# Climate variability and changes in the climate extremes of Mexico as detected from the global to the local scale

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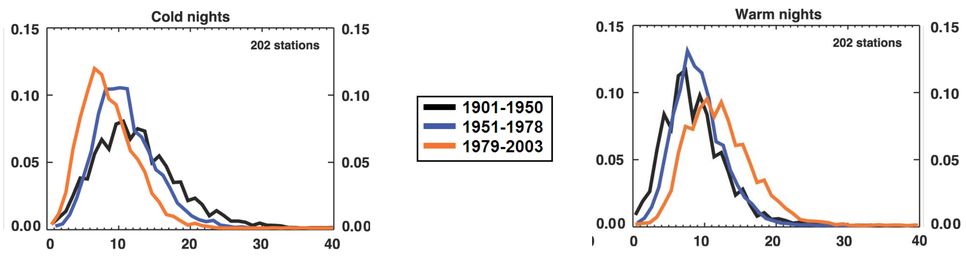
## Changes in the climate extremes

Recent studies derived from daily data have improved our understanding on changes in climate extremes.The last IPCC Assessment Report included results showing detected shifts in the distribution of daily maximum and minimum temperature (1). Further studies using more extensive data showed that such changes in extremes are consistently detected at regional and local scales: For North America, the frequency of warm *nights and days* is increasing whereas the frequency of cold *nights and days* is decreasing (2). At the local scale of a particular area in eastern Mexico, the same changes are significantly observed as an increasing (decreasing) in the frequency of warm (cold) *days* (3). On the other hand, observed precipitation changes vary from one region to another. Whereas in the global and regional studies a general increase is found in extreme precipitation indices, local analysis found no significant changes.

### (1) Global

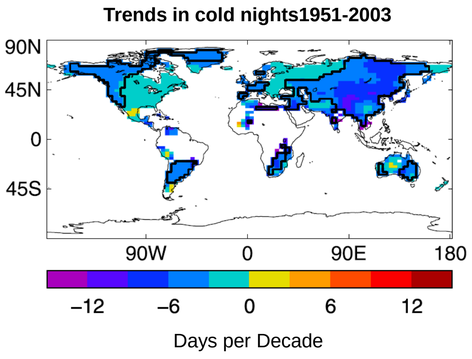
From Alexander et al., 2006.

**PDFs for cold nights (Tn10p, left) and warm nights (Tn90p, right ) 1901-2003**

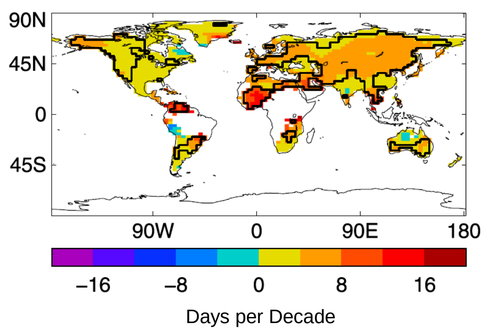



Percentage of time during the year below the 10th or above the 90th percentile of minimum temperature.

**Trends in cold nights1951-2003**




**Trends in warm nights1951-2003**

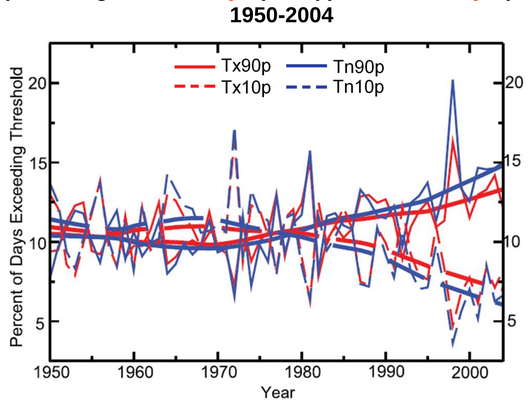



### (2) Regional

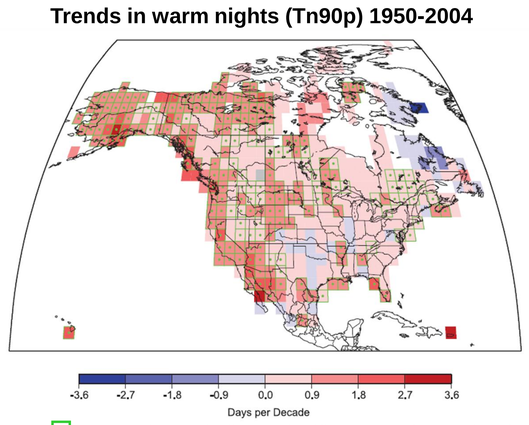
(North America)

From Peterson et al., 2008.

**Percentage of cold nights (Tn10p) and warm nights (Tn90p) & percentage of cold days (Tx10p) and warm days (Tx90p) 1950-2004**




**Trends in warm nights (Tn90p) 1950-2004**



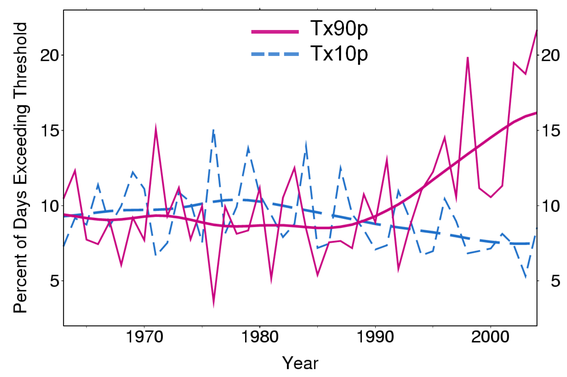

Green boxes indicate significance at the 5% level

### (3) Local

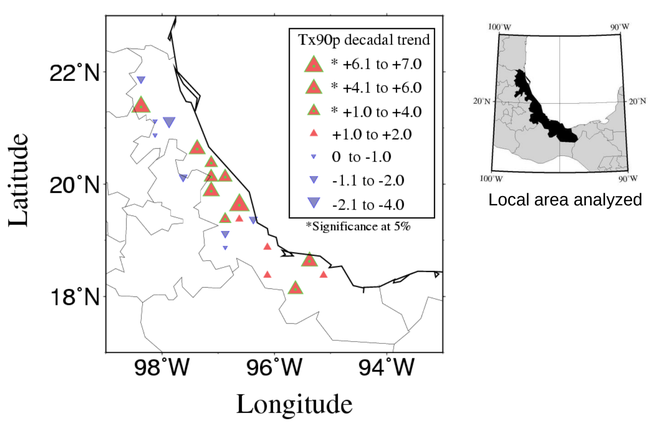
(State of Veracruz, Mexico)

From Vazquez et al., 2008.

**Percentage of cold days (Tx10p) and warm days (Tx90p) 1963-2004**

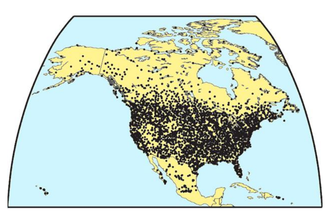



**Trends in warm days (Tx90p) 1963-2004**

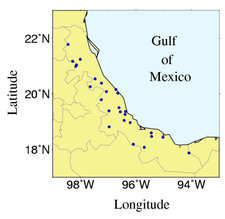



## Data & methods.

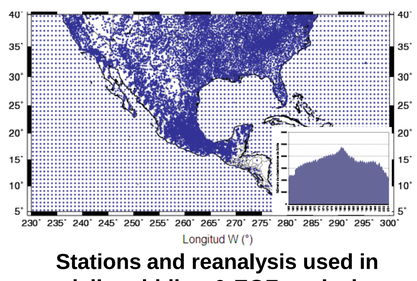
Daily time-series of maximum and minimum temperature were analyzed for the globe (2223), North America (2847) and Veracruz (26) using the Indices approach proposed by the WMO/JCOMM/CLIVAR Expert Team on Climate Change Detection and Indices (ETCCDI).



Stations used in North America




Stations used in Veracruz



Stations and reanalysis used in daily gridding & EOF analysis

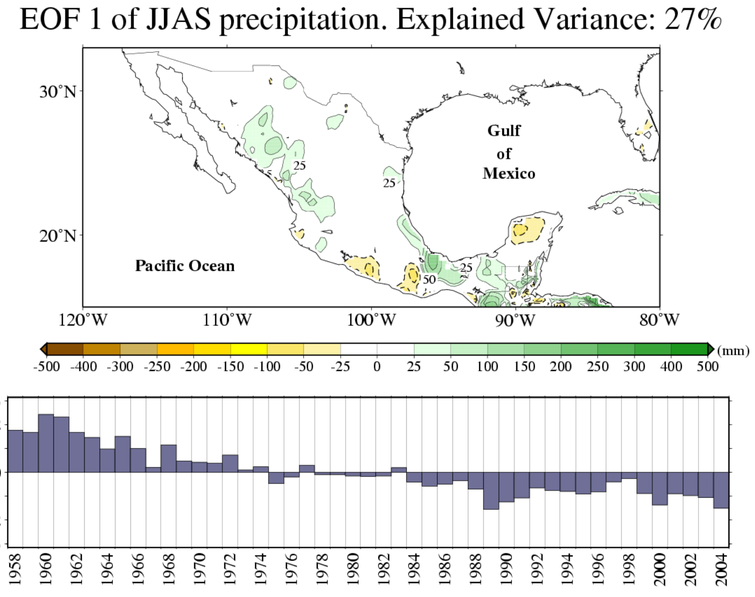
ETCCDI indices provide an internationally agreed formulation for studying the extremes*. All the time-series were quality-controlled based on logical errors, the original records, outliers, visual inspection of the plots, fronts and tropical cyclone records, the values of adjacent days at the same station, data from the same day at nearby stations, anomalies and synoptic patterns based on reanalysis & local-expertise. The homogeneity of the QCed time-series was tested using Rhtest. For the analysis of precipitation in Mexico, a daily gridded dataset was created using the Cressman objective analysis, then EOF analysis was applied for summer (JJAS).

## Climate variability.

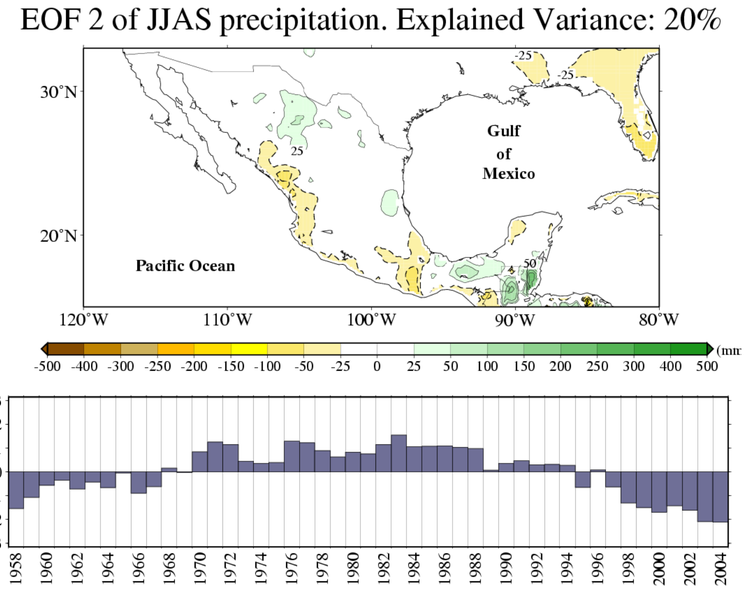
The first three principal components of summer precipitation in Mexico are shown in the figures below. Physical reasoning of these patterns indicate that important modulations in the observed amount of rainfall are due to a) the large-scale systems and the long-term trend, b) the Atlantic Multidecadal Oscillation, and c) the interannual variability related to the El Niño – Southern Oscillation (ENSO). It is interesting to note that ENSO appears the third in importance, explaining only a small amount of variance.

| Atmospheric / Oceanic Index | JJAS precipitation EOF | Correlation (0.01 significance) |
|---|---|---|
| Global Temperature Record | 1 | -0.78 |
| Atlantic Multidecadal Oscillation | 2 | -0.66 |
| Niño 3.4 SST Anomaly | 3 | -0.56 |

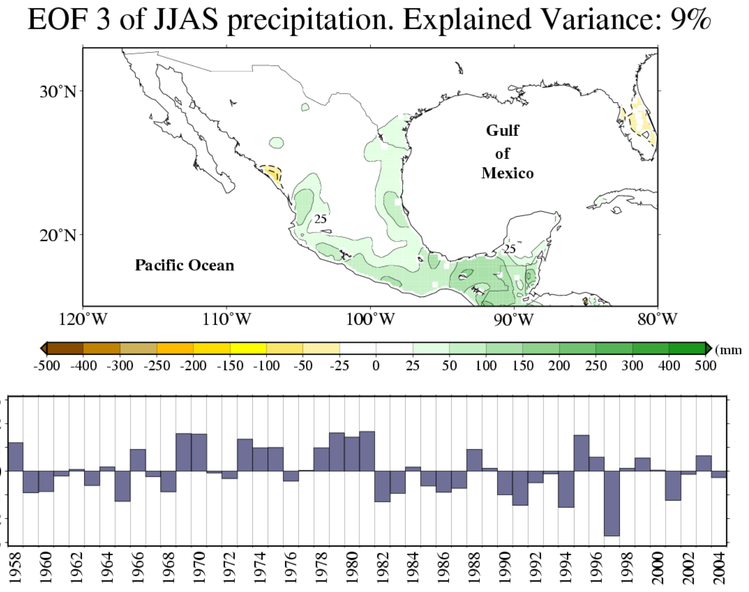
EOF 1 of JJAS precipitation. Explained Variance: 27%




EOF 2 of JJAS precipitation. Explained Variance: 20%




EOF 3 of JJAS precipitation. Explained Variance: 9%




## Future work

Improved daily gridded datasets for temperature and precipitation are being created for the region using the EU FP6 ENSEMBLES project approach. The resulting grids are expected to accelerate studies on the extremes. Further analyses of daily data are being conducted to update the extreme indices time-series for AR5.

### References

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*ETCCDI indices definitions and software are available at http://cccma.seos.uvic.ca/ETCCDMI/

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