

Abstract Submitted
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Can a butterfly in Brazil control the climate of Texas? QIQI WANG, Massachusetts Institute of Technology MIT — The butterfly effect is a well-known phenomenon in fluid dynamics. A small perturbation to a chaotic dynamical system, such as turbulent flows or the Earth's atmosphere, can lead to large differences at a later time. Lorenz famously posed the question, does the flap of a butterfly's wings in Brazil set off a tornado in Texas? The answer is now widely accepted to be yes. While a tiny perturbation can change the state of a chaotic system, it is unclear whether it can change the long-time statistics. Statistics of many turbulent flows are known to be stable, insensitive to initial conditions. Ergodic theory provided a foundation for such stability. If the weather is ergodic, then it seems unlikely that the butterfly in Brazil can affect the long-time statistics of weather, also known as the climate of Texas. Can a butterfly in Brazil change the climate of Texas? Here we investigate this question computationally with simple chaotic systems, including the Lorenz attractor. We show that arbitrarily small perturbations can significantly influence the statistics of a stable, ergodic system. We also study what it takes to exercise such influence. With the skill to forecast well into the future, one may change the climate of a system through imperceptibly small effort.

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