New conditioning methods for improving the application of fractional Brownian motion fields to fractal aquifer media

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Abstract. Predicting aquifer material at unsampled sites is a problem that regularly plagues models in hydrology. Many studies have observed fractal scaling for aquifer properties such as hydraulic conductivity, which suggests a possible solution with fractional fields. Recent efforts to create more widely applicable and realistic models of fractal aquifer material have led to the use of operator-stable fractional Brownian motion (osfBm) fields. In order for these osfBms to accurately model aquifer material, these fields must be conditioned to field or laboratory data. Previously employed conditioning methods have suffered from slow computational speed and inexact recreation of the user-defined fractal scaling. Conditioning is achieved by taking an unconditioned osfBm field with the same scaling characteristics as the real-world data and reordering within the osfBm field to correspond to the real-world data set. Computation time is influenced by the amount of conditioning and methods used. Compared with previous conditioning methods, employment of new optimization algorithms reduce computational time and better honor fractal scaling parameters.

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