

## ***Interactive comment on “Improving the precipitation accumulation analysis using radar-, gauge- and lightning measurements” by E. Gregow et al.***

### **Anonymous Referee #1**

Received and published: 17 April 2016

The aim of the paper is twofold: (i) present and assess a novel operational methodology to include lightning information in radar-gauge precipitation accumulations and (ii) analyze the impact of different integration time intervals in the radar-gauge correction method.

The topic of the paper is of interest for the readers of the journal and the manuscript is well written and concise. The idea of including lightning information in precipitation estimation for intense events is challenging and very interesting both from operational and research points of view.

Nevertheless, the methodology used for the assessment of the new method is not adequate to the purposes of the method and masks out any improvement provided

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by the method itself, that, as is currently presented, looks almost useless. For this reason I recommend that the study undergoes a major revision before publication. In the following my major concerns and a list of minor comments.

Major comments:

1. The phenomenon of lightning is usually associated to convection, that is generally characterized by relatively small spatial scales. Such meteorological events are known to be difficult in terms of quantitative precipitation estimation (QPE) because: (i) owing to their small spatial scales are difficult to be adequately sampled by gauges and (ii) radar system may experience important problems due to attenuation of the signal, hail contamination and other issues. Therefore, the use of the LDA potentially represents an important source of information for improving the QPE for such situations. Despite this, results presented in this work show no significant improvement when LDA is used together with the already implemented system (Radar + RandB). If I understood correctly, the information provided by LDA is equivalent to a radar profile of reflectivity corresponding to locations and times in which a lightning occurred. This information is local in terms of space and time (as shown in Fig 6), therefore the potential effects of the use of LDA cannot be detected when large scales (the whole Finland) and long periods (seasonal) are used for the assessment, as they would be masked out. The authors partially recognize this problem and focus on a shorter period (the short, 4-days period) but keep on analyzing the country-scale picture. Furthermore, the use of only 7 independent gauges strongly limits the potential of the study, because of the small scales in which lightning information is available. In fact Tab. 2 confirms this: absolutely no information is available for the short study period (the more interesting one). I would recommend to revise the analysis as follows: (1) limit the analyses, both in space and time, to rainfall events characterized by lightning strikes; (2) select independent gauges in meaningful location for each event.

2. How are Fig 4 and Fig 8 obtained? Are they based on the dependent gauges? Do they show 1h estimates (I assume so since the figures show "mm/h" for the accumu-

lations)? Using 1h estimates for the comparison with the dependent gauges (that are used on 1h scale for the RandB process) will have the Rad\_LDA\_RandB (1h product) necessarily being the best.

3. I suggest to choose one between  $r^2$  and Pareson's correlation coefficient since the two statistics provide the same information. Moreover, basing results on RMSE can be tricky because errors are not weighted.

Minor comments:

1. The title should include more clearly the second objective of the study (impact of different integration time intervals in the radar-gauge correction method)

2. lines 1-5: the sentence is difficult to read. Moreover the second objective of the study should be better stressed. What about: "Two main objectives are addressed: (i) the assimilation of lightning observations in radar and gauge measurements and (ii) the analysis of the impact of different integration time intervals in the radar-gauge correction method."

3. line 6: is the reference Gregow et al. (2013)?

4. The state of art section (lines 28-39) is rather short and can be organized in a clearer way

5. line 47: " usually with a higher quality than radar" a reference can be helpful

6. lines 54-55: "long" rather than "longer", "short" rather than "shorter"

7. line 62: more information about how "poor data quality" stations are identified is needed

8. line 70: Lat-Lon information are not shown in the figure

9. lines 70-72: something is missing in the sentence

10. line 108: I couldn't find the work by Pessi and Albers, 2014

11. lines 120-124: this is not useful for the purposes of the paper
12. line 121 and 127: I couldn't find the work by Pessi, 2013
13. line 184: why 0.3? more details are needed
14. Fig 7: the colors of the regression lines are not explained in the caption

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-113, 2016.

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