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Hydrology and Earth System Sciences Discussions

Interactive comment on "

Potential of high-resolution detection and retrieval of precipitation fields from X-band spaceborne Synthetic Aperture Radar over land" *by* F. S. Marzano et al.

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General comments My overall impression of the paper is positive: it addresses a pos-

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sible use of SAR images in quantitative precipitation detection by means of different approaches showing two case studies. Moreover, the authors provide a correction for geometrical effects to be applied to a published retrieval algorithm, and, finally, try to address the ground resolution issue in precipitation remote sensing. »> We thank the reviewer for the appreciation of the work.

Since the use of SAR for precipitation is not yet very widespread, I would appreciate a little bit more detailed discussion on the expected role of SAR estimates in the more general framework of the precipitation instruments already in use (passive and active MW, ground radar). What contribution can be expected by SAR rainrate observation ? Hundred-meters resolution rainfall maps over land are available from ground radar since decades, with good accuracy, especially if polarimetric capabilities are exploited. Could SAR retrieval be used over scarcely observed regions (i.e. where radar data are not available) ? or over complex orography, where ground radar fail ? What is the revisit time of the current SAR observation system ? »> Agreed. We have incorporated into the new version of the Introduction the suggestion of the reviewer by specifying about the role of XSAR rainfall estimation together with its potential (i.e., high-spatial resolution access to remote regions, non-instrumented areas, ocean surfaces and mountainous regions) and limitations (i.e., low temporal resolution or repetition period due to limited swath, typically less than 200 km, and orbit duty cycle, typically less than 20%).

Specific comments I will focus my specific comments on the section 4 of the paper. Here the authors address the sampling/beam filling issue, downscaling the SAR rainrate maps to the FOV of two sensors widely used for rain retrieval purposes, such as TRMM-PR and TMI. First, I do not see the need to show real TRMM images in figure 2 of hurricane Gustav: they are not "nearly contemporary" to TSX (1:30 hour is a big difference if convective systems are concerned), and they are never really used in the paper. »> When correcting the proofs we did not realize that Figs. 2 to 5 were not cited: these figures were indeed cited in the original text as they illustrated the case study from space using TRMM, TSX and showing the rain rate retrieval results.

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We have amended this proofreading error. Instead of removing Fig. 2, we have emphasized its descriptive support within the section. Indeed, Fig. 2 is also useful to qualitatively show the sensor spatial averaging effects on rainfall field, as discussed in the last section of the text.

section 4.1 To assess the spatial resolution degradation of rainrate maps the authors simulated rainrate maps at TRMM-PR and TRMM-TMI@37GHz resolution by downscaling TSX maps at 0.5 km: the results are compared with Weather Radar rain maps, computing RMSE, FRMSE, BIAS and correlation coefficient. I suggest to summarize the results in a table to make easier the comparison, and I also would recommend a deeper discussion of these results. It seems that TMI-like has very low correlation with reference map, but BIAS, RMSE are comparable with the TSX estimates, while PR-like shows large RMSE and large (and positive !) BIAS. An attempt to explain such conflicting results should be pursued. Probably this analysis is too simplistic and the results too much dependent on the particular scene and on the spatial properties of the considered precipitation pattern. »> Agreed. We have improved the figures and discussed the results in a clearer way. The goal of the section was to show the modification of the probability density of the estimated rainrate field and its correlation with the high-resolution spatial reference (WR) field. Even though it is an expected result (see the new reference Harris et al., 2003), the message is to show an example of the possible advantages to exploit XSAR-based retrievals.

section 4.2 I think that the "beam filling" effect cannot regarded as "systematic error", since it depends on the observed precipitation pattern and does not affect the measure in a constant way with the same intensity. I suggest to omit the sentence about raingauges: this is a rather complex issue and it is not addressed in this paper at all. »> Agreed. We have removed the sentence.

The sentence "Another effect is due to antenna pattern... because of the weighting introduced by antenna pattern" tells twice the same thing and should be reworded. »> Agreed. We have reworded the sentence.

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In figures 8 and 9 the sampling rainrate interval changes between top and bottom panels, and this should be clearly introduced and the reason explained. If I well understand, the red line in figs 8 and 9 marks the gaussian weighted values: probably it would be better, for clarity, to mark the unweighted mean values in the top panels, to illustrate differences. Moreover, I suggest to extend horizontal axis to the whole rainrate range, in order to fully show the broad rainrate spectrum. »> Agreed. Figs. 8 and 9 have been improved by introducing 2 new panels with non-degraded histograms from WR and TSX and using the same step.

technical comments There is a mistake in the equation numbers: probably eq. 1b should be eq. 2, and the following numbers rescaled accordingly. »> Agreed. Indeed, the original manuscript had these numbers correctly listed.

The name of Japan Space Agency is JAXA since october 2003. »> Agreed. It has been corrected.

In the caption of figure 2, the "convective cell indicated in figure 1" is mentioned. If it is referred to the hurricane, "convective cell" is not the proper name. »> Agreed. Name has been corrected.

The differences between REA and MREA results should be discussed with more quantitative detail, showing scatterplot between figs 5 top and bottom and/or computing some difference measure. »> Agreed. We have computed the average and deviation of the difference between the REA and MREA estimated fields. A new table summarizes it.

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