The CLIMDEX project: Creation of long-term global gridded products for the analysis of temperature and precipitation extremes.

Lisa Alexander[1,2], Markus Donat[1], Yoichi Takayama[1] and Hongang Yang[1]

1. Background

The CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) has developed a suite of indices derived from daily temperature and precipitation data with a primary focus on extreme events (Table 1). These indices have been calculated at station locations using quality controlled data from international daily datasets e.g. daily Global Historical Climatology Network (GHCN-Daily) and the European Climate Assessment (ECA&D), with data sparse regions of the globe supplemented with data from targeted regional workshops. To account for the uneven global distribution of stations and in order to easily compare with climate model output, these indices were gridded onto a 3.75 longitude x 2.5 latitude grid to create the dataset HadEX (Alexander et al., 2006).

ID	Indicator name	Indicator definitions	UNITS
TXx	Max Tmax	Monthly maximum value of daily max temperature	ºC
TNx	Max Tmin	Monthly maximum value of daily min temperature	ºC
TXn	Min Tmax	Monthly minimum value of daily max temperature	ºC
TNn	Min Tmin	Monthly minimum value of daily min temperature	ºC
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	%
DTR	Diurnal temperature range	Monthly mean difference between daily max and min temperature	ºC
GSL	Growing season length	Annual (1st Jan to 31st Dec in NH, 1st July to 30th June in SH) count between first span of at least 6 days with TG>5ºC and first span after July 1 (January 1 in SH) of 6 days with TG<5ºC	days
FD0	Frost days	Annual count when daily minimum temperature < 0°C	days
SU25	Summer days	Annual count when daily max temperature > 25°C	days
TR20	Tropical nights	Annual count when daily min temperature > 20°C	days
WSDI	Warm spell duration indicator	Annual count when at least 6 consecutive days of max temperature > 90th percentile	days
CSDI	Cold spell duration indicator	Annual count when at least 6 consecutive days of min temperature < 10th percentile	days
RX1day	Max 1-day precipitation amount	Monthly maximum 1-day precipitation	mm
RX5day	Max 5-day precipitation amount	Monthly maximum consecutive 5-day precipitation	mm
SDII	Simple daily intensity index	The ratio of annual total precipitation to the number of wet days (≥ 1 mm)	mm/day
R10	Number of heavy precipitation days	Annual count when precipitation ≥ 10 mm	days
R20	Number of very heavy precipitation days	Annual count when precipitation ≥ 20 mm	days
CDD	Consecutive dry days	Maximum number of consecutive days when precipitation < 1 mm	days
CWD	Consecutive wet days	Maximum number of consecutive days when precipitation ≥ 1 mm	days
R95p	Very wet days	Annual total precipitation from days > 95th percentile	mm
R99p	Extremely wet days	Annual total precipitation from days > 99th percentile	mm
PRCPTOT	Annual total wet-day precipitation	Annual total precipitation from days ≥ 1 mm	mm

Table 1: The extreme temperature and precipitation indices recommended by the ETCCDI (some user defined indices are not shown). Precise definitions are given at http://cccma.seos.uvic.ca/ETCCDI/list_27_indices.html.

2. Issues and uncertainties

While HadEX made significant advances to our understanding of global changes in temperature and precipitation extremes (see Fig. 1) and allowed evaluation of modelled extremes for the first time using state-of-the-art global climate models, it still suffers from a lack of coverage over large areas (particularly for precipitation extremes), only covers the period 1951-2003 and does not contain the measures of uncertainty required to fully assess the trends and variability in extremes.

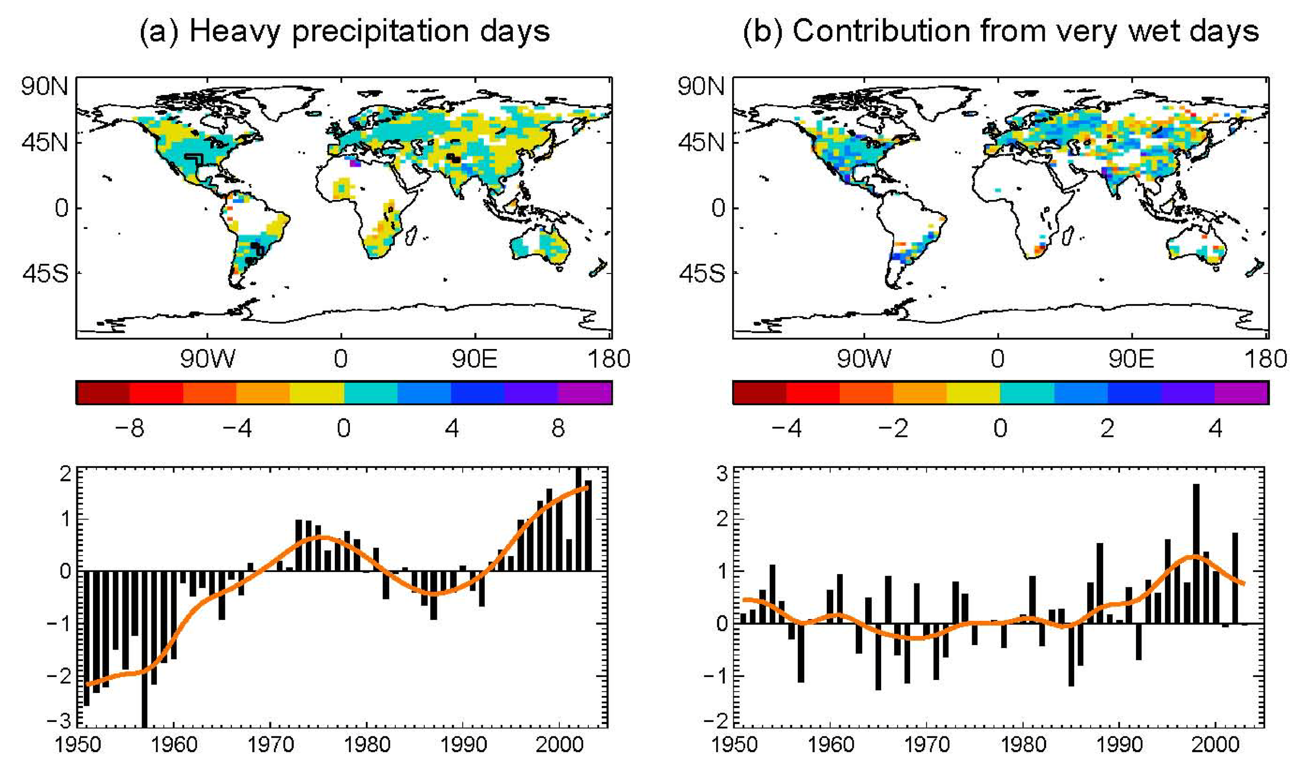


Fig. 1: Trends (days/decade, shown as maps) and annual time series anomalies relative to 1961–1990 mean values (shown as plots) for annual series between 1951 and 2003 for (a) R10 and (b) R95pT (i.e. (R95p/PRCPTOT)*100 - see Table 1) from HadEX dataset (Alexander et al., 2006)

3. The CLIMDEX Project

The "next generation" of global gridded extremes products (the CLIMDEX project) represents a collaboration between the University of New South Wales, the University of Melbourne, the National Climatic Data Center (NCDC) and Environment Canada and is funded by the Australian Research Council and the Department of Climate Change and Energy Efficiency. Other research institutes such as the Hadley Centre are also contributing to the project. The project aims to improve our understanding of the variability of extremes, enhance detection and attribution studies and provide the highest quality observations for model evaluation. Advances over previous datasets include longer-term data availability, delivery via a web interface including near-real time updates, and an assessment of the uncertainty in the gridded products (see Donat et al., 2011).

4. Project data sets

Dataset	Data Source	Time period
HadEX	Quality controlled data from individual researchers, ETCCDI and other regional workshops, GHCN-Daily (mostly over USA and Brazil); Alexander et al., 2006 (see Fig. 2a)	1951-2003
HadEX2	As HadEX but with additional and more recently updated data	TBA
HadGHCNDEX	Quality controlled GHCN-Daily data with long records (see Fig. 2b); Donat et al., 2011 update of Caesar et al., 2006	1950-2009
GHCNDEX	All GHCN-Daily data with 40+ years of record (see Fig. 2c); Donat et al. 2011	1951-present (updated monthly)
STATDEX	All available station data used in the above datasets	As long as available station record

Table 2: Information on datasets that will be included in the CLIMDEX project. All datasets calculate indices from station data before gridding except HadGHCNDEX in which daily station data are gridded first before indices are calculated. This adds additional uncertainty estimates to global timeseries (see Fig. 2d).

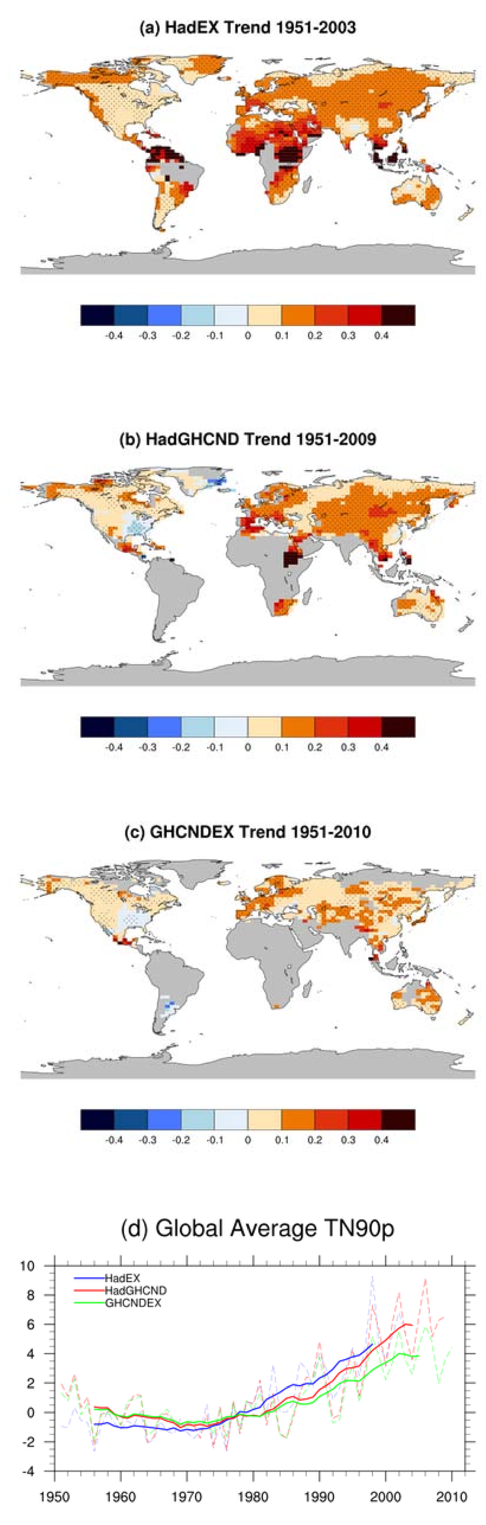
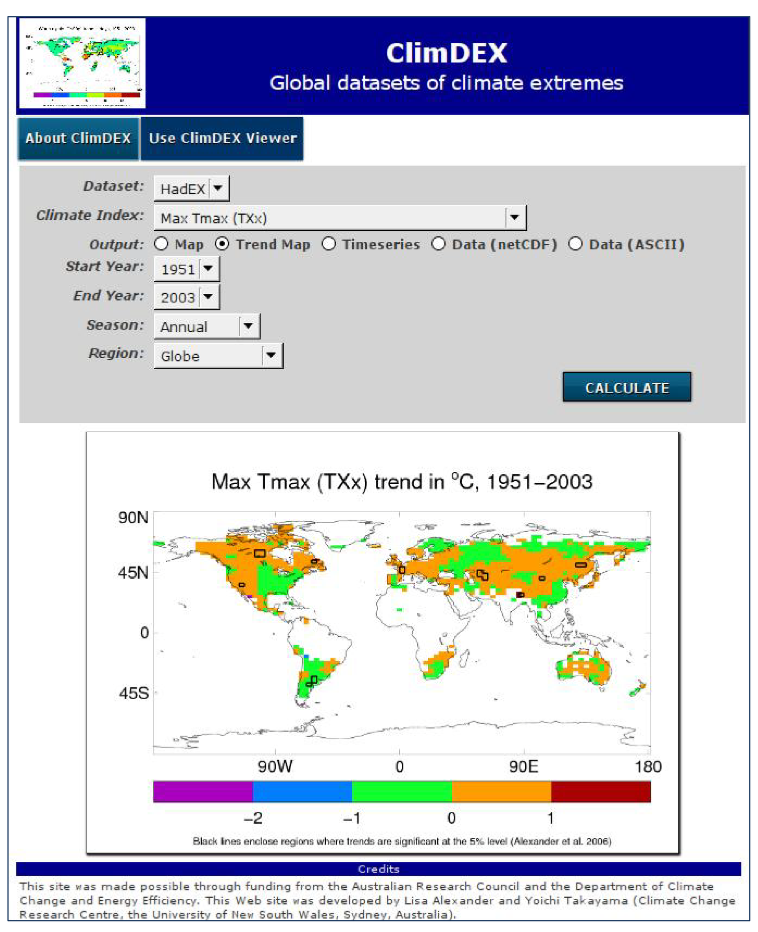


Fig. 2: (a)-(c) Annual trends in TN90p using different datasets for the periods indicated and (d) global average timeseries plots for each of the three datasets with associated 11-year running means.

5. Data access

Data sets will be available through a web interface www.climdex.org



References

Alexander LV 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.

Donat MG. et al. (2011), Uncertainties related to the production of gridded global data sets of observed climate extreme indices, WCRP Open Science Conference, Denver, USA

[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

l.alexander@unsw.edu.au