SINGLE AND MULTIPLE DISLOCATION MODELS OF EXTENDED EARTHQUAKE SOURCES

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Summary: A short review of simple theoretical models for extended earthquake sources visualized as single and multiple dislocations is presented. Formulas for the duration of the radiation \( \delta t_i \) from the starting point of the destruction up to the region forming the amplitude maxima of body waves are given. A method for determining some basic parameters of extended earthquake sources (length and depth of the dislocation, azimuth of the first dislocation and the angles between every two consecutive dislocations) from the seismogram data for \( \delta t_i \) is presented. The procedure is applied to yield some practical results.

1. INTRODUCTION

The study of the mechanism of formation of the maximum seismic amplitude is of great importance for the correct interpretation and full use of seismograms.

It is well known that the maximum amplitude \( A_{\text{max}} \) or maximum velocity \( (A/T)_{\text{max}} \) of the \( P \)-wave is observed on seismograms seconds or tens of seconds after the first \( P \)-arrival. Generally its delay depends on the source size or on the earthquake magnitude and azimuthal site of the seismic stations, respectively. At the same time, from a physical point of view, if an earthquake source is considered to be extended, \( A_{\text{max}} \) or \( (A/T)_{\text{max}} \) are not formed near the origin or end point of the fault line, where the density of the elementary energy sources or the intensity of the destruction process and the velocity of faulting are very low. The maximum of the radiated energy will be formed in the area of the most intensive destruction. In this case the maximum of the radiated energy will be formed somewhere between the middle and end points of the fault line.

A single dislocation model of an extended earthquake source has been developed by Christoskov [1] who paid special attention to the most prominent amplitude maximum of the \( P \)-wave group.

A careful study of the amplitudes of the \( P \)-wave group shows that several consecutive maxima of the amplitude pattern on the seismograms are observed especially in very strong earthquakes. A number of authors explain the occurrence of more than one maximum by the consecutive multiple destructions at the dislocation line in the source [2–6]. Such a process is visualized as multiple stopping and renovation of the destruction process leading to the formation of several consecutive dislocations. In practice such sources are already specified as “multiple” events. Following [7] and [8], the formation of a series of amplitude maxima for this kind of source is considered.

Here the results of single and multiple theoretical dislocation models of extended earthquake sources are generalized. A method determining the principal parameters of the earthquake source is proposed and the results of its application in practice are presented.

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2. MODELS OF EXTENDED EARTHQUAKE SOURCES IN CASES OF SINGLE AND MULTIPLE DISLOCATIONS

A geometrical representation of an extended earthquake source as a projection on the Earth's surface is given in Fig. 1a. Point $O(\varphi_0, \lambda_0)$ denotes the epicenter (the projection of the initial point of destruction) where $\varphi_0$ and $\lambda_0$ are the latitude and longitude of point $O$, respectively. The points from $F_1$ to $F_n$ mark the subsequent stopping of the rupture process as a result of which dislocation lines $l_1$ and $l_n$ are generated. In the case of a single rupture only the dislocation line $l_1 = OF_1$ is con-

Fig. 1a) Mutual positions of the dislocations under single ($i = 1$) and multiple ($i = 2, 3, \ldots, n$) destruction and seismic station $S$. b) Vertical section for dislocation $L_i$. 

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