RESPONSES TO COASTAL CLIMATE CHANGE: INNOVATIVE STRATEGIES FOR HIGH END SCENARIOS –ADAPTATION AND MITIGATION–

RESPONSES TO COASTAL CLIMATE CHANGE (RISES-AM-)
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DELTAS IN TIMES OF CLIMATE CHANGE II
OPPORTUNITIES FOR PEOPLE, SCIENCE, CITIES AND BUSINESS

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What "is" Climate Change

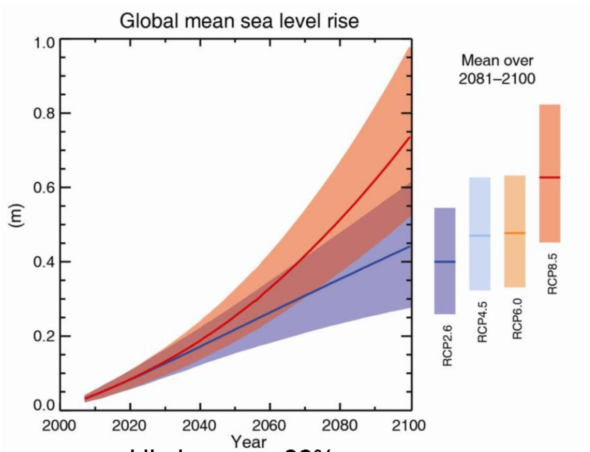
Marine factors: Sea Level Rise

We shall focus on high end conditions

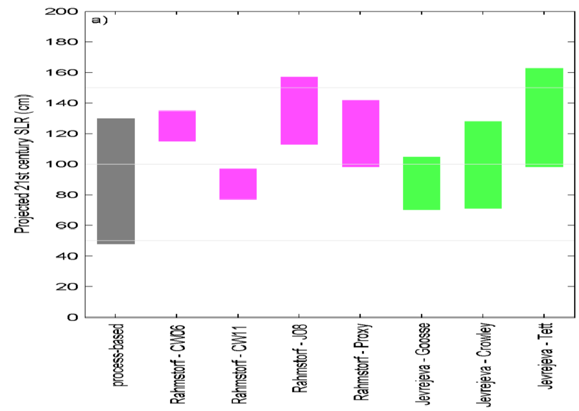
1. RCP 4.5 and 8.5
2. Other scenarios (e.g. SRES A1B)
3. Upper limit of 2.0m (up to)

Time slices

- 2050
- 2070
- 2100



Likely range, 66%
(SPM, 2013)



95% or "max"
(Moore et al 2013)

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Global SLR (emphasis on high-end) for various quartiles/authors

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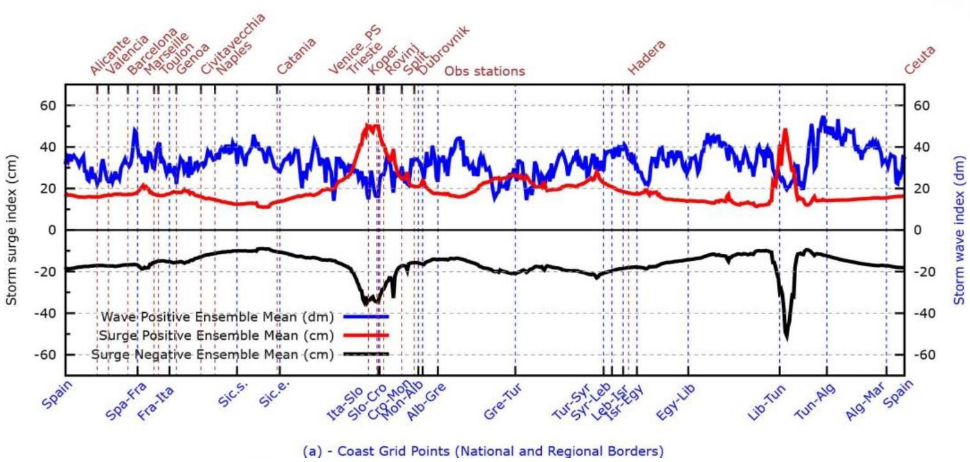
Other factors:

a) Marine

Waves, surges (regional projections sometimes)



Surge level (cm) / wave height (dm)

Ensemble mean storm surge index (cm) for + (red line, cm) and **-** (black line, cm) surges & waves (dm) in **present climate simulations**

Coastal points are ordered clockwise starting from Gibraltar.

Positive surges   Negative surges   Waves

S Surge and Hs distribution along Mediterranean coast (Conte and Lionello, Global and Planetary Change)

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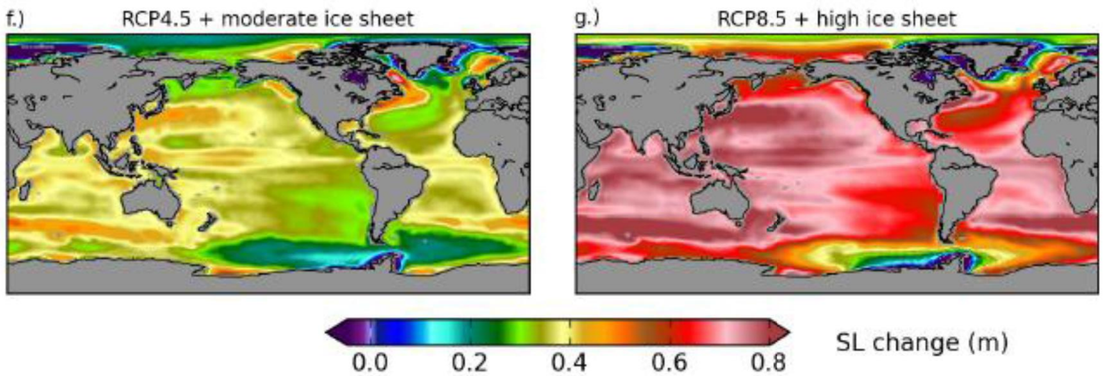
Required downscaled (regional to local) values

- Decisions are taken at local to regional scales
- Mounting uncertainties
- Here high end scenarios: RCP 4.5 & RCP8.5 + upper limit
- Combining regional MSL components (fig with median projections)



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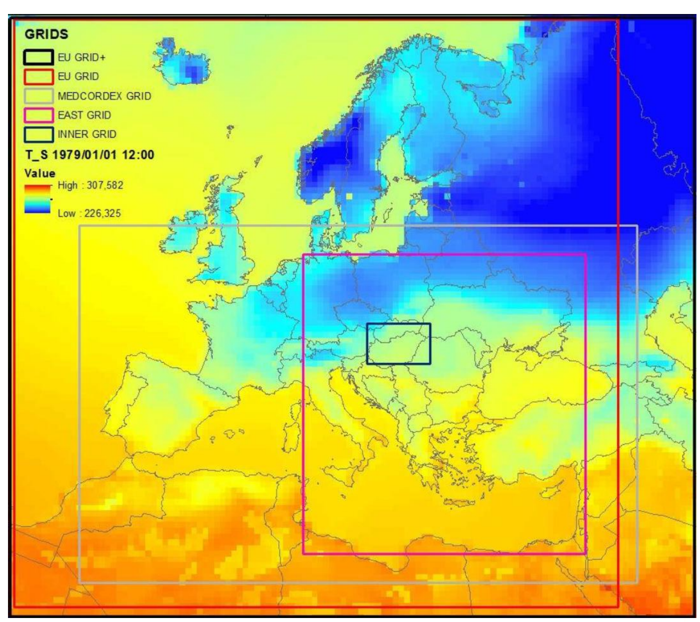
Required downscaled (regional to local) values

- Combining MSL with storm surges and wave set up (total level)
- Evaluating future wave impacts (future waves and coastal zone)
- Waves + storm surges for time slice 2070-2100
- Only RCP 8.5 and one model

(1 GCM + 1 RCM - CMCC)

Computational grid for Europe



Results: Changes in wave direction in **winter** (5 GCM-RCM sets for SRES)

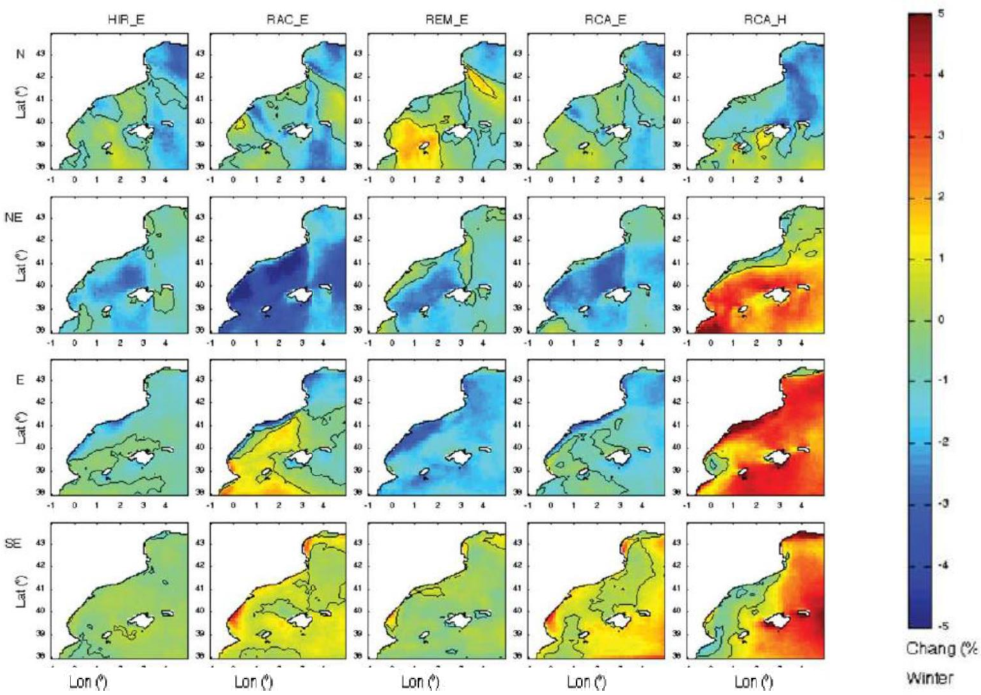
Directions

N
(less freq)

NE

E

SE
(more freq)



Projected changes in absolute value (relative values are higher, exceeding in some cases 100%)

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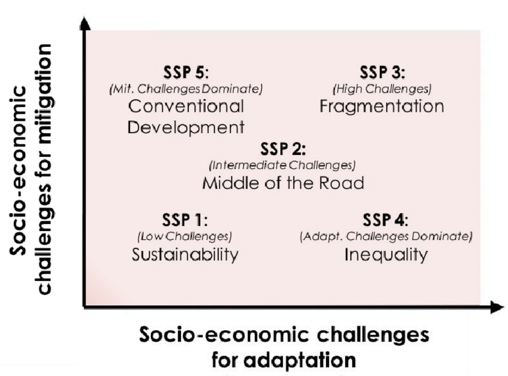
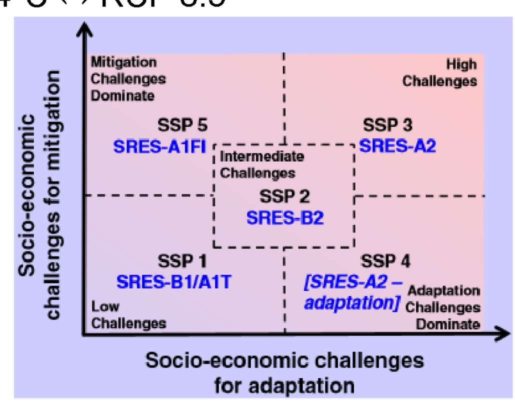
Projection of social and economic conditions

- Vulnerability (and risk) must result from consistent projections
- Focus on high end conditions (SSPs & RCPs)
- SSP narratives linked to adaptation/mitigation challenges, not emissions (SRES)
- Focus on SSP 3, 4, 5 for warming level of 4ºC ↔ RCP 8.5

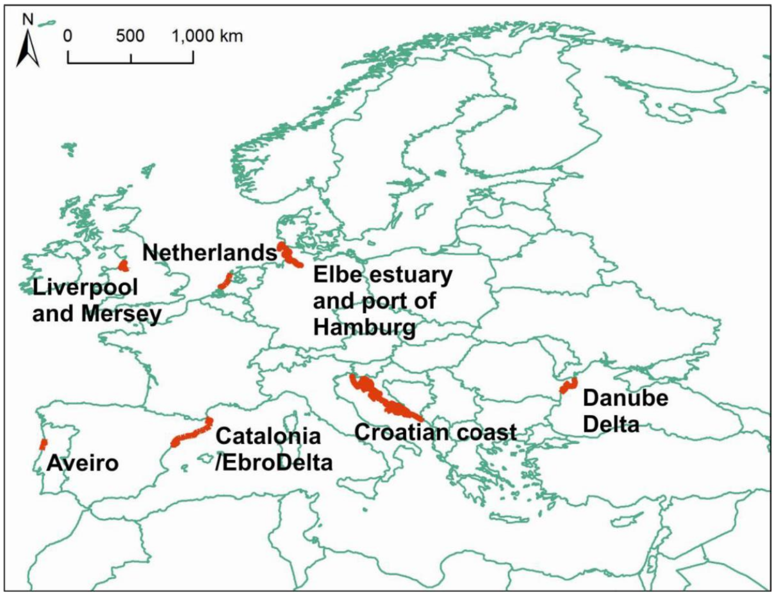




Source: O'Neil et al., 2013

SSP1 and SSP5 – highest GDP /lowest population
SSP3 – "Fragmentation " (GDP lowest / highest population)
SSP4 – "Inequality" (highly unequal world, within and across countries)

Projection and modelling
Regional



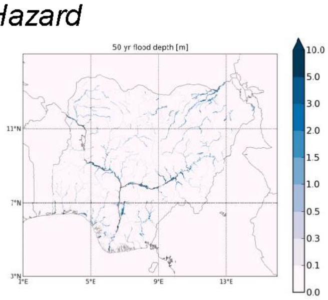
DIVA coastal segmentation
- case study based
- o-o-m 50km
- EU local case studies

U Southampton, GCF; Sussex, Kiel and Cambridge Universities

Projection and modelling
Global

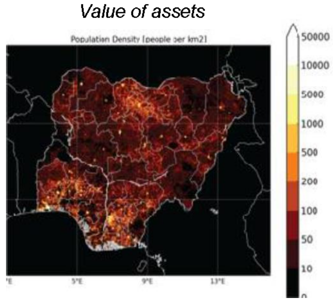
Global scale models
- DIVA, GLOFRIS
- Combining marine-riverine flooding
- Within a risk frame

Hazard



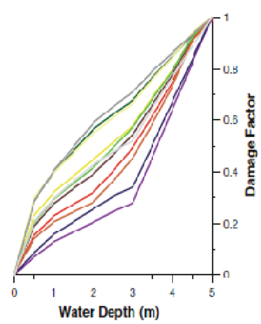
Inundation depth (50 yr return period)

Value of assets

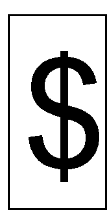


Exposure

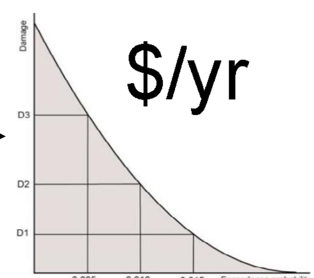
Vulnerability



Damage per return period



Annual expected Damage



GLOFRIS – overview (IVM, VU University, Deltares)

Projection and modelling
Cross cutting

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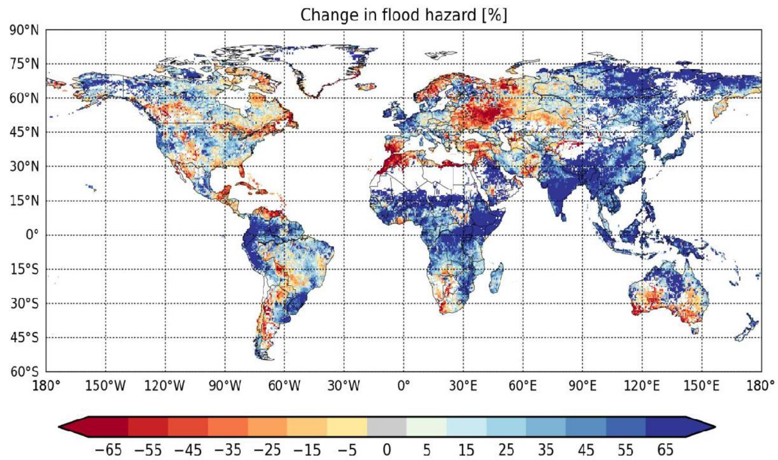
Global scale projections providing
- ➢ Drivers for cross cutting cases (small islands, coastal cities, deltas)
- ➢ Assessing risks without shifting costs to other scales
- ➢ Combining physical and socio-economic info.



Change in flood hazard (2000 – 2080)

Winsemius et al., submitted
IVM Inst Env Studies

Projection and modelling
Cross cutting

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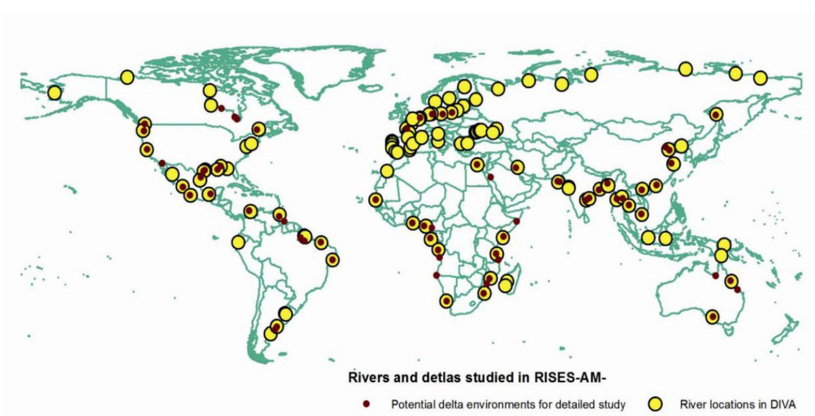
Global scale projections and modelling providing
- ➢ Comparative (objective) assessments
- ➢ Basis to select vulnerability hotspots (in depth analyses)
- ➢ Incorporating "local" scale advances (into global analyses - DIVA)

Year 1990
Year 2004
Year 2015
Year 2025
Year 2035
Year 2045



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Projection and modelling
Local

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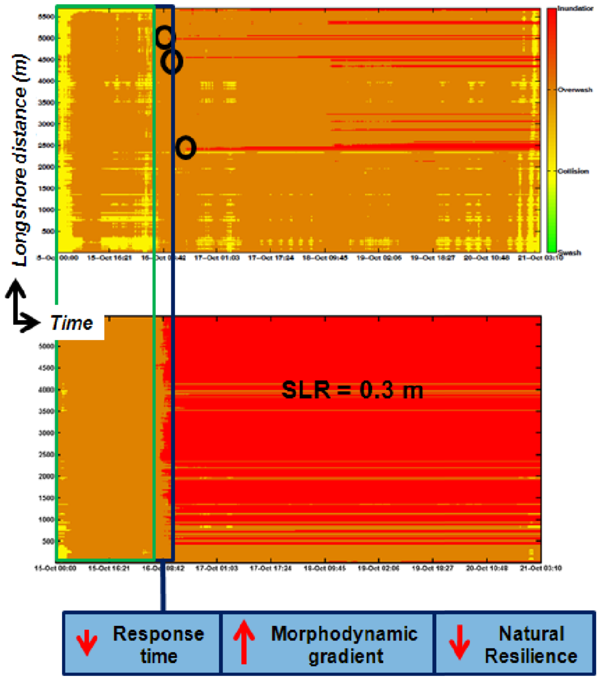
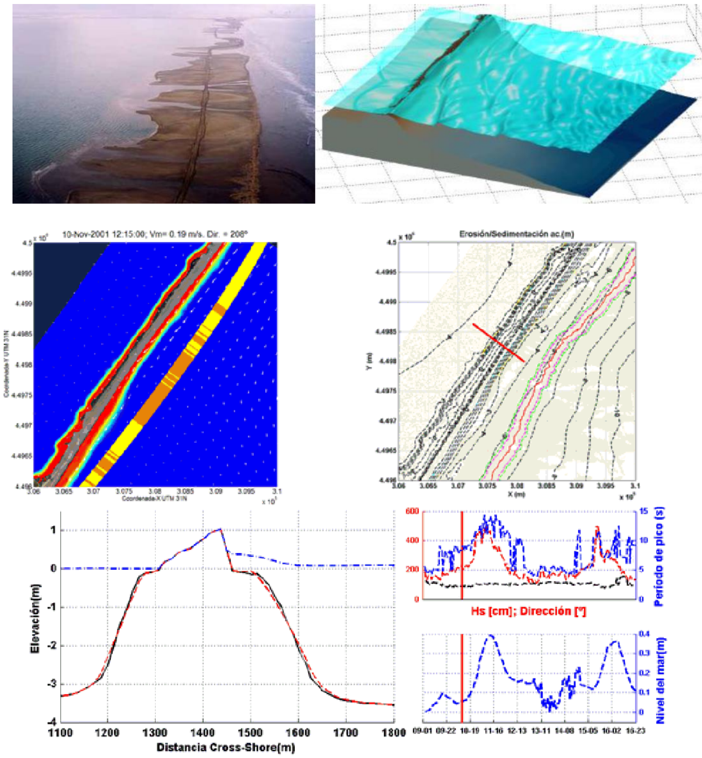
Erosion – Flooding results





Trabucador barrier beach – Ebre delta

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Efficient responses

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Limited Impact	Environmentally Friendly

Longer Duration	Energetically Friendly

Novel / Green Interventions

Enhanced vertical accretion

Flexible	Different services Different Phys/S-E Conditions

Adaptable	Functional (under new conditions) Modifiable

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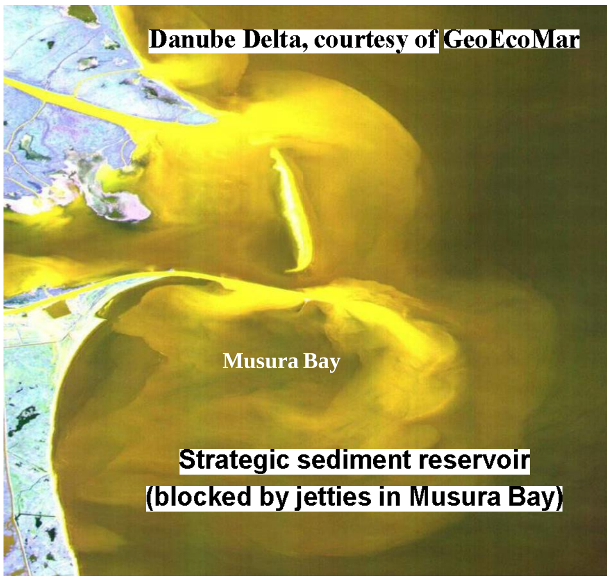
Efficient responses

Efficiency criteria
Based on “green” (novel/conventional) solutions

- Avoid “rigidisation” (loss of natural dynamics)
- Use sediment reservoirs as “fossil” sources
- Work with vegetation as a means to reduce mobility



Conclusions

Efficient coastal responses to *Climate Change* must consider

- Scale requirements (trends + extremes; deltas vs other coasts)
- Cost (initial + maintenance + impact) at short and long term scales
- Novel + conventional interventions (working with Nature)
- Performance in terms of risk and contribution to climate mitigation (C footprint)

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Framework for responses

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1a	**Catalan coast**	Western Med	Mitigation / conservation / protection strategies
1b	**Catalan harbors**	Western Med	Adaptation measures to improve port exploitation
2	**Croatian coast**	Central Med (Adriatic)	Protection and development strategies
4	**Danube Delta**	Black Sea	Sustainable development of the Danube Delta Biosphere Reserve
5	**Ebro Delta**	Catalonia, Spain	Adapt to relative sea-level rise and extreme events through a set of management, restoration [illegible] measures.
6	**Elbe estuary / Hamburg port**	North Sea	Economic and environmental acceptable measures
7	**Global deltas**	Global	Maintain risk levels against flooding (amount of people)
8	**Global impacts**	Global to regional (e.g. European or Med)	Mix of protect, accommodate and retreat options and considering multiple impacts to improve adaptation approaches
9	**Coastal cities**	Ho Chi Minh City, Rotterdam & New York	Cross cutting impacts and adaptation
10	**Liverpool bay and Mersey estuary**	Irish Sea	Dual tidal barrage (flood protection and power generation)
11	**Maldive islands**	Small islands case representative	Options for different types of islands against SLR
12	**Netherlands**	Low lying sandy coasts	Sandy based strategies for blue growth
13	**Med and Black Sea deltas**	Deltaic regional archetype	Sustainability strategies and efficiency

THANKS !

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