



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 available stress orientations of any geographical region. Selections by type of stress indicator, the tectonic regime or data quality can also be made. 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 CASMO generated stress maps or the WSM database release 2025 in publications, we kindly ask you to cite our work as:

Heidbach, O., Rajabi, M., Di Giacomo, D., Harris, J., Lammers, S., Morawietz, S., Pierdominici, S., Reiter, K., von Specht, S., Storchak, D., and Ziegler, M. O. (2025): World Stress Map Database Release 2025, *GFZ Data Services*, <https://doi.org/10.5880/WSM.2025.001>

Heidbach, O., Rajabi, M., Di Giacomo, D., Harris, J., Lammers, S., Morawietz, S., Pierdominici, S., Reiter, K., von Specht, S., Storchak, D., and Ziegler, M. O. (2025). World Stress Map 2025, *GFZ Data Services*, Potsdam, <https://doi.org/10.5880/WSM.2025.002>

As CASMO is mainly based on the mapping tool GMT [Wessel *et al.*, 2019] special thanks goes to Paul Wessel and his colleagues. The plate boundaries shown in the maps are taken from the global plate model PB20023 of Peter Bird [Bird, 2003]. The data related to his global plate boundary model are available on his ftp-site. Topography and Bathymetry data are from Tozer *et al.* [2019].

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 Technical Report 25-01 of Rajabi *et al.* [2025] that is available on our website.

Dataset

In this section can be chosen, if only data from the WSM Database release 2025 are plotted (default) or if also the mean S_{Hmax} stress orientations is plotted as well. For further information about the mean stress pattern, please look at Heidbach *et al.* [2018].

General map properties

Coordinates & Map interaction

Possible Values:

Longitude (East and West) [-180....180],

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

You can specify the range of your map. The values represent the geographical coordinates of the map boundaries (Fig. 1). These boundaries can be picked 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 very high (near 90°) or very low (near -90°) latitudes because in Mercator projection these regions appear extremely distorted.

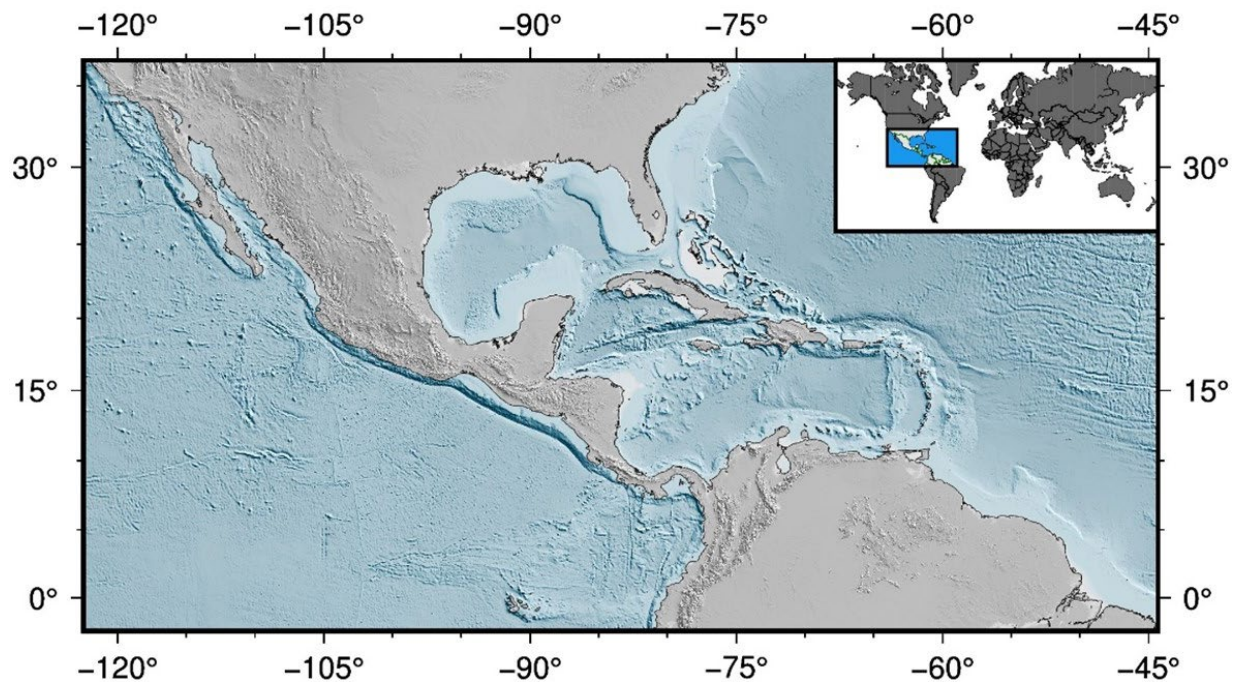


Figure 1. Map of Middle America including a global overview map.

Projection

Possible values are:

- Mercator
- Lambert (azimuthal equal area)
- Lambert (conic conformal)
- Albers (conic equal area)

For further details, please, look at the GMT website, where all projections are explained in detail.

Map Colors

Possible values are:

- Sea: Blue & Land: Gray (Default)
- Sea: White & Land: Gray
- Sea: Blue & Land: White
- Sea White & Land: Blue

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

Landscape toggle on to display the shorter side up. Default: Landscape toggled off: the map is displayed as a portrait (longer side up).

Note: If you want to import the produced *.ps file into other software, we recommend Portrait.

Hillshade (default toggled on) adds lights to the surface. The light source is at 045°N.

Plate boundaries toggle on/off (displayed in black)

Political boundaries toggle on/off (displayed in black)

Note: The political boundaries are not always perfectly up-to-date. The 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.

Major rivers toggle on/off (displayed in light blue) The major rivers are defined in GMT. The rivers types 1 & 2 are plotted. For further information, look at the GMT Documentation PSCOAST -Iriver.

Lakes (default 400km²) Defines the minimum area [km²] 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 as a point without the S_{Hmax} orientation. All data are quality ranked according to the WSM quality ranking scheme 2025 as documente in the WSM Technical Report 25-01 [Rajabi et al., 2025]. The highest quality is A, the lowest E. To indicate the different qualities the stress data have different symbol length (Fig. 2).

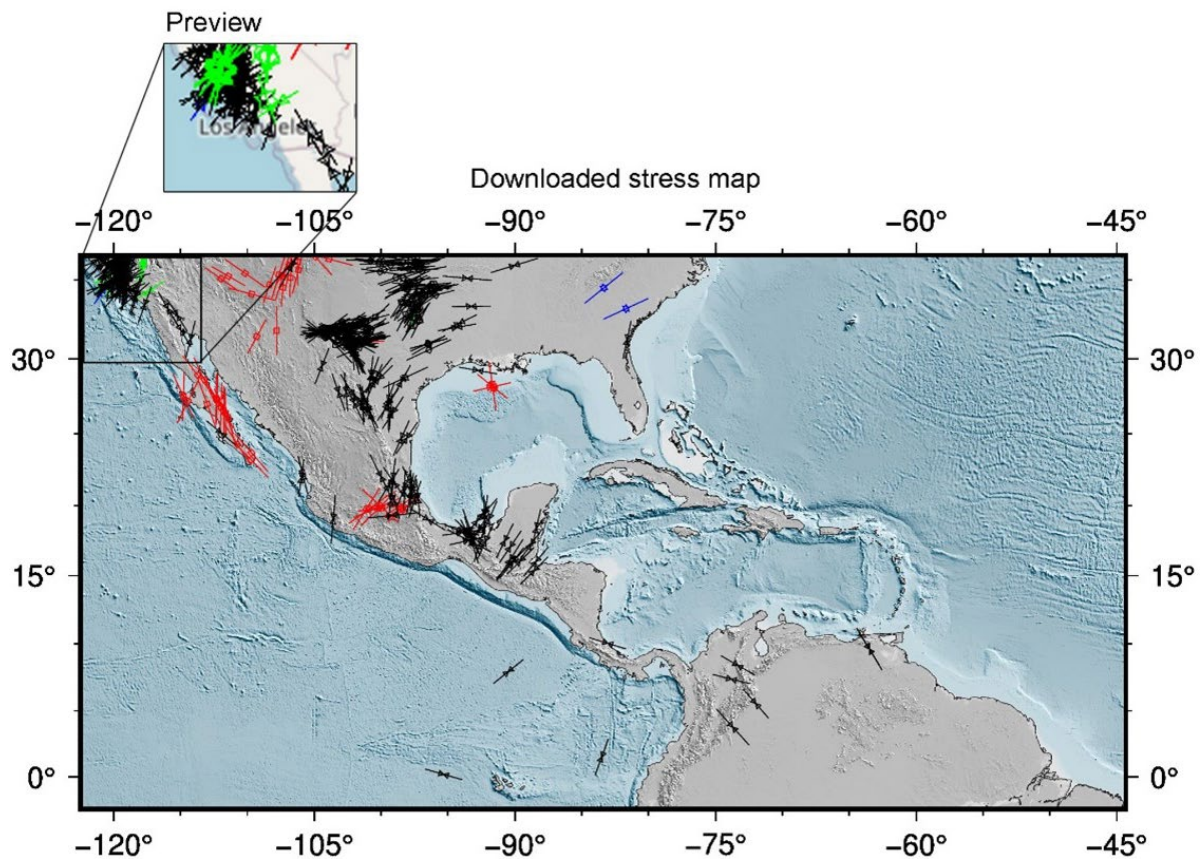


Figure 2. Stress map of Middle America including all stress data records (except FMF) with A- and B-quality. It shows the difference between the preview and the downloaded map caused by the plotting schedule of the stress data records in regions of a high data set density.

Tectonic stress regime

Possible stress regime categories: TF (Thrust Faulting), SS (Strike-Slip), NF (Normal Faulting) and U (Unknown). Different tectonic 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 regime is printed in black. These are usually data that are interpreted from borehole logs since here the information of relative stress magnitudes is usually not available.

Stress data type

Stress data type refers to the eight different stress indicators used in the WSM database:

- Borehole Breakout (BO)
- Geological Fault Inversion (GFI)
- Geological Volcanic Alignment (GVA)
- Hydraulic Fracturing (HF)
- Overcoring (OC)
- Drilling Induced Fractures (DIF)
- Focal Mechanism Single (FMS)
- Formal Inversion of Focal Mechanism (FMF)

The different types of stress indicators are shown by different symbols (Fig. 2, 3).

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. Thus, the background of the downloaded stress map will be different from the preview, as the digital elevation model is the base of the background. Eventually, the appearance of the stress data will vary as well. In regions of a high data record density the data will be plotted on top of each other. Hence, the plotting schedule causes variations between the preview and the downloaded stress map (Fig. 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 all data are plotted that. Note: In contrast to earlier version of the WSM database release we skip the earlier 40 km depth limit of our data compilation, but use instead the global crustal model of Szwilius et al. [2019]. Thus, as a default value we give the deepest point of the crust according to their model which is 75 km, which is the crustal depth including one standard deviation as stated in the electronic supplement material of that paper.

Stress map legend

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

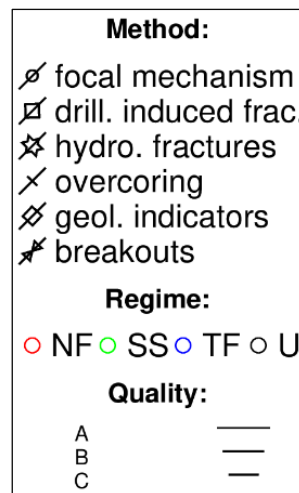


Figure 3. Legend for a stress map with A-C quality data records.

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, S_{Hmax} Azimuth, Type, Depth, Quality, Regime

For example:

22.3, 23.4, 130, FMS, 13, A, NF

42.3, 123.4, 170, FMS, 13, B, TF

24.3, 99.4, 122, BO, 13, C, U

Note: The depth value has to be given in kilometer

The data can be copied into the text field in the section “Plot your own data”. Type, quality, and regime have to be letters, but make sure that you exclusively use the abbreviations described in the WSM Technical Report 25-01 from Rajabi et al. [2025] 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

- Bird, P. (2003), An updated digital model for plate boundaries, *Geochemistry Geophysics Geosystems*, 4(3), 1027, doi:10.1029/2001GC000252.
- Heidbach, O., Rajabi, M., Cui, X. Fuchs, K., Müller, B., Reinecker, J., Reiter, K., Tingay, M., Wenzel, F., Xie, Furen, Ziegler, M. O., Zoback, M.-L., Zoback, M. D. (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
- Rajabi, M., S. Lammers, and O. Heidbach (2025), WSM database description and guidelines for analysis of horizontal stress orientation from borehole logging, WSM TR 25-01, 118 pp, GFZ Helmholtz Centre for Geosciences, Potsdam, doi: 10.48440/WSM.2025.001
- Szwilius, W., J. C. Afonso, J. Ebbing, and W. D. Mooney (2019), Global Crustal Thickness and Velocity Structure From Geostatistical Analysis of Seismic Data, *Journal of Geophysical Research: Solid Earth*, 124(2), 1626-1652, doi:10.1029/2018jb016593
- Tozer, B., D. T. Sandwell, W. H. F. Smith, C. Olson, J. R. Beale, and P. Wessel (2019), Global Bathymetry and Topography at 15 Arc Sec: SRTM15+, *Earth and Space Science*, 6(10), 1847-1864, doi:10.1029/2019ea000658
- Wessel, P., J. F. Luis, L. Uieda, R. Scharroo, F. Wobbe, W. H. F. Smith, and D. Tian (2019), The Generic Mapping Tools Version 6, *Geochemistry, Geophysics, Geosystems*, 20(11), 5556-5564, doi:10.1029/2019gc008515