GMT examples:

# Plotting an equidistant map centered on NW Siberia

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## General information

If you make use of the content described in this manual please give reference to my disseration in which a slightly modified version of the presented map is included:

> Grund, M. (2019), *Exploring geodynamics at different depths with shear wave splitting*, Karlsruhe Institute of Technology (KIT), doi:10.5445/IR/1000091425.

## 1 Plotting the map

All content shown in the following is based on the bash-script `MAP_Siberia_EQUDIST.gmt` that can be downloaded together with all required files (station locations, event-station paths etc.) from https://github.com/michaelgrund/GMT-plotting. If GMT 5.2.1 (or higher, Wessel et al., 2013) is installed on your (Linux) system you can directly reproduce the whole content shown in this manual by running `MAP_Siberia_EQUDIST.gmt` via command line. In the following the individual steps to get the final figure are lined out.

### 1.1 Basic settings

```
#!/bin/bash

gmtset  MAP_GRID_PEN_PRIMARY 0.3p,dimgrey \
        PROJ_LENGTH_UNIT c \
        MAP_ANNOT_OBLIQUE 30 \
        COLOR_MODEL rgb \
        FONT_ANNOT_PRIMARY 4p,Helvetica \
        FONT_LABEL 8 \
        PS_MEDIA A4 \
        MAP_FRAME_TYPE fancy \
        MAP_FRAME_WIDTH 0.5p \
        MAP_FRAME_PEN 0.6p

################################################################################################
# GMT (5.2.1) script to plot a map centered on northwestern Siberia as well as an inset
################################################################################################

# 2019, Michael Grund (KIT Karlsruhe, Geophysical Institute)
```

```
# Required files to run this script are included in the download directory.

################################################################################################
# If you use the content of this script or the accompanying files please acknowledge GMT
# and my PhD thesis (DOI: 10.5445/IR/1000091425) in which a modified version of the generated
# map is included.
################################################################################################

################################################################################################################
# outputfile

ps=MAP_Siberia_EQUDIST.ps

################################################################################################################
```

## 1.2 Plot basic map centered on northwestern Siberia

```
##########
# Fig. 1 # plot basic map centered on northwestern Siberia
##########

centerN=71.658
centerE=74.305

map_radi=1.8i
colorall=197.6/197.6/197.6

pscoast -Rg -JE$centerE/$centerN/160/$map_radi -Dc -C$colorall -Swhite \
    -G$colorall -K -P -Baf > $ps

# add plate boundaries after Bird (2002)
psxy PB2002_boundaries_GMTready.txt -J -R -W0.5p,245.7600/204.8000/204.8000 -O -K >> $ps

# plot dashed circle
psxy -R -J -SE- -Wblack,3_1:0p -Wthinner -O -K << EOF >> $ps
$centerE   $centerN   18000
EOF

################################################################################################################
```

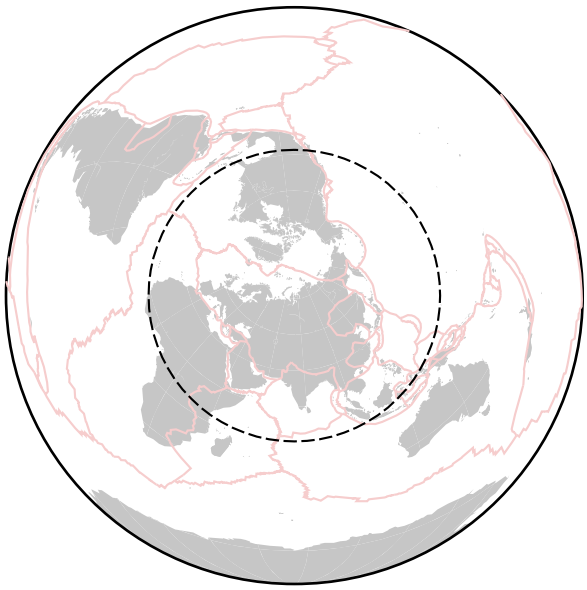

**Figure 1:** Plot a map centered on NW Siberia and plate boundaries (red lines) after Bird (2003).

## 1.3 Plot raypaths from earthquake sources to station locations

```
##########
# Fig. 2 # plot raypaths
##########

transparency=97.5
colpath=darkorange
psxy pathlist_SA_2.dat -R -J -Wthinnest -O -K -t$transparency -W$colpath >> $ps

transparency=80
colpath=darkblue
psxy pathlist_RUSSIA.dat  -R -J  -Wthinnest -O -K -t$transparency -W$colpath >> $ps

#########################################################################################################
```

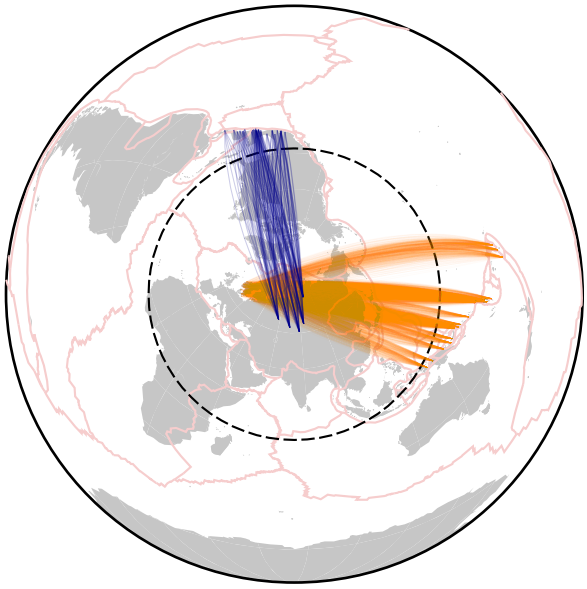

**Figure 2:** Plot raypaths (thin colored lines) from earthquake source locations to station locations of two different networks (stations are not shown here). Transparency of the raypaths allows to generate a kind of ray-density look.

## 1.4 Plot target area and station locations

```
##########
# Fig. 3 # plot target area and station locations
##########

psxy -R -J -Sc8.1p  -Gyellow -O -K -t30 -Wblack -Wthinnest  << EOF >> $ps
$centerE $centerN
EOF

psxy coord_ScanArray.dat -R -J -St1.3p -Gorange -Wblack -W0.01p -O -K >> $ps
psxy coord_Russia.dat -: -R -J -St1.3p -Gdarkblue -Wblack -W0.01p -O -K >> $ps

#########################################################################################################
```

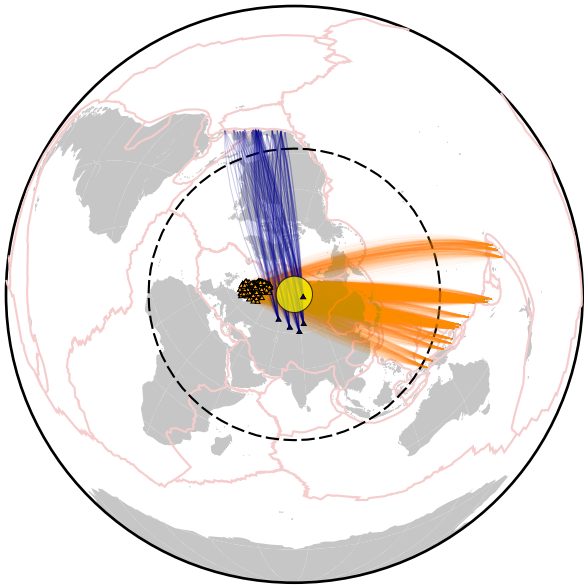

**Figure 3:** Plot target area (yellow filled circle) and station locations (small triangles, blue and orange).

### 1.5 Plot event locations and add annotations

```
##########
# Fig. 4 # plot event locations and add annotations
##########

psxy EQall.dat -: -R -J -Sc1.7p  -Gwhite -Wblack -O -K >> $ps

# annotations
pstext -R -J -F+f4p -N -O -K <<EOF >>$ps
21.00 18.38 Africa
$centerE -75 Antarctica
-135.553  41.099 North
-140.553  48.099 America
102.255 35.704 Asia
-54.665 -17.154 South America
138.51 -29.7 Australia
-13.708 47.388 Europe
EOF

#########################################################################################################
```

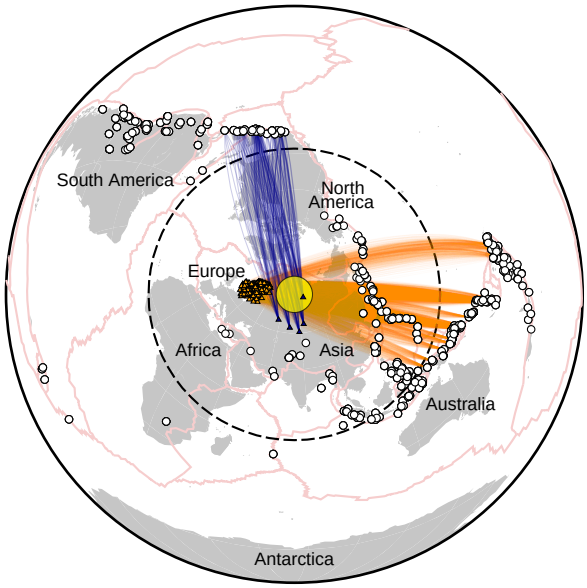


**Figure 4:** Plot event locations as small white circles (with black edges) and add annotations to indicate continents.

## 1.6 Plot zoom-in lines

```
##########
# Fig. 5 # plot zoom-in lines
##########

gmtset MAP_LINE_STEP 0.75p

insN=-11
insE=73.3

# use vectors to generate zoom-in lines
psxy -R -J -Gblack -SV0c+e+n5.0c+a0 -W2.4,black,3_1:0p -K -N -O -t30 << EOF >> $ps
$insE $insN 106.75 5
EOF

insN=155

psxy -R -J -Gblack -Gblack -SV0c+e+n5.0c+a0 -W2.4,black,3_1:0p -K -N -O -t30 << EOF >> $ps
$insE $insN 70.5 5
EOF

#################################################################################################
```

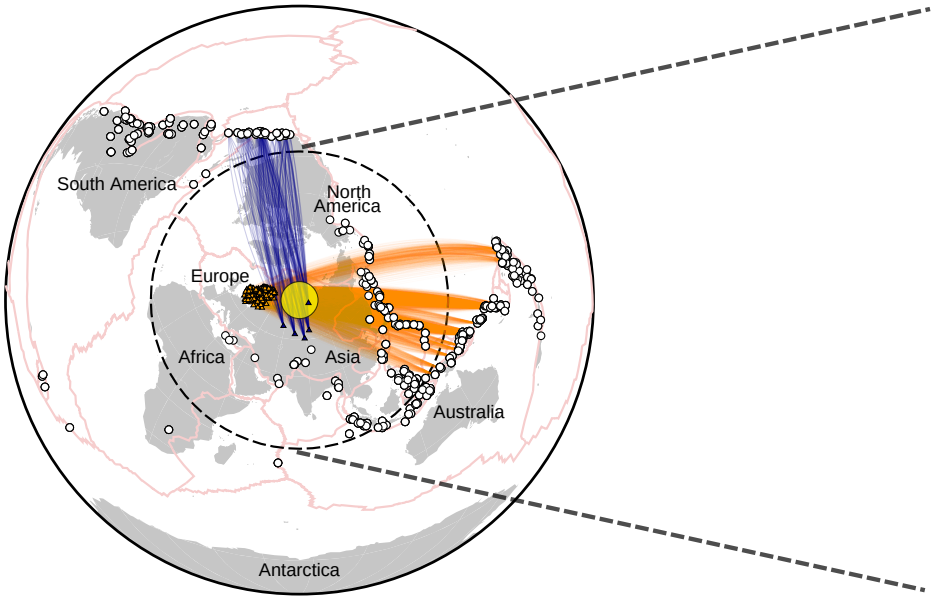


**Figure 5:** Plot black dashed lines connecting the inset (shown in Fig. 6) to the main map. Here you have to adjust the vector attributes (angle of rotation and length of the vector/line).

### 1.7 Add zoom-in map and plate boundaries

```
##########
# Fig. 6 # add zoom in map and plate boundaries
##########

equiX=2.05i

pscoast -Rg -JE$centerE/$centerN/80/$map_radi -Dc -C$colorall -Swhite \
    -G$colorall -X$equiX -K -O -P -Baf >> $ps

psxy -J -R PB2002_boundaries_GMTready.txt -W0.5p,245.7600/204.8000/204.8000 -O -K >> $ps

#########################################################################################################
```

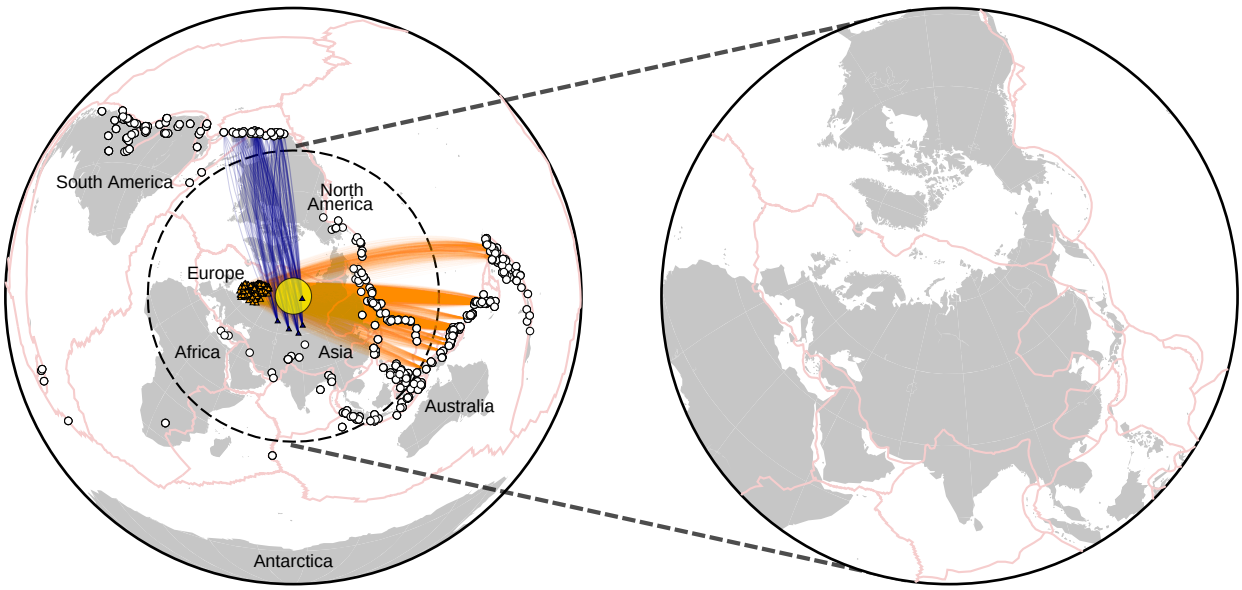


**Figure 6:** Add zoom-in map and plate boundaries.

## 1.8 Plot further raypaths

```
##########
# Fig. 7 # plot raypaths
##########

# use only suitable USArray stations
awk '{if ($1 > 60 ) print($2,$1)}' coord_USArray_Alaska.dat > coord_USArray_Alaska_SUB.dat

transparency=97.5
colpath=darkorange
psxy pathlist_SA.dat -R -J -Wthinnest -O -K -t$transparency -W$colpath >> $ps

transparency=97.5
colpath=dodgerblue2

psxy pathlist_AA_temp.dat -: -R -J -Wthinnest -O -K -t$transparency -W$colpath >> $ps
psxy pathlist_AA_perm.dat -: -R -J -Wthinnest -O -K -t$transparency -W$colpath >> $ps

transparency=94.5
colpath=darkred
psxy pathlist_USA.dat -R -J -Wthinnest -O -K -t$transparency -W$colpath >> $ps

transparency=60.5
colpath=springgreen3
psxy pathlist_GREEN.dat -R -J -Wthinnest -O -K -t$transparency -W$colpath >> $ps

#############################################################################################################
```

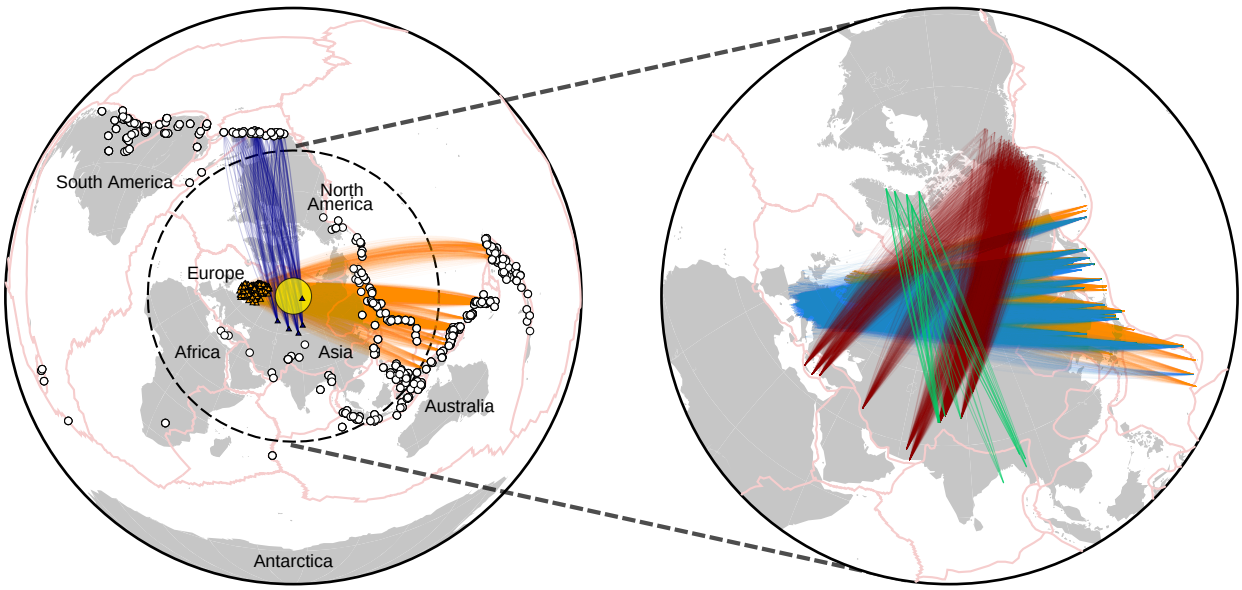


**Figure 7:** Plot further raypaths in different colors (again with transparency).

## 1.9 Plot event locations, station locations, enlarged target area and add annotations

```
##########
# Fig. 8 # plot event locations, station locations, enlarged target area and add annotations
##########

psxy EQall.dat -: -R -J -Sc1.7p -Gwhite -Wblack -O -K >> $ps

#plot stations on top of raypaths
psxy coord_AlpArray_temp.dat -: -R -J -St2p -Gdodgerblue2 -Wblack -W0.026p -O -K >> $ps
psxy coord_AlpArray_perm.dat -: -R -J -St2p -Gdodgerblue2 -Wblack -W0.026p -O -K >> $ps
psxy coord_USArray_Alaska_SUB.dat -R -J -St2p -Gred -Wblack -W0.026p -O -K >> $ps
psxy coord_ScanArray.dat -R -J -St2p -Gorange -Wblack -W0.026p -O -K >> $ps
psxy coord_Greenland.dat -: -R -J -St2p -Gspringgreen2 -Wblack -W0.026p -O -K >> $ps

# target area
psxy -R -J -Sc17p -Gyellow -O -K -t30 -Wblack -Wthinnest << EOF >> $ps # path connection
$centerE $centerN
EOF

# annotations
pstext -R -J -F+f4p -N -O -K <<EOF >> $ps
21.00 18.38 Africa
-100.553 41.099 North America
102.255 37.704 Asia
-13.708 47.388 Europe
EOF

#############################################################################################################
```

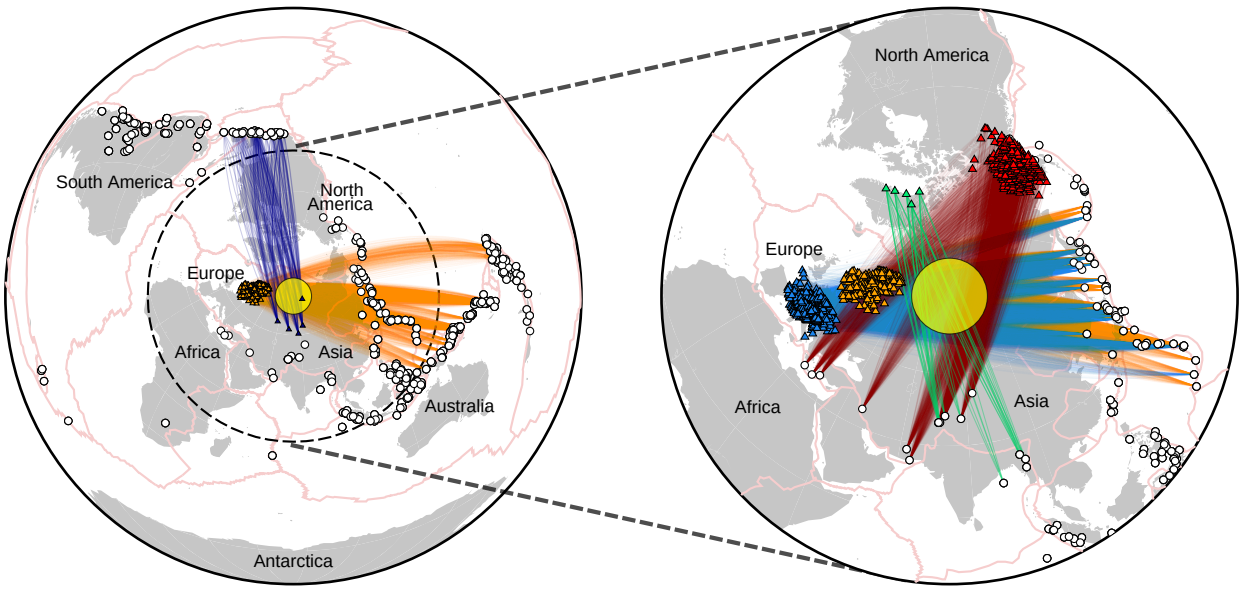


**Figure 8:** Plot event locations (white circles with black edges), station locations (colored triangles), enlarged target area (yellow circle) and add annotations.

## 1.10 Add a legend

```
##########
# Fig. 9 # add legend
##########

pslegend -R -J -Dx-0.335i/-0.05/1.07c/1.1c/BL -F+r0.5p+pblack+gwhite+p0.5p -t0 \
    -O -K << EOF >> $ps
G -0.03i
N 1
S 0 t 2.5p dodgerblue2 0.13p 0.05i AlpArray
G 0.02i
S 0 t 2.5p darkred 0.13p 0.05i USArray
G 0.02i
S 0 t 2.5p darkorange 0.13p 0.05i ScanArray
G 0.02i
S 0 t 2.5p springgreen2 0.13p 0.05i Greenland
G 0.02i
S 0 t 2.5p darkblue 0.13p 0.05i Russia
G 0.02i
EOF

########################
#gv $ps &
ps2pdf $ps $ps.pdf
pdfcrop $ps.pdf $ps.pdf
########################
```

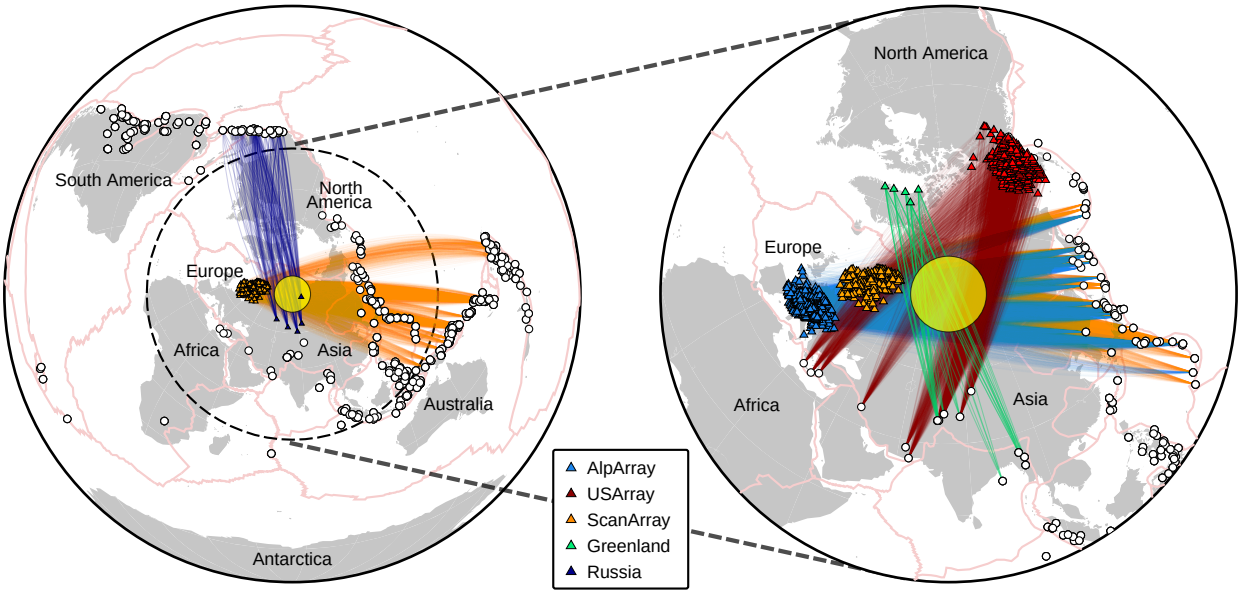


**Figure 9:** Finally add a legend explaining the different colors of the triangles.

## References

Bird, P., 2003. An updated digital model of plate boundaries, *Geochem. Geophys. Geosyst.*, **4**, 1027.

Wessel, P., Smith, W. H. F., Scharroo, R., Luis, J., & Wobbe, F., 2013. Generic Mapping Tools: Improved version released, *Eos Trans. AGU*, **94(45)**, 409–420.