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NETWORK CHARACTERIZATION OF TSUNAMI TIME SERIES USING VISIBILITY GRAPH ANALYSIS: THE 30 OCTOBER 2020 İZMİR–SAMOS TSUNAMI EVENT

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ABSTRACT

The 30 October 2020 İzmir–Samos tsunami generated substantial sea-level oscillations throughout the eastern Aegean Sea and was recorded at several tide-gauge stations. Since the event, numerous studies have examined its hydrodynamic behavior, spectral characteristics, and predictability using conventional time-series analysis techniques [1]. However, comparatively less attention has been given to the structural organization of the recorded signals and the possibility of describing tsunami evolution from a network perspective. Sea-level records from the Syros and Bodrum tide-gauge stations are analyzed using visibility graph analysis, a method that transforms a time series into a complex network by establishing connections between mutually visible observations [2]. Following mean removal and spectral detrending, natural visibility graphs are constructed from the processed tsunami records. The resulting network representation enables the characterization of the time series through graph-theoretical measures rather than solely through conventional amplitude- or frequency-based descriptors. The analysis focuses on whether different phases of tsunami evolution can be distinguished through the topological properties of visibility graphs constructed from sea-level records. To examine this issue, each record is divided into three periods corresponding to pre-tsunami conditions, the interval of strongest tsunami activity, and the subsequent oscillatory stage. For each period, network measures including average degree, clustering coefficient, and average path length are evaluated and compared. Rather than proposing a new graph construction algorithm, the study focuses on the applicability of visibility graph analysis to tsunami observations. The resulting network measures provide a complementary description of tsunami-induced sea-level fluctuations and support the use of network-based approaches in coastal and ocean engineering research.

Keywords Tsunami time series · Visibility graph analysis · Complex networks · Graph theory · İzmir–Samos Tsunami

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