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# A critical review on the scaling theory of dispersion

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The phenomenon of dispersive mixing of solutes in aquifers is subject of research since decades. The characterization of dispersivity at a particular field site is a prerequisite to predict the movement and spreading of a contaminant plume. Experimental investigations have shown, that field-scale dispersivities vary over orders of magnitude, which apparently depends on the scale of measurement.

Gelhar et al. [1992] and Schulze-Makuch [2005] have reviewed a large number of transport experiments reported in the literature. Based on that data Schulze-Makuch [2005] performed a trend analysis of longitudinal dispersivity, fostering the empirical relationship of a power law between dispersivities and the scale of measurement without an upper bound.

The goal of our study is to critically revisit not only the data used for the trend analysis but the power-law scale dependence of longitudinal dispersivity (e.g. Neuman [1990], Xu and Eckstein [1995]). Our particular focus is on the reported dispersivities of large amount (larger than 100m) and large measurement scales (in the order of kilometers).

We aim to evaluate current theories of transport against a critical "mass" of field experiments and to bracket the conditions of their applicability. We further aim to evaluate the adequacy of the field sampling techniques that were employed from the perspective of more than 30 years development in modeling and field characterization. Given the tremendous progress in field data acquisition techniques and new insights gained, it is reasonable to expect that interpretations of past experiments may be flawed due to the limitations or inadequacy of field sampling techniques.

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