APPLIED MATHEMATICS COLLOQUIUM

High Latitude Statistical Mechanics

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Abstract: We derive a generalized description of the Arctic sea ice thickness distribution (the pdf of ice thickness) using concepts from stochastic dynamics. The full problem can be forced by atmospheric and oceanic fluxes and produce the observed climatology of the ice pack through the numerical solution of a single Fokker-Planck equation (FPE). As such, it provides a far simpler framework for climate modeling than does the typical approach. Further insight is provided by analysis of the FPE. For example, it can be cast in terms of a Bessel-like process described by an FPE with a logarithmic potential and solved by seeking solutions through an expansion into a complete set of eigenfunctions. The associated imaginary-time Schrödinger equation exhibits a mix of discrete and continuous eigenvalue spectra, corresponding to the quantum Coulomb potential describing the bound states of the hydrogen atom. We demonstrate this technique by solving the Brownian motion problem and the Bessel process both with a constant negative drift. The use of this approach allows one to study Earth's polar climate using a single equation and/or two equations for each of the seasons.

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Applied Math Colloquium: https://math.mit.edu/amc/fall18/
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