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Variation of Geophysical Parameters During Preparation of Seismic Events

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ABSTRACT

The article contain information about several hydrodynamic and geomagnetic anomalies were observed during March 2017 - December 2017 on the multiparametric monitoring network of M. Nodia institute of Geophysics. Data were analyzed by the special program which gives possibility to exclude the influence of geological factors by the common value of tidal variations. Was analyzed reaction of parameters to the earthquake preparation process.

Key Words: hydrodynamic and geomagnetic anomalies, seismic event precursors.

Introduction

Georgia is very vulnerable to various natural disasters, including earthquakes [1]. Significant number of works on the registration of earthquakes and the detection of their possible precursors is here carried out (electromagnetic and acquisition emissions, atmospheric electric parameter, soil radon, ULF electromagnetic variations, etc.) [2-10]. Multiparametric data (water level, atmosphere pressure, temperature, geomagnetic field etc.) were recorded with a minute frequency, in the deep boreholes located on the territory of Georgia. Observations were carried out using the special equipment providing measurement of deformation up to 10^{-8} degrees [11-12]. In order to exclude the influence of geological factors, the data from various stations were rated against the common value of tidal variations [13-14]. Variation and reaction of parameters to the earthquake preparation process [15-19] were analyzed.

Data analysis

Therefore, were analyzing the value of stress field by hydrodynamical parameters [20-21] and geomagnetic field variations during preparation of several earthquake processes on the territory of Caucasus were calculated and analyzed:

Earthquake in Tsalka area -24.03.2017 Mag-3.7

The earthquake of 24 March 2017 (Mag- 3.7, Tsalka), anomalies was observed on the Marneuli borehole, as well as at Dusheti Geomagnetic Observatory and Oni magnetic station.

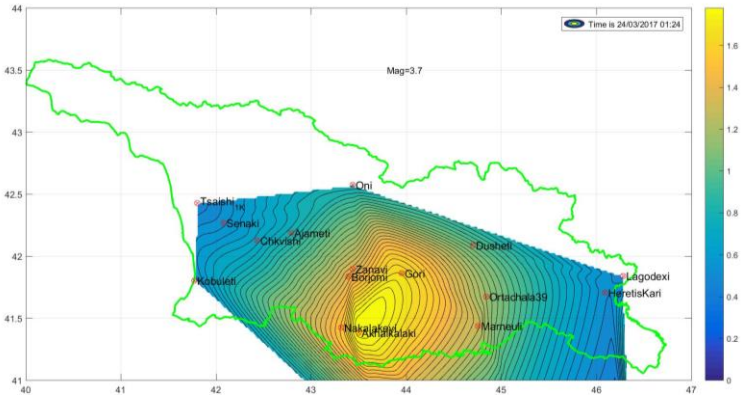

Fig.1 Stress map on the moment of 24 March 2017 earthquake, Mag-3.7.

Anomaly was revealed on Marneuli station before 24 March 2017 earthquake, 4 days earlier. At the same time water level falling can be seen on the graph (Fig.2). Earthquake happened in 68 km far from the station.

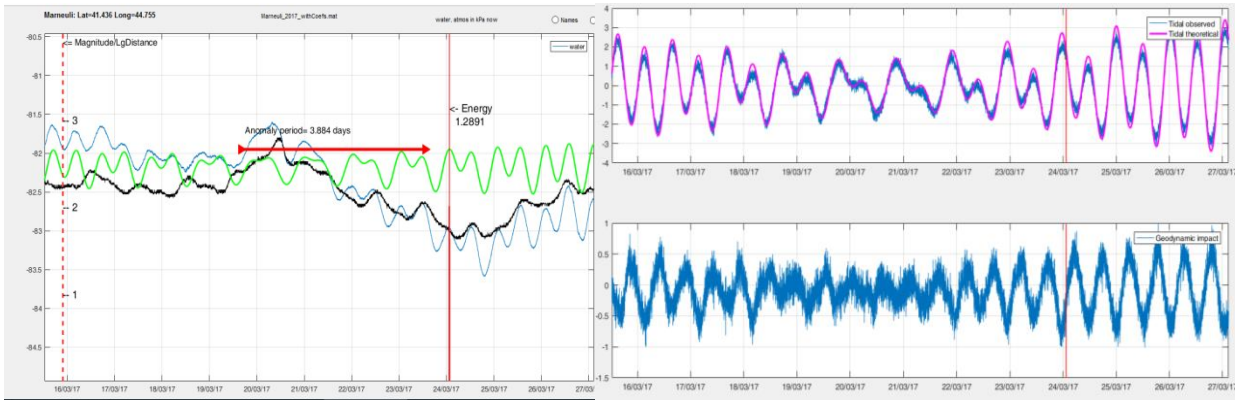

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Fig.2. a - Water level, atmospheric pressure and tidal variations at the Marneuli borehole. Vertical line marks an earthquake. On abscis axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

At the Oni station, like the one at Dusheti Geomagnetic Observatory, anomaly was observed 3 day earlier before event.

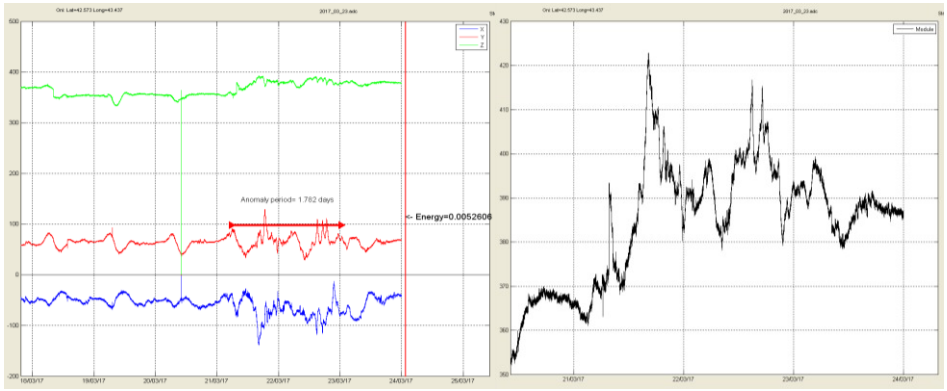

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Fig.3. a-Variation of x,y,z components of the magnetic field at the Oni Station. b- Variation of the module value.

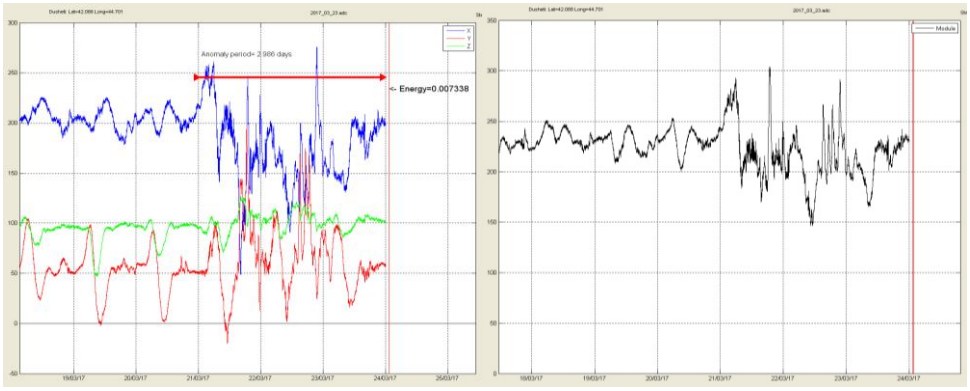

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Fig.4. a-Variation of x,y,z components of the magnetic field at the Dusheti Geomagnetic Observatory. b-Variation of the module value.

Earthquake in Kvareli area-15.04.2017, Mag-3.6.

Before the earthquake of 15 April 2017 (Mag- 3.6, Kvareli), anomalies were observed on the Naqalaqevi, Gori, Marneuli stations, as well as at Dusheti Geomagnetic Observatory.

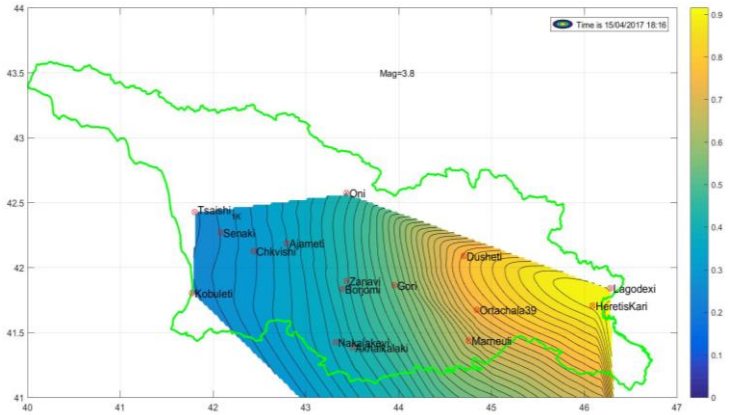

Fig.5 Stress map on the moment of 15 April 2017 earthquake, Mag-3.6.

Anomaly was observed in Naqalaqevi borehole 1 day earlier before event of 15 April 2017. The Earthquake occurred in 210 km far from a station.

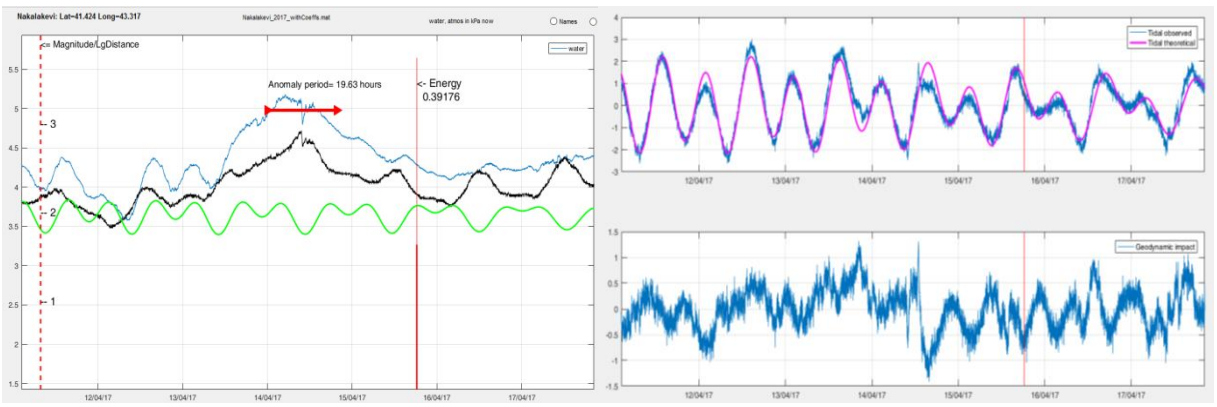

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Fig.6. a - Water level, atmospheric pressure and tidal variations at the Naqalaqevi borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

As wall as Naqalaqev's station, at the Gori borehole anomaly of behavior of water level is revealed 1 days earlier before earthquake, 145 km from station.

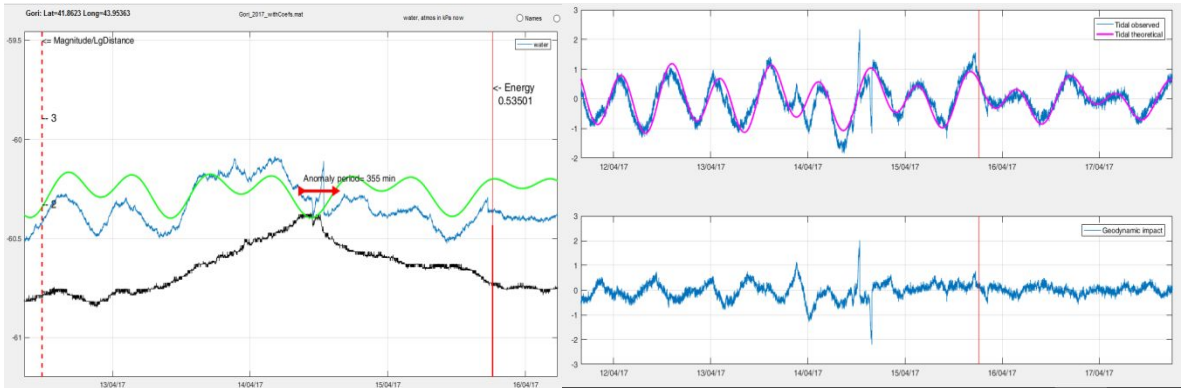

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Fig.7. a - Water level, atmospheric pressure and tidal variations at the Gori borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

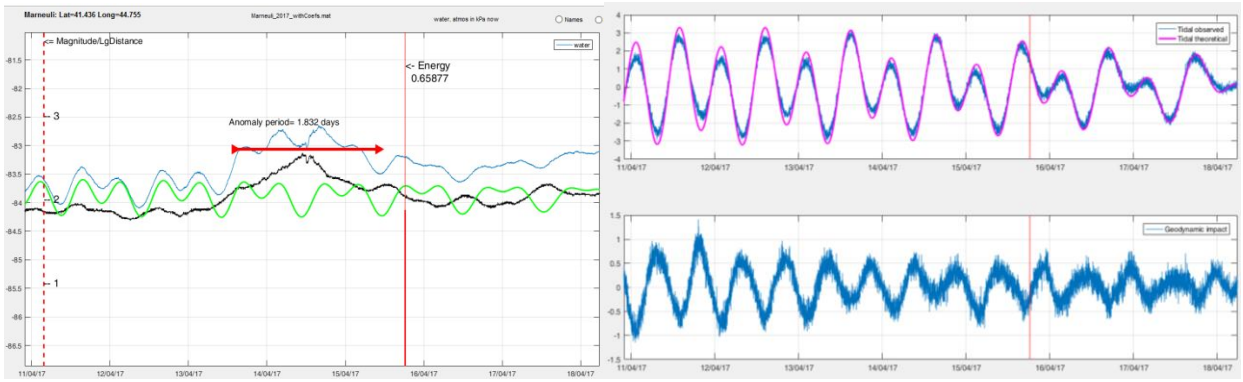

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Fig.8. a-Water level, atmospheric pressure and tidal variations at the Marneuli borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

At Marneuli station anomaly behavior was 1 day earlier before the earthquake. Earthquake epicenter was located in 107 km far from the station.

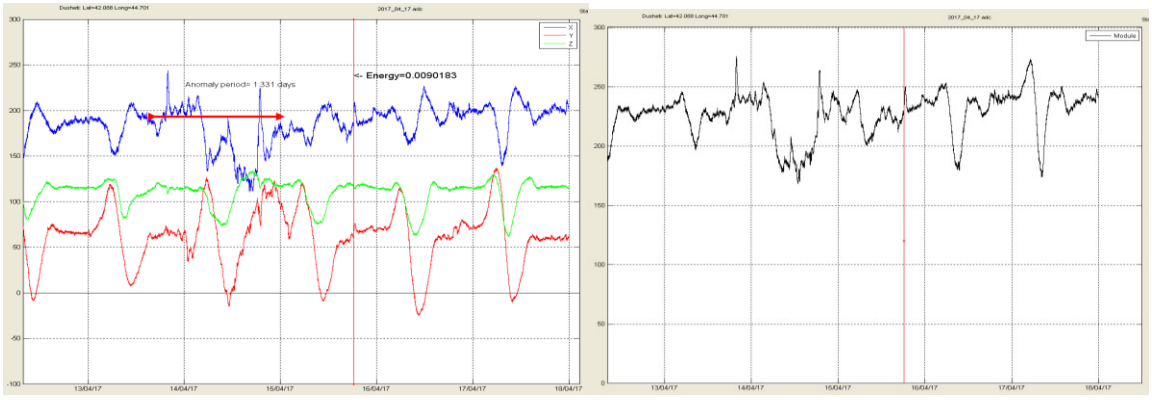

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Fig.9. a-Variation of x,y,z components of the magnetic field at the Dusheti Geomagnetic Observatory. b-Variation of the module value.

Anomaly was observed at Dusheti Geomagnetic Observatory, 2 days earlier before the earthquake 15 April. The anomaly continued for 1 day. The earthquake occurred in 80 km far from the Dusheti.

Earthquake in Dmanisi area-09_05_2017, Mag-3.6.

The earthquake of 09 May 2017 (Mag- 3.6, Tsalka), anomalies was observed at the Kobuleti, Naqalaqevi, Oni, Gori and Marneuli boreholes.

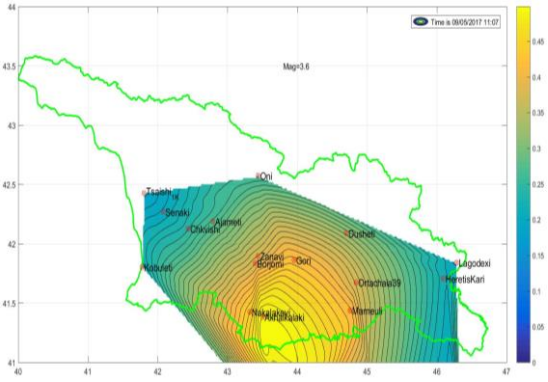

Fig.10 Stress map on the moment of 09 May 2017 earthquake, Mag-3,6.

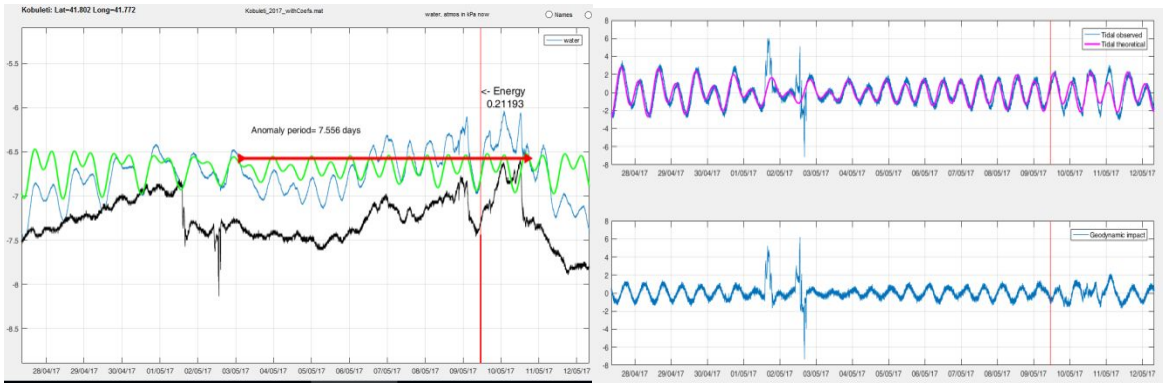

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Fig.11. a - Water level, atmospheric pressure and tidal variations at the Kobuleti borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

In Kobuleti, which is 193 km away from the epicenter, we observed an anomaly that continued for 7 days.

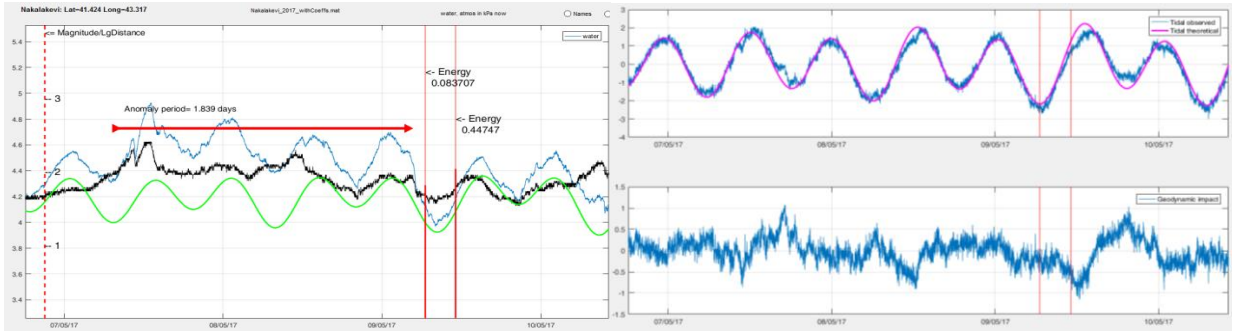

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Fig.12. a - Water level, atmospheric pressure and tidal variations at the Naqalaqevi borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

At Naqalaqevi station anomaly was observed 2 days before of the earthquake. The duration of the anomalous period is fixed on figure. Naqalaqevi station is 58 km far away from the epicenter.

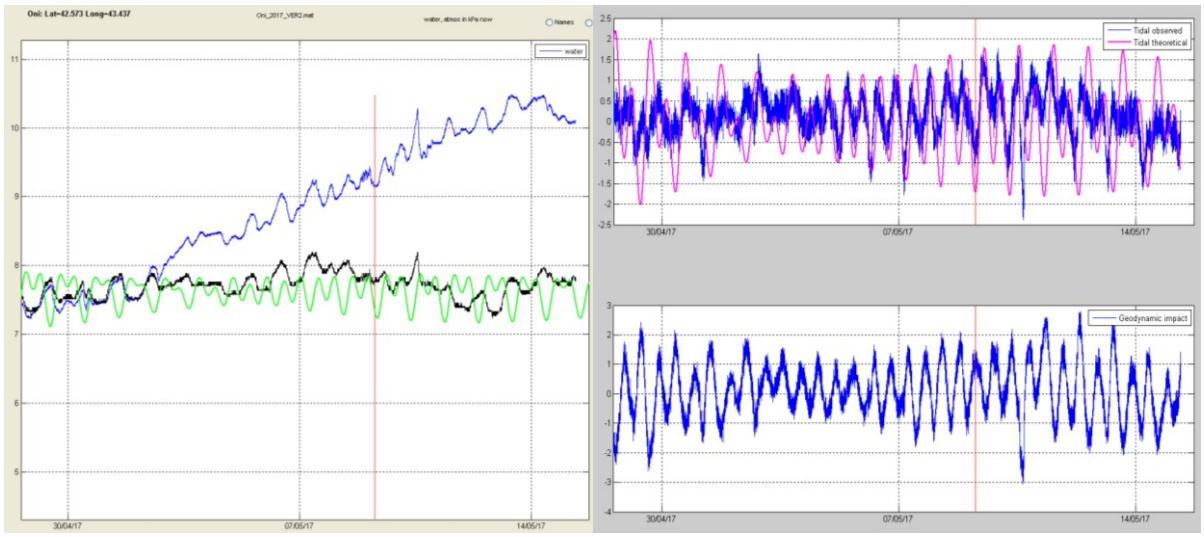

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Fig.13. a - Water level, atmospheric pressure and tidal variations at the Oni borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

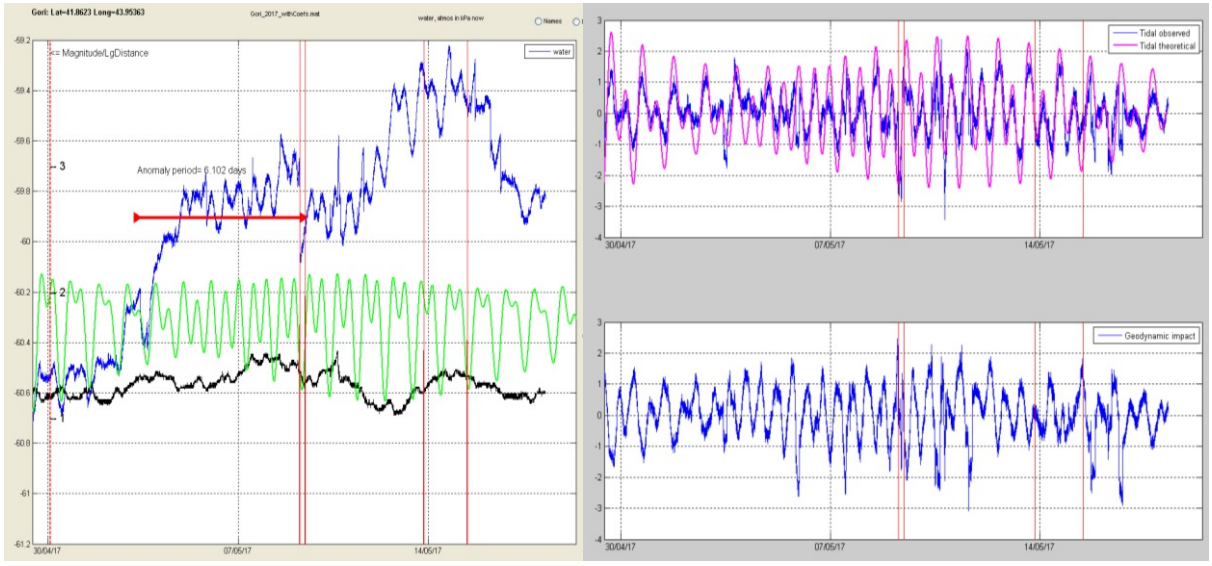

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Fig.14. a - Water level, atmospheric pressure and tidal variations at the Gori borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

Increasing of water level at the Gori and Oni station can be seen on the graph (Fig.13 Fig.14). Anomaly can be seen before 5 days earlier of earthquake and continued after the event.

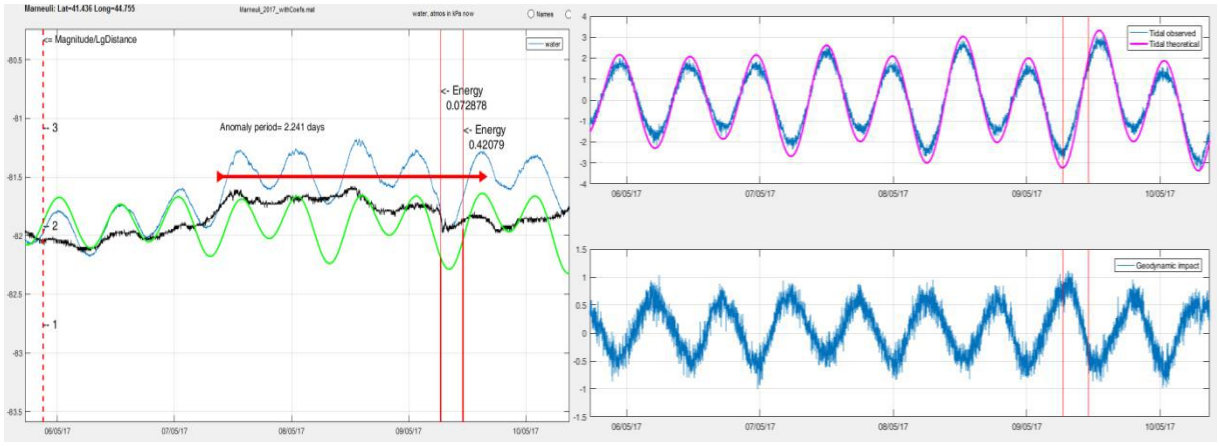

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Fig.15. a - Water level, atmospheric pressure and tidal variations at the Marneuli borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

At Marneuli borehole, which is 67 km away from the epicenter, the anomaly was observed 2 days prior to the earthquake. The duration of the anomalous period is shown on figure

Earthquake in Dedofliswyaro area-17_07_2017, Mag-4.1.

The earthquake of 17 July 2017 (Mag- 4.1, Dedoflitskaro), anomalies was observed on the Naqalaqevi borehole, as well as at Dusheti Geomagnetic Observatory and Oni station.

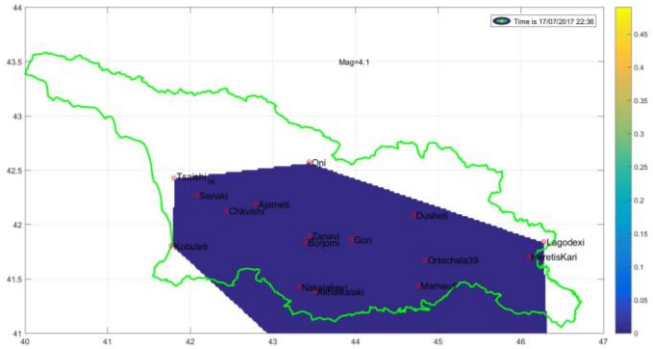

Fig.16 Stress map on the moment of 17 July 2017 earthquake, Mag-4,1.

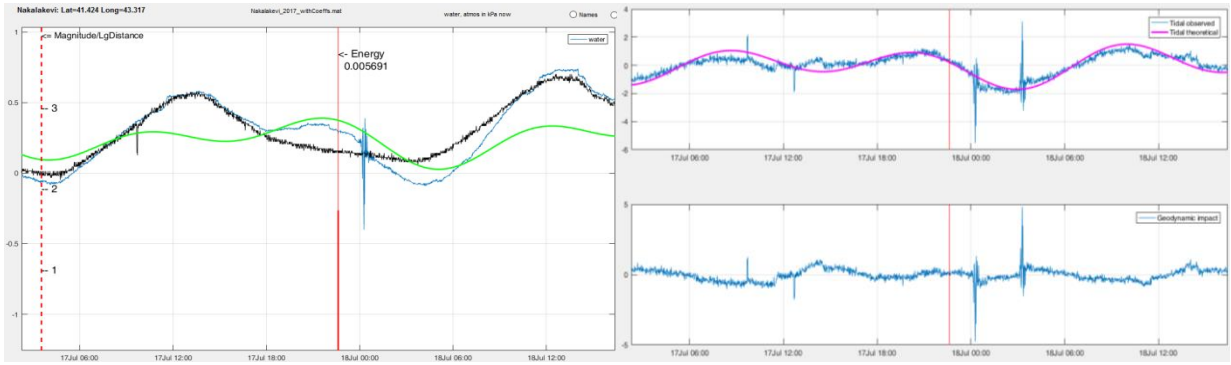

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Fig.17. a - Water level, atmospheric pressure and tidal variations at the Naqalaqevi borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

Anomaly can be seen at Naqalaqevi station, before earthquake. The Epicenter of the 17 July earthquake occurred 232 km away from Naqalaqevi station. It is noteworthy that the earthquake of 20 July 2017 (Mag- 4,5 Azerbaijan) happened after this anomaly.

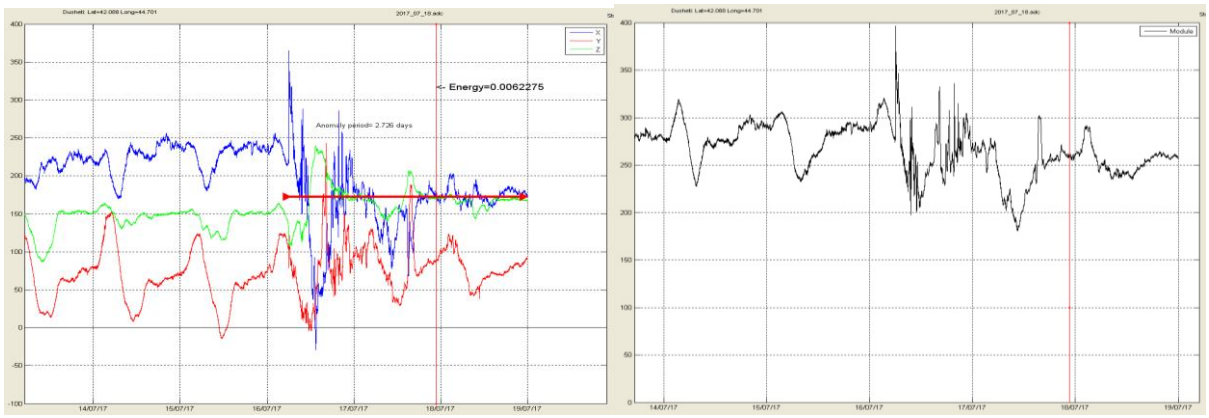

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Fig.18. a-Variation of x,y,z components of the magnetic field at the Dusheti Geomagnetic Observatory. b- Variation of the module value.

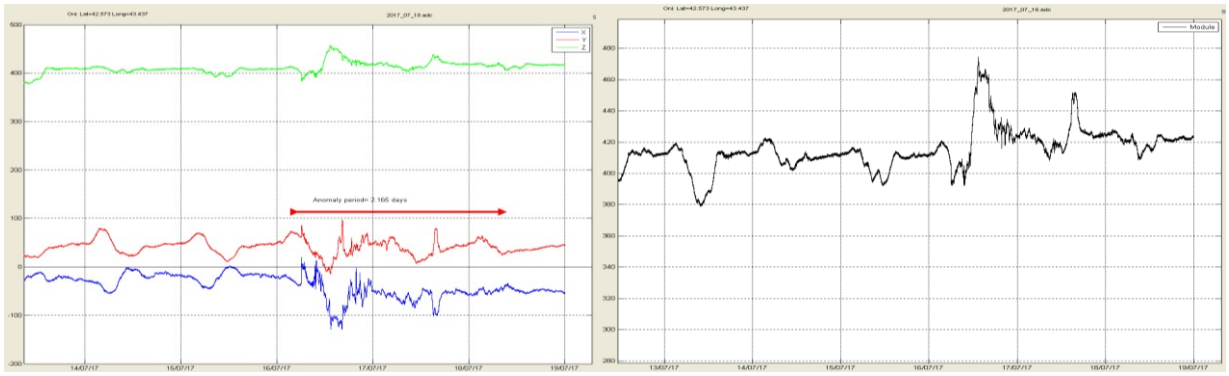

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Fig.19. a-Variation of x,y,z components of the magnetic field at the Oni Station. b- Variation of the module value.

About three days of anomalies are observed in the variations of magnetic field's components and its modules at Dusheti Geomagnetic Observatory and Oni station.

Earthquake in Tkvarcheli area-14_09_2017, Mag-3.4.

The earthquake of 14 September 2017 (Mag- 3.4, Tkvarcheli), anomalies was observed on the Naqalaqevi and Gori boreholes, as well as at Dusheti Geomagnetic Observatory.

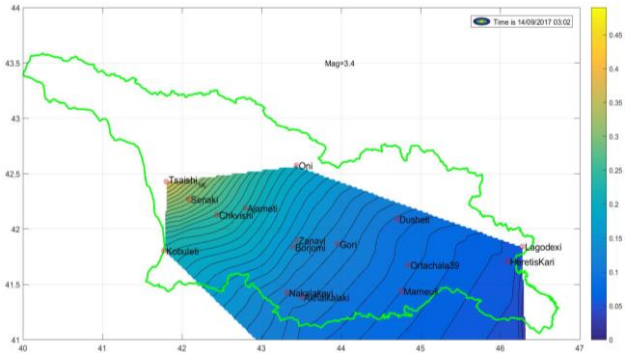
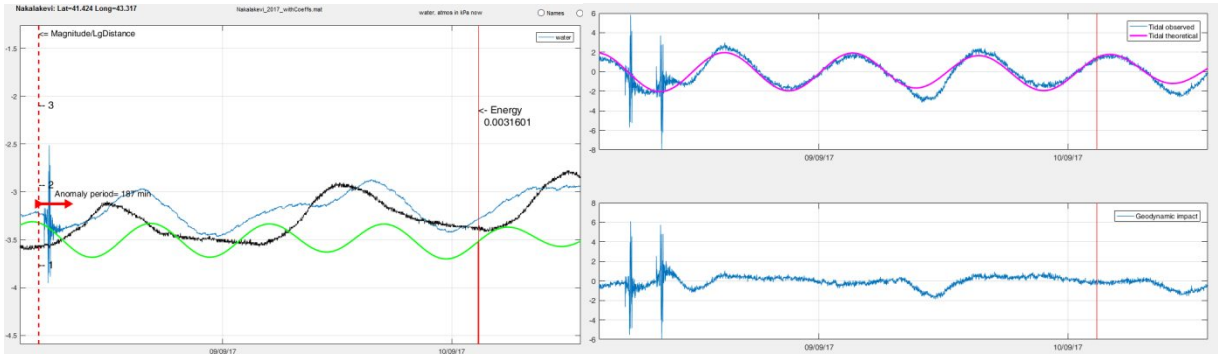


Fig.20 Stress map on the moment of 14 September 2017 earthquake, Mag-3,4.



a b

Fig.21. a - Water level, atmospheric pressure and tidal variations at the Naqalaqevi borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

As we can see the graph, the anomaly at Naqalaqevi borehole is observed 6 days prior to the 14 September earthquake.

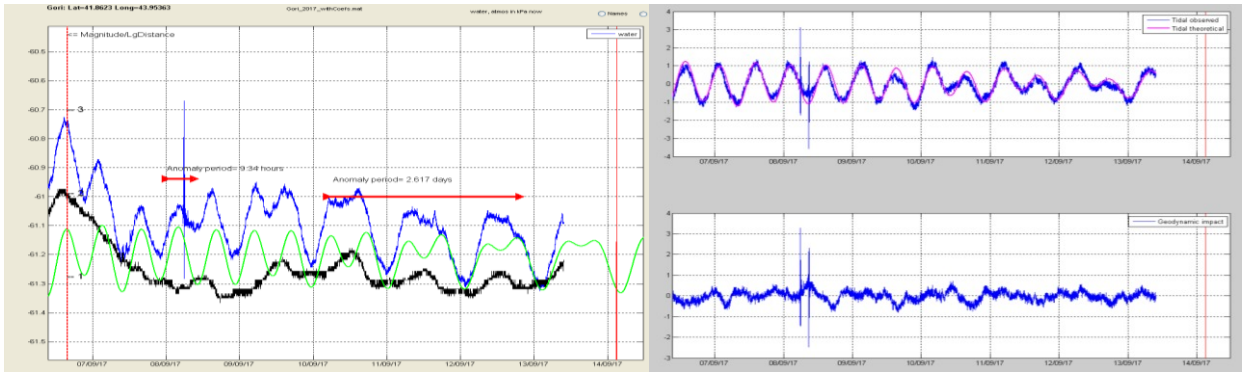


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Fig.22. a - Water level, atmospheric pressure and tidal variations at the Gori borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Speed factor of variations water level and earth tidal and the difference between them.

At Gori station the anomaly was observed a week prior to the earthquake. Gori borehole is located 254 km away from the epicenter.

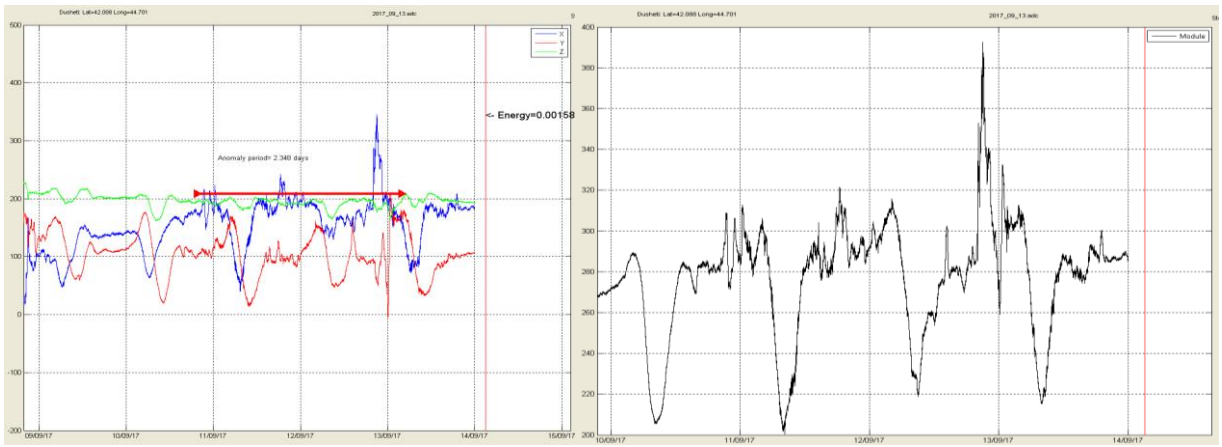

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Fig.23. a-Variation of x,y,z components of the magnetic field at the Dusheti Geomagnetic Observatory.

b- Variation of the module value.

A 2-day anomaly that is observed before 14 September 2017 earthquake is shown on the Dusheti magnetic data plot.

Conclusions

Variations in hydrodynamic and geomagnetic parameters are caused by the earth stress. During normal period it change according tidal variation and has "background" value. Before seismic event character of variation changed above "background" value, as indicator of tectonic activity. During the observed time period were fixed earthquakes with Magnitude 3-5, between 200-500 km from the station, occurred on the territory of Caucasus. Character of "anomalies" depended on energy of earthquakes. Period of "anomalies" varied between 2-5 days.

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გეოფიზიკური პარამეტრების ვარიაციები სეისმური მოვლენების მომზადების პროცესში

გ. მელიქაძე, თ. ჯიმშელაძე, გ. კობზევი, ა. ჭანკვეტაძე

რეზიუმე

სტატია გადმოგვცემს ინფორმაციას სხვადასხვა ჰიდროდინამიკურ და გეომაგნიტურ ანომალიებზე, რომლებიც დაფიქსირებულია 2017 წლის მარტიდან დეკემბრამდე, მ. ნოდიას სახ. გეოფიზიკის ინსტიტუტის მულტიპარამეტრიკულ ქსელზე. მონაცემები მუშავდებოდა სპეციალური პროგრამის მეშვეობით, რათა გამორიცხულიყო გეოლოგიური ფაქტორების გავლენა სხვადასხვა სადგურების მონაცემები კალიბრებოდა მიმოქცევითი ვარიაციებით. გაანალიზდა პარამეტრბის ვარიაციები და რეაქციები მიწისძვრის მომზადების პროცესზე.

Вариации геофизических параметров в период подготовки землетрясений

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Резюме

Статья содержит информацию о гидродинамических и геомагнитных аномалиях в период с марта по декабрь 2017 года по данным наблюдений мультипараметрическом мониторинговой сети Института геофизики им. М. Нодиа. Данные проанализированы с помощью специальной программы. С целью исключения влияния геологических факторов, данные с различных станций были откалиброваны с помощью значений приливных вариаций. Осуществлен анализ вариаций и реакции параметра на процесс подготовки землетрясения.