INQUA Peribaltic 2015 Working group meeting & International field symposium

Quaternary Geology and Modern Questions

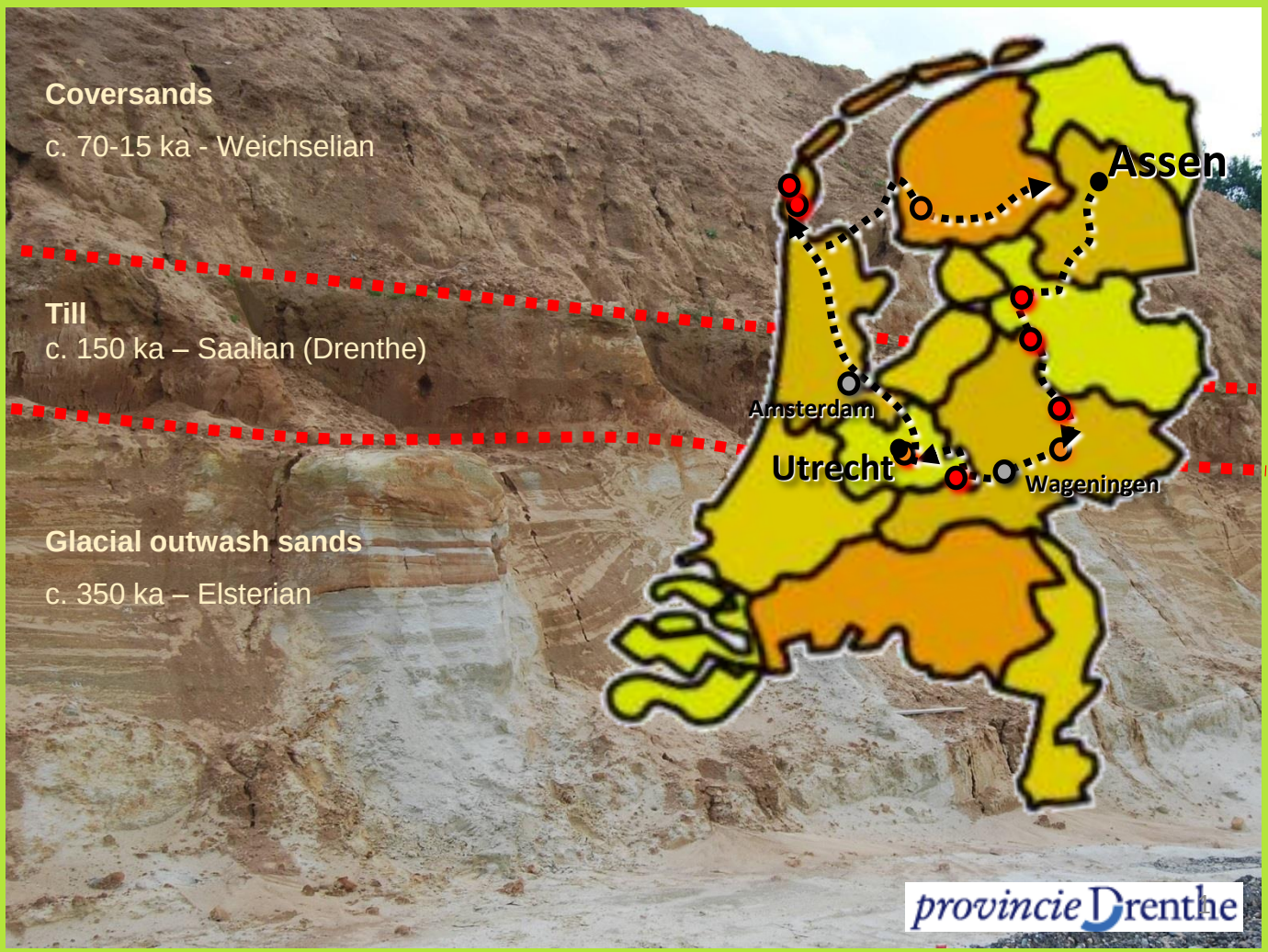
FIELD GUIDE

Part 1

Utrecht – Texel – Assen Tue 3 November

Assen – IJssel Valley – Utrecht Fri 6 November

The Netherlands | November 2 – 8, 2015 | Utrecht – Assen - Utrecht



Program

Information:

in this guide

in other guide(s)

Mon 2 November - Arrival in Utrecht *icebreaker*

Tue 3 November - Fieldtrip Utrecht – Texel – Assen

Check-out Utrecht Hotel – Check-in Assen Hotel

Visit NIOZ institute. Coastal Stop at Slufter Texel.

Diner at Workum, halfway between Texel and Assen, *before check-in*

Wed 4 November - Fieldtrip Assen – Drenthe – Assen

Thu 5 November - Conference day Assen

Fri 6 November - Fieldtrip Assen – IJssel – Utrecht

Check-out Assen Hotel – Check-in Utrecht Hotel

Visit Wageningen Univ., glacial and fluvial stops IJssel + Rhine.

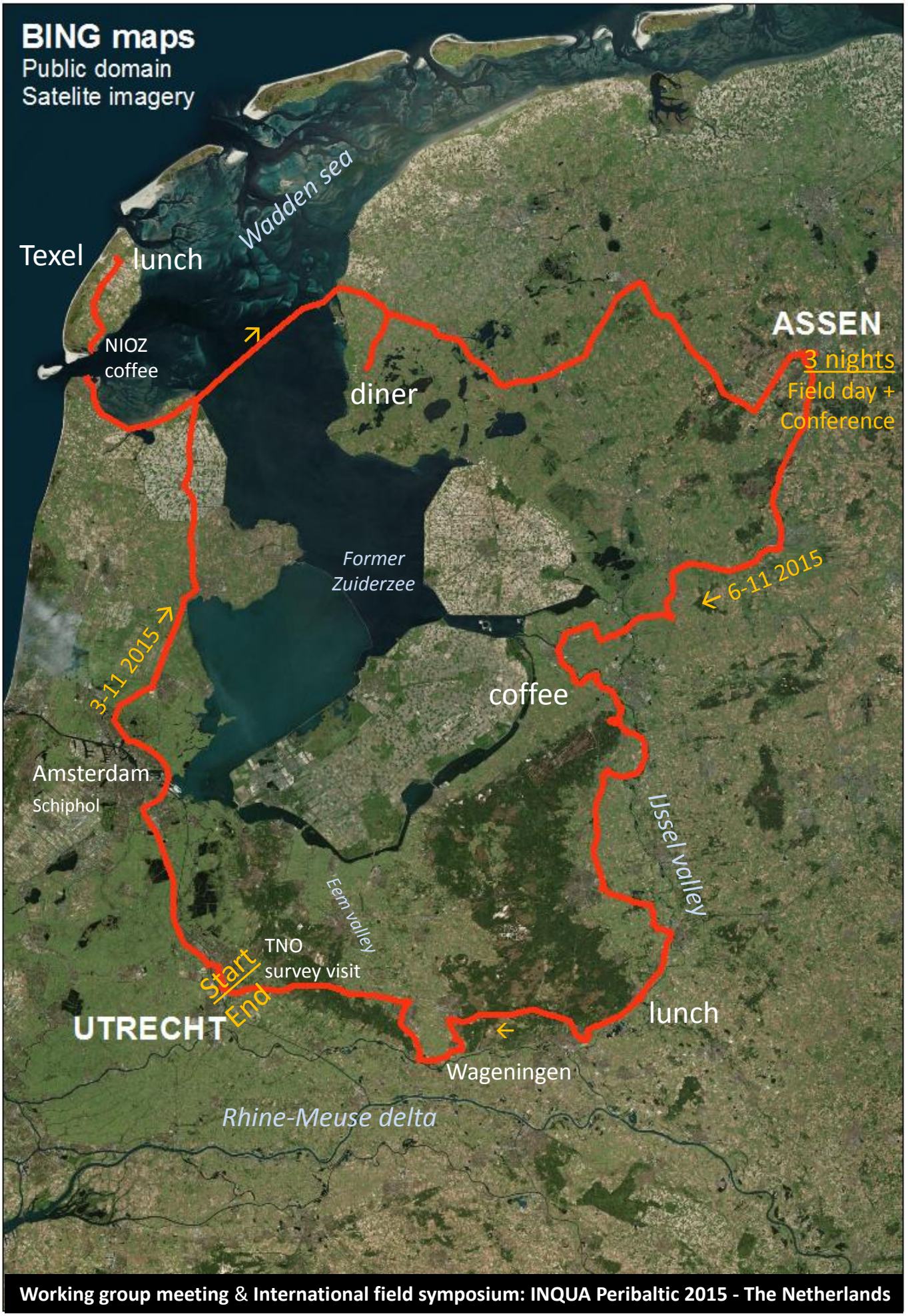
Diner at Utrecht, walking distance of hotel, *after check-in*

Sat 7 November - Visit TNO Geological Survey NL

Sun 8 November - Departure from Utrecht

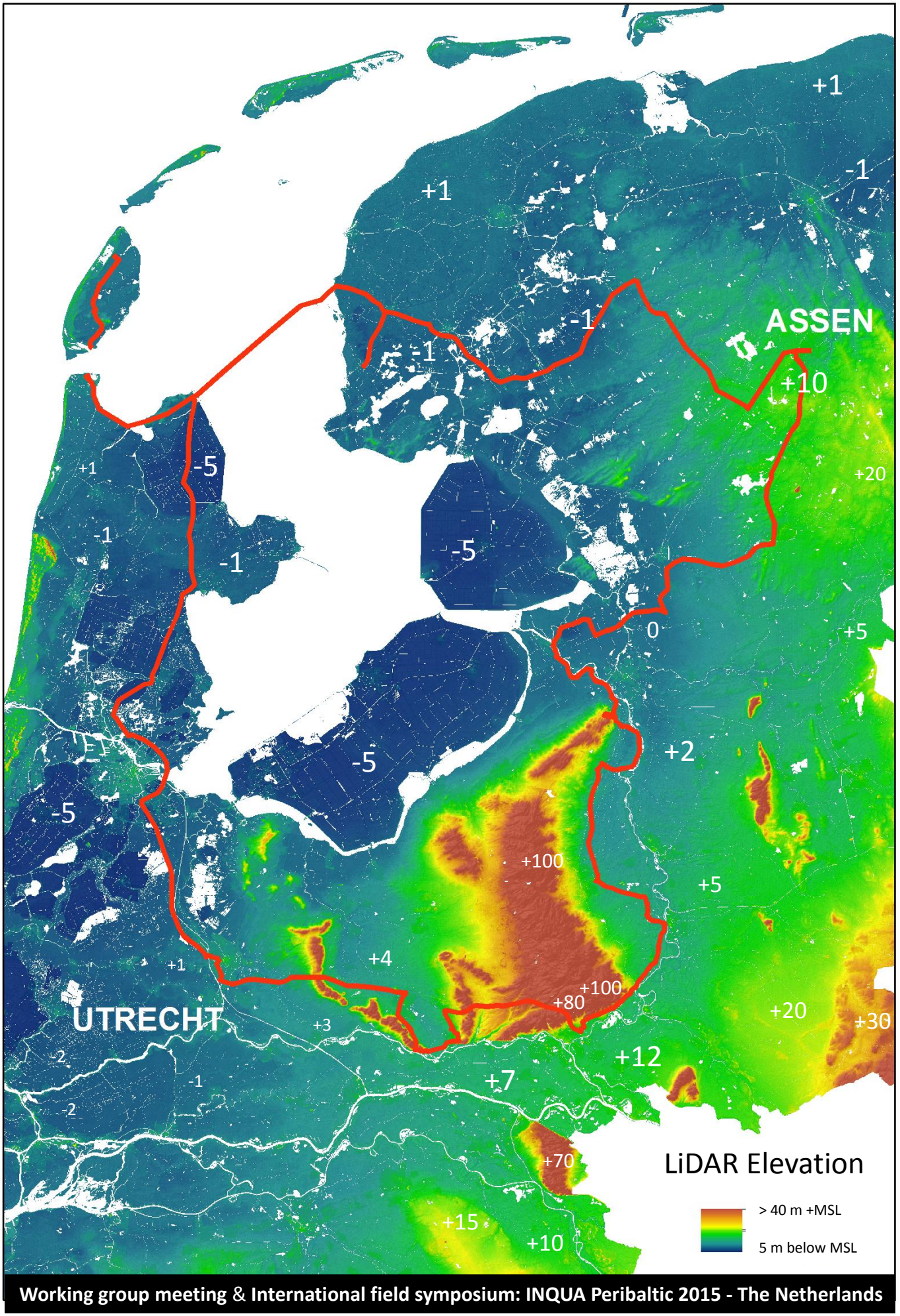
This guide: Cohen, K.M. & Busschers, F.S. (2015) INQUA Peribaltic 2015 Working group meeting & international field symposium (2-7 Nov. 2015) Field guide Part 1. Utrecht University, TNO Geolical Survey of the Netherlands, Province of Drenthe. Utrecht/Assen (The Netherlands) - 54 pp.

Field guide contents

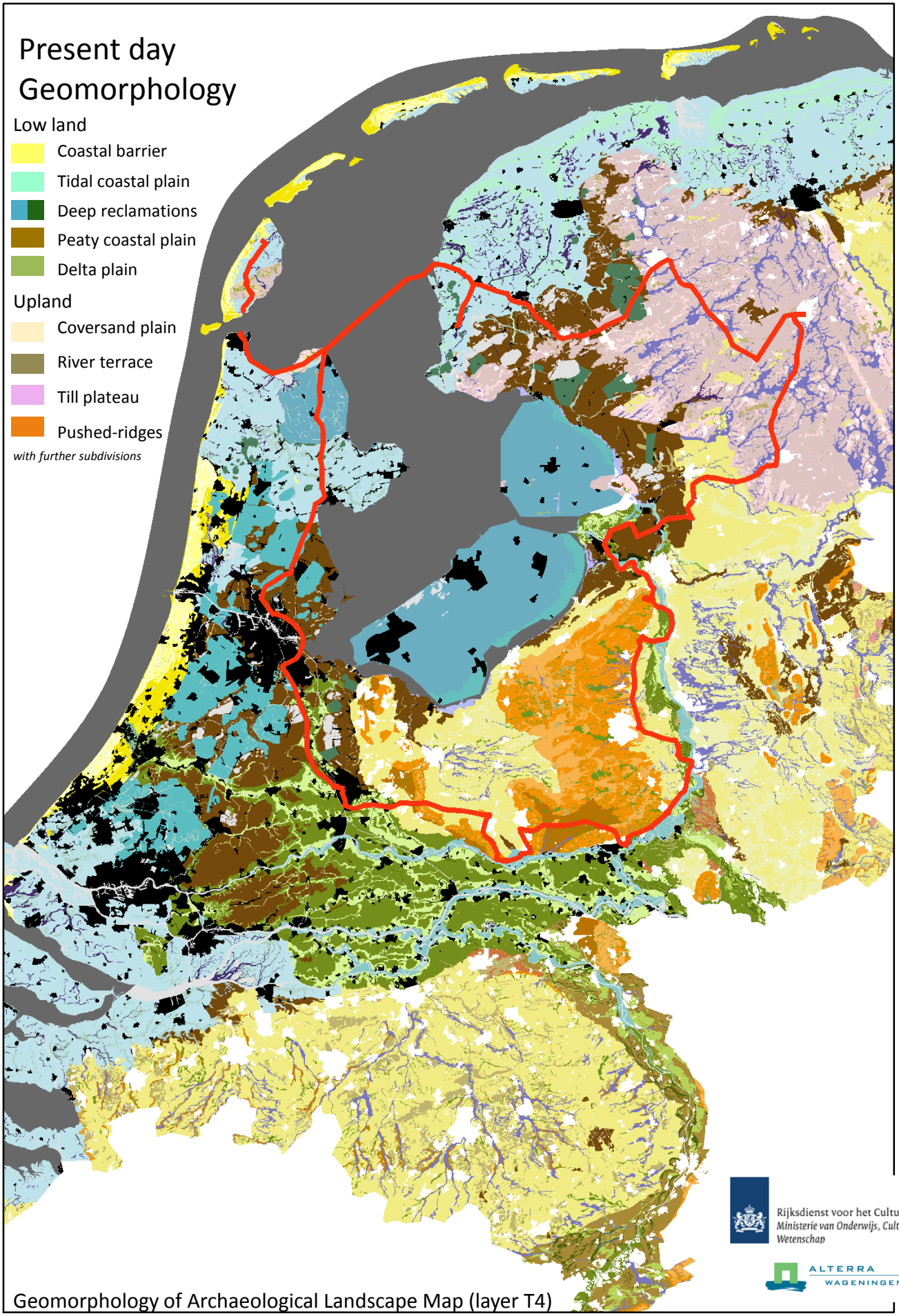


Working group meeting & International field symposium: INQUA Peribaltic 2015 - The Netherlands

time	Stop	Logistic note
8:30 8:30-8.45	Check-out Utrecht Hotel Boarding the Bus.	**BRING YOUR LUGGAGE**
8.45	**Bus leaves at 8.45**	**LOAD YOUR LUGGAGE**
9.30	Drive-by Amsterdam	
10.30	Drive-by Lagoon Reclamations Wieringen former island & Polder Wieringermeer (1932)	
11.15 11.30 11.50	Arrival at Den Helder Ferry harbour Ferry departure Den Helder – **ENJOY THE VIEW AT SUN DECK** Ferry arrival Texel, disembarking	
12.00 12.15 12.35- 13.15	**Arrival at NIOZ** - *Coffee* *Introduction NIOZ* ***Lecture Prof. Dr. Jaap Damsté*** *(NIOZ, Utrecht Univ.)* ***Organic Biochemistry Baltic Sea***	
13.30	Pick up Field lunch and drive to Slufter	
14.00	Arrival at Slufter. Climb the dune and enjoy the view. ***Fieldwalk lead by Prof. Dr. Ab Grootjans*** *(KUN, RUG)* ***Ecology of coastal dune landscapes***	
16.15 17.00-17.30 18.30	Departure from Slufter Ferry Crossing Texel-Den Helder Arrival at Workum – Restaurant	
c. 21.00	Departure from Workum – Drive to Assen	
c. 22.00	Arrival and check-in **Hotel Assen**	**UNLOAD YOUR LUGGAGE**



Working group meeting & International field symposium: INQUA Peribaltic 2015 - The Netherlands



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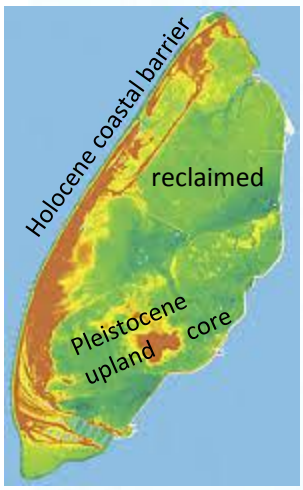
Ministerie van Onderwijs, Cultuur en Wetenschap

ALTERRA WAGENINGEN UR

Geomorphology of Archaeological Landscape Map (layer T4)
RCE Cultural Heritage Agency, based on Alterra Geomorphological map of the Netherlands
Kosian, Weerts, Feiken, Rensink, Lauwerier et al. (2015)

3th Nov.

TEXEL



SLUFTER
Coastal dune
Wetland ecology

NIOZ
marine research institute

20 minutes

Mainland Holland
(Den Helder)

Prof. Dr. Ir. Jaap S. Sinninghe Damsté

Prof. Damste (NIOZ, UU) holds a chair in Organic Geochemistry and is one of the Netherlands most prolific geoscientists. He works on all organic components (biomarkers) in the marine sedimentary and fossil record: the full myriad of organic molecules derived from marine (algae, (cyano)bacteria, archae) and terrestrial organisms living at the time of deposition. These biomarkers contain information in past climatic and palaeo-environmental changes. Their contained information is used (i) to improve understanding natural and anthropogenic influences on present-day climates and depositional systems, and (ii) to deciphering the conditions which have led to sequestration of organic carbon in the geological record. His talk contribution during our stop at NIOZ will be on:

Marine organic geochemistry of the Baltic Sea: temperature reconstruction through the Holocene

The talk is preluded by an introductionary movie of the NIOZ institute, its mission and its research vessel Pelagia.

Pelagia

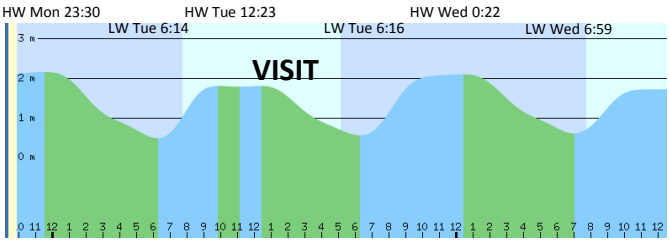
NIOZ institute history

www.nioz.nl

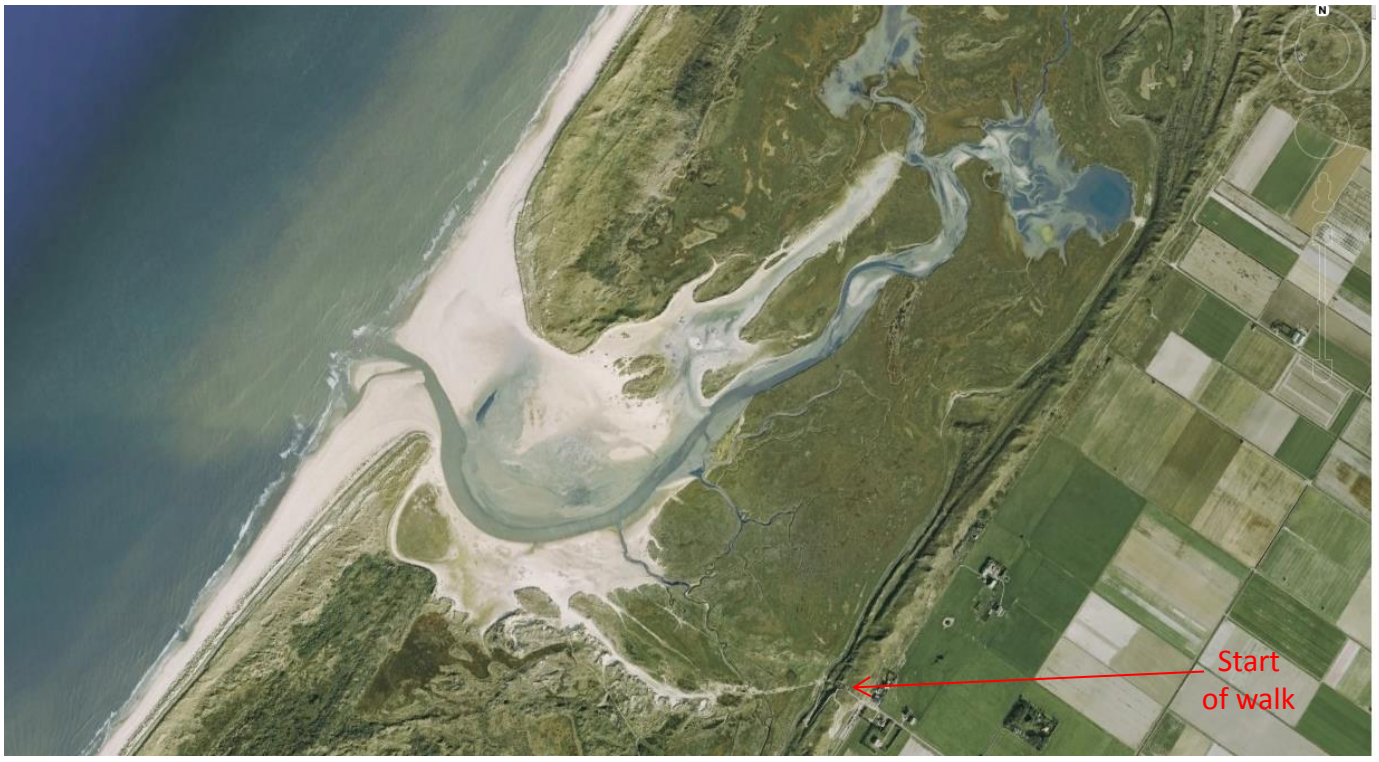
The history of the institute and its marine field research began in 1872 with the founding of the Dutch Zoological Society. The Society owned a dismountable building that was used as a field station until 1890. In general, no more than five people were at work here, including the first directors who would carry out their research unsalaried. In 1877 the building was stationed in the city of Vlissingen. From here, a schooner departed for a fist scientific cruise to the English coast and Helgoland. From 1931 onward, the Dutch government financially supported the Zoological Station, which significantly strengthened its ties with the biological faculties of universities by organizing student courses. The economic crisis however set a limit to the expansion with additional staff. After World War II, the workforce expanded with researchers on temporary positions. In 1957, director Verweij submitted a proposal to widen the scope from biology to chemistry, physics and geology, which was instantly approved. In 1960 the Zoological Station was renamed the 'Netherlands Institute for Sea Research' and a year later the first issue of Netherlands Journal for Sea Research was released.

The institute expanded and soon appeared too small to accommodate some 150 employees. Besides, the potential for intake of sea water in Den Helder was too limited. In 1969 the NIOZ moved to the 'provisorium' a temporary housing in polder 't Horntje at the Frisian island of Texel and only in 1977 the new building was opened. Since 1990, NIOZ is part of NWO and has been disincorporated from the Dutch Zoological Society. As per 1st of January 2012, NIOZ has merged with the former NIOO-CEME (Centre for Estuarine Marine Ecology) in Yerseke. The institute now has two locations, one on the Island of Texel at the border between the North Sea and the Wadden Sea, and about 100 km north of Amsterdam, and one in Yerseke, southwest Netherlands, in the delta area, some 150 SW of Amsterdam.

TIDES



Texel Noordzee, Netherlands 53.1167° N, 4.7333° E
2015-11-03 Tue 7:42 AM CET Sunrise
2015-11-03 Tue 9:49 AM CET 1.80 meters High Tide
2015-11-03 Tue 11:06 AM CET 1.78 meters Low Tide
2015-11-03 Tue 12:23 PM CET 1.80 meters High Tide
2015-11-03 Tue 5:06 PM CET Sunset



Google Earth

Bing maps

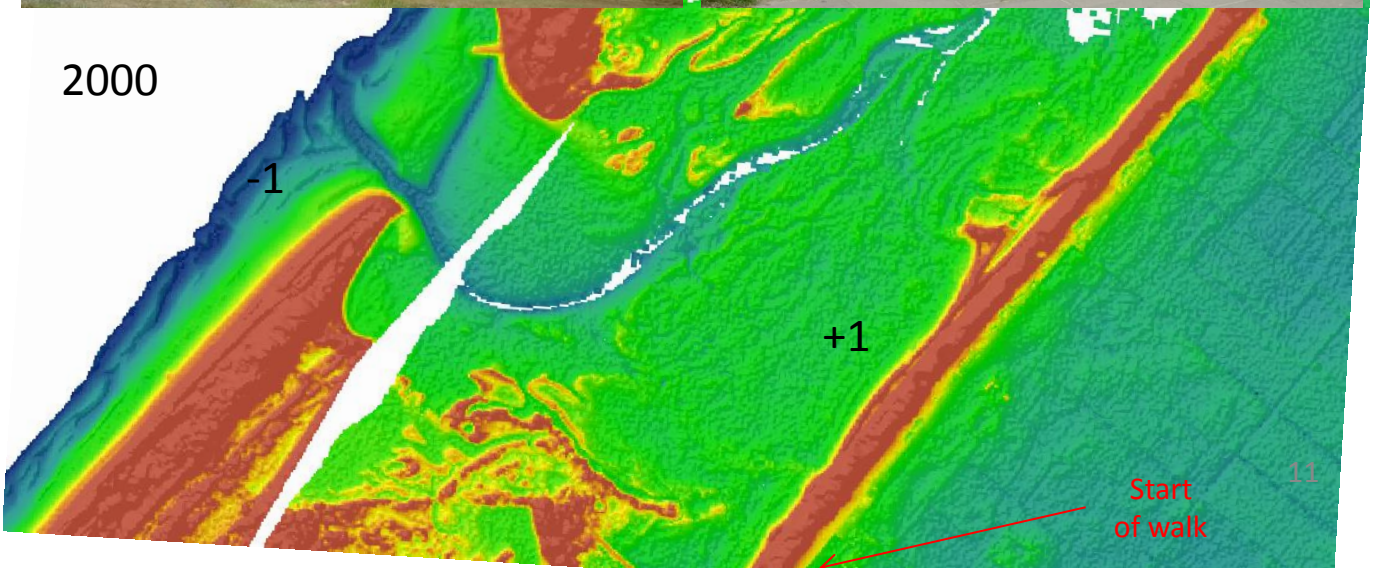
Semi-natural vegetation and natural beach and channel dynamics … but human-managed limits to what the channel is allowed, and from time to time the channel mouth is repositioned.

Prof. Dr. A.P. (Ab) Grootjans

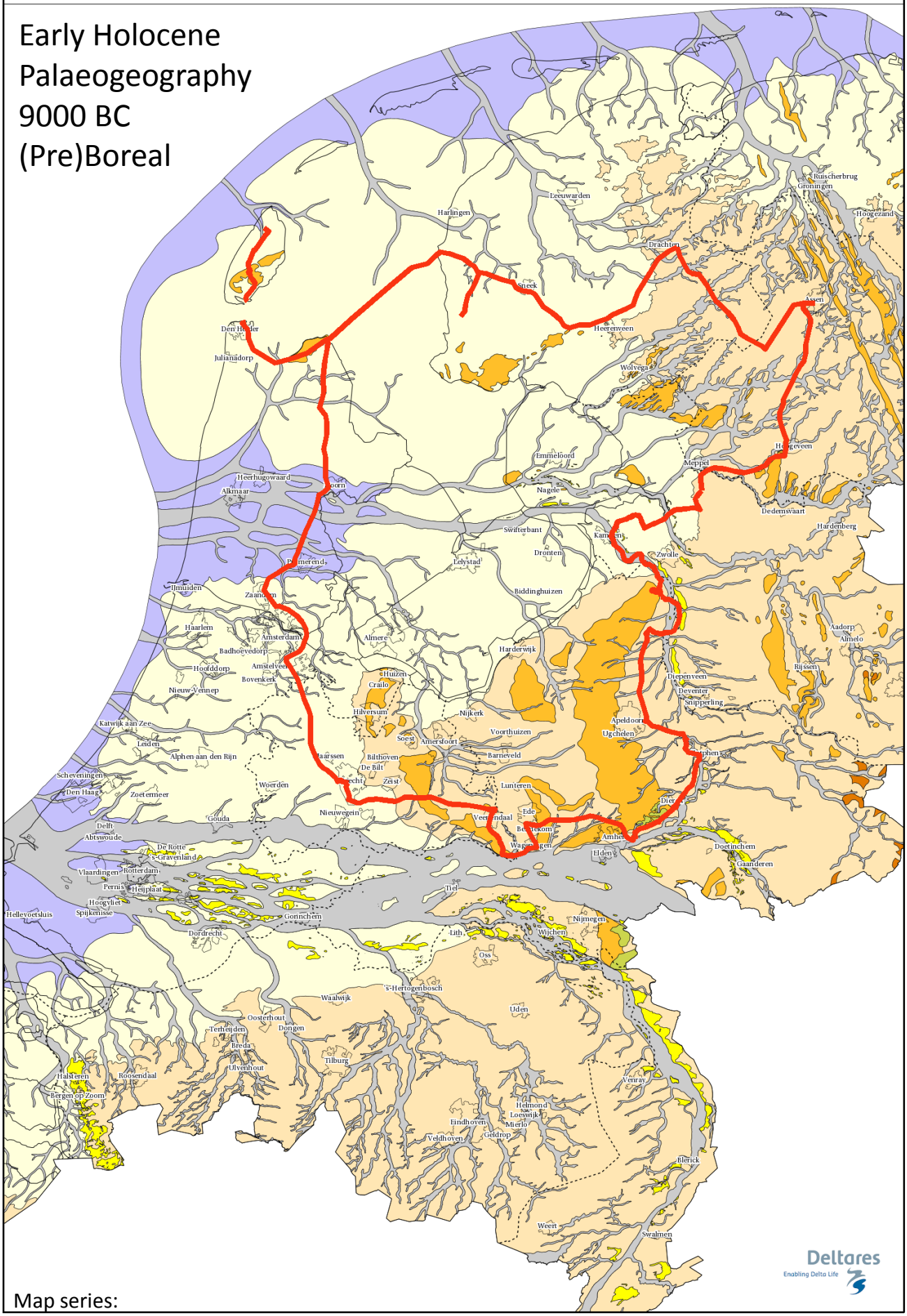
Prof. Grootjans holds a chair in Ecohydrology of Wetlands at the University of Groningen and at Radboud University Nijmegen. His expertise is on ecohydrological approaches to nature conservation and restoration ecology. His research is carried out on the landscape and the habitat scales, with focus on the relationships of wet ecosystems with the hydrological cycle on the landscape level. Prime research areas are mires, peatlands and coastal wetlands. The former have been studied in Poland, Slovakia, Latvia, South-Africa, Tierra del Fuego (Argentina) and The Netherlands. The latter in The Netherlands, England, South Africa and West-Australia.

Prof. Grootjans will guide us during a

Fieldwalk on dune wetland ecohydrology , Slufter area, Texel.

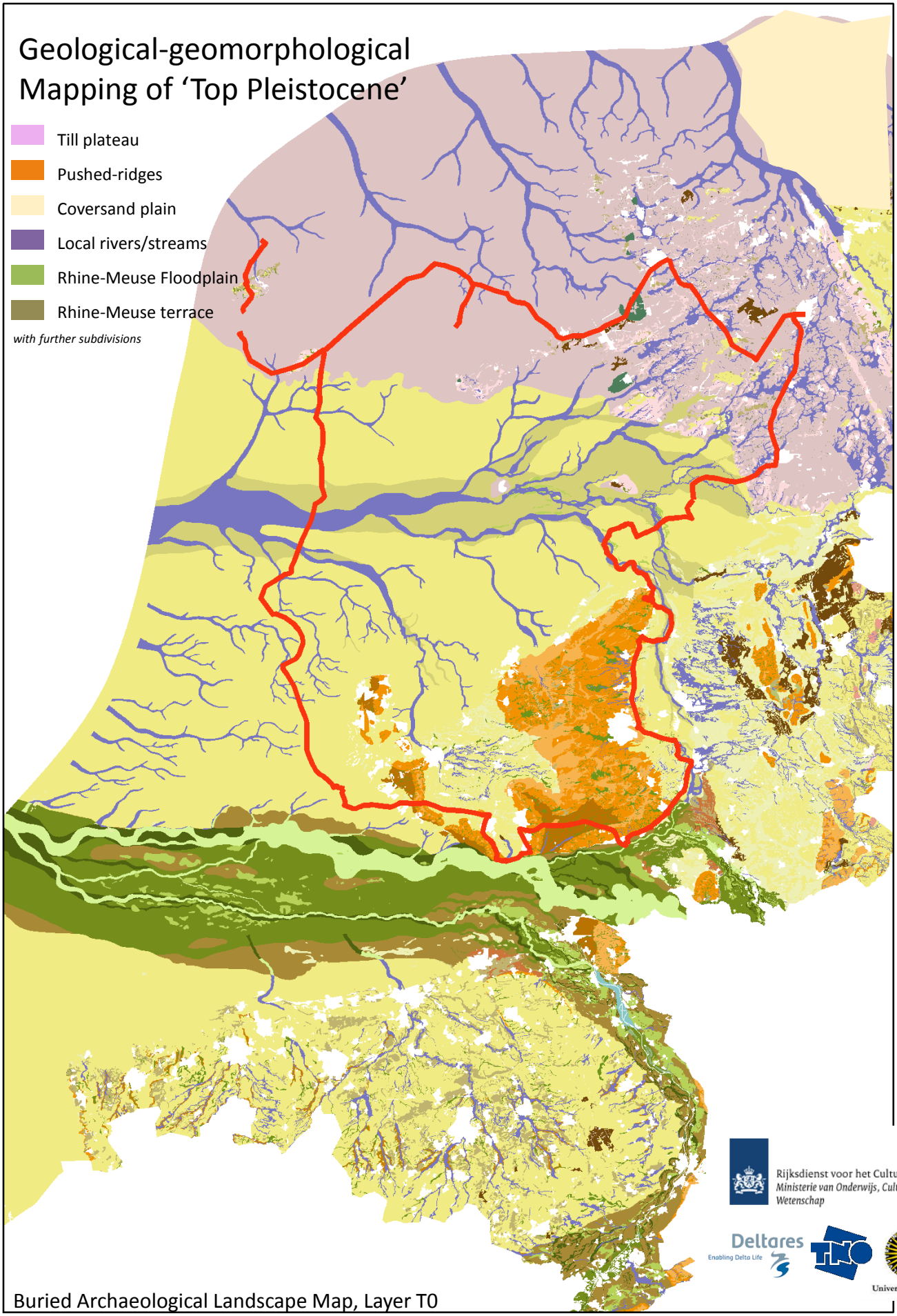


Early Holocene Palaeogeography 9000 BC (Pre)Boreal



Map series:
Vos et al. 2011; Vos & De Vries (2013); Vos (2015)
Deltares, TNO Geol .Survey; RCE Cult. Heritage Agency

Geological-geomorphological Mapping of 'Top Pleistocene'



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Deltares
Enabling Delta Life

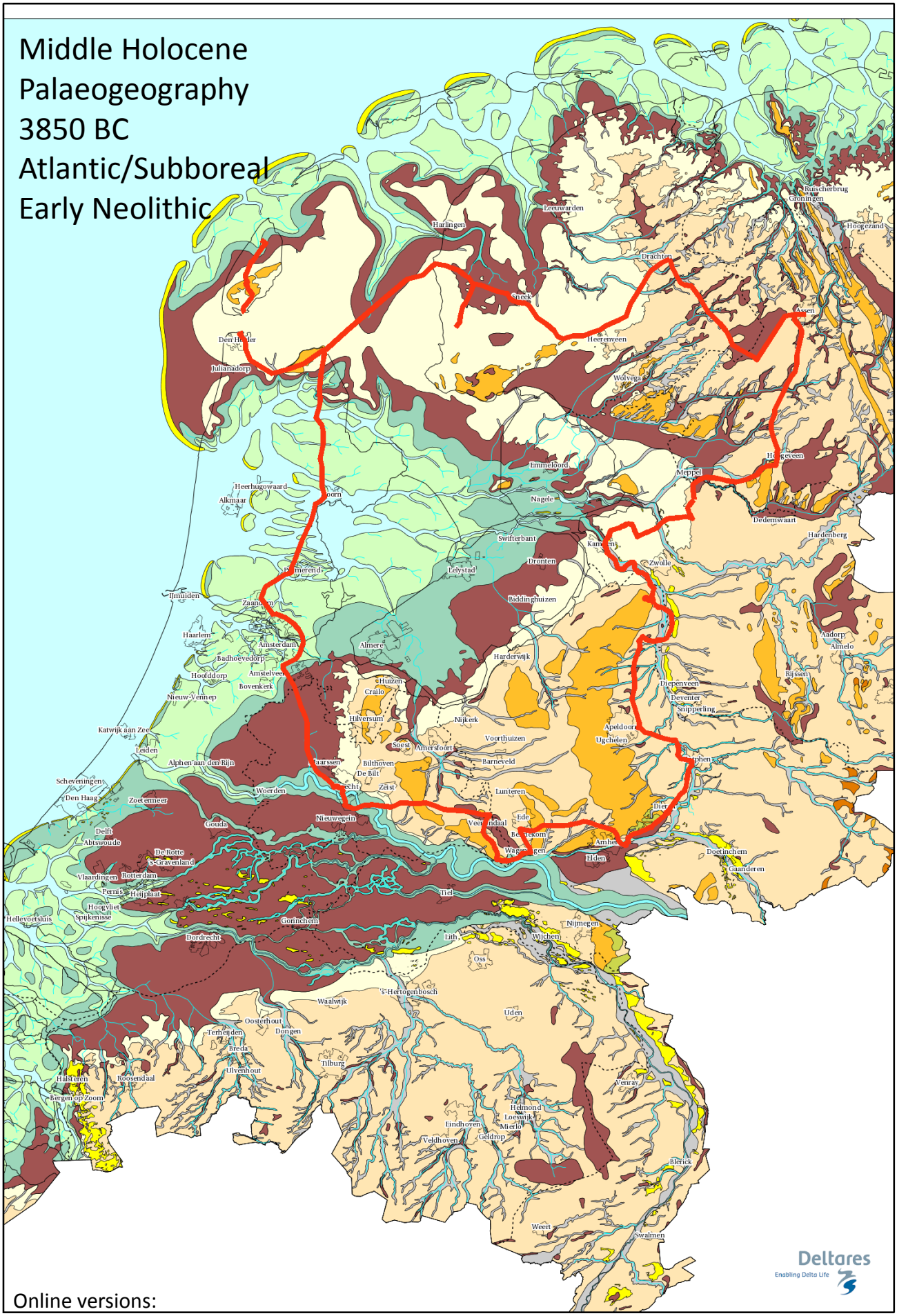
TNO

Universiteit Utrecht

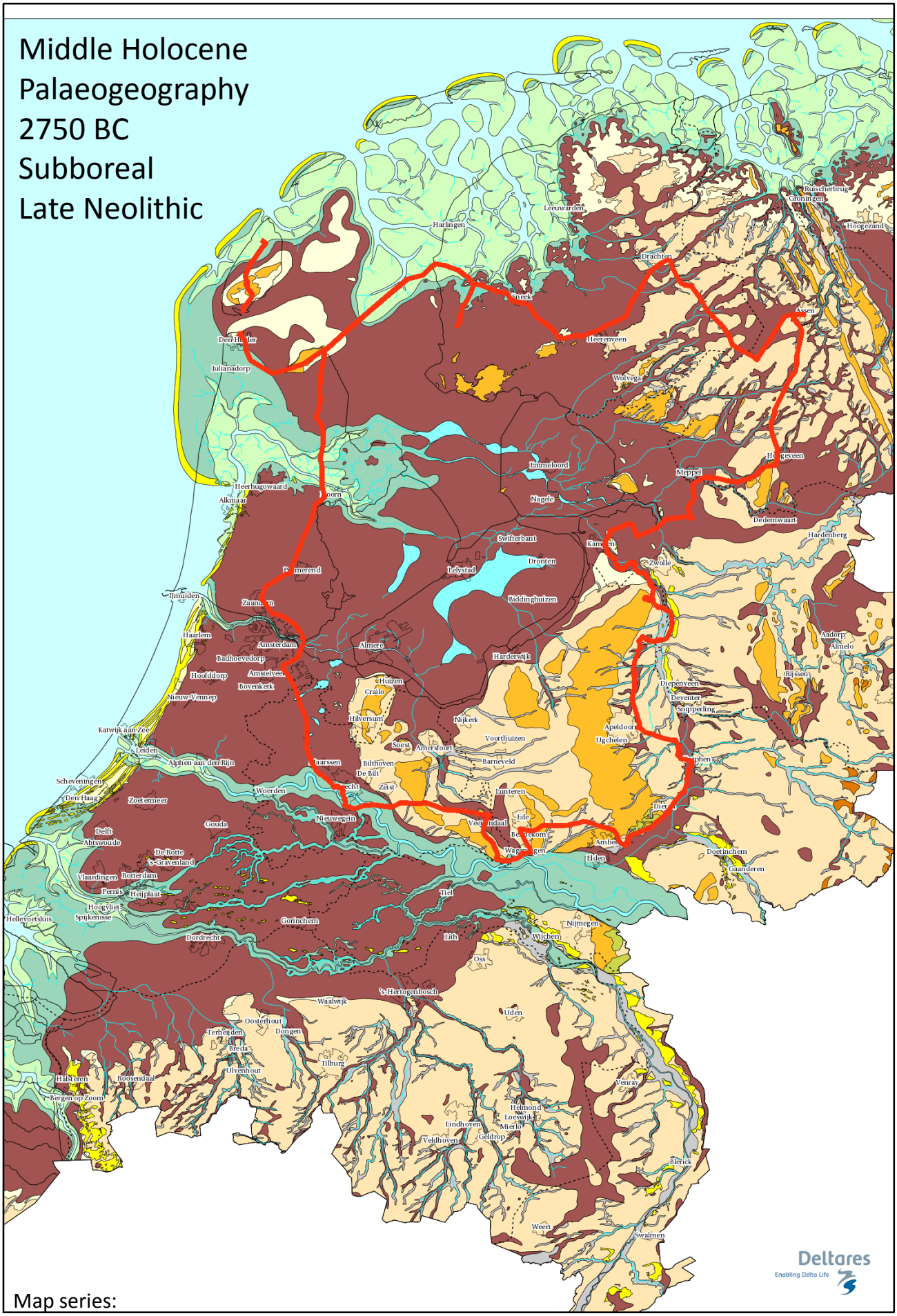
Buried Archaeological Landscape Map, Layer T0
Deltares, TNO Geological Survey, Utrecht University and RCE Cultural Heritage Agency
Cohen, Dambrink, De Bruijn, Schokker, Hijma (2015)

Middle Holocene Palaeogeography 5500 BC Mid Atlanticum Late Mesolithic

Map series:
Vos et al. 2011; Vos & De Vries (2013); Vos (2015)
Deltares, TNO Geol .Survey; RCE Cult. Heritage Agency



Online versions:
Android App: Google Play – Deltares Palaeomaps
PDF/GIS: www.archeologievannederland.nl



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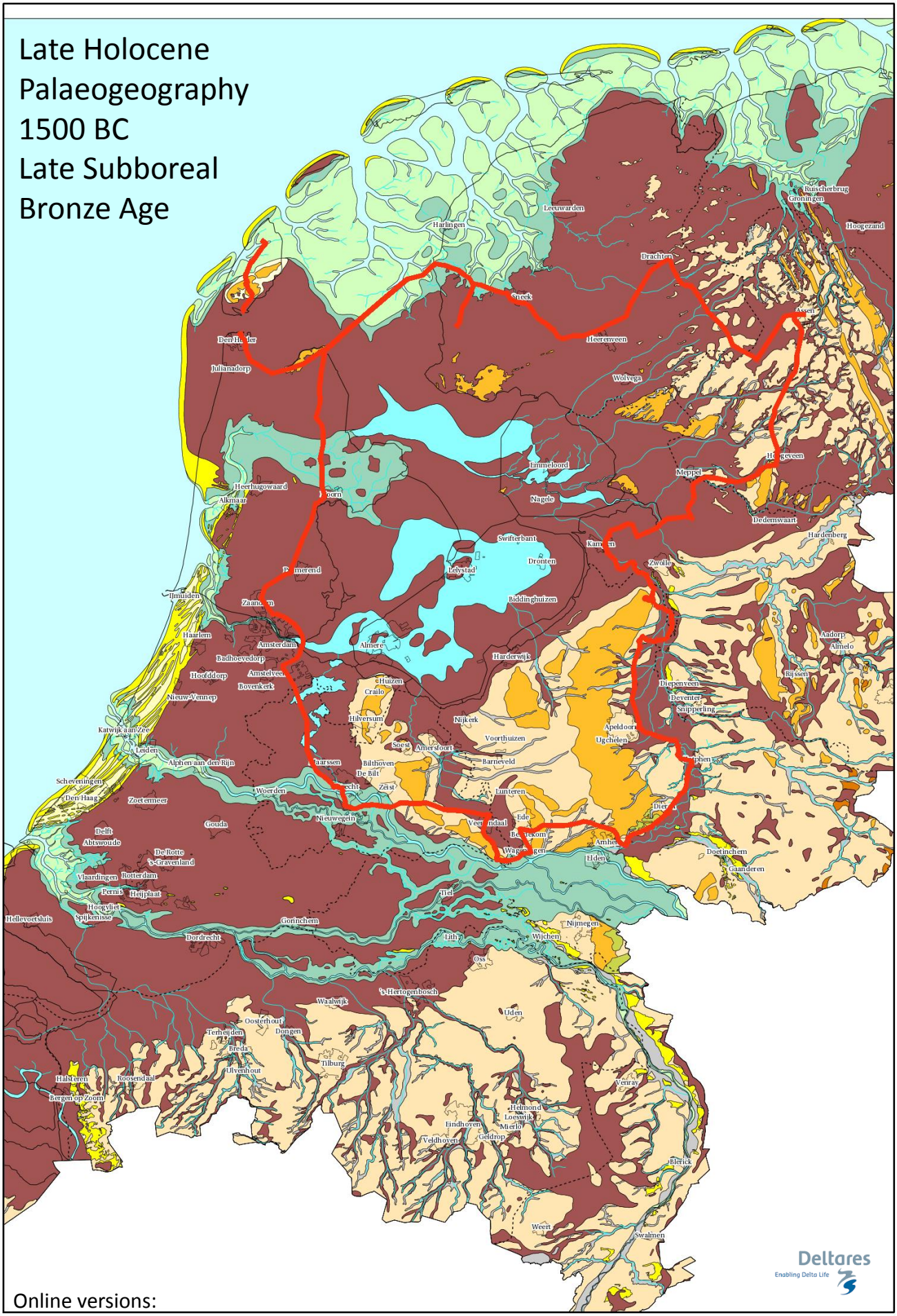

Online versions:
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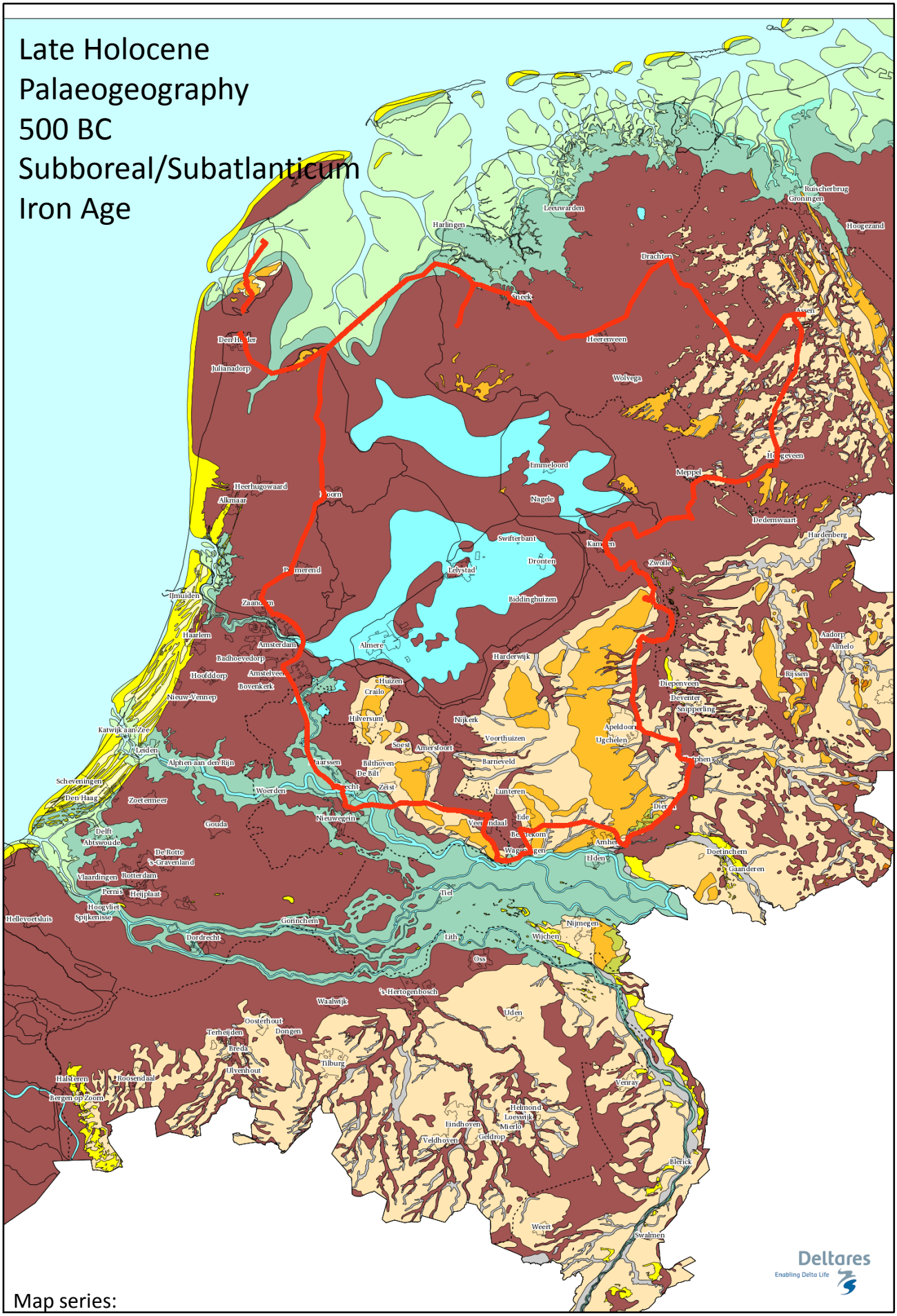
Late Holocene Palaeogeography 500 BC Subboreal/Subatlanticum Iron Age



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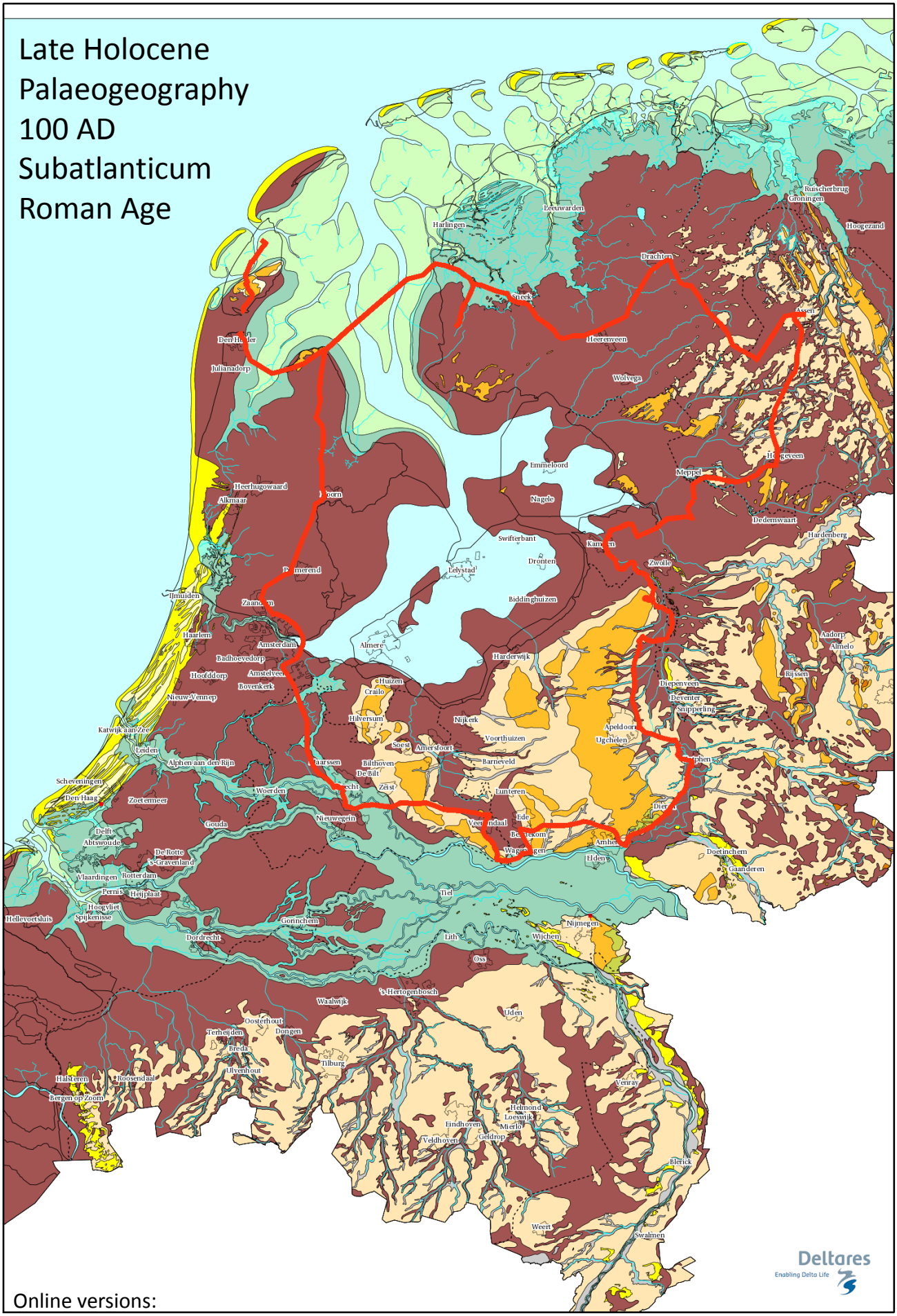

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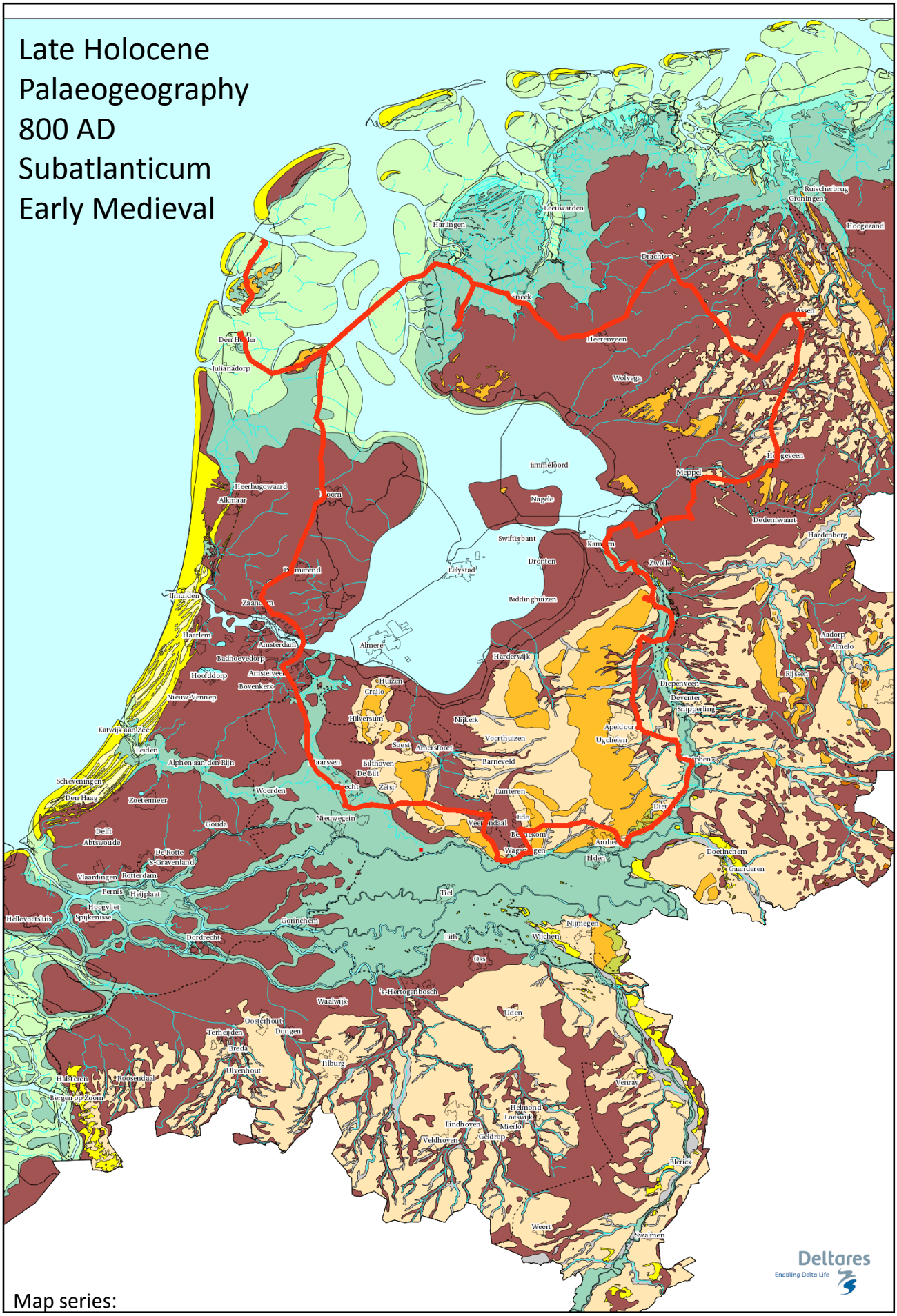
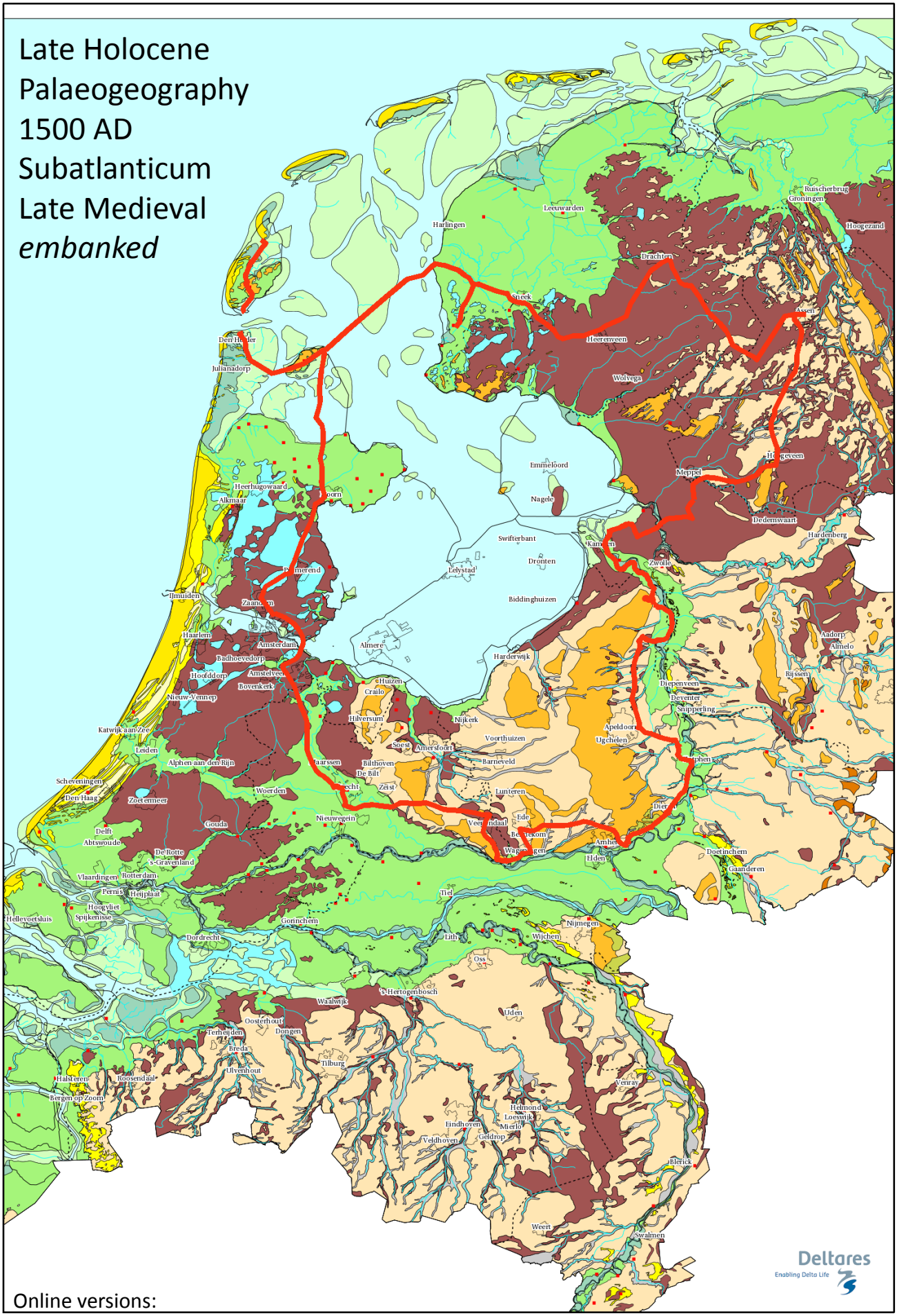


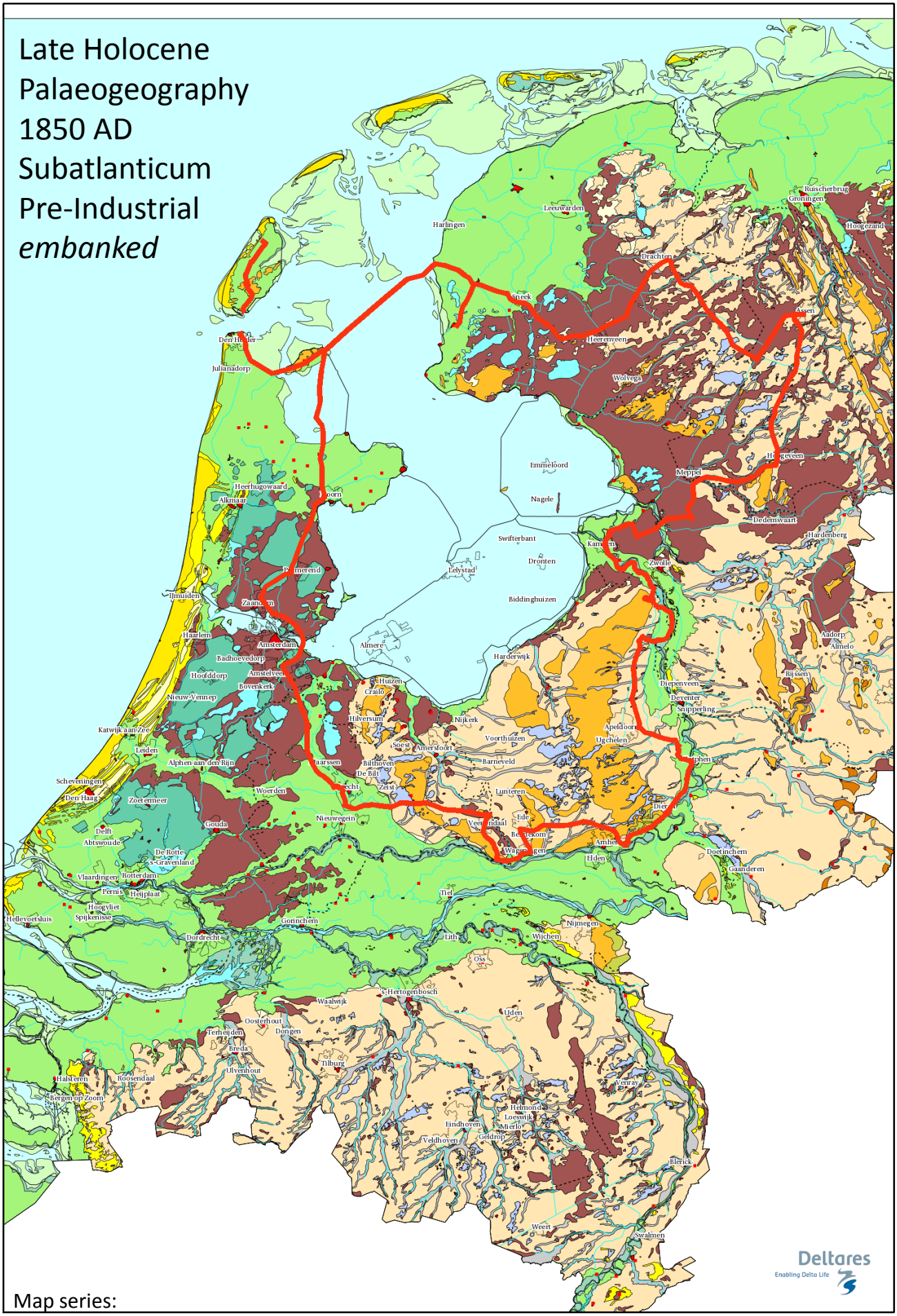
Map series:
Vos et al. 2011; Vos & De Vries (2013); Vos (2015)
Deltares, TNO Geol .Survey; RCE Cult. Heritage Agency

Late Holocene Palaeogeography 1500 AD Subatlanticum Late Medieval *embanked*



Online versions:
Android App: Google Play – Deltares Palaeomaps
PDF/GIS: www.archeologievannederland.nl

Late Holocene Palaeogeography 1850 AD Subatlanticum Pre-Industrial *embanked*



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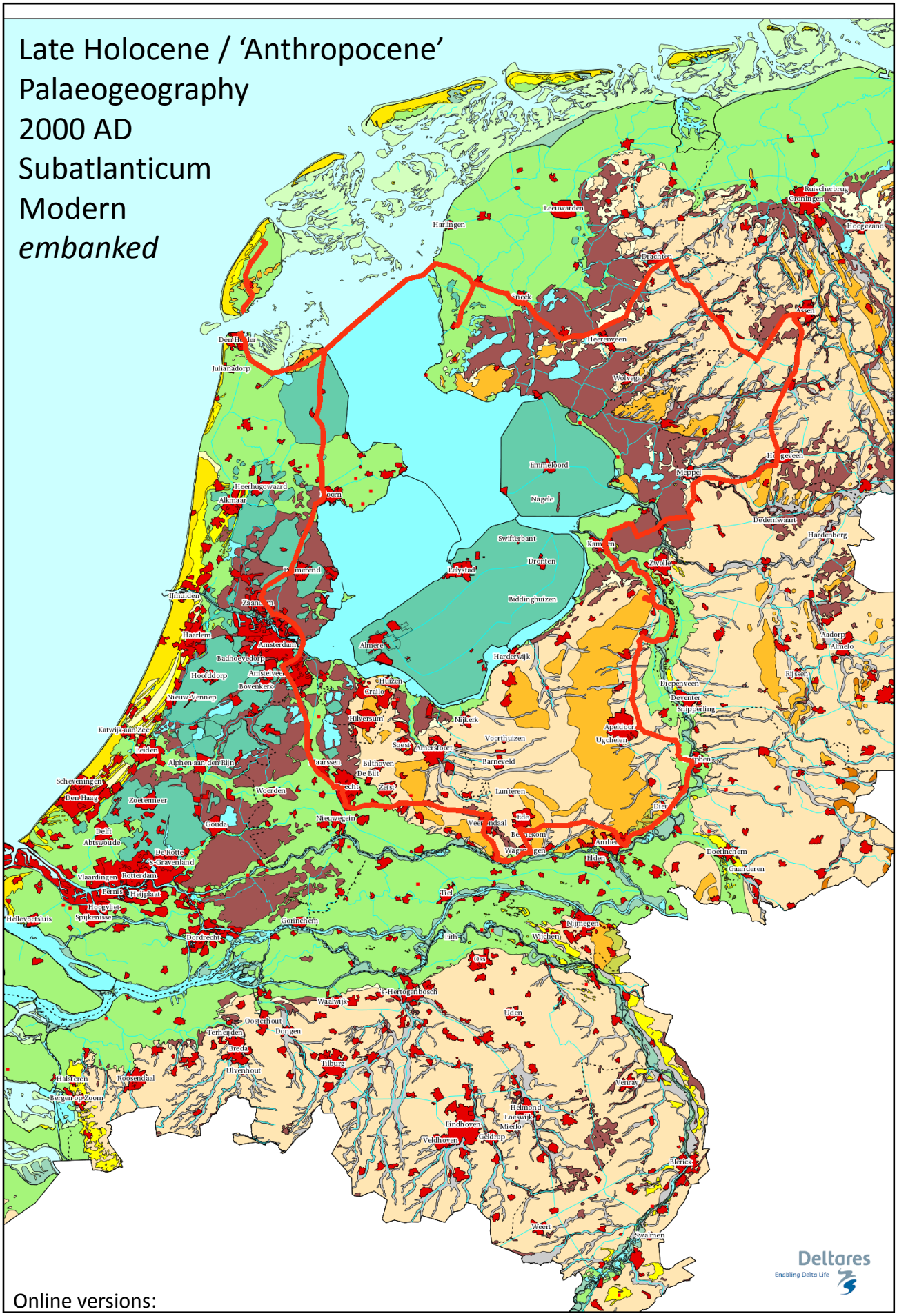
Deltares, TNO Geol .Survey; RCE Cult. Heritage Agency



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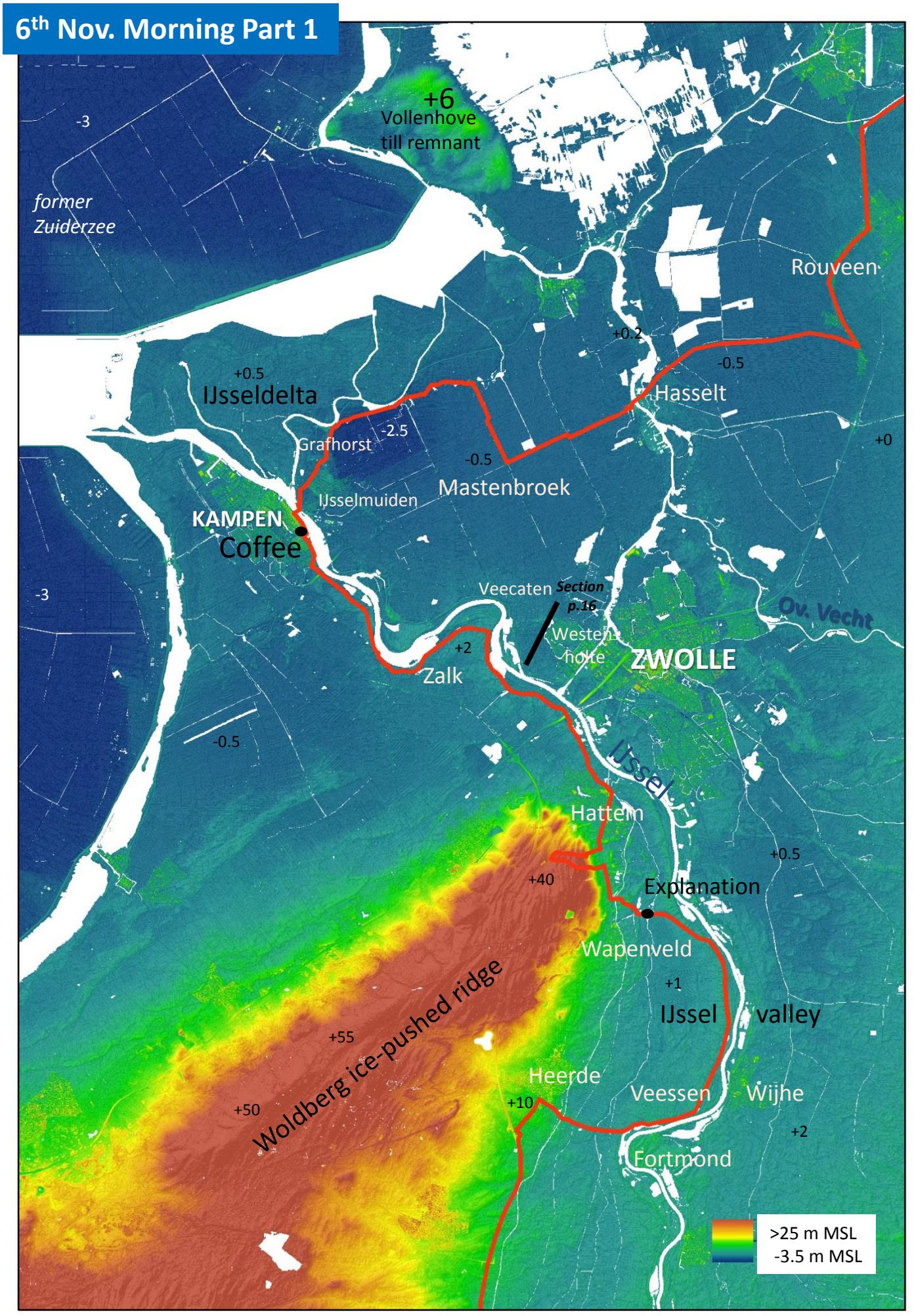
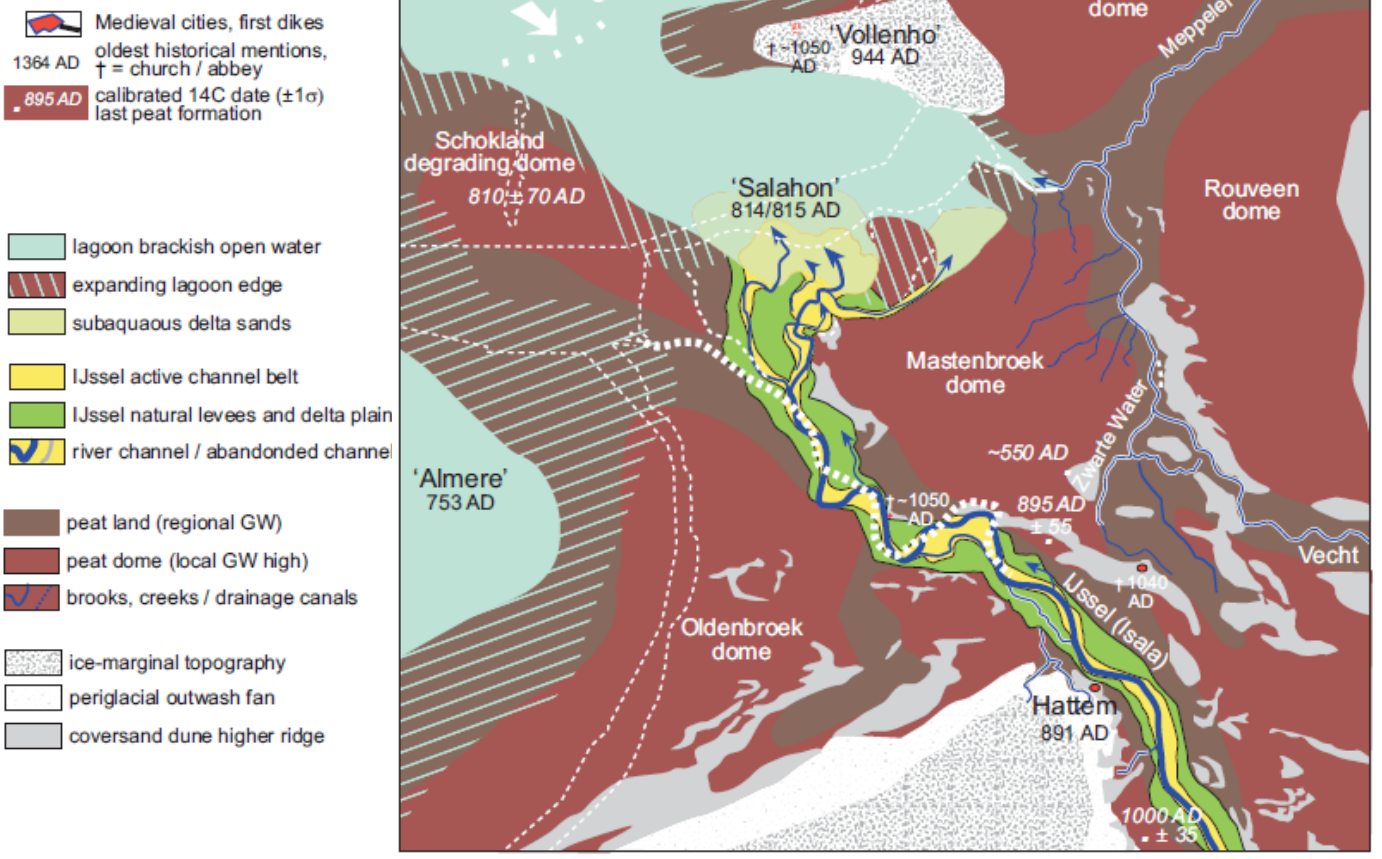

6th Nov. Morning Part 1
-3
former Zuiderzee
+6
Vollenhove till remnant
Rouveen
+0.2
-0.5
+0.5
IJsseldelta
Hasselt
Grafhorst
-2.5
+0
-0.5
Mastenbroek
IJsselmuiden
KAMPEN
Coffee
-3
Veecaten
Section p.16
Ov. Vecht
Westenholte
ZWOLLE
+2
Zalk
IJssel
-0.5
Hattem
+0.5
+40
Explanation
Wapenveld
+1
IJssel valley
+55
Woldberg ice-pushed ridge
Heerde
Veessen
Wijhe
+50
+10
+2
Fortmond
>25 m MSL
-3.5 m MSL

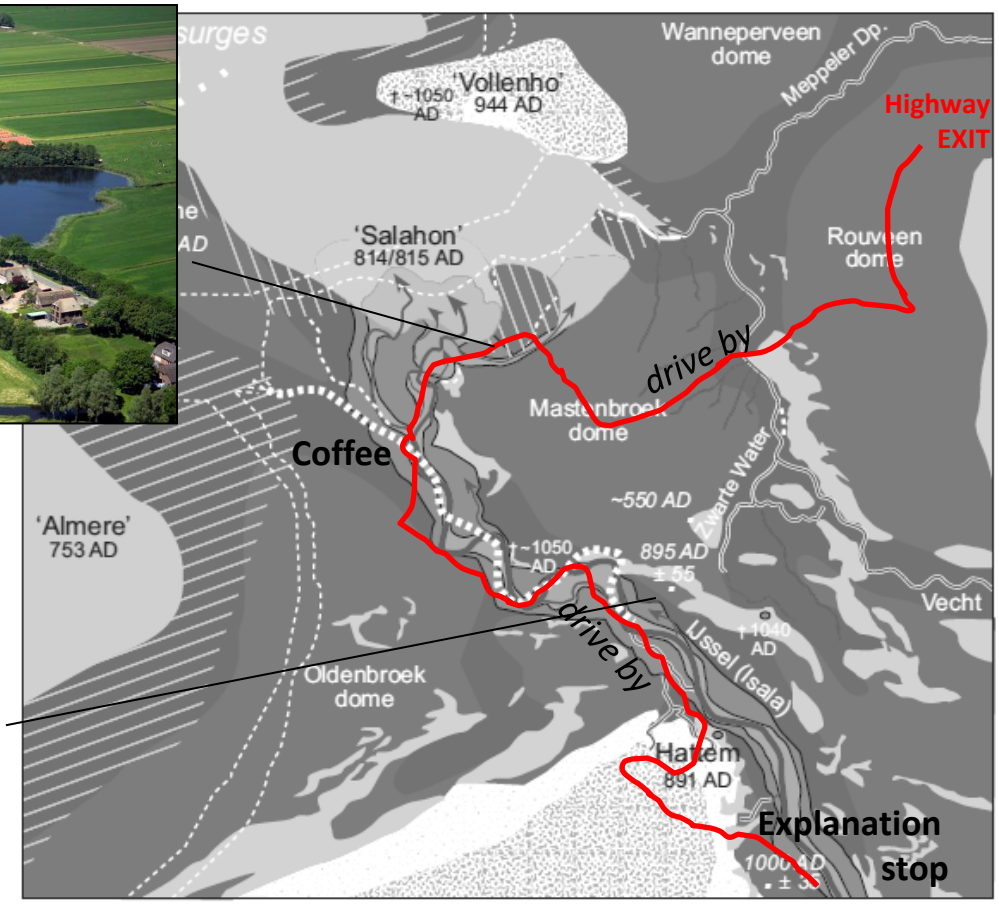
time	Stop	Logistic note
8.30 8.30-8.45	Check-out Assen Hotel Boarding the Bus.	**BRING YOUR LUGGAGE**
8.45	**Bus leaves at 8.45**	**LOAD YOUR LUGGAGE**
9.25 10.00-10.20	Drive-by Rouveen – **Polder** Mastenbroek – Grafhorst **Coffee stop Kampen** – Koornmarktspoort, Bovenkerk	
10.25	Drive-by Zalk – **Lower IJssel** – Hattem – **Ice-pushed ridge**	
11.05 11.20	**Explanation Stop Wapenveld** – Freek Busschers, Kim Cohen Saalian, Eemian, Weichselian Rhine: Freek Busschers Late-glacial, Holocene, Medieval IJssel: Kim Cohen	
11.30 11.45-12.05	Drive-by Lower IJssel – **14th-21st cy river management** Veessen *Highway A50 transfer to Middle IJssel*	
12:15	***Explanation Stop Voorst: mini-walk IJssel*** *– Kim Cohen* Late-glacial, Holocene, Medieval IJssel: Kim Cohen	
12.45-13.05 13.10	*Drive-by Middle IJssel Empe – Zutphen (De Hoven) – Brummen* **Lunch Stop – Dieren – with view on Upper IJssel**	
14.15	*leave Lunch Location – bus to Wageningen University campus*	
14.50	***NCL Netherlands Centre of Luminescence dating*** *– intro & tour* ***ISRIC - World Soil Museum*** *– intro & tour* ***Wageningen University*** - Prof. Jakob Wallinga & Stephan Mantel	
16.30	*leave Wageningen campus*	
16.45	***Rhenen Grebbeberg Koningstafel view point*** *– Kim Cohen* *Sunset view of Rhine-Meuse delta*	
c. 19.00	Arrival and check-in NH Hotel Utrecht (same hotel as Monday)	**UNLOAD YOUR LUGGAGE**
c. 20.00	Diner in restaurant Harbour *10 minute walking distance of Hotel*	

Palaeogeographical reconstruction medieval lower IJssel

Early Medieval situation with young river IJssel: 700-1100 AD

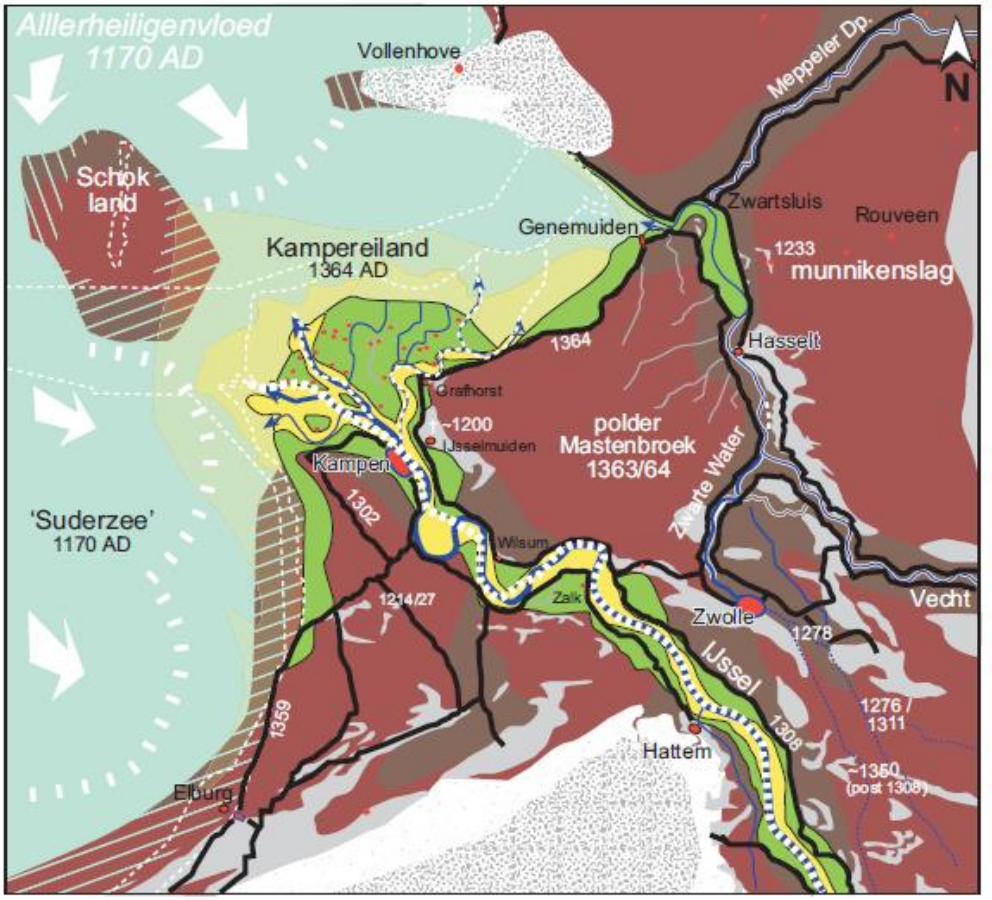


Dike breach scars
Former storms Zuiderzee
Kamperzeedijk



Westenholte
Late Roman/Dark Ages tree finds

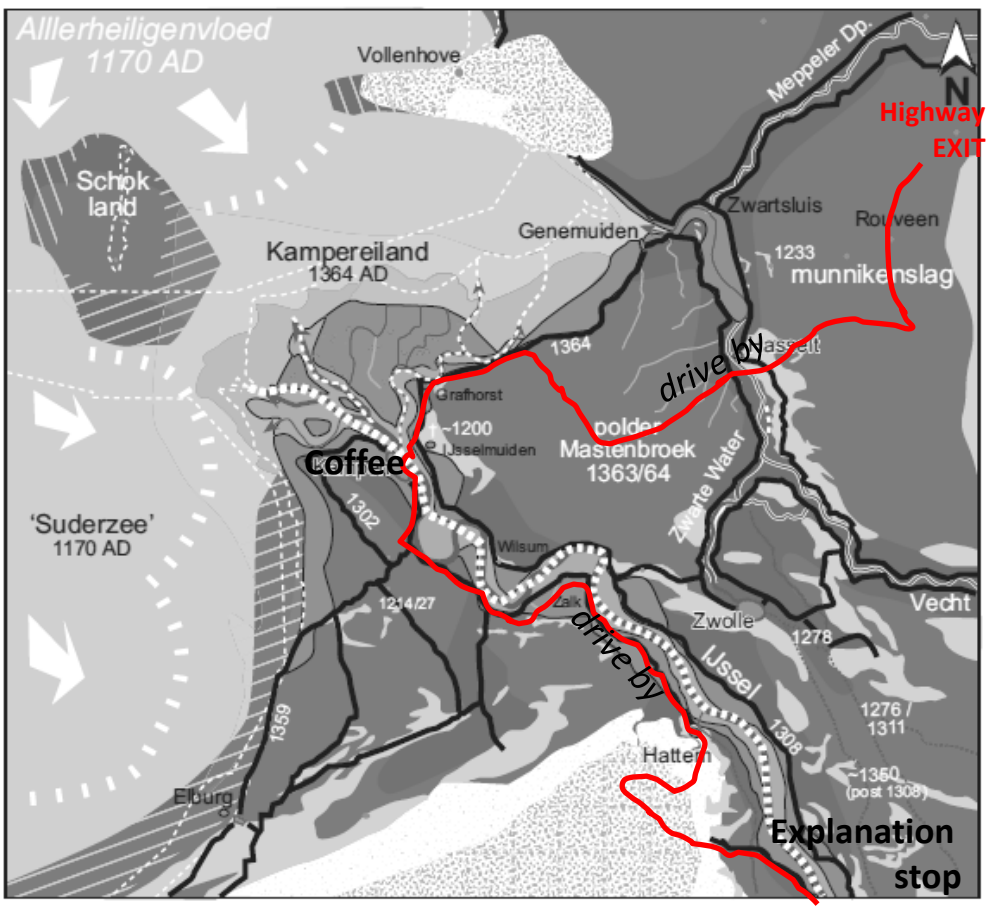
Late Medieval situation with embanked river IJssel: 1100-1400 AD



Rouveen, Staphorst
Farm house tradition
Long-owned family land

Map source publication:

Cohen, K.M., Stouthamer, E., Hoek, W.Z., Berendsen, H.J.A. & Kempen, H.F.J. (2009). Zand in Banen – Zanddiepte-kaarten van het Rivierengebied en het IJsseldal in de provincies Gelderland en Overijssel. Arnhem: Provincie Gelderland. 130 pp. With a summary in english summary.



Kampen;
14th cy gate + city wall
Koornmarkt - *grain market*

Location of coffestop

K.M. Cohen

Lower IJssel dike — Example cross-section — Polder Mastenbroek

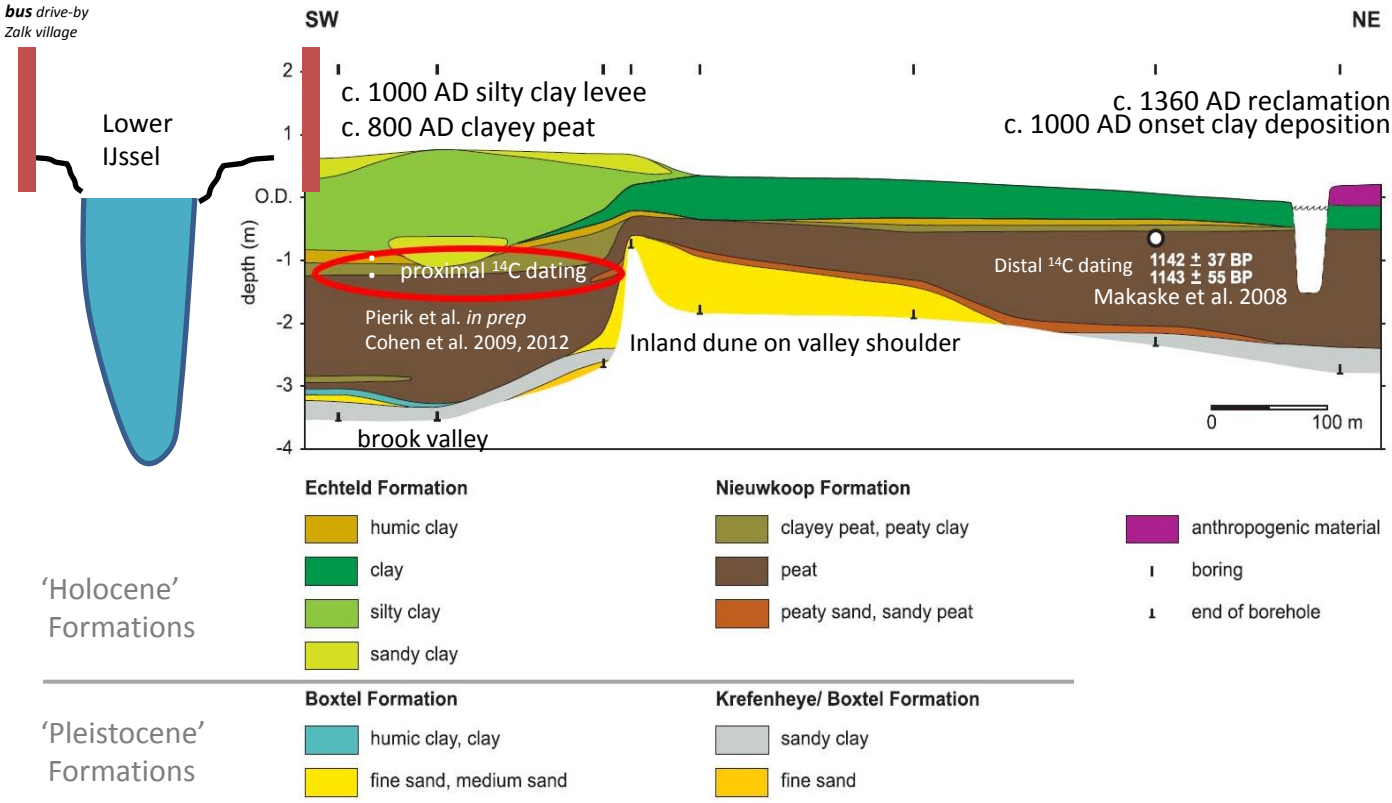


Fig. 6. Borehole cross-section from the Westenholte study area (see Fig. 3 for location) showing the position of radiocarbon-dated subsamples WH-I-1 and WH-I-2 (white dot). Borings were carried out for this study using an Edelman auger and a gouge. Sediment properties were described every 10 cm,

Source: Makaske et al. 2008 - Age and Origin of Gelderse IJssel - Neth. Journal of Geosciences

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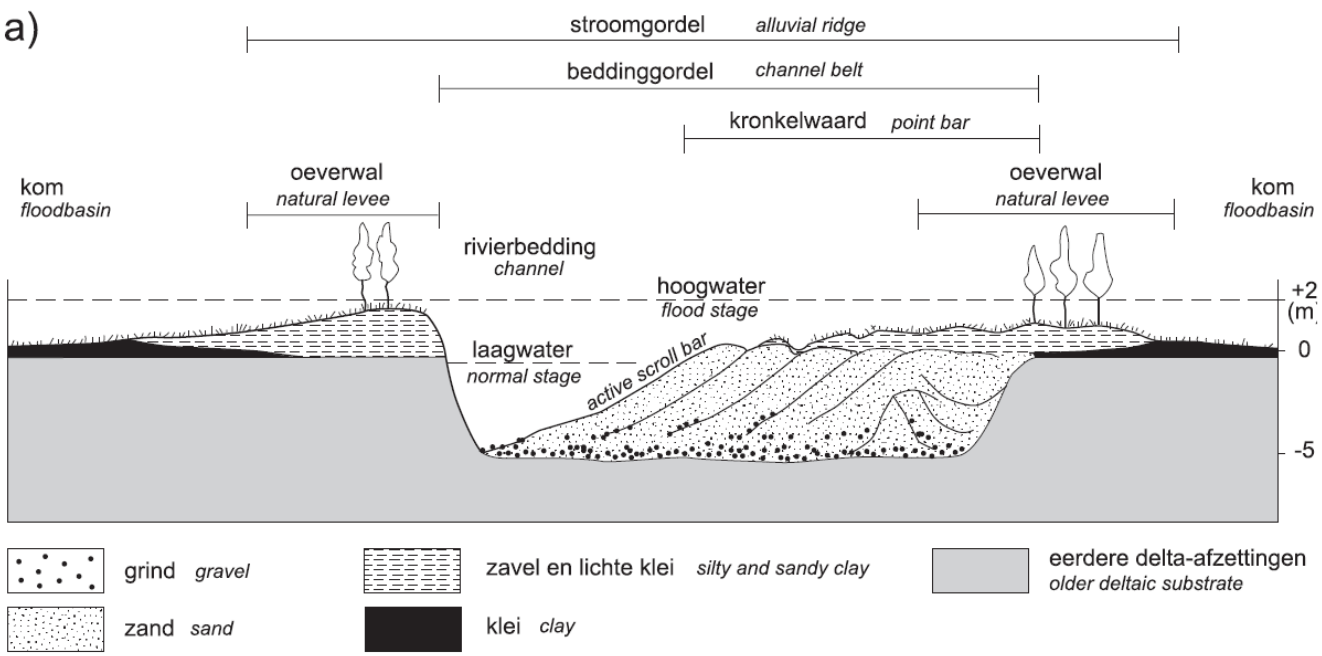
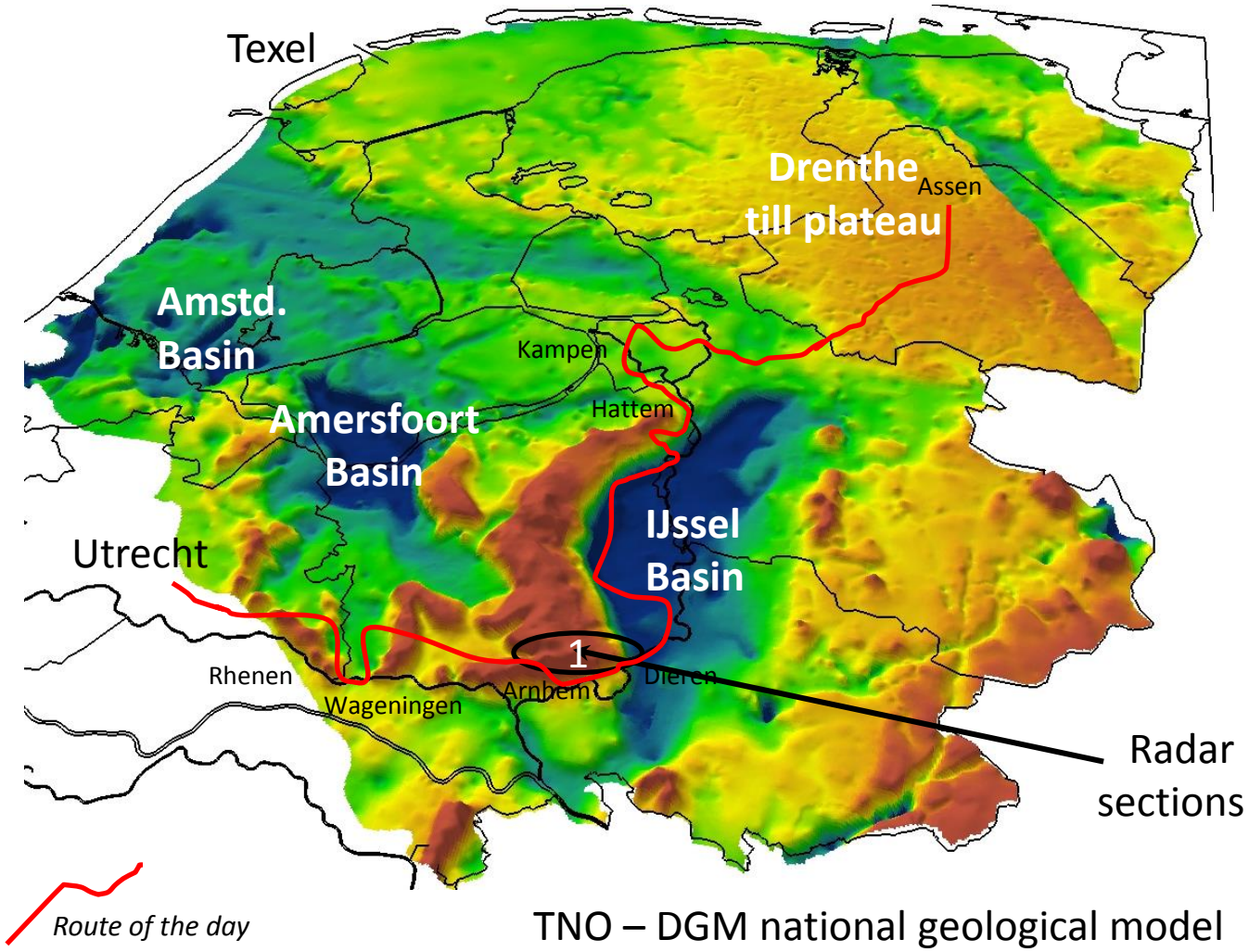
Sedimentary and geomorphological terminology

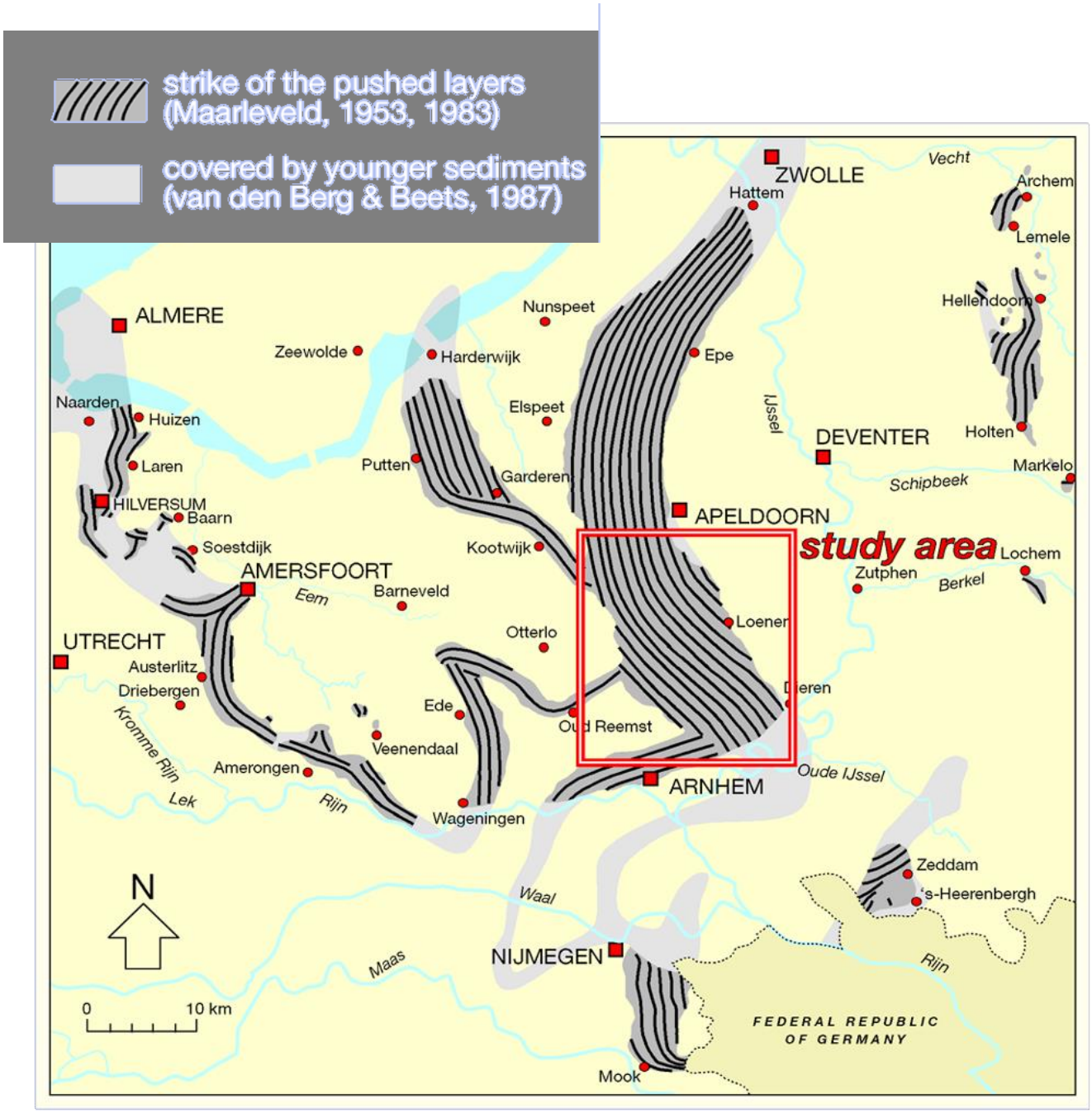


21th cy River management: Room for the River

By-pass green river for use at peak discharge Veessen- Wapenveld

Geological surface showing structures after the Saalian glaciation



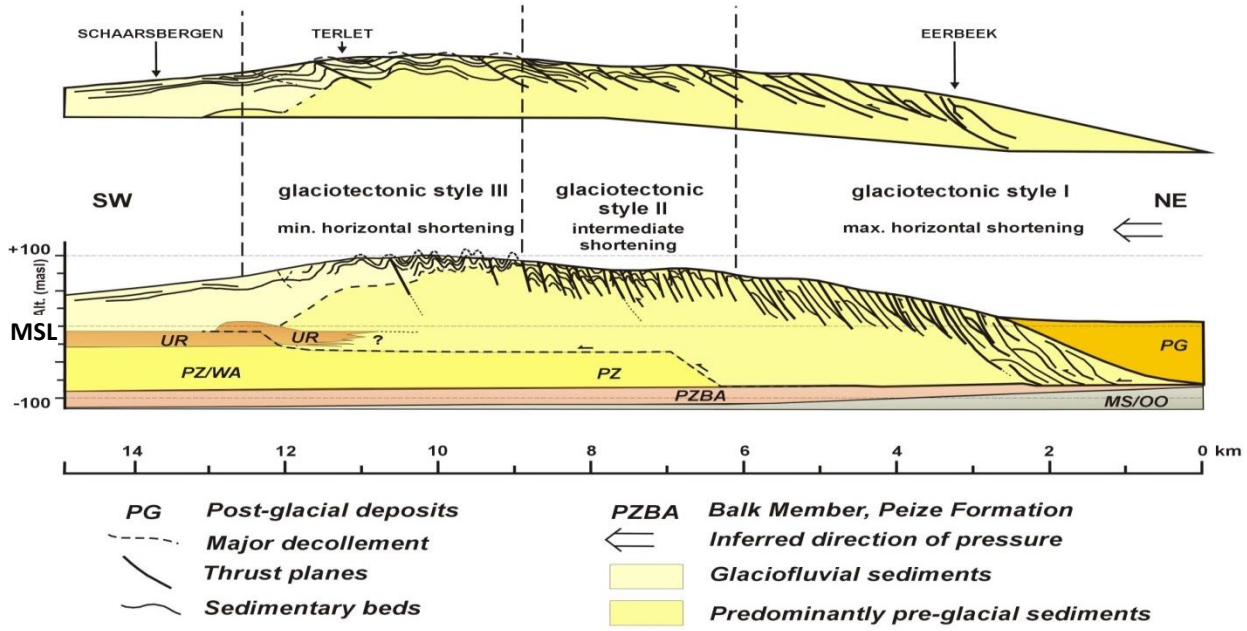


Strike of pushed ridges (Maarleveld 1953, 1963)

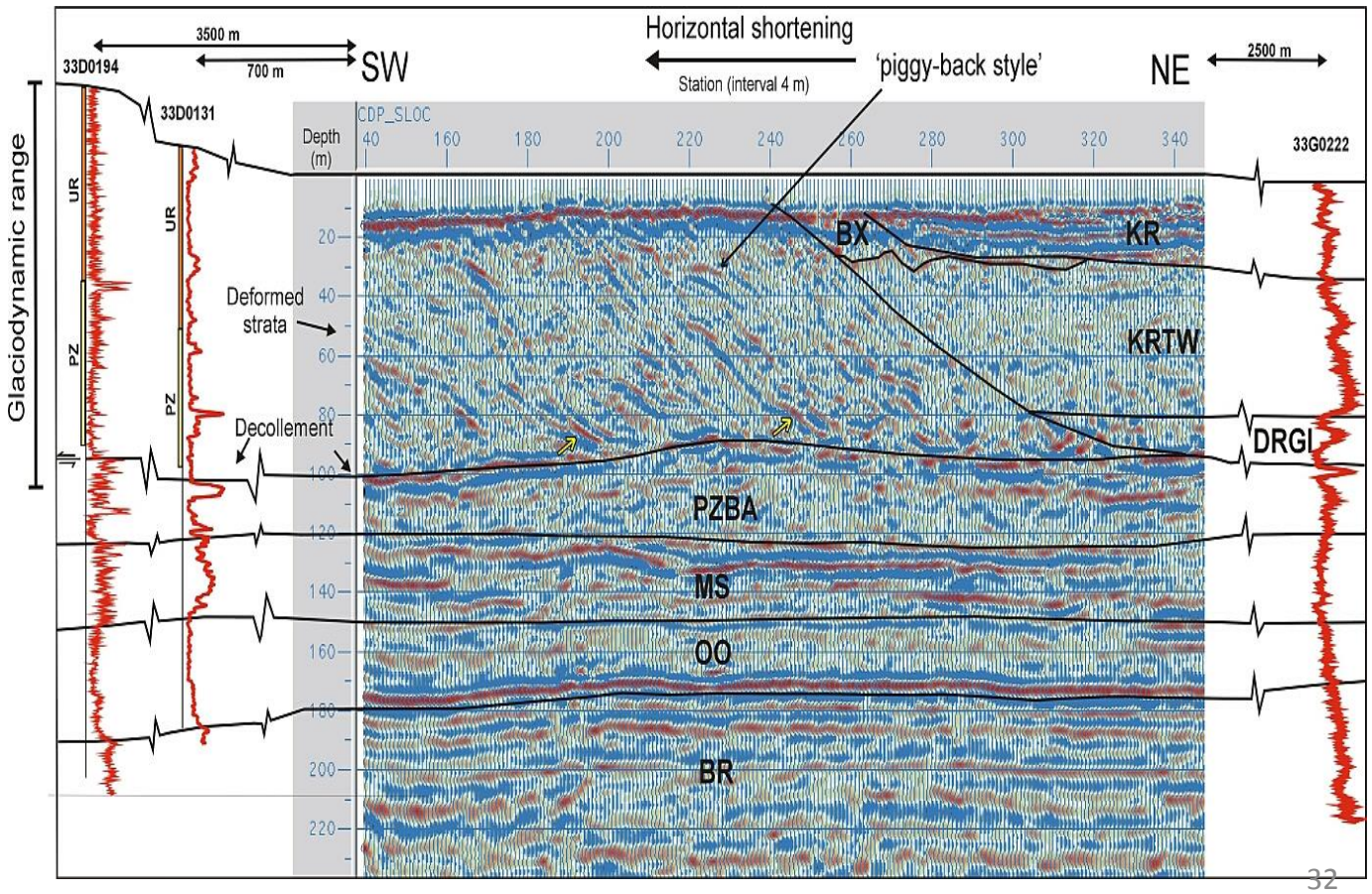
Ridge glacio-tectonic structure

Ground radar + Lidar geomorphology

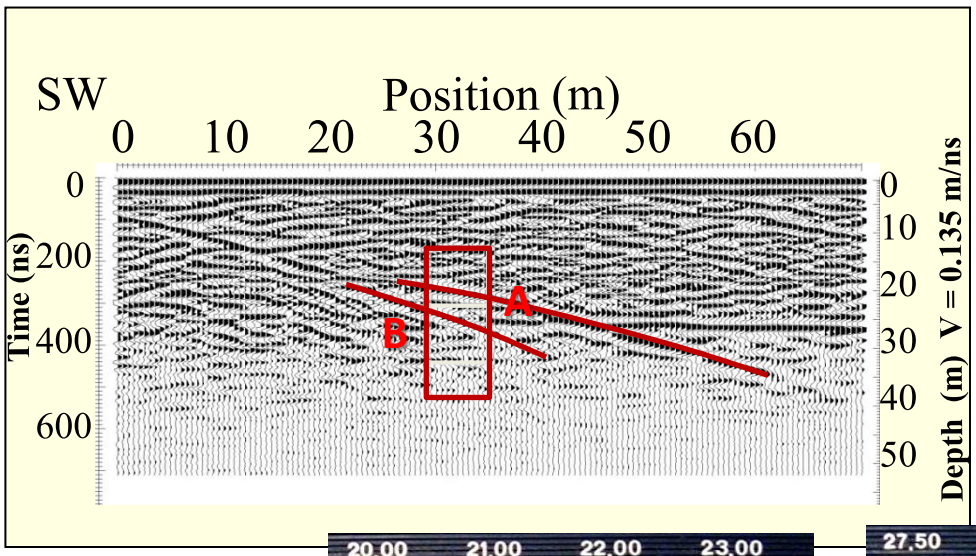
Bakker, 2006



Shallow seismics + boreholes

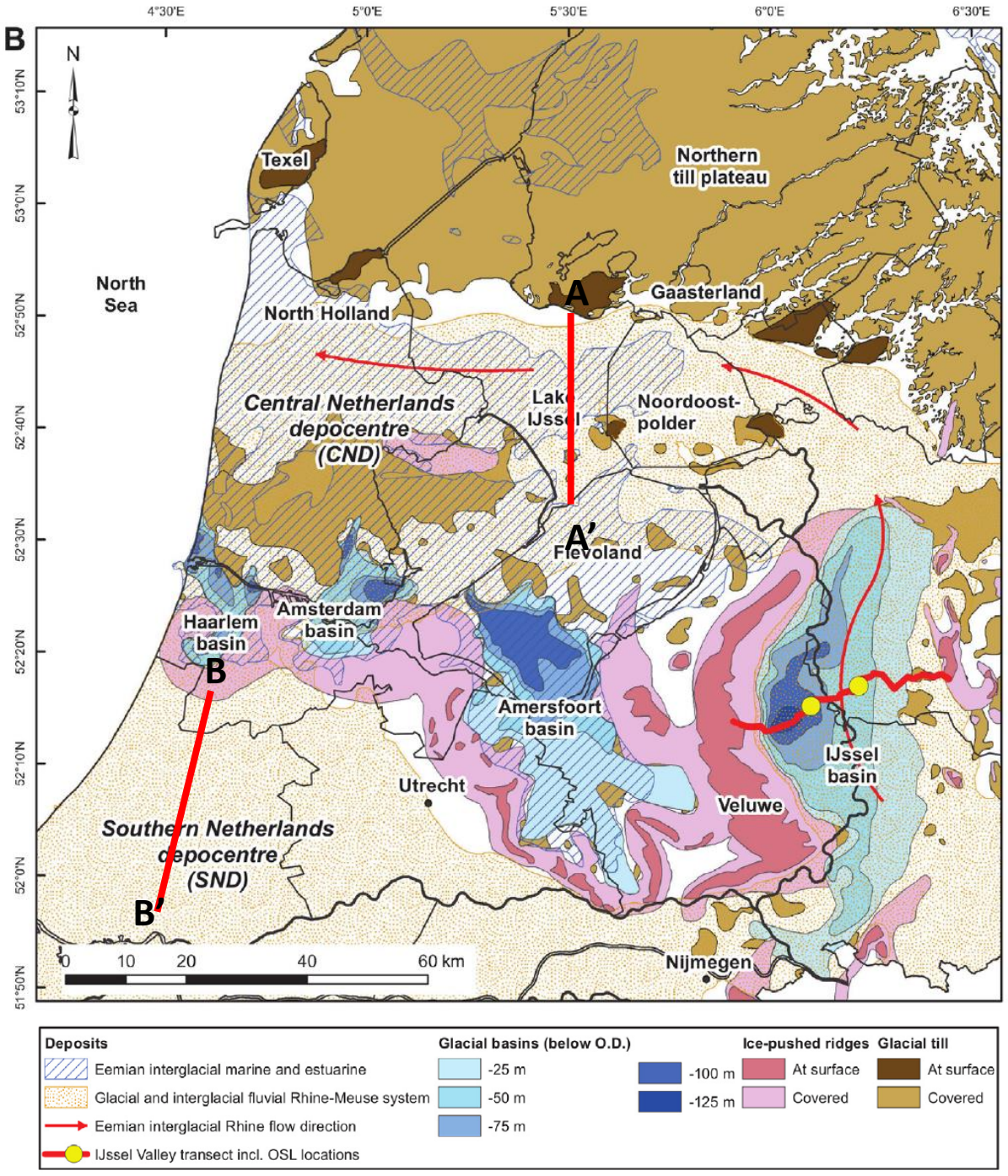


Middle Pleistocene clays as
the shear-planes of the thrust nappes



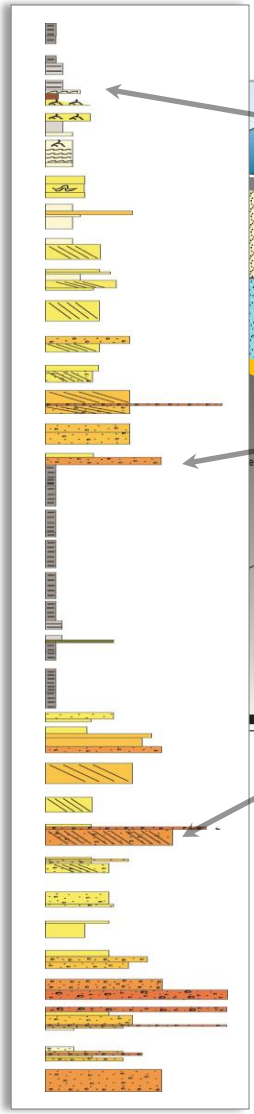
Bakker, 2006 –

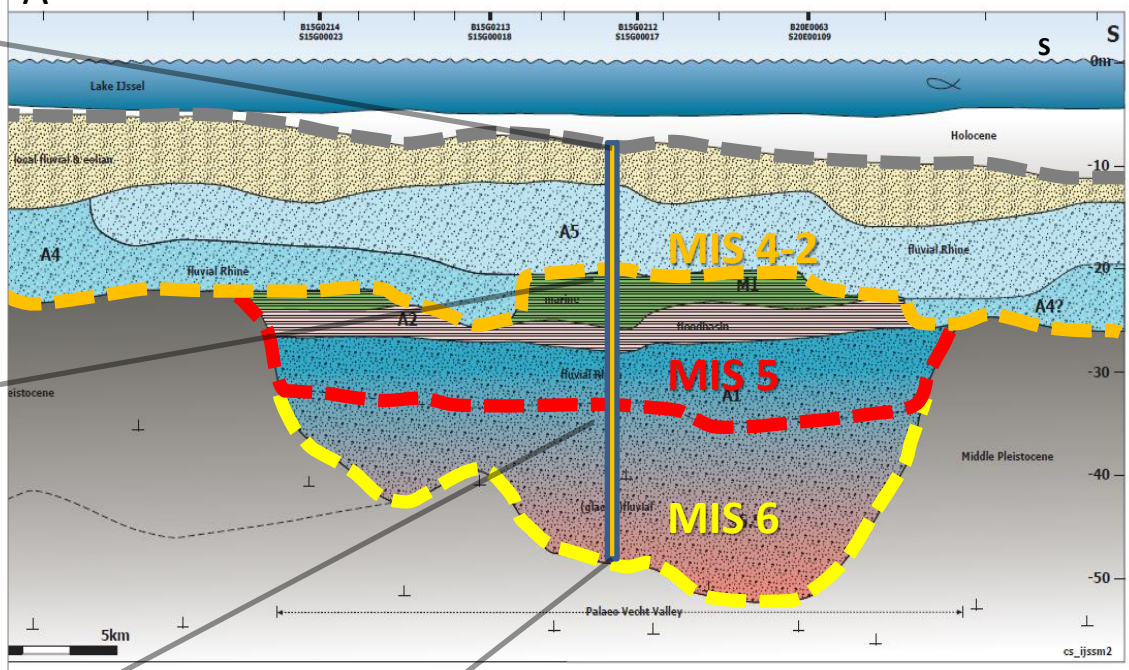
Cross-section approach
Mapping approach
Dating approach



Peeters et al.
exp. 2016 QSR

6th Nov. Morning Part 2



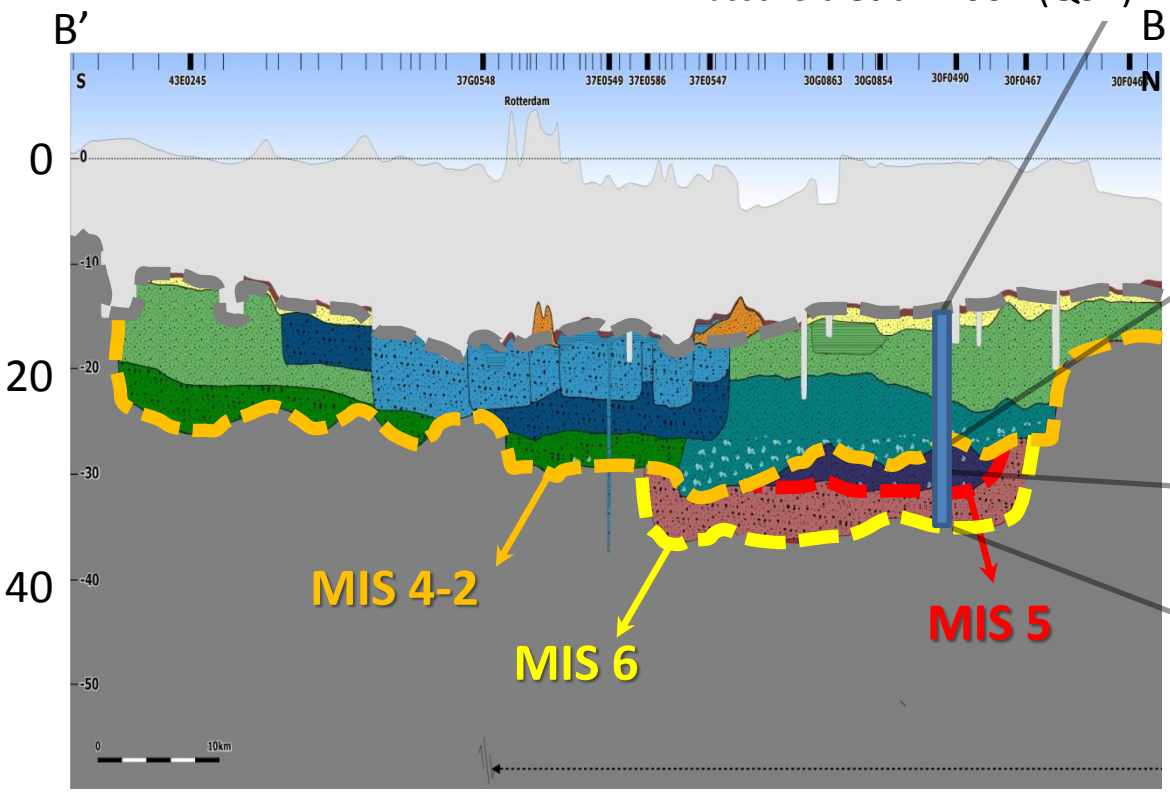


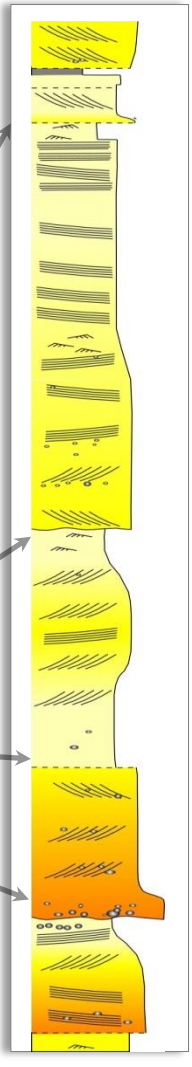
Northern palaeovalley

Peeters et al., in pr. (QSR)

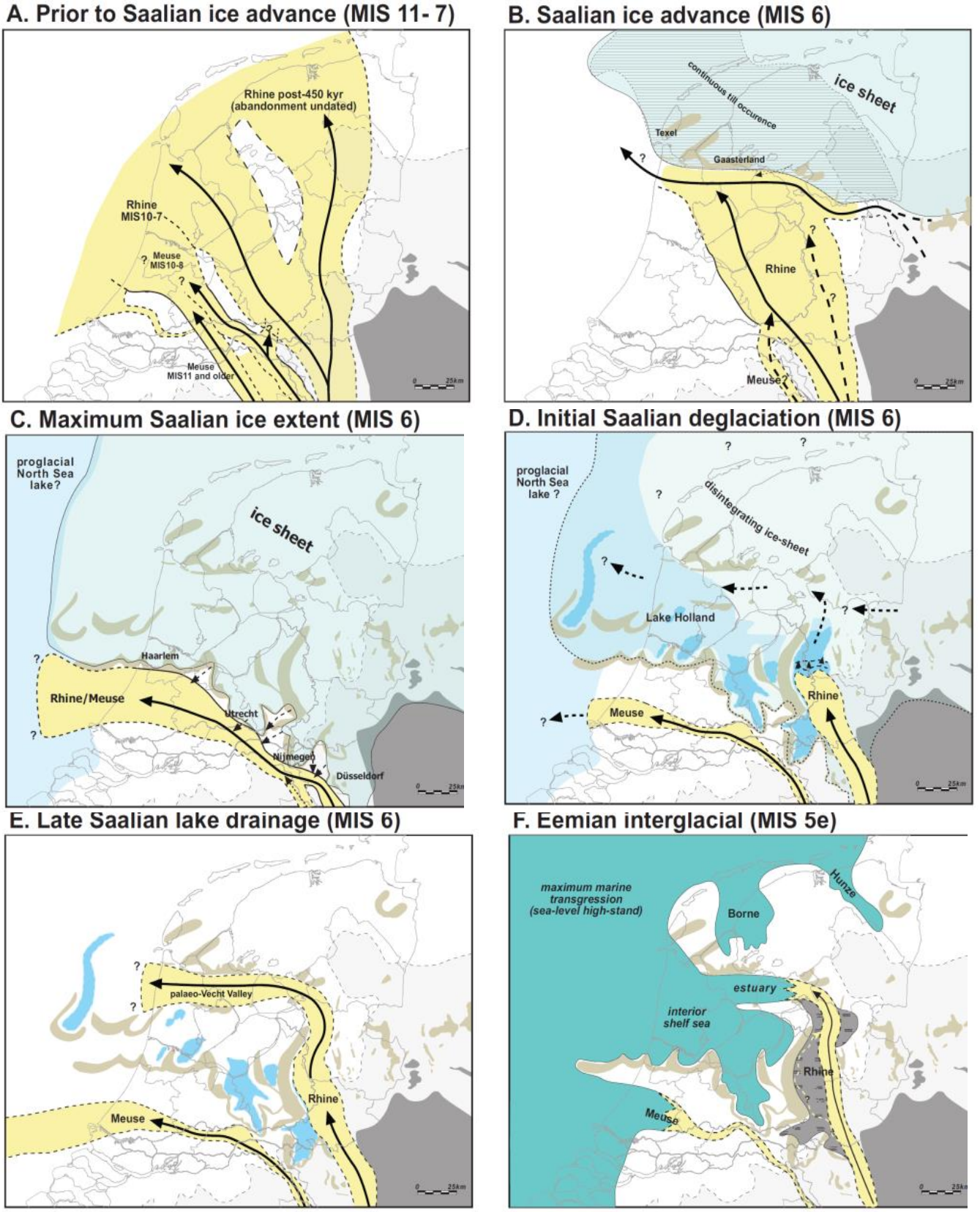
Southern palaeovalley

Busschers et al. 2007 (QSR)

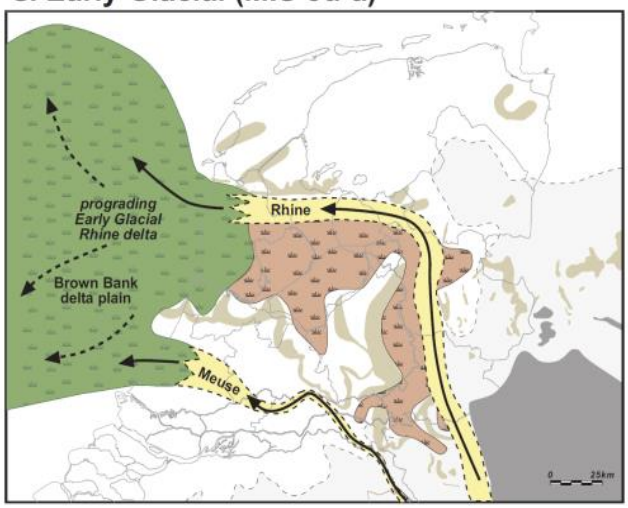




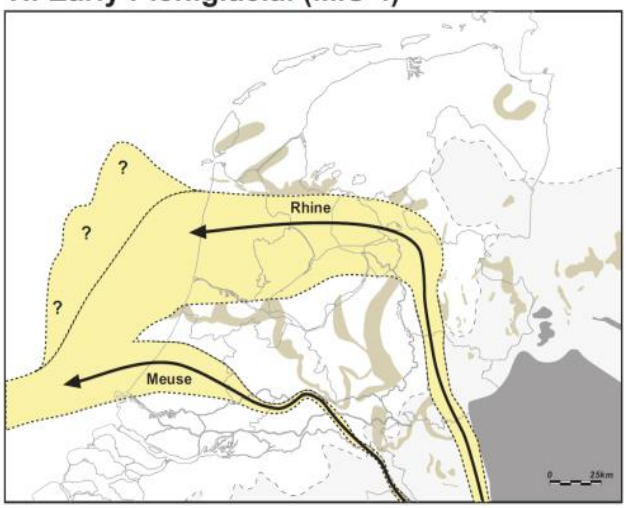
F.S. Busschers



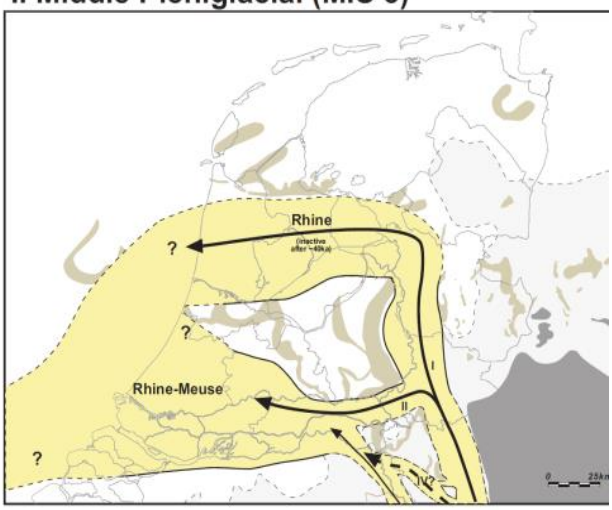
G. Early Glacial (MIS 5d-a)



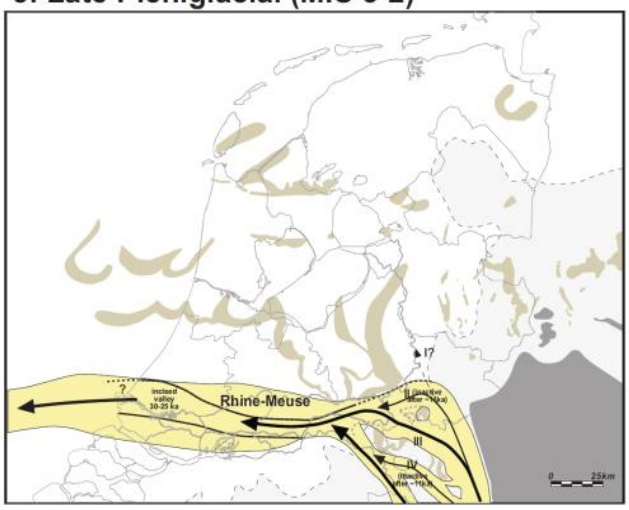
H. Early Pleniglacial (MIS 4)



I. Middle Pleniglacial (MIS 3)



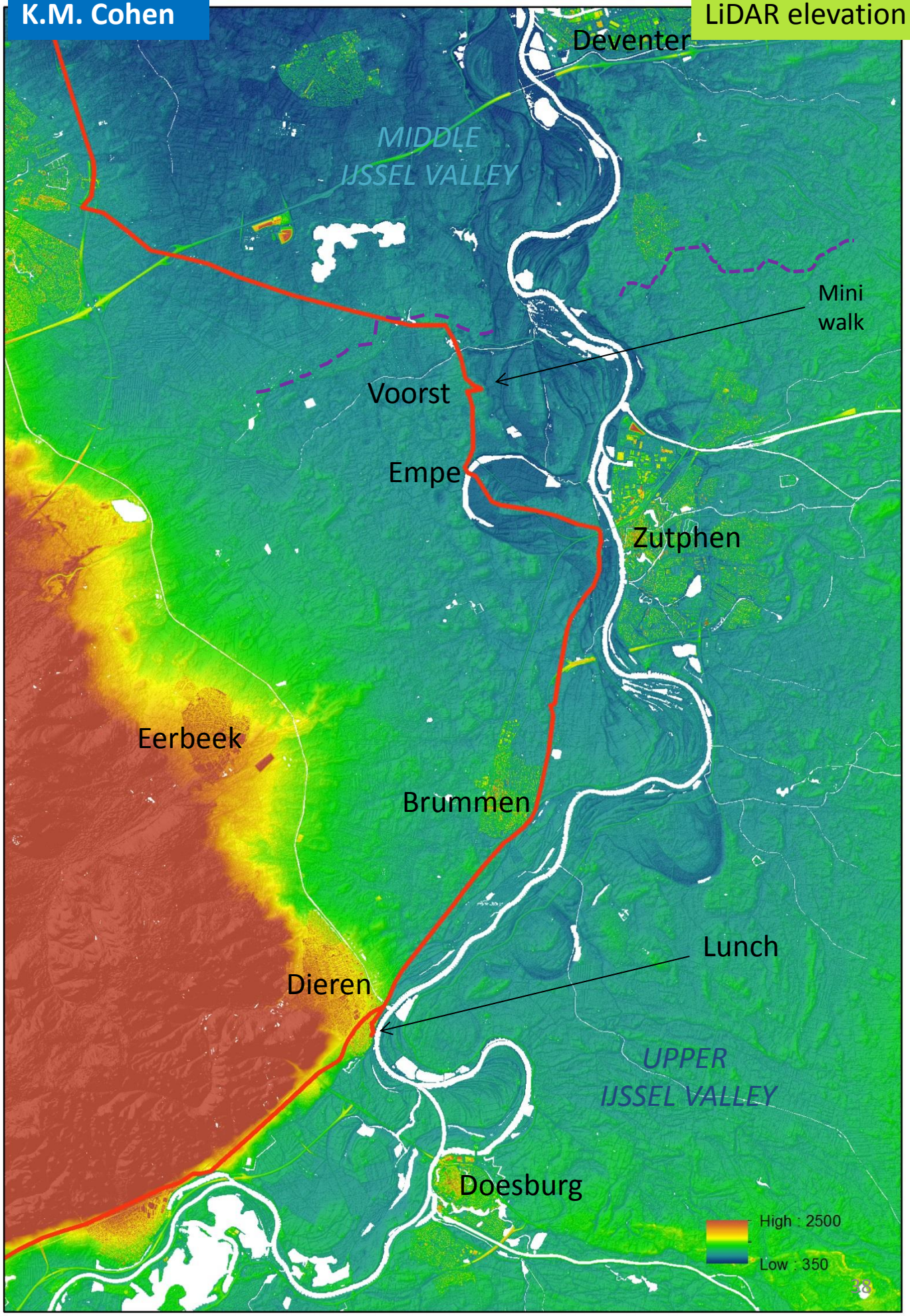
J. Late Pleniglacial (MIS 3-2)



Legend

- Channel belt
- Flow direction
- Flood basin (dominantly clastic)
- Flood basin (dominantly peat)
- Lacustrine-deltaic environment (partly brackish)
- Present topography >10m a.s.l.
- Paleozoic outcrops
- Glacio-tectonic ridges
- High-stand sea
- Proglacial lake
- Subglacial basins
- Ice sheet

Busschers et al. 2007 (QSR),
Busschers et al. 2008 (Boreas),
Peeters et al. 2015 (QI)
Peeters et al. in press (QSR)

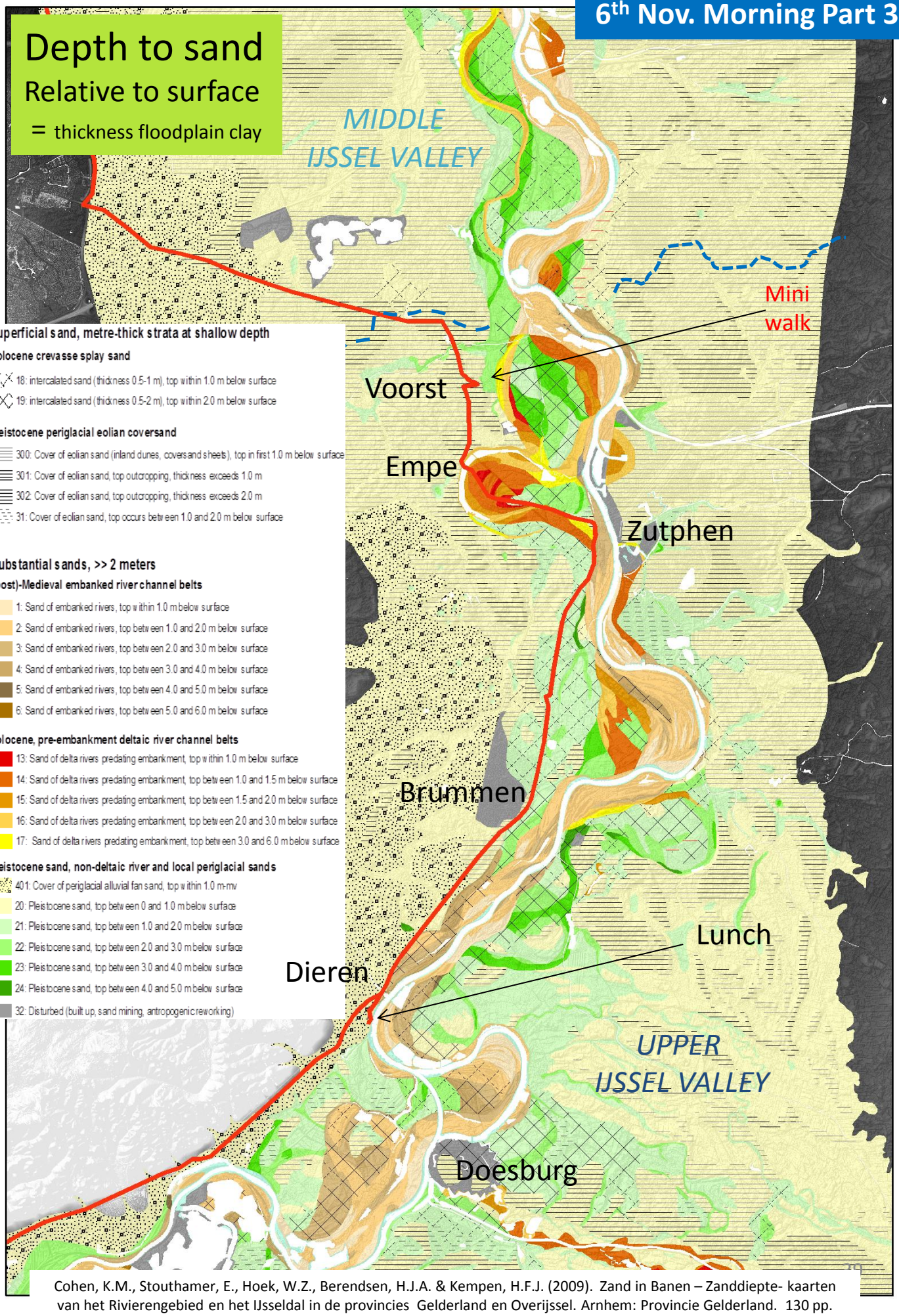

K.M. Cohen
LiDAR elevation
Deventer
MIDDLE
IJSSEL VALLEY
Mini
walk
Voorst
Empe
Zutphen
Eerbeek
Brummen
Lunch
Dieren
UPPER
IJSSEL VALLEY
Doesburg
High : 2500
Low : 350

6th Nov. Morning Part 3

Depth to sand

Relative to surface

= thickness floodplain clay



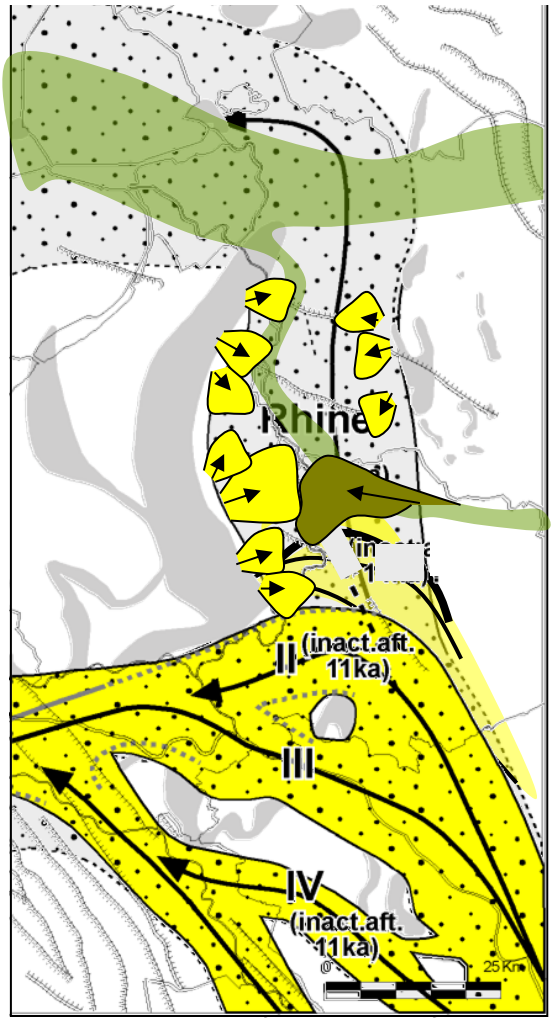
Cohen, K.M., Stouthamer, E., Hoek, W.Z., Berendsen, H.J.A. & Kempen, H.F.J. (2009). Zand in Banen – Zanddiepte- kaarten van het Rivierengebied en het IJsseldal in de provincies Gelderland en Overijssel. Arnhem: Provincie Gelderland. 130 pp.

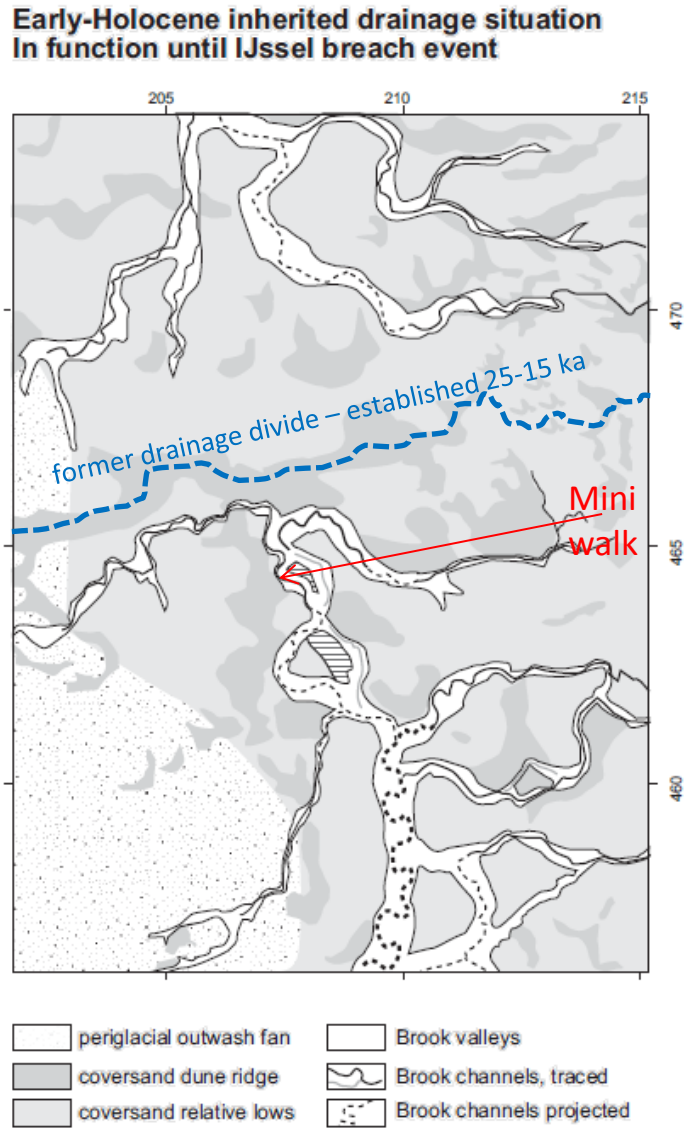
K.M. Cohen

Alluvial fans make a drainage divide

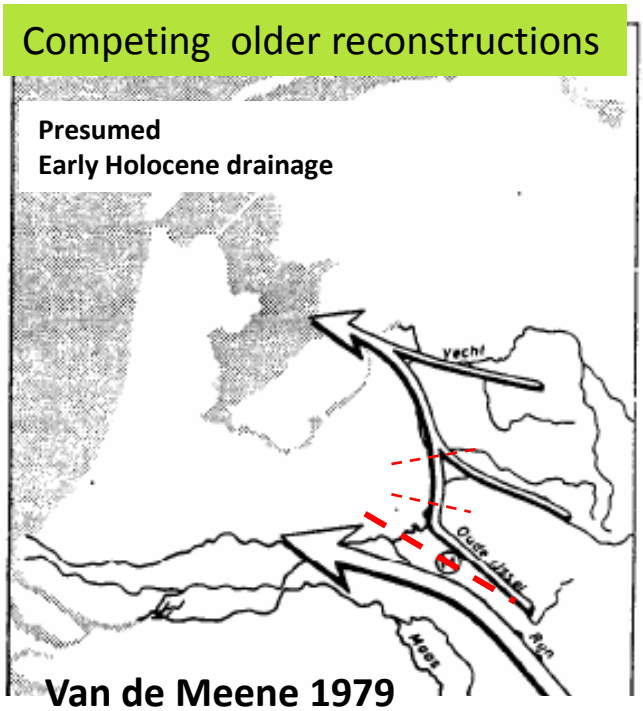
Alluvial fans 40-25 ka …

… 25-15 ka, 15-11 ka

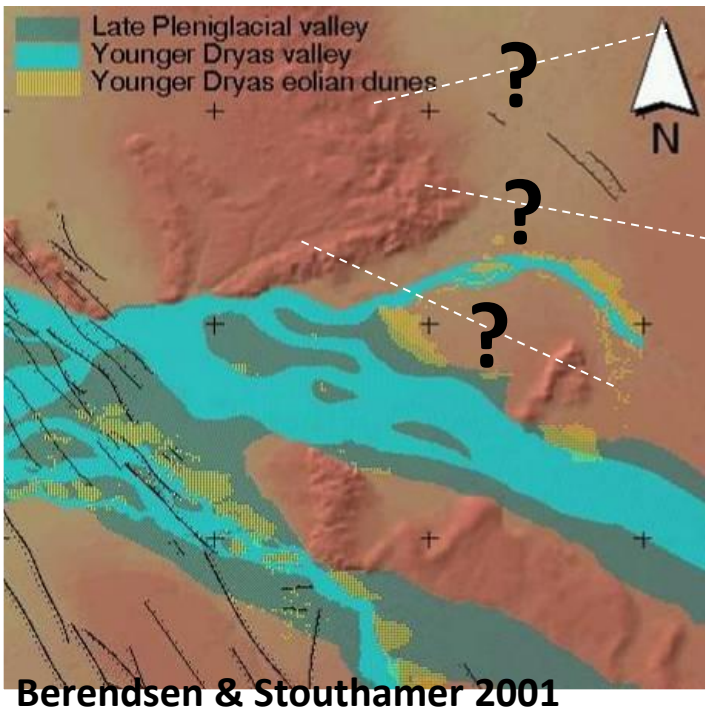




Competing older reconstructions



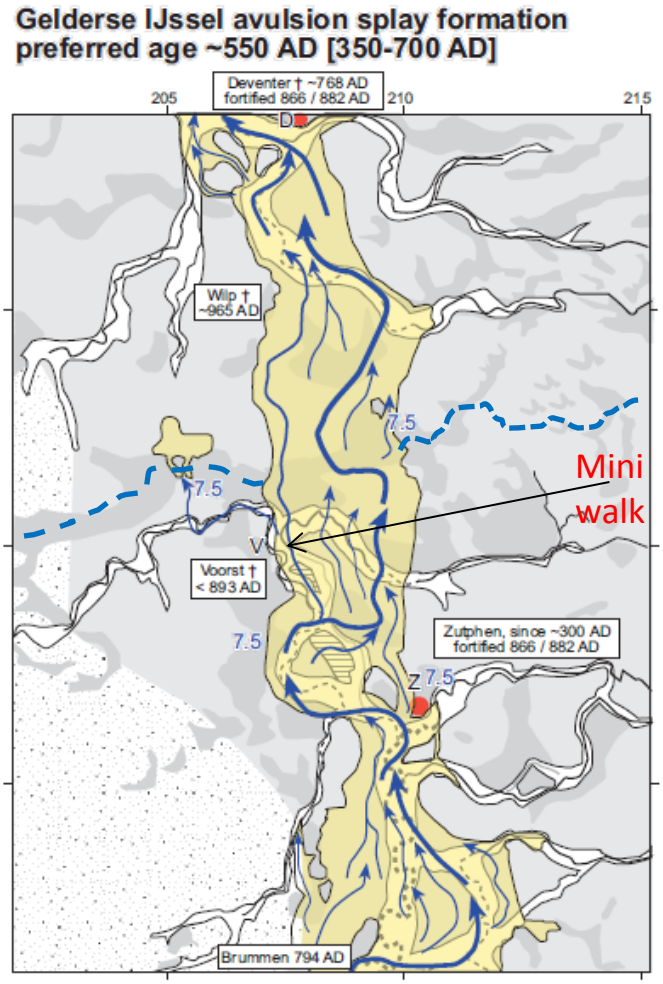
Van de Meene 1979

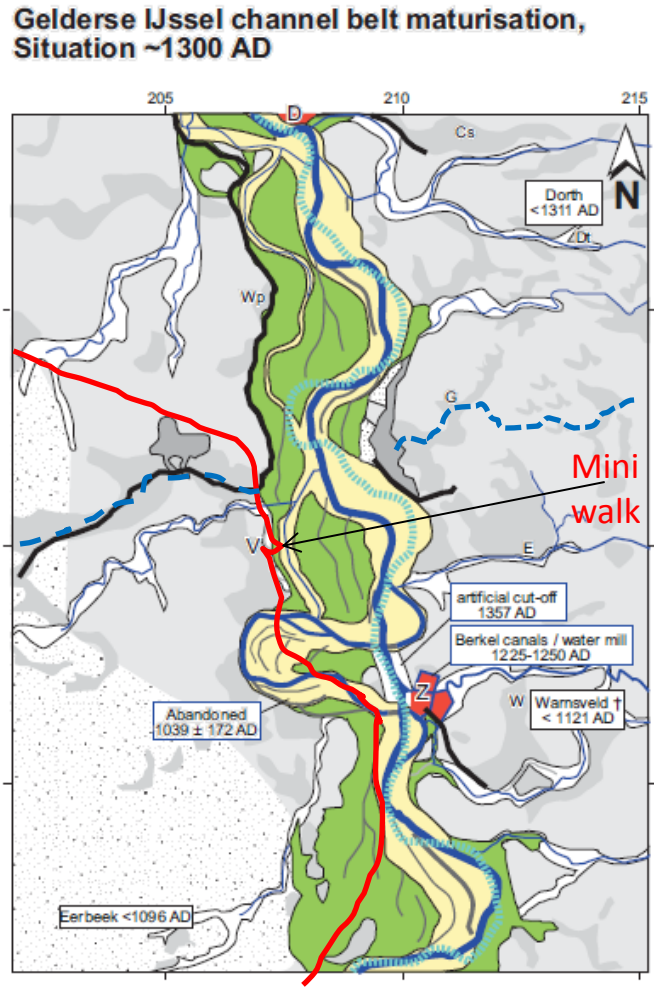


Berendsen & Stouthamer 2001

Avulsion of the Gelderse IJssel

6th Nov. Morning Part 3





Splay and initial channel belt formation
Splay channels
Early Medieval Fortified Settlements
7.5
drainage divide &
breached col heights
Channel belt
Silted-up splay floodplain
Isolated breach splays
Active channelsand moats
Residual channels
Medieval cities, first dikes

Largest floods
c. 550 AD
c. 690 AD
c. 784 AD
1342 AD
1374 AD
Toonen (2013)

Oldest clay-on-peat ^{14}C dates north of divide:
1295 ± 35 (GrA-44639)
~700 AD
Cohen et al. 2012

Wageningen University

WAGENINGEN UR
For quality of life

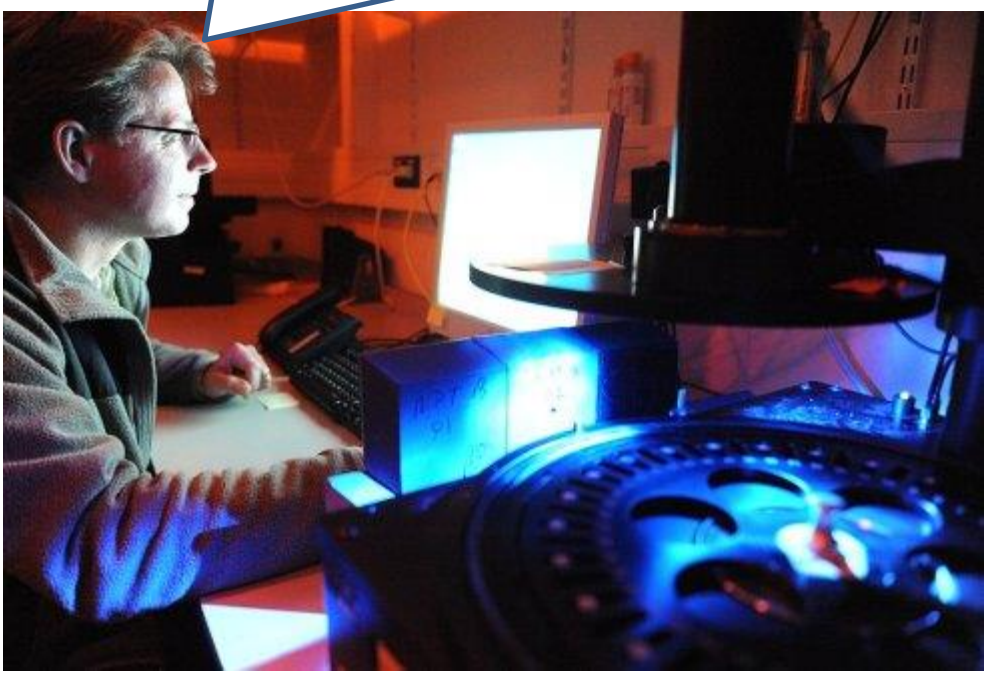
NCL
Netherlands Centre for Luminescence dating

http://www.ncl-geochron.nl/

Prof. Dr. Jakob Wallinga

Chair of Soil Geography and Landscape Group

At the Netherlands Centre for Luminescence dating we develop new and improved luminescence dating methods. We apply luminescence dating in collaboration with NCL partners and external users.



World Soil Information

WAGENINGEN UR
For quality of life

http://www.isric.org/

Ing. Stephan Mantel

ISRIC staff – specialization: Land evaluation and decision support

ISRIC - World Soil Information is an independent, science-based foundation. It was founded in 1966 following a recommendation of the International Soil Science Society (ISSS) and United Nations Educational, Scientific and Cultural Organization (UNESCO). ISRIC is the International Council for Science (ICSU) accredited World Data Centre for Soils (WDC-Soils) since 1989 and it maintains the World Soil Museum.

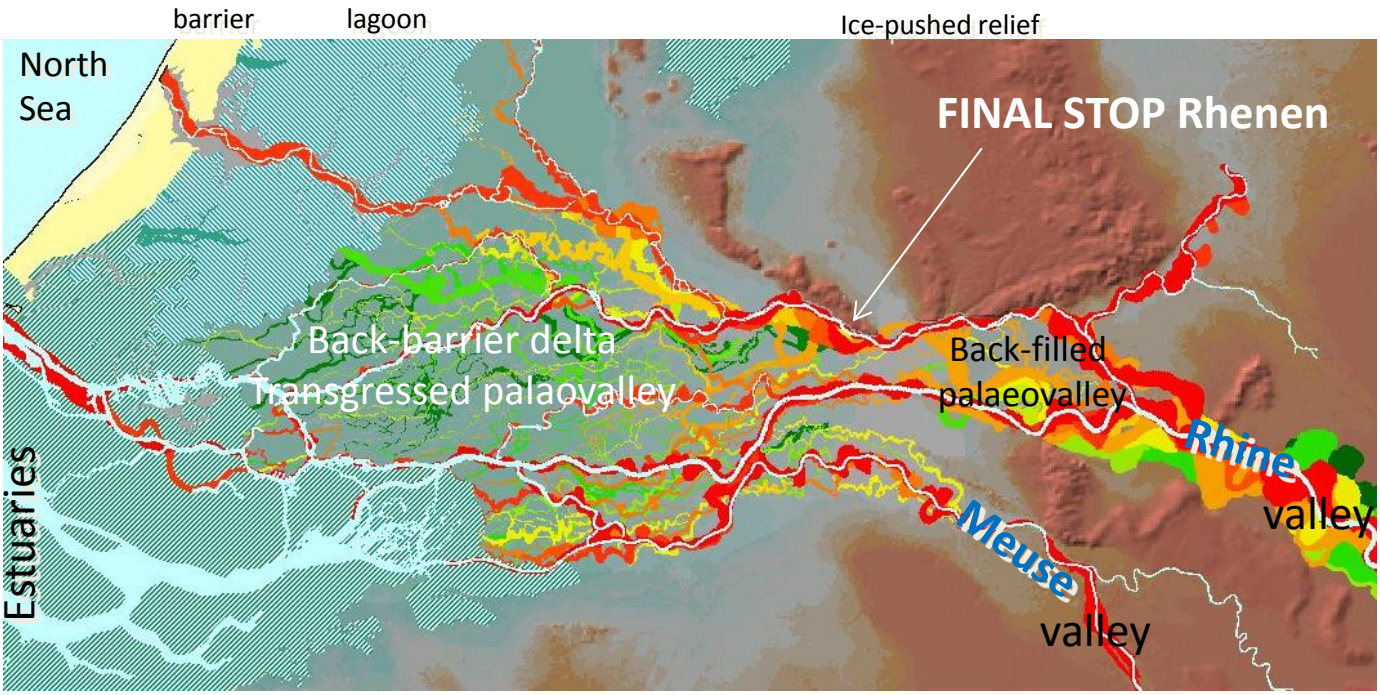
Gleysol

Kastanozem

WAGENINGEN UR
For quality of life

Wageningen campus impressions

Holocene Rhine-Meuse delta - Age of channel belts



Berendsen & Stouthamer 2001, updated; Gouw & Erkens 2007; Hijma & Cohen 2011

8.5 ka  present

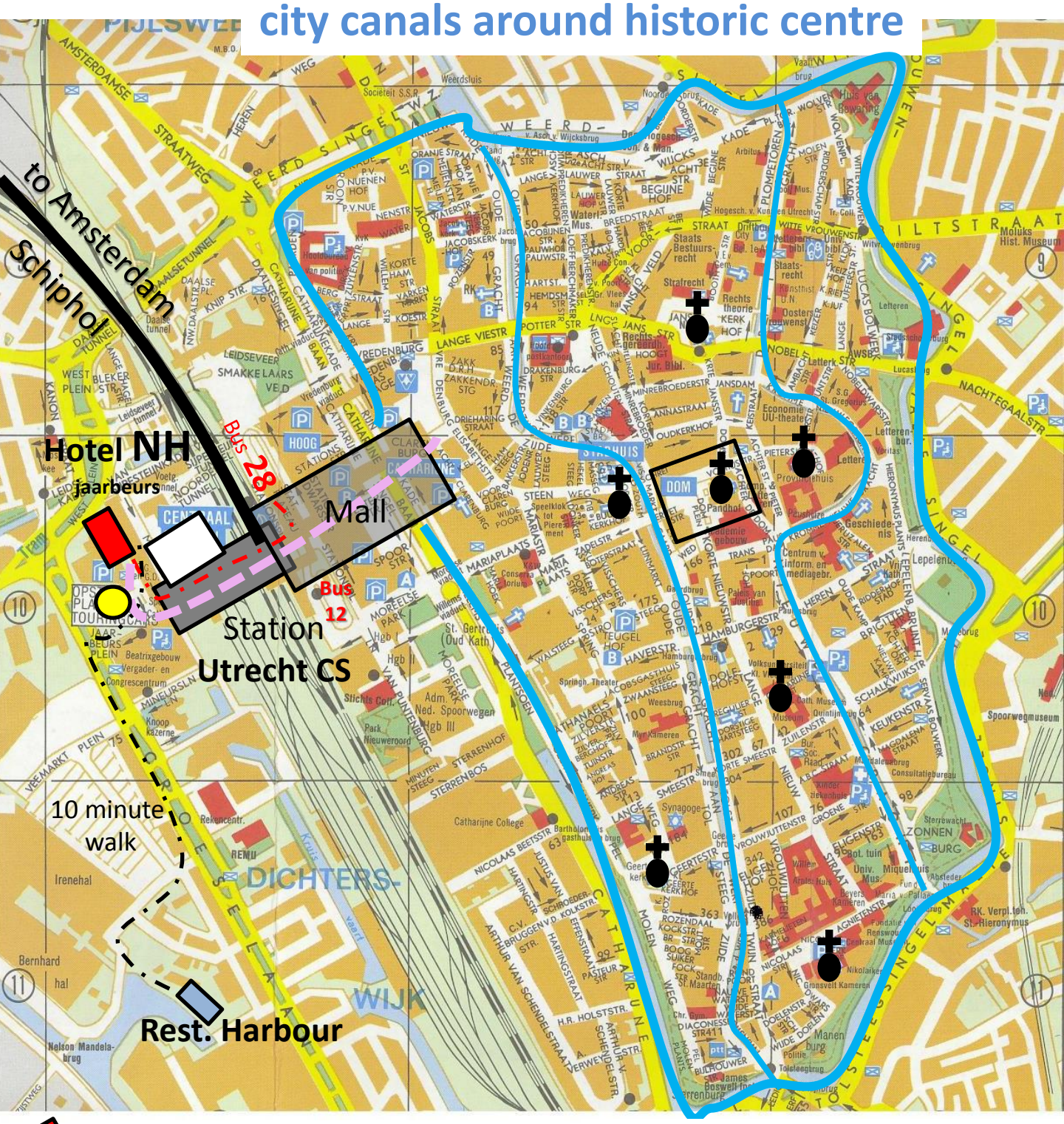
sunset , fall, glacial terminations…

Theme of the day: Pleistocene bounds to Holocene floodplains

UTRECHT CITY CENTRE

6th Nov. HOTEL, DINER, CITY CENTRE

city canals around historic centre



Drop off Bus near Hotel
& walk to DINER 6th November
Restaurant HARBOUR

Walk to City Bus 28 UITHOF
7th November morning

Selected cross-of-churches and outline Roman *Castellum* at Dom Square

walk Hotel <> city
via Station and Mall
Friday/Saturday/Sunday

Centre by Night

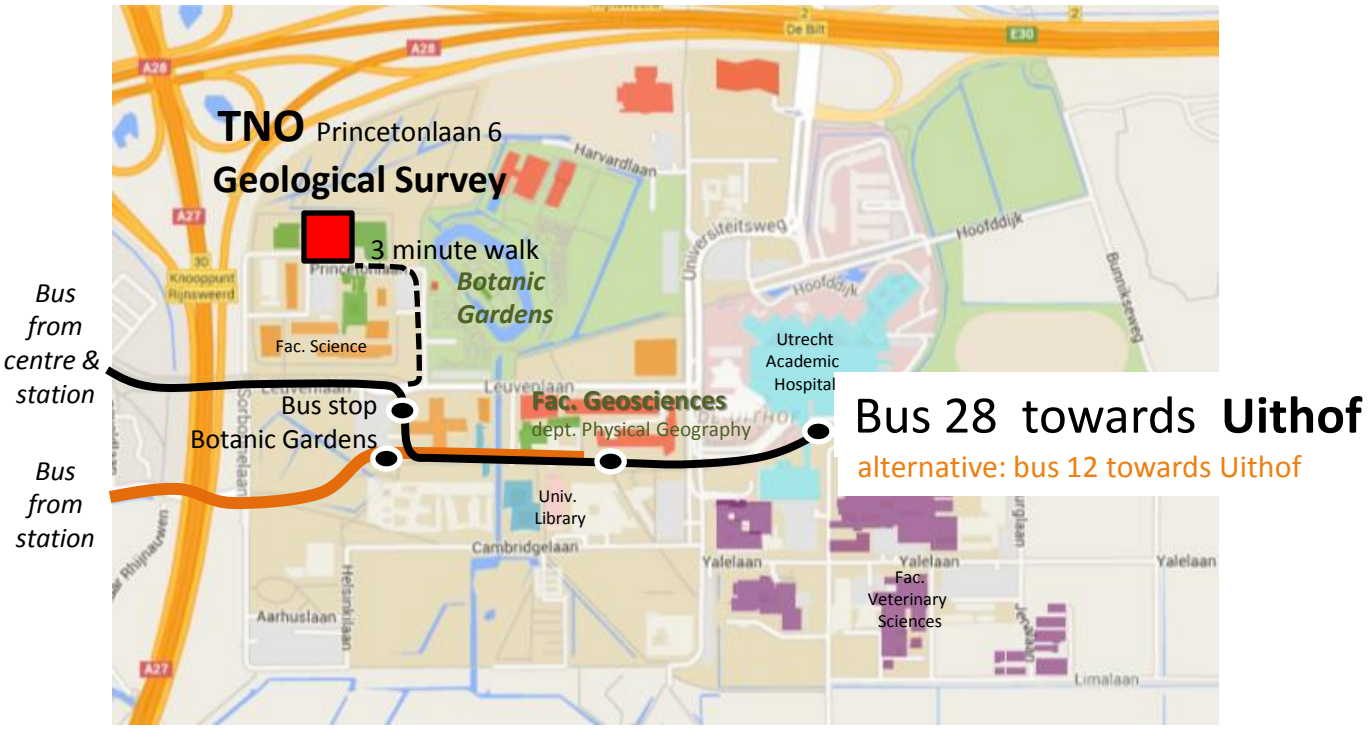
Dom

Campus

Uithof Campus by Day

Entrance of TNO Geological Survey - past Botanic Gardens

TNO Geological survey of the Netherlands visit



The Geological Survey of the Netherlands

The Netherlands' national Geological Survey is part of TNO (Netherlands Organization for Applied Scientific Research), an independent national research and technology institute. The Survey operates in a densely populated and intensely used area. Over 60% of the country's shallow subsurface consists of fluvial and coastal lowland sediments. The rest consists mostly of Pleistocene fluvial and glacially-modified basin fill terrains.

Flooding of the lowlands is a strong natural hazard, in places increased owing to land-subsidence following human interferences (water-table lowering, extraction of gas and salt). Not particularly hazardous but significant in terms of costs and financial risks is building on young and soft coastal plain soils. Hereto high resolution data and mapping of the heterogeneous fluvial and coastal deposits is needed. The mission of the Netherlands' Geological Survey thus reads:

To provide geoscientific data, information and knowledge

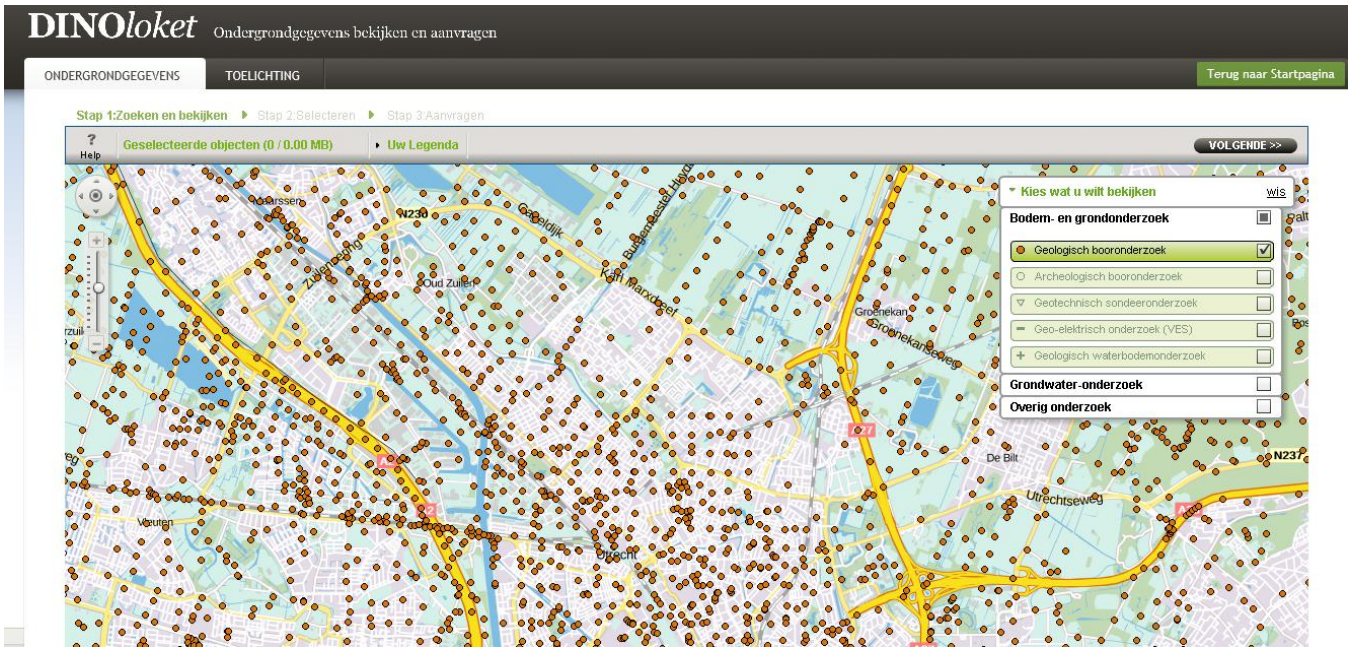
- for sustainable management of Earth resources and the environment in general; and
- to reduce societal costs and risks associated with geohazards and adverse ground conditions.

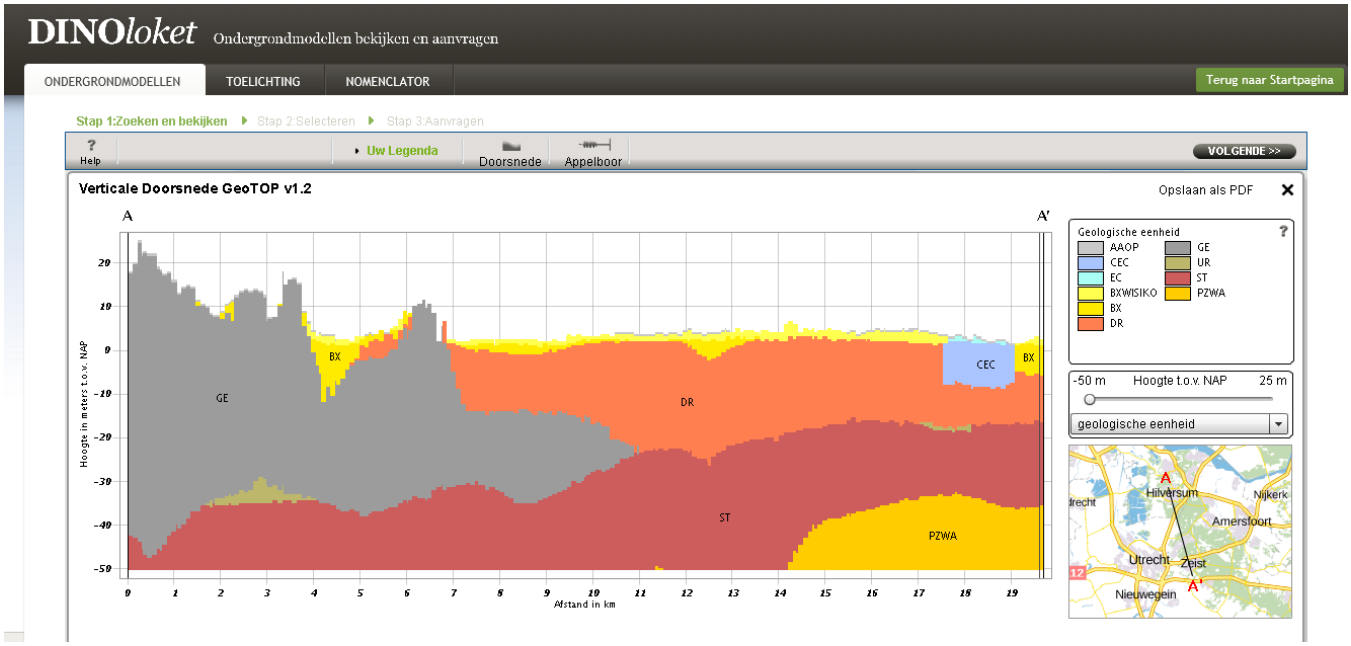
time	Talk
10.00	**Coffee and cookies** *Leave the hotel around 9.30. Travel with bus 28*
10.30	**Introduction Geological Survey of the Netherlands** (Michiel van der Meulen)
11.00	**GeoTOP voxel modelling: data & methods** (Freek Busschers)
11.20	**3D demo GeoTOP voxel model** (Freek Busschers)
11.45	**Visit to core processing facility** (Ronald Harting)
12.30	**Lunch**
13:30	**End of TNO-GDN visit**

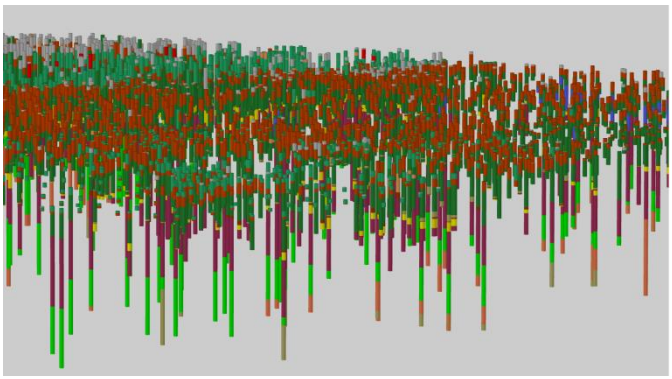
The survey activities are conducted under a single government funded programme, the main elements of which are data management (e.g. borehole handling workflow, quality assurance, public exposure) and geomodelling (2D/layer models, 3D/voxel models). A database (DINO) and a legislation-supported national register (BRO) for digital subsurface data the Survey's main assets.

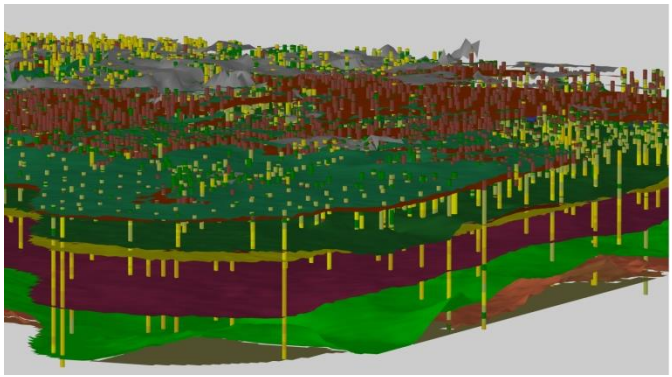
The survey invests in communication, in maintaining a knowledge base and in scientific publication. We cooperate with other surveys, research institutes and universities; nationally and internationally.

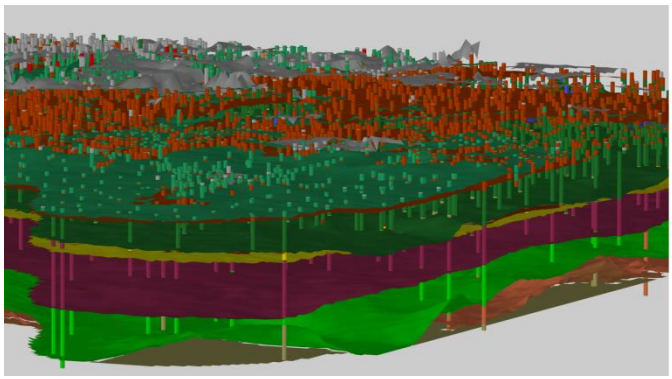
TNO Geological survey of the Netherlands visit

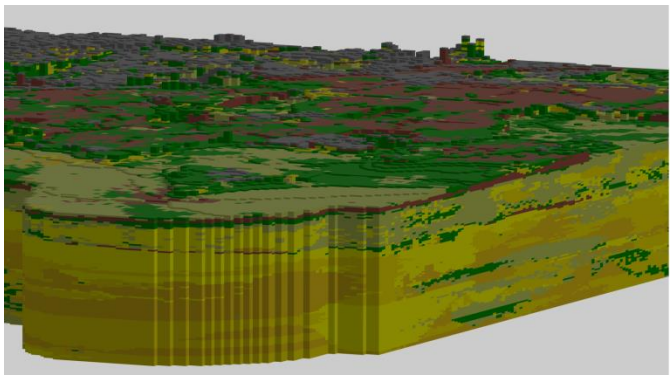




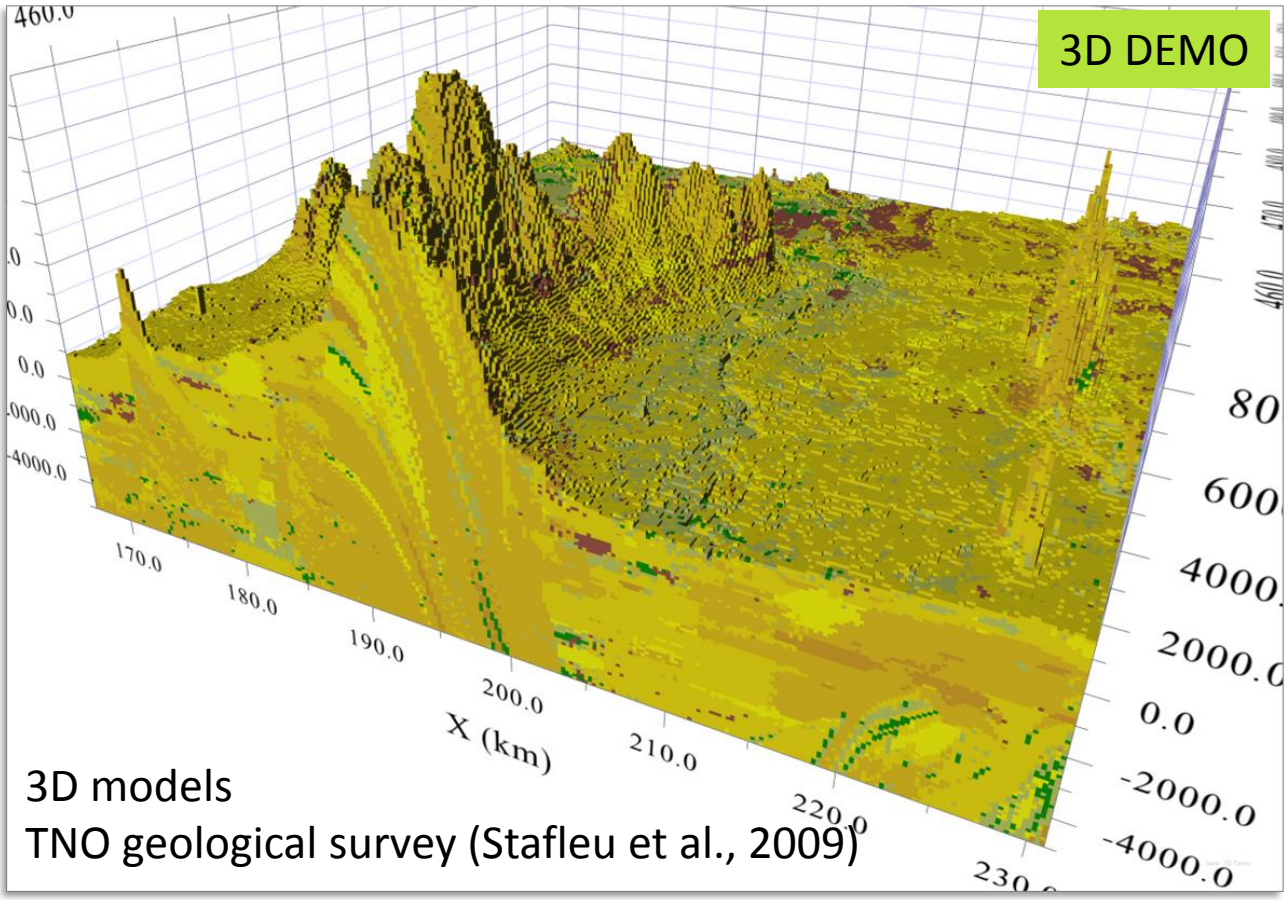








Voxel models



3D models
TNO geological survey (Stafleu et al., 2009)

Borehole description facility
TNO geological survey

Roadmap of The Netherlands

with excursion route Tue 3 Nov and Fri 6 Nov

Quaternary Geology and Modern Questions

Thank you for your attention

provincie Drenthe

Universiteit Utrecht

TNO innovation for life

rijksuniversiteit groningen

WAGENINGEN UNIVERSITY
WAGENINGEN UR

NIOZ Royal Netherlands Institute for Sea Research

Radboud Universiteit

VU VRIJE UNIVERSITEIT AMSTERDAM