A data-driven Mathematical Modelling Approach for Malaria in Africa

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Every year, millions of people contract vector-borne diseases, and tragically, many lose their lives. Public health authorities can implement effective protective measures only by thoroughly understanding the dynamics of these diseases. In this study, we propose a compartmental model to analyze the dynamics of vector-borne diseases, incorporating the transmission rate's dependence on temperature and altitude. We conduct a steady-state analysis of the proposed model and examine the stability of both the disease-free and endemic steady states. Since the system's parameters influence its dynamics, we utilize three different neural network architectures: artificial neural networks (ANNs), recurrent neural networks (RNNs), and physics-informed neural networks (PINNs) to estimate the parameters of the SIR-SI dynamical system. We then use these estimated parameters to predict the trajectories of the compartments. To better understand the severity of a disease, calculating the associated risk is crucial. In this work, we calculate the risk using dynamic mode decomposition (DMD) based on the trajectory of the infected individuals.

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