

Spatial and Temporal Stream Tracer Extrapolation¹

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ABSTRACT: In analysis of stream tracer observations, it is usually appropriate to assume that average velocity of the tracer equals the water velocity. However, instantaneous tracer velocity passing a fixed stream location is not generally equal to water velocity. Tracer velocity is defined here such that instantaneous tracer mass flux equals the product of tracer velocity, stream cross-sectional area, and concentration. Though not directly observable from tracer data, tracer velocity may be computed from observations using model-dependent assumptions. Three alternative models are examined here: the frozen-cloud (FC) model which assumes that tracer velocity equals the constant average water velocity, the convective spreading (CS) model which assumes that each parcel of tracer moves downstream at a constant velocity dependent on its position in the tracer cloud, and the advection-dispersion equation (ADE). For each model, tracer velocity is integrated and change in concentration is derived. These results are applied in derivation of spatial and temporal tracer extrapolation equations, and application of these equations provides new alternatives for estimation of cumulative tracer mass curves and spatial variance.

CE Database subject headings: Travel time, Mass transport, Mathematical models, Dispersion, Spills, Water quality

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