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UNIVERSITAT POLITÈCNICA DE CATALUNYA

RISES-AM-
EU Research Project

Impactos costeros bajo climas futuros
El proyecto RISES-AM-

Prof. A. Sanchez-Arcilla

1) Impactos y tipos de costa
2) Escala de décadas y de tormentas
3) Seguimiento
4) Niveles de riesgo (coste)
5) Sostenibilidad (?)

Courtesy Univ. Southampton

More than SLR !

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Coast Typology & Vulnerability. Present

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Costal Development

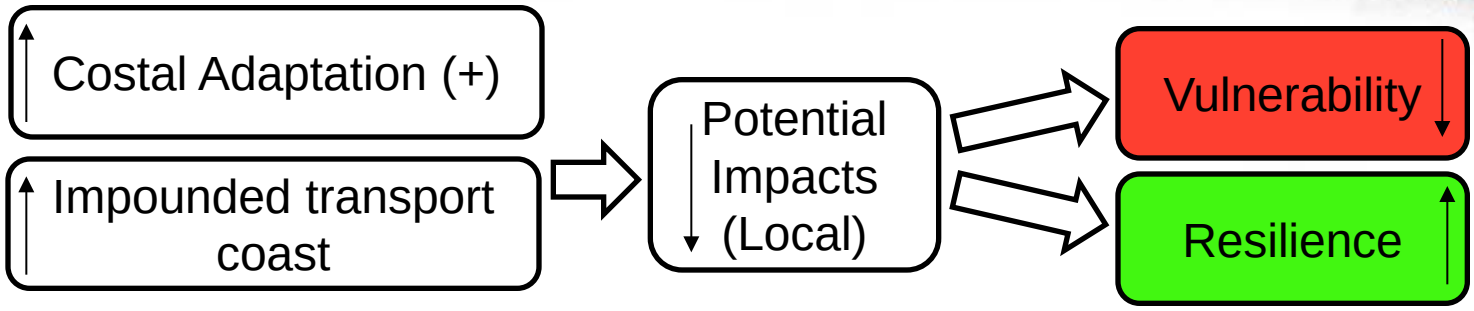
Free-transport coast

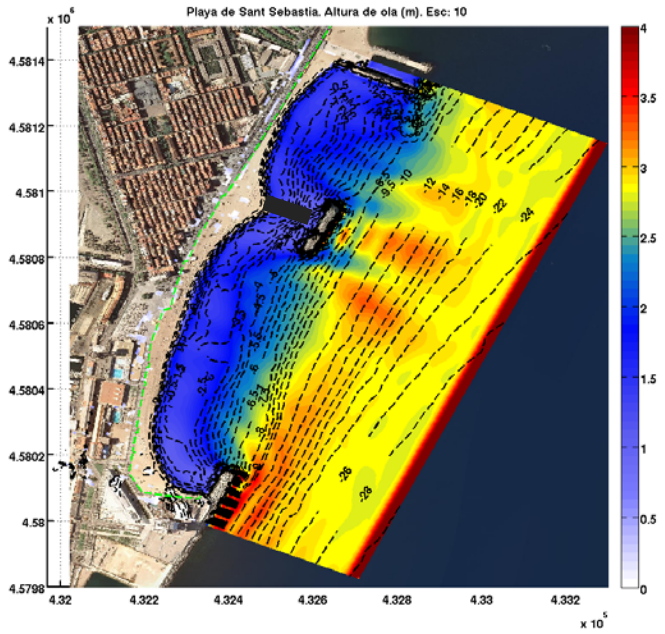
Potential Impacts (General)

Vulnerability

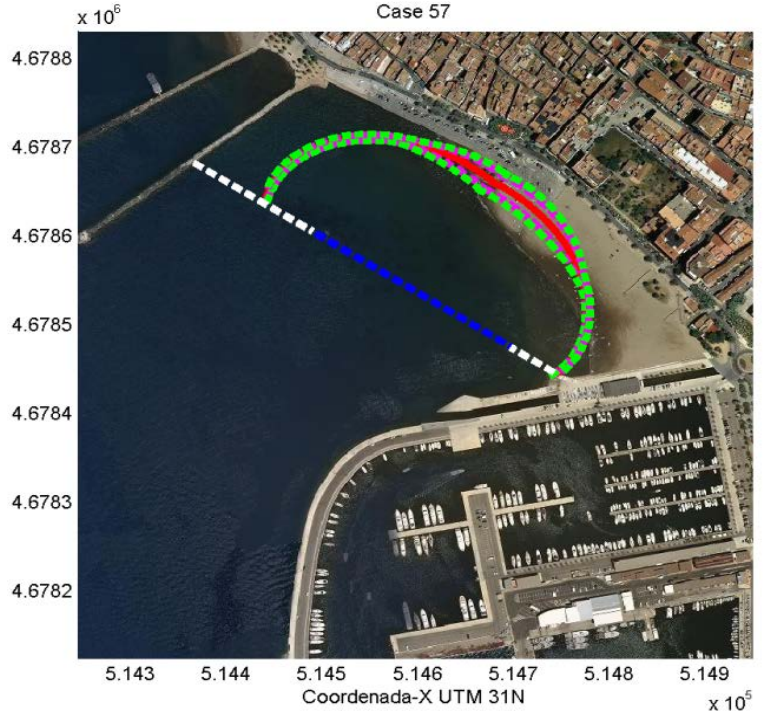
Resilience

Coast Typology & Vulnerability. Present





Barcelona Beach *(Wave Height [m])*



Adaptation to

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

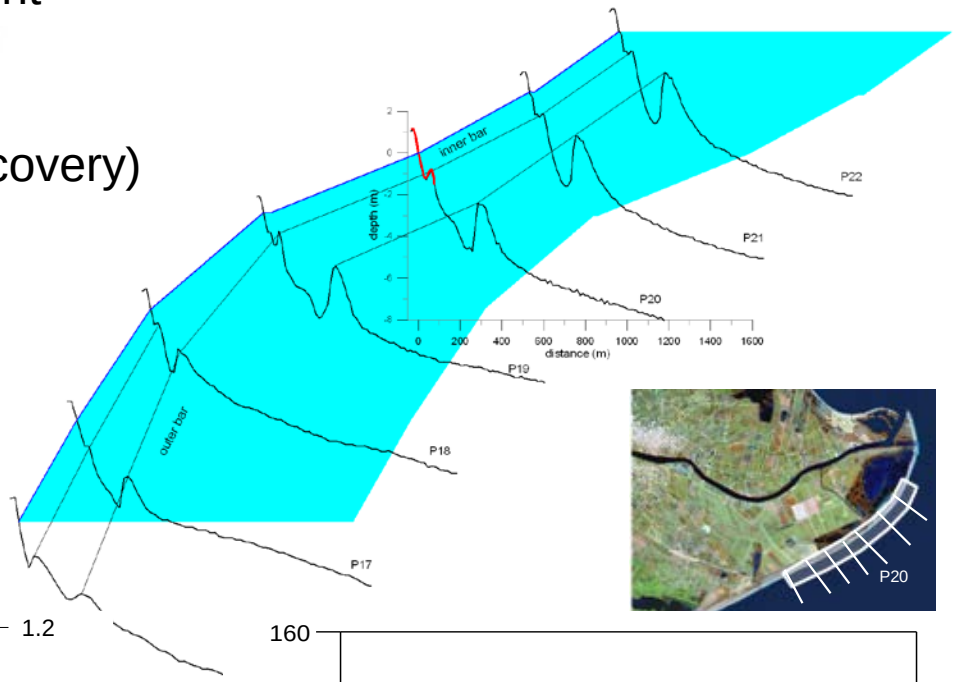


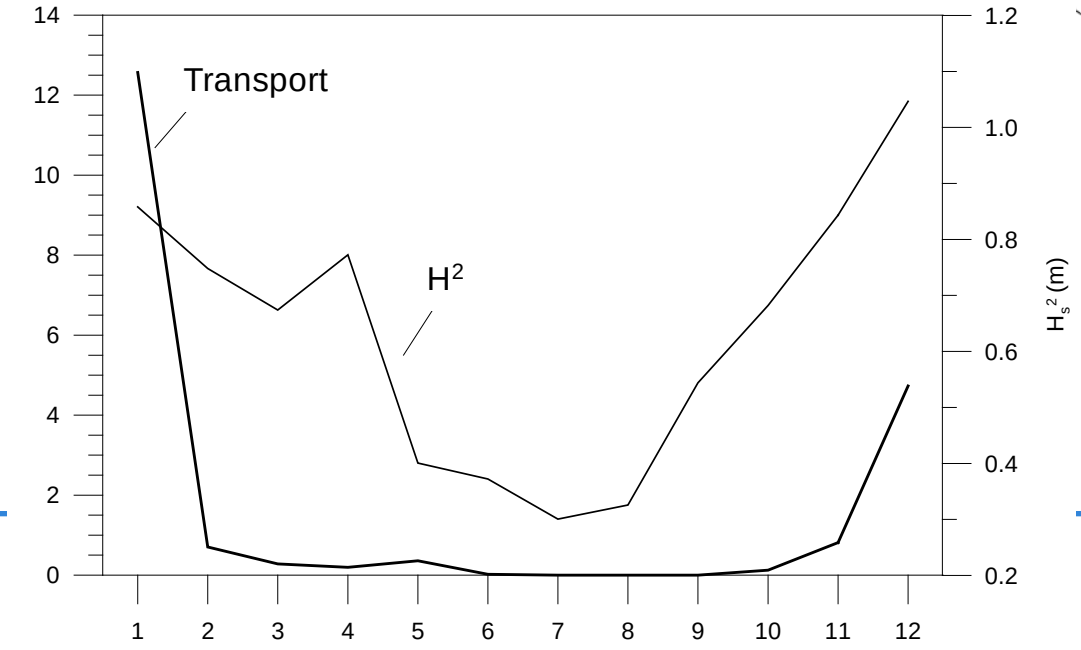


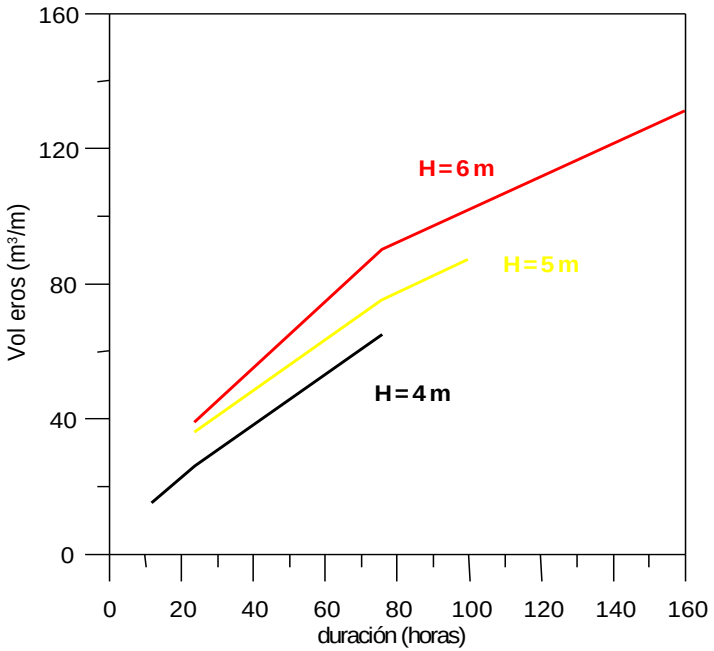

For a given "pressure" (Hs, MSL…)
Impact = f(typology)
Different for present / future conditions
Impact (damage) **hotspots**

Med-type coast
Semi-enclosed environments
Present

- Sediment starvation
- Permanent bars (limited natural recovery)
- Only "active" 20% in a year
- Highly sensitive to storm features (other than Hs)

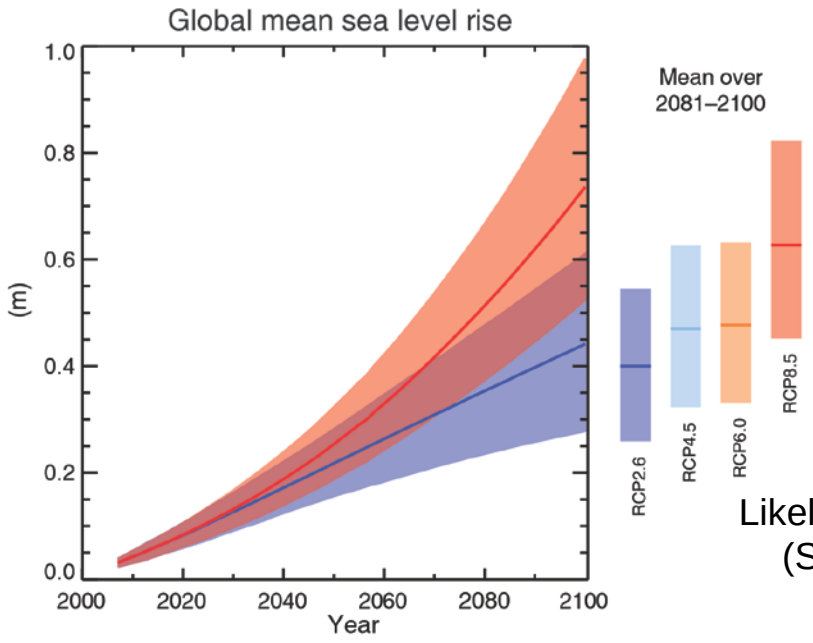






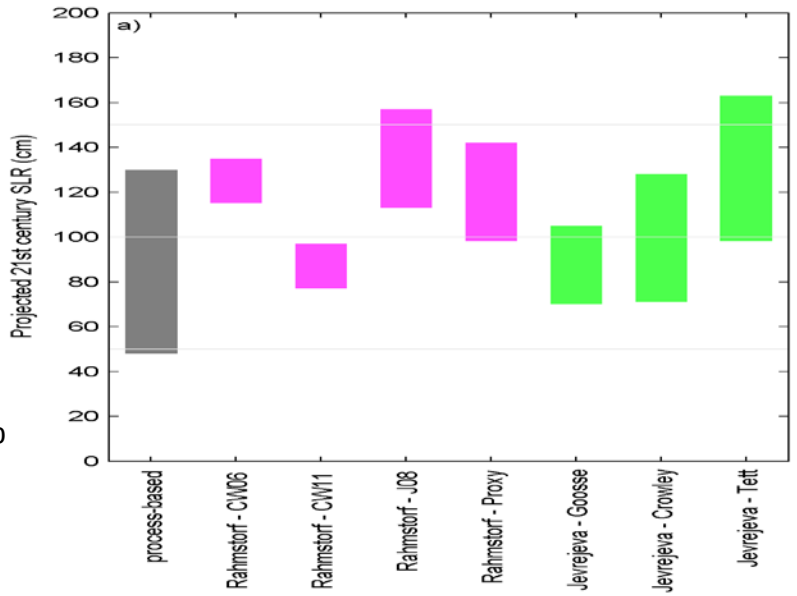
Long-term considers future scenarios (high-end with warming up to 4ºC)

- **Physical (MSL + waves + storm surges): RCP4.5 & RCP8.5 + upper limit SLR**
- **Socio-economic: SSP5 + SSP3**



Likely range, 66%
(SPM, 2013)

95% or “max”
(Moore et al 2013)



SSP5 – Lower population
SSP3 – “Fragmentation “

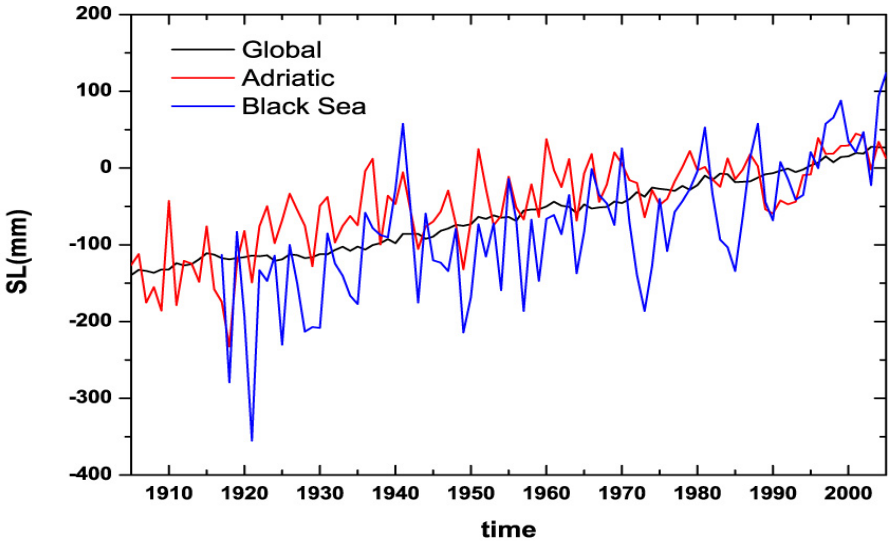
GDP pc + population projections
IIASA realisations

LT decisions require downscaling (Med – Observations)

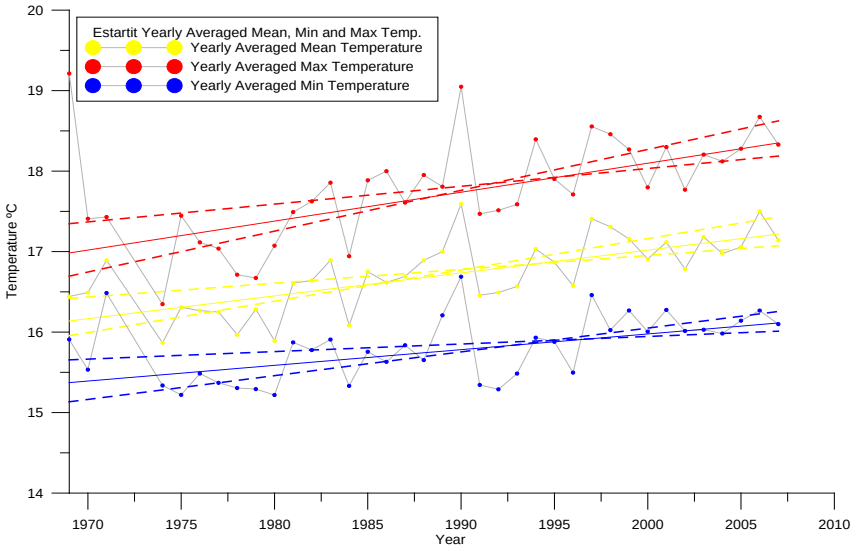
Future scenarios

→ Need to downscale (my beach, my harbour…)

→ Impact adjustment requires monitoring (**pressures & impacts**)



Lionello et al



S.-Arcilla et al, data from **J. Pascual**

LT decisions require downscaling (Med – AR 4 – Sierra et al 2013)

Results: Changes of directional frequencies in **winter** (5 GCM-RCM sets)

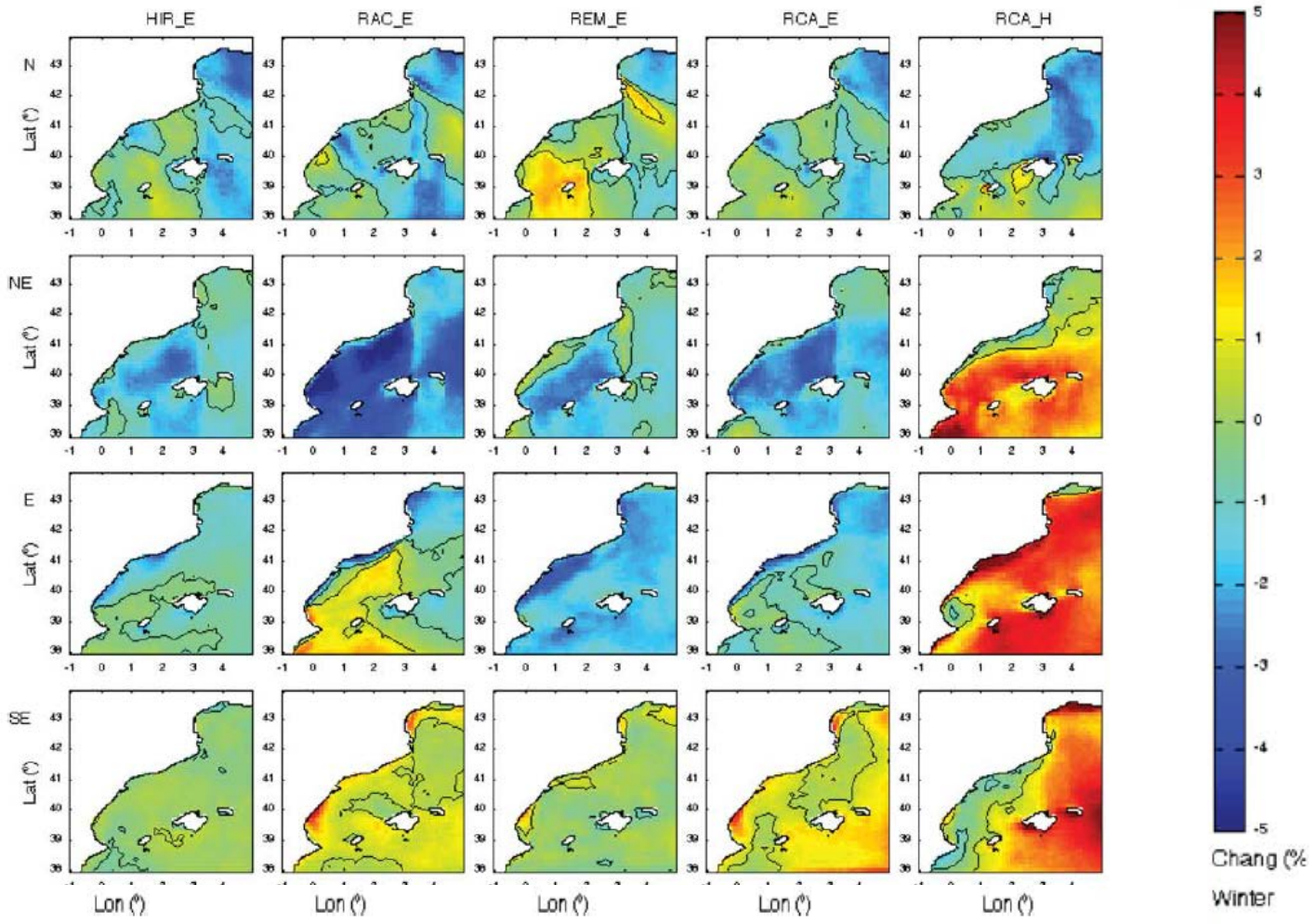
Directions

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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LT decisions require downscaling (Med – AR 4 – Lionello et al 2014)

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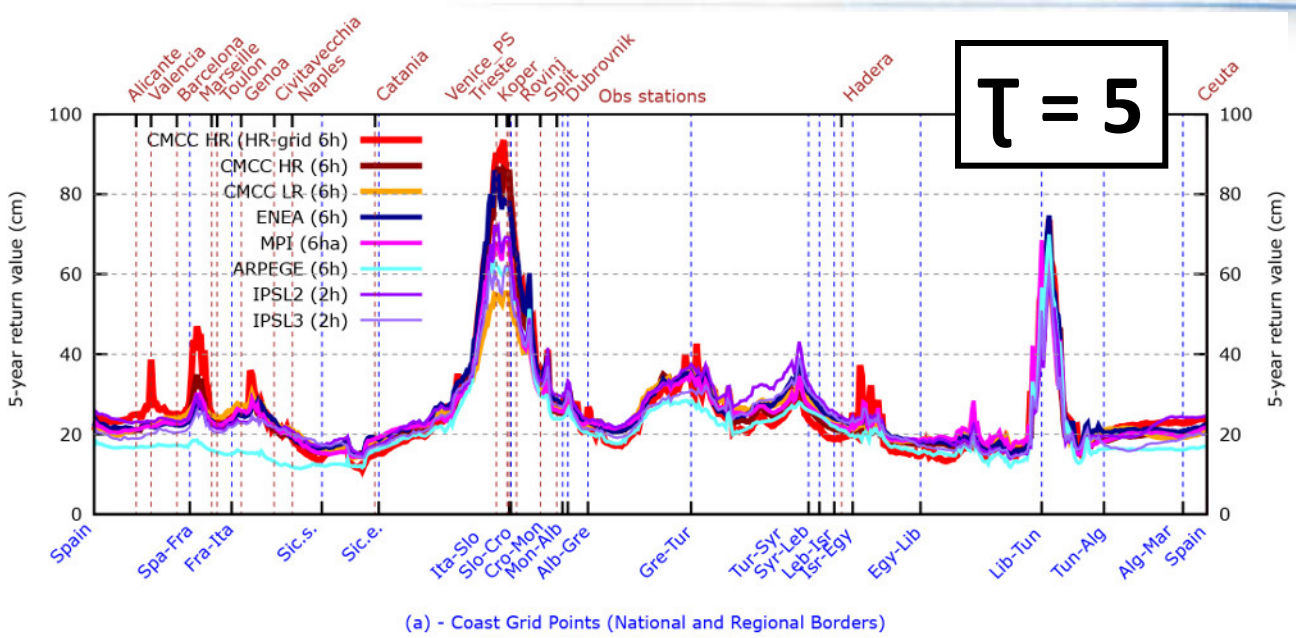
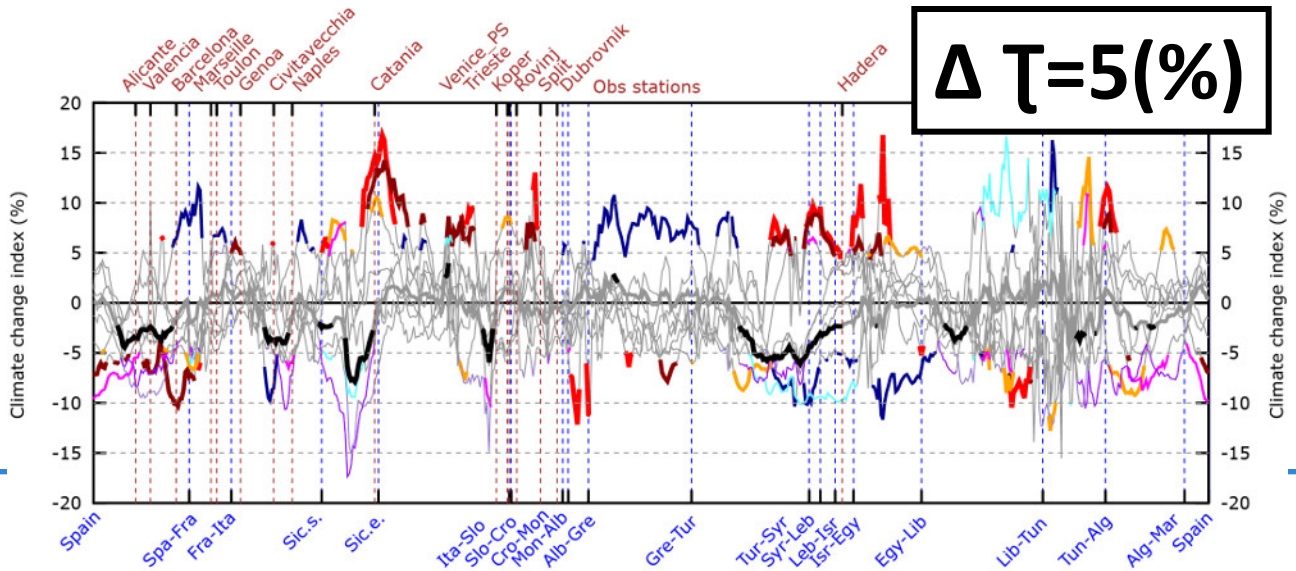


Τ = 5

(a) - Coast Grid Points (National and Regional Borders)

5-year Τ positive surges (cm) under present climate for the Med (simulations).



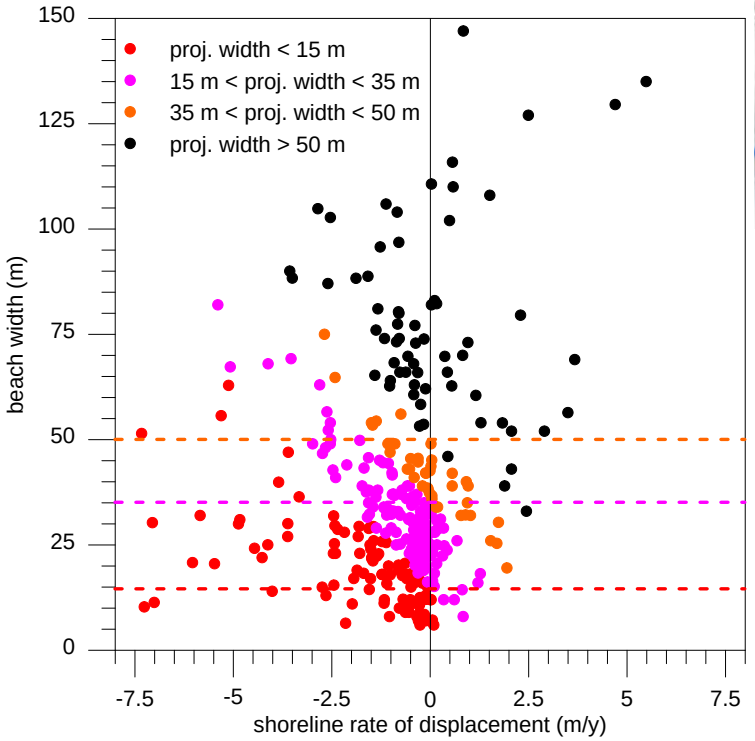
Δ Τ=5(%)

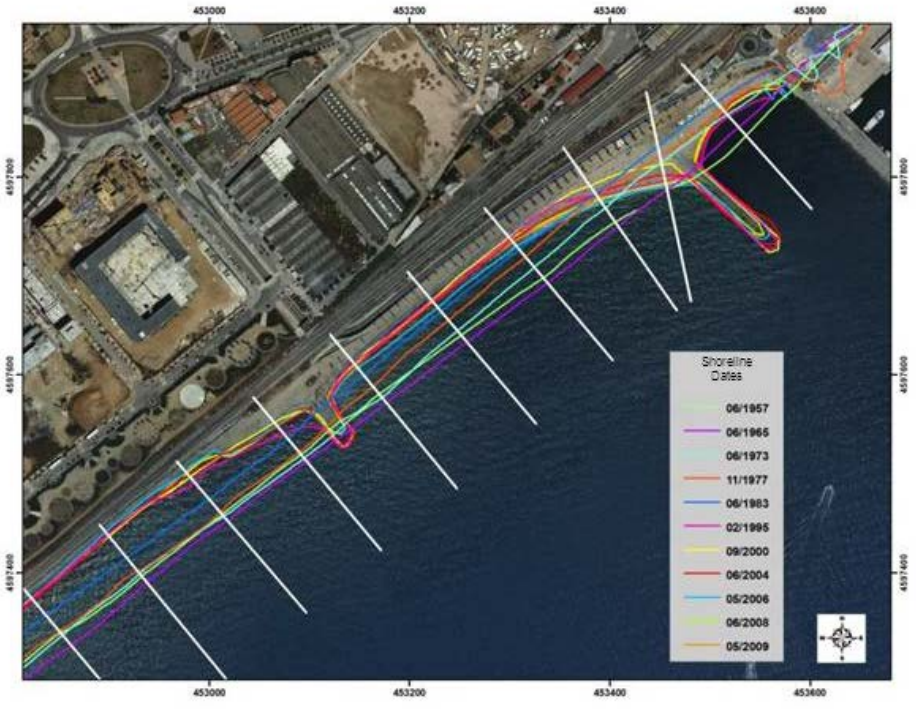
(c) - Coast Grid Points (National and Regional Borders)

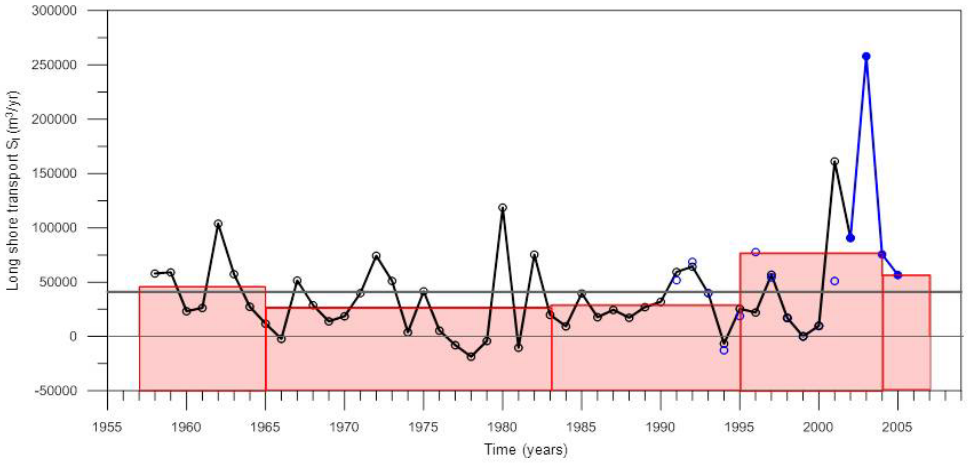
(%) variation under future climates (thick lines indicate CC is significant). **Black line** is the ensemble mean.

Example: Catalan coast. Future conditions
A1B SRES, AR4 (Med, Black seas)

- Predictions – 10 years (Davos forum)
- Based on 1995-2004 data
  - Aerial images
  - Wave climate
  - Longshore transport computations
- Indicator: beach width and berm height (**follow-up**)

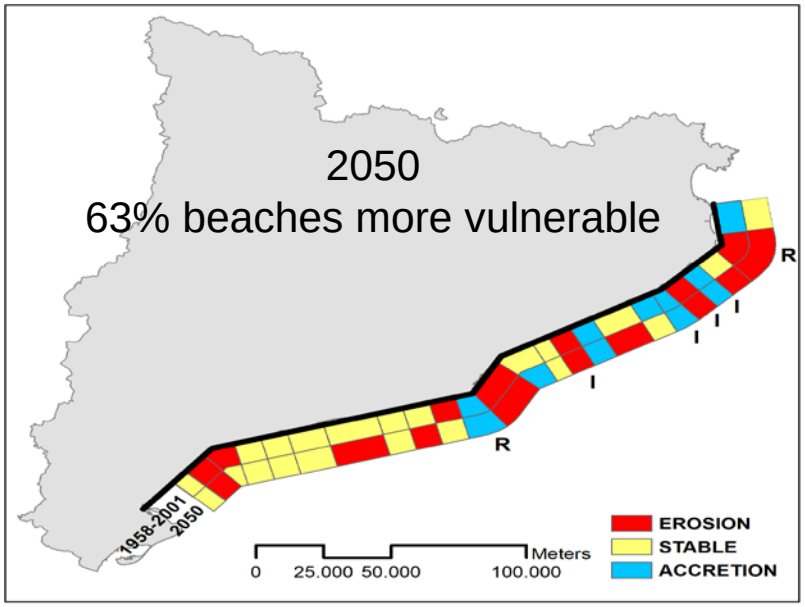


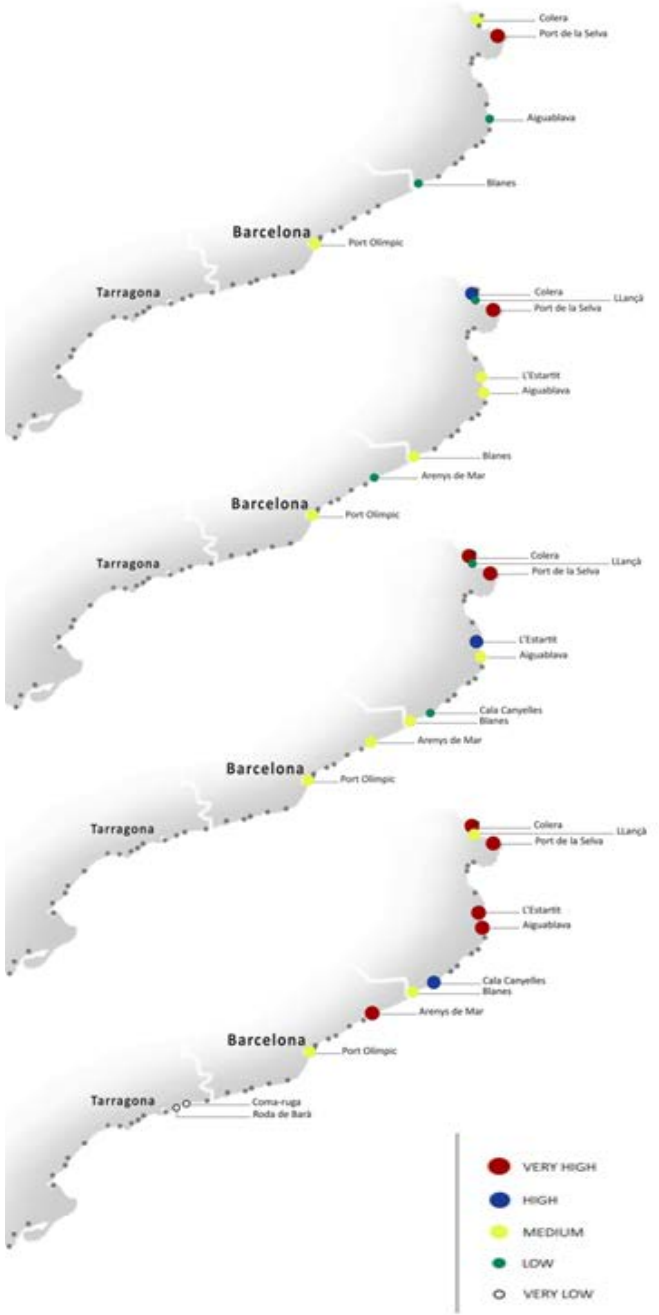




Catalan coast. Future conditions
A1B SRES, AR4 (Med, Black seas)

- Projections – 50 to 100 years (SRES & RCPs)
- Based on 1971-2000 vs 2071-2100 comparison
  - Several models (5 GCM-RCM for SRES)
- Indicators (**follow-up**):
  - Beach width/height for tourism and protection
  - Harbour agitation for port exploitation
- Characterising a coast (beaches and harbours) **out of wave "equilibrium"**





Overtopping vulnerability for 5 year storm in 2050

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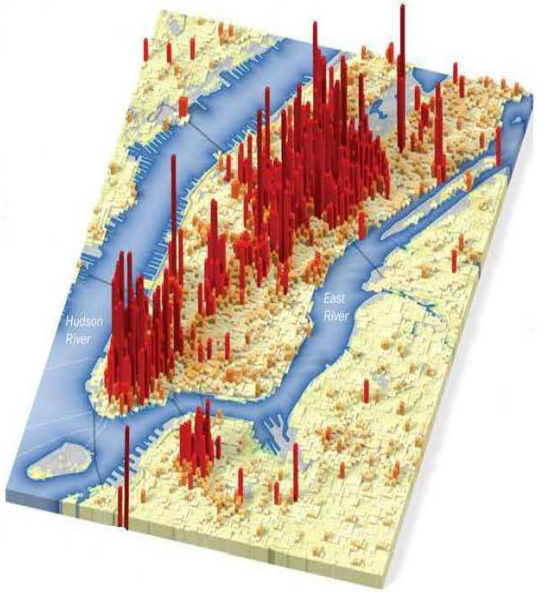
Economic cost:
Function of risk level

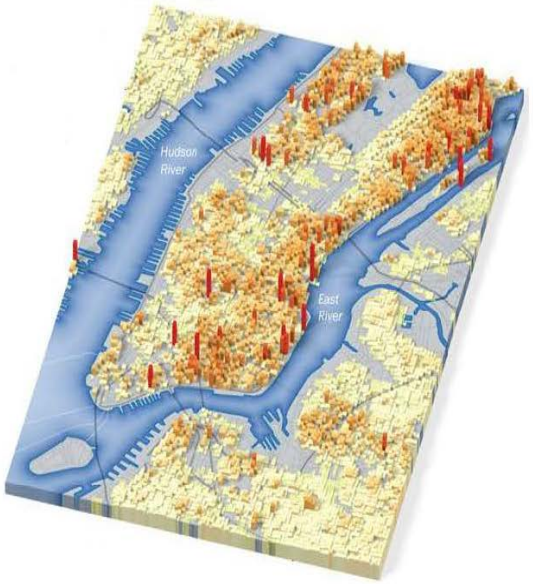
RISK = HAZARD X DAMAGES

Exp. x Vuln.

Manhattan by day . . .



. . . and by night



• **Transient** "pressures"

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

Maresme by summer

⋯and by winter

• **Scarce** territory with

reduced *"natural" response*

capacity

• High level of damages

(potential) **and risks** (present)

to get more *acute* in the *future*

Sustainability: novel/sustainable “solutions” at local, regional and global scales

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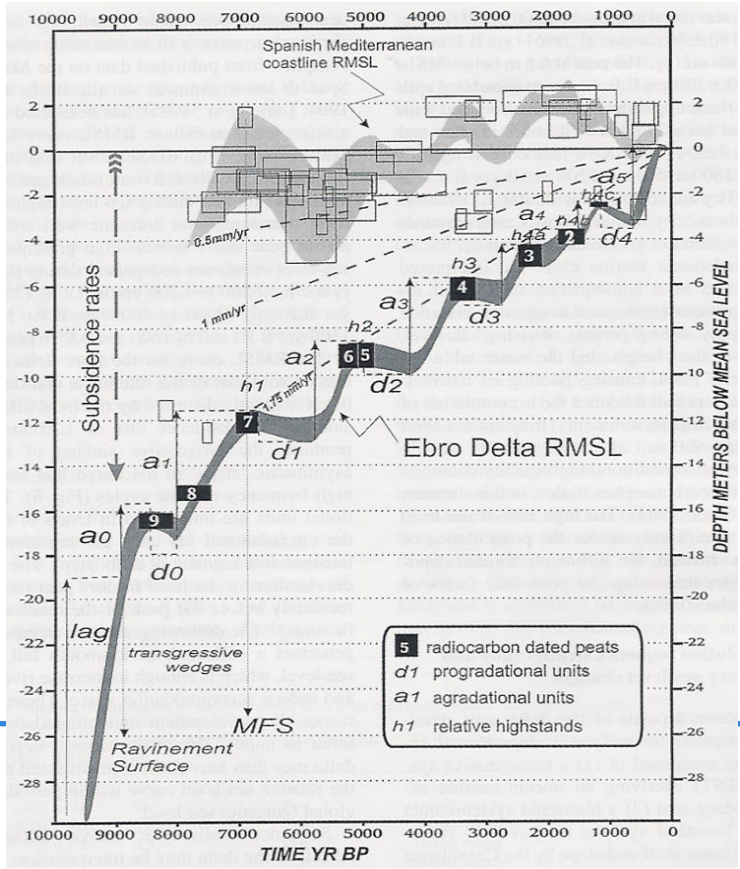
Among assessment cases:
Deltas / Estuaries

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



Holocene subsidence rates (Somoza et al 1998)

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

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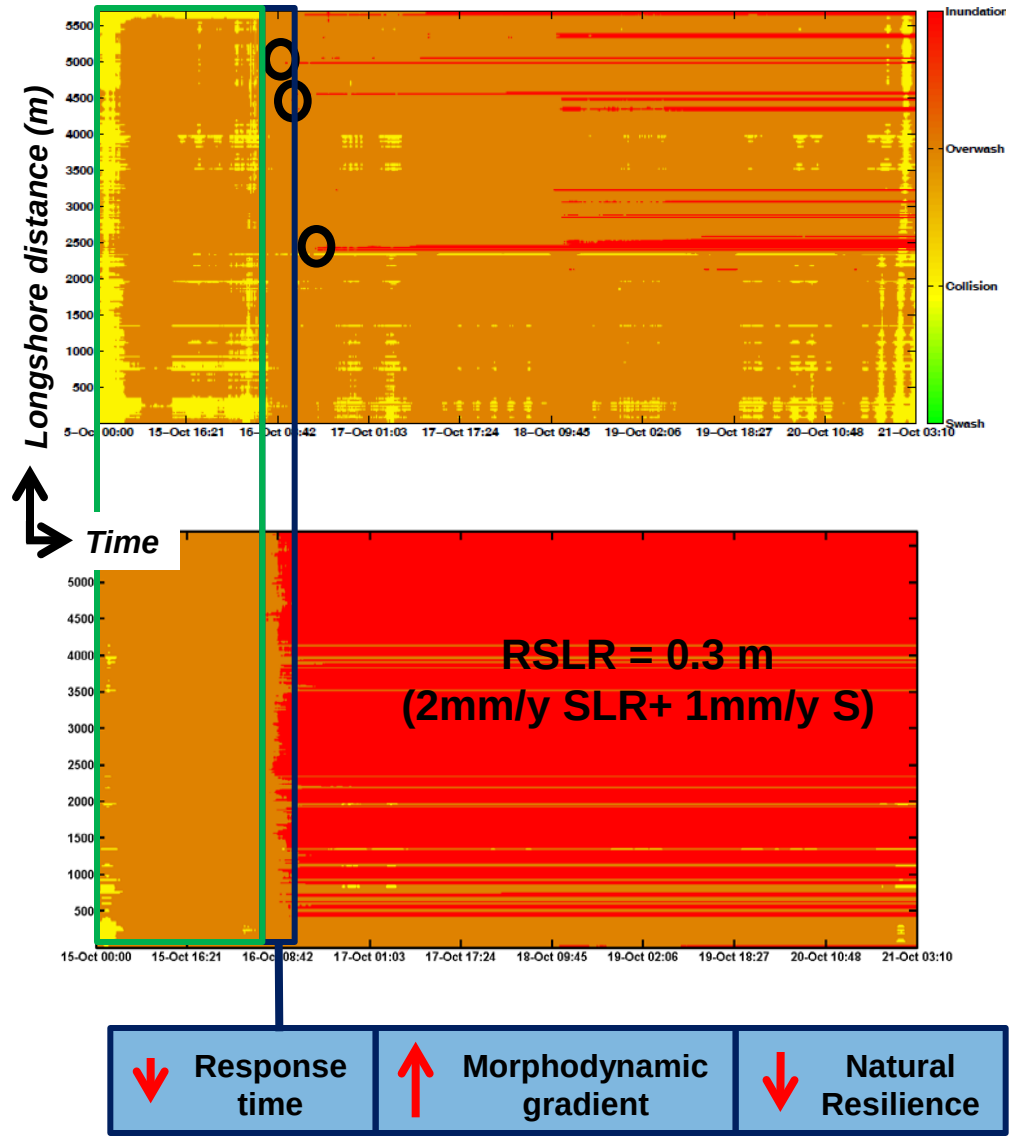
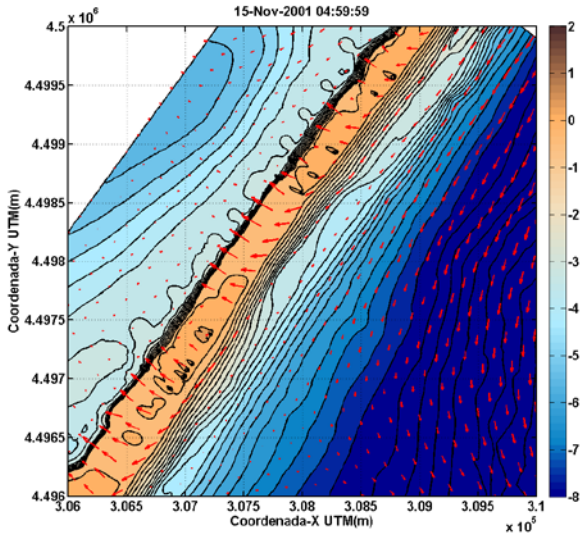
Sustainability under RSLR + storm events

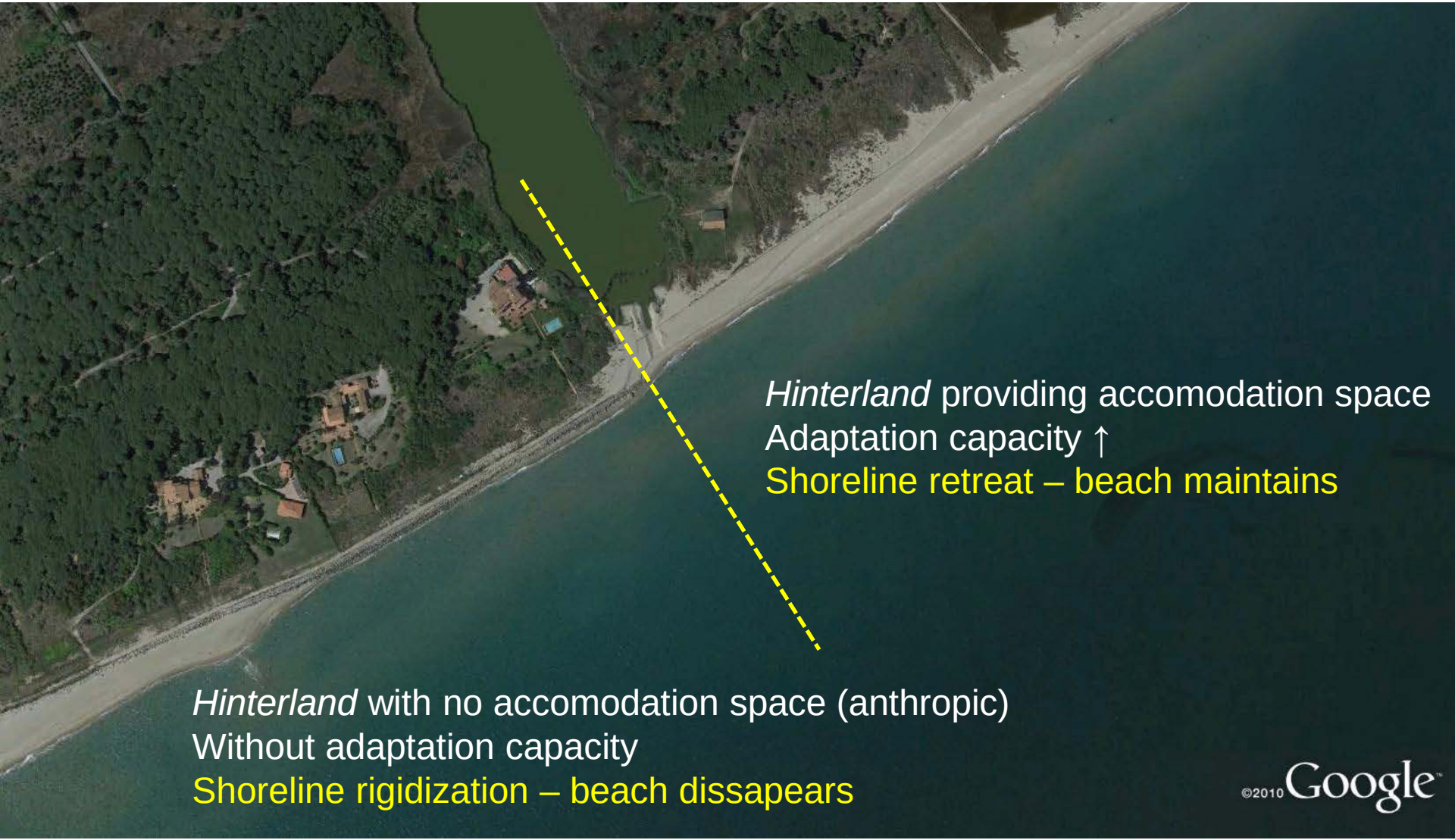
Oct 2003, τ = 5y ○ ***Flooding threshold***





Response time	Morphodynamic gradient	Natural Resilience
↓	↑	↓

Sustainability paradox and dilemma: value of land vs value of beach (shoreline definition)

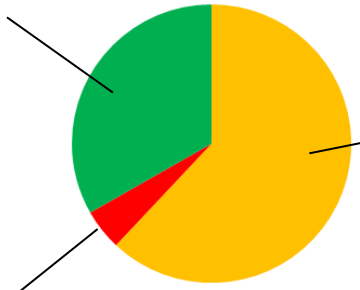


Sustainability paradox and dilemma: natural vs artificial shoreline assessment (setback line concept)

1-line CZ definition
Conundrums
By 2100
ICC image + projection

Sustainability via adaptation: accommodation space needed

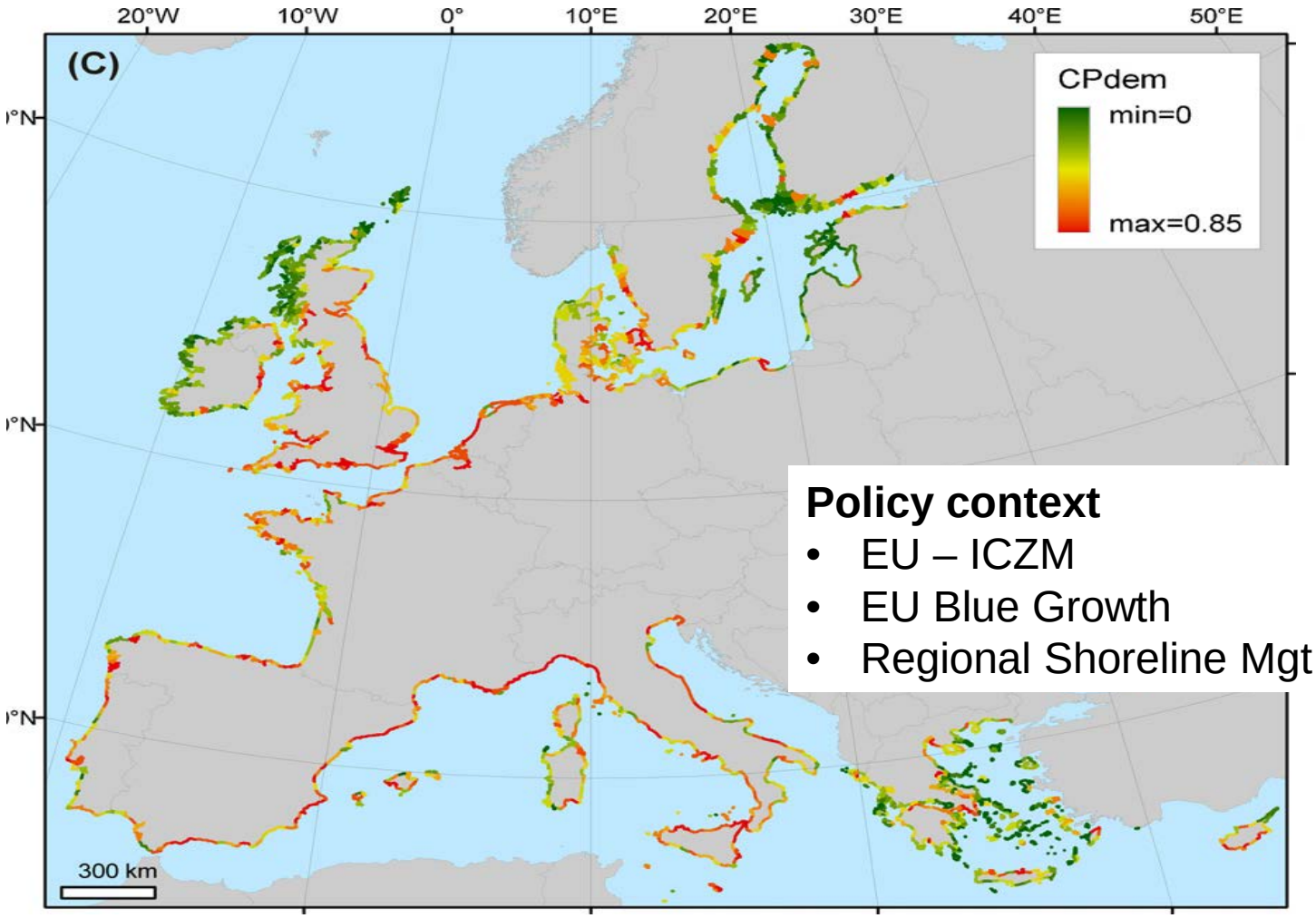
Accom. space 33 %



No accom. space (human) 62 %

No accom. space (natural) 5 %

Sustainability via Policy objective: Demand for Safety



Demand for coastal protection

Policy context

- EU – ICZM
- EU Blue Growth
- Regional Shoreline Mgt

Liquete et al 2013. Assessment of **coastal protection** as an **ecosystem service** in Europe.

Conclusions

Efficient coastal responses to *Climate Change* must consider

- Scale requirements: **trends + extremes**
- **Vulnerability hotspots** (deltaic & urban 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**

North Carolina's coast, after Sandy
© Program for the Study of Developed Shorelines / WCU