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Relating soil structure images directly to hydraulic properties using machine learning

Efim Lavrukhin (1), Marina V. Karsanina (2,3), Kirill M. Gerke (2,3)

(1) Computational Mathematics and Cybernetics, Lomonosov Moscow State University, Moscow, 119991, Russia (efi2795@yandex.ru), (2) Schmidt Institute of Physics of the Earth of Russian Academy of Sciences, Moscow, 107031, Russia (marina.karsanina@gmail.com), (3) Institute of Geospheres Dynamics of Russian Academy of Sciences, Moscow,119334, Russia (cheshik@yahoo.com)

In soil physics the most widespread method to relate soil structural features to its physical properties is pedotransfer functions. With recent development of computational hardware and machine learning techniques it is now possible to directly relate structure information in the form of images against soil hydraulic properties. In this contribution we report a first study on soil pore cross-sectional 2D images against their hydraulic conductances based on direct pore-scale simulations [1]. To do so we combine pore-network extraction techniques [2] with machine learning based image classification [3]. Such an approach is not only capable to further relax computational efforts for pore-scale flow and transport simulations as opposed to direct voxel-based simulations [4], but also provides a better framework to build soil structure-property relationships. We clearly show that it is possible to directly related soil structure images and its physical properties. We also analyze all strong sides and current pitfalls and discuss future directions of research in this direction. In particular, we find image scaling to be potentially addressed using rescaled correlation functions [5,6,7] which will be incorporated into future refinements of the current technique.

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