

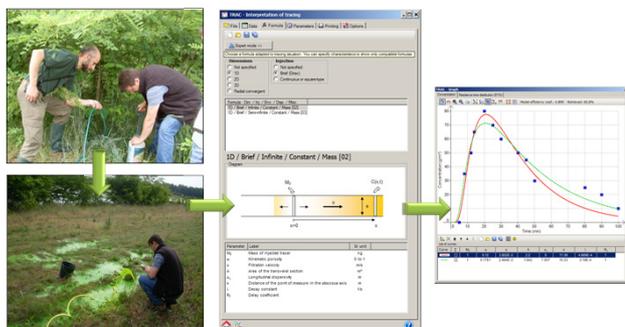
TRAC : a software for tracer test interpretation

Hydrogeology tracer tests are *in situ* experiments that consist in injecting a conservative tracer (no or little reaction with the medium) in order to observe its restitution after transport in groundwater. Sometimes tracer tests are merely exploited in a qualitative manner. The objective of TRAC is to provide the community of hydrogeologists with an effective tool that helps the design and the interpretation of artificial tracer tests. Tracer testing is a powerful method for characterizing the groundwater flow and predicting the fate of solutes in groundwater. They are essential for the protection and management of the water resource.

1. Context

Monitoring the injection and restitution of tracers is often interpreted as present or absent. Actually, the concentration curve obtained at site of restitution depends on : the groundwater flow and the chemical / biological processes that control transport of solutes in the aquifer.

The interpretation of the restitution curve is very instructive on the potential transfer of contaminants and in the description of hydrodispersive parameters. The French Geological Survey (BRGM) has developed an interpretative tool with features that enhance the accuracy and ease-of-use of tracer test results.



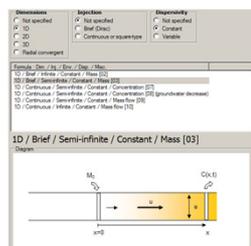
Tracer test : injection, restitution and interpretation

2. Analytical solutions

TRAC operates on the basis of validated analytical solutions (comparisons of results with numerical models) that can be selected depending on the configuration of the tracer test. Up to now, the following interpretation methods are available:

- ✓ 1D, 2D, radial converging/diverging flow;
- ✓ Instantaneous (Dirac), continuous or step-injection;
- ✓ Possibility of taking into account a delay factor and a degradation constant (exponential form);
- ✓ Space (i.e. time) variable dispersivity to consider the scale effect;
- ✓ Variable direction of the flow in order to respect the uncertainty of the groundwater flow direction.

Tracer testing methods continue to evolve and new interpretation methods are being developed. TRAC gives the experienced users the possibility to add their own analytical solution. TRAC can thereby be updated continuously and enhanced by the contributions of the community of users.



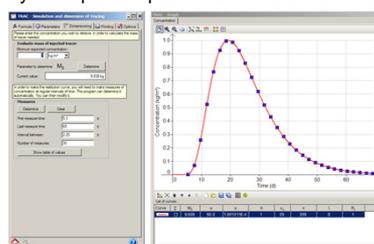
Set of analytical solutions

3. Design or interpret your tracer test

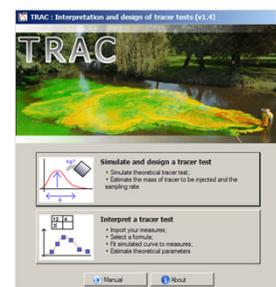
TRAC's startup offers two modes : « simulate and design » or « interpret » field tracer tests or soil-column experiments.

The "simulation" mode estimates the optimal mass or concentration to be injected and the sampling frequency.

The "interpretation" mode consists in determining by calibration the hydrodispersive parameters of the medium.

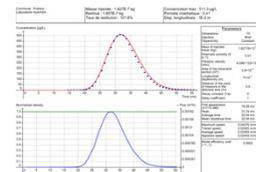


Designing a tracer test



TRAC start-up

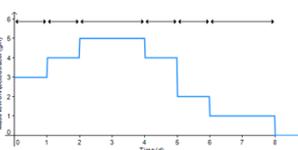
The printing options allow a synthetic representation of the tracer test interpretation, including the summary of the parameters, the plot of the cumulative restitution curve moreover they can be quickly customized.



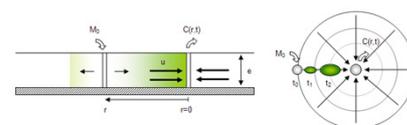
Synthetic printings

4. Features

- ✓ **Converging radial flow** (instantaneous, continuous or step-injection) : a new more accurate semi-analytical solution has been added (to be published by D. Thiéry);
- ✓ **Step-injection** : use of superposition principle in TRAC allows users to interpret tracer tests with an easy-to-setup step-injection;
- ✓ **Optimization process** : besides the possibility of manual adjustment of parameters (pore velocity, effective porosity, dispersivities, ...), TRAC offers an automatic parameter estimation facility (modified Rosenbrock algorithm, 1960);
- ✓ **TRAC GUI is user-friendly and intuitive**, it offers common import/export options (*.csv files) or direct entry of pairs data « on-the-fly » from Excel or any spreadsheet program;
- ✓ **Add your own analytical solution** : TRAC allows the users to introduce their own analytical solutions (including scheme, description and parameterization).



Step-injection



Converging radial flow solution

Authors affiliations

Download TRAC on : <http://trac.brgm.fr>

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