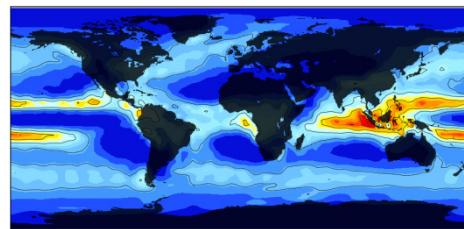


**- Panoply -**  
**A Tool for Visualizing NetCDF-Formatted Model Output**



## C O N T E N T S

**I Getting to Know Panoply**

The netCDF File Format	1
What is Panoply?	1
Installing Panoply	1
Open Panoply and load a dataset – access to model data in PANGAEA®	2
<i>Accessing a local dataset</i>	3
<i>Accessing a remote dataset</i>	4

**II Creating a Plot**

Creating a two-dimensional plot	5
<i>Latitude-longitude Map</i>	6
<i>Vertical profile</i>	6
Combination plots	7
<i>Comparing a variable between two datasets</i>	8
<i>Comparing different variables in the same dataset</i>	10
<i>Combined vector plots</i>	11
Time-latitude plot (Hovmöller diagram)	12

**III Modifying the Plot Area**

Scale	12
Contours and vectors	12
Map	13
<i>Global map projections</i>	13
<i>Regional map projection</i>	14
Continent overlays and grids	15
Labels	16
Saving plots and preferences	16

## I Getting to know Panoply

The following documentation will focus on the Windows operating system (XP, Vista, Windows 7). For further information on the use of other operating systems and general guidance consult the official program website of Robert Schmunk from the NASA Goddard Flight Space Center at <http://www.giss.nasa.gov/tools/panoply/>. An independent guide, which is based on an older version of Panoply, is available from [http://www.meteor.iastate.edu/classes/mt452/EdGCM/Documentation/EdGCM\\_Panoply.pdf](http://www.meteor.iastate.edu/classes/mt452/EdGCM/Documentation/EdGCM_Panoply.pdf)

### The NetCDF File Format

The Network Common Data Format (NetCDF, '.nc') represents a standard format for array-oriented scientific data, especially model data. Most applications within Panoply will deal with this file type. NetCDF files are self-describing, that is, datasets include information about the data they contain. They are furthermore portable, meaning the data is represented in a form that can be accessed by computers with different operating systems.

### What is Panoply ?

Panoply is a graphical visualization tool which is able to produce two-dimensional plots of geographically referenced data. Generally, Panoply can:

- \* Plot longitude-latitude arrays as global or regional maps
- \* Plot zonal average curves of longitude-latitude data
- \* Plot latitude-vertical arrays
- \* Plot time-latitude arrays, i.e. Hovmöller diagrams
- \* Combine two sets of data by differencing, summing or averaging them
- \* Use a range of 40 color tables and over 75 map projections
- \* Save plots in a variety of file formats and export animations as AVI or MOV videos

Besides the netCDF format, Panoply can recognize HDF (Hierarchical Data Format) and GRIB (Gridded Binary) file formats.

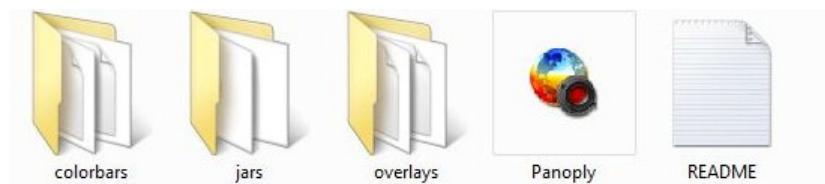
### Installing Panoply

The Panoply software can be obtained from the NASA website at <http://www.giss.nasa.gov/tools/panoply/>. Depending on the operating system you use, Panoply can be downloaded for Macintosh (MS OS X), Windows and Linux ('Generic') operating systems. The following documentation including the download and retrieval of datasets assumes the use of Windows. In order to install Panoply,

1. Go to <http://www.giss.nasa.gov/tools/panoply/> and click the 'Panoply for Windows' link.
2. Choose to download Panoply for either the 32-bit Windows ('Download Panoply for Windows') or the 64-bit Windows ('Download Panoply for 64-bit Windows'). The right choice is dependent on the version of Windows you use. Usually this can be found under 'Computer' (Start menu or Desktop) and then 'Properties' → 'System type'.
3. Save the respective file and extract the Panoply folder (Panoply will be downloaded as zipped folder (PanoplyWin.zip) by right-clicking the folder, and then 'Extract All' after which you can choose a destination folder.

- ☞ Stick to this manual download. If you let Windows unzip the Panoply folder automatically by programs (such as Winzip), Panoply won't work.

4. Once the Panoply folder is unzipped, you will find the following:



The **colorbars** and **overlays** folders contain the colors and continent overlays that will be used when creating plots in Panoply. Therefore, they need to be in the same directory as the *panoply.exe* file which runs Panoply. The same applies to **jars** which contains the Panoply application code, so removing the jars files will break Panoply. **README** gives aiding comments on the download and installation procedure. **Panoply(.exe)** will actually start the program.

However, before starting Panoply, make sure a **Java 6 SE runtime environment** is installed on your computer. If you don't have Java installed, an error message will appear when trying to start Panoply. On Windows, Java may not be pre-installed, so you need to download Java from the Java website <http://www.java.com/>.

### Open PANOPLY and load a dataset

After double-clicking the **panoply.exe** icon, Panoply will open (you may be prompted with a security warning, simply choose *Run*, and Panoply will open). Datasets can now be loaded from local sources on your computer, or accessed via the world wide web. In the following, the retrieval of a dataset will be illustrated by the access from the Pangaea database platform.

### Access to model data in PANGAEA

The following describes how to visualize model data that is stored in Pangaea.

1. Go to the PANGAEA website (<http://www.pangaea.de>) and look for the specific dataset of interest in the search engine. Usually, you will find the published data as supplementary material to an article. For instance:

**Fischer, N; Jungclaus, JH (2010):** Three time-slice simulations of the Eemian, the mid-Holocene and a pre-industrial control run with the coupled atmosphere-ocean-model ECHAM5/MPI-OM. doi:10.1594/PANGAEA.757004.

Which is a supplement to:

**Fischer, Nils; Jungclaus, Johann H (2010):** Effects of orbital forcing on atmosphere and ocean heat transports in Holocene and Eemian climate simulations with a comprehensive Earth system model.  
Climate of the Past, **6**, 155-168

2. Select 'View as HTML' or 'Download Dataset' at the bottom of the respective publication page. This will open a table (scroll down) with files listed as part of the dataset. In the most right column, 'Format', you can see in which file format the data is presented. Files can appear in **compressed** ('.nc.gz' in the Format column) or **uncompressed** ('.nc' or 'netCDF') form. If compressed, the files need to be downloaded and saved to the computer first, to be then opened as a local dataset, while uncompressed files can be loaded directly into Panoply.

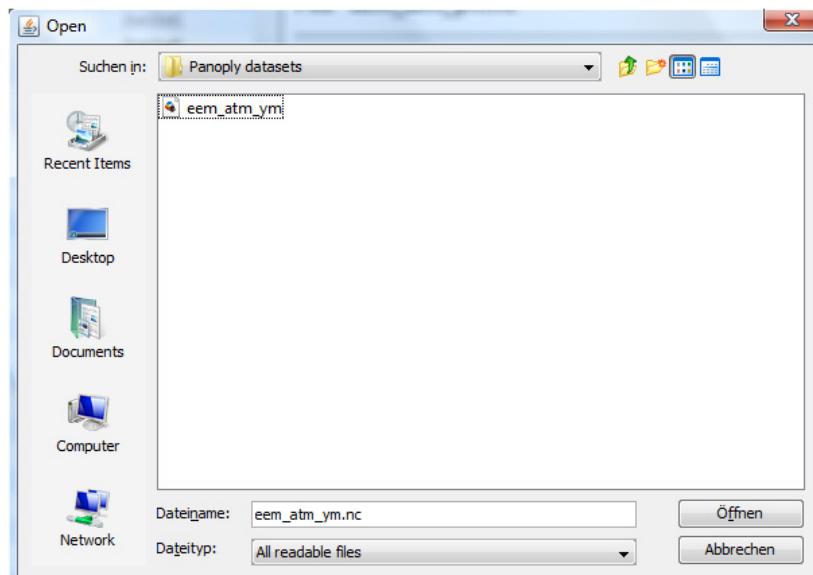
1 File	2 Experiment	3 Parameter	4 Abbrev	5 Unit	6 URL model	7 Size [kByte]	8 Format
eem_atm_ym.nc	atmosphere model ECHAM5, Eem (125 ka), yearly means	evaporation	evpsbl	[kg/m^2s]	<a href="#">Link</a>	115	netCDF
		large scale precipitation	pr	[kg/m^2s]			
		mean sea level pressure	psl	[Pa]			
		2m temperature	tas	[K]			
		10m u-velocity	uas	[m/s]			
		10m v-velocity	vas	[m/s]			
eem_atm_ymm.nc	atmosphere model ECHAM5, Eem (125 ka), monthly means	same as above			<a href="#">Link</a>	1300	netCDF
hol_atm_ym.nc	atmosphere model ECHAM5, Holocene (6 ka), yearly means	same as above			<a href="#">Link</a>	115	netCDF
hol_atm_ymm.nc	atmosphere model ECHAM5, Holocene (6 ka), monthly means	same as above			<a href="#">Link</a>	1300	netCDF
pri_atm_ym.nc	atmosphere model ECHAM5, pre-industrial, yearly means	same as above			<a href="#">Link</a>	115	netCDF
pri_atm_ymm.nc	atmosphere model ECHAM5, pre-industrial, monthly means	same as above			<a href="#">Link</a>	1300	netCDF
eem_ym_mpiom.nc	ocean model MPIOM, Eem (125 ka), yearly means	temperature (surface, 100m, 485m, 960m, 2080m, 3070m, 5170m)	thetao	[?C]	<a href="#">Link</a>	2600	netCDF
		sea surface salinity (yearmean only)	sss	[psu]			
		sea ice cover	sic	[frac.]			
		sea-ice thickness	sit	[m]			
eem_ymm_mpiom.nc	ocean model MPIOM, Eem (125 ka), monthly means	same as above			<a href="#">Link</a>	28000	netCDF
hol_ym_mpiom.nc	ocean model MPIOM, Holocene (6 ka), yearly means	same as above			<a href="#">Link</a>	2600	netCDF
hol_ymm_mpiom.nc	ocean model MPIOM, Holocene (6 ka), monthly means	same as above			<a href="#">Link</a>	28000	netCDF
pri_ym_mpiom.nc	ocean model MPIOM, pre-industrial, yearly means	same as above			<a href="#">Link</a>	2600	netCDF
pri_ymm_mpiom.nc	ocean model MPIOM, pre-industrial, monthly means	same as above			<a href="#">Link</a>	28000	netCDF

List of datasets and variables which are contained in the publication of Fischer et al. (2010).

### Accessing a Local Dataset

In many cases, the files are **compressed** and appear as ‘.nc.gzp.’ in the ‘Format’ column which stands for GNU- zipped netCDF files. In this case you will need to

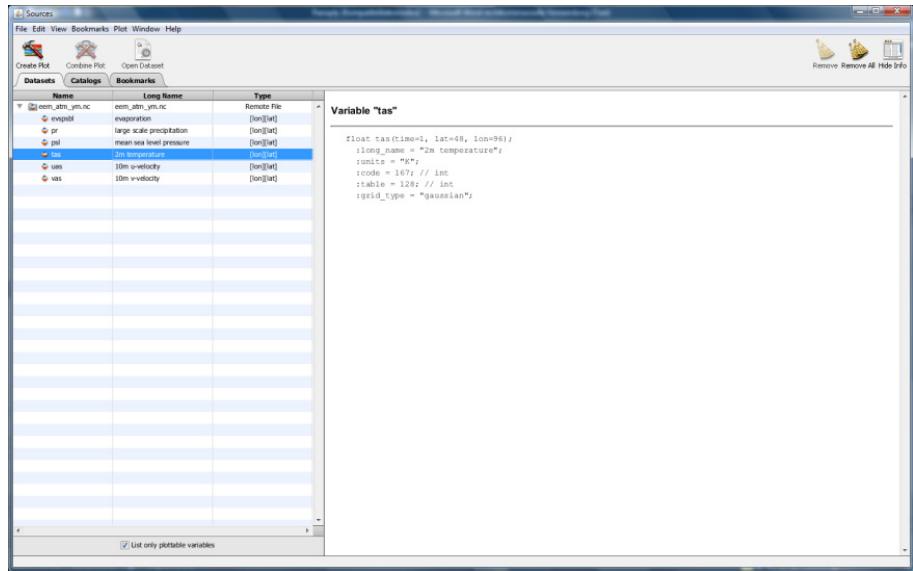
1. Save the relevant files by right-clicking ‘Link’ in the *URL model* column.
2. Extract these files with appropriate software (e.g. BitZipper).
3. Once uncompressed you can open the dataset in Panoply. Launch Panoply as described above.
4. First an **Open window** will appear. From the *File menu* choose ‘Open file’ to load the relevant dataset. Panoply will only list files which it can open according to the file extension (netCDF, HDF, GRIB). The first example file of the Fischer et al. dataset as listed in Table 1 would be listed as follows:



The Open window showing the ‘eem\_atm\_ym’ dataset (atmosphere model CHAM5, Eem (125 ka), annual means) from Fischer et al. (2010).

Upon choosing a dataset, the corresponding variables are listed in the **Sources window**:

The **Sources window** listing the *eem\_atm\_ym* dataset from Fischer et al. (2010).

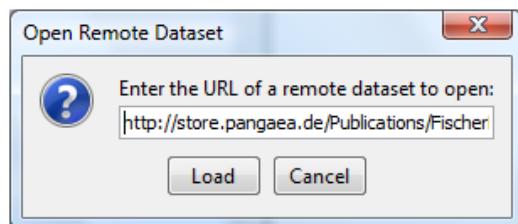


The Sources window lists the file(s) you selected with the correspondent variables, e.g. ‘tas’ for the air temperature 2 meters above the ground. The ‘Type’ column displays the *dimensions* in which the variables are given, e.g. longitude and latitude for the 2-m air temperature. You have the option to add further files by clicking ‘Open File...’ in the File menu. The right panel shows details of the variable selected on the left, i.e. ‘2 m temperature’ in units Kelvin etc. Apart from the plottable physical variables Panoply lists latitude and longitude as variable; you can choose ‘List only plottable variables’ at the bottom of the Sources window and Panoply will only plot ‘pure’ physical variables. You have the option to **remove a dataset** by selecting ‘Remove’ or ‘Remove all’ in the upper right corner of the Sources window.

### Accessing a remote dataset

**Uncompressed files** will appear as simple ‘.nc’ (NetCDF) files in the ‘Format’ column. In this case you can

1. Right-click ‘Link’ in the URL model column and choose ‘Copy Link Address’ in the drop-down menu.
2. In the File menu, choose ‘Open Remote File...’ after which a window appears ‘Open Remote Dataset’. Here you can paste the copied link address. This will subsequently list the files with its variables in the Sources window as shown above.



☞ **Note:** This works for uncompressed files only (e.g. ‘.nc’). If compressed (e.g. ‘.nc.gzip’) you need to uncompress the file first (see above).

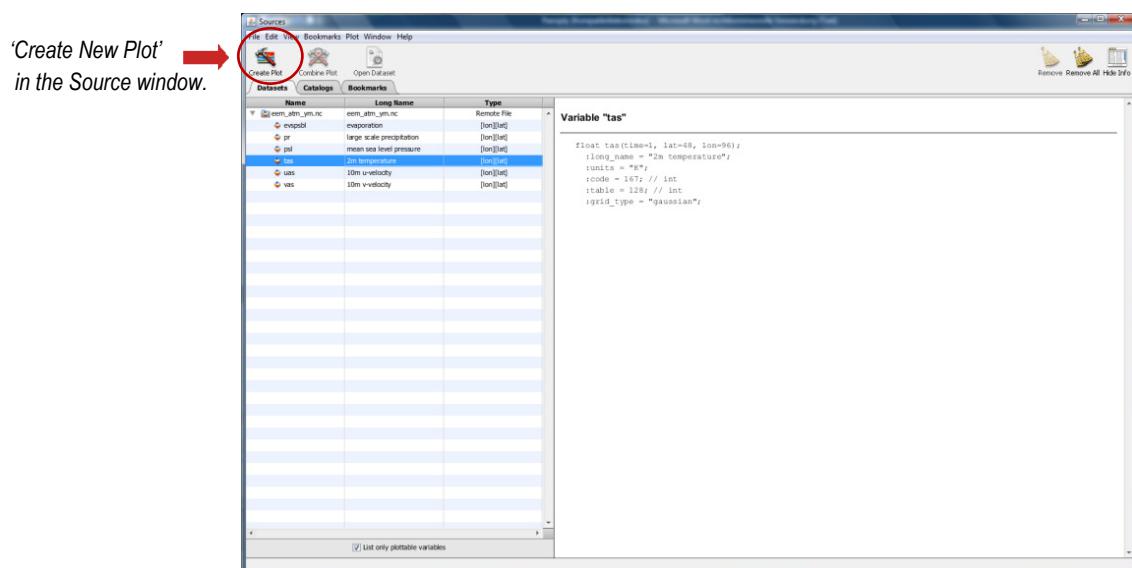
In case you just launched Panoply and want to access a remote file, select ‘Cancel’ in the Open window upon which the Sources window will appear.

## II Creating a Plot

### Creating two-dimensional plots

One advantage of Panoply is the variety in which scientific data can be plotted. For opening a local file or accessing a remote dataset from the web refer to Section I. Starting again from the **Sources window**, the table should now list all the variables contained in the dataset, however, note that not all variables are plottable. The latter are marked by a long dash in the 'Type' column. Plots can be created in different ways:

1. Select a variable in the list, then choose 'Create Plot' in the upper left corner:



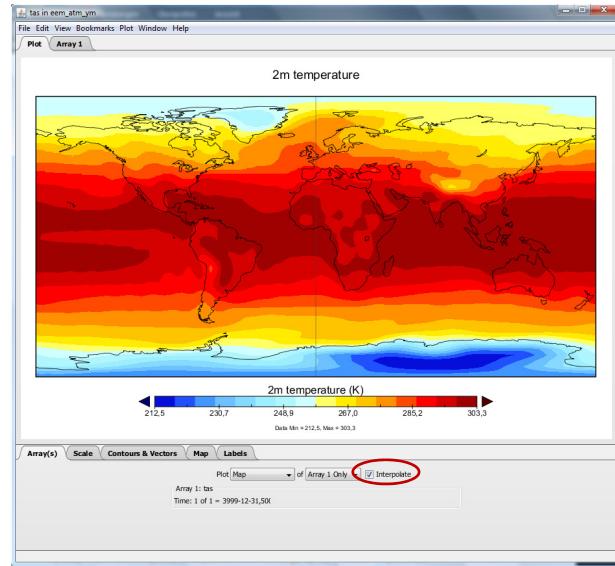
2. Alternatively, simply double-click the variable in the list (e.g. 'tas' 2-m air temperature), or...
3. You can right-click the variable and decide between different plot sizes, depending on the size of your display (from extra small to jumbo plot). If you prefer a particular size of plot for every time you make a plot, you can specify a particular size under 'Window', and then 'Preferences' where you can also change other settings (see section III Modifying the Plot Area).

The **Type column** to the right indicates the dimensions in which the variable can be plotted. Possible combinations are:

- **Latitude-longitude** map, *[lon] [lat]*, this will plot a map with latitude and longitude as dimensions
- **Latitude-vertical** grid *[lat]-[vert]*, displays a vertical profile (depth or altitude) versus latitude
- **Longitude-vertical** grid *[lon]-[vert]*, displays a vertical profile (depth or altitude) versus longitude
- **Time-latitude / longitude** grid, *[lat]* or *[long]-[time]*, produces a Hovmöller diagram

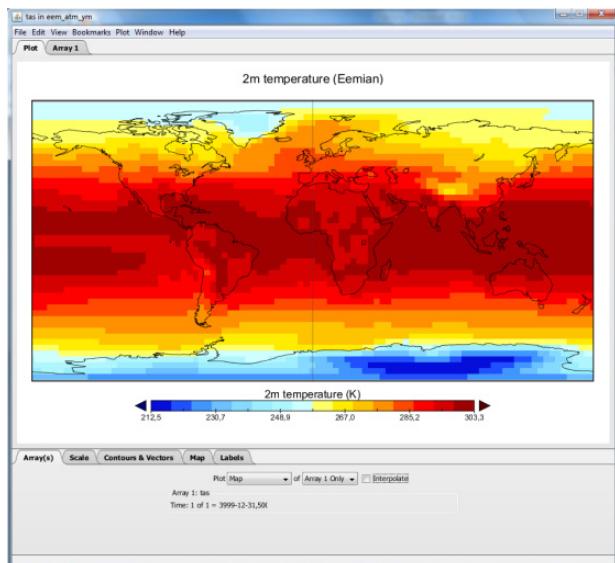
### Latitude-Longitude Map

As an example, the 2-meter air temperature ‘tas’ in the Fischer et al. dataset (‘eem\_atm\_ym.nc’; 2010) has longitude [*lon*] and latitude [*lat*] as dimensions. As a result, the temperature can be plotted as a 2-dimensional map:



2-m air temperature, ‘tas’ [K], during the Eemian (Fischer et al. dataset ‘eem\_atm\_ym.nc’; 2010), displayed in interpolated (left) or non-interpolated form, as gridded cells (bottom).

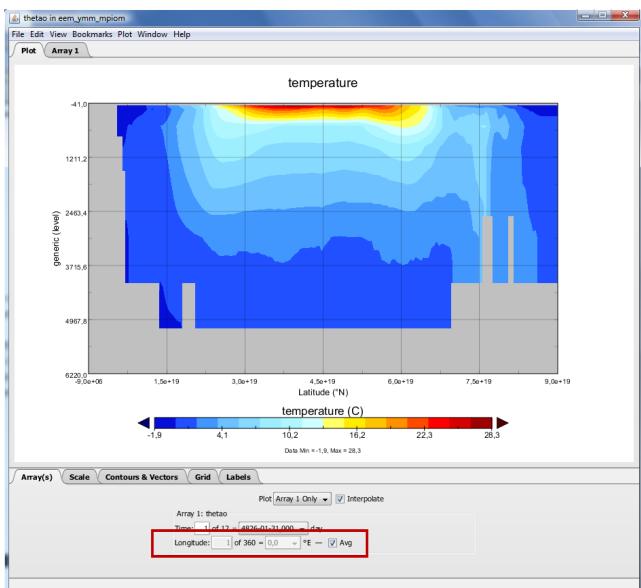
You can choose to interpolate the data (usually the default) by checking the ‘**Interpolate**’ box to the right under the ‘Arrays tab’. If unchecked the data will appear as gridded cells, i.e. the model resolution. In case the variable can be plotted in more than two dimensions, you will be prompted to choose between three possibilities (e.g. *Time-Lat*, *Time-Lon* or *Lon-Lat*).



### Vertical Profile

A variable can also be plotted in latitude or longitude versus depth or altitude. ‘*Thetao*’ (potential temperature) from the Fischer et al. (2010) dataset (this time ‘eem\_ymm\_mpiom.nc’) has three dimensions: latitude, longitude and depth (*lat*, *lon* and *vert*), so three kinds of different plots can be produced: *latitude - longitude*, *latitude - depth* and *longitude - depth*. When creating a plot, choose between ‘*Lat-Vert*’ or ‘*Long-Vert*’ in the ‘Select Plot Type’ window. Under ‘*Arrays*’ you can specify the longitude (in °E) along which your vertical plot shall be displayed, alternatively, decide for the zonal average (‘*Avg*’). The example to the right shows zonal averages of seawater potential temperature plotted latitude versus depth.

Vertical profile of ‘thetao’, the potential temperature of seawater with latitude on the x-axis. (Fischer et al. (2010) dataset ‘eem\_ymm\_mpiom.nc’).



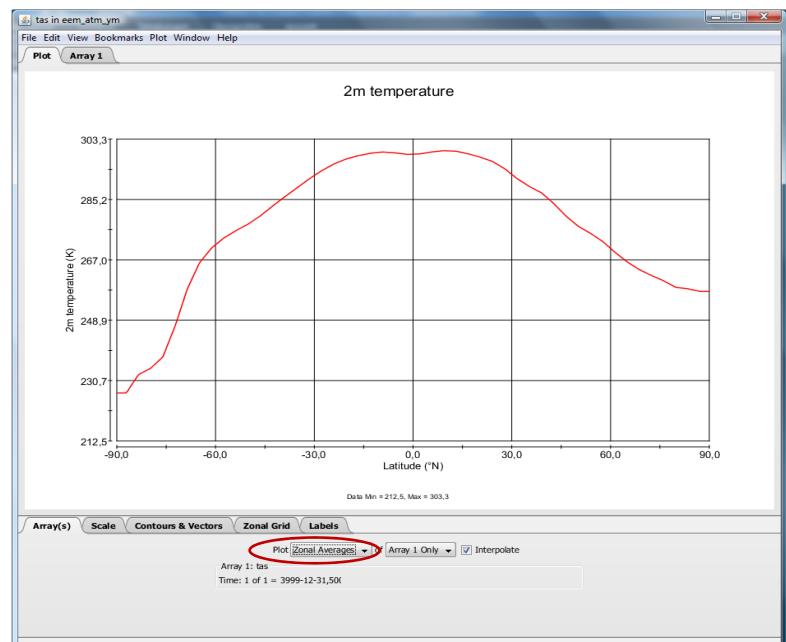
Next to the Plot tab at the top there is an ‘**Array1**’ tab. Here you can find the actual values of the variable. Besides the long name of the data set, the variable (*2-m air temperature*) and units (K), this table lists the temperature for each resolved latitude and longitude. You have the option to focus on a particular part of the dataset (see below) with the option to copy it to somewhere else. In case the variable you have chosen covers only a small range, you can modify the number of decimal places by changing ‘Format’ below the Array table to **floating (%1f)**, **exponential (%1E)** and **generic (%1G)**. The latter chooses between exponential or floating whichever is shortest. Regions where grid cells have no available data (e.g. SST over continents) will show a ‘NaN’ (not a number).

The screenshot shows the 'Array1' tab of the Panoply software. At the top, it displays the dataset information: 'tas in eem\_atm\_ym'. Below this, the variable is specified as 'tas, 2m temperature' with units 'K'. The table itself has columns for X-axis (longitude in °E) and Y-axis (latitude in °N). The first few rows of data are as follows:

	0.0	3.750	7.500	11.250	15.000	18.750	22.500	26.250	30.000	33	Avg.
87,159	257,6	257,6	257,7	257,7	257,8	257,8	257,8	257,8	257,9		257,5
83,479	260,7	261,0	261,3	261,4	261,5	261,5	261,5	261,5	261,4		258,3
79,777	266,4	267,7	268,5	268,5	265,1	265,0	266,7	266,6	266,4		258,7
76,070	274,5	275,4	275,8	275,9	275,7	274,9	274,0	273,3	272,9		260,7
72,362	277,9	278,3	278,3	278,2	277,7	276,8	275,9	274,9	273,8		262,3
68,652	278,2	278,4	278,4	277,7	276,6	277,0	272,3	271,6	270,6		264,1
64,942	278,8	278,9	278,3	277,1	274,5	273,2	273,2	271,6	271,2		266,4
61,323	280,5	279,8	279,8	279,1	274,5	274,1	274,6	274,4	274,2		268,4
57,521	281,1	280,3	279,1	278,7	278,4	277,5	277,0	277,7	277,1		272,6
53,810	282,1	281,3	280,9	280,9	281,1	281,0	280,4	279,5	278,6		275,0
50,099	283,6	283,0	282,6	282,4	282,2	281,7	281,2	281,1	281,6		277,2
46,389	285,8	285,1	284,5	284,2	283,9	283,5	283,6	284,6	286,0		280,2
42,678	288,4	287,7	287,4	288,3	288,5	288,1	286,8	287,0	284,0		
38,967	289,6	290,2	291,0	291,4	293,4	291,4	292,0	289,5	290,1		287,2
35,256	290,3	292,1	293,1	292,1	292,6	293,0	292,5	291,8	291,6		289,1
31,545	292,8	292,8	292,8	292,8	293,0	293,2	294,5	293,5	293,6		291,5
27,833	295,0	295,0	295,1	295,0	295,0	295,5	295,5	295,0	295,7		294,4
24,122	298,7	297,3	295,7	294,5	294,5	295,0	294,7	295,1	297,0		296,6
20,411	299,4	297,4	295,5	294,9	295,5	295,5	294,3	295,0	298,4		297,9
16,700	298,9	297,8	296,7	296,9	296,0	296,9	294,9	295,2	298,0		298,9
12,989	298,6	298,5	297,5	297,9	296,9	297,2	295,3	296,4	298,0		299,7
9,278	298,4	298,6	296,9	296,3	297,3	296,8	296,2	298,6	300,4		299,9
5,567	299,2	299,4	298,2	296,6	297,1	298,1	297,8	298,5	299,5		299,5
1,856	300,3	301,1	299,9	297,9	297,5	299,4	298,9	296,3	295,5		298,9
-1,856	300,5	301,2	300,8	298,5	297,0	298,4	298,9	296,1	294,0		298,8
-5,567	300,8	301,4	300,8	299,5	298,3	298,9	298,9	298,1	299,2		
-9,278	299,0	299,6	301,3	301,1	297,4	295,0	296,6	297,5	295,7		299,5
-12,989	297,5	298,1	300,0	300,0	296,5	293,9	296,0	298,3	297,1		299,1
-16,700	295,4	296,1	298,2	299,0	297,4	296,2	298,4	300,5	299,4		298,4

2-m air temperature dataset, for each resolved latitude and longitude (Fischer et al., 2010). Adjust the data format under ‘Format’ below the Array table.

In the ‘**Array(s)**’ tab on the bottom of the Plot window you have the option to plot a **one-dimensional zonal average** plot. For instance, 2-m air temperature as function of latitude.



Zonal average of the 2-m air temperature during the Eemian (Fischer et al.(2010) dataset.

## Combination Plots

One very attractive option is to relate variables to each other by generating combination plots. This is meaningful, for example, in situations in which one variable is known for different time slices (e.g. surface temperature for the Last Glacial Maximum vs. present day). Alternatively, in case two variables have the same units, differences can be plotted at one time instant

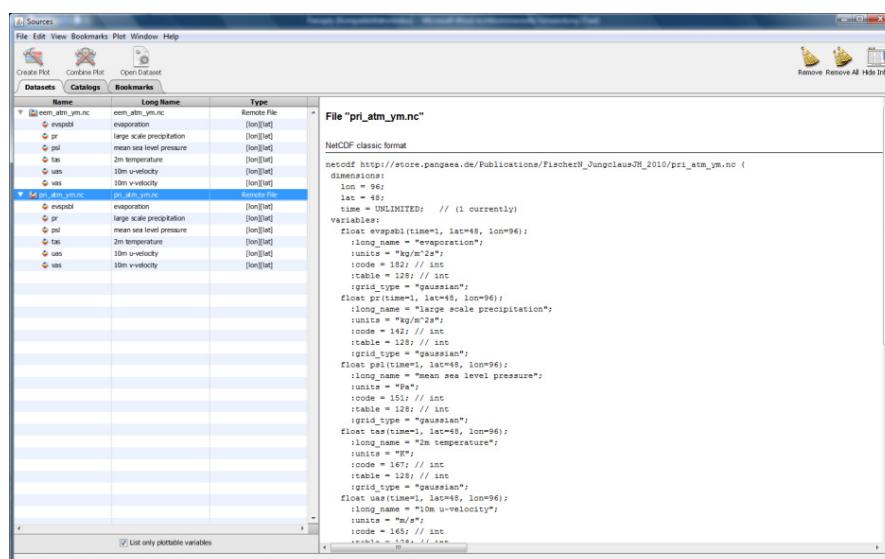
(e.g. precipitation vs. evaporation). In the following, the different possibilities for combination plots are illustrated by three examples from the Fischer et al. dataset (2010):

- Comparing a variable between two data sets  
e.g. *Temperature anomaly between Eemian and Holocene*
- Comparing different variables in the same dataset  
e.g. *Precipitation - evaporation during the Eemian*
- Combined vectors  
e.g. *u- and v-velocity*

• **Comparing a variable between two data sets: *Temperature anomaly between Eemian and Holocene***

The following example serves to illustrate the general procedure.

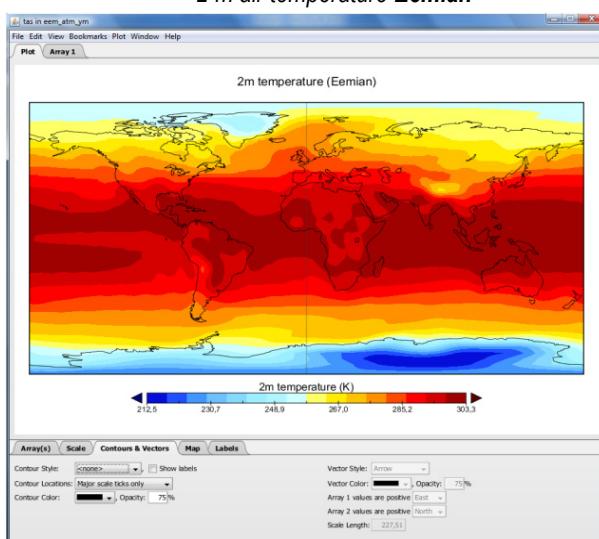
1. Having loaded the relevant datasets (annual means of Eemian: *eem\_atm\_ym.nc*, and annual means of Pre-industrial: *pri\_atm\_ym.nc*), you need to plot the variable of both datasets separately (as described in II), i.e. the 2-m air temperature ('tas') of the Eemian and of the Pre-industrial.



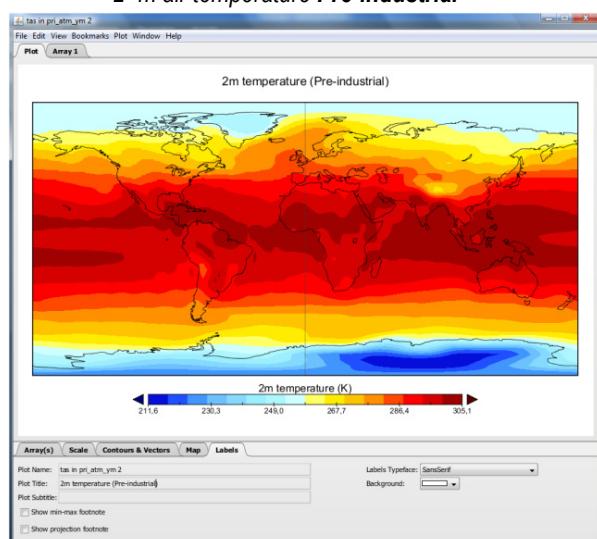
*Loading both datasets'  
'pri\_atm\_ym.nc' and  
'eem\_atm\_ym.nc' from Fischer et  
al.(2010) dataset.*

*...and plotting each variable  
separately:*

2-m air temperature **Eemian**



2- m air temperature **Pre-industrial**

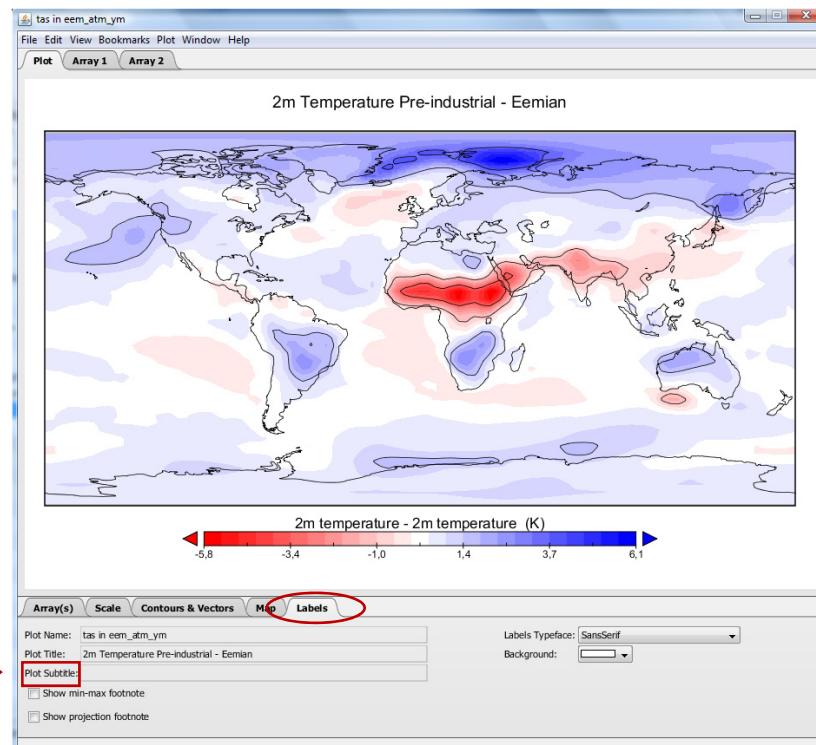


2. In the Sources window, depending on which of the variables has been plotted last in step 1 (e.g. 'tas' from the Eemian, 'eem\_atm\_ym.nc'), click 'Combine Plot' next to 'Create Plot' in the upper left corner. Now you will be given a choice of variables that have also been plotted which can make a combination plot with. Having selected 'tas' from the Eemian, choose 'tas' from the Pre-industrial ('pri\_atm\_ym') in the 'Combine Plot' window which will produce a combination plot of the 2-m air temperature of both time slices (see below).

*Combining arrays of different datasets with each other.*

Be patient, it can take some time for Panoply to produce a plot since the required data is only loaded when a plot is created. You see if a plot is being produced at the bottom of the 'Sources' window.

Combination plot of temperature difference between the Pre-industrial and Eemian.



**Note:** Panoply does not automatically adjust the **titles of the plot**. You need to adjust the plot title under '**Labels**' in the field below the plot area (also see section III. Modify the Plot Area). Also note the colorbar with white in the exact center.

Especially when plotting anomalies, it may be useful to choose a **color bar** under 'Scale' that has white in the exact center in order to depict regions of no difference, e.g. red indicating negative anomalies and blue indicating positive anomalies, as shown in the example above.

In the default case, variable 1 is subtracted from variable 2. However, under the **Array1** tab you can choose other ways of combining variables with each other:

Array 2 - Array 1

Array 1 + Array 2

Array 1 x Array 2

Array 1 / Array 2

Array 2 / Array 1

(Array 2 - Array 1) / Array 1

(Array 1 – Array 2) / Array 2

Further Options are:

**Averaged Arrays** (arithmetic mean at each point; set to NaN if either value is NaN)

**Combined Arrays** (arithmetic mean at each point; set to valid value if only one value is NaN; useful for swath data which may not overlap, or overlap only slightly)

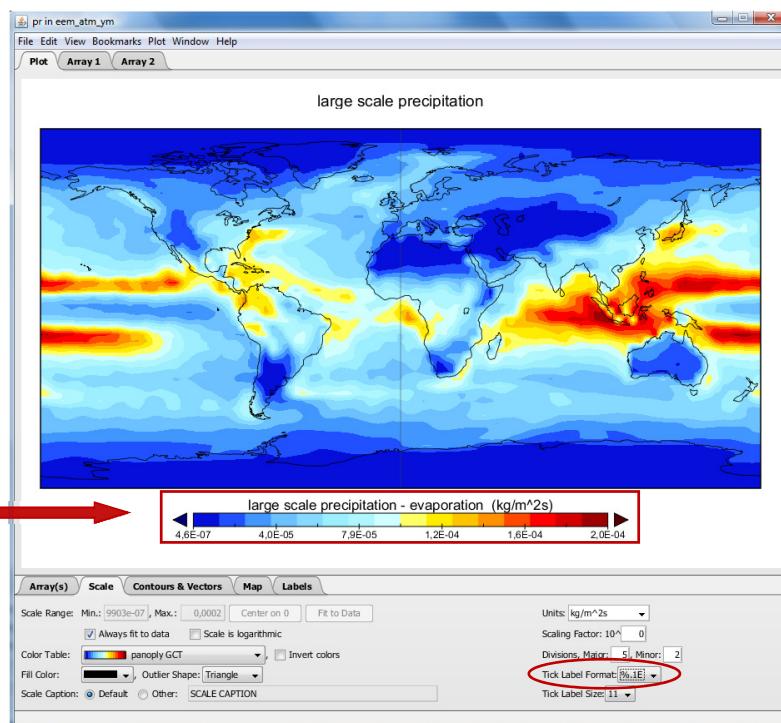
**Vector Magnitude** (square root of the sum of both arrays; direction is indicated by arrows).

- Comparing different variables of same units: **Precipitation minus evaporation during the Eemian**

Combination plots can also be applied to different variables (of same units). Shown here is the net precipitation (precipitation – evaporation) for the Eemian. Generating this kind of combination plot follows the same procedure as described above.

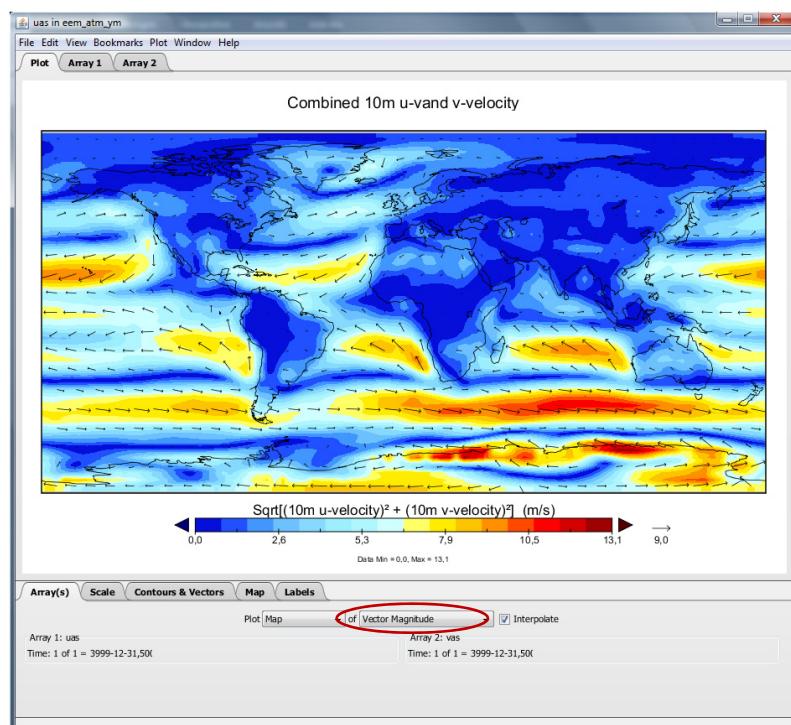
**Note** the small data range (Fischer et al., 2010). This can be adjusted in the ‘Scale’ tab by **changing the format** to ‘float’ (e.g. %1f) or exponential (e.g. %1E) in order to depict the difference.

Adjust the scale bar

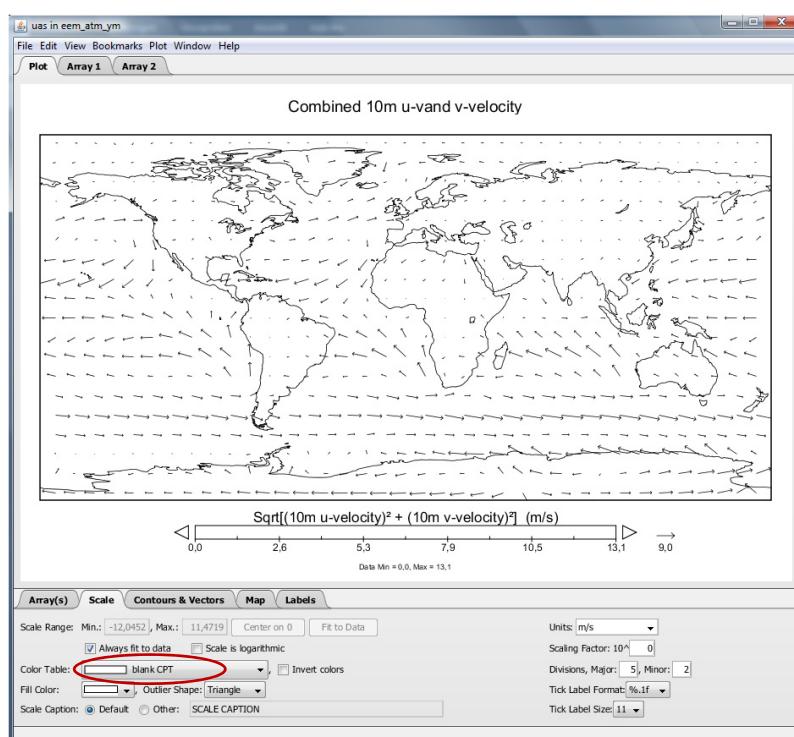


- **Vector plots: combined 10 m u- and v-velocity**

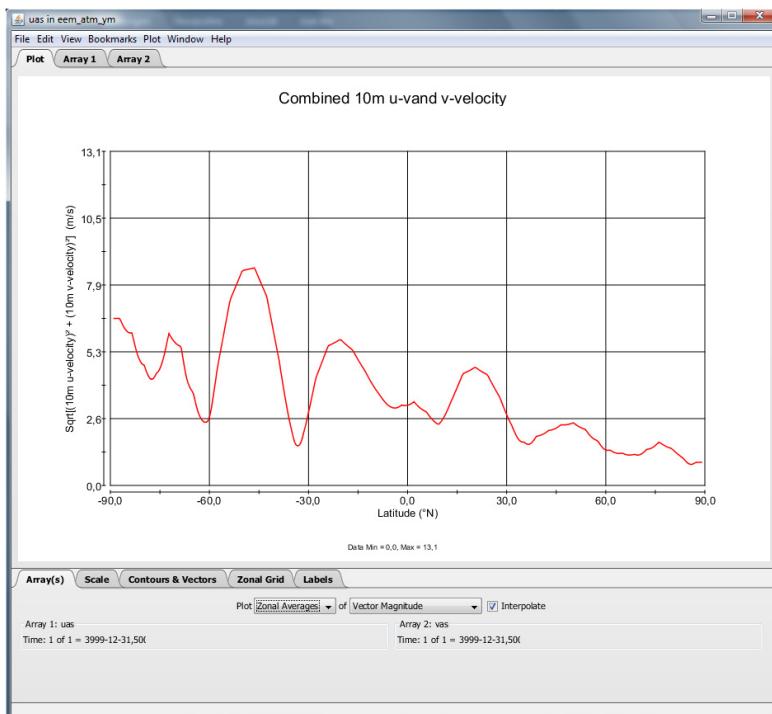
'**Vector Magnitude**' under the **Arrays** tab displays the magnitude of a vector field as a filled contour plot. Additionally, the local direction of the vector field is indicated by the arrows. The following example shows a vector field as combination of the u- and v-velocity components during the Eemian.



2-dimensional plot of vector magnitude (colors as well as vector length) and direction of the 10-m wind velocity during the Eemian (Fischer et al. 2010).



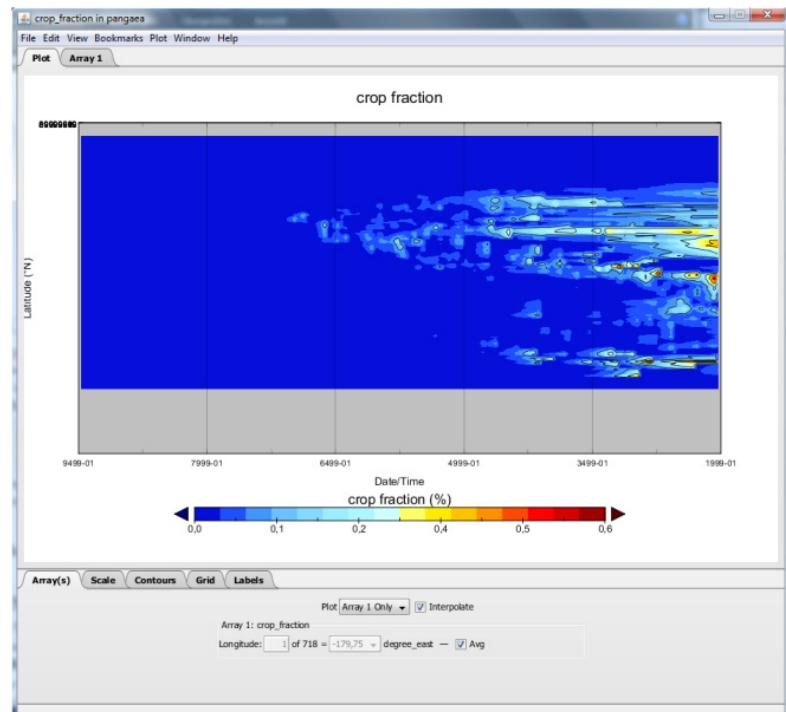
Choose '**Blank CPT**' as color table if you prefer a white background for vector fields.



Combination plots can also be plotted as zonal averages. Shown here is the magnitude of the 10-m wind velocity during the Eemian.

### Time - Latitude array (Hovmöller diagram)

A Hovmöller diagram displays a time evolution of a variable versus latitude or longitude. Hence, time must be included as a plottable dimension in the 'Type' column. In Panoply, a time evolution of a variable can be plotted only versus latitude. Hence, choose 'Time-Lat' in the 'Select Plot Type window' and a Hovmöller diagram should appear. The following example shows the crop fraction changes over 7500 years as dependent on latitude (*Lemmen 2009: World distribution of land cover changes during pre- and protohistoric times and estimation of induced carbon releases, doi: 10.1594/PANGAEA.737958*).



Hovmöller diagram of pre- and protohistoric crop fraction over 7450 years as function of latitude (Lemmen, 2009.)

## III Modifying the Plot Area

### Array(s)

As introduced earlier, in the **Array(s)** tab you have the possibility to combine datasets in various ways and create a zonal average plot besides general 2-dimensional maps. However, there are more powerful tools that help you to optimize the illustration of your plot in order to emphasize important details.

### Scale

In the **Scale** tab you have several options to modify your plot. You can adjust the **Scale Range** and set minimum and maximum values of the data range ('Min' and 'Max'), for which you need to uncheck 'Always Fit to Data', or choose 'Center data on 0' or 'Scale is logarithmic', clearly depending on your data range. 'Fit to data' will plot the default settings. Concerning the format, you can adjust 'Tick Label Format' with %1f, %1E, %1G, %2f, %2E, and so on.

The **Color Table** option lets you choose among many different color tables (currently 49) to plot your data, with the option to invert colors. You can decide for a white background by selecting **Blank CPT**, or two-end-member color tables (e.g. blue-red) which are suitable for plotting anomalies (e.g. temperature anomaly). The '**Units**' are also displayed. By changing the '**Scaling Factor**' you can increase or decrease the data range. Details of the scale bar can be adjusted with '**Divisions**' (Min and Max) and the '**Tick Label Size**', which determines the font size of the annotations on the scale bar.

### Contours & Vectors

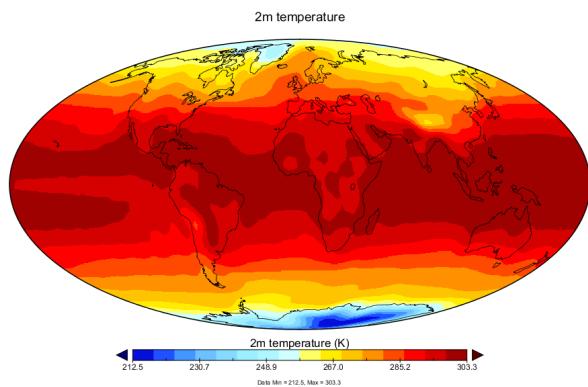
Under **Contours & Vectors** you can choose to display contour lines and alter their style ('**Contour Style**'), and add or remove contour labels ('**Show Labels**'), decide to also show minor scale ticks ('**Contour Locations**') and change their appearance ('**Contour Color**' and '**Opacity**'). In case you have a vector array, such as the combined 10 m u- and v-velocity (see above 'Combined Vectors' section II), you can adjust the '**Vector Style**', '**Color**' and '**Opacity**', and decide to which direction positive (negative) values point, i.e. change the direction of the arrows. You can also adjust the length of the arrows ('**Scale Length**').

### Maps

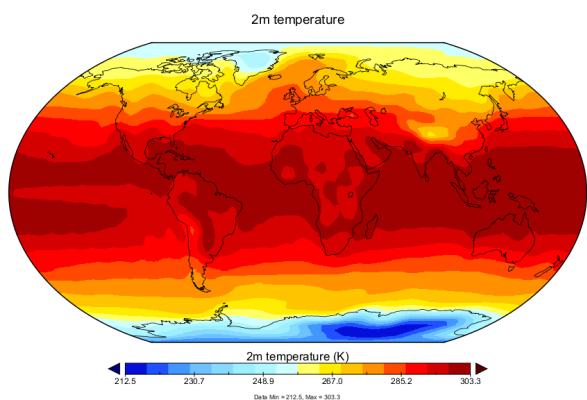
#### Global Map Projections

For 2-dimensional latitude-longitude plots, in the menu **Map** under '**Projections**' you can choose amongst over 70 projections. As mentioned earlier you can load additional projections into the Panoply folder. Regional projections can be realized using the '**Equirectangular Regional**' projection (see below). Shown here are some examples of global map projections. In all cases (also for the default Equirectangular projection) you can choose a longitude on which you would like your projection to center on ('**Center on: Lon. °E**'), and in case you choose a '**bird's eye view**' projection such as '**Vertical Perspective**', '**Azimuthal Equal Area**' or '**Azimuthal Equidistant**' you can additionally choose a central latitude ('**Center on: Lat.. °N**'), as well as how much you'd like to 'zoom in' under '**Center Distance**' in the '**Vertical Perspective**' and '**Radius**' in the '**Azimuthal Equidistant / Equal-Area**' projection. Coordinates are given in North and East, for western longitudes and southern latitudes you need to add a minus sign, so -50°E and -50°N corresponds to 50°W and 50°S, respectively.

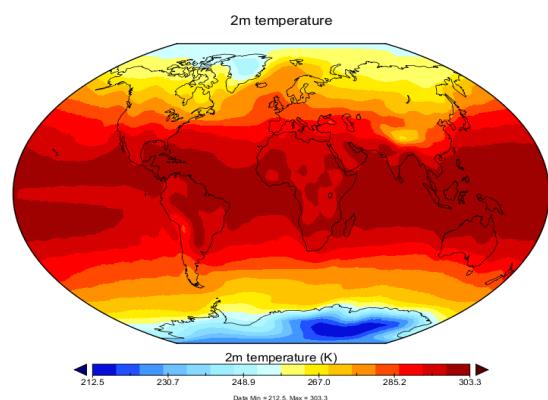
**An ensemble of global map projections**



Mollweide

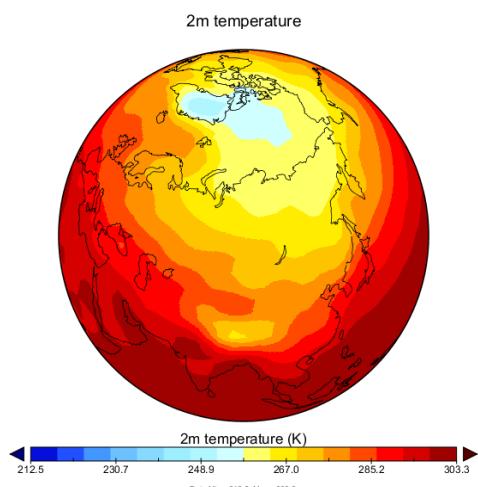


Robinson

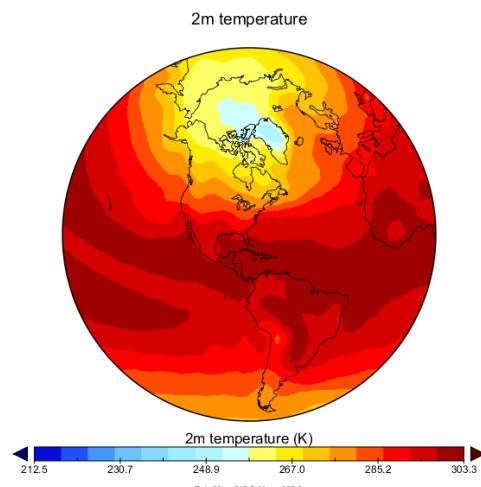


Winkel Tripel

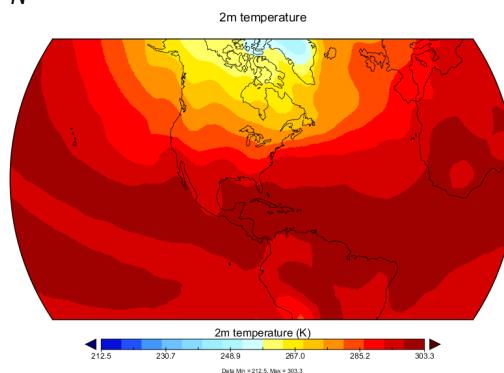
**'Bird's eye view' projections**



Vertical Perspective  
Center on: 90°E, 60°N



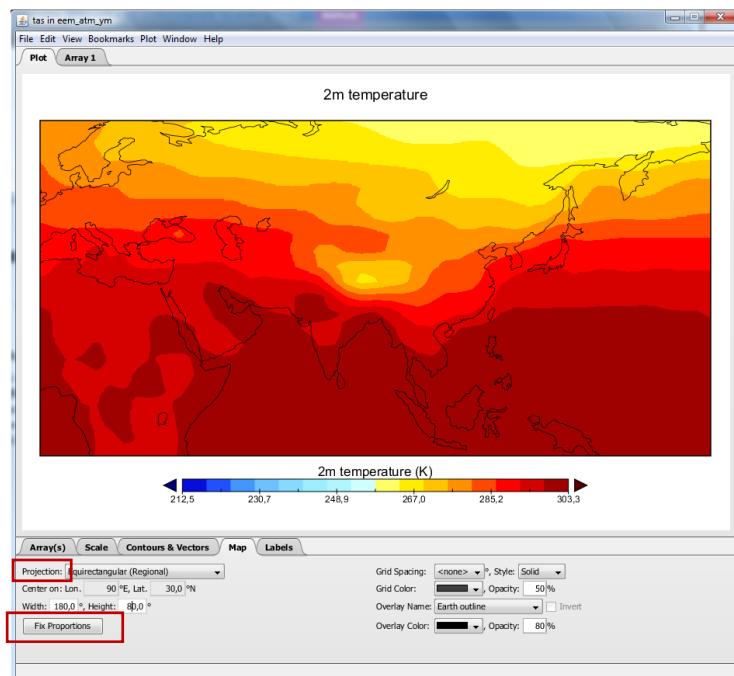
Azimuthal Equidistant  
Center on: -80°E, 30°N



Azimuthal Equidistant  
Center on: -80°E, 30°N  
Radius: 50°

### Regional map projection

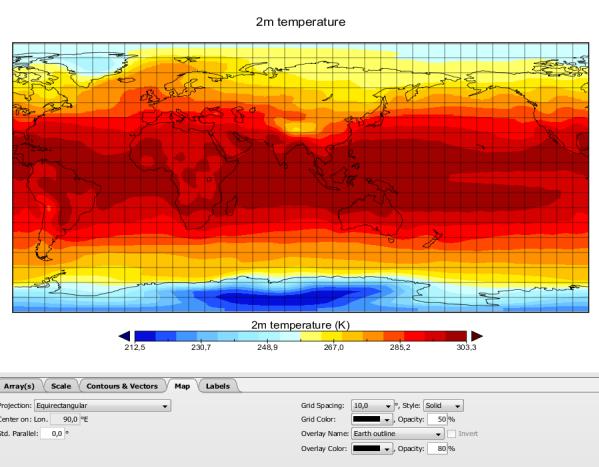
A very useful option is to zoom in a particular area. You can do this by selecting the projection '**Equirectangular (Regional)**' under '**Projection**', again in the '**Map**' menu. The size of this window you can determine via '**Width**' and '**Height**', and as before, you can optimize the central latitude and longitude ('**Center on: Lon... Lat...**'). The example on the right shows the 2-m air temperature (Fischer et al., 2010) plotted for parts of Africa, Europe and Asia (Center on: Lon 90.0°E, 30.0°N; Width 180.0°, Height 80.0°).



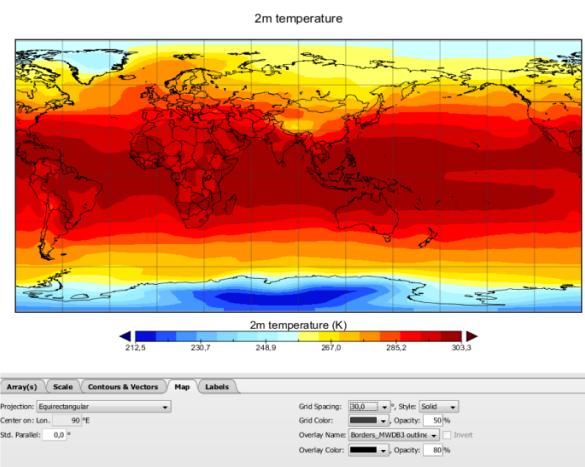
**Note:** If you choose **Height** and **Width** not in proportion to each other, you can adjust these with '**Fix Proportions**'.

### Grids and Overlays

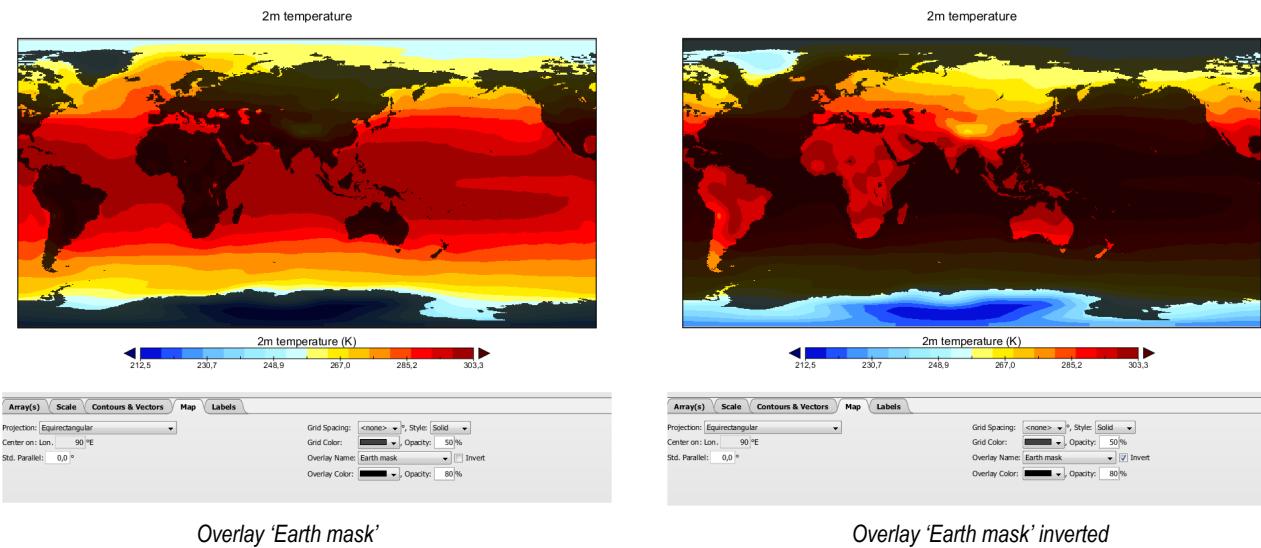
Under the **Map** array you have furthermore the option to put a grid on your map using **Grid Spacing**, ranging from 0.25° to 90.0°, but however note that this grid is a display option and not identical to the model grid. Choose a specific '**Style**', '**Grid Color**' and '**Opacity**'. Decide for an '**Overlay**' that determines the way in which continents appear on your map. '*Earth outline*' is the default setting and shows the basic continental borders. More detailed continental borders are shown by '*Earth\_MWDB3 outline*'. '*Earth Mask*' will let all continents appear black, and inverted (tick '*Invert*') does the opposite and masks all oceans black. With '*Border\_MWDB3 outline*' you will see all national boundaries. You can decide for a specific '**Overlay Color**' and '**Opacity**' of the lines or filled areas.



10° grid spacing



30° grid spacing, with '*Border\_MWDB3 outline*' to depict national boundaries



Additional color tables and continent overlays can be downloaded from the Panoply home page (<http://www.giss.nasa.gov/tools/panoply/>) and added to the Panoply library by placing them in the according directory.

## Labels

Under the **Labels** tab you can modify all the labels in the plot window. You can determine a '*Plot Name*' which what your plot will be saved as; configurations to '*Plot Title*' and '*Plot Subtitle*' will appear in the plot area itself, for instance '*2-m temperature*' as Plot Title, and '*Eemian*' as Plot Subtitle, or anything that suits you. Change the font of the labels under '*Labels Typeface*', and the background color to black if you prefer, under '*Background*'. You can also choose to show or not show minimum and maximum of the scale bar ('*Show min-max footnote*') and details about the map projection ('*Show projection footnote*') in the lower left of the plot window.

## Saving Plots and Preferences

At any point you can save any your plotting preferences in the '*Window*' menu under '*Preferences*', concerning general adjustments ('All Plots'), '*Scale*', '*Contours and Vectors*', '*Longitude Latitude*', '*Projection*', and settings for other kind of plots ('Other', for vertical profiles and time-latitude plots). Equally you can reset all settings to default under '*Reset all Prefs*' at the bottom of the '*Preferences*' window. You can save images in the Plot window using '*Save file as*' in the File menu. You can choose between the PNG, GIF, JPEG, PDF, PNG, postscript and TIFF format.

