Predicting water flow in the pore space of sand samples mapped with synchrotron radiation

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Flow and transport processes in soils depend on the shape, size and connectivity of the voids between the solid particles. For this reason, the geometric properties of the pore space must be measured with a high spatial resolution. Sand samples with 1.5 and 0.5 cm in diameter were mapped with a voxel size of 11.0 and 3.5 microns using X-rays from synchrotron radiation resulting in discretizations in excess of 10^8 grid nodes.
The sand samples differ in the size of the particles, ranging from 80 to 900 microns. The permeability of the samples was computed with a Lattice-Boltzmann approach and the predictions were compared to laboratory experiments.
To analyze the isotropy of the structure, the water flow was calculated for pressure gradients applied in different directions. The calculations were compared with various geometric properties. In three samples, two different sand materials were arranged in series or in parallel. In the transition zone between the two sand materials, the water flow velocity is of special interest, because the mixing of solutes between different soil materials depends on this velocity distribution. Therefore, the change of water flow velocity in the vicinity of the boundary was determined.