INTERDECADAL, INTERANNUAL, INTRASEASONAL CLIMATE VARIABILITY: IMPACTS AND MECHANISMS

October 2002 Report

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A) INTRODUCTION

During the third Co-PI's meeting at Mar del Plata, Argentina, in October 2002, there were 10 presentations in our section. Here, besides the authors and titles, a brief summary of its contents will be given. Further information about the talks can be obtained from the PROSUR homepage:
http://cima.at.fcen.uba.ar/prosur or directly to the authors.

B) TITLES AND AUTHORS OF THE WORK PRESENTED IN THE MEETING

1) **The influence of the tropical and subtropical Atlantic and Pacific Oceans on precipitation variability over Southern-Central South America on seasonal time scales.**
Guillermo J. Berri and Germán I. Bertossa. Departamento de Ciencias de la Atmósfera y los Océanos, Universidad de Buenos Aires.

2) **The Relation between Sea Surface Temperature at the Subtropical South-Central Pacific and Precipitation in Southeastern South America** .
Vicente Barros (1, 2) and Gabriel Silvestri (2). 1 Dto. Ciencias de la Atmósfera y los Océanos, Universidad de Buenos Aires. 2 Consejo Nacional de Investiga-ciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina

3) **Inter-El Niño (and La Niña) variability of the Southern Hemisphere circulation during austral Spring**.
Carolina Vera (1, 2), Gabriel Silvestri (3), Vicente Barros (2, 3) and Andrea Carril (4). 1 Centro de Investigaciones del Mar y la Atmósfera (CONICET). 2 Departa-mento de Ciencias de la Atmósfera y los Océanos, Universidad de Buenos Aires. 3 Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina. 4 Istituto Nazionale di Geofisica e Vulcanologia (INGV), Bologna, Italy

4) **The El Niño Impact on Summer Monsoon in Brazil: Regional Processes versus Remote Influences.**
Alice M. Grimm. Universidade Federal do Parana.

5) **How do La Niña events disturb the summer monsoon system in Brazil?**
Alice M. Grimm. Universidade Federal do Parana.

6) **Further analysis of ENSO impacts on the subtropical South América: evolution of the precipitation anomalies on pentad timescale.**
Everaldo B. de Souza and Tércio Ambrizzi. Departamento de Ciências Atmosfé-ricas, IAG, Universidade de São Paulo, SP, Brasil

7) **Possible mechanisms responsible for strengthening and weakening the monthly mean Subtropical Jet over South America during the austral winter.**
Pablo Luis Antico and Guillermo Jorge Berri. Departamento de Ciencias de la Atmósfera y los Océanos, Universidad de Buenos Aires.

8) **On the leading modes of sea surface temperature variability in the South Atlantic Ocean.**
Virginia Pastalanga, Carolina Vera e Alberto R. Piola.

9) **Relação entre a variabilidade interanual e interdecadal da chuva no sudeste da América do Sul e da temperatura da superfície do mar nos oceanos Atlântico e Pacífico.**
Alice M. Grimm (1) e Angela A. Natori (2). 1 Universidade Federal do Parana
2 Universidade de Sao Paulo

10) **Tendência linear e variabilidade interdecadal da precipitação sobre a América do Sul.**
Carlos A. Nobre e Guillermo O. Obregón. Centro de Previsão de Tempo e Estudos climáticos - CPTEC

C) BRIEF SUMMARY OF THE PRESENTATIONS

1) **Berri and Bertossa: influence of tropical and subtropical Atlantic and Pacific Oceans on precipitation over southern-central South America (SCSA).**

CCA of bi-monthly precipitation and SST, using 10 EOFs of SST and 9-11 EOFs of precipitation, that explain at least 80% of the variance. The most robust association between SST and precipitation occurred in November-December, followed by Mach-April and May-June. The weakest association between SST and precipitation was observed during January-February.

Identification of oceanic regions and SCSA whose SST and precipitation anomalies are correlated. Example of November-December: the Pacific Ocean has stronger and more spread out influence over SCSA than the Atlantic Ocean, which shows some influence only in the northwestern and southeastern parts of the region.

Relationship with - tropical oceans: warm-wet, cold-dry
- subtropical oceans: warm-dry, cold-wet.

2) Barros and Silvestri: relationship between SST at subtropical south-central Pacific and precipitation in southeastern South America (SSA) during austral spring.

Two first modes of CCA show warm-wet and cold-dry relationship between tropical SST and precipitation. SST in the equatorial regions does not modulate rainfall variability among EN and LN cases, but between EN and LN cases in the whole period and among neutral cases. The SSA rainfall response to equatorial Pacific SST is not linear over the observed SST range. SST in the SSCP modulates the seasonal rainfall over most of SSA.

SST in Niño 3 and Niño 3.4 and SST in SSCP are negatively correlated over the whole period, but are uncorrelated when only EN or neutral cases are considered. Stratification of cases: difference between cases with constant equatorial SST and different SST in SSCP shows a ENSO-like wave-train. Most of the ENSO signal at mid and high latitudes is associated with SST variability in SSCP.

3) Vera, Silvestri and Barros: inter ENSO variability of the Southern Hemisphere circulation during austral spring

Stratification of the springs associated with ENSO events according to SST conditions over El Niño 3.4 sector and over the SSCP region: WC and WW cases.

WC cases: enhanced convection not only in the equatorial central Pacific but also in subtropical regions of the southeastern Pacific Ocean. Intensification of a localized Hadley produces a well-defined Rossby wave pattern in the central south Pacific extratropical region.

WW cases: anomalous circulation pattern more concentrated in the tropics.

The heating forcing present in the WC cases in the south central Pacific subtropical region is essential to maintain the wavelike circulation over that area.

4 and 5) Grimm: The El Niño and La Niña impact on summer monsoon in Brazil: regional processes versus remote influences. (2 papers: Journal of Climate and Climate Dynamics)

Data: Precipitation monthly totals from more than 1800 selected stations were used in the period 1956-1992, so that at least 5 El Niño episodes are included in each station. Surface temperature observations and reanalysis data are also used.

The El Niño and La Niña impact on Brazil's summer monsoon has not been adequately assessed through seasonal analysis because it shows significant subseasonal variations. There are abrupt changes of anomalies within the summer monsoon season, suggesting the prevalence of regional processes over remote influences during part of the season. Precipitation and circulation anomalies that are consistent and important during part of the season are smoothed out in a seasonal analysis.

In early summer monsoon season remotely produced atmospheric perturbations prevail over Brazil. Perturbations in the Walker and Hadley circulation over East Pacific and South America, and a Rossby wave-train over southern SA that originates in the eastern Pacific favor negative (positive) precipitation anomalies in north and central-east Brazil and positive (negative) ones in south Brazil.

In January, with the enhancement (weakening) of the continental subtropical heat low by anomalous surface heating (cooling) during the spring, there is anomalous low-level convergence (divergence) and cyclonic (anticyclonic) circulation over southeast Brazil, while at upper-levels anomalies of divergence (convergence) and anticyclonic (cyclonic) circulation prevail.

This anomalous circulation directs moisture flux towards central-east Brazil (southern Brazil), causing moisture convergence in this region. A favorable thermodynamic structure enhances precipitation over central-east Brazil (southern Brazil), the dry (wet) anomalies in north Brazil are displaced northward, and the wet (dry) anomalies in south Brazil almost disappear.

In February there is a return to previous conditions.

Influence function analysis shows that while the anomalies of circulation over southeast Brazil in spring of El Niño years are mostly due to remote influences from the tropical East Pacific, those in January are probably due to local influence. During this month the monsoon-like circulation is enhanced.

Simultaneous and lagged correlation analysis of SST and rainfall in central-east Brazil shows that SST anomalies in the Atlantic Ocean off the southeastern coast of Brazil fluctuate on the same timescale as the circulation and precipitation anomalies.

6) Souza e Ambrizzi: analysis of ENSO impacts on the subtropical South America (SSA) on pentad timescale (in preparation)

Composite of pentad GPCP precipitation and 200 hPa wind anomalies for El Niño and La Niña events during the period 1979-2000.

Positive (negative) precipitation anomalies are stronger in South Brazil. The precipitation anomalies are rather uniform during El Niño (La Niña) episodes, but there is a reversal of sign over part of the region in periods of 1 to 3 pentads.

The strengthening (weakening) of the subtropical jet over SSA is associated with positive (negative) precipitation anomalies in the region.

7) Antico e Berri: possible mechanisms responsible for strengthening and weakening the monthly mean subtropical jet over South America during the austral winter. (To be submitted)

Composites for 4 cases of strong STJ and 5 cases of weak STJ in July-September of the period 1978-1999 were presented. Strong (weak) STJ is due to strong (weak) Hadley cell associated with enhanced (suppressed) convection in the eastern Pacific, off the Central America coast.

There are 2 cases different from the other ones: a strong STJ in 1995 and a weak one in 1992, due to Rossby wave propagation from the western Pacific (1995) and from tropical South America (1992). Anomalous STJ produces anomalous meridional circulation downstream (indirect meridional cell) and consequently upward motion and cloudiness.

8) Pastalanga, Vera, and Piola: leading modes of the sea surface temperature variability in the South Atlantic

EOF analysis of the monthly mean SST fields from the NCEP-NCAR reanalysis, for 1972-2000 was used.

S-EOFs are obtained from analysis in the spatial domain and T-EOFs are obtained from analysis in the time domain.

T-EOF1: north-south dipole with dominant interdecadal variability.
T-EOF2: strong center in subtropical central Atlantic with centers of opposite sign south of Africa and off the Argentinean coast. Interannual and sub-annual variability, with this last one located over the Brazil-Malvinas confluence and the Agulhas retroflection were observed.
T-EOF3: east-west dipole at mid-latitudes with significant interannual variability associated with ENSO.

Only the first S-EOF mode agrees with a corresponding T-EOF mode. The EOF analysis in the time domain is an efficient tool to isolate the SST leading patterns without requiring additional filtering.

9) Grimm and Natori: relationship between the interannual and interdecadal variability of precipitation in southeastern South America and SST in the Pacific and Atlantic oceans. (presented at the XII Brazilian Meteorological Congress; to be submitted).

CCA of rainfall for 515 stations from northeast Brazil to Patagonia and SST (HADISST) from Pacific and Atlantic oceans in austral spring were used in this work. The analysis for the Pacific shows 3 ENSO-like modes (1, 2 and 5) with differences in the location of the largest SST anomalies, tropics-extratropics SST gradients, and precipitation anomalies.

The analysis for the Atlantic shows 2 modes (1 and 3) correlated with Niño 3 SST, and correlated with the three ENSO-like modes of the Pacific. They also have different SST and precipitation anomalies. Mode 4 is not correlated with Niño 3 SST, but is correlated with mode 1 for the Pacific. Those different modes have different interdecadal oscillations, which explain the interdecadal modulation of El Niño events and their impact on precipitation.

In some cases the areas of significant correlation for precipitation in the analysis for both oceans are the same, indicating that they have the same effect. However, the isolated influence of one ocean is sometimes more important.

Examples: 1) the mode 2 for Pacific+Atlantic is a mixture of modes 1 and 2 for Pacific (which shows in the canonical map for precipitation), and modes 3 and 4 for the Atlantic (which also shows in the canonical map for precipitation.

2) The mode 1 for Pacific+Atlantic is a mixture of mode 3 for the Pacific and mode 1 for the Atlantic (these ones are not correlated). The precipitation canonical maps for mode 3 for Pacific and mode 1 for Atlantic are different in most of southeastern South America (central an northern Argentina, Uruguay, and southern Brazil). In these regions the mode 1 for Pacific+Atlantic is not associated with significant precipitation anomalies. When mode 1 for Atlantic appears isolated there are significant anomalies in Uruguay, and the eastern part of Argentina.

10) Nobre and Obregón: linear tendency and interdecadal variability of the precipitation over South America (based on the thesis of Obregón, to be submitted)

The linear tendency and interdecadal variability of annual precipitation are determined with non-parametric statistical methods for 1951-1990. There are different regional tendencies: negative over northwestern Amazonia and southeast Brazil, and positive ones in south Brazil and the subtropical region east of the Andes.

There are abrupt changes in the 70´s, apparently associated with ENSO-like interdecadal variability.