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Tuesday, March 30
10:30 AM – 12:00 Noon
SESSION 15: Arc Hydro Groundwater

The Arc Hydro Groundwater Data Model and Tools - Norm Jones, Brigham Young University, Provo, UT (co-author: Gil Strassberg)

Arc Hydro Groundwater (AHGW) is a data model is an ArcGIS-based data model for managing groundwater data. It is an extension to the Arc Hydro surface water data model and is designed to support various types of groundwater data in ArcGIS, including well/borehole data, 3D representations of hydrostratigraphy, and data from simulation models. We have developed a suite of tools in partnership with ESRI to support the AHGW data model. The tools are divided into three categories: Groundwater Analyst: Groundwater Analyst provides a suite of tools to import and map basic groundwater datasets such as wells and time series of water levels and water quality data into the geodatabase. Tools in the Groundwater Analyst suite create common products such as water level, water quality, and flow direction maps. MODFLOW Analyst: MODFLOW Analyst contains tools that allow the user to create, edit, archive, and visualize MODFLOW models within ArcGIS. The tools in MODFLOW analyst provide an option to import an existing model into a geodatabase and geo-reference the model so one can visualize and analyze the results in context with other GIS data, as well as create new models or edit existing models using GIS datasets. The MODFLOW Analyst tools are built as geoprocessing tools and therefore can be scripted to build high-level custom workflows. Subsurface Analyst: Subsurface Analyst provides a suite of tools to create, edit, and visualize 3D hydrogeologic models within an ArcGIS environment, starting with classification and visualization of borehole logs, creation and editing of cross sections, and the generation of 3D volumes and fence diagrams.

Automated Well Permitting Using Arc Hydro Groundwater - Alan Lemon, Aquaveo, Provo, UT (co-authors: Doug Gallup; Gil Strassberg)

Abstract: The MODFLOW Data Model (MDM) is an extension to the Simulation component of the Arc Hydro Groundwater data model. The MDM is a geodatabase design that supports the integration of MODFLOW models into the ArcGIS environment. The integration of model data into the geodatabase, which includes spatial and temporal registration of the model inputs and results, enables querying, visualization, and analysis of the MODFLOW data with standard GIS functionality. The data model consists of feature classes to support the grid geometry and tables to support all of the main packages associated with MODFLOW 2000. Other versions of MODFLOW will be added in the future. Advanced tools are built on top of the data model classes to enable reading in complete MODFLOW models, enabling users to populate new MODFLOW packages from GIS features and create visualizations of the model data. The MODFLOW Analyst is a set of ArcGIS geoprocessing tools associated with the MDM. The tools in MODFLOW analyst provide an option to import an existing model into a geodatabase and geo-reference the model so one can visualize and analyze the results in context with other GIS data, as well as create new models or edit existing models using GIS datasets. Because the MODFLOW Analyst tools are built as geoprocessing tools, they can be scripted to build high-level custom workflows. In this paper, we present an application of the MODFLOW Analyst tools for automated well permitting. We have developed an automated system for determining the impact of candidate wells associated with a well permit application using a regional MODFLOW model. The system was developed for use with the well permitted program operated by the Virginia Department of Environmental Quality. Several criteria are analyzed, including area of impact and drawdown below a critical surface. The outputs from the system are map layers than can be immediately imported for use in a permit application report.

Arc Hydro Groundwater Tools and GMS - Michelle Smilowitz, Aquaveo, Provo, UT (co-authors: Norm Jones, Derrick Whitehead)

The Western Placer County Groundwater Management Plan Model (WPCGMP Model) encompasses an area of approximately 1,360 square miles (871,000 acres), overlying the North American and South American subbasins of the Sacramento Valley Groundwater Basin, and the Cosumnes subbasin of the San Joaquin Groundwater Basin. The WPCGMP Model was developed on behalf of the City of Roseville to provide an analytical tool to support Aquifer Storage and Recovery Operations and WPGMP modeling efforts that are being conducted to maintain the quality and ensure the long-term availability of groundwater to meet backup, emergency, and peak demands. The WPCGMP model utilizes GMS and Arc Hydro Groundwater as pre- and post-processing tools. GMS was used for the initial creation and calibration of the model, and the Arc Hydro Data Model and Arc Hydro Groundwater tools were used to process, store, and manage model inputs and outputs for the WPCGMP model. The data model provided a component to generate native MODFLOW input files from automated custom workflows. Custom workflows were developed using the ArcGIS Model Builder Application, which were directly linked to the Arc Hydro Data Model for automated recharge and water demand calculations. The data model was used to store the native input files, including PRISM precipitation data, GSSHA modeling output tables, and land use survey data. The Arc Hydro Groundwater Tools were used to convert GIS data into native MODFLOW format for direct input to GMS for large, complex, transient datasets. The Make Time Series Statistics tools within the AHGW toolkit were used to generate monthly averages of groundwater levels for calibration input files. The Arc Hydro Groundwater tools were used to generate cross sections and fence diagrams for "on-the-fly" presentation to clients and water purveyors during discussions and meetings. The tools were also used to compare published regional cross sections with model-generated stratigraphy. The Arc Hydro Groundwater tools, in combination with GMS, provide the long-awaited bridge for integrating geospatial processing tools with groundwater modeling needs with an ArcGIS framework.

Hydrogeologic Site Characterization via Cross Section Editing - Timothy Whiteaker, The University of Texas at Austin, Austin, TX (co-authors: Norm Jones, Douglas Gallup, Gil Strassberg)

The Arc Hydro Groundwater data model design includes a multi-patch feature class called "GeoSection" for representing 3D cross sections of hydrogeologic units in ArcScene. These features can be constructed by projecting a 2D line through a set of 3D rasters representing the tops and bottoms of hydrogeologic units and automatically extracting a set of multipatch features that have the appearance of 3D polygons in each panel or unit of the cross section. In many cases, however, it is advantageous to manually construct a cross section by sketching the hydrogeologic units based on analysis of borehole logs and other data. To support this approach, the Arc Hydro Groundwater data model introduces a new set of feature classes for 2D cross section editing in ArcMap. The strategy used with these features involves transforming the z-coordinate of the vertical cross section panels to the y-coordinate of an ArcMap data frame while the x-coordinate represents the distance along the cross section line. This coordinate transformation requires that each cross section is located in a separate data frame. A vertical exaggeration can be placed on the z-coordinate, and a coordinate grid can be associated with the data frame that takes the vertical exaggeration into account. The feature classes are built and modified using geoprocessing (GP) tools. Custom GP tools have also been developed to transform various features onto the local coordinate system of each cross section to aid in the interpretation of the site hydrogeology. This includes borehole logs for adjacent wells, lines from rasters, and lines representing the intersection with surficial geology maps. The polygons in the 2D cross sections are constructed using the standard ArcMap editing tools. Completed 2D cross sections can be transformed to 3D multipatches and vice versa. We will illustrate the feature classes and tools using data from a recent case study in the Sacramento California region.