Review of OTIS and OTIS-P

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OTIS, One-dimensional stream solute Transport with lateral Inflow and Storage, is a publicly available numerical model that simulates transport of conservative solutes via advection, dispersion, and transient storage, as well as the effects of lateral inflows and outflows. For non-conservative solutes, OTIS also simulates first-order uptake (in the stream and in storage) and sorption to bed material.

The code has been widely used to simulate solute breakthrough curves from stream tracer experiments (see figure). OTIS represents streams as finite-difference domains. An individual storage zone is associated with each finite-difference control volume. However, individual storage zones are not directly connected to each other. Parameters (such as cross-sectional area of the storage zone) are effective over user-specified reach lengths.

Options for the upstream boundary condition include: 1) a concentration-step profile, in which abrupt changes in concentration at a single time step are indicated (useful for simulating stream tracer experiments); 2) a flux-step profile, in which abrupt changes in the product of solute concentration and discharge are indicated (useful for simulating stream-tracer experiments during dynamic flow conditions); and 3) a concentration-continuous profile, in which upstream-solute concentrations are provided and interpolated linearly for intermediate time steps. OTIS accounts for dynamic discharge within the model domain, as provided by the user. The output provides simulated solute concentrations at designated stream locations, and optional storage zone solute concentrations at the same locations.

OTIS input and output files may be used with parameter estimation or sensitivity analysis codes (such as UCODE), although OTIS-P, a parameter-optimization version of OTIS, is also available.

OTIS-P uses the STARPAC least-squared error method of optimization, outputting parameter standard deviation, 95-percent-confidence intervals, residual sum of squares, and optimized parameter values.

The source code and precompiled executable files for both models are available online. PC and Unix versions are available, as well as full documentation, a list of published applications of OTIS, and six example input files. A graphical user interface is not available, but the manual contains a succinct theory of the model, clear instructions, and complete documentation for the example files. Additional lists of published applications of OTIS and similar transient storage models are available through the U.S. Geological Survey's Surface Water Quality and Flow Modeling Information Group (SMIG) Web pages at smig.usgs.gov/SMIG/reading_refs.html.

Download OTIS and OTIS-P at co.water.usgs.gov/otis/. Contact Michael Gooseff at mgooseff@mines.edu.

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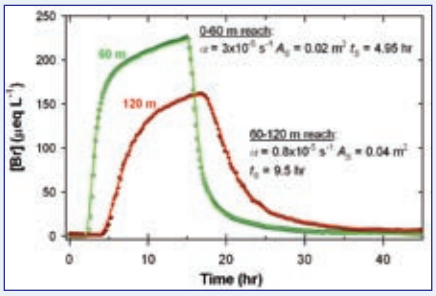

OTIS was used to simulate conservative stream tracer data during discharge recession in a small New Zealand stream. For comparison between two reaches, three metrics are noted: the first-order exchange coefficient between the stream and storage zone (α), the cross-sectional area of the storage zone (A_s), and the mean residence time of the storage zone, (t_s).

Application
Stream Solute Transport Modeling

Ease of Use:	
GUI:	N/A
Output/Plotting:	
Documentation:	
Speed:	
OVERALL RATING:	

Best Feature
Output of both stream and storage zone solute concentrations

Worst Feature
OTIS-P parameter optimization has to be done in steps as only a finite number of parameter refinement runs are made.

Rating System: Excellent Poor

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