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Calcium is a critical component in many cellular functions. It serves many important functions such as signal transduction, contraction of muscles, enzyme function, and maintaining potential difference across excitable membranes. In this study, we examine spontaneous calcium waves in heart cells and how they initiate, propagate, and effect a transient measure of total cytosolic calcium. Calcium sparks are intracellular release events which are important in converting electrical stimuli into mechanical responses. We investigate the effects of stochastic release from calcium release units (CRUs) on generating calcium waves considering a distribution for the flux density term sampled (i) once for all CRUs and (ii) for each CRU independently. We include a stochastic flux density term as more physiologically appropriate than a fixed release rate. We use an array of statistical techniques as well as parallel computing to facilitate the large number of simulation runs. (Received January 22, 2014)