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Hydrology and Earth System Sciences Discussions

Interactive comment on "Evidences of relationships between statistics of rainfall extremes and mean annual precipitation: an application for design-storm estimation in northern central Italy" *by* G. Di Baldassarre et al.

Y. Alila (Referee)

alila@interchange.ubc.ca

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GENERAL COMMENTS:

The study calculates the L-moment statistics of annual rainfall extremes at a dense network of gauge stations in Northern Central Italy and reports relationships between these statistics and the mean annual precipitation. These relationships are in turn used to develop and report a regional rainfall frequency model for estimating design storms at gauged and ungauged sites in the study area for storm durations ranging from 15 min to 24 hours.

The reported regional rainfall frequency model, which is based on a very well established methodology, would be of use to engineers / professionals for estimating design storms at gauged and ungauged locations in Northern Central Italy.

However, this manuscript does not present any novel concepts or ideas because similar relationships between rainfall statistics and mean annual precipitation for this and other study areas have already been published (Schaefer 1990, Alila 1999, Brath et al. 2003). This manuscript also does not present any novel tools (at least at the conceptual level) because similar models have already been reported for other study areas (Schaefer 1990, Alila 1999).

What could have been unique to this study is the fact that the authors had access to a great deal of long-term rainfall data at a very dense rain gauge network. Unfortunately, this wealth of data had not been used to get to the bottom of the processes causing the reported behavior of the frequency characteristics of the precipitation extremes within the study area. This study focused on crunching data through statistical tests and procedures with no reflections on the process understanding or interpretative connections to the physics of precipitation extremes. It is a lost opportunity for better understanding the spatial and temporal variability of precipitation extremes and for advancing the science of hydrometeorology.

FINAL RECOMMENDATION:

In its current form, I rank the ms as not appropriate for publishing (at least not in its current shape). The whole paper needs to be rewritten with a balance in the emphasis between number crunching and results interpretations from the physical and process stand point. This is over and above some other technical concerns that need to be addressed (see below).

Even though HESS is interested in publishing engineering and applied hydrology, I am not sure we should be encouraging the blind reliance on statistical tests of hypothesis and statistical models with little or no reflections on the physical processes, which defies the purpose of any scientific investigation.

SPECIFIC COMMENTS:

1. Inconsistencies of findings for the same study area between this manuscript and another recently published WRR paper by the same group:

The relationships between the L-moment statistics and the mean annual precipitation (MAP) using the same data set from the same study area have already been published in Brath et al. (2003). There appears to be some inconsistencies that I am not able to reconcile between what is being reported in this new manuscript and what was published in Brath et al. (2003). This current manuscript lumps the whole study area into the same systematic patterns of decreasing L-Cv and L-Cs with an increasing MAP. However, Brath et al. (2003) results and conclusions were emphatically built on the empirical finding that the Tyrrhenian sub-region within the bigger study area exhibits a conflicting behavior for the same relationship between these L-statistics and MAP. As a result of the drastic differences in the nature of the relationships between L-Cv/L-Cs and MAP different set of regional design storm estimation equations have been reported in Tyrrhenian sub-region and in the remainder of the study area (Brath et al. 2003). I quote from Brath et al. (2003, p. 4):

“The results of the analysis (of Brath et al. 2003) show that the findings of Schaefer (1990) and Alila (1999) hold for a rather large potion of the study region, as the values of L-Cv and L-Cs of rainfall extremes are low in humid areas, while both statistics tend to increase, more or less markedly depending on the considered storm duration, as the local MAP value decreases. Nevertheless, the merger of two river basins indicated in Figure 1 as the Tyrrhenian Region, due to its closeness to the Tyrrhenian coast, exhibits a conflicting behavior. Table 2 reports the rainfall data for the Tyrrhenian Region. The region is mountainous and therefore humid (average MAP ˜ 1400 mm), yet it shows high L-Cv and L-Cs values for all the storm durations considered in this study. ĚFigure 2 shows the anomalous behavior of the Tyrrhenian Region and the consistency with the results obtained by Schaefer (1990) and Alila (1999) for the remainder of the study region."

To further justify splitting the overall study area of Northern Central Italy into two regions with conflicting behavior of precipitation extremes, Brath et al. (2003) went on to say:

"The anomaly of the Tyrrhenian Region was already pointed out by Castellarin et al . (2001) and Castellarin and Brath (2002). This atypical behavior may be accounted for by the proximity of the region to the Tyrrhenian shoreline and two windows in the Apennine divide, which locally drops below 1000 m asl, being normally above 1400-1500 m asl. These windows, known in the literature as the Genoa gap, produce a fundamental topographic control, channeling the most severe disturbances coming from the south and originating over the Tyrrhenian Sea, and allowing them to have significant climatic control beyond the Apennine divide (Tripoli et al., 2002). The fact that the northern coastal area of the Tyrrhenian Sea exhibits a maritime rainfall regime and rather high coefficient of variation and skewness of rainfall extremes (Brath and Rosso, 1995) may partly explain the high L-Cv and L-Cs values observed for the Tyrrhenian Region, despite its rather high MAP values. These considerations were behind the formulations of the regional depth-duration-frequency equations, which is described in the next section."

In the conclusion section of the Brath et al. (2003), the authors went on to say:

"Ě The analysis showed that for a large portion of the study area, the statistical properties of rainfall extremes are consistent with the results provided by published studies referring to different geographical and climatic contexts. The analysis also detected a misbehaving region, in which, probably because of a topographic channeling of severe disturbances originated beyond the Apennine divide, the relationship between the statistics of rainfall extremes and MAP contradicts the observation made for the remainder of the study area. This physical evidence was included in the regional rainfall depth-duration equations developed by the study."

Note that in both Brath et al. (2003) and in this current study submitted to HESS/HESSD the authors are using exactly the same study area (37,200 square km) with exactly the same word by word description and map in Figure 1. It does not appear that this anomalous Tyrrhenian Region had been excluded in this new manuscript. It looks as if it has been lumped with the remainder of the study area with the same trends of decreasing L-statistics with an increasing mean annual precipitation (which then conflicts with Brath et al. 2003).

2. This manuscript makes reference to Alila (1999) in many places. In one incidence, the authors misrepresented work published by Alila (1999):

On page 2402, the authors stated "L-Cv can be considered to be independent of the geographical location (or MAP) for storm duration less than one hour, with different values for the 15 and 30 min durations (Alila, 1999)"

This is diametrically opposite to what Alila (1999) published. Table 3 in Alila (1999 p. 31650) reported statistically significant functional relationships between the L-Cv and MAP for the following storm durations 5, 10, 15, 30, and 60 min and 2, 6, 12, and 24 hours.

3. Use of incorrect and misleading terminology for describing and mathematically reporting the regional rainfall frequency model called "index storm" approach:

The index storm (similar to index flood approach of Dalrymple (1960)) is a regional frequency model for estimating the magnitude and frequency of extremes at gauged and ungauged location. The index storm or flood approach is based on the most restricting assumption that the L-Cv and L-Cs of the annual extremes (rainfall or flood) do not vary with location.

On one hand, the authors is reporting statistically strong dependence of the L-Cv and L-Cs on geographical location (with MAP used as a surrogate) but at the same time the authors are calling, referring, and reporting the resulting regional rainfall frequency model as being an index storm approach. I view this as an incorrect use of the rather restrictive “index storm” approach to regionalization, and as a matter of fact, it does not do justice to what the data in this study area is empirically revealing (i.e. dependence of tail characteristics of the rainfall frequency distribution on the geographic location).

4. Limitations in the applicability of the regional model:

Authors have not discussed the limitations in the applicability of the developed regional model. This discussion should go beyond just saying that the developed model is applicable to only storm duration ranging from 1 to 24 hours and for only return periods ranging from 1 to 100 years. What about ungauged locations at a much higher elevations than the existing gauged sites? What about micro climate effects on the spatial interpolation of rainfall extremes (say leeward and windward side of the same mountain or rain shadow effects)? Etc.

SUMMARY OF EVALUATIONS:

1) Does the paper address relevant scientific questions within the scope of HESS?

No: Because the reporting of the regional model for estimating design storms at gauged and ungauged locations using very well established methodologies and concepts is conducted with no discussion of processes or reflections on the physics of precipitations extremes.

2) Does the paper present novel concepts, ideas, tools, or data?

The developed model is a tool but not new to the science literature. It would however be of help to professionals for estimating design storms in this study area in Italy.

3) Are substantial conclusions reached?

No - because the same relationships between L-statistics and MAP have already been reported in Brath et al. (2003).

4) Are the scientific methods and assumptions valid and clearly outlined?

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Not applicable - In my view there is very little science here.

5) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

NO - miss use of the index storm approach.

6) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

There is no discussion or interpretation of the results in the context of processes and physical reality of the precipitation extremes in this manuscript. The manuscript is heavy on crunching a large data set through statistical tests and procedures with no reference to process understanding and physics of precipitation extremes.

References

Alila Y. (1999), A hierarchical approach for the regionalization of precipitation annual maxima in Canada, J. Geophysical Research, 104(D24), 31645-31655.

Brath A., A. Castellarin, and A. Montanari (2003), Assessing the reliability of regional depth-duration-frequency equations for gaged and ungaged sites, Water Resources Research, Vol. 39, No. 12, 1367, doi:10.1029/2003WR002399.

For all other references cited in this review please refer to current manuscript and Brath et al. (2003).

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