

Hybrid (empirical-dynamical) EUROBRISA forecasting system

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The Leverhulme Trust



PLAN OF TALK

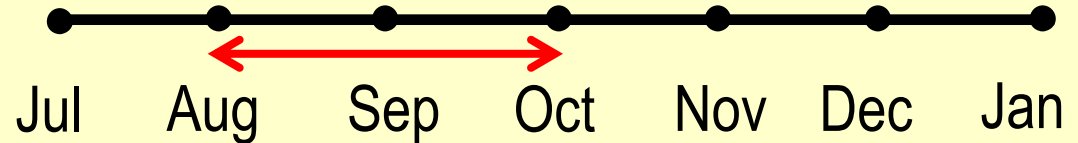
1. Introduction: seasonal precipitation prediction practice in South America
2. EUROBRISA forecasting system
3. Contribution to seasonal forecasting practice in S. America
4. Summary

Developers meeting on the GFCS-relevant climate data, products and tools for implementation of the Climate Services Information System

Geneva, Switzerland, 6-8 December 2016

Introduction

Seasonal prediction: Expected (mean) climate conditions for next 3-6 months



South American seasonal precipitation predictions have been produced since around the mid-nineties using both ***empirical (statistical) models*** and physically based ***dynamical models***

Empirical (statistical): based on past (historical) observations for the predictand (e.g. precipitation over South America) and for relevant predictors (e.g. SST)

Dynamical: based on prognostic physical equations

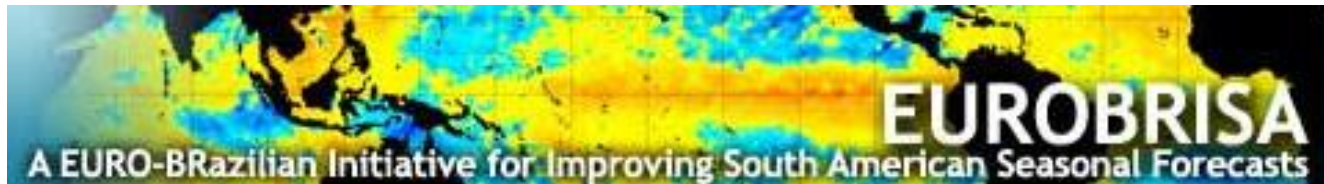
- 2-tier systems (first predict SST, next climate variables)
- 1-tier systems (predict ocean and atmos. together)

Both empir. and dyn. predic. are expressed probabilistically

Seasonal forecast availability

- Empirical/statistical models
- Dynamical atmospheric models
- Dynamical coupled (ocean-atmosphere) models

EUROBRISA conception



<http://eurobrisa.cptec.inpe.br>

Why not combine all available state-of-the-art forecast information from both sources (empirical and dynamical)?



EUROBRISA Integrated (combined and calibrated) precipitation seasonal forecasting system for South America

EUROBRISA

A EURO-BRazilian Initiative for Improving South American Seasonal Forecasts

EUROBRISA Integrated (empirical-dynamical combined and calibrated) precipitation seasonal forecasting system for South America

Collaborative effort:
INPE/CPTEC, Univ. Exeter, ECMWF,
UK Met Office, Météo-France, UFPR,
USP and INMET

Previously supported by:



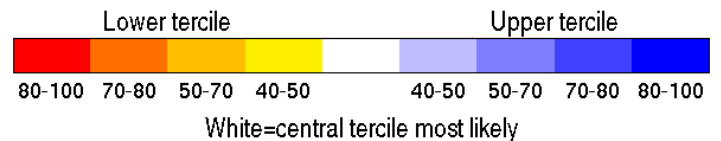
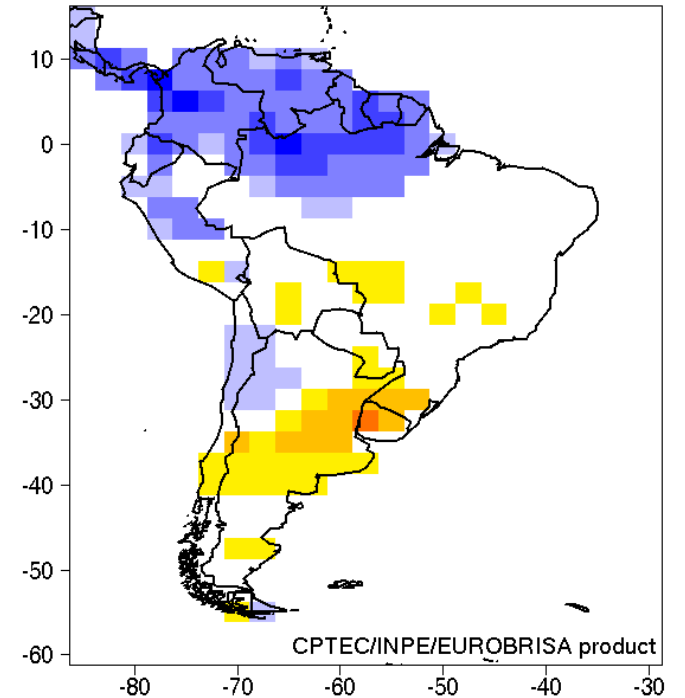
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Currently supported by:



<http://eurobrisa.cptec.inpe.br>

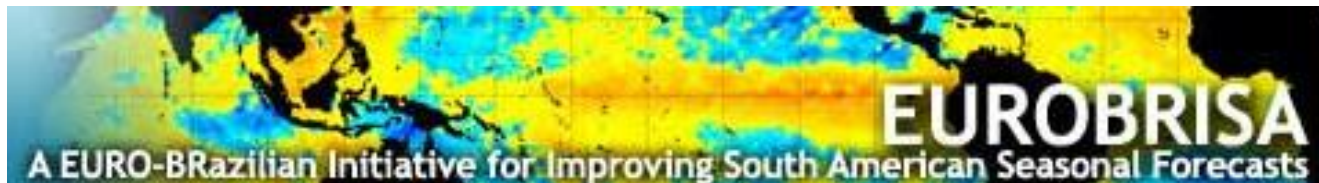
Integrated: Prob. of most likely precip. tercile (%)
Issued: Nov 2016 Valid for DJF 2016



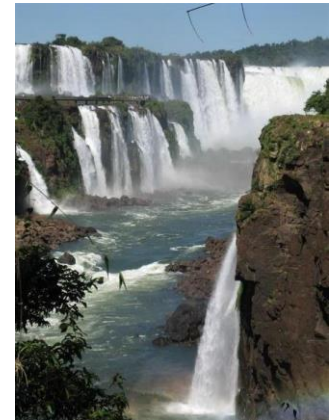
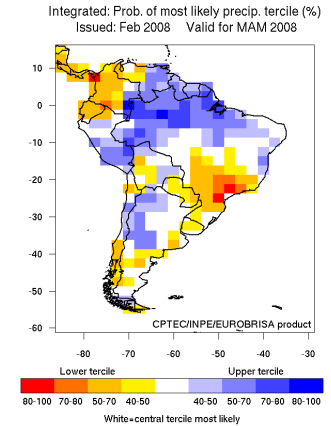
EUROBRISA aims

- Strengthen collaboration and promote exchange of expertise and information between European and South American climate scientists;
- Produce improved seasonal climate forecasts for South America using recent scientific advances in both coupled ocean-atmosphere modelling and statistical calibration and combination of multi-model ensemble forecasts;
- Develop forecast products for non-profitable governmental use in South America (e.g. reservoir management, hydropower production, agriculture and health) **Aligned with GFCS priority areas**

A GREAT OPPORTUNITY
TO DO SOMETHING REALLY USEFUL!



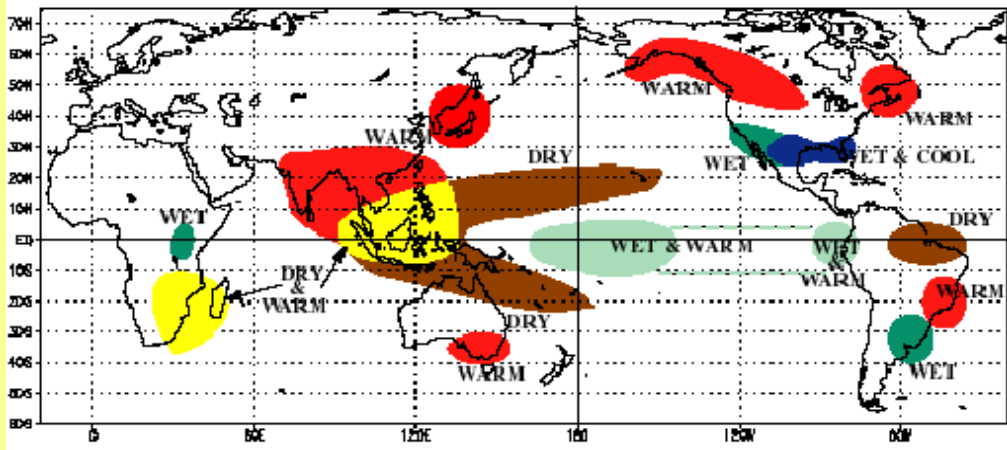
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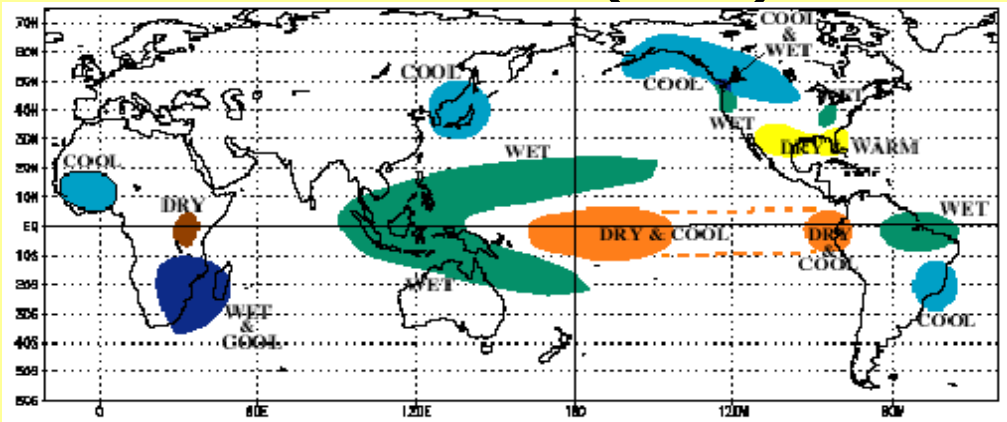
Why South America?

EUROBRISA key Idea: To improve seasonal forecasts in S. America a region where there is seasonal forecast skill and useful value

El Niño (DJF)

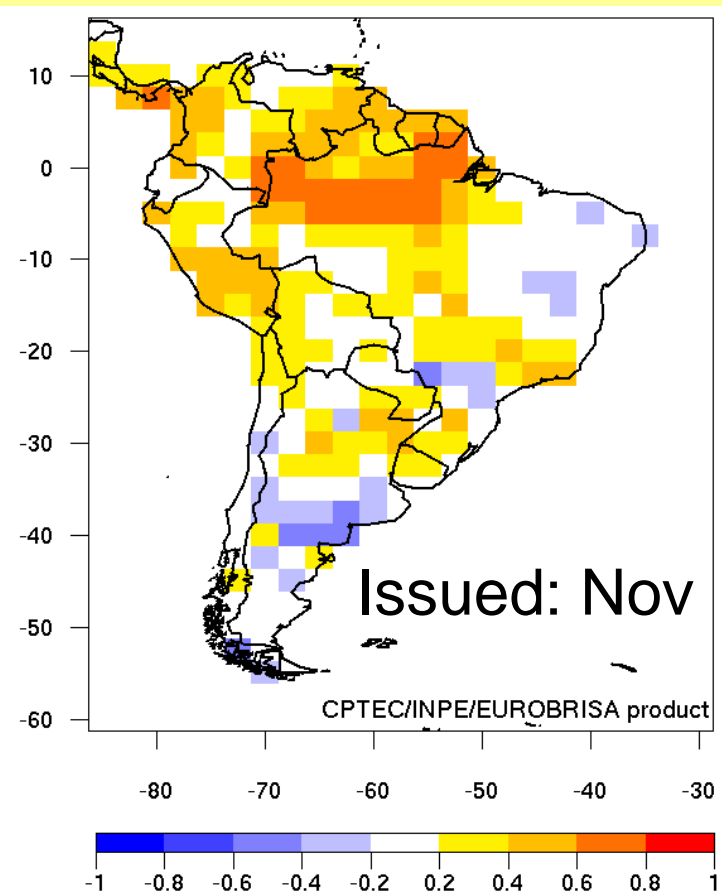


La Niña (DJF)



Source: Climate Prediction Center
(<http://www.cpc.ncep.noaa.gov>)

Correlation skill precipitation forecasts for DJF



Pos. values: moderate-good skill

Application areas in need of seasonal forecasts

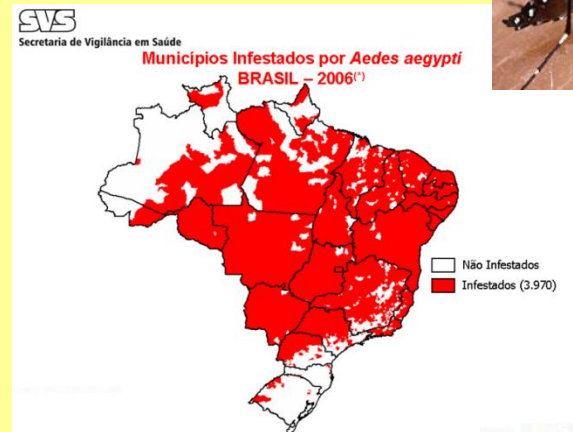
→ Electricity: Brazil, about 70% produced by hydropower stations



→ Agriculture (e.g. crop yield)



→ Health (e.g. dengue)

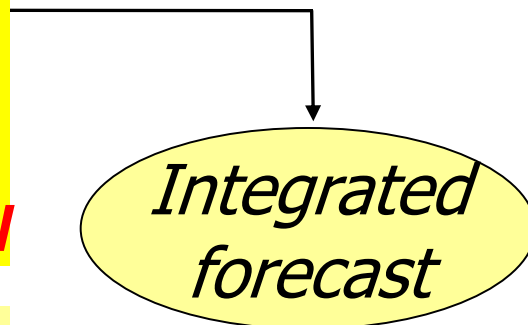


Current EUROBRISA integrated forecasting system for South America

→ Combined and calibrated coupled + empirical precip. forecasts

→ Hybrid multi-model probabilistic system

<i>Couple model</i>	<i>Country</i>
ECMWF Sys 4	International
UKMO GloSea5 GC2	U.K.
Meteo-France Sys 5	France ← NEW



Updated empirical model
Predictors: Atlantic and Pacific SST
Predictand: Precipitation
Coelho *et al.* (2006) *J. Climate*, 19, 3704-3721

Produced with
forecast assimilation
Stephenson et al (2005)
Tellus A . Vol. 57, 253-264

Hindcast period: 1981-2010

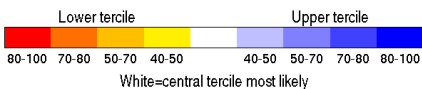
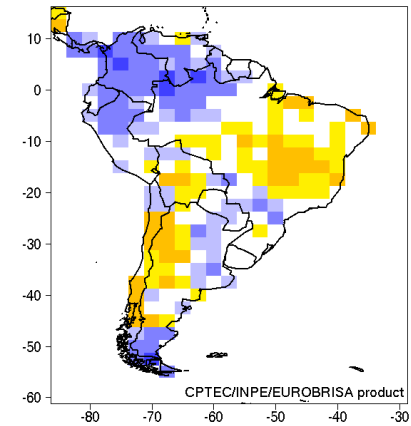
Updated in July 2016

EUROBRISA integrated fcst for DJF 2016/17

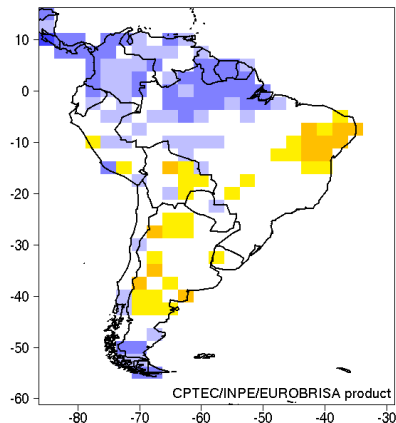
Issued in Nov 2016: Most recent forecast

Obs. SST anomaly Oct 2016

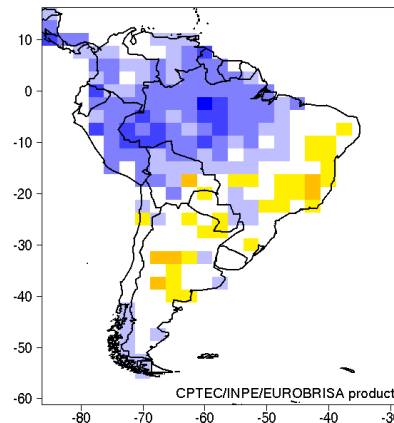
Empirical



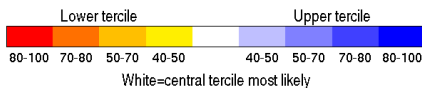
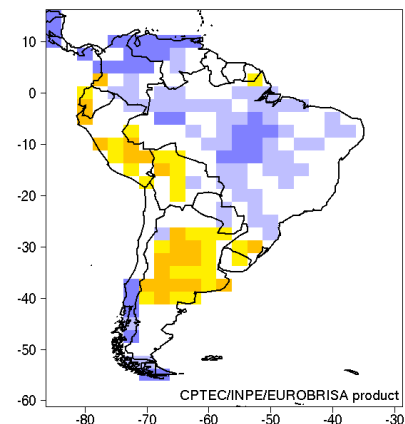
ECMWF



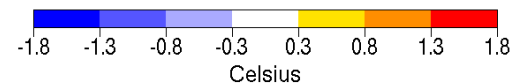
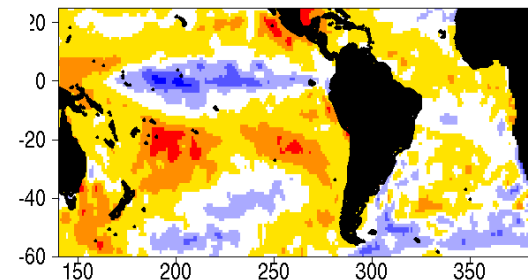
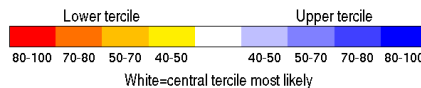
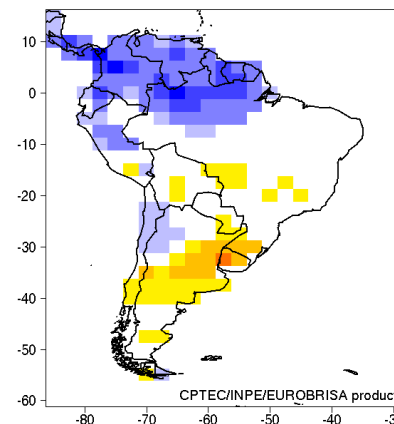
UKMO



Meteo-France



Integrated



Prob. of most likely precipitation tercile (%)



EUROBRISA fcsts disseminated in NCOFs/RCOFs in South America

New version of EUROBRISA system updated Jul 2016

EUROBRISA: A EURO-Brazilian Initiative for improving South American seasonal forecast

INPE CPTec

Home Weather Climate Numerical Forecasts Energy Satellites Waves Observational Data Met. Instrumentation Air Quality

<http://eurobrisa.cptec.inpe.br>

PRODUCTS.

Product: Forecast Variable: precip. Model: Integrated Date Issued: Jul 2016

Forecast Type: Prob. most lik. tercile

→ (Products documentation)
→ Previous EUROBRISA operational System (operational until Jun 2016)

Key idea: To improve seasonal forecasts in South America, a region where there is seasonal forecast skill and useful value

→ HOME

■ AIMS

- Strengthen collaboration and promote exchange of expertise and information between European and South American seasonal forecasters
- Produce improved well-calibrated real-time probabilistic seasonal forecasts for South America
- Develop real-time forecast products for non-profitable governmental use (e.g. reservoir management, hydropower production, and agriculture).

■ PROJECT INFORMATION

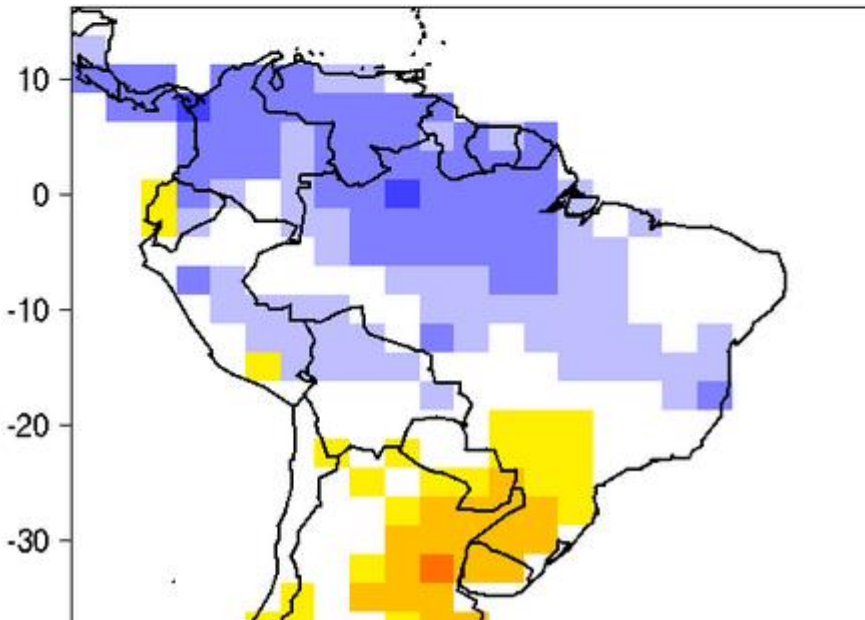
- History
- Partners

■ DOCUMENTS

- EUROBRISA project proposal approved by ECMWF council in June 2005: see page 5 of ECMWF newsletter No. 104
- Leverhulme research network proposal
- Powerpoint overview

■ PRESENTATIONS

Integrated: Prob. of most likely precip. tercile (%)
Issued: Oct 2016 Valid for NDJ 2016



Hybrid (empirical-dynamical) multi-model ensemble system for South America

New version of EUROBRISA system updated Jul 2016



<http://eurobrisa.cptec.inpe.br>

PRODUCTS.

Product: Forecast Variable: precip. Model: Integrated Date Issued: Jul 2016

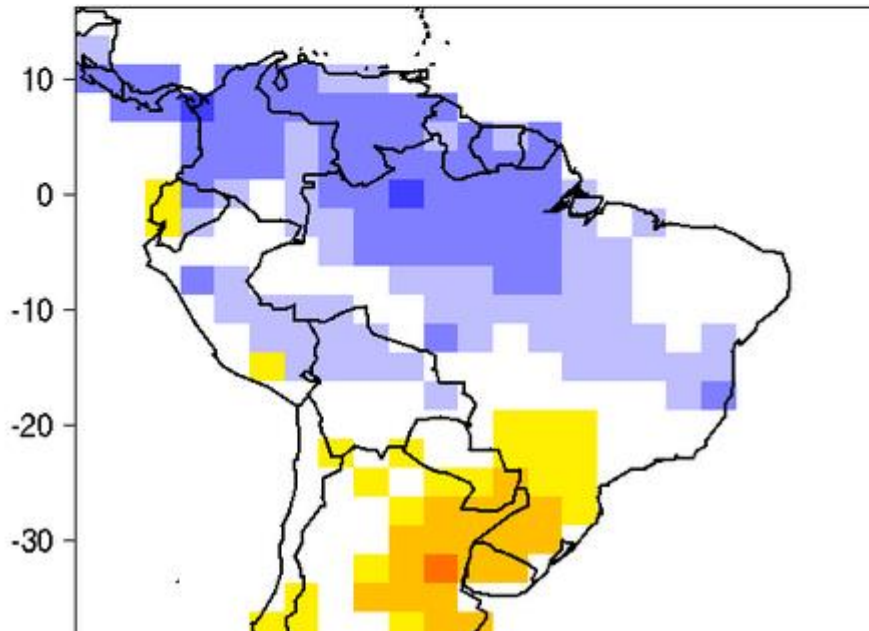
Forecast Type: Prob. most lik. tercile

→ (Products documentation)
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Key idea: To improve seasonal forecasts in South America, a region where there is seasonal forecast skill and useful value

Real-time forecast and verification products

Integrated: Prob. of most likely precip. tercile (%)
Issued: Oct 2016 Valid for NDJ 2016



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PRESENTATIONS

Hybrid (empirical-dynamical) multi-model ensemble system for South America

New version of EUROBRISA

1-month lead forecasts

EUROSIP: ECMWF (System 4)

UKMO (GloSea 5 GC2)

Meteo-France (System 5) (NEW)

Empirical (SST based)

Integrated (Combination of 4 models above)



<http://eurobrisa.cptec.inpe.br>

Key idea: To improve seasonal forecasts in South America, a region where there is seasonal forecast skill and useful value

PRODUCTS.

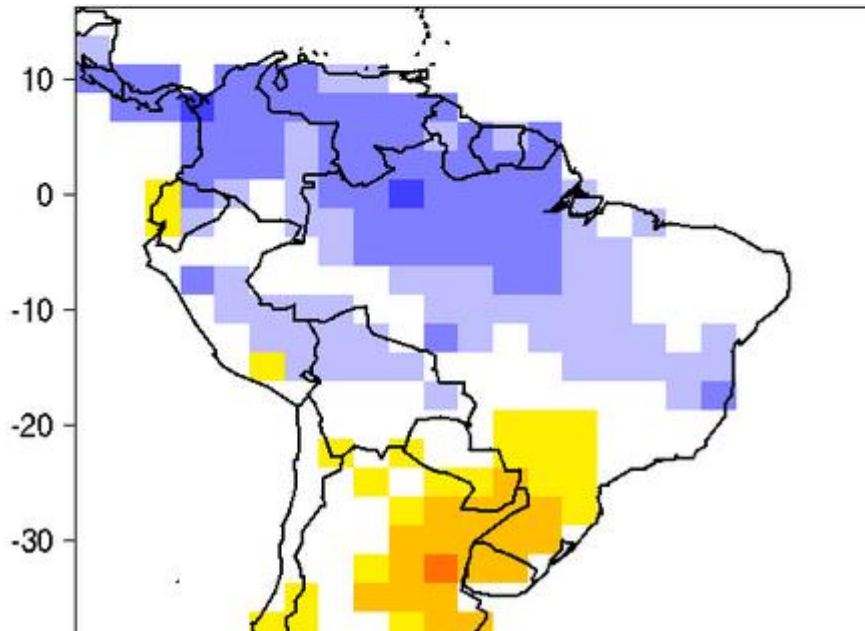
Product: Forecast Variable: precip. Model: Integrated Date Issued: Jul 2016

Forecast Type: Prob. most lik. tercile

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Real-time forecast and verification products

Integrated: Prob. of most likely precip. tercile (%)
Issued: Oct 2016 Valid for NDJ 2016



AIMS

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PROJECT INFORMATION

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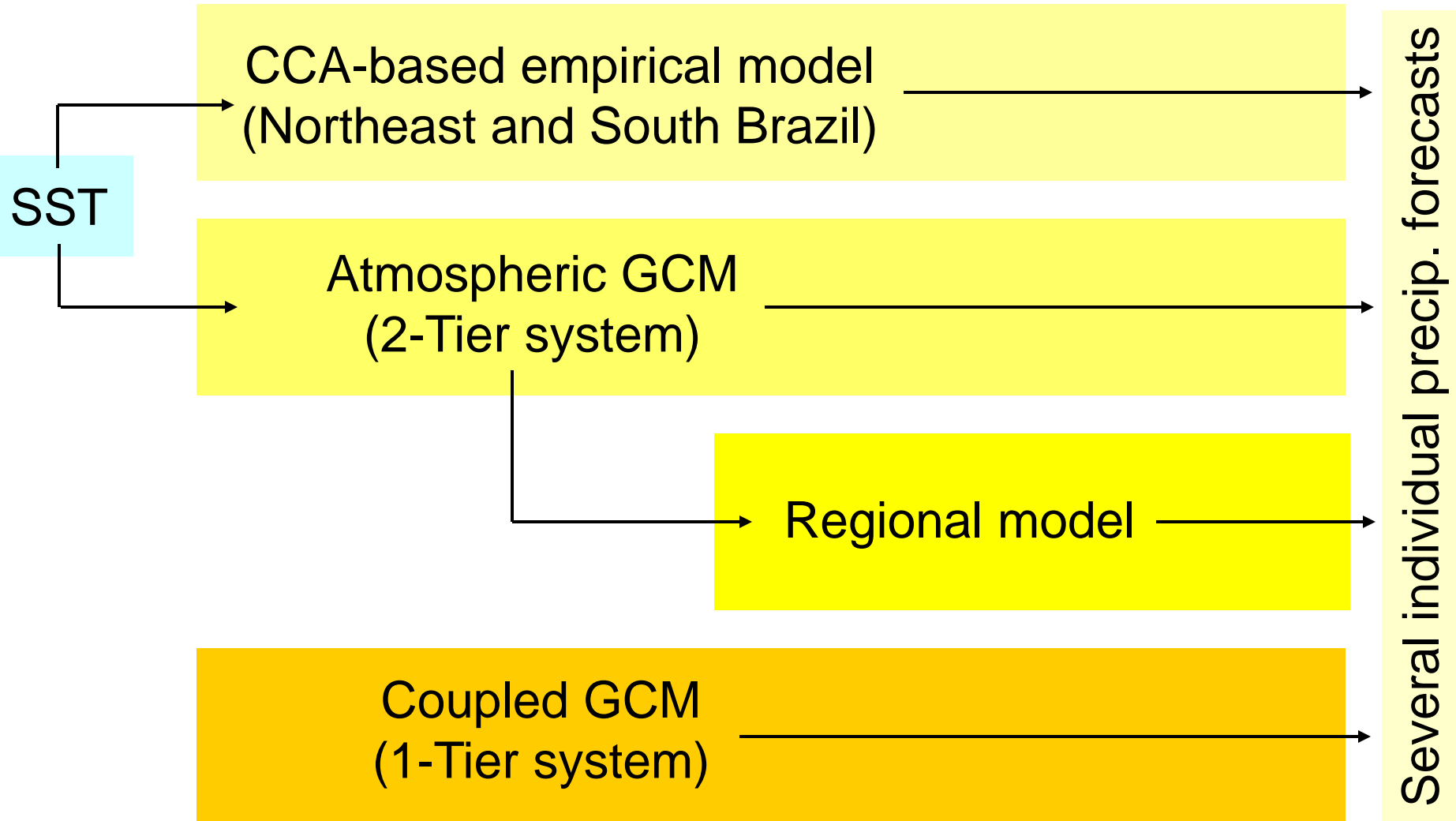
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PRESENTATIONS

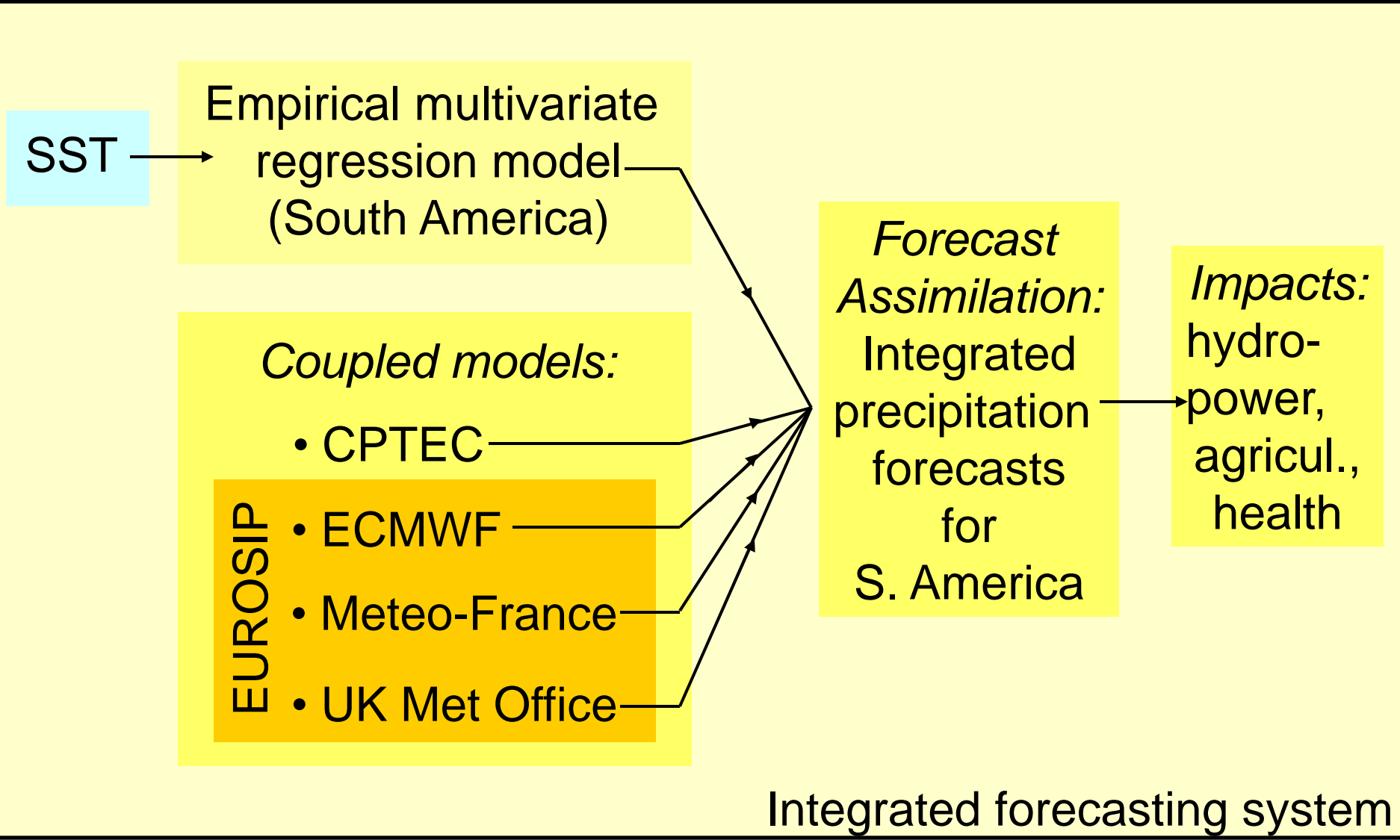
Hybrid (empirical-dynamical) multi-model ensemble system for South America

How has EUROBRISA contributed for improving seasonal forecasting practice in S. America?

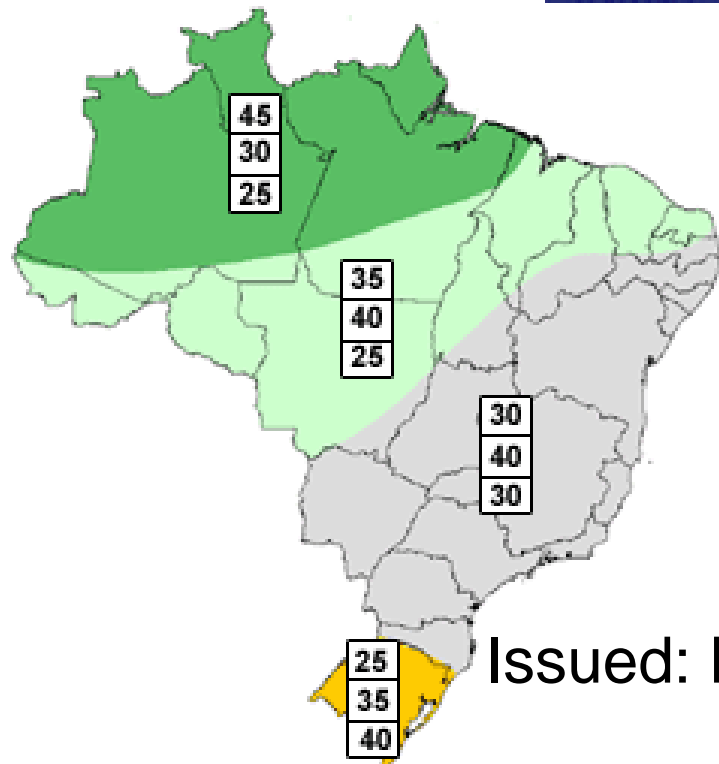
Seasonal forecasting system before EUROBRISA



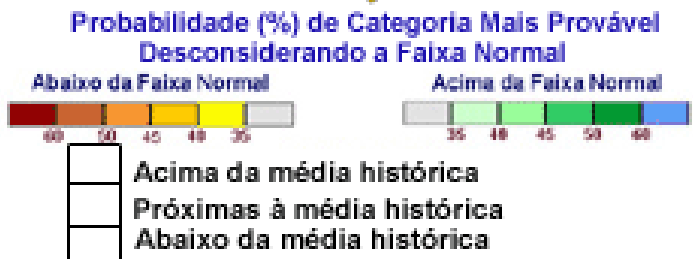
After EUROBRISA



Official forecast for Brazil for DJF 2010/2011

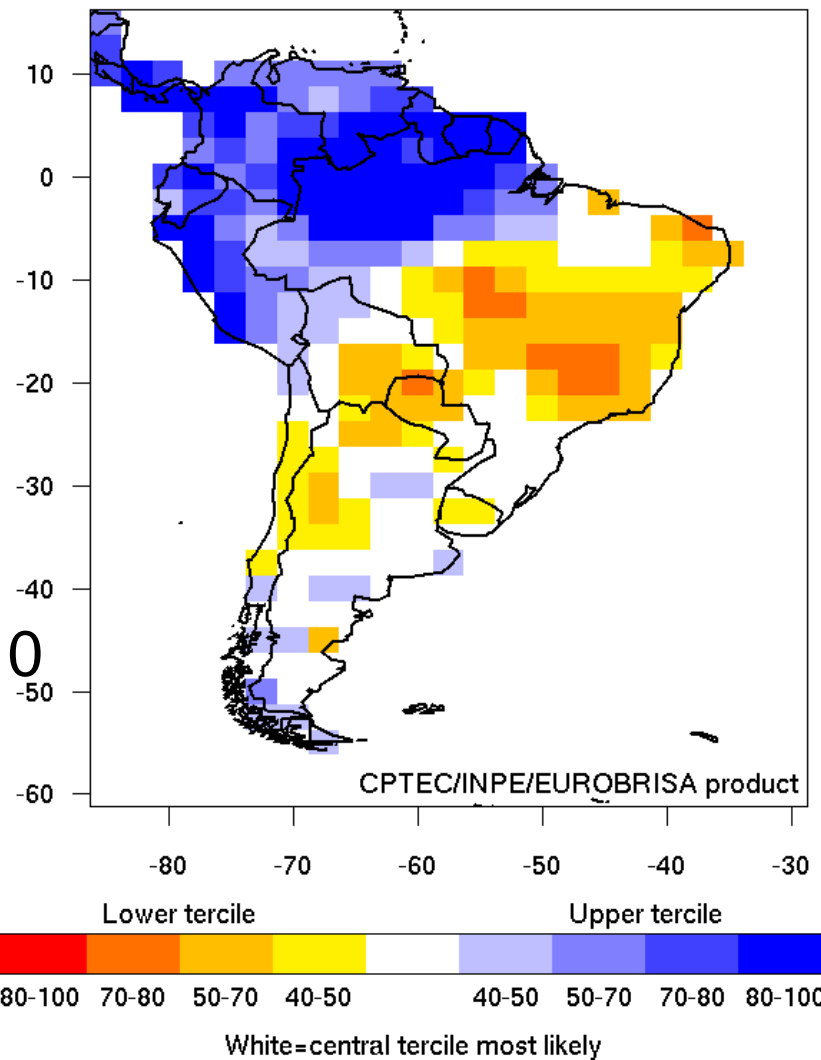


Issued: Nov 2010



EUROBRISA forecast for DJF 2010/2011

Integrated: Prob. of most likely precip. tercile (%)
Issued: Nov 2010 Valid for DJF 2010



→EUROBRISA forecast helps define official seasonal forecast in Brazil

Summary: EUROBRISA forecast system

- Successful research initiative bringing together expertise on coupled ocean-atmosphere seasonal forecasting and statistical calibration and combination of multi-model ensemble forecasts
- Developed novel integrated precipitation seasonal forecasting system for South America
- Developed research and demonstrations on the integration of seasonal forecasts in relevant GFCS priority areas
- Helped improve and advance seasonal forecasting practice in South America by objectively combining empirical and dynamical model seasonal forecasts
- Forecast products disseminated to RCOFs and NCOFs and readily available via EUROBRISA website

Acknowledgements

- ECMWF, Météo France and UK Met Office for providing the seasonal forecast data for EUROBRISA
- Leverhulme Trust for funding the EUROBRISA network project (F/00144/AT)
- FAPESP foundation for research funding
- EU for funding the SPECS project that supported the maintenance of EUROBRISA

THANK YOU FOR YOUR ATTENTION!

EUROBRISA articles: forecasting system

- Coelho C.A.S., 2010: A new hybrid precipitation seasonal forecasting system for South America. XVI Brazilian congress of meteorology.
- Coelho C.A.S., 2009: Hybrid precipitation seasonal forecasts for South America. 9th International Conference on Southern Hemisphere Meteorology and Oceanography.
- Coelho C.A.S., 2008: EUROBRISA: A EURO-BRazilian Initiative for improving South American seasonal forecasts. XV Brazilian congress of meteorology.
- Coelho C.A.S., D.B. Stephenson, F.J. Doblus-Reyes, M. Balmaseda and R. Graham, 2007: Integrated seasonal climate forecasts for South America. CLIVAR Exchanges. No.43. Vol. 12, No. 4, 13-19.
- Tim E. Jupp, T. E., R. Lowe, C.A.S. Coelho and D. B. Stephenson, 2012: On the visualization, verification and recalibration of ternary probabilistic forecasts. *Phil. Trans. R. Soc. A*, 370, 1100–1120

Available at <http://eurobrisa.cptec.inpe.br/publications.shtml>