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Data-Driven Modeling and Prediction of Arctic Sea Ice

Dmitri Kondrashov, Mickael Chekroun, and Michael Ghil

University of California, Los Angeles, Department of Atmospheric and Oceanic Sciences, Los Angeles, United States (dkondras@atmos.ucla.edu)

We present results of data-driven predictive analyses of sea ice over the main Arctic regions. Our approach relies on the Multilayer Stochastic Modeling (MSM) framework of Kondrashov, Chekroun and Ghil [Physica D, 2015] and it leads to probabilistic prognostic models of sea ice concentration (SIC) anomalies on seasonal time scales. This approach is applied to monthly time series of state-of-the-art data-adaptive decompositions of SIC and selected climate variables over the Arctic. We evaluate the predictive skill of MSM models by performing retrospective forecasts with "no-look ahead" for up to 6-months ahead. It will be shown in particular that the memory effects included intrinsically in the formulation of our non-Markovian MSM models allow for improvements of the prediction skill of large-amplitude SIC anomalies in certain Arctic regions on the one hand, and of September Sea Ice Extent, on the other. Further improvements allowed by the MSM framework will adopt a nonlinear formulation and explore next-generation data-adaptive decompositions, namely modification of Principal Oscillation Patterns (POPs) and rotated Multichannel Singular Spectrum Analysis (M-SSA).