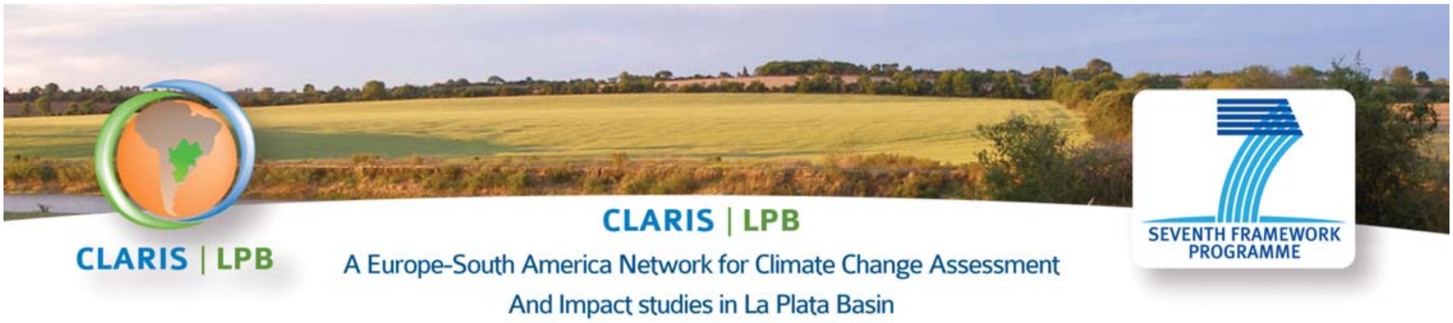

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Deliverables

Instrument: **SP1 Cooperation**

Thematic Priority: **Priority Area 1.1.6.3 "Global Change and Ecosystems"**

FP7 Collaborative Project – Grant Agreement 212492

CLARIS LPB
A Europe-South America Network for Climate Change Assessment and Impact Studies in La Plata Basin

DELIVERABLES

D6.1: Report on the results of the First Annual Workshop on Extreme Events

Due date of deliverable: Month 12

Start date of project: **01/10/2008** Duration: 4 **years**

Organisation name of lead contractor for this deliverable: P - INPE

Deliverable No	Deliverable title	WP	Lead beneficiary	Estimated indicative person-months (permanent staff)	Nature	Dissemination level	Delivery date
D.6.1	Report on results of First Annual Workshop on Extreme Events	WP6	P - INPE	12,95	R	PU	12

Report on the results of the first annual workshop on extreme events.

1. Introduction.

The first WP6 workshop was held at Punta Del Este (Uruguay) from 16 to 18 November 2009. 19 researchers and students of WP6 participated presenting their preliminary results and discussing on the ongoing activities related to the planned tasks: *1: Exploring the large scale conditions in which the extremes are embedded and the processes controlling/interacting with the extremes; T6.2: Quantifying observed trends in extremes and exploring, in the models, the capability to reproduce those trends; T6.3: Assessment of the global warming influence on the statistics of the extreme events.* There were also presentations by representative participants of WP3, WP5, WP8 and WP9. Besides the presentations we had discussions about indices that have been used (like in STARDEX project, ETCCDI, IPCC) and the need to create a table with the indices that WP6 will use to identify extremes. We found that some indices used in previous studies should be modified to adapt to the La Plata region. A preliminary table will be prepared. We also discussed about the observed data which have been prepared in WP3. Temperature and precipitation data from Brazil areas will be included in the dataset (already provided). The regional model results should be available in the beginning of 2010, according WP5. Information from WP8 and WP9 about applications on agriculture and hydrology were also presented by the invited participants and the requirements from those groups on extremes, were discussed. Some of the requirements will be prepared as a table of indices, and for some of them there is a need of further discussions with WP8 and WP9 groups. After the presentations we had time for discussions and there were many interactions and suggestions. In the last day we worked in groups to have the summary of presentations, a list of references of published papers, a summary of suggested indices and the planned activities for the next year. We also discussed about interaction among the participants, during the next period, collaboration work, papers to be prepared, references of studies on extremes, use of the CLARIS-LPB home page and activities in the next year.

Participants : Iracema FA Cavalcanti, Madeleine Renon, Noelia Micevicius, Claudia Martinez, Bárbara Tencer, Natalia Pessag, Maria Laura Bettoli, Olga Penalba, Federico Robledo, Juan Rivera, Claudia Campetella, Matilde Rusticucci, Laura Zamboni, Claudio G. Menendez, Roger Rodrigues Torres, Armelle Reca Remedio, Rosmeri Porfirio da Rocha, Farall Andres, Jhan_Carlo Espinoza. Marcelo Barrero from WP8 participated in the first day. Rafael Terra represented WP8 bringing information from the subproject, and from WP9 the information was presented by Moira Doyle. Claudio Menendez presented information from WP5 and Olga Penalba/Madeleine Renon from WP3.

2. Results of WP6 subproject

The workshop agenda is displayed in section 5 and a summary of presentations is given bellow:

2.1 A Southeastern South American Daily Gridded Data Set of Observed Surface Minimum and Maximum Temperature for 1961-2000

Contribution to task 2: *Bárbara Tencer*[1,2] *, Matilde Rusticucci*[1,2] *, Phil Jones*[3]
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[2] *CONICET, Argentina*
[3] *Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, UK*

This study presents a Southeastern South American daily gridded data set of minimum and maximum surface temperature for 1991-2000. The data used for the gridding are daily data observed in meteorological stations of Argentina, Brazil, Paraguay and Uruguay from the CLARIS database. This gridded data set is newly for the region both because of its spatial and temporal extension, as well as for its temporal resolution. Since the methodology used produces an estimation of the grid square averages, the data set obtained is very useful for the validation of Regional Climate Models. The region for which the gridded dataset has been developed is 20º-40º S, 50º-70º W, with a resolution of 1º x 1º and the period covered is 1961-2000. The comparison of gridded and observed data provides an evaluation of the level of likelihood of the interpolated data. According to monthly mean values and interdiurnal variability the methodology of interpolation, developed during the ENSEMBLES-based Predictions of Climate Changes and their Impacts project for its application in Europe, is suitable also for Southeastern South America. Mean square root error for the whole region is 1.90 for minimum temperature and 1.45 for maximum temperature. The monthly means of minimum temperature for grid points and station points are shown in Figure 1.

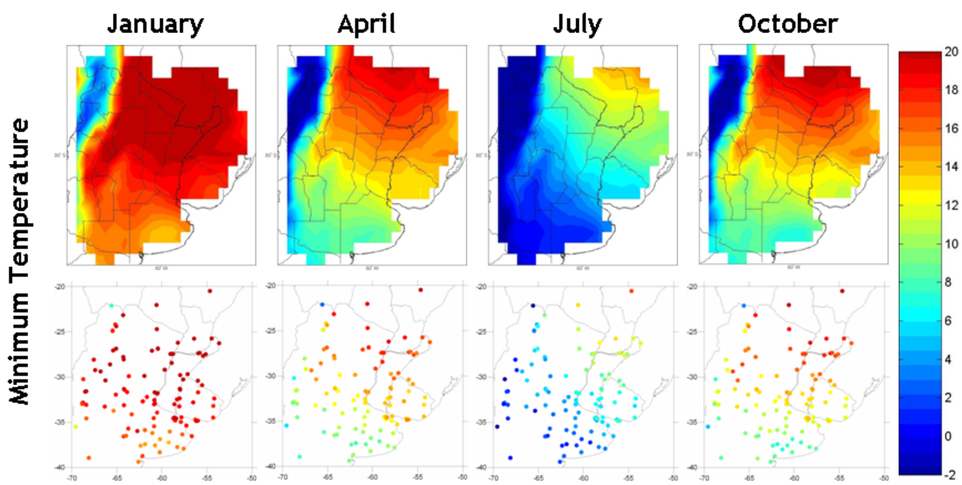

Figure 1. Monthly means of minimum temperature (ºC) for grid points (upper row) and station points (lower row) for January, April, July and October for 1991-2000.

2.2 Inter-annual and inter-decadal variability on dry days in La Plata Basin. Monitoring extreme dry conditions.

Contribution to Task 1: Juan A. Rivera, Olga C. Penalba, María L. Bettolli
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Drought is an extreme climatic event and its spatial and temporal limits are difficult to detect. Where adaptation strategies for water resources managing are not designed, this adversity could become in a natural disaster. Since the influence of atmospheric conditions on the lack of precipitation is regional-dependent, drought definition used to be regional-related. At present, no universally acceptable definition of drought exists, except the concept of lack of rain. Therefore, we propose to use the amount of dry days as a drought index and to analyze their temporal variabilities based on an objective regionalization at annual and seasonal scales over Argentina. Daily data from 62 rain gauges was provided by the National Weather Service of Argentina for the period 1970-2005. The regionalization was obtained by subjecting the 62 stations to the *k*-means method. In order to find the main modes of variability and to evaluate the performance of the amount of dry days as a monitoring tool for dry and wet periods, we make an examination of the temporal variability of each region. This analysis shows that the amount of dry days is a good indicator of the prevailing hydrological conditions during the period studied. Superimposed to this interannual variability, it was found the existence of significant tendencies in several regions of the country. The most important ones were located at annual level in the Central-West region, and in the La Plata Basin during the winter season. For a monthly scale approach, we present an analysis of the dry periods occurred during the last 49 years identified by an index that considers the monthly anomalies in the number of dry days filtered using a moving average with a 12-month window. The behaviour of the dry episodes was analyzed during the sub-period 1960-1974, 1975-1990 and 1991-2008 by severity-duration curves. It was verified that the decadal variability plays an important role in modulating the dry periods. The last years of study showed a trend towards drier conditions, which were verified by the accumulation of the index in periods of 1, 2 and 5 years. The drought of 2008-09 was the most extreme in several stations of the country in the last decades (Figure 2 and Figure 3).

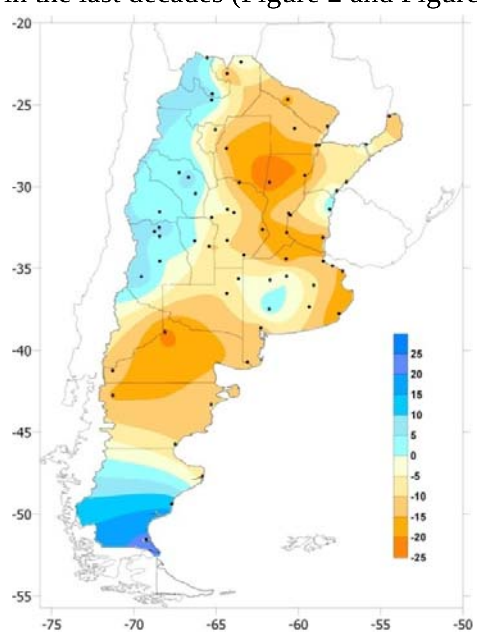

Figure 2. Accumulation of the Lack Of Rain (LOR) Index during 2008.

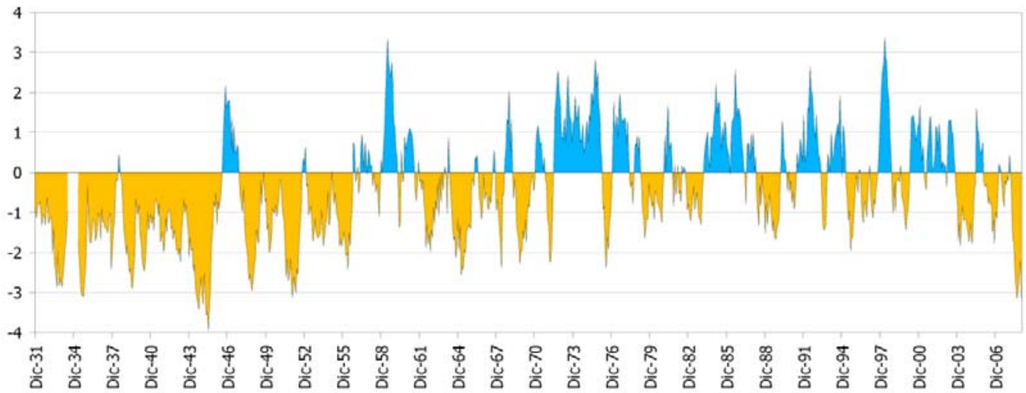

Figure 3. Time series of LOR Index for Ceres station (29.53ºS-61.57ºW) for the period 1931-2008.

2.3 Inter-annual and inter-decadal variability of extreme hydrological conditions in La Plata Basin

Contribution to task 2: *Olga Penalba*[1], *Vanesa Pántano*[1], *Spescha L. B.*[2], *Murphy. G. M.*[2]
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The climate and its variability represent one of the most important factors to take into account in many productive activities. Such variability mainly depends on the change in the frequency of occurrence or the intensity of extreme events. The extreme hydrological conditions play an important role in the development of the crops producing a socio- economic impact in the affected zones. The objective of this work is to analyze and evaluate the decadal variability of the extreme water conditions of the soil in the centre- north east region of Argentina. Monthly data of precipitation and maximum and minimum temperatures have been used in 35 stations for the period 1960-2008. From de Water Balance, the decadal variability of the percentage amount of deficit (excess) and extreme deficit (extreme excess) was analyzed for each season. The following analyses were performed: a) *Mean and standard deviation of the hydric condition, for each decade and season. b) Spatial variability of favorable and unfavorable conditions. c) Interdecadal variability of extreme conditions.* In the region of study, La Plata Basin shows a progressive increase in precipitation during the last decades, displacing the agriculture border towards the west. The favorable hydric conditions tend to occur during autumn, with greater probability of occurrence northeastward of the region. During summer, the major excess is produced in all the stations. Towards the north this result is favorable, reducing the negative evapotranspiration effect. Winter presents the fewer inter-annual variability, meanwhile the greater variability is observed during autumn and spring, mainly in the western stations. In general, the region is under deficit conditions, where west of 60ºW is the most unfavorable zone. Figure 4 show the percentage of year below of the unfavorable condition. The 1960 decade was the most extreme because of its intensity and spatial-temporal domain; while the 70s, 90s and 2000 decades presented extreme water conditions in autumn, winter and spring, respectively. Regarding the excess conditions, Mesopotamia region presents the greatest probability of occurrence. Analyzing these extreme water conditions, the result was more sectorized, depending on the season and decade. A greater number of favorable extreme events is observed during summer and autumn, especially during the lasts years, being consistent with the increase of the precipitation in the region. In this context, the extensive agriculture has experimented changes of great magnitude: increase in the surface sown with crops and its productivity; changes in the relative importance of the crops; incorporation of new high impact technologies.

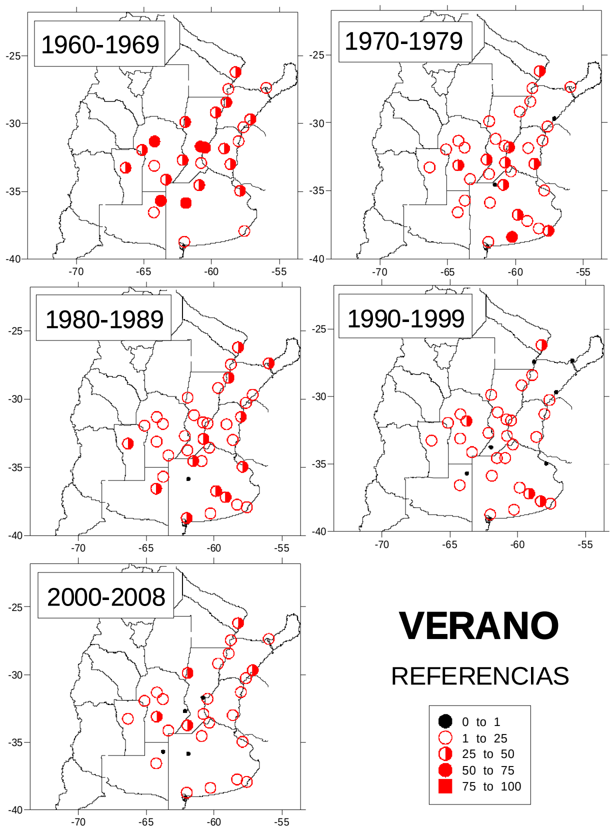

Figure 4. Percentage of years below the unfavorable condition.

2.4 Heat waves over South America: preliminary results.

Contribution to Task 1: Laura Zamboni and Annalisa Cherchi
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The development of a methodology to characterize heat waves (HW) over South America has started. In this preliminary work daily maximum temperature for the period 1961-2000 from the NCEP reanalysis and the SINTEXG (CMCC-INGV) atmosphere-ocean-sea-ice coupled GCM (T106) *(Gualdi et al., 2008)* were implied. The reason for these choices are simply the immediate availability of the data when the analysis was started while other GCM outputs (as for example other integrations of the coupled and uncoupled GCM) as well as other observations (as station data as it was suggested during the meeting) will be considered for the future investigations.

The occurrence of a HW is defined as a period of at least three consecutive days in which the daily maximum temperature at 2m is above the 90th percentile. The 90th percentile is computed at each grid point for each calendar day: this allows the comparison among different regions and different months since the thresholds so defined are normalized to the local climate and automatically filter the submonthly and intraseasonal variability.

The area more affected by HW is in the reanalysis, according to the mean number of HW over the period 1961-2000, the Amazon regions (3-4 events), while over the LPB the number is 2-3. SINTEXG has a comparable occurrence but this particular simulation does not capture the pattern over the Amazon and also presents smaller values (1-2) over the north and east of the continent.
To the purpose of identifying regional patterns of HW and the large scale processes associated with them, we attempted to link the occurrence of these extremes events to the monthly distribution of temperature. The goal is to assess whether the distribution of monthly Tmax in months characterized by a larger number of HW corresponds to a shit toward higher temperatures with respect to the climatological distribution or presents differences in its tail. Physically, we aim to assess whether there exist mechanisms affecting the occurrence extreme events only or "symmetrically" impacting the entire temperature field. As a first attempt, we correlate the number of HW with the mean, standard deviation and skewness of monthly maximum temperature in time and at each grid point (Figure 5). Results are consistent with the existence of a symmetric shift of the monthly temperature corresponding to a larger number of HW over the entire continent. Furthermore, a larger variability of the temperature is also identified over a region closely resembling the monsoon pattern. Similar outcomes are found for both the NCEP reanalysis and the CGCM.

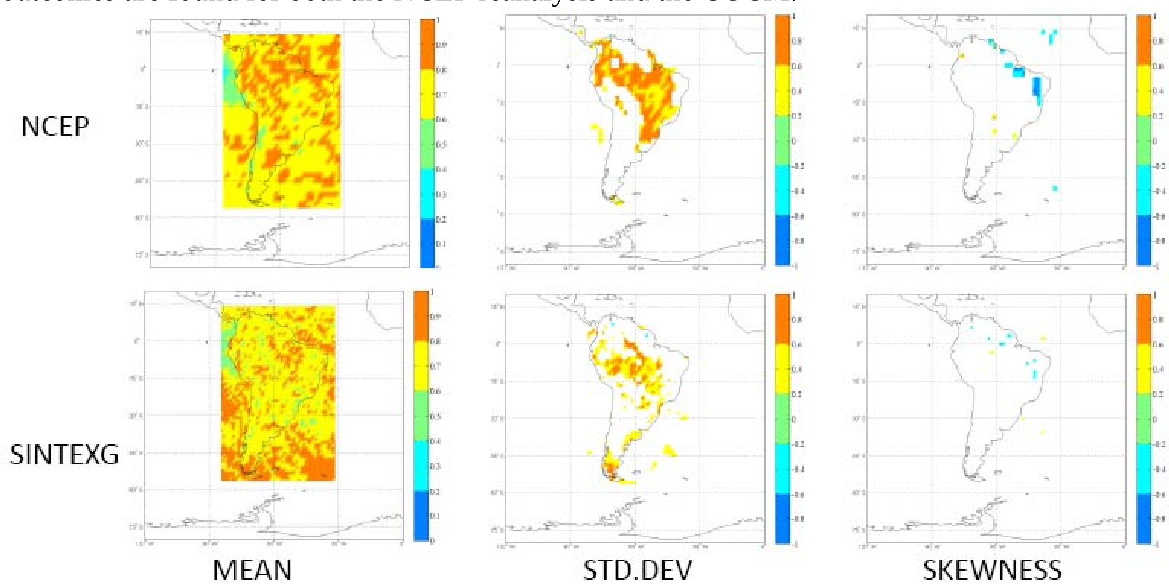

Figure 5. Correlation among the number of heat waves and the mean (left panels), standard deviation (middle panels) and skewness (right panels) of the monthly maximum temperature distribution for NCEP reanalysis (upper panels) and the INGV-CMCC CGCM.

2.5 Simulating precipitation extremes with CGCMs and RCMs over South America

Contribution to tasks 1 and 3: *Claudio Menéndez*
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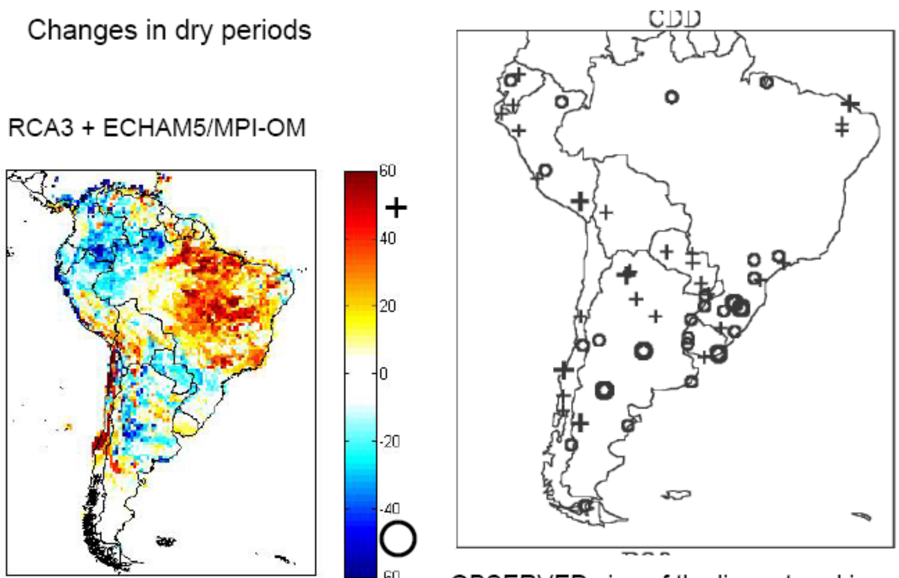
UBA, CIMA

The likely changes in climate extremes under enhanced greenhouse gases over the southern extratropics, with emphasis in southern South America and sub-Antarctic seas were presented through the analysis of extreme indices measured from models participating in the IPCC 4th Assessment Report. It was discussed how the anthropogenic climate change under A1B scenario influences both the patterns of mean change of extreme indices and the likelihood of occurrence of severe extreme indices. The likelihood of occurrence of a year with a large number of days with "warm" minimum temperatures is estimated to increase by a factor of 4 by the end of this century over most of the southern extratropics. By that time, the risk of "severe" precipitation intensity is projected to rise in most areas with the exception of the subtropical anticyclones areas, which experience particularly strong drying. Over the Southern Ocean this likelihood has increased to over 60%. Corresponding estimates of the changing likelihood for very long dry spells show a banded structure with positive ratios to the north of about 50°S and negative ratios in the sub Antarctic seas. In southern South America this risk about doubled between present and future climates. The consecutive dry days from model results (future –present climate) is illustrated in Figure 1. In large areas of LPB a decrease in the number of CDD is projected for the future climate. On the other hand, an increase in CDD is simulated in tropical South America. Another study, which was published in Climatic Changes (Menendez and Carril, 2009) is the investigation of the Southern Annular Mode influences on the occurrence of severe extreme indices during the period 2070-2099. Its positive phase inhibits the extremely warm minimum temperatures in the Southern Ocean, with the exception of the eastern Bellingshausen Sea, and favors severe frost days to the north of the Ross Sea. Temperature indices show very little change induced by the SAM to the north of 50°S. Severe dry spells are inhibited during the positive phase along the sub Antarctic seas, while the mid-latitudes, including most of Patagonia, show the opposite behaviour. The Southern Ocean reveals a non-uniform distribution with both increases and decreases in the occurrence of heavier precipitation during positive SAM.

The responses of precipitation seasonal means and extremes over South America in a downscaling of a climate change scenario using the Rossby Centre Regional Atmospheric Model (RCA) is assessed. The anthropogenic warming under A1B scenario influences more on the likelihood of occurrence of severe extreme events like heavy precipitation and dry spells than on the mean seasonal precipitation. The extreme precipitation risks increases in the south eastern South America with a factor of 1.5-2.5 during all seasons and in the north western part of the continent with a factor 1.5-3 in summer season, while it decreases in central and north eastern Brazil during winter and spring. In southern Amazonia the maximum number of consecutive dry days increases and mean winter and spring precipitation decreases, indicating a longer dry season and a later onset of the monsoon season. In the La Plata Basin, the seasonal precipitation and heavy rainfall events tend to increase by the end of this century especially in the northern part of the basin, although with a no clear pattern of change for the dry spell duration. The maximum number of simulated CDD by an ensemble of regional models and CDD observed trend areshown in Figure 6. These results were submitted in South American precipitation changes of the 21th century – a dynamical downscaling within CLARIS. (Sorensson et al.).

Other results are related to the investigation of the performance of one stretched-grid atmospheric global model, five different regional climate models and a statistical downscaling technique in simulating three months (January 1971, November 1986, July 1996) characterized by anomalous climate conditions in the southern La Plata Basin. Models were driven by reanalysis (ERA-40). The analysis has emphasized on the simulation of the precipitation over land and has provided a quantification of the biases of and scatter between the different regional simulations. Most but not all dynamical models underestimate precipitation amounts in south eastern South America during the three periods. Results suggest that models have regime dependence, performing better for some conditions than others. The models' ensemble and the statistical technique succeed in reproducing the overall observed frequency of daily precipitation for all periods. But most models tend to underestimate the frequency of dry days and overestimate the amount of light rainfall days. The number of events with strong or heavy precipitation tends to be under simulated by the models. These results were published in Menendez et al (2009): **Downscaling extreme month-long anomalies in southern** South America. Climatic Change, DOI 10.1007/s10584-009-9739-3.

Downscaling extreme month-long anomalies in southern South America
Menéndez C.G., M. de Castro, J.-P. Boulanger, A. D'Onofrio, E. Sanchez, A.A. Sörensson, J. Blazquez, A. Elizalde, D. Jacob, H. Le Treut, Z.X. Li, M.N. Núñez, S. Pfeifer, N. Pessacg, A. Rolla, M. Rojas, P. Samuelsson, S.A. Solman, C. Teichmann, 2009:



The maximum number of consecutive dry days response, CDD for future climate minus CDD for present climate.

OBSERVED sign of the linear trend in CDD in 1960-2000. An increase is shown by a plus symbol, a decrease by a circle (Haylock et al 2006)

Figure 6. Features of Consecutive dry days.

2.6 Uncertainties in simulating extreme precipitation events with a regional climate model

Contribution to task 2: Natalia L. Pessacg and Silvina A. Solman
CIMA (CONICET-UBA)

This work focuses on the evaluation of the Regional Climate Model MM5 in representing rainfall over South America. With the aim of quantifying the uncertainties associated with the model and defining an optimal model configuration, several sensitivity experiments were designed and evaluated. In particular, we focused on the representation of frequency and intensity of precipitation extreme events. Sensitivity experiments were carried on to evaluate different combination of convective and planetary boundary layer schemes, model version and treatment of boundary conditions using the nudging technique.

The study period was November 1986 associated with rainy (dry) anomalous conditions over La Plata Basin-LPB (South Atlantic Convergence Zone-SACZ), and December 1986 with opposite characteristics.

Results showed that the experiments achieved reproduce the variability between both months in LPB region. More frequency of events with more intensity in November than in December linked with the positive phase of SASS.

Kain Fritsch convective scheme presented troubles for simulating daily precipitation in LPB region, that problem is associated with the deficiencies that this scheme showed for representing the circulation at low layers. These deficiencies were solved with the nudging option, and this also improves the simulation of daily precipitation in LPB region.

Frequency of weak precipitation events was higher than the observed frequency in the most of cases, while the frequency of moderate and intense events was underestimated. Besides that, the experiments showed a level of uncertainties in SACZ region higher than in LPB region, with a major dispersion and range of daily precipitation. The level of uncertainties is bigger in wet months than in dry months.

Experiments without nudging failed in representing the value of 90th percentile, in most of cases; this value was underestimated in both regions. Experiments with nudging improve the simulation of 90th percentile (Figure 7).

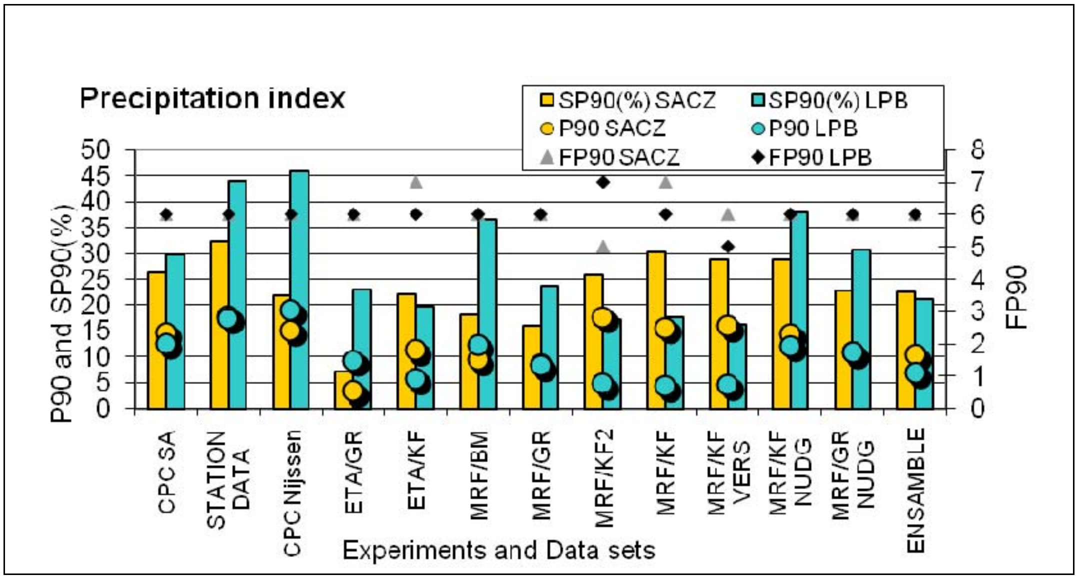


Figure7. Precipitation indexes for experiments, data sets and ensemble in LPB and SACZ, for period November-December 1986. SP90 (%): amount of precipitation that exceed 90th percentile in percentage of total precipitation observed. P90: Value of 90th percentile. FP90: Frequency of days that exceed 90th percentile.

2.7 Interdecadal Variability of Temperature Extreme Events in Argentina: a peaks-over-threshold approach

Contribution to Task 2: Bárbara Tencer , Matilde Rusticucci *Laboratorio de Extremos Climáticos en Sudamérica, Departamento de Ciencias de la Atmósfera y los Océanos, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, CONICET, Argentina*

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The frequency of occurrence of temperature extreme events has changed throughout the last century: significant positive trends in warm nights and negative trends in cold nights have been observed all over the world. In Argentina, the probability of occurrence of warm annual extremes of maximum temperature has decreased in the last decades, while there has been an increase of warm annual extremes of minimum temperature. The main objective of this report is to evaluate observed changes in temperature events that exceed a fixed threshold in Argentina over the period 1941-2000, by applying the Extreme Value Theory. The availability of daily data allows to fit a Generalized Pareto Distribution (GPD) to daily temperature anomalies over the 95P^{thP} (5P^{thP}) percentile for warm (cold) extremes followed by the estimation of return values (Figure 8). A return value associated with a return period *p* is a value that is exceeded, on average, once every *p* years. However, this statement is only true under the assumption of a stationary process and is not valid in the presence of climatic shifts or long term trends. Therefore, in this paper daily temperature anomalies are divided in three consecutive and non-overlapping subperiods of 20 years. GPD is fitted to each subperiod independently and a comparison is made between return values estimated in each subperiod. Results show that there is a decrease in the intensity of warm extreme events of maximum temperature, together with an increase in its frequency of occurrence in the last subperiod analysed, also seen in warm extremes of minimum temperature. However, for cold extremes of minimum temperature both intensity and frequency of occurrence show a decrease in the last 20 years of the century (Figure 9).

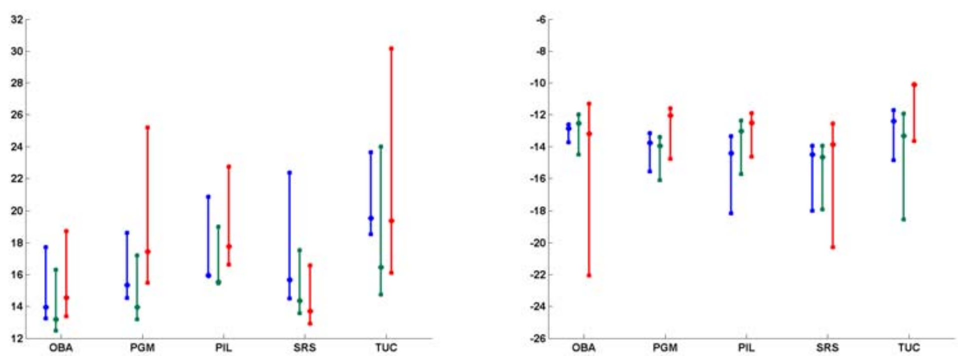

Figure 8. 30-yr return values (in ºC) for (left) warm extremes of maximum temperature (HTx) and (right) cold extremes of minimum temperature for the different periods (1941-1960 in blue, 1961-1980 in green and 1981-2000 in red) and stations studied (OBA, PGM, PIL, SRS, TUC).

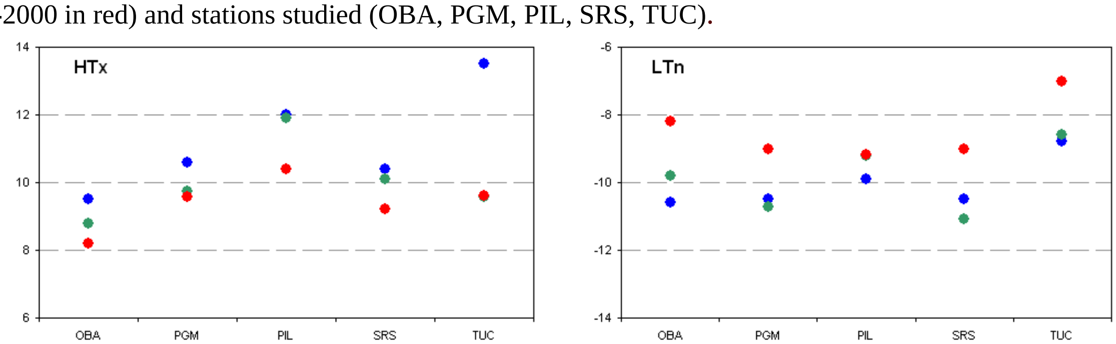

Figure 9.Thresholds used for (left) warm extremes of maximum temperature (HTx, 95P^{thP} percentile) and (right) cold extremes of minimum temperature (LTn, 5P^{thP} percentile) for the different periods (1941-1960 in blue, 1961-1980 in green and 1981-2000 in red) and stations studied (OBA, PGM, PIL, SRS, TUC) .

2.8 Precipitation anomalies variability over 2 sectors of La Plata Basin and extremes-GFDL and HADCM3 projections compared to the present climate.

Contribution to Task 1: *Iracema FA Cavalcanti, CPTEC/INPE Brazil*
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The objective is to identify extreme precipitation in two sectors of La Plata Basin and the associated atmospheric characteristics (seasonal and monthly). The data used in the first analysis are reanalysis atmospheric data, GPCP precipitation data, CPTEC/COLA AGCM climate simulation, HADCM3 and GFDL simulations for the 20^{th} century and SRES A2 results. These models were selected due to the closest climatological precipitation over South America in DJF, which was the first season analyzed. The initial methodology to extract the extreme wet and dry years was to select the 5 wettest and the 5 driest DJF in the model results of HADCM3, GFDL and CPTEC/COLA AGCM during the 1951-2000 period for the 20^{th} century and 2051-2100 for the future climate. Observed data analysis was performed during the 1979-2006 period. The main preliminary results are:

CPTEC/COLA AGCM represents the typical precipitation dipole associated with the SACZ influence during the extreme cases, influencing in an opposite way the northern and southern La Plata basin region. The seasonal atmospheric characteristics associated with this dipole are well represented by the atmospheric model. HADCM3 and GFDL represent the precipitation dipole northern/southern La Plata and some of the atmospheric features close to South America. Precipitation is intensified over Southern sector of La Plata in the future climate. Both HADCM3 and GFDL present similar results in this area of the La Plata basin. Figure 1 shows the composite precipitation anomalies of the 5 wettest and driest years in the 20^{th} century and SRES A2 future projections.

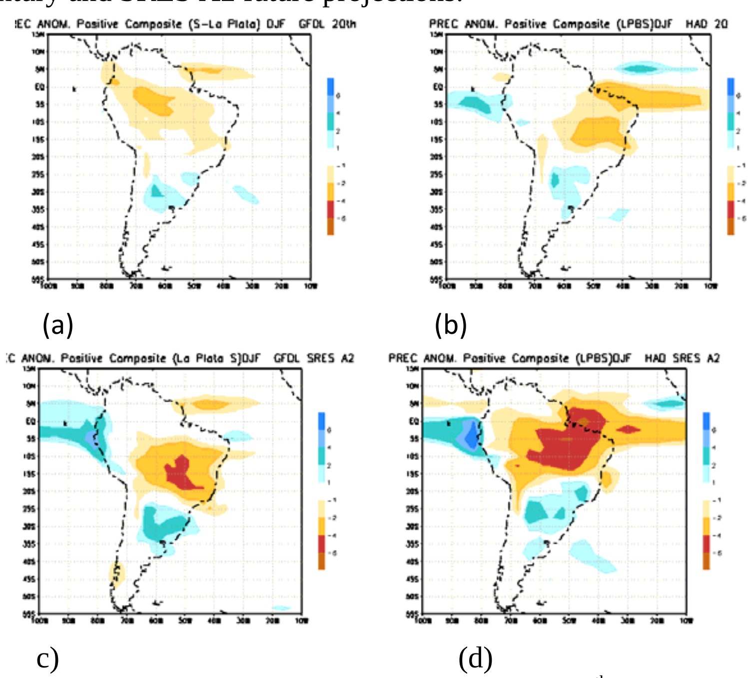

Figure 10. . Composite precipitation anomalies (a) GFDL 20^{th} century; (b) HADCM3 20^{th} century; (c) GFDL SRES A2; (d) HADCM3 SRES A2.

2.9 Observed changes in interannual variability of extreme temperature events in Uruguay alter 1976 climate shift.

Contribution to Task 2: Madeleine Renom[1,3*] (WP6, WP3), Matilde Rusticucci [2,3](WP6,WP3) y Marcelo Barreiro [1](WP4)
[1] Unidad de Ciencias de la Atmósfera, FCiencias, UR, Uruguay
[2] DCAO, FCEN, Universidad de Buenos Aires, Argentina
renom@fisica.edu.uy

The index selected for this study based on daily minimum and maximum temperature are the cold (warm) nights, TN10 (TN90) and cold (warm)days, TX10 (TX90). The trend analysis show in an annual basis for the period 1950-2005, significant negative trends for the warm days and for the cold extreme events (TN10 and TX10). In a seasonal scale the trends shows for summer (DJF) a negative trend in warm days (TX90) and in cold nights (TN10), while for autumn season the most significant result shows a night time warming, while for winter season the cold events (TN10 and TX10) present a negative trend.
Trying to find which are the atmospheric features that are associated with the extreme events and how the 1976 climate shift affected this kind of events, we analyze the observed changes in interannual variability of minimum temperature extremes during summer and winter in Uruguay. The indexes selected were warm nights for winter season and cold nights for summer season. They were analyzed in 2 periods: 1946-75 and 1976-05. For winter significant changes were observed in the correlations between the temperature index and global SST anomalies, particularly in the tropical Pacific Ocean (Figure 11). Before 1976 a strong correlation between the occurrences of warm nights and ENSO events are observed. This correlation weakens after 1976 and significant correlation appears in the Southern Atlantic Ocean. For summer a significant correlation between cold nights and the negative phase of SAM was detected before 1976, while after 1976 the main anomalies are due to internal atmospheric variability.

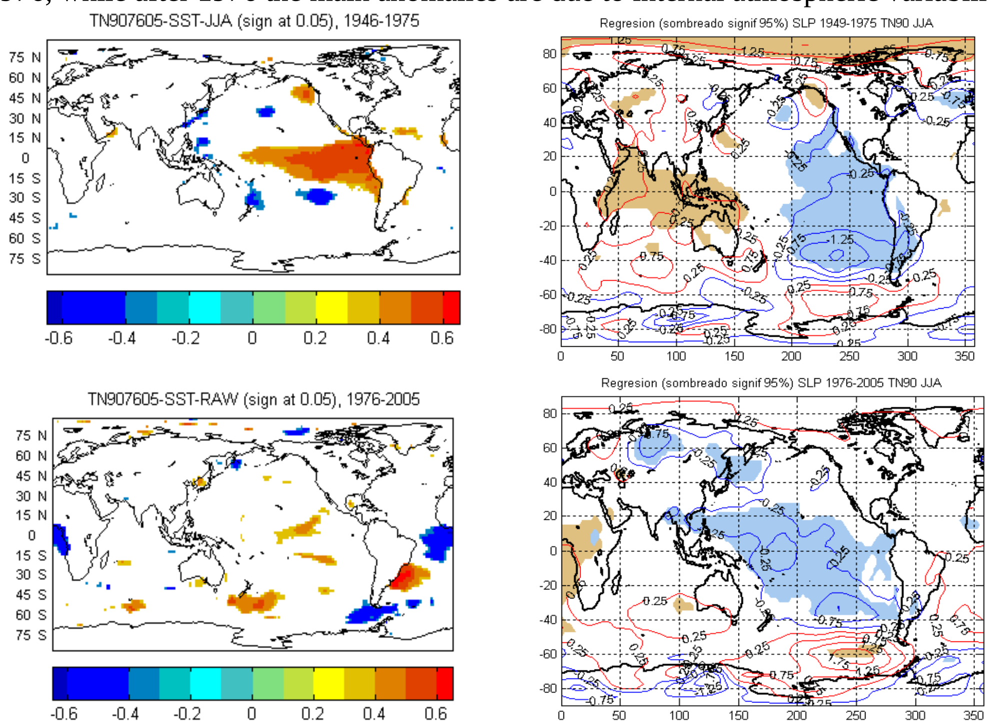

Figure 11. Correlation of TN90 with SSTa (left panels) and regression of TN90 with SLPa (right panels) with during winter. Upper panels 1946-1975, bottom panels 1976-2005. Significant values are shaded.

2.10 Inter-annual and interdecadal variability of Sea Surface Temperature in the Central Pacific Ocean and relations with daily intensity of extreme rainfall in South America.

Contribution to Task 1: Robledo F. and Penalba O.
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We consider extreme daily precipitation when rainfall it is greater than mean 75th daily percentile for the period 1961-2000 (Penalba and Robledo 2009). The monthly mean of daily intensity of extreme rainfall index (hereafter DIER index) is the quotient between monthly accumulated extreme rainfall (AE) and the number of days with extreme precipitation per month (PE). Equation 1 represents the daily intensity of extreme precipitation.

$$DIER_{i,j} = \frac{AE_{i,j}}{PE_{i,j}}$$

Equation 1. Daily intensity of extreme rainfall index ($DIER_{i,j}$). Where *i* represent months (1 to 12) and *j* represents the years (from 1962 to 2005).

To evaluate inter-annual variability of the temperature conditions in the Central Pacific Ocean, we consider the four month average (August to November) of SST anomalies of the region Niño 3.4 for each year (hereafter SST3.4 index). When SST3.4 is greater (lower) than 0.4ºC (-0.4ºC) we consider a warm (cold) condition in the central Pacific Ocean for that year. When the |SST3.4| is lower than 0.4ºC we consider neutral conditions.

a. DIER analysis for November

Figure 12 shows the Spearman correlation coefficient between DIER index for November and each of the previous 11 months (January to November) for SST3.4 index. In central east and northeast region of Argentine, DIER for November shows a positive and significant correlation with the SST3.4 from June to November. The positive and significant correlation with May SST3.4 is only observed in the central and northeast Argentine. From January to April, the SST3.4 does not present significant correlations with DIER for November.

b. DIER analysis for December

Figure 13 shows the Spearman correlation coefficient between DIER for December and with each of the previous 12 month (January to December) of SST3.4. DIER index for December, in the central and the northeast region of Argentine shows a positive and significant correlation with SST3.4 between July and December. This means that with a positive anomaly of SST in the Central Pacific evidence a positive anomaly of the intensity of extreme daily rainfall.

c. In central east and northeast region of Argentine, DIER for November shows a positive and significant correlation with the SST3.4 between June and November. In the central and the northeast region of Argentine, DIER for December shows a positive and significant correlation with SST3.4 between July and December. This means that with a warm (cold) condition of SST in the Central Pacific, DIER for December increase (decrease).

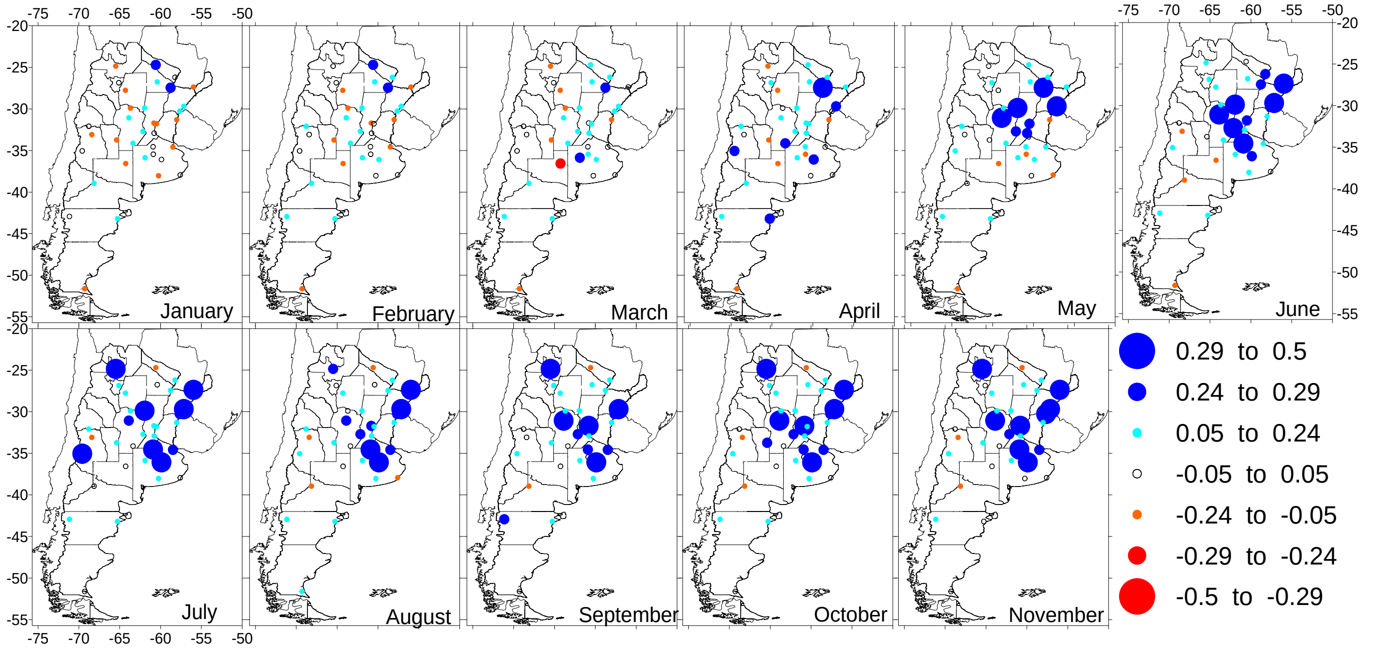

Figure 12. Spearman non linear correlation coefficient between DIER for November and the previous 11 month (January to November) of SST3.4.. Values greater than |0.24|, are significative to 10% and greater than |0.29| are significative to 5%

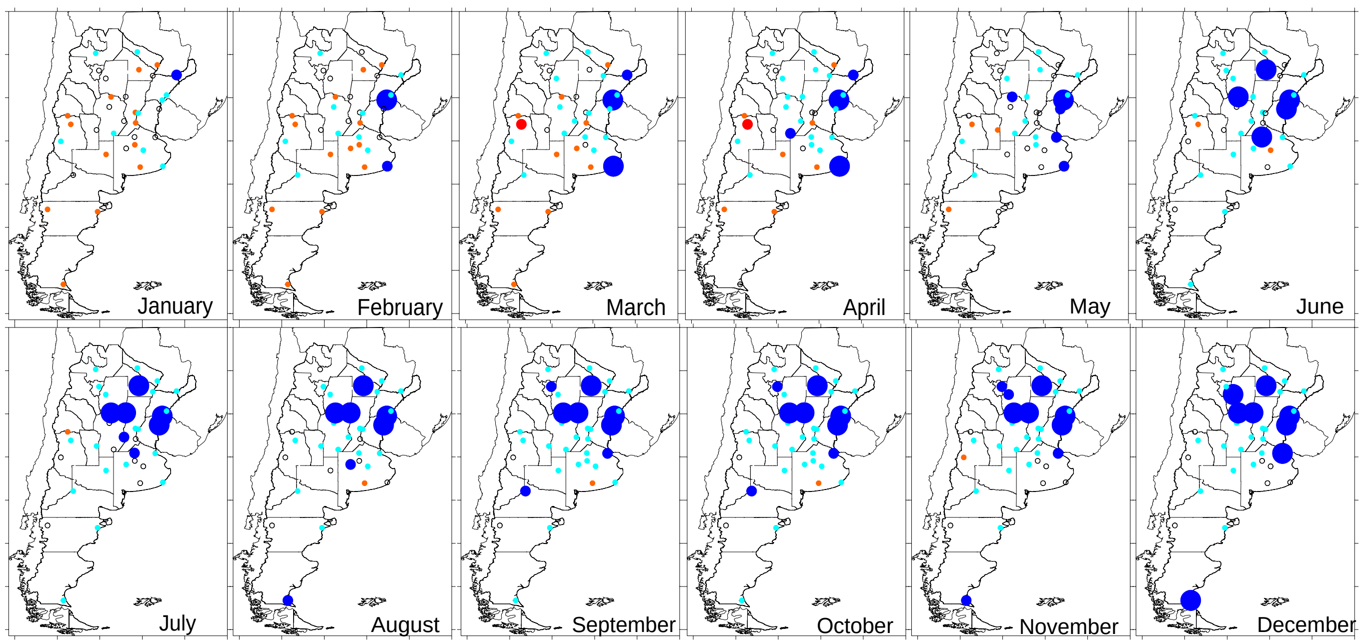

Figure 13. Spearman non linear correlation coefficient between DIER for December and the previous 12 month (January to December) of SST3.4. Period 1962-2005. Values greater than |0.24| are significant to 10% and greater than |0.29| are significant to 5%. The scale is the same than the Figure 5.

2.11 An intercomparison of observed and simulated extreme rainfall and temperature events during the last half of the twentieth century and historical trends.

Contribution to Task 2: Matilde Rusticucci · José Marengo · Olga Penalba · Madeleine Renom

In this study we examine the performance of eight of the IPCC AR4 global coupled climate models used in the WCRP CMIP3 Multimodel Dataset, as well as their ensemble mean, in simulating annual indices of extreme temperature and precipitation climate events in South America. In this first part we focus on comparing observed and modeled mean values and interannual variability. Two extreme temperature indices based on minimum temperature (warm nights and frost days) and three indices of extreme precipitation (R95t, R10 and consecutive dry days), obtained both from meteorological stations during 1961–2000 and model outputs, were compared. An example is shown in Figure 14. The number of warm nights is better represented by models than the FD. The interannual variability pattern is also in good agreement with the observed values. For precipitation, the index that is best represented by the models is the R95t, which relates the extreme precipitation to local climate. The maximum of dryness observed over the central Argentinean Andes or the extensive dry season of the Amazon region could not be represented by any model. **These results were published in part1: mean values and variability. *Climatic Change* DOI 10.1007/s10584-009-9742-8.**

On the basis of three indices of climate extremes, we compare observed and modeled trends in time and space, including the direction and significance of the changes at the scale of South America south of 10□ S. Theclimate extremes described warm nights, heavy rainfall amounts and dry spells. The reliability of the GCM simulations is suggested by similarity between observations and simulations in the case of warm nights and extreme rainfall in some regions. For any specific extreme temperature index, minor differences appear in the spatial distribution of the changes across models in some regions, while substantial differences appear in regions in the interior of tropical and subtropical South America. The differences are in the relative magnitude of the trends. Consensus and significance are less strong when regional patterns are considered, with the exception of the La Plata Basin, where observed and simulated trends in warm nights and extreme rainfall are evident. These results were published in

part2: Historical Trends. *Climatic Change* 10.1007/s10584-009-9743-7

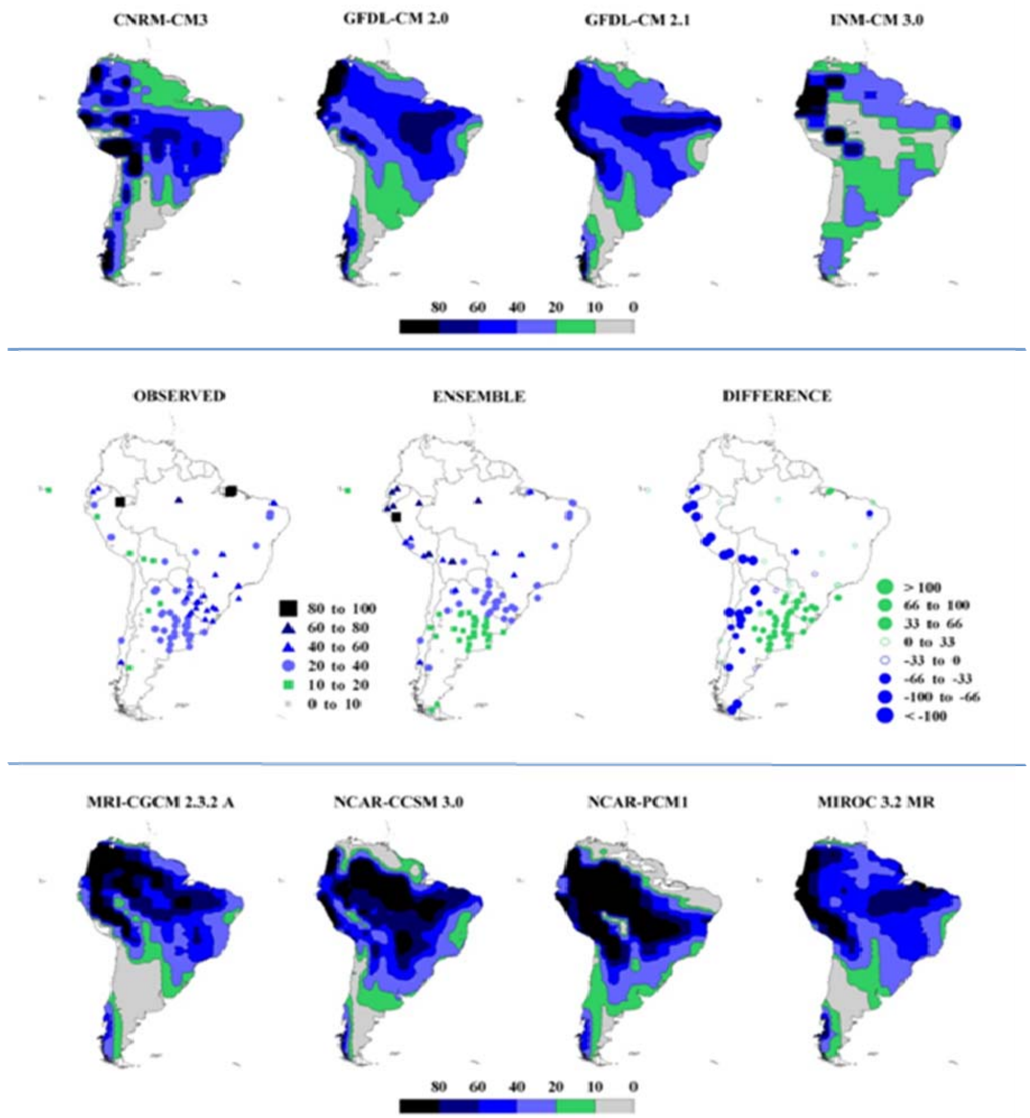

Figure 14. Mean values of R10 (number of days where the precipitation was over 10 mm/day) for the period 1961-2000,. GCM outputs (top and bottom lines), observed, ensemble means and their difference, observed minus ensemble in percentage over the observed (center).

2.12 Synoptic Weather Types and their Relationship to Extreme Daily Rainfall in the South of LPB

Contribution to Task 1: Bettolli, ML- Penalba, OC- Vargas, WM
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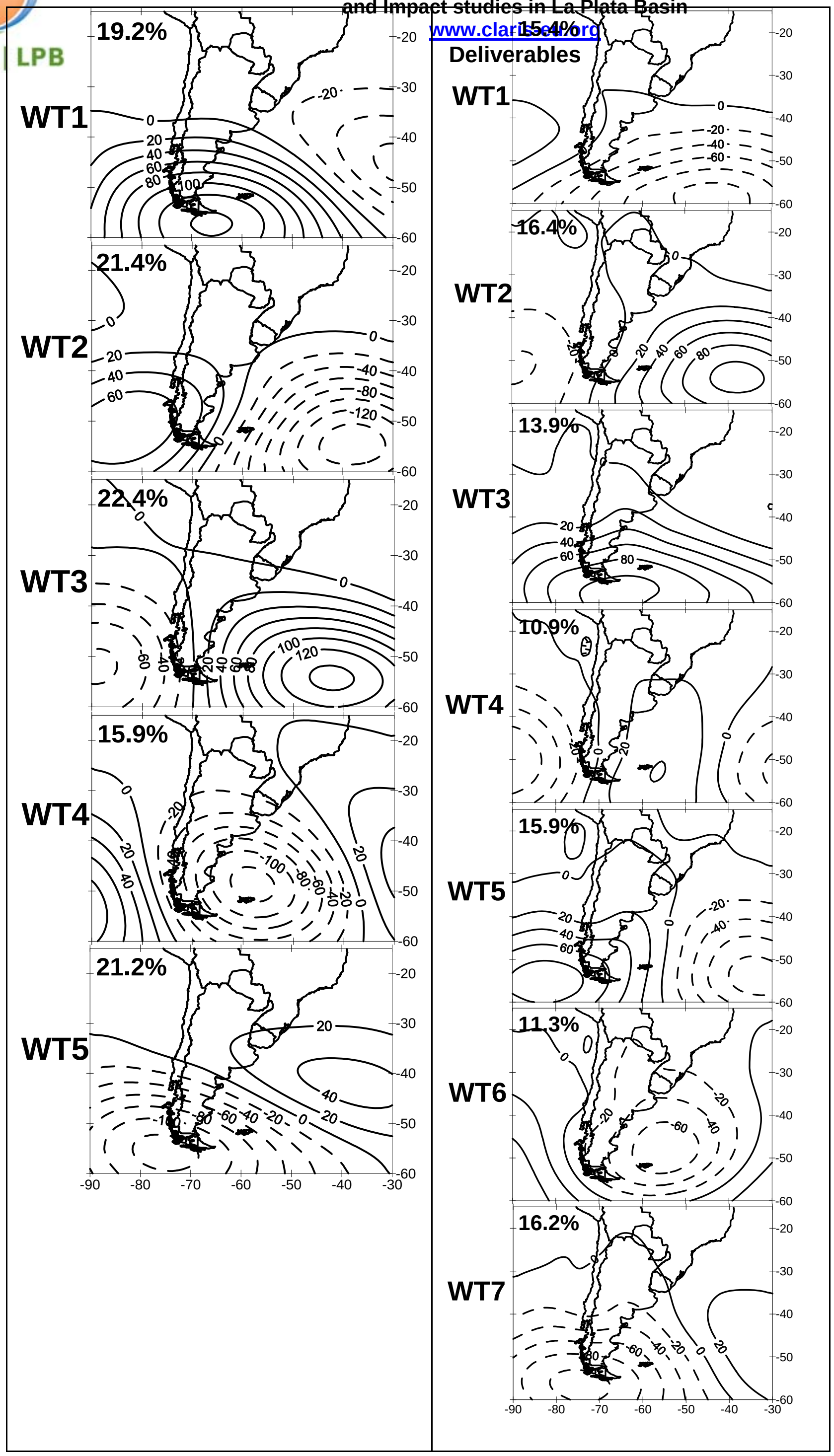
We classify daily geopotential height anomalies at the 1000 hPa and 500 hPa levels for the period 1979-2001, and examine the capability of these atmospheric patterns to discriminate between the occurrence and non-occurrence of rainfall in the core crop-producing region located in the south of LPB. The resulting optimal classification has seven and five weather-type categories for the 1000 hPa and 500 hPa levels, respectively. The analysis focusses on the season of highest rainfall in the region, which coincides with the growing season of the main summer crops (October-May). These crops are critically dependent on rainfall and its spatial and temporal distribution, since irrigation is rarely employed in the region. The synoptic structures identified in this work can be related to daily rainfall in the region under study. Dry days are significantly favoured by structures with negative geopotential height anomalies at low levels toward the south of the South Atlantic Ocean, inducing an anomalous flow from the southwest over the south of the continent. They are also favoured by positive geopotential height anomalies centred to the east of the continent, inducing stability at low levels. At the 500 hPa level, a positive anomaly in the southwest of the continent centred at the Pacific Ocean, intensifying ridges west of the Andes, favours dry days. On the other hand, rainy days are favoured by patterns with positive geopotential height anomalies at the 1000 hPa level at the south of the continent, enhancing an anomalous flow from the east-southeast in the central region of Argentina and its corresponding moisture advection at low levels. Rainy days are also favoured by the patterns characterised by a cyclonic anomaly to the east of the continent, affecting the whole region. At the 500 hPa level, local rainfall can be related to patterns characterised by negative geopotential height anomalies centred at the Falkland Islands, which induce instability. More regional rainfalls are favoured by structures which weaken the westerlies over Patagonia at the 1000 hPa level and by structures which induce northwest flow over Patagonia and northeast flow over the northeast of the country at the 500 hPa level. The seasonal frequencies of the 1000 and 500 hPa synoptic weather types are consistent with the interannual rainfall variability documented for the region. The influence of the El Niño-Southern Oscillation was also identified in the daily atmospheric circulation anomalies in the south of South America.



500 hPa 1000 hPa

Figure 15. 500 and 1000 hPa Synoptic Weather Types and percentage of days corresponding to each group. The dashed (solid) lines represent negative (positive) geopotential height anomalies. The contour interval is 20 m

2.13 The contribution of cut-off lows to rainfall in LPB: Preliminary results

Contribution to Task 1: *C. Campetella, A. Godoy y M. Saucedo*
Departamento de Ciencias de la Atmósfera y los Océanos –UBA; Centro de Investigaciones del Mar y la Atmósfera
claudiac@cima.fcen.uba.ar

The goal this work is to explore the relationship between cutoff lows and the occurrence of precipitation over La Plata Basin during 2002-2006. Cutoff lows can bring moderate to heavy rain or snowfall over large areas. We used de NCEP reanalysis to determine life cycle of cutoff lows and a gridded precipitation database produced by Liebmann and Allured, with 1 degree horizontal resolution. The seasonal distribution of cutoff lows shows the greatest frequency of occurrence during the cold season located off the central Chilean coast while in spring and summer is located over the coast of the province of Buenos Aires and Uruguay. For the analyzed period, only 10% of the events were not associated with precipitation. The maximum accumulated rainfall per event ranged from 1 to 200 mm. The contribution of cutoff lows to the annual precipitation over LPB may be summarizing as follows: a) in spring, summer and autumn the contributions are about 10 to 30% and b) in winter cutoff lows made its major contribution to the precipitation with percentages higher than 50% in the SW region (Figure 16).

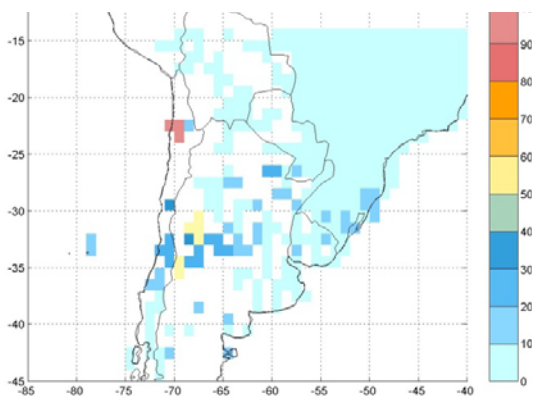


Figure 16. Percentage of winter precipitation that was associated with cutoff lows

2.14 Preliminary analysis of cyclonic activity tendency over South Atlantic Ocean.

Contribution to Task 1: Rosmeri Porfírio da Rocha, Luiz Fernando Kruger, *Eduardo M. Gonçalves Dutra* and Tércio Ambrizzi.
Department of Atmospheric Sciences – IAG - University of São Paulo (DCA-IAG-USP)

The cyclones climatology over South Atlantic simulated by RegCM3 (Regional Climate Model) nested in the HadAM3 global model to two future climate scenarios (A2 and B2 from 2071 to 2085) was compared with present climate climatology (1975-1989). Figure 17 illustrates the results. The cyclones in simulations were identified through an automatic scheme of tracking based on minima of relative vorticity from 10-m height wind (ζ_{10}). The projected climatologies for the A2 and B2 scenarios indicated decrease in the total of cyclones of 7.2% and 4.7%, respectively). Regarding the initial mean vorticity of the systems the scenario B2 presents similar values of the present climate, while in A2 the cyclones are initially weaker than in B2. The spatial distribution of the cyclogenetic in the A2 and B2 scenarios, in general, is similar to present climate. However, can be noted a small displacement of the cyclones development toward southern. In general, the scenario with higher greenhouse gases (concentration of A2) cyclones climatology is more affected. A complementary analysis tries to connect the extreme in air temperature over the city of Sao Paulo and the cold front activities, using a long observed time series (1936-2005). This analysis shows that during all season the warm events are more frequent (50-60% of them) in the two days before the cold front crosses the city of Sao Paulo. There is a indication that pre-frontal warm advection is a very important feature to the extremes of temperature. The cold fronts present stronger association with the higher (95 and 98th) percentiles (Figure 18).

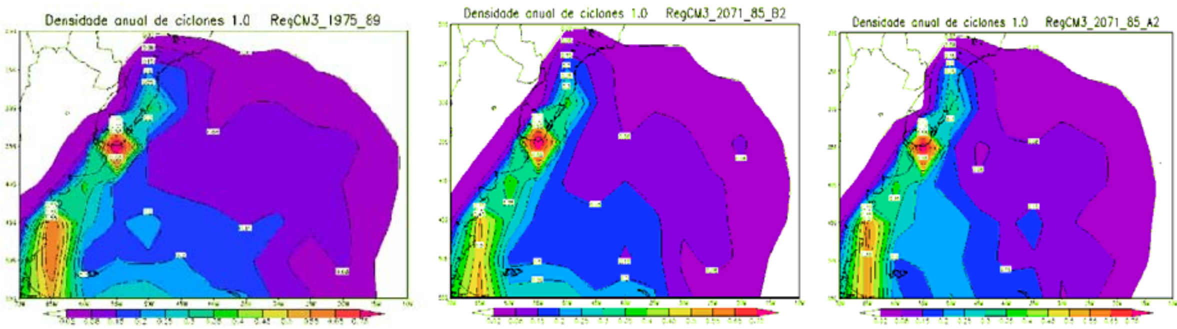


Figure 17. Mean density cyclogenetic simulated by RegCM3 nested in the HadAM3 for (a) present climate (1975-1989), (b) B2 scenario (2071-2085) and (c) A2 scenario (2071-2080).

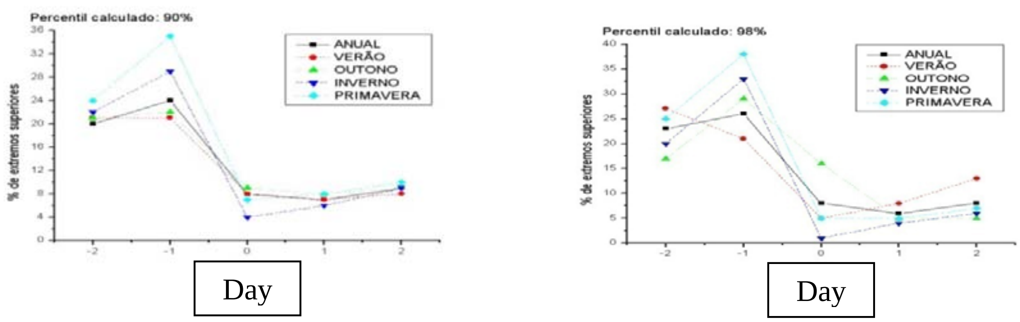


Figure 18. relative frequency of the 90th (a) and 95th (b) percentiles of mean daily air temperature since two days before (-2) until two days after (+2) the cold front crosses the city of São Paulo.

2.15 Connections of regional scale flows and mesoscale convection systems in South America: Part 1 Focus on the South American Low Level Jet

Contribution to Task 1: Armelle Reca C. Remedio, Daniela Jacob, Susanne Pfeifer
Max Planck Institute of Meteorology, Hamburg

The La Plata Basin in South America has a high frequency of occurrence of mesoscale convective systems (MCSs). These systems are responsible for a large proportion of rainfall in tropical and warmer mid-latitudes and often produce severe convective weather events such as strong winds, hail tornadoes, lightning and flooding. The occurrence of MCSs is associated with the low level jet (LLJ) east of Andes which develop from the Amazons and propagates downstream towards the La Plata Basin. A considerable amount of moisture is being transported from the Amazons towards the La Plata which favor the organization of convection into MCSs and in turn, could strengthen or weaken the LLJ maximum in the

Bolivian region. It is therefore crucial to study the mechanism of the South American LLJ (SALLJ) and how it influences its associated MCSs. The horizontal and vertical structure of SALLJ and its relationship to convection is evaluated using REMO, the MPI regional climate model. The model simulations from a previous project (CLARIS – A Europe-South America Network for Climate Change Assessment and Impact Studies) with a horizontal resolution of approximately 50 km covering the whole continent is analyzed. The model results on winds and precipitation are then compared to reanalysis data and observations. Preliminary results show the representation of the horizontal structure of SALLJ in a regional climate model (Figure 1a). During summer, where the LLJ and the MCS are prominent, the model shows the vertical structure of the meridional winds (Figure 1b). The model also captures the spatial distribution of the mean daily precipitation. Further validation of the regional model will be done using the observations from rain gauge network and radiosondes from the intensive SA LLJ Experiment (SALLJEX) campaign.

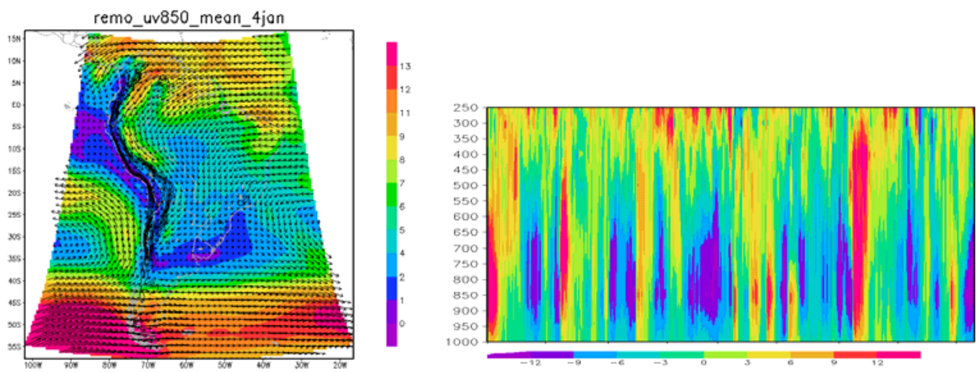


Figure 19. Simulated horizontal and vertical structure of the LLJ for January months of 1997 to 2000. a) Simulated mean winds at 850hPa. Shaded regions indicate the magnitude of the wind and arrows indicate the direction; b) Simulated meridional winds. Shaded regions indicate the magnitude of the meridional wind.

2.16 Spatial and temporal variability of the frequency of extreme daily rainfall regime in the La Plata basin during the 20th century.

Contribution to Task 2: Olga C. Penalba[1] and Federico A. Robledo [1,2]
Laboratorio de Extremos Climáticos en Sudamérica, Departamento de Ciencias de la Atmósfera y los Océanos, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, CONICET, Buenos Aires.

We analyzed trends, interdecadal variability, and the quantification of the changes in the frequency of daily rainfall for two thresholds: 0.1 mm and percentile 75th, using high quality daily series from 52 stations in the La Plata Basin (LPB) (Figures 20- 23). We observed increases in the annual frequencies in spatially coherent areas. This coherence was more marked in austral summer, autumn, and spring, during which the greatest increases occurred in southern Brazil, especially during extreme events. In winter, the low and middle basins of the Río Uruguay and Río Paraná showed negative trends, some of which were significant. Interdecadal variability is well defined in the region with more pronounced positive jumps west of the basin between 1950 and 2000. This variability was particularly more marked during periods of extreme rainfall in summer, autumn, and spring, unlike in winter when extreme daily rainfall in the lower Rio Paraná basin decreased by up to 60 per cent. The changes in the past century during extreme rainfall produced modifications in the annual rainfall cycle. The annual cycle of both indices was broader during the last period which is mainly explained by the strong decreases in winter.

This study was published in Climatic Change DOI10.1007/s10584-009-9744-6

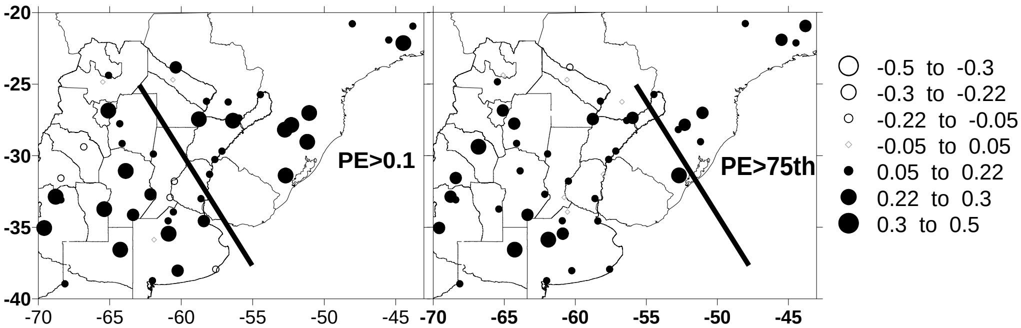


Figure 20. Sign of the annual trend of the PE>0.1 (left) and PE>75th (right) as measured by Kendall Tau. An increase is showed by "•" and a decrease by "o". Values greater than (-0.22; + 0.22) indicate significant p<0.05. The black solid line represents the seasonal gradient inversion axis (SGIA).

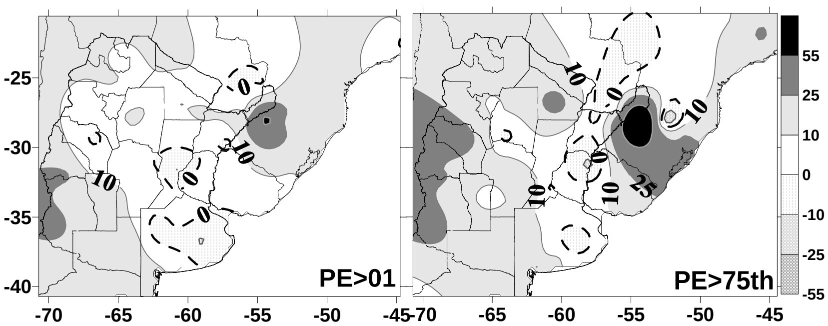


Figure 21. Percentage of change for PE>0.1(left) and PE>75th (right) between 1961-1975 and 1980-1996.

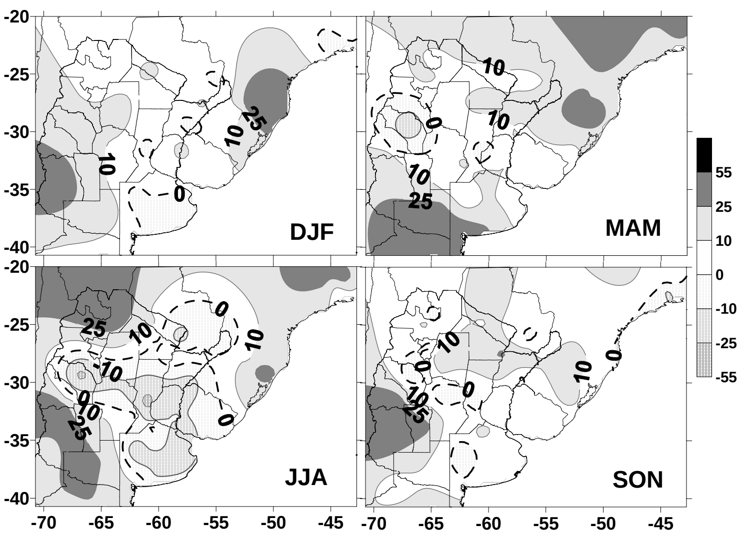


Figure 22. Percentage of change for PE>0.1 between 1961-1975 and 1980-1996 for summer (DJF), autumn (MAM), winter (JJA) and spring (SON).

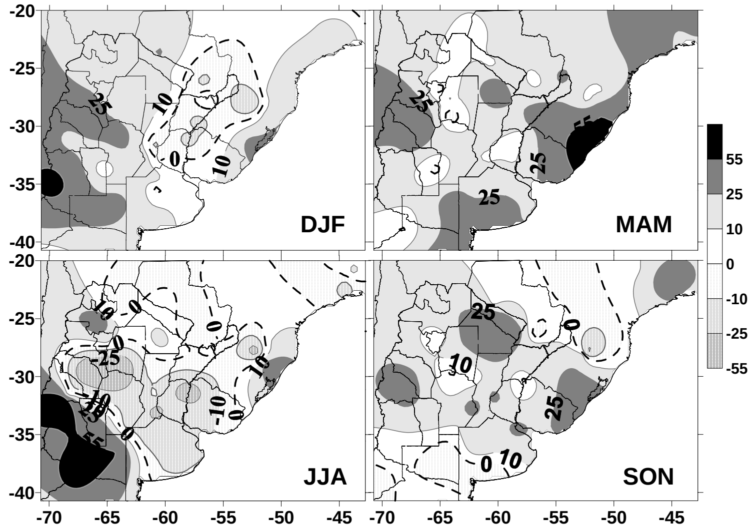
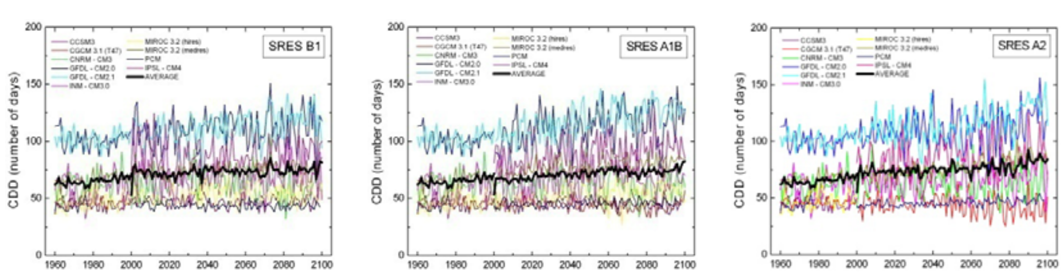


Figure 23. Percentage of change for PE>75th between 1961-1975 and 1980-1996 for summer (DJF), autumn (MAM), winter (JJA) and spring (SON).

2.17 Projections of climate extreme on the La Plata basin by the end of XXI century based on global and regional climate models.

Contribution to Task 3: *Roger Rodrigues Torres & Jose Antônio MarengoCPTEC; CCST /INPE* Centro de Ciência do Sistema Terrestre, Instituto Nacional de Pesquisas Espaciais, Cachoeira Paulista - SP, Brasil. roger.torres@cptec.inpe.br

In this work were evaluated the tendencies of temperature and precipitation extremes on the La Plata Basin (LPB) by the end of XXI century. Simulations from three Regional Climate Models (RCMs) analyzed in the CREAS project (Regional Climate Change Scenarios for South America**)** in the scenarios SRES A2 and B2 and ten Global Climate Models (GCMs) from the multi-model ensemble CMIP3 in the scenarios SRES B1, A1B and A2 were used. The RCMs indicate for the LPB region an increase of mean annual temperature that can reach up to 3-4 ºC regarding to the HadRM3P and RegCM3 models, and 4-6 ºC regarding to the Eta model. For the precipitation projections, the RCMs show a high level of uncertainty: two of them agree with an increase in the mean annual precipitation in the scenario B2, and two models indicate a decrease of precipitation in the scenario A2. The results found in this work regarding to the extreme index of precipitation and temperature projected by the GCMs and RCMs are consistent with a dryer climate compared with the present climate in the LPB region, with high diurnal and nocturnal temperature and with intense precipitation concentrated in short periods. Examples are shown in Figure 24.



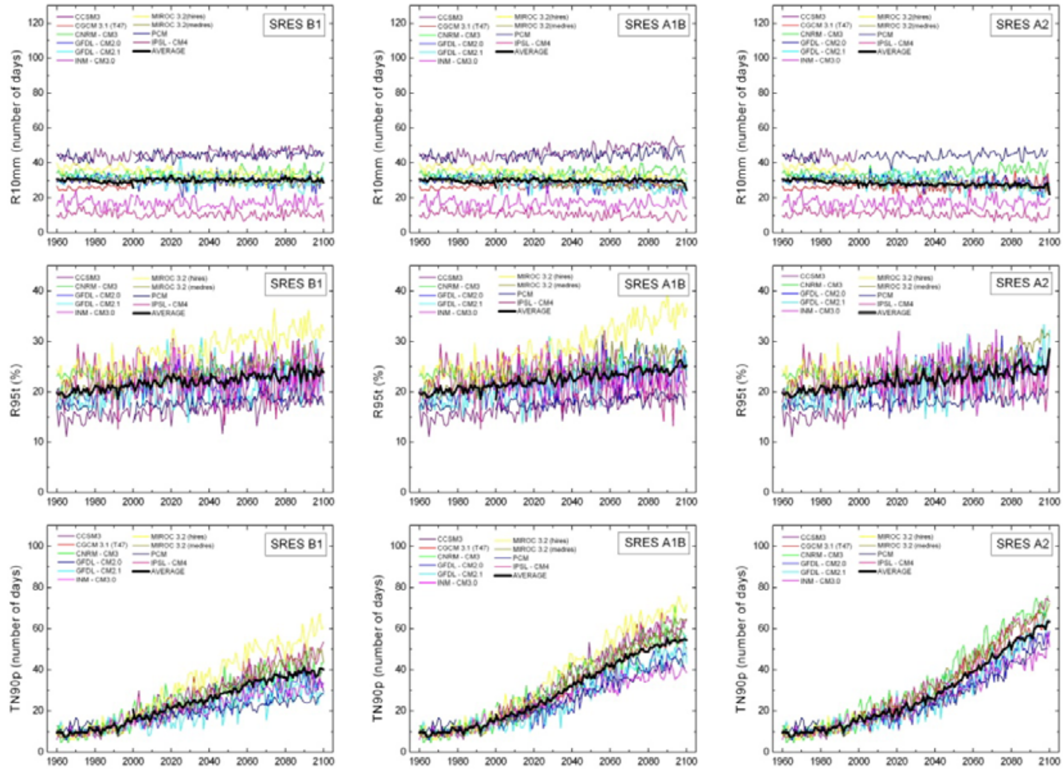


Figure 24.Temporal series of extremes index of precipitation and temperature on the La Plata Basin simulated by some global climate models from multi-model ensemble CMIP3 by the period 1961-2100 in the scenarios B1 (left), A1B (center) and A2 (right). The index showed are: Consecutive Dry Days (CDD), number of days in a year with precipitation above 10 mm (R10mm), percentage of the annual total precipitation due to extreme events above the 95º percentile of the 1961/90 distribution (R95t) and number of days in a year that the minimum temperature is above the 90th percentile of the 1961/90 distribution (TN90p).

3. Contributions from other work packages

3.1 WP3- Making progress on the CLARIS LPB Database

Olga Penalba and Madeleine Renom
Departamento de Ciencias de la Atmósfera y los Océanos, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, CONICET, Buenos Aires.
Unidad de Ciencias de la Atmosfera, Fac. de Ciencias, UR, Uruguay.

One of the tasks of WP3 is: "*To collect daily information originating from different institutions and local cooperatives (sources already identified in CLIVAR/VAMOS/ SALLJEX), to improve the CLARIS digitally-available record of daily weather data over the LPB".*

During the last six months the following progress has been made.

Argentina: National Weather Service provided daily information for 115 stations (Figure 25, left) and Instituto Nacional de Tecnología Agropecuaria (INTA) contributed with 29 stations (blue triangles in Figure 25, right). Two universities have sent local data: El Pozo station from the Universidad Nacional del Litoral (UNL) and Universidad Nacional de Entre Ríos (UNER). The locations of these stations are shown in Figure 25, right. The period of maximum and minimum daily temperatures at El Pozo station is 1920-2008.

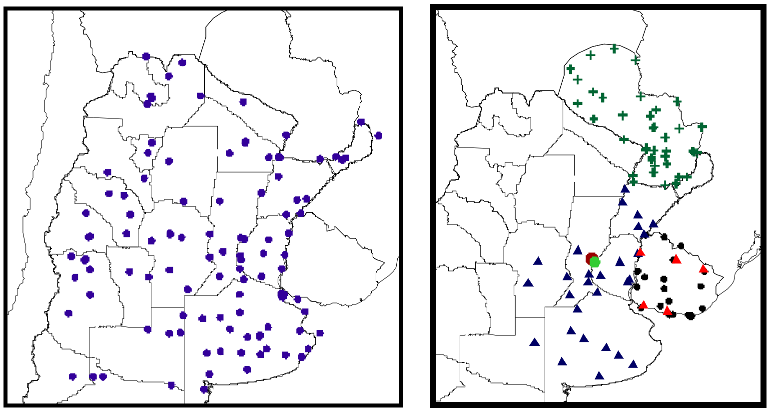


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Figure 25: Location of the stations provided by National Weather Service of Argentina (left) and INTA (blue triangles, right), UNER (red dot, right) and El Pozo of UNL (green dot, right).

Paraguay: The 44 stations shown in Figure 25(green marks, right) were obtained from National Oceanic and Atmospheric Administration (NOAA). During the last month, the Dirección de Meteorología e Hidrología-Dirección Nacional de Aeronaútica Civil (DMH-DINAC) and Ministerio de Agricultura y Ganadería (MAG) have agreed to participate in the project.

Uruguay: The data set consist of 5 stations obtained from Instituto Nacional de Investigaciones Agropecuarias (INIA, red triangles in Figure, 25 right) and 26 stations from NOAA.

The Uruguayan National Weather Service (DNM, in Spanish) has a relatively rich dataset of long daily precipitation records. Most of these data are still on paper and, under WP3 objectives, CLARIS has contributed to the digitalization of a selected part of this data as a contribution to the long regional daily dataset. Most of the effort to be carried out at Universidad de la República, Uruguay (UR) under this Work Package is, therefore, aimed at the digitalisation and quality control of these daily data. During this period we made contact with the DNM in Uruguay, first to know the state of the daily precipitation data (how many series they have, if the data is in paper form, etc). Data from other sources were also collected (INIA,UTE). All the precipitation data were plotted and geo-referenced and we are also preparing a metadata file. Figure 26shows what we have actually in the daily data set (left) and the National Pluviometer Network from DNM (right) for the period 1960-2009. It is important to mention that the daily precipitation dataset is less organized than the extreme temperature dataset. The maximum and minimum daily temperature is updated with the effort of the previous CLARIS project. At an institutional level during the next months we are planning to start negotiations with DNM to design a benchmark agreement that could serve as framework for collaborations in the execution of the CLARIS-related digitalisation effort.

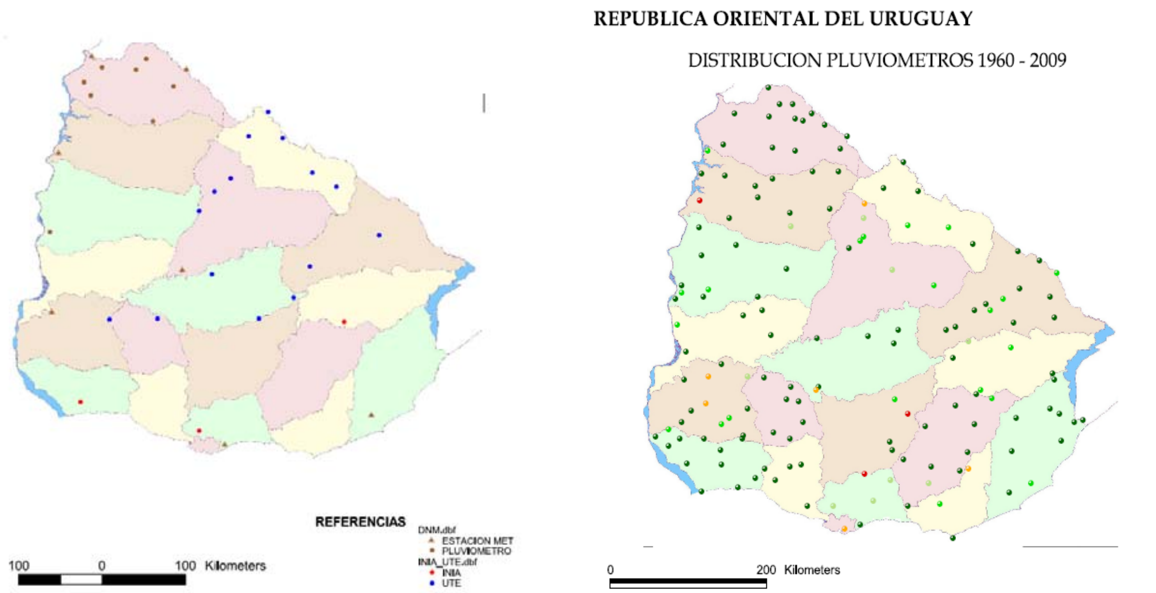

Fig. 26. Daily dataset from different sources (upper panel) and DNM pluviometer network (lower panel)

Brazil: 54 different institutions have been contacted and we now have around 8000 stations (Figure 27). The majority of them are rain gauges. Little work has yet been undertaken with these data.

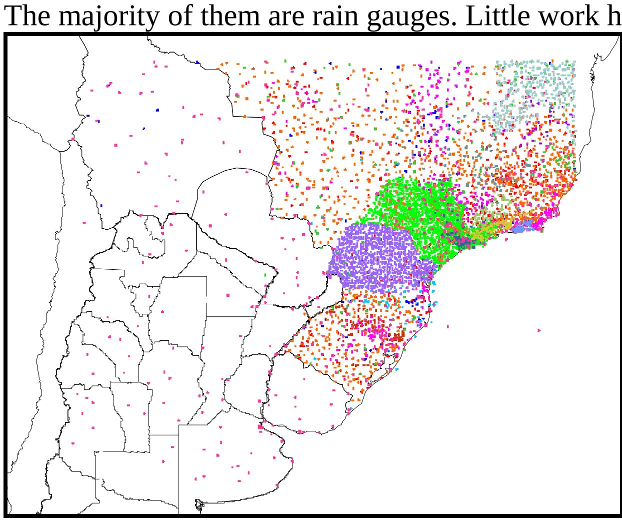

Figure 27: Location of stations in Brazil provided by different institutions.

New variable needed by WP8

During the Kick off meeting carried out in Buenos Aires, Argentina, it was decided to collect also daily radiation/sunshine data. This variable is needed to run agronomic models. For Argentina, the INTA´s stations measure sunshine data. Universidad de El Litoral provided the foil charts for this information for the El Pozo station for the period (1995-2008). This information was digitized by WP3.

3.2 WP4 - Assessing the capacity of IPCC-GCMs to reproduce weather types in tropical South America: An approach using a Neuronal Networks method

Espinoza JC[1,2], Boulanger JP[1,2], Lengaigne M[2], Rust H[2,4], Ronchail J[2,3], Bettolli ML[5]
[1.-] CLARIS-LPB Program. Universidad de Buenos Aires. Argentina.

[2.-] IRD / LOCEAN-IPSL. Paris France.
[3.-] Université de Paris 7. France.
[4.-] REGYNA Program. Paris France.
[5.-] DCAO. UBA. Argentina.

In this work we assess and compare observed atmospheric circulation patterns from ECMWF ERA-40 reanalysis and those simulated by 14 coupled ocean-atmosphere circulation models (GCMs) from IPCC-AR4/CMIP3. Circulation patterns and their clustering in weather types (WTs) are described using observed and simulated 850hPa winds over tropical South America (10˚S-40˚S and 50˚-80˚W), a neural clustering (Self-Organizing Maps) and classification algorithm (hierarchic agglomerative classification). In order to identify the models that best reproduce the observed atmospheric circulation, several statistic tests are applied. Systematic biases are noticed in most models. The principal one is associated to inaccurate trajectories of the low-level winds that cross the Andes Cordillera instead of being deflected by this obstacle. More, observed and simulated WTs/rainfall relationships are analysed with a special focus on the La Plata and Amazon Basins. Significant biases in these relationships are identified, especially in the north-western part of the Amazon Basin. Finally, models that reasonably reproduce atmospheric circulation, WTs and WTs/rainfall relationships in tropical South America are the following: INGV ECHAM4, CNRM CM3.0 and MIROC 3.2 high resolution. The results of this work facilitate choosing suitable models for rainfall prevision and for determining the hydrological impacts of the Climate Change in the La Plata and Amazon Basins.

Initial criteria to describe the capability of the GCMs to define circulation patterns

Figure 28a displays the Kohonen Map (Kc) computed using observed and simulated 850hPa winds in the whole region for September – October – November (SON) season and the number of days projected on each neuron. With the aim to describe the main atmospherics situations obtains in the Kc, we can go one step further by computing Hierarchical Agglomerative Clustering (HAC) to group neurons describing similar situations and extract more synthetic information. The HAC computes a hierarchical clustering of the 289 reference vectors of the Kc. The neurons have been classified in 15 classes. Figure 28b shows the location of 15 classes on the Kc and Figure 28c displays the mean low-level winds associated to 15 classes grouping similar observed and simulated days.

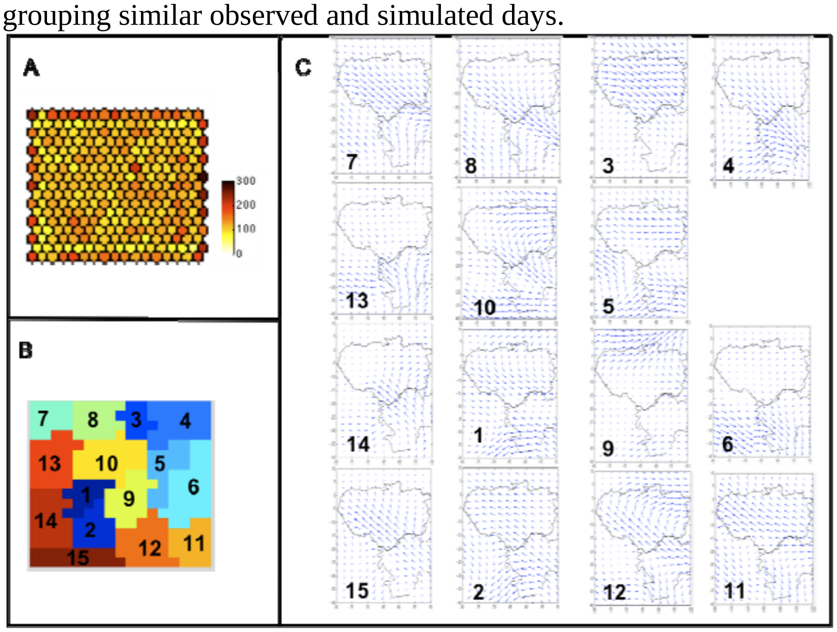

Figure 28. A) Kohonen Map computing using observed and simulated 850hPa winds in SON season and the number of days projected on each neuron. B) Location of 15 classes on the Kc. C) mean low-level winds associated to 15 classes, limit of the Amazon and La Plata Basins are indicated. Western limit of the basins represent the top of the Andes Cordillera.

In order to identify if there are classes more associated to simulations or to observations the indice dP_{ij} is computed using Formula 1 and shown in Figure 29.

$$dP_{ij} = P(ERA\text{-}40)_i - P(GCM_j)_i \qquad (1)$$

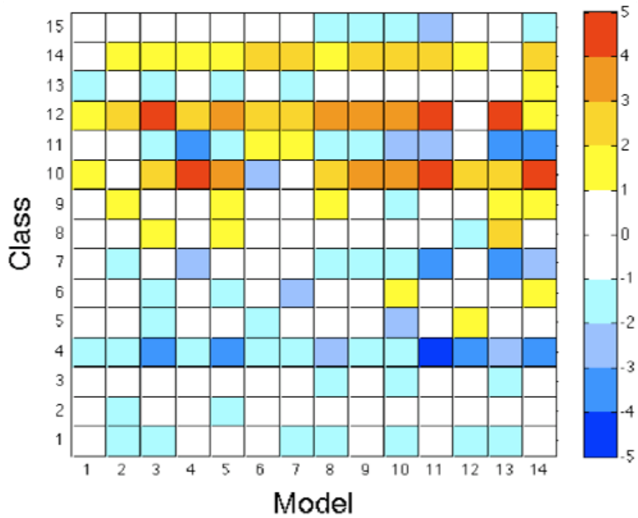

Figure 29. dP_{ij} values for 15 class and 14 models. Models are designed as follow: 1=CNRM CM3.0; 2=MIROC 3.2 high resolution; 3=MIROC 3.2 medium resolution; 4=MPI ECHAM5; 5=CCCMA CGM 3.1; 6=CSIRO MK3.0; 7=CSIRO MK 3.5; 8=GFDL CM 2.0; 9=GFDL CM 2.1; 10=INM CM3.0; 11=MRI CGCM 2.3.2a; 12=INGV ECHAM4; 13=IPSL CM 4; 14=MIUB ECHO.G.

Reference: Downscaling extreme month-long anomalies in southern South America Menéndez C.G., M. de Castro, J.-P. Boulanger, A. D'Onofrio, E. Sanchez, A.A. Sörensson, J. Blazquez, A. Elizalde, D. Jacob, H. Le Treut, Z.X. Li, M.N. Núñez, S. Pfeifer, N. Pessacg, A. Rolla, M. Rojas, P. Samuelsson, S.A. Solman, C. Teichmann, 2009.

3.3 WP5 - Regional climate change assessments
Presented by Claudio Menendez Universidad Buenos Aires

The Goal is: *to better understand the regional effects of climate change and variability on various components of the hydrologic cycle of the La Plata Basin, with emphasis in land surface- atmosphere feedbacks and their impact on extreme events*.

The planned integrations are: RCMs driven by ERA-interim boundary conditions for the period 1989-2008. The climate model scenarios will be A1B.
The planned process studies are: Land-Atmos feedbacks; Vegetation/land use; Soil moisture.
The tasks are:
TASK 1: RCM ensembles of regional hydroclimate and climate change scenarios
TASK 2: Assess the uncertainties in the climate and hydrologic cycle of the basin

TASK 3: Land surface-atmosphere feedbacks in a changing climate
TASK 4: Regional Impacts of land cover changes and changing climate

Table 1 illustrates the integration features.

TABLE 1	
Domain	Continental
Regional models	REMO, RCA, MM5, Eta, LMDZ (zoomed version) PROMES, RegCM3, WRF
Boundary conditions	ERA interim reanalysis, ECHAM5/MPI-OM, HadCM3
Horizontal resolution	50 km
Period	Not yet well defined (originally were proposed 1970-2000; 2010-2040; 2070-2100; some groups will perform 1950-2100)
Scenario	A1B

SCHEDULE OF DATA AVAILABILITY

Evaluation experiment: RCMs + ERA-interim (period 1989-2008) Participating models: MM5 and WRF (CIMA); RegCM3 (USP); Eta (CPTEC); PROMES (UCLM); REMO (MPI); RCA3 (Rossby); LMDZ (LMD)	End of December -hopefully *(+ homogenization of different output files?)*
Evaluation experiment (remaining from the previous CLARIS project): RCMs + ERA40 (period 1991-2000) Participating models: LMDZ, PROMES, REMO, RCA3	Already available upon request (daily data)

Regional climate model scenarios (50 km) + high resolution simulations (20 km)	• Month 24 ?? • Biannual Report of WP5: "*Some discussions are still in progress about the climate change regional model simulations strategy*."

3.4 WP8 -Land use change, agriculture and socio-economic implications
Presented by Rafael Terra Universidad de la República - Uruguay

Primary objective of WP8:

To reveal deep and comprehensive insights into the complex net of impacts and interdependencies of climate variability and change and anthropogenic adaptation measures to climate change on land use, agriculture and deforestation.

Specific objectives

- To identify causal chain relationship between climate change (scenarios) and induced anthropogenic reactions on land use, agriculture, bio energy and deforestation
- To carry out an assessment making explicit the strong relationship existing between land use systems, climate and water cycle, in order to define integrated adaptation strategies to climate change impacts

- To elaborate scenarios of potential future land use options identifying its impacts on potential social and economic implications
- To develop an indicator framework for the development of an assessment tool to be integrated on a later stage into a warning and decision support system for decision makers.

The needs of WP8 in terms of "extreme events" are determined by the issues addressed by the different research teams, taking into consideration, for example:

- Effects of radiation, temperature, rainfall, relative humidity and winds on evapotranspiration and soil hydrologic balance;
- Effects of solar radiation, temperature, humidity and wind on photosynthesis;
- Mechanical effects of wind on crop;
- Effects of hail and frosts on crops, pastures, fruits and vegetables;
- Fire outbreaks on pastures, forests, etc;
- Socio-economic implications.

Other requested information:

Intensity, frequency, duration, time and spatial distribution of:

1. Hail
2. Frosts (out-of-season frosts, frosts without snow)
3. Floods
4. High intensity rainfalls (mm/h)
5. Droughts (duration) and extreme temperatures (> 40ºC)
6. Windstorms (> 80 km/h)
7. UV-B-radiation (daily maximum)
8. Tmax & Tmin (different thresholds and seasons)
9. Tmed (degree.days for different seasons)
10. Monthly Tmax, Tmin and Precip
11. Change in Precip. pattern

3.5 WP9 - Water resources in La Plata Basin in the context of climate change
Presented by Moira Doyle- Universidad Buenos Aires

The main objective of WP9 is: "To assess the impacts of Climate Change on the more sensitive aspects of the water resources of La Plata Basin to climate variations and to help to build the corresponding adaptation strategies"

Specific Objectives are:

- *Compute an ensemble of hydrological scenarios based on distributed hydrological models*
- *Design statistical prediction schemes and hydrological scenarios Iberá wetlands ecosystems*
- *Floods*
- *Effects on navigation and in the Paraná Delta front urbanization*
- *Operation strategy of the dams in the Brazilian South/South-East subsystem of La Plata Basin*
- *Vulnerabilities of the hydropower sector*

With relation to Floods: Local or small regional floods; Main rivers floods
The objectives are:

Local floods: To explore meteorological and/or climate forcings and to evaluate changes in these conditions under CLARIS climate scenarios.

Main rivers floods: To assess the impact of climate change for the upcoming decades in the frequency and magnitude of extreme streamflows considering climate change scenarios from selected Global Climate Models as input to the VIC hydrological model.

With relation to Soil moisture: Use of the CLASS U3M-1D Model (Cooperative Research Center for catchment hydrology – Australia)

The needs of Sediments Impact group are:

Future time series (100 yrs)

- *1-daily temperature and rain on Bermejo basin*

- *2-daily discharge of Paraguay river at Puerto Pilcomajo and of Iguazù river at Ituzaingo*

Scenarios (1 year hydrograph)

- *daily discharge of Paraná river at San Lorenzo-Rosario to 2D/3D simulate Rosario Reach morphodynamic*

Future land use of the whole basin

The needs of Hydropower Group are:

Time series

- *Mean daily temperature (South and SE Brazil)*

  Available: 1961 - 2002
  Needed: 1931 – 2005 (critic period 1945 – 1959)

The needs of Floods Group are:

Mesoscale Systems

- *Behavior in future scenarios (frequency, intensity, area)*

Modelling (Hydrology, Soil moisture)

Time Series (Precipitation, Max and Min Temperature, wind, relative humidity, pressure, radiation)

4. Conclusion

The objective of the workshop was reached, with presentations of ongoing work and status of planned tasks. Some of the requested information from WP8 and WP9, as data set must be sent to WP3. Some indices will be provided from WP6, but we felt that it is important to have further communication about the needs. A table of indices will be prepared based on discussions during the workshop. Some ideas are to define other indices, such as: mixed indices of temperature and precipitation without using the empiric relationship, under the concept of continuity of the variables; heat Wave Index; and indices thresholds specific for the analyzed region. A list of references on extremes and a list of published results from the participants will be posted on the web site. During the first 6 months the group analyzed the available Global Models results and observed data, and it is expected to have the regional model results from WP5 to specific and detailed analysis with high resolution.

Annex 1: Workshop Agenda

Workshop WP6 2009
Punta del Este, Uruguay
16 -18 November 2009

16/11

9:00- 9:30- Opening session-Welcome, Workshop Information and Objectives, Review of tasks/ Deliverables/ Table of activities- Iracema FA Cavalcanti and Madeleine Renom.

Presentations and discussions:

- 9:30-9:50- Barbara Tencer- A Southeastern South America daily gridded data set of observed surface minimum and maximum temperature for 1991-2000.
- 9:55-10:15- Juan Rivera, Olga Penalba and María Laura Bettolli - Inter-annual and inter-decadal variability of dry periods in La Plata Basin. Monitoring extreme conditions.
- 10:20-10:40 - Coffee Break
- 10:40-11:00 - Olga Penalba, Vanesa Pántano, Spescha L. B., Murphy. G. M. -Inter-annual and inter-decadal variability of extreme hydrological conditions in La Plata Basin.
- 11:05-11:25- Laura Zamboni -Heat waves over South America: preliminary results from a coupled model.
- 11:30-12:30-Discussions on Índices from STARDEX, ENSEMBLES, ETCCMDI, outros. (everybody).
- 12:30- 14:30 Lunch
- 14:30- 14:50- Claudio Menendez-Simulating extremes with CGCMs and RCMs.
- 14:55- 15:15- Natália Pessag- Uncertainties in simulating extreme precipitation events with a regional climate model.
- 15:20-15:40 – Barbara Tencer- Interdecadal variability of temperatures extreme events in Argentina
- 15:45 - 16:05- Iracema F.A.Cavalcanti- Precipitation anomalies variability over 2 sectors of La Plata Basin and extremes-GFDL and HADCM3 projections compared to the present climate.
- 16:10-16:30- coffee break
- 16:30-16:50- Madeleine Renom, M. Rusticucci and M Barreiro- Observed changes in interannual variability of extreme temperature events in Uruguay after 1976 climate shift".
- 16:55 -17:15- Federico Robledo- Different scales approches on extreme daily rainfall on La Plata Basin.
- 17:15-18:00- Discussions on results and Working groups

17/11

- 9:10- 9:30- Matilde Rusticucci- An intercomparison of model- simulation in extreme rainfall and temperature events during the last half of the XX century.
- 9:30-9:50- Bettolli ML and Penalba OC- Synoptic Weather Types and their Relationship to Extreme Daily Rainfall in the South of LPB
- 9:55-10:15- Claudia Campetella- The contribution of cut-off lows to rainfall in LPB: Preliminary results
- 10:20- 10:40- Coffee break
- 10:40-11:00- Armelle R.C. Remedio- Understanding mesoscale convective systems and regional flows in South America using a regional model.

11:05- 11:25- Rosmeri P. Rocha-Preliminary analysis of cyclonic activity tendency over South Atlantic Ocean.
11:30-11:50 Information on Results of WP5
11:55-12:15- Olga Penalba – Making progress on the CLARIS LPB data base- Information from WP3.
12:20- 14:30- Lunch
14:30- 14:50-Rafael Terra- WP8
14:55-15:15-Moira Doyle- WP9
15:20 -15:40- Jhan Carlo Espinoza- Assessing the capacity of IPCC-GCMs to reproduce weather types in tropical and sub-tropical South America: An approach using a Neuronal Networks method.
15:45-16:15 – Coffee Break
16:15- 17:35- *Roger Rodrigues Torres*- Projections of extreme events on the La Plata Basin by the end of the XXI century based on global and regional climate models.
17:40- 18:40- Discussion on methods and data, Discussions on collaboration work, ideas to improve the exchange collaboration, suggestions to the group.

18/11
9:00- 10:30- Working groups (to the report and to include in Deliverable 1)
Group 1- Summary of results and activities (abstract from each study and 1 figure)
Group 2- Summary of metrics and indices to extremes in LPB
Group 3- Collection of references on extremes
Group 4- Planned activities in the next year
10:30- 10:50- coffee break
10:50 - 12:00-Presentations from the groups