

FLANDERS ENVIRONMENT AGENCY



35 years of data collection and regional modelling of the confined aquifer systems in N-Belgium

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No Abstract 1483

Objectives of the hydrogeological research at SCK•CEN

- Understand phenomenology of the hydrogeological system surrounding the Boom Clay
- Evaluate radionuclide pathways
- Understand past evolution of the hydrogeological system in view of formulation of expected behavior in present + future
 - Long-term climate change (10⁶ years)
 - Warming: marine transgression
 - Cooling: permafrost
- Provide flow conditions required for transport calculations





Study area – Boom Clay extent



Geological structure of N-Belgium



Geological structure of N-Belgium



Groundwater flow in a regional context





Data acquisitions

2010

• Pumping tests at Doel and Kallo. Deep aquifers *K*.

2008

- Extensive cAt site characterization. CPT prospection, pumping tests and *K* measurements up to depth of 50m.
- ON-Dessel-5 borehole. Investigation of deep layers of the Neogene aquifer.

2005

 NEB'05 campaign. Drilling of Essen and Herenthout. *K* measurements for Boom Clay and Oligocene.

2002

 ON-Dessel-2 borehole. Large pumping test and laboratory K measurements.

2000

 cAt site characterization. Preliminary site investigation, start of local piezometric network.

1998

 Doel boreholes. Boom Clay and Ypresian Clay K laboratory measurements.

1997

 ON-Mol-1 borehole. The most complete dataset for Boom Clay K at the Mol site. Combining various techniques.

1996

 NEB'96 campaign. Zoersel, Rijkevorsel, Weelde and Turnhout boreholes. Many K measurements for Boom Clay and Oligocene.

1993

 ON-Dessel-1 borehole drilled, defining more detailed stratigraphy from Neogene to Cretaceous based on geophysics.

1981

- First piezometers of the regional network drilled
- Construction of HADES granulometry and geometry of the Neogene aquifer

Modelling

2012

2015

2010

2005

2000

1995

1990

1985

1980

 \rightarrow

 Update of the Deep Aquifer Pumping model introducing complex geology of Oligocene

2011

 Update of the Local model for cAt license application

2008 - 2009

- Neogene Aquifer model for the Nete catchment
- Deep Aquifer Pumping model for the aquifers below the Boom Clay

2002

- Second update of the north-eastern Belgium model. MODFLOW used. Recommendation to consider the
- systems above and below Boom Clay separately

2001

 First version of the Local model for cAt project (Mol site)

1998

 Sub-regional model. Kleine and Grote Nete rivers used as boundaries. Neogene aquifer only.

1995

 First update of the Regional model of north-eastern Belgium. NEWSAM used, Boom Clay explicitly included. recommendation to characterize the Boom Clay and aquifers at regional scale.

1985

 Regional model of north-eastern Belgium using NEWSAM. Combining aquifers above and below the Boom Clay into a single model.

Overview of (more than) 35 years research

- Iterative data acquisition & modelling integrating the knowledge
- Moving from one big model (combining aquifers above and below the Boom Clay) to separate models
 - Neogene aquifer model
 - Deep aquifer pumping model



Question from FEA (Flemish Environment Agency):

- Development of a groundwater flow model of the confined aquifers in Flanders (similar to SCK DAP model)
- Bad quantitative status of groundwater bodies in confined aquifers in Flanders:
 - excessive groundwater extraction and limited infiltration
 - decreasing groundwater heads



Groundwater extraction in confined aquifers





Limited infiltration



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Decreasing groundwater heads



Decreasing groundwater heads





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Bad quantitative status of groundwater bodies



- FEA needs a groundwater model in order to monitor and manage (licence policy) the confined aquifers
 impact of future alternative exploitation scenarios on
 - impact of future alternative exploitation scenarios on quantitative status of aquifers (<100 years)
- Current groundwater model of FEA:
 - Steady-state
 - Model boundaries not appropriate



Conceptual model comparison

FEA model



DAP model

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congress

Conclusions

- Similar groundwater models for different puposes:
 - Different focus
 - Groundwater management versus deep geological disposal
 - area of interest
 - New data
 - Continous improvement of conceptual model
 - Refining of existing DAP model





