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Simple indices for monitoring climate extremes: an overview of ETCCDI activities related to climate extremes

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Climate Research Division

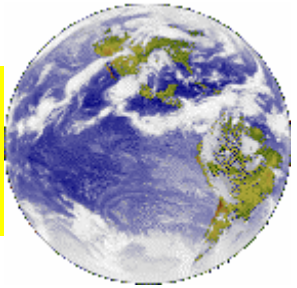
The ETCCDI

- CCl/CLIVAR/JCOMM Joint Expert Team for Climate Change Detection and Indices
- Current members
  - CCl: Brad Garanganga, Albert Klan Tank (co-chair), Blair Trewin, Xuebin Zhang
  - CLIVAR: Phil Jones, David Karoly, Gabriele Hegerl, Francis Zwiers (co-chair)
  - JCOMM: David Parker, Elizabeth Kent, Val Swail, Scott Woodruff

The nature of problem and two-pronged solution

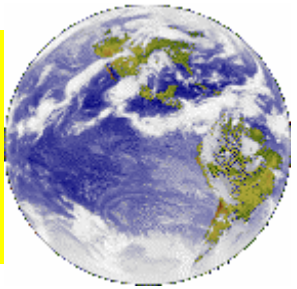
- The problem
  - IPCC SAR (1996): *available data and analyses inadequate for assessment of global changes in extreme climate events*
  - *Monitoring many of extremes require daily data which were unaviable*
  - *Analyses limited to few countries*
- Solution – two approaches taken by the ET in 1999
  - Internationally coordinating the exact formulation of a suite of agreed indices of climate extremes from daily data
  - Promote the analysis of extremes around the world by organizing regional climate change workshops
- Software and indices data available at
  http://cccma.seos.uvic.ca/etccdi

Simple indices



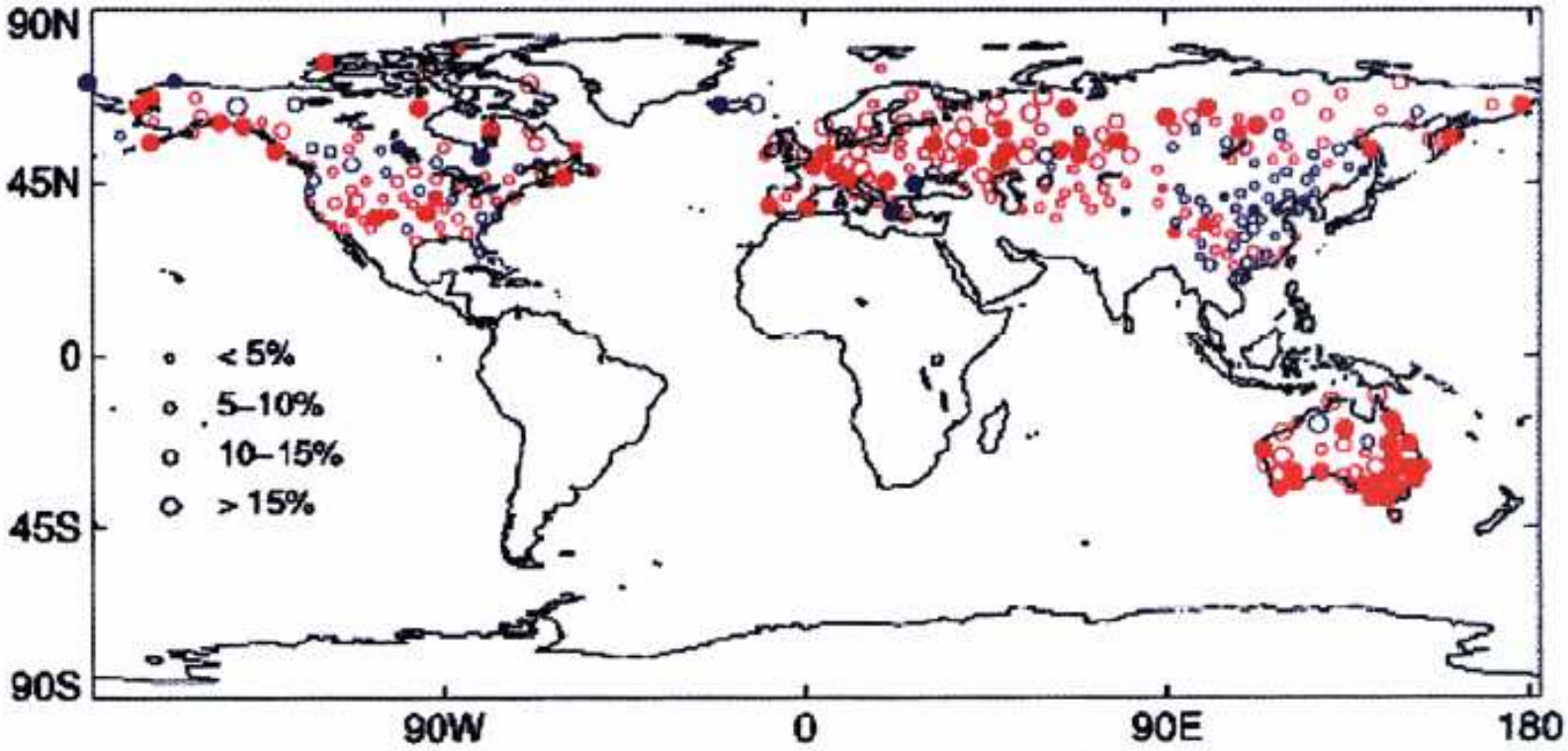
- Time series of annual counts or exceedences
  - E.g., number of exceedence above 90th percentile
    - Some studies use thresholds as high as 99.7th percentile
- Coupled with simple trend analysis techniques or standard detection and attribution methods
  - Detected anthropogenic influence in observed surface temperature indices
  - Perfect and imperfect model studies of potential to detect anthropogenic influence in temperature and precipitation extremes

Indices approach is attractive for practical reasons - basis for ETCCDI strategy



Percent of time Tmin > 90th percentile (194 Tn90)

Change (%) between two multi-decadal averages during 2nd half of 20th Century



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

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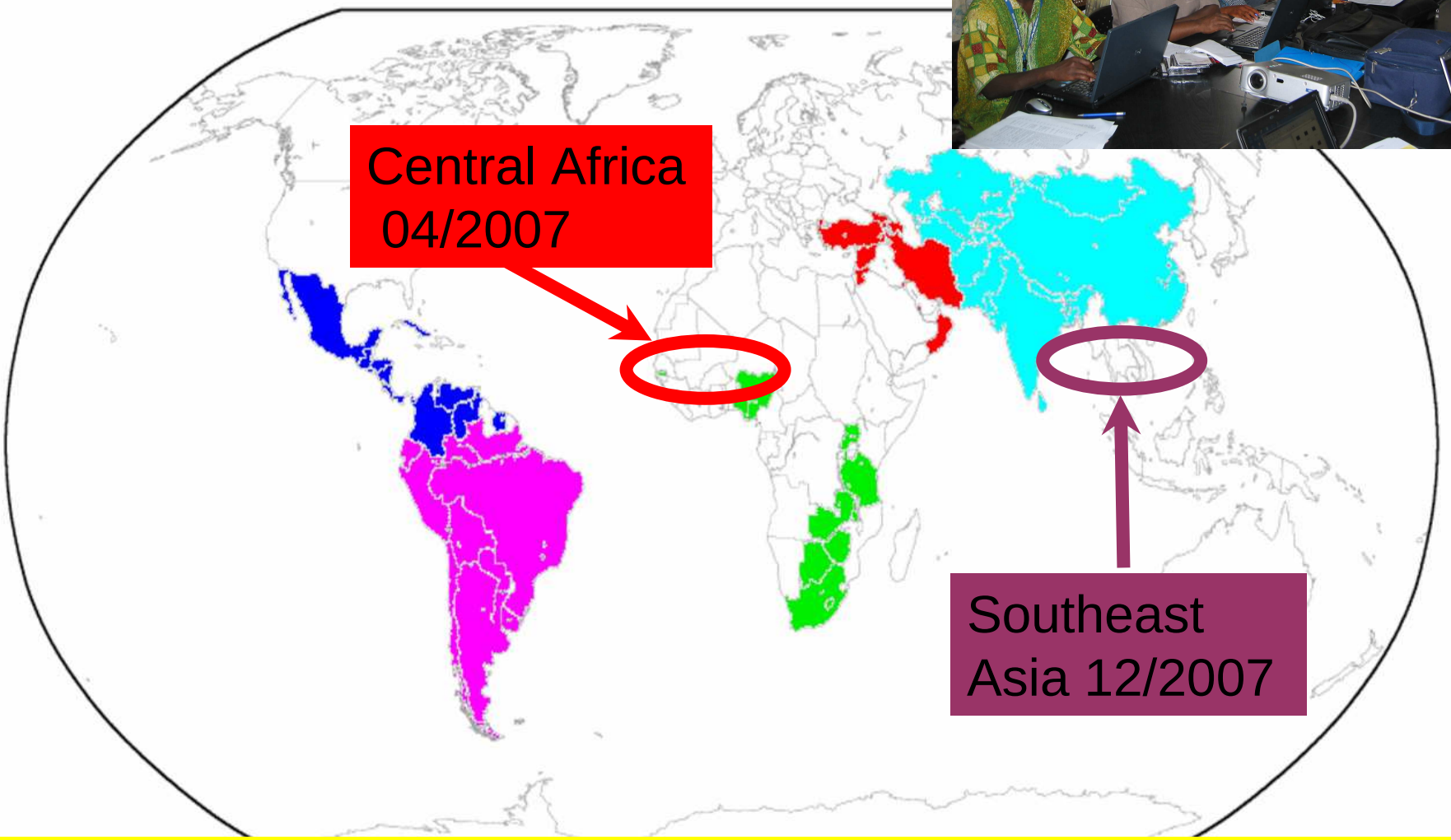
WMO ETCCDI Workshops

Working together



ETCCDI coordinated efforts contributed significantly to the IPCC AR4

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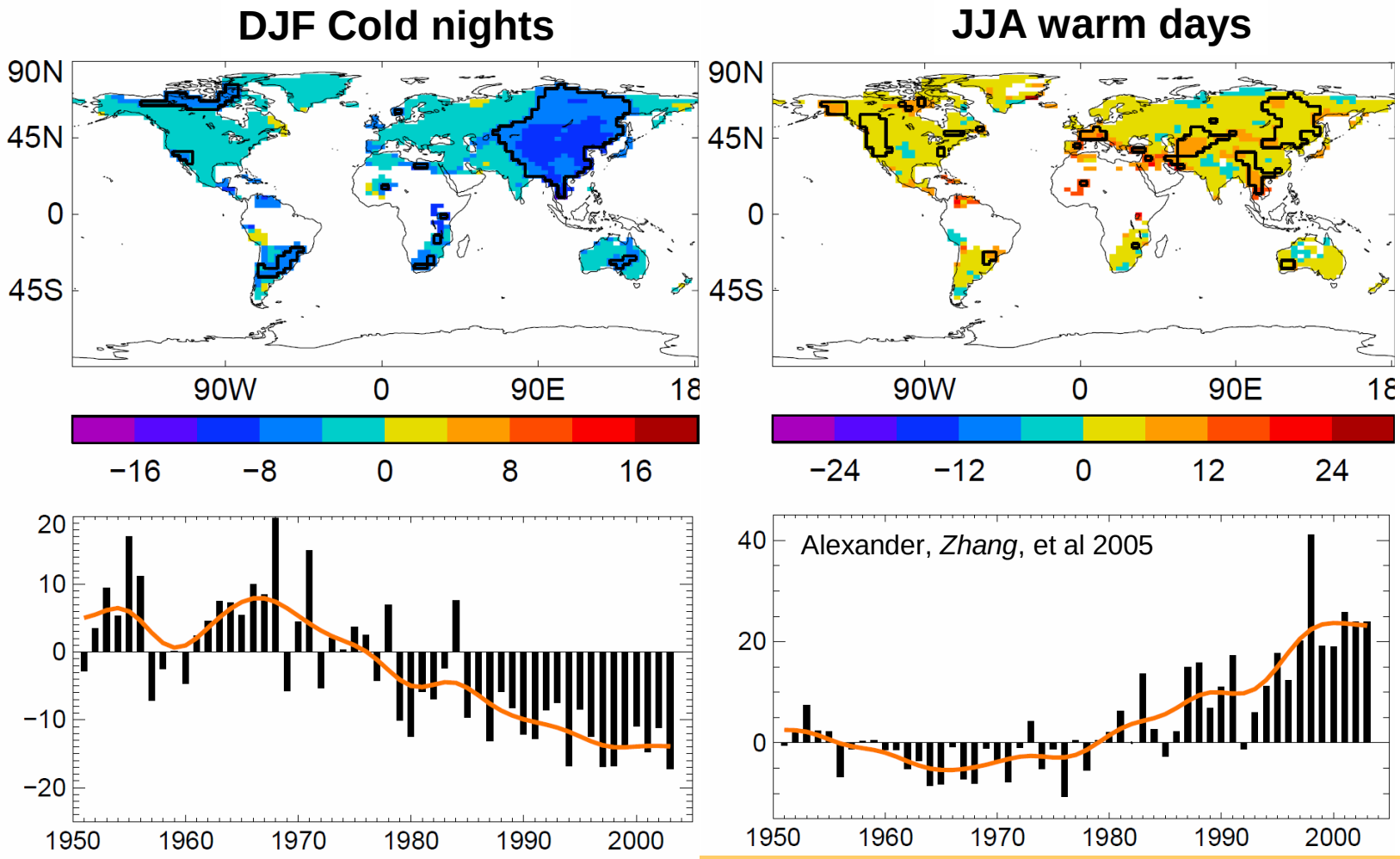
Indices of temperature “extremes”



- Anthropogenic influence detected in indices of cold nights, warm nights, and cold days

Christidis, et al 2005

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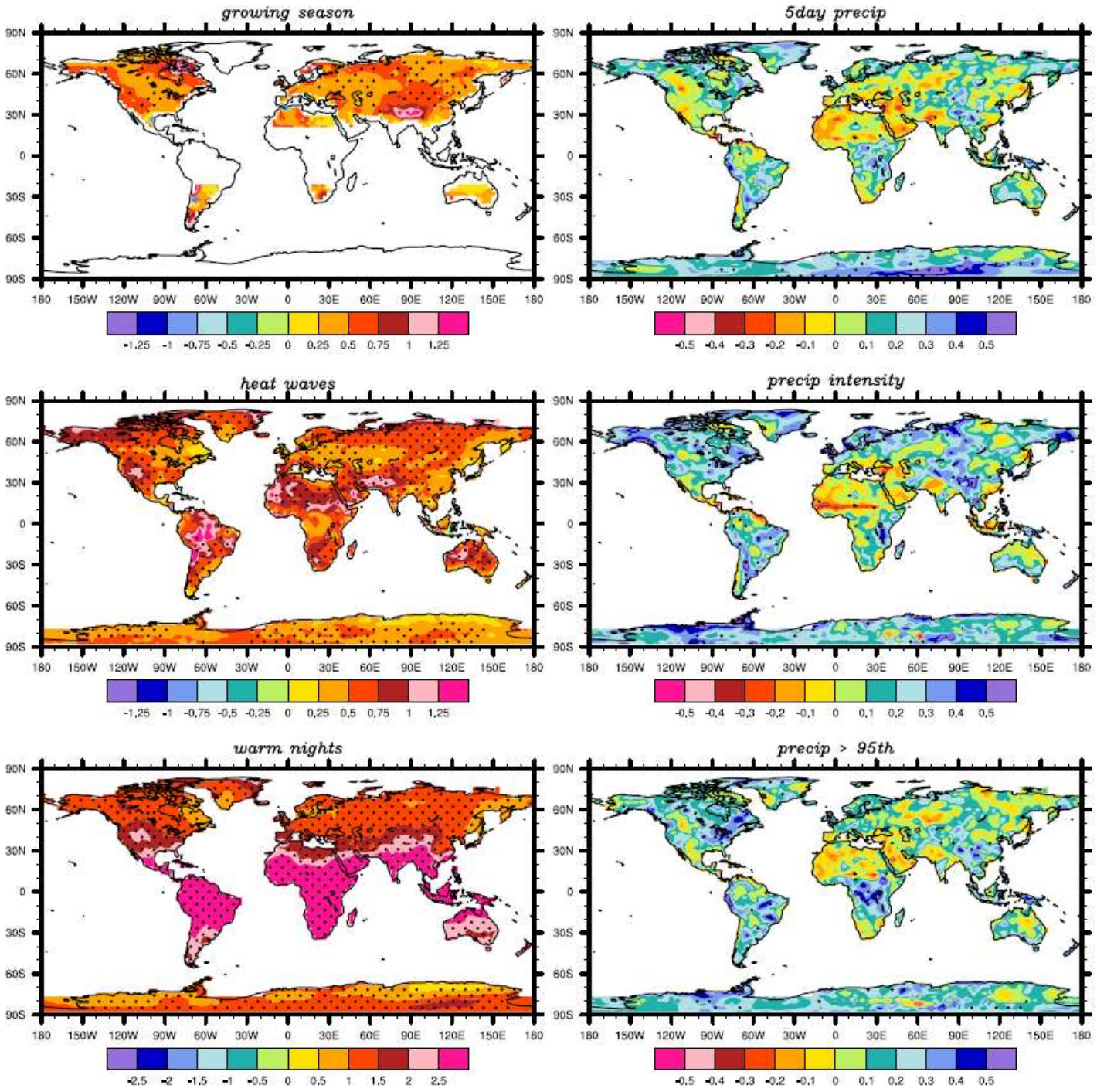

Tebaldi et al.
2006

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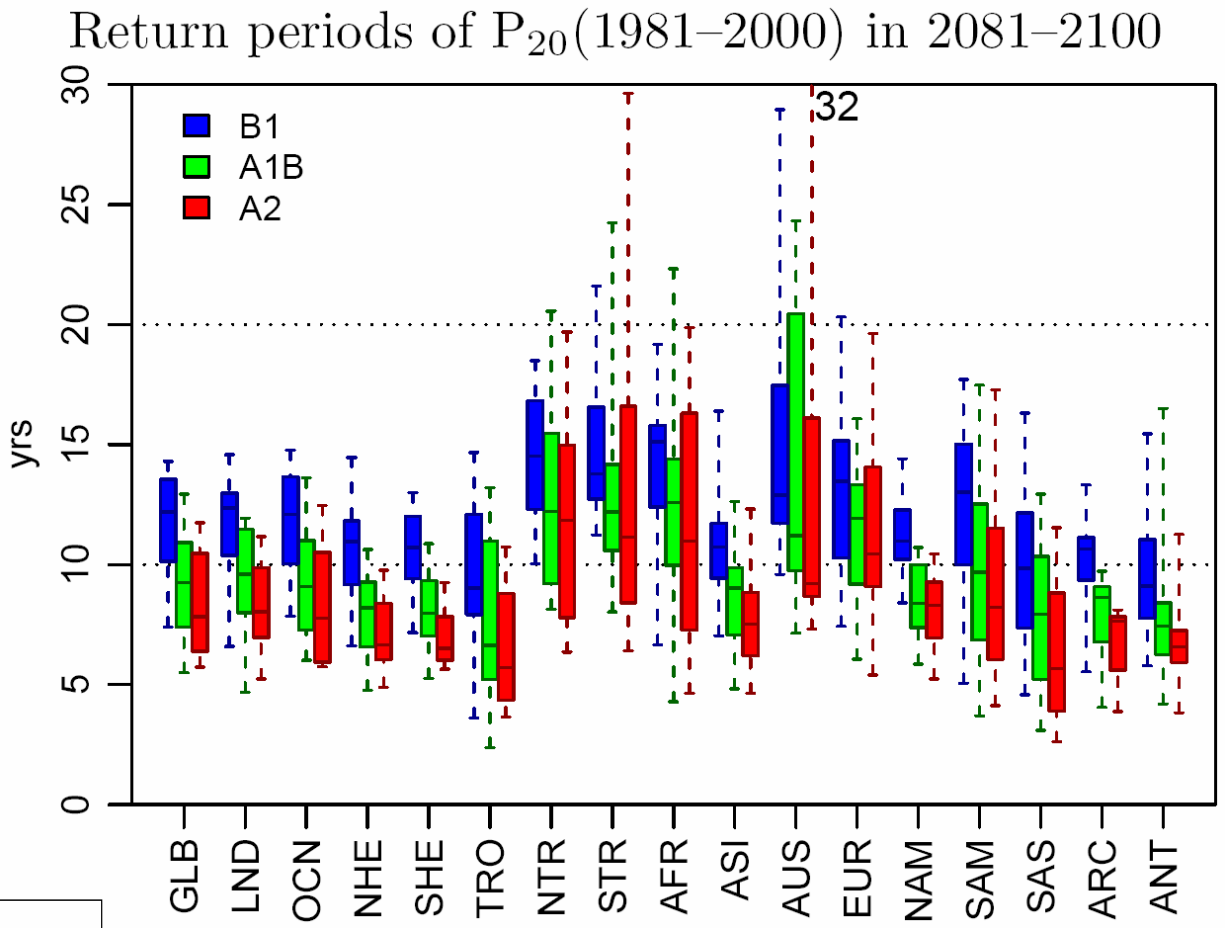
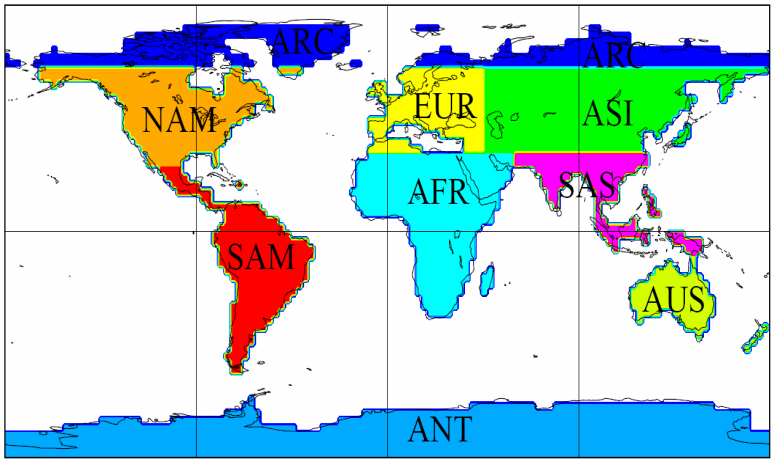
Projected waiting time for current climate 20-yr 24-hr PCP event





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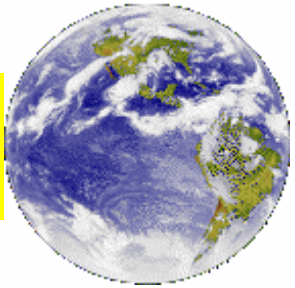
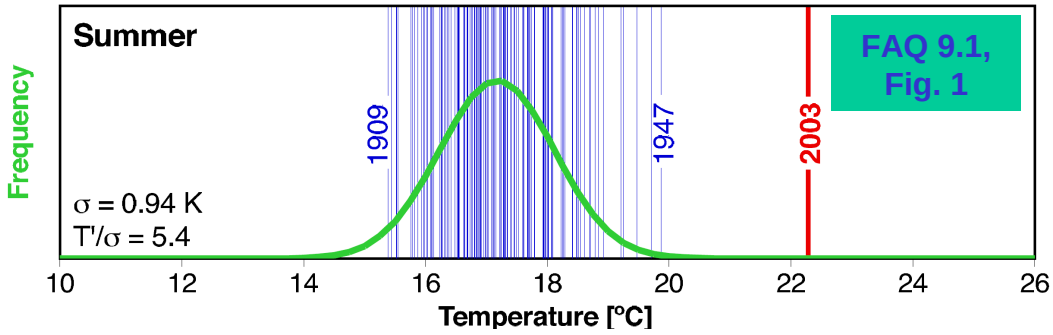
Surface temperature extremes



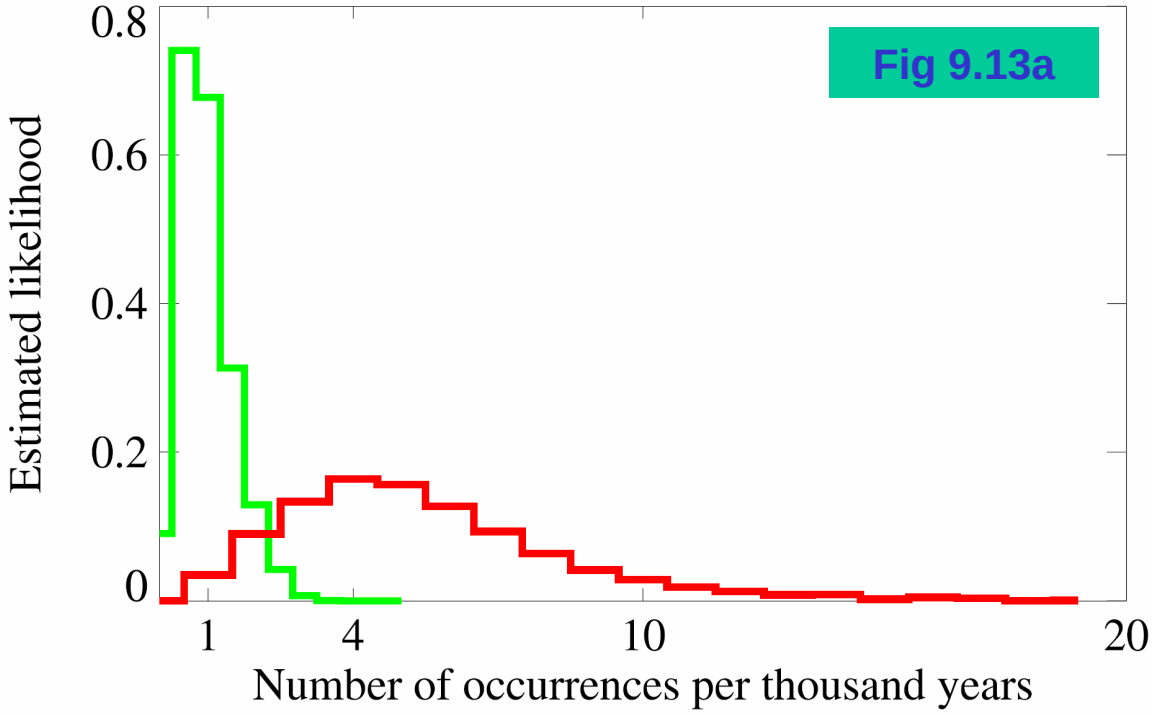
Human influence:

- Has likely affected temperature extremes
- May have increased the risk of extremely warm summer conditions regionally.



Risk of extreme warm European summer in 1990s (1.6°C > 1961-90 mean):

- **natural forcing only**
- **"all" forcing**



Issues

- Indices calculation and analysis
  - “resolution” of observational data
  - adaptation of threshold to base period
  - use of simple analysis techniques that implicitly assume data are Gaussian
- Data coverage rather messy, indices update problematic
- Scaling issue
  - point observation and model grid
  - what to compare model output against

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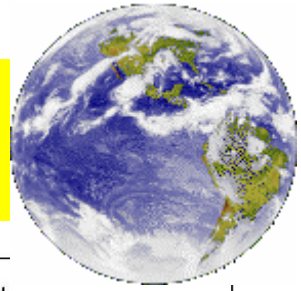
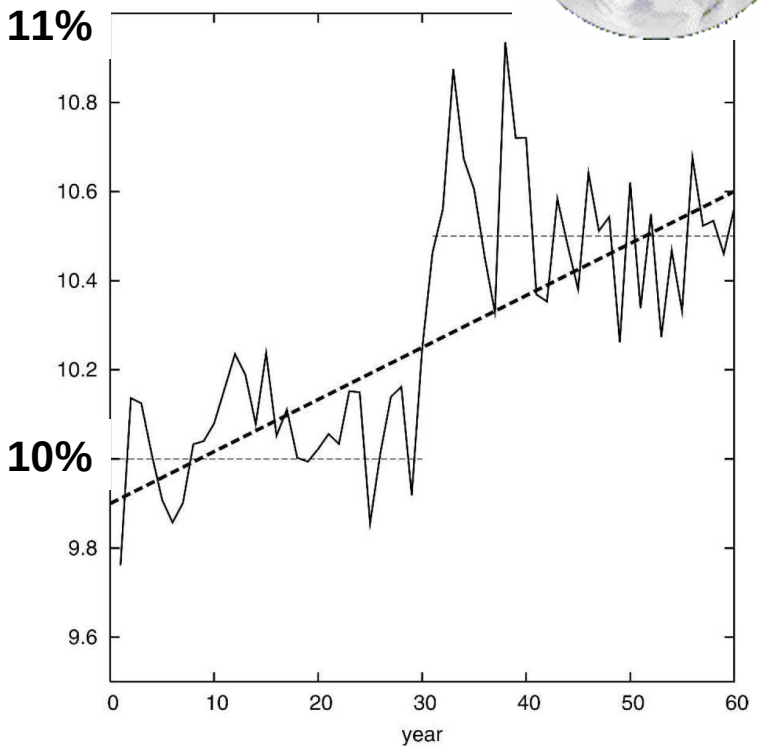
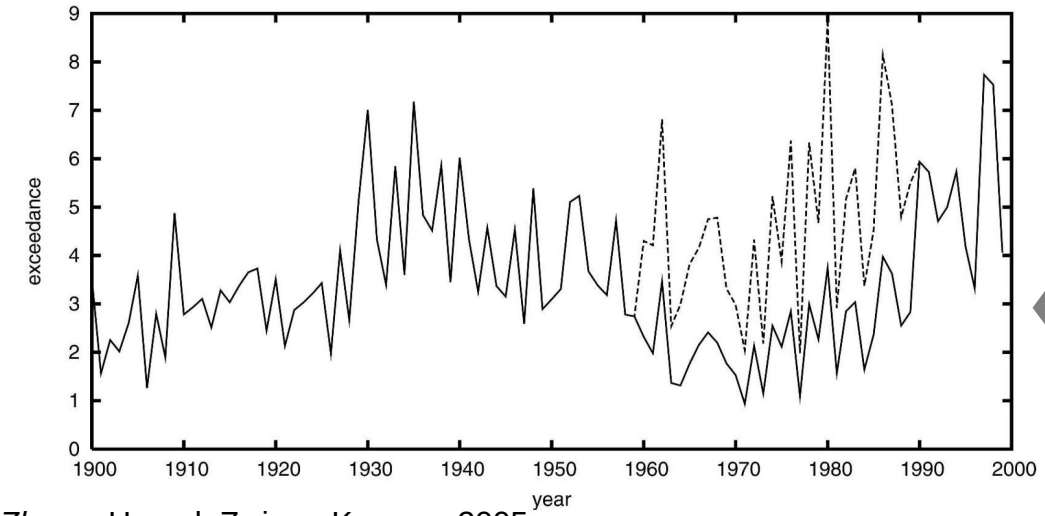
Some simple indices not so simple …



Rate at which 90th percentile is exceeded in simulated 60-year records
(when threshold is estimated from first 30-years)

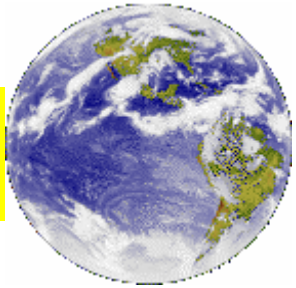


Number of days per year in Canada with temperature above 99th percentile



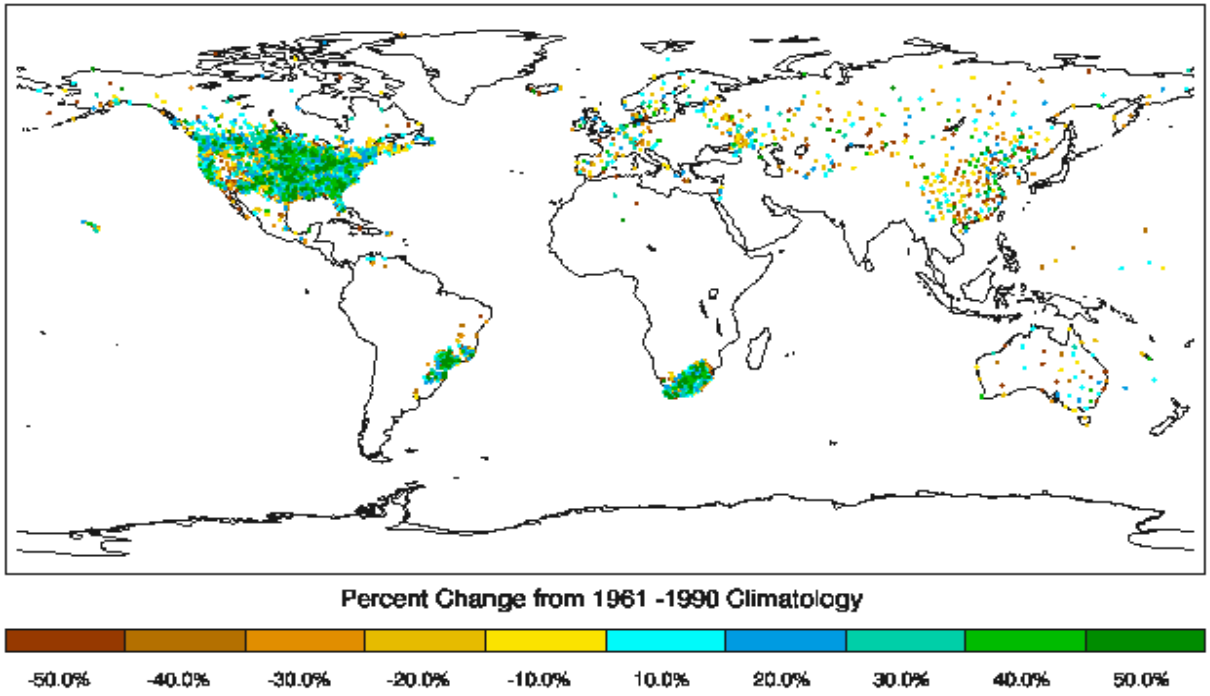
Zhang, Hegerl, Zwiers, Kenyon, 2005

Observational data rather messy

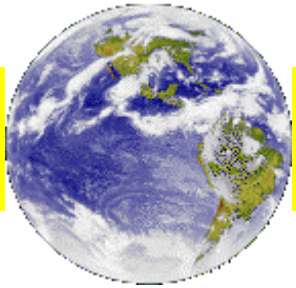


- Uneven availability in space and time
- Weak spatial dependence
- Spatial averages over grid boxes may not be good estimates of “grid box” quantities simulated by climate models

Trend 5-day max pcp 1950-99 (data: Alexander et al. 2006)



Summary



- **Workshops successful but need to worry about updates**
- **Good progress but issues remain**
- **Formal climate change detection studies on extremes beginning to appear despite challenges …**
- **Comparison between models and observation still a challenge**
  - **Data availability**
  - **Point ~ area mean**
- **Also attempting to estimate FAR (Fraction of Attributable Risk) in the case of "one-of" events**
  - How does one pose the question and avoid selection bias?