

A Statistical Investigation of Earthquakes in Greece and the Effect of the Lunar Triggering

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Abstract. The aim of this paper is to investigate the influence of the lunar period in Greek earthquakes. All earthquakes of magnitude >4 within the decade 2000-2009 have been classified according to their time distance from the full moon and studied with statistical methods.

Keywords: Greek Earthquakes, Lunar Triggering, independent Samples T-Test.

1 Introduction

Lunar gravity force as a triggering factor of earthquakes is an hypothesis of discussion statistically examined in the seismological society since the end of the 19th century (Knott 1896; Schuster, 1897), in many different geographical regions as in (Allen, 1936; Lin et.al 2003). The geological form is dominated by alpine (marbles, schists, limestones and sandstones) and post-alpine rocks (Neogene and loose Quaternary formations) (Diakakis et al., 2016).

Greece is located at the front of the collision between two tectonic plates, the Eurasian and the African, the front part of which is sinking under the former. As a result although Greece covers 0.09% of the global area it accounts for the 2% of the global seismicity (Bath, 1983) and it is by far the most seismic country in Europe (Chalikias, 2012).

In the present paper we investigate whether there exists a statistic significant correlation between the seismic phenomena in Greece and their distribution in the lunar time. Data of earthquakes in Greece were used and the correlation was proved by the usage of statistical Tests.

2 Research Methodology

The data of this researched have been obtained from the detailed catalogue of earthquakes in Greece and adjacent areas in (Makropoulos et al, 2012). Due to the

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hundreds of the earthquakes that take place every year we constrained our sample on the ones of magnitude 4 or higher that took place within the ten year period 2000-2009.

We classified the sample according to the daily distance from the date and accurate time of the nearest full moon. We defined as 0-day the period consisted of the 12 hours prior and 12 hours after the earthquake. For the processing of the data we have used the IBM SPSS Statistics Software Package. With Kolmogorov Smirnov Test the normality of the data were examined and one sample T-Test were used to demonstrate the correlation of earthquakes and the effect of Lunar Triggering.

3 Statistical Analysis

From earthquake data collected from the period 2000-2009, we observe that 59% of the earthquakes occur during the period beginning 6 days before and ending 6 days after the day of the full moon (Table 1), while a large majority, 81.3% of the earthquakes occur during the period beginning 10 days before and ending 10 days after the day of the full moon (Table 2).

Table 1. Time distance between earthquakes and the full moon

Time Distance from Daylight Saving Day (counted in days)	Count of earthquakes	Percent of earthquakes	Cumulative percent of earthquakes
7 and more	53	39,6	40,2
Up to 6	79	59,0	100,0
Total	132	98,5	
Missing	2	1,5	
Total	134	100,0	

Table 2. Time distance between earthquakes and the full moon

Time Distance from Daylight Saving Day (counted in days)	Count of earthquakes	Percent of earthquakes	Cumulative percent of earthquakes
11 and more	23	17,2	17,4
Up to 10 days	109	81,3	100,0
Total	132	98,5	
Missing	2	1,5	
Total	134	100,0	

The normality test for the time distance between earthquakes and the full moon was then performed. The test revealed that the time distance variable follows the normal distribution with mean time distance -0.34 days and standard deviation of 7.34 days.

The t-test, performed for the time distance of 6 day had the results shown in Table 3.

Table 3. t-Test

<i>Test Value = 6</i>						
<i>t</i>	<i>Df</i>	<i>Sig. (2-tailed)</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>		
				<i>Lower</i>	<i>Upper</i>	
V16	,147	131	,883	,05303	-,6594	,7654

From the results of this statistical analysis we cannot exclude the research hypothesis that the average time distance between earthquakes and the full moon is 6 days.

4 Conclusions

Although there is not a satisfactory model on the effect of lunar triggering the discussion has come recently to the surface due to results that relate statistically earthquakes of high magnitude with the lunar phases (Ide et.al. 2016). It is easy to conclude that except the wavelet analysis (Haigh et.al., 2002) statistical methods can be used in order to examine the connection between the earthquakes and the effect of

the Lunar Triggering. The present work focuses on the large-scale earthquakes that took place within a decade in Greek territories. The result proves a connection between the time that earthquakes take place and the effect of the Lunar Triggering (more earthquakes take place near Lunar Triggering days. Furthermore it is of interest the distribution of the intense of the earthquakes to be examined.

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