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REVISITING SOIL ARCHITECTURE IN DEEPLY WEATHERED SOILS THROUGH THE EFFECT OF PSEUDOSANDS ON SOIL HYDROLOGY

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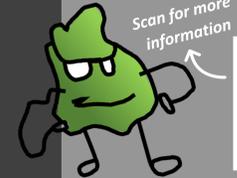
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WHY DO PSEUDOSANDS MATTER?



Discrepancies between measured and modelled data are larger for tropical regions and deeply weathered soils.

Texture is one main input when describing nutrient dynamics, water balances or gaseous losses. To serve standardization, all particles are disintegrated into their clay-, silt- and sand-sized bits and pieces in widely used laboratory protocols. Yet, pseudosands are perceived as sand in the field, they are measured as clay and silt – and yet overlooked in soil process understanding.

WHERE CAN THEY BE FOUND?

Literature review was challenged by range of different names (!), therefore we aimed for similarity in methodology (here: wet sieving).

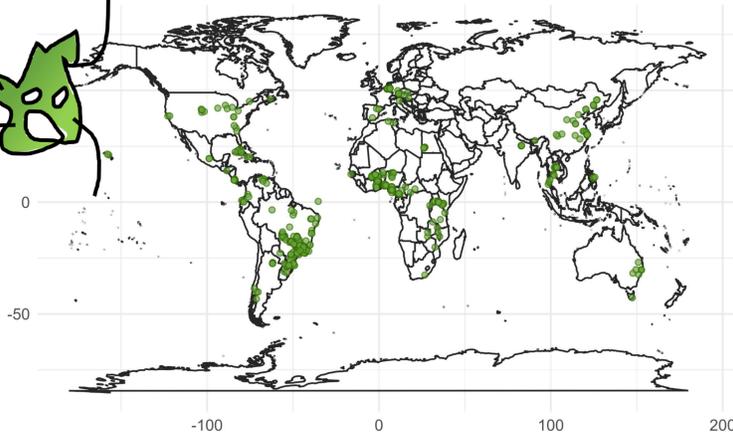


Fig. 4. Sampling locations from the reviewed literature reveal a global distribution of water-stable aggregates determined via wet-sieving ($n_{\text{publication}} = 178$, $n_{\text{sampling points}} = 432$). A multidisciplinary and multilingual approach was used to overcome the lack of systematic classification and geographical researchers bias. Kilian Salas et al. (in prep.)

The tropics dominate the body of literature (~70%), as well as climatic zones with a pronounced seasonality of dry and wet periods within the tropics and subtropics (~60%). Beyond the subtropics, carbonatic parent materials predominated.

HOW IS IT DIFFERENT FROM SAND?

Pseudosands are more wettable and have increased water holding capacity – especially in the fine sand size class - due to its unique surface properties.

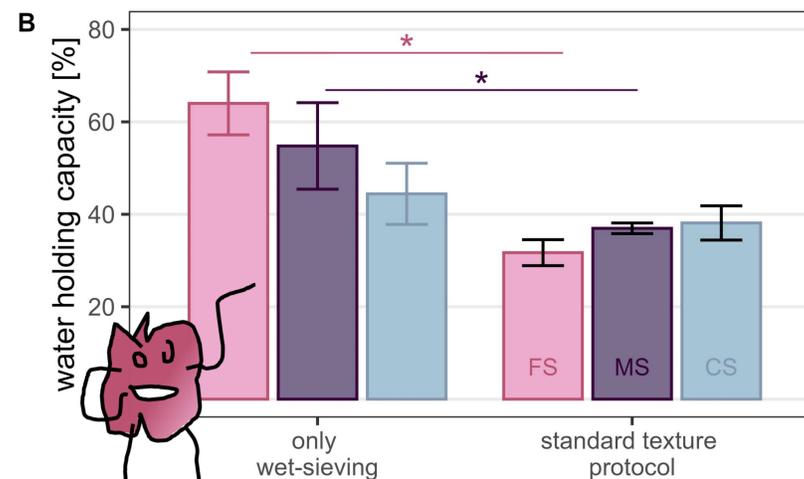
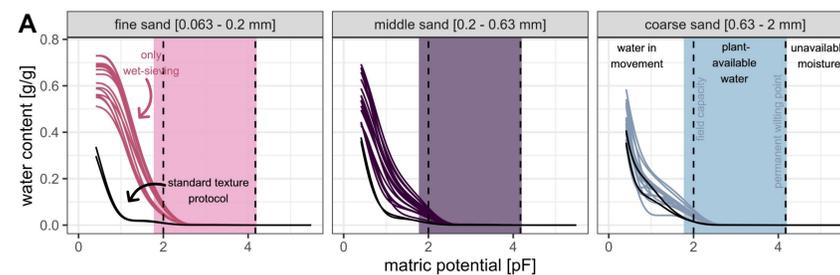


Fig. 2. (A) pf-curves determined by Nuclear-Magnetic-Resonance measurements of sand size classes in different colours. Coloured lines represent pseudosand samples; black lines show quartz sand after standard texture analysis from a pooled sample. (B) Water-holding-capacity of pseudosands identified via wet-sieving and sand after standard texture protocols. Wilcoxon rank-sum test was used for post-hoc comparisons. Kilian Salas et al. (in prep.)

Internal properties reveal a diverse and complex composition or solid and porous phases, as well as incrustation of organic material – potentially also a bioreactor?

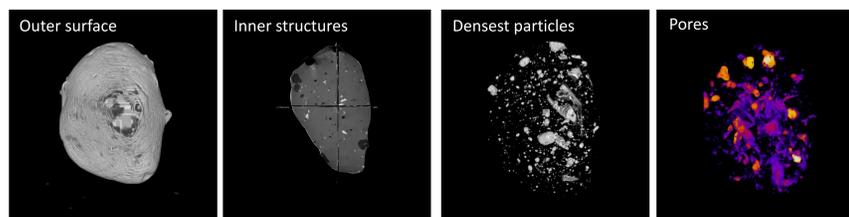


Fig. 3. Micro-CT segmentation of a representative pseudosand particle showing internal structural features, material variability, and porosity, highlighting heterogeneity relevant to mechanical and transport properties. Kilian Salas et al. (in prep.)

... AND NOW?

We study pseudosands in relation to mechanical stability, binding agents and biogeochemical soil functions within a systematic framework to disentangle pseudosands within water-stable aggregation.

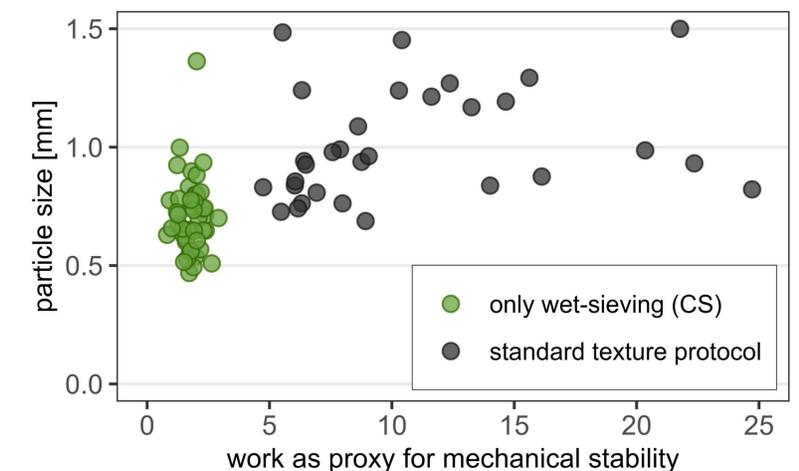


Fig. 4. Mechanical stability is calculated from the area under the curve showing the force [N] needed to crush single particles in the coarse sand size fraction. Pseudosands were hand-picked after optical identification via close-focus binoculars. Modified, from Kilian Salas et al. (2024).

TAKE-AWAY

Pseudosands cannot simply be replaced by sand in modelling as their true nature is far more multifaceted and diverse than sands. They should be treated as an additional soil texture class that reflect its internal and external properties.



Kilian Salas, S., Meurer, K. H. E., Boy, D., Díaz García, E., Woche, S. K., Boy, J., Guggenberger, G., Peth, S., Schroeder, P. A., & Jungkunst, H. F. (2024). The "extra pinch" of pseudosand to enhance tropical biogeochemical processes understanding. *Journal of Plant Nutrition and Soil Science*, 187(2), 161–170.

