The overarching objective of the research in the San Gorgonio Pass SFSA is to constrain the seismic hazards of the San Andreas Fault through this region. Guiding questions include: *What is the probability of a through-going San Andreas rupture?* A definitive answer to this question has fundamental implications for forecasting the earthquake hazard in southern California. Related to the potential for earthquakes rupturing through the San Gorgonio Pass are several other questions. *What is the subsurface geometry of active faulting through the San Gorgonio Pass?* In order to best predict potential rupture through the San Gorgonio "knot" and ground motions we need to know the active fault configuration. *What is the earthquake potential in the San Gorgonio Pass region?* If fault geometry, stressing rates and slip rates are known, then we will be able to develop more accurate earthquake models, which will in turn produce better estimates of earthquake size, earthquake interactions, ground motion, and seismic hazard. This long-term project has important broader impacts not just for the San Gorgonio Pass and greater southern California region, but also for improving our understanding of the physical processes that govern earthquake generation.

A detailed discussion of the aims of the San Gorgonio Pass as a SFSA is provided within the workshop report at http://www.scec.org/workshops/2012/sgp/index.html. We encourage all PIs submitting proposals to examine that document. We welcome proposals that either directly or indirectly contribute to the specific tasks and/or general goals of this science plan.

Year 1(on-going)-2: Many of these are multi-year efforts that were started in Year 1 and that will continue in subsequent years

- *Question 1: How do we reconcile deep and shallow structure? What is the active 3D structure?*
  - Develop a high resolution San Gorgonio Pass 3D Fault Model (SGP-FM) that would be an alternative to and more detailed version of the UCERF3 model for active fault structures in SGP.
    - Test what factors matter and what specific region refinements might do.
    - The database should provide tags for the source data for each fault surface.
    - Test whether complex models cause issues with earthquake simulators
  - Develop interseismic models that incorporate the active fault structures revealed by microseismicity at depth and test the results against those based on surface trace geometry.
  - Re-evaluate old seismograms (for example, 1944 Kitching Peak events) in the context of newer location algorithms and relative location techniques. Another look at previous events (e.g., 1948 Desert Hot Springs event, 1947 Morongo Valley event, other pre-1986 N Palm Springs events) may yield new insights.
  - Collect information from existing water wells or other industry well data to help constrain near sub-surface geology.
  - Use existing seismic data sets to invert for active subsurface 3D fault geometry and velocity structure. Identify relevant interface reflections or trapped waves; resolve important gradients in the seismic velocity or potential field; and help provide suggestions for future station locations where additional data would be most helpful to improve network imaging capability. If fruitful, this may necessitate seeking funding beyond those available to SCEC to implement additional elements of both passive and active seismic arrays for high-resolution studies of SGP.
- *Question 2: What is the current pattern of deformation in SGP and how may this relate to earthquake potential?*
  - Gather existing ages and uplift estimates from available data sets (e.g., LiDAR data) to obtain uplift rates. Compare to uplift patterns from existing mechanical models and provide recommendations for further dating and model refinement (also for question 1).

  - Continue to collect campaign GPS data from available sites to test multiple fault interpretations.
  - Refine the velocity model for northern Coachella Valley.
  - Develop crustal deformation models to validate the existing earthquake catalog. These investigations may compare focal mechanisms and inferred stresses from the focal mechanisms.
  - Incorporate slip rate data from detailed 3D mechanical models of the SGP into the larger UCERF models for all of CA.

- *Question 3: Can rupture pass through the SGP?*
  - Additional geologic and geomorphic studies can both fill slip-rate data gaps and constrain the rupture history through the pass. In particular the analysis of megatrenches that span longer time spans is much needed.
  - Use existing data (e.g. focal mechanism) to test SHmax as dynamic rupture-model results depend strongly on pre-stress pattern on fault.
  - Prepare dynamic earthquake rupture models that incorporate the geometry of active faulting in the SGP. Issues include 1) the step from the SGP Fault zone to the San Bernardino strand 2) the branching of the Mission Creek, Garnet Hill and Banning strands from the Coachella Valley segment of the SAF and 3) the Crafton Hills fault. In particular, dynamic rupture models may be most sensitive to changes of fault geometry through SGP.
  - Determine which dynamic rupture models generate accelerations small enough to permit the interpreted pattern of ground shaking revealed by the distribution of precarious rocks.
  - Investigate the electrical structure within the SGP. Fluids could facilitate rupture and electrical or deep seismic reflection can assess fluid presence.

Years 3-4:

- *Question 1: How do we reconcile deep and shallow structure? What is the active 3D structure?*
  - Dating of additional deformed surfaces using a variety of methods to provide uplift rates in regions that mechanical models reveal as particularly sensitive to alternative fault interpretations (also question 2).
  - Testing of the SGP-FM with crustal deformation models, earthquake simulators and rupture models and suggestions for subsequent revisions.
  - Tag faults within the SGP-FM database for how well they match independent data sets within various model investigations. The resulting database will contain the fault surface, the source that produced this interpretation, and some validation on whether models using this surface match independent datasets.
  - Determine if there are mechanisms or dynamic earthquake models that would allow for a through-going fault or major slip at depth, but not necessarily be resolvable as fault offset or a through-going fault at the surface (e.g., Loma Prieta earthquake).

- *Question 2: What is the earthquake potential?*
  - Refine alternative fault configurations within the high-resolution SGP-FM and report results of comparison with UCERF3 model results.

- *Question 3: Can rupture pass through the SGP?*
  - Use earthquake simulator models using detailed fault configuration to provide initial stress conditions for rupture scenario models.
  - Compare the results from earthquake simulators and dynamic rupture models with correlations from paleoseismic data (do models support paleoseismic scenarios?).
  - Refine rupture models to better incorporate observations from trench and slip rate sites.