Ph.D. Defense Announcement
Kirsten Mayer
August 22, 2022, at 9:00 a.m. MT

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Ph.D. Defense

Monday, August 22, 2022
9:00 a.m.

Defense
ATS Large Classroom (101 ATS) or [Teams](#)

Post Defense Meeting
Riehl Room (211 ACRC)

Committee:
Elizabeth Barnes (Adviser)
James Hurrell
Eric Maloney
Charles Anderson (Computer Science)

Application of Neural Networks to Subseasonal to Seasonal Predictability in Present and Future Climates

Subseasonal to seasonal timescales (S2S; 2 weeks to a season) are known for their lack of predictability. Yet accurate predictions on these timescales provide crucial, actionable lead times for agriculture, energy, and water management sectors. Fortunately, specific earth system states – deemed forecasts of opportunity – can be leveraged to improve prediction skill. Our current understanding of these opportunities are rooted in our knowledge of the historical climate. Depending on societal actions, the future climate could vary drastically, and these possible futures could lead to varying changes to S2S predictability. In recent years, neural networks have been successfully applied to weather and climate prediction. With the rapid development of neural network explainability techniques, the application of neural networks now provides an opportunity to further understand our climate system as well. The research presented here demonstrates the utility of explainable neural networks for S2S prediction and predictability changes under future climates.

The first study presents a novel approach for identifying forecasts of opportunity in observations using neural network confidence. It further demonstrates that neural networks can be used to gain physical insight into predictability, through neural network explainability techniques. We then employ this methodology to explore S2S predictability differences in two future scenarios: under anthropogenic climate change and stratospheric aerosol injection (SAI). In particular, we explore subseasonal predictability and forecasts of opportunity changes under anthropogenic warming compared to a historical climate in the CESM2-LE. We then investigate how future seasonal predictability may differ under SAI compared to a future without SAI deployment in the ARISE-SAI simulations. We find differences in predictability between the historical and future climates and the two future scenarios, respectively, where the largest differences in skill generally occur during forecasts of opportunity. This demonstrates that the forecast of opportunity approach, presented in the first study, is useful for identifying differences in future S2S predictability that may not have been identified if examining predictability across all predictions. Overall, these results demonstrate that neural networks are useful tools for exploring subseasonal to seasonal predictability, its sources, and future changes.

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