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Fractal dimension and variability of soil particle in grassland

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Introduction Fractal dimension of soil particle is not only a token of soil particle, but also a index of variability of soil texture. So the study on variability of fractal dimension redound is in favor of describing the distribution of soil texture quantificationally. It can also provide a basis in improving desertification and protecting ecosystem in grassland.

Methods and materials the proving ground is in the natural grassland in Wushen county in Inner Mongolia. It is sandy soil, the vegetation are composed of natural sabulicola. the total area of proving ground are 5.04hm² (140m × 360m), the interval of sampling is 20 meters.

Theory and models fractal dimension of soil particle can be expressed in the following:

$$W(\delta > \bar{d}_i) / W_0 = 1 - (\bar{d}_i / \bar{d}_{max})^{3-D} \quad (1)$$

where \bar{d}_i is mean value between d_i and d_{i+1} ; $W(\delta > \bar{d}_i)$ is the total weight of soil particles more than \bar{d}_i ; $W(\delta < \bar{d}_i)$ is the total weight of soil particles less than \bar{d}_i ; \bar{d}_{max} is mean diameter of the biggest particle size; W_0 is the total weight of all soil particles is the fractal dimension.

Semi-variogram can be expressed in the following:

$$\gamma^*(h) = \frac{1}{2N(h)} \sum_{i=1}^{N(h)} [Z(x_i) - Z(x_i+h)]^2 \quad (2)$$

where $\gamma(h)$ is the variogram value at lag distance h , $N(h)$ is the number of lag distances, and $Z(x_i)$ is the value of the observation at point x_i .

Conclusions (1) The correlativity between fractal dimension and content of sand particle ($d > 0.1\text{mm}$) is negative proportion, the correlativity between fractal dimension and content of clay particle ($d < 0.05\text{mm}$) is negative proportion. It indicated the loss of silt ($d < 0.05\text{mm}$) result in desertification serious and decrease of fractal dimension, so the fractal dimension is a reflection of loss of soil particles, it can be used to denote the degree of desertification; (2) The variogram of soil particle is spherical model, variability of soil particle is mainly affected by stochastic factors, and the range of fractal dimension is larger than that of soil particle appreciably; (3) As a general and representative index of soil particle, the relationship between fractal dimension and distribution of soil particle is very close, so soil particle in different size can be replaced by fractal dimension to describe the variability of soil texture and the degree of desertification, and it is more useful in researching the process of desertification and rule of variability of soil in grassland.

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