1.9 Greatest Eclipse and Greatest Duration

Greatest Eclipse is defined as the instant when the axis of the Moon's shadow passes closest to the center of Earth. The computation of the duration of the total (or annular) phase at this point is typically done using a smooth Moon that ignores the effects of mountains and valleys along the lunar limb. For total eclipses, the instant of *Greatest Eclipse* offers a very good approximation (typically within 0.1 seconds) to the *Greatest Duration* of totality along the entire eclipse path.

Because of its rigorous geometric definition, the instant of *Greatest Eclipse* is easily calculated for total, annular and partial eclipses, and is the standard time used for comparing different eclipses with each other. For example, the time and date of each eclipse in the *Thousand Year Canon of Solar Eclipses: 1501 – 2500* (Espenak 2014) corresponds to the instant of *Greatest Eclipse*.

Greatest Duration is defined as the instant when the length of the total (or annular) phase reaches a maximum along the central eclipse path. The computation of the eclipse duration is again done using a smooth Moon that ignores the effects of mountains and valleys along the lunar limb. Although the location of *Greatest Duration* may be relatively close to the point of *Greatest Eclipse*, it differs slightly because of several factors including Earth's oblateness, the relative motion of the Moon's shadow with respect to Earth's Equator, and the latitude of the shadow axis.

The length of the total eclipse calculated at *Greatest Duration* is typically 0.1 seconds longer compared with *Greatest Eclipse*, and the geographic location typically differs by ~75 kilometers. These values are based on the 67 central total solar eclipses occurring during the 21st Century. The statistics for *Greatest Eclipse (GE)* vs. *Greatest Duration (GD)* for these eclipses are as follows.

Greatest Eclipse and Greatest Duration for Total Solar Eclipses of the 21st Century

Statistic	Duration (GD–GE)	Distance (GD-GE)
Average	0.084 sec	74.2 km
Std. Dev.	0.138 sec	66.2 km
Minimum	0.000 sec	2.5 km
Maximum	0.608 sec	251.6 km

Unlike *Greatest Eclipse*, there is no explicit or analytical solution for the determination of *Greatest Duration*. It may be calculated though an iterative series of approximations. When the highest accuracy is needed, a *Corrected Greatest Duration* must be calculated that includes the effects of the Moon's limb profile, which may differ by a couple seconds from the uncorrected value. (see next section)

The table below summarizes the values for *Greatest Eclipse* and *Greatest Duration* for the total solar eclipse of 2017 August 21. The central line duration of totality is 0.13 seconds longer at the point of *Greatest Duration*, which lies 144.4 km west of the point of *Greatest Eclipse*.

Greatest Eclipse and Greatest Duration for 2017 August 21

Event	Time (UT1)	Latitude	Longitude	Duration
Greatest Eclipse:	18:25:31.7	36°58.0'N	087°40.3'W	02m40.12s
Greatest Duration:	18:21:49.0	37°34.6'N	089°06.6'W	02m40.25s

