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Relating Random Walk Models with Classical Perturbation Theory for Macro-Dispersion Predictions

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Over the past years, several stochastic Lagrangian models were developed that enable computationally inexpensive predictions of flow and transport statistics for highly heterogeneous subsurface formations. Recently, some of these models were extended to account for non-stationary conductivity and flow statistics including point measurements. Till now, the stochastic processes at the heart of these models were calibrated numerically based on flow statistics from Monte Carlo simulation studies. Our present work provides a more rigorous basis for some of these models by formally relating the process characteristics to velocity statistics obtained from classical low-order perturbation expansions. Besides formally relating perturbation expansions and Lagrangian stochastic models, we explore the consistency between the two in our work.