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Application of Detection Probabilities in the IDC Global Association Process

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The Global Association (GA) process at the IDC is an automated procedure that associates detections by stations in the International Monitoring System (IMS) in order to form event hypotheses. These hypotheses will later be reviewed by analysts before the Reviewed Event Bulletin is issued. We have continued the work presented at the 2011 EGU on investigating ways to improve the GA process for seismic data, in particular by incorporating amplitude data and station detection probabilities in the automatic process. We build on a previous study which has provided regional detection capability estimates for individual primary and auxiliary IMS stations, and use these estimates to develop and test various consistency measures. The purpose of these measures is to provide a means to assess the validity of seismic events automatically defined in the Standard Event Lists (SEL1, SEL2 and SEL3) and assess the consistency of individual phases associated with such events. By feeding the results of such assessments back to the GA procedure, we anticipate that the results of the global association can be iteratively improved.

Our basic approach is to make the hypothetical assumption that each automatically defined candidate event is real and correctly located. Using the regionalized station detection thresholds, we have the basis for calculating the station detection probability for events at that location as a function of event magnitude. By taking into consideration the actual pattern of detecting and non-detecting stations for the candidate event as listed in the SEL, we can therefore estimate a maximum-likelihood (MLE) magnitude for the hypothetical event. Based on this magnitude estimate, we then calculate, for each station, its probability of detection. By ranking the stations according to their detection probability, we can assess which stations are likely to detect or not detect this hypothetical event. We can then compare these probabilities to the actually observed phase list for the event as given in the SEL, and identify any inconsistencies.

An important consideration is to be able to identify whether or not a non-detecting station has actually been in operation at the expected time of detection. We accomplish this by making use of the continuous threshold monitoring (TM) system which is in operation at the IDC. The TM system calculates a threshold for each primary station at any point in time where data from that station is available, and therefore provides a reliable indication of the station's operational status.

In addition, we are exploring procedures to increase the number of valid event hypotheses generated by the automatic system, in order to relieve the analyst of some of the elaborate work of manually adding events that is now necessary. This paper presents some case studies illustrating various aspects of our approach.