Hoppenbrock, J., Beyer, M., Gerchow, M., and Bücker, M.: Technical note: Monitoring diel soil water variations below trees using high-resolution electrical resistivity tomography, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2026-4818, 2026.

The global demand for development has driven rapid urbanization across the world. However, human infrastructure remains inherently bound to the natural climate system. To mitigate and pacify the climate alterations caused by rapid urban expansion, various counter-measures have been introduced. Among these, urban trees play a critical role, acting as both biological filters and natural fans that provide microclimate cooling and carbon dioxide sequestration.

Despite their benefits, urban trees are frequently planted without a sufficient understanding of the underlying subsurface system, specifically within the complex unsaturated zone. To address this critical knowledge gap, the authors utilize Electrical Resistivity Tomography (ERT) measurements alongside sap flow and soil water content (SWC) monitoring. This experimental setup allows them to evaluate subsurface dynamics during <u>non precipitation periods</u> and contribute valuable data to the existing literature. Based on the information presented in the manuscript, the following points are brought forward for discussion:

1. In **Figure 4**, subplots (a) and (b) are based on **Archie's law** (**Equations 1 and 2**). The current scaling of the data creates the impression that the plots were tailored specifically to demonstrate that the observed data follows a y = mx^2 + c relationship. While the x-axis spans widely from 0 to 16, the actual data points are tightly clustered within a very narrow range: between **8 and 10 in subplot (a)**, and between **2 and 3 in subplot (b)**. Consequently, compressing the data into such restricted windows visually forces an artificial alignment with the trendline, masking the true distribution and variance of the data.

2. In **Equations 1 and 2**, which are based on **Archie's law**, bulk electrical conductivity is determined by scaling the pore fluid conductivity by a specific formation factor. This factor is typically expressed as a function of parameters such as **soil water content (SWC)** and **porosity**. Modern theoretical advancements have expanded this framework by incorporating **surface conductivity** as an additive term to the factored pore fluid conductivity.

While Section 4.2 attempts to explain the findings presented in **Figure 4**, critical methodological details have been omitted from the text, thereby obscuring the authors' exact workflow and assumptions. To ensure transparency and reproducibility, the following points regarding the figures require immediate clarification:

2.1 In Figure 4, in subplot (a), the exponent m is set to **2**, whereas subplot (b) uses a value of 1.81. Reviewing the equations, if m = 2 (as in subplot a) and the variable n is also set to **2**, the exponent term (m – n) becomes 2 - 2 = 0. Consequently, the term porosity^{m-n} (or equivalent porosity) in equation 2 vanishes to 1, meaning this parameter exerts no influence on the fluid conductivity scaling.

Conversely, in subplot (b), m is set to 1.81. This implies that porosity *does* influence the bulk conductivity. However, because n remains fixed at 2, the exponent becomes negative (1.81 - 2 = -0.19), resulting in an inverse relationship for that factor. The authors need to justify the physical mechanism behind this inverse relationship and explain why different m values were applied across the subplots. It is understood that these subplots represent the experimental data collected at depths of 1 m and 2 m, respectively.

2.2 Clarification regarding the **surface conductivity values** must be included in the manuscript or technical note. Subplot (a) shows that the surface conductivity—acting as the additive term in equation 2—is **0.27 units**. In contrast, this value increases nearly fivefold to **1.17 units** in subplot (b).

Because subplot (a) corresponds to a depth of **1 m** and subplot (b) corresponds to a depth of **2 m**, the authors need to provide a clear physical or geochemical justification for this substantial fivefold jump in surface conductivity with depth. Factors such as changes in clay content, mineralogy, or soil compaction across these two horizons should be explicitly discussed to validate these parameters.

Furthermore, this justification must align logically with the **porosity values** assumed by the authors, which decrease from **0.50 at a depth of 1 m** to **0.44 at a depth of 2 m**. The authors must reconcile these physical parameters with the mathematical coefficients applied to the porosity term—specifically, an exponent of **0 in subplot (a)** versus **-0.19 in subplot (b)**. A cohesive explanation is required to show how these combined changes in surface conductivity, porosity, and structural exponents physically represent the soil conditions at their respective depths.

2.3 An evaluation of the values presented in **subplots (a) and (b)** reveals a remarkable shift in magnitude between the two depths. In subplot (a) (1 m depth), the **bulk conductivity** is bounded between **0.30 and 0.35**, while in subplot (b) (2 m depth), it ranges between **1.5 and 2.0**. More notably, the **pore fluid conductivity** jumps drastically from **7.23** in subplot (a) to **276** in subplot (b).

This represents a massive, multi-orders-of-magnitude increase in fluid conductivity over a mere 1-meter depth interval. Based on the information provided by the authors, the **groundwater table** is assumed to be situated much deeper, at **4.0 to 5.5 m** below the ground surface. Given that both monitored intervals reside well within the unsaturated zone, such an extreme spike in fluid salinity or conductivity is highly anomalous. The authors must provide a thorough, decoded breakdown and physical justification for these presented values.

3. In **Equation 3**, the authors demonstrate that standard methodologies are available in the literature to normalize soil electrical conductivity (**EC**) to a reference temperature of **25°C**. However, according to the variable descriptions, this temperature correction is explicitly applied only to the measured bulk EC.

This raises a critical methodological question: does this imply that **Equations 1 and 2** cannot be fused with **Equation 3** to extend Archie's law framework and define bulk conductivity directly at the reference temperature of 25°C? From a reader's perspective, the current presentation makes these equations appear completely disconnected from one another.

Moreover, it is unclear whether **Equation 3** was actually utilized in the analysis or if it is merely highlighted as background theory. The authors need to explicitly state how Equation 3 integrates with the rest of their workflow.

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PROFESSIONAL SUMMARY

Computational Hydrologist, Systems Architect, and Environmental Modeler with a proven track record of engineering high-velocity software and mathematical solutions to complex catchment anomalies. Expert in continental-scale hydrological datasets, Physics-Informed Machine Learning, and high-resolution gridded watershed frameworks. Core contributions include solo-engineering the foundational spatial integration of the multi-million-element USGS NHDPlus dataset into the United States national grid using Soil and Water Assessment Tool (SWAT), and serving as the principal technical architect behind the 3D mathematical physics modeling for Singapore's sovereign urban stormwater initiatives.

CORE TECHNICAL COMPETENCIES

Hydroinformatics Frameworks: Expert in orchestrating multi-scale water frameworks and hydroinformatics pipelines using engines like SWAT.
Geospatial Engineering: Full-stack development across ESRI enterprise ecosystems and advanced open-source spatial stacks.
Intelligent Modeling: Design and deployment of Physics-Informed Machine Learning models.
Advanced Analytics: Production-grade integration of spatio-temporal statistical pipelines, custom APIs, and advanced clustering matrices.

CONCISE CAREER TRAJECTORY & IMPACT

- **One Tool Any Country (OTAC) Global Framework (Ongoing):** Conceptualized and independently developing a multi-year global Python framework fusing surface/groundwater, water quality, and climate science with GCMs, satellite imagery, and advanced ML pipelines.
- **Continental-Scale Big Data Integration:** Executed the integration of the multi-million-element **USGS NHDPlus** watershed dataset into the United States national grid using the **SWAT.**
- **Enterprise Software Engineering Support:** Engineered custom codebase workarounds for enterprise clients directly at **ESRI Headquarters (Redlands, CA).**
- **Sovereign Infrastructure Modeling:** Modeled 3D rain garden physics at the **National University of Singapore (NUS)**, directly defining Singapore's National Bioretention Guidelines.
- **Academic Instruction:** Delivered advanced undergraduate engineering curriculum covering core disciplines in hydrology, hydraulics, and fluid mechanics.

SCIENTIFIC SERVICE & GOVERNANCE

- **Interactive Scientific Peer Review:** Contribute analytical commentaries within the interactive open-access review platforms of **Hydrology and Earth System Sciences (HESS / European Geosciences Union)**, driving technical accountability in climate and hydrological literature (e.g., *hess-2023-275*).
- **Selected Peer-Reviewed Publication:** Mylevaganam, S., Srinivasan, R., & Singh, V. (2015). Ecohydrologically Driven Catchment Evaluation and Prioritization. *Open Journal of Applied Sciences*, 5, 325-334.

EDUCATION & CREDENTIALS

M.S. in Spatial Science (Hydrology) | Texas A&M University, USA

- MS GPA: 4.0/4.0 | Doctoral Coursework GPA: 3.78/4.0

M.Eng. in Water Engineering and Management | Asian Institute of Technology, Thailand

- Coursework GPA: 3.83/4.0 | Research GPA: 4.0/4.0

B.Sc. Eng. in Civil Engineering | University of Moratuwa, Sri Lanka
- GPA: 3.86/4.0 | First Class Honors