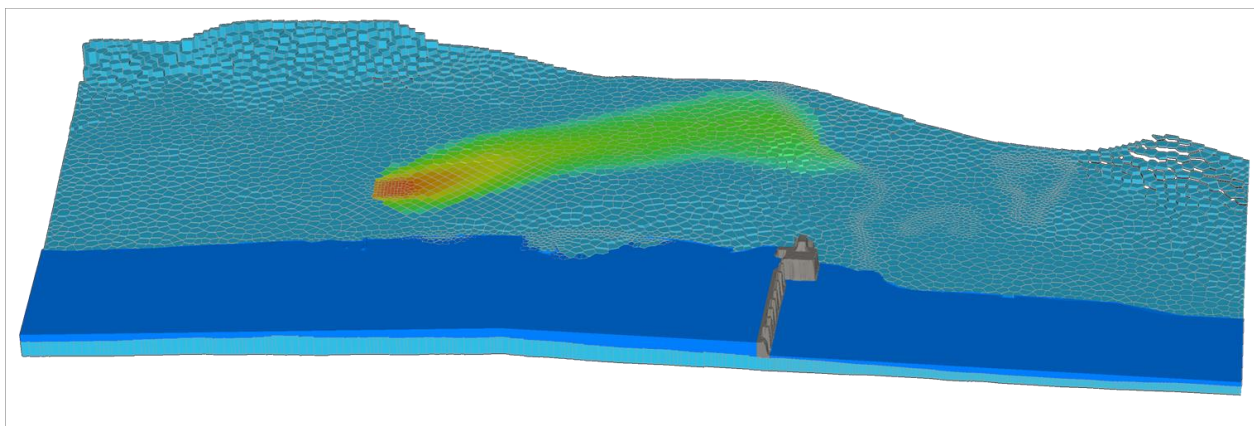


Visual MODFLOW Flex 12.0

Integrated Conceptual & Numerical Groundwater Modeling Software

Visual MODFLOW Flex brings together industry-standard codes for groundwater flow and contaminant transport, essential analysis and calibration tools, and stunning 3D visualization capabilities in a single environment. The conceptual model approach, unique to Visual MODFLOW Flex in groundwater modeling user interfaces, allows you to:

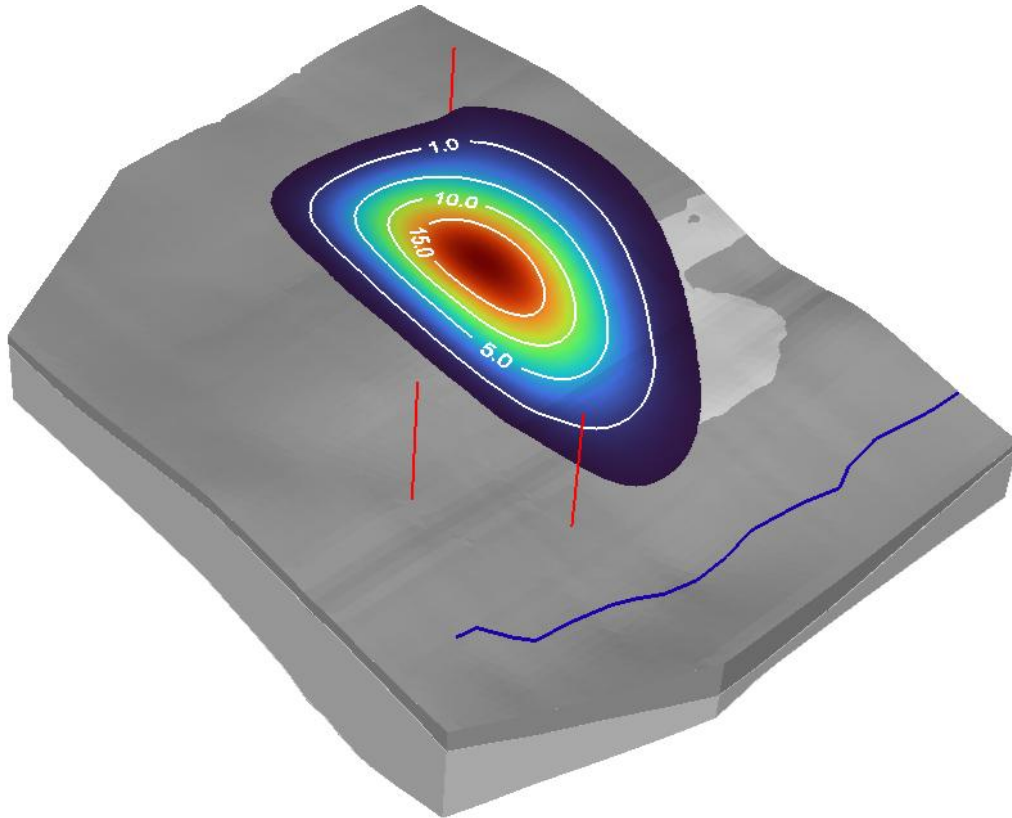


- *Build a conceptual model of the groundwater system, prior to the simulation* - Geologic formation structures, hydrogeologic properties, and boundary conditions are all designed outside the model grid or mesh; this allows the flexibility to adjust your interpretation of the groundwater system before applying a discretization method and converting to a numerical model.
- *Build the model with minimal data pre-processing required* - Working with grid-independent data allows you to maximize the use of your existing GIS data and incorporate physical geology and geographic conditions before designing a grid or mesh.
- *Generate and simulate regional and local-scaled models* – With support for unstructured Voronoi and Quadtree grids and local grid refinement (LGR), you can design localized/refined grids around areas of interest, directly within the conceptual model environment. With the ability to easily extract subgrids, calculated heads from a regional model can also be used as boundary conditions for local-scaled models.
- *Design the correct models faster* - The grid-independent raw data is left intact and is not defined by grid cells or mesh elements when modifying the data and project objective. This allows you to generate multiple numerical models from the same conceptual model.
- *Make changes to the model data and immediately see results* - The conceptual model environment provides simultaneous 2D and 3D views which are updated whenever changes to the data are made.

Visual MODFLOW Flex Improvements

Version 12.0 of Visual MODFLOW Flex contains the following improvements:

MT3D-USGS

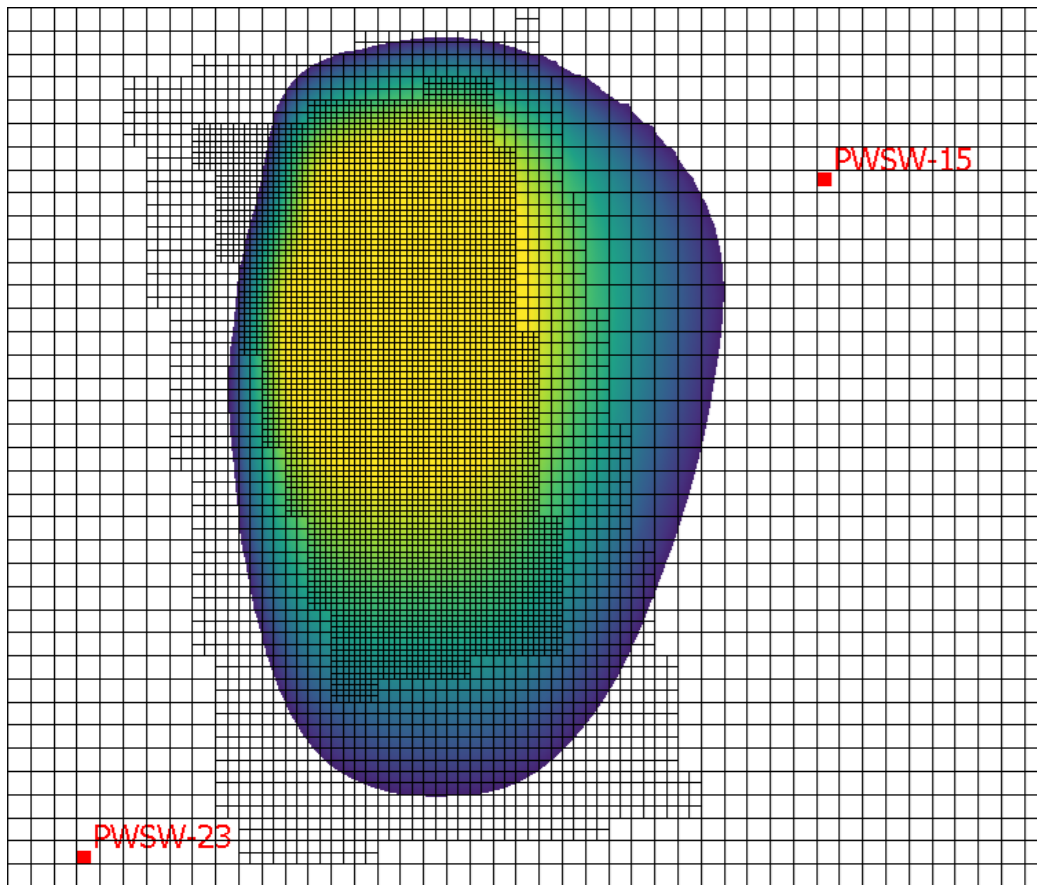


The MT3D-USGS solute transport engine is an upgrade of MT3DMS, expanding its capabilities while retaining its familiar input format.

- **Parent/daughter reactions:** Simulate arbitrary reactions where decaying parent species produce other species
- **Redox reactions:** Full support of MT3D's redox (electron donor/electron acceptor) reaction models, allowing for the simulation of instantaneous reactions involving two species or kinetic reactions involving an arbitrary number of electron donors and electron acceptors
- **MODFLOW-6 integration:** MT3D can be run with MODFLOW-6 flow simulations on structured grids, allowing users to combine MT3DMS-like transport modeling with MODFLOW-6's robust flow engine
- **Extended dual-domain simulations:** Expanded retardation model allowing for the simulation of dual-domain mass transfer with different linear sorption parameters in the mobile and immobile domain



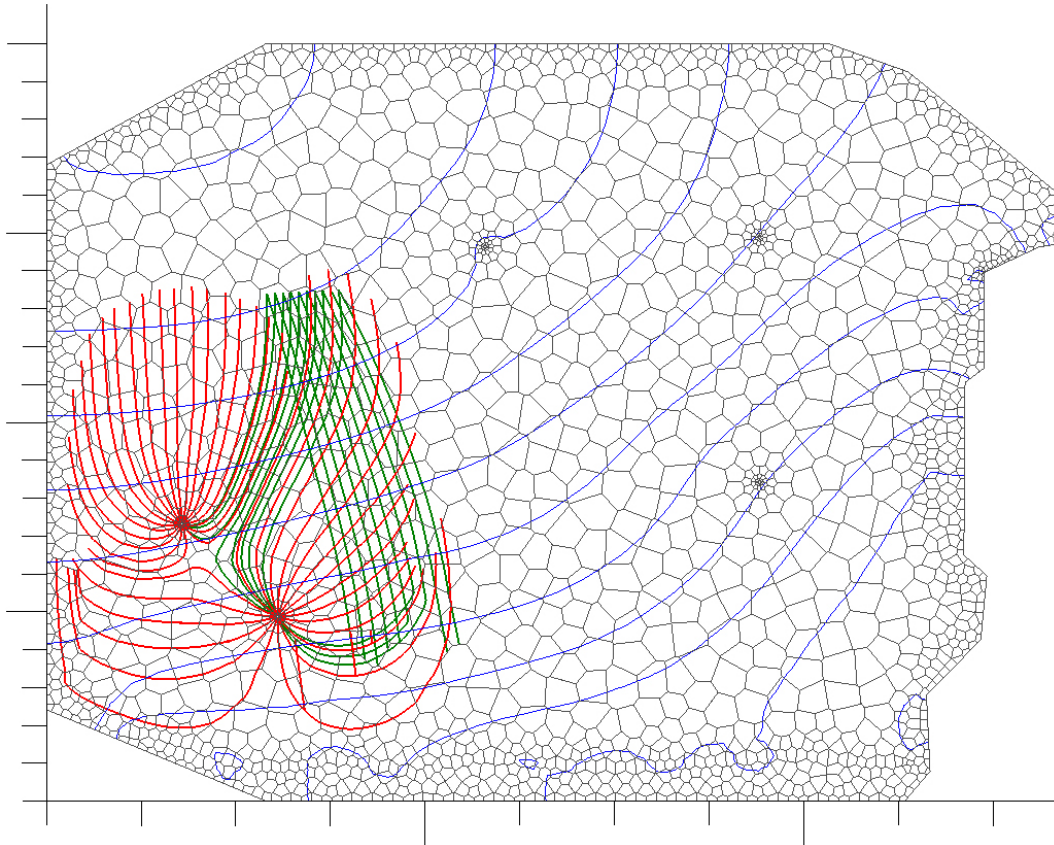
MODFLOW-USG Transport



The MODFLOW-USG Transport engine is now supported, giving users access to its unique capabilities:

- **Transport modeling with MODFLOW-USG:** For the first time in Flex, users can perform transport modeling using the MODFLOW-USG flow engine
- **Time-variant material properties:** Change hydraulic conductivity and storage parameters with time, with cell-by-cell precision
- **Chain decay reactions:** Specify arbitrary parent/daughter reactions, allowing for the simulation of scenarios such as the degradation of chlorinated solvents

Engine updates and upgrades



MODFLOW-6 Particle Tracking Model (PRT)

Visual MODFLOW Flex now supports the PRT particle tracking model for MODFLOW-6:

- **Full capabilities:** The familiar Flex workflows can be used to create MODFLOW-6 forwards and backwards particle tracking models that are as capable as the previously-supported engines
- **Any grid, out of the box:** PRT can be run on any structured or unstructured grid in Flex, without requiring third-party tools
- **The full MODFLOW-6 workflow:** With the addition of PRT, all major parts of the numerical modeling workflow – flow simulation, transport simulation, automated calibration, subregional water budget analysis, and particle tracking – can now be performed with MODFLOW-6 in Flex

MODFLOW-6 flow engine updates

The included version of MODFLOW-6 has been upgraded from version 6.4.1 to 6.7.0:



- **Improved multi-domain simulations:** For models with one or more immobile domains, users now explicitly specify the volume fraction of each immobile domain
- **Seamless upgrade:** Existing projects will be automatically upgraded to the new parameterization

MODPATH 7.2

Users now have the option of using MODPATH 7.2 as the particle tracking engine.

- **Quadtree grid particle tracking:** MODPATH 7.2 can be used as a first-party particle tracking engine for flow simulations on Q-grids run using MODFLOW-6 or MODFLOW-USG

Performance and usability enhancements

Visual MODFLOW Flex includes the following improvements for working with your models:

Performance:

Algorithm improvements have greatly decreased runtimes when

- Generating model horizons
- Saving recharge and evapotranspiration boundary conditions which have many stress periods
- Editing and saving recharge and evapotranspiration boundary conditions on structured grids with many grid cells
- Assigning properties or boundary conditions using complex polyline data objects
- Moving between workflow steps when using Q-grids with many cells

Usability:

- Species initial concentrations can now be defined using .UCN output files in the Translate workflow step for MT3D, MT3DMS, and RT3D simulations, similar to the existing implementation for MODFLOW-6
- When the transport model is changed, irrelevant parameters are now removed from the Model Explorer
- Added a keyboard shortcut to navigate between workflow steps (Ctrl + Page Up/Page Down)

For a full version history, see the Visual MODFLOW Flex readme file at:
<https://www.waterloohydrogeologic.com/visual-modflow-flex-readme/>

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