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Global manifolds and the transition to chaos in the Lorenz system

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The Lorenz system is a three-dimensional polynomial vector field with quadratic nonlinearities. It still fascinates many people because — in spite of the simplicity of the equations — it features very complicated dynamics and associated global bifurcations. This talk addresses the role of the stable and unstable manifolds in organising the dynamics more globally throughout phase space. A main object of interest is the stable manifold of the origin of the Lorenz system, also known as the Lorenz manifold. This two-dimensional surface and associated manifolds of saddle periodic orbits can be computed accurately with numerical methods based on the continuation of orbit segments, defined as solutions of suitable two-point boundary value problems. We use these techniques to give a precise geometrical and topological characterisation of global manifolds during the transition from simple dynamics, via preturbulence to chaotic dynamics and beyond.

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