

## ***Interactive comment on “Attributing trends in extremely hot days to changes in atmospheric dynamics” by J. A. García-Valero et al.***

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#### General comments

The manuscript describes frequency of Extreme Hot Days (EHD) in Spain for the period 1958-2008. The study is about trend detection and attribution of EHD taking into account the trend of circulation types (CTs). The data used are maximum temperature (Tmax) from Spain02, SLP, T850 and Z500 from ERA40 and ECMWF analysis. One of the contributions of this study is that the trend of EHD can be partially attributed to the trend of Circulation Types (CTs). However, other factors such as global warming, soil-atmosphere feedbacks or surface properties changes may be responsible of EHD tendency (mentioned on the manuscript).

Studies on attribution of extreme events attract attention because of the impacts and

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the interest on the mechanisms of extreme occurrence, which may present regional differences. Among the causes of extremes are the characteristics or air mass. Therefore, the aims of this study are relevant. However, my impression is that the manuscript is not easy to read because the steps to describe the methods are poorly presented. One of the conclusions is that the method can be used for statistical downscaling, however the study is focussed only on the trend component of EHD and CTs, consequently the utility of the downscaling application is limited for not considering other scales of variability.

#### Specific comments

##### Section 2

The large-scale dataset used are from ERA40 (1958-2002) and ECMWF (2003-2008) analysis. My recommendation is to consider same data for the entire period, for example ERA-interim reanalysis.

##### Section 3

To obtain the regional series k-means clustering procedure is applied to Tmax daily anomalies.

Are the anomalies obtained with respect to the seasonal cycle?

Why the period 1951-2008 is used for the regionalization if the study is applied for the period 1958-2008? How sensitive is the regionalization to the period used?

Would the regionalization be different when the annual time series is considered instead of summer?

I think that the study should indicate the degree of homogeneity of each region according to EHD or to inform about the representativeness of EHD at each region by comparing the correspondence between EHD of the Tmax averaged and the EHD at every point in each region.

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Figures 2 are too small to distinguish the evolution of the time series. How is the agreement between Tmax and EHD for the different regions?

#### Sub-section 3.3

863 EHD are obtained for the period 1951-2008, however the trend and attribution correspond to 1958-2008. The reasons to consider two periods should be clarified because it causes some misunderstanding. Is the percentile computed for the period 1958-2008 or 1951-2008?

According to results depicted on Table 1, the significance of the Tmax and EHD trend is similar but I recommend including the confidence interval of the Sen's test.

#### Section 4

The classification of Circulation is obtained for 784 days over a small window that covers the Iberian Peninsula. In my opinion a wider area would represent better the advection effects associated to EHD.

My understanding is that the procedures applied to obtain CTs, the evaluation with effectiveness index are not clear. Probably other easier methods would inform about features of air mass characteristics to explain the extremes at each region. This opinion is based on as the authors comment on page 3327 "the atmospheric patterns associated with extreme events represent a small number of days".

In my opinion composite maps of the atmospheric circulation corresponding to the extreme Tmax days at each region would be more informative on the characteristics of air mass that cause the extreme. Then, the correlation maps between the composite circulation and the every day circulation would allow to give the frequency of the circulation type that cause the extreme in each region.

#### Sub-section 5.3

The main objective of the manuscript is to obtain attribution of the EHD trend. For doing

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this on page 3339 line 14 is written: " a simple attribution model of the EHDs trends to the trends in the CTs frequency appearance is presented". Here the trend of CTs is computed by applying a linear function to the frequency of CTs, while for EHD the Sen's test has been used. Is the approach attribution a comparison of trend obtained using Sen (EHD) and trend using linear method (CTs)?

I suggest to filter out high frequency components of EHD and CTs and to compare the low frequency component, what would allow investigating the influence of the changes of trend component of CTs on EHD.

#### Technical corrections

On page 3327, line 11 is written "the study is applied over the IP". The authors should have considered that the maximum temperature used corresponds only to Spain. The title should include the area of the study

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