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Short Communication

Detection Probabilities for Earthquakes in Sweden

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In recent years, the need for improved seismic risk evaluations in Sweden has led to accurate estimates of detection probabilities with respect to weak Swedish earthquakes. Generally, these rather low-magnitude events ($M_L < 4$) are recorded only by means of the *Swedish Seismograph Station Network* (SSSN), currently consisting of six permanent stations. Only occasionally do neighbouring Finnish and/or Norwegian stations also contribute with arrival-time readings. Hence, for weak regional events, we lack the usual reference system of organisations like ISC, NEIS or EMSC when estimating the detection performance of the SSSN-stations. The problem has recently been studied and a solution suggested by Shapira et al. (1979a), to be referred to as Paper I. In short, their method, which is based upon a modification of the approach of Ringdal (1975), enables the estimation of threshold magnitudes for weak events monitored exclusively by regional networks.

The main objective of the present short communication is to indicate the ability of the SSSN to detect earthquakes in Sweden and the relative detection contributions from individual network stations. The data used comprise 121 earthquakes located within Sweden and adjacent waters (Wahlström 1978). The statistical model used and other theoretical aspects of the modified approach are discussed in greater detail in Paper I and are not repeated here.

When applying the modified approach, the detectability is related to the epicentral distance rather than to a certain seismic region. To introduce the distance dependence, all available earthquakes are relocated to a common epicentral distance. It is assumed that recorded amplitudes and periods are not influenced by performing the distance and corresponding magnitude conversion. Employment of the distance transformation enables calculations of magnitudes for fictitious events located at a number of chosen epicentral distances. For more details, the reader is referred to Paper I and to Shapira et al. (1979b).

The decision "detected" or "not detected" is based upon the conserved amplitude and period values linked with the *Sg*-phase. Thus, when the actual earthquake is detected by station *A*, then it is assumed that all relocated events associated with this actual earthquake, are also detected. The percentage of detections, for each magnitude, is fitted to the detection curve $P(M_R)$ which yields estimates of biased threshold magnitudes $b \pm s$. Corrected threshold magnitudes $\hat{b} = b + C_A$ and their variance $\hat{s}^2 = s^2 - \rho_A^2$ are to be used when comparing the detecting power of stations within the network. C_A is station magnitude bias and ρ_A^2 is magnitude variance.

The modified approach has been applied to each of the six SSSN-stations. Events were relocated to a common epicentral distance of 500 km. A fit to the detection curve and estimates of *b* and *s*, associated with 50% probability, are presented in Fig. 1 Numerical values of $\hat{b}$ and $\hat{s}$, corresponding to 50% probabilities, are also given in Fig. 1. Considering 90% detection levels, station UDD contributes to the detecting power more than any other station of the SSSN. The second best station is SKA, although its operational magnification is the lowest among the six stations.

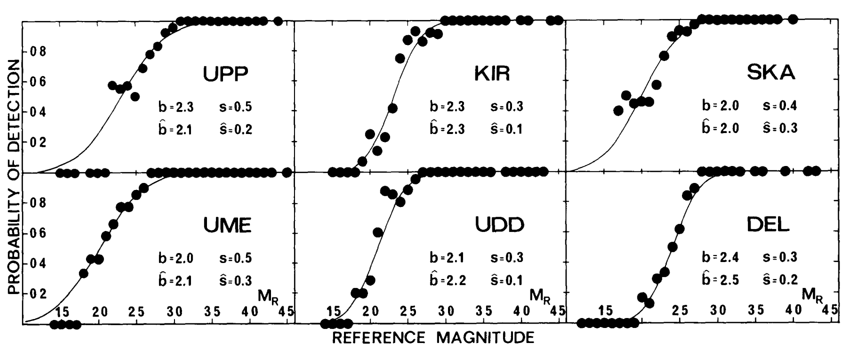

Fig. 1. Matched detection curves, $P(M_R)$ (*solid lines*), and observed detection probabilities (*solid circles*) for the six stations considered (*UPP*= Uppsala, *KIR*=Kiruna, *SKA*=Skalstugan, *UME*=Umeå, *UDD*=Uddeholm, *DEL*=Delary) and for epicentral distance of 500 km. Biased and corrected threshold magnitudes and corresponding variances, associated with 50% probabilities, are given for each station

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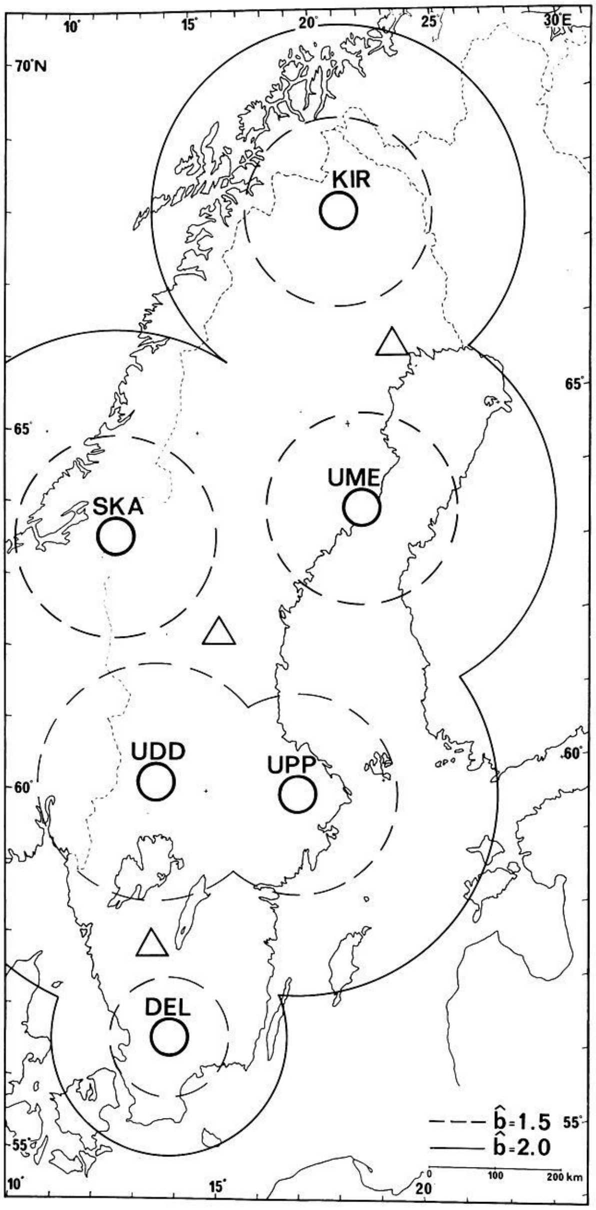

Fig. 2. Locations of the six permanent seismograph stations of the current SSSN (*open circles*). Loci of constant threshold magnitudes $\hat{b}=1.5$ and $\hat{b}=2.0$ (*thin circles*) with respect to the SSSN and 90% detection level. *Open triangles* show three suggested new recording sites

In Fig. 2, 90% probability contours corresponding to $\hat{b}=1.5$ and $\hat{b}=2.0$ are displayed. It follows from the figure, that Swedish earthquakes of magnitude 2.0 or larger will be detected by at least one station of the current SSSN. To increase the detection capability, say, to a threshold magnitude of 1.5, we may suggest three additional stations, as shown in Fig. 2. The three new recording sites are suggested with regard to the known seismicity of Sweden.

Our main conclusions may be summarized as follows: (1) The applicability of the well-known direct estimation method has been extended to weak earthquakes recorded solely by regional seismograph networks. (2) Swedish earthquakes of magnitude $M_L=2.0$ or larger are detected with 90% probability by at least one station of the current SSSN.

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