Stochastic variational multiscale theory for coarsely discretised transport equations.

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Computer simulations of geophysical transport equations often require rather coarse discretisations, due to the numerous spatial and time scales involved. The lack of a clear separation of scales in many physical systems necessitates sub-grid modelling of the unresolved scales. Through a formal decomposition of the system into equations for resolved and unresolved scales, the variational multiscale approach provides a reasoned approach for constructing such sub-grid models. By applying some results from stochastic calculus, the equation for the unresolved scales can be expressed exactly as an expectation with respect to a stochastic process. The approach taken here is to use this formal result to construct stochastic sub-grid contributions to numerical simulations. Some results from the application of this approach to test problems such as the advection-diffusion equation and Burger's equation will be presented.