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EARTHQUAKES EXOGENOUS INITIATIVE FACTORS

Introduction. The preliminary determination of geographical location of incoming earthquakes, its energy and occurring moment is the first problem up to these days. A group of scientists consider that both endogenous and exogenous factors play significant role in the initiation of earthquakes. This implies that the earthquakes "triggering mechanism" is an extremely complex phenomenon. Earthquakes initiative factors have been intensely studied for the recent years [1, 2, 3, 4].

Our aim is to study earthquakes triggering factors. Namely, we are looking for possible relationships between geophysical and astronomical phenomena.

Method of Searching. We have studied the connection between the earthquakes and distribution of planets (or couple of planets) for Caucasus, Turkey and Greece seismoactive regions. We have tried to determine perhaps the planets (or couple of planets) certain location on heavenly sphere can influence on the process of an origination of earthquakes.

In the presented paper searching was carried out for the regions of the Caucasus $M \geq 4.5$, Turkey $M \geq 6.6$ separately and Turkey-Greece united region $M \geq 7.0$ earthquakes (besides other catalogues we have used the catalogue of the Bolder Seismological Centre).

Calculations were made by the use of two systems of accounting with respect to the point of vernal equinox and to the eastern point of intersect of ecliptic and horizon planes. We refer this point as the "Eastern point".

Planets distribution was studied by the use of Poisson's approximation formulae:

$$P = a^k e^{-a} / k! \quad (1)$$

where P is probability, K – number of suitable phenomena, a – events total quantity multiplied by the probability of one suitable case.

Caucasus catalogue (393 earthquakes in all since 1900 to 1992 years) is divided into three part:

393 earthquakes with $M \geq 4.5$, 50 earthquakes with $M \geq 5.6$ and 343 earthquakes with $4.5 \leq M \leq 5.5$.

For cases which probabilities were in three order less than the maximum probabilities are given as considerable and cases probabilities of which were four order less than the maximum probabilities are pointed out by (*).

Results. I. First of all we study Caucasus $M \geq 4.5$ earthquakes:

1). Task is considered with respect to the point of vernal equinox:

Table 1

Planet	Interval in degrees	Number of phenomena	Maximum Probability	Probability	Remark
Mars	145 – 155	29*	0,12	0,000026	
	145 – 160	37*	0,0988	0,0000047	
	145 – 165	45*	0,085	0,000005	
	135 – 165	58	0,0697	0,000019	
	125 – 165	72	0,0604	0,000022	
Saturn	290 – 300	26	0,12	0,000044	
	290 – 310	41	0,085	0,000079	
	270 – 300	58	0,0697	0,000019	
	70 – 100	13	0,0697	0,0000479	The prohibi-ted zone
	270 – 310	73	0,0604	0,000013	
	65 - 105	19	0,0604	0,000013	The prohibi-ted zone

2). Task is considered for couple of planets:

The most active are following couples of planets in condition that angular distances between them is:

Sun – Mars - ($0^0 - 30^0$); ($350^0 - 20^0$) or ($10^0 - 40^0$);

Mercury-Mars - ($295^0 - 310^0$), ($290^0 - 320^0$) or ($340^0 - 10^0$).

Sometimes certain planets or couple of planets create their own so-called "prohibited zones" or zones when planet or couple of planets are "in their prohibited sector" with earthquake occurrence extremely minor probability: Saturn is in the interval ($65^0 - 105^0$) (case with respect to the point of a vernal equinox);

In cases of planets distribution studying concerning each other, minimum quantity of earthquakes are fixed when angular distances between them is following:

Sun - Mars - ($160^0 - 190^0$) or ($210^0 - 240^0$);

Mercury-Mars – ($160^0 - 190^0$) or ($195^0 - 225^0$);

A good result is gotten for "prohibited zone" in cases when Venus - Mars planets couple is in the interval ($155^0 - 175^0$) but we emphasize angular distance ($145^0 - 175^0$) as in this case probability is in two order less than probability for angular distance ($155^0 - 175^0$).

It seems interesting the case when Venus - Mars couple planets angular distance is ($165^0 - 175^0$) as in this case earthquakes

do not occur in general.

II. In the cases of Caucasus earthquakes with $M \geq 5.6$ there is not revealed any significant result.

III. We have got the following results for Caucasus $4.5 \leq M \leq 5.5$ earthquakes:

1). A maximal quantity of earthquakes occurs when:

Mars is in 20^0 and 40^0 strips - $(145^0 - 165^0)$ and $(125^0 - 165^0)$ correspondingly and Saturn is in 40^0 strip $(260^0 - 300^0)$ (task is considering with respect to the vernal equinox point).

Pluto is in interval $- (95^0 - 110^0)$ when calculation is carried out in the east point system.

If the planets distribution is considered concerning each other most active couple of planets is when angular distances between them are the following:

Saturn - Node of the Moon $- (265^0 - 285^0)$ or $(270^0 - 310^0)$;

Mars - Jupiter $- (145^0 - 160^0)$;

Mars - Saturn $- (150^0 - 160^0)$ or $(140^0 - 170^0)$;

Mercury-Mars $- (295^0 - 310^0)$, $(290^0 - 310^0)$, $(295^0 - 335^0)$ or $(350^0 - 30^0)$;

Venus - Mars $- (335^0 - 355^0)$ or $(340^0 - 20^0)$;

Uranus - apogee of the Moon $- (150^0 - 170^0)$, $(155^0 - 180^0)$ or $(150 - 180^0)$;

Sun - Mars $- (0^0 - 30^0)$, $(335^0 - 15^0)$ or $(350^0 - 30^0)$;

Jupiter - the Node of the Moon $- (270^0 - 285^0)$, $(255^0 - 275^0)$, $(250^0 - 280^0)$ or $(245^0 - 285^0)$;

Neptune - apogee of the Moon $- (185^0 - 210^0)$;

2). Besides minimal quantity of earthquakes are fixed when angular distances between planets are the following:

Mars- Jupiter $- (65^0 - 80^0)$;

Mercury-Mars $- (200^0 - 225^0)$, $(195^0 - 225^0)$, $(210^0 - 240^0)$ or $(185^0 - 225^0)$;

Venus - Mars $- (160^0 - 180^0)$, $(335^0 - 5^0)$ or $(145^0 - 185^0)$;

Sun - Mars $- (170^0 - 185^0)$, $(210^0 - 225^0)$, $(210^0 - 240^0)$, $(150^0 - 190^0)$ or $(200^0 - 240^0)$;

3). It is interesting that earthquakes do not occur in general when angular distance between planets are following:

Mars- Node of the Moon $- (265^0 - 275^0)$;

Venus - Mars $- (165^0 - 175^0)$;

Uranus - apogee of the Moon $- (195^0 - 205^0)$;

Node of the Moon everywhere is meaning expression "ascending node of the Moon".

IV. For the next step we consider the similar tasks for separate Turkey regions $M \geq 6.6$ earthquakes:

Following results are gotten with respect to the eastern point:

Table 2

Planet	Interval in degrees	Number of phenomena	Probability	Maximum probability	Remark
The node of the Moon	140 - 150	6	0,0023	0,35	
Venus	240 - 270	9	0,0027	0,434	The prohibited zone
Uranus	170 - 180	6	0,0022	0,35	

Following results are gotten with respect to the point of vernal equinox:

Table 3

Planet	Interval in degree	Number of phenomena	Probability	Maximum probability	Remark
Venus	240 - 270	0	0,0004	0,1606	The prohibited zone

V. Besides we have carried out tasks for Turkey-Greece united seismoactive regions 72 large earthquakes in all including 49 large earthquakes with $M \geq 6.6$ taking place in Turkey and 23 earthquakes taking place in Greece.

We considered cases as significant one when probabilities were in three order less than the maximum probabilities.

We have got following results with respect to the point of vernal equinox:

Table 4

Planet	Interval in degrees	Number of phenomena	Probability	Maximum probability
Sun	135 - 150	8	0,0027	0,434
Venus	175 - 190	9	0,0027	0,434
Saturn	200 - 240	18	0,00094	0,140
Uranus	120 - 125	7	0,000073	0,368

And finally results with respect to the eastern point are given below:

Table 5

Planet	Interval in degrees	Number of phenomena	Probability	Maximum probability	Remark
Mercury	315 - 324	7	0,002	0,298	
Mars	280 - 340	21	0,00006	0,139	
Node of the Moon	260 - 280	11	0,0019	0,195	
	140 -145	7	0,00007	0,308	
	60 - 90	0	0.0025	0,1606	The prohibi-ted zone

Conclusions. If the certain distribution of planets or couple of planets on heavenly sphere can influence on the process of an origin of earthquakes, based on the getting results it is possible to make the following conclusions:

1. There are revealed sectors on heavenly sphere, in which planets or couple of planets being it is fixed maximum quantity of earthquakes;

2. For separate planets and planets couple there are founded certain sectors on heavenly sphere, so-called “the prohibited zones”, in which planets or couple of planets being it does not occur earthquake in general or their quantity is minimal.

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პლანეტების ან პლანეტათა წყვილების ცის თაღზე განსაკუთრებული განაწილება განიხილება, როგორც მიწისძვრათა ტრიგერული ფაქტორი.

გამოვლენილია სექტორები, რომლებშიც პლანეტების ან პლანეტათა წყვილების მოხვედრისას მიწისძვრათა მაქსიმალური ან მინიმალური რაოდენობა ხდება

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Planets or planets couple special distribution on heavenly sphere is considered as earthquakes triggering factors.

There are revealed sectors on heavenly sphere in which planets or planets couples being occurs maximal or minimal quantity of earthquakes.

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ЭКЗОГЕННЫЕ ИНИЦИИРУЮЩИЕ ФАКТОРЫ ЗЕМЛЕТРЕСЕНИЙ./Качкачишвили М., Рамишвили Г., Качкачишвили Н., Киладзе Р., Кухианидзе В./ Сб.Трудов Института Гидрометеорологии Грузии. –2008. – т.115. – с. 349-353. – Рус.; Рез. Груз., Анг.,Рус.

Особое распределение планет или пар планет на небесном своде рассматривается как триггерный фактор землетрясений.

Выявлены секторы на небесной своде при нахождении в которых планет или пар планет происходит максимальное или минимильное количество землетрясений.