Geophysical Research Abstracts
Vol. 13, EGU2011-12237, 2011
EGU General Assembly 2011

Estimating Specific Surface Area from Particle-Size Distribution: A Fractal Approach

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Specific surface area not only depends on the size of soil particles, but also depends on their shapes. The smaller the soil particles, the larger the specific surface area. In this study, we developed a continuous probability distribution function to represent particle-size distribution. We defined the specific surface area as the surface area per volume of particles, and developed a mathematical model to estimate specific surface area from particle-size distribution data and porosity. In order to evaluate the developed fractal model, we used 18 soil samples each of which contained more than 10 points for particle-size distribution. Specific surface area of the samples was measured with the ethylene glycol monoethyl ether (EGME) method. We used graphs of log cumulative mass versus log particle size to find maximum and minimum particle radii as well as the fractal dimensionality of solid phase. Comparison of the estimated specific surface area and the measured one rendered a line slope and correlation coefficient (R2) values equal to 0.99 and 0.87, respectively, indicating excellent agreement between theory and experiment over two orders of magnitude.