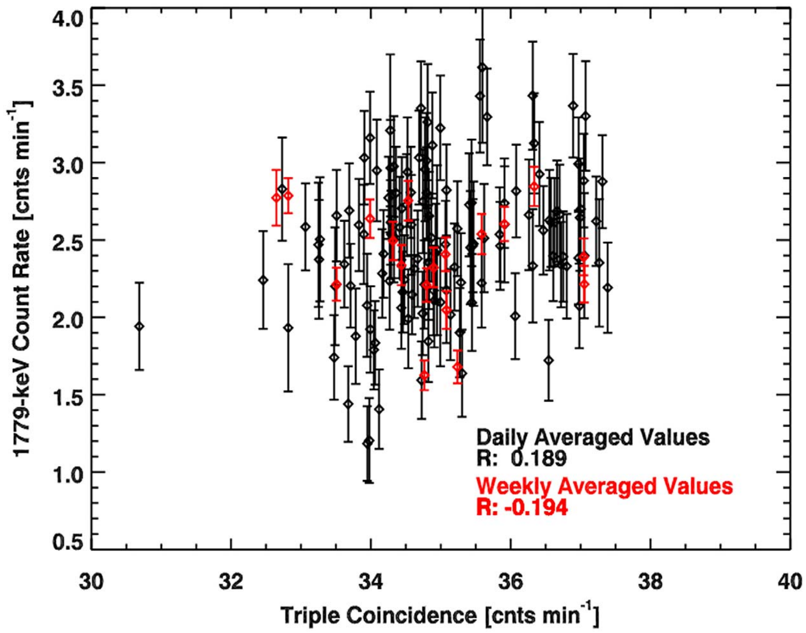

Figure 3. Daily (black) and weekly (red) summed low-altitude 1779-keV Si gamma-ray count rate plotted versus the corresponding high-altitude NS triple coincidence count. The low correlation coefficient (R) demonstrates that GCR-correlated variations in the 1779-keV Si gamma ray are not observed within the statistical uncertainties of the measurements, and so a GCR correction to MESSENGER GRS data is not warranted at this time. The errors for the triple-coincidence measurements are sufficiently small that they are not included in this figure or in the calculation of the correlation coefficient R (see section 3.3).

parameters that were based on fits to summed spectra having lower statistical errors that are scaled by the relative integration times. For example, the high-count-rate 1809-keV gamma-ray peak was used to constrain the τ and σ parameters for the fit to the peaks in the 1779-keV region, and the starting parameters were derived from fits of the entire low-altitude spectrum scaled by the fraction of the integration time for the pixel of interest to the total low-altitude data set.

[20] Fitted peak areas were corrected for the channel size (0.603 keV/channel), data integration period, and detector dead time to produce the measured high- and low-altitude gamma-ray count rates for each peak, along with the one-standard-deviation statistical errors. Examples of the peak fits for Si, K, and Th are shown in Figure 4, and the results are summarized in Table 3 for the high- and low-altitude data sets. The high-altitude measurements are used to define the background contributions to the low-altitude GRS measurements. For the 1461-keV K and 2615-keV Th gamma rays, the high-altitude measurements quantify the spacecraft-originating backgrounds resulting from K and Th contamination in the spacecraft. Subtracting these from the low-altitude measurements results in a determination of the planet-originating signal. For the 1779-keV Si and 6129-keV O gamma rays, the high-altitude measurements quantify the GCR-induced backgrounds. This background varies with the altitude of the spacecraft, and subtracting the high-altitude value multiplied by the altitude-dependent fraction of the spacecraft field of view that is not obscured by Mercury removes this contribution from the low-altitude measurements (see section 3.6 and Appendix C). These background corrections were applied to all data used in the following sections.

3.6. Solid-Angle Correction

[21] The dominant source of variation in the low-altitude gamma-ray count rates is the altitude of the spacecraft (equation (1)). These variations have the potential to mask smaller effects such as compositional heterogeneity on the surface and must be removed by correcting for the altitude-dependent solid angle, $\Omega(h)$, of the measurements. $\Omega(h)$ is defined as the fraction of the 4π-sr unit sphere around the GRS that is subtended by the horizon-to-horizon field of view of the planet as seen by the instrument and is calculated from

$$\Omega(h) = \frac{\int_0^{2\pi}\int_0^{\theta\max} \sin\theta \, d\theta \, d\varphi}{\int_0^{2\pi}\int_0^{\pi} \sin\theta \, d\theta \, d\varphi} = \frac{1 - \cos\theta_{\max}(h)}{2} \tag{4}$$

where the angle from the spacecraft sub-nadir point to the horizon ($\theta_{\max}$) is

$$\theta_{\max}(h) = \operatorname{acos}\left[\frac{\left[(R_M + h)^2 - R_M{}^2\right]^{1/2}}{(R_M + h)}\right] \tag{5}$$

The geometry of the solid angle and its relationship to the spacecraft altitude are discussed in Appendix A. For the purpose of comparative studies of the abundances of elements on the surface, the relative solid angle $\Omega_R(h)$ is defined to be

$$\Omega_R(h) = \frac{\Omega(h)}{\Omega(2000\ \text{km})} \tag{6}$$