Comparing temperature and precipitation extremes across multiple reanalyses and gridded *in situ* observational datasets

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In this presentation:

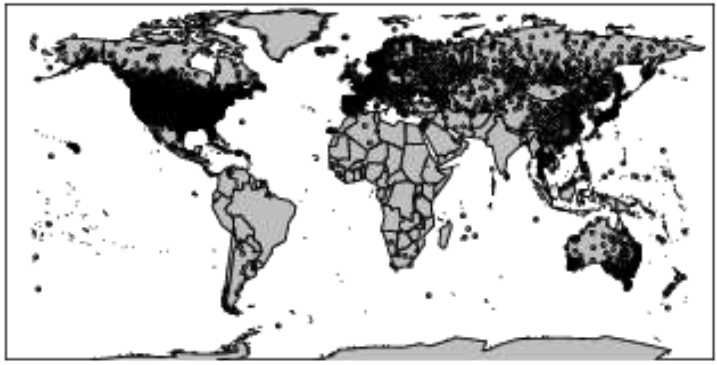
Are the changes in extremes robust across different datasets – gridded observations vs. reanalyses?

Observational global gridded data sets of climate extremes indices to monitor changes in extreme temperature and precipitation

GHCNDEX:

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

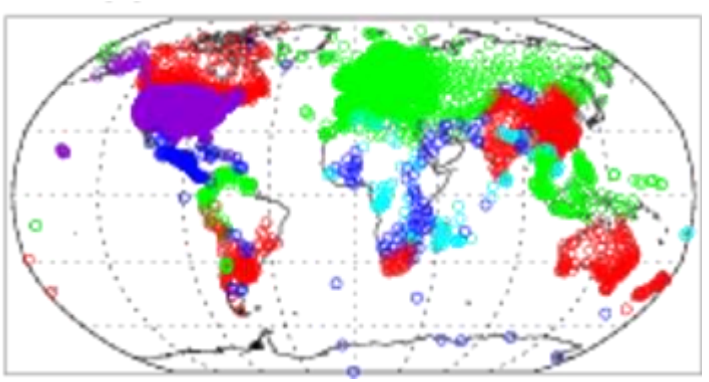
(Donat et al. 2013, BAMS)



HadEX2:

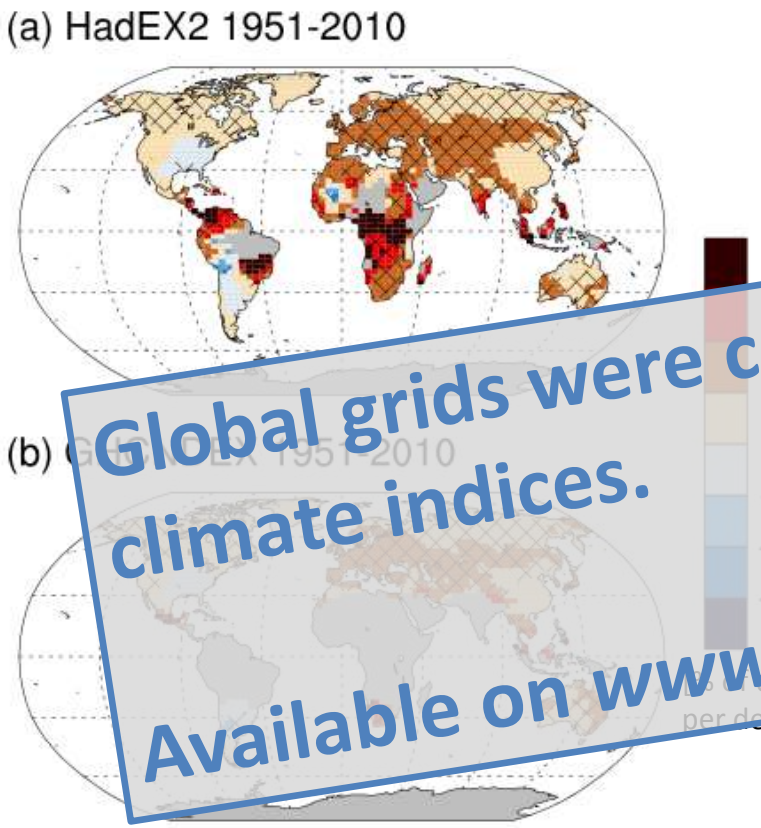
- based on multiple data sources (free archives, ETCCDI workshops, personal contacts), only HQ stations, checked for homogeneity
- 1901 to 2010, 3.75° x 2.5° regular grid
- static

(Donat et al. 2013, JGR)

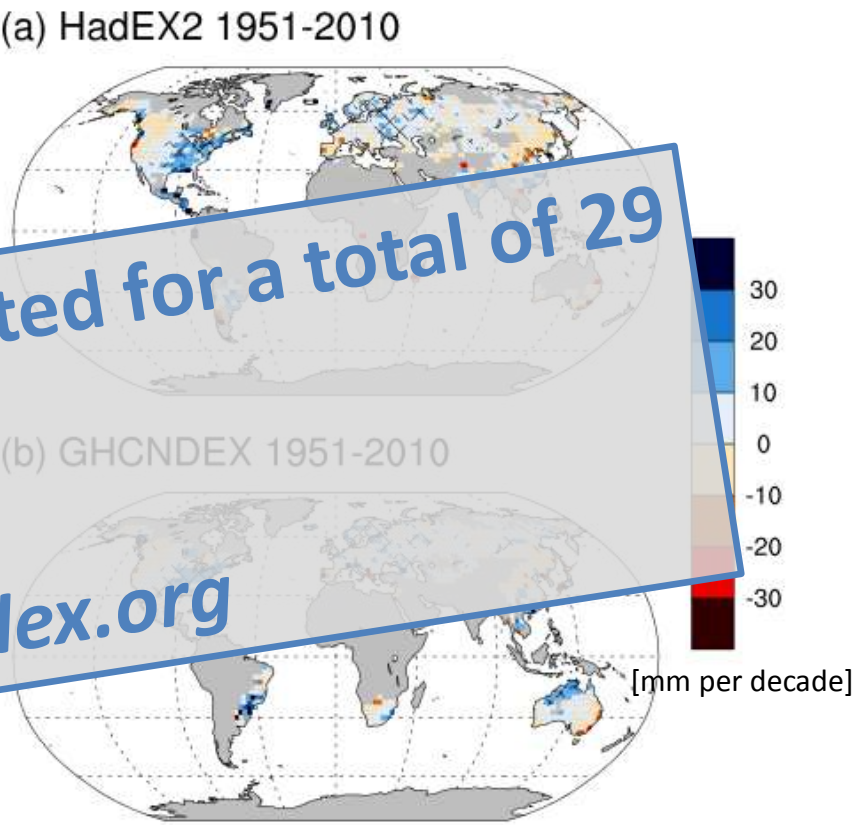


Extreme temperature and precipitation trends (1951-2010)

e.g. **Frequency of warm days (TX90p)**

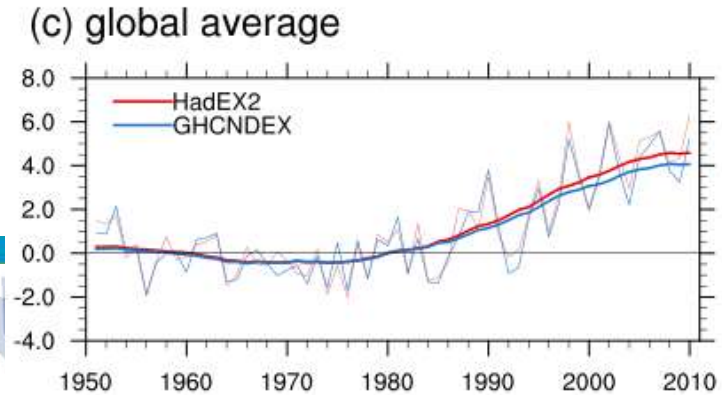


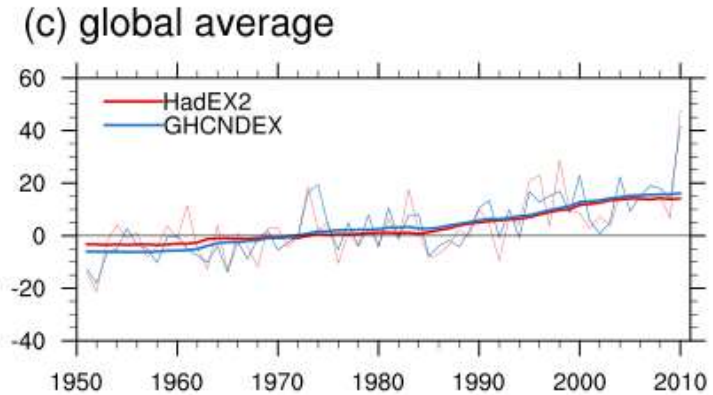
Contribution from very wet days (R95p)



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

Available on www.climdex.org





Can reanalysis be used to inform about observed changes in extremes?

Reanalysis based on observational data assimilated into GCM

→ provide physically consistent fields

→ complete spatial coverage

1. Intercomparison of many available datasets representative for recent climate:

- 3 x observational: HadEX2, GHCNDEX, HadGHCND
- 5 x Reanalysis: NCEP1, NCEP2, ERA40, ERA-Interim, JRA25

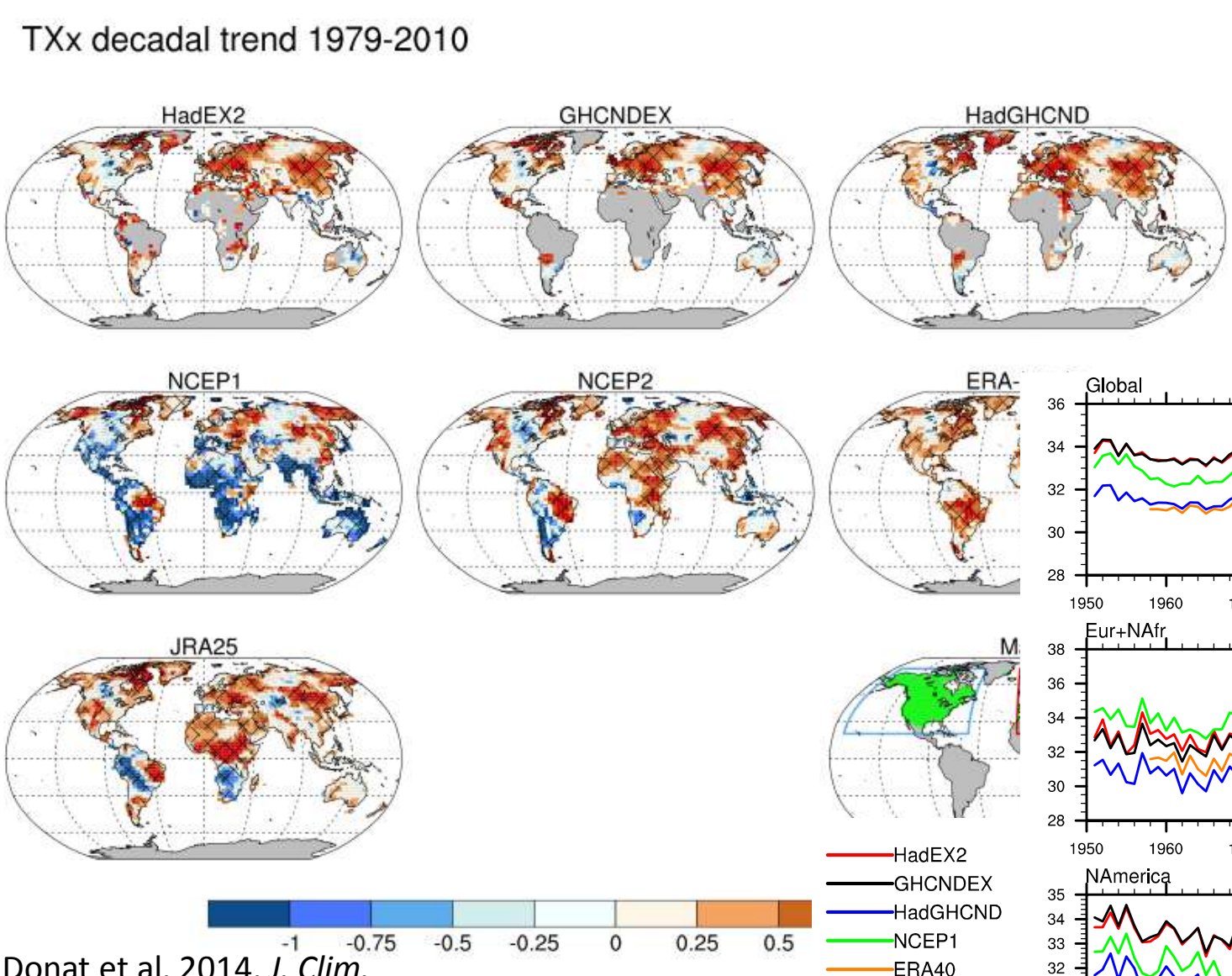
…different coverage in space and time…

→ restrict comparison to 1979-2010* and grid boxes with complete coverage in all 3 *in situ*-based datasets

2. Comparison of century-long gridded observations and reanalysis:

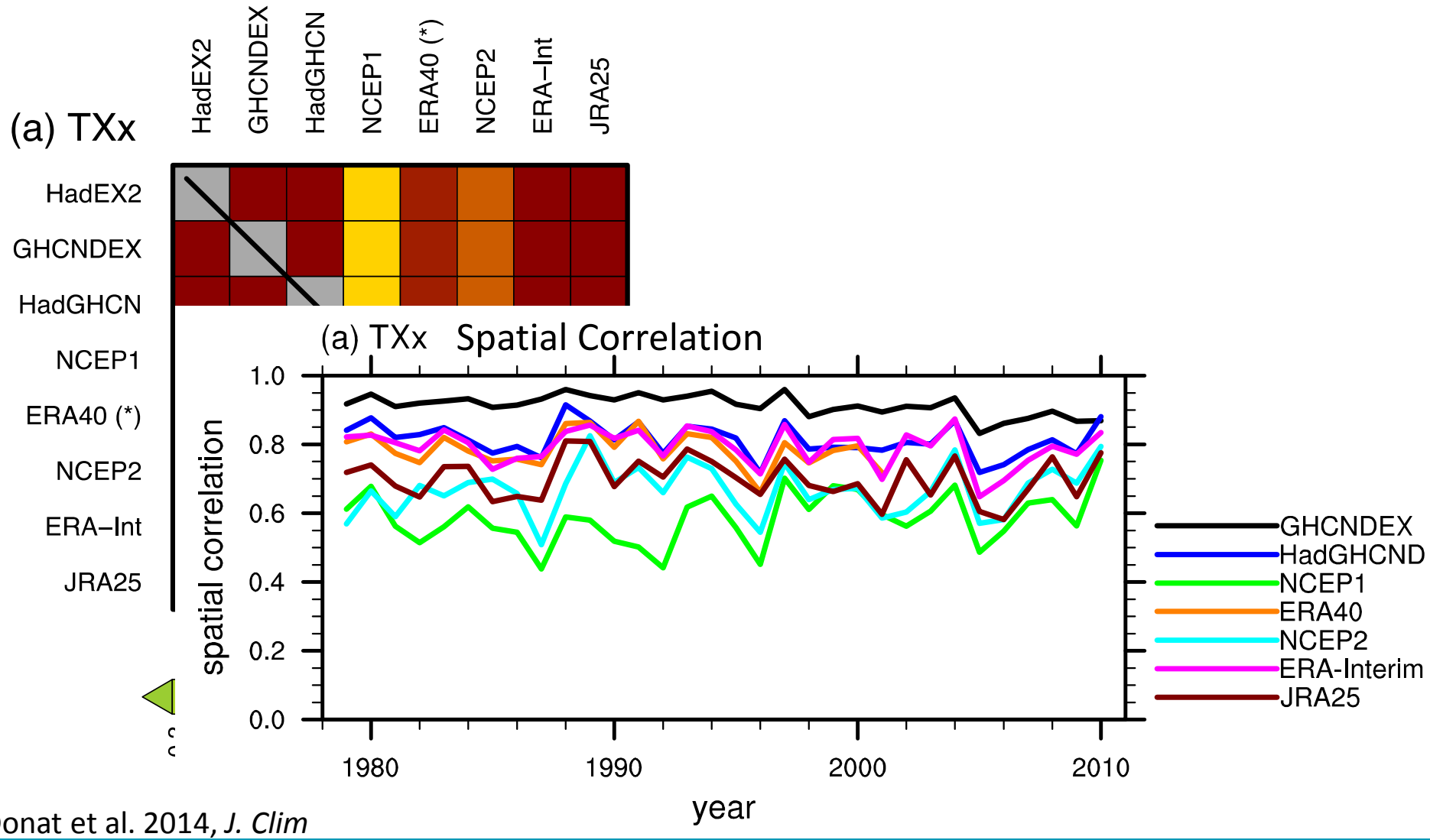
- HadEX2 vs 20CR (1901-2010)

Reanalysis data in comparison to gridded *in situ* data sets



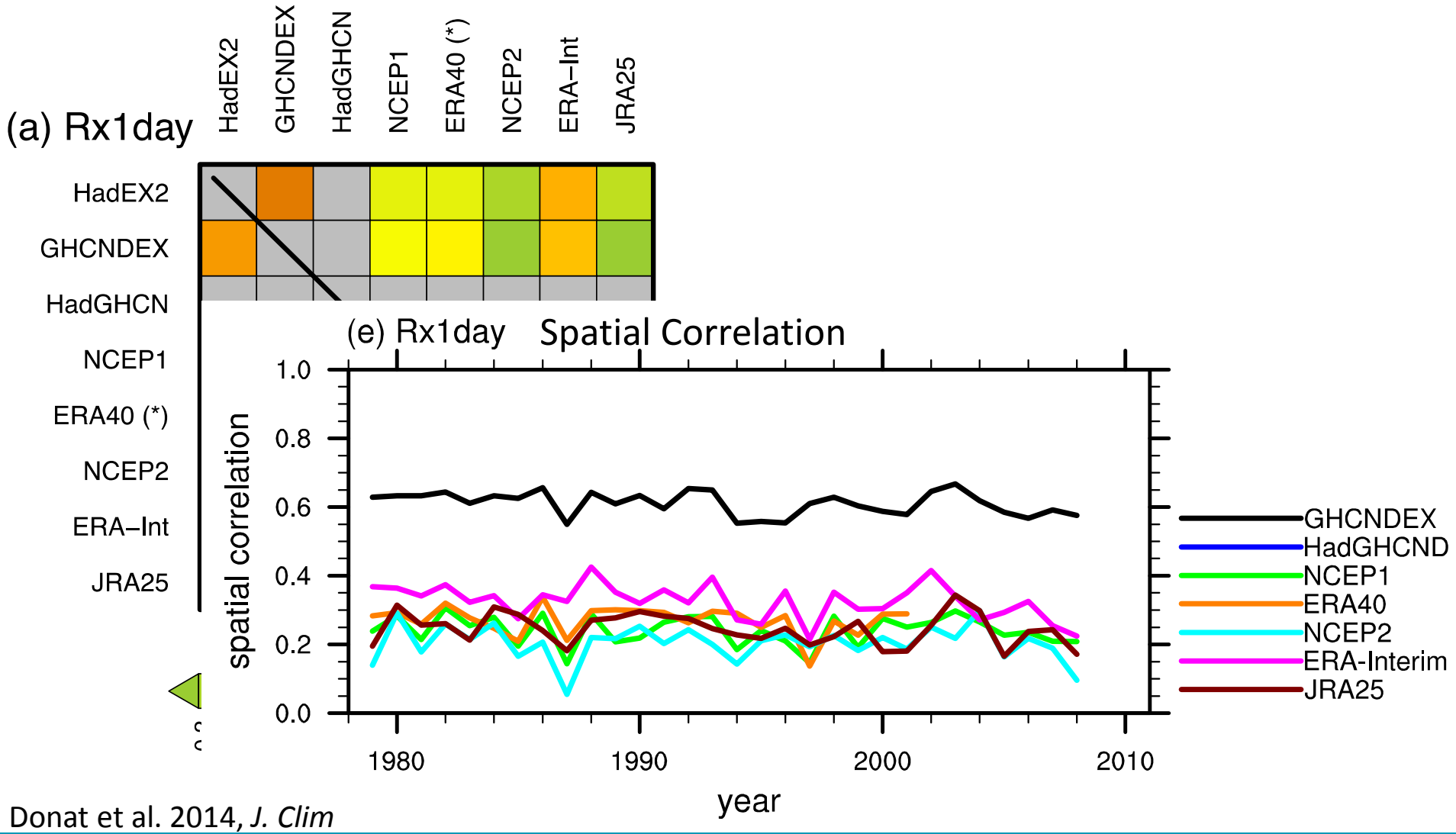
Donat et al. 2014, *J. Clim.*

Temporal and spatial correlation between datasets - extreme temperature (hottest day of the year, TXx)



Donat et al. 2014, *J. Clim*

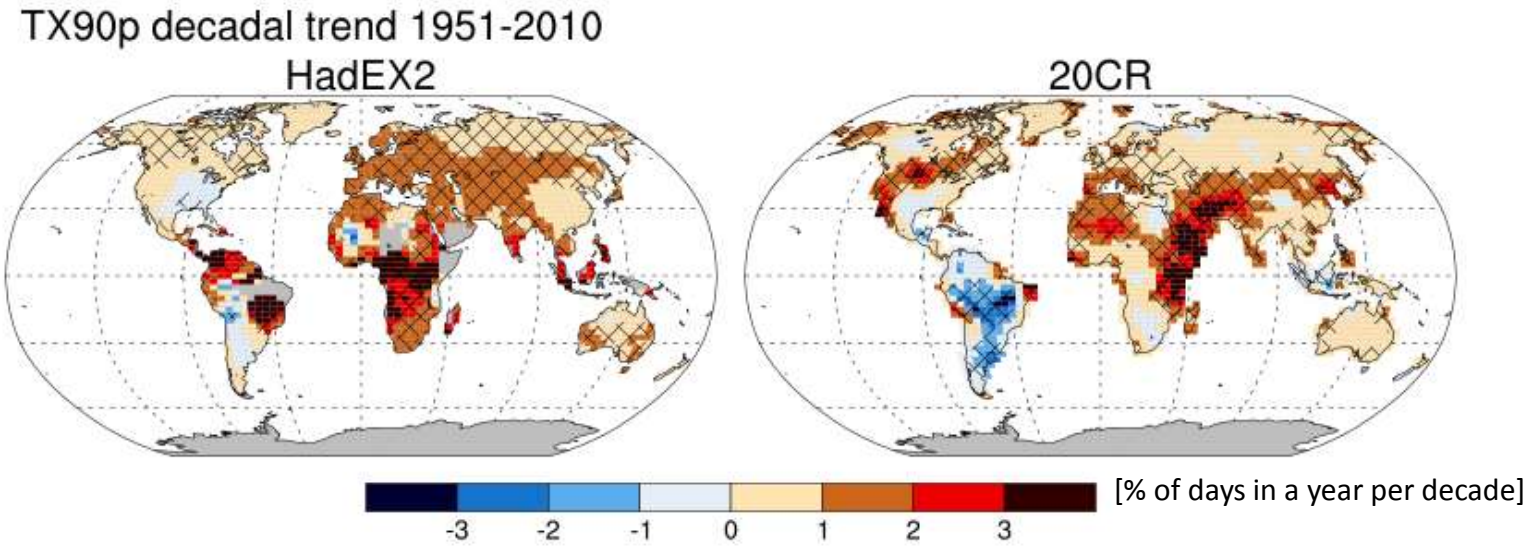
Temporal and spatial correlation between datasets - extreme precipitation (max. 1-day precipitation, Rx1day)

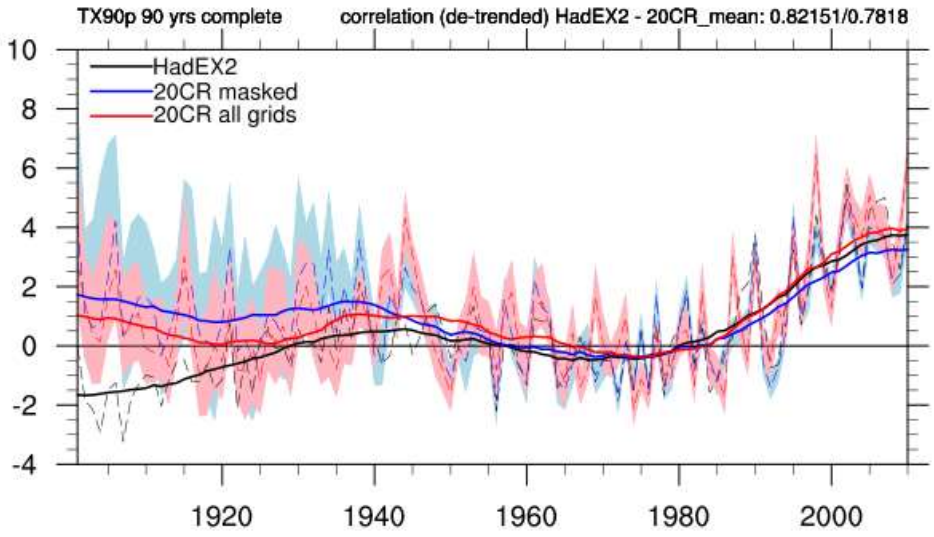


Donat et al. 2014, *J. Clim*

Century-long Observations and Reanalysis

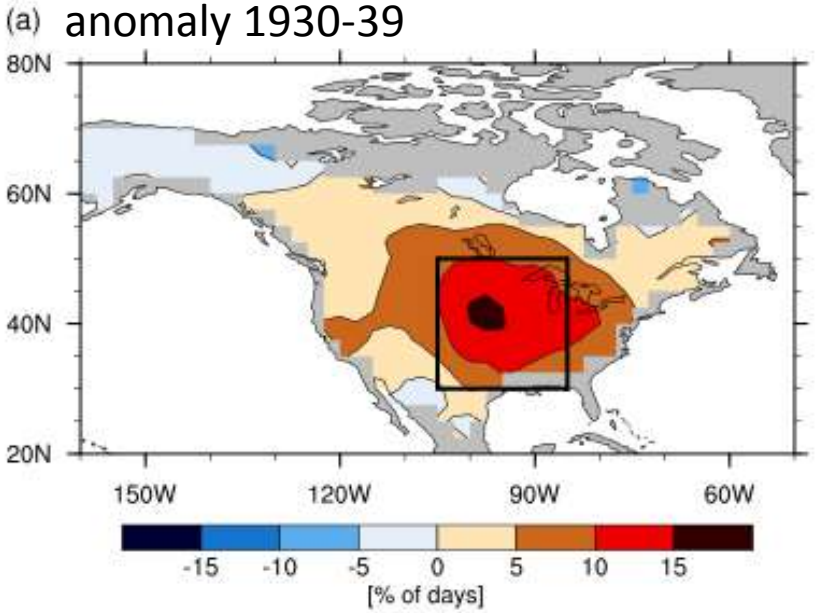
for example: TX90p (frequency of warm days)



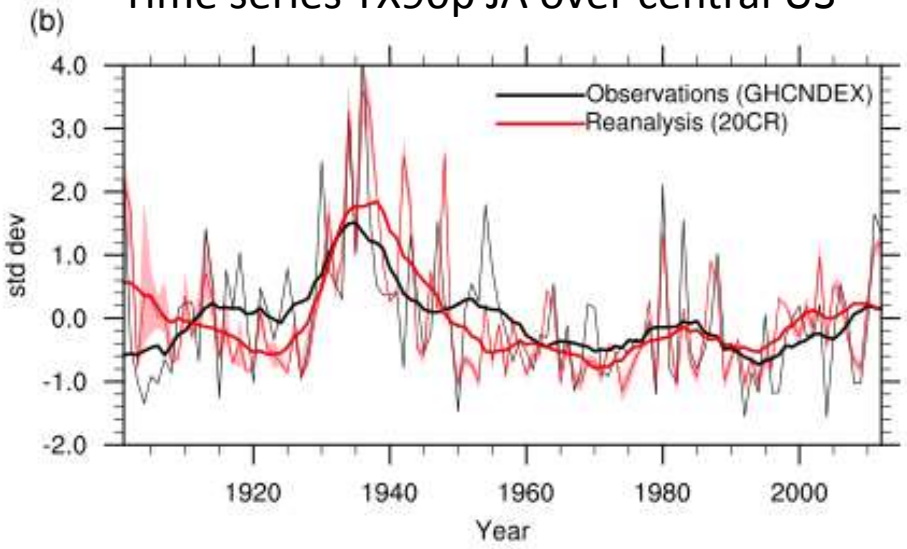


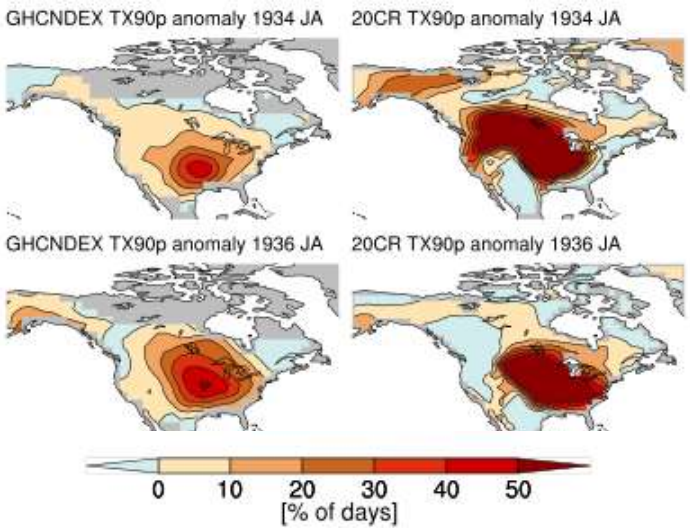
Reasonable agreement throughout the 20th century in regions with good observational coverage, e.g. North America

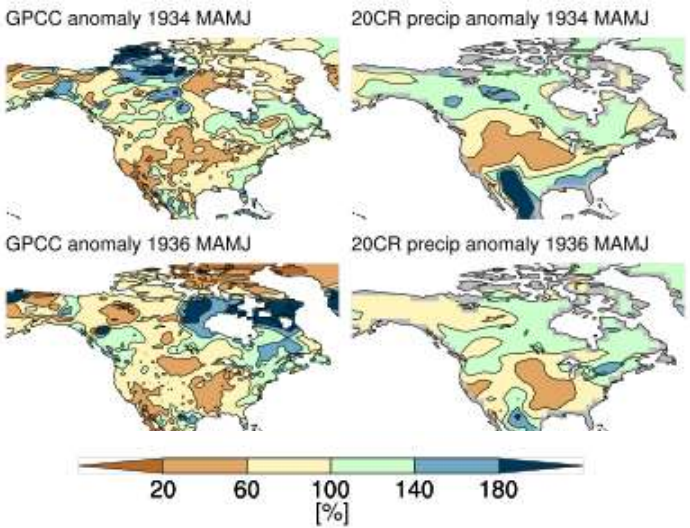
Warm day frequency (TX90p JA), anomaly 1930-39



Time series TX90p JA over central US

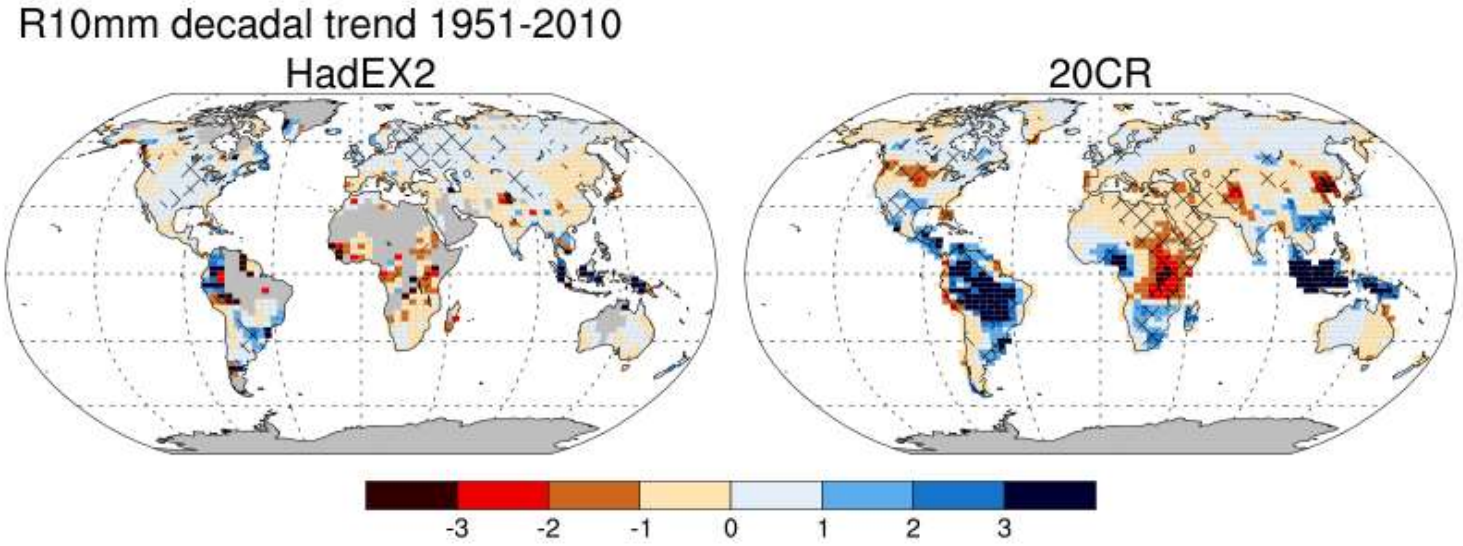


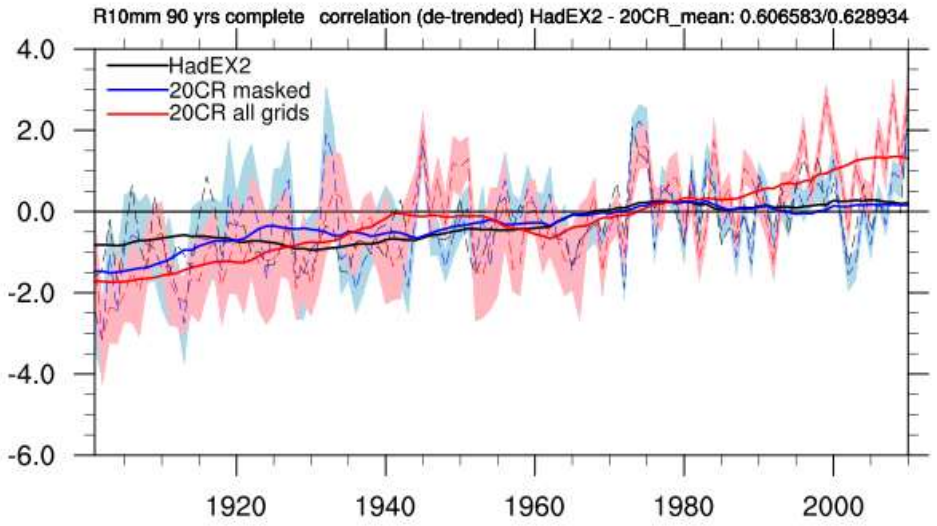




Century-long Observations and Reanalysis

for example: R10mm (heavy precipitation days)





Summary

Observational datasets of extremes and reanalyses indicate

→ **Consistent warming** in (almost) all regions

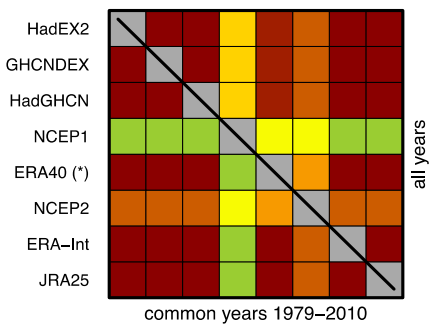
→ Spatially **heterogeneous changes for precipitation** indices, larger areas with significant trends towards wetter conditions than areas with drying trends

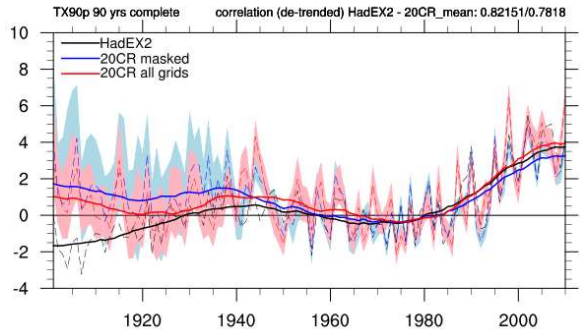
Intercomparison of multiple observational (*in situ*) and reanalysis datasets

→ **high robustness** of observational (*in situ*-based) datasets back to 1950

→ **reanalyses show good agreement after 1979** (satellite era) for temperature extremes, less (but still reasonable) agreement for precipitation extremes in regions where observations are available

→ century-long observations and reanalysis data agree well after ±1950, larger differences in first half of 20th century (however better agreement in regions with dense observations)





Thank you.

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Reanalysis data in comparison to gridded *in situ* data sets