Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Machine Learning for Trajectory Prediction in Geophysical Flows[1] PHILIP YECKO, Cooper Union, ERIC FORGOSTON, Montclair State University, KEVIN YAO, The Cooper Union — Echo state network based machine learning (ML) is applied to two elementary models of ocean circulation: the well-known double-gyre stream function model with time-variable forcing and a one-layer quasi-geostrophic (QG) basin model. These models are used to generate time-dependent two-dimensional stream function fields, from which flow maps, trajectories and ensembles of trajectories are computed, assuming ideal particles. Varied physical model parameters allow sampling of a wide range of dynamical behaviors corresponding to diverse geophysical flow regimes; the QG PDE model can realize Munk, Stommel or strongly nonlinear time-dependent solutions. We evaluate the effectiveness and fidelity of our machine learning approach in capturing the characteristics of trajectories, both directly and indirectly, via stream function field prediction. We asses the predictive power of ML models against other predictive and descriptive models of QG flows, including finite time Lyapunov exponent, or FTLE, accounting for the role of physical and numerical parameters on our results.

[1]partially supported by NSF CMMI awards 1462823 and 1462884

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Date submitted: 01 Aug 2019 Electronic form version 1.4