Characterization of the Regional Hydrologic Cycle of the South America

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Introduction

- **Precipitation is one critical diagnostics** that is not only sensitive to the observing system and model physics, **but also reflect the general circulation** .

- **Using these** available **data associated with troposphere data** (wind and specific humidity), **the transport of moisture** on the South America **was evaluated** for the period of 1979 through 2007.

Introduction

✓ Evaluate the **main characteristics in the hydrological cycle** over the South American region, based on:

New generation reanalysis

✓ **Six reanalyses data**

Reanalysis	Reference
MERRA	Bosilovich et al. 2008
ERA INTERIM	Simmons, 2007
NCEP CFS	Saha et al., 2010
NCEP 1	Kalnay et al. 1996
NCEP 2	Kanamitsu et al. 2002
ERA 40	Uppala et al. 2005

✓ **Five observed precipitation** data product

Reanalysis	Reference
CPC	Xie et al. 2010
SALDAS	Gonçalves et al., 2009
CMAP	Xie and Arkin, 1997
GPCP	Adler et al., 2003)
GLDAS	Rodell et al., 2004);

Data and methodology

- Because SA has different rainfall regimes
- We present for all SA and several continental regions (ocean mask):
  - the comparisons of the time series of annual, seasonal and monthly variables;
  - average spatial correlations and standard deviations;
  - mean differences.
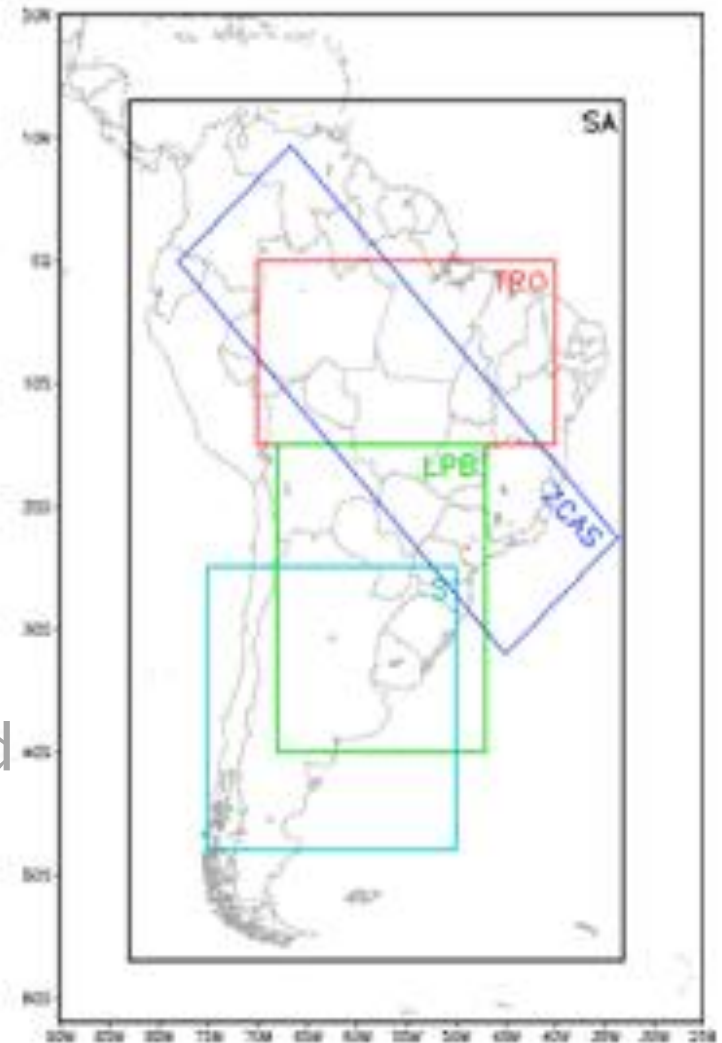
- Fig. 1. Five continental regions considered in the evaluations (SA – South America; Tropical – TRO; La Plata Basin– LPB; South – S; South Atlantic Convergence Zone – SACZ). The thicker solid lines show the bounding of the 1.0 X 1.0 grid boxes.

Data and methodology

- **Monthly means** from each **of** the **reanalyses and** the **precipitation analyses products** are used to evaluate:
  - The spatial **pattern of precipitation** (climatology and bias);
  - **Time series** of precipitation.
- **All monthly means are regridded** to 1.0° x 1.0° resolution (box averaged).
- We will also analyze:
  - **skill at reproducing annual precipitation** spatial distribution **with Taylor diagrams** (Taylor 2001).
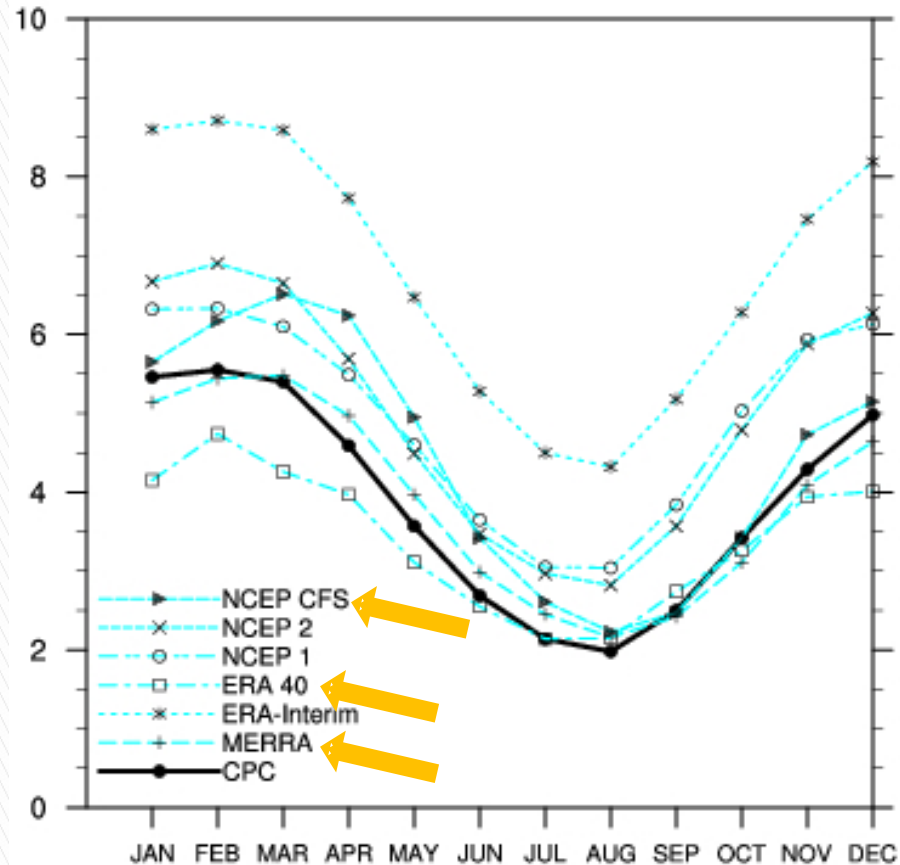
Annual cycle – SA region

Fig. 2. Area-average precipitation (mm/day) of the CPC and reanalyses MERRA, Era-Interim, ERA 40, NCEP 1, NCEP 2and NCEP CFS for the SA region. The data are time averaged from 1979 to 2007.
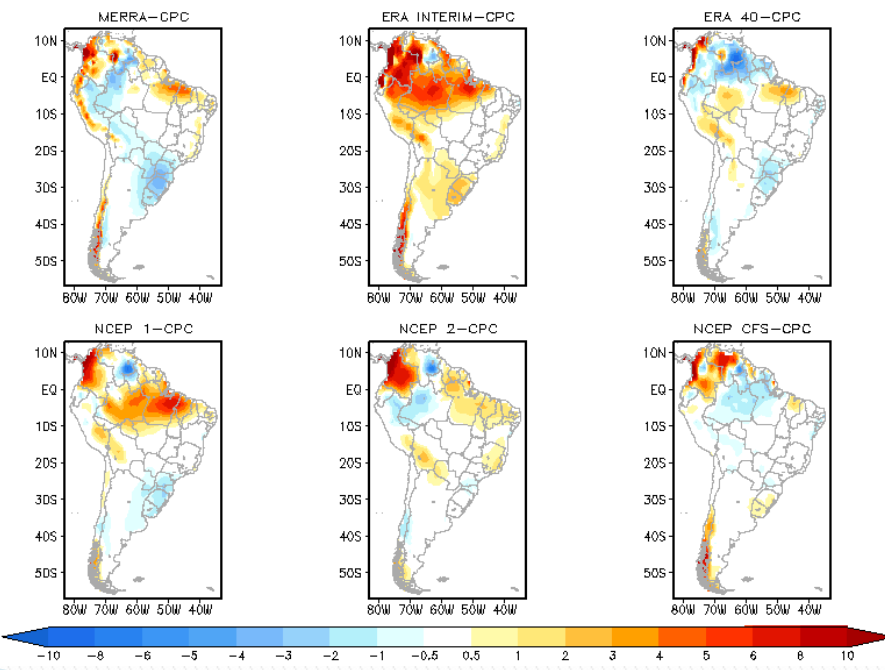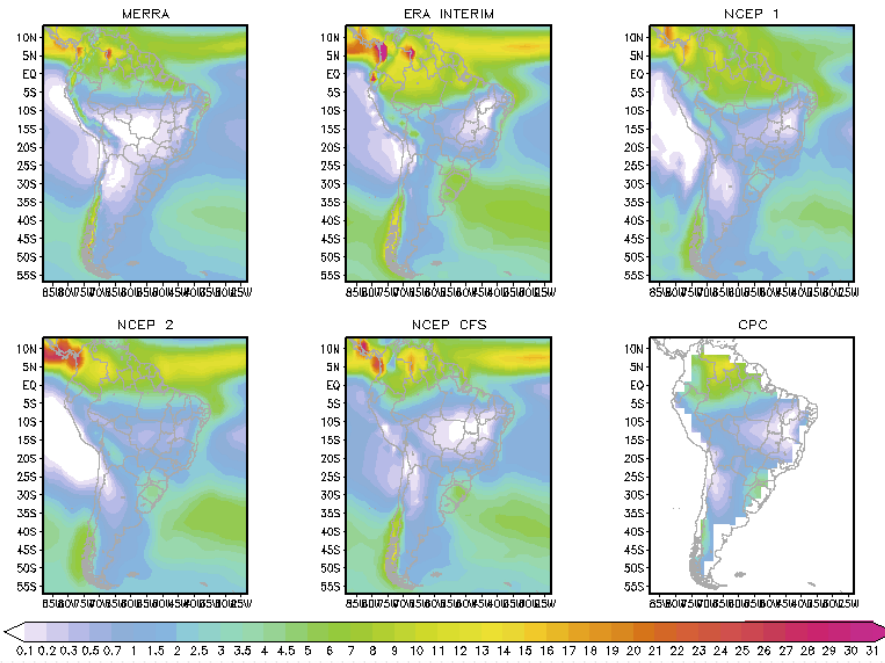
Results for DJF

AVE PRECIP. (mm/day) DJF (1979 – 2007)

- **Climatological map of precipitation** from Reanalyses and the CPC:
  - **NCEP CFS** presents the best results;
  - **MERRA** shows a negative bias in central/south of South America (SA), and a positive anomaly in north region.
  - **ERA INTERIM** shows a positive bias;
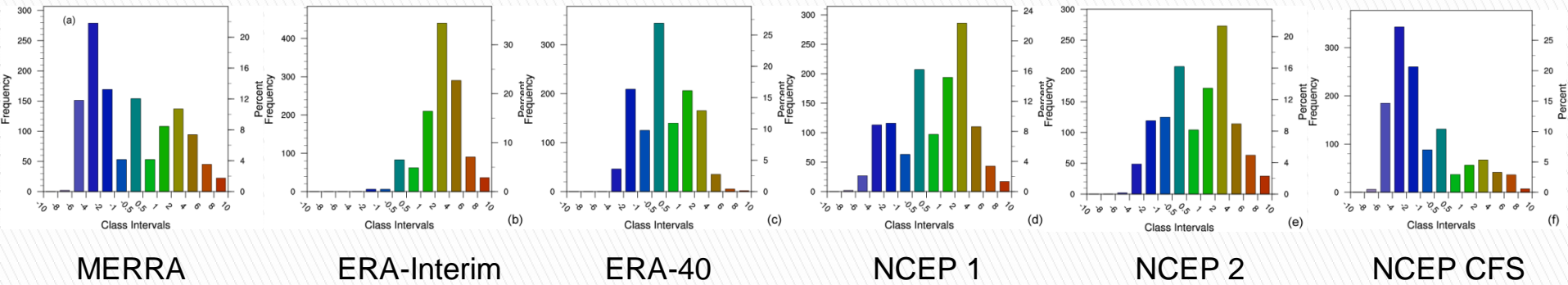 - **NCEP 1 and 2** present significant bias over the Andes
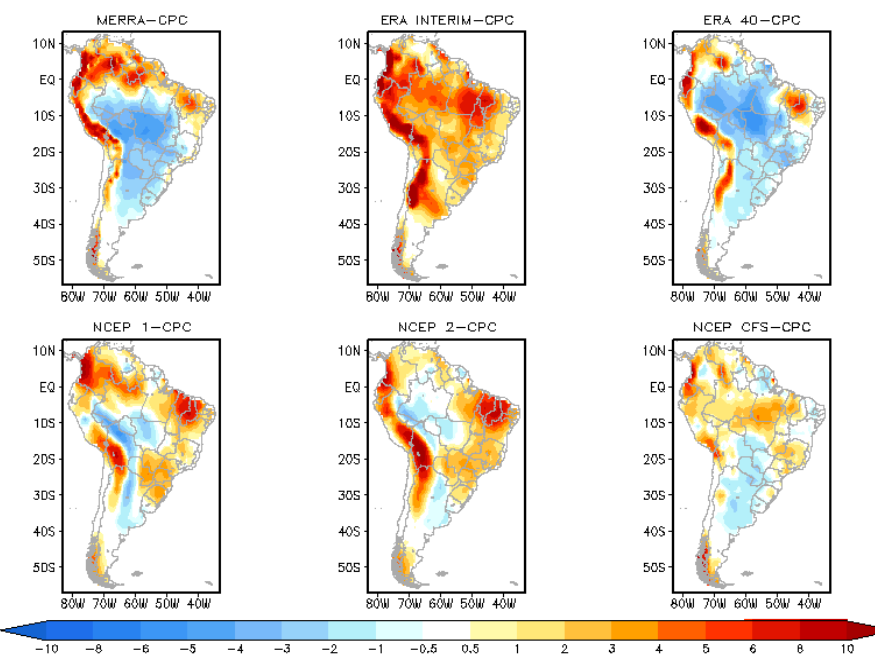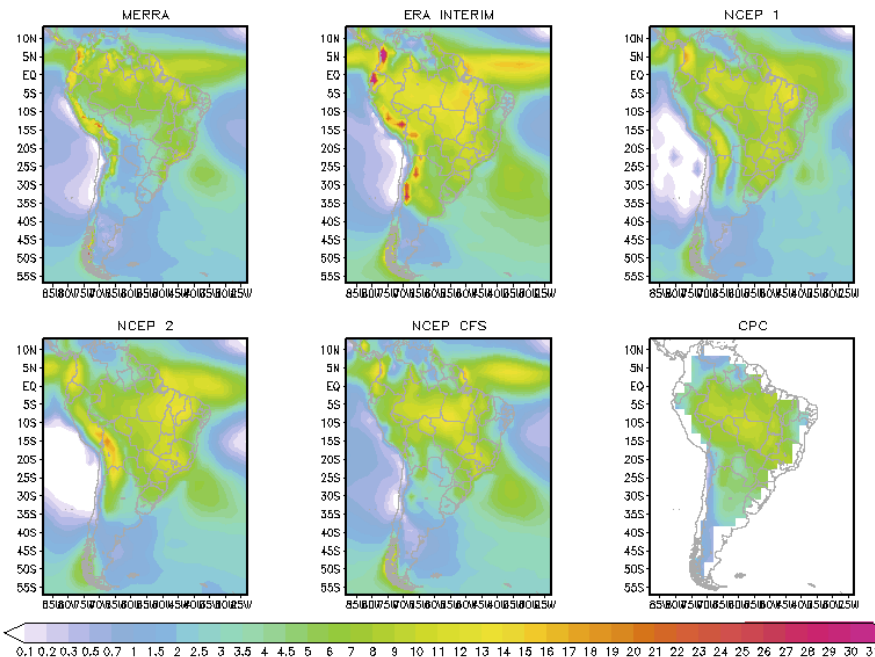
Results for JJA

- **Climatological map of precipitation** from Reanalysis and the CPC:
  - **CFS** presents the best results;
  - **MERRA** and **NCEP 1** show a negative bias might be associated with the stationary frontal systems over LPB region and south of Brazil that extends from Southeast to Northwest SA
  - **ERA-Interim and NCEP 1** show a significant positive bias on the Tropical Region;

AVE PRECIP. (mm/day) JJA (1979 – 2007)

MERRA ERA INTERIM NCEP 1
NCEP 2 NCEP CFS CPC

MERRA-CPC ERA INTERIM-CPC ERA 40-CPC
NCEP 1-CPC NCEP 2-CPC NCEP CFS-CPC

Histograms SACZ region – DJF

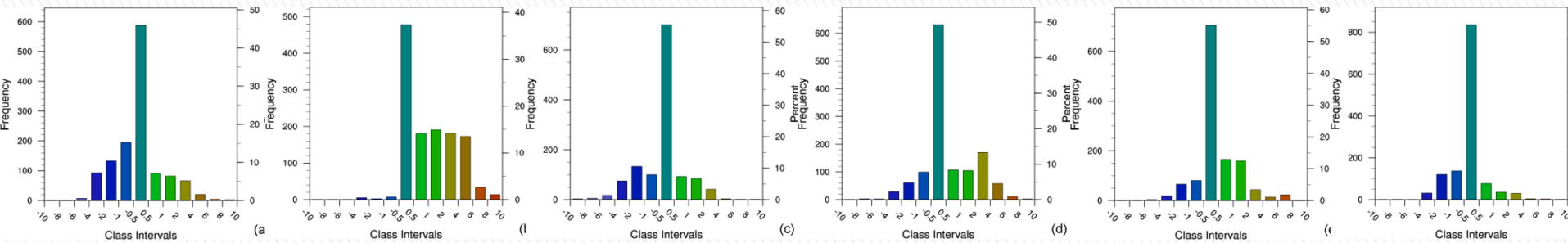MERRA   ERA-Interim   ERA-40   NCEP 1   NCEP 2   NCEP CFS

MERRA   ERA-Interim   ERA-40   NCEP 1   NCEP 2   NCEP CFS

Taylor Diagrams

LPB Annual Mean Cor. - REF: CPC (1979-2007)

Standardized Deviations (Normalized)

Correlation

CPC
SALDAS
CMAP
GPCP
GLDAS
NCEP CFS
NCEP 2
NCEP 1
ERA-INTERIM
MERRA
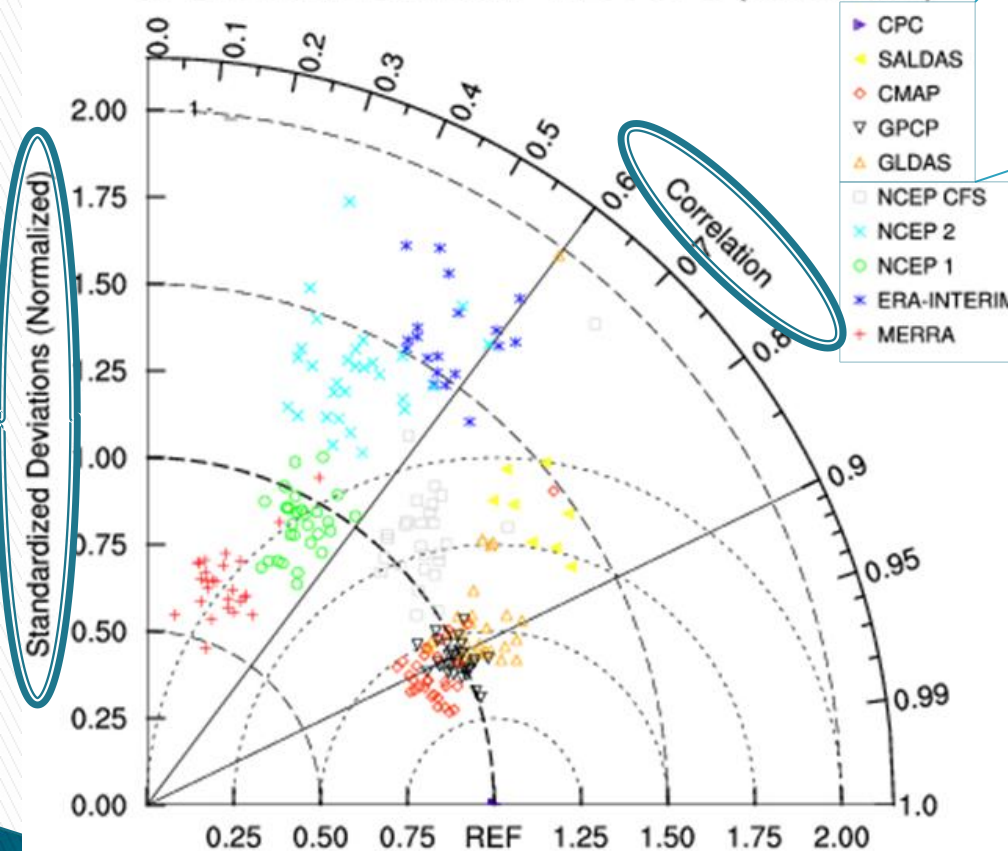
▶ Presents the **skill of the reanalyses and observation-based precipitation relative to the reference dataset (CPC, 2001):**

(Taylor, 2001):

▶ STD increase with radial distance from the origin.

▶ All STD are normalized to CPC. 1.0 matches the reference value (REF).

Reanalyses

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Taylor Diagrams

- In general all regions show:
  - **Observation-based products** (CMAP, SALDAS, GPCP, GLDAS and SALDAS) **tend to be tightly grouped and close proximity to the CPC** reference point.

  - most of reanalyses show correlations below 0,6.
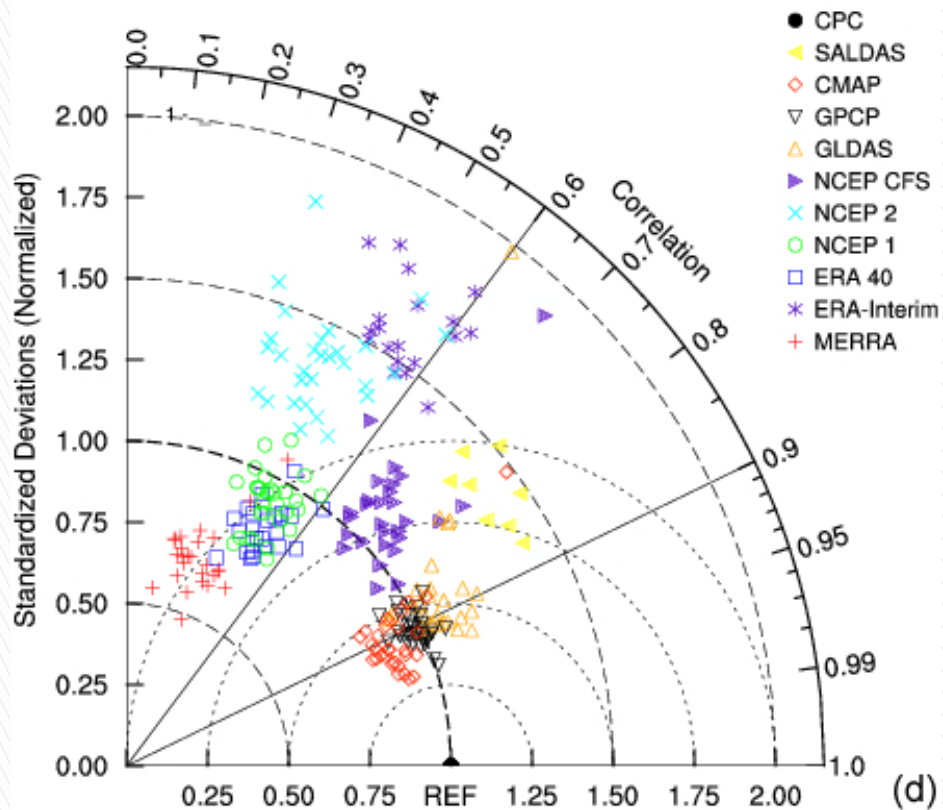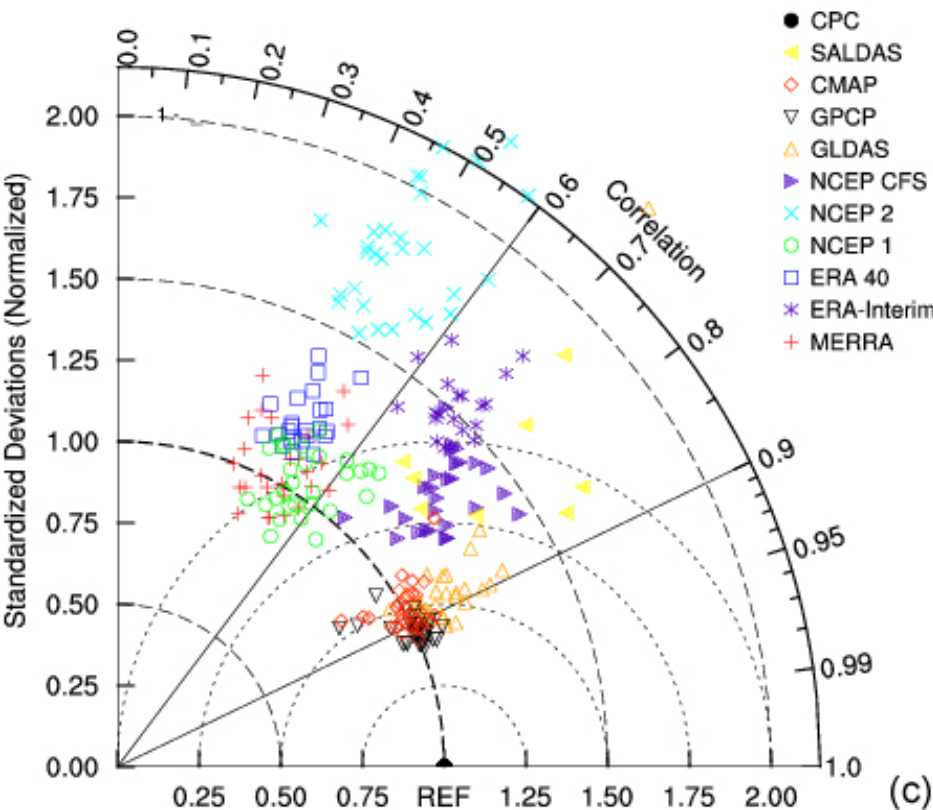
  - Only **NCEP CFS presents high correlations**

Annual mean – SA Region
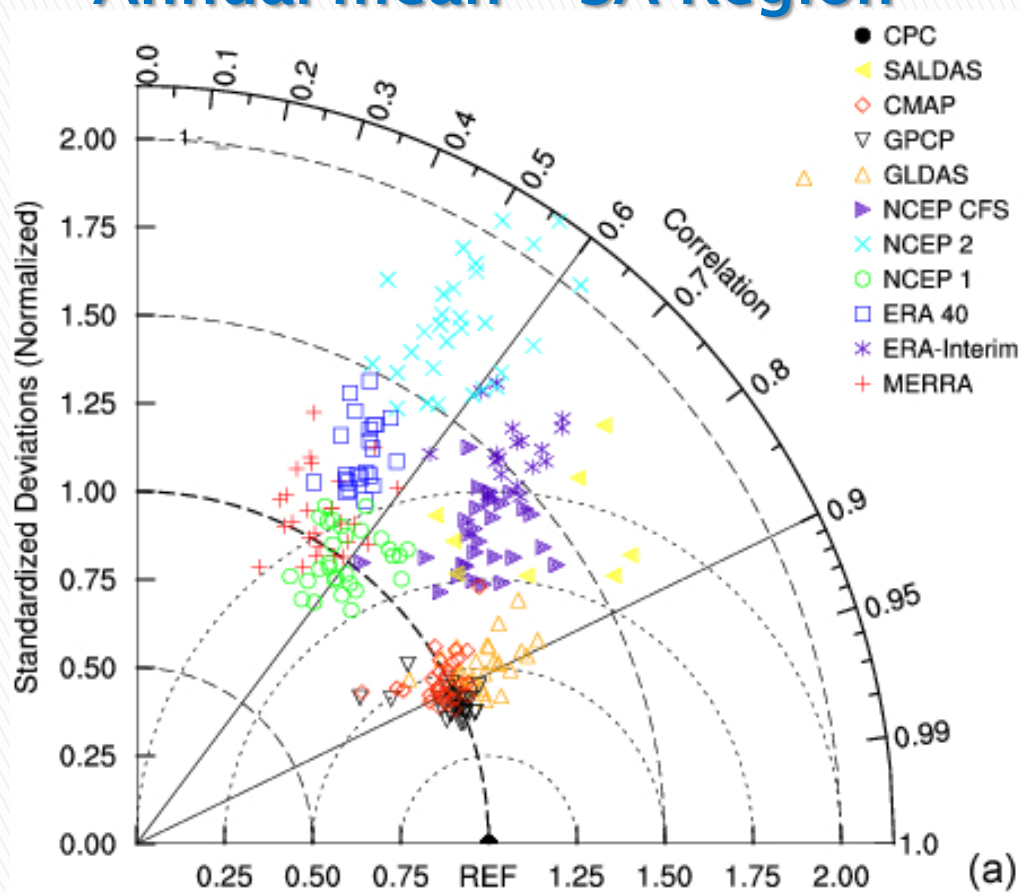
Taylor Diagrams
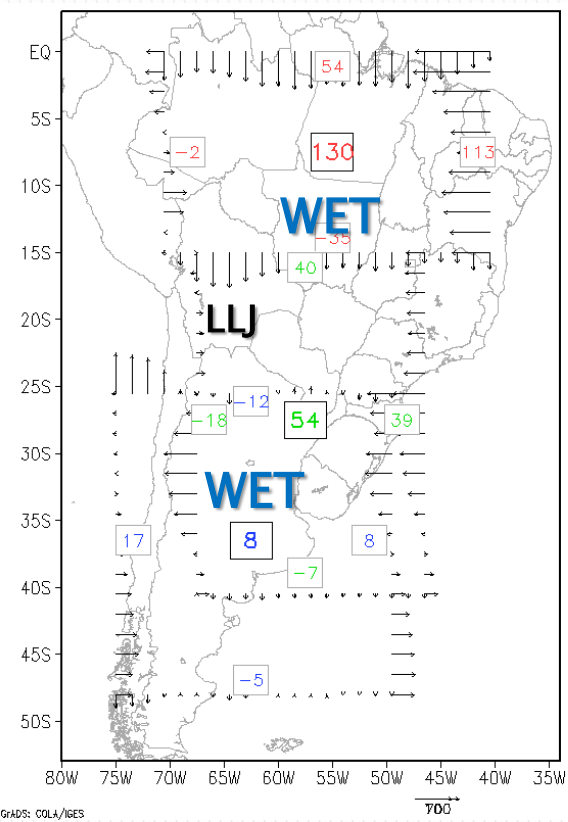
Annual mean – SACZ Region

Annual mean – LPB Region
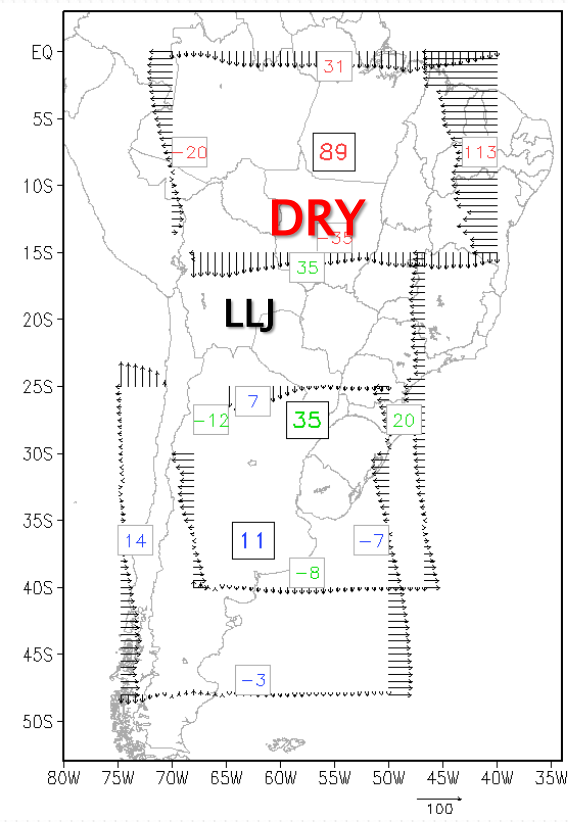

- ▸ NCEP CFS and ERA–Interim presents high correlations (> 0.6)

- ▸ Only NCEP CFS high correlations (> 0.6)

Summer Climatological Flux of Atmospheric Water Vapour (TRO, LPB and S regions)
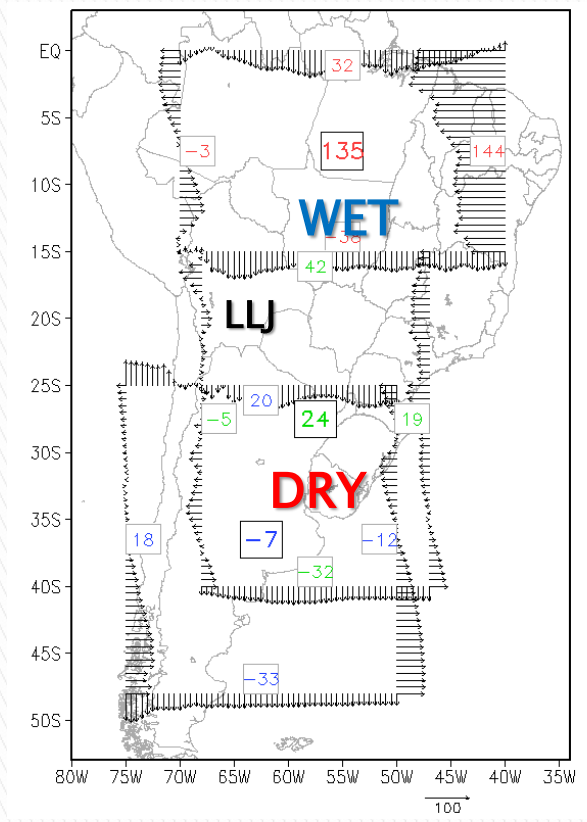

ERA–INTERIM

MERRA
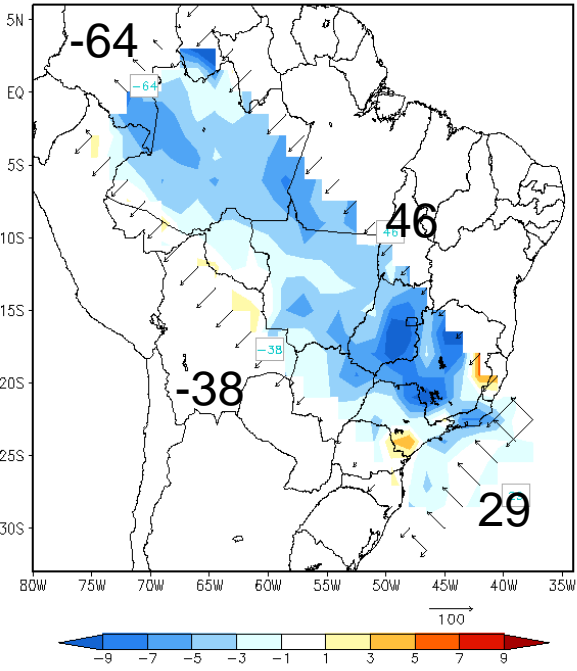
NCEP CFS

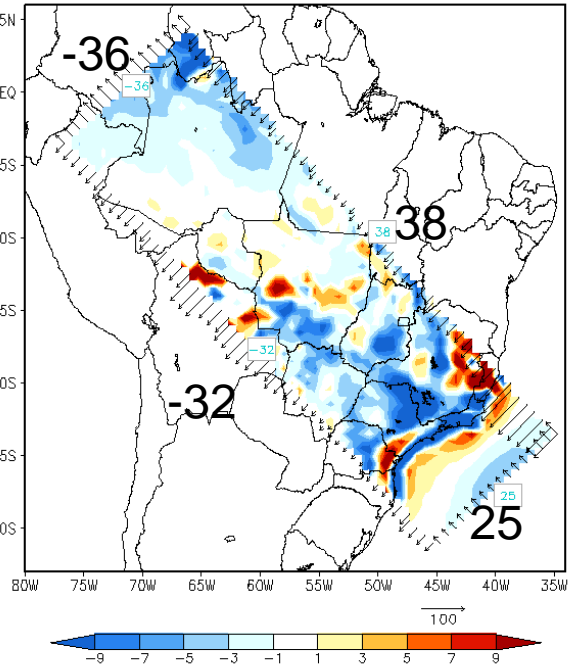# Summer Climatological Flux of Atmospheric Water Vapour (SACZ region)

ERA–INTERIM

MERRA

NCEP CFS

Moisture Net -> -27
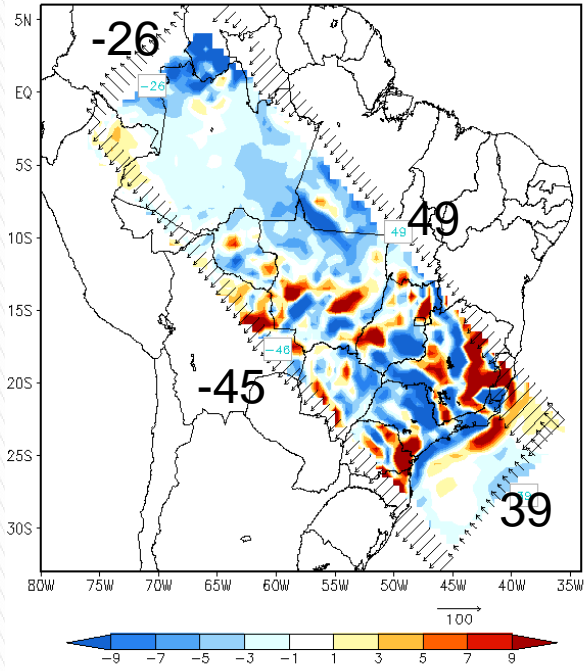
Moisture Net -> -5

Moisture Net -> 16

Conclusions

- This work shows the **progress of the new generations of reanalyses** on the attempt to represent more adequately the rainfall.

- Specifically, **all reanalyses represent the austral summer precipitation** of reference (CPC)

- MERRA and NCEP CFS are those that most closely match the curve of the CPC.

- In **most part of South America**, the **NCEP CFS** reanalysis **shows the lowest biases**.

Conclusions

▸ The **Taylor diagrams** show that the **NCEP CFS reanalysis presents the largest correlations**.

▸ Other reanalyses show smaller correlations, around 0,6.

▸ The **integrated flux of moisture shows opposite signs** in the central part of AS :
  ◦ positive bias (ERA–Interim)
  ◦ negative (MERRA) and

▸ These differences contribute to the excess (ERA-Interim) and deficit (MERRA) of precipitation in the region of LPB.

Obrigado!!!!

References

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