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Hydrology and Earth System Sciences Discussions

Interactive comment on "Radar rainfall estimation for the post-event analysis of a Slovenian flash-flood case: application of the mountain reference technique at C-band frequency" *by* L. Bouilloud et al.

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General comments

This paper is an account of the use of previously developed radar data processing algorithms to estimate rainfall accumulations in a mountainous region for the purpose of post-flood hydologic analyses. The novelty of this well-written paper lies in the fact that an algorithm developed for X-band (the mountain reference technique or MRT, see Delrieu et al., 1997) and a radar processing system developed for S-band (TRADHy, see Delrieu et al., 2009) are applied at C-band. The analyses of the added value of

the different data processing steps provide is very useful, and provides insight into the potential pitfalls of using radar data in hydrology. On the other hand, the great improvement of the quantitative preciptation esitimates due to the employed techniques in this paper shows that using radar data should be considered in hydrology. I do have some comments on some specific issues in the paper. These comments are given below.

Specific comments

In Section 2 (page 671), Table 1 is introduced, in which the parameters of the Lisca radar are given. Given the importance of the calibration factor in ths paper, could you add some information on whether or not the electronic calibration and the transmitter/receiver stability are monitored, and if so, how this is done? This is also relevant in relation to Section 4.2 and Figure 2, where the signal stability is discussed.

On page 671, lines 18-19, it is stated that a strong ground clutter area can be seen in Figure 1 at about 20 km from the radar in the North-west direction. Because of the importance of this clutter area for the rest of this paper, and because it is not very clear from the figure, could you add an inset to Figure 1, in which th clutter area is shown in greater detail? This would also allow you to delineate the clutter area, making it clear to the reader which radar pixels are actually used.

On pages 675-676 it is stated that "Such a condition may not be fulfilled for a growing number of profiles as δ_c increases." Shouldn't this be "decreases" (because δ_c is in the denominator as β is always positive)?

On page 676, lines 6-7, it is indicated that the capping of the calculated PIA values is accounted for in the optimization criterion. Could you explain how this is accounted for?

On page 679, lines 3-5, it is stated that "Due to the strong non-linearity of the attenuation correction, it was found important to perform the screening correction before the attenuation correction." I do not think that the (strong) nonlinearity of the attenuation

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correction is the cause of this. I believe the main cause for this is the fact that the attenuation correction factor at a given range depends on what happens on the path between the radar and the given range cell. Even if the attenuation correction factor was independent of the given range cell (i.e. the correction itself is linear), but dependent on the path between it and the radar, it would still be important to correct for screening before correcting for attenuation.

On pages 680-681, it is first stated that "the application of the δ_c brings a significant, though insufficient, improvement", after which the attenuation correction is said to be "effective in improving the radar QPE". This, together with the remarks "attenuation correction using the Hitschfeld Bordan algorithm allowed obtaining good radar QPEs/satisfactory radar rain estimates" in both the conclusions and the abstract (pages 682-683 and 668, respectively), could lead the reader to conclude that the attenuation correction is far more important than the adjustment of the calibration factor. However, because the attenuation correction is highly dependent on the calibration factor, this is not generally the case. To clarify this, consider the following example:

If the total path-integrated attenuation (PIA) to a certain radar pixel is 10 dB (which is quite high), $S(r_0, r)$ can be computed using Eq. (3), with $A(r_0) = 1$, $\delta_c = 0.56$, and $\beta = 1.09$. The resulting value of S is 0.516. Given measured reflectivities, this value is independent of δ_c. This value can therefore be used to assess the relative impact of the calibration correction and the attenuation correction. If both the calibration and attenuation would be corrected for in the radar pixel under consideration, the correction factor that would have to be applied is $(A\delta_c)^{-1} = (0.1 \cdot 0.56)^{-1} = 17.9$. If only the calibration would be corrected, this would become $\delta_c^{-1} = (0.56)^{-1} = 1.8$. If only attenuation correction would be applied, the correction factor A should be computed using Eq. (3), with $\delta_c = 1$ (because no calibration correction is used). This yields $A = 0.45$. This in turn leads to a correction factor to be applied to the given radar pixel of $A^{-1} = (0.45)^{-1} = 2.2$.

These correction factors show that the calibration correction has great influence on

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the attenuation correction, and that the two should not be viewed separately. I therefore strongly suggest that this be more strongly stated in Section 5, as well as in the conclusions and the abstract.

On page 681, lines 8-9, it is stated that scatter in Figure 6 is enhanced by radar-gauge pairs affected by screening and by pairs at ranges greater than 120 km. I think it would be instructive to use different symbold for those points in Figure 6. For instance, you could use circles for the radar-gauge pairs that are affected by screening and squares for the pairs at ranges greater than 120 km.

Technical corrections

On page 669, line 19, “millions” should be “million”.
On page 669, line 20, I would use “affected” instead of “concerned”.
On page 669, line 22, “millions” should be “million”.
On page 669, line 25, I would use “single” instead of “unique”.
On page 670, line 4, I would use “gathered” instead of “elaborated”.
On page 670, line 11, “of” should be “from”.
On page 670, line 14, I would insert “hourly” between “and few” and “raingauge time series”.
On page 671, line 3, “replaced” should be “placed”.
On page 671, line 13, “noticed” should be “noted”.
On page 672, line 11, “Leinjse” should be “Leijnse”.
On page 672, line 19, “for” should be “with”.
On page 673, lines 4-5, I would replace “is an eventual radar calibration” by “is a radar calibration”.
On page 673, line 11 (Eq. (2)), you could write $2\frac{\ln(10)}{10}$ or $\frac{2}{10\log(\mathrm{e})}$ instead of 0.46, just so that it is clear that this is not some sort of empirical factor.
On page 674, line 11 (Eq. (5)), the placing of the exponent β is ambiguous. Please use

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extra brackets to clarify. For example

$$\mathrm{PIA_c}(r_\mathrm{M}) = -10\log\left(\left[A(r_0)^{1/\beta} - \frac{S(r_0, r_\mathrm{M})}{\delta_\mathrm{c}^{1/\beta}}\right]^{\beta}\right).$$

On page 676, line 11, I would leave out the word “comprised”.
On page 678, lines 14-15, I would use “for” instead of “thanks to”.
On page 678, line 27, “PPI” is not defined before in the text. Maybe it is better to use “angle” (as on line 26) here.
On page 679, line 24, could you elaborate on what you mean by “upstream”?
On page 680, line 6, “In” should be “On”.
On page 680, line 10, I would insert “local” between “non availability” and “rain-typed”.
On page 680, line 27, “the” should be inserted between “seen in” and “second line”.
On page 681, lines 10-12, I don’t quite understand the second part of this sentence “..., the well-known ... is considered (Figs. 6d and 7d)”. Could you rephrase or elaborate?
On page 681. line26, I would replace “the eventual” by “possible”.
On page 682, line 18, I would replace “thanks to” with “using”.
On page 683, line 3, I would replace “pattern” with “period”.
On page 683, line 10, I would replace “big” by “large”.

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