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Global Population: from Super-Malthus behavior to Doomsday Criticality

Abstract: Global population changes from the Holocene beginning to 2023, are discussedvia two Super Malthus (SM) scaling equations. SM-1 is the empowered exponential dependence: , and SM-2 is the Malthus-type relation with the time-dependent growth rate or relaxation time : . The analysis explores qualitatively new set of data, based on population data from a few sources which are numerically filtered to obtain a 'smooth' dataset, allowing the distortions-sensitive and derivative-based analysis. The test recalling SM-1 equation revealed the essential transition near the year 1970 (population: ~3 billion): from the compressed exponential behavior () to the stretched exponential one (). Recalling complex systems physics it can be called to the 'cumulation' or 'dissipation' of the system internal energy. For SM-1 relation based modeling the creation of self-organized and internally ordered local structures, interacting and growing with passing time is the inherent feature of the complex system – in the given case the rising global population and the emerging human civilizations, developing from the local to the global level.

For SM-2 dependence, explicitly evidenced linear changes of during the Industrial Revolutions period, since ~1700 till today, led to the constrained critical behavior: where critical 'Dooms-year' (year) is the extrapolated year of the infinite population. The above relation recalls the so called 'constrained criticality', the model concept developed in Soft Matter and complex systems physics. The above relation enables a reliable forecasting at least for the next decades. Notable is the link to the famous 'hyperbolic' or 'Doomsday' equation by von Foerster et al. which can be considered the 'rough' approximation of the above relation. Doomsday equation is shown. The universal features of the per capita relative growth rate as the check-point for population scaling models are further discussed.

Finally the influence of available resources, first of all food and the general energy, in subsequent development stages with model-scaling is considered. It includes the impact on the growth and ordering of the human global population.

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Keywords: Global population, Super-Malthus behavior; Soft-Matter modelling, Doomsday
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