MULITFRACTAL BIODIVERSITY: ANALYSIS AND SIMULATIONS

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Ecosystems involve highly nonlinear interactions between species and their environments over wide ranges of scales and give rise to population number and biomass densities which are highly intermittent in both space and time. The simplest hypothesis about the variability of individual density fields is that they are scale invariant in space-time, this had been demonstrated in some cases (e.g. plankton). In addition, at fixed space-time location there is a well-established information theory approach for treating the biodensity for different species. In this 'species space', there are already two scaling biodiversity models: the (mono) fractal and lognormal models.
We propose a simple anisotropic multifractal cascade in space-time-species space in which the scaling exponent functions are bilinear. This model is tested on a unique data base involving nearly three hundred different species densities each over a range of spatial scale of 50 from six underwater sites in the St. Lawrence estuary, we test this simplest 'superscaling' model showing that all species densities are compatible with a four parameter bilinear model. We show how to use this information to numerically simulate the spatial variability of joint species densities, and discuss how this framework can be used to define scale invariant measures of biodiversity.