Predictable or Chaotic? Orbits vs. Weather

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Predictable or Chaotic: Orbits vs. Weather investigates the predictability of planetary and weather systems. In order to do this, a computer code was written to model each system. A simple analogy of weather prediction is the Lorenz attractor, a set of differential equations that model atmospheric convection. A large number of simulations were run with many distinct initial conditions. It was demonstrated that no matter how close together the initial points are set, the paths will diverge if given enough time. In the solar system model, gravitational properties such as Newton's third law and Newton's law of universal gravitation are applied to the masses of the planets. After giving all of these planets accurate initial velocities and positions, this simple model of the solar system was used to predict planetary orbits. By perturbing the initial positions of Earth and Jupiter in a large number of simulations, it was shown that planetary orbits are relatively stable. Although large perturbations in the initial locations cause large alterations of the orbit, small perturbations cause small changes. These models show the fundamental difference between chaotic and predictable systems: weather is only predictable for a short period of time and is very sensitive to initial conditions, while planetary orbits are predictable for long durations and are not very sensitive to small perturbations.