MAKING THE DUTCH 3D GEOMODELS SUITABLE FOR THE ENERGY TRANSITION – CHALLENGES AND SUCCESSES FOR GEOTHERMAL ENERGY

Johan ten Veen, Denise Maljers, Hans Veldkamp, Andreas Kruisselbrink, Anuska Kaliar (TNO – Geological Survey of the Netherlands)

ThermoGIS is a public, web-based geographical information system that contains depth, thickness, porosity and permeability and temperature maps of many potential aquifers in the Netherlands. These property maps are used to calculate the most important outputs of ThermoGIS which are geothermal potential maps of the Netherlands that can be consulted in a map viewer. The ThermoGIS workflow consists of several steps of which the three most important ones are: (1) modelling aquifer geometry; (2) estimating aquifer properties and temperature; and (3) incorporating technical and economical parameters. This presentation focuses on the aquifer modelling.
ThermoGIS builds upon the nationwide 3D DGM-deep model that includes 13 stratigraphic levels that represent the (near) bases of the Palaeozoic, Mesozoic, and Cenozoic lithostratigraphic units. This model is based on seismic interpretation and well data and supported by biostratigraphy. It does not contain information on individual saline aquifers. To incorporate these aquifers a workflow is developed to model the depth and thickness of all aquifers that reside within the DGM-deep units by using information of nearly 4000 wells. All aquifers within a DGM-deep unit are modelled with respect to the base of that unit, making ThermoGIS and DGM-deep fully consistent. This consistency is not obvious as the number of wells used for ThermoGIS is considerably higher than that used for the calibration (well-tying) of DGM-deep.

Therefore, a reiterating process is employed in which the bases of the aquifers are derived by interpolating the difference between base of the aquifer from well data and base of the group-level grid and adding it to the latter. Subsequently, the interpolated thickness is added to obtain the top of the aquifer. Multiple aquifers are stacked between groups' base and top and intersections are corrected for. The interpolation process is assisted by polygons demarcating the aquifers' spatial extent. These polygons have thickness values assigned that can be used to steer the thickness at pinch-outs and faults. The aquifer thicknesses are stochastically modelled using kriging and the resulting kriging variance which represents the thickness uncertainty is used to calculate P10 and P90 thickness maps.
Each modelled aquifer is populated with vertically averaged well porosities and -permeabilities. Subsequently, the heat in place (HIP) is calculated by using these flow properties, net thickness of the aquifer and its temperature. In a next step, technical (doublet) and economical parameters are incorporated to derive the technical and economic potential and the potentially recoverable heat.
In the future, ThermoGIS will also focus on shallow geothermal energy and heat storage for which the shallow aquifers of the hydrogeological model REGIS II need to be incorporated. This model includes Neogene aquifers and uses the geological DGM-model for the shallow subsurface as a basis.