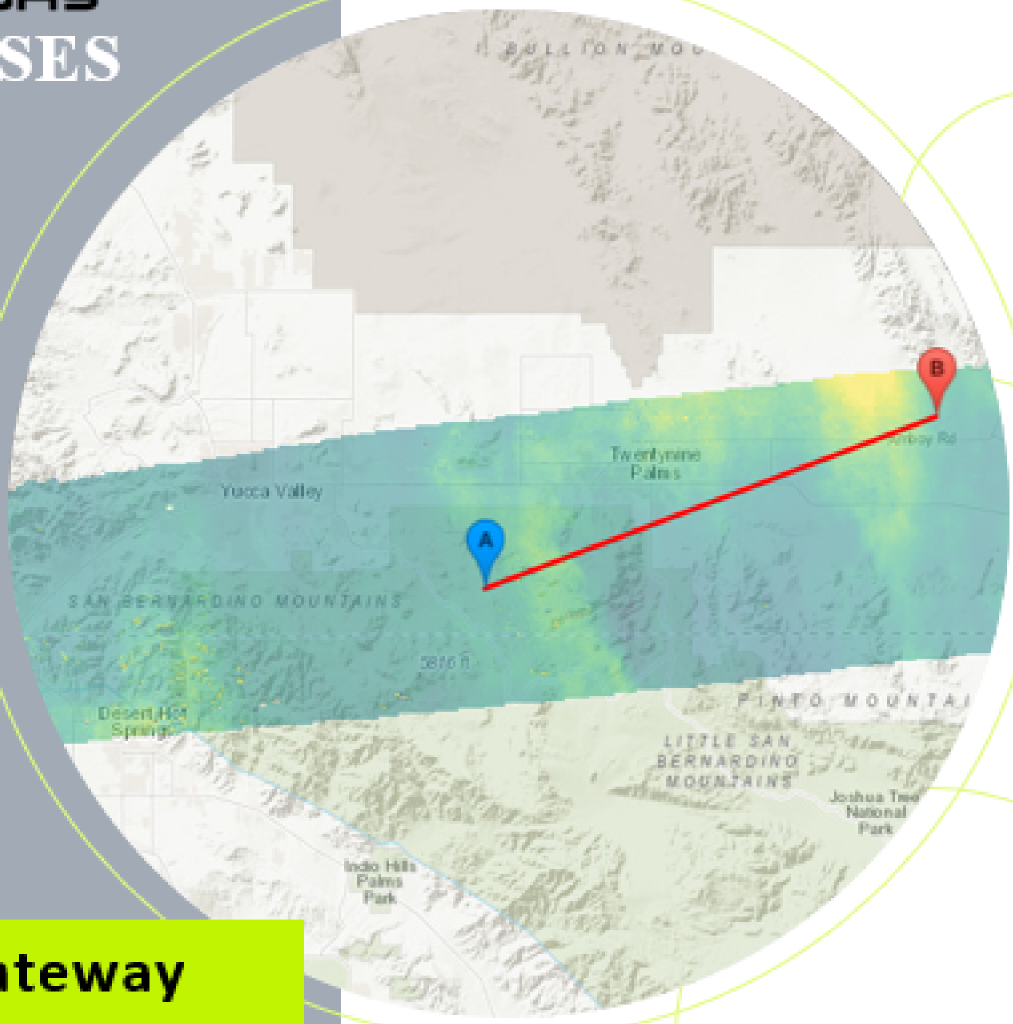
GeoGateway

EXERCISES



GeoGateway Exercises

Map Tools

UAVSAR

GNSS

Magnitude

Table of Contents

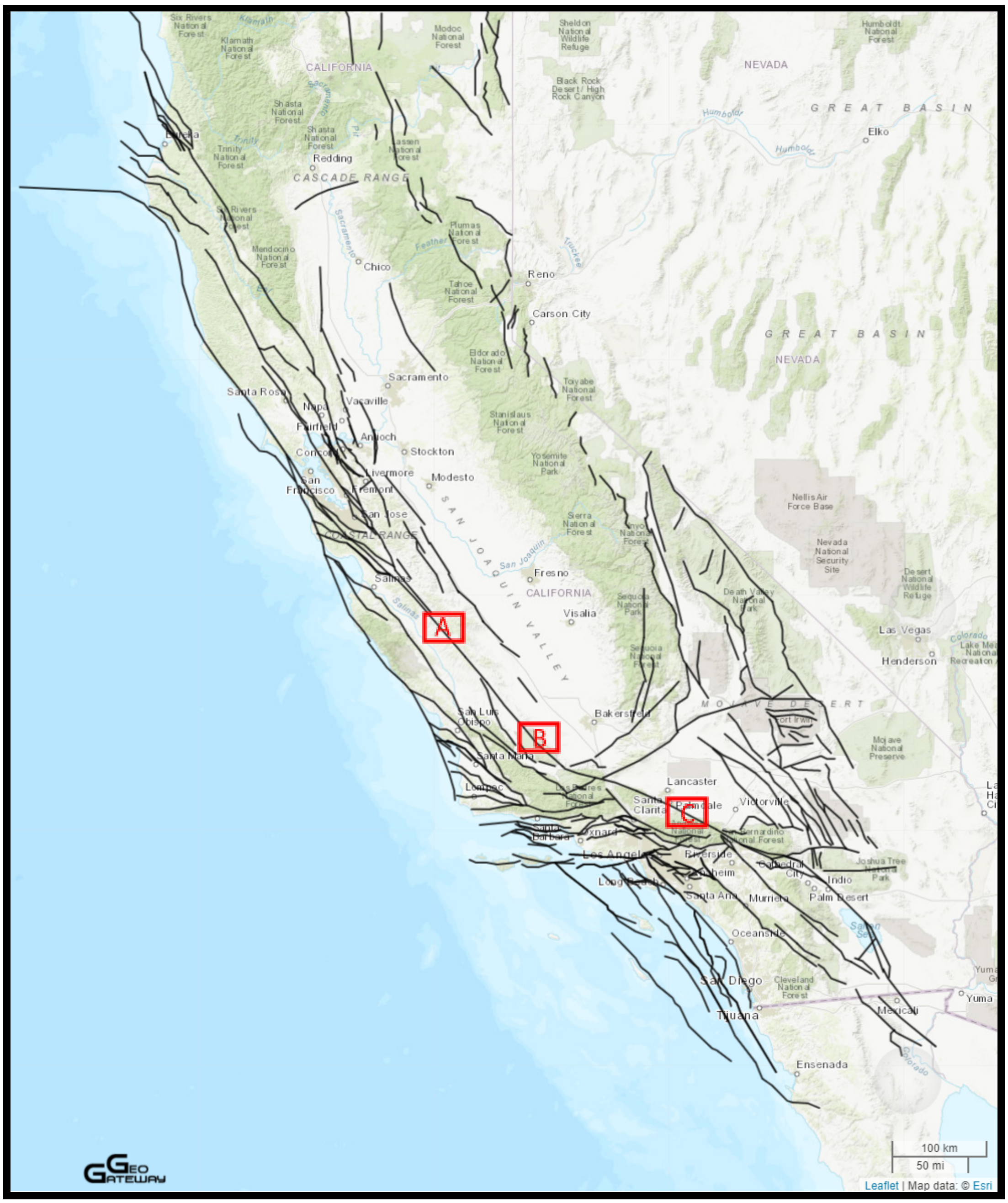
Exercise: San Andreas Fault and the Uniform California Earthquake Rupture Forecast v3 (UCERF3)

GeoGateway allows users to overlay layers such as faults, borders, and KMZ files onto the map. In this exercise, users will label 3 sections of the San Andreas fault used in UCERF3.

Step 1: Go to https://geo-gateway.org

Step 2: Click on the "**Maptools**" tab

Step 3: Check the box next to UCERF3 Faults. Note, clicking on the faults provides users with a popup description of the fault.



Step 4: Looking at the provided map, match the letters to the proper section of the San Andreas Fault.

A ___________________________

B ___________________________

C ___________________________

Carrizo Section
Mojave Section
Creeping Section

Results:

A Creeping Section

B Carrizo Section

C Mojave Section

Exercise: Locating and Imaging Faults Using UAVSAR Interferograms

GeoGateway allows users to analyze UAVSAR interferograms. In this exercise, users will use UAVSAR interferograms to locate a creeping section of the San Andreas Fault.

Step 1: Go to https://geo-gateway.org

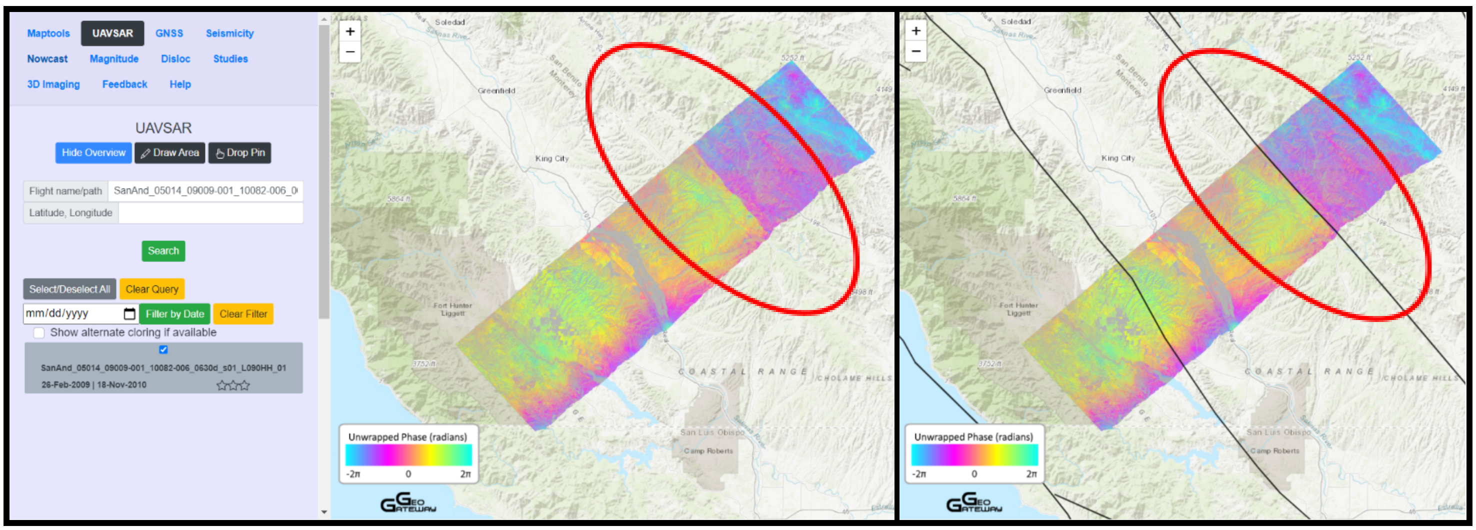
Step 2: Click on the "**UAVSAR**" tab

Step 3: In the box titled "Flight name/path", type the following

SanAnd_05014_09009-001_10082-006_0630d_s01_L090HH

and click search.

Step 4: Check the interferogram displayed to view the interferogram on the map.



Looking at the image of the interferogram to the left, notice the line within the circle. This "creeping" section of the San Andreas Fault is moving at a slow, steady rate. Change in the ground surface due to creep causes a Line of Sight difference which is prominently imaged by the UAVSAR interferogram. The image to the right shows the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) faults plotted as black lines overlain on the UAVSAR interferogram**.**

Exercise: Explore and Analyze UAVSAR Interferograms

Step 1: Go to https://geo-gateway.org

Step 2: Click on the "**UAVSAR**" tab

There are two methods to search for a UAVSAR interferogram.

1. The "flight name/path" directly finds the flight name and path
2. The "latitude, longitude" option returns all flight paths crossing paths with the specified coordinates.

Step 3: For this exercise, enter 26501 (flight name/path) in the search window and click Search. (Name is SanAnd_26501_09083-010_10028-000_0174d_s01_L090HH_C2)

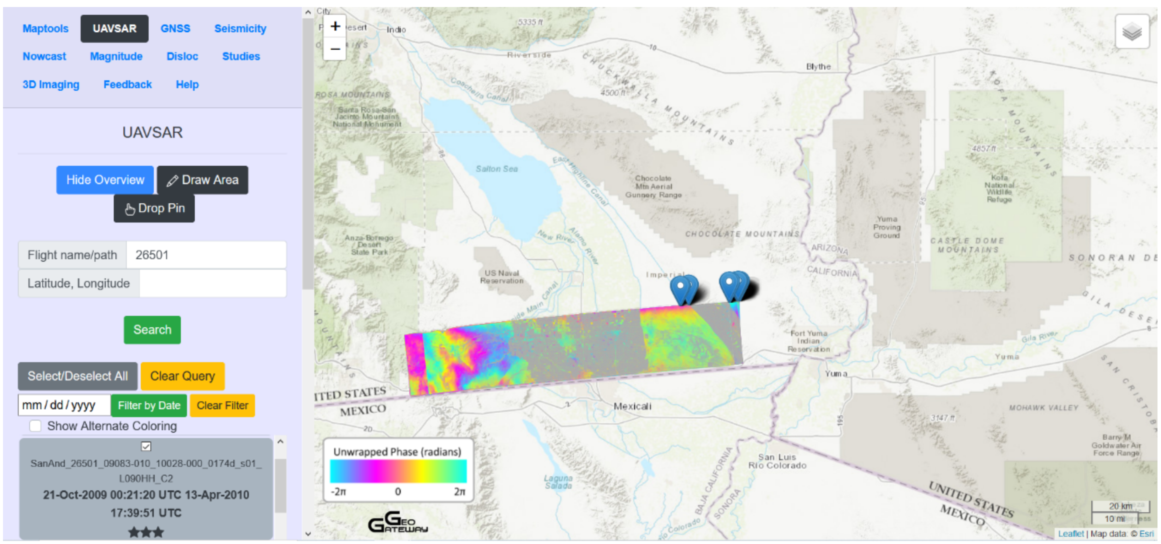


Figure 1 : Interferograms displayed after searching 26501 flight name/path

Step 4: Check the box next to "Show Alternate Coloring" followed by re-selecting the interferogram

Select the second interferogram on the list by clicking the shaded box.

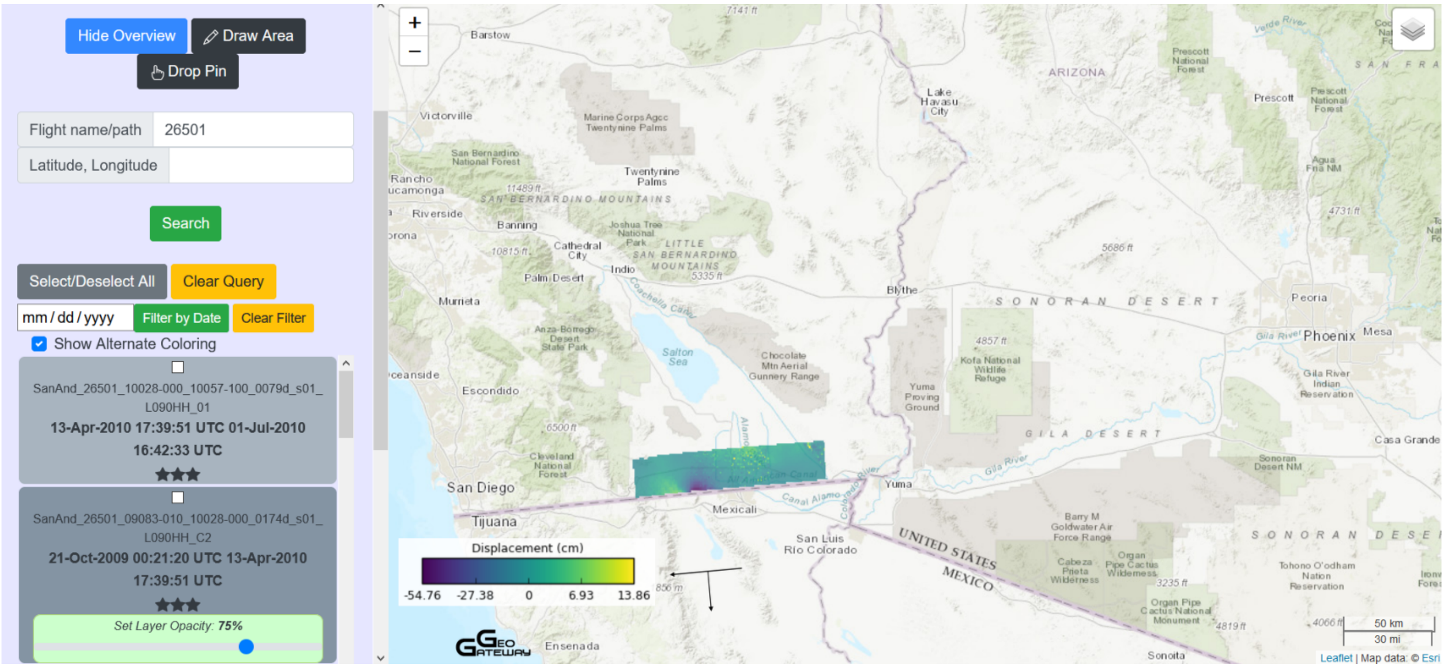


Figure 2: Interferogram displayed in units of displacement (cm)

Step 5: Zoom into the area of the two lobes that are green/yellow and purple.

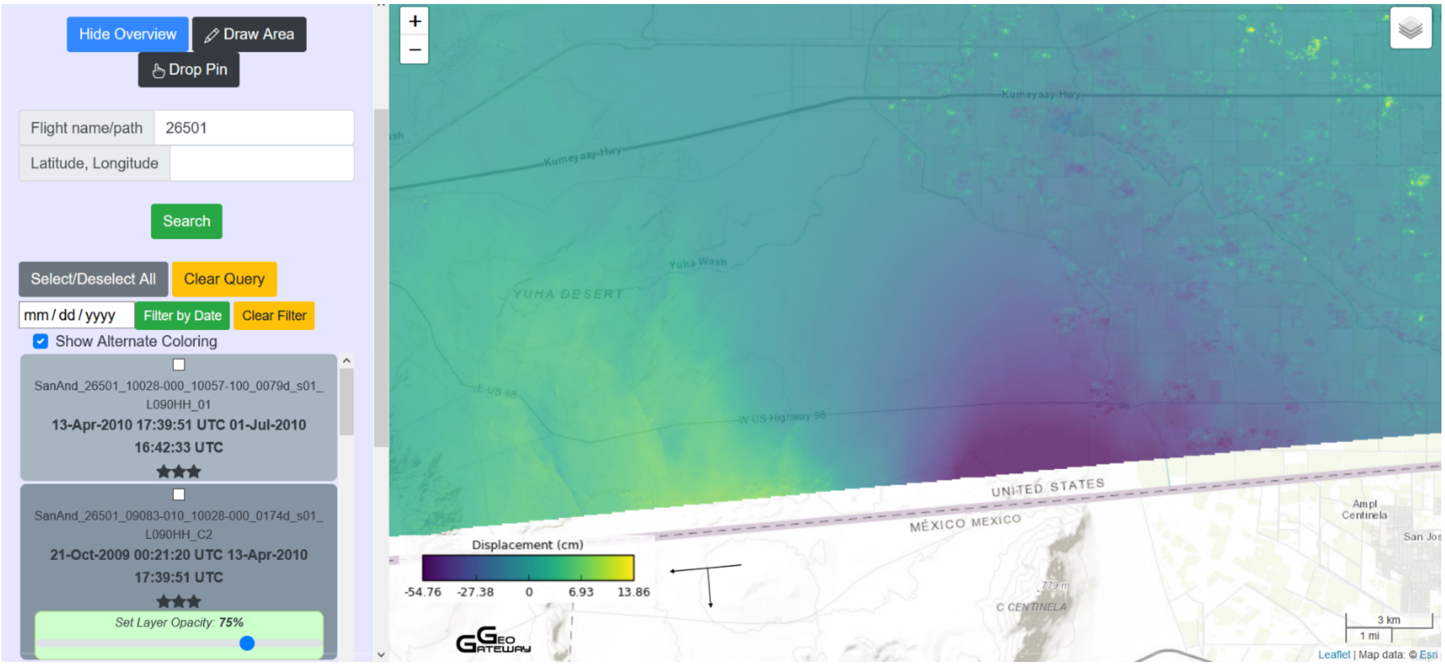


Figure 3: Interferogram shown zoomed into the two green/yellow and purple lobes. Yellow lobe shows more surface fracturing

Step 6: Activate the Line-Of-Sight (LOS) Tool by clicking on the map.

a. Adjust the endpoints of the profile to be on the product but parallel to the south end of the product through the largest color difference.

b. Mouse over the plot and read the maximum and minimum ground range change (GRC) from the upper right corner of the plot

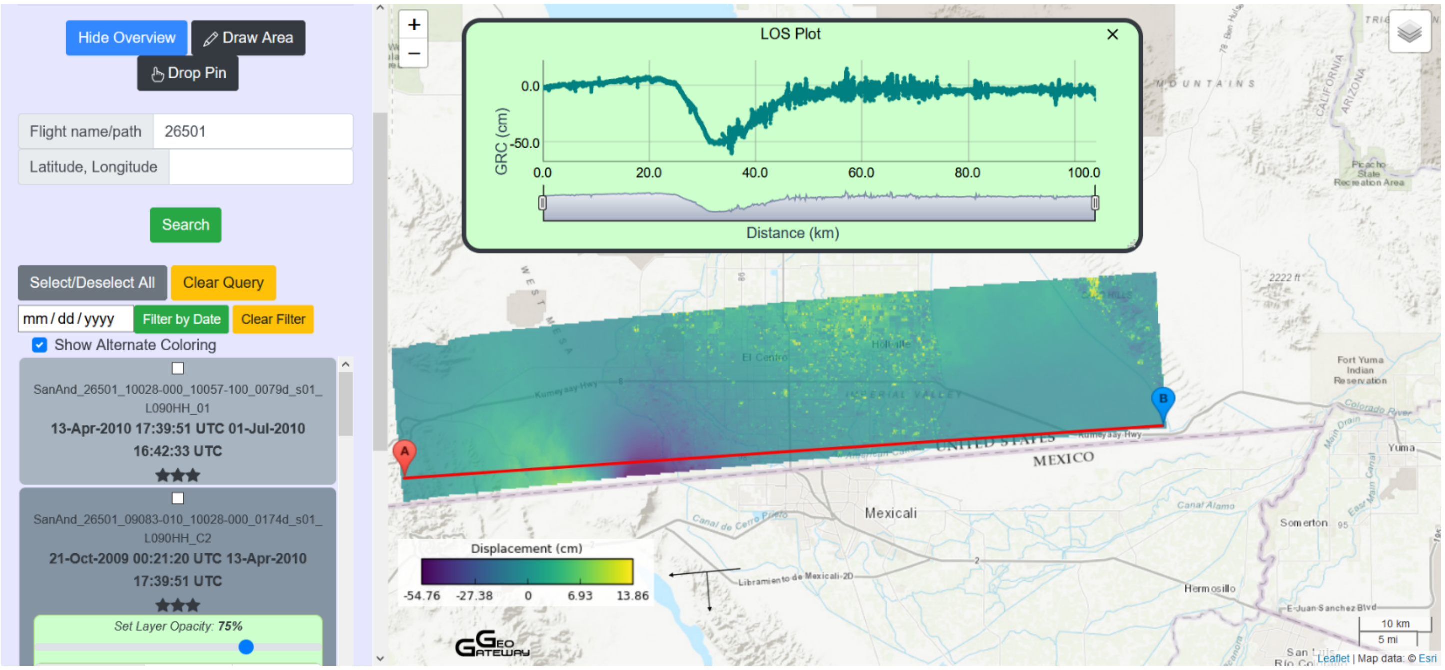


Figure 4: LOS Plot. Notice the ground range change that occurred across the two lobes.

The purple lobe moved away from the instrument on the aircraft. As shown on the legend, the negative (darker color) implies that the ground moved away from the instrument on the aircraft

Step 7: Visit the "Maptools" tab and select the "UCERF3 Faults."

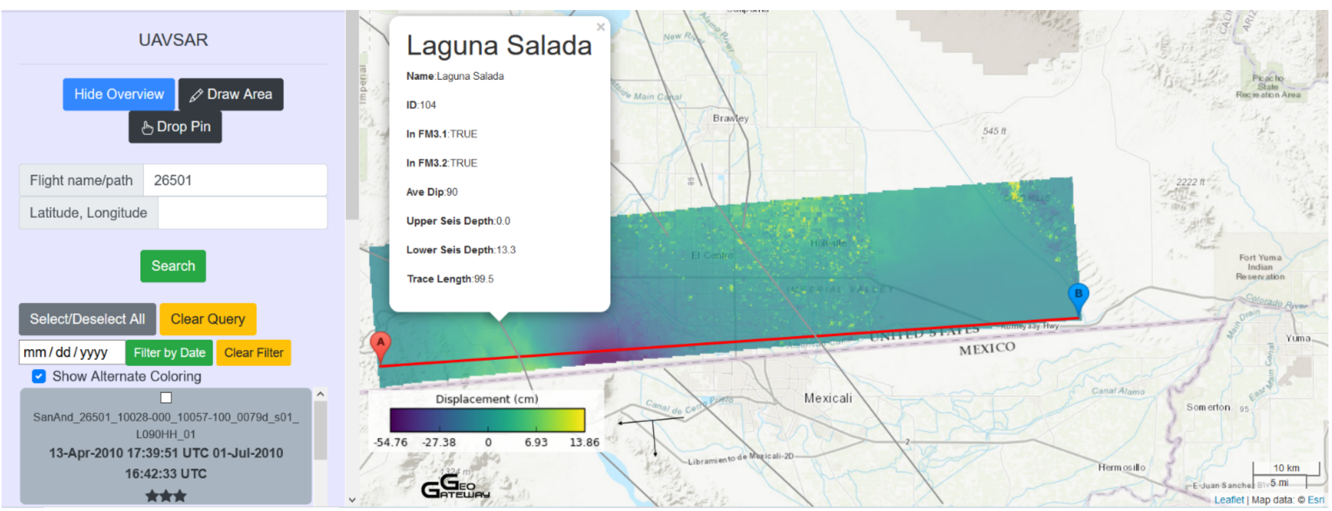


Figure 5: The mapped fault, Laguna Salada, ruptured in the 2010 El Mayor – Cucapah earthquake.

Step 8: Scroll down and find line

SanAnd_26501_10028-000_10057-100_0079d_s01_L090HH_02 with dates 13-Apr-2010 17:49:59 UTC 1-Jul-2010 16:49:41 UTC

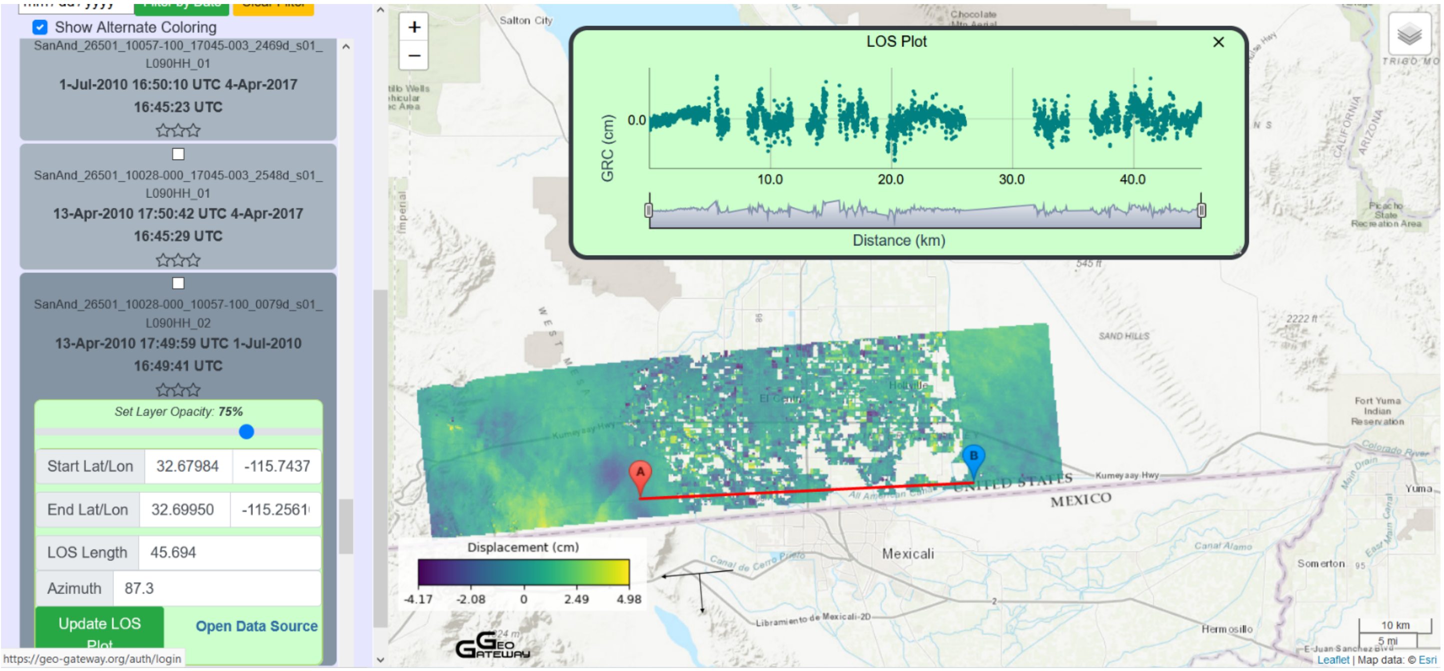


Figure 6: Notice the difference when selecting a different time frame. Also the signal is decorrelated in some areas, as shown by the absence in color.

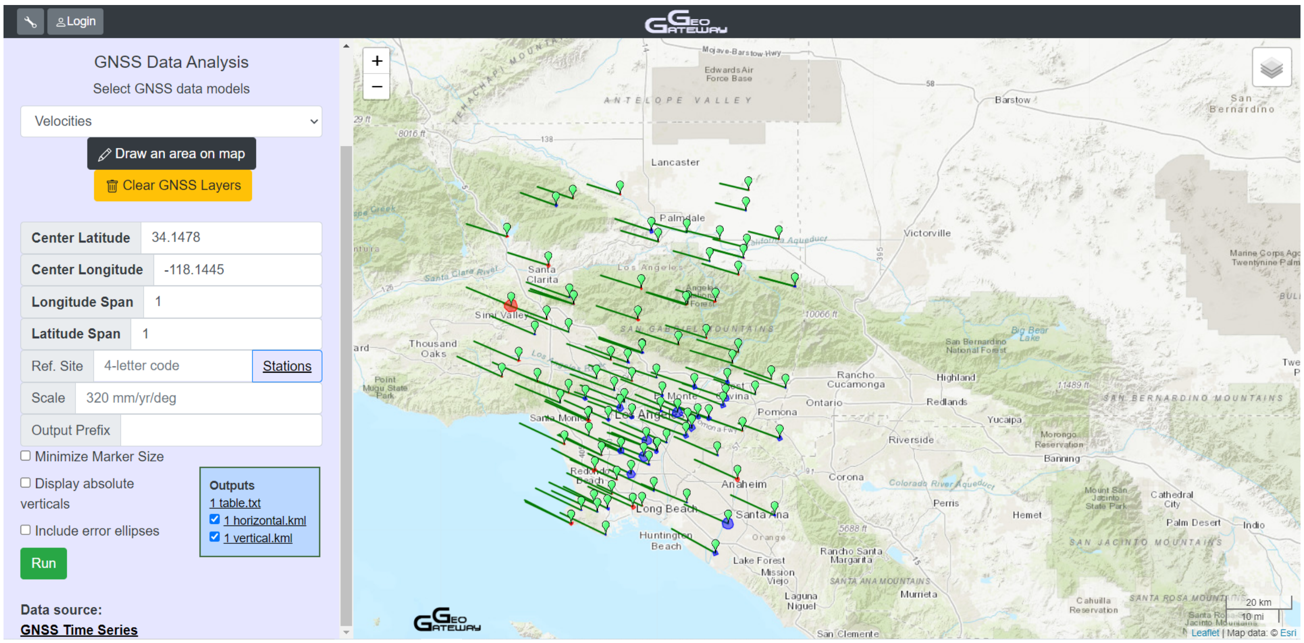
Exercise: Explore GNSS Velocities and Displacements

Step 1: Go to https://geo-gateway.org

Step 2: Click on the "**GNSS**" tab

Step 3: Construct a GNSS velocity map with no reference

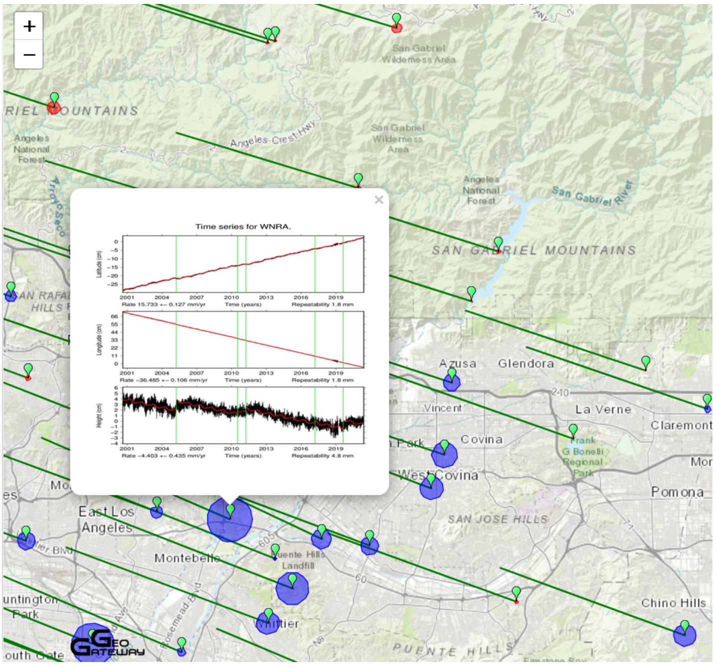
a. Select center latitude and center longitude in decimal degrees
b. Select longitude span and latitude span in degrees (try 1 degree)
c. Leave reference site blank



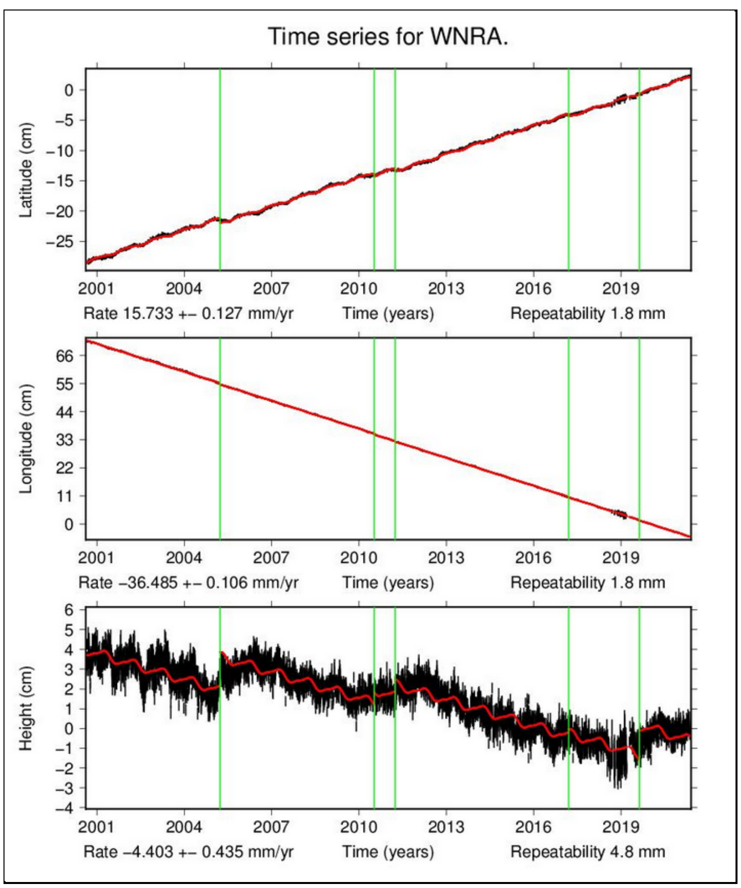
d. Click on "Run"
e. **Download the velocity table by clicking on "table.txt"**

Site	Lon	Lat	Delta E	Delta N	Delta V	Sigma E	Sigma N	Sigma V
AZU1	-117.896492	34.126020	-35.945000	11.890000	-1.635000	0.100000	0.110000	0.454000
BGIS	-118.159702	33.967120	-38.270000	15.292000	-4.142000	0.118000	0.136000	0.510000
BKMS	-118.094704	33.962260	-40.068000	17.099000	-0.828000	0.223000	0.264000	0.947000
BLSA	-118.028682	33.799545	-39.558000	16.391000	-0.786000	0.286000	0.333000	1.182000
BRAN	-118.277055	34.184896	-37.451000	13.931000	0.740000	0.099000	0.115000	0.483000
BTDM	-118.188231	34.292807	-35.552000	11.806000	1.226000	0.147000	0.153000	0.560000
CBHS	-118.629810	34.138563	-38.942000	17.629000	0.555000	0.051000	0.057000	0.218000
CCCO	-118.211202	33.876262	-37.277000	18.131000	-3.599000	0.203000	0.240000	0.859000
CCCS	-117.864947	33.862744	-36.802000	17.335000	1.927000	0.143000	0.170000	0.606000
CGDM	-117.964950	34.243994	-35.313000	10.754000	0.517000	0.050000	0.063000	0.221000
CHIL	-118.026004	34.333424	-34.415000	10.753000	0.259000	0.048000	0.056000	0.213000
CHMS	-117.827705	34.640463	-24.910000	5.466000	0.267000	0.094000	0.115000	0.391000
CIT1	-118.127290	34.136710	-36.874000	12.733000	-0.652000	0.105000	0.122000	0.429000
CJVG	-118.144233	34.530322	-30.862000	10.523000	-1.825000	0.205000	0.234000	0.825000
CLAR	-117.708814	34.109929	-35.101000	11.997000	-0.650000	0.097000	0.113000	0.403000
CMP9	-118.411429	34.353181	-36.487000	12.912000	-0.696000	0.099000	0.120000	0.412000
CRHS	-118.272771	33.823506	-39.009000	17.972000	0.312000	0.072000	0.084000	0.317000
CSDH	-118.256722	33.861479	-39.984000	17.710000	0.974000	0.059000	0.072000	0.245000
CSN1	-118.523817	34.253552	-37.876000	15.738000	-0.894000	0.092000	0.109000	0.382000
CTDM	-118.613215	34.516551	-35.061000	10.697000	0.916000	0.079000	0.095000	0.327000
CVHS	-117.901722	34.082013	-37.675000	12.633000	-2.493000	0.176000	0.208000	0.736000
DAM1	-118.397367	34.333997	-38.330000	11.540000	0.730000	0.366000	0.376000	1.601000
DAM2	-118.396869	34.334837	-36.844000	13.162000	0.735000	0.079000	0.081000	0.347000
DAM3	-118.397471	34.333992	-36.584000	12.826000	-0.056000	0.216000	0.210000	0.955000
DSHS	-118.348546	34.023934	-36.860000	17.245000	-0.390000	0.169000	0.196000	0.710000
DVPB	-117.860132	34.413414	-31.269000	9.248000	0.635000	0.045000	0.056000	0.194000

f. Click on a station to show the time series



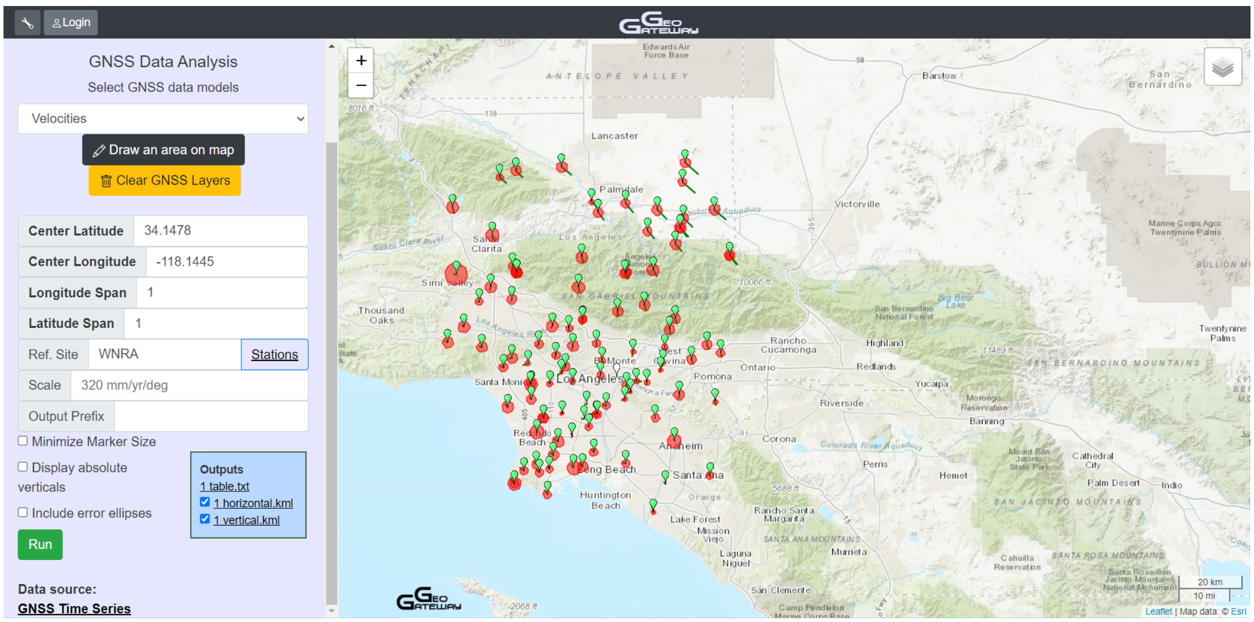
g. Click on the time series thumbnail to open the larger version of the graphs



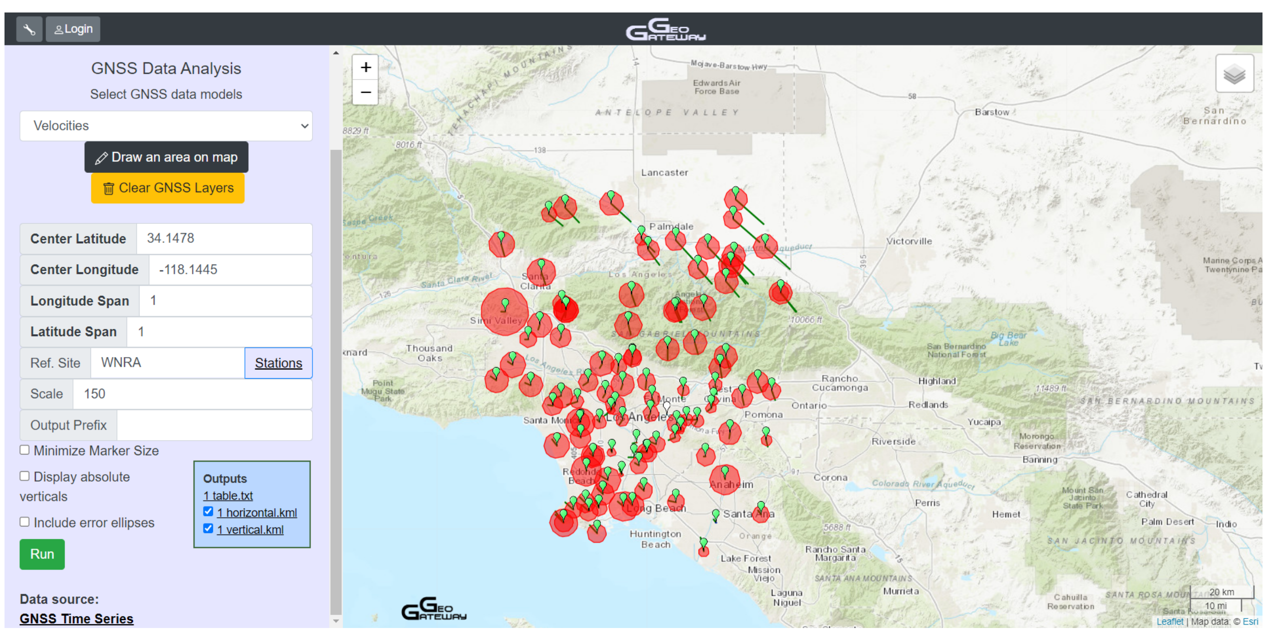
h. Download the KML file if you would like to save it. This can later be plotted using the "KML Uploader" on the Maptools tab

Step 4: Now construct a GNSS velocity map with a reference site

a. Select center latitude and center longitude
b. Select longitude span and latitude span in degrees (1 degree is often good)
c. Select a reference site from the previous plot
d. Click on "Run"

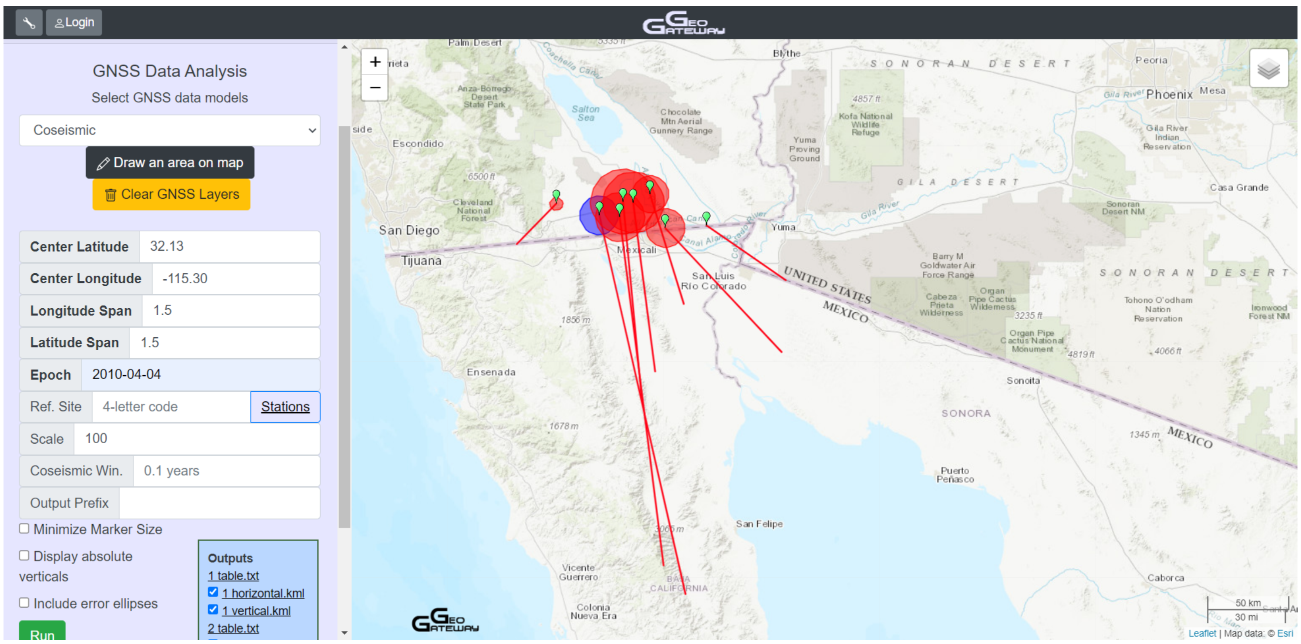


e. Vary the scale to see the result (hint – smaller number results in larger vectors).

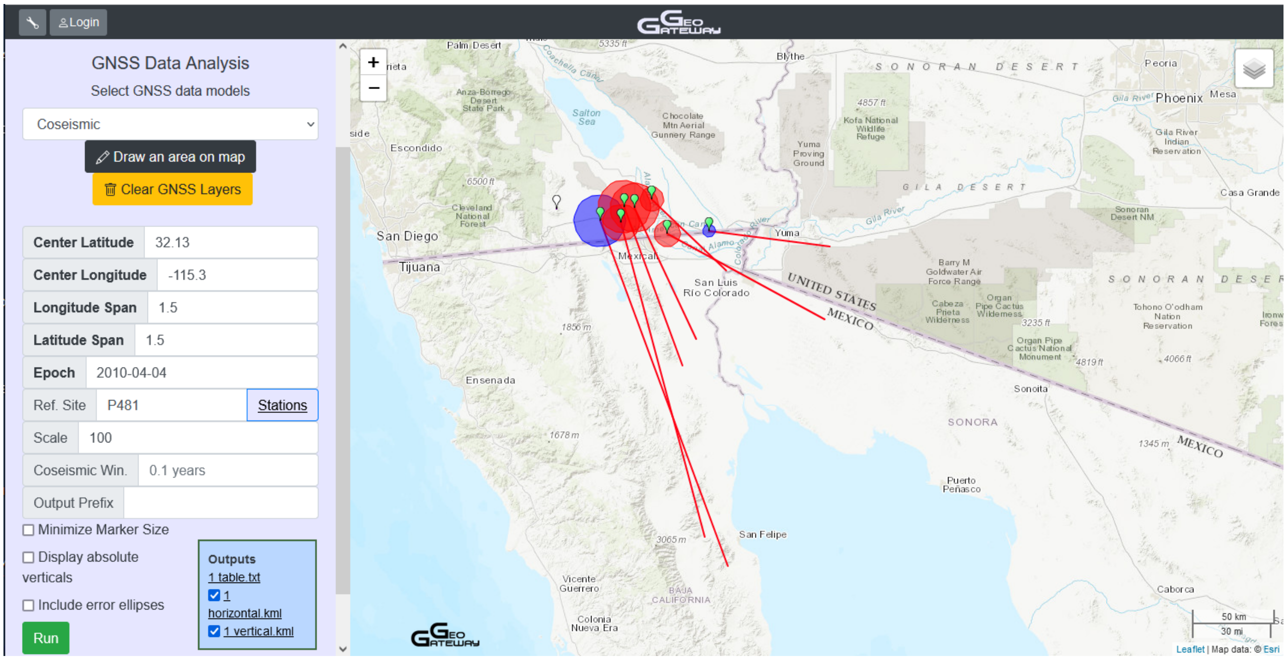


Step 5: Repeat for coseismic displacements. Choose Coseismic from dropdown box.

a. Select center latitude and center longitude near a large event (e.g. El Mayor–Cucapah earthquake).
b. Enter date of earthquake YYY-MM-DD
c. **Print plot with no reference**



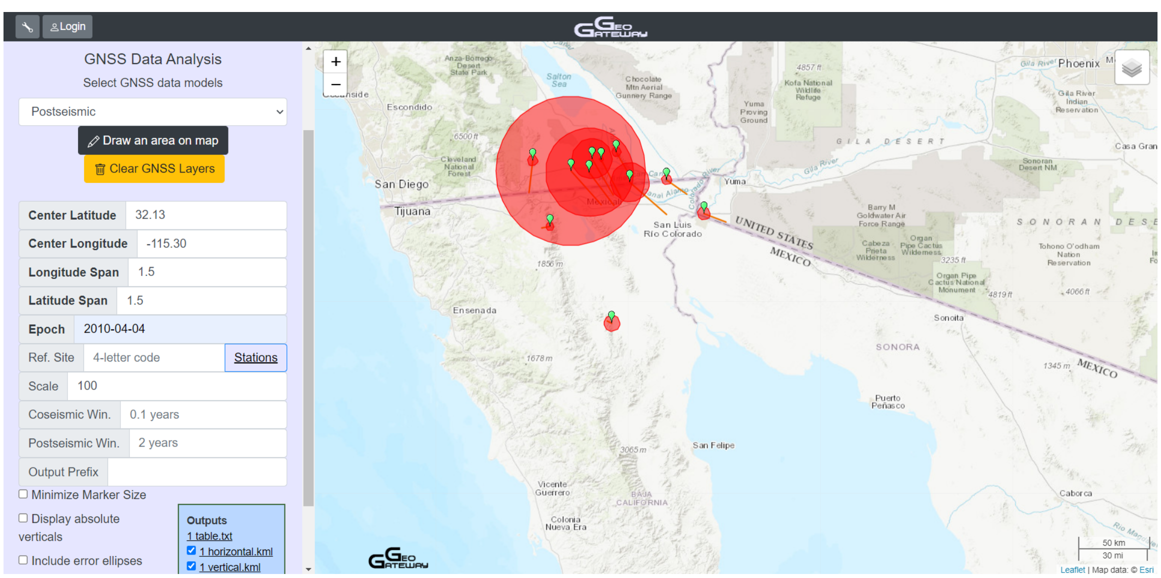
d. **Print new plot with a reference station**



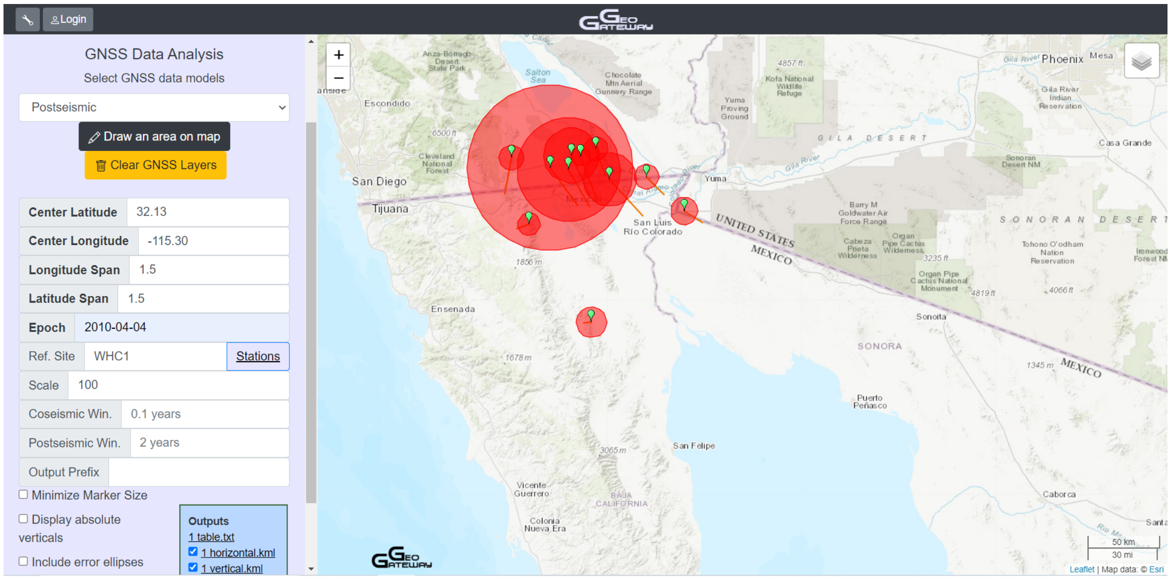
Step 6: Repeat for postseismic displacements. Select Postseismic dropdown.

a. Select center latitude and center longitude of a large event (e.g. El Mayor–Cucapah earthquake)
b. Enter date of earthquake, and postseismic time window in years
c. Experiment with different postseismic windows

d. Print plot with no reference

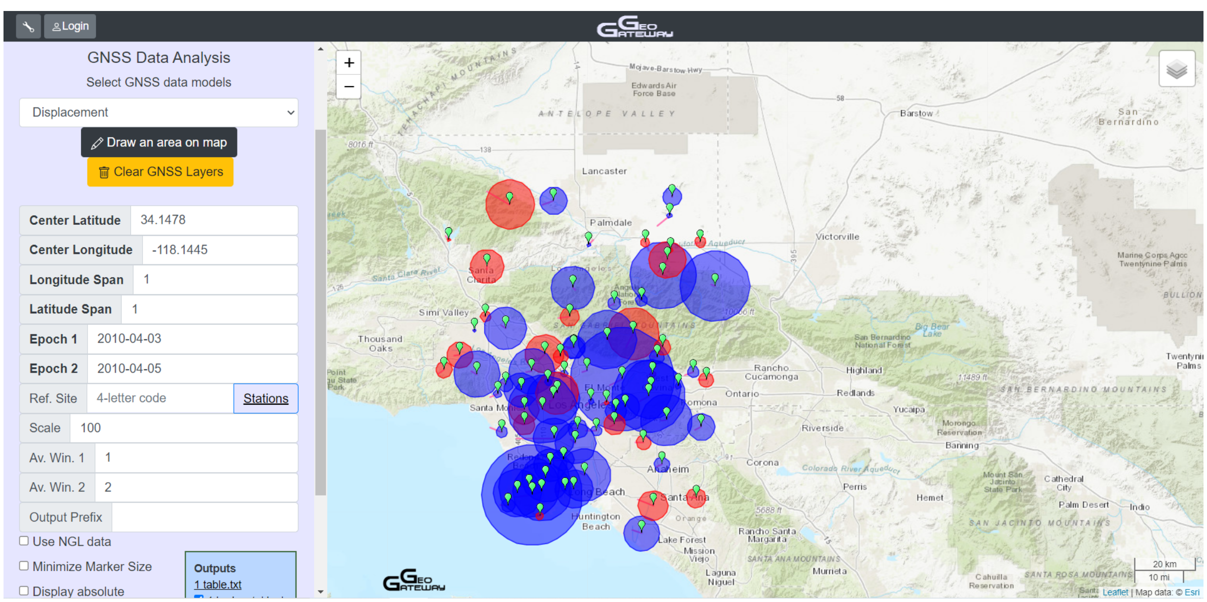


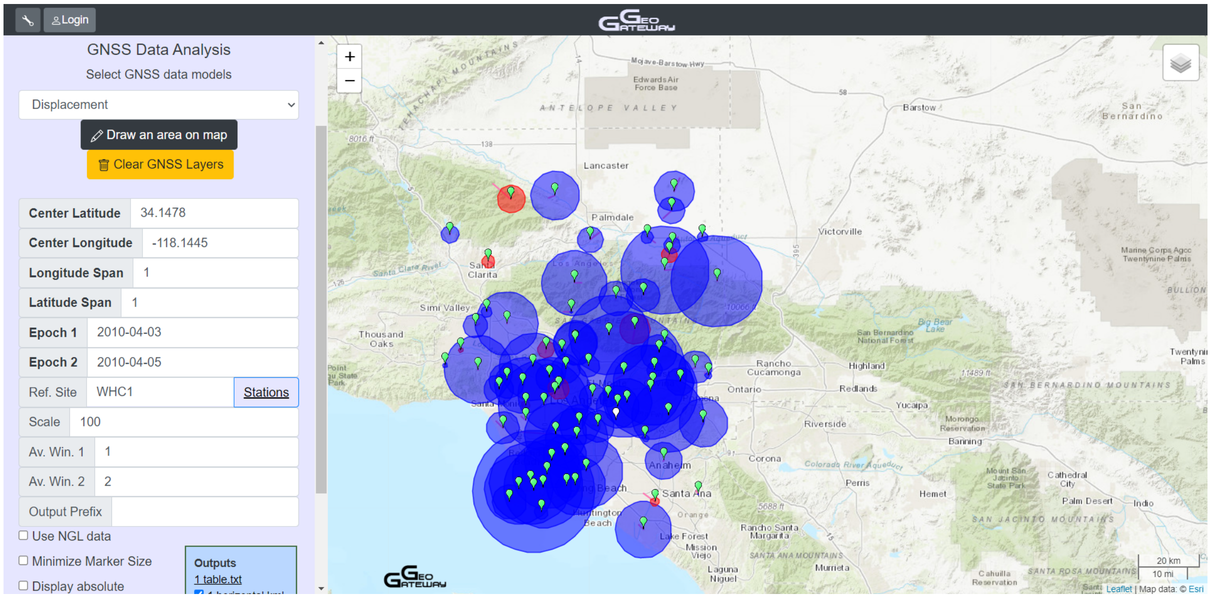
e. Print new plot with a reference station



Step 7: Repeat for displacements. Select Displacement.

- **a.** Select center latitude and center longitude
- **b.** Enter two dates to calculate displacements between time 1 and time 2
- **c. Print plot with no reference**



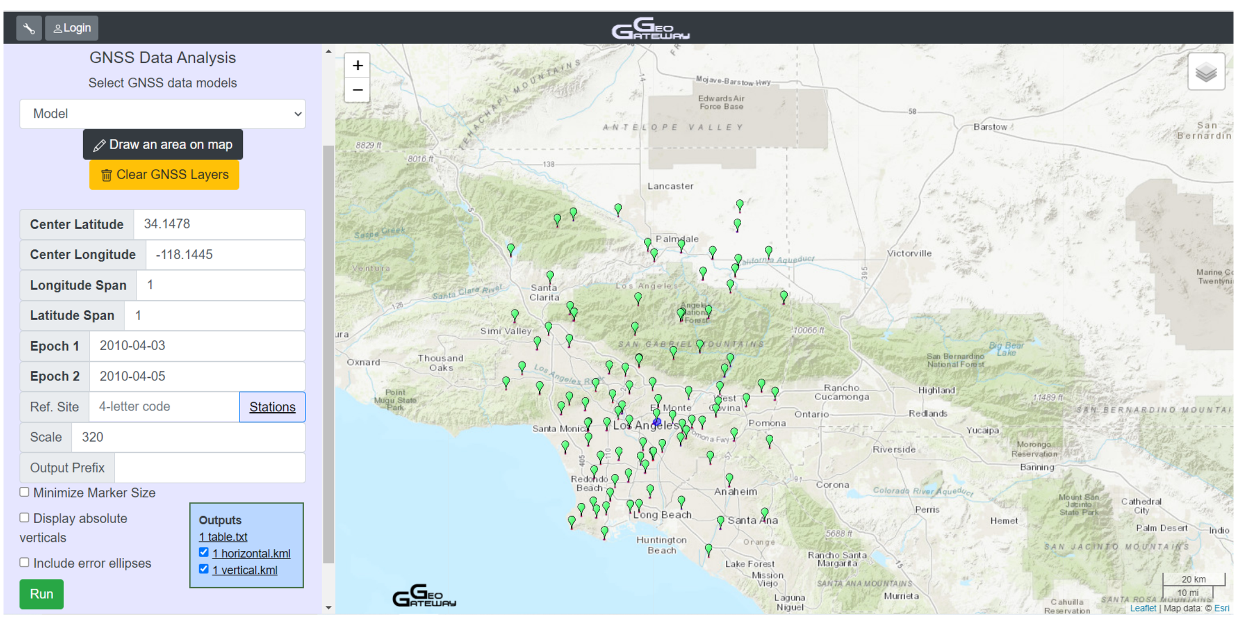
d. 

Step 8: Repeat for model. Select Model from dropdown menu

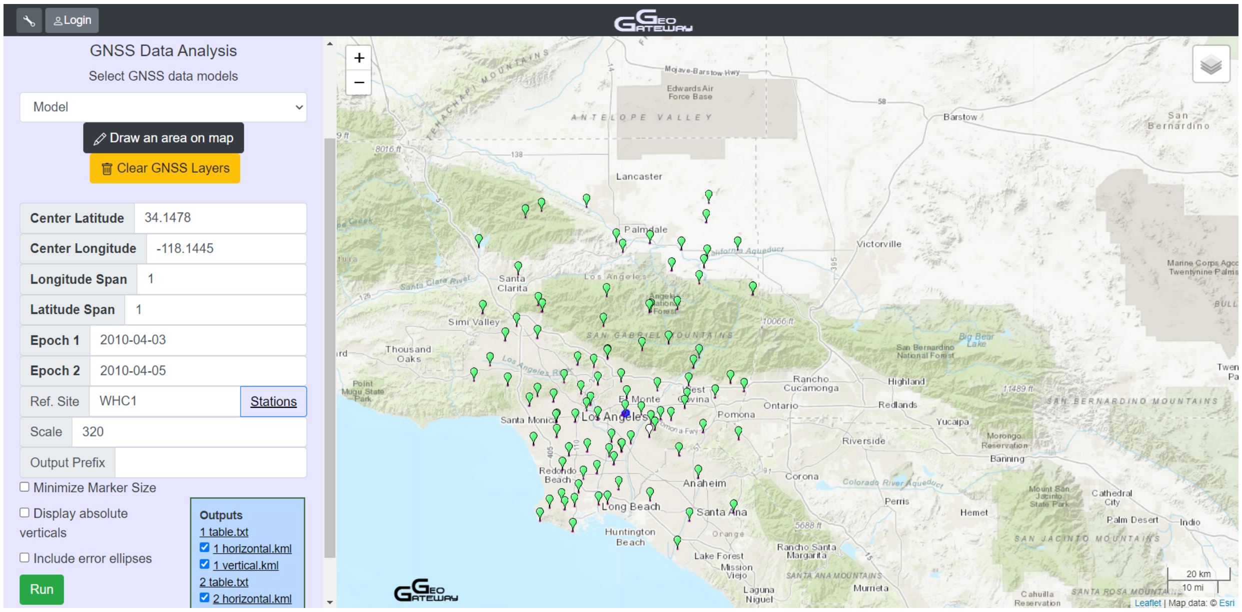
a. Select center latitude and center longitude

b. Enter two dates to calculate displacements between time 1 and time 2

c. **Print plot with no reference**



d. **Print new plot with a reference station**



Login
GNSS Data Analysis
Select GNSS data models
Model
Draw an area on map
Clear GNSS Layers
Center Latitude
34.1478
Center Longitude
-118.1445
Longitude Span
1
Latitude Span
1
Epoch 1
2010-04-03
Epoch 2
2010-04-05
Ref. Site
WHC1
Stations
Scale
320
Output Prefix
Minimize Marker Size
Display absolute verticals
Include error ellipses
Run
Outputs
1 table.txt
1 horizontal.kml
1 vertical.kml
2 table.txt
2 horizontal.kml
Lancaster
Palmdale
Victorville
Santa Clarita
Simi Valley
Thousand Oaks
Santa Monica
Los Angeles
El Monte
Pomona
Ontario
Rancho Cucamonga
Redlands
Riverside
Corona
Anaheim
Santa Ana
Long Beach
Huntington Beach
Redondo Beach
Barstow
Perris
Hemet
Murrieta
20 km
10 mi
Leaflet | Map data: © Esri

Exercise: Calculating Moment Magnitude

GeoGateway allows users to calculate the magnitude of an earthquake based on rupture of a rectangular fault. In this example exercise, the result is a moment magnitude 6.0 earthquake.

Step 1: Go to https://geo-gateway.org
Step 2: Click on the "**Magnitude**" tab

Step 3: Enter parameters to create a moment magnitude 6.0 earthquake on a rectangular fault. Length is the rupture length. Rupture width is perpendicular to length. In this example we use a square fault with 2 m average slip.

a. Length (km): 4

b. Width (km): 4

c. Slip (m): 2

d. Shear Modulus (10^{11} dyne/cm^2): 4

e. Click Calculate

Results: The seismic moment and moment magnitude are

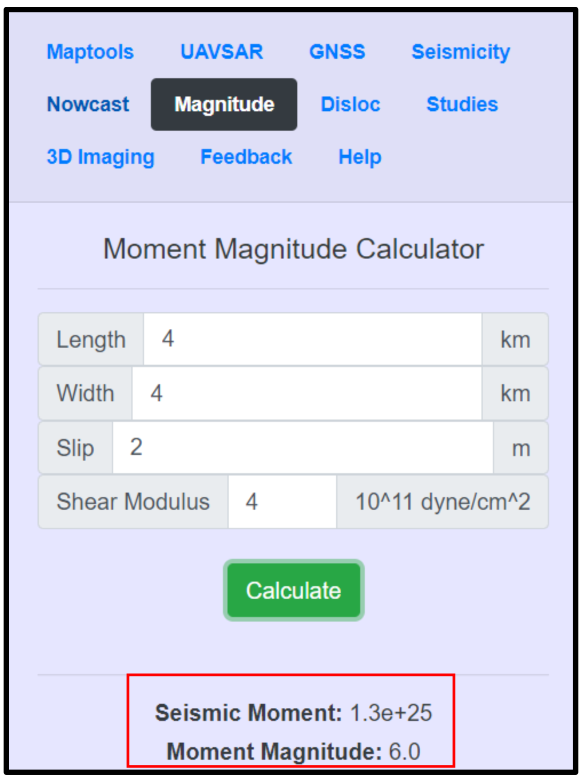


Figure: Results of seismic moment and moment magnitude generated by GeoGateway's Moment Magnitude Calculator.

Example Application:

Use GeoGateway's Moment Magnitude Calculator to estimate the magnitude of an earthquake that ruptured a 200-km section of the San Andreas fault with 5 m average slip. If we assume the rupture depth is 12 km, what is the magnitude?