MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Understanding and forecasting extreme weather events in Andes lee side: The Relampago opportunity

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Pan-WCRP Modelling Groups Meeting
Exeter - Oct 2017

Outline

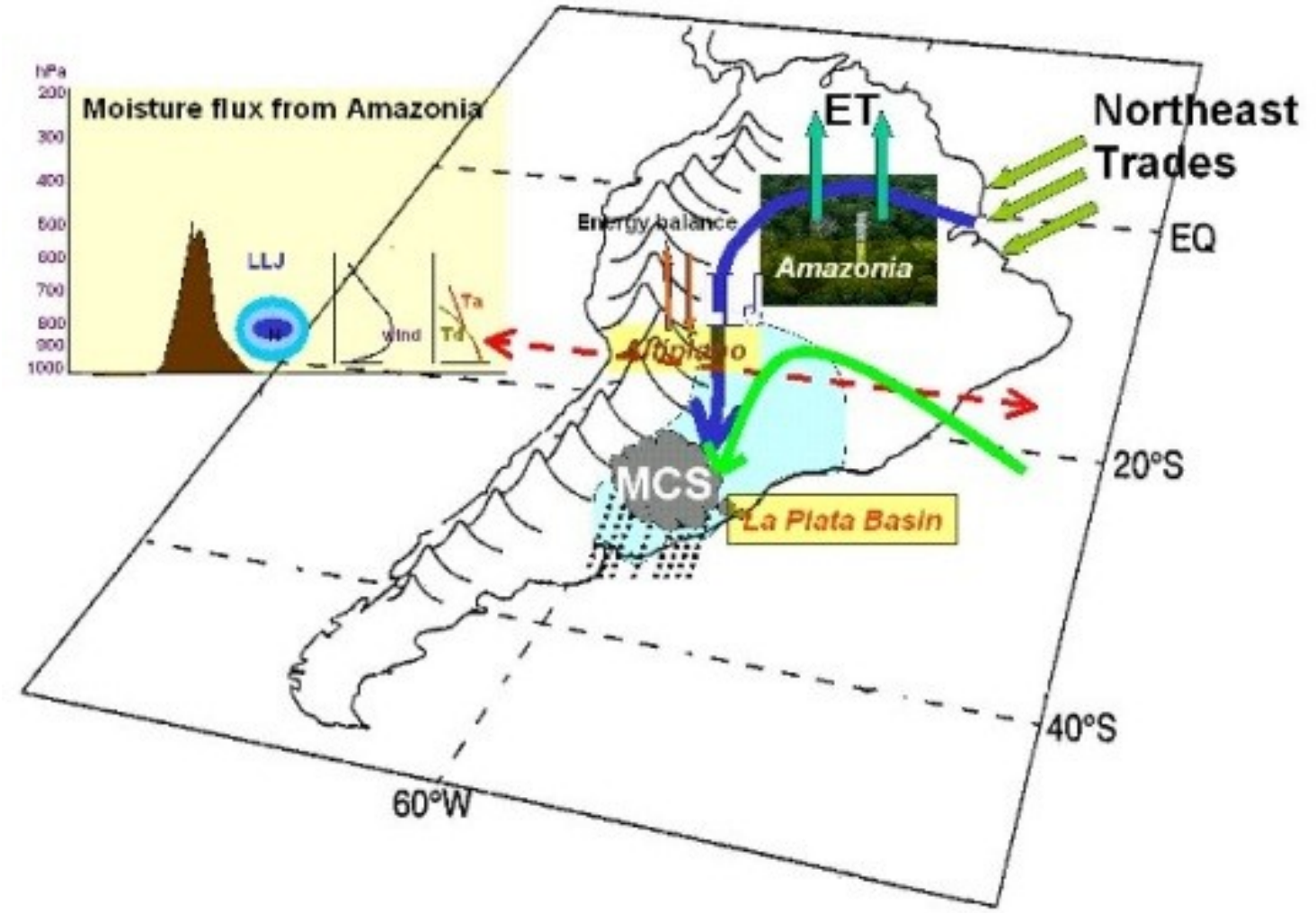
South American synoptic and mesoscale characteristics

What has been leaned from field campaigns in South America

The RELAMPAGO project

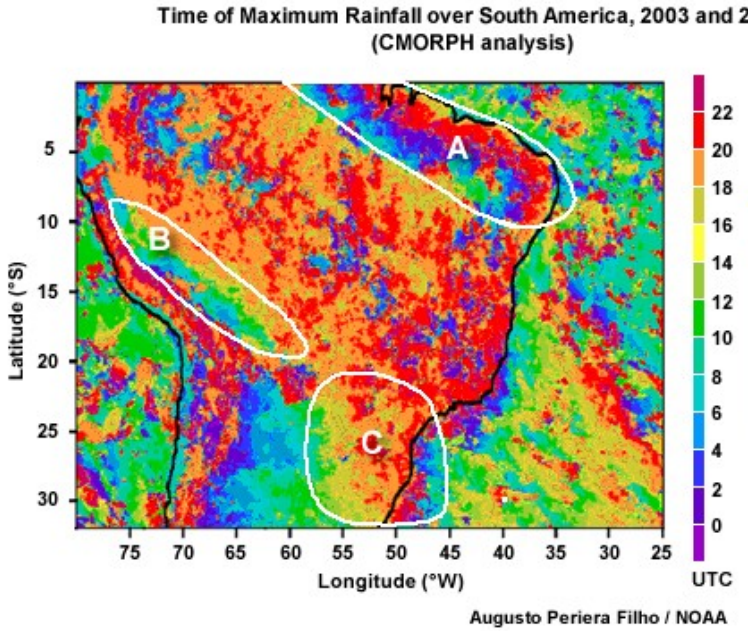
CPTEC/INPE modeling efforts

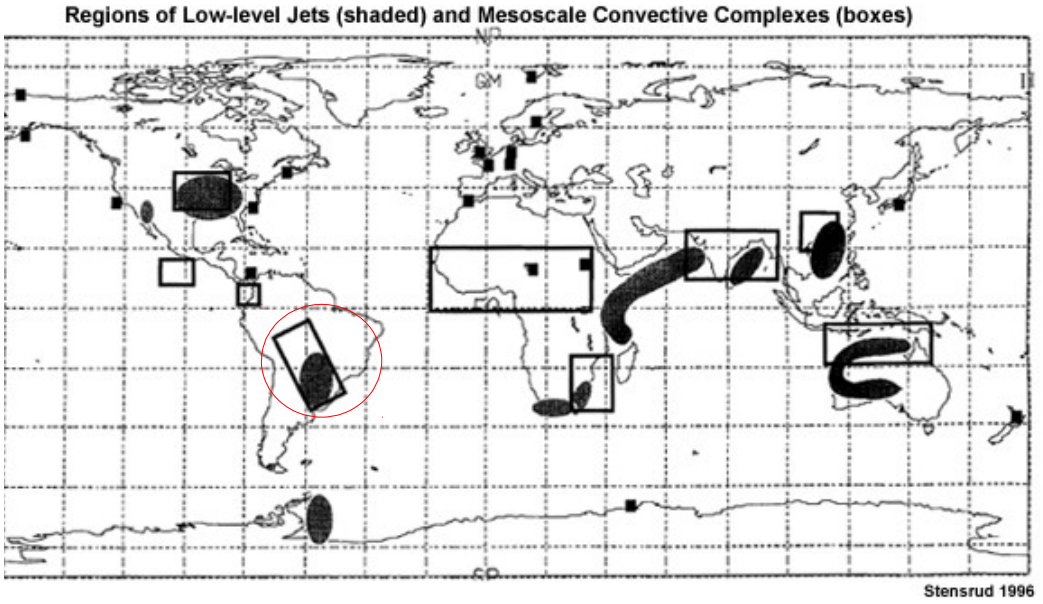
Meteorological systems that influence Southern South America



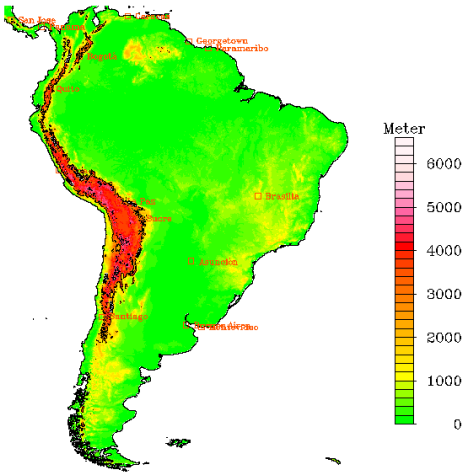
Marengo et al., 2004, J. Clim.

Mesoscale convective systems in South America

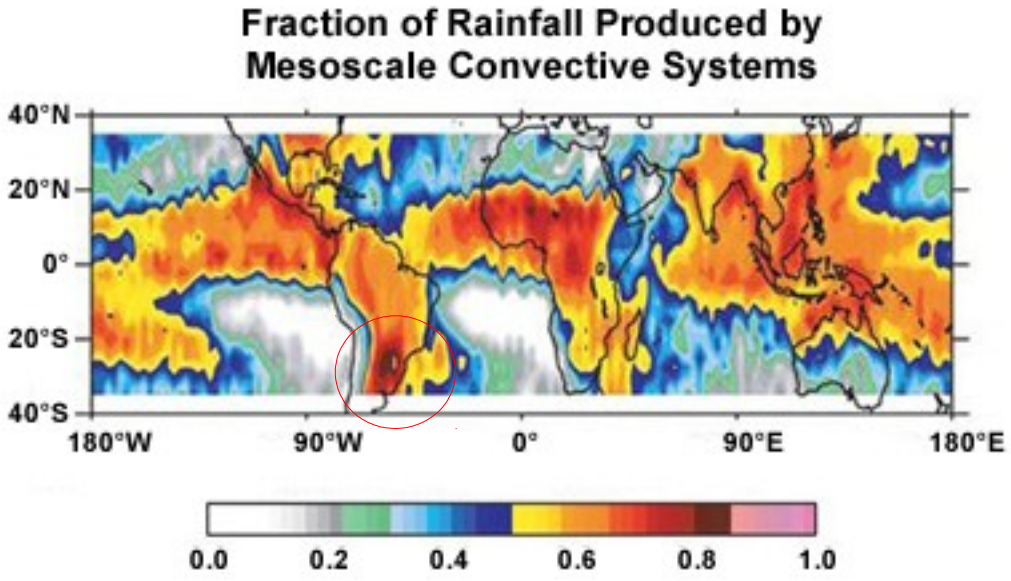




Stensrud, 1996, J. Climate



Nesbitt et al., 2006, Mon. Wea. Rev.



Topography
USGS

What was learned during prior experiments in the region

SALLJEX (2003) – La Plata Basin

- The position and intensity and internal structure of the LLJ: **The network deployed during SALLJEX was not enough to describe the mesoscale environment or convective initiation.**

- A relationship between SACZs, Chaco Low and SALLJ – synoptic scale

- The relationship between MCS and SALLJ

- The sounding network: most were at 06 UTC (overnight)

Adapted from RELAMPAGO project

What was learned during prior experiments in the region

CHUVA*-SUL (2012) – Rio Grande do Sul, Brazil

- New regional radar networks (in regions they are currently deployed) can be useful in describing the mesoscale structure of systems, but capabilities (Doppler, dual-Polarization) vary at present
- Large scale processes strongly control the precipitation mechanisms over the area
- Southern Brazil region is characterized typically by organized deep convection associated with large amount of rain and some strong winds. Severe weather related with hail is located over central Argentina rather than over this region
- *NWP models have varied success in predicting the initiation, propagation speed, intensity, and organization of convective systems in Southern Brazil and Uruguay*

***The Chuva Project: How Does Convection Vary across Brazil? Machado et al., BAMS, 2014**

Courtesy of RELAMPAGO project

RELAMPAGO

Remote sensing of **E**lectrification, **L**ightning, **A**nd **M**eso-scale/micro-scale
Processes with **A**daptive **G**round **O**bservations
(translates to lightning flash in Spanish and Portuguese)

Envisioned to be an international multi-agency field program to study multi-scale aspects of intense, organized convective systems that produce severe weather in subtropical south America

CACTI: Cloud, Aerosol, and Complex Terrain Interactions

PI: Steve Nesbitt, University of Illinois at Urbana-Champaign
Co-PIs: Rita Roberts, NCAR
Jeff Trapp, University of Illinois at Urbana-Champaign

When:

1 Nov – 15 Dec 2018

Where:

West central Argentina

Adapted from RELAMPAGO project

Science Areas to be explored

Convective lifecycle

Microphysics

Aerosols

Electrification

Severe weather

Hydrometeorology/land surface, flooding

Nowcasting and forecasting

Societal impacts from HIweather

It will involve:
AMF-1 cloud-aerosol-radiation observatory
Mobile Aerosol Observing System (MAOS*)
CSAPR-2 precipitation radar
Surface meteorological network
It will also bring intensive airborne observations during RELAMPAGO through the deployment of the G-1 aircraft

CACTI field campaign

When:

1 Oc 2018 – 30 Apr 2019

Where:

West central Argentina

*MAOS is a platform and instrument suite for Intensive Operation Periods (IOPs) to conduct in situ measurements of aerosols and their precursors. MAOS is part of the ARM Climate Research Facility

Endorsements

Research and Forecasting Demonstration Project for WWRP

Endorsed by:

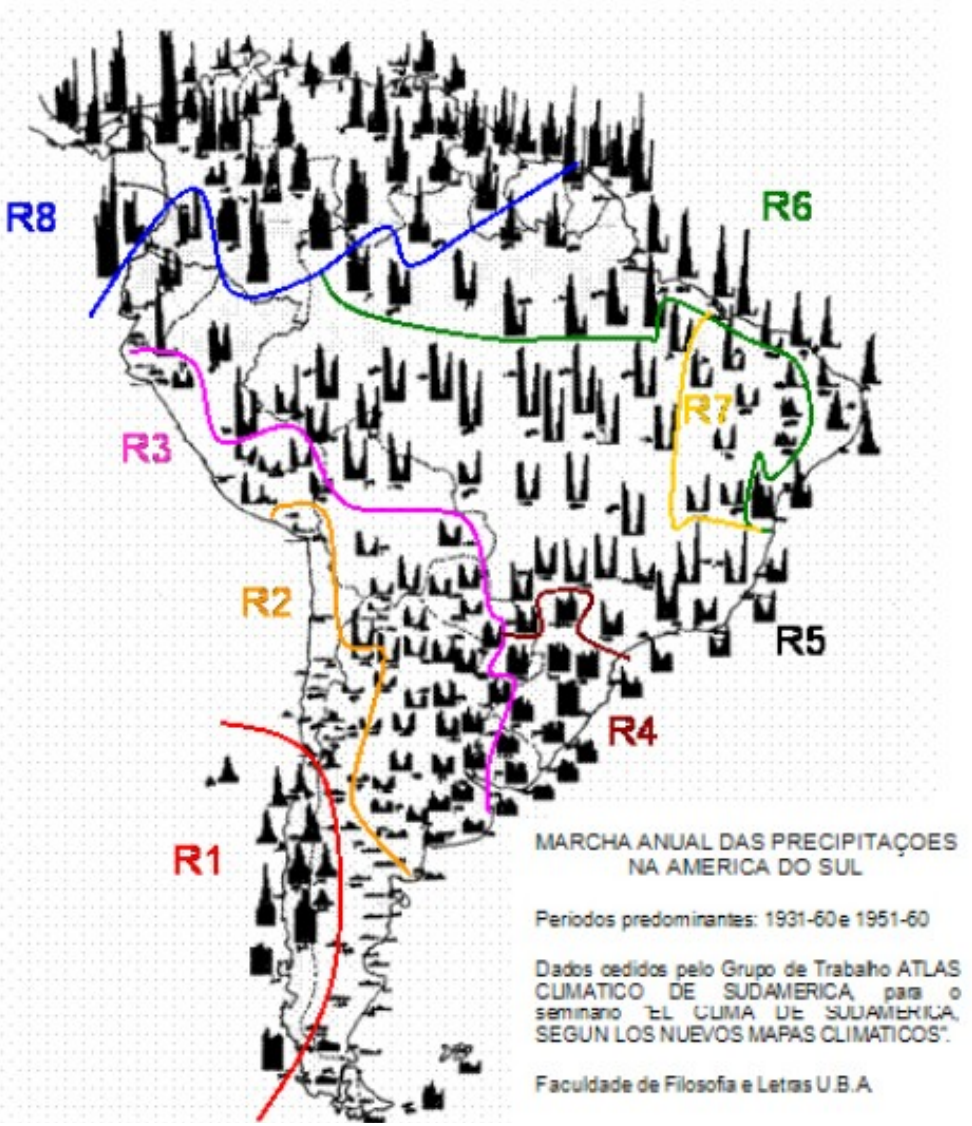
Nowcasting and Mesoscale Weather Forecasting Group of the WWRP

Joint Scientific Committee-WWRP

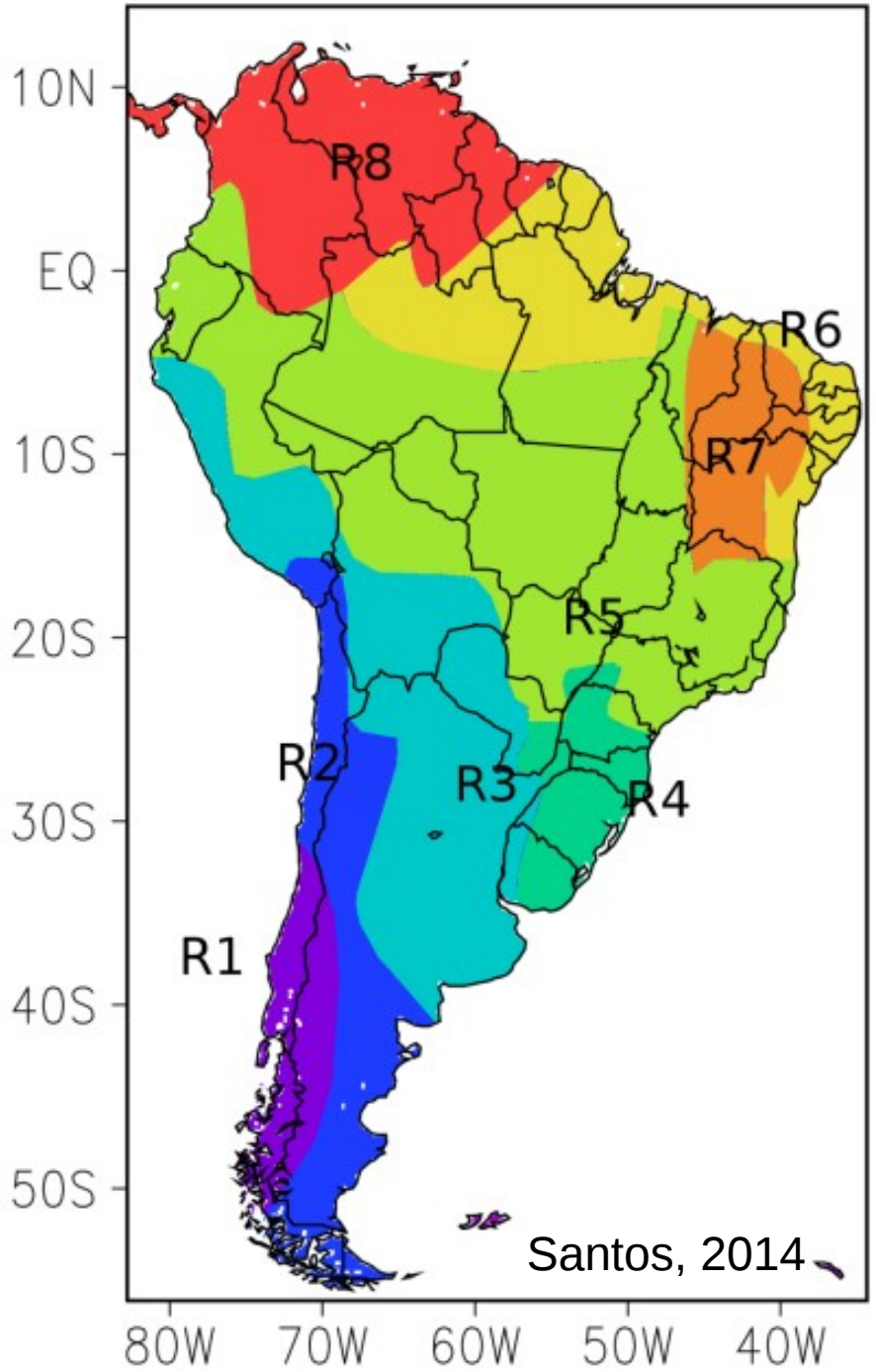
Scientific Steering Committee-WWRP

CLIVAR/GEWEX Hydroclimatology Panel

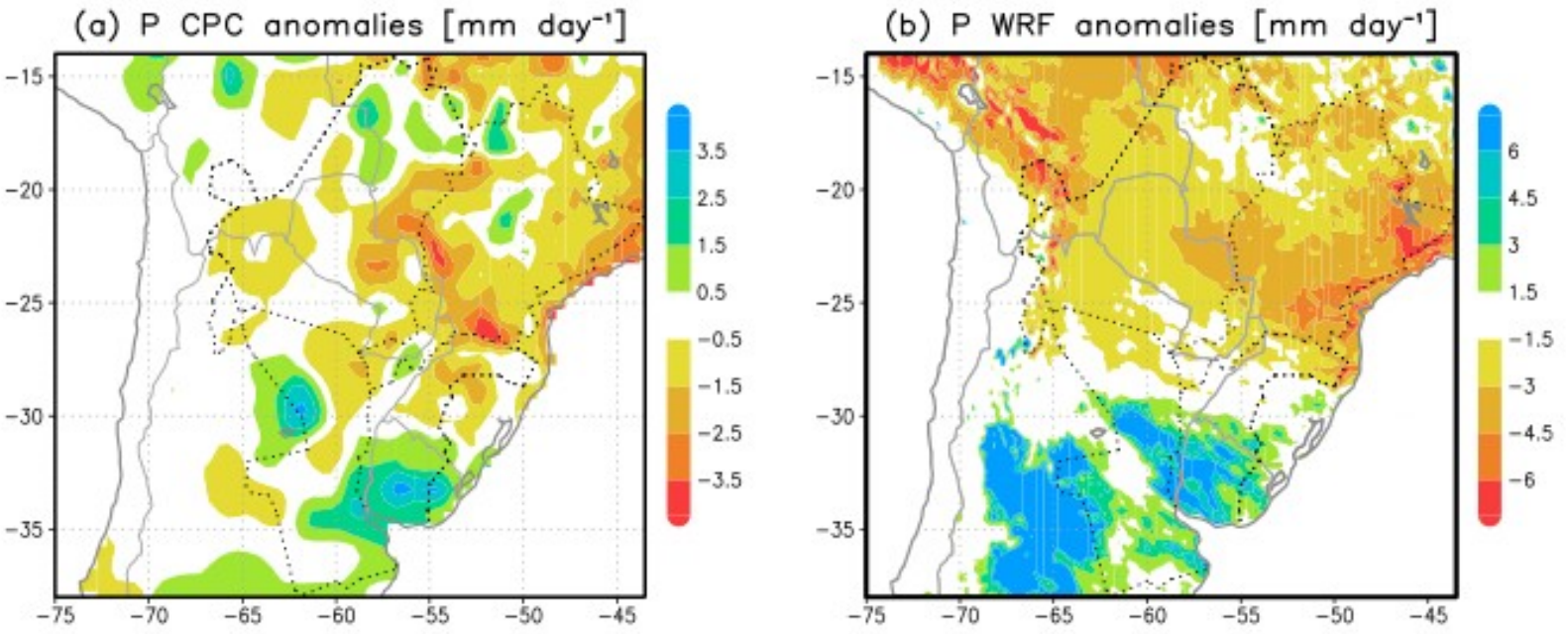
Annual precipitation distribution



Reboita et al, 2010



WRF evaluation over Argentina

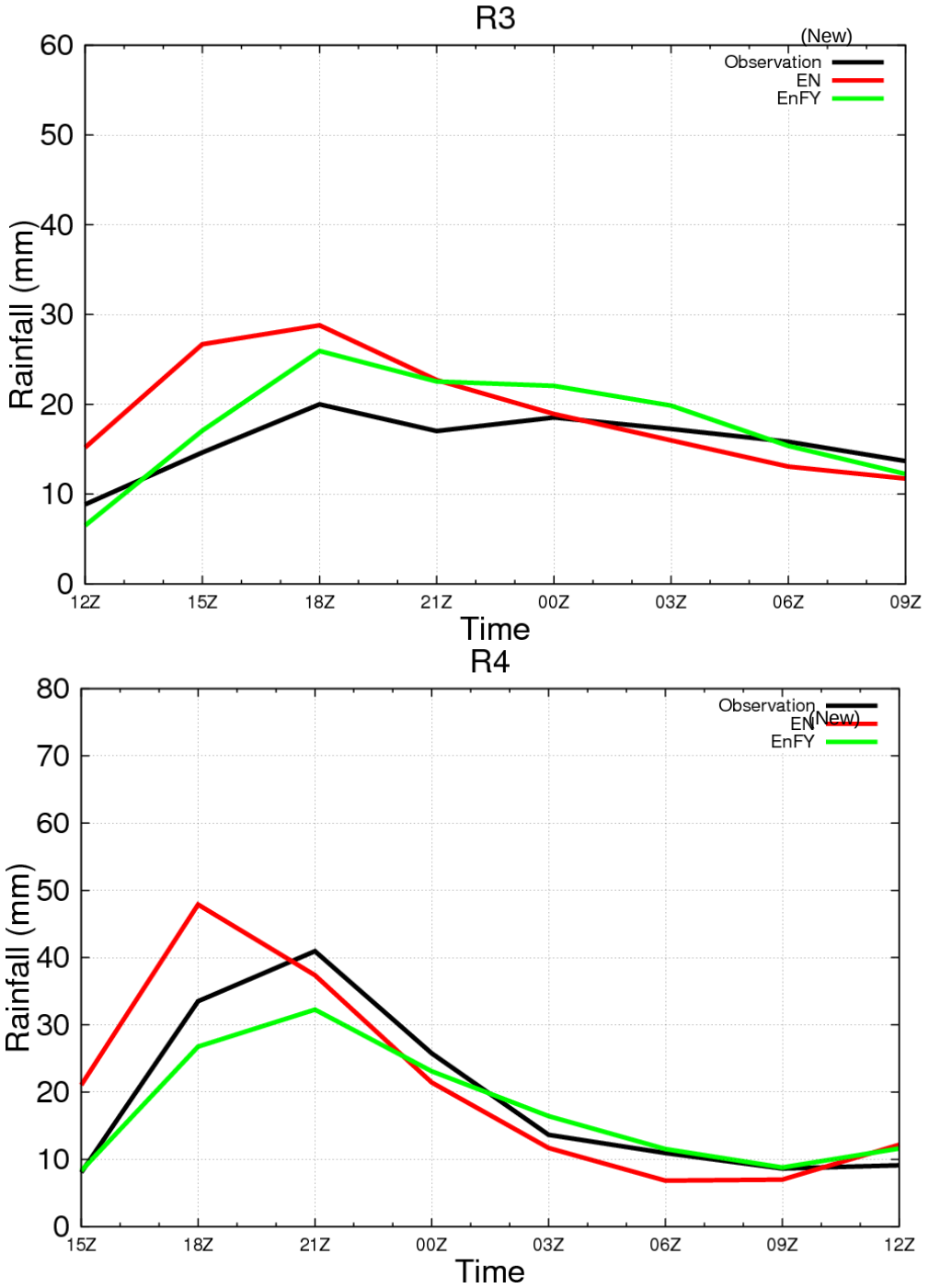


15km horiz. Res.

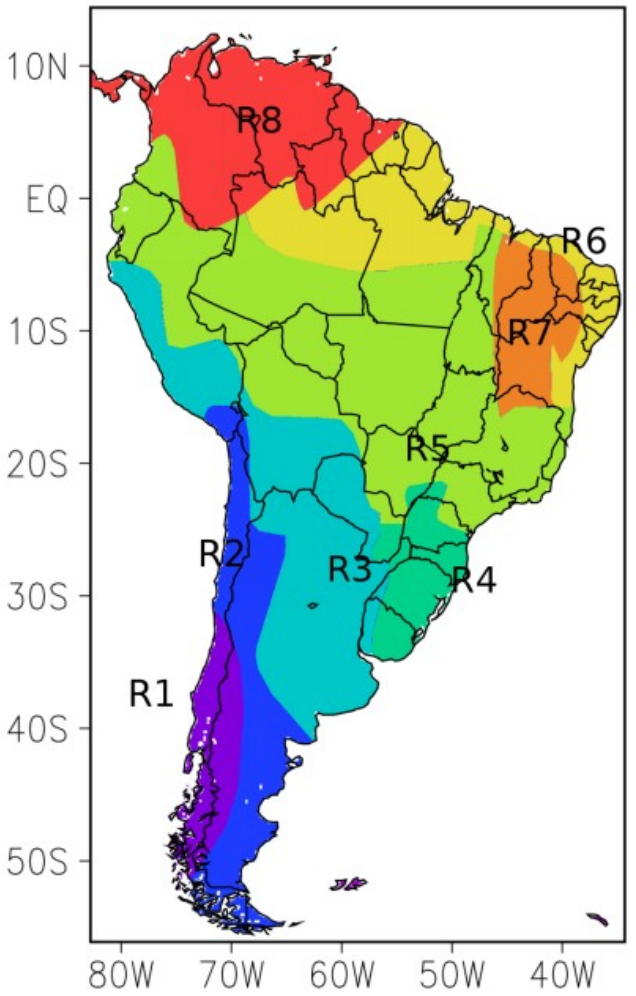
2014 austral spring anomaly

Muller et al, 2016, Wea. Forecasting

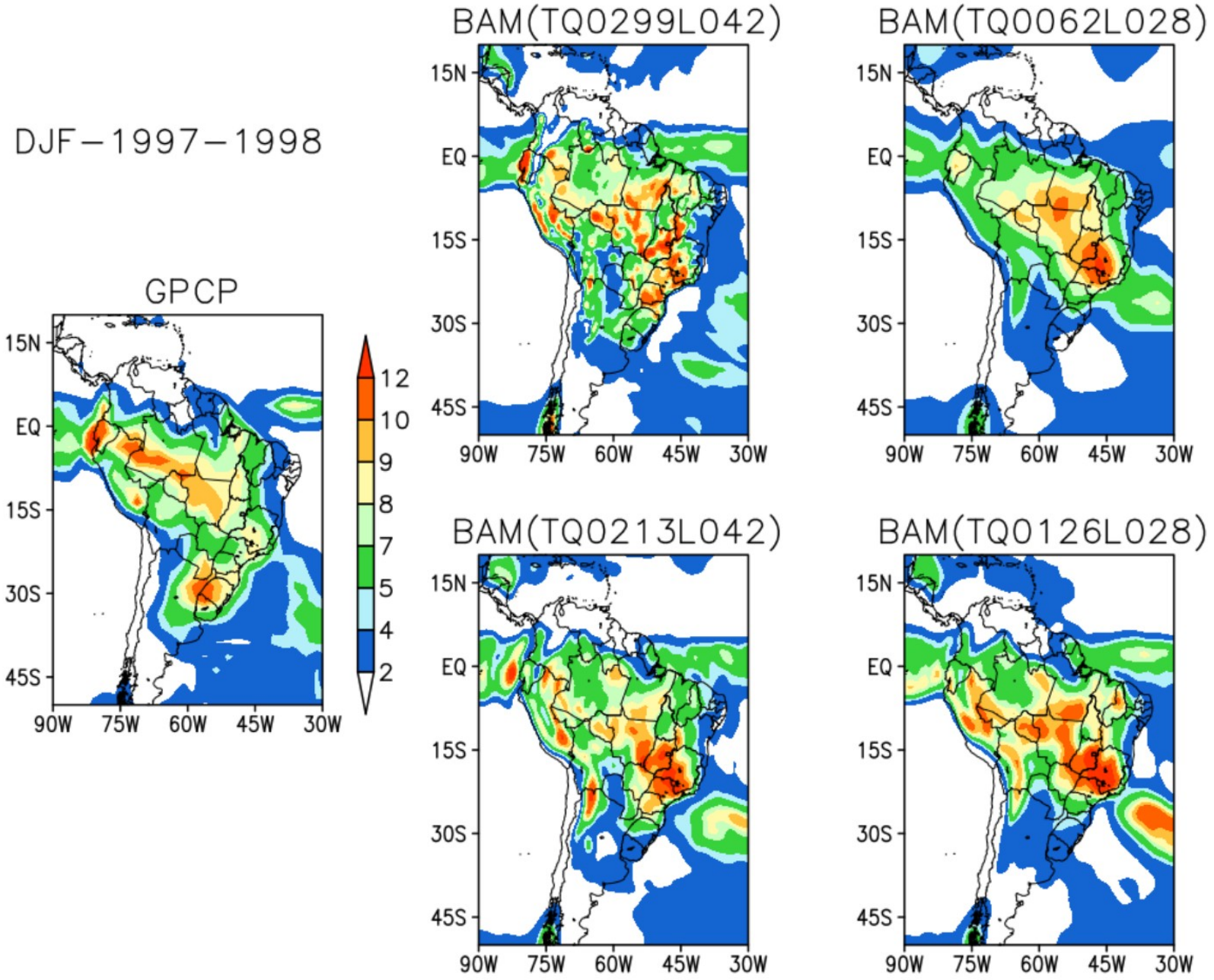
BRAMS stochastic parametrization



Diurnal cycle of precipitation
Stochastic correction of Jan 2010
24h BRAMS forecasts
Santos 2014



BAM – Brazilian global Atmospheric Model



Courtesy of Dayana Castilho

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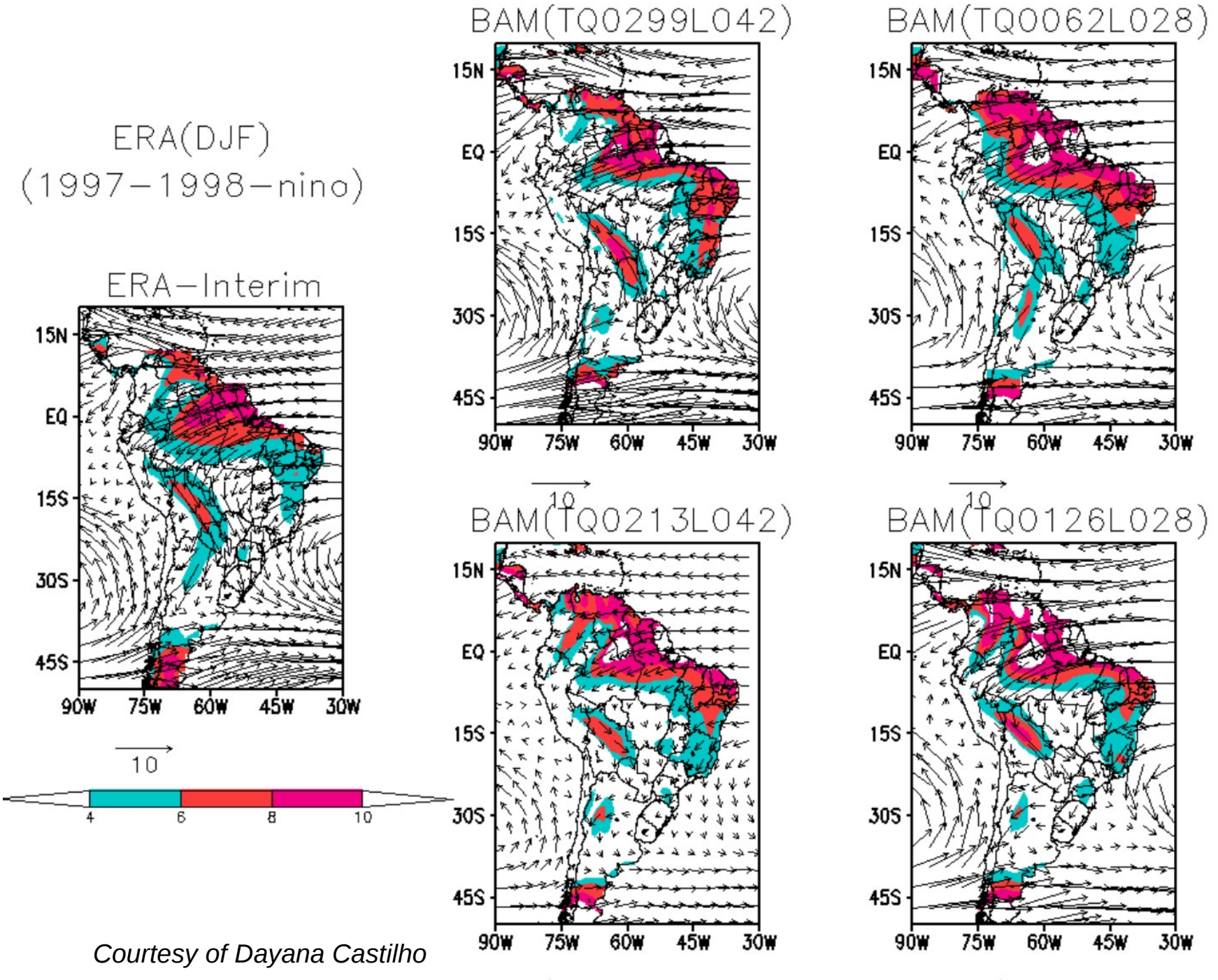
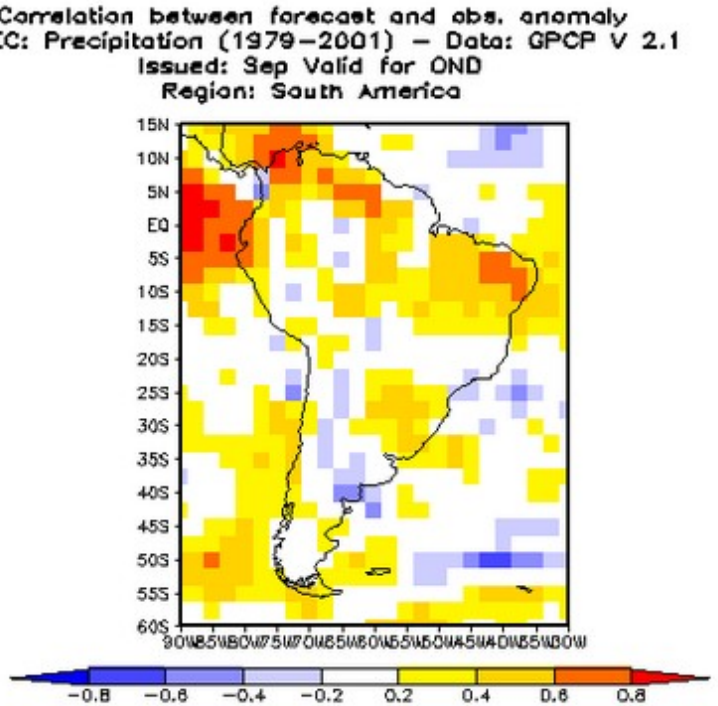
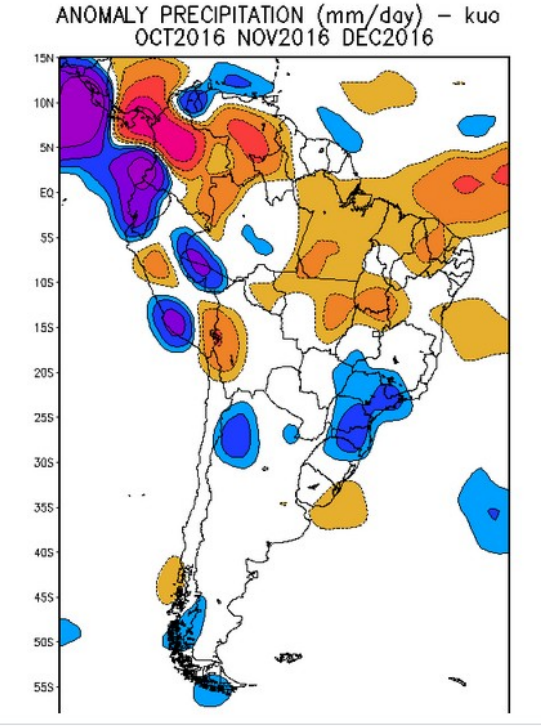


Courtesy of Dayana Castilho

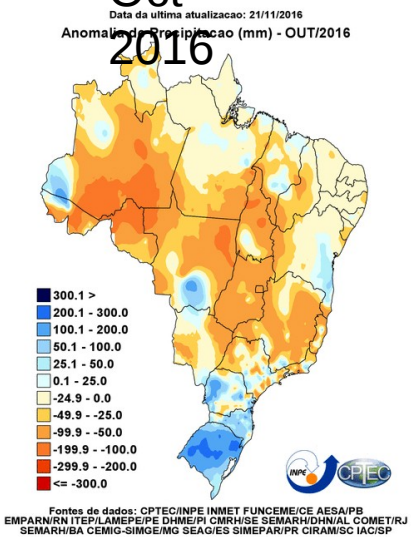
CPTEC/INPE Seasonal forecast



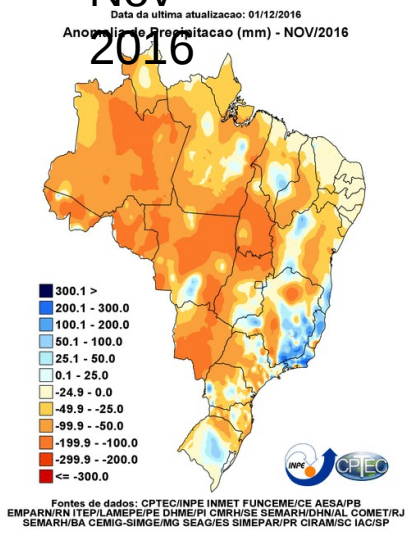


Observed precipitation

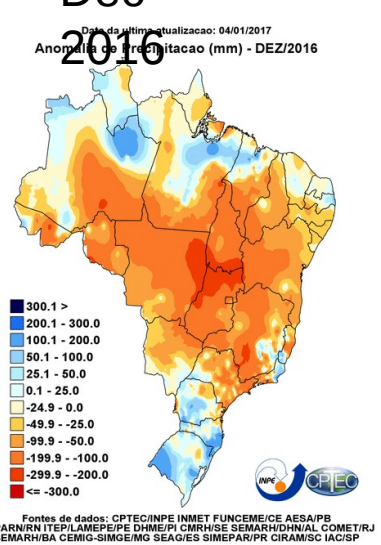
Oct 2016



Nov 2016



Dec 2016



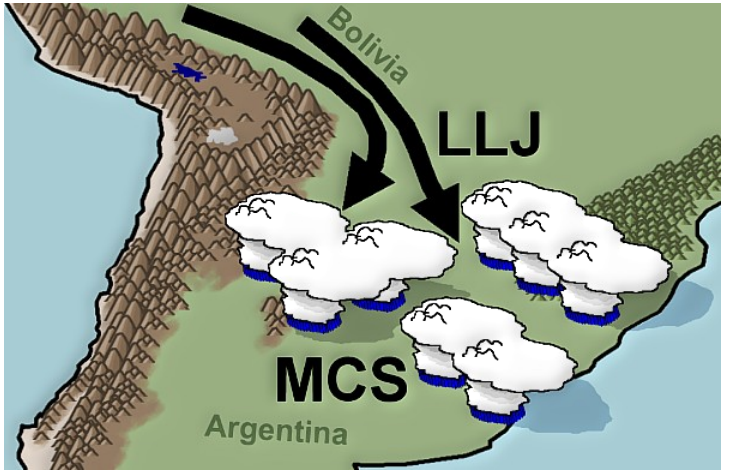
Prediction

- Why do numerical models, at mesoscale NWP scales to climate models, have very low skill in this region? Are they missing important data for assimilation or are there missing physical processes in numerical models?

- Does the large zonal soil moisture gradient in Northern Argentina control the intensity, structure, and predictability of convective systems?

- What datasets are missing in order to provide for more accurate nowcasting and short term NWP predictions in the region?

- What are possible inferences and limits of predictability on synoptic to intraseasonal time scales for subtropical South American convection?



Courtesy of RELAMPAGO project

Could RELAMPAGO be a great laboratory for WGNE experiments?

RELAMPAGO webpage:
https://publish.illinois.edu/relampago/

Thanks!