and the response system possesses a stable equilibrium or a limit cycle. We theoretically prove that the chaos of the drive system makes the response system behave also chaotically. Extension of sensitivity and period-doubling cascade are rigorously approved. The appearance of cyclic irregular behavior is discussed, and it is shown that the phenomenon cannot be explained by means of generalized synchronization. Intermittency in coupled Lorenz systems is also demonstrated.

The principal novelty of our investigation is that we create exogenous chaotic perturbations by means of the solutions of a chaotic Lorenz system, plug it into a regular Lorenz system, and find that chaos is inherited by the solutions of the latter. Such an approach has been widely used for differential equations before, but for regular disturbance functions. That is, it has been shown that an (almost) periodic perturbation function implies the existence of an (almost) periodic solution of the system. While the literature on chaos synchronization [1, 25, 33, 35, 38, 47, 53, 60] has also produced methods of generating chaos in a system by plugging in terms that are chaotic, it relies on the asymptotic convergence between the chaotic exogenous terms and the solution of the response system for the proof of chaos creation. Instead, we provide a direct verification of the ingredients of chaos for the perturbed system [2]–[10]. Moreover, in Section 6 we represent the appearance of cyclic chaos, which cannot be reduced to generalized synchronization. Very interesting examples of applications of discrete dynamics to continuous chaos analysis were provided in the papers [14]–[17]. In these studies, the general technique of dynamical synthesis [14] was developed, and this technique was used in the paper [4].

There are many published papers which have results about chaos considering first of all its mathematical meaning. This is true either for differential equations [41, 69] or data analysis [22]. Apparently there are still few articles with meteorological interpretation of chaos ingredients. We suppose that our rigorously approved idea for the extension of chaotic behavior from one Lorenz system to another will give a light for the justification of the erratic behavior observed in dynamical systems of meteorology.

The question *"Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?"* is very impressive and it has done a lot to popularize chaos for both mathematicians and non-mathematicians [45]. *From this question one can immediately decide that the butterfly effect is a global phenomenon, and consequently, the underlying mathematics has to be investigated.* Some of the authors say that the question relates sensitive dependence on initial conditions in dynamical systems considered as unpredictability for meteorological observations. Lorenz himself, in successive his talks and the book [45], was obsessed by the question and sincerely believed its possibility. He also supposed that his system can give a key for the positive answer of the question. Generally, analysis of chaotic dynamics in atmospheric models is rather numerical [23, 34, 39, 46, 50] or depend on the observation of time-series [26, 27]. In Section 8, we describe how one can use the rigorously approved results of the present paper to investigate the global behavior of the weather unpredictability. Our suggestions are not about a modelling, but rather an effort to answer the question why the weather is unpredictable at each point of the Earth, on the