WCRP Conference for
Latin America and the Caribbean:
Developing, linking and applying climate knowledge

Regional Climate Monitoring: Current State and Perspectives

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Relevance of the regional climate monitoring

- For operational activities made by meteorological services or climate centers, monitoring is needed to better characterize the current climate status for a particular region and to underpin the regional climate prediction that can still have limited skill.

- There are many socio-economic sectors sensitive to climate variability that besides climate prediction information; they also need real-time monitoring of climate variables to trigger interventions, and analyses of historical trends and variability to identify emerging risks.

Climate monitoring current status

- It is being provided in Latin America and the Caribbean (LAC) by a diversity of institutions including national and regional meteorological centers, and also by many sector oriented organizations.

- Monitoring products available are very diverse and for many LAC regions they address very basic features of climate variability.

- Institutional arrangements appear insufficient to provide the relevant, credible and actionable knowledge (Podesta invited talk)

- The forecast-centric focus has possibly detracted from production and effective use of other kinds of climate information (historical records, diagnostics of recent conditions) that can help to narrow significantly the range of likely outcomes (Podesta invited talk).

Better and more profound knowledge about climate variability in LAC

- During the last decade significant progress has been made in better describing and understanding the climate variability in the LAC region by the academic-scientific sector.

- Many WCRP Programs, like the “Variability of the American Monsoon System” (VAMOS) have contributed to that.

- However, such knowledge has not been used enough yet to expand and improve climate monitoring products and activities.

Good Opportunities!

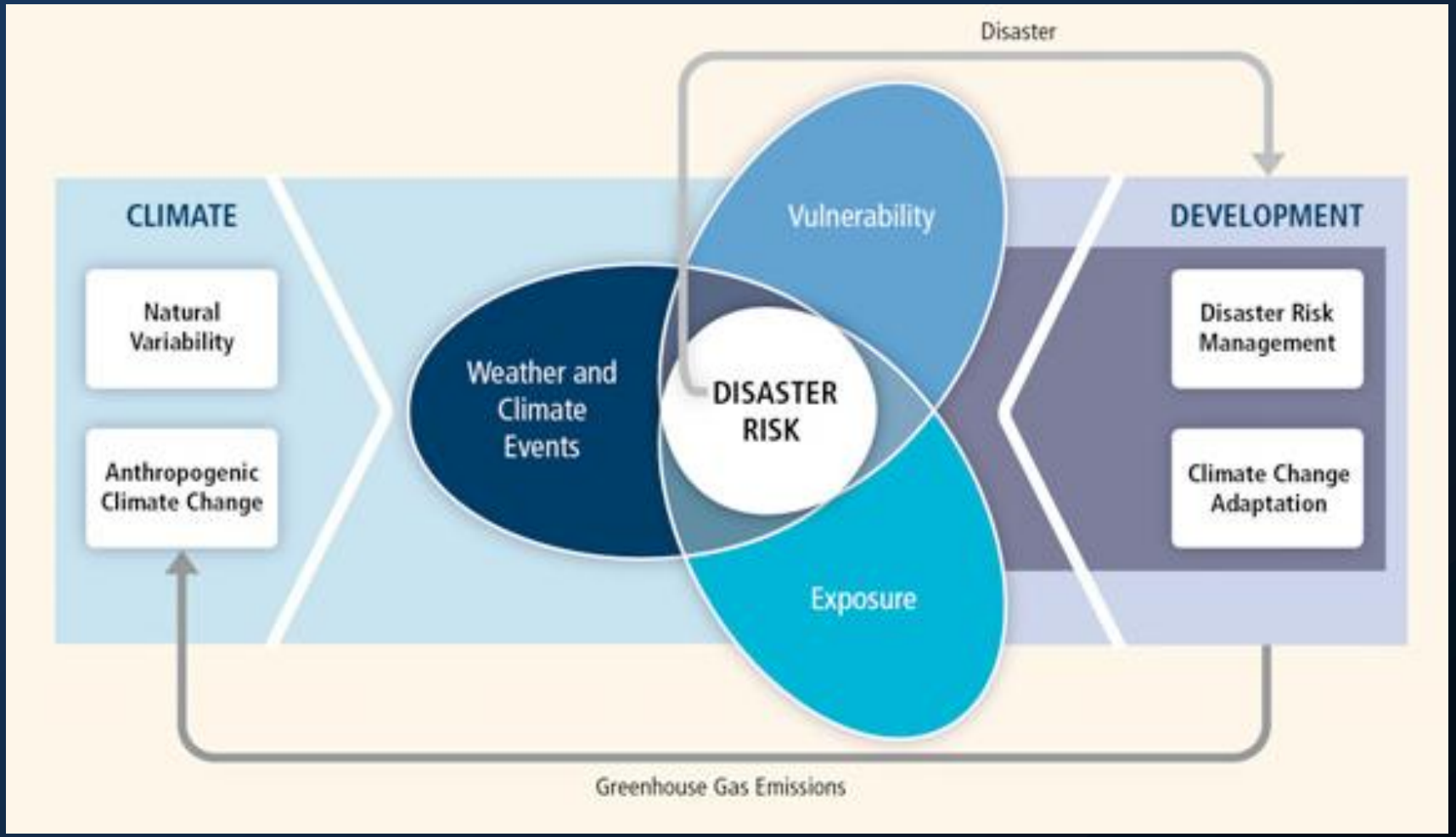
- The implementation of many regional climate centers by WMO in the LAC region is currently happening. Many sector-oriented organizations have increased their climate-related monitoring.

- This provides an excellent opportunity for the academic-scientific research community to underpin this process.

- The discussion of the research framework needed to underpin regional climate monitoring is then needed.

- Specific examples for southern South America in which recently gained scientific knowledge on climate variability can contribute to climate monitoring improvement on:
  - Subseasonal time scales (weeks)
  - Interannual time scales (seasons)
  - Decadal and multi-decadal time scales (years)
  - Climate change (decades)

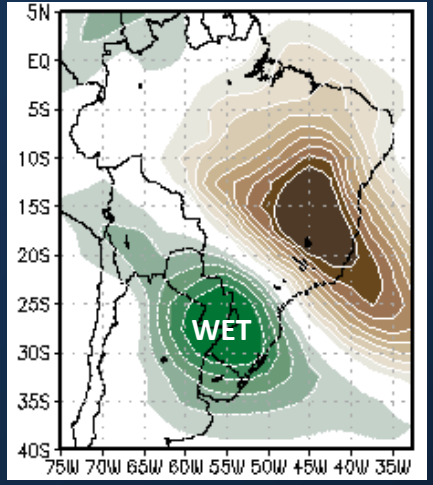
“Climate” oriented examples that might be useful for “Demand-led” problems

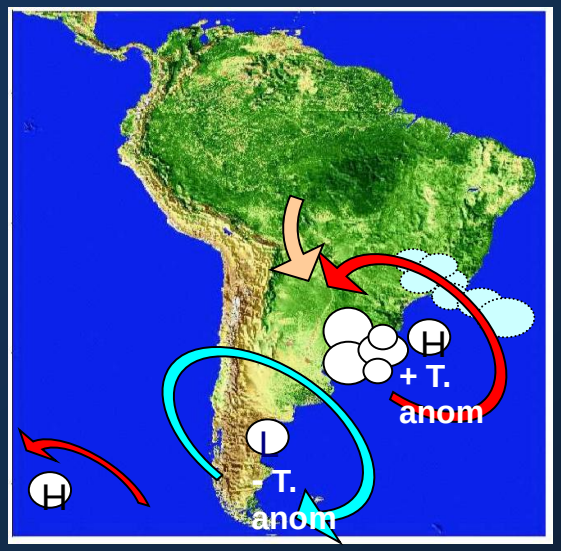


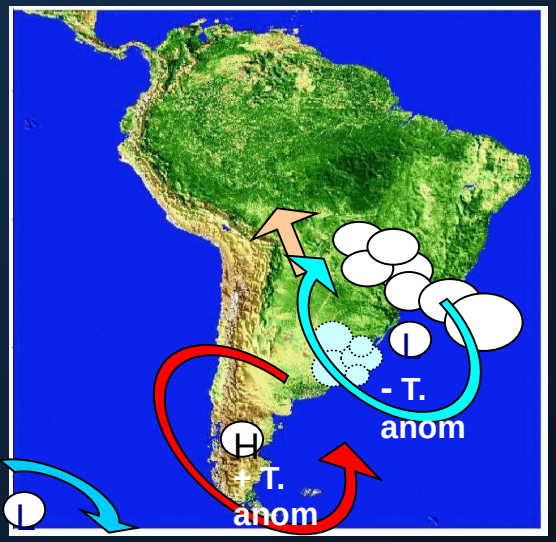
IPCC SREX (2012)

Wet and dry spells are evidences of the intraseasonal variability

(dominant temporal periods around 20 and 40 days)







From Díaz and Aceiturno (2003)

WET PHASE

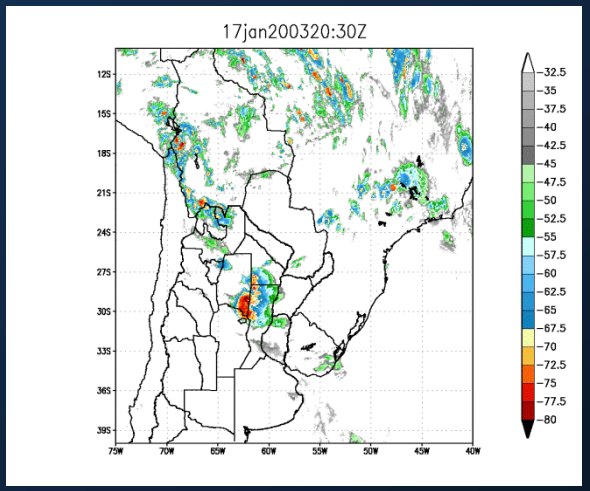
- Above normal precipitation in SESA
- Intensified northwesterly moisture flow into SESA
- Below-normal pressure conditions to the south and above-normal pressure conditions to the north of SESA

DRY PHASE

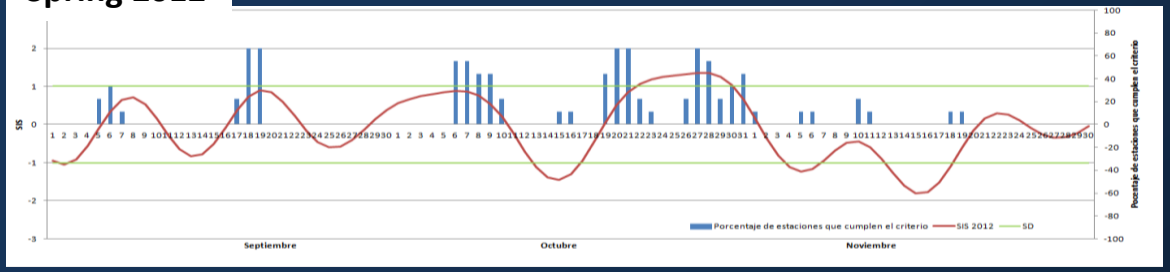
- Below normal precipitation in SESA
- Weakened northwesterly moisture flow into SESA
- Above-normal pressure conditions to the south and below-normal pressure conditions to the north of SESA

Modulation of the occurrence of convective storms associated with extreme surface winds by the intraseasonal variability

Intraseasonal variability (ISV) index: computed as the principal component of 10-90 day filtered OLR EOF1

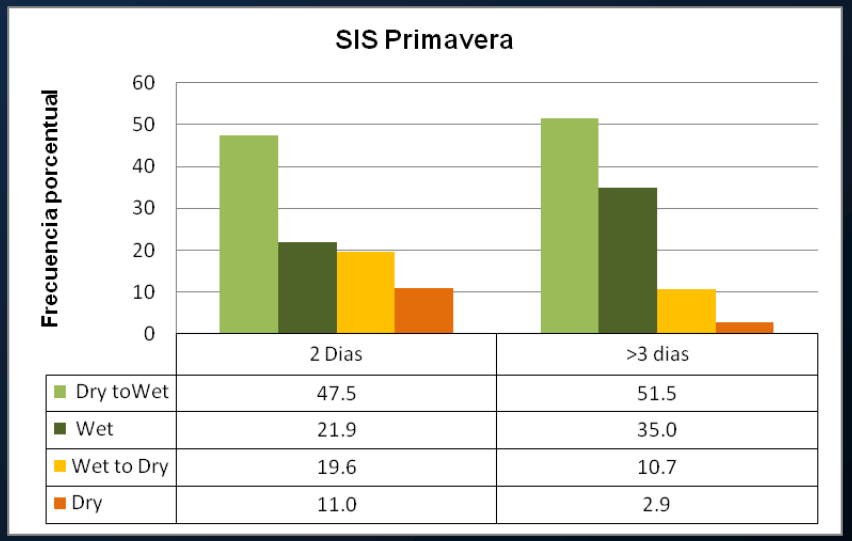


Spring 2012



Red line: ISV index Blue bars: % of stations that reported extreme events

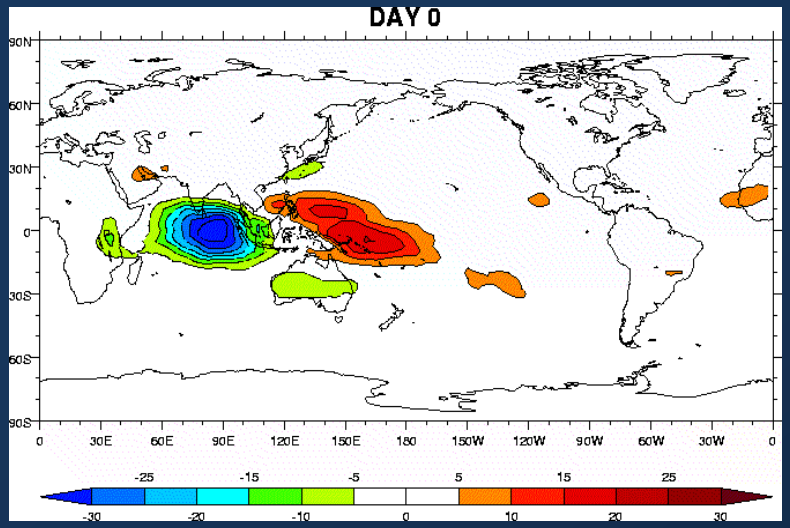
More than 70 % of the 2-day extreme events and more than 85% of the 3-day extreme events occurred during a dry-to-wet or wet phase of the ISV pattern (1999-2012)



	2 Dias	>3 dias
Dry toWet	47.5	51.5
Wet	21.9	35.0
Wet to Dry	19.6	10.7
Dry	11.0	2.9

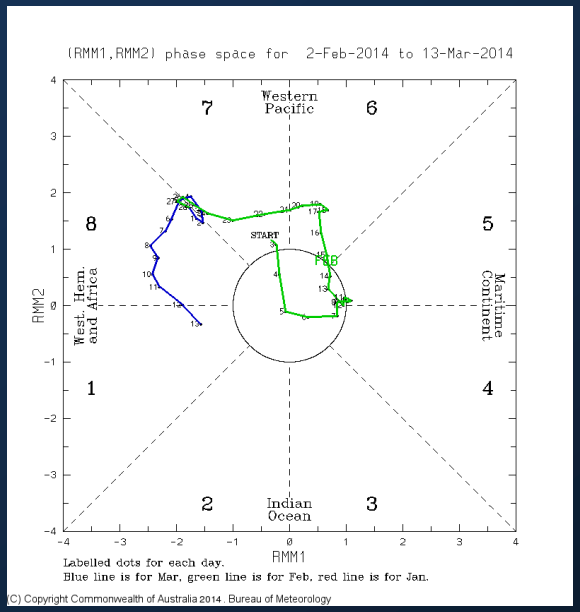
F. Otero Master thesis at UBA, 2014 (Advisors: P. Salio, C. Vera)

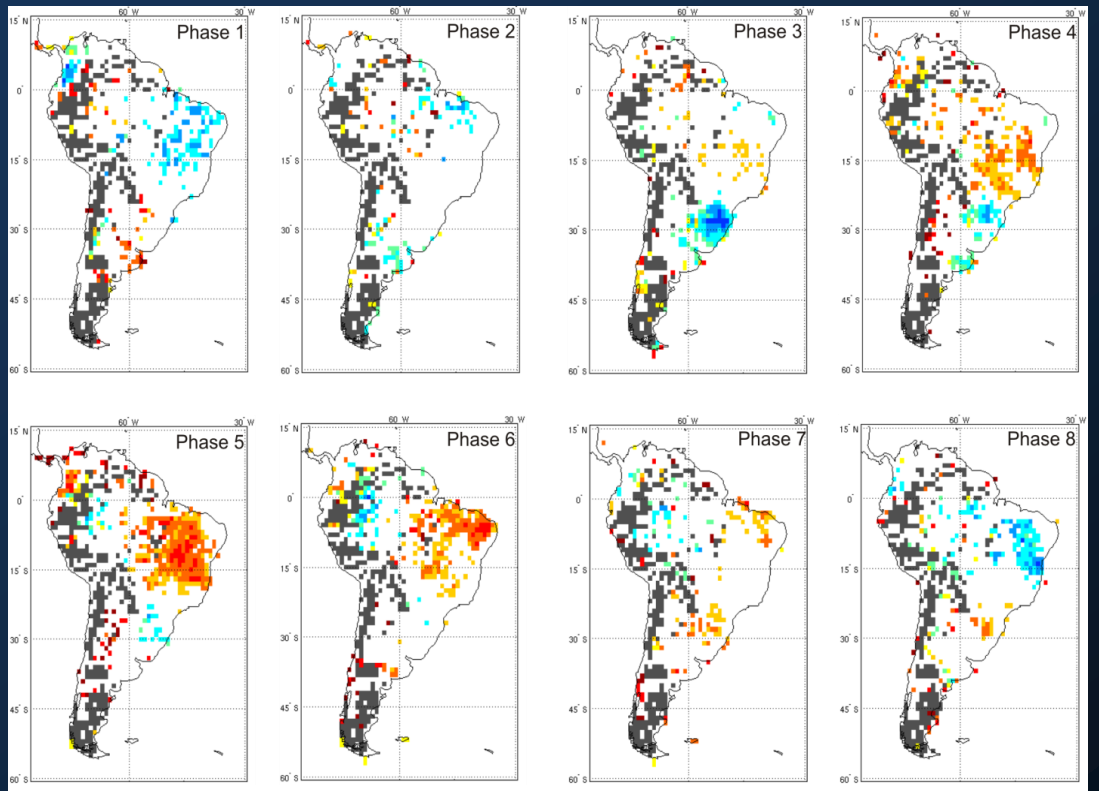
Madden-Julian Oscillation (MJO)



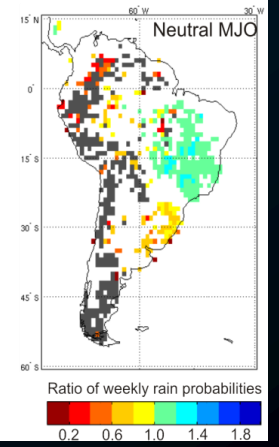
Wet conditions Dry conditions

MJO ACTIVITY MONITORING FEB-MAR 2014





Average weekly rain probability (1980-2011).



Colors represent chances of exceeding the upper-tercile
(Blue: high probabilities, yellow-red low probabilities)

(M. Alvarez and C. Vera, 2014, Afternoon Poster Session)

Tiempo ARGENTINO

06.03.2012 | hasta la medianoche regía un alerta por tormentas. las precipitaciones seguirían hasta el jueves

Volvió a llover y, según los científicos, es por la "oscilación intraestacional"

Investigadores de la UBA y el CONICET asocian la sucesión de jornadas secas y sofocantes y días muy lluviosos de este verano a la Oscilación de Madden-Julian, un fenómeno climático tropical que suele durar entre 20 y 40 días.

Por:
Susana Gallardo

El verano no dio respiro a los porteños. Una sucesión de jornadas con calor sofocante, seguidos de varios días lluviosos –como el de ayer y los que se anuncian hasta el jueves– fue la característica del clima en enero y febrero

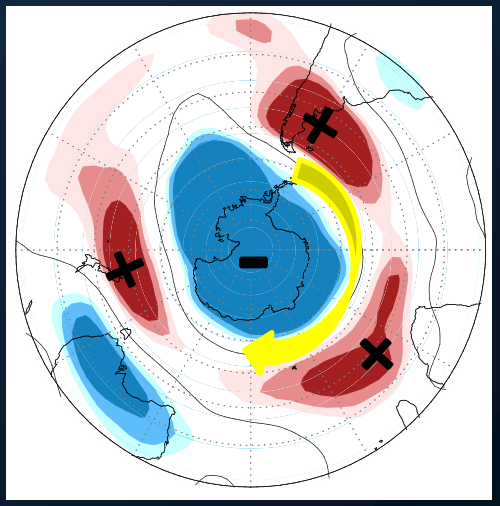
Influence of the polar stratospheric circulation on the intraseasonal variability in South America

•During winter and spring the westerly flow at middle and high latitudes of the Southern Hemisphere dominates from the troposphere to the stratosphere.

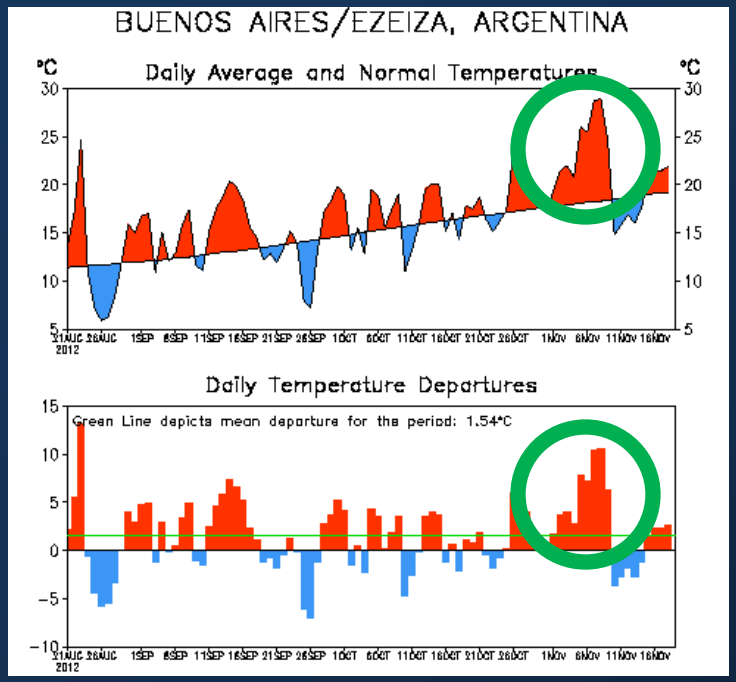
•Stratospheric circulation variations might influence that in the troposphere, for example accelerating or weakening the westerlies, which in turn can induce variations in the climate of South America.

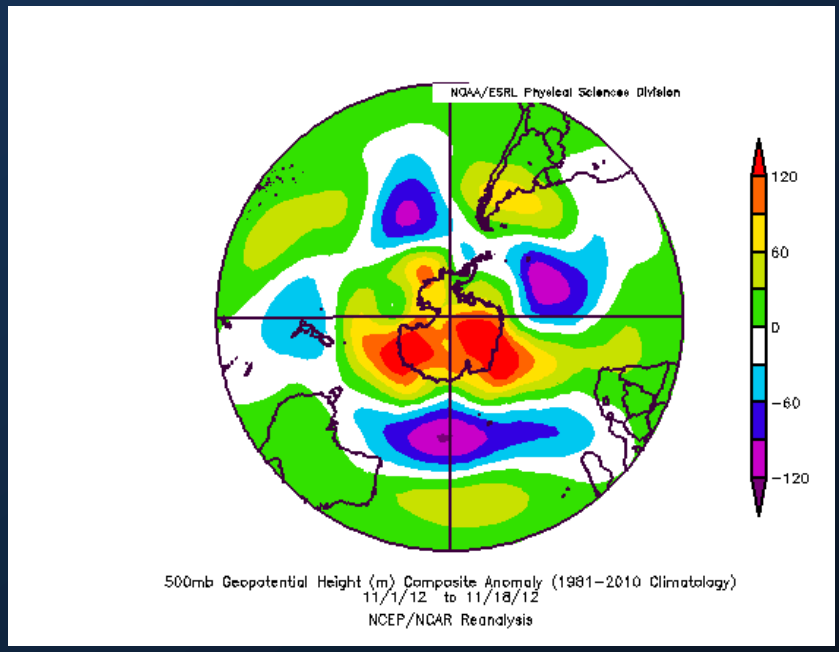
•Assessing changes in the intensity of the polar vortex or in the activity of the Southern Annular Mode (SAM) are some of the ways of monitoring possible stratosphere-troposphere interactions.

Pressure anomaly pattern associated with SAM



Influence of the polar stratospheric circulation on the intraseasonal variability in South America



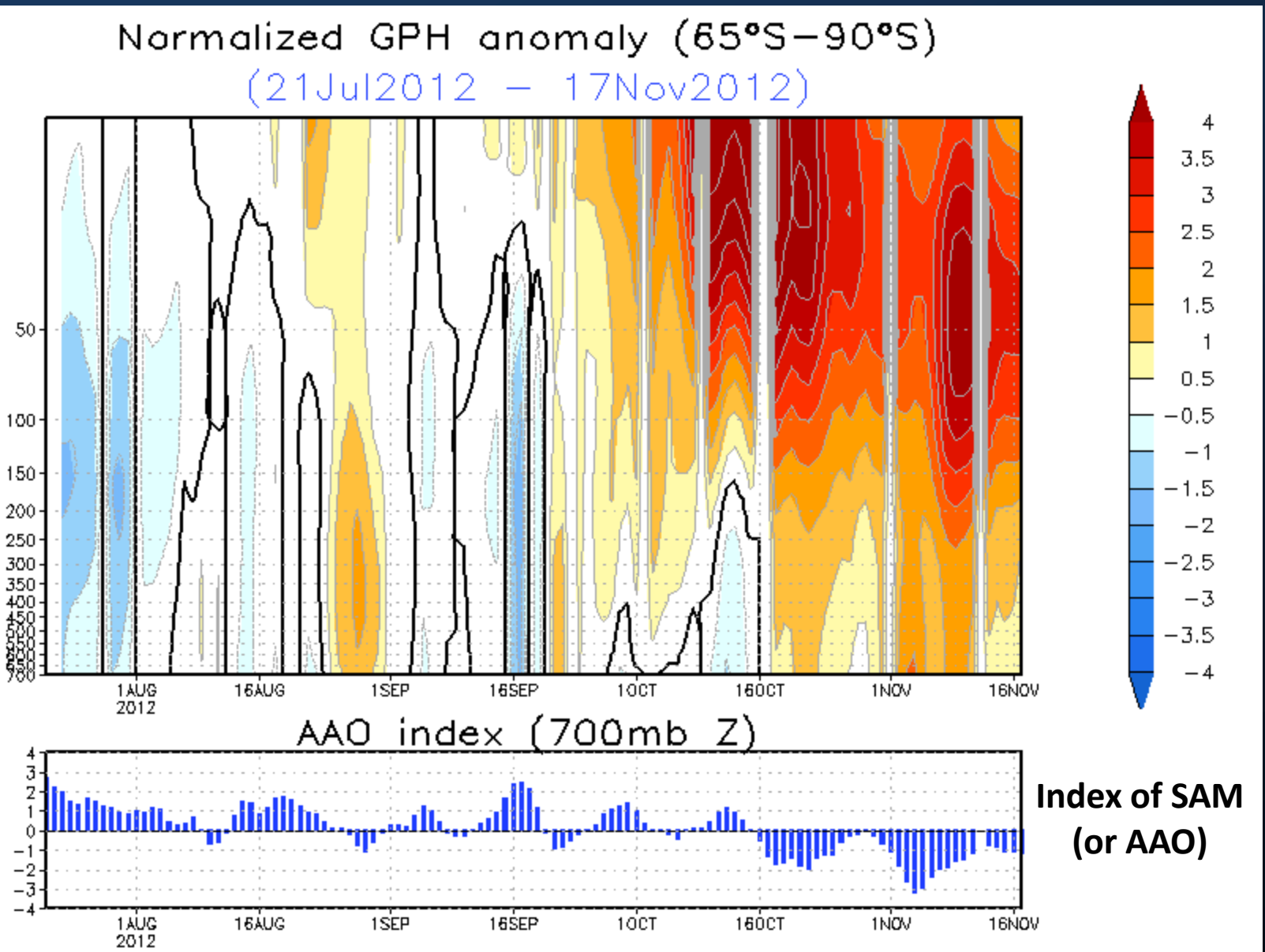


- Above normal surface temperature affected Buenos Aires between 1 and 11 November 2012

- It was induced by the development of above normal pressure conditions in southern South America in association with an intensification of a SAM negative phase (weakening of the westerlies)

- It was a neutral ENSO year and it occurred during a period of Neutral MJO activity

Evolution of the SAM pattern and the polar vortex between August and November 2012



Vertical cross section of the evolution of the intensity of the polar vortex

Yellow-red: weakening of the polar vortex

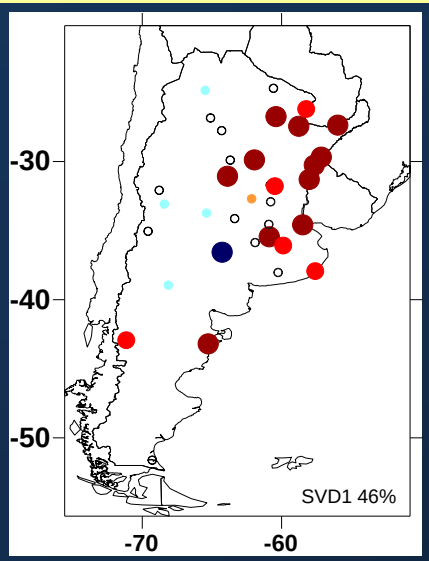
Index of SAM (or AAO)

Interannual variability

Leading patterns of variability of extreme daily rainfall events in spring (SON) in association with sea surface temperature (SST) anomalies

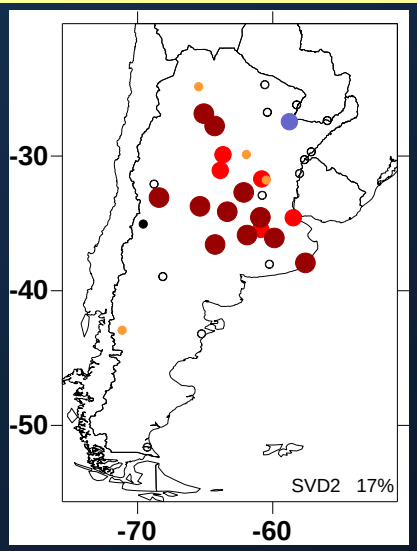
Seasonal mean intensity of extreme daily rainfall events

First pattern



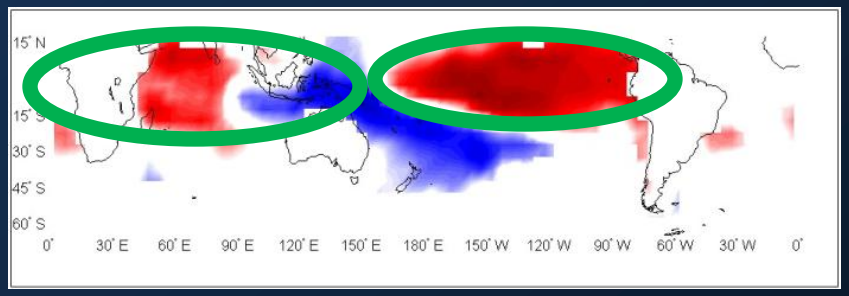
Red: positive anomalies

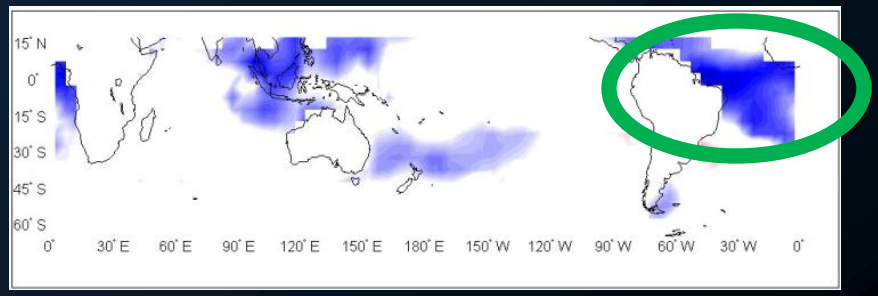
Blue: negative anomalies



Second Pattern

Sea Surface temperature (SST) anomalies

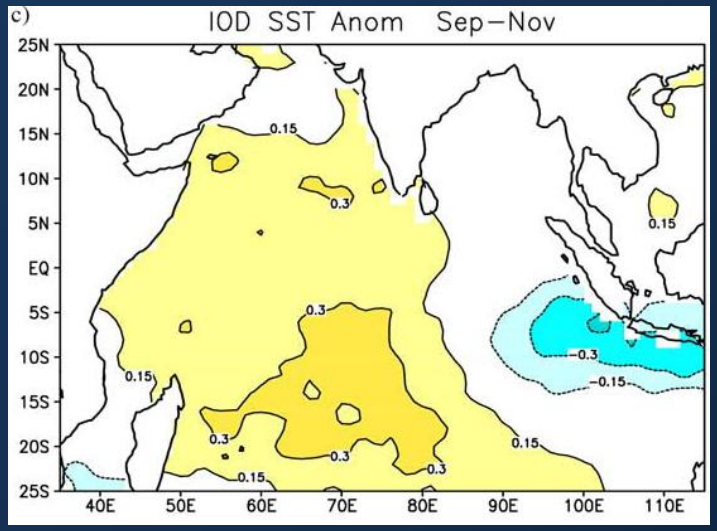




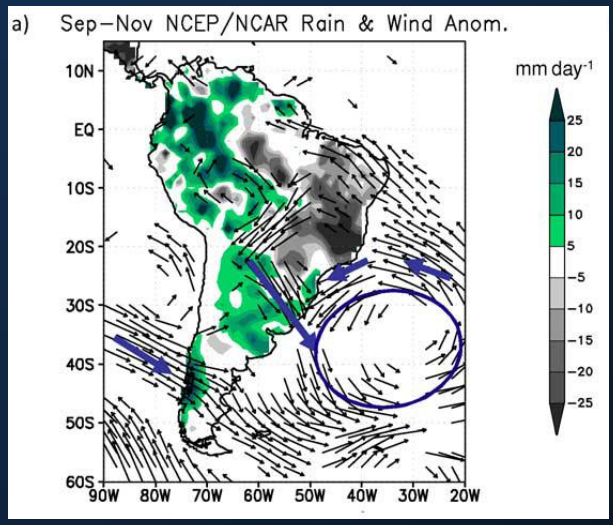
(Robledo et al 2011)

Influence of the Indian Ocean Dipole (IOD) on precipitation interannual variability in South America

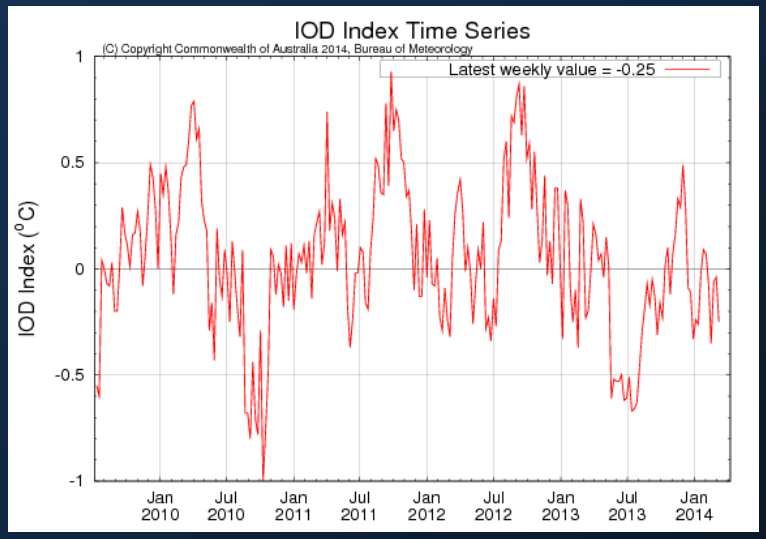
SON composite SST anomalies for pure positive IOD events.



SON composites of rainfall and 850-hPa wind anomalies during pure positive IOD events

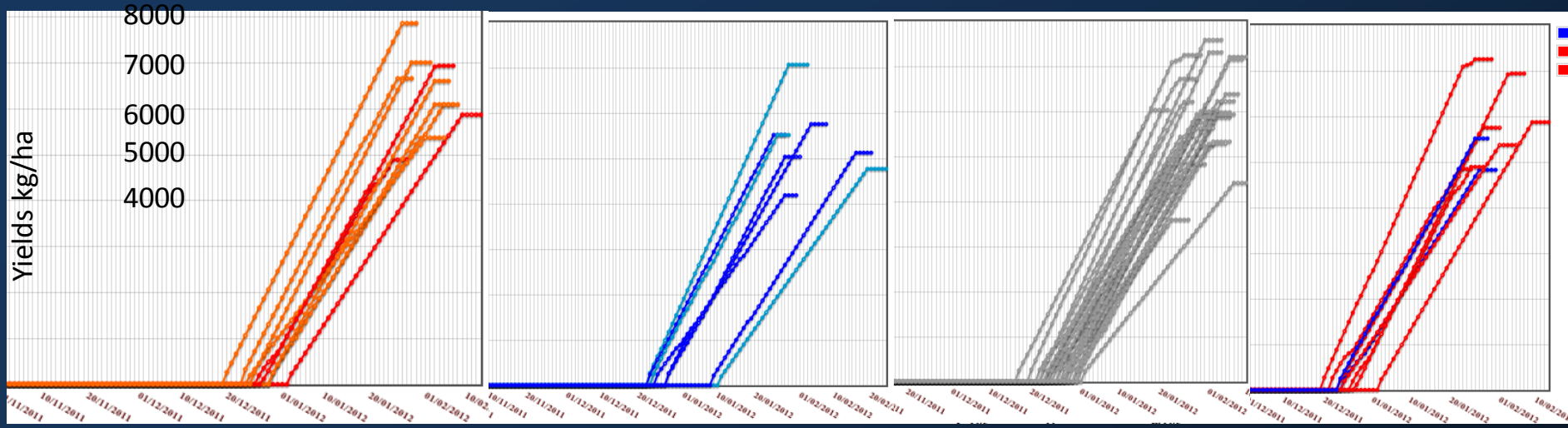


(Chan et al. 2008)



The evolution of the IOD is monitored by the global climate centers

ENSO & IOD Impact on Maize Yields



El Niño years

La Niña years

Neutral ENSO years

El Niño+IOD & IOD years

Maize Yields estimated using DSSAT model run with observed conditions in Pergamino.

(A. Rolla et al, 2014, in preparation)

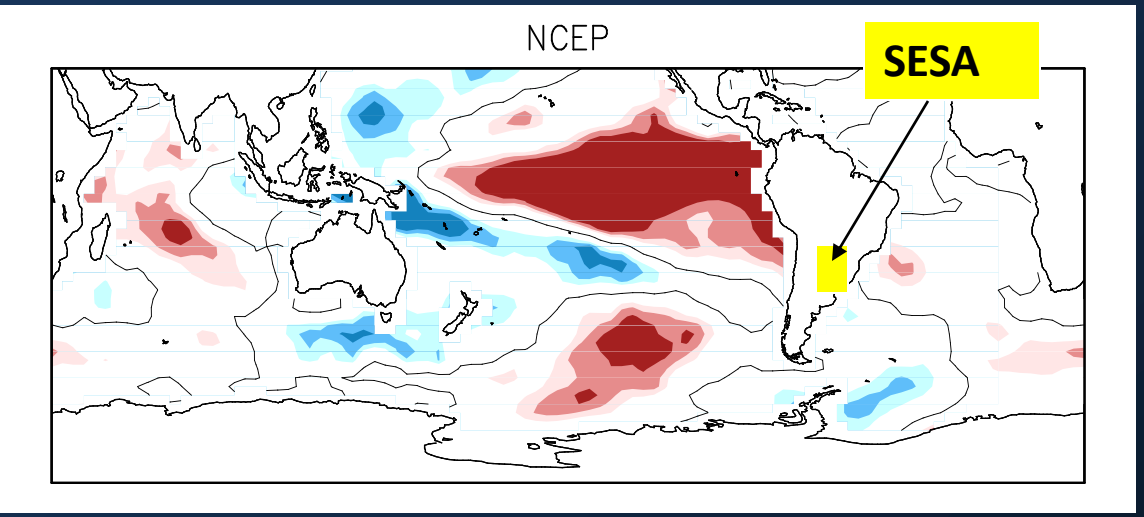
Combined influence of different large-scale climate signals

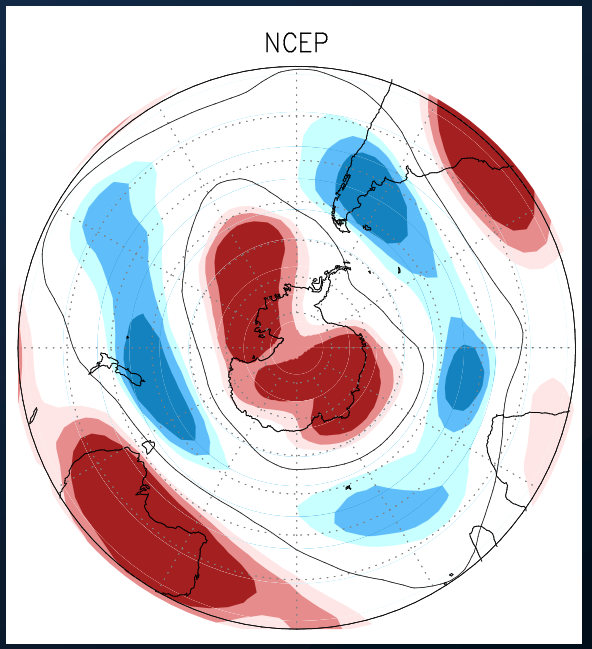
-ENSO warm events

-SAM negative phase

→

Positive OND precipitation anomalies in SESA

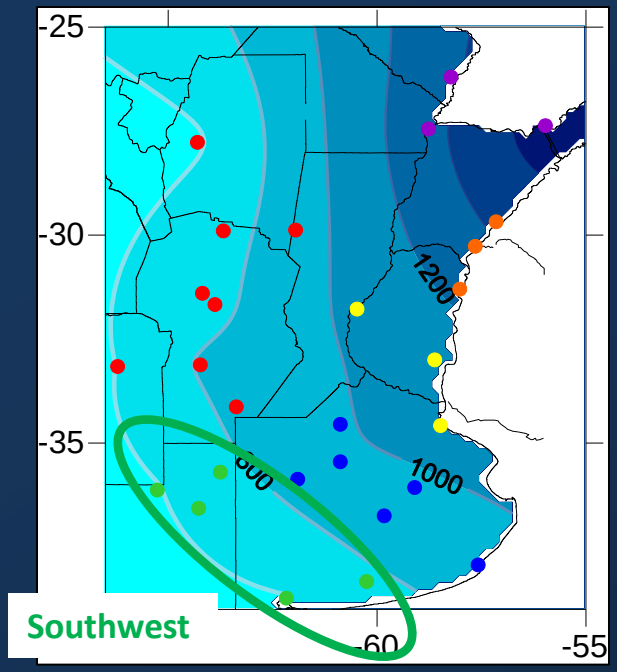


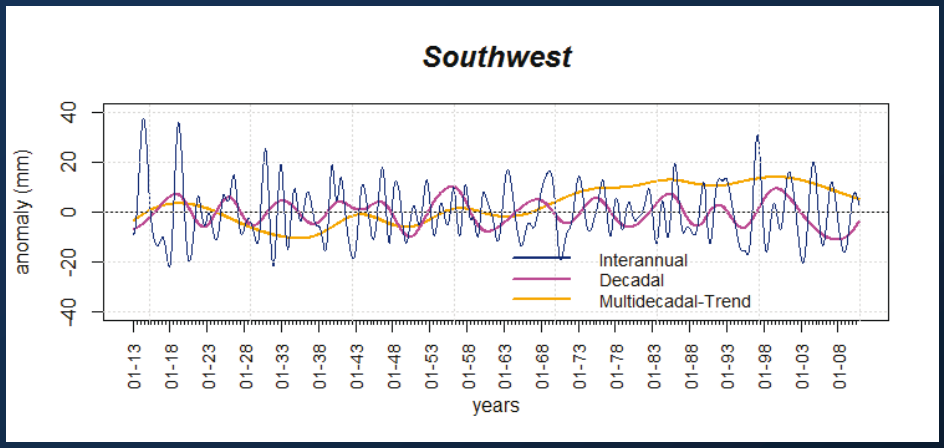


Correlations between precipitation anomalies in SESA and (left) SST anomalies and (right) 500-hPa geopotential height anomalies. Significant values at 90, 95 and 99% are shaded. NCEP reanalysis data. (1970-1999)

(Vera and Silvestri 2009)

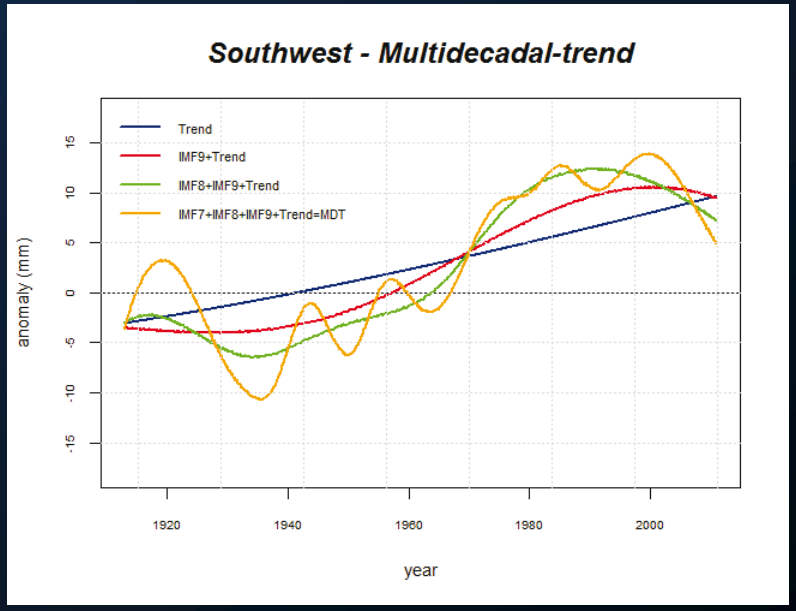
Climate variability on decadal and longer time scales





Components of rainfall variability associated with interannual (blue), decadal (pink) and multi-decadal plus trend (orange) from an EEMD analysis

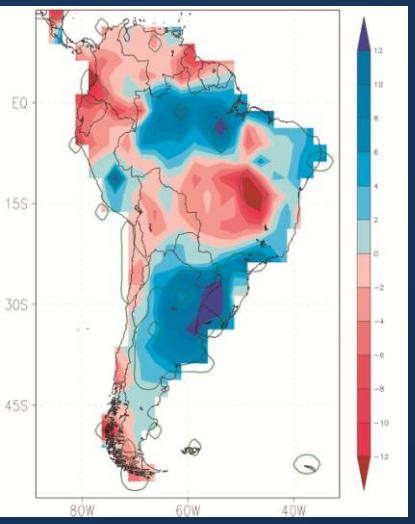
- A positive positive linear trend observed in the annual mean precipitation between 1911 and 2011 in "Southwest"
- Decadal and multidecadal variations contribute to reduce the trend impact in the 50s-60s and enhance it in the 70s and 80s.
- Since late 90s and first decades of XXI century, signals associated with decadal and multidecadal variations are weakening



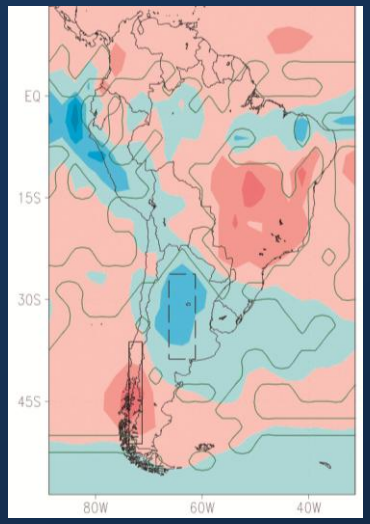
(M.M. Skansi, C. Vera, and G. Podestá 2014, Afternoon Poster Session)

Anthropogenic influence on summer precipitation trends over South America in CMIP5 models

DJF RAINFALL LINEAR TREND 1902-2005 (mm/summer/decade)



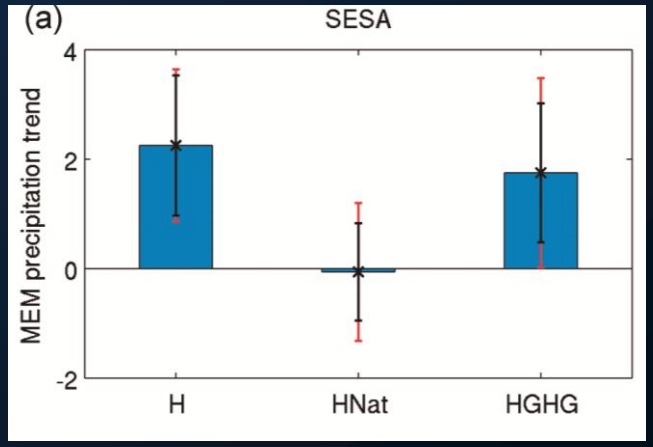
Observations (GPCC)



CMIP5 Multi-model ensemble mean (MEM)

59 simulations from 14 coupled global models from WCRP/CMIPt dataset

MEM trends in SESA obtained from simulations with both anthropogenic and natural forcings (H) considered, are significantly different from those obtained when natural forcing is only considered (HNat)



(Blue) MEM trends in SESA, (black) model uncertainties, (red) internal climate variability

(L. Díaz and C. Vera, 2014, Afternoon Poster Session)

Final Remarks

- Many global climate centers of the world periodically provide monitoring products of the large-scale climate signals (MJO, SAM, IOD, etc.)

- Such information combined with the knowledge about the climatological influence of those signals on regional climate could provide an added value to the current regional monitoring activities.

- Still, better use of the climate variability knowledge obtained by the academic-scientific community could be further made

How to make progress on regional climate monitoring in LAC

- WCRP future activities in LAC should include the implementation of pilot projects that help to accelerate the co-design and co-production of innovative regional monitoring products.

- Two different strategies:
  - Projects in which researchers jointly with personnel of the national meteorological services or regional climate centers elaborate conceptual models of the regional climate variability and co-develop products to monitor it.

  - Projects to address the monitoring needs of specific socio-economic sectors in which researchers, personnel of operational climate monitoring agencies and experts of the socio-economic sectors co-design and co-produce new and innovative monitoring products valuable for sector decision-making.

- Capacity building and training should be an essential component of these projects.