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Project Title: *Data-Driven Modelling and Prediction of Complex Nonlinear Critical Phenomena in Climate Change Dynamics and Variability in Manipur*

Project Abstract: The world has witnessed and experienced the adverse effects of climate change, and its impacts continue to intensify. The small state of Manipur is no exception, as it has also seen significant changes, with no signs of improvement. As a citizen of the state, I have personally observed the rise in temperature and noticeable shifts in rainfall patterns over the past few years. Through this research proposal, we aim to study these climatic changes from a theoretical perspective by applying both deterministic and stochastic formalisms. Employing a stochastic approach will offer a new perspective by accounting for random fluctuations that occur during the periods of climatic change. We will analyze real-time data to identify changing patterns, potential causes and critical phenomena in the complex dynamics. The potential threats of rise in temperature, changing rainfall patterns, critical transformation in ecosystems, changes in biodiversity and rise in levels of greenhouse gases will also be thoroughly analyzed. Based on these patterns, we will construct a mathematical model and optimize it to reflect the behaviors observed in the real-time data in order to construct robust data-driven model for accurate predictions. Dimensionality reduction methods in data-driven modelling, which we have previously used in our own work with Dr. A. Surjalal Sharma can also be applied. Additionally, we will study the impact of introducing influential factors like afforestation/reforestation, abundances of atmospheric components, etc. that could bring positive changes to the climate deterioration. Lastly, we aim to incorporate Artificial Intelligence (AI) and Machine Learning (ML) tools to make predictions and analyze climatic trends for the future, both with and without the inclusion of these influential factors. Using the predicted trends, we can also formulate constructive policies for awareness and adoption to bring sustainable changes to the environment, ecosystem and biodiversity.