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CFM Version 5.1: New and revised 3D fault representations and an improved database.

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Abstract

We present an updated version of the SCEC Community Fault Model (CFM) for southern California. For version 5.1, we focused on improving the database component of CFM which is critical for the internal consistency and maintainability of the model. This system also enables model consumers to access and assess the full richness of the various modeled fault systems and their alternative 3D fault representations. The improved database now contains more than 800 rows of named fault-component objects organized in a sensible hierarchical scheme. These components are fault sections, splays and strands comprising faults and fault systems. The database is now synchronized with the latest catalog of individual t-surf CFM fault representations. This synchronization included recent updates to the database with over 300 new fault-component objects developed for the San Andreas fault system and Eastern Transverse Ranges, Mojave & Offshore Continental Borderland fault areas. Through this process, we identified more than 30 fault components that needed updating and were improved either by developing new 3D alternative fault models or by better regularization of their 3D fault surface meshes. as well as by a more consistent assignment to suitable locations in the hierarchical system. In addition, important independent fault attributes such as average strike and dip and the fault's equivalent USGS Quaternary Fault (qfault) id association were updated to reflect any changes in underlying fault geometry.

As a result, many new or updated 3D representations were added to CFM in the Mojave and Eastern Transverse Ranges fault areas, together with updated, revised models for the Newport-Inglewood-Rose Canyon fault system and faults in the Western Transverse Ranges associated with the Ventura Special Fault Study Area. These fault updates in CFM include extending the active North Channel-Pitas Point-Red Mountain fault system west to Pt. Conception, updating the geometry of the offshore Oak Ridge and Mid-Channel faults, and incorporating sub-horizontal faults linked to S-dipping faults in the western, eastern, and mid-channel areas, including the Hondo, Padre Juan & Oak Ridge faults based on mapping with industry seismic reflection data. Further, a number of these faults were extended to greater depths with available relocated seismicity.

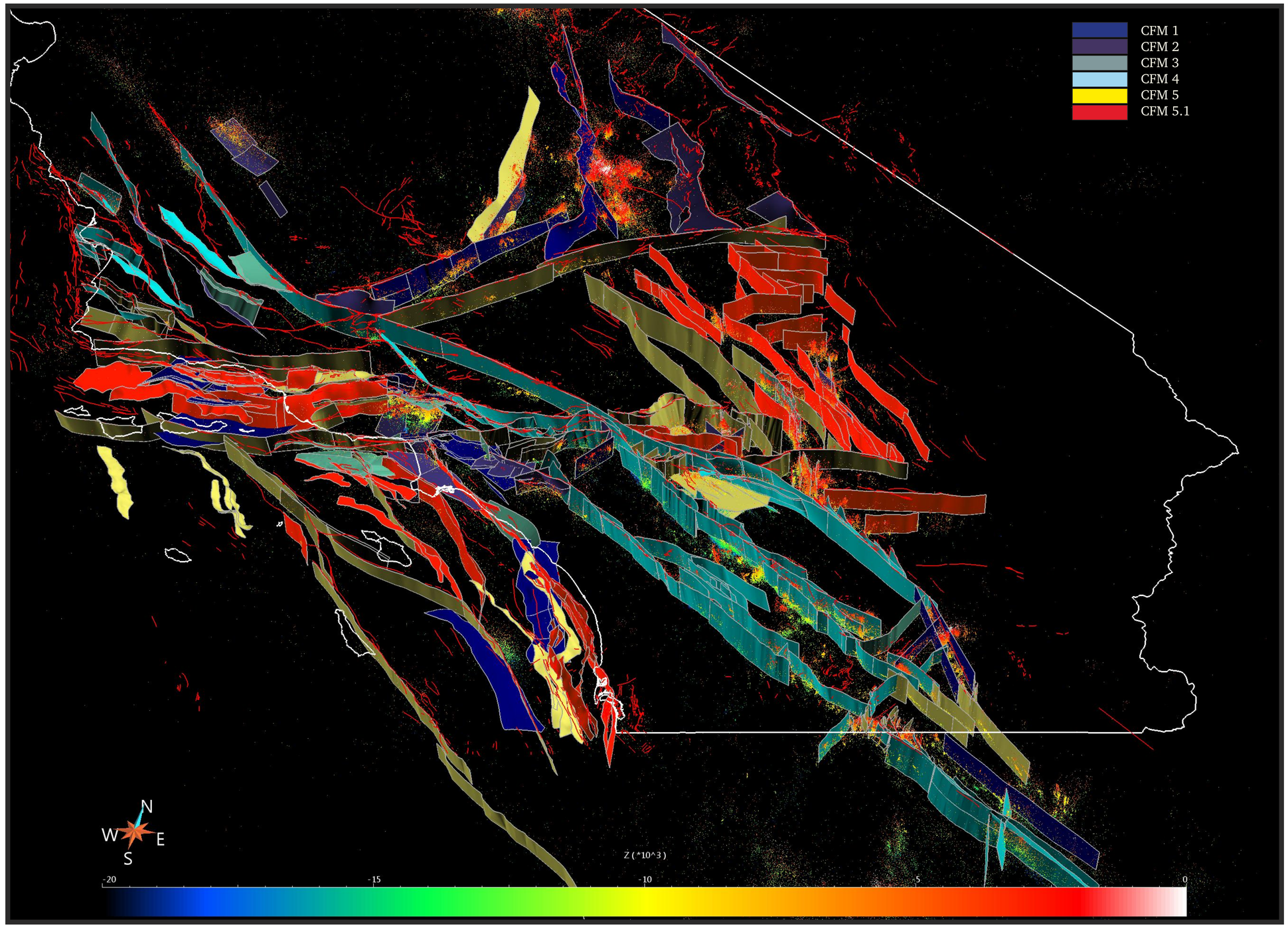

Fig. 1: Overview over development history of CFM 5.1 . The perpective view shows primary representations for each of the ca. 350 fault and fault sections in the model. The color refers to when the current fault presentation was added or improved during development of the CFM. All phases of development from CFM1 to CFM5 are still represented in the current model showing the need for an organized and systematic database which accompanies the model. 1981-2011 hypocenter locations by Egill Hauksson.

Database Improvements

The database currently is contained in large spreadsheet. In the spreadsheet each tsurf representation of a fault or fault components and potential alternatives are listed and attributed to a place in the hierarchy of the naming system. In addition to providing a fault system hierachy, the database also serves book-keeping purposes necessary for keeping track and locating available fault model components. During recent development of updated fault tsurf representations for the current release of CFM, the database was left behind compared to the actually available fault representation. We now synchronized the database with the latest catalog of tsurf fault files. The synchronization required a new strategy for primary storage of the fault objects. In contrast to our traditional system of storing fault objects in a hierarchical directory structure, we now use Gocad project files for storage and rely completely on the naming system and the database to express heirarchical structure.

The version 5.1 and future distribution of CFM are extracted from primary storage as flat collections of properly named tsurf files in ASCII format.

Inner Borderland Updates

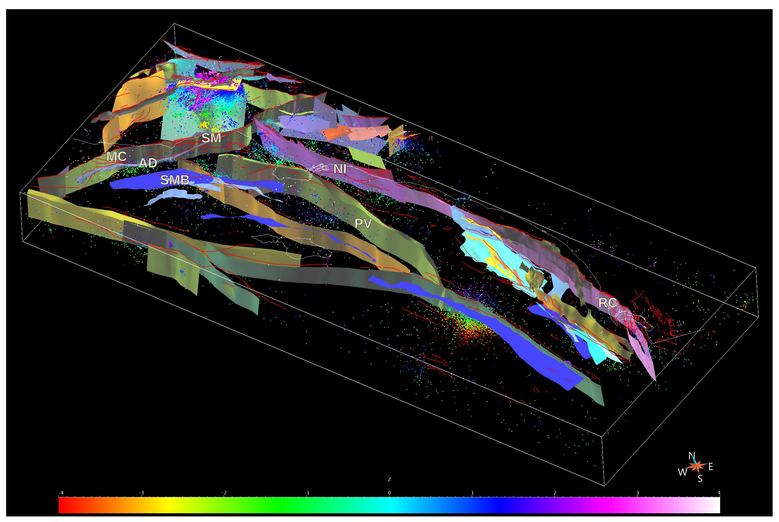

Fig. 2: Perspective view from south to north across the Inner Borderland. We added an updated alternative representation of the Newport-Inglewood fault (NI) which is registered to the USGS Quaternary Fault and Fold database (qfaults) of fault traces and includes the fault's major splays in the LA basin branching off the main fault in 5 km to 7 km depth. The Rose Canyon fault (RC) was also updated to conform to the qfaults trace. In addition, S. Monica Bay fault system (SMB) mapping was updated and a new and extended alternative representation of the Palos Verdes fault (PV) was added. The view shows an alternative configuration of the S. Monica (SM) - Malibu Coast (MC) -Anacapa Dume fault (AD) system where thrust faults truncate into steeply dipping faults. The CFM hosts such alternative configurations for many fault systems.

Support for SFSA Ventura Basin

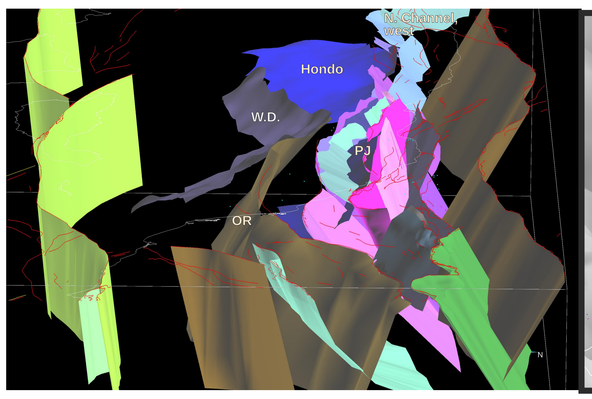

Fig. 3: Perspective view from east to west along the S. Barbara Channel. We added a "Western Deep" fault (W.D.) and the Hondo detachment fault, and updated the Oakridge (OR) and Padre Juan (PJ) faults. See poster by C. Nicholson.

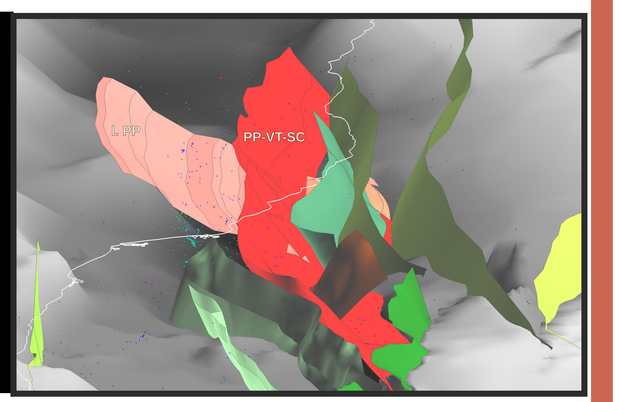

Fig. 4: Perspective view from east to west along the S. Barbara Channel showing the lower Pitas-Point thrust ramp (l. PP) and detachment level under the active Pitas-Point-Ventura-South Cayetano fault system (PP-VT-SC) extending over 120km. The CFM repository of fault representation in the Ventura SFSA proved to be a valuable resource for fault system, tsunami and seismic risk analyses.

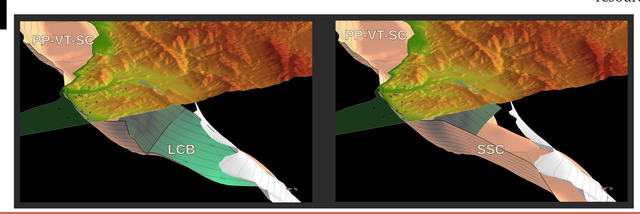

Fig. 5: Perspective views of alternative CFM models made available for seismic risk analyses at the eastern limit of the Pitas-Point-Ventura-South San Cayetano fault system (PP-VT-SC, Hubbard et al. 2012). In the configuration on the left, an extended Lion Canyon backthrust (LCB) is chiefly accommodates shortening by slip, whereas in the configuration on the right, slip and seismic potential is concentrated on a blind Southern San Cayetano fault (SSC).