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Spatial and Temporal Distribution of the Earthquakes in Seismically Active Regions of the World in 2000-2015

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Abstract

The research enables proving the hypothesis that there are some regions, where events are better distributed in time and space regarding normality and there are also regions, in which the earthquakes are not distributed normally in time (only 10%-15% according to the statistics). Finally, we may assume that there are seismic regions with strongly similar, more or less similar and very different statistical structures. The theme for the following research is making cluster analysis of other regions and constructing a mathematical model in order to reveal triggered earthquakes.

Methodoology

The research is based only on the global. statistical data of earthquakes with magnitude 5 and more (catalog http://www.isc.ac.uk). According to the obtained database we constructed in a 3D plot of expression T=F(t ,φ, λ), where t is time, which participates in the model as the catalog time of the given earthquake in the converted time series format (vertical axis) and (φ, λ) are geographic coordinates (Fig.1). Models built program Mathalb2015a.

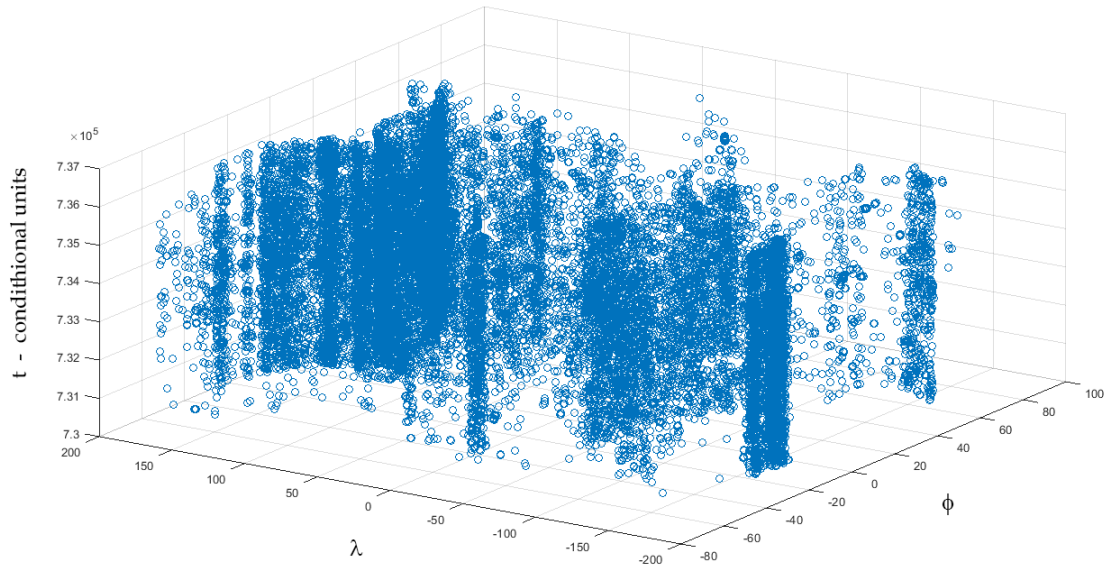

Figure. 1. 3D visualization of spatio-temporal structure of earthquakes hypocentres locations in 2000-2015 (magnitude >=5). (φ, λ) geographic coordinats (degrees), t- condithional units.

Rezults and Discussion

The developed 3D model enables assessing the confidence intervals for specific regions with certain assumptions in time. When we insert geographic parameters range diapason in the model it

will return the time interval of the ?following earthquake with a specific probability for a specific region. Visualization enables distinguishing linearly arranged structures positioned vertically on the time axis in certain regions. The structures develop in time and the final pattern is shown in Fig.1.

It is interesting also to construct the graphical interpretation of simultaneous structure of spatio-temporal distribution in seismically very active regions.

Taking into account these data we observed the most active regions separately in time and space. Quite interesting statistical structures were revealed for various regions (Fig.2). The graphical image shows that for some regions during the whole time (2000-2015) the earthquakes are not distributed normally in time, except some cases. The red signs in the scheme denote the cases strongly declined from normal distribution and the vertical red dividing line in a rectangle means an median value **.**

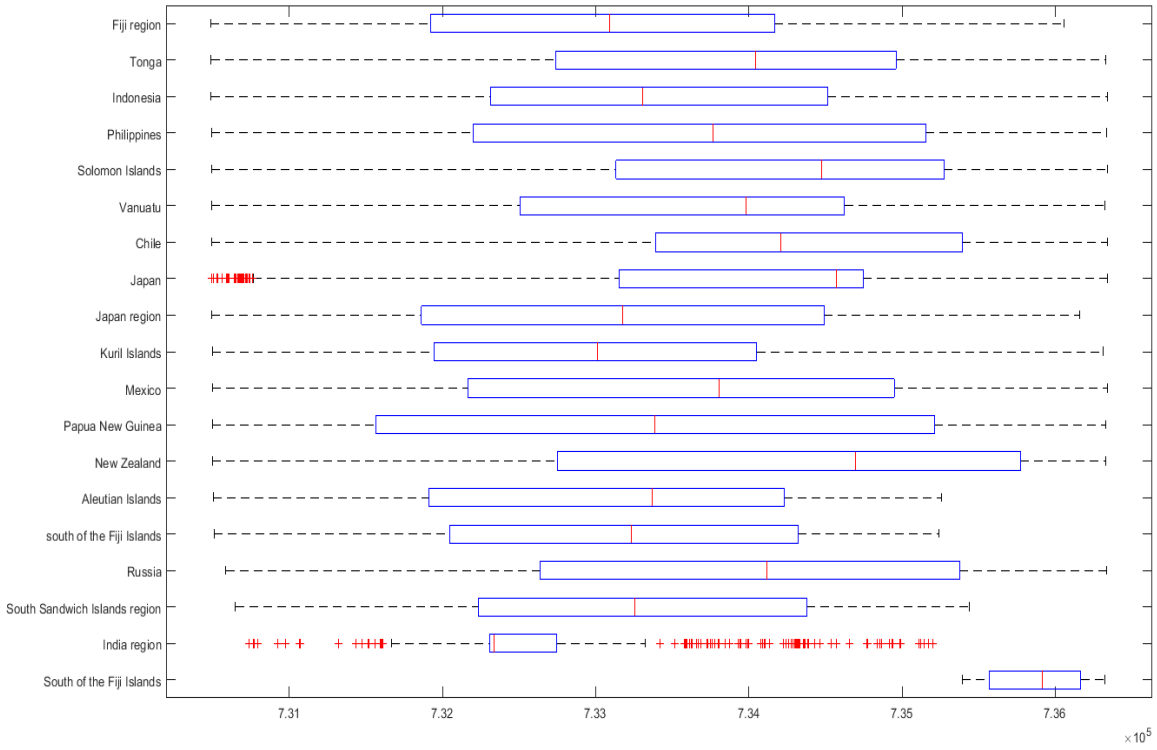

Figure 2. Comparative survey of temporal distribution of earthquakes for active seismic regions. (boxplot, Soft - Mathlab 2015a)

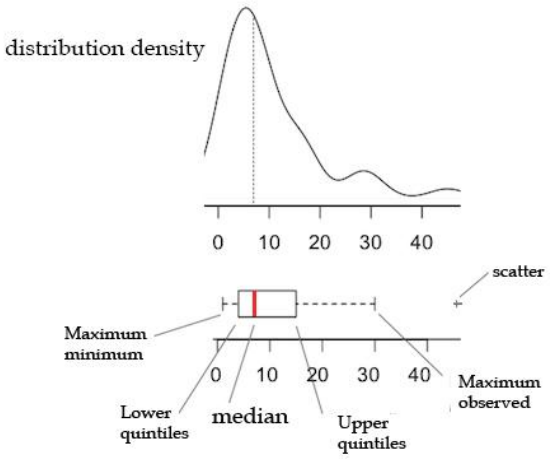

Figure 2a. Example of how to read infographic

The extreme points of the rectangles are known as quantiles and dotted lines to the left and right of the rectangle are the statistics left beyond the normal data distribution area of the specific region.

The individual percentage ratio of (temporally) normally distributed and outlying events for different regions is obvious.

This is also can be seen in the hypocentres' distribution visualization (Fig.3).

The following is the visual image of the hypocentres' values normality for the most active regions, where 3 regions are distinguished for their 80% normality with average depth 400 km (see Fiji regions).

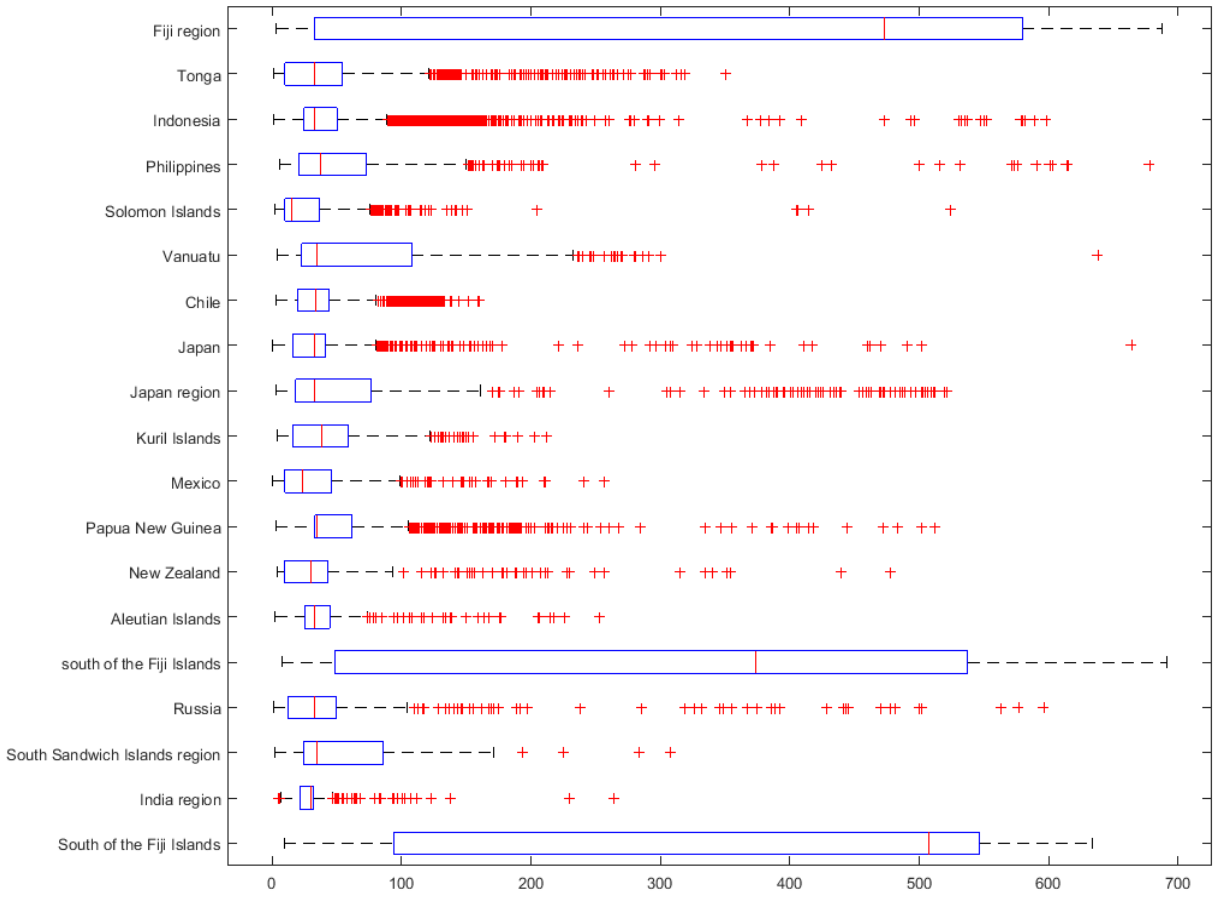

Figure 3. Comparative survey of hypocentres' distribution normality of earthquakes for most active seismic regions: hypocentres depth are shown on the x-axis.

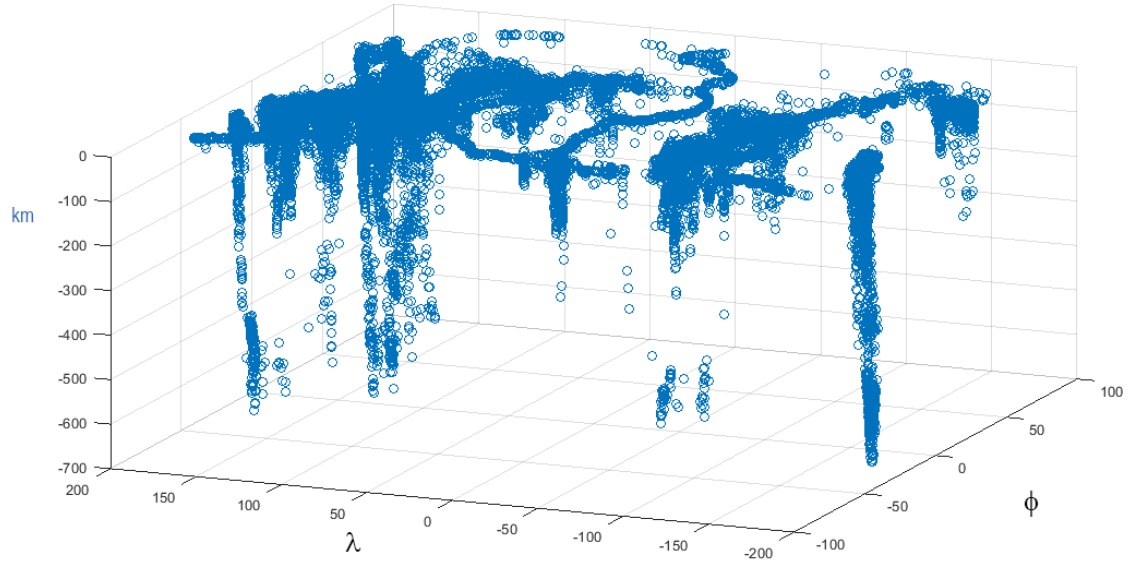

Figure 4. 3D model of hypocentres distribution of earthquakes for top seismic regions (vertically, depth in km, (φ, λ) longitude-latitude in degrees.

Figure 4 presents the 3D model of above mentioned supposition on hypocentres distribution. The highlighted vertical linear structures show certain order in depth distribution of earthquakes in relevant regions. Such regions are apparently a minority and this is a separate issue for consideration.

Finally it is to be said that according Figures 3 and 4 we may distinguish so called regional clusters with distribution visualization.

Acknowledgments

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References:

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2000-2015 წლების მსოფლიოს სეისმურად აქტიური რეგიონების მიწისძვრების განაწილება სივრცეში და დროში

თ. ქირია

რეზიუმე

ნაშრომში განხილულია სეისმური კატალოგიდან ამორჩეული ძლიერ აქტიური რეგიონების მძლავრი მიწისძვრების გარშემო ჩატარებული სტატისტიკური სტრუქტურების და კლასტერული ანალიზის საკითხები, მიწისძვრის, როგორც დროში მიმდინარე შემთხვევითი პროცესის პარამეტრების დრო-კოორდინატის და კოორდინატი-ეპიცენტრის ურთიერთკავშირების და განაწილებითი თვისებების არაერთგვაროვნების ნიშნები, რომელიც ამყარებს აქამდე არსებულ შედეგებს (იხ. Public Release of the ISC–GEM Global Instrumental Earthquake Catalogue (1900–2009) Dmitry A. Storchak, Domenico Di Giacomo, István Bondár, E. Robert Engdahl, James Harris, William H. K. Lee, Antonio Villaseñor, and Peter). მოყვანილი ვიზუალიზაციიდან იკვეთება რეგიონები, რომლებიც დროით სივრცეში უკეთ განაწილდებიან ნორმალურობის თვალსაზრისით და, ასევე, აშკარად ჩანს რეგიონები, რომელთა მიწისძვრები დროში არ განაწილდნენ ნორმალურად (მხოლოდ 10%-15% სტატისტიკით). საბოლოოდ, შეიძლება ითქვას, რომ არსებობენ ძლიერად მსგავსი, მეტნაკლებად მსგავსი და ძლიერ განსხვავებული სტატისტიკური სტრუქტურების მქონე სეისმური რეგიონები.