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Using reservoir computing to predict temperature fluctuations in turbulent Rayleigh-Bénard convection[1] SARAH CHANG, Swarthmore College, DANIEL LATHROP, University of Maryland, College Park — Turbulent flows are ubiquitous in the fundamental processes of nature—from the Earth's mantle to its atmosphere. Among their many complexities, turbulent flows are chaotic, which makes them computationally expensive to simulate and difficult to study analytically. Thus, prediction of turbulent systems is an ongoing challenge. Machine learning methods, specifically reservoir computing, have recently shown promise in predicting turbulent flows. Reservoir computing is a recurrent neural network model that uses a reservoir of randomly connected nodes to process the input data and predict the output for the next time step. As a proof-of-concept, here we test the effectiveness of reservoir computing on the prediction of temperature fluctuations in turbulent Rayleigh-Bénard convection (RBC) because it has a relatively simple experimental setup and relevant applications, like weather prediction. We built a water-filled cylindrical convection apparatus, heated from below and cooled from above, and achieved Rayleigh numbers up to 4.5×10^{11}. We train the reservoir computer on our experiments temperature time-series data, collected with thermistors inserted at multiple heights in the flow, aiming to predict temperature fluctuations in turbulent RBC flow.

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