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Frontiers of Mathematical Modelling In Environmental Sciences: Social Dynamics, Tipping Points, And More

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Extended Abstract

Mathematical modelling is pervasive in the environmental sciences. In recent years, researchers have been expanding its application to new study systems, such as modelling the interactions between human and environmental systems and using mathematics to better anticipate environmental tipp,ing points. I will describe some of my research over the past decade that uses mathematical and computational models to analyze the nonlinear interplay between social dynamics and climate/ecosystem dynamics, ranging from fisheries and mosaic ecosystems to the global temperature anomaly. We find that phenomena such as social learning and social norms can have profound implications for the long-term trajectory of such systems. I will also describe research that hybridizes dynamical systems and deep learning algorithms to improve prediction of tipping points in various systems, such as anoxification in the Mediterranean, and paleo-climate shifts. This approach relies upon the presence of universal archetypes of dynamical behavior near tipping points to not only improve early warning signals of such transitions, but also predict what environmental state might lie beyond.