EA Graphic Tools 2022

Users' Manual for

Sky Luminance / Radiance

Distribution Viewer

"SkyMap"

Meteorological Data System Co. Ltd.

May, 2022

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Contents

Introduction

This manual describes the outline of a tool program named SMAP, a sky luminance/radiance distribution viewer, first, and its usage second. The distribution is estimated by excellent computation theories by Igawa. These are sky luminance distribution models named "*i*-All Sky Model-L (2016)" or "*i*-All Sky Model-L (2012)"; and sky radiance distribution models named "*i*-All Sky Model-R (2016)" or "*i*-All Sky Model-R (2012)" (see refs. [2]–[6])*[1].

To understand these models, which mean the theory of its computation, please refer some techinical documents (downloadable PDF) provided via a home page our company, MetDS.

1 Outline of SkyMap

1.1 What's SkyMap?

SkyMap is a tool program to draw tile (step) colored distribution maps of luminance and radiance in equidustant projection of the sky. It will be described a little bit in detail later but now you may know that the estimated distribution maps are calculated by Igawa's two models, "*i*-All Sky Model-L/R (2016)" and "*i*-All Sky Model-L/R (2012)" (refs: [2]–[6]).

Sky luminance distribution map and/or sky radiance distribution map give very important design information for lighting , heating and cooling environment, especially for glazing/window implements. As well as ColorMap program, SkyMap has very visual property for showing estimated results, too. Thus, we expect that SkyMap may be useful as an educational design tool.

Additionally, not only to draw the distribution maps, SkyMap has features to output estimated data at 145 points determined by the IDMP*[2] guidebook[7] and sectional data of the sky in degree by degree as csv tables and/or graphics*[3] to be used as one of computer-aided design tools practucally.

As mentioned above, SkyMap had been developed for the both practical and education purposes and updated with considering higher precision, ease to use and so on.

1.2 Calculation Flow

State of the sky can be classified by two indices; clear sky index Kc and cloudless index Cle, which are calculated from solar position's parameters, horizontal global solar irradiance and horizontal diffuse solar irradiance. Igawa's sky luminance/radiance models, a set of *i*-All

*[1] The model "*i*-All Sky Model-L/R (2012)" (refs: [5] and [6]) and the newest model "Igawa_D" (ref: [2]) were implemented to the current version of SkyMap as well as the previous version 3.0. The default model is latter one. To get more information on the default mode, see references [2]–[4].

*[2] An acronym for the International Daylighting Measurement Programme. This program was produced by CIE (Commission Internationale de l'Eclairage) in order to collect and apply the precise measured data of daylight and solar energy world-widely.

*[3] The data and/or graphs can be printed out and saved as files.

Sky Model-L (2016) and *i*-All Sky Model-R (2016) or a set of *i*-All Sky Model-L (2012) and *i*-All Sky Model-R (2012), include his proposal of these indices, however, in brief, the models are mathematical functions having predictor variables of the solor position parameters, horizontal global and diffuse solar irradiances, and two indices of Kc and Cle.

When you select a specified year's EA weather data (Wea2 file) from this program and you select a specified AMeDAS station, this program start automatically to calculate the solor position parameters, split the global solar irrandiance into beam and diffuse components, calculate the two indices and so on in order to prepare all the predictor variables for applying the models. So you can get a drawn distribution map easily at any daytime for every station and every year[*4]. Simply speaking, SkyMap is a drawing tool of sky luminance/radiance destribution after dealing with complecated calculation rocedures.

Calculation procedures' flow applied in SkyMap is illustrated in Fig.1 . From this figure, you can understand that SkyMap has a drawing method by manual operation. However, such function of SkyMap will be explained latter. Now we concentrate to explain the procedure after getting horizontal global solar irradiance, horizontal diffuse solar irradiance, solar altitude, and solar azimuth.

(1) At first, Sky status index Si, and indices of Kc and Cle mentioned above are calculated. The index of Si is called sky index which is a function of c and Cle.

(2) In addition to these three indices, solor altitude γ_s, atltitude for a specified sky segment (point) γ and the angular distance between the sun and the segment (point) ζ are prepared. Now relative distribution $L(\gamma_s, \gamma, \zeta)$ can be obtained.

(3) The calculation of $L(\gamma_s, \gamma, \zeta)$ should repeat as a procedure of numerial integration and its inverse number $LzEd$ can be calculated [*5]. N ote that the inverse number $LzEd$ is described in the calculation flow (Fig.1).

(4) To obtain the zenith radiance, $Lez(\gamma_s, Kc, Cle)$, $LzEd$ should be multiplied by horizontal diffuse solar irradiance.

(5)–1 The distribution of sky radiance is expressed by an arithmetic that the zenith radiance $Lez(\gamma_s, Kc, Cle)$ multiplied by the relative distribution $L(\gamma_s, \gamma, \zeta)$.

(5)–2 And in order to obtain the distribution of sky luminance, luminous efficacy η_d for diffuse solar irradiance should be estimated[*6]. At first, η_d should be multiplied by $LzEd$ to obtain the zenith luminance $Lvz(\gamma_s, Kc, Cle)$. Then $Lvz(\gamma_s, Kc, Cle)$ is multiplied by the relative distribution $L(\gamma_s, \gamma, \zeta)$ to get the distribution value of sky luminance.

Excepting item (3), of which calclation should be done just one time, procedures from item (2) to item (5–1) or (5–2) are repeated for all the sky segments (points) with varying γ and ζ. Then we can get the whole sky distribution.

[*4] As mentioned latter, SkyMap can work without Wea2 file and AMeDAS station data for education purpose.

[*5] PDF Technical Notes explains the another method using regression functions of Kc and Cle, instead of the numerical integration method. However, SkyMap is based on the numerical integration method. The interval is fixed as 1.0° .

[*6] For estimation of the luminous efficacy η_d, SkyMap is implemented two models: Igawa_C model[5]; and Igawa_D model[2]. In these models, η_d can be calculated as a function of Kc and Cle.

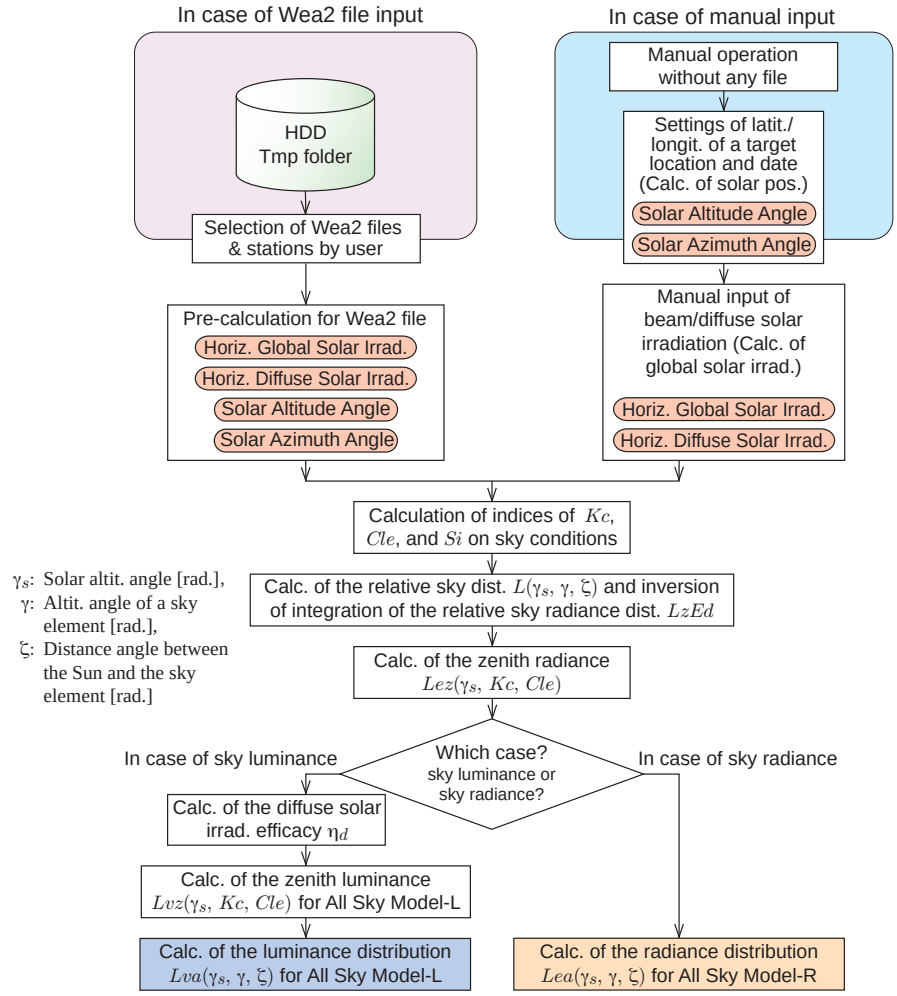


Fig. 1 Calculation Flow in SkyMap

1.3 Functional Differences by Input Data Kinds

There are two kinds of data input methods in SkyMap: (1) a method using `Wea2` file; (2) a method using manual input values including location's latitude and longitude data. Some operations are limited for method by method. For instance, in case of (2), animation function, which is a repitition of drawing for different input data, never work.

Such limitations are summaried in Table 1 for your reference.

Table. 1 Functional limitation Caused by Input Methods in SkyMap

Function	Input by `Wea2` file	Input by Manual (Keyboard)
Menu for Manual Input	✓	—
Free Location and Year		✓(type in)
Free Solar Irrad. Data		✓(type in)
Change of `Wea2` file	✓	—
Animation Drawing	✓	

✓ : Workable, — : Not Available

We explain fundamental usage of SkyMap through a tutorial-style article in the next chapter. And after the chapter 2, a little bit complected functions will be explained.

2 Tutorial of Fundamental Operation

2.1 Startup

In order to learn how-to-use of SkyMap, startup it immediately. Generally speaking, there are many manners to start an executable file (program) and it may depend on the OS version and/or personalization of the OS environment. However, the startup method explained here must be a classical and typical one, which may be well known.

As shown in Fig.2, click the [Start] button on the task bar of your desktop window to display a list menu of programs and select sub-folder labeled [EA_Graphic Tools 2022]. Then a series of tool programs appears as sub-menus. So click SkyMap menu.

Soon after the operation, a main window illustrated in Fig.3 appears.

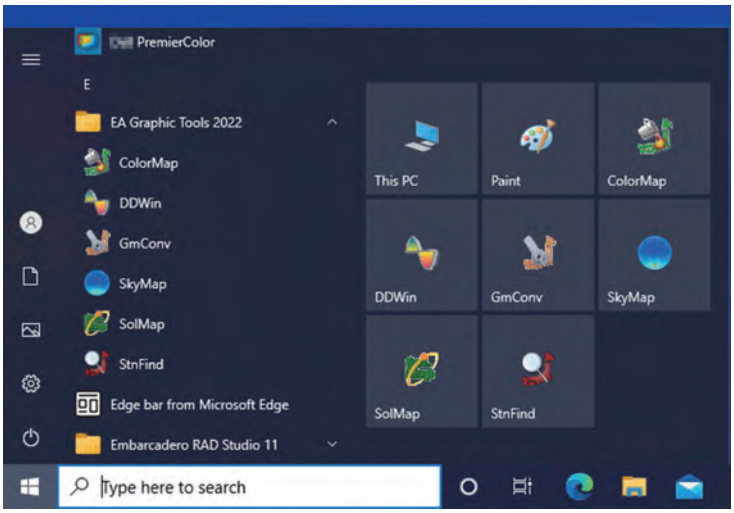


Fig. 2 Startup of SkyMap from Program Menus

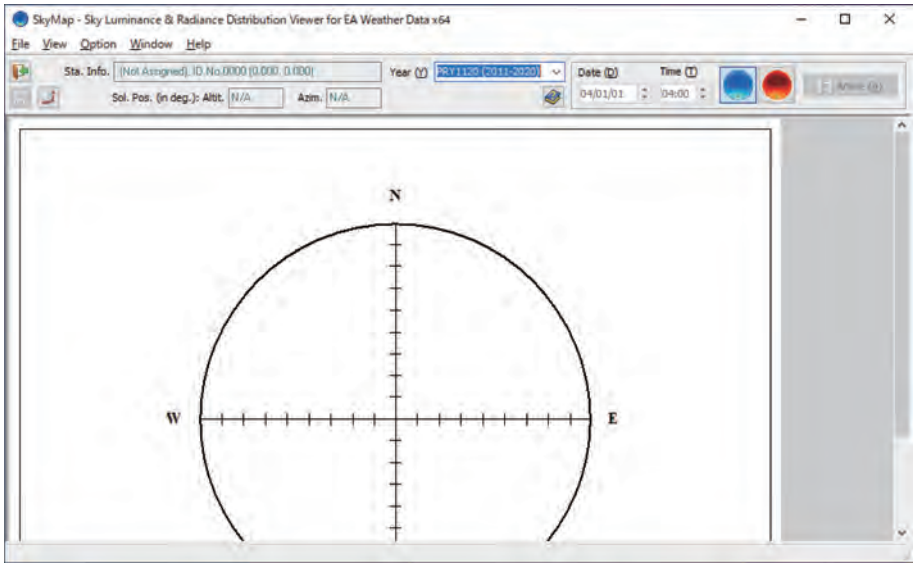


Fig. 3 Main Window of SkyMap at Startup Status

The main window soon after startup shows vacant sky image of circle with cross direction scales on E–W and S–N. The window's upper panel has several components like speed buttons,

text boxes, combo list boxs and so on but almost all components indicate meaningless messages and/or setted to be disabled to select. Now SkyMap just wakes up and does not get any command from user. The appearance of SkyMap shows such initial status.

However, if you look at the window's top panel crefully, you can find some speed buttons are enabled to select or be clicked. When you move mouse cursor on the enabled speed button, tip hint will pop up and brief explanation will be described in the status bar on the windows' bottom edge. Many icons drawn in the speed button are popular for general application programs of window system rather than unique ones. So we expect that you can understand the function of each speed button by intuition. But a pair of large toggle action buttons,  are original for this program. We will explain it in tutorial contents described latter. But you must remember the button works as a toggle switch line a radio buttons, if one button pressed, the another one pulled always, and the button is for selecting drawing target is luminance destribution or radiance distribution: Left button is pressed to draw luminance and right button is pressed to draw radiance.

2.2 Input of Target Wea2 File

You can select your target Wea2 file (kind and year) from list menu in a combo list box labeled [Year (Y)] placed in the center of panel under the menu bar as shown in Fig.3. In the figure, list item "PRY1120 (2011-2020)" is highlighted to select. If you don't have that Wea2 file, replace the selecting file as you like.

Then click the speed button,  in the left side of the main window. Immediately, a dialog window shown in Fig.4 pops up. This dialog window is a common one for several programs of "EA Graphic Tools 2022" in order to select AMeDAS station(s).

The same operation can be done by selecting [Open (O)...] menu.

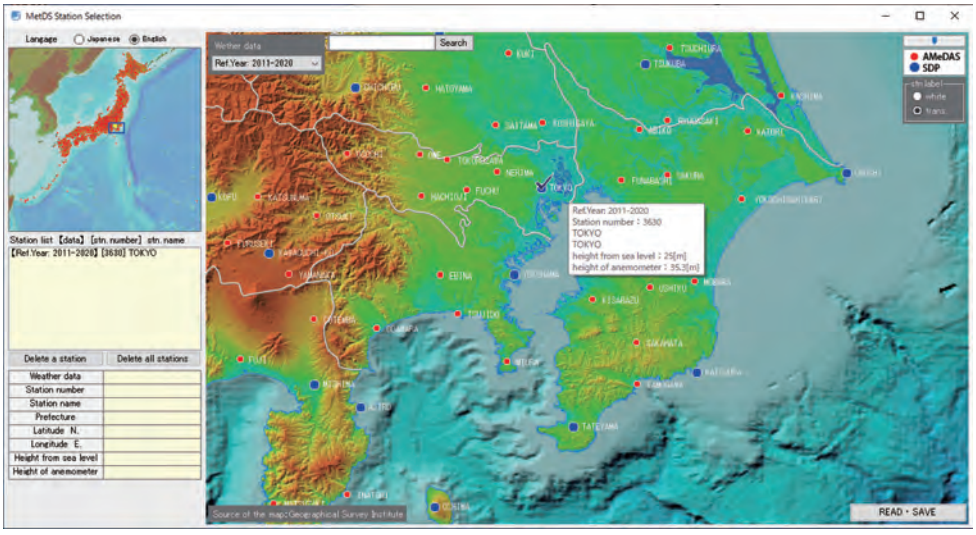


Fig. 4 Selection of AMeDAS Station from Map GUI Window

Now assume that we want to draw Tokyo's sky map using the past reference year of 2020 (PRY1120 (2011-2020)). So select Tokyo (ID:3630) from the window and click [OK] button. Then The map GUI window disappears and the main window of SkyMap must change its display content as shown in Fig.5 .

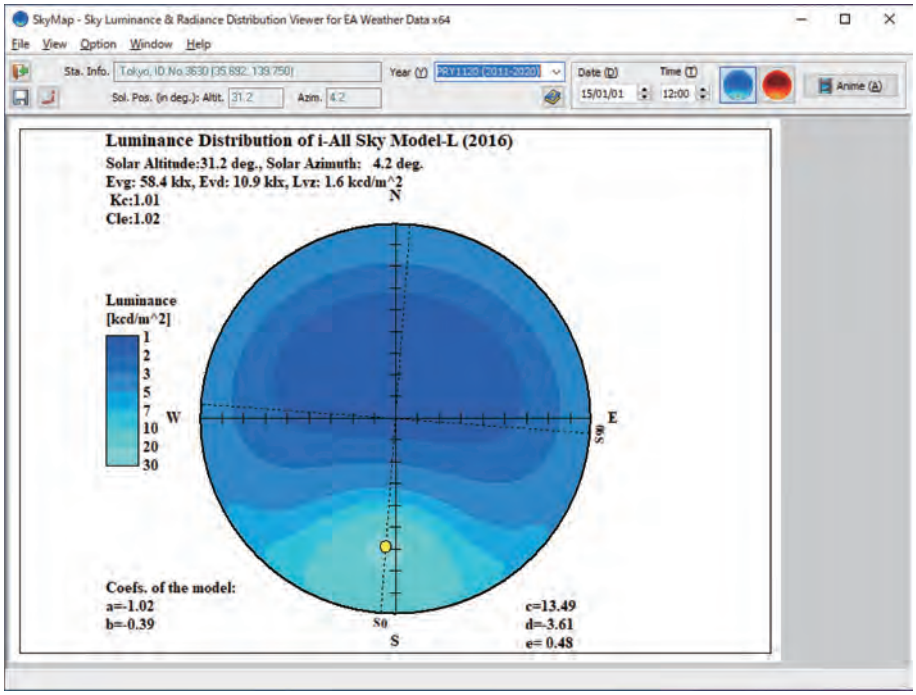


Fig. 5 Main Window of SkyMap after reading data of Tokyo

IN the figure, look at the panel located under the menu bar. In the text box labeled [Sta. Info.], a line information [Tokyo, ID.No.3630 (35.690, 139.760)] appears. And the two text boxes under the wide text box mentioned above show the solor position. On right hand, you can see a group box having enabled two edit boxes with up-down buttons: left one is labeled [Date (D)]; right one is labeled [Time (T)]. The left edit box shows [15/01/01] and the right one shows [12:00]. These mean that drawing the sky luminance distribution map was done automatically just after reading the Wea2 file's Tokyo data*7. In the distribution map image, the disk ● is a symbol of the sun and that located in precisely calculated position.

2.3 Drawing Other Distribution Maps

Now try to change the contents of edit boxes labeled [Date (D)] and [Time (T)] by clicking the up-down buttons. You can understand that changing the date and time causes new drawing of map and get different images day by day and hour by hour. SkyMap draws new map for all the user directed time, excepting the time before the sunrise and after the sunset.

Then click the right side red button of the coupled speed buttons  . Now you can see

*7 Date [15/01/01] means January 1, 2015. The year of 2015 is a represented year for the reference year data for 10 years from 2011 to 2020.

quite different colored map. This operation means that drawing of luminance distribution map is changed to drawing of radiance distribution map. The same operation can be done by menu [View | Map Selection (S) | Sky Luminance (L)] and menu [View | Map Selection (S) | Sky Radiance (R)].

Next, click the button labeled [Anime (A)] beside the coupled speed buttons. Although drawing speed must depend on your computer's GPU performance, for the date selected in the [Date (D)] edit box, from sunrise to sunset, every hour map displays continuously. After animation work, a message box in Fig.6 appears. When you click [OK] button of the message box or after some seconds elapsing the message box disappears and maps at noon is drawn again.

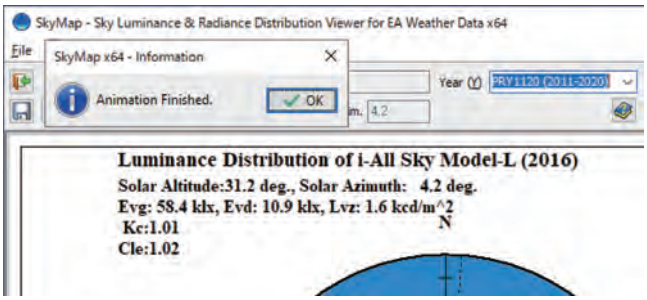


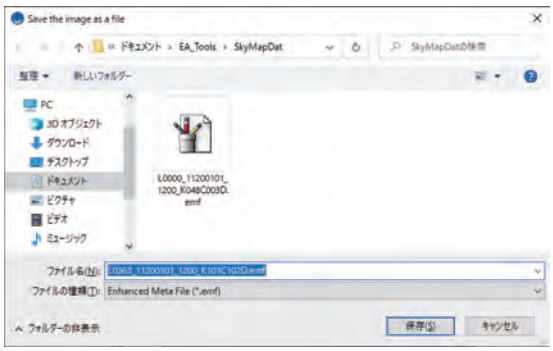
Fig. 6 Message Box at the End of Animation Map Drawing Operation

2.4 File Save of Drawn Map

We expect that you are practiced well after reading explanation of operations in the section 2.3. Now you may redraw the sky luminance distribution map at noon in January 1 and confirm that drawn map is the same as the image illustrated in Fig.5 in the previous page.

As you can see on the main window in Fig.5, speed button with a floppy disk icon is enabled now. When you put mouse cursor on that button, you can get hit on function of the button. Although the hit may be enough, the function of the speed button is that drawn map is saved as an image file with a dialog window shown in Fig.7 (a). You can select the image format from EMF file (Enhanced Metafile), BMP file (Bitmap file), or EPS file (Encapsulated PostScript file).

(a) Status before Saving as EMF file



(b) Status under Previewing Saved EMF file

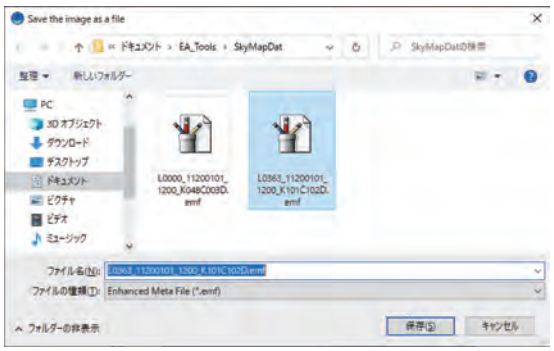


Fig. 7 Dialog Window for Map Image Saving in SkyMap

Here we explain the default filename for the image file and so on.

Please look at Fig.7 (a) carefully. At first, the drop-down style file list box on the top of the dialog window shows the location SkyMapDat. The folder [SkyMapDat] is a dock folder of SkyMap file output, located under user's [Documents] folder. This folder is created automatically by installer of "EA Graphic Tools 2022". SkyMap can output several files, which are mentioned latter but all the files are saved in this folder. Please remember the folder [SkyMapDat].

And you can see that the main filename is already assigned L3630_11200101_1200_K101C102D. In general, SkyMap gives the default filename with following rules:

XLLLL_YYYYMMDD_hhQQ_KlmnCdefZ

where

X : In case of sky luminance then X = L, in case of sky radiance then X = R
LLLL : Station ID, LLLL = 0010–8420
YYYYMMDD : Date (year: YYYY, month: MM, day: DD
YYYY = 1981–2020, or8195, 9100, 0110, 1120, 7795)
hh : Time (hh = 01∼24)
lmn : Clear sky index Kc = l.mn (2 digit after decimal point)
def : Cloudless index Cle = d.ef (2 digit after decimal point)
Z : Igawa_C *i.e.* based on "*i*-All Sky Model-L/R (2012)" model then Z = C,
Igawa_D *i.e.* based on "*i*-All Sky Model-L/R (2016)" model then Z = D
(underlined number 0 and characters K and C are displyed as they are.)

Of course, the default name can be changed as you like.

By the way, according to the rule mentioned above, the main filename of L3630_11200101_1200_K101C102D can be translated that the map is drawn at 12:00 in January 1 of the 2020 edition reference year (PRY1120) for Tokyo (Station ID: 3630) with indices, $Kc = 1.02$ and $Cle = 1.02$.

Now click the speed button in the main window shown in Fig.5. Then new dialog window titled [Save the image as a file] pops up as shown in Fig.7 (a). You can save the drawn image as a file using this window. Try to save by clicking the save button. Then the dialog window closes.

When you return to the main window of SkyMap, click again the speed button to display the dialog window again. Then you can find the file saved just before. Select the file. Now you can see the window like shown one in Fig.7 (b) to confirm the saved file.

2.5 Termination

When you click the speed button on the main window of SMAP llustrated in Fig.5 (p.6), the system icon , or select menu [File | Exit (X)] from the menu bar, SkyMap can terminate normally.

3 Drawing with Manual Input

SkyMap can draw a sky luminance / radiance distribution map without Wea2 file and AMeDAS station's data. Of course in order to draw the map, you must set specified location's latitude and longitude, specified date and time, and specified horizontal diffuse irradiance and normal beam solor irradiance data. So SkyMap can be used without Wea2 files but many common functions for SkyMap are shared with the other programs via the dynamic link library. Thus it is not recommended that the folder location of SkyMap.exe assiged automatically by the installer is changed by user.

Anyway, manual input data use for SkyMap is explained in this section to be useful as a visual educational tool of building environmental science and design.

3.1 Setup of Manual Input Mode — Settings of Location and Year

During SkyMap main window is focused, you can enter "Manual Data Input Mode", in which you can draw with your original location, date and time, and solar irrandiance data. To enter the mode, select menu MENUOptionManual Setting (M)... from the menu bar of the main window of SkyMap as shown inFig.8 . Then a new dialog window illustrated in Fig.9 (a) appears. This subwindow have two radio buttons as a toggle switch: Manual Input (T); Select from the AMeDAS stations (S). Soon after the subwindow pops up, the radio button [Manual Input (T)] is selected automatically.

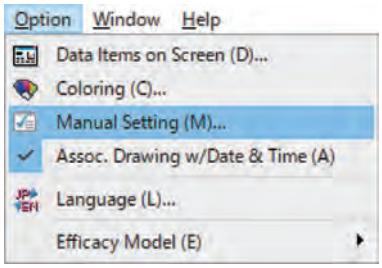


Fig. 8 Menu Operation to Enter Manual Data Input Mode in SkyMap

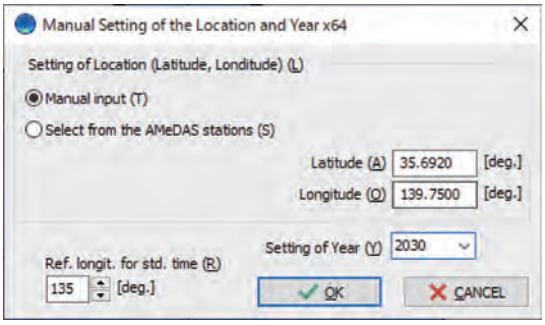
You can set a specified location by inputing latitude and longitud[*8] in edit boxes. And the reference longitude for the time zone should be given in the another edit box labeled [Ref. longit. for std. time (R)]. In this program, unfortunately consideration of summer time at specified time zone but you can input any location around the world via this dialog window in Fig.9 (a). It means that SkyMap is independent from AMeDAS stations.

Additionally, as you can see a drop-down style list box named [Settings of Year (Y)], you use the list box to select specified year from 1981 to 2099. The selected year must be calculation target timing.

On the other hand, if you want to choose a location with AMeDAS station in Japan, the radio button labeled [Select from the AMeDAS stations (S)] should be turned on. Then the subwindow changes its appearance like shown one in Fig.9 (b). You can choose the station number (ID) from a drop-down list box to select the location. You can also click a large button labeled [AMeDAS Map (M)] to show the map GUI window (Fig.4 , p.5) for selecting the station.

[*8] A positive value of latitude means north latitude and a positive value of longitude means the east longitude.

(a) In Case that Target Location Is Inputed Manually (With Invoked Subwindow)



(b) In Case that Target Location Is Selected from AMeDAS Stations

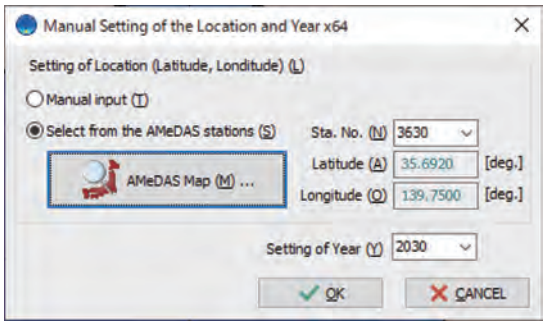


Fig. 9 Subwindow for Manual Input Settings in SkyMap

By the way, when this subwindow appears by a menu operation on the main window of SkyMap, default latitude and longitude are set to be 35.6920° and 139.7500°, respectively, whose values are for AMeDAS station "Tokyo" (ID: 3630), and default reference longitude to be 135° for Japan Standard Time (JST). Additionally, displayed setting of year is automatically set to be suitable one*9.

Click [CANCEL] button to cancel to enter the manual data input mode.

After setting the location and the year, sometime reference longitude for time zone, click [OK] button in the subwindow in Fig.9 (a) or (b) to display another new window*10 illustrated in Fig.10.

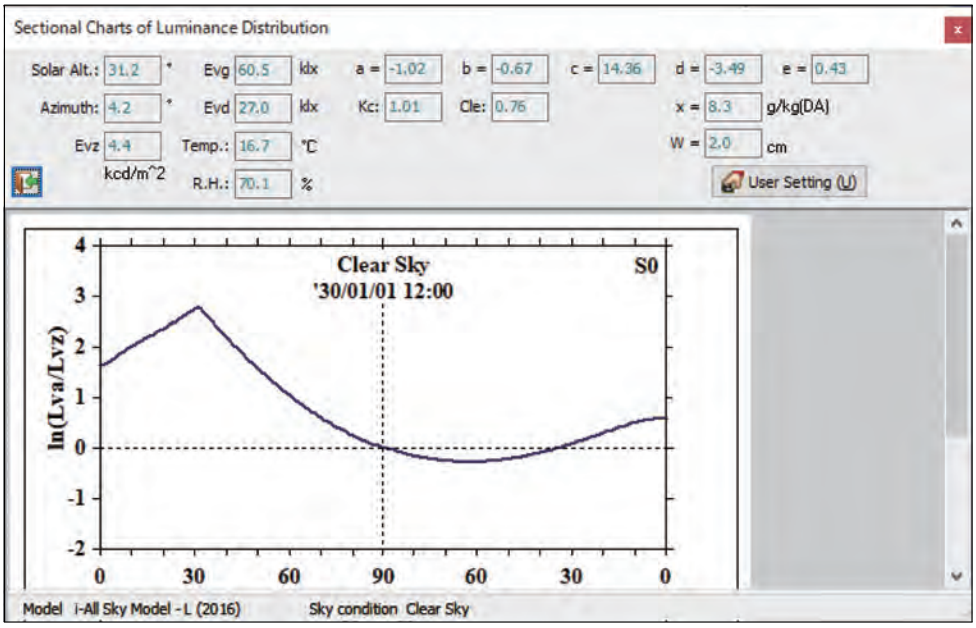


Fig. 10 Sectional Charts Subwindow with Manual Data Input Functions in SkyMap

*9 The year setting depends on previous operation with SkyMap. There is no rule to determine the default year in SkyMap.

*10 There are two graph frames in the center of the poped up window. However sometime actual curves are drawn as shown in Fig.10. The situation is depended on operation status of SkyMap. You should understand that Fig.10 is just an example illustration.

3.2 Operation of Manual Input Window — Setting of Solar Irradiance

Figure 10, a tool window*11 has a purpose to input solar irradiance data by user manually.

When you click a button labeled [User Setting (U)], appearance of the upper panel of the window changes like as shown in Fig.11. In the figure, you can see several edit boxes being ready to accept user input: a edit box labeled [Ees] for normal beam solar irradiance, a edit box labeled [Eed] for horizontal diffuse solar irradiance, and edit boxes for air temperature and relative humidity with slide bars*12.

Fig. 11 Sectional Charts of Luminance Distribution Tool Window Accepting Solar Irradiance Data Manually (Partial Image)

When you select each edit box, hits are displayed in the status bar on the bottom of the main window. They tell that input normal beam solar irradiance for the edit box labeld [Ees] in [W/m^2] unit and horizontal diffuse solar irradiance ofr the edit box labeled [Eed] in [W/m^2] unit. Including ait tempaerature and relative humidity settings, when you finish to input all the data, press a wide button labeled [Redraw (R)]. Then temporal map drawing is done*13.

Simple input error can be checked by SkyMap and some message boxes are displayed for simple error cases. Even if the input data are valid, the message box shown in Fig.12 appears to confirm the manual input data. When no error is detected, click [Yes] button. If you need to reset the input data, click [No] button on the message box. When you click the [Yes] button, then map is redrawn under the cindition with the input data.

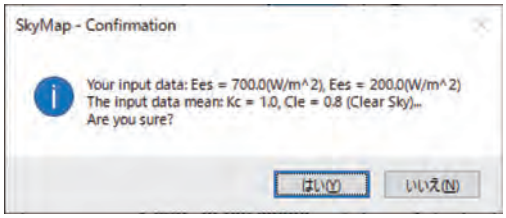


Fig. 12 Confirmation Message Box to Check the Input Data before Drawing Map

*11 Almost all subwindows explained above, are dialog (dialogue) windows with mode, modal dialog (dialogue) windows in alternative name, or message boxes with mode. The meaning of "mode" or "modal" is that appeared window is a child of the parent window that controls the new window's display and the focused child window must be closed for putting the focus to the parent window. However, the tool window does not follow this operation mechanism. The tool window and the parent window can work in parallel.

*12 The both of edit boxes for air temperature and relative humidity are not enabled simultaneously as it is designed. If you want to input relative humidity data, click the box for relative humidity to set the focus and be enabled. By the way, in case using *i*-All Sky Model-L/R (2012) (Igawa_C model), These two edit boxes do not appear.

*13 We say "temporal" here because you don't decide and assign the date and time.

3.3 Parallel Operation of Main and Tool Windows — Tuning of Drawn Image

In the situation that the both of the main window and the tool window are displayed, now click the [Date (D)] edit box and/or the [Time (T)] edit box to adjust the instant to be drawn. Out of the manual data input mode, every changing of these boxes is reflected to the image, *i.e.,* drawing occures everytime. But in the manual mode, you should click the wide button in the tool box named [Redraw (R)] mentioned above. The toggled large buttons  can not work for redrawing the image, these buttons are active out of the manual data inpu mode for selecting luminance or radiance distribution.

Although the explanation may be complicated, finally we want you to know that you may display the main window and the tool window in parallel during the manual data input mode, set the designated values in the both windows as you like, and click the [Redraw (R)] button to draw the image again.

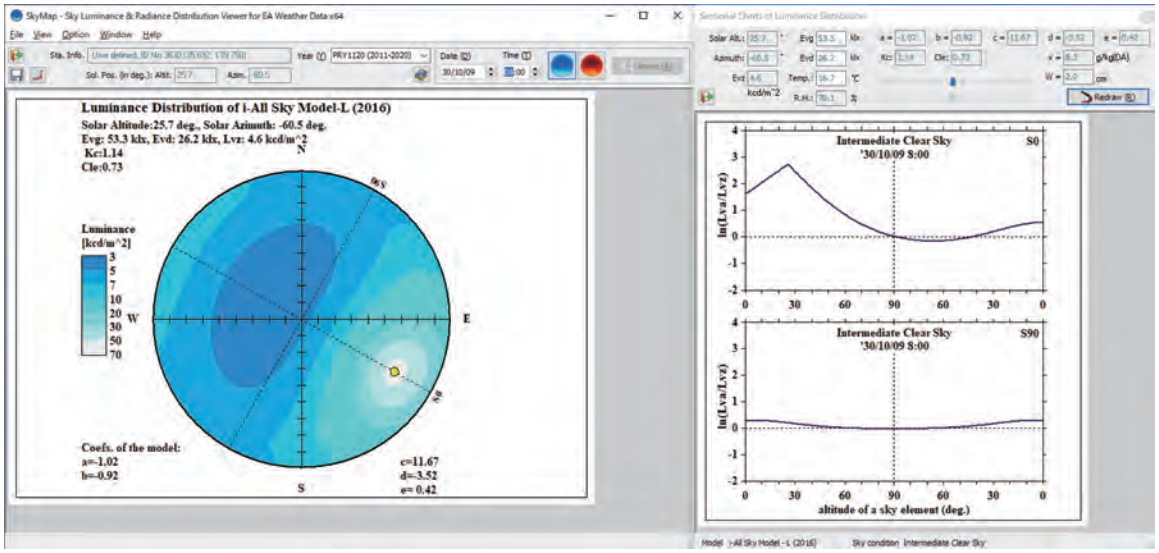


Fig. 13 Example of Working Situation with Two Windows in Manual Input Mode

3.4 Reset of Manual Input Mode

There is no special operation component to return from the manual data input mode. You can select Wea2 file and AMeDAS station in stead of the manual mode. We have already explained how-to-use SkyMap with Wea2 file in Chapter 2 (pp.4–8). That may be more general use of SkyMap. When you want to enter the manual data input mode again, follow the description in this chapter (Chapter 3, pp.9–12).

4 Usage of Sectional Charts Subwindow

The tool window displayed in the right side of Fig.13 is named "Sectional Charts Subwindow" and has another functions not to input data manually. In this chapter, usage of this subwindow is focused.

4.1 Operation to Display the Window

In order to pop up and display the sectional charts subwindow, [Window | Cross Section Chart (C)...F1] menu should be selected and clicked from the menu bar of the main window of SkyMap shown in Fig.14. Then the subwindow appears as shown in Fig.15.

Fig. 14 Menu to Display the Sectional Charts Subwindow in SkyMap

This window is the same one illustrated in Fig.10 (p.10). However in this case, the window is not working with manual data input mode, so the wide button labeled [User Setting (U)] is disabled. In addition, note that the subwindow contains different components in cases of liminance drawing mode and radiance drawing mode changed with a coupled buttons  .

4.2 How-to-Read Displayed Information

Although the appearance difference exists in cases of luminance drawing mode and radiance drawing mode, formations of the both windows are similar. Thus we explain using a luminance drawing mode's subwindow shown in Fig.15. And we describe some comments if the difference exists.

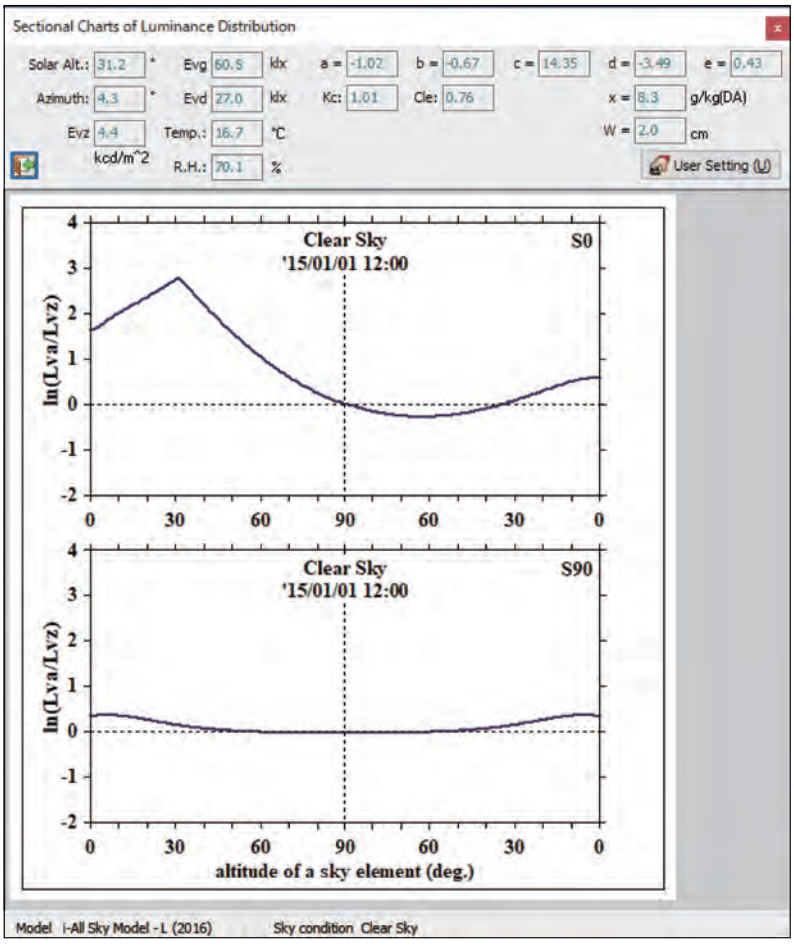


Fig. 15 Sectinal Charts Subwindow (for Luminance Distribution) of SkyMap

There are many components indicating meaningful information on the top panel of the subwindow: solar position, global illuminance (global solar irradiance), sky illuminance (horizontal diffuse solar irradiance), zenith luminance (zenith radiance), important calculation parameters of clear sky index and cloudless index, and coefficients of an estimate function of the relative distribution (see the PDF Technical Notes for getting more information in detail) are dosplayed. these values never edit but can copy to clipboard. You may know that the same information can be obtained from map image in the main window but the information is rasterised and inconvinient to copy and paste work. Thus the subwindow may be useful from this point of view.

In the center of the subwindow, two sectional distribution of the main window image are displayed in xy coordinate graphs. One of them is a cross sectinal chart that include the sun and the zenith and called "`Section S0`" and the another one is a cross section that intersect "`Section S0`" orthogonally with including the zenith and called "`Section S90`". The both section lines are displayed in the main window's image, too. In these graphs (charts), vertical axes units are relatively normalized by the value at the zenith and have logarithmic scales. In addition, the estimation model name [*14] is displayed in the status bar of the subwindow.

In this place, sky condition is also displayed with five classified descriptions:

- `Overcast Sky`
- `Near Overcast Sky`
- `Intermediate Sky`
- `Near Clear Sky`
- `Clear Sky`

There is no menu or button in this subwindow. However, this subwindow's image can be output as an image file or print out by operation of menus and speed button in the main window of SkyMap.

5 Usage of Table-Style Subwindow

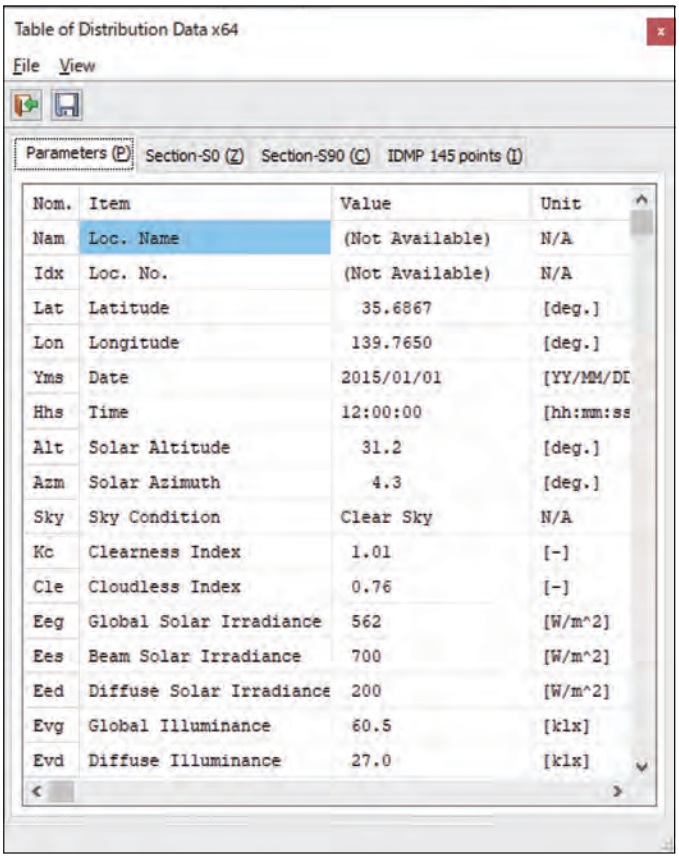
When you want to know the data values themselves of the curve in the sectional charts as shown in Fig.15 , you can use a table-style subwidow explained in this chapter. In table-style subwindow, there is a specialized page (function) to display the values at 145 points of the sky sphere defined by IDMP guidebook[7]. It may be useful to apply for daylighting design proedure.

5.1 Operation to Display the Window

As shown in Fig.14 , click [`Window` | `Data Table (T)...F2`] menu from the menu bar of the main window of SkyMap. Then you can display a table-style subwindow illustrated in Fig.16 .

[*14] In case of luminance drawing, "*i*-All Sky Model-L (2016)" or "*i*-All Sky Model-L (2012)" is displayed. And in case of radiance drawing, "*i*-All Sky Model-R (2016)" or "*i*-All Sky Model-R (2012)" is displayed, too.

This table-style subwindow contains four pages with tabs to set the focus (display in front), which are labeled [Parameters (P)], [Section-S0 (Z)], [Section-S90 (C)], and [IDMP 145 points (I)]. Each page is filled wth a grid box.



Nom.	Item	Value	Unit
Nam	Loc. Name	(Not Available)	N/A
Idx	Loc. No.	(Not Available)	N/A
Lat	Latitude	35.6867	[deg.]
Lon	Longitude	139.7650	[deg.]
Yms	Date	2015/01/01	[YY/MM/DI
Hhs	Time	12:00:00	[hh:mm:ss
Alt	Solar Altitude	31.2	[deg.]
Azm	Solar Azimuth	4.3	[deg.]
Sky	Sky Condition	Clear Sky	N/A
Kc	Clearness Index	1.01	[-]
Cle	Cloudless Index	0.76	[-]
Eeg	Global Solar Irradiance	562	[W/m^2]
Ees	Beam Solar Irradiance	700	[W/m^2]
Eed	Diffuse Solar Irradiance	200	[W/m^2]
Evg	Global Illuminance	60.5	[klx]
Evd	Diffuse Illuminance	27.0	[klx]

Fig. 16 Table-Style Subwindow of SkyMap (1)

5.2 Utilization of Displayed Information

Figure 16 shows the initial page of the four grid box pages, which is always displayed defaultly in the first time when the subwindow pops up. This page has tab named [Parameters (P)]. As you can understand from the name, in this page, there are many calcutation parameters required to estimate sky luminace / radiance by *i*-All Sky Model-L/R (2016) or *i*-All Sky Model-L/R (2012) are listed, *i.e.,* several coponents of solar irradiances, global illuminance, zenith luminance and radiance and so on.

The two pages with tabs named [Section-S0 (Z)] and [Section-S90 (C)] display the tabulated relative data of luminance or radiance across the section "S0" and section "S90" degree by degree. See the fiigure shown in Fig.17 (a).

In addition, as shown in Fig.17 (b), the page with tab named [IDMP 145 points (I)] displays all the data of luminance or radiance at IDMP defined 145 points.

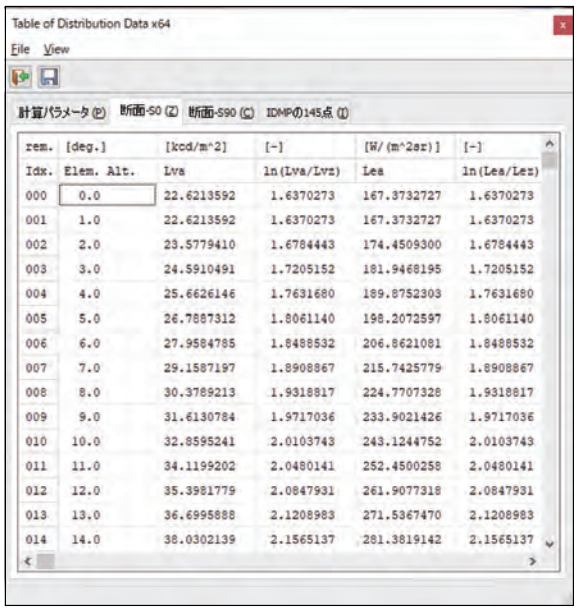
This table-style subwindow has following functions:

(1) Any cell block, line, row, continous cells, in every grid box (table) can be selected to copy the selected cell's data in CSV/SSV format into clipboard memory.
→Click right mouse button on the highlighed cells.

(2) Save the whole table as a CSV/SSV format file.
→ Click the speed button in the subwindow or select [File | Save As... (A) Ctrl+A] menu of the subwindow.

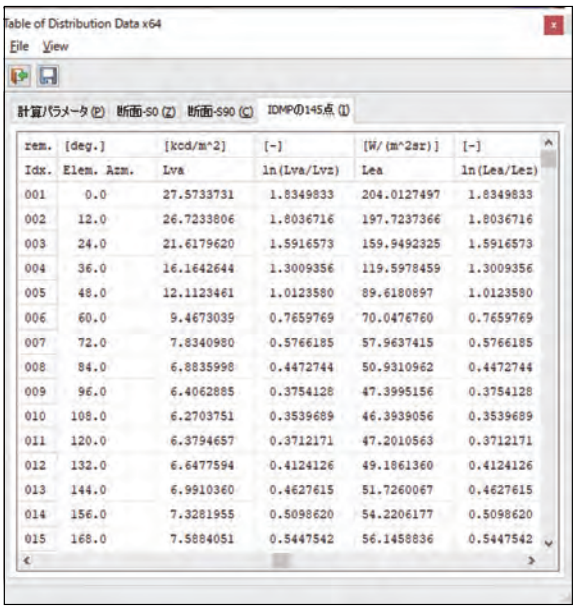
(3) Print out the table in every page as it is by printer.
→ Select [File | Print... (P) Ctrl+P] menu of the subwindow.

(a) [Section-S0 (Z)] Page



rem.	[deg.]	[kcd/m^2]	[-]	[W/(m^2sr)]	[-]
Idx.	Elem. Alt.	Lva	ln(Lva/Lvz)	Lea	ln(Lea/Lez)
000	0.0	22.6213592	1.6370273	167.3732727	1.6370273
001	1.0	22.6213592	1.6370273	167.3732727	1.6370273
002	2.0	23.5779410	1.6784443	174.4509300	1.6784443
003	3.0	24.5910491	1.7205152	181.9468195	1.7205152
004	4.0	25.6626146	1.7631680	189.8752303	1.7631680
005	5.0	26.7887312	1.8061140	198.2072597	1.8061140
006	6.0	27.9584785	1.8488532	206.8621081	1.8488532
007	7.0	29.1587197	1.8908867	215.7425779	1.8908867
008	8.0	30.3789213	1.9318817	224.7707328	1.9318817
009	9.0	31.6130784	1.9717036	233.9021426	1.9717036
010	10.0	32.8595241	2.0103743	243.1244752	2.0103743
011	11.0	34.1199202	2.0480141	252.4500258	2.0480141
012	12.0	35.3981779	2.0847931	261.9077318	2.0847931
013	13.0	36.6995888	2.1208983	271.5367470	2.1208983
014	14.0	38.0302139	2.1565137	281.3819142	2.1565137

(b) [IDMP 145 points (I)] Page



rem.	[deg.]	[kcd/m^2]	[-]	[W/(m^2sr)]	[-]
Idx.	Elem. Azm.	Lva	ln(Lva/Lvz)	Lea	ln(Lea/Lez)
001	0.0	27.5733731	1.8349833	204.0127497	1.8349833
002	12.0	26.7233806	1.8036716	197.7237366	1.8036716
003	24.0	21.6179620	1.5916573	159.9492325	1.5916573
004	36.0	16.1642644	1.3009356	119.5978459	1.3009356
005	48.0	12.1123461	1.0123580	89.6180897	1.0123580
006	60.0	9.4673039	0.7659769	70.0476760	0.7659769
007	72.0	7.8340980	0.5766185	57.9637415	0.5766185
008	84.0	6.8835998	0.4472744	50.9310962	0.4472744
009	96.0	6.4062885	0.3754128	47.3995156	0.3754128
010	108.0	6.2703751	0.3539689	46.3939056	0.3539689
011	120.0	6.3794657	0.3712171	47.2010563	0.3712171
012	132.0	6.6477594	0.4124126	49.1861360	0.4124126
013	144.0	6.9910360	0.4627615	51.7260067	0.4627615
014	156.0	7.3281955	0.5098620	54.2206177	0.5098620
015	168.0	7.5884051	0.5447542	56.1458836	0.5447542

Fig. 17 Table-Style Subwindow of SkyMap SkyMap

Note that in the file save of table function, item (2) in the list above, the target table is the former one displayed in front. Don't misunderstand that this means all the four page's tables. However, default main filename is not differ for each page table. The default main filename is defined by following rule:

XLLLL_YYYYMMDD_hhQQ_KlmnCdefZ

where

X : In case of sky luminance then X = L, in case of sky radiance then X = R
LLLL : Station ID, LLLL = 0010–8420
YYYYMMDD : Date (year: YYYY, month: MM, day: DD
YYYY = 1981–2020, or8195, 9100, 0110, 1120, 7795)
hh : Time (hh = 01∼24)
lmn : Clear sky index Kc = l.mn (2 digit after decimal point)
def : Cloudless index Cle = d.ef (2 digit after decimal point)
Z : Igawa_C *i.e.* based on "*i*-All Sky Model-L/R (2012)" model then Z = C,
Igawa_D *i.e.* based on "*i*-All Sky Model-L/R (2016)" model then Z = D
(underlined number 0 and characters K and C are displyed as they are.)

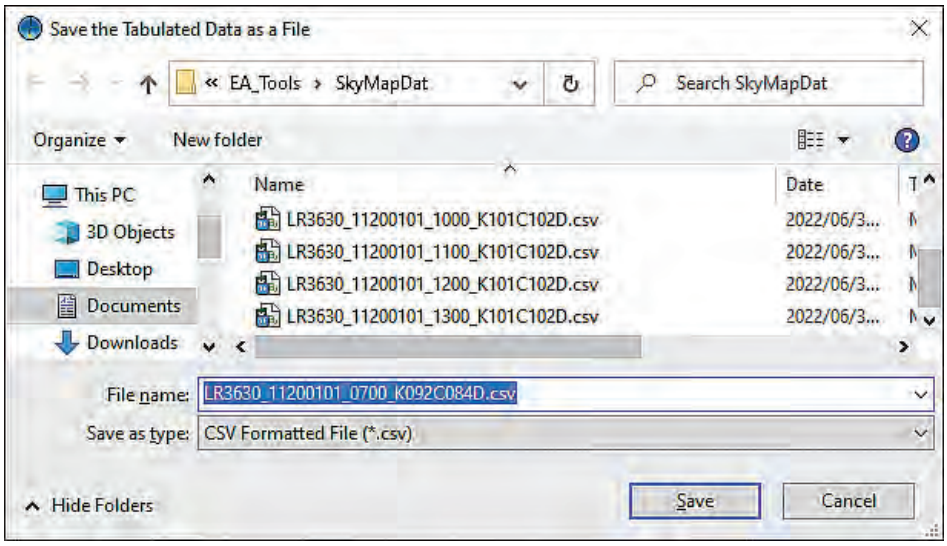


Fig. 18 Save the Tabulated Data As a File Dialog Window Called from the Table-Style Subwindow

By this incovenient feature, we are afraid that user may overwrite the previous saved data file. Please take care such trouble. Of course, the filename can be set as you like.

As Fig.18 showing, format of the file to save can be chosen from the drop-down list box named [Save as type].

By the way, default folder for saving the table data file is setted to SkyMapDat, which is the same folder for saving map image as an EMF file.

6 File Save of IDMP 145 Data for Whole Year

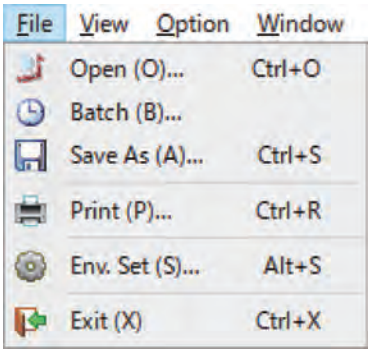


Fig. 19 File Menu of SkyMap

This function is new feature added in this version in 2022. As shown in Fig.19, click [File | Batch (B)...] menu to use this new function. Then a dialog window like as shown in Fig.20 appears. You can select specified year and specified AMeDAS station and start the batch job. This function makes a CSV format file including relative values for every 145 points and absolute values of luminance and radiance for the zenith and many related calculation parameters. One record is built for one hour. This batch job repeat the record build for every 17 hours (4:00–20:00) of each day of the year.

The output flename is determined as DMP145All_{Wea2 main filename}_{Station ID} .csv automatically ans saved to the default folder. Due to so many repetition in this batch work, large file space and long computaion time are required*15.

*15 It is experienced that three or four minites elapsed under plain Japanese Windows environment on Intel

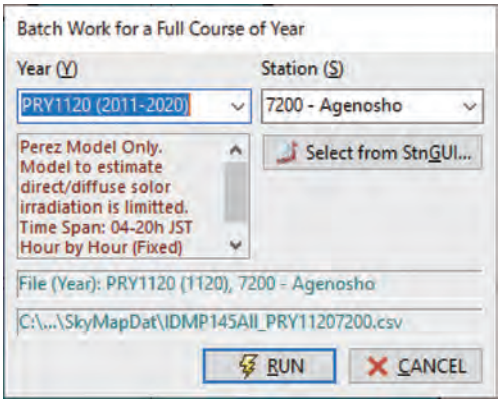


Fig. 20 Batch Work for a Full Course of Year Dialog Window

7 Miscellaneous Functions

There are four more functions to be explained especially as enumerated below:

(1) Chosing function of calculation models for estimating sky luminance/radiance distributions,

(2) Optional functions: Tuning up the drawig items in the main window; Choice whether setional charts are included as an drawn image to be saved as a file and/or printed out,

(3) Color set changing function for drawing map,

(4) Set a simultaneous map drawing switch with changing of the edit boxes labeled [Date (D)] and [Time (T)].

7.1 Option for Selecting the Calculation Model

The selection is one of two models for luminous efficacy of diffuse solar irradiance: "*i*-All Sky Model-L/R (2012)" applied to Igawa_C model and "*i*-All Sky Model-L/R (2016)" applied to Igawa_D model. The latter one is default model of SkyMap. If you don't have any clear reason to select the former model, then you should not touch this menu.

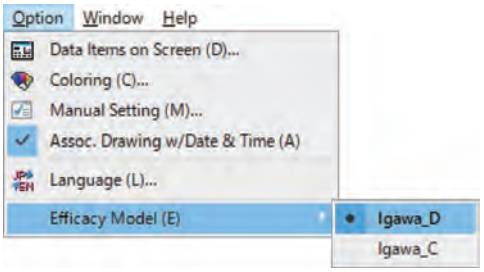


Fig. 21 Menu to Select Calculation Model in SkyMap

This setting is effective during SkyMap is executing and affect to new drawings after setting operation. Due to no way to record this setting into registry system, when you wake up SkyMap again, the default setting is applied anytime.

This function is set by selecting [Option | Efficacy Model (E)]. That menu has two sub menus that you can select by clicking to turn the radio button on.

Core i9–10900 (2.80GHz base) machine.

7.2 Option for Selecting Items to Draw

SkyMap has functions to select the items to be drawn in the main window; to include or avoid sectional charts into the image that is saved as a file and/or printed out.

In order to use these functions, you should display the setting dialog window illustrated in Fig.22 by selecting [Option | Data Items on Screen (D)...] menu from the menu bar of the main window (see Fig.21). In this setting, your selected conditions are saved in the registry system and reflected to your next executing of SkyMap.

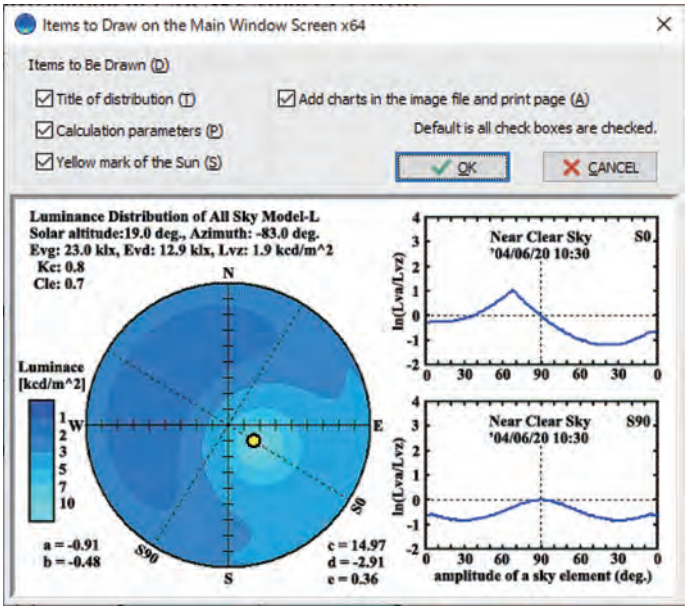


Fig. 22 Items to Draw Dialog Window of SkyMap

7.3 Option for Changing Color Set

Use a dialog window illustrated in Fig.23, which appears by selecting [Option | Coloring (C)...] menu from the menu bar of the main window (see Fig.21).

The following settings can be done by this window:

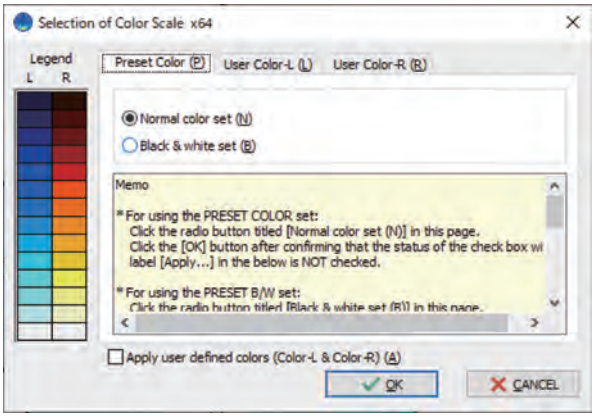


Fig. 23 Selection of Color Scale Dialog Window of SkyMap

- Changing to B/W (Gray) tile colors prepared in SkyMap as a default set,
- Designing color sets for luminance distribution and radiance distribution by users originally and the settings are save in the registry system and load from the registry system,
- Reset to the default color setting.

Probably, you can use the dialog window shown in Fig.23 without any instruction. However, we inform to you that the usage of this window is quite similar with a dialog window of ColorMap, a color contour map drawing tool program, of which PDF manual[15] is ready to read for geting more information on the usage of these kind of dialog windows. Please refer the PDF manual if you need.

7.4 Option for Simultaneous Drawing with Date/Time Changing

In default setting of SkyMap working out of the manual data input mode, when you change the data of two edit boxes named [Date (D)] and [Time (T)], the image on the center pf the main window is redrawn after calculating the new situation's distribution. However this action can be controlled by the option setting. The option switch is assigned as a check mark on [Option | Assoc. Drawing w/ Date & Time (A)] as shown in Fig.21 (p.18).

When you tern off the simultaneous drawing, you can set the date and time as soon as possible without any waiting time for recalculation and redrawing. This option switch cannot save in the registry system. Thus if you need this function, then you should set the menu at every occasion of executing SkyMap.

8 List of Menu Items

This is the last chapter of the manual of SkyMap. Finally, menus are summarized in Table 2.

Table. 2 Menu List of SkyMap (1/2)

Main Window

Menu		Explanation of	Short-	Speed
Main	Sub/Subsub	Operation or Function	cut Key	Button
[File]	[Open(O)...]	Read specified stations' Wea2 file data.	Ctrl+O	
	[Batch(B)...]	File output for a specified stations annual calculated data.		
	[Save As(A)...]	Save the map and charts as an image file.	Ctrl+S	
	[Print(P)...]	Print out the map and charts.	Ctrl+R	
	[Env. Set(S)...]	Invoke EA_SetEnv2022. Environment settings for EA Graphic Tools 2022.	Ctrl+R	
	[Exit(X)]	Terminate SkyMap.	Ctrl+X	
[View]	[Map Selection(S)]			
	[Sky Luminace(L)]	Draw luminance distribution map.	Ctrl+L	
	[Sky Radiance(R)]	Draw radiance distribution map.	Ctrl+R	
[Option]	(on Screen)	Selection of data items to be drawn.		
	[Data Items(D)...]	Add sectional charts or not.		
	[Coloring(C)...]	Setting colors of distribution map.		
	[Manual Setting(M)...]	User setting of location, year, solar, air temperature and humidity data.		
	[Assoc. Drawing w/ Date & Time(A)]	Simultaneous action of drawing and date/time changing.		(cont)

Table. 2 Menu List of SkyMap (2/2)

Main Window

Menu		Explanation of Operation or Function	Short-cut Key	Speed Button
Main	Sub/Subsub			
[Option]	[Language(L)...] [Efficacy Model(E)]	Display in Japanese / English. Selecting *i*-All Sky Model-L/R (2016) (Igawa_D) model or *i*-All Sky Model-L/R (2012) (Igawa_C) model		
[Window]	[Cross Section Charts (C)... [Data Table(T)...]	Display sectional charts subwindow. Display table-style subwindow.	F1 F2	
[Help]	[Usage(U)...] [Version Info.(I)...]	Browse information on MetDS HP. Display "About" message box.		

Subwindow (Tool Window)

Menu		Explanation of Operation or Function	Short-cut Key	Speed Button
Main	Sub/Subsub			
[File]	[Save As(A)...]	File save of table displayed in front.	Ctrl+A	
	[Print(P)...]	Print out of table displayed in front.	Ctrl+P	
	[Exit(X)]	Close the subwindow.	Ctrl+X	
[View]	[Parameters(P)]	Display [Parameters(P)] page.		
	[Section-S0(Z)]	Display [ection-S0(Z)] page.		
	[Section-S90(C)]	Display [ection-S90(C)] page.		
	[IDMP 145 points(I)]	Display [IDMP 145 points(I)] page.		

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EA Graphic Tools 2022
Users' Manual for
Sky Luminance / Radiance
Distribution Viewer
"SkyMap"

May 31, 2022 Ed.1, Rev.1
Writen and Edited by Meteorological Data System Co. Ltd.
Printed and Published by Meteorological Data System Co. Ltd.
10–19–1105 Koraicho, Kagoshima 890–0051, Japan
URL https://www.metds.co.jp/
