

TRMM V7 Roll Corrections

Notes from Steve Bilanow, updated October 4, 2011

This note discusses the roll correction which has been incorporated in V7 processing. These changes will affect the geolocation (latitude and longitude) of pixels on the Earth's surface by a small amount, typically less than a kilometer.

The nominally required accuracy for TRMM pointing is 0.2 degrees, so these errors were originally corrected in V6 products only for the period immediately after the altitude change from 350 to 402.5 kilometers in 2001 when significant control system adjustments were needed. However, since this data provides an incremental improvement in the geolocation accuracy, it was decided to test and apply the corrections for the mission span available when V7 updates were implemented.

The corrections are based on PR surface echo trending data which has been accumulated during V6 processing. It is based on fitting a cosine function to PR-measured roll angles for each orbit:

$$\text{Roll_Error} = A * \cos(\text{Orbit_Angle_Since_Granule_Start} + P) + B$$

where A is the amplitude of the orbit period roll errors, P is the phase angle of the peak roll, and B is a bias in the roll angle. All angles are output in degrees as stored in the file named "geo_roll_corr.dat" for use with the TRMM geolocation toolkit. A constant value of 0.058 degrees was removed from the bias term plotted because this is thought to represent an alignment offset of the PR which is already approximately corrected by the PR ray vector model used by the geolocation toolkit. Large outliers have been replaced by reasonable values based on neighboring orbits. Some remaining zero values occur during periods of non-science-collection with the spacecraft in safe-hold mode.

Figure 1 illustrates the amplitude, phase, and bias values based on this data. The periods where the spacecraft flies with a yaw angle of 180 degrees (with -X forward) have been color coded red (as opposed to black for yaw = 0 in the +X forward orientation)

It should be noted that the orbit period sinusoidal roll variation applies more strictly to the post-boost period (after August 2001). The geolocation toolkit implementation also includes yaw angle coupling with the roll errors as is expected by the post-boost Kalman Filter attitude estimation onboard. Errors in the pre-boost period are more random over each orbit, and this data just picks out the orbit period effects which are probably mainly due to seasonal systematic errors from the Earth horizon sensors.

Note that there are small systematic and random errors in pitch pointing that these corrections do not address. In addition there are different constant alignment offsets in pitch, roll, and yaw for each instrument (particularly noticeable at the ¼ pixel level for TMI) which may get further evaluation in the future.

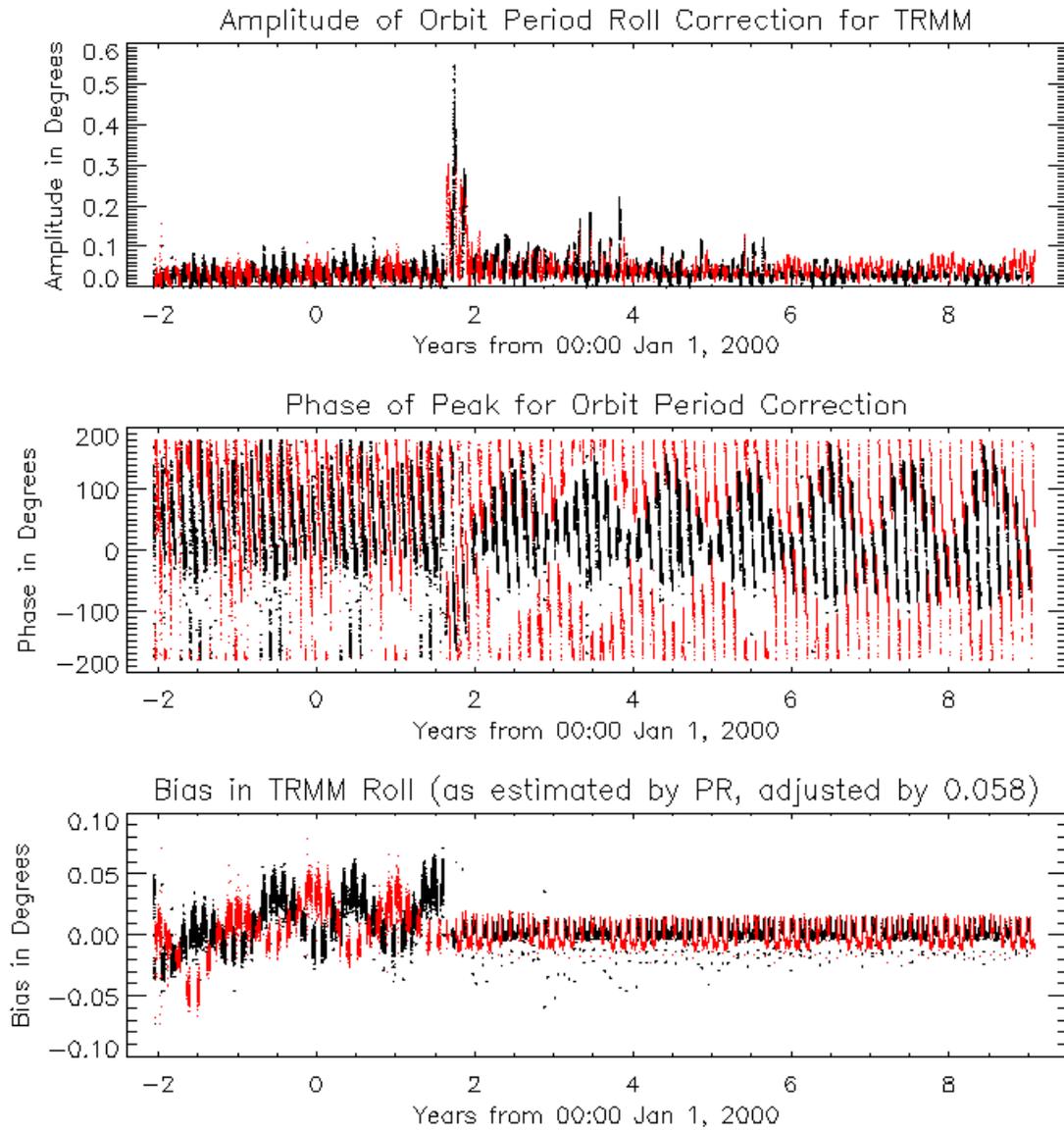


Figure 1. Amplitude, Phase, and Bias values in geo_roll_corr.dat file as of April 16 2009.
 (Note that orbits with Yaw=180 are color-coded in red.)