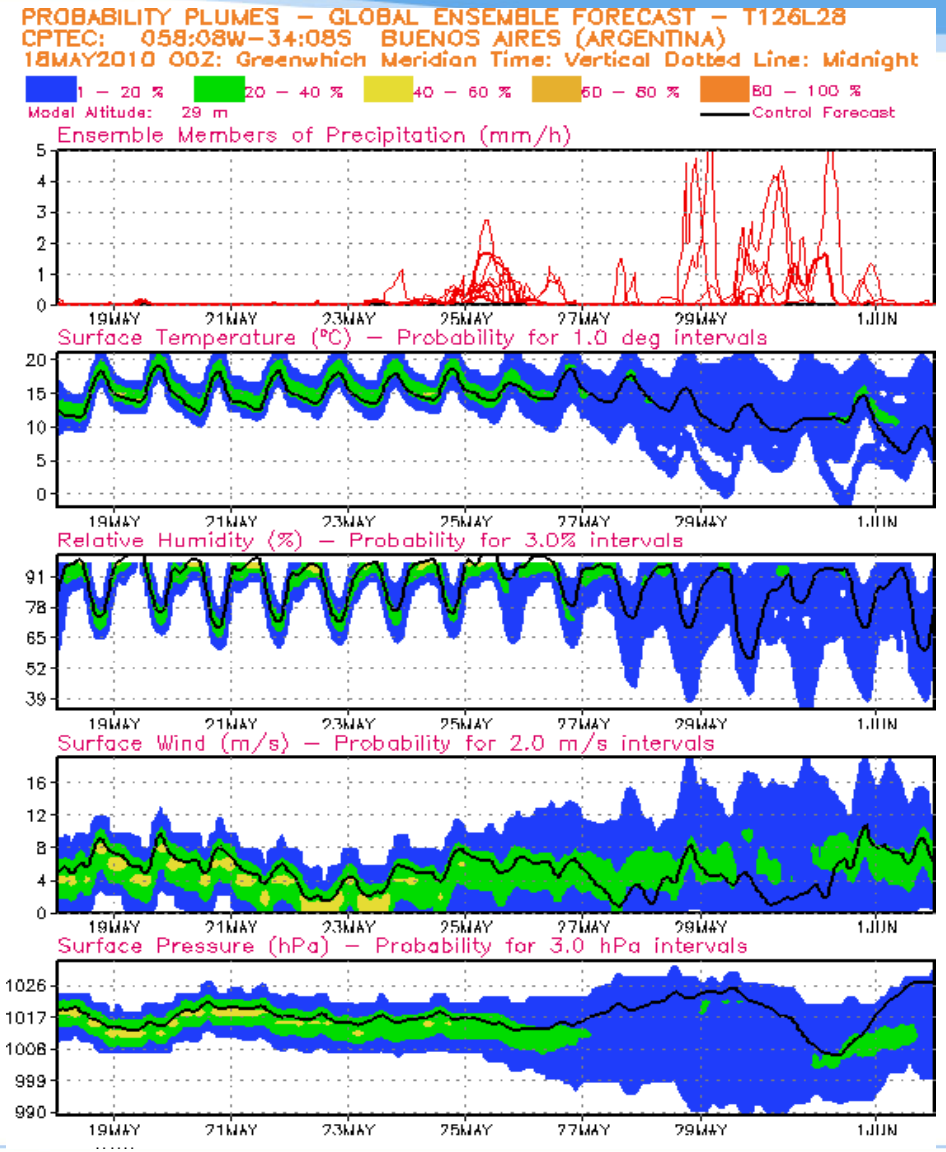


Probability Plumes

- Grid Point for Rio de Janeiro
- Forecast from 05/18/2010 00Z



- Grid Point for Buenos Aires - AR
- Forecast from 05/18/2010 00Z



Evaluations

- Daily statistical indexes calculated:

  → anomaly correlation of ensemble mean

  → root mean square error of ensemble mean

  → mean error (bias) of ensemble mean

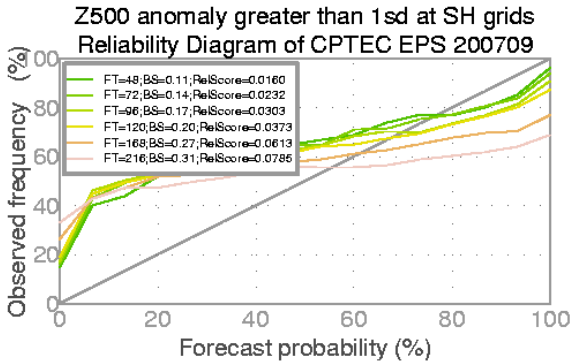
  → ensemble spread

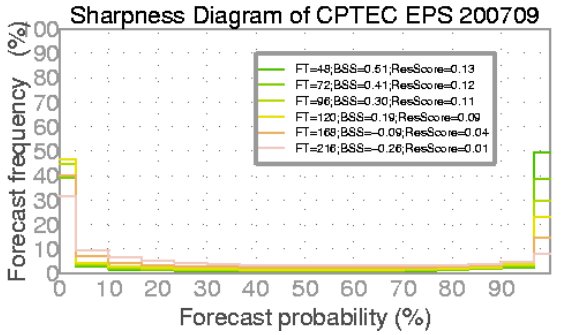
  → deterministic and reliability tables for exchange EPS verification

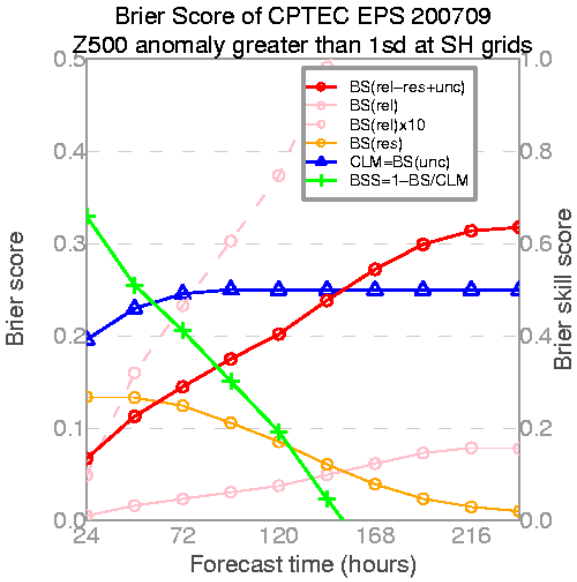
- Results following the instructions of WMO for EPS producers*:*

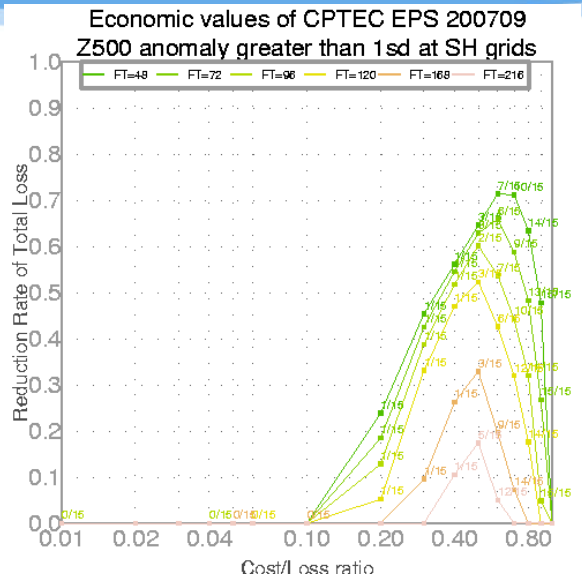
  - monthly mean tables are sent to Lead Center (JMA)

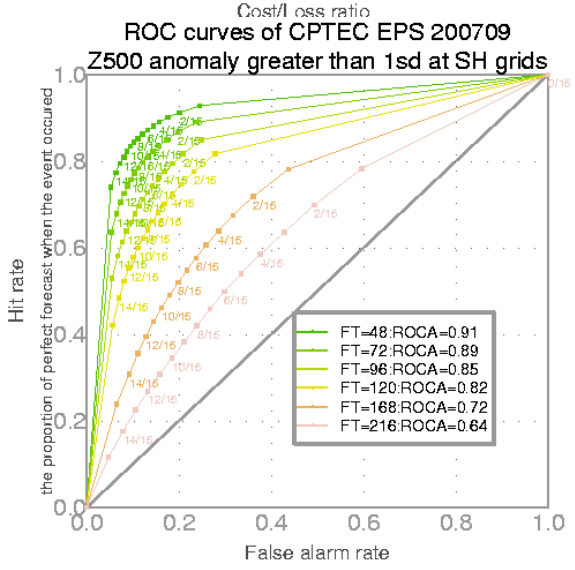
Table for Probabilistic Forecasts











- CPTEC is currently a EPS producer;
- Those scores are sent to the Lead Centre on Verification of Ensemble Prediction System (JMA)
- Bug fixing on the calculation process

TIGGE

- CPTEC is currently recovering data from the TIGGE members, in testing status.

- So far feeds from four origins are able to be downloaded:
  - NCEP Washington, DC
  - AMMC Melbourne, Australia
  - CMC (Canadian Met. Centre), Canada
  - ECMWF, Reading - UK

SREPS

Short Range Ensemble Prediction System

•Method: perturbed initial conditions

•The perturbed initial conditions are obtained from the ensemble weather forecasts generated by the CPTEC global model at T126L28 (GCM EPS);

•The perturbations of CPTEC GCM EPS are based on Empirical orthogonal Functions (EOF);

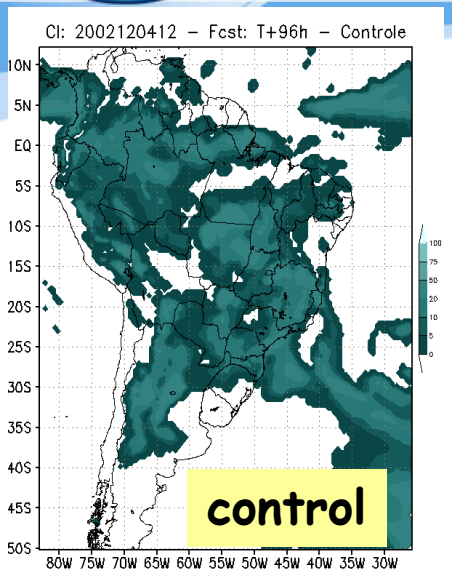
•These perturbations are applied to wind and temperature fields (at 850 hPa) in the tropical region;

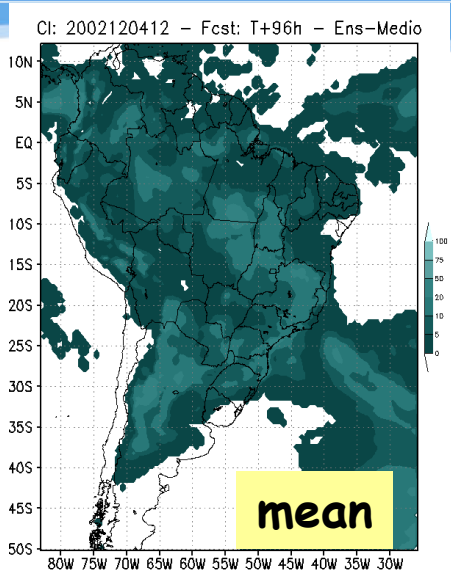
•15 members (1 control + 14 perturbations) are generated;

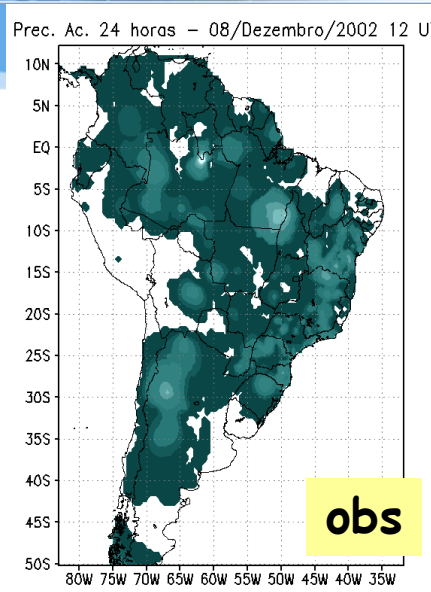
•Cluster analysis is applied and generates 4 groups. One representative member is extracted from each group.

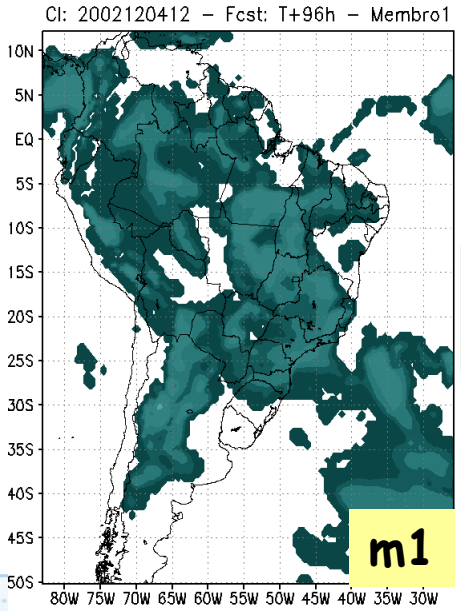
(J. Bustamante, Chou, Mendonça)

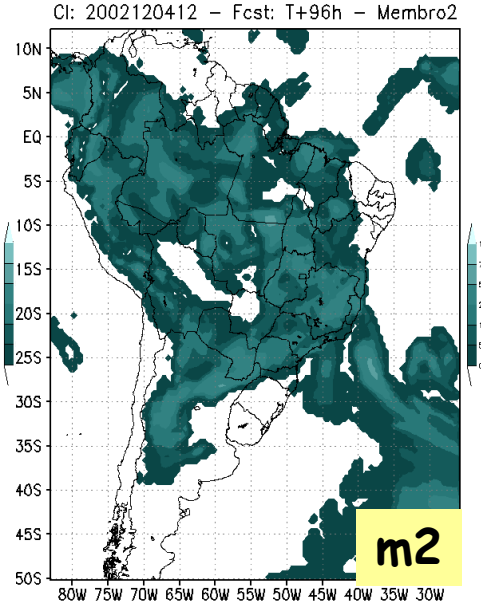
Regional Ensemble Forecast

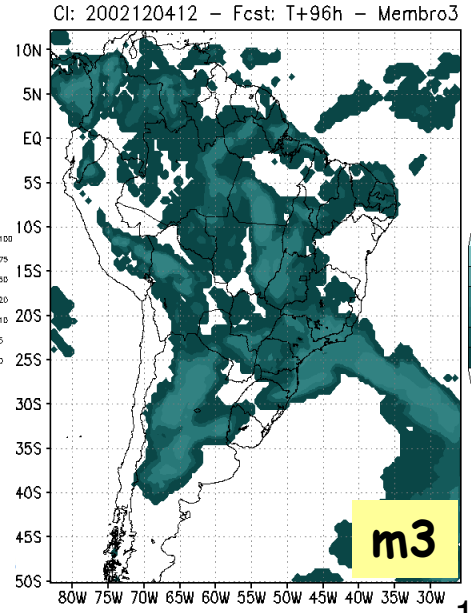


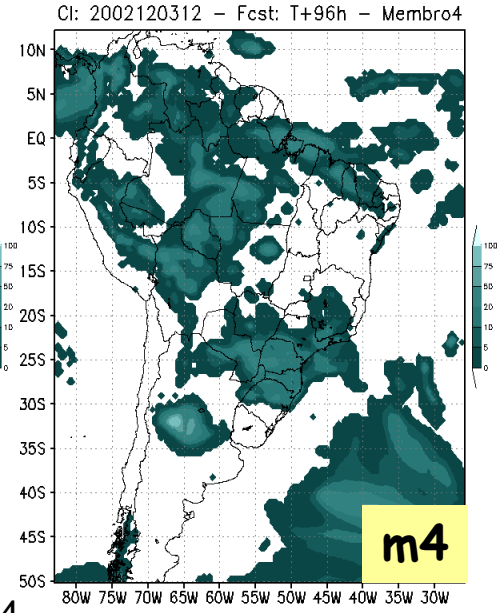








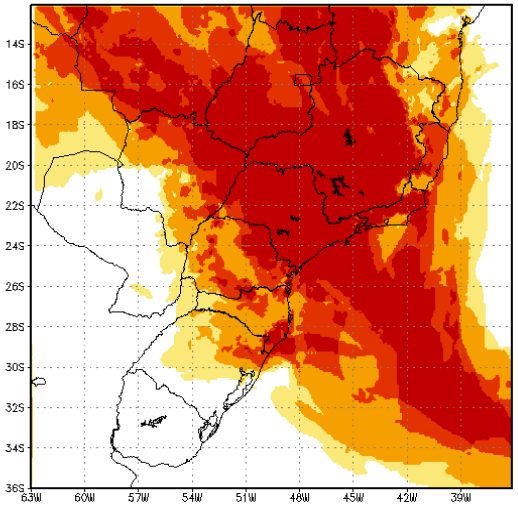




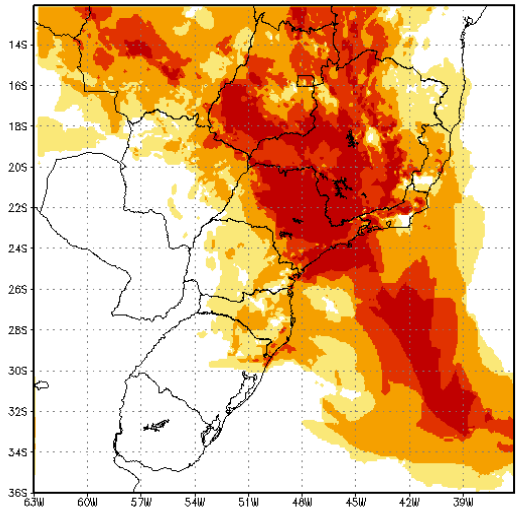
Eta Ensemble Forecast Products

Probability forecasts

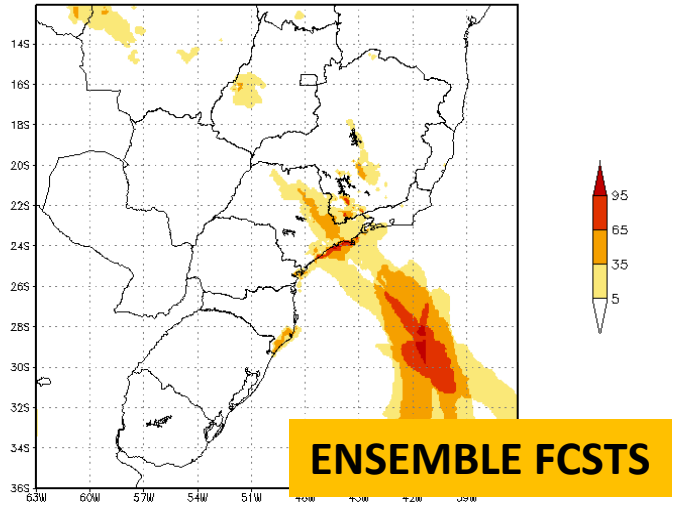
Probabilidade de precipitacao > 1,0 mm – T+7



Probabilidade de precipitacao > 10,0 mm – T



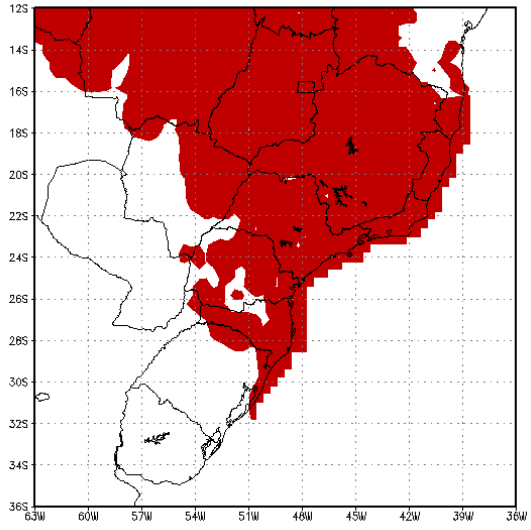
Probabilidade de precipitacao > 50,0 mm – T+72h



ENSEMBLE FCSTS

Precip > 1mm

Precipitacao acima de 1 mm
2000010212



Precip > 10mm

Precipitacao acima de 10 mm
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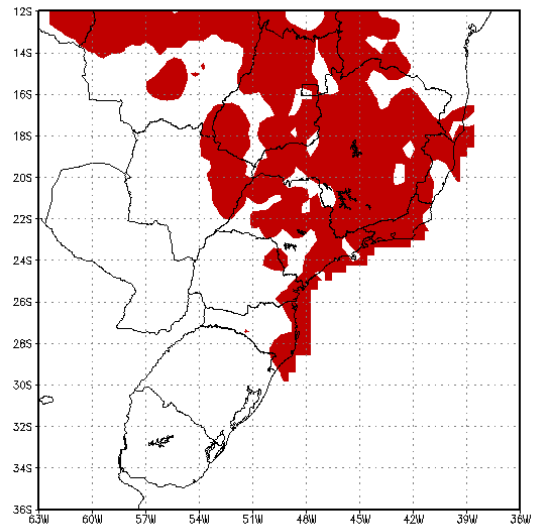
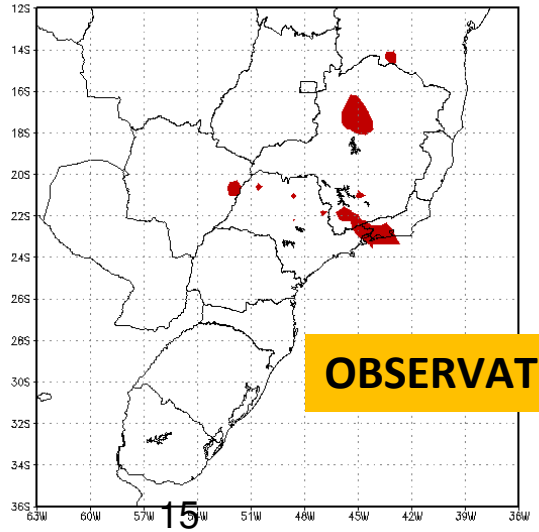


Precip > 50mm

Precipitacao acima de 50 mm
2000010212



OBSERVATIONS

Current Developments

Ensemble of Parameterizations

The multiple ensembles consists of different integrations of the CPTEC/INPE MCGA combining different parameterizations and different perturbed initial conditions;

The combined parameterizations were short and long wave radiation, and deep convection;

The combination of those three parameterizations totalizes six ensembles, which were integrated from 15 perturbed initial conditions each.

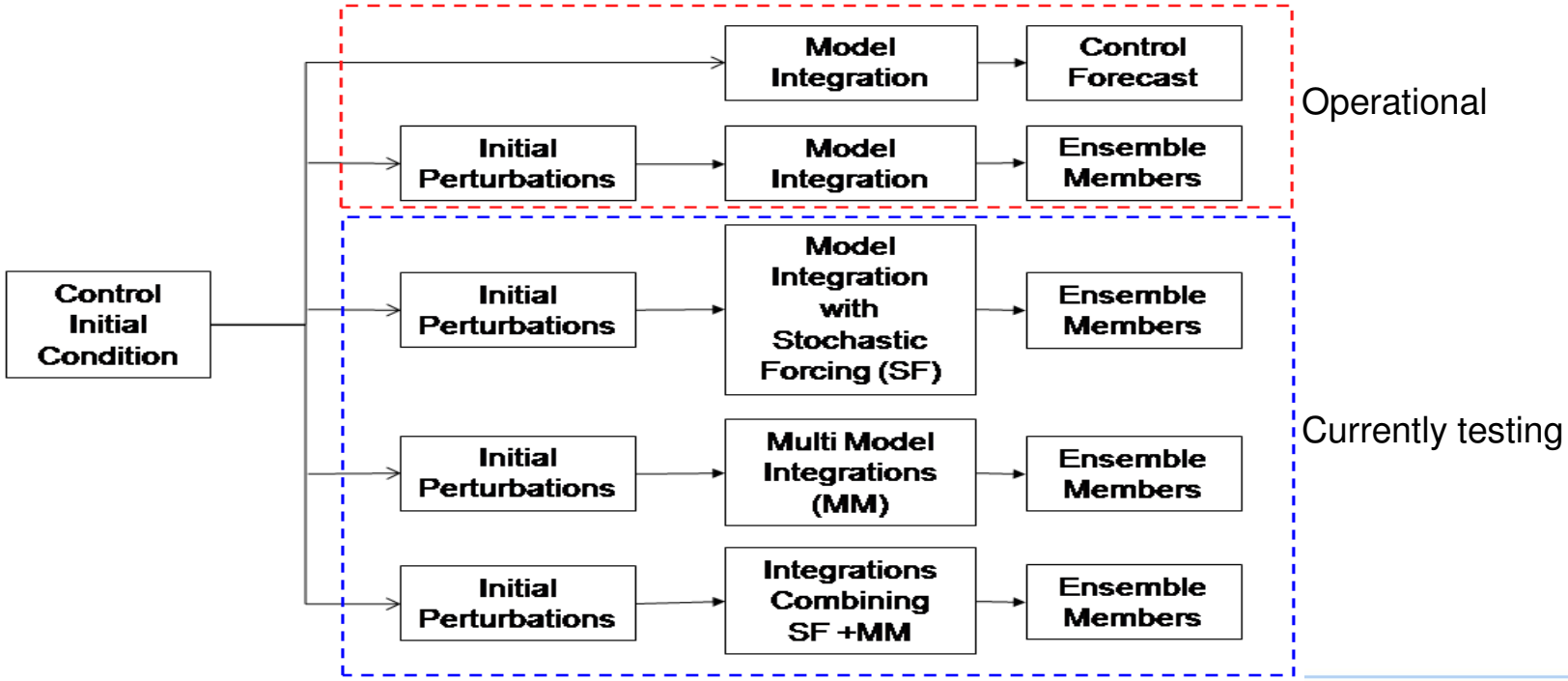
Current Developments

Ensemble of Parameterizations

- Consider the uncertainty on model formulation through perturbation in physics:

• use different parameterizations for model integration (multi-model)

• use stochastic perturbations on the tendency of physical process



Current Developments

MODIFICATIONS ON INITIAL PERTURBATIONS

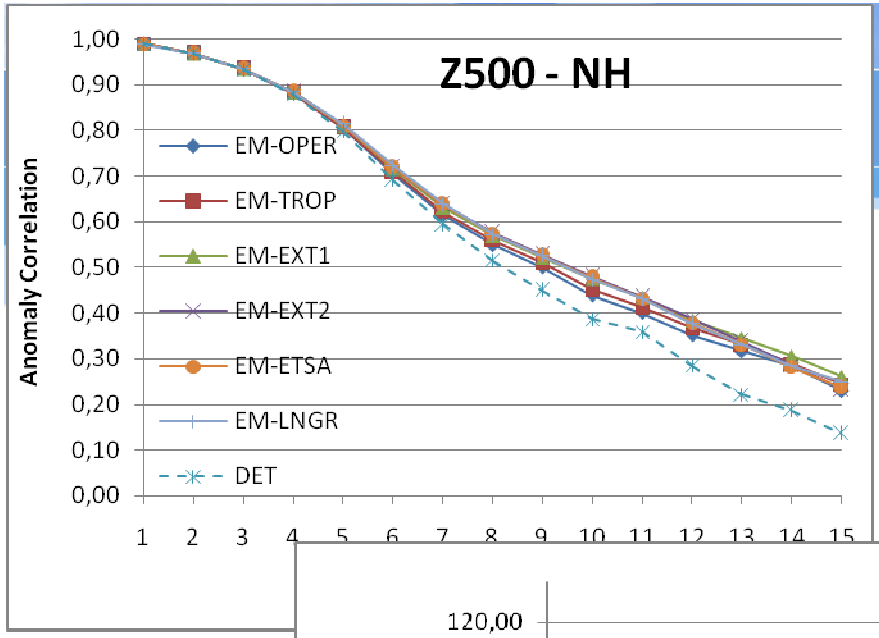
Experiments
(the modifications with respect to operational version are in red)

Experiment	*Regions used for computing perturbations*	*Perturbed fields*	*Unstable modes selecting methodology*
OPER	TRE	T,U,V	mode 1
EXT1	NH,SH,TR	T,U,V	mode 1
TROP	TRE	P,T,Q,U,V	mode 1
EXT2	NH,SH,TR	P,T,Q,U,V	mode 1
ETSA	NH,SH,TR,NSA,SSA	P,T,Q,U,V	mode 1
LNGR	NH,SH,TR,NSA,SSA	P,T,Q,U,V	linear growth

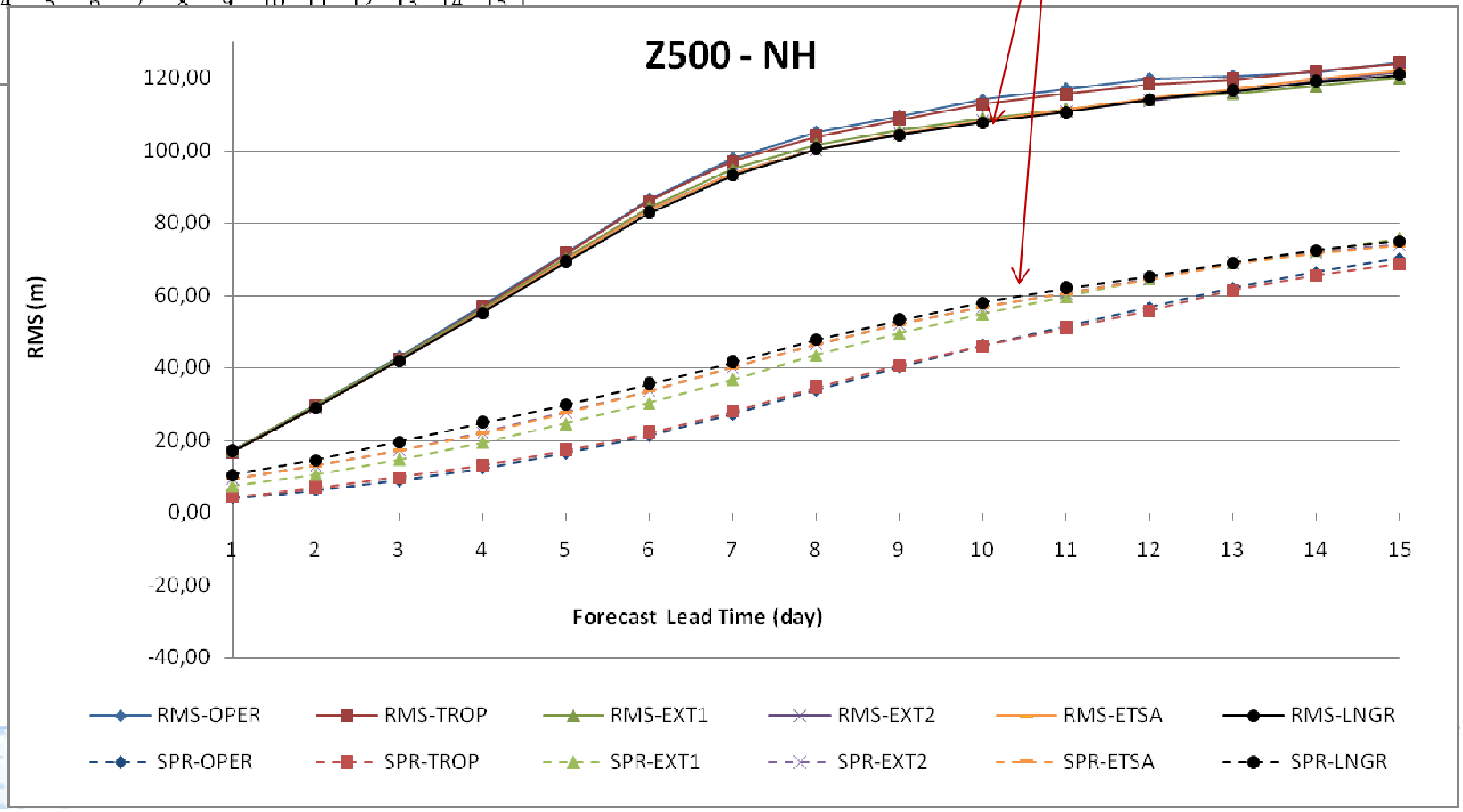
Main Characteristics of the Ensemble Forecasts Evaluated

- performance of the ensemble mean
- ensemble spread
- quality of the probability forecasts
- quality of the perturbations
- Cyclone Catarina trajectory

Performance of Ensemble Mean and Spread – Monthly Average for Jan/2005

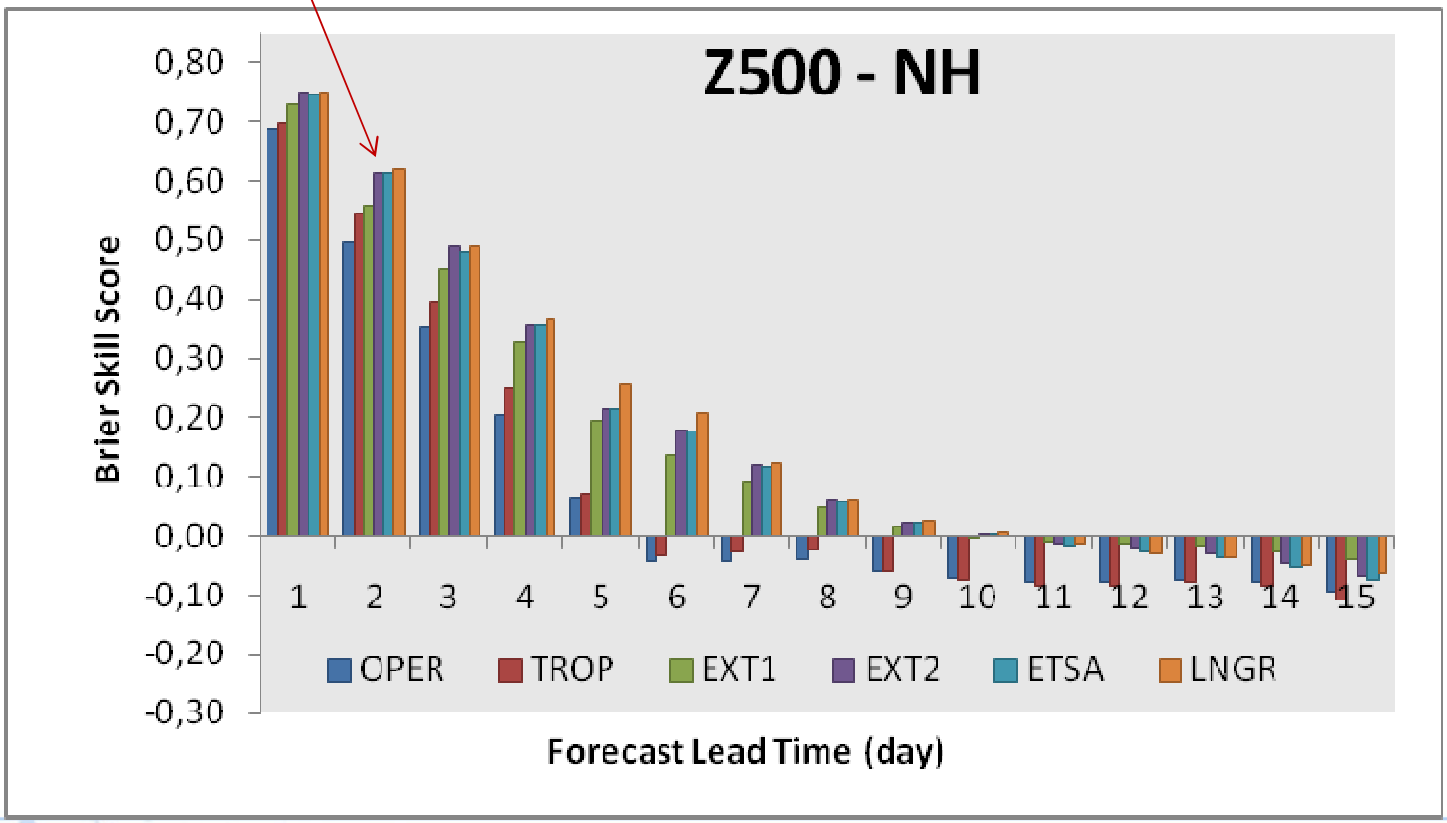


New perturbations reduce the forecast error and increase the ensemble spread



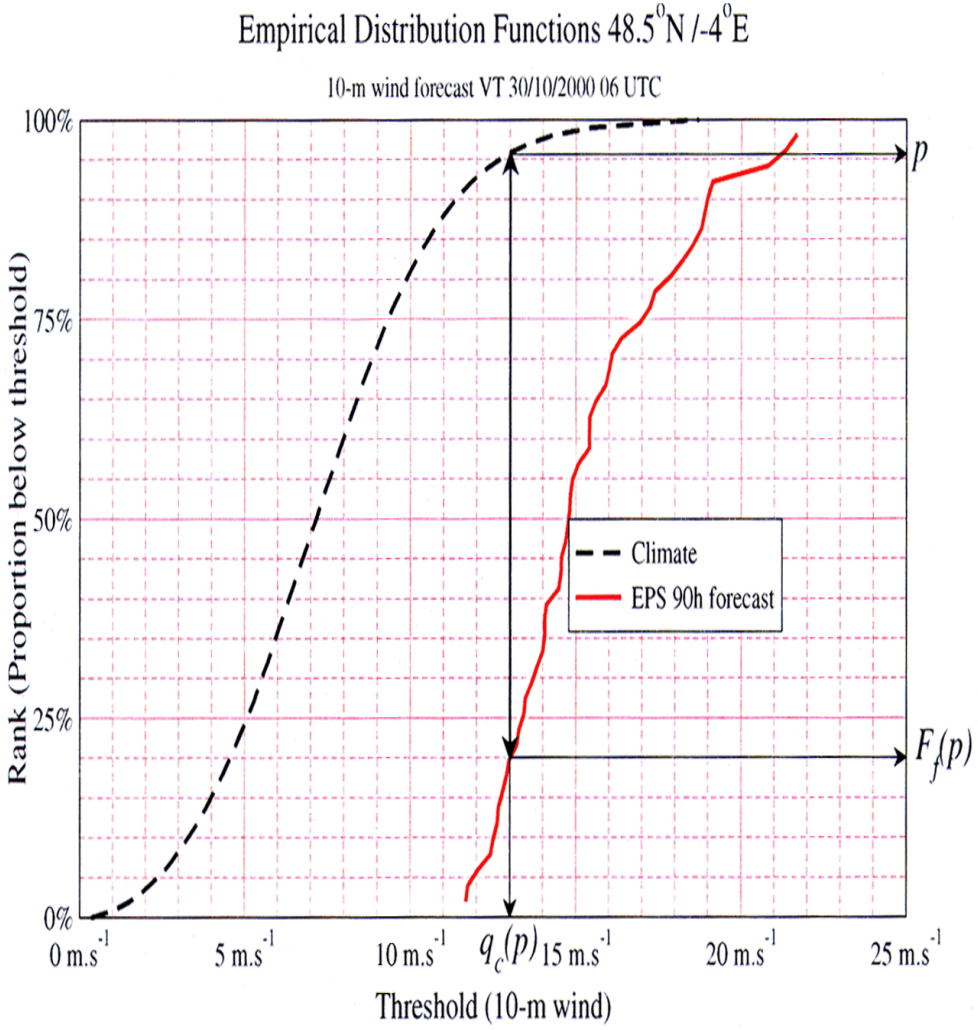
Quality of the probability forecasts
Monthly Average for Jan/2005

Better probabilistic forecasts are obtained with new initial perturbations



Current Developments

Extreme Forecast Index (EFI)



Based on Lalaurette (2003):

It is a measure of the difference between a probabilistic forecast and a model climate distribution

Climatological Distribution:

- based on the ensemble forecasts from each month of three earlier years
- it is used the analyses and the EPS forecasts of lead time 5 and 10 days (15 members for each one)

Future Developments

2011 -2012

Use the Local Ensemble Kalman Filter to Data Assimilation and Ensemble Forecasting for Global and Regional System (collaboration with Eugenia Kalnay group at UMD)

New Supercomputer

- 244 Tflops peak
- 30.500 processors

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Obrigado

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