CASMO – Create A Stress Map Online

World Stress Map database interface developed by Tim Hake

Introduction

CASMO is a web-based HTML-form that allows the user to create own stress maps using the data of the WSM database. Requests for stress maps will be sent to our server for further processing. CASMO creates maps with the selected data records of any geographical region. Selections can be made by type of stress indicator, stress regime or data quality. Additional features like topography, rivers, overview maps, etc. can be added. Possible output formats are postscript, pdf, png or jpeg bitmap format. The requested map will be provided for download as a compressed file (*.zip). You can decompress this file with standard software such as WinZip or 7-Zip. If you intend to use the stress maps or WSM data in publications, we kindly ask you to cite our work as:

Heidbach, O., M. Rajabi, X. Cui, K. Fuchs, B. Müller, J. Reinecker, K. Reiter, M. Tingay, F. Wenzel, F. Xie, M.O. Ziegler, M.-L. Zoback, and M.D. Zoback. 2018, The World Stress Map database release 2016: Crustal stress pattern across scales. Tectonophysics, 744,484-498, doi:10.1016/j.tecto.2018.07.007

Heidbach, O., M. Rajabi, K. Reiter, M.O. Ziegler, WSM Team (2016): World Stress Map Database Release 2016. GFZ Data Services, doi:10.5880/WSM.2016.001

Special thanks to Paul Wessel and Walter H.F. Smith for their great mapping tool GMT (Wessel et al., 2019); CASMO is based to large extend on this tool. The plate boundaries shown in the maps are by courtesy of Bird (2003) and the global topography is the ETOPO1 dataset from Amante and Eakins (2009). The data related to his global plate boundary model are available on his ftp-site.

The following sections describe briefly the functions of the CASMO website form. Further technical details about the WSM database structure and content is presented in the WSM STR 16-01 that is available on the WSM website.

Dataset

In this section can be chosen, if the WSM database shall be plotted (WSM database only) or if mean stress orientations should be plotted in the geographical region. Additionally, the WSM data can be plotted next to the mean stress orientations (Add WSM Data). For further information about the mean stress pattern, please look at Heidbach et al. (2010) and the reference for the mean stress orientations (Heidbach and Ziegler, 2018).

General map properties

Coordinates & Map interaction

Possible values to choose the geographical region of your map are:

Longitude (East and West) [-180….180]
Latitude (North and South) [-90…..90]
(West < East and South < North)

The values represent the geographical coordinates of the map boundaries (Figure 1). You can specify the range of your map in two ways. Your either enter directly the numbers in the given fields or you can pick the map boundaries on the map. The position of the map can be changed by click and drag. You can use the mouse wheel to zoom in and out. The area of interest can be selected by drawing a rectangle on the map. Start to draw a rectangle by clicking on the map a second click finishes the rectangle. Another mouse click resets the previous selection and initiates a new rectangle.

Longitudes west of the zero meridian (Greenwich) are counted negative (down to -180°), longitudes east of it positive (up to 180°). Latitudes south of the equator are counted negative (down to -90°), north of it positive (up to 90°). Note: Be careful with high (near 90°) or low (near -90°) latitudes because Mercator projection appear here extremely distorted.

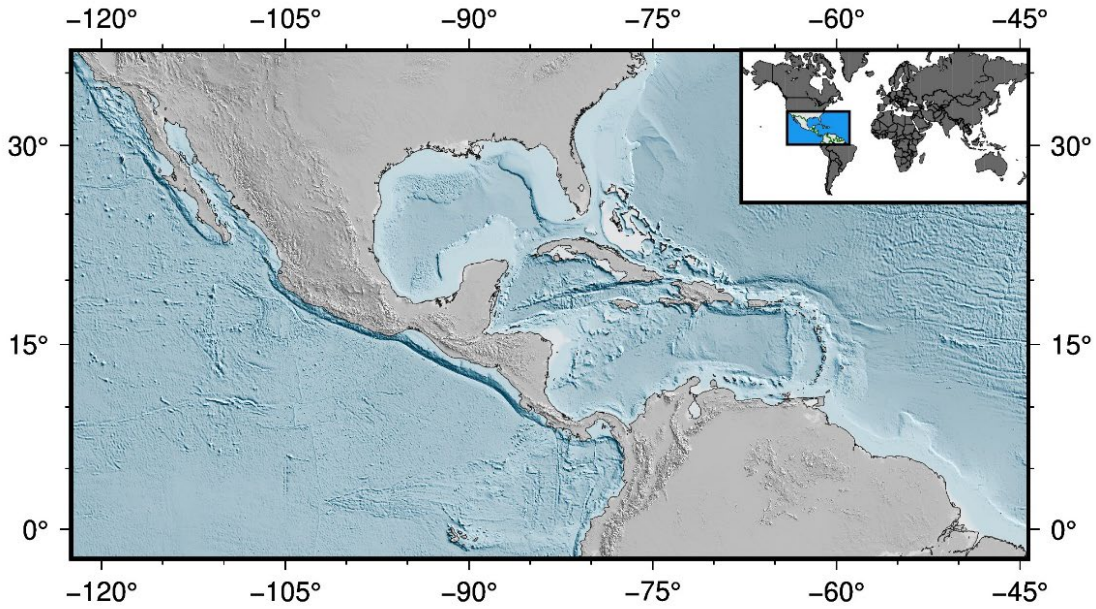

Figure 1. *Map of Middle America including a global overview map.*

Map projection options

We provide the following four different projections. Further details are given at the GMT website (http://gmt.soest.hawaii.edu):

1. Mercator
2. Lambert (azimuthal equal area)
3. Lambert (conic conformal)
4. Albers (conic equal area)

Map colour option

Possible values are:

- Sea: Blue & Land: Grey (Default)
- Sea: White & Land: Grey
- Sea: Blue & Land: White
- Sea White & Land: Blue
- Sea: Blue & Land: classic WSM (green-brown color scale)

Further map options

In the next section there are several options to toggle on/off:

- **Hillshade** (default toggled on) adds lights to the surface. The light source is at 45°N.
- **Plate boundaries** toggle on/off (displayed in black) (**Note:** Plate boundaries shown in the maps are taken from the global tectonic model of Bird (2003). Since this is a global model the plate boundaries on regional to local stress maps is not recommended due to limited resolution of tectonic features taken from a global model).
- **Political boundaries** toggle on/off (displayed in black). (**Note:** Political boundaries are not always perfectly up-to-date).
- **Major rivers** toggle on/off (displayed in light blue): Major rivers are defined in GMT and we plot rivers types 1 & 2. For further information, look at the GMT Documentation PSCOAST -Iriver.
- **Lakes** (default 400 km^2): Defines the minimum area [km^2] of the lakes to be plotted (displayed in light blue). For further information, look at the GMT Documentation PSCOAST -A.

Select stress data

Data quality

Possible categories: A, B, C, D; and E where only the location is plotted without the S_{Hmax} orientation. All data are quality ranked according to the quality ranking scheme developed by Zoback and Zoback (1991; 1989) and updated by Sperner et al. (2003) and Heidbach et al. (2010). The highest quality is A, the lowest E. To indicate the different qualities the stress data have different symbol length (Fig. 2).

Tectonic stress regime

Possible stress regime categories are: TF (Thrust Faulting), SS (Strike-Slip), NF (Normal Faulting) and U (Unknown). Different stress regimes are characterized by different symbol colours. NF data is printed in red, SS data in green, and TF data in blue. Data with an unknown stress regime is printed in black (further details).

Stress data type

Possible categories: Borehole Breakout (BO); Geological Indicators (GI); Geological Volcanic Alignment (GVA); Hydraulic Fracture (HF); Overcoring (OC); Borehole Slotter (BS); Pental Centerline (PC); Drilling Induced Tensile Fractures (DIF); Shear Wave Splitting (SW); Focal Mechanism, Formal Inversion (FMF); Focal Mechanism, Average (FMA); and Focal Mechanism, Single (FMS), with additional data filters. The different types of stress indicators are shown by different symbols (Figures 2 and 3).

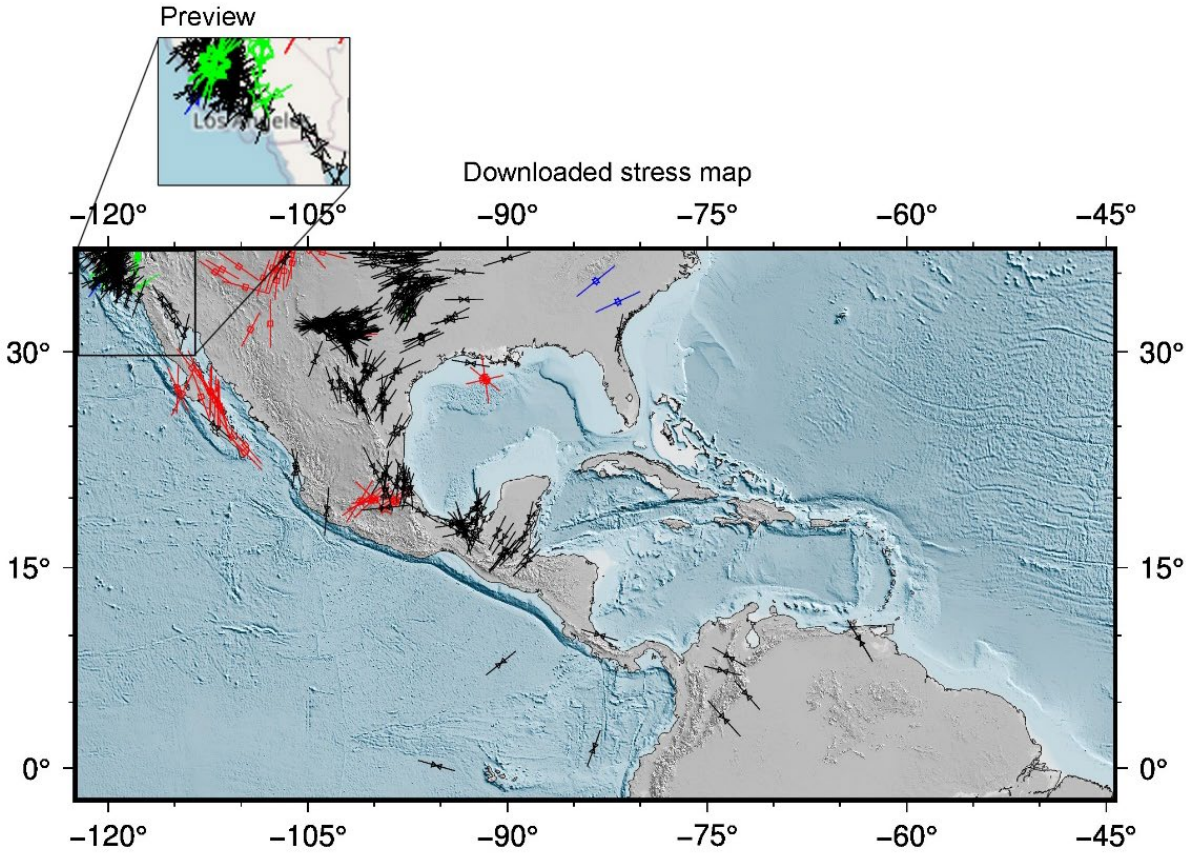

Figure 2. *Stress map of Middle America including stress data records with A- and B-quality. It shows the difference between the preview and the downloaded map caused by the plotting schedule of the stress data records in regions of a high data record density.*

Preview

The preview only displays the currently chosen stress data records on the open street map. It does not preview the final stress map product as shown in Figure 2 as the background of the downloaded stress map will have the chosen topography colour and setting. Eventually, the appearance of the stress data will vary as well. In regions of a high data set density data sets will be plotted on top of each other. Hence, the plotting schedule causes variations between the preview and the downloaded stress map (Figure 2).

Depth interval

You can specify the depth interval from a top value to a deepest value. Depth values have to be positive. The surface has the value 0. The default setting is that data records between 0-40 km depth are plotted.

Stress map legend

It lists the plotted features (stress indicators, stress regimes, qualities and depth interval) as chosen by the user, i.e. if borehole breakout data have been selected as only stress indicator, then only the borehole breakout symbol will appear in the legend.

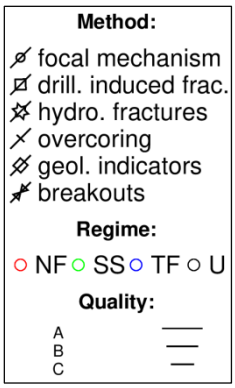

Figure 3. *Legend for a stress map with A-C quality data records.*

Plot your own stress data

You can add your own stress data to the map by inserting your data in the text field in a comma separated format. The inserted data will be interpreted as:

Latitude, Longitude, Azimuth, Type, Depth [km], Quality, Regime

For example:

22.3,23.4,130.3,FMS,13,A,NF
22.3,23.4,70.3,FMS,13,B,TF
22.3,23.4,989.6,BO,13,C,NF

Type, quality, and regime have to be letters, but make sure that you exclusively use the abbreviations described in the WSM Scientific Technical Report 16-01 that is available on the WSM website. All columns need to be filled with information.

Format

You have the possibility to get your stress map as *.ps, *.pdf, *.png or *.jpg file. The compressed file will be provided for download in a compressed file (*.zip). You can decompress this file with standard soft-ware such as WinZip or 7-Zip. You can also select multiple file formats at once and all files will be provided in one *.zip file in the download section.

References

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