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Crustal Deformations Studies in Egypt Using Gravity and Geodetic Observations

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The mass re-distribution and related density changes are one of the main factors affecting Earth's dynamics. Therefore, we used the observed temporal gravity variations to understand the surface tectonics and geodynamic processes. Temporal gravity variations in parallel with the geodetic technique (GPS) had been used to monitor recent crustal movements in Egypt since 1997. The geodetic networks around the High Dam, Aswan, were the first net to be measured in Egypt. More than five times of measurements were performed till Dec. 2009. The non-tidal gravity changes were constrained by the vertical component of surface movements derived from the GPS observations. The trend of gravity changes indicated a positive stress south of the Kalabsha fault in combination with expected lake water penetration into the Nubian sandstone; the lowest gravity changes along the Kalabsha fault reflect the strike component of the stress field.

Also, the gravity changes were correlated with seismic activity in the areas around Cairo, Egypt (Greater Cairo and Southern part of Delta). As example, a relative considerable increase of gravity values was noticed for the network between the epochs of 2000 and 2004. Otherwise, the temporal gravity variations were reported a considerable decrease in gravity values between the two campaigns of 2004 and 2007 for the same stations. This behavior could explain by compressive deformation and strain buildup stage before the Southwest Cairo earthquake (July 31, 2005 with Mw 4.3). Then, the stress release stage were occurred after the main-shock which showed by the negative change of gravity values from the measurements of 2007. Although, the existing of this relation from gravity campaigns in 2000 – 2004 - 2007, and due to the small number of observations, we assume there is a relation rather between gravity changes and continuous deformation process, than a direct relation to earthquake occurrence. However, the limited number of campaigns has not allowed yet developing a model of such relation.

The results of geodetic measurements of the network around Cairo after five campaigns showed that the average estimated horizontal velocities for most points are about 5.15 mm/year in approximately NW-SE direction. This proves the high geodynamic activity of the region and the need of further observations.