



3D geological property modelling at TNO - Geological Survey of the Netherlands

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The Geological Survey of the Netherlands (GSN) defines digital geological models as predictions of both geometry and properties of the subsurface. In contrast to singular observations in boreholes and the projected information of traditional maps, models provide continuous representations of the subsurface built with all geological expertise available. The GSN systematically produces 3D models of the upper 500 m 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 as 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. The models are quantitative and user-oriented, i.e. they are applicable for non-geologists in their own area of expertise. They are also stochastic in nature, which implies that model uncertainty can be quantified.

GeoTOP is the latest generation of Dutch subsurface models at TNO – Geological Survey of the Netherlands. GeoTOP schematises the shallow subsurface in millions of voxels of 100 by 100 by 0.5 m up to a depth of 30-50 m, which is the main zone of current subsurface activity. The model provides estimates of lithostratigraphy and lithology (including grain-size classes), as well as physical and chemical parameters, such as hydraulic conductivity and chemical element concentrations. Modelling is performed per province using all available digital borehole descriptions, components of the layer-based DGM model and a context of geological maps created during the last few decades (e.g. 1:50,000 map sheets and channel belt mapping). An important component of the GeoTOP model workflow is that all digital borehole descriptions are stratigraphically interpreted using automated procedures. These procedures deliver a set of uniformly and consistently interpreted boreholes that are used in the subsequent modelling stages.

GeoTOP provides a base for answering subsurface-related questions about, amongst others, groundwater management and infrastructural issues. Current applications include:

- Modelling groundwater flow, using the architecture and sediment composition of glacially deformed sediments to assign hydraulic parameters.
- Modelling solute transport, using the distribution of lithology and sand grain-size classes to assign hydraulic parameters.
- Forecasting long-term (up to 200 y) land subsidence in the western part of the country, using the distribution of soft sediments (peat and clay) to model subsidence rates.
- Constructing risk maps for surface water-groundwater interaction in a river-deepening project, based on the architecture and sediment composition of fluvial channel belts.

Our models are disseminated free-of-charge through the DINO web 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. In co-operation with INSIGHT Geologische Softwaresysteme GmbH, the freely downloadable Subsurface Viewer was recently added to the portal, allowing users to download and visualise the layer-based models as well as GeoTOP on their desktop computers.