Deltares

Enabling Delta Life

Connectivity and a system approach as missing links in marine project monitoring: lessons learned

Dr. Arjen Boon

Deltares

Presentation NECOV April 8 2014

Sand Engine

Deltares

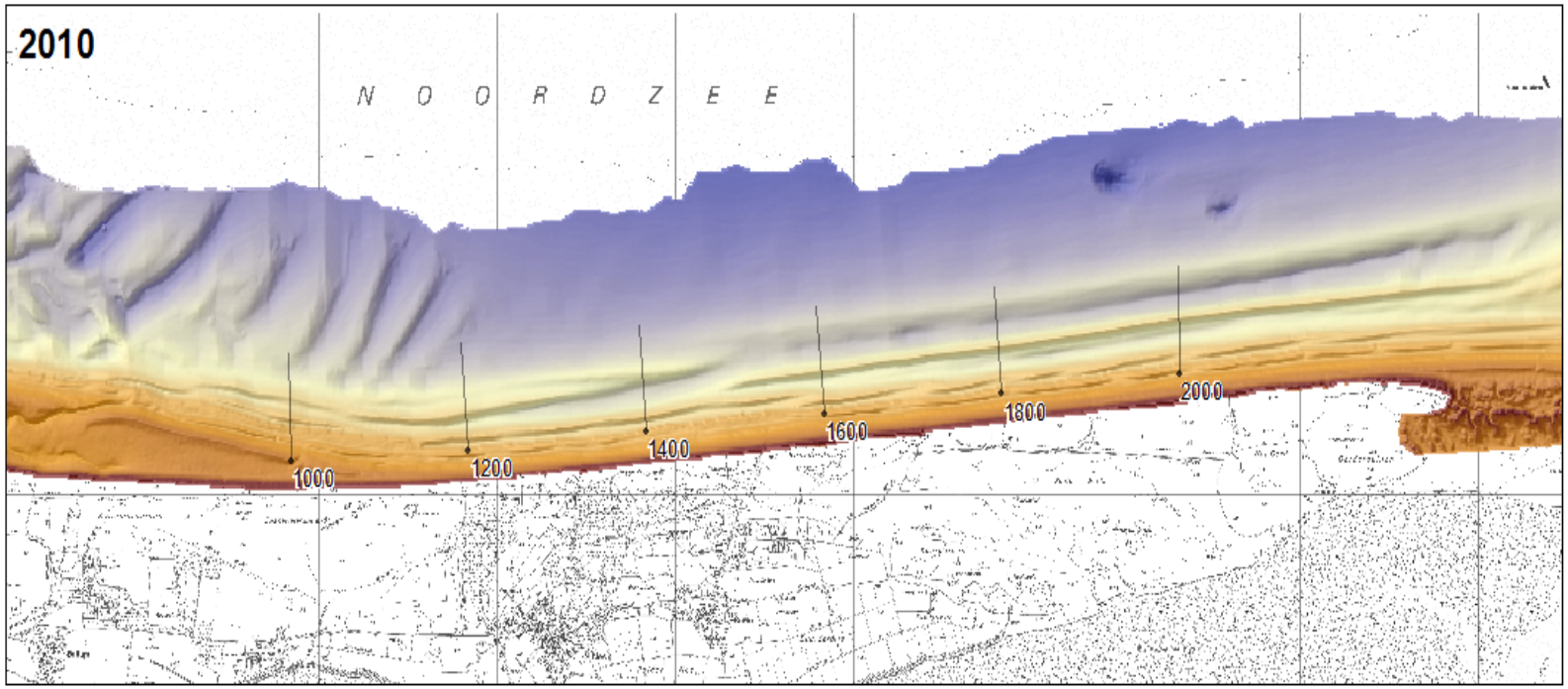
Offshore Wind Farm Egmond aan Zee

Deltares

Compensation MV2 Voordelta

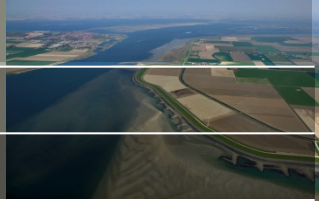
Deltares

Coastal nourishment Ameland



Deltares

Goals project monitoring (benthos)



OWEZ: expectation: increased B, S, N, Assemblage (BACI)

Sand engine: increased natural value (BACI)

Compensation MV2: 10% biomass increase (BACI)

Ameland: decreased B, S, N, Assemblage (BACI)

Deltares

Satisfying results - mindless monitoring?

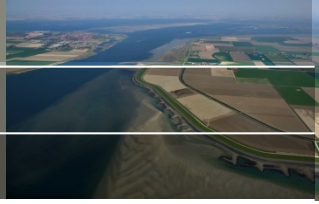
OWEZ: gradients E-W, N-S, but no impact of reduction of fisheries

Sand engine: so far “goal” attained: increased benthic diversity - but what does it mean?

Compensation MV2: goals not attained

Ameland: no effect nourishment

WHY? Assumptions ok?



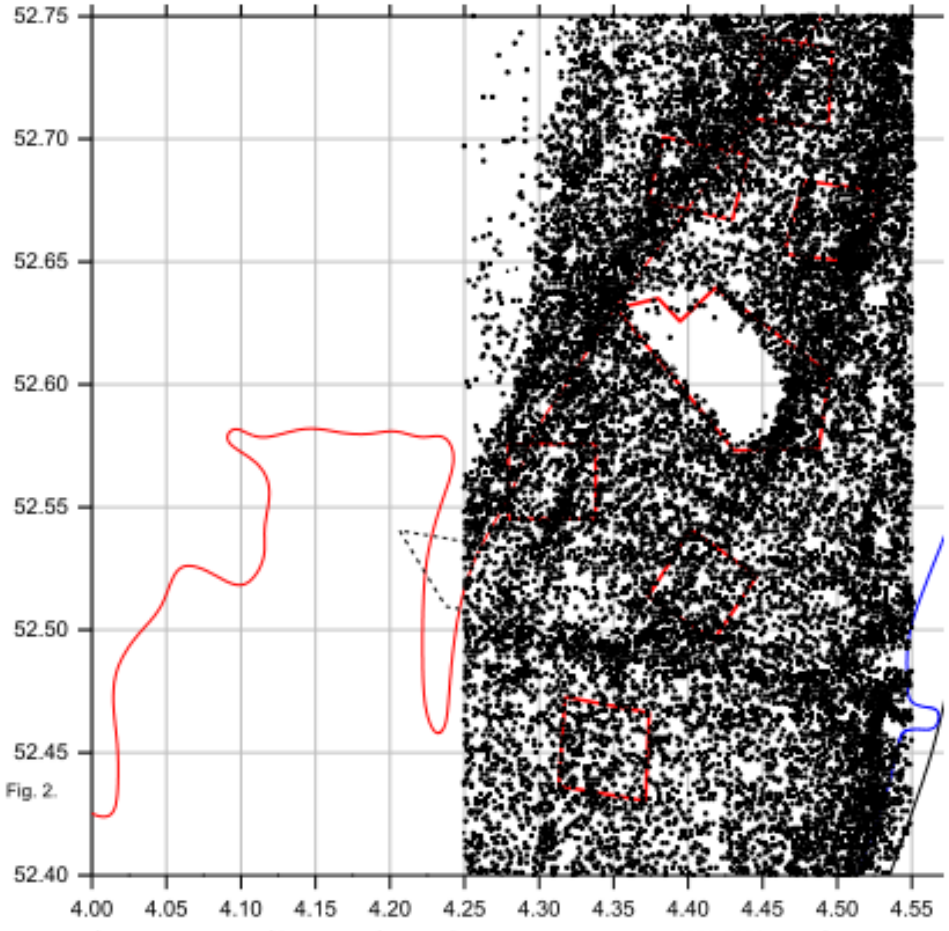
OWEZ: reduction of fishery leads to resilience of benthic assemblages

Sand engine: adding low dynamic habitat adds species

Compensation MV2: see OWEZ

Ameland: mortality benthos and resetting assemblages reduces diversity etc.

OWEZ study set up



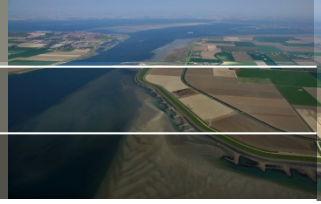
High level of beam trawl fishing

OWF would release benthos from fishing pressure

Bergman et al. 2012

Deltares

WHY? Experimental design ok?

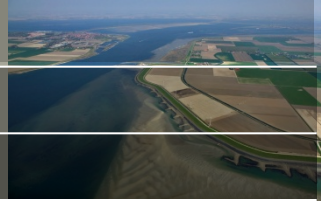


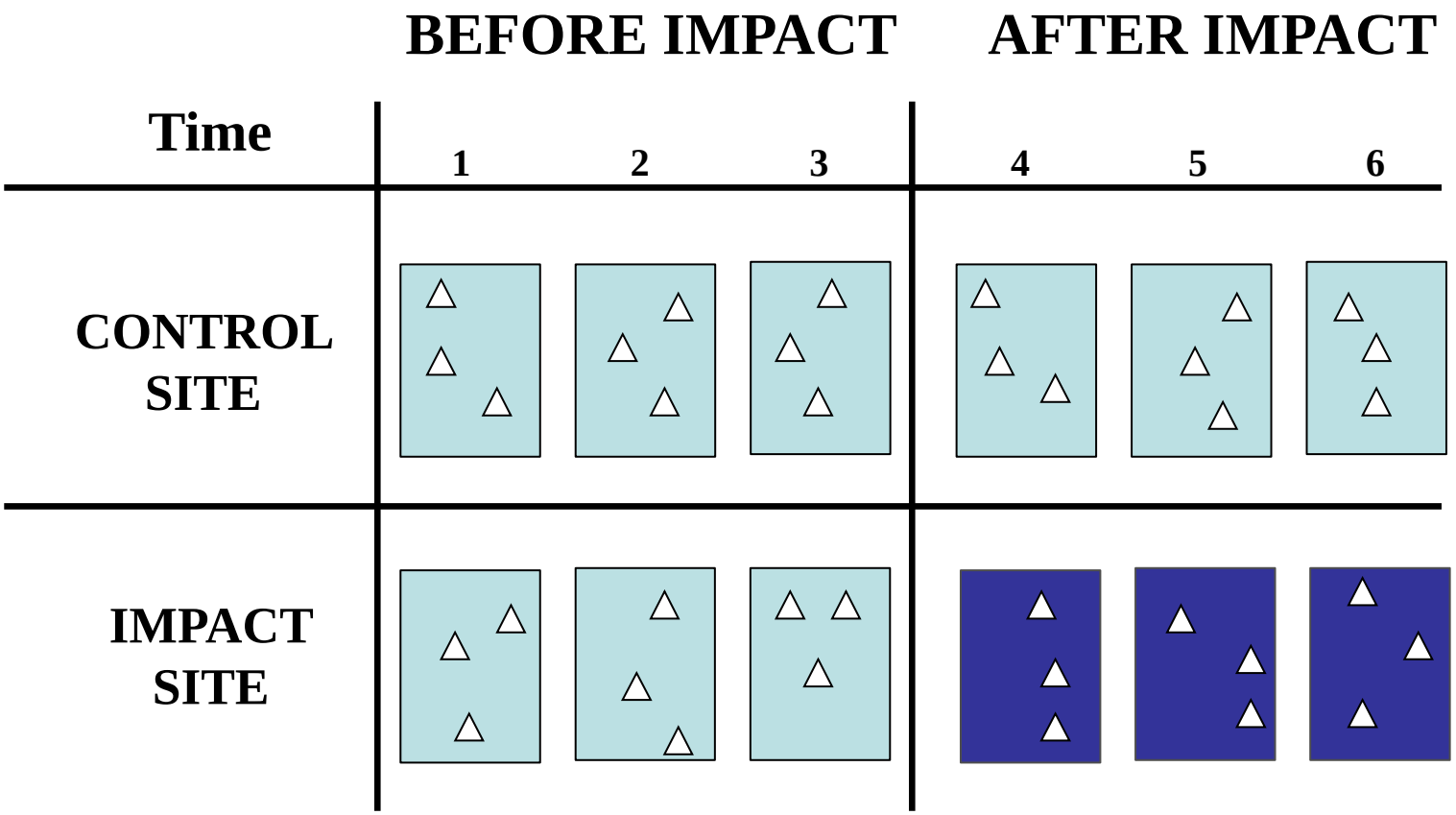
BACI design seems ok, but in a variable environment:

- Number of impact and control sites
- Proper control site
- Power of sampling design

- Two different sites may have different time-courses in the numbers/biomass/assemblages of target species (e.g. Underwood 1992)
- Solutions proposed: BACI(P), MBACI

BACI (P) – partly-nested

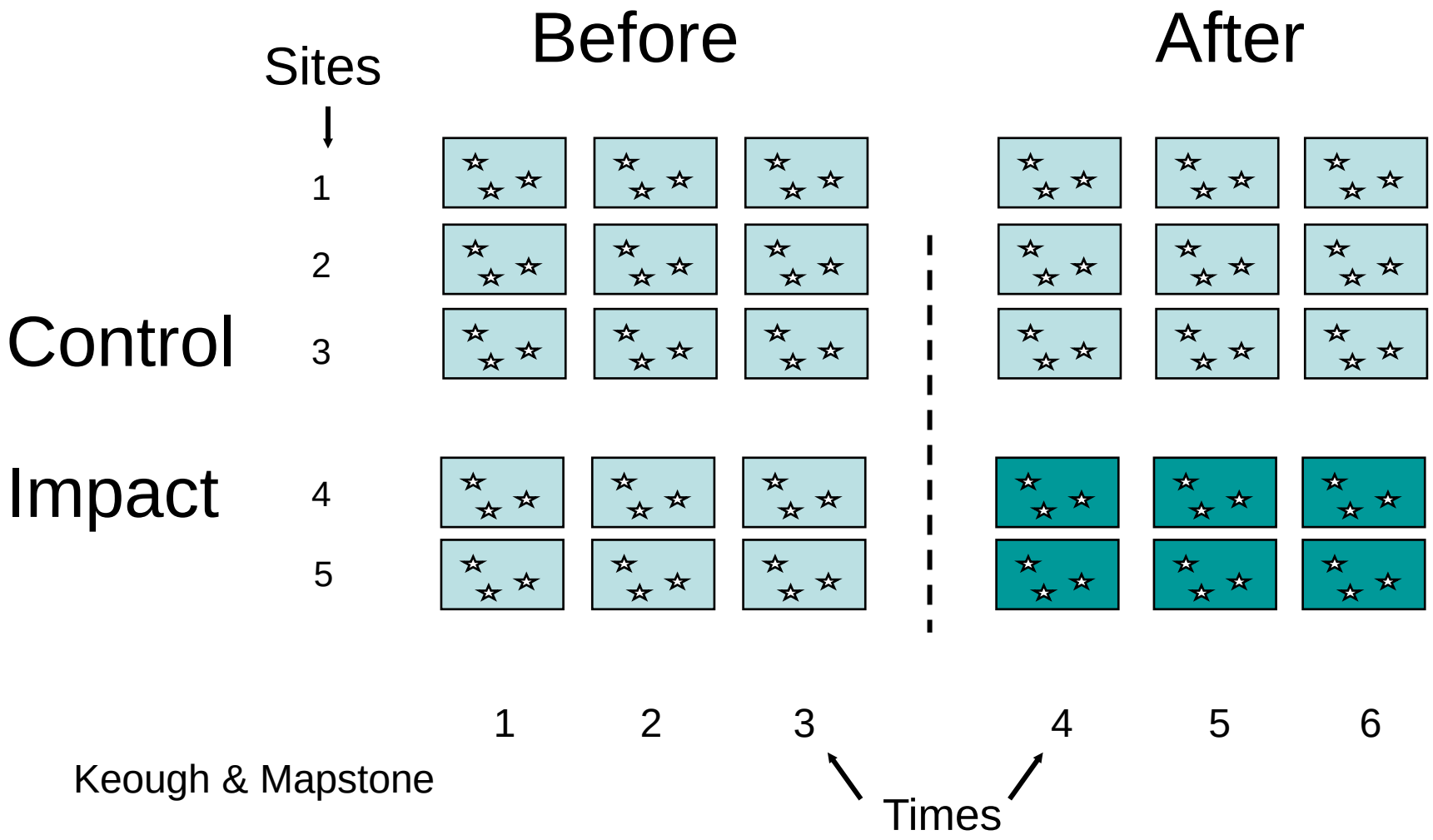




Stewart Oaten / Green

Deltares

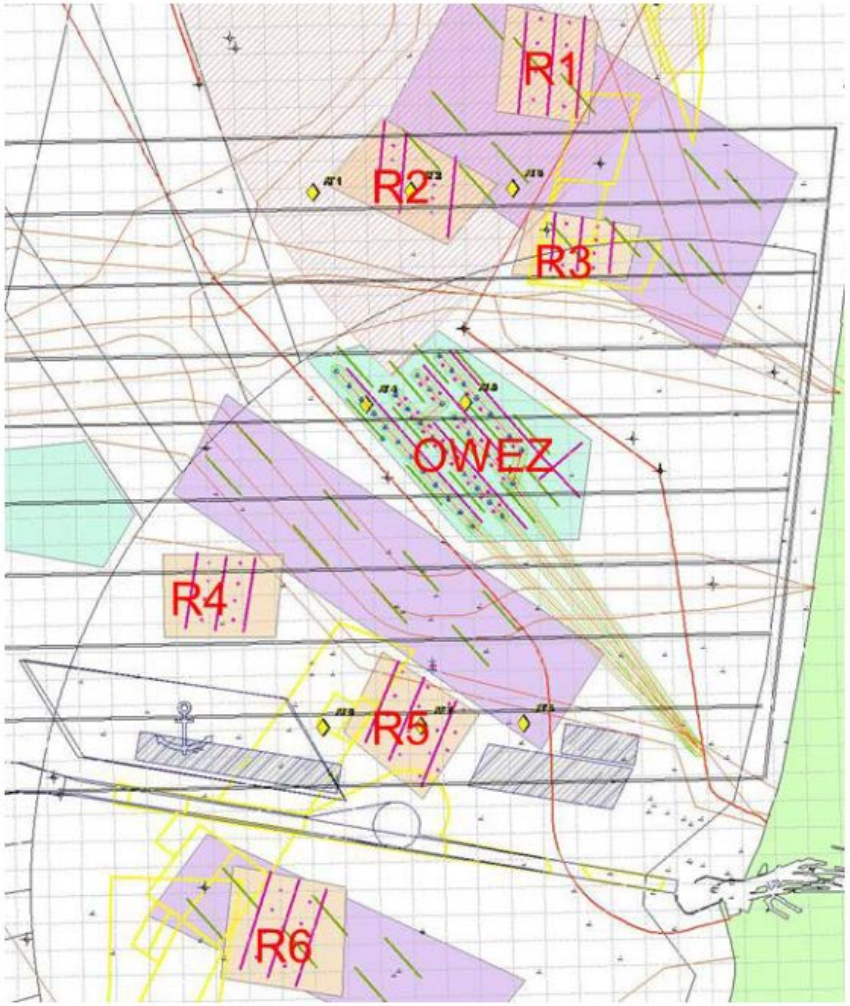
MBACI :Multiple BACI



Keough & Mapstone

Deltares

OWEZ – (Almost) MBACI design

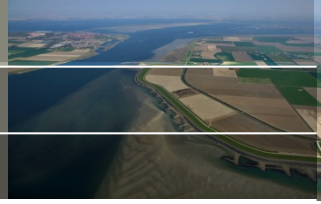


Sampling design 2007 and 2011. R1 and R6 were sampled in T0

Bergman et al. 2012

Deltares

But is that enough?



Armonies 2000:

- Despite fairly calm conditions, translocation of organisms by currents exceeded 1 km. In about half of the species, the spatial changes in abundance within these two weeks roughly equalled the average variation between two consecutive years.
- Sampling of a large area is suggested to yield the most reliable estimates of population development in the coastal North Sea.
- However, in view of the expected spatial scale of redistribution during storm tides and the spatial variability of recruitment, even a 180 km2 sampling area may be too small.

WHY? Understanding the (benthic) system?

OWEZ/MV2:

Are the assumptions right: does reduction of fisheries lead to ‘resilience’ of benthic system? Return to what?

So, do we ask the right questions?

Does reduced mortality lead to

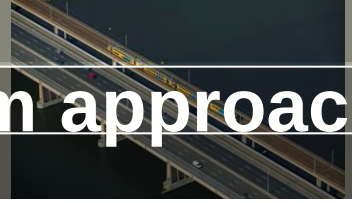
- Changes in recruitment per species: connectivity - where are the sources? Are there still any?
- Dominance of local effects over system forcing?
- Short of long-term effects? Recruitment succes every year?

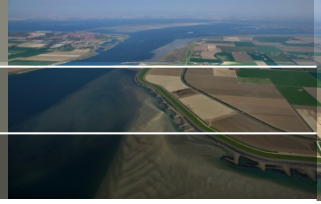
Understanding the (benthic) system - 2

Many factors not understood:

- Increased survival/growth: cohort development
- A matter of time – engineering species needed?
- System variability in time and space (see Armonies 2000)
- Physical forcing: understand how currents and waves impact sediment dynamics and benthos (dynamics)
- Connectivity: benthos is no island
- Structure versus production: where do process changes go?
- Back to basics:
  - Formulate exact questions/goals
  - Formulate hypothesis
  - Fill the gaps: operationalize
  - Include system forcing and connectivity processes

Add connectivity and a system approach





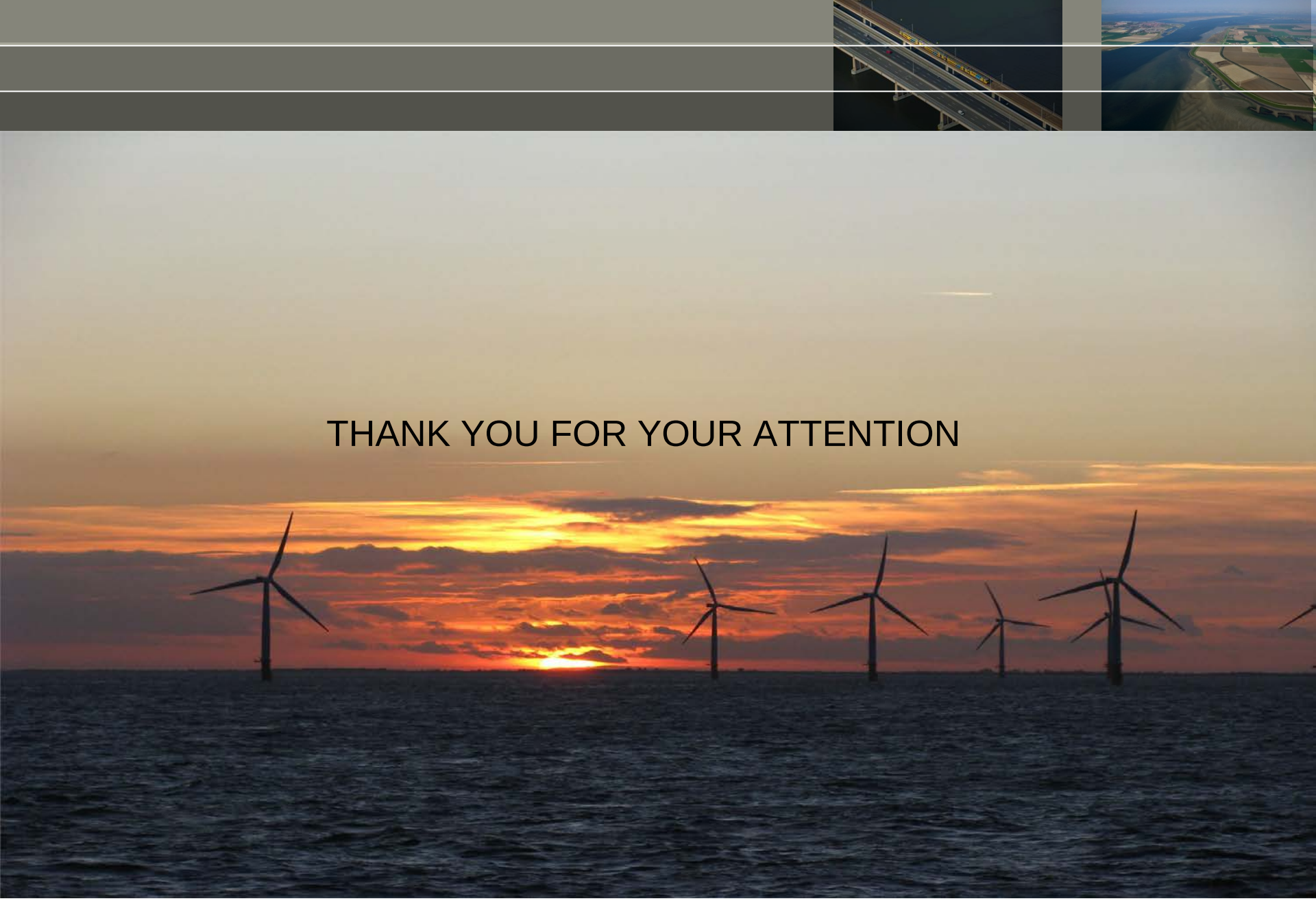
A two-track monitoring strategy needed…

Offshore wind farm monitoring should ideally comprise two parallel and complementary monitoring tracks.

Baseline monitoring	Targeted monitoring
• Focus on *a posteriori* resultant effect quantification	• Focus on cause-effect relationships of selected, *a priori* defined impacts
• Observing rather than understanding impacts	• Understanding rather than observing impacts
• Basis for halting activities	• Basis for mitigating activities
• Spatial area-specific	• Spatially generic
• Most often mandatory	• Most often not mandatory

Degraer ea (in prep.) Environmental impact assessment of offshore renewable energy installations: A call for hypothesis-based and collaborative monitoring and research programmes.

Deltares



Deltares