Is This Yet Another Virtual Globe?

ArcGIS Explorer Review

One year after the release of Google Earth ESRI announced an alternative virtual globe. The current version of ArcGIS Explorer will be evaluated here. A distinctive focus is given to different aspects such as data integrity, OGC conformity, GIS analysis capabilities, user interface and the underlying business model will have a distinctive focus. Only ArcGIS Explorer is reviewed, but compares capabilities/shortcomings to alternative virtual globes if necessary.

By Stefan Kienberger and Dirk Tiede

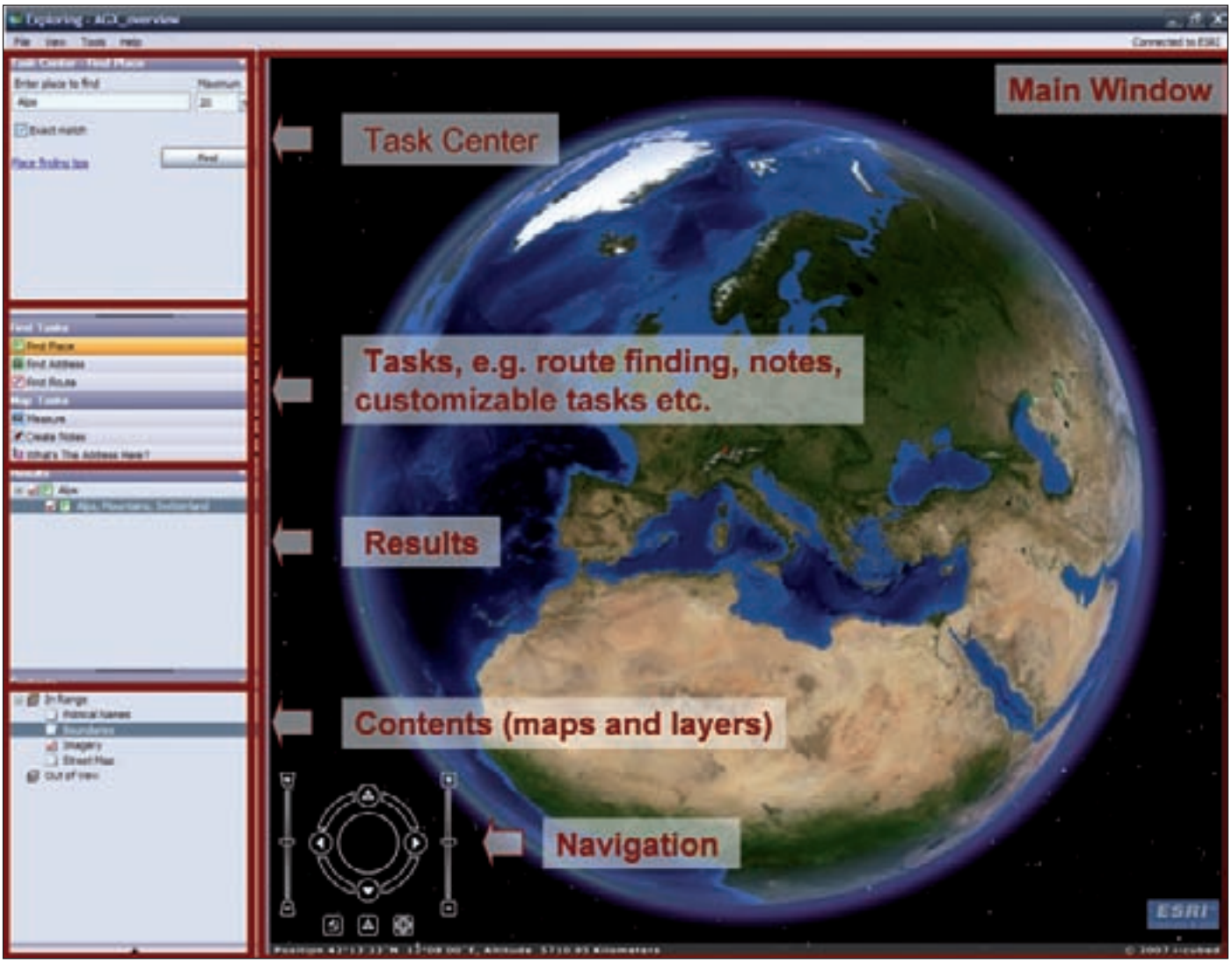

Figure 1: Graphical User Interface (GUI) of ArcGIS Explorer

Virtual Globe Concept and User Interface

ArcGIS Explorer from ESRI is a virtual globe software, which is part of the ArcGIS software suite, but can also be downloaded for free (www.esri.com/software/arcgis/explorer/index.html). The first version (Build 350) was published at the beginning of 2007. After several improvements and bug-fixes the actual version is Build 440, published on December 19, 2007. ArcGIS Explorer can be used as standalone software on a Windows OS, but it unfolds its full potential if used as a lightweight client to the (non-free) ArcGIS Server.

At first glance ArcGIS Explorer has a similar look and feel to other virtual globes. A main window shows the globe, and on the left side different horizontal bars and panels are available that form its control center or console (see Figure 1). Different options can be set to "start-up" the globe (open the last saved map, open ESRI's default map, open a map which is saved locally). Appealing are

different effects such as the atmospheric halo and the simulation of stars in the background. Additional options can be set, for instance the enabling of sun lighting and the integration of current cloud cover by connecting to specific web services. The vertical exaggeration can be adjusted accordingly and additional atmospheric effects, such as fog density, can be simulated.

At the bottom left of the display a transparent status area provides information about the current position next to specifications regarding the altitude of the observation point. On the right side of the status area, copyright statements for each visible layer are provided as well.

Navigation within ArcGIS Explorer is intuitive, using different mouse button and scrolling combinations to tilt and rotate the globe. Navigation devices from 3D Connexion (www.3dconnexion.com) are supported. The navigator, located in the lower left corner, provides various ways to move around the map and control the viewing position. It indicates the orientation of the map and the degree to which it has been tilted ("tilt disc"). The navigator has two modes. It first appears on the display in its Indicator mode which shows the orientation of the map and the degree to which the map has been tilted. Moving over the navigator with the mouse accesses more control panels such as zooming and tilting controls and various reset buttons (tilt to initial setting, set north at the top of the map, display the full extent of the map).

The console with its different application windows is located along the left side of the ArcGIS Explorer window. Main applications are the task center, the choice of different tasks itself, results and the content window.

The task windows and the results are a specific feature of ArcGIS Explorer. The availability of the tasks depends on the selected base map and can be adjusted in the tools menu. Examples of such tasks are the options to find places, names or addresses, to measure features, create notes or get driving directions. A noteworthy feature of ArcGIS Explorer is the ability to integrate specifically designed tasks or geo-processing services in connection with an ArcGIS Server (see chapters below).

Each task has its corresponding task center window which opens automatically and carries out actions on the map. Results of the various tasks are shown in the respective window. Next to the result's name, a check box is provided which will hide or show the result on the display when toggled.

The content window provides an overview of the different data layers. Interesting to note is that a categorization in out-of-view-data and in-range-data is provided. Data layers can be turned off and on and manipulated accordingly. Additionally, by right clicking, functionalities of transparency, a swipe tool and a legend are given. Opened data sets such as shapefiles can be visualized with different outline and filling colors, but classification and visualization based on different attribute values are currently not available.

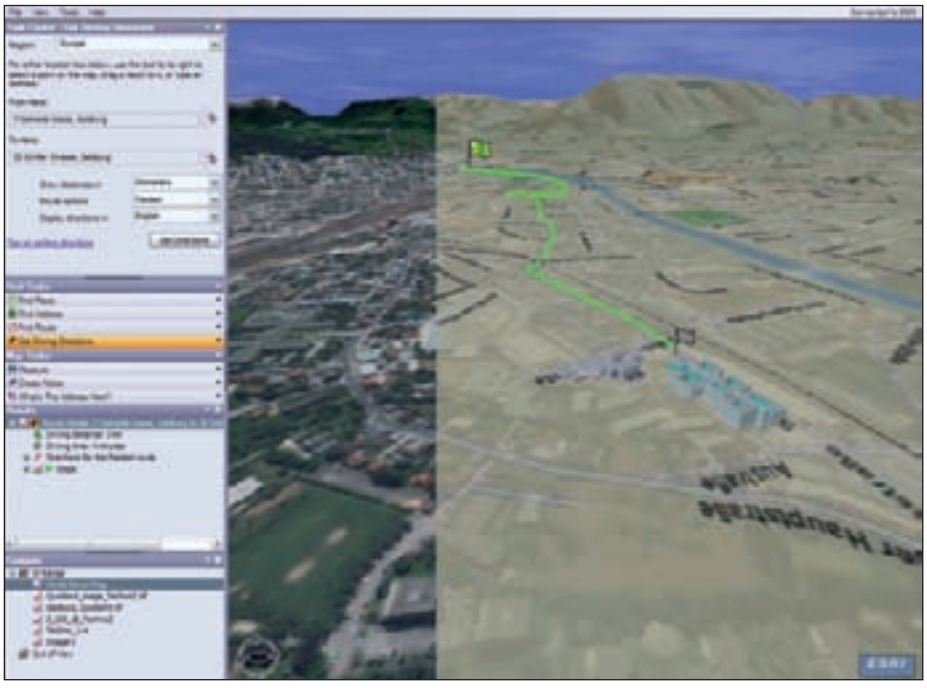

Figure 2: Data integration in ArcGIS Explorer (here: satellite imagery, street maps, 3D kmz files and DEM data) and the use of tasks (here: route finding). Note: The swipe tool and transparency can be useful to compare superimposed layers

These windows can be arranged according to user needs and can be turned off and on individually.

With the task "Creating Notes" the user is able to draw point, line and polygon features. Symbols for point features can be chosen from an extended symbol library but individually designed symbols can also be imported (.png, .jpg and .bmp format). A pop-up window allows the feature to be described which can be adapted through the application of HTML code according to user needs. Thus hyperlinks can be integrated which open in a new browser window.

An additional function is the easy integration of display overlays (such as logos) in the main globe window.

Data Integration

ArcGIS Explorer supports various file formats and web server connections. Proprietary ESRI file formats like the new file-geodatabase or shapefiles are also supported (personal geodatabase format is unsupported) as are a lot of different non-ESRI formats such as Erdas Imagine image (.img), JPEG (.jpg), Tagged Image File Format (.tif), ARC/INFO and Space Imaging BIL (.bil), MrSID (.sid), USGS ASCII DEM (.dem), PCI Geomatics Database File (.pix) and many more (see Figure 2). Data integration is supported through a wizard which, for example, helps to define the scale range and symbologies for vector layers. If an elevation data set is loaded, the user is automatically asked how the data should be integrated (as elevation source or as draped layer). By choosing the elevation source option, the layer is seamlessly integrated into the globe surface, which makes it easy to refine the basic elevation data (streamed by ESRI over the web) with more detailed data from other sources where needed,

Surprisingly, Keyhole Markup Language (KML/KMZ) files which are mainly used in Google Earth and Google Maps are also supported by default. At the moment the supported KML versions are 2.0 and 2.1, but tests in ArcGIS Explorer showed that not all KML

elements are really supported (e.g. no time stamp support), and complex KML files are only visualized in a downscaled version. It will be interesting to keep an eye on KML file support in the future, especially as KML has candidate status for becoming a new Open Geospatial Consortium (OGC) standard for earth browsers (www.opengeospatial.org/standards/requests/45).

Textual data (.txt., .csv) with associated coordinates (e.g. addresses, GPS tracks) can be imported using a wizard, allowing a comfortable selection of the appropriate fields defining the x, y and z coordinates.

Additionally, ArcGIS Explorer has its own (.nmf) file format, which is basically an XML document

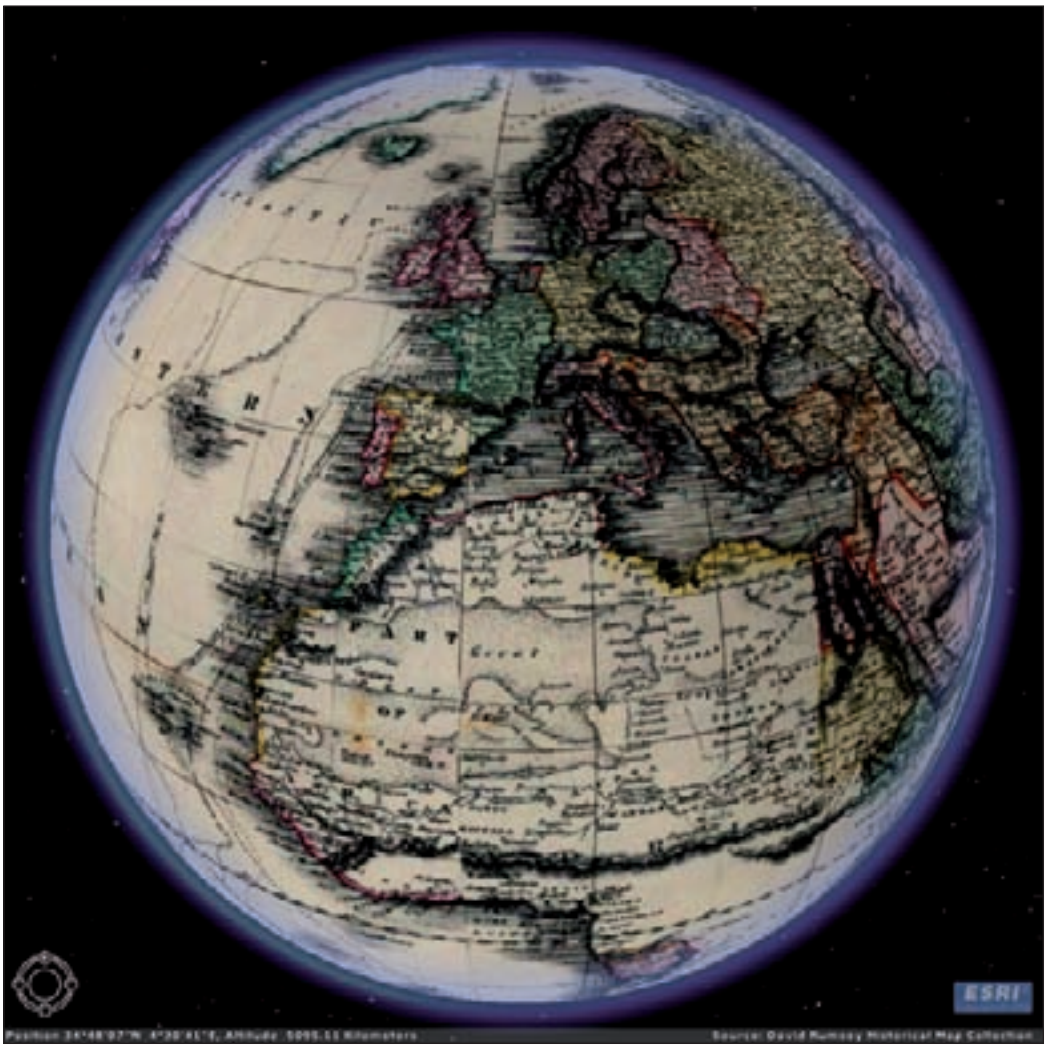

Figure 3: Example for a base map from ESRIs resource centre (here: A historical map from the David Rumsey Map Collection).

that contains information about connected layers and properties, but simple geometries can be stored as well.

Data integration in ArcGIS Explorer (here: satellite imagery, street maps, 3D KMZ files and DEM data) and the use of tasks (here: route finding). Note: The swipe tool and transparency can be useful to compare superimposed layers]

Web service integration possibilities encompass three different types: ArcIMS, WMS and ArcGIS Server connections. The ArcGIS Server connection in particular allows connecting not only to map services but also to what are called "globe services". They can be created in ArcGlobe (ESRI's 3D Analyst Extension) and published via ArcGIS Server. The idea behind these globe services is that not only map layers can be provided via the web, but entire globe coverages (see also the next chapter). Users can then, for example, select a certain "Globe Service" as their home server and receive data views tailored to their needs.
It has to be pointed out that ArcGIS Explorer, in contrast to Google Earth or NASA World Wind, supports what is called "projection on the fly". As in ArcGIS, data with known coordinate systems are automatically integrated. The routine works quite well, but the user cannot select a specific transformation method. Therefore the integration of data - which needs an adapted transformation method for "projection on the fly" – can sometimes lead to an offset due to the use of standard transformation methods only.

Integration of Base Maps and Additional Tasks
ArcGIS Explorer allows - besides the available content - the integration of additional data layers through its ArcGIS Explorer Resource Center website (http://resources.esri.com/arcgisexplorer/). By default, information on boundaries and places, transportation and imagery is provided. The imagery shows satellite and aerial data at a 15m minimum resolution worldwide, and 1m resolution for the U.S.
At the resource website, additional content can be included such as supplementary maps, layers, tasks and results. New base maps, such as imagery, streets, shaded relief and physical features can be integrated and will then replace the current map (see Figure 3). Layers provide additional information and will be displayed over the currently shown map. At the moment, layers of transportation, physical features, political names, and historical maps, to name a view, are available. During the fierce bushfires in California in 2007, ESRI provided an additional layer integrating different disaster-relevant data (such as current extent of fire, evacuation zones etc.) to the rescue community.

Besides maps and layers, customized tasks such as a spatial Wikipedia Search, Weather Finder or Business Reports can be integrated. Results are also available for download (e.g. US state high points or US National Parks with a description of the parks and links to different websites). For each of these additional contents a brief description is provided.
A general shortcoming of the hosted data sets is long loading time compared to other virtual globes such as Google Earth. A negative aspect is the rastering of vector features (KML files are not affected). However, it follows an algorithm similar to that integrated in ESRI's ArcGlobe environment (3D Analyst extension).

User Guidance and Help

As already mentioned, additional content can be downloaded from the ArcGIS Explorer Resource Center. The website also provides showcases and case studies of exciting projects of ArcGIS Explorer users. Case studies can be submitted online and - if appropriate - will be added to the website. A useful implementation is the blog which constantly provides information about updates and other useful developments. A link to the forum section within the ESRI support center allows users to discuss problems and general issues related to the software. Additionally, a link to the ArcScripts website is given, where specifically designed scripts can be downloaded for use within ArcGIS Explorer.
Help itself can be accessed online and provides an in-depth discussion of ArcGIS Explorer. Next to the textual description, excellent quality graphics are available. The help menu is structured in different sections but includes an index and search functionality (see Figure 4).

Geo-processing Services in Connection with ArcGIS Server

As mentioned above, ArcGIS Explorer can be used as a standalone virtual globe / GIS viewer, but its full potential is only avail-

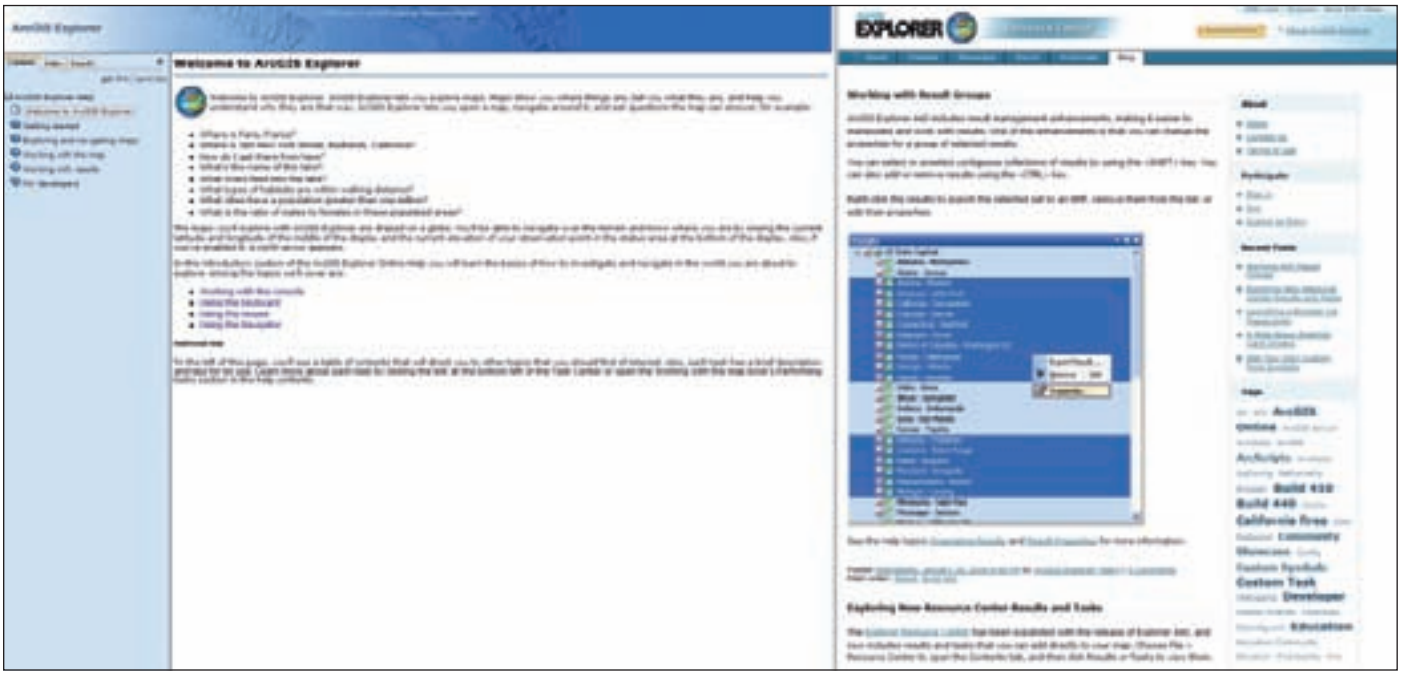

Figure 4: ArcGIS Explorer online help (left) and ArcGIS Explorer Resource Centre (right)

able if it is used as a client to the ArcGIS Server. Besides data integration and data streaming capabilities via map and globe services, the most outstanding capability of the client is the use of geo-processing services. These services are provided by the ArcGIS Server installation and can - theoretically - encompass most of ESRI's ArcGIS geo-processing functionality. ArcGIS Model Builder (a graphical tool to combine different geo-processing tools in an easy drag-and-drop mode) can be used to develop even complex models, which are simply published to ArcGIS Server and integrated into the ArcGIS Explorer software as a customized task.

Figure 5 shows an example of a calculation of contours based on a DEM (digital elevation model). The (client-) user can interact with the task and define certain parameters which are sent to the ArcGIS Server machine where the calculation is done. The user is kept informed about calculation time, calculation success and potential errors. At the end, only the resulting contour data is sent back to the client over the web.

Software Developer Kit (SDK)

ArcGIS Explorer comes with an additional Software Developer Kit (SDK) containing samples and documentation on how to connect to ArcGIS Explorer API classes. The SDK is mainly suited for programmatic customization, but it is limited to creating new (customized) tasks. Integration of ArcGIS Explorer functionality into other applications is not possible. Programming has to be done in Visual Studio Express 2005 (VB.NET or C#) and the .NET framework is required. Figure 6 shows an example of a customized task, exporting place results in ArcGIS Explorer to a Google Earth KML file. Other useful customizations would be to connect and query remote databases, retrieve data from the internet or interact with applications/services on the internet. Customized tasks are compiled as Dynamic Link Library (DLL) files and can be easily integrated using the Task Manager in ArcGIS Explorer.

Conclusion

With ArcGIS Explorer, ESRI provides a sophisticated new virtual globe. A lot of free virtual globes and similar applications in recent years have been called "Google Earth killer" (cf. Butler, 2006), but none of them is. There should be enough space for more than one application in this field. If we consider, for instance, the Microsoft Virtual Earth solution

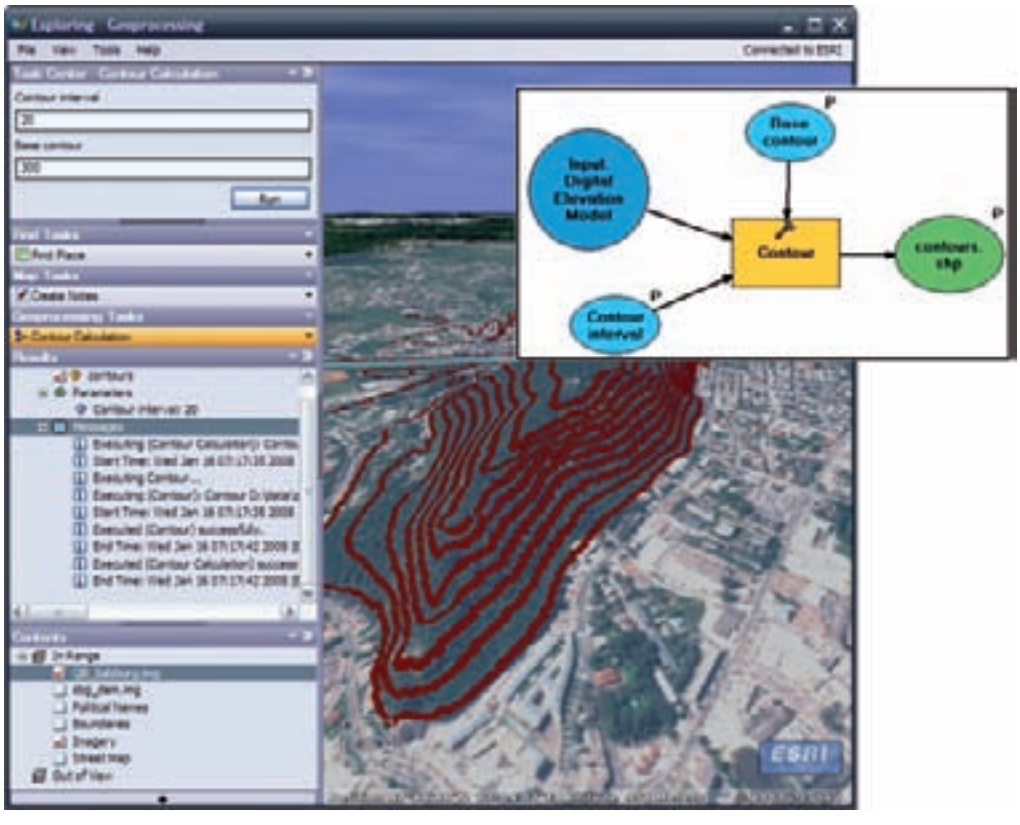

Figure 5: Geoprocessing functionality in ArcGIS Explorer using an ArcGIS Server connection. Right: Geoprocessing model for contour calculation is published as customized task. Left: Calculation progress is reported in the "Results" window; the calculation result is sent back to the ArcGIS Explorer client and integrated as new result layer (red contour lines).

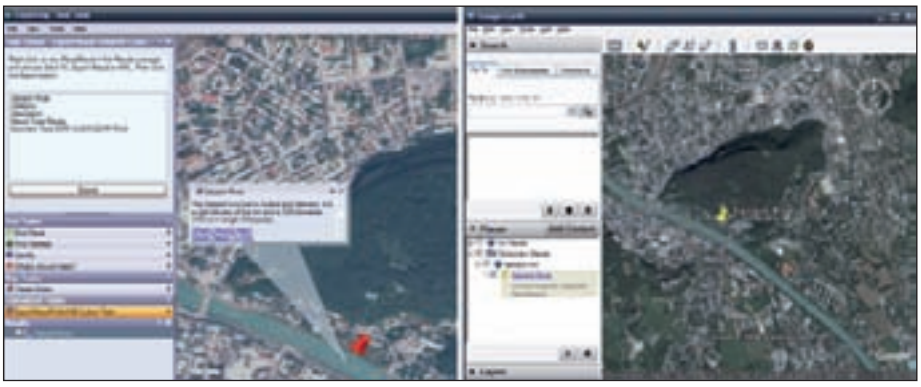

Figure 6: Customized tasks in ArcGIS Explorer. Here: Export of place results as kml file (left) and visualization in Google Earth (right).

and Google Earth, it is obvious that both would not have developed that dynamically without direct competition.

Therefore, ArcGIS Explorer is not replacing an existing solution – it is occupying a niche that is not filled adequately by other software solutions. Concerning available base data and performance, ArcGIS Explorer cannot cope with Google Earth, but it brings GIS capabilities and - in connection with ArcGIS Server - even GIS analysis capabilities to a free virtual globe client.

The specific strength of ArcGIS Explorer is the integration of geo-processing facilities and the support of various datasets. This fits the need of GIS professionals who want to communicate their models or different data within an appealing virtual globe environment to a wider audience. An obvious shortcoming is insufficient support of ESRI's proprietary vector file formats concerning visualization and classification of attribute values. Nevertheless, ArcGIS Explorer is not just another virtual globe, but enriches the globe family with – from a GIS perspective – advanced and valuable opportunities.

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