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Estimating station noise thresholds for seismic magnitude bias elimination

Sheila Peacock
AWE Blacknest, Reading, United Kingdom (geophyspeacock@googlemail.com)

To eliminate the upward bias of seismic magnitude caused by censoring of signal hidden by noise, noise level at each station in a network must be estimated. Where noise levels are not measured directly, the method of Kelly and Lacoss (1969) has been used to infer them from bulletin data (Lilwall and Douglas 1984). To verify this estimate of noise level, noise thresholds of International Monitoring System (IMS) stations inferred from the International Data Centre (IDC) Reviewed Event Bulletin (REB) by the Kelly and Lacoss method for 2005-2013 are compared with direct measurements on (i) noise preceding first arrivals in filtered (0.8-4.5 Hz) IMS seismic data, and (ii) noise preceding the expected time of arrival of signals from events, where signal was not actually seen (values gathered by the IDC for maximum-likelihood magnitude calculation). For most stations the direct pre-signal noise measurements are $\sim$0.25 units of log A/T lower than the Kelly&Lacoss thresholds; because the IDC automatic system declares a detection only when the short-term-average-to-long-term-average ratio threshold, which varies with station and frequency band between $\sim$3-6, is exceeded. The noise values at expected times of non-observed signal arrival are $\sim$0.15 units lower than the Kelly and Lacoss thresholds. Exceptions are caused by faulty channels being used for the direct noise or body-wave magnitude (m_b) measurements or, for station ARCES and possibly FINES, SPITS and HFS, the wider filter used for signal amplitude than for signal detection admitting noise that swamped the signal. Abrupt changes in thresholds might show mis-documented sensor sensitivity changes at individual stations.