INTRODUCTION

The diurnal periodicity of earthquakes in Southern California has been studied in different publications. However, most-often analyzed are data from one relatively short-term interval (Zhuravlev and Sidorin, 2005, 2006; Sidorin, 2010, 2012, 2013) or an entire catalog (Atef et al., 2009). But the earthquake catalog of Southern California is characterized by a very high inhomogeneity of data. The contribution of aftershock activity to this inhomogeneity and the influence of the gradual development of the observation system are considerably magnified by the dense local observation networks installed after strong seismic events. This decreases the validity and statistical significance of the conclusions.

On the example of earthquake catalog of Greece, we proposed, and successfully used, an approach that enables us to significantly increase the validity of results (Deshcherevskii and Sidorin, 2012c, d, 2013a). This approach implies a detailed analysis of the spatiotemporal distribution of catalog representativity and the formation of a large number of quasi-homogeneous samples on the basis of analysis results (the samples differ in their energy and representativity level—the magnitude of events recorded without misses). A comparison between analysis results for multiple independent data samples, with different methods used for analysis, enables us to obtain robust estimates of the statistical significance of the hypothesis about presence of diurnal periodicity of earthquakes and about the possible mechanisms of its appearance.

In the present work, this approach is used to study the earthquake catalog of Southern California. Therefore, the aim of the present paper is to investigate the parameters of diurnal periodicity of earthquakes in Southern California on the basis of multiple quasi-homogeneous earthquake samples with the subsequent complex analysis of these samples, with robust estimates of the statistical significance of the obtained results.

INITIAL DATA

We used the earthquake catalog of Southern California for the period from 1932 to June 2013. This is one of the most complete catalogs of local earthquakes in the world. It was compiled by the Southern California Earthquake Data Center (SCEDC), based on data from the Southern California Seismic Network (SCSN). Detailed information about this catalog can be found in (Hutton et al., 2010).

A preliminary analysis of the catalog revealed territories with uncertain representativity of earthquakes, and these areas were not considered in the further study. As a result, the spatial limits of the catalog analyzed in the present work are shown by the polygonal frame in Fig. 1. This catalog included 567199 events, or about 98% of the total number of earthquakes in the initial catalog.

FORMATION OF SAMPLES

The samples were formed based on the results of an analysis of catalog representativity for different territories over different observation intervals. The technique of this analysis is described in (Deshcherevskii and Sidorin, 2013b). The purpose of the analysis was to distinguish the time intervals (epochs) over which no sharp changes in the quality of earthquake recording were observed and the earthquake series could be considered homogeneous to the first approximation. In accord with the results of the present work, nine
epochs were chosen for analysis: six reference epochs and three transitional ones; transitional epochs are those for which the homogeneity criterion was not satisfied. We considered earthquakes occurring within the area limited by a polygonal frame (see Fig. 1). The list of epochs and their dates are given in Table 1.

The total number of events for all epochs is 551,524, including 189,595 events in the reference samples. Table 2 presents the volumes of each sample, and the filled cells denote representativity characteristics.

In order to enable a more complete catalog, the graph of minimal magnitude change for the observation period was plotted (Fig. 2). Each point of this graph indicates a monthly lowest magnitude value.

The graph of minimal magnitudes clearly shows that the subdivision of the entire catalog into epochs, as was done in (Deshcherevskii and Sidorin, 2013b, 2013c) for the purpose of keeping the homogeneity of seismic network and the respective earthquake series, adequately reflects the inner structure of the catalog. All the essential changes of the $M_{\text{min}}$ graph are seen in the boundaries of epochs; and vice versa, almost all boundaries between the distinguished epochs are accompanied by changes in the $M_{\text{min}}$ graph. Significant changes are only not observed at three boundaries out of eight: C–D, D–DE, and E–EF.

To analyze the periodic variations in seismicity for each sample, we constructed a series of earthquake numbers (SEN). For this purpose, the number of earthquakes, with their respective energy, occurring during each hour was counted. Then a time series with an even time step was constructed; each value of this series was a total hourly number of earthquakes (hereinafter, THNE). A detailed description of THNE construction is given in (Deshcherevskii and Sidorin, 2012d, 2013a, 2013b). Note that due to the high non-