Science Societies

Integrating empirical and AI approaches improves sediment load prediction

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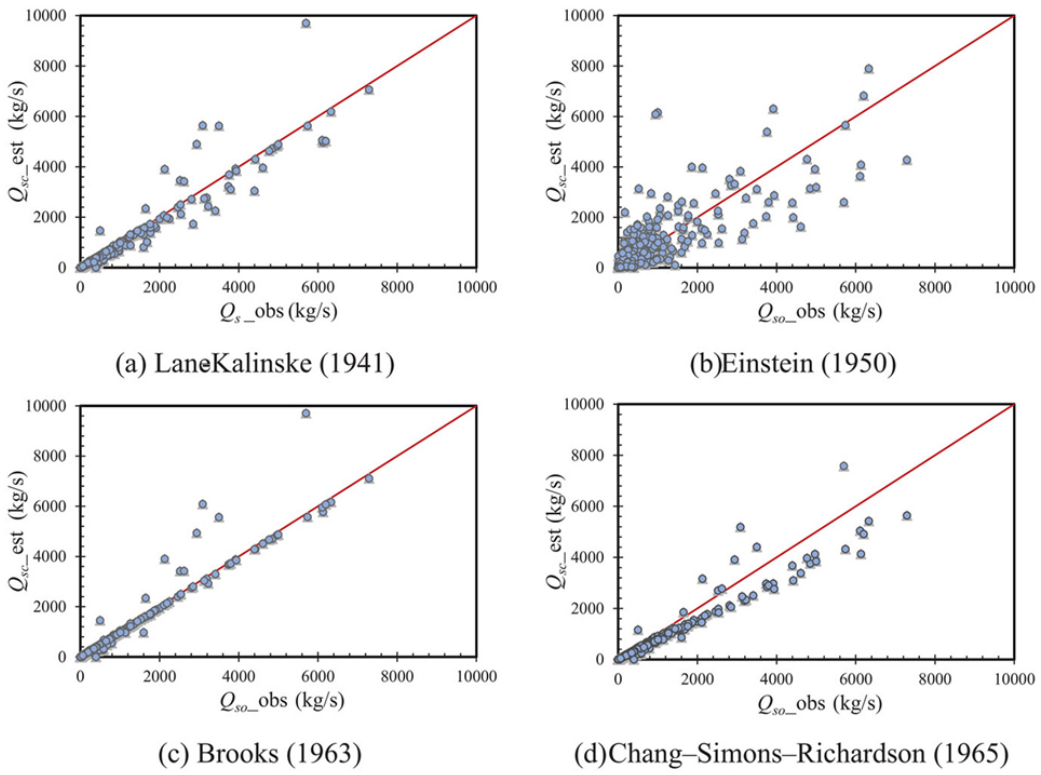

Evaluation of various empirical methods for estimation of suspended load (sediment kept in suspension). Figure courtesy of Chrakan Ibrahim Taher.

Accurately predicting sediment transport in rivers is essential for designing reservoirs, dams, and flood-control structures, yet it remains notoriously difficult due to complex interactions between water flow, sediment properties, and channel geometry. While many empirical equations and machine learning models exist, no single method provides reliable predictions across diverse river systems, and few studies have systematically compared both approaches on a large scale.

To address this gap, researchers analyzed data from 93 stations across 64 U.S. rivers, evaluating 12 classical empirical equations and 10 artificial intelligence (AI) models. They found that the Brooks equation performed best for suspended sediment, while Kalinske and Du Boys were most reliable for bed load. Notably, the team developed two new empirical equations that significantly outperformed existing methods, reducing prediction errors by over 60% for suspended sediment and up to 33% for bed load.

While AI models like wavelet-neural networks achieved high accuracy, they lack interpretability. The new equations offer engineers practical, transparent tools that combine the strengths of traditional theory with modern data-driven insights. These advances can improve river management, infrastructure design, and environmental protection efforts worldwide.

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Ibrahim Taher, C., Ghodsian, M., & Abdi Chooplou, C. (2026). Integrating empirical and AI approaches for sediment load prediction: Comparative insights and model development. *Soil Science Society of America Journal*, *90*, e70240. https://doi.org/10.1002/saj2.70240

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