Nasa, Navy, And AES/York sea Ice Concentration Comparison of Ssm/i Algorithms with Sar Derived Values

Per Gloersen, Don Cavalieri, Rene Ramseier, Irene Rubinstein, Joey Comiso, and James Hollinger

Abstract

Previous research studies have focused on producing algorithms for extracting geophysical information from passive microwave data regarding ice floe size, sea ice concentration, open water lead locations, and sea ice extent. These studies have resulted in four separate algorithms for extracting these geophysical parameters. Sea ice concentration estimates generated from each of these algorithms (i.e., NASA/Team, NASA/Comiso, AES/York, and Navy) are compared to ice concentration estimates produced from coincident high resolution Synthetic Aperture Radar (SAR) data. The SAR concentration estimates are produced from data collected in both the Beaufort and Greenland Sea in March 1988 and March 1989, respectively. The SAR data is coincident to the passive microwave data generated by the Special Sensor Microwave/Imager (SSM/I).

KEYWORDS: Sea Ice Comparison, SAR, SSM/I, Sea Ice Concentration, Sea Ice Algorithm Comparison

Figure 3 is a plot of the total ice concentration estimates versus the Corresponding SAR estimates for the 17 March 1989 data. The key on the plot illustrates a symbol for each of the four algorithms (the NASA Alg. refers to the NASA/Team algorithm and the Comiso Alg. refers to the NASA/Comiso algorithm) along with the slope "a" and y-intercept "b" of the linear regression analysis. Notice that the linear trend corresponding to each of the algorithm estimates is relatively close to the line with slope 1.0 and y-intercept 0.0 (this is the line where y=x representing an exact match between the SAR and SSM/I estimates). The AES/York estimates provide the best match while the NASA/Comiso estimates have a slope very near 1.0 shifted by -9.096. Figure 4 illustrates the corresponding plot for the 20 March 1989 data. Again, this plot shows relatively good results for the NASA/Team, AES/York, and Navy algorithms while the NASA/Comiso algorithm tends to underestimate the total ice concentrations. Figures 5 and 6 show plots of multiyear ice concentrations versus the SAR estimates for the 17 and 20 March 1989 data sets, respectively. These plots show that the Navy algorithm generates ice concentrations that are consistently higher than the SAR. This is expected since this algorithm generates a total ice concentration value. Both the NASA/Team and AES/York algorithms produce multiyear estimates that are consistently lower than the SAR. This is surprising since the multiyear estimates generated for the Beaufort Sea data were consistently higher than the SAR. This might be due to different characteristics in the multiyear ice signatures between the two locations, or possibly the absence of pressure ridges from first-year ice in the MIZ (remember the NASA/Team algorithm misclassified approximately 30% of the first-year ice as multiyear ice on the 18 March 1988 Beaufort Sea data).

5.0 CONCLUSIONS

The NASA/Team algorithm generated multiyear ice concentration estimates similar to the SAR in the multiyear ice pack for the 19 March 1988 Beaufort Sea data (mean difference of approximately 6.5%). It also produced a misclassification error of approximately 30% (due to the pressure ridges) in the first-year ice pack for the 18 March 1988 Beaufort Sea data. The AES/York and Navy algorithms were not affected by the pressure ridges in the first-year sea ice, both produced a 0% multiyear estimate in the first-year ice area. Both the AES/York and Navy algorithms were able to distinguish between the first-year/multiyear ice pack boundaries, but they also overestimate the ice concentrations in the multiyear pack. The total ice concentration estimates derived from the 17 and 20 March 1989 Greenland Sea data are relatively close to the SAR estimates for the NASA/Team, AES/York and Navy algorithms. Each of these algorithms produced a Normalized Standard Error (NSE) less than 0.1, where the NSE is computed as the mean difference between the SSM/I and SAR estimates divided by the mean square of the SAR estimates (NSE equal to zero means no difference between the SAR and SSM/I derived concentration estimates). The NASA/Comiso algorithm underestimated the total ice percentage for the 20 March 1989 data (NSE equals 0.2). However, a much larger discrepancy was found in the multiyear estimates. The Navy algorithm which produces a total ice estimate containing mostly multiyear sea ice generated NSE values of 0.285 and 0.450 for both the 17 and 20 March Greenland Sea data respectively. The AES/York algorithm generated NSE values of 0.320 and 0.553, and the NASA/Team algorithm NSE values were 0.467 and 0.681 for the 17 and 20 March 1989 Greenland Sea data respectively. This implies that even though the Navy algorithm generates a total ice estimate, the estimates are closer to the SAR estimates than the NASA/Team or AES/York algorithm estimates.

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