

# Application of observation head browser for spatial-temporal display of the groundwater tables in GIS environment: the Zagreb aquifer system, Croatia

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**Abstract:** Observation Head Browser is an auxiliary tool for development of the groundwater table maps that constitute the basis for a spatial-temporal analysis of the groundwater tables. The Observation Head Browser is used for browsing of systematically organized groundwater table data on a specific date, and for processing of data used to compile the groundwater table maps.

**Key words:** groundwater table maps, GIS

## INTRODUCTION

Spatial presentation of observation wells, and direct access to the systematically organized groundwater table data were all organized within the ArcView GIS project as a background for a spatial-temporal analysis of the groundwater tables. The first stage of the spatial-temporal analysis is expected to resolve the issues related to the groundwater table hydrogeological maps, and the flow direction vectors. Since plotting of an equipotential demands availability of the groundwater table data measured at observation wells on a specific date, a need arose for an automatic data browsing because manual browsing of large quantity of data to be processed would be time-consuming and prone to errors. Thus, the Observation Head Browser was created for automatic browsing of Excel files containing the data on groundwater tables measured at the observation wells. The Observation Head Browser results are stored in a number of files, each having a specific use. The observation wells at which the groundwater tables were measured are spatially displayed in ArcView GIS project, and groundwater tables are subsequently interpolated. The resulting equipotentials and the groundwater flow direction vectors on different dates are used as the basis for the spatial-temporal analysis of the groundwater tables.

## RESULTS AND DISCUSSION

### *Observation Head Browser*

The Observation Head Browser is a program developed mainly for browsing of the groundwater table data. The program browses results of the groundwater tables measured at observation wells on a specified date, and stored in previously systematically organized Excel files. The program report is created in three files, each having a specific use.

The Observation Head Browser had initially been conceived as an independent application but for practical purposes it has later been integrated into an ArcView GIS Project that offers a possibility of a well designed spatial display of all the observation wells set up in the Zagreb aquifer system area. The program is user-friendly and simple. The user enters a date for which he/she wants to get the groundwater table data in a "Textbox" (Figure 1). After clicking "Search", the program starts to search groundwater table data systematically organized in Excel files.



**Figure 1.** Main form of the Observation Head Browser program

Depending on the computer configuration, the browsing operation lasts for up to 10 minutes. When the browsing operation is finished, the program stores the results in one Excel and two ASCII files.

The data stored in an Excel file comprise a list of observation wells with data on measured groundwater tables on the specified date, observation well coordinates, ground elevation, zero elevation and filter elevation. Further, the observation wells on which no groundwater measurements have been carried out on the specified date are also listed. This file is created in the report format.

The data stored in the first ASCII file also include a list of observation wells with data on measured groundwater tables on the specified date, observation well coordinates, ground elevation, zero elevation and filter elevation. These data are added to the ArcView project as a table and displayed as a point theme in an ArcView's View. This ASCII file contains only those observation wells at which measurements were carried out on the specified date, unlike the Excel file that contains a report on unmeasured observation wells as well. In this way, the ArcView renders a spatial overview of only those observation wells at which the measurements were conducted on the specified date, along with the measurement results. The data stored in another ASCII file include only those on X and Y coordinates of the observation well and measured groundwater levels on the specified date. This file is intended for program interpolation, so its structure was adequately defined.

#### *Interpolation of data obtained with the Observation Head Browser*

Once the groundwater table data browsing is finished and the data are stored into the files, their interpolation starts. The interpolation may be performed by using the program or manually. The programmed interpolation is practical because it is fast, but the results i.e. equipotentials are less precise. The manual interpolation, on the other hand, is more time-consuming, but the resulting equipotentials in most cases give a more realistic picture since additional information, such as river, brook or lake levels can be taken into consideration during interpolation. Further, it is possible to approximate the groundwater tables for an area where it was not measured on the specified date by using the values measured a couple of days earlier/later, because the measurements are not conducted simultaneously on all the observation wells. This is additional information the programmed interpolation does not take into consideration. Future versions of Observation Head Browser will include browsing of observation head data measured few days before or after specified date if measurements were not conducted on specified date, as well as browsing of additional data mentioned above. This will make program interpolation more precise.

#### *Results display*

When the program interpolation is used, the resulting equipotentials are exported from the interpolation program as CAD theme and displayed as such in ArcView GIS project. For manual interpolation, the equipotentials are digitized and geocoded and then added into the ArcView GIS project. The resulting equipotentials are then used for vectorization of the groundwater flow directions. Special programs are used for creation of the groundwater flow direction vectors. The display of equipotentials and groundwater flow directions renders a general picture of the groundwater tables (Figure 2).

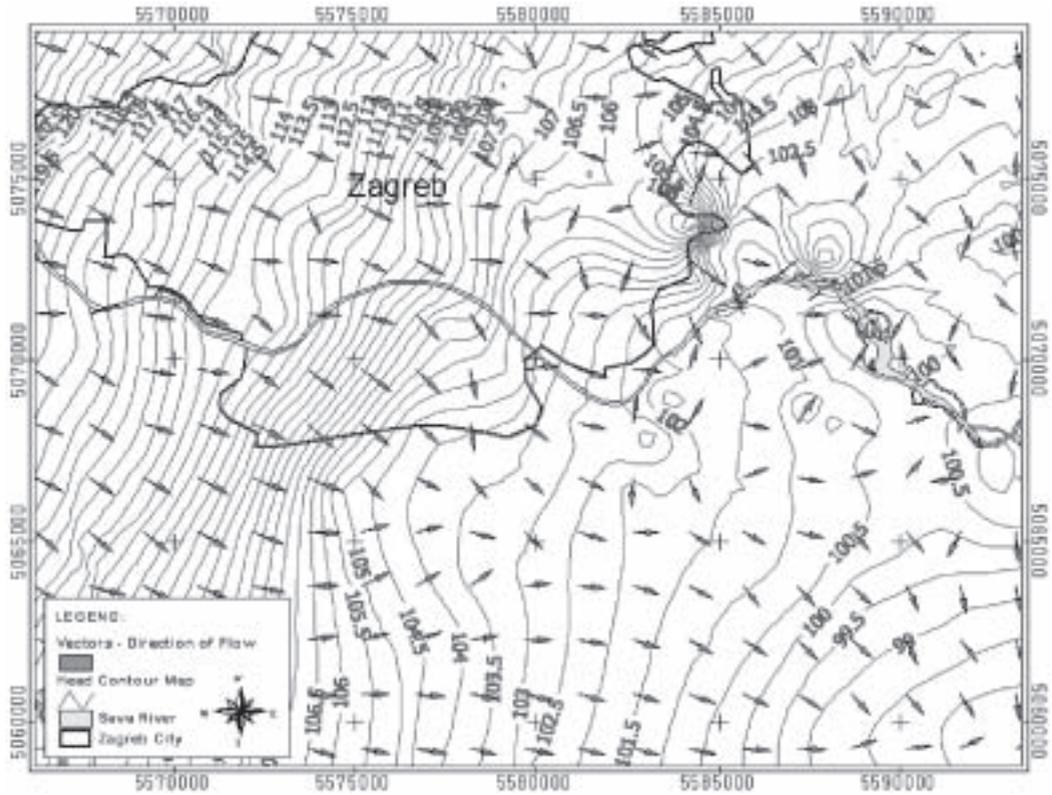


Figure 2. Display of equipotentials and groundwater flow direction vectors

## CONCLUSIONS

The spatial display of equipotentials and groundwater flow directions for different time periods or display of time series within the ArcView GIS project creates the basis for the spatial-temporal analysis of the groundwater tables. The principal advantage is the speed with which the equipotentials and groundwater flow direction vectors are accessed and a possibility of overlaying the views for different time periods within the ArcView GIS project. This method of groundwater table data processing and display enables the spatial-temporal analysis of the groundwater tables, which has an important role in resolving of the engineering geology problems.

## REFERENCES

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