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Fourth Year PhD Presentation

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Statistical Emulation of General Circulation Models

WEDNESDAY, November 2, 2011 at 2:30 PM

110 Eckhart Hall, 5734 S. University Avenue

ABSTRACT

General Circulation Models (GCMs) are mathematical models aiming at reproducing physical processes on a global scale and at predicting quantities like temperature and precipitation given some forcing inputs such as carbon dioxide (CO_2). The use of these models spans from global warming assessments to climate decision making and its development is a wide and active field of study in the geophysical community. Currently GCM developers are intensively looking at higher resolutions in space and time, and at improving the modeling of complex physical processes, such as cloud formation. Since every improvement adds to the complexity of the model, it is computationally infeasible to run models for more than a few CO_2 scenarios.

In this talk I will present a new approach to GCMs based on the opposite assumption: what if we have many CO_2 scenarios at coarse space time resolution? Using a library of such runs provided by the Department of Geophysical Sciences, I will show how it is possible to statistically model both temperature and precipitation as a function of CO_2 in an easy and physically interpretable fashion, and how this can done efficiently with only a few scenarios. In this way it is possible to reproduce (emulate) computer output for other scenarios by just predicting the outcome of a statistical model, thus avoiding direct computations and potentially saving a significant amount of time. I will discuss implications and limitations of this approach, as well as future direction of research to improve this emulator.