Evaluation of pedodiversity in terms of generalized entropy.

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Generalized entropy has been widely used as a useful index of various diversities such as biodiversity and geodiversity. In this work we have evaluated the diversity of soil, that is the pedodiversity which is one of geodiversity, in terms of the generalized entropy.

Pedodiversity is closely related to biodiversity, on the other hand, pedodiversity might determine land use. In this work, we have proposed diversity indexes by which we can evaluate the pedodiversity in the composition distribution and the spatial distribution in terms of generalized entropy, both objectively and quantitatively. We have calculated pedodiversities in various regions of Hokkaido, Japan. In this work, we have developed the following formula

\[ Y_A = -\frac{1}{\log n} \sum_{k=1}^{n} p_k \log p_k \]

Where \( n \) and \( p_k \) are defined as follows.

1. In the case of the pedodiversity in the composition distribution, \( n \) represents the number of types of soils, and \( p_k \) is defined as the area ratio of \( k \)th soil to the total area of region \( A \). In this case, pedodiversity \( Y_A \) indicates diversity in components making up soil composition in each region.

2. In the case of the pedodiversity in the spatial distribution, \( n \) represents the number of spatial meshes, and \( p_k \) is defined as the area ratio of \( k \)th spatial mesh to the total area of soil \( A \). In this case, pedodiversity \( Y_A \) indicates diversity in spatial locations of each soil.

It can be inferred that the higher a value of pedodiversity in the spatial distribution is, the higher a value of the diversity of land use in the spatial distribution becomes, and a network between small elements of land use, such as farms of various crops, can be realized. This network is expected to make some significant circulation in various industries.

In order to ascertain the above conjecture in which the correlation between diversity of soil and land use is supposed, we also used the relative entropy based on the information theory, and we have evaluated its correlation quantitatively in each region.

The formula is as follows.

\[ I(A, B) = S(A) + S(B) - S(A, B) \]

\[ r(A, B) = \frac{1}{2} I(A, B) \left( \frac{1}{S(A)} + \frac{1}{S(B)} \right) \]

where \( A \) and \( B \) represent the soil and land use respectively, and \( S(A) \) and \( S(B) \) represent the entropy of the distribution of soil and land use respectively, \( S(A, B) \) is the entropy of the simultaneous distribution of soil and land use, \( I(A, B) \) is the relative entropy between soil and land use and \( r(A, B) \) represents the index of correlation between soil and land use. We have calculated in various regions of Hokkaido and Kyushu, Japan. We would like to show our calculation results in our presentation.

We believe the index \( r(A, B) \) can be useful in evaluating suitable crops for land in the future.