CLIVAR-SPAIN CONTRIBUTIONS:

Spatial and temporal comparative of temperature observations (SDATS), ERA-40, NCEP/NCAR and NOAA-CIRES 20th Century reanalysis, and CCCma GCM in the Iberian Peninsula along nineteen and twenty century

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Introduction:

Temperature has been the first climatic variable to be studied in diferent analysis –i.e. detection and attribution of climatic change-. And this is because their records of observed data, directly and indirectly, are comprehensive and reliable, and are well understood and well described by models and reanalysis. Their response to external forcing, as greenhouse gas, is too stronger than other climate variables responses. This has allowed us to examine the local fields of near-surface temperature over the Iberian Peninsula (IP) from different set of data. The aim of this work is to evaluate the differences in spatial and temporal trends of maximum, minimum and mean temperature series in the Iberian Peninsula

Data and methods:

Five different set of data are used: observations, GCM simulation and three reanalysis simulations -ERA-40 (1), NCEP/NCAR (2) and NOAA-CIRES 20th Century (3)-.

1-Observed surface air temperature data were obtained from the Dataset of Spanish Daily Adjusted Temperature Series (SDATS) (4) -a new adjusted dataset composed of the 22 longest and most reliable Spanish daily temperature records. The observed data include the maximum and minimum daily temperature for the period 1850-2003-.

2-The near surface daily-mean air temperature data generated by a GCM (the Third Generation Atmospheric General Circulation Model of The Canadian Centre for Climate Modelling and Analysis) (5), whose simulations from 1850 consider greenhouse gasses levels increasing as observed through the 20th century (20C3M).

3-Two meter surface monthly-mean air temperature reanalysis ERA-40 from 1958.

4-Two meter surface monthly-mean air temperature reanalysis NCEP/NCAR from 1948.

5-Two meter surface monthly-mean, maximum and minimum air temperature reanalysis NOAA-CIRES 20th Century reanalysis –from 1871-.

We interpolated gridded data from reanalysis and a GCM and used statistical methods for comparing meteorological measurements with simulated temperatures and reanalysis. The graphs show time evolution of the temperature parameter. An average has been obtained for the whole IP. In the case of SDATS, this is the average of 22 observatories in IP. In the case of reanalysis data and GCM data, an average of all the grids that include the IP has been calculated.

The maps represent isotherms of anomalies in Celsius degrees, for gridded data from NCEP / NCAR reanalysis and ERA-40 reanalysis. From top to bottom, the movil average of temperature along a period of 30 years is shown spatially in three successive maps around 1970, 1980 and 1990.

Results:

Results show important differences in data adjustment of GCM, reanalysis and observations (SDATS). These differences have been found in spatial patterns and in the behavior of time series.

In the case of the time series, if we look at the longer records (SDATS, NOAA and GCM), we appreciate a good fit between them as the time series evolves toward the end of XX century, although reanalysis data deviate from observed and GCM data during last decades of nineteenth century (figure 1a). When we attend at the second half of XX century (figure 1b) –all the five time series included- we observe some differences in their trends, especially during the recent past. So, we can see that from the second half of the eighties, with the steady increase in the observed temperatures, only the ERA-40 reanalysis and NOAA continue that trend, while, both GCM as reanalysis NCEP / NCAR, take a flat profile and even down, respectively.

In the case of NOAA reanalysis and SDATS,we have been able to make a comparative examination of seasonal maximum and minimum temperatures (figures 2a,2b). Tmax winter SDATS anomalies and Tmin summer SDATS anomalies increase faster than NOAA anomalies during last decades of nineteenth century. Likewise, as it happens with mean temperatures, we observed that a discrepancy exists between temperatures, both maximum and minimum of SDATS and NOAA reanalysis. Observing the period from the XIX century, observed temperatures increases have been much more pronounced than which is reflected by reanalysis time series. Especially, regarding the evolution of maximum temperatures.

Looking at the maps with data reanalysis of NCEP/NCAR and ERA-40 (figure 3) , we can note an uneven development between both reanalysis anomalies. ERA-40 shows an increase in temperature which, from the continent, introduce into IP and installs in the center of it, while areas closest to the sea show more modest increases. In the case of NCEP/NCAR, first, we observe that temperature increases are lower than for ERA-40 in the average of all IP. This is consistent with the evolution of time series (figure 1b). Second, and contrary to what happens with ERA-40, NCEP/NCAR increases are much more independent from spatial variable. This means that no territorial pattern is clearly observed. Finally, when we compare both ERA-40 and NCEP/NCAR, we found that divergences observed in both time series from the second half of the eighties (figure 1b), are due to higher temperature increases reflected by ERA-40 with respect to NCEP/NCAR in the center of the IP.

References:

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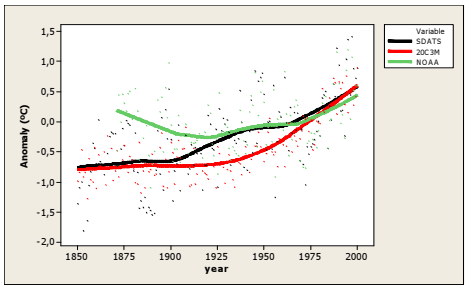
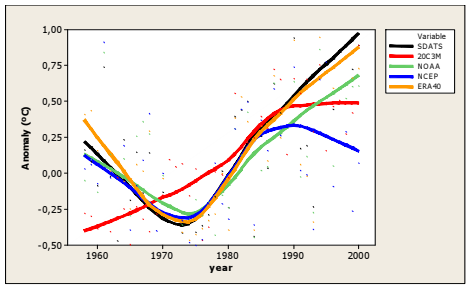
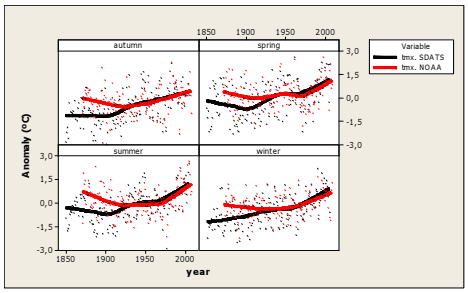
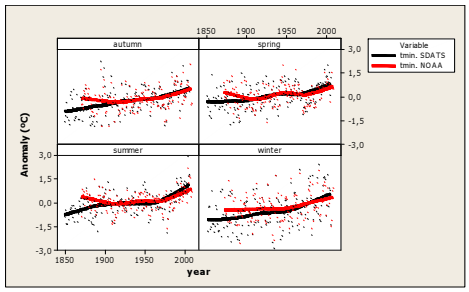
(5) McFarlane, N.A., J. F. Scinocca, M. Lazare, R. Harvey, D. Verseghy, and J. Li, 2005: The CCCma third generation atmospheric general circulation model. CCCma Internal Rep., 25 pp.





Figures 1a(left),1b: Lines represent a lowess smoother of anomalies from the 1961-1990 mean of annual means values of temperature air surface in the Iberian Peninsula.





Figures 2a(left), 2b Lines represent a lowess smoother of anomalies from the 1961-1990 mean of seasonal means values of maximum and minimum temperature air surface in the Iberian Peninsula.

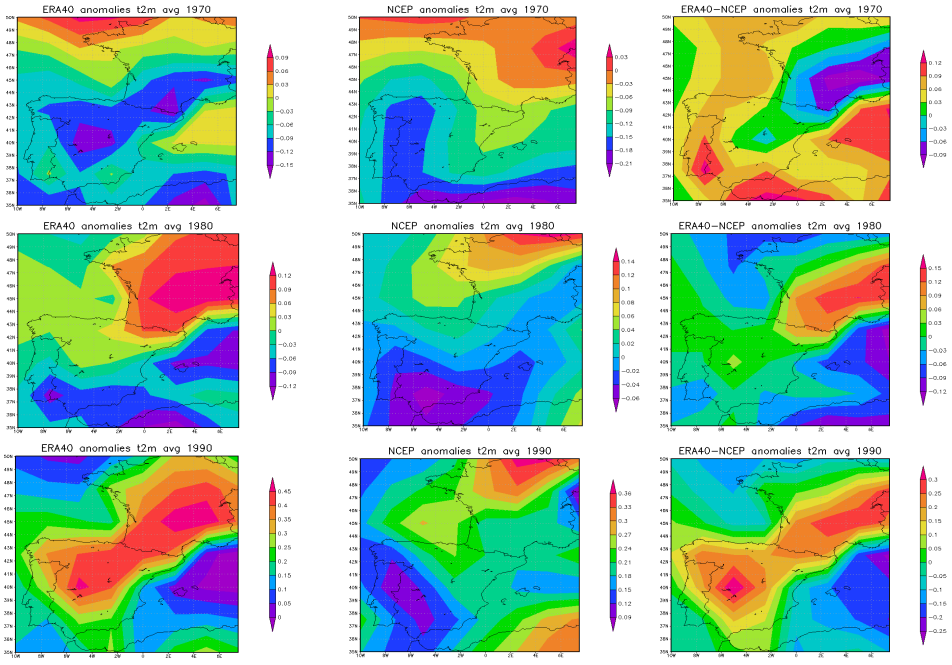


Figure 3: Maps show moving averages (30 years of amplitude) of anomalies from the 1961-1990 mean of monthly means values of the temperature air surface in the Iberian Peninsula. Third column maps show the difference between NCEP / NCAR and ERA 40 reanalysis