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Hydrology and Earth System Sciences Discussions

Interactive comment on "Joint statistical correction of clutters, spokes and beam height for a radar climatology in Southern Germany" *by* A. Wagner et al.

Anonymous Referee #1

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Title: Joint statistical correction of clutters, spokes and beam height for a radar climatology in Southern Germany Author(s): A. Wagner et al.

GENERAL COMMENTS

This paper describes a set of statistical corrections to be applied to rainfall radar data in order to derive a radar-based precipitation climatology. The corrections are calculated based on a 7-years calibration dataset, tested on a 3-year dataset and validated on another 3 years not included in the calibration dataset. The radar observations are taken from an operational C-band weather radar operated by the German weather service.

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Interactive Discussion
Discussion Paper

The correction algorithm deals with systematic errors caused by ground clutter, beam blockage, beam broadening and height effects.

It does not clearly appear in the abstract and in the introduction but the objective of the study is to present an algorithm which is suitable to derive climatological information on rainfall amounts for durations at least equal to one year. Even if the dataset is relatively short considering this time scale, it is clearly interesting to investigate the best strategy to be able to derive climatological information from radar observations. The authors investigate very carefully the long-term statistics of rainfall occurrence and amounts. Nevertheless I have some concerns about the applicability of the proposed algorithm. First an important part of the correction is based on the so-called PX-product which includes only six reflectivity classes. Is such a poor data resolution sufficient to identify and correct for uncertainties related to the height of the radar measurements ? A second major issue is that the errors are considered as systematic while most of radar uncertainties are strongly variable. For example, ground echoes strongly depend on the propagation conditions. It is questionable whether a static correction scheme is appropriate. At the end, the authors propose a long-term statistical correction which is applied to estimate annual rainfall amounts. It is not clear to me whether there is an added-value of these rainfall statistics with respect to those derived from a dense climatological network of rain gauges. In my view these major issues must be addressed by the authors before final publication. More details are given below.

SPECIFIC COMMENTS

Title

The word "precipitation" or "rainfall" is missing.

Abstract

It should better explain the objective of the study and, in particular, the time scale of interest.

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L15 : "measuring effect" : the authors should already explain here which effects are considered

1. Introduction

p4705,L 20 : Bright band effect is an important source of error but is not the only one related to the height of the measurements.

p 4706, L10 : In order to better understand the difference between the two approaches it would be useful to explain what is included in "usual correction algorithms for single radar images". L15: The errors listed here can not be considered as systematic. Ground echoes depend on atmospheric propagation conditions. Errors related to the height of the measurements and the beam width depend on the precipitation type and are highly variable in space and time. It is questionable whether a static correction is appropriate.

2. Data

p 4707, L11: The expression "oscillating scan" is somewhat misleading.

p 4708: which kind of rain gauges are used ? Is there any quality control ?

3. Method

p 4708, L21 : How do you define light, moderate and heavy rain ? It is stated that correction of light rain is of minor interest and that the frequency of occurrence of heavy rain is too small to be statistically significant. Does it mean that you concentrate only on moderate rain ?

p4709, L4: How to distinguish between radar artefacts and real climatological variations is a crucial issue. It is briefly addressed here but it should be more extensively discussed.

L8 and further: The clutter correction method does not allow removal of anaprop ground echoes. Can you comment on this ?

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L14-18 : This part of the correction method is not very clearly explained.

p 4710, L25 : How do you deal with possible changes in electronic calibration ?

4. Analysis of disturbances in radar images

4.1 Variations in height

The analysis of the variations in height is based on the analysis of the frequency of occurrence in the different reflectivity classes (6 in total). The general mean systematic variations with altitude or distance from the radar is obtained using a linear regression model. We know that height-related errors strongly vary in time and space, which makes this approach questionable. Furthermore, I'm not convinced that vertical profiles of frequency of occurrence can be used to correct for vertical variations of rainfall. This point should be clarified.

p 4712

The analysis of the seasonal variation of the variation in height is very interesting but the seasonal dependence is apparently not used in the correction scheme.

4.2: Analysis of clutter effects

p 4714, L4: This sentence is somewhat confusing. It concerns the clutter correction performed on single images, I guess. Please describe it here and not further in the text.

4.2.3. Spokes

As far as I know, spokes (beam blockage effect) is generally not considered as a clutter effect. It is true that it is caused by obstacles, mountains, .. which also produce ground clutter.

p 4715, L2-3: I don't see what you mean

5. Correction algorithm 5.1 Altitude correction

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The altitude correction is apparently performed before the clutter correction. Can you explain this choice ? Is it not reasonable to start with ground clutter removal and to apply the altitude correction on clutter free data ?

p 4718, L25 : "The results of the altitude correction is a radar image with comparable frequencies of occurrence of radar reflectivities independent of the distance from the radar". Does this assume that the real frequency of occurrence is uniform over the geographical area of interest ? Is it valid to make this assumption if the final objective is to produce a radar-derived climatology in which spatial variations of precipitation are allowed. This is a crucial point which requires clarification.

5.2 Correction of clutter effects

Is is not clear to me how the 3 correction modules are combined. Can you explain a bit more ?

5.3 Adjustment

p 4720,

L14 : Can you easily identify bright band effects with only 6 reflectivity classes ?

L25 : Tt is assumed that the mean adjustment factor can be used to correct the frequency of occurrence of radar reflectivities. The rationale is not obvious. Can you further explain ?

General question on correction methods : how do you deal with contamination by hail and orographic enhancement ?

6. Evaluation of the method

All along section 6 and the figures there is a confusion between rainrates and rainfall amounts. It is not clear which radar and rain gauge quantities are compared. Mean yearly rainfall amounts ? The terminology must be more precise.

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Interactive Comment

7. Summary

The discussion on the validity of the long-term correction approach is fundamental but not very extensive. I think that this discussion could be deepened.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 4703, 2012.

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