A Transportable Regional Discriminant Using a Maximum Likelihood Analysis of Surface Waves

J. L. Stevens and K. L. McLaughlin
S-CUBED
P. O. Box 1620
La Jolla, CA 92038
Contract No. F19628-95-C-0110
Sponsored by AFTAC

Abstract

The objective of this research is to develop a robust extension of the mb:Ms discriminant that is:

1. transportable from region to region,
2. optimizeable for each region,
3. frequency independent,
4. usable at regional and teleseismic distances,
5. applicable to small magnitude events,
6. able to determine an upper bound in the absence of surface wave data,
7. robust with respect to regional variations and operational considerations,
8. usable in an operational system.

The product of this research will be a procedure to analyze surface waves from earthquakes, explosions, and other seismic sources, and to form a discriminant, an extension of the mb:Ms discriminant, that can be implemented in an automated, semi-automated, or interactive system. The research will test the procedure on a broad range of data to determine the range of reliability, minimum magnitude for which the method provides reliable results, limitations and unusual conditions that might cause the analysis procedure or discriminant to fail.

In brief, the method that we plan to implement works as follows: In place of Ms, we use path corrected spectral magnitudes (scalar moment) combined with a maximum likelihood procedure. The path corrections include phase-matched filtering which compress the data into a relatively small time window, reducing the problem of interfering arrivals. The scalar moment is essentially a spectral magnitude, averaged over a range of frequencies and corrected for source and path effects. An explosion Green's function is used for path correction for both explosions and earthquakes. Since it is not necessary to know the source type in advance, the method can be used for discrimination in the same manner as mb:Ms. An upper bound on the scalar moment can be found even if no surface wave data is measureable. Stevens and McLaughlin (1988) applied this procedure to a large number of explosions and earthquakes in Central Asia and the Western United States.

Keywords: Seismic, Discrimination, Surface Wave, Explosion, Earthquake, Ms