# GEODYNAMICAL IMPACT ON THE HYDRODYNAMIC FIELD

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**Abstract**

It is known that variations of water level represents itself an integrated response of aquifer to different periodic as well as non periodic influences, including earthquake related strain generation in the earth crust. Quantitative analysis of impacts of separate components in observed integral dynamics remains one of the main geophysical problems. Taking into account their possible prognostic values especially important for non periodic processes related to the earthquake generation.
In the present study the dynamical complexity of water level variations has been analyzed. Dependence of dynamics on the presence of periodic components in considered data records (time series) was investigated. Modern tools of time series analysis have been used. We present results of the analysis of the data of observations by a special program. The results illustrate that the water level is an indicator of tectonic activity. In order to explain this, the strain-sensitivity of each borehole should be studied, as well as distribution of strain field on the area and its geological characteristics.

**Keywords:** strain field.

## 1. Introduction

The hydrodynamic field senses geodynamic variation and allow us to study variation of strain in the terrestrial crust in time and space. Organization of a hydrodynamic monitoring network in Caucasus is being processed since 1985. Till now the network of 10 boreholes of different depth (from 250 up to 3500 m) covers the whole territory of Georgia. Boreholes located on the main geoplates and open deep aquifer, actually represent sensitive volumetric strainmeters. They fixed the deformations about $10^{-7}$ -$10^{-8}$ degree, caused both by endogenous, and exogenous factors (1-3). In the present study the dynamical complexity of water level variations has been analyzed for the period of strong earthquakes (Racha -12.09.2009).

## 5. Data analysis

In order to monitor tectonic processes in real time and to mark out a seismic component, based on previous investigations the special method has been worked out. Using "Matlab" program we calculate correlation between water level variations and those exogenous factors, which gives possibility to divide multi-signal into its components. Namely, we get the "calculated" signal without influence of tidal, atmospheric pressure and precipitation variations (fig. 1) and the rest of signal can be divided into "geodynamic" and noise" components (Fig. 2)

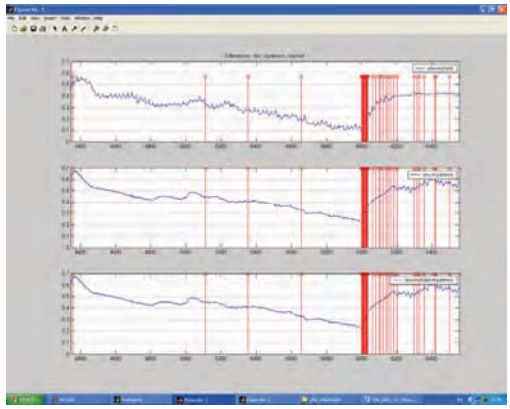

Fig. 1 Removal of "exogenous" components

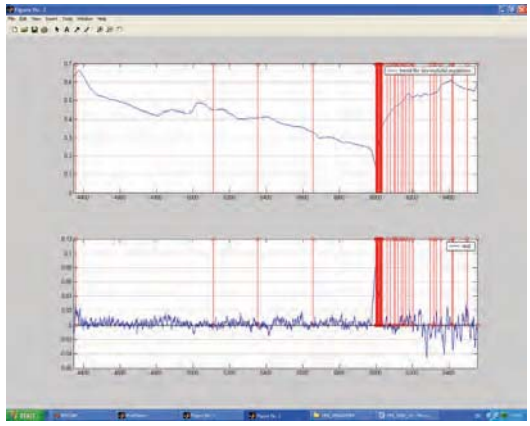

Fig. 2 Variation of "geodynamic" and "noise" signals

For every borehole corresponding values have been calculated. The next step is the standardizing of the "geodynamic" component of a station from -1 to +1 and the creation of a geodynamic picture. At the same time, the positive value of

subtraction (real value of water level is more than theoretical) corresponds to a compressive deformation, when a negative value – to the expansion one.

The geodeformation field evolution during and after "Oni" earthquake (12.09.2009), you can see in the pictures bellow. It clearly shows the migration of compressive deformation from the East to the West direction, as well as increasing of its value in the epicenter zone.

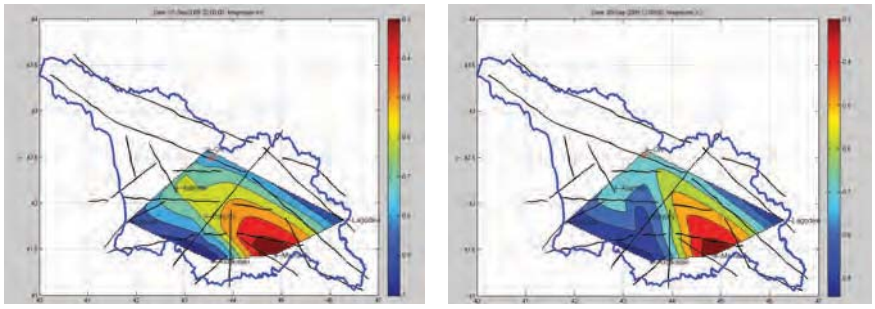

Fig. 3 Variation of a geodeformation field from 7.09.2009 22:00 till 8.09.2009 12:00

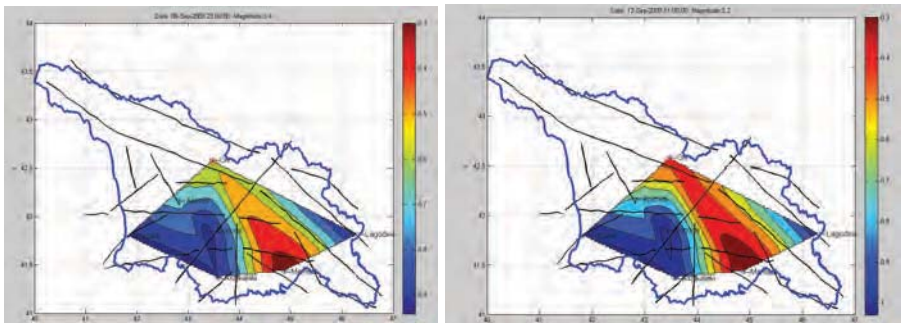

Fig. 4 Variation of a strain geodeformation field from 9.09.2009 23:00 till 12.09.2009 11:00

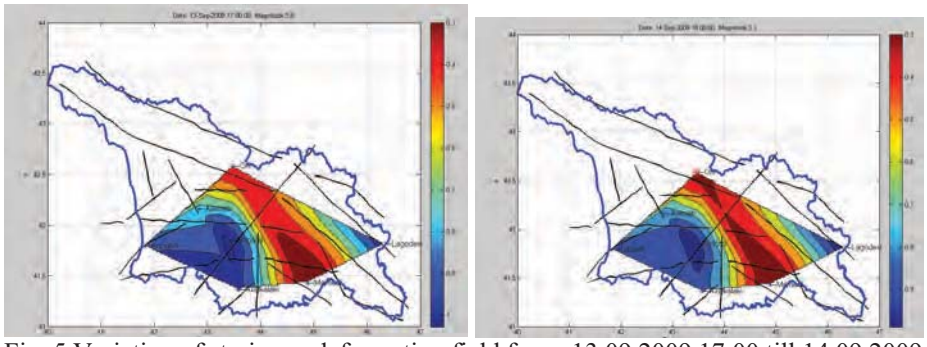

Fig. 5 Variation of strain geodeformation field from 13.09.2009 17:00 till 14.09.2009 18:00

From 14 till 14 September time period, we can observe the reducing of an intensity of a strain which corresponds to the unload deformation. Until 28 of September we still observe the increasing of a strain deformation, which was induced by the aftershocks' preparation processes.

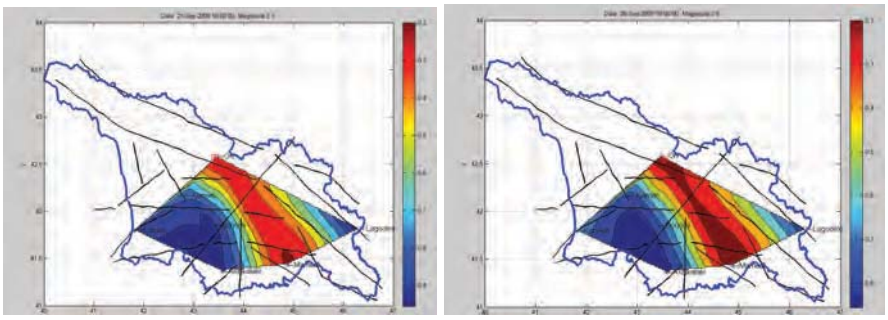

Fig. 6 Variation of strain geodeformation field from 21.09.2009 16:00 – till 28.09.2009 18:00 period

## 6. Conclusion

According to the statistics, epicenter of an earthquake coincides with the extreme gradient zone in the deformation field. The abnormal infringements of water level were marked on the whole territory of Georgia (and Caucuses), that doubtlessly shows the deformation scope processes of preparation on this large territory. According to the range of variation of water level in boreholes, the development of deformation processes were marked. This development occurs from periphery to the centre, to increase of intensity of pressure during several months.

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