World Meteorological Organization

International Research Center on El Niño

Regional Training Workshop on Statistical Analysis of Climate Extremes for South America

January 17th – 21th of 2010
Guayaquil - Ecuador

1. Opening Session

The Opening session of the Training Workshop on Statistical Analysis of Climate Extremes was held in CIIFEN facilities at 09h30 of Monday January 17th. 2011.

Mr. Hama Kontongomde, Scientific Officer of the Observing and Information Systems Department from World Meteorological Organization, expressed:

"It is a real pleasure for me to be here and on behalf of the Secretary General of WMO Mr. Michel Jarraud, I would like to express my appreciation to the Permanent Representative of Ecuador Mr. Carlos Naranjo, to Mr. Rodney Martinez, Acting Director of CIIFEN, for hosting this Training Workshop on Statistical Analysis of Climate Extremes, and for making all the necessary arrangements for what I am sure will be a successful workshop.

In recent years, several workshops on Statistical Analysis of Climate Extremes were held in many regions. We had a workshop on Climate indices in April 2007 in Brazzaville, Congo for countries in Central Africa conducted by Dr. Manola Brunet, Dr Eric Aguilar both from Spain and Dr. Zuebin Zang from Canada. A second workshop was held in Hanoi, Vietnam in December 2007 for countries in South-East Asia.

In South America, a workshop on enhancing climate change indices was organized in 2004 in Brazil. This workshop resulted in a publication entitled: "*Observed Trends in Indices of Daily Temperature Extremes in South America 1960–2000*" by Vincent et al. 2005. There was another publication by Haylock, M.R. et al, 2006 entitled: *"Trends in total and extreme South American rainfall 1960-2000 and links with sea surface temperature"* by Haylock et al. 2006. These two publications which show that :

- Significant increasing trends in the coldest night (coldest night getting warmer) are found at several stations located along the west coast of South America, and a few are also identified in southern Brazil

- There are, more tropical nights in southern Brazil, Paraguay, and Uruguay. The most profound changes are observed in the percentage of days with extreme cold and warm nights. Over 40% of the stations show significant decrease in the number of nights and an increase of the number the warm nights.

- Data quality and homogeneity assessments are crucial before trends in climate indices are computed. Erroneous outlier values and artificial steps due to changes in instrument exposure affect the trends in temperature extremes. In addition, it is essential to use a

consistent methodology to define and calculate the climate extremes for a better comparison across regions.

The Global Framework for Climate Services (GFCS) initiated during the World Climate Conference-3 (WCC-3) expressed the fact that understanding climate processes, analyzing climate change trends and making predictions requires information spanning countries, continents and the globe.

It is therefore necessary to update and provide the necessary training to ensure all NMHSs from the region can apply the methodology to obtain reliable and high quality Climate indices sets at national, regional and global level.

It is important on the basis of a rigorous and scientific sound analysis, to get the climate indices trends for the region, to update the previous ones and publish them in order they can be included in IPCC reports.

Ms Manola Brunet, Mr Enric Aguilar and Mr Javier Sigró, three of the best knowledgeable experts in this domain will conduct the training.

Before I conclude, I would like to express my gratitude to the local organizers, and particularly to Rodney Martinez and Ms Evelyn Ortiz Sanchez for the tremendous preparation and follow up work they have done. I wish you a successful workshop".

Mr. Rodney Martínez, Scientific Coordinator of the International Research Center on El Niño – CIIFEN, expressed:

"The Training Workshop on Statistical Analysis of Climate Extremes is an activity whose planning began more than a year. I must begin my intervention, expressing my appreciation to the World Meteorological Organization for their strong support to perform this activity and especially to Commission of Climatology and especially to Dr. Manola Brunet, who endorsed this initiative since the beginning as Co-Chair of CCl-OPACE II. We also thank to Dr. Enrique Aguilar and Dr. Javier Sigró, for sharing their experience and knowledge with us.

Last years, have been very significant for global climate community. In 2009, the Third World Climate Conference, launched the Global Framework for Climate Services, which nowadays is ready to begin its implementation phase and will become the new mechanism to promote climate-related activities by the upcoming decades. In Bogotá, Colombia, in September 2010, the Regional Association III, adopted historic decisions regarding to climate issues, agreeing for South America, the start of the pilot phase of three potential Regional Centers Brazil, Argentina and CIIFEN. In Santiago de Chile, in November 2010, the Ibero American Conference of NMHS Directors recognized the challenge for the region about the implementation of the Global Framework and the urgent need to strengthen the climate services of each Meteorological Service. Similarly, in both forums, actions were

agreed to enable NMHSs, to gain or consolidate a leading role in the actions carried out in each country related to climate change and National Adaptation Plans.

NMHSs of South America, have been developed with significant differences from country to country, the capabilities to work in the provision of climate services. Throughout the region, we can evidence deep asymmetries. Is its fundamental, to create regional synergy to stimulate South-South cooperation and enhance the operational capabilities for climate activities. NMHSs are those who maintain the basic observation network, are the ones who must respond for the quality and availability of data and yet in many cases, they are on the periphery of national efforts related to climate change and adaptation. Given the importance, for data knowledge and understanding local weather, it is essential that NMHSs, develop capabilities to migrate their traditional roles as data providers, to become generators of climate services with added value and economical, social and political relevance. As consequence, these increased capacities will lead to obtain more financial support for NMHSs from their Governments.

This reasoning, also applies in the global context. While, South America is more cohesive on issues related to climate change, greater the chances will be to negotiate as a block, common positions within the COPs and greater will be the chance to access to Adaptation Funds. To achieve this integration policy, taking to other levels, is essential to work first at technical level in the region. Let's remember, that South America has gained a historical integration through UNASUR that slowly, it is consolidating more integration agreements in different area, such as, risk management and security.

Dear colleagues from the region. This workshop it is not an isolated event, it is not one more training activity. This workshop is just the beginning of a process. Therefore, we ask all, a lot of enthusiasm and a deep commitment, because the expectations of the NMHSs Directors of South America and the World Meteorological Organization are considerable. You may count with the support of our distinguished instructors and CIIFEN Staff. We are very pleased to have you here with us".

Finally, **Mr. Carlos Naranjo**, Executive Director of INAMHI and WMO Permanent Representative of Ecuador, welcome to all participants and remarked the importance for NMHSs from South America Region work on the implementation of climate services. He recalled the discussions in the last RA III Association Assembly held in Bogota, Colombia in September 2010, where the data issues were clearly identified as a priority need. That included strengthen NMHSs capabilities on quality control, quality assurance, data traceability among others. He wished the best success to participants and inaugurated the workshop.

The Agenda of the workshop is in the **Annex "A"**. The workshop was attended by 15 participants from Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Suriname, Uruguay, Venezuela and CIIFEN. The list of participants is in the **Annex "B".**

2. Introduction to the Training workshop

Most of the countries in RA-III are implementing National Adaptation Strategies and Plans. However, in some cases the climate information used for climate projections at national level comes from Global Models. This information in several cases -has not been complemented with observed data and adequate climatological analysis. In previous climate indices estimation in South America (Vincent et al. 2005, Haylock et al. 2006), a considerable amount of information was not included. It is necessary to update and provide the necessary training to ensure all NMHSs from the region can apply the methodology to obtain reliable and high quality Climate indices sets at national level to be used in addition to modeling projections and reduce uncertainties about future climate trends. Other important aspect in the region is to give a step forward on extreme events prediction. During the last 10 years, the increase of disasters related to extreme events is clearly evident (EM-DAT, 2009). It is critical to initiate the necessary processes to improve the national capacities on their prediction and agree medium term action plans to make it operational. Finally, there is a clear unbalance in the IPCC-AR4 regarding South America climate information, and more asymmetry within the region between the Atlantic countries and WCSA countries. It is important on the basis of a rigorous and scientific sound analysis, to get the climate indices trends for the region, to update the previous ones and publish them in order they can be included in IPCC-AR5.

The objectives of this workshop were:

a) To extend, update, process, validate and discuss the climate indices for South America, including as many as possible new stations/records for the region.
b) To provide training on multivariate statistical approaches for assessing climate extremes.
c) To agree on a Regional Action Plan to publish the results from the region in a peer reviewed Journal and their further inclusion on IPCC-AR5.

2.1 The relevance of Climate Indices in NAPAs and the upcoming IPCC AR5 - Mr. Rodney Martínez -CIIFEN

In this presentation Mr. Martinez introduced the methodological approach that CIIFEN has been applied to carry out vulnerability assessments and contribute on the design of climate adaptation plans in South America. The principles of this approach are:

a) To understand and estimate the "Near Climate Change (10-15 years)" considering this timeframe is consistent with planning and the nearest to the political cycles and needs.

b) To privilege the analysis of indexes derived from climate data rather than scenarios generated by "downscaled models".

c) Present Climate Risk Management: the first step to the feasible adaptation.

d) To understand and estimate the existent vulnerability and its historical evolution pattern at local scale.

e) The Adaptation to climate change is a bottom up social construction that should be implemented by the local actors.

It was emphasized the importance of good data at the time to estimate climate trends. NMHSs should play a critical role in the National Adaptation Plans, not only as data providers, but as producers of high quality climate services consisting in tailored products for authorities to support decisions on this matter.

Some specific recommendations were presented:

a) NMHSs should generate their Local Climate indexes and extend the climatological analysis as much as possible as main strategy for implementing climate services for adaptation purposes.
b) NMHSs should systematize the local climate knowledge to complement the risk and vulnerability assessments.
c) NMHSs should enhance the liaison with local communities, communitarian networks and local media for an efficient dissemination of tailored products applicable for climate change adaptation and climate risk management.
d) NMHSs should consider to enhance the liaison with environmental and risk management communities in order to address their needs and ensure provision of high quality and opportune climate services.

3. Part 1: Estimating and validating Climate Extreme Indices

3.1 Climate extreme indices: introduction to develop high-quality indices (Dr. Manola Brunet - Spain)

As scheduled in the Agenda of the workshop, several talks were given in order to teach attendees on several aspects leading to the development and assessment of high-quality climate extreme indices.

The first talk on *Climate extreme indices: introduction to develop high-quality indices* addressed the different components that integrates the estimation of climate extreme indices using high-quality and homogeneous daily meteorological data. From the need to ensure climate data quality, time series homogeneity and homogenisation to the estimation and assessment of the core climate indices identified, developed and programmed (RClimDex software) by the joint World Meteorological Organization (WMO) Commission for Climatology (CCl)/World Climate Research Programme (WCRP) project on Climate Variability and Predictability (CLIVAR)/Joint WMO– Intergovernmental Oceanographic Commission of the United National Educational, Scientific and Cultural

Organization (UNESCO) Technical Commission for Oceanography and Marine Meteorology (JCOMM) Expert Team on Climate Change Detection and Indices (ETCCDI).

The need for ensuring that the national temperature and precipitation networks analysed contain the longest, well-spaced and climatically-representative records was also stressed, along with the need of ensuring both data and methods reproducibility and traceability of any resulting study based on the selected datasets. It was also stressed the need for improving both temporal and spatial data coverage, emphasising the currently reduced data availability and accessibility and the need for reverting this situation. Finally, some ideas about the quality controls and the homogenisation exercises to be past on the data were provided, as well as the rational for using the ETCCDI approach for estimating and assessing climate extreme indices.

3.2 Homogenization (Dr. Enric Aguilar - Spain)

A mandatory step after quality control and previous to climate data analysis is to assess climate data homogeneity and proceed to homogenization whenever is possible. At the WS a theoretical lecture on homogenization was provided. First the concept of homogeneity – as described at the WMO-TD 1186 Guidelines on Climate Metadata and Homogenization – was introduced stressing the difference between climate fluctuations (either natural or forced) and artificial biases introduced in climate time series. Homogenization was described as the conjunction of two different problems: detection of discontinuities and their adjustment and different approaches (direct homogenization based on overlapping time series; absolute homogenization based on data itself; and relative techniques, supported by ratios or differences between climate data and reference series). Relative techniques were described – according to WMO recommendations and the findings of the COST action Advances in homogenisation methods of climate series: an integrated approach (HOME) – as the most powerful and adequate approach. The talk also distinguished between tests based on data segmentation and multiple breakpoints detection, being the later the most powerful, although less developed at the present moment. The session ended discussing different strategies for the adjustment of daily climate data, as needed for the calculation of RClimdex based indices. The superiority of those techniques which rely on the modeling of the statistical distributions of the series to be homogenized using a close correlate neighbor was recognized. The difficulties in finding for most cases a suitable reference suggests the application of a simple but effective technique, based on the interpolation of monthly factors to daily data.
After the theoretical discussion, the participants were briefed on the use of the C3's rsnht software, an R package based on the widely applied SNHT test modified by the instructors. The package allows Rclimdex users to transform daily data into monthly values, perform breakpoint detection over monthly serial data using the first principal component of the dataset as reference, adjust monthly data (both breakpoints and artificial trends) and interpolate the monthly factors to construct adjusted daily time series, suitable for its use with Rclimdex.

3.3 Calculating Extreme Indices using daily adjusted data and RClimDex (Dr. Manola Brunet - Spain)

On the second talk, entitled *Calculating Extreme Indices using daily adjusted data and RClimDex,* the rationale for adopting the ETCCDI approach for estimating and assessing climate extreme indices, along with main characteristics of the 27 ETCCDI's core suit of extreme indices, were given. It was also assessed the interest and applicability of them in the region, as well as their calculation and interpretation using the RClimDex software.

The training workshop had as aims to capacity building on daily climate data quality controls, homogeneity testing and homogenisation, to estimate climate extreme indices, to assess trends in extreme indices and to apply multivariate statistical techniques for assessing climate extremes, in order to enhance knowledge on long-term changes in climate extreme indices over South America and improve temporal and spatial coverage of climate extremes over the continent for contributing to the IPCC/AR5: towards the development of a Regional Action Plan for RA III.

3.4 Summary of National presentations

Participants introduced the information of the meteorological stations to be processed during the workshop. The summary of their reports is indicated in Table 1.

Country	Number of stations	Precipitation data	Max temp.	Min Temp.
Argentina	51	30	15	6
Bolivia	21	21	21	21
Brasil	130	91	91	87
Chile	19	18	18	18
Colombia	5	4	4	4
Ecuador	6	6	6	6
Paraguay	24	24	24	24
Perú	37	37	30	29
Suriname	9	9	4	4
Uruguay	4	5	6	6
Venezuela	9	9	9	9

Table 1.- Summary of stations reports

4. Part 2: Multivariate statistical analysis for assessing climate extremes and other climatological studies

4.1 Quality control using Rclimdex with quality control extra functionalities (Dr. Javier Sigró – Spain).

The first talk, *Quality control using Rclimdex with quality control extra functionalities*, was about the quality control procedures with normal Rclimdex quality control (QC) developed and programmed (RClimDex software) by the Expert Team on Climate Change Detection and Indices (ETCCDI) and with the extra QC functionalities developed by Enric Aguilar.

Careful analysis of data quality, particularly of daily data, is a key activity before undertaking any homogeneity assessment or any estimation of climate extreme indices with these data. A well-defined data quality control (QC) can avoid many potential errors that could compromise the adjustments calculated from any homogeneity tests run on the data. This is also an indispensable step for improving any assessment with respect to changes in climatic extremes. Furthermore, data quality tests largely enable improvement not only of the quality of the raw data but also the completeness of the dataset, as some fraction of flagged values can be filled in after examining the original sources.

4.2 Regionalization Techniques (Dr. Javier Sigró – Spain).

On the second talk, *Regionalization Techniques,* some spatial grouping procedures as Cluster Analysis (CA) and Principal Component Analysis (PCA) are showed, and a software for hierarchical CA and procedures to plot a regional map was applied to a data example. Cluster analysis (CA) is one of the most useful tasks in the data mining process for discovering groups and identifying interesting patterns in the underlying data. It has come to be recognized as an effective statistical tool to deal with tasks for grouping stations into climatologically homogeneous regions.

5. Regional Action Plan

5.1 Summary of National presentations

Participants presented a standard situation analysis of their stations after attending to the Training workshop. They found different limitations and previously non identified problems in some data sets. A summary of their results and the stations committed for the Regional Action Plan are shown in Table 2.

Country	Stations proposed for analysis	Stations used in analysis	Problems found	Start Homogeneous period	End homogeneous period	Quality control	Homogeneization	Stations Committed for Regional Action Plan
Argentina	**51**	**24**	1) Lack of access to metadata during the WS. 2) Quality control in data sets before 1957.	1940	2010	12	24	**24-40**
Bolivia	**21**	**15**	1) Temperature time series shorter than precipitation. 2) Lack of metadata. 3) High percentage of missing data.	1961	2010	15	15	**>21**
Brasil	**130**	**20**	1) In the case of Brazil, it was considered one of the five regions of the country (Northern region). 2) Lack of metadata. 3) Insufficient time for homogenization and indices analysis.	1961	2010	20	20	**> 130**
Chile	**19**	**17**	1) Lack of metadata. 2) More time required to homogenize more stations.	1961	2010	17	17	**17**
Colombia	**5**	**4**	1) Lack of metadata. 2) Missing data in time series.	1978	2009	4	4	**>27**
Ecuador	**6**	**7**	1) High percentage of missing data. 2) Lack of stations for comparison. 3) Lack of metadata.	1965	2010	7	7	**15**
Paraguay	**24**	**12**	1) Lack of metadata	1961	2010	12	12	**>9**
Perú	**37**	**8**	1) Lack of metadata. 2) Missing data.	1965	2010	8	8	**15**
Suriname	**9**	**3**	1) Missing data. 2) Duplicated data. 3) Lack of metadata.	1961	2010	3	3	**>4**
Uruguay	**4**	**6**	1) Lack of medata. 2) Missing data.	1950	2008	3	3	**>10**
Venezuela	**9**	**9**	1) Lack of metadata. 2) Missing data. 3) Institutional changes.	1969	2009	9	9	**20-30**

Table 2. Regional summary of committed meteorological stations

Figure 1, shows the number of stations initially proposed to be analyzed during the workshop (blue) and the number of stations effectively analyzed during the training workshop (red). The main factors to spend more time in the analysis

are described in Table 2. The impact of metadata limitations was common within the region and significant at the time to analyze the time series.

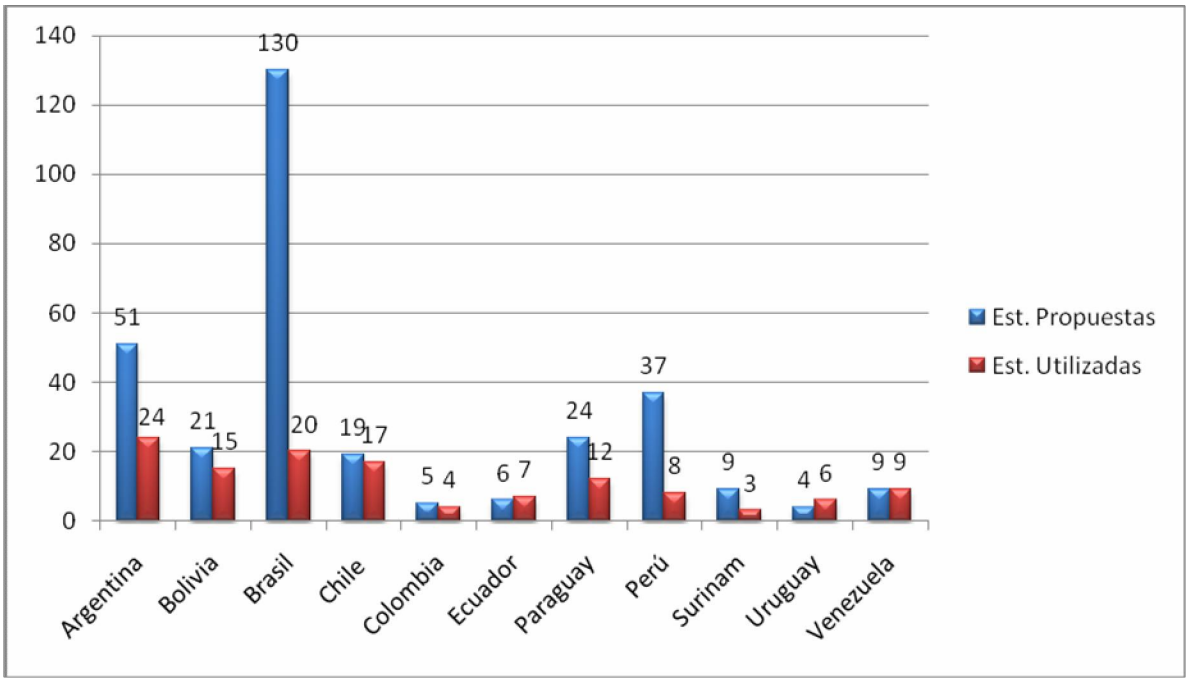

Figure. 1

In some of the participant countries the lack of metadata was temporal because, this information is available in NMHSs, however in other cases, many stations do not have metadata files. This caused severe limitations to perform homogenization procedures.

The stations committed by participants to be full analyzed applying the techniques learnt in the workshop are shown in the Figure. 2

Figure 2. Meteorological stations committed by participants

5.2 Regional Coordinators and Action Plan

In order to integrate the efforts of all the participants for the preparation of the paper, participants agreed to designate Regional Coordinators to lead this effort in close coordination with the Trainers and CIIFEN.

Participants agreed to designate as Regional Coordinators to:

- Ms. María de los Milagros Skansi (Argentina)
- Ms. Claudia Villaroel (Chile)
- Mr. Max Pasten (Paraguay)

The Regional Action Plan, with the specific actions and time lines was agreed by participants considering their duties in NMHSs and time availability of the trainers. The full Action Plan is shown in Table 3

REGIONAL ACTION PLAN
(Guayaquil, Ecuador January 2011)

ACTIVIDAD	RESPONSABLE	FECHA
1. **Final report of the Workshop**	**CIIFEN**	**31-January-2011**
2. **Letter to NMHSs informing agreements and Regional Action Plan 2011**	**CIIFEN**	**31-January-2011**
3. **Quality control of designated stations**	**Participants from NMHSs-Trainers**	**30- June – 2011**
4. **Homogenization of designated stations**	**Participants from NMHSs-Trainers**	**31-October-2011**
5. **Verification of Regional data set**	**Regional Coordinator Trainers-CIIFEN**	**30-November-2011**
6. **Calculation of indices in each country**	**Participants from NMHSs-Trainers**	**31- December-2011**
7. **Final analysis, paper preparation and submission to a peer review Journal.**	**Regional Coordinator participants NMHSs-Trainers-CIIFEN**	**30-March-2012**

Table 3.- Regional Action Plan

7. Closure of the Regional workshop

Dr. Manola Brunet on behalf of the trainers congratulated to participants for the interest and enthusiasm demonstrated during the workshop. Mr. Rodney Martinez expressed its gratitude to the Trainers for their effort, congratulated to participants for their performance during the workshop and encouraged them to accomplish the agreed Action Plan. The participants received certificates of participation and the workshop was closed on Friday 21st at 17h00.

Annexes:

Annex "A" Agenda
Annex "B" List of participants
Annex "C" Photos

Annex "A"
Agenda

Monday 17th January 2011

08h30-09h00 Registration

09h00-10h00 Opening Ceremony

- Mr. Hama Kontongomde- WMO Representative
- Mr. Rodney Martínez – Scientific Coordinator of CIIFEN
- Mr. Carlos Naranjo, Head of INAMHI and WMO Permanent Representative in Ecuador
- Group Photo

10h00-10h30 Coffee Break

Part I : Estimating and validating Climate Extreme Indices

10h30-11h00 Introduction to the Training workshop: The relevance of Climate Indices in NAPAs and the upcoming IPCC AR5 - **Mr. Rodney Martínez -CIIFEN**

11h00-11h30 Climate extreme indices: introduction to develop high-quality indices.
Dr. Manola Brunet – (Spain)

11h30 – 13h30 Practical Session 1 (Climate data quality control using an improved RClimDex) **Dr. Javier Sigró (Spain)**

13h30-14h30 Lunch Break

14h30-16h00 Introduction to the selected climate network in each participant country: e.g. location, length of records, data completeness and climatic representativeness.
National representatives 10' each one

16h00- 16h30 Coffee Break

16h30-18h00 Presentations of participants

Tuesday 18th January 2011

09h00-10h00 Practical Session 1 continues: Participants work on applying quality control to their data

10h00-10h30 Coffee break

10h30-13h30 Practical Session 1 continues: Participants work on applying quality control to their data

13h30-14h30 Lunch Break

14h30-16h00 Testing homogeneity and homogenizing daily time series.
Dr. Enric Aguilar (Spain)

16h00- 16h30 Coffee Break
16h30-18h00 Practical Session 2: Assessing homogeneity and homogenizing time series with Centre for Climate Change (C3) approach and software

Wednesday 19th January 2011

Part I: Calculating Climate Extreme Indices
09h00-10h00 Practical Session 2 continues: Participants work on applying homogenization techniques to their data, as well as continuing quality control

10h00-10h30 Coffee break

10h30-13h30 Practical Session 2 continues: Participants work on applying homogenization techniques to their data, as well as continuing quality control

13h30-14h30 Lunch Break

14h30-16h00 Practical Session 2 continues

16h00- 16h30 Coffee Break

16h30-18h00 Practical Session 2 continues

Thursday 20th January 2011

Part I: Calculating Climate Extreme Indices

09h00-10h00 Keynote speaker: Calculating Extreme Indices using daily adjusted data and RClimDex. By **Dr. Manola Brunet (Spain)**

10h00-10h30 Coffee break

10h30-13h30 Practical Session 2 continues: Participants work on producing climate extreme indices time series

13h30-14h30 Lunch Break

14h30-16h00 Practical Session 2 continues

16h00- 16h30 Coffee Break

16h30-18h00 Practical Session 2 continues

Friday 21th January 2011

Part II Multivariate statistical analysis for assessing climate extremes and other climatological studies

09h00-10h00 Applying multivariate statistical techniques for assessing climate extremes.
Dr. Javier Sigró (Spain)

10h00-10h30 Coffee break

10h00-13h30 Practical Session 3: PCA and cluster applications to assess climate extremes

13h30-14h30 Lunch Break

14h30-16h00 Practical session 3 continues

16h00- 16h30 Coffee Break

16h30-18h00 Countries presentations with the final results of each country
National representatives 15' each one

18h00-18h30 Wrapping up and final discussion on the RAP and contributions to IPCC/AR5

18h30-19h00 Closure session.

Annex "B"

LIST OF PARTICIPANTS

ARGENTINA

María de los Milagros Skansi
Auxiliar del Dpto. De Climatología
Servicio Meteorológico Nacional
Teléfono: (54) 51676767
Email: mms@smn.gov.ar

BOLIVIA

Yaruska Castellón Geier
Departamento de Meteorología
SENAMHI
Teléfono: 591-2355824
Email: yaruska@senamhi.gob.bo

BRASIL

Andrea Malheiros Ramos
Instituto Nacional de Meteorología
Investigadora de la Coordinación de Desarrollo e Investigación CDP-INMET
Teléfono/fax: (5561) 21024776
Email: andrea.ramos@inmet.gov.br

COLOMBIA

Ruth Leonor Correa Amaya
Subdirección de Meteorología
IDEAM
teléfono/fax: 352-7160/ 1630
Email: ruleca@yahoo.es / rcorrea@ideam.gov.co

CHILE

Jacqueline Hidalgo Pizarro
Dirección Meteorológica de Chile
DMC
Tel.: (056) 0974860083
Email: jhidalgo@meteochile.cl

Claudia Villarroel Jiménez
Oficina de Estudios
Dirección Meteorológica de Chile
DMC
Tel.: (56) 02 4364531
Email: cvilla@meteochile.cl

ECUADOR

Carlos Naranjo
Director
Instituto Nacional de Meteorología e Hidrología
INAMHI
Tel.: (593 4) 2 246405
Email: cnaranjo@inamhi.gob.ec

Homero Jácome
Dpto. de Climatología
Teléfono: (5934) 2 -244407
Email: hjacome@inamhi.gob.ec / h_jacome@hotmail.com

Cristina Recalde Coronel
INAMHI
Teléfono: (5934)2 532315
Email: crisrecc86@gmail.com

PARAGUAY

Alejandro Max Pasten
Dirección de Meteorología e Hidrología
Teléfono: (595) 21-425046
Email: max.pasten@meteorologia.gov.py/ maxpasten@gmail.com

PERU

Clara Oria Rojas
Departamento de la Dirección General de Meteorología
SENAMHI
Teléfono/fax: (511) 6141408
Email: Coria@senamhi.gob.pe

SURINAME

Sukarni Sallons Miltro
Dirección de Meteorología
Meteorological Service
Teléfono: 597-498209
Email: sukarnimitro@yahoo.com

URUGUAY

Oscar J. Bentancur
Dirección Nacional de Meteorología
Teléfono/fax:+(598) 23549475
Email: obent@fagro.edu.uy / obent@adinet.com.uy

VENEZUELA

Juan Andrés Arévalo
Gerencia de Servicios Hidrometeorológicos
Instituto Nacional de Meteorología e Hidrología (INAMEH)
Teléfono: (58) 212 9852330
Fax: 535 3242
Email: jarevalo@inameh.gob.ve

Trainers

Manola Brunet
Directora
Centro de Cambio Climático
University Rovira i Virgili-Tarragona
Telefono: +349 77559580
Email: manola.brunet@urv.cat

Enric Aguilar
Grupo de Investigación
Centro de Cambio Climático
University Rovira i Virgili-Tarragona
Telefono: +349 77559580
Email: enric.aguilar@urv.cat

Javier Sigró
Grupo de Investigación
Centro de Cambio Climático
University Rovira i Virgili-Tarragona
Telefono: +349 77559580
Email: javier.sigro@urv.cat

WORLD METEOROLOGICAL ORGANIZATION

Hama Kontongomde
Scientific Officer
Observing and Information Systems Department
World Meteorological Organization
Tel: (+4122) 730 8251
Fax: (+4122) 730 8042
Email: Hkontongomde@wmo.int
7 Bis Avenue de la paix
CH-1211 Geneva 2

CIIFEN

Rodney Martínez Güingla
Coordinador Científico
CIIFEN - Centro Internacional para la Investigación del Fenómeno de El Niño
Teléfono/fax: (593 4)2514770 / (593 4) 2514771
Email: r.martinez@ciifen-int.org

Juan Jose Nieto
Jefe Sistemas de Información
CIIFEN - Centro Internacional para la Investigación del Fenómeno de El Niño
Teléfono/fax: (593 4)2514770 / (593 4) 2514771
Email: j.nieto@ciifen-int.org

Alexandra E. Rivadeneira Uyaguari
Sistemas de Información
CIIFEN - Centro Internacional para la Investigación del Fenómeno de El Niño
Teléfono/fax: (593 4)2514770 / (593 4) 2514771
Email: a.rivadeneira@ciifen-int.org

ANNEX "C"

PHOTOS OF THE WORKSHOP