Uncertainties related to the production of gridded global data sets of observed climate extreme indices

Markus G. Donat[1], Lisa V. Alexander[1,2], Imke Durre[3], and Russell Vose[3]

1. Background

This poster reports on the production of new global gridded data sets of extreme climate indices derived solely from daily in situ observations of temperature and precipitation, in order to assess observed regional changes in the frequency and intensity of climate extremes within a global context. Inherent to the production of these data sets are not only the uncertainties related to the observations themselves (e.g. instrumental errors, errors of representativity, inhomogeneities introduced through station relocation, different regional observing practices) but also uncertainties related to methodological choices made ('parametric' uncertainties) as well as the fundamental assumptions made within a methodological framework ('structural' uncertainties).

Here, we assess the effect that these uncertainties have in the production of such data sets.

2. Climate Data and Indices

Extreme climate indices, as recommended by the Expert Team on Climate Change Detection and Indices (ETCCDI), are calculated from daily temperature and precipitation records (see Table 1 for selected indices).

We use daily weather records from national weather service (BoM, Australia) and data collected in the Global Historical Climatology Network-Daily (GHCND) dataset. In future work, we will include indices obtained from ETCCDI regional workshops to improve the coverage over data sparse regions.

ID	Indicator name	Indicator definitions
TXx	Max Tmax	Monthly maximum value of daily max temperature
TNx	Max Tmin	Monthly maximum value of daily min temperature
TXn	Min Tmax	Monthly minimum value of daily max temperature
TNn	Min Tmin	Monthly minimum value of daily min temperature
TN10p	Cool nights	Percentage of time when daily min temperature < 10th percentile
TX10p	Cool days	Percentage of time when daily max temperature < 10th percentile
TN90p	Warm nights	Percentage of time when daily min temperature > 90th percentile
TX90p	Warm days	Percentage of time when daily max temperature > 90th percentile
WSDI	Warm spell duration indicator	Annual count when at least 6 consecutive days of max temperature > 90th percentile
CSDI	Cold spell duration indicator	Annual count when at least 6 consecutive days of min temperature < 10th percentile
RX1day	Max 1-day precipitation amount	Monthly maximum 1-day precipitation

Table 1: selected ETCCDI extreme climate indices. For complete list of indices and precise definitions see http://cccma.seos.uvic.ca/ETCCDI/list_27_indices.html

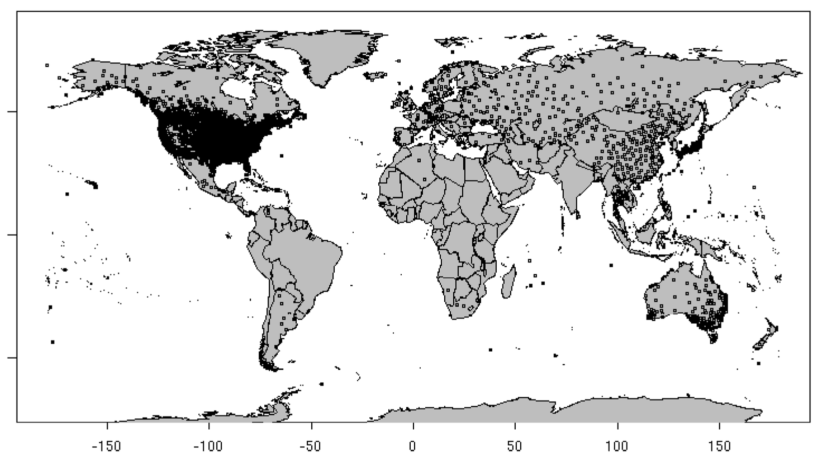

Figure 1: Stations in GHCND for which annual max. temperature (TXx) is available for at least 40 years during 1951-2010.

3. Sensitivity Tests for Australia

We tested the sensitivity of different gridding methods and different input data using Australia as a test case since it contains a relatively dense coverage of data.

- ***Minor effects*** on (sub-) continental scale from varying grid sizes between 0.5° and 5.0° and different parameter settings for the correlation decay function in the Angular Distance Weighting interpolation method
- ***Major uncertainty*** comes from the data source, i.e. stations used for gridding, and the gridding technique (particularly over data sparse regions), see Fig. 2.

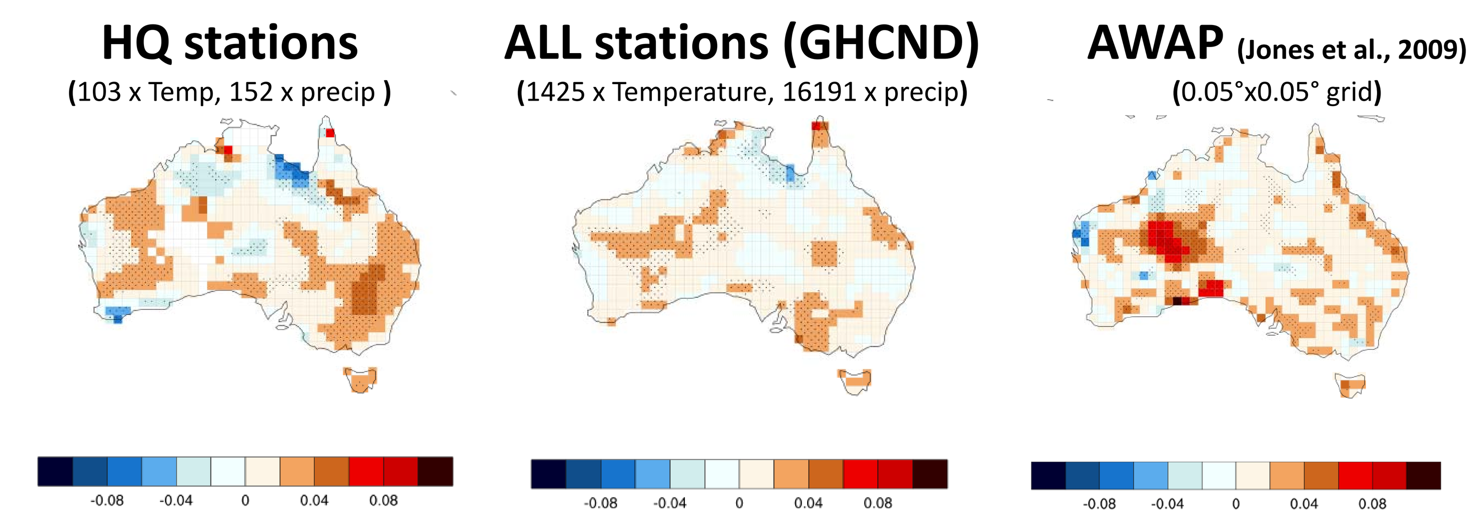

Figure 2: Trends in annual maximum of daily maximum temperature (TXx) 1950-2008 in three different gridded data sets.

4. GHCNDEX – An operational global gridded data set of climate extremes

The extreme climate indices are calculated for all of the stations contained in the GHCND archive, and then interpolated onto a global grid. To avoid effects from varying station density, we only include stations with at least 40 years of valid data in the 1951-2010 period (e.g. Fig. 1).

The gridded product is compared to the HadEX data set (Alexander et al., 2006) and climate indices calculated from daily gridded data (HadGHCN; Caesar et al., 2006), see Fig. 3.

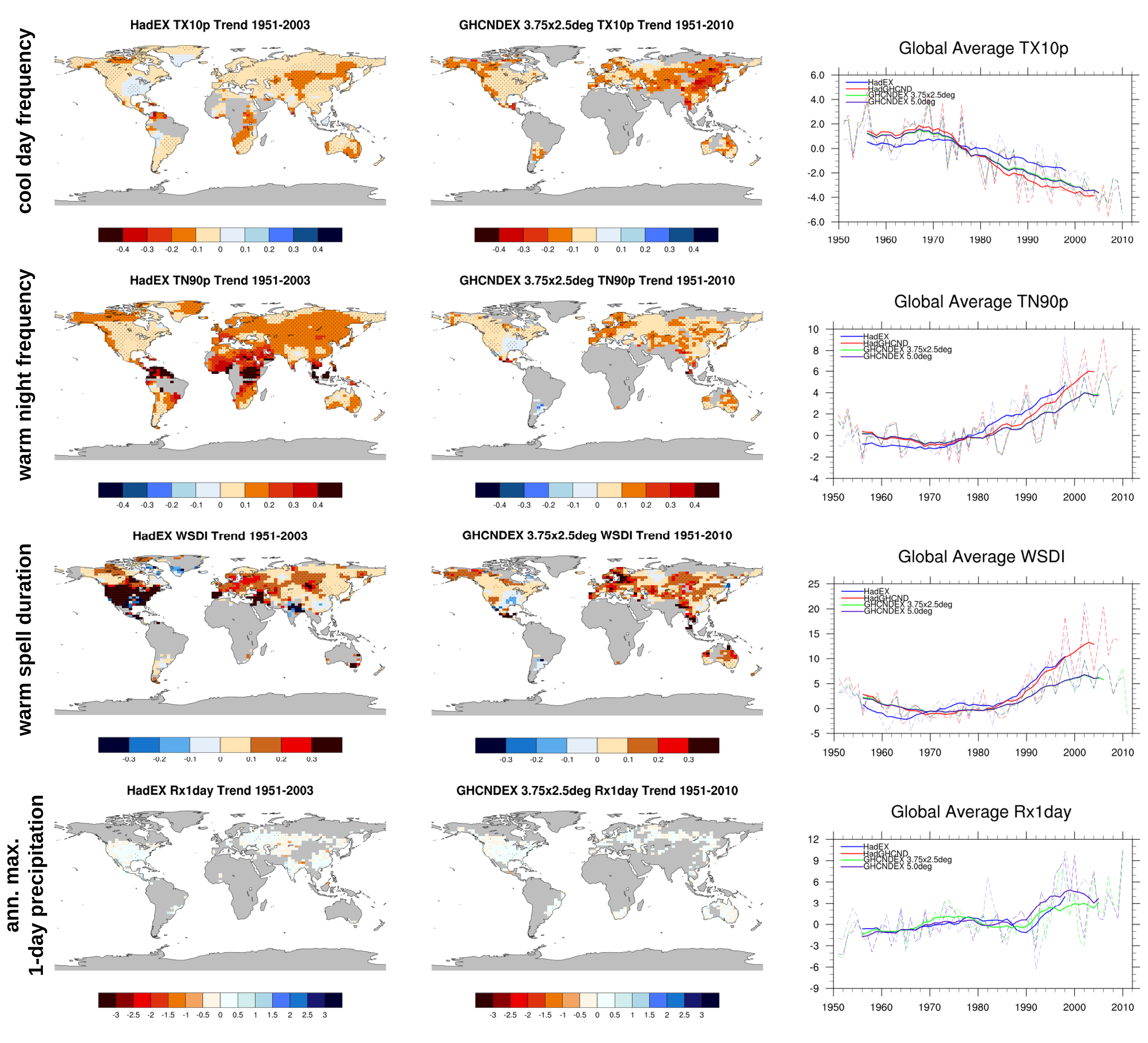

Figure 3: Trend maps of selected indices in HadEX (left, 1951-2003), GHCNDEX (middle 1951-2010) and time series of the global average in the different data sets (right).

5. Conclusions

- We find robust trends in extreme climate indices since 1951, calculated from different data sets, e.g.
  - increasing extreme temperatures, more warm nights and warm days, longer warm spell durations
  - less cool nights and cool days, shorter cold spell durations
  - Spatially different trends in extreme precipitation, but increasing global average
- The spatial coverage of the GHCNDEX data set is poor, due to limited availability of observational data over many regions, in particular Africa and South America
- Data gaps will be (partly) filled in future work, using data gained from ETCCDI regional workshops

References

Alexander, L. V., et al. (2006), Global observed changes in daily climate extremes of temperature and precipitation, J. Geophys. Res., 111, D05109, doi:10.1029/2005JD006290.

Caesar, J., L. Alexander, and R. Vose (2006), Large-scale changes in observed daily maximum and minimum temperatures: Creation and analysis of a new gridded data set, J. Geophys. Res., 111, D05101, doi:10.1029/2005JD006280.

Jones D, Wang W, Fawcett R (2009) High-quality spatial climate data-sets for Australia. Aust Meteorol Ocn J 58(12):233–248

[1] Climate Change Research Centre, University of New South Wales, Sydney Australia
[2] ARC Centre of Excellence for Climate System Science, University of New South Wales, Sydney Australia
[3] National Climatic Data Center/NOAA, Asheville, North Carolina, USA

m.donat@unsw.edu.au