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Multiscale modelling of the climate system: Lessons from the laboratory (solicited)

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The performance of predictive climate models is severely limited by processes operating on length scales that are too small to be explicitly resolved by the numerical grids. Examples of such processes include gravity waves in the atmosphere and mesoscale eddies in the ocean. Often, the approximate treatment (i.e. parameterization) of these processes in models is relatively unconstrained by theory and observations. A large degree of uncertainty in future climate predictions is one direct consequence. In the absence of strong theoretical and observational constraints on parameterization schemes, how can progress be made?

In this talk, I will argue that useful insights into the climatic role of small-scale fluid dynamical processes may be gained from rotating laboratory experiments. In the laboratory, the interactions of multiscale processes may be studied without the ad-hoc approximations of numerical and theoretical approaches. One recent insight from laboratory experiments regards the topical question of whether deterministic parameterization is appropriate, or whether it must be replaced by stochastic parameterization if the full range of subgrid-scale impacts seen in nature is to be captured.