# Recommendation for *a-priori* Bias & Scale Parameters for Level-1B ACC Data (Version 2)

(Srinivas Bettadpur, Jun 17, 2009)

**Usage:**

The accelerations contained in the ACC1B data product include an instrument scale and bias offset. The scales & biases for the linear accelerations have been routinely estimated in GRACE data processing for precise orbit & gravity field determination. Using the results of these analyses, a recommendation is made for initial estimates of the scale & bias to apply to the provided ACC1B data time series. The resulting time-series should be closer to true non-gravitational accelerations than the ACC1B time series.

*Note: The recommendation is based on analysis of data between launch and Mar 31, 2009. The quality of the recommendations will progressively worsen as the epoch of the data moves further into the future.*

The bias & scale corrections are supplied separately for each axes of the two accelerometers, and must be used in the sense:

$$f_{new} = bias + scale \times f_{acc1b}$$

The values in this note are provided only as an aid to initiating data analysis from the ACC1B product. Past experience has shown that these parameters can vary a lot depending on the analysis methods, and the context of data usage – and thus it is useful to remind the users that these are values estimated simultaneously with orbit parameters.

Users should expect to refine the estimates of biases & scales for their own specific applications – these values are merely intended to help the users get started.

**Recommended Scales:** The following values of scales are "recommended" in the sense that the biases (next section) were determined with scales held fixed to these values.

| Direction (SRF) | GRACE-A | GRACE-B | Uncertainty |
|---|---|---|---|
| X | 0.9595 | 0.9465 | ±0.002 |
| Y | 0.9797 | 0.9842 | ±0.02 |
| Z | 0.9485 | 0.9303 | ±0.02 |

There is no reason to believe, *a priori*, that the accelerometer instrument scales should be significantly different from 1.0. The user is advised to not eliminate from consideration the use of 1.0 for scale values in all directions, together with the bias values provided in the next section.

**Recommended Biases**

For several reasons the bias estimates (determined once per day in the orbit determination process) can change over time. The day-to-day variability, while complex, can be modeled to within a few percent by a quadratic over a large span. The parameters of the quadratic are provided in this section. The last column of the table gives the standard deviation of the residual daily accelerometer bias estimates relative to the quadratic fit. The general form for the bias is (*the independent $T_d$ is the Modified Julian Date*):

$$bias = c_0 + c_1(T_d - T_0) + c_2(T_d - T_0)^2$$

The curves have been fit to daily estimates in two separate data spans – before March 7, 2003; and after March 7, 2003. The same values of scales may be used with either estimate of bias. *Note that the reference time $T_0$ is different for each span.*

All entries in the tables have units of $\mu/s^2$.

*For Data Before March 7, 2003:* ***Use $T_0$ = 52532***

| Direction | C0 | C1 | C2 | Residual |
|---|---|---|---|---|
| **Grace-A Xsrf** | -1.106 | 2.233E-4 | 2.5E-7 | 0.003 |
| **Grace-A Ysrf** | 27.042 | 4.46eE-3 | 1.1E-6 | 0.053 |
| **Grace-A Zsrf** | -0.5486 | -1.139E-6 | 1.7E-7 | 0.019 |
| | | | | |
| **Grace-B Xsrf** | -0.5647 | -7.788E-5 | 2.4E-7 | 0.002 |
| **Grace-B Ysrf** | 7.5101 | 7.495E-3 | -9.6E-6 | 0.080 |
| **Grace-B Zsrf** | -0.8602 | 1.399E-4 | 2.5E-7 | 0.020 |

*For Data After March 7, 2003.* ***Use $T_0$ = 53736***

| Direction | C0 | C1 | C2 | Residual |
|---|---|---|---|---|
| **Grace-A Xsrf** | -1.2095 | -4.128E-5 | 9.7E-9 | 0.002 |
| **Grace-A Ysrf** | 29.3370 | 6.515E-4 | -3.9E-7 | 0.056 |
| **Grace-A Zsrf** | -0.5606 | -2.352E-6 | 3.8E-9 | 0.020 |
| | | | | |
| **Grace-B Xsrf** | -0.6049 | -1.982E-5 | 3.5E-9 | 0.002 |
| **Grace-B Ysrf** | 10.6860 | 1.159E-3 | -4.3E-7 | 0.076 |
| **Grace-B Zsrf** | -0.7901 | 4.783E-5 | -6.5E-9 | 0.020 |