Exercise: Calculating Moment Magnitude

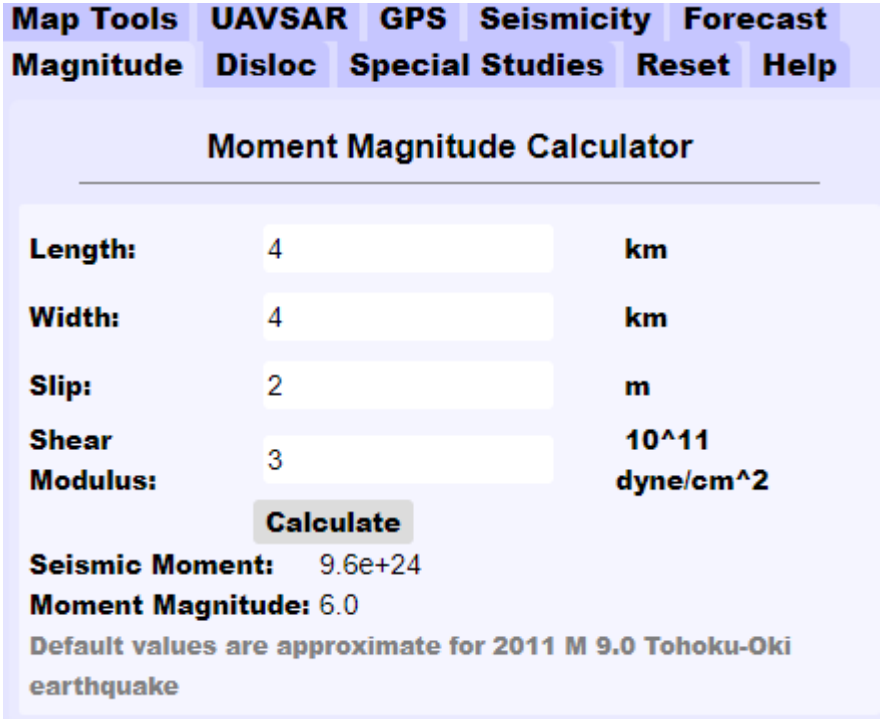
GeoGateway allows users to calculate the moment magnitude by clicking on the "Magnitude" tab and further inputting data. Within this exercise you will create a M6 earthquake.

Go to http://geo-gateway.org

Click on the "**Magnitude**" tab

Enter parameters to create a M6 earthquake and list the parameters used (hint: length and width should be equal)

a. Length (km): 4
b. Width (km): 4
c. Slip (m): 2
d. Shear Modulus (10^{11} dyne/cm^2): 3



Extra: Use the GeoGateway Moment Magnitude Calculator to estimate the number of earthquakes.

Assume a San Andreas fault slip rate of 35 mm/yr. Use the above slip to estimate the number of M6 earthquakes that should occur over 100 years at that slip rate

Answer →

35 mm/yr x 100 years = 3,500 mm
3,500 mm to m = 3.5 m
Slip is 2 m
2 m / 3.5 m = **0.57 earthquake(s)**

Exercise: Produce GPS Velocities, Offsets, and Displacements

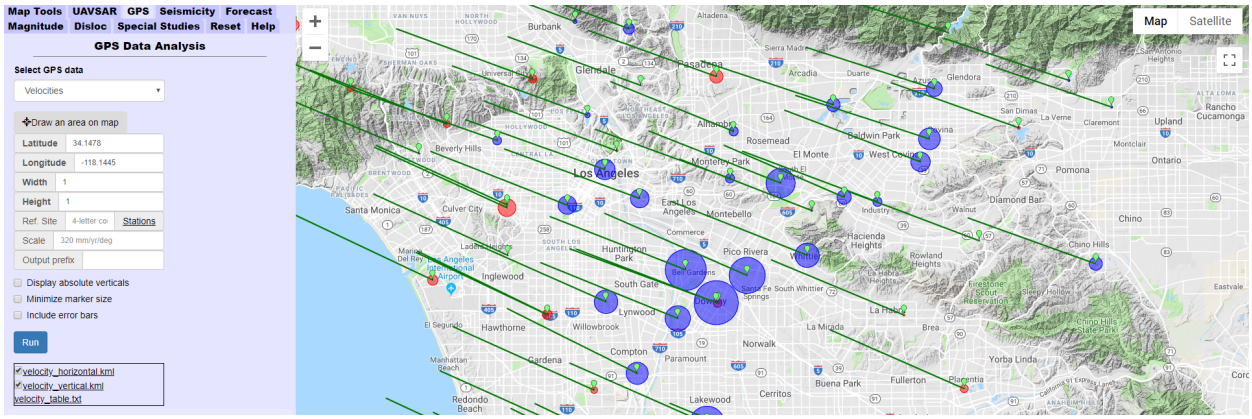
Go to http://geo-gateway.org

Click the "**GPS**" tab

In all following screen captured maps include the input window to show parameters that were used

On bottom left construct GPS velocity map with no reference

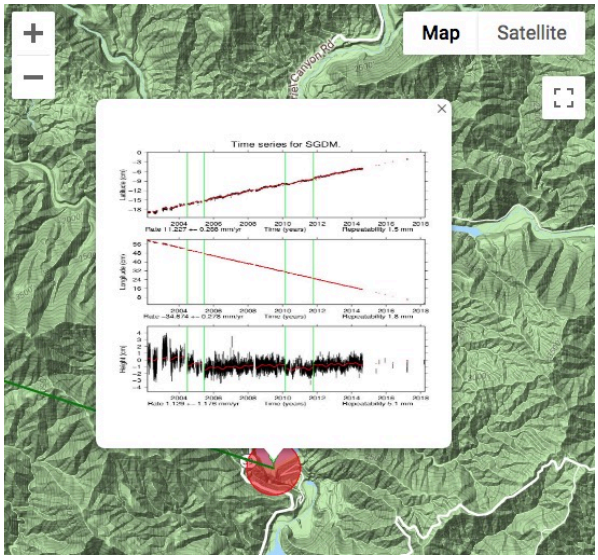
a. Select latitude and longitude of plot center in decimal degrees
b. Select width and height in degrees (try 1 degree)
c. Leave reference site blank



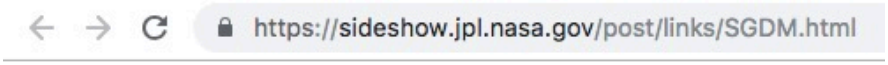
d. Run
e. **Download the velocity table**

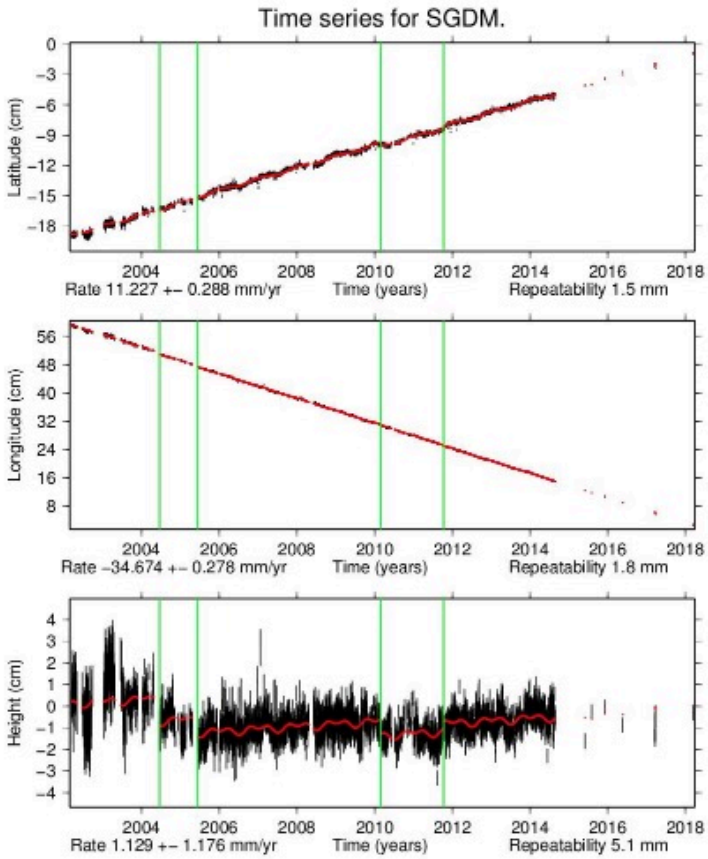
Site	Lon	Lat	Delta E	Delta N	Delta V	Sigma E	Sigma N	Sigma V
AZU1	-117.896492	34.126020	-35.998000	11.564000	-2.179000	0.132000	0.145000	0.607000
BGIS	-118.159701	33.967119	-38.117000	14.906000	-5.755000	0.188000	0.217000	0.817000
BKMS	-118.094703	33.962260	-40.042000	17.478000	-5.153000	0.336000	0.400000	1.442000
BLSA	-118.028681	33.799545	-39.311000	16.080000	0.623000	0.529000	0.615000	2.202000
BRAN	-118.277055	34.184896	-37.323000	13.865000	-0.572000	0.157000	0.181000	0.766000
BTDM	-118.188231	34.292807	-35.512000	11.793000	1.333000	0.149000	0.155000	0.565000
CBHS	-118.629810	34.138563	-38.956000	17.556000	0.615000	0.055000	0.062000	0.237000
CCCO	-118.211202	33.876262	-36.542000	18.169000	-3.102000	0.416000	0.493000	1.768000
CCCS	-117.864947	33.862744	-37.807000	16.582000	1.277000	0.345000	0.419000	1.475000
CGDM	-117.964950	34.243994	-34.979000	11.036000	0.170000	0.139000	0.174000	0.614000
CHIL	-118.026003	34.333424	-34.183000	10.891000	0.435000	0.104000	0.120000	0.451000
CHMS	-117.827705	34.640463	-24.895000	5.370000	0.359000	0.103000	0.125000	0.426000
CIT1	-118.127290	34.136710	-35.936000	12.876000	1.905000	0.157000	0.185000	0.631000
CJVG	-118.144232	34.530321	-32.252000	9.905000	-0.988000	0.470000	0.531000	1.865000
CLAR	-117.708814	34.109929	-35.182000	11.874000	-2.351000	0.167000	0.197000	0.689000
CMP9	-118.411429	34.353181	-36.500000	12.756000	-1.502000	0.160000	0.195000	0.670000
CRHS	-118.272771	33.823506	-39.095000	17.583000	0.276000	0.286000	0.341000	1.292000
CSDH	-118.256722	33.861479	-39.775000	17.849000	0.955000	0.133000	0.159000	0.543000
CSN1	-118.523816	34.253552	-37.776000	15.955000	-0.476000	0.136000	0.164000	0.569000
CTDM	-118.613215	34.516550	-35.093000	10.691000	0.798000	0.081000	0.097000	0.335000
CVHS	-117.901722	34.082012	-37.513000	12.163000	-3.045000	0.205000	0.243000	0.862000
DAM2	-118.396869	34.334837	-36.140000	12.895000	0.779000	0.218000	0.221000	0.975000
DAM3	-118.397471	34.333992	-36.480000	12.720000	-0.344000	0.239000	0.233000	1.048000
DSHS	-118.348546	34.023933	-36.929000	16.780000	0.169000	0.497000	0.579000	2.090000
DVPB	-117.860132	34.413413	-31.540000	9.082000	0.361000	0.085000	0.108000	0.373000
DYH2	-118.127463	33.938315	-39.221000	15.001000	-6.207000	0.219000	0.260000	0.875000
DYHS	-118.125987	33.937990	-41.475000	15.214000	1.221000	0.402000	0.495000	1.760000
ELSC	-118.208437	34.029735	-37.978000	13.947000	-2.623000	0.121000	0.137000	0.515000
ELTS	-118.453765	34.599292	-30.844000	10.972000	-1.216000	0.292000	0.359000	1.188000
FVPK	-117.935719	33.662329	-38.376000	17.186000	-0.834000	0.431000	0.511000	1.756000
FXHS	-118.359483	34.080606	-40.732000	14.282000	-1.247000	0.156000	0.184000	0.723000
GVRS	-118.112898	34.047448	-37.773000	13.712000	-1.278000	0.097000	0.115000	0.388000
HBCO	-118.285799	33.783648	-37.537000	18.626000	-0.680000	0.198000	0.236000	0.845000
HOL3	-117.845130	34.458156	-29.274000	7.886000	0.716000	0.047000	0.055000	0.186000
HOLP	-118.168176	33.924541	-38.536000	15.645000	-3.524000	0.187000	0.218000	0.758000
JNHG	-117.955441	34.449064	-30.703000	9.158000	-0.147000	0.207000	0.255000	0.834000
JPLM	-118.173232	34.204822	-36.552000	12.928000	-1.234000	0.166000	0.186000	0.724000

f. Click on a station to show time series



g. Click on small time series thumbnail to produce web page of result

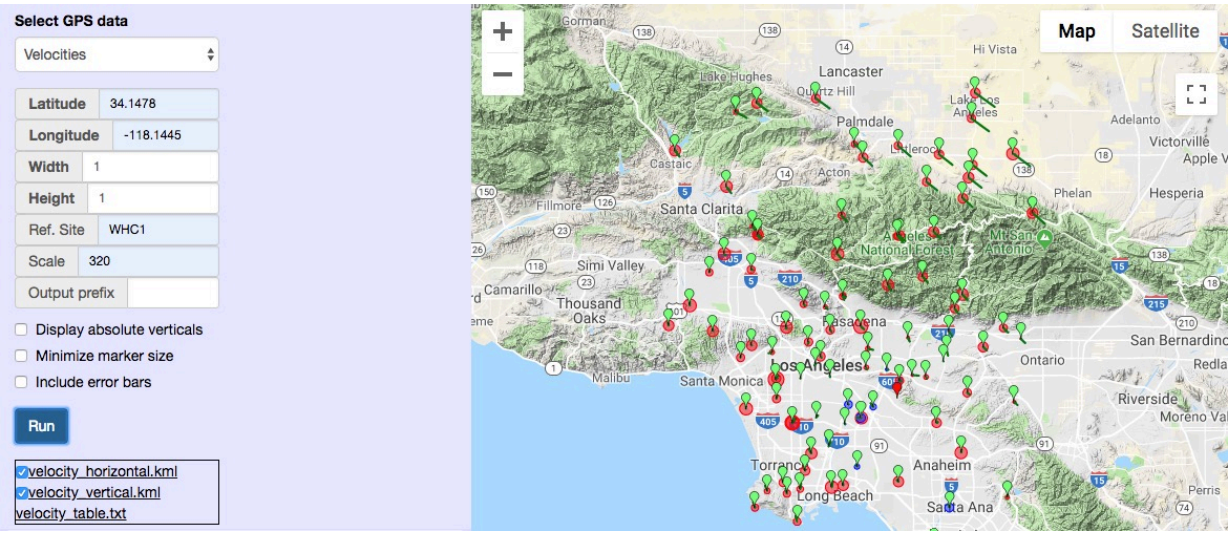




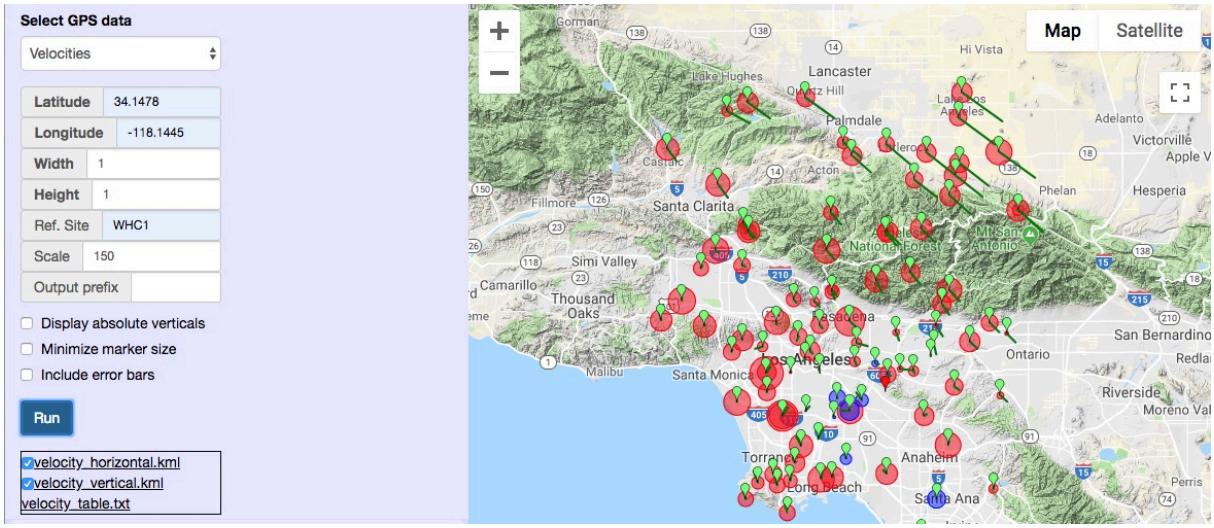
h. Download KML file if you would like to save it. This can be later plotted with the KML mapper on the map tools tab

On the bottom left construct a GPS velocity map with reference

a. Select latitude and longitude of plot center
b. Select width and height in degrees (1 degree is often good)
c. Select a reference site from previous plot
d. Run

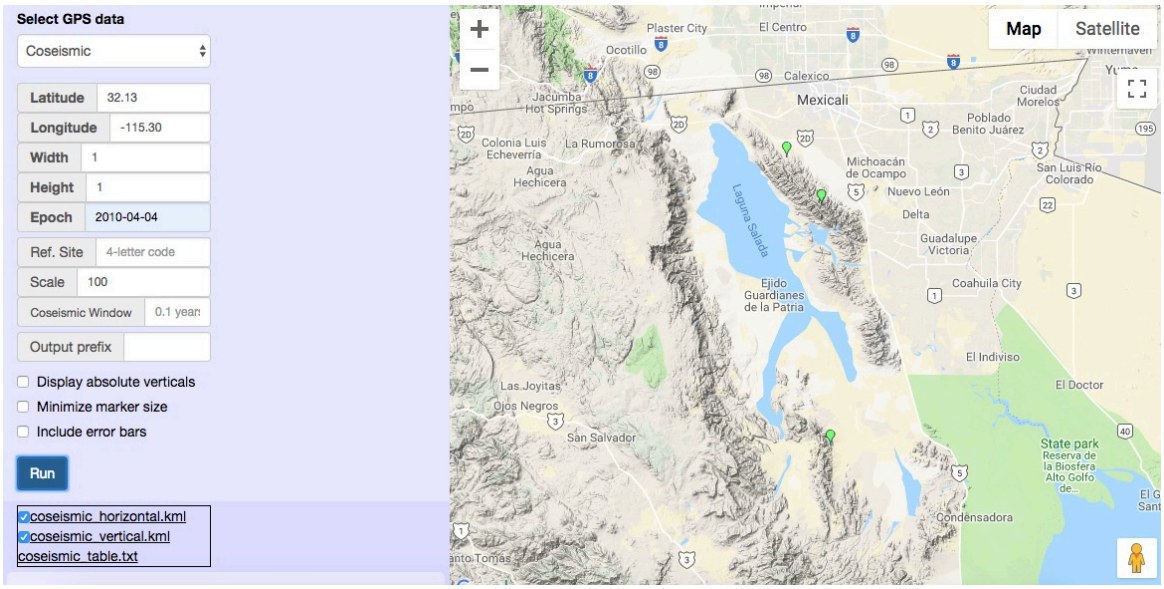


e. Vary the scale to see the result (hint – smaller number results in larger vectors).

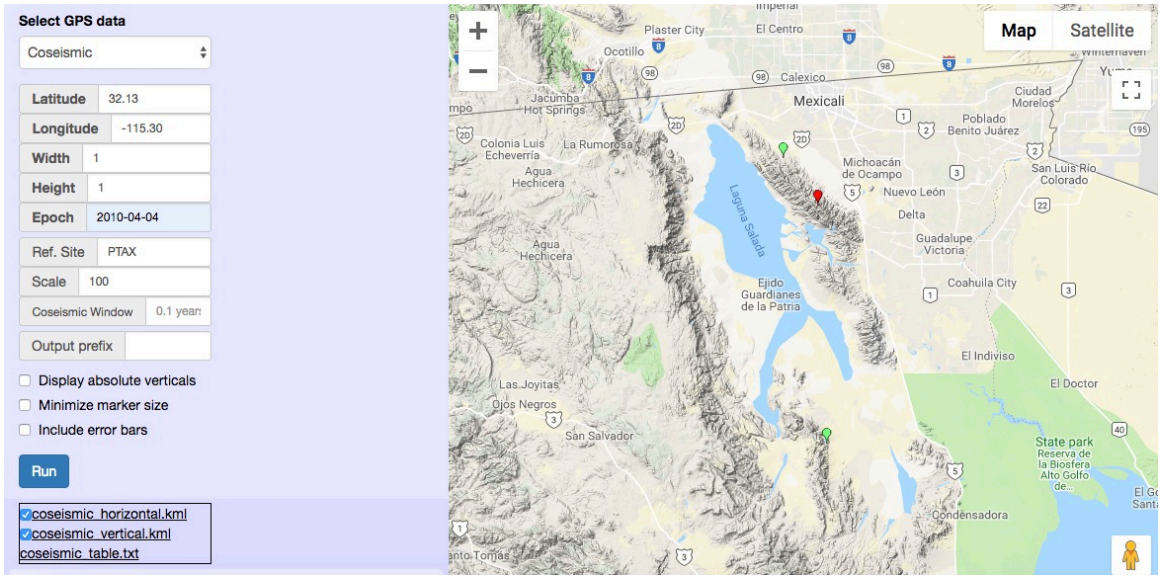


Repeat for coseismic displacements

a. Select latitude and longitude of plot center near a large event (e.g. South Napa or El Mayor – Cucapah earthquake)
b. Enter time of earthquake
c. Print plot with no reference

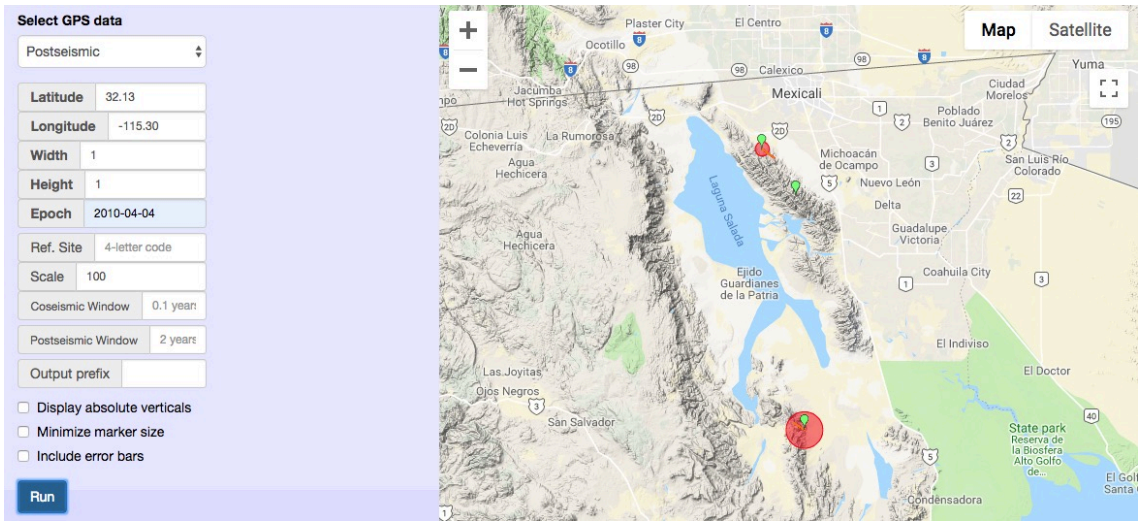


d. Print new plot with a reference station

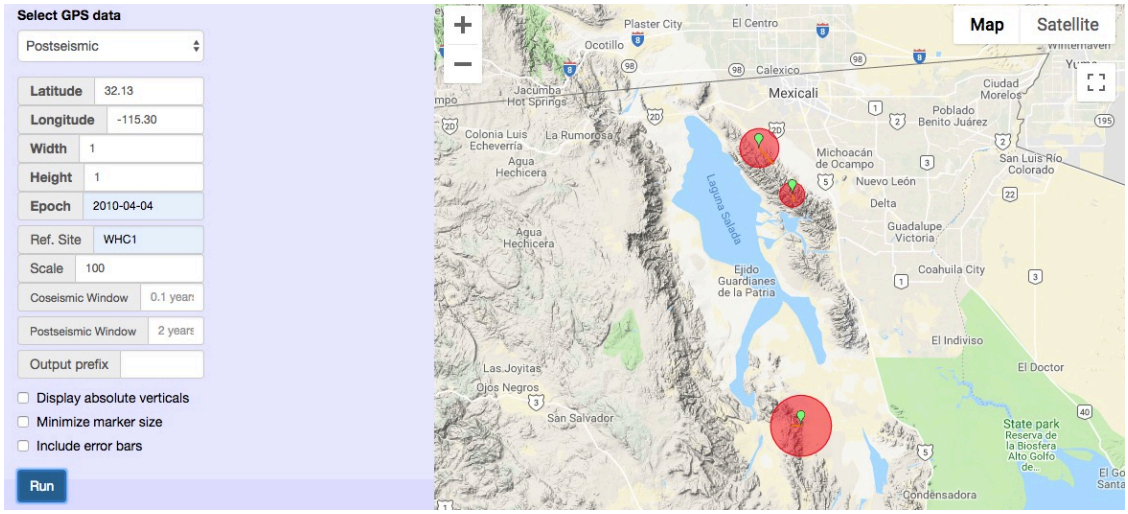


Repeat for postseismic displacements

a. Select latitude and longitude of plot center near a large event (e.g. South Napa or El Mayor – Cucapah earthquake)
b. Enter time of earthquake
c. Experiment with different postseismic windows
d. Print plot with no reference

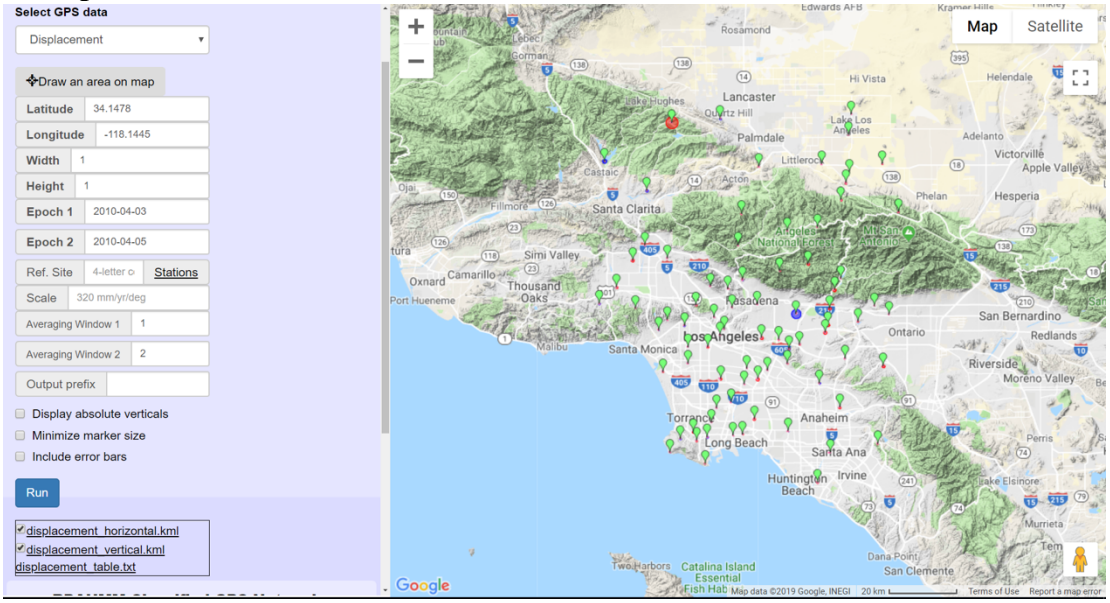


e. Print new plot with a reference station

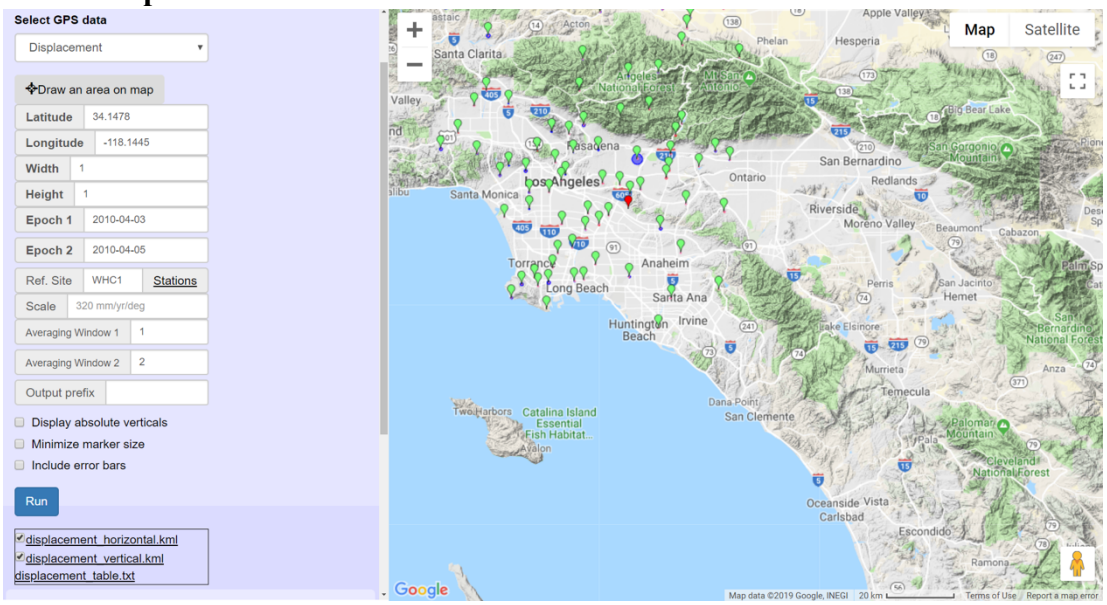


Repeat for displacements

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

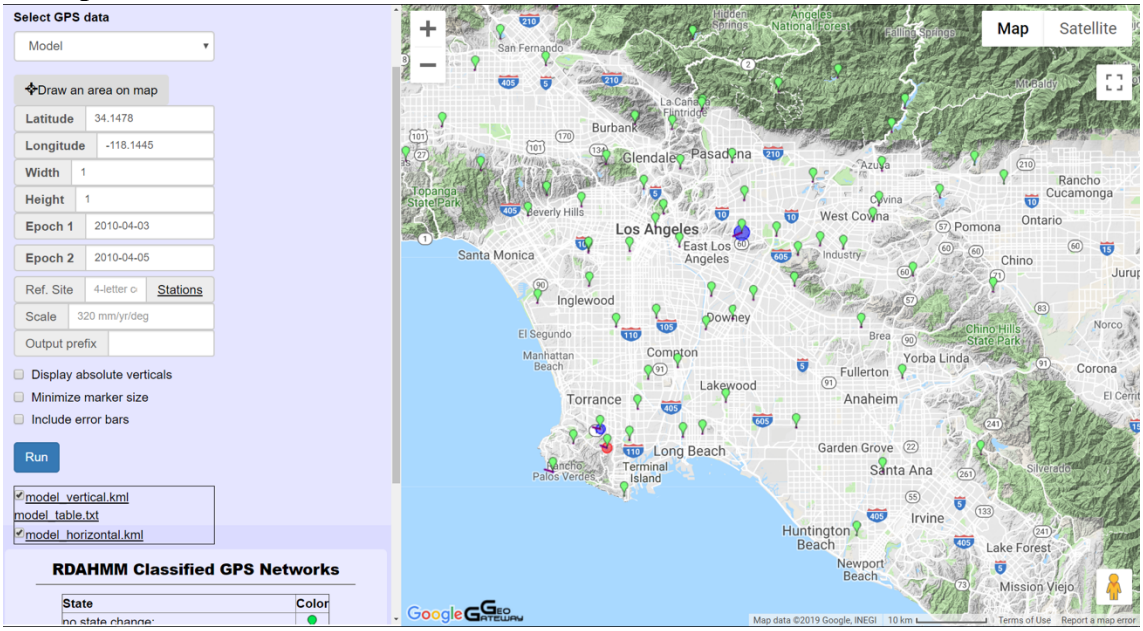


d. **Print new plot with a reference station**

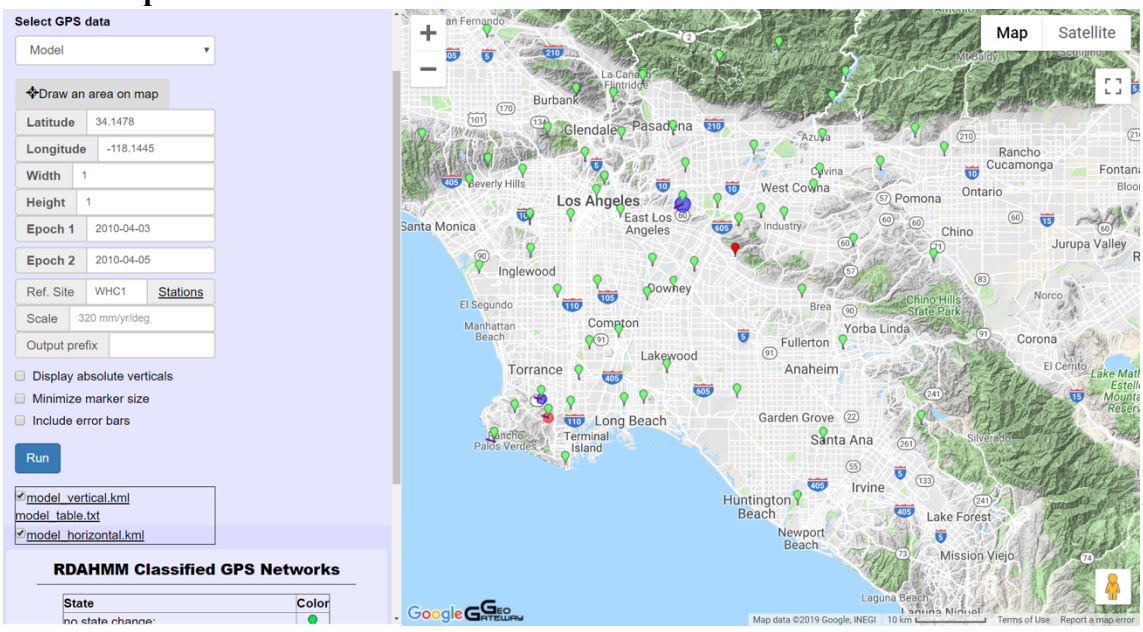


Repeat for model

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

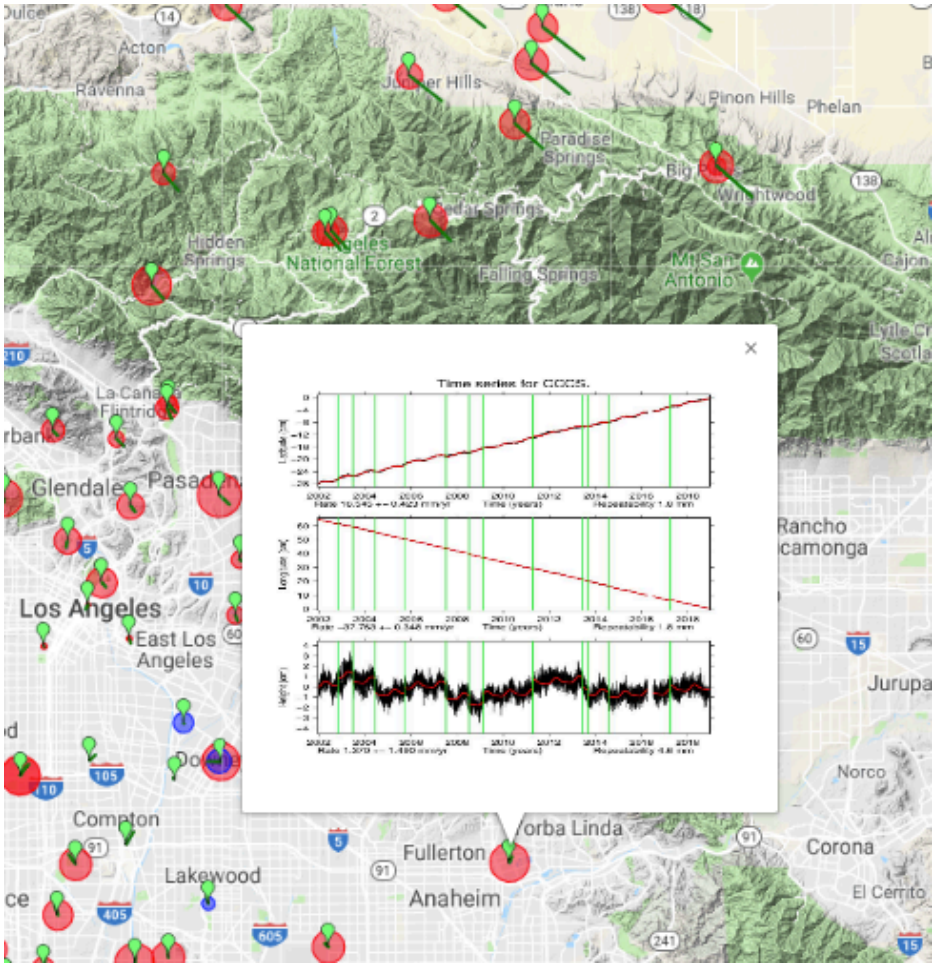


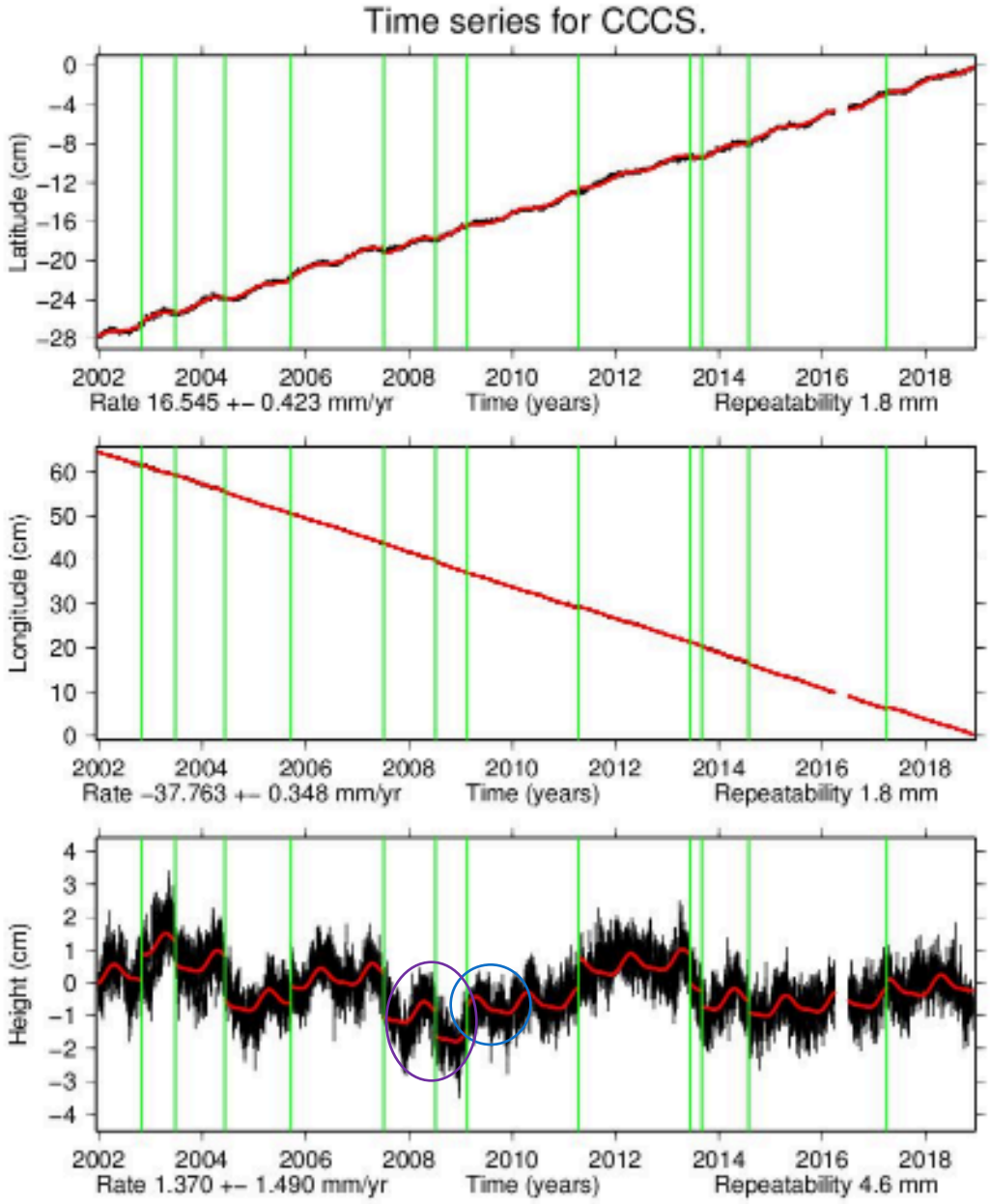
d. Print new plot with a reference station



Find and print a time series that shows an offset and postseismic motion

a. Label offset
b. Label postseismic motion
c. Point to time series





Purple oval shows offset

Blue circle shows postseismic motion

Exercise: Model and Analyze Interferograms

Go to http://geo-gateway.org

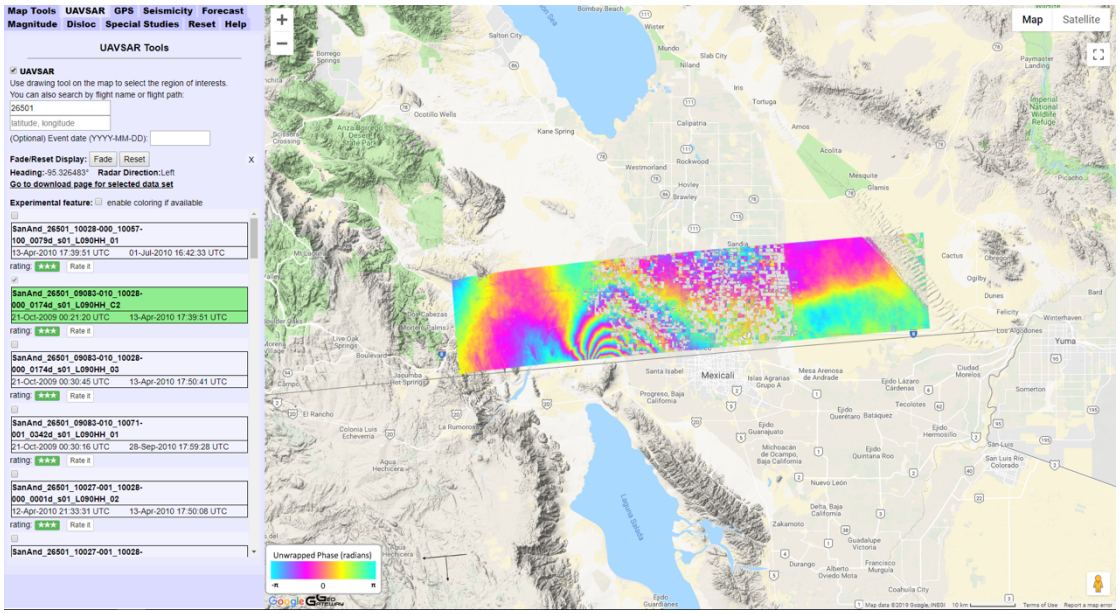
Click the "**Map Tools**" tab on the top left.

Check UAVSAR box

There are two methods a user may use to search for a UAVSAR Interferogram.

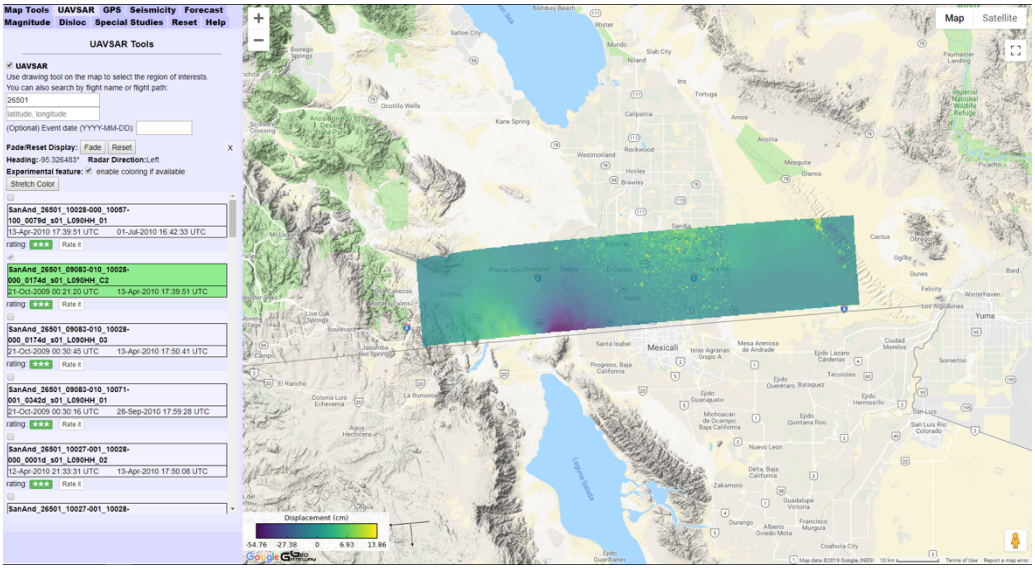
1. The "flight name/path" directly finds the flight name and path wanted
2. The "latitude, longitude" option returns all flight paths crossing paths with those coordinates.
   In the case of this exercise, enter 26501 (flight name/path) in the search window and hit return.

Select second line in list
(Name is SanAnd_26501_09083-010_10028-000_0174d_s01_L090HH_C2, should end in C2)



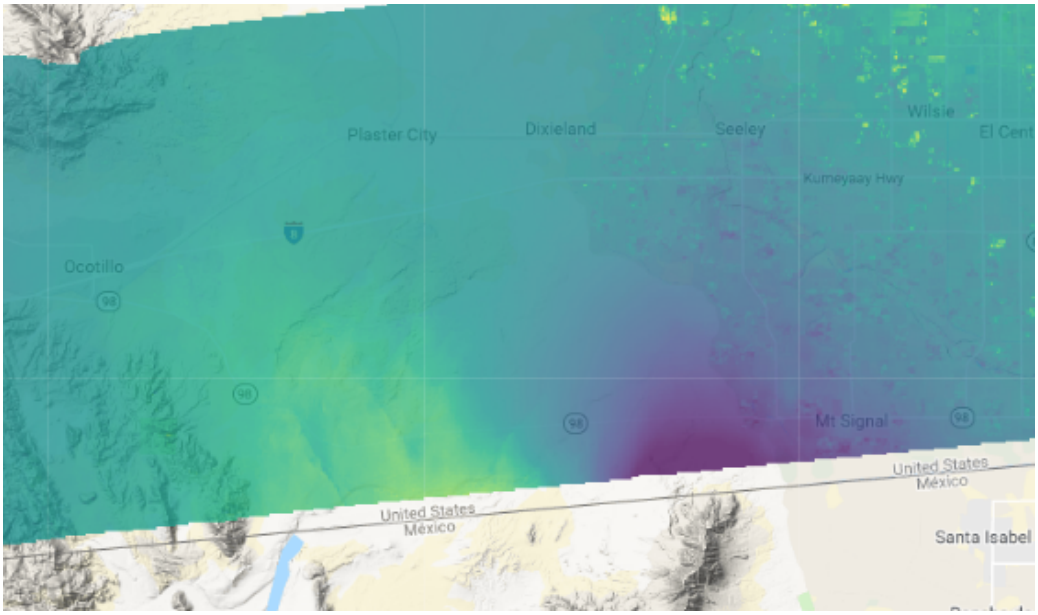
Click on "**Experimental feature: enable coloring if available**" just above the list of repeat pass interferometry (RPI) products

Re-select second line in list
(Name is SanAnd_26501_09083-010_10028-000_0174d_s01_L090HH_C2, should end in C2)



Zoom into area of the two lobes that are green/yellowish and purple.

- **a.** Click fade
- **b.** Click reset

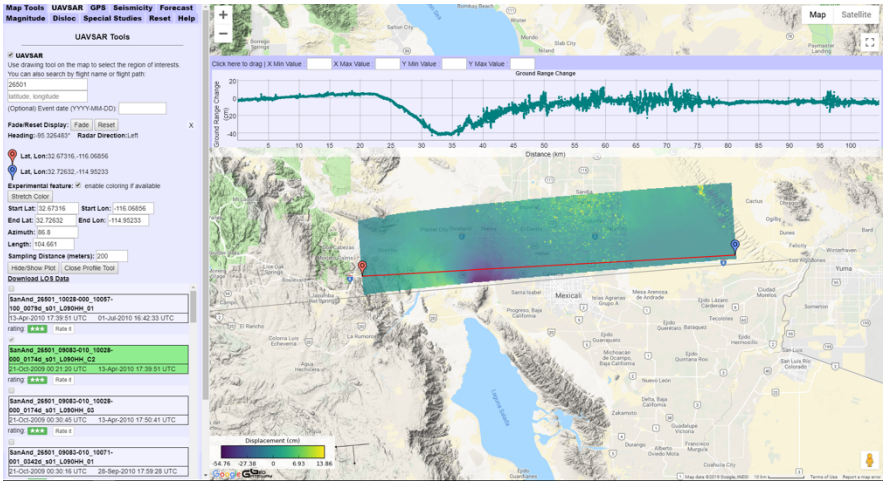


Yellow lobe shows more surface fracturing

Click on the map.

- **a.** Adjust the endpoints of the profile to be on the product, but parallel 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 from the upper right corner of the plot

Ground range change occurred across the two lobes as shown below.



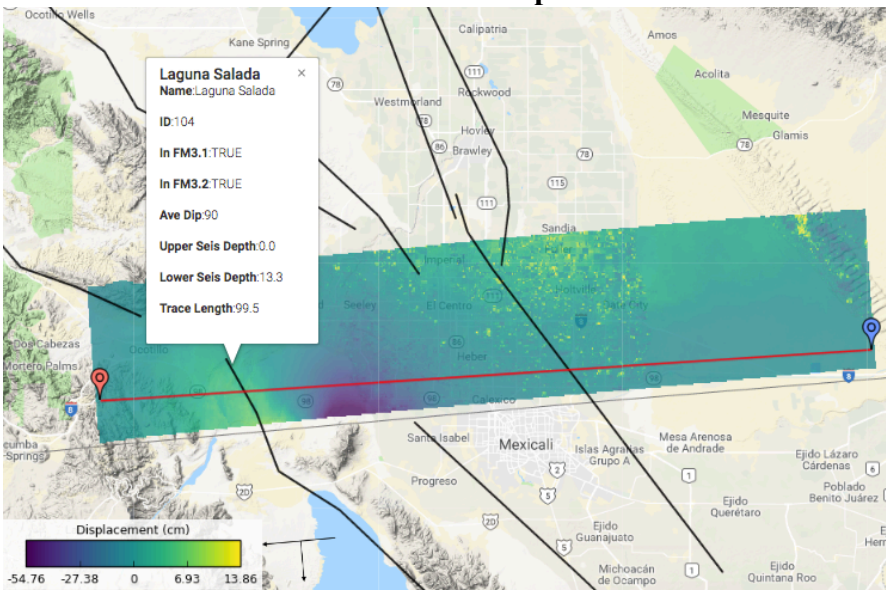
The purple lobe moved away from the instrument on the aircraft as we see that the negative (darker color) implies that the ground moved away from the instrument on the aircraft.

Scroll to the very bottom of the left panel and click the "UCERF3 Faults" check box

a. Click on the black line (fault)

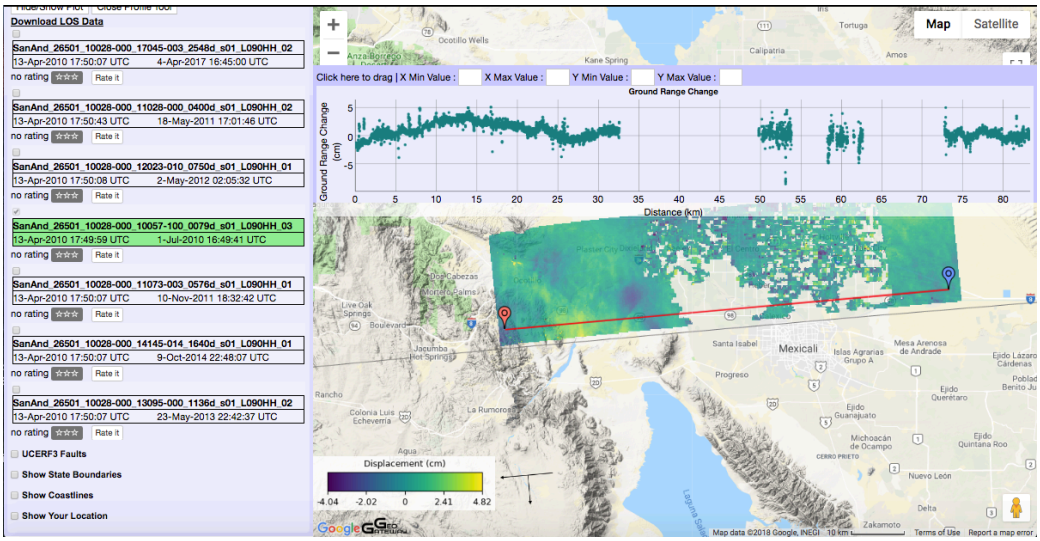
b. **Read off the fault that extends into the product.**

c.



The mapped fault ruptured in the earthquake.

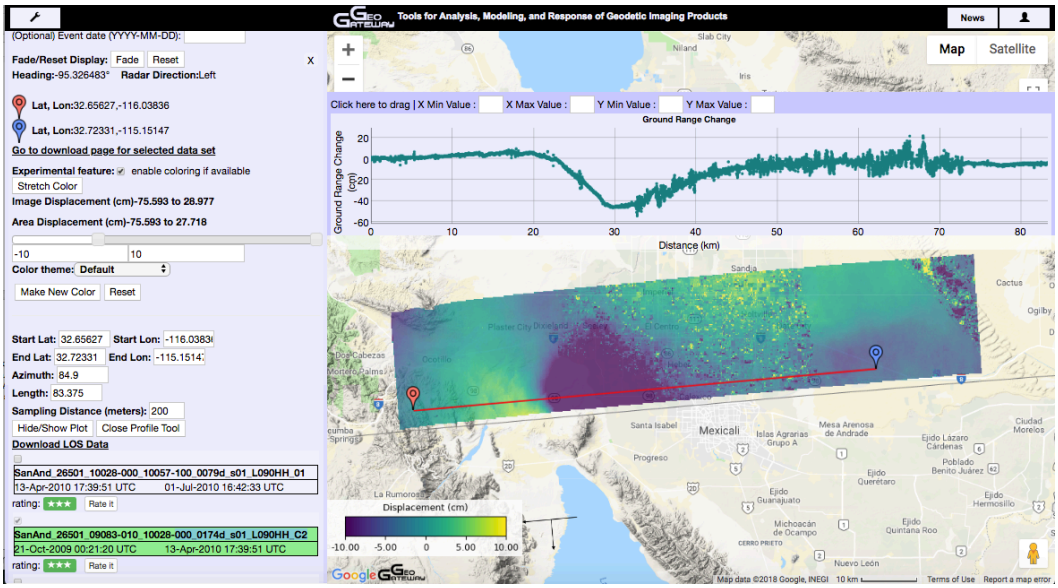
d. Scroll down and find line SanAnd_26501_10028-000_10057-100_0079d_s01_L090HH_02 with dates 13-Apr-2010 17:49:59 UTC 1-Jul-2010 16:49:41 UTC



We see a difference when selecting a different time frame, also some slips have error as shown from the absence in color.

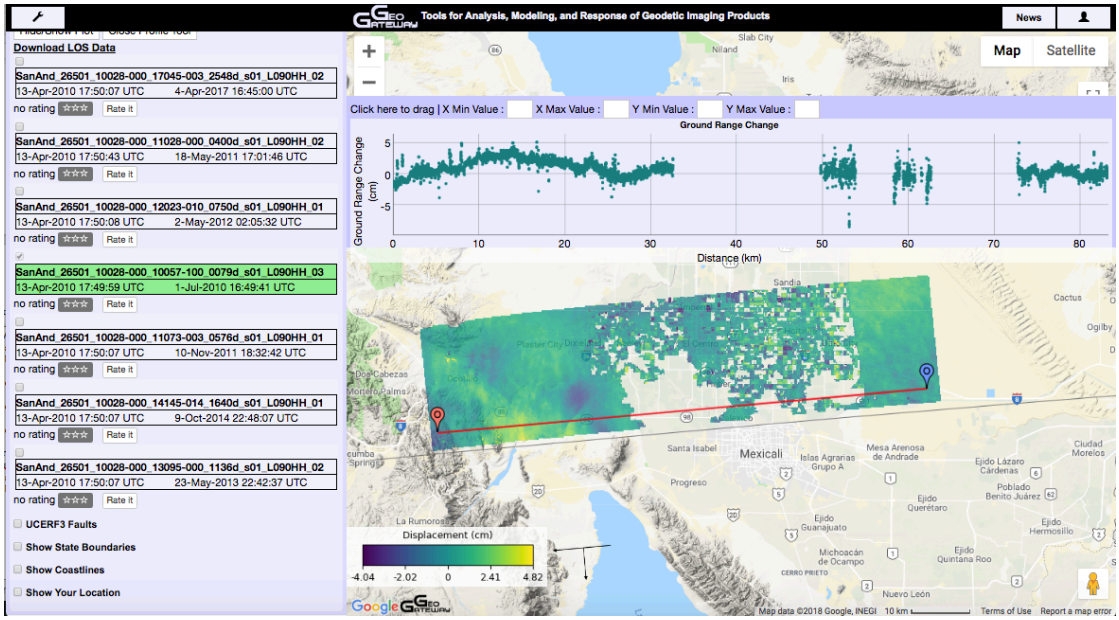
Re-select second line in list
(Name is SanAnd_26501_09083-010_10028-000_0174d_s01_L090HH_C2, should end in C2)

a. Adjust the endpoints to cover the yellow lobe only
b. Zoom into the yellow lobe
c. Click on "Stretch color"
d. Click on "Make new color"
e. Slide the color bars to roughly -10 and 10 or enter -10 and 10 into the fields and "Make new color"



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

a. Leave color stretch as it was (-10 to 10) and select “Make new color”



Coseismic offset, and postseismic slip is visible.

Edit/Updates

Start Date: January 24, 2019
Edit: February 04, 2019
Edit: February 21, 2019