Costa i clima. Un tema de variabilitat

COSTA I CLIMA. UN TEMA DE VARIABILITAT

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Jornada Erosió i Inundació a la Zona Costanera.
Dinàmiques, Reptes i Gestió
ICC, 18 Octubre 2007

Laboratori d'Enginyeria Marítima
UNIVERSITAT POLITÈCNICA DE CATALUNYA

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- **Illustration of damages to coastal infraestructures**

1. Introduction

- Illustration of damages to harbour infrastructures

1. Introduction

- **Illustration of damages to river infrastructures**

1. Introduction

- Illustration of “damages” to river/coastal ecosystems

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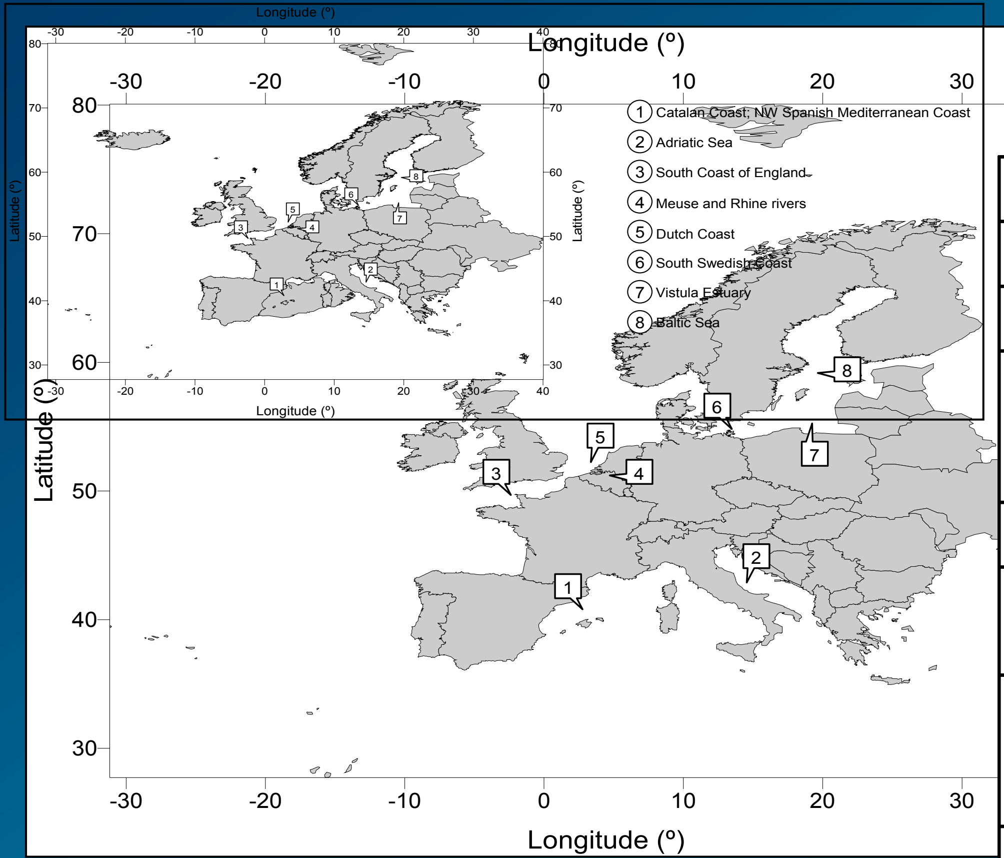
•FLOODSITE Task 2 Data Base



Site	Environment	Data	Periodicity	Length
1	C	H_s, T_p, θ_M	Hourly	15 years
2	C	SL	Hourly	
3	C R	SL H_s, T_M, θ_M P	Hourly 3 hourly Hourly	10 years 5 years
4	R	Q_R	Daily	87 years
5	R, C	SL, H_s Q_R	3 hourly Daily	23 years
6	C	U_{10}, θ_W, Pa SL-1 SL-2	3-12 hourly Daily Hourly	44 years 99 years 23 years
7	E	SL	Daily	29 years
8	C	U_{10}, θ_W, Pa H_s, T_p, θ_M	Hourly Hourly	12 years 12 years

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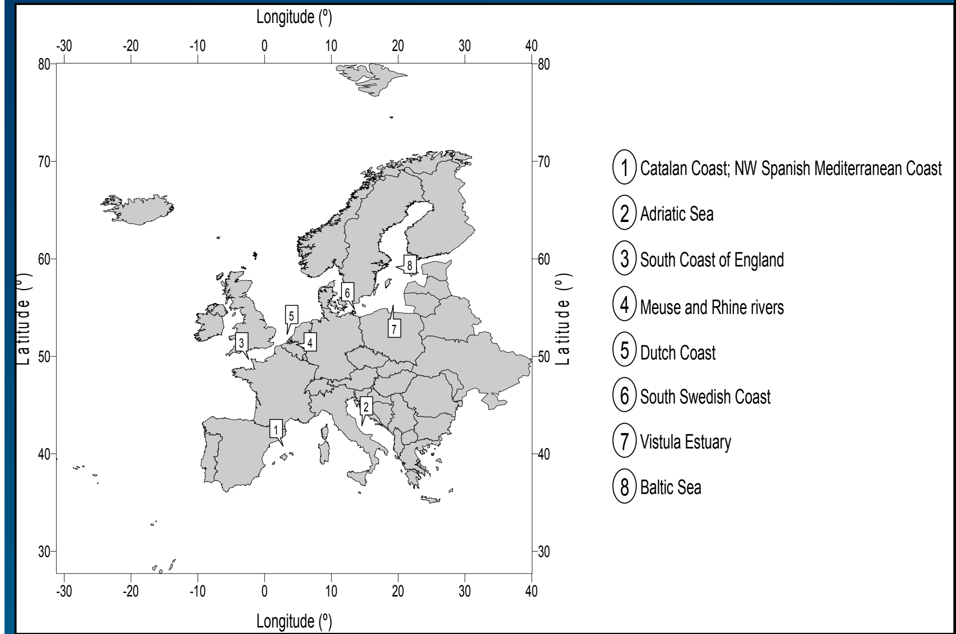
- **FLOODSITE Task 2 Techniques Considered**

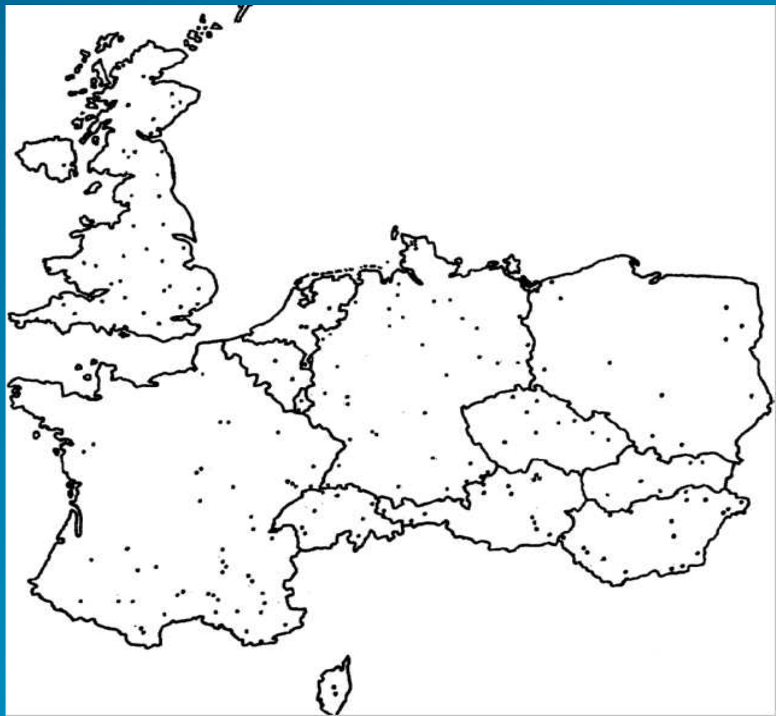


Site	Environment	Main Techniques
1	C	Generalized Pareto Distribution Bayesian Techniques Conventional Extreme/Long-Term Distributions Log-scaling
2	C	Singular Spectrum Analysis
3	C, R	Joint Probability Analysis
4	R	Cluster Analysis
5	R, C	Regional Frequency Approach Generalized Pareto and Gamma Distributions Conventional Extreme/Long-Term Distributions Joint Probability Analysis Bayesian Techniques Log-Scaling
6	C	Conventional Extreme Distributions
7	E	Canonical Correlation Analysis Bootstrapping
8	C	Neural Networks

2 - Data Handling

a) DATA PREPARATION

- More discretion to use skill



Distribution of river stations over North-Western and Central Europe.

2 - Data Handling

b) STATIONARITY (PDF does not change with time)

- Basic assumption: extremes are independent and identically distributed events
- Remove: trends, seasonality, twin storm peaks
- Memory time-scales: auto-correlation function (slope to zero)
- SSA to separate trends and periodic signals (Fourier analyses is for stationary signals)

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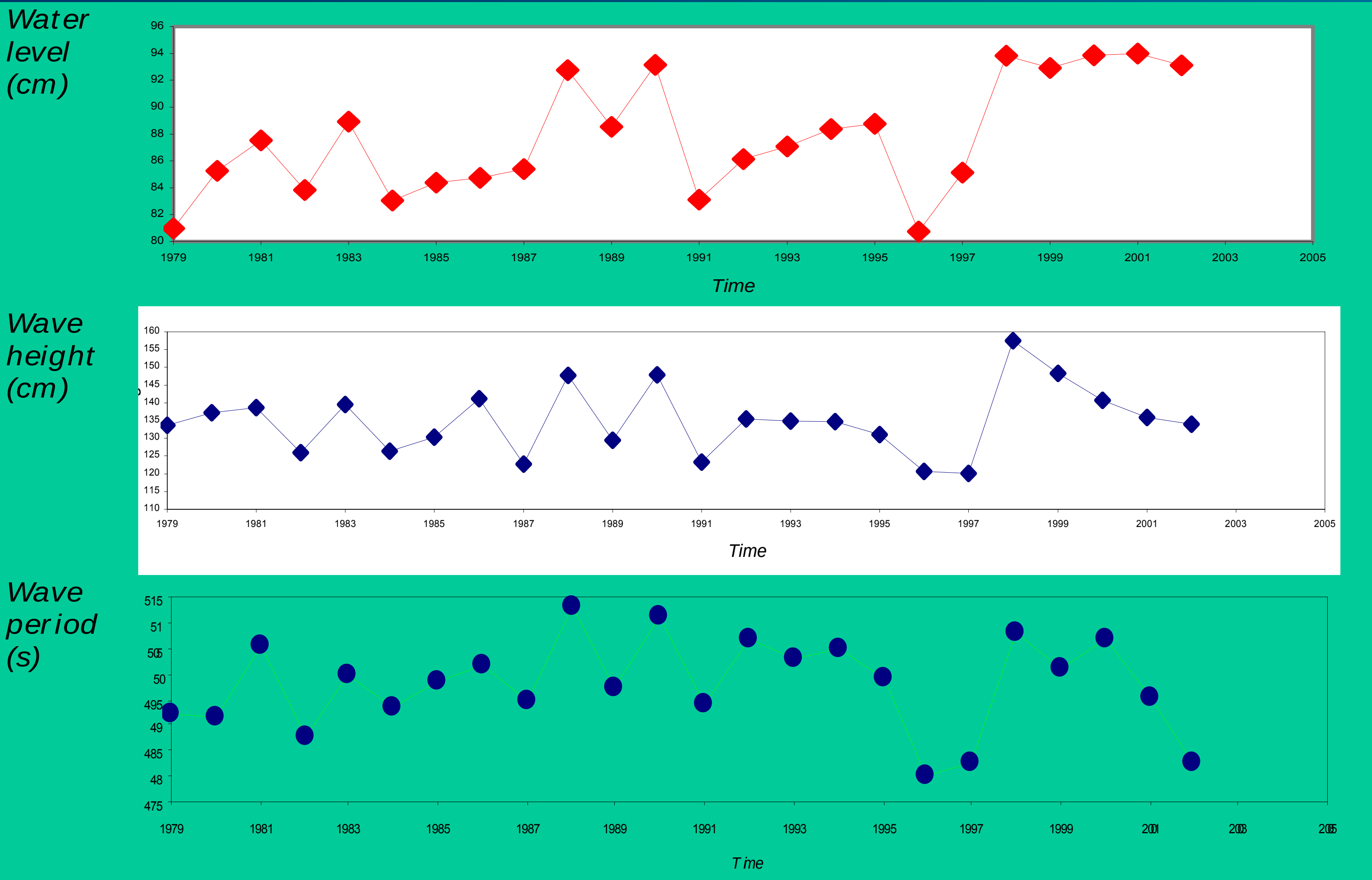

Annual wave height, water level , wave period series at Noordwijk

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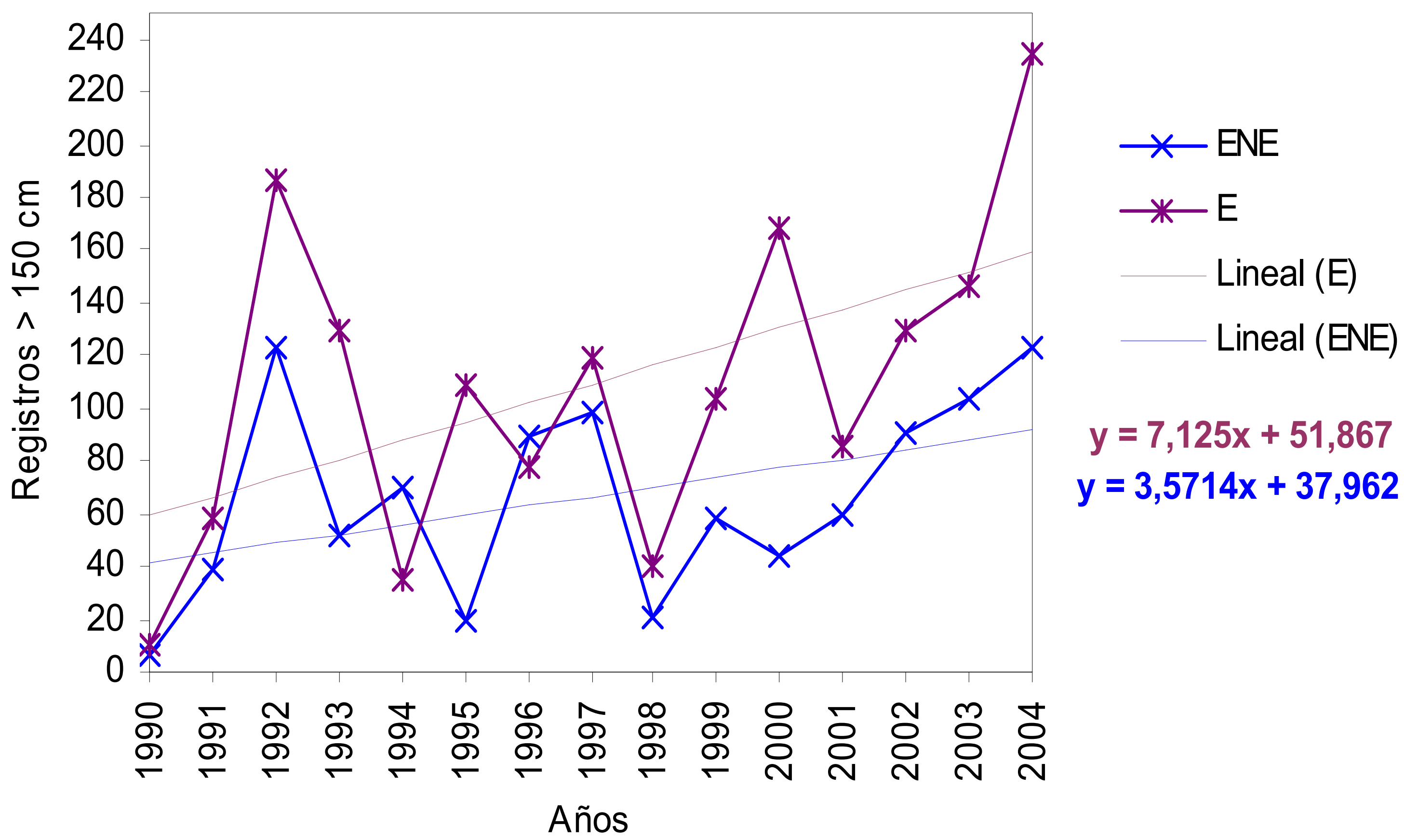

Wave records with H1/3 > 150 cm for E & ENE sectors in 1990 - 2004 (Ebre delta wave buoy)

2 - Data Handling

c) SELECTION OF EXTREMES

- Definition (POT, AM, r-largest maxima per year)
- Variables (Q_R, H, h_{sea} but also duration)
- Balance between variance (threshold ↑, variance ↓) and bias (threshold ↓, bias ↑)
- Event definition more complex for JPA (river flow events last longer than sea storm events)
- Balance between physics and statistics

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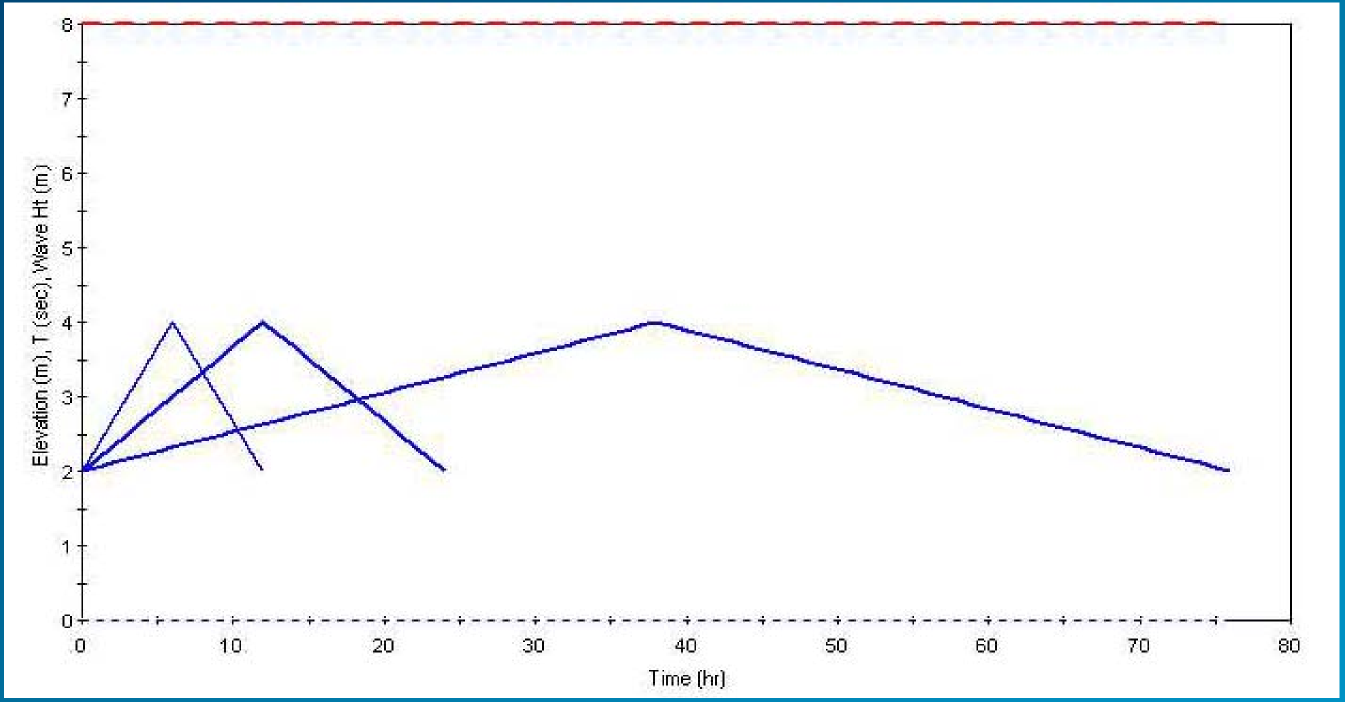
Storm Duration (12 ,24, 76,100 y 160 hrs)



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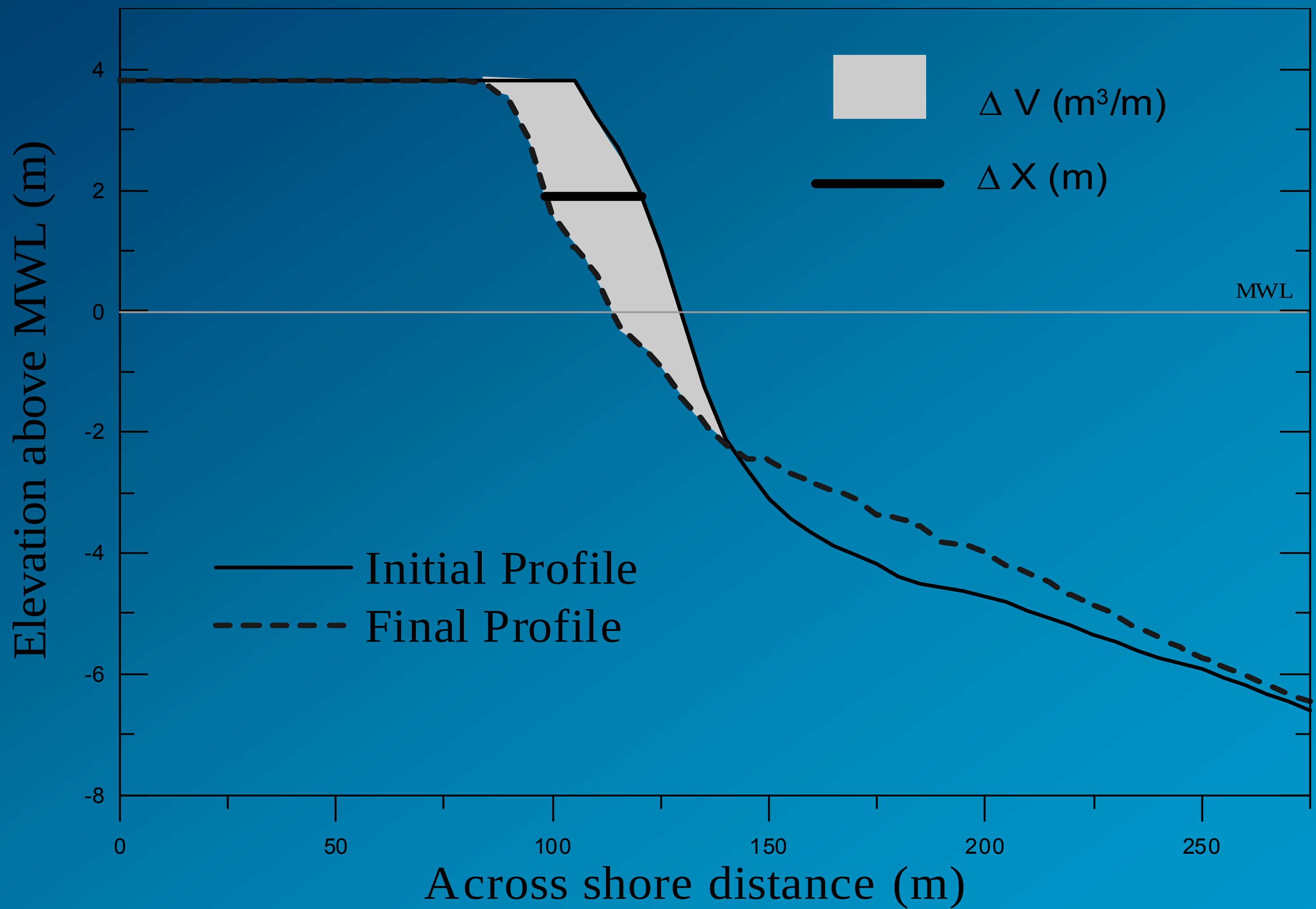
Erosion for reflective beaches using SBeach



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SBEACH

$$q = q_z \left[\frac{x - x_r}{x_z - x_r} \right]$$

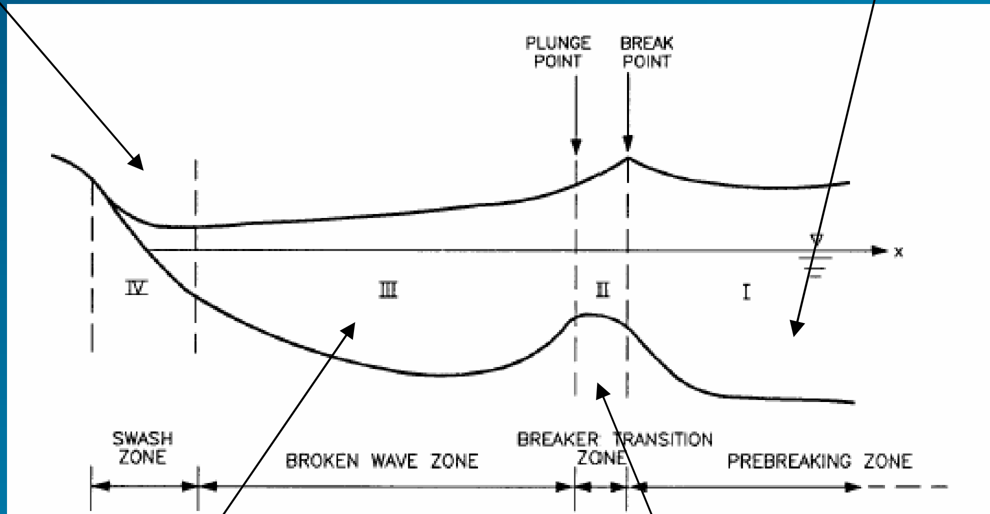
$$q = q_b \exp\left[-\lambda_1 (x - x_b)\right]$$

waves

$$\frac{d(F\cos\theta)}{dx} = -\frac{\kappa}{d}(F - F_s)$$

$$\frac{dS_{xx}}{dx} = -\rho g (h+\eta)\frac{d\eta}{dx}$$

$$\frac{sen\,\theta}{L} = cte$$



$$q = q_p \exp\left[-\lambda_2 (x - x_p)\right]$$

SED. TRANSPORTE

$$q = \begin{cases} K\left(D - D_{eq} + \frac{\varepsilon}{K}\frac{dh}{dx}\right) & D > D_{eq} - \frac{\varepsilon}{K}\frac{dh}{dx} \\ 0 & D < D_{eq} - \frac{\varepsilon}{K}\frac{dh}{dx} \end{cases}$$

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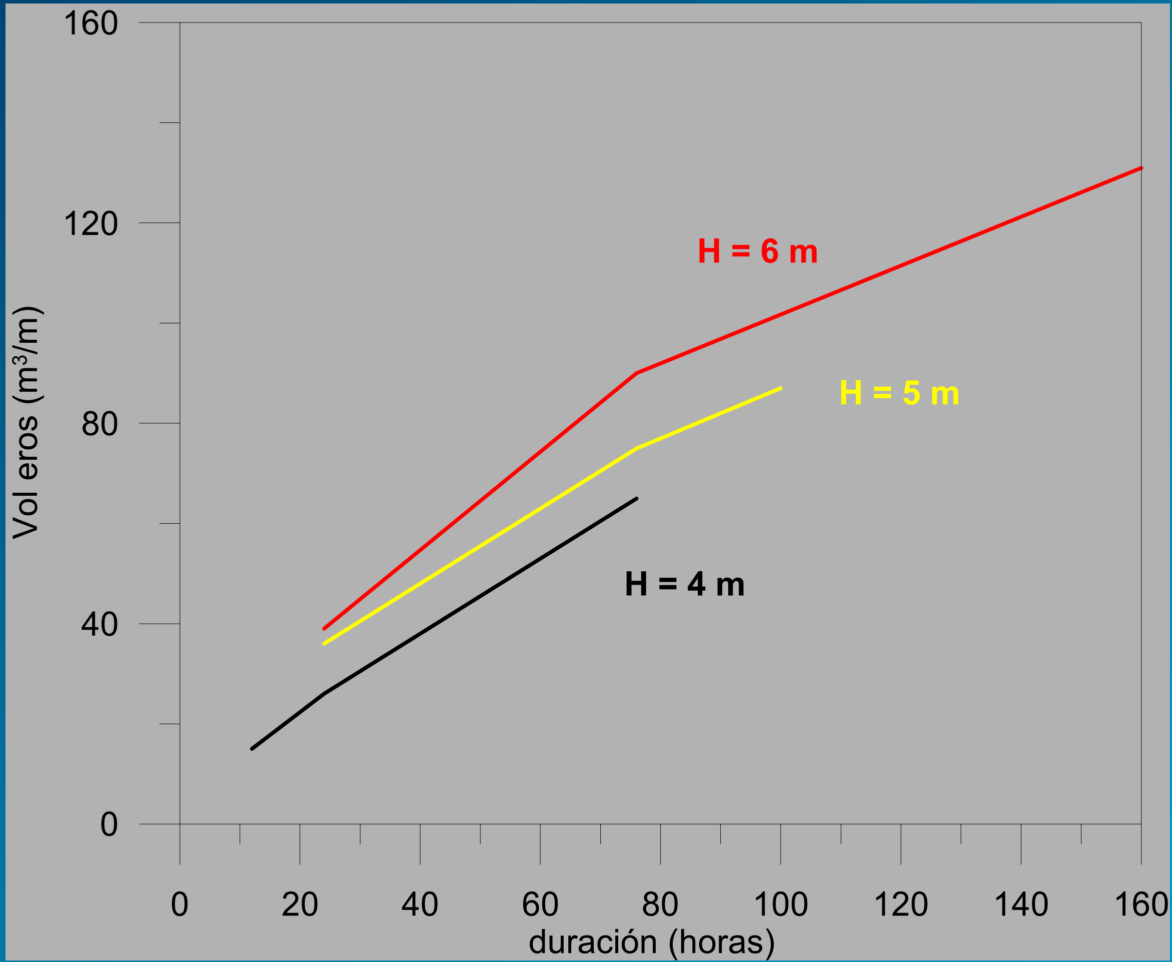


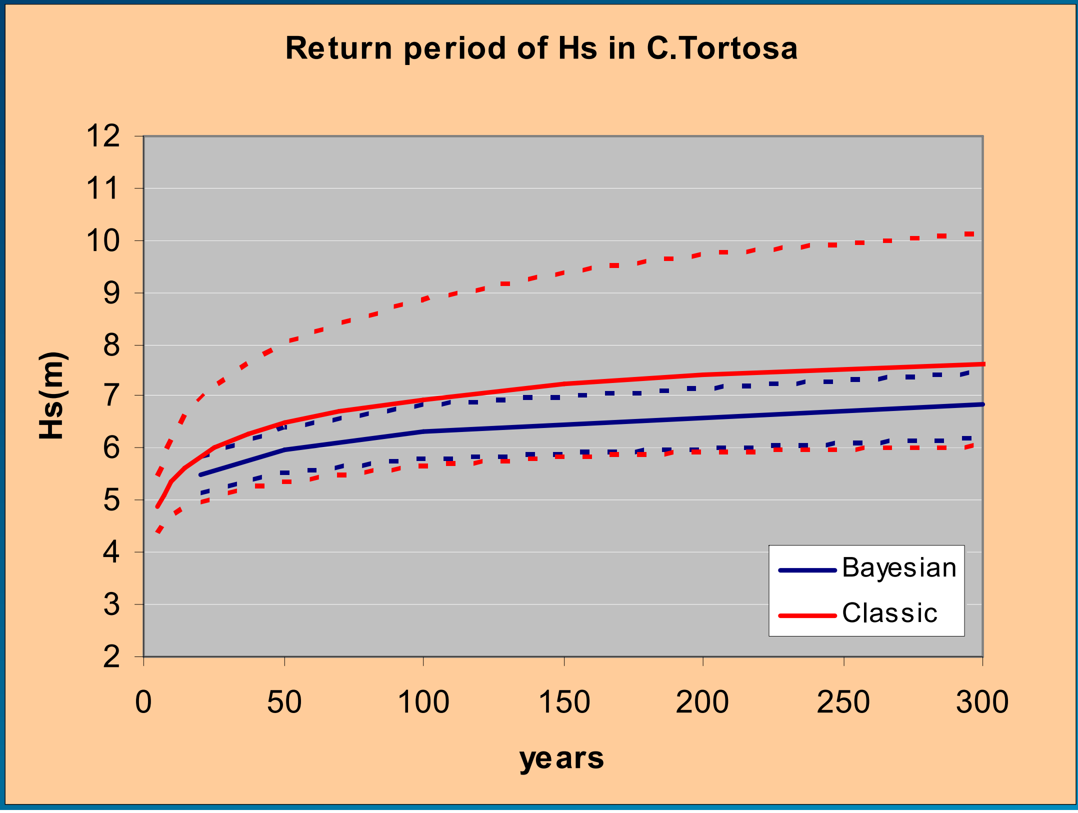
3 - Extreme analyses (SINGLE)

a) INTRODUCTION

- Ideally: data series much longer than the largest τ of interest (1 year storm from 10 year data set)
- Normally: the other way round (extrapolation outside the source data, e.g. h_R available for 50 to 100 years and design h_R need τ=1,000 to 10,000 years)

3. Wave Characterization for Risk

- Conventional vs Bayesian estimates



Uncertainties due to

- Physical
- Numerical
- Observational

} SOURCES

4 - Extreme analyses (MULTIPLE)

a) INTRODUCTION

- **Same variable at multiple locations in space (flooding simult. over a wide area)**
- **Multiple variables at single location (flooding from multiple sources)**
- **Probabilities of joint occurrence**

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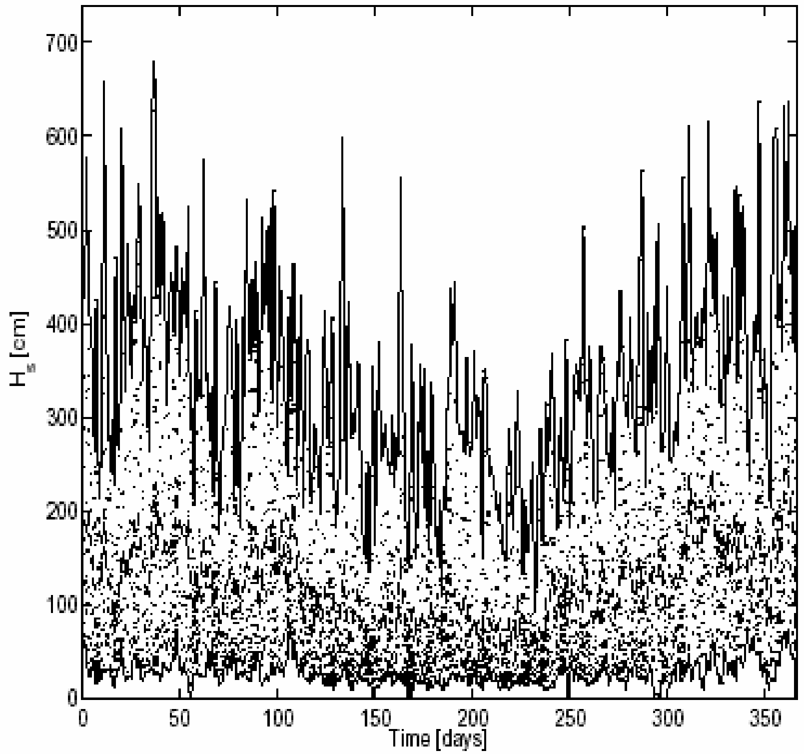
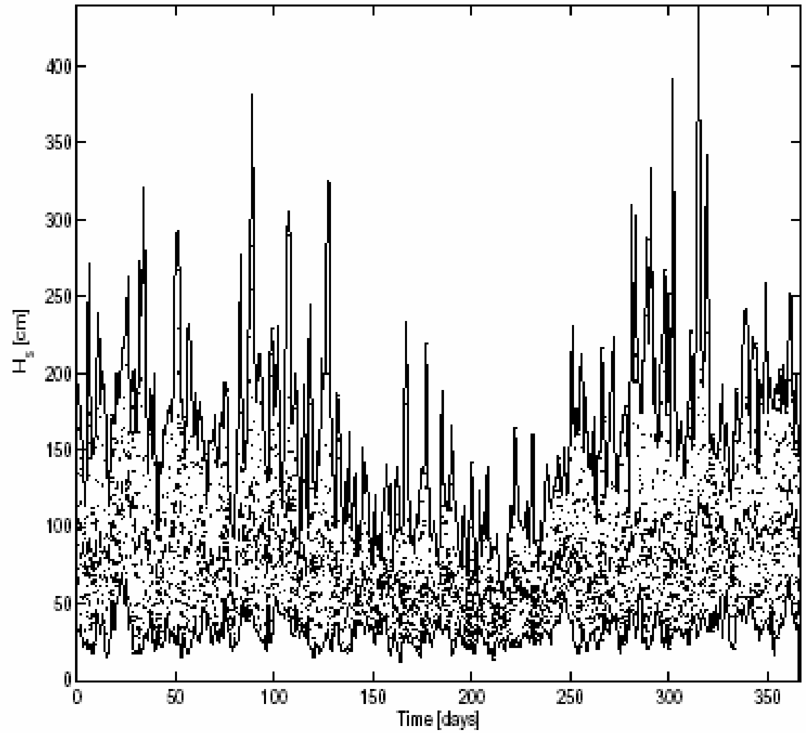


Max and min Hs during one year at Alghero (Italy) in the period 1990-2004.



Max and min Hs during one year at Tortosa (Spain) in the period 1990-2004.

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Trabucador (Ebro delta) - October 1990

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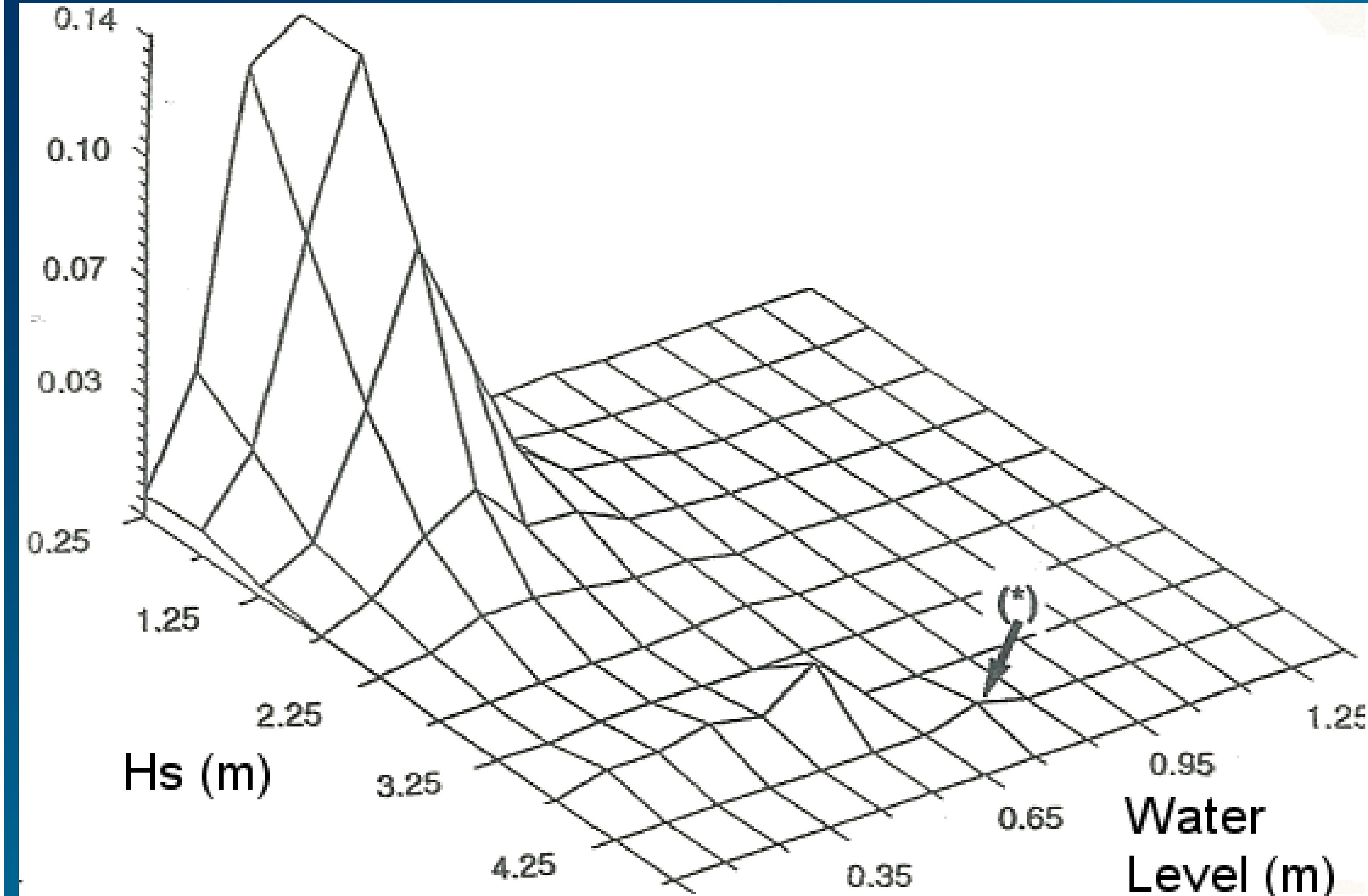

Joint Prob. Distrib. for Hs & MSL. The asterisk (*) indicates breaching conditions for Trabucador

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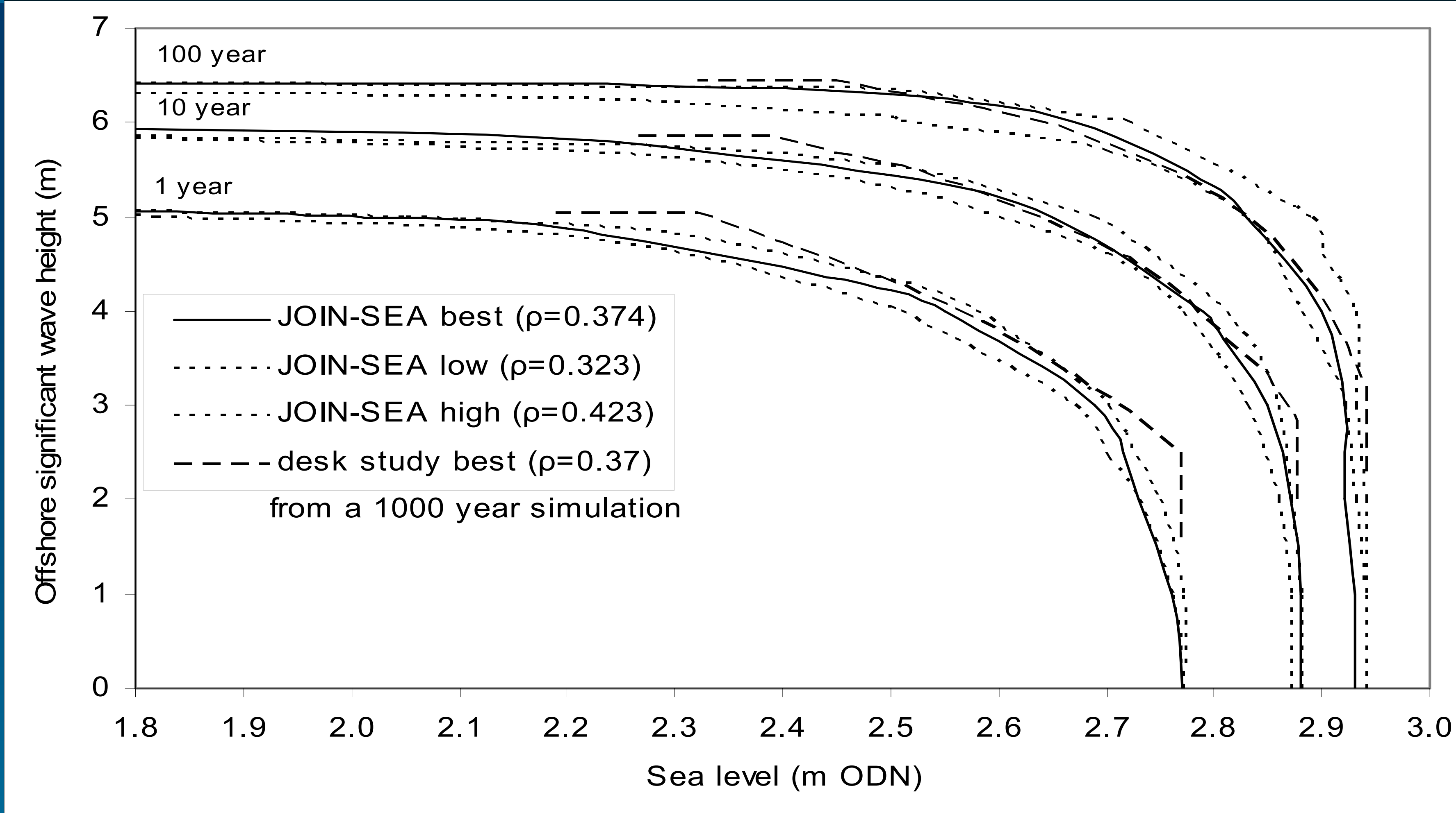

Joint exceed. extremes, for Weymouth MSL and Hs at high tide (1991-2001)
Different analysis methods and different levels of dependence

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Pedregalejo : El Palo

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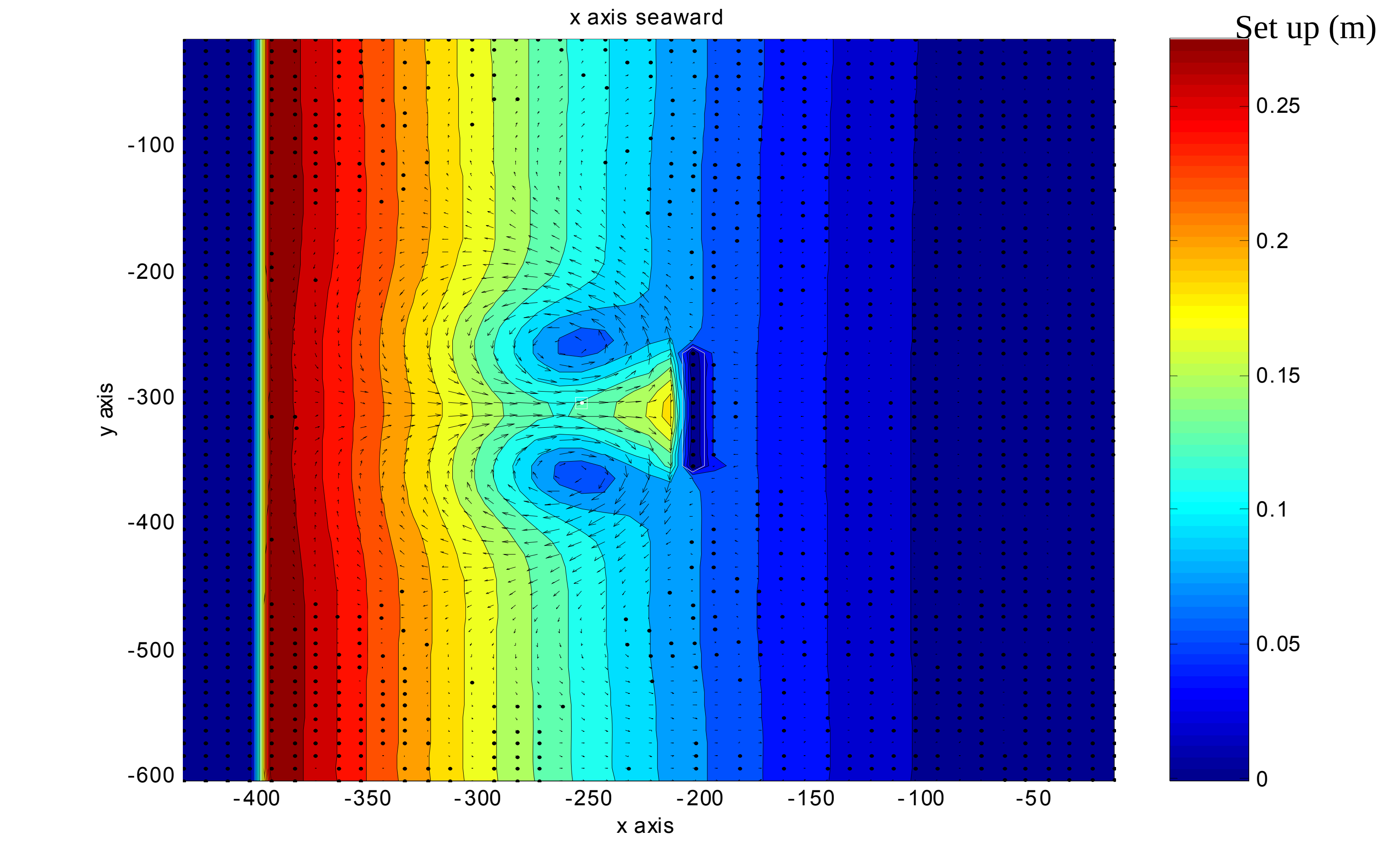
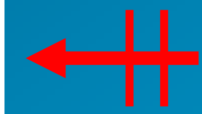


Normal incidence



Current field (2DH) around a detached breakwater computed by the Q-3D numerical model (LIMCIR) with overtopping and freeboard Rc = 1 m

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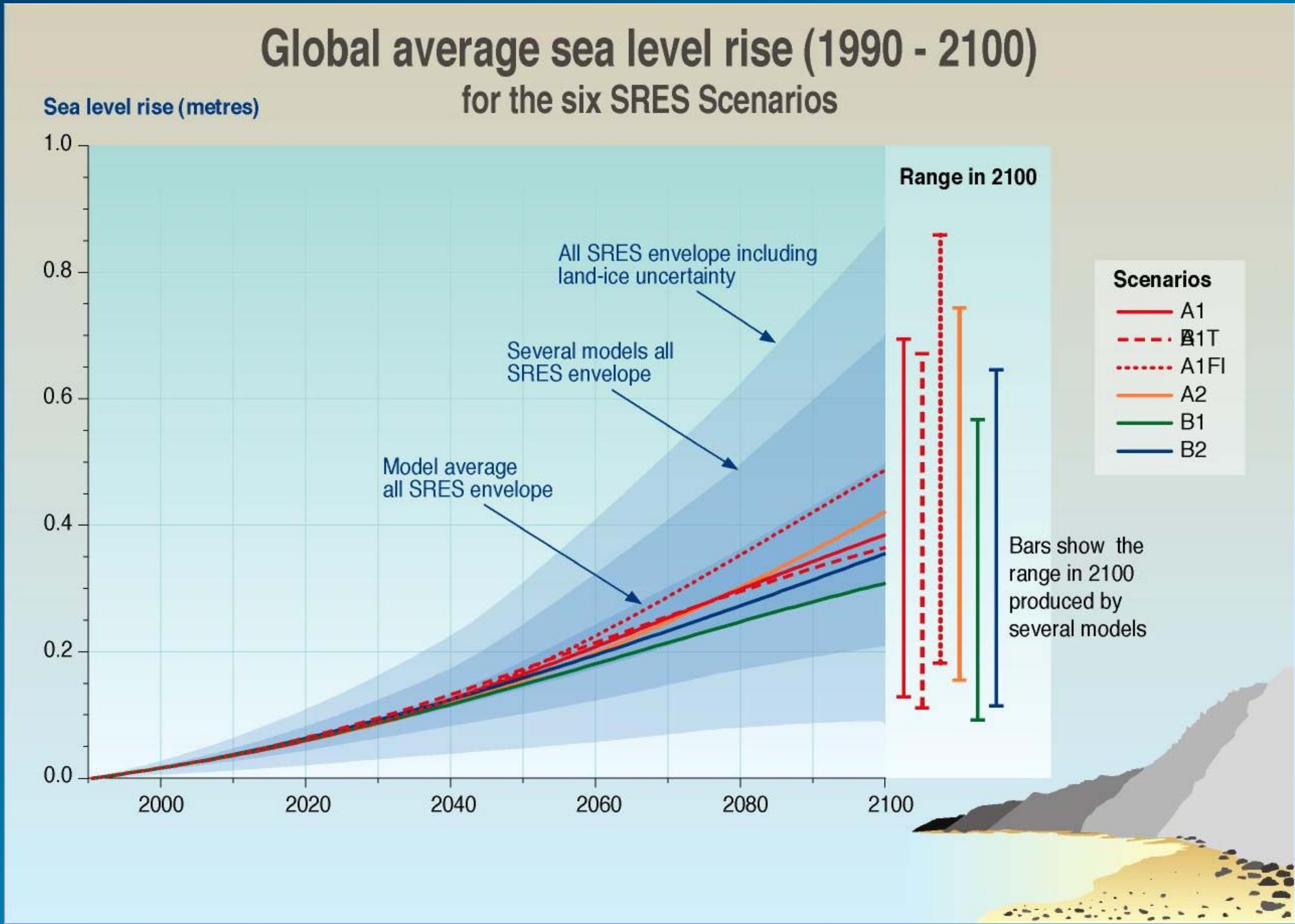
Recent projections of MSL for various scenarios (source: IPCC)



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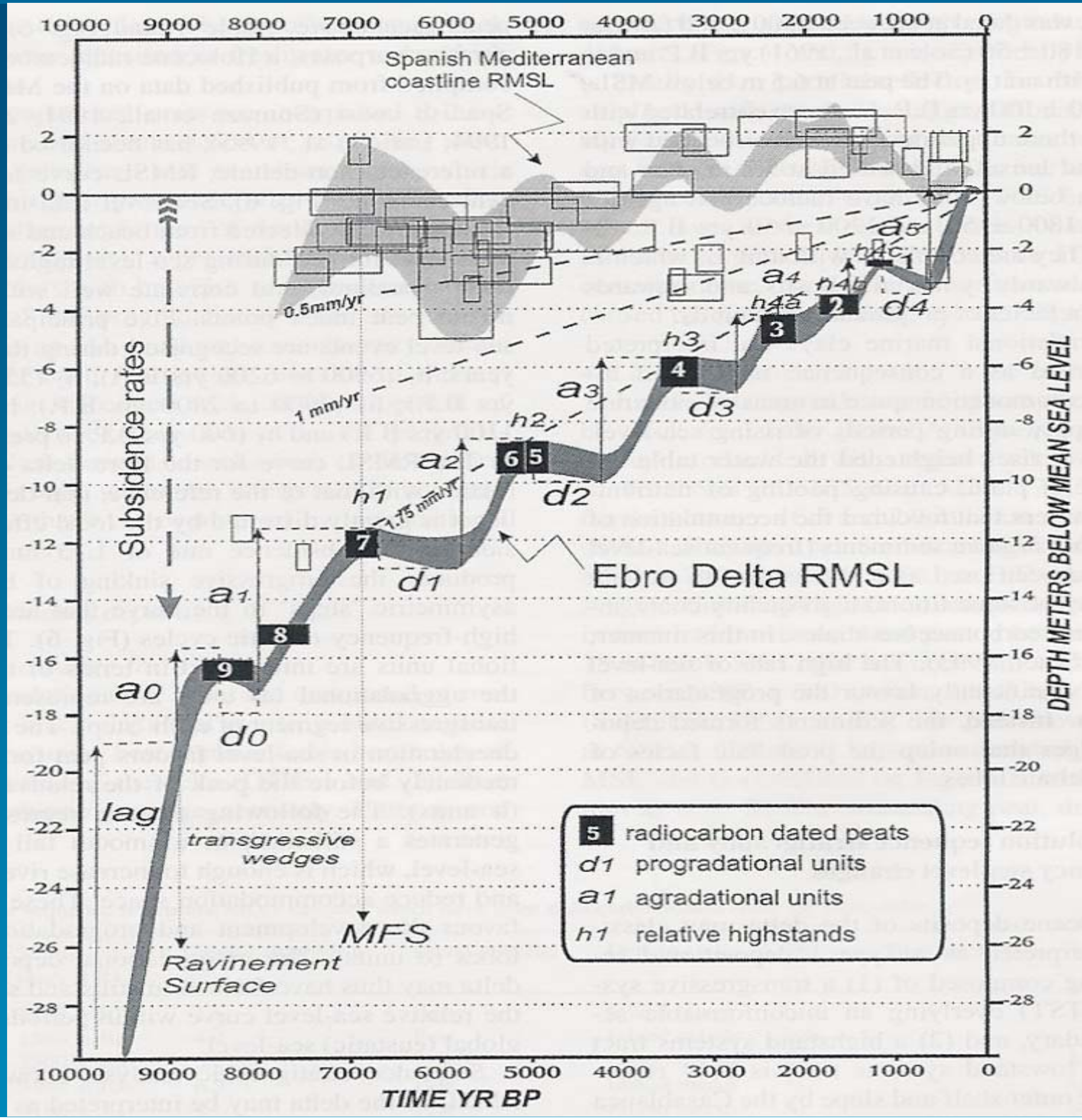
Holocene RMSL curve for the Ebre Delta and adjacent Spanish Mediterranean coast (Somoza et al., 1998)



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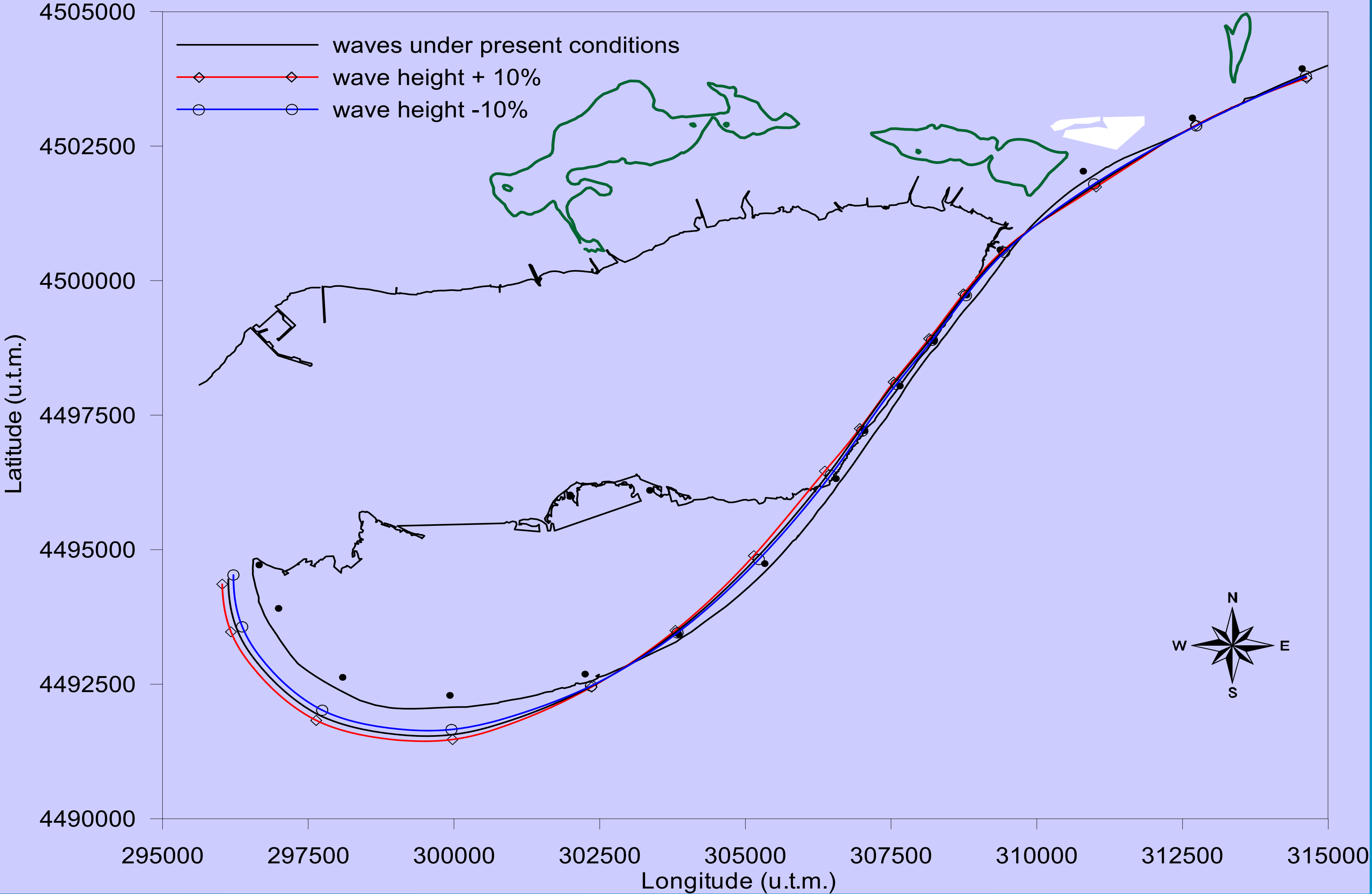

Jimenez & S.-Arcilla, 2006

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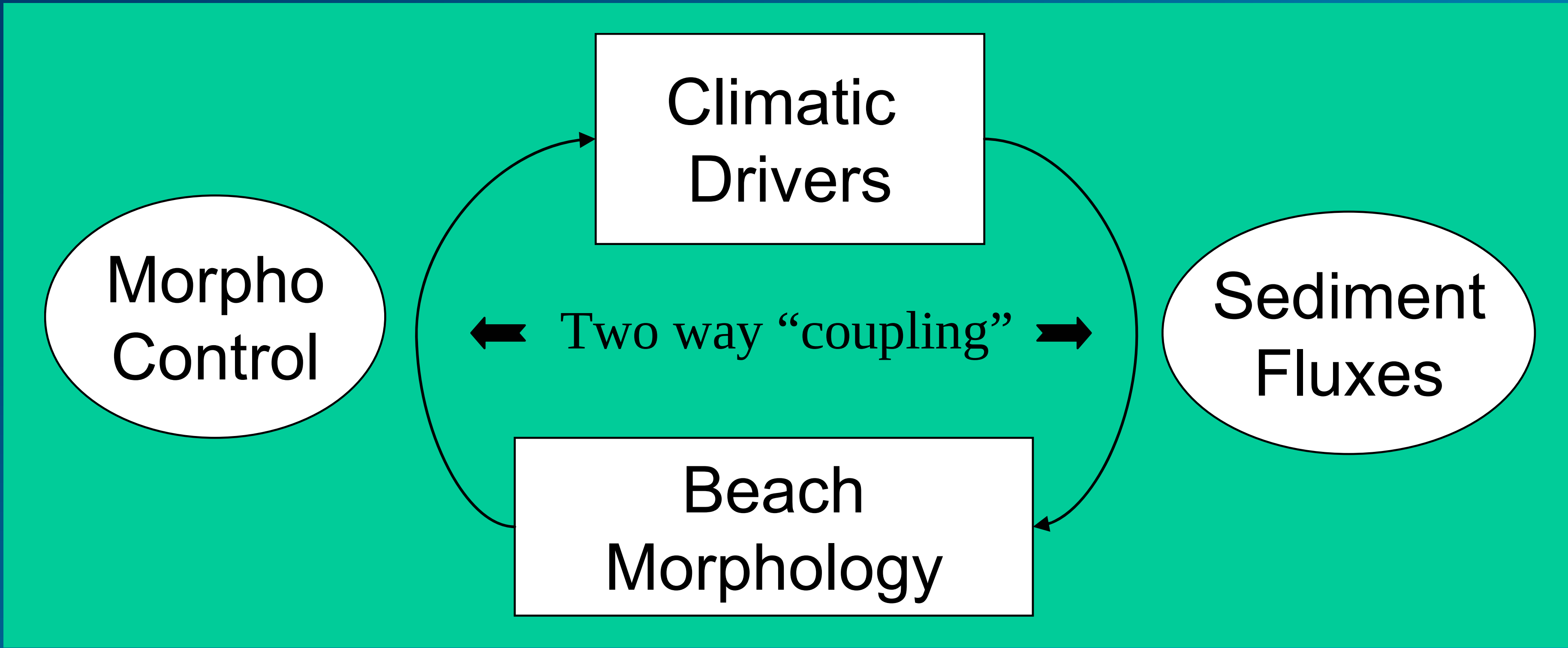

Schematization of the Morphodynamic Control (Modified from Sánchez-Arcilla et al., 2005).

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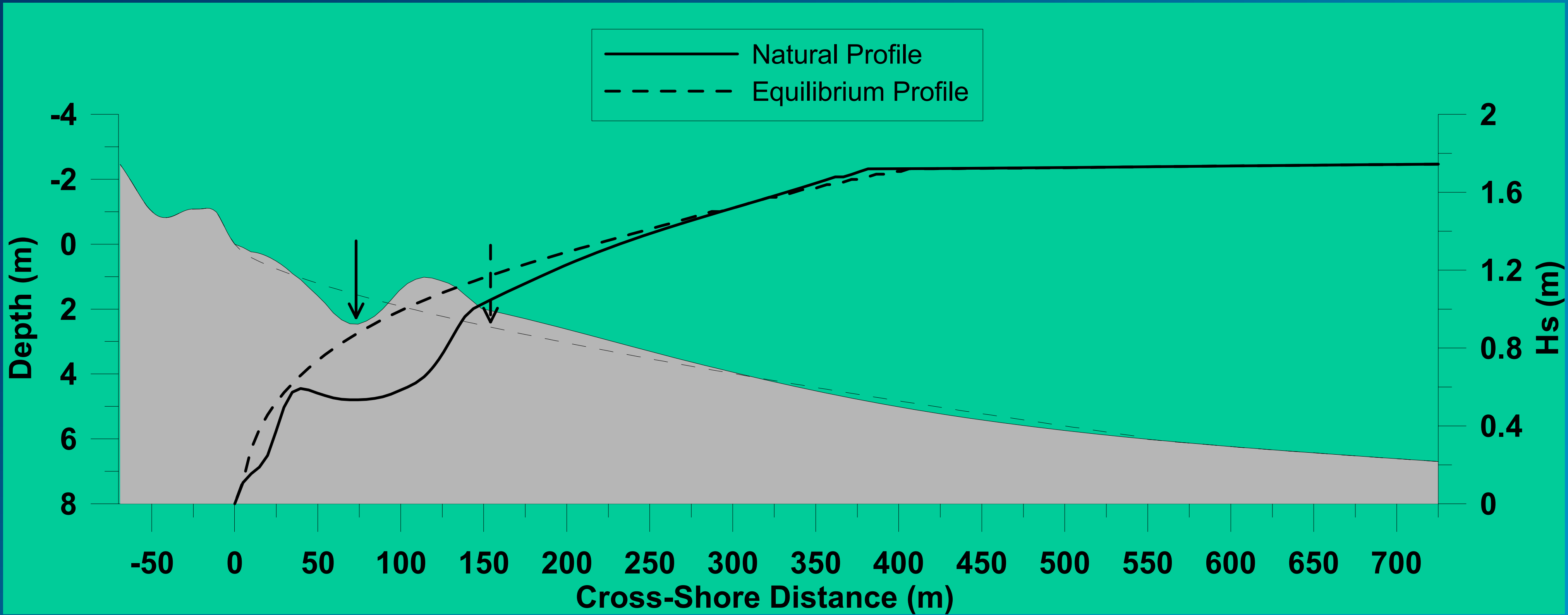

Eastern storm decay for the natural (solid line) and equilibrium (dashed line) beach profile assuming a breaker formulation according to Battjes and Janssen (1978). Arrows indicate both control points locations.

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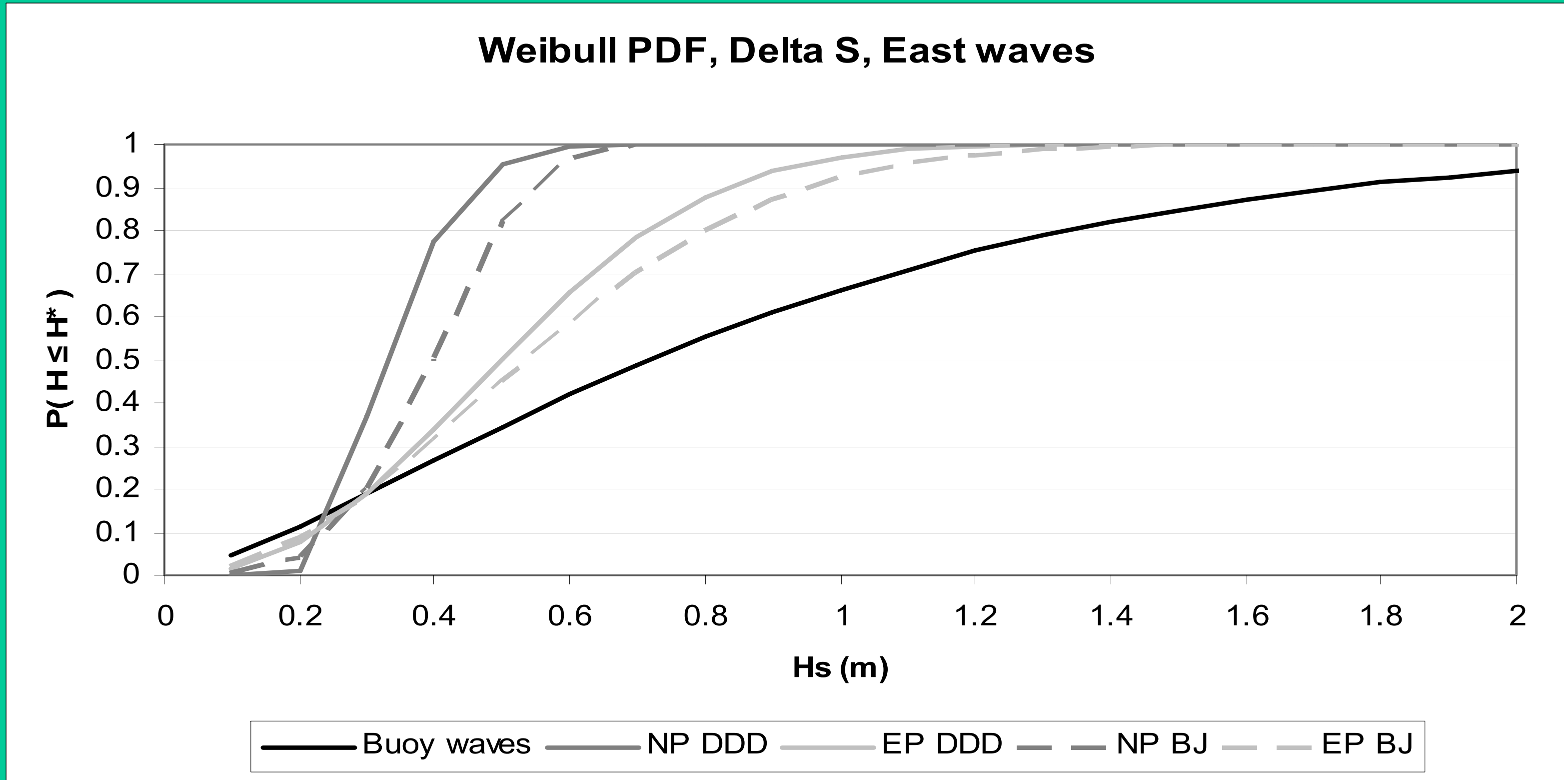

	NP DDD	EP DDD	NP BJ	EP BJ
A	0.1824	0.0000	0.0000	0.0000
B	0.1762	0.5831	0.4370	0.6372
C	1.9214	2.3551	3.9934	2.0930
r	0.6186	0.9078	0.9328	0.9757

Cumulative PDF for Hs (E) waves over natural and equilibrium beach profiles.Breaking models of Dally et al. (1985, solid lines) and Battjes and Janssen (1978, dashed lines). Distribution parameters are also shown.

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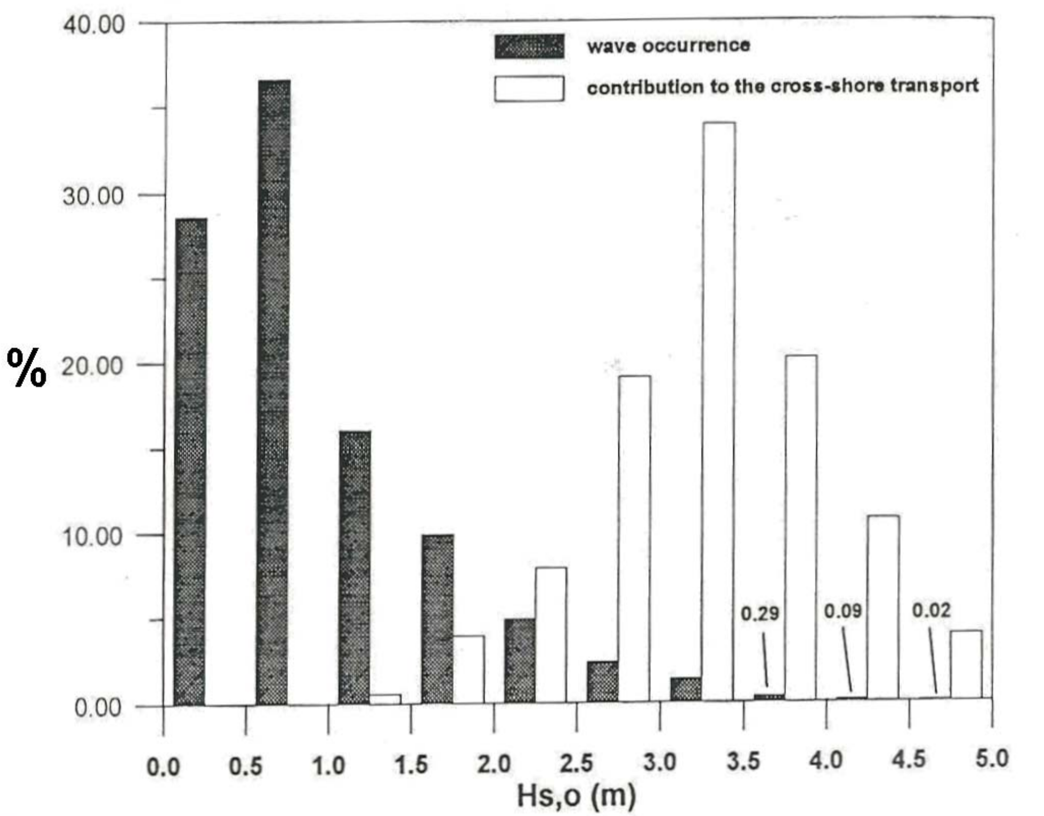
Respuesta Sedimentaria

Contribución de la altura de ola al transporte transversal



- **1m erosivo / 1cm SLR**
- **Un ascenso de 0.5m. produciría una pérdida del 30% de playas del País Vasco + Cantabria**

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REFERENCIAS RESUMEN

- Agustín Sánchez-Arcilla, José A. Jiménez y Joan Pau Sierra. 2005. Zones costaneres: dinàmica sedimentària, 609-641 pp. Informe sobre el canvi climàtic a Catalunya, E.LLebot, Institut d'Estudis Catalans
- Antonio Cendrero , Agustín Sánchez-Arcilla y Caridad Zazo . 2005. Impactos sobre las zonas costeras. Ministerio de Medio Ambiente, Madrid, ES, 822 pp. (http://www.mma.es/oecc/impactos.htm)
- Agustín Sánchez-Arcilla y Panagiotis Prinos. 2007, editors FLOODSITE issue in Journal of Hydraulic Research (from the FLOODSITE project)

Vulnerability and Risks

- **Máximum "hazard": beaches**

  i. **Protected (scarce sediment and no waves)**

  (e.g. coastal lagoons with flooding risk and no dynamic response)

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Deltas

→Costa "pristina"

→Cuenca drenaje artificializada

→Limitacion del funcionamiento natural

→Sujetos a climatologia local propia de "cambio climatico"

(alta vulnerabilidad)

Vulnerability and Risks

- **Máxima "hazard": beaches**

  ii. Confined / Narrow

  (e.g. urban beaches artificially "maintained")

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Playas regeneradas → artificiales → mantenimiento (sin cambio climatico)

Malaga SE Med Spain

Vulnerability and Risks

- **Máximum "hazard": beaches**

  iii. Mild slope (fine sediment)

  (e.g. under new MSL or storminess scenarios)

  iv. Under a combination of driving terms (eg storm surge plus wave attack plus flood discharge)

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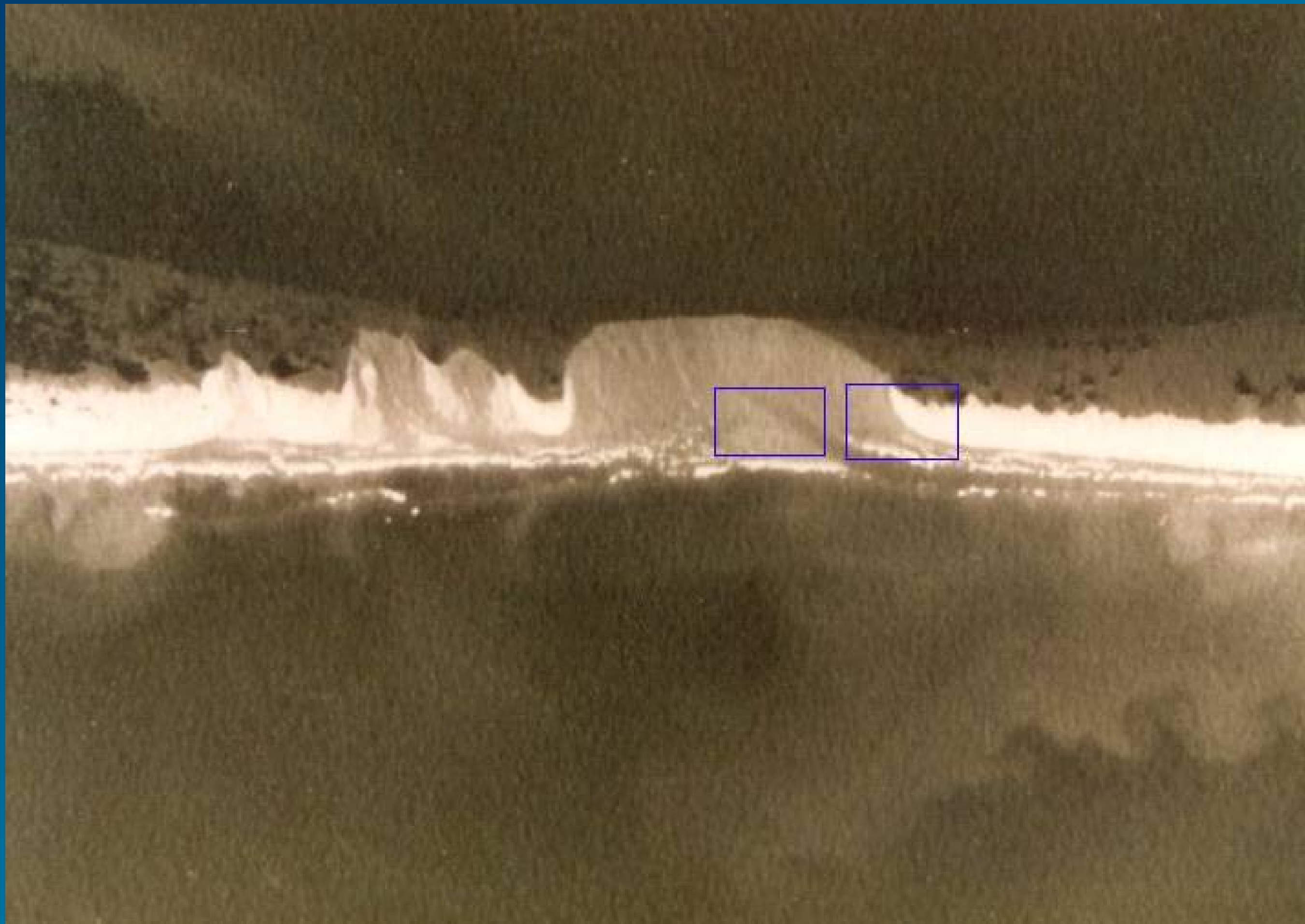

Trabucador barrier beach under wave and storm surge

Vulnerability and Risks (end)

Máximum vulnerability: beaches

- **With high “hazard” levels**
- **Supporting high-valued uses and resources**

Difficulties

- **Scale (time – space) for the evaluation**
- **Integrate “quantitative” consequences**

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THANKS !