UNIVERSITÄT AUGSBURG

Physikalisches Kolloquium

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On Melting and Turbulent thermal convection: From the lab to the ocean

The quantitative understanding of glacial ice melting into the ocean is one of the most outstanding challenges in environmental fluid dynamics. The lack of understanding is on a fundamental level, due to the highly complex multi-scale, multi-physics nature of the problem. The process involves intricate multi-way coupling effects, yet the core of the problem can be deduced to the Rayleigh-Bénard problem: What is the heat transfer in a box heated from below and cooled from above. We report on how to solve this problem and emphasize the role of the thermal boundary layers. We in particular show that two regimes exist, namely a classical regime with a laminar-type boundary layer and an ultimate regime with a turbulent-type boundary layer and strongly enhanced heat transfer. We then transfer the results and methods from Rayleigh-Bénard convection to other wall-bounded turbulent flows. Finally, we show that also in ice melting the very same two regimes exist and that the ultimate regime corresponds to a strongly enhanced melting rate of the ice and the glaciers.