Global land-based gridded datasets of climate extremes indices (ETCCDI)

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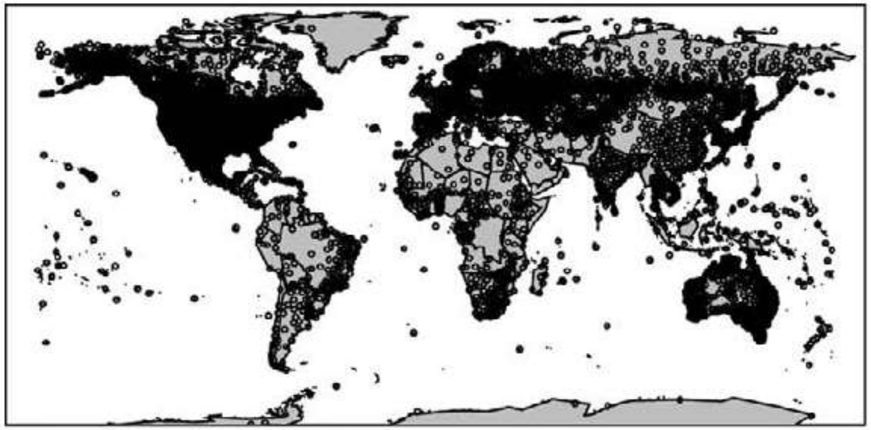
“Is the occurrence of extreme climate events changing?”

Problem: limited availability of daily observational data

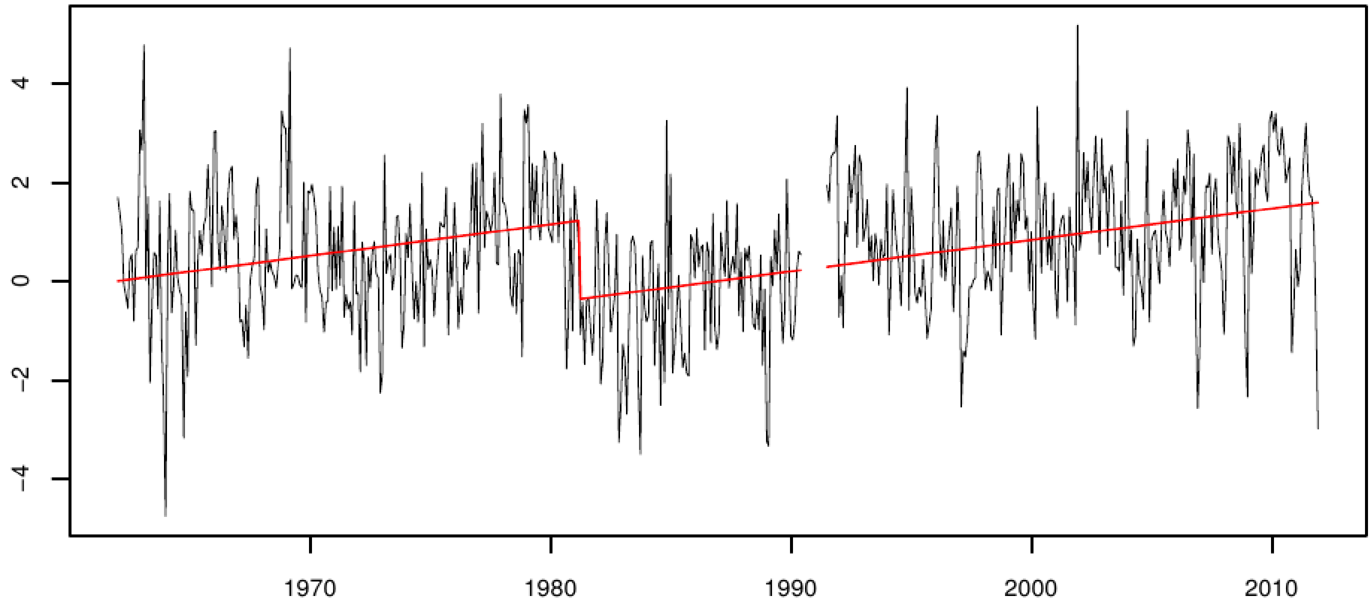
e.g. NCDC’s Global Historical Climatology Network (GHCN)-Daily dataset GHCN-D:
(*the world’s largest repository of daily in situ observations of temperature and precipitation*)

(a) Tmax 29277 stations



Issues

- Investigating extremes requires high resolution data (time and space)
- Limited availability/accessibility of suitable data for researchers (daily/sub-daily data, long period records)
- Extremes are calculated differently across regions e.g. heatwaves, droughts
- Different measures: intensity, frequency, duration
- Quality / Homogeneity of data (data errors are likely to show up as “extreme”)



ETCCDI climate extremes indices

Data providers are often happier to share derived indices,

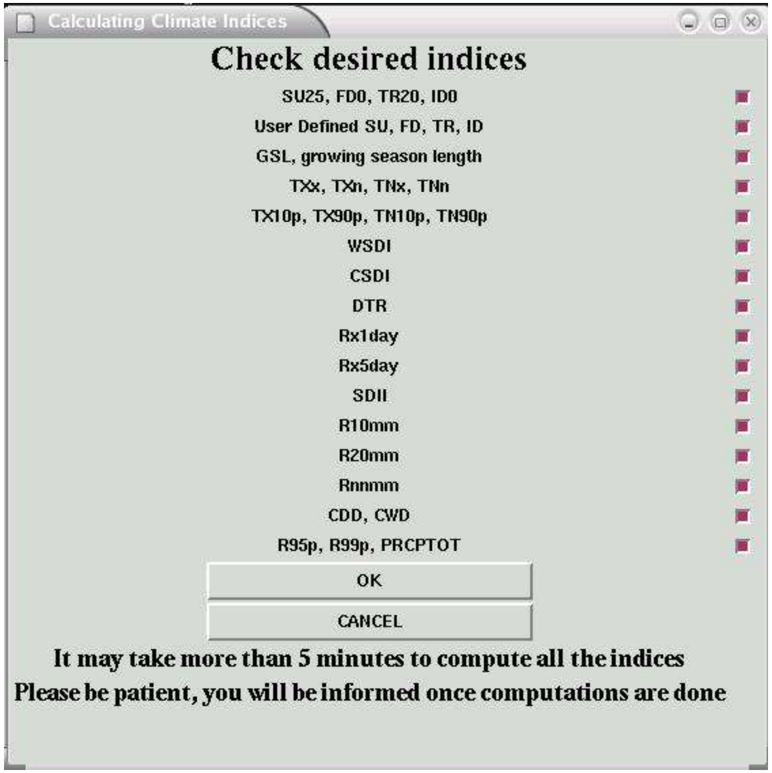
ETCCDI recommends simple climate indices based on temperature and precipitation data, e.g.:

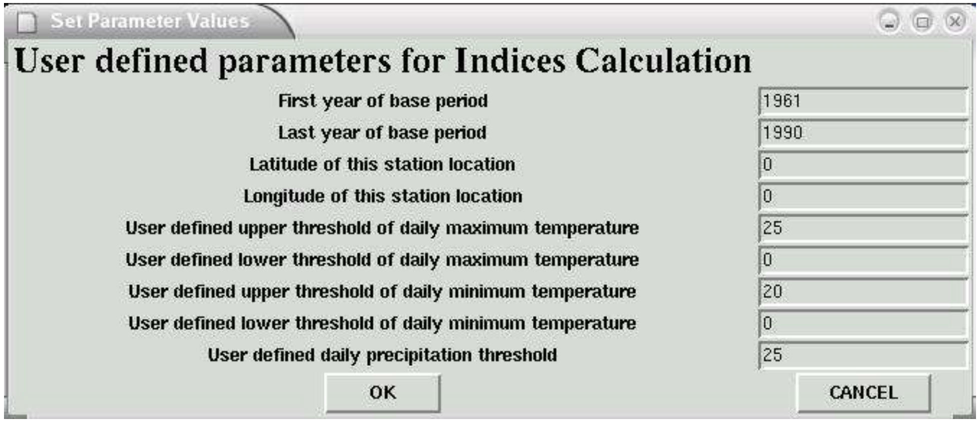
	Index	Name	Definition
temperature	TXx	Max Tmax	Warmest daily maximum temperature
	TNn	Min Tmin	Coldest daily minimum temperature
	TX10p	Cool days	Share of days when Tmax < 10th percentile
	TN10p	Cool nights	Share of days when Tmin < 10th percentile
	TX90p	Warm days	Share of days when Tmax > 90th percentile
	TN90p	Warm nights	Share of days when Tmin > 90th percentile
	WSDI	Warm spell duration indicator	Annual number of days with at least 6 consecutive days when Tmax > 90th percentile
precipitation	Rx1day	Max 1-day precipitation	Annual maximum 1-day precipitation
	R95p	Annual contribution from very wet days	Annual sum of daily precipitation > 95th percentile
	R10mm	Heavy precipitation days	Annual number of days when precipitation >= 10 mm

(see full list of 27 indices here: http://etccdi.pacificclimate.org/list_27_indices.shtml)

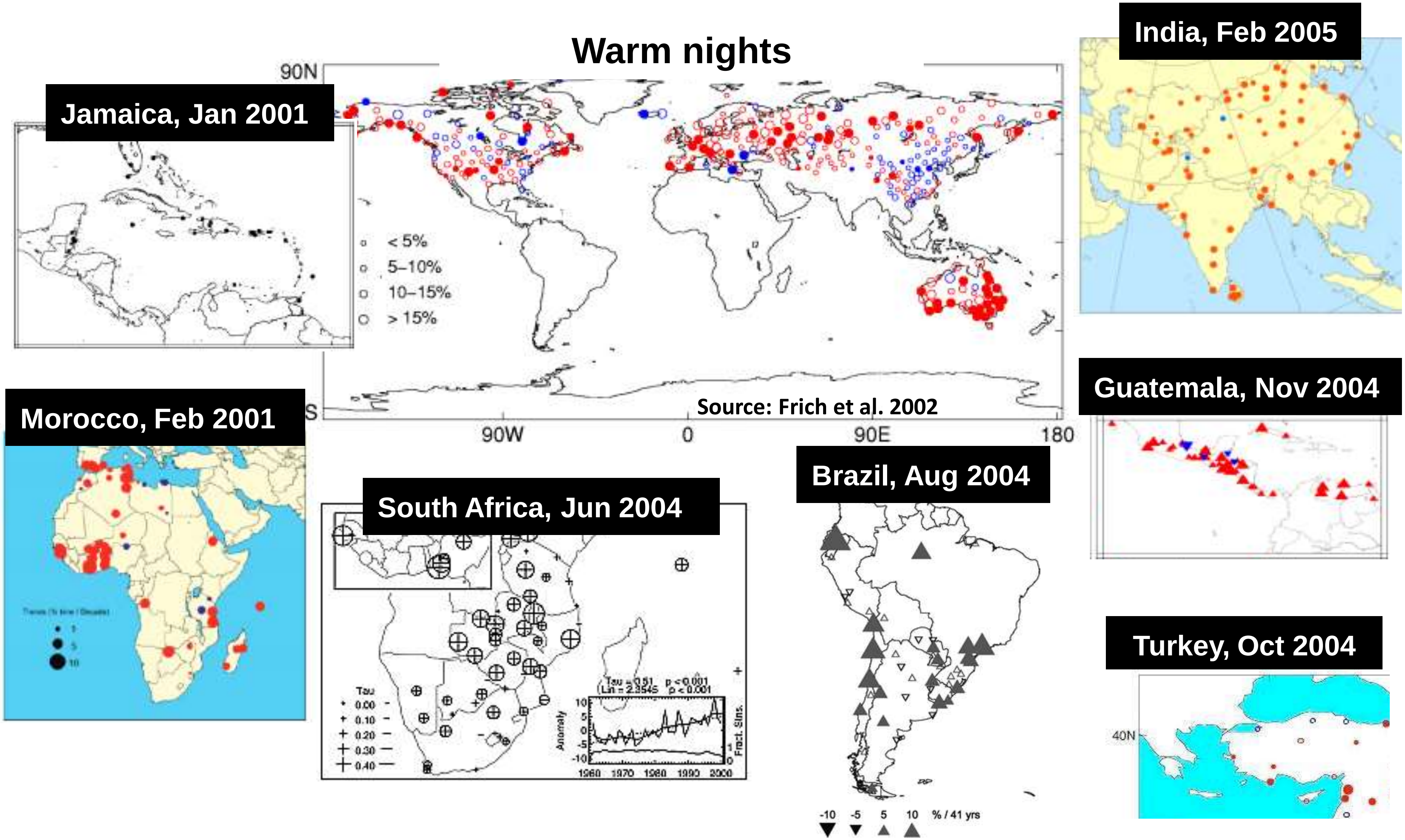
Software

- Open source
- R and Fortran versions (new and experienced users)
- RClimDex has simple GUI
- User guide in English, French, Spanish and Arabic
- Includes RHtest (homogeneity)





ETCCDI Workshop success at filling in data gaps

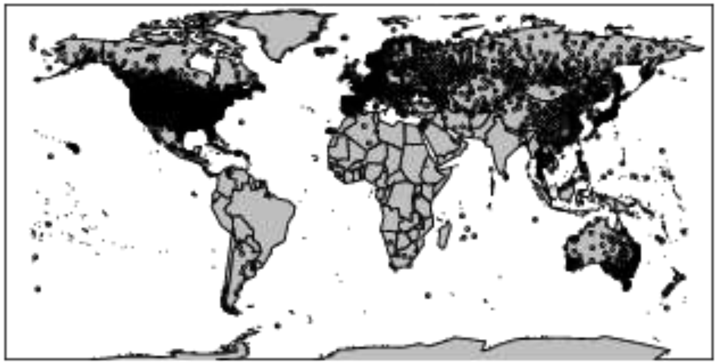


New observational global gridded data sets of climate extremes

GHCNDEX:

- based on GHCN-Daily, long-term stations only
- 1951 to present, 2.5° x 2.5° regular grid
- operational, monthly updates
- reproducible / traceable

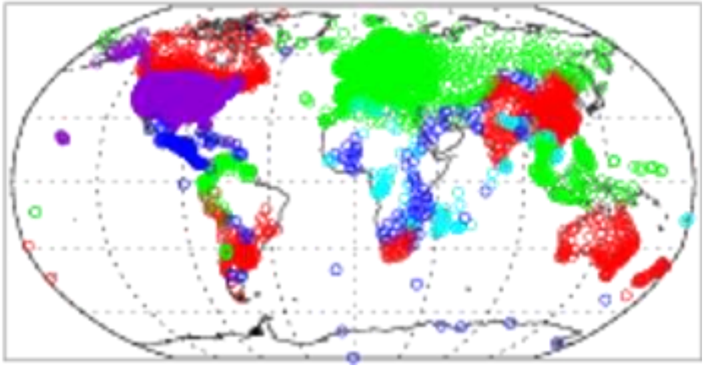
(Donat et al. 2013, BAMS)



HadEX2:

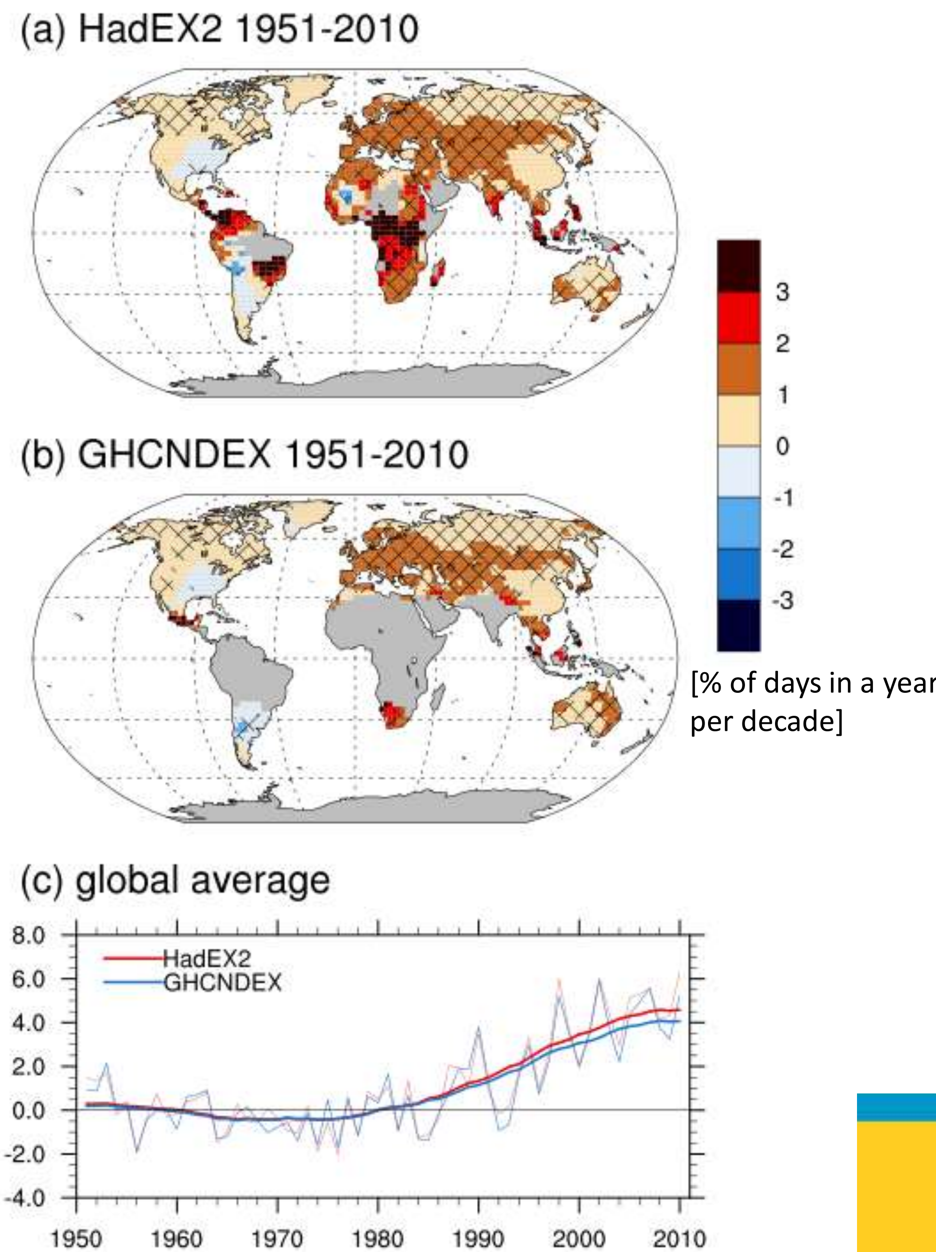
- based on multiple data sources (free archives, ETCCDI workshops, personal contacts), only HQ stations, checked for homogeneity
- 1901 to 2010, 3.75° x 2.5° regular grid
- static

(Donat et al. 2013, JGR)

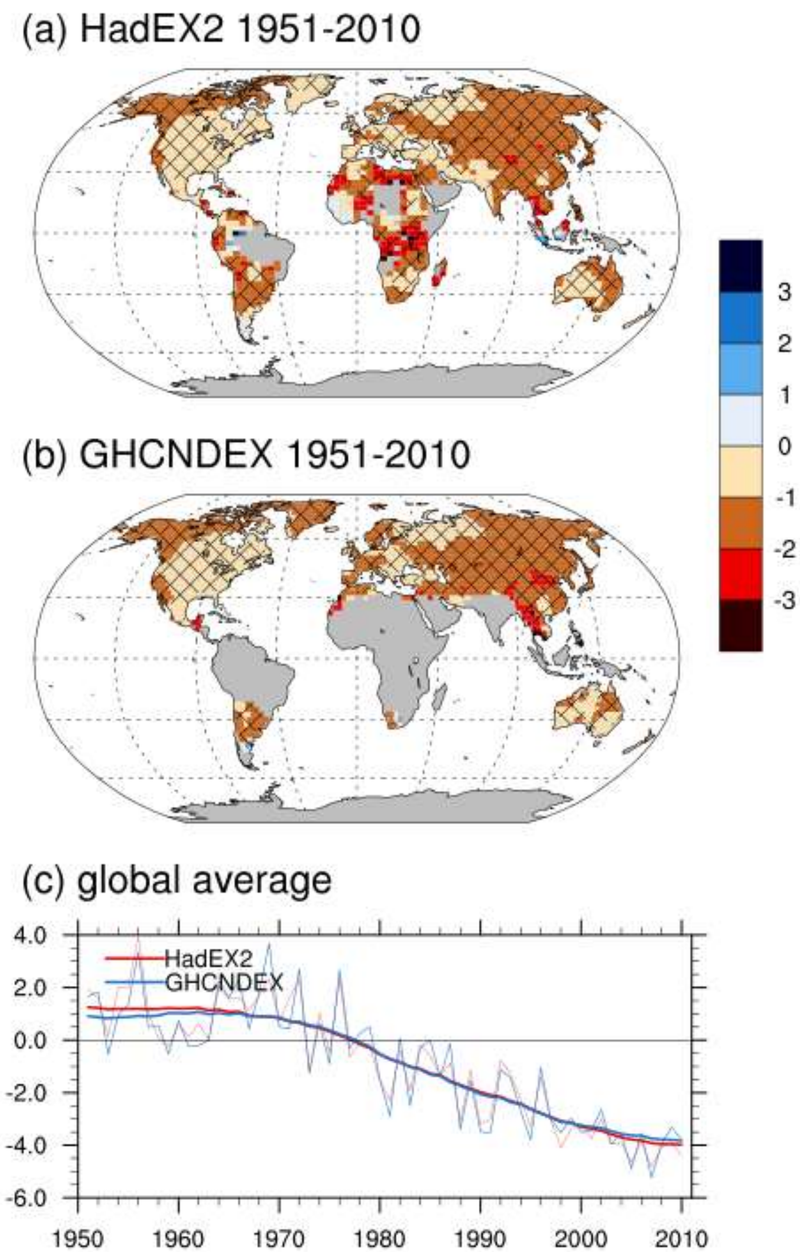


Extreme temperatures trends (1951-2010)

Frequency of warm days (TX90p)

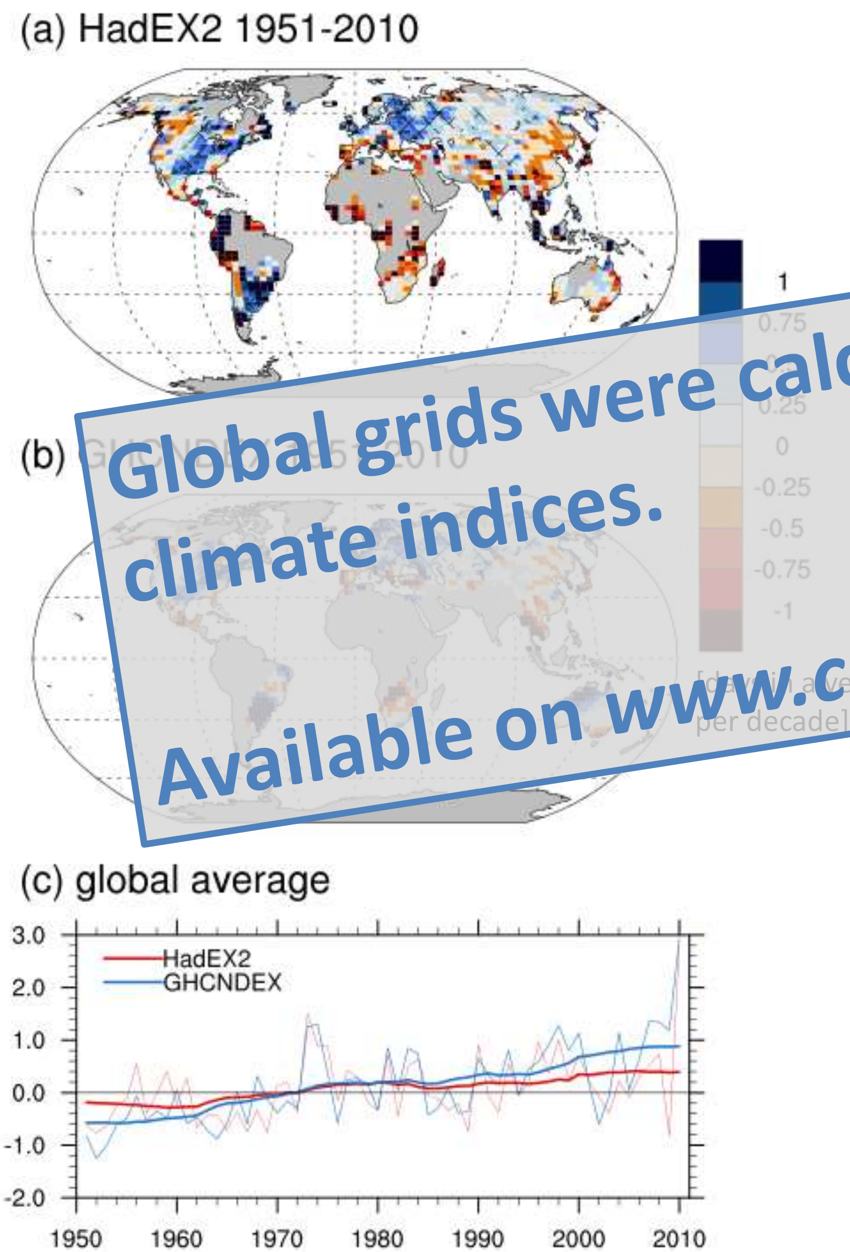


Frequency of cold nights (TN10p)

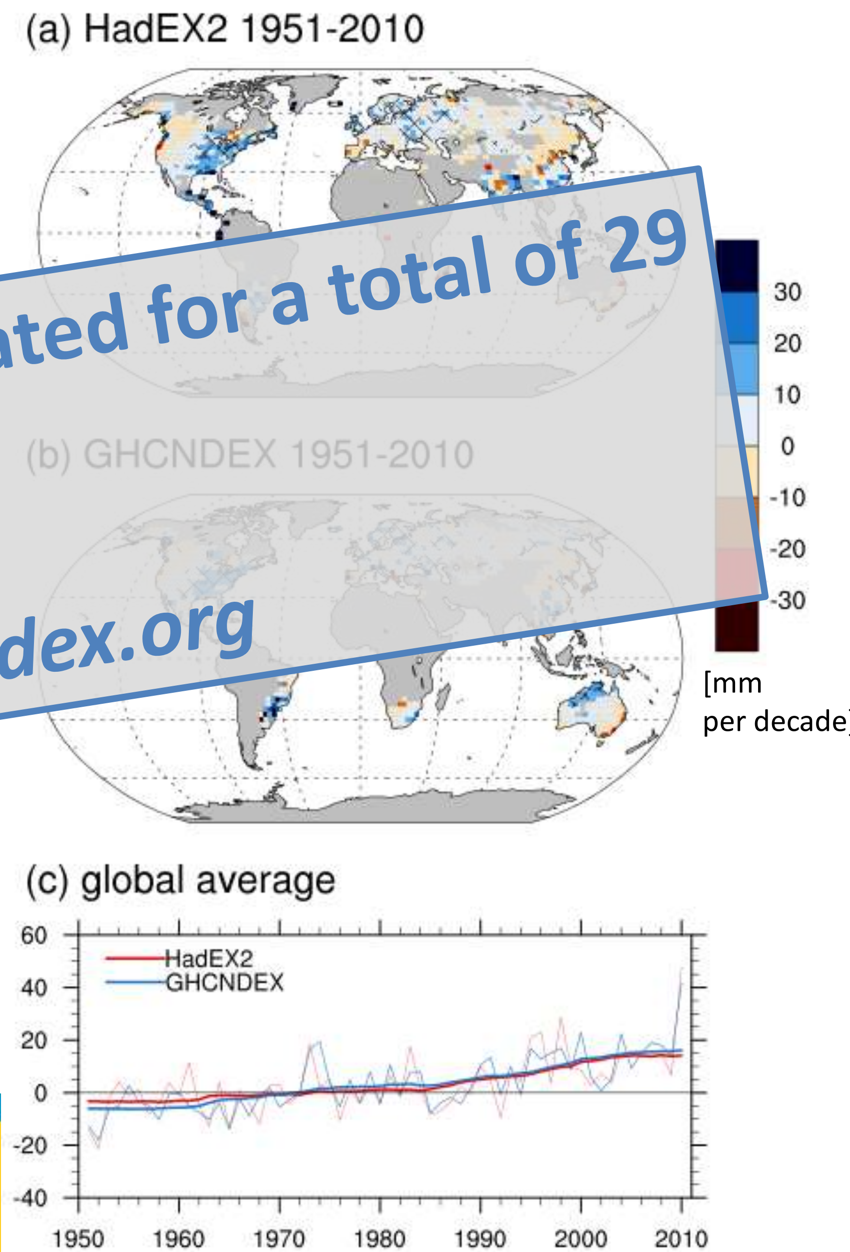


Extreme precipitation trends (1951-2010)

e.g. **heavy precipitation days (R10mm)**



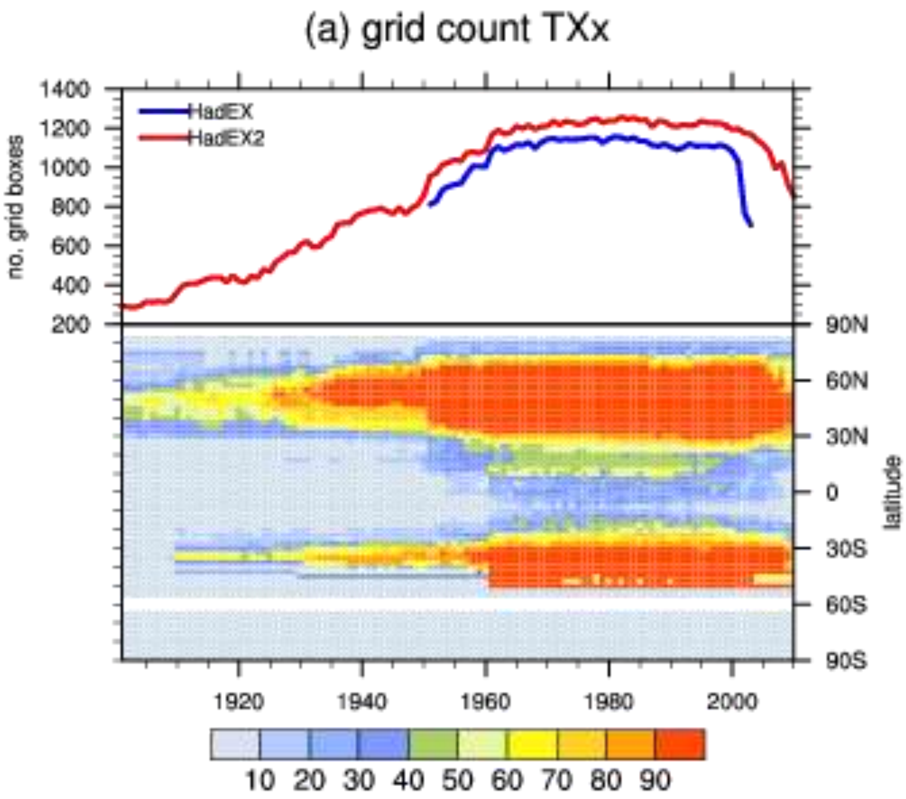
Contribution from very wet days (R95p)

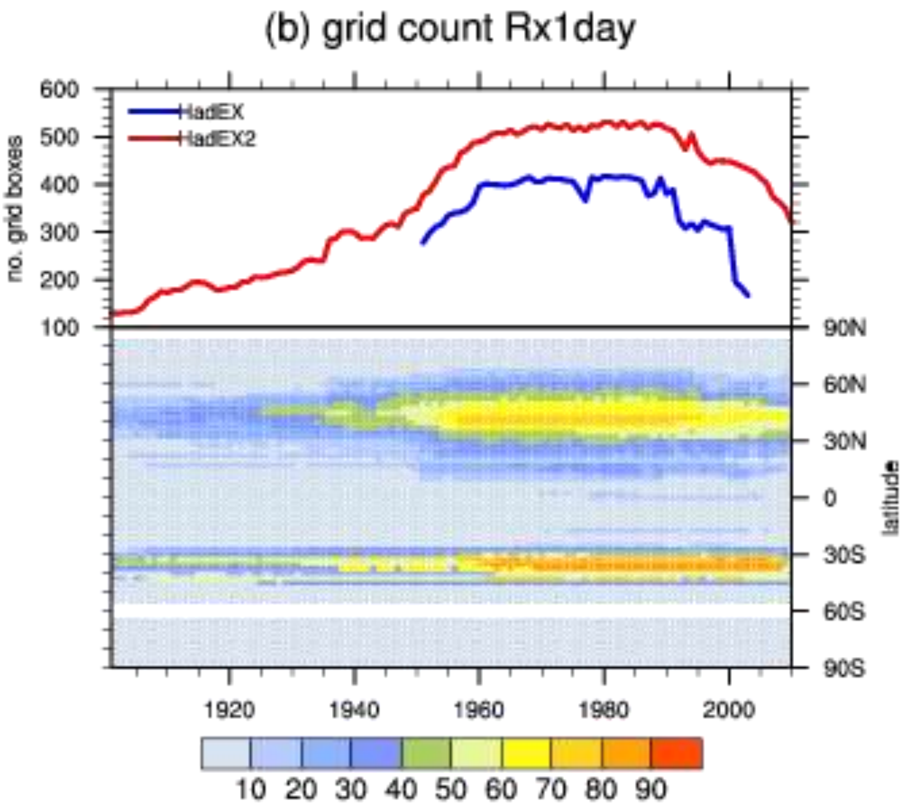


Global grids were calculated for a total of 29 climate indices.

Available on www.climdex.org

Variability in spatial coverage





- Sparse data before mid-20th Century

- GHCNDEX uses only long-term stations (40+ years of data after 1951)

Summary

- Compilation of 2 observational global (land-based) gridded data sets of ETCCDI climate extremes indices, **GHCNDEX (1951-present)** and **HadEX2 (1901-2010)**

Trend calculations indicate

→ **Consistent warming** in (almost) all regions, warming mostly stronger for indices calculated based on Tmin
→ Spatially **heterogeneous changes for precipitation** indices, larger areas with significant trends towards wetter conditions than areas with drying trends

- Confidence in the **robustness** of the identified trends is gained from agreement between different (partly independent) datasets, and also agreement with previous datasets

- Missing availability of suitable observational data still limits the spatial (and temporal) coverage

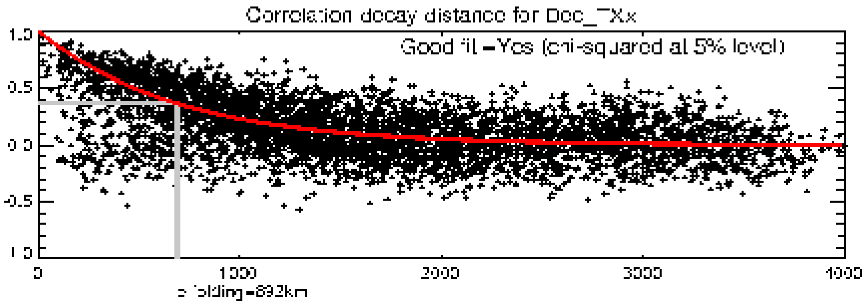
Thank you.

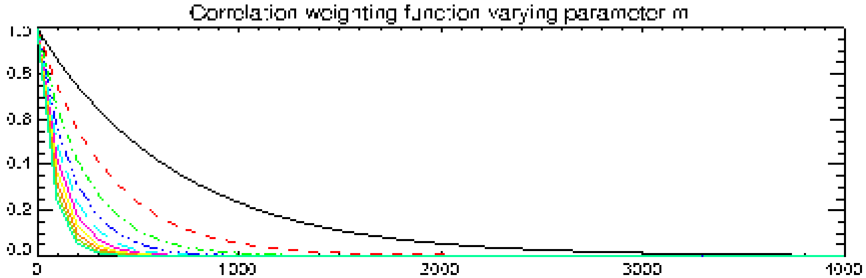
Spatial Interpolation of station observations

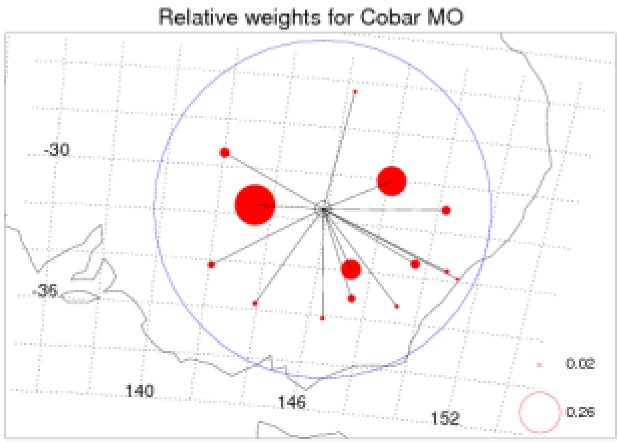
Angular Distance Weighting (ADW) method

Angular distance weights for ith station, wi, which are defined as:

$$\omega_i = f_i^{\,m} \left\{ 1 + \frac{\sum_k f_k^{\,m} \left[1 - \cos(\theta_k - \theta_i) \right]}{\sum_k f_k^{\,m}} \right\}, \qquad i \neq k$$







We can calculate parametric uncertainties by testing our choices within our model framework

By using multiple gridding methods we can begin to assess structural uncertainty