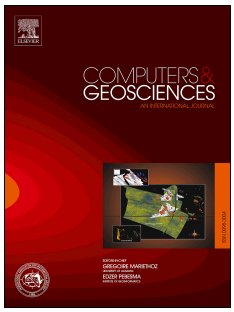
Accepted Manuscript



A density-based clustering algorithm for earthquake zoning

Sanja Scitovski

PII: S0098-3004(17)30592-7

DOI: 10.1016/j.cageo.2017.08.014

Reference: CAGEO 4011

To appear in: *Computers and Geosciences*

Received Date: 25 May 2017

Revised Date: 24 July 2017

Accepted Date: 20 August 2017

Please cite this article as: Scitovski, S., A density-based clustering algorithm for earthquake zoning, *Computers and Geosciences* (2017), doi: 10.1016/j.cageo.2017.08.014.

A density-based clustering algorithm for earthquake zoning

Sanja Scitovski[1]
University of Osijek
Trg Sv. Trojstva 3, HR–31 000 Osijek, Croatia
e-mail: sscitov@unios.hr

Abstract. A possibility of applying the density-based clustering algorithm Rough-DBSCAN for earthquake zoning is considered in the paper. By using density-based clustering for earthquake zoning it is possible to recognize nonconvex shapes, what gives much more realistic results. Special attention is thereby paid to the problem of determining the corresponding value of the parameter ϵ in the algorithm. The size of the parameter ϵ significantly influences the recognizing number and configuration of earthquake zones. A method for selecting the parameter ϵ in the case of big data is also proposed. The method is applied to the problem of earthquake data zoning in a wider area of the Republic of Croatia.

Keywords: Earthquake zoning; Density-based clustering; Big data; Rough-DBSCAN;

1 Introduction

In this paper, we consider a problem of seismogenic zoning in some bounded area (see e.g. Markušić and Herak (1998); Morales-Esteban et al. (2014); Scitovski and Scitovski (2013)). It is well known that seismic moments can be considered as stationary Poisson processes with a fixed occurrence rate over time (Cho et al., 2010), and that devastating earthquakes usually occur without warning and in seconds they can destroy whole cities and severely injure or even kill thousands of inhabitants. Hence it is important to regularly monitor the occurrence of earthquakes and to study their characteristics. The well-known Gutenberg-Richter Law is often used in various studies of seismic activity, e.g. Asencio-Cortés et al. (2017) have studied different seismogenic zones in a wider area of the Republic of Croatia (hereinafter referred to as: Croatia) in terms of earthquake predictability.

Seismic activity in a wider area of Croatia is considered in this paper. Namely, due to its nonconvex geographical shape, in order to analyze seismogenic zones of Croatia, the whole area of Bosnia and Herzegovina and parts of Montenegro, Serbia, Italy and Slovenia should be taken into consideration. Data on seismic activity in a wider area of Croatia can be downloaded free of charge from U.S. Geological Survey http://earthquake.usgs.gov/. These data are of the form: *Year/Month/Day/hh/mm/ss/Latitude (φ)/Longitude (λ)/Depth/Magnitude (M_i)/*. Similarly to Scitovski and Scitovski (2013), based on such data the set

$$\mathcal{A} = \{a^i = (\lambda_i, \varphi_i) \in \mathbb{R}^2 \colon L_\lambda \leq \lambda_i \leq U_\lambda, \quad L_\varphi \leq \varphi_i \leq U_\varphi\} \tag{1}$$

[1]Corresponding author: Sanja Scitovski, e-mail: sscitov@unios.hr, telephone number: +385-31-224-105, fax number: +385-31-224-165