

In your own words, provide a summary of your educational program objectives and your long-range professional goals.

- As part of this statement, we are interested in your ideas about:
 - **the kinds of research in which you would like to be engaged** during your graduate study or in the longer term; or
 - **specific research questions that interest you** and how you became interested in them
- **Please discuss these research interests in sufficient detail for an expert who is technically competent in your field to judge your understanding of the questions to be addressed.** This includes relevant hypotheses and approaches one might take to answering the questions, and other research principles required to investigate the research area you identify.
- **We are interested in not only the science, but also your longer-term goals and how the science fits into your life as an individual.** We do not want this to look like a grant submission.

Your response will be limited to 3,000 characters, including spaces. There is no extra space for citations. If you are writing this text elsewhere and copy-pasting it into this box, be aware that some word processing programs will transfer spaces and returns differently.

Response:

I'm audacious. I love to explore extreme ideas that others do not even consider imaginable. I'm not shy to use the latest technology (like Quora and Stack Exchange) to accelerate my research in ways that have not been foreseen by anyone else. I also use my significant online profile to recruit undergraduates to professors that I've been involved with.

Though I have an astrophysics background, I found that climate modeling was the perfect route to merge my interests in astronomy with those in other areas, so I moved into the geosciences. We are now facing the possibility where we may be able to characterize the atmosphere of the first habitable exoplanet. And even if we may not be able to zero in on a habitable exoplanet in the span of my professional career, all the intermediary work involved has the potential to significantly transform science in multifaceted ways. Since there are billions of possible exoplanets, I know that if we want to characterize their climates, we must develop highly-generalizable climate models that are not "force-fit" to our modern-day Earth. These models can also help us test the assumptions that are often made in climate modeling. Increased awareness of these assumptions can make our interpretations of them more robust.

At Brown, I have the opportunity to test a new climate modeling technique - known as Direct Statistical Simulation (DSS) – which solves the equations of motion for the statistics themselves. This is in contrast to Direct Numerical Simulation (DNS) – which is used in normal climate models. Since DSS solves for the statistics, it has the potential to significantly speed up our simulations, which would help me explore how rotation rate and other parameters can help out our simulation. Since DSS allows us to average out our fast modes of motion, it also helps

with our physical insight – which would help us characterize the most important features of climates that we don't know yet.

I would also like to test out the ergodic hypothesis - the assumption that the long-time statistics of any observable does not depend on the initial conditions that are used. But in which domains is this hypothesis actually safe? Some simulations show that under conditions of decreased friction, the atmosphere would depend on initial conditions longer than it otherwise would – so it would be non-ergodic. If our simulations showed non-ergodic behavior for a wider range of planetary atmospheres than previously suspected, then they could carry disturbing implications on how we model the atmospheres of other planets and even possibly Earth itself. For example – the early Earth was covered up in oceans, which could presumably produce less friction on the atmosphere and cause it to be non-ergodic.

Ultimately – planetary atmospheres has a lot of low-hanging interdisciplinary fruit. A NDSEG fellowship would give me the intellectual freedom to continue pursuing highly-ambitious research that spans different disciplines.