

# Numerical Groundwater Contaminant Transport Modeling With Spreadsheets

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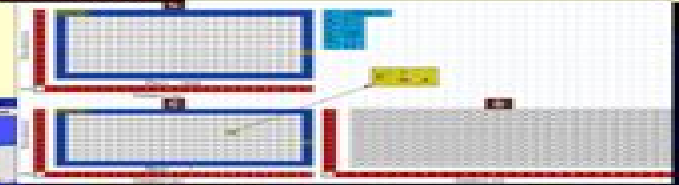
## Aims of Using Spreadsheets

There are two main methods for numerical contaminant transport modeling using general commercial software (the second). One is CTRANW, an application written in languages such as MATLAB or Visual Basic. Both methods have advantages. Commercial software has been developed with a view to solving governing equations and therefore they are not subject to some particular errors. On the other hand, writing spreadsheets needs a high level of knowledge of computer programming. This paper describes the Spreadsheets CTRANW, which is both flexible, user-friendly, and also helpful for educational purposes.



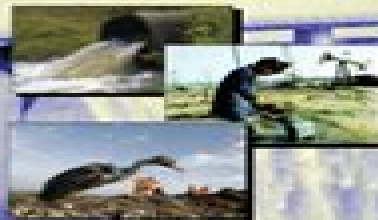
MODFLOW

A simplified 2D SCTR



## Methods of Modeling with Spreadsheets

The basis of a spreadsheet-based numerical groundwater model is that each cell represents an equal node in a finite difference grid. The model is developed using a spreadsheet and incorporates the contaminant transport governing equation, generally known as the advection-dispersion equation (ADE).  
 Co-ordination (X,Y,Z)  
 Co-ordinate velocity (U,V,W)  
 Co-ordinate dispersion coefficient (D<sub>x</sub>, D<sub>y</sub>, D<sub>z</sub>)



Example1: Ogata 1D analytical solution no adsorption and decay

Comparison of SCTR with CTRANW and Analytical Solution



## Verification

This paper introduces the mathematical framework and techniques for modeling groundwater contaminant transport using spreadsheets. The model is developed using a spreadsheet and incorporates the contaminant transport governing equation, generally known as the advection-dispersion equation (ADE). The model is verified by comparing the results of SCTR with the results of CTRANW and an analytical solution. The model is also verified by comparing the results of SCTR with the results of a 3D numerical model (MODFLOW).

$$C = \frac{Q}{4\pi T} \left( \exp\left(-\frac{r^2}{4Dt}\right) + \exp\left(-\frac{r^2}{4D't}\right) \right)$$

Where:  
 C = contaminant concentration at the source boundary (mg/L)  
 Q = injected mass (kg)  
 T = transmissivity (m<sup>2</sup>/s)  
 D = diffusion coefficient (m<sup>2</sup>/s)  
 D' = transmissivity (m<sup>2</sup>/s)  
 r = radial distance from the source boundary (m)  
 t = time (s)

A similar comparison is made with respect to the velocity (U,V,W) and the dispersion coefficient (D<sub>x</sub>, D<sub>y</sub>, D<sub>z</sub>). Finally, a 3-dimensional numerical model of contaminant transport (MODFLOW) is compared against the proposed SCTR model.

Polluted Lagoon



Example2: 2D numerical model of contaminant transport polluted lagoon

A sample of result of SCTR



## Results

The SCTR model has the required accuracy despite its simplicity. Some of advantages of model are being user friendly, giving a graphical presentation to user, intuitive process for changing data in each node, quick access to all output data. These advantages make SCTR to a suitable method for professional and educational aims. However this method just can be used to make reference calculations and it is not suitable for the more complex models.

# Applied Contaminant Transport Modeling

**Chunmiao Zheng, Gordon D. Bennett**



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