Contribution ID: **1013**

Type: **Oral Presentation**

Effective Characterization of Fractured Media with PEDL: A Deep Learning-Based Data Assimilation Approach

Thursday, 16 May 2024 14:20 (15 minutes)

In various research fields such as hydrogeology, environmental science and energy engineering, geological formations with fractures are frequently encountered. Accurately characterizing these fractured media is of paramount importance when it comes to tasks that demand precise predictions of liquid flow and the transport of solute and energy within them. Since directly measuring fractured media poses inherent challenges, data assimilation (DA) techniques are typically employed to derive inverse estimates of media properties using observed state variables like hydraulic head, concentration, and temperature. Nonetheless, the considerable difficulties arising from the strong heterogeneity and non-Gaussian nature of fractured media have diminished the effectiveness of existing DA methods. In this study, we formulate a novel DA approach known as PEDL (parameter estimator with deep learning) that harnesses the capabilities of DL to capture nonlinear relationships and extract non-Gaussian features. To evaluate PEDL's performance, we conduct two numerical case studies with increasing complexity. Our results clearly demonstrate that PEDL outperforms three popular DA methods: ensemble smoother with multiple DA (ESMDA), iterative local updating ES (ILUES), and ES with DL-based update (ESDL). Sensitivity analyses confirm PEDL's validity and adaptability across various ensemble sizes and DL model architectures. Moreover, even in scenarios where structural difference exists between the accurate reference model and the simplified forecast model, PEDL adeptly identies the primary characteristics of fracture networks.

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

Country

China

Porous Media & Biology Focused Abstracts

References

Conference Proceedings

I am not interested in having my paper published in the proceedings

Primary author: Prof. NAN, Tongchao (Hohai University)

Co-authors: Prof. LU, Chunhui (Hohai University); Prof. ZHANG, Jiangjiang (Hohai University); Prof. WU, Jichun (Nanjing University); Dr XIE, Yifan (Hohai University)

Presenter: Prof. NAN, Tongchao (Hohai University)

Session Classification: MS03

Track Classification: (MS03) Flow, transport and mechanics in fractured porous media