Episodic groundwater recharge in a semi-arid environment- assessing the impact of the 2015 16 El Niño in Central Tanzania
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Groundwater recharge in semi-arid environments occurs directly by rainfall infiltrating in-situ, and indirectly via focused pathways that involve leakage from ephemeral or perennial surface water bodies. Very few detailed monitoring networks observing groundwater recharge exist in semi-arid regions hindering resolution of recharge processes and the relative contributions of direct and indirect recharge pathways. Previous research in a semi-arid basin of central Tanzania (Makutapora) compiled a near-continuous 60-year record of groundwater-level observations and showed that recharge occurs episodically, depending primarily on heavy seasonal rainfall associated with El Niño Southern Oscillation (ENSO). The top decile of recharge events coincide with El Niño years and account for >50% of recharge by volume. Here we report on new observational evidence derived from the deployment, prior to the onset of the 2015-16 ENSO event, of new instrumentation in the Makutapora Wellfield (59 km2). This enables hourly monitoring of groundwater levels in 6 monitoring wells, and river stage at both the inlet and outlet of the wellfield, which is the primary source of water for the capital of Tanzania, Dodoma. Unprecedented rates of groundwater-level decline (~6 m year) observed in 2015, coinciding with increased abstraction, now exceeding 1.5 million m3 per month, have heightened concerns over the long term viability of groundwater abstraction and the need to identify potential adaptive strategies (e.g. Managed Aquifer Recharge) to amplify recharge and enhance sustainability. Preliminary results reveal that recharge derived from anomalously heavy rainfall during the 2015 16 El Niño, has arrested the water-level decline. Further analyses of high-frequency observations will examine (1) recharge process by exploring the presence (focused) or absence (diffuse) of the development and decay of groundwater ‘mounds’ near stream channels or ponded areas+ and (2) recharge thresholds resulting from intense rainfall exceeding a runoff threshold (focused) or cumulative rainfall overcoming a soil moisture deficit (diffuse).