Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu

Overview ETCCDI

Expert Team on Climate Change Detection and Indices

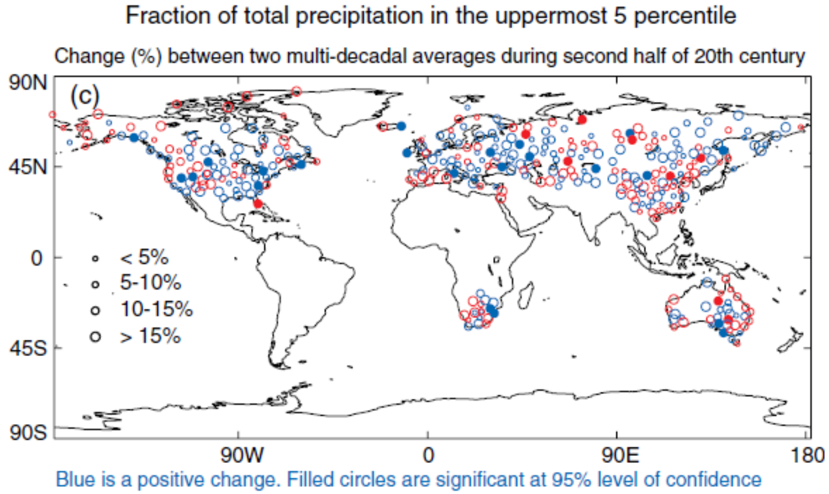
Albert Klein Tank
KNMI, The Netherlands

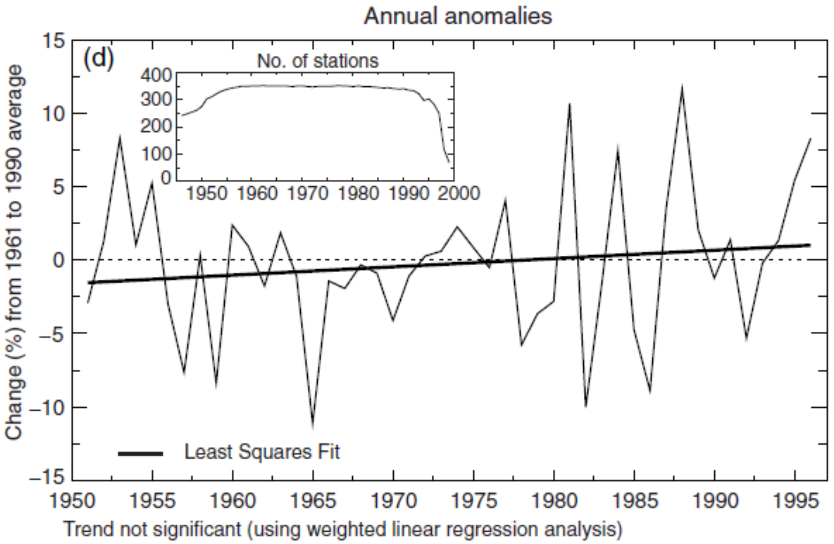
Agenda items

- Short history of the ETCCDI
- Current status
- Extremes indices (and issues)
- Regional workshops
- Use of indices in climate services

Motivation

- In the late 90s almost no information was available to answer the question: *"Has climate variability changed, or have climate extremes changed?"*
- ETCCDI was established in 1999 to support the IPCC-TAR

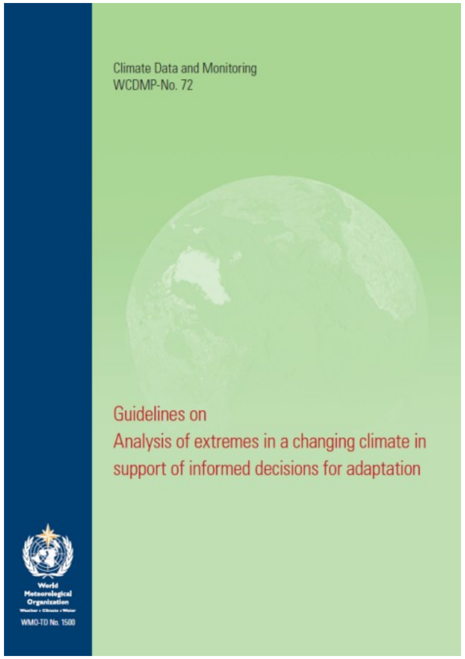




IPCC-TAR, 2001, Fig 2.36

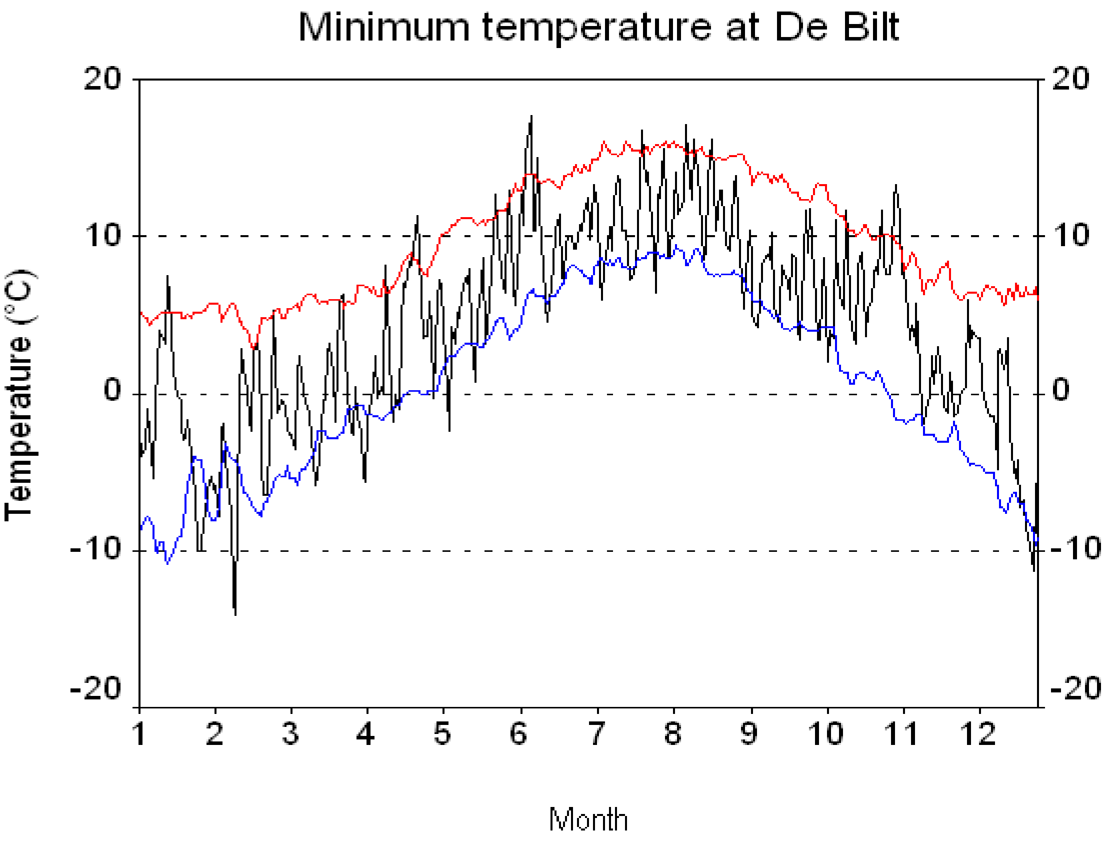
ETCCDI indices

- List of 27 standardized indices for near the surface over land
- Internationally coordinated
- Focus on counts of days crossing a threshold
- Used for both observations and models
- Coupled with simple trend analysis techniques and standard D&A methods
- Complement the analysis of more rare extremes using EVT



Klein Tank et al., 2009, WMO-TD No. 1500

Percentile thresholds for TN10p & TN90p

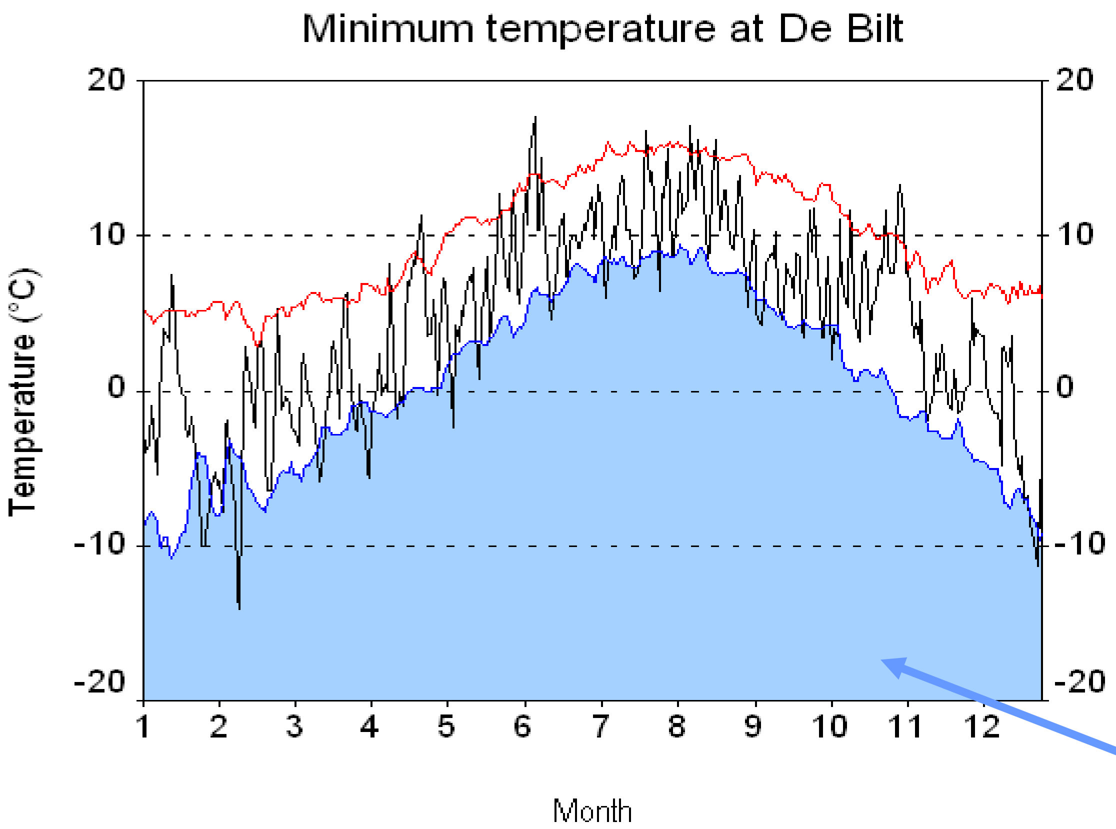


upper 10-ptile
1961-1990

the year 1996

lower 10-ptile
1961-1990

Percentile thresholds for TN10p & TN90p



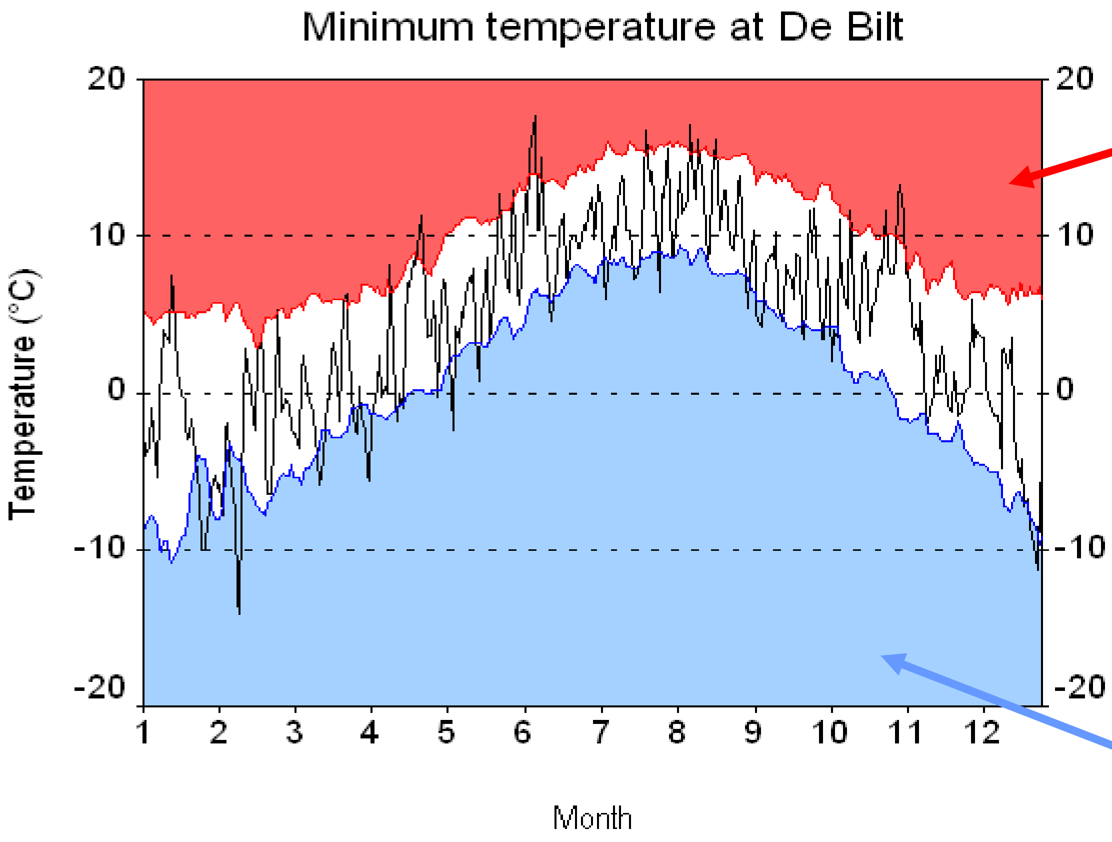
upper 10-ptile 1961-1990

the year 1996

lower 10-ptile 1961-1990

“cold nights”

Percentile thresholds for TN10p & TN90p



"warm nights"

upper 10-ptile 1961-1990

the year 1996

lower 10-ptile 1961-1990

"cold nights"

U.S. NEWS

THE NUMBERS | By Jo Craven McGinty

To Gauge Climate Change, Don't Go to Extremes

The weather events that have the gravest impact on society are monster storms— hurricanes, tsunamis and other devastating tempests that destroy property and take lives. But those relatively uncommon events are poor measures of climate change.

They happen too seldom. They are only noted when they occur near populated areas. And their severity is generally gauged by the destruction they inflict. Tornadoes, for example, are rated according to the Fujita Scale, which gives its highest rating to storms that cause the worst damage.

"What if no building gets hit?" said Harold Brooks, a scientist with the National Severe Storms Laboratory in Norman, Okla., who studies tornadoes. "Or if a building is really badly built and weak?"

Because of such flaws, even determining whether the number of tornadoes or other major storms has increased over time is difficult. That is why scientists who wish to study changes in extreme weather don't focus on major events. Instead, they examine subtle changes in temperature and precipitation.

"That is part of the tradeoff," said Thomas C. Peterson, a scientist with the National Climatic Data Center who studies climate change. "If you want a reliable estimate on how it is changing, the event has to be not too rare."

Until recently, however, no global data existed to permit such a study. That began to shift 20 years ago when the World Meteorological Organization drafted a dozen of its members to develop meaningful measurements of extreme weather that could be used reliably throughout the world.

The group, now known as the Expert Team on Climate Change Detection and Indices, developed 27 measures derived from daily observations of temperature and precipitation. They conducted workshops in countries that didn't have a history of analyzing, or even sharing, data. And they launched the first global effort to assemble information on extreme weather.

When they began, digital records were available for about half the globe, and what was available was typically boiled down to monthly averages, which obscure extremes. To assess changes in extreme weather, using daily metrics was key, and to understand global trends, more data were needed. "We had the U.S., Russia, Canada, China, Australia, and most of Europe," said Mr. Peterson. "Most of the rest of the globe was blank."

After the team devised its measurements, it launched workshops to teach countries how to use the indexes. The first was in Jamaica in 2001. Others followed in Morocco, South Africa, Brazil, Kenya, Turkey, India, Pakistan, Congo, South Korea and Indonesia.

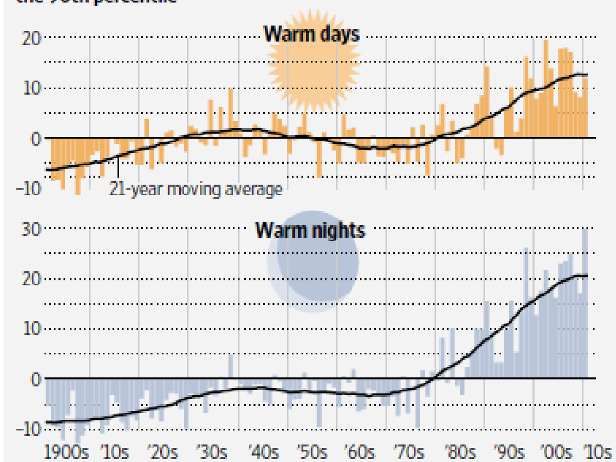
Among the series of indexes the team developed, 17 are devoted to temperature and 12 are devoted to precipitation. Taken together, they provide a more reliable gauge of trends in extreme weather than any single measurement, or a handful of severe storms.

For example, to document heat patterns, the group measures the maximum temperature in a period, tallies the number of days when the temperature is above 77 degrees Fahrenheit, and counts how often the maximum temperature exceeds the 90th percentile in

A Finer Measure of Weather

Climatologists use measurements of temperature and precipitation to document changes in climate, such as increases in the number of unusually warm days. These "moderate extremes" occur more frequently than severe storms and are better for analyzing global trends.

Average number of days per year that the global temperature exceeded the 90th percentile



Source: Markus Donat, Journal of Geophysical Research 2013 The Wall Street Journal

a single day, as well as for six or more consecutive days.

"If we say heat waves are changing over time, we like to do it on a basis of two or three different indicators," said Albert Klein Tank, head of observations research at the Netherlands Weather Service and co-chair of the Expert Team. "The results are more robust."

Counts with fixed thresholds—such as the number of days below freezing —are useful for tracking trends in a particular region but may not translate to other parts of the world, since what is extreme in one area may be normal in another. The percentile measurements allow for comparisons across regions.

While the information has improved, it isn't perfect. The data only account for weather over land, and even then gaps remain in South America and Africa. Records vary from country to country—Bhutan's data, for example, only go back to the 1990s, while Sri Lanka's go to 1860. Some countries won't disclose their full data sets.

"Last year, Brazil opened its archives," Mr. Peterson said. "The year before Israel did. India is terrible. Iran is great. We're pretty happy if we can go back to 1950 in a region."

The findings the scientists produce are nuanced—and perhaps less likely than shocking storms to frighten the public. The coldest temperature that weather stations around the world read each year is on average about 5 degrees warmer than it was in the 1950s.

But though their methods are subtle, the researchers are confident in their results. "You can say hot days have increased, and you can quantify that," said Mr. Klein Tank. "Before, it was only speculation."

Indices in IPCC

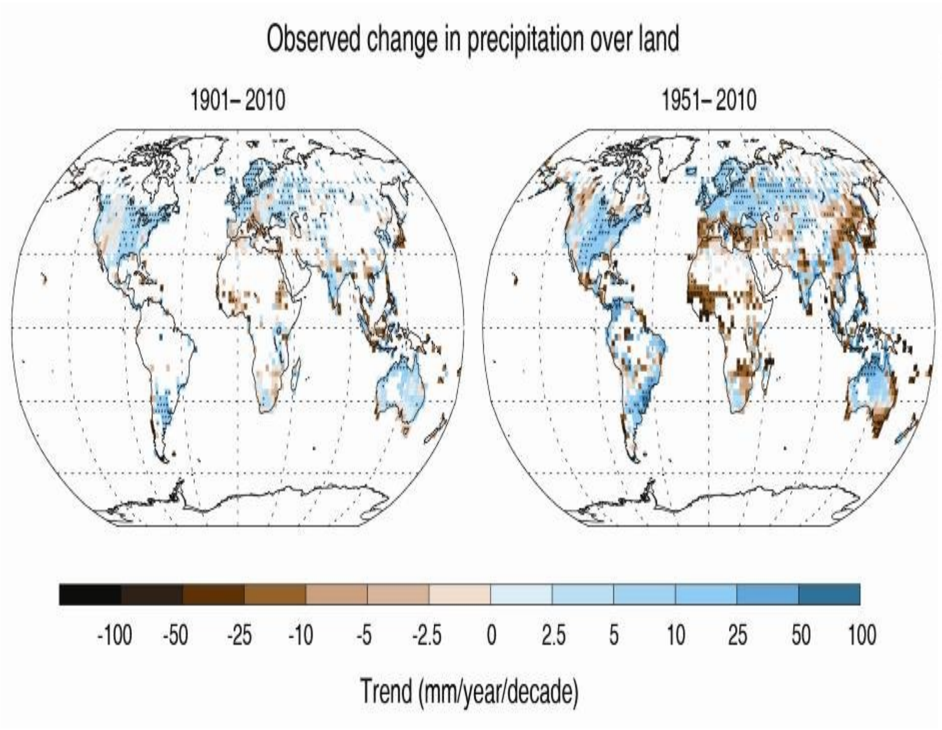
Table SPM.1 | Extreme weather and climate events: Global-scale assessment of recent observed changes, human contribution to the changes, and projected further changes for the early (2016–2035) and late (2081–2100) 21st century. Bold indicates where the AR5 (black) provides a revised* global-scale assessment from the SREX (blue) or AR4 (red). Projections for early 21st century were not provided in previous assessment reports. Projections in the AR5 are relative to the reference period of 1986–2005, and use the new Representative Concentration Pathway (RCP) scenarios (see Box SPM.1) unless otherwise specified. See the Glossary for definitions of extreme weather and climate events.

Phenomenon and direction of trend	Assessment that changes occurred (typically since 1950 unless otherwise indicated)	Assessment of a human contribution to observed changes	Likelihood of further changes	
			Early 21st century	Late 21st century
Warmer and/or fewer cold days and nights over most land areas	*Very likely* {2.6} *Very likely* *Very likely*	***Very likely*** {10.6} *Likely* *Likely*	*Likely* {11.3}	*Virtually certain* {12.4} *Virtually certain* *Virtually certain*
Warmer and/or more frequent hot days and nights over most land areas	*Very likely* {2.6} *Very likely* *Very likely*	***Very likely*** {10.6} *Likely* *Likely* (nights only)	*Likely* {11.3}	*Virtually certain* {12.4} *Virtually certain* *Virtually certain*
Warm spells/heat waves. Frequency and/or duration increases over most land areas	***Medium confidence*** on a global scale *Likely* in large parts of Europe, Asia and Australia {2.6} *Medium confidence* in many (but not all) regions *Likely*	***Likely***[a] {10.6} Not formally assessed *More likely than not*	Not formally assessed[b] {11.3}	***Very likely*** {12.4} *Very likely* *Very likely*
Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation	*Likely* more land areas with increases than decreases[c] {2.6} *Likely* more land areas with increases than decreases *Likely* over most land areas	***Medium confidence*** {7.6, 10.6} *Medium confidence* *More likely than not*	*Likely* over many land areas {11.3}	***Very likely*** over most of the mid-latitude land masses and over wet tropical regions {12.4} *Likely* over many areas *Very likely* over most land areas
Increases in intensity and/or duration of drought	***Low confidence*** on a global scale *Likely* changes in some regions[d] {2.6} *Medium confidence* in some regions *Likely* in many regions, since 1970[e]	***Low confidence*** {10.6} *Medium confidence*[f] *More likely than not*	*Low confidence*[g] {11.3}	***Likely*** *(medium confidence)* on a regional to global scale[h] {12.4} *Medium confidence* in some regions *Likely*[e]
Increases in intense tropical cyclone activity	***Low confidence*** in long term (centennial) changes *Virtually certain* in North Atlantic since 1970 {2.6} *Low confidence* *Likely* in some regions, since 1970	***Low confidence***[i] {10.6} *Low confidence* *More likely than not*	*Low confidence* {11.3}	***More likely than not*** in the Western North Pacific and North Atlantic[j] {14.6} *More likely than not* in some basins *Likely*
Increased incidence and/or magnitude of extreme high sea level	*Likely* (since 1970) {3.7} *Likely* (late 20th century) *Likely*	***Likely***[k] {3.7} *Likely*[k] *More likely than not*[k]	*Likely*[l] {13.7}	***Very likely***[l] {13.7} *Very likely*[m] *Likely*

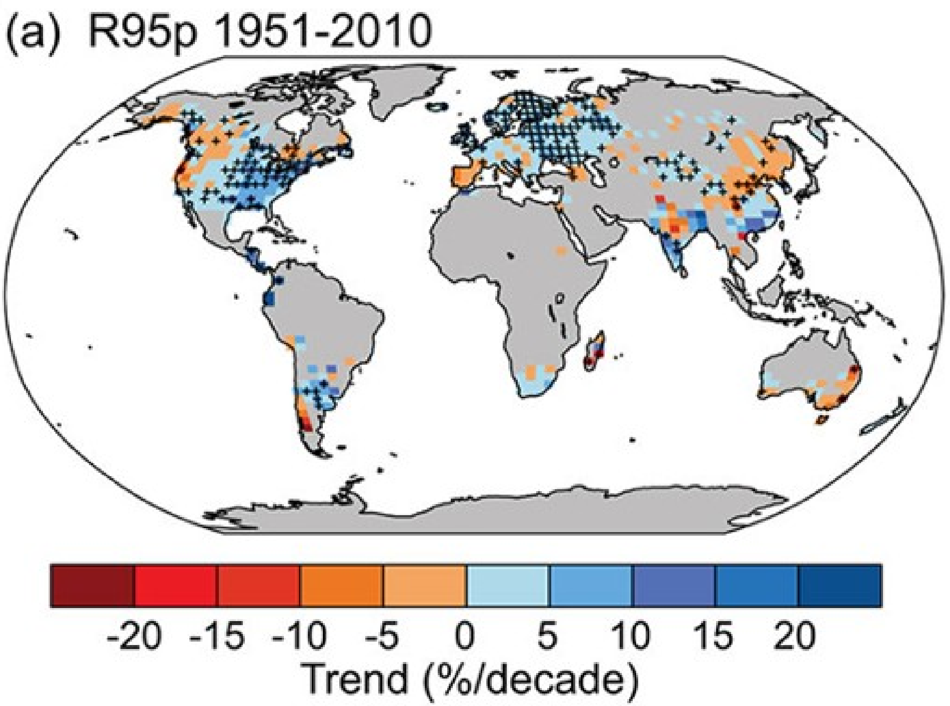
IPCC-WG1, 2013, Table SPM.1

Observed change in precipitation over land

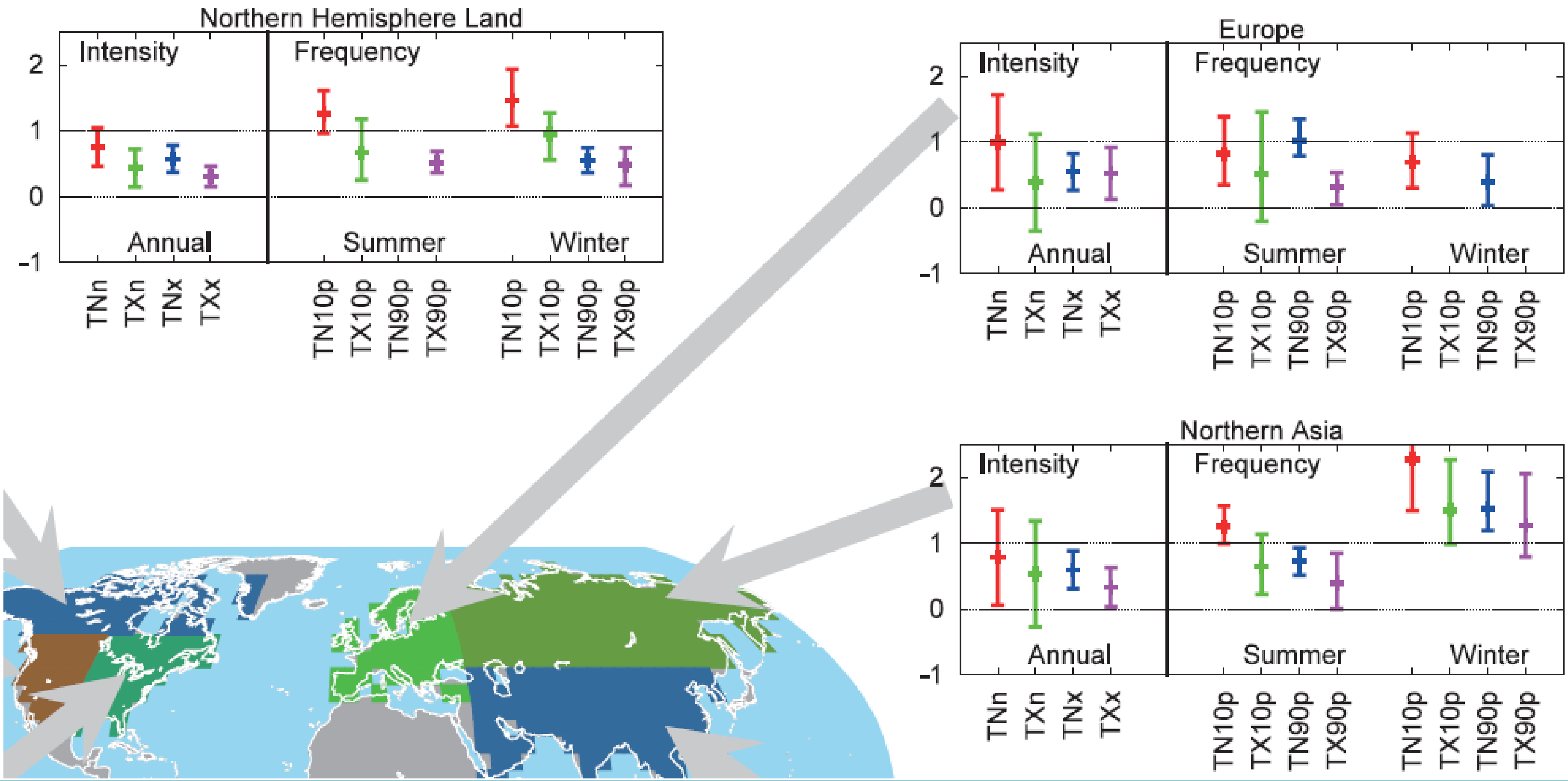
Total amounts



Index for heavy precipitation (R95p)



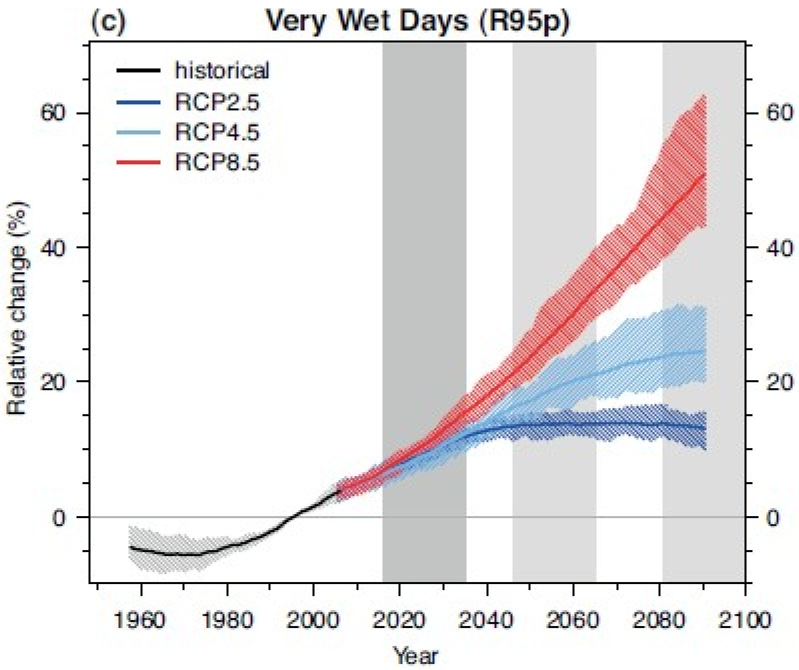
D&A change, 1951-2000



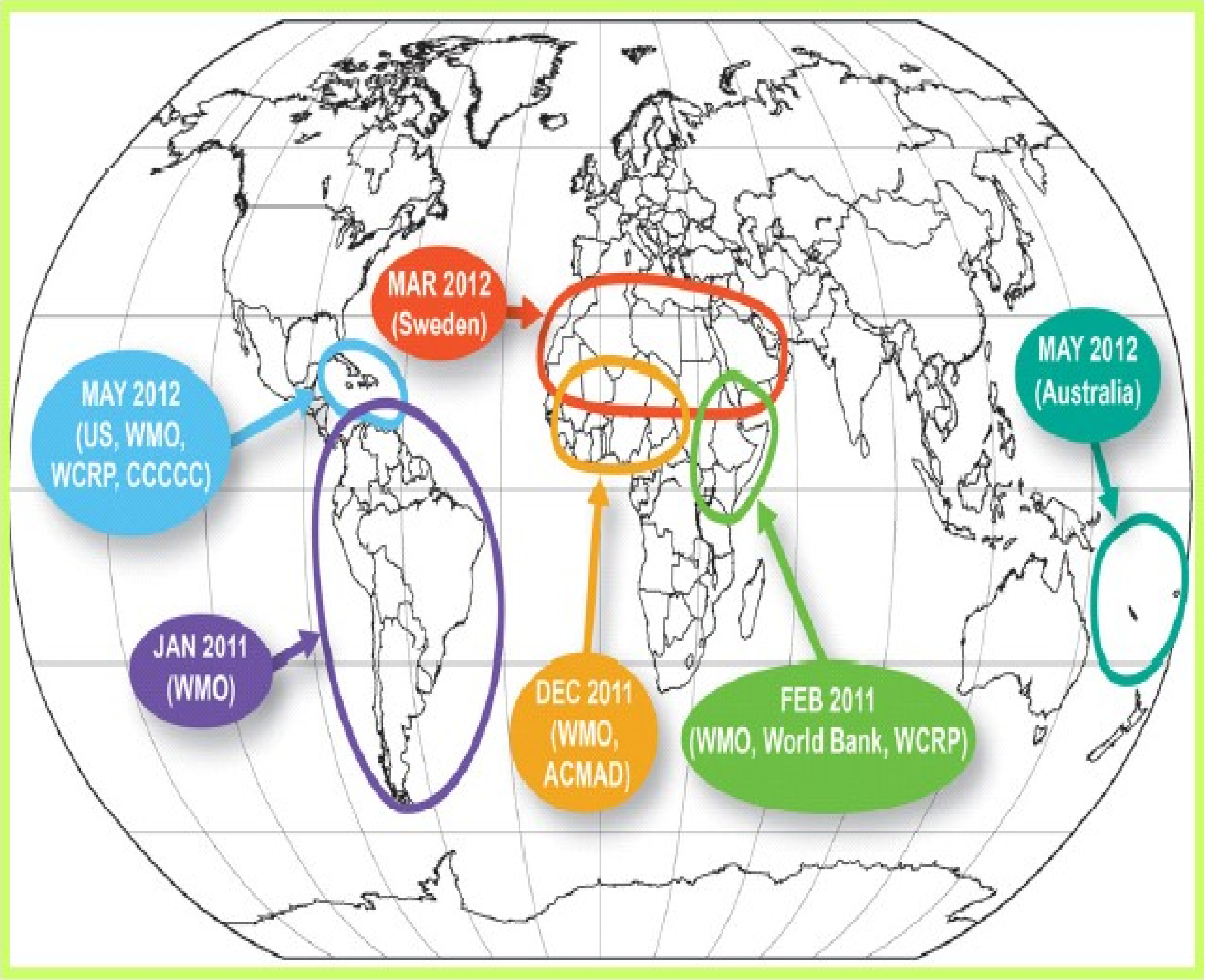
IPCC-WG1, 2013, Fig. 10.17

Projected change

Index for heavy precipitation (R95p)



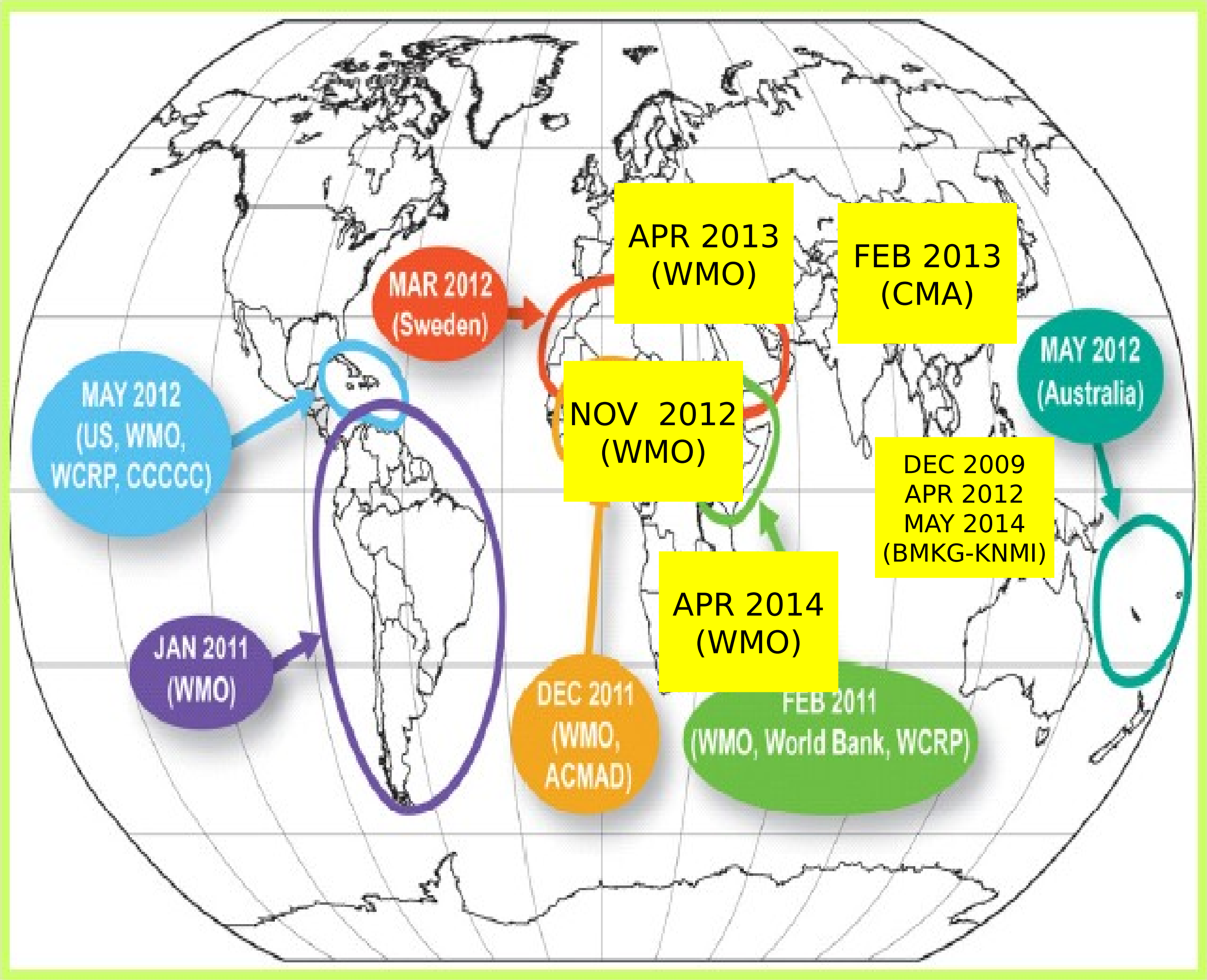
ETCCDI Regional Workshops 2011 - 2012



Workshops use R-based software package developed by Environment Canada

Zhang et al., WIREs Clim Change, 2011

ETCCDI Regional Workshops 2011 - 2012



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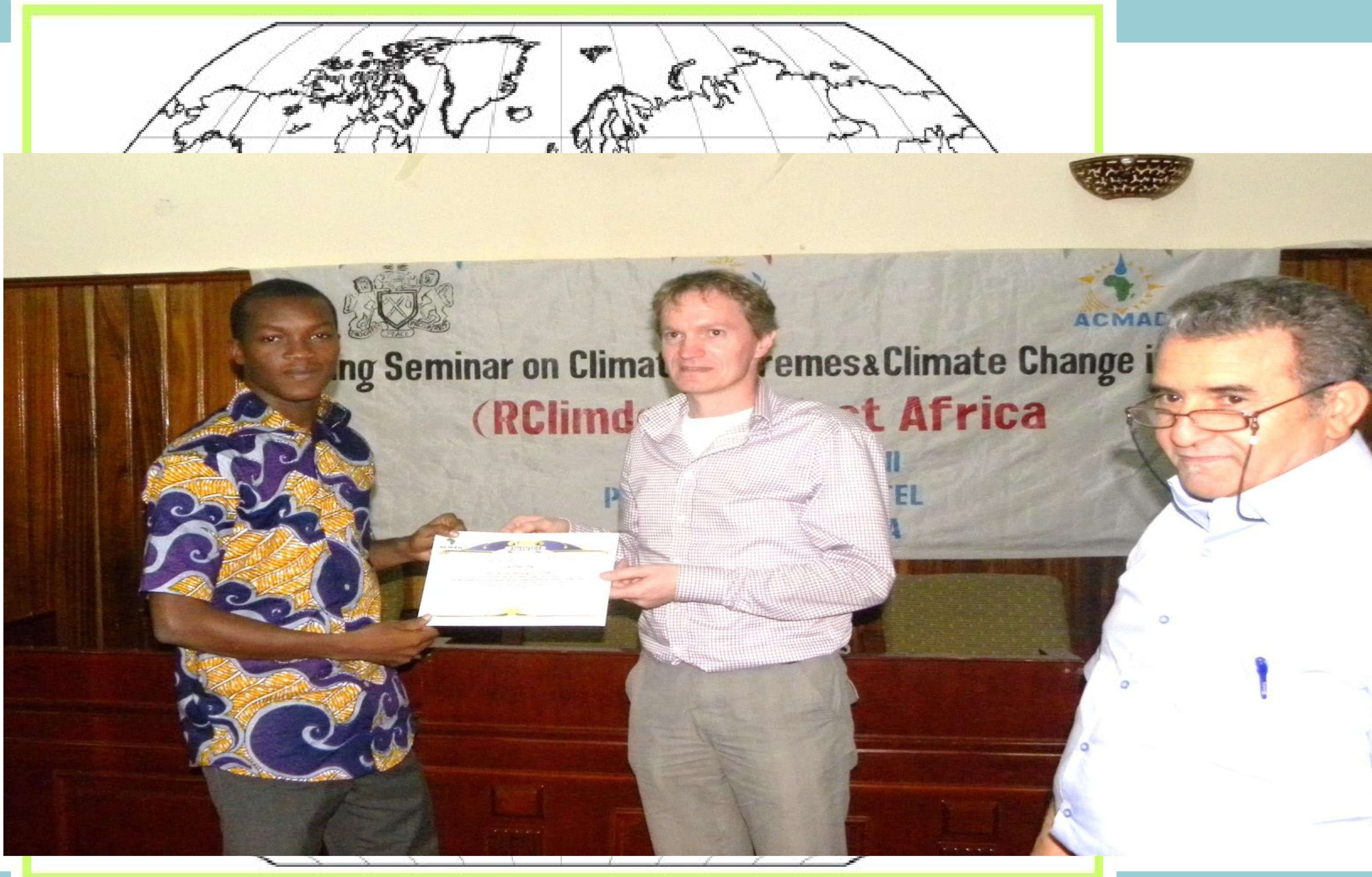
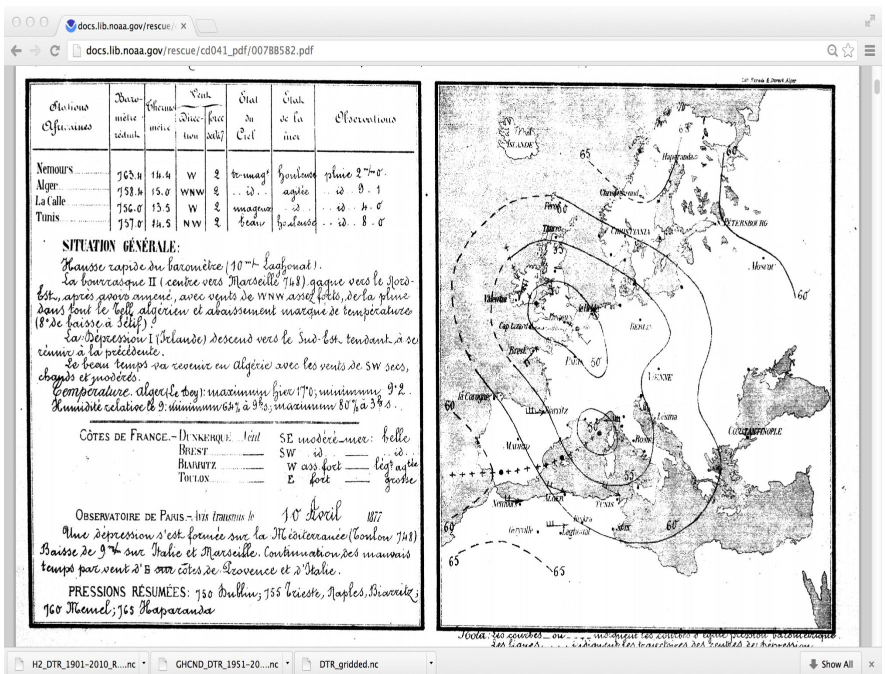


Zhang et al., WIREs Clim Change, 2011

ETCCDI triggers DARE activities

At best…



36 million images at NOAA

…but more common

Climate archive in Mauritius

Issues with indices definitions

- Discontinuities of percentile indices at the beginning and end of the base period (Zhang et al., J. Climate, 2005)
- Trends in indices for the cold tail and warm tail not directly comparable (Klein Tank et al., J. Climate, 2003)
- Different meaning of indices for areal averaged data (climate models) compared to point data (stations)
- Lack of information if separate model climatologies are used for each simulation (Sillmann et al., Int. J. Climatol, 2014)
- ....

Issues with R95p

Positive trends over Europe, 1961-2010 (MK-test)

Season	Region	R95p	S95p
DJF	north	77.4 %	38.5 %
	south	60.3 %	63.5 %

Contrary to R95p, which uses a fixed climatological 95th percentile, the new index S95p assumes a separate 95th percentile for each year

Membership and sponsors

- Do we involve the relevant experts?
- Current sponsors and members:

WMO-CCl	JCOMM	CLIVAR	GEWEX
Moukouba Moutoumounkata	Scott Woodruff	Kathy McInnes	Lisa Alexander
Ying Sun	Kevin Horsburgh	Gabi Hegerl	Lukas Gudmundsson
Jorge Vazquez-Aguirre	Xiaolan Wang	Xuebin Zhang (co-chair)	Ali Behrangi
James Renwick			
Albert Klein Tank (co-chair)			

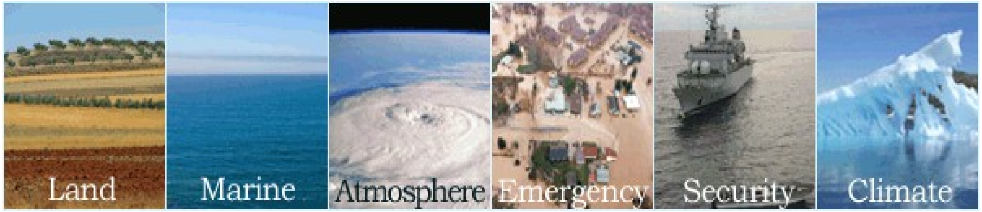
- Many other experts are involved on an ad hoc basis

Use of indices for climate services

GFCS
GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Copernicus
The European Earth Observation Programme

Climate Change Service



Use of indices for climate services

- ECA&D data repository www.ecad.eu
- ICA&D www.ecad.eu/icad.php:
- The ECA&D concept transferred to other regions of the world,
- in particular Southeast Asia, Latin America and West Africa

BMKG

CIIFEN

ACMAD

DATA ACCESS

INTERNATIONAL CLIMATE ASSESSMENT & DATASET: CLIMATE SERVICES ACROSS BORDERS

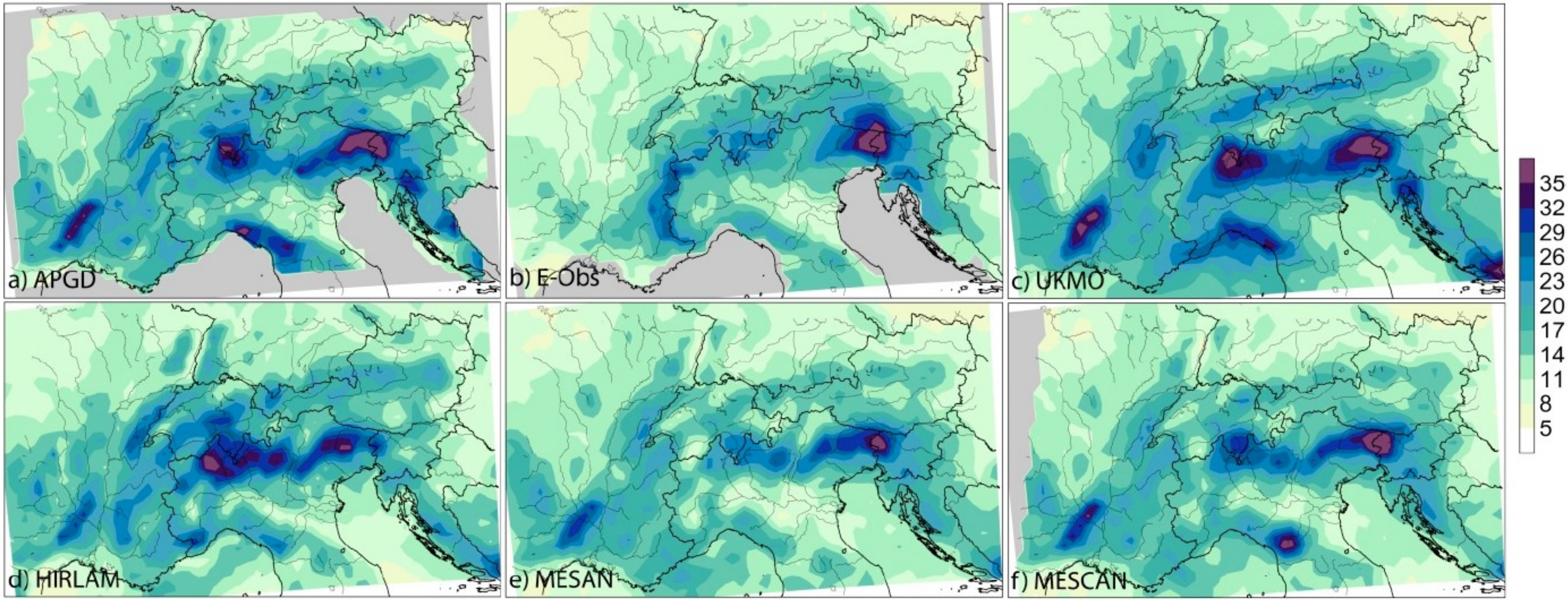
BY ELSE J. M. VAN DEN BESSELAAR, ALBERT M. G. KLEIN TANK, GERARD VAN DER SCHRIER, MARIAMA S. ABASS, OMAR BADDOUR, ARYAN F.V. VAN ENGELEN, ANDREA FREIRE, PEER HECHLER, BAYU IMBANG LAKSONO, IQBAL, RUDMER JILDERDA, ANDRE KAMGA FOAMOUHOUE, ARIE KATTENBERG, ROBERT LEANDER, RODNEY MARTÍNEZ GÜINGLA, ALBERT S. MHANDA, JUAN JOSÉ NIETO, SUNARYO, ARIS SUWONDO, YUNUS S. SWARINOTO, AND GÉ VERVER

MOTIVATION. The demand for information services on weather and climate is growing rapidly

these series, are important requirements for assessing the vulnerability of societies to weather extremes and,

Calculating indices for reanalysis data

- In situ datasets (APGD,E-OBS) against regional reanalysis datasets for the 95% quantile of daily precipitation (mm) in the year 2008 (EU-FP7 projects EURO4M and UERRA)



Frei, 2014, EURO4M deliverable 2.13

Questions?