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Atmospheric Measurement Techniques Discussions

Interactive comment on "Field-of-view characteristics and resolution matching for the Global Precipitation Measurement (GPM) Microwave Imager (GMI)" *by* Grant W. Petty and Ralf Bennartz

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Summary of Review

This manuscript presents a method to match channels of a conically-scanning microwave radiometer to a common field of view, which is applied to the GMI sensor on GMI. The methodology is sound and produces the expected result, specifically, the the lower-frequency channels cannot be deconvolved to high-resolution, higher-frequency channels without introducing some artifacts, whereas higher-resolution channels can be convolved to a lower resolution without difficulty (although as the authors note, the

89 GHz channels do not completely sample the scene). I have some general comments, which mainly elicit an elaboration on some of the implicit assumption in the manuscript, but I would classify these as minor revisions since they would not materially affect the conclusions. There are also a number of specific comments and typographical errors that should be addressed prior to publication.

General Comments

1. What is the source of information for the IFOV beamwidth? The beamwidths provided in the Hou et al., 2014 are slightly different than those published by Draper et al., 2015 (which, I believe, used actual measurements during calibration maneuvers after launch).

2. The process of determining optimal weights seeks to maximize the correlation between channels, which implies that the radiances themselves are more dependent on resolution than on the channel. Of course, if this was the case, there would be no need for the low-resolution channels, yet we utilize them precisely because of the additional information content they present relative to the higher frequencies despite the lower resolution. One can imagine a case where the 23.8 Ghz channel is deconvolved to the 89 GHz FOV. Since the 23.8 channel is more sensitive to the water vapor, which varies smoothly, whereas the 89 GHz radiances are much more sensitive to liquid clouds, which have sharper boundaries, the incorrect weights might be selected that over-amplify noise in an attempt to reproduce the cloud response at 89 GHz with the water vapor response at 23 GHz. While this is admittedly an extreme case (and there are many other situations, such as a coastline under clear conditions, where the radiances are quite similar at different frequencies), I think a little more discussion is merited of the strengths and weaknesses of using inter-channel correlation as a proxy for optimal resolution enhancement. Why not simply use a high-resolution model where simulated radiances may be obtained at any frequency and resolution, and attempt to maximize the correlation between deconvolved and actual high-resolution radiances at a given frequency?

3. The 166 and 183 GHz channels were not treated in this paper due to the inconsistent scan geometry relative to the 10-89 GHz channels, but I am curious if it is possible to determine their weights as a function of the (variable) cross-scan and along-scan distance from the center of the high-frequency FOV to the center of the target low-frequency FOV. Would such averaging be superior to the current method used in the 1C-R product, which (as I understand) is simply a nearest-neighbor match to the target low-frequency FOV?

Specific Comments

Page 1, Line 12: F19 was actually launched more recently than GMI (although no longer operational).

Page 1, Line 15: The 1/(d*freq) relationship for beam width only holds for the 10-18-23 GHz channels on GMI - at higher frequencies, the antenna is "under-illuminated" resulting in larger beamwidths than the minimum possible, presumably in the interest of minimizing under-sampling the scene at high frequencies (although, as the authors note, this is an issue at 89 GHz and above for GMI). Although this doesn't affect the result in any way it should probably be noted in the introduction.

Page 5, Line 27: This sentence seems incomplete, as it doesn't follow directly from the preceding paragraph. What exactly is being derived in Appendix A?

Figure 4: This figure displays correlation and gamma as a function of noise amplification factor, but the prescribed variable is actually gamma and I think it would be more logical to view both correlation and noise amplification as a function of gamma.

Figure 6: A color bar would be useful to interpret the magnitude the of the ringing artifacts.

Typos

Page 1, Line 7: should be "Modest improvement in resolution is achieved for the 10.65 GHz channels, ..."

Page 4, Line 12: should be "Advanced Microwave Scanning Radiometer"

Page 8, line 15: equation should end with a period.

Table 2, last row: extraneous "km" after 52.78 degrees.

Table 3: According to Draper et al., 2015, the Ka-band GMI frequency is 36.64 GHz.

References

Draper, D. W., Newell, D. A., Wentz, F. J., Krimchansky, S., & Skofronick-Jackson, G. M. (2015). The global precipitation measurement (GPM) microwave imager (GMI): Instrument overview and early on-orbit performance. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 8(7), 3452-3462.

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