Thesis Project Portfolio

Enhancing Regional Climate Accuracy Through Earth Balance and Regional Climate Models

(Technical Report)

Framing the Unknown: Climate Model Uncertainty, Public Trust, and the Ethics of Communication

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

David Choi

Spring, 2025

Department of Computer Science

Table of Contents

Sociotechnical Synthesis

The dual projects presented in this portfolio explore the complex intersection of science, technology, and society through the lens of climate change. On one side lies a technical capstone that enhances regional climate accuracy through the coupling of Earth Balance Models (EBM) and Regional Climate Models (RCM). On the other lies a Science, Technology, and Society (STS) analysis that investigates how the communication of uncertainty in climate models through climate scientists and the media shapes public trust and support for climate policy. Accurate models and simulations are essential, but without public trust and effective communication, even the most sophisticated forecasts may fall short of inspiring meaningful action. Together, these works address increasing local prediction accuracy through a hybrid climate forecasting tool and the sociopolitical challenges in making those forecasts credible, actionable, and communicated in an ethical manner.

My technical project targets a well-known limitation in current climate modeling in the inability of global models to capture fine-grained regional variations. Using North Tampa, Florida as a test suite, I developed a hybrid forecasting system that couples an Earth Balance Model (EBM) with a Regional Climate Model (RCM) and machine learning tools such as random forests and LSTM neural networks. This work represents a deliberate attempt to make climate predictions more locally meaningful and practically useful. By refining how we model regional climates, it helps to make climate data more relevant, trustworthy, and usable in decision-making contexts.

My STS paper investigates how media framing, psychological biases, and communication between climate experts and the public contribute to responses to scientific uncertainty in climate change models. Drawing on STS theories of credibility and co-production,

as well as cognitive psychology concepts like motivated reasoning, I analyzed how different framings of uncertainty affect public trust. I found that structured and transparent scenarios often build credibility, while ambiguous or even technical expressions of uncertainty tend to erode trust. Moreover, the media plays a decisive role in filtering and amplifying scientific narratives, which can either bridge or widen the gap between climate science and public action. Ultimately, I argue that the communication of uncertainty is not just a technical detail, but an ethical and political act that influences whether climate models become tools for improvement or figures that cause confusion.

The synergy between these two projects lies in their shared commitment to confronting and understanding uncertainty. In the technical project, uncertainty is addressed quantitatively through model refinement, integration of new variables, and evaluation of predictive accuracy. In the STS research, uncertainty is approached qualitatively in the scope of a communicative and ethical dilemma. Combined, they suggest that better climate adaptation does not stem solely from better models, but from models that are also contextualized and transparently communicated to society. Technical advancement alone cannot solve climate-related problems. Not only do climate models have to be right, but they have to be right and conveyed in a manner that is understandable and more importantly, actionable.