Calculating climate indices using RClimdex

By Lucie Vincent

Climate Research Branch
Environment Canada

Capacity building workshop on Data Rescue and Climate Change Indices
The University of the West Indices, Mona, Jamaica
7-10 May 2012

Background

- RClimdex produces the 27 indices recommended by the CCl/CLIVAR Expert Team for Climate Change Detection, Monitoring and Indices
- carefully selected to cover many aspects of the changing global climate
- valuable to evaluate the potential impact of climate change on our activities, agriculture, economy
- useful for monitoring climate change on a global basis

Approach to calculate climate indices

Based on fixed threshold value:

- summer days (days with tmax > 25°C)
- heavy precipitation days (days with prec > 10 mm)

➢ Easy to understand but not significant to all regions of the world:

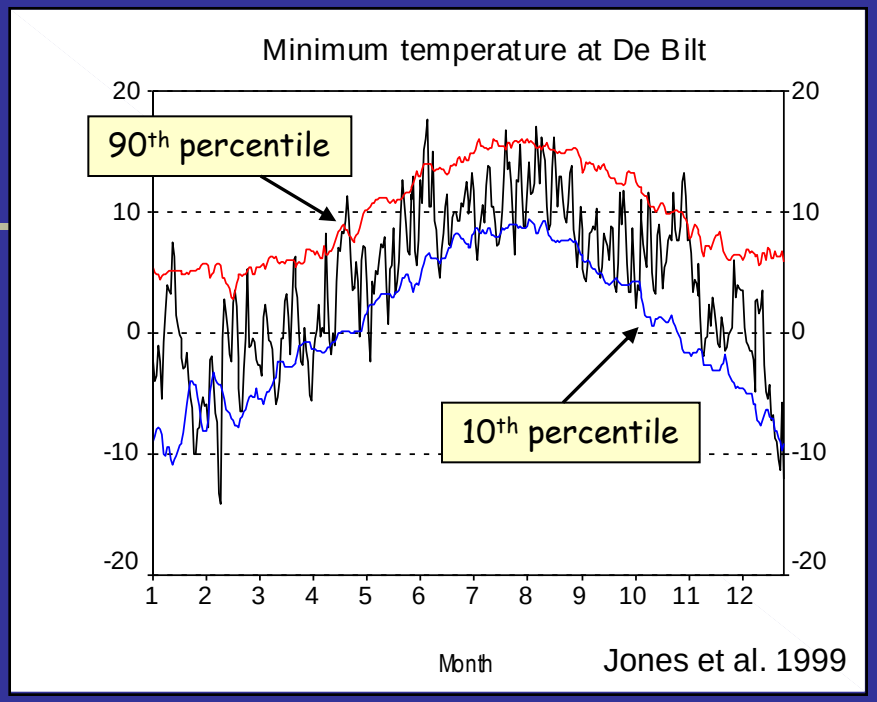
- ice days (days with tmax < 0°C) are not too frequent in the Caribbean!

Based on variable threshold value:

- warm nights (% days when tmin > 90th percentile)
- very wet days (total prec when prec > 95th percentile)

➢ More difficult to interpret but facilitate comparison between different parts of the world

Calculation of the percentiles

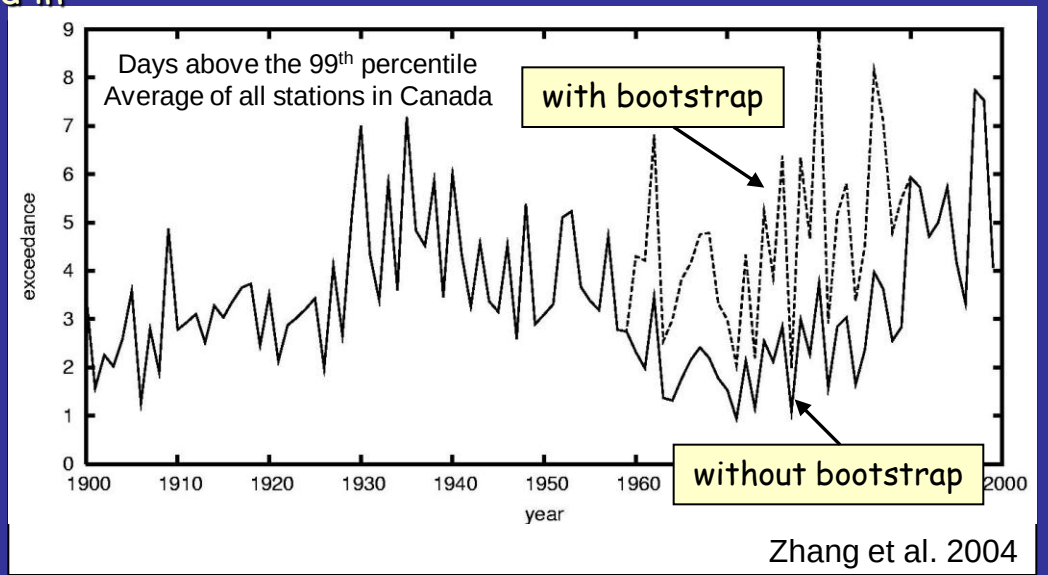


Temperature indices

- 10th & 90th percentiles calculated from 1961-1990
- percentiles obtained for each day of the year using a 5-day window centered at the calendar day Jones et al. 1999
- new approach based on bootstrap methodology developed by Zhang et al. 2004 to obtain percentiles within the base period to provide temporally consistent estimate of threshold in and out the base period

Precipitation indices

- 95th & 99th percentiles calculated from all days during the year when prec >1 mm during 1961-1990



Missing values

- indices are calculated on
  - monthly and annual bases
  - annual basis only
- indices calculated on monthly basis
  - if number of days missing > 3 days then monthly value missing
- indices calculated on annual basis
  - if number of days missing > 15 days or monthly value is missing then annual value missing

Definition of temperature indices
(16 indices)

Cold Extremes

Frost days (tmin < 0°C)

Ice days (tmax < 0°C)

Monthly lowest value in tmax

Monthly lowest value in tmin

Cold nights (% days w tmin < 10th perc.)

Cold days (% days w tmax < 10th perc.)

Cold spell duration index (count of days w at least 6 cons. days w tmin > 10th perc.)

Warm Extremes

Summer days (tmax > 25°C)

Tropical nights (tmin > 20°C)

Monthly highest value in tmax

Monthly highest value in tmin

Warm nights (% days w tmin > 90th perc.)

Warm days (% days w tmax > 90th perc.)

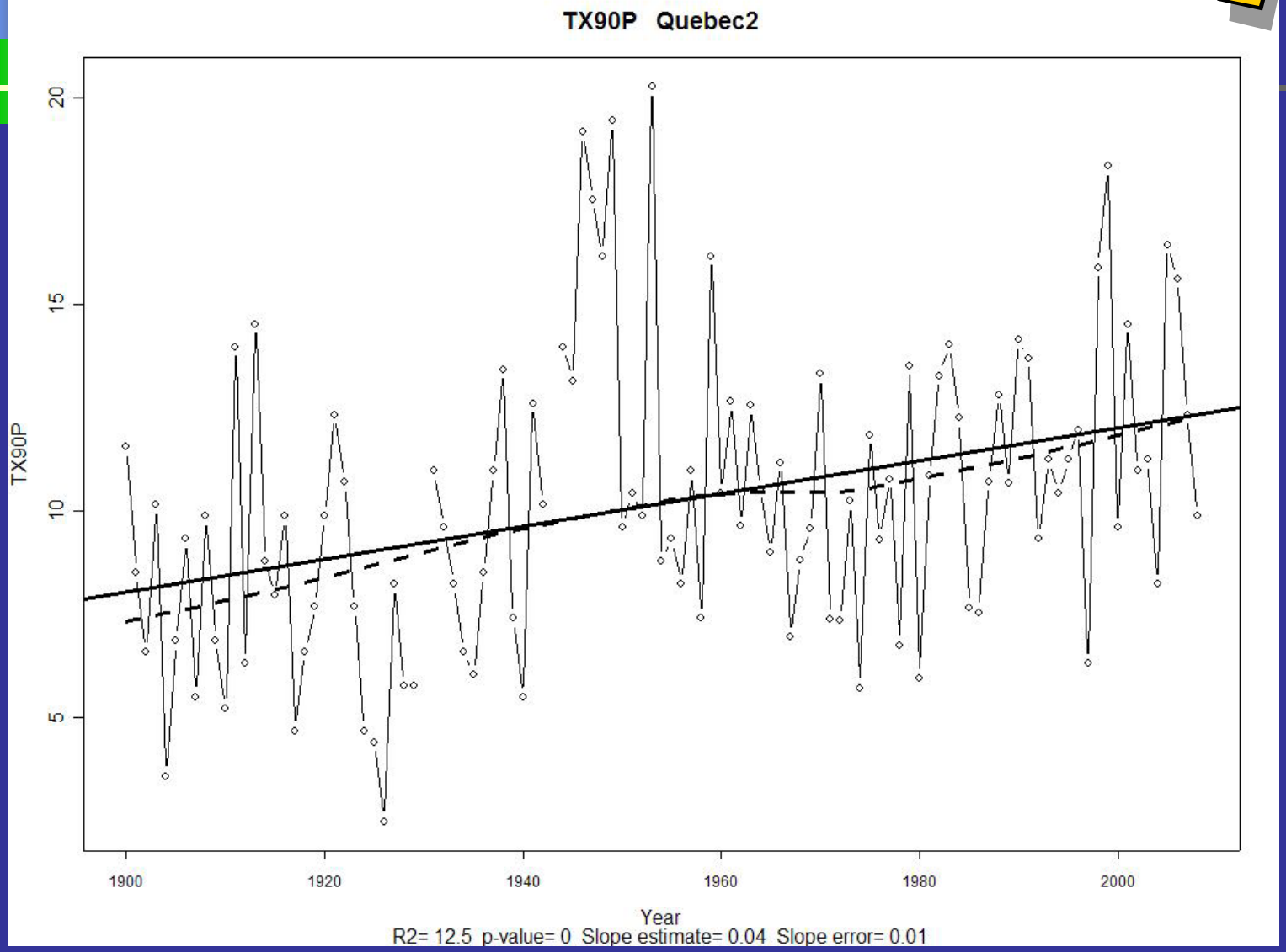
Warm spell duration index (count of days w at least 6 cons. days w tmax > 90th perc.)

Others

Growing season length (6 days with TG >5°C & 6 days with TG < 5°C; North & South Hemispheres)

Diurnal temperature range (monthly mean difference between tmax & tmin

Example


TX90P Quebec2
TX90P
5
10
15
20
1900
1920
1940
1960
1980
2000
Year
R2= 12.5 p-value= 0 Slope estimate= 0.04 Slope error= 0.01

Definition of precipitation indices
(11 indices)

Extremes

Monthly highest 1-day prec

Monthly highest 5-day cons. prec

Heavy prec days (prec > 10 mm)

Very heavy prec days (prec > 20 mm)

Consecutive dry days (max number of cons. days w prec < 1 mm)

Consecutive wet days (max number of cons. days w prec ≥ 1 mm)

Very wet days (annual total prec w prec > 95th perc.)

Extremely wet days (annual total prec w prec > 99th perc.)

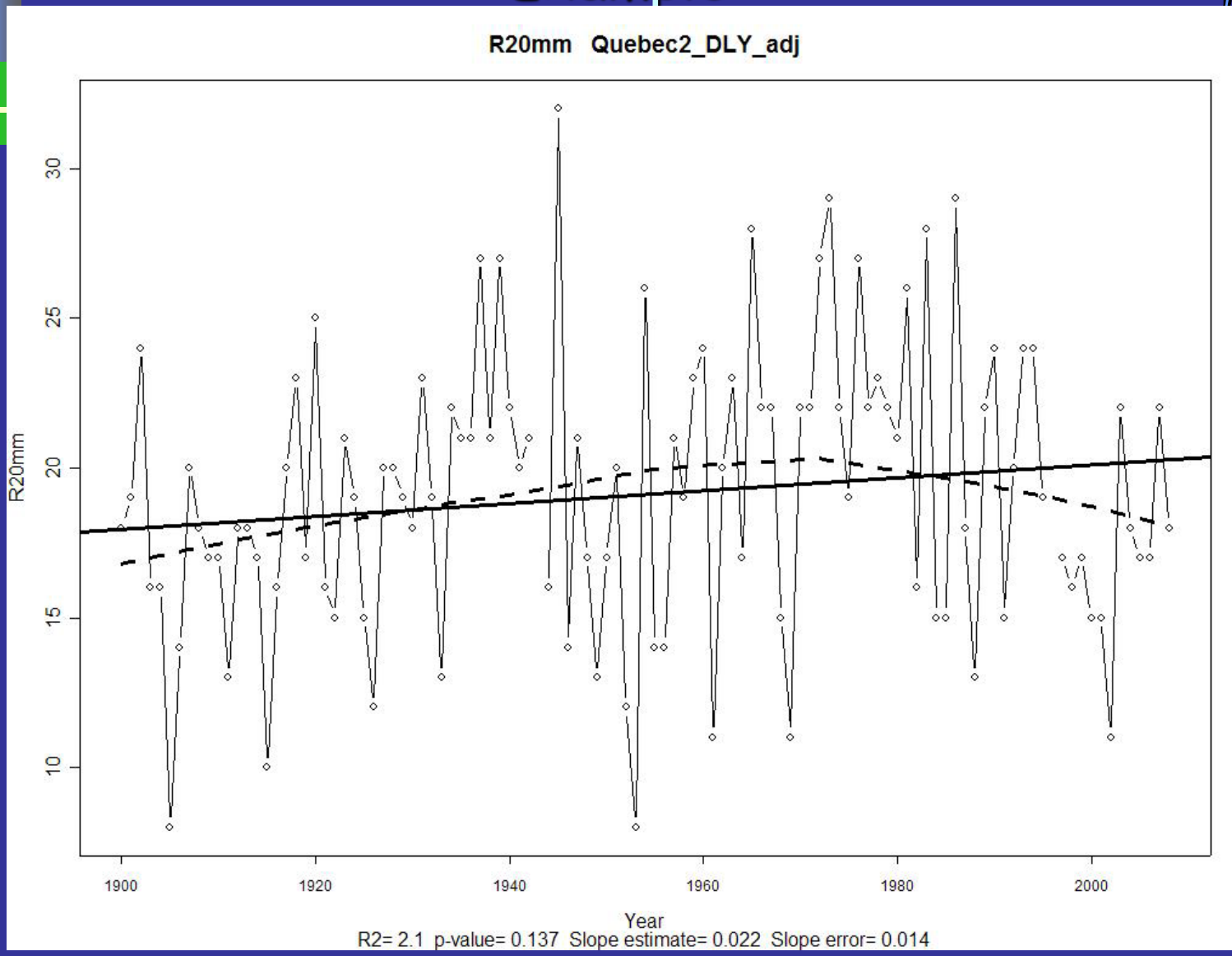
Others

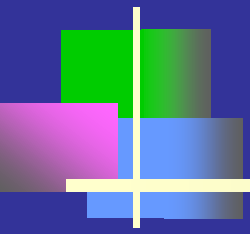
Simple Day Intensity Index (total prec divided by number of wet days)

Days w prec > xx mm

Annual total precipitation

Example


R20mm Quebec2_DLY_adj
R20mm
10
15
20
25
30
1900
1920
1940
1960
1980
2000
Year
R2= 2.1 p-value= 0.137 Slope estimate= 0.022 Slope error= 0.014



Thanks!