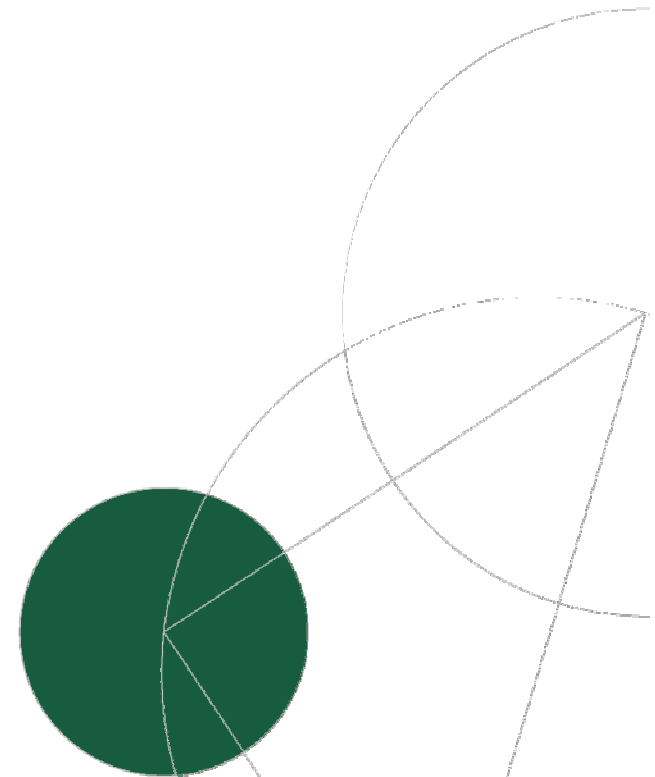




Implications of climate change on Coastal Zone Management

Aart Kroon
Workshop on ICZM in a Climate change perspective
Lubiatowo, Poland
2-5 June 2008



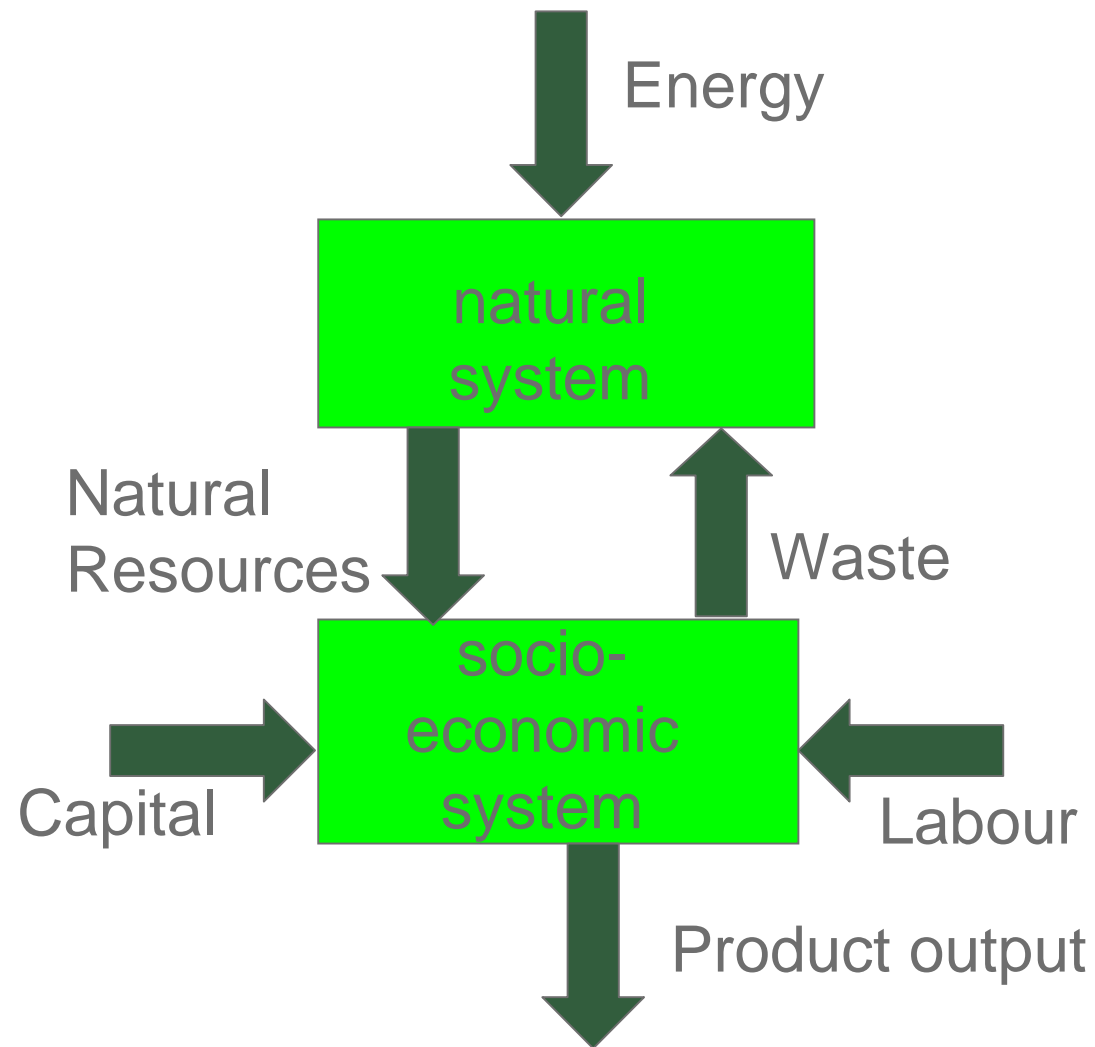
Introduction

Coastal Zone Management & Spatial Planning in Denmark

Climate Change Impact on Coastal Areas in Denmark

Implications of Climate Change on Coastal Zone Management in Denmark



CZM

CZM and Spatial Planning in DK

Many different levels:

EU – National – Regional – Local

Many governmental organizations:

Ministries

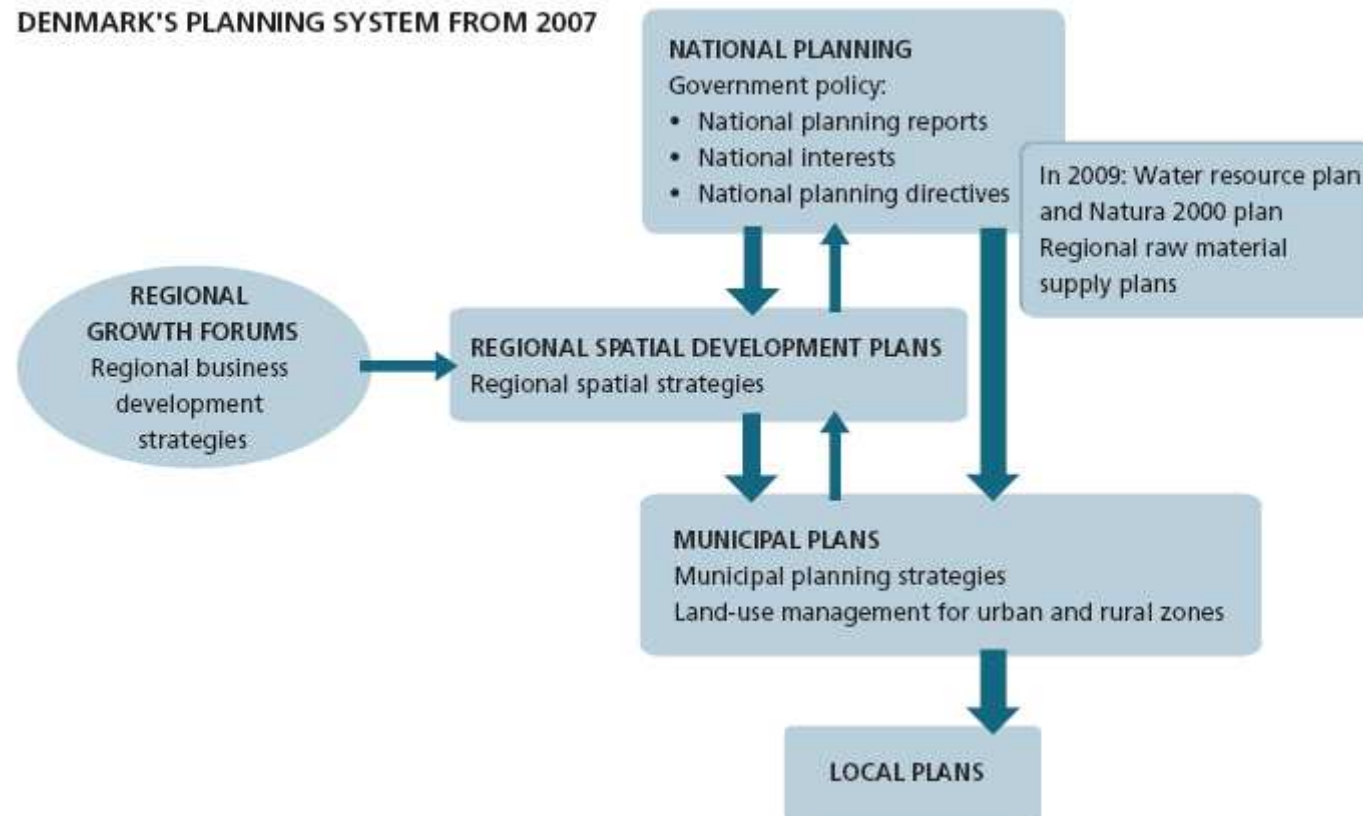
Ministry of the Environment is responsible for planning in DK

Other ministries have a sector responsibility



CZM and Spatial Planning in DK

DENMARK'S PLANNING SYSTEM FROM 2007



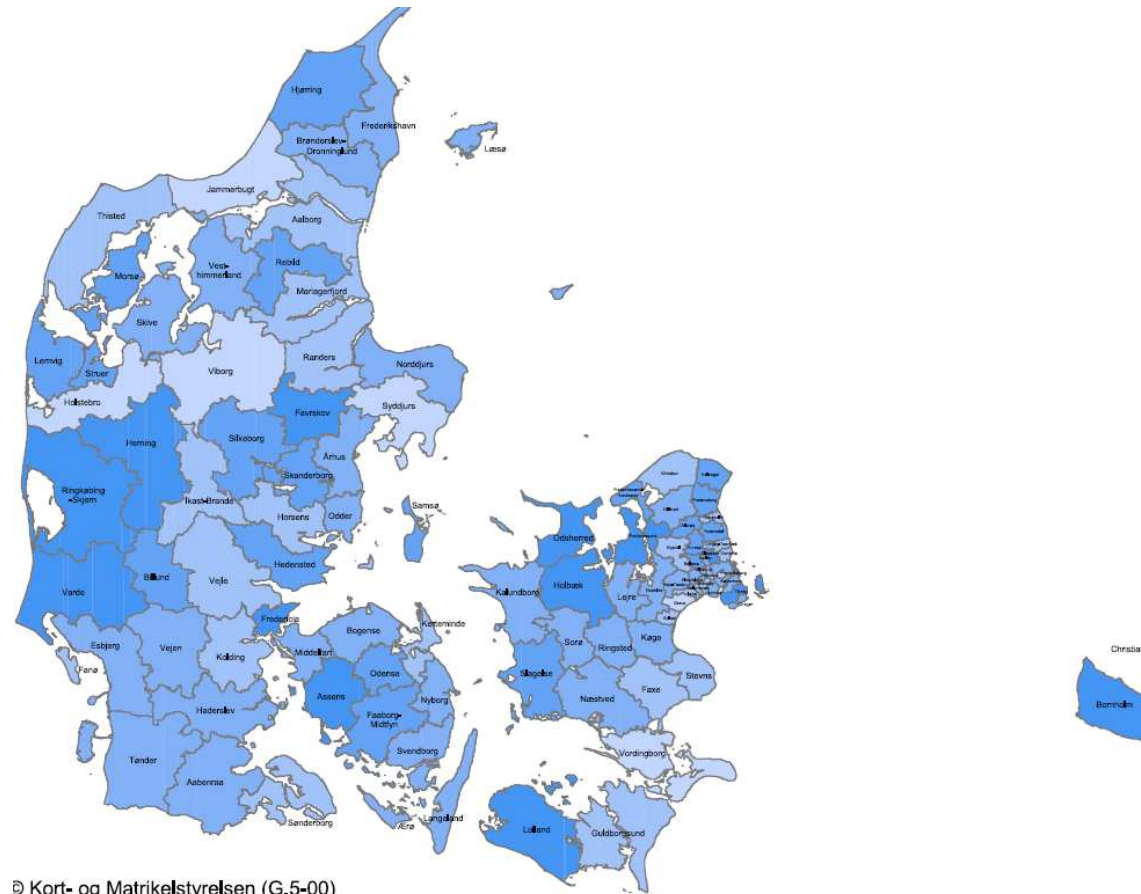
CZM and Spatial Planning in DK

Since 2007:

Two layers

National

Local



© Kort- og Matrikelstyrelsen (G.5-00)



CZM and Spatial Planning in DK

PLANLÆGNING FOR **KYSTOMRÅDER**

Planloven indeholder særlige regler for planlægning i kystområderne.
De åbne danske kyster skal bevares som åbne kyststrækninger.



Ministry of the Environment, 2007



CZM and Spatial Planning in DK

Example sector responsibility:

**Coastal protection and
sea defense**

**Ministry of Transport
(Coastal Authority)**



Danish Coastal Authority, 2005



CZM and Spatial Planning in DK

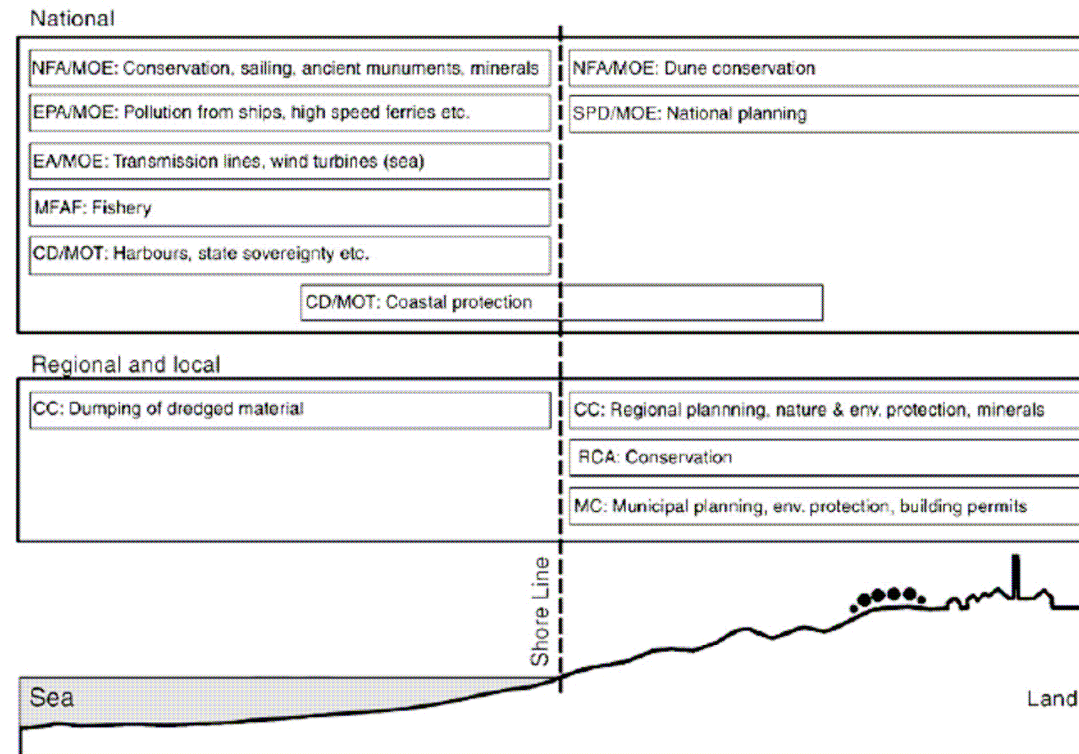
	Sea	Land
National level	Navigation Fishing Nature protection Resources exploitation Military	Coastal protection Sea defence Nature protection Resources exploitation Military
Regional level	Local fishing Navigation works Oil spill contingency Water quality monitoring	Water quality Water catchment Aquaculture Nature protection
Local level	Port owner	Water supply Waste collection & treatment Cultural heritage



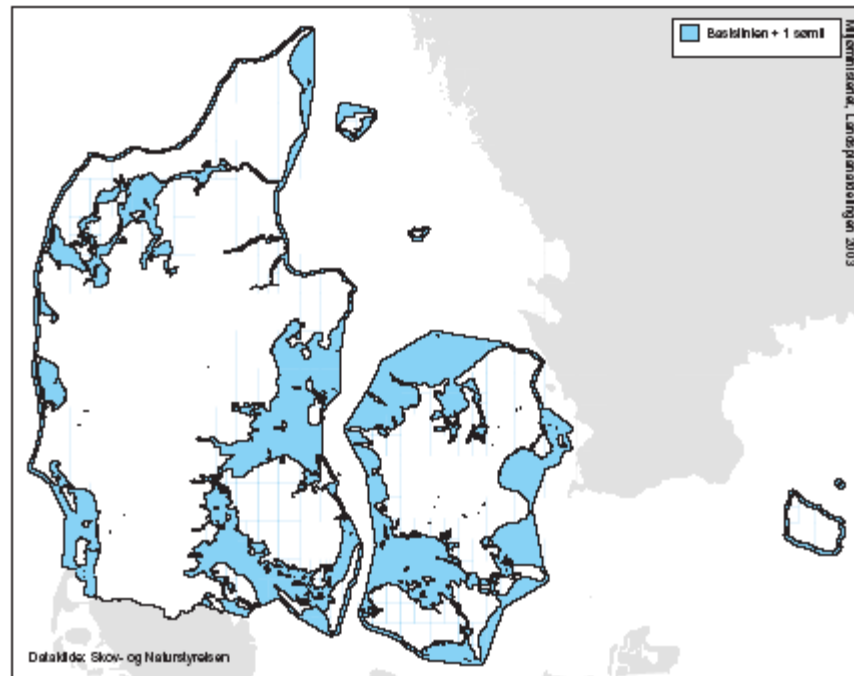
After: Mangor, 2004



CZM and Spatial Planning in DK



Central powers in the Danish coastal zone. The legal and regulatory framework establishes a management barrier in the shore line. CC: County councils; CD: Coastal Directorate; EA: Energy Agency; EPA: Environment Protection Agency; MC: Municipal councils; MFAF: Ministry for Food, Agriculture & Fisheries; MOE: Ministry of the Environment; MOT: Ministry of Transport; NFA: National Forest & Nature Agency; RCA: Regional Conservation Authorities; SPD: Spatial Planning Department.



3 km zone

Kystnærhedszonen i tal

Danmark	Hele landet		Kystnærhedszonen	
	km ²	%	km ²	%
Hele landet	43.003	100	10.995	100
Byzone	2.457	6		
Sommerhusområde	447	1	418	4
Sommerhusaftaleområde	11	0	10	0
Landzone	40.099	93	10.577	96
Kystnærhedszonen	10.995			

Ydre grænse for fysisk planlægning på havet i udvalgte lande¹⁾

	Landværts	Kystlinjen	12 sømil
GB /Skotland	Regional & Lokalplaner		
Tyskland	Føderale Statsplaner		
Norge	Regional & Lokalplaner	Yderste øer	
Sverige	Lokalplaner		
Holland	Regionalplaner	1km.	
Finland	Lokalplaner		

Ministry of the Environment, 2003



Climate change

Quaternary history of the Danish Coast

Climate change and the IPCC

expressed in global numbers

**emphasis on temperature and
sea level changes**

Effects for coastal areas in Denmark



Climate change



'Ishavstiden' ca. 10.000 BC



'Fastlandstiden' ca. 8-6.000 BC



'Littorinahavets tid' ca. 5-2.000 BC



Kruger / Kystdirektoratet, 2008



Climate change

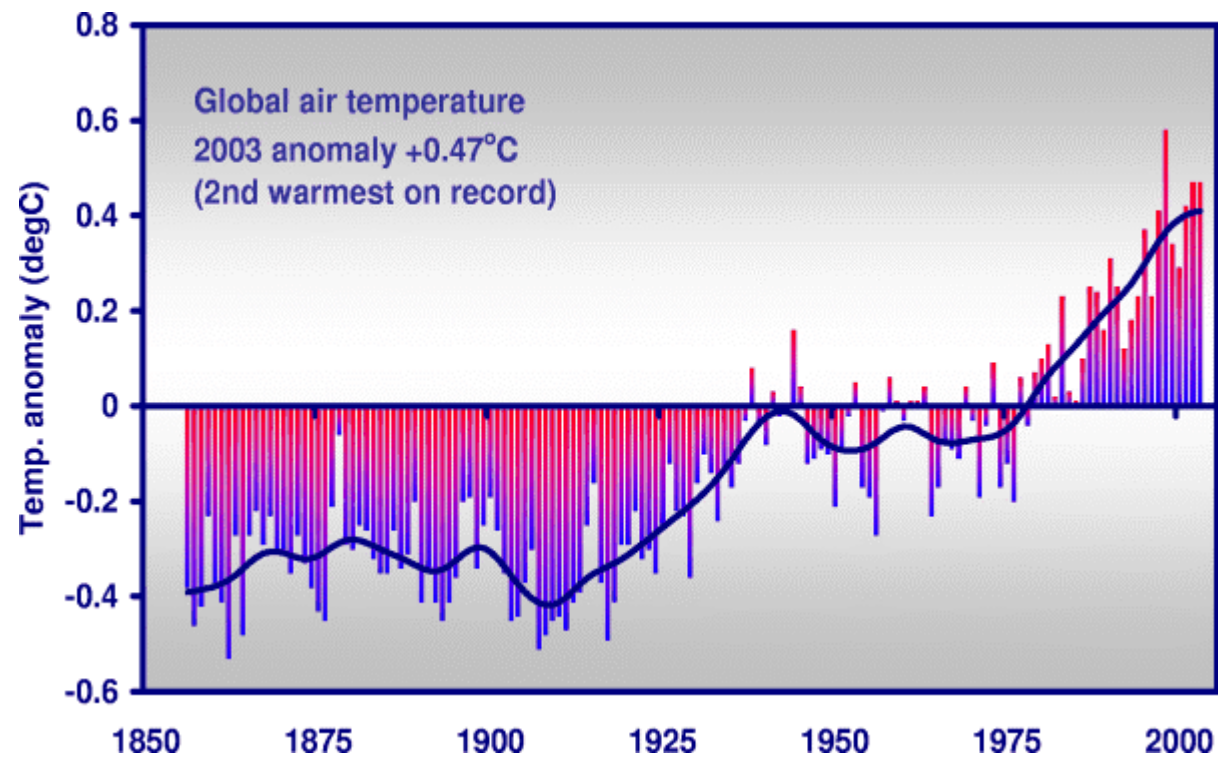


Climate change



Relative land rise in Holocene (m)

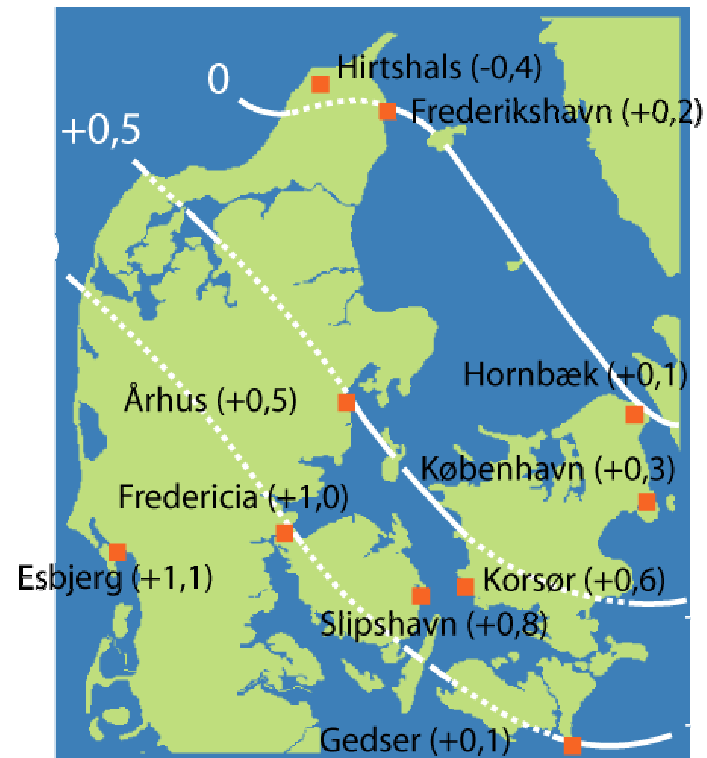
Climate change



CRU in Jensen and Knudsen, 2008



Climate change



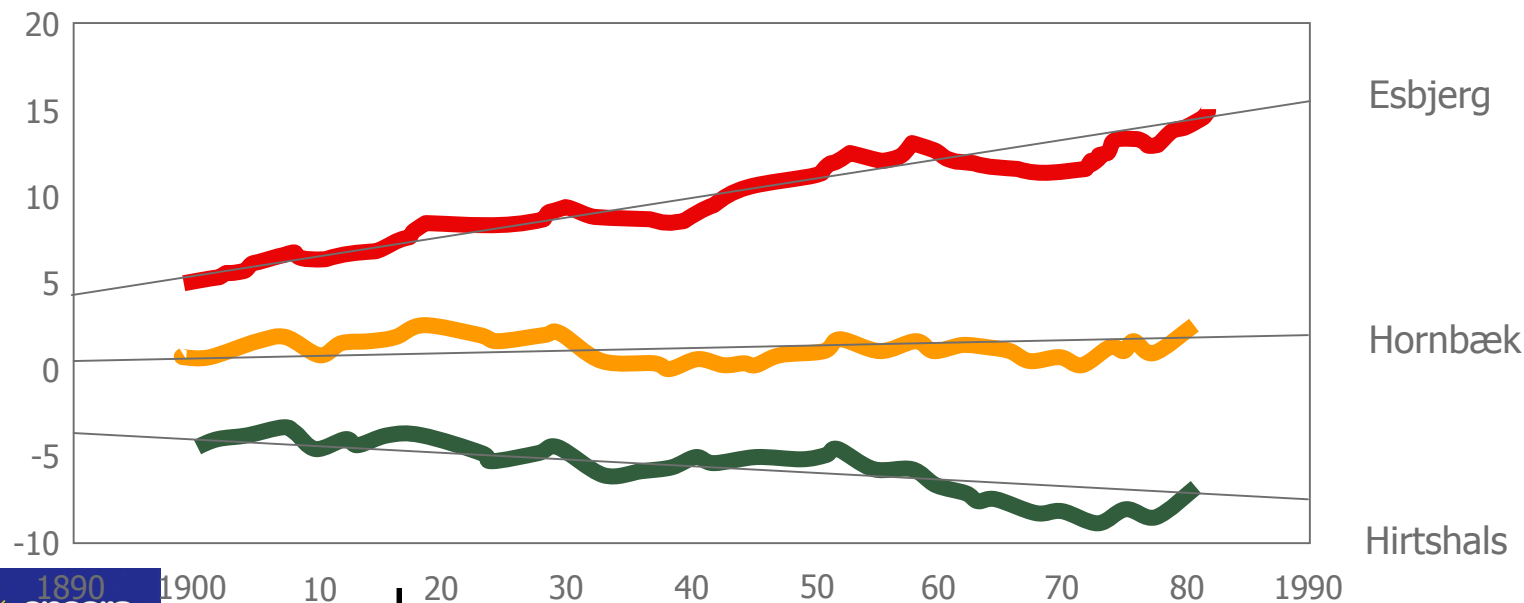
Relative sea level change (mm/year) over the last 100 year

Impacts on Coastal Areas



Mean water level evolution

cm above DNN

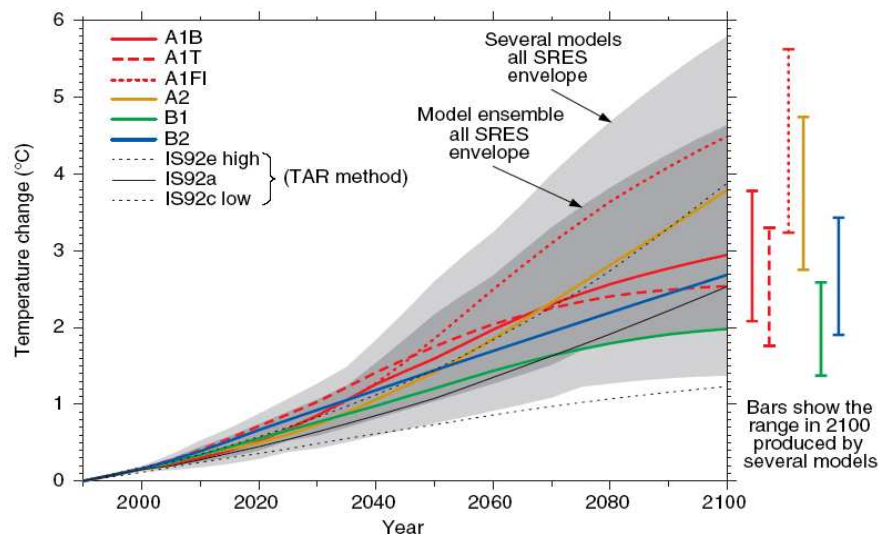


Jensen and Knudsen, 2008

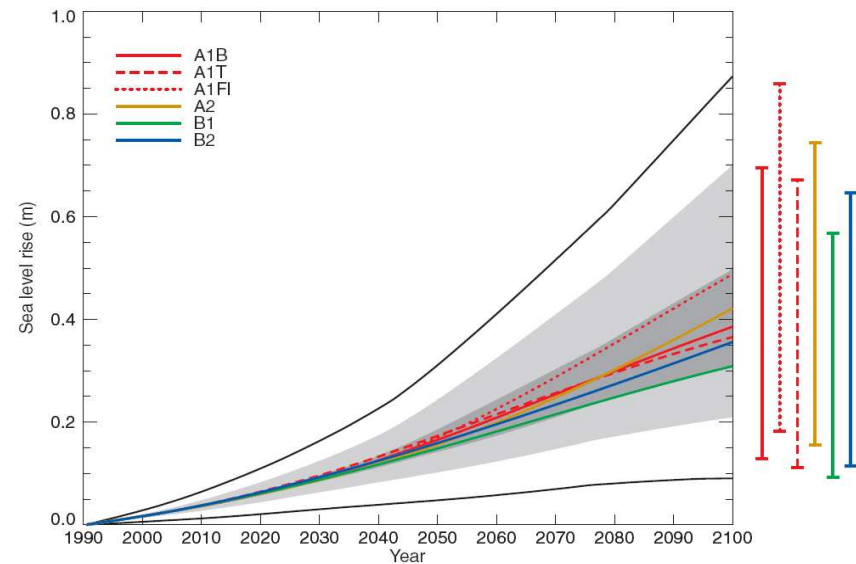


Climate change

Global Mean Temperature



Global Sea Level



IPCC in Jensen and Knudsen, 2008



Scenarium	A2		B2		EU2C	
Årstal	2006-2035	2071-2100	2006-2035	2071-2100	2006-2035	2071-2100
Land						
Årsmiddeltemperatur	+0,6° C	+3,1° C	+0,7° C	+2,2° C	+0,7° C	+1,4° C
Vintertemperatur	+0,6° C	+3,1° C	+0,7° C	+2,1° C	+1,0° C	+2,0° C
Sommertemperatur	+0,5° C	+2,8° C	+0,6° C	+2,0° C	+0,7° C	+1,3° C
Årsnedbør	+2 %	+9 %	+2 %	+8 %	0 %	0 %
Vinternedbør	+8 %	+43 %	+6 %	+18 %	0 %	+1 %
Sommernedbør	-3 %	-15 %	-2 %	-7 %	-2 %	-3 %
Maximum døgnnedbør	+4 %	+21 %	+5 %	+20 %	+11 %	+22 %
Hav						
Middelvind	+1 %	+4 %	+1 %	+2 %	+1 %	+1 %
Max. vandstand ved Vestkysten		+0,45-1,05 m				
Såvel hav som land						
Max. stormstyrke	+2 %	+10 %	0 %	+1 %	+1 %	+1 %

Tabel 1 Beregnet dansk klimændring udtrykt som ændring i forhold til perioden 1961-90 for de tre klimascenarier.¹ (Kilde:DMI)



Impacts on Coastal Areas

Sea level changes

... probably increased sea level rise

Changes in frequency and intensity of storms

... probably more intense and more frequent

Changes in rainfall distributions

... more/less surface run-off to the shore



Impacts on Coastal Areas

Increased sea level rise

- ... higher erosion rates?
- ... more flooding?
- ... other constructions?

More intense and more frequent storms

- ... similar impacts?

Rainfall and surface run-off to the shore

- ... more flooding?
- ... larger sluices?



Impacts on Coastal Areas



Erosion of cliffs, Nørre Lyngby

Impacts on Coastal Areas



Flooding areas, Søndervig



Photo: Danish Coastal Authority



Impacts on Coastal Areas



Flooding Rømø, Wadden Sea



Photo: Danish Coastal Authority



Impacts on Coastal Areas



Barrier island, Køge Bugt



Impacts on Coastal Areas

Spatial aspects

West and North Coast Jutland

- ... more erosion (southern part)
- ... extra flooding around fjords
- ... not a lot of people

Wadden Sea

- ... accumulation in pace with rise (?)
- ... extra flooding, more dikes (?)



Impacts on Coastal Areas

Spatial aspects

East Coast Sealand

- ... bit more erosion
- ... extra flooding
- ... lot of people

Other inner coastlines

- ... bit more erosion
- ... extra flooding
- ... not so people



Implications for CZM

Extra attention in future spatial planning

Initiatives / strategies in DK

**Spatial Planning: Ministry of Environment,
Ministry of Climate**

Coastal safety and defence: Coastal Authority



Implications for CZM

Government of Denmark developed a **climate strategy**
for different sectors

Aim: to anticipate on climate change

**in CZM (coastal protection),
spatial planning (flooding),
infrastructure,
laws,
etc.**



Danish Government, 2008



Implications for CZM

Danish Coastal Authority strategy for sector CZM:

More erosion: extra nourishments

More flooding:

**protection with extra dikes, etc.
(especially Wadden Sea) or
drawback in marginal areas**



Jensen and Knudsen, 2008



References

- Anker, H. et al., 2004. ICZM in Denmark.
Danish Coastal Authority, 2005. Fremtidens kyster.
Danish Government, 2008. Strategi for tilpasning til klimaændringer i Danmark.
Jensen J. and Knudsen, S.B., 2008. Klimaændringers effekt på kysten (DCA).
Mangor, K., 2004. ICZM and shorelinemanagement (DHI).
Ministry of the Environment, 2003. Planlægning i kystnærhedszonen.
Ministry of the Environment, 2006a. The new map of Denmark – Spatial planning under new conditions.
Ministry of the Environment, 2006b. Report to the EU Commission concerning the implementation ... on integrated coastal zone management.
Ministry of the Environment, 2007. Planloven i praksis.
Schou, A., 1949. Landskabskort over Danmark (geomorfologi).

