Ecography

ECOG-03031
Fordham, D. A., Saltré, F., Haythorne, S., Wigley, T. M. L., Otto-Bliesner, B. L., Chan, K. C. and Brooks, B. W. 2017. PaleoView: a tool for generating continuous climate projections spanning the last 21 000 years at regional and global scales. – Ecography doi: 10.1111/ecog.03031

Supplementary material

Appendix 1: PaleoView (version 1.0) setup and use

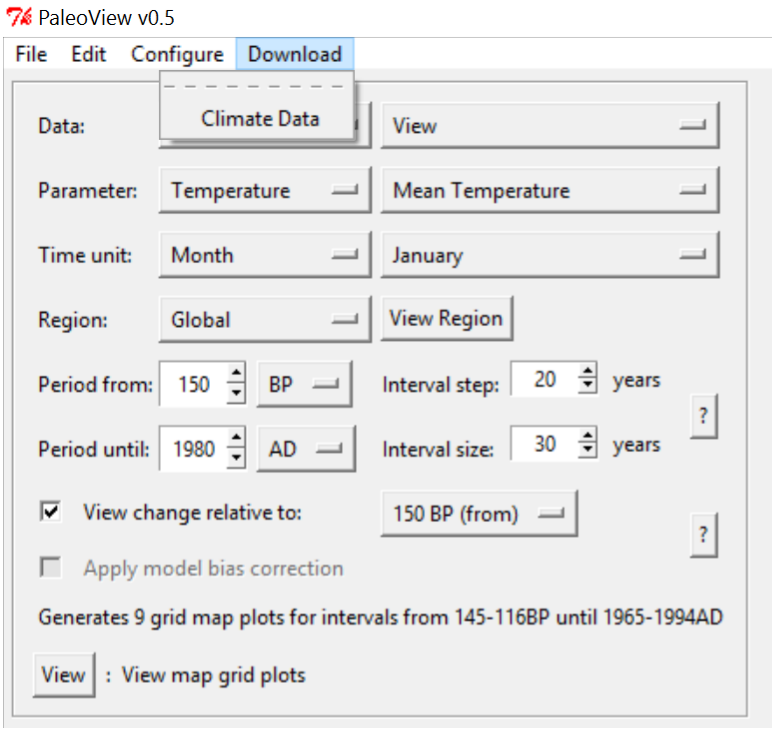
1. *Installing PaleoView*

The software and associated data can be downloaded from here:
https://github.com/GlobalEcologyLab/PaleoView/releases

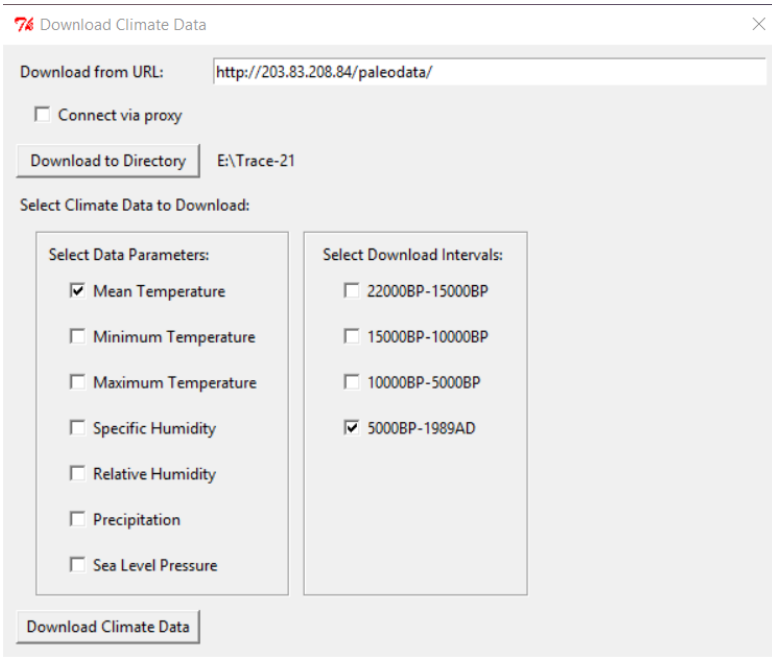
The software has been compiled for Windows and Mac operating systems. When installing on Mac OS, control click the app icon then select "Open". This is used to exempt Developer ID signature protection from a unidentified developer. For further information see how to open an app from an unidentified developer and exempt it from Gatekeeper at https://support.apple.com/en-au/HT202491

2. *Downloading climate data*

PaleoView utilizes monthly-mean climate model data that are stored on a server on the internet. The most efficient way to use PaleoView is to download the climate data (compressed in NetCDF form) to a local directory on your computer, or on another network disk drive within your organization. It is also possible to configure PaleoView to make use of raw climate data directly from the internet server, although this is considerably slower (see Step 3).



Climate data can be downloaded using the “Download” tab and clicking on “Climate Data”.



Click on the "Download to Directory" tab and set the file path where you would like to save the climate data. Select the climate data to download by ticking boxes for "Data Parameters" and "Download Intervals". Then click "Download Climate Data". The files are approximately 2 GB each and can take approximately 2 hours per file to download using a high-speed internet connection. You may download additional data at any time as necessary.

If PaleoView has problems connecting to the public data server from within your organization, then you may need to consult your network administrator for assistance to "Connect via proxy", or to configure the organization's firewall to allow PaleoView to connect to the server.

Data can also be downloaded via a web browser. The URL is automatically populated within the tool.

3. *Configuring input data directory*

Open the "Configure" tab and click on "Climate Data Location".

The "Local Directory" containing the downloaded climate data (see Section 1) should be selected. If PaleoView has been reinstalled or the data has been moved then "Select Directory" and navigate to the new location. Most users will use PaleoView with the downloaded data in NetCDF format. If you (generally as part of the core research group involved in PaleoView's development) are running the tool using updated raw climate data, then select the "Data File Type": "Raw Data" and set the directory to the location of the raw data.

PaleoView can also use raw climate data directly from the data server without the need to download data intervals (see Section 1) by selecting "Network URL" rather than "Local Directory". While useful for *ad hoc* or infrequent use, this setting is considerably slower and is not recommended for ongoing use, for which downloading climate data to a local directory is far more efficient.

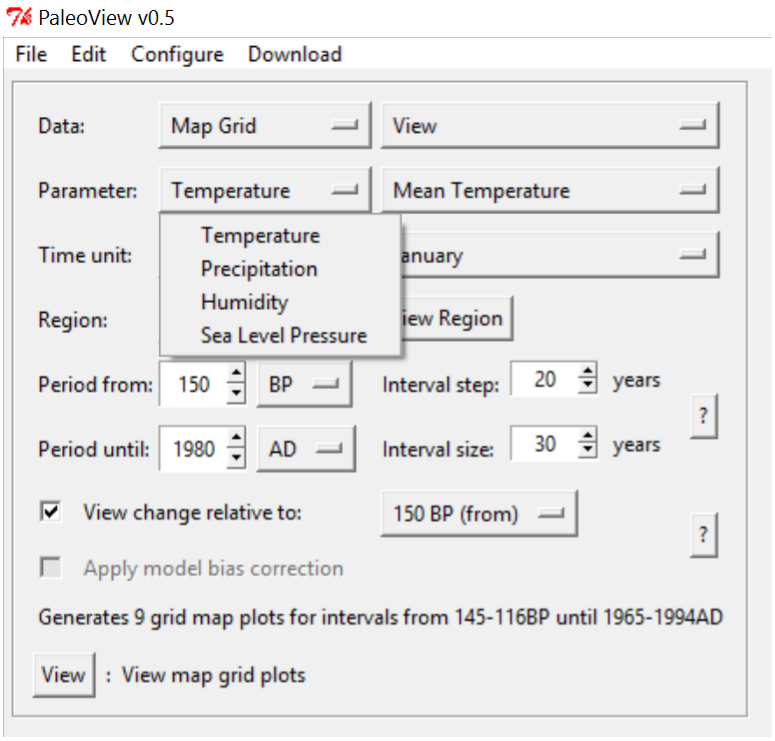
4. *Configuring output data directories*

Open the "Configure" tab, click on "Default Output Directory" and choose the file directory where you would like PaleoView to store output files.

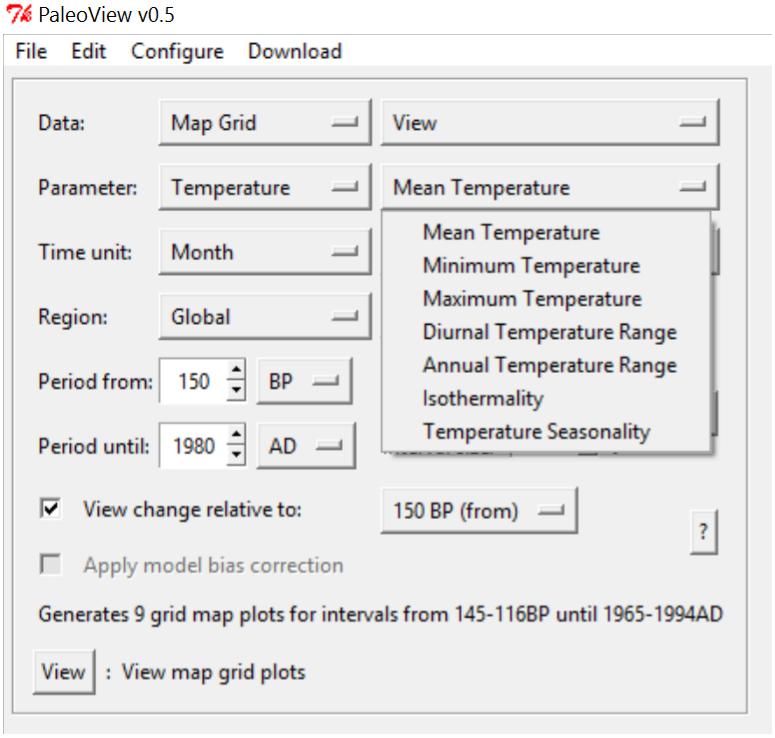
5. *Viewing climate change projections*

Choose whether you want to view climate data as spatial maps (“Map Grid”) or as “Time Series” data. If you choose “Map Grid”, then PaleoView can generate a maximum of 20 maps for viewing at one time.

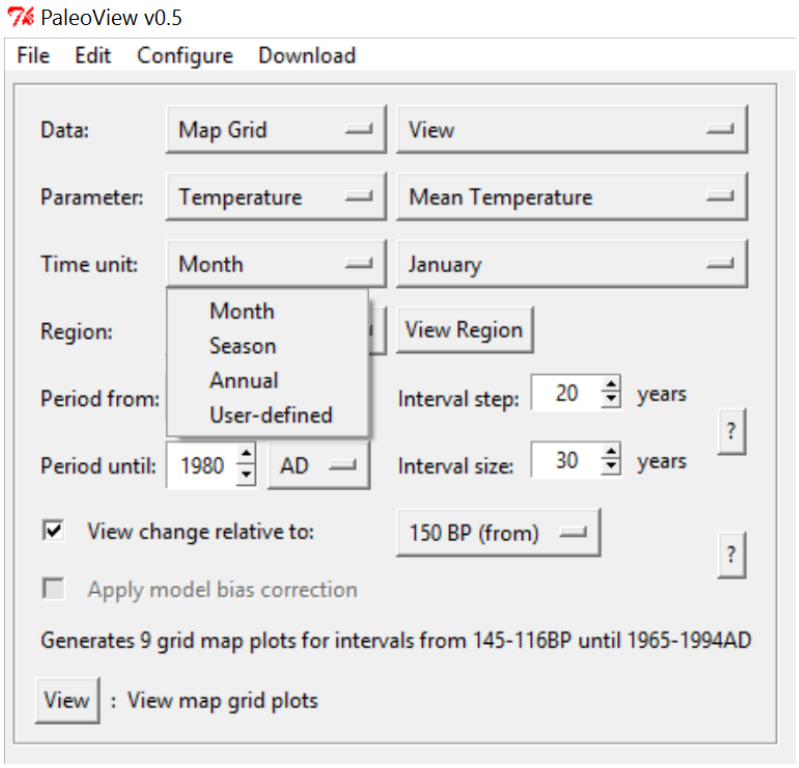
Open the first “Parameter” tab (numbering from left to right) and click on “Temperature”, “Precipitation”, “Humidity” or “Sea Level Pressure”.



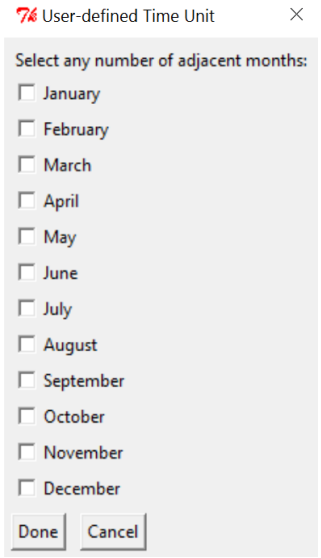
Open the second “Parameter” tab (from left to right) and choose the specific climate parameters to be generated. For temperature, a total of seven different parameters can be generated (see below).



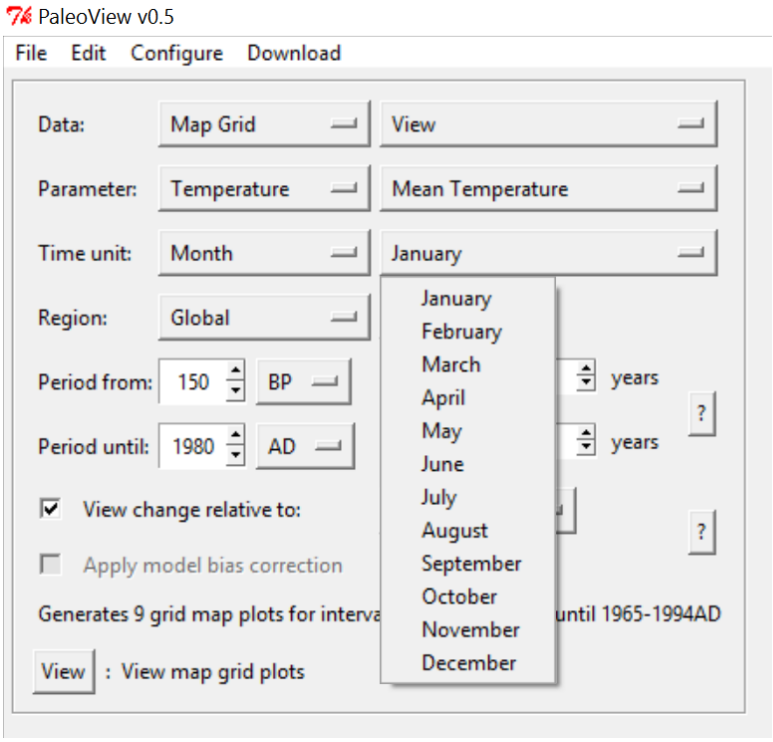
Open the first “Time unit” parameter and choose whether climate estimates should be calculated monthly, seasonally, annually, or for a user-defined set of months.



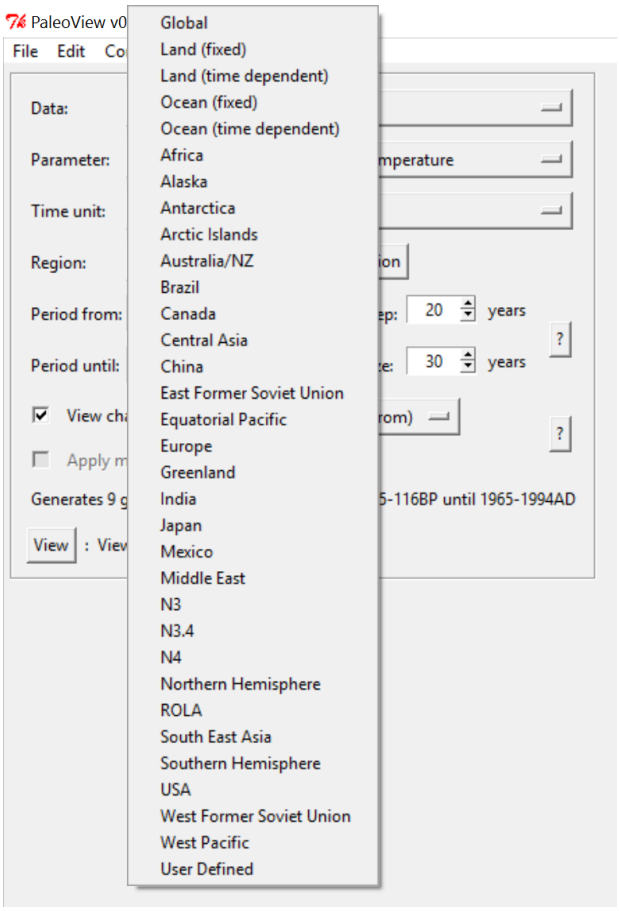
Clicking on “User-defined” allows the user to generate climate estimates over important periods that do not confirm to a standard calendar season; e.g., wet and dry seasons in tropical regions. This is done by ticking adjacent months and clicking “Done”.



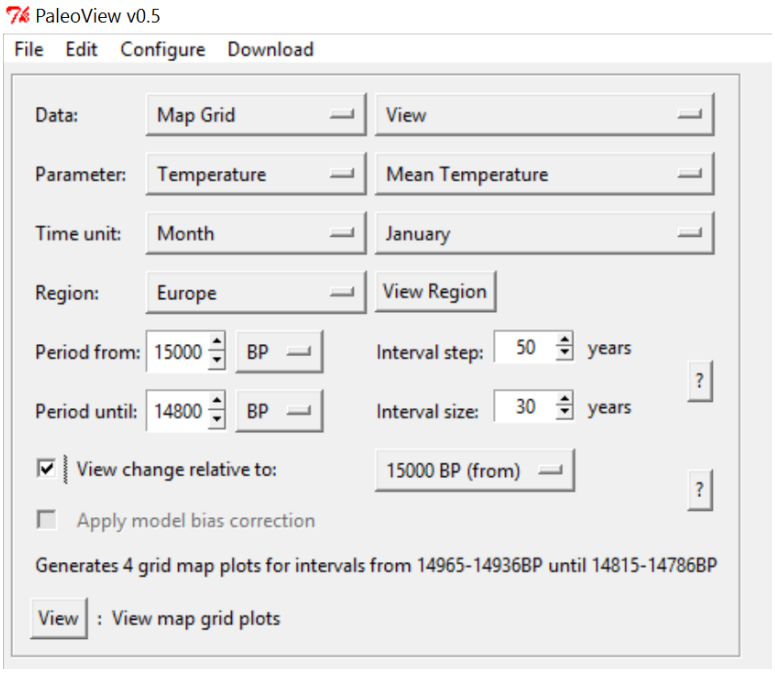
If monthly or seasonal climate data is to be generated, the focal month or season is selected using the second “Time unit” tab. For example, if the time unit is month, any one of twelve months, or combinations of adjacent months, can be selected.



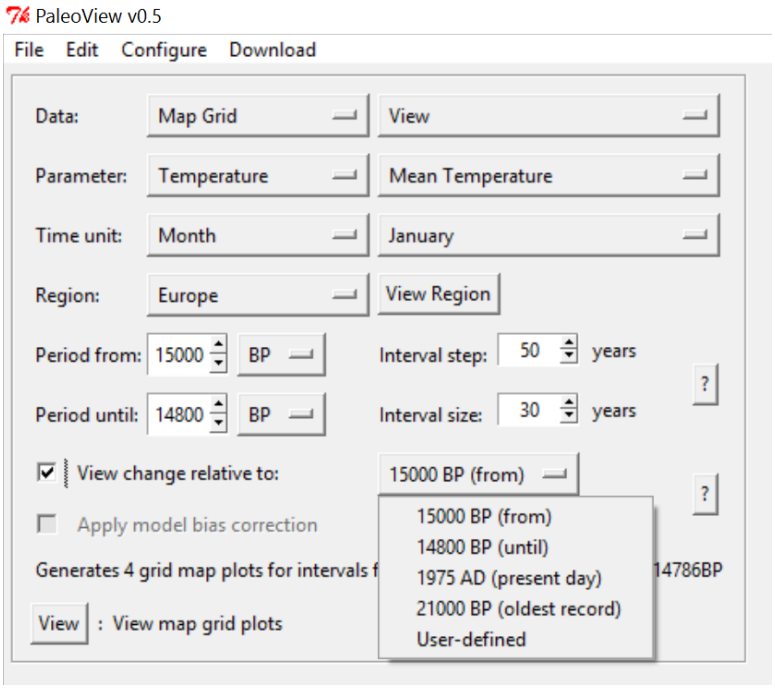
PaleoView has built in geographical masks. Clicking on the “Region” tab will give a pull-down menu of region options. These are either “hardwired” regions, or, if “User-defined” is selected, the user can mouse out a rectangular latitude/longitude region on the map of the world. There is, in addition, the option of using a dynamic or fixed land-sea boundary, by selecting “Land (time dependent)” or “Ocean (time dependent)”. Doing this tracks the changes of ice sheets and sea level by interpolating between sea ice and coastline reconstructions at 1,000 year time steps. Current-day masks can be viewed by clicking the “View Region” button.



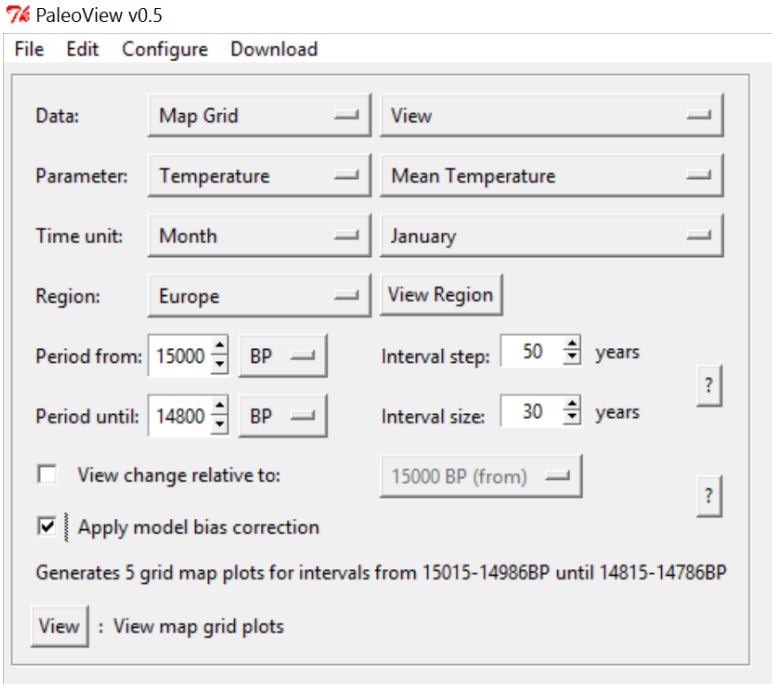
The time period for calculating climate intervals is set using the “Period from” (first year) and “Period until” (last year) buttons. The time period over which the climate data are averaged (usually 20 or 30 years, with a minimum of 10 years) is set using “Interval size”. The step between each climate estimate is set using the “Interval step”. For the example below, PaleoView would return 30-year average climate estimates for the period between 15,000 (15,015 – 14,986) BP to 14,800 (14,815 – 14,786) BP at 50 year time steps for Europe.



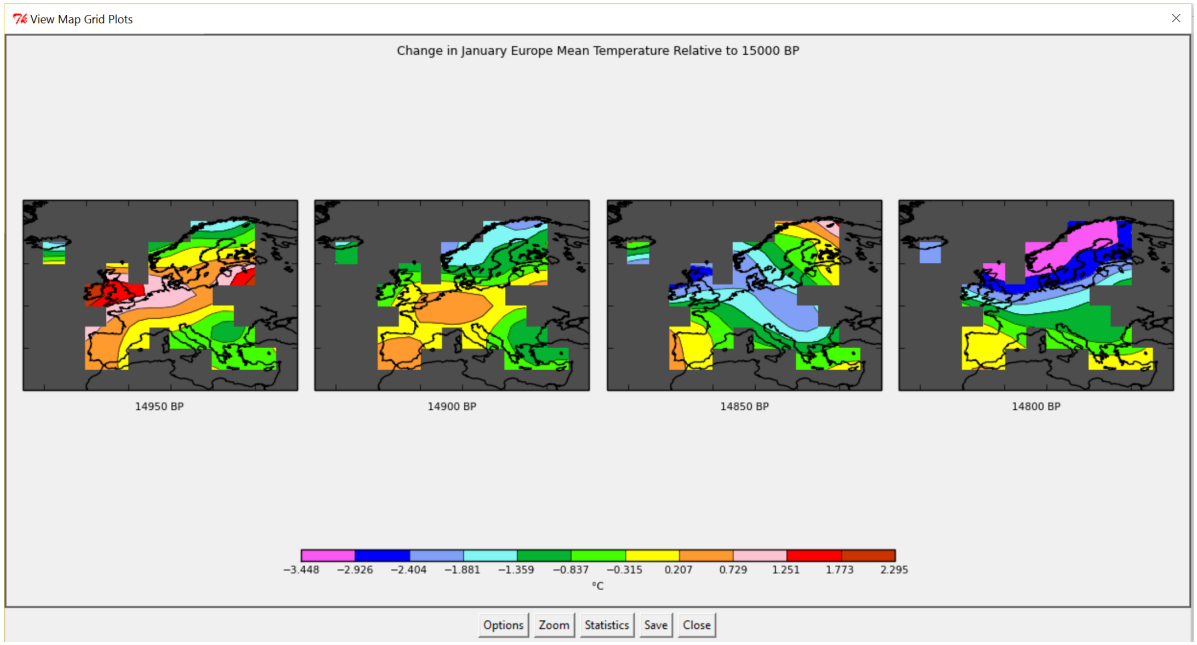
Anomalies (rather than absolute values) are generated if the “View change relative to” (or “Generating change relative to”) box is ticked. The user can define the period from which to calculate the anomaly by clicking on the adjacent button (see below).



If absolute values (not anomalies) are needed, the “View change relative to:” box should be unticked. The user then has a choice as to whether to generate absolute values with or without a correction factor. The correction factor adjusts values to account for the difference between observed and modelled data over a near-present-day reference period (see Appendix 2).



Clicking on the "View" button generates maps, which can be saved as Portable Network Graphics (.png) or Portable Document Format (.pdf) files. The example below shows changes in the 30-year January-mean temperature for Europe relative to 15,000BP.

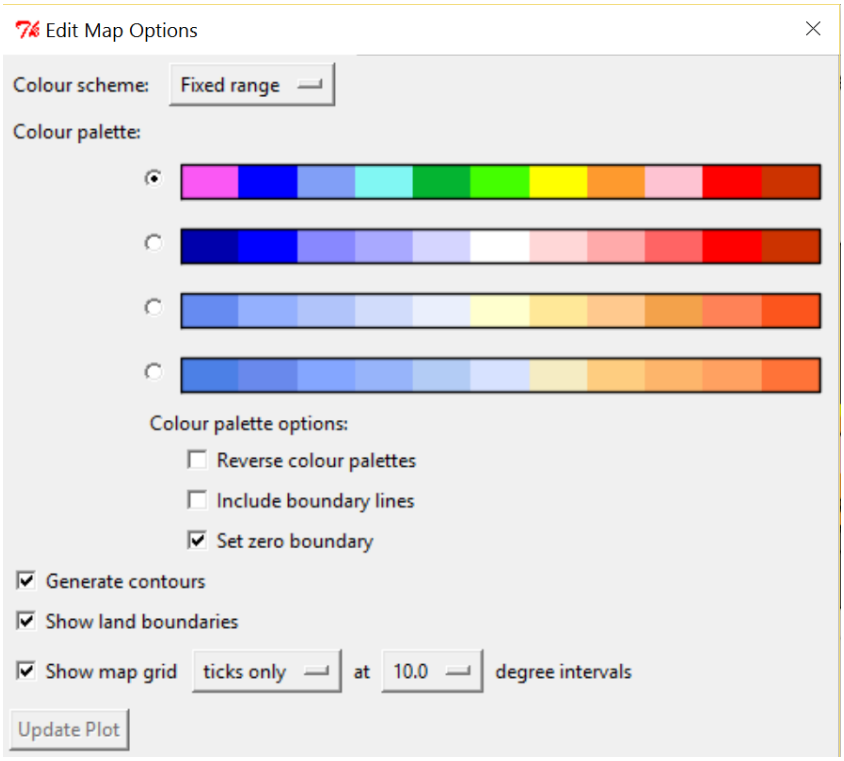


Clicking on the "Options" button on the map display allows the user to:

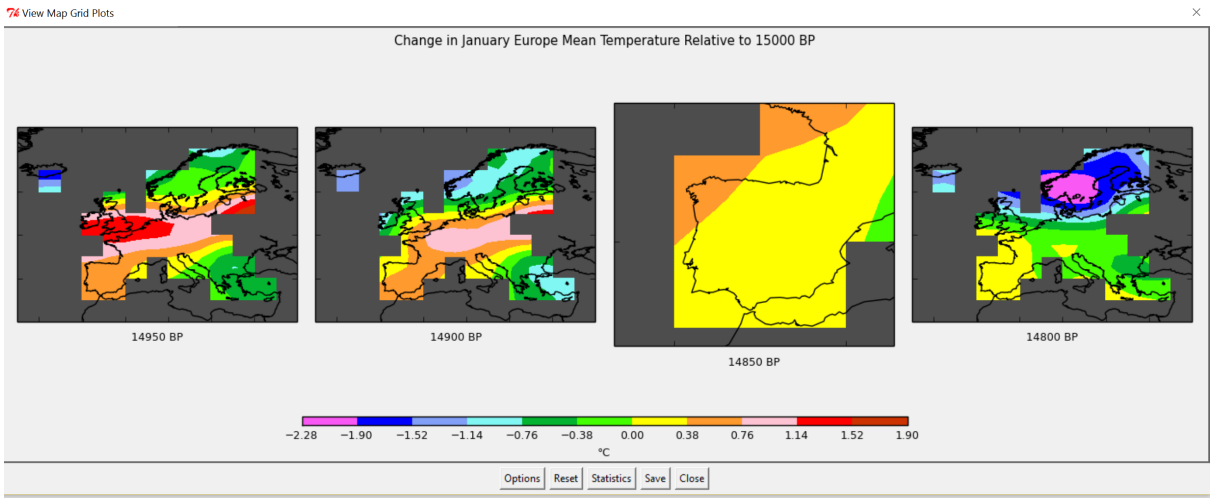
1. Change the colour scheme from a "Fixed Range" (hard-wired into the code) to a 90% range. In the latter case, grid-point values over the study region are sorted to determine the 90% confidence range, and the colour scheme boundaries are defined from this.
2. Note that there are four hard-wired palette options. The fourth (lowest) option becomes available when the "Set zero boundary" option is chosen.
3. Use "Colour palette options" to reverse the colour palette and modify the colour palette legend ("Include boundary lines"). The "Set zero boundary" option allows the user to have the zero isoline in the middle of the colour scheme.

4. Remove contour plots and land boundaries from maps.
5. Remove or edit the spacing of latitude and longitude ticks on maps.

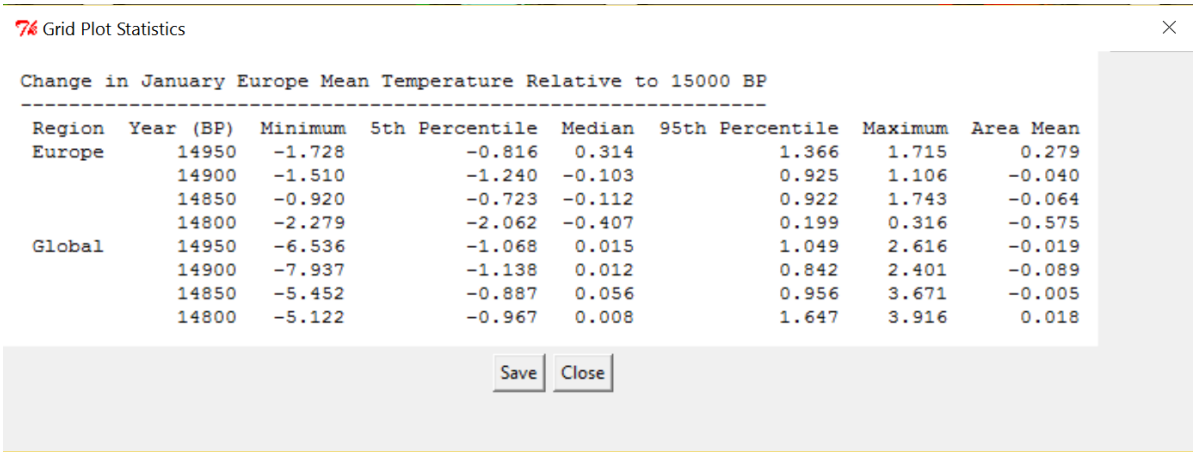
Note that the map display can also be set using “Map Options” in the “Edit” tab.



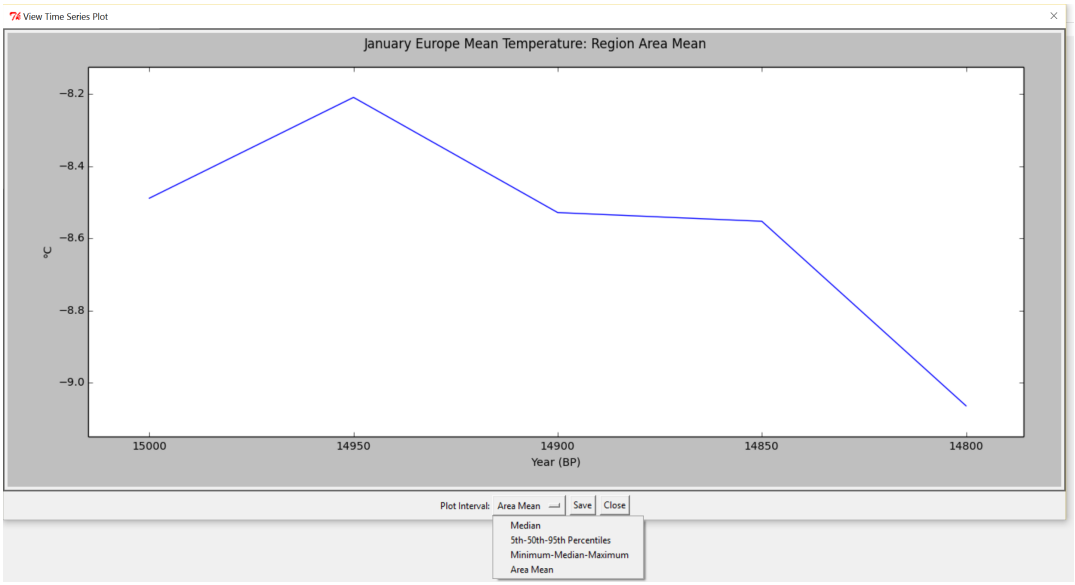
Clicking on the “Zoom” button on the map display (see below) allows the user to zoom into areas of interest using the cursor to trace out the region of interest. In the example below, the Iberian Peninsula has been traced out for the year 14,850BP.



Pressing on the “Statistics” tab provides important climate summary metrics at regional (here, Europe) and global scales. These can be saved as well as viewed.



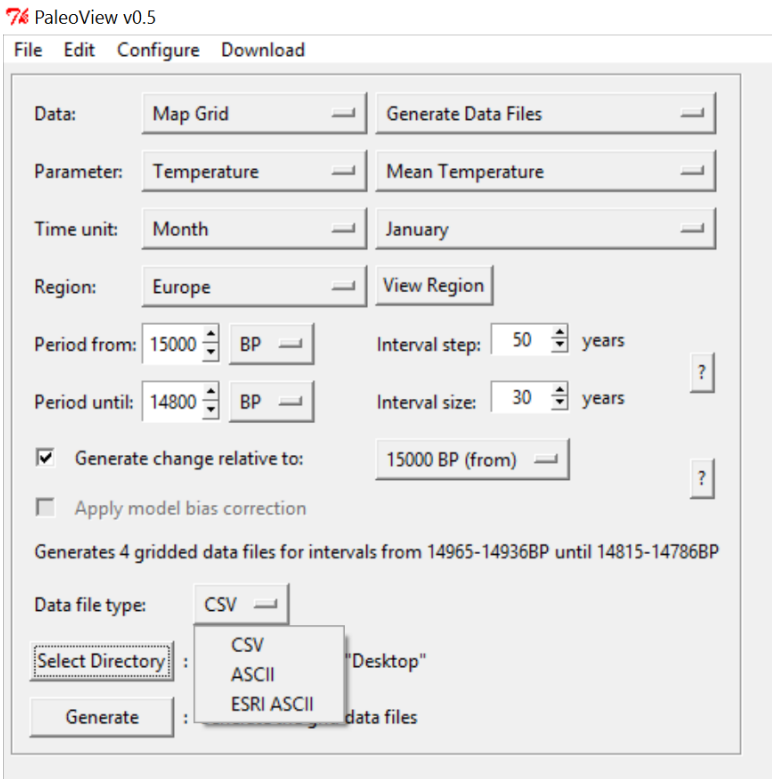
PaleoView also allows these statistics to be viewed graphically as a time series plot. This can be done by choosing “Time Series” rather than “Map Grid” in the “Data” tab and then clicking on the “View” tab. Climate change can be shown as area means, percentiles, minimum and maximum values and median values. See below.



By viewing data as a time series, the user is not restricted in the number of climate estimates they can view: i.e., unlike viewing maps, the user can view climate data for time intervals greater than 20 years.

6. *Generating data files*

Gridded and time series data can be generated in PaleoView (i.e., as maps or as trajectories across time) and exported, rather than viewed, by returning to the “Data” tab and clicking on “Generate Data Files” rather than “View”.The “Data file type” allows the user to choose between three formats for saving files: CSV, ASCII and ESRI ASCII.



The user can change the output directory using the “Select Directory” button. Output is produced by clicking on the “Generate” tab. The user is not restricted in the number of climate estimates they can export.

References

Dee, D. P. et al. 2011. The ERA-Interim reanalysis: configuration and performance of the data assimilation system. — Quarterly Journal of the Royal Meteorological Society 137: 553-597.

Rienecker, M. M. et al. 2011. MERRA: NASA's Modern-Era Retrospective Analysis for Research and Applications. — Journal of Climate 24: 3624-3648.