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Hydrology and Earth System Sciences Discussions

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Interactive Comment

Interactive comment on "Characteristics of 2-D convective structures in Catalonia (NE Spain): an analysis using radar data and GIS" *by* M. Barnolas et al.

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We deeply appreciate the reviews of our manuscript and we largely accept the suggestions and corrections provided. Please find below an item-by-item response to all the comments (general and specific) provided.

«MAJOR ISSUES Fig. 5: The reader is left to judge visually the goodness of the fit. The use of probability density functions and the scale of the y-axis makes it difficult to judge the agreement especially in the tails. I think that a plot of cumulative function is more appropriate together with a log-log plot for the Pareto fit and log normal. Moreover, a quantitative measure of fit goodness (E.g. Kolmogorov-Smirnoff test) must be used: the fit of the orientation with a GEV looks quite "awful" (probably will not pass the KS test a 5% confidence).»

Considering reviewer comments we have plotted cumulative functions to let the reader judge visually the goodness of the fit in a better way (Fig. 1 bellow). We have also used the Kolmogorov-Smirnoff test to measure the goodness of the fit in a quantitative way. Given that the critical value in the KS test, in the one sided version, is given by the expression c(α)* , where c(α) is a parameter depending on the level of statistical significance (5%), and "n" the number of data, our critical value is 0.115. All the parameters (except orientation) pass the KS test as the values obtained for the KSrat are lower than the critical value (Fig 2 bellow). In the case of orientation we agree that GEV function doesn't seem to be the most suitable function for the parameter, but it is the one that fits better the observed frequency distribution for this parameter. As the KS test is very sensitive to the number of data we have tested it with a random sample of 400 values and in this way it has passed the KS test. Other authors (feral, et al; 2000) merely show the histogram for this parameter and comment the tendency for a preferential orientation

«I think the Authors should also quantify what the goodness of the Q-Q plot. They claim that the "cumulated rainfall value do not seem to differ significantly between them". Judging just from the plot of Fig. 7 I do not reach their conclusion. E.g. 0.24 for Pradar correspond to circa 0.28 for Pellipse which is a relative difference of 0.04/2.4=16% which I would not judge as negligible. Same relative discrepancy occurs for 0.96 Pradar which corresponds to circa 0.8 for Pellipse. While 1.44 Pradar corresponds to circa 1.15 Pelipse for 20% relative discrepancy. The Authors must do a better job in quantifying objectively the discrepancy between model and observations. What are the consequences of 16-20% discrepancy for the purpose of flood prediction?»

Results will be improved with an analysis of the spatial distribution of rainfall over the ellipse. In this work a first approach has been realized considering constant precipitation over the ellipse. Results are quite acceptable taking into account the simplicity of the assumption. Q-Q plot shows that both datasets have similar distributions (Fig. 7) with a scatter plot closer to a 1-1 line, except for high values which are less probable. In this way we lose some extreme events that would be overestimated with another assumption of constant precipitation. Moreover the accuracy of the weather radar used in the study is of more or less 0.1 mm, and then it results impossible to consider discrepancies under this threshold.

«METHODOLOGY ISSUES ON THE IDENTIFICATION OF CONVECTIVE STRUCTURES pg. 4711 line 16: why the threshold is set to 43dBz? It seems that a reader has to go Llasat 2004 to have an idea of why this particular value. It should not be so. This is an important threshold for the methodology and its choice should motivated.: e.g add a brief sentence which described the "physical" motivation for the choice of this particular value and again the reference to the manuscript where a detailed description of the motivation can be found.»

In the methodology applied on the identification of structures, firstly, a reflectivity threshold (43 dBZ) is applied based on the fact that convective rain rates are more intense than stratiform ones. Following your commentary we will add in the revised version, in page 4711, line 16, after the sentence “Firstly, a reflectivity threshold. . .than stratiform ones”, the sentence:

“This threshold can vary attending the radar type and the study zone, but in Mediterranean region it is, usually, near 40dBz. In the case of the radar used in this work, Llasat et al (2007) showed, after comparing convective precipitation distribution from raingauges (using the β parameter) and radar imagery and for all the heavy rainfall cases recorded between 1996 and 2000, that the threshold of 43 dBZ was the most suitable one.”

Ref: Llasat, M.C., M. Ceperuelo, T. Rigo, 2007: Rainfall regionalization on the basis of the precipitation convective features using a raingauge network and weather radar

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observations. Atmospheric Research, 83, 415-426.

«pg. 4711 line 20: considered function? If the choice a threshold of reflectivity has a straightforward physical motivation (convective cell are associated with heavy rainfall rate) the gradient criteria is not immediately evident. Of course the motivation for this criteria is in the cited literature but it would be better to have a short sentence to describe the physical motivation.»

The second requirement is based on gradient criteria. The nature of convective rainfall, with a high variability and a great gradient of reflectivity values between close pixels, is considered in order to identify the areas of transition of convective rainfall. A pixel is considered as convective, in the case that the reflectivity threshold is not exceeded, if the difference between its value and a mean value of its background exceeds a considered value, which depends on the intensity of the echo. The considered function is: $Z\text{-}Zbg > 8*\cos(\pi*Zbg/128)$ where Zbg is the background reflectivity (Rigo and Llasat, 2004)

We will add, in the new version, the following paragraph, after the sentence " This function depends on. . ..radar characteristics":

"In this work, the following function, proposed by Rigo and Llasat (2004) for Catalonia, has been applied: $Z\text{-}Zbg > 8*\cos(\pi*Zbg/128)$ where Zbg is the background reflectivity. This requirement tries to take into account the showers of low rainfall intensity that, although being of convective character, do not arrive to the 43 dBz threshold."

«pg. 4711 line 22: "adjacent". Does adjacent "mean" only left-right and up-down neighbors? Or also diagonal neighbors?»

The third requirement considers that if the pixels adjacent, including left-right, up-down and also diagonal neighbours, to the analysed pixel are convective, the later could be considered as convective.

«pg. 4725 Table 3: The values of the Minor axis are not sound. E.g 0.04km, how is possible if the smallest pixel is 2x2kmËĘ2??»

Thank you very much for this observation; it has been a technical problem. Table 3 was not correct. Instead of minor axis values there were orientation values/1000, I have used the wrong column while doing the units transformation. Correct Table 3 is included bellow

«NOT PROPER ENGLISH OR LOGICALLY FLAWED pg. 4708; lines: 6-7; "in the lowest level", what does it mean exactly? (the lowest possible resolution of the radar?) . Use “at the lowest possible resolution” instead.»

It means the lowest CAPPI (Constant Altitude Plan Position Indicator) level. This term is usual in the bibliography about meteorological radar. However, following your proposal we can write, in the new version, “. . .identified in the lowest CAPPI (Constant Altitude Plan Position Indicator) level “

«minor pg.: 4708; lines 19-21; "The first authors obtain these results from the analysis of convective cells in tropical precipitation and the others for convective cells at mid-latitudes." Please change into "The first authors adopt the exponential profile as best choice for convective cells in tropical precipitation and the others for convective cells at mid-latitudes."»

OK

«pg. 4709; lines: 10-12; "As the use...." till to "suitable format". Please write this sentence in proper English or simply eliminate it.»

Taking into account that the use of GIS is very extended on the implementation of distributed hydrological models, this tool will be used in a future work in the generation of random rainfall fields. In this way it will provide inputs in a suitable format. However, following your recommendation, we prefer to eliminate it.

«last line of pg. 4709 and first 3 lines of pg. 4710. another example of not proper English. Please fix it. ("Even this way"!??, "volume ... is much higher" !??).»

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Thanks for the observation. The new sentence could be:

“Radar data has been selected to carry out the present study, thus it represents the spatial variability of the precipitation in surface more accurately than rain gauge data. This advantage is particularly important when we refer to heavy rainfall events associated to convective precipitation”.

We will change the order of the paragraphs and we will move the paragraph comprised between lines 17-29 (4710) following the previous sentences. In the new version we will change INM by AEMET writing “. . .Spanish Weather Service (AEMET, former INM).

«pg. 4710; lines 5-16. Please improve the presentation because it is very confusing and not logically sound. Do not start a sentence with "beta parameter is". What is the meaning of "some" on line 13: not all of them! Ok but if you select "some" how do you select them and which criteria you adopt?. Also provide a reference for the MEDEX proposed criteria for heavy rainfall. »

Thanks for your observation. We have found a little mistake that we will correct. Bearing in mind your comments, the new paragraph could be:

“Pluviometric data in surface have been obtained from the Automatic System of Hydrologic Information (SAIH) for the period 1996-2000. This network comprises 126 automatic rain gauges, giving continuous information on accumulated rainfall at intervals of 5 min. Charts for total daily and β parameter have been obtained using a kriging method. This parameter, defined by Llasat (,2001) represents the rate of convective precipitation to total precipitation, and allows to distinguish between slight convective events (0<$\beta\leq$ 0.3) ,moderate convective events (0.3<$\beta\leq$ 0.8), and strongly convective events (0.8<$\beta\leq$ 1). The events selection has been made in basis to the following criteria: a) a high amount of total daily precipitation above 60 mm/24 h at least in one rain gauge, b) moderate or strongly convective events in order to include in the selection other kind of events (local and intense ones), that produce floods in the region The threshold of 60 mm/24 h follows the recommendations made in the framework of the

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MEDEX project (MEDEX is part of the WMO- World Weather Research Programme: http://medex.aemet.uib.es/). All these selected events and their convective structures have been analyzed using the meteorological radar.

«pg.: 4707; lines: 15-16; please correct spelling of "Garcia-Batual"» ok, it is Garcia-Bartual

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 4705, 2009.

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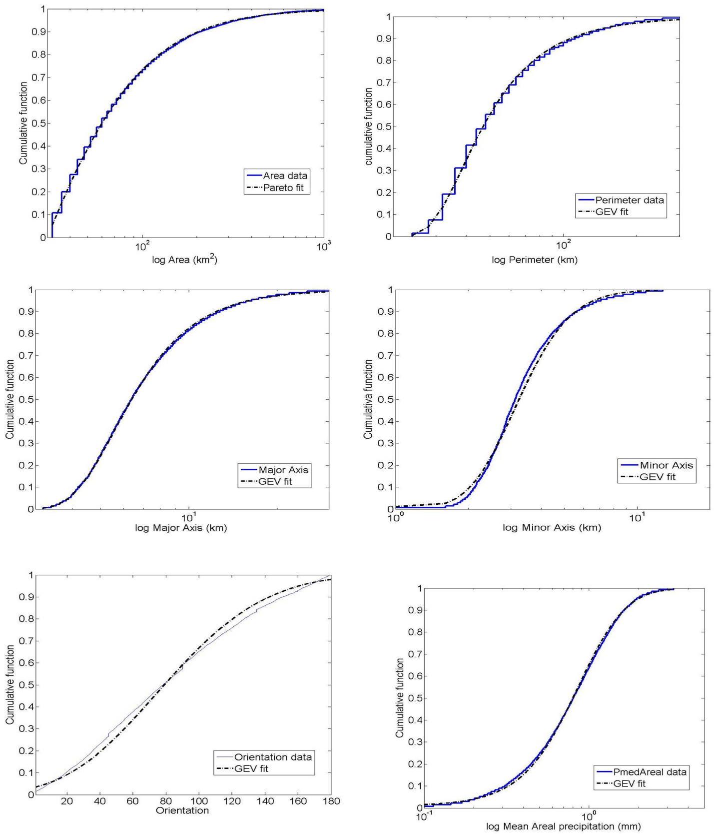

Fig. 1. Fig 1

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Parameter	KSrat
Area	0.05
Perimeter	0.01
Mayor axis	0.01
Minor axis	0.04
PmedAreal	0.02

Fig. 2. Fig 2

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ID	Area (km^2)	Perimeter (km)	Thickness (km)	Xcentroid (UTM)	Ycentroid (UTM)	Majoraxis (km)	Minoraxis (km)	Ori (°)
13	68	48	1.4	407 959	4 676 990	7.16	3,02	36.76
17	40	40	1.0	393 300	4 674 470	3.64	3,49	45.00
25	236	108	4.2	401 375	4 649 140	14.06	5,34	112.90
43	116	64	3.4	424 141	4 637 420	6.77	5,46	132.50
50	52	32	3.0	482 285	4 631 020	5.11	3,24	10.64
53	496	212	5.0	455 852	4 616 390	17.37	9,09	177.52
60	240	144	3.0	423 200	4 615 470	11.53	6,62	125.97
63	136	76	3.0	461 841	4 603 520	11.17	3,87	149.61
72	304	180	3.4	451 242	4 541 630	13.00	7,44	115.23
76	112	76	3.0	465 114	4 546 660	8.56	4,17	81.53
85	32	28	1.0	401 650	4 528 120	3.81	2,67	1.79
90	36	28	1.4	403 122	4 514 430	4.31	2,66	150.48

Fig. 3. Table3

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