Building with Nature

Challenges for sustainable development of surface water infrastructure

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MUST WE CARRY ON LIKE THIS?

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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

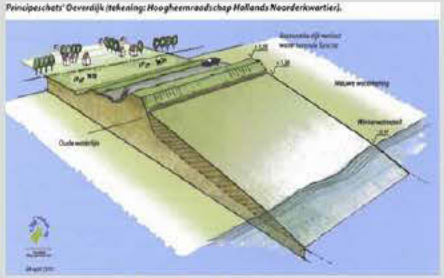
Galgeplaat
shoal nourishment

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

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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

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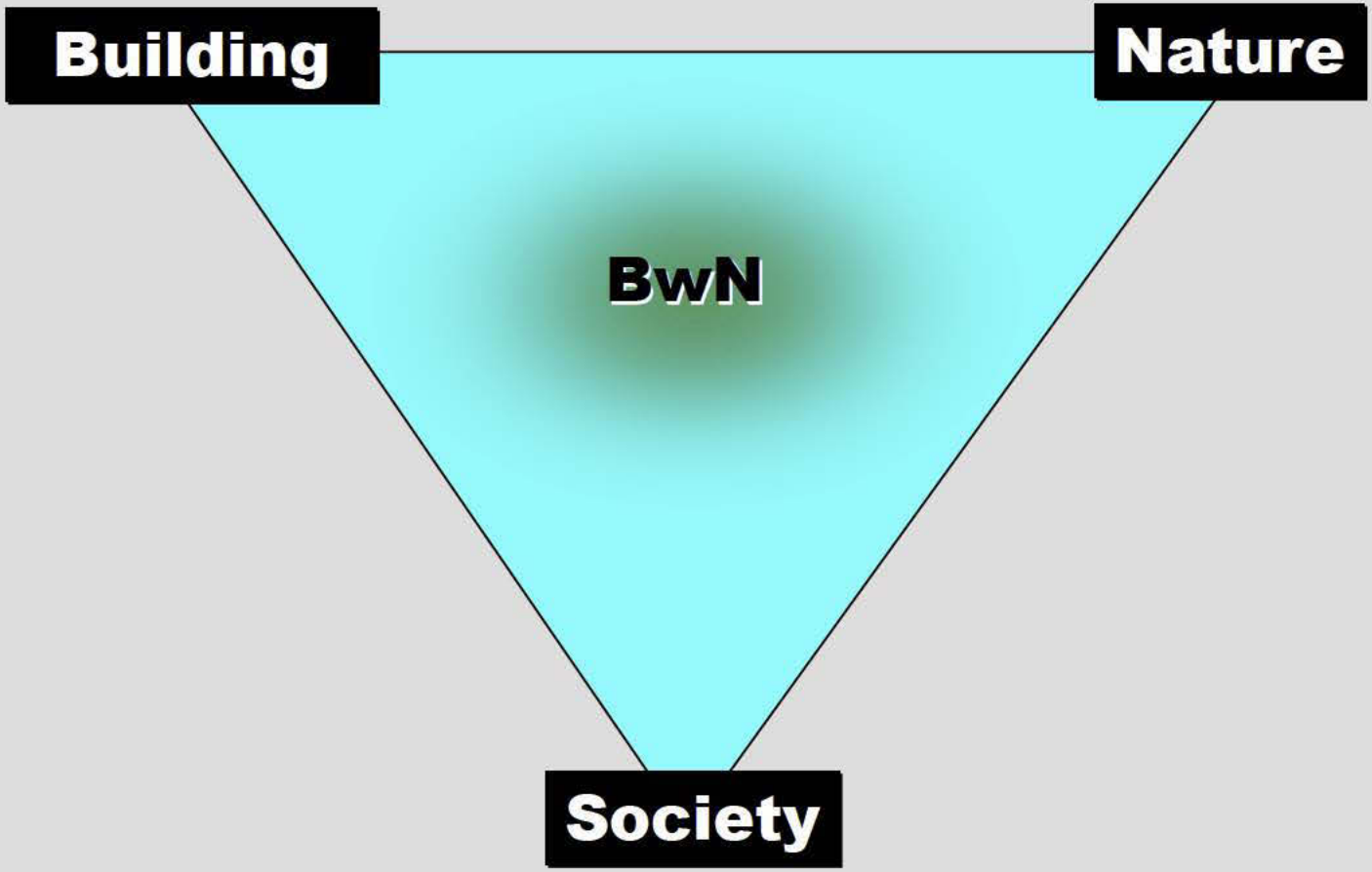
field of operation



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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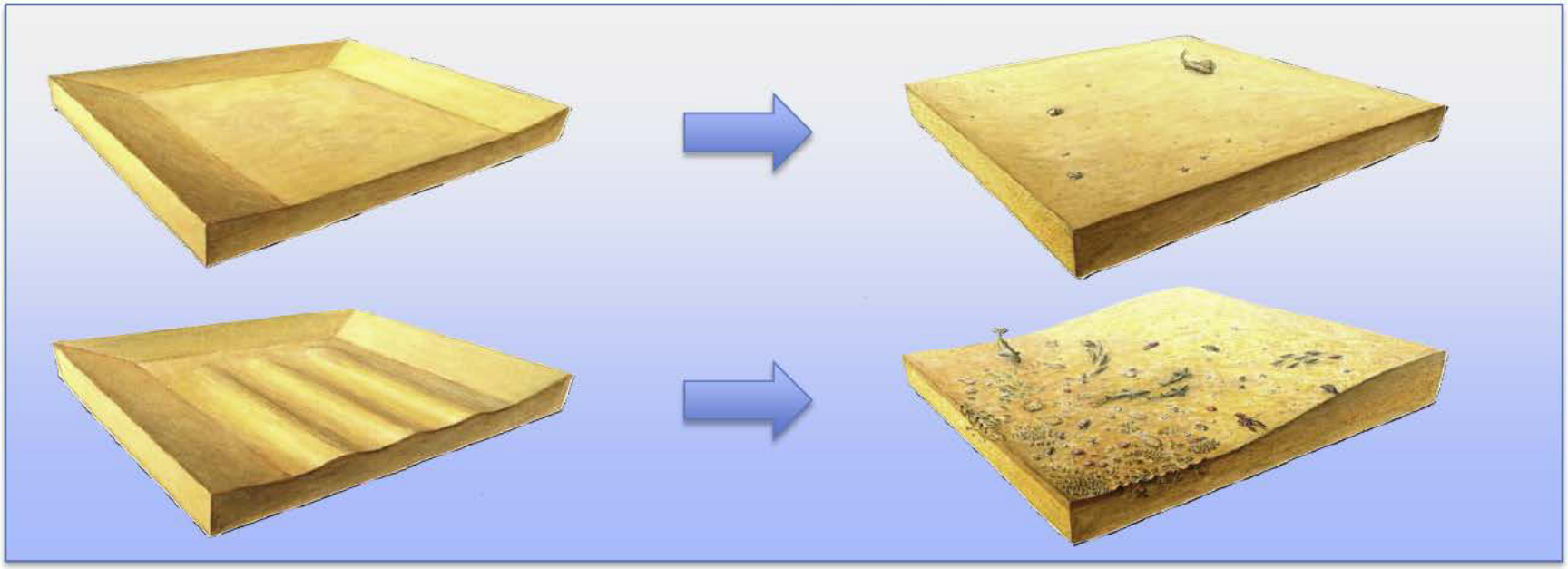
Ecological landscaping of mining areas

- 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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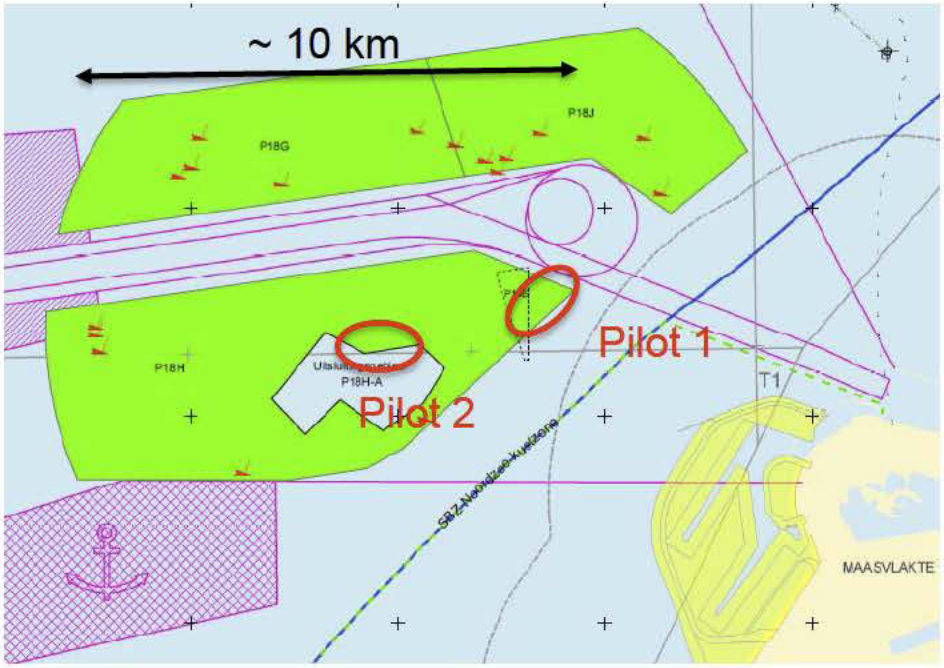
Pilot Ecological Mining pit (2010/2011)

- 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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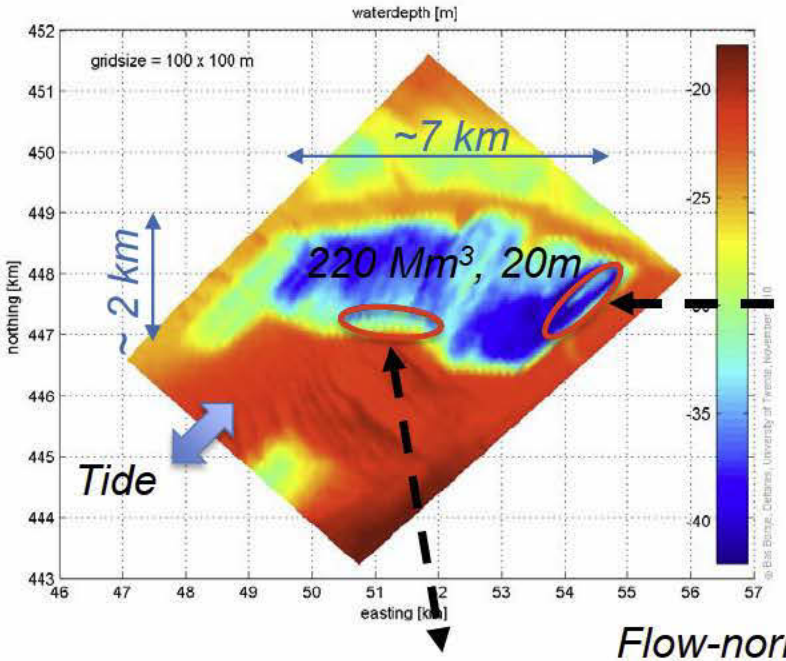
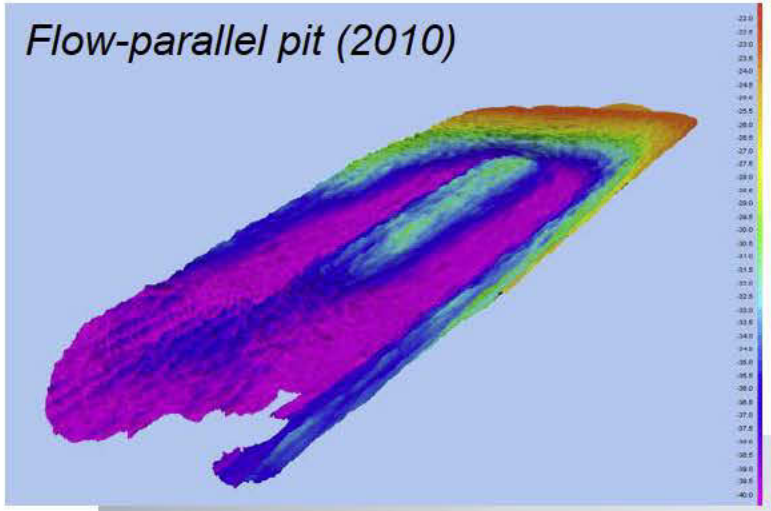
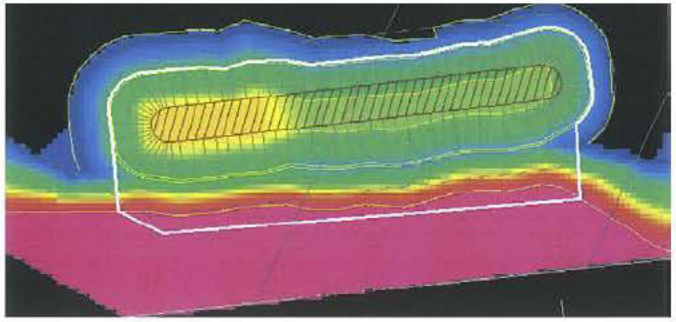
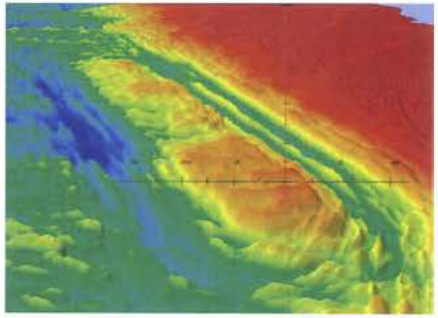
Realization of Ecological Mining pits (2010/2011)





Flow-normal pit (2011)





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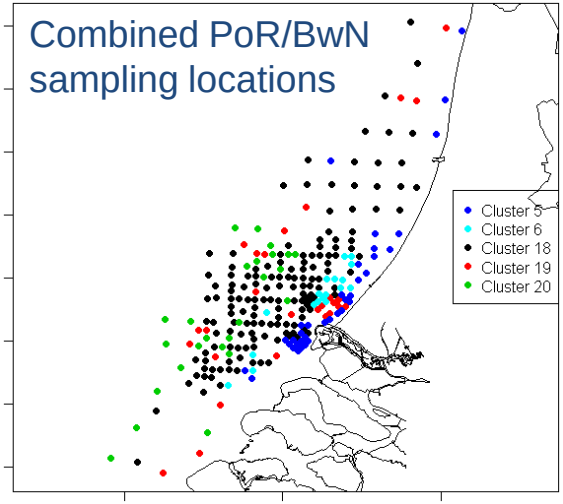
Ecological mining pit: Where are we now?



- 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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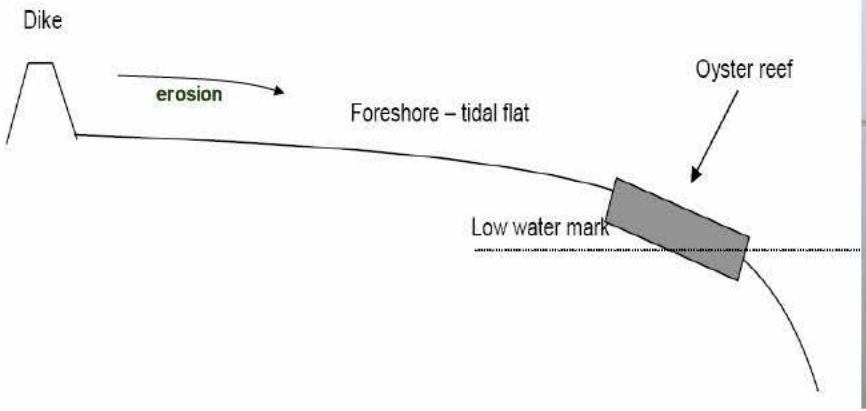
Coastal protection with oyster reefs

- 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



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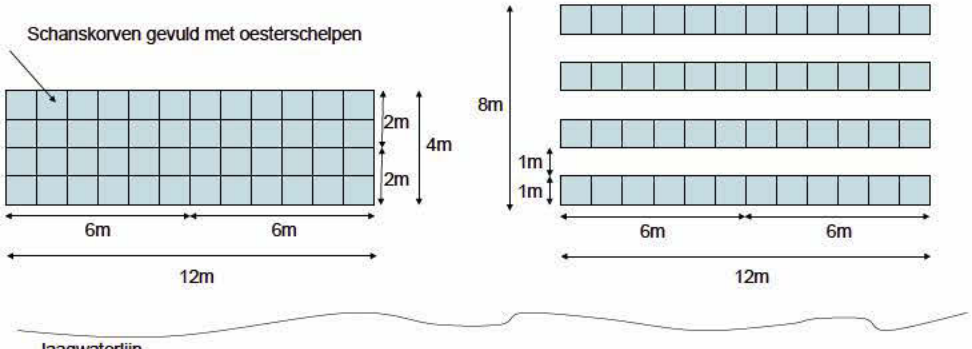
BwN Pilot oyster reefs

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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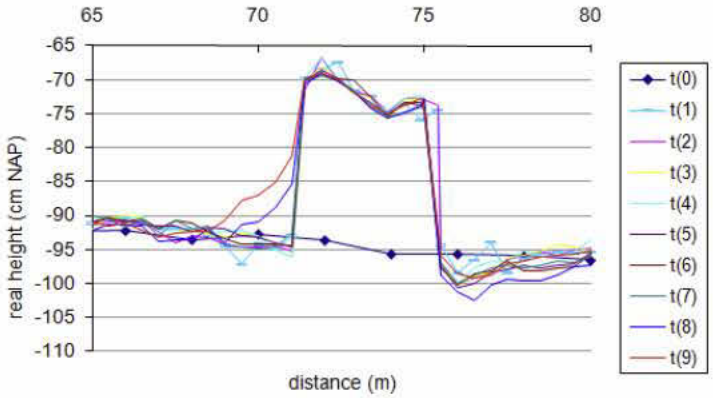
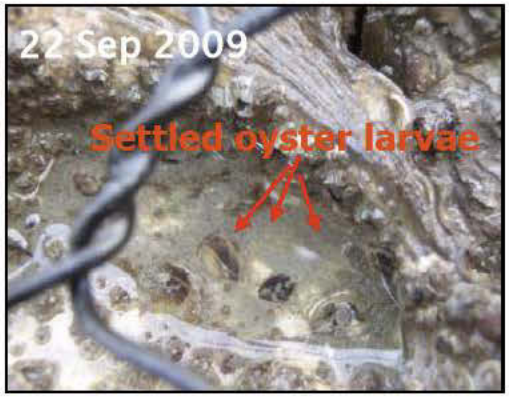
Oyster reefs: Where are we now?



- 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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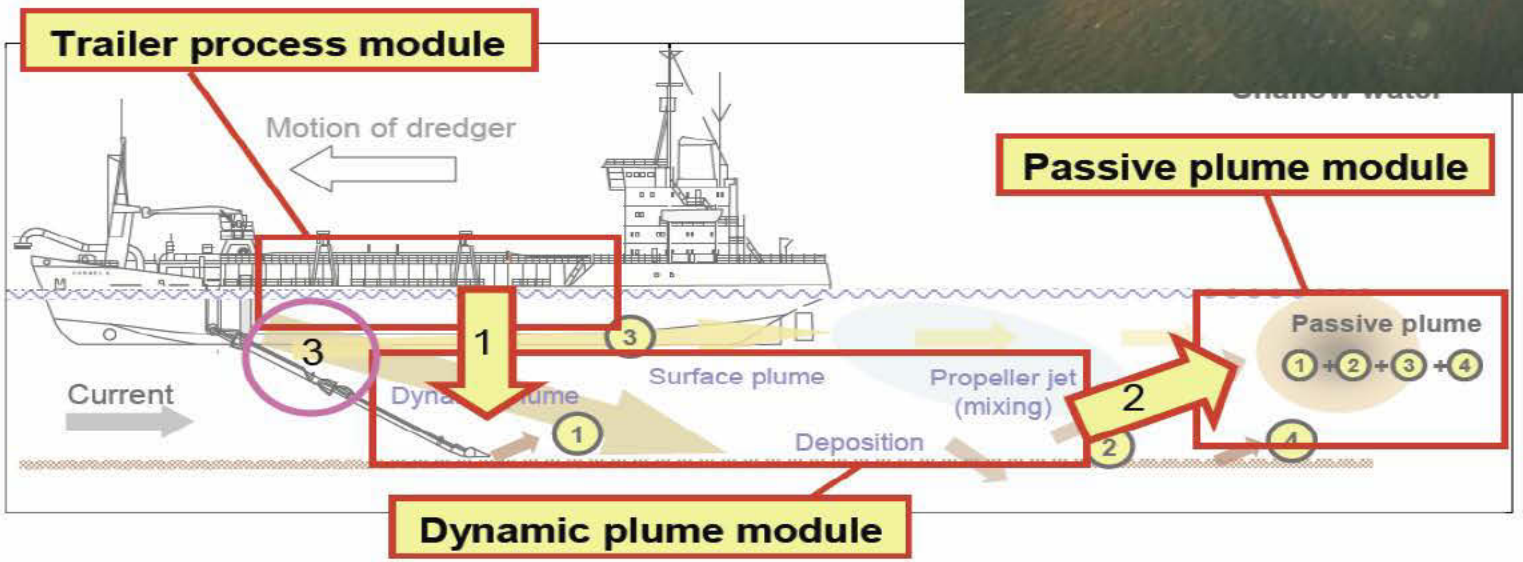
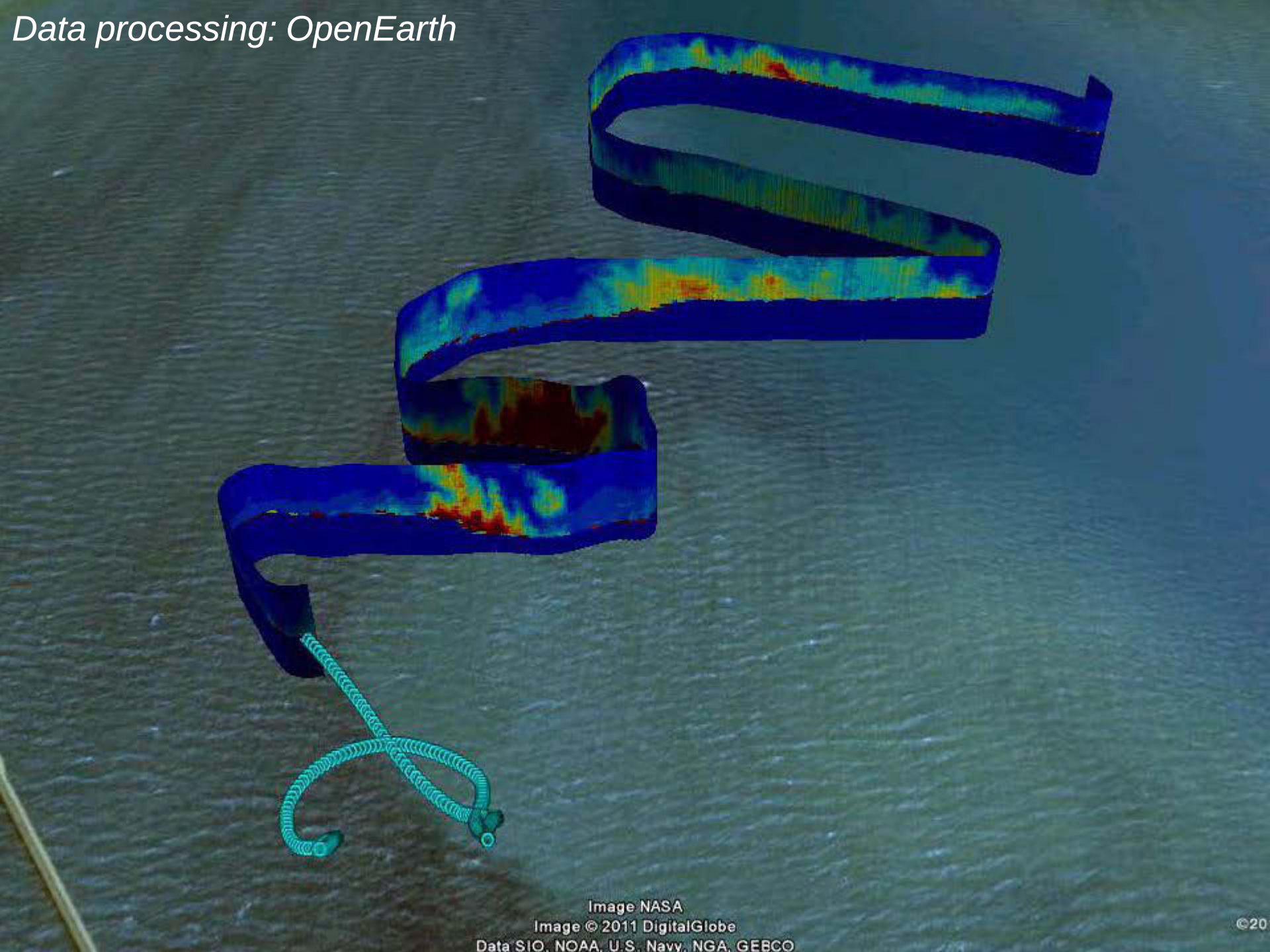
Adaptive management of dredging operations

- 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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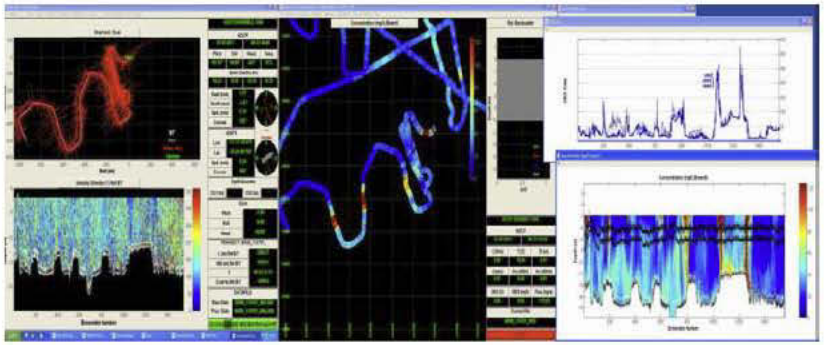
Turbidity research: Where are we now?

- 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"