3D Paleohydrogeological modelling of the Nile Delta

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ABSTRACT
The Nile Delta in Egypt is a heavily populated area with high agro- and socio-economic importance for Egypt. Though its lands are traditionally irrigated with surface water from the Nile, the discharge of this river is reduced due to the building of large upstream dams, such as the Aswan dam in Egypt (1970), the Merowe dam in Sudan (2011), and possibly in the future the Grand Ethiopian Renaissance Dam in Ethiopia (under construction, estimated to finalized end of 2018). This reduced surface water availability will probably lead to an increased use of groundwater for irrigation. Adding to this stress on the groundwater system, there is a strongly growing population which further amplifies extraction rates. Furthermore, there is the estimated sea level rise. These stresses will cause the country to increasingly rely on groundwater in the near-future. Therefore, an assessment of the current and future status of the groundwater resources is critical to safeguard these precious resources for the coming generations.

Several studies found that the area is vulnerable to salt water intrusion (e.g. Kashef, 1983; Sefelnasr and Sherif, 2014) due to the shallow topography of the area and the high transmissivity of the aquifer. Furthermore, hydrogeochemical measurement campaigns have shown the strong influence of paleohydrogeologic processes on the current groundwater salinity distribution (Geirnaert and Laeven, 1992; Barrocu and Dahab, 2010; Geriesh et al., 2015). However, the previous hydrogeological models created for this area ignored the influence of the paleohydrogeology, likely due to computational limitations, even though some studies show a paleo reconstruction increases our understanding of the groundwater system considerably (Tran et al., 2012; Delsman et al., 2013; Larsen et al., 2017; Vallejos et al., 2017). In this study, we model the complete Nile Delta Aquifer in 3D over several thousands of years. To tackle the computational burden this model created, we use the new iMOD-SEAWAT code (Verkaik et al., 2017), that allows parallel computation on a super computer. Calculations were conducted on the Dutch National Supercomputer “Cartesius”. In this presentation, we show the results of our efforts and compare these to a database, compiled of data from the published articles. The influence of paleohydrogeological circumstances and the (uncertain) lithology is shown.

REFERENCES


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