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Atmospheric Measurement Techniques Discussions

Interactive comment on "On the link between precipitation and the ice water path over tropical and mid-latitude regimes as derived from satellite observations" *by* Yaniv Tubul et al.

Anonymous Referee #2

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This manuscript reports on correlations between gridded precipitation and ice water path observations from TRMM and MODIS, respectively. The paper seeks to add to the literature concerning algorithms for retrieving convective precipitation intensity from visible and infrared radiance measurements through a somewhat different pathway that first involves retrieving IWP as opposed to directly correlating radiances to surface rainfall rate. The subject is appropriate for Atmospheric Measurement Techniques but there are fundamental with the manuscript that make it unsuitable for publication at this time. These include critical deficiencies in the approach, the omission of any direct evaluation of the technique, and a failure to acknowledge some fundamental circularity in the logic. Specifically, no justification is offered concerning the choice of datasets

used in the study, there is no discussion of the impact of uncertainties in the IWP and RR estimates including the representativeness of visible and infrared-derive IWP in convective storms, and the physical significance of correlating rainfall and IWP at a resolution of 5x5 (i.e. much larger than the scale over which precipitation processes occur) is not discussed. In addition, little evidence is provided to support the claim that this technique might offer a more robust method for retrieving rainfall rate than those that have been developed in the past. Indeed, the very dataset the authors adopt to develop their statistical regressions already incorporates infrared estimates of rainfall intensity information that they purport to replace with this new algorithm. As a result of these concerns, which are elaborated below, I cannot recommend publication of this paper at this time.

Specific Comments:

1. Despite the authors claims concerning the novel nature of this technique, it is not clear how this work advances the state of rainfall intensity retrievals from visible and infrared radiances that already exist in the literature. While it is clear that ice water and rainfall intensity are physically connected through ice-phase precipitation processes, it is not clear that the specific approach presented here is any different from simply using these radiances directly to infer rainfall rate. By regressing separate IWP retrievals against rainfall rate, the method simply introduces the additional step of first estimating IWP from the raw radiances that can introduce its own uncertainties including assumed particle size, shape, vertical structure, sensitivity to large particles, and saturation at high IWP that complicate the subsequent relationship to rainfall rate. There is no mention of the influence of these sources of uncertainty in the manuscript. In fact, based on the fact that the authors use existing cloud products and do not perform any retrievals themselves, it is not clear they are aware of these issues or the fact that the measure of IWP used here is likely far from optimal for precipitating cloud scenes.

2. More problematic is the fact that the precipitation dataset used in this analysis actually includes geostationary infrared radiance information in it. This guarantees a

relationship between the TRMM precipitation estimates and associated cloud fields since similar observations influence both retrievals. Other than a quick mention of this at the top of page 5, this circularity is not discussed at any length in the manuscript.

3. Another concern centers on the lack of error bars on any of the component datasets used in the analysis. What is the accuracy of the rainfall rates and ice water path estimates used? How does the accuracy of these products vary with rainfall intensity? The IWP estimates almost certainly 'saturate' in more convective cloud regimes and visible and infrared measurements are generally not sensitive to precipitation-sized particles from which rain actually forms. No attempt is made to compare the MODIS IWP estimates to those from collocated passive microwave observations provided by TRMM.

4. While the sensitivity of the results to averaging-scale was 'tested' according to the authors, it is still not clear how the physical processes described earlier in the manuscript relate to IWP and rainfall rate estimates over a 5x5 grid box. How much of the 'signal' emerging from the regressions shown in Figure 1 is simply caused by the correlation between cloud fraction and rain fraction within these large boxes? Has any effort been made to normalize the results by cloud fraction and rain fraction to remove such effects? I do not believe that normalizing by the mean IWP and R over each grid box fully accomplishes this.

5. Each of these concerns brings up one additional overarching concern related to the choice of datasets adopted for this analysis: it is not at all obvious that the datasets adopted here are optimal for this study. Since TRMM carries the Visible and InfraRed Scanning radiometer (VIRS), ice water path estimates similar to those derived from MODIS observations can be compared against TRMM rainfall estimates from either the Precipitation Radar (PR) or Microwave Imager (TMI) directly avoiding the issues of collocating MODIS and TMPA. Collocating these two datasets from independent satellites merely introduces uncertainties owing to time/space collocation errors, restricts the time of day to 1:30 pm, introduces artificial correlations through the influence of IR

measurements on the TMPA, requires analyzing larger grid boxes (see below), and precludes the use of passive microwave IWP estimates for independent validation. What's more, many of the visible/infrared rainfall retrieval techniques currently employed have been developed using these direct collocated datasets and are, therefore, likely more robust than the technique proposed here.

6. That leads me to my final point – no independent evaluation or comparisons to other techniques is provided to support the claims concerning the benefits of this new approach. Evaluation against independent rainfall estimates is required to assuage fears concerning the flaws outlined above.

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