Sources of Uncertainty in the Observed Climate Record

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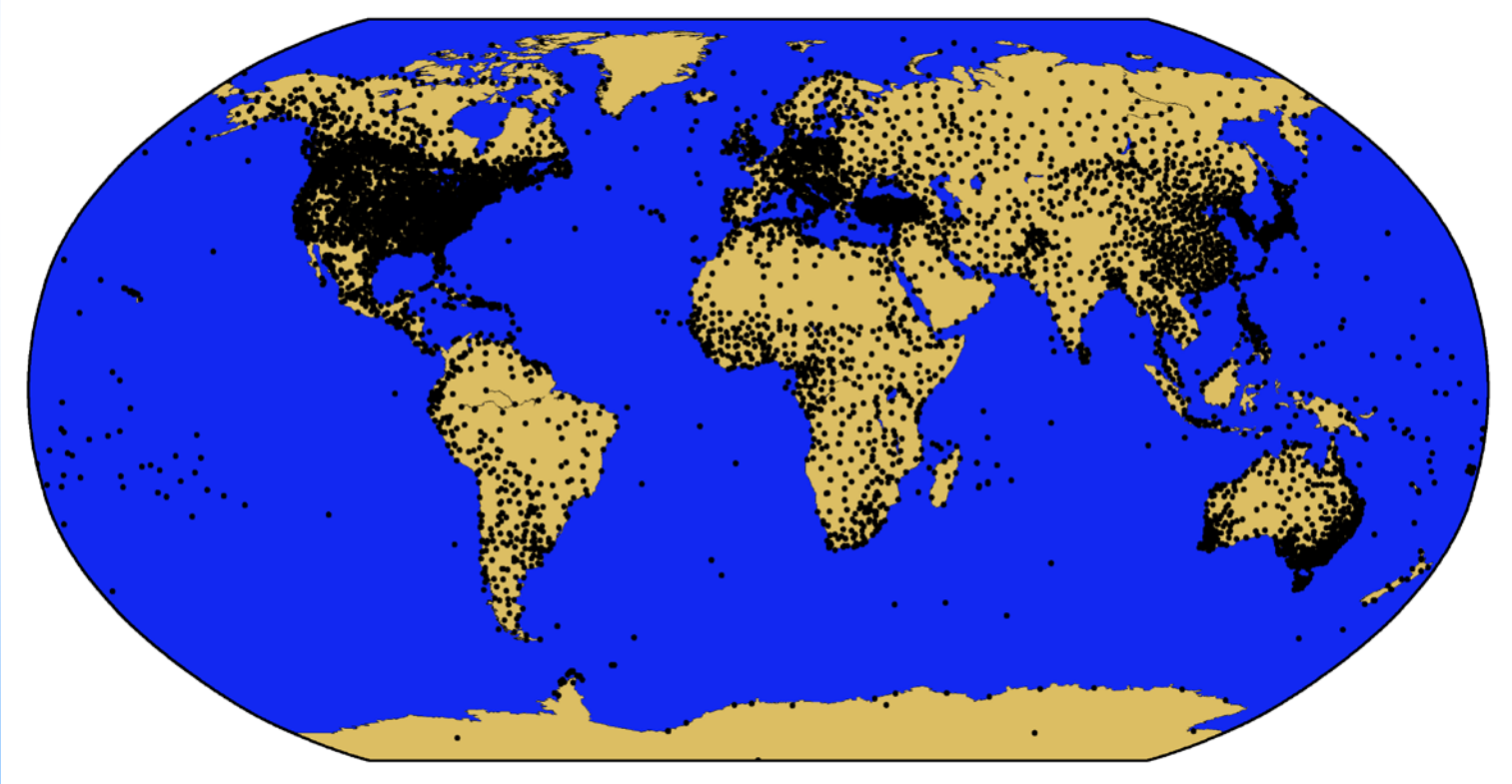
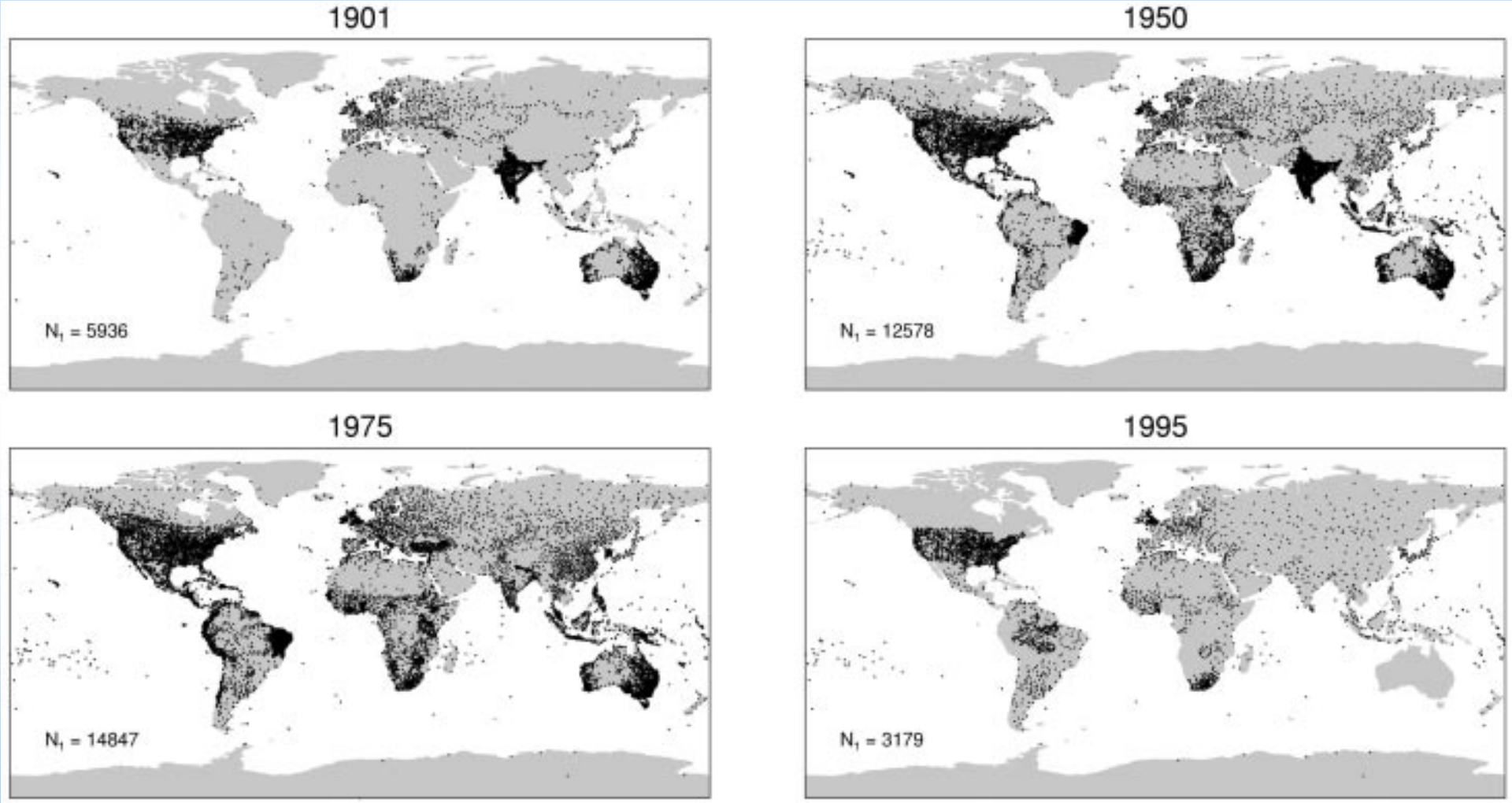
GHCN-Monthly Version 3.0

- The dataset for global climate monitoring and assessment
  - 7280 mean temperature stations; >20,000 precipitation stations
  - Global coverage from 1880 to present
  - GHCN-M Version 3 released in 2010 (temperature only)



Changing Mix of Stations: Raingauge Stations Over Time

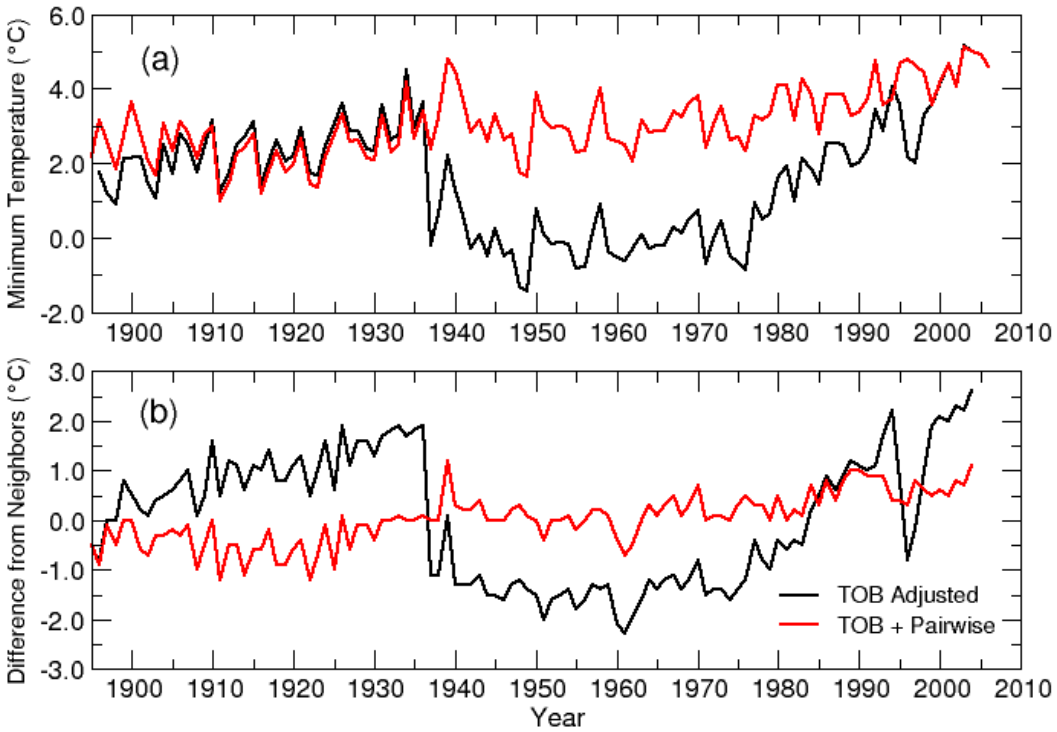
(NOAA GHCN Dataset)



New et al. 2001

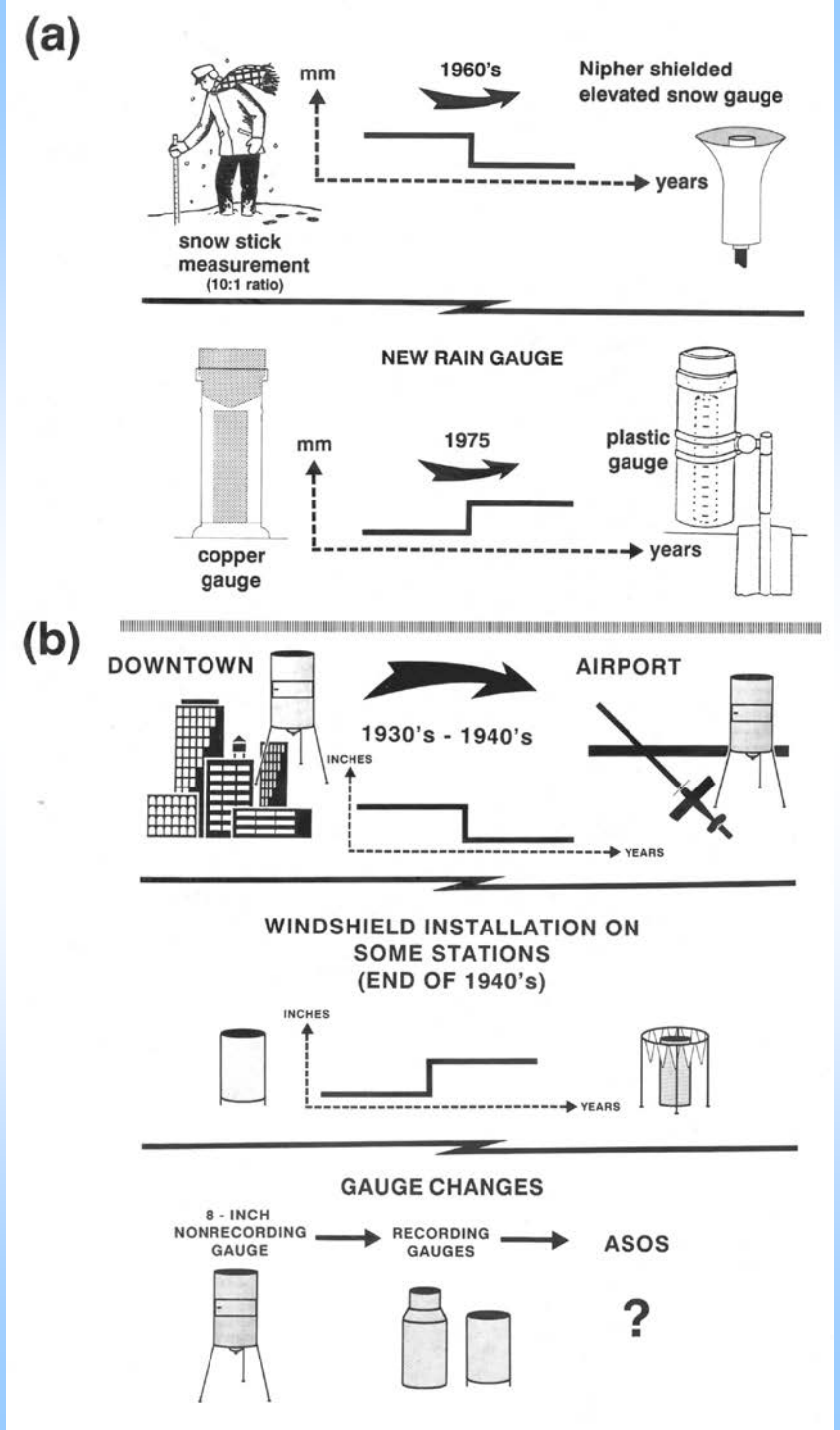
Homogeneity adjustments – Land air temperature station example

Reno Nevada annual minimum temperature



From Menne et al., 2008

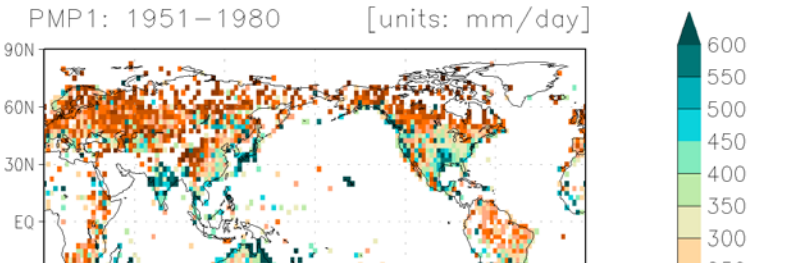
- Red is fully adjusted
- Black is only time of observation adjusted
- Top: temperatures
- Bottom: difference between Reno and mean of 10 nearest neighbors

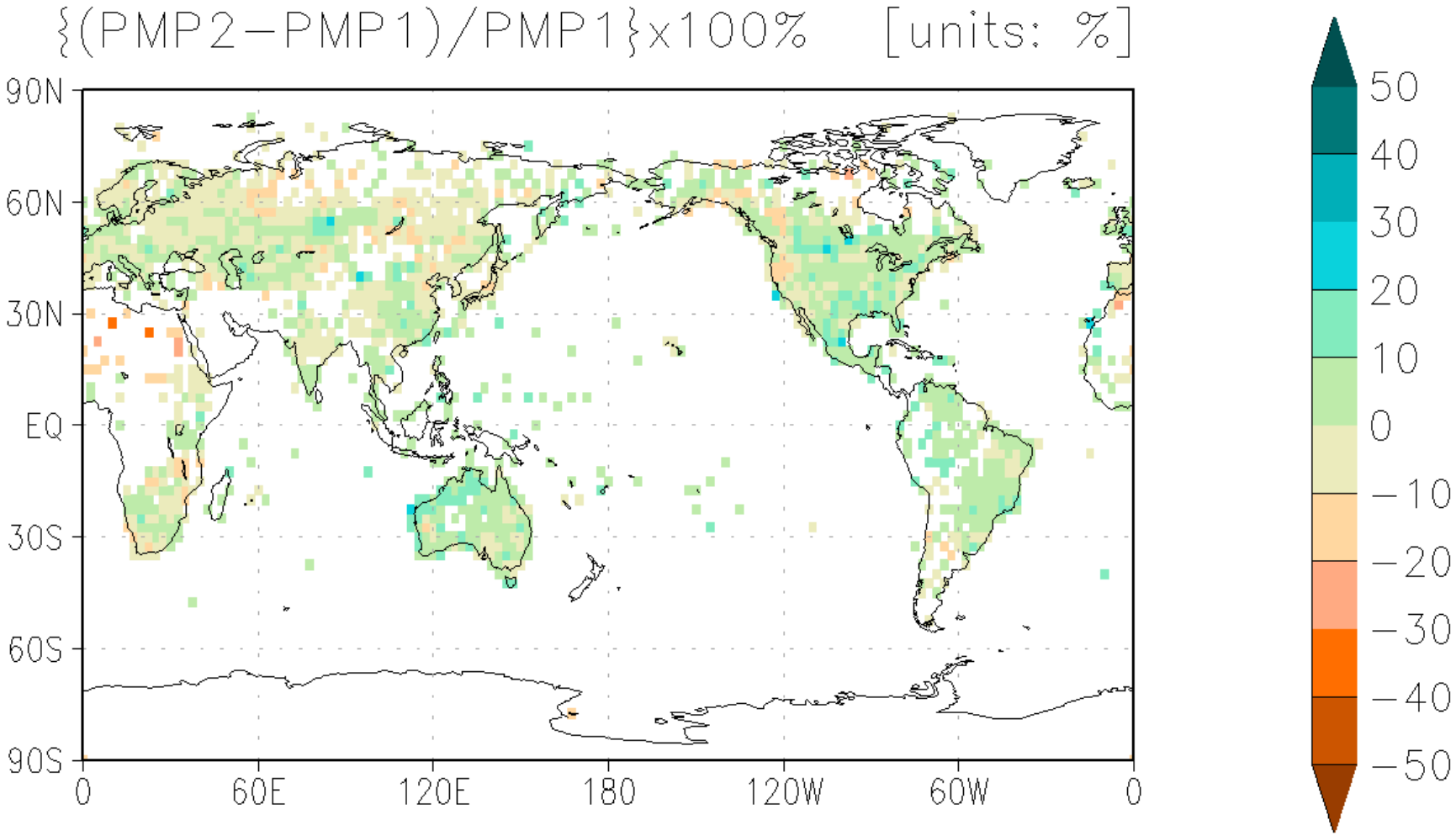

(a)
mm
1960's
Nipher shielded elevated snow gauge
years
snow stick measurement
(10:1 ratio)
NEW RAIN GAUGE
mm
1975
plastic gauge
copper gauge
years
(b)
DOWNTOWN
AIRPORT
1930's - 1940's
INCHES
YEARS
WINDSHIELD INSTALLATION ON SOME STATIONS (END OF 1940's)
INCHES
YEARS
GAUGE CHANGES
8 - INCH NONRECORDING GAUGE
RECORDING GAUGES
ASOS
?

Observed Changes in Probable Maximum Precipitation

- GHCN-Daily
- NCEP-NCAR Reanalysis
- 20th Century Reanalysis

NCEP/NCAR
1951-2010





How Well Do We Define Drought?

- Palmer Drought Severity Index (PDSI)
  - Considers both P and T
  - How well does it work for observed record and models?
- Standardized Precipitation Index (SPI)
  - Only statistics of P.
  - No consideration of Evaporation
- Other Indices (e.g. Keech-Byram)
- Land Surface Models

Thank You

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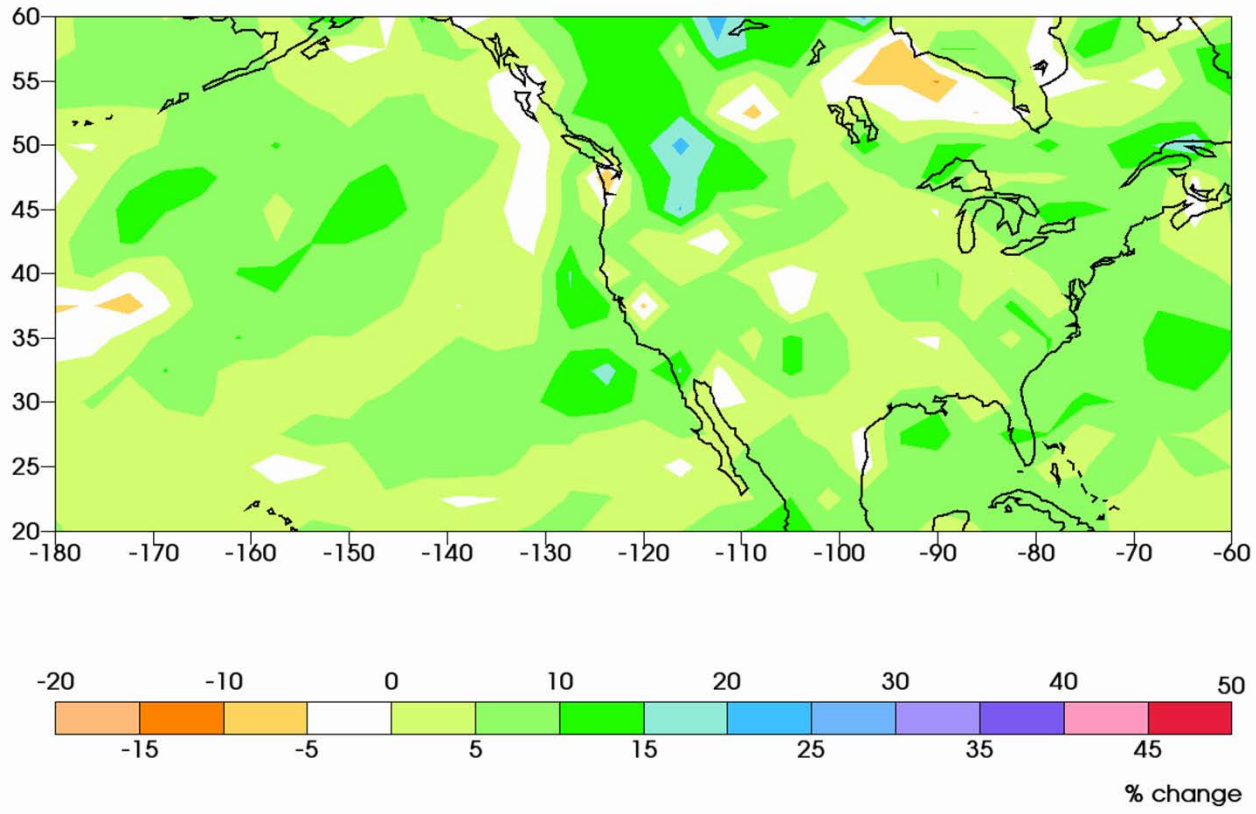
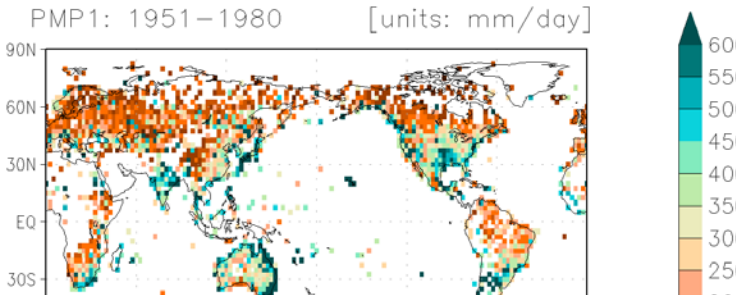
CMIP5 Model Analysis

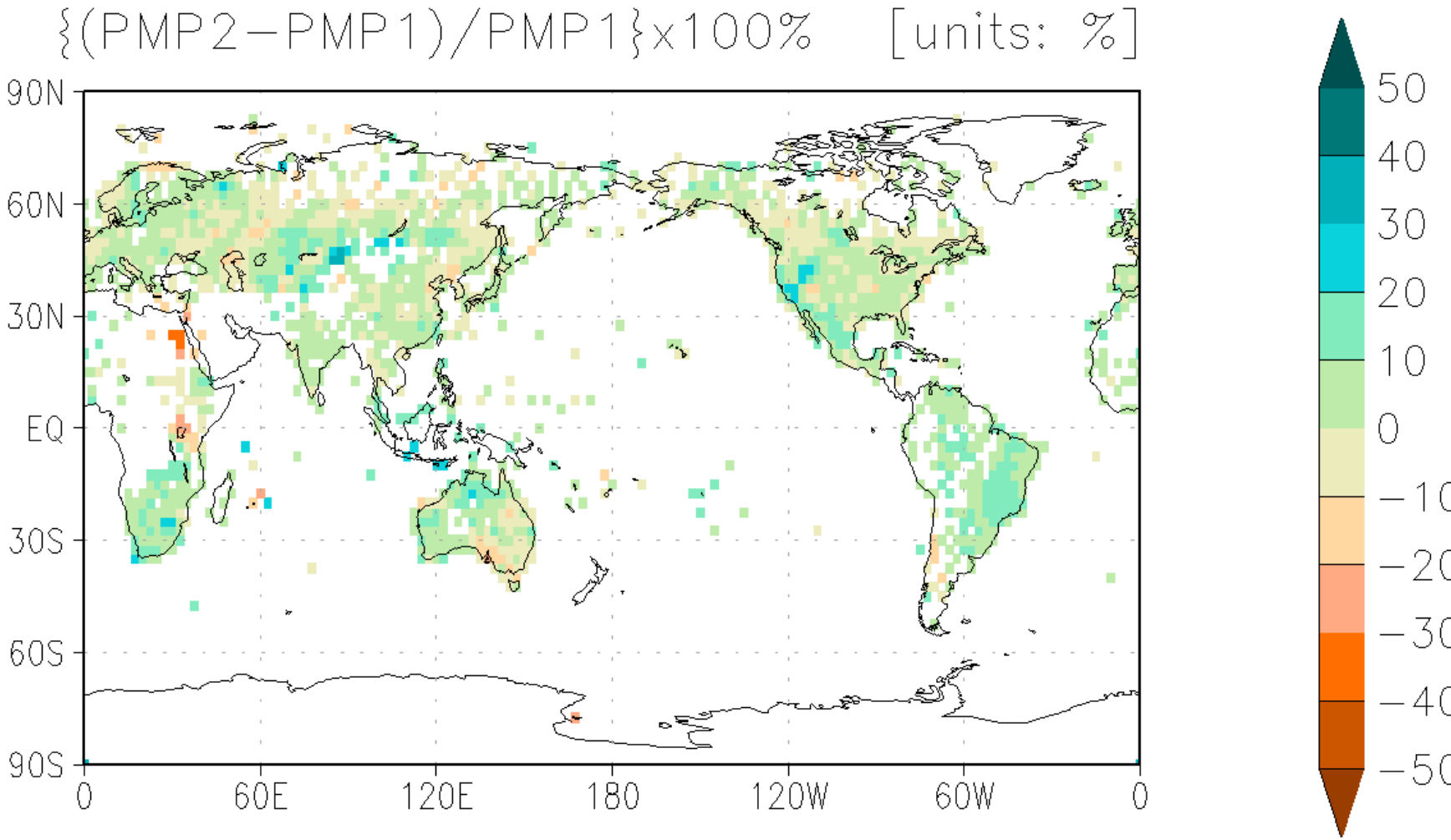
- We examined ratio of surface specific humidity between an historical control period of 1979-2005 and early and late 21st Century future periods
- CMIP5 RCP4.5 scenario
- Models analyzed thus far: Canadian ESM2, Hadley Center CM3, and Norwegian ESM1

Change in Maximum Specific Humidity
HadCM3
1979 – 2005 to 2006 - 2035



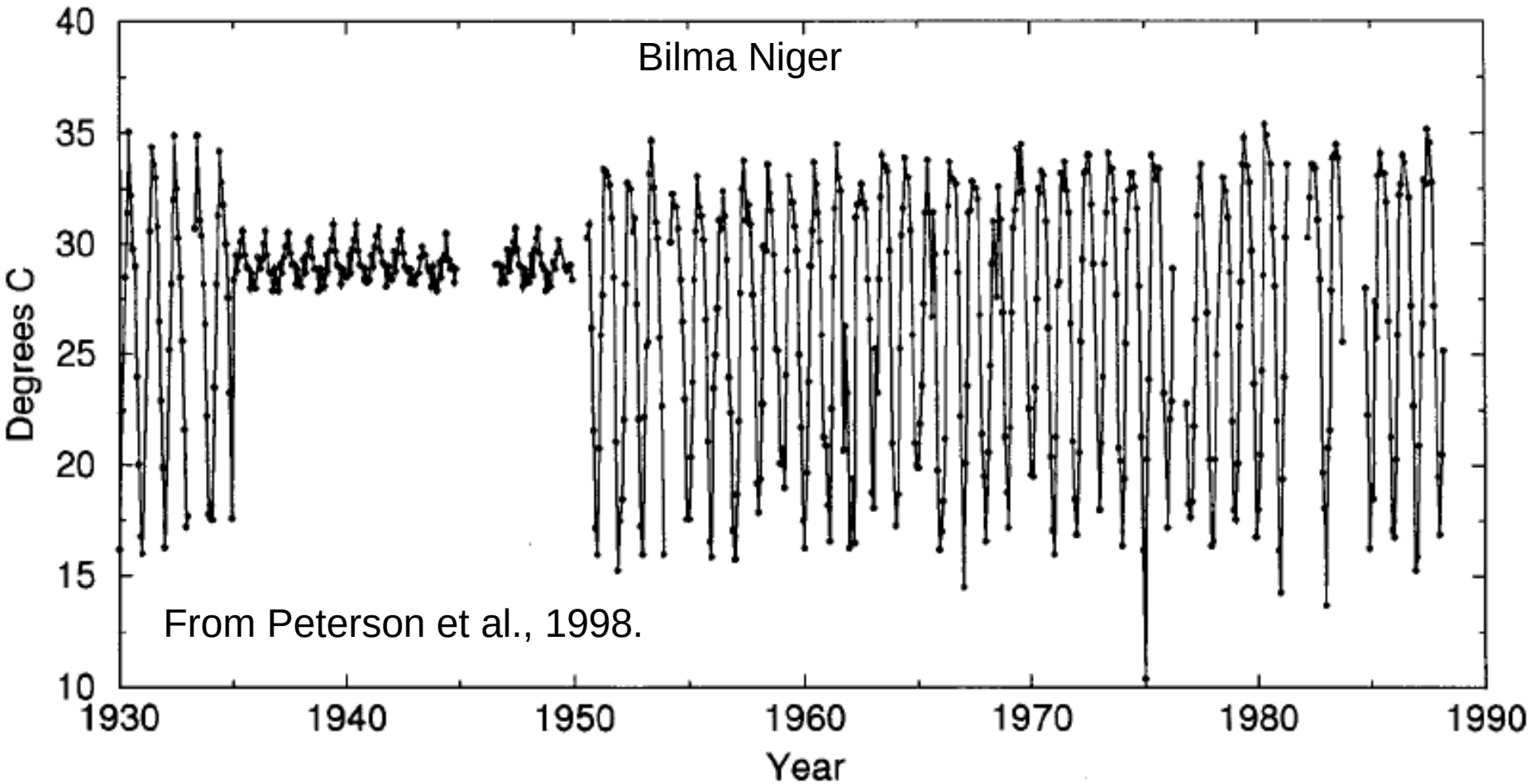
20th Century
1951-2010



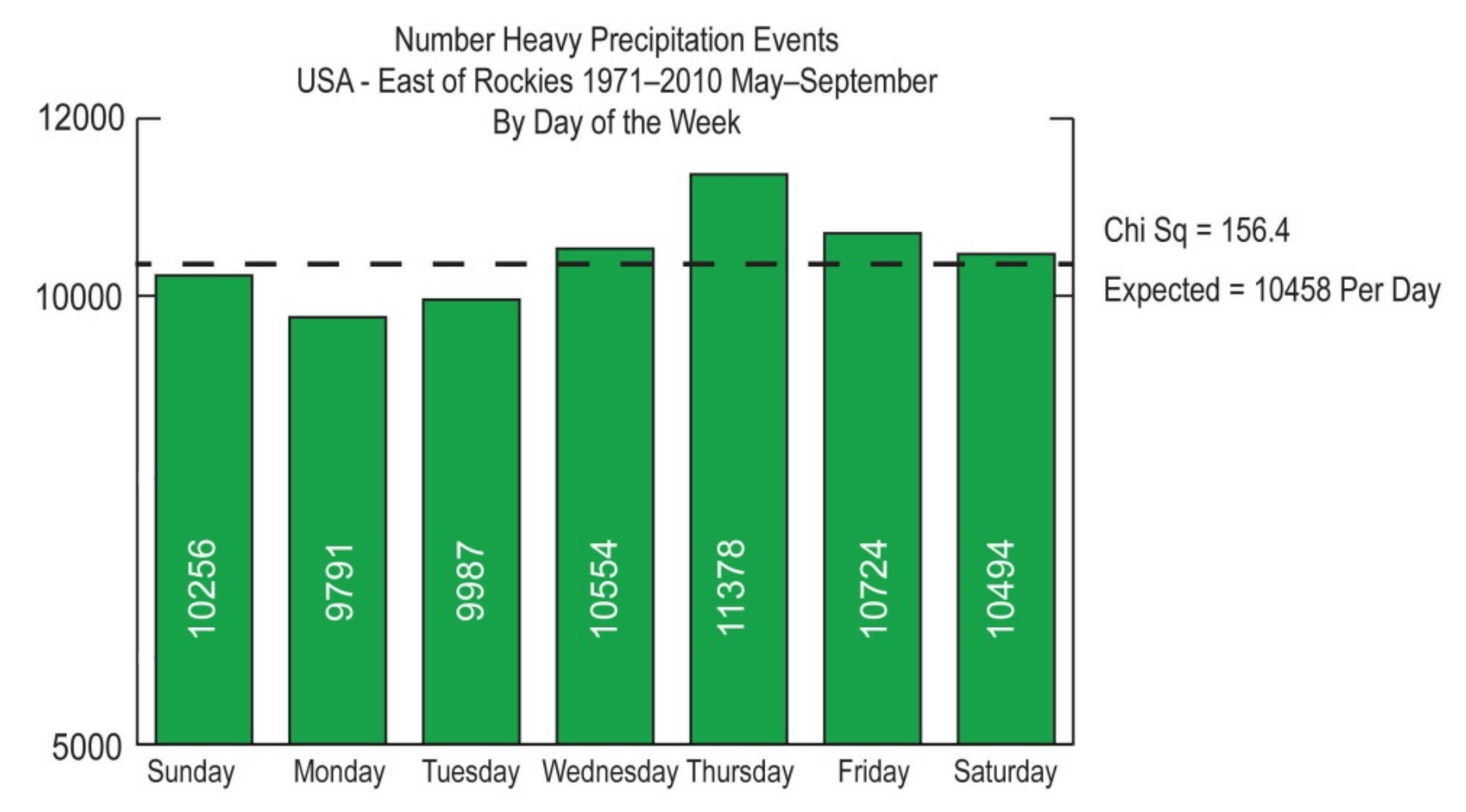


Quality control

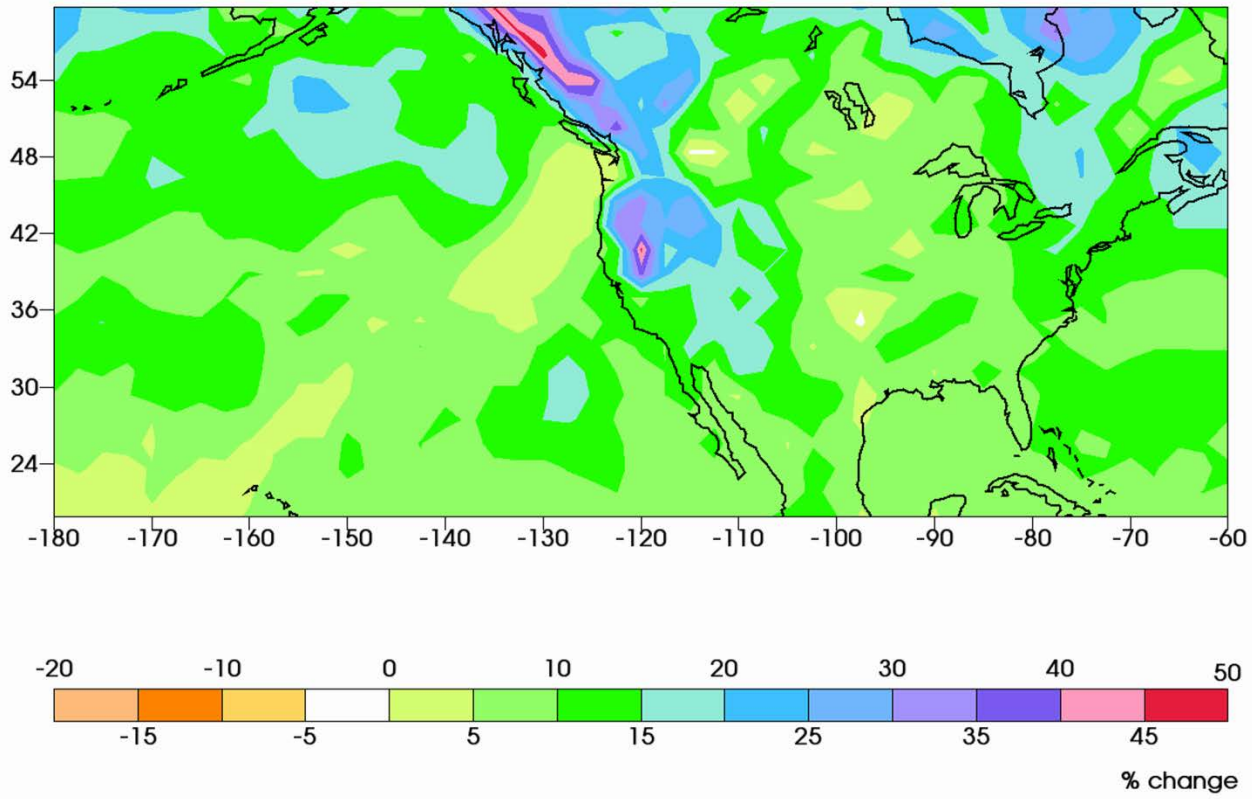
- A wide variety of checks have been developed to identify erroneous data points.



Is there a day of the week signal in heavy precipitation events



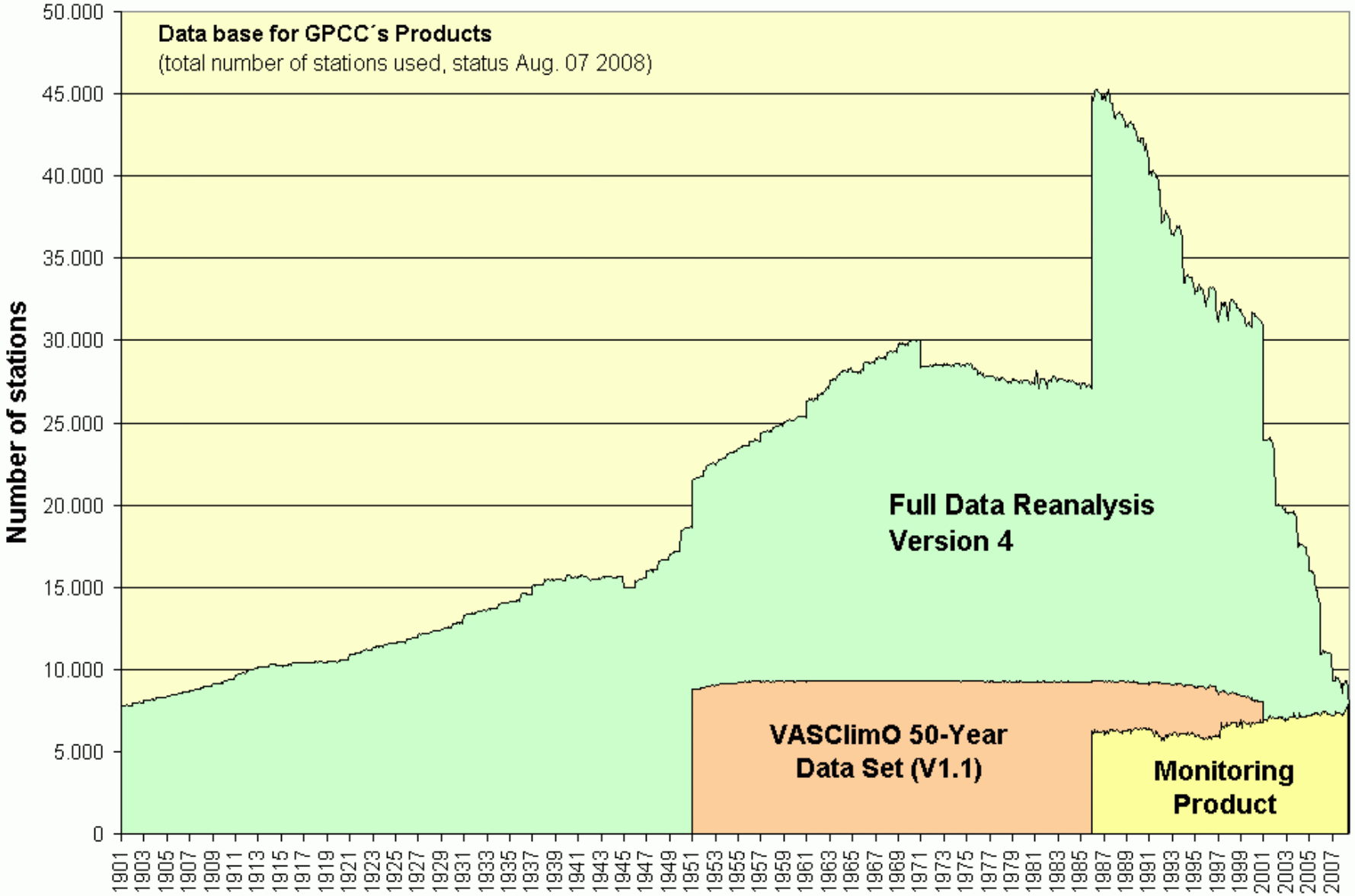
Change in Maximum Specific Humidity
NorESM1-M
1979 – 2005 to 2071 - 2100



Moisture maximization

- The one factor that is likely to change due to global warming is moisture maximization due to warming oceans and increased evaporation
- We have seen intriguing evidence that recent extreme precipitation events have been accompanied by higher atmospheric water vapor

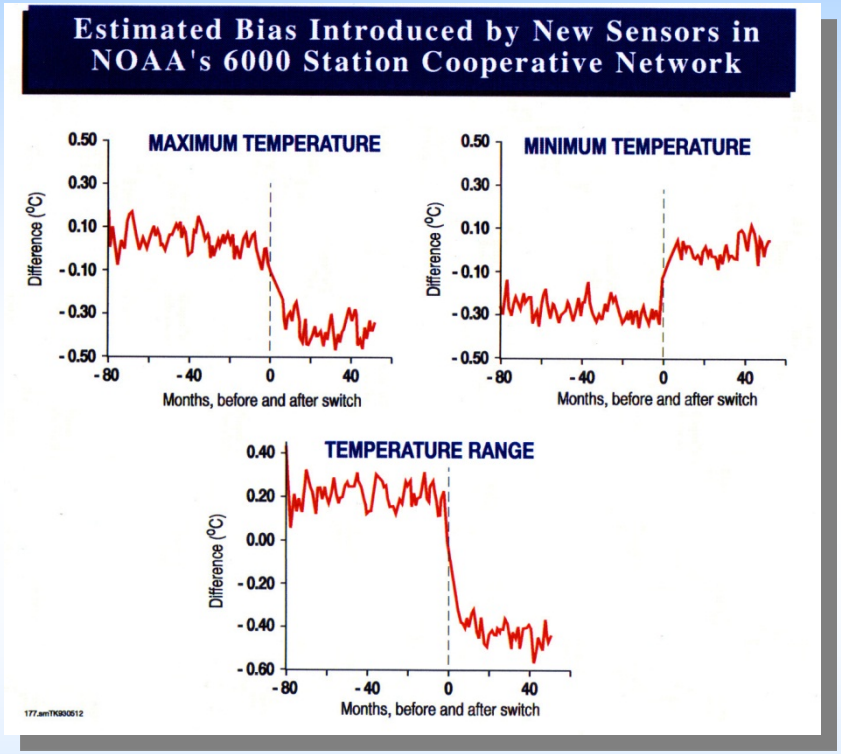
Global Rain-gauge Number over Time (in GPCC data base)

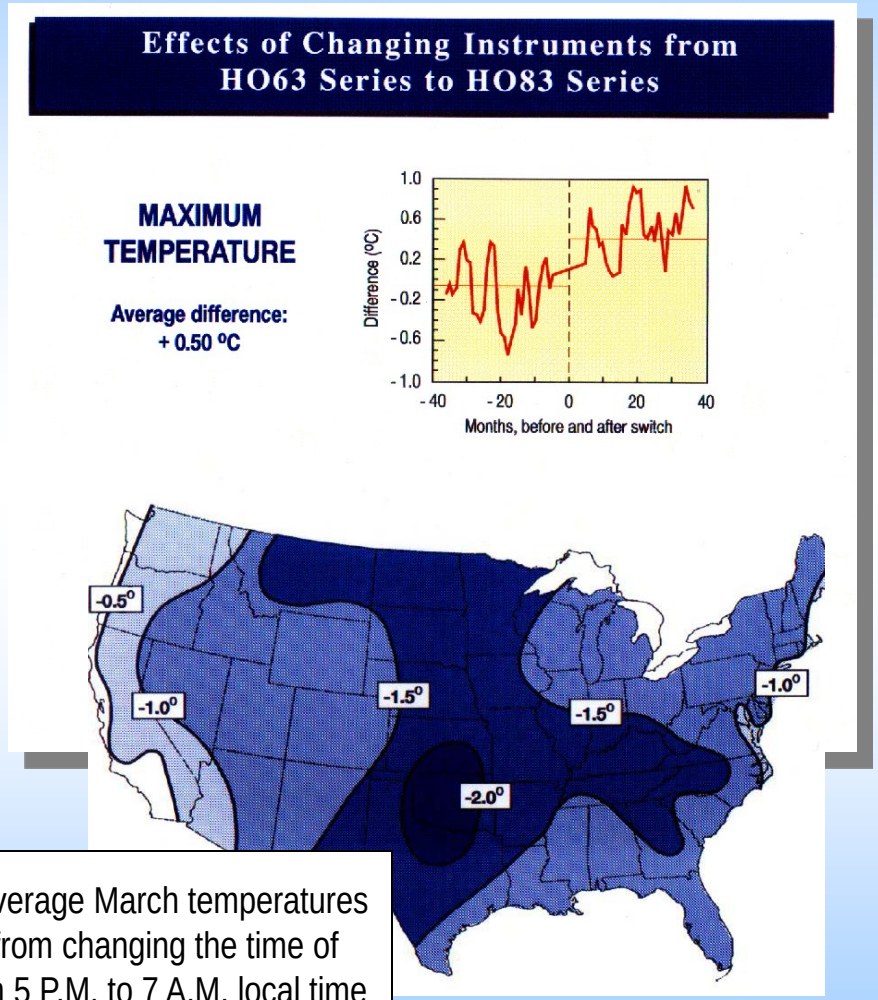


Schneider et al. 2008

Observing and Data System Deficiencies

✓ Issues with Surface-based observations





✓ Most observations taken for other purposes, e.g., weather forecasting

Change in the average March temperatures (°C) resulting from changing the time of observation from 5 P.M. to 7 A.M. local time