University of Miami, Physics Department Colloquium

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Date: Wednesday, April 10th, 2024
Time: 4:00 pm – 5:00 pm
Location: zoom link:
https://miami.zoom.us/j/92025906560?pwd=Ulp2RktUYzJyN21WZkYvWkhka0NNZz09

Brownian Motion, Polar Oceans, and the Statistical Physics of Climate

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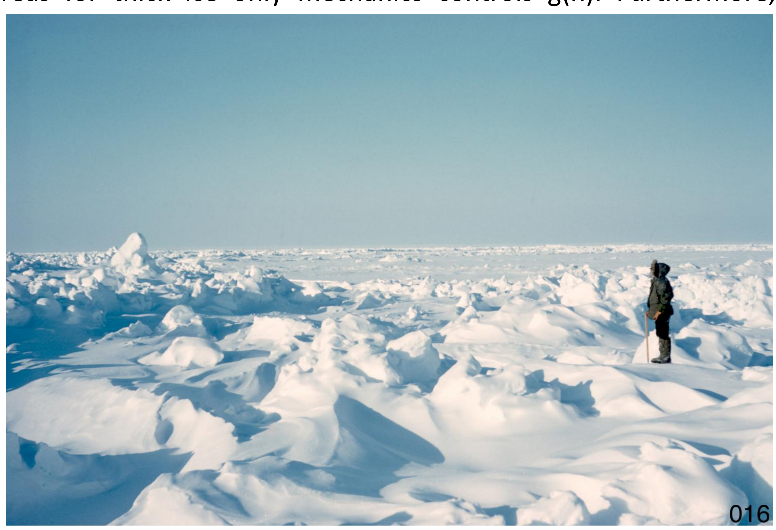
Abstract

In this talk, I will show how tools from statistical physics can be used to study the Earth's climate. The specific problem addressed is the geophysical-scale evolution of Arctic Sea ice. Using an analogy with Brownian motion, the original evolution equation for the sea ice thickness distribution function, g(h), by Thorndike *et al*. (*J. Geophys. Res*. **80**(33), 4501(1975)) is transformed to a Fokker-Planck-like equation. The steady solution for wintertime is g(h) = N(q, H) * h^q * exp(-h/H), where q and H are expressible in terms of moments over the transition probabilities between thickness categories. This solution exhibits the functional form used in observational fits and shows that for thin ice, g(h) is controlled by both thermodynamics and mechanics, whereas for thick ice only mechanics controls g(h). Furthermore, seasonality is introduced by using the Eisenman-Wettlaufer (*Proc. Natl. Acad. Sci. USA* **106***,* 28 (2009)) and Semtner (*J. Phys. Oceanogr.* **6**, 379 (1976)) models for the thermal growth of sea ice. The time-dependent problem is studied by numerically integrating the Fokker-Planck equation. The results obtained from these numerical integrations and their comparison with submarine and satellite observations of ice thickness will also be discussed.



Biography: Dr. Srikanth Toppaladoddi is a Lecturer (Assistant Professor) in applied mathematics at the University of Leeds. His research sits at the interface between applied mathematics, climate, computational and statistical physics. Prior to joining Leeds, he was a Research Fellow at All Souls College, Oxford, and obtained his Ph.D. in theoretical geophysics from Yale. His recent work has been focused on developing kinetic theories for the evolution of different components of the Arctic ice cover.