Annual Meeting of the North Pacific Marine Science Organization (PICES), Hiroshima, Japan, 12-21 October, 2012
Effects of natural and anthropogenic stressors in North Pacific ecosystems: Scientific challenges and possible solutions

Sensing marine life and livelihoods at the seashore

An integrated monitoring network for the Wadden Sea, a coastal UNESCO World Heritage site

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Wadden Sea

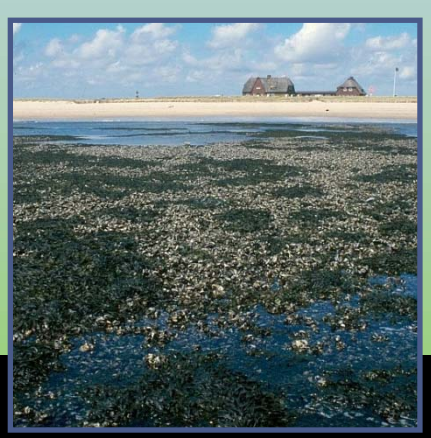
- shaped by Holocene sea level rise since its origin 7,500 years ago
- temperate-climate sandy barrier coast in NW Europe
- coastal stretch of approximately 500 km
- total area of 14,700 km² (including 11,200 km² nature reserve)
- largest unbroken stretch of sandflats and mudflats worldwide
- UNESCO world heritage site since June 2009




Wolff et al. 1983, Reise et al. 2010, Lotze et al. 2005

Wadden Sea - ecology

- dunes, salt-marshes & tidal flat ecosystems
- highly productive phytoplankton & microphytobenthos
- extensive seagrass, mussel and oyster beds
- nursery for flatfish
- stopover for migratory birds
- mammals (harbour & grey seals, harbour porpoises)

Wolff et al. 1983, Reise et al. 2010

Wadden Sea - economy

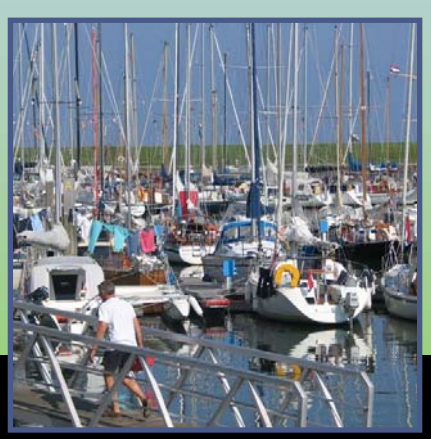
- approximately 75 000 inhabitants on the islands (NL+GE+DK)
- population decline (as in other rural areas in NW Europe)
- rural development, increasingly shaped by interregional economics
- exploitation of natural (living) resources (gas, shellfish & shrimps)
- strong tourism economy (the islands and the sea)
- major ports (Hamburg, Bremen, …., JadeWeser in 2012)

Lotze et al. 2005, Butt et al. 2009, Sijtsma et al. 2012

Wadden Sea - monitoring

long-term & large-scale monitoring programs
- governmental (ministries, provinces, municipalities)
- science-driven (institutes, universities, volunteers)
- impact studies (companies, sectors)






Wadden Sea - monitoring

still not possible to define underlying processes (e.g., cause-effect relationships) nor to answer overarching questions (e.g., impacts of climate change on food web interactions)

- data often not accessible
- data often not comparable
- some essential parameters missing
- no integration of information (data + knowledge = information)

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Wadden Sea Long Term Ecosystem Research
- adaptive monitoring approach
- conceptual models
- integration of spatiotemporal scales
- integration of ecology and socio-economy

Adaptive monitoring: a new paradigm for long-term research and monitoring

D.B. Lindenmayer & G.E. Likens

Trends in Ecology and Evolution
24, 482-486 (2009)

Effects of biodiversity on ecosystem functioning: a consensus of current knowledge

D.U. Hooper and co-authors

Ecological Monographs
75, 3 - 35 (2006)

Directional changes in ecological communities and social-ecological systems: a framework for prediction based on Alaskan examples

F.S. Chapin III and co-authors

American Naturalist
168, s36-s49 (2006)

Funded by the "Waddenfonds" and the provinces of North-Holland and Fryslan

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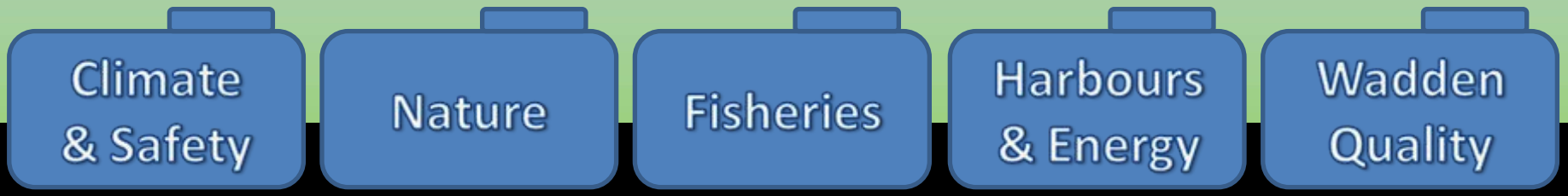
STEP 1: nationwide inventories to define the **essential questions**
e.g.:

- will Wadden Sea sediment fluxes keep pace with sea level rise?
- do anthropogenic nutrient loads affect the carrying capacity for birds?
- how can mussel and cockle fisheries become sustainable?
- does cargo turnover further increase due to the new port?
- will the World Heritage designation lead to more tourism?



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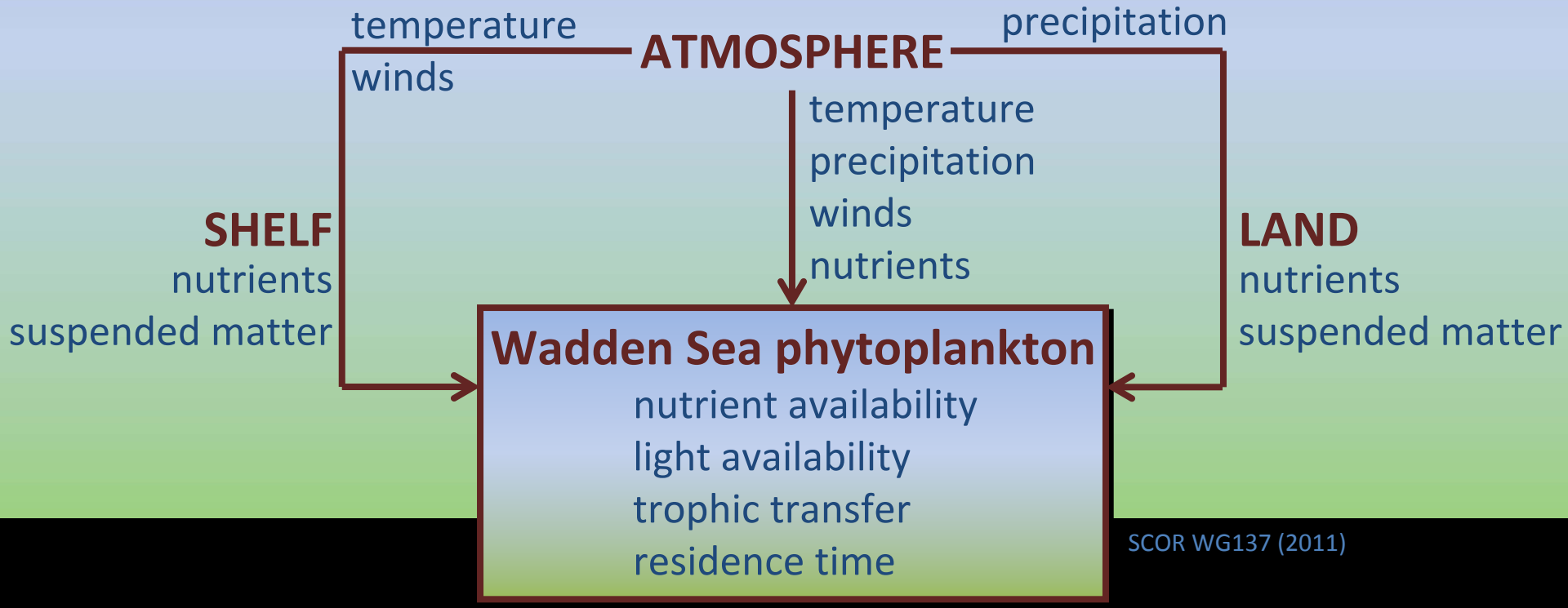
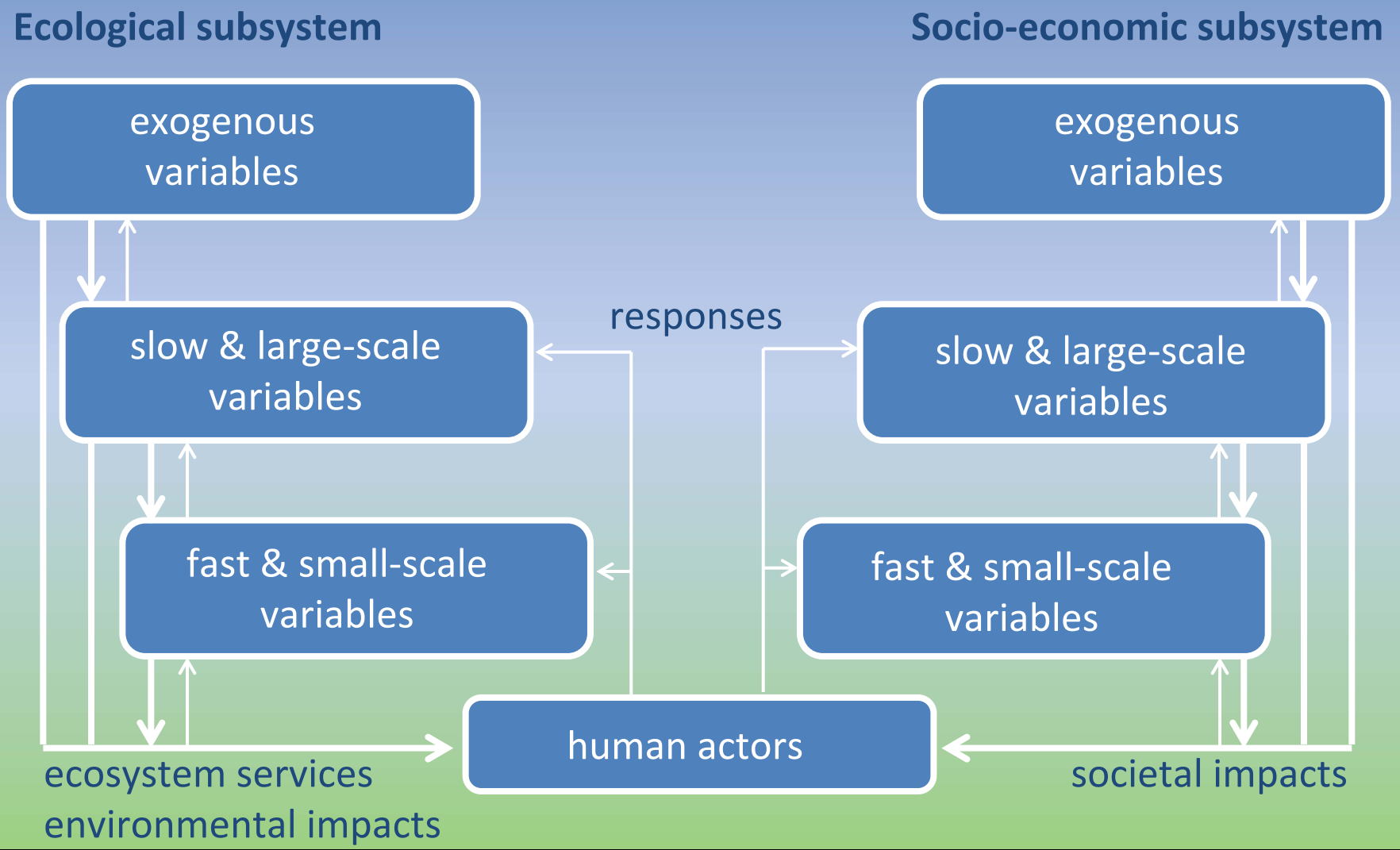
STEP 2: building conceptual models to define the **essential parameters** e.g.:



SCOR WG137 (2011)



Chapin III et al. (2006)

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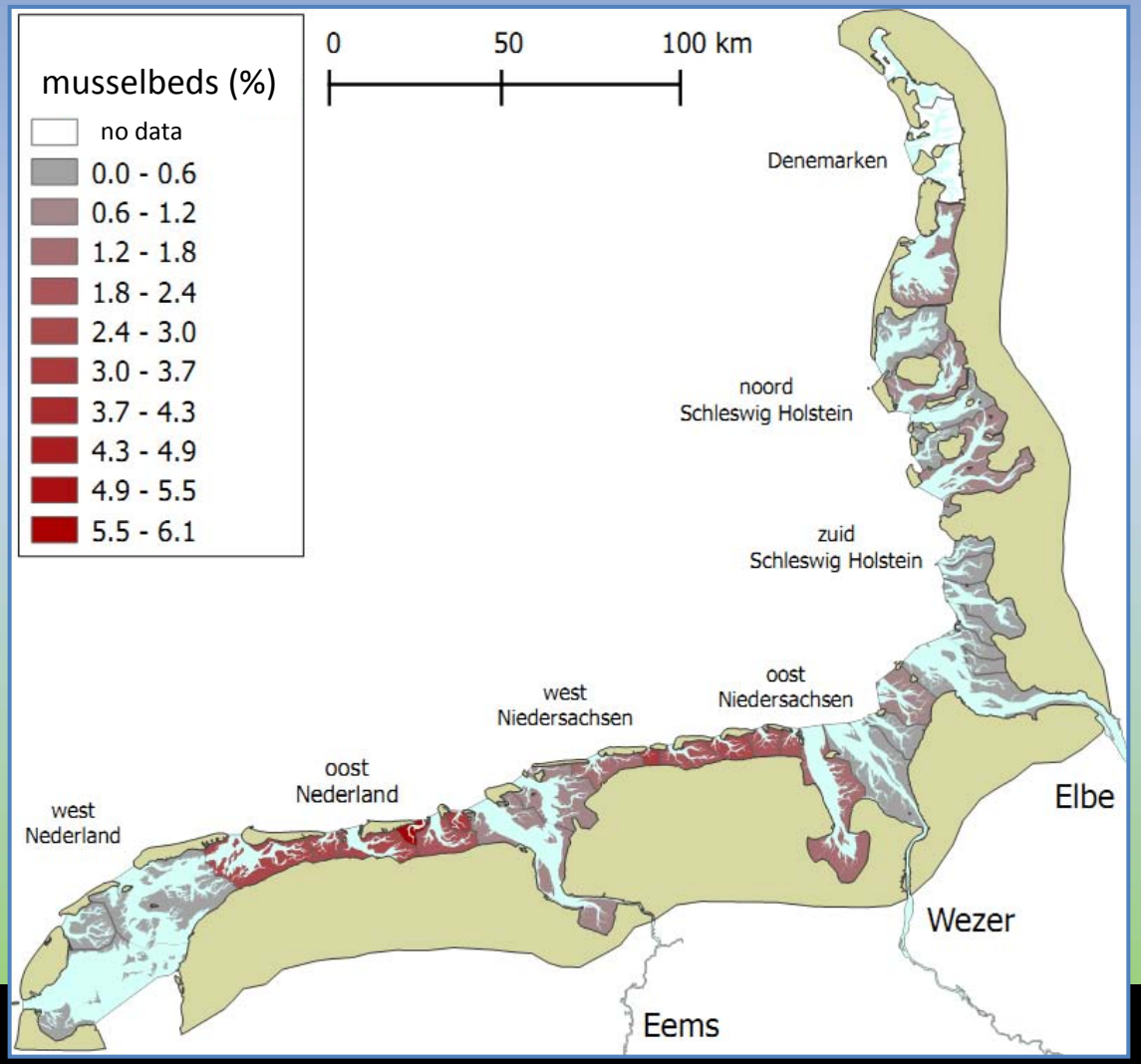
STEP 3:
analysing existing observations to define the **essential data**
e.g.:
annual spatial variation in **area mussel beds** as input for understanding spatiotemporal variation in recruitment success

mean values (1999-2009)



Folmer et al. (in prep.)

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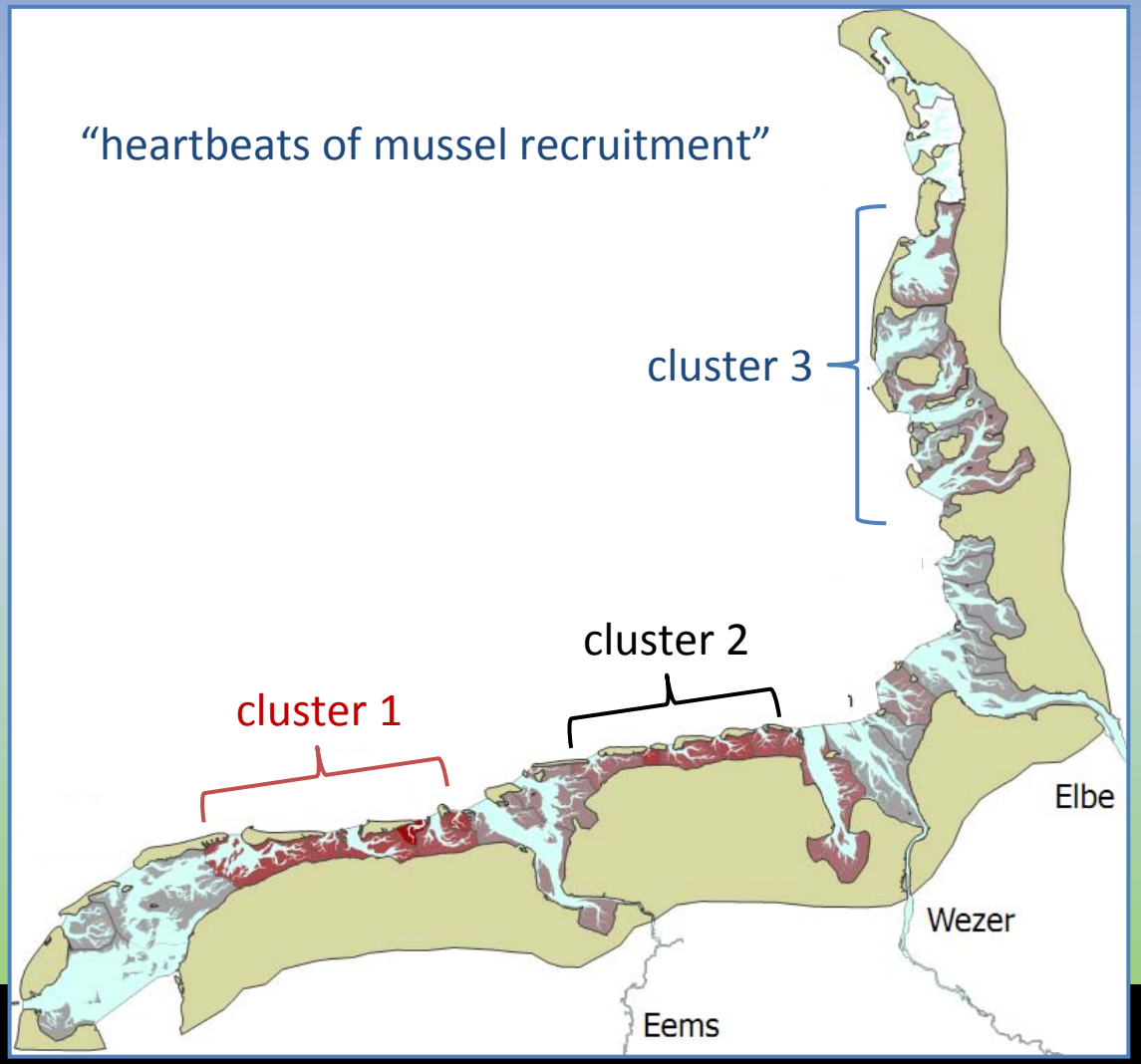
STEP 3:
analysing existing observations to define the **essential data**
e.g.:
annual spatial variation in **area mussel beds** as input for understanding spatiotemporal variation in recruitment success

clusters of correlation between time series of tidal basins



Folmer et al. (in prep.)

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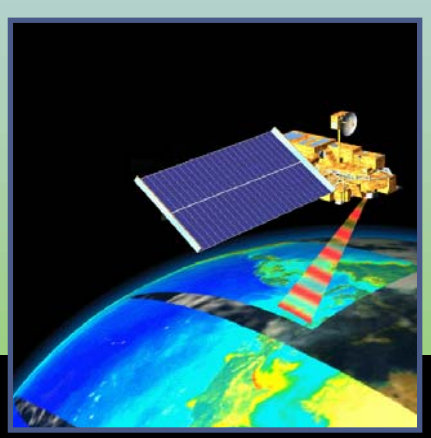
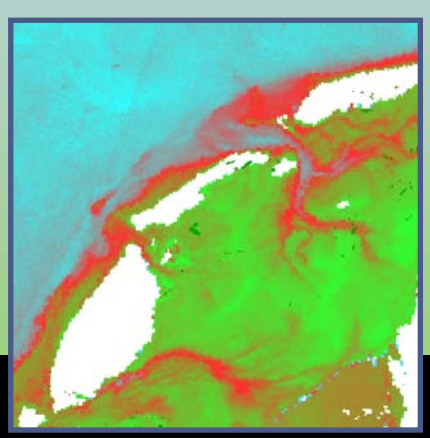
STEP 4: building a **data portal** to make existing (and future) data available e.g.:
spatiotemporal variation in primary productivity by means of data assimilation of in situ observations, automatic monitoring networks and remote sensing products (satellite & airborne)



IN PLACE project (in prep.)

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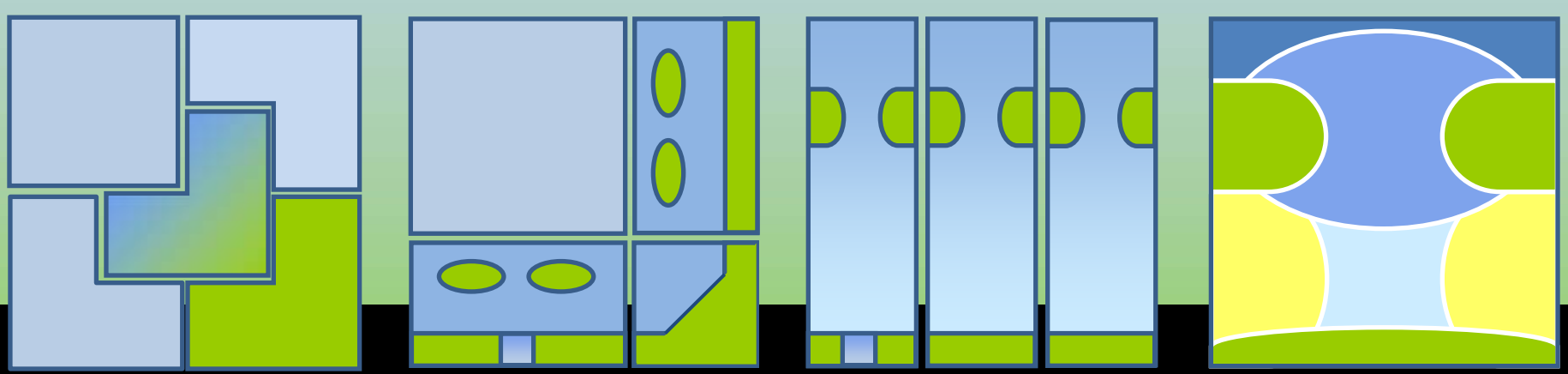
STEP 5: making a **blueprint** for an integrated monitoring network
e.g.:

- technical aspects
- management structure
- business plan
- long-term commitments



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STEP 1: Inventory of the main monitoring needs → Essential Monitoring Questions

STEP 2: Conceptual models of ecologic & economic interactions → Essential Monitoring Variables

STEP 3: Statistical analyses of the existing observations → Essential Monitoring Data

STEP 4: Data portal Wadden Sea existing & future observations → Essential Information Exchange

STEP 5: Blueprint of the integrated monitoring network → Essential Monitoring Network

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essential monitoring network = **mutually beneficial** monitoring network

Partners, Resonance Group & Advice Board
with representatives of major monitoring efforts, e.g., ministries, governmental organizations, scientific research programs, land owners, fisheries, oil & gas companies, large harbor organizations, etc.

All involved need proof to get convinced…!

WaLTER

STEP 1: Inventory of the main monitoring needs

STEP 2: Conceptual models of ecologic & economic interactions

STEP 3: Statistical analyses of the existing observations

STEP 4: Data portal Wadden Sea existing & future observations

STEP 5: Blueprint of the integrated monitoring network

Lighthouse Projects

e.g.,
developing & testing of "spat fall forecasts" as a cost-efficient tool for sustainable mussel fisheries (jointly with nature conservation and fishers)

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Apply for an International Long Term Ecosystem Research (ILTER) membership

"ILTER's vision is a world in which science helps prevent and solve environmental and socioecological problems"



watch our network grow and develop

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