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Field measurements and swash parameterization on beaches

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Outline

- INTRODUCTION
- FIELD DATA
- PARAMETERIZATION
- RESULTS
- CONCLUSIONS AND FUTURE RESEARCH

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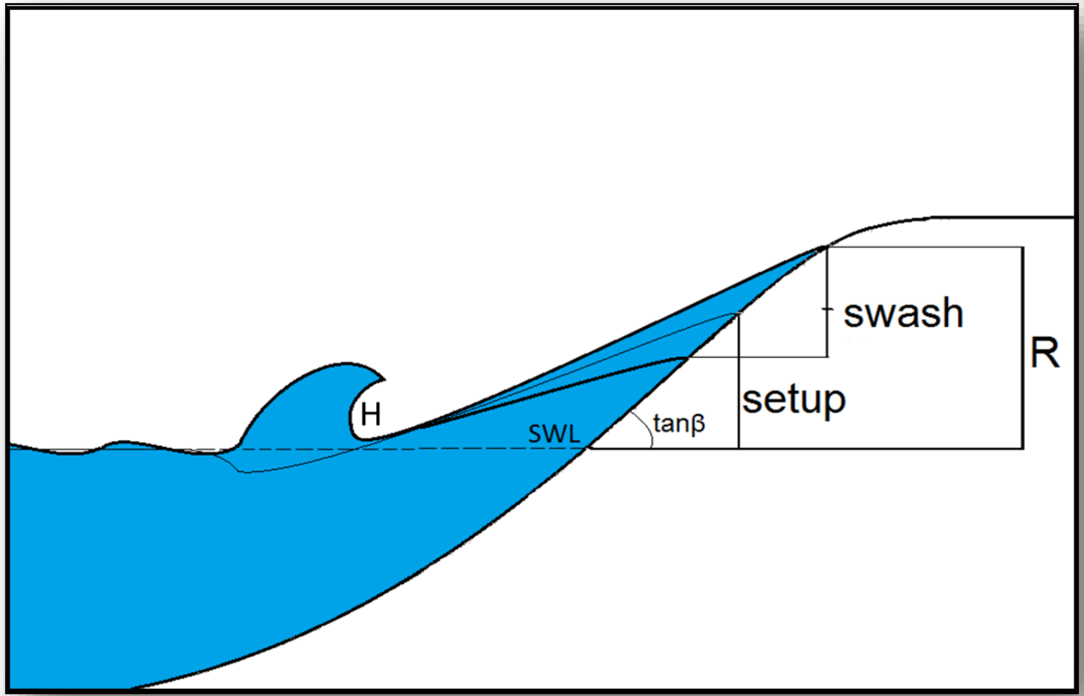
Introduction

- Motivation and basic concepts



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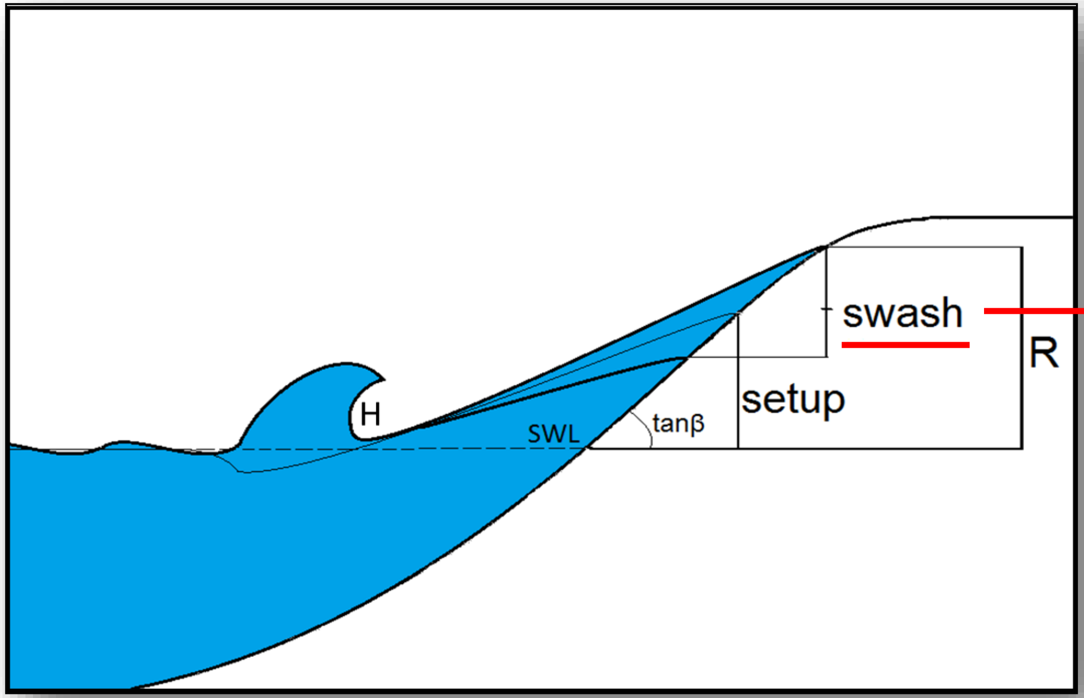
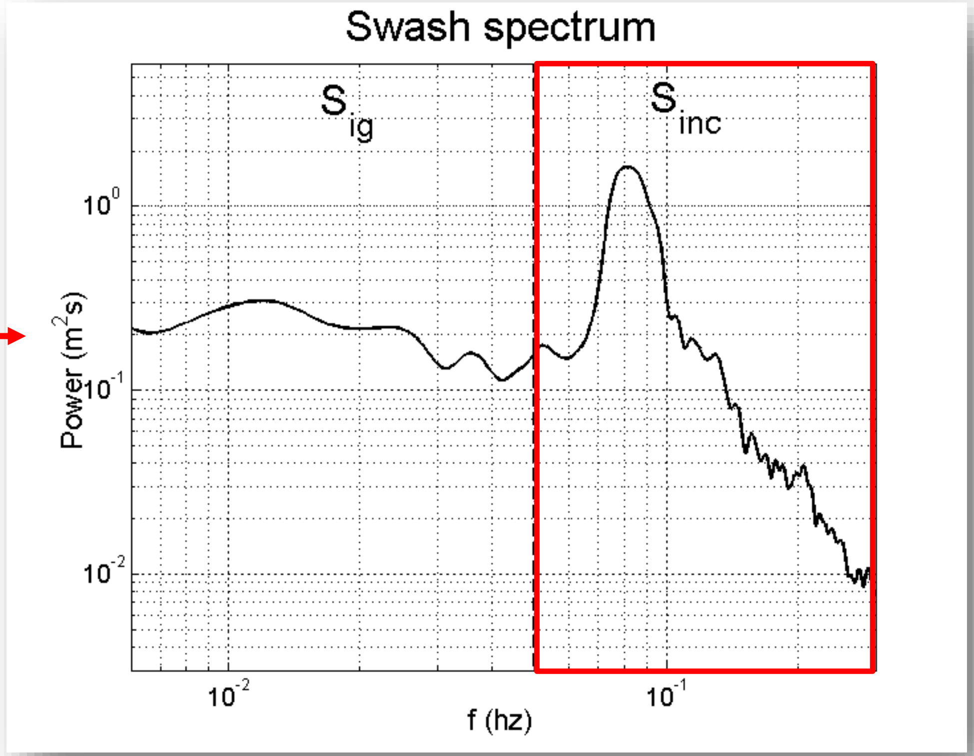
Introduction

- Basic concepts



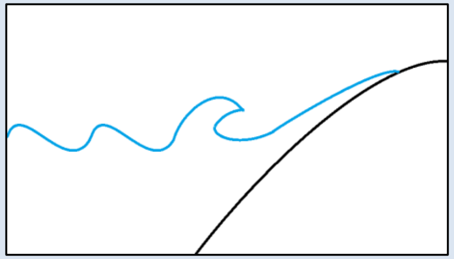


Introduction

- Basic concepts

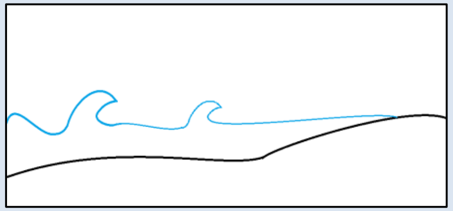
MORPHODYNAMICS

↑ $tan\beta$
↓ Ω



Estaleiro beach (www. playasdebrasil.com)

↓ $tan\beta$
↑ Ω

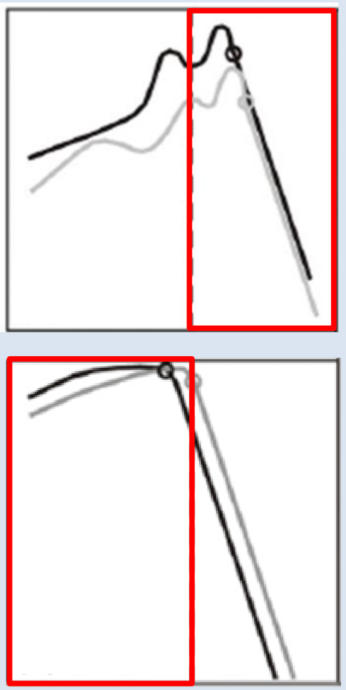


Cassino beach (www.worldatlas.com)

SWASH

↑ s_{INC}

↑ s_{IG}



from Hughes et al. (2012)

$$\Omega = H/wT$$

Introduction

- Recent runup formulas: based on parameters stablished with monochromatic waves
- Hunt's formula

$$\frac{R}{H} = \xi \qquad \xi = \tan\beta/\sqrt{HL}$$

  - Examples

Nielsen and Hanslow (1991)

$$R_{2\%} = 0.188\tan\beta(H_0L_0)^{0.5} \quad \text{for} \quad \tan\beta > 0.1$$

$$R_{2\%} = 0.049(H_0L_0)^{0.5} \quad \text{for} \quad \tan\beta < 0.1$$

Introduction

- Recent runup formulas: based on parameters stablished with monochromatic waves
- Hunt's formula

$$\frac{R}{H} = \xi$$

  - Examples

Stockdon et al. (2006)

$$Setup = 0.35\tan\beta(H_0L_0)^{0.5}$$

$$S_{inc} = 0.75\tan\beta(H_0L_0)^{0.5}$$

$$S_{ig} = 0.06(H_0L_0)^{0.5}$$

Introduction

- Other studies based on monochromatic waves – based on Miche's hypothesis
- Carrier and Greenspan (1958), Guza et al. (1984)

$$\frac{S}{H} = \begin{cases} 3\,\xi^2/\pi & \text{for} \quad \xi < \xi_c/3 \quad \textbf{saturation} \longrightarrow S = 3\,tan\beta^2 L/\pi \\ (2\pi tan\beta)^{-0.25}\xi & \text{for} \quad \xi_c\,/\,3 < \xi < \xi_c \quad \textbf{transition} \\ (\pi/2tan\beta)^{0.5} & \text{for} \quad \xi > \xi_c \quad \textbf{reflection} \end{cases}$$

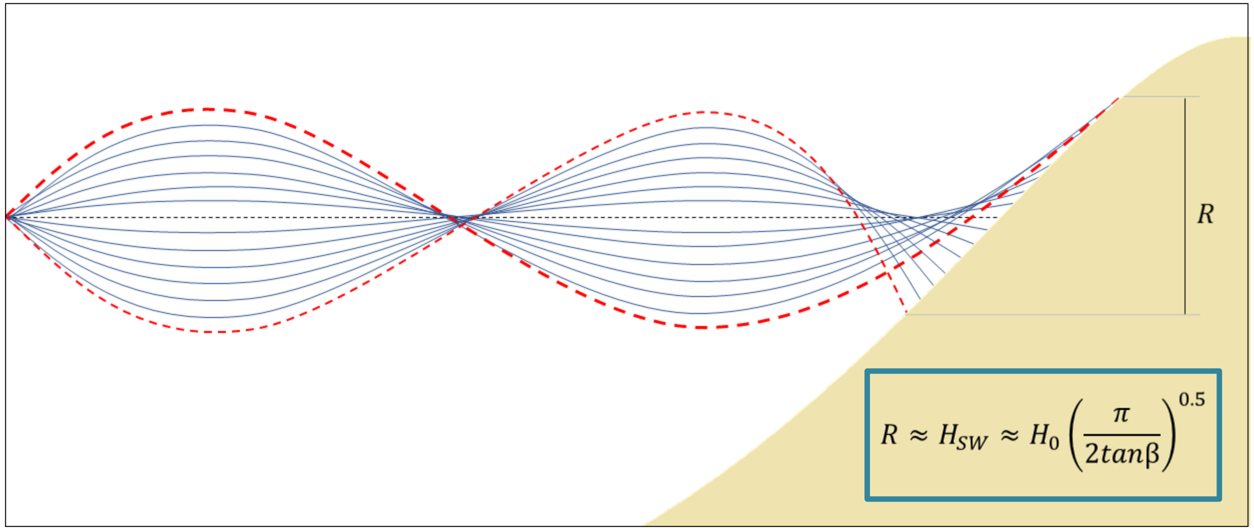
- Application to natural beaches?

Introduction

- 2018: $S_{IG} = f\left[\left(\frac{H_0 L_0}{tan\beta}\right)^{0.5}\right]$ (Gomes da Silva et al, 2018)

- Role of the beach slope: $tan\beta^{-0.5}$

$$\frac{S}{H} = \begin{cases} 3\,\xi^2/\pi & \text{for} \quad \xi < \xi_c/3 \quad \textbf{saturation} \\ (2\pi tan\beta)^{-0.25}\xi & \text{for} \quad \xi_c\,/\,3 < \xi < \xi_c \quad \textbf{transition} \\ (\pi/2tan\beta)^{0.5} & \text{for} \quad \xi > \xi_c \quad \textbf{reflection} \end{cases}$$



Introduction

- S_{inc}

Objective:

- To assess the **applicability** of the formulas for different conditions of reflection presented by **Guza et al. (1984) to calculate S_{inc} in natual beaches**

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Field Data

2 sources of data:

i) Compiled dataset

- Stockdon et al. (2006)

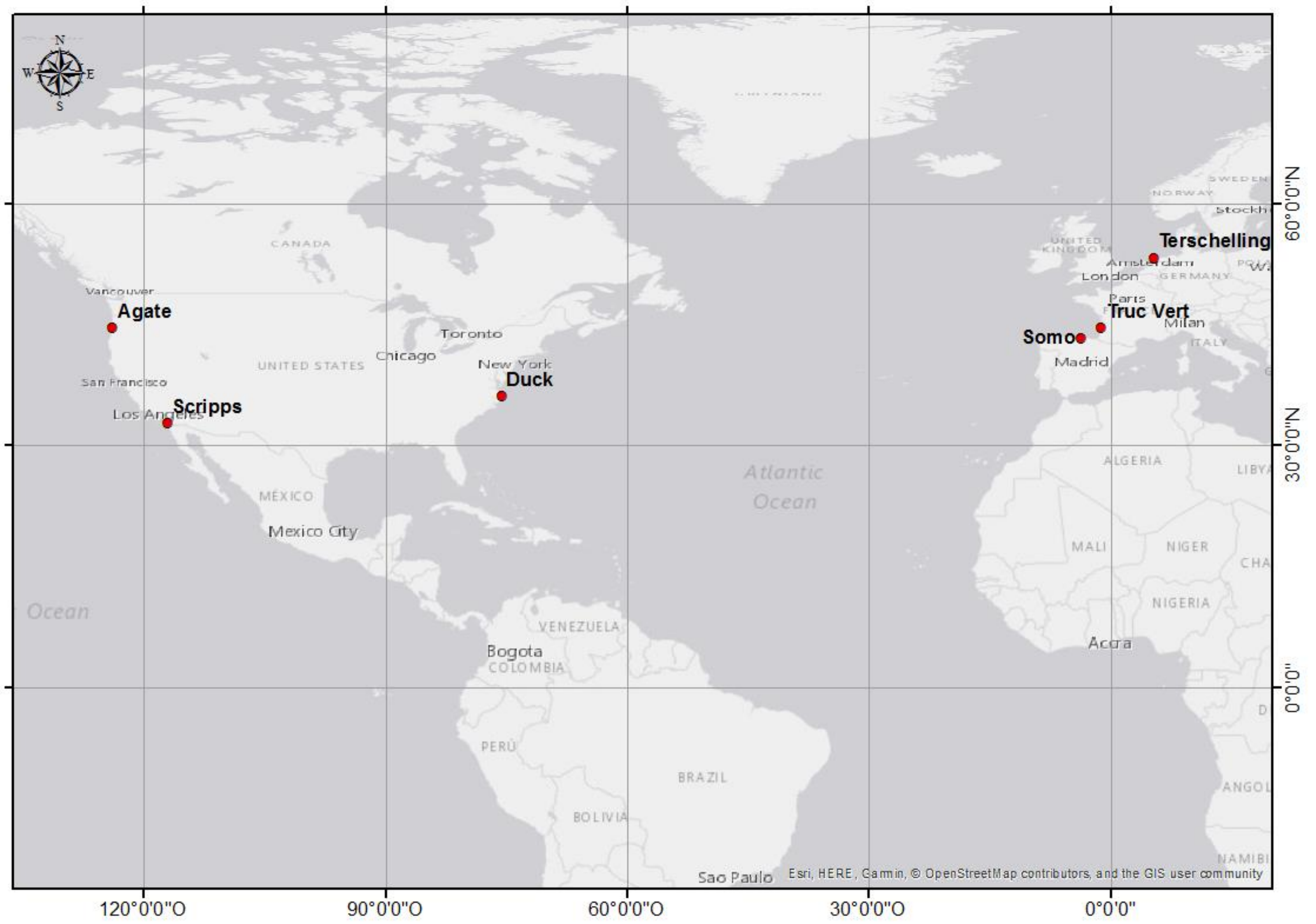
  US and NL beaches

- Senechal et al. (2011)

  Truc Vert Beach

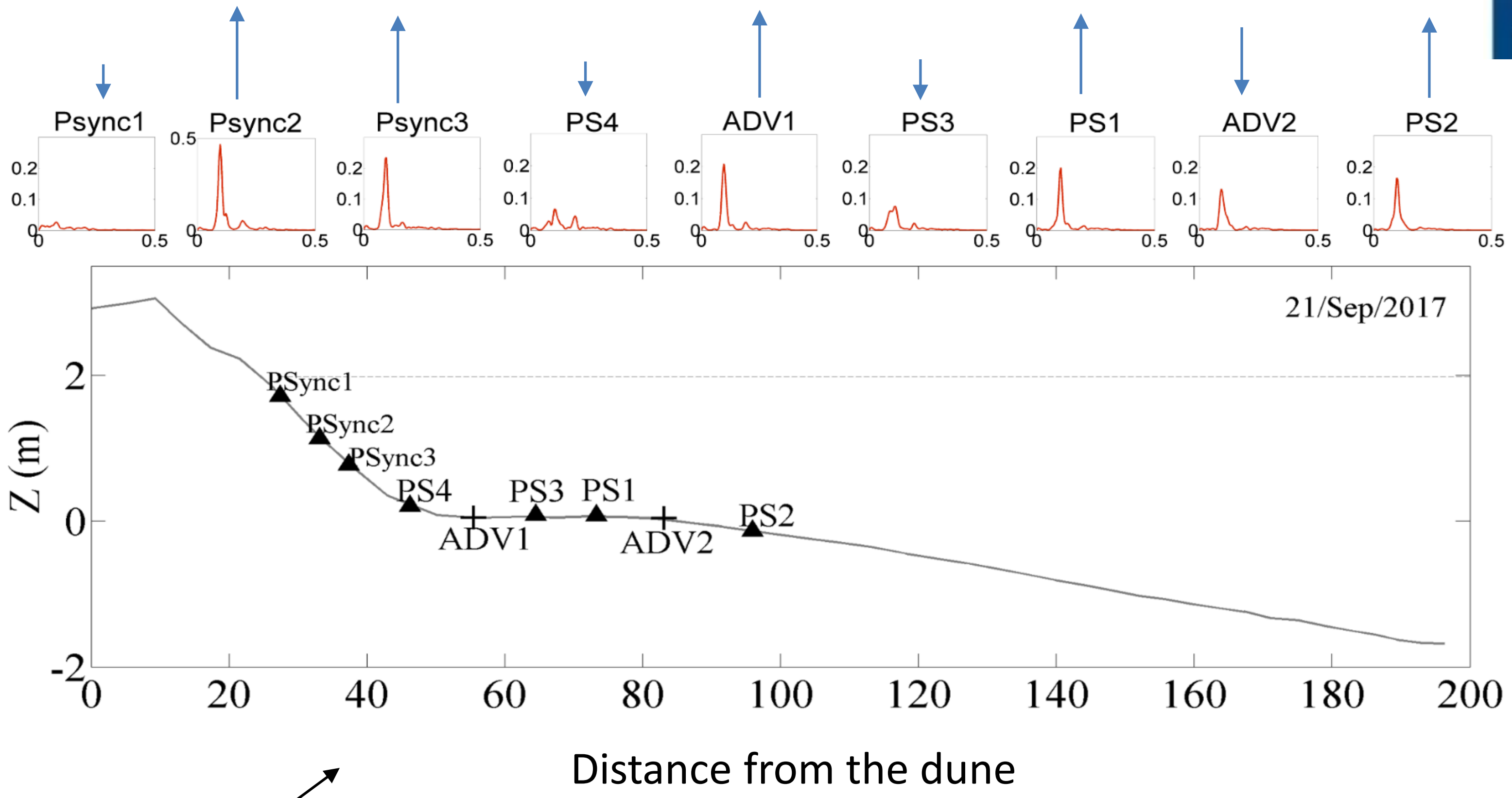
ii) Field Measurements

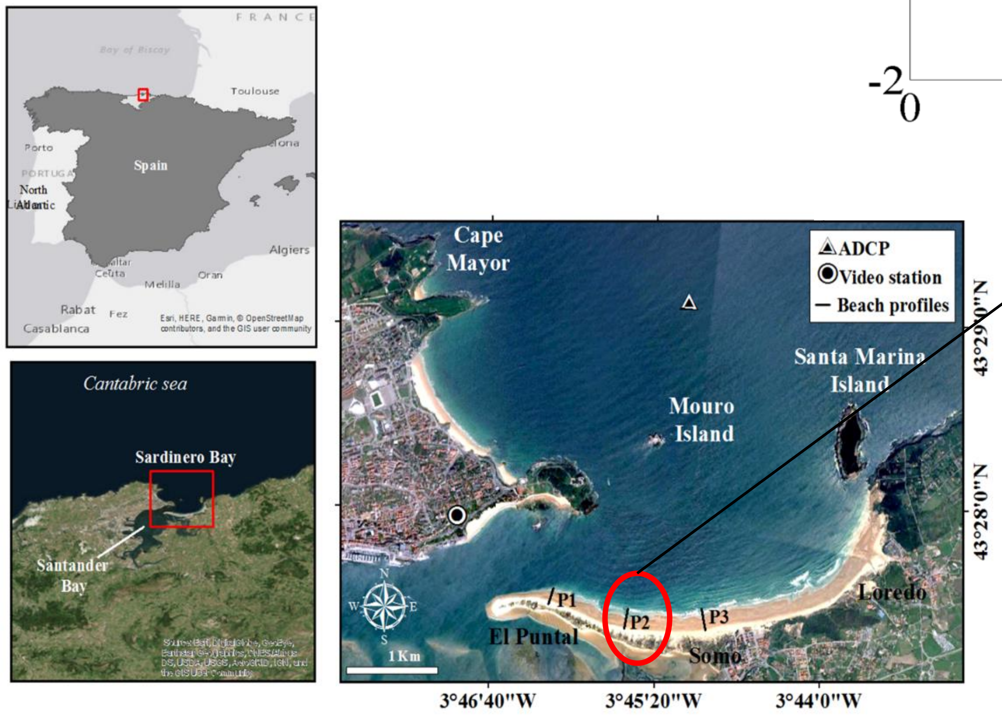
Somo beach – Noth Spain



Field Data

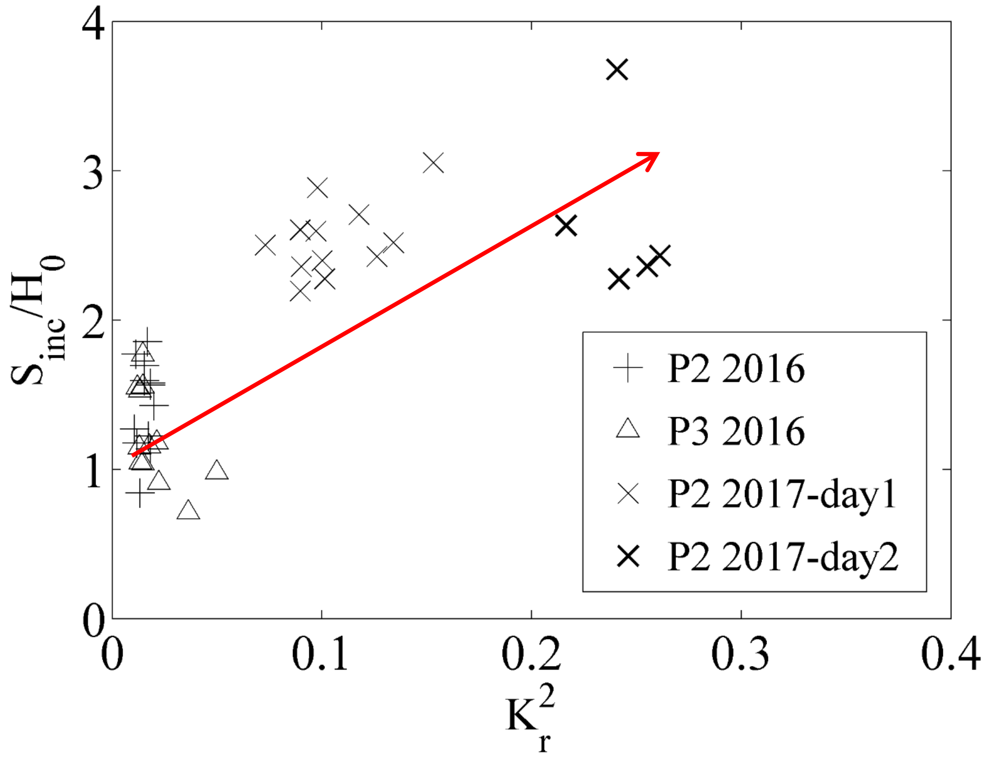
Field measurements Somo beach 2016/2017





Field Data

Field measurements Somo beach
MUSCLE-Beach 2017/2016



MORPHODYNAMICS

WAVE REFLECTION

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Parameterization

Basical form: $$\frac{S_{inc}}{H_0} = \boldsymbol{a} * tan\beta^{\boldsymbol{b}} \left(\frac{H_0}{L_0}\right)^{\boldsymbol{c}}$$

$$\frac{S}{H} = \begin{cases} (\mathbf{3}/\boldsymbol{\pi}) tan\beta^{\mathbf{2}} \left(\frac{H_0}{L_0}\right)^{\mathbf{-1}} & (saturation) \\ (\mathbf{2}\boldsymbol{\pi})^{\mathbf{-0.25}} tan\beta^{\mathbf{0.75}} \left(\frac{H_0}{L_0}\right)^{\mathbf{-0.5}} & (transition) \\ (\mathbf{3}/\boldsymbol{\pi}) tan\beta^{\mathbf{-0.5}} \left(\frac{H_0}{L_0}\right)^{\mathbf{0}} & (reflection) \end{cases}$$

$\bar{\bar{\Omega}} \leq 1.5$	a, b, c (dissipative)
$1.5 < \bar{\bar{\Omega}} \leq 5.5$	a, b, c (intermediate)
$\bar{\bar{\Omega}} > 5.5$	a, b, c (reflective)

$\bar{\bar{\Omega}}$ (Wright et al., 1985)

Hypothesis: *a*, *b* and *c* vary according to the morphodynamic state

Outline

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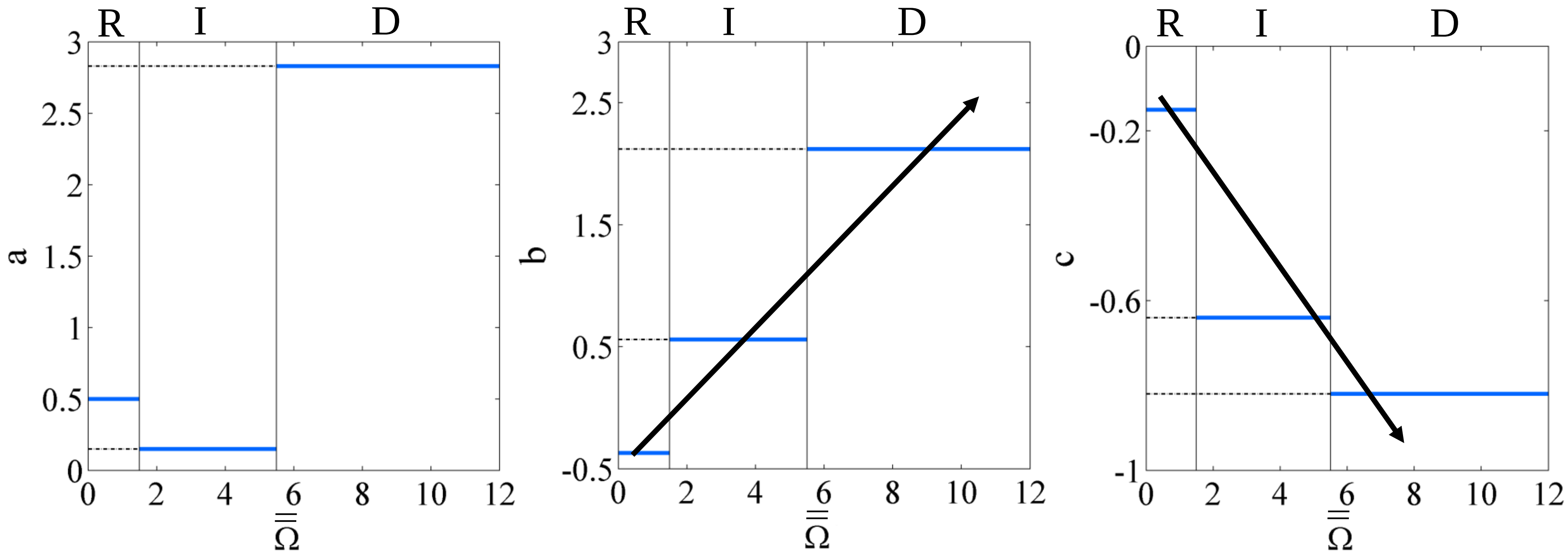
Results

Coefficients a, b and c

$$\frac{S_{inc}}{H_0} = a * tan\beta^{b}\left(\frac{H_0}{L_0}\right)^{c} \begin{cases} a = 2.83; b = 2.12; c = -0.82 & (dissipative) \\ a = 0.15; b = 0.56; c = -0.64 & (intermediate) \\ a = 0.50; b = -0.37; c = -0.15 & (reflective) \end{cases}$$

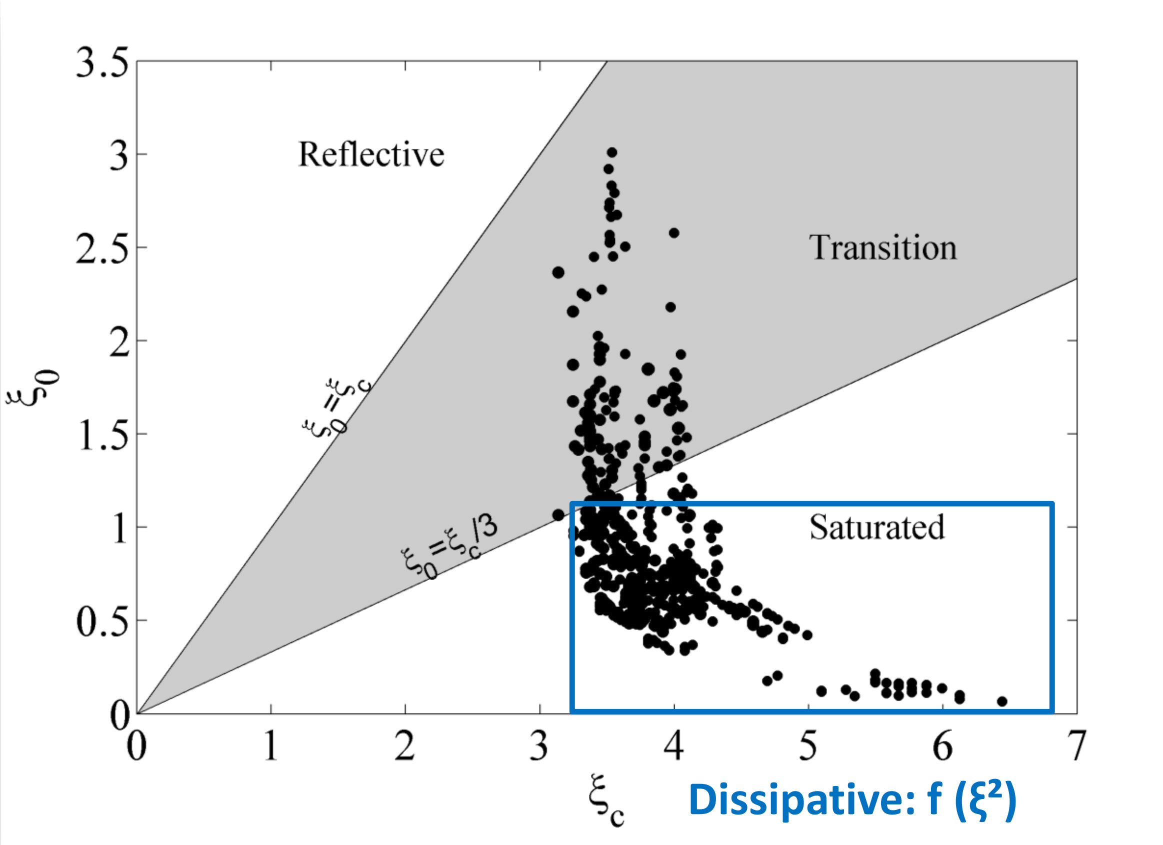


Results

Coefficients a, b and c

$$\frac{S_{inc}}{H_0} = \boldsymbol{a} * tan\beta^{\boldsymbol{b}} \left(\frac{H_0}{L_0}\right)^{\boldsymbol{c}} \begin{cases} a = 2.83; b = 2.12; c = -0.82 & (dissipative) \\ a = 0.15; b = 0.56; c = -0.64 & (intermediate) \\ a = 0.50; b = -0.37; c = -0.15 & (reflective) \end{cases}$$

Guza et al. (1984)		This work
$b_{reflective} = 2.0$ $c_{reflective} = -1.0$	≈	$b_{reflective} = 2.12$ $c_{reflective} = -0.82$
$b_{saturation} = -0.5$ $c_{saturation} = 0$	≈	$b_{dissipative} = -0.37$ $c_{dissipative} = -0.15$



Dissipative: f (ξ²)

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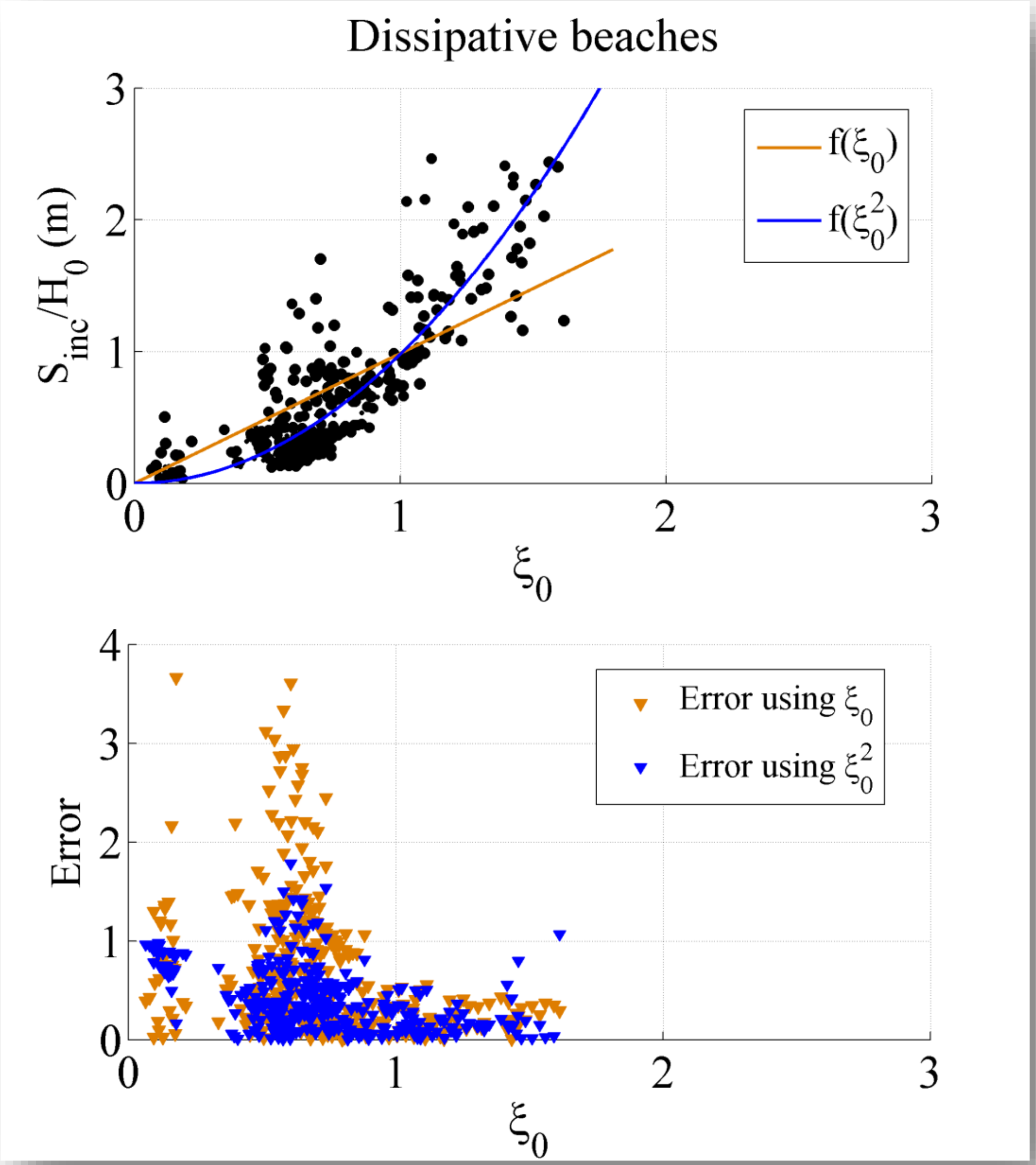
Parameterization



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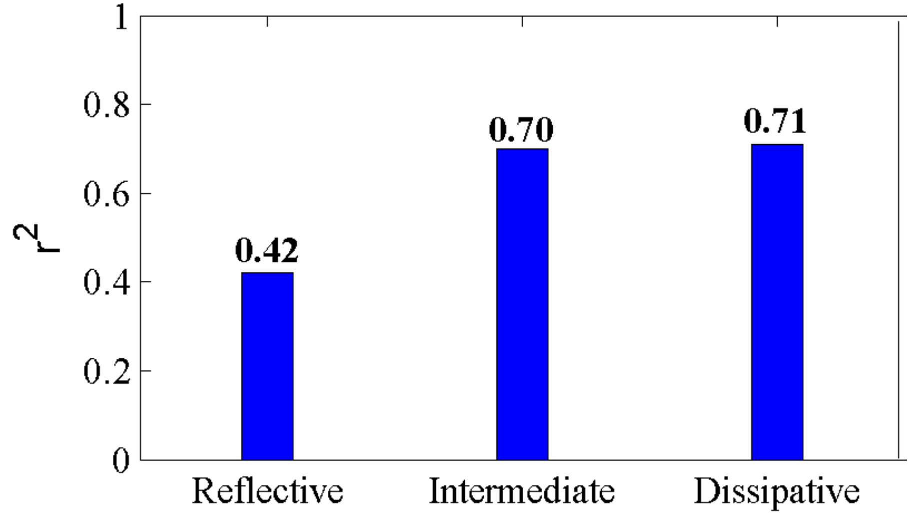
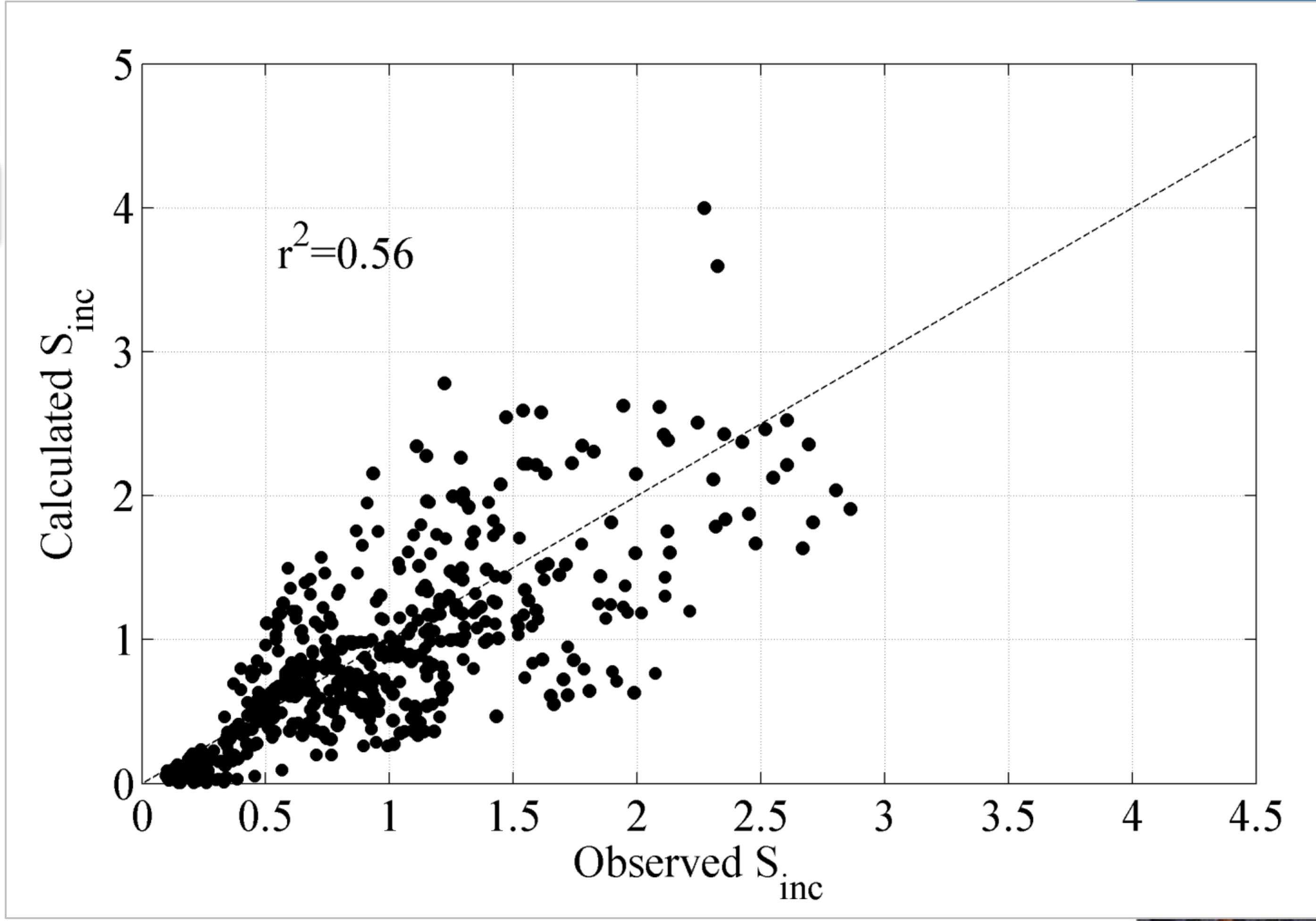
Results

r² = 0.56 this work

r² = 0.31 Stockdon et al. (2006)





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Conclusions and future research

- The importance of the amount of reflection on swash values was assessed

- S_{inc} parameterization established assuming a relation between the condition of reflection/saturation and the morphodynamics of the beach using field data

- The role of the foreshore slope and the wave steepness showed to vary according to the morphodynamic state

- Three formulas were obtained to describe the incident swash in reflective, intermediate and dissipative conditions

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Conclusions and future research

- Effect of additional parameters (*e.g.* f_s, σ_θ)
- Effect of the tidal level S_{inc}

Thank you!

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