Hurricane dynamics and rapid intensification via dynamical systems indicators

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Although the lifecycle of hurricanes is well understood, it is a struggle to represent their dynamics in numerical models, under both present and future climates. We consider the atmospheric circulation as a chaotic dynamical system, and show that the formation of a hurricane corresponds to a reduction of the phase space of the atmospheric dynamics to a low-dimensional state. This behavior is typical of Bose-Einstein condensates. These are states of the matter where all particles have the same dynamical properties. For hurricanes, this corresponds to a "rotational mode" around the eye of the cyclone, with all air parcels effectively behaving as spins oriented in a single direction. This finding paves the way for new parametrisations when simulating hurricanes in numerical climate models.