Will Machine-Learning Approaches Improve Antarctic Sea Ice Predictability?

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Sea ice in the polar oceans is an active component of the global climate system and amplifies climate change in polar regions. With its large seasonal and interannual variability, Antarctic sea ice greatly affects surface energy balances in the atmosphere and ocean by changing surface albedo, salt injection, and insolation between the air-sea interface. As such, long-range forecasts of Antarctic sea ice are very much in demand, not only because of the potential importance of sea ice in the global climate, but also for the purpose of exploring the Antarctic continent. Interactions between air and sea ice are not well studied nor understood, thus making general circulation models supported by these interactions infeasible. As a result, the best methods of forecasting sea ice variability currently are statistical models. The first attempt at this was done by Chen and Yuan in 2004, with the development of a linear Markov model. This model was then updated with another 21 years of data, along with the addition of oceanic variables by Bernard Wang in 2022. Now, a machine-learning-based model in the form of a feedforward neural network has been built to simulate and predict short-term sea ice variability in the Antarctic. The model looks to outperform the Markov model by testing both linear and non-linear activation functions in the model's layers. Previous to model construction, dimensionality reduction was applied to the data in the form of multivariate empirical orthogonal functions. The linear machine-learning model was found to outperform the non-linear and to perform roughly the same as the Markov model. Further work will include adding more extensive training data to produce better results with the non-linear model.