SEISMIC LOCATION CALIBRATION FOR 30 INTERNATIONAL MONITORING SYSTEM STATIONS IN EASTERN ASIA

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ABSTRACT

We review the progress of a collaborative academic-industry research consortium, comprised of five institutions, that has started an integrated series of projects to improve the capability to locate seismic events based on data acquired by International Monitoring System (IMS) stations in Eastern Asia. This effort is to develop and deliver validated high-resolution travel time grids for operational use.

During the first year of work we have focussed on IMS stations in Central Asia and Northern Pakistan, specifically the stations MAK, BRVK, KURK, AAK, AKTO, ZAL, PRPK/NIL, for which we are obtaining preliminary Source Specific Station Corrections (SSSCs). Each station presents its special problems and opportunities. Thus, although only two of these stations (ZAL and NIL) are currently contributing data to the International Data Centre (IDC), we have broadband high-quality data from surrogate stations at or close to the planned IMS sites for the other five sites. In joint projects with the National Nuclear Centre of the Republic of Kazakhstan (NNCRK) and the Institute of Dynamics of the Geosphere of the Russian Academy of Sciences, regional waveforms from Borovoye (BRVK) have become available for 80 Soviet PNEs, 228 Semipalatinsk explosions and 11 Lop Nor explosions. In a joint project with the NNCRK and the Complex Seismological Expedition based in Talgar, Kazakhstan, regional waveforms from 37 Soviet Peaceful Nuclear Explosions (PNEs) have become available for several other stations in Central Asia. Since 1994 we have operated broadband instrumentation jointly with the NNCRK at MAK, BRVK, KURK, and AKTO — enabling, for example, the recording of regional waves from numerous earthquakes throughout Central Asia, and some nuclear explosions (Lop Nor). We have obtained empirical travel times from all these datasets, using published high-quality ground truth information for the Soviet PNEs.

Other valuable sources of empirical travel time information have been the Deep Seismic Sounding (DSS) profiles carried out with chemical explosions in and near Kazakhstan, and DSS profiles carried out with nuclear explosions in the northern part of the former Soviet Union. We have been able to document the variability of regional travel times with these data, finding in particular that *Sn* and *Lg* waves show significant variability. Preliminary Source Specific Station Corrections have been used for stations MAK, AAK, KURK, ZAL, TLY, ULN, NIL, and BRVK to relocate nuclear explosions at Lop Nor, showing improved accuracy and reduced confidence ellipses. We are extending this process of validation to include PNEs and other underground nuclear explosions in the former Soviet Union, and earthquakes for which we have adequate ground truth.

We are now collecting high-precision hypocenter locations for mainland China by applying a double-difference (DD) earthquake relocation technique to travel time data given in the Annual Bulletin of Chinese Earthquakes (ABCE). In areas with dense seismicity, where the DD technique minimizes model effects without the use of station corrections, we find the relocated events cluster in space and appear to delineate local tectonic features. Analysis of the residuals indicates that the phase picks are of high quality, and that they are best suited to image seismicity with high resolution on a local (several km) scale. Increasing earthquake density by including ABCE data from additional time periods might help to relocate earthquakes over larger distances, such as entire fault systems. Such studies have the potential to increase groundtruth data as well as contribute to a better understanding of the tectonic processes in China.

KEY WORDS: earthquake location, Peaceful Nuclear Explosions, Chinese seismicity.