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Rise and Set Definitions

Horizon: Wherever one is located on or near the Earth's surface, the Earth is perceived as essentially flat and, therefore, as a plane. The sky resembles one-half of a sphere or dome centered at the observer. If there are no visual obstructions, the apparent intersection of the sky with the Earth's (plane) surface is the horizon, which appears as a circle centered at the observer. For rise/set computations, the observer's eye is considered to be on the surface of the Earth, so that the horizon is geometrically exactly 90 degrees from the observer's zenith.

Rise, Set: During the course of a day the Earth rotates once on its axis causing the phenomena of rising and setting. Excluding circumpolar objects, celestial bodies – stars and planets included – seem to appear in the sky at the horizon to the East of any particular place, then to cross the sky and again disappear at the horizon to the West. The most noticeable of these events, and the most significant in regard to ordinary affairs, are the rising and setting of the Sun and Moon. Because the Sun and Moon appear as circular disks and not as points of light, a definition of rise or set must be very specific because not all of either body is seen to rise or set at once.

Sunrise and sunset conventionally refer to the times when the upper edge of the disk of the Sun is on the horizon. Atmospheric conditions are assumed to be average, and the location is in a level region on the Earth's surface.

Technical Definitions and Computational Details

For computational purposes, sunrise or sunset is defined to occur when the geometric zenith distance of center of the Sun is 90.8333 degrees. That is, the center of the Sun is geometrically 50 arcminutes below a horizontal plane. For an observer at sea level with a level, unobstructed horizon, under average atmospheric conditions, the upper limb of the Sun will then appear to be tangent to the horizon. The 50-arcminute geometric depression of the Sun's center used for the computations is obtained by adding the average apparent radius of the Sun (16 arcminutes) to the average amount of atmospheric refraction at the horizon (34 arcminutes).

Accuracy of rise/set computations. The times of rise and set phenomena cannot be precisely computed, because, in practice, the actual times depend on unpredictable atmospheric conditions that affect the amount of refraction at the horizon. Thus, even under ideal conditions (e.g., a clear sky at sea) the times computed for rise or set may be in error by a minute or more. Local topography (e.g., mountains on the horizon) and the height of the observer can affect the times of rise or set even more. It is not practical to attempt to include such effects in routine rise/set computations.

The accuracy of rise and set computations decreases at high latitudes. There, small variations in atmospheric refraction can change the time of rise or set by many minutes, since the Sun and Moon intersect the horizon at a very shallow angle. For the same reason, at high latitudes, the effects of observer height and local topography are magnified and can substantially change the times of the phenomena actually observed, or even whether the phenomena are observed to occur at all.