NOTES AND CORRESPONDENCE

Comments on "Comparisons of SSM/I Liquid Water Paths with Aircraft Measurements"

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In their excellent study, Cober et al. (1996) were able to show wide disagreement among current Special Sensor Microwave Imager (SSM/I) cloud liquid water path (LWP) retrieval methods using aircraft measurements as validation. This comment, however, focuses on the results of the total precipitable water (TPW) retrievals in that study as compared to aircraft dropsonde measurements. The results from the Greenwald et al. (1993) method showed a significant disagreement in which the authors were at a loss to explain. Based on my past experience with the retrieval method, these results were highly suspicious and prompted me to investigate the cause of this disagreement.

A review of the computer source code used by Cober et al. (1996) revealed a coding error in calculating the Fresnel coefficients for a flat sea surface and the omission of an important constant in the physical retrieval model. The constant served as a general calibration factor to account for possible systematic errors in the measurements and the physical model (Greenwald et al. 1993). Admittedly, the discussion by Greenwald et al. (1993) overstated the role of measurement error as a determining factor, which gave the impression that the calibration constant was to be used solely for the SSM/I on the *F-8* Defense Meteorological Satellite Program satellite. I want to emphasize that this calibration factor must always be used in the physical model, regardless of the source of the SSM/I measurements. Investigators

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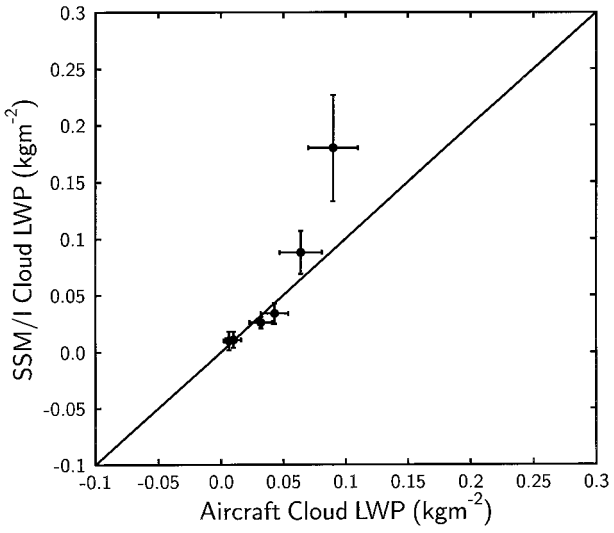

FIG. 1. Comparison between retrievals of cloud liquid water path (LWP) from Special Sensor Microwave Imager (SSM/I) measurements based on the method of Greenwald et al. (1993) and aircraft observations for the case studies of Cober et al. (1996). Error bars indicate the standard deviations of the observations. The line of perfect agreement is also shown.

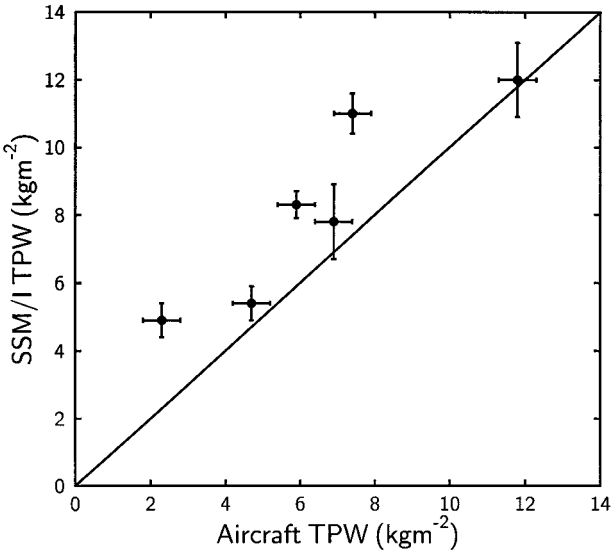

FIG. 2. Same as Fig. 1 except for the total precipitable water (TPW) retrievals. Error bars for aircraft observations are assumed as ± 0.5 kg m^{-2}.

TABLE 1. Summary of the cloud liquid water path (LWP) and total precipitable water (TPW) retrievals (mean and standard deviation) from Special Sensor Microwave/Imager measurements for the six cases of Cober et al. (1996). All values are in kilograms per square meter.

Quantity	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
LWP	0.034 ± 0.009	0.088 ± 0.019	0.010 ± 0.008	0.011 ± 0.007	0.026 ± 0.005	0.18 ± 0.047
TPW	7.8 ± 1.1	11 ± 0.6	8.3 ± 0.4	5.4 ± 0.5	4.9 ± 0.5	12 ± 1.1

who are interested in this retrieval method, however, are encouraged to use a new version of the method (Greenwald et al. 1995) that has a slightly more detailed physical model and improved calibration and that uses the 22.235-GHz measurements.

The quantitative results of the reanalysis for the cloud LWP and TPW retrievals are shown for each case in Table 1, with the comparisons against the aircraft observations illustrated in Figs. 1 and 2, respectively. The changes in the results, as compared to those of Cober et al. (1996), averaged $+0.008$ kg m^{-2} for the cloud LWP retrievals and -3.2 kg m^{-2} for the TPW retrievals. While these results bring the TPW retrievals into far better agreement with the aircraft observations, there remains a 1–2 kg m^{-2} systematic error in the retrievals. This was expected and is likely attributed to the lack of calibration in the retrieval model at 19.35 GHz. Fortunately, these modified results do not alter one of the main conclusions of Cober et al. (1996); that is, the cloud LWP retrieval method of Greenwald et al. (1993) was more consistent with the aircraft measurements than most other well-known published methods.

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