

Interdisciplinary Studies for Urban Hazards: Seattle (SHIPS) and Southern California (SCEC)

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The U.S. government's FEMA (Federal Emergency Management Agency) 366 Report indicates that the majority of all the earthquake hazard risk in the United States is located along the Pacific-North American plate boundary in western U.S. Three major urban centers are at risk: Southern California (Los Angeles - San Diego), Bay Area (San Francisco - Oakland - San Jose), and Seattle. All three regions have been the subject of focussed interdisciplinary study during recent years and at present. The Seattle metropolitan area is under current study by the SHIPS project. Southern California was studied for ten years by SCEC and is beginning a new phase of study by SCEC-2.

The Seismic Hazard Investigation of Puget Sound (SHIPS) is a collaboration between the U.S. Geological Survey and several universities. The SHIPS project has seismological investigations including earthquake hypocenter locations and 3D tomography from data collected into permanent and temporary arrays, active-source seismic reflection and refraction experiments to produce high resolution velocity tomography of crust and upper mantle and reflection profiles for seismogenic fault structures, and local site response using diverse seismic source data. This study thus represents a major improvement in the knowledge of the detailed structure under Seattle.

SHIPS has four major phases of activity. "Wet" and "Dry" SHIPS represents seismic data collection involving marine airgun sources and land explosions, respectively. Kingdome SHIPS was a two-dimensional array deployed throughout the Seattle basin in order to get basin response when the old Kingdome stadium was demolished using explosive implosion methods. Seattle SHIPS is a current passive seismic deployment for site response. All of these efforts were collected to identify subsurface fault geometries and local site amplification behavior.

The Southern California Earthquake Center (SCEC) is a consortium of universities and government agencies seeking to quantify the seismic hazard in the greater Los Angeles metropolitan region (including Santa Barbara to San Diego). SCEC is focussed on probabilistic seismic hazard assessment (PSHA) and forecasting rather than on prediction. A diverse set of disciplinary studies are needed to provide accurate information to allow for best PSHA. This requires research ranging from surface geology to upper mantle geophysics. SCEC has emphasized the identification of active faults in greater Los Angeles, deformation rates at scales ranging from the current (GPS), historical (seismicity rates), 5,000 to 50,000 years based on paleoseismology, to long term rates (tectonics). SCEC has also pursued structural and physical property characterization of surface and buried faults, basins, and the geotechnical surface layer. 3D velocity structure of Southern California has been compiled and a similar attempt for 3D fault geometry is underway. SCEC is also studying the more theoretical topics of fault rupture dynamics (initiation and cessation) as well as stress transfer loading and triggering. Strong interaction between SCEC scientists has emphasized the importance of interdisciplinary interaction and exchange of data and results. An important SCEC activity is to make scientific results available to local government and industry officials.

Similarities and differences in geography and societal infrastructure exist between the western U.S. and Japan urban centers. These factors include population density, building "verticality", transportation networks, and economic and utilities infrastructures. The differences suggest more focussed quantitative efforts for direct local seismic hazards assessment in the Kanto and Kansai regions. However, proximity of the (plate) tectonics driving mechanisms indicates regional characterization is necessary. Finally, integration of diverse geological and geophysical studies is needed for proper seismic hazard assessment.