Thomas Jordan **University of Southern California, USA**
AFL: Southern California Earthquake Centre, USA

Forecasting Earthquakes and Predicting Their Hazards

Seismic hazards change dynamically in time, because earthquakes release energy on very short time scales and thereby alter the conditions within fault systems that will cause future earthquakes. Reliable and skilful earthquake prediction—i.e. casting high-probability space-time alarms with low false-alarm and failure-to-predict rates—is not yet (and may never be) possible. However, statistical models of earthquake interactions have begun to capture many of the spatiotemporal features of tectonic seismicity, such as aftershock triggering and seismic clustering. Such models can be used to estimate changes in the probabilities of future earthquakes over short intervals, in some cases with gain factors of 100-1000 relative to long-term forecasts. Operational earthquake forecasting (OEF) comprises procedures for gathering and disseminating authoritative information on time-dependent seismic hazards to help communities prepare for potentially destructive earthquakes. This presentation will discuss how physics-based simulations of earthquakes can be used in OEF and the related geotechnologies of probabilistic seismic hazard analysis (PSHA) and earthquake early warning (EEW). SCEC researchers have combined large ensembles of deterministic earthquake simulations with probabilistic rupture forecasts to create CyberShake 1.0, the first physics-based hazard model for Southern California. In the highly-populated sedimentary basins, CyberShake predicts long-period shaking intensities substantially higher than the empirical attenuation relations currently used in PSHA, primarily due to the strong coupling between rupture directivity and basin excitation. The application of numerical simulations in OEF, PSHA, and EEW offers new (and urgent) computational challenges, including requirements for robust, on-demand supercomputing and rapid access to very large data sets.