Accomplishments and Challenges in Global Climate Monitoring

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Consider a city running low on drinking water during a drought

- If you were in charge of the city's long-term water planning, what would you do?

The answer depends on climatic conditions

- Is this is a once in 200 years drought or a once in 20 years drought?
- Do long-term data (and model projections) indicate that droughts of this magnitude are tending to become more frequent or less frequent?
- How could you possibly make the rig decision without climate monitoring information?

Climate Variability and Change

- Impacts numerous societal, economic and environmental aspects
  - Safety, health, food security, tourism, energy, etc.
- Therefore, coping and adapting to these changes requires understanding their causes, nd to predict t

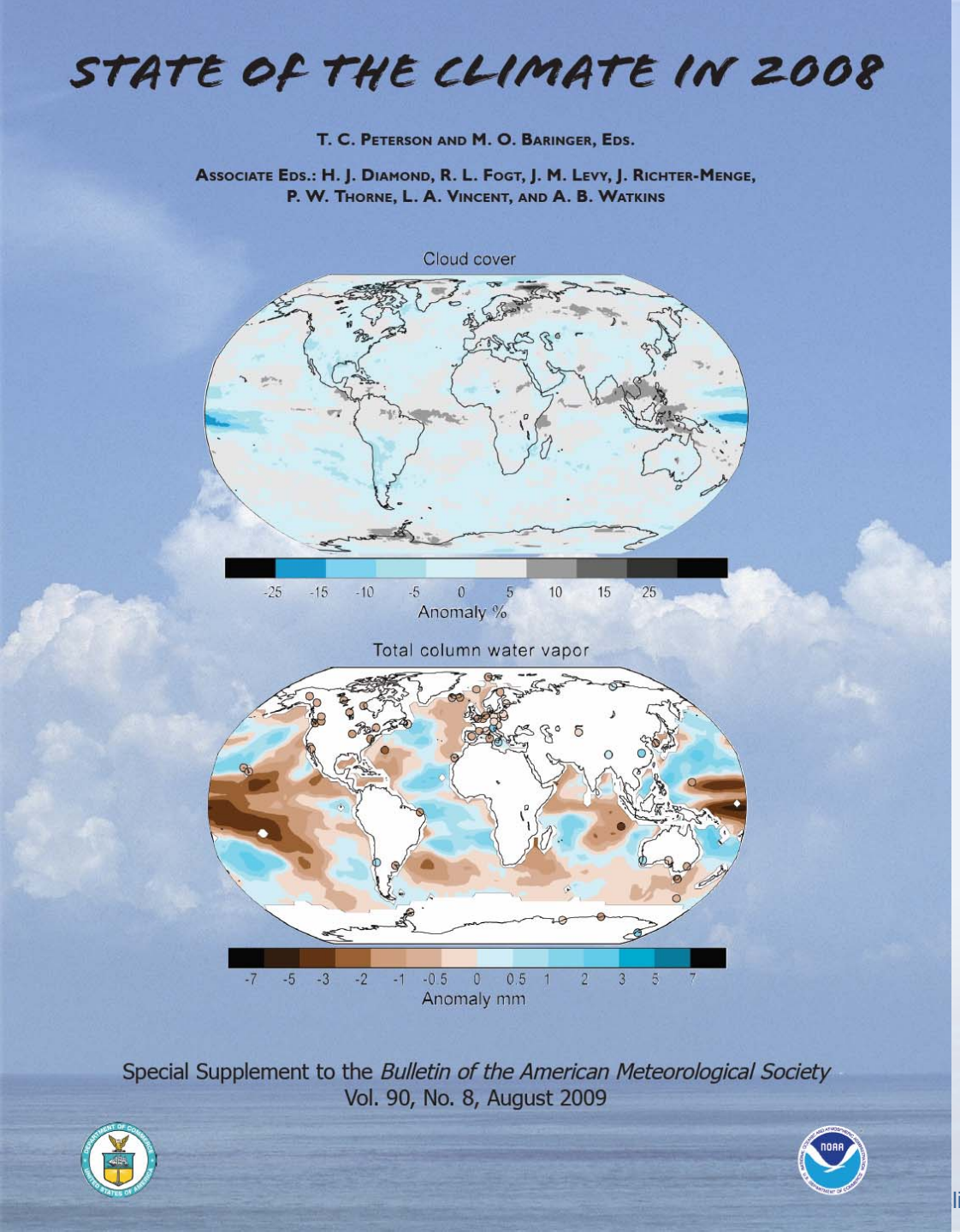
Climate Monitoring

- Provides information needed for effective planning
  - As well as for operations to respond to extreme events

Monitoring the Earth's climate

by Xiaolan L. Wang[1], Thomas C. Peterson[2], Jay Lawrimore[2], Manola Brunet-India[3], Randall Cerveny[4], Craig Donlon[5], Fatima Driouech[6], Wan A. Wan Hassan[7], Rainer Hollmann[8], Mark D. Schwartz[9], Zuqiang Zhang[10]

WMO Bulletin April 2008



Climate Monitoring State of the Art

- Annual review
- 196 pages
- 280 authors from
- 42 countries
- Peer-reviewed
- Published in the *Bulletin of the American Meteorological Society*
- NOAA/NCDC led with WMO

GCOS ECVs

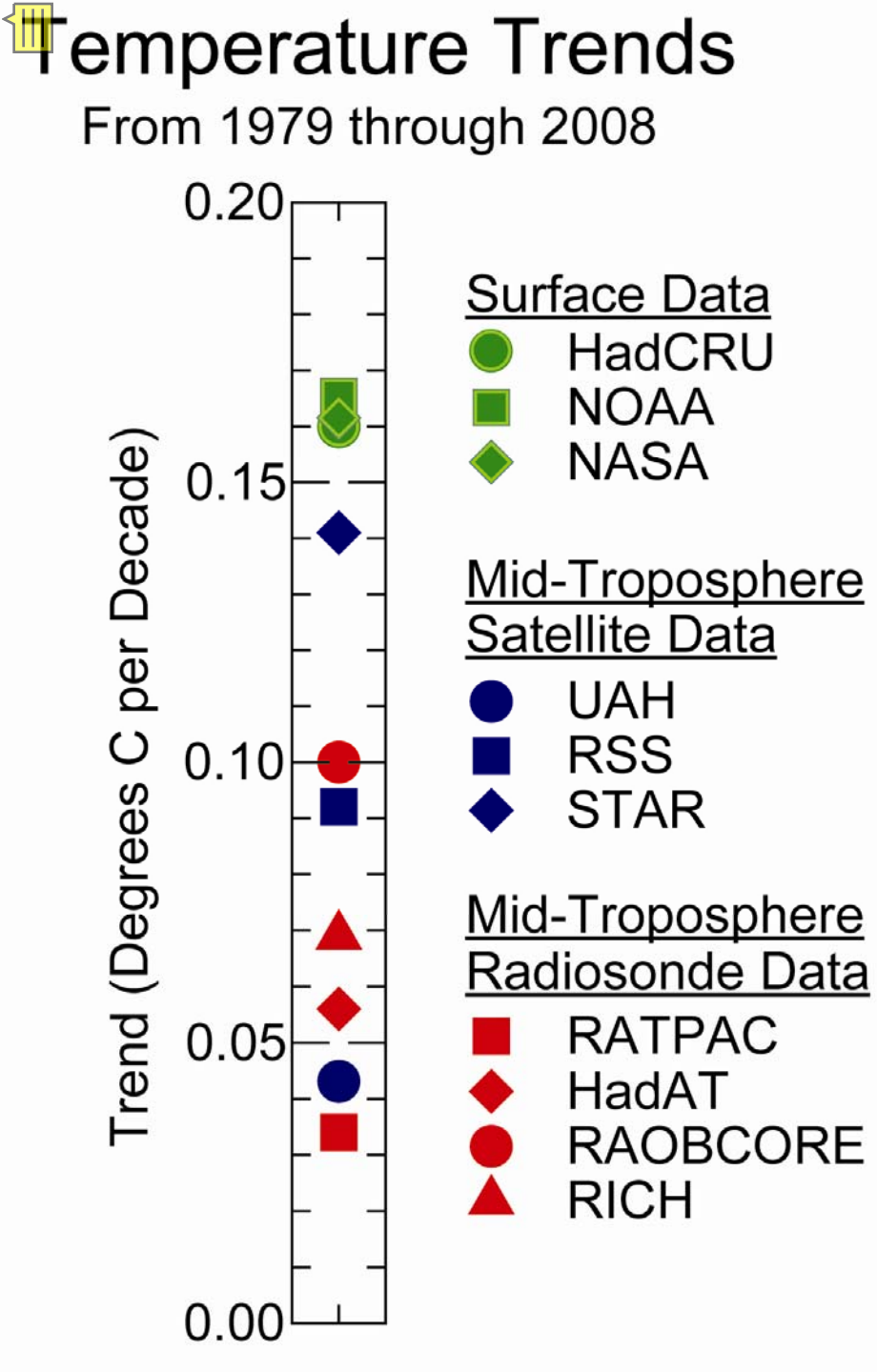
Atmospheric	Ocean	Terrestrial
Surface	**Surface**	Soil moisture (Emerging ECV)
Air temperature	Sea surface temperature	Snow cover
Precipitation	Sea surface salinity	Permafrost and seasonally-frozen ground
Air pressure	Sea level	Glaciers and ice caps
Surface radiation budget	Sea state	River discharge
Wind speed and direction	Sea ice	Water use
Water vapor	Current	Ground water
Upper Air	Ocean color	Lake levels
Earth radiation budget	Carbon dioxide partial pressure	Albedo
Upper-air temperature	**Subsurface**	Land cover
Wind speed and direction	Temperature	Fraction of absorbed photosynthetically active radiation
Water vapor	Salinity	Leaf area index
Cloud properties	Current	Biomass
Composition	Nutrients	Fire disturbance
Carbon dioxide	Carbon	
Methane	Ocean tracers	
Ozone	Phytoplankton	
Nitrous oxide		
Chlorofluorocarbons		
Hydrochlorofluorocarbons		
Hydrofluorocarbons		
Sulphur hexaflurorides		
Perfluorocarbons		
Aerosol properties.		

BAMS State of the Climate 2008

Not all GCOS Essential Climate Variables are currently being monitored

Climate Monitoring

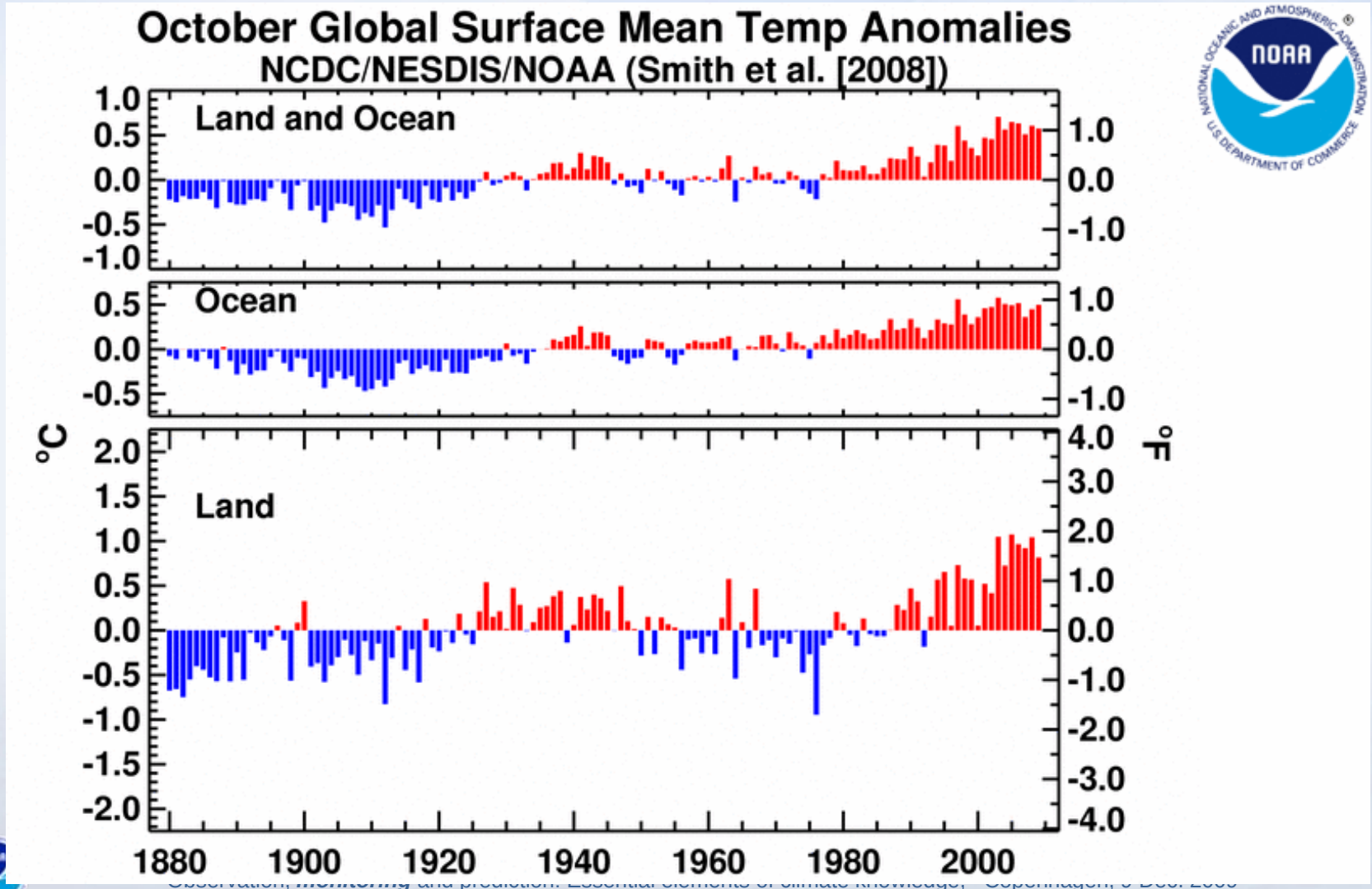
- Not as simple as launching a satellite or exchanging some data
- Data must be rigorously quality controlled to account for potential errors in data entry, transmission or instrument malfunction.
- Data must be processed to remove time-dependent biases
  - Such as the jump from one satellite to the next.
  - Or changes in sea surface temperatures from ships to buoys
- Peer-reviewed article describing data set creation approaches taken
  - But still no guarantee that it is accurate
    - Helps to compare to other data sets



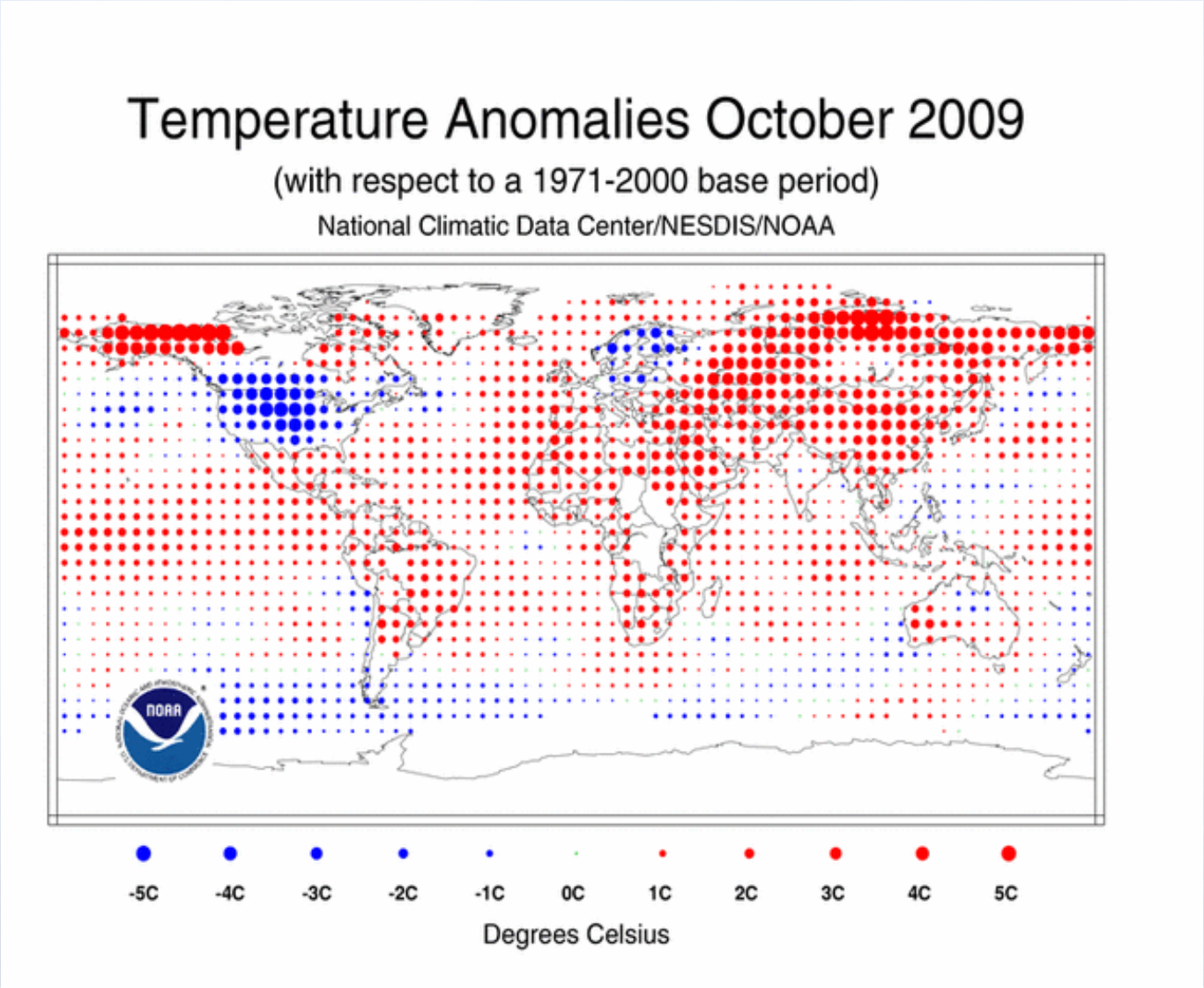
Data set agreement

- Surface temperature data agree very well
  - With very different approaches to address time-dependent biases
- Upper air data vary considerably
  - Both satellite and radiosonde data
  - A measure of structural uncertainty

Monitoring Annual Temperature: Accomplishments



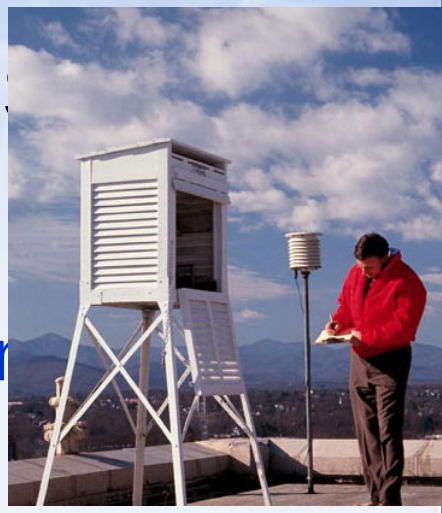
Monitoring Monthly Temperature: Accomplishments



Monitoring Daily Temperature: Challenges

- Can't globally monitoring daily temperature extremes
  - Yet extremes are more societal relevant than monthly average
    - Heat wave related to increased mortality
    - Cold extremes related to agricultural damages
- The same is true for precipitation extremes
  - Long-term droughts can be monitored
  - But heavy flood producing precipitation events often can not be monitored globally and put into accurate historical perspective

Challenge: Monitoring Temperature and Precipitation Extremes



- Requires daily data
  - Many countries are reluctant to exchan historical daily data
    - GCOS Surface Network exchanges some daily data
  - WMO Expert Team on Climate Change Detection and Indices is coordinating the calculation of a series of indices derived from daily data
    - Most countries are willing to release these derived indices
    - But first in country scientists needed to understand

Climate Extremes Workshops: Accomplishment

- Series of regional workshops held around the world primarily coordinated by the ETCCDI
- Hands-on teaching of data of data processing
  - Quality control, homogeneity testing
- Calculation of the indices

MONITORING CHANGES IN CLIMATE EXTREMES

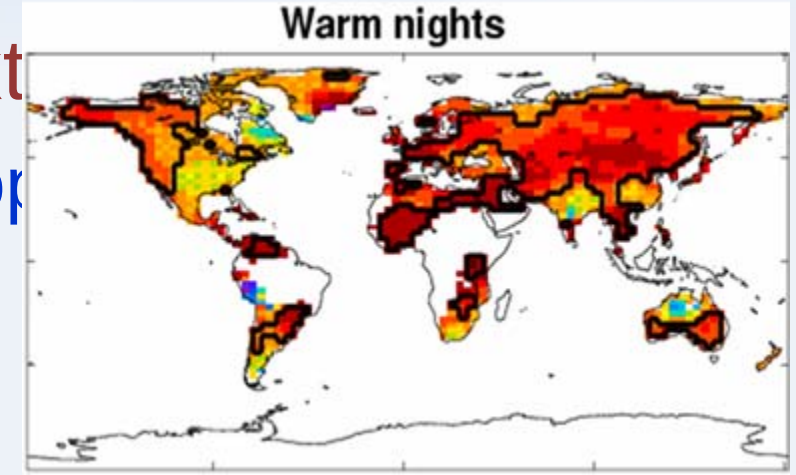
A Tale of International Collaboration

BY THOMAS C. PETERSON AND MICHAEL J. MANTON

Bulletin of the American Meteorological Society, September 2008

Challenge: Updating Historical Indices of Extremes

- Many countries now have the tools to monitor changes in ext
  - Thanks to the worksho



- Sharing updated indices is still very limited
  - But the reporting in the annual State of the Climate report is enhancing cross-border collaboration on climate monitoring.

Summary

- Real-time global climate monitoring poses tremendous challenges.
  - But international collaboration is continually improving our understanding of how the world's climate is changing.
- Society needs this information to help guide adaptation to climate change

See
www.ncdc.noaa.gov/climate-monitoring
for more information on climate monitoring, including pdfs of the annual *Bulletin of the American Meteorological Society's* State of the Climate