

ICZM and shoreline management

People and the coast

As pressures on coastal zones mount, there is a growing need for frameworks that can be used to conceptualize complex sustainability challenges and help organize research that increases understanding about interacting ecological and societal processes, predicts change, and supports the management, persistence, and resilience of coastal systems (Lewison et al., 2016: 110).

Why Coastal Zone Management?



World Demographics

Why are these figures important for conservation?

Time unit	Births	Deaths	Natural Increase
Year	129,358,036	56,150,533	73,207,503
Month	10,779,836	4,679,211	6,100,625
Day	353,437	153,417	200,021
Hour	14,727	6,392	8,334
Minute	245	107	139
Second	4.1	1.8	2.3

Source: U.S. Bureau of the Census, International Data Base

COASTAL MEGACITIES

Top Ten Largest Cities:

- * Tokyo, Japan - Coastal
- * Mexico City, Mexico - Inland
- * Mumbai (Bombay), India - Coastal
- * São Paulo, Brazil - Inland
- * New York City, USA - Coastal
- * Shanghai, China - Coastal
- * Lagos, Nigeria - Coastal
- * Los Angeles, USA - Coastal
- * Calcutta, India - Coastal
- * Buenos Aires, Argentina - Coastal

Big problem for coastal zone



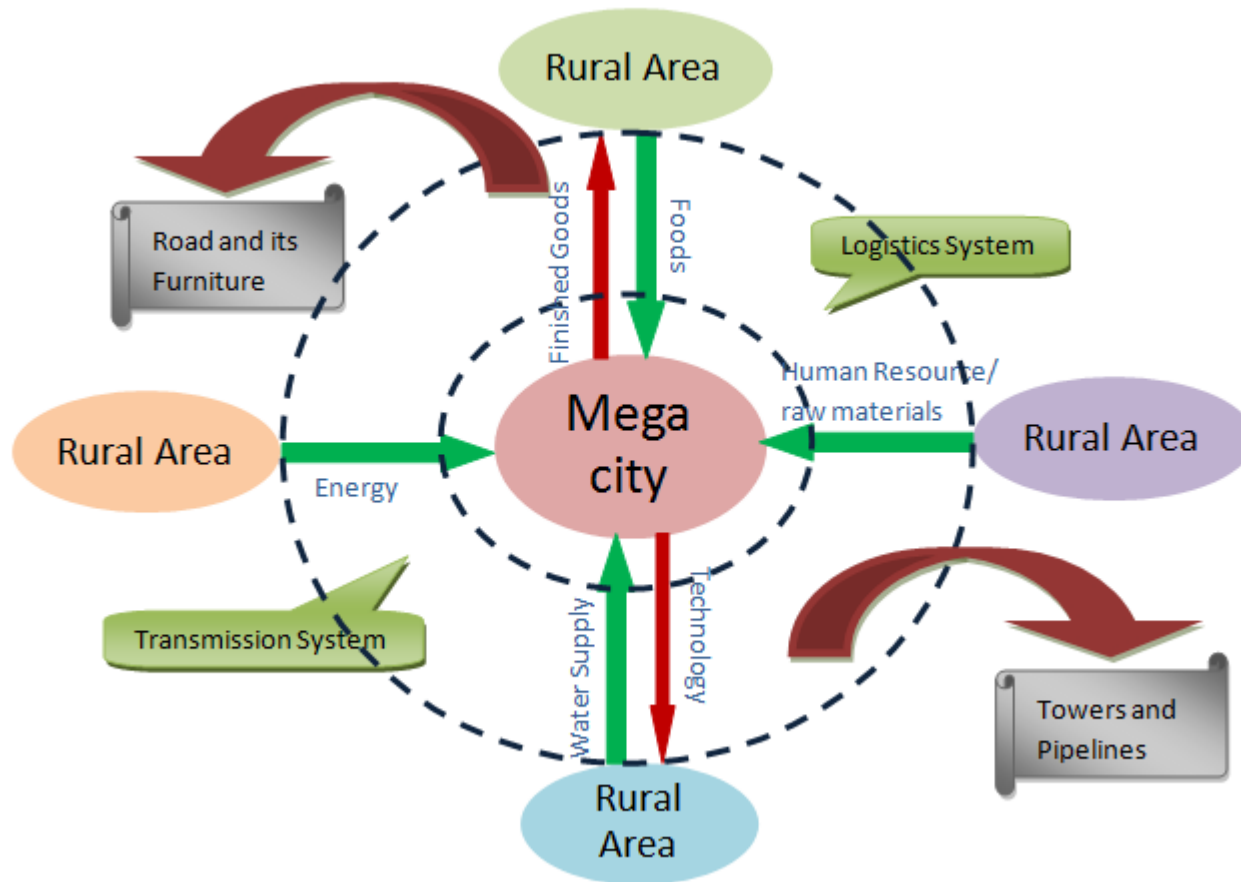
N.B. More than 50% of world's coasts are threatened by development!

Finkl,
2005

Demographics and the coast

- * **What is the Coastal Zone and why is it important?**
 - * Due to the close link between population development and natural resources they expect an increase of about 35% in an even narrower band of about 100km of the coast which translates to roughly 2.75 billion people (2025).
 - * The coastal zone contains natural systems that provide more than half of the global ecosystem goods (e.g., fish, oil, minerals) and services (e.g., natural protection from storms and tidal waves, recreation).
 - * In addition, 14 of the world's 17 largest megacities are located along coasts and most of them (11) are located in Asia's fastest growing economies.
 - * 40% of these cities accommodate populations of 1 million to 10 million people generating a variety of pressures driven by demand for water, energy, space, sanitation and infrastructure.
 - * Also, OECD estimates that with some 3,000 billion US\$ of assets at stake in coastal port cities about 5% of global GDP is at stake in context of flooding and storm surges (Nicholls et al. 2007). (Cited in LOICZ, 2013: 3) **Read and summarise**
- * [Professor Simon Haslett coastal pressures 4 mins](#)

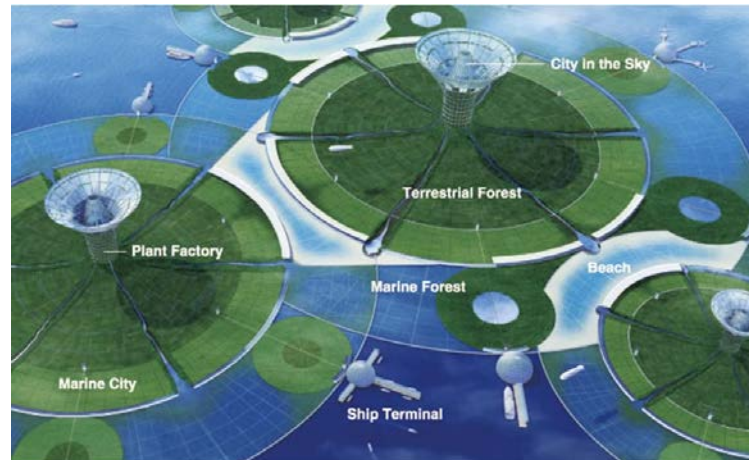
Mega cities and their hinterland





Exercise

- * In groups
- * Post notes
- * List the following issues that influence the environmental problems in coastal megacities
 - * Causes
 - * Impacts
 - * Solutions.



Causes and Impact

* Causes of Environmental problems

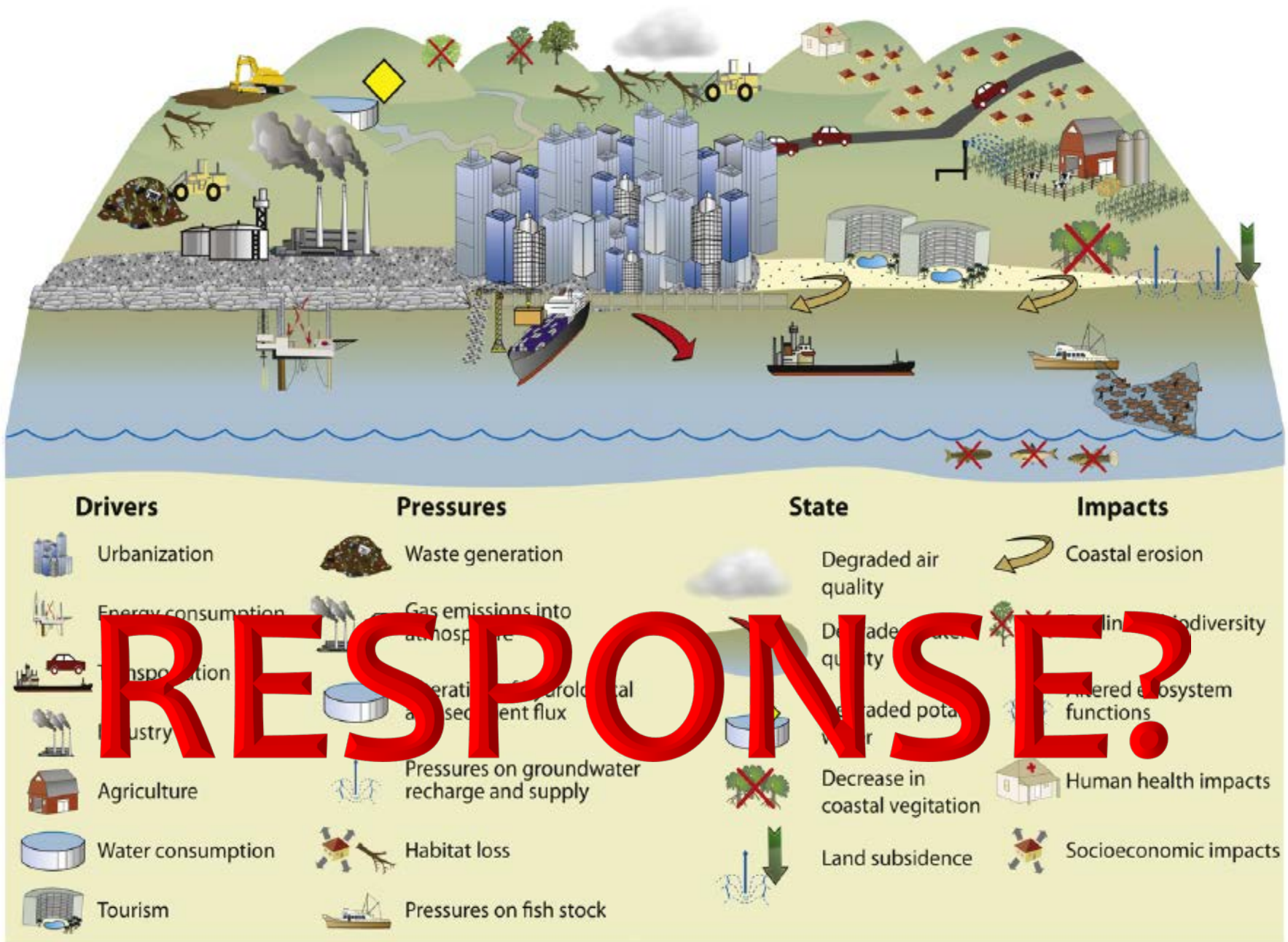
- * Urbanisation
- * Energy generation and consumption
- * Urban transport
- * Maritime transport
- * Food production
- * Water consumption
- * Tourism



* Impact

- * Solid & liquid waste
- * Nutrient pollution
- * Air pollution
- * Noise pollution
- * Water quality
- * ground water
- * Marine
- * Oil spill
- * Hydrology
- * Sediment profiles (e.g. dredging)
- * Coastal erosion
- * Loss of marine habitats, fish stocks
- * Reduced biodiversity
- * Socio-economic problems





Driver-pressure-state-impact-response framework for coastal management (Sekovski et. al. , 2012)

Managed response

Governance examples

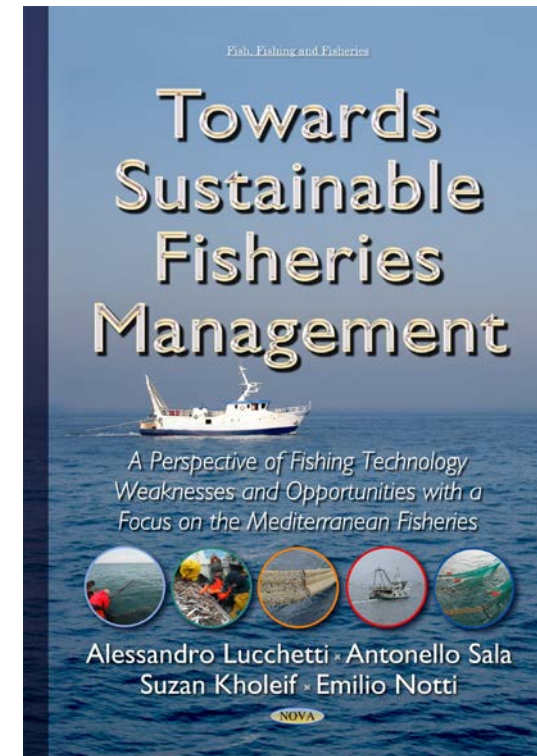
Issue	Governance Measures
Water quantity and quality	• Water Pricing[*] • Polluters pay[†] • Quantity restrictions[‡]
Air quality	• Urban planning schemes to reduce commuting[‡] • Regulation of public transport and industrial emissions
Sea level rise	• Rising settlements on higher elevation^{††} • Opening of eco-corridors^{††}
Conservation of coastal flora and fauna	• Proclamation of biosphere reserves^{§§} • Restoration of native species^{§§} • Regulation regarding fisheries and discharge from vessels^{¶¶}



Managed response

Tech examples

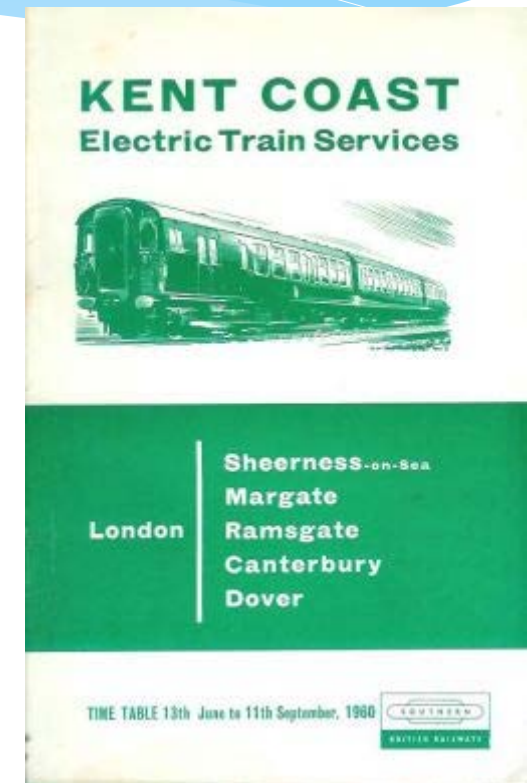
Issue	Technological Improvements
Water quantity and quality	• Wastewater treatment[†] • Leakage detection[†] • Technologies for saving water[*]
Air quality	• Catalytic converters for personal vehicles • Shift in fuel usage^{**}
Sea level rise	[†] • Hard and soft protection systems^{##}
Conservation of coastal flora and fauna	• Introduction of less devastating fishing techniques and improvement of discharge treatment^{""}



Managed response

Mgt practice examples

Issue	Best Management Practices
Water quantity and quality	• Reuse of storm water and wastewater[§]
Air quality	• "Green" transport (bicycles, metro)[¶]
Sea level rise	• Planting the flood resistant and salt-tolerant species in agriculture^{††}
Conservation of coastal flora and fauna	• Participation of local communities in conservation and restoration projects^{§§}



Challenges to Managed response

Goal	Challenge
• Defining responsibilities for the management of coastal megacities	• Administrative fragmentation due to the difficulties in determining the physical and administrative boundaries of coastal megacities
• Improved environmental state as a result of economic development	• Reducing social inequity • Insufficient participation of local communities
• Implementation of the DPSIR framework	• Generic definition of its components and related subjectivity • No uniform system of environmental indicators • Issues with data relevance

Recommendations to Managed response

Goal	Recommendation
• Defining responsibilities for the management of coastal megacities	• Empowerment of local authorities • Improvement in local-national and public-private cooperation • Switching the policy aims from sector-level to a holistic urban level
• Improved environmental state as a result of economic development	• Using the advantage of big financial capacity of megacities • Include local people in environmental programs
• Implementation of the DPSIR framework	• Developing an unique system of environmental indicators • Collection of data on urban level

Conclusion to megacity coastal management

* Conclusion

- * Impact on environment is significant (rapid development, high population densities and high consumption rate)
- * Developing countries experiencing particular difficulties: > growth, .pollution, food/water shortages, poor sanitation therefore health.
- * Predicted slowing of megacity growth
- * Impact of climate change / SL / consumption patterns still unclear
- * (Estuarine, Coastal and Shelf Science 96 (2012))



Seminar to megacity coastal management

Identify and evaluate
DPSIR

- * **SEMINAR**
- * Read the hand-out on, how to review a paper
- * Construct a review (one side of A4) of the following paper (on Moodle):

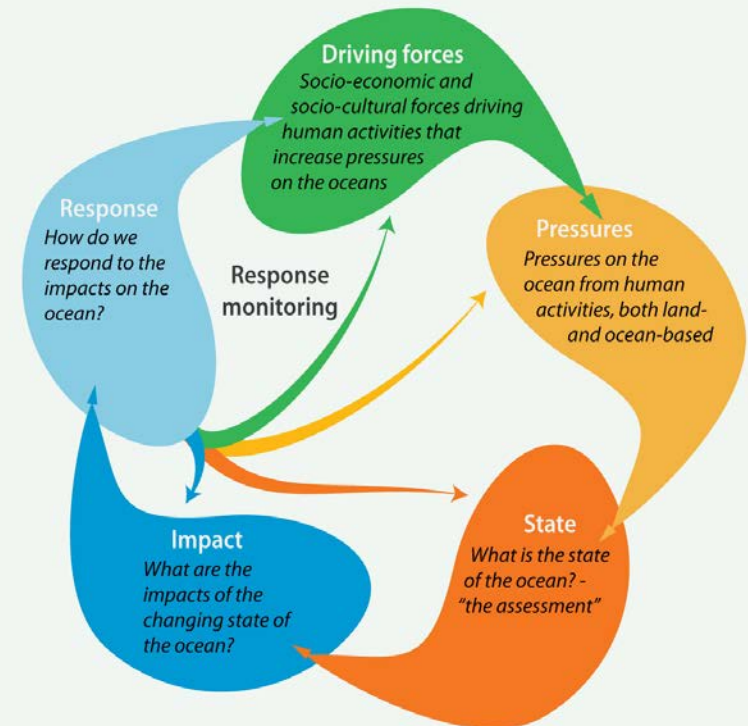
Ivan Sekovski et al. (2012)

Megacities in the coastal zone: Using a driver-pressure-state-impact-response framework to address complex environmental problems.

Estuarine, Coastal and Shelf Science (96, 48-59)

The levels of DPSIR framework

- Driving forces - Pressures - State (of the oceans) - Impacts - Responses



Planning

- * There are 3 principal planning laws in Wales
 1. Planning Act 2008
 2. Planning And Compulsory Purchase Act 2004
 3. Town And Country Planning Act 1990
- * These work at 2 levels
 - * National under WAG
 - * Local Planning Authorities (22 in Wales) & National Parks
- * The planning policy is guided by the Planning Policy Wales (2002). These guidance notes covers wildlife, landform, habitat, social and economic also need to be sustainable (WAG, 2014)
 - * People, Places, futures: The Wales Spatial Plan (updated 2008 & 2018 next slide) and it helps deliver the issues of the One Wales document
 - * Furthermore LA's should consult with the Technical Advisory Notes (TAN) various TANS e.g. noise, tourism etc. TAN 14: Coastal Planning (1998)
 - * NB Below Low water it becomes Marine Spatial Planning

National Development Framework

- * **2018**
- * **The Planning Directorate is working on the production of a National Development Framework (NDF). The NDF will set out a 20-year land use framework for Wales and will replace the current Wales Spatial Plan.**
- * **The NDF will:**
 - * set out where nationally important growth and infrastructure is needed and how the planning system - nationally, regionally and locally - can deliver it
 - * provide direction for Strategic and Local Development Plans and support the determination of Developments of National Significance
 - * sit alongside Planning Policy Wales, which sets out the Welsh Government's planning policies and will continue to provide the context for land use planning
 - * support national economic, transport, environmental, housing, energy and cultural strategies and ensure they can be delivered through the planning system
 - * be reviewed every 5 years

[Consultation](#) 3 mins



These now influence coastal

links between the Acts

Environment (Wales) Act 2016

Well-being of Future Generations (Wales) Act 2015

Planning (Wales) Act 2015

ICZM

- * System of planning, information collecting, management and monitoring
- * Sustainable management of resources (Vivero, 2012)
- * It aims to reduce the competition between social development, economics and the environment (Alder, 2000)
- * Holistic management of a coherent network of stakeholders
 - * Fisheries
 - * Aquaculture
 - * Tourism
 - * Industry
 - * Development
 - * Adaptation to climate change
 - * Shipping
 - * Energy mitigation and climate change (EU, 2015)
- * Therefore the integration is complex and crosses various pieces of legislation, authority and policy areas.
- * The House of commons (1998); Ballinger, (1999) and others have noted this fragmentation

Barcelona Convention on ICZM 2002

Marine and Coastal Access Act 2009

- * System of management and protection of marine & coastal environments.
- * Factors
 1. Marine Management Organisation (MMO)
 2. Strategic Marine Planning system
 3. Streamlined marine licensing
 4. Marine nature conservation
 5. Fisheries management and marine enforcement
 6. Migratory and freshwater fisheries
 7. Coastal access
 8. Coastal and estuarine management (DEFRA, 2010)

Factors 7 & 8 are the principal factors for ICZM

Local and Regional Coastal Zone Management

Whimpwell was a parish adjoining Happisburgh, the village of Whimpwell is no longer there, by 1183 Whimpwell was under the sea. In 1987 the Yarmouth Sub-Aqua Club discovered a large stone structure on the sea bed, it is L shaped, 75 yards by 200 yards and in places rises to 40 feet. This is believed by many to be the quayside of the medieval village of Whimpwell.

1. Uncertainty
2. Building Insurance
3. No Investment in Local Business
4. Property Prices have Plummeted
5. No Central Government or Local Authority Compensation

It has been decided that nothing should be done, about the erosion (SMP)

Habitat Loss in the UK

Name	Area lost	Period
The Wash	47000 ha	since Roman
Severn Estuary	c8000 ha	since Roman
Dee Estuary	6000 ha	since 1730
Humber Estuary	4600 ha	1600-1850
Greater Thames Estuary	4340 ha	mostly pre-1800
Tees Estuary	3300 ha	since 1720
Ribble Estuary	2320 ha	since 1800
Morecambe Bay	1320 ha	1200-1900
Ore/Alde/Butley Estuary	3640 ha	since 1200
Deben Estuary	2240 ha	since 1200
Stour Estuary	1600 ha	since 1200
Blyth Estuary	1280 ha	since 1200
Orwell Estuary	980 ha	since 1200
Southampton Water	690 ha	since 1830
Poole Harbour	530 ha	since 1807
Portsmouth Harbour	490 ha	since 1540
Mersey Estuary	490 ha	1800-1900
Total	91250 ha	

The case of East Anglia

The rear of the houses at Beach Road, Happisburgh near Whimpwell.







(C) Mike Page 31.05.2004



26.10.2004 (c) Mike Page



Time

(Read Tebboth, 2013 Adapting to coastal change (2 pages))

<http://blog.geographydirections.com/2013/11/01/adapting-to-coastal-change-understanding-different-points-of-view-in-coastal-erosion-management/>



* Tebboth, M. (2013) Understanding intractable environmental policy conflicts: the case of the village that would not fall quietly into the sea. *The Geographical Journal* . ABSTRACT

* Coastal erosion is an emotive issue with deeply held views that are often resistant to consensual approaches to identify mutually acceptable solutions. Using the village of Happisburgh on the East Anglian coast in England as a case study, this research analyses how the issue of coastal erosion has been framed and whether the presence of different frames acts as a barrier to building consensus between stakeholders. The study uses Frame Theory and Cultural Theory to understand how the UK Government and the Coastal Concern Action Group (CCAG), a local pressure group based in Happisburgh, communicate and perceive the issue of coastal erosion. Additionally, the study explores whether the different ways of understanding coastal erosion resonate within the community itself. A multi-method approach was used (policy discourse and media frame analysis) to identify the dominant framings of coastal erosion. The resonance of these frames was tested within the community of Happisburgh through a questionnaire with follow-up focus groups. The study revealed that the Government discourse of coastal erosion shares many of the characteristics associated with Cultural Theory's hierarchical worldview. Conversely, CCAG's discourse can be likened to the egalitarian position. The community of Happisburgh was found to strongly agree with the discourse that is representative of an egalitarian worldview. Furthermore, there was an increased uniformity of views regarding coastal erosion compared with attitudes towards nature more generally. The study concludes that different framings act as a barrier to building consensus. Efforts should be made to develop governance solutions to tackle the explicit disagreements (revealed in this study) whilst acknowledging the more implicit origins of these differences.

SMP (Shoreline Management Plan)

- Coastal sediment department are open and closed (Davies (1974))
- Coastal cells conceived by Carter (1988)
- A previous study of coastlines for England and Wales carried out on behalf of MAFF (Ministry of Agriculture Fisheries and Food, now reconfigured), established that coastal sediment movements occur within distinct boundaries, or cells, these cells rarely coincide with administrative boundaries.
- Coastal protection schemes have therefore in many areas been piecemeal, and not always compatible with coastline needs elsewhere in the same sediment cell. Norfolk and Suffolk Authorities therefore, decided to produce an SMP, where all the needs and constraints of the coastline can be identified and considered as a whole.



Allegorical engraving of the "opposition" of land and sea in the Venice Lagoon, taken from Bernardo Trevisan, *Della Laguna di Venezia, Trattato*, published in 1715. Reproduced here from Lasserre and Marzollo (2000).

Principal tools in ICZM

1. **No active intervention:** undeveloped coasts Needs low value and limited interest
2. **Managed alignment:** relocation of communities/industry and strict planning restrictions. Comparatively low risk & no protection costs. But high initial econ. & social cost. Needs strong govt and legislation
3. **Accommodation:** Adapting to impacts eg rising buildings, flood warning systems & drainage. Changing activities eg types of agrarian economies. Needs high levels of organisation and community participation
4. **Hold the line:** physical protection. Hard engineering eg sea walls Soft engineering eg beach nourishment. Social, economic and political advantages but linked to £value. Needs economic, social and political viability

Geomorpho
logically
sustainable
(Masselink,
2012)

* EXERCISE

- * Consider these tools in relation to environmental conservation. Construct a table of advantages and disadvantages

Coastal conservation

Exercise

1. [ICZM in the USA an interview with JR Clark](#)

http://www.youtube.com/watch?v=qvcw_petP2w 13mins

2. **ICZM interview with Dr. Peter Burbridge (Newcastle University, 2012) 20 mins**

<http://www.youtube.com/watch?v=g3uD-m6DPcc>

3. Exercise

- * What do these clips tell us about coastal conservation ?
- * Use a flip chart to construct a table highlighting how the 2 presentations are similar/dissimilar. Present to the rest of the class
- * From the presentations construct a word document that highlights the principals of coastal conservation

DEFRA's 'Making Space for Water' policy

H Hold the line

M Managed realignment

N No active intervention

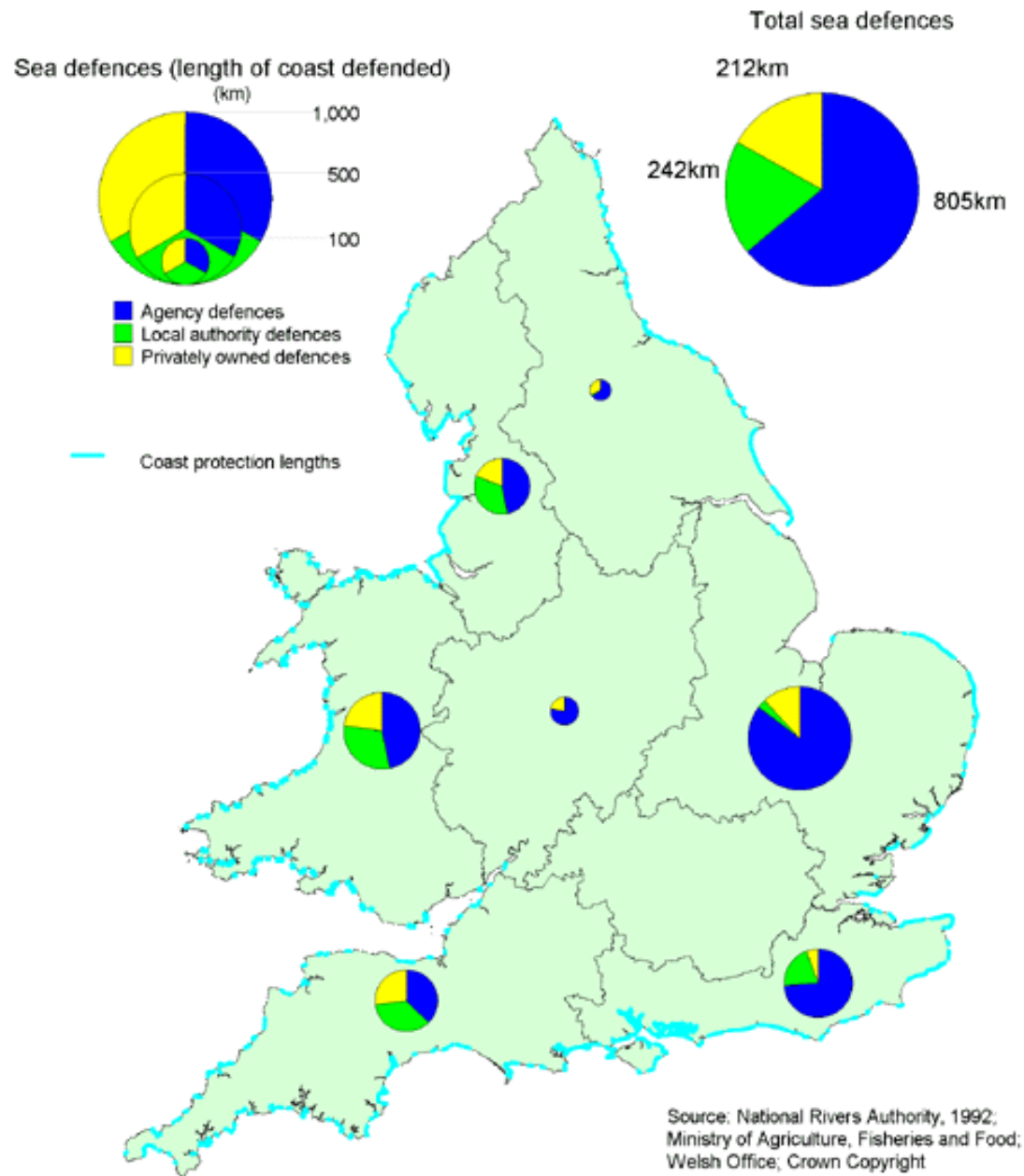
Table 17.4 Preferred management policies for Kelling to Lowestoft, Norfolk, UK, according to the draft Shoreline Management Plan

Policy unit	Recommended management policy		
	0-20 years	20-50 years	50-100 years
Kelling Hard to Sheringham	N	N	N
Sheringham	H	H	H
Sheringham to Cromer	N	N	N
Cromer	H	H	H
Cromer to Overstrand	N	N	N
Overstrand	H	M	M
Overstrand to Mundesley	N	N	N
Mundesley	H	H	M
Mundesley to Bacton Gas Terminal	N	N	N
Bacton Gas Terminal	H	H	M
Bacton, Walcott and Ostend	H	M	M
Ostend to Eccles	N	N	N
Eccles to Winterton Beach Road	H	H	M
Winterton to Scrabby	N	N	N
California to Caister-on-Sea	H	M	M
Caister-on-Sea	H	H	M
Great Yarmouth	H	H	H
Gorleston	H	H	H
Gorleston to Hopton	N	N	N
Hopton	H	N	N
Hopton to Corton	N	N	N
Corton	H	M	M
Corton to Lowestoft	N	N	N
Lowestoft North (to Ness Point)	H	H	H

H = hold the line; M = managed realignment; N = no active intervention

Coastal Protection

Hard vs soft
engineering 3 mins



(a)



(b)



(c)



(d)



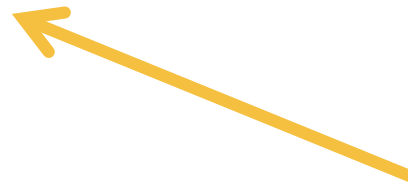
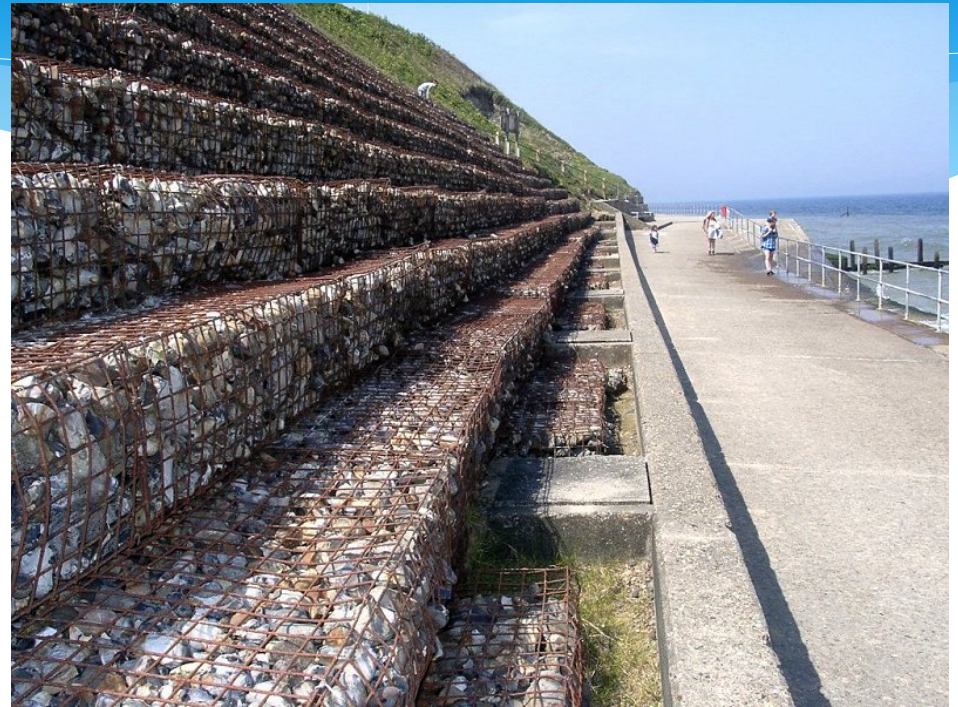
Figure 17.42 Examples of hard coastal engineering structures: (a) vertical seawall with curved top; (b) wooden groynes deployed on Blyth Beach, Northumberland, UK. It can be seen that the left hand side has a raised beach where it has trapped longshore drift compared to the right hand side which has a shortened beach with water much closer to the camera. (c) **Jetties** are designed to prevent the silting up of tidal inlets and harbour entrance channels by blocking the littoral drift. In the photo, the littoral drift direction is from right to left. (d) Clay embankments or sea dikes installed as part of land reclamation efforts near the spring high-tide level seem inoffensive enough. However, the land they are protecting from flooding is at the same time deprived of the influx of sediment that would otherwise enable it to keep up with rising sea level. In this photo, the land to the left of the embankment which is flooded during spring high tide is at least 0.5 m higher than the land to the right. (Source for (c): Photo courtesy of Aart Kroon)

to prevent the silting up of tidal inlets and harbour entrance channels by blocking the littoral drift. In the photo, the littoral drift direction is from right to left. (d) Clay embankments or sea dikes installed as part of land reclamation efforts near the spring high-tide level seem inoffensive enough. However, the land they are protecting from flooding is at the same time deprived of the influx of sediment that would otherwise enable it to keep up with rising sea level. In this photo, the land to the left of the embankment which is flooded during spring high tide is at least 0.5 m higher than the land to the right. (Source for (c): Photo courtesy of Aart Kroon)

Revetments and steel
piling at Overstrand,
North Norfolk



Rip rap and recurved sea
walls at Withernsea on the
Holderness coast, Yorkshire



Gabions of stones, in this case they look like flint, at Overstrand. They are retained behind timber works, a concrete esplanade and steel piling!



Absorbs energy

Revetments, steel piling,
rip rap and wooden
retaining posts at
Overstrand, North Norfolk



A stepped sea wall, and concrete/stone groynes at Walton-on-the-Naze.



A stone groyne at Mapplelton, Holderness, in Yorkshire. Rip rap protects the cliff in the foreground. a small beach has built up to the north of the groyne.

Coasts



◀ Figure 6.19

The effect of groynes on longshore drift, Southwold, Suffolk — this type of coastal management is usually undertaken on beaches at holiday resorts where the sand and sea are a major attraction to tourists





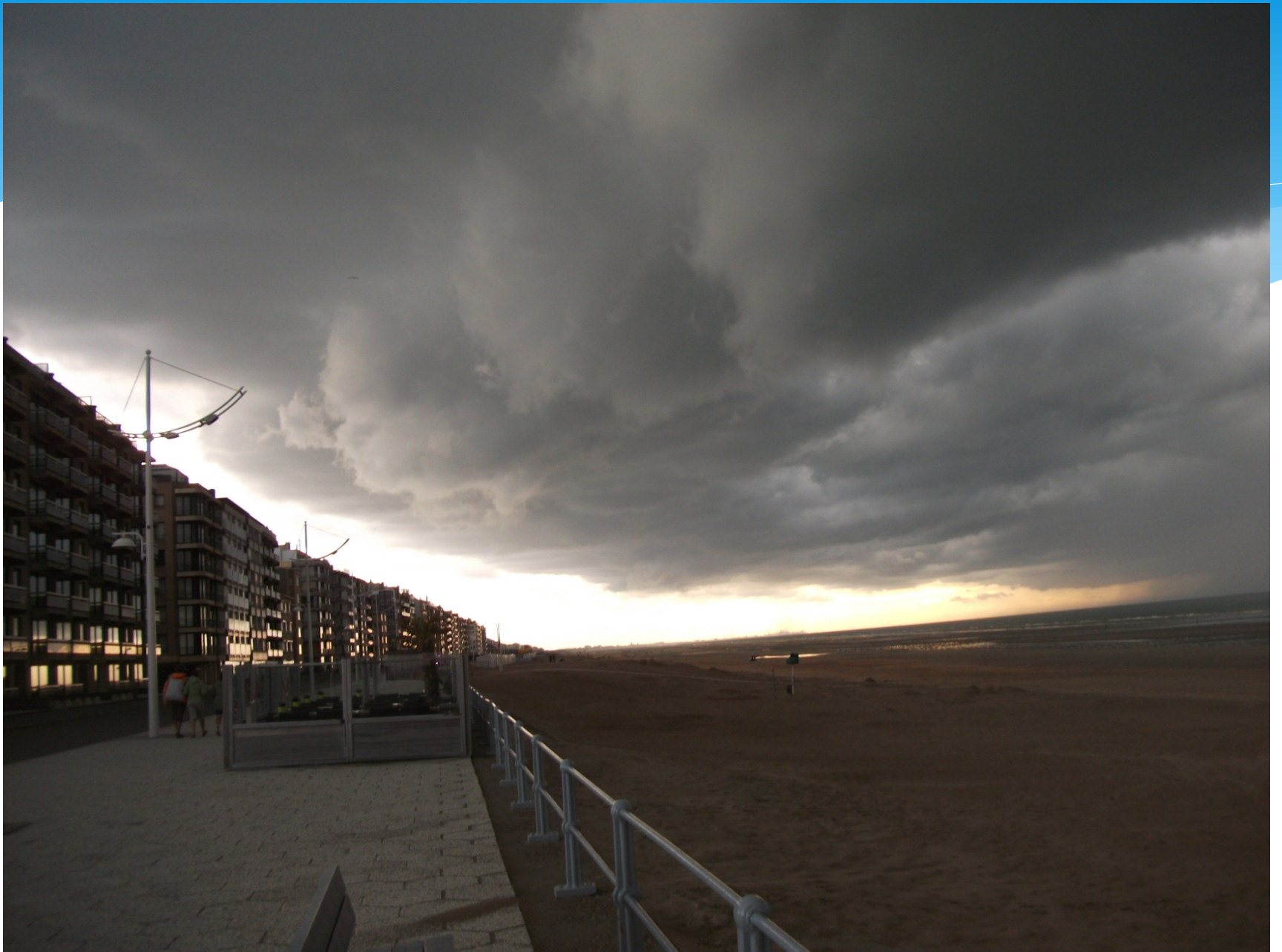
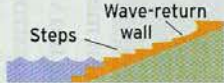
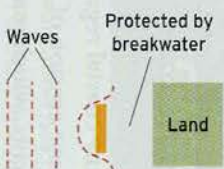
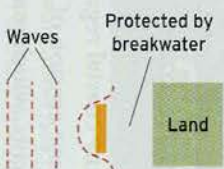
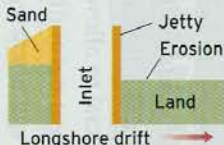


Table 17.3 A selection of coastal engineering works

Management issue	Engineered solution(s)	Types	Description	Problems	Illustration
Cliff erosion	Sea walls	Vertical wall	A wall constructed out of rock blocks, or bulkheads of wood or steel, or simply semi-vertical mounds of rubble in front of a cliff	Rock walls are highly reflective, bulkheads less so. Loose rubble, however, absorbs wave energy	
		Curved wall	A concrete constructed concave wall	Quite reflective, but the concave structure introduces a dissipative element	
		Stepped	A rectilinear stepped hard structure, as gently sloping as possible, often with a curved wave-return wall at the top	The scarps of the steps are reflective, but overall the structure is quite dissipative	
		Revetment	A sloping rectilinear armoured structure constructed with less reflective material, such as interlocking blocks (tetrapods), rock-filled gabions and asphalt	The slope and loose material ensure maximum dissipation of wave energy	
Coastal inundation	Sea walls	Earth banks	A free-standing bank of earth and loose material, often at the landward edge of coastal wetlands	May be susceptible to erosion, and overtopped during extreme high-water events	
	Tidal barriers		Barriers built across estuaries with sluice gates that may be closed when threatened by storm surge	Extremely costly, and relies on reliable storm surge warning system (e.g. Thames Barrier)	
Beach stabilization	Groynes		Shore-normal walls of mainly wood, built across beaches to trap drifting sediment	Starve downdrift beaches of sediment	
	Beach nourishment		Adding sediment to a beach to maintain beach levels and dimensions	Sediment is often rapidly removed through erosion and needs regular replenishing; often sourced by dredging coastal waters	
Offshore protection	Breakwaters		Structures situated offshore that intercept waves before they reach the shore. Constructed with concrete and/or rubble	Very costly and often suffer damage during storms	
Tidal inlet management	Jetties		Walls built to line the banks of tidal inlets or river outlets in order to stabilize the waterway for navigation	The jetties protrude into the sea and promote sediment deposition on the updrift side, but also sediment stavigation and erosion on the downdrift side	

Where and why would you use these near Swansea?

Cardiff California

Idyllic?

What about coastal management?



Cardiff California



Coastal defences change wave processes



Figure 17.13 Reflection of breaking waves at the vertical face of a seawall giving rise to a criss-cross wave pattern.

LOICZ

- * The following 3 slides are based on the LOICZ (Land Ocean Interactions in the Coastal Zone Land) approach, its themes and goals, as well as where it fits in the International Geosphere Biosphere Program.
 - * They address approaches and new techniques that can be used to start solving global coastal environmental problems.
 - * These conceptual diagrams are still evolving as our understanding of these system develops, and as such we welcome input from scientists with experience in these regions and biological systems.
 - * From <http://ian.umces.edu/loicz/>
 - * Construct a Pecha Kucha presentation (4 slides one minute each) based on polar, temperate and tropical coastal zones. Using the internet describe and explain the main factors that are portrayed on the slides.
1. Polar
 2. Temperate
 3. Tropical

Land-Ocean Interactions in the Coastal Zone

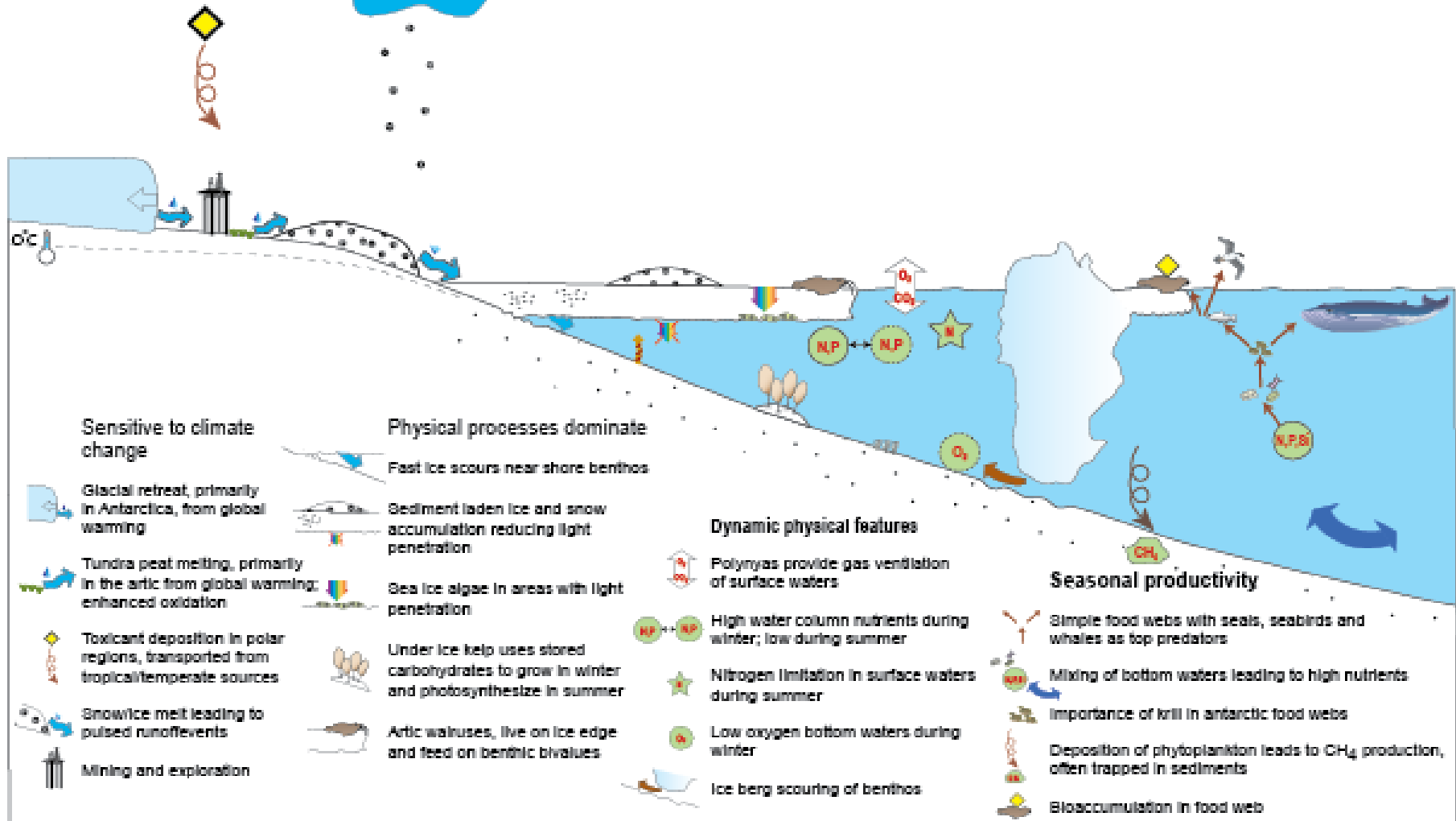
POLAR

Glaciers + Tundra
(antarctic) (arctic)

Fast ice + Sea ice

Polynyas +
Ice bergs

Sea ice +
Open water



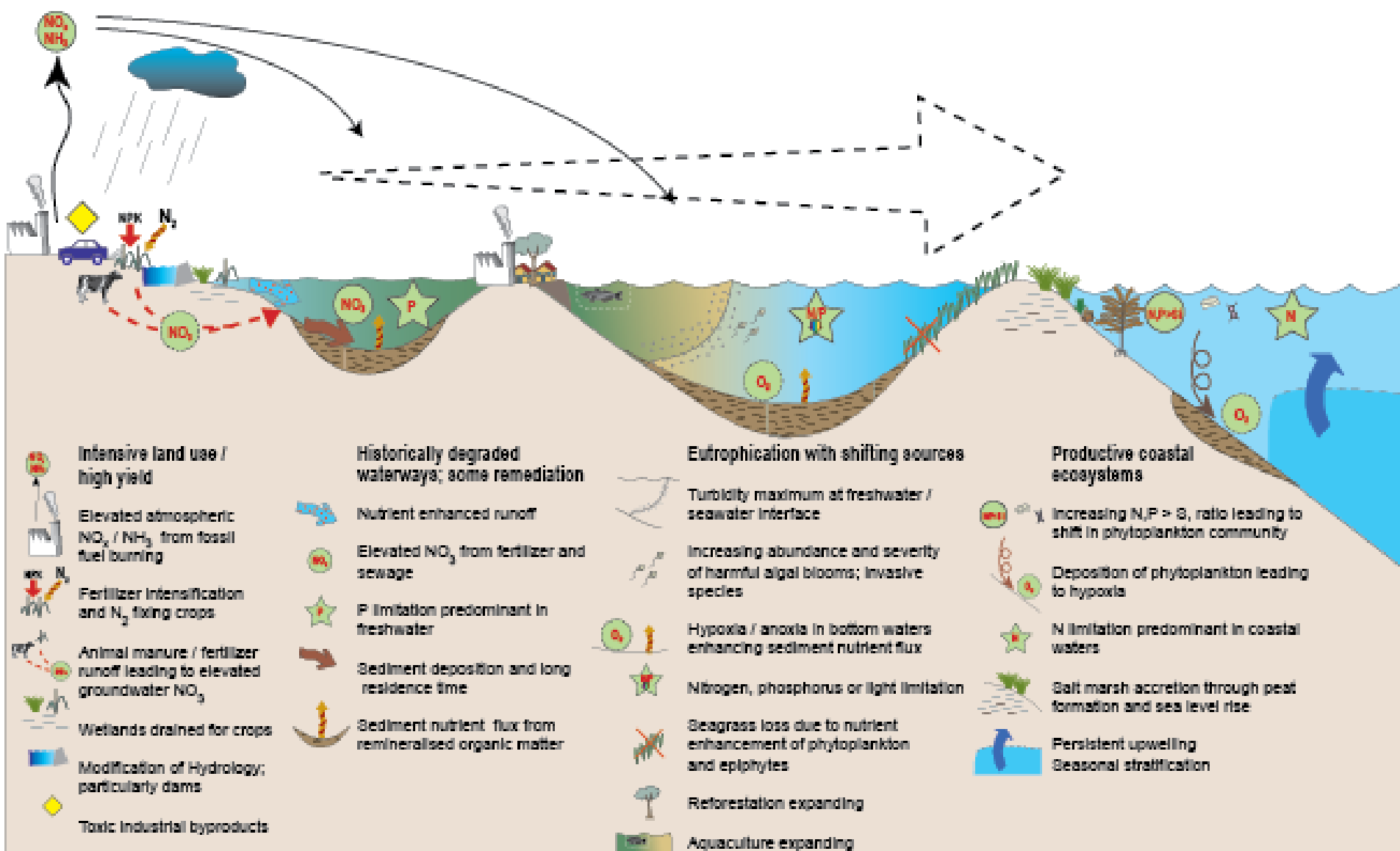
TEMPERATE

Catchment / Watershed

River

Estuary

Coastal



TROPICAL

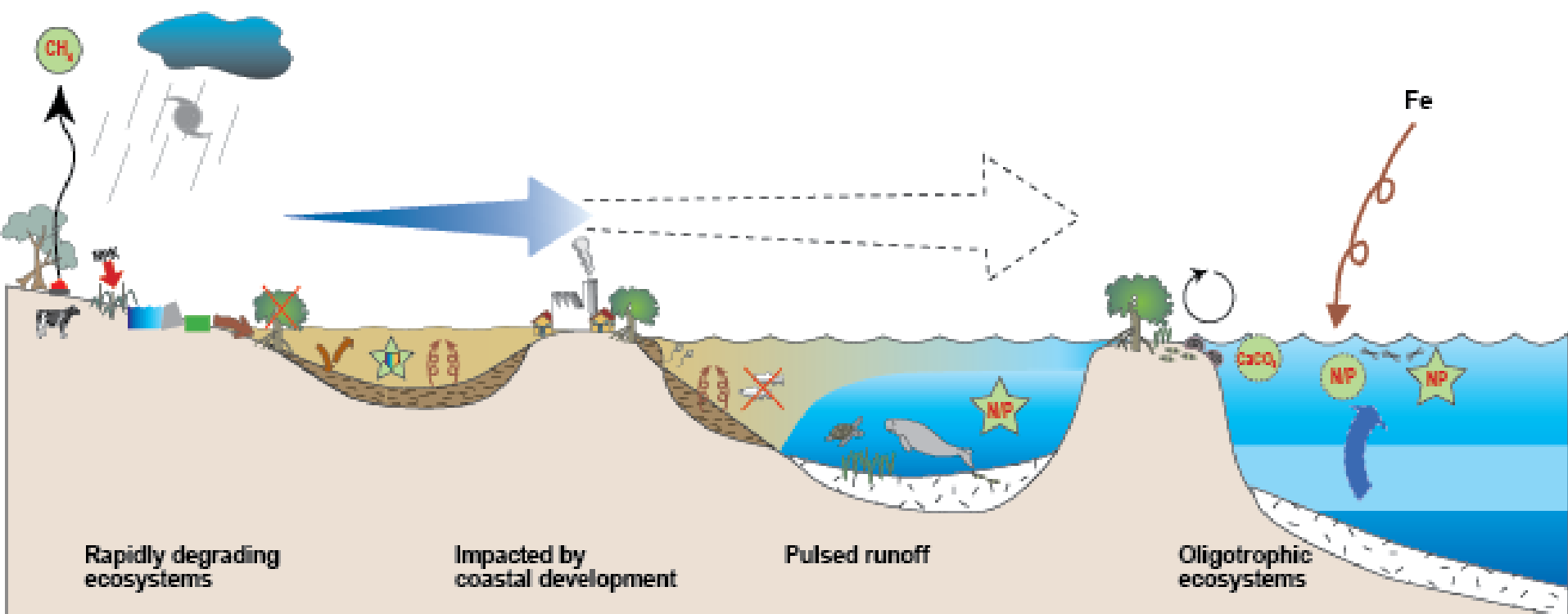
Catchment / Watershed

River / Estuary

Coastal

Reef

Ocean



Rapidly degrading ecosystems

- More variable monsoonal rainfall; tropical storms increasing in frequency and intensity
- Expanding deforestation
- Fertilizer intensification, particular in Asia
- Intensified grazing
- Expanding aqua / marl culture
- Modification of hydrology, particularly dams
- Forest burning and methane production

Impacted by coastal development

-  Pulsed, sediment-laden runoff
-  Sediment deposition (dry) and scouring (floods)
-  Light limitation due to turbidity
-  Resuspension of fine grained sediments
-  Rapidly expanding urban areas
-  Mangrove deforestation

Pulsed runoff^{Fr}

-  Mud deposition and mangrove encroachment
-  Increasing abundance and severity of harmful algal blooms
-  Resuspension of muddy sediments
-  Tropical seagrasses controlled by macrograzers
-  Ubiquitous benthic microalgae
-  Nitrogen or phosphorus limitation
-  Wild stock fisheries decline

Oligotrophic ecosystems

- Responsive communities of mangroves, seagrasses, benthic microalgae and corals to pulsed runoff events
- Low water column nutrients in surface waters
- Co-limitation of nitrogen and phosphorus
- Iron dust deposition stimulating *Trichodesmium* blooms; possible increase due to land use and climate
- Seasonal upwelling permanent stratification
- Decreasing carbonate saturation

How do we manage our sea?

- * The example of Ospar
- * [David Johson OSPAR 8 mins](#)



Life's a beach!

