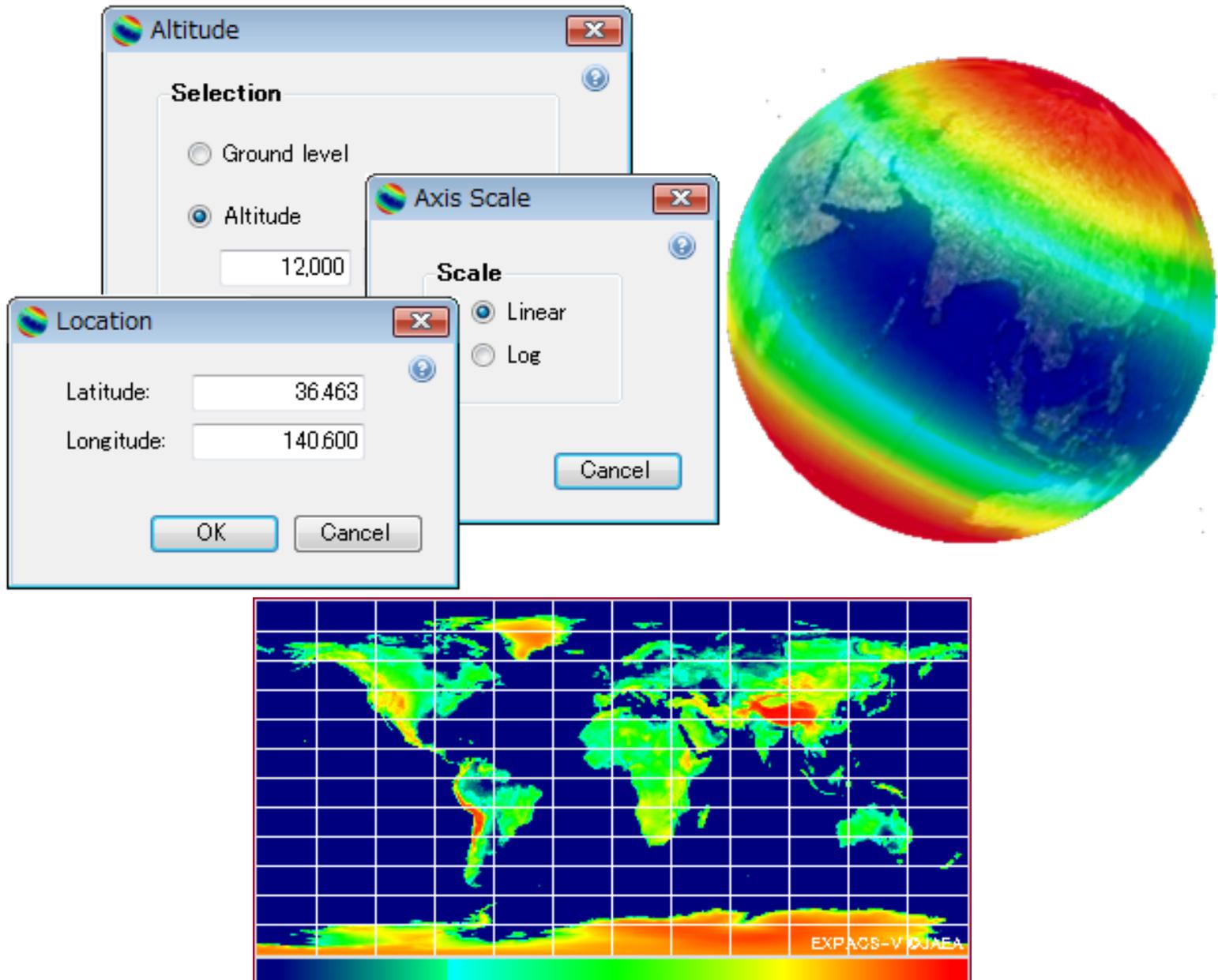


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Abstract

EXPACS-V is designed for visualizing the results of EXPACS on the map of Google Earth™. EXPACS represents EXcel-based Program for calculating Atmospheric Cosmic-ray Spectrum. It was made for estimating atmospheric cosmic-ray dose and spectrum based on PARMA: PHITS based Analytical Radiation Model in the Atmosphere. PARMA is capable of calculating neutron, proton, He nucleus, muon, electron, positron and photon spectra for anywhere in the world, except for the altitudes over 20 km, by specifying the altitude, latitude, longitude and time of your interest. EXPACS-V is free software, and you can use/redistribute/modify it for any purposes.



Open *.epc file

*.epc file includes the information on calculation conditions of EXPACS-V, such as altitude, location and time. To open *.epc file, follow the procedures below.

Icon



When you click this button, open-file-dialog is displayed.

Operation

1. *.epc files are listed in open-file-dialog.
2. Select folder and file.
3. Press "open" button.
4. If there is no *.epc file in the folder, no file is listed in open-file-dialog.
5. If you want to cancel to open *.epc file, press "cancel" button.

Save *.epc file

*.epc file includes the information on calculation conditions of EXPACS-V, such as altitude, location and time. To save *.epc file, follow the procedures below.

Icon



When you click this button, save-file-dialog is displayed.

Operation

1. Select folder.
2. Input file name.
3. Press "save" button.
4. If you want to cancel to open *.epc file, press "cancel" button.

Export calculation conditions to EXPACS

EXPACS-V can export altitude, latitude, longitude and time information to EXPACS for estimating cosmic-ray spectra for the conditions. EXPACS represents EXcel based Program for Calculating Atmospheric Cosmic-ray Spectrum. It is automatically installed in the folder of EXPACS-V.

Icon



When you click this button, EXPACS-V exports the calculation conditions.

Operation

If you click this button while the cursor of Google Earth is moving, wrong latitude and longitude information may be exported to EXPACS. In this case, you must click this button again after the cursor is stopped.

Redraw

When you click this button, EXPACS-V recalculates the dose rates and draws the results on Google Earth.

Icon



Click this button.

Control

Redraw

Click this button.

Animation mode

EXPACS-V can animate the dependence of the cosmic-ray dose rates on time or altitude.

Control

Animation

If you click "animation mode" button, setting-animation-dialog is displayed.

Dialog

The image displays two side-by-side screenshots of the 'Animation' dialog box. The left dialog box has the 'Time parameter' tab selected, showing 'Start' as 2007/01/01, 'Last' as 2007/12/31, and 'Number of scenes' as 20. The right dialog box has the 'Altitude parameter' tab selected, showing 'Start' as 12,000 m, 'Last' as 0 m, and 'Number of scenes' as 20. Both dialog boxes include 'OK' and 'Cancel' buttons at the bottom.

Operation

1. If you want to animate the time-dependence of the cosmic-ray dose rates, click "time dependence".
2. Input initial and final date for the animation.
3. Input number of scenes.
4. If you want to animate the altitude-dependence of the cosmic-ray dose rates, click "altitude dependence".
5. Input initial and final altitude for the animation.
6. Input number of scenes.
7. Press "OK" to play the animation.
8. You can terminate the animation by pressing "Cancel" button in the control window.

Global display Mode

Draw the global dose rates in the specified resolution. It may take time if you choose high resolution.

Control

Display mode

- Global
 Regional

Operation

1. Select "global mode" in the radio button.
2. You will see the message "Draw the global dose rates in the specified resolution. It may take time if you select high resolution"
3. If you want to continue, press "Yes"
4. If you want to cancel, press "No"

Restriction.

1. In the global mode, you cannot open/save *.epc file. You also cannot save picture of dose rates.
2. In the global mode, you cannot select "2-minutes" for the map resolution.

Order of Windows

You can fix "EXPACS-V control window" at the top of the display.

Control

Windows order

- Foremost
 Not fixed

1. If you want to fix "EXPACS-V control window" at the top of the display, choose "Yes" in the "always top" radio button.
2. If you do not want to fix "EXPACS control window" at the top of the display, choose "No" in the "always top" radio button.

Camera angle

You can choose the Google-Earth camera angle from the fixed or auto mode.

Control

Camera angle

- Fixed
 Auto

Operation

1. If you choose "Fixed" in the radiobutton in "Camera angle" in the control window, EXPACS-V does not adjust the camera angle of Google Earth.
2. If you choose "Auto" in the radiobutton in "Camera angle" in the control window, EXPACS-V automatically adjusts the camera angle of Google Earth.

Save dose rate map as a picture

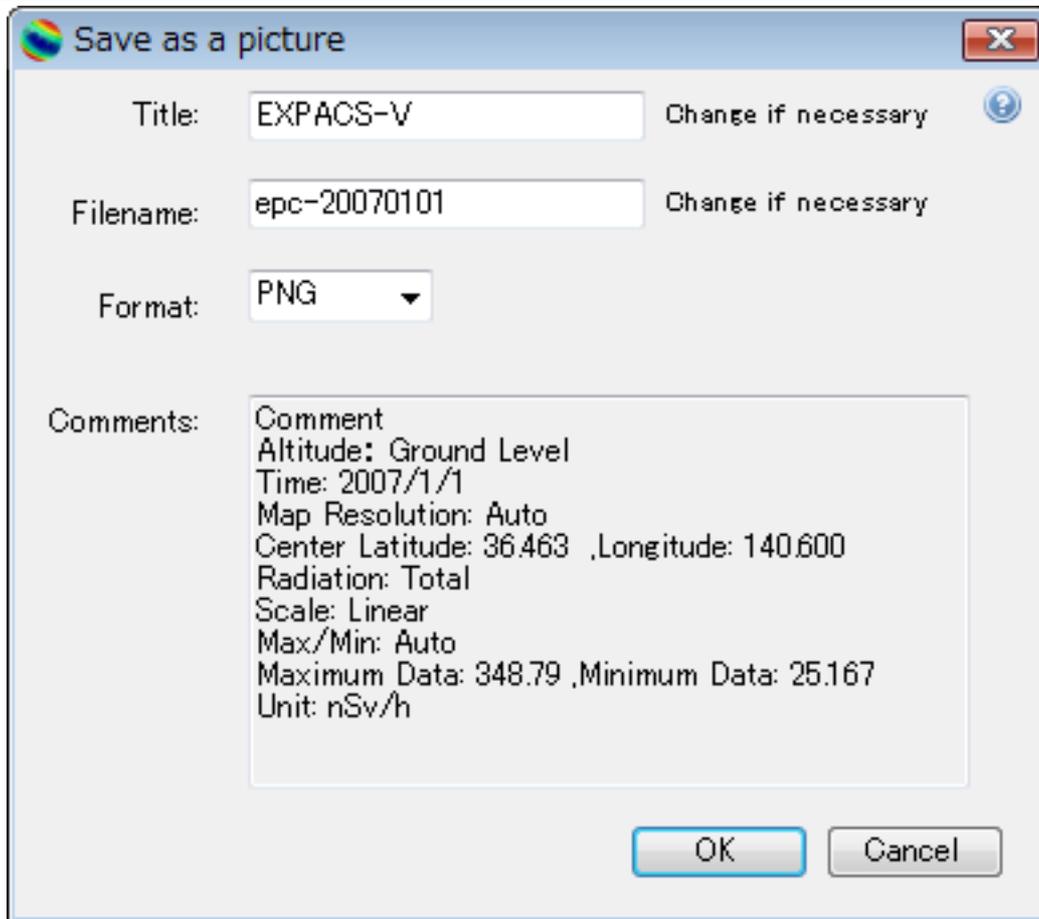
You can save the calculated dose rate map with input conditions in picture formats.

Icon



When you click this button, save-picture-dialog is displayed.

Dialog



Operation

1. Input the title of picture.
2. Input the file name of picture.
3. Select the format of picture. You can choose from "png", "jpeg", "gif" and "bmp" formats.
4. Change the comments described in picture. The calculation conditions are described as default comments.
5. If you click "OK", save-file-dialog is displayed.
6. Select folder.
7. If you want to cancel to save picture, press "Cancel" button.

Save dose rate map in Google Earth format

You can save the calculated dose rate map in Google Earth format (.kml).

Icon



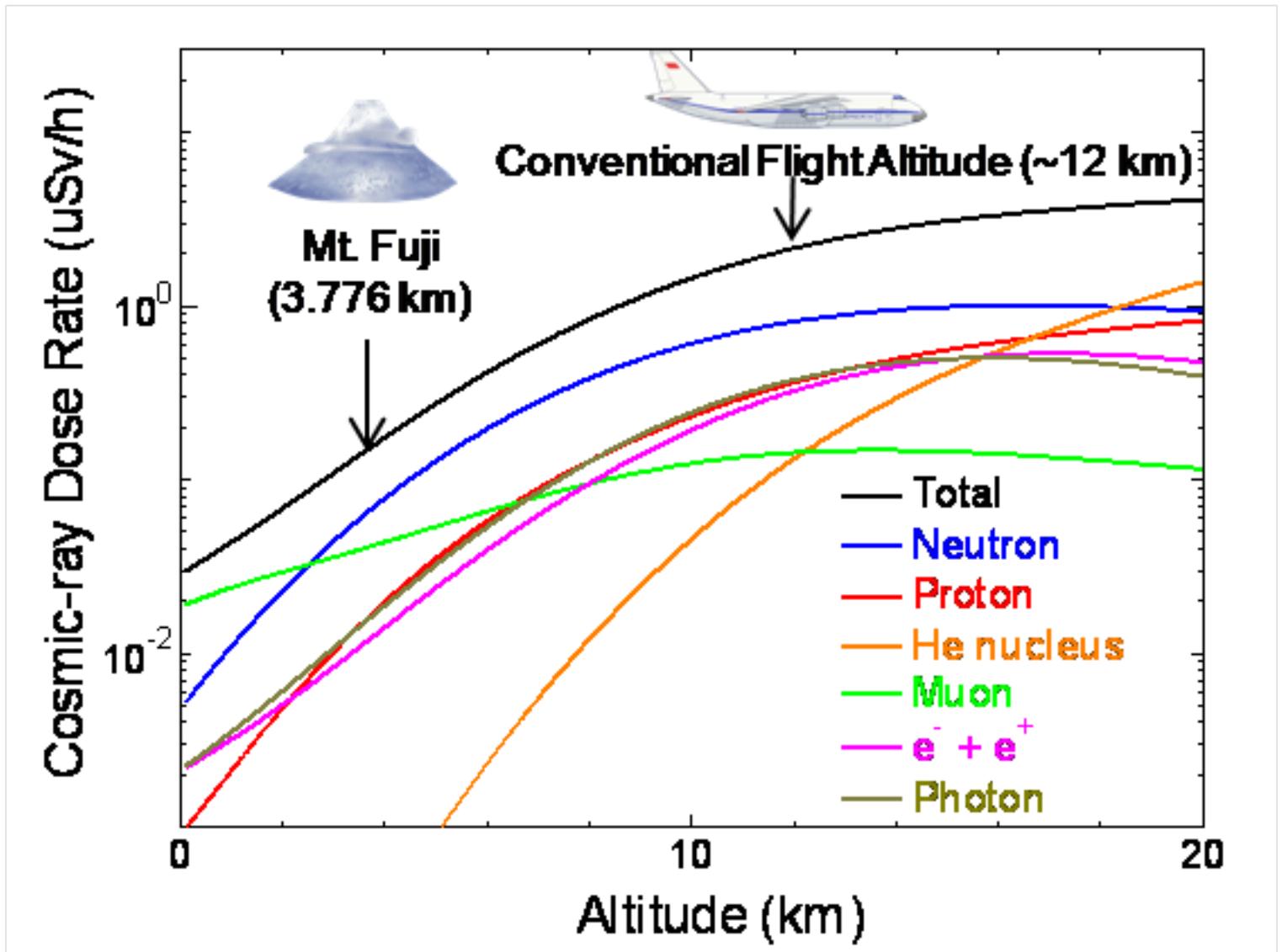
When you click this button, save-file-dialog is displayed.

Operation

1. Select folder.
2. Input file name.
3. Press "save" button.
4. If you want to cancel to save picture, press "Cancel" button.

Input altitude.

You can draw the cosmic-ray dose rate map at a fixed altitude below 20 km (corresponding to 65617ft and 54 g/cm²) or at the ground level. In general, cosmic-ray dose increases consistently with altitude, and that at conventional flight altitude (~10km) is approximately 100 times higher than that at sea level.



Calculated cosmic-ray dose rates above Tokyo (1/1/2007) as a function of altitude

Icon



You can choose the "fixed altitude" or "ground level" mode by this drop-down button.

Control



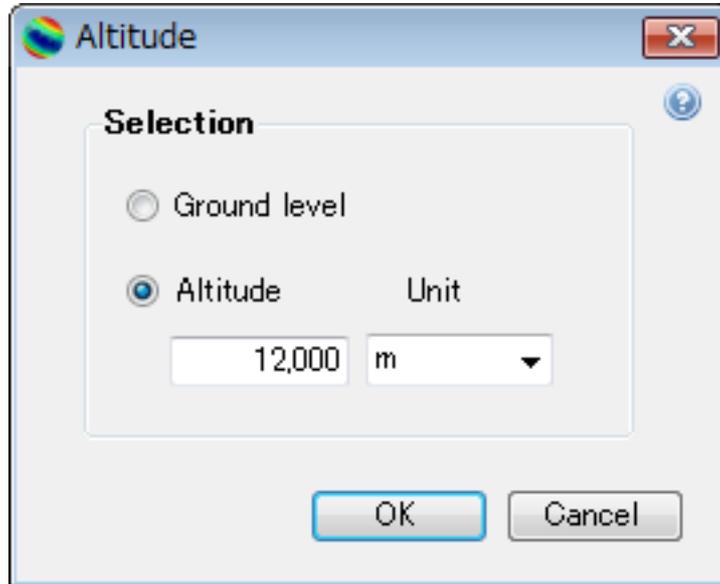
If you click "ground level", EXPACS-V calculates the cosmic-ray dose rates at ground level using the global relief data ETOPO2v2, which is provided by National Geophysical Data Center. If you click "fixed altitude", input-altitude-dialog is displayed.

Altitude: Ground Level 

Altitude: Fixed Altitude  12,000 m

This panel shows the input altitude. If you click the icon , input-altitude-dialog is displayed.

Dialog



Operation

1. If you choose "ground level" in the radio button, EXPACS-V calculates the cosmic-ray dose rates at ground level.
2. If you choose "fixed altitude" in the radio button, EXPACS-V calculates the cosmic-ray dose rates at a fixed altitude.
3. For "fixed altitude" mode, you must input the altitude and its unit.
4. You can choose the unit of altitude among "m", "ft" and "g/cm²"
5. If you want to execute the calculation with input condition, press "OK"
6. If you want to cancel the calculation, press "Cancel"

Input location

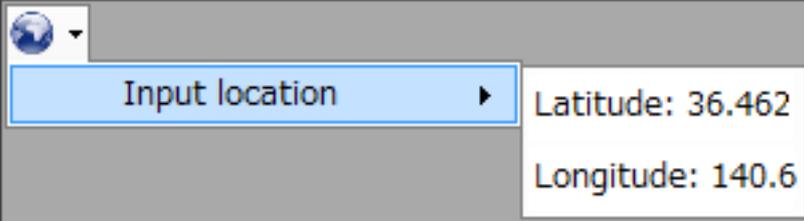
You need to specify the latitude (-90 to 90, north+) and longitude (-180 to 180, east+) at the center of the cosmic-ray dose rate map. EXPACS-V estimates the magnitude of the magnetosphere based on the vertical cut-off rigidity calculated by MAGNETOCOSMICS.

Icon

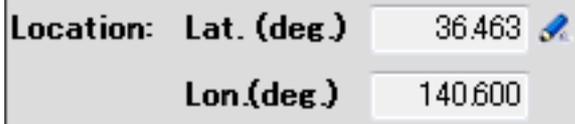


If you click "input location" in drop-down button, input-location-dialog is displayed.

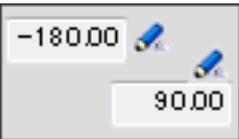
Control



If you click "input location", input-location-dialog is displayed.

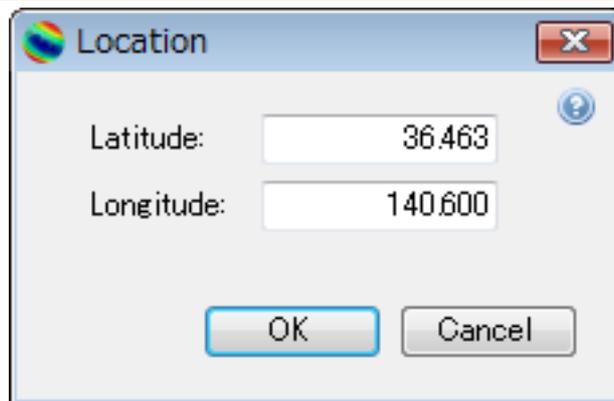


These panels show the latitude and longitude at the center of the cosmic-ray dose rate map. If you click the icon  in the control window, input-location-dialog is displayed.



If you click the icon  in the control window, input-location-dialog is displayed.

Dialog

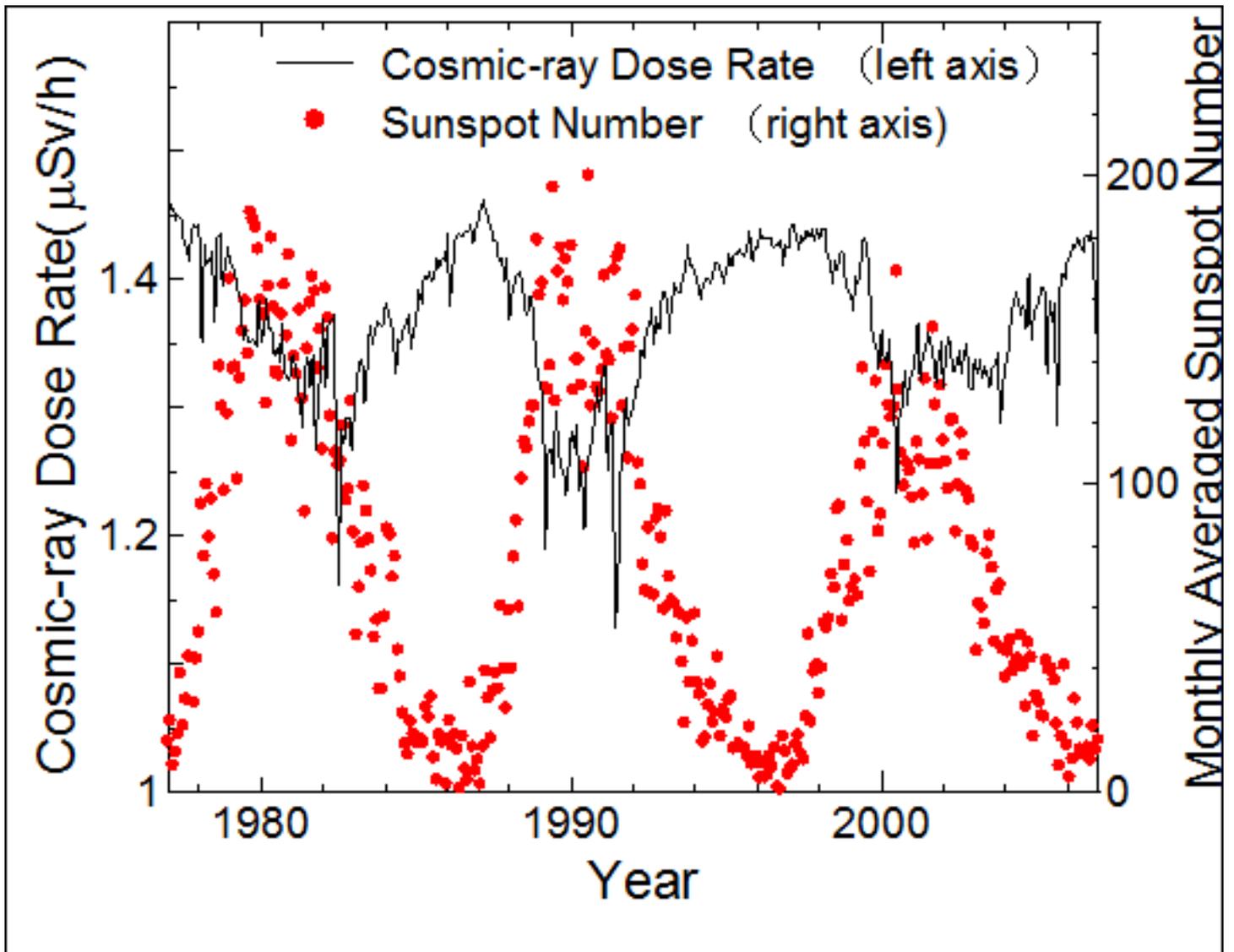


Operation

1. Input latitude between -90 and 90 in north positive decimal degrees.
2. Input longitude between -180 and 180 in east positive decimal degrees.
3. If you want to execute the calculation with input condition, press "OK".
4. If you want to cancel the calculation, press "Cancel".

Input date

You need to specify the date for calculating cosmic-ray dose rates. The cosmic-ray dose rates depend on the solar activity. In EXPACS-V, the solar activity is expressed by the force field potential (FFP). The numerical values of FFP can be determined from the count rates of several ground-level neutron monitors for the date. If the specified date is before year 1951, i.e. before ground-level neutron monitors in operation, EXPACS-V calculates the FFP based on the reconstructed cosmic-ray intensity (Usoskin et al, JGR 107(A11), 1374, 2002). EXPACS can calculate the force field potentials from year 1614, but cannot estimate during the Maunder Minimum (1647-1699) because of the lack of sunspot number data. However, you can input the year only after 1753 in EXPACS-V because of the calendar limitation.



The time dependence of the calculated cosmic-ray dose rates at 11 km above Tokyo in comparison with that of the monthly averaged sun-spot number, an index of the solar activity.

Icon



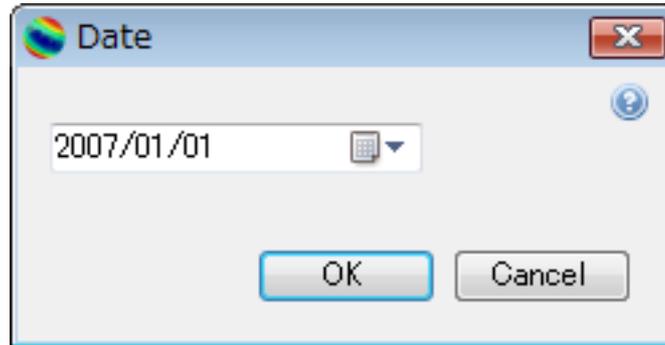
If you click this button, input-date-dialog is displayed.

Control

Date: 2007 / 1 / 1 

This panel shows the date for calculating cosmic-ray dose rates. If you click the icon  in the control window, input-date-dialog is displayed.

Dialog

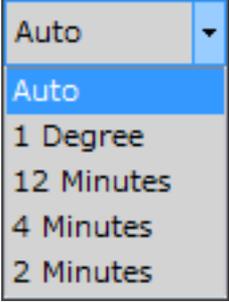


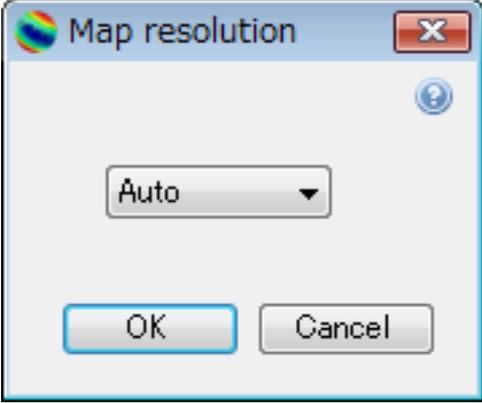
Operation

1. Input date for the calculation.
2. If you want to execute the calculation for the date, press "OK".
3. If you want to cancel the calculation, press "Cancel".

Setting map resolution

You can choose the resolution of the cosmic-ray dose rate map among 2, 4, 12 minutes/pixel and 1 degree/pixel.

Control	
	You can choose the resolution of the cosmic-ray dose rate map among the values listed in the combo-box. If you choose "auto", EXPACS-V automatically determines the resolution by referring the camera altitude of Google Earth.
	The panel shows the resolution of the cosmic-ray dose rate map. If you click the icon  in the control window, map-resolution-dialog is displayed.

Dialog

<p>Operation</p> <ol style="list-style-type: none">1. Choose the resolution of the cosmic-ray dose rate map among the values listed in the combo-box.2. If you choose "auto", EXPACS-V automatically determines the resolution by referring the camera altitude of Google Earth.3. If you want to execute the calculation with input condition, press "OK".4. If you want to cancel the calculation, press "Cancel".

Definition of dose

In EXPACS-V, the word of "dose" implies the "effective dose".

Control

Calculated dose rate: 30.954

This panel shows the cosmic-ray dose rate at the center of the map.

Unit of dose rate

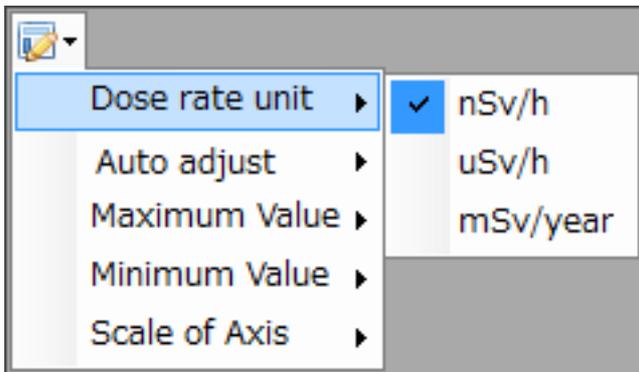
You can choose the unit of dose rate.

Icon



If you want to change the unit, you must select "dose rate unit" in the drop-down list.

Control

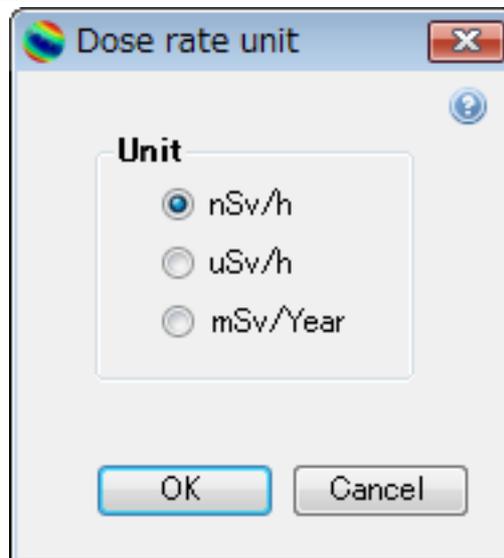


Choose your preferable unit for expressing dose rate.



This panel shows your selected unit of dose rate. If you click the icon  in the control window, select-unit-dialog is displayed.

Dialog



Operation

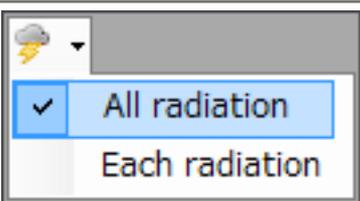
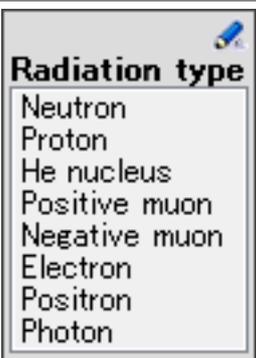
1. choose your preferable unit for expressing dose rate among nSv/h, uSv/h and mSv/year.
2. If you want to execute the calculation with input condition, press "OK".
3. If you want to cancel the calculation, press "Cancel".

Selection of radiation type

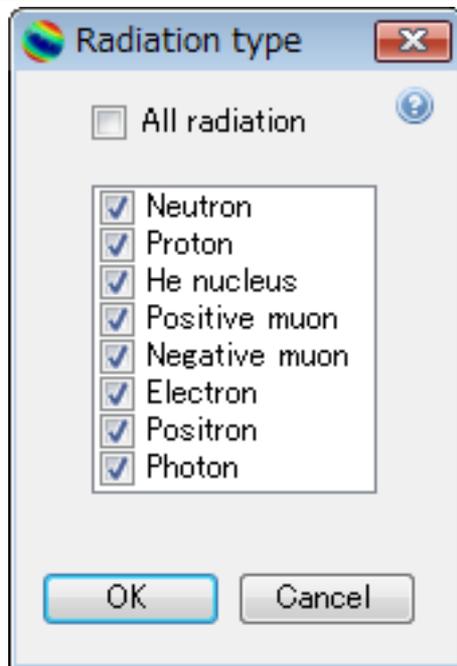
In EXPACS-V, you can calculate the cosmic-ray dose rates from neutron, proton, He nucleus, positive muon, negative muon, electron, positron and photon separately, and draw the map of any combinations of each contribution.

Explanation of radiation type.	
Neutron	Non-charged radiation with strong penetrability through materials. It has dominant contribution to the cosmic-ray dose rate at conventional flight altitudes.
Proton	Charged radiation. The primary cosmic-ray predominantly consists of proton.
He nucleus	Heavy charged radiation. It consists of 2 protons and 2 (or 1) neutrons.
Muon	Charged radiation with strong penetrability through material. It has dominant contribution to the cosmic-ray dose rate at sea level.
Electron and Positron	Negative and positive charged radiations, respectively. The current of electron is the source of the electric power.
Photon	Non-charged radiation without mass. It is the carrier of electromagnetic radiation, including gamma-rays, X-rays, ultraviolet light, visible light, infrared light, microwaves and radiowaves.

Icon		If you choose "all radiation" in the drop-down button, EXPACS-V calculates the sum of the all cosmic-ray dose rates. If you choose "each radiation", choose-radiation-dialog is displayed.
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Control	
	If you choose "all radiation", EXPACS-V calculates the sum of the all cosmic-ray dose rates. If you choose "each radiation", choose-radiation-dialog is displayed.
	The panel shows the type of radiations included in the calculation of the cosmic-ray dose rates by EXPACS-V. If you click the icon  in the control window, select-radiation-dialog is displayed.

Dialog



Operation

1. If you check "all radiation", EXPACS-V calculates the sum of the all cosmic-ray dose rates.
2. If you want to know the cosmic-ray dose rates only from some radiations in which you are interested, you need to check the check-box for your interested.
3. You must check at least one check-box.
4. If you want to execute the calculation with input condition, press "OK".
5. If you want to cancel the calculation, press "Cancel".

Axis of dose rate

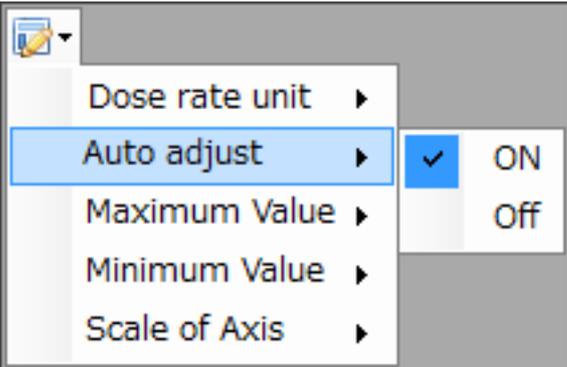
You can adjust the minimum and maximum values drawn in the cosmic-ray dose rate map.

Icon

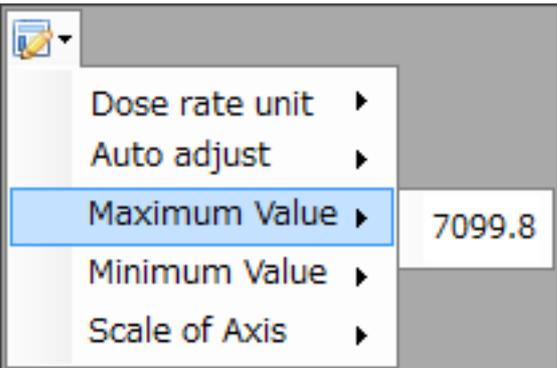


If you choose "On" in the "auto adjust" item, EXPACS-V automatically adjusts the minimum and maximum values by referring the calculated cosmic-ray dose rates. If you choose "Off", or you choose "maximum" or "minimum" item, control-axis-dialog is displayed.

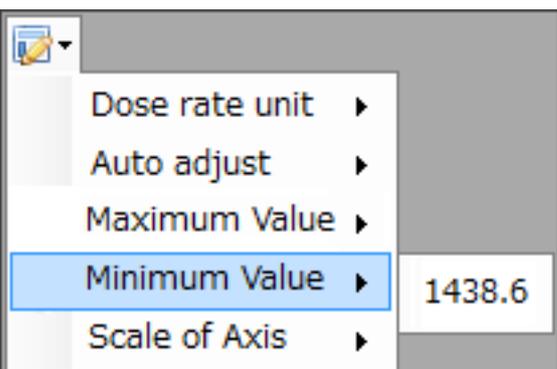
Control



If you choose "On", EXPACS-V automatically adjusts the minimum and maximum values by referring the calculated cosmic-ray dose rates. If you choose "Off", control-axis-dialog is displayed.



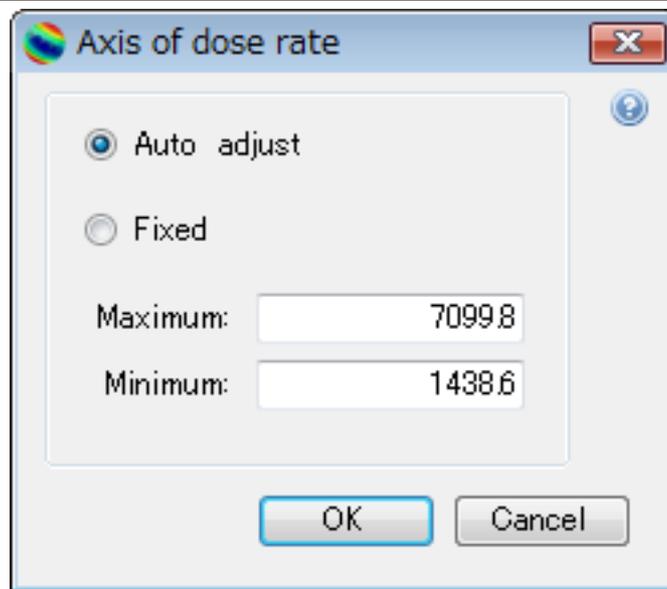
If you click "maximum" or "minimum", control-axis-dialog is displayed.



Axis:

The panel shows whether the minimum and maximum values are automatically adjusted or fixed. If you click the icon in the control window, control-axis-dialog is displayed.

Dialog



Operation

1. If you choose "auto adjust", EXPACS-V automatically adjusts the minimum and maximum values by referring the calculated cosmic-ray dose rates.
2. If you want to specify the minimum and maximum values by yourself, check "fixed".
3. Input minimum and maximum values of the cosmic-ray dose rates drawn in the map.
4. If you want to execute the calculation with input condition, press "OK".
5. If you want to cancel the calculation, press "Cancel".

Setting axis scale

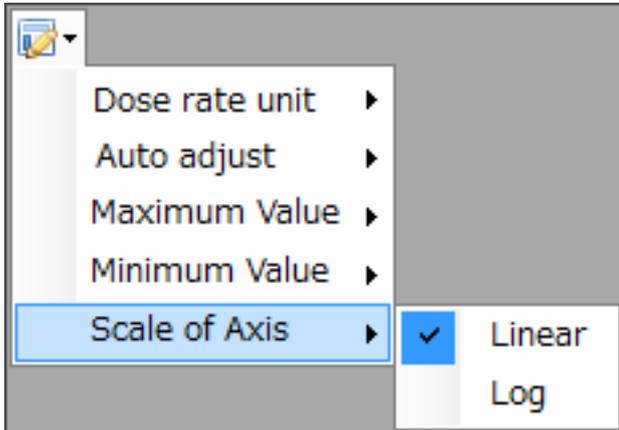
You can choose linear or log scale for the dose rate axis.

Icon



You can choose linear or log scale for the dose rates axis using this icon.

Control



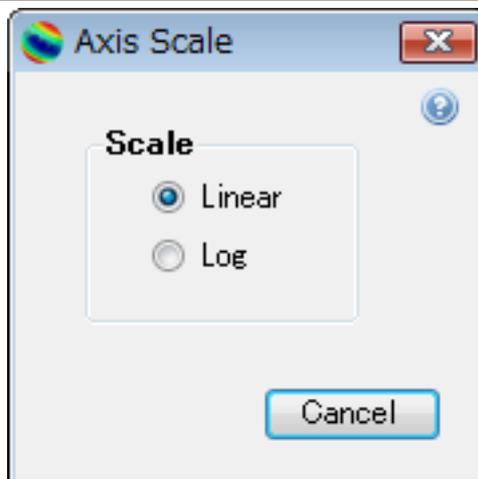
You can determine linear or log scale for the dose rates axis by selecting "linear" or "log" in the "scale" item.

Scale: Linear

The panel shows the axis scale.

If you click the icon in the control window, select-scale-dialog is displayed.

Dialog



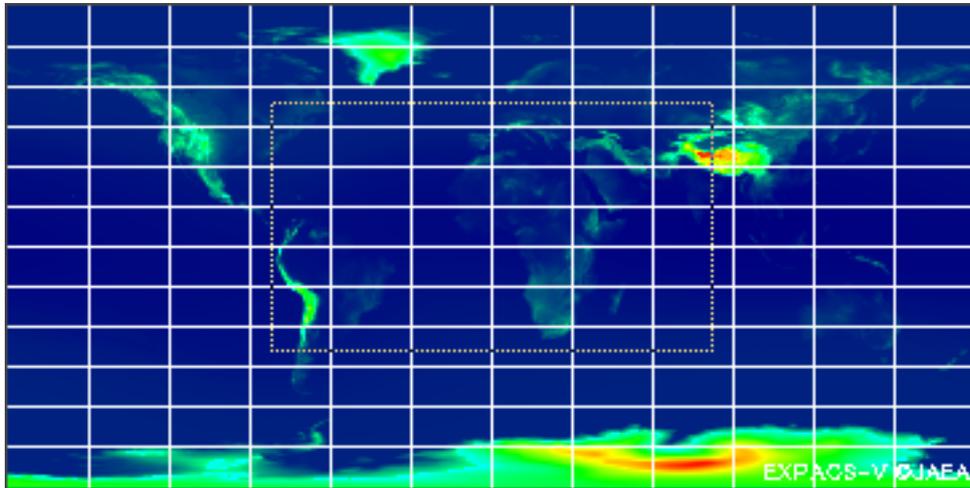
Operation

1. Choose "linear" or "log" in the radio button.

What you can do on dose rate map

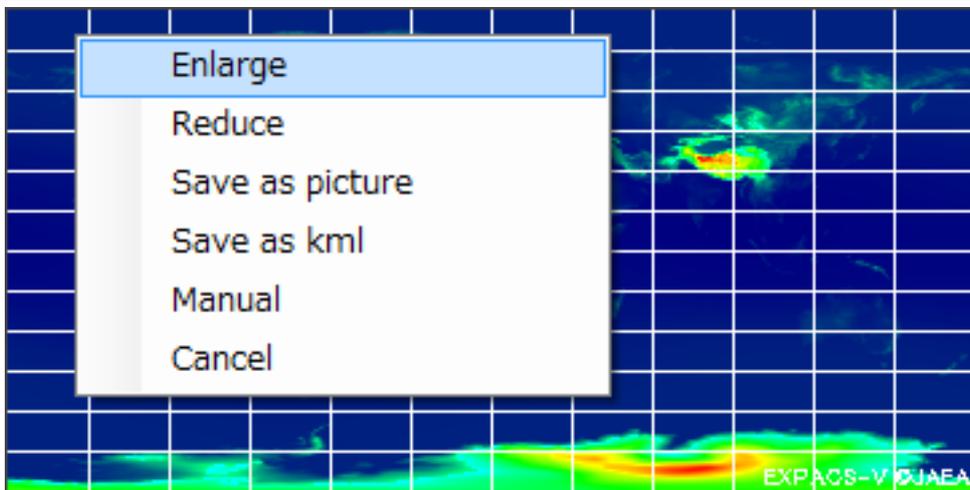
There are several functions that you can do on the dose rate map.

Control



Operation (Mouse Left Button)

1. If you click on the map by left button, EXPACS-V redraws the map by centering the location.
2. If you draw a box on the map by left button, EXPACS-V redraws the map for the selected area. The resolution of the map is automatically adjusted by referring the size of the area.



Operation (Mouse Right Button)

1. If you click on the map by right button, the menu is displayed.
2. If you select "enlarge", EXPACS-V redraws the map for smaller area with higher resolution.
3. If you select "reduce", EXPACS-V redraws the map for larger area with lower resolution.
4. If you select "save as picture", save-picture-dialog is displayed.
5. If you select "save as kml", save-file-dialog is displayed.
6. If you select "manual", manual is displayed.
7. If you select "cancel", the menu is disappeared

FAQ

Q. Two cosmic-ray dose rate maps are drawn on Google Earth in duplicate. Why?

A. You must check "favorite" folder in Google Earth whether "EXPACS-V" and "Marker" folders exist in the folder or not. If yes, delete "EXPACS-V" and "Marker".

Q. The latitude and longitude exported to EXPACS is occasionally not precise. Why?

A. If you click the export button while the cursor of Google Earth is moving, wrong latitude and longitude information may be exported to EXPACS. In this case, you must click this button again after the cursor is stopped.