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Regional and local deformation analysis results from the Nile River Valley and its relation to seismicity

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The National Research Institute of Astronomy and Geophysics, Helwan, Egypt installed a number of geodetic deformation monitoring networks in the Nile River Valley. The main goal of these works is to study the recent crustal movements using GPS measurements as well as the seismicity and tectonic setting to mitigate the seismic hazard threat in this region.

The first network was established to monitor the region around the last earthquakes Kalabsha (November 14, 1981, M5.6), Cairo (October 12, 1992, M5.9) and Sohag (December 14, 1998 and April 30, 1999, M 4.8 and 4.) The second, more local study was established in the Abu-Dabbab area located in the central part of the Eastern Desert of Egypt at latitude 25.0 – 25.6°N and longitude 34.2 – 34.9°E, 27 km inland from the Red Sea coast. Here the focus is on the study of the micro-earthquake events that are monitored since the early eighties. The spatial distribution of the earthquakes constructing the seismicity map of Abu-Dabbab area shows that the earthquakes of Abu-Dabbab take a perpendicular trend to the Red Sea trend, which also one of the main fault trends at Abu-Dabbab area, nearly northeast-southwest direction. The majority of these earthquakes have magnitudes less than 3.0 ML (micro-earthquakes).

The control networks with 12 sites each were observed in 4 and 5 epochs respectively by geodetic GPS receivers. The analysis was done by the Bernese GPS software at the TU Darmstadt and ITRF2005 coordinates according to the IGS standards were estimated for each epoch. Finally a velocity field was computed for both networks. In this paper we present the results of the deformation analysis done by two different approaches. The standard comparison of the residuals of the velocity field estimation is compared to the output of a geodetic deformation analysis tool called MONIKA. MONIKA is an abbreviation for “Deformation Integrity Monitoring for GNSS-Positioning Services including a Scalable Hazard Monitoring by the Karlsruhe Approach” (Jäger, R. et al, 2007) by a coordinate-based deformation analysis using the epoch-SINEX files of the Bernese processing. Some stations of the network indicate significant changes while other stations indicate no significant changes through the period of observations. The majority of the stations do not show significant changes.