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Sinking phytoplankton in a turbulent flow

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Most phytoplankton species are heavier than water, thus they sink. As numerous earlier work did, we focus on the question of how and when these sinking species manage to persist. It is known that the main factors which determine the dynamics of phytoplankton species are the self-shading of phytoplankton individuals and the redistribution caused by the turbulent flow.

While turbulent structures and the finite size of plankton individuals are neglected in earlier models, we have taken into account both effects. Since the dynamical problem is extremely complex, we modelled the turbulent flow by point vortices, and solved it by individual simulation of the plankton components. We made a series of simulations with a set of biologically relevant parameters. In accordance with experimental observations, and earlier models, we found stable population density distributions with a peak near the water surface. The fluctuations are markedly higher than in earlier models. There is, in addition, a threshold, below which extinction takes place and the dynamics is sensitively parameter-dependent around this threshold.