EARTH-SUN NUMERICAL VALUES

Mean Earth-Sun Distance (center to center) = 1.49597870691 X 10^{11} meters
The mean earth-sun distance has been calculated from both radiometric and optical measurements. It is the mean distance from the center of the Earth to the center of the Sun, averaged over the geometric ellipse of the Earth's orbit. For climatic purposes, a value averaged over time (vernal equinox year) would be more accurate. However, the difference is likely to be slight.

Mean Solar Radius = 6.96 X 10^8 meters
Since the Sun's photosphere is both gaseous and turbulent, a more precise average is not possible at this time.

Mean Earth Equatorial Radius	**= 6.3783774 X 10^6 meters**
Mean Earth Polar Radius	**= 6.3568927 X 10^6 meters**
Mean Earth Radius	**= 6.3712158 X 10^6 meters**

Mean Photon Travel Distance (D) = 1.488955 X 10^{11} meters
This distance (D) is the mean distance that a photon must travel from the photosphere of the Sun to the surface of the Earth. This value is easily obtained by taking the mean center-to-center distance, and subtracting the respective values for the equatorial radii of the Earth and the Sun.

Eccentricity of Earth's Orbit (e) = 0.016726
This is the departure of the earth's orbit from a perfect circle. A perfect circle has an eccentricity of zero. This eccentricity defines the elliptical path of the earth as it orbits the sun. It changes slowly over a cyclic period of approximately 100,000 years. The minimum value during that long cycle is close to zero. The maximum value is close to 0.06. This cycle is one of the three cycles used in the Milankovich Hypothesis. This hypothesis attempts to explain continental glaciation events.

Mean Photon Travel Distance at Perihelion D X (1 - e) = 1. 4640507 X 10^{11} meters
This is the distance from the surface of the Earth to the Sun's photosphere at the Earth's closest approach to the Sun. Perihelion occurs on or about the 4th of January each year. This date will vary from the 2nd to the 5th depending upon how close the current year is to a leap year and depending upon which date zone you happen to be in at the instant of perihelion.

Mean Photon Travel Distance at Aphelion D X (1 + e) = 1.5138592 X 10^{11} meters

This is the distance from the Earth to the Sun at the farthest point on the Earth's orbit. This point on the orbit will be reached on or about the 4th of July each year. This date will vary from the 3rd to the 7th depending upon how close the current year is to a leap year and depending upon which date zone you happen to be in at the instant of perihelion.

Vernal Equinox Year = 365.2424 days = 3.155694336 X 10^{7} seconds

This is the average amount of time it takes to go from one March Equinox to the subsequent one. It is a true climatic year, and well suited to climatic calculations. This year varies slightly over time, but should be good for calculations during the next millennium or so.

Mean Area of the Earth's Global Disc = 1.2779511 X 10^{14} square meters

This is the effective interception area of incoming solar radiation. It is calculated using the mean Earth radius given above, plus and additional 6750 meters. This latter figure is an estimate of the mean molecular height above the surface of the Earth of the molecules of the atmosphere. Since the atmosphere absorbs a significant portion of the incoming solar radiation, it cannot be omitted from consideration. This area is used only in calculations of absorption and reflection of incoming solar radiation by the atmosphere alone.

Mean Area of the Solid/Liquid Disc = 1.2752475 X 10^{14} square meters

This is the effective interception are of incoming solar radiation intercepted by the Earth's land and ocean areas. This area is used in calculations of absorption and reflection of incoming solar radiation by the surface of the Earth.

Solar Constant = 1,366.1 watts per square meter

Sensing instruments on artificial satellites have measured incoming solar radiation (insolation) at the outside of the earth's atmosphere. They have detected and measured small variations from time to time over the course of minutes and days. They have detected and measured much larger variations over the course of the year. It is very likely that there are even longer-term variations; that is, over decades and over centuries. However, since we have been making such measurements only since the late 1970's, the record is too short to produce any reliable estimate of such long-term variations.

The average of these readings of incoming solar radiation over a period of some twenty-two years (two complete eleven-year sunspot cycles) is termed the *Solar Constant*, and amounts to roughly 1,366.1 joules per square meter per second, measured normal to the incoming radiation. The actual value given above is a constant (until revised), but the amount of insolation per unit area and unit time is not a constant. It is a variable.

Mean Insolation at Perihelion = 1,413 watts per square meter

This is the value for insolation at the outside of the Earth's atmosphere at perihelion (the first week in January). It is measured normal to the plane of the Earth's effective disc. It represents an increase of 3.43% over the mean orbital value.

Mean Insolation at Aphelion = 1,322 watts per square meter
This is the value for insolation at the outside of the Earth's atmosphere at aphelion (the first week in July). It is measured normal to the plane of the Earth's effective disc. It represents a decrease of 3.26% over the mean orbital value.

Annual Global Budget Constraint = 5.50924 x 10^{24} joules per year
This is the mean amount of energy that arrives at the outside of the Earth's atmosphere over the course of a year. It is a simple multiple of the Solar Constant times the Earth's effective global disc times the number of seconds in a vernal equinox year. The amount of energy that leaves the Earth during that time must be very close to that number. Some of this incoming energy will be stored by various chemical, physical and biological processes; and some previously stored energy will be released. Nevertheless, it is a useful constraint in developing annual heat budgets.

