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Visualization and dissemination of 3D geological property models of the Netherlands

Jan Stafleu (1), Hans-Georg Sobisch (2), Denise Maljers (1), Jan Hummelman (1), Roula M. Dambrink (1), and Jan L. Gunnink (1)

(1) TNO - Geological Survey of the Netherlands, Utrecht, The Netherlands (jan.stafleu@tno.nl), (2) INSIGHT GmbH, Cologne, Germany (Hans-Georg.Sobisch@gmx.de)

The Geological Survey of the Netherlands (GSN) systematically produces 3D geological models of the Netherlands. To date, we build and maintain two different types of nation-wide models: (1) layer-based models in which the subsurface is represented by a series of tops and bases of geological or hydrogeological units, and (2) voxel models in which the subsurface is subdivided in a regular grid of voxels that can contain different properties.

Our models are disseminated free-of-charge through the DINO-portal (www.dinoloket.nl) in a number of ways, including in an on-line map viewer with the option to create vertical cross-sections through the models, and as a series of downloadable GIS products. A recent addition to the portal is the freely downloadable SubsurfaceViewer software (developed by INSIGHT GmbH), allowing users to download and visualize both the layer-based models and the voxel models on their desktop computers.

The SubsurfaceViewer allows visualization and analysis of geological layer-based and voxel models of different data structures and origin and includes a selection of data used to construct the respective model (maps, cross-sections, borehole data, etc.). The user is presented both a classical map view and an interactive 3D view. In addition, the SubsurfaceViewer offers a one dimensional vertical view as a synthetic borehole as well as a vertical cross-section view. The data structure is based on XML and linked ASCII-files and allows the hybrid usage of layers (tin and 2D raster) and voxels (3D raster).

A recent development in the SubsurfaceViewer is the introduction of a data structure supporting irregular voxels. We have chosen a simple data structure consisting of a plain ASCII-file containing the x,y,z -coordinates of the lower left and upper right corner of each voxel followed by a list of property values (e.g. the geological unit the voxel belongs to, the lithological composition and the hydraulic conductivity).

Irregular voxels are used to deliver voxel models that display more detail (i.e. smaller voxels) where data density is high, and less detail where data density is low. In general, data density in the Netherlands allows the construction of detailed voxel models with a resolution of 100 x 100 x 0.5 m for the upper 30 m. The incorporation of soil data (both maps and boreholes) allows an even higher resolution (25 x 25 x 0.1 m) in the upper 2 m.

An interesting spin-off of the irregular voxels is that they allow the efficient storage and analysis of layer-based models. Using irregular voxels, the layer-based hydrogeological model of the Netherlands, for instance, can be stored in a single file rather than in a large set of separate raster-files of top, base, thickness and hydraulic conductivity for each of the 128 hydrogeological layers in the model.