

***Interactive comment on* “Uncertainties in rainfall retrievals from ground-based weather radar: overview, case study, and simulation experiment” by R. Uijlenhoet et al.**

Anonymous Referee #4

Received and published: 15 October 2006

General comments

This manuscript's contribution to radar (hydro)meteorology is an experimental framework which allows different attenuation correction algorithms to be compared at different frequencies. Using two rain episodes, a “moderate” one and an “intense” one, two attenuation corrections algorithms, one formulated by Hitchfield and Bordan (1954), and the other formulated by Marzoug and Amayenc (1994), are compared. Differences in results highlight the respective algorithms performances in different situations.

The paper starts with several sections intended to provide a history of rainfall mea-

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

surements with rain gauges and then with radar. These sections fall short of the goal. Instead, the authors mostly provide an introductory text applicable to the complete beginner to weather radar, and even then there are a multitude of errors. Even if the contents of these sections had been flawless, an article in a scientific journal isn't the appropriate place for such introductory texts. Instead, the authors should focus on the task at hand: providing the reader with the background required to understand the experimental framework which they then present. Another unfortunate side-effect of the attempt to provide the "overview" is that the authors don't succeed in making it clear that the main purpose of the article is to present the framework and test it with the two attenuation correction algorithms. The whole issue of attenuation is buried under the "overview".

An additional section presents a "case study" which is almost completely irrelevant in relation to the "overview" and the experimental framework. Removing this section (Sec. 4) and the previous two sections (2 and 3) would improve the article, not least since removing the majority of the figures supporting these sections would yield well-needed focus.

It is obvious that an overhaul of this manuscript is necessary. Giving the authors the benefit of the doubt, I recommend the article be accepted subject to major revisions. Scaling away the introductory texts (Secs. 2-4) will provide the opportunity to concentrate on providing the necessary introduction/background to Sec. 5. Such a consolidation of the article should render it publishable, although this must be checked with a new review. In the process of revising the manuscript, the authors should consider whether a new title would be more appropriate, perhaps containing the terms "experimental framework" and "attenuation correction".

Specific comments

Abstract: "a detailed analysis of the associated observation uncertainties" is not undertaken. An introductory text is given which points out a few sources of error.

The whole idea of presenting the gauge and radar *eras* is misleading. Gauges came first, radar came later, but it's not like the one superceded the other. Presenting *eras* makes it seem as though the two technologies are categorically sequential, which is not true even based on the material the authors present. I would recommend that the *era* concept be removed.

Sections 2-4 contain no information that can't be found in proper textbooks, review articles, and relevant reports. It's not the purpose of a scientific article to provide a general introduction to radar (hydro)meteorology. These three sections can and should easily be removed and replaced with no more than a couple of paragraphs (max one page) giving the background to the radar topic which is to be covered in this article.

Following the point above, 15 figures is far too many for a single article, especially considering that ten of them are introductory in nature and the others contain subfigures. Figures 1 and 9 contain redundant information; only one of these should remain in the article. Figures 2-8 contain such basic and general information, unrelated to the scientific thrust of the article, that they can also be removed, unless the content in Section 5 somehow motivates their presence.

The following detailed points mostly deal with Sections 2-4, and generally support the recommendation to remove them from the manuscript.

2.1 "All kinds of procedures" is too vague. "(such as the geostatistical technique known as kriging)" is irrelevant.

2.2 Weather radar "is currently reaching a state of maturity which renders its hydrological application feasible" depends on the definition of "current". Radar has been used in operational hydrology for over a decade. The way in which radar is presented in this section makes it sound like it has been useless to hydrology up to now, which simply isn't true. Radar's "sampling capabilities were generally *insufficient*" needs to be substantiated or removed. In the last paragraph, the sentence starting "However, it remains to be seen ..." isn't self-consistent; what point are the authors trying to make? Again,

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

“all kinds of errors” is too vague and should be removed. Despite the last sentence, the authors have to acknowledge that gauge adjustment gave bf major improvements to radar-based QPE, and thus constitutes a great step forward.

2.3 “The objective is to apply ground-based weather radar to estimate the spatial and temporal distribution of rainfall at the ground.” How does this objective differ from the objectives of the past? The second paragraph doesn’t recognize the advances made during last 10-20 years of research and development. Radar hydrology doesn’t start now. “This new approach” isn’t explicitly mentioned or explained. What is it?

3.1 Algorithms that “... are known as retrieval algorithms” is so basic it doesn’t need to be mentioned, especially since this clarification is made after “... reliable methods (‘retrieval algorithms’) ...” which can also be removed. Z - R relations aren’t always statistical, ie. a regression model, although many are. The description “hardly ever” can be replaced with “never”.

3.2 The first sentence makes a false claim: we haven’t assumed perfect radar measurements. Even if we had done so, the uncertainty in the DSD being the main source of error would certainly not be true. The explanation of how radar makes its measurements is so basic that it can be removed. (Incidentally, radars scan in a polar geometry comprising **azimuth** gates and **range** bins.)

3.2.1 The second sentence implies that the pulse volume increases with range. I have never heard of a radar signal processor which averages range bins (or several pulses at the same range, representing one output bin) non-uniformly in range. The radar beam is non-uniform (Fig. 4), but that doesn’t mean that data coming out of the radar are. The authors need to clarify the difference between the characteristics of data from a single pulse and data in output by the radar for analysis in the form of operational scans/volumes. The CAPPI is not designed to deal with overshooting, but rather to minimize ground clutter for low CAPPI heights and otherwise to render data as representative as possible at a given, higher, height. The pseudo-CAPPI is the same as

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

a CAPPI at heights where the radar has measurements, otherwise where the closest radar measurement in the vertical, ie. a pseudo-CAPPI is “a CAPPI or the closest thing to it”.

3.2.2 “Ground clutter” is a phenomenon that occurs relatively close to the radar even in normal propagation conditions.

4. This example, with 10-min gauge accumulations being compared with instantaneous radar-based rainrates, is useful only in showing how an extreme case like this can provide reasonable agreement only because of the presence of high rainrates. In normal conditions, such a comparison would be almost useless due to the necessity of integrating over at least an hour, preferably several, in order to suppress noise. In the Y-axis in the plots of Fig. 10, “reflection” should be replaced with *reflectivity*.

5. The simulation experiment section is well structured and enables the reader to easily follow the experiment and its results. There are still some minor issues to be pointed out:

page 2399 (line 13): the reference (link) to CASA should be put in the list of references and referred to in the text as any other reference.

page 2399 (line 28): ‘... scales between 25m and 50km.’ You might refer to subsection 5.2. In case of 50 km scale there is no spatial variability of (moderate) rainfall at all.

page 2401 (line 14): ‘... the distance lag where the autocorrelation of the process has decreased to e^{-2} .’ e^{-2} needs an explanation because usually it is e^{-1} .

page 2403 (line 9): $|K|^2$ isn’t “a coefficient related to the dielectric constant ...”, it *represents* the dielectric constant.

page 2404 (line 17): ‘... OBSERVER’S problem ...’

page 2405 (line 15): ‘... limit where the radar range resolution tends to zero ...’ This needs clarification.

page 2406 (Sec. 5.5) the beginning of this section repeats part of the introduction to Sec. 5, which is unnecessary.

page 2407 (line 5): remove Z_A),

page 2408 (line 14): It is not clear what you mean by '(over 50 km profiles)'.

Fig 10-15: In the manuscript provided by the editor these figures are arranged in a different way than described in the corresponding captions.

6. "As an example, we present ...": this sentence refers to the previous sentence and the reader expects an example of "a thorough physically-based treatment of the associated errors and uncertainties". All that is presented is a suspect comparison between gauges and radar in which all errors are addressed collectively and statistically.

Figure 7 is poor quality.

The authors' standard of English is relatively high. There are a few places which require attention, but this issue can be reconsidered after resubmission.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 2385, 2006.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper