Direction and Non-linearity in Non-local Diffusion Transport Models

V.R. Voller[1]

[1]*Civil Engineering, University of Minnesota, Minneapolis, Minnesota,*

ABSTRACT: There is a keen current interest in modeling non-local diffusion transport in network-channelized systems. In a one-dimensional domain such a model can be realized by defining a non-local flux as an integral representing a weighted sum of “local-fluxes” over a region extending away from the point of interest. The local flux in this construction can be defined in terms of a function of an appropriate potential gradient at a specified point in the integration region; e.g., a constant times the gradient to a power n >1. There are potentially three parameters that define this non-local diffusion. A measure of the level of non-locality 0<alpha<=1, a measure of the up vs. downstream weighting 1>beta>-1 of the non-locality, and a measure of the non-linearity n>1 in the local gradient term. Whereas the key parameter is the level of non-locality the direction and non-linear parameters can also have important physical consequences for the model predictions. Here, in the context of sediment transport in fluvial channel networks, it is shown that changes in the direction value beta generate distinct outputs that reinforce the role of this parameter in determining the direction of information flow in the system. In addition, by investigating the value of the gradient exponent n, important insights into the relationship between non-local vs. non-linear behavior is obtained.