

Science as a Camouflage: A Critical Review of Unsubstantiated Claims on the Safety of the GERD Saddle Dam

By the Ethiopian National Committee on Dam Safety, Addis Ababa, Ethiopia, June 25, 2026

Summary

The Ethiopian National Committee on Dam Safety, a body of senior scientists and engineers specializing in hydrology, geophysics, geodesy, and dam engineering, presents a critical review of “*The world's largest saddle dam at risk: Multi-sensor geohazard analysis and downstream impacts*” authored by *El-Askary et al.* (2026) published in the International Journal of Disaster Risk Reduction.

Using science as a camouflage and based on unsubstantiated claims, the Article concluded that there is massive groundwater infiltration, dam seepage, and differential settlement at the saddle dam, reservoir-induced seismicity and dam breach flood risks. Based on these unfounded claims and creating false alarm of dam failure, the Article recommend for international monitoring and governance frameworks for the Grand Ethiopian Renaissance Dam (GERD).

Our comprehensive technical audit of the publication has revealed a failure of scientific rigor, characterized by fundamental methodological errors, the use of fabricated data, and a pervasive lack of ground-truth validation. The Article is a rushed publication driven by a narrative designed to bias the international community against the GERD rather than offering independent scientific evidence to readers.

We submit the following technical evidences:

Misapplication of Satellite Data: Over-localization of basin-scale Gravity Recovery and Climate Experiment (GRACE) observations, which contains significant methodological and interpretational shortcomings, leading to misinterpretation of coarse-resolution data and drawing unsupported inferences about groundwater processes and structural controls. Using GRACE observations to interpret localized groundwater accumulation, groundwater flow pathways, or structural controls at the spatial scale implied by the article exceeds the resolving capability of the dataset.

The interpretation of the reported PS-InSAR deformation patterns remains insufficiently substantiated because the manuscript does not quantify the uncertainty associated with the reported displacement estimates and lacks independent ground-based validation. Although differential settlement of up to 40 mm is reported, the PSI-derived measurements are relative line-of-sight observations whose interpretation is sensitive to processing choices and reference selection. Furthermore, independent reprocessing of Sentinel-1 data covering the same period did not reproduce the reported deformation pattern. In addition, available saddle dam monitoring information indicates no observable structural distress or observable embankment uplift at the right abutment. The embankment also appears to have largely reached its final consolidation stage. Consequently, the evidence presented is insufficient to

conclusively link the reported PSI observations to seepage-induced settlement or structural concerns.

Seismological Analysis and Data Fabrication: Perhaps one of the major scientific misconducts in the Article is the fabrication of fault data and the corresponding misinterpretation of regional seismicity. The treatment of Reservoir-Induced Seismicity (RIS) demonstrates a profound disregard for well-established geodynamic understanding. While scientific consensus constrains RIS effects to a maximum radius of about 25–37 km from the reservoir, this study erroneously attributes seismic activity occurring 400 to 650 km away, within the Afar Depression and the Main Ethiopian Rift, to the hydraulic loading of the GERD. By attempting to establish a causal link between distal active rifting and reservoir filling through a technically inappropriate Poisson regression model for this distance range, the authors present a relationship that is geologically and statistically invalid. Most critically, the fabrication of fault data and the mischaracterization of regional tectonic events as reservoir-induced geohazards represent a clear departure from scientific integrity, replacing empirical evidence with a baseless, alarmist narrative.

Major Hydrological and Infiltration Analysis Errors: The Article's estimation of GERD reservoir infiltration as 41 BCM over 2020-2024 is highly exaggerated. The inflated estimate is drawn based on the SWAT-based inflow estimate of Blue Nile at GERD site of 85 BCM/year which is much higher than the present inflow estimates over the same period. Wet years in the basin were in 2020 and 2025, while 2021, 2022, 2023 and 2024 had near-average rainfall, as demonstrated using both GPM and CHRIPS rainfall data. Our estimate of reservoir bed and bank infiltration is 3.6 BCM considering the reservoir water level, hydrogeology and soil of the reservoir area.

Seepage through the dam: One of the central arguments of the article to show that the saddle dam is at risk rests on the satellite observed ponded water in the vicinity of the saddle dam. However, there is no causal linkage between the satellite-observed ponded water and dam seepage. Moreover, Sentinel-2 based image analysis made for 3rd week of March over the period 2019-2026, does not show ponded water bodies downstream of the saddle Dam. Thus, the "ponded water" downstream of the Saddle Dam, cited as evidence of leakage, was actually the result of end of April 2024 rainfall events.

Data Processing and usage: The lack of transparent data processing, absence of fully propagated error budget, and inadequate temporal harmonization across data set represent critical methodological deficiencies. These issues undermine the reliability and reproducibility of the analysis, rendering the conclusions insufficiently supported by the presented evidence.

Science as a Camouflage: A Critical Review of Unsubstantiated Claims on the Safety of the GERD Saddle Dam

By the Ethiopian National Committee on Dam Safety, Addis Ababa, Ethiopia, June 25, 2026

1 Introduction

The Grand Ethiopian Renaissance Dam (GERD) is located on the Blue Nile River, about 470 km air distance north-west of Addis Ababa. The GERD comprises a 145 m high roller compacted concrete main dam with crest length of 1,780 meters, and a 50 meter high concrete faced rock fill saddle dam with crest length of 5200 meters. The GERD storage at full supply level of 640 meters above sea level is 74 billion m³. The design and construction of the GERD followed the highest international standard and safety considerations. It has a total installed capacity of 5,150 MW with an average annual energy production of 15700GWhr.

The GERD has emerged as a focal point of global scholarly discourses, with thousands of publications indexed on Google Scholar, as of early 2026 alone. While such intense academic interest is to be welcomed, the integrity of the discourses depends entirely on adherence to the highest standards of scientific rigor and ethical foundations. Unfortunately, some of the publications have leveraged prestigious journals to advance geopolitical narratives rather than objective scientific inquiry, resulting in their removal from some journals¹. The article by El-Askary et al. (2026), titled “The world's largest saddle dam at risk: Multi-sensor geohazard analysis and downstream impacts” is a rushed publication driven, by what we believe, a preconceived narrative designed to bias the international community against the GERD rather than offering an independent scientific evidence to readers.

This critical review is prompted by demonstrable inaccuracies regarding the GERD saddle dam and a fundamental commitment to upholding the integrity of scientific discourse on methodological, ethical, and legal grounds. To validate its predetermined conclusions, the Article relies on flawed assumptions alongside data omission and manipulation. Consequently, its assertions regarding the risk to the saddle dam are unfounded, and its subsequent recommendations for international monitoring and governance frameworks are inappropriate and unacceptable.

2 Details of the Critical Review

2.1 Fact Check and Corrections

The Committee starts with few facts check that need to be corrected and would also like to point out the misleading nature of the title chosen by the authors. The title sounds sensational by erroneously calling the GERD saddle dam “The world’s largest saddle

⁵¹ <https://eos.org/articles/will-ethiopias-disputed-dam-collapse>

dam”, which is not. The GERD saddle dam is a typical embankment dam which is not the largest in the world. There is no authoritative global ranking of saddle dams that lists GERD’s saddle dam as the largest. The article also refers to the saddle dam as “rock-fill structure with bituminous surface sealing” while it is a concrete-faced rock fill dam. Besides, the power system incorporates two powerhouse complexes hosting 13 Francis turbines, delivering 5150 MW of installed capacity, not 16 turbines as stated in the article.

2.2 Misapplication of GRACE Satellite Data

Over-Localization of basin-scale GRACE observations: the use of GRACE (Gravity Recovery and Climate Experiment) data in the paper raises significant methodological and interpretational concerns. Specifically, the study extrapolates basin-scale satellite gravimetry observations (~300 km resolution), to infer localized groundwater processes in the GERD surroundings, which exceeds the physical capability of the dataset. The resulting conclusions regarding groundwater infiltration and structural controls are therefore not sufficiently supported.

The Article has stated that the data was downloaded from JPL and CSR in the following manner: “GRACE satellite mission data, covering TWS variations from 2002 to 2024, were acquired from the Center for Space Research (CSR) and Jet Propulsion Laboratory (JPL).” (El-Askari, 2026, section 3.2, p. 5). First and foremost, JPL deliver data on a grid of (0.5°×.5°). In relation to the CSR data (0.25°×0.25°), the following has been mentioned in the CSR home page (https://www2.csr.utexas.edu/grace/RL06_mascons.html) : “These spherical harmonic fields are provided up to degree and order 720x720. Note that d/o 720 does not represent the resolution of the fields but only used to represent the mascons. The need for representing these solutions up to d/o 720 arises from the fact that you need a very high degree and order expansion to represent the sharp discontinuities of the signals at the coastline.” Therefore, one cannot use the data to resolve sources in a very short distance other than the original grace resolution capacity. The mascon solutions improve localization and reduce signal leakage relative to spherical harmonic solutions; but they do not fundamentally increase the intrinsic spatial resolution of GRACE observations.

Further, the Article stated that “GRACE data reveals a spatial gradual increase in the groundwater content between Ethiopia and Sudan near the GERD.” (El-Askary et al., 2026, Section 4.1, p. 8, first paragraph) and in another “A spatially increasing anomaly in the seasonal peak difference product of in GRACE-derived Terrestrial Water Storage $GRACE_{TWS}$ was observed in the region along the Sudan–Ethiopia border during the period of GERD reservoir filling, an anomaly that had not been previously detected in this area over the previous five years from the start of filling.” (El-Askary et al., 2026, Section 4.1, p. 10, second paragraph). While the paper describes spatial patterns in $GRACE_{TWS}$, it misinterprets these variations as indicative of groundwater changes along the Sudan–Ethiopia border. This interpretation is not supported by the spatial resolving capability of GRACE; meaning that the observed signals reflect large-scale, basin-

integrated mass variations rather than localized hydrological processes. Therefore, statements referring to groundwater increases “near the GERD” or along specific border regions inappropriately over-localize inherently coarse-resolution signals. The spatial patterns shown in Fig. 3A–B of the article (El-Askari, 2026) cannot reliably be attributed to hydrological changes associated with GERD at the spatial scale implied by the authors' interpretation nor can they distinguish localized groundwater responses from broader regional variability.

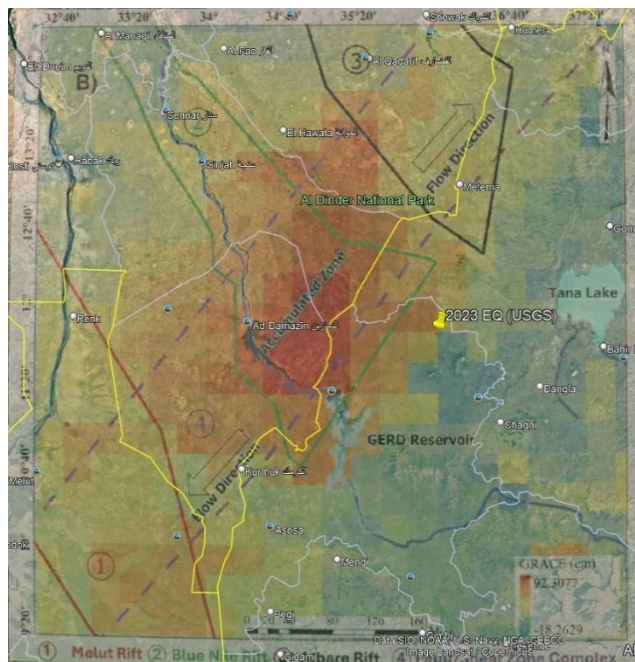


Figure 1 The GRACE_{TWC} from Al-Askary (2026) overlain on Google Map

Even if one accepts the authors' use of GRACE for small-scale interpretation, despite this being beyond its typical capability, the maximum water mass signal appears downstream, north-northwest (NNW) of GERD and east-northeast (ENE) of Roseires Dam, rather than over the GERD reservoir. This observation is particularly relevant because the authors state that “GRACE data reveals a spatial gradual increase in the ground water content between Ethiopia and Sudan near the GERD” (El-Askary et al., 2026, Section 4.1, p. 8, first paragraph). The GRACE_{TWS} map is reproduced here (Figure 1) to show the omitted (Fig. 3B, El-Askary, 2026) Roseires dam reservoir location within the area of the reported major mass accumulation.

Under expected physical conditions, if GRACE_{TWS} were capable of resolving hydrological mass changes between 2024 and 2019 at the spatial scale claimed by the authors, the strongest water mass anomaly would have been expected within the GERD reservoir footprint or its immediate vicinity, reflecting the largest newly impounded water mass following reservoir filling. However, this pattern is not observed. In contrast, the reported anomaly is centered approximately 60 km NNW of the GERD, outside the principal reservoir body, which is difficult to reconcile with the interpretation of the signal as evidence of groundwater accumulation and groundwater movement associated

with GERD. This interpretation is reflected in the authors' statement that “When the GRACE TWS spatial increase findings are integrated with the region's previously mentioned structural geology, one can deduce that the groundwater portion of total water storage accumulates within the Blue Nile Rift and flows in a NE–SW direction, consistent with the orientation of Precambrian shear zones” (El-Askary et al., 2026, Section 4.1, p. 10, second paragraph). Furthermore, if the reported signal is attributed to the claimed seepage (~41 BCM), while the retained reservoir storage at peak conditions is approximately ~71 BCM, the gravity-derived signal would still be expected to indicate a stronger positive anomaly over the GERD reservoir itself rather than downstream areas. This discrepancy further indicates that the spatial resolution of GRACE is too coarse to support the level of spatial attribution proposed by the authors. In general, given the inherently coarse spatial resolution of GRACE data, it is not possible to reliably resolve or infer directional groundwater flow or structurally controlled pathways at the scales discussed. Such interpretations would require high-resolution hydrogeological, geological, and geophysical data, which are not presented in this study.

Wrong interpretation of GRACE_{TWS} temporal data: In relation to temporal variation, the authors also stated that “An increase in the TWS levels anomalies post-filling compared to pre-filling was observed around the vicinity of the GERD reservoir, confirming our observation of possible infiltration from reservoir to the underground water component (Supplementary Fig. 4 –Supplementary Fig. 5)” (El Askari, 2026, section 4.1, p. 8, first paragraph)

The interpretation presented in the Article regarding the observed increase in GRACE_{TWS} over the GERD region requires careful consideration. Given the progressive filling of the GERD reservoir between 2020 and 2024 and the resulting addition of a substantial water mass, an increase in total water storage is a natural and expected observation. However, attributing this increase specifically to groundwater accumulation, infiltration or groundwater movement is not sufficiently supported by the spatial distribution of the reported signal. The maximum GRACE_{TWS} anomaly is not centered over, or in the immediate vicinity, of the reservoir where the additional mass (71 BCM) is stored, but is instead reported farther downstream. It is also important to note that the reported “gradual increase in groundwater content” appears soon after the transition from the GRACE mission (2002–2017) to GRACE-FO (from 2018 onward), a period during which comparable shifts in GRACE-derived TWS signals have been reported in other regions of the world.

Moreover, the observed temporal increase should be interpreted with caution and should not be uniquely attributed to groundwater accumulation without additional supporting evidence. Recent studies (e.g., Ge, 2025, Fig. 2a; Mousavimehr, 2025, Fig. 2b; Fatolazadeh, 2025, Fig. 2c) provide important context for interpreting such signals. Although conducted at a broader spatial scale within the same basin, Ge et al. (2025) observed similar TWS shifts beginning around 2019, before the commencement of GERD reservoir filling in 2020, and coincident with the GRACE-to-GRACE-FO transition. This suggests that similar temporal behavior may occur at the basin scale and therefore should

not be uniquely attributed to groundwater accumulation in the downstream region of GERD without further supporting evidence. Similarly, Fatolazadeh (2025) reports apparent trends and spatial anomalies in hydrologically distinct regions, such as the Niger Delta, indicating that such features are not unique to the GERD area, and may thus be partly attributable to other technical issues (Figure 4.2-1b). Importantly, Mousavimehr (2025) also identifies a noticeable shift in TWS behavior across the GRACE–GRACE-FO transition (Fig. 2), although expressed as a decrease rather than an increase (Figure 4.2-1c). Collectively, these findings demonstrate that such post-2018 variations, whether positive or negative, are not unique to the GERD region and therefore should not be interpreted as evidence of groundwater accumulation downstream of GERD without first excluding broader basin-scale influences.

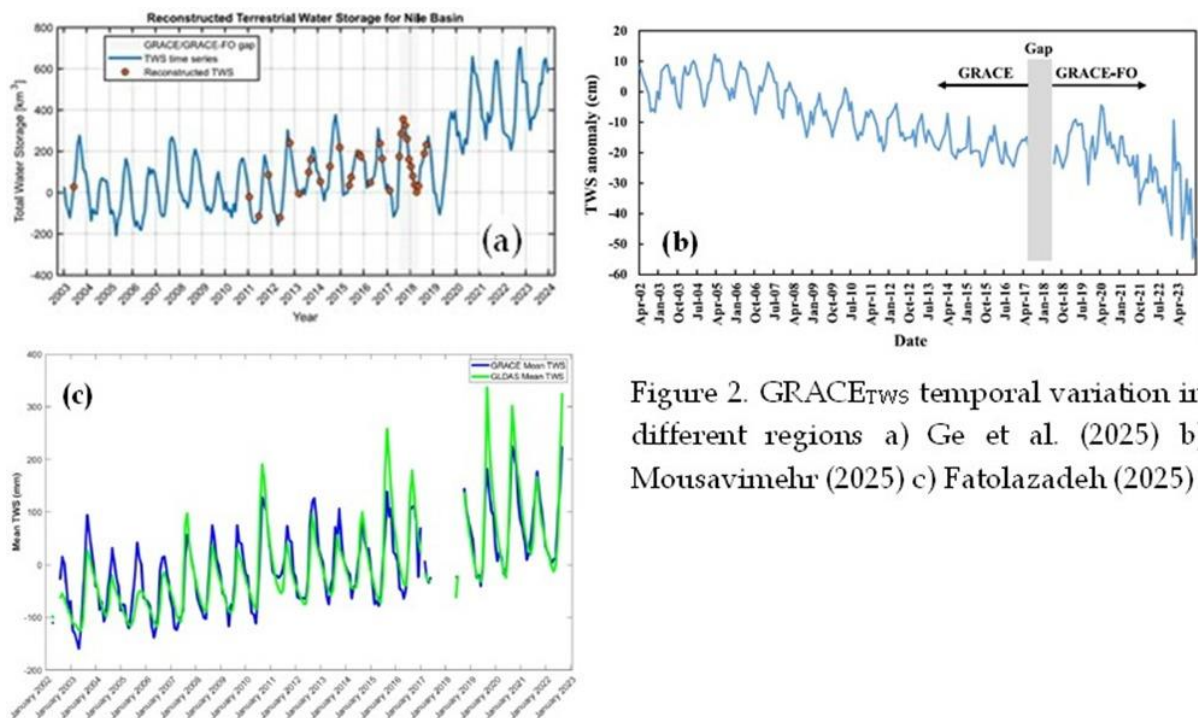


Figure 2. GRACE_{TWS} temporal variation in different regions a) Ge et al. (2025) b) Mousavimehr (2025) c) Fatolazadeh (2025)

The study presents multiple differential GRACE datasets, both in the main paper and supplementary materials, derived by differencing various years relative to 2019. However, the authors fail to specify which months are used in these comparisons. This omission constitutes a significant methodological deficiency, as GRACE data are strongly influenced by seasonal hydrological cycles. Without strict temporal consistency (i.e., comparing identical months or seasons), the resulting differences may primarily reflect seasonal variability rather than true interannual change, thereby rendering the results ambiguous and prone to misinterpretation.

In conclusion, the study misapplies GRACE data beyond its valid spatial and physical scope, leading to misinterpretation of basin-scale signals as localized hydrological processes. Thus, the conclusions regarding groundwater infiltration, its magnitude, and its structural controls are therefore not substantiated by the GRACE observations presented. This constitutes a significant data & methodological limitation that undermines the reliability of the infiltration claim.

2.3 Seismological Analysis and Data Fabrication

The article claims that GERD produced RIS inferred from seismic data observed hundreds of kms away from the reservoir based on data acquired from the USGS earthquake catalogue. Studies of RIS (cf. Gupta et al., 1972; Durá-Gómez and Talwani, 2010) show that their epicentres are located within a distance of 25 to 37 km from the dam lakes. The claimed RIS is not caused by filling of the GERD reservoir but by active rifting mixed with magmatic intrusions (Figure 3(a); Wright et al., 2006; Ayele et al., 2007; Ayele et al., 2009; Ebinger et al., 2010).

Overall, the conclusion and assertion by El-Askary et al., 2026 are based on faulty assumption and observation which is baseless for the following reasons:

Unrealistic model assumption

The authors wrongly claim the entire seismic activity located at hundreds of kms air distance from the active rift margin and caused by active rifting and volcanism that occurred in the Afar and Main Ethiopian rift (Keir et al, 2006; Ayele et al., 2024; Wright et al., 2006; Ayele et al., 2007; Ayele et al., 2009; Ebinger et al., 2010) to be caused by the different phases of GERD filling.

The authors used the following model:

$$\log(\lambda_i) = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2}$$

where

λ_i is the expected count of earthquake occurrences for month i

β_0 is the intercept

X_{i1} is a binary variable indicating the presence of lake filling at month i

X_{i2} is a binary variable indicating volcanic activity at month i

β_1, β_2 are the corresponding effect sizes or coefficients

The Article employed Poisson regression model in the above equation but with a gross assumption of parameter correlation with no causal relationship between tectonic and magma- driven seismicity in the adjacent active rift with filling periods of GERD. This parameter correlation between lake filling and observed seismicity would hold valid if the authors have RIS data in the vicinity of the GERD. All earthquakes that occurred in the Main Ethiopian Rift and the Afar Depression caused by tectonic and magmatic processes are considered in the event count and used in the above equation which is unrealistic assumption.

The other misconception is the use of coulomb stress modelling and misusing Madson & Sheng (2021) where coulomb stress increases in excess of 10 kPa are considered to be the

threshold at which seismicity is affected while in reality the model applies within few tens of kilometres from the reservoir. The single earthquake to-date, occurred on May 8, 2023 of magnitude 4.4 is 110km away from the nearest shoreline of the reservoir. This event cannot be caused by the GERD filling, as claimed by the Article.

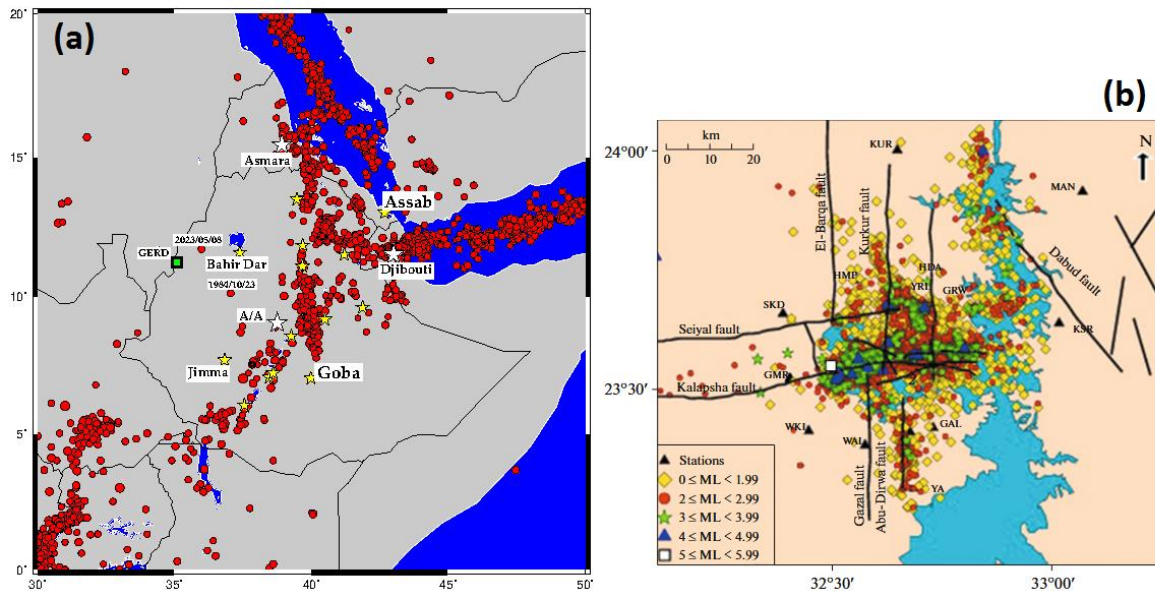


Figure 3. (a) Seismicity of the Horn of Africa region. Red dots represent earthquake epicentres with magnitude $M_w \geq 4.0$ since 1900. Green rectangle represent the location of GERD. White stars are capital cities of some countries in the region and yellow stars are major town in Ethiopia. (b) Location map of earthquakes distribution in and around the Aswan dam which occurred during 1982–2017 time period (Omar et al., 2019)

Data fabrication: El-Askary et al. 2026 used a single earthquake of magnitude 4.4 that occurred on 8 May 2023 at air distance of > 110 km from the GERD lake body and located at 11.7476° latitude and 36.2562° E longitude as a justification for the observation of RIS related with dam filling.

In the absence of a fault plane solution and inherent USGS location error for this earthquake, El-Askary et al. 2026 associate the epicenter with NE–SW-oriented God-Serpent Dyke swarm located 70 kms southeast of the event with 70 km air distance. In reality, the study does not show the existence of active faults in the vicinity of the epicenter (Figure 2b). This fabricated information is then misused to substantiate their false claim of hydrological loading of the GERD dam at 111 km distance, which is in huge contrast to commonly observed epicentral distance of RIS observation (e.g., Gupta et al., 1972; Dur'a-G'ome and Talwani, 2010;).

The authors claim that the May 8, 2023 magnitude 4.4 earthquake is the only event recorded ever about 110 km away from GERD. However, record shows that there was a magnitude 4.8 event that occurred on October 23, 1984 at about 250 km from the present GERD dam site before the existence of the GERD (Figure3a).

As comparison, on another dam along the Nile River, Aswan High dam was completed in 1970 and started operation in 1971 where a high level of seismicity was reported (Figure 3b) in and around the reservoir, and yet no record of critical dam safety issues were reported and published. By citing a poorly located single earthquake with unknown fault plane solution, which is far away from the GERD dam, the article used as evidence of alarming dam safety issue to confirm their preconceived bias.

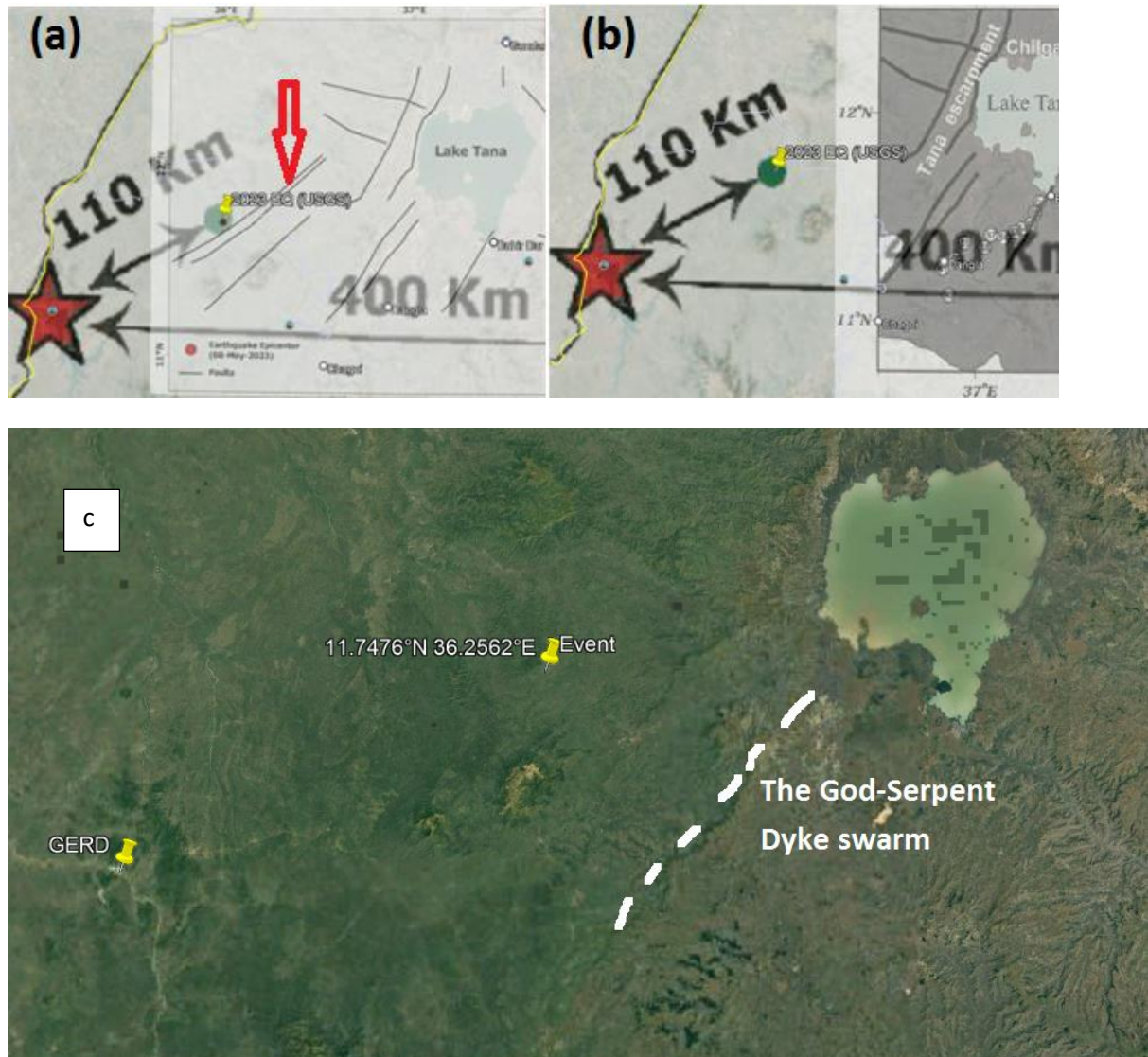


Figure 4. The earthquake location of May 8, 2023 as plotted by El-Askary et al., 2026 (a) with fabricated fault data (red arrow), (b) the actual distance of the earthquake location relative to faults in the Tana graben as shown by Hautot et al. (2006), (c) Google earth map showing relative location of the God-Serpent dike swarm, GERD and earthquake location.

Misinterpretation of seismicity data:

The figure in the supplementary document (Supplementary Fig. 15, El-Askary, 2026) presents seismicity frequency only from 2015 onward, thereby preventing readers from

appreciating the episodic nature of the earthquakes illustrated by looking at the 2005 event to mischaracterize the episodic nature the rift activities (Figure 5).

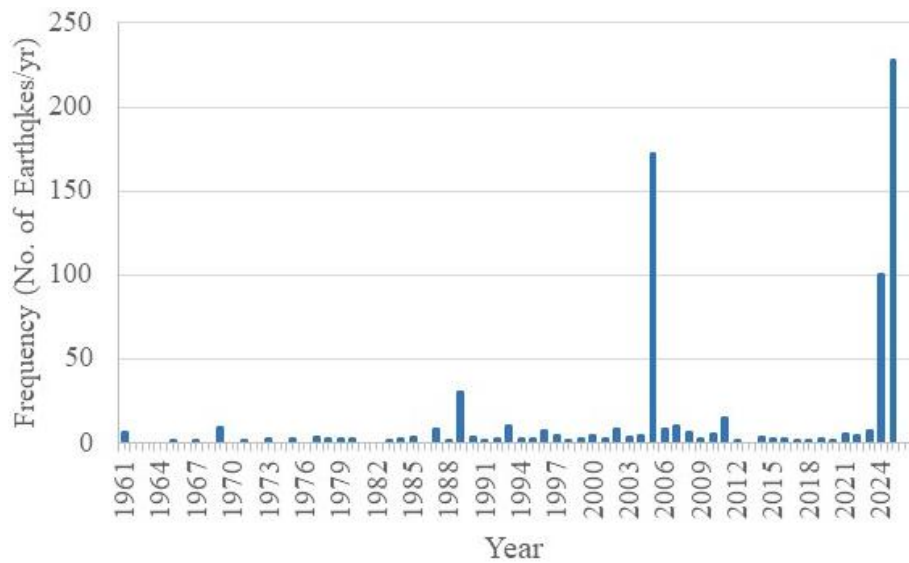


Figure 5. Major elevated frequency of occurrence ($M > 4$) in Karakore (1961), Serdo (1969), Dobi Graben (1989), Dabbahu activity (2005) Fentale-Dofen (2024 & 2025)

The worldwide seismic station network distribution progressively improves with time over the years, the recent one being always better compared to the past. When seismic station network gets better and better, our chance of detecting smaller magnitude earthquakes improves as displayed in Figure 6, which shows the magnitude versus time plot with more event counts. That being the actual global observation, El-Askary et al., 2026 boldly concluded that the 2020 to 2025 slightly elevated event count to be associated with the commencement of the GERD impoundment in 2020 which is misinterpretation of facts and figures established in observational seismology.

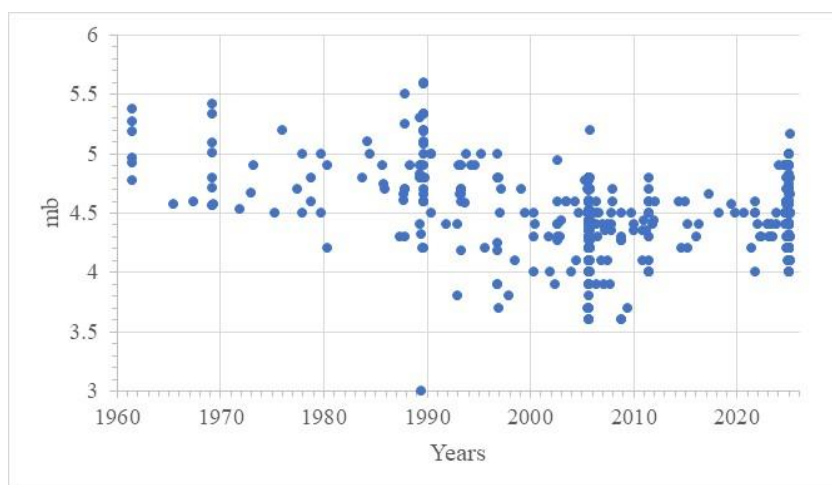


Figure 6. Earthquakes of magnitude ≥ 3.0 mb in Ethiopia (1961–2025) where the clustered activity nicely matches with the distinct activities or event counts displayed in Figure 3 i.e., Karakore (1961), Serdo (1969), Dobi Graben (1989), Dabbahu activity (2005) Fentale-Dofen (2024 & 2025)

Overall, the conclusion drawn by El-Askary et al. (2026) to infer anomalous seismicity of the GERD's saddle dam based on unrealistic model assumption of Reservoir Induced Seismicity), misuse of coulomb stress modelling and fabricated fault data is scientifically unfounded and baseless. All the issues of the bold claim stem from associating the natural seismicity caused by the tectonic and magmatic activity that occurred 100s of km distance to the GERD without consideration of the context of distance scale in dam loading dynamics, which is unscientific. We have also observed data inclusion (Figure 4) and de-emphasis (Figure 5) as deemed relevant for the assertion of El-Askary et al. (2026), which is not an accepted norm in science.

2.4 Major Hydrological and Infiltration Analysis Errors

Infiltration and Reservoir Seepage: The study heavily relies on satellite-derived data and hydrological modelling to assess the structural and hydrological risks of the GERD Saddle Dam. While these methods are valuable, the lack of in-situ geotechnical and hydrological data undermines the reliability of the findings. Ground-truth validation is essential for confirming satellite observations, and the absence of such data introduces significant uncertainty. The estimation of groundwater infiltration (41 BCM) is based on a water balance approach that assumes 'residual errors are primarily due to deep percolation'. This assumption oversimplifies the complex hydrological processes in the region, such as evapotranspiration rates and other unmeasured factors.

There is no detail evidence to confirm whether the estimated inflow is in the right order of magnitude. The inflow of the Blue Nile River at GERD was estimated using SWAT model in which no detailed results (evaporation, interflow, base flow) of the water balance components were provided. The calibration and validation periods should have been clearly presented.

Reliable estimate of total reservoir seepage using inflow into GERD, outflow from GERD, net evaporation, and change in reservoir storage is possible provided that the inflow (the largest component) is reasonably estimated, which was not the case as explained below.

Observed annual maximum flows of the Blue Nile river at GERD over the period of 1911-2003 were 67 BCM in 1998 and 69 BCM in 1929. The historical minimum flow of 21BCM was observed in 1913 and in 1984 it was 29BCM. The long-term average flow is 49 BCM/year. However, the article claimed that all SWAT estimated flows were above 70 BCM/year over the period of 2020-2024, and their average estimated annual flow is 85 BCM, much higher than our estimated average inflow into GERD over the same period. Wet years in the GERD watershed were in 2020 and 2025, while 2021, 2022, 2023 and 2024 had near average rainfall as inferred from both GPM and CHRIPS data. This error presumably is caused by mainly due to error in biased corrected CHRIPS data as well as SWAT model calibration. The Article did not provide any details in both cases. As a result of the overestimated total inflow to GERD during the four year period, the Article

wrongly produced 41 BCM seepage from the GERD reservoir, using reservoir water balance.

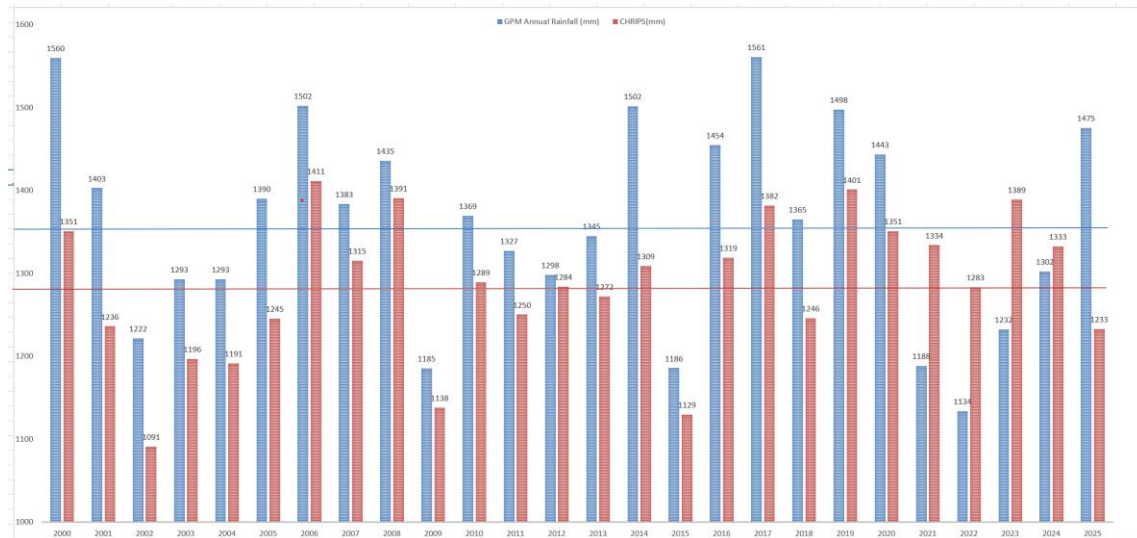


Figure 7: GPM & CHRIPS annual rainfall (mm) over the watershed of the Blue Nile river at GERD from 2000-2025

Evapotranspiration (ET) is one of the largest components of the water balance in the Blue Nile basin and even a 10 % error in ET translates into several BCM of estimated flow and thus the claimed exaggerated infiltration.

The following basic calculation illustrates the overestimation of the Blue Nile flow at GERD site by El-Askary et al. (2026). The average annual runoff coefficient, based on observed data, in the Blue Nile at GERD site is between 0.20-0.30 depending mainly on antecedent moisture condition and rainfall intensity and duration. From Figure 4, GPM based average rainfall over 2020-2024 is 1259 mm (considering satellite rainfall uncertainty). Taking a runoff coefficient of 0.25, the mean annual flow at GERD site, generated from 172,250 km² watershed area, is 54 BCM, not 85 BMC as estimated by Hesham et a El-Askary et al. (2026).

Seepage from the reservoir bed and bank: In the article seepage estimate did not explicitly partition between the reservoir seepage and through dam seepage. Our estimate of seepage in reservoir is mainly determined by the reservoir bed and bank infiltration capacity, percolation and the interconnectivity of percolated water with larger aquifer (hydraulic gradient of the flow) and seepage through the dam.

Eighty percent of the geological unit of the reservoir area is Precambrian basement and the remaining 20% is Tertiary units. The Basement rocks of Ethiopia are described as a system of regional aquiclude and low productivity ((Cherinet,1988). The Precambrian units have low water storage and slow and limited recharge capacity (Deyassa et al., 2014), while the tertiary units have better storage. Aquifers in basement rock are controlled by deep weathering, stripping processes, and secondary porosity developed in the shallow fractures. The main groundwater weathering profiles properties vary on a

regional and local scale. The regolith, which is the main water bearing zone in the western crystalline basement, diminishes westward with increasing aridity in the reservoir area. The older structures are filled with secondary mineralization and lost their hydraulic conductivity, to make this zone part of the regional aquiclude (Nyiayu, 2019, Alemayehu et al., 2018; Kebede, 2003). These geological and structural characteristics of the GERD reservoir area make it an ideal site for a dam. There is no major expected water losses through geological structures as the reservoir area is located in inactive Blue Nile rift and away from Juvenial crest (Hamimi et al., 2022; Alemu, 2021, Fritz et al., 2013). Arcisols soil dominates 80% of the reservoir bed with low infiltration capacity (Curi, et al., 2023), and the remaining area is covered by Eutric Regosols, in which moderate infiltration is expected under natural condition.

Furthermore, infiltration in the GERD reservoir bed during filling and afterward is affected by reservoir sedimentation. The Blue Nile sediment is mainly composed of 30% clay, 40% silt and 30 % fine sand (Steenhuis et al., accessed 16, April 2026). During GERD reservoir filling (2020-2024 and afterwards), this fine suspended sediment progressively settled (as GERD reservoir trap efficiency is 97% (Ahmed G. et al. 2025) in a reservoir bed and banks formed a blanket or seal that significantly lowered infiltration and led to reduced seepage losses. This process is more effective around the saddle and main dams, as more of the suspended clay reaches these areas, creating a watertight bed. Clogging layer and pore blockage by deposition of suspended clay weakened the hydraulic connection between the water level in the basin and the water table of the unconfined aquifer until nearly no water could infiltrate into the aquifer (Ahmed et al., 2025, Zou et. al., 2019).

The Committee's estimated total GERD reservoir bed and bank seepage as 3.6 BCM over the period 2020-2024, taking an average of 2 mm/day seepage loss (the first year filling about 4 mm/day, after sediment ceiling reducing to 0.5 mm/day in 5 years) from the reservoir bed and banks considering: (a) limiting underlying rock storage and transmissivity capacity, and (b) the gradual build-up of silt-clay sediment in reservoir bed and banks and saturation of underlying strata.

2.5 Standing water body at downstream Saddle dam

The article states, "Data from The Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) indicated that 25th, April 2024 was the only day of recorded precipitation in that period, with a rainfall intensity of 1.3,mm/h a level insufficient to generate significant surface water accumulation. Thus, the findings may indicate water emergence from non-precipitation-related sources. The only plausible source of water contributing to the observed standing water bodies appears to be the GERD reservoir, which is located approximately 200 to 300 m from these areas". However measured rainfall data from the GERD site indicates that moderate rainfall of 16.8 mm was recorded on the 25th of April 2024. Moreover, Sentinel-2 based image analysis made for 3rd week of March over of the period 2019-2026, when we can find

cloud free image, does not show ponded water bodies downstream of the saddle dam (Figure 8). These show that the article wrongly attributed rain generated pools of water as dam seepage.

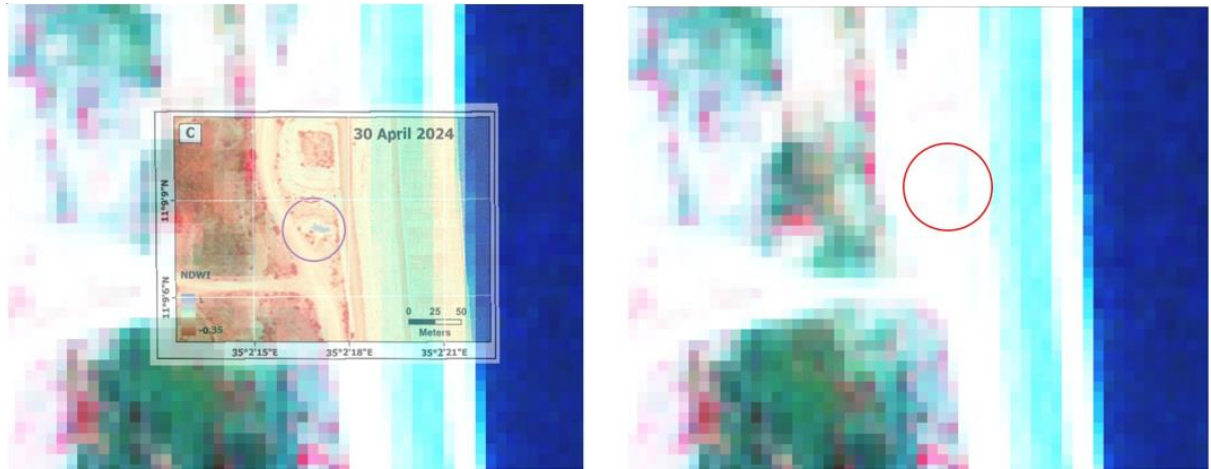


Figure 8: No seepage is seen on Sentinel 2 Image (10m), sensed on 13/04/2026 (right), at the site indicated as strong evidence by the authors (left).

The alleged findings about infiltration and seepage risks are thus speculative and based on faulty results and non-causal reasoning.

2.6 Differential settlement

The article states that “Persistent Scatterer Interferometry (PSI) from Sentinel-1 (SAR) deformation analysis detected differential settlement up to 40 mm in structurally sensitive zones, aligning with seepage-prone areas.” The manuscript does not quantify the uncertainty associated with the reported 40 mm displacement magnitudes, making it difficult to assess the statistical significance of the inferred deformation patterns. Moreover, PSI-derived displacements are relative and highly sensitive to reference selection. Without ground truth validation, the results remain indicative at best, not conclusive. Furthermore, reprocessing the InSAR data from the same satellite and period reported in El-Askary et al. (2026), did not validate the claimed deformation pattern. Given the sensitivity of PSI results to processing choices, reference selection, atmospheric corrections, and quality-control criteria, the reproducibility of the reported deformation signal cannot be assessed from the information provided in the manuscript.

The manuscript appropriately acknowledges that PSI results are relative LOS measurements lacking independent validation. However, the subsequent interpretation links these observations to seepage-prone zones, differential settlement, and IPoE geotechnical concerns in a manner that exceeds what can be demonstrated from unvalidated relative PSI measurements alone.

2.7 Technical Flaws in Dam Breach Simulation

The alleged dam breach consequences estimated using HEC-RAS model has no sound technical basis because :

- (a) the model used low resolution DEM data (SRTM 30x30 m with, vertical accuracy > ~3 m),
- (b) used arbitrary worst-case breach parameters,
- (c) hydraulic roughness was parameterized using Manning's coefficients of 0.035 for river channels and 0.05 for floodplains with no spatial variation. The model is not calibrated.
- (d) the model uses very rough spatial resolution for estimating water level and other parameters.

This indicates the analysis suffers from fundamental methodological flaws, unjustified assumptions, internal inconsistencies, and alarmist conclusions unsupported by sound modeling. The section does not meet minimum standards for credible dam breach risk assessment.

2.8 Lack of Transparency and Error Budgeting

The evaluation of the study reveals substantial deficiencies, particularly regarding the lack of clearly showing data processing procedures and the absence of a comprehensive error budget. These shortcomings fundamentally undermine the reliability, reproducibility, and scientific validity of the presented results.

Although the authors state that they integrate multiple datasets (e.g., GRACE, Sentinel-1, Sentinel-2, SWAT modeling, and seismic catalogs), the study does not present a transparent or reproducible data processing workflow. There is no clear description of the preprocessing steps applied to the key datasets.

As a result, the study does not meet the minimum reproducibility standards expected in geophysical and remote sensing research.

3 Conclusion

The use of GRACE data to infer localized groundwater processes at the dam site exceeds the resolving capability of the dataset. GRACE is a basin-scale monitoring tool with a spatial resolution of approximately 300 km. The Article's attempt to use this coarse data to identify specific "seepage-prone areas" at the scale of a single dam structure is technically invalid. Furthermore, even if one were to accept the resolution incorrectly attributed to GRACE by the Article, the mass accumulation detected by GRACE is located NNW of the GERD, near the Roseires Dam in Sudan, which the Article omitted from the maps. The reported temporal increase in water storage following the filling of GERD is not unexpected. However, its attribution to ground water should be interpreted with caution because similar temporal shifts have been reported in broader basin-scale analyses and across the GRACE-GRACE-FO transition period.

Similarly, the interpretation of PSI -InSAR results as evidence of differential settlement and seepage-related structural concerns remains insufficiently substantiated. The reported deformation estimates are derived from relative line-of-sight measurements and were not independently validated using GNSS, leveling, or other ground-based observations. Furthermore, independent reprocessing of Sentinel-1 data acquired during the same period did not reproduce the reported deformation pattern. Available monitoring information also indicates no observable structural distress, including noticeable cracking of the parapet wall foundation or crest road, and no observable embankment uplift at the right abutment. Consequently, the evidence presented is insufficient to conclusively link the reported PSI observations to seepage-induced settlement or structural instability.

The other scientific misconduct in the article is the fabrication of fault data and the misinterpretation of regional seismicity. The Article claims that the GERD is an active geohazard hotspot due to reservoir-induced seismicity. However, the Article mainly attributes earthquakes occurring 400 to 650 kilometers away in the Main Ethiopian Rift and the Afar Depression to the hydraulic loading of the GERD. Established RIS mechanisms and Coulombs stress modeling are generally confined to the immediate vicinity of the reservoir (maximum radius of 25–37 km).

The Article's claim of massive groundwater infiltration (~41 BCM) and structural risk is also technically untenable due to a lack of ground-truth validation and systemic modeling errors. It significantly overestimated annual inflow of 85 BCM, compared to the historical average, while ignoring the natural sealing effect of reservoir sedimentation that drastically reduces seepage. The Committee's estimated total GERD reservoir bed and bank seepage is 3.6 BCM. Furthermore, the "standing water" downstream of the Saddle Dam, cited as evidence of seepage, was actually the result of observed 17.8mm total rainfall, recorded on April 24, 26 and 28, 2024.

In light of the systemic methodological failures, the misapplication of basin-scale data to site-specific conditions, and the demonstrable misrepresentation of seismic and geotechnical risks, this publication fails to meet the foundational requirements of academic rigor and ethical inquiry. These errors do not represent mere differences in scientific interpretation; rather, they constitute a fundamental departure from evidence-based research which risks misleading the international community on a matter of critical infrastructure safety.

Consequently, the Committee demands the permanent removal and formal retraction of this article. Given the gravity of the data fabrication and the alarmist nature of the conclusions, the removal of the article from the scholarly record is the only ethical course of action to limit the dissemination of these untenable claims. Based on these unfounded claims and creating false alarm of dam failure, the Article recommend for international monitoring and governance frameworks for the Grand Ethiopian Renaissance Dam (GERD), which the Committee categorically reject.

References

- Ahmed, G., Cattapan, A., Omer, A., & Mohamed, Y. (2025). A hybrid approach to evaluate sedimentation in large dams: case study of the Grand Ethiopian Renaissance Dam and Roseires Dam across the Blue Nile. *Journal of Hydrology: Regional Studies*, 60, 102585. <https://doi.org/10.1016/J.EJRH.2025.102585>
- Alemayehu, T.; Kebede, T.; Liu, L., 2018. Basin characterization and determination of hydraulic connectivity of mega basins using integrated methods: The case of Baro-Akobo and mega watershed beyond. *Journal of African Earth Sciences*.
DOI: 10.1016/j.jafrearsci.2017.09.011
- Alemu, T., 2021. Tectonic Evolution of the Pan-African Belt in Western Ethiopia, Southern Arabian-Nubian Shield. Springer Nature Switzerland AG 2021 Z. Hamimi et al. (eds.), *The Geology of the Arabian-Nubian Shield, Regional Geology Reviews*, https://doi.org/10.1007/978-3-030-72995-0_4.
- Ayele A, Jacques E, Kassim M, Kidane T, Omar A, et al. 2007. The volcano-seismic crisis in Afar, Ethiopia, starting September 2005. *Earth Planet. Sci. Lett.* 255:187–97
- Ayele, A., D.Keir, C.Ebinger, T. J.Wright, G. W.Stuart, W. R.Buck, E.Jacques, G.Ogubazghi, and J.Sholan (2009), September 2005 mega-dike emplacement in the Manda-Harraro nascent oceanic rift (Afar depression), *Geophys. Res. Lett.*, 36, L20306, doi:10.1029/2009GL039605.
- Ayele, A., Lockett, R., Baptie, B. and Whaler, K., (2024). The 2015 earthquake swarm in the Fentale volcanic complex (FVC): A geohazard risk for Ethiopia's commercial route to the Djibouti port., *Journal of African Earth Sciences*, Volume 213, 105236, ISSN 1464-343X, <https://doi.org/10.1016/j.jafrearsci.2024.105236>.
- Curi, N., Silva, S. H. G., & Inda, A. V. (2023). Humid subtropical ecozone with emphasis on Acrisols and Alisols. In *Encyclopedia of Soils in the Environment*, Second Edition (pp. V4-343-V4-352). Elsevier. <https://doi.org/10.1016/B978-0-12-822974-3.00068-9>
- Deyassa, G., Kebede, S., Ayenew, T., & Kidane, T. (2014). Crystalline basement aquifers of Ethiopia: Their genesis, classification and aquifer properties. *Journal of African Earth Sciences*, 100, 191–202. <https://doi.org/10.1016/J.JAFREARSCI.2014.06.002>
- Durá-Gómez, I., & Talwani, P. (2010). Reservoir-induced seismicity associated with the Itoiz Reservoir, Spain: a case study. *Geophysical Journal International*, 181(1), 343–356. <https://doi.org/10.1111/J.1365-246X.2009.04462.X>
- Ebinger, C., Ayele, A., Keir, D., Rowland, J., Yirgu, G., Wright, T., Belachew, M., Hamling, I. (2010). Length and Timescales of Rift Faulting and Magma Intrusion: The Afar Rifting Cycle from 2005 to Present. *Annual Review Earth and Planetary Sciences*. 38:439-466. <https://doi.org/10.1146/annurev-earth-040809-152333>

El-Askary, H., Morgan, H., Maharjan, S., Elgendy, A., Li, W., Thomas, R., Madson, A., Rakovski, C., (2026), The world's largest saddle dam at risk: Multisensor geohazard analysis and downstream impacts, *International Journal of Disaster Risk Reduction*, 135, <https://doi.org/10.1016/j.ijdr.2026.106045>.

Fritz, H. M. Abdelsalam K. Ali., Bingen, A.S. Collins, A.R. Fowler, W. Ghebreab, C.A. Hauzenberger, P.R. Johnson, T.M. Kusky, P. Macey, S. Muhongo, R.J. Stern , G. Viola. 2013. Orogen styles in the East African Orogen: A review of the Neoproterozoic to Cambrian tectonic evolution. *Journal of African Earth Sciences* 86 (2013) 65–106

Fatolazadeh, F., & Goïta, K. (2025). Understanding Terrestrial Water Storage Changes Derived from the GRACE/GRACE-FO in the Inner Niger Delta in West Africa. *Water*, 17(8), 1121. <https://doi.org/10.3390/w17081121>.

Ge, Y., Ferreira, V., Xu, J., & Ndehedehe, C. (2025). High-resolution GRACE-based assessment of hydrological drought patterns and recovery dynamics across the Nile Basin countries (2003–2023). *Journal of Hydrology: Regional Studies*, 62, 102904. <https://doi.org/10.1016/J.EJRH.2025.102904>

Gupta, H., Rastogi, B. K. and Narian , H., (1972), Some discriminatory characteristics of earthquakes near the Kariba, Kremasta, and Koyna artificial lakes, *Bulletin of the Seismological Society of America*, 62 (2), 493-507, <https://doi.org/10.1785/BSSA0620020493>

Hamimi Z, Hagag W, Fritz H, Baggazi H and Kamh S (2022) The Tectonic Map and Structural Provinces of the Late Neoproterozoic Egyptian Nubian Shield: Implications for Crustal Growth of the Arabian–Nubian Shield (East African Orogen). *Front. Earth Sci.* 10:921521. doi: 10.3389/feart.2022.921521.

Hautot, S., Whaler, K., Gebru, W., & Desissa, M. (2006). The structure of a Mesozoic basin beneath the Lake Tana area, Ethiopia, revealed by magnetotelluric imaging. *Journal of African Earth Sciences*, 44(3), 331–338. <https://doi.org/10.1016/J.JAFREARSCI.2005.11.027>

ICOLD Bulletin 141 (2010) Concrete Face Rockfill Dam, Concept for the Design and Construction.

Keir, D., C. J. Ebinger, G. W. Stuart, E. Daly, and A. Ayele (2006), Strain accommodation by magmatism and faulting as rifting proceeds to breakup: Seismicity of the northern Ethiopian rift, *J. Geophys. Res.*, 111, B05314, doi:10.1029/2005JB003748.

Madson, A., & Sheng, Y. (2021). Coulomb stress analysis for several filling and operational scenarios at the Grand Ethiopian Renaissance Dam impoundment. *Environmental Earth Sciences* 2021 80:7, 80(7), 286-. <https://doi.org/10.1007/S12665-021-09591-W>

Mousavimehr, S.M., Kavianpour, M.R, (2025), A non-stationary downscaling and gap-filling approach for GRACE/GRACE-FO data under climatic and anthropogenic influences. *Appl Water Sci* 15, 91. <https://doi.org/10.1007/s13201-025-02427-z>

[Nyiyayu Halimatussa'diyah](#), [Mohammad Syamsu Rosid](#), [Helmi Indrajaya](#) 2019. Identification of fractured-basement reservoir based on integration of FMI Log and seismic attributes in hydrocarbon field "I", Barito Basin, South Kalimantan. *IOP Conference Series Earth and Environmental Science* 311(1):012088, DOI: [10.1088/1755-1315/311/1/012088](https://doi.org/10.1088/1755-1315/311/1/012088)

Omar, K. A., El-Amin, E. M., Dahy, S. A., & Ebraheem, M. O. (2019). Study of the Relationship between Recently Induced Earthquakes and Water Level at the Northwestern Side of Lake Nasser in Aswan Region, Egypt. *Geotectonics* 2019 53:2, 53(2), 251–259. <https://doi.org/10.1134/S0016852119020067>

Steenhuis, T.S, Easton, Z. M. Awulachew S. B., Ahmed A A., Bashar, K. A, , Adgo, E., Yihenew, Gebre Selassie, Y., Tilahun, S.A. Accessed 16April2026 <https://cgspac.cgiar.org/server/api/core/bitstreams/2aa9557b-8034-47bc-8369-98805faf0b9e/content>.

Tesfay Cherinet, 1988. Hydrogeological Map of Ethiopia, Ethiopian Institute of Geological Surveys.

Wright T.J, Ebinger C, Biggs J, Ayele A, Yirgu G, Keir D, Stork A. Magma-maintained rift segmentation at continental rupture in the 2005 Afar dyking episode. *Nature*. 2006; 442(7100): 291-4. doi: 10.1038/nature04978. PMID: 16855588.

Zhike Zou, Longcang Shu, Xing Min and Esther Chifuniro Mabedi, 2019. Clogging of Infiltration Basin and Its Impact on Suspended Particles Transport in Unconfined Sand Aquifer: Insights from a Laboratory Study [Water](#)2019, 11(5), 1083;<https://doi.org/10.3390/w11051083>.