

Interactive comment on “Dynamics of finite causal processes” by Kalman Ziha

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These are the comments on discussion submitted by anonymous Referee #1 for manuscript entitled 'Dynamics of finite causal processes'

Referee: This manuscript attempts to apply the concepts of the 'general systems theory' (GST) of Ludwig von Bertalanffy to explain changes of the physical climate, in particular the causal relationship between 'finite ice melting' (the cause M) and 'ice mass Losses' (The effect). The 'general systems theory' of Ludwig von Bertalanffy is a holistic, controversial theory, started in 1938, that may qualitatively explain some phenomena in ecology and social sciences but is far from being accepted as a science subjected to verification and falsification. Moreover, it presents a simplistic theory of the linear feedback which comes out as a very particular case of the much more general and well-grounded and mathematically funded 'Control system's theory'.

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Comment: The manuscript evokes the formalism of the 'general systems theory' (GST) of Ludwig von Bertalanffy (1938) in order to put the concept of finite causality in systemic framework. It also recalls the mathematical structure of the control system theory (CST) of Wiener (1948) (Eqns. 1-5 and Fig. 1) as a platform for decomposition of general causal relations to primary proportional and to appropriate interaction parts (Eqns. 6-10 and Fig. 1). This decomposition is needed for definition of continuous Finite Cause-and-Effect-Interaction (FCEI) concept that is mathematically elaborated in the manuscript (Eqns. 11-20 and Fig. 2). Hence, the article extends the concept of simplistic unlimited linear feedback of the CST by the novel FCEI concept of additional feedback induced solely by the fact of finiteness of processes with exhaustible causal capacities.

Referee: The application of GST formalism to the relationship between 'Finite ice Melting' and 'ice mass Losses' seems therefore inappropriate giving rise to 'vague' concepts without any physical correspondence. Examples of that are quoted from the manuscript.

Comment: Instead of the GST formalism, the combined FCEI approach (Eqns. 11-20 and Fig. 2) is applied in the manuscript to investigate the relationships between 'Finite ice Melting' and 'Ice mass Losses' in Interaction with climate system (FMLI) (Eqns 21-33 and Figs. 3-4). The FMLI concept in the article accounts for physical interchange of environmental heat energy between climate system and inherent finite heat capacity of ice sheets (Eqns. 23-26). The examples quoted by the reviewer as 'vague', in the manuscript represent the wordily interpretations either of mathematical terms (Eqns. 11-20 and 21-33) or of figures (Figs. 1-2). Here there are.

Referee: 1) 'This study of finiteness of natural processes recognizes the temporal FCEI (Finite Cause-and-Effect Interaction) empirical concept as a continuous sharing of irreplaceable and restricted overall ultimate causal capacity CU between the observable elapsed effect E in the past and the imperceptible but conceivable forthcoming limited exhaustible cause C beyond the instant of observation in the future. 2) The

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trans-temporal finite interaction implies the empirical link in continuation of the known uninterrupted past and the imaginable but finite perpetuating future separated by the instant of observation at the present time'

Comment: This two statements in the manuscript wordily explains the temporal character of the mathematical rate of change $E(C)/(CU-C)$ in the FCEI definition (Eqn. 12) as the ratio between the growing elapsed effect $E(C)$ in the past and the diminishing remaining driving cause $(CU-C)$ with respect to the waste ultimate causal capacity CU in the future separated by the instant of observation (Fig. 2). 3) The mathematical model of the FCEI in this study considers a simple intuitive term of the continuous residual causal capacity $R(C)$ after spending some primary effect $E'(C)$ (1) of the limited cause C on the expense of the ultimate cause CU .

Comment: This statement represents the conservation principle between elapsed effect and forthcoming cause which expresses the assumption that a continuous finite causal relation does not change its properties of propensity to and intensity of interaction during unchanged environmental conditions with respect to wasting of ultimate causal capacity CU over time (Eqns. 11-20).

Referee: Beyond the above criticisms, the author tries to make millenary climatic predictions (extrapolations) using the simplistic GST relationships, as quoted from the manuscript: 'It is possible to predict by extrapolating the FMLI ice mass loss curve (28) that the melting out of the total mass of ice $MU=2.50 \times 10^6$ Gt due to the interaction with climate change under same environmental conditions could happen in the year $T_M=2850 \pm 70$ with 8% uncertainty of ultimate ice mass MU estimation (Figs. 3 and 4). That prediction is totally speculative and cannot be accepted.

Comment: The mathematical model of finite causal processes provides analytic parameters based on observed data which allow calculations beyond the instant of observation. Some of these results are exemplarily presented in the manuscript (Fig. 4). Following the reviewer's comment this extrapolations should be more appropriately

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denoted as calculations than predictions.

Referee: Moreover, the author does totally ignore alternative approaches studying the causality in the climatic system (e.g. Granger causality) ...

Comment: Granger statistical causality investigates causal dependency between stochastic variables and do not indicate real causality in the deterministic context of the manuscript. Instead of Granger statistical concept of causality, the manuscript focuses on deterministic physical interpretations of work done by environmental effects and inherent properties of ice sheets giving the propensity, sensitivity and interaction intensity parameters of the mathematical model by derivatives and integration of the FCEI interaction curves (Eqns. 11-20 and Fig. 2). With respect to the scope and size of the manuscript no statistical analysis is planned.

Referee: ... and therefore it is not understood in which the manuscript adds new knowledge.

Comment: Submission of this manuscript is encouraged with declared aims and scopes of ESD journal. The manuscript presents a novel interdisciplinary approach to system dynamics that conceptualized, modelled and quantified the influence of finiteness of deterministic continuous causal processes with exhaustible capacities what was not applied earlier in investigations of Earth mechanisms. The manuscript introduces the finiteness as a property inseparable of other physical properties of continuous processes with limited causal capacities. It provides apt mathematical model of finite causal processes. The calculus in the manuscript implies a new general definition of derivatives of functions with respect to bounds of finite variables. The study also uncovers a new application of the mathematical model that makes it possible to discover and to estimate the unknown ultimate causal capacities from relevant information of supposedly finite causal processes beyond the instant of observation. The proposed analytics confirms that the climate system and ice mass anomaly monitored recently on Greenland and Antarctica ice sheets under global interaction of a combination of var-

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ious component systems, such as the atmosphere, cryosphere, hydrosphere, oceans and human activities may be viewed as finite dynamical causal processes by definition given in the manuscript. Extrapolations suggest dates of beginning of intensive ice mass losses. The reverse numerical calculation procedure satisfactorily re-estimated the total ice mass of ice sheets within the suggested limits.

Referee: Giving the above arguments, the manuscript must be rejected and cannot be accepted to 'Earth System Dynamics' journal.

Comment: This discussion gives useful general comments that suggest additional clarifications which could hopefully improve the manuscript. What is missing is the analysis of the merit of the mathematical model and of the numerical analysis. A more detailed consideration of the concept and mathematical model of finite causal processes perhaps could give another view on intentions of the manuscript and on presented results. The introduction of finiteness in studies of natural phenomena is plausibly an important encouragement for understanding and analysis of finite processes in earth system dynamics. There are many potentially finite causal processes all over the world which might be studied by using coherent mathematical apparatus capable to deal with finiteness. Therefore, the publication of this submission with additional clarifications might be nevertheless useful for readers and researchers having interests in ESD journal.

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