Big Data in groundwater

Theo Olsthoorn

Giesbeek (nl) webinar 2018-06-25

Big data (wikipedia)

- **Big data** is data sets, so voluminous and complex that traditional data-processing application software are inadequate to deal with them.
- Big data includes capturing, storage and analysis of data.
- Big data also refers predictive analytics, user behavior analytics, or certain other advanced methods that extract value.

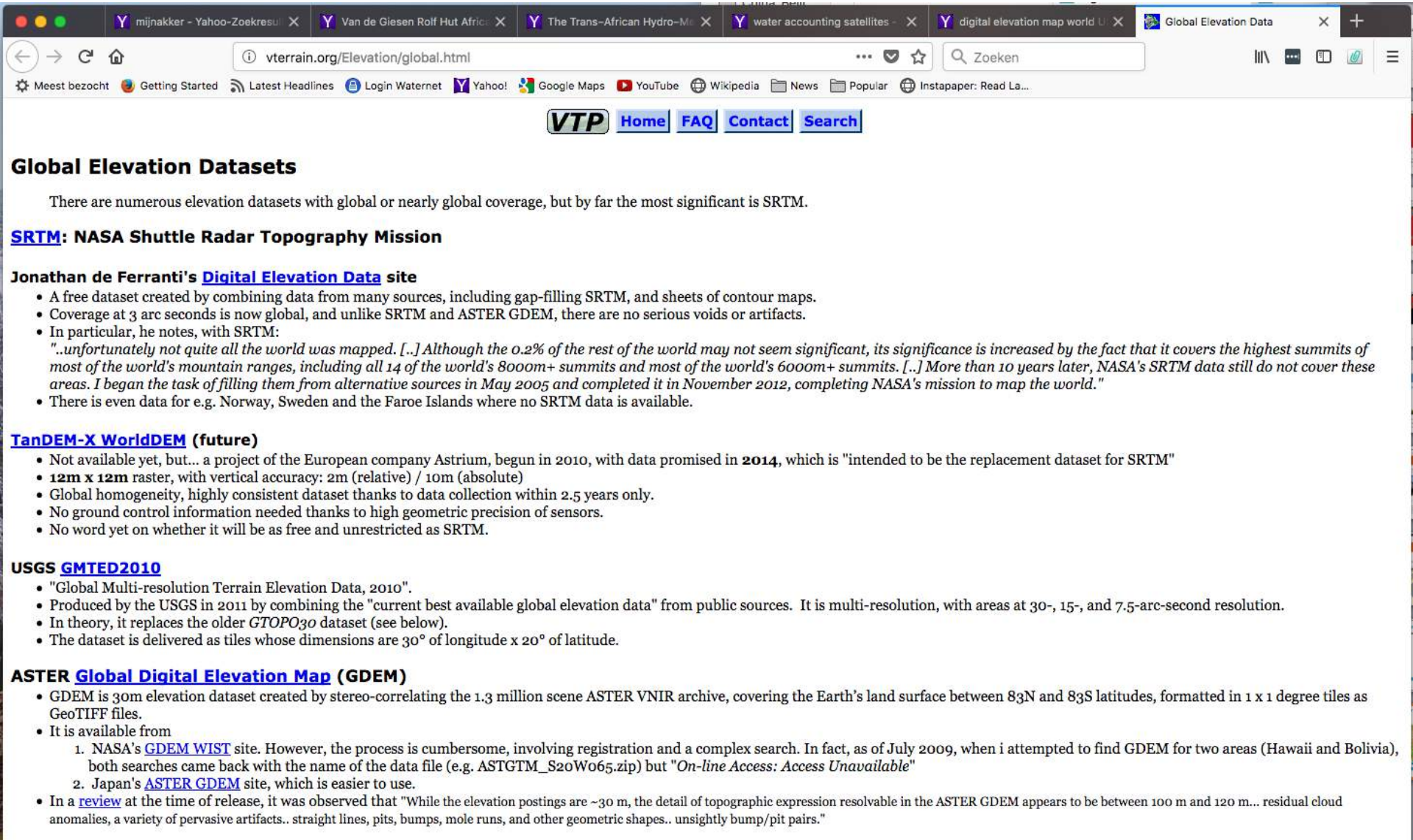
Data Mining

- The process of discovering meaningful correlations, patterns and trends by sifting through large amounts of data stored in repositories.

Groundwater hardly any Google results but there is enough that is relevant to us

- National and international repositories
- National and international models

Global digital elevation data sets ready to download

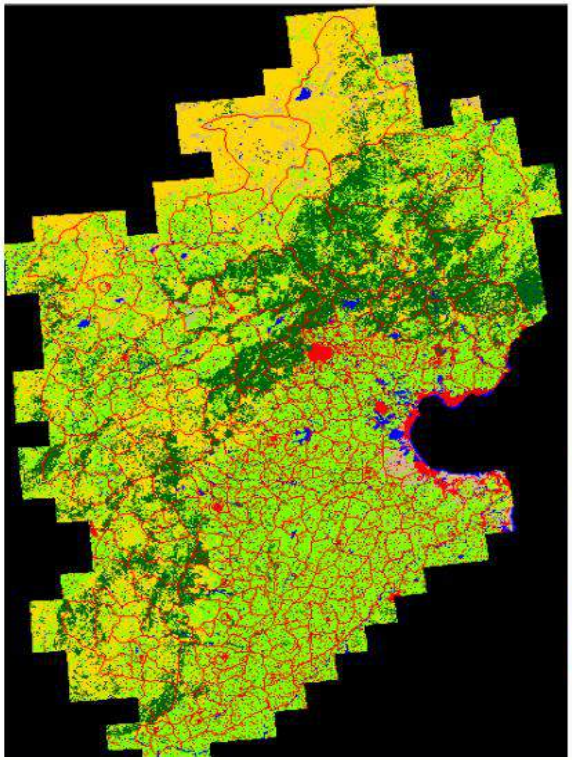


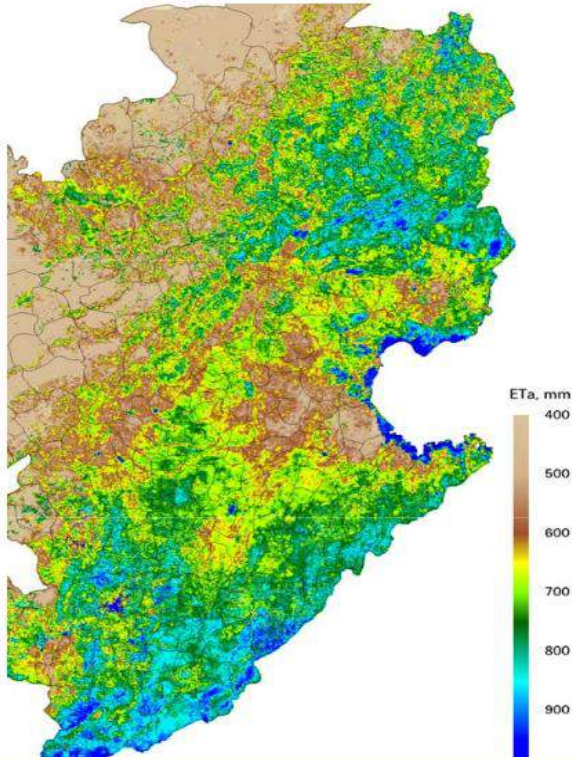
Water Accounting From Satellites

First steps towards a standardized description of water resources

Land and water use Hai Basin

Wim Bastiaanssen





Delft/Mini Symposium

Water Accounting

March 2, 2009

CiTG – Water Management

TU Delft
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eLEAF provides satellite based applications and data to optimise crop production and water management.

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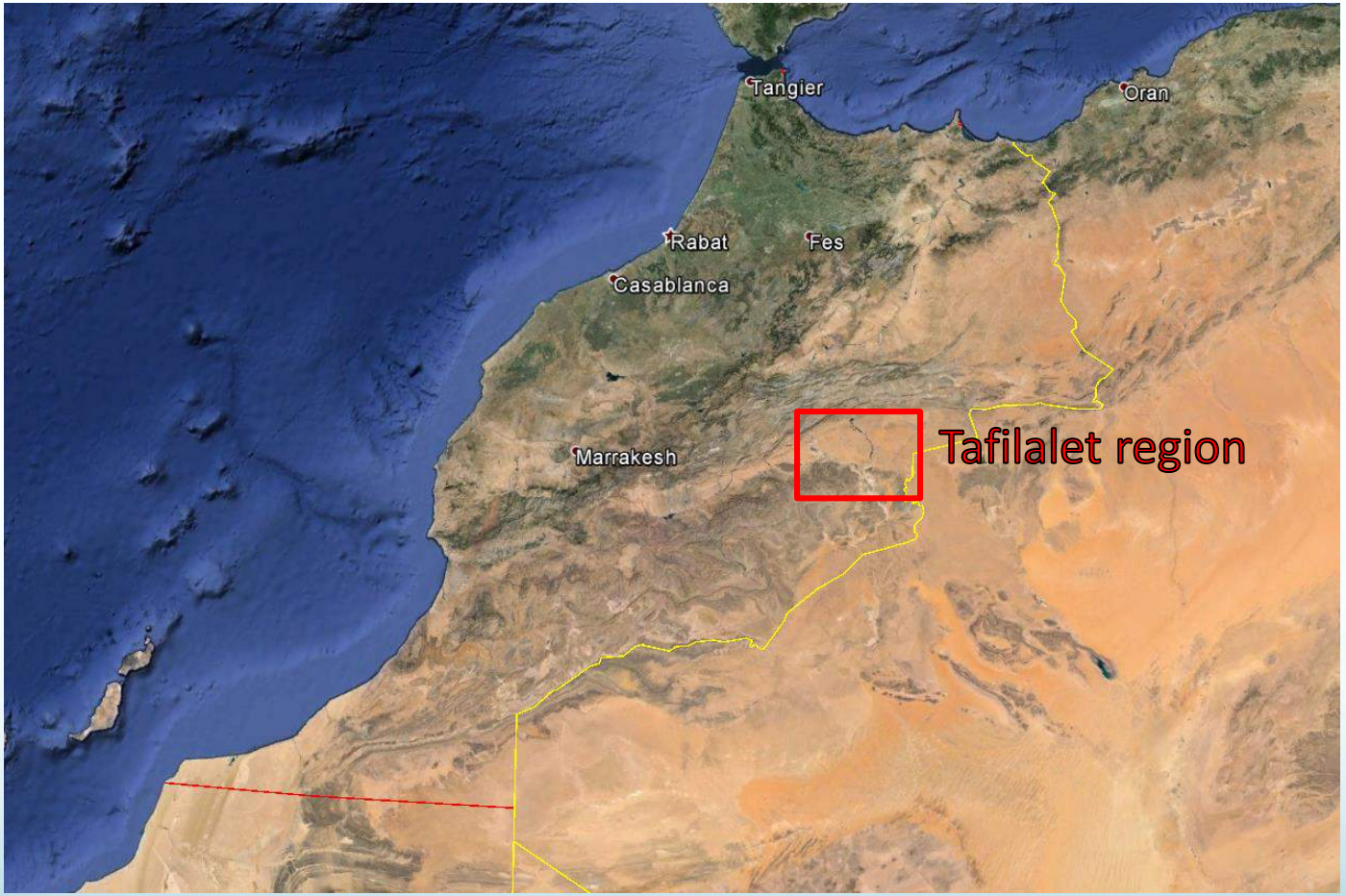
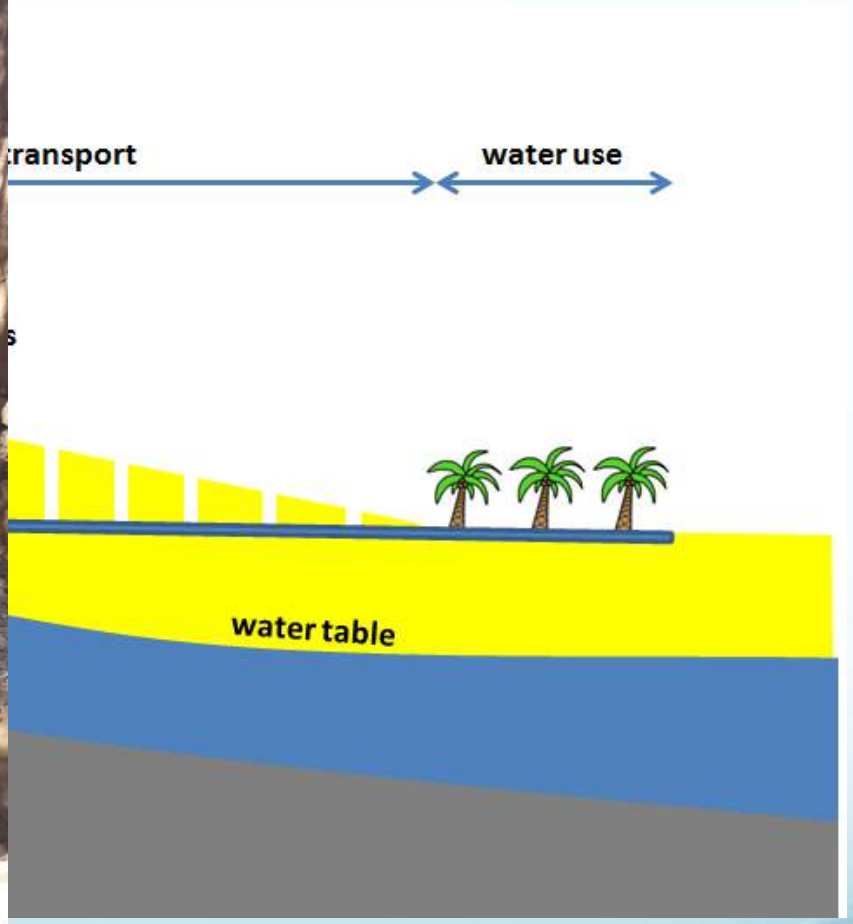
Tafilalet Khettaras (Erfoud, Morroco)

Morocco

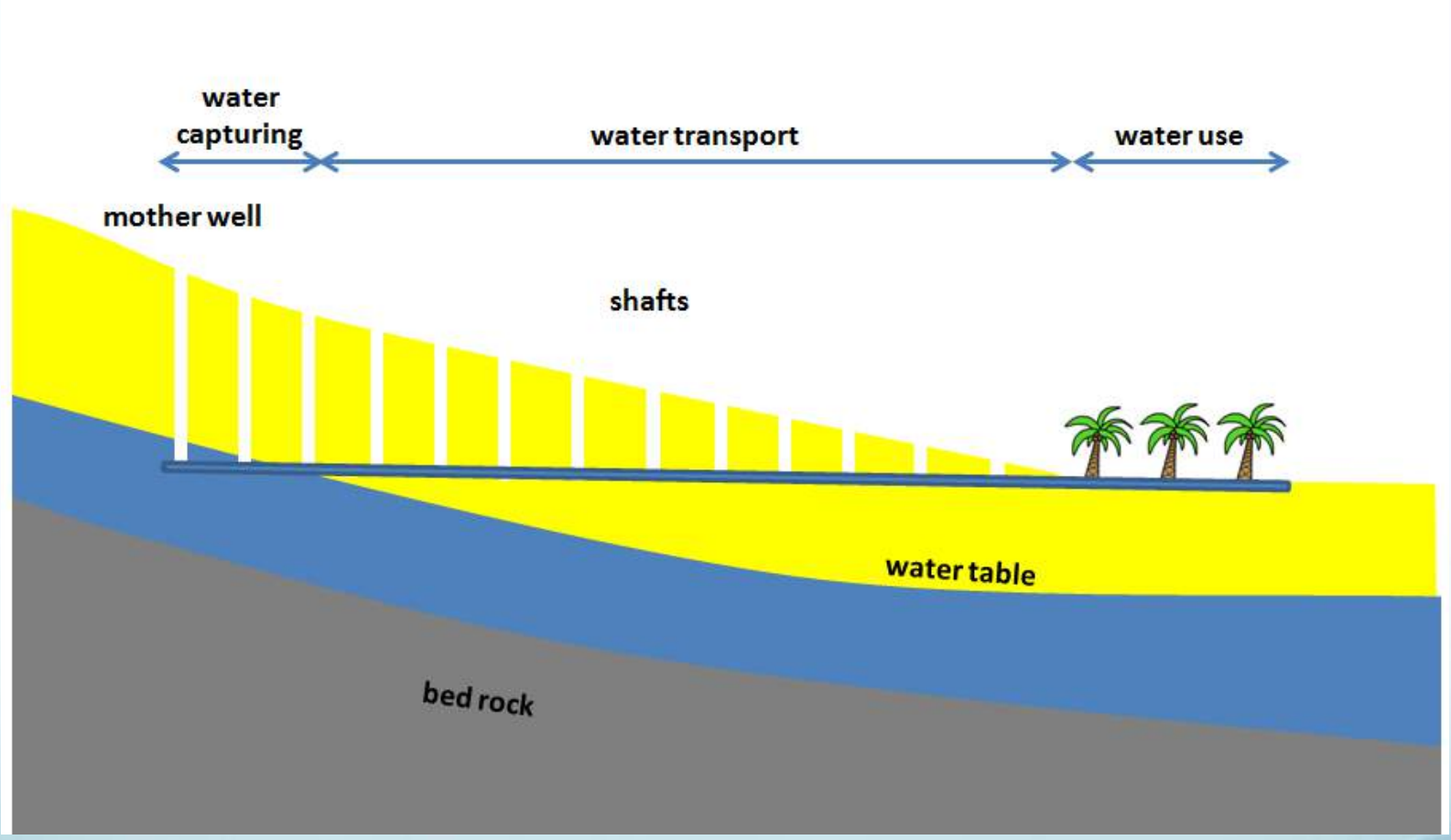


← Coert Strikker MSc



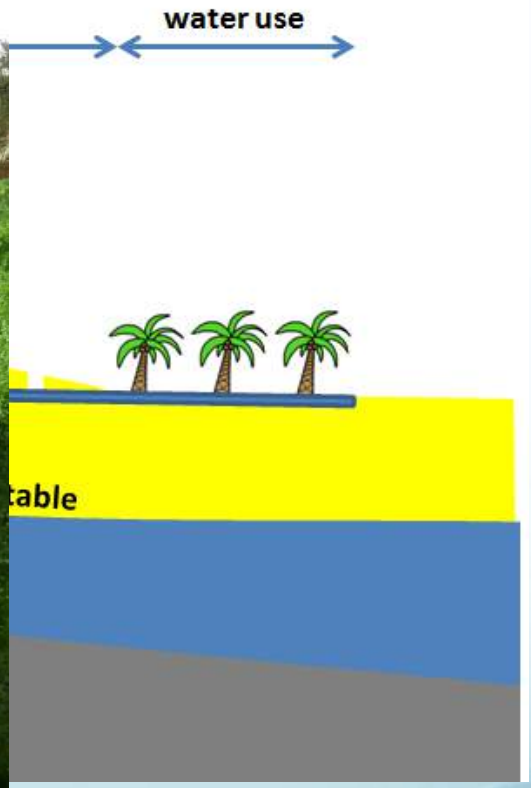
Introduction

Khettaras



Introduction

Khettaras



Introduction

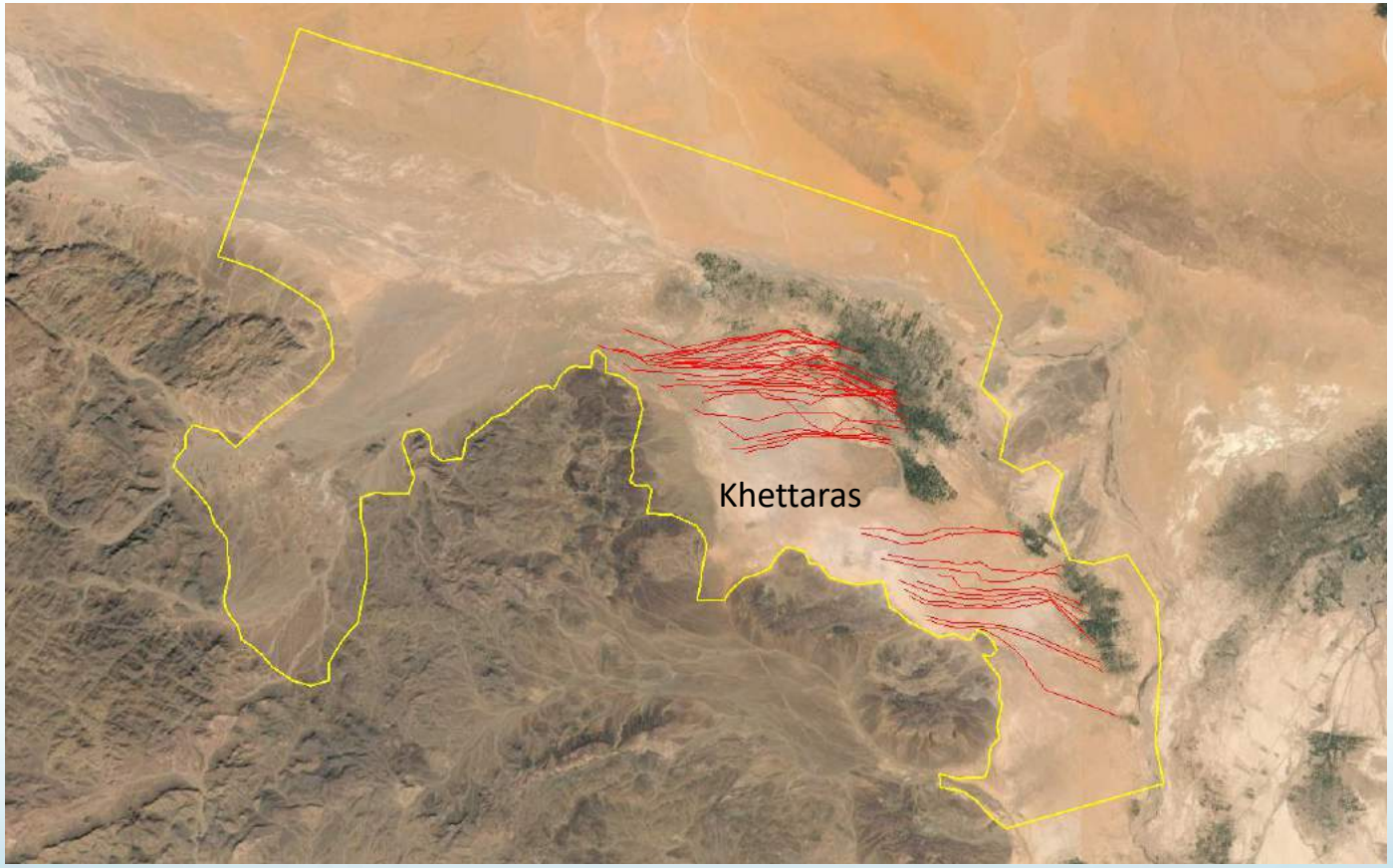
Khettaras

Model setup

Hydrology

Model setup

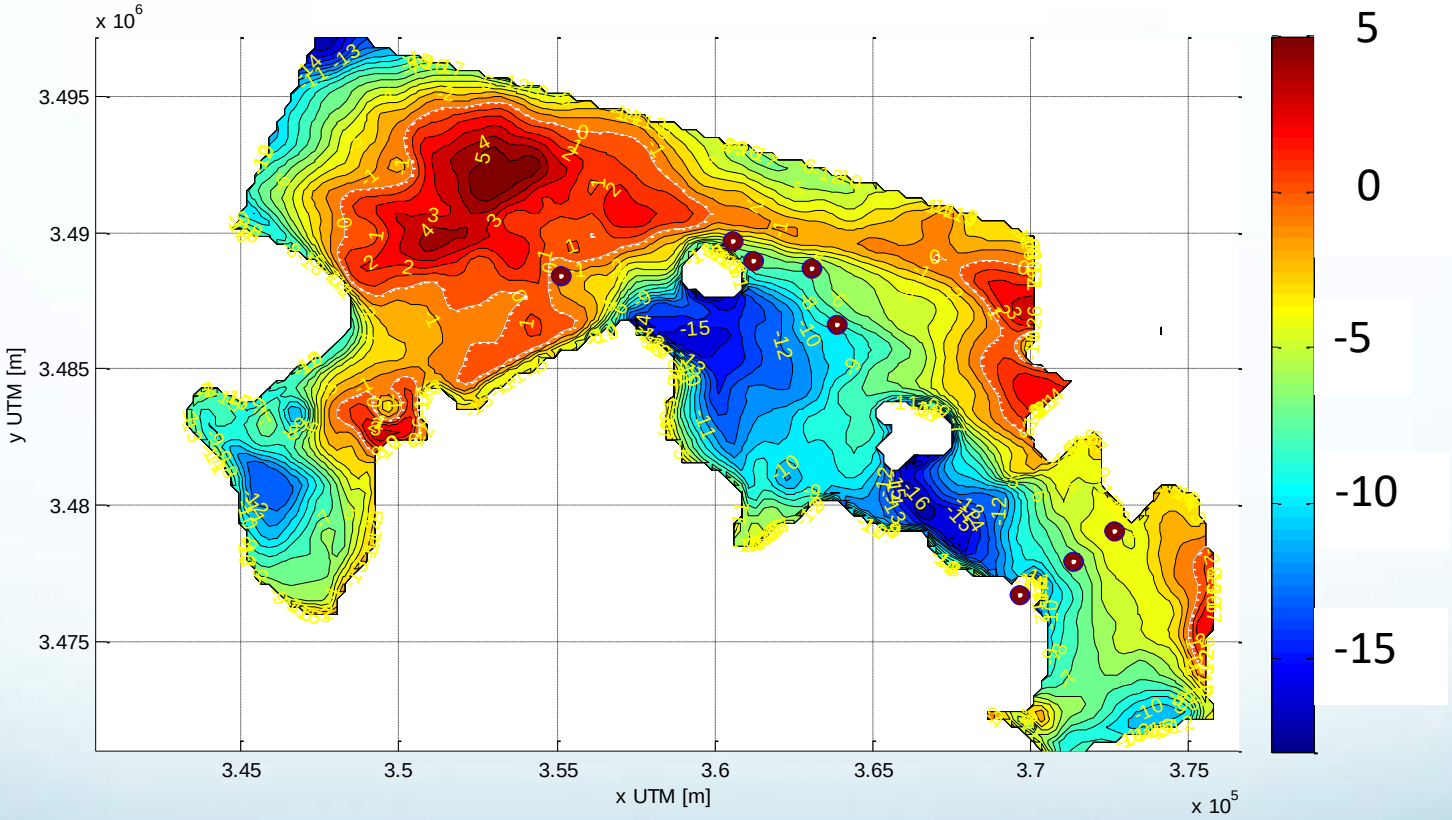
Hydrology



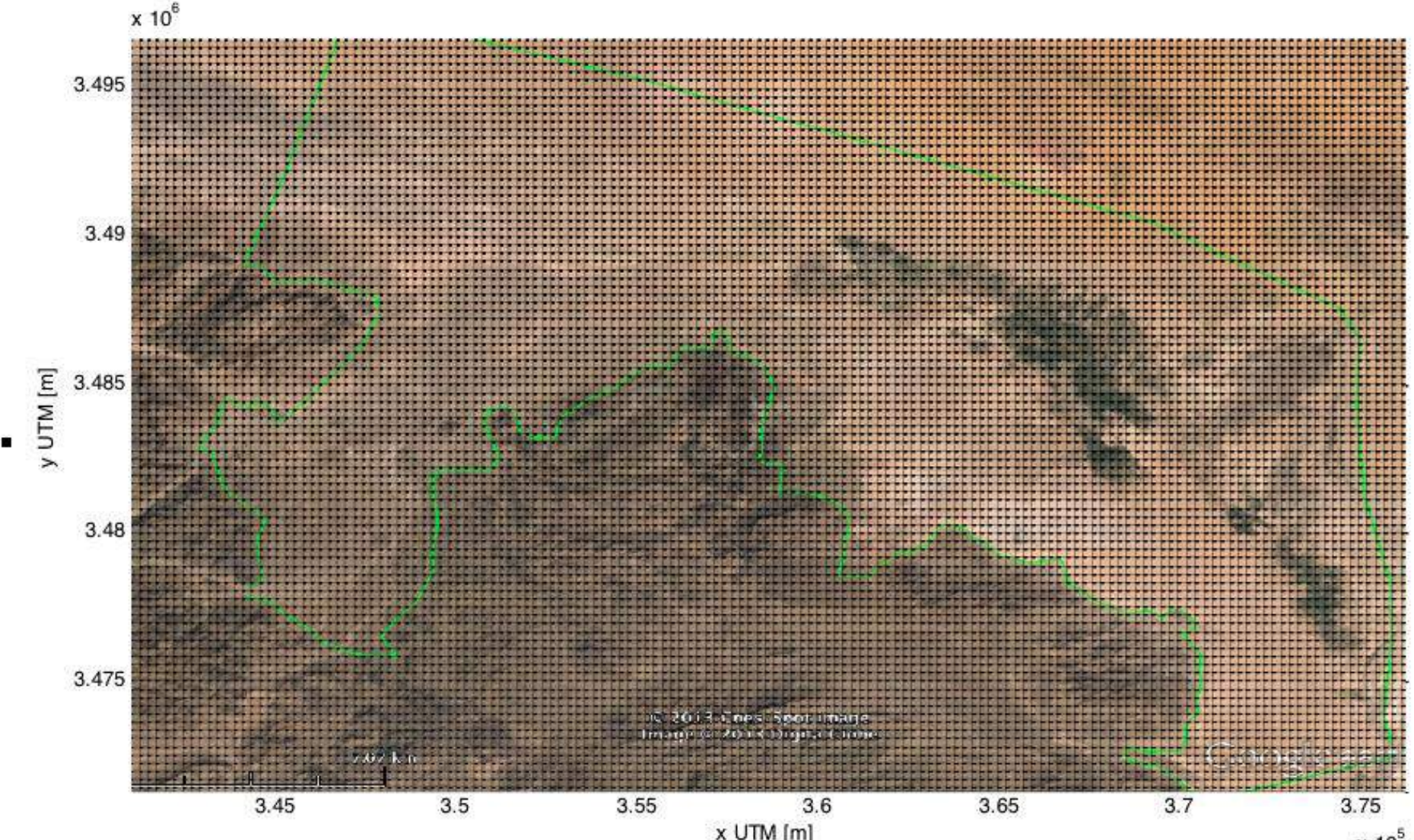
Calibration

Initial model

Water level
with respect to ground surface
(m)



Model Grid from SRTM (NASA)



Only monthly precipitation data locally available

Year	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1977/1978	*	*	*	8.3	3.4	*	0	3.2	2	0	0	23.6
1978/1979	0.3	7	0	0.5	62.4	*	2.4	*	0.1	4.7	0	*
1979/1980	25.3	78.9	2.9	0	17.7	28.5	33	21.5	0.8	0	0	1.7
1980/1981	15.3	3.2	14.7	22.9	0	9.7	0	*	2.3	14.4	0.3	1.7
1981/1982	2.2	*	*	0	28.9	1.9	*	58	42.5	0.8	*	*
1982/1983	0.9	0.7	5.3	0	1.9	*	*	4	23.1	*	*	0.3
1983/1984	*	1.9	*	0	*	0	1.8	*	11.5	1.5	0	0
1984/1985	3.3	0	12.6	0	15.8	15.7	0.9	12	9.7	0	0	2
1985/1986	14.1	15.5	8.9	45.8	4.3	3.7	1.3	0	3.3	0.4	0	0
1986/1987	3.7	52.2	*	0	0.3	*	21.7	0	10.4	10.9	0	0
1987/1988	18.7	7.7	13.1	10.1	4	34.1	8.3	1.1	2.5	*	0	*
1988/1989	0.3	15.3	45.4	0	0	21.2	3.2	4.5	0	6.8	2.8	29
1989/1990	13.6	70.5	41.7	52.3	1.6	0	8.5	10.8	24	0	0.4	0.3
1990/1991	4.8	0	*	29.8	0	12	11.2	16	3	10.7	0.2	8.4
1991/1992	8.3	4	0	9.5	0	17.4	3.9	7.5	10.9	1.4	*	0.1
1992/1993	*	1	5.8	24.7	5.9	11.5	5.2	0	*	0	0	2.8
1993/1994	*	8.2	49	3.1	69	0	0	10	0	0	*	2.2
1994/1995	*	48.2	0	0	0	0	29.7	28.5	0	12.2	*	8.3
1995/1996	4	49.8	0	3.2	16.6	45.3	12.2	*	1.4	43.9	17.9	0

Spatial Data and Python

Python course at IHE, 2017

Tim Hessels

UNESCO-IHE
Institute for Water Education

Download Python packages

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Introduction to R Programming

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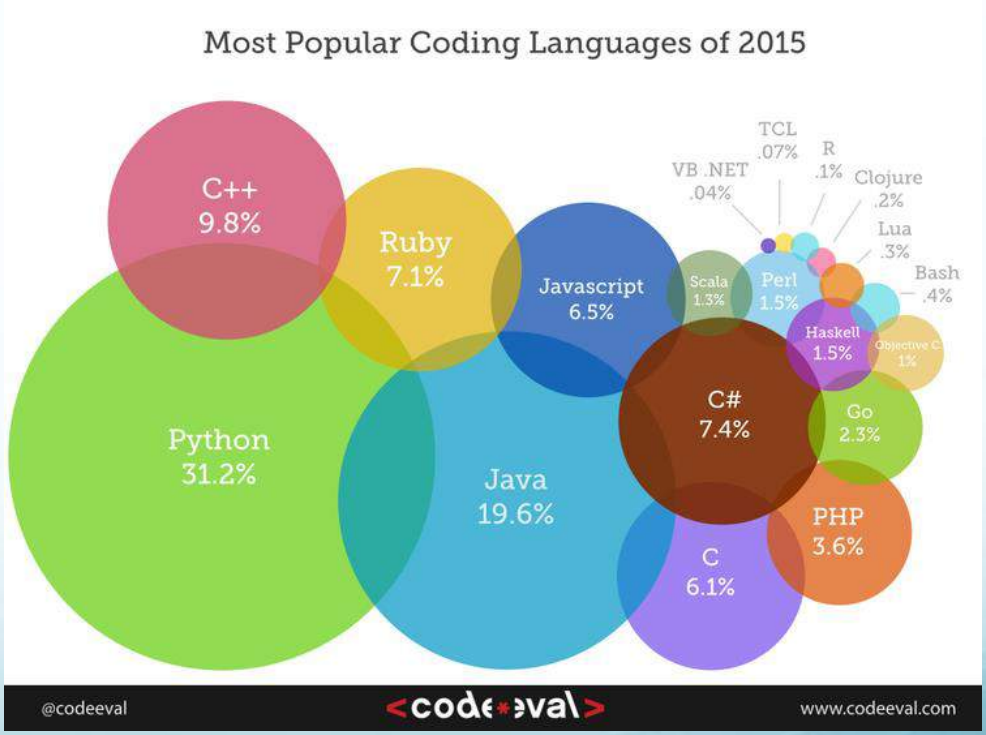
perl Programming Language



Python

GTIFF = GEO Location + Array

Includes:
- Projection
- Geo Transform
- No Data Value

Includes:
- Pixel Values

Downloading data

1. Download daily CHIRPS data of October till December 2016 by using FileZilla
   - Download the daily data for Africa only
   - /pub/org/chg/products/CHIRPS-2.0/africa_daily/tifs/p05/2016

2. Unzip the data

Climate Hazards Group Infrared Precipitation with Station data (CIRPS)hirps data

IRPS

chg.geog.ucsb.edu/data/chirps/

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DATA

CHIRPS

What is CHIRPS?

Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. Spanning 50°S-50°N (and all longitudes), starting in 1981 to near-present, CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring. As of February 12th, 2015, version 2.0 of CHIRPS is complete and available to the public. For detailed information on CHIRPS, please refer to our paper in *Scientific Data*.

History and Intent

Since 1999, U.S. Geological Survey (USGS) and CHG scientists, supported by funding from the U.S. Agency for International Development (USAID), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA), have been developing techniques for producing rainfall maps, especially where surface data is sparse.

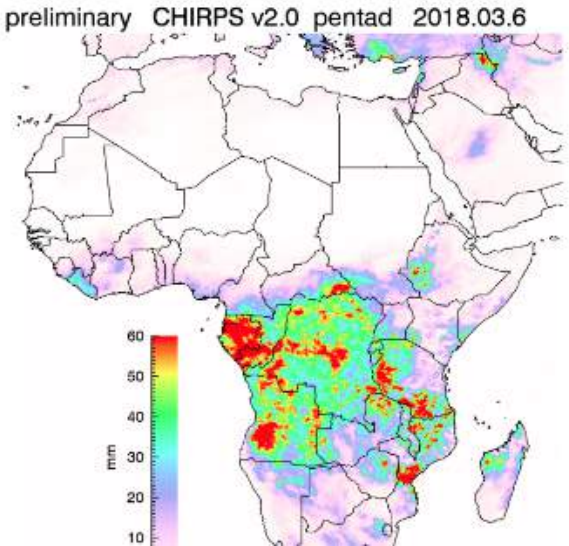
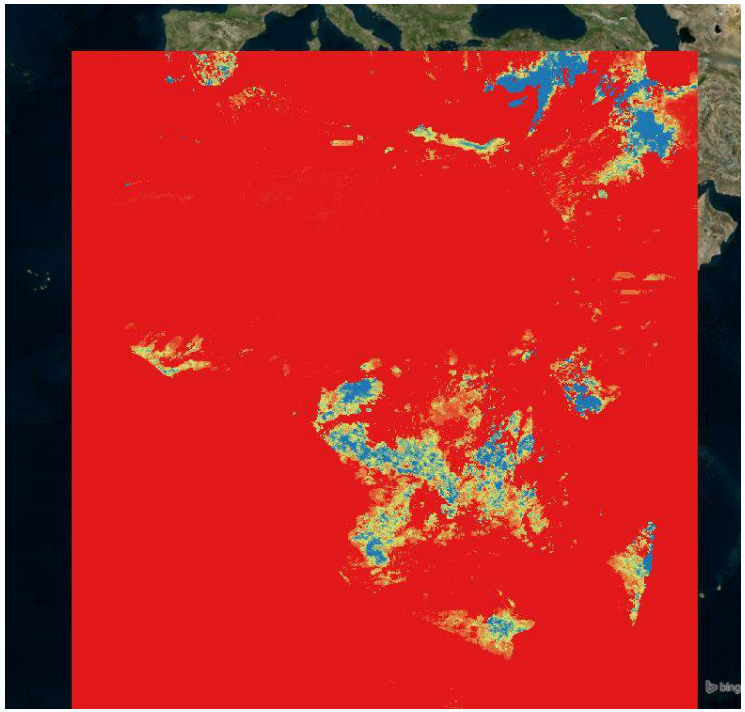


Table of Contents

Data & Tools

Python

Open chirps-v2.0.2016.12.01.tif in QGIS and you get:

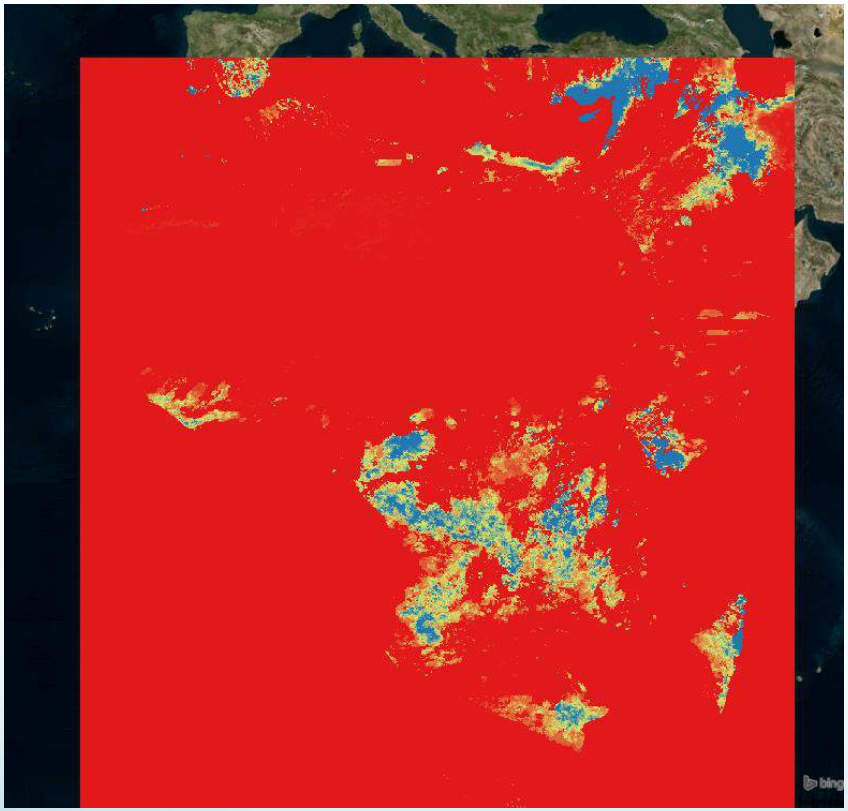


No Data Value is not defined, this is therefore shown as a red (Value = -9999)

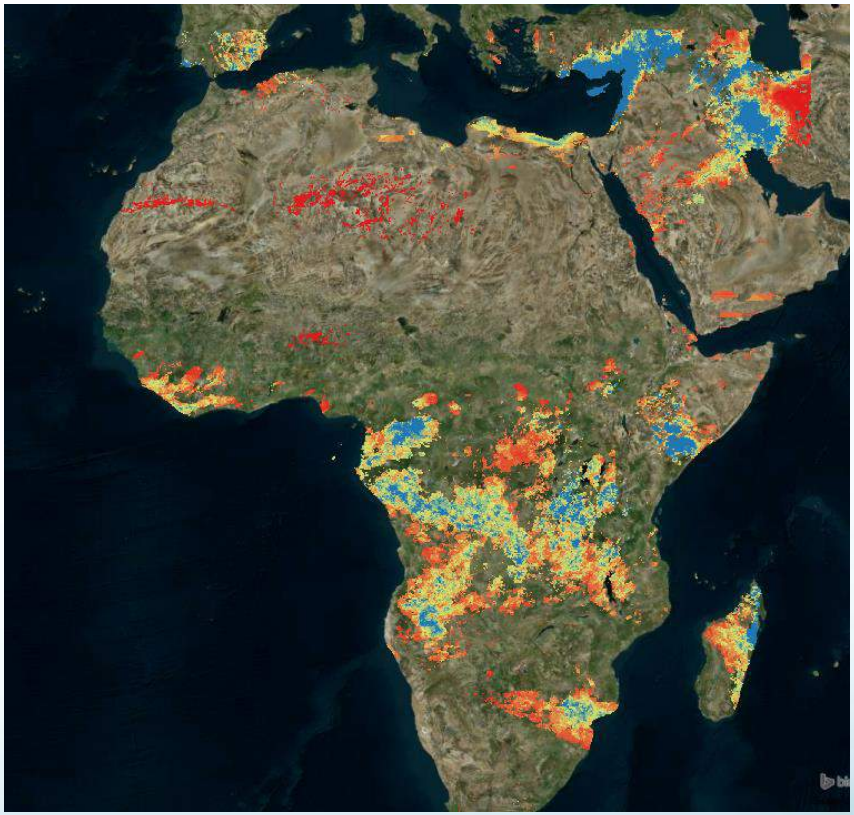
Now we will create a new tiff file where the no data value is defined and the pixels with 0 rainfall is also defined as no data

Python

Now create a new tiff file where the no data value is defined and the pixels with 0 rainfall is also defined as no data



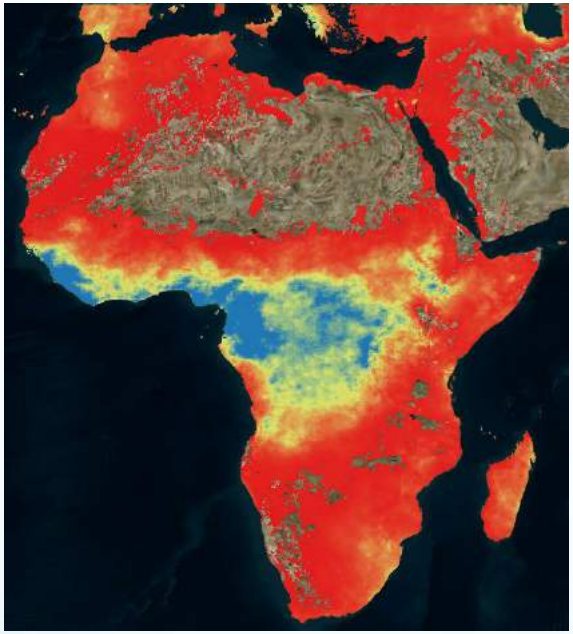
Old Tiff



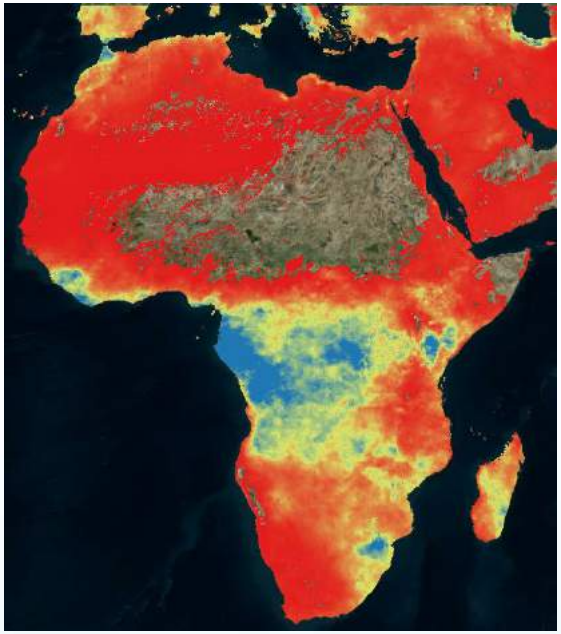
New Tiff

Python

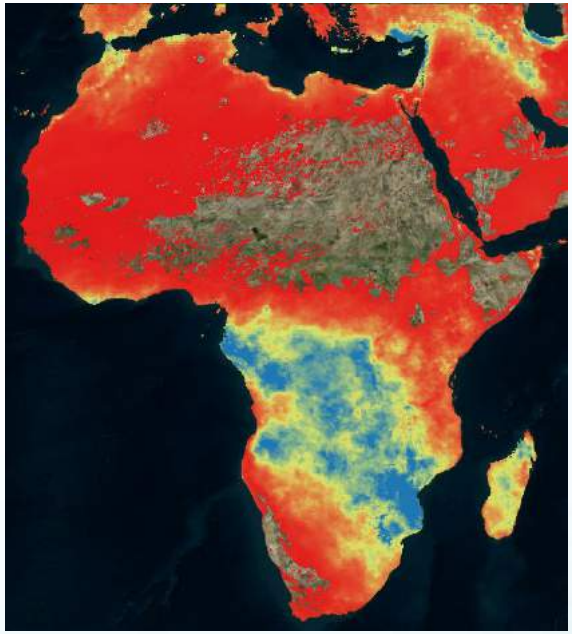
October 2016



November 2016



December 2016



International Groundwater Re ×

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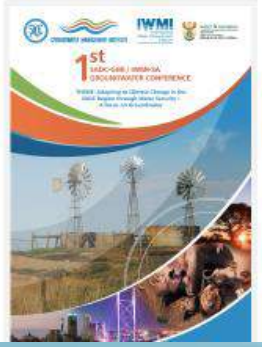


Flyer official launch Groundwater Overview

Global Groundwater Information System (GGIS)

The Global Groundwater Information System (GGIS) is an interactive, web-based portal to groundwater-related information and knowledge.

The GGIS consists of several modules structured around various themes. Each module has its own map-based viewer with underlying database to allow storing and visualizing geospatial data in a systematic way.

Transboundary groundwaters

In the modules below, you can obtain more information about transboundary aquifers (TBA's).

Transboundary Aquifers (TWAP Project)

Selection of 199 aquifers and 43 SIDS.

Ramotswa Aquifer

Shared between Botswana and South Africa.

Dinaric Karst (DIKTAS Project)

Shared by Albania, Bosnia and Herzegovina,

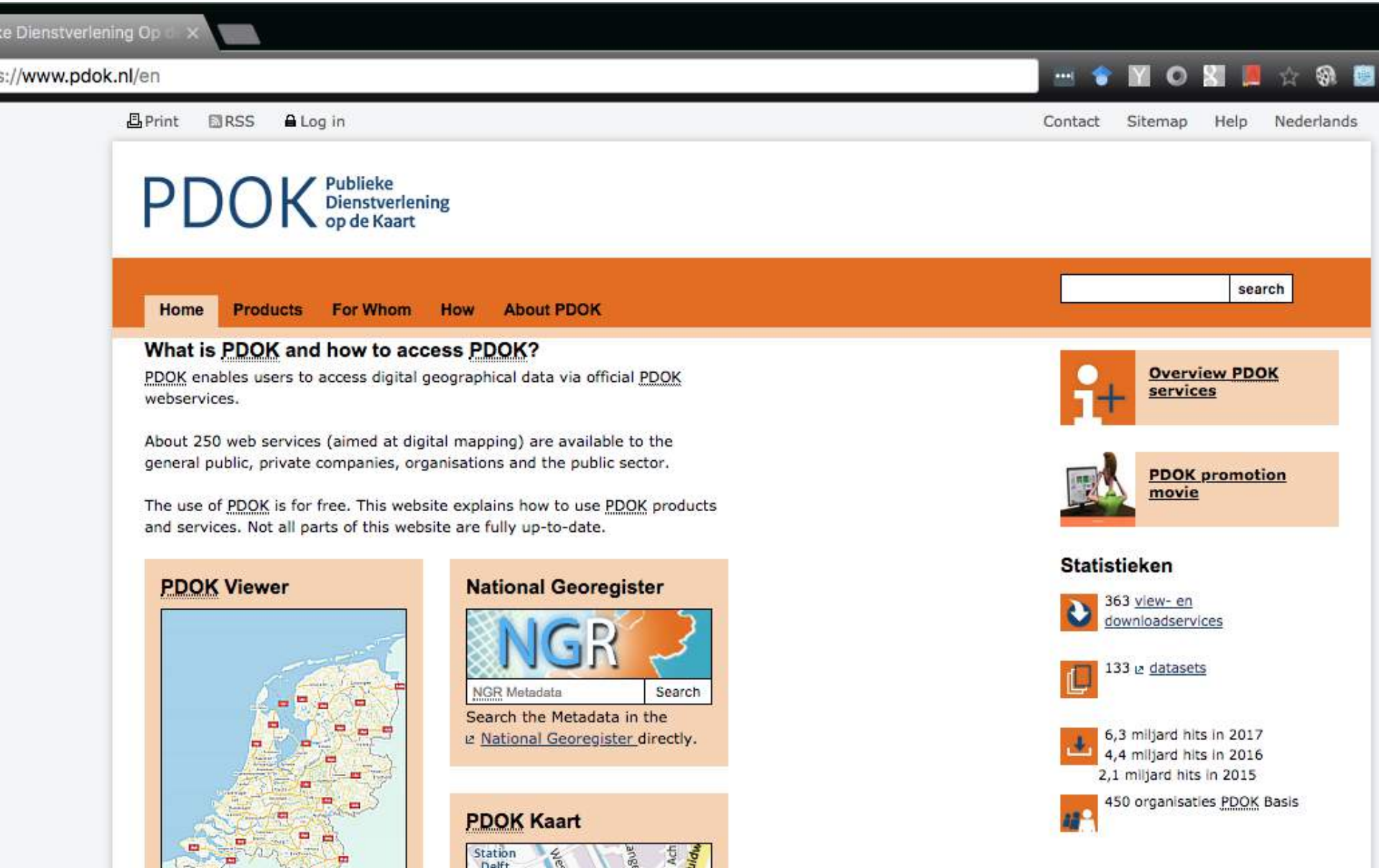
Related Resources

Global Groundwater Information System (GGIS)

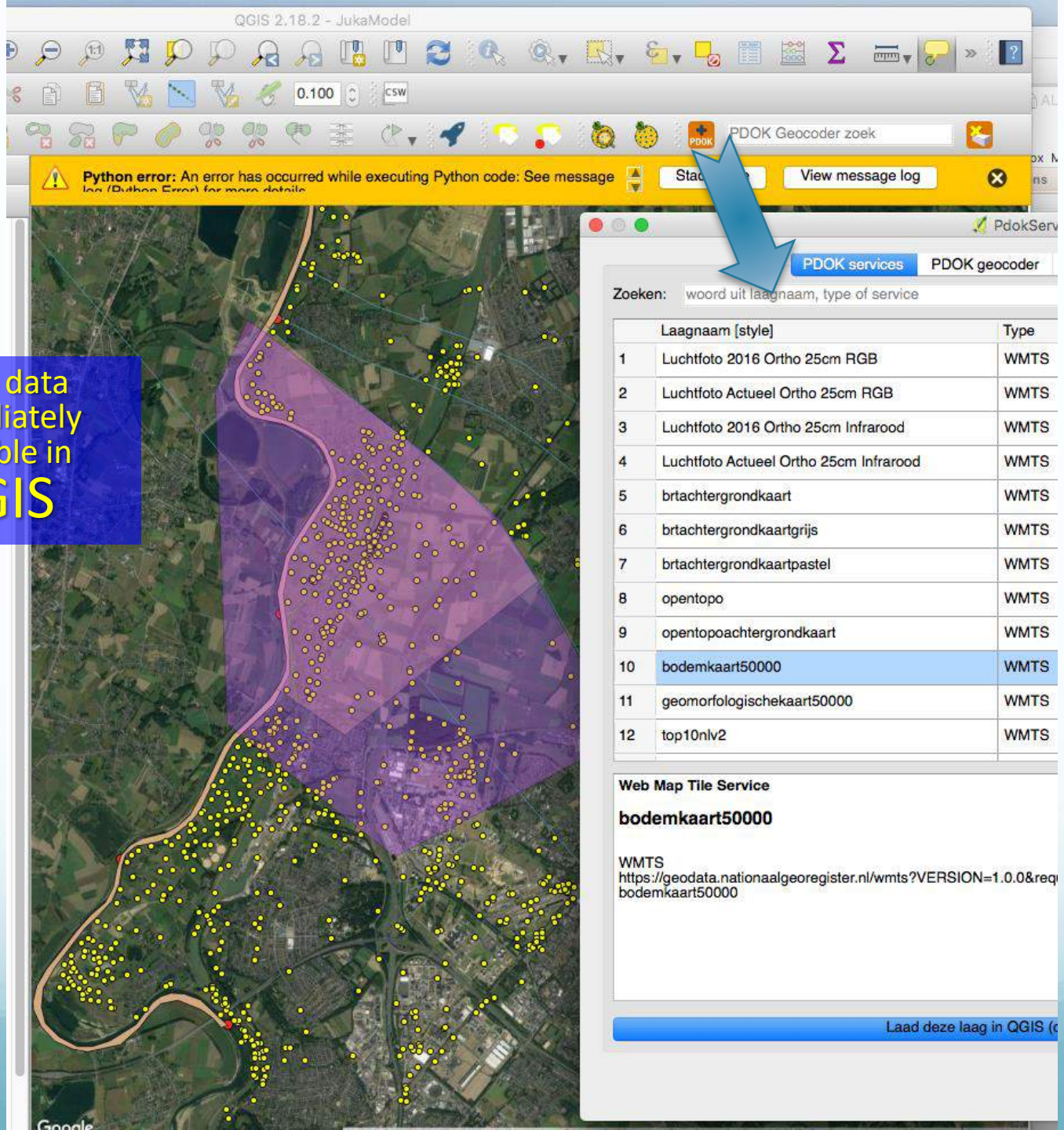
Netherlands

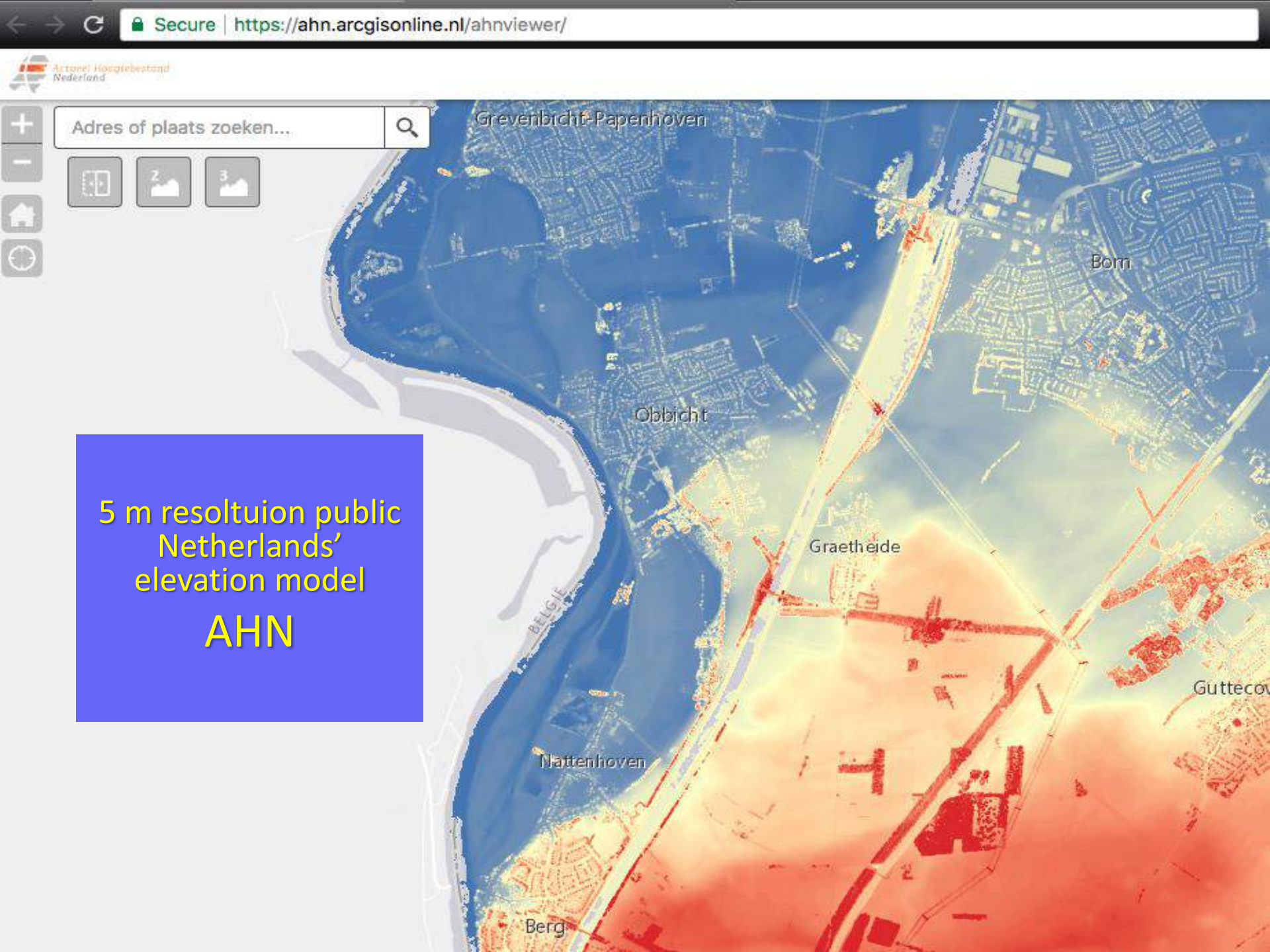
- National and company repositories including documents (example pdfs, WaternetT)
- Notably in NL AHN
- Dinoloket
- KNMI
- Social → See

The Netherlands' national portal for getting public data



PDOK data immediately available in QGIS

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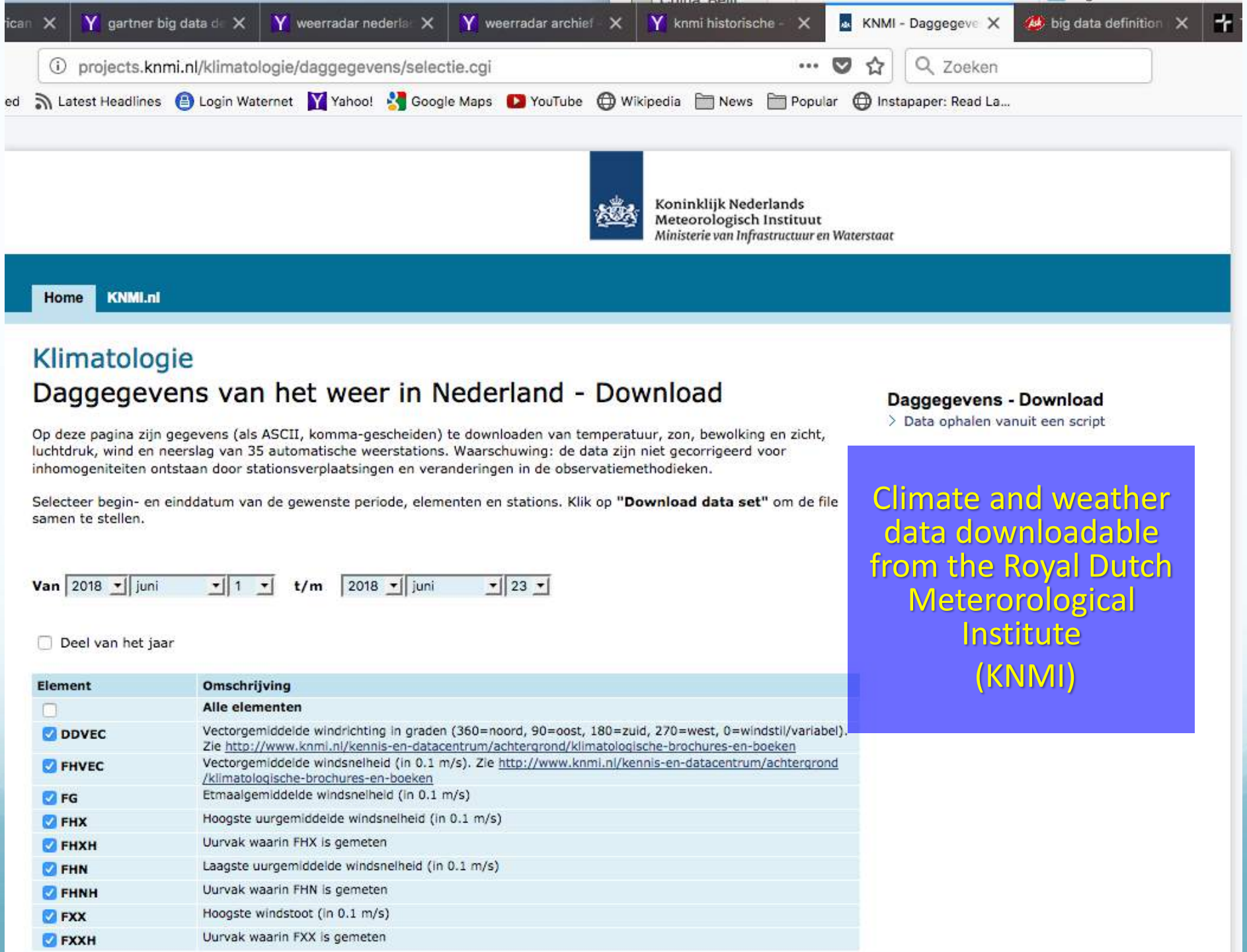
Actueel Hoogtebestand Nederland
Adres of plaats zoeken...
Grevenbicht-Papenhoven
Born
Obbicht
Graetheide
BELGIE
Nattenhoven
Berg
5 m resoltuion public Netherlands' elevation model
AHN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KNMI - Daggegeve
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Daggegevens van het weer in Nederland - Download
Op deze pagina zijn gegevens (als ASCII, komma-gescheiden) te downloaden van temperatuur, zon, bewolking en zicht, luchtdruk, wind en neerslag van 35 automatische weerstations. Waarschuwing: de data zijn niet gecorrigeerd voor inhomogeniteiten ontstaan door stationsverplaatsingen en veranderingen in de observatiemethodieken.
Selecteer begin- en einddatum van de gewenste periode, elementen en stations. Klik op "Download data set" om de file samen te stellen.
Van 2018 juni 1 t/m 2018 juni 23
Deel van het jaar
Element
Omschrijving
Alle elementen
DDVEC
Vectorgemiddelde windrichting in graden (360=noord, 90=oost, 180=zuid, 270=west, 0=windstil/variabel). Zie http://www.knmi.nl/kennis-en-datacentrum/achtergrond/klimatologische-brochures-en-boeken
FHVEC
Vectorgemiddelde windsnelheid (in 0.1 m/s). Zie http://www.knmi.nl/kennis-en-datacentrum/achtergrond/klimatologische-brochures-en-boeken
FG
Etmaalgemiddelde windsnelheid (in 0.1 m/s)
FHX
Hoogste uurgemiddelde windsnelheid (in 0.1 m/s)
FHXH
Uurvak waarin FHX is gemeten
FHN
Laagste uurgemiddelde windsnelheid (in 0.1 m/s)
FHNH
Uurvak waarin FHN is gemeten
FXX
Hoogste windstoot (in 0.1 m/s)
FXXH
Uurvak waarin FXX is gemeten
Daggegevens - Download
Data ophalen vanuit een script
Climate and weather data downloadable from the Royal Dutch Meterorological Institute (KNMI)


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DINOloket
Data en Informatie van de Nederlandse Ondergrond
Subsurface data repository maintained by
TNO
Welkom
Iedereen die geïnteresseerd is in de ondergrond, kan op DINOloket van TNO, Geologische Dienst Nederland, gratis gegevens van de ondergrond bekijken en aanvragen. Deze gegevens komen uit de database van DINO én de BRO (Basisregistratie Ondergrond). Gegevens gerelateerd aan de Mijnbouwwet vindt u op NLOG.
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Zoeken, bekijken, selecteren en aanvragen via de kaart

Ondergrondgegevens betaversie

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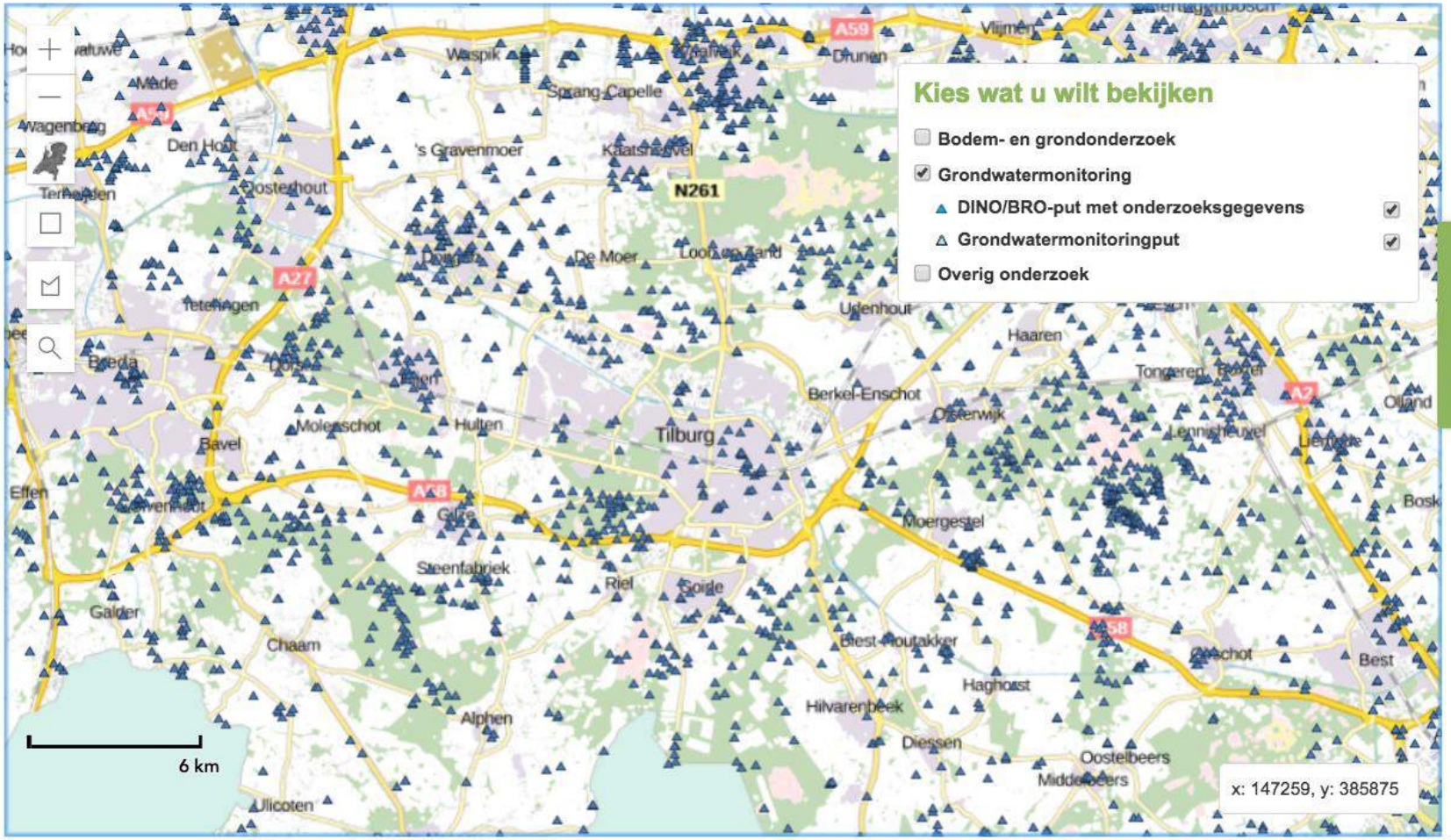
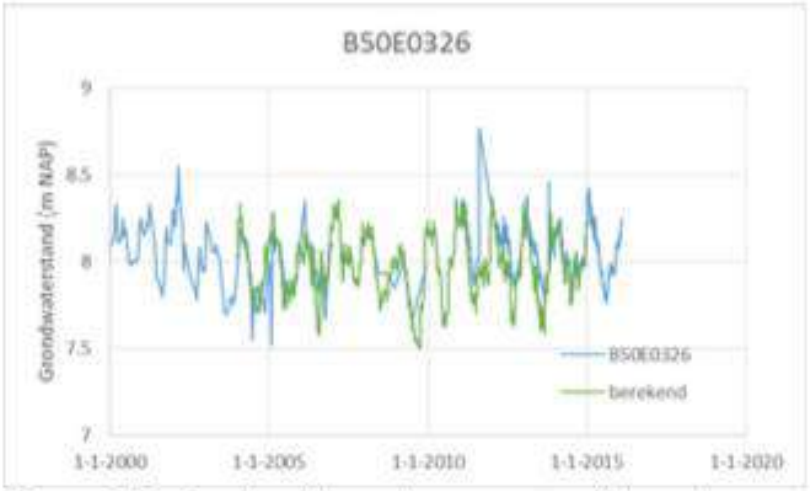


Deze site maakt deel uit van: BodemenOndergrond.nl

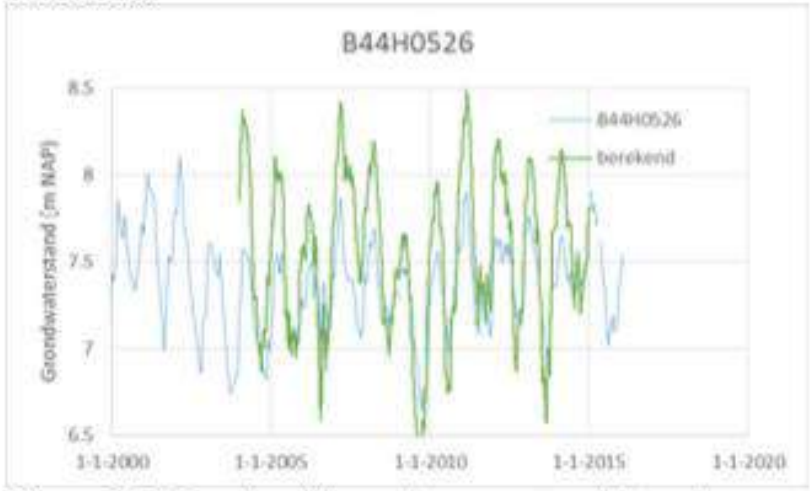
TNO innovation for life | WAGENINGEN UNIVERSITY & RESEARCH

Voorwaarden van deze website

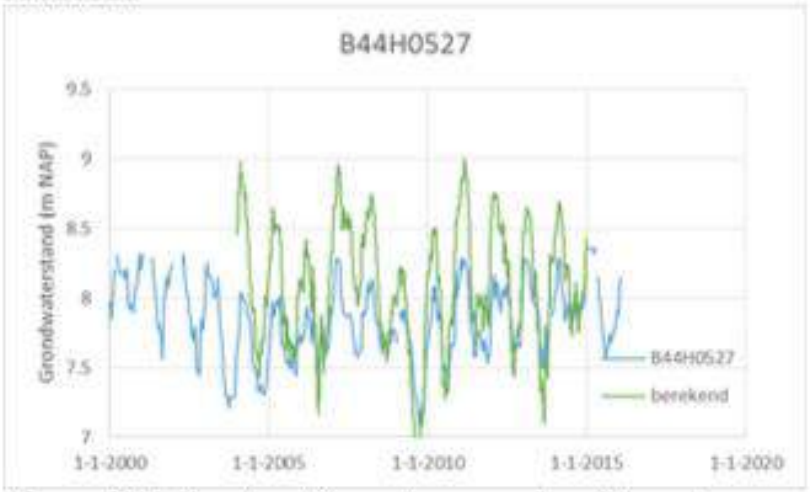


Figuur 6-15: Berekend (groen) en gemeten (blauw) B50E0326

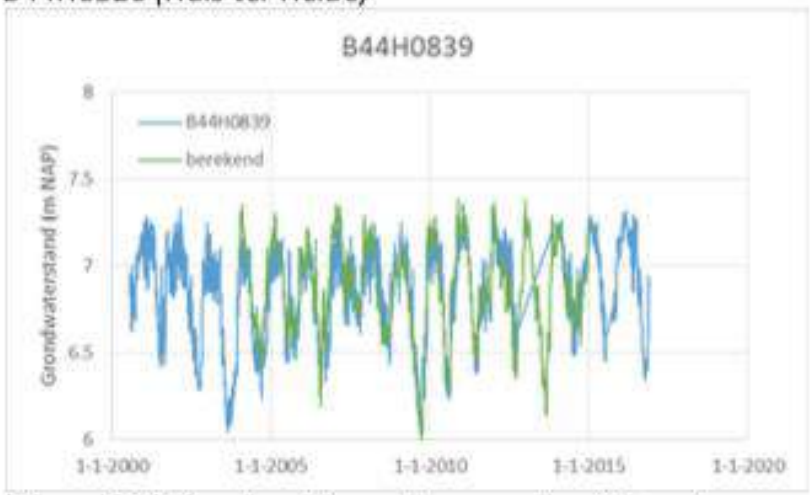
B44G0388



Figuur 6-16: Berekend (groen) en gemeten (blauw) B44H0526 (Huis ter Heide)



Figuur 6-17: Berekend (groen) en gemeten (blauw) B44H0527 (Huis ter Heide)

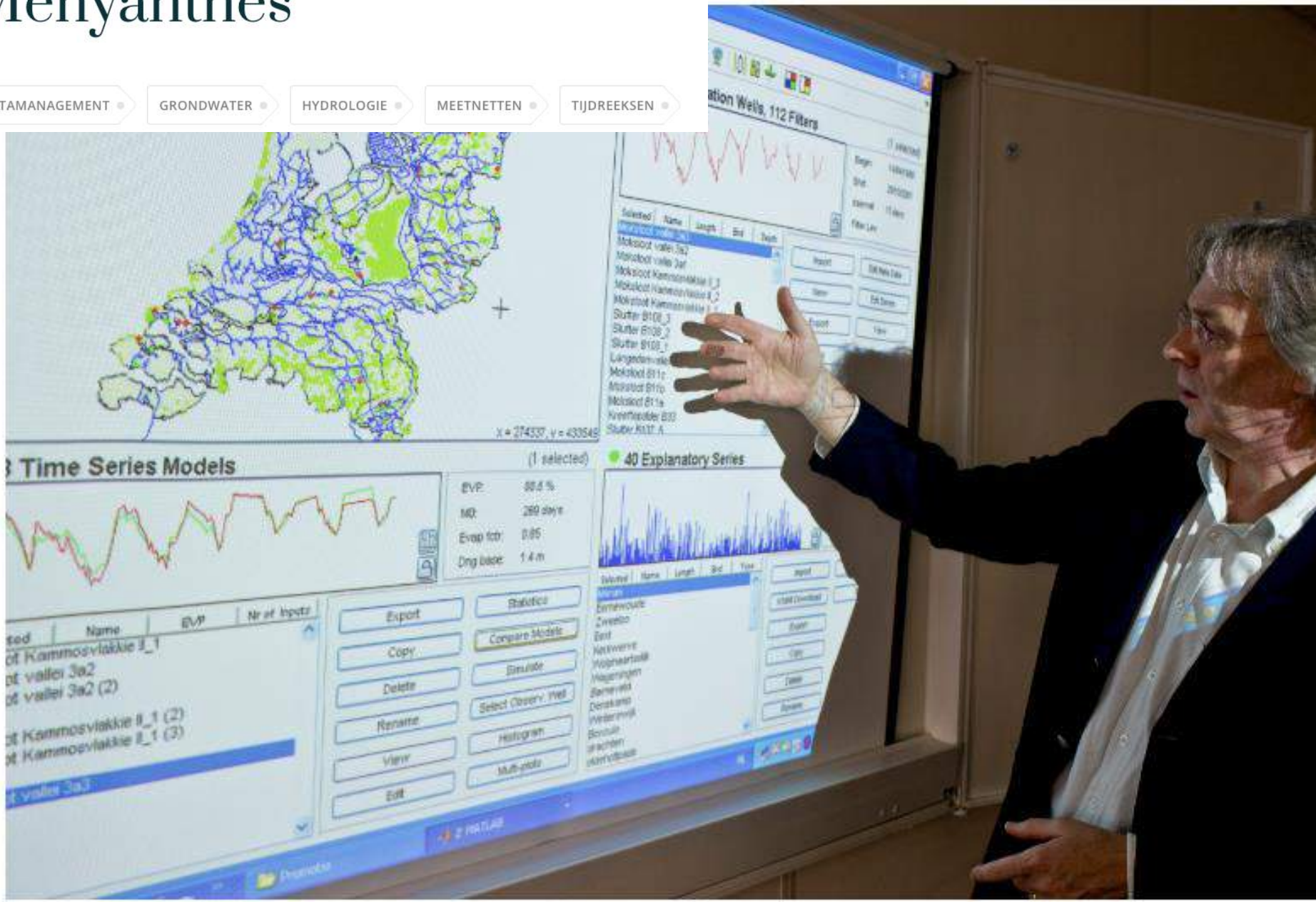


Figuur 6-18: Berekend (groen) en gemeten (blauw) B44H0839 (De Brand)

EEN BRUG SLAAN TUSSEN DATA EN HYDROLOGIE

Menyanthes

DATAMANAGEMENT · GRONDWATER · HYDROLOGIE · MEETNETTEN · TIJDREEKSEN



Pastas is an open-source framework for the analysis of hydrological time series.

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build passing

codecov 62%

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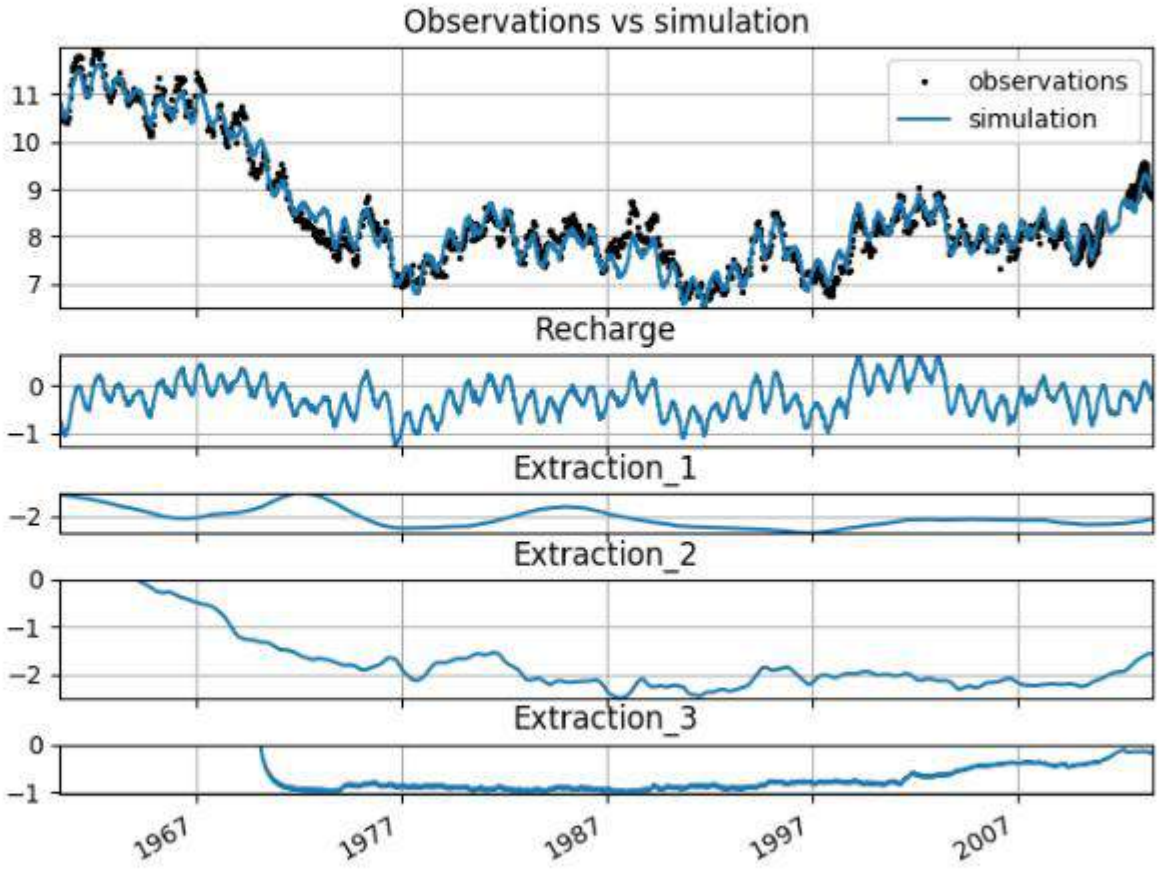
Introduction

PASTAS is an open source python package for processing, simulating and analyzing hydrological time series. The object oriented stucture allows for the quick implementation of new model components. Time series models can be created, calibrated, and analysed with just a few lines of python code with the built-in optimization, visualisation, and statistical analysis tools.



Model Whilhelminakanaal, Tilburg

Antea-Group:

700 tijdreeksen ganalyseerd als voorbewerking voor de model-ijking

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DINOloket

Data en Informatie van de Nederlandse Ondergrond

Welkom

Iedereen die geïnteresseerd is in de ondergrond, kan op DINOloket van TNO, Geologische Dienst Nederland, gratis gegevens van de ondergrond bekijken en aanvragen. Deze gegevens komen uit de database van DINO én de BRO (Basisregistratie Ondergrond). Gegevens gerelateerd aan de Mijnbouwwet vindt u op NLOG.

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Nomen

Basisr

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Betaversie

Ondergrondmodellen
Betaversie

Ondergrondgegevens
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Ondergrondmodellen
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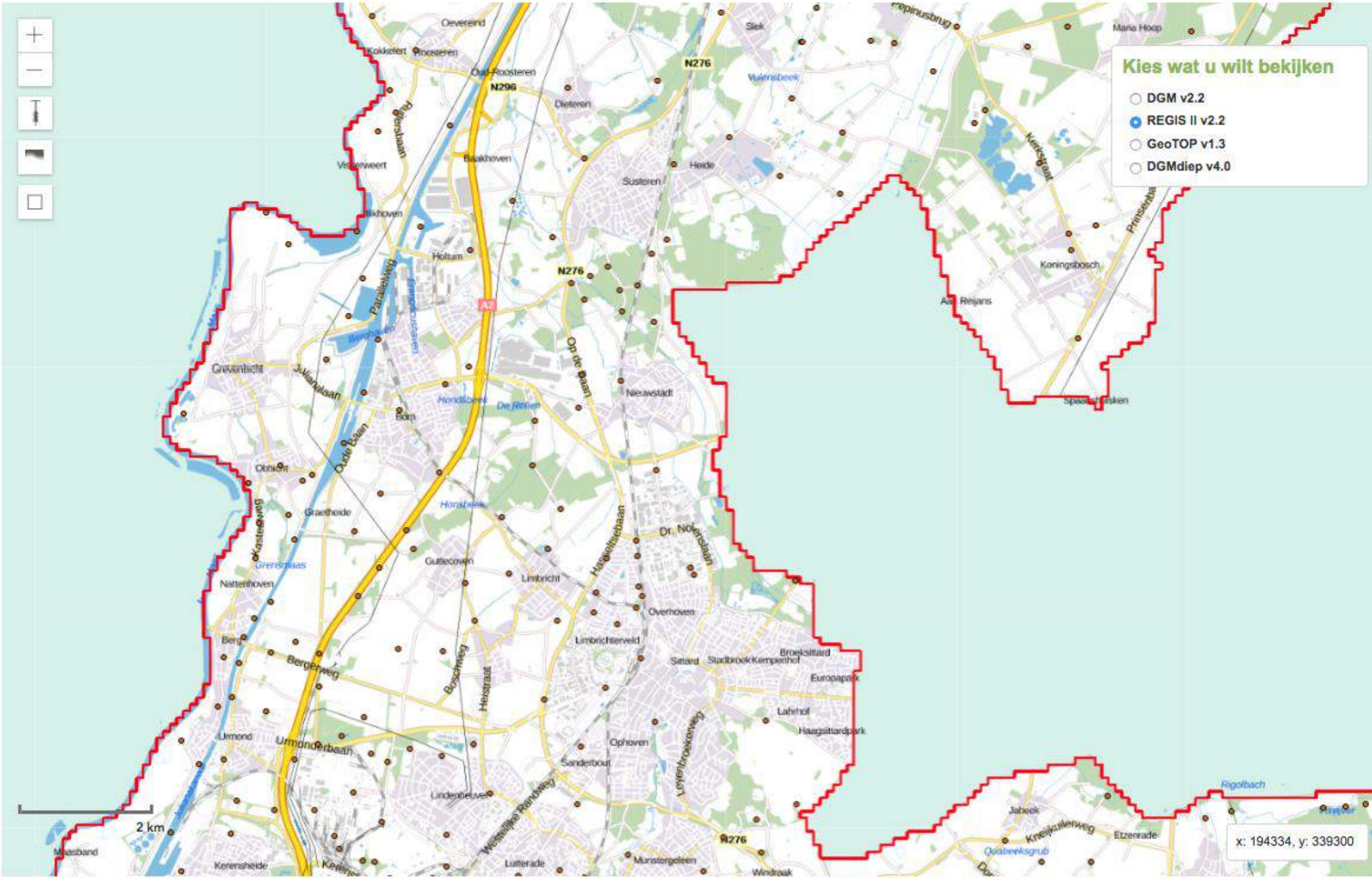

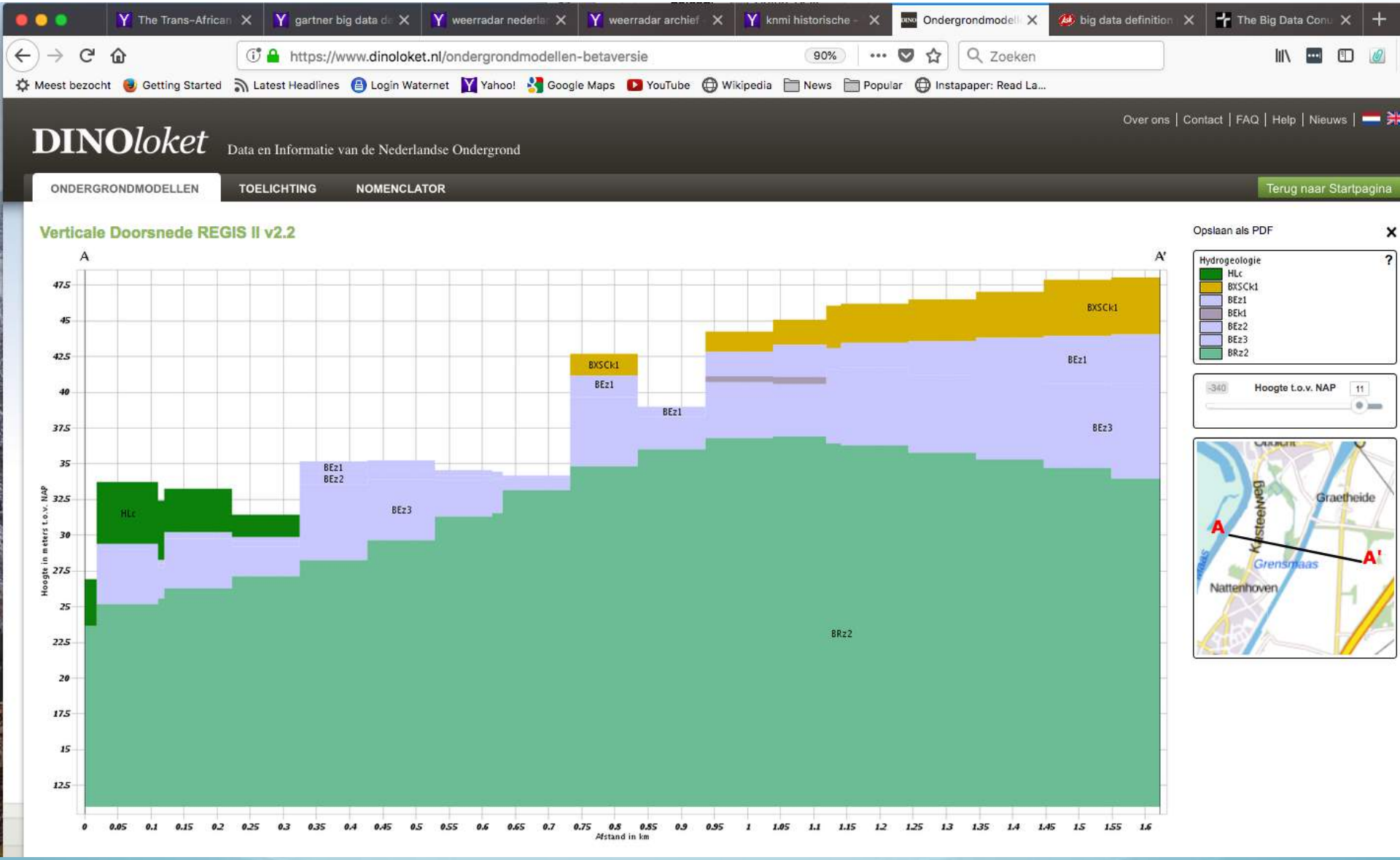
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BEz1
BEz2
BEz3
BRz2
Opslaan als PDF
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DINOloket

Data en Informatie van de Nederlandse Ondergrond

Welkom

Iedereen die geïnteresseerd is in de ondergrond, kan op DINOloket van TNO, Geologische Dienst Nederland, gratis gegevens van de ondergrond bekijken en aanvragen. Deze gegevens komen uit de database van DINO én de BRO (Basisregistratie Ondergrond). Gegevens gerelateerd aan de Mijnbouwwet vindt u op NLOG.

Direct

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Basisr

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Betaversie

Ondergrondmodellen
Betaversie

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Ondergrondmodellen
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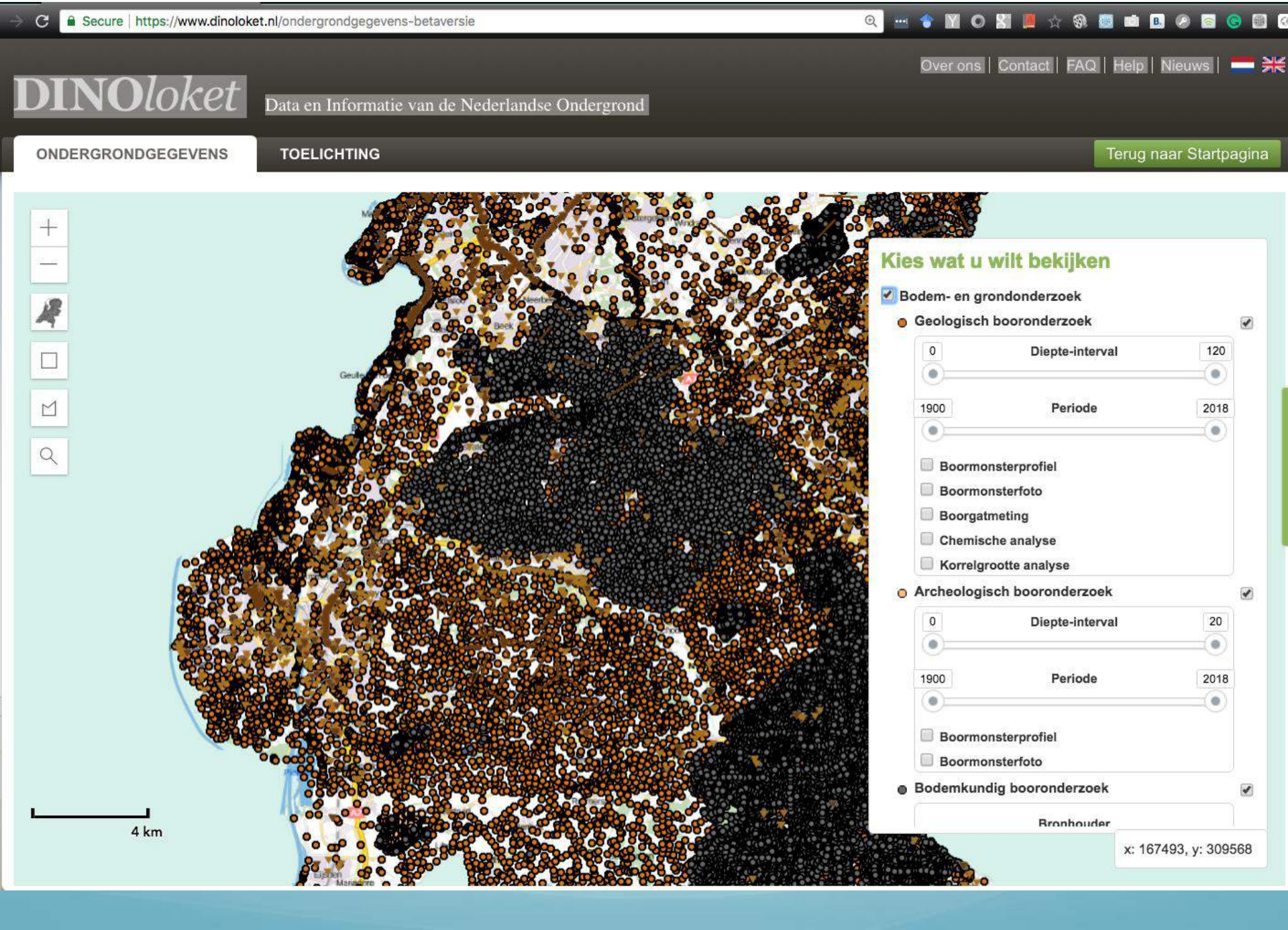
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Kies wat u wilt bekijken
Bodem- en grondonderzoek
Geologisch booronderzoek
0
Diepte-interval
120
1900
Periode
2018
Boormonsterprofiel
Boormonsterfoto
Boorgatmeting
Chemische analyse
Korrelgrootte analyse
Archeologisch booronderzoek
0
Diepte-interval
20
1900
Periode
2018
Boormonsterprofiel
Boormonsterfoto
Bodemkundig booronderzoek
Bronhouder
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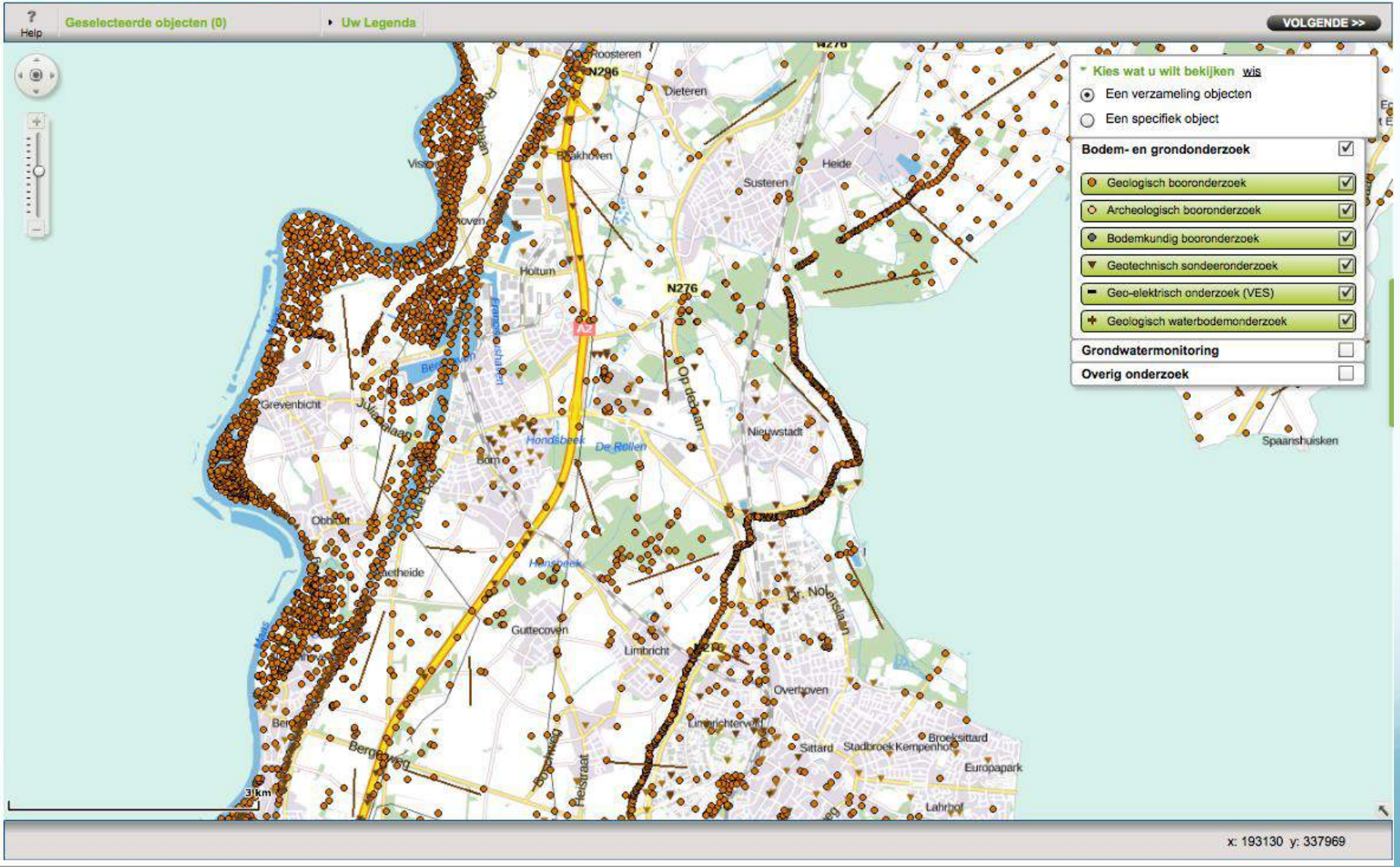

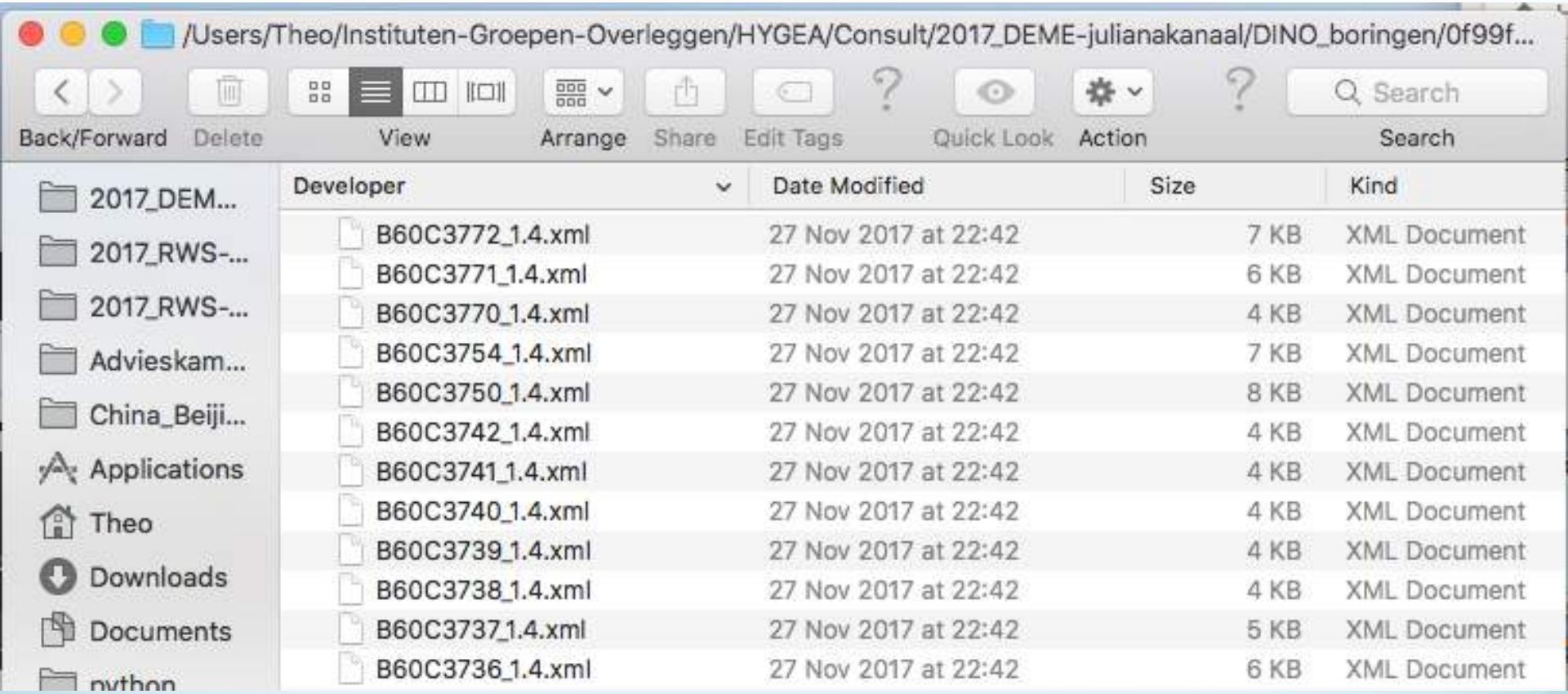
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Arrange
Share
Edit Tags
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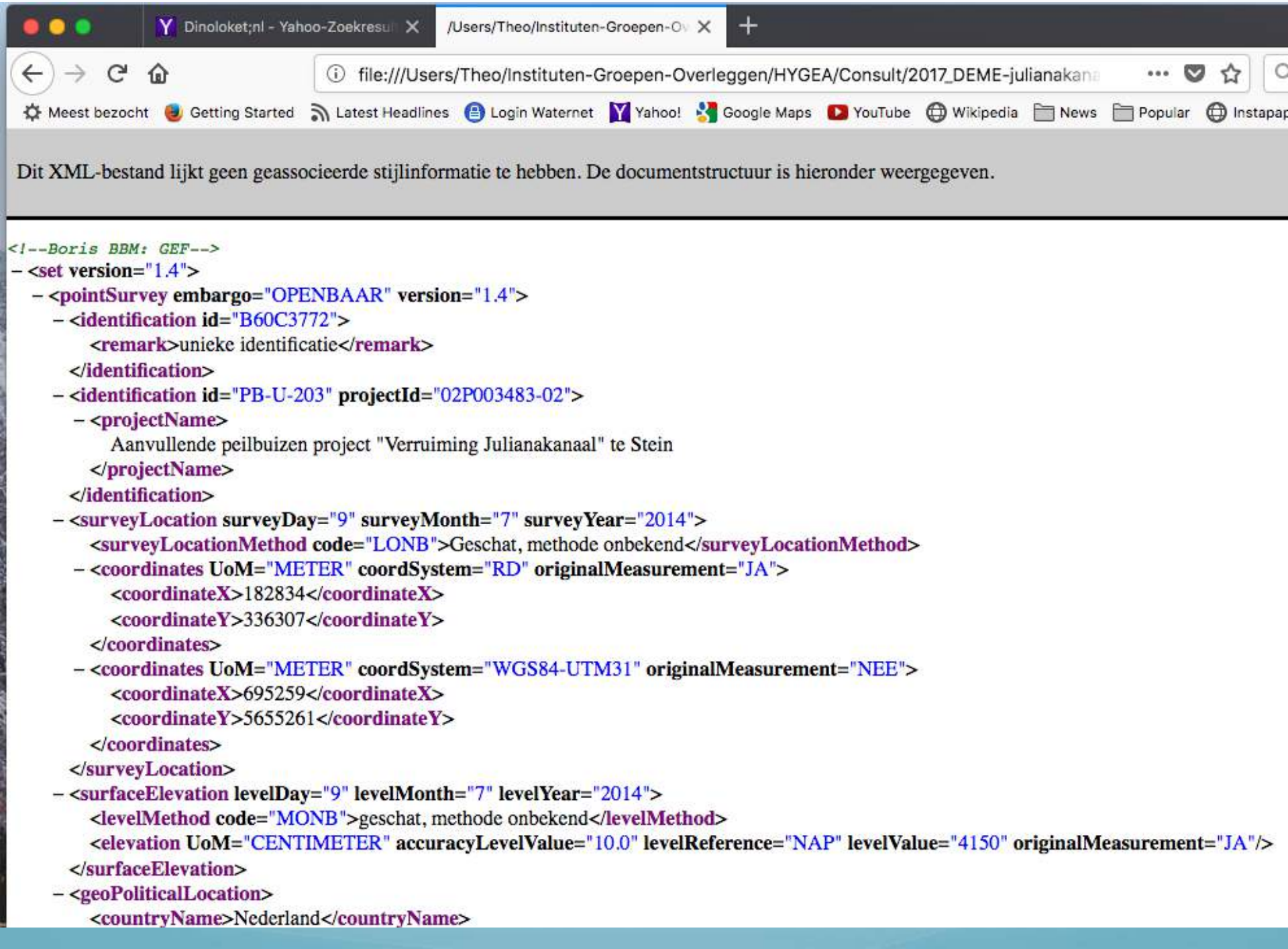
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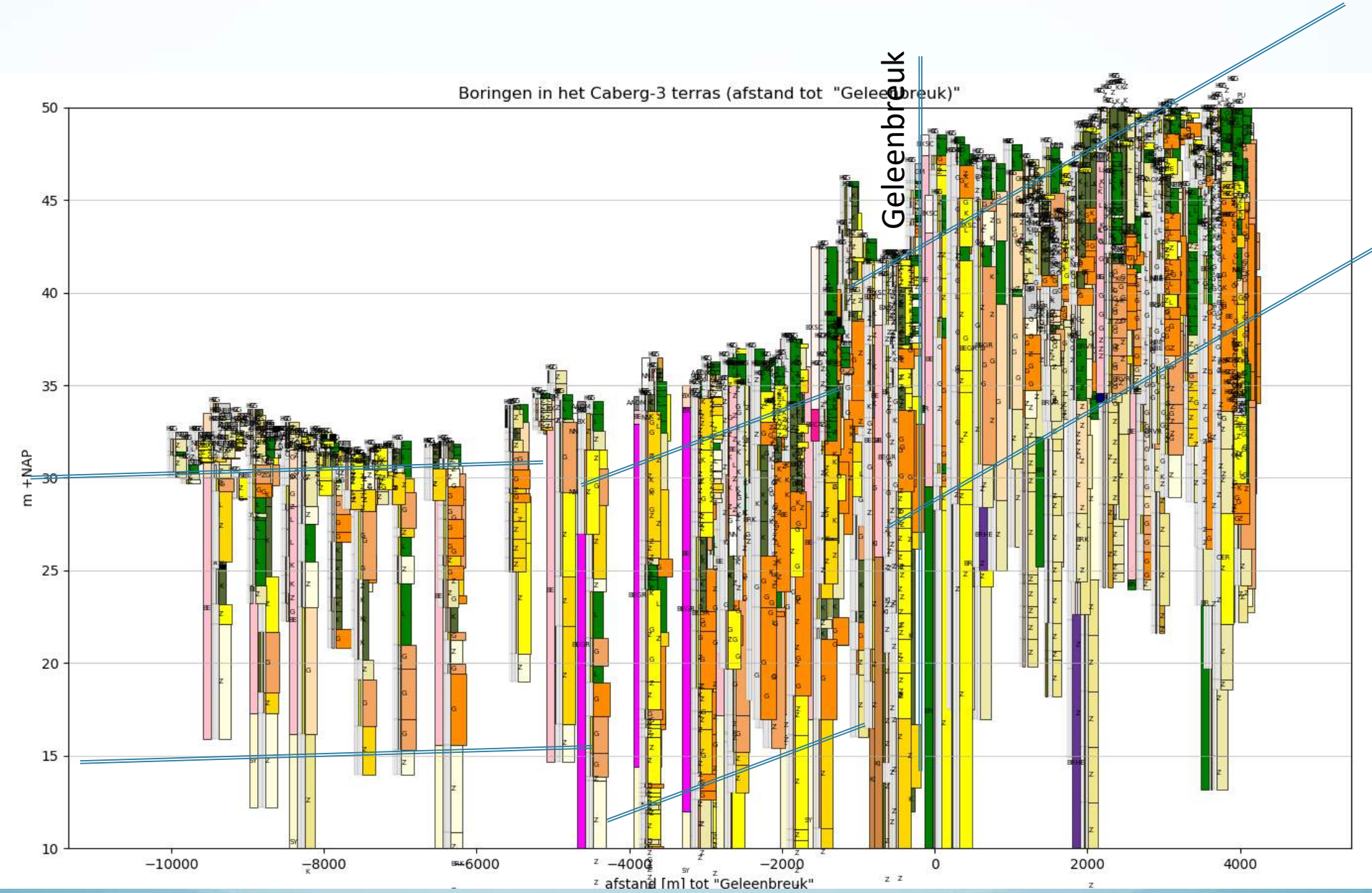
Boringen in het Caberg-3 terras (afstand tot "Geleenbreuk)"
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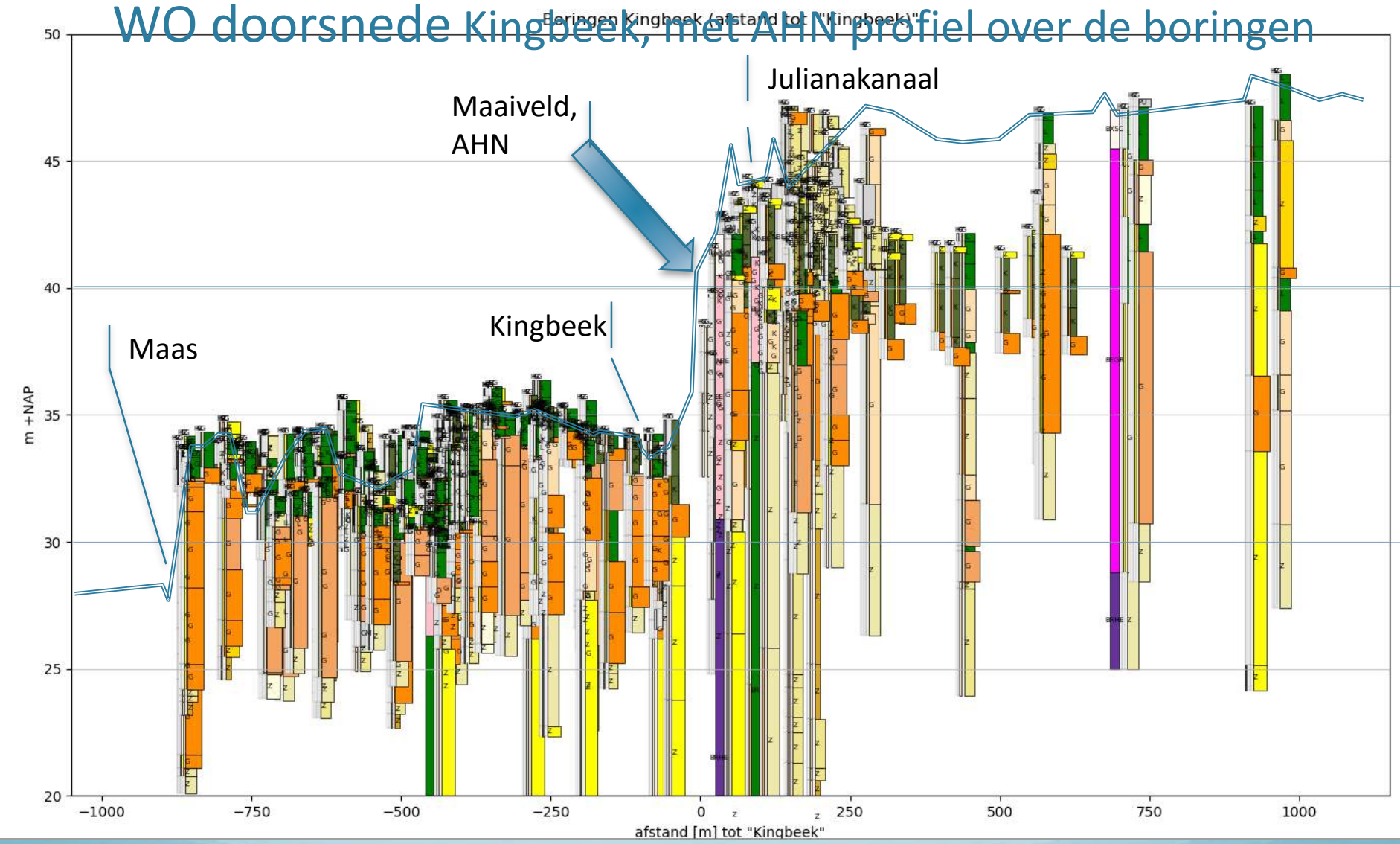
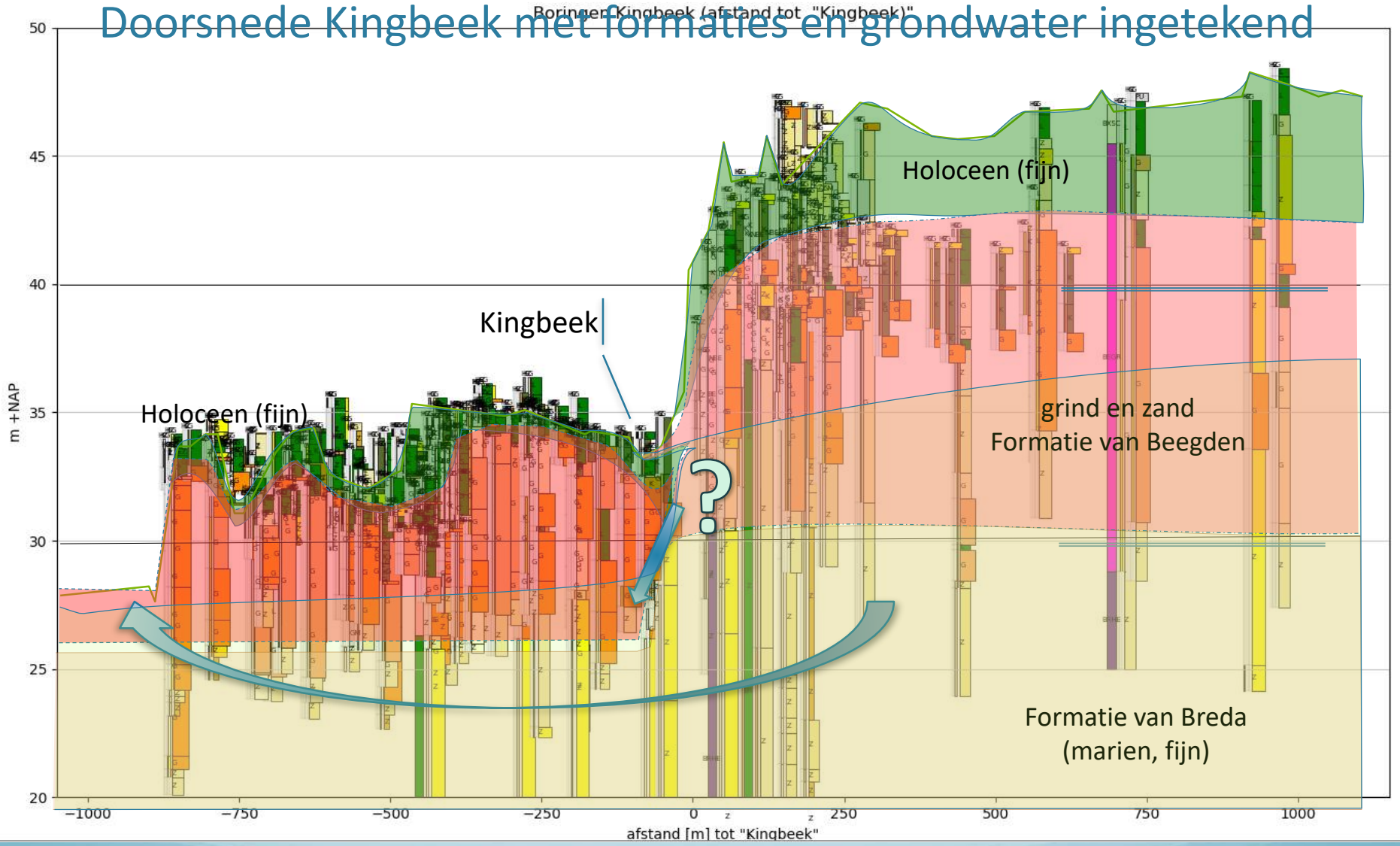
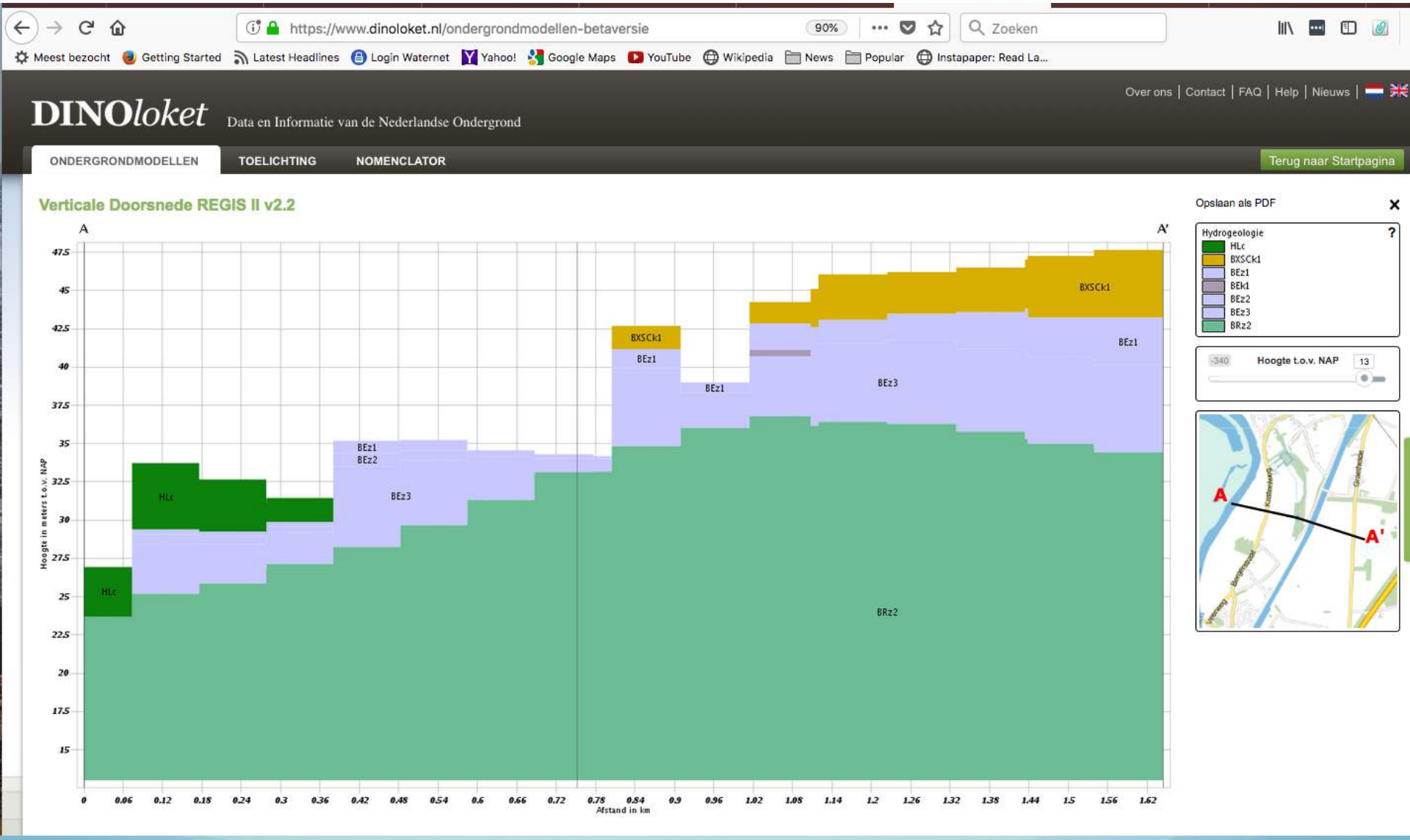
WO doorsnede Kingbeek, met AHN profiel over de boringen



Doorsnede Kingbeek met formaties en grondwater ingetekend

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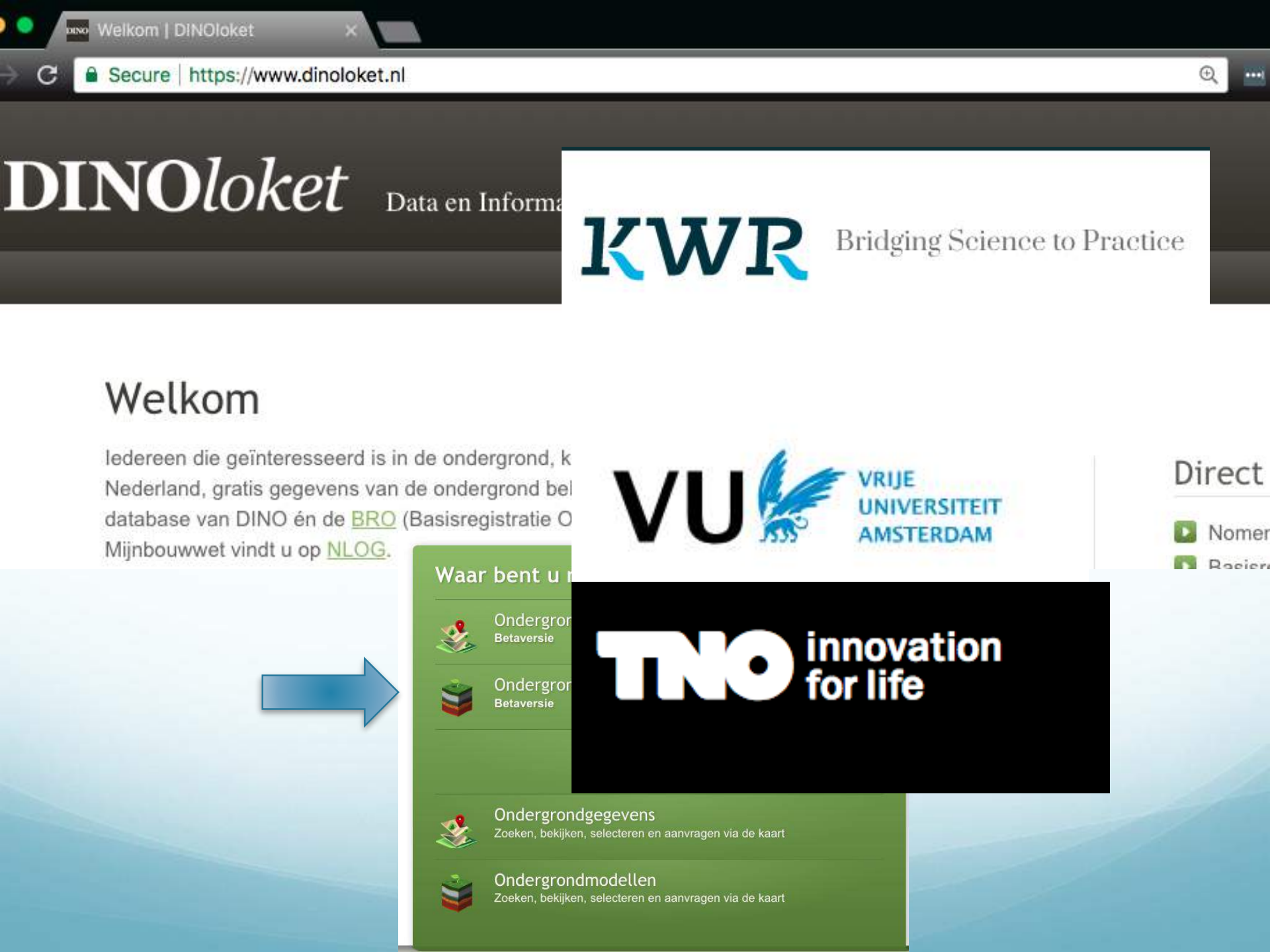
Hoogte in meters t.o.v. NAP
Afstand in km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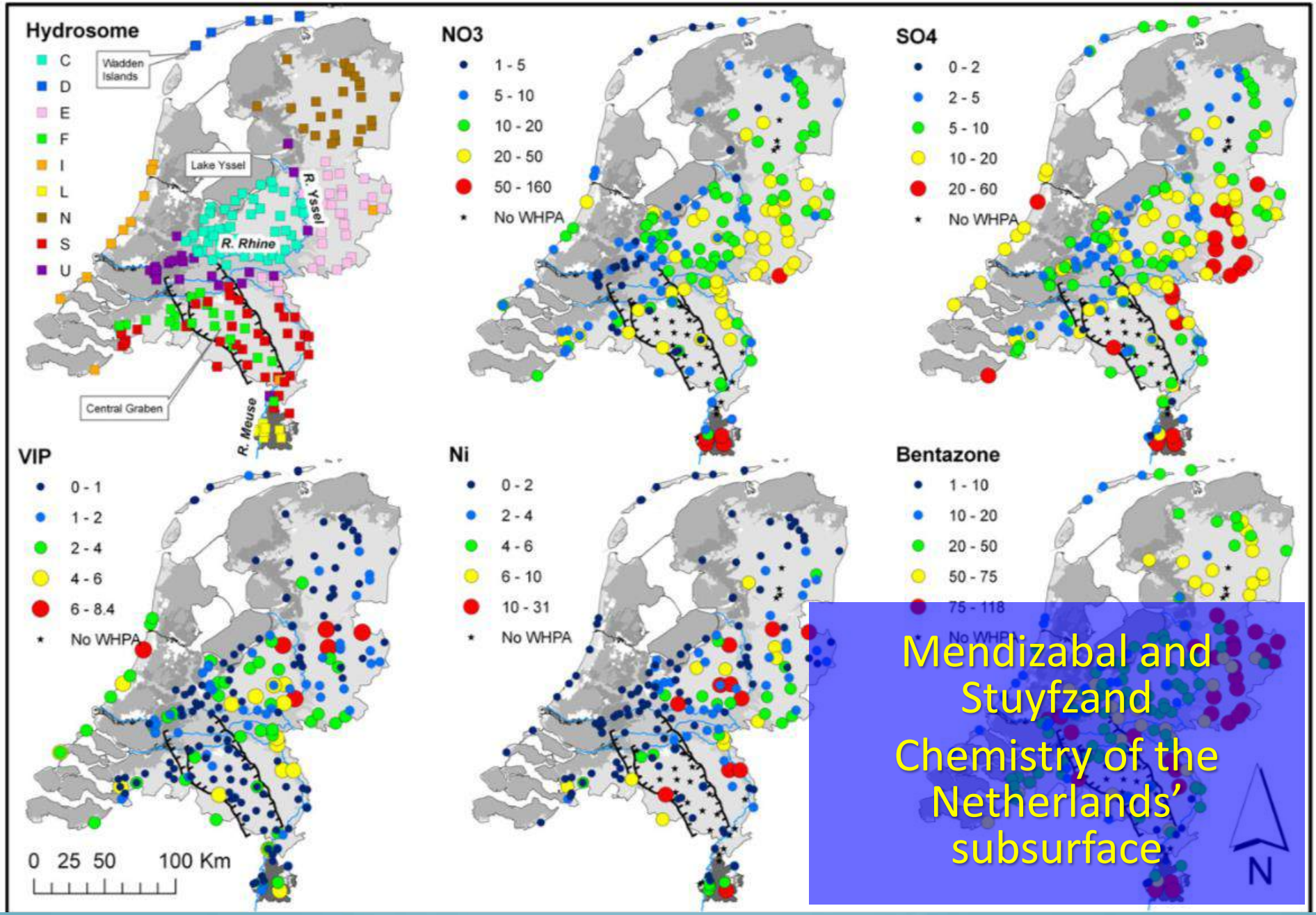
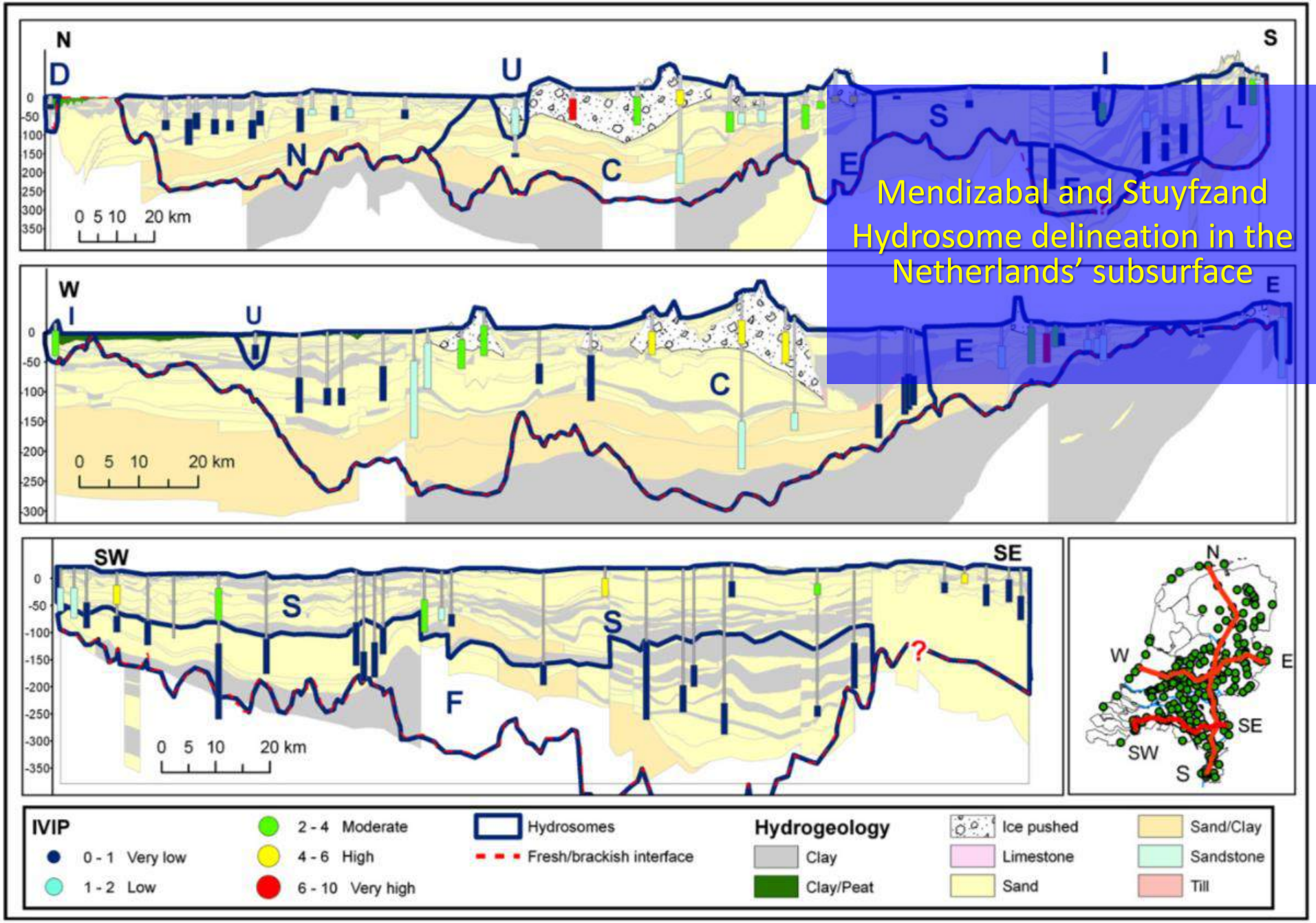


Mendizabal and Stuyfzand

Chemistry of the Netherlands' subsurface



Mendizabal and Stuyfzand Hydrosome delineation in the Netherlands' subsurface

Conclusions

- Satellite and remote sensing in general are extremely important, indispensible in fact, but are not the panacea for everything.
- The increasing number of repositories of groundwater data in the public domain allow much more sophsiticated and comprehensive analysis of groundwater related phenomena.
- This way, big data is not only relevant on the national scale, it is so locally as well.
- Professionals will have to be or become aware to stay relevant and will need to become skilled in accessing and handling and analysing large(r) amounts of data to make use of it.
- Modern software and flexible scripting languages in the public sector together with the available data permit everybody on earth to become professional, it only requires the will and effort to learn.
- At least engineering and science students should get famliar and skilled in the iinvolved techniques as soon as they come to the university.

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