Intercalibration of Passive Microwave Rain Products

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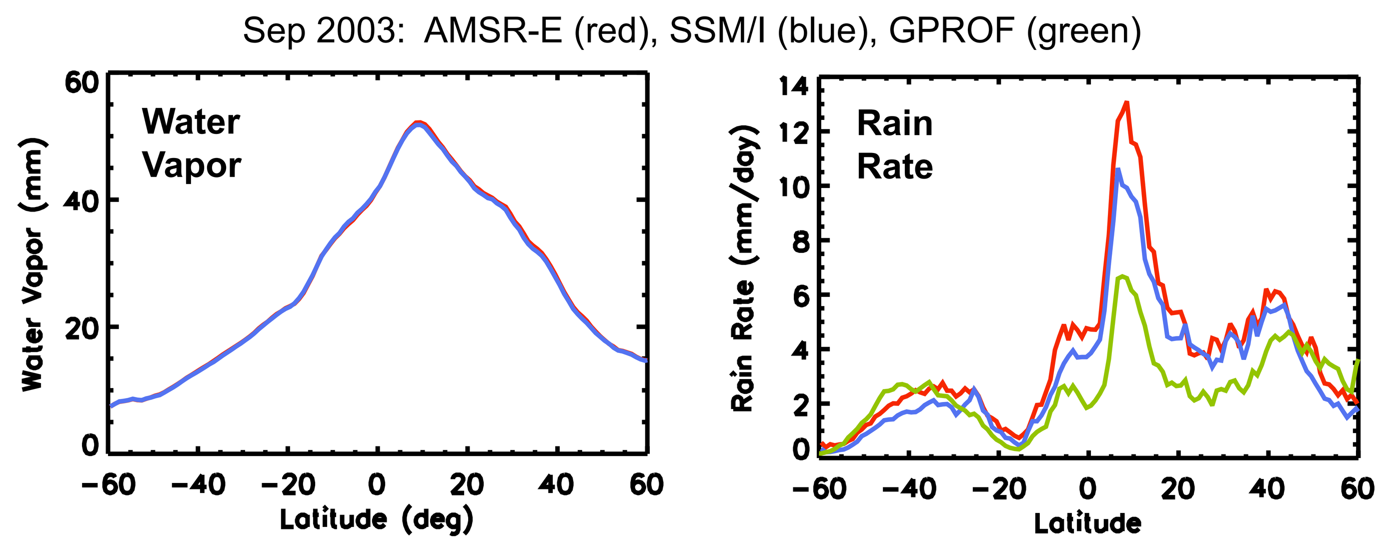
INTRODUCTION



Rain rates from current AMSR-E and SSM/I RSS rain products do not agree. Also, both rain estimates are high relative to established climatology.

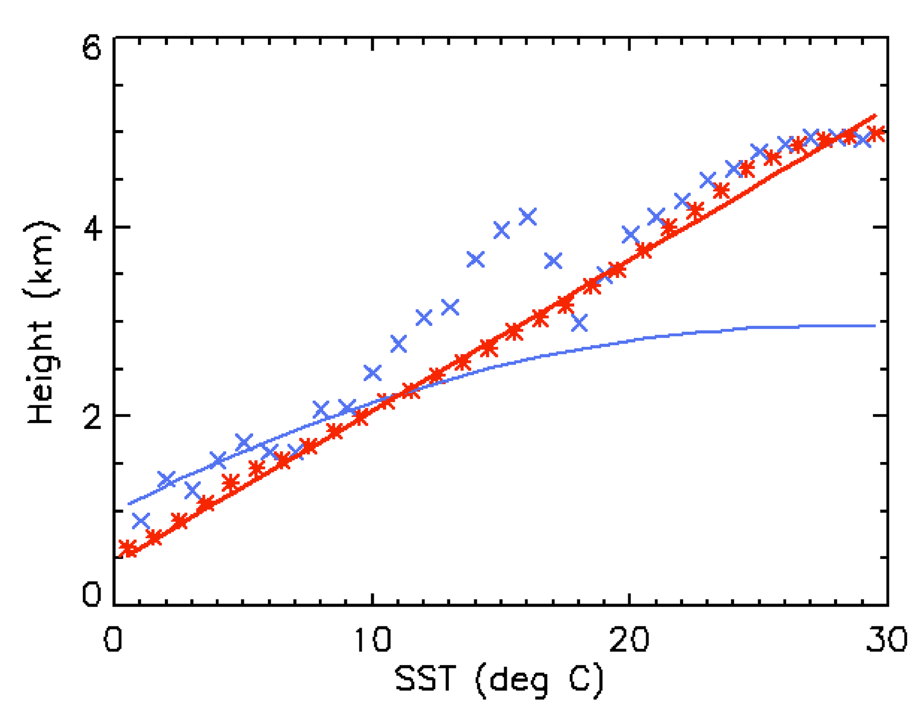
The disagreement is not due to calibration problems. See the water vapor plot (above left) showing the good calibration of these satellites.

Remote Sensing Systems uses the Wentz and Spencer algorithm, not the GPROF algorithm (Wentz and Spencer, *J. Atmos. Sci.*, Vol. 55, May 1998, p. 1613-1627) to retrieve rain rates.

Footprint resolution is the only difference between AMSR-E (12 km) and SSM/I (32 km) not currently included in the Wentz and Spencer algorithm.

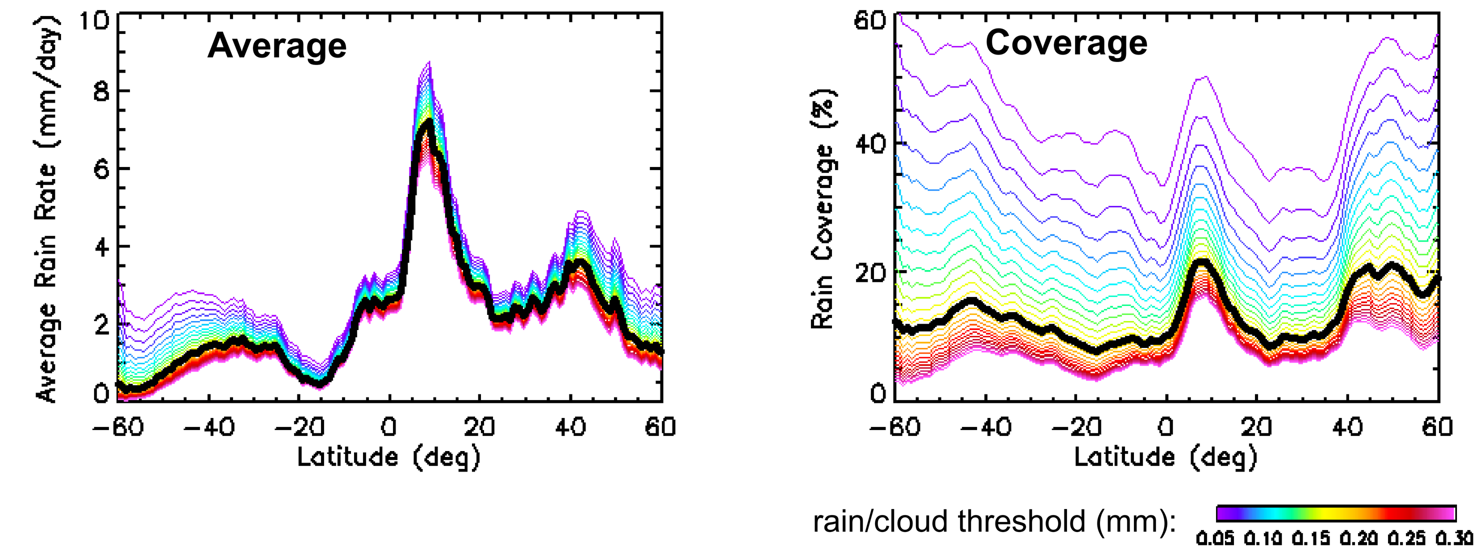
The three sources of uncertainty are: 1) rain column height, 2) cloud-rain partitioning, and 3) beamfilling. Differences in footprint resolution could plausibly affect (2) and (3), but the magnitude of (2) is not large enough to explain the differences.

RAIN COLUMN HEIGHT



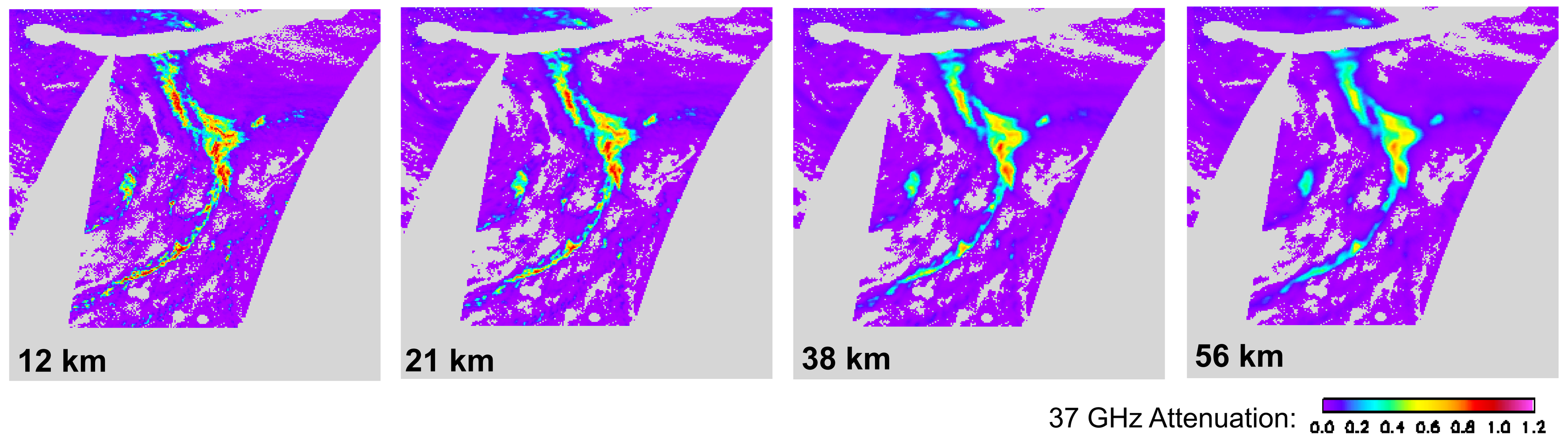
Plotted are: old rain column heights (blue line), new rain column heights (red line), NCEP 0°C height for rain (red asterisk), and radiosonde freezing level for rain (blue X). The bump in the radiosonde heights between 10-20°C is because very few observations are available in this temperature range. The new rain column heights were derived from NCEP.

RAIN/CLOUD PARTITIONING

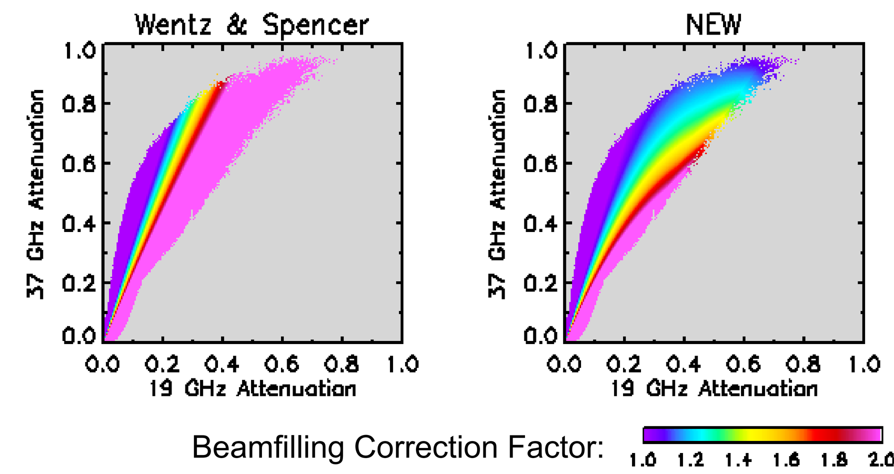


Modest changes in average are associated with large changes in coverage. A typical value of 0.18 mm is used by our algorithm (heavy black line) as the threshold.

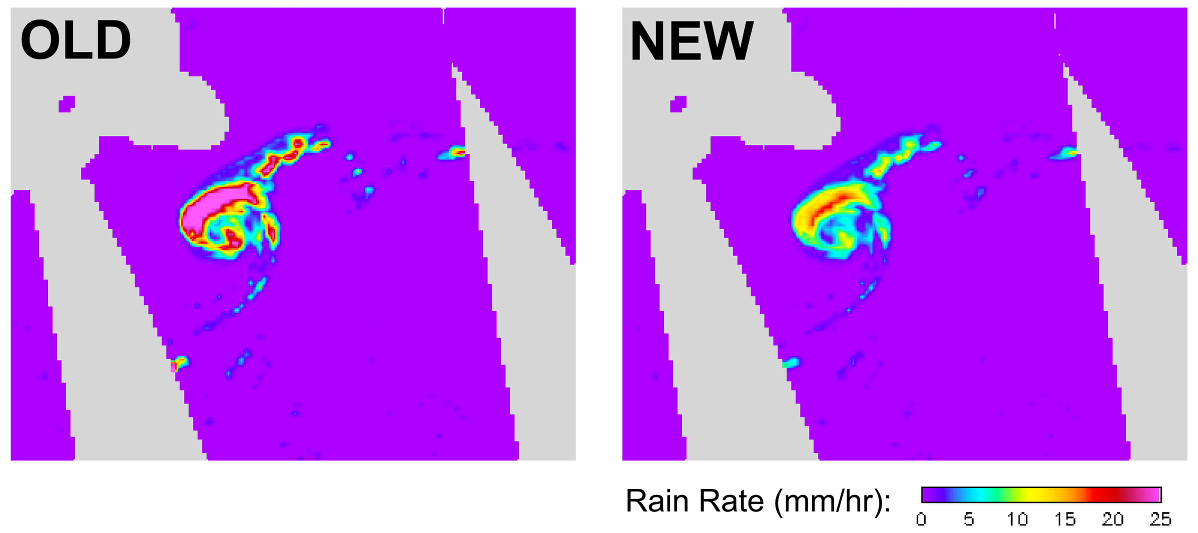
BEAMFILLING CORRECTION



Attenuation retrieved after AMSR-E brightness temperatures were resampled to lower resolutions. Scene average attenuations are: 1.17, 0.95, 0.86, and 0.79 (from left to right) - this biasing is known as the beamfilling effect.

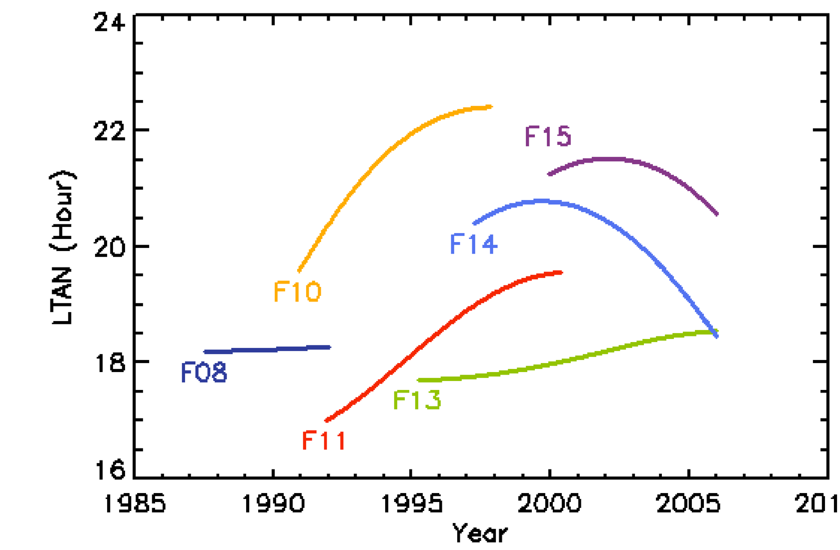


The Wentz & Spencer beamfilling correction uses the 19 to 37 GHz attenuation ratio assuming that liquid in the footprint is spatially distributed following a gamma distribution (left). The new correction also models saturation and footprint resolution dependence (right).

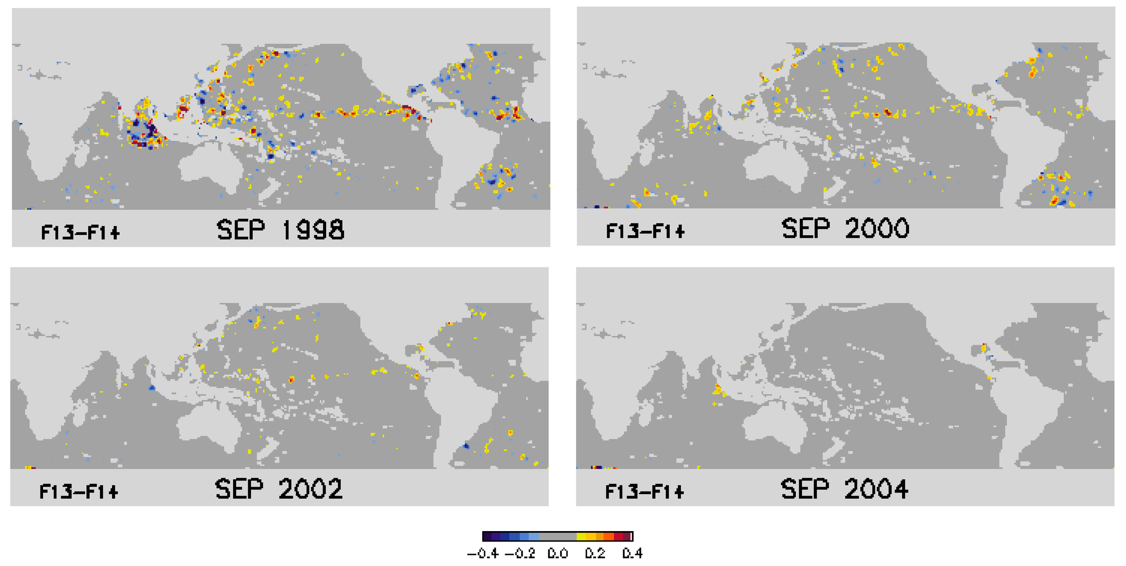


This storm in the North Atlantic illustrates the impact of modeling saturation. Note the changes in the strength of both the center of the storm system and in the isolated showers.

TIME-OF-DAY EFFECTS

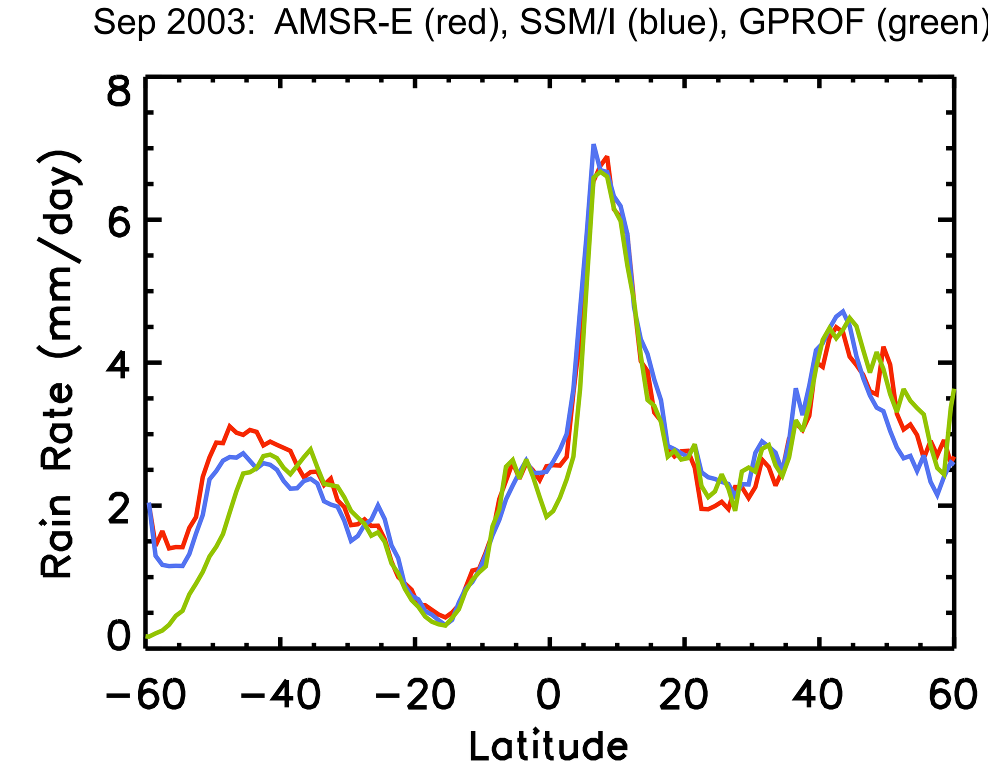


Local equatorial crossing time of ascending node for the DMSP series of SSM/I. Note that F08 is 12 hours out of phase with the others so the descending node time is plotted.



F13 minus F14 rain rate difference maps for Sep 1998 (2:52 hours apart), Sep 2000 (2:40 hours apart), Sep 2002 (1:56 hours apart), and Sep 2004 (0:48 hours apart). This shows that as the F13 and F14 crossing times become closer, the rain rate differences disappear.

NEW RAIN RATES



The new rain rates agree better with other climatologies (due to the change in rain column height) and AMSR-E and SSM/I agree (due to the changes in the beamfilling correction). New AMSR-E rain rates are currently available on www.remss.com. New SSM/I and TMI rain rates will be available by the fall.