



GWSDAT (GroundWater Spatiotemporal Data Analysis Tool)

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A novel software application called the GroundWater Spatio-Temporal Data Analysis Tool, or GWSDAT, has been developed by Shell Global Solutions to facilitate the analysis and reporting of trends in groundwater monitoring data. GWSDAT automatically uploads data from MS Excel to generate a user-friendly interface, which allows users to scroll through the groundwater monitoring history of a site, exporting trend plots and graphics as required. The underlying statistical calculations and graphical output are generated using the open-source statistical program "R" (www.r-project.org)

GWSDAT performs a spatiotemporal analysis of concentration data, creating a 3D model in which the concentration distribution for each solute varies continuously with time(t). The user can select to view XY plots generated from this X,Y,t concentration distribution and overlay these on a plan of the site to show changes in solute concentration distribution through time. Contour plots of the groundwater piezometric surface are automatically generated and can also be overlaid. Sets of these images can then be automatically exported to MS Powerpoint or other software applications for reporting purposes.

GWSDAT is not intended as a replacement for numerical flow/transport models (e.g. MODFLOW) or geographical information systems (e.g. ARC-GIS). It is designed to maximise the value of datasets where only concentration, water level and possibly NAPL thickness data is available, together with a site plan. Very little training is required to use GWSDAT: provided the input dataset is entered correctly, the trend analysis/ reporting is carried out automatically. This greatly reduces the time and resources required for data analysis, and ensures that the data is processed and reported in a consistent manner. Potential benefits of using GWSDAT include:

- The early identification of rising contaminant concentration trends, leading to reduced response time in the event of leaks/ spills.
- Improved data transparency leading to better designed monitoring networks and more robust conceptual site models, thereby avoiding the collection of redundant data.
- Clarity on the relationship between dissolved solute concentrations and groundwater elevation/ flow direction, for improved plume control measures/ fit for purpose remediation system design.
- Significantly reduced time/ resource expenditure on the analysis and reporting of monitoring data, particularly in the case of smaller sites where insufficient data is available to justify the cost of using GIS / flow and transport simulations.

Research is currently underway to develop more advanced spatiotemporal algorithms that also take into account historic variations in groundwater flow direction, relationships between solute concentrations and variation in the Z dimension, while ensuring that the data processing time remains reasonable for large datasets. A key feature of the GWSDAT software is that large datasets (comprising >50,000 rows of data) can be processed and reported in < 1 hour.