Using machine learning to accurately identify high latitude atmospheric rivers

Christine Shields*[1]

[1]National Center for Atmospheric Research – United States

Abstract

Atmospheric rivers and high latitude moisture transport serve as a bridge between extratropical and polar weather by injecting water and energy into the high latitude climate system, ultimately with significant implications for the cryosphere. Despite similarities with the extratropics, polar weather often has unique spatial and physical characteristics. Here, we focus on high latitude atmospheric rivers (ARs), which typically incorporate moisture transport, low pressure systems, and blocking highs. High latitude ARs have been recognized to impact both sea and land ice with strong winds, temperature anomalies, and precipitation extremes. Standard identification techniques (both traditional thresholding and machine learning) are typically developed with an emphasis on the mid-latitudes and are inadequate for high latitude systems.

Developing tools to correctly identify high latitude ARs are necessary to be able to accurately characterize physical systems and their impacts and quantify their uncertainties. Starting with ClimateNet, an open, community-sourced human-expert-labeled curated dataset in high-resolution (25km) Community Atmosphere Model (CAM5.1) simulations, we train a light-weight neural network, CGNet, to increase the computational efficiency of the original segmentation model and add spatio-temporal tracking of individual events. Incorporating over 1000 labels created from high latitude weather experts, and focusing only on events poleward of 60o N/S, we emphasize only those events that reach into the Arctic Circle and Antarctic, respectively. We present evidence of the necessity of using a polar specific identification, as well as preliminary results from high resolution climate models. As we move into a warmer and changing future, machine learning techniques may be better suited to identify weather features that are not dependent on the climate base state.

*Speaker