

Interactive
Comment

Interactive comment on “Changing trends and abrupt features of extreme temperature in mainland China during 1960 to 2010” by S. Fang et al.

S. Fang et al.

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Response to Anonymous Referee #1

Received and published: 9 June 2015 This paper describes the trends of extreme temperature in mainland China from 1960 to 2010. Compared to previous studies, the main distinction is that the authors chose the 95th and 99th percentiles (instead of 90th) as threshold for extremes in trend analyses. Their key results show more stations have significant decrease in extreme cold days than significant increase in extreme hot days. Overall I feel this paper is potentially publishable, if the authors illustrate the key difference of their results compared to those in previous studies using the 90th

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percentiles (i.e., Zhou and Ren, 2011). In fact, the consistency, not difference among results using the 90th, 95th and 99th percentiles are discussed in this paper. It would justify the necessity of using the 95th and 99th percentile thresholds if the authors highlights the features that would have been missed by analyzing the 90th percentile extremes alone.

A: We thank the reviewer for the feedback, we replied in blue within the manuscript to the reviewer's feedback. We compared the difference of temporal trends and spatial distribution and our results with those in Zhou and Ren, 2011. In fact, we had explained the necessity of using the 95th and 99th percentile thresholds and highlighted our motivation. All were listed as followed:

(1) The warm days (TX95p) and hot days (TX99p) showed increasing trends over the last 51years, with linear trends of +1.80 d/10yr and +0.62d/10yr, respectively (Fig. 2 (a)), which is much less than the trend of TX90p, +5.22 d/10yr (Zhou and Ren, 2011).The cold nights (TN05p) and freezing nights (TN01p) showed linear trends of -3.18d/10yr and -1.01d/10yr, respectively (Fig. 2 (b)), which is also much less than the trend of TN10p, -8.23 d/10yr (Zhou and Ren, 2011). (page 9 lines 6-11.) (2) The trends of TX99p and TX95p have similar spatial patterns, although the trend values may be different, showing an increasing trends in all regions of the mainland except for Central China(CC) and its surrounding areas, which presented decreasing or insignificant trends (Fig. 4a, b). This was similar to the TX90p spatial trend distribution, which showed an increasing trend in nearly all the regions except for a few stations in the central region and the eastern part of Southwest China (Zhou and Ren, 2011).Except for the junction area of North and Northwest China(NC and NWC), the northwest of Southwest China(SWC), and a few sites in the northeast of East China(EC), most of the sites exhibited decreasing trends in TN05p and TN01p (Fig. 4c, d), and nearly all the stations exhibited significant decreasing trends in TN10p, with a few exceptions in the eastern part of Southwest China(Zhou and Ren, 2011) .(page 10, lines 2-12). (3) Most of the studies based on the 10th (90th) percentiles as thresholds are set to

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assess moderate extremes that, on average, occur 36.5 times every year (10 percent of 365 days) rather than high-impact, once or twice-in-a-year, weather events. Compared to the moderate extremes, the high extreme temperatures that are based on 5th or 1th (95th or 99th) percentiles have higher potential risks on people's health and lifestyles, the economy, society, and the environment. However, there has been very little research on the occurrences of high extreme warm days and cold nights according to the 5th or 1th (95th or 99th) percentiles. (page 4, lines 2-10).

Another major part of the analyses are the detection of abrupt changes in the temperature extremes, which the authors called "mutations". Some readers may not be familiar with the methodology involved, and it would make the paper more clear if the authors describe their method in detail, in addition to a few citations. Were the statistical tests performed on the regional averages, or individual stations? If on the regional averages, how large are the variations within each region?

A: We thank the reviewer's suggestions, and we added the description of method in detail as followed (from page 7 line 18 to page 8 line 16, as supplement showed). The statistical tests performed on the regional averages. Because the climate zones divided by temperature and precipitation data (Zhang and Yan, 2014), and the stations in the same climate zone should have same temporal pattern of temperature time series, so we ignored the variations within each region.

In addition, I have the following comments: 1. For readers unfamiliar with the CMA dataset or the RHtest software, some technical description (either in main text or appendix) would be helpful.

A: We thank the reviewer's suggestions, combined with feedback of reviewer 2 we described the data set in detail as followed (from page 5 lines 5-25): It is important in observational studies that the data used are homogeneous. The National Meteorological Information Center (NMIC) of the China Meteorological Administration (CMA) developed the first national homogenized temperature data set (Li et al., 2009) and

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its updated version (Xu et al., 2013). To avoid inhomogeneity in percentile-based indices of temperature extremes, the newly homogenized data sets of daily maximum and minimum temperatures over the period from 1951 to 2010 at 825 stations were chosen for this study. By using the RHtestsV3 software package (Wang and Feng, 2010), the penalized maximum t test with the first-order autocorrelation accounted for is used to detect the change points, and the quantile-matching (QM) algorithm is used to adjust the data time series to reduce discontinuities (Xu et al., 2013). Because much missing daily data was found in some stations, especially in the years before 1960, we chose time series in the period from 1960 to 2010. Further, according to the criteria that the series length should be no less than 51 yrs and that the missing data should be no more than 2% of the data points in every year at the stations, the data of 591 stations over the period from 1960 to 2010 were ultimately selected for analysis. In the data sets of the 591 stations, a total of 34776 missing daily data, accounting for 3.16% of the total data, were found at 95 of the 591 stations in the period from 1960 to 2010. The largest numbers of missing data were less than 2% in every year in all the stations, so the missing values were ignored in the following analyses. The 591 stations that had good quality data were chosen for the analysis (Fig.1).

2. The division between SWC and SC climate zones is not clear in figures. A: Thanks for the reviewer's revised suggestions. We have added division between SWC and SC climate zones in fig.1 and fig. 4.

3. A more careful examination on the units throughout the text should be performed. For example, the abbreviation "yr" and "a" are used, both of which should mean "year", but it was not explained; sometimes it is also missing, i.e., in P984L18, "+0.62 day/10". Also in Figure 3 caption: "5a moving average", perhaps changing to "5-year moving average" ?

A: Thanks for the reviewer's revised suggestions. We have carefully checked all the above and revised it, all "a" changed into "yr", and "5a moving average", changed to "5-year moving average". Other mistakes were also revised after carefully checking.

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3. Inconsistent wording in text and figure captions: should it be “cold/frozen days” or “cold/frozen nights”?

A: Thanks for the reviewer’s carefully check. We have fully checked and changed all of them into cold/freezing nights (words “freezing nights” suggested by native English refine).

4. How do results such as Figure 2b and Figure 3 compare with Figure 8 and Figure 9b in Zhou and Ren (2011)?

A: We compared the difference of temporal trends and spatial distribution and our results with those in Zhou and Ren, 2011, listed as followed: (1) The warm days (TX95p) and hot days (TX99p) showed increasing trends over the last 51years, with linear trends of +1.80 d/10yr and +0.62d/10yr, respectively (Fig. 2 (a)), which is much less than the trend of TX90p, +5.22 d/10yr (Zhou and Ren, 2011).The cold nights (TN05p) and freezing nights (TN01p) showed linear trends of -3.18d/10yr and -1.01d/10yr, respectively (Fig. 2 (b)), which is also much less than the trend of TN10p, -8.23 d/10yr (Zhou and Ren, 2011). (page 9 lines 6-11.) (2) The trends of TX99p and TX95p have similar spatial patterns, although the trend values may be different, showing an increasing trends in all regions of the mainland except for Central China(CC) and its surrounding areas, which presented decreasing or insignificant trends (Fig. 4a, b). This was similar to the TX90p spatial trend distribution, which showed an increasing trend in nearly all the regions except for a few stations in the central region and the eastern part of Southwest China (Zhou and Ren, 2011).Except for the junction area of North and Northwest China(NC and NWC), the northwest of Southwest China(SWC), and a few sites in the northeast of East China(EC), most of the sites exhibited decreasing trends in TN05p and TN01p (Fig. 4c, d), and nearly all the stations exhibited significant decreasing trends in TN10p, with a few exceptions in the eastern part of Southwest China(Zhou and Ren, 2011) .(page 10, lines 2-12).

5. Figure 3: suggest moving the x axis to the bottom of the graph, so as not to overlap

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with the bar and line plots.

A: We have revised fig.3 as reviewer's suggestion.

Reference

Frich, P., Alexander, L. V., Della-Marta, P., Gleason, B., Haylock, M., Klein Tank, A. M. G., and Peterson, T.: Observed coherent changes in climatic extremes during the second half of the twentieth century, *Climate Research*, 19, 193-212, 10.3354/cr019193, 2002. Li, Q., Zhang, H., Liu, X., Chen, J., Li, W., and Jones, P.: A Mainland China Homogenized Historical Temperature Dataset of 1951–2004, *Bulletin of the American Meteorological Society*, 90, 1062-1065, 10.1175/2009BAMS2736.1, 2009. Wang, X. L., and Feng, Y.: RHtestsV3 User Manual, UserManual. doc., Climate Research Division, Science and Technology Branch, Environment Canada, Toronto, Ontario, Canada. 26 pp. Available online at <http://cccma.seos.uvic.ca/ETCCDMI/RHtest/RHtestsV3>., 2010. Xu, W., Li, Q., Wang, X. L., Yang, S., Cao, L., and Feng, Y.: Homogenization of Chinese daily surface air temperatures and analysis of trends in the extreme temperature indices, *Journal of Geophysical Research: Atmospheres*, 118, 9708-9720, 10.1002/jgrd.50791, 2013. Zhang, X., Hegerl, G., Zwiers, F. W., and Kenyon, J.: Avoiding Inhomogeneity in Percentile-Based Indices of Temperature Extremes, *Journal of Climate*, 18, 1641-1651, 10.1175/JCLI3366.1, 2005. Zhou, Y., and Ren, G.: Change in extreme temperature event frequency over mainland China, 1961-2008, *Clim Res*, 50, 125-139, 10.3354/cr01053, 2011.

Please also note the supplement to this comment:

<http://www.earth-syst-dynam-discuss.net/6/C460/2015/esdd-6-C460-2015-supplement.pdf>

Interactive comment on Earth Syst. Dynam. Discuss., 6, 979, 2015.

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