samsi
NSF·Duke·NCSU·UNC

Climate Program Opening Workshop
August 21-25, 2017

Lecture: ***Developing Stochastic Parameterizations of Subgrid Variability of Clouds and Turbulence using High-Resolution Simulations***

Speaker: Chris Bretherton

Abstract:

Climate model parameterizations of cumulus convection and other clouds that form due to small-scale turbulent eddies are a leading source of uncertainty in predicting the sensitivity of global warming to greenhouse gas increases. Even though we can write down equations governing the physics of cloud formation and fluid motion, these cloud-forming eddies are not resolved by the grid of a climate model, so the subgrid covariability of cloud processes and turbulence must be parameterized. Many approaches are used, all involving numerous subjective assumptions. Even when optimized to match present-day climate, these approaches produce a broad range of predictions about how clouds will change in a future climate.

High resolution models which explicitly simulate the clouds and turbulence on a very fine computational grid more realistically simulate cloud formation compared to observations. But it has proved challenging to translate this skill into better climate model parameterizations.

We will present one naturally stochastic approach for this using a computationally expensive approach called ‘superparameterization’ and then we will lay out a vision for how machine learning could be used to do this translation, which amounts to a form of stochastic coarse-graining. Developing the statistical and computational methods to realize this vision is a good challenge for this SAMSI year.