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Marine snow, organic solute plumes, and optimal chemosensory behavior of bacteria

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ABSTRACT: Leaking organic solutes form an elongated plume in the wake of a sinking aggregate. These solutes may both be assimilated by suspended bacteria and guide bacteria with chemokinetic swimming behavior toward the aggregate. We used modifications of previously published models of the flow and concentration fields around sinking aggregates and of chemokinetic behavior of bacteria to identify the behavior that optimizes aggregate colonization and plume utilization. The optimal solution is governed by physical constraints and is a trade off between a high sensitivity to chemical signals and a long signal integration time. For a run-and-tumble swimming behavior, the predicted tumbling frequency is between 1 and 10 s21, similar to that reported for marine bacteria. The predicted optimal sensitivity to chemical signals is similar to or greater than that known for *Escherichia coli*. The optimal behavior was used to examine the potential contribution of aggregate-generated solute plumes for water column bacterial production. Despite occupying only a small volume fraction, the plumes may provide important growth habitats for free bacteria and account for a significant proportion of water column bacterial production at typical concentrations of marine snow aggregates.

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