**Atmospheric
Measurement
Techniques
Discussions**

Interactive comment on "Validation of the METEOSAT storm detection and nowcasting system Cb-TRAM with lightning network data – Europe and South Africa" *by* T. Zinner et al.

T. Zinner et al.

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Received and published: 6 May 2013

Dear Referee,

thanks for your comments. We put much effort in improving the language as requested as major points by referee 1 and 2. Please find my reply (labeled with "——") to your comments further down in your original review.

Best Regards, Tobias Zinner

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General Comments

This paper provides an interesting overview of Cb-TRAM performances for two different areas. The quantitative and objective approach offers a positive alternative to classical case studies. Nevertheless the analysis of the results is made difficult by the differences in lightning network used as ground truth, a point that is mentioned at different steps of the paper. Thus it is difficult to distinguish between lightning data effects and regional climatology effects.

—— This is not solvable within the scope of this manuscript. The overall results are very comparable for EU and SA and thus the emphasis is laid on this fact.

Analysis of the results concerning day/night differences is made difficult by the differences in algorithm (use of HRV texture during the day and use of WV during the night). Thus it is difficult to distinguish between algorithm impact and day/night features of convection.

—— For this reason we focus on daylight results and show the night-time results only in the appendix. We could remove these tables? The paper is meant to be user oriented. And a warning tool, of course, wants to use the best possible data available (which is HRV during daytime). Alternatively, we could include another table showing the daytime numbers for the "night mode" retrieval (without HRV). But I doubt, that it would improve the overall readability.

The authors remain sometimes on a descriptive level and should suggest or discuss some mid- term or long-term improvement along the text or in last chapter: MTG/LI for lightning detection, fusion of small cells for forecast range > 30 minutes, use of Atmospheric Motion vector or NWP guidance to improve the displacement, etc.

—— I included your suggestions into the discussions. Thanks.

The values of score should be more discussed considering different categories of possible use of the Cb-Tram by forecasters, Air Traffic Management, warning systems, etc. For some unfavourable configuration FAR are very high, are they still acceptable?

—— We could do this. But every possible application of a forecast would lead to another set of suited skill measures. Each would deserve a new paper and would be a new project. Compared to other tools out there, it already is an important improvement to have at least one first validation.

Specific Comments

* Reference (Guillou, 2007): much more recent references are available on NWCSAF website. More generally, references are a little bit old, most of them before year 2009 —— Replaced by the new version Autones, 2012, ATBD issue 2.3.

* Page 1273 line 6-8: Are ATD, WWLN or GLD360 data available for the period and both areas? If yes, why these network are not used (location accuracy?)? If not, are they available for a more recent period than 2008? —— WWLN and GLD360 provide global data sets, but have a comparably low location accuracy of many kilometres. If we would have included further lightning detection systems, we would have an even wider range of sensitivities. This would open up a field of research in itself. Nonetheless, this issues are discussed in the paper now.

* Paragraph 3.1 (page 1278) and 3.2 (page 1279): description of lightning networks should be homogeneous. For example, "Detection Efficiency" and "Location accuracy" could also be indicated for LINET. —— We added the information: "95%" and "150 m".

* Page 128 line 16 : I don't have the value of 0.01, but rather 0.03. Please verify —— Sorry. You are correct. Should have been 0.035.

* Spatial matching between cells and object is well described, temporal matching could be more described —— Added a discussion of temporal inaccuracies after the introduction of spatial accuracy classes: "In principle there are inaccuracies in time which should be considered too. If the timing of lightning detections is assumed to be perfect, the uncertainty results from the timing precision of the METEOSAT measurements. A full METEOSAT SEVIRI scan takes about 12.5 minutes to cover the visible earth be-

tween about 75° southern latitude and 75° northern latitude. Although the resulting differences in the time of data collection for the South African and European SEVIRI data are taken into account, an inaccuracy of about 1-2 min can be expected. Thunderstorms usually move several metres per second. I.e., an assumed storm motion around 10 m/s would translate to a spatial inaccuracy up to around 1000 m within 2 min. Consequently the effect of temporal mismatches is well below the different spatial accuracy levels which will be tested in the following."

* I suggest to avoid the use of "skill score" expression for POD or FAR. Skill score are used to indicate whether or not a forecast is better than a reference. —— Ok. We avoided the term "skill score" and replaced it with "skill measure".

* page 1284 lines 22-25. Choice is made to compare forecast with ground truth rather than analysed objects or pixel. Please discuss and justify a little bit more (a choice closer to en- user point of view, but that does not allow to tell convection-representativeness error from advection-scheme error. —— We extended the paragraph along your arguments: "Once a Cb-TRAM object has reached the mature stage, the nowcasts of this object's position up to 60 min into the future are investigated too. For simplicity, we apply the approach presented above to compare nowcasted positions against the measured lightning activity (in 15 min time frames around the forecast times 15, 30, 45 and 60 min). Although this way errors due to the advection and/or forecast scheme are mixed with errors due to the original detection, we want to avoid the introduction of another system of quality assessment at this stage (e.g. the comparison of nowcast to future Cb-TRAM detections). In addition, this approach seems to be the most user oriented. A user is not interested in the source of error, but only in the fact whether a forecast is correct or not, i.e., whether lightning occurs at the forecasted location."

* page 1286 lines 3-22 : I did not well understood these paragraphs, the use of "area" term is confusing. Idem the use of "from space". ——I tried to simplify the text. It was a bit obfuscated. Sorry. "Area" was intended to be a synonym for "number of pixels"

and "From space" is equivalent to "Cb-TRAM". I made both more clear or removed the "area"/ "from space".

* paragraph 5.2: is there any dilatation of the objects with forecast range. Are fusion of objects managed. —— No dilatation. Splitting and fusion with other cells is part of the record of each object, but is not used here. I included the question of dilatation in the discussion.

Technical Comments

* Use and place of "also" —— Checked.

* Some sentences are long and should be cut in two. —— Language was completely revised as this was requested by all reviewers.

* page 1276 line 7: "crteria" —— done.

* page 1277 line 2-3 "led to the combination of different detectable signs of storm activity in a weighted non-binary sense": not understood —— Revised part: "As mentioned above, a~positive difference of these two channels is not sufficient for a clear identification of deep convection. It can lead to miss-detections of large cloud areas especially in frontal systems. Changing this detection threshold to positive values, on the other hand, causes missed detections. In the original setup the insensitivity of the main temperature remained an issue. This led to a weighted combination where additional detectable signs of storm activity were included. The turbulent cloud top structure of active convective updraft cores is utilised in this context. It is particularly well detectable in the HRV channel during day-time (shadows)."

* page 1280 line 23-24 "red colored areas in constitute the lightnig cell" : not understood —— The word "in" was removed. New sentence: "In Fig. b (any lightning) and c (intense lightning activity) orange and red coloured areas represent the lightning cells (Cb-TRAM objects are coloured in blue and red)."

* page 1282 line 6-8 : idea already given —— Removed.

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* page 1286 line 7 : "fromany" —— Corrected.

* page 1285 line 19 "sl" —— Corrected. Part of the TEX command "\sl" for slanted font.

* Sentence page 1286 line 26-27 : not understood —— New text: "However this pixel-based analysis is biased to large objects/cells which contribute many pixels to the analysis and which, at the same time, are more likely to be detected. Small single cell storms that only cover a few METEOSAT pixels are not represented well. They are much harder to detect and even harder to forecast. Nonetheless, a user might be just as interested in these smaller scale events."

* page line 287 l21 "necessaryly" —— Corrected.

* Table2 p line 298: areas are not indicated —— ? I did not understand what you want me to improve here?

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 1269, 2013.