World Meteorological Organization

Working together in weather, climate and water

Climate Indices and Analysis for Sectoral Application

Leslie Malone, WMO

The Abdus Salam International Centre for Theoretical Physics (ICTP) Summer School on Climate Impacts Modeling for Developing Countries: Water, Agriculture and Health
5-16 September 2011
Trieste, Italy

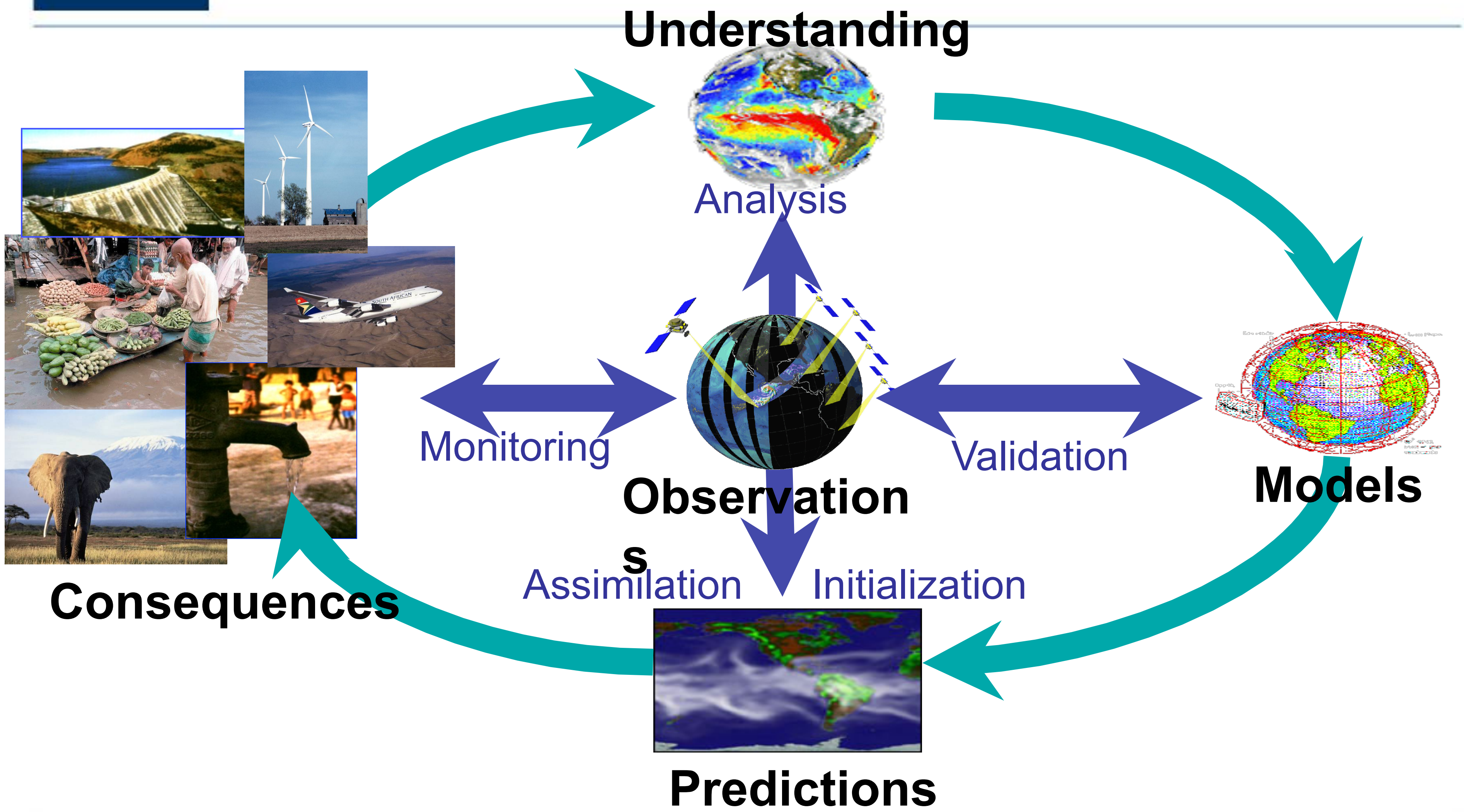
Outline

- **Overview of WMO**
- New directions for climate – WMO and partners
- Climate indices and analysis for sector application

World Meteorological Organization (WMO)

- WMO is UN Specialized Agency
  - Coordinates collective Member contributions in weather, water and climate
  - 189 States & Territories signatory to its Convention
  - Established in 1951, earlier roots from 1873 (IMO)
  - Annual Secretariat Operating budget ~ $70M CH
  - International cooperation has been its hallmark
- Vision: To provide world leadership in expertise and international cooperation in weather, climate, hydrology and water resources, and related environmental issues, and thereby to contribute to the safety and well being of people throughout the world and to the economic benefit of all nations.
- **Services anchor its work and are based on our understanding of the Earth's environmental system.**

the WMO MISSION



Achievements over the past 60 years have been made possible because WMO has:

- Effective governance & structures that engage Members
- Unique framework for exchange of weather, climate and hydrological information across borders
- System of standardized observational networks
- Free & unrestricted exchange of data and products (Critical)
- Capability to develop and deliver information and services to meet specific societal needs (real time and beyond)
- International cooperation in observations, scientific research, prediction and services to satisfy users' requirements

WMO OMM

WMO Priorities

- Results-based Strategic and Operational Planning framework that coordinates efforts of Members, and enables & enhances their capabilities and performance by…
  - Improving weather, water and climate **services** in support of life and property, safe transportation, environment and economic development;
  - Informing and supporting **disaster mitigation and risk reduction** strategies;
  - Implementing new WMO Integrated Global Observing System (**WIGOS**) and WMO Information System (**WIS**);
  - Enhancing our **understanding and predictability** of the Earth system related to weather, climate and hydrology;
  - Implementing Global Framework for Climate Services (**GFCS**) to support adaptation to climate variability and change;
  - Building **capacity** especially within least developed countries;
  - Fostering effective **collaboration** among international organizations

WMO Structures and Co-sponsored Programmes

- **Regions:** Africa (I); Asia (II); South America (III); North America, Central America and the Caribbean (IV); South-west Pacific (V); Europe (VI)

- **Scientific and Technical Commissions** for:
  - Basic Systems (CBS)
  - Atmospheric Sciences (CAS)
  - Instruments and Methods of Observation (CIMO)
  - Hydrology (CHy)
  - Climatology (CCl)
  - Agricultural Meteorology (CAgM)
  - Aeronautical Meteorology (CAeM)
  - Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM)

- **Co-sponsored Programmes**:
  - Intergovernmental Panel on Climate Change (IPCC)
  - World Climate Research Programme (WCRP)
  - Global Climate Observing System (GCOS)

WMO OMM

WMO-ICTP MOU, as of 6 August 2009

The Abdus Salam
International Centre for Theoretical Physics

World Meteorological Organization

WMO and ICTP agree to the promotion of weather and climate research and modeling, predictions and applications in support of sustainable socio-economic development, protection of the environment, education and training in relevant fields including capacity building of scientists in developing countries by providing wider access to the benefits from advances and application of the sciences of weather and climate.

Outline

- Overview of WMO
- **New directions for climate – WMO and partners**
- Climate indices and analysis for sector application

World Climate Conference-3

Geneva, Switzerland
31 August–4 September 2009

World
Meteorological
Organization
Weather • Climate • Water

Better climate information for a better future

UN SYSTEM
DELIVERING AS ONE ON
CLIMATE KNOWLEDGE

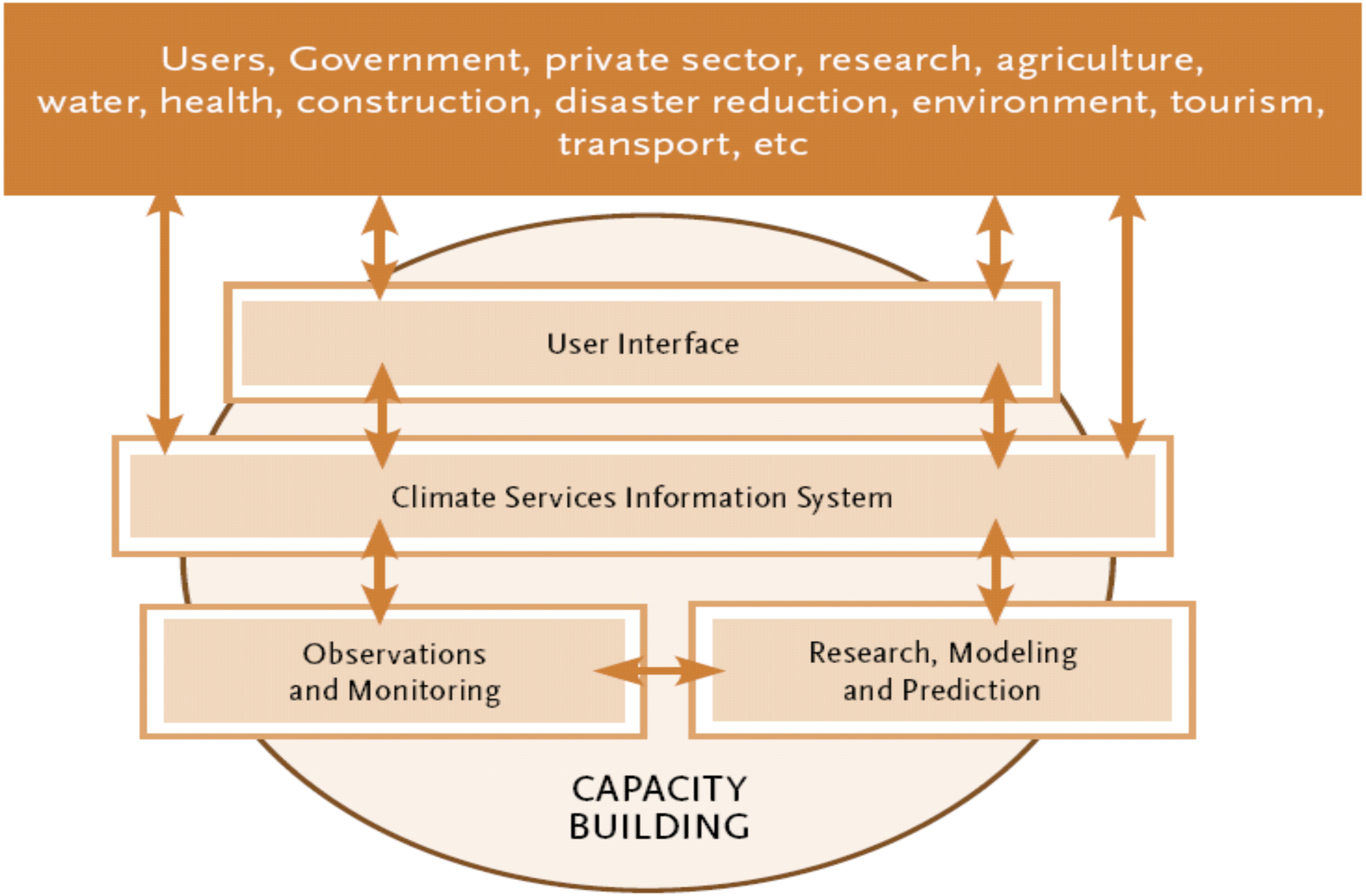
Findings of the Taskforce

- Present capabilities to provide climate services fall short of meeting present and future needs particularly the case in developing and least developed countries;
- Existing climate services are not focused well enough on user needs do not reach to the people who need them most;
- To support climate services, high quality observations is inadequate, particularly in developing countries;
- Effective climate services will depend on new research developments and strengthened collaboration between all relevant research communities;
- Current capacity building activities to support climate services need to be scaled up and better coordinated.

GFCS: Objectives

- **Provide a cooperative framework** in which all nations, International organizations, scientists and sectors will work together to operationally provide climate information to meet the needs of users;
- **Enable users to benefit** from improved user driven climate information and prediction;
- **Mobilize climate science globally** to advance the skills of seasonal-to-interannual and multi-decadal climate predictions to generate and provide future climate information on an operational basis;
- **Cooperative global infrastructure** to foster sharing new advances in science and information.

GFCS Overview



Priority Sectors for GFCS

- In the initial implementation, the HLT recommends a priority to climate services for Agriculture, Water, Health and for Disaster Risk Reduction
- The User Interface component of the GFCS requires cross disciplinary knowledge and collaboration.
- WMO and partners will collaborate closely in development of tailored climate services

Outline

- Overview of WMO
- New directions for climate – WMO and partners
- **Climate indices and analysis for sector application**

Commission for Climatology, 2010-2014

CCl Panels:

1. Climate Data Management
2. Climate Monitoring and Assessment
   - Joint CCl-CLIVAR-JCOMM Expert Team on Climate Change Detection and Indices
3. Climate Products and Services and their Delivery Mechanisms
4. Climate Information for Adaptation and Risk Management
   - Expert Team on Climate Risk & Sector-Specific Climate Indices

CCl-CAgM-CHy Working Group on Climate Food and Water

ET- CCDI Background

- Climate extremes will have a much greater impact on society and ecosystems than changes in mean climate.
- In 1996, IPCC SAR concluded that the available data and analyses were inadequate for assessment of the nature of global changes in extreme climate events.
- Then, the focus was on monthly data, and international exchange of daily climate records was limited.
- The available analyses were hard to compare, as they used different measures of extremes.

Aims of the CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices

ET-CCDI (CCl, CLIVAR, JCOMM) was created to address the need for the objective measurement and characterization of climate variability and change.

It agreed to formulate a suite of climate indices based on daily data, to promote analysis of extremes around the world in a systematic approach, and to facilitate international collaboration on climate change detection and relevant indices.

Building high quality datasets in this manner is meant to encourage the comparison of modeled data and observations.

CCDI approach

- the ETCCDI developed a core set of 27 descriptive climate indices for moderate extremes

- these focus on counts of days crossing a threshold; either absolute/ fixed thresholds or percentile/variable thresholds relative to local climate

- The indices are used for both observations and models, globally as well as regionally, and can be coupled with
  - simple trend analysis techniques
  - standard detection and attribution methods

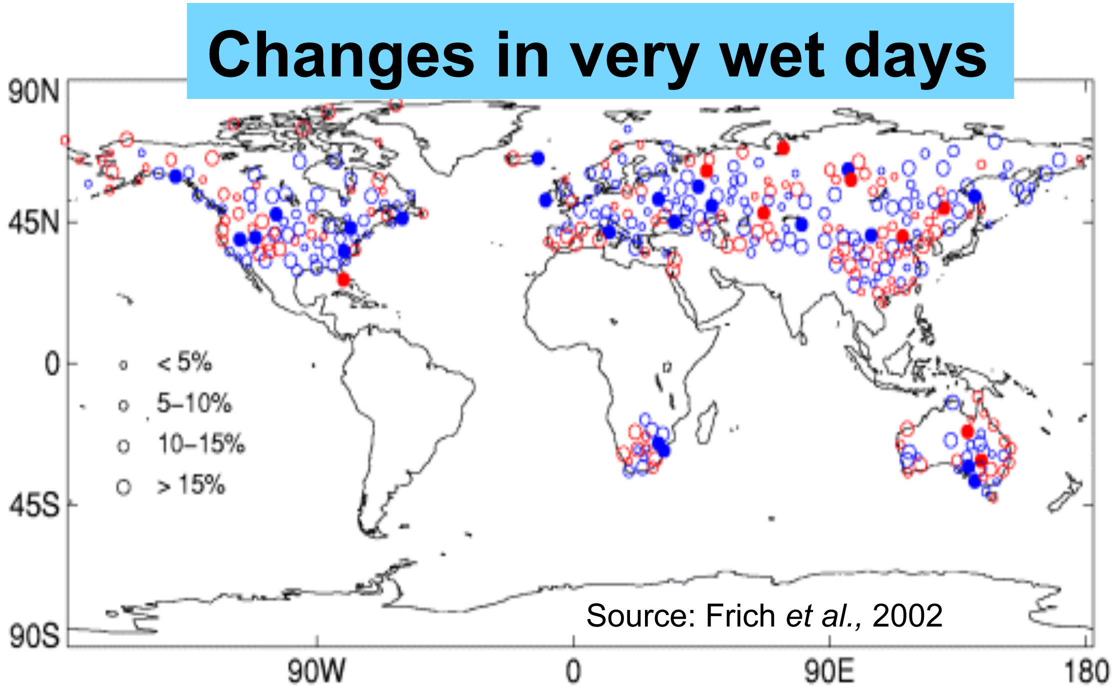
- The work complements the analysis of more rare extremes using EVT

Tools, methods, software, outputs......

- A website http://cccma.seos.uvic.ca/ETCCDMI/index.shtml has been developed to provide:
  - ET approved definitions and guidance on the calculations of climate change indices, along with standard software packages
  - Practical guidance on the homogenization of climate data
  - Materials for use in ETCCDI training workshops
  - Access to online resources of climate indices
  - A place for the submission of new or updated indices data

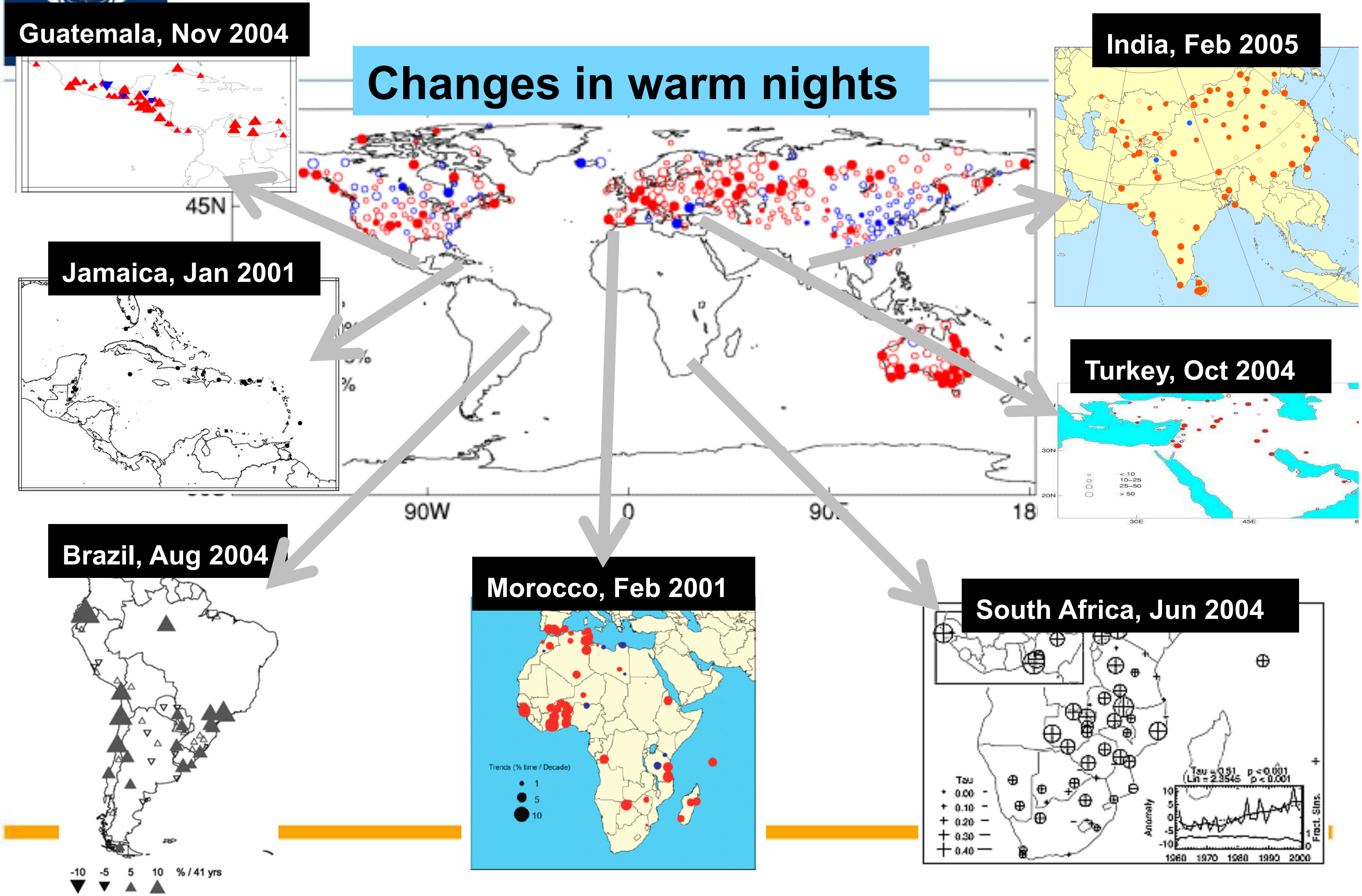
Why the need for international coordination?

In the IPCC Third Assessment Report (TAR) in 2001 there was little or no data on observed changes in extremes for much of Asia, Africa and South America



Blue is a positive change. Filled circles are significant at 95% level of confidence

Workshop success at filling in data gaps



Examples of peer-reviewed publications

All workshop participants helped to write publications which formed a major part of the observations chapter of the Fourth Assessment Report (AR4) of the IPCC in 2007

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 107, NO. D21, 4601, doi:10.1029/2002JD002251, 2002

Recent changes in climate extremes in the Caribbean region

Thomas C. Peterson,[1] Michael A. Taylor,[2] Rodger Demeritte,[3] Donna L. Duncombe,[4] Selvin Burton,[5] Francisca Thompson,[6] Avalon Porter,[7] Mejia Mercedes,[8] Elba Villegas,[8]

Evidence of trends in daily climate extremes over southern and west Africa

Mark New,[1] Bruce Hewitson,[2] David B. Stephenson,[3] Alois Tsiga,[4] Andries Kruger,[5]

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 111, D16105, doi:10.1029/2005JD006316, 2006

Changes in daily temperature and precipitation extremes in central and south Asia

Observed Trends in Indices of Daily Temperature ... South America 1960–2000

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 110, D22104, doi:10.1029/2005JD006181, 2005

Trends in Middle East climate extreme indices from 1950 to 2003

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 110, D23107, doi:10.1029/2005JD006119, 2005

Changes in precipitation and temperature extremes in Central America and northern South America, 1961–2003

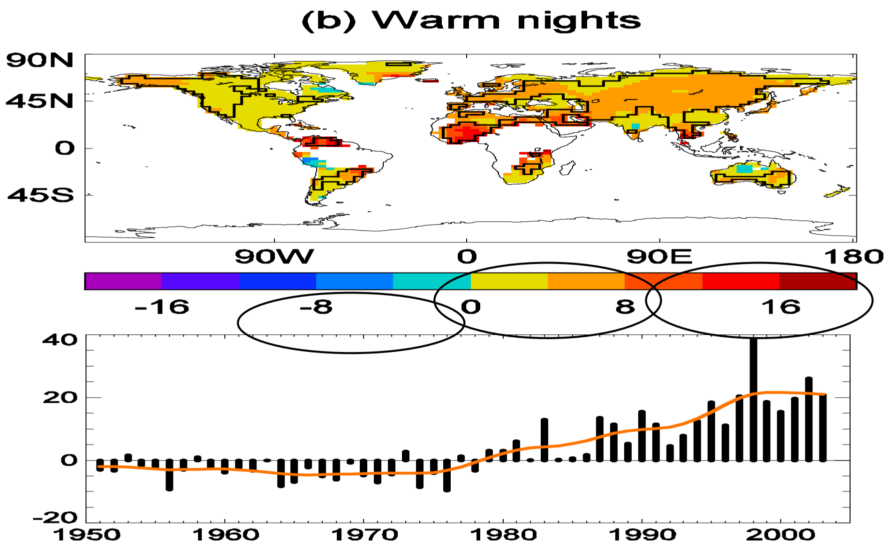
E. Aguilar,[1] T. C. Peterson,[2] P. Ramírez Obando,[3] R. Frutos,[4] J. A. Retana,[5] M. Solera,[5] J. Soley,[6] I. González García,[7] R. M. Araujo,[8] A. Rosa Santos,[8] V. E. Valle,[8] M. Brunet,[1] L. Aguilar,[9] L. Álvarez,[10] M. Bautista,[10] C. Castañón,[10] L. Herrera,[10] E. Ruano,[10] J. J. Sinay,[10] E. Sánchez,[10] G. I. Hernández Oviedo,[11] F. Obed,[12] J. E. Salgado,[12] J. L. Vázquez,[13] M. Baca,[14] M. Gutiérrez,[14] C. Centella,[15] J. Espinosa,[16] D. Martínez,[17] B. Olmedo,[15] C. E. Ojeda Espinoza,[18] R. Núñez,[18] M. Haylock,[19] H. Benavides,[20] and R. Mayorga[20]

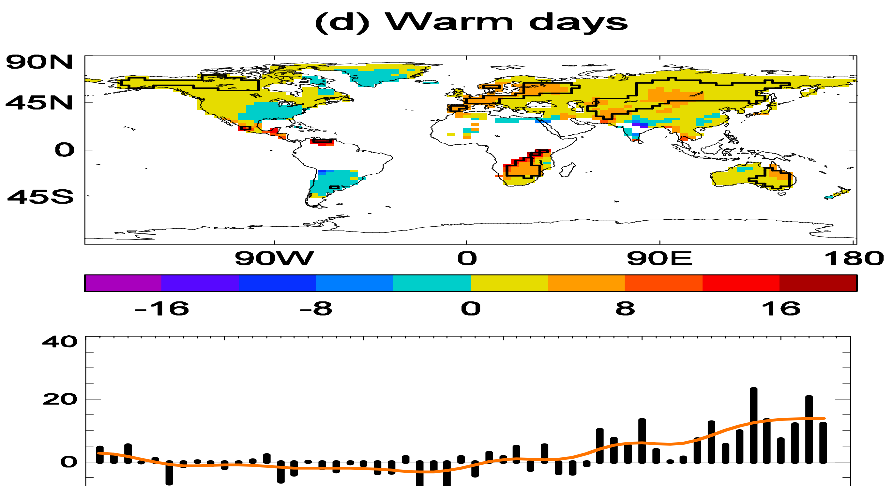
Received 22 April 2005; revised 2 August 2005; accepted 20 September 2005; published 6 December 2005.

[1] In November 2004, a regional climate change workshop was held in Guatemala with the goal of analyzing how climate extremes had changed in the region. Scientists from Central America and northern South America brought long-term daily temperature and precipitation time series from meteorological stations in their countries to the workshop. After undergoing careful quality control procedures and a homogeneity assessment, the data were used to calculate a suite of climate change indices over the 1961–2003 period. Analysis of these indices reveals a general warming trend in the region. The occurrence of extreme warm maximum and minimum temperatures has increased while extremely cold temperature events have decreased. Precipitation indices, despite the large and expected spatial variability, indicate that although no significant increases in the total amount are found, rainfall events are intensifying and the contribution of wet and very wet days are enlarging. Temperature and precipitation indices were correlated with northern and equatorial Atlantic and Pacific Ocean sea surface temperatures. However, those indices having the largest significant trends (percentage of warm days, precipitation intensity, and contribution from very wet days) have low correlations to El Niño–Southern Oscillation. Additionally, precipitation indices show a higher correlation with tropical Atlantic sea surface temperatures.

Citation: Aguilar, E., et al. (2005), Changes in precipitation and temperature extremes in Central America and northern South America, 1961–2003, *J. Geophys. Res.*, *110*, D23107, doi:10.1029/2005JD006119.

IPCC AR4 2007





The workshops have directly led to a much better understanding of global and regional changes in climate extremes

This leads to a much greater confidence in projections of climate extremes in the future

…but there are still gaps

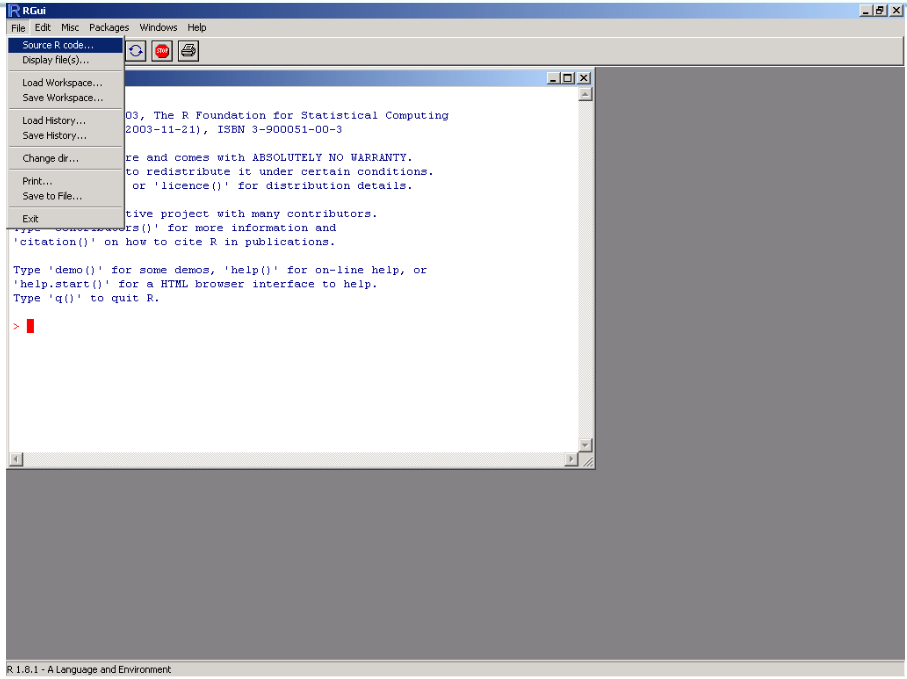
The workshop “recipe”

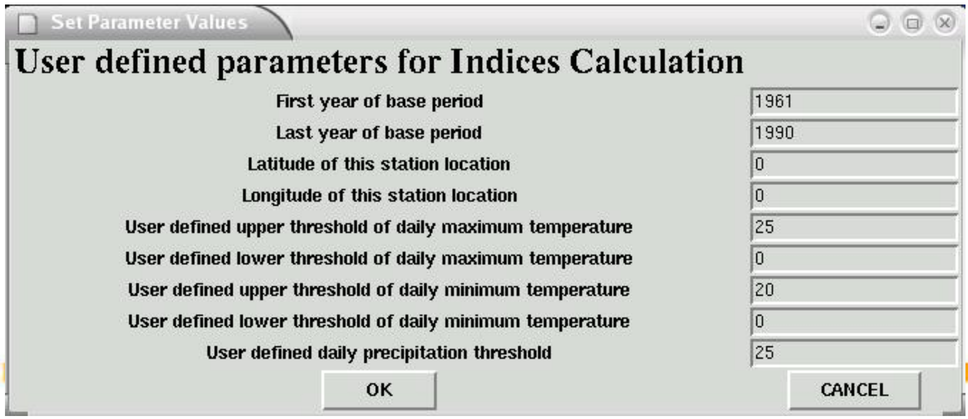
- Based on Asia-Pacific Network (APN) format
- Introductory presentations on climate variability and change and climate projections for the region (and the globe)
- Presentations by participants on the climate of their country
- Introduction to statistical techniques and workshop software RClimDex & RHTest
- “Hands on” analysis - quality control of data and calculation of ETCCDI extreme indices
- Presentation of results from each country and region wide analysis
- Discussion of results

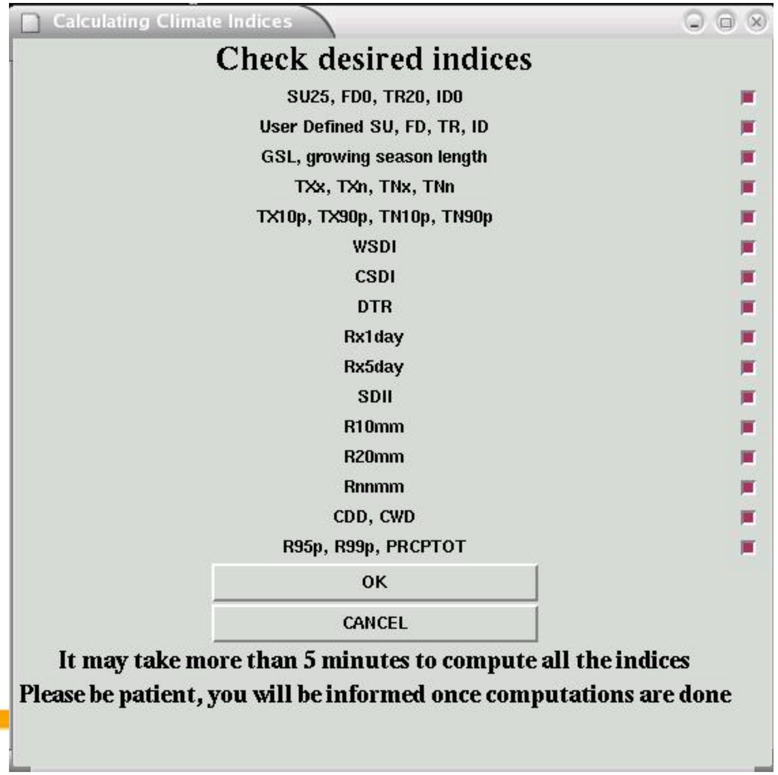
The CCDI Software

- designed for both new and more sophisticated users
- Transparent (fully open and available)
- R and Fortran versions available
- RClimDex has simple GUI, and computes 27 Indices in text or Excel output formats, with indices and trend plots in pdf
- User Guide in English and Spanish
- Technical support available by e-mail
- Includes RHtest (homogeneity) and Mass calculation
- 1200 registered users since 2010

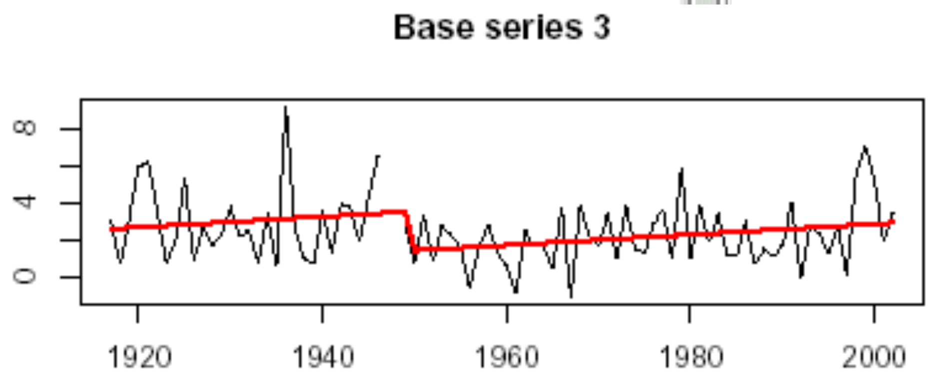
Using the software








RHtest
RHtest
Load Data
Set MinSeg
H-test
Quit
File /home/xzhang/myXP/etccd/RClimDex/exmaple.txt loaded
Data from: 1944 to: 1999
MinSeg set to: 20
Done, result saved as: /home/xzhang/myXP/etccd/RClimDex/log/exmaple_20.pdf
Click Load Data for another station or click Quit to exit.


Base series 3
0
4
8
1920
1940
1960
1980
2000

The CCDI Indices

Temperature indices:

1. FD, frost days: count of days where TN (daily minimum temperature) < 0°C
Let TN*ij* be the daily minimum temperature on day *i* in period *j*. Count the number of days where TN*ij* < 0°C.

2. SU, summer days: count of days where TX (daily maximum temperature) > 25°C
Let TX*ij* be the daily maximum temperature on day *i* in period *j*. Count the number of days where TX*ij* > 25°C.

3. ID, icing days: count of days where TX < 0°C
Let TX*ij* be the daily maximum temperature on day *i* in period *j*. Count the number of days where TX*ij* < 0°C.

4. TR, tropical nights: count of days where TN > 20°C
Let TN*ij* be the daily minimum temperature on day *i* in period *j*. Count the number of days where TN*ij* > 20°C.

The CCDI Indices

Temperature indices:

5. GSL, growing season length: annual count of days between first span of at least six days where TG (daily mean temperature) > 5°C and first span in second half of the year of at least six days where TG < 5°C.
Let TG_{ij} be the daily mean temperature on day *i* in period *j*. Count the annual (1 Jan to 31 Dec in Northern Hemisphere, 1 July to 30 June in Southern Hemisphere) number of days between the first occurrence of at least six consecutive days where $TG_{ij} > 5°C$ and the first occurrence after 1 July (1 Jan in Southern Hemisphere) of at least six consecutive days where $TG_{ij} < 5°C$.

6. TXx: monthly maximum value of daily maximum temperature:
Let TX_{ik} be the daily maximum temperature on day *i* in month *k*. The maximum daily maximum temperature is then $TXx = \max(TX_{ik})$.

7. TNx: monthly maximum value of daily minimum temperature:
Let TN_{ik} be the daily minium temperature on day *i* in month *k*. The maximum daily minimum temperature is then $TNx = \max(TN_{ik})$.

The CCDI Indices

Temperature indices:

8. TXn: monthly minimum value of daily maximum temperature:
Let TXik be the daily maximum temperature on day i in month k. The minimum daily maximum temperature is then TXn = min (TXik).

9. TNn: monthly minimum value of daily minimum temperature:
Let TNik be the daily minimum temperature on day i in month k. The minimum daily minimum temperature is then TNn = min (TNik).

10. TN10p, cold nights: count of days where TN < 10th percentile:
Let TNij be the daily minimum temperature on day i in period j and let TNin10 be the calendar day 10th percentile of daily minimum temperature calculated for a five-day window centered on each calendar day in the base period n (1961-1990). Count the number of days where TNij < TNin10.

The CCDI Indices

Temperature indices:

11. TX10p, cold day-times: count of days where TX < 10th percentile
Let TX_{ij} be the daily maximum temperature on day i in period j and let $TX_{in}10$ be the calendar day 10th percentile of daily maximum temperature calculated for a five-day window centered on each calendar day in the base period n (1961-1990). Count the number of days where $TX_{ij} < TX_{in}10$.

12. TN90p, warm nights: count of days where TN > 90th percentile
Let TN_{ij} be the daily minimum temperature on day i in period j and let $TN_{in}90$ be the calendar day 90th percentile of daily minimum temperature calculated for a five-day window centered on each calendar day in the base period n (1961-1990). Count the number of days where $TN_{ij} > TN_{in}90$.

13. TX90p, warm day-times: count of days where TX > 90th percentile
Let TX_{ij} be the daily maximum temperature on day i in period j and let $TX_{in}90$ be the calendar day 90th percentile of daily maximum temperature calculated for a five-day window centered on each calendar day in the base period n (1961-1990). Count the number of days where $TX_{ij} > TX_{in}90$.

The CCDI Indices

Temperature indices:

14. WSDI, warm spell duration index: count of days in a span of at least six days where TX > 90^{th} percentile
Let TX_{ij} be the daily maximum temperature on day i in period j and let $TX_{in}90$ be the calendar day 90th percentile of daily maximum temperature calculated for a five-day window centered on each calendar day in the base period n (1961-1990). Count the number of days where, in intervals of at least six consecutive days $TX_{ij} > TX_{in}90$.

15. CSDI, cold spell duration index: count of days in a span of at least six days where TN > 10^{th} percentile
Let TN_{ij} be the daily minimum temperature on day i in period j and let $TN_{in}10$ be the calendar day 10th percentile of daily minimum temperature calculated for a five-day window centered on each calendar day in the base period n (1961-1990). Count the number of days where, in intervals of at least six consecutive days $TN_{ij} < TN_{in}10$.

16. DTR, diurnal temperature range: mean difference between TX and TN (°C)
Let TX_{ij} and TN_{ij} be the daily maximum and minimum temperature on day i in period j. If I represents the total number of days in j then the mean diurnal temperature range in period j $DTR_j = \text{sum}(TX_{ij} - TN_{ij}) / I$.

The CCDI Indices

Precipitation indices:

17. RX1day, maximum one-day precipitation: highest precipitation amount in one-day period
Let RR*ij* be the daily precipitation amount on day *i* in period *j*. The maximum one-day value for period *j* is RX1day*j* = max (RR*ij*).

18. RX5day, maximum five-day precipitation: highest precipitation amount in five-day period
Let RR*kj* be the precipitation amount for the five-day interval *k* in period *j*, where *k* is defined by the last day. The maximum five-day values for period *j* are RX5day*j* = max (RR*kj*).

19. SDII, simple daily intensity index: mean precipitation amount on a wet day
Let RR*ij* be the daily precipitation amount on wet day *w* (RR ≥ 1 mm) in period *j*. If *W* represents the number of wet days in *j* then the simple precipitation intensity index SDII*j* = sum (RR*wj*) / W.

20. R10mm, heavy precipitation days: count of days where RR (daily precipitation amount) ≥ 10 mm
Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the number of days where RR*ij* ≥ 10 mm.

The CCDI Indices

Precipitation indices:

21. R20mm, very heavy precipitation days: count of days where RR ≥ 20 mm
Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the number of days where RR*ij* ≥ 20 mm.

22. Rnnmm: count of days where RR ≥ user-defined threshold in mm
Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the number of days where RR*ij* ≥ nn mm.

23. CDD, consecutive dry days: maximum length of dry spell (RR < 1 mm)
Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where RR*ij* < 1 mm.

24. CWD, consecutive wet days: maximum length of wet spell (RR ≥ 1 mm)
Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where RR*ij* ≥ 1 mm.

The CCDI Indices

Precipitation indices:

25. R95pTOT: precipitation due to very wet days (> 95th percentile)
Let RR*wj* be the daily precipitation amount on a wet day *w* (RR ≥ 1 mm) in period *j* and let RR*wn*95 be the 95th percentile of precipitation on wet days in the base period *n* (1961-1990). Then R95pTOT*j* = sum (RR*wj*), where RR*wj* > RR*wn*95.

26. R99pTOT: precipitation due to extremely wet days (> 99th percentile) Let RR*wj* be the daily precipitation amount on a wet day *w* (RR ≥ 1 mm) in period *j* and let RR*wn*99 be the 99th percentile of precipitation on wet days in the base period *n* (1961-1990). Then R99pTOT*j* = sum (RR*wj*), where RR*wj* > RR*wn*99.

27. PRCPTOT: total precipitation in wet days (> 1 mm)
Let RR*wj* be the daily precipitation amount on a wet day *w* (RR ≥ 1 mm) in period *j*. Then PRCPTOT*j* = sum (RR*wj*).

What are the benefits?

- Improve quality control, homogeneity and inventories of national, regional and global climate data
- Increase the capacity of National Weather Services to regularly evaluate climatic change in their country – "capacity development" rather than just "capacity building"
- Freely available standard software encourages a consistent approach to climate change analysis across borders
- Climate indices available via the ET website from previous workshops have improved analysis of:
  - climate variability, climate change, climate model validation, detection and attribution studies, climate impacts
- Participate in multi-national publications which directly inform international processes such as IPCC
- To come together with common goals, help each other, collaborate

Something further is needed...

- Continuing the CCDI workshops, maintaining and improving the software, improving the user manuals are essential.
- Increasing focus is needed on requirements of sectors for indices pertinent to their activities and decision systems.
- Motivation and support are provided through GFCS implementation, the interests of partnering agencies in UIP, the new CCl/CAgM/Chy Expert Group on Climate Food and Water

CCl Expert Team on Climate Risk & Sector Specific Climate Indices:

1st meeting of the ETCRSCI July 13 - 15, 2011
Tarragona, Spain

Lisa Alexander, Climate Change Research Centre

CRSCI Expected Deliverables

- A collection and analysis of existing climate indices with particular specific sectoral (e.g. for agriculture, health, water, DRR) applications at national and regional scales;
- Technical publication on climate indices for sectoral application in risk assessment and adaptation;
- Methods and tools, standardized software and associated training materials required to produce sector-specific climate indices for systematic assessment of the impact of climate variability and change and to facilitate climate risk management and adaptation;
- Pilot training workshop on development of the indices

CRSCI tasks – in collaboration with partners

- Review the 27 existing indices for sector applicability;
- Identify new indices for the RClimDex set for Agriculture (for drought, e.g.), health (e.g. for heat and cold extremes), etc.;
- Consider complex indices (combined climate elements or combined climate and sector data)
- Consider the implications of increasing the numbers of climate variables required, and the benefits....

New CRSCI Indices – preliminary

- SPI: **Standardized Precipitation Index (various time scales) (identified by the CAgM as having global acceptance and applicability for drought assessment)**

- SPEI: **Standardized Precipitation Evapotranspiration Index (various time scales):** The SPEI uses the monthly (or weekly) difference between precipitation and PET (potential evapotranspiration). This represents a simple climatic water balance (Thornthwaite, 1948) which is calculated at different time scales.

- Heatwaves**: a method for identifying periods of consecutive days and nights where the temperatures stay above specific thresholds (these thresholds will vary with locale and time of season, etc)**

- **TX50:** count of days where TX (daily maximum temperature) > 50°C

New CRSCI Indices - preliminary

- **TX95p, very warm day-times:** count of days where TX > 95th percentile
- **FD2, frost days:** count of days where TN (daily minimum temperature) < 2°C
- **FD-2, hard freeze days:** count of days where TN (daily minimum temperature) < -2°C
- **FD-20, plant damage freeze days:** count of days where TN (daily minimum temperature) < -20°C
- **TM5, cold 24hr days:** count of calendar days where TM (daily mean temperature) < 5°C
- **TM10, cool 24hr days:** count of calendar days where TM (daily mean temperature) < 10°C

New CRSCI Indices - preliminary

- **TX30, hot (summer) days:** count of days where TX (daily maximum temperature) > 30°C
- **TX35, very hot (summer) days:** count of days where TX (daily maximum temperature) > 35°C
- **HDDheat, heating degree days:** accumulated departures of daily mean temperature below a specified threshold (to be identified by the user), i.e. there is one HDD for each degree of departure below the standard during one day.
- **CDDcold, cooling degree days:** accumulated departures of daily mean temperature above a specified threshold (to be identified by the user), i.e. there is one CDD for each degree of departure above the standard during one day.

New CRSCI Indices - preliminary

- **GDDgrow, growing degree days:** accumulated departures of a base temperature (standard or reference) from the daily mean temperature. GDD values less than zero are set to zero. The summation over time is related to development of plants, insects, and disease organisms. The reference/base/ standard temperature (below which development either slows or stops is species dependent and needs to be identified by the user accordingly.

- **WSDIflex, warm spell duration index (flexible):** count of days in a span of at least Z days where TX > 90th percentile

- **CSDIflex, cold spell duration index (flexible):** count of days in a span of at least Z days where TN > 10th percentile

- **RXday_flex, maximum Z-day precipitation:** highest precipitation amount in any Z-day period

Next steps for CRSCI

- Develop the indices in RClimDex software
- Test the new package to ensure it is complete and robust
- Include background and explanatory materials in the User's Manual (E/S)
- Set up a training package for application of this material
- Proof of concept workshop (Autumn 2012):
  - Participants to include meteorological personnel familiar with the CCDI indices work, who will provide the meteorological inputs (temperature and precipitation data) to the exercise
  - Participants to include representatives of user communities (e.g. Agriculture, health), preferably those with a background in statistics and modeling
  - Workshop will evaluate the materials, manuals, as well as produce and critique outputs
  - Participants will provide recommendations for finalization of the materials and advice on further developments for the benefit of users
- The materials will be shared (web access)
- The process, concept and benefits will be published and disseminated widely
- The Expert Team will recommend an implementation strategy for NMHS and sectoral experts

WMO OMM

Thank you Merci Спасибо
Gracias شكرا 谢 谢

For more information, please contact:

Leslie Malone
Scientific Officer
Climate Prediction & Adaptation Branch
Climate & Water Department
World Meteorological Organization
Tel: 41.22.730.8220
Fax: 41.22.730.8042
Email: LMalone@wmo.int

Lisa Alexander
Senior Lecturer
The University of New South Wales
Climate Change Research Center
Mathews Bldg
Kensington Campus
SYDNEY, NSW 2052
Australia
Tel.: +61 2 93858954
Fax: +61 2 93858969
l.alexander@unsw.edu.au


Thank you
Merci
Спасибо
Gracias
كرا
谢 谢

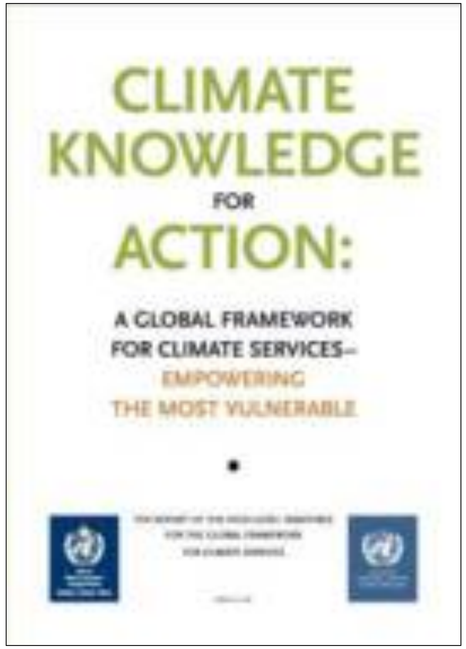
WMO OMM

Sixteenth World Meteorological Congress
16 May to 3 June 2011, Geneva, Switzerland

- Appreciated the work of the High-level Taskforce on the Global Framework for Climate Services in producing a high quality and well balanced report and endorsed the broad thrust of the Report

- Decided to support the implementation of the GFCS as a priority of the Organization in the sixteenth financial period

- Noted the urgent need to put in place improved climate services for all, but especially in developing countries



Requested Members to:

- Further develop national/regional requirements for climate services so that capacity development projects can be designed and implemented;

- Facilitate coordination and collaboration among various institutions within the countries required for the generation and use of climate services through appropriate legal and institutional arrangements

- Provide adequate resources to the NMHSs for strengthening weather, climate and water data networks and recruiting experts in new technical skills required for generating and delivering climate services;

Requested NMHSs to:

(1) Develop partnerships with relevant intermediary organizations and specialized sectoral institutions within the countries including establishing NCOFs/National Climate User Platforms;

(2) Collaborate with universities, climate research institutions, and regional and national training centres to continuously improve the technical skills for developing climate services and serving the needs of various users;

(3) Continue to improve the technical skills of the staff within their institutions through regular training.

Requested Technical Commissions to:

(1) Regularly review the technical needs of the Framework as they relate to the activities and competencies of their Commission, guide establishment and improvement of procedures and processes on technical matters to support GFCS operations, and assist with the implementation of the Framework to the extent possible;

(2) Improve coordination of ongoing activities relevant to the Framework within, and between, technical commissions;

Requested Executive Council to:

(1) Provide support for, and guidance to, the process of developing the detailed implementation plan and monitoring of its implementation through appropriate working mechanisms;

(2) Review Annex I of Resolution 40 (Cg-XII) with a view to ensuring that the climate data and products needed for the GFCS's climate services are included therein;

(3) Review the role and operation of NMHSs specifically addressing the needs of GFCS;