Dealing with uncertainties in climate adaptation in the Netherlands

A case of "Delta Committee"

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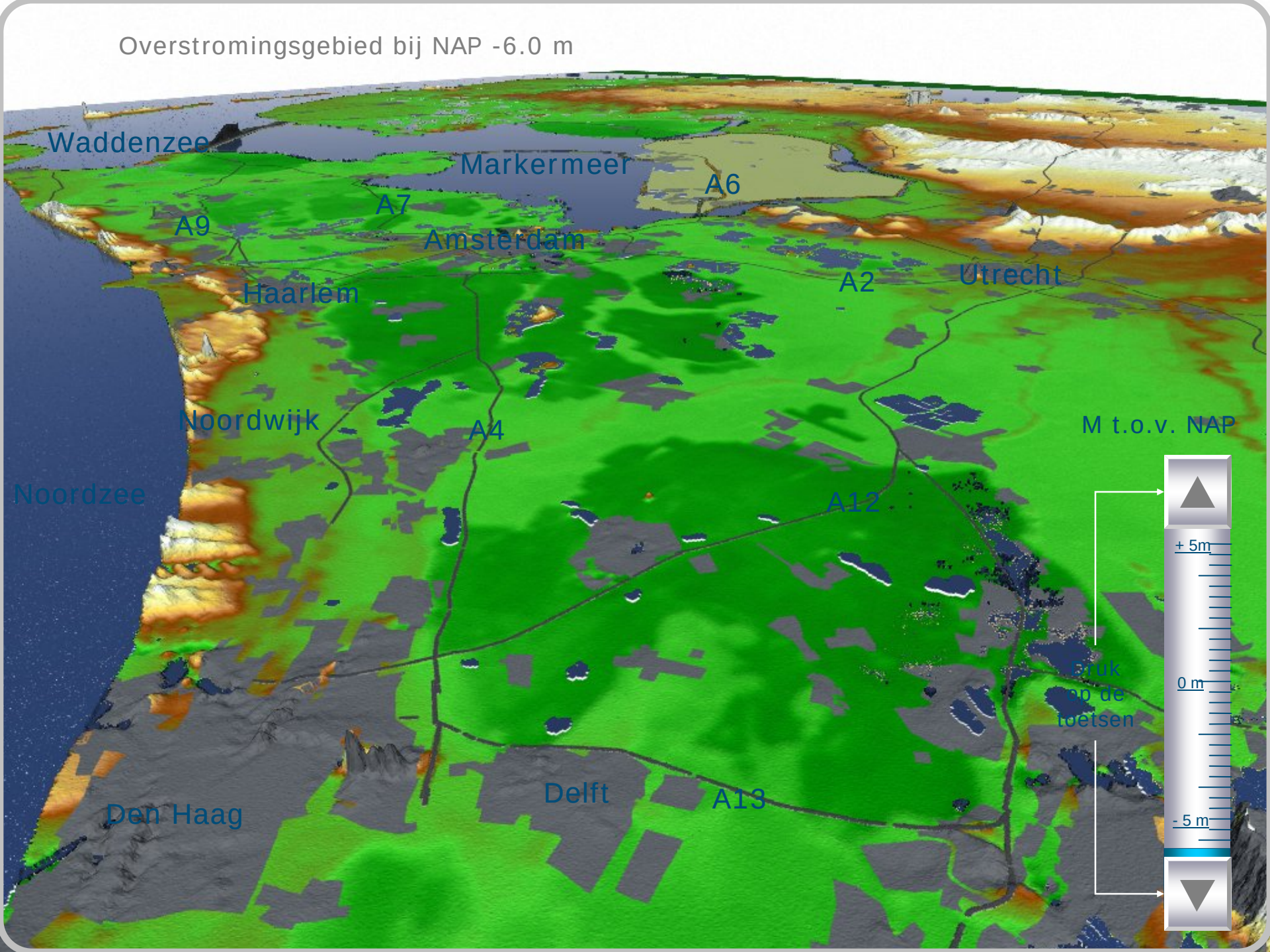
Earth System Science & Climate Change Group www.ess.wur.nl
Climate Centre (CCB) Wageningen UR www.wur.nl/ccb
National Climate Change Programme Netherlands
www.climatechangesspatialplanning.nl
Member DeltaCommittee (www.deltacomissie.com)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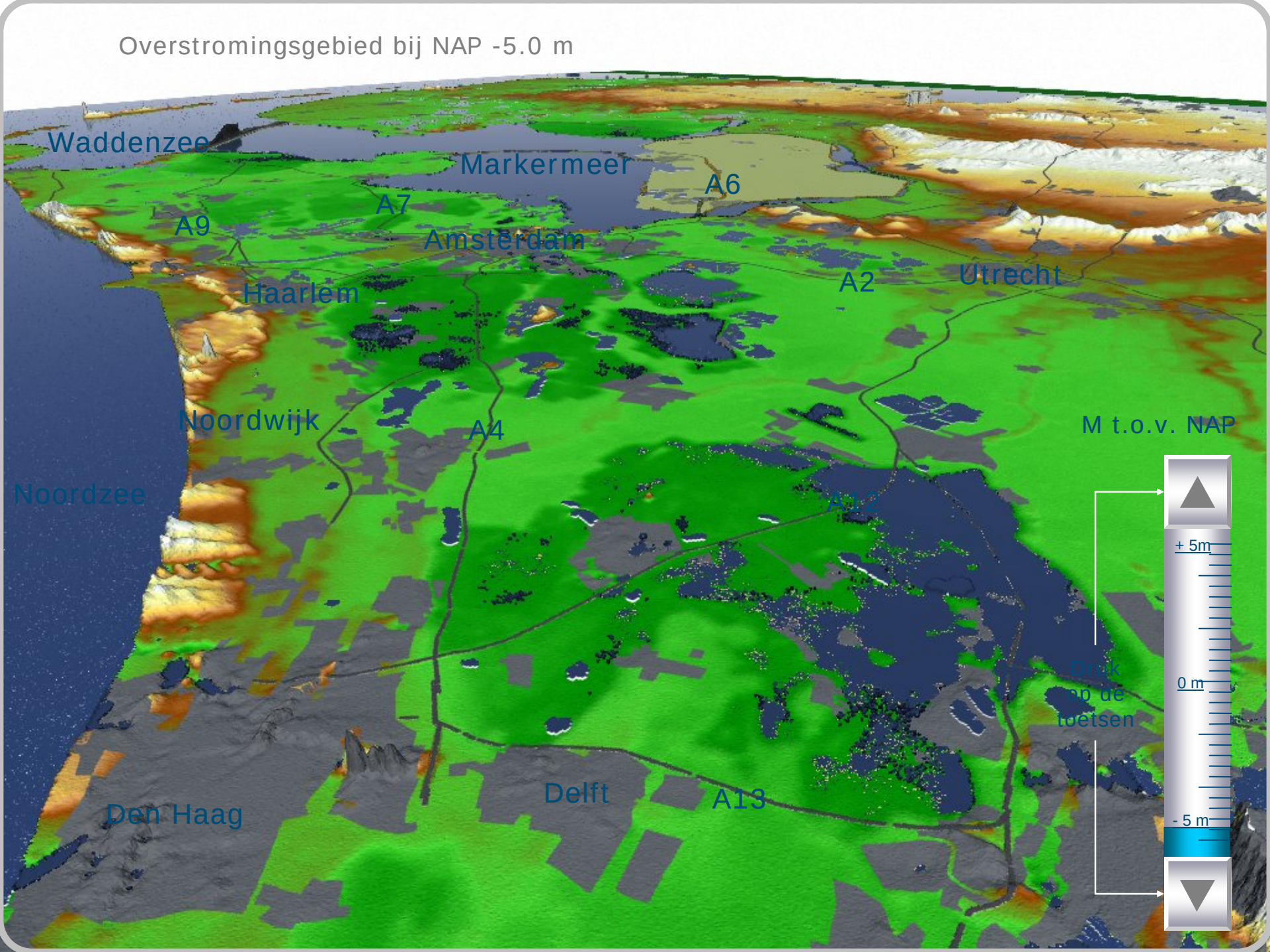
Waddenzee
Markermeer
A6
A7
A9
Amsterdam
A2
Utrecht
Haarlem
Noordwijk
A4
M t.o.v. NAP
Noordzee
A12
+ 5m
0 m
- 5 m
Druk op de toetsen
Delft
A13
Den Haag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Noordzee
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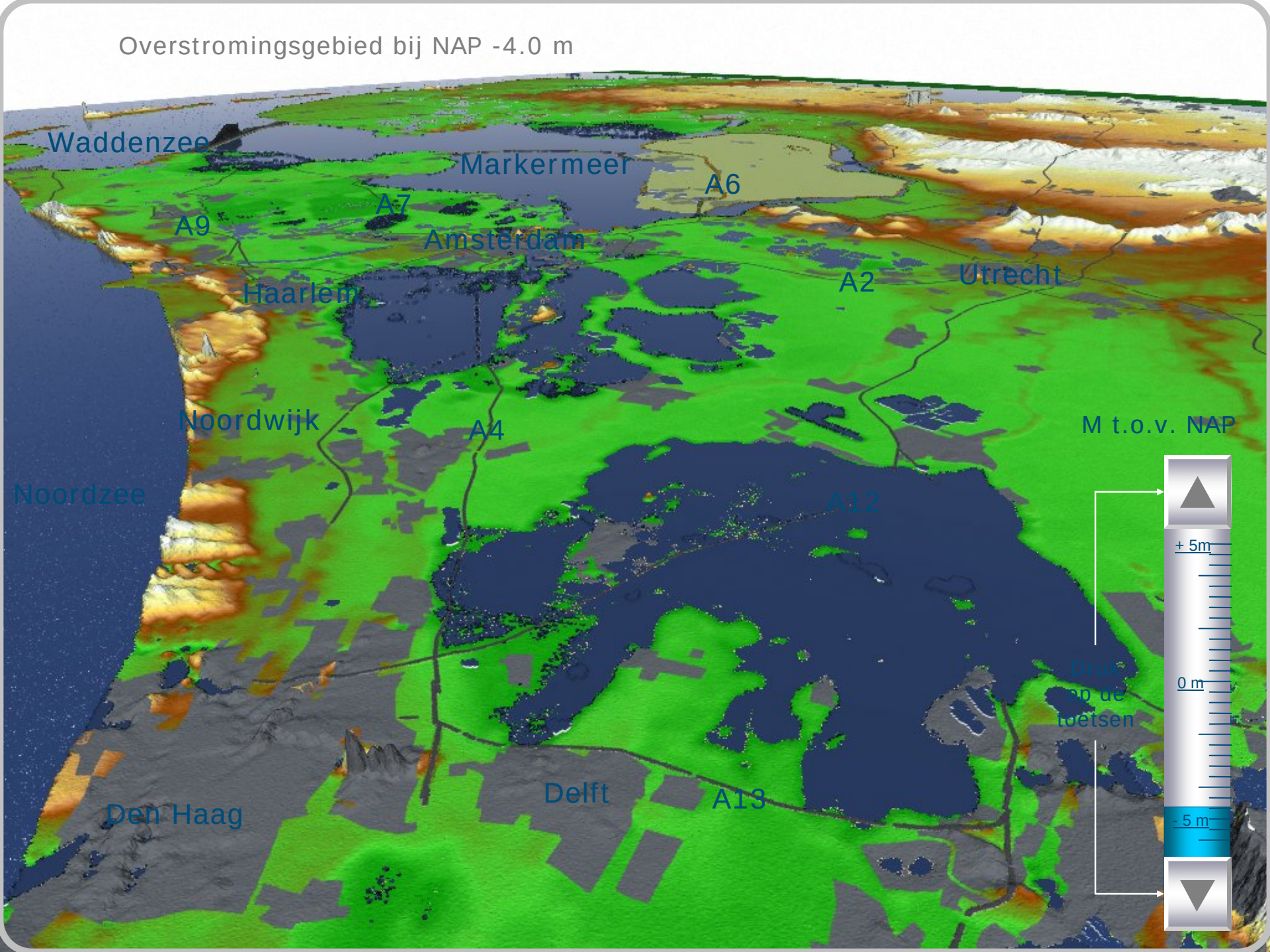
+ 5m
0 m
- 5 m
Druk op de toetsen
Delft
A13
Den Haag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Haarlem
Noordwijk
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M t.o.v. NAP
Noordzee
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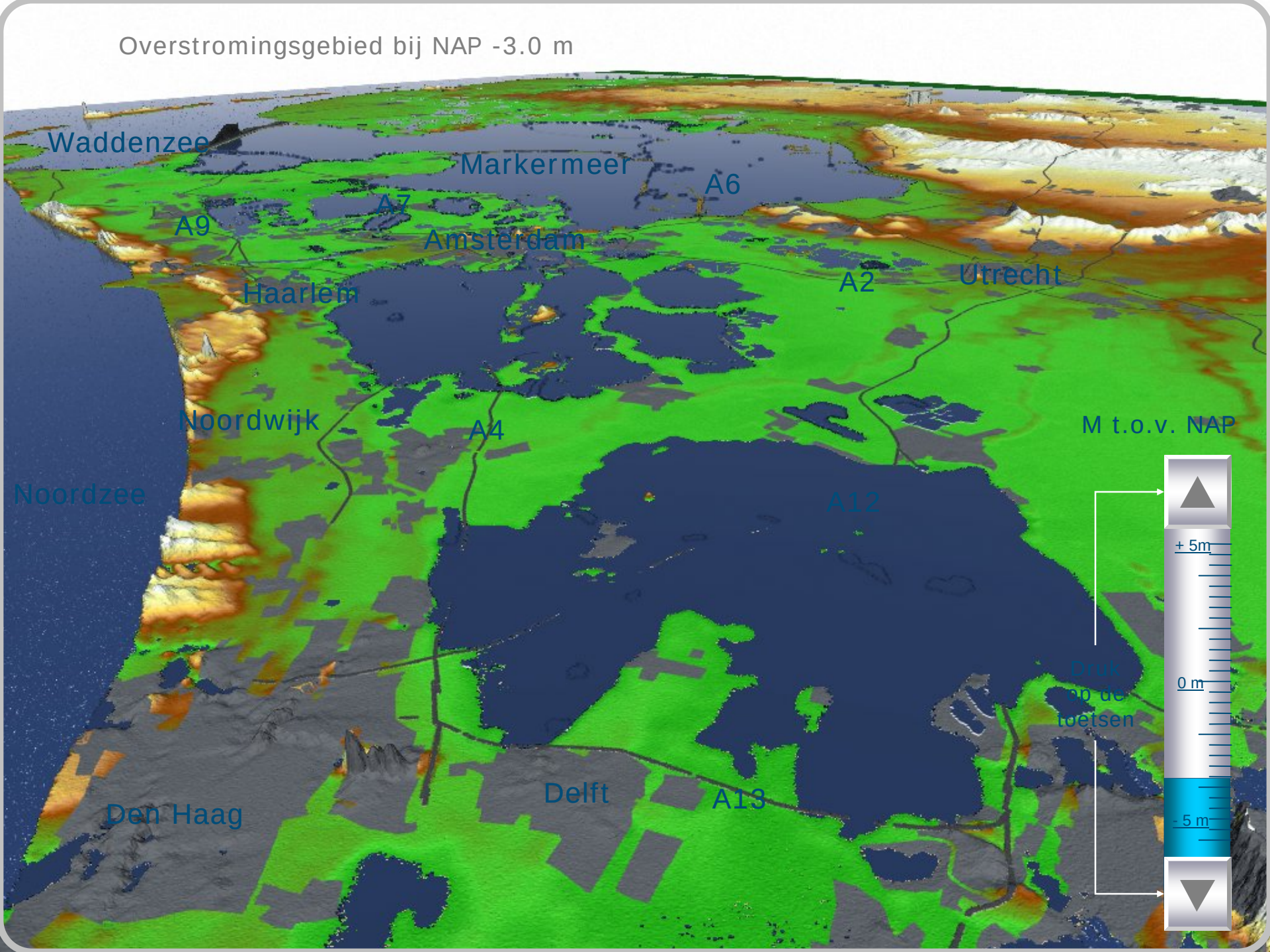
+ 5m
0 m
- 5 m
Druk op de toetsen
Delft
A13
Den Haag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Markermeer
A6
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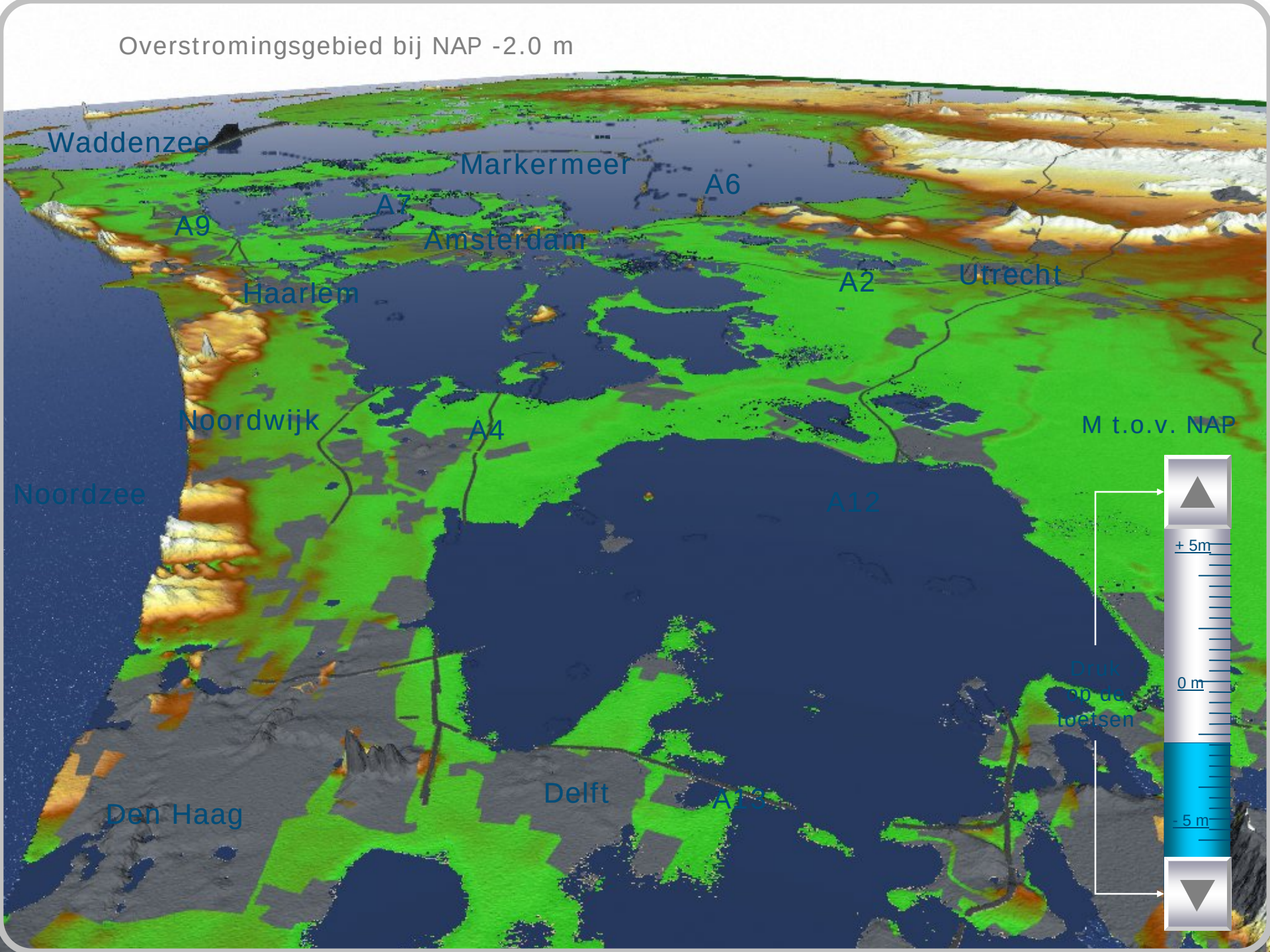
A9
Amsterdam
A2
Utrecht
Haarlem
Noordwijk
A4
M t.o.v. NAP
Noordzee
A12
+ 5m
0 m
- 5 m
Druk op de toetsen
Delft
A13
Den Haag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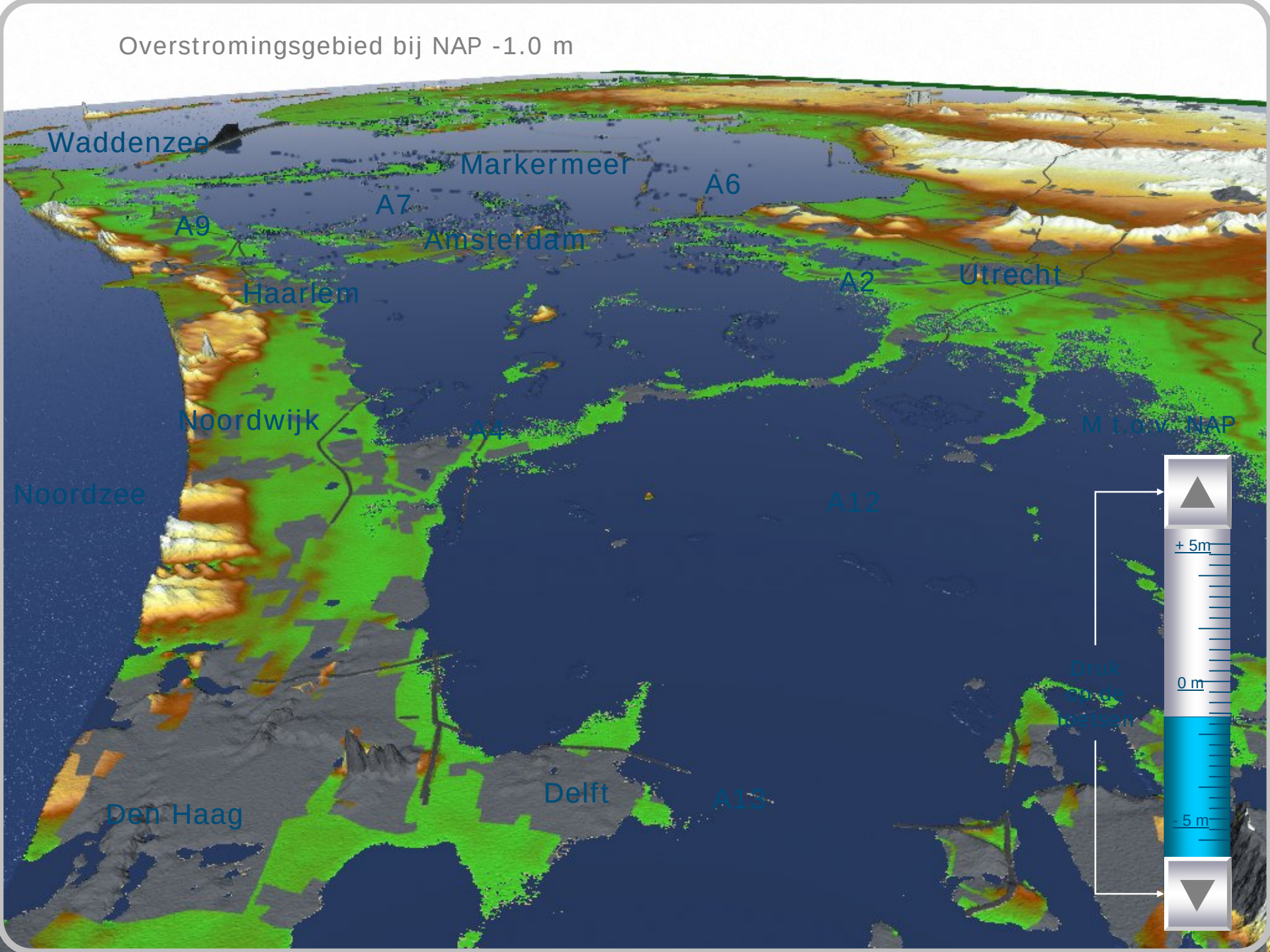
Amsterdam
A2
Utrecht
Haarlem
Noordwijk
A4
M t.o.v. NAP
Noordzee
A12
+ 5m
0 m
- 5 m
Druk op de toetsen
Delft
Den Haag


Overstromingsgebied bij NAP -1.0 m
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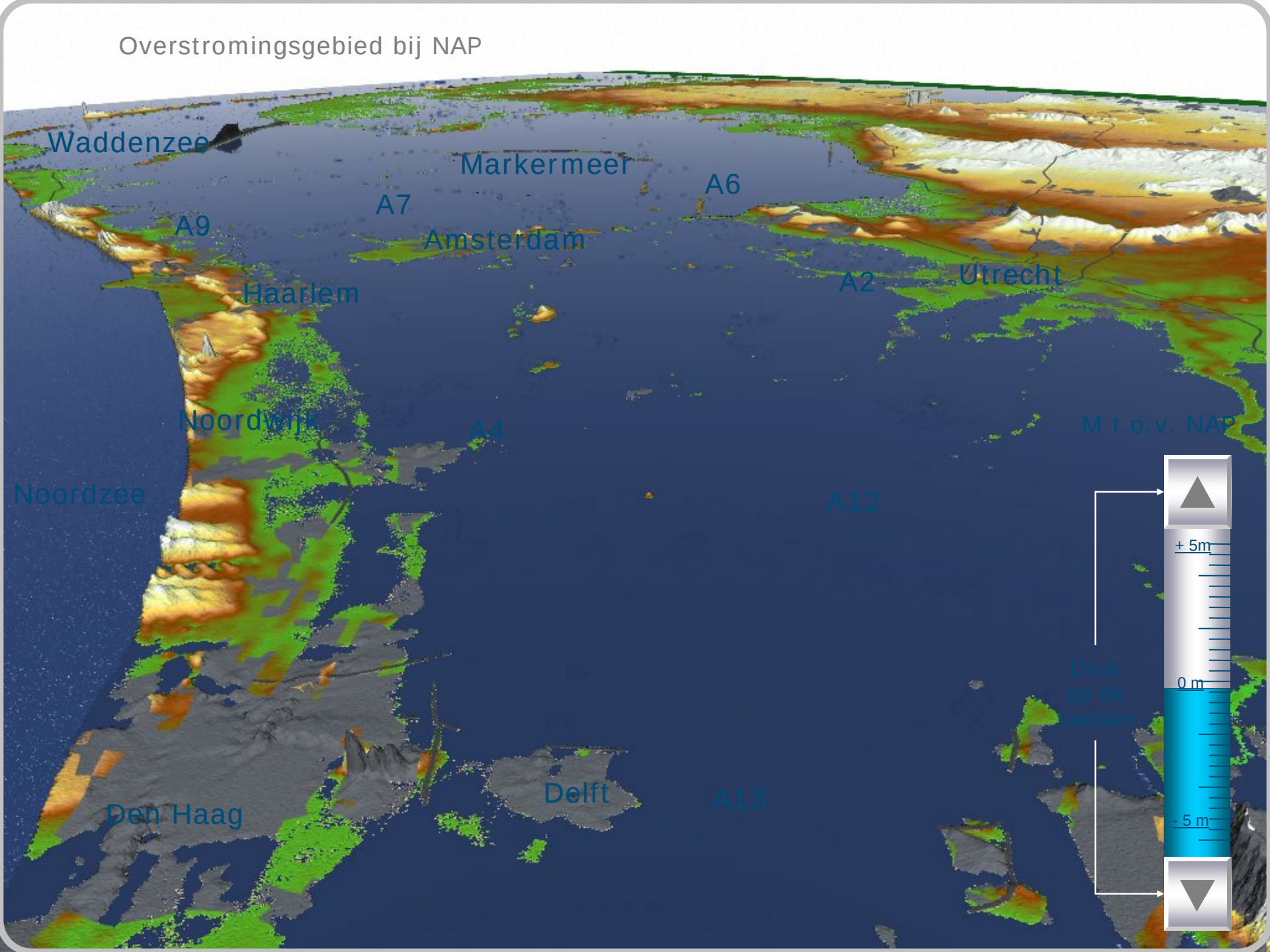
Amsterdam
A2
Utrecht
Haarlem
Noordwijk
A4
M t.o.v. NAP
Noordzee
A12
+ 5m
0 m
- 5 m
Druk op de bootsen
Delft
A13
Den Haag


Overstromingsgebied bij NAP
Waddenzee
Markermeer
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Amsterdam
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Utrecht
Haarlem
Noordwijk
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M t.o.v. NAP
Noordzee
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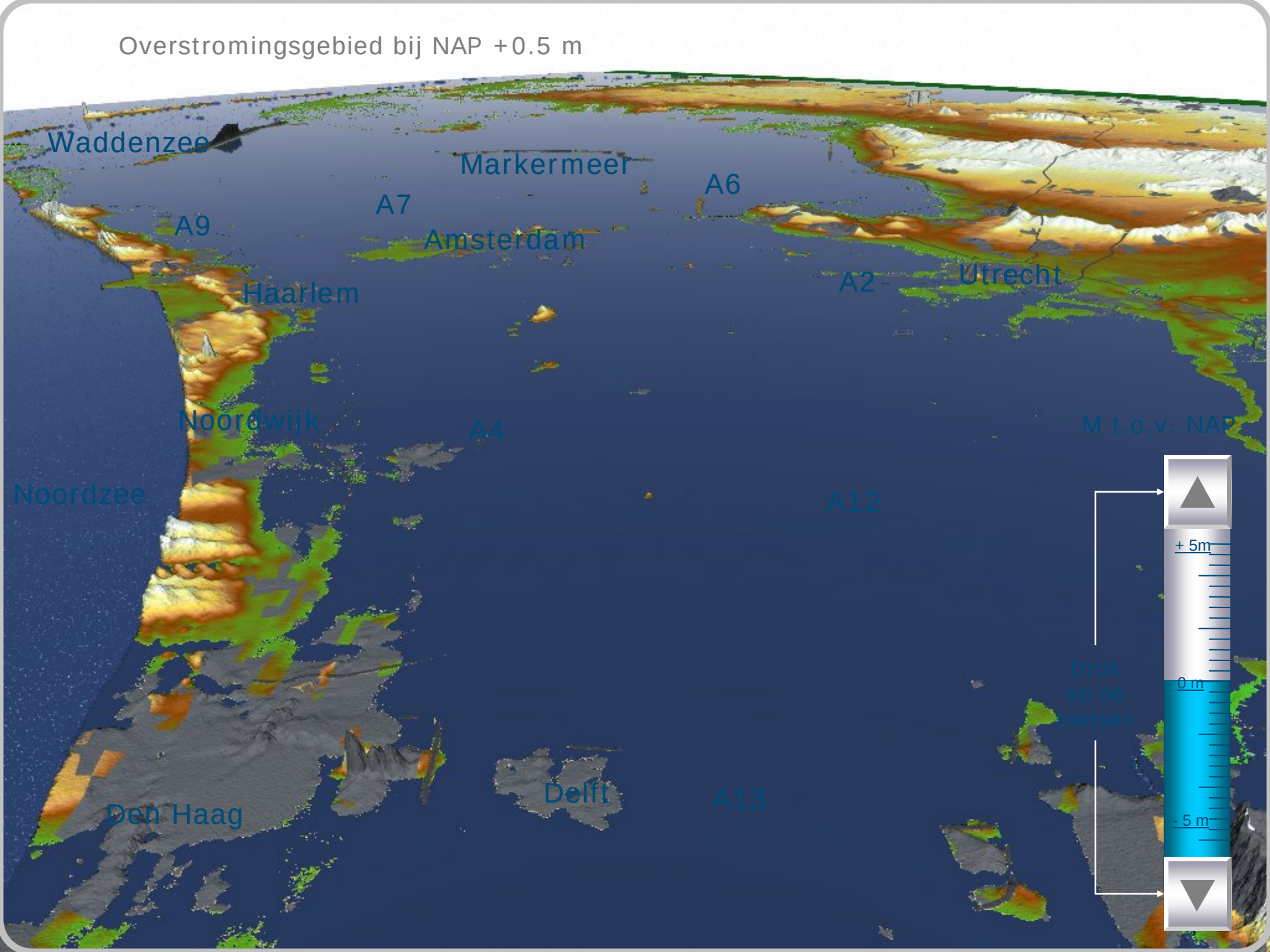
0 m
- 5 m
Druk op de toetsen
Delft
A13
Den Haag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Waddenzee
Markermeer
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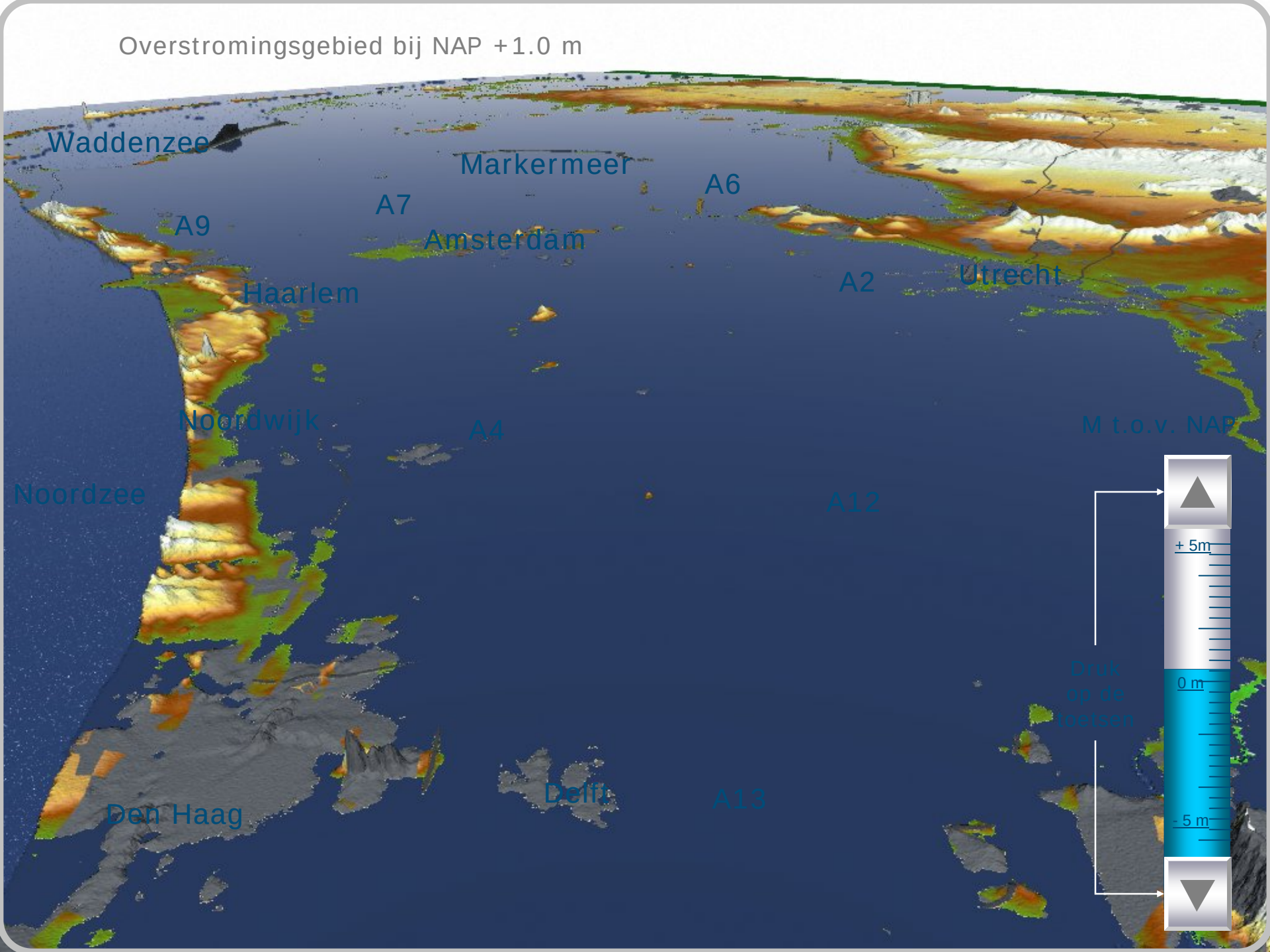
Amsterdam
A2
Utrecht
Haarlem
Noordwijk
A4
M t.o.v. NAP
Noordzee
A12
+ 5m
0 m
- 5 m
Druk op de toetsen
Delft
A13
Den Haag


Overstromingsgebied bij NAP +1.0 m
Waddenzee
Markermeer
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Amsterdam
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Haarlem
Noordwijk
A4
M t.o.v. NAP
Noordzee
A12
+ 5m
0 m
- 5 m
Druk
op de
toetsen
Delft
A13
Den Haag


Ameland, 9 november 2007


Vlieland, 9 november 2007

Texel, 9 november 2007


Noordwijk, 9 november 2007

Zandvoort, 9 november 2007

Climate proofing concept….

"The climate is changing and we should make our country climate proof. The national government together with science, policy and other stakeholders"

Jan-Peter Balkenende - Dutch Prime Minister, november 2005"

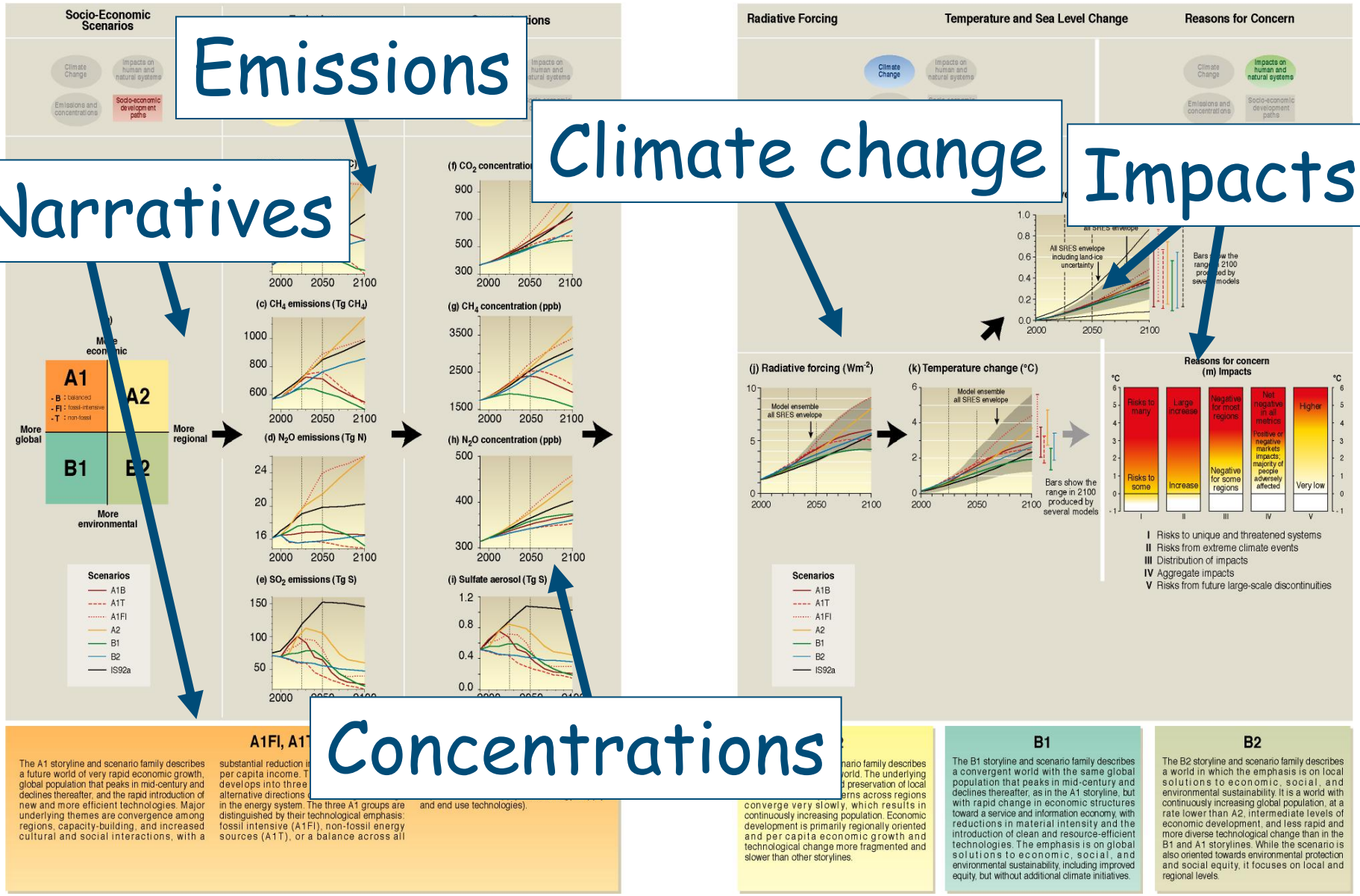
Vol. 438|17 November 2005 nature

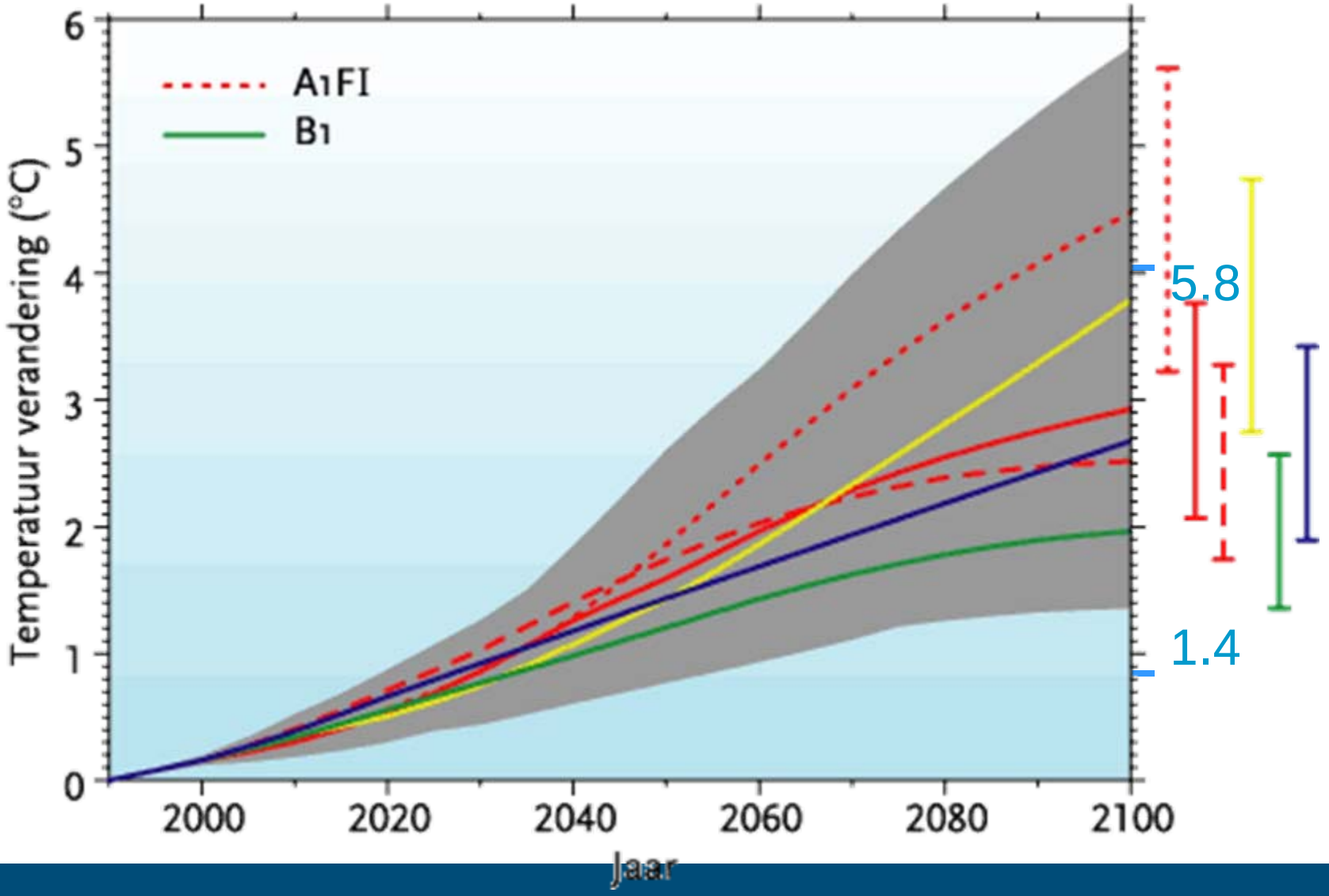
COMMENTARY

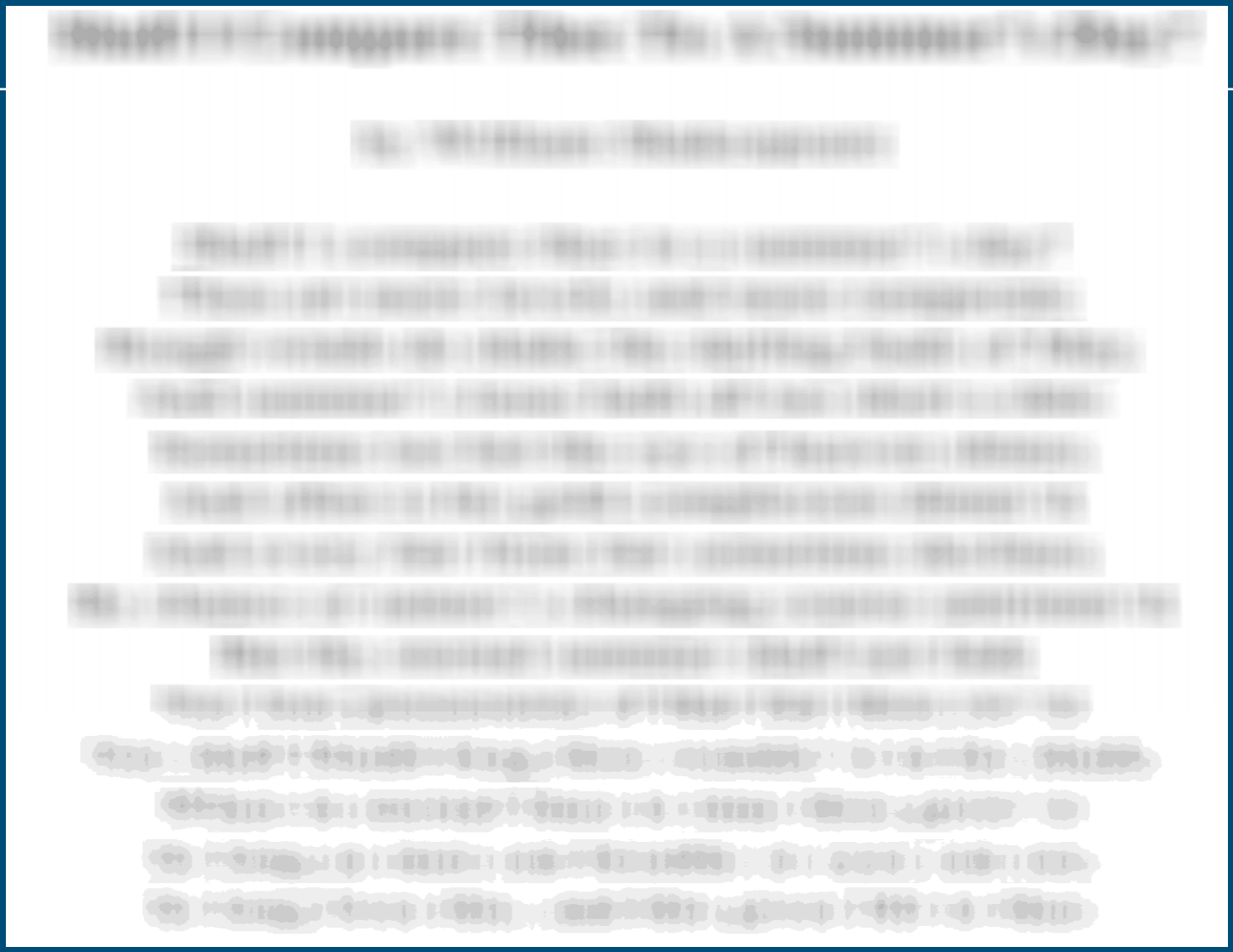
Climate proofing the Netherlands

Regional climate change should not be seen only as a threat; changes to weather patterns could generate opportunities for large-scale innovations, say **Pavel Kabat**, **Pier Vellinga** and their colleagues.

Science - Policy interaction


Emissions
Climate change
Impacts
Narratives
Concentrations
Socio-Economic Scenarios
Radiative Forcing
Temperature and Sea Level Change
Reasons for Concern
A1
A2
B1
B2
More global
More regional
More environmental
(c) CH4 emissions (Tg CH4)
(d) N2O emissions (Tg N)
(e) SO2 emissions (Tg S)
(f) CO2 concentration
(g) CH4 concentration (ppb)
(h) N2O concentration (ppb)
(i) Sulfate aerosol (Tg S)
(j) Radiative forcing (Wm-2)
(k) Temperature change (°C)
(m) Impacts
Model ensemble all SRES envelope
All SRES envelope including land-ice uncertainty
Bars show the range in 2100 produced by several models
Scenarios
A1B
A1T
A1FI
A2
B1
B2
IS92a
Risks to many
Risks to some
Large increase
Increase
Negative for most regions
Negative for some regions
Net negative in all metrics
Positive or negative markets impacts; majority of people adversely affected
Higher
Very low
I Risks to unique and threatened systems
II Risks from extreme climate events
III Distribution of impacts
IV Aggregate impacts
V Risks from future large-scale discontinuities
A1FI, A1T
The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity-building, and increased cultural and social interactions, with a
B1
The B1 storyline and scenario family describes a convergent world with the same global population that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.
B2
The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.


A1FI
B1
Temperatuur verandering (°C)
0
1
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Jaar
5.8
1.4



Summer

summer

temperate

Rough winds

summer

hot

fair fair

nature

summer

fair

shade

time

life

Shall I Compare Thee To A Summer's Day?

by William Shakespeare

Shall I compare thee to a summer's day?
Thou art more lovely and more temperate.
Rough winds do shake the darling buds of May,
And summer's lease hath all too short a date.
Sometime too hot the eye of heaven shines,
And often is his gold complexion dimm'd;
And every fair from fair sometime declines,
By chance or nature's changing course untrimm'd;
But thy eternal summer shall not fade
Nor lose possession of that fair thou ow'st;
Nor shall Death brag thou wander'st in his shade,
When in eternal lines to time thou grow'st:
So long as men can breathe or eyes can see,
So long lives this, and this gives life to thee.

Climate Uncertainty: Accuracy versus Precision

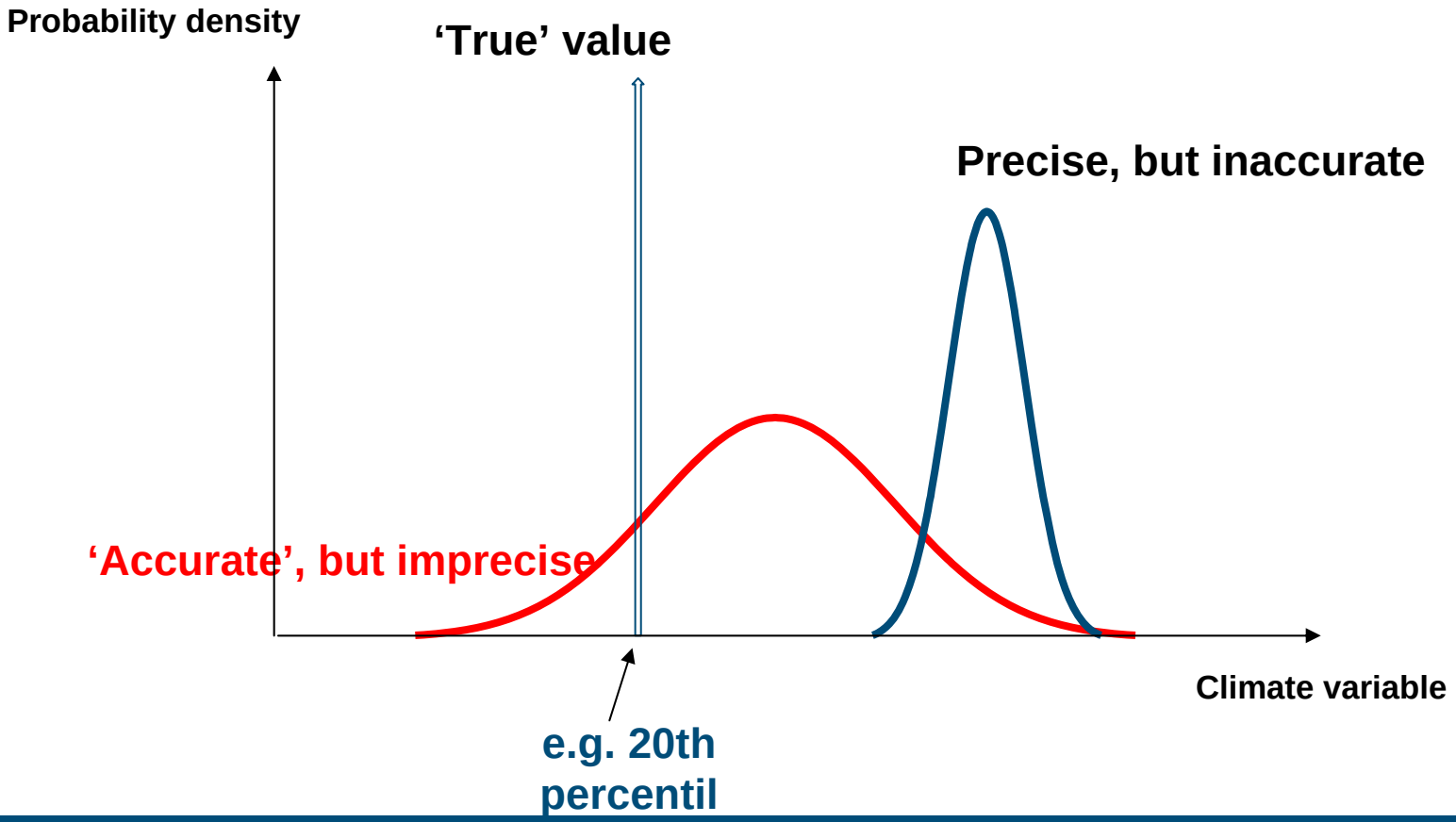
High accuracy
Low precision

‘Global mean temperature will increase between 1.4º and 5.8ºC by the end of the century’

Low accuracy
High precision

‘Mean maximum summer temperature will increase by 3.7ºC by the end of the century in the Rotterdam area’

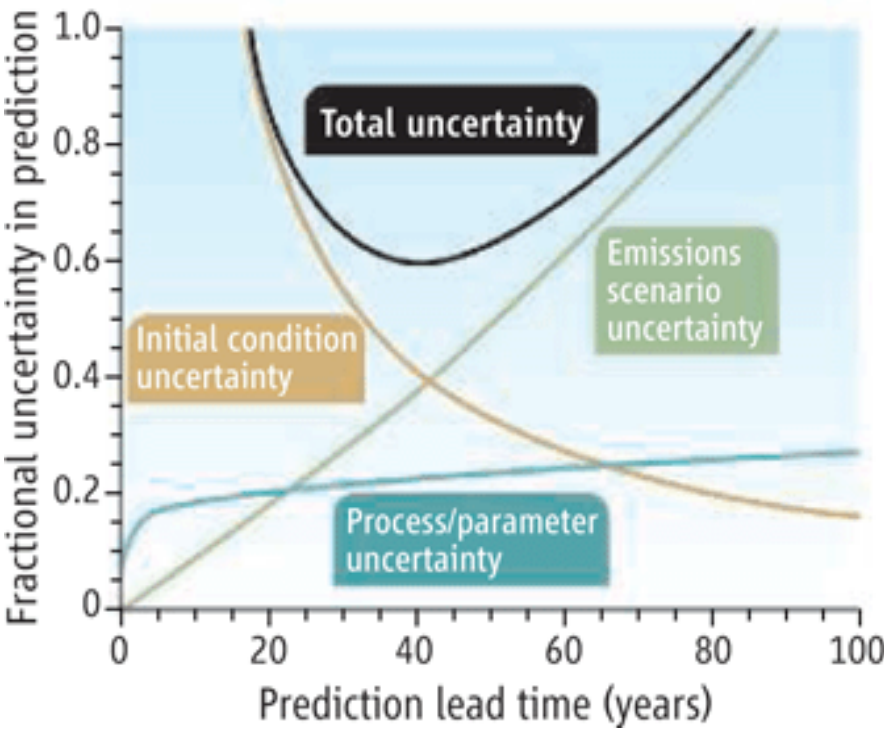
Accuracy versus Precision



So What are the Limits to Climate Prediction?

Uncertainties in climate prediction arise from:

- **Lack of knowledge (Epistemic uncertainty)**
  - **Parameter uncertainty**
  - **Structural uncertainty**
- **Randomness (Natural stochastic uncertainty)**
  - **Initial conditions uncertainty**
- **Human actions (Human reflexive uncertainty)**



Cox and Stephenson, *Science*, 2007

UNIVERSITY OF EXETER

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Adaptation

Hazard

Exposure

adaptive capacity

Impact

vulnerability

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"Acceptable risk"

Adaptation (with investments)

"Acceptable risk"

$\overline{X}_1$

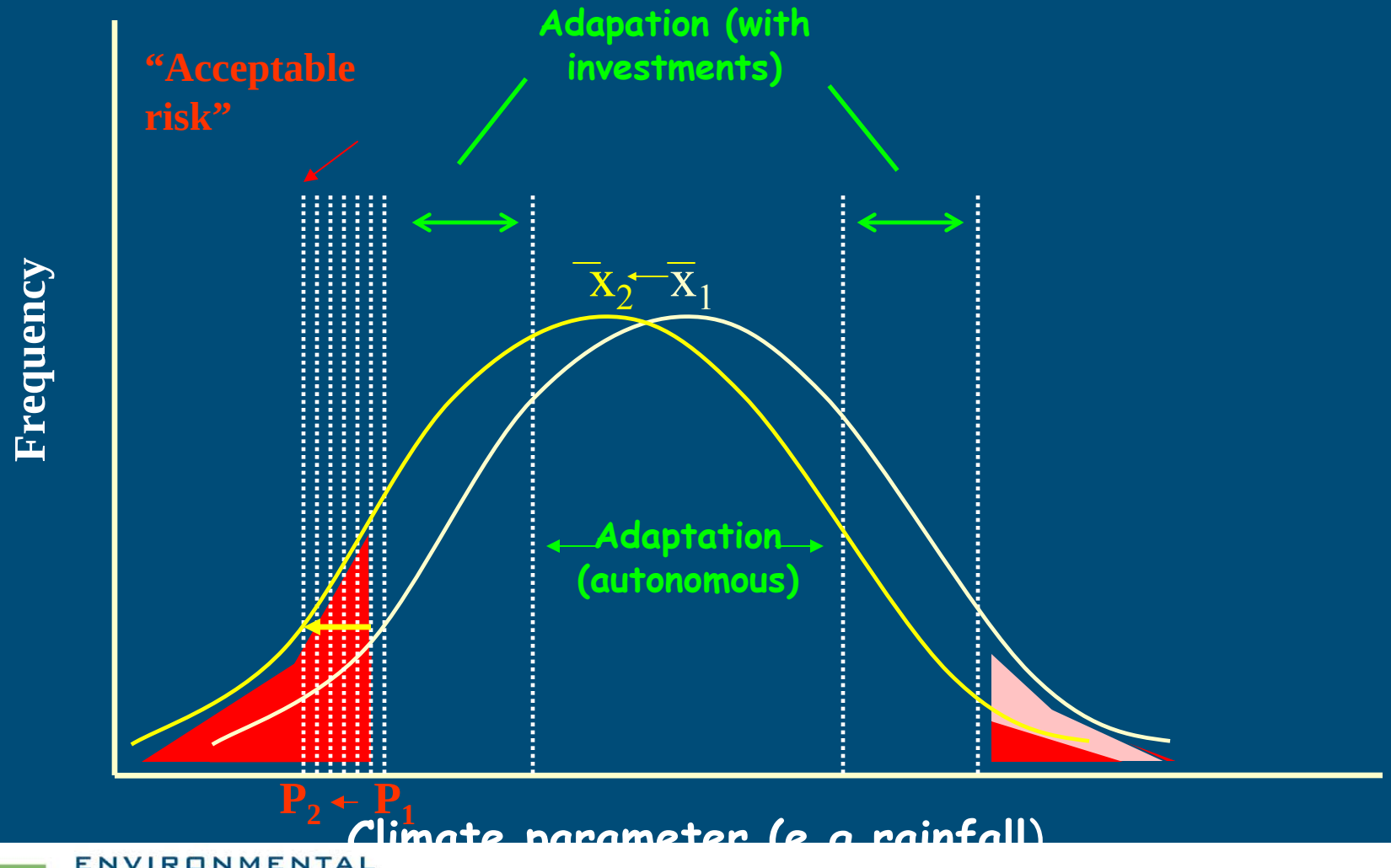
Adaptation (autonomous)

Drought risk

Flood risk

Climate parameter (e.g. rainfall)

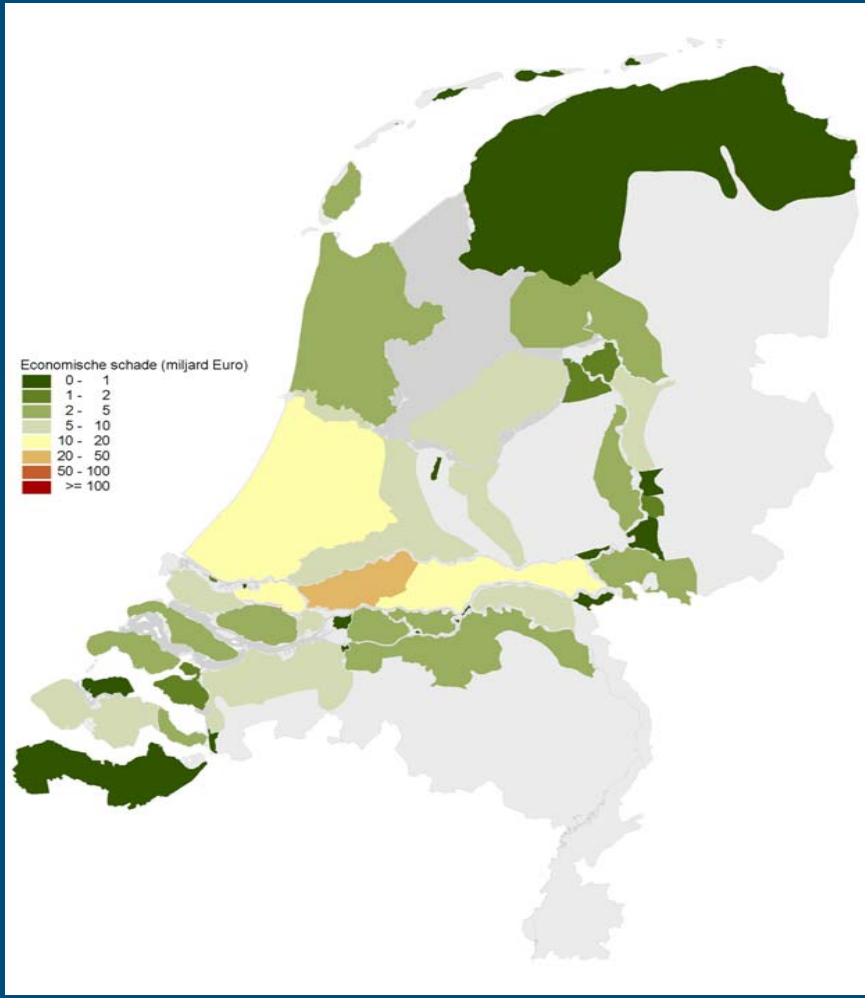
Climate Change

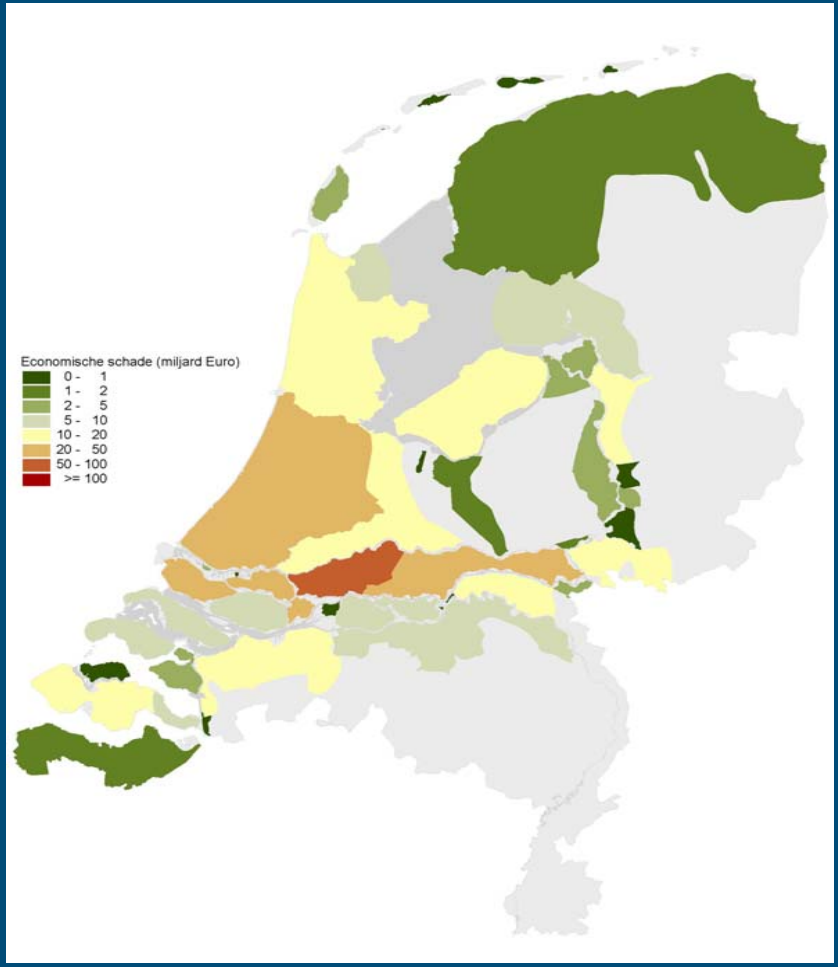


1 The Netherlands as Rhine-delta

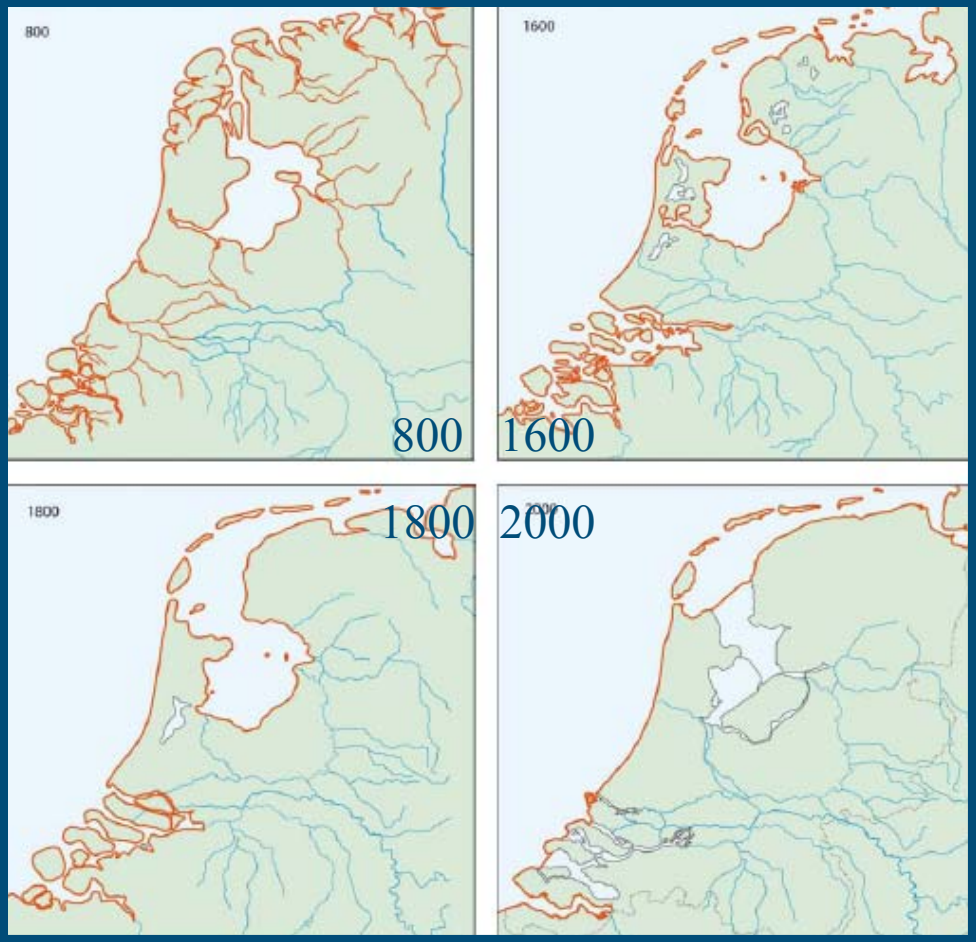
- About 400 km of Rhine river
- International catchment
- About 350 km coastline
- About 9 million inhabitants below flood level
- Invested value 1800 10^9 euro, 65% of GNP
- Safety level: 1:10.000 – 1:1250
- $Q_{design:}$16.000 m^3/s
- 3500 km of flood defences, hundreds of locks, sluices, pumping stations

Potential damage 2000 -2040





(former) strategy: shortening the coastal line



2. Committee on Sustainable Coastal Development

- prof. dr. C.P. Veerman
- mrs. ir. I.M. Bakker
- dr. J.J. van Duijn
- ir. A.P. Heidema
- mrs. prof. dr. ir. L.O. Fresco
- prof. dr. P. Kabat
- mrs. T. Metz
- ing. Jac.G. van Oord MBA
- prof. dr. ir. M.J.F. Stive
- ir. B.W.A.H. Parmet

Assignment

Ministerie van Verkeer en Waterstaat

Datum
07 SEP 2007
Nummer
HDJZ/WAT/2007-1020
Onderwerp
Regeling instelling commissie duurzame kustontwikkeling

HOOFDDIRECTIE JURIDISCHE ZAKEN

DE STAATSSECRETARIS VAN VERKEER EN WATERSTAAT EN DE MINISTER VAN BINNENLANDSE ZAKEN EN KONINKRIJKSRELATIES,

Handelende in overeenstemming met het gevoelen van de ministerraad;

Gelet op artikel 6, eerste lid, van de Kaderwet adviescolleges;

BESLUITEN:

Artikel 1
Er is een commissie duurzame kustontwikkeling, hierna te noemen: de commissie.

Artikel 2
De commissie heeft tot taak de Staatssecretaris te adviseren over:

a. de te verwachten zeespiegelstijging, de wisselwerking tussen die stijging en de afvoer van de grote Nederlandse rivieren en andere klimatologische en maatschappelijke ontwikkelingen tot 2100-2200, die van belang zijn voor de Nederlandse kust;
b. de gevolgen van deze ontwikkelingen voor de Nederlandse kust;
c. mogelijke strategieën voor een samenhangende aanpak die leidt tot duurzame ontwikkeling van de Nederlandse kust, op basis van a) en b) en
d. daarbij voor deze strategieën aan te geven wat, naast de veiligheid voor het achterland, de maatschappelijke meerwaarde is voor de korte en lange termijn

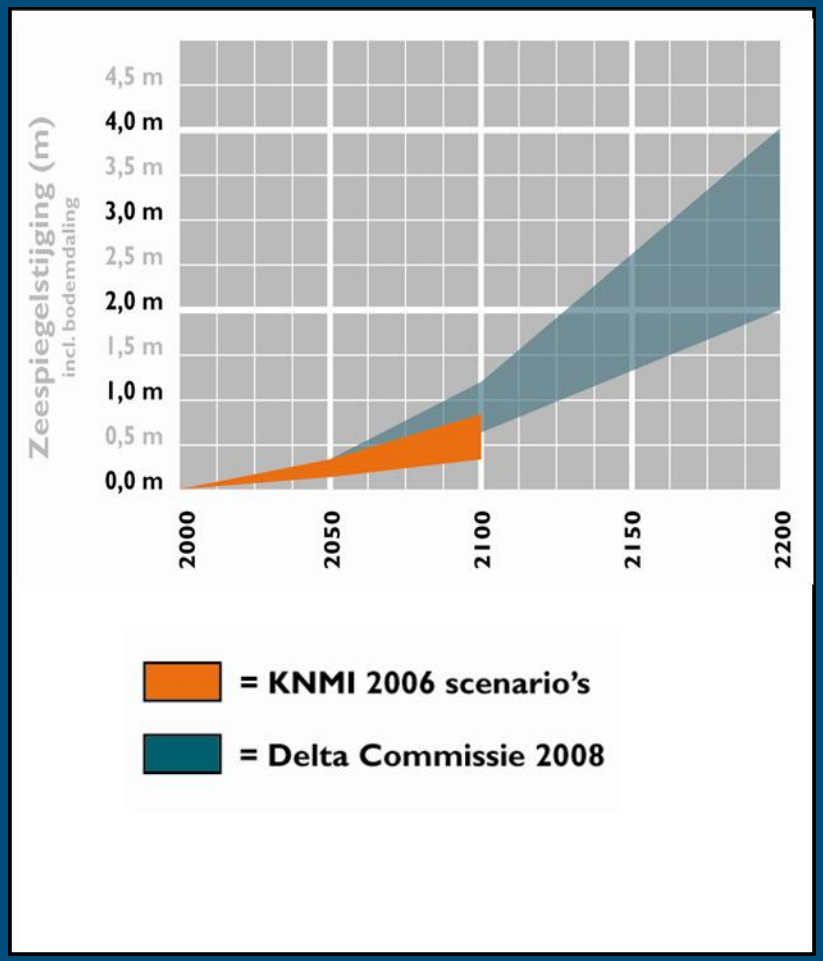
Artikel 3
De commissie bestaat uit een voorzitter en maximaal acht andere leden.

Artikel 4
1. Het advies wordt vóór 1 april 2008 aan de Staatssecretaris van Verkeer en Waterstaat uitgebracht.
2. Na het uitbrengen van het advies is de commissie opgeheven.

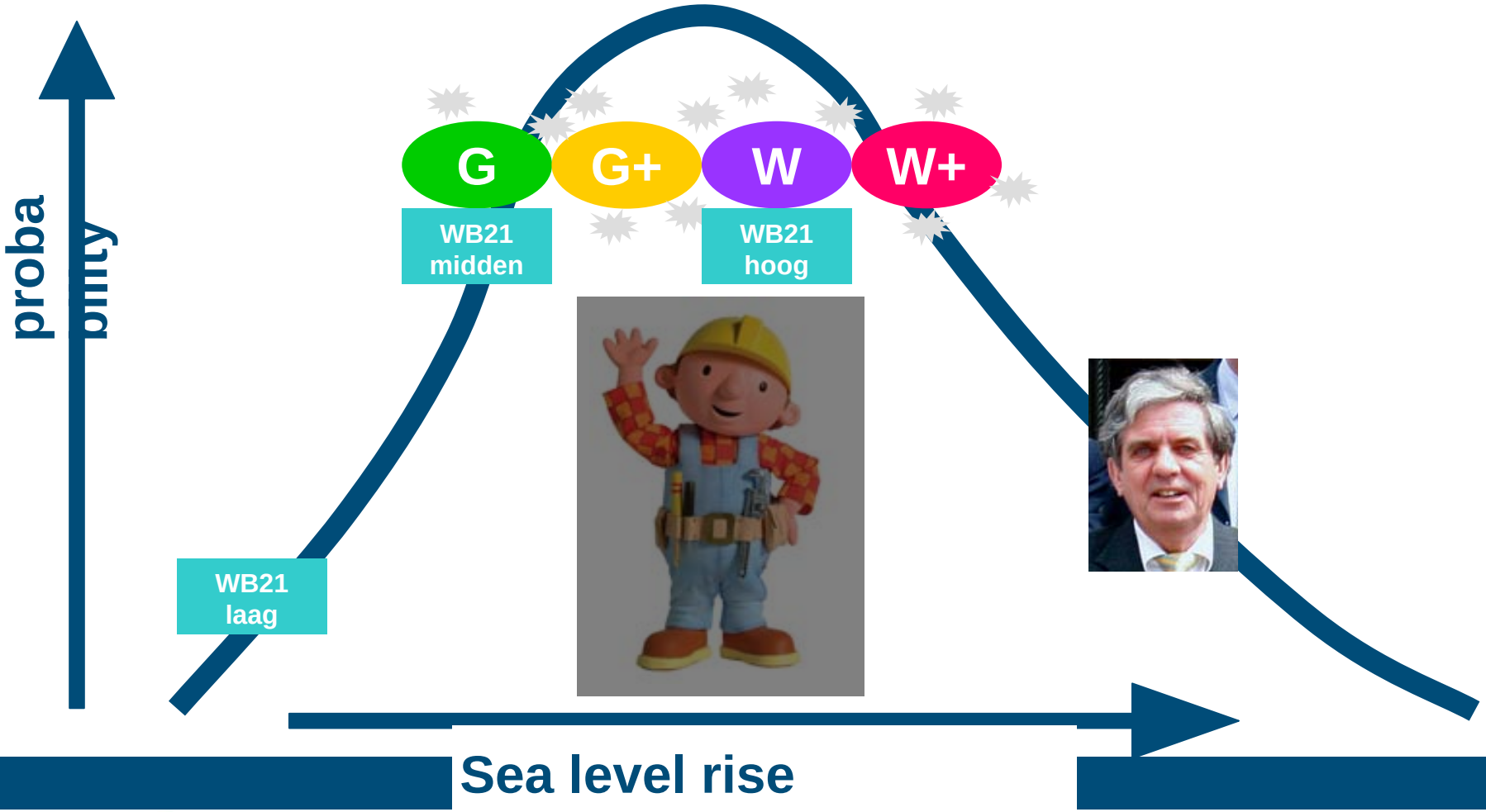
Advice on protecting the coast and the entire low lying part of the Netherlands against the consequences of climate change on a time scale of 2100 –2200

Wider scope than only safety, multifunctional approach

Sea level rise



- 2050: + 0.4 m
- 2100: + 0.65 - 1.30 m
- 2200: + 2 - 4 m



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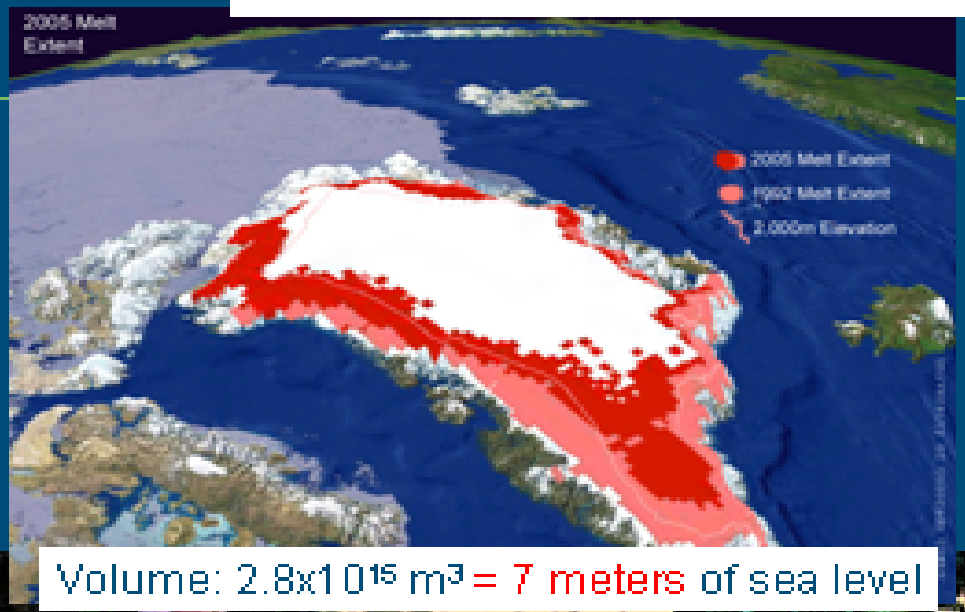
Relative SLR

- ***Plausible high-end scenarios*** necessary to judge the sustainability of our dike-ring concept
- High-end and low-end scenarios necessary for robust design
- Plausible high end scenarios are the most probable ones!

Long-term Sea Level: Ice Sheets



Volume: 2.8×10^{15} m^3 = 7 meters of sea level

Ice sheet response time "is of the order of centuries, not millennia".
Hansen (2005)

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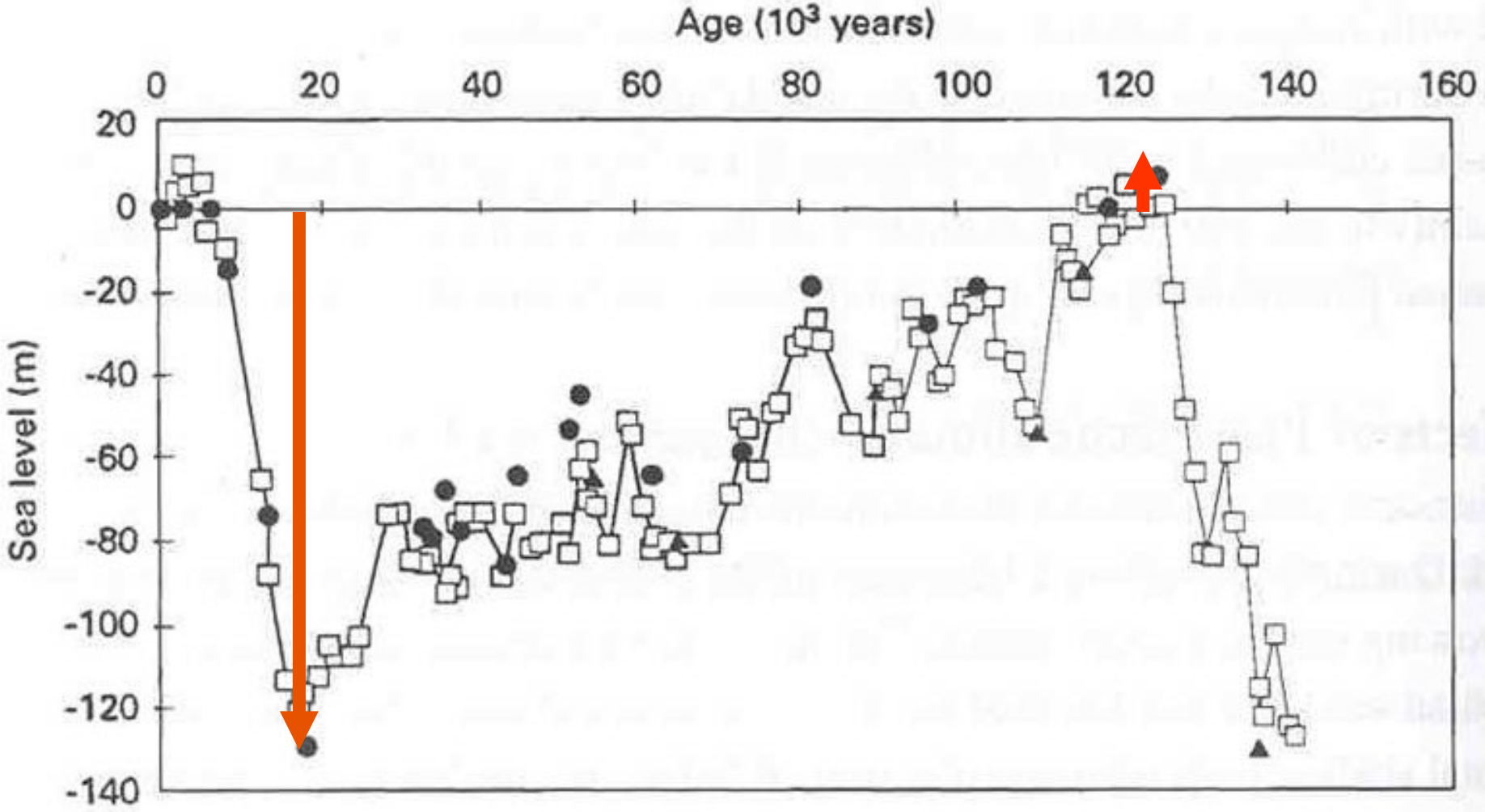
Natuurlijke dynamiek zeespiegel

-120m, ijstijd

+ 6m, warme tijd

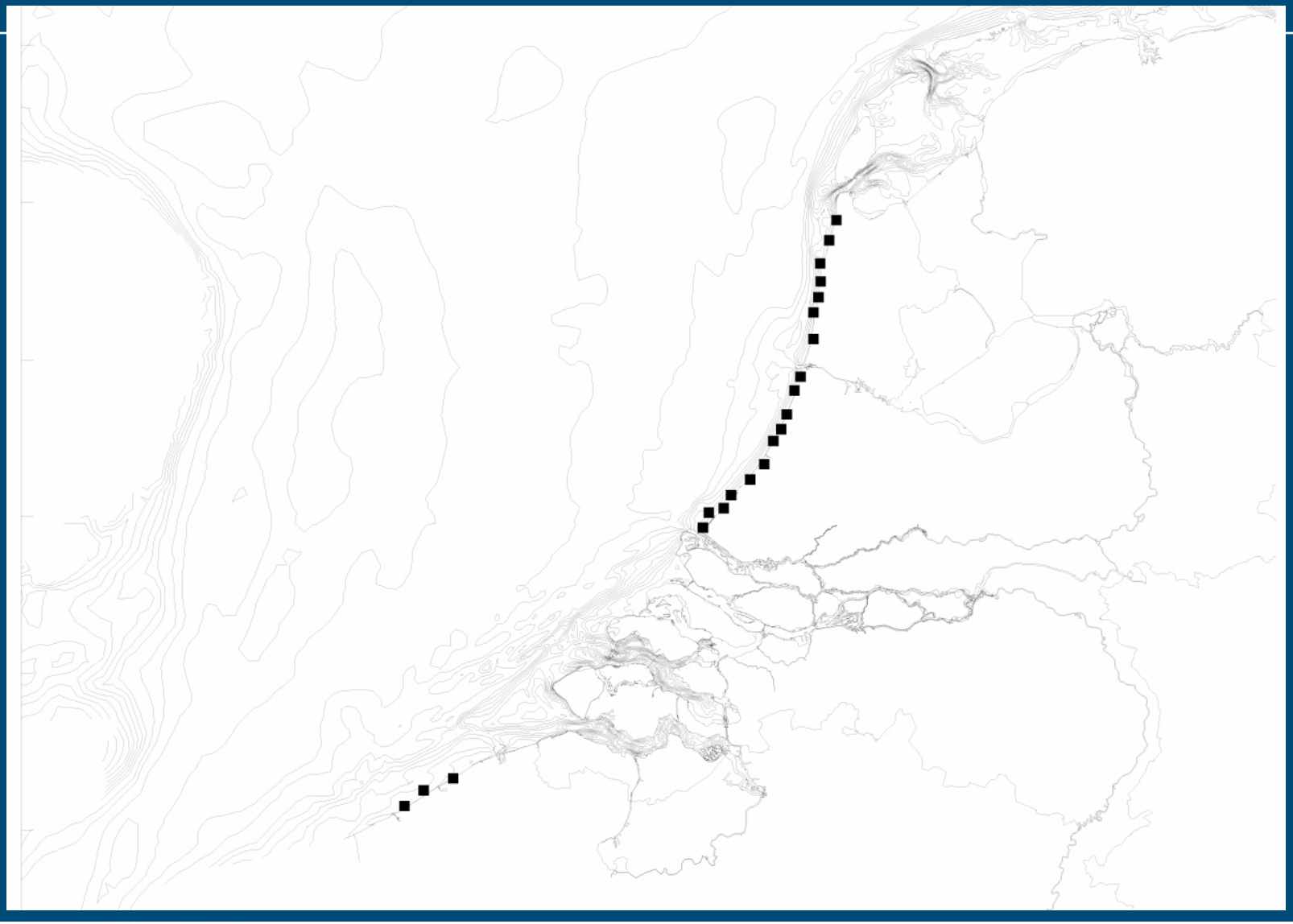


20 000 jaar geleden: eb

120 000 jaar geleden: vloed

North Sea coast

- Follow sealevel rise
- Building with nature → beach nourishments
- Optional: reclamation of new coastal land



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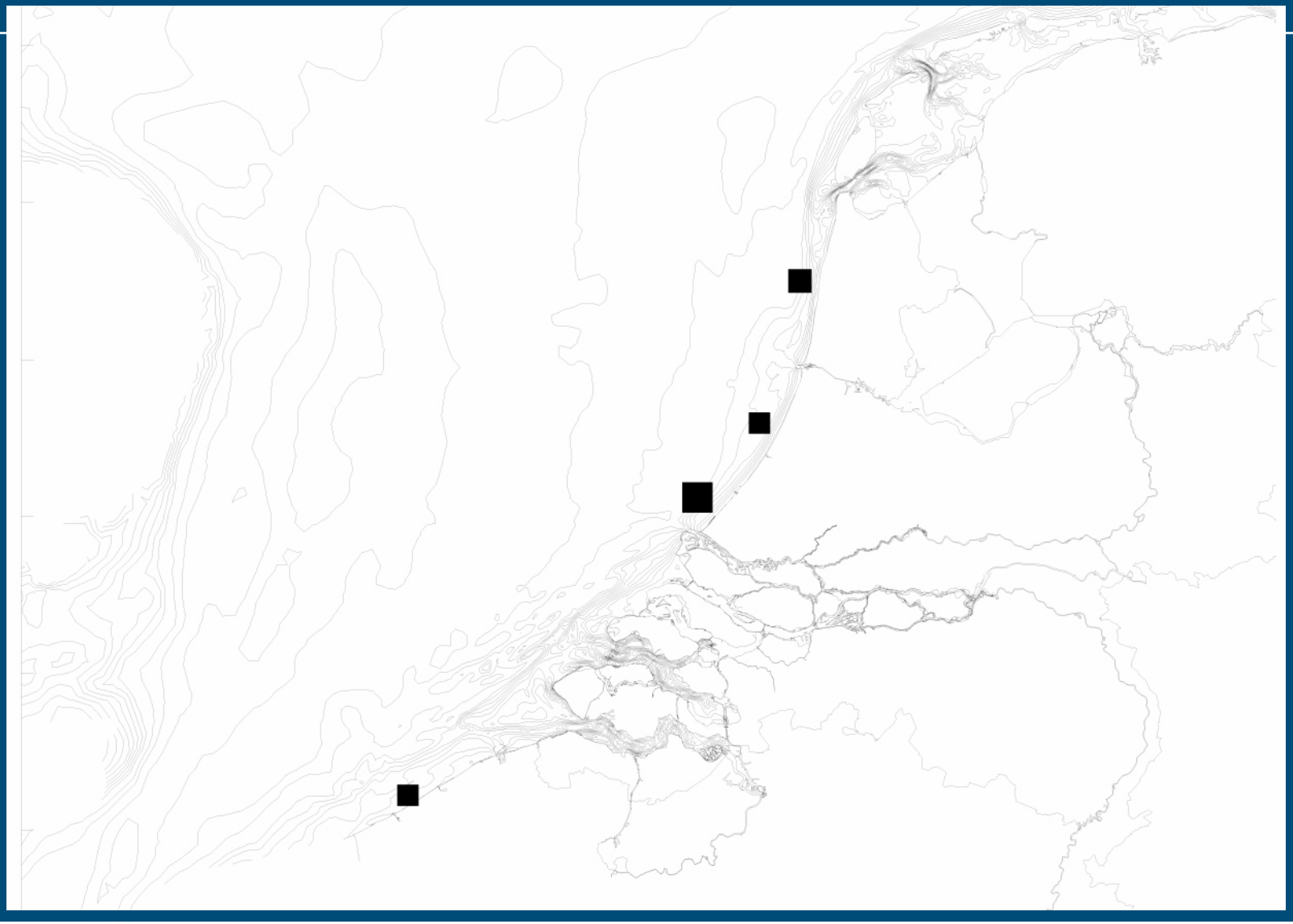
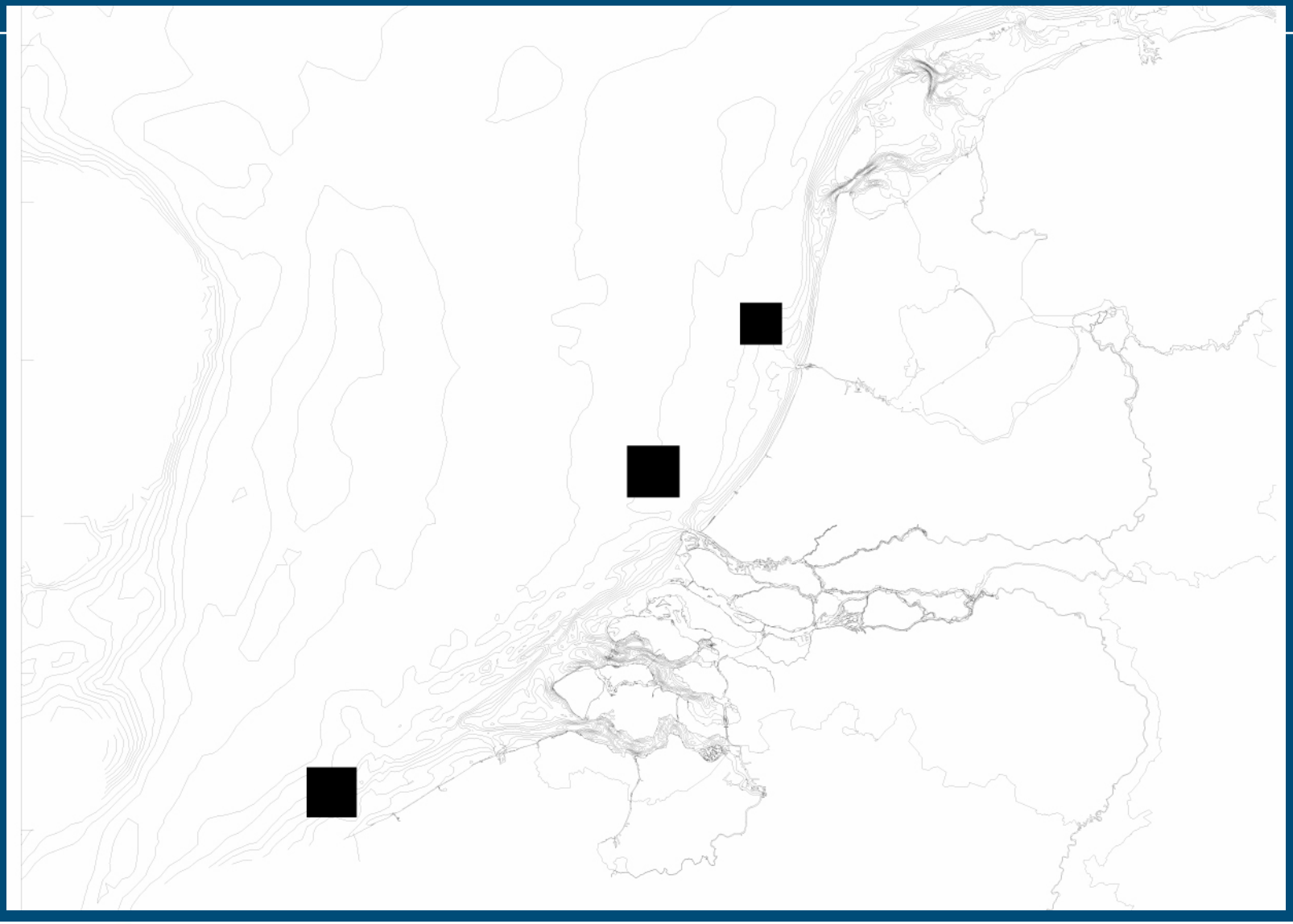
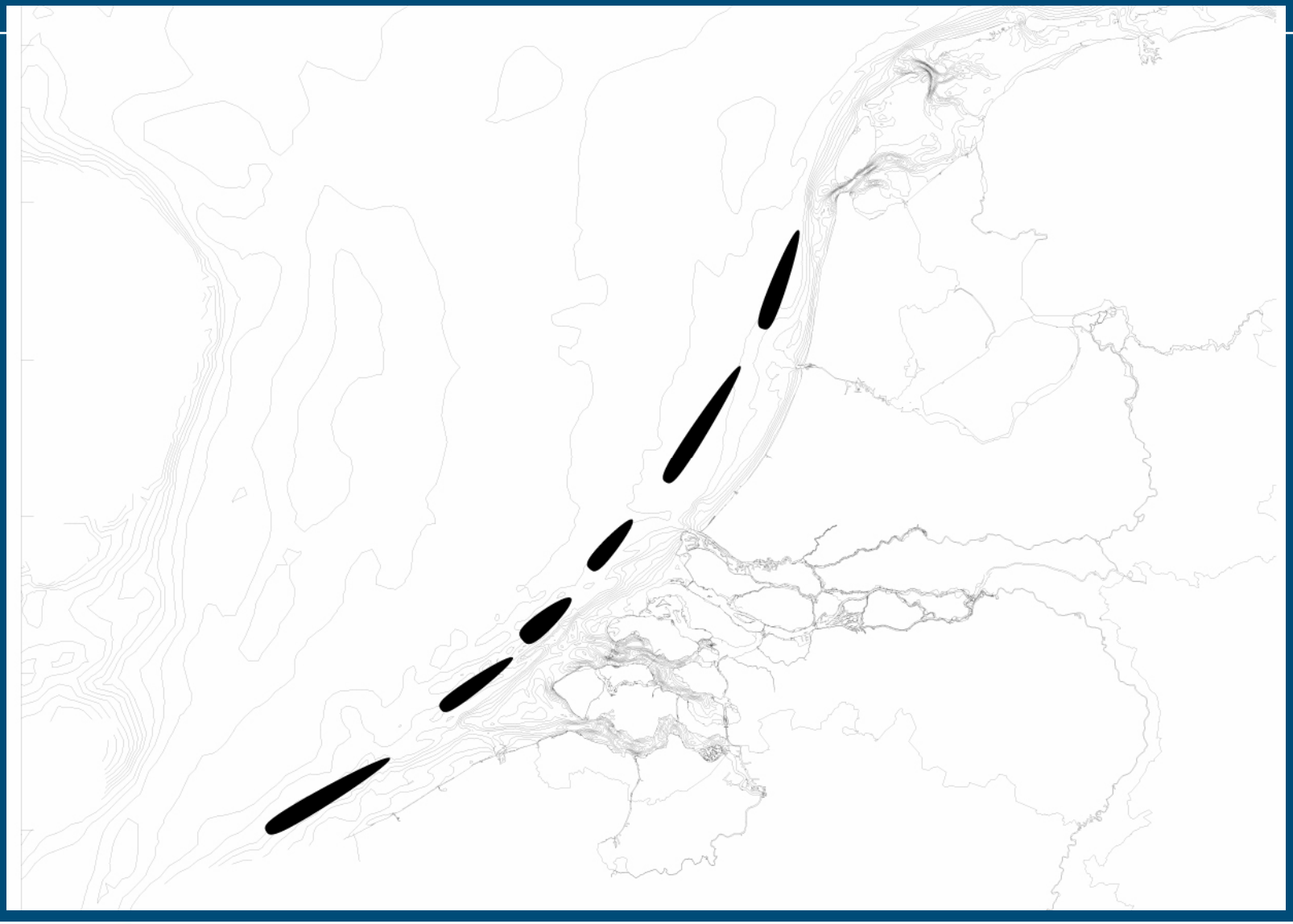
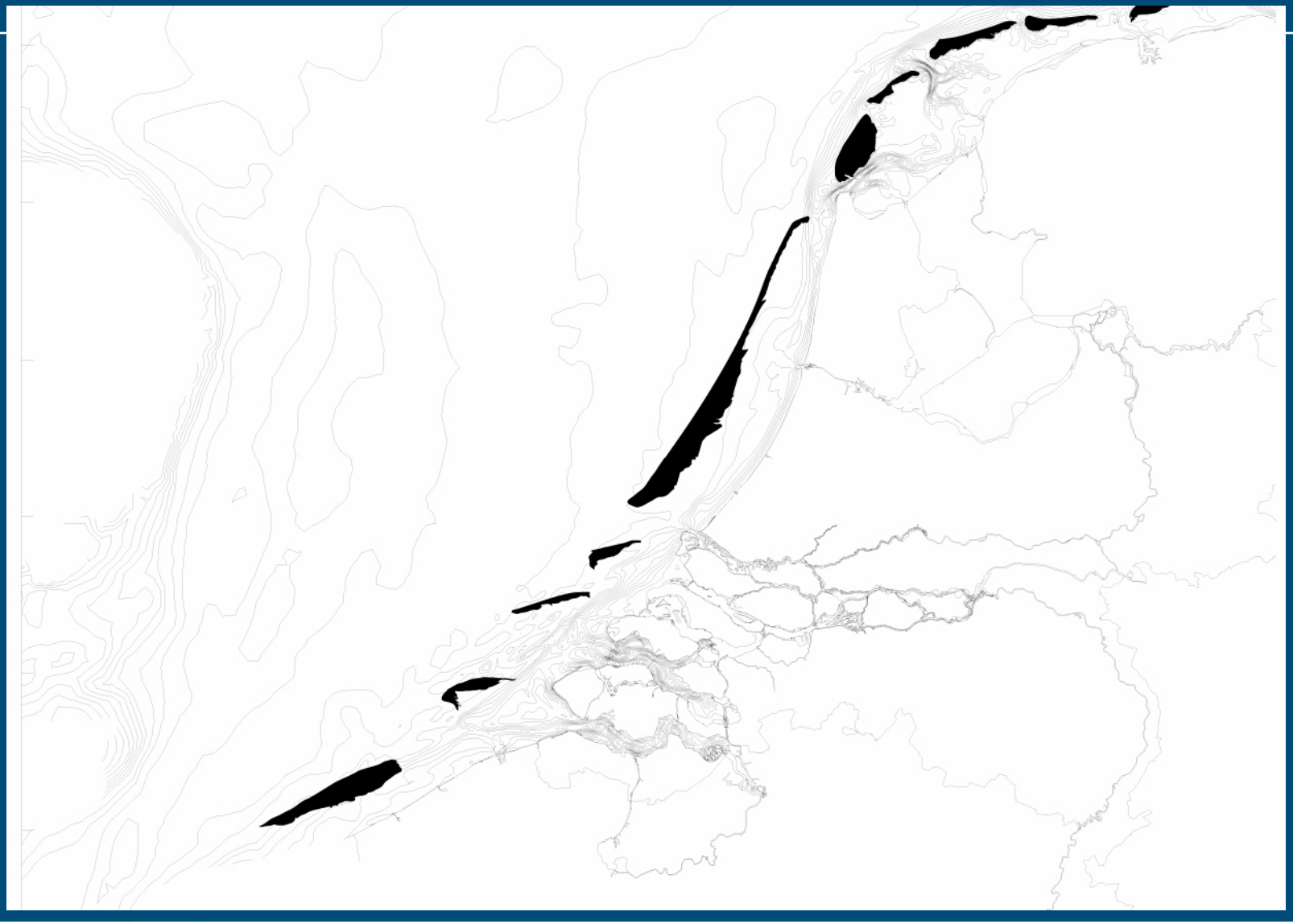








“Building with Nature”

- Flexible regarding changing conditions and societal values, and increased understanding
- Cost-effective
- Opportunities for integrated and multifunctional approach

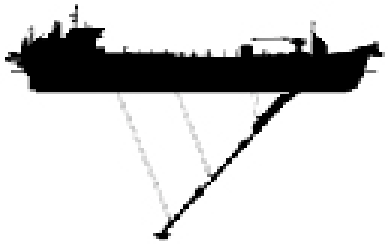

URSA

. € 15

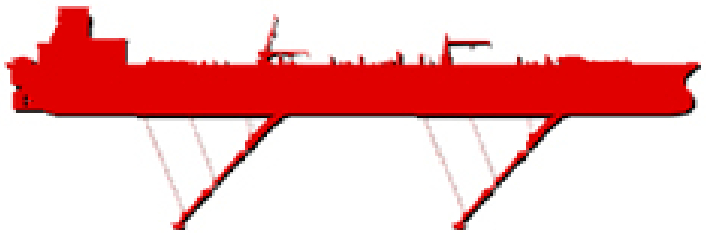
. € 8

. € 5

. € 3

n 

. € 2

n 

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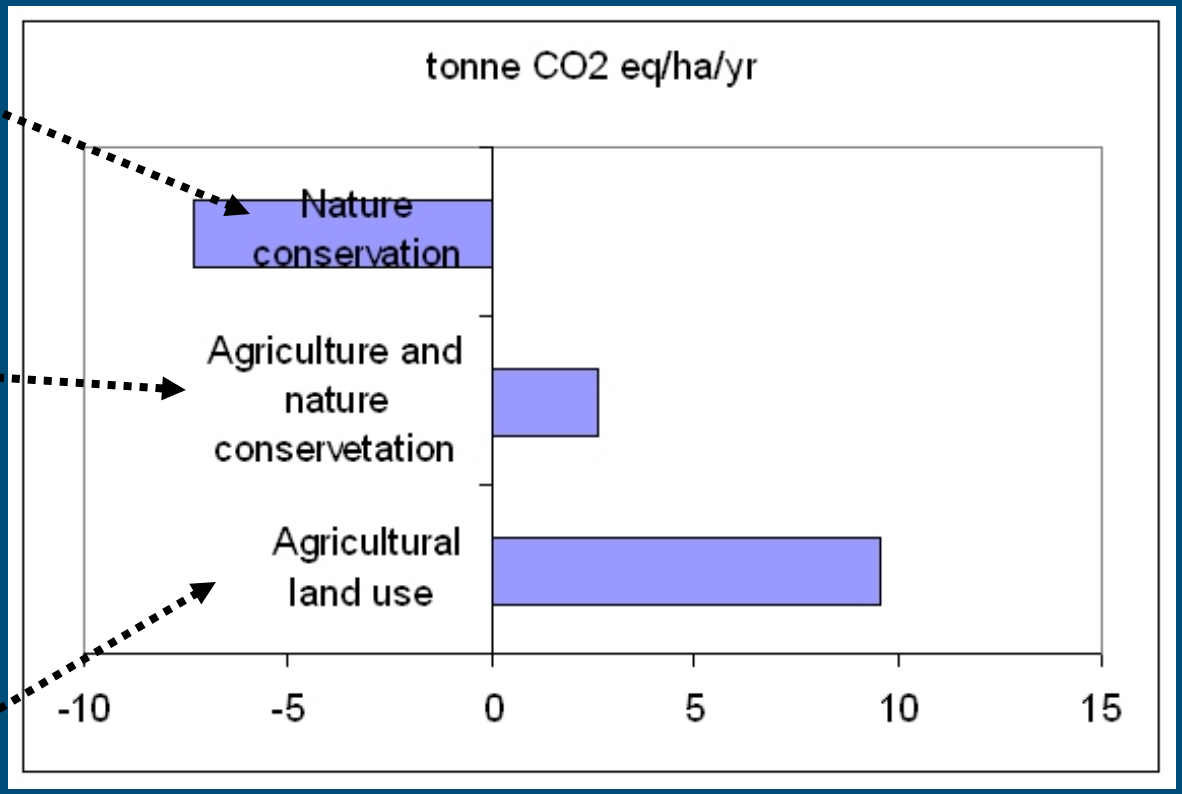
SCIEN
WAGENINGEN UR

Flood protection, Land use planning: climate serv

GHG balance in peat meadow area



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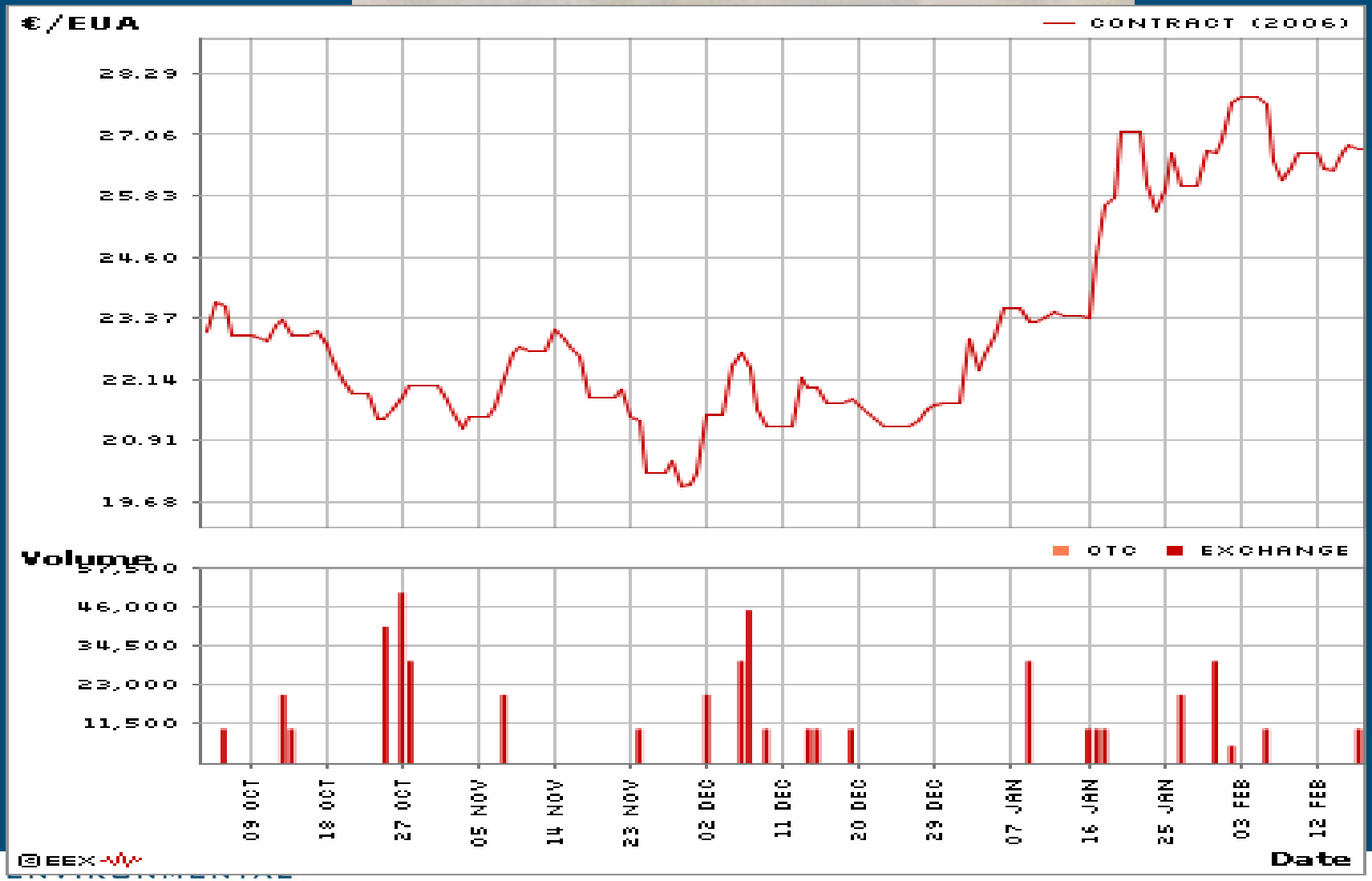
vd Born et al. 2003 (RIVM)

Geld verdienen met broeikasgassen



Thank you