Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

A Numerical Study of Surface Renewal Statistics at a Free Surface ALIREZA KERMANI, LIAN SHEN, Department of Civil Engineering, Johns Hopkins University — In order to investigate gas-liquid interfacial transport, direct numerical simulation of Navier-Stokes equations for the fluid motions of a turbulent open-channel flow and of the convective-diffusion equation for the transport of passive scalars has been performed. Surface renewal, the replacement of fluid close to the surface with bulk flow, is the most dominant interfacial transfer process. Correlations of scalar flux with various stages of surface renewal have been identified. Surface age of interfacial fluid elements, which is the interval of surface renewal encountered by surface elements, has been quantified with highly accurate Lagrangian and Eulerian methods. Based on extensive simulation data, we obtain valuable statistics of the surface renewal process. With the probability distribution function of surface ages obtained, various theoretical results, including exponential, Gamma, normal, and lognormal distributions have been examined. It has been concluded that surface renewal statistics can be best described by the lognormal distribution, which may be used as a basis for model development for interfacial scalar transfer.

Lian Shen
Department of Civil Engineering, Johns Hopkins University

Date submitted: 03 Aug 2007 Electronic form version 1.4