Special Seminar

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Exploring stochastic and multiscale modeling for improving weather and climate models

Hosted by David Randall

1:30 p.m. Wednesday, Nov. 6
ATS 101

The accurate parameterization of moist convection presents a major challenge for the accurate prediction of extreme weather events through numerical models. Super-parameterisation is a recent alternative strategy for including the effects of moist convection through explicit turbulent fluxes calculated from a cloud-resolving model (CRM) embedded within a global climate model (GCM). Basic scales for cloud-resolving modeling are the microscales on the order of 10 km in space and on time scales on the order of 15 min, where vertical and horizontal motions are comparable and moist processes are strongly nonlinear. In this presentation, we compare the impact of ensemble super-parameterization, within the European Centre for Medium-Range Weather Forecasts (ECMWF) ensemble prediction system, with stochastic physics schemes as a way to represent model uncertainty in medium and subseasonal range weather forecasts. We especially focus on forecast evaluation of Madden Julian Oscillation, tropical cyclones, and atmospheric river events. We will present forecast evaluations of a series of medium and subseasonal-range hindcasts.

We will also present a new paradigm for dynamical core development. Dynamical cores should not be more precise than the level of uncertainty inherent in ensemble forecasting systems (which are modeled using stochastic schemes). Implementing dynamical cores with excessive numerical accuracy will not bring forecast gains, and may even hinder them since valuable computer resources will be tied up doing insignificant computation and therefore cannot be deployed for more useful gain, such as to increase model resolution or ensemble sizes. Here we describe a low-cost stochastic scheme, which can be implemented in any existing deterministic dynamical core as an additive noise term. This scheme could be used to adjust accuracy in future dynamical-core development work. We propose that such an additive stochastic noise test case should become a part of the routine testing and development of dynamical cores in a stochastic framework.