Building with Nature

Challenges for sustainable development of surface water infrastructure

Stefan Aarninkhof, Anneke Hibma,
Mindert de Vries, Martin Baptist,
Gerard van Raalte and Mark van Koningsveld

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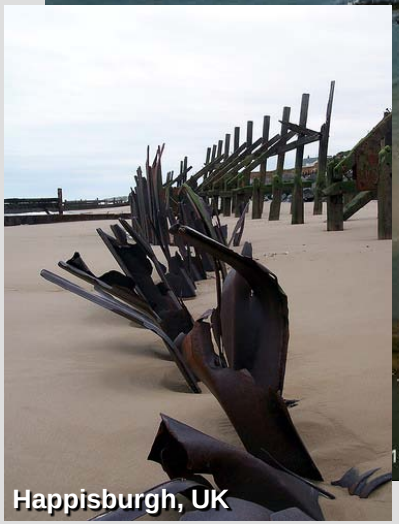
MUST WE CARRY ON LIKE THIS?



building with nature?

cannot we let nature do part of the work ...

while creating new new opportunities for itself?

building with nature

soft solutions

hard solutions

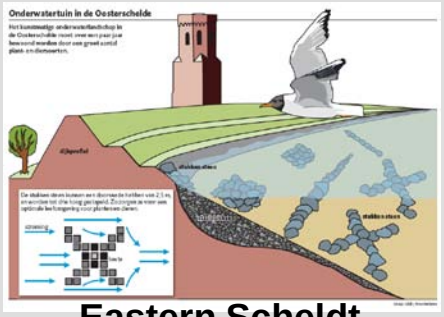
tidal

non-tidal

Galgeplaat
shoal nourishment

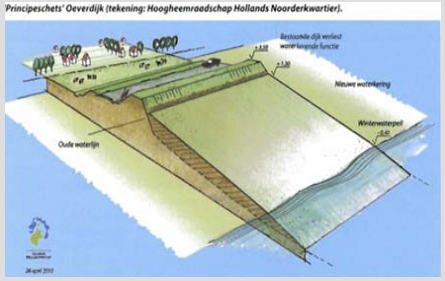
Delfland coast
Sand Engine

ES: oyster reefs
as shore protection



Eastern Scheldt
underwater garden

IJsselmeer
foreshore nourishment



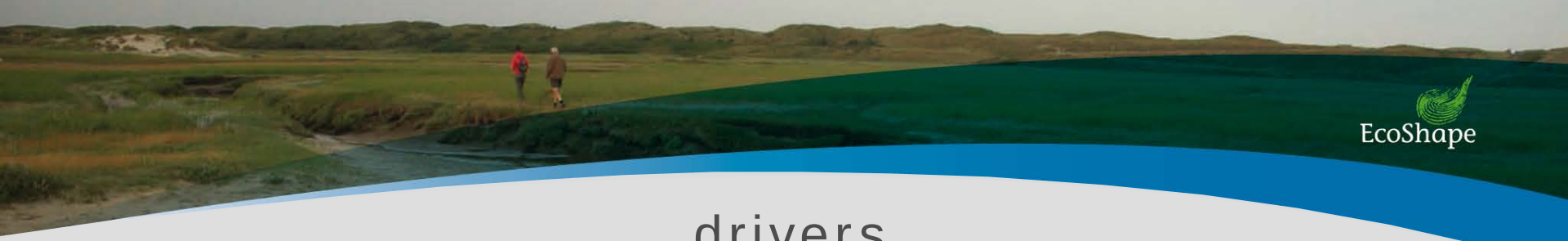
Markermeer
eco-levee

Noordwaard: willow
forest foreshore

'rich levee'

focus on
ecosystem
functioning

focus on
infrastructure
development



drivers

- government: seeks to become more agile via better informed decision making
- industry: seeks to realise growth at the high end of the market
- consultancies: seek competitive advantage by offering new concepts
- RTO's: seek added value via rapid transfer of relevant new knowledge
- academia: seeks fast valorisation of new knowledge and ideas
- NGO's: seek reconciliation of economical development and ecological sustainability

consortium

NGO's

INDUSTRY
dredging firms
consultancies
offshore industry

GOVERNMENT
I&E – DG Water
I&E – Rijkswaterstaat
Municip. Dordrecht

2008-2012

RESEARCH INST.
Deltares
IMARES
Alterra

ACADEMIA
TUD/UT/WUR
NIOZ
NIOO-CEME

our mission

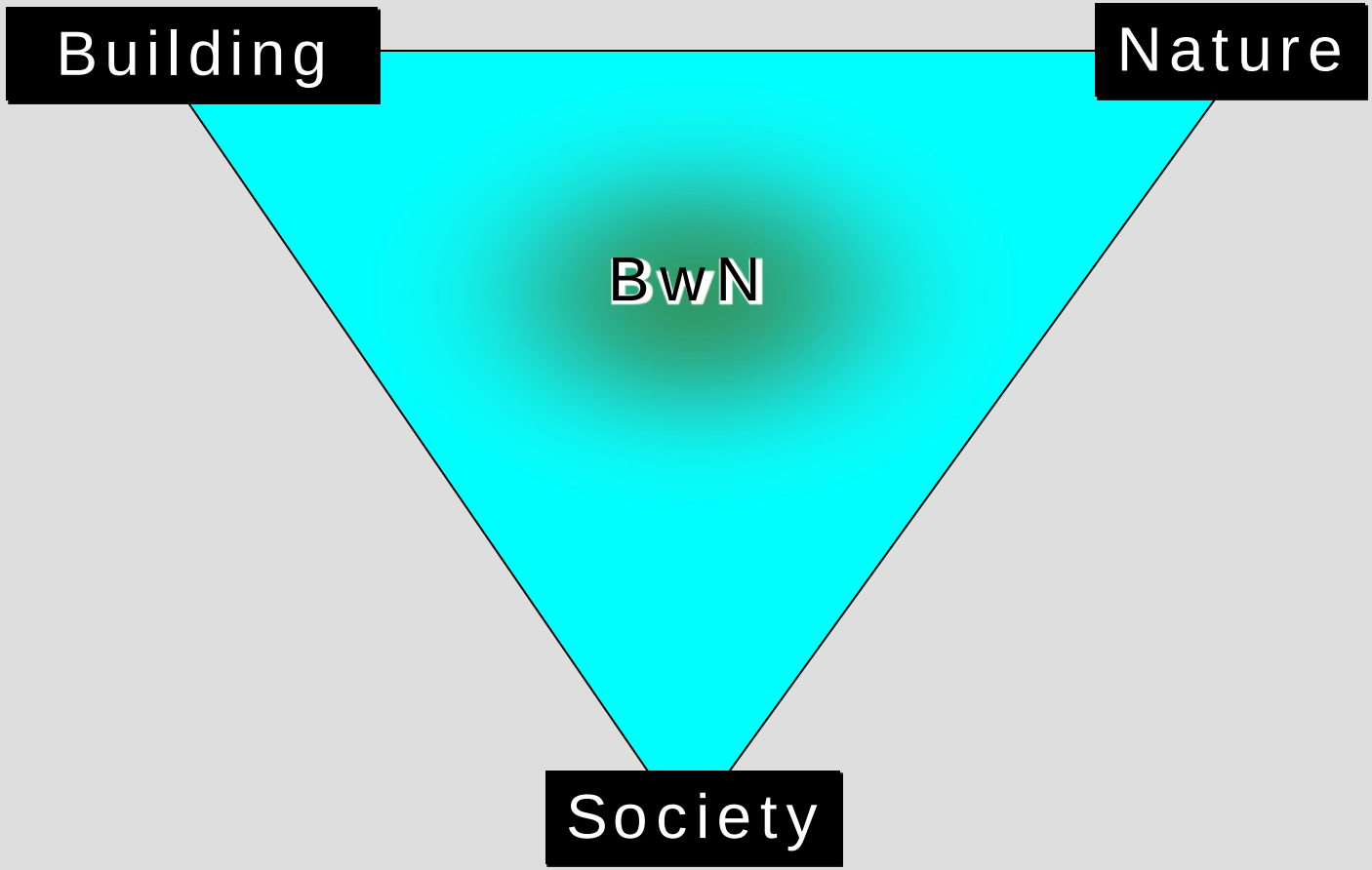
to show that it's possible,

developing infrastructure

and at the same time

creating opportunities for nature

field of operation



programme set-up

scientific research programme	case & pilot programme	manual & tools programme
19 PhD-students in (biogeo-) morphology ecology governance	4 ‘live’ cases each with 2 or more pilot experiments	application guideline portfolio of examples tools lessons learned

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Sand Engine Delfland: Why BwN?

Pilot Sand Engine Delfland:
100-150 ha, 21,5 mln m3

- One Mega Nourishment vs long term annual nourishment schemes
- Minimum impacts on ecosystem
- Natural redistribution of sand along coastline
- Smart design to promote nature development
- Innovative: Engineers and ecologists team up
- Are we able to predict? Are we able to manage?

Artist impression of development – not based on science

Example 1

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09-08-2011 (One month after completion)

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Sand Engine Delfland: Where are we now?

Rapid changes of morphology

- Major changes in first weeks after completion
- Baseline monitoring 2012-2016 in place, extension foreseen
- Pilot experiment attracts lot of attention
  - Coastal Zone Management interest
  - Research interest (De Vries, De Schipper)
- Role model for public/private collaboration on innovations in CZM

Vegetation

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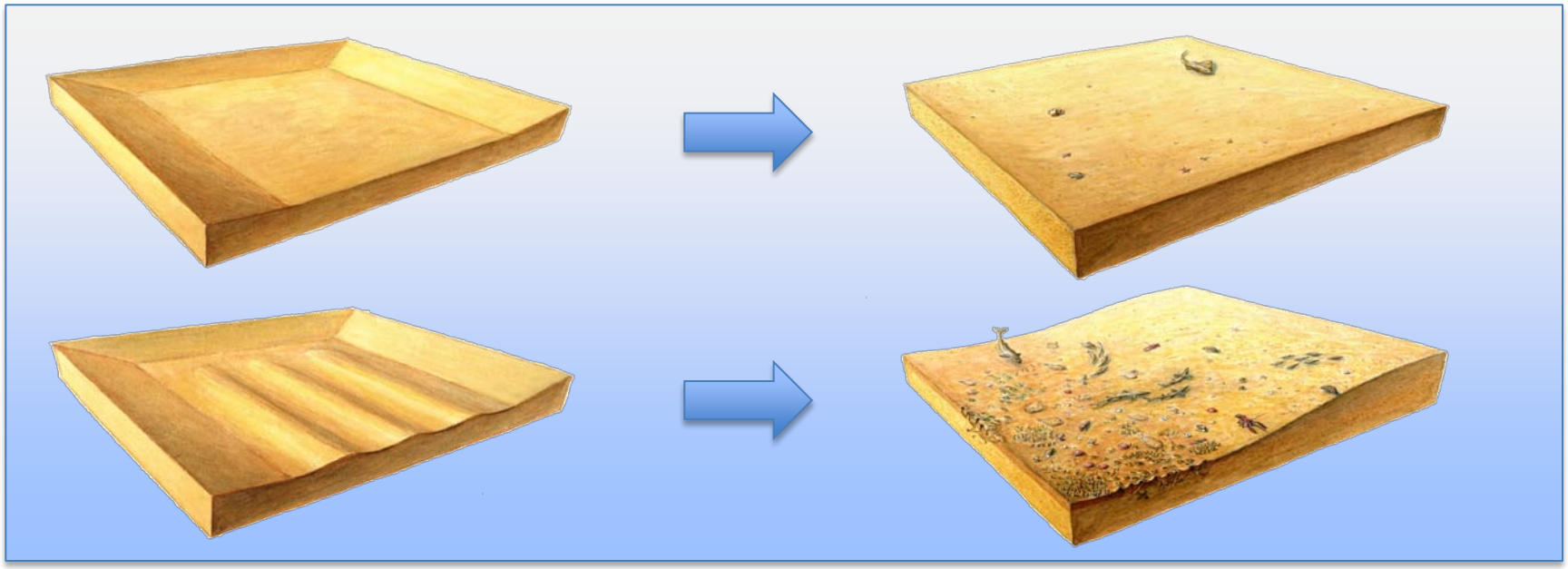
Ecological landscaping of mining areas

- Involves realization of large-scale bed forms in mining area
- Large potential for ecological development and mutual benefits for stakeholders (hypothesis)
  - habitat diversity (benthos) + faster recolonization
  - Positive effect on populations of fish, birds & mammals
  - increase economical value of a dredging area



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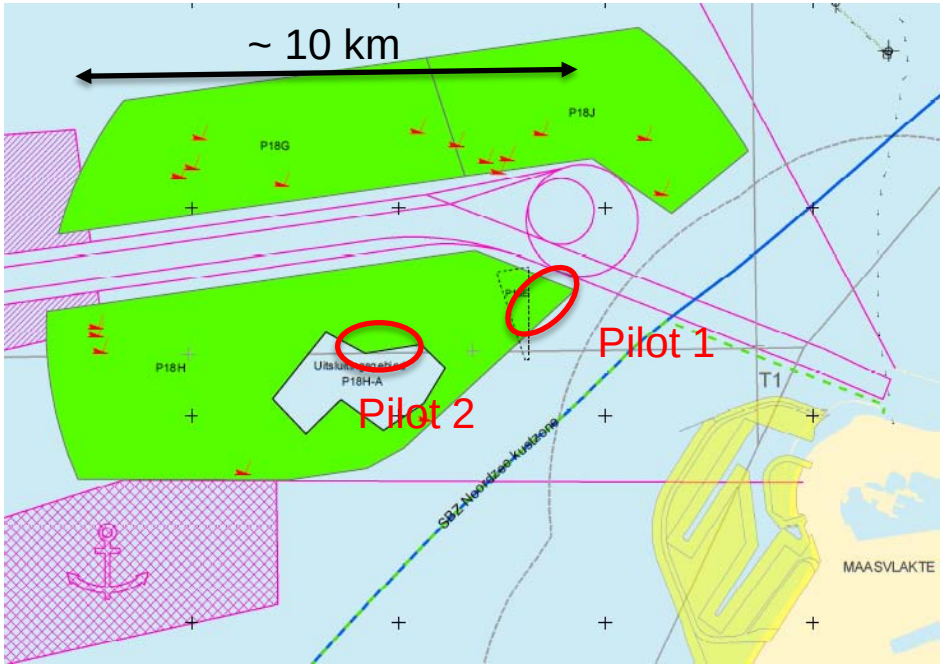
Pilot Ecological Mining pit (2010/2011)

- Realised as part of sand mining for Maasvlakte-2 project
- Assessment of feasibility within existing permits
- Assessment physical dimensions (L ~ 300-400 m, V > 1-10 Mm^3)
- Identification of suitable location
- Design of monitoring strategies (4-6 yrs after realisation)
- Organization of framework for data analysis
- Permanent liaison with stakeholders (PoR, RWS, PUMA, ...)



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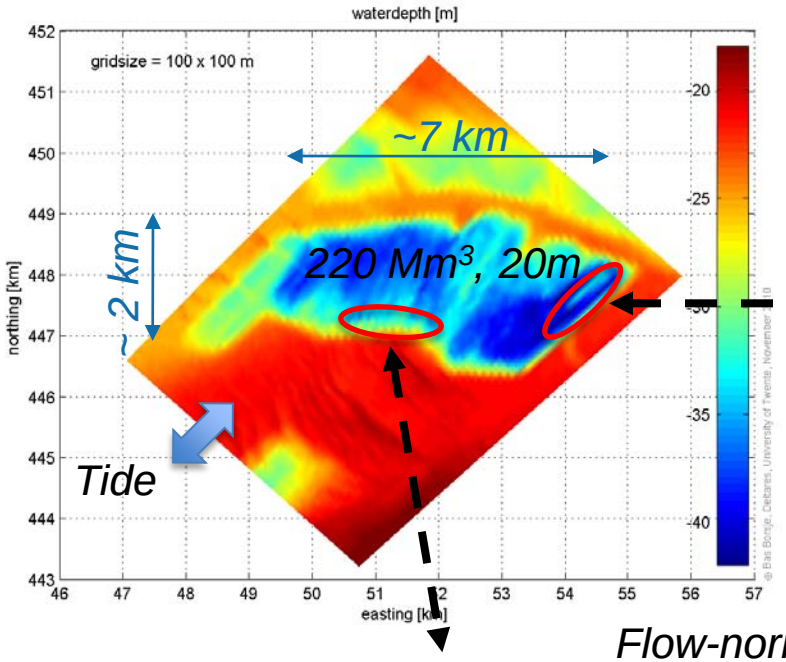
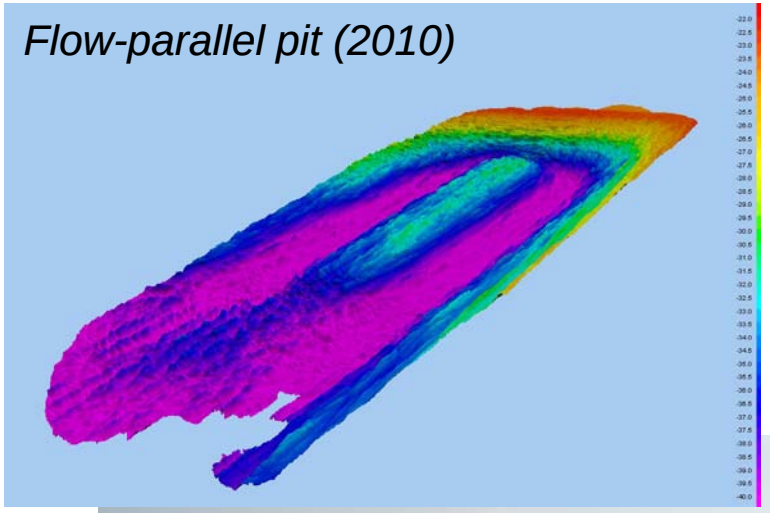
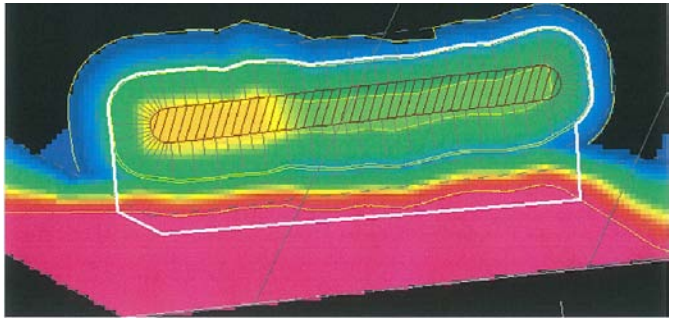
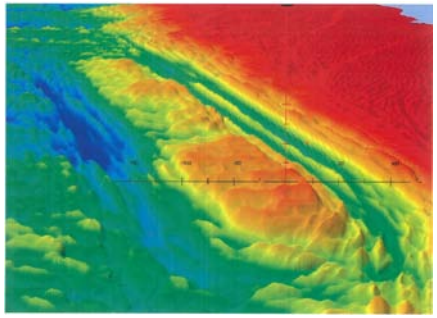
Realization of Ecological Mining pits (2010/2011)

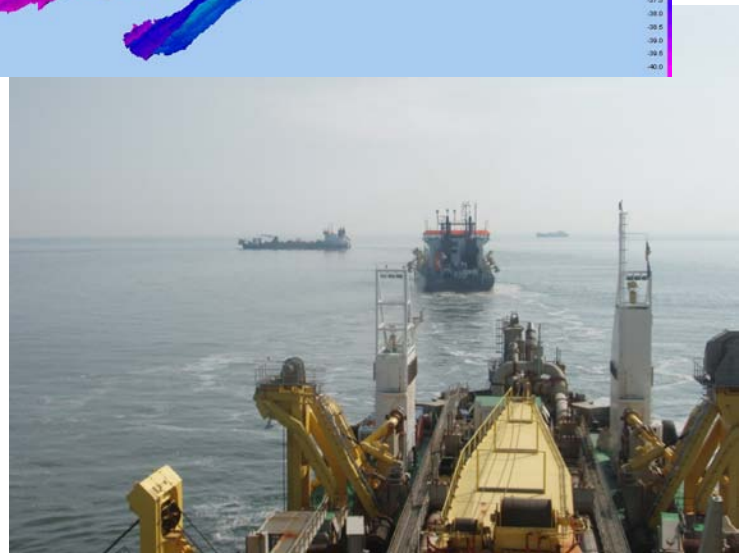




Flow-normal pit (2011)







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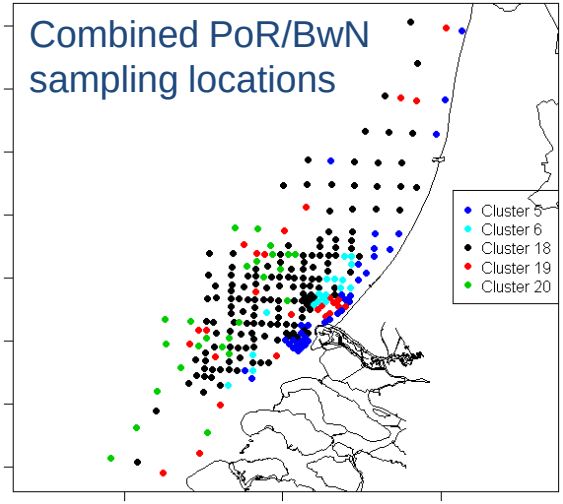
Ecological mining pit: Where are we now?



- Monitoring program 2008-2012 well underway (close collaboration with Port of R'dam)
  - 2010: Hardly any difference inside/outside
  - 2011 (*provisional*): 4 times more fish inside pit than outside (De Jong)
- Relate biological changes to bed param's (grain size, sorting, mud content, organic mat)
- Enable design of future ecological mining pits

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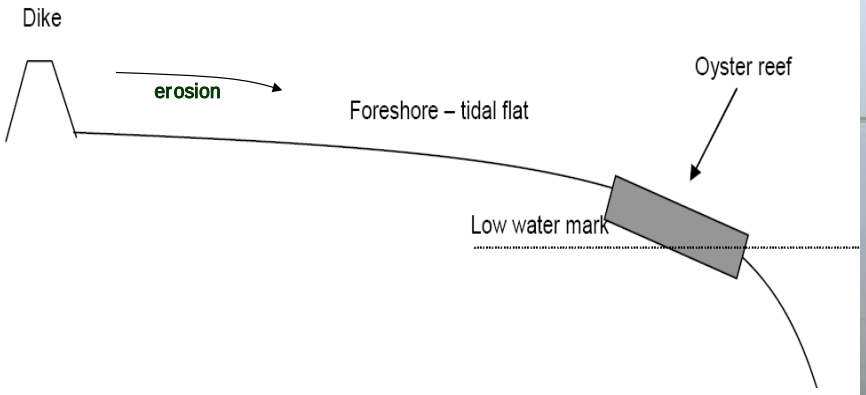
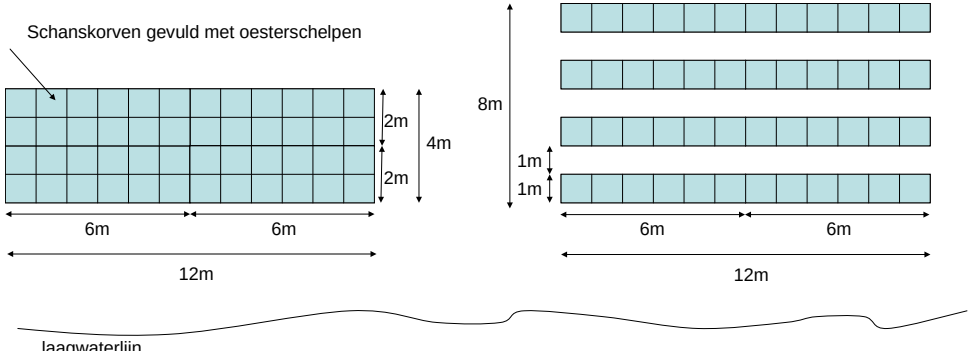
Coastal protection with oyster reefs

- Involves use of eco-engineers to mitigate erosion of tidal flats in Eastern Scheldt
- Ecosystem engineers such as reef building oysters can protect tidal flats from erosion, reduce wave energy, trap sediment, form diverse habitats, …and protect dikes
- The use of oyster reefs is successful if they are self-sustainable and stabilize tidal flats



BwN Pilot oyster reefs

1. testing of different materials and cages in small-scale experiments => use of gabions most promising
2. small scale pilot June 2009: gabions filled with oyster shells



100 m^2
11000 kg oyster shells

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Large-scale experiments (2010)
3 reefs, 400 m3 oyster shells each

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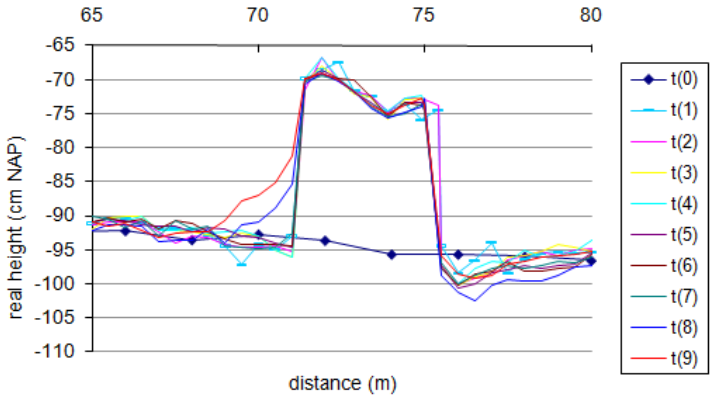
Oyster reefs: Where are we now?



- Small-scale pilot positively evaluated
  - Gabions with oyster shells stable
  - Local sedimentation / reduced erosion
  - Oyster larvae settle & grow on reef
- Lage-scale pilot realized in 2010
  - In 2011: Less spat than envisaged
  - Settlement of mussel shelfs
  - NB: Morphological effects storm events!

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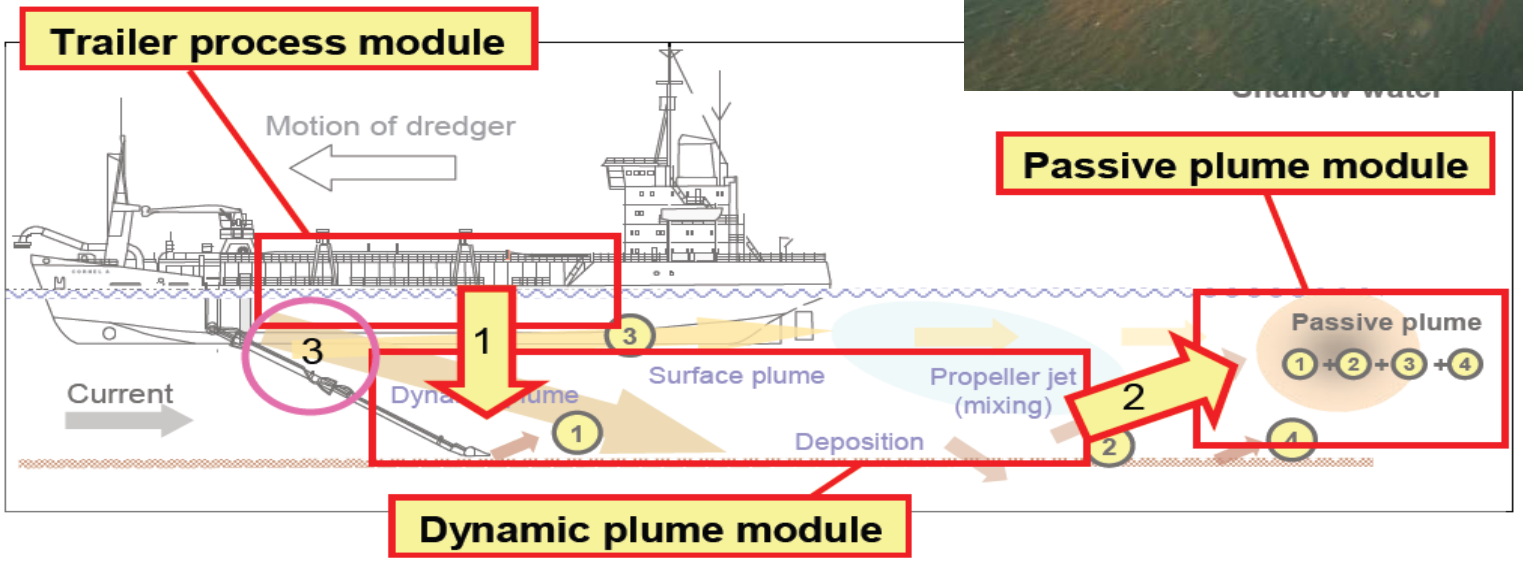
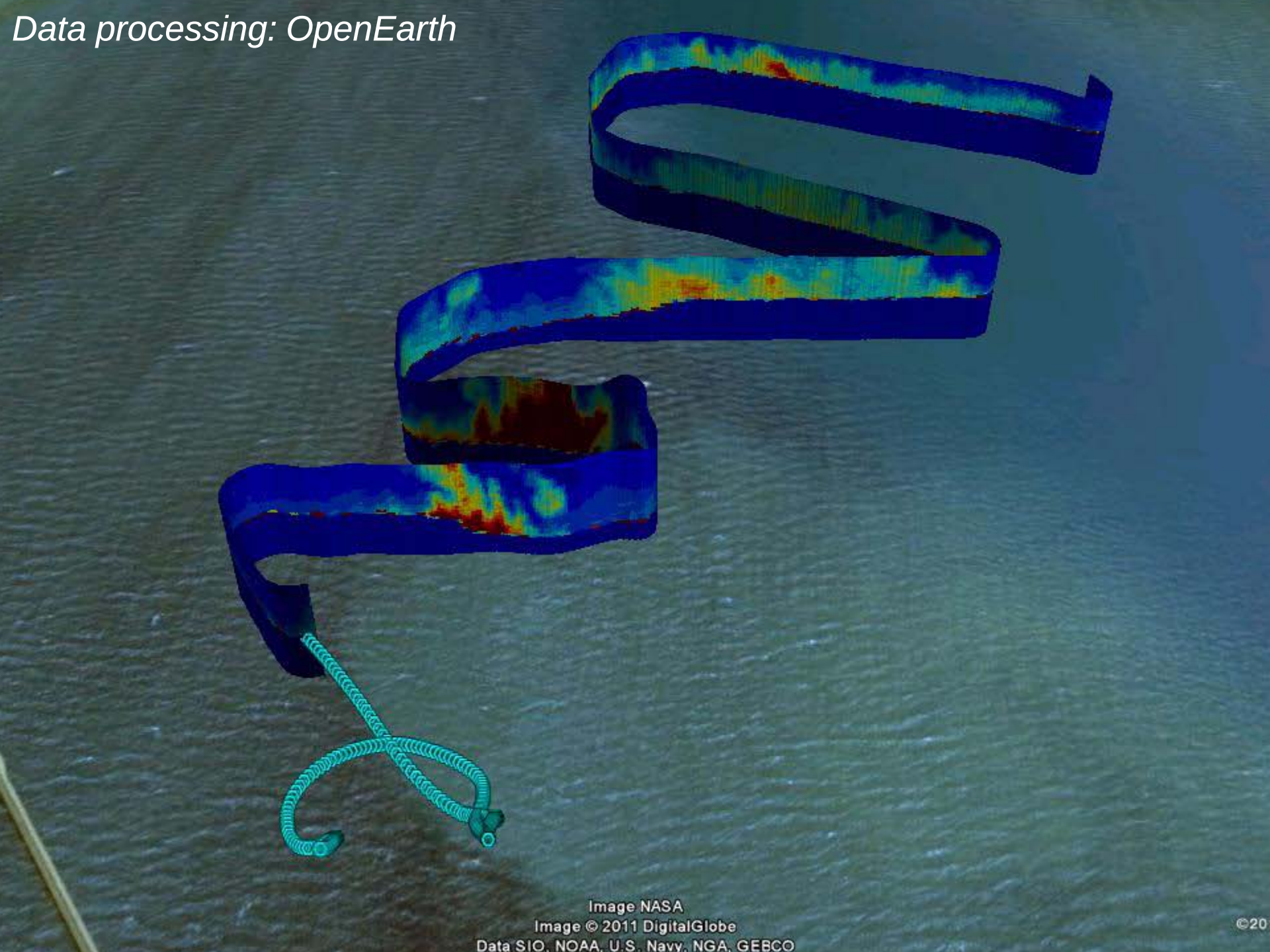
Adaptive management of dredging operations

- Nature as starting point for specification of environmental limits
- Still: #1 parameter = turbidity
- Requires predictive understanding of resuspension processes
- TASS experiment NW-Australia (July)



Data processing: OpenEarth



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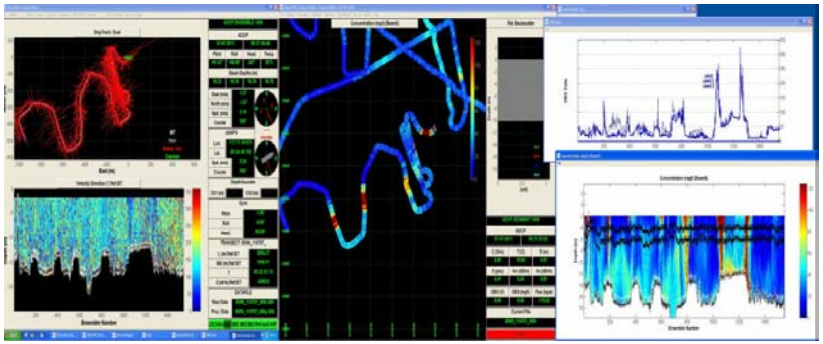
Turbidity research: Where are we now?

- TASS experiment NW Australia
  - Experiment successfully completed (July 2011)
  - Data presently analyzed
- Adaptive management of dredging operations
  - Develop & validate predictive tools (CFD - Lynyrd de Wit, TASS)
  - Relate turbity impacts to ecosystem responses
  - Establish guidelines for better norms
- Share proven knowledge



Challenges for sustainable development of surface water infrastructure

- BwN solutions are available and realistically feasible
  - Multi-disciplinary collaboration & stakeholder interaction pays off!
- Key challenge: Application in real-world projects
  - BwN solutions should be competitive ($$$)
  - BwN solutions should be embedded in regulatory systems
    - Procedure to assess robustness during extreme conditions
    - Responsibility for keeping BwN solution in condition
  - BwN solutions should be incorporated as adequate alternative in early stages of project development / design cycles
- Demands strong involvement of government policy, regulation and agency practices

Guiding principle BwN after 2012

From

"Show that it Works"

To

"Make it Happen"