2011 SCEC Report

Implementing a Statewide Community Fault Model in coordination with UCERF3 and the USGS/CGS Q-fault database

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Summary
In the past year, we developed new, substantially enhanced versions of the SCEC Community Fault (CFM) and Statewide Community Fault (SCFM) Models in collaboration with Craig Nicholson (UCSB). The models were improved by updating fault representations using more precise fault traces and relocated seismicity, with an emphasis on refining fault geometry and segmentation along the San Andreas and San Jacinto fault systems. We also developed more than 70 new fault representations in northern California. These new models are currently being evaluated by the SCEC community and will serve as a basis for the Uniform California Earthquake Rupture Forecast (UCERF 3) working group efforts. Finally, we developed a new nomenclature system for the CFM that is more informative and consistent with the USGS Qfault database, enabling users to access and combine fault information more readily.

Updates to the SCEC CFM (southern California)
The SCEC Community Fault Model (CFM 4.0) includes more than 150 fault representations in southern California that are based on surface exposures, seismicity, seismic reflection profiles, well data, and other types of information. At the outset of the effort to develop the CFM, the fault trace map of Jennings (1994) was chosen as the primary database for defining surface fault traces, due to its widespread use in hazard assessment efforts. Since the early days of the CFM, however, a major effort has been undertaken by the USGS and CGS to develop a more accurate and comprehensive catalog of surface fault traces, and to reflect this information in the Quaternary Fault & Fold database. These fault traces are generally more precise than Jennings (1994), and often include more fault splays than the original compilation. In addition, SCEC investigators have also developed a series of new, relocated earthquake catalogs that offer much improved hypocentral locations that can be used to constrain subsurface fault geometries (Shearer et al., 2005; Lin et al., 2007). In collaboration with Craig Nicholson (UCSB), and in coordination with the USGS and CGS, we systematically revised fault representations in the CFM to be more compatible with the Qfault traces and the relocated earthquake catalogs. This involves redefining the interpolated patches of the CFM faults based on the CFM traces, and re-interpolating the 3D fault surfaces to be consistent with both surface and subsurface constraints. This past year, we focused on refining the representations of the southern San Andreas, San Jancinto fault, and Elsinore fault systems (Figure 1). This resulted in much more highly detailed and segmented representations of the faults. Care was given to defining the termination and linkage of fault segments, and to generating subsurface representations that were compatible with earthquake locations. These more precise representations are designed to inform assessments of single and multi-segment earthquake scenarios based on geometric criteria (e.g., distance between fault segments), and to serve as a basis for more detailed fault representations in geodetic block model and dynamic rupture simulations.

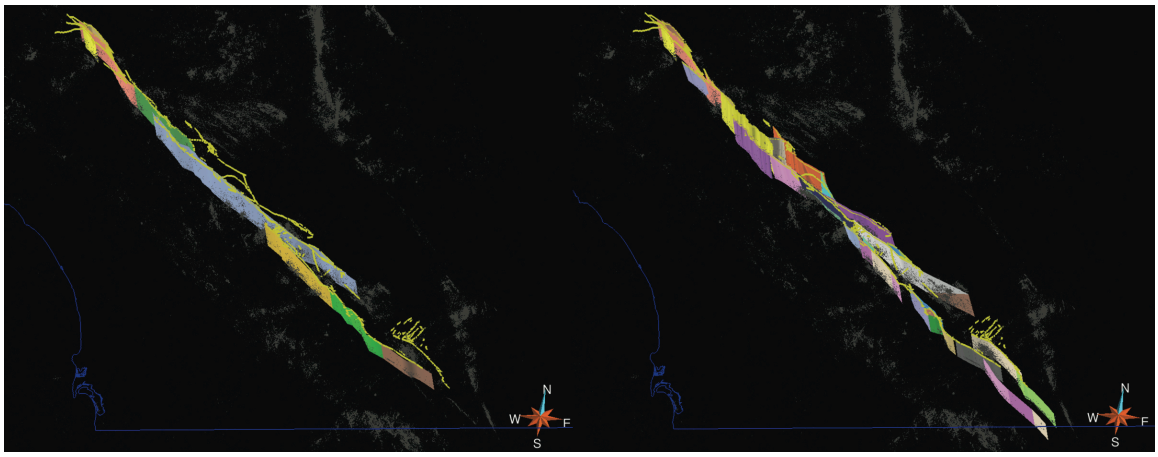

Figure 1: The CFM San Jacinto fault representation before (left) and after (right) refining the surfaces using relocated hypocenters (gray points; after Lin et al., 2007) and the Qfault traces.

We also developed and implemented a revised fault nomenclature for the CFM in the updated version of the model database. This new nomenclature was developed by Craig Nicholson (UCSB) in collaboration with our group and is designed to be more informative and consistent with the Qfault database. Over the past few years, review of the CFM with a number of SCEC PI's (e.g., Nicholson [UCSB]; Hauksson [Caltech]; Shearer [Scripps]) has identified the advantage of a revised fault nomenclature for accessing model components. Thus, we developed a revised fault hierarchy and naming convention that establishes a *Fault Area, Fault Zone, Fault Section, Fault Name, Splay, and Alternative Designation* for each representation in the CFM. This system was presented at the 2011 Annual Meeting (Nicholson et al., 2011), and has been subsequently improved based on feedback. Once fully implemented, this system will enable users to access individual faults by name, or groups of faults based on their area or system designation. Moreover, the *Fault Zone, Fault Section, and Fault Name* designations will be essentially identical to those used in the Qfault database. This will ensure that users can properly related fault information from the CFM and Qfault database, such as geometry and slip rate, respectively. Ultimately, this revision will allow for individual tsurf fault representations in the CFM to be made available directly through the Qfault database, as well as through the complete fault model versions that are accessible through the SCEC websites.

Implementing a new version of the Statewide CFM

Efforts in statewide seismic hazards assessment (e.g., UCERF2, UCERF3) and fault systems modeling (e.g., Bird et al., 2004; Rundle et al., 2004; Meade and Hager, 2004) often require plate-boundary scale fault models, rather than those arbitrarily limited by political and cultural boundaries. To address this need, SCEC initiated an effort to extend its southern California Community Fault Model (CFM) to a statewide representation. In 2011, we completed the second version of the statewide Community Fault Model (SCFM 2.0). The model is comprised of the SCEC CFM in southern California (Plesch et al., 2007; Nicholson et al., 2011), the USGS San Francisco Bay Area fault model (USGS, 2010) and a new, comprehensive representations of more than 150 faults in northern California. Seventy of these northern California fault representations were developed by our group in 2011. These fault representations include many updated or new faults in the San Francisco Bay area such as the Contra Costa Shear Zone and the Mt. Diablo Thrust, major faults in the Northern Coast Ranges such as Maacama-Garberville fault and the Bartlett Springs fault, and in the Sierra Nevada such as the Kern Canyon fault.

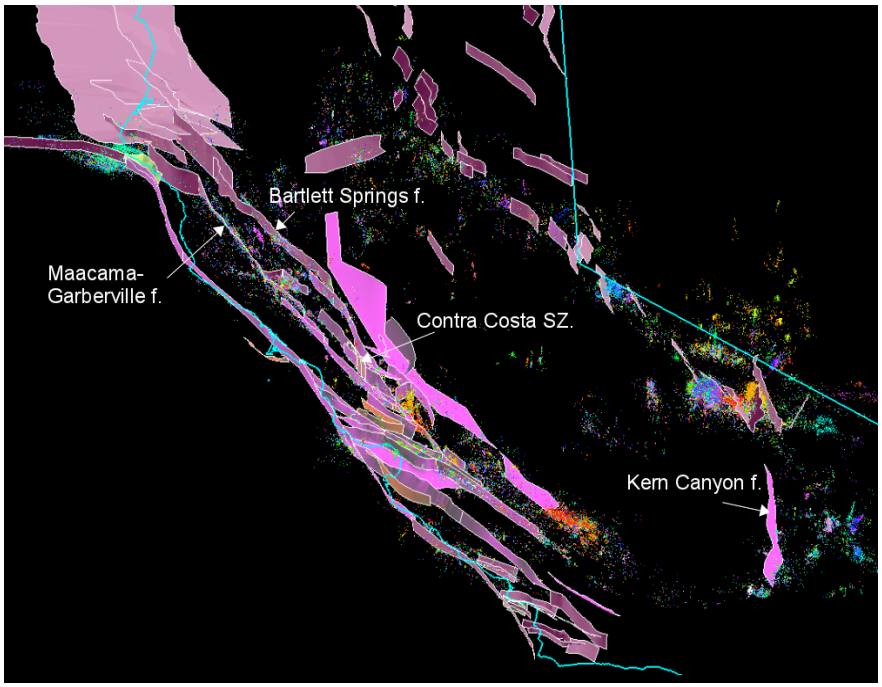

Figure 2: Perspective view of new or updated fault representations in Northern California (all purple and brown surfaces; selected faults labeled).

We are currently in the process of completing a formal evaluation of the SCFM in coordination with Timothy Dawson, CGS and the Uniform California Earthquake Rupture Forecast (UCERF 3) effort. As was the case in southern California for UCERF2, UCERF3 plans to use the SCFM representations to help define the geometries of their earthquake source representations. The current model evaluation involves a virtual workshop in which participants are evaluating the SCFM 2.0 using the SCEC VDO visualization software. Participants are visualizing the fault representations in 3D, and reviewing a basic fact sheet describing the representation of each fault. The fact sheet specifies the geometric aspects of the representations (e.g., average dip) and the information sources used to constrain the fault surface. Participants are assessing the completeness and accuracy of each fault representation, in part by assigning a quality ranking (1-5) to each fault representation based on criteria used to evaluate the SCEC CFM. These rankings, which largely reflect the amount of data available to directly constrain the interpretations, will be provided as an attribute for each fault in the fault model database. Once the review is completed, we will implement these rankings into new versions of the community fault models. Specifically, the rankings will be used to compose the preferred (versioned) fault model as well as a series of alternative fault groupings. These preferred and alternative fault models will be provided as both triangulated surface (tsurf) and rectilinear representations. The rectilinear representations are necessary for UCERF3 and many other modeling applications, and will be generated by segmenting the faults and determining average strike and dips using geometric criteria. This effort will culminate in new release of both the tsurf and rectilinear fault model versions (SCFM and SCFMR, respectively).

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