

Interactive comment on “Satellite based high resolution mapping of rainfall over Southern Africa” by Hanna Meyer et al.

Anonymous Referee #1

Received and published: 21 February 2017

Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-33, 2017

Review of Satellite based high resolution mapping of rainfall over Southern Africa by Hanna Meyer, Johannes Drönner, and Thomas Nauss.

General: The paper describes the formulation of a satellite-based precipitation estimation scheme based upon the MSG SEVIRI observations over southern Africa, and provides a comparison of this technique, together with that of the GPM IMERG product against gauge data. As such it is an interesting and useful paper since it covers a region that is often neglected.

My overall recommendation is that the paper is acceptable for publication following (minor/) major revision. The technical issues need to be addressed, in particular the ones relating to the masking of the data in the comparison (masking to just the MSG-

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identified cloud regions could bias the statistics).

I would point the authors to the work of the International Precipitation Working Group team working on the South Africa data, also using gauge data to inter-compare daily precipitation products.

Key issues: i) Need to check the gauge data. First, ensure that the quality control is optimal, e.g. do some gauges never report rainfall? Do gauges distinguish between 'zero' and no-data? It is possible, once you have the satellite estimates, to check the performance of individual gauges – are there individual gauges that always are 'incorrect' compared to the satellite data? It would be unlikely that the satellite product would be consistently wrong over a particular gauge if it is correct over a neighbouring gauge.

ii) The use of the cloud mask in the statistical analysis (page xxx) removes regions where the gauge might report rainfall, but the satellite does not, thus, it biases the analysis.

iii) Although it is mentioned that the IMERG product is aggregated from the 30 minute product resolution to a 1-hour resolution, I could not find how the 15-minute MSG observations are aggregated into hourly estimates. Also, the authors should be careful with the time stamp of the products – do these relate to the start or end time (UTC) of the product? Also, is the gauge data in UTC or local time?

iv) (P6, first paragraph) Since there is a daytime and a nighttime 'algorithm', how do the two compare? In particular, since (presumably) the nighttime algorithm can be used both night and day, it could be used to assess the differences in performance. This is somewhat critical since a smooth transition in rainfall estimates between day and night is clearly desirable. Also, how do you define 'day' and 'night'?

General Technical issues: Check use of capitals for acronyms, e.g. P1, L3: 'Spinning Enhanced Visible and InfraRed Imager (SEVIRI)' Check the consistency of capitals,

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e.g. P1, L6/7: ‘...(Probability of Detection, POD). However the False Alarm Ratio (FAR)...’. Check use of acronyms: The general rule is, define all acronyms on first usage, after this only use the acronym (usually following on after the abstract). Only use an acronym if used more than once – and only if it is a commonly-used acronym (i.e. don’t make up acronyms).

Specific Technical issues: P1, L1: consider ‘necessary’ instead of ‘highly required’ P1, L3 (and elsewhere): use of capitals for acronyms – ‘Spinning Enhanced Visible and InfraRed Imager (SEVIRI)’ P1, L4: remove ‘for years’ and replace ‘truths’ with ‘truth’ P1, L5: replace ‘predicting’ with ‘the estimation of’, and replace ‘during’ with ‘over’ P1, L6/7: ‘...(Probability of Detection, POD). However the False Alarm Ratio (FAR)...’. P1, L10: Define ‘IMERG’ P1, L16: replace ‘on a’ with ‘at’ and replace ‘resolution’ with ‘resolutions’ P1, L20: replace ‘An accurate’ with just ‘Accurate’ P1, L21: replace ‘in’ with ‘at’ and ‘resolution’ with ‘resolutions’

P2, L5: replace ‘for entire’ with ‘covering the entire region of’ P2, L11: replace ‘resolution’ with ‘resolutions’ and ‘in’ with ‘at’ P2, L12: replace ‘can’ with ‘might’; insert ‘would’ after ‘products’; insert ‘degree of’ before ‘accuracy’ and replace ‘as’ with ‘since’ P2, L16: replace ‘;’ with ‘and’; capitals for ‘Meteosat Second Generation’ and ‘Spinning Enhanced Visible and InfraRed Imager’ P2, L19: should ‘South Africa’ be ‘southern Africa’ (middle and end of line)? P2, L27: replace ‘prediction’ with ‘estimation’ P2, L30: replace ‘yearly’ with ‘annual’, remove ‘sums’ and replace ‘follow’ with ‘follows’. P2, L32: replace ‘rains’ with ‘rain’

P4, L1: replace ‘sums’ with ‘totals’ P4, L2: replace ‘;’ with ‘and’. P4, L5: remove ‘the years’ P4, L6: replace ‘from’ with ‘at’ P4, L7: remove ‘the year’

P5, L4: The 3 x 3 km resolution is the IR resolution; i) the visible channels are about 1 x 1 km, but ii) the resolution over southern Africa for both the IR and visible channels is of course, poorer. P5, L9/10: the last sentence is gobbledygook: ‘xx1 technology’ if you google it, is to do with cycling, and the link to the web-page provided does not exist.

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Reword/revise. P5, L11: remove 'the years' P5, L17: consider 'excluded' rather than 'masked' P5, L21: replace 'predict' with 'retrieve' P5, L25: replace 'many confusions' with 'much confusion' P5, L30: If all the channels are included in the NN, surely any channel differences should also be considered within the NN without having to include them as separate entities?

P6, L7: replace 'two-folded' with 'two-step' (?) P6, last paragraph: see above regarding use of cloud mask, acronyms, use of capitals. P6, L34: the HSS can be bias-dependent since if all retrievals are zero and surface data non-zero, it will be dependent.

P7, L2: By 'Spearman's' I presume you mean the 'Spearman's Product Moment Correlation'; suggest rewording 'Spearman's rho' to 'Spearman's Product Moment Correlation (rho)' (or use the greek letter 'rho') P7, L2/3: replace 'Further the root mean square error (RMSE) was used' with 'The root mean square error (RMSE) was also calculated'. P7, L3: replace 'clouded' with 'cloudy' P7, L8: replace 'aiming at' with 'designed for' P7, L9: The reference to 'Smith et al., 2007' is somewhat antiquated: use 'Hou et al., 2014 and Skofronick-Jackson et al., 2017.' (Full references below) P7, L10: replace 'instruments' with 'estimates'

P8, L3: The initial sentence here is not evident from Figure 3. (see comments below about the box-plots). P8, L4: replace 'predictions' with 'estimates' P8, L5: presumably the '0.72 mm⁴' should be '0.72 mmh⁻¹' (use journal style for mm/hr) P8, L5: replace 'in' with 'on' P8, L6: reword 'rainfall quantities assignment' (I don't know what is meant by this). P8, L7/8: replace 'quantities could be' with 'is' P8, L8: replace 'rainfall sums' with 'totals' and 'predictions' with 'estimates' P8, L9: replace 'are shown for the year 2013' with 'for 2013 are shown' P8, L30: replace 'Manhique et al. (2015).' with '(Manhique et al., 2015).'

P9, L1: replace 'retrieval' with 'retrievals' and replace 'highlights also' with 'also highlights' P9, L3: remove 'to elevated levels' P9, L5: parallax shifts would generally be < 1 pixel at this region.

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P10, L3: move comma from after 'pixel' to after 'problematic' P10, L8: replace 'Kidd and Huffman (2001)' with '(Kidd and Huffman, 2011)' P10, L8/9: see comment above about checking gauge data. P10, L15: remove 'view to' P10, L16: replace 'GMP' with 'GPM'

P11, L2: Insert 'scheme' after 'retrieval' P11, L5: Insert 'technique' after 'retrieval' and replace 'in' with 'at'

P12, L1: 'overestimation of rainfall areas' – care is needed here – is there an over-estimation of 'rain area' or 'rain occurrence' (these are different, but linked). P12, L2: remove 'global'; remove 'assignment; replace 'even advantageous' with 'better' P12, L6: replace 'are' with 'is'

References: Include data set references (most data sets now have doi's – and the GPM ones certainly do so).

Captions/Figures Figure 2: replace 'yearly' with 'annual'

Figure 3: replace 'predicted' with 'estimated'.

Figure 5: replace 'predicted' with 'estimated'; remove 'the year'; replace 'on' with 'at'; remove 'and on...levels'. Also, the colours seem to be smeared – particularly in (d) where each green point appears to be surrounded by a yellow 'ring'.

Figures 3,4,7 & 8: The box plots are not terribly good at conveying the necessary information. It would be much more valuable to display these as 'violin' plots (see Figure 5 of <http://dx.doi.org/10.1175/JHM-D-16-0079.1>)

Figure 9: would be good to include the gauge locations. Also, note that the MSG-estimate is a daytime retrieval scheme.

References: Hou, A. Y., and Coauthors, 2014: The Global Precipitation Measurements Mission. Bull. Amer. Meteor. Soc., 95, 701-722, doi:10.1175/BAMS-D-13-00164.1. Skofronick-Jackson, G., and Coauthors, 2017: The Global Precipitation Measurement

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