Outstanding Alum Award Presentation

Tristan L'Ecuyer

Professor at the University of Wisconsin-Madison

3 p.m. Thursday, Dec. 9

ATS 101
Hosted by Emily Fischer

From the Tropics to the Poles: How an ATS PhD Research Topic Links These Two Seemingly Diverse Environments

It is a wonderful surprise and a great honor to be recognized with the CSU ATS Outstanding Alum Award. This occasion allowed me to pause and fondly remember my days as a graduate student in ATS and reflect on how my career has evolved to this point. Rather trying to share that whole story, however, my presentation focuses on a new satellite mission designed to address a startling gap in polar climate observations using two CubeSats, each about the size of a cereal box. Nevertheless, I will show how this project has unlikely roots in the Tropical Rainfall Measuring Mission research I began as a graduate student in ATS.

The Arctic climate is changing more rapidly than anywhere else on Earth owing to several unique feedbacks that locally amplify the effects of increased greenhouse gas concentrations. While the physical basis for these feedback mechanisms has been known for some time, current climate models still struggle to capture observed rates of sea ice decline and ice sheet melt. This may be explained, in part, by a lack of observational constraints on thermal energy exchanges between the atmosphere and surface and the processes that influence them. I will demonstrate that recent and anticipated satellite measurements offer great potential for filling this observational void. Using satellite data from the past decade, for example, we have learned that the Arctic is now unambiguously absorbing more SW radiation than at the start of the century. We have also learned that 40% of clouds on the Greenland ice sheet contain super-cooled liquid droplets, enhancing ice sheet melt by 25 Gt yr-1, providing tangible constraints on Arctic process models.

However, there remains a troubling gap in our ability to observe key properties of the polar environment. Far-infrared radiation (that occurring at wavelengths longer than 15 microns) makes up 60% of the thermal emission from the Arctic and nearly half of global emission but, while far-infrared spectra have been collected from every other planet in the solar system, Earth’s far-infrared emission spectrum has never been systematically documented. The Polar Radiant Energy in the Far-InfaRed Experiment (PREFIRE) seeks to fill this critical observational gap. Utilizing low-cost CubeSats, PREFIRE will systematically document thermal emission spectra from 5 – 54 microns, encompassing 97% of Earth’s emission. By distinguishing the unique far-infrared fingerprints of changes in temperature, water vapor, clouds, and surface melt processes on sub-daily to seasonal scales, PREFIRE will help untangle the complex, time-varying errors in model physics responsible for the large spread in simulations of the Arctic energy budget.