



**vito**

vision on technology



**Vlaanderen**  
verbeelding werkt

15/07/2015

# A Voxel Model for Mineral Resources: Loess Deposits in Flanders

8th EUREGEO – Barcelona

*Flemish Knowledge Centre of the  
Subsurface (VLAKO), part of VITO  
Flemish Government (LNE-ALBON)*

*Chris De Groot  
Tom van Haren*

# Outline

- » Introduction
- » Objectives
- » Methodology
- » Results
- » the 'Mineral Resource Explorer'
- » Next steps



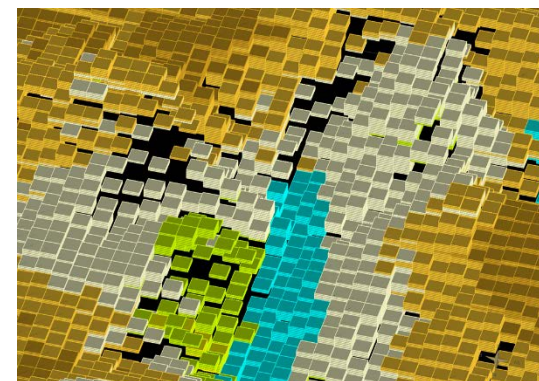
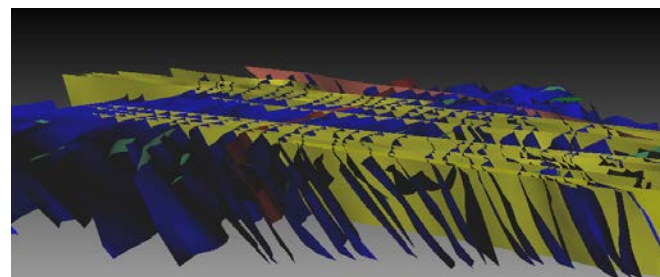
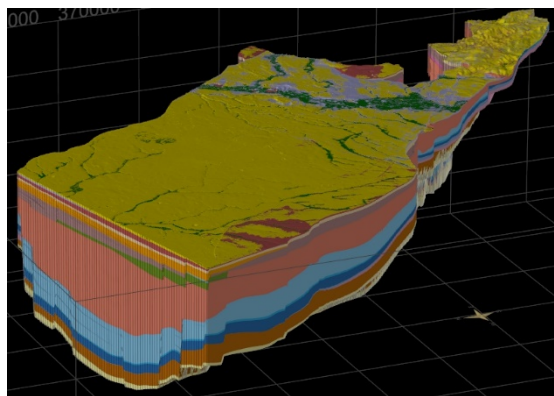
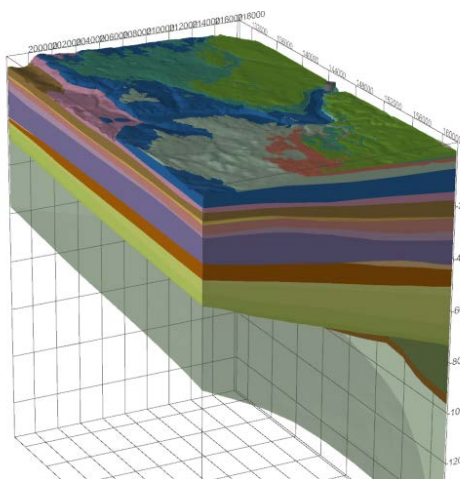
# Introduction

» Flemish government: Natural Resources Service

## Competences

1. Raw Materials Policy
2. Sustainable management of the deep subsoil
3. Geological knowledge: policy-supporting research & data sharing

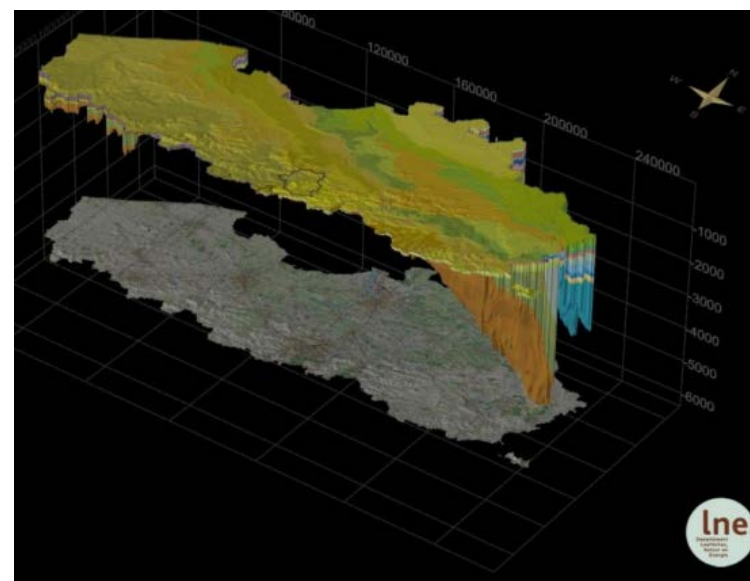
» VITO (VLAKO-group)





# Introduction

- » Voxel model part of geological 3D (layer) model of Flanders, Belgium
  - » Area: Flanders and Brussels Capital Region
  - » Free accessible @ <http://dov.vlaanderen.be>



# Introduction

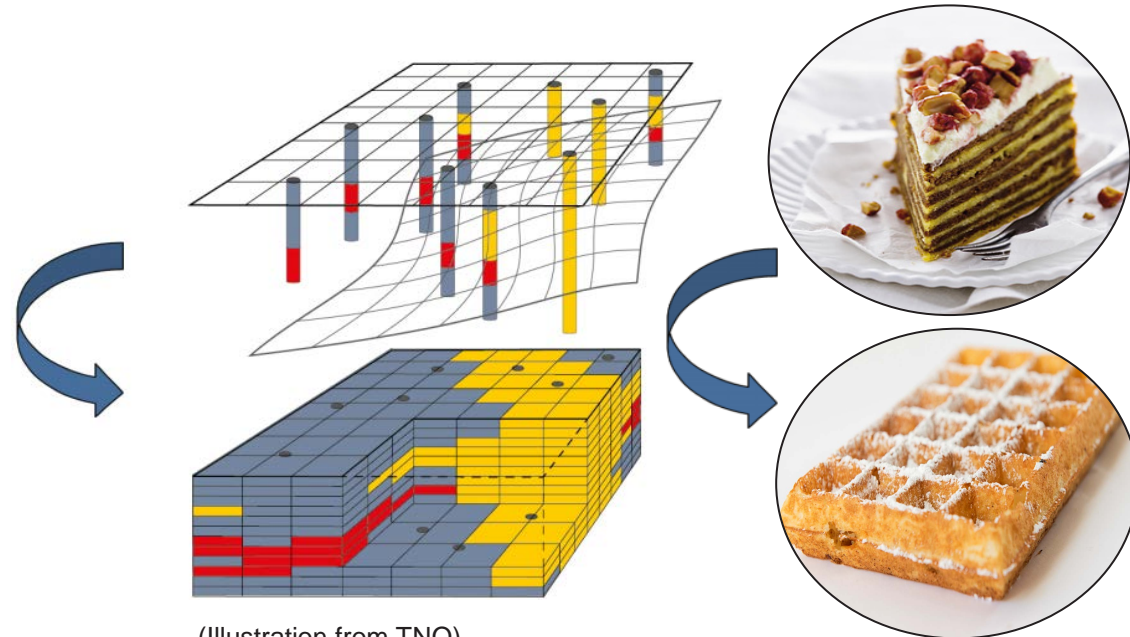
2006:  
start

2013:  
"1<sup>st</sup> complete  
layer model"

2011:  
"first results"

next

- » Next:
  - » Refining layer model
  - » creating first voxel model

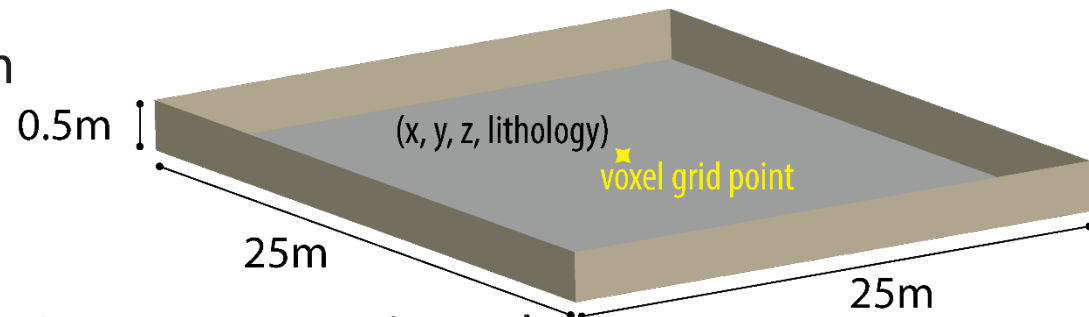


(Illustration from TNO)

# Objectives voxel model

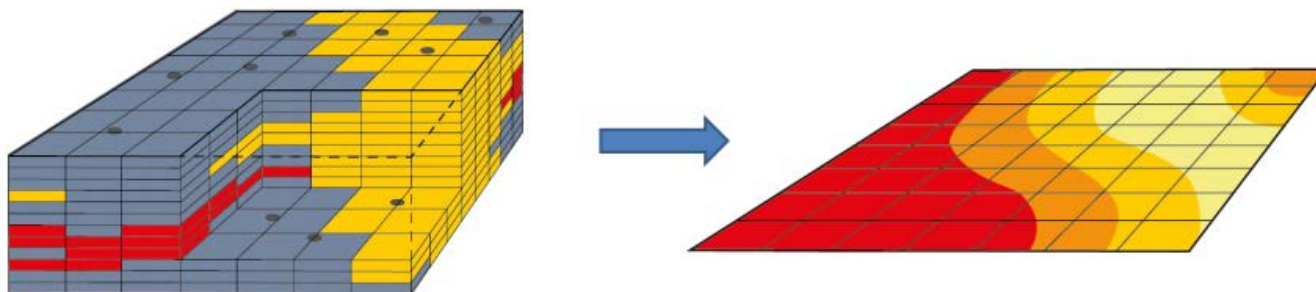
» Combining layer model + borehole information

» 3D Grid: 25 x 25 x 0.5 m



» Priority areas: significant Quaternary mineral resources

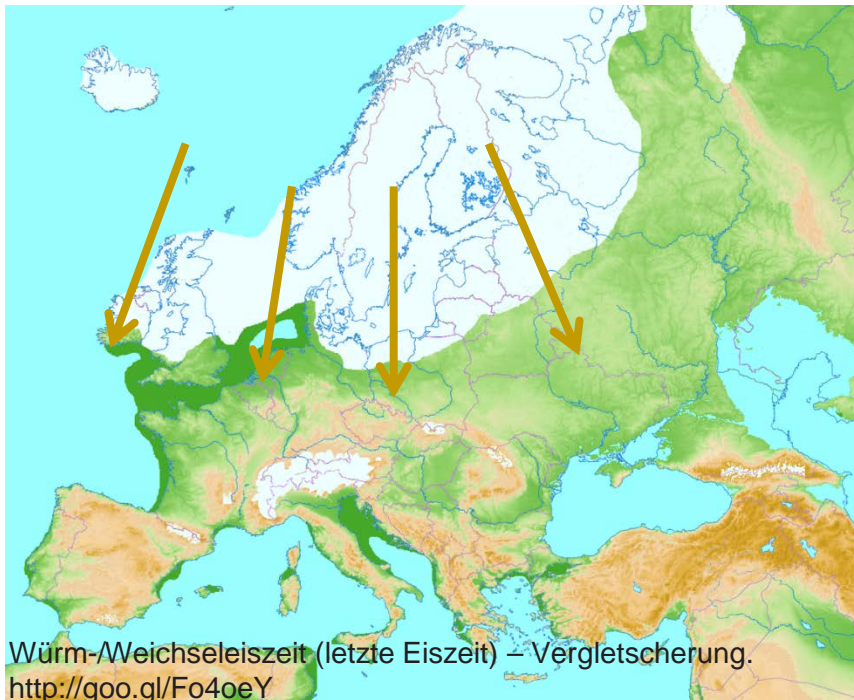
» Offering external users an online viewer for mineral resources



(Illustration from TNO)

# Objectives voxel model

- » First focus area: Loess deposits in Flanders
  - ! Still of importance for brick and ceramic industries in Belgium
  - » Part of Middle to Late Pleistocene aeolian deposits



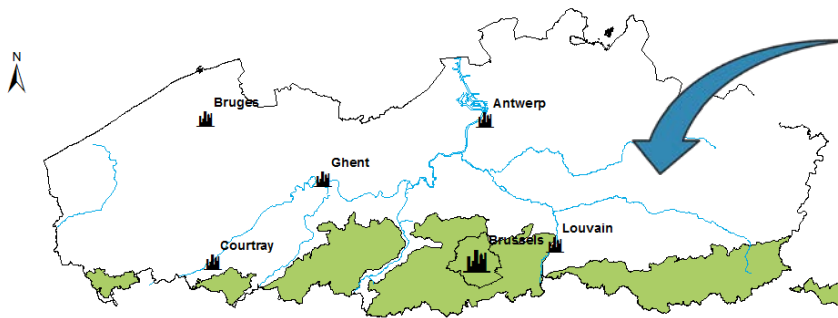
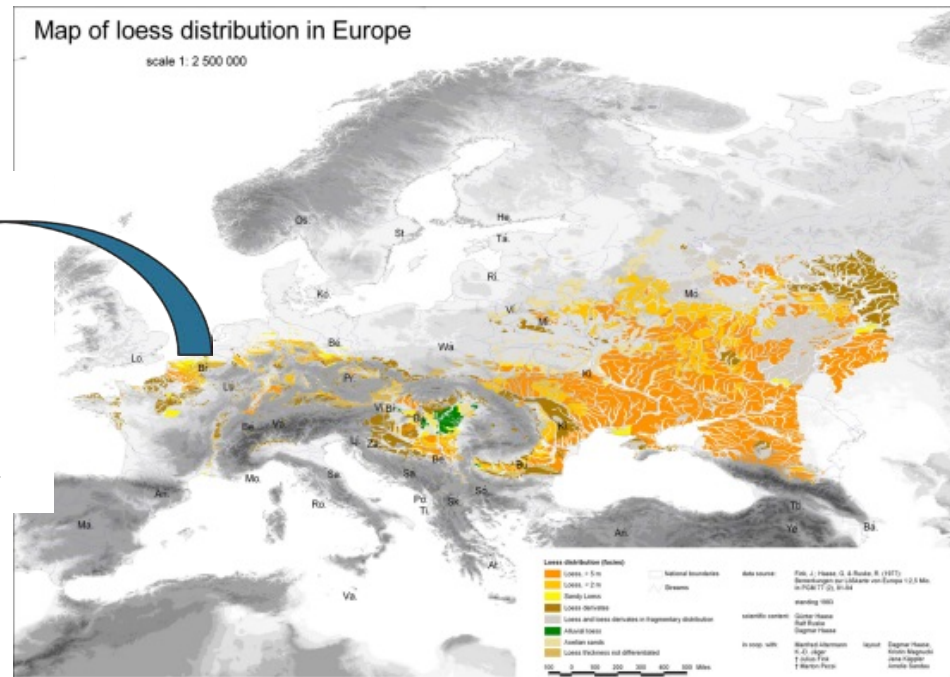


# Objectives voxel model

» First focus area: Loess deposits in Flanders

! Still of importance for brick and ceramic industries in Belgium

» part of European loess belt



Haase et al., 2007. Loess in Europe - its spatial distribution based on a European Loess Map, scale 1:2,500,000. Quat.Sci.Rev. 26 (9-10), 1301-1312



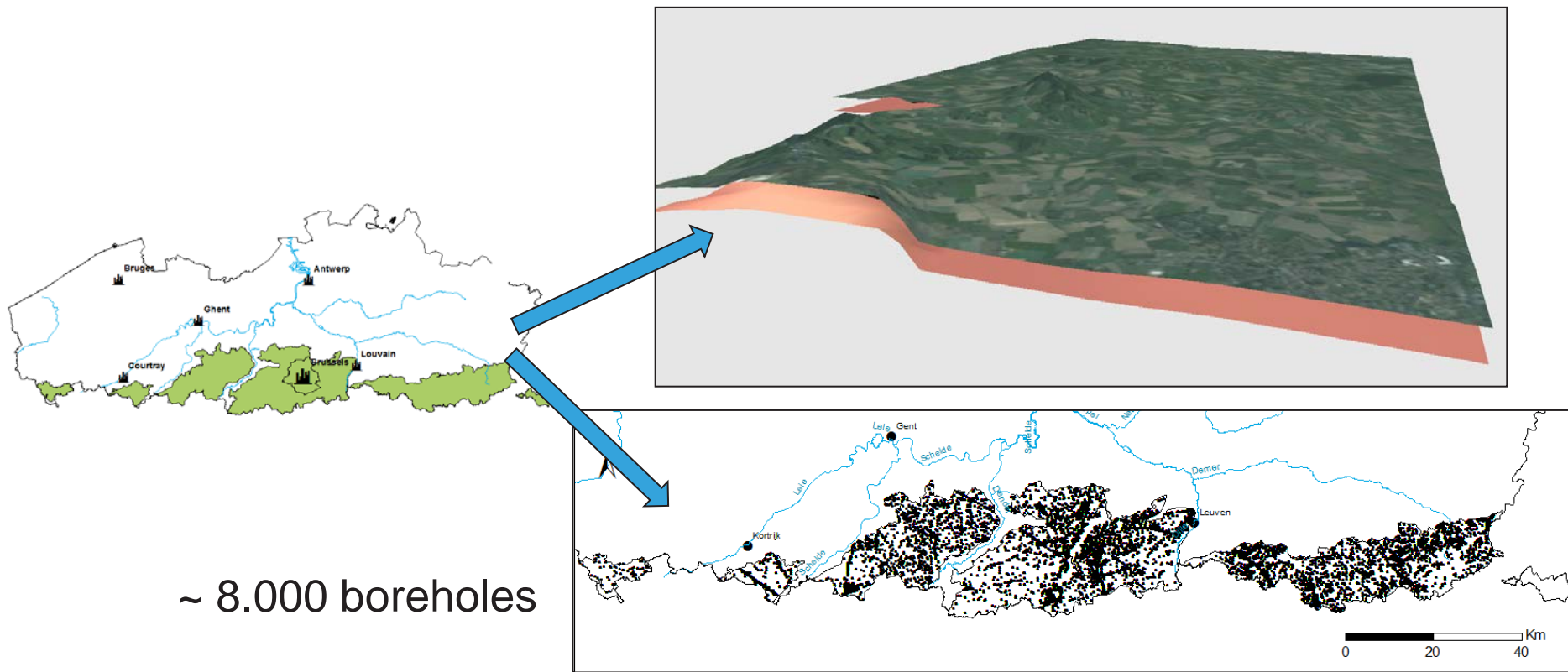
# Methodology

- 1) Selection of area, layers & boreholes
- 2) Translation & conversion boreholes → datapoints
- 3) Interpolation datapoints

*Software: ArcGIS, AutoCAD, Surfer, Voxler*

# Methodology - 1

- 1) Selection set: area, layer model and boreholes



# Methodology - 2

## 2) Translation & conversion boreholes → data points

- » Translation: lithological descriptions → categories
- » Conversion: categorised descriptions → datapoints

**Boring 1132104w-B42**

**Boring**  
Proefnummer: 1132104w-B42  
Situatie: 1132104w-B42 (op kaart)  
Voorloper: 1132104w-B42 (op kaart)  
Zwaarte: 1132104w-B42  
Omschrijving: op kaart

**Lithologische beschrijving**  
Acties: 1132104w-B42 (op kaart)  
Diepte (m): 0 - 0.5  
0.5 - 2  
2 - 2.5  
2.5 - 3

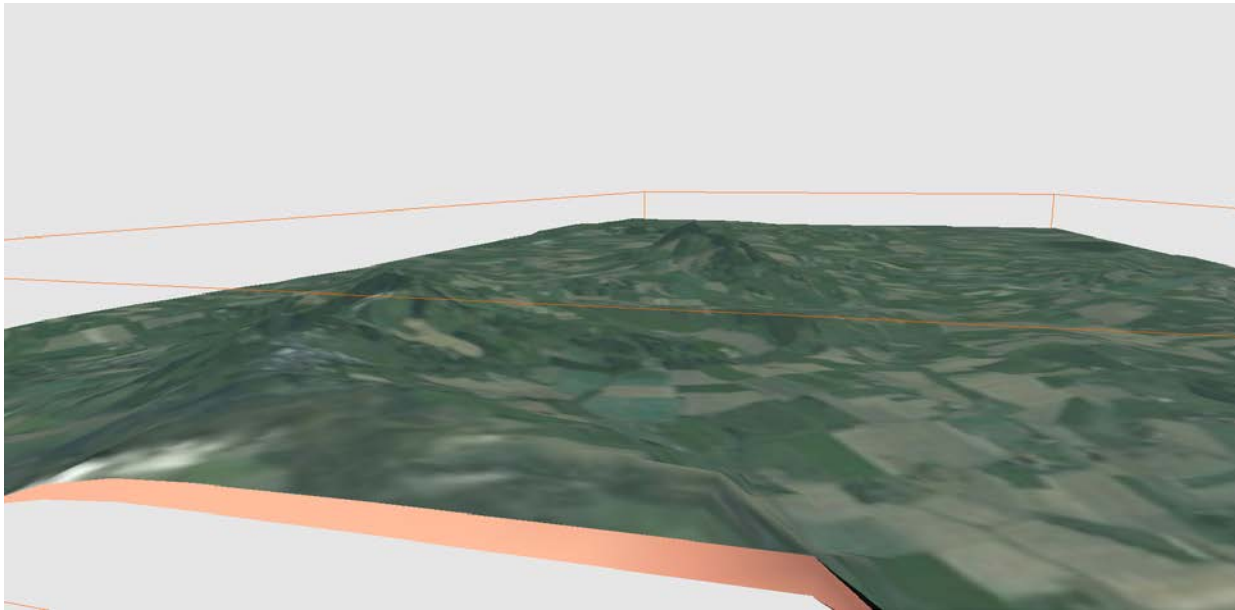
**Boring 1132104w-B43**  
Acties: 1132104w-B43 (op kaart)  
Diepte (m): 0 - 0.5  
0.5 - 2  
2 - 2.5  
2.5 - 3

*0 – 0.5 m: clay*  
*0.5 – 2 m: loam*  
*2 – 2.5 m: sandy loam*  
*2.5 – 3 m: loamy sand*

# Methodology - 3

## 3) Interpolation data points

- » Two step process
  - » First: 2D interpolation along top + base Quarternary

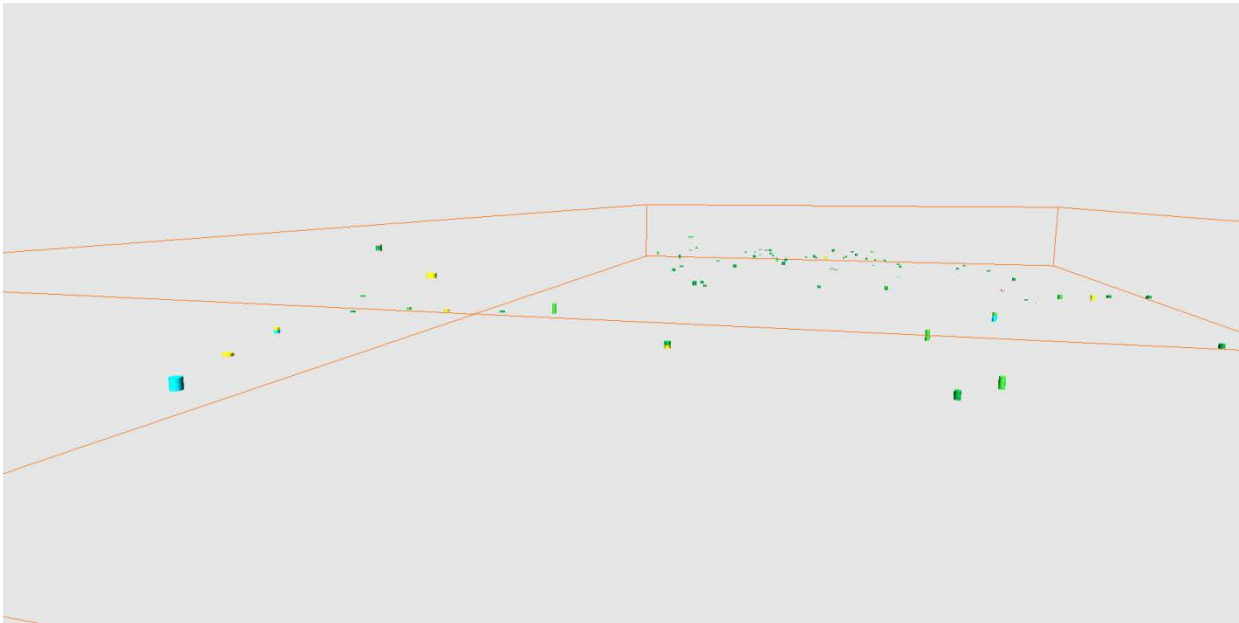




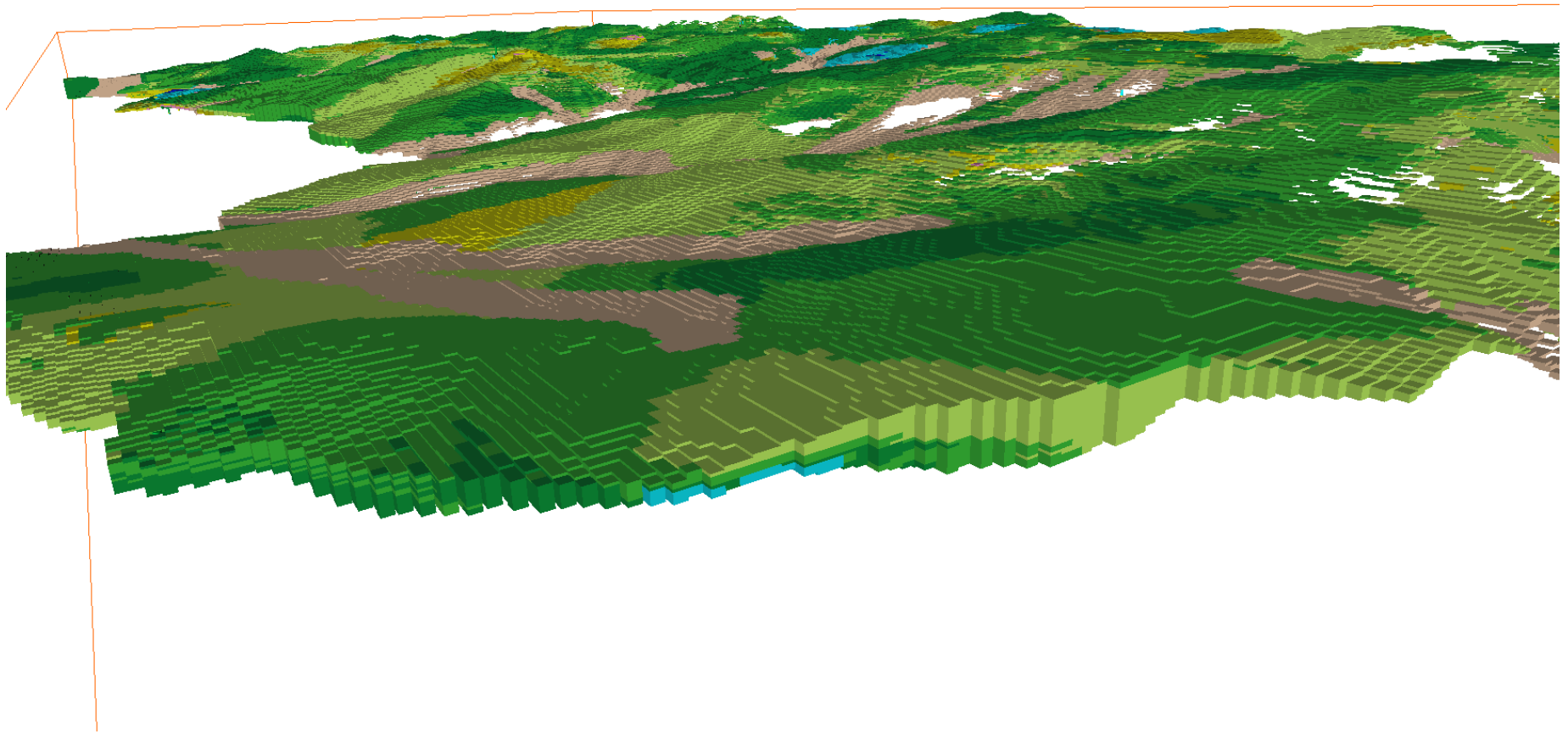
# Methodology - 3

## 3) Interpolation data points

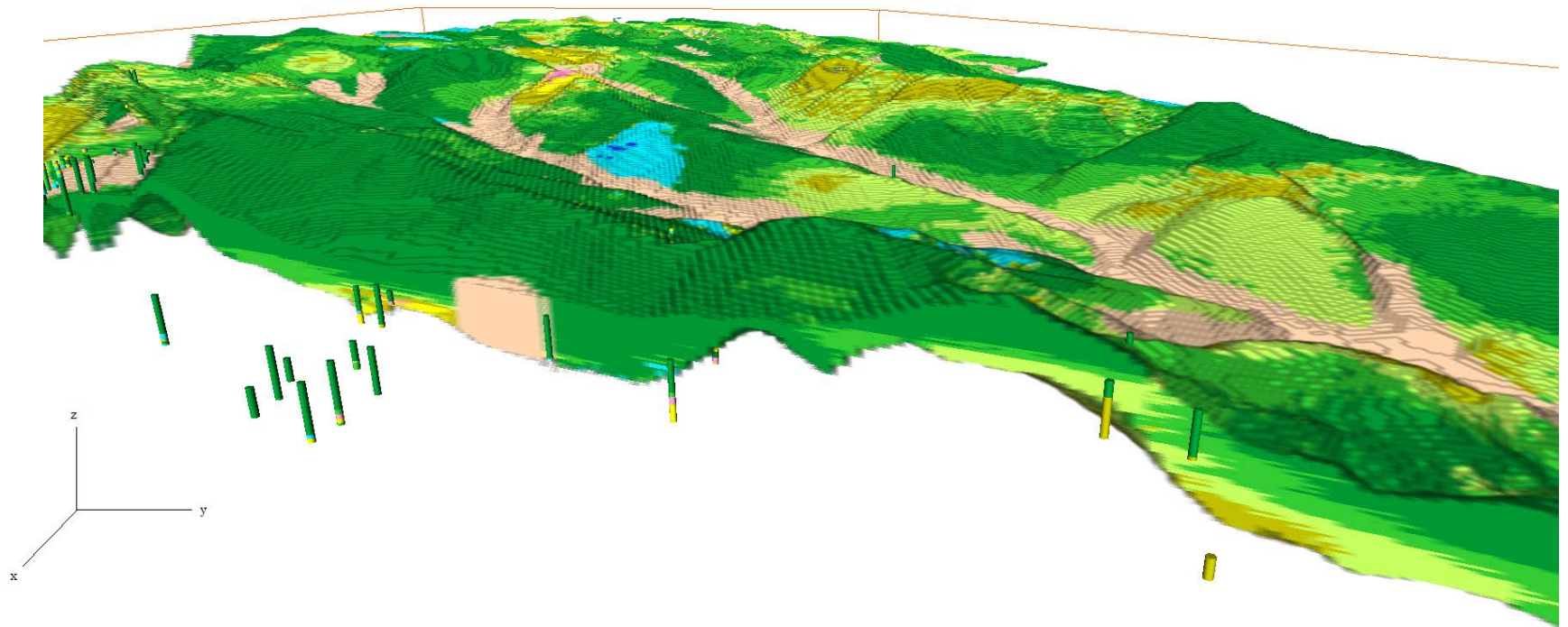
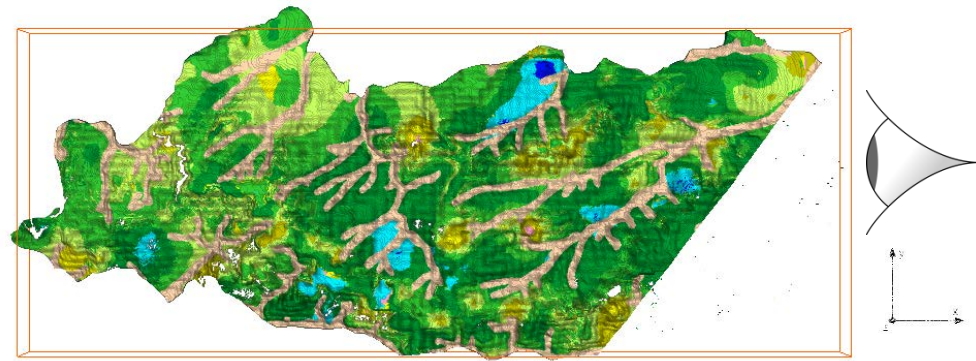
- » Two step:
  - » Second: 3D interpolation  
combining 2D grids + datapoints boreholes



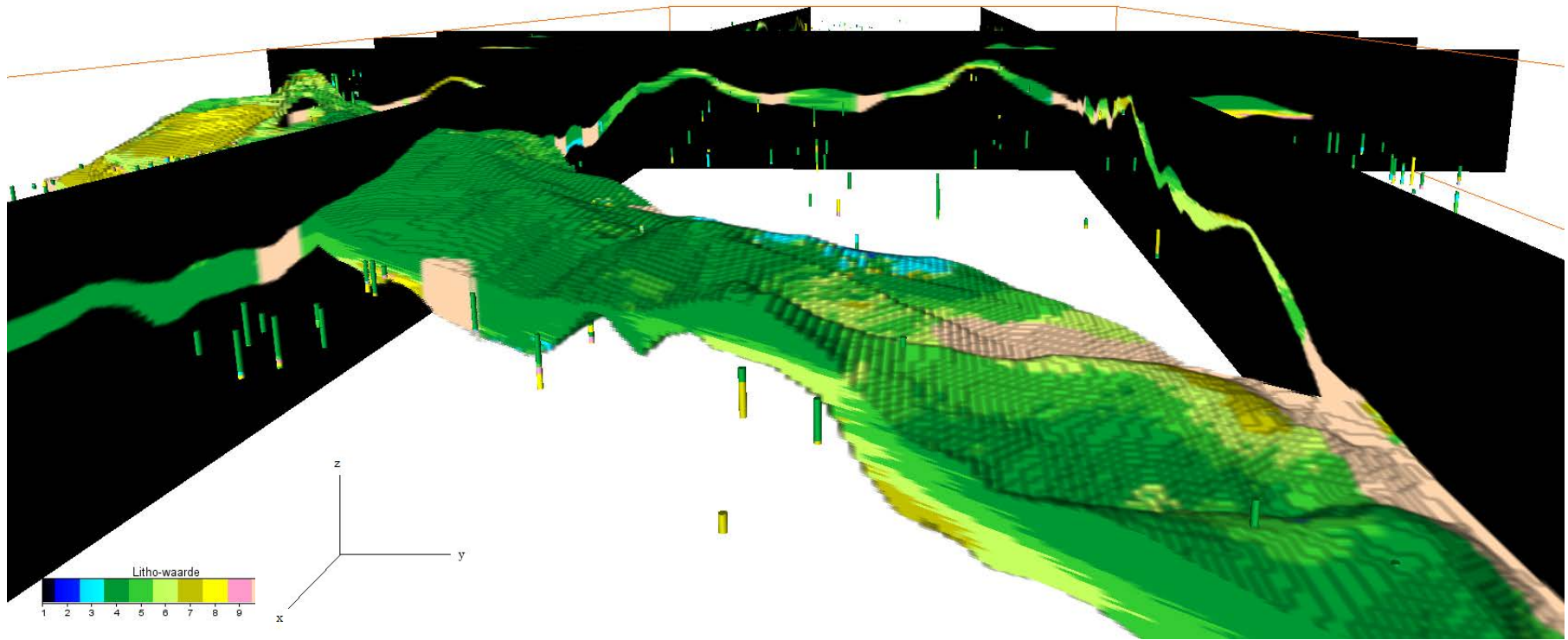
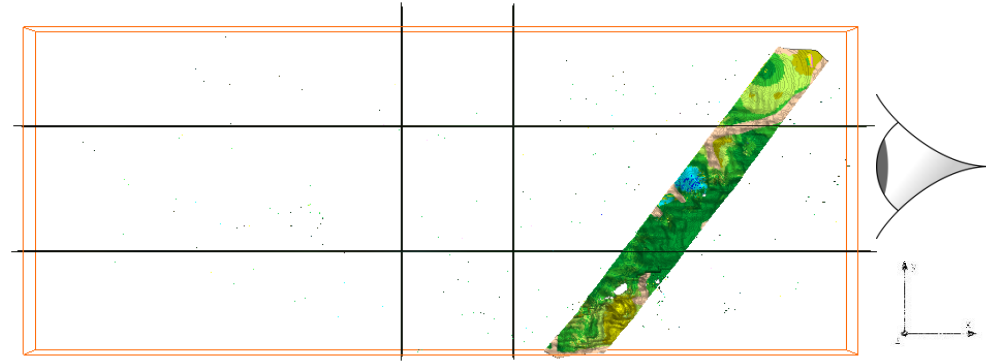
# Results - Example



# Results - Example

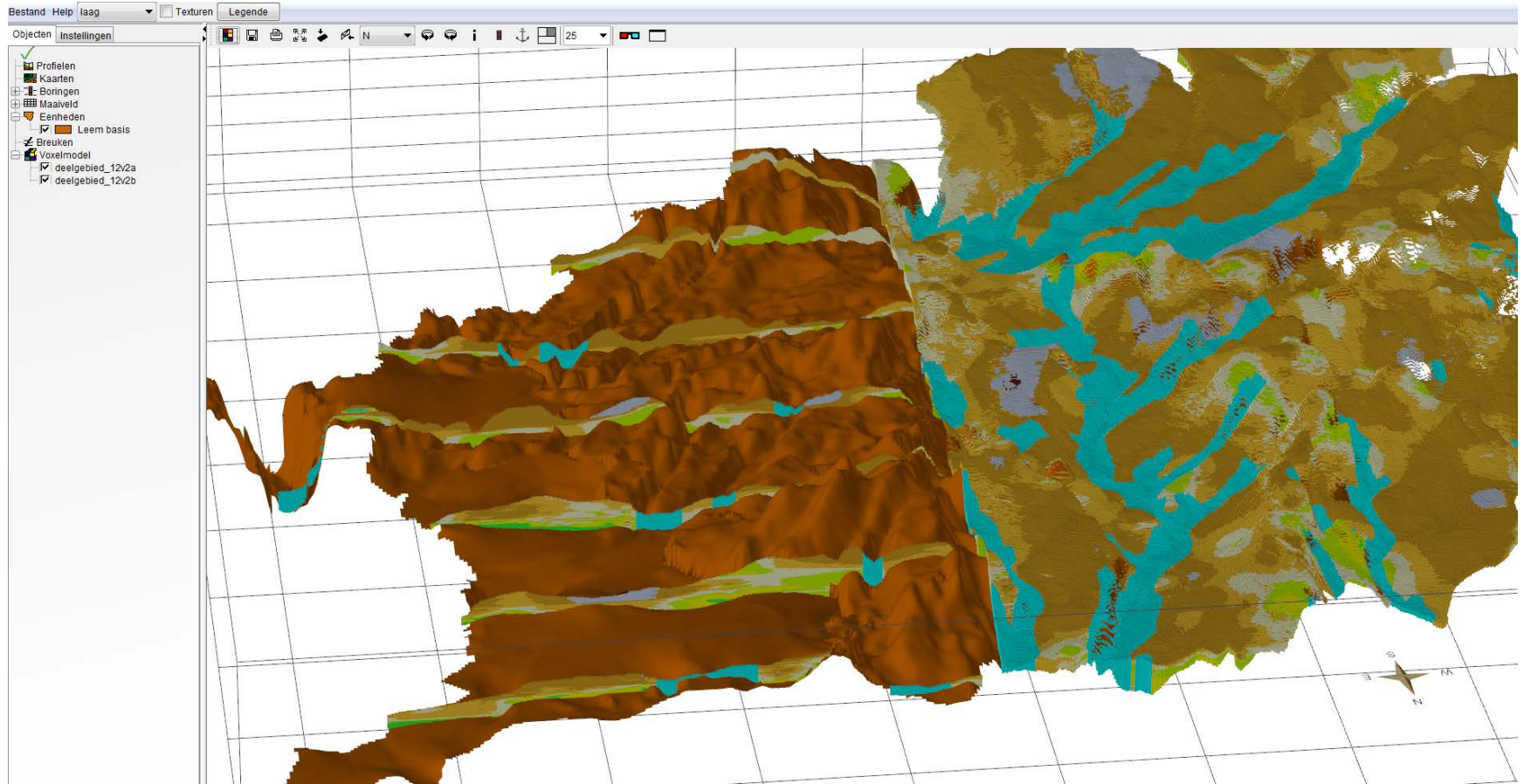


# Results - Example





# Results – 3D Subsurface Viewer®



# 'Mineral Resource Explorer'

- » Why a 'Mineral Resource Explorer'?
  - » user friendly
  - » mineral resources policy
  - » opportunities
  - » mineral extraction industry

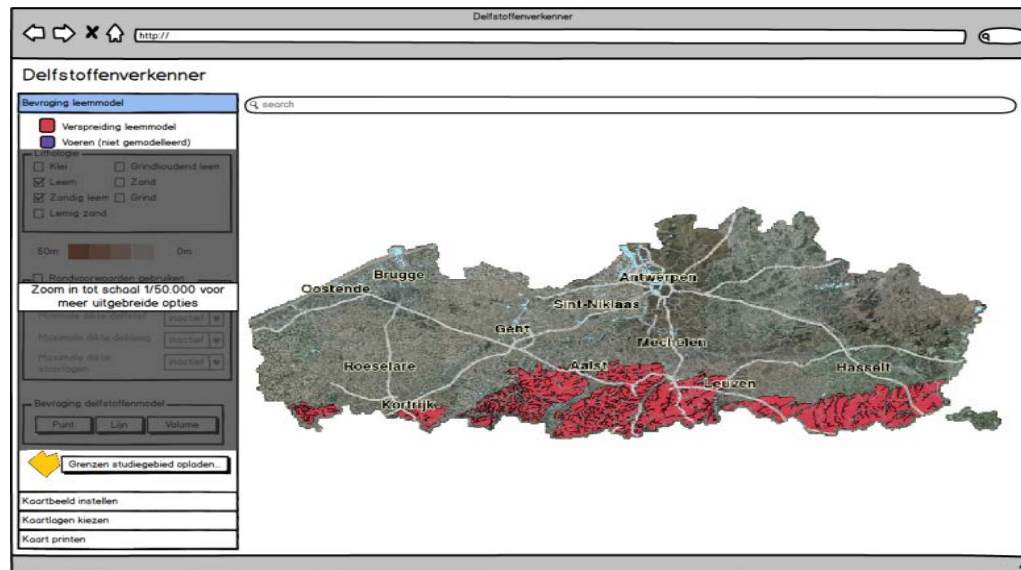
- » Result

allows users to view **3D data**, to do **calculations** and to combine it with other models and **geographical information**.



# the 'Mineral Resource Explorer'

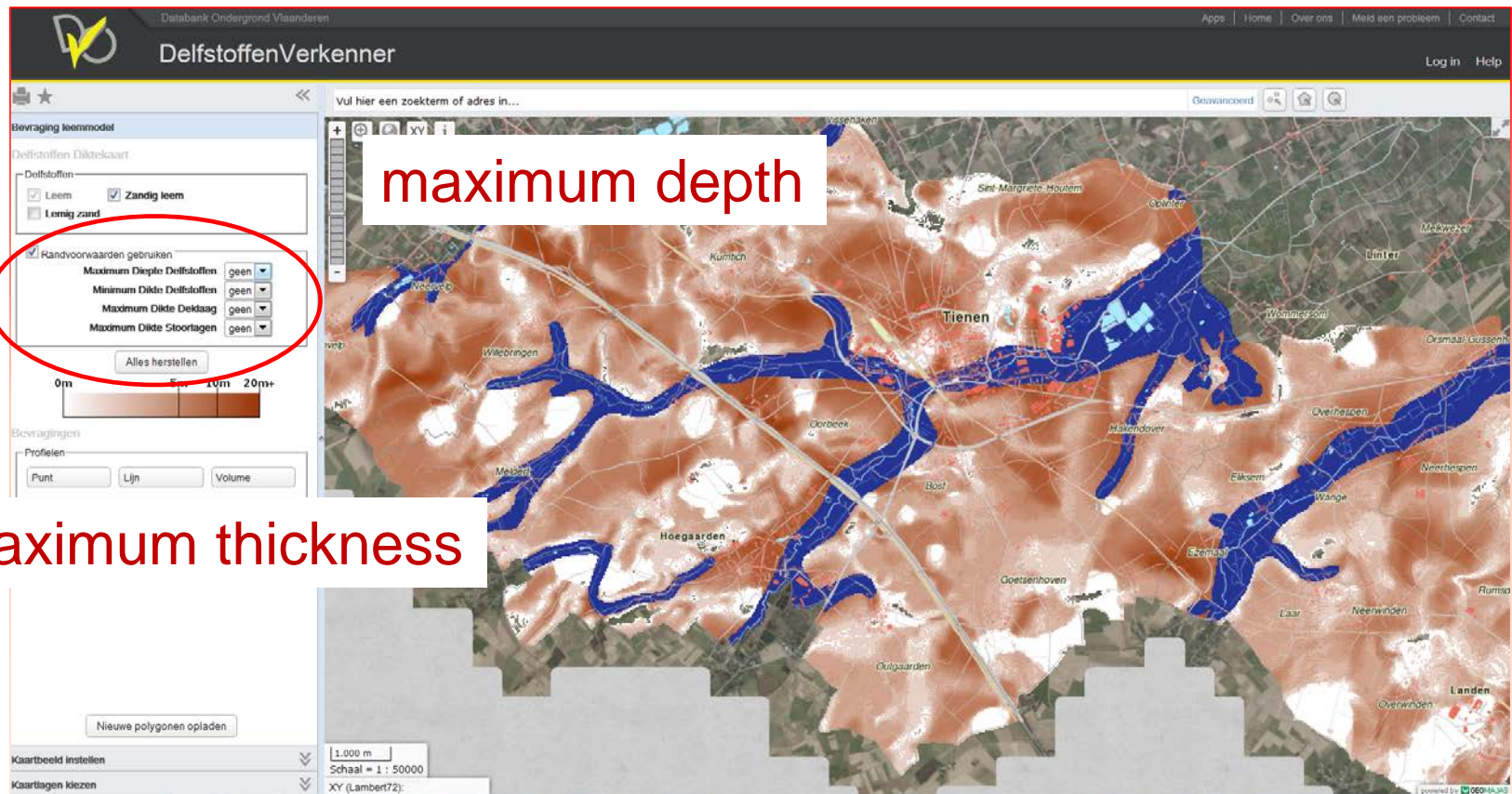
- » **First** voxel model: Loess deposits
- » In the **future** also other voxel models:
  - » clay, industrial sand, gravel, ...
- » Visualizing appearance of the Quaternary loess deposits





# the 'Mineral Resource Explorer'

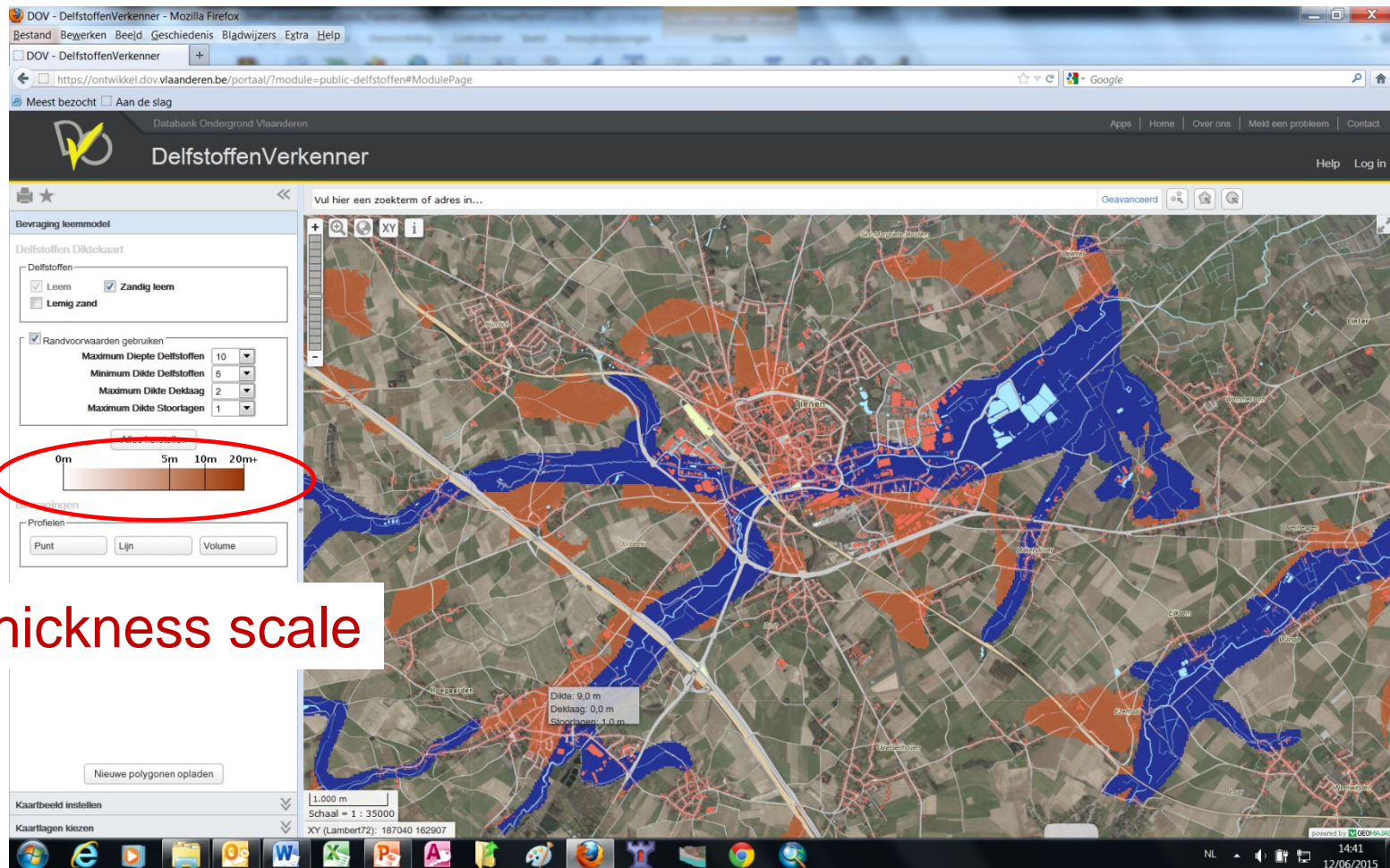
- » possible to determine the extractable mineral resources based on certain preconditions





# the 'Mineral Resource Explorer'

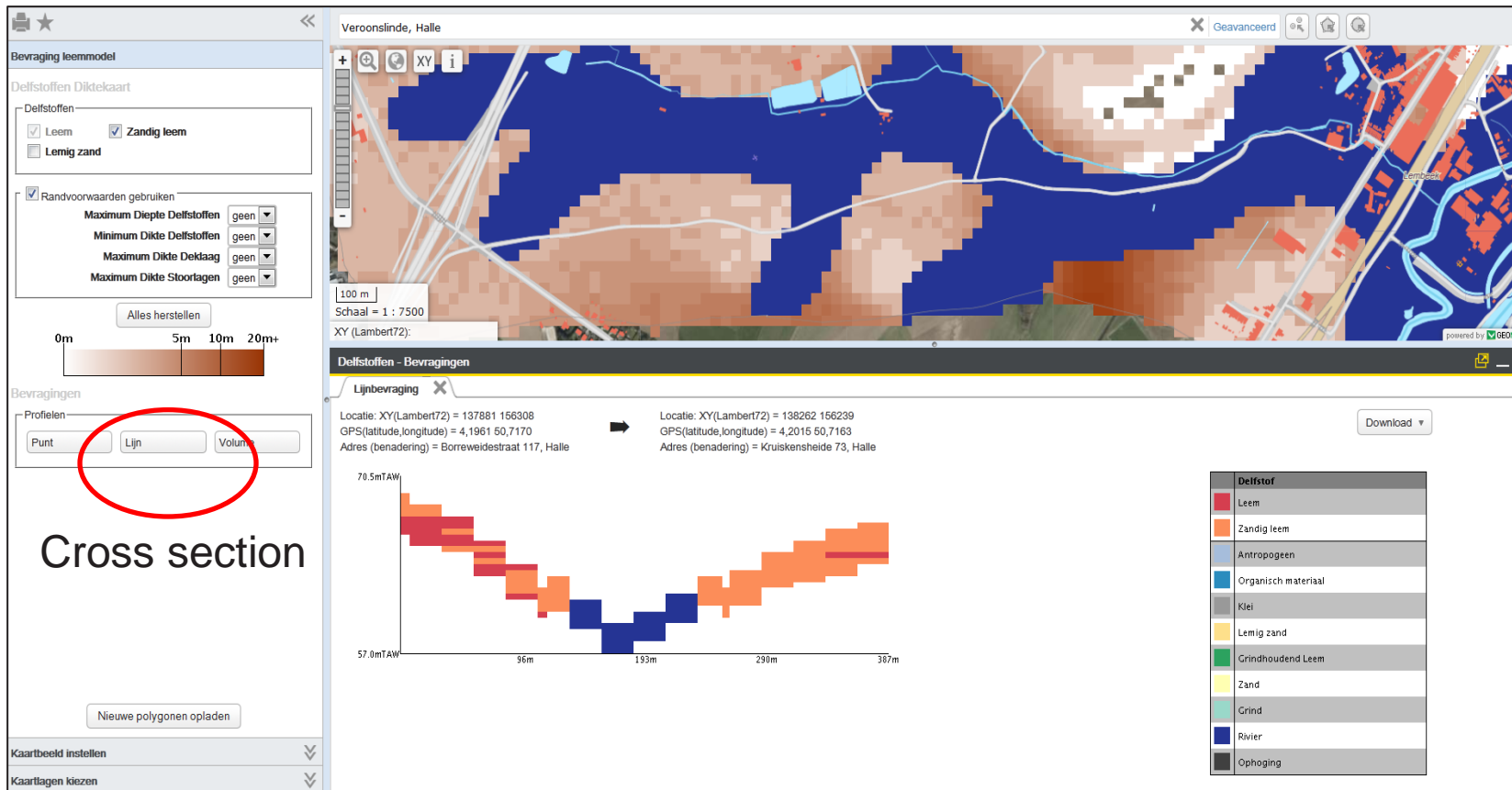
» New 'extractable' mineral resource map



Thickness scale

# the 'Mineral Resource Explorer'

» More specific interactions:



# the 'Mineral Resource Explorer'

- » More functionalities:
  - » GIS functionalities and volume calculation

The screenshot displays the 'Mineral Resource Explorer' software interface. On the left, there is a control panel for 'Bewraving leemmodel' (Leem model) with various settings for soil types and extraction parameters. A red circle highlights the 'Volume' button in the 'Bewravingen' (Extractions) section. The main map shows a 3D perspective view of an extraction area, divided into 'Eliksem Hakendover West' (shaded purple) and 'Eliksem Hakendover Oost' (shaded blue). A scale bar indicates 0m, 5m, 10m, and 20m. Below the map, a data panel titled 'Delfstoffen - Bewravingen' (Soil - Extractions) provides details for 'Volumebewraving: Eliksem Hakendover West'. A red circle highlights the volume calculation table.

Samenvatting:	
Totaal volume	205.183 m <sup>3</sup>
▼ Geselecteerde delfstoffen	153.602 m <sup>3</sup>
▼ Deklaag	4.537 m <sup>3</sup>
▼ Stoorlagen	47.044 m <sup>3</sup>
▼ Rivieren	0 m <sup>3</sup>

Total volume of existing extraction area



# the 'Mineral Resource Explorer'

» Integration in Flanders' Soil and Subsoil Database (DOV)

The screenshot displays the 'DelfstoffenVerkenner' (Substance Explorer) web application. The interface includes a search bar at the top with the text 'Vul hier een zoekterm of adres in...'. On the left, a sidebar menu lists various data layers, with 'Proeven en metingen' (Measurements) and 'Grondwateronderzoek' (Groundwater research) circled in red. The main map area shows a geographical view with numerous colored dots (green, orange, blue) representing data points. The map includes a scale bar (250 m) and a scale of 1:15000. The application is powered by GEOMA.JRS.

**Proeven en metingen** Boreholes

- Boringen
- Sonderingen
- Peilgatenmetingen

**Grondwateronderzoek** Observation wells

- Grondwatermeetnetten



# Next steps

- » 2016: 2<sup>nd</sup> voxel model: Sand + Gravel deposits
- » Development modelling techniques (different deposits need different approaches)
- » Other voxel parameters + combining them?: granular size, stratigraphical information, ...
- » Dealing with big data volumes!
- » Online explorer: dynamic evolution

*Thank you for your attention*  
*Gràcies per la vostra atenció*  
*Gracias por su atención*

**¿Any questions?**

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