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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Observed variability and trends in extreme rainfall indices and Peaks-Over-Threshold series" *by* H. Saidi et al.

H. Saidi et al.

h.saidi@ise.cnr.it

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Answer to Referee #3

We would like to use this opportunity to sincerely thank the Referee #3 for his detailed comments. We will take all these comments into account in the revised version of the paper.

Please find a detailed response to each questions/comments point by point below

C1: Title The title matches with the theme of the study. However, the study area is not mentioned.

A1: The title of the manuscript will be:" Observed variability and trends in extreme

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rainfall indices and peaks-Over-Threshold series: a case study in Piedmont (North-West Italy).

C2: Abstract This section seems a little too verbose. The authors may want to put less emphasis on qualitative descriptions and more on quantitative results.

A2: We reformulated the abstract as follows: “Intensification of heavy precipitation as discussed in climate change studies has become a public concern, but it has not yet been examined well with observed data, particularly with data at short temporal scale like hourly and sub-hourly data. In this research we digitalized sub-hourly precipitation recorded at the stations of Vercelli (since 1927), Bra (since 1933), Lombriasco (since 1939) and Pallanza (since 1950) in order to investigate historical change in extreme short precipitations. These stations are located in the northwest of Italy. Besides seasonal and yearly maximum of precipitation we adopted two indices of extreme rainfall: extreme frequency and extreme intensity. The results showed a statistically significant increase of the extreme frequency index and spring maximum precipitation for Bra and Lombriasco. The extreme intensity index is decreasing for Bra regarding hourly precipitation and increasing for Lombriasco regarding 20 minutes extreme events. In Pallanza, we noticed only a positive trend of the extreme frequency and extreme intensity indices of events with duration of 30 minutes. Analysis based on the peak-over-threshold approach showed that extreme events have risen in the last 20 years only for short duration. Here it cannot be said that in our study area recent sub-hourly and hourly precipitation have become unprecedently strong or frequent for all the stations and for all the extreme events duration.”

C3: Page 2, line 5. “digitalized”. The term “digitalized” is often referred to on dictionaries (e.g. http://www.thefreedictionary.com/digitalized) and also used in the scientific literature (e.g. Brunetti et al., 2004). However, it may appear to have a medical meaning or a use in a technical jargon, e.g. when converting from an analog to a digital signal (http://forum.wordreference.com/showthread.php?t=338539&langid=6). The term “digitized” corresponds to standard English.

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A3: We would like to thank the reviewer for this information. The word “digitilized” will be replaced by “digitized”

C4: Introduction Page 3, lines 4-11. "Climate simulations indicate that a warming climate could result in an increase in the proportion occurring in extreme events : : : as well as a decrease in heavy precipitation in at some parts of the world”. The authors should update this paragraph with ground on more recent literature, such as IPCC special report on extreme events, published in 2012 (http://ipcc-wg2.gov/SREX). The authors may also elaborate on where extreme events are expected to increase or decrease, avoiding generic statements such as “many parts of the world” or “some parts of the world”.

A4: We reformulated as follows (page 6051 lines 4-11): “Climate simulations indicate that a warmer climate could result in an increase in the proportion of precipitation occurring in extreme events (Karl et al., 1995). It seems to be generally accepted that the expected climatic changes are not necessarily associated with a higher intensity of extreme values, but rather with a higher frequency of the occurrence of extreme values. In 2012, the Intergovernmental Panel on Climate Change (IPCC, 2012) concluded that more studies show an increase than a decrease in extreme precipitation, but that there are also wide regional and seasonal variations, and trend in many regions are not statistically significant.“

C5: Page 3, lines 14-20. Dating back to as far as 1993 (Iwashima and Yamamoto, line 17), not more recent than 2006 (Brunetti et al., line 20, this paragraph seems outdated. The authors may update it to reflect newly available information.

A5: We agree with the reviewer that the first version of the paper was lacking recent studies references. The new submission version contains some recent references (page 6051 line 14 to page 6052 line 11): “Some studies relating to the variation of heavy and extreme events were performed for the USA and North America (Karl and Knight, 1998, Peterson et al., 2008), central and south America (Marengo et al., 2009,

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Re and Ricardo Barros, 2009) Japan (Fujibe et al., 2006), eastern and north-eastern Australia (Suppiah and Hennessy, 1998; Hennessy et al., 1999; Aryal et al., 2009), South Africa (Roya and Rouault, 2013), the UK (Jones and al., 2013) and Italy (Brunetti et al., 2004; Brunetti et al., 2006, Brugara et al., 2012). Based on station data from Canada, Mexico and the United States, Peterson et al. (2008) reported that extreme precipitation has been increasing over 1950-2004. Karl et al. (1995) and Karl and Knight (1998) observed a significant positive trend in the frequency of extreme rainfalls (greater than 50 mm per day) over the last few decades in the USA. In Australia, Suppiah and Hennessy (1998) and Hennessy et al. (1999) showed a significant increase in the 90th and 95th percentiles, while Aryal et al. (2009) showed that extreme summer rainfall in western Australia increased over 1950-2003 while extreme winter rainfall decreased. Fujibe et al. (2006) found that, in Japan, more stations recorded their highest rainfall events in recent decades and heavy precipitation increased during 1901-2004. Brunetti et al. (2004, 2006) confirmed a strong decrease in precipitation trends over Italy, with a cumulative rainfall reduction of about 135 mm in the southern regions during the last 50 years. Groisman et al. (1999, 2005) performed a study on heavy precipitation over a wide area comprising Canada and Norway (for the period 1900–1995), the USA and Australia (spanning the period 1910–1999), the former Soviet Union (1936–1994), Mexico, China, Alaska and Poland (whose data are available for post-World War II). They found an increase both in summer rainy days and in heavy precipitation frequency over the past century for the USA, Norway and Australia, but they found no significant trend for any other country where the series are shorter and/or have many missing data. In most of the analysed areas, the positive trend observed in rain intensity is generally associated with an increase in total precipitation. Groisman et al. (1999, 2005) studied the relationship between the increase in total precipitation and the frequency of heavy rain events."

C6: Page 3, lines 27-29. "Brunetti et al. (2004, 2006) confirmed a strong decrease in precipitation trends over Italy, with a rainfall reduction of about 135 mm in the southern regions during the last 50 yr". Here and elsewhere, the authors should be accurate in

what they write about amounts, intensities, trends. The authors may specify if 135 mm is the cumulative reduction over 50 years, as this reviewers guesses.

A6: We can confirm that 135 mm is the cumulative reduction over 50 years. In the revised version page 6051 lines 27-29 we reformulated as follows: “Brunetti et al. (2004, 2006) confirmed a strong decrease in precipitation trends over Italy, with a cumulative rainfall reduction of about 135 mm in the southern regions during the last 50 years.”

C7: Page 4, lines 18-20. “In the Alpine regions the evidence is growing stronger that climate warming is accompanied by an increase in frequency of intense precipitation events”. This sentence should be rewritten because language inaccuracies obscure the meaning.

A7: We reformulated as follows: “There is strong evidence that climate worming in the Alpine region is accompanied by increase in frequency of intense precipitation events”

C8: Page 4, line 27. “: : : 4 different sites : : :”. The authors may omit “different”.

A8: Done and acknowledged.

C9: Page 5, lines 3-4. “The implications of changes on the seasonal scale are particularly significant for water resources management processes related to seasonal cycles”. This sentence seems inappropriate to end up the introduction. If this is a general statement, the authors should support it with reference(s). If it is the finding of the analysis performed in this study, it should take place later on the manuscript.

A9: This sentence will be moved to page 6060 line 4.

C10: Data Page 5, lines 6-8. “Understanding climate change demands attention towards changes in climate variability and extremes, but knowledge of the behaviour of these variables has been limited by the lack long-term high-resolution data”. A statement as fundamental as this cannot be left unsupported by evidence from published literature.

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A10: The following references will be added to this statement: (Frei and Schär, 2000; kanae et al., 2004)

C11: Page 5, line 18. “Vercelli, Bra, Lombriasco and Pallanza”. A map indicating the localization of the sites is desirable.

A11: We agree with the reviewers comment that a map is important to indicate the location of the four stations. Figure 1 will be added to the revised version.

C12: Page 5, line 20. “... good allocated in the flat total area”. The expression seems inaccurate, and also does not take full account of the orography of the zone of interest. According to Table 1 (page 18), some elevation gain is noticed moving from Vercelli (135 m a.s.l.) to Bra (290 a.s.l.).

A12: We reformulated as follows: “All the station are situated in plain going from the south to the north of Piedmont region (figure 1)”

C13: Page 6, lines 21-22. “: : : and comparing them with another independent daily precipitation dataset”. Details are missing here about the dataset used for independent comparison.

A13: We reformulated as follows: “ and comparing them with another independent daily precipitation dataset provide by territorial environmental agencies”

C14: Methods Page 7, line 24. “: : : statistic Mann-Kendall test”. It is probably “Mann-Kendall test statistic”.

A14: Done and acknowledged.

C15: Page 7, line 24. “: : : 95 % significance : : :”. This wrong. It is “: : : 5% significance”, as correctly written page 8, lines 4-5.

A15: Done and acknowledged.

C16: Page 8, lines 6-21. “In this test : : : <0”. This part should be greatly trimmed

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down, because the Mann-Kendall test is a well-known and established statistical test.

A16: We reformulated as follows: “The Mann–Kendall test (Kendall, 1962; Sneyers, 1990) is used to assess the existences of statistical significance trend. This test is based on the comparison between the observed number of increases and decreases (jumps) and the values expected from random series. The occurrence of a trend is suggested if the null hypothesis of no trend is rejected when the level of significance is below a given threshold (here set at value α = 0.05).”

C17: Results and discussion Page 11, line 19. “is situated is in : : :”. The second “is” has to be omitted.

A17: Done and acknowledged.

C18: Conclusions Page 13, lines 11-14. “It is well known : : : for analyzing extreme events”. The authors may consider omitting this sentence from the conclusions.

A18: Done and acknowledged.

C19: Tables Table 1, page 18. Geographic coordinates can be used to locate sites for readers unfamiliar with UTM coordinates (otherwise a marked map can be useful).

A19: As suggested by the reviewer the location of the sites in table 1 (supplement file) will be in terms of latitude N and longitude E:

C20: Table 2, page 19. “significant level greater than 95 %”. It is “significant level lower than 5%”.

A20: Done and acknowledged.

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Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C3770/2013/hessd-10-C3770-2013-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 6049, 2013.

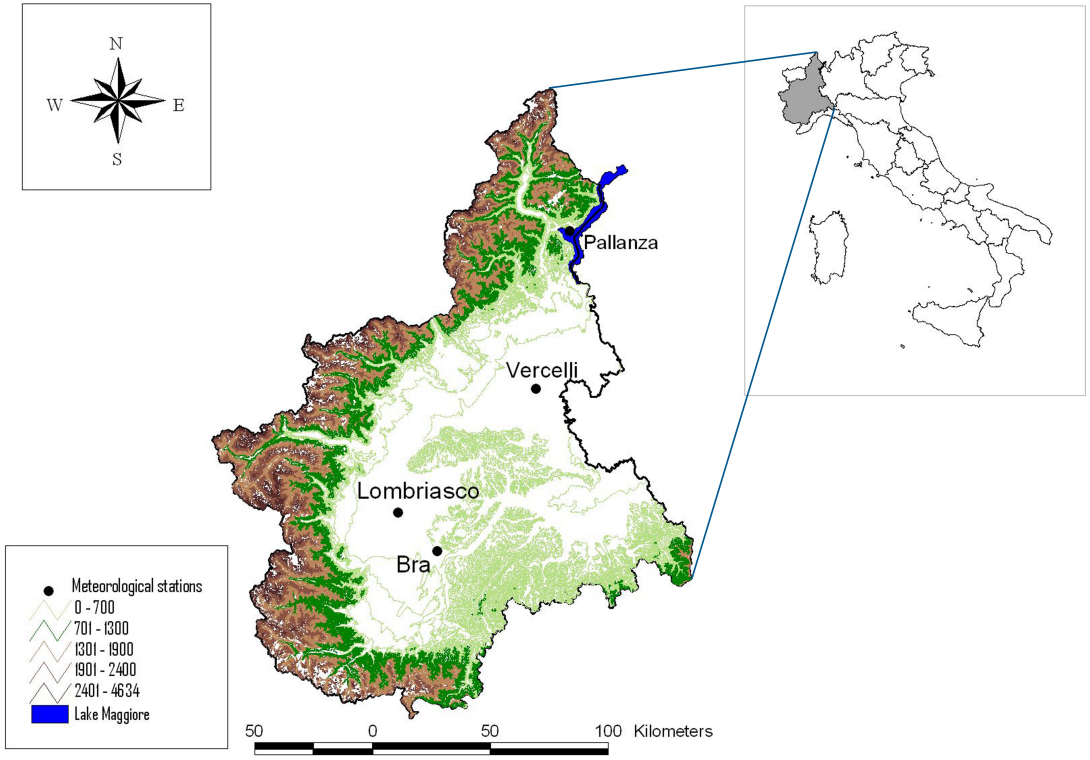

Fig. 1. Study area and spatial distribution of the stations

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Table 1. Main characteristics of meteorological station:

Station name	Elevation m a.s.l	Location		Observation period Year
		Latitude (N)	Longitude (E)	
Bra	290	44° 04' 18"	7° 51' 09"	1933-2003
Vercelli	135	45° 19' 32"	8° 23' 26"	1927-2003
Lombriasco	241	44° 53' 14"	7° 41' 15"	1939-2003
Pallanza	211	45° 55' 36"	8° 32' 56"	1950-1991

Fig. 2. Table_1

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