Lorenz Attractor

The Lorenz attractor is an attractor that arises in a simplified system of equations describing the two-dimensional flow of fluid. In the early 1960s, Lorenz accidentally discovered the chaotic behavior of this system when he found that, for a simplified system, periodic solutions of the form

$$\psi = \psi_0 sin(\frac{\pi a x}{H}) sin(\frac{\pi z}{H})$$

$$\theta = \theta_0 cos(\frac{\pi a x}{H}) sin(\frac{\pi z}{H})$$

grew for Rayleigh numbers larger than the critical value, . Furthermore, vastly different results were obtained for very small changes in the initial values, representing one of the earliest discoveries of the so-called butterfly effect.

Lorenz obtained the simplified equations

$$\dot{X} = \sigma(Y - X)$$

$$\dot{Y} = X(\rho - Z) - Y$$

$$\dot{Z} = XY - \beta Z$$

now known as the Lorenz equations.