

Accepted Manuscript

Relating Recent Random Walk Models with Classical Perturbation Theory for Dispersion Predictions in the Heterogeneous Porous Subsurface

Daniel W. Meyer

PII: S0309-1708(16)30579-6
DOI: [10.1016/j.advwatres.2017.04.017](https://doi.org/10.1016/j.advwatres.2017.04.017)
Reference: ADWR 2832



To appear in: *Advances in Water Resources*

Received date: 21 October 2016
Revised date: 23 April 2017
Accepted date: 24 April 2017

Please cite this article as: Daniel W. Meyer, Relating Recent Random Walk Models with Classical Perturbation Theory for Dispersion Predictions in the Heterogeneous Porous Subsurface, *Advances in Water Resources* (2017), doi: [10.1016/j.advwatres.2017.04.017](https://doi.org/10.1016/j.advwatres.2017.04.017)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Relating Recent Random Walk Models with Classical Perturbation Theory for Dispersion Predictions in the Heterogeneous Porous Subsurface

Daniel W. Meyer*

Institute of Fluid Dynamics, ETH Zürich, Sonneggstrasse 3, CH-8092 Zürich, Switzerland

Abstract

Recently developed stochastic macro-dispersion models enable computationally inexpensive flow and transport predictions for highly heterogeneous formations with statistically non-stationary conductivity and flow statistics. So far, the random processes at the heart of these models have been calibrated numerically based on velocity statistics from Monte Carlo simulation studies. In this work, we provide a more rigorous foundation to some of these models by analytically relating the process definition to given velocity statistics from classical first-order perturbation expansions.

Keywords: macro dispersion, PMVP model, random walk, perturbation expansion, **Fokker–Planck equation**

1. Introduction

2 The spreading of tracers in subsurface aquifers is typically dominated by
 3 velocity variations induced by the heterogeneity of the hydraulic conductivity,
 4 which is quantified by the log-conductivity variance σ_Y^2 . This process is referred
 5 to as macro-dispersion [1, equation (5.1.10)]. Over the past few years, a number
 6 of publications have dealt with the formulation of effective Lagrangian transport
 7 models that enable the numerical prediction of subsurface dispersion [2–8]. At
 8 the heart of these transport models are different kinds of random walks that
 9 operate in velocity space. Earlier work [e.g., 9, 10] has focused on **random walk**
 10 **models** in physical space to account for pore-scale dispersion. This numerical
 11 **treatment of pore-scale dispersion** is attractive as it eliminates numerical diffu-
 12 sion, which is a problem in conventional schemes given the high Péclet numbers
 13 that arise in applications [11, section 10.5.2]. **For the formulation of these mod-**
 14 **els, the concentration evolution or advection–dispersion equation was rewritten**
 15 **as a Fokker–Planck (FP) equation [9, section 2] including a dispersion tensor**

*Corresponding author

Email address: meyerda@ethz.ch (Daniel W. Meyer)

Download English Version:

<https://daneshyari.com/en/article/5763702>

Download Persian Version:

<https://daneshyari.com/article/5763702>

[Daneshyari.com](https://daneshyari.com)