

Interim Project Report SCEC Project #19044

Collaborative Proposal: Constraining convergence and uplift of the Ventura Avenue anticline with new GPS observations

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INTERIM REPORT: Abstract

The purpose of this project is to provide constraints from Global Positioning System (GPS) data to constrain convergence and uplift across the Ventura Avenue anticline and Ventura fault in the western Transverse Ranges near Ventura, CA. Geologic observations and geophysical imaging suggest that the Ventura Avenue Anticline is uplifting at a rate of up to 5 mm/yr, however GPS observations in the immediate region are sparse, limiting geodetic estimates of active convergence and strain accumulation around the fault. The proposed work will densify the Southern California Earthquake Center (SCEC) Community Geodetic Model (CGM) in this region of sparse spatial coverage. We will evaluate existing benchmarks across the Ventura region and establish new monuments where necessary, and establish initial positions for determining secular velocities. This project has been delayed by 1) PI Evans' maternity leave in the second half of 2019 and 2) the COVID-19 pandemic in 2020-2021. Due to easing of fieldwork restrictions, we expect the survey, archiving, and final model development to be completed by September, 2021.



Figure 1: Photos from reconnaissance trips. Clockwise from top left: PI Eileen Evans identifying monument Cozy; Station Ortega; Station Heliport, viewed from north (photo: graduate student Jeng Hann Chong); Station HPGN CA 05 1; Station Ozena, viewed from west (photo: Jeng Hann Chong); Station Barely (this and all other photos by PI Gareth Funning)

Completed so far:

Field Reconnaissance

A number of pre-existing benchmarks exist in the Ventura region that have not been used in any UNAVCO-archived field survey. The first step was to identify and locate these existing benchmarks primarily through the National Geodetic Survey (NGS) (www.ngs.noaa.gov). PIs Evans and Funning performed a preliminary reconnaissance trip in March, 2019 to establish the current state of these benchmarks and inform any necessary monument creation (Figure 1). CSUN graduate student Jeng Hann Chong (advised by PI Evans) performed a second reconnaissance trip in Spring, 2020 (Figure 1). These two trips identified seven benchmarks that are accessible with good visibility to be surveyed in summer 2021 (Figure 2).

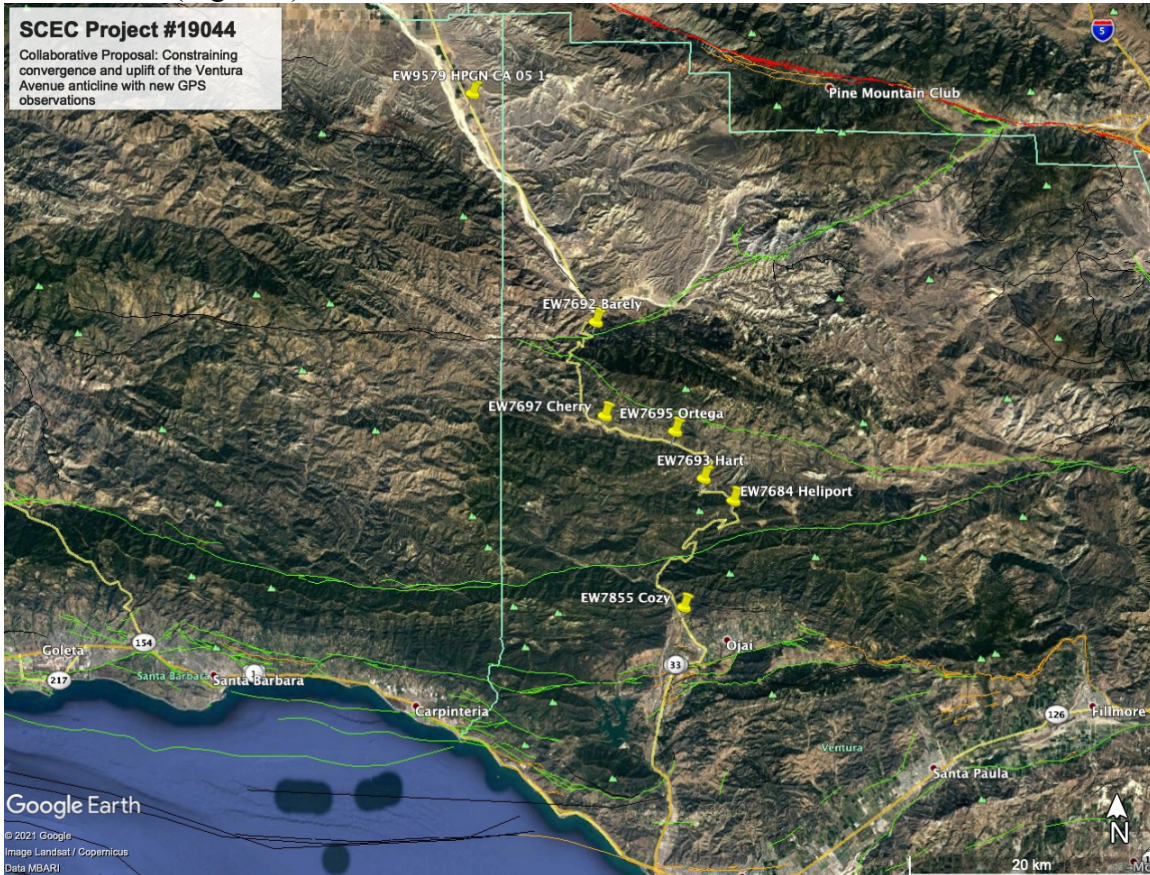


Figure 2: Stations identified for survey(s) in summer, 2021

Preliminary modeling

Undergraduate student Julia Carras performed preliminary kinematic models of suggested fault geometries of the Ventura Anticline (e.g., Marshall et al., 2017). Julia was unable to complete her portion of the project for personal and health-related reasons. However, to facilitate this project PI Evans created a Matlab GUI tool to facilitate 2D models of dip-slip faults (Figure 2). This tool allows undergraduate researchers with limited programming ability to quickly and easily create and evaluate their own models. This is an exciting product of this project and will greatly facilitate future undergraduate modeling projects.

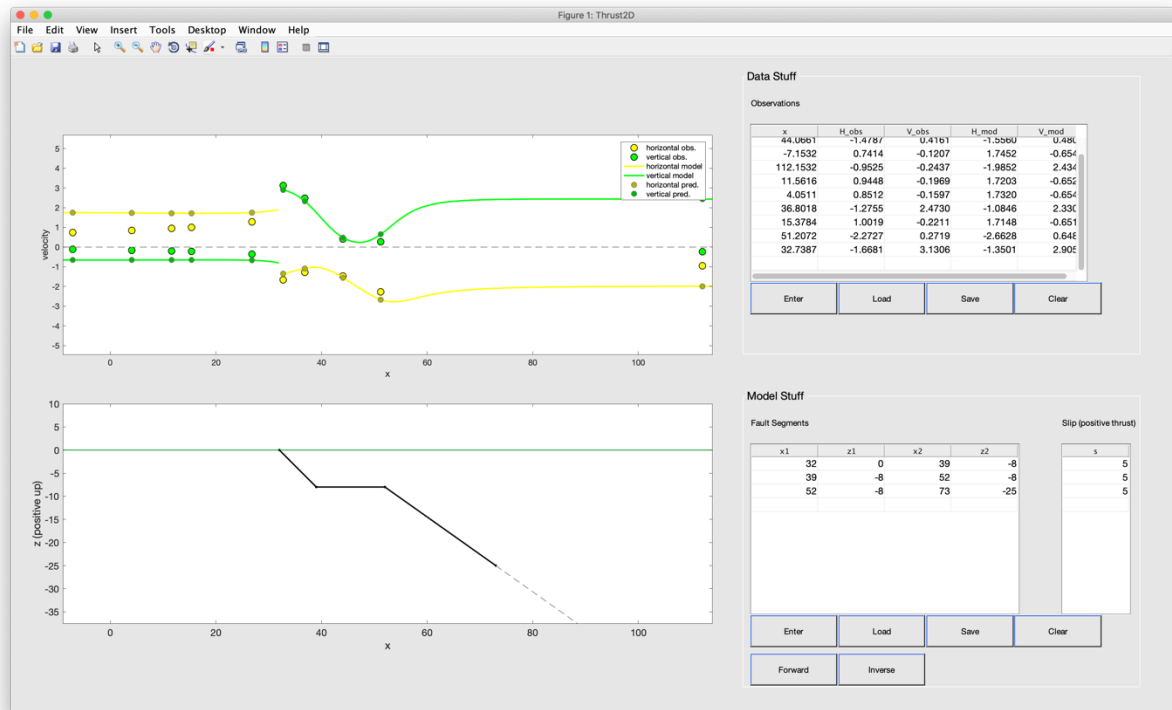


Figure 3: Demonstration of modeling tool developed for this project. It is easy for students to add data (top panels), add simple fault geometries (bottom panels) and run forward and inverse models.

Estimated timeline for completion:

May 2021: Final debugging and testing of the Matlab-based modeling tool. The completed tool will be made publicly available on PI Evans' GitHub repository (<https://github.com/elevans11>).

June 2021: We will perform a field campaign of existing and new benchmarks. Given student availability, we expect to perform the GPS survey in early summer, target June, 2021. This will allow a second survey, where feasible, later in the summer. Where possible, we will set up semi-permanent GPS stations over new benchmarks to help establish a stable velocity and mitigate seasonal biases.

July 2021: Data from the first survey will be processed using the GAMIT/GLOBK software. All data will be archived at UNAVCO as well as incorporated into the SCEC CGM.

August 2021: We will perform a second survey, where semi-permanent installation is infeasible, in August 2021.

September 2021: Data from the second survey will be processed using the GAMIT/GLOBK software. All data will be archived at UNAVCO as well as incorporated into the SCEC CGM.

Reference:

Marshall, S. T., G. J. Funning, H. E. Krueger, S. E. Owen, J. P. Loveless, (2017) Mechanical models favor a ramp geometry for the Ventura-pitas point fault, California. *Geophysical Research Letters* 44, 1311-1319