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Seasonal Predictability of Antarctic Sea Ice based on Deep-learning Approaches

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There is a distinct difference in the behavior of sea ice extent response to global warming between the Arctic and Antarctic; the former is decreasing while the latter had been increasing slightly until recently. However, satellite data show that Antarctic sea ice has been continuously decreasing since 2016 and reached its minimum in February 2023. The minimization of sea ice extent in Antarctica would have various impacts on the Earth's system. Since ice is more reflective than liquid water, sea ice plays a significant role in maintaining the Earth's energy balance. Therefore, it is crucial to accurately predict future sea ice response. Here, we aim to predict the sea ice extent for the upcoming season using deep learning models, employing U-Net, ConvLSTM, and a combination of U-Net and ConvLSTM. Atmospheric and oceanic data related to sea ice, such as sea surface temperature, wind speed, etc., were used as features, while the sea ice extent was set as the target. We trained and tested the models using data from the CESM2 Large Ensemble. The performance of each model was compared using Correlation and RMSE as evaluation metrics. Additionally, to assess the impact of each variable within the model, we replaced each variable with its climatological mean and observed the changes in the evaluation metrics to determine their importance. These research findings are anticipated to significantly contribute to predicting more accurate changes in Antarctic sea ice and understanding future Antarctic sea ice changes.

Key words: Sea ice, Antarctica, Deep learning