

# **Spatio-temporal dynamics of country sizes and crop cultivation areas: What do they have in common?**

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## **ABSTRACT**

Countries appear, grow, merge, fragment, decrease and disappear over time. Empires rise and fall. The business of growing crops shows analogous cycles of boom and bust. And so do many other complex dynamic systems. History describes these cycles in great detail and explains them through specific human actions, and natural constraints and catastrophes, i.e. the sum of little actions and accidents frozen in time and selected by the environment. But is there more to it than that? The fact that the spatio-temporal dynamics of many different systems follow similar broad patterns suggests so. Little actions are to these broad patterns like molecular movements are to thermodynamics: no amount of calculation of molecular movement can lead us to understand the mechanics of gases. The latter requires the development of a new paradigm, the statistical aggregation of gaseous properties. In an analogous paradigm, the development of complex systems statistics allows us to probe into the large scale behaviour of spatio-temporal patterns. This paper uses examples from the historical dynamics of nation sizes (world) and crop abundances (New Zealand, Peru) to illustrate some of the insights gained into their behaviour: return to the log-normal pattern attractor (emergence, connectivity), random "Brownian motion", turnover rates, prediction capability, boundaries and outliers, resource attraction models, robustness and effect of disturbance, limiting thresholds of empire and collapse (bifurcations).