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Statistical Mechanics and the Climatology of the Arctic Sea Ice Thickness Distribution[1] JOHN WETTLAUFER, SRIKANTH TOPPALADODDI, Yale University — We study the seasonal changes in the thickness distribution of Arctic sea ice, $g(h)$, under climate forcing. Our analytical and numerical approach is based on a Fokker-Planck equation for $g(h)$, in which the thermodynamic growth growth rates are determined using observed climatology. In particular, the Fokker-Planck equation is coupled to an observationally consistent thermodynamic model. We find that due to the combined effects of thermodynamics and mechanics, $g(h)$ spreads during winter and contracts during summer. This behavior is in agreement with recent satellite observations from CryoSat-2. Because $g(h)$ is a probability density function, we quantify all of the key moments (e.g., mean thickness, fraction of thin/thick ice, mean albedo, relaxation time scales) as greenhouse-gas radiative forcing, ΔF_0, increases. The mean ice thickness decays exponentially with ΔF_0, but *much slower* than do solely thermodynamic models. This exhibits the crucial role that ice mechanics plays in maintaining the ice cover, by redistributing thin ice to thick ice–far more rapidly than can thermal growth alone.

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