PREDICTION ANALYSIS APPLIED TO HYPOCENTER DETERMINATIONS FROM THE SOUTHEAST MISSOURI REGIONAL SEISMIC NETWORK

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Errors in the hypocenter determination for earthquakes are dependent upon random and systematic errors in the reading of arrivals and systematic errors in the parameters defining the appropriate velocity model. These errors are particularly critical in the study of local earthquakes detected by small aperture seismic arrays and regional networks, such as Saint Louis University's Southeast Missouri Regional Seismic Network.

The classical approach in seismology to hypocenter determination is to apply least squares analysis to arrivals of seismic phases as recorded on a set of seismograms. In this method the differences between observed and calculated travel times are minimized. In most cases an "error-free" velocity model is used. From the model parameters, the station coordinates, and the observed arrival times, corrections to an estimated hypocenter are computed. With the corrections applied to the estimated hypocenter the procedure is repeated until a desired accuracy is achieved. The estimates of the accuracies derived in this manner are somewhat artificial since the assumed error-free model does have uncertainties and since the arrival times are read with a degree of uncertainty. It becomes important, then, to place realistic bounds on the accuracies of the hypocenter and to incorporate these uncertainties into the assumed model.

The method to be used in investigating the accuracies of hypocenters is based on prediction analysis. Prediction analysis

is a general method for predicting the accuracy of results that can be expected from a proposed experiment. The standard deviations of the unknown parameters of the experiment are determined as a function of all parameters, variables and standard deviations of the experiment.

In this study an earthquake hypocenter is passed across a grid of points encompassing the area of the network of seismic stations. At each grid point the expected errors in the hypocentral parameters are computed. These errors are then contoured yielding maps of predicted accuracy of hypocentral determination. The predicted errors and the errors determined by a hypocenter location program are compared to check for consistency.