Reviewer #2

We thank the reviewer for the effort and the time spend on this manuscript.
Thank you very much for putting forward very concrete proposals for improving it. The article after the correction was checked by a specialist in hydrology and mathematical modelling in urban drainage basins.

Below we present detailed answers to the following comments.

Comment 1
The authors have used some variables. It would be useful to add a table with the most important variables, their meaning and unit.

At the end of the paper there is a table with a list of all used symbols, parameters and abbreviations.

N.m.	Symbol	Meaning	
1	AUC	area under curve	
2	CDF	cumulative distribution function of probability density	
3	d_{av}	weighted mean of the retention depth of the catchment area	
4	$f(x)$	probability density function	
5	$F(x)_c$	theoretical distribution to simulate rainfall characteristics due to rainfall:	convective
6	$F(x)_f$		frontal
7	$F(x)_{cz}$		in convergence zones
8	$F(\zeta)_c$	theoretical distribution to simulate the annual number of rainfall events:	convective
9	$F(\zeta)_f$		frontal
10	$F(\zeta)_{cz}$		in convergence zones
11	i	average rainfall intensity [L·s^{-1} ha^{-1}]	
12	IC	Iman-Conover method	
13	M	annual number of rainfall events	
14	$M = const(i)$	calculation variant (annual number of overflow events), in which for simulation constant average annual number of rainfall events is used and to identify the overflow in a rainfall episode the following logit models were applied:	logit model $p = f(i)$
15	$M = const(P_{tot}, t_r)$		logit model $p = f(P_{tot}, t_r)$
16	$M = var(i)$	calculation variant (annual number of overflow events), in which the annual number of rainfall events caused by precipitation (convective, frontal, in convergence zones) is modelled, and for identification of overflow in a rainfall episode the following logit models were applied:	logit model $p = f(i)$
17	$M = var(P_{tot}, t_r)$		logit model $p = f(P_{tot}, t_r)$
18	M_c	annual number of rainfall events caused by rainfall:	convective
19	M_f		frontal
20	M_{cz}		in convergence zones
21	MC	Monte Carlo method	
22	N	number of samples in the Monte Carlo simulation	
23	p	probability of a storm overflow event	
24	P_{tot}	total rainfall [mm]	

25	t_r	rainfall duration [min]	
26	R	Spearman's correlation coefficient	
27	R_z^2	counting error	
28	SENS	sensitivity	
29	SPEC	specificity	
30	SWMM	*Storm Water Management Model*	
31	Z	annual number of storm overflow events	
32	Z_c	annual number of storm overflow events due to rainfall:	convective
33	Z_f		frontal
34	Z_{cz}		in convergence zones
35	x_i	independent variables included in the logit model	
36	α_i	values of estimated coefficients in the logit model	
37	$\alpha, \beta, \sigma, \lambda, \mu, \gamma, \zeta$	empirical coefficients estimated in statistical distributions	
38	$(\mu_1(x_1), \mu_2(x_2),...,\mu_i(x_i))_s$	mean value of variable x_i in the data set obtained from simulation using the Iman-Conover method	
39	$(\sigma_1(x_1), \sigma_2(x_2),...,\sigma_i(x_i))_s$	value of standard deviation of variable x_i in the data set obtained from simulation using the Iman-Conover method	

The following sentence (P10L28):

,,in the data obtained from simulation and measurements, the mean values $(\mu_1(x_1), \mu_2(x_2),...,\mu_i(x_i))_s$ and the standard deviations $(\sigma_1(x_1), \sigma_2(x_2),...,\sigma_i(x_i))_s$ of the variables (x_i) considered in j samples do not differ by more than 5 %"

has been modified as follows:

,,in the data obtained from simulation and measurements, the mean values $(\mu_1(x_1), \mu_2(x_2),...,\mu_i(x_i))_s$ and the standard deviations $(\sigma_1(x_1), \sigma_2(x_2),...,\sigma_i(x_i))_s$ of the variables (x_i) considered in j samples do not differ by more than 5 %."

Comment 2

   In line 9-11 Ptot and tr are mentioned, but defined later in line 9-29. There it would be better to write q = Ptot / tr = 166.7 . . .

   The reviewer knows q as specific discharge ore runoff rate, but not as rain intensity. In English parers for rain intensity stands often I or i (sometimes PI for precipitation intensity).

The following text (P9L11):

,,In order to obtain the best possible matching of theoretical data (precipitation characteristics including P_{tot} and t_r values for precipitation of appropriate genesis) with empirical data, the following statistical distributions were considered …"

has been modified as follows:

,,In order to obtain the best possible fit of theoretical data to empirical precipitation data (including: total rainfall – P_{tot}, rainfall duration – t_r and average rainfall intensity – i, for precipitation of appropriate genesis), the following statistical distributions were considered …"

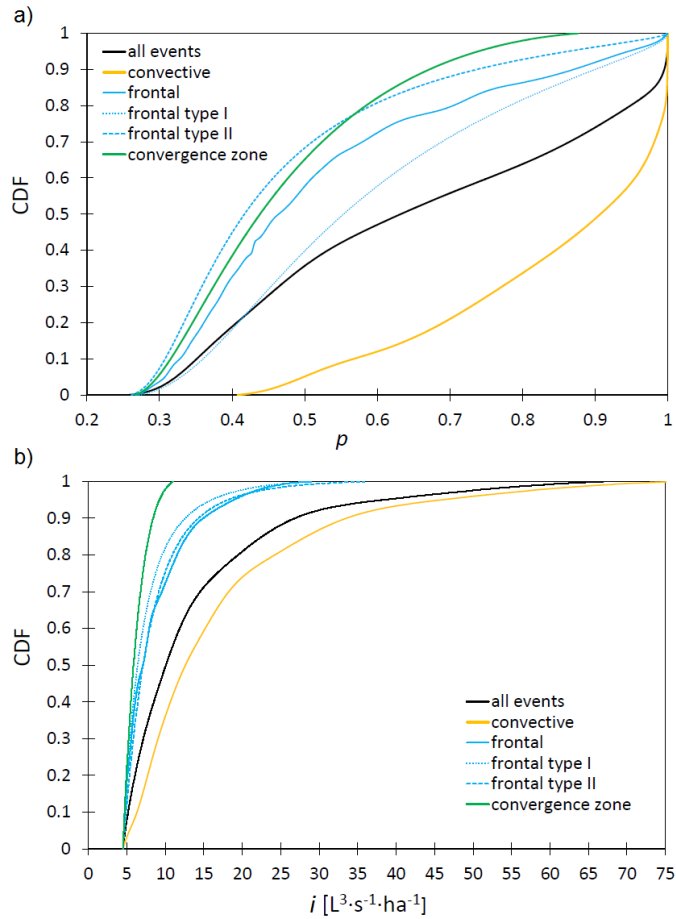The designations in Figures 8 and 9 below have thus been changed:

Fig. 8: Impact of rainfall genesis on: (a) the probability of storm overflow, (b) rainfall intensity distribution determining overflow.
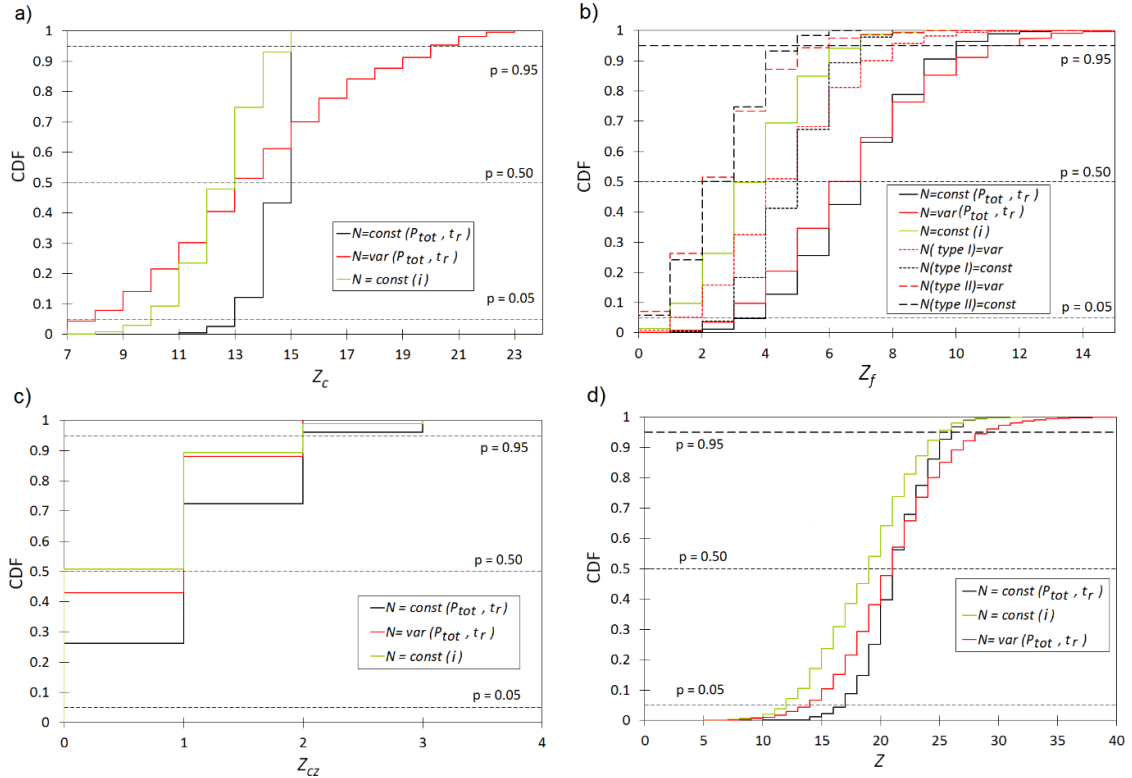

Fig. 9: (a) Distribution function (CDF) showing the annual number of overflows due to convective rainfall; (b) Distribution function (CDF) showing the annual number of overflows due to frontal rainfall; (c) Distribution function (CDF) showing the annual number of overflows due to rainfall in convergence zones; (d) Curve showing the probability of non exceeding the annual number of overflows.

3

In view of the modification of the designations in Figures 8 and 9, further following corrections have been made:
- P13L18; text „$q = 4.030 \approx d_{av}$" has been modified as follows: „$i = 4.030 \approx d_{av}$"
- P13L27; text „(P_{tot}, t_r, q, M)" has been modified as follows: „(P_{tot}, t_r, i, M)"
- P18L6; text „and the value q" has been modified as follows: „and the value i"
- P18L18; text „$q = 4.49–35.50$ L s^{-1} ha^{-1}" has been modified as follows: „$i = 4.49–35.50$ L s^{-1} ha^{-1}"
- P18L22; text „it corresponds to q = 4.49–35.50 L s^{-1} ha^{-1}" has been modified as follows: „it corresponds to $i = 4.49–35.50$ L s^{-1} ha^{-1}"
- P18L27; tekst „when q > 4.86 L s^{-1} ha^{-1}" has been modified as follows: „when $i > 4.86$ L s^{-1} ha^{-1}"

Comment 3
In table 1 and figure 8 the terms "frontal, type I" and frontal, type II" are used, but they are defined first in line 18-2. Why do the authors not use the terms "cold front" and "warm front"? In table 1 the symbol M is used, but nowhere declared.

Table 1 (P14L3) is supplemented by additional explanatory notes: frontal type I – cold front, frontal type II – warm front (see answer to Comment 5).
In Answer 1 there are descriptions of symbols included in the work.

Comment 4
In line 7-25 CDF's "describe the probability of exceeding the flow number of storm overflow discharges." But in the paper CDF is used generally, as customary. On the contrary in picture 8b) CDF is the distribution of the rain intensity. Beside "exceeding" seems to be not correct, since CDF's represent the probability of undershooting!

Of course, we agree with the reviewer. We have corrected the use of the CDF term in the text.

Comment 5
Table 1: The sequential arrangement of the variables is not perfect. The order could be all P_{tot}, t_r , q, and M ore all annual values, convective frontal . ..

Table 1 has been modified (in accordance with the remark above) to the following form:

Variable	Distribution	Model parameters	p (KS)	p (Chi)
P_{tot} (all events)	Weibull	$\beta = 0.772$; $\gamma = 5.158$; $\mu = 3.00$	0.121	0.096
t_r (all events)	GEV	$\zeta = 0.466$; $\sigma = 129.355$; $\mu = 108$	0.096	0.071
i (all events)	log-normal	$\sigma = 1.932$; $\mu = 0.855$	0.112	0.096
M (all events)	Poisson	$\lambda = 32.80$	0.624	0.053
P_{tot} (convective)	Weibull	$\beta = 0.821$; $\gamma = 3.102$; $\mu = 3.00$	0.477	0.412
t_r (convective)	beta	$\alpha = 1.391$; $\beta = 1.173$; $c = 5.5$; $d = 150$	0.268	0.173
i (convective)	log-normal	$\sigma = 2.557$; $\mu = 0.694$	0.238	0.211
M (convective)	Poisson	$\lambda = 14.33$	0.871	0.756
P_{tot} (frontal)	Weibull	$\beta = 0.968$; $\gamma = 6.054$; $\mu = 3.00$	0.353	0.314
t_r (frontal)	Weibull	$\beta = 1.201$; $\gamma = 164.99$; $\mu = 150$	0.639	0.589
i (frontal)	log-normal	$\sigma = 1.485$; $\mu = 0.644$	0.906	0.878
M (frontal)	Poisson	$\lambda = 15.95$	0.372	0.831
P_{tot} (frontal, type I)	Weibull	$\beta = 0.862$; $\gamma = 4.535$; $\mu = 3.00$	0.631	0.425
t_r (frontal, type I)	beta	$\alpha = 1.221$; $\beta = 1.372$; $c = 150$; $d = 270$	0.200	0.145
i (frontal, type I)	log-normal	$\sigma = 1.701$; $\mu = 0.612$	0.104	0.085
P_{tot} (frontal, type II)	Weibull	$\beta = 1.065$; $\gamma = 7.222$; $\mu = 3.00$	0.397	0.342
t_r (frontal, type II)	beta	$\alpha = 0.829$; $\beta = 1.562$; $c = 266$; $d = 650$	0.270	0.226
i (frontal, type II)	log-normal	$\sigma = 1.289$; $\mu = 0.611$	0.059	0.056

P_{tot} (convergence zone)	log-normal	$\sigma = 0.603$; $\mu = 3.00$	0.969	0.856
t_r (convergence zone)	Weibull	$\beta = 0.802$; $\gamma = 276.138$; $\mu = 650$	0.947	0.879
i (convergence zone)	log-normal	$\sigma = 1.296$; $\mu = 0.497$	0.942	0.923
M (convergence zone)	Poisson	$\lambda = 2.55$	0.067	0.652

frontal type I – cold front, frontal type II – warm front.

Comment 6

In Figures 6 and 7 (P15L14-P16) the descriptions of X and Y axes have been modified in accordance with the drawings below.

The X axis is described as:
- theoretical quantiles of P_{tot} values,
- theoretical quantiles of t_r values,
- theoretical quantiles of i values,
- theoretical quantiles of M values,

The Y-axis is described as:
- empirical quantiles of P_{tot} values,
- empirical quantiles of t_r values,
- empirical quantiles of i values,
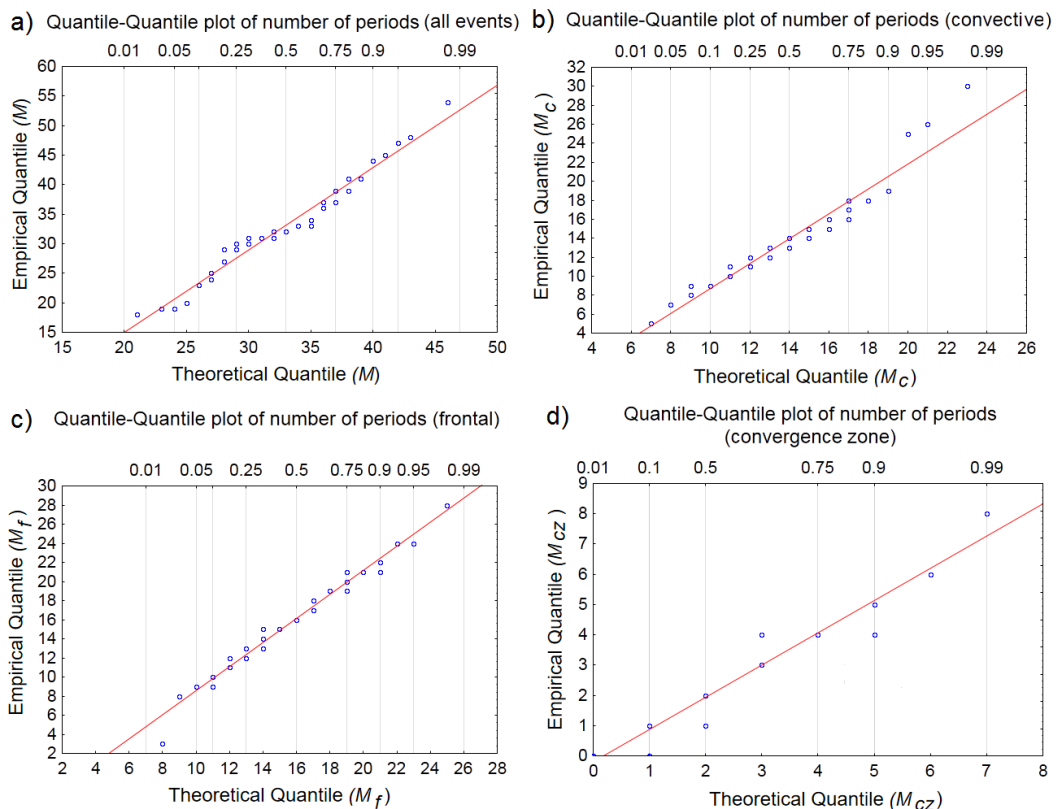- empirical quantiles of M values,

Fig. 6. Comparison of empirical and theoretical quantiles concerning the number of rainfall episodes and distinguishing rainfall types: (a) all events (b) convective, (c) frontal, (d) in convergence zones.

Fig. 7: Comparison of quantiles of empirical and theoretical distributions of P_{tot} and t_r values for: (a) all events, (b) convective, (c) frontal, and (d) rainfall in convergence zones.

The title of Figure 6 has been corrected according to the reviewer's remark: „Comparison of empirical and theoretical quantiles concerning the number of rainfall episodes and distinguishing rainfall types: (a) all events, (b) convective, (c) frontal, (d) in convergence zones".
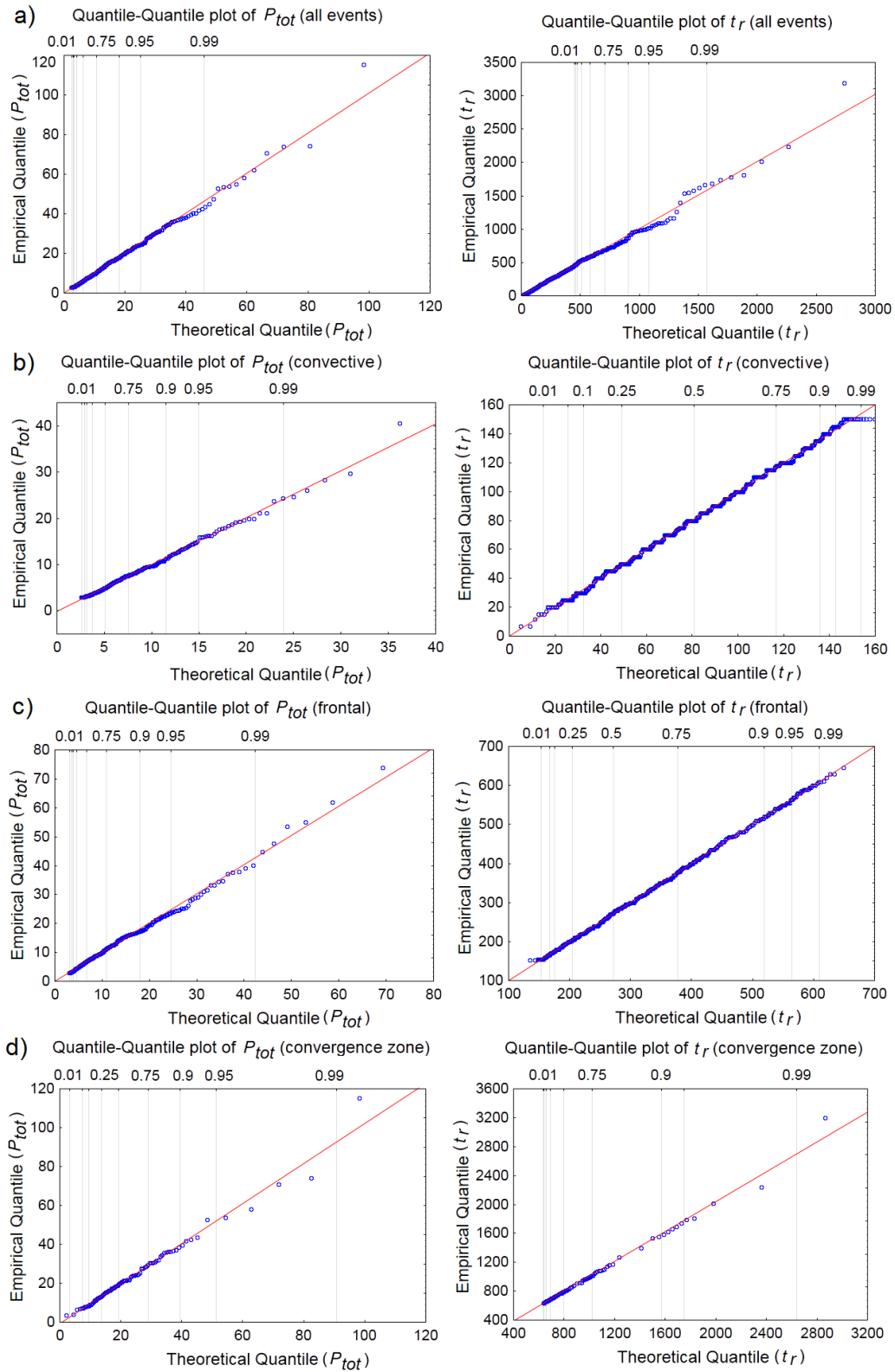
It is possible, but unreasonable, to perform Figure 6 in such a way as to maintain an identical range of variation in the annual number of rainfall events of different genesis. This is due to the large variation in the independent variable. Identically, this issue relates to the rainfall depth and its duration.

Comment 7
      Figure 6: Is it right, that the sum of the highest values of b), c) and d) = 55 should be equal to the highest value of a)?

Thank you for your valuable insight. The maximum values for the number of rainfall events caused by convectional, frontal and rainfall in convergence zones were recorded for the same year. This means that the sum does not have to be 55, but it may be less, as was obtained in the case under consideration.

Comment 8
      Figure 8 (a): p is the probability of overflow discharge. But for wich variable stands CDF here? The reviewer has not found any remarks. Therefore he don't understand in line 18-5 why "the percentiel value p = 0,50 is as high as 0,90"? It looks like that the CDF-value 0,50 is as high as 0,90? But what means CDF here?

Indeed, the markings introduced are misleading. The CDF value means the probability of non-exceedance the probability of stormwater overflow by a storm overflow in a rainfall episode. Thus, further modifications have been made to the manuscript:
- P18L5 now: ,,percentile value p = 0.50" after modification: ,,percentile value of 0.50"
- P19L9 now: ,, for example, for p = 0.05" after modification: ,, for example, for percentile value 0.05"
- P19L10 now: ,,for the percentile value p = 0.95" after modification: ,, for the percentile value 0.95"
- P20L4 now: ,,The influence of the theoretical distribution of the number of rainfall events per year on the values of $0.99 > p > 0.50$ is confirmed by Szeląg et al. (2018)" after modification: ,,The influence of the theoretical distribution of the number of rainfall events per year on the values of percentiel 0.50–0.99 is confirmed by Szeląg et al. (2018)".

Comment 9
      Line 1-15: The Model is innovative, formulate more clear, what the reasons are

The following manuscript text (P1L15): ,,This paper proposes an innovative probabilistic model to simulate the number of storm overflow discharges, which takes into atmospheric circulation and related rainfall in the research area (the city of Kielce located in the central part of Poland)."
has been modified to the following form:
,,The paper presents a probabilistic model for simulating the annual number of storm overflows. In this model, an innovative solution is to use the logistic regression method to analyze the impact of rainfall genesis on the functioning of a storm overflow on the example of a catchment located in Kielce city (central Poland).

The following manuscript text (P2L2): ,,They can be used to develop warning systems, in which information on the predicted rainfall genesis is a component of the assessment of the operation of the stormwater system and the facilities located on it."
has been expanded by the sentence:
,,This approach is an original solution that has not yet been considered by other researchers. On the other hand, it is an important simplification and an opportunity to reduce the data to be measured."

Comment 10
      Line 1-24 and 7-21: The generator should be mentioned as first element.

The text (P1L18) in the manuscript: ,, The first element is the model of logistic regression, which can be used to model storm overflow discharge resulting from the occurrence of a single rainfall episode. The paper confirmed that storm overflow discharge can be modeled on the basis of data on the total amount

of rainfall and its duration. An alternative approach was also proposed, in which the possibility of forecasting overflow discharge only on the basis of the average rainfall intensity was demonstrated, which is a big simplification in simulation of the phenomenon under study in comparison with the works published so far in this scope. It is worth noting that the coefficients determined in logit models have a physical interpretation and these models have a universal character, which is why they can be easily adapted to other examined catchment areas. The second element of the model is a synthetic precipitation generator, in which the simulation of rainfall takes into account its genesis resulting from various processes and phenomena taking place in the troposphere. This approach makes it possible to take into account the stochastic nature of rainfall also in relation to the annual number of events"

has been modified as follows (P1L18):

„The first element of the model is a synthetic precipitation generator, in which the simulation of rainfall takes into account its genesis resulting from various processes and phenomena taking place in the troposphere. This approach makes it possible to take into account the stochastic nature of rainfall also in relation to the annual number of events. The first element is the model of logistic regression, which can be used to model storm overflow resulting from the occurrence of a single rainfall episode. The paper confirmed that storm overflow can be modeled on the basis of data on the total rainfall and its duration. An alternative approach was also proposed, in which the possibility of prediciting storm overflow only on the basis of the average rainfall intensity was demonstrated, which is a great simplification in simulation of the phenomenon under study in comparison with the works published so far in this scope. It is worth noting that the coefficients determined in logit models have a physical interpretation and these models have a universal character, which is why they can be easily adapted to other examined catchment areas."

The text (P7L21) in the manuscript: „The first component is a logit model, which is used to simulate the occurrence of a storm overflow discharge. Another component are synthetic precipitation generators, which are realized in two variants. In the first variant it was assumed that the basis for the simulation of rainfall series is their genesis. In the second variant precipitation is forecasted regardless of its origin – in the annual cycle."

has also been modified as follows:

„The first component are synthetic precipitation generators, which are realized in two variants. In the first variant it was assumed that the basis for the simulation of rainfall series is their genesis. In the second variant precipitation is predicted regardless of its origin – in the annual cycle. Another component is a logit model, which is used to simulate the occurrence of a storm overflow."

Comment 11

Line 2-14: write "such discharges". Mostly the words "overflow discharge" are used, but in some further cases only the word "discharge" (for example 8-4 and 18-29), while "overflow discharge" is meant. Please check such cases.

The vocabulary was modified in the paper. Expression „overflow discharge" has been replaced by „storm overflow", and the expression „annual number of overflow discharges" has been replaced by „annual number of overflows".

Comment 12

Line 5-22: write better "It concerns events with high intensity and short duration.

The following manuscript text (P5L22): „These data were taken into account in the conducted analyses, as the launch of a new device, the SEBA electronic rain gauge (tipping-bucket SEBA rain gauge), a few years later in the state measuring network, resulted in the recording of significantly lower precipitation levels (by several percent) high intensity and short-lived, compared to measurements recorded by a traditional pluviograph (Kotowski et al., 2011)"

has been modified as follows:

„These data were taken into account in the conducted analyses, as the launch of a new device, the SEBA electronic rain gauge (tipping-bucket SEBA rain gauge), a few years later in the state measuring network,

resulted in the recording of significantly lower precipitation levels (by several percent). It concerns events with high intensity and short duration (Kotowski et al., 2011)"

Comment 13

Lines 7-7 to 7-11: this paragraph seems to be a repeat.

Based on this Comment, the following manuscript text (P7L7 to P7L11): ,,Within the conducted analyses, an innovative probabilistic model was proposed for forecasting the number of storm overflow discharges (Figure 4). This model allows for the forecast of the annual number of discharges and the simulation of the number of events per year, taking into account the genesis of rainfall (convective in air mass, frontal, convergence zones precipitation), which is typical for countries located in central Europe and other regions of world. Although the paper focuses on the genesis of rainfall developed by Kupczyk and Suligowski (1997, 2011), the proposed approach is universal. The distribution of rainfall data may be based on local conditions determining the movement of air masses, which has a key impact on the dynamics of rainfall events. The time range of particular rainfall groups can then be determined on the basis of meteorological, synoptic and statistical analysis in the periods of high precipitation sums or precipitation intensity in a given area (Llasat, 2001; Rigo and Llasat, 2004; Millán et al., 2005; Langer and Reimer, 2007; Federico et al., 2008; Lazri et al., 2012; Berg and Haerter, 2013)."
has been modified as follows (P7L11):
,,An innovative probabilistic model was proposed for modelling the annual number of storm overflows (Figure 4). This model allows for the predict of the annual number of overflows and the simulation of the number of events per year, taking into account the genesis of rainfall, which is typical for countries located in central Europe and other regions of world. Although the paper focuses on the genesis of rainfall developed by Kupczyk and Suligowski (1997, 2011), the proposed approach is universal. The distribution of rainfall data may be based on local conditions determining the advection of air masses, which has a key impact on the dynamics of rainfall events. The time range of particular rainfall groups can then be determined on the basis of meteorological, synoptic and statistical analysis in the periods of high precipitation sums or precipitation intensity in a given area (Llasat, 2001; Rigo and Llasat, 2004; Millán et al., 2005; Langer and Reimer, 2007; Federico et al., 2008; Lazri et al., 2012; Berg and Haerter, 2013)."

Comment 14

Lines 8-9 to 9-2: Both sentences sound similar.

The following sentences are indeed similar: ,,The paper presents the following stages of construction of a probabilistic model on the example of an urban catchment located in the area of Kielce city. In the following sections the individual steps of the above mentioned calculation algorithm of the probabilistic model (separation of rainfall events, creation of a logistic regression model, development of a rainfall generator) are discussed in detail (Figure 4).

Therefore, the text has been modified as follows (P8L9): ,,The paper presents the following stages of construction of a probabilistic model on the example of an urban catchment located in Kielce city."

Comment 15

Line 9-5: What is meant by "in the ranks of"

The following sentence (P9L5) has been modified: ,, One of the basic conditions allowing for the completion of a synthetic precipitation generator is the separation of single independent rain events in the ranks of rainfall"
do postaci:
,, One of the basic conditions allowing for the completion of a synthetic precipitation generator is the separation of single independent rain events in rainfall time series".

Comment 16

Lines 9-9 to 9-18: this paragraph seems to be a repeat.

In the first quoted sentence (P9L9) the reader was informed only about empirical distributions, determined on the basis of separated rain episodes. In the next paragraph of the text this information is detailed and the methodology of research is presented. Thus, although the sentences P9L9 and P9L18 are similar, both are of significant importance in the applied research methodology.

Comment 17
Line 9-24: "simulate objects" sounds strange, write better "simulate the influence of constructions on flow procsses"

The following sentence (P9L24): ,,It is also used to simulate objects located in rainwater drainage networks (storm overflows) (Szeląg et al., 2018)"
has been modified as follows:
,,It is also used to simulate the influence of constructions on flow processes."

Comment 18
Line 10-14: The investigation period is 1961 to 2000 (page 5). Here the years 2012-2014 are discussed?

Description of the data used to construct the model (P10L11-15): ,,The second variant assumes simplification and considers a single independent variable, i.e. average rainfall intensity. To determine the logit model, the results of measurements of the operation of the investigated storm overflow have been used from the years 2009-2011, when 69 overflow of 188 precipitation events occurred, and from the years 2012-2014, when 42 overflow of 93 precipitation events occurred."
has been made more specific:
,,In the urban catchment area, continuous flow measurements were carried out in the period 2009-2011 (69 storm overflows during 188 rainfall events were separated at that time), whereas in the years 2012-2014 only fillings in the diversion chamber were measured (42 overflows during 93 rainfall episodes were separated). The reason for this was the construction works carried out in the analysed catchment and a large amount of suspended solids limiting the operation of the measuring devices. Since 2015, MES1 and MES2 flow meters have been installed, which also allow the measurement of the volume of stormwater discharged by overflow. Thus, on the basis of data from the period 2009-2014, a logit model was developed, while data from the period 2015-2017 were used to verify it."

Comment 19
Line 11-14: Whant is meant by "period separating subsequent rainfall events"?

The following sentence (P11L14): ,,Currently conducted research in the field of rainfall simulators based on multidimensional boundary distributions combined with the so-called dome functions take into account the distribution of rainfall in the rainfall episode (Vernieuwe et al., 2015), spatial diversity of rainfall (Dai et al., 2014), seasons (Khedun et. al., 2014) and the period separating subsequent rainfall events (Balistrocchi and Bacchi, 2011)."
has been modified as follows:
,,Currently conducted research in the field of rainfall simulators based on multidimensional boundary distributions combined with the so-called copula functions take into account the distribution of rainfall in the rainfall episode (Vernieuwe et al., 2015), spatial diversity of rainfall (Dai et al., 2014), seasons (Khedun et. al., 2014) and the antecendent period (Balistrocchi and Bacchi, 2011)."

Comment 20
Line 11-15 to 11-24: This part concerns not methods. Similar discussions are in the first parts of the paper.

The text from P11L15 to P11L24 and P10L17 to P10L24 is shortened and included in the introduction (P2L22) in the following form:

„Multidimensional scaling methods and fractal geometry (Rupp et al., 2009; Licznar et al., 2015; Müller-Thomy and Haberlandt 2015) are used to simulate rainfall series. An alternative solution is an approach based on multidimensional distributions created on the basis of theoretical distributions and copula functions (Vandenberghe et al., 2010; Vernieuwe et al., 2015). Despite numerous applications, these solutions are relatively complex and require expert knowledge. For the storm overflow simulation, hydrodynamic models are usually used, and less frequently empirical models (Szeląg et al., 2018). Nevertheless, this approach to the simulation of the annual number of overflows is very local and in many cases requires the construction of a catchment model."

Due to the above correction and Comment 5, the text after P9L19 was also modified:
"Taking into account the computational algorithm described in Chapter 4 (Methodology), on the basis of determined distributions of theoretical rainfall characteristics describing the operation of a storm overflow, a model for simulation of synthetic rainfall series was adopted for further analysis. The simulations carried out for this purpose included the modified Monte Carlo - Iman-Conover method (1982). This model gives the possibility to simulate independent variables on the basis of determined theoretical distributions.
In this method the variability of the considered variables is described by boundary (theoretical) distributions, and the basis for evaluation of their correlation is the Spearman correlation coefficient. The conditions, which must be met in order for the results obtained to be considered correct, are as follows:
– in the data obtained from simulation and measurements, the mean values $(\mu_1(x_1), \mu_2(x_2),..., \mu_i(x_i))_s$ and the standard deviations $(\sigma_1(x_1), \sigma_2(x_2),...,\sigma_i(x_i))_s$ of the variables (x_i) considered in j samples do not differ by more than 5%,
– theoretical distributions of x_i variables obtained from simulation are consistent with those obtained from measurements; in order to meet this condition it is recommended to use the Kolmogorov-Smirnov test,
– the value of the correlation coefficient (R) between individual dependent variables (x_i) obtained for data from MC simulation does not differ by more than 5% from the value of R obtained for empirical data."

Comment 21
Lines 12-8 to 12-11: This sentences are nearly a repeat of pages 7/8, but the steps are not denominated identical. Here 4 steps are listed, but the chapter consists of the two parts 5.1 and 5.2 only.

Indeed, the text on page P12L8 to P12L11 is similar to this one on pages 7/8. The text (P12L8 to P12L11) lists in detail the stages that are discussed in the manuscript below.
To eliminate the similarity, the Section 5.2 has been divided into three following chapters:

5.2. Identification of empirical distributions and theoretical rainfall characteristics
Subchapter 5.2 includes analyses related to the determination of statistical distributions of the following variables: rainfall depth (P_{tot}), rainfall duration (t_r), average rainfall intensity (i), and number of rain events in a year of varied genesis.
Chapter 5.2 in the manuscript contains the text from P13L24 to P17L5.

5.3. Impact of rainfall genesis on the probability of overflow occurring
Subchapter 5.3 presents the determined relationship between the genesis of rainfall and the probability of overflow event, as well as the ranges of variation of average rainfall, taking into account the rainfall genesis, which determines the occurrence of storm overflow event.
Subchapter 5.3 in the manuscript contains the text from P17L6 to P17L27.

5.4. Impact of precipitation genesis on the annual number of overflow events
Subchapter 5.4 presents the annual number of overflow events caused by rainfall (convective, frontal, in convergence zones). At the same time, a comparative analysis of the annual number of overflow events obtained with a simplified logit model (based on the average rainfall intensity) and the number of overflow events obtained with an accurate model (based on the total amount of rainfall and its duration) is carried out in this chapter.
Subchapter 5.4 in the manuscript contains the text from P18L28 to P20L16 in the manuscript.

Comment 22

Line 13-19: The reviewer don't know what "values of free words" are? Possibly other readers will have the same problem.

The following sentence (P13L19 – P13L21): ,,On the basis of the relationships (eq. 5 and eq. 6) it can be concluded that the values of free words obtained in them are similar to the weighted average value of the catchment retention (d_{av}). The relative difference between the values of free words and retention of the catchment area does not exceed 5 % "
has been modified as follows:
,,On the basis of this relationships it can be concluded that the values of intercept obtained in them are similar to the weighted average value of the catchment retention (d_{av}). The relative difference between the values of intercept and retention of the catchment area does not exceed 5 %.

Comment 23

Line 1-16: The text within the brackets should be formulated as sub-clause or as an additional sentence.

The manuscript text has been corrected (see Comment and Answer 9).

Comment 24

Line 1-21: write "great great" instead of "big"

The amended sentence is set out in answer to Comment 10.

Comment 25

Line 1-29: two times determine

The following sentence (P1L29): ,,On the basis of the obtained results, the range of variability of average rainfall intensity was determined, which determines the discharge by storm overflow, as well as the annual number of discharges resulting from the occurrence of rain of different genesis."
has been modified as follows:
,,On the basis of the obtained results, the range of variability of average rainfall intensity was defined, which determines the storm overflow, as well as the annual number of overflows resulting from the occurrence of rain of different genesis."

Comment 26

Line 1-31: the results are suited for implementation

The following sentence (P1L31): ,,The obtained results enable their practical implementation in the assessment of storm overflows only on the basis of knowledge concerning the genetic type of rainfall."
has been modified as follows:
,,The results are suited for implementation in the assessment of storm overflows only on the basis of the genetic type of rainfall."

Comment 27

Line 2-2: three times the word "of" in series.

The following sentence (P2L2): ,,They can be used to develop warning systems, in which information on the predicted rainfall genesis is a component of the assessment of the operation of the stormwater system and the facilities located on it."
has been modified as follows:
,,They may be used to develop warning systems in which information on the predicted rainfall genesis is an element of assessment of the rainwater system and its facilities. "

Comment 28
Line 2-29: what was not taken into account when rainfall generators were used to simulate

The following sentence (P2L29): ,,It seems puzzling why the fact that the time course and dynamics of rainfall are the result of complex movements of air masses (Serrano et al., 2009; Alhammoud et al., 2014; Dayan et al., 2015) was not taken into account when modelling rainfall generators to simulate storm overflows."
has been modified as follows:
,,It seems puzzling why the fact that the time course and dynamics of rainfall are the result of complex movements of air masses (Serrano et al., 2009; Alhammoud et al., 2014; Dayan et al., 2015) what was not taken into account when rainfall generators used to simulate storm overflows."

Comment 29
Line 2-32: "concern simulations" sounds strange, write perhaps better "consider"

The following sentence (P2L32): ,,The models created concern simulations of meteorological conditions changing in time and determining the distribution of temperature…."
has been modified as follows:
,,The models created consider simulations of meteorological conditions changing in time and determining the distribution of temperature…."

Comment 30
Line 3-1: "course of precipitation phenomena" sounds strange.

The following sentence (P3L1): ,,The models created concern simulations of meteorological conditions changing in time and determining the distribution of temperature, pressure and humidity, which affects the dynamics of air movement and, consequently, the course of precipitation phenomena."
has been modified as follows:
,,The models created concern simulations of meteorological conditions changing in time and determining the distribution of temperature, pressure and humidity, which affects the dynamics of air movement and, consequently, the patterns of precipitation phenomena."

Comment 31
Line 3-4: "forecasting the operation" sounds strange, write "basis for the control of systems"

The following sentence (P3L4): ,,This information may be the basis for forecasting the operation of the stormwater system and developing an early warning system against the risks of flash flood."
has been modified as follows:
,,This information may be the basis for control of the systems and developing an early warning system against the risks of flash flood."

Comment 32
Line 3-11: Sometime it is written "model of the rainfall generator". The generator is a model, the word "model" seems to be unnessecary.

The following sentence (P3L11): „In the model of the rainfall generator the genesis of rainfall was taken into account, which allowed to determine the curves showing the influence of rainfall genesis on the occurrence of overflow discharge in a single rainfall episode."
has been modified as follows:
„In the rainfall generator the genesis of rainfall was taken into account, which allowed to determine the curves showing the influence of rainfall genesis on the occurrence of storm overflow in a single rainfall episode."

Comment 33

Line 3-22: a space is missed

A space is inserted between the sentences (P3L22): .... (Szeląg et al., 2016). The length ....

Comment 34
Line 3-23: better "height difference", cancel "of ordinates"

The following sentence (P3L23): „The maximum difference of ordinates in the catchment is 12.0 m and the average slope in the catchment is 7.1 %."
has been modified as follows:
„The height difference in the catchment is 12.0 m and the average slope – 7.1 %."

Comment 35
Line 4-10: "generated" better as "shaped"

The following sentence (P4L10): „Precipitation is shaped by two different precipitation mechanisms: convective and stratiform (Houze, 2014)".
has been modified as follows:
„Precipitation is generated by two different precipitation mechanisms: convective and stratiform (Houze, 2014)".

Comment 36
Line 4-11: write "A third", since before only two mechanism are announced

The following sentence (P4L11): „The third rainfall mechanism, which may have the above mentioned components, is related to the orographic lifting of air masses over mountains or hills (Smith, 1993)."
has been modified as follows:
„A third rainfall mechanism, which may have the above mentioned components, is related to the orographic lifting of air masses over mountains or hills (Smith, 1993)."

Comment 37
Line 4-11: write "which include both above mentioned components"

The following sentence (P4L11): „The third rainfall mechanism, which may have the above mentioned components, is related to the orographic lifting of air masses over mountains or hills (Smith, 1993)."
has been modified as follows:
„A third rainfall mechanism, which inlude both above mentioned components, is related to the orographic lifting of air masses over mountains or hills (Smith, 1993)."

Comment 38
Line 4-16: write at the end "are" instead of "is"

The following sentence (P4L16): „Convective precipitation induced by single thunderstorm cells, their complexes or squall lines is short-lived, but is characterized by high average intensity (Kane et al., 1987) and causes flash floods in many areas (Gaume et al., 2009; Marchi et al., 2010; Bryndal, 2015)."
has been modified as follows:
„Convective precipitation induced by single thunderstorm cells, their complexes or squall lines is short-lived, but are characterized by high average intensity (Kane et al., 1987) and causes flash floods (Gaume et al., 2009; Marchi et al., 2010; Bryndal, 2015)."

Comment 39
Line 5-2 and 5-13: line break (new paragraph)

We agree with the Reviewer's #1 comment that the considerations on this subject presented in Chapter 3 may be shortened and partly moved to the introductory chapter of the article.

Therefore, the following changes have been made to the manuscript:

– the title of Chapter 3 (P4L7) has been changed as follows: "Rainfall data and analysis"

– the previous content presented in the text from P4L8 to P5L17 was modified in the following way and moved to Chapter 1 (after P3L7):

"Rainfall is universally classified into three types (Sumner, 1988): convective, cyclonic and orographic. The main distinguishing feature between convective precipitation in air mass and frontal precipitation in mid-latitudes is its spatial extent and duration. The range of convective precipitation associated with local air circulation is much smaller than in the case of travelling extratropical cyclones with weather fronts. Convective precipitation induced by single thunderstorm cells, their complexes or squall lines is short-lived, but are characterized by high average intensity (Kane et al., 1987) and causes flash floods (Gaume et al., 2009; Marchi et al., 2010; Bryndal, 2015). On the other hand, the lifespan of the mechanisms of creating cyclonic precipitation is much longer than that of convective precipitation – in the order of days rather than hours. Hence, the effect of this is long-term rainfall with a high depth (Frame et al., 2017), often causing regional floods (Barredo, 2007). The presented classification of precipitation types distinguished by Sumner (1988) due to the origin, developed for the British Isles and Western Europe, cannot be directly applied in practical hydrology in other regions of the continent, especially in its eastern and central parts. This is the result of exceptional variability of meteorological conditions occurring in the temperate zone of warm transition climate – on the borderline of air masses coming from the Atlantic and continental masses from the east (Twardosz and Niedźwiedź, 2001; Niedźwiedź et al., 2009; Twardosz et al., 2011; Łupikasza, 2016). Analysis of maximum rainfall of different duration in Poland carried out at the end of the 1990s (Kupczyk and Suligowski, 1997, 2011), supplemented by the analysis of synoptic situation (on the base of surface synoptic charts of Europe, published in Daily Meteorological Bulletin of the Institute of Meteorology and Water Management – IMGW in Warsaw) and a calendar describing the types of atmospheric circulation together with air masses and air fronts (Niedźwiedź, 2019), led to the separation of three types of genetic precipitation: convective in air mass, frontal and generated in convergence zones."

Comment 40
Line 5-17: "convergence zone" is not a type of precipitation, write better "generated in convergence zones"

The amended text is presented at the end of the answer to Comment 39.

Comment 41
Line 5-19: write "only these data were"

Fragment of the sentence (P5L19): ,,These data were taken into account in the conducted analyses,…."
has been modified as follows:
,,Only these data were taken into account in the conducted analyses, …."

Comment 42
Line 5-33: "variable" instead of "varied"

The following sentence (P5L33): ,,The second type (frontal rainfall) forms a group of precipitation in Kielce, in which the duration is very varied and ranges from 2.5 h to 10.5 h."
has been modified as follows:
,,The second type (frontal rainfall) forms a group of precipitation in Kielce, in which the duration is very variable and ranges from 2.5 h to 10.5 h."

Comment 43
Line 6-12: "precipitation emitted" sounds strange.

The following sentence (P6L12): ,,Transformation of air masses over the western part of the continent, lower speeds of movement of frontal zones, as well as weakening of the dynamics of processes in the front zone cause that precipitation in Kielce differ in intensity and duration in relation to precipitation emitted by Sumner (1988) as cyclonic."

has been modified as follows:

,,Transformation of air masses over the western part of the continent, lower speeds of movement of frontal zones, as well as weakening of the dynamics of processes in the front zone cause that precipitation in Kielce differ in intensity and duration in relation to precipitation defined by Sumner (1988) as cyclonic."

Comment 44
Line 7-25: overflow discharges per year

The following sentence (P7L25): ,,On this basis, distribution functions (CDF) are determined that describe the probability (Z) of exceeding the number of storm overflow discharges."

has been modified as follows:

,,On this basis, distribution functions (CDF) are determined that describe the probability of non exceeding the annual number of storm overflows."

Comment 45
Line 10-10: Write ". is a simplification. It considers only a single"

The following sentence (P10L10): ,,The second variant assumes simplification and considers a single independent variable, i.e. average rainfall intensity."

has been modified as follows:

,,The second variant is a simplification. It considers only a single."

Comment 46
Line 10-18: set methods before the brackets.

The above remark has already been taken up in answer to Comment 20 and the quotes have been moved to the end of the sentence.

Comment 47
Line 10-30: write better "should be consistent"

The following sentence (P10L30): ,,…theoretical distributions of x_i variables obtained from simulation are consistent with those obtained from measurements; in order to meet this condition it is recommended to use the Kolmogorov-Smirnov test…"

has been modified as follows:

,,…theoretical distributions of x_i variables obtained from simulation should be consistent with those obtained from measurements; in order to meet this condition it is recommended to use the Kolmogorov-Smirnov test…"

Comment 48
Line 13-16: write "are valid" instead of "take place"

The following sentence (P13L16): ,,Based on theoretical considerations conducted by Thorndahl and Willems (2008), who provided a generalised model for forecasting the volume of wastewater discharge via a storm overflow, it can be concluded that in this case the following relations take place:"

has been modified as follows:

,,Based on theoretical considerations conducted by Thorndahl and Willems (2008), who provided a generalised model for modeling the overflow volume, it can be concluded that in this case the following relations are valid:"

Comment 49

    Line 13-19: write "of this relationship" and cancel the "(eq. 5 and eq. 6)"

The corrected sentence is in answer to Comment 22.

Comment 50

    Line 15-8: expressed better by

The following sentence (P15L8): ,,Also, the variation in rainfall duration in episodes resulting from rainfall of different genesis in most cases is described by the Weibull distribution and only in the case of data measured over an annual cycle is it expressed by the GEV distribution (eq. 9)."
has been modified as follows:
,,Also, the variation in rainfall duration in episodes resulting from rainfall of different genesis in most cases is described by the Weibull distribution and only in the case of data measured over an annual cycle is it expressed better by the GEV distribution (eq. 9)."

Comment 51

    Line 18-3: Write "distinguished" instead of "made".

The following sentence (P18L3): „Within the framework of the conducted analyses, the division of frontal rainfall events of the duration not longer than 4.5 h (related to the cold front – type I) and exceeding the given value (due to the displacement of the warm front – type II) was additionally made."
has been modified as follows:
„Within the framework of the conducted analyses, the division of frontal rainfall events of the duration not longer than 4.5 h (related to the cold front – frontal type I) and exceeding the given value (due to the displacement of the warm front – frontal type II) was additionally distinguished.

Comment 52

    Line 18-6: line break (new paragraph).

Chapter 5.2 and its division is discussed in answer to Comment 21.

Comment 53

    Following words seems to be unnessecary: Line 1-20: was demonstrated; Line 1-31/32: knowledge concerning; Line 2-10: collecting; Line 2-19: in the work; Line 2-22: of simulation; Line 2-27: in its modeling; Line 3-26: the work; Line 4-6: article ;Line 4-17: in many areas; Line 5-3: of the phenomenon; Line 9-6: in the paper ;Line 10-10: in the analysis performer ;Line 11-13: in the rainfall episode ; Line 13-1: using the model.

All words indicated by the reviewer have been deleted.