Introduction to Climate Indices

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What is a climate extreme?

- Rare, high impact event
  - floods, heatwaves, droughts, storms

- An event which occurs in the tails of a probability distribution (representing climate conditions) of a given variable
  - e.g. daily temperature, precipitation etc.
What is a climate extreme index?

- Still a rare, high impact event occurring in the tails of a probability distribution function including but not limited to the most extreme event in an analysis period.

It is difficult to perform robust statistical analysis on events that are too rare.
Why are indices useful?

- (Usually) meaningful across many different climates
- Consistent analysis can be performed across countries/regions/continents/globe
- More likely to be exchanged amongst scientific researchers than daily data
  (however not reproducible by other scientist who lack access to data!)
- Can be used to compare with output from climate models and detect human-induced climate change signal (or not)
Examples of types of indices

1. Absolute – maximum or minimum values
2. Percentile - sample the extreme end of a reference period distribution
3. Threshold - number of days above or below a fixed threshold
4. Duration - periods of excessive warmth, cold, wetness or dryness
5. Other - e.g. diurnal temperature range, annual precipitation amount
Climate indices calculated by RClimDex

• 27 indices
  – 16 temperature, 11 precipitation
• Derived from daily maximum and minimum temperature and daily precipitation
• Each has an index name and exact definitions are given in the RClimDex manual
• Some of the indices can be calculated monthly as well as annually
Temperature Indices

- Maximum Tmax (TXx), Maximum Tmin (TNx), Minimum Tmin (TNn), Minimum Tmax (TXn)
- Cold nights (TN10p), Warm nights (TN90p), Cold days (TX10p), Warm days (TX90p)
- Frost days (FD), Ice days (ID), Summer days (SU), Tropical Nights (TR)
- Warm spell duration (WSDI), Cold spell duration (CSDI)
- Growing season length (GSL), Diurnal temperature range (DTR)
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Seasonal and annual
Precipitation Indices

• Maximum 1-day rainfall (RX1day), Maximum 5-day rainfall (RX5day)
• Days above 10mm (R10), Days above 20mm (R20)
• Consecutive wet days (CWD), Consecutive dry days (CDD)
• Simple daily intensity (SDII)
• Amount above 95th percentile (R95p), amount above 99th percentile (R99p)
• Annual total precipitation from wet days (PRCPTOT)
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Seasonal and annual
Not all indices are useful for every climate so some additional indices can be calculated for upper and lower thresholds of Tmax and Tmin and daily R.
Indices of relevance for the Arab region

- Maximum Tmax (TXx), Maximum Tmin (TNx), Minimum Tmin (TNn), Minimum Tmax (TXn)
- Cold nights (TN10p), Warm nights (TN90p), Cold days (TX10p), Warm days (TX90p)
- Warm spell duration (WSDI)
- Consecutive dry days (CDD), Annual total precipitation from wet days (PRCPTOT)
- Maximum 1-day rainfall (RX1day), Maximum 5-day rainfall (RX5day)
Check RClimateDex manual for exact definitions
From station to regional analysis

What will trends look like across the region?