Ensemble super-parameterization for subseasonal-to-seasonal prediction

*Aneesh C Subramanian[1]

1. University of Oxford

The sub-seasonal forecast timescale, which has long been known as the “predictability desert”, is receiving more interest from most weather forecasting centers in the recent decade. A major reason is due to improved representation of climate modes of variability that act as important potential sources of predictability at these timescales, such as the Madden-Julian Oscillation (MJO) and other tropical modes. Convection and cloud processes play a key role in the dynamics of the tropical atmosphere, especially in the MJO. Despite significant improvements in global modeling over the last three decade, our shortcomings in parameterising convection in global climate models (GCMs) are limiting our ability to simulate and understand the climate and weather of the planet. Recent innovative ideas on convection parameterisation such as super-parameterisation (embedding cloud resolving models within the GCM grid) or stochastic-parameterisation implemented in the ECMWF climate model has helped improve the model’s representation of the climate and weather systems. These two approaches in convection parameterisation have emerged as new paths forward and complement the conventional approaches rather than replace them. We study the impact of these two approaches and a combination of the two on forecasts from weather to sub-seasonal timescales with ensemble forecasts over a 20-year time period. Results from evaluation of forecast skill in the Tropics and for organized convective systems such as the MJO will be presented. We show that the combination of the two approaches helps improve reliability of forecasts of certain tropical phenomena, especially in regions that are mainly affected by deep convective systems. We will also present studies on how these new approaches impact the forecast of clouds and precipitation processes and their interaction with the dynamics. This has implications on improving conventional convection parameterisation using hybrid approaches for probabilistic earth system forecasting as we await the exascale computing systems of the future to resolve convective processes in climate models.

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