



Built Environment
leArning for Climate
AdaptatiON



Applicability of equilibrium-based and reduced-complexity models on coastal management and climate change adaptation

L. de Freitas¹, C. Jaramillo¹, E. M. González¹ and R. Medina¹

1: IHCantabria

University of
HUDDERSFIELD
Inspiring global professionals



L-Università
ta' Malta



Co-funded by the
Erasmus+ Programme
of the European Union



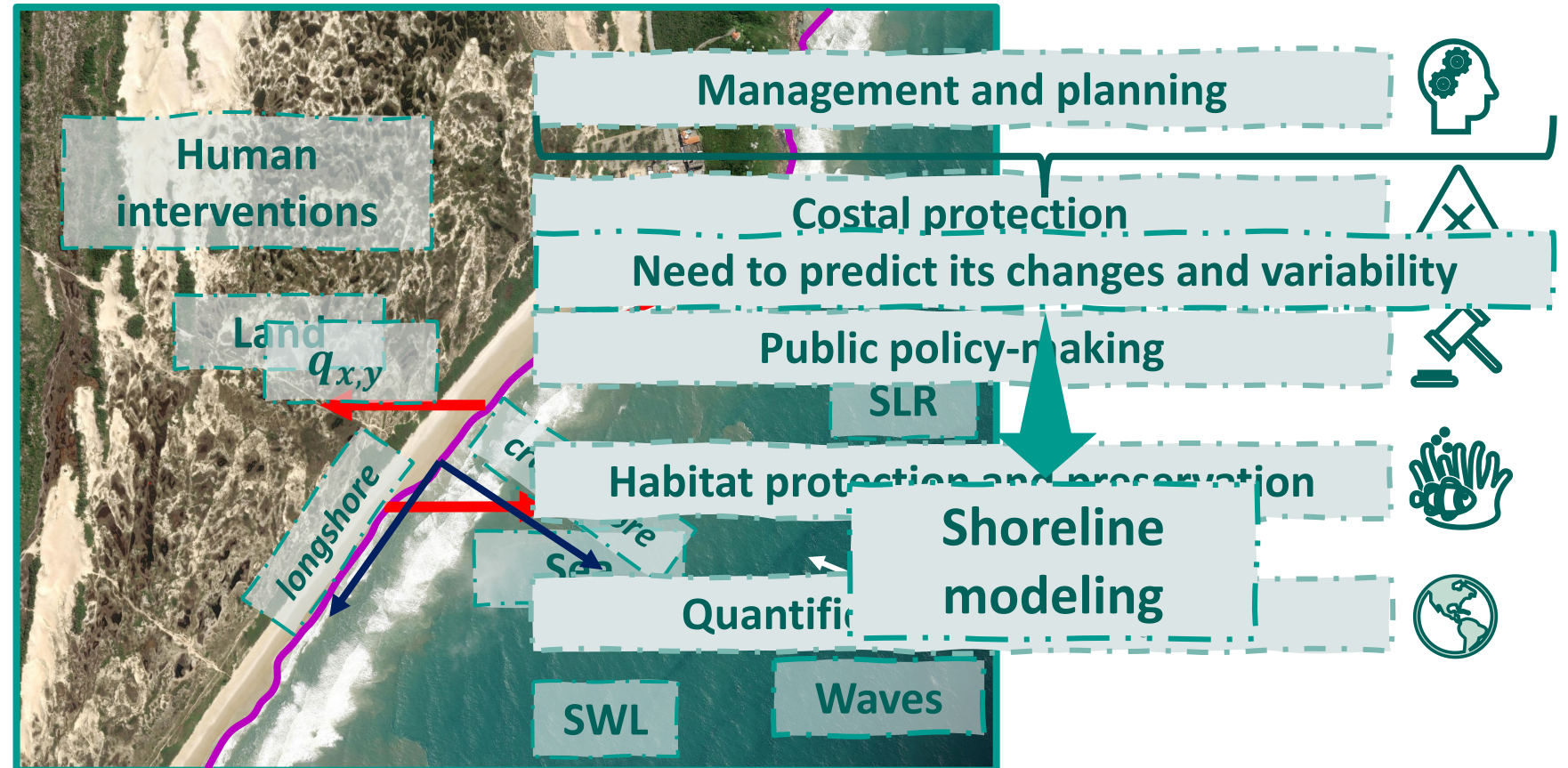
Introduction

Shoreline modeling

Study case

Conclusions

What is the shoreline importance?





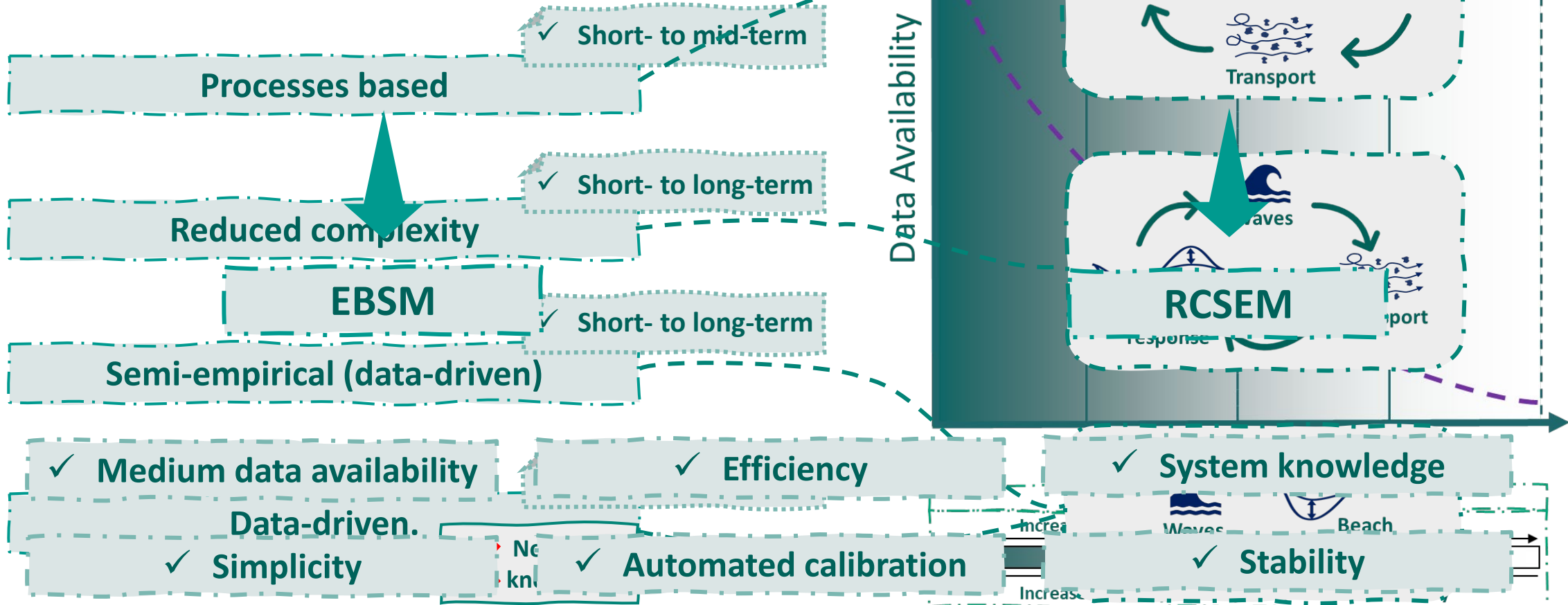
Introduction

Shoreline modeling

Study case

Conclusions

Shoreline modeling



Modified from Hunt et al. 2023



Introduction



Shoreline modeling

Study case

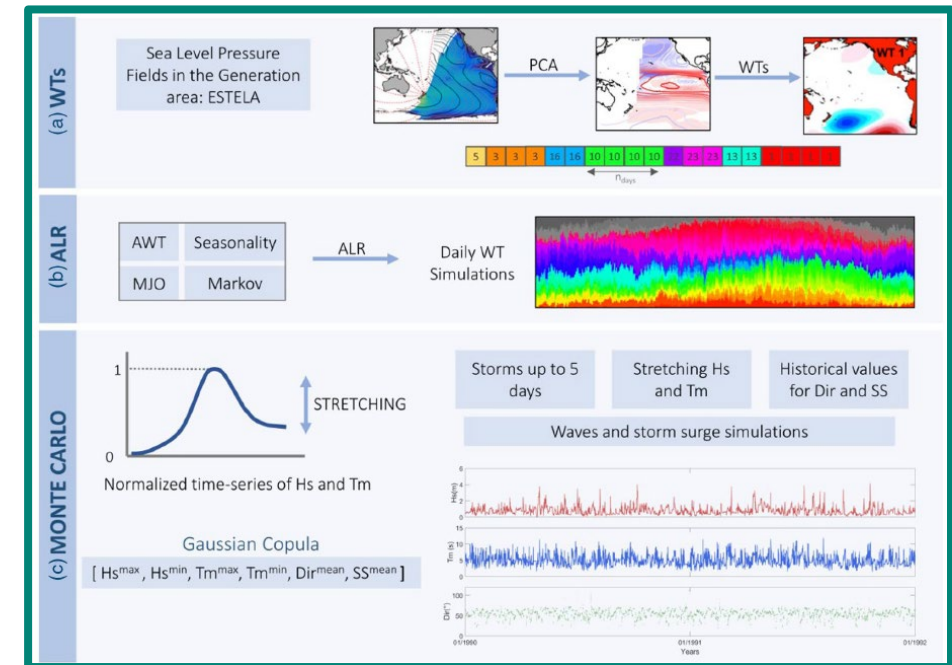
Conclusions

Study case



15 years of shoreline position data available (1999-2014)

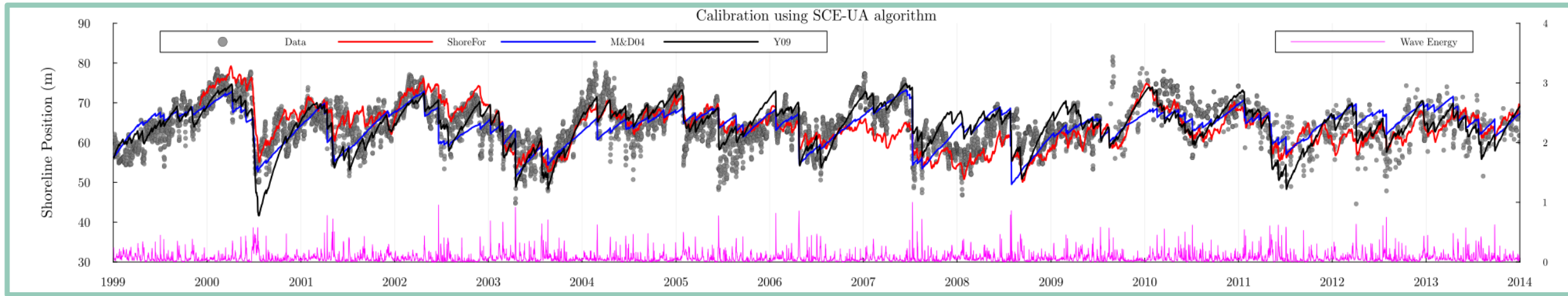
Full waves hindcast from 1999 to 2014 and 1000 sea states Monte Carlo simulations from 2000 to 2100, maintaining wave climate



Results

M&D04	Y09	ShoreFor
$Y(t) = k^{+/-}(Y_{eq} - Y)$	$Y(t) = c^{+/-}E^{0.5}$	$Y(t) = k^{+/-}(\bar{\Omega} - \Omega)$
<ul style="list-style-type: none"> ✓ Equilibrium position ✓ Sea Level+ ✓ Parameter varying 	<ul style="list-style-type: none"> ✓ Wave Energy ✓ Equilibrium position ✓ Damping term 	<ul style="list-style-type: none"> ✓ Dean parameter ✓ Beach memory ✓ No fixed SL position

	M&D04	Y09	ShoreFor
<i>MSS</i>	0.56	0.63	0.60
ρ_p	0.55	0.63	0.61
<i>RMSE</i>	4.79 m	4.74 m	4.90 m



Results – Miller and Dean (2004)

The model's dumping lead to a shoreline equilibrium state

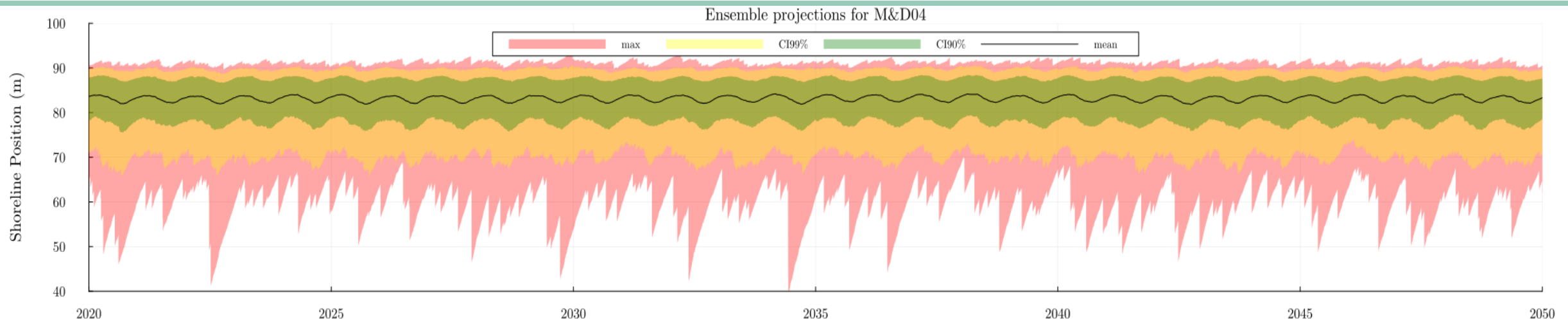
Accretion is limited by the models' dumping

Shoreline erosion can reach a maximum of 40 m

Same data variability in projections

Biggest erosion events trend to occur during winter

Accretion events do not exceed 20 m



Results – Yates et al. (2009)

The model's dumping lead to a shoreline equilibrium state

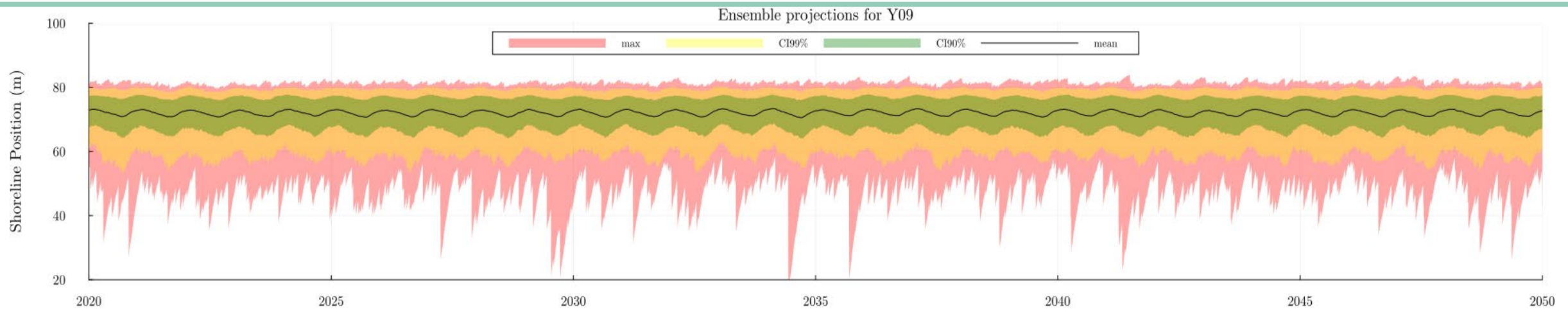
Accretion is limited by the models' dumping

Shoreline erosion can reach a maximum of 60 m

Greater data variability than projections

Biggest erosion events trend to occur during winter

Accretion events do not exceed 10 m



Results – ShoreFor – Davidson et al. (2013)

Absence of dumping leads to a wide variability

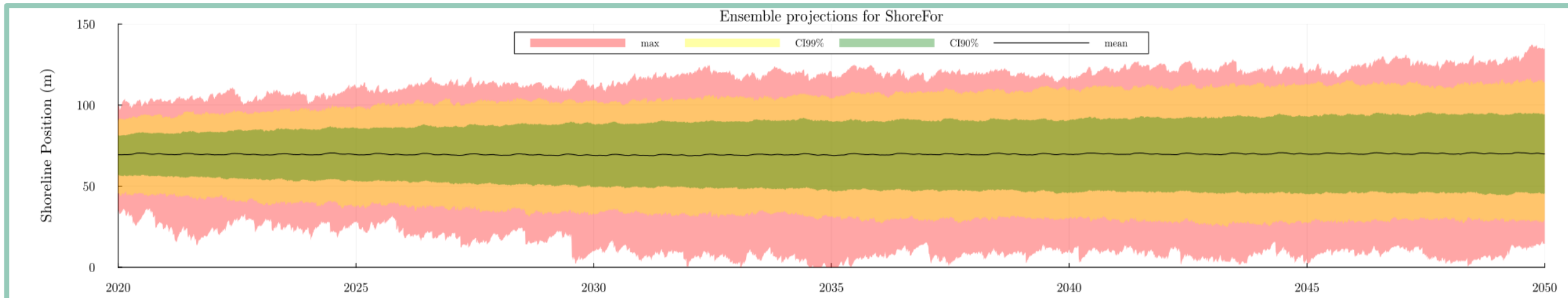
Accretion has the same variability as erosion

Shoreline erosion can reach a maximum of 80 m

Increasing variability over time

No seasonal variability observed

Shoreline accretion can reach a maximum of 80 m





Introduction

Shoreline modeling



Study case

Conclusions

Conclusions

- ✓ Short- to long-term shoreline modeling is needed to provide information of shoreline evolution to decision-makers concerning different processes
- ✓ EBSEM and RCSEM are useful tools for med- to long-term shoreline modeling, allowing statistical approaches such as ensemble analysis or multiple management scenarios overtime
- ✓ Results of the study case shows that all the three models are capable to reproduce the observed shoreline variability over the whole calibration period
- ✓ The projections simulated showed that each model can lead to a different future scenario, highly conditioned to the wave climate



Built Environment
leArning for Climate
AdaptatiON



Thank you

L. de Freitas¹, C. Jaramillo¹, E. M. González¹ and R. Medina¹

1: IHCantabria

University of
HUDDERSFIELD
Inspiring global professionals



L-Università
ta' Malta

