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Joint Edition of the Newsletter of the Climate Variability and Predictability Project (CLIVAR) Exchanges and the CLIVAR Variability of the American Monsoon Systems Project (VAMOS)

VAMOS !

Exchanges

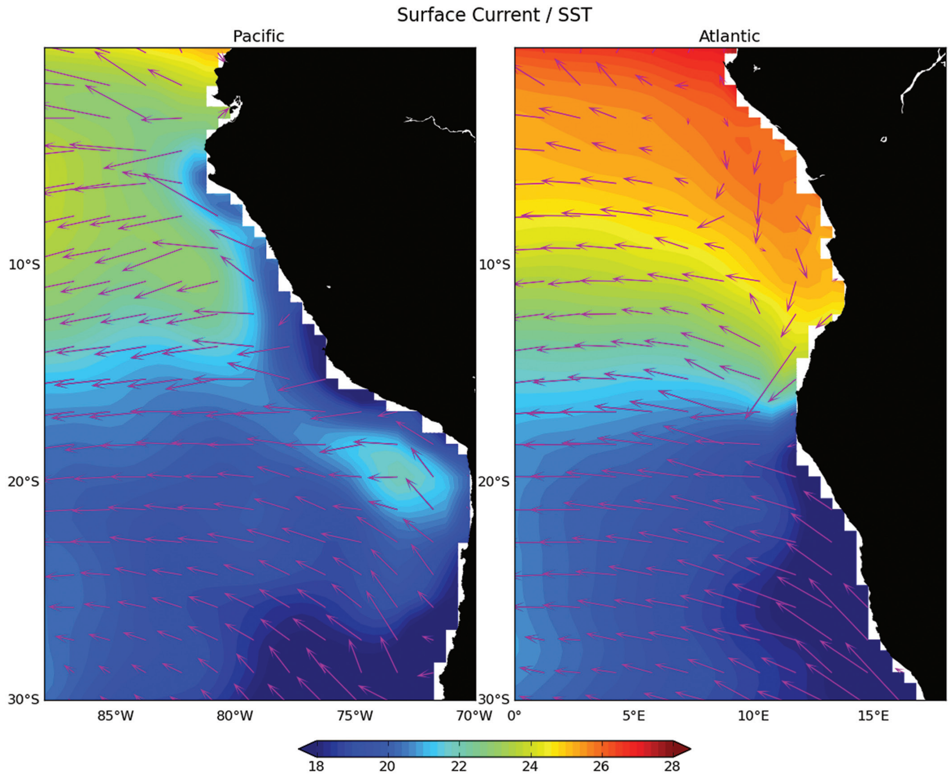

Fig.2: Annual-mean sea surface temperature and surface currents, from the Simple Ocean Data Assimilation (SODA) Reanalysis. Note the strong SST gradient in the Atlantic known as the Angola-Benguela front. To its north, at approximately 10E/10S, lies the Angola dome. In contrast, the southeast Pacific has no comparable SST gradients or thermocline domes. Plot courtesy of Dr. Mingkui Li. //Temperatura media anual de la superficie del mar y corrientes en superficie del Reanálisis de la Asimilación Simple de Datos Oceánicos (SODA). Nótese el fuerte gradiente de SST en el Atlántico, conocido como el frente Angola-Benguela. Al norte de éste, a 10E/10S aproximadamente, se encuentra el Domo de Angola. En contraste, el Pacífico Sudoriental no tiene gradientes de SST comparables ni domos en la termoclina. Figuras cortesía de Dr. Mingkui Li. *(see article by Paquita Zuidema et al on page 12) (ver artículo de Paquita Zuidema et al en la página 12)*

CLIVAR is an international research programme dealing with climate variability and predictability on time-scales from months to centuries. CLIVAR is a component of the World Climate Research Programme (WCRP). WCRP is sponsored by the World Meteorological Organization, the International Council for Science and the Intergovernmental Oceanographic Commission of UNESCO.

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Editorial

This issue of CLIVAR Exchanges is multi-purpose. It is a combined version of Exchanges and the VAMOS! Newsletter. The combination demonstrates the depth and breadth of CLIVAR research.

With respect to CLIVAR, we used to say in the 1960's (giving my age away now), "the times they are a changing". The ICPO, US CLIVAR and WCRP are in the midst of some dramatic transitions. I am towards the end of my fifth month as Director of ICPO having replaced Dr. Howard Cattle on 1 September. My biography appeared in the last Exchanges so I will not repeat any of the details, except to say this position has been a CHANGE for me. I am truly amazed with all CLIVAR is doing.

With respect to the ICPO Staff Scientists, Dr. Kate Stansfield resigned when I came on board to take an academic position at the University of Southampton here in Southampton. We were very fortunate to find an excellent replacement for Kate, Catherine Beswick. Catherine started on 17 January and a short biography appears in this Exchanges.

Changes continue, as on 31 March 2011 (i.e., before the next Exchanges appears) Mrs. Sandy Grapes will retire as my Personal Assistant. Not a day I am looking forward to, as Sandy is a fount of knowledge about the inner workings of the ICPO, NOC and NERC. Irreplaceable could prove to be an understatement regarding her departure.

With respect to US CLIVAR, Dr. David Legler has resigned as Director of the US CLIVAR Office as of 1 February. Although I knew David before I took the ICPO position, working with him and trying to coordinate US/International CLIVAR activities demonstrated to me how valuable he was to the program. Fortunately, I have worked in the past with his interim replacement Dr. Mike Patterson and I see continued activities to strengthen US/International coordination to the benefit of CLIVAR.

Finally, WCRP is in the process of changing it's structure, with details of the new WCRP being developed. At a minimum, we know that it will be more multidisciplinary and include some aspects of climate services. Many decisions will be made at the WCRP Open Science Conference (OSC) to be held in Denver Colorado from 24 to 28 October. The OSC promises to be an exciting expose of the scientific results of the four WCRP projects and the program's future direction. Go to the WCRP website for additional information and plan to attend and provide a description of your research (see the website for details on how to submit an abstract).

I think you now get the idea of why I opened with "the times they are a changing". Although the magnitude of the changes appears large, fortunately we have a core of staff members who have shown they can continue to function effectively during times of flux. Stay tuned for updates on how these changes have affected CLIVAR.

Bob Molinari

Introducing Catherine Beswick

Catherine Beswick grew up in the seaside town of Bournemouth, which is located in the South of England on a particularly fascinating stretch of coastline. Countless family expeditions to areas such as the Jurassic Coast and beyond inspired the decision to study Geology at the University of Oxford, where she took a particular interest in palaeontology and oceanography. After obtaining her undergraduate degree, she moved on to the National Oceanography Centre Southampton (NOCS), where she received a Master of Science in Oceanography from the University of Southampton in 2007.

During her MSc, Catherine developed further interests in anthropogenically-induced impacts on the natural environment and how science feeds into decision-making. She therefore embarked on an internship in climate policy with the environmental charity Green Alliance, based in London. She simultaneously worked with an insurance firm trading under the Lloyd's marketplace as a Catastrophe Risk Analyst, which gave her an insight into how climate change is affecting business decisions and risk management. On completion of her internship, she moved to Bristol to take up employment with an environmental consultancy, which specialises in waste management, resource efficiency and climate change. During this role Catherine worked with numerous public sector organisations – at local, national and international levels – providing advice on the environmental, economic

and social implications of different policy scenarios. Catherine is thrilled to be back at NOCS working as a Staff Scientist for the International CLIVAR Project Office and is excited about her involvement in the project going forward.

Membership of CLIVAR Panels and Working Groups

The International CLIVAR program on Climate Variability and Predictability (http://www.clivar.org) is a project of the World Climate Research Program (WCRP). The World Meteorological Organization, the International Oceanographic Commission of UNESCO and the International Council for Science sponsor WCRP. CLIVAR's mission is to facilitate observation, analysis and prediction of changes in the earth's climate system with a focus on ocean-atmosphere interactions, enabling better understanding of climate variability and change, to the benefit of society and the environment in which we live. As CLIVAR advances, it becomes increasingly important to address all aspects of the climate system, including the role of biogeochemical cycles and to build the application of CLIVAR science to societal applications and impacts. Thus CLIVAR looks to partnerships with other international programs, especially the International Biosphere-Geosphere Program, the International Human Dimensions Program and the International Program of Biodiversity Science. CLIVAR addresses its mission through a group of panels and working groups.

CLIVAR seeks qualified individuals to serve on its Panels and Working Groups. These groups formulate goals and required strategies, catalyze and coordinate activities, and work with agencies and other international partners to advance the progress of the climate research community, particularly with regard to addressing relevant goals of the World Climate Research Programme (WCRP). Qualified nominees are expected to represent the broader interests of the research community, be willing and able to engage in scientific as well as programmatic discussions leading to the activities of the particular group, and work with other members of the CLIVAR organization.

There are 4 types of CLIVAR Panels including ocean basins, modeling, regional and observations and data. The 4 ocean basin panels address the Atlantic, Pacific, Indian and Southern Oceans. The 3 modeling panels consider seasonal to interannual prediction, coupled modeling and ocean model development. The 3 regional panels address the Asian-Australian and American Monsoon Systems and African climate variability. Finally, the 3 observations and data working groups provide guidance on data synthesis, Paleoclimate, and climate change detection and indices. Thus, there are a wide variety of panels and topics to choose from. Details on the terms of reference and actions of the CLIVAR panels and working groups are given on the CLIVAR website (http://www.clivar.org).

Panel members are expected to attend the group's meeting, which varies in location. Additional meetings are possible, particularly with respect to task teams under the panel's guidance. However, most Panel activity is carried out through email and teleconferences. Members generally serve terms of 3-4 years. The terms are staggered so that changes in panel membership typically occur annually. Two co-chairs, one of whom attends the CLIVAR SCIENTIFIC STEERING Group's annual meeting, lead most panels and working groups. CLIVAR panels are encouraged to have gender and regional balance reflected in their membership.

To nominate (self nominations are welcome) and be considered for a particular Panel membership, please submit the following:

- 2-page vitae noting the most relevant publications
- A paragraph describing qualifications, research interests, and the Panel of interest

Materials should be sent electronically to the International CLIVAR Project Office and the Staff Scientist who assists the particular panel. Staff Scientist responsibilities and Email addresses are given on the website. Please note "Panel Nomination" in the subject heading. Membership changes typically occur annually, although not for every panel. Except occasionally, there are no specific dates for submission of applications for membership. Thus, your submissions will be kept on file until an opening is available and your application will be considered.

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South African mid-summer seasonal rainfall prediction performance by a coupled ocean-atmosphere model

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1 Introduction

Estimation of the evolution of SST anomalies, which are often relatively predictable, and subsequently employing them in atmospheric general circulation models (AGCMs), provides means of generating forecasts of seasonal-average weather (Graham et al. 2000; Goddard and Mason, 2002). Such a so-called two-tiered procedure to predict the outcome of the rainfall season has been employed in South Africa for a number of years already (e.g., Landman et al., 2001). The advent of fully coupled ocean-atmosphere models (e.g. Stockdale et al, 1998), or one-tiered systems, promised improved seasonal forecasts since in theory coupled models should eventually outperform two-tiered systems because the former is able to describe the feedback between ocean and atmosphere while the latter assumes that the atmosphere responds to SST but does not in turn affect the oceans (Copsey et al., 2006). This notion will be tested here by comparing the seasonal rainfall forecast performance over the mid-summer season of December to February (DJF) of a two-tiered system with forecasts from a fully coupled system. For both the two-tiered and fully coupled systems the same AGCM will be used.

2 Data and global models

Hindcasts from one- and two-tiered systems are statistically downscaled to South African mid-summer seasonal rainfall totals (see below). Three-month seasonal rainfall data used for the downscaling are calculated from the district rainfall data set of the South African Weather Service, and comprises of 94 evenly distributed locations across South Africa. This data set consists of monthly data from 1951 to 2009.

All of the global model data are obtained from the data library of the International Research Institute for Climate and Society (IRI). The AGCM data used are produced by the ECHAM4.5 (Roeckner et al., 1996) and consists of two sets. The first set (available from January 1950 to present) is produced by forcing the ECHAM4.5 with observed SST and consists of 24 ensemble members, and the second set (available from January 1957 to July 2008), also consisting of 24 ensemble members, is produced by forcing the model with SST anomalies that are forecast using constructed analogue SST (Van den Dool, 2007). Forecast data from a coupled model are also used. The ocean model is the MOM3 (Pacanowski and Griffies, 1998) directly coupled to the ECHAM4.5 (DeWitt, 2005). The coupled model forecast set consists of 12 ensemble members, and the data are available from January 1982 to present.

There are four forecast lead-times considered. For the two-tiered system, forecasts are produced near the beginning of the month, and for the ECHAM4.5-MOM3 system near the end of the month. A 1-month lead-time for two-tiered system implies that there are about three weeks from the issuance of the forecast to the beginning of the forecast season. For example, a 1-month lead-time forecast for the DJF season is produced at the beginning of November, 2-month lead-time forecasts are produced early October, and so on. For the ECHAM4.5-MOM3 system, there are at least 4 weeks between the production of the forecast and the first month of the forecast season. For example, DJF rainfall forecasts at a 1-month lead-time are produced near the end of October.

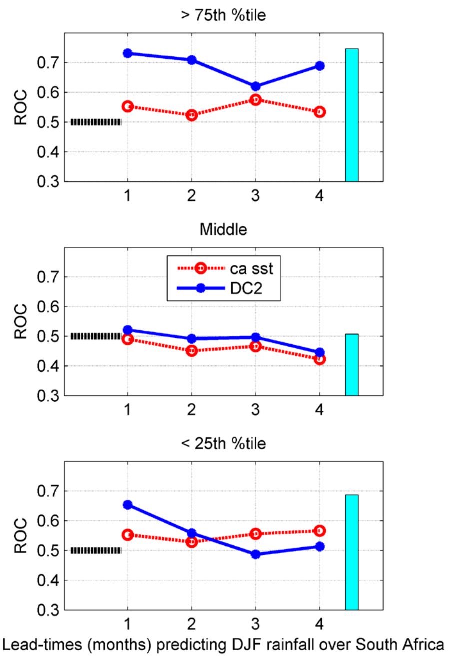

Figure 1. ROC scores for the prediction of DJF rainfall totals over South Africa. The scores of the fully coupled and AGCM downscaled forecasts are shown for each lead-time (solid and dashed lines), as well as the scores for the AGCM simulation runs (bar).

3 Model output statistics

Model output statistics (MOS; Wilks, 2006) equations are developed here because they can compensate for systematic deficiencies in the global models directly in the regression equations. The reason why these model errors can be overcome is because MOS uses predictor values from the global models in both the development and forecast stages. Notwithstanding, the selection of the appropriate model field require careful consideration. Variables such as large-scale circulation are more accurately simulated by models than rainfall and should therefore be used instead in a MOS system to predict seasonal rainfall totals (Landman and Goddard, 2002).

The MOS equations are developed by using the canonical correlation analysis (CCA) option of the Climate Predictability Tool (CPT) of the IRI (http://iri.columbia.edu). The forecast fields from each global model used in the MOS are restricted over a domain that covers an area between the Equator and 45°S, and 15°W to 60°E. Empirical orthogonal function (EOF) analysis is performed on both the predictor (modelled 850 hPa geopotential height fields) and predictand sets (district rainfall) prior to CCA, and the number of EOF and CCA modes to be retained in the CPT's CCA procedure is determined using cross-validation skill sensitivity tests.

In order to minimize artificial inflation of forecast skill, the downscaled forecast performance of the individual models should be verified over a test period that is independent of the training period and should involve evaluation of predictions compared to their matching observations excluding any information following the forecast year. Such a system mimics a true operational forecasting environment where no prior knowledge of the coming season is available. For DJF rainfall, the models are first trained with information from 1982/83 and leading up to and including 1994/95. The seasonal rainfall of the next year (1995/96) is subsequently predicted using the trained models. The various MOS sets of equations are subsequently retrained using information leading up to and including 1995/96 to predict for 1996/97 conditions. This procedure is continued until the 2008/09 DJF rainfall is predicted using MOS systems trained with data from 1982/83 to 2007/08, resulting in 14 years (1995/96 – 2008/09) of independent forecast data. In estimating the skill in predicting seasonal rainfall totals over South Africa, the observed and predicted fields are separated into three categories defining above-normal, near-normal and below-normal seasonal rainfall totals. However, these categories are not equi-probable here since the above- and below-normal threshold values respectively represent the 75th and 25th percentile values of the climatological record.

The distribution of individual ensemble members is supposed to be able to indicate forecast uncertainty. However, only a finite ensemble is available (12 or 24 members depending on the available global model data) suggesting that the forecast distribution may be poorly sampled and also differently sampled owing to the difference in the available ensemble sizes – and so the uncertainty associated with the forecasts has to be estimated. Probabilistic MOS forecasts for each of the 14 retro-active years are obtained here from the error variance of the cross-validated predictions using the ensemble mean (Troccoli et al., 2008) for each of the

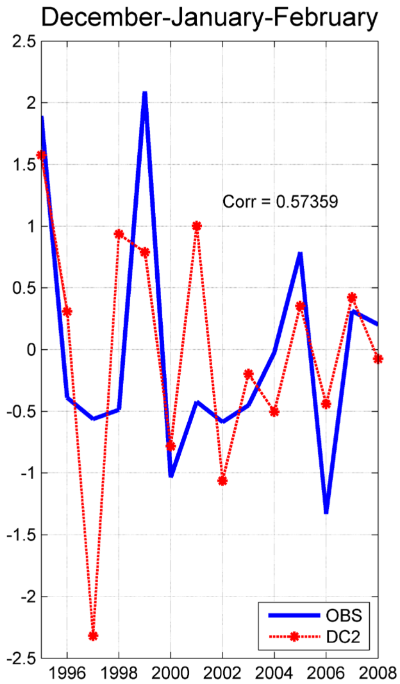

Figure 2. Forecast area-averaged (over 94 South African rainfall districts) and then standardized DJF rainfall anomalies over the 14-year test period (red dotted line) vs. observed area-averaged standardized DJF rainfall. The years are associated with the Decembers of the DJF seasons

various training periods. Cross-validation is performed using a (large) 5-year-out window, which means that 2 years on either side of the predicted year is omitted, in order to minimize the chance of obtaining biased results.

Seasonal climate is inherently probabilistic, and so seasonal forecasts should be judged probabilistically. The forecast verification measure presented here is the relative operating characteristic (ROC; Mason and Graham, 2002). ROC applied to probabilistic forecasts indicates whether the forecast probability was higher when an event such as a flood season occurred compared to when it did not occur, and therefore identifies whether a set of forecasts has the attribute of discrimination.

4 Preliminary results

A ROC graph is made by plotting the forecast hit rates against the false alarm rates. The area beneath the ROC curve is used as a measure of discrimination and is referred to as a ROC score. If the area would be ≤ 0.5 the forecasts have no skill, and for a maximum ROC score of 1.0, perfect discrimination has been obtained. Figure 1 shows the ROC scores for the three forecast categories for DJF rainfall totals for each of the individual downscaled models as calculated over the 14-year test period. On the figure the ROC scores for the coupled model and AGCM are shown for the three categories and for the four lead-times, together with the ROC scores from the simulations that used observed SSTs to force the AGCM (the reference scores).

For the most part ROC scores associated with the coupled model are higher than the scores associated with the two-tiered system, especially for the prediction of mid-summer wet conditions over South Africa. Notwithstanding, neither the coupled nor two-tiered system outscores the reference forecasts, suggesting that further improvement in operational seasonal rainfall forecast skill for South Africa should still be achievable.

The middle panel shows scores when predicting for the near-normal category defined by 50% of the climatological record. These verification results support the notion that predicting for the middle category has limited skill since ROC scores for most of the lead-times are near or below 0.5.

Figure 2 shows times series of area-averaged deterministic forecasts vs. observations over the 14-year test period for forecasts produced at a 1-month lead-time (the averages are calculated over all of the 94 districts). The correlation between the forecast and observed time series is significant at the 95% level, but forecast rainfall anomalies are often over- or underestimated. Notwithstanding these discrepancies, rainfall "trends" from one season to the next are captured 11 out of the 13 cases (the "trends" of 1998/99 to 1999/00 and 2003/04 to 2004/05 the exceptions). This is a hit rate of 85% and suggests that the prediction of predictands other than seasonal rainfall totals could supplement existing forecast output disseminated to the end-users of forecast information.

5 Discussion and conclusion

Centres producing operational seasonal forecasts for South Africa need to know whether or not modelling research should be directed towards more expensive coupled models as opposed to more generally used two-tiered operational forecasting systems. This will be the case when a more demanding (in a computational and resource based sense) coupled system outscores a two-tiered system, which has been shown to be the case here for DJF rainfall totals. However, when skilful SST forecasts are used two-tiered systems may perform at least equally well as coupled systems as has been demonstrated by the simulation case when the AGCM was forced with observed SST. In conclusion, coupled models perform skillfully over South Africa and may even be as skilful as an AGCM forced with perfect SST. This modelling contribution has therefore demonstrated that it certainly is feasible to direct some of the available research and modelling funds as well as effort towards the development of operational seasonal forecasting systems that incorporate fully coupled models, but at the same time that two-tiered systems as operational forecasting systems remain valid and should be used.

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Report of the 6th Meeting of the CLIVAR/CliC/SCAR Southern Ocean Region Panel and the Workshop on the Upper and Lower Cells of the Meridional Circulation in the Southern Ocean, 14 - 17th June 2010

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The 6th Session of the CLIVAR/CliC/SCAR Southern Ocean Region Panel (SOP) was hosted by the National Oceanography Centre (NOC) in Southampton, UK. SOP was extremely grateful for the welcome and organization provided by the Southampton based International CLIVAR Project Office (Director Howard Cattle) and the work and support of local hosts Alberto Naveira Garabato (NOC) and Gareth Marshall (British Antarctic Survey).

The science goals of this meeting were to explore the latest ideas for the dynamics of the Upper Cell of the Meridional Overturning Circulation (MOC) in the Southern Ocean (SO), taking into account the presence of many of the key investigators being located in the UK, and to discuss missing elements and appropriate future observations needed to fill out our understanding of the Lower Cell of the MOC in the SO, more specifically the inflow of deep water and outflow of bottom water. These goals were intended to further the objectives of the Southern Ocean Observing System (SOOS), and to help plan for collaborative studies with carbon and other groups. The panel meeting consisted of two half days for panel only discussions and three half days of science presentations and discussion. The science sessions were broadly organized by talks on Upper Cell overturning circulation and processes and talks on Lower Cell overturning circulation and processes.

Climate modeling status, goals

Main activities in climate modeling since the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) are: additional analysis of existing simulations (weighting of models) and preparation of the models/simulations for IPCC Fifth Assessment Report (AR5). Model tests and validation in the Southern Ocean include tests at the process level and reproducing the main characteristics of the observed mean state and recent trends. For example, ozone only models appear to produce slightly better agreement with the sea-ice observations and getting the Southern Annular Mode right does not mean that the model gets the sea-ice coverage correct.

The main objective of the IPPC class models is to get the best projection of climate change. But how would a specific model be excluded or weighted? Should we continue with model democracy or should some models be removed based on objective/subjective criteria? One possibility is instead of performing simple multi-model average, the results of the various models could be weighted according to some measure of their performance for example based on hindcast performance. We don’t have a good way to evaluate the models so how do we choose the “right” way to weight the various models.

For example could we select a set of key observations/ diagnostics to make a benchmark of models in the Southern Ocean and/or should we insist on the evaluation of multi-decadal timescales to determine the weighting of individual models. A key point is that where the signal is strong models should reproduce this signal (preferably on multi decadal time scales).

Front row, left to right: Dave Munday, Gareth Marshall, Hugues Goosse, Eberhard Fahrbach, Matthew England, Kevin Speer, Steve Rintoul, Doug Martinson, Alberto Naveira Garabato, Chris Hughes; second row: Karen Heywood, Julie Jones, Emily Shuckburgh, Sabrina Speich, Nikki Lovenduski, Andy Watson, David Marshall; third row: Stuart Daines, Laure Zanna, Andy Hogg, Ted Maksym, Kate Stansfield, Andrew Thompson, Helen Johnson, Mike Meredith.

The AR5 simulations begin in haste so the panel need to produce a short list of parameters/processes the models need to get right for the Southern Ocean and send this list to the Coupled Model Intercomparison Project Phase 5 (CMIP5) group. Diagnostics could include the strength of the Antarctic Circumpolar Current (ACC), sea ice extent, the position of the maximum Westerly's, basin divergence of heat and freshwater etc. The list could comprise of a fundamental level of diagnostics (i.e. the models should not get these wrong) and a fine-tuning list (e.g. processes, stratification, mixed layer depth?) these could provide targets/benchmarks for processes that are important for the ocean overturning. It is important to produce quantitative metrics that are easy for the modeling community to evaluate.

The panel discussed the use of different timescales in model evaluation (e.g. seasonal/decadal). It was felt that mean and seasonal timescales are already considered as they are such a strong feature of the observations (e.g. sea ice extent). However decadal timescales are more difficult as there are fewer multi decadal datasets for model evaluation. It was suggested that perhaps ocean hindcasts could provide a "data set". For example, for sea-ice, perhaps the last 30 years of observations are not enough to address decadal predictability (e.g. the large variability in the Weddell Sea polyna).Of the major oceans the SO has one of the shortest data time series the question is whether the last 30 years are representative of, say, a 100yr average?

Process modeling status and goals

Current themes in SO process modeling are:

a) Southern Ocean overturning (and carbon system) response and ACC adjustment to perturbed climatic forcing with the aim of understanding how the Southern Ocean MOC and ACC transport respond to changes in wind and buoyancy forcing and in low- and high-latitude mixing and convection.
b) Transport across jets with the aim of understanding the physical controls of eddy-induced mixing across jets, and jet formation itself.

Emerging themes include:

a) Eddy - topography interactions / internal wave radiation / loss of geostrophic balance with a focus on understanding the energy and momentum balances of the ACC and the role of unbalanced motions in the Southern Ocean overturning (lower cell)
b) Upper-ocean physics / subduction in the ACC - present studies overlook the top boundary condition, the role of mixed layer processes, seasonality and other processes in the upper cell
c) Variability of Antarctic Slope Front (ASF) and shelf-slope processes - knowledge of ASF processes involved in Antarctic Bottom Water (AABW) formation and ice shelf melting rudimentary at best, critical for sea level rise
d) Subpolar gyre adjustment to perturbed forcing - impact of changes in the wind on AABW export by modulation of subpolar gyre baroclinicity

Upwelling was identified as a key process at U.S. Southern Ocean Carbon, Ecosystems and Biogeochemistry meeting but what are the key processes that control getting water into the surface mixed layer? Ekman pumping? The seasonal cycle of entrainment?

SOOS Observations, process and sustained status, goals

When SOOS is fully implemented the SO will be the first to have a multi disciplinary observing system, however there are still gaps in the number of sustained observations in the plan and also with planned links to the carbon and ecosystem communities.

Bridges need to be built between LTER/ecosystem programs and SOOS and an expansion of observations in the vicinity of ecosystem projects might be considered especially in the light of the retreat of sea ice from the W Antarctic peninsula. If a new LTER-like site were to be proposed where should it be located and what should it measure?

The final SOOS document was released at the SCAR meeting in Buenos Aires in August, however there are still some weaknesses in terms of biology and carbon. The biological community is not used to thinking in the "big picture" and typically don't have sensors that as are advanced as say the physics or chemistry groups. The carbon community have been working on their own "global" science plan so it has been hard to get their attention to help strengthen the SOOS plan.

The panel queried the status of O2 sensors on Argo floats. Currently there are only about a dozen floats with the sensors but 10 more are expected to be deployed in the coming Antarctic field season. However there are significant stability issues with the sensors. The panel commented that If the community wishes to augment the ARGO floats with biological sensors then what sensors would be required and what would be the correct number of floats?

It was noted that JAMSTEC will be deploying two surface flux moorings one at 60°S (south of Australia) and one at 47°S. Is intended that the 60°S be subjected to "ice" (rime ice). In addition, an ORION mooring will be deployed at 55°S mooring. These locations should be added to the SOOS diagram.

It was also reported that the LTER project will be deploying 6 moorings and 3 gliders every year (currently summer only) with plans to run the gliders between Palmer and Rothera.

It was suggested that the ARGO program could be used as a model for the future implementation of SOOS. The SOOS community needs to decide whether the observing system will operate in active or responsive mode. The lack of champions for the program is the biggest threat to SOOS - not enough people are really committed at the present time. Currently the load is carried by the research community and there is no single agency to sponsor or support the observing system.

There is an International group for discussing Antarctic base activities; however the ocean component is mostly overlooked. As with SCAR the SOOS needs a long term commitment of say 10 to 15 years initially. It was mentioned that should such a commitment be forthcoming it would be possible to host a SOOS secretariat at Hobart.

To aid it in its work, the panel has produced a vision document for climate variability research in the Southern Ocean-ice-atmosphere system. The document summarizes significant progress in research in this area achieved over the past few years and identifies a number of imperatives and frontiers for CLIVAR research, expanding on the most pressing research issues and questions for the coming 3-5 years.

Presentations from the meeting, the final meeting report, and the vision document can be found through the panel webpage at:

http://www.clivar.org/organization/southern/southern.php

New CLIVAR relevant Research Centre in Australia

In late 2010 the Australian Research Council (ARC) announced a list of successful Centres of Excellence, and this included the ARC Centre of Excellence for Climate System Science. This is a multimillion dollar initiative, over 7 years, substantially focused on the physical and biophysical climate system. Many of the research activities of the Centre align with key CLIVAR themes, including climate variability, climate predictability, ocean-atmosphere processes, and long-term change.

The goal of the Centre is "to resolve key uncertainties undermining the reliable projection of Australia's climate". To achieve our goal we will work with a suite of partners on understanding key aspects of the climate system using observations, parameterization development, model development and global and regional climate models.

The Centre will directly contribute to several CLIVAR goals including improving our understanding of the physical processes responsible for climate variability and predictability on interannual, decadal, and centennial time-scales, through the development and application of models of the coupled climate system. We will also contribute to our understanding of the response of the climate system to increases in greenhouse gases, land use change and other regionally significant forcings via research programs in extremes, detection and attribution and model development.

We are currently developing five major research programs:

1. The effects of tropical convection on Australia's climate (including the development of new convection parameterizations)
2. Risks, mechanisms, and attribution of changes in Australian climate extremes
3. The role of land surface forcing and feedbacks for regional climate (including the building of new capacity into land surface models)
4. Drivers of spatial and temporal climate variability in extratropical Australia
5. Mechanisms and attribution of past and future ocean circulation change

The Centre is hosted by the University of New South Wales in Sydney. The Partner Universities are Monash University, The University of Melbourne, The Australian National University, and the University of Tasmania.

We collaborate with a series of key groups nationally including the CSIRO, Australian Bureau of Meteorology, the National Computational Infrastructure (NCI), the Department of Climate Change and Energy Efficiency, the NSW Department of Environment, Climate Change and Water, and the Australian National Data Service.

Internationally, we partner with CNRS in France, NASA, NCAR, GFDL and the University of Arizona in the USA, the Hadley Centre and the National Centre for Atmospheric Science in the UK.

A large number of research fellowship positions and PhD scholarships will be advertised through 2011. In addition, we will be encouraging international exchange of scholars over the next seven years. A web site at www.climatescience.org.au will provide details in due course. In the meantime any questions should be referred to Professor Andy Pitman, the Centre Director, at a.pitman@unsw.edu.au.

Corrigendum: Report of the NPOCE Inauguration Meeting: a CLIVAR newly endorsed international joint program

We sincerely apologize that the list of NPOCE Scientific Steering Committee (SSC) members in the above paper, published in the last issue of CLIVAR Exchanges (No.54), was incomplete. The correct NPOCE SSC member list is as follows:

NPOCE Scientific Steering Committee (SSC)

Chair:

- Dunxin Hu, Institute of Oceanology, Chinese Academy of Sciences, China

Members:

- Rameyo Adi, BRKP, Ministry of Marine Affairs and Fisheries, Indonesia
- Kentaro Ando, Japan Agency for Marine-Earth Science and Technology, Japan
- Dake Chen, Second Institute of Oceanography, State Oceanic Administration, China
- Arnold Gordon, Columbia University, US
- William Kessler, National Oceanic and Atmospheric Administration, US
- Jae-Hak Lee, Korea Ocean Research and Development Institute, Korea
- Bo Qiu, University of Hawaii, US
- Stephen Riser, University of Washington, US
- Cesar Villanoy, University of the Philippines, Philippines
- Fan Wang, Institute of Oceanology, Chinese Academy of Sciences, China
- Lixin Wu, Ocean University of China, China

RAPID - US AMOC
International Science Meeting
12-15 July 2011 in Bristol UK

Past , Present and Future Change in the Atlantic Meridional Overturning Circulation

Call for Abstracts

Observations and numerical modelling experiments have suggested links between variability in the Atlantic Meridional Overturning Circulation (AMOC) and global climate patterns. Reduction in the strength of the overturning is thought to have played a key role in rapid climate change in the past and may have the potential to so in the future. This is the motivation for research conducted in the UK RAPID and US AMOC science programmes.

The 2011 International Science Meeting is a joint initiative between the two programmes, and will explore the scientific understanding of Atlantic variability on a range of time scales, with a main focus of the role of the AMOC.

The venue for the meeting is the At-Bristol Science and Discovery Centre, which lies in the heart of the Bristol's historic Harbourside.

SCIENCE THEMES

Authors are invited to address one or more of the four science themes below, or related topics of interest to the RAPID and US AMOC science communities.

1. What do we know about present and past changes in the AMOC on seasonal to millennial time scales?
2. How does the AMOC influence ocean, atmosphere and terrestrial climate and ecosystems?
3. How will the AMOC change over the next few decades and over the 21st century?
4. Outlook and Challenges.

For abstract submission and more information about the International Science Meeting, see the website:

http://www.noc.soton.ac.uk/rapid/ic2011

NATURAL ENVIRONMENT RESEARCH COUNCIL · CLIVAR · NSF · NOAA · NASA · CAPE FAREWELL

EuroGOOS, the European Global Ocean Observing System

The 6th EuroGOOS Conference will be held on 4-6 October, 2011 at Sopot, Poland. It will focus on sustainable operational oceanography and topics include ‘oceanography for climate monitoring and impact’ and ‘nowcasting, forecasting and re-analysis’. The deadline for abstracts is 1 May, 2011.

Further information is available at www.eurogoos2011.eu

Editorial

It is our pleasure to bring a new issue of the VAMOS! Newsletter. During 2010, we continued promoting collaborations across the Americas, and the activities under the Extremes Working Group led by Siegfried Schubert and Iracema Cavalcanti are a prime example. We invite you to read their article in this Newsletter and visit the remarkable web site they have created for extremes over the Americas (http://gmao.gsfc.nasa.gov/research/subseasonal/atlas/Extremes.html). In the same way that VAMOS is seeking to integrate its activities among its science components, we are also looking for new partnerships and ways of contributing to the CLIVAR and WCRP objectives. Along these lines, the VAMOS Panel Meeting 13 was held in conjunction with the CLIVAR Working Group on Seasonal to Interannual Prediction (WGSIP) in order to discuss ways to carry out the implementation of the VAMOS Modeling Plan (http://www.clivar.org/organization/vamos/Publications/Vamos_Modeling_Plan_Jun08.pdf). Given the progress in understanding how the Atlantic Ocean helps modulate the climate of the Americas and how it relates to biases in numerical models, our next panel meeting is being coordinated with the CLIVAR Atlantic Implementation Panel (AIP). The meeting will be preceded by the Workshop on Coupled Ocean-Atmosphere-Land Processes in the Tropical Atlantic, being organized by AIP and VAMOS (http://www.clivar.org/meetings/tropical_bias.php). We firmly believe that it will be through this type of interactions that the VAMOS, CLIVAR and WCRP objectives will be fully achieved.

On a different note, Jose Marengo has completed his term as VAMOS co-chair. Below this editorial, he is writing his own perceptions on VAMOS at the end of his term. We thank Jose for his years of dedication to the panel and wish him well for his future activities.

Howard Cattle, the International CLIVAR Project Office Director has recently retired. He has always helped VAMOS with its mission and goals, and he will be missed by all the VAMOS community. We wish that he could have equal success with his favorite pastime, taking care of his garden. But with the same warmth that we say goodbye to Howard, we welcome Bob Molinari, the new Director of ICPO. Bob has rapidly adapted to his new role, and we look forward to many years collaboration.

Finally, we take this opportunity to thank Jose Meitín for his dedication and his critical support to the many VAMOS activities.

Best wishes in the New Year,

Tenemos el gusto de presentar un nuevo número de la revista VAMOS! Newsletter. Durante 2010, hemos continuado promoviendo la cooperación en las Américas, y las actividades del Grupo de Trabajo sobre Extremos, dirigido por Siegfried Schubert e Iracema Cavalcanti son un excelente ejemplo. Los invitamos a leer su artículo en esta revista y visitar el excepcional sitio web que han creado para los extremos en las Américas (http://gmao.gsfc.nasa.gov/research/subseasonal/atlas/Extremes.html). Igual que VAMOS busca integrar las actividades entre sus componentes científicos, también estamos buscando nuevos socios y formas de contribuir con los objetivos de CLIVAR y el PMIC. Siguiendo estos lineamientos, la 13ª Reunión del Panel de VAMOS se realizó junto con el Grupo de Trabajo de CLIVAR sobre Predicciones Estacionales a Interanuales (WGSIP, por sus siglas en inglés) con el fin de debatir formas de llevar a cabo la implementación del Plan de Modelado de VAMOS (http://www.clivar.org/organization/vamos/Publications/Vamos_Modeling_Plan_Jun08.pdf). En vista del avance en la comprensión de cómo el Océano Atlántico ayuda a modular el clima de las Américas y qué vínculos existen con los sesgos en los modelos numéricos, se está organizando la próxima reunión de nuestro panel con el Panel de CLIVAR para la Implementación en el Atlántico (AIP, por sus siglas en inglés). La reunión será precedida por el Taller sobre Procesos Acoplados Océano-Atmósfera-Tierra en el Atlántico Tropical, cuyos organizadores son AIP y VAMOS (http://www.clivar.org/meetings/tropical_bias.php). *Creemos firmemente que será a través de este tipo de interacciones que se alcanzarán de forma completa los objetivos de VAMOS, CLIVAR y el PMIC.*

Cambiando de tema, el período de José Marengo como copresidente de VAMOS ha finalizado. A continuación de este editorial, él presenta su visión de VAMOS luego del tiempo que ha estado en el panel. Agradecemos a José por los años que ha dedicado al panel y le deseamos lo mejor en sus actividades futuras.

Howard Cattle, el Director de la Oficina Internacional del Proyecto CLIVAR se ha jubilado recientemente. Él siempre ayudó a VAMOS con su misión y objetivos, y la comunidad de VAMOS lo echará de menos. Le deseamos el mismo éxito con el cuidado de su jardín, su pasatiempo favorito. Pero, con la misma calidez con que despedimos a Howard, le damos la bienvenida a Bob Molinari, el nuevo Director de ICPO. Bob se ha adaptado rápidamente a sus nuevas funciones, por lo que esperamos una cooperación de muchos años.

Finalmente, aprovechamos la oportunidad para agradecer a José Meitín por su dedicación y su apoyo fundamental a las numerosas actividades de VAMOS.

Los mejores deseos para el Año Nuevo,

Hugo Berbery
Dept. of Atmospheric and Oceanic Science
University of Maryland, USA
Co-chair of VAMOS Panel / Copresidente del Panel VAMOS

Carlos Ereño
ICPO Representative for the VAMOS Panel /
Representante de ICPO para el Panel de VAMOS

Dear colleagues of the VAMOS Community, after completing the four-year period co-chairing this prestigious CLIVAR panel, I have decided to leave the position for the several other activities I am involved in. Among those, is the position as head of the Natural Sciences Division of the new Earth System Science Center at INPE, and also is the new phase of one of the flagship projects of VAMOS, the Monsoon Experiment for South America (MESA), which I continue to chair. So, this is not a goodbye, but a change and I hope I will be able to continue serving on CLIVAR VAMOS.

My special thanks go to Wayne Higgings and Hugo Berbery, with whom I had the pleasure and honor of sharing the leadership of the VAMOS panel along these years. I am also grateful to Carlos Ereño and José Meitín, who have provided continued support to my work. Finally, I thank the members of the VAMOS panel, who participated a major and essential restructuring of the panel activities in the last years. Results have already been achieved and contributions made to the knowledge on Climate Variability and Predictability in the Americas, particularly on a recent review paper on the South American Monsoon System published in the International Journal of Climatology. No doubt, the new panel leaders will maintain this direction.

Estimados colegas de la comunidad de VAMOS, después de cumplir el período de cuatro años de copresidencia de este prestigioso panel de CLIVAR he decidido alejarme de esta función para poder dedicarme con mayor esfuerzo a las otras múltiples actividades que me ocupan. Entre ellas, está el puesto de director de la División de Ciencias Naturales del nuevo Centro de Ciencias del Sistema Terrestre del INPE, y la nueva etapa de uno de los emblemáticos proyectos de VAMOS, el Experimento del Monzón de América del Sur (MESA) que continúo presidiendo. Así que esta no es una despedida sino un cambio en el que espero continuar sirviendo a CLIVAR VAMOS desde otra función.

Deseo brindar un especial agradecimiento a Wayne Higgings y Hugo Berbery, con quienes fue un gusto y honor compartir la conducción del panel de VAMOS en estos años. También quiero reconocer a Carlos Ereño y José Meitín, quienes me apoyaron sostenidamente en mi labor. Finalmente agradezco a los miembros del panel de VAMOS, con quienes encaramos una importante y esencial reestructuración de las actividades del panel en estos últimos años, que ya ha brindado sus aportes científicos al conocimiento de la Variabilidad y Predictabilidad del Clima de las Américas, y sin duda continuará en esta senda con la nueva conducción del panel.

José Marengo
CPTEC/INPE, Brazil
Co-Chair of VAMOS Panel / Copresidente del Panel VAMOS

VAMOS Panel

E.Hugo Berbery (co-chair), University of Maryland, College Park, USA
José Marengo (co-chair), CPTEC, INPE, Brazil
Jen-Philippe Boulanger, Laboratoire d'Oceanographie Dynamique et de Climatologie, Paris, France
Teresa Cavazos, CICESE, Ensenada, Baja California, Mexico
David Enfield, NOAA/Atlantic Oceanographic Meteorological Observatory (AOML), Miami, USA
Luis Farfan, CICESE, La Paz, B.C.S, Mexico
David Gochis, NCAR RAO, Boulder, Colorado, USA
Lisa Goddard, IRI, Palisades, USA
Ben Kirtman, Rosenstiel School of Marine & Atmospheric Sc., Univ. of Miami and COLA, USA
C.Roberto Mechoso, UCLA, Los Angeles, USA
Aldo Montecinos. University of Concepcion, Chile
Celeste Saulo, CIMA, Universidad de Buenos Aires, Buenos Aires, Argentina
Paquita Zuidema, Rosenstiel School of Marine & Atmospheric Sc., Univ. of Miami, USA

The ICPO contact for the CLIVAR VAMOS Panel is Carlos Ereño.

Coupled ocean-atmosphere-land processes in the tropical Atlantic

Coupled GCMs suffer from common biases in the Pacific and Atlantic basins. These include the so-called double ITCZ problem, and an associated SST bias along the equator and in the southeastern tropical basins where modeled SST is significantly warmer than observations. This is shown in Fig. 1 for a boreal summer 12-model ensemble mean of IPCC models, and for the NCAR Community Climate System Model CCSM3 in particular. These errors limit predictability at both regional and climate scales. While the newer-generation CCSM4, which has an improved deep convective and land surface parameterization, has demonstrated an overall reduced SST bias compared to CCSM3, it nevertheless retains a similar SST-bias spatial pattern (Gent et al., 2010).

VOCALS (see Wood et al., 2007), building on the previous Eastern Pacific Investigation of Climate (EPIC) project, has brought a southeastern Pacific-specific address of these problems. Their observations and high-resolution modeling are improving our understanding of the relevant processes. They have encouraged a stronger physical basis to the boundary layer representation in climate models such as the CCSM5 that are improving representations of the sea surface temperature for all of the eastern ocean basins.

Significantly, however, these model improvements have had less impact on the simulated SSTs in the Atlantic than for the Pacific. The Atlantic still exhibits the most severe bias problem among all the tropical oceans in the current generation of climate models. In fact, the Atlantic bias problem is still so severe that some of the most fundamental features of the equatorial Atlantic Ocean – the east-west equatorial SST gradient and the eastward shoaling thermocline – cannot be reproduced by most of coupled climate models (e.g., Richter and Xie 2008). In many models, the warm SST bias along the Benguela (west Africa) coast is in excess of 5°C and the warm pool in the western basin is severely underestimated. These deficiencies seriously degrade the credibility of the models in their simulation and projection of future climate change in the Atlantic sector.

The lack of progress in the Atlantic bias problem may be attributed to two major factors: 1) the complex nature of the bias problem and 2) a lack of focused attention from the research community. Hypotheses for a complex Atlantic bias problem tend to draw on the fundamental observation that the Atlantic basin is far smaller than the Pacific basin. The smaller Atlantic basin compared to the Pacific encourages a tighter and more complex land-atmosphere-ocean interaction with not just the east side of the ocean basin, but also its west side. In one hypothesis, deep convection over the Amazon impacts the Atlantic equatorial cold tongue via the equatorial trade winds (Richter and Xie, 2008, Fig. 4)– drawing attention to model representations of the Amazonian convection. Another hypothesis focuses on differences between the two eastern basins' coastal oceanic circulations: while the southeast Pacific has no oceanic domes and weak, transient oceanic frontal zones, the southeast Atlantic features a strong SST gradient known as the Angola-Benguela front at approximately 17S, and a shallow thermocline structure known as the Angola Dome at approximately 10S (Fig. 2, see cover page of this newsletter). Cloud-SST feedbacks can then amplify these differences for a southern Atlantic stratocumulus deck that covers a much larger fraction of its basin than does the southeast Pacific deck. Continental circulation patters influence the southeast Atlantic free troposphere

Procesos acoplados océano-atmósfera-tierra en el Atlántico tropical

Los GCMs acoplados presentan sesgos comunes en las cuencas del Pacífico y el Atlántico. Éstos incluyen el así llamado problema de la doble ZCIT y un sesgo asociado a la SST a lo largo del ecuador y en las cuencas tropicales del sudeste, donde la SST modelada es significativamente más cálida que las observaciones. Esto se muestra en la Fig. 1 para la media de un verano boreal obtenida de un ensamble de 12 modelos del IPCC y del Modelo Comunitario del Sistema Climático CCSM3 de NCAR en particular. Estos errores limitan la predictibilidad en las escalas regionales y climáticas. Si bien el CCSM4 de más nueva generación, con una mejor parametrización de la convección profunda y de la superficie de la tierra, ha mostrado en general una reducción en el sesgo de la SST en comparación con el CCSM3, este sesgo mantiene un patrón similar (Gent et al., 2010).

Basándose en el proyecto previo de Investigación del Clima en el Pacífico Oriental (EPIC, por sus siglas en inglés), VOCALS (ver Wood et al., 2007) ha incorporado un abordaje específico para esta problemática en el Pacífico Sudoriental. A través de sus observaciones y modelado de alta resolución está mejorando nuestra comprensión de los procesos relevantes. El grupo ha promovido una base física más fuerte para la representación de la capa límite en modelos climáticos como el CCSM5 que mejoran la representación de la temperatura de la superficie del mar de todas las cuencas oceánicas orientales.

Sin embargo, resulta significativo que el impacto de estas mejoras en los modelos haya sido menor en las SSTs simuladas en el Atlántico que en el Pacífico. De todos los océanos tropicales, el Atlántico sigue presentando los más severos problemas de sesgo en la generación actual de modelos climáticos. De hecho, el problema del sesgo del Atlántico continúa siendo tan grave que la mayoría de los modelos climáticos acoplados no pueden reproducir algunas de las características más fundamentales del Atlántico ecuatorial –el gradiente ecuatorial este-oeste de la SST y la disminución de la profundidad hacia el este de la termoclina (por ejemplo, Richter y Xie 2008). En muchos modelos, el sesgo cálido de la SST a lo largo de la costa de Bengala (África Occidental) supera los 5°C y la hoya cálida de la cuenca occidental está severamente subestimada. Estas deficiencias degradan seriamente la credibilidad de las simulaciones y proyecciones del cambio climático futuro en el sector Atlántico de los modelos.

La falta de avances en el problema del sesgo del Atlántico puede atribuirse a dos factores importantes: 1) la naturaleza compleja del problema y 2) la falta de atención por parte de la comunidad de investigadores. Las hipótesis de que el sesgo del Atlántico constituye un problema complejo tienden a surgir sencillamente de observar que la cuenca del Atlántico es mucho más pequeña que la del Pacífico. El menor tamaño de la cuenca del Atlántico respecto de la del Pacífico promueve una más estrecha y compleja interacción tierra-atmósfera-océano no sólo al oriente de la cuenca oceánica, sino también en su sector occidental. En una de las hipótesis se sostiene que la convección profunda sobre la Amazonía afecta la lengua fría del Atlántico ecuatorial a través de los vientos alisios ecuatoriales (Richter y Xie, 2008, Fig. 4), lo que vuelve la atención sobre cómo los modelos representan la convección amazónica. Otra hipótesis se centra en las diferencias entre la circulación oceánica costera de las dos cuencas orientales: mientras el Pacífico sudoriental no tiene more obviously than the southeast Pacific because the western African coastal range does not extend as high as the Andes. The southeast Atlantic continental outflow also includes optically-thick aerosol layers from biomass burning, stimulating unique aerosol-cloud-climate interactions that are difficult to confidently constrain with only satellite observations.

A workshop is currently planned to bring focus specifically to the bias problem in the tropical Atlantic. A current impediment to international coordination is that a coherent synthesis of existing knowledge is lacking for this region, as is the identification of a network of interested researchers. A lack of synergy currently exists between researchers from the northern and southern hemispheres. For example, one community of primarily South African scientists interested in climate variability are mostly focusing on the austral summer rainy season, another research community is focusing on coastal fisheries and ecosystems, while a considerable international research effort is successfully studying the west African monsoon and tropical Atlantic cold tongue, primarily during the austral winter. These communities have much to gain from each other, motivating our successful request for WCRP support of the workshop (http://www.clivar.org/meetings/tropical_bias.php).

Thus, workshop objectives include identifying an international network of interested, active researchers and developing a coherent synthesis of the state-of-the-art knowledge on the Atlantic biases

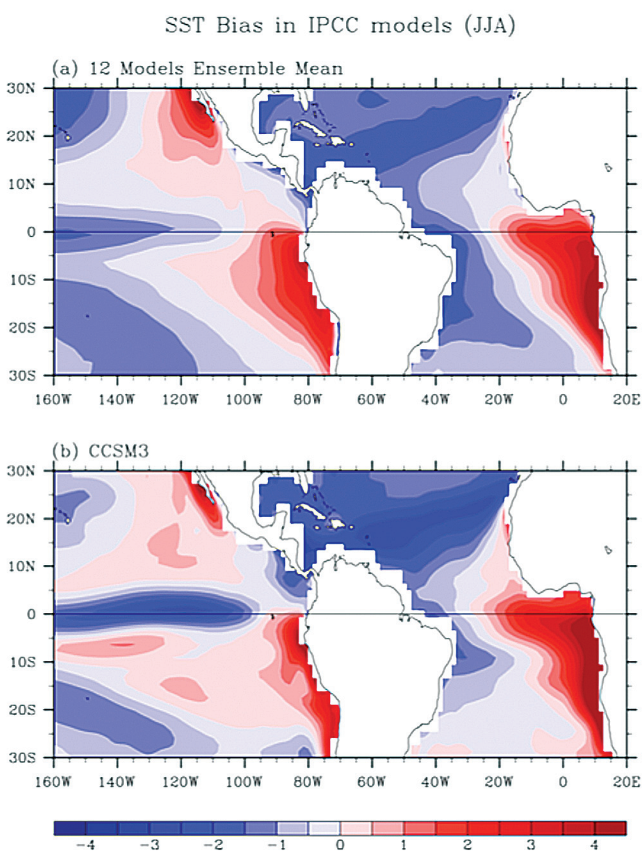

Figure 1: June-July-August sea surface temperature biases in a) a 12-IPCC-model ensemble mean, and b) Community Climate System Model Version 3.0. Plot courtesy of Roberto Mechoso, Chunzai Wang, and Sang-Ki Lee. // Figura 1: Sesgos en la temperatura de la superficie del mar para junio-julio-agosto en a) una media de un ensamble de 12 modelos del IPCC, y b) Versión 3.0 del Modelo Comunitario del Sistema Climático. Gráfico cortesía de Roberto Mechoso, Chunzai Wang y Sang-Ki Lee

domos térmicos oceánicos ni zonas frontales oceánicas débiles y temporales, el Atlántico sudoriental muestra un fuerte gradiente de SST conocido como el frente Angola-Bengala ubicado a 17S aproximadamente, y una estructura de termoclina somera conocida como el Domo de Angola, a 10S aproximadamente (ver Fig. 2, ver tapa de la revista). Las retroacciones nubes- SST pueden entonces amplificar estas diferencias en presencia de una cubierta de estratocúmulos en el Atlántico Sur que cubre una fracción mucho más grande de su cuenca de lo que lo hace la del Pacífico Sudoriental. Los patrones de circulación continental afectan la tropósfera libre del Atlántico Sudoriental más obviamente que las del Pacífico Suroriental porque la cadena montañosa de África Occidental no alcanza las altitudes de los Andes. El flujo desde el continente al Atlántico Sudoriental también incluye capas de aerosoles de espesor óptico provenientes de la quema de biomasa, estimulando interacciones aerosol-nube-clima únicas, que son difíciles de forzar de manera segura sólo con observaciones satelitales.

Se está planeando la realización de un taller para concentrarse específicamente en el problema del sesgo en el Atlántico tropical. Un impedimento actual a la coordinación internacional es que no se cuenta con una síntesis coherente del conocimiento existente en la región, ni está identificada la red de investigadores interesados. Actualmente existe una falta de sinergia entre los científicos de los hemisferios norte y sur. Por ejemplo, una comunidad formada principalmente por científicos sudafricanos interesados en la variabilidad climática está concentrándose mayormente en la época de lluvias del verano austral, otra comunidad de científicos se está concentrando en las pesquerías y ecosistemas costeros, mientras que un considerable esfuerzo de investigación internacional está dirigido con éxito al monzón de África Occidental y la lengua fría del Atlántico tropical, principalmente durante el invierno austral. Estas comunidades tienen mucho que aprender unas de otras, lo que motiva nuestra solicitud al PMIC de apoyo para el taller (http://www.clivar.org/meetings/tropical_bias.php).

Así, los objetivos del taller incluyen la identificación de una red internacional de investigadores activos e interesados en desarrollar una síntesis coherente del conocimiento de vanguardia sobre los sesgos del Atlántico y sus causas, en la parte tropical sudoriental y oriental de dicho océano, así como un conjunto de hipótesis refinadas. El objetivo último es articular un camino efectivo para avanzar. ¿Será éste un análisis más profundo de los modelos? Y de ser así, ¿serán intercomparaciones de modelos atmosféricos, oceánicos y/o acoplados combinadas con más reanálisis/análisis satelitales? ¿Una asimilación de datos dirigida y experimentos coordinados de modelado? ¿Nuevos programas de campo y/o la modificación de las redes observacionales existentes, por ejemplo, Experimento del Clima del Atlántico Tropical? Dada la extensión geográfica (desde la Amazonía hasta la costa de Bengala) involucrada en las principales teorías acerca de las fuentes de los errores de los sesgos de las SST del Atlántico ecuatorial, es necesario definir un foco geográfico adecuado o varios, junto con su extensión(es) espacial(es). Entre los productos concretos que se espera obtener del taller se incluye un informe que ponga de relieve las similitudes y diferencias entre el desempeño de los GCM en el Atlántico y el Pacífico tropical, incluyendo un debate profundo y actualizado de las causas y procesos físicos relevantes; una encuesta escrita acerca de los programas de campo realizados, en curso y en desarrollo; la formación de un subgrupo AIP-VAMOS que identificará temas comunes con otros paneles de CLIVAR, implementará las actividades realizables identificadas en el taller (por ejemplo, los dos informes escritos), promoverá el trabajo sobre los impactos humanos y el desarrollo de capacidades y organizará una conferencia informativa; una lista de correo del 'Atlántico Sudoriental' basada inicialmente en la lista de participantes del taller, con el fin de continuar el intercambio de and their causes for the southeast and eastern tropical Atlantic, as well as a set of sharpened hypotheses. The ultimate objective is to articulate an effective way forward. Should this be further model analysis, and if so, atmosphere, ocean and/or coupled model intercomparisons combined with further reanalysis/satellite analysis? targeted data assimilation and coordinated model experiments? new field programs and/or modification of existing observational networks, e.g., the Tropical Atlantic Climate Experiment? Given the geographical range encompassed by leading theories on the error sources for the Atlantic equatorial SST biases, from the Amazon to the Benguela coast, an appropriate geographical focus or foci needs to be defined, along with its spatial extent(s). Planned concrete workshop outcomes include a report highlighting similarities and differences between GCM performance in the tropical Atlantic and Pacific, including an in-depth and up-to-date discussion of causes and relevant physical processes; a written survey of field programs completed, in progress, and under development; formation of an AIP-VAMOS subgroup that will identify common issues with other CLIVAR panels, implement tractable future activities identified at the workshop (e.g., the two written reports), encourage work on human impacts and capacity building, and prepare a conference briefing; a 'southeast-Atlantic' listserv initially based on the workshop participant list, towards continuing the exchange of ideas; recommendations for future actions; and a workshop summary suitable for publication in EOS or a similar journal.

The interests of the VAMOS panel in the Atlantic are substantial. VAMOS is focused on the mechanisms controlling extra-tropical moisture transport to America's monsoons, and as such, is concerned with variations in tropical Atlantic moisture flux modulating Amazon convection and the South American low-level jet. The tropical Atlantic also influences the Atlantic Warm Pool, the Intra-American Seas, and the principal moisture flux conduits to the North American monsoon. As outlined in the VAMOS Modeling Plan, modeling and predicting sea surface temperature variability in the Pan-American seas is a paramount theme of the overall VAMOS modeling strategy. SST variability influences the pan-American phenomena that are key to America's monsoons (e.g., low-level jets, land/sea breezes, tropical storms), provides the link between regional and larger-scale climate variability, and provides the initial and boundary conditions for smaller-scale modeling studies. As such, VAMOS goals in addressing Atlantic SST biases are a shared interest with the CLIVAR Atlantic Implementation Panel, with both panels sponsoring this Atlantic workshop.

ideas; recomendaciones de acciones en el futuro; y una síntesis del taller que pueda ser publicada en EOS o una revista similar.

El interés del panel VAMOS en el Atlántico es considerable. VAMOS está concentrado en los mecanismos que controlan el transporte extra-tropical de humedad a los monzones americanos, y como tal, está interesado en las variaciones en el flujo de humedad del Atlántico tropical que modula la convección amazónica y la corriente en chorro en niveles bajos de América del Sur. El Atlántico tropical también afecta la Hoya Cálida del Atlántico, los Mares Intraamericanos y los principales conductos del flujo de humedad al monzón norteamericano. Como se esbozó en el Plan de Modelado de VAMOS, el modelado y la predicción de la variabilidad de la temperatura de la superficie del mar en los mares panamericanos es un tema primordial para toda la estrategia de modelado de VAMOS. La variabilidad de la SST tiene influencia en fenómenos panamericanos que son clave para los monzones americanos (por ejemplo, la corriente en chorro en niveles bajos, las brisas tierra/mar, las tormentas tropicales), establece el vínculo entre la variabilidad climática regional y de mayor escala y ofrece las condiciones iniciales y de contorno para estudios de modelado de menor escala. Por tanto, los objetivos de VAMOS para abordar los sesgos en la SST del Atlántico son compartidos con el Panel de Implementación del Atlántico (AIP) de CLIVAR, y ambos paneles patrocinarán este taller sobre el Atlántico.

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VAMOS and extremes in the Americas: an update of the Extremes Working Group activities

VAMOS y los Extremos en las Américas: Una actualización de las actividades del grupo de trabajo sobre extremos

The VAMOS Working Group on Extremes (co-chairs Siegfried Schubert and Iracema F. A. Cavalcanti) was formed at the end of 2009. Work officially began in February 2010 after finalizing the membership and completing a prospectus. The working group has broad participation with membership and/or expertise that covers much if not most of the Americas (see list below).

The group was tasked with making progress on some of the recommendations of an earlier task force on extremes (Boulanger et al. 2008). The working group was encouraged by the VAMOS panel to focus on the physical-dynamic forcing of extremes in the Americas, and to consider the use of indices and indicators of climate variability and change as defined by the CLIVAR/CCl/JCOMM Expert Team on Climate Change Detection and Indices (http://www.clivar.org/organization/etccdi/etccdi.php). It was also encouraged to collaborate with the CLARIS LPB (www.claris-eu.org) Workpackage 6 (WP6) effort: "Processes and future evolution of extreme climate events in La Plata Basin". The main objective of WP6 is to elucidate climate processes that are associated with extreme hydro-climate conditions over the LPB region, in South America, considering both the role of the large scale forcing and the local interactions, and the way in which the frequency and intensity of such cases may change according to different projections of global climate change.

The basic objective of the VAMOS working group is to improve our understanding of the mechanisms and predictability of extremes. Specifically, the focus is on precipitation and temperature extremes

El Grupo de Trabajo de VAMOS sobre Extremos (copresidentes Siegfried Schubert e Iracema F. A. Cavalcanti) se creó a fines de 2009. Oficialmente su trabajo comenzó en febrero de 2010 luego de haber completado su plantel de miembros y elaborado un prospecto. El grupo de trabajo tiene una amplia participación de miembros y/o conocimientos que abarcan gran parte, si no toda América (ver la lista al final).

Se encomendó al grupo la tarea de avanzar en algunas de las recomendaciones hechas por un equipo de trabajo previo sobre extremos (Boulanger et al. 2008). El panel de VAMOS alentó al grupo a concentrarse en los factores dinámicos y físicos que fuerzan los extremos en las Américas, y considerar el uso de índices e indicadores de variabilidad y cambio climáticos según las definiciones del Equipo de Expertos en Índices y Detección de Cambios Climáticos de CLIVAR/CCl/JCOMM (http://www.clivar.org/organization/etccdi/etccdi.php). Se promovió también la cooperación con el Paquete de Trabajo 6 (WP6) de CLARIS LPB (www.claris-eu.org): "Procesos y evolución futura de eventos climáticos extremos en la cuenca del Río de la Plata". El objetivo principal de WP6 es dilucidar los procesos climáticos que están asociados a condiciones hidroclimáticas extremas en la cuenca del Río de la Plata, en América del Sur, considerando tanto el papel de los forzamientos de gran escala como las interacciones locales, así como el modo en que pueden modificarse su frecuencia e intensidad, según distintas proyecciones de cambio climático global.

Members of the VAMOS Extremes Working Group / Miembros del Grupo de Trabajo de VAMOS sobre Extremos

- *Siegfried Schubert: NASA/GMAO –USA, (co-chair)*
- *Iracema F.A. Cavalcanti: CPTEC/INPE-Brazil, (co-chair)*
- *Alexander (Sasha) Gershunov, Scripps, UCSD, USA*
- *Alice Grimm, Federal University of Paraná, Brazil*
- *Brant Liebmann: CIRES/University of Colorado, USA/SA*
- *Charles Jones: ICESS/UCSB-USA/Brazil/SA*
- *Dave Gochis, ESSL/NCAR, USA*
- *Hugo Berbery: UMD, USA*
- *Hugo Hidalgo: Universidad de Costa Rica, Costa Rica*
- *Jae Schemm: CPC/NOAA, USA*
- *Kingtse Mo; CPC/NOAA –USA*
- *Leila Vespoli De Carvalho: ICESS/UCSB-USA/SA*
- *Matilde Rusticucci, FCEN–Universidad de Buenos Aires, Argentina*
- *Olga Penalba, University of Buenos Aires, Argentina*
- *Paulo Sergio Lucio, University of Rio Grande do Norte, Brazil*
- *Tereza Cavazos, Dept. of Physical Oceanography, CICESE, Mexico*
- *Tim LaRow, COAPS/FSU, USA*
- *Viatcheslav (Slava) Kharin, Canadian Centre for Climate Modelling and Analysis, Canada*
- *Xuebin Zhang, Environment Canada*
- *Young-Kwon Lim, GEST and NASA/GMAO –USA*

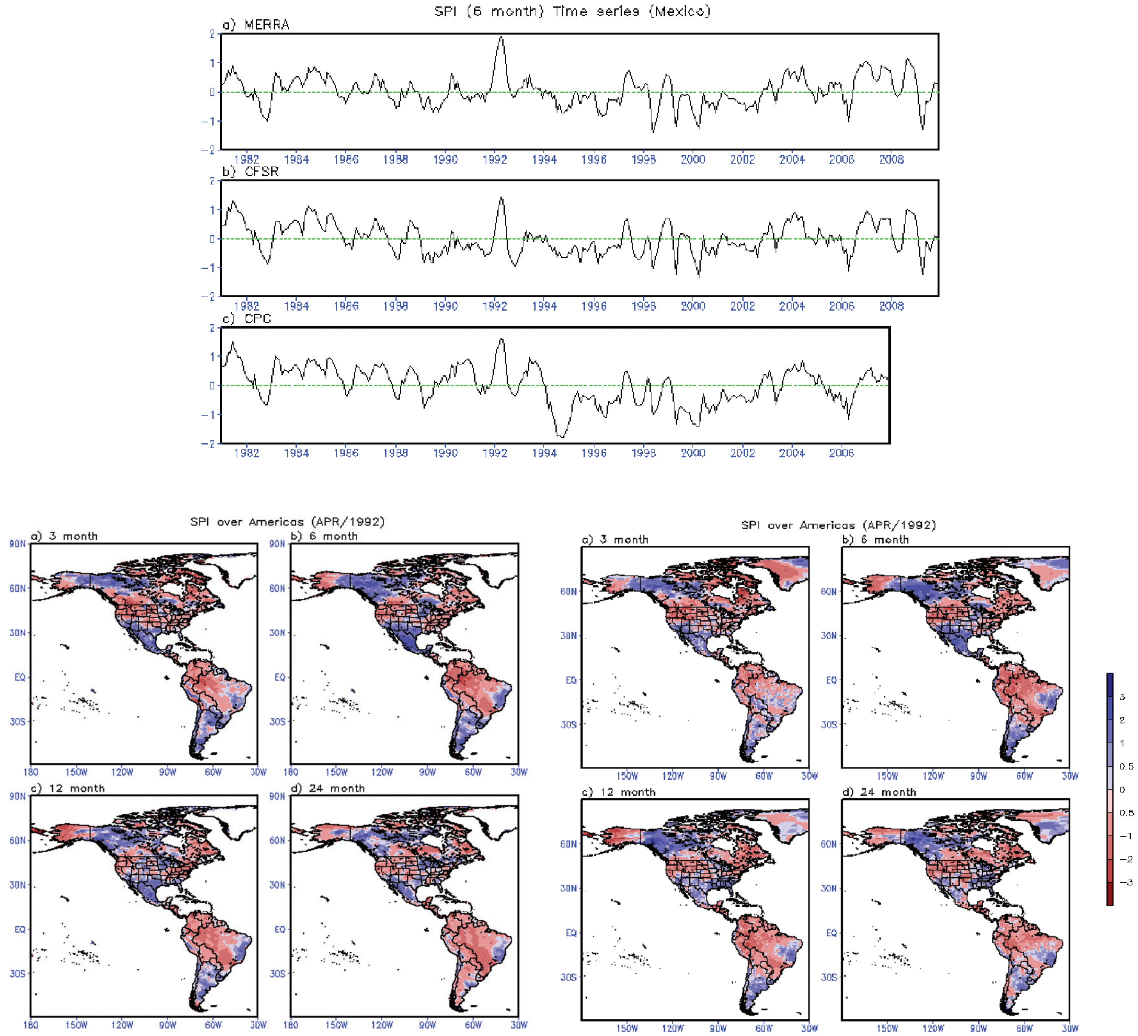

Figure 1: Top panels: Time series of SPI6 based on daily MERRA, CFSR and CPC gridded precipitation observations averaged over Mexico. Bottom panel: April 1992 maps of SPI3, SPI6, SPI12 and SPI24 based on MERRA (left) and CFSR (right) // Figura 1: Paneles superiores: Series temporales de SPI6 basados en observaciones diarias en puntos de grilla MERRA, CFSR y CPC promediadas sobre México. Panel inferior: mapas de abril de 1992 de SPI3, SPI6, SPI12 y SPI24 basados en MERRA (izquierda) y CFSR (derecha)

on both short term (weather) and climate scales, and includes such phenomena as heat waves, floods and droughts. Specific tasks include 1) the development of an on-line atlas of extremes over the Americas, 2) the evaluation of existing and planned simulations including the CMIP5 IPCC/AR5 global and CLARIS-LPB regional scenarios, decadal hindcasts, seasonal hindcasts, ultra-high resolution global climate model simulations, and 3) formulating and coordinating new model simulations to help shed light on the mechanisms and predictability of extremes.

The initial focus has been on the development of the on-line atlas based on gridded observations (Liebmann and Allured, 2005; Higgins et. al. 2000) and the recently completed reanalyses from NASA/MERRA (Rienecker et. al. 2010) and NOAA/CFSR (Saha et. al. 2010). In addition to providing basic information about weather and short-term climate extremes throughout the Americas, it is hoped that the atlas will provide an important tool for validating model simulations. A beta version of the atlas is now available at

http://gmao.gsfc.nasa.gov/research/subseasonal/atlas/Extremes.html

El objetivo básico de este grupo de VAMOS es mejorar nuestra comprensión de los mecanismos de los extremos y su predictibilidad. Específicamente, se pone el foco en los extremos de precipitación y temperatura en escalas temporales tanto de corto plazo (tiempo) como climáticas, y se incluyen fenómenos como olas de calor, inundaciones y sequías. Entre las tareas específicas se cuentan 1) el desarrollo de un atlas on-line de extremos en las Américas, 2) la evaluación de simulaciones existentes y planeadas incluyendo los escenarios globales de CMIP5 IPCC/AR5 y los regionales de CLARIS-LPB, hindcasts decenales, hindcasts estacionales, simulaciones de modelos climáticos globales de ultra alta resolución y 3) la formulación y coordinación de nuevas simulaciones de modelos para contribuir a echar luz sobre los mecanismos y la predictibilidad de los extremos.

En un principio, se centró el interés en el desarrollo de un atlas on-line basado en grillas de observaciones (Liebmann and Allured, 2005; Higgins et. al. 2000) y los reanálisis recientemente finalizados por NASA/MERRA (Rienecker et. al. 2010) y NOAA/CFSR (Saha et. al. 2010). Además de brindar información básica acerca del tiempo y los extremos climáticos de corto plazo en las Américas, se espera

The working group is particularly interested in getting feedback from the community regarding the usefulness of the atlas and welcomes suggestions for improvements. An important part of the atlas is the inclusion of information (companion text files) on the quality of the basic input data for assessing extremes (both gridded observations and reanalyses) that will be updated as we learn more through research and applications of the data sets. We feel that having multiple datasets for comparison greatly facilitates that effort. In that regard, the working group is also looking into collaborating with the European Climate Assessment & Dataset (http://eca.knmi.nl/) project to adapt their on-line station-based atlas (currently focused on the European region) to the Americas.

In the figures we show a few examples of the types of products currently available from the atlas (initially focused on precipitation). Figure 1 highlights the Standardized Precipitation Index (SPI) products, including time series, and maps for specific months and various time scales (3, 6, 12 and 24 months) that are available based on both the reanalyses and gridded observations. Figure 2 shows examples of the results of fitting daily precipitation maxima during September, October, November (SON) to the Generalized Extreme Value distribution, and displayed as maps of return values (2, 5, 10 and 20 year). In addition to the basic results, the atlas includes explanations of the various calculations performed for each map, to facilitate the interpretation of the results.

Work is on-going to assess the quality of these results and to develop a better understanding of the physical mechanisms (e.g. circulation changes linked to ENSO, etc.) that lead to the extremes. Current plans include expanding the atlas to include information on extremes

que el atlas constituya una importante herramienta para la validación de simulaciones de modelos. Actualmente está disponible una versión beta en

http://gmao.gsfc.nasa.gov/research/subseasonal/atlas/Extremes.html

El grupo de trabajo tiene particular interés en la respuesta de la comunidad respecto de la utilidad del atlas y con gusto recibe sugerencias para mejorarlo. Una parte importante del atlas es la información que se incluye (archivos de texto para acompañar) acerca de la calidad de los datos básicos de entrada para la evaluación de extremos (tanto observaciones en grilla como reanálisis), que se irá actualizando a medida que avance la investigación y la aplicación de los conjuntos de datos. Creemos que contar con varios conjuntos de datos para comparar facilita notablemente el esfuerzo. A ese respecto, el grupo de trabajo también busca cooperar con el proyecto European Climate Assessment & Dataset (http://eca.knmi.nl/) para adaptar su atlas on-line basado en estaciones para las Américas (actualmente se concentra en la región europea).

En las figuras se muestran algunos ejemplos de los tipos de productos que están disponibles en el atlas (inicialmente concentrados en la precipitación). La Figura 1 ilustra los productos del Índice de Estandarizado de Precipitación (SPI), incluyendo series temporales y mapas para meses determinados en diferentes escalas de tiempo (3, 6, 12 y 24 meses) que están disponibles tanto sobre la base de reanálisis como de grillas de observaciones. La Figura 2 presenta ejemplos de los resultados de ajustar los máximos de precipitación de septiembre, octubre y noviembre (SON) a la distribución de Valor Extremo Generalizado. Estos se muestran como mapas de valores

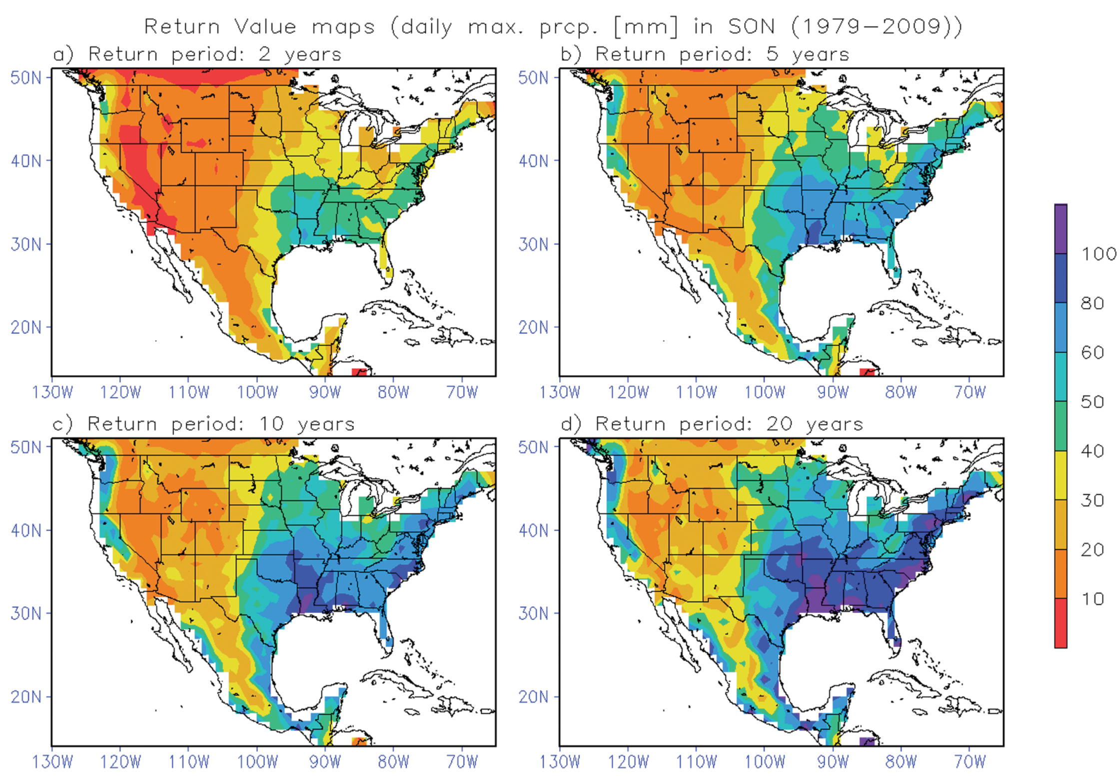

Figure 2: Return values (2, 5, 10, and 20 years) of maximum daily precipitation for SON based on NOAA/CPC gridded precipitation observations (left panels, Higgins et al. 2000) and NOAA/CDC observations (right panels, Liebmann and Allured, 2005) // Figura 2: Valores de retorno (2, 5, 10 y 20 años) de la precipitación diaria máxima para SON sobre la base de grillas de observaciones de la precipitación de NOAA/CPC (paneles de la izquierda, Higgins et al. 2000) y observaciones de NOAA/CDC (paneles de la derecha, Liebmann and Allured, 2005)

in temperature, other indices, and adding new datasets (e.g. from Canada) as they become available.

de retorno (2, 5, 10 y 20 años). Además de los resultados básicos, el atlas contiene la explicación de los diferentes cálculos realizados para cada mapa, para facilitar la interpretación de los resultados.

Se está trabajando para evaluar la calidad de estos resultados y desarrollar una mejor comprensión de los mecanismos físicos (por ejemplo, cambios en la circulación relacionados con el ENOS, etc.) que llevan a la ocurrencia de extremos. Los planes incluyen la expansión del atlas para incluir información sobre los extremos de temperatura, otros índices y agregar nuevos conjuntos de datos (por ejemplo de Canadá) a medida que estén disponibles.

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A view forward for North American Monsoon research

Una visión al futuro para la investigación del Monzón de América del Norte

Coordinated research activities under the North American Monsoon Experiment (NAME) formally sunset during 2010, marking the programmatic end to the ten-year research program. (See Figure 1 for a timeline of NAME research activities.) NAME was conceived and endorsed by CLIVAR and GEWEX to address fundamental shortcomings in the understanding of multi-scale processes controlling the behavior of the North American Monsoon (NAM) and its modes of variability that were thought to be limiting prediction skill of warm season precipitation. Its stated goal of "Determine(ing) the sources and limits of predictability of warm season precipitation over North America, with emphasis on time scales ranging from seasonal-

Las actividades de investigación coordinadas bajo el Experimento del Monzón de América del Norte (NAME) concluyeron formalmente en 2010, marcando el final programático de los diez años del programa investigación (en la Figura 1 se muestra el cronograma de las actividades de investigación de NAME.). NAME fue pensado y apoyado por CLIVAR y GEWEX para abordar deficiencias fundamentales en la comprensión de los procesos en múltiples escalas que controlan el comportamiento del Monzón de América del Norte (NAM, por sus siglas en inglés) y sus modos de variabilidad, que se creía limitaban la habilidad de predicción de la precipitación de la estación cálida. Su objetivo planteado de "Determinar las fuentes y límites de la predictibilidad de la precipitación de la estación cá-

to-interannual" implied an ambitious under-taking given the large range in spatial and temporal scales of interest, the complexity of the processes being studied and the limited availability of reliable long-term datasets of key hydroclimatic processes within the study domain of southwestern North America. More specifically, the tiered programmatic structure designed and implemented in NAME served to address key objectives of improving predictions of:

1. The diurnal cycle of warm season convection in complex terrain (within locus of maximum North American continental diabatic heating region)
2. Intra-seasonal variability of the NAM (and its associated linkages to synoptic & mesoscale transients)
3. Seasonal and interannual cycles of NAM moisture convergence and rainfall patterns (e.g. monsoon onset, mature, decay phases)

Research activities under NAME peaked during 2004 and the following years as diagnostic and modeling studies were conducted using a large variety of field data collected during the 2004 Enhanced Observing Period (EOP – see Higgins et al., 2006 for a summary of the 2004 NAME-EOP). This work has now borne fruit with over 80 peer-reviewed papers, 3 full journal special issues, several review articles and a host of field campaign and synthesis datasets being generated since 2004 alone. Topics of these works have ranged from mesoscale analysis, to numerical modeling, to remote sensing, to climatological analysis, to oceanographic studies, to ecohydrologic process investigations. As described in Higgins et al. (2006), the successful execution of NAME has relied upon a close linkage between process and modeling studies. Under NAME, numerous model analyses, re-analyses and model assessment activities were coordinated, each contributing to improved identification of the sources of error in model simulations and predictions.

While a thorough review of all the accomplishments of NAME is beyond the scope of this contribution, the sunsetting of NAME affords the opportunity to synthesize a few of the most important findings and accomplishments that were achieved as they relate to current challenges that have either persisted or that have emerged and continue to impede progress on improving the skill of warm season precipitation forecasts in the NAM region. In the following paragraphs a set of recommendations are offered with the intent of articulating challenges and identifying potential pathways for improving predictions. The recommendations are broken into 4 general topical areas: 1) controls on inter-annual variability (IAV); including ocean-atmosphere and land-atmosphere coupling; 2) modes of intra-seasonal variability (ISV) and their relation to seasonal anomaly structures; 3) model predictions; and 4) observational infrastructure. Obviously a much more extensive list of topics is warranted but such discussions will need to be conducted in additional venues.

Controls on Interannual Variability

As a weakly forced, open system that is intimately linked to tropical processes, improved understanding and depiction of large-scale tropical modes and time-mean structures of eastern Pacific and Intra-America Seas (IAS) tropical overturning in models are needed to positively impact NAM precipitation simulations (e.g. Lin et al., 2008; Liang et al., 2008; Yang et al., 2009). This is also relevant with respect to seasonal predictions of the Madden-Julian Oscillation (MJO). The basic dynamical paradigms developed for the NAM circulation under NAME must now be expanded to account for time-varying influences of Pacific and Atlantic SST forcing (Wang et al., 2010) as well as potential cross-equatorial linkages with the South American Monsoon system (c.f. Mechoso et al., 2005; Wu and Zhang, 2010). Comparatively little progress has been made in these areas compared the progress in understanding regional scale NAM circulation patterns. Advancing understanding of the dynamics and evolution of the large-scale NAM circulation should, ideally, translate into improved seasonal forecasts of the NAM for which prediction

lida en América del Norte, con énfasis en escalas temporales que van desde la estacional a la interanual" implicó un emprendimiento ambicioso en vista del amplio rango de las escalas espaciales y temporales de interés, la complejidad de los procesos en estudio y la limitada disponibilidad de conjuntos de datos confiables y de largo plazo de los procesos hidroclimáticos clave en el dominio de estudio del sudoeste de América del Norte. Más específicamente, la estructura programática escalonada diseñada e implementada en NAME sirvió para abordar objetivos clave para mejorar las predicciones de

1. *el ciclo diurno de la convección de la estación cálida en terreno complejo (en la región continental de máximo calentamiento diabático de América del Norte)*
2. *la variabilidad intraestacional del NAM (y sus vínculos asociados a las perturbaciones transitorias sinópticas y de mesoescala)*
3. *los ciclos estacionales e interanuales de los patrones de convergencia de humedad y precipitación del NAM (por ejemplo, las etapas de inicio, madurez y finalización del monzón)*

Las actividades de investigación de NAME tuvieron su pico en 2004 y los años siguientes, cuando se realizaron los estudios de diagnóstico y modelado, utilizando una gran variedad de datos de campo recolectados durante el Período de Observaciones Intensivas de 2004 (EOP, por sus siglas en inglés – ver en Higgins et al., 2006 una síntesis del NAME-EOP 2004). Este trabajo ahora ha dado sus frutos con más de 80 trabajos revisados por pares, 3 ediciones especiales de revistas completas, varios artículos de revisión y la generación de una gran cantidad de conjuntos de datos de campo y de síntesis sólo desde 2004. Los temas de estos trabajos van desde el análisis de mesoscala, pasando por el modelado numérico, la percepción remota, el análisis climatológico, estudios oceanográficos hasta la investigación de procesos ecohidrológicos. Según se describe en Higgins et al. (2006), la exitosa ejecución del NAME se ha apoyado en una relación estrecha entre estudios de proceso y de modelado. En el marco de NAME, se coordinaron numerosas actividades de análisis de modelos, re-análisis y de evaluación de modelos, cada una de ellas contribuyendo a una mejor identificación de las fuentes de error en las simulaciones y predicciones de los modelos.

Si bien una revisión exhaustiva de todos los logros del NAME está fuera del alcance de este artículo, la finalización del experimento ofrece una oportunidad para sintetizar algunas de las conclusiones y logros más importantes que se relacionan con los desafíos que actualmente persisten o han surgido y continúan impidiendo avances en la mejora de la habilidad de los pronósticos de la precipitación de la época cálida en la región del NAM. En los párrafos siguientes se presenta una serie de recomendaciones que tienen por objeto articular desafíos e identificar caminos potenciales para mejorar las predicciones. Las recomendaciones se dividen en 4 áreas generales para las regiones tropicales: 1) controles en la variabilidad interanual (IAV, por sus siglas en inglés); incluyendo el acoplamiento océano-atmósfera y tierra-atmósfera; 2) modos de variabilidad intraestacional (ISV, por sus siglas en inglés) y su relación con las estructuras de las anomalías estacionales; 3) predicciones de modelos; e 4) infraestructura observacional. Obviamente, la lista de temas es mucho más larga, pero esos debates deberán llevarse a cabo en otra oportunidad.

Controles en la variabilidad interanual

Por tratarse de un sistema débilmente forzado, abierto e íntimamente ligado a procesos tropicales, se necesita una mejor comprensión y descripción de los modos tropicales de gran escala y de las estructuras medias temporales de retorno en el Pacífico Oriental y los Mares Intraamericanos (IAS, por sus siglas en inglés). Así se logran impactos positivos en las simulaciones de la precipitación del NAM (por ejemplo, Lin et al., 2008; Liang et al., 2008; Yang et al., 2009). Esto también es importante respecto de las prediccio-

skill has remained elusive. Improvements in the understanding, simulation and prediction of tropical behavior will also help increase the credibility of future climate scenarios of NAM precipitation.

Modes of Intra-seasonal Variability

While the characterization, detection and forecasting of many transient features of the NAM (e.g. tropical easterly waves, gulf surges, the MJO and inverted troughs) is improving, there exists a critical deficiency in understanding the mechanisms behind upscale convective organization, diabatic heating and mesoscale responses emanating from these disturbances. Also, the influence of orography on convective initiation and organization in 'weakly forced' environments is still not properly captured in most global forecast models and in many regional prediction systems (c.f. Gutzler et al., 2009). The need to resolve large topographic structures in order to resolve basic features of the NAM precipitation climatology is now well recognized. However, simple increases in model resolution often do not translate into improved forecasts of organized convective events which produce very large amounts of rainfall. Progress in this area will require improvements in basic understanding of boundary layer evolution and storm circulation processes over complex terrain. It will also require improved understanding and modeling of how the regional circulation and propagating transients alter stability and moisture convergence, in how such transients interact with topography and in how terrestrial hydrologic systems respond to extreme events. The role of land-surface memory processes, such as vegetation phenology and positive/negative feedbacks due to positive/negative soil moisture anomalies is still not well quantified.

Land-falling tropical cyclones are arguably the most devastating and costly high-impact weather events influencing the NAM region, potentially impacting nearly all reaches of the NAM domain. While significant progress has been made in forecasting the track of tropical cyclones, particularly in the Atlantic basin, significant difficulties persist in developing accurate predictions of hurricane strength (wind, rainfall and storm surge) and their associated hydrological impacts, particularly in complex terrain landscapes. Furthermore, track prediction in the Eastern Pacific, particularly for those systems that recurve onto the N. American continent, lag behind those predictions in the Atlantic basin.

Seasonal dynamical predictions

Insufficient effort to date has been directed towards coordination and evaluation of NAM forecasts at both seasonal and sub-seasonal timescales. The product of this shortcoming is that the current sources of error limiting monsoon prediction skill are poorly understood. NAME provided a sizeable foundation of research which has improved our climatological understanding of the monsoon as well as identified and quantified a few key metrics for control of monsoon behavior. For example, work conducted under the NAME Forecast Forum has shown that while the current generation of coupled prediction models can reasonably predict early-season rainfall anomalies, they have difficulty in maintaining useful forecast skill throughout the monsoon season. The reasons behind the fall-off in coupled model skill likely are related to problems with large-scale air-sea and land-air coupling but exactly how and to what degree remains unsolved. While tracking of model performance is being addressed, in part through the NFF and forecast evaluation and consolidation products hosted by IRI, increased effort is required to understand the reasons behind this persistent low skill in coupled dynamical models.

Observational Infrastructure

NAME research (e.g. Mo et al., 2007; Nesbitt et al., 2008; and Johnson et al., 2010) has highlighted key deficiencies in atmospheric and hydroclimatic analyses over the NAM region which can directly impact forecast skill. Further progress in NAM research

nes estacionales de la Oscilación de Madden-Julian (MJO). Los paradigmas dinámicos básicos que, en el marco de NAME, fueron desarrollados para la circulación del NAM deben ahora expandirse para tomar en cuenta las influencias variables en el tiempo de los forzamientos de la SST del Pacífico y el Atlántico (Wang et al., 2010) así como las potenciales conexiones transecuatoriales con el sistema del Monzón de América del Sur (ver Mechoso et al., 2005; Wu y Zhang, 2010). Comparativamente, se han hecho pocos avances en estas áreas respecto del avance logrado en la comprensión de los patrones de circulación en niveles bajos del NAM en escala regional. Idealmente, un avance en la comprensión de la dinámica y evolución de la circulación de gran escala del NAM debiera traducirse en mejores pronósticos estacionales del NAM para los que la habilidad de predicción sigue siendo esquiva. Mejoras en la comprensión, simulación y predicción del comportamiento tropical ayudarán también a aumentar la credibilidad de los escenarios climáticos futuros de la precipitación del NAM.

Modos de variabilidad intraestacional

Mientras mejora la caracterización, detección y pronóstico de muchas perturbaciones transitorias del NAM (por ejemplo, ondas tropicales del este, las surgencias del Golfo de California, la MJO y las vaguadas invertidas), existe una deficiencia crítica en la comprensión de los mecanismos detrás de la organización de la convección profunda, el calentamiento diabático y las respuestas de mesoescala que emanan de dichas perturbaciones. Además, la mayoría de los modelos globales de pronóstico y muchos sistemas de predicción regional no capturan la influencia de la orografía en la iniciación y organización de la convección en ambientes 'débilmente forzados' (ver Gutzler et al., 2009). La necesidad de resolver grandes estructuras topográficas con el fin de resolver las características básicas de la climatología de la precipitación del NAM está ahora bien reconocida. Sin embargo, un simple aumento en la resolución de los modelos a menudo no se refleja en mejores pronósticos de eventos de convección organizada que producen precipitaciones muy abundantes. El avance en esta área requerirá mejoras en la comprensión de la evolución de la capa límite y los procesos de circulación de las tormentas en terrenos complejos. También requerirá una mejor comprensión y modelado del modo en que la circulación regional y la propagación de perturbaciones transitorias alteran la estabilidad y la convergencia de humedad, cómo interactúan estas con la topografía y cómo responden los sistemas hidrológicos terrestres a los eventos extremos. Aún no se ha cuantificado adecuadamente el papel de los procesos de memoria de la superficie del suelo, como la fenología de la vegetación y las retroacciones positivas/negativas debidas a anomalías positivas/negativas de la humedad del suelo.

Podría decirse que los ciclones tropicales que entran a tierra son los eventos más devastadores y de gran impacto económico del tiempo que afectan la región del NAM, y pueden impactar potencialmente casi todas las regiones del dominio del NAM. Si bien se ha hecho un avance significativo en el pronóstico de la trayectoria de los ciclones tropicales, particularmente en la cuenca del Atlántico, continúa habiendo importantes dificultades en el desarrollo de predicciones precisas de la intensidad de los huracanes (viento, precipitación y onda de tormenta) y sus impactos hidrológicos asociados, especialmente en paisajes de terrenos complejos. Además, la predicción de las trayectorias en el Pacífico Oriental, especialmente para los sistemas que se recurvan en el continente norteamericano, queda detrás de las predicciones para la cuenca del Atlántico.

Predicciones dinámicas estacionales

Hasta ahora ha sido insuficiente el esfuerzo dirigido a la coordinación y evaluación de los pronósticos del NAM en escalas estacionales y subestacionales. El producto de esta deficiencia es la escasa comprensión de las fuentes actuales de error en la habilidad de predicción de los monzones. NAME brindó una base de investigación and predictions requires the development and maintenance of a robust, operational regional climate observing network over the entire NAM region, including the waters of the eastern tropical Pacific and the Intra-America Seas region to the east. If implemented, an enhancement of the regional climate observing system should provide critical data for diagnostic analysis as well as data assimilation for forecast model initialization. The network should emphasize characterization of the main regional and large-scale thermodynamic and moisture flow patterns including new measurements of upper-ocean temperatures, soil moisture, and lower tropospheric winds and moisture. To this end, a new coordinated network of ground-based Global Positioning System (GPS-see Kursinski et al., 2007 for a description of such a network) stations for water vapor retrieval across Mexico and the Caribbean has been proposed. If implemented, the proposed GPS network should offer significant improvements in atmospheric vapor pattern characterization. More generally however, an enhanced

considerable, que ha mejorado nuestra comprensión climatológica del monzón e identificó y cuantificó algunas métricas clave para el control de su comportamiento. Por ejemplo, el trabajo realizado en el marco del Foro de Pronóstico del NAME ha mostrado que mientras la generación actual de modelos acoplados de predicción puede predecir de manera razonable las anomalías en la precipitación al inicio de la estación, éstos tienen dificultad en mantener una habilidad de pronóstico útil a lo largo de la temporada monzónica. Las razones que subyacen a la disminución en la habilidad de los modelos acoplados están probablemente relacionada con problemas de acoplamiento aire-mar y tierra-aire de gran escala, aunque sigue sin saberse exactamente cómo y en qué medida. Si bien se está haciendo el seguimiento del desempeño de los modelos, en parte a través de NFF y los productos de evaluación y consolidación de pronósticos ofrecidos por el IRI, son necesarios mayores esfuerzos para comprender las razones de esta persistencia en la baja habilidad de los modelos dinámicos acoplados.

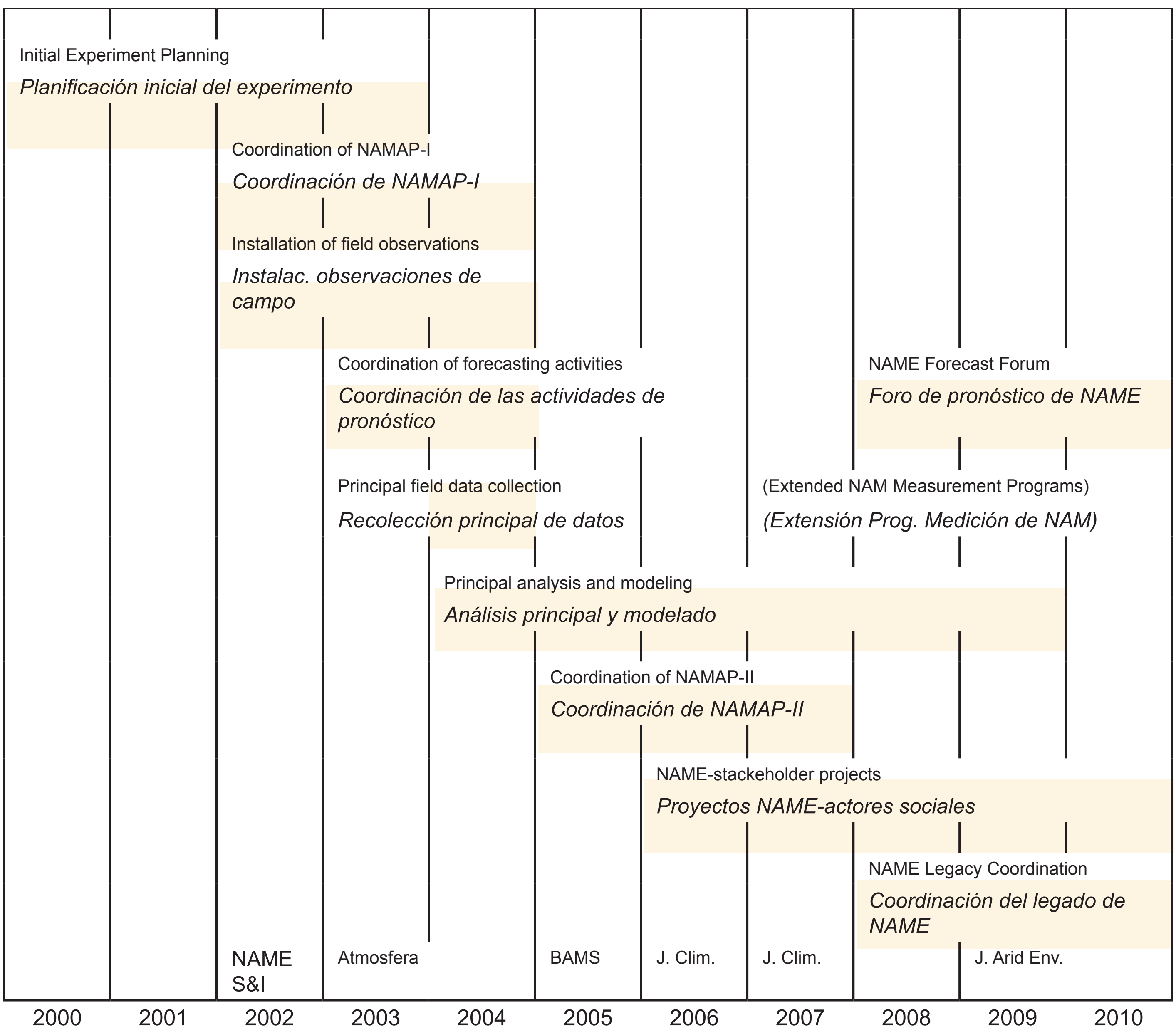

Figure 1: NAME Program Timeline // Figura 1: Cronograma del Programa NAME

and sustained network of observations would be invaluable in documenting and understanding long-term changes in the climate of southwestern North America, which have been predicted to be severe (e.g. Seager et al., 2007) but as of yet are proving to be somewhat more subtle (e.g. Kunkel et al., 2003; Cavazos et al., 2008; Anderson et al., 2010).

Infraestructura para observaciones

La investigación del NAME (por ejemplo, Mo et al., 2007; Nesbitt et al., 2008; y Johnson et al., 2010) ha puesto de manifiesto deficiencias clave en los análisis atmosféricos e hidroclimáticos en la región del NAM que pueden tener impacto directo en la habilidad de pronóstico. Para avanzar en la investigación y predicción del NAM será necesario desarrollar y mantener una red regional operativa de observación del clima en toda la región del NAM, incluyendo las aguas del Pacífico Oriental tropical y la región oriental de los Mares Intraamericanos. De implementarse, un fortalecimiento del sistema regional de observación del clima debiera brindar datos cruciales para el análisis de diagnóstico y la asimilación de datos para la inicialización de modelos de pronóstico. La red debiera poner de relieve la caracterización de los principales patrones termodinámicos y de flujo de humedad regionales y de gran escala, incluyendo las nuevas mediciones de las temperaturas de las capas superiores del océano, la humedad del suelo y los vientos y la humedad en la baja tropósfera. A este fin, se ha propuesto una nueva red coordinada de Sistema de Posicionamiento Satelital basada en estaciones en tierra (GPS, la descripción de la red puede hallarse en Kursinski et al., 2007) para observaciones de vapor de agua en México y el Caribe. De implementarse, la red GPS propuesta debería brindar importantes avances en la caracterización de los patrones de vapor atmosférico. De un modo más general, sin embargo, una red de observaciones mejorada y sostenida sería invaluable para documentar y entender los cambios de largo plazo en el clima del sudoeste de América del Norte, que serán severos según se predice (por ejemplo, Seager et al., 2007), pero que por el momento están siendo algo más sutiles (por ejemplo, Kunkel et al., 2003; Cavazos et al., 2008; Anderson et al., 2010).

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Use of Ecosystem Functional Types to represent the interannual variability of vegetation biophysical properties in regional models

Climate is the main regional driver of ecosystem structure and functioning by determining the timing and amount of energy (both heat and solar radiation) and water that is available in the system (Stephenson, 1990). Conversely, ecosystems also influence climate through multiple pathways, primarily by determining the energy, momentum, water, and chemical balance (e.g. albedo, longwave radiation, surface roughness, evapotranspiration, greenhouse gases, or aerosols) between the land-surface and the atmosphere (Chapin Iii et al., 2008). Hence, extensive impacts on ecosystems, both from natural and human origin, may alter one or several pathways of the ecosystem–climate feedbacks that may end up affecting the regional and global climate.

Vast areas of South America are suffering from human-induced changes in land cover and management practices of crop-systems that may affect ecosystem-climate feedbacks, with deforestation and land-clearing for agriculture and cattle ranging being the most important ones (Foley et al., 2007; Volante et al., in revision). According to Bonan (2008), land-clearing produces an increase in albedo, a reduction of transpiration, and a net release of CO_2 that increases the heat-trapping capacity of the atmosphere. On the other hand, other extensive land-use changes in South America, such as grassland afforestation (Beltrán-Przekurat et al., 2010), produce a decrease in albedo, a rise of evapotranspiration, and greater surface roughness. Yet, other effects on ecosystem-climate feedbacks would be the extensive practice of no-tillage agriculture and the also extensive expansion of irrigated agriculture over drylands (De Oliveira et al., 2009), which increases evapotranspiration and decreases albedo.

These kinds of ecosystem-climate feedbacks are a central problem for modeling the land-atmosphere interactions of the climate system (Mahmood et al., 2010), but their incorporation in current regional and global circulation models is not straightforward. Many models use land-cover maps of different plant functional types (i.e. groups of plants that share functional traits) to estimate maps of biophysical properties (West et al., in press). Such estimates rely on the relationship between particular plant functional traits and different ecosystem functioning properties (Smith et al., 1997). However, several works have shown that plant functional types classifications are not reliable to predict ecosystem functioning (Wright et al., 2006; Bret-Harte et al., 2008). In addition, these land-cover maps are difficult to update in a yearly basis and are mainly dictated by structural features of vegetation (such as leave life-span) that have little sensitivity to environmental changes. Overall, this representation of vegetation may result in a delayed response and reduces the ability of models to represent rapid changes including land-use shifts, fires, floods, droughts, and insect outbreaks. Hence, to account for land-use/cover change effects on climate models it is necessary to improve the way the spatial and interannual variability of vegetation dynamics are considered in the coupling of the atmosphere and the land-surface.

Functional attributes of vegetation, which are descriptors of the energy and matter exchange between the biota and the atmosphere at the ecosystem scale (Valentini et al., 1999; Virginia et al., 2001) may help to fulfill these needs since they show a quicker response to environmental changes than structural ones (Mcnaughton et al., 1989). Additionally, they are relatively easy to monitor using the satellite-derived Normalized Difference Spectral Index (NDVI) to get

Uso de los Tipos Funcionales de Ecosistemas para representar la variabilidad interanual de las propiedades biofísicas de la vegetación en modelos regionales

El clima es el principal motor regional de la estructura y funcionamiento de los ecosistemas, al determinar el momento y la cantidad de energía (calor y radiación solar) y agua disponibles (Stephenson, 1990). Por el contrario, los ecosistemas también afectan el clima mediante varios caminos, principalmente determinando la energía, cantidad de movimiento, agua y balance químico (por ejemplo, el albedo, la radiación de onda larga, la rugosidad de la superficie, la evapotranspiración, los gases de invernadero y los aerosoles) entre la superficie de la tierra y la atmósfera (Chapin Iii et al., 2008). Por consiguiente, los amplios impactos sobre los ecosistemas, tanto de origen natural como humano, pueden alterar uno o varios de los caminos de las retroacciones ecosistema-clima que pueden terminar afectando el clima regional y global.

Vastas áreas de América del Sur están sufriendo cambios inducidos por el hombre en la cobertura de la tierra y las prácticas de manejo de los sistemas de cultivos que pueden afectar las retroacciones ecosistema-clima. Los más importantes de ellos son la deforestación y el desmonte para agricultura y ganadería (Foley et al., 2007; Volante et al., en revisión). Según Bonan (2008), el desmonte produce un aumento en el albedo, una reducción en la transpiración y una liberación neta de CO_2 que incrementa la capacidad de la atmósfera de retener calor. Por otro lado, otros cambios extensos en el uso de la tierra en América del Sur, como la aforestación de pastizales (Beltrán-Przekurat et al., 2010), dan lugar a una disminución del albedo, un aumento en la evapotranspiración y una mayor rugosidad de la superficie. Otros efectos sobre las retroacciones ecosistema-clima son el amplio uso de la siembra directa y la expansión también generalizada de la agricultura de riego en zonas áridas (De Oliveira et al., 2009), que aumenta la evapotranspiración y disminuye el albedo.

Este tipo de retroacciones ecosistema-clima constituyen un problema central para el modelado de las interacciones tierra-atmósfera del sistema climático (Mahmood et al., 2010), pero su incorporación en los modelos global y regionales actuales de circulación no es sencilla. Muchos modelos usan mapas de la cobertura del suelo de diferentes tipos funcionales de plantas (es decir, grupos de plantas que comparten rasgos funcionales) para estimar los mapas de las propiedades biofísicas (West et al.,en prensa). Dichas estimaciones se apoyan en la relación entre los rasgos funcionales de plantas particulares y diferentes propiedades del funcionamiento de los ecosistemas (Smith et al., 1997). Sin embargo, varios trabajos han mostrado que las clasificaciones de tipos funcionales de plantas no son confiables para predecir el funcionamiento de los ecosistemas (Wright et al., 2006; Bret-Harte et al., 2008). Además, estos mapas de la cobertura del suelo son difíciles de actualizar anualmente y están principalmente condicionados por las características estructurales de la vegetación (como el tiempo de vida de las hojas) cuya sensibilidad a los cambios ambientales es baja. En términos generales, esta representación de la vegetación puede resultar en un retraso en la respuesta y reduce la habilidad de los modelos de representar cambios rápidos incluyendo los cambios en el uso del suelo, los incendios, las inundaciones, las sequías y los brotes de insectos. Por consiguiente, para explicar los efectos del cambio en el uso/cobertura del suelo en los modelos climáticos es necesario mejorar el modo en que se considera la variabilidad espacial e interanual de la dinámica de la vegetación en el acoplamiento de la atmósfera y la superficie del suelo.

surrogates for productivity, seasonality, and phenology of carbon gains. These functional attributes of vegetation can be used to map Ecosystem functional types (EFTs), defined as patches of the land surface that exchange mass and energy with the atmosphere in a common way, and that show a coordinated and specific response to environmental factors (Valentini et al., 1999; Soriano & Paruelo, 1992; Paruelo et al., 2001; Alcaraz-Segura et al., 2006). EFTs can be considered a top-down approach to capture the spatial and temporal heterogeneity of ecosystem functioning at a higher level of the biological hierarchy than the more traditional bottom-up approach that classifies land-cover types based on plant functional types to derive ecosystem properties (Alcaraz-Segura et al., in preparation).

Since EFTs can be defined in a year-to-year basis, they can give a much better representation of time-varying land surface properties that reflect the actual characteristics of vegetation functioning and not just time-fixed vegetation types. In this sense, the use of time-varying EFTs captures the effect of human-driven changes in land use and management. In addition, the NDVI dynamics of a particular year does not only reflect the vegetation response to the environmental conditions of that particular year, but it also exhibits the memory of the system to the climatic conditions and disturbance effects from previous years (Wiegand et al., 2004).

In this note, we use Ecosystem Functional Types to describe the interannual variability of selected biophysical properties in southern South America and propose a method to replace the traditional land-cover types in regional climate models by time-varying EFTs. We first produced annual EFTs maps from 1982 to 1999 using three metrics of the NDVI dynamics from the AVHRR-LTDR datarecord (this methodology is discussed in Alcaraz-Segura et al. 2006, 2010, in preparation). Then, we estimated the biophysical properties of each EFT based on the Noah land-surface model parameterization for the USGS land-cover classes. Finally, we formally evaluated the

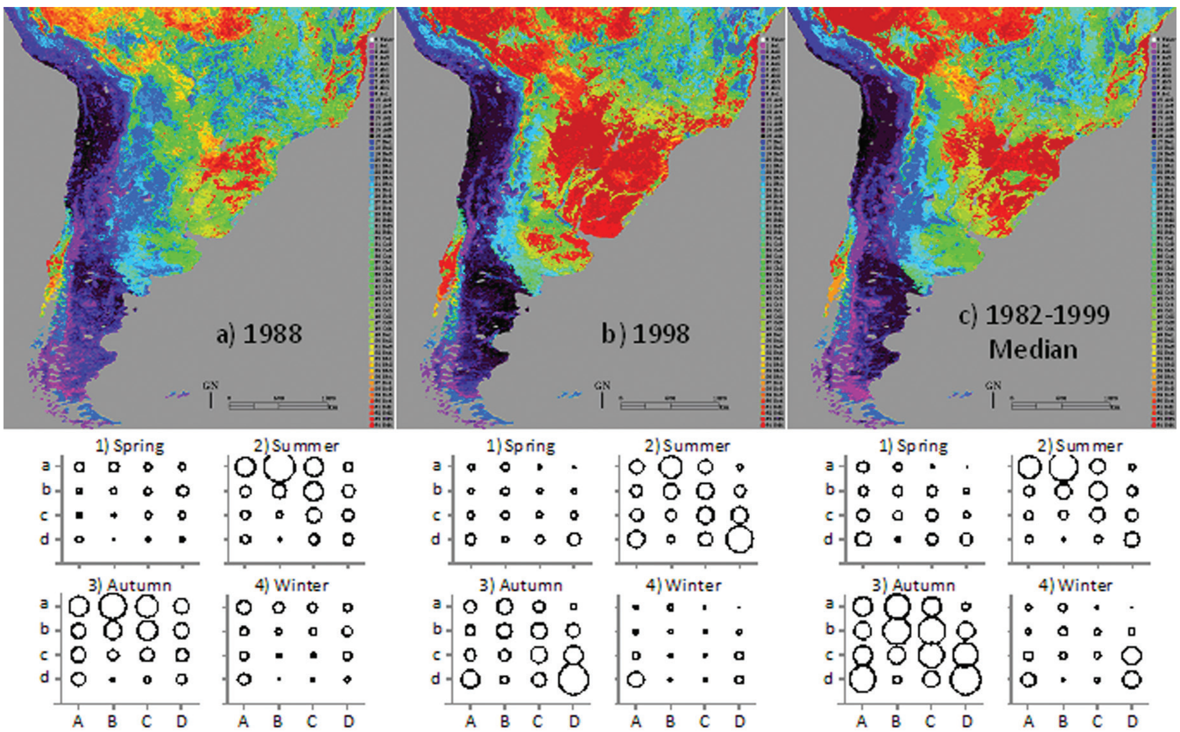

Figure 1: Ecosystem Functional Types distribution in South America based on the NDVI dynamics for the 1988 and b) 1998 years and for the c) median distribution of the 1982-1999 period. // Figura 1. Distribución de los Tipos Funcionales de Ecosistemas en América del Sur basada en la dinámica del NDVI para a) los años 1988 y b) 1998 y para c) la distribución de medianas del período 1982-1999.

Los atributos funcionales de la vegetación, que son descriptores del intercambio de energía y masa entre la biota y la atmósfera en escala de ecosistemas (Valentini et al., 1999; Virginia et al., 2001) pueden contribuir a satisfacer esas necesidades dado que muestran una respuesta más rápida a los cambios ambientales que a los estructurales (Mcnaughton et al., 1989). Además, son relativamente fáciles de monitorizar utilizando el Índice Espectral de Vegetación de Diferencias Normalizadas obtenido de satélites (NDVI, por sus siglas en inglés) para obtener sustitutos de la productividad, la estacionalidad y la fenología de la ganancia de carbono. Estos atributos funcionales de la vegetación pueden utilizarse para realizar mapas de los Tipos funcionales de ecosistemas (TFEs), definidos como parches de la superficie del suelo que intercambian masa y energía con la atmósfera de un modo común, y que muestran una respuesta coordinada y específica a los factores ambientales (Valentini et al., 1999; Soriano & Paruelo, 1992; Paruelo et al., 2001; Alcaraz-Segura et al., 2006). Puede considerarse que los TFEs constituyen un enfoque top-down para capturar la heterogeneidad espacial y temporal del funcionamiento de los ecosistemas en un nivel más alto de la jerarquía biológica que el más tradicional enfoque bottom-up que clasifica los tipos de cobertura del suelo sobre la base de los tipos funcionales de plantas para obtener las propiedades de los ecosistemas (Alcaraz-Segura et al., en preparación).

Al poder definir los TFEs sobre una base anual, se tiene una representación mucho mejor de las propiedades de la superficie del suelo variables en el tiempo que reflejan las características reales del funcionamiento de la vegetación en lugar de simples tipos de vegetación invariantes con el tiempo. En este sentido, el uso de TFEs variables en el tiempo captura el efecto de los cambios inducidos por el hombre en el uso y manejo del suelo. Además, la dinámica del NDVI de un año en particular no sólo refleja la respuesta de la vegetación a las condiciones ambientales de ese año, sino que también muestra la memoria del sistema a las condiciones climáticas y effect of our approach on the spatial and interannual variability of land-surface properties over southern South America and tested the sensitivity of the simulations to the surface properties.

The Ecosystem Functional Types (median for 1982-1999) presented in Fig. 1c show an average characterization of ecosystem functioning. On average, ecosystems of temperate South America show maxima in autumn and summer. EFTs with summer maxima tend to show medium-to-low productivity and high seasonality, while EFTs with autumn and spring maxima represent most of the possible combinations of productivity and seasonality. EFTs with NDVI maxima during winter tend to exhibit either very low or very high productivity under very low seasonality values. Strong differences in the EFTs distribution are observed between 1988 and 1999 due to climate factors (e.g., Figs. 1a,b). In 1998 EFTs with high productivity and low seasonality dominated temperate South America, and particularly La Plata basin. On the other hand, in 1988 the dominant EFTs showed high seasonality and medium to low productivity.

The interannual variability of vegetation properties is presented in Fig. 2. Great interannual variability was found for Surface Roughness, Stomatal Resistance, and Minimum Leaf Area Index (Figs. 2a-d). Low interannual variability was observed for Emissivity and Radiation Stress (Figs. 2e-g). Rooting Depth, Background Albedo, Green Vegetation Fraction, and Maximum Leaf Area Index showed intermediate variability. On average, the interannual coefficient of variation of the entire study area across all biophysical properties was relatively low (13%). However, some regions (e.g., semi-arid areas of the Patagonian steppe, the NW-SE transect from southeastern Bolivia to Uruguay, and the Brazilian Atlantic Plateau) repeatedly presented high interannual variability across all properties.

los efectos de las perturbaciones de los años anteriores (Wiegand et al., 2004).

En esta nota, utilizamos los Tipos Funcionales de Ecosistemas para describir la variabilidad interanual de propiedades biofísicas seleccionadas en el sur de América del Sur y proponemos un método para reemplazar los tipos tradicionales de cobertura de la tierra de los modelos climáticos regionales por TFEs variables en el tiempo. En primer lugar, generamos mapas anuales de TFEs desde 1982 hasta 1999 utilizando tres métricas de la dinámica del NDVI del registro de AVHRR-LTDR (se analiza esta metodología en Alcaraz-Segura et al. 2006, 2010, en preparación). Luego, estimamos las propiedades biofísicas de cada TFE sobre la base de la parametrización de Noah para modelos de la superficie de la tierra para las clases de cobertura de la tierra de USGS. Finalmente, evaluamos formalmente el efecto de nuestro enfoque en la variabilidad espacial e interanual de las propiedades de la superficie de la tierra en el sur de América del Sur y probamos la sensibilidad de las simulaciones a las propiedades de la superficie.

Los Tipos Funcionales de Ecosistemas (mediana para 1982-1999) de la Fig. 1c muestran una caracterización promedio del funcionamiento de los ecosistemas. En promedio, los ecosistemas de áreas templadas de América del Sur presentan máximos en otoño y verano. Con los máximos de verano, los TFEs tienden a presentar una productividad media a baja y una estacionalidad alta, mientras que los máximos de otoño y primavera de los representan la mayoría de las combinaciones posibles entre productividad y estacionalidad. Los TFEs con máximos invernales de NDVI tienden a mostrar una productividad muy baja o muy alta con valores muy bajos de estacionalidad. Entre 1988 y 1999 se observan grandes diferencias

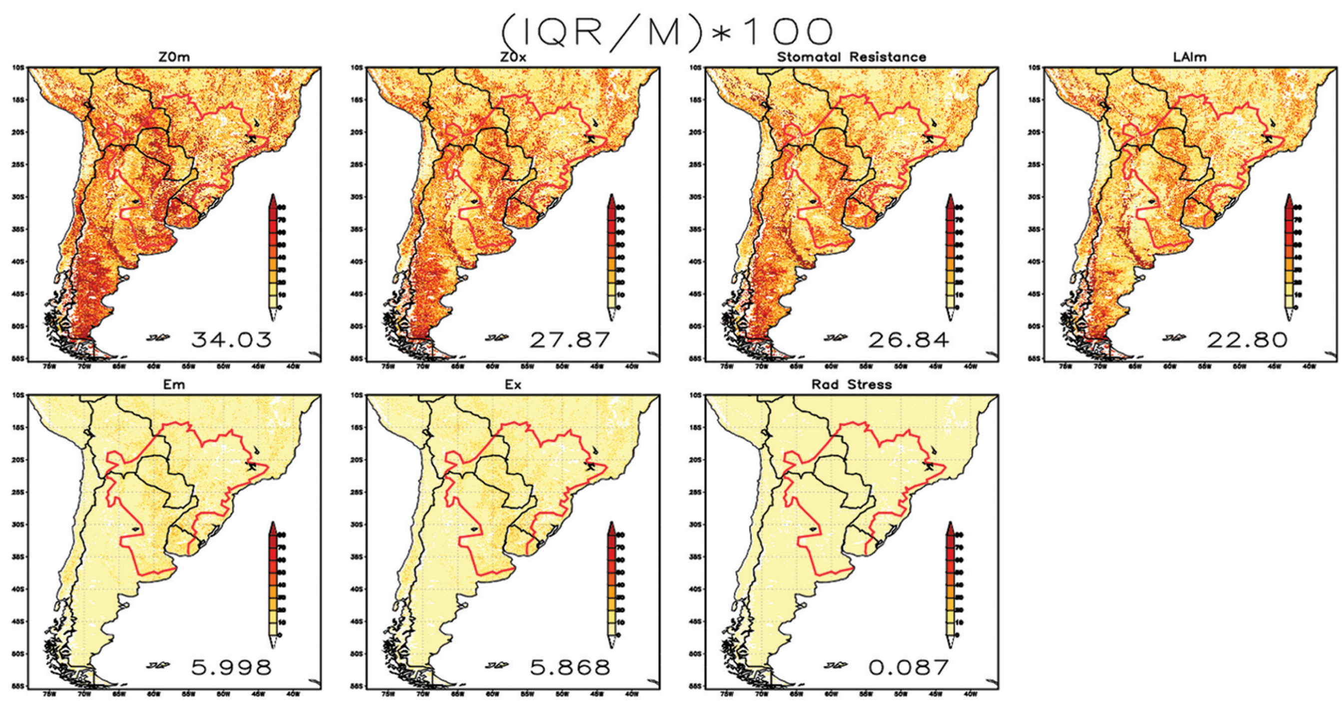

Figure 2: Interannual variability of different biophysical properties measured as the interquartile range over the median (in %). Top row, selected parameters with large variation. Bottom row, selected parameters with low variation // Figura 2: Variabilidad interanual de distintas propiedades biofísicas medidas como el rango intercuartil sobre la mediana (en %). Fila superior, parámetros seleccionados con variación alta. Fila inferior, parámetros seleccionados con variación baja

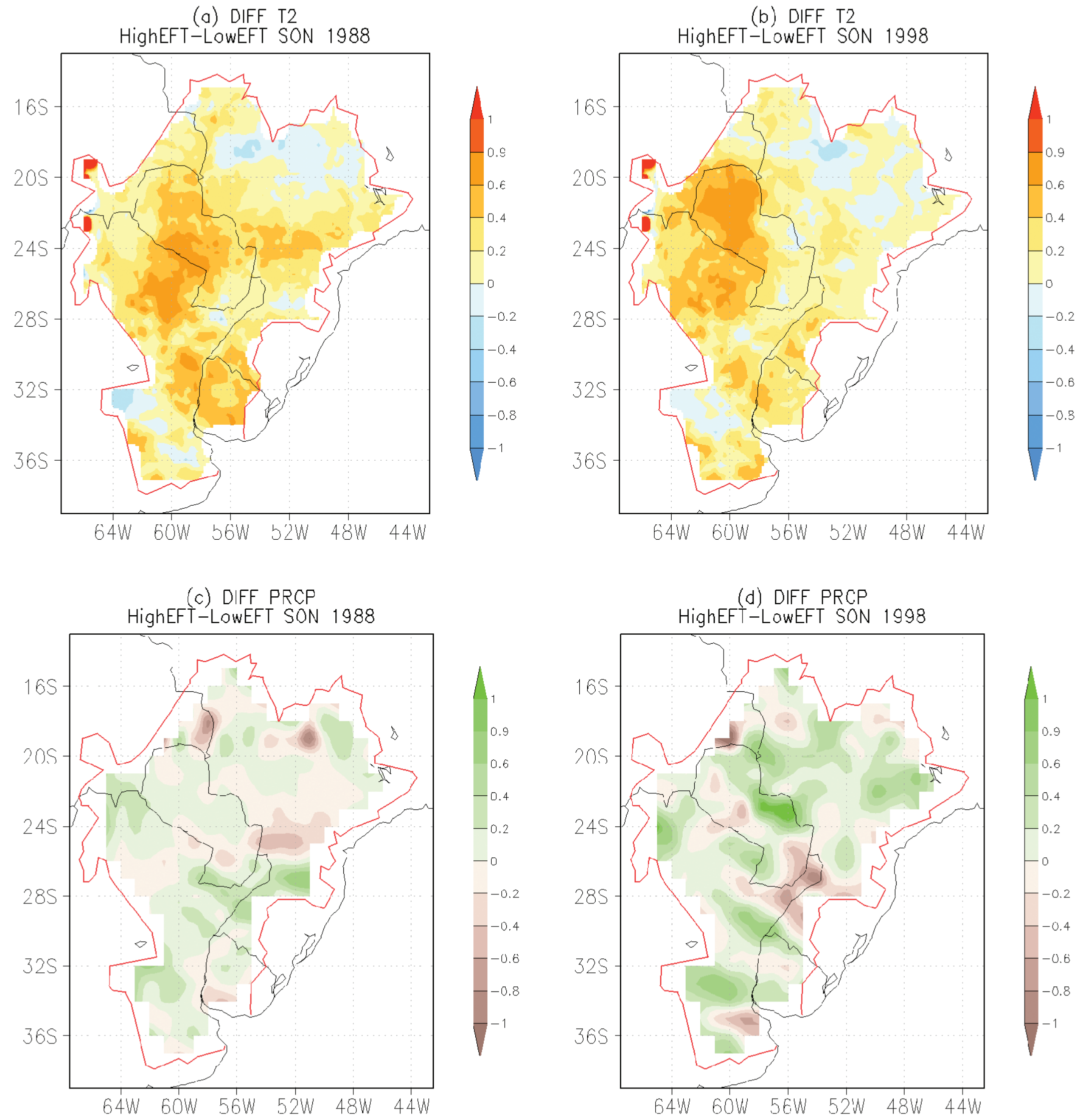

Figure 3: Sensitivity studies showing the impact in temperature (top row) and precipitation (bottom row) of using high or low productivity EFTs. 1988 was a dry year, while 1998 was a wet one// Figura 3: Estudios de sensibilidad que muestran el impacto en la temperatura (fila superior) y la precipitación (fila inferior) de utilizar TFEs de baja o alta productividad. 1988 fue un año seco, mientras que 1998 fue húmedo

The sensitivity of near surface temperature and precipitation to the interannual variability of EFTs was tested with the WRF regional model by performing seasonal simulations for a low productivity year (1988) and a high productivity year (1998). Simulations were done with the corresponding EFT types, and a second set of simulations was performed reversing their order (a low productivity year was simulated using the EFTs of the high productivity year and vice versa). Figures 3a,b show that when using EFTs with high productivity and a weak seasonal cycle the near surface temperature for the 1988 and 1998 springs tends to increase by as much as 1° C in the central and western portions of La Plata Basin. Figures 3c,d show that precipitation differences were in general positive, regardless of whether it was a dry or a wet year. However, the patterns are not uniform and exhibit certain patchiness with drier conditions. This note shows that using Ecosystem Functional Types instead of the Land Cover Types opens up the possibility of incorporating interannual changes of biophysical properties into land-surface and climate models.

en la distribución de los TFEs debidas a factores climáticos (por ejemplo, Figs. 1a,b). En 1998, los TFEs con productividad alta y baja estacionalidad dominaron la región templada de América del Sur, y particularmente la cuenca del Plata. Por otra parte, los TFEs dominantes en 1988 exhibían una alta estacionalidad y una productividad media a baja.

En la Figura 2 se muestra la variabilidad interanual de las propiedades de la vegetación. Se observó una gran variabilidad interanual en la Rugosidad de la Superficie, la Resistencia Estomática y el Índice de Área Foliar Mínima (Figs. 2a-d). Se observó una baja variabilidad interanual para el Estrés por Emisividad y Radiación (Figs. 2e-g). La Profundidad Radicular, Background Albedo, la Fracción de Vegetación Verde y el Índice de Área Foliar Máxima mostraron una variabilidad intermedia. En promedio, el coeficiente interanual de variación en toda el área de estudio y para todas las propiedades biofísicas fue relativamente bajo (13%). Sin embargo, algunas regiones (por ejemplo, las áreas semiáridas de la estepa patagónica, la transecta NO-SE desde el sudeste de Bolivia hasta Uruguay y la Meseta Brasileña del Atlántico) presentaron repetidamente una alta variabilidad interanual en todas las propiedades.

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Para probar la sensibilidad de la temperatura cerca de la superficie y la precipitación a la variabilidad interanual de los TFEs con el modelo regional WRF se realizaron simulaciones estacionales para un año de productividad baja (1988) y otro de alta (1998). Las simulaciones se hicieron con los TFEs correspondientes, y se realizó un segundo conjunto de simulaciones invirtiendo su orden (se simuló un año de baja productividad usando los TFEs del año de productividad alta y viceversa). Las Figuras 3a,b muestran que cuando se usa TFEs con alta productividad y un ciclo estacional débil, la temperatura cerca de la superficie para las primaveras de 1988 y 1998 tiende a aumentar hasta 1° C en las partes central y oeste de la cuenca del Plata. En las Figuras 3c,d se ve que las diferencias en precipitación fueron positivas en general, independientemente de si se trató de un año seco o húmedo. Sin embargo, los patrones no son uniformes y muestran cierta presencia de parches bajo condiciones más secas. Aquí se muestra que el uso de Tipos Funcionales de Ecosistemas en lugar de los Tipos de Cobertura del Suelo abre la posibilidad de incorporar cambios interanuales en las propiedades biofísicas en los modelos climáticos y de la superficie del suelo.

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Contents

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