Title: Building a Cornell Climate Model to Broaden Stakeholder Participation in the Validation, Use, and Development of Seasonal Forecast Tools

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Abstract: Extreme weather is a serious threat to agriculture, human safety, and economic development throughout the world. Climate change is likely to increase the risk of severe weather, particularly heat waves, droughts, and floods. To flourish in spite of these hazards, societies will require a toolkit of infrastructural, technological, and policy adaptations to manage the risk of extremes. Numerical models of weather and climate will be among the most important of these tools because they empower decision makers with information to anticipate and prepare for consequential events.

Historically, large national research labs have been the centers for numerical climate model design, development, and validation(1,2,3). Such institutions have made astonishing advancements in simulating global climate processes, biogeochemical cycles, and the role of human activity in warming the planet. Despite these contributions, the existing models are not yet adequate for making accurate seasonal to decadal forecasts(4,5). Although it is not completely understood why these time horizons are so difficult to forecast, two factors likely play a role. First, even the most powerful supercomputers are insufficient for directly simulating weather phenomena on the smallest to the largest geographic scales, yet variations across this continuum may be important for climate prediction(6,7). Second, most of the existing models are exclusively deterministic, meaning that very large ensembles are needed to estimate likely future outcomes from a set of initial conditions. Because model development has not taken advantage of explicitly probabilistic methods for representing unresolvable phenomena(7,8), hybridizing the existing deterministic methods with more probabilistic ones presents an opportunity to develop a new generation of models that are computationally faster and better at representing the full range of future possibilities.

Existing model limitations also severely restrict their utility for stakeholders making decisions on a week-to-week or seasonal timeframe. An equally serious shortcoming found in the current generation of models is that the people whose lives and livelihoods are most directly impacted by severe weather and climate change have been left out of the development and evaluation of global climate models. This has led to distrust of climate models and the science of climate change by a large percentage of the general population in the United States(9).

Why Cornell?
Research into climate change and its impacts is vibrant across campus, yet nearly all of the projects rely on the static output from models that were developed elsewhere. The Cornell Climate Model will allow the university to take greater ownership in the underlying scientific process of understanding climate change, while at the same time initiating a new dialogue between scientists and stakeholders (including farmers and municipal officials) on what information is most needed and useful to help guide more informed decision making. Given its longstanding tradition of doing science in service of society, Cornell is uniquely posed to play a

leadership role in pioneering a new paradigm for global climate model design, deployment, and development of decision support tools.

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