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Atmospheric Measurement Techniques Discussions

Interactive comment on "A novel algorithm for detection of precipitation in tropical regions using PMW radiometers" *by* D. Casella et al.

Anonymous Referee #1

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Review_AMT_2014-256

Overall quality of paper: The paper outlines the formulation and testing of a rain/no-rain methodology for use with passive microwave radiometers using the Precipitation Radar on the Tropical Rainfall Measuring Mission as the calibrator. The results indicate that the technique can usefully discriminate the rain/no-rain boundary between about 0.15 and 0.40 mmh-1 depending upon the sensor and surface type. The paper is generally well-structured and written, although there are a number of specific issues and technical corrections that require attention.

I would note that the paper tackles the problem of rain/no-rain from largely a mathematical viewpoint. For many applications it is the spatial distribution of precipitation that is

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important and it would have been very useful to have seem at least a couple of figures that showed mapped precipitation – even if it was just this techniques occurrence of precipitation vs that derived from the TRMM PR data; that way the reader could easily discern how applicable the technique was to 'global' rainfall estimations and to their particular region.

Specific comments: i) calibration/training of technique: the authors use the Precipitation Radar on the Tropical Rainfall Measuring Mission as the high-quality precipitation calibrator. At no stage do the authors note/acknowledge that the nominal minimum detectable rainfall signal for this instrument is 0.7 mmh-1. While this figure relates to a single footprint at c.5 km resolution, and that resampling to the lower resolution of the current passive microwave radiometer footprints will allow a lower rain-rate 'observation', the author's choice of 0.1 mmh-1 threshold is someone subjective. Of course, for the cross-track sensors, whose footprint size increases dramatically towards the edge of scan, this will be further complicated.

ii) application/verification of results: these seem to be done using the same data as the calibration/training data – these should really be independent to ensure usability; applying the results to different time periods would provide a better understanding of the robustness of the technique over time. Indeed, splitting the data between 'seasons' (although in the Tropics this might be more seasonal weather regimes, rather than climatological seasons), might also provide a better insight into whether, for example, the technique works well for monsoonal conditions as for semi-arid – two quite different regimes with quite different socio-economic issues.

iii) parallax: is this really necessary? There might be some rational for applying a parallax correction where the correction is equal or greater than the sensor resolution (and maybe a large fraction of the resolution). However, this is not the case in this instance. First it should be noted that the passive instruments see an integrated total of the precipitation through the atmospheric column, not just that at the surface, or at the top of the precipitation column. Second, even at a viewing angle of 45 degrees,

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the maximum parallax, assuming that all the signal is from the top of the precipitation column, will be about 4-5 km – but much less in shallow precipitation systems. Given the SSMIS sampling at 12.5 km, and MHS at 16 km (at nadir) this is only 1/3 to $\frac{1}{4}$ of the actual footprint. If a parallax-correction is to be applied it should consider the full vertical profiles available from the TRMM PR, preferably using the original level 1A data to allow sub-footprint analysis to be done.

iv) acronyms: in the result section the authors make use of different 'detection' algorithms (or rather detection scheme within algorithms). However, the acronyms used within the text do not match up with the acronyms in the figures: these need to be consistent to enable the reader to interpret and understand the results.

v) in the results mention is made to differences in the detection threshold between the different surface types, in particular that of arid surfaces. It should be noted that the different surface have fundamentally different rainfall regimes which would be reflected in the training dataset – indeed, it might be expected that the arid surface might have very little or no rainfall.

Technical corrections: P9238, L2: insert '-orbiting' after 'polar' P9238, L4: remove 'ly' from 'independently' P9238, L11: replace 'and' with 'with' and remove 'was' P9238, L13: add 's' to 'algorithm' P9238, L14: add 's' to 'show' P9238, L17: add 's' to 'surface' P9238, L17: Question: does 'total amount' relate to occurrence or accumulation? P9238, L23: remove 'ly' from 'globally' P9238, L24: replace 'in' with 'over' P9238, L25: replace 'in the' with 'over' and remove 'by 2015'

P9239, L1: replace 'France, India' with 'France/India' (since Megha-Tropiques is a joint mission) P9239, L3: the DPR is the 'Dual-frequency Precipitation Radar' P9239, L6-8: items need to be plural P9239, L12: SAPHIR needs to be spelt out in French (Sondeur Atmosphérique du Profil d'Humidité Intertropicale par Radiométrie); this is a cross-track sensor so should not be included with the conical-sensors, but later with the other cross-track sensors. P9239, L13: 'the last two. . .' – no, AMSR2 is on GCOM-W; I sus-

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pect that the authors have originally mentioned MADRAS and SAPHIR. Please correct this section accordingly. P9239, L18-19: remove reference to JPSS since it has yet to be launched. P9239, L20: revise text to 'It is also worth mentioning the. . .' P9239, L29: revise text to '. . .the Bayesian-based Goddard PROFiling algorithm (GPROF2014). . .'

P9240, L3-4: move 'also' from line 3 to line 4 between 'is' and 'of' P9240, L5: move 'to be' to after radiometers and move 'detect' to after 'efficiently' P9240, L15: add 's' to 'satellite' P9240, L17: replace 'the ones' with 'that', remove 'type of' and add 's' to 'surface' P9240, L18: replace 'in' with 'at' P9240, L20: revise 'allows to detect the' to 'allows the detection of' P9240, L23: revise 'has still' to 'still has' P9240, L26: replace 'estimate' with 'estimation' P9240, L29: replace 'the algorithms estimating precipitation' with 'the estimation scheme'

P9241, L3: replace 'unfrequent' with 'infrequent' P9241, L4: remove 'As a matter of fact, over' with just 'Over' P9241, L10-11: better reference than 'Barrett et al., 1988' would be 'Kidd, 1998' (reference would be: Kidd, C., 1998: On rainfall retrieval using polarization-corrected temperatures. International Journal of Remote Sensing 19, 981-996.) P9241, L19: remove 'large' P9241, L24: insert 'while' before 'Islam' P9241, L29: elaborate where the 'high quality precipitation measurements' are from.

P9242, L2: replace 'to' with 'by' P9242, L3: replace 'estimate' with 'estimation' P9242, L6: replace 'compared' with 'compare' P9242, L7: replace 'for' with 'using'; also note that these techniques are not necessarily just detection techniques. P9242, L10: replace 'Europe' with 'European' P9242, L13: remove 's' from 'multi-channels' P9242, L17: replace 'are' with 'is' P9242, L29: add 's' to 'part', and remove 'part of the' and:

P9243, L1: remove 'n' from 'American', remove 'continent and part of', and add 'the' before 'Indian'. P9243, L2: replace 'considering' with 'using' P9243, L14: replace 'in' with 'for' P9243, L4-5: TRMM was never officially an operational satellite, however its' data has been used operationally, and as such it is still providing data (and will do so for at least the next 3-4 months). Revise sentence. P9243, L7: replace 'at' to 'to a' P9243,

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L8-9: need for clarity over the ‘observation angle’; the scanning angle is 45 degrees, while the Earth incidence angle is 53.1 degrees. P9243, L9: the swath width is 1707 km. P9243, L11: the 22 GHz is vertically polarized (not horizontally). P9243, L13: the 50.3-60.8 GHz channels are vertically polarized or right-circular polarized. P9243, L19: insert ‘183 GHz’ before ‘water vapor’ P9243, L20: scan angles are -48.95 to 48.95 degrees (from nadir). P9243, L21: replace ‘around’ with ‘about’ P9243, L22: replace ‘considering’ with ‘within’ P9243, L24: replace ‘considered’ with ‘analysed’ P9243, L25: replace ‘considering’ with ‘for the’ P9243, L26: insert ‘therefore’ between ‘have’ and ‘been’

P9244, L12: replace ‘considered’ with ‘used’ P9244, L16: remove ‘Then’

P9245, L5: replace ‘in’ with ‘over’ P9245, L11-25: see above comment about the parallax correction.

P9246, L2-5: Some would question the use of the 50 GHz channels for precipitation retrievals since these are essentially oxygen absorption channels.

P9247, L12: As noted above, the TRMM PR has a minimum threshold of 0.7 mmh-1: the selection of a threshold of 0.1 mmh-1 will therefore be a function of the fraction coverage of the precipitation within the satellite footprint – overwhich the TRMM PR is averaged. P9247, L18-19: replace ‘an HSS equal to’ with ‘where’

P9248, L1: replace ‘trained using separately two’ with ‘trained separately for the two’ P9248, L2-3: replace ‘considering’ with ‘using’ P9248, L18: replace ‘It’ with ‘This’

P9249, L18: replace ‘following’ with ‘the scattering index’ P9249, L19: replace ‘considering also the’ with ‘with the’ P9249, L20: remove ‘following’ P9249, L23: remove ‘we have considered’ P9249, L24: replace ‘considers differences’ with ‘uses the difference’

P9250, L2: remove ‘following’ P9250, L3-4: replace ‘we have considered’ with ‘that uses’ P9250, L7: replace ‘shows a synthetic description of’ with ‘summarises’ P9250, L9: replace ‘shown’ with ‘evaluated’

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P9251, L10: revise ‘the signal deriving from the surface’ to ‘the surface signal’ P9251, L25: replace ‘maximize the’ with ‘has a maximum’ P9251, L26: remove ‘threshold’ P9251, L27: insert ‘which’ before ‘maximizes’

P9252, L7-16: As noted above, ensure that the reference to the detection schemes is consistent between the text and the figures. P9252, 21: replace ‘conditions’ with ‘situation’

P9253, L5-6: replace ‘represent’ with ‘represents’ P9253, L19: replace ‘brings’ with ‘leads’ P9253, L21: replace ‘as’ with ‘while’

P9254, L9: insert ‘the’ before ‘HSS’ P9254, L14: revise ‘values of rain rate’ to ‘rain rate values’ P9254, L15: replace ‘considered detect’ with ‘are able to detect’ P9254, L16: revise ‘more efficiently high rain rates’ to ‘high rain rates more efficiently’ P9254, L17: remove ‘the’ before ‘low precipitation’ P9254, L18: revise ‘estimate’ to ‘estimation’ P9254, L27: revise ‘algorithm’ to ‘algorithms’ P9254, L28: revise ‘estimate’ to ‘estimates’ and ‘estimate’ to ‘estimation’

P9255, L4-24: consider using more common terminology for ‘fraction of precipitation due to hits’ (e.g. ‘hits’) and ‘fraction of precipitation due to false alarm (e.g. ‘false alarms’).

P9256, L3-4: revise ‘rainfall rate high quality estimates’ to ‘high quality rainfall rate estimates’ P9256, L6-7: revise ‘maximize’ to ‘maximizes’ P9256, L14: insert ‘by’ after ‘generated’ P9256, L21: revise ‘shows almost always’ to ‘almost always shows’ P9256, L24: replace ‘large’ with ‘high’

P9257, L9-10: clarify whether ‘total amount of precipitation’ relates to occurrence or accumulation. P9257, L16-17: replace ‘Lots of efforts are’ with ‘Lots of effort is’

P9258, L3: The CloudSat radar is the Cloud Profiling Radar (CPR) not the CloudSat Precipitation Radar.

P9263, Table2: Why are there asterisks in brackets? P9271/9272„ Figures 4/5: Caption

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acronyms need to match those in the text (or vice versa).

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