Probable Maximum Precipitation Estimation in a Humid Climate

Editor's Comments:	
Comments to the Author:	
Dear Author: In my email explaining my previous decision, I asked you to consider the comments of reviewer 1 and to provide a revised version with the information and discussion that he/she recommended. I also anticipated that your manuscript was going to be returned to reviewer 1. However, in your "Author's Response", I find only your replies to my comments. Please, provide a version of the manuscript accounting also for the comments of reviewer 1 and your explicit and pointwise responses to them.	Dear Editor, The authors appreciate the editors and reviewers. Also, we would like to express our much apologies for the lack of reviewers response. The manuscript carefully was checked for typos, and co-authors' affiliations, terminology, updates of data in tables, or updates of variables in equations. A point-by-point response to the Editors' and Reviewers' comments is below. Also, all changes were determined in the main text by using red color. With warm regards, Corresponding Author, Bakhtiari, B.
Question:	Author's Response:
Further, I am not fully convinced by some replies of yours. 1) The statement "In the theory definition, the PMP refers to the upper bound with a zero probability of exceedance." Is in my view misleading, in general, and should be deleted. If you have a Gaussian distribution, for whatever value of K_M there will be probability (vanishingly small as K_M increases) of exceeding the PMP computed using (1). The rest of the sentence is acceptable to me, but it should be slightly rephrased after the deletion.	1) The sentence was deleted based on the editor's suggestion, and the following sentence has been replaced: "In the theory definition, the PMP is the extreme rainfall for a given duration that is physically possible over an area" (Page 12, Line 2).
2) I think that the information that PMP and P_50 are numerically similar is important and should be added to the manuscript.	2) Statistical analysis was performed on the P_{50} and the PMP data, based on the editor's suggestion. The results show the significant correlation and are added on (Page 9, Line4).
3) If P_50 and PMP are numerically similar, what is the advantage of using PMP instead of computing P_50 using the Generalized Extreme Value theory? A short comment about this should be added.	3) The Generalized Extreme Value theory was used to calculate 50-year precipitation (P_{50}). For this purpose, the GEV model was fitted on rainfall data. The results showed that there is a significant correlation between the standard and revised estimates of PMP_{24} and P_{50}. The values of the coefficient of determination (R^2) between the standard and revised estimates of PMP_{24} and P_{50} were 0.97 and 0.98, respectively. The relationships of PMP_{24} and P_{50} are defined by Eq. (13 and 14). $PMP_{24}=3.85(P_{50})-24.1$ (13) $PMP_{24}=1.91(P_{50})-20.3$ (14) The use of Hershfield was recommended, for the application of the GEV model was led to underestimates the upper tail.
4) You write that "Since the magnitude of point PMP at an individual station should normally not exceed three times the highest observed rainfall from a long period of rainfall data (Hershfield, 1962), …".This statement sounds strange to me. The factor three would imply a huge overestimation, especially if the observation cover along (suppose 100-year long) period. The involved factor should have some dependence with the length of the period covered by the observation and should decrease for long periods. Please, clarify/correct	4) The sentence was deleted based on the editor's suggestion, and the following sentence has been replaced: "Because the ratio of the point PMP_{24} to the $(P_{24})_{max}$ in the standard method was high at the study stations, this method is not recommended in this basin" and is added on (Page 12, Line 23&24).
5) Instead of "the construction costs will be increased", I would write "the construction costs will be unnecessarily high". A clear conclusion of your work is that in this basin the standard Hershfield Method is not adequate (and you write this). I would also emphasize in the abstract and in the conclusions that it produces unrealistically large PMP values for construction costs.	The sentence "the construction costs will be increased" was revised to "the construction costs will be unnecessarily high" according to the editor (Page 12, Line 26&27). The sentence "the standard method gives uselessly large PMP values for construction costs." Was added to abstract (Page 1, Line 22).
A further comment: I do not see the relevance of the info provided by figure 2and I suggest to remove it and its reference in the text.	Figure 2 was removed based on this comment.

Probable Maximum Precipitation Estimation in a Humid Climate

Reviewer's Comments:	
Question:	**Author's Response:**
Probable Maximum Precipitation Estimation in a Humid Climate By: Afzali-Gorouh et al. In general, the authors have addressed many of the concerns and issues that were raised in my previous review of the manuscript. However, the introduction section is still poor in terms of content. A comprehensive review of the relevant literature is lacking. Also, the result's section needs to be updated to provide additional discussion on the results they obtained. I recommend **Moderate Revision**, and specifically addressing issues related to the introduction and the results section.	The authors wish to thank the reviewers for their time in effort in reviewing our manuscript. We hope the changes listed have made the manuscript suitable for publication.
Major Comments	
Introduction: 1) The introduction is too short, and the body of the introduction section is only one paragraph, lacking sufficient background information. 2) Furthermore, a review of literature on the physical approaches for PMP estimation is lacking which can enhance the introduction.	1) The introduction was revised. Background information was mentioned in the separate paragraph. 2) A review of literature on the physical approaches for PMP estimation was added to text.
The results section needs to be updated to add additional discussions and analyses on different aspects of the results they already obtained. Just providing one or two sentences that are obvious from the figures or tables is not appropriate for a paper at this level.	The results were written based on this comment.
An appendix section must be added to give a brief overview of the PMP Calculator app, along with its download link for the interested readers.	The appendix was available for this application, but according to the editor's opinion regarding the deletion of Figure 2, the appendix was not included in the article's text. Whenever a person wants software, send authors an email, and then we send him/her this application.
Authors are strongly encouraged to check the grammar and language of the manuscript before resubmission. Some of these errors are mentioned here, but there are more errors and typos that need to be corrected.	The manuscript was checked from the viewpoint if the grammar and language.
Minor Comments	
P1L19: Must be "rainfalls"	It was corrected and was mentioned in P1L24 by yellow highlight.
P1L19: delete "one" , replace with "among"	It was corrected and was mentioned in P1L24 by yellow highlight.
P1L19: What are social damages? Damages to societies seems to be more relevant here.	The sentence was revised to "Intensive rainfalls and heavy floods are among the most catastrophic natural hazards which have large social consequences for communities all over the world."
P1L22: Replace "specific project" with "hydrologic infrastructure"	It was corrected and was mentioned in P1L27 by yellow highlight.
P1L25: Where does the quotation end?	It was corrected and was determined in P1L30 by yellow highlight.
P1L26: "A statistical …" Review of statistical methods should go to a separate paragraph.	It was corrected and was determined in P2L3 by yellow highlight.
P1L29:30 years "of" daily data …	It was corrected and was determined in P2L4 by yellow highlight.
P1L28: "basins"	It was corrected and was determined in P2L5 by yellow highlight.
P1L29: "kilometers"	It was corrected and was determined in P2L5 by yellow highlight.
P1L29: 1) Mention the names of other statistical methods and discuss their differences. 2) Also mention why the Hershfield method is more popular. 3) Review of statistical methods must be a separate paragraph for itself.	1) The name of the statistical methods was mentioned in P2L6, and was determined by yellow highlight. 2) It was mentioned in p2L18 and was determined by yellow highlight. 3) It was applied.

P2L1: Any references?	It was mentioned in P2L23. Rakhecha, P. R., Deshpande, N. R., and Soman, M. K.: Probable maximum precipitation for a 2-day duration over the Indian Peninsula. Theor. Appl. Climatol., 45, 277-283, 1992.
P2L2: Discuss the physical methods in a separate paragraph.	It was discussed and was determined in P2L24 by yellow highlight.
P2L2: "characteristic of the deterministic…" Not sure what you mean!	It was deleted.
P2L6: Some physical methods are mentioned; however, nothing special about their characteristics and differences have been mentioned. The only thing mentioned is that they are not easy to use. Please consider adding more details about the different physical methods, and their differences and pros and cons. Also, keep in mind that the difficulty in estimation is not the case in many parts of the world.	Required descriptions were added to the text and were determined in P2L24 by yellow highlight. The advantages and disadvantaged of physical methods were discussed.
P2L8: 1) Comparison of the physical and statistical methods need to go to a separate paragraph. 2) A more detailed review of the literature is required. For instance, why in some regions the two methods give similar results and why in some other regions they are totally different?	1) Comparison of the physical and statistical methods was mentioned in a separate paragraph and was determined in P3L7 by yellow highlight. 2) Some sentence was added about this difference (P3L20).
P2L11: "The results of these researchers have indicated that although the statistical approaches provide larger estimates of PMP, it is proposed for areas where hourly rainfall, dew point temperature, wind speed, and vertical radiosonde measurements are unavailable" The first and the second statements are irrelevant to each other.	The sentence was revised and mentioned in P3L23.
P2L18-19: It has already been mentioned in L11.	The sentence in line 11 was mentioned with focus on the studies in Iran.
P2L19: What is the overall conclusion from these studies?	The overall conclusion was added in P3L34.
P2L20: Replace "was" with "is"	This part was rewritten and was replaced by new sentences. It was determined in P4L9 by yellow highlight.
P2L20: delete "written" and write "prepare a" instead	This part was rewritten and was replaced by new sentences. It was determined in P4L9 by yellow highlight.
P2L20: Estimation alone is not a good goal for a paper. You can draw more useful information from your results. For instance, using the PMP24 maps, you can specify the regions that are more likely to experience intense storms. Such information could be useful for water resources planning and management, flood risk assessment, and catastrophe management.	The aim of study was rewritten. It was determined in P4L9 by yellow highlight.
P3L2: 1) Where do you want to put figure 1? 2) For figure 1, it is also suggested to name each of the small figures, as a, b, and c. Then, give a short description in the figure caption for each of them.	1) After the first paragraph of materials and methods in P4L26. 2) It was corrected based on the reviewer's comment. Required description was added in P16 by yellow highlight
P3L17: Delete "then"	It was deleted based on the reviewer's comment.
P3L18: To be added to what?	It was corrected and was determined in P5L10 by yellow highlight. It means the number of standard deviations (S_n) to be added average rainfall ($\overline{X}_n$) to obtain PMP. It should be noted that, this sentence is from "Manual on Estimation of Probable Maximum Precipitation, page 66, section 4.2-1, Line 12". If the maximum observed rainfall X_m is substituted for X_t, and K_m for K, K_m is then the number of standard deviations to be added to to obtain X_m, or $X_t = \overline{X}_n + K_m S_n$ (4.2)
P3L19: Delete "of America"	It was deleted.
P4L1: should be "the" standard deviation	It was corrected and was determined in P5L14 by yellow highlight.
P4L2: To do what? Say, the goal first; then, mention the steps.	It was corrected and was determined in P5L16 by yellow highlight.
P4L12: Information about the discharge data is still missing in the data section. Add it!	Maximum 24-hour rainfall in each station and the maximum instantaneous peak discharge were used to determine the date of storms. The maximum instantaneous peak discharge data was used because of the inherent dependence of rainfall and runoff. Therefore, The maximum instantaneous peak discharge has resulted from an intensive rainfall after a certain lag-time or delay. Based on the authors' opinion, because discharge data was not used directly in the calculation of PMP, was not mentioned in the text.

P5L12: mean “squared” error	It was corrected and was determined in P7L4 and P7L5 by yellow highlight.
P6L20: 1) Provide more discussion on figures. 2) Is there any specific gradient in the PMP values? 3) Which parts of the basin experience more severe storms? Which parts of the basin experiences more extreme precipitations? Why? 4) Is the basin homogenous in this regard?	P8L17: 1) A more detail analysis of the PMP in the study area could be presented using the PMP_{24} isohyetal lines using the Hershfield standard and revised methods which are shown in Fig. 2. PMP values at each point in the study area could be approximated from these maps. Also, the range of PMP values and its variation was shown clearly. From Fig. 2(a), it is clear that the highest PMP_{24} values for the standard Hershfield method is at the southwest parts of basin around the Kord Kooy and Ghaz Mahalleh stations which are from 450 to 430 mm, whereas the lowest PMP values is at the south-eastern parts of basin around the Ziarat where the isohyetal lines are less than 240 mm. From Fig. 2(b), the PMP_{24} values resulting from the use of the Hershfield revised method are lower in south-eastern parts and higher in the western parts of the study area. 2) Generally, the PMP_{24} values resulting from both Hershfield methods decrease from west to east (Fig. 2). 3) The results of Fig. 2 showed that the western parts of the basin, that are closer to Caspian Sea, experience more severe storms. 4) The studied stations are located in the homogeneous parts of Golestan province. This issue is confirmed in the article (N. Hasanalizadeh, N., Mosaedi, A., Zahiri, A.R., Babanezhad, M. 2014. Determine of Homogeneous Regions Distribution of Annual Rainfall in Golestan Province Using Clustering and L-moments. Journal of Water and Soil, 28(5): 1061-1071. [in Persian with English abstract]).
P8L14: Not sure what does the most moderate mean!	It means Lenient. It was corrected and was determined in P10L19 by yellow highlight.
P9L4: “Based on ….” not relevant to the previous sentences. It could be a separate paragraph, joint with the next paragraph.	It was corrected and was determined in P11L5 by yellow highlight.

Appendix

Introduction

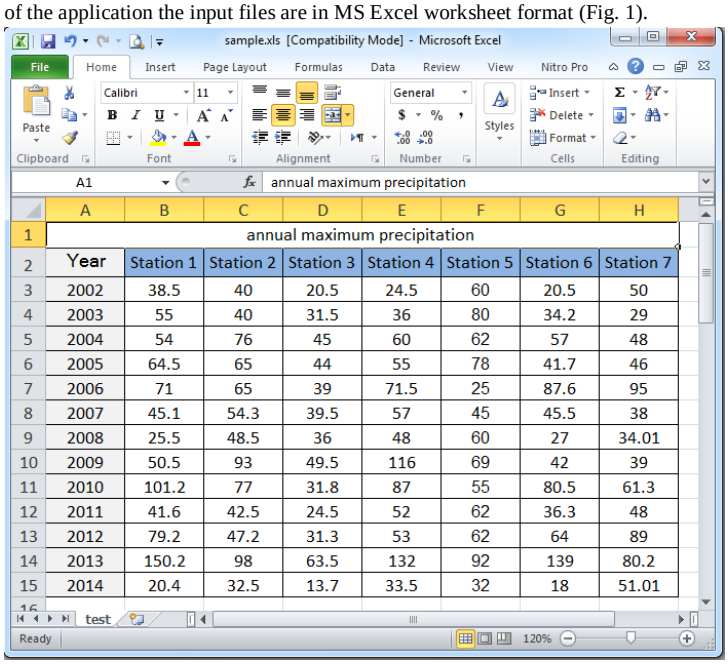
PMP calculator is a user friendly and multi-platform application tool dedicated to the estimation of Probable Maximum Precipitation (PMP) for 5 minutes, 1, 6 and 24-hours duration using the Hershfield standard method (proposed by WMO, 2009) and the Hershfield revised method by Dasa et al. (2001). In this application, PMP is calculated without consideration of adjustment of area reduction curve and depth area relation.

Installation

PMP Calculator is a user-friendly and multi-platform JAVA application which is applicable on Windows, Linux, and Macintosh OS X platforms.
Run "pmp.jar" application to initialize the software setup.

Data Input

The Input data for both methods are the annual maximum precipitation for a certain duration including 5 minutes, 1, 6 and 24 hour. In order to improve the interface of the application the input files are in MS Excel worksheet format (Fig. 1).



	A	B	C	D	E	F	G	H
1	annual maximum precipitation							
2	Year	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
3	2002	38.5	40	20.5	24.5	60	20.5	50
4	2003	55	40	31.5	36	80	34.2	29
5	2004	54	76	45	60	62	57	48
6	2005	64.5	65	44	55	78	41.7	46
7	2006	71	65	39	71.5	25	87.6	95
8	2007	45.1	54.3	39.5	57	45	45.5	38
9	2008	25.5	48.5	36	48	60	27	34.01
10	2009	50.5	93	49.5	116	69	42	39
11	2010	101.2	77	31.8	87	55	80.5	61.3
12	2011	41.6	42.5	24.5	52	62	36.3	48
13	2012	79.2	47.2	31.3	53	62	64	89
14	2013	150.2	98	63.5	132	92	139	80.2
15	2014	20.4	32.5	13.7	33.5	32	18	51.01

Fig. 1. Example of the file format

Calculation Process

The setting for the calculation of PMP values are defined in the PMP calculator by pressing "Select File…" (Fig. 2). Then, user should select the duration (Fig. 3). The output file is stored at the input folder. The output file is contained three sheets, which input data is stored on the first sheet, the results of the standard method is stored in second sheet, and the results of the revised method is stored in third sheet.

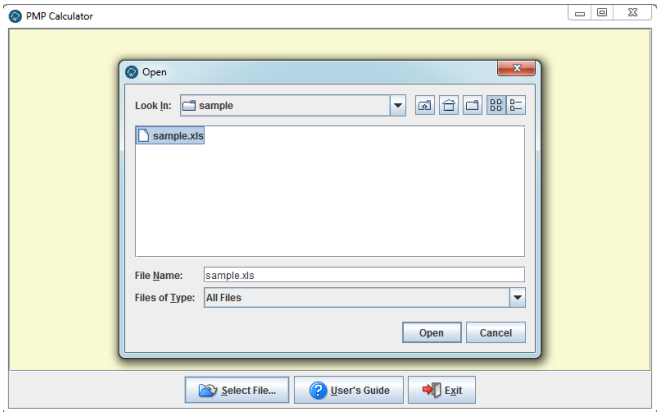


Fig. 2. Select the input file

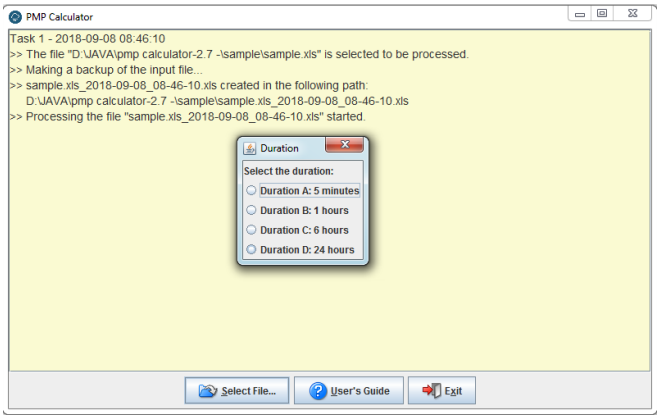


Fig. 3. Select the duration

Output data

In the Hershfield standard method, output file has included in N, mean, K_m, SD, Max, $Mean_{n-m}$, SD_{n-m}, E, F, C_1, C_2, C_3, C_4, $Mean_1$, SD_1, PMP_{ini}, C_5, PMP_{final} and CP. Description of output data in the Hershfield standard method is mentioned in Table 1. The output file is shown in Fig. 4.

Table 1. Description of output data in first approach

variable	Description
N	Length of record
Mean	Mean of the annual series
K_m	Frequency factor
SD	Standard deviation of the annual series
Max	The maximum item in the series
$Mean_{n-m}$	Mean of the annual series computed after excluding the maximum item in the series
SD_{n-m}	Standard deviation of the annual series computed after excluding the maximum item in the series
E	Ratio of the $mean_{n-m}$ to the mean
F	Ratio of the SD_{n-m} to the SD
C_1	Adjustment of $\bar{X}_n$ for maximum observed event
C_2	Adjustment of S_n for maximum observed event
C_3	Adjustment of $\bar{X}_n$ for sample size
C_4	Adjustment of S_n for sample size
$Mean_1$	Adjusted $\bar{X}_n$
SD_1	Adjusted S_n
PMP_{ini}	Initial PMP
C_5	Adjustment for fixed observational time intervals
PMP_{final}	Final PMP
CP	Ratio of the PMP to the maximum item in the series

In the Hershfield revised method, output file has included in N, Mean, SD, Max, $Mean_{n-m}$, SD_{n-m}, K_m, K_m^*, PMP_{ini}, C, PMP_{final} and CP. Description of output data in the Hershfield revised method is mentioned in Table 2. The output file is shown in Fig. 5.

Table 2. Description of output data in second approach

variable	Description
N	Length of record
Mean	Mean of the annual series
SD	Standard deviation of the annual series
Max	The maximum item in the series
$Mean_{n-m}$	Mean of the annual series computed after excluding the maximum item in the series
SD_{n-m}	Standard deviation of the annual series computed after excluding the maximum item in the series
K_m	Frequency factor
K_m^*	The maximum Frequency factor
PMP_{ini}	Initial PMP
C	Adjustment for fixed observational time intervals=1.13
PMP_{final}	Final PMP
CP	Ratio of the PMP to the maximum item in the series

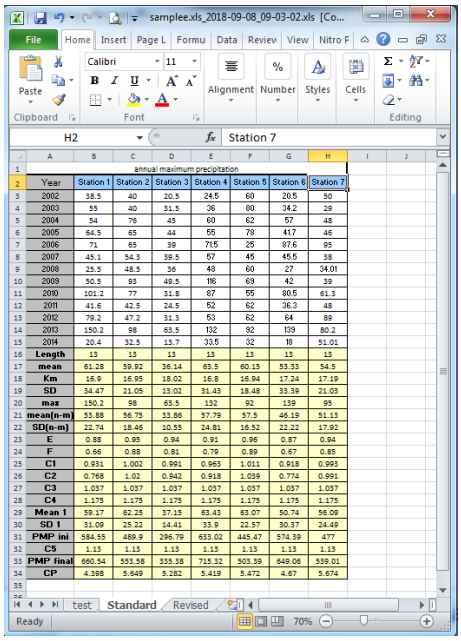


Fig. 4. The output of Hershfield standard method

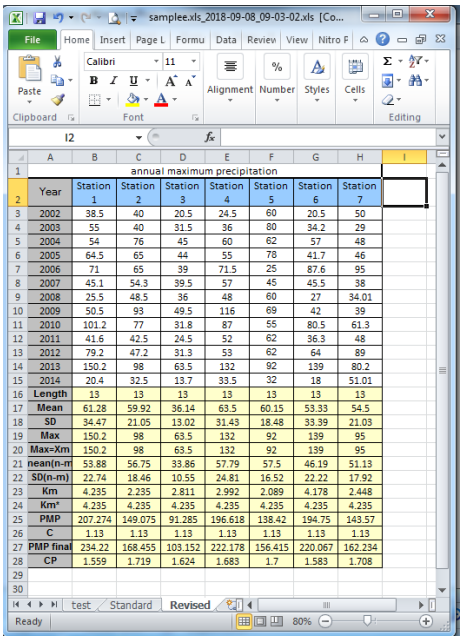


Fig. 5. The output of Hershfield revised method