

# IDENTIFYING CRITICAL SCALES FOR TIPPING IN NOISY, NEARLY NON-SMOOTH STOMMEL-TYPE MODELS

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We overview stochastic methods for studying dynamic bifurcations, relevant in canonical climate-related models and other applications. Our focus is on dominant factors in different scenarios of tipping, that is, where the transition related to the dynamic bifurcation may be advanced or delayed. Analysis of equations for the time dependent density of the state variables points to at least two different types of behavior with very different variation in the tipping dynamics. The results do not depend on computing the solutions, allowing flexibility of application for more complex modes. The analysis points to competition between different important contributions, including stochastic forcing, high and low frequency components, the “non-smoothness” of the underlying bifurcations, bi-stability, and the slow variability of critical physical and environmental process. The analysis points to some fundamental differences in the smooth and non-smooth cases, particularly for increased degrees of freedom, where coherence resonance may also play a role. This suggests a wider variety of tipping mechanisms in non-smooth-like settings.