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Developing A New Predictive Dispersion Equation Based on Tidal Average (TA) Condition in Alluvial Estuaries

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Abstract: Dispersion mathematical representation of tidal mixing between sea water and fresh water in The definition of dispersion somehow remains unclear as it is not directly measurable. The role of dispersion is only meaningful if it is related to the appropriate temporal and spatial scale of mixing, which are identified as the tidal period, tidal excursion (longitudinal), width of estuary (lateral) and mixing depth (vertical). Moreover, the mixing pattern determines the salt intrusion length in an estuary. If a physically based description of the dispersion is defined, this would allow the analytical solution of the salt intrusion problem. The objective of this study is to develop a predictive equation for estimating the dispersion coefficient at tidal average (TA) condition, which can be applied in the salt intrusion model to predict the salinity profile for any estuary during different events. Utilizing available data of 72 measurements in 27 estuaries (including 6 recently studied estuaries in Malaysia), regressions analysis has been performed with various combinations of dimensionless parameters . The predictive dispersion equations have been developed for two different locations, at the mouth D0TA and at the inflection point D1TA (where the convergence length changes). Regressions have been carried out with two separated datasets: 1) more reliable data for calibration; and 2) less reliable data for validation. The combination of dimensionless ratios that give the best performance is selected as the final outcome which indicates that the dispersion coefficient is depending on the tidal excursion, tidal range, tidal velocity amplitude, friction and the Richardson Number. A limitation of the newly developed equation is that the friction is generally unknown. In order to compensate this problem, further analysis has been performed adopting the hydraulic model of Cai et. al. (2012) to estimate the friction and depth.

Keywords: dispersion, alluvial estuaries, mixing, salt intrusion, predictive equation