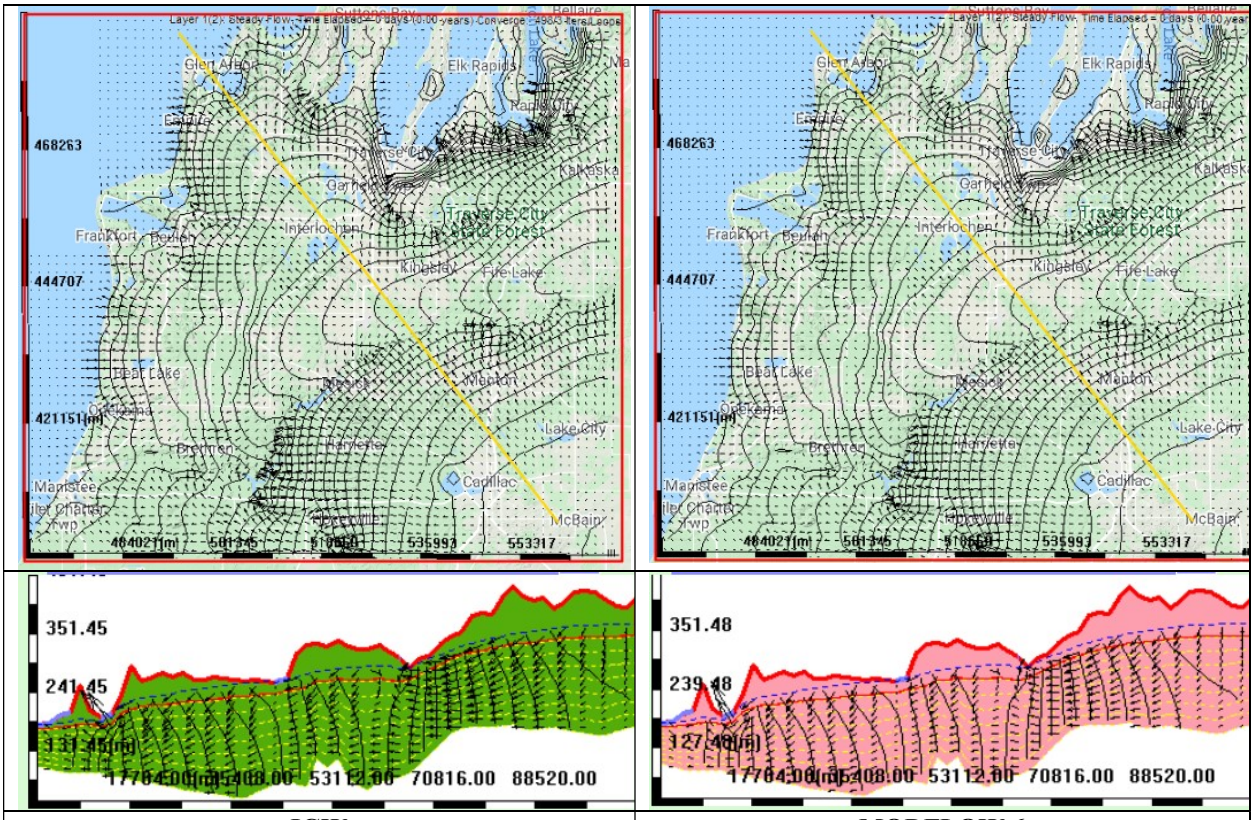
REALTIME INTEACTIVE MODFLOW ON MAGNET!

The real time interactive MAGNET platform now includes MODFLOW - the USGS groundwater flow modeling program widely used by the international groundwater modeling community.

MAGNET MODFLOW is cloud powered, data-enabled, accessible on demand anywhere and anytime via an Internet browser - free of charge.



IGW	MODFLOW 6

3D modeling of groundwater flow in the greater grand traverse bay area, Michigan, USA
Systematic comparisons between the original MAGNET IGW (interactive Ground Water) and MAGNET-MODFLOW shows the two modeling engines produce identical results when identical assumptions/options are used.

UNIQUE CAPABILITIES

Realtime Interactive Modeling. MAGNET MODFLOW - live-linked to a preprocessed, constantly expanding global water database, enables, for the first time, users to navigate to anywhere in the world to almost instantly create a groundwater model and visualization that can be further customized, refined, or expanded based on the user's local data, expertise, and experience. MAGNET MODFLOW users can further perform – based on the simulated velocity field – water budget analysis, particle tracking, solute transport modeling, and stochastic Monte Carlo simulation. (The current version of MAGNET uses the Interactive Ground Water, or IGW, source code for transport modeling. We are in the process of making MT3D available on MAGNET.)

Realtime Model Calibration. MAGNET MODFLOW users can instantly compare simulated hydraulic head on a regional scale with observed static water levels contained in the global water well database (currently, data is only available in the United States for about half of the country).

Realtime Synthetic Modeling. MAGNET-MODFLOW users can also easily build a synthetic model, treating the platform as a virtual "interactive testing ground" or "numerical sandbox". They can specify, on the fly, boundary conditions, heterogeneities, and stresses and immediately simulate and visualize results in animation. This synthetic modeling capability is ideal for learning basic concepts, testing hypothesis, and developing scientific intuition.

Realtime Visualization and Analysis. For time-dependent simulation (unsteady flow simulation, particle tracking, or solute transport modeling), MAGNET MODFLOW is dynamically coupled with water budget analysis, particle tracking, and solute transport modeling, so that the user can visualize the integrated modeling results - as simulation proceeds.

Realtime Conceptual Modeling. At any time, MAGNET MODFLOW users can pause to edit and interact with virtually any aspects of the modeling process, and then resume the simulation. They can change model assumptions, conceptual framework, resolution, representation, or stresses and immediately see their implications, with multiple layers of information intelligently integrated, organized, overlaid, visualized, analyzed, and compared at the instant it is required, providing a real sense of continuous exploration.

Realtime Transport Modeling. MAGNET MODFLOW users can introduce interactively particles as "tracers" in a variety of styles - at a point, in a zone, around a well(s), or along a line – or contaminants in different modes – as specified concentrations, fluxes, or head dependent fluxes, from various surface or subsurface sources, including polluted streams, lakes, injection wells, or leaky landfills/dump sites – and instantly track and visualize particles and plume migration, taking into account diffusion, dispersion, sorption, and reactions.

Realtime Hierarchical Modeling. MAGNET MODFLOW users can insert instantly a model(s) in a model, creating on the fly a nested simulation system or hierarchy of (connected, uniformly gridded) models (with increasing resolutions) and enabling the understanding of large, complex systems efficiently across-scales or obtaining critical details in the areas of special interest.

Realtime Scientific Discovery. Real-time interactive modeling and visualization puts human "in the loop". MAGNET MODFLOW users are empowered to steer calculations, interact online with their data, and drive in real-time the scientific discovery / problem solving process. Being able to visualize flow, transport, and transformation as they evolve over time and the complex interrelationships among hydrological and environmental variables sparks pivotal insights, giving rise to an intuitive grasp of the hydrogeological and chemical processes that cannot be readily obtained otherwise.

MODFLOW-IGW COMPARISON

Systematic comparisons between the original MAGNET IGW (interactive Ground Water) and MAGNET-MODFLOW shows the two modeling engines produce identical results when identical assumptions are used.

HOW IT WORKS

To use MAGNET MODFLOW, the user first builds a conceptual groundwater model, including all of the needed data, boundary conditions and fluxes. Then, they simply choose to simulate the model with the MODFLOW solver. When the simulation is "triggered", the conceptual model is converted to a numerical model, which is passed on to MODFLOW and executed via FloPy. Finally, results are passed back to the online interface where the user will find the intuitive visualization tools available (like for any MAGNET groundwater model).

MODFLOW VERSIONS

By default, the MODFLOW engine uses MODFLOW-6 with effective default parameters sufficient for most models. For optimal performance the user can explore different MODFLOW versions, flow formulations, solvers, and additional parameters, though in most cases this is unnecessary. Support is provided for MODFLOW-6, MODFLOW-2005, MODFLOW-USG, and MODFLOW-NWT.

While the current form of MODFLOW through MAGNET is restricted to uniform structured grids, the on-the-fly nested modeling capability allows grid refinement in areas of interest. Boundary conditions or sources and sinks are modeled with the common packages (CHD, DRN, EVT, GHB, RCH, RIV, WEL), with future support for additional packages (SFR, LAK).

WHAT'S NEXT?

In addition to the capabilities described here, ultimately the rest of the MODFLOW family (SEAWAT, MODPATH, MT3D, etc.) will be integrated into the MAGNET platform. We will also offer users the option to run and visualize existing MODFLOW models, and to upload Python Scripts and use FloPy to create / visualize groundwater models.