Extending GIS Concepts into True 3D for Geologic and Hydrogeologic Descriptive Modeling

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Abstract. While focus in most presentations concerning 3D modeling appropriately rests on the models themselves, their creation and subsequent utility to the researcher and to scientists applying results to real world problems can be limited if tools are developed in a piecemeal fashion for each case. Discussion of some underlying concepts can help clarify our appreciation of the process and help define general goals as this technology gains greater application for water resource analysis. Geographic Information Systems (GIS by most definitions) concepts serve very well as the starting point for consideration of more rigorous 3D modeling processes, but these GIS concepts must be extended to make GIS become an ambiguous acronym. Perhaps "GIS" could also come to represent Geologic Information Systems.

Traditional GIS has organized information on the basis of geographical location, usually on the surface of the earth. More an more, GIS systems can deal with a stack of surfaces, each with attributes and phenomena related to the X,Y coordinates of those surfaces. Points, lines, polygons, surfaces, and images (and the limits of the area under study) comprise the list of geographically located entities in a GIS. Attributes attach to these entities. 3D geology requires only one more entity, a volume. In this sense, a volume is body defined by bounding surfaces. Because such a body is fully enclosed, 'airtight', as it were, it can carry attributes and be interacted with other entities. The analogy to the use of polygons in a GIS is a good one. For our geo- and hydro- purposes volumes spatially describe stratigraphic zones, fault blocks, intrusions, hydrostratigraphic units, and volumes where a 3D property (porosity, conductivity, salinity) falls within a certain range. A full set of the GIS attributes plus some new ones apply to volumes.

The poster will discuss the creation of volumes, their uses, and their interactions, and relate them to conventional GIS operations and approaches. Vector and raster-based volume entities each have their particular utility, and, as with GIS systems, a combination should yield the greatest utility.

Geologic/hydrogeologic models constructed with topologic rigor, using elements designed to represent the underlying phenomena as naturally as possible, can substantially increase the understanding of those phenomena, and make that understanding available and useful to the scientific community and to society.