Laboratori d'Enginyeria Marítima
UNIVERSITAT POLITÈCNICA DE CATALUNYA

RISES -AM-
EU Research Project

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

COASTAL VULNERABILITY IN "FUTURE WORLDS"

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European Contract No. 603396

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BELMONT FORUM

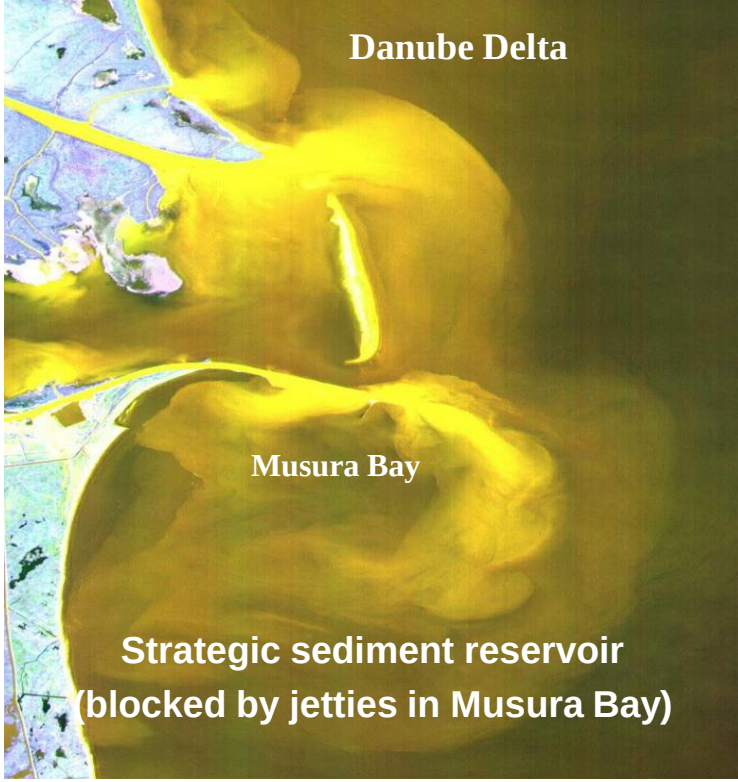
Contents

- Project overview
- Evolution (scenarios and impacts)
- Coastal vulnerability
- Projection & modelling across scales
- Conclusions and future work

To project impacts through coastal cases

• Wide range of **climate** factors **evolving** continuously (terrestrial, marine, morphology, population...)

• With high **adaptation** *deficit* (costs) (small islands, developed deltas...)



Coastal adaption in place (Maldives)

Images courtesy of Ministry of Environment and Energy, Maldives

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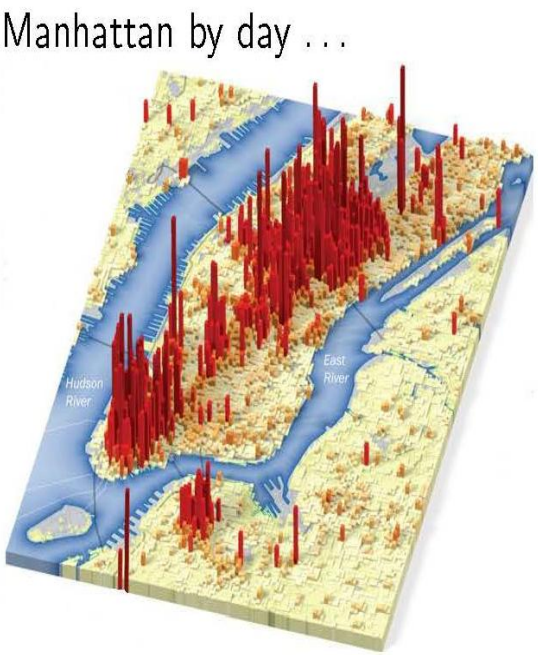
To evaluate responses through coastal cases

• **Transient** "pressures"

(wave *storms*, *population*...)

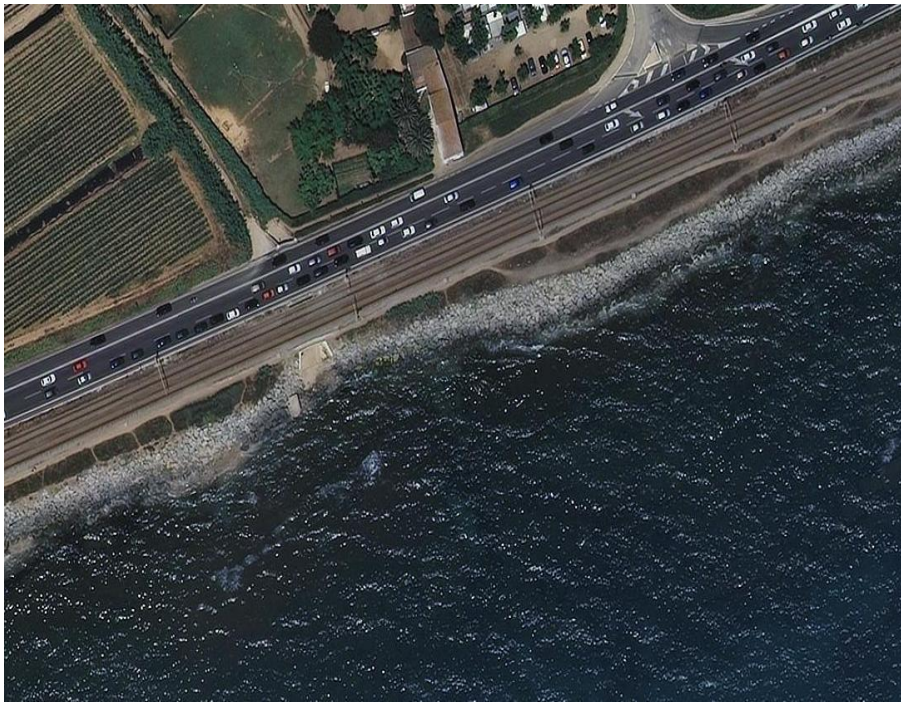


• **Scarce** territory with

reduced *"natural" response* capacity

• With high level of **conflicts** (present)

to get more *acute* in the *future*



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To assess novel/sustainable “solutions” at local, regional and global scales

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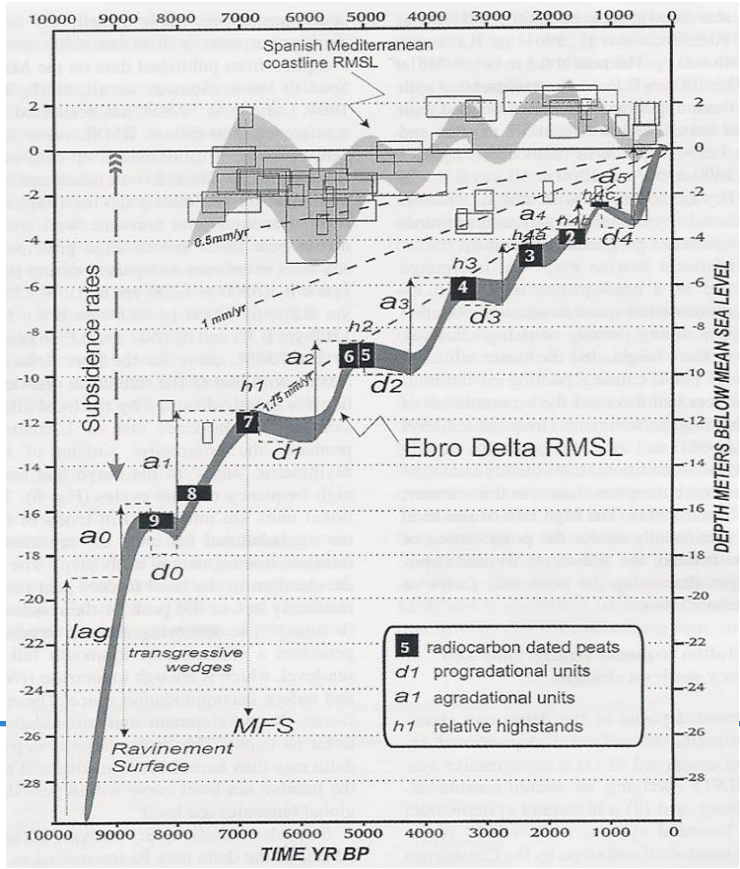
Among assessment cases:
Deltas / Estuaries

- Higher impact (vulnerability)
- Natural Scale Integrators (forewarning)



Novel interventions: promote vertical accretion (flooding “compensates” subsidence)

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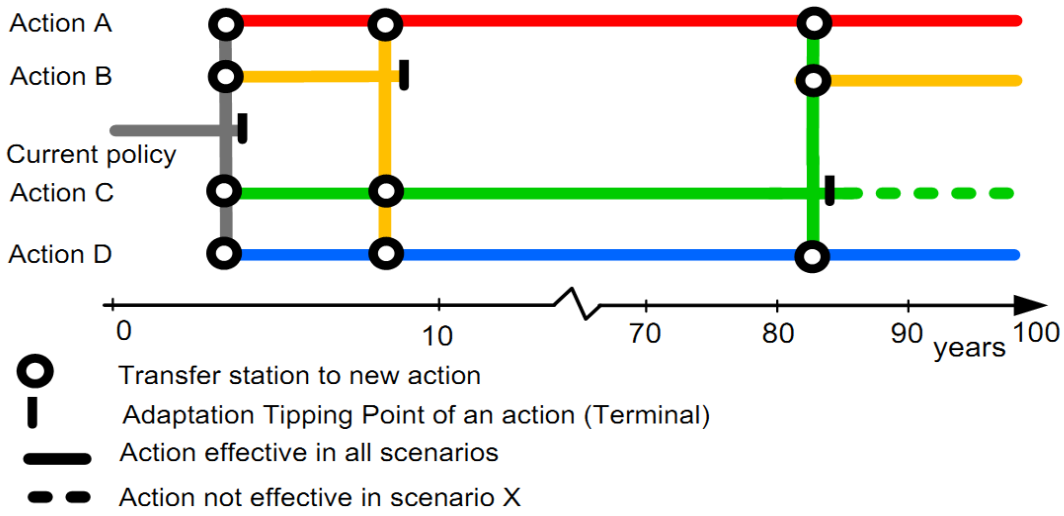
Holocene subsidence rates (Somoza et al 1998)

RISES –AM – methodology explicitly includes

- **Adaptation pathways** (sequence of policy actions)

→ to achieve **targets** (**limiting** future "**regrets**")
→ under *changing* **physical** drivers
→ under *changing* **socio-economic** conditions

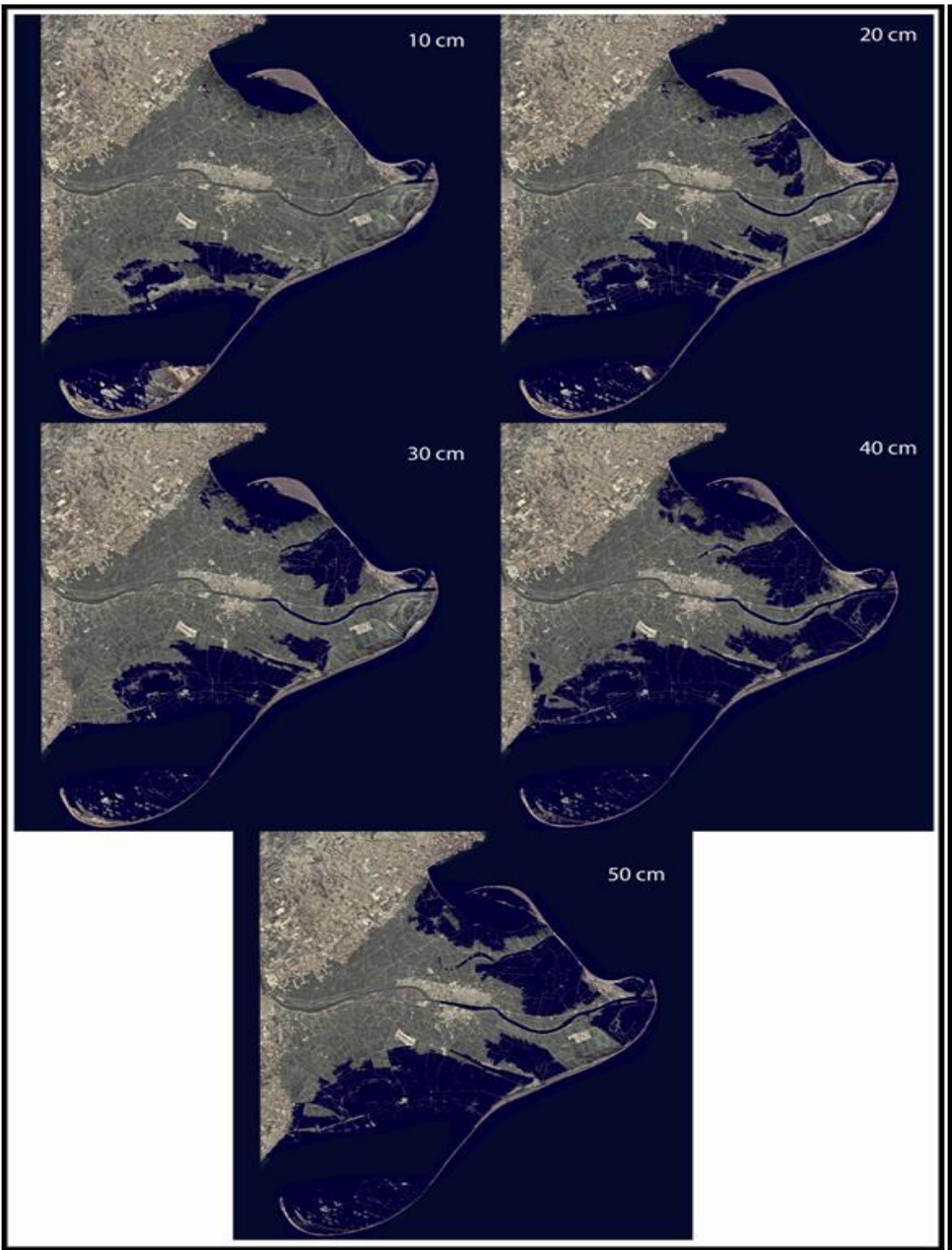


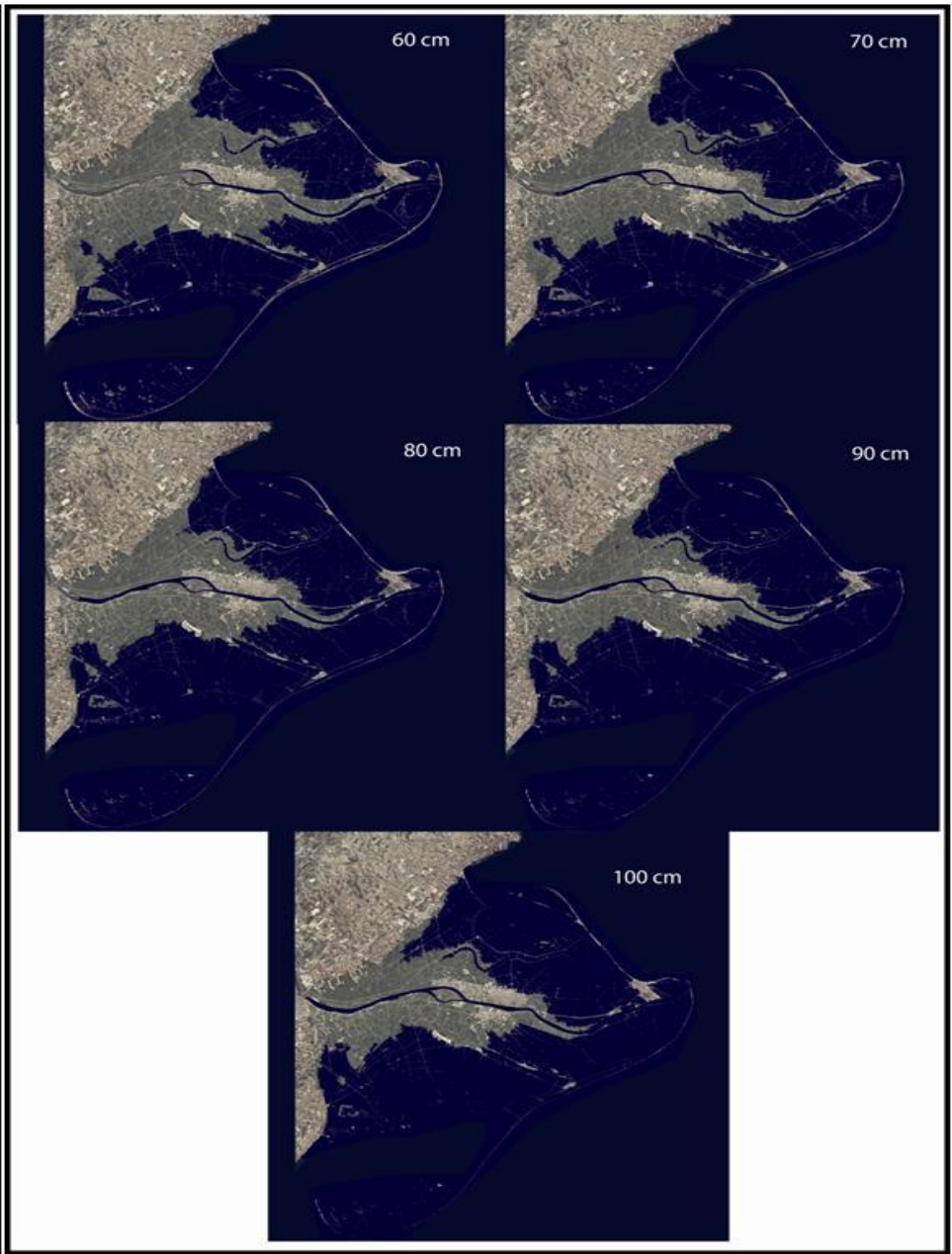
Adaptation Pathways Map

	Path actions	Relative Costs	Target effects	Side effects
1		+++	+	0
2		+++++	0	0
3		+++	0	0
4		+++	0	0
5		0	0	-
6		++++	0	-
7		+++	0	-
8		+	+	- - -
9		++	+	- - -

Scorecard pathways

Deltaic sediment starvation
Tipping points for reservoirs & deltas (Ebre delta)

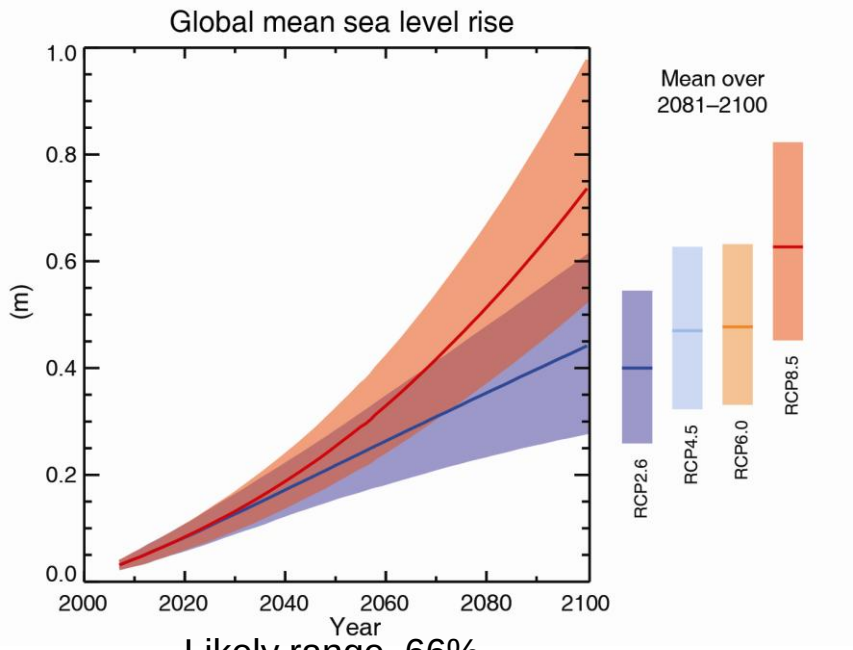




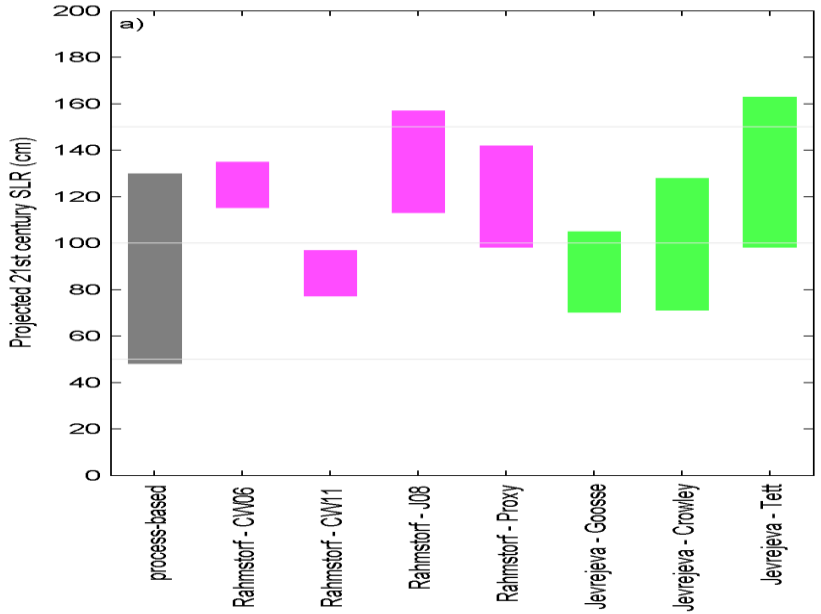
Scenarios and projections

A. Global scale – Only Sea Level Rise

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



Likely range, 66%
(SPM, 2013)



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

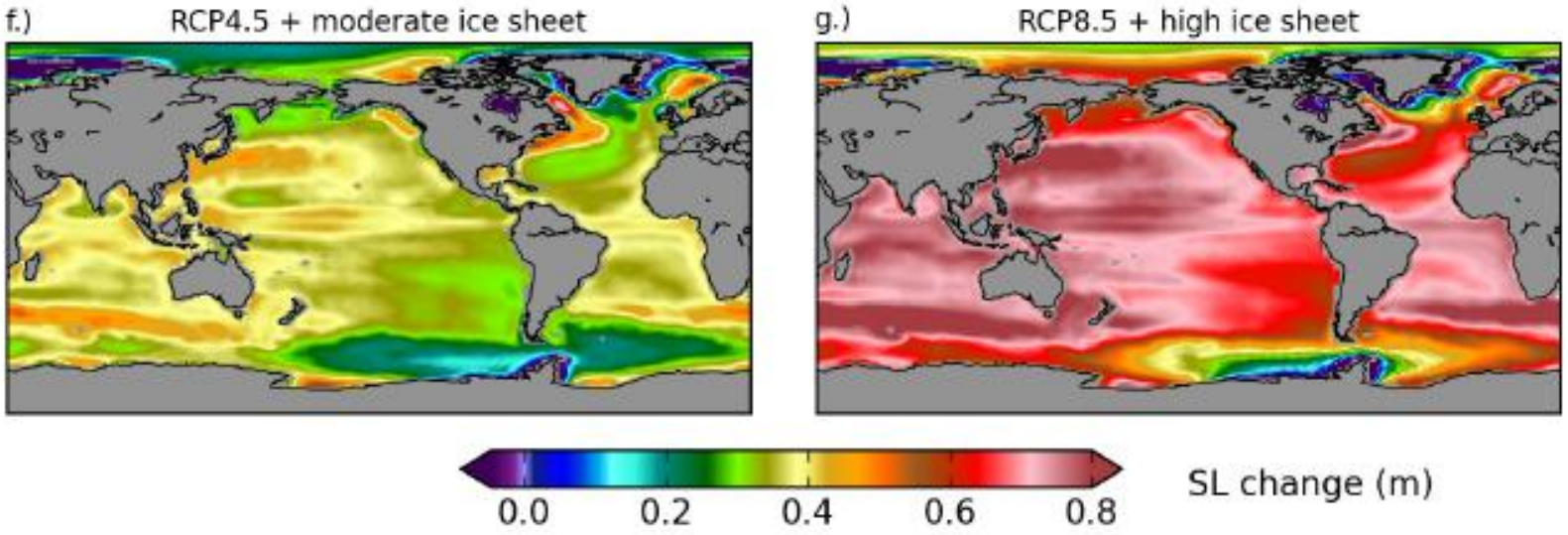
Global SLR (emphasis on high-end) for various quartiles/authors

B. Regional

B.1. Sea Level Rise

RCP 4.5 & RCP8.5 + upper limit

Regional (downscaled) projections → Regional MSL components combined (e.g. fig below for median projections).

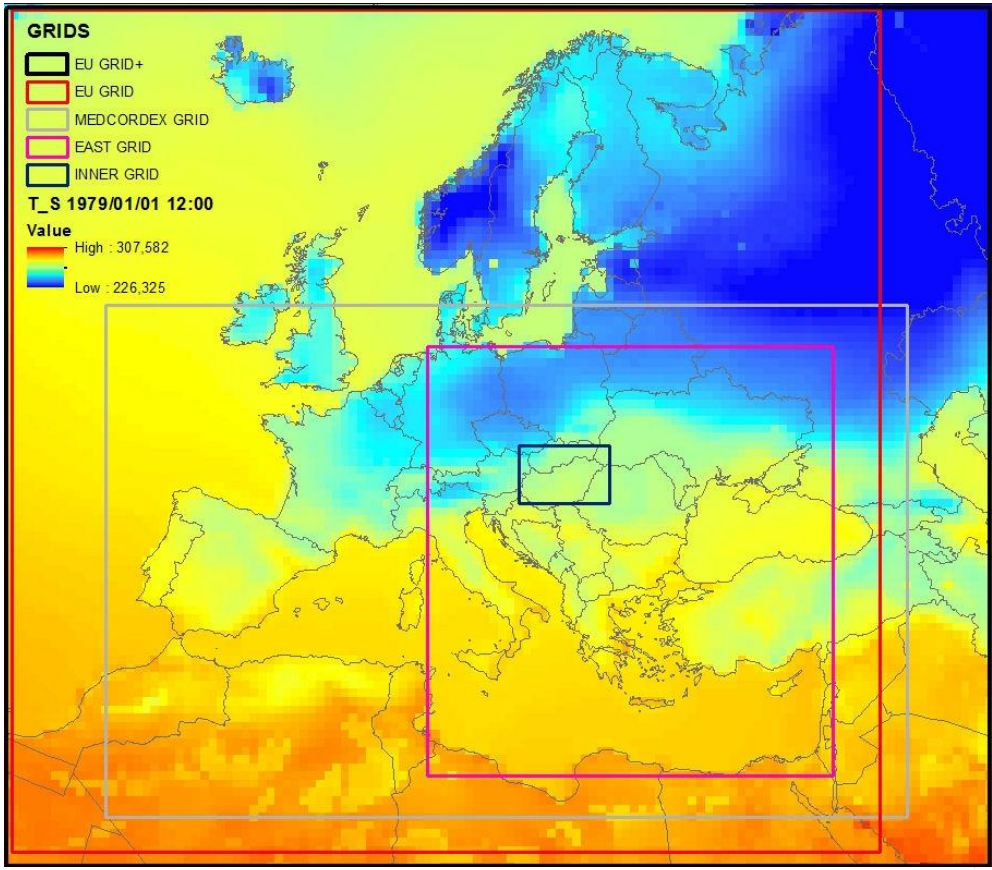


B.2. Waves + Storm Surges

Regional scale projections for waves & storm surges (1 GCM + 1 RCM)

Realisation for the time slice 2070-2100.

- Only RCP8.5 (1 model- CMCC)
- Computational grid for Europe



Distribution along Mediterranean coast
(Conte and Lionello, Global and Planetary Change)

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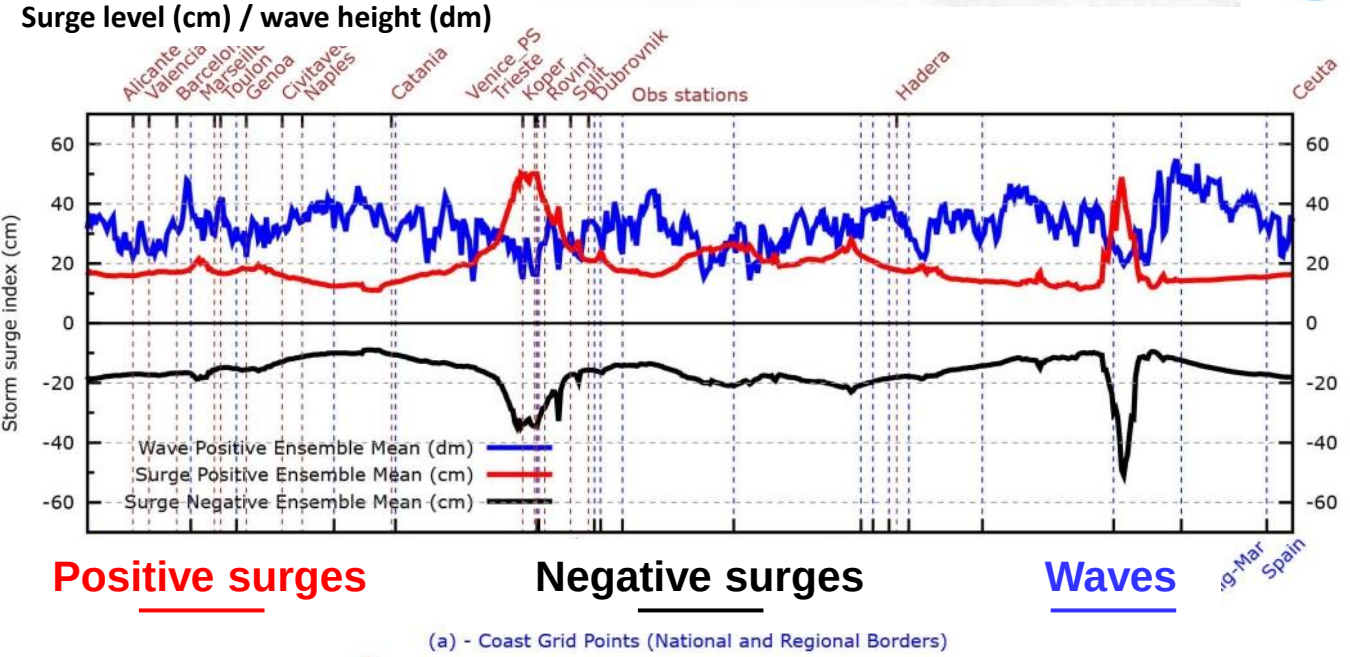
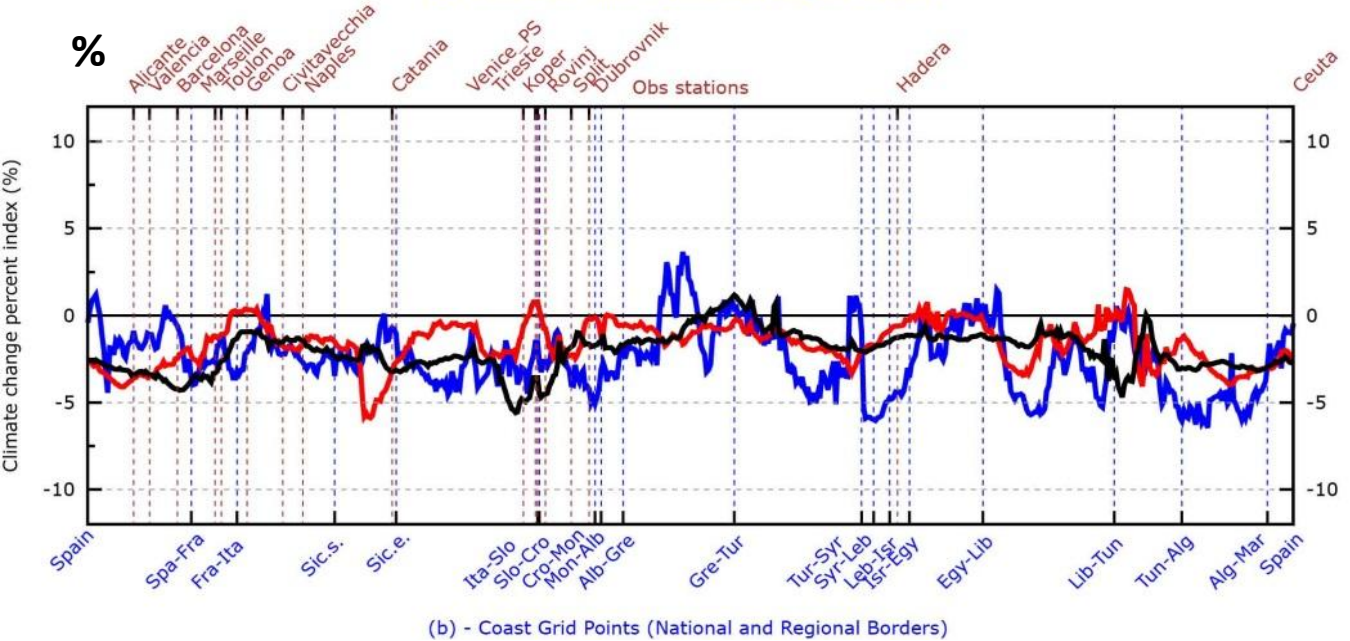




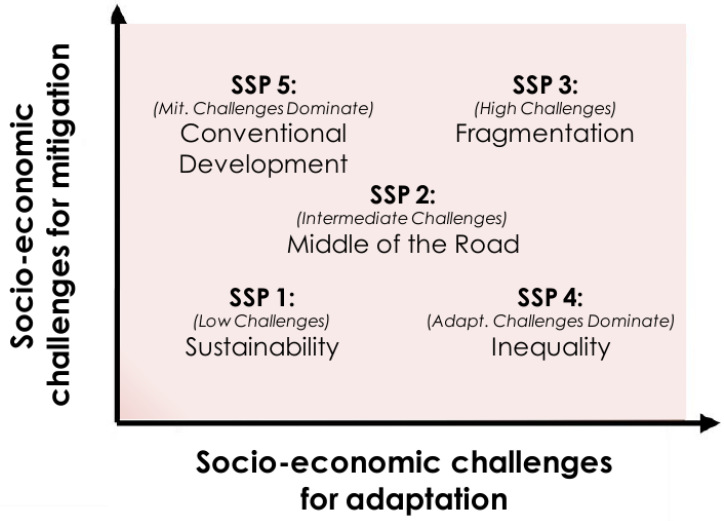
TOP: **Ensemble mean** storm surge index (cm) for + (red line, cm) and - (black line, cm) surges & waves (dm) in **present climate (simulations)**

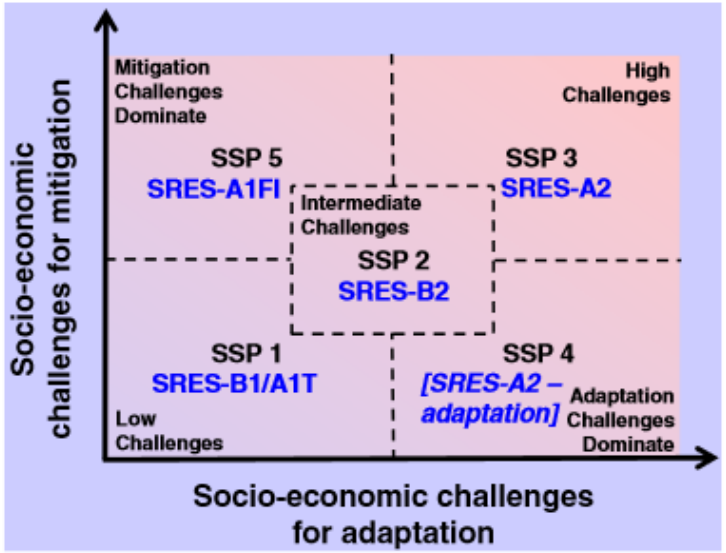
Coastal points are ordered clockwise starting from Gibraltar.

BOTTOM: **Climate change percent index** (%) for positive (red line) and negative (black line) surges and waves (blue line)

SSPs and SRES

Source: O'Neil et al., 2013





SSPs narratives (5) distinguished on **challenges to adaptation and mitigation**, rather than on emissions pathways (e.g. SRES).

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

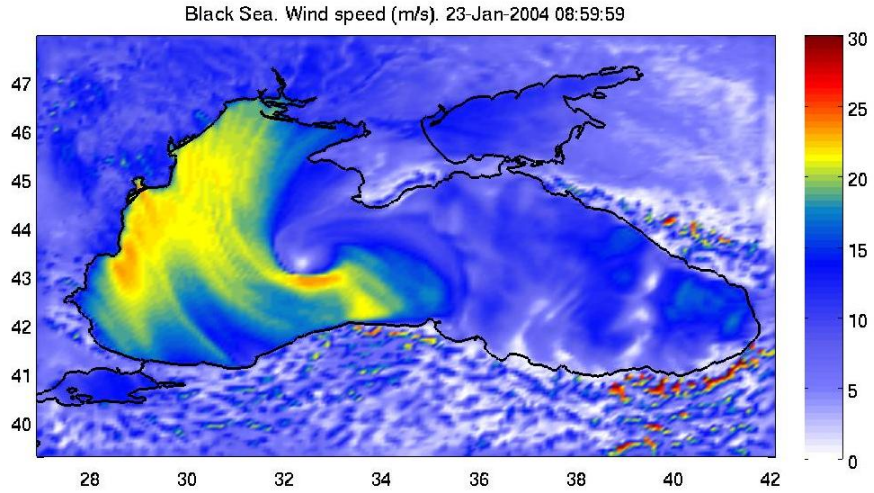
Emphasis on SSP 3, 4 and 5 (consistency with high end conditions)
Warming level of 4ºC ⟹ RCP 8.5 ⟹ SSP 3, 4, 5

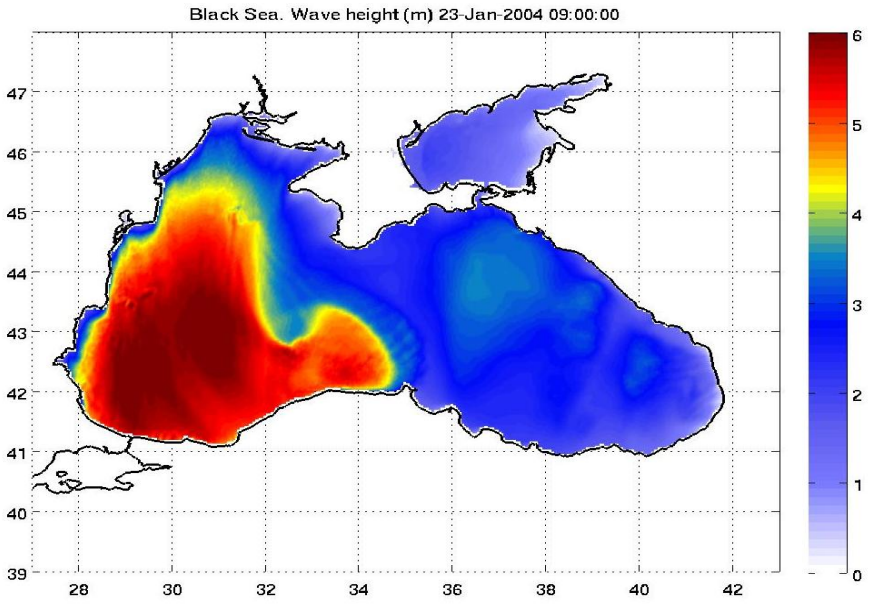
Model List – Time Scales

- **Decadal Scale**
- **Yearly Scale (months to years)**
- **Event Scale (hours to days, Ƭ = decades)**

Long-term low lying coast (Netherlands)

Storm event for Black Sea coast

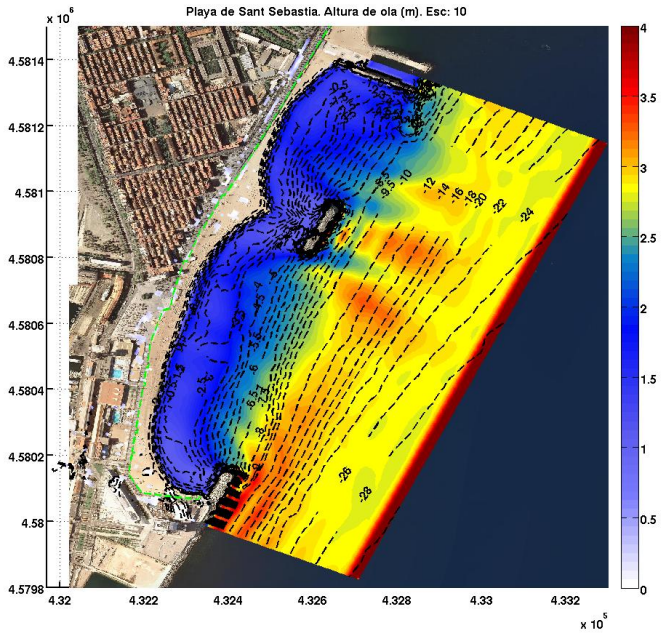




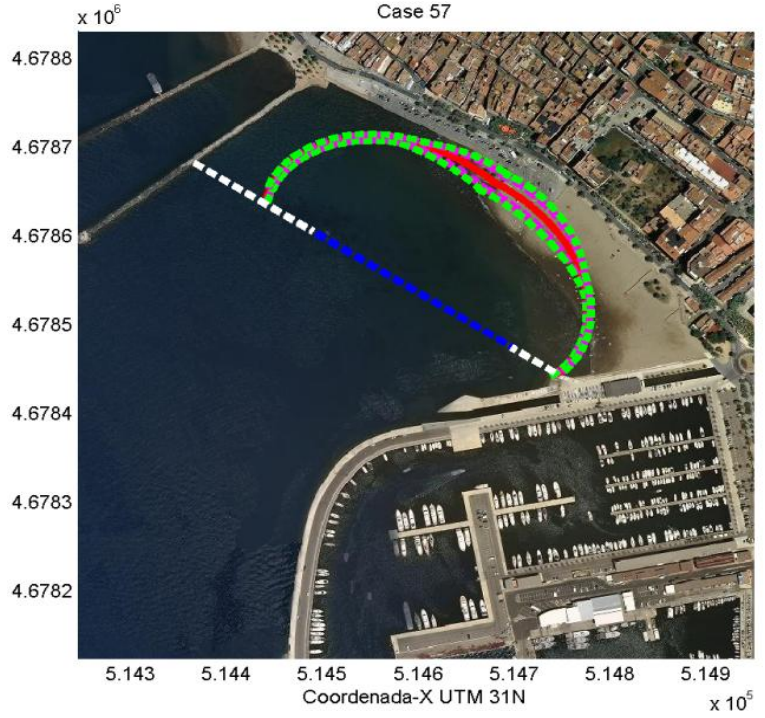
Costal Development → Potential Impacts → Vulnerability ↑ / Resilience ↓

112 emergències

Costal Adaptation (+) ⇒ Potential Impacts ⇒ Vulnerability ↓ / Resilience ↑



Barcelona Beach *(Wave Height [m])*



Adaptation to

- Available space (present conditions)
- Storm impact range (future conditions)

CONCLUSIONS (0N-GOING WORK)

- Use downscaled future scenarios (physical and socio-economic components) to project impacts
- Combine decadal scale and storm scales
- Transfer across spatial scales (from local to regional and global)
- Use present hydro-morpho and economic models to assess vulnerability
- Make uncertainties explicit (whenever possible)

CONCLUSIONS (0N-GOING WORK)

- Use downscaled future scenarios (physical and socio-economic components) to project impacts
- Combine decadal scale and storm scale
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- Use results from eco-morpho and economic models to assess vulnerability
- Make uncertainties explicit (whenever possible)

THANKS!!!