

NIGHTTIME ASTRONOMICAL CALENDAR

By John Thorstensen, Dartmouth College
with a Web interface by [Brian Casey](#).

This web page uses a slightly older version of skycalendar; the changes since have been minor. The most recent version is available, packaged with [skycalc](#), via [anonymous ftp](#). The following are the notes from the program.

http://imagiware.com/astro/skycalendar_notes.html

This calendar is designed to provide information useful for the planning of nighttime observations. The format should minimize confusion; each line gives the phenomena for a single (local!) night, and each line is labeled with both evening and morning (local) day and date. Note that all times given are LOCAL CIVIL (zone) times.

The rise/set times printed are the times at which the center of the object is 50 arcminutes below the geometrical horizon. At the given twilight, the center of the sun is 18.0 degrees below the geometrical horizon.

The moon positions (and rise/set times) are generated by an implementation of the Low-Precision formulae in the *Astronomical Almanac*. The *Almanac* states that the error seldom exceeds 0.3 degrees. Topocentric corrections are included. Comparisons with tables for Kitt Peak in the *NOAO Newsletter* indicate that the rise-set times are good to + 2 min or so. The moon's RA, Dec, and illuminated fraction are given for local midnight, regardless of whether the moon is actually up at that time. Note that the moonrise and moonset times are not printed if they occur near mid-day.

The LST at evening and morning twilight are tabulated. This gives an accurate idea of the range of RA's accessible during the night.

The JD is given (severely rounded off) for local midnight. Again, this avoids any ambiguity.

Credits:

The sidereal time and Julian date routines were originally coded in PL/I by Steve Maker of Dartmouth College. The algorithms originated in the old *American Ephemeris*. The routine to convert JD back to calendar date is adapted from *Numerical Recipes in C*, by Press et al.

Cautions:

I believe that the program which generates these tables is reasonably accurate. However, it has not been exhaustively tested, so you should be sure to run 'sanity checks' on the results. Also, in view of the approximations used, the results should not be used when high precision is needed. Extension to dates far from the present (1990) should be done with great caution. The code has not been tested for the

eastern or southern hemishpheres. Rise/set times are slightly incaccurate and rather confusing at circumpolar latitudes, where the concept of a 'night' is blurry.

The daylight savings time conventions (if used) are quite specific (to U. S., post-1986) and subject to change. I know that the code has many infelicities; if you should find actual errors, please notify John.Thorstensen@dartmouth.edu

This output comes from a (hopefully) portable, completely self-contained program in the c language. It is available from the author and may be used freely for scientific or educational purposes. If you use it for profit, please contact the author to arrange a (modest!) fee. Source code is copyright John Thorstensen, 1990.

Web version

Brian Casey has written the web wrapper around skycalc for some specific calculations. I (BC) make no guarantees that the web form is bug free. Please let me know of any problems at bcasey@imagiware.com.

Skycalc v4

By John Thorstensen, Dartmouth College
with a Web interface by [Brian Casey](#).

Skycalc is a program useful for performing many calculations, some of which I have provided a Web interface for. The code for skycalc, packaged with [skycalendar](#), may be obtained via [anonymous ftp](#).

Accuracy

The distinctions between UTC, UT1, TDT (etc.) are ignored except that a rough correction to TDT is used for the moon. The solar ephemeris used is good to a few arcsec. Moon positions are topocentric and +/- about 30 arcsec, hence solar eclipse paths are +/- 50 km and +/- 1 min. All rise/set times are computed to about +/- 1 min; non-level horizon, site elevation, and refraction uncertainties are often larger than this.

The lunar sky brightness model assumes ideal atmospheric conditions; true lunar contributions to sky will vary widely. To compare a dark site has about $V=21.5$ mag/sq.arcsec (variable)! Twilight brightness prediction is for blue, and only very approximate.

The planetary calculations are truncated, but the error should seldom exceed 0.1 degree; MV are best(1'), MJSU ok, Pluto worst.

Note that the local sidereal time given is Mean, not true, and that it assumes the input is true UT, not UTC (< 1 second)

Daylight savings time, if selected, is established using a site-specific convention (e.g., USA). Beware of ambiguities and nonexistent times when the clock is reset. If necessary, use the 'g' option and enter times and dates as Greenwich (UT), or disable DST in site params (see discussion under 'i').

The **precession** routine used is a 'rigorous' rotation matrix routine, taken from L. Taff's *Computational Spherical Astronomy*. It uses IAU1976 constants, is good to < 1 arcsec in 50 years, and has no troubles near the pole. Proper motion corrections are done crudely as $x = x_0 + \mu * dt$; this is inaccurate near the poles. Use another routine if sub-arcsec accuracy is critical. Apparent place (with nutation, aberration) is NOT computed.

The parallactic angle follows Filippenko (1982, PASP 94, 715).

The barycentric ('heliocentric') corrections are computed using an elliptical earth orbit with a few periodic perturbations including lunar recoil. The helio-to-barycentric transformation uses the same algorithms as the planetary positions. Overall max error: < 0.2 sec and < 0.005 km/s. Velocity correction includes earth rotation.

The galactic coordinate routine is rigorously accurate, and precesses to 1950 before transforming. The ecliptic coord. routine is for coordinates of date and is good to < 1 arcsec.

These routines are **not necessarily correct** at times very far from the present (1990s). The program rejects input outside 1900-2100.

When porting to a new machine, run tests to ensure correctness and accuracy. Experience shows that compiler peculiarities arise surprisingly often.

Cautions, Legalities

Many routines take a time argument which is a double-precision floating-point julian date; on most workstations, this gives time resolution of < 0.1 second. When porting to another machine or compiler, test that the accuracy is sufficient.

I (JT) cannot guarantee that this program is bug-free, and caution that not all routines are thoroughly precise and rigorous. The user of this program is responsible for interpreting results correctly. I disavow any legal liability for damages caused by use of this program.

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John.Thorstensen@Dartmouth.edu

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bcasey@imagiware.com.