Environmental compensation for port extension

The case of Rotterdam harbor

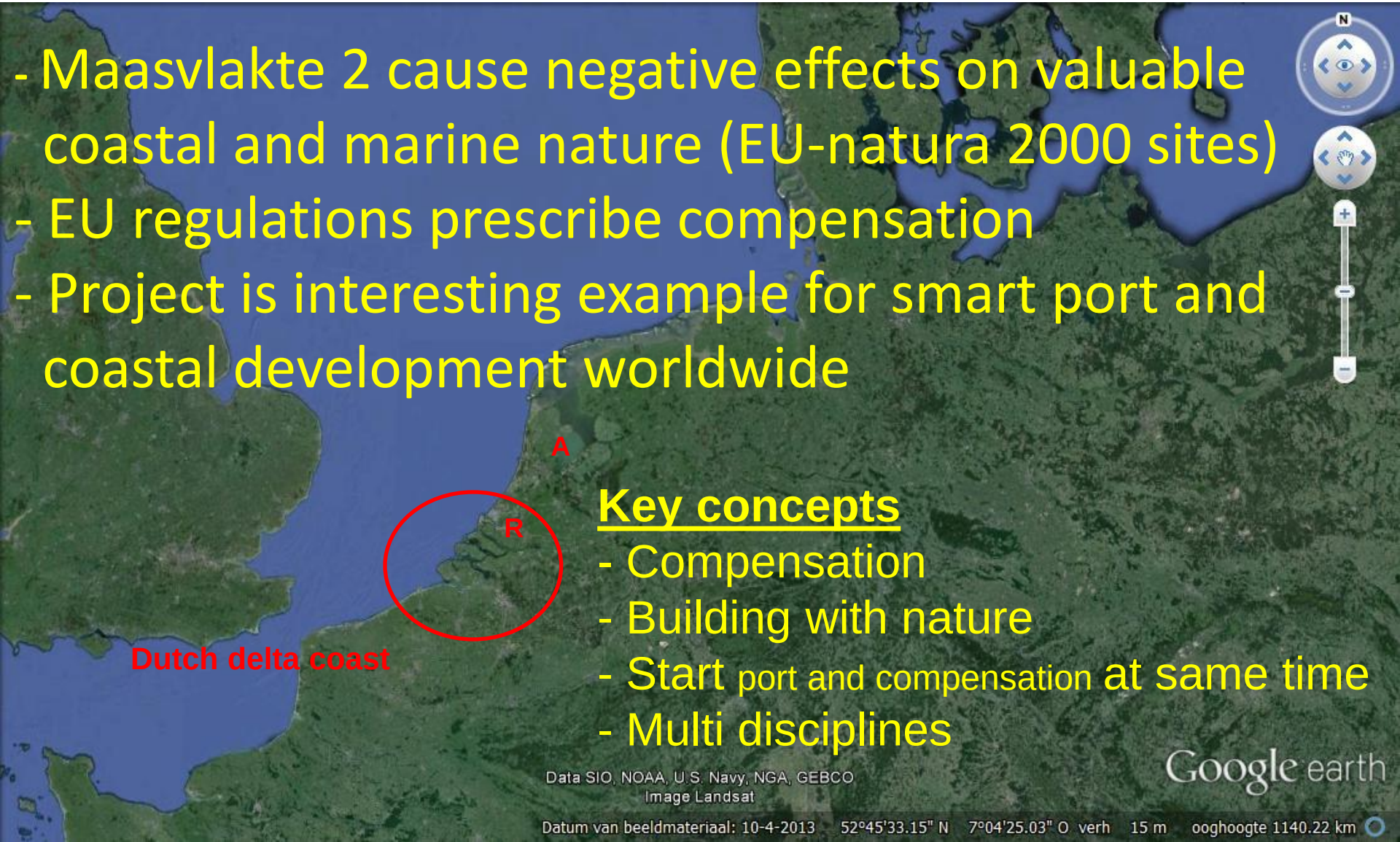
Frank van der Meulen

Ass Professor emeritus, UNESCO-IHE and Deltares, Delft, The Netherlands

with dr. Bert van der Valk

Connect economy with ecology

- Maasvlakte 2 cause negative effects on valuable coastal and marine nature (EU-natura 2000 sites)
- EU regulations prescribe compensation
- Project is interesting example for smart port and coastal development worldwide



Compensation activities

Damage and compensation

Dune habitat Natura 2000 *(air pollution NOx)*	damage (ha)	compensation (ha)
Wet dune valley	1,5	6
Dry Grey dune	4,5	10
Marine habitat Natura 2000 *(disturbance)*		
Shallow sea (bottom)	2500	25000 reserve 10% quality improve
Resting places sea birds	lost	make new

Compensation targets

New dunes, marine reserve and new resting places for sea birds

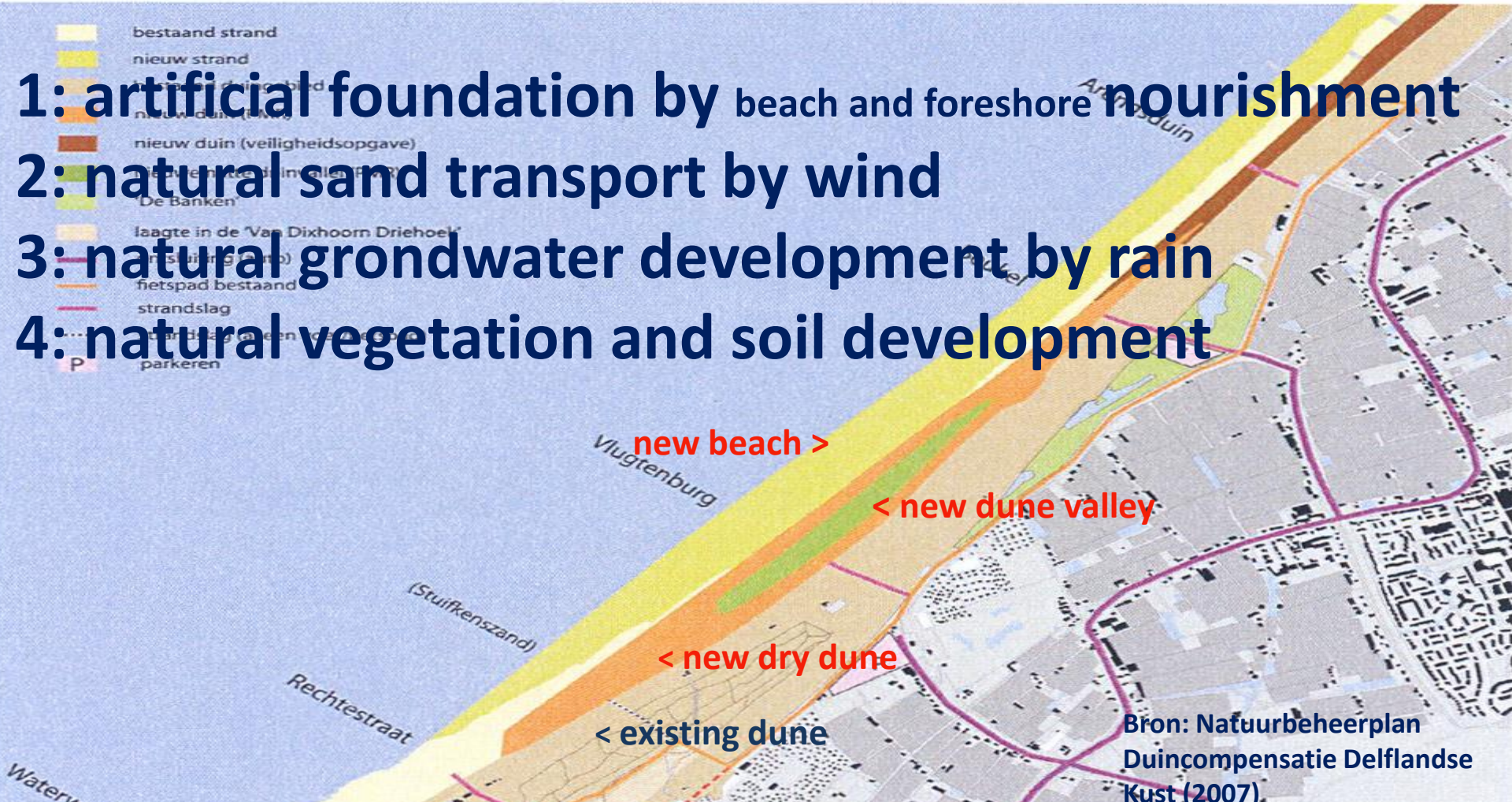
Common scoter

Sandwich tern

Common tern

Dune: design and phases of development

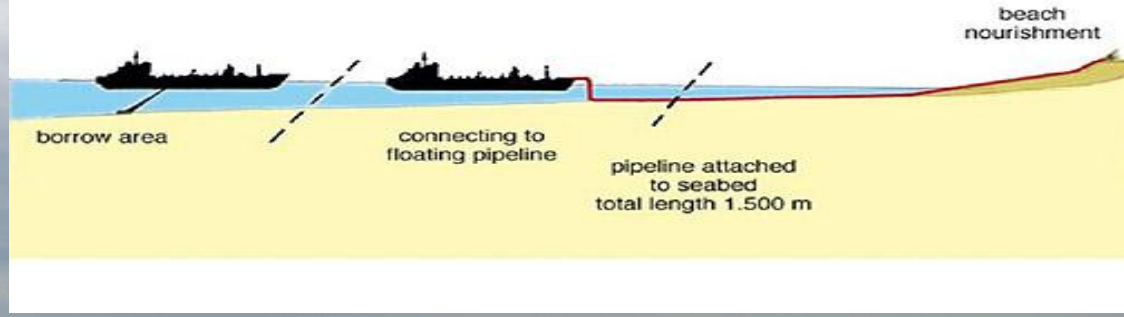
building with nature 35 ha, 6 miln m³ of sand



1: artificial foundation by beach and foreshore nourishment
2: natural sand transport by wind
3: natural grondwater development by rain
4: natural vegetation and soil development

Bron: Natuurbeheerplan Duincompensatie Delflandse Kust (2007)

Before (2008)



North Sea

Construction: beach and foreshore nourishment

Sand of special character was used 180-250 µ 6 mln m³

End (2010)

After 6 years of monitoring (T1=2009-2015)

- Abiotic conditions in place: dune form, soil and groundwater
- Target vegetation still to come: we need seed bank and colonisation by desired plant species

Marine compensation

- Marine protected area

No trawl fishing >260 hp

- Resting areas for seabirds

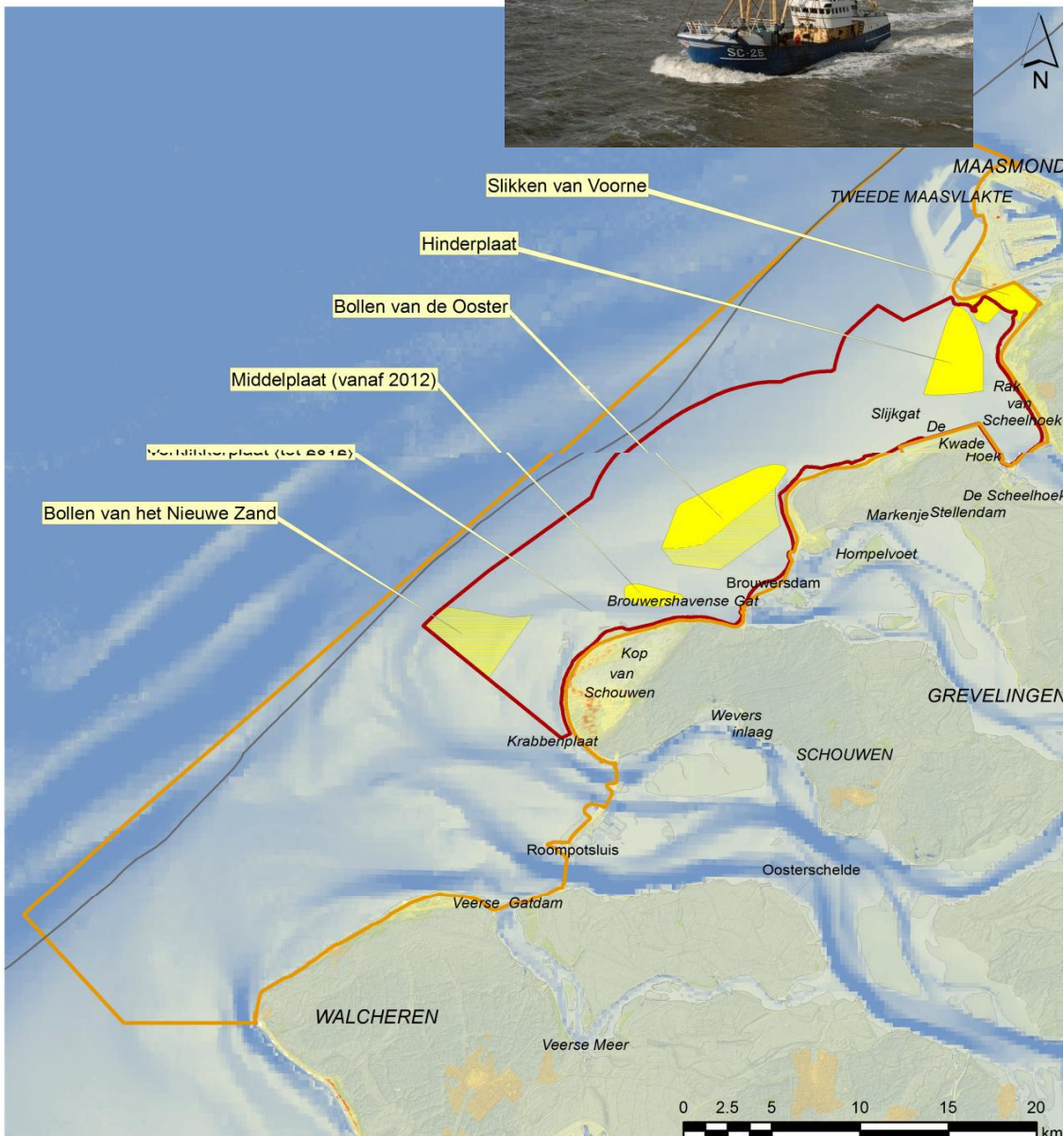
No human activity

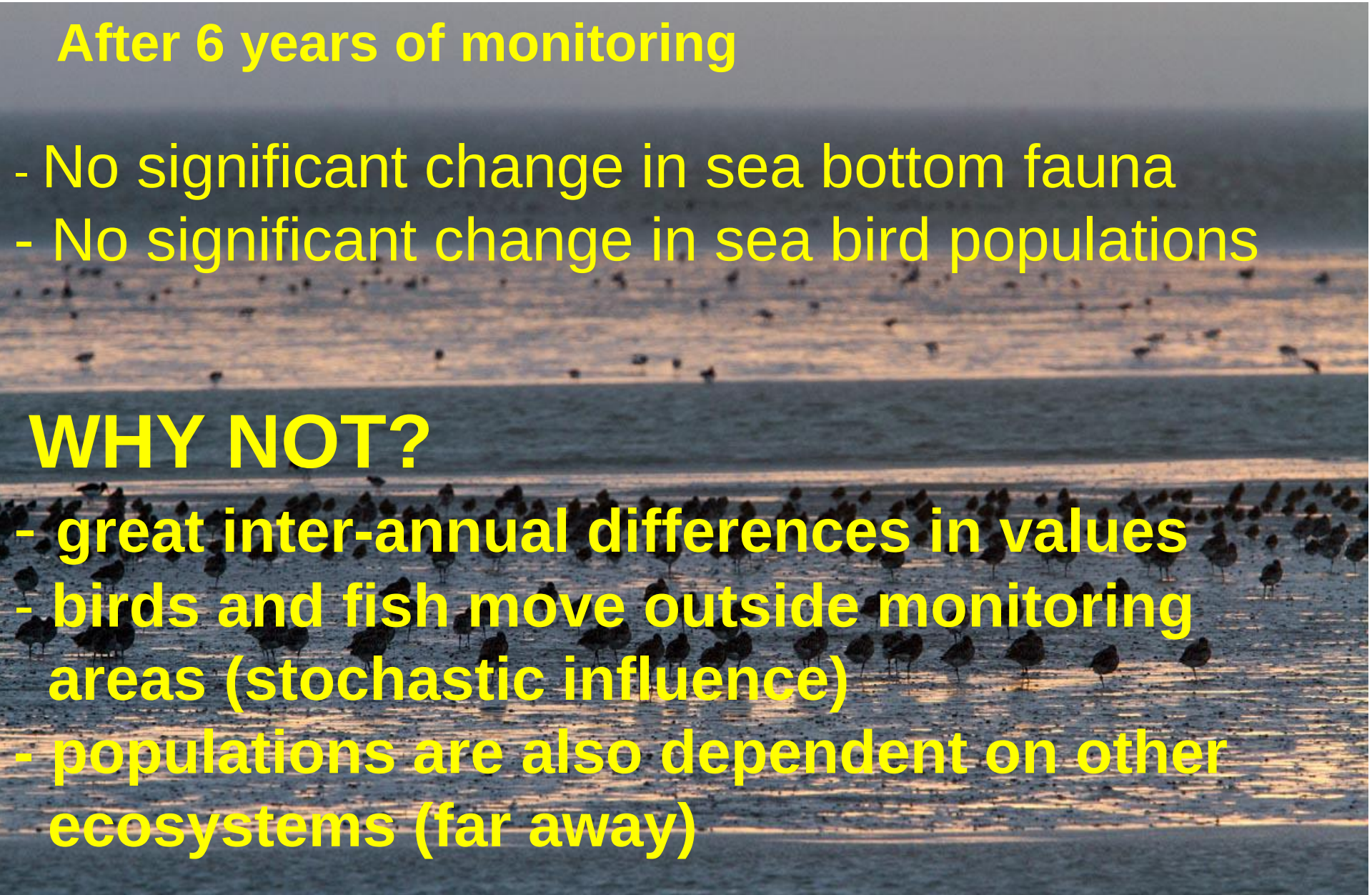
<u>Monitor</u>

- Fish(ing)
- Sea bottom fauna
- Sea birds
- Human activities

To= 2004-2007

T1= 2009-2015-2019





After 6 years of monitoring

- No significant change in sea bottom fauna
- No significant change in sea bird populations

WHY NOT?

- great inter-annual differences in values
- birds and fish move outside monitoring areas (stochastic influence)
- populations are also dependent on other ecosystems (far away)

Key points to apply worldwide

- Compensate nature damage due to port extension
- Start port and compensation at same time
- Multi-disciplines for design, construction and monitoring
- Building with nature
- Nature needs time to develop
- Patience in policy and management


Thank you

THE INTERNATIONAL MARITIME TRANSPORT & LOGISTICS CONFERENCE (MARLOG 5)

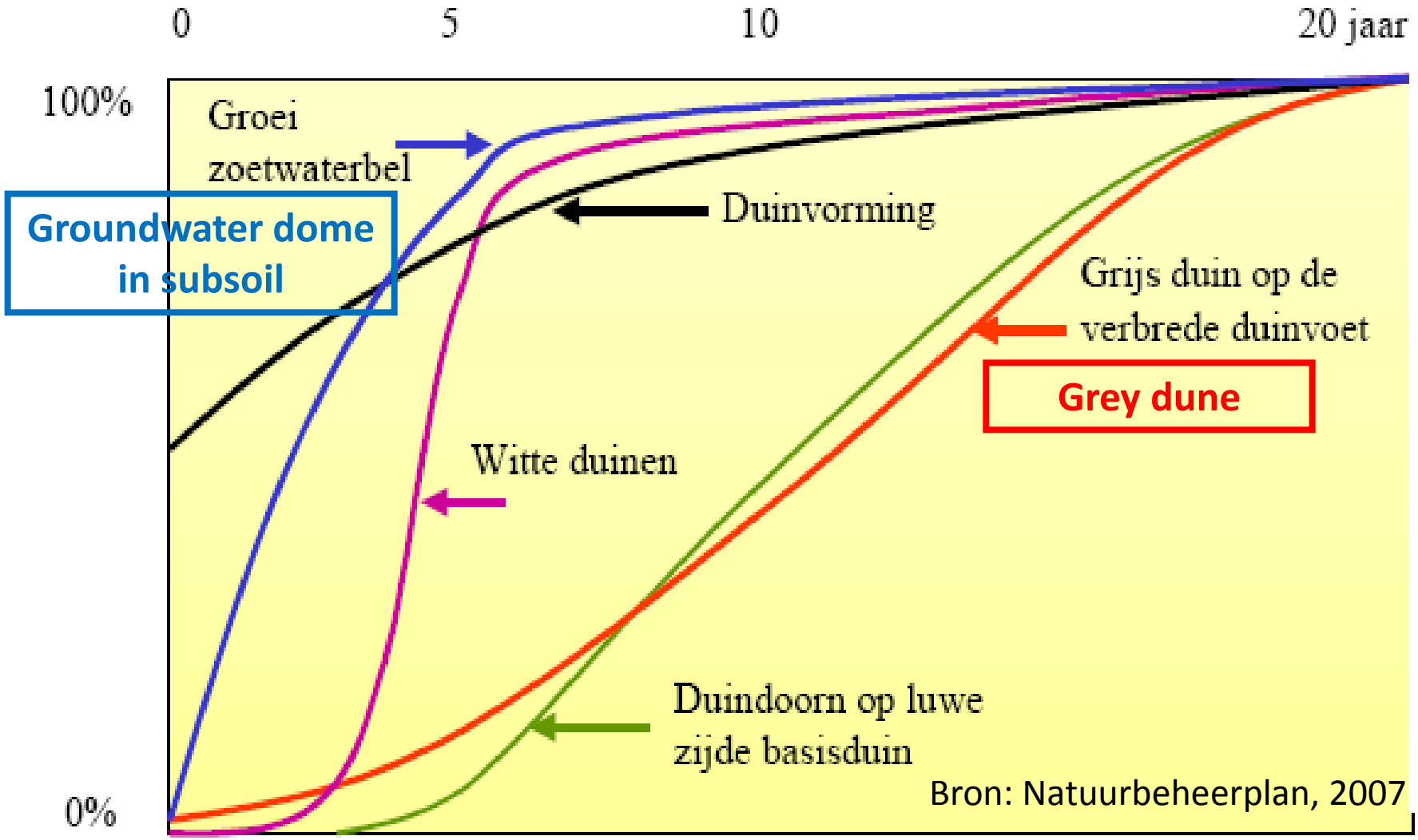
TOWARD SMART PORTS

13– 15 MARCH 2016

Learn from doing monitoring and indicators

	Phase	Element	Monitor	Entity
1	**Nourishment beach & foreshore**	Basic foundation	baseline	Meters, pixels
2	**Dynamics wind action**	Terrain form	Transect, laser altimetry	Meters, pixels
3	**Dynamics groundwater**	Phreatic levels, water quality	Piezometer, chemical analysis	Height above ASL, concentrations
4	**Vegetation development**	Plant communities, plant species	Maps,PQs	Ha, species
5	**Management to fine tune**	……	…….	…….

Estimated development time of target habitats (and monitoring times)



Monitoring: questions, elements

Existing dunes: is damage as expected?

- Groundwater/Soils
- Vegetation/Species
- N-balance
- Management

Not part of this presentation

New dunes: of enough nature quality to compensate damage?

- Morphology
- Groundwater/Soils
- Vegetation/Species
- N-balance
- Management

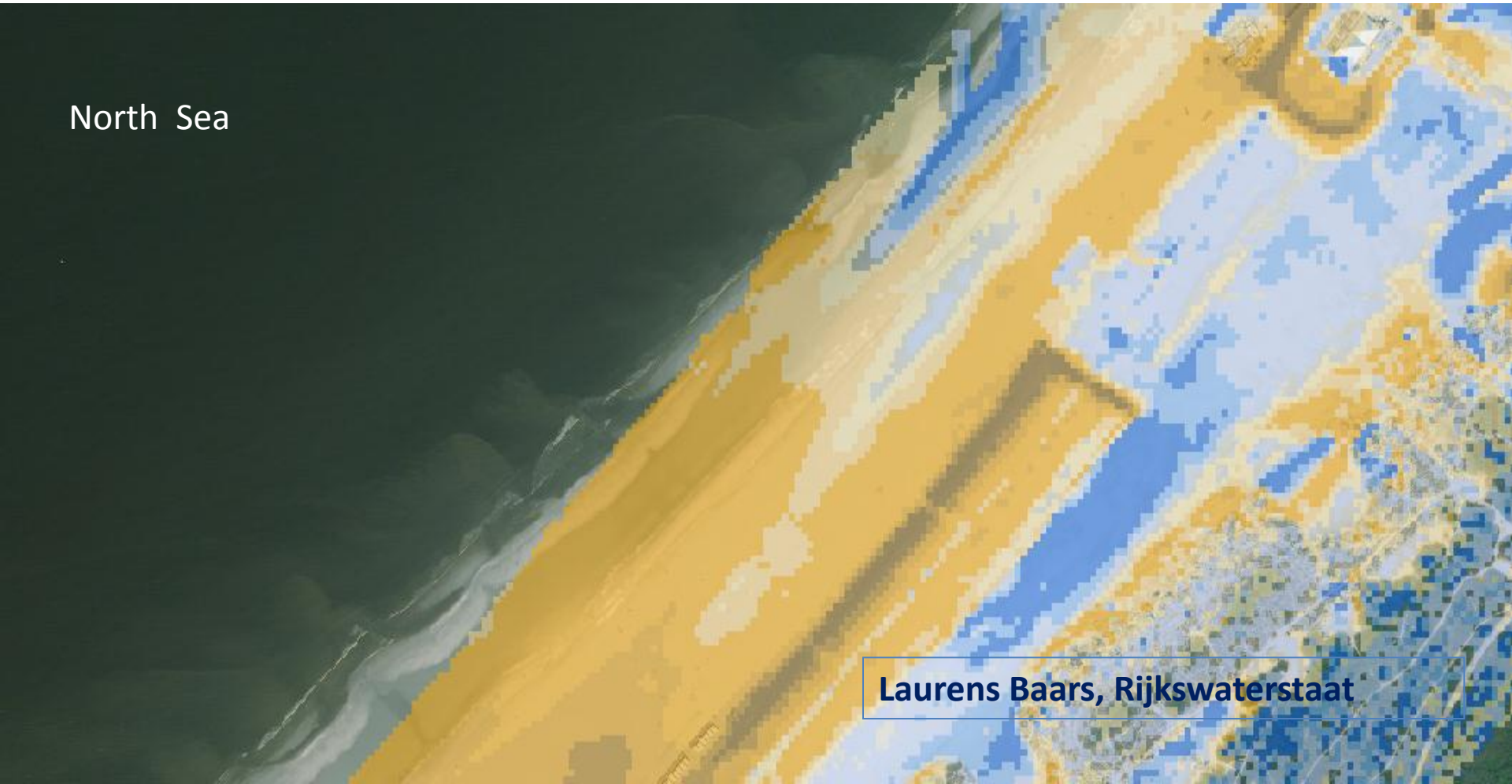
Evaluate and report to Govt and EU

Monitor Morphology

Difference 2009-2012 yearly laser altimetry maps

browns=accumulation
dark:+20-250cm

blues=deflation
dark: -50-280cm



Laurens Baars, Rijkswaterstaat

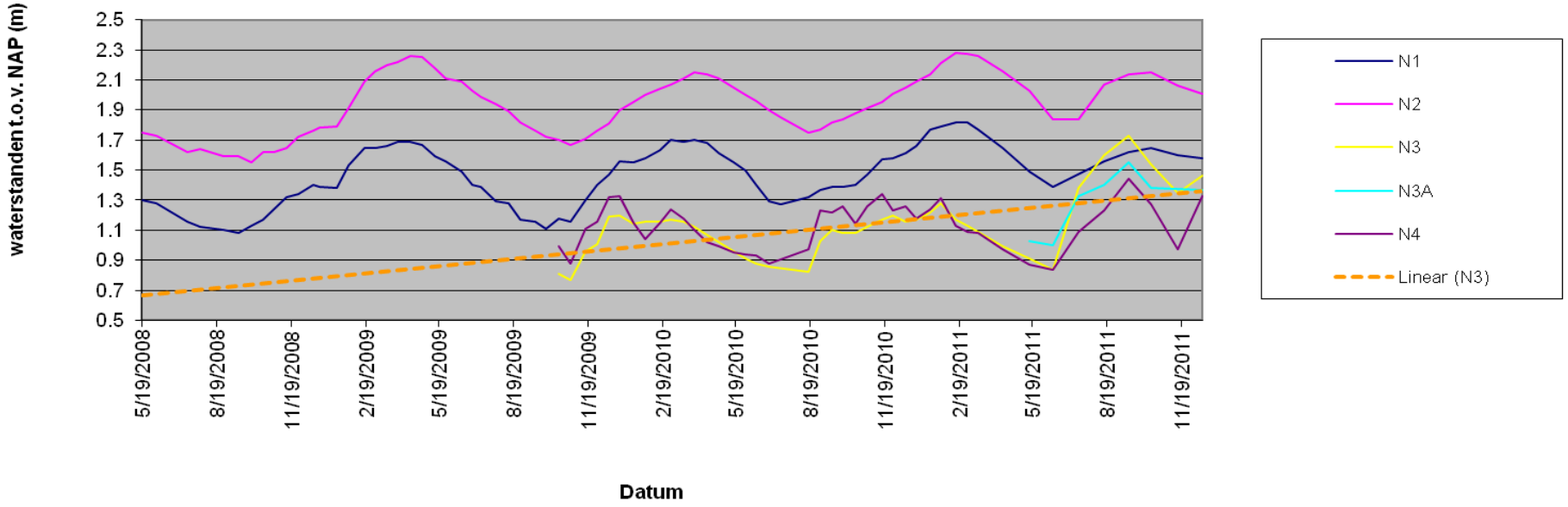
Groundwater monitoring

Network of piezometers in the valley

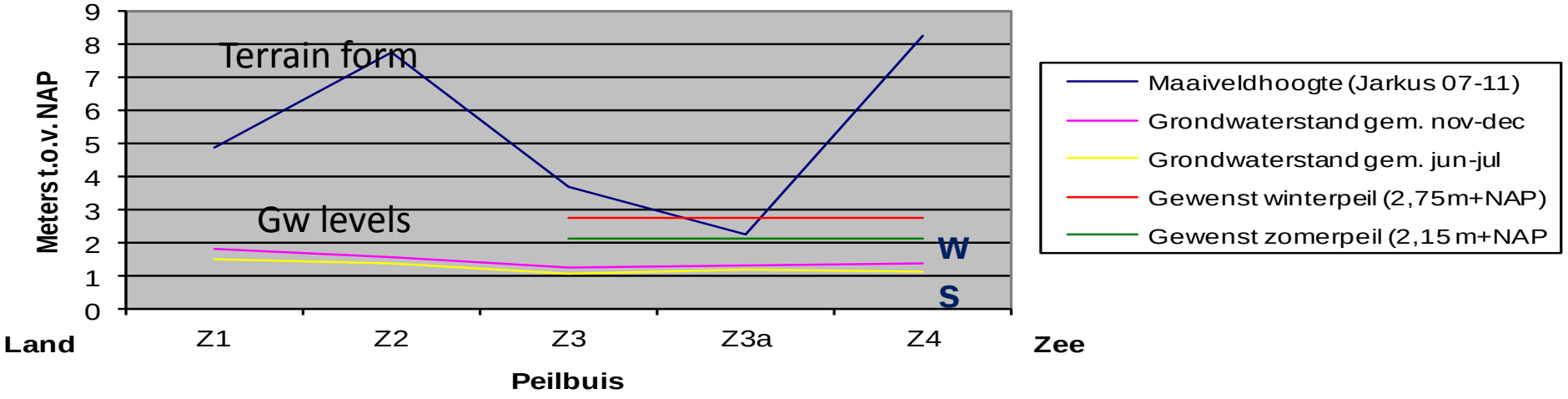
p

sp

Gw-levels 2008-2011 per piezometer



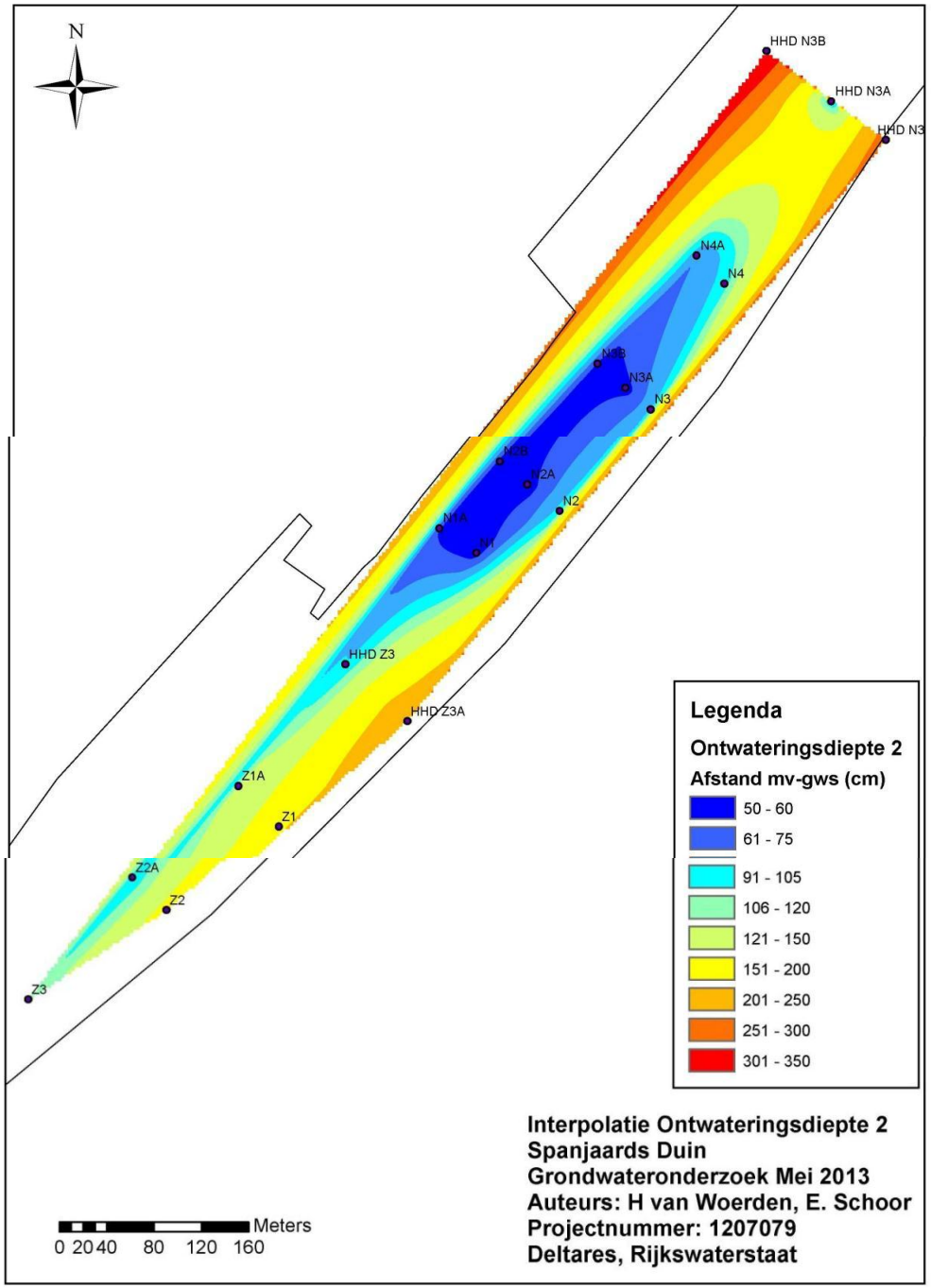
GW-levels winter and summer



Groundwater May 2013

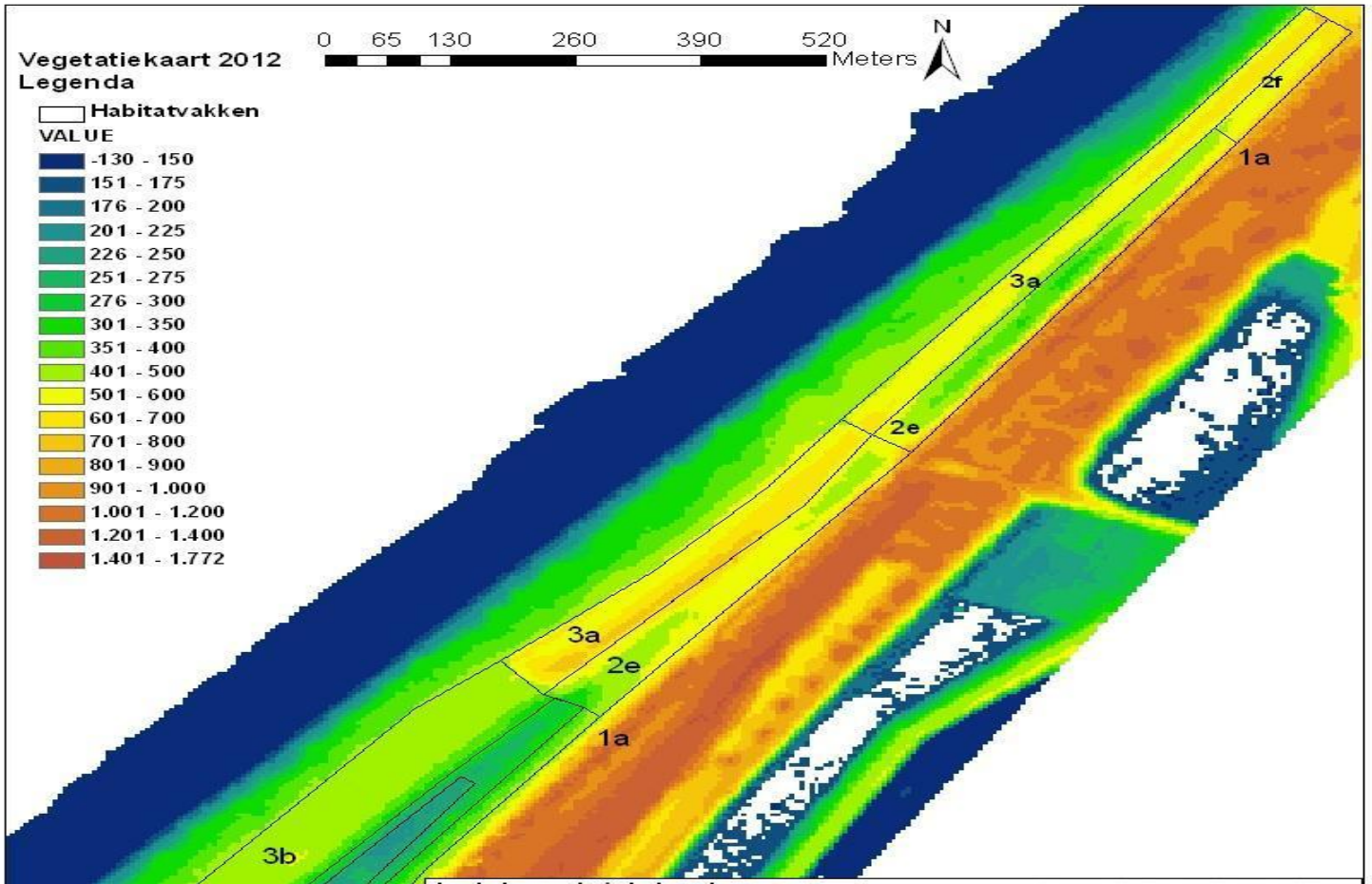
Difference soil surface-phreatic surface in the valley

Spanjaards Duin



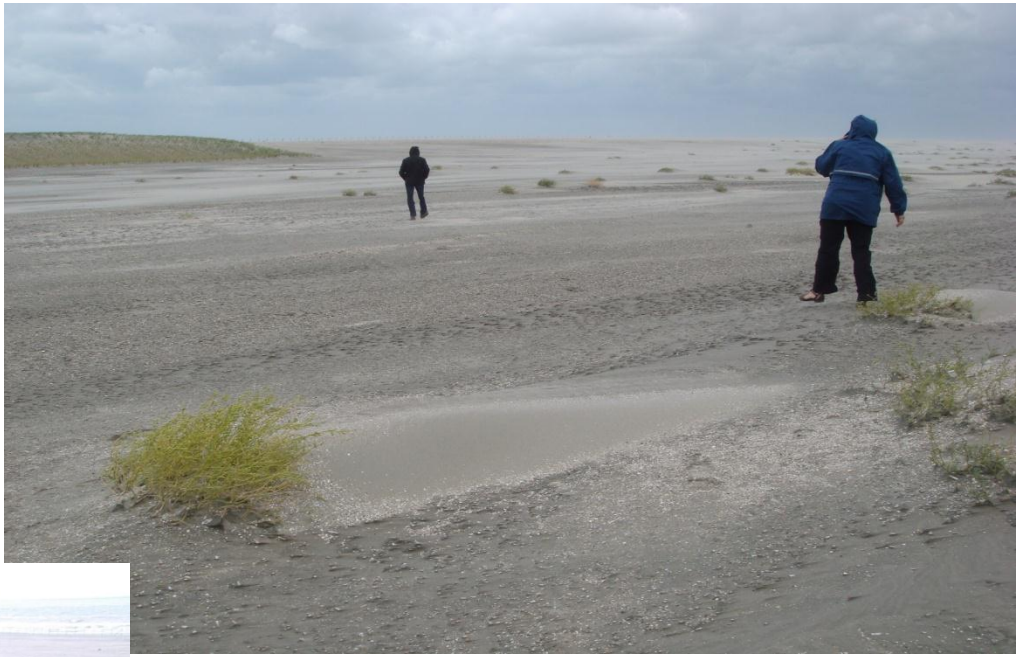
First habitat types based on elevation and ground-water

2012

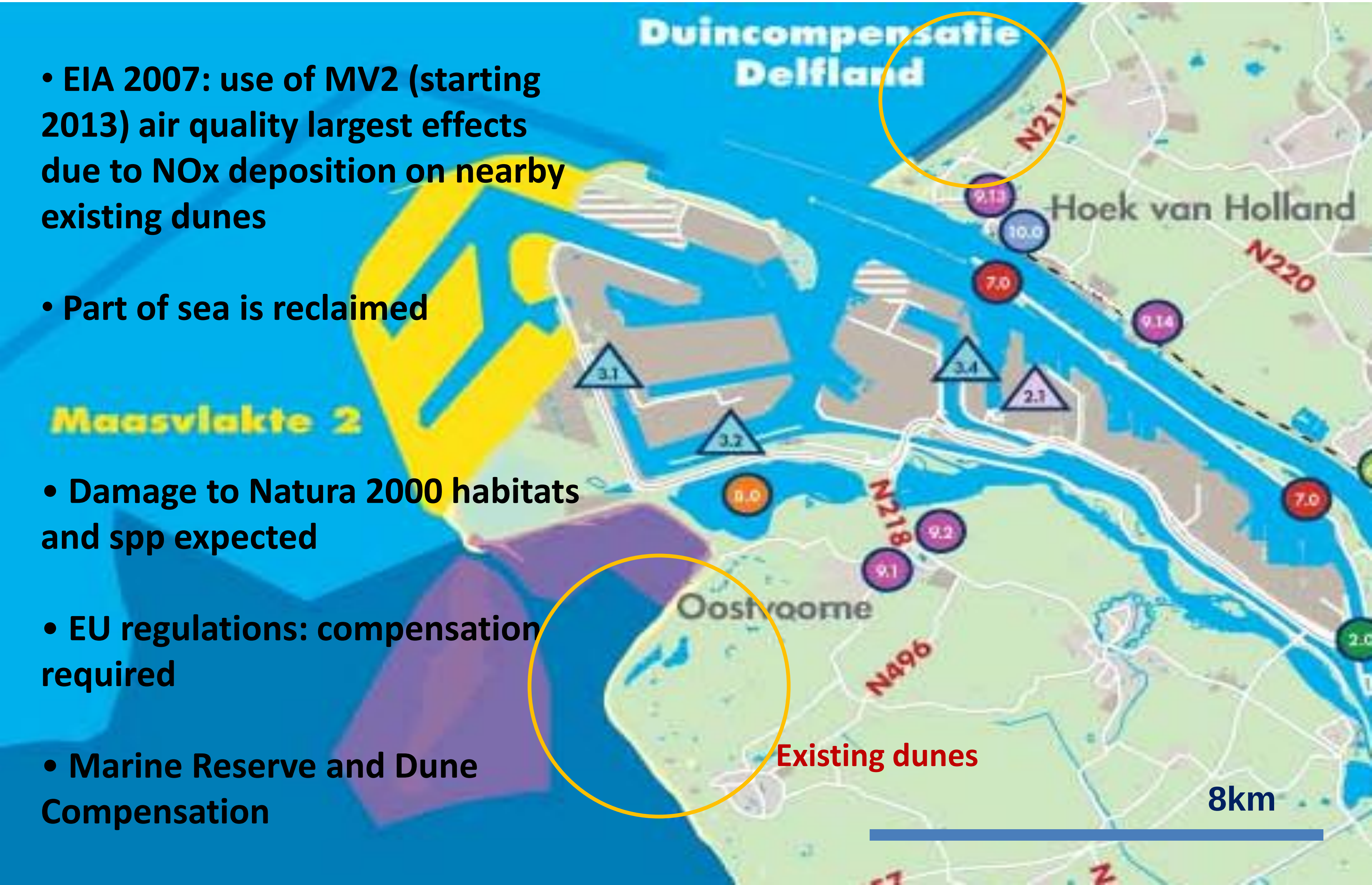


Landschapsecologische legenda		
Type	**Huidige situatie**	**Gewenste situatie (ha.)**
1: Oude Zeereep		
a) Gekerfde oude zeereep	Steile zeewaartse duinhelling met sterke accumulatie en helmgroei	Grijs duin, duindoornstruweel (onb)
b) Nieuwe duintjes	Smalle overgangszone met lage jonge duintjes met helm	Grijs duin (0,99)
c) Droog licht golvend duin	Smalle overgangszone met geïsoleerde zeeraket	Grijs duin (0,83)
2: Duinvallei		
a) Vochtige lage vlakke vallei	Vochtig grijs schelprijk zand	Vochtige duinvallei (1,41)
b) Droge lage vlakke vallei	Droog schelprijk zand met licht reliëf door lokaal deflatie en accumulatie	Vochtige duinvallei of grijs duin (4,66)
c) Kaal hellend*	Droog zand, loopt op richting Slag Vlugtenburg	N.v.t. (0,25)
d) Hogere vallei	Droog schelprijk zand, licht reliëf door deflatie en accumulatie, lokaal helm en zeeraket	Grijs duin of vochtige duinvallei (5,61)
e) Hoge uiteinde van de vallei	Schelprijk zand, lokaal wat helm. Weinig reliëf	Grijs duin (8,83)
f) Hoogste uiteinde van de vallei	Helmbegroeiing van basisduin loopt door, ook qua hoogte gelijk aan basisduin	Grijs duin (0,63)
3: Basisduin		
a) Hoger aangelegde duinrichel	Beplant, licht tot sterk begroeid met helm afhankelijk van accumulatie, lokaal sterk accumulatie	Wit duin/grijs duin/duin-doornstruweel (11,06)
b) Lager aangelegde duinrichel	Niet beplant, schelprijk zand, lokaal zeeraket, overwegend deflatie	Nog niet bekend (6,83)
* Wordt waarschijnlijk veroorzaakt door Slag Vlugtenburg		

Natural sand transport by wind



Harbour extension and negative impact on Natura 2000 dune sites. NOx emission *(nutrients)* is main impact



- EIA 2007: use of MV2 (starting 2013) air quality largest effects due to NOx deposition on nearby existing dunes
- Part of sea is reclaimed
- Damage to Natura 2000 habitats and spp expected
- EU regulations: compensation required
- Marine Reserve and Dune Compensation

Dune compensation

strenghthen weak link The Hague - Hook of Holland

20mln m3

Dune compensation

6 mln m3