The Use of Public Datasets in Distributed Parameter Groundwater Flow Models in the Twin Cities

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The Highlights

• Overview of modeling process
• How is data used in groundwater models
• What type of data do we commonly use
• What data do we wish we had
Ok – So what’s a “Distributed Parameter” Groundwater Flow Model?

- Hydrogeologic Parameters *can* vary considerably in three dimensions (and sometimes in four dimensions)
- Numerical approximation is finite difference or finite element
- e.g. MODFLOW
The Pieces of a Groundwater Flow Model Puzzle

• The steps involved in groundwater modeling

• The data used groundwater modeling
1. A problem arises that is best solved with a groundwater model.
2. A conceptual hydrogeologic model is developed
3. The data compilation process begins

• Boundary conditions
• Parameterization
• Initial conditions
• Sources and sinks
Twin Cities Data Sources

- Gridded data of geologic unit base elevations (MGS)
- CWI (MGS)
- SWUDS appropriations (DNR)
- WELMAN database (Dakota County)
- Metro Model calibration data sets (MPCA)
- Metro Model aquifer parameters (MPCA)
4. The model is built

- Modeling is performed in specialized graphical user interfaces (GUIs)
- Model properties are assigned to grid cells
Intrinsic aquifer parameters are typically “zoned”

Examples:
1. Hydraulic conductivity
2. Porosity
3. Storage parameters
4. Infiltration (recharge)
5. Solute transport parameters
Aquifer geometries are distributed, interpolated, grid values

Examples:
1. Aquifer base elevations
2. Top elevation
3. Initial heads
Sources, sinks and calibration targets are typically line or point data.

Examples:
1. Streams/rivers
2. Production wells
3. Head targets
5. The model is calibrated

• Either done by hand, i.e. trial-and-error

• Or done by an inverse model, for example PEST or UCODE
6. The model is used to make predictions

Figure 1: Sample Locations

Proposed Sample Locations

* Numbers correspond to "Map ID" in Table 1
How do we get the data into the model?

- Most GUIs import and export ESRI shapefiles, XYZ text files, and DXF files.
- Grid data is typically entered as XYZ data or point shapefile data (and interpolated within the GUI).
A large part of what we do in model construction is manipulate files in ArcView/ArcGIS.
How do we manage all of this data

• GIS Served Data – Pristine

• Project Data – Manipulated

• Model data – Further manipulated
That’s the data we have, but what do we want (or don’t know about)?

- Time of travel information
- Regional hydraulic conductivity values
- Base flow information and stage duration curves
- Maps of known contamination plumes (and the geological unit they are in)
That’s the data we have, but what do we want (or don’t know about)?

- Sub-unit grid elevations (e.g. Oneota, Franconia, basal St. Peter)
- Elevations (and extent) of continuous permeable zones in PDC
- Elevations (and extent) of more permeable zones in FIG
Data for Transient Models

- Time variant targets
- Select databases of monthly pumping
- Stage-duration curves