A Guide to LunaCal Version 5.6

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The primary purpose of LunaCal is to provide calendrical dates which are somehow connected to the Moon. Thus for a given year LunaCal will produce tables of the phases of the Moon, a calendar, dates of the Jewish, Islamic, Indian and Chinese New Year, Easter, Ash Wednesday and Ramadan. The dates of solstices and equinoxes are also shown as are the various eclipses during that year. More detailed information on eclipses with regard to global and local circumstances are also available. For total and annular eclipses a world map showing the center line can be drawn.

In addition to this LunaCal can convert (Julian or Gregorian) calendar dates into the respective dates the Hebrew, Islamic, (civil) Indian and Chinese calendars. It also calculates the position of the Sun and the Moon as well as the times for rise and set and the civil, nautical and astronomical twilight.

New in Version 4.0: Use of the Qt library to enable LunaCal to run under Linux as well as under Windows. Some slight changes to the user interface compared to former version but otherwise identical to version 3.8.

New in Version 4.1/4.2: "Special Eclipse" feature which allows to calculate solar eclipses for surfaces other than the Earth surface (for the height of satellite orbits to check eclipse conditions there).

New in Version 4.3: Yearly totals can be calculated for sunshine hours, twilight and moonshine hours at the specified location.
New in Version 4.4: Dates for negative Julian Day numbers are now possible.
New in Version 4.5/4.6/4.7: A small correction to the calculation of lunar phases. Some internal recoding to increase compatibility among different compilers.
New in Version 5.0: Changed from Qt3 to Qt4 library. Maps are also available as Northern and Southern Hemisphere stereographic projections and as a physical map.

New in Version 5.1 / 5.2 /5.3: Lunar phase as fraction between 0 and 1 added to Sky Details.

New in Version 5.4: Fixed a problem with floating point numbers in different localizations.

New in Version 5.5 / 5.6: Solar Panel Statistics introduced. Small change to low magnitude solar eclipse calculation.

Contents

1 Installation and Running

1.1 System Requirements

LunaCal runs under Windows as well as under Linux.

1.2 Installation

Simply unpack `LunaCal_5.6_Win.zip` for Windows or `LunaCal_5.6_lx.tar.gz` for Linux to obtain the `LunaCal` directory. No special setup is necessary.

1.3 Starting and Exiting LunaCal

Simply click the `LunaCal.exe` icon (under Windows; `lunacal` or `lunacal64` under Linux) in the folder you created or on the desktop (if you placed a shortcut there). Upon starting, LunaCal normally expects a file with the name `lunacal.cfg` to be present in the respective folder. This file contains the configuration of the last run of LunaCal (like the timezone and geographic coordinates used). If this file is not present default values will be used for the start up (this will be the case for the first run).

To Exit LunaCal, select `File`, then `Exit` or click the Windows close icon in the upper right corner. Note that there is a difference between these two exit options. Using the `File-Exit` menu option will cause LunaCal to write the currently selected geographic coordinates, timezone etc. to the file `lunacal.cfg`. These values will then be used for the initialization of the next LunaCal run. If you exit LunaCal by clicking the windows close icon nothing will be written to the file Lunacal.cfg and the current configuration will not be preserved.

1.4 Accelerator keys / hot keys

As with other programs, menu items can be activated by mouse click or by key selections. There are also special accelerator keys like `<crtl>` + `D` for the Date dialog. For lazy people like me who don't want to press two keys at once LunaCal allows to enter just the letter without the `<crtl>` key. The lazy method works great but has one small problem: Some mouse operations will cause he focus to shift and LunaCal might not respond to your key input. The recovery is simple: Just press the `<crtl>` key (as you should have done anyway!) once.

2 Input

LunaCal lets you select the year, timezone, delta-time and location (the last two items are only of importance for details of eclipse calculations).

2.1 Input of the Year:

Select `Input`, then `Date` or click the `Date` icon. Alternatively you can press `D`. Enter the respective year (the current year is default at the beginning of the run).

There are no particular restrictions with regard to the year, however if you move more than a few thousand years into the past or the future some calculations might no longer be accurate enough and others (like certain holidays) simply wouldn't make sense (like Christian holidays before the birth of Christ or Islamic holidays before the birth of the Prophet Mohammed). Use some critical judgement of what you can do with LunaCal.

NOTE: LunaCal takes the year before the year 1 as year `0`. This year will be labelled as 1 B.C. by historians. Thus to find the total eclipse of the year 585 B.C. (one which allegedly led to the end of a long standing war in Greek history) you would have to enter the year as `-584`.

2.2 Input of the Timezone:

Select `Input`, then `Date` or click the `Date` icon.

Timezones toward the East are positive. To enter half hour timezones add 0.5 (e.g. for India `+5.5` and NOT 5.30!) Eastern Standard Time in the U.S.A (e.g. New York) would be `-5`, Singapore `+8`. There is no provision for daylight savings time (summer time) as the change to standard time is different in different countries (if it is used at all). So you must decide on one timezone for the whole year or perform two seperate calculations per year with one for the standard time, the other for the summer time. Sorry! If you enter values >14 or <-14, the timezone will be set to `0` as those timezones don't exist.

Note: The timezone you enter here does not have to agree with the timezone you entered on your system but is simply the timezone used for outputting the various times.

2.3 Input of Delta TT - UT:

This is only of importance for eclipse calculations and you can normally use the default. The deviation of this default value from the actually determined value is at most 2 seconds for any year of the 20st century and probably also for the first one or two decades of the 21st century (the correct future values however can only be determined by proper mesurement). Somewhat larger deviations can be expected for other centuries (past or future) but the default usually provides resonable values. Only if you know exactly what this whole delta-time is all about and if you have your very own opinion on what value to use do you ever want to enter a manual value here. Everyone else: Keep the default! To set it manually, select `Input`, then `Delta-Time`. De-select the `Use Default` checkbox, then enter your value of TT - UT in seconds. To set it back to default, mark the `Use Default` checkbox.

2.4 Input of Location:

This is only needed for the local circumstances of eclipses and for the Sky Details window. There is no need to specify a location if you are only interested in some of the other options.

Select `Input`, then `Location` or click the Location icon. The latitude and longitude of the location can be entered either in decimal degrees (meaning degrees and fraction of a degree) or in degrees, minutes and seconds. To enter geographic latitude and longitude in decimal degrees mark the `Decimal Degrees` radio button. For angles in Degrees, minutes and seconds mark the `DD.MMSS` radio button; (in this case an angle of e.g. 49° 52′ 48" has to be entered as `49.5248`. This angle would be equivalent to `49.88` decimal degrees) North is positive, South negative, East is positive and West is negative. The height is in meters. The name of the location is abitrary text but limited to 25 characters. The setting of the `Decimal Degrees / DD.MMSS` radion button will also affect the way in which the coordinates of the center line for central eclipses is displayed and vice versa. See section 5.

3 Phases of the Moon, Solstices and Equinoxes

Select `Calculate`, then `Moon Phases` or click the `Moon Phases` icon.

A table with the lunar phases (New Moon, First Quarter, Full Moon and Last Quarter) will appear. In addition the dates of solstices and equinoxes as well as the dates of lunar and solar eclipses for the selected year will be shown. The times given are with regard to the selected timezone and are typically accurate to within about two minutes at the present epoch (but will deviate more the further you go forward or backward in time). (The times given for the eclipses refer to the approximate global maximum of the respective eclipse. The overall event happens for a few hours around this time.)

4 Display the Calendar

Select `Calculate`, then `Calendar` or click the `Calendar` icon.

A calendar for the respective year will appear. To see the calendar as a whole you should maximize the window (click the middle button at the upper right corner of the window). Up to 4-OCT-1582 the Julian Calendar is used, then from the next day on (15-OCT-1582) the Gregorian Calendar. The Julian Calendar is extended to years earlier than -45 (the official inauguration year of the Julian Calendar) to enable cronological dates before Caesar's reform (Julian Proleptic Calendar).

Note that LunaCal automatically switches between the Gregorian and Julian Calendar depending whether the date is before or after 15-OCT-1582. The actual introduction of the Gregorian Calendar occured during different years (and even centuries) in different countries so that you should be careful with

corresponding historical dates. There might be a discrepancy if the Julian Calendar was still in used after 1582 by whoever came up with that date.

5 Calculate Details of Eclipses

Select `Calculate`, then `Eclipses` or click the `Eclipse` icon. A list of all eclipses of the year appears. Click the the respective line to get the details of that eclipse. (Or yor can key in the respective number). The global beginnning and end times of the various phases of the selected eclipse will be displayed as will the time and magnitude of maximum eclipse. Also shown will be the local circumstances with regard to the geographic location selected. This means whether the eclipse is visible from that site and at which times and in case of solar eclipses the maximum magnitude of the eclipse as viewed at that site and also the corresponding elevation of the sun at the corresponding time.

In case of a central solar eclipse, a table will be displayed with the time, latitude and longitude of the center line at that time, duration of totality or annularity in sec, path width (in km) and elevation of the Sun at that position. During the rare occurrence of a combined annular/total eclipse (like the one on 8-APR-2005 an `a` or a `t` will precede each line in the center line listing to indicate whether the eclipse was annular or total at that moment. The time step for the center line coordinates can be set via the `View`, `Eclipse Settings` menu (see section 8.1). The latitude and longitudes can be dispayed either in decimal degrees or in degrees.minutes whatever the respective setting was selected under the Entry of Location window (see section 2.4). (An angle of 47°43′ would be displayed as `47.43` if the `DD.MMSS` option was selected but as `47.71` if the `decimal degrees` option was selected.)

The accuracy of the eclipse calculations is normally within one minute for the general dates and within a few seconds for the times of totalities or annularities (for years around the present epoch). For most of the central eclipses the center line coordinates and the width of the zone of totality or annularity is within a few kilometers of their actual value over much of their path. Larger deviations do occur at the beginning and end (during low sun angles) of the eclipse or for polar eclipses with a low sun angle. The general circumstances of solar eclipses are calculated without atmospheric refraction however for the local circumstances a standard correction for refraction is being applied (consequently there may be some minor discrepancies in the data shown for local as compared to global circumstances). Likewise, for lunar eclipses a standard correction for the Earth's atmosphere is being done. Thus for most preliminary planning purposes the accuracy of LunaCal will probably be enough except if higher precision at the beginning or end or at the edge of the zone of totality or annularity for central eclipses is required. Of course, LunaCal cannot compete in accuracy with eclipse bulletins prepared for specific eclipses and you are advised to consult those bulletins when making detailed plans for eclipse observations.

In some rare "borderline" cases when the Moon's umbra barely touches the

Earth, LunaCal might label the a solar eclipse as a very deep partial one instead of non-central total or annular. The next such case is the non-central annular eclipse of 29-April-2014 which LunaCal will label as "partial" with a maximum phase of 0.99. (The local circumstances, however, will be correctly marked as `total/annular` if a suitable location was entered. Try for example 70deg, 38.7 min South and 131deg, 19.9 min East for the just mentioned eclipse.) In most such cases, however, (like the following one in the year 2043 when there is a non-central total eclipse on April 9 as well as a non-central annular one on October 3) will be handled correctly by LunaCal.

When selecting the details for a solar eclipse a map of the eclipse will be displayed. The position of maximum eclipse is shown as a green circle and the northern and southern limits of the penumbra are marked by black lines (often there is only a northern or a southern limit but not both). The curves which outline the areas where the eclipse happens at sunrise or sunset are shown in purple. For central eclipses the central line will be displayed in 1 minute steps. Total eclipses are shown in blue, annular ones in red. (The speed of the shadow is much faster at the beginning and end of an eclipse resulting in seperate dots as compared to a continuous line during the middle of the eclipse).

When you move the mouse over the eclipse map the cursor will change to crosshairs. When clicking the (left or right) mouse button LunaCal will display the local circumstances of the respective position on the map. Click the `OK` button or `<esc>` to continue. By thus clicking at different points on the map you can find out about where the eclipse is visible in what way.

The lines for the northern and/or southern limits of the eclipse help delineate the area in which the eclipse is visible. Also shown are the lines of sunrise and sunset which form the remaining parts of the delineation. If the northern as well as the southern limit is shown (which will be the case for central eclipses which happen close enough to the equator) two seperate areas where the eclipse starts or ends at sunrise or sunset will appear. Each of the area is delineated by two segments which look like an elongated teardrop. Often, however, only a northern or a southern limit will appear (this is always the case for partial eclipses) in which case the two areas join and the curve of eclipse at sunrise and sunset forms a distorted figure-eight. Of the two segments which delineate a sunrise/sunset area the outermost one is for "Eclipse ends at Sunrise" or "Eclipse begins at Sunset" and the innermost one has the meaning "Eclipse begins at Sunrise" and "Eclipse ends at Sunset". Note that the position of maximum eclipse of a partial eclipse is invariably within the sunrise / sunset area. Note that the position of maximum eclipse is calculated to the nearest minute without taking refraction into account while the local circumstance data displayed when clicking the mouse over the respective position are adjusted for refraction. Likewise the curves for the eclipse at sunrise or sunset are calculated without taking refraction into account. So there may be some (minor) differences between the local and global data and you may find that the actual visibility might extend slightly beyond the delineation.

The solar eclipses so far relate to the Earth surface. If you are interested in solar eclipses of satellite orbits a special option exists: Select `Calculate`,

then `Special Eclipses` or press the `I` key. In the Special Eclipse Settings dialog enter the day of New Moon you are interested in (eclipses at the height of satellites can happen on New Moons other that the ones which give rise to normal Earth surface eclipses). The hours, minutes etc need not be specified as LunaCal will check the two days surrounding the given date. The time step is needed for moving along the central line in the plot. The height above the Earth surface must be given in km. Mark the `Use Ellipsoid` checkbox if the assumed surface is an ellipsoid with the same flattening as the Earth. Leave it unmarked for a spherical surface (which is what you normally want for satellites). The Special Eclipse map only shows the central line of the eclipse (if there is one). Blue marks a total and red an annular eclipse. Below the map the time as well the corresponding coordinates of the eclipse at that time are shown. Note that there can be two seperate places with an eclipse at the same time (with one typically being a total eclipse and the other an annular one). To step forward or backward in time use the right or left arrow key. (If the key does not respond try using `<crtl>` + right (or left) arrow key once to clear the impass. If you want to change the time step select the `Special Eclipse` option again and change the time step. Of particular interest are eclipses of geostationary satellites at a height of `35788.1` km. These satellites are stationed above the equator so look for the equator crossings of the central line to find the time and place of those occurences. Note that the time given in the Special Eclipse option is always Universal Time indepent of what timezone you entered in the date dialog.

NOTE: LunaCal seems to do a reasonable job to show eclipses which were documented in historical times. If you go back much further in time (let's say beyond -2000) you should exercise considerable caution. The formulae used by LunaCal for listing the dates of eclipses are deteriorating more quickly than the more accurate formulae for the positions of the Sun and the Moon. You may find that something listed as a total eclipse actually is a partial one (or vice versa) if you compare it with the eclipse details. The times of maximum eclipse will begin to differ. In any case the eclipse details show the more accurate information. Eventually the formulae for the positions of the Sun and the Moon will also deteriorate to the point of becoming useless. So don't try to calculate eclipses for the year -25398 with LunaCal (even if LunaCal let's you do that!). In fact even with a highly accurate numerical propagation of the Sun and the Moon you would still not be able to calculate eclipses accurately for dates very much in the past or the future because the difference TT - UT is not known accurately for those times. Although geographic latitude of places where an eclipse could be seen would be reasonably accurate the longitude could be all over the globe. The same problem happens with dates very much into the future.

6 Display Cultural and Religious Holidays

Select `Calculate`, then `Holidays` or click the `Holdays` icon.

A list with the dates for Ash Wednesday, Easter, Jewish-, Islamic-, Indian- and Chinese New Year as well as Yom Kippur and Ramadan will be displayed. The Indian New Year refers to the Indian Civil calendar and will not be active for years less than 82. The Hebrew dates will only be displayed for years > -3762. The Islamic dates will only be displayed from the year 622 on. The other holidays will always be shown no matter what year you selected but just because LunaCal calculates these dates doesn't mean they are real. Use your own judgement. (I would doubt whether Easter made any sense during Ceasar's time! The Jewish holidays however did and probably also the Chinese.)

Jewish and Islamic dates actually start at sunset the day before the indicated date. The observance of Islamic holidays depends on the actual sighting of the Moon so those dates might be shifted by a day or so on occasion. The calculations for the Jewish holidays are based on the meridian of Jerusalem.

The calculation for the Chinese New Year is based on the meridian of 120 degrees and should be in line with the one issued by the Purple Mountain Observatory but some divergent calculations might be found elsewhere.

In case of the various New Years the respective number of the year is also given except for the Chinese New Year where the corresponding name is shown together with the English translation of the Terrestrial Branch of that name.

7 Display Day and Sky Details

7.1 Display Day Specifics:

Select `Calculate`, then `Day Details`. Or you may key in `A`. A window appears which displays the weekday, day of the year and the week as well as the corresponding day, month and year in the Hebrew, Islamic, Indian and Chinese calendars. No Hebrew dates will be displayed for years < -3762. No Islamic dates are displayed for years less than 622 and no Indian dates are displayed for years less than 82. Chinese dates are only shown for positive Julian Date numbers (years > -4712). When either `Day Details` or `Sky Details` is called for the first time they will use the current day and time. To have a different day than the current date displayed change the year, month or day in the respective fields then press the `Refresh` button. This date will be preserved upon exiting the dialog.

To close the Day Details window press the `Close` button or press `<esc>` or click the `close window` icon.

The Islamic dates refer to civil epoch (and thus might differ by one day compared to dates referred to the astronomical epoch) , the Indian dates refer to the Indian Civil calendar.

The number of the week is defined such that the first working day (e.g. banking day) of the day is contained in week 1. Thus if New Year's Day falls on Friday, Saturday or Sunday, their week number would correspond to the last week of the previous year (in which case the week number will not be displayed by LunaCal).

In a leap year, the Hebrew calendar has 13 months with month 6 labelled Adar I followed by month 6+ (called Adar II).

In a leap year, the Chinese calendar has 13 months with the intercalary month having the same number as the preceding month but with the specification "intercalary" added.

Note that the days in the Hebrew and Islamic calendars actually start at sunset the evening before.

If you enter a month < 1 it will be set to 1, if you enter a month > 12 it will be set to 12. Entering a day < 1 will set the day to 1 and entering a day > 31 will set the day to 31. No check will be done whether the respective day would fit into the respective month. Thus LunaCal allows you to enter a day 31 for month 4 (April) in which case LunaCal interpretes the day as the first of May.

You can use the Day Details window iteratively to find the dates of some Jewish holidays in addition to the ones automatically calculated in the Holidays window. The following holidays have fixed dates on the Hebrew calendar:

Hanukka day 25, month 3 (December)

Passah day 15, month 7 (March / April)

Shavout day 6, month 9 (May / June)

Purim day 14, month 6 (in an ordinary year) or month 6+ (Adar II, in a leap year)

Knowing the approximate (Gegorian) dates of these holidays, one can quickly find the date corresponding to the correct Hebrew date in a trial-and-error way.

7.2 Display Sun and Moon Specifics:

Select `Calculate`, then `Sky Details`. Or you may key in `S`. A window appears which displays the position of the Sun and Moon as well as their rise and set times and the time for civil, nautical and astronomical twilight for the date and time specified. When either `Day Details` or `Sky Details` is called for the first time they will use the current day and time. To have a different date and time than the one currently displayed change the respective fields then press the `Refresh` button. This date and time information will be preserved upon exiting the dialog.

Also displayed are the illuminated fraction of Moon's disk, the libration angles of the Moon, the position of the Moon's terminator, the apparent magnitude of the Moon, the angular separation between the Sun and the Moon (in degrees), the Julian Date and the Local Sidereal Time. The Phase of the Moon is given as a continuous number between 0 and 1. New Moon corresponds to 0, First Quarter to 0.25, Full Moon to 0.5 and Last Quarter to 0.75.

The equatorial coordinates of the Sun and the Moon as well as the libration angles and apparent magnitude are topocentric and refer to the specified location. These values will thus differ slightly from corresponding geocentric values normally listed in almanacs. (It does allow you to check for occultations visible from the selected location and also gives the libration angles as viewed

from the specified positon which may differ by up to 1 degree from the geocentric ones normally listed in almanacs.) If you need the geocentric values set the height in the geographic location to `-6378140.0` meters.

The libration angles are `L` for longitude and `B` for latitude. Positive values are East selenographic longitudes and North selenographic latitudes. The position of the selenographic longitude of the terminator is likewise positve for Eastern longitudes (toward Mare Crisium) and negative for Western longitudes. It will the terminator facing the Earth i.e. the morning terminator for increasing phase and the evening terminator for decreasing phase of the Moon.

The elevation angles have been corrected for refraction as long as the elevation is greater than -2 degrees. Below -2 degrees the elevation will be shown uncorrected. (You thus experience a sudden jump in elevation of about 1 degree at the cutoff point.)

The first time you display the Sky Details window it starts out with the system date and time. If you specified a timezone in LunaCal different from the one in your system the time (and also the date) will have been adjusted accordingly. If your system time is correct the time used by LunaCal will also be correct even if displayed in a different timezone. In any case the time and timezone to which all the data refer are listed at the top of the Sky Details window together with the location for which it is valid.

Although not mentioned in section 2.3 the value of Delta TT - UT slightly affects the calculations in the Sky Details window. But as was said there keeping the default is the best for you to do. (For dates very much into the future or the past the uncertainity of the Delta TT - UT value can amount to several days - so keep that in mind if you go some ten thousand years into the past or future!)

The input values are restricted as followed and will be adjusted if out of range: month from `1` to `12`, day from `1` to `31`, hour from `0` to `24`, minutes and seconds from `0` to `59`, the timezone from `-14` to `+14`.

The times for rise and set and the twilight times will be selected such that the time for rise is before the time selected. This may lead to some of the times to occur on the day prior to the one selected. Changing to the next day or to a later hour on the same day will shift the dates correspondingly. If you are interested in rise and set of the Sun and in twilight times choosing the midday hour of a particular day would be the best choice to get the times for the very day. In any case the date as well as the time is shown for each calculated event to avoid any confusion.

To close the Day Details window press the `Close` button or press `<esc>` or click the `close window` icon.

7.3 Yearly Totals of Sunshine and Moonshine Hours

Select `Calculate`, then `Year Totals`. Or you may key in `Y`. An input box appears and asks for a cutoff angle. If this angle is greater than 90 degrees a standard output will occur giving the total hours of sunshine, civil, nautical and astronomical twilight as well as the hours of moonshine for the selected

year and the selected location. Also displayed are the number of hours of dark skies (Sun elevation less than -18°) and no Moon. If the cutoff angle is less than 90 degrees the total hours during which the Sun and the Moon respectively were at an apparent elevation above this value will be calculated.

7.4 Solar Panel Statistics

Select `Calculate`, then `Solar Panel`. Or you may key in `R`.

A dialog appears which lets you specify the azimuth, elevation (in degrees) and efficiency (in percent) of a (fixed) solar panel. You can also specify the beginning month and the end month of the interval for which the statistic will be calculated.

This statistic displays the percentage of the sunshine received by the fixed solar panel at the currently set location as compared to one which tracks the sun as well as the electricity in kWh produced per square meter if there were no clouds. The calculation is done for the currently selected year and extends over the whole year or to the specified interval of months.

8 Display Settings

8.1 Eclipse Settings

Select `View`, then `Eclipse Settings`. You have a choice between a 10° or a 30° grid or no grid for the eclipse map and whether the background should be grey or white. You can select a world map either as a simple outline or as a physical map or stereographic maps of the Northern or Southern hemisphere. For these maps you can specify the central meridian (in degrees).

This is also the dialog to specify the step size (in minutes) for the central eclipse position listings.

8.2 Font Size

Select `View`, then `Font Size`. This is to specify the font size of the main display (and some of the dialogs). The font size can only be changed between `8` and `10`.

9 Saving Data on File

9.1 Standard Save

Select `File`, then `Save` or press the `Save File` Icon to write the table with lunar phases, solstices and equinoxes and eclipse dates as well as the holidays and the table with the calendar for the year in question to the currently selected save file. The default for this file is `LUNASAVE.TXT` and it will be found in the folder where LunaCal is located.

9.2 Changing the Name of the Save File

To change the name of the save file select `File`, then `Save As`.

9.3 Saving the Detailed Eclipse, Detailed Day and Detailed Sky windows

The Save File option does not save the information from the Detailed Eclipse window. You can, however, copy this information to the clipboard and then paste it into a text file using the following procedure:

Move the mouse to the `Detailed Eclipse` Window and click the right mouse button. A small edit window will appear. Choose `Select All`, then `Copy`. (If you have a Windows keyboard you can use the Windows document key instead to have the small edit window displayed.) You can now paste the contents of the clipboard into a text file. This procedure also works for the `Detailed Day` and the `Detailed Sky` window.

9.4 Saving the Eclipse Map on file

The Save File option does not save the information from the eclipse map. To copy this map you may use any screen shot program available under your system.

9.5 Printing LunaCal Save Files

To view or print the information on the Save File, open this file with a text editor. Depending on the settings of your editor you might find the columns of the tables not properly aligned. To get the tables right you may have to select a particular font, like `COURIER NEW`.

You may also have to insert a Page Break to fit the information properly on pages before you print the file via the text editor.

10 Help Information

For online help select `Help`, then `Help`.

This will display a window with basic help information. (No special Windows help was deemed necessary as LunaCal is a fairly compact program and the simple help window seemed to be adequate.) To move up and down this Help Info, press the `UP` or `DOWN` key first, then use these or the `Page Up` or `Page Down` keys. Alternatively, click the vertical scroll bar.

Like other GUI programs, hints about the function of icons or menu items will be dispayed on the Status Bar at bottom while moving the cursor over the corresponding item and there are also tool tips and the "What's This" help available.

11 References

All the information about calendars and the calculation of holidays used by LunaCal is based on chapter 12 of the Explanatory Supplement to the Astronomical Almanac, University Science Books, Mill Valley, California, 1992. Chapter 8 of that same book gives details about eclipse calculations and chapter 2 contains formulas for the calculation of historical delta TT - UT data.

Formulas for the calculation of the phases of the Moon, eclipse occurrences, solstices and equinoxes as well as a number of other useful topics can be found in Jean Meeus, Astronomical Formulae for Calculators, 4th edition, Willmann-Bell, Inc, Richmond, Virginia, 1988.

The calculation of Sun and the Moon with reasonably high precision suitable for use in PCs, calculation of solar eclipses, coordinate conversions and many other userful algorithms are covered in O.Montebruck and T.Pfleger, "Astronomy with a PC", Springer Verlag, Berlin, Heidelberg, New York, 1989. This book also contains a good formula for the delta TT - UT calculation.

The calculation of the apparent magnitude of the Moon is based on Table L-9 (page 823) of James R. Wertz, "Spacecraft Attitude Determination and Control",
Reidel Publishing Company, Dordrecht, Holland, 1980.

Back issues of the Astronomical Almanac in addition to the above mentioned books as well as a few odd bits of literature, including travel guides, provided useful data for testing the program and on occasion to modify some of the formulas to better fit the needs.

A APPENDIX

A.1 LIST OF HOT KEYS

A number of LunaCal functions can be handled by pressing Hot Keys. Here is a list of the respective keys.

`A` Day Details
`C` Calendar
`D` Date / Timezone
`E` Eclipses
`F` Save on File
`I` Special Eclipse Calculation
`L` Location
`M` Moon Phases
`O` Holidays

P Eclipse Settings
Q Quit
R Solar Panel Statistics
S Sky Details
Y Yearly Totals of Sun and Moon
T Terrestial Time - Universal Time
Z Font Size

You are supposed to press these keys together with the <crtl> key. If you press these keys without <crtl> it still works - most of the time. The exception: If you had accidentally still highlighted a menu while pressing the key SatCal might not respond to your key input. The recovery is simple: Just press the <crtl> key (as you should have done anyway!) once.

A.2 TROUBLE SHOOTING

Although most of the following situations have already been dealt with above, the following is a list of (perceived or real) problems you could encounter with LunaCal.

- The times for Sun or Moon rise are not shown for the selected day

LunaCal tries to calculate the time for Sun or Moon rise such that it occurs before the time currently selected. The set time will be the following set time. The beginning of twilight times will be the times prior to the time for rise. Select the following day or a later hour to have the various times suit you. Note that there may be days during which the Moon does not rise or set.

- The times for civil, nautical or astronomical twilight are missing

If for high latitudes the Sun is above the horizon all the time, LunaCal doesn't display the times for twilight as there is no twilight in this case. Likewise, if there is a particular twilight continously (lets say the Sun is above -12 degrees all the time, the condition for Nautical Twilight) there is no need to display the next "deeper" twilight (in this case the Astronomical Twilight).

So everything is OK.

- The position of the maximum eclipse location is outside the eclipse region

For dates which are too far back in time (some 6000 years or more) the list of eclipses is no longer in sync with the more accurate detailed eclipse information. Sometimes an eclipse listed as total is in fact partial (or vice versa). In these cases the place of maximum eclipse will be calculated wrongly. In case of (actual) total and annular eclipses you could try the Special Eclipse option instead (with a hight of 0 m) to get a plot of the central line anyway. (But be advised that the geographic longitude would be completely uncertain in these instances because the Delta TT - UT is not known precisely for those distant years.