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Characterising Edge States: Measures on chaotic non-attracting invariant sets

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In this work, we explore how to extend the concept of physical measures from attractors to chaotic non-attracting invariant sets. Building on Sweet and Ott's work from 2000, we make their ideas rigorous by defining a measure on non-attracting sets in terms of Lebesgue Measure and show how to sample it numerically. We discuss its relevance for simple climate models and the sampling techniques' limitations in the context of more complex and higher dimensional (climate) models. Knowing the measure of a non-attracting set, for example of a saddle or of an edge state (also known as melancholia state), also provides information about its fractal dimension and geometric complexity which can be useful to better understanding tipping phenomena and uncertainty close to a basin boundary.