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How the growth of lake ice depends on the fluid dynamics underneath[1] CHAO SUN, ZIQI WANG, Tsinghua University, ENRICO CALZAVARINI, Universit de Lille, FEDERICO TOSCHI, Eindhoven University of Technology — Convective flows coupled with solidification or melting in water bodies play a major role in shaping geophysical landscapes. Particularly in relation to the global climate warming scenario, it is essential to be able to accurately quantify how water-body environments dynamically interplay with ice formation or melting process. By combining experiments, numerical simulations and theoretical model, we investigate solidification of fresh water, properly considering phase transition, water density anomaly, and real physical properties of ice and water phases, which we show to be essential for correctly predicting the different qualitative and quantitative behaviors. We identify, with increasing thermal driving, four distinct flow-dynamics regimes, where different levels of coupling among ice front, stably and unstably stratified water layers occur. Despite the complex interaction between the ice front and fluid motions, remarkably, the average ice thickness and growth rate can be well captured with the theoretical model. It is revealed that the thermal driving has major effects on the temporal evolution of the global icing process, which can vary from a few days to a few hours in the current parameter regime.

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