

RSS Version-7 SSM/I Geolocation

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This technical report documents the changes to pointing parameters in Remote Sensing Systems (RSS) Version-7 SSM/I dataset.

Methodology

1. Static alpha (azimuth) and beta (nadir) adjustments were derived through the minimization of ascending-minus-descending (A-D) antenna temperature (T_A) differences.
2. A time-varying pitch adjustment was derived from a separate analysis of along-scan measured-minus-simulated antenna temperature differences.
3. Timing adjustments were derived from a second A-D T_A analysis.
4. Visual inspection of A-D T_A maps identified F10 anomalies.

The A-D T_A analysis examined the SSM/I dataset at a granularity of 6-month (2500-orbit) averages. Pointing parameters were perturbed about Version-6 values to minimize the RMS difference of A-D T_A . The perturbations were performed at an angular resolution of 0.05° . This corresponds to an along-track shift of approximately 1.8 km on the Earth for beta and pitch; and 0.8 km across-track for alpha, roll, and yaw. Time was perturbed at a resolution of 0.2 sec, or about 1.3 km along-track on the Earth.

The time-varying pitch adjustment was derived by examining year-to-year along-scan variations of measured-minus-simulated antenna temperature. Pitch was adjusted to minimize these along-scan variations.

As a final step, $1/8^{\text{th}}$ degree maps of all of the Version-6 and Version-7 A-D T_A differences were visually inspected. All 123 6-month periods in the SSM/I dataset were examined by hand. This process identified the anomalies in F10 geolocation in the last year of mission life.

Results

Table 1 provides values of Version-6 and Version-7 alpha (boresight azimuth angle at the start of the scan) and beta (boresight nadir angle). For alpha, only F10 and F11 changed. F11 had the larger change of 0.20° , which represents a 3 km across-track shift on the Earth. Beta changed slightly for all sensors, the largest being a 0.06° reduction for F13. This represents a 2 km along-track shift. The changes to alpha and beta were the product of our minimization methodology and also manual-inspection of A-D T_A differences perturbed at a 0.01° resolution.

Figure 1 shows the values for the pitch adjustment. The largest change was an increase of 0.028° for F13, which represents a 1 km along-track shift on the earth. Figure 2 shows the timing adjustments. The largest change was a decrease of 1.1 sec for F14 and the second largest change was 0.7 sec for F13. These represent 7.7 and 4.8 km along-track shifts, respectively.

F10 has a linear increase in roll starting with orbit 31000, and reaching a maximum of 0.13° by the last orbit 36360. F10 also has a linear decrease in pitch of 0.25° starting with orbit 35000. The roll adjustment produces a maximum 2.0 km across-track shift on the Earth, and the pitch adjustment produces a maximum 9.6 km along-track shift.

Finally, Figures 3-8 show 1/8th degree maps of evening-minus-morning 19H antenna temperature. F13 and F14 had the largest overall changes, except for F10 in the last 3 months of mission life. The coastlines visible in RSS Version-6 A-D T_A imagery are absent in Version-7.

	V6 alpha	V7 alpha	V6 beta	V7 beta
F08	-129.60	-129.60	45.00	45.02
F10	51.10	51.17	45.37	45.34
F11	51.05	50.85	44.98	45.03
F13	50.90	50.90	44.80	44.74
F14	50.35	50.35	44.97	44.96
F15	51.20	51.20	44.74	44.69

Table 1. Version-6 and Version-7 alpha (boresight azimuth angle) and beta (boresight nadir angle).

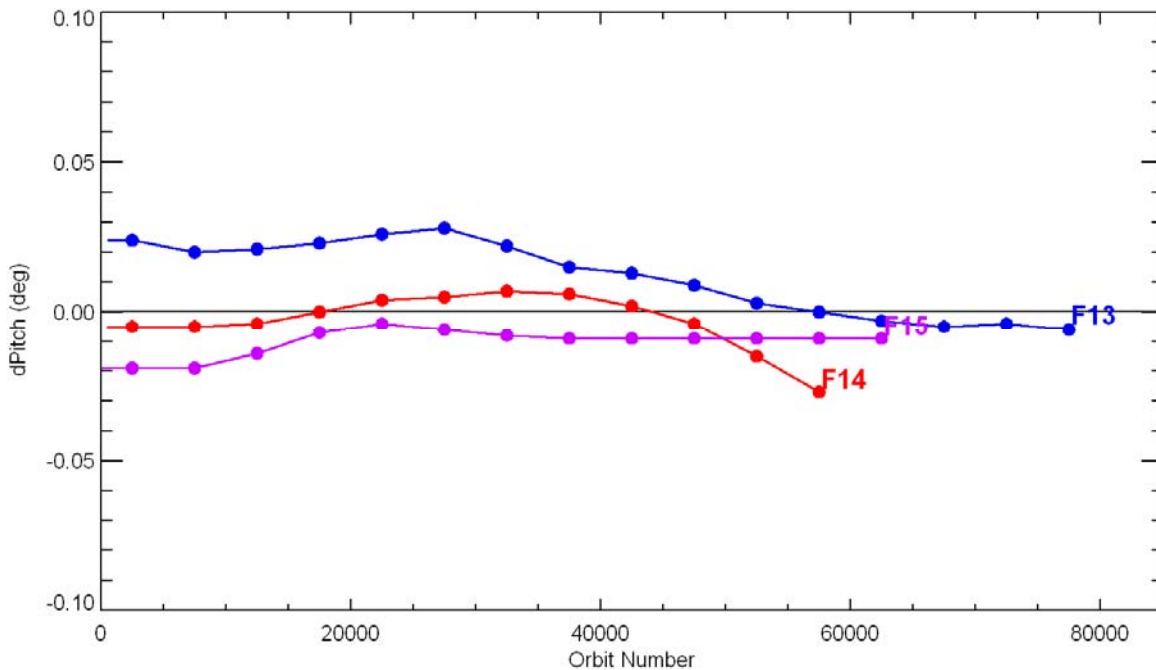


Figure 1. Version-7 time-varying pitch adjustment.

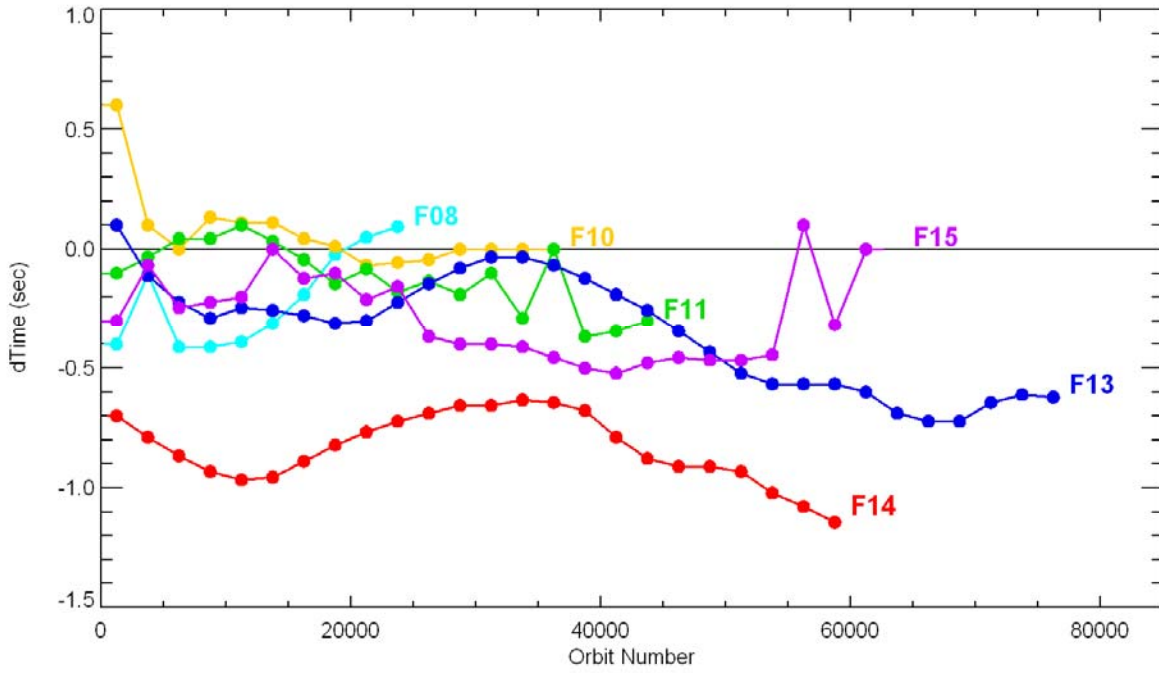


Figure 2. Version-7 timing adjustment.

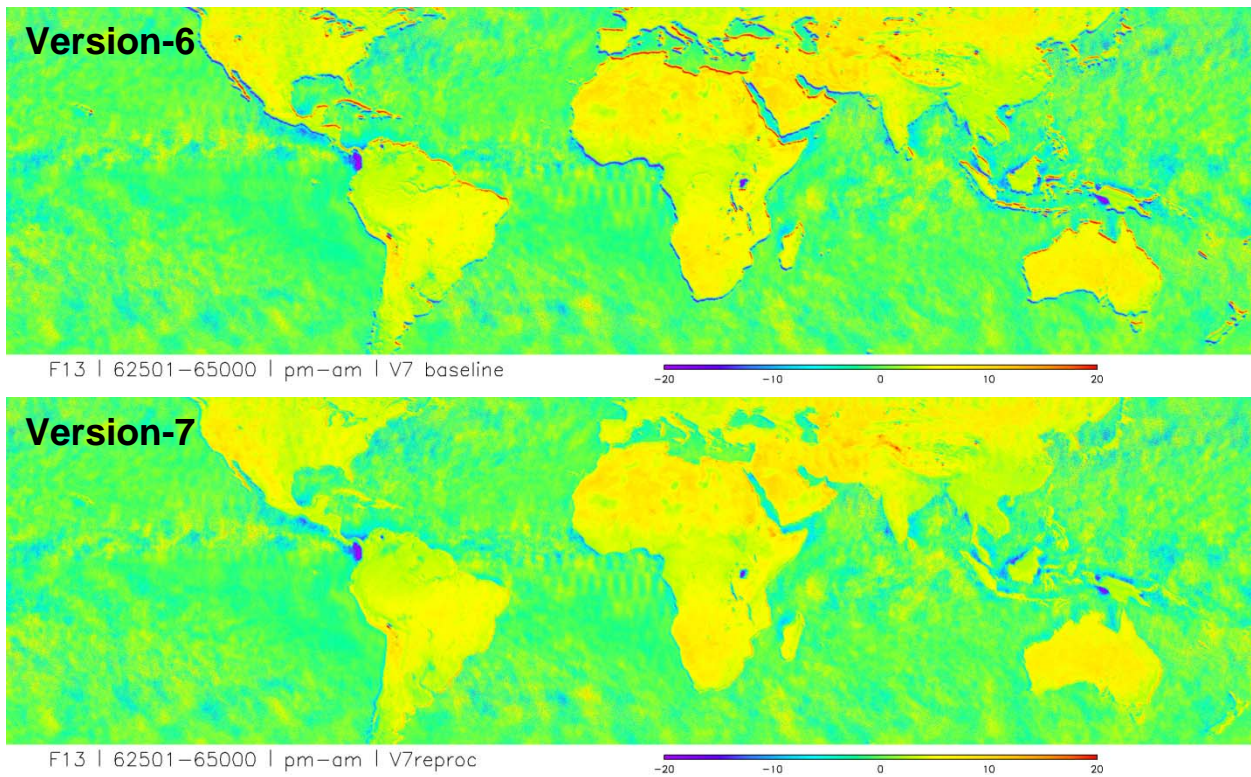


Figure 3. F13 Version-6 (top) and Version-7 (bottom) evening minus morning 19H antenna temperature difference. This period has a 6:30 PM local time of ascending node (LTAN).

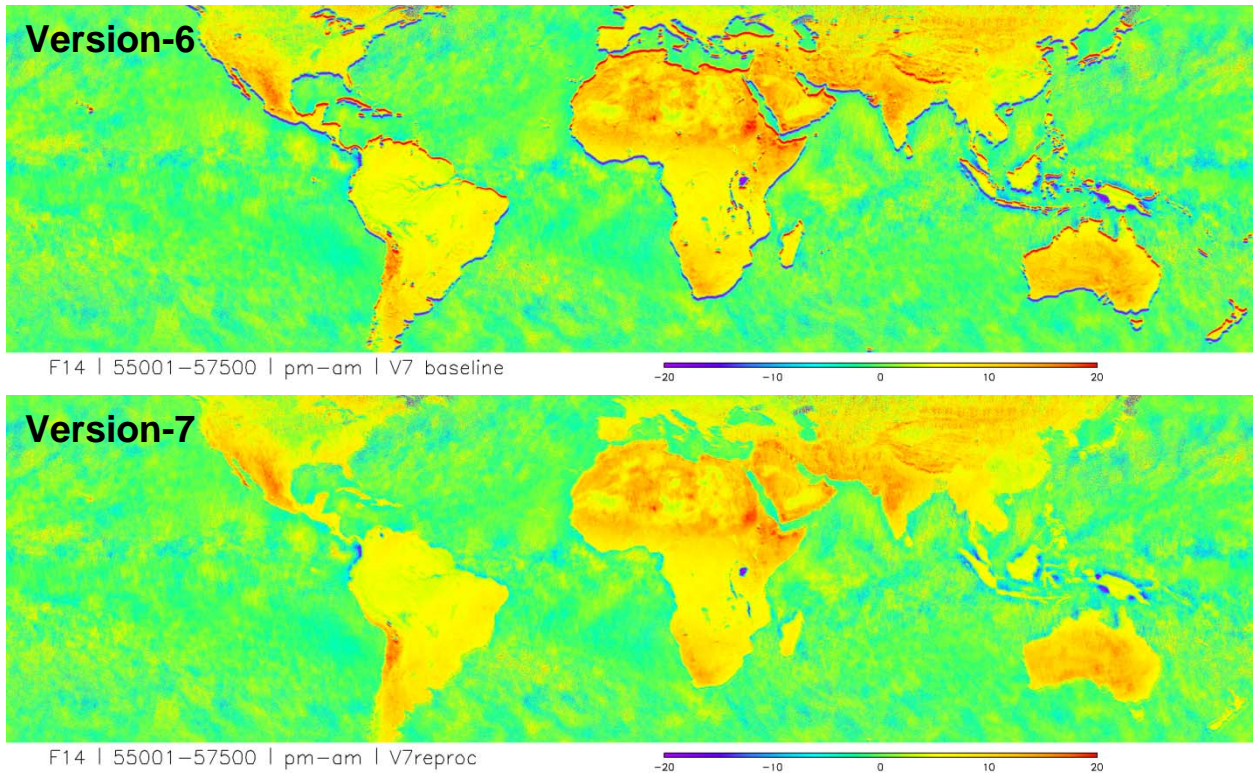


Figure 4. F14 Version-6 (top) and Version-7 (bottom) evening minus morning 19H antenna temperature difference. LTAN is 5:00 PM.

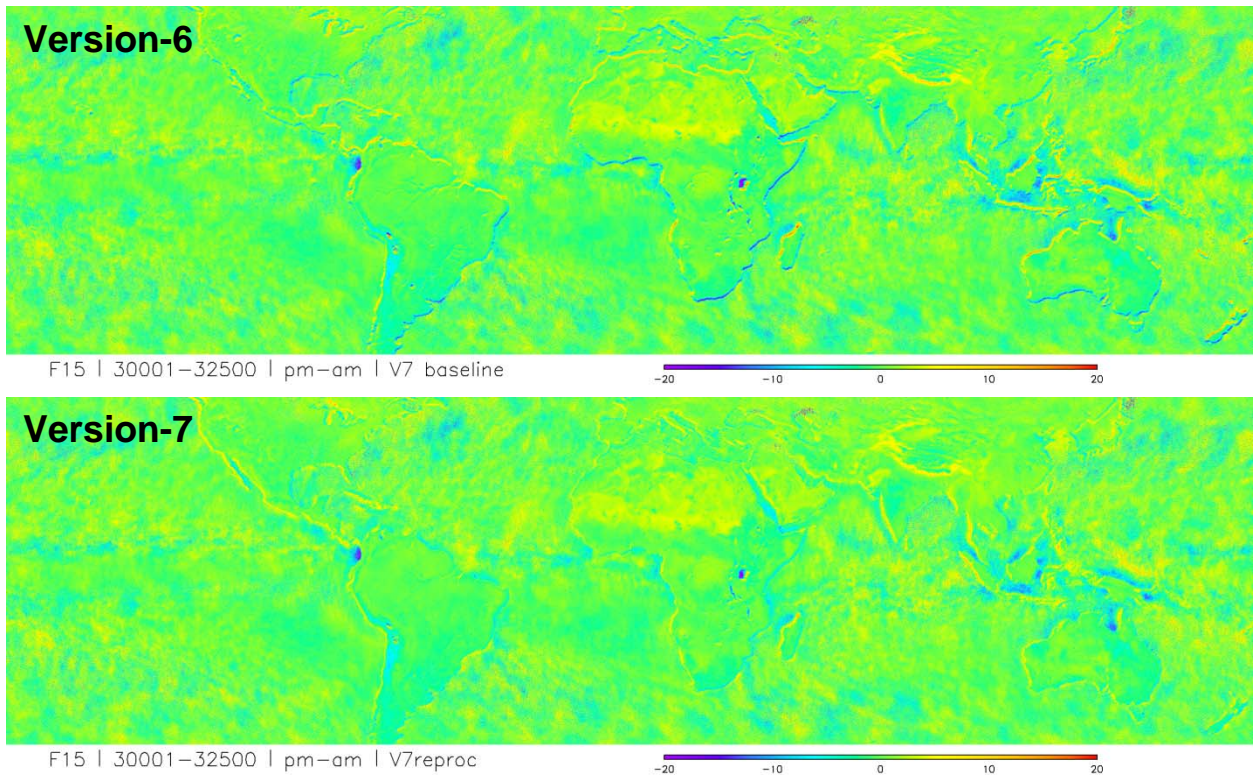


Figure 5. F15 Version-6 (top) and Version-7 (bottom) evening minus morning 19H antenna temperature difference. LTAN is 8:30 PM.

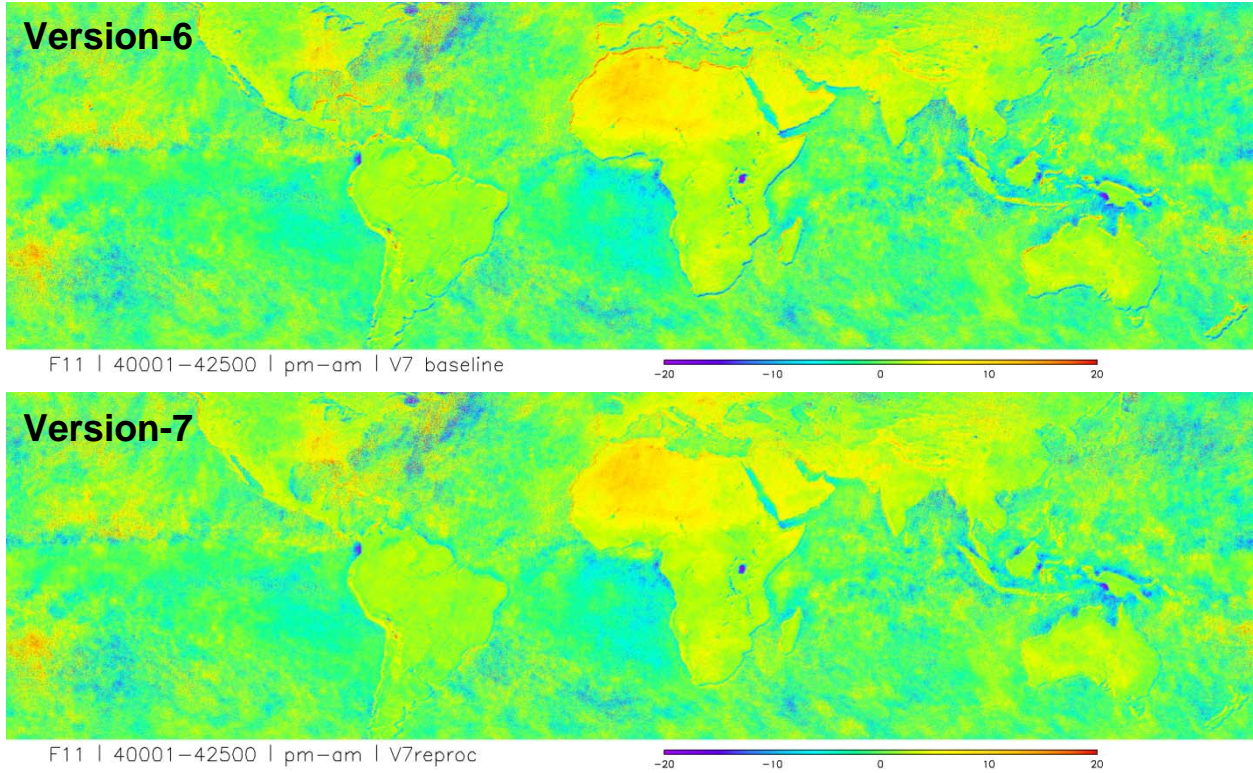


Figure 6. F11 Version-6 (top) and Version-7 (bottom) evening minus morning 19H antenna temperature difference. LTAN is 7:30 PM.

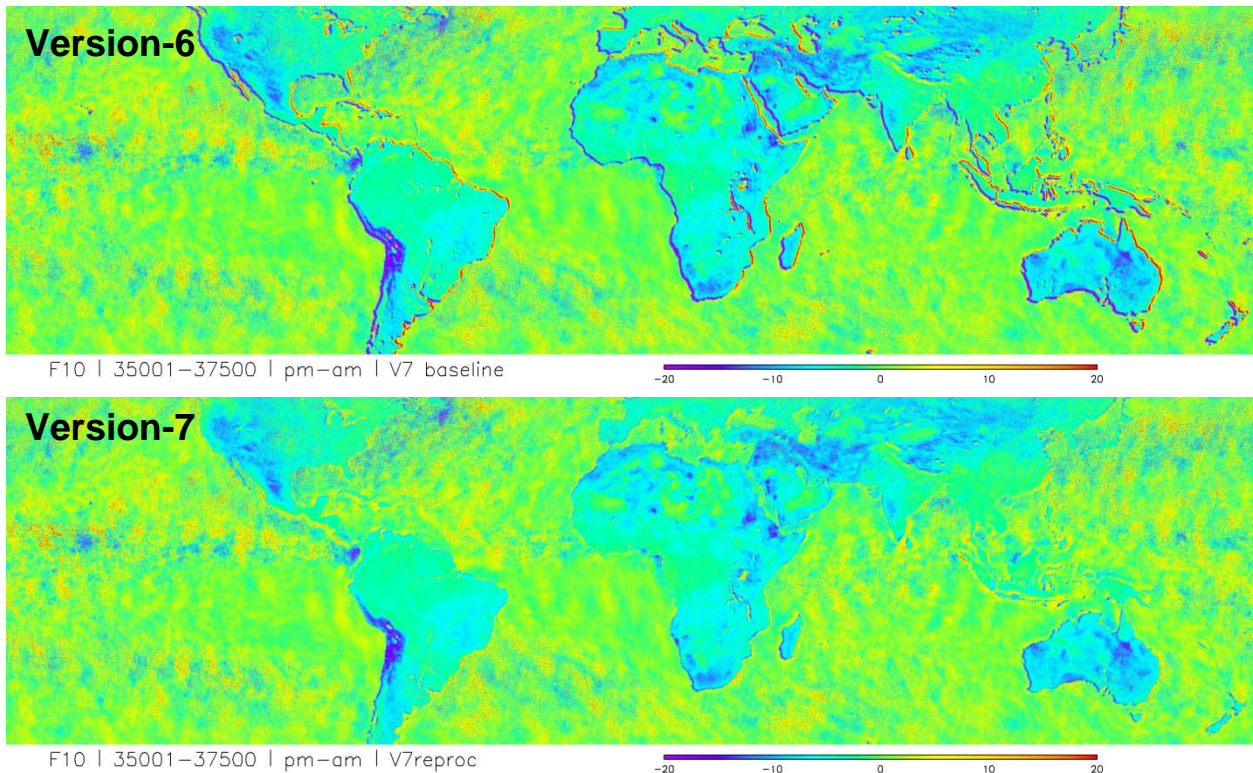


Figure 7. F10 Version-6 (top) and Version-7 (bottom) evening minus morning 19H antenna temperature difference. LTAN is 10:30 PM.

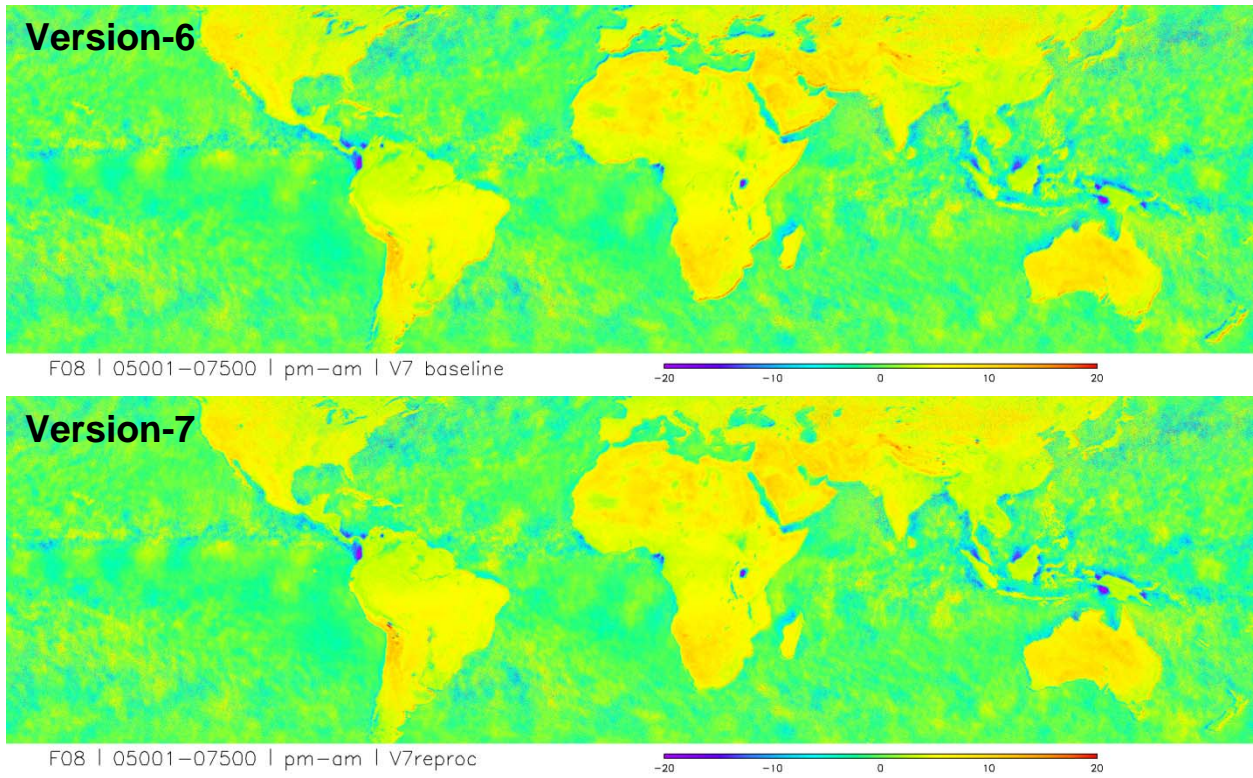


Figure 8. F08 Version-6 (top) and Version-7 (bottom) evening minus morning 19H antenna temperature difference. LTAN is 6:00 PM.