Reading Record

[Dauphiné, 1995]

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Date

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1 Linear Reading

Introduction

Semi-stationarity of geographical systems. New thematics : non-linear dynmics, chaos, fractals. Logical theoretical compatibility.

1.1 New principles

1.1.1 Out of reductionism

Burgess and Von Thunen models are reductionist.
Systemic approach : Forrester. Also multivariate statistics. Pb : simplify reality. simulation of complex phenomena from simple rules (cf Prigogine). simple example of Julia sample.

1.1.2 Non-predictible determinism

classical determinism : random fluctuations due to unobserved variable. But chaos exists : cf Lorenz attractor. Henon attractor : strange attractor.
non-linearity and sensitivity to initial conditions. feedbacks and self-regulations are non-linear. necessary (but not sufficient) to have chaotic behavior. sensitivity to initial conditions : Lorenz ; billard dynamics. Ren Thom : deterministic chaos is not disorder.

1.1.3 Non-linear dissipative systems yield fractal structures

(back on fractal generation). scale invariance. multifractality : different levels in nature.
In dissipative systems, strange attractors are fractals. dissipative : far from equilibrium. Reciprocally, dynamical system non-linear yield fractal structures. chaos : dynamics ; fractals : form.

1.1.4 From order to chaos and chaos to order

Parametrized dynamics : from stability to chaos. bifurcation (Hopf bifurcation). Sub-harmonic cascade : progressi ve switch from equilibrium, to periodicity and chaos. Intermitent chaos. (economic crisis ? Floquet matrix). Quasi periodicity.
order to chaos : example KdV. (waves) solitons.
chaos and catastrophes. R Thom. exogenous bifurcation, contrary to chaos where it is endogeneous.

1.2 Techniques

1.2.1 Deductives

Equa dif ; iterative resolution. Visualisation of derivative field. : stable or not. Iterated maps : convergence in (x_n, x_{n+1}).
Phase space representations ; time-series ; spectrum for periodic systems.
Attractors in phase space.
Poincarr projection : projection of phase space in 2d.
Liapounov. classification of attractors depending on Liapounov values.

1.2.2 Inductives

Complex systems "random" and disordered -¿ ? . Separate deterministic chaos from random disorder. *do not agree, complex system has not random but self-organized behavior. depends on scale. but yes great number of variables or parameters.*
Reconstruction of strange attractor : $x_{t+1} = f(x_t)$. : phase space for unidimensional series.
Random vs chaotic : correlations between prediction. *Wrong ? gives stationarity of random process*
Spectrum of chaos.
dynamically finite generated systems (?)

1.2.3 Fractal Dimensions

Def of fractal dimension. ; concrete computation.
Other dimensions : Hausdorff, etc. Kolmogorov entropy.
Multifractals.

1.3 Functional chaos

1.3.1 Physical geography

ecological models : malthus. Verlhust with carrying capacity. Generalisation with chaos. (arima at diffeent orders). works for ecology (experimental cases) not for human populations. Chaos in epidemiology empirically proven : due to network propagation ?
Prey-predator models.
chaos in climatology : fractals in space and time ; chaotic dynamics of atmosphere.
Physical geography : terrestrial shapes.

1.3.2 Human geography

non-linearity of economic time-series. Growth model with different scales and agents (Day).
Logistic map : 49 different behaviors.
example of eco-energetic model : PACA. simulation of catastrophes, chaos.
activation-inhibition : biology.

1.4 Chaos and Geographical fractals

1.4.1 Diffusion

back to Hgerstrand. spatial diffusion
Linear, continuous, hierarchical, random diffusions.
Macro and micro diffusion : brownian motion. Refined models.
Macrodiffusion : Partial diff eq. (Fick, Fourier, etc). Ohm model for migratory flows.

1.4.2 Various models

DLA and DBM. DBM better (Batty). city growth and network growth. Zipf law.
Morphogenesis model : polarisation and aggregation.
Percolation models. explosive percolation. diffusion of innovations.
CA : ex Game of Life.
Macrodiffusion : Hotelling. Meinhardt : polarized structures (physical geography).

Conclusion

Pertinence of geo knowledge ? gravitation models etc have given insight.
Lack of theoretical support in geographical knowledge : advantage of chaos and fractals. Qualitative argument invalid.
chaos : non-linearity, non-predictalibility.

References

[Dauphiné, 1995] Dauphiné, A. (1995). Chaos, fractales et dynamiques en géographie, volume 4. GIP Reclus.