A diffusive description of Vertical Mixing in the Benthic Biolayer.

Original
A diffusive description of Vertical Mixing in the Benthic Biolayer / Monofy, A.M.I.M., Boano, F., Grant, S.B., Rippy, M.A.. - (2021). (EGU General Assembly 2021) [10.5194/egusphere-egu21-843].

Availability:
This version is available at: 11583/2971756 since: 2022-09-26T17:43:19Z

Publisher:
EGU

Published
DOI:10.5194/egusphere-egu21-843

EGU21-843
https://doi.org/10.5194/egusphere-egu21-843
EGU General Assembly 2021

A diffusive description of Vertical Mixing in the Benthic Biolayer.

Ahmed Monofy[1], Fulvio Boano[1], Stanley B. Grant[2], and Megan A. Rippy[2]
[1]Department of Environment, Land and Infrastructure Engineering, Politecnico di Torino, Torino 10129, Italy.
[2]Occoquan Watershed Monitoring Laboratory, The Charles E. Via Jr. Department of Civil and Environmental Engineering, Virginia Tech, 9408 Prince William Street, Manassas VA 20110, USA

In-stream environments, many biogeochemical processes occur in the benthic biolayer, i.e., within sediments at a very shallow depth close to the sediment-water interface (SWI). These processes are important for stream ecology and the overall environment.

Here, a 1D diffusive model is used to analyze the vertical exchange of solutes through the SWI and in the benthic biolayer. The model is applied to an extensive set of previously published laboratory experiments of solute exchange with different bed morphologies: flatbeds, dunes, and alternate bars. Although these different bed features induce mixing that is controlled by different physical processes at the SWI, overall mixing within the sediment is well represented by a parsimonious diffusive model, provided that the diffusivity profile declines exponentially with sediment depth.

For all morphology types, mixing is better simulated by an exponential diffusivity model than a constant diffusivity approach. Two parameters define the exponential diffusivity model; the effective diffusivity at the SWI, and a depth scale over which the exponential profile decays. Using a combination of classification and regression trees (CART) and multiple linear regression approaches, we demonstrate that a single predictive model captures measured variability in the effective diffusivity coefficient at the SWI across all morphological types. The best predictive model for the decay depth scale, on the other hand, is tailored to each morphological type separately.

The predictive framework developed here contributes to our understanding of the physical processes responsible for mixing across the SWI, and therefore the in-bed processes that contribute to the biogeochemical processing of nutrients and other contaminants in streams.