Climate Variability and Observed Change in Southern Africa

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Introduction

- *Climate change can be described as shift in long-term mean or change in occurrence of extreme events.*

- *Frequencies of extremes can change over long-term; due to shift in mean and/or increase in variability.*

- *Society experiences climate change primarily through increased intensity / frequency of extreme weather events.*

- *In general: Expectation of more frequent and intense warm events, and less frequent cold events.*

- *Regional differences in magnitudes of climate change evident → need for historical trend studies to cover as much of the globe as possible.*

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Identification of historical climate trends

Challenges:

- Data quality,

- Available parameters – rainfall and temperature most widely measured. Other parameters increasing in importance: e.g. wind for wind energy potential and proper design of infrastructure – limited long-term measurements available.

•Metadata (e.g. move of stations, instrument types, changes in exposure, roughness etc.)

•Lengths of records,

•Spatial density,

- Optimal assessment of trends => max period with sufficient density of continuous measurements;

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Observed trends

- The determination of historical climate change important for:
  1. Identification of regions which has become stressed,
  2. Verification of climate models.

- Focus on mean trends & trends in extremes.

- Internationally recognised indices - developed by WMO ETCCDI.

Index	Description	Units
TX90P	Annual percentage of days when TX > 90th percentile	%
TX10P	Annual percentage of days when TX < 10th percentile	%
TXx	Annual maximum value of TX	°C
TXn	Annual minimum value of TX	°C
WSDI	Annual count of days with at least 6 consecutive days when TX > 90th percentile	d
TNx	Annual maximum value of TN	°C
TNn	Annual minimum value of TN	°C
TN90P	Annual percentage of days when TN > 90th percentile	%
TN10P	Annual percentage of days when TN < 10th percentile	%
CSDI	Annual count of days with at least six consecutive days when TN < 10th percentile	d

WMO extreme temperature indices applicable to South Africa

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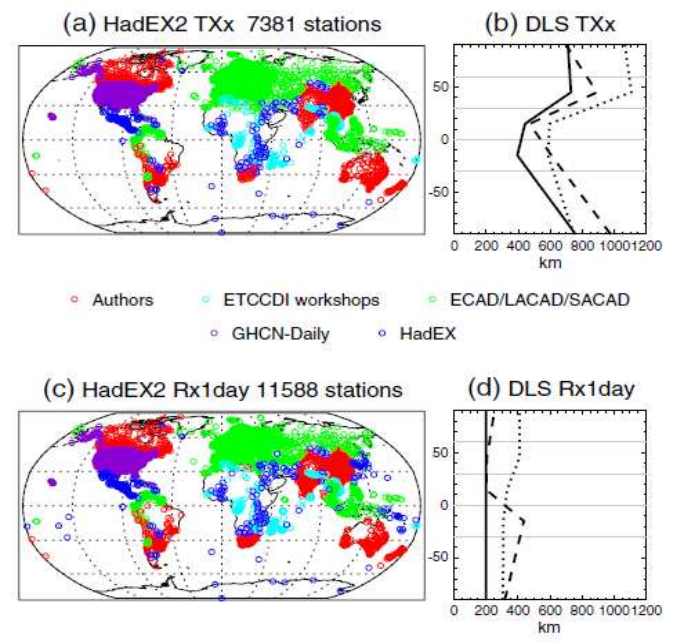
Global Analyses

•HadEx and HadEX2 datasets – collation of data & analyses with WMO indices

•HadEX2 - Donat *et al.* 2013.



Data sources for HadEX2 – Donat *et al.* 2013

•Largest gaps in sparsely populated regions, e.g. Africa, Amazon basin

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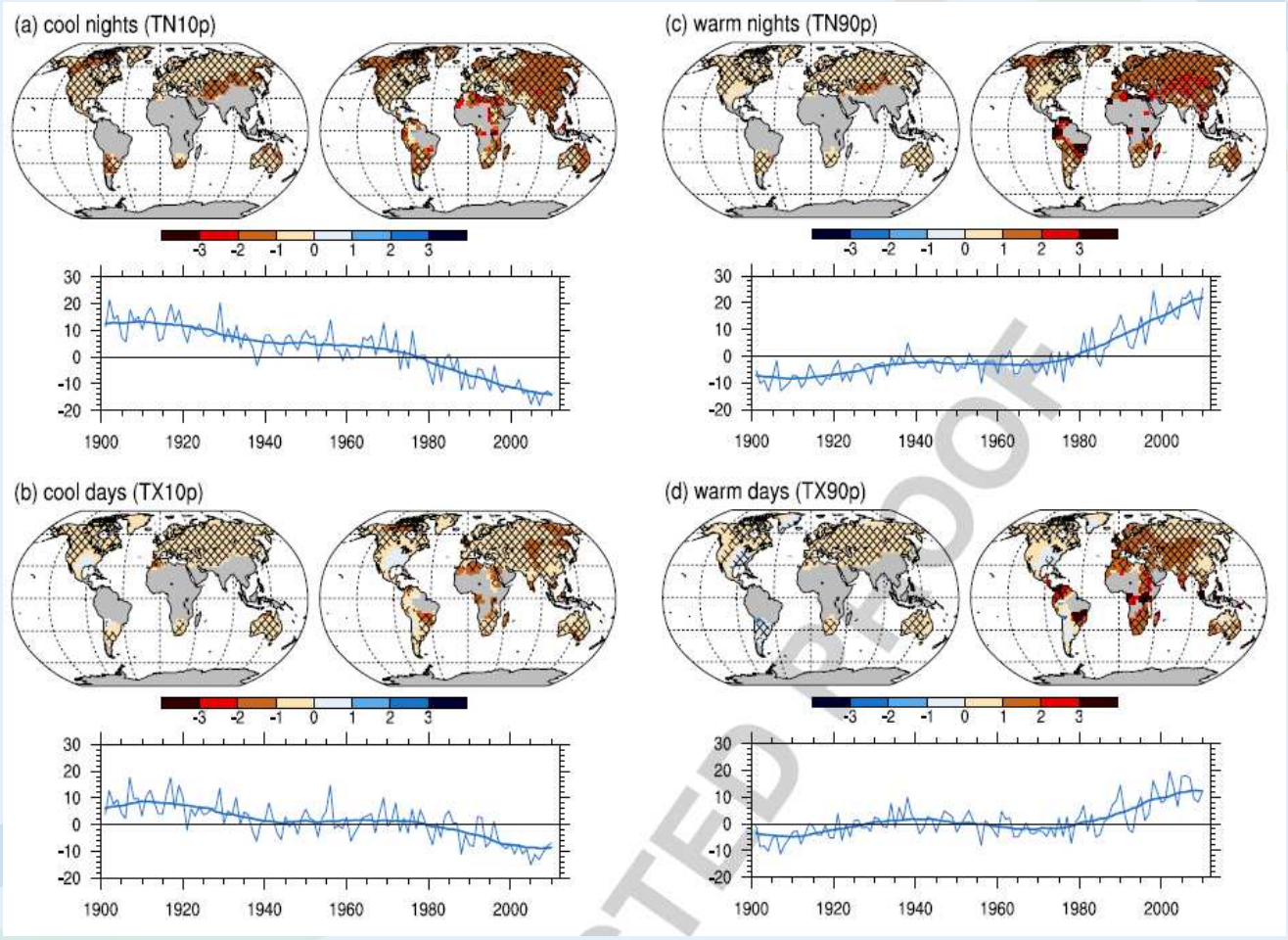
Temperature extremes

•Global and regional trends:

- Max temps: Annual number of days increased; cool days decreased
- Min temps: Cool nights decreased, warm nights increased.
- Southern Africa – stronger trends for 1951-2010 vs. 1901-2010.



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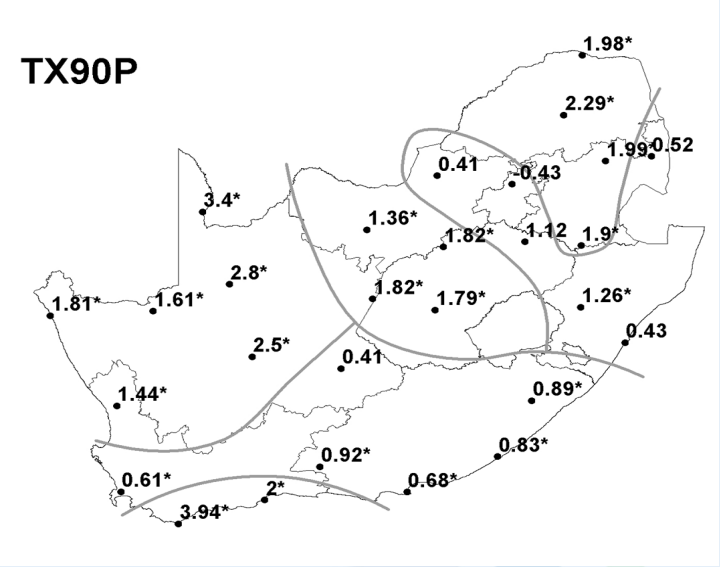
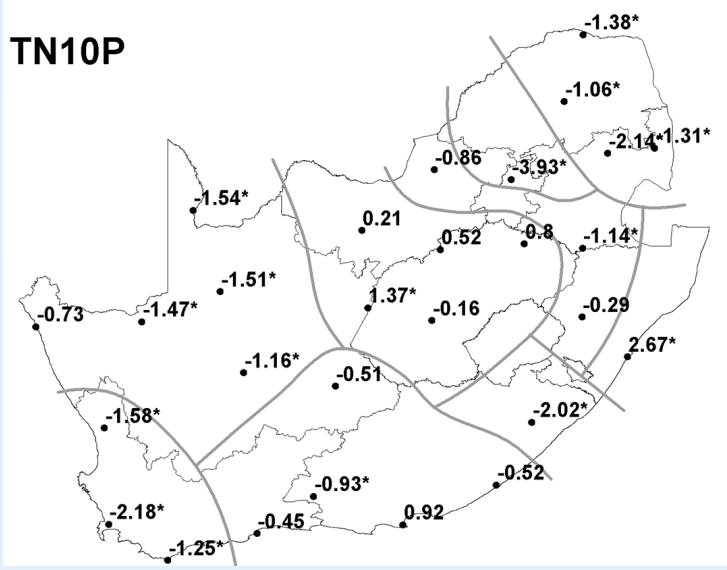
- South Africa: 1961 – 2010 (28 stations) (Kruger & Sekele, 2012):
  - Spatially variable results, but general increase of warm days and nights (Tx90P and Tn90P) and decreases cold days and nights (Tx10P and Tn10P);
  - N and S Cape => greatest increases: Warm days (TX90P): 2 – 4 days / decade:





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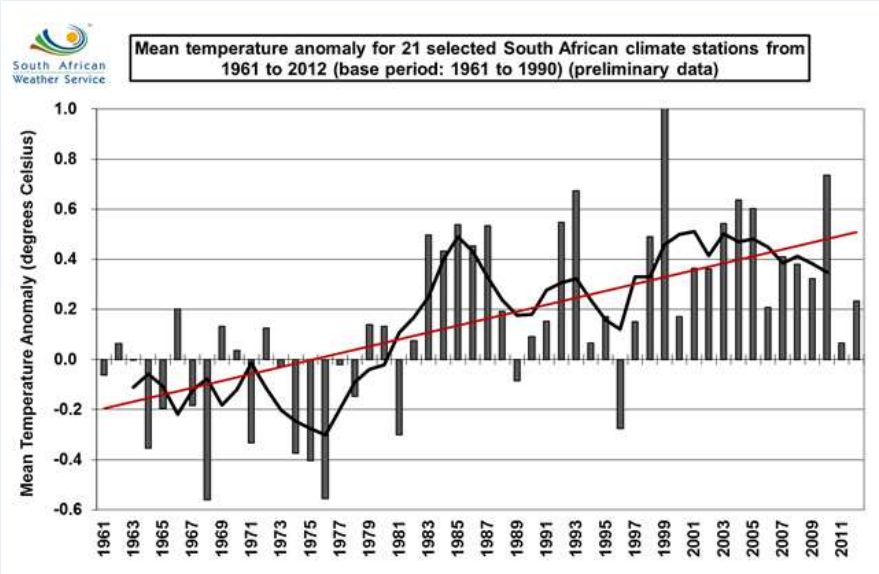
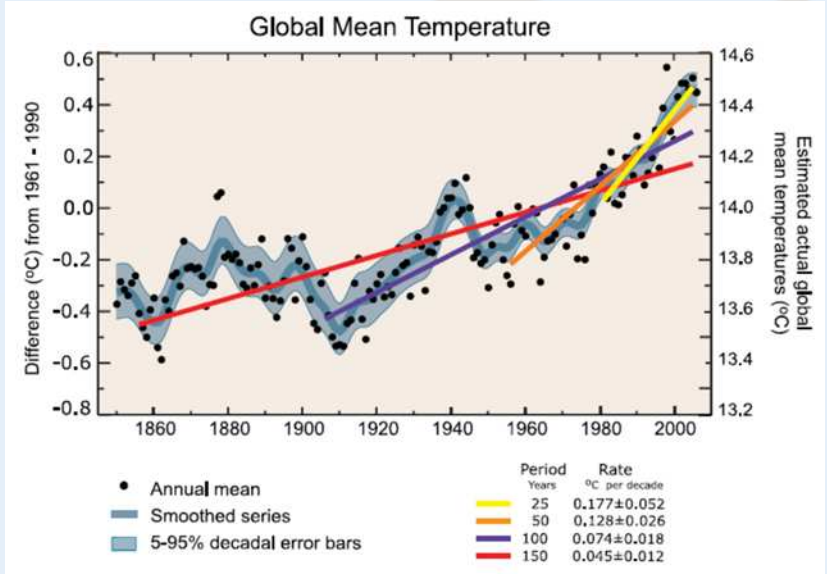
- South Africa - mean trend +- 0.174℃ / decade (1961 – 2010)
- Similar to increasing global trend +- 0.177℃ / dec ade





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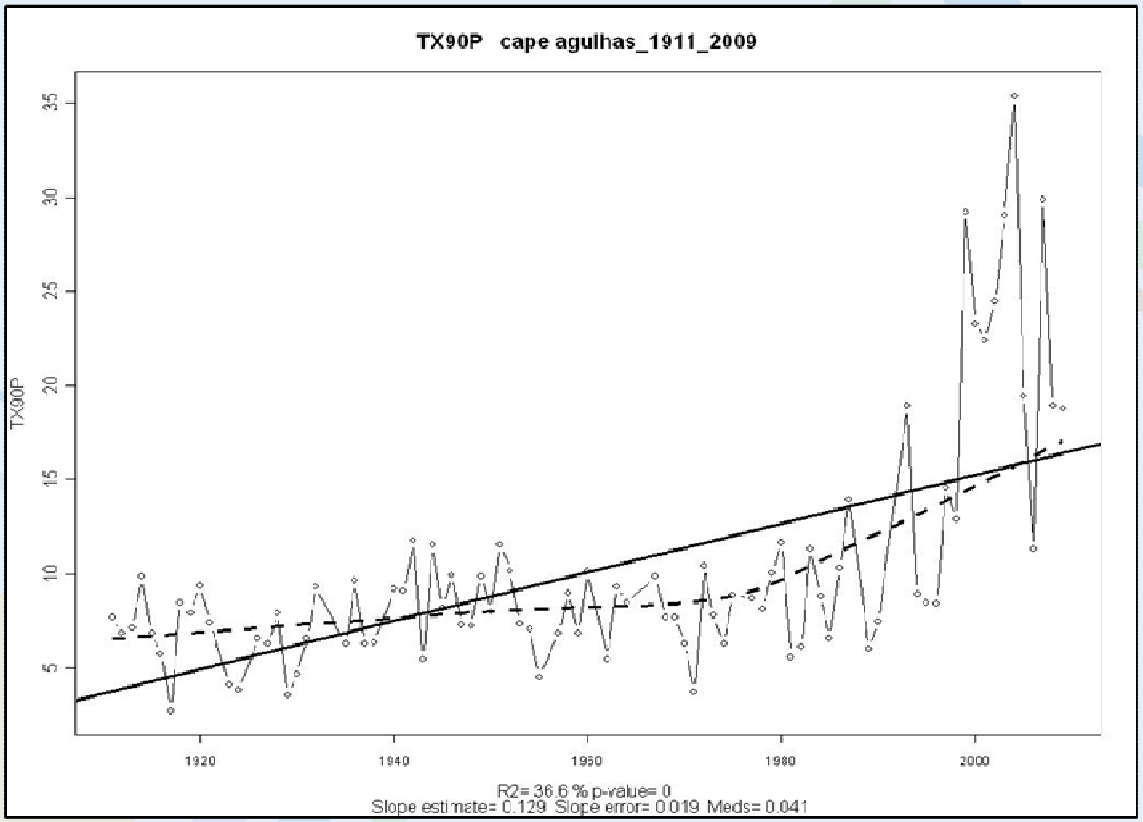
- Analyses of longer time series => confirm likelihood that warming accelerated since the mid-1960's;



Increase in number of warm days at Cape Agulhas: 1911 – 2009.

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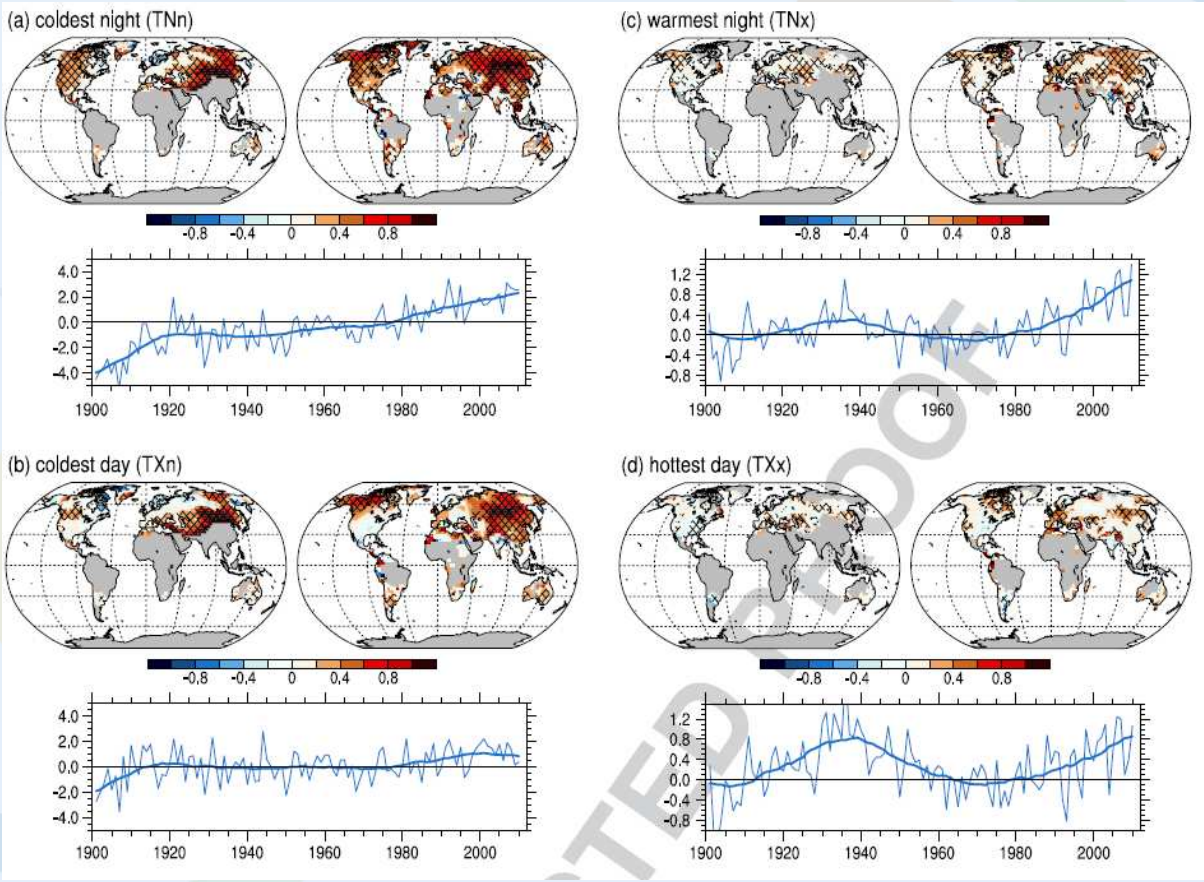
Annual extremes

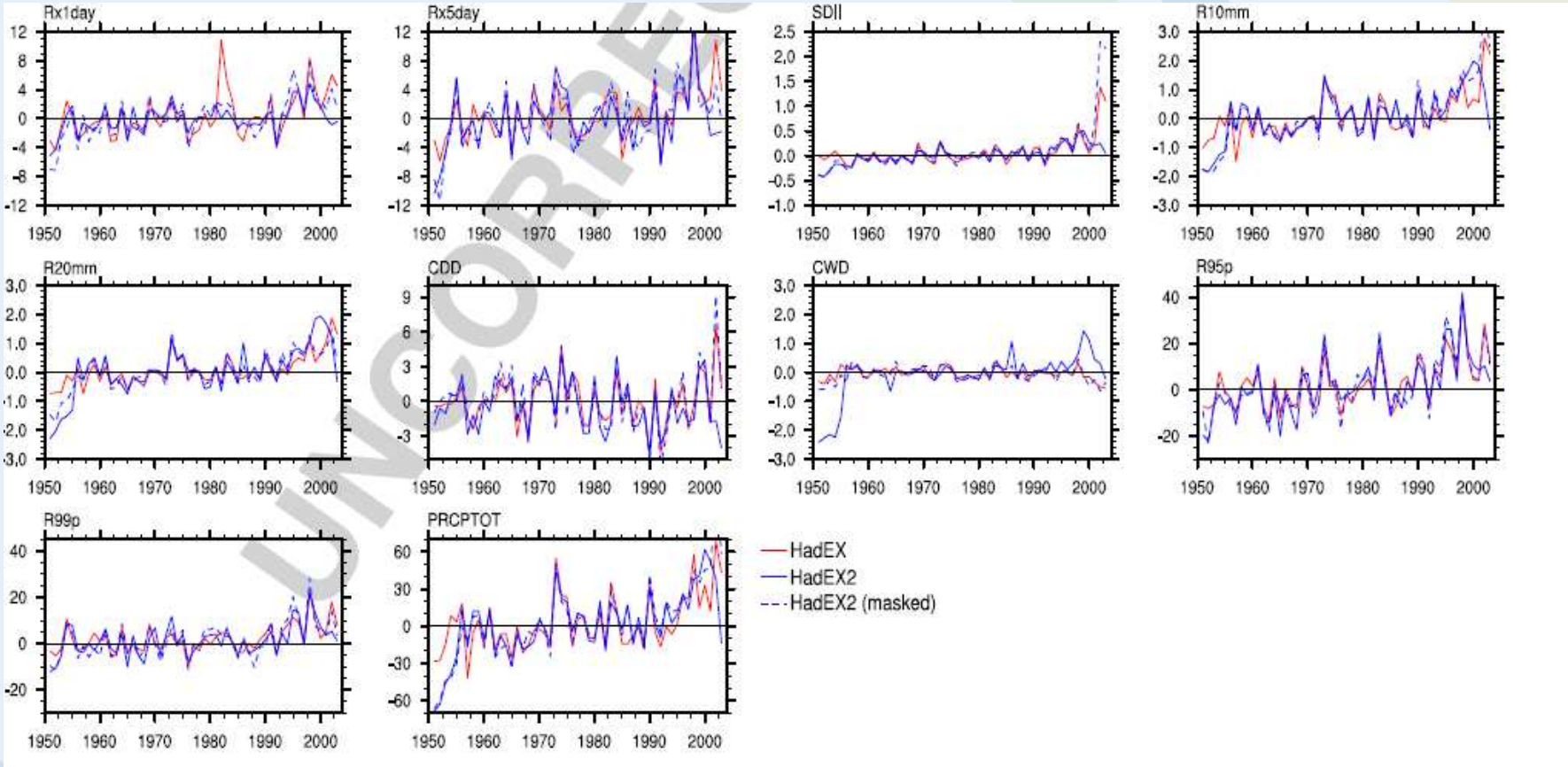
•Annual maximum and minimum temperature

- Weaker global signal
- Fewer regions with significant trends
- Extreme temperatures not always attributable to anthropogenic climate change
- E.g. southern Africa – no regional significant trends.



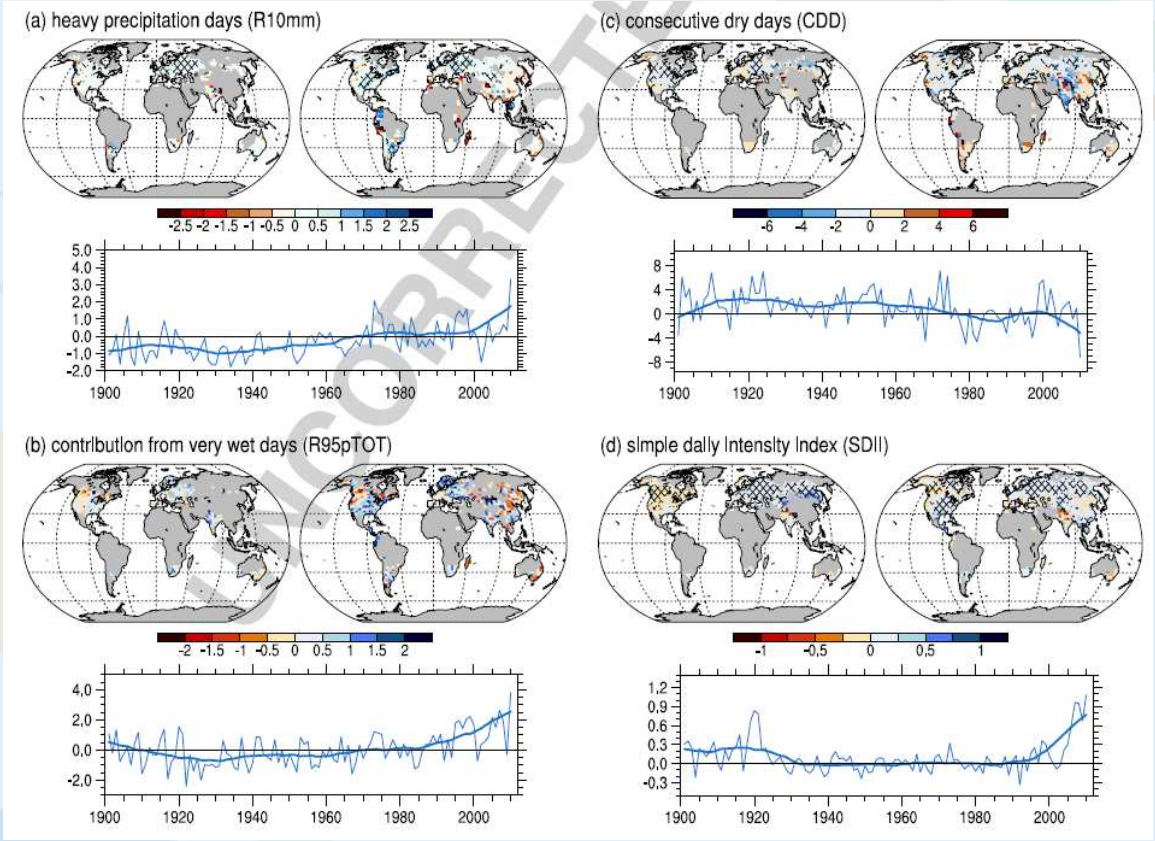
Precipitation

- WMO indices:

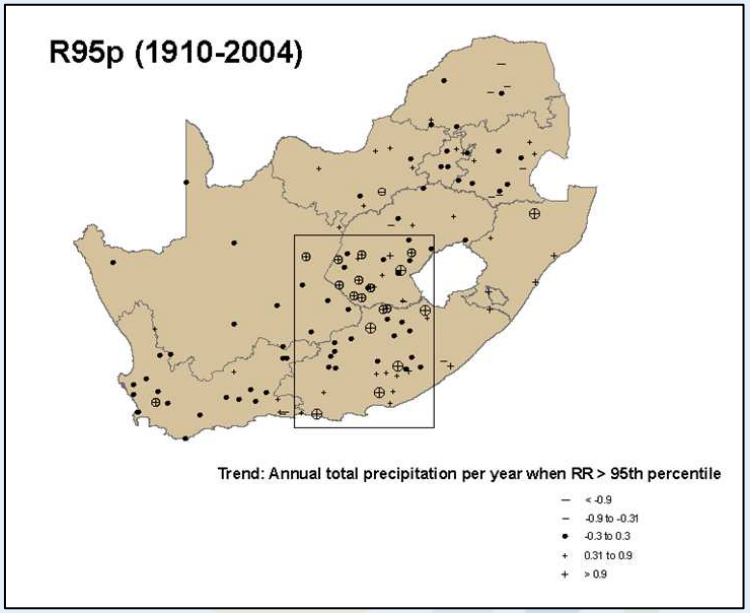


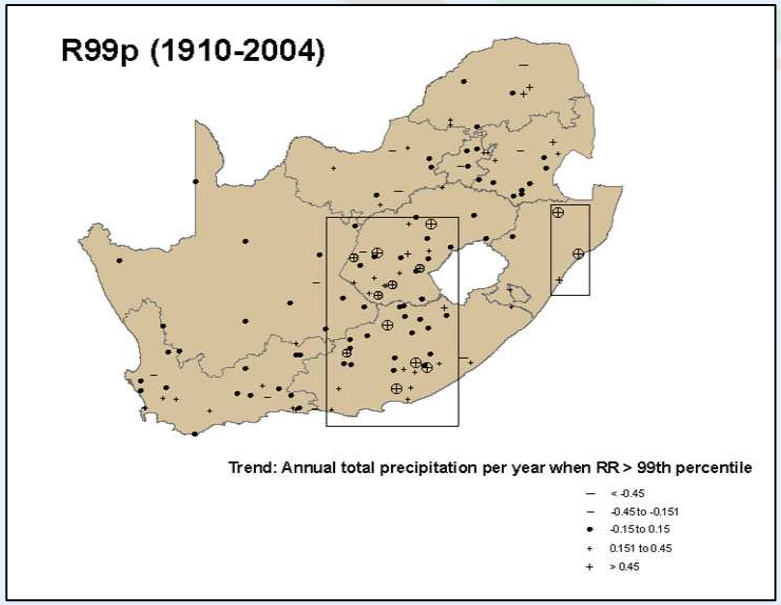
WMO extreme precipitation indices and global mean results

- Tendency toward wetter conditions;
- Intensity, frequency, and duration of extreme precipitation is increasing on average;
- Results spatially highly variable – regional results of extreme indices limited to South Africa.



- 1910 – 2004 study: Region covering S Free State and most of Eastern Cape province: Significantly positive trends in amount of annual precipitation from extreme daily events.





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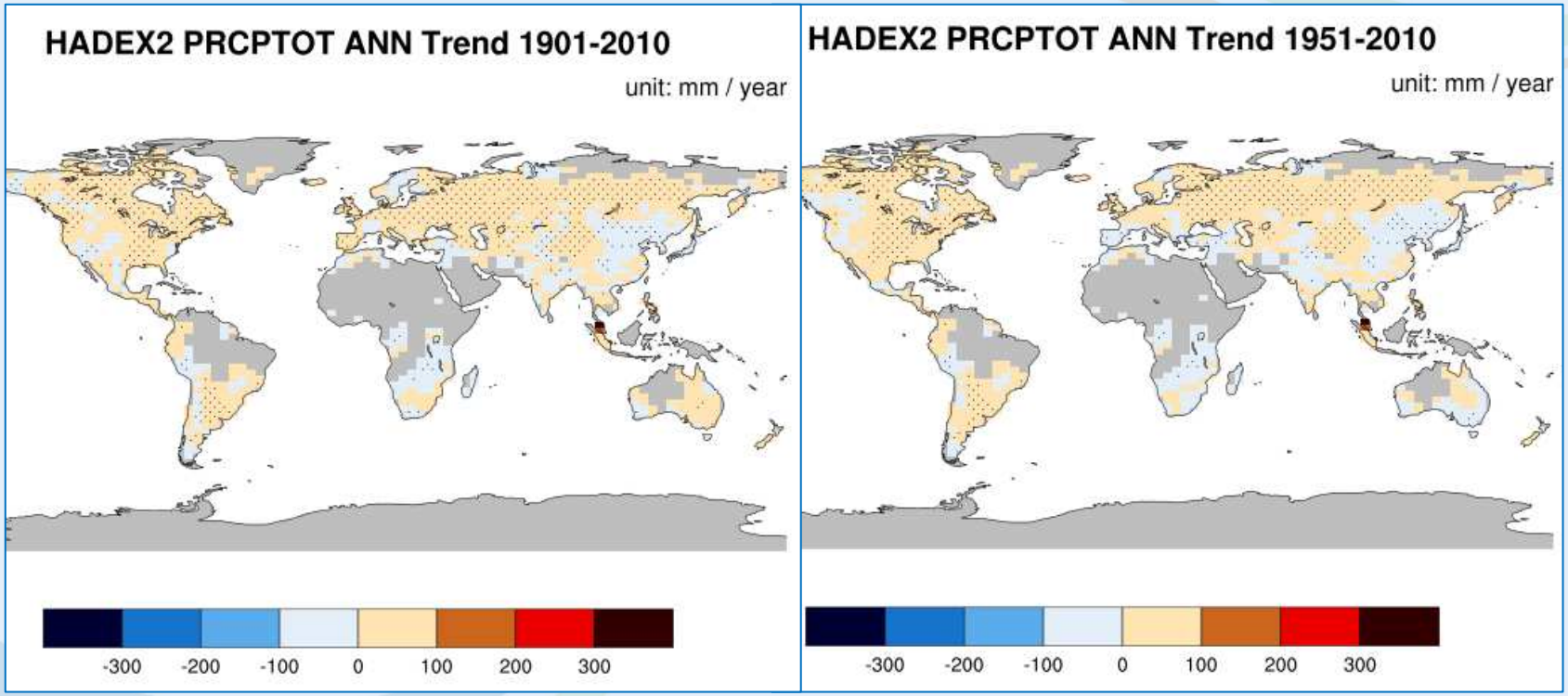
Total precipitation

- Southern Africa: 1901 – 2010 – wetter to north and south, dryer in central parts (central S Africa, parts of Mozambique),
- Weaker trends for 1951-2010 vs 1901-2010,
- Most results statistically insignificant,



Source: http://www.climdex.org

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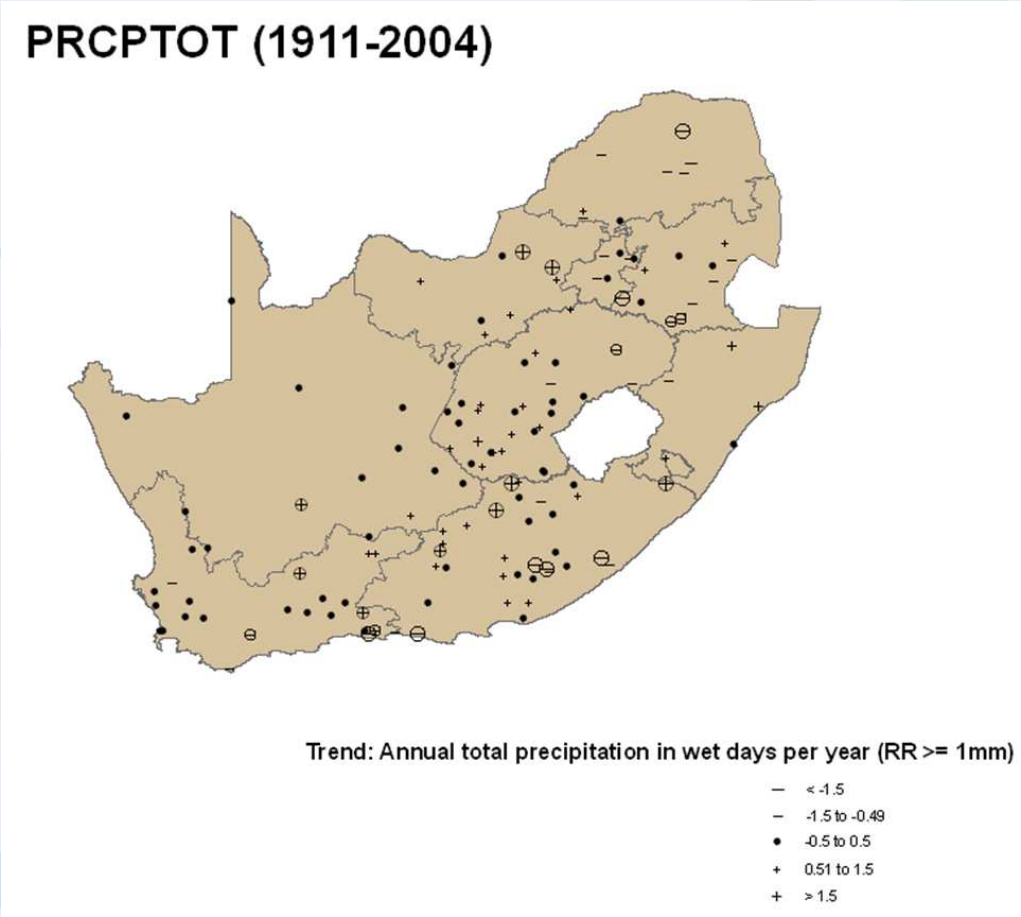
- **South Africa:** no countrywide consistency in trends for 1911 - 2004,
- Most results statistically insignificant,
- Update of results – more stations and more stringent QC procedures.



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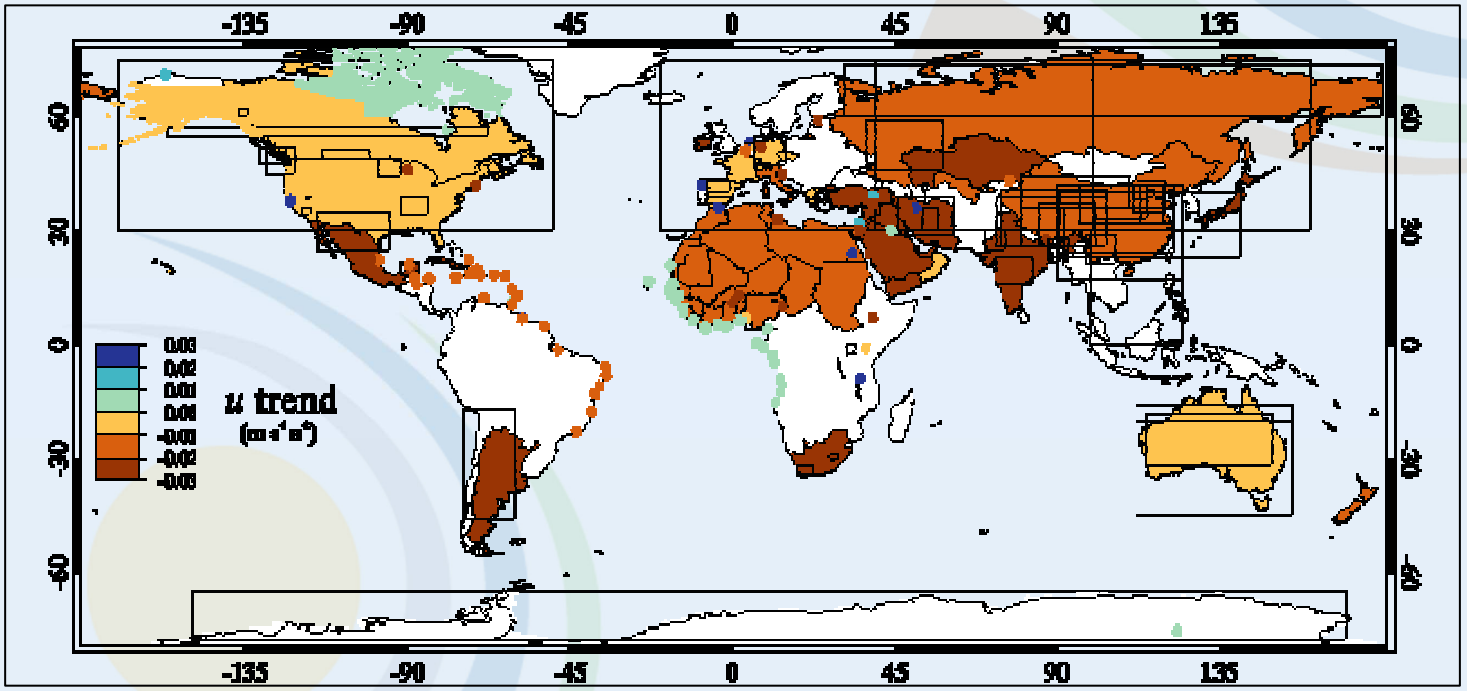
Wind

•Mean wind – general tendency for lower mean wind speed – Changes in surface roughness or changes in mean circulation?



Global distribution of observed *u* trends (McVicar et al., 2012).

•Extreme wind – most studies indicate little or no trend.

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Conclusions

General warming over the region and accelerating trends evident from long-term climate stations

Mixed results from rainfall trends – regional results sparse

Suggestions

- Identification of regional long-term key stations, especially those still operational;
- Metadata from regional stations
- Proper data quality control
- Regional contribution to global analyses
- On-going data rescue
- Sector-specific indices (e.g. health)
- Strategic expansion of observation network

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THANK YOU

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