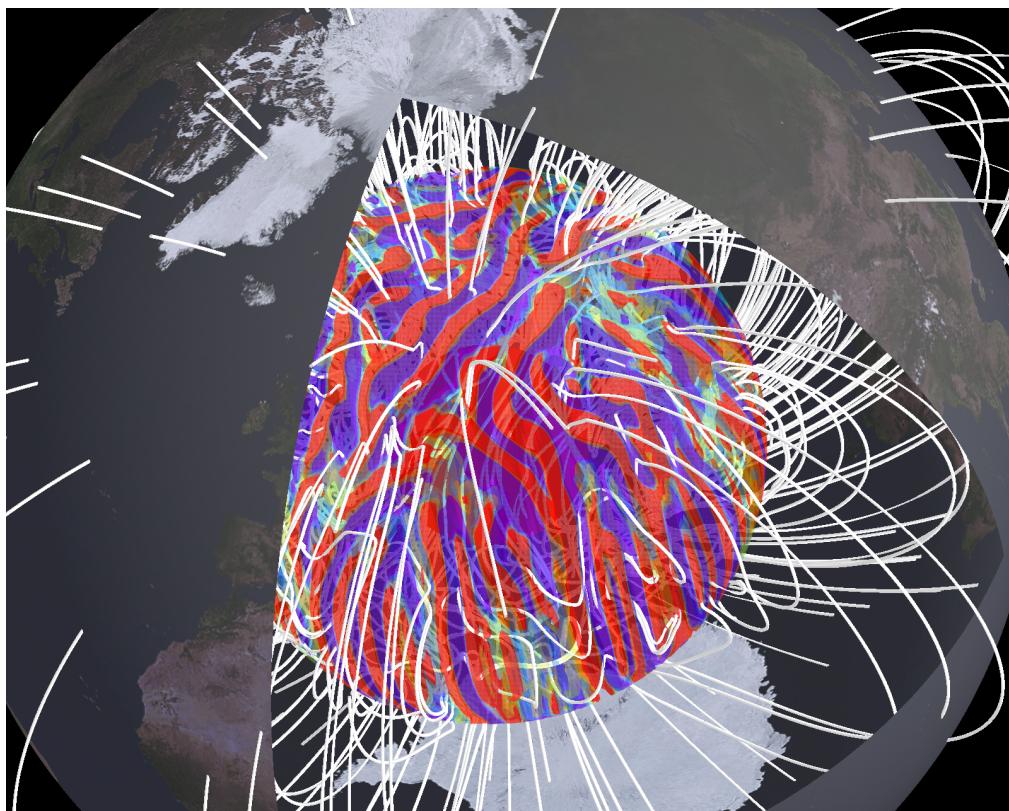


# Calypso

User Manual  
Version 2.0



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## Preface

CalypsoView is a date viewer program for sections and isosurfaces generated by Calypso.  
This program is intended to run on a desktop computer.

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# 1 Introduction

CalypsoView is a date viewer program for sections and isosurfaces generated by Calypso. Calypso is a program package for magnetohydrodynamics (MHD) simulations in a rotating spherical shell for geodynamo problems. This program is intended to run on a desktop computer with a single process.

To make the program simple and small as possible, CalypsoView can only visualize cross section and isosurface results and saves image data. To visualize the data with whole volume, please use more powerful visualizaion program such as ParaView or VizIt.

This user guide provides instructions for the configuration and execution of CalypsoView.

# 2 History

Calypso has its origins in two earlier projects. One is a dynamo simulation code written by Hiroaki Matsui in 1990's using a spectral method. This code solves for the poloidal and toroidal spectral coefficients, like Calypso, but it calculates the nonlinear terms in the spectral domain using a parallelization for SMP architectures. The other project is the thermal convection version of GeoFEM, which is Finite Element Method (FEM) platform for massively parallel computational environment, originally written by Hiroshi Okuda in 2000. Under GeoFEM Project, Lee Chen developed cross sectioning, iso-surfacing, and volume rendering modules for data visualization for parallel computations.

In GeoFEM project, Yoshitaka Wada developed GppView, which is a mesh and surface viewer for FEM mesh data with GeoFEM format and cross sections and isosurfaces obtained by sectioning module from GeoFEM. In 2012, Hiroaki Matsui has developed the data viewer with a same features as GPPView because of the halting of the development of GPPView.

CalypsoView Ver. 0.1 supports the following features and capabilities

- Visualize cross sections and isosurface data from Calypso.
- Visualize on map using Aitoff projection for contour map.
- CalypsoView can display up to 10 sectioning and isosurface data in total.
- Ouptput sequential image files with rotating along with  $x-$ ,  $y-$ , or  $z-$ axis (or movie file for Mac OS version)
- Ouptput time sequential image files (or movie file for Mac OS version)

- Attach image data as a texture using a spherical coordinate.

CalypsoView DOES NOT SUPPORT the following features and capabilities.

- Input result data with whole domain and construct isosurface or cross sections.

### 3 Acknowledgements

Calypso was primarily developed by Dr. Hiroaki Matsui in collaboration with Prof. Bruce Buffett at the University of California, Berkeley. The following NSF grants supported the development of Calypso,

- B.A. Buffett, NSF EAR-0509893; Models of sub-grid scale turbulence in the Earth's core and the geodynamo; 2005 - 2007.
- B.A. Buffett and D. Lathrop, NSF EAR-0652882; CSEDI Collaborative Research: Integrating numerical and experimental geodynamo models, 2007 - 2009
- B.A. Buffett, NSF EAR-1045277; Development and application of turbulence models in numerical geodynamo simulations ; 2010 - 2012

### 4 Citation

Computational Infrastructure for Geodynamics (CIG) and the Calypso developers are making the source code to Calypso available to researchers in the hope that it will aid their research and teaching. A number of individuals have contributed a significant amount of time and energy into the development of Calypso. We request that you cite the appropriate papers and make acknowledgements as necessary. The Calypso development team asks that you cite the following papers:

Matsui, H., E. King, and B.A. Buffett, Multi-scale convection in a geodynamo simulation with uniform heat flux along the outer boundary, *Geochemistry, Geophysics, Geosystems*, **15**, 3212 – 3225, 2014.

## 5 Installation

CalypsoView has a MacOS version and Linux implimentaion. Installation procedure and look and feel are different between these implimentaion.

### 5.1 MacOS

CalypsoView has a binary application bundle in the package. This application needs simply to drag and drop into /Application folder (see Figure 1).



Figure 1: Folder of the MacOS binary

#### 5.1.1 Compiler Requirements

Source code of CalypsoView\_Cocoa is written in C and Objective-C. To hack and build the program, Xcode is required.

#### 5.1.2 Library Requirements

Calypso requires the following libraries for MacOS version.

- Xcode (<https://developer.apple.com>)
- zlib (<https://www.zlib.net>)

zlib and other foundations are pre-installed in MacOS. Consequently, program should work without installing any other libraries.

## 5.2 Linux

### 5.2.1 Compiler Requirements

Source code of CalypsoView\_GLFW is written in C. Fortran90 is also used to make a C source code including shader program. Consequently, Fortran compiler is required. GCC, the GNU Compiler Collection (<https://gcc.gnu.org>) includes gfortran compiler in the most of Linux distributions. For MacOS, any fortran compiler needs to be installed because Xcode does not have fortran compiler.

### 5.2.2 Library Requirements

- GNU make
- zlib (<https://www.zlib.net>)
- libpng (<http://www.libpng.org/pub/png/libpng.html>)
- gtk+3 (<https://developer.gnome.org/gtk3/stable/>)
- OpenGL (<https://www.opengl.org>)
- GLFW (<https://www.glfw.org>)

Linux and MacOS use GNU make as a default 'make' command, but some system (e.g. BSD or SOLARIS) does not use GNU make as default. `configure` command searches and set correct GNU make command.

In the most of Linux distributions have these libraries as a default except for **GLFW**, but they should have a package to install GLFW.

### 5.2.3 Installation of required softwares for Ubuntu Linux

GCC, the GNU Compiler Collection (<https://gcc.gnu.org>) is already installed in the most of Linux distributions. However, packages for development are need to be installed. For Ubuntu 20, for example, the required compilers and libraries can be installed by using `apt` command as following::

```
% sudo apt install pkg-config  
% sudo apt install git  
% sudo apt install gfortran  
% sudo apt install zlib1g  
% sudo apt install zlib1g-dev
```

```
% sudo apt install libpng-dev  
% sudo apt install libgtk-3-dev  
% sudo apt install libglfw3-dev
```

### 5.3 Known problems

#### OpenGL on MacOS

Apple set OpenGL as a deprecated library. OpenGL is still supported, but some alternative needs to be considered.

### 5.4 Directories

The top directory of Calypso (ex. [CALYPSO\_HOME]) contains the following directories.

```
% cd [CALYPSO_HOME]  
% ls  
CMakeLists.txt Makefile.in configure.in examples  
INSTALL bin doc src  
LICENSE configure doxygen work
```

**bin:** directory for executable files

**cmake:** directory for cmake configurations

**cmake:** directory for document generated by doxygen

**doc:** documentations

**examples:** examples

**src:** source files

**work:** work directory. Compile is done in this directory.

### 5.5 Doxygen

Doxygen (<http://www.doxygen.org>) is a powerful document generation tool from source files. We only save a configuration file in this directory because thousands of html files generated by doxygen. The documents for source codes are generated by the following command:

```
% cd [CALYPSO_HOME]/doxygen  
% doxygen ./Doxyfile_CALYPSO
```

The html documents can be seen by opening [CALYPSO\_HOME]/doxygen/html/index.html. Automatically generated documentation is also available on the CIG website at <http://www.geodynamics.org/cig/software/calypso/>.

## 5.6 Install using configure command

### 5.6.1 Configuration using configure command

Calypso uses the configure script for configuration to install. The simplest way to install programs is the following process in the top directory of Calypso.

```
%pwd  
[CALYPSO_HOME]  
% ./configure  
...  
% make  
...  
% make install
```

After the installation, object modules can be deleted by the following command;

```
% make clean
```

./configure generates a Makefile in the current directory. Available options for configure can be checked using the ./configure --help command. The following options are available in the configure command.

Optional Features:

```
--disable-option-checking ignore unrecognized --enable/--with options  
--disable-FEATURE do not include FEATURE (same as --enable-FEATURE=no)  
--enable-FEATURE[=ARG] include FEATURE [ARG=yes]  
--enable-silent-rules less verbose build output (undo: "make V=1")  
--disable-silent-rules verbose build output (undo: "make V=0")  
--enable-cocoa Use Cocoa framework  
--enable-dependency-tracking  
do not reject slow dependency extractors  
--disable-dependency-tracking  
speeds up one-time build
```

Optional Packages:

```
--with-PACKAGE [=ARG]      use PACKAGE [ARG=yes]
--without-PACKAGE         do not use PACKAGE (same as --with-PACKAGE=no)
--with-zlib=DIR            root directory path of zlib installation defaults to
                           /usr/local or /usr if not found in /usr/local
--without-zlib             to disable zlib usage completely
--with-x                   use the X Window System
```

Some influential environment variables:

```
CC          C compiler command
CFLAGS      C compiler flags
LDFLAGS     linker flags, e.g. -L<lib dir> if you have libraries in a
nonstandard directory <lib dir>
LIBS        libraries to pass to the linker, e.g. -l<library>
CPPFLAGS    (Objective) C/C++ preprocessor flags, e.g. -I<include dir> if
you have headers in a nonstandard directory <include dir>
PKG_CONFIG  path to pkg-config utility
CPP          C preprocessor
ZLIB_CFLAGS C compiler flags for ZLIB, overriding pkg-config
ZLIB_LIBS   linker flags for ZLIB, overriding pkg-config
PNG_CFLAGS  C compiler flags for PNG, overriding pkg-config
PNG_LIBS    linker flags for PNG, overriding pkg-config
GL_CFLAGS   C compiler flags for GL, overriding pkg-config
GL_LIBS     linker flags for GL, overriding pkg-config
GTK3_CFLAGS C compiler flags for GTK3, overriding pkg-config
GTK3_LIBS   linker flags for GTK3, overriding pkg-config
GLFW_CFLAGS C compiler flags for GLFW, overriding pkg-config
GLFW_LIBS   linker flags for GLFW, overriding pkg-config
```

Use these variables to override the choices made by 'configure' or to help it to find libraries and programs with nonstandard names/locations.

At the end of the configuration, The following message can use to check if libraries can be referred correctly:

```
----- Configuration summary -----  
host:      "x86_64-apple-darwin16.7.0"  
  
Use Cocoa...      no  
Use X Window...   yes
```

```
Use zlib ...          yes
Use PNG output...    yes

Use GTK3+...         yes
Use GLFW...          yes
```

---

### 5.6.2 Compile

Compile is performed using the `make` command. The Makefile in the top directory is used to generate another Makefile in the `work` directory, which is automatically used to complete the compilation. The object file and libraries are compiled in the `work` directory. Finally, the executive files are assembled in `bin` directory. You should find the following programs in the `bin` directory.

```
kemoviewer(GLFW:  
          Viewer program
```

The following library files are also made in `work` directory.

```
libcalypsosview.a: CalypsoView library
```

### 5.6.3 Clean

The object and fortran module files in `work` directory is deleted by typing

```
% make clean
```

This command deletes files with the extension `.o`, `.mod`, `.par`, `.diag`, and `.`

### 5.6.4 Distclean

To revert the files and directory to the original package, use `make distclean` as

```
% make distclean
```

### **5.6.5 Install**

The executive files are copied to the install directory `$ (INSTDIR) /bin`. The install directory `$ (INSTDIR)` is defined in Makefile, and can also set by `$ {--prefix}` option for `configure` command. Alternatively, you can use the programs in `$ {SRCDIR} /bin` directory without running `make install`. If directory `$ {PREFIX}` does not exist, `make install` creates `$ {PREFIX}`, `$ {PREFIX}/lib`, `$ {PREFIX}/bin`, and `$ {PREFIX}/include` directories. No files are installed in `$ {PREFIX}/lib` and `$ {PREFIX}/include`.

### **5.6.6 Construct dependecies (only for developper)**

C source files need dependency among include files. Consequently, list of dependency of source files are saved in the file `Makefile.depends` in each directory. When you modify the source files with changing the module usage, `Makefile.depends` files need to be updated. To update the `Makefile.depends` files, use the `make` command at the `[CALYPSO_HOME]` directory as

```
% make depends
```

The dependency is generated by the `gcc` with `-MM -w -DDEPENDENCY_CHECK` option. Consequently, the dependencies need to be generated by the environment with `gcc` or compatible compiler. After generating the dependency, you can transfer the modified package and build without using `gcc`.

## **5.7 Install without using configure**

It is possible to compile Calypso without using the `configure` command. To do this, you need to edit the `Makefile`. First, copy `Makefile` from template `Makefile.in` as

```
% cp Makefile.in Makefile
```

In `Makefile`, the following variables should be defined.

`SHELL` Name of shell command.

`SRCDIR` Directory of this `Makefile`.

`INSTDIR` Install directory.

**MPICHDIR** Directory names for MPI implementation. If you set fortran90 compiler name for MPI programs in MPIF90, you do not need to define this valuable.

**F90** Command name of local Fortran 90 compiler to make a C source file including GLSL shader sources.

**AR** Command name for archive program (ex. `ar`) to generate libraries. If you need some options for archive command, options are also included in this valuable.

**RANLIB** Command name for `ranlib` to generate index to the contents of an archive. If system does not have `ranlib`, set `true` in this valuable. `true` command does not do anything for libraries.

**OPTFLAGS** Optimization flags for C compiler

**BLAS\_LIBS** Library lists for BLAS (ex. `-lblas`)

**ZLIB\_CFLAGS** Option flags for zlib (ex. `-I/usr/include`)

**ZLIB\_LIB** Library lists for zlib (ex. `-L/usr/lib -lz`)

**PNG\_CFLAGS** Option flags for libpng (ex. `'pkg-config --cflags libpng'`)

**PNG\_LIBS** Library lists for libpng (ex. `'pkg-config --libs libpng'`)

**X\_CFLAGS** Option flags for X window (ex. `|pkg-config --cflags x11—`)

**X\_LIBS** Library lists for X window (ex. `'pkg-config --libs x11'`)

**OPENGL\_INC** Option flags for OpenGL (ex. `'pkg-config --cflags glfw3'`)

**OPENGL\_LIBS** Library lists for OpenGL (ex. `'pkg-config --libs gl'`)

**GTK3\_CFLAGS** Option flags for gtk+-3 (ex. `'pkg-config --cflags gtk+-3.0'`)

**GTK3\_LIBS** Library lists for gtk+-3 (ex. `pkg-config --libs gtk+-3.0`)

**GLFW\_CFLAGS** Option flags for GLFW (ex. `'pkg-config --cflags glfw3'`)

**GLFW\_LIBS** Library lists for GLFW (ex. `'pkg-config --libs glfw3'`)

## 5.8 Install using cmake

CMake is a cross-platform, open-source build system. CMake can be downloaded from <http://www.cmake.org>. The following procedure is required to install.

1. Create working directory (you can also use [CALYPSO\_HOME]/work).
2. Generate Makefile and working directories by cmake command.
3. Compile programs by make command.

In this section, [CALYPSO\\_HOME]/work is used as the working directory. Options for CMake can be checked by cmake -i [CALYPSO\_HOME] command at [CALYPSO\_HOME]/work. There are a number of options can be found, but the following values are important settings for installation:

- Install directory

CMAKE\_INSTALL\_PREFIX  
Install directory

- Compiler settings

CMAKE\_Fortran\_COMPILER  
Fortran90 compiler.  
CMAKE\_C\_COMPILER C compiler.  
CMAKE\_Fortran\_FLAGS  
Optimization flags for Fortran90 compiler.  
CMAKE\_C\_FLAGS  
Optimization flags for C compiler.

- Manual settings for optional features

CMAKE\_LIBRARY\_PATH  
CMake library search paths. This directory is used to search FFTW3 library.  
CMAKE\_INCLUDE\_PATH  
CMake include search paths. This directory is used to search include file for FFTW3.

The easiest example of using CMake on Mac OS X with gcc9 is the following:

```
% cd build
% cmake ~/CALYPSO/ -DCMAKE_Fortran_COMPILER=/opt/local/bin/gfortran-mp-9
? -DCMAKE_c_COMPILER=/opt/local/bin/gcc-mp-9 \
? -DCMAKE_Fortran_FLAGS="-O3 -g" -DCMAKE_c_FLAGS="-O3"
```

After configuration, compile and install are started by

```
% make
...
% make install
```

After running `make` command, execute files are built in `[CALYPSO_HOME]/work/bin` directory.

## 6 Start the program

### 6.1 Mac OS

The program will start by double clicking the application icon. Viewer window and menu window will open as shown in Figure 2.

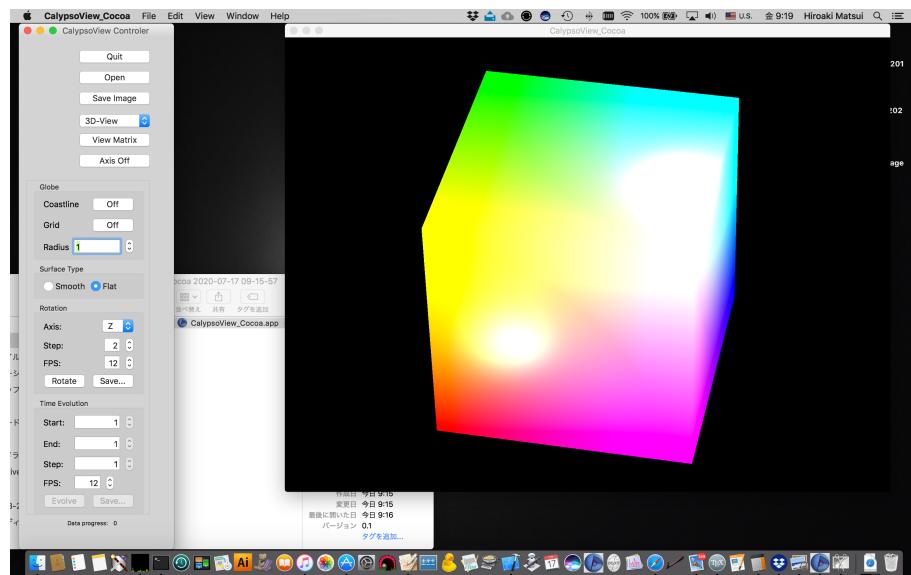


Figure 2: Windows of CalypsoView at starting.

## 6.2 Linux

The program is started by input the command in terminal as

```
% make  
...  
% [BINDIR]/CalypsoView(GLFW
```

The viewer window and menu window will be displayed as shown in Figure 3.

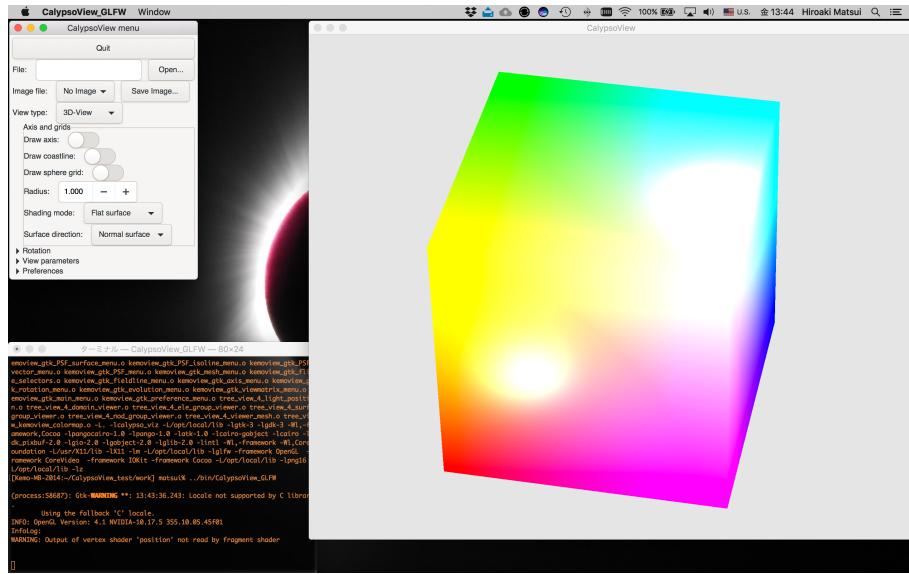


Figure 3: Windows of CalypsoView at starting.

## 7 Usage of program

The menu window at starting is shown in Figure 4. The program can finish by pushing "Quit" button (1 in Figure 4).

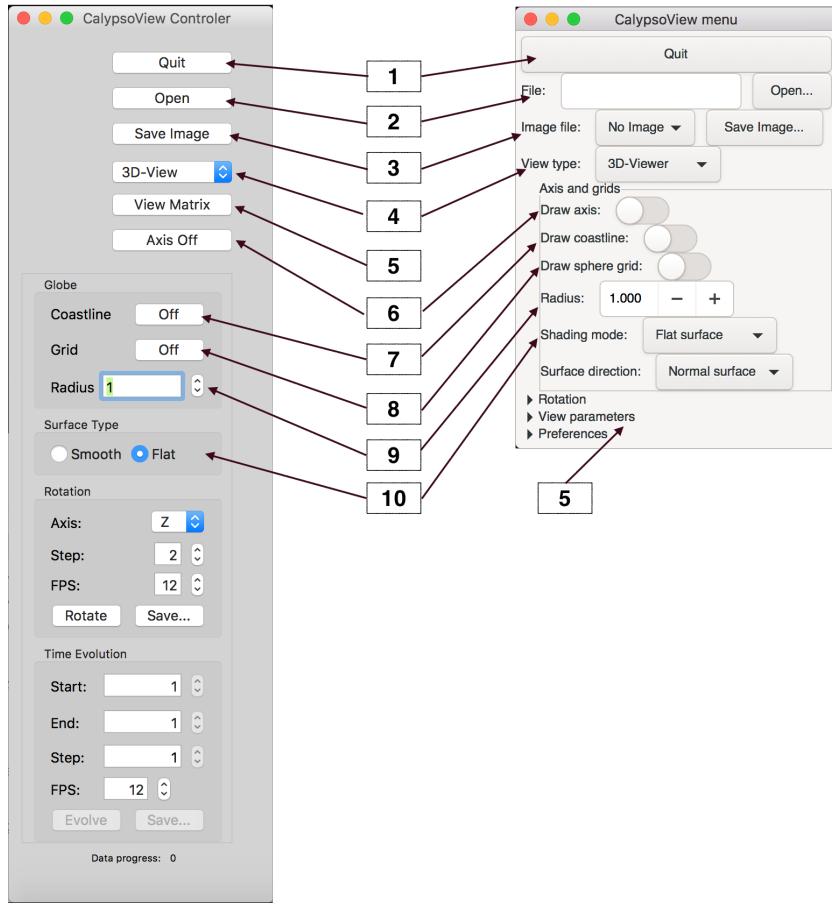


Figure 4: Menu windows of CalypsoView at starting.

### 7.1 Open file

First of all, data for visualization is required to be loaded. The file menu is opened by clicking "Open" button (2 in Figure 4). In Mac version, the file can drag and drop into the viewer window. In Linux version, file name can input the file name box. CalypsoView can

treat a unstructured grid data with triangle element or quadrature elements. The file name has to have a step number and extension as [file\_prefix].[step #].[extension]. The available data formats and extensions are listed in Table 1. For (compressed) sectioning binary data, the file for grid data [file\_prefix].0.sgd or [file\_prefix].0.sgd.gz is required in the same directory as the data file.

Table 1: Data format and extensions for CalypsoView

File format	extension
VTK	.vtk
Compressed VTK	.vtk.gz
Sectioning binary	.sdt <sup>(*)</sup>
Compressed sectioning	.sdt.gz <sup>(*)</sup>
Isosurface Binary	.sfm
Compressed isosurface binary	.sfm.gz

(\*) Grid data [file\_prefix].0.sgd or [file\_prefix].0.sgd.gz is required.

After loading the data, the menu is expanded to control surface visualization parameters as shown in Figure 6. CalypsoView can load up 10 surfacing data. The detailed control of the sectioning data is described in section 7.6.

**Note:** At the first time using CalypsoView on MacOS, nothing could be displayed in the viewer window. In that case, lighting parameter may be missing. Please set light parameters in [Preference menu](#).

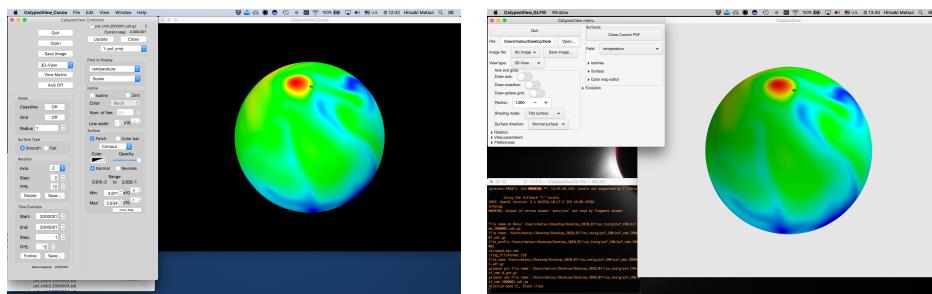


Figure 5: Desktop after loading data for MacOS (left) and Linux (right).

## 7.2 Save image

To save image of the viewer window, click "Save image" button (3 in Figure 4) and set the image file name and directory to save in the file menu. Image data can be saved as PNG (.png) or bitmap (.bmp) format. PNG format is smaller size than bitmap format. If no file extension is set in the file save menu, file format is chosen in the default format in the [Preference menu](#) (for Mac) or in the next of the "Save Image" button (Linux).

## 7.3 Interface of Viewer window and viewing mode

The visualised objects can move by mouse or trackpad. The mouse interface depends on the viewing mode. The viewing mode is selected by View type menu (4 in Figure 4). The following viewing mode can choose:

3D-View: 3-dimensional view.

Stereo-View: Stereo view using anaglyph. Please use red and blue glasses.

Map-View: Map projection using Aitoff projection.

Map projection does not support graph (arrow) visualization.

XY-View: Display parallel with  $xy$ -plane.

XZ-View: Display parallel with  $xz$ -plane.

YZ-View: Display parallel with  $yz$ -plane.

The mouse interface is the following:

Push and drag:

3D-View and Stereo-View Rotate object

Map-View, XY-View, XZ-View, and YZ-View Move object horizontally in screen.

Swipe by two finger: Zoom in and out.

Push two finger and drag: Move object horizontally in screen.

Push option and drag: Move object vertically in screen.

### 7.3.1 Axis and grids

The axis is drawn when "Axis" switch (6 in Figure 4) is turned on. The axis is not shown in the Map-View mode. The coastline is drawn when "Coastline" switch (7 in Figure 4) is turned on. A grid on a sphere with 30 degree increment is drawn when "grid" switch (8 in Figure 4). The radius of the coastline and grid are set in the "Radius" box (9 in Figure 4). Example images for axis, coastline, and grid are shown in Figure ??.

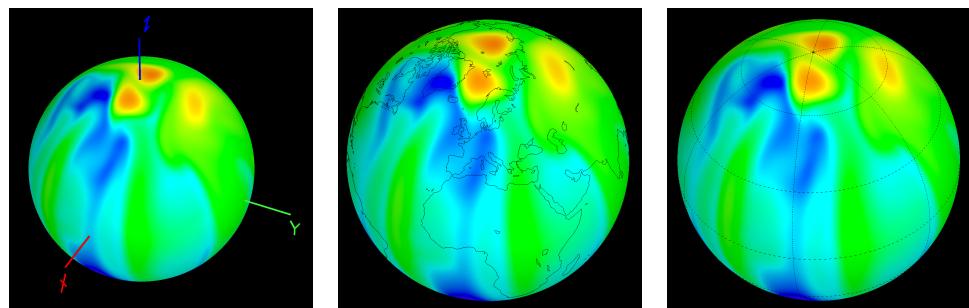


Figure 6: Images with axis(left), with coastline(middle), and sphere grid(right).

## 7.4 Preference menu

## 7.5 View transfer menu

## 7.6 Surfacing menu

## References

- [1] Bullard, E. C. and Gellman, H., Homogeneous dynamos and terrestrial magnetism, *Proc. of the Roy. Soc. of London, A***247**, 213–278, 1954.
- [2] Christensen, U.R., Aubert, J., Cardin, P., Dormy, E., Gibbons, S., Glatzmaier, G. A., Grote, E., Honkura, H., Jones, C., Kono, M., Matsushima, M., Sakuraba, A., Takahashi, F., Tilgner, A., Wicht, J. and Zhang, K., A numerical dynamo benchmark, *Physics of the Earth and Planetary Interiors*, **128**, 25–34, 2001.

# Appendix A Definition of parameters for control files

## A.1 Block view\_transform\_ctl

Parameters to construct view transform matrix and projection matrix are defined in this block.

(Back to Section [7.5](#))

### A.1.1 Block image\_size\_ctl

Number of pixels of the image is defined in this block.

x\_pixel\_ctl [NUM\_PIXEL\_X]

Number of pixels in the horizontal direction [NUM\_PIXEL\_X] is defined by integer.

y\_pixel\_ctl [NUM\_PIXEL\_Y]

Number of pixels in the vertical direction [NUM\_PIXEL\_Y] is defined by integer.

### A.1.2 Array viewpoint\_in\_viewer\_ctl [DIRECTION] [POSITION]

Position of eye in the viewer coordinate is defined in each [DIRECTION] and [POSITION]. [DIRECTION] is set by text (x, y, or z), and [POSITION] is set by real.

### A.1.3 Array look\_at\_point\_ctl [DIRECTION] [POSITION]

Position to look at is defined in each [DIRECTION] and [POSITION]. [DIRECTION] is set by text (x, y, or z), and [POSITION] is set by real.

### A.1.4 scale\_factor\_ctl [SCALE]

Scale of the object is defined by real. In viewer coordinate, object is scaled by 1 / [SCALE] times.

### A.1.5 Array view\_rotation\_vec\_ctl [DIRECTION] [POSITION]

Direction of the rotation axis of the object is defined by [DIRECTION] and [POSITION]. [DIRECTION] is set by text (x, y, or z), and [POSITION] is set by real.

**A.1.6** view\_rotation\_deg\_ctl [DEGREE]

Angle of the rotation of the object is defined by [DEGREE].

**A.1.7 Block** projection\_matrix\_ctl

Parameters of projection is defined in this block.

perspective\_angle\_ctl [PERSPECTIVE]

Angle of perspective [PERSPECTIVE] is defined by real.

perspective\_xy\_ratio\_ctl [XY\_RATIO]

Aspect ratio of horizontal and vertical screen [XY\_RATIO] is defined by real.

perspective\_near\_ctl [NEAR]

Nearrest distance from eye [NEAR] is defined by real.

perspective\_far\_ctl [FAR]

Farest distance from eye [FAR] is defined by real.

**A.1.8 Block** streo\_view\_parameter\_ctl

Parameters of streo image is defined in this block. This block is only used for the streo view.

focal\_point\_ctl [FOCAL]

Focal point [FOCAL] is defined by real.

eye\_separation\_ctl [SEPARATION]

Eye separation [SEPARATION] is defined by real.

**A.2 Block** pvr\_color\_ctl

Parameters to construct colormap and colorbar information in this block.

(Back to Section [7.5](#))

### A.2.1 Block colormap\_ctl

Parameters to construct colormap information in this block.

colormap\_mode\_ctl [COLORMAP\_MODE]

Colormap [COLORMAP\_MODE] is defined by character. The following colormap is applicable:

rainbow: Rainbow color map.

blue\_to\_red: Change color from blue to red.

grayscale: Grayscale.

symmetric\_grayscale: Grayscale with respect to amplitude of data.

data\_mapping\_ctl [COLORMAPPING\_TYPE]

Color mapping interpolation mode [COLORMAPPING\_TYPE] is defined by the following:

minmax: Linear scaling between [range\\_min\\_ctl](#) and [range\\_max\\_ctl](#).

colormap\_list: Linearly chanded color scale between feature points. the feature points of the data [DATA] and color scale at this value [COLOR\_SCALE] are defined  
in [color\\_table\\_ctl](#).

**Array** color\_table\_ctl [DATA] [COLOR\_SCALE]

List of the feature points of the data [DATA] and color scale at this value [COLOR\_SCALE] are defined by real. [COLOR\_SCALE] is set between 0. and 1.0. The color between the feature points are interpolated by the linear function.

opacity\_style\_ctl [OPACITY\_MODE]

Opacity mode [OPACITY\_MODE] is defined by the following:

constant: Constant opacity defined by [constant\\_opacity\\_ctl](#)

point\_linear: Linearly chanded opacity between feature points. the feature points of the data [DATA] and opacity at this value [OPACITY] are defined  
in [linear\\_opacity\\_ctl](#).

```
constant_opacity_ctl [OPACITY]  
Constant opacity [OPACITY] is defined by real.
```

**Array** linear\_opacity\_ctl [DATA] [OPACITY]

List of the feature points of the data [DATA] and opacity at this value [OPACITY] are defined by real. The opacity between the feature points are interpolated by the linear function.

```
range_min_ctl [MIN_VALUE]
```

Minimum value of the color and opacity map [MIN\_VALUE] is defined by real.

```
range_max_ctl [MAX_VALUE]
```

Maximum value of the color and opacity map [MAX\_VALUE] is defined by real.

### A.2.2 Block colorbar\_ctl

Parameters to construct colorbar information in this block.

```
colorbar_switch_ctl [SWITCH]
```

Switch to display colorbar. [SWITCH] is set to be On or Off.

```
colorbar_scale_ctl [SWITCH]
```

Switch to display numbers in colorbar. [SWITCH] is set to be On or Off. This switch is always "On" in CalypsoView.

```
font_size_ctl [SIZE]
```

Size of text of the color bar [SIZE] is defined by integer. This value is not used in CalypsoView.

```
num_grid_ctl [NUM_OF_GRID]
```

Number of grids in color bar [NUM\_OF\_GRID] is defined by integer. This value is not used in CalypsoView.

```
iflag_zeromarker [SWITCH]
```

Switch to display position of zero in colorbar. [SWITCH] is set to be On or Off. This switch is always "On" in CalypsoView.

colorbar\_range [MIN\_VALUE] [MAX\_VALUE]

Range of the color bar is defined here. [MIN\_VALUE] and [MAX\_VALUE] are defined by real. This switch does not reflect from reading from the file because the range of the color bar is defined by the values in [range\\_min\\_ctl](#) and [range\\_max\\_ctl](#).

axis\_label\_switch [SWITCH]

Switch to display axis. [SWITCH] is set to be On or Off. This switch does not reflect from reading from the file.

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