

Final Event –ECCLIPSE Project

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Puertos del Estado,
Madrid



Ocean climate projections

José María García-Valdecasas
Bernal



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2'

What is needed?

How to obtain answers?

METHODOLOGY

10'

Description

Method validation

RESULTS

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Summary of results

CONCLUSIONS

3'

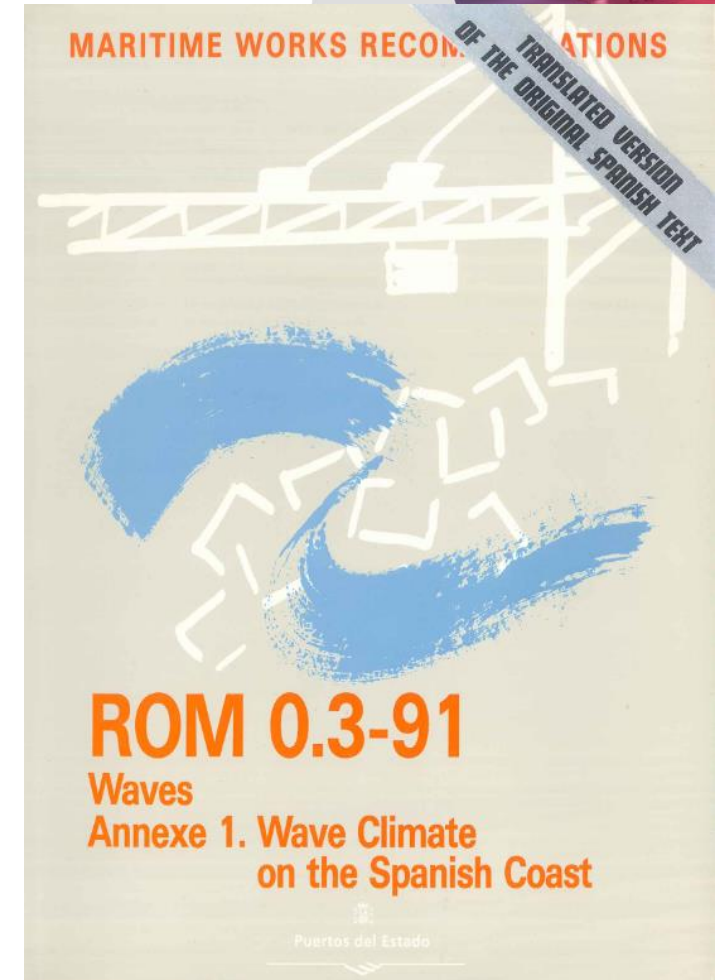
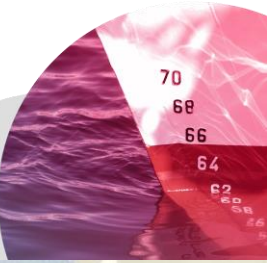
Conclusions

Future works

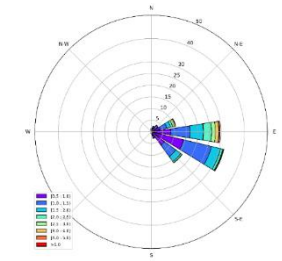
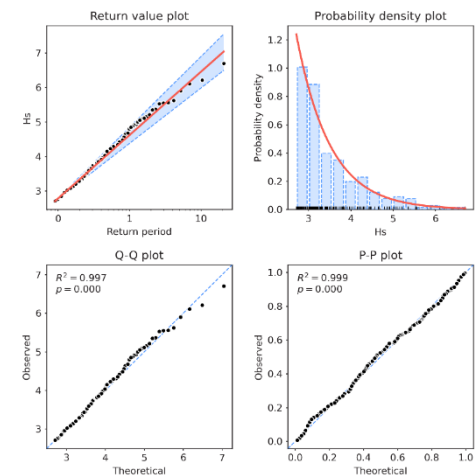
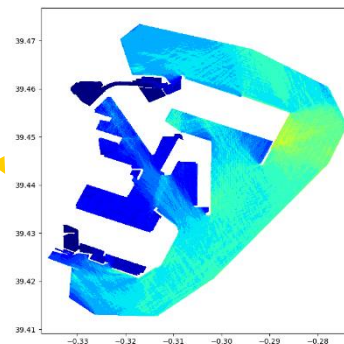
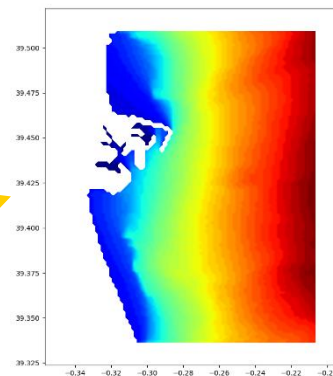
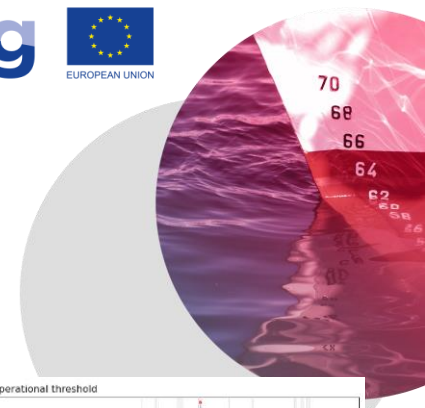
1. OBJECTIVE

Need for wave climate projections

- The main objective is to better understand **how climate change will affect port operations and infrastructure maintenance**
- The assessment of mean and extreme regimes for wave climate for future scenarios will provide **qualitative information on climate risks likelihood**



1. OBJECTIVE

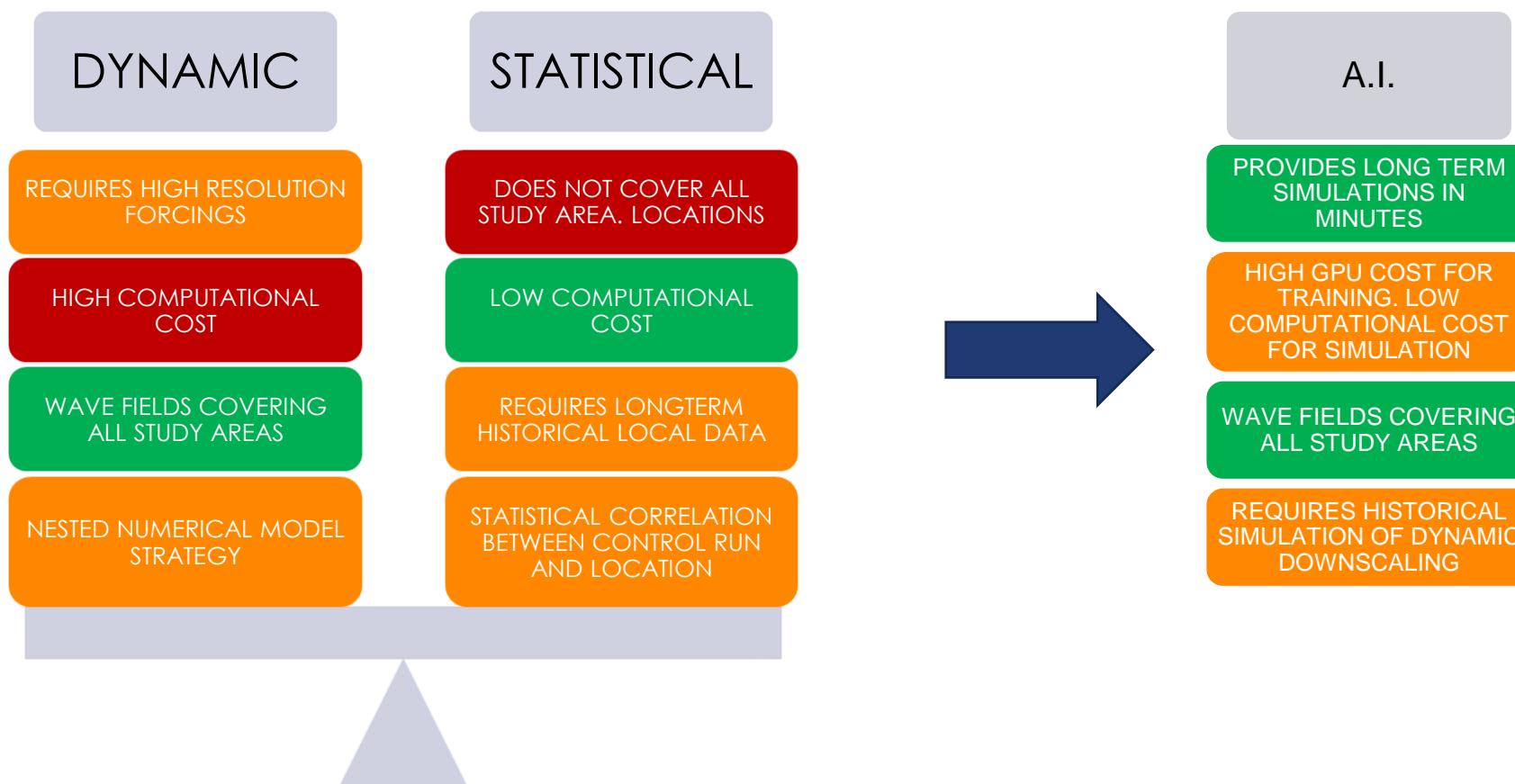


GCM WAVES

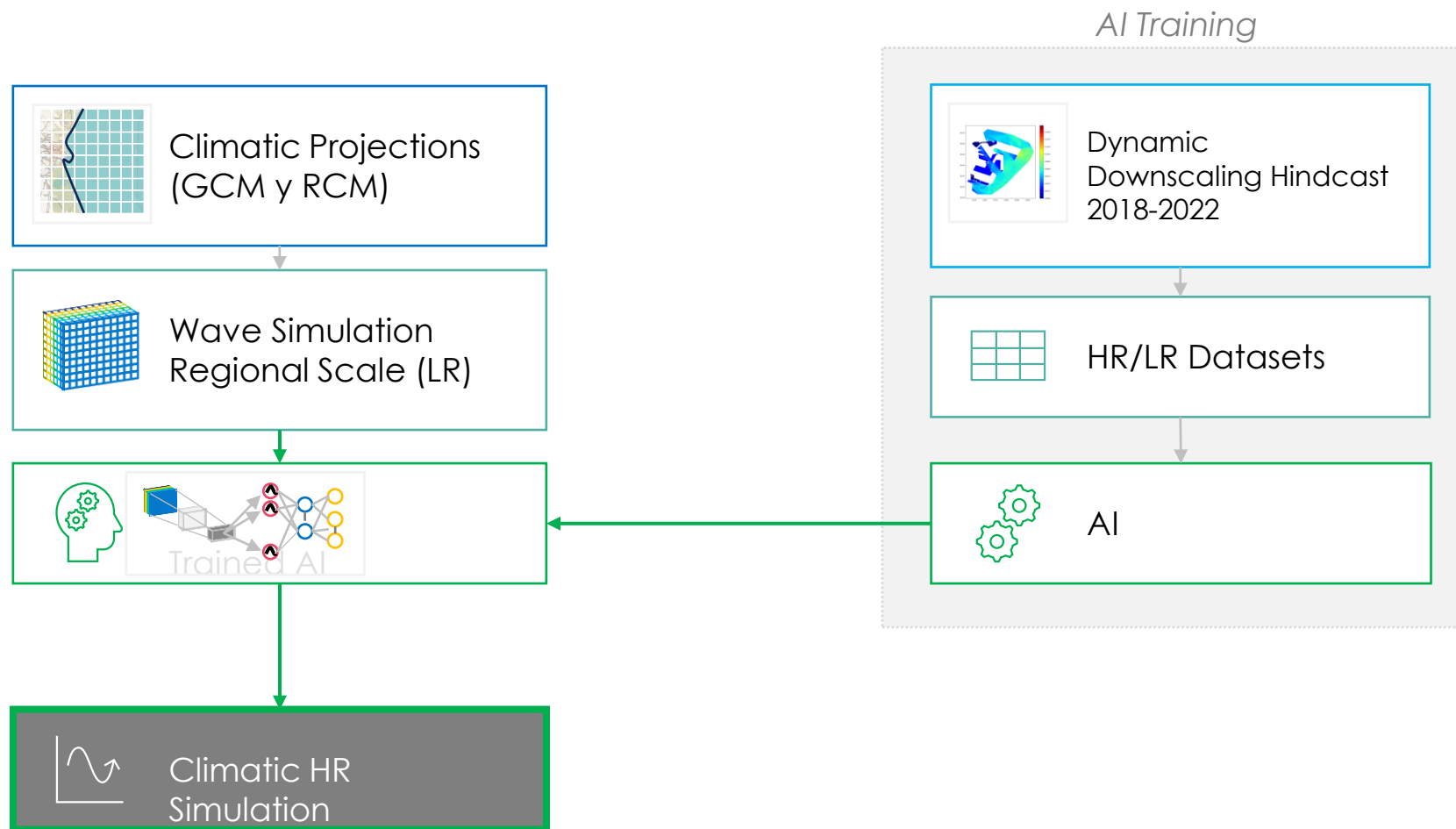
COASTAL AND PORT SCALE

TIME SERIES ANALYSIS

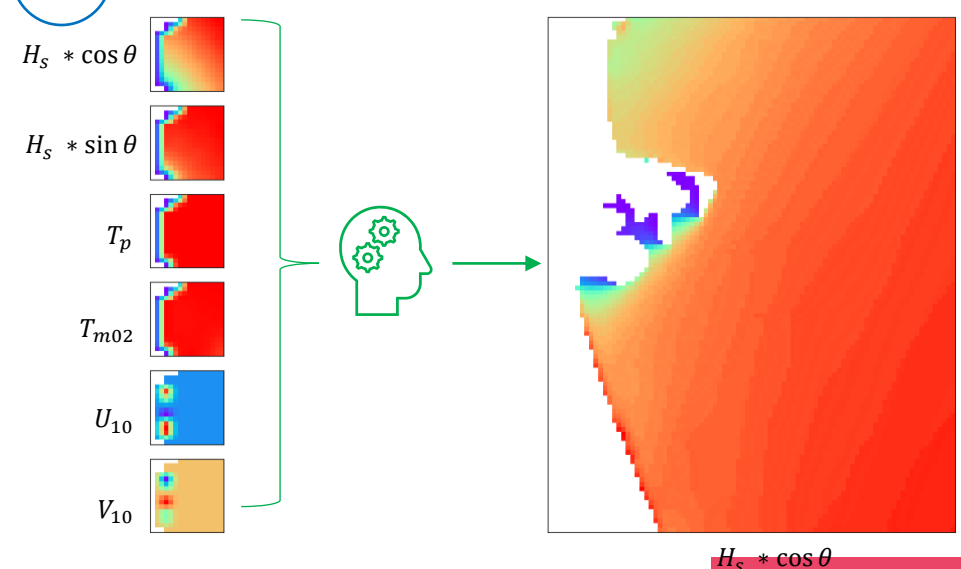
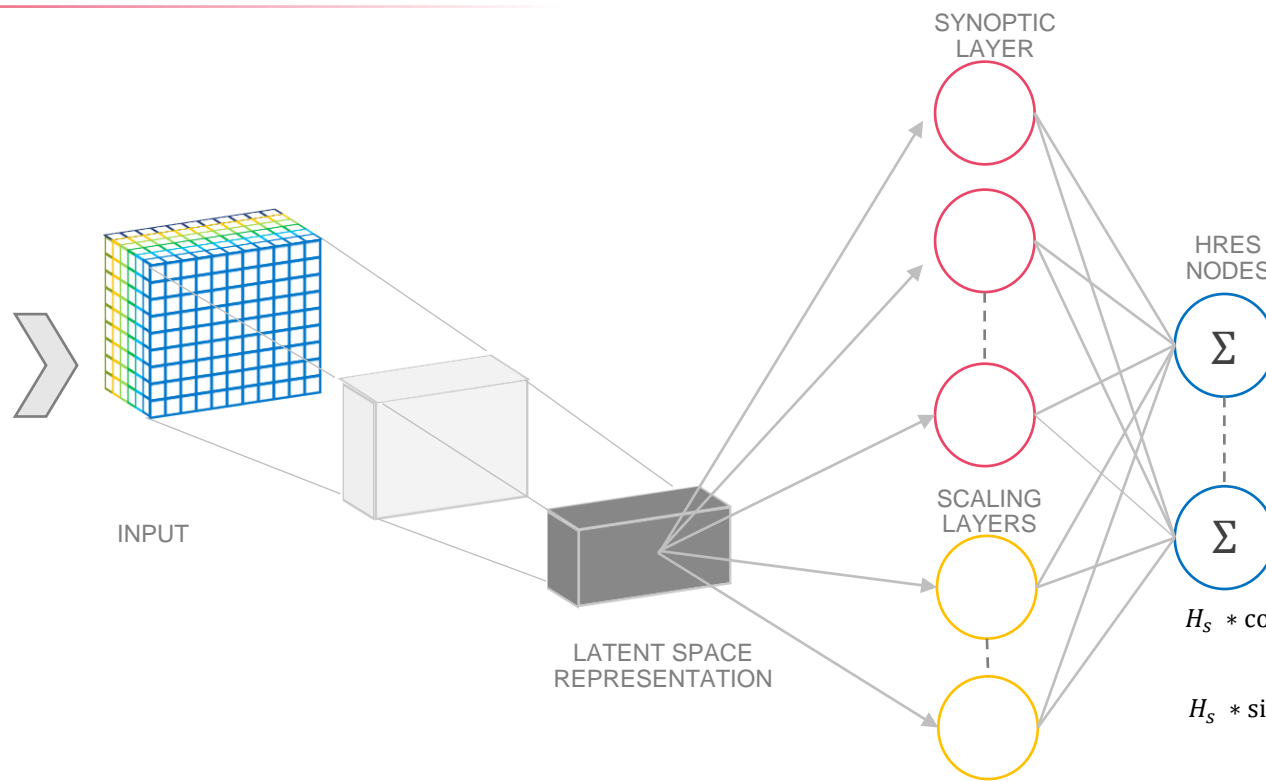
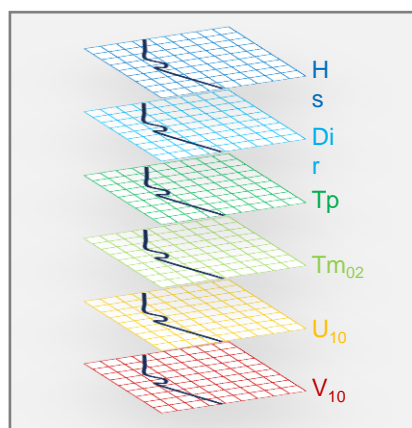
2. METHODOLOGY



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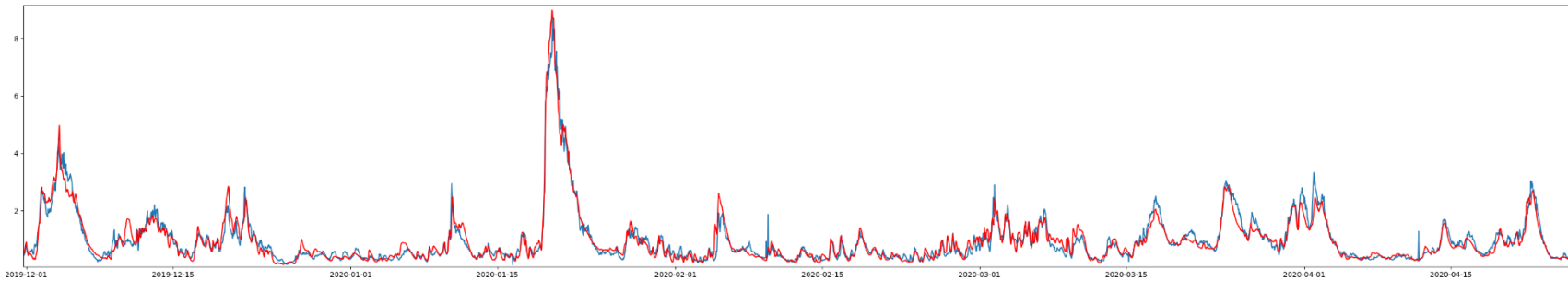
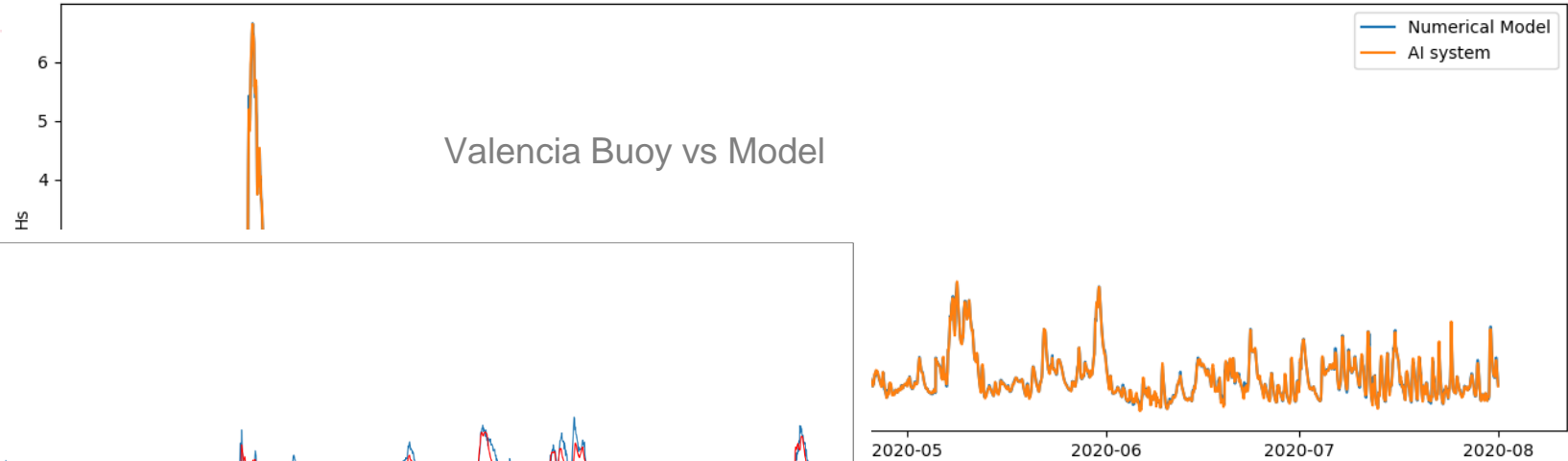


$H_s * \cos \theta$

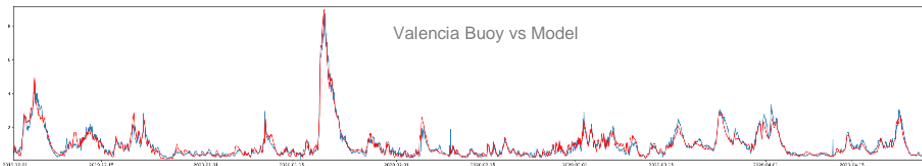
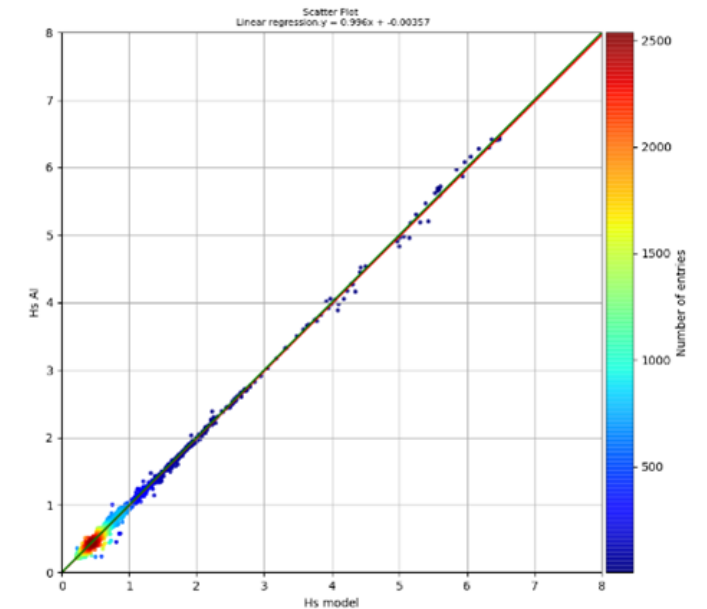
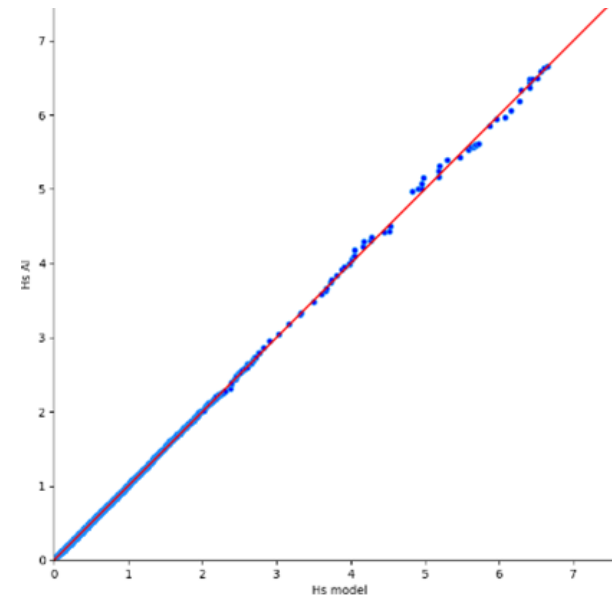
2. METHODology

Dynamical downscaling vs C-RBF AI

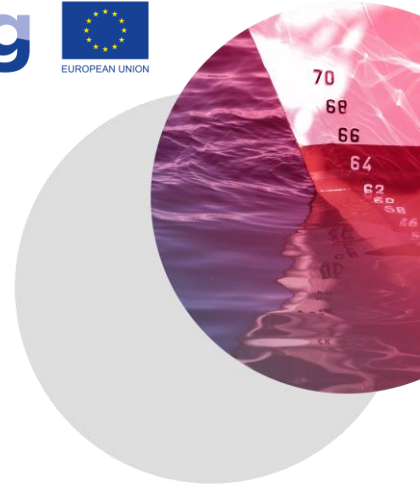
Validation



- Over **3 years** of dynamic simulation
- Train + Validation using 3 years
- Test dataset: 8 months, including unseen events like **GLORIA Storm (Jan 2020)**



3. RESULTS

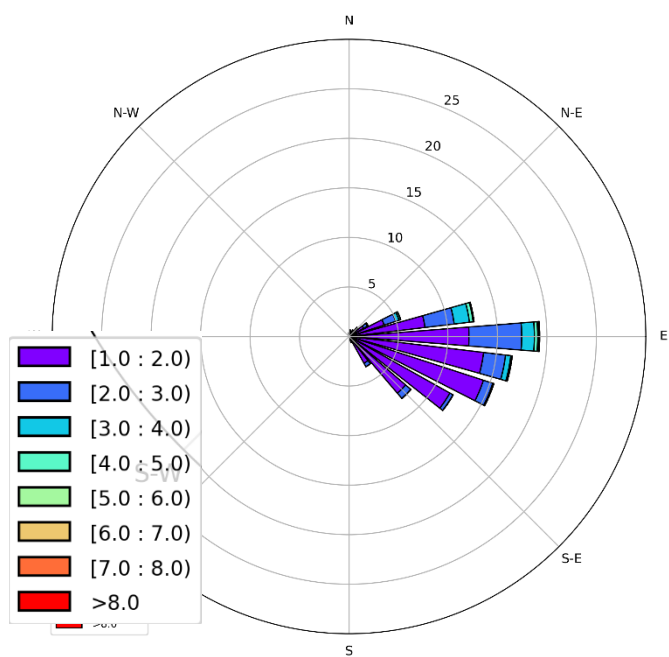


- Global Circulation Models parametrize regional and local effects. This leads to **uncertainty in the simulations**.
- The **assessment of climate change** must be analyzed in terms of **variation ratios** or **statistical parameters differences**.
- This variation is done by comparing one of the future climate blocks with the control simulation of each model (1985-2005).
- To reduce uncertainty, **multiple models and climatic scenarios** should be used in the analysis
- **Shown results are for Valencia Port**. Equivalent results have been obtained for Gandia and Sagunto Ports.

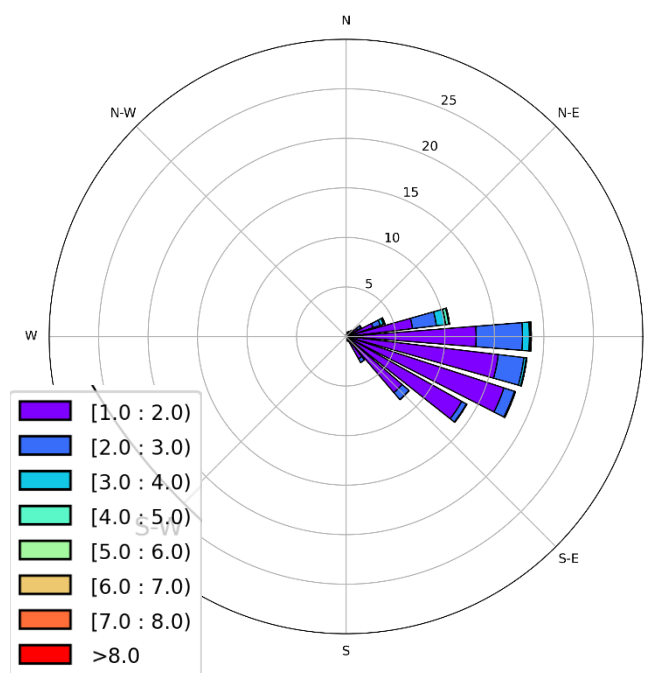
3. RESULTS



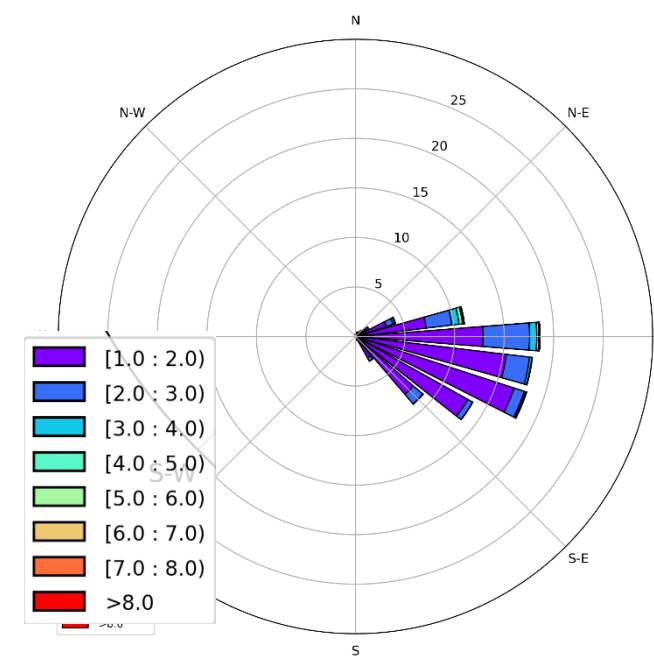
Wave mean regime



Wave Rose: Control Run
1985 - 2005



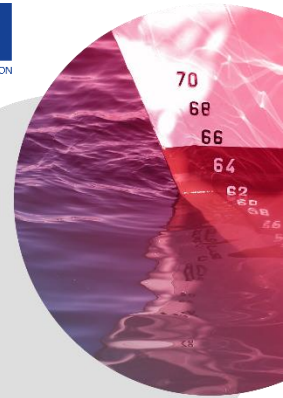
Wave Rose: RCP 4.5
2080 - 2100



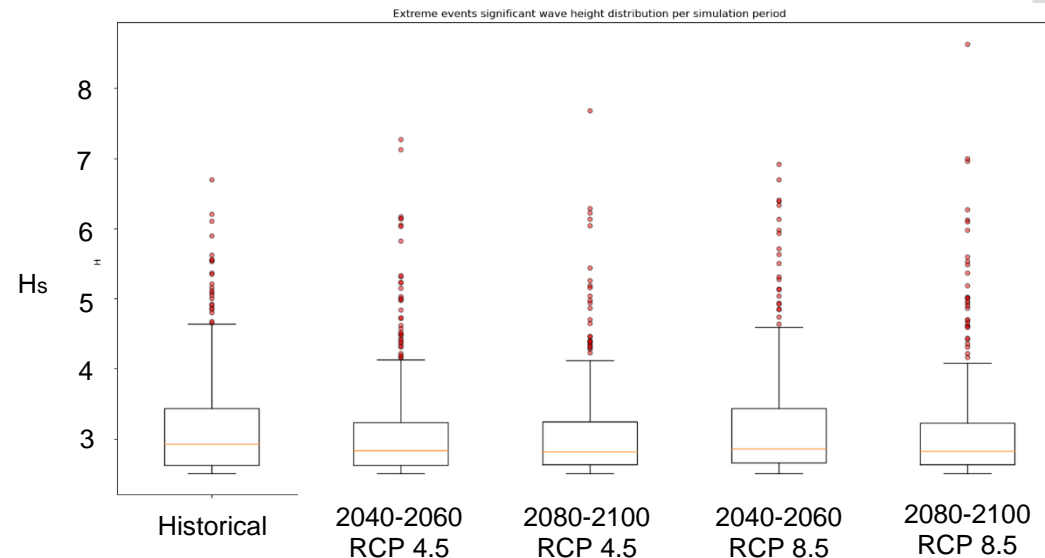
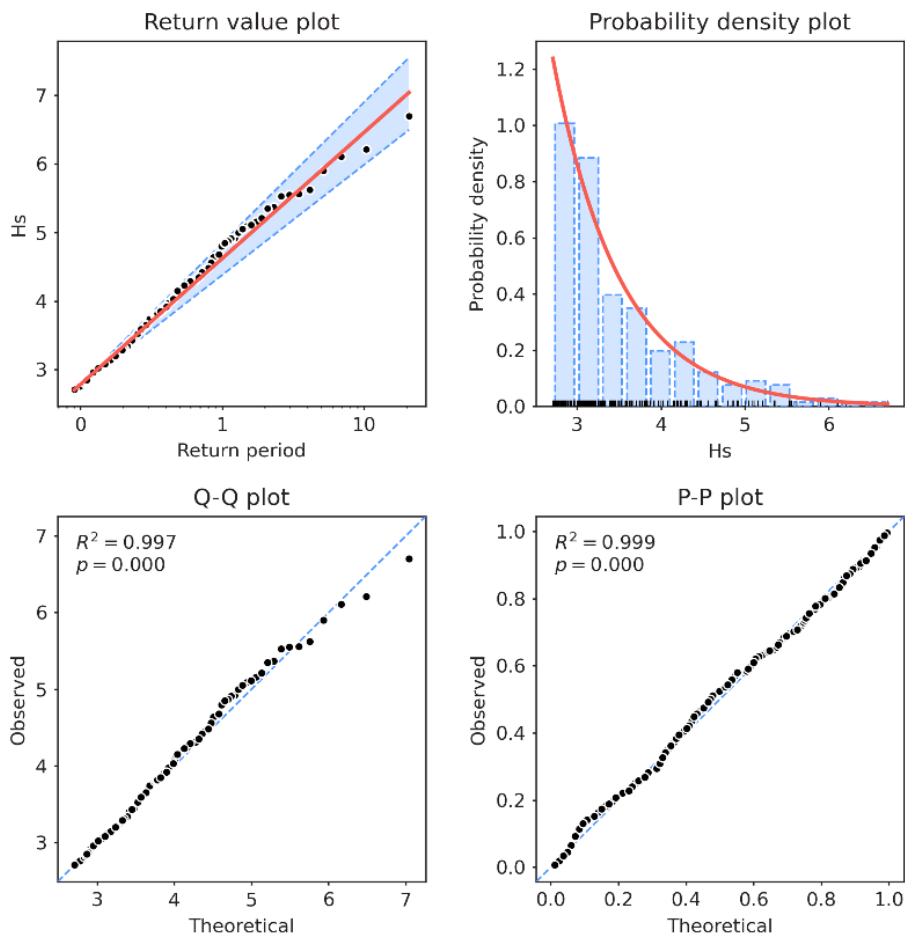
Wave Rose: RCP 8.5
2080 - 2100

Slight change of wave direction **to the South**

3. RESULTS



Extreme events

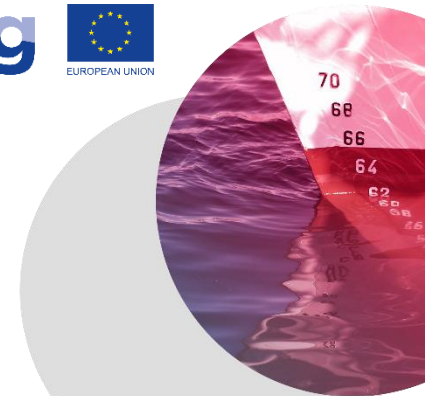


	RCP 4.5		RCP 8.5	
	2040 – 2060	2080 – 2100	2040 – 2060	2080 – 2100
N° Storms/year	-31%	-29%	-18%	-24%
Mean duration	-4%	-3%	13%	-1%

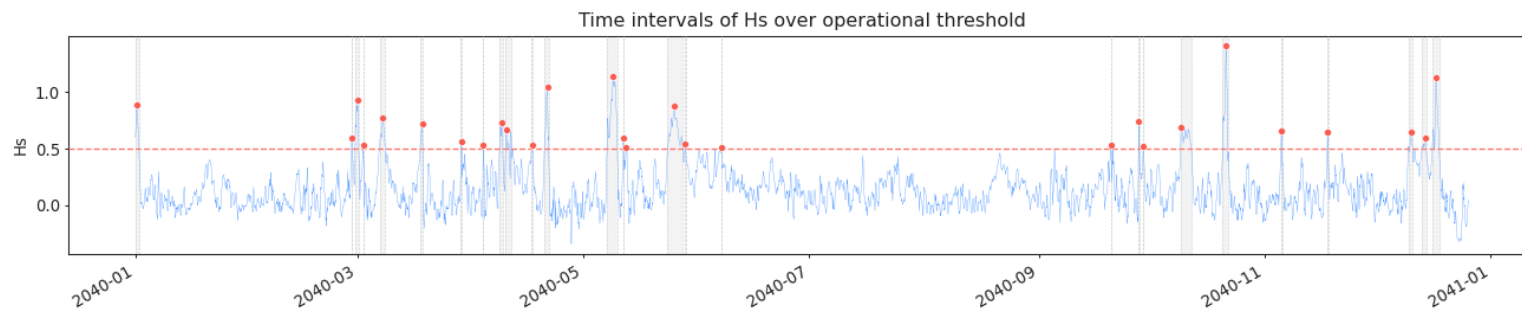
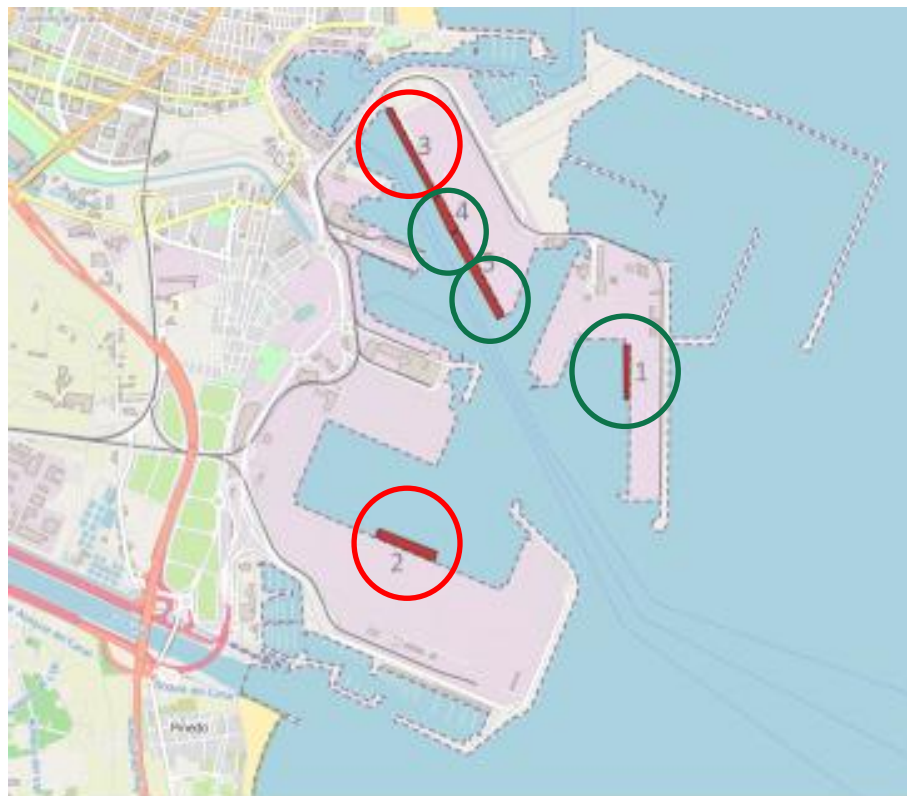
Excedance probability of design wave in 50 years	Historical	RCP 4.5		RCP 8.5	
	1985-2005	2040-2060	2080-2100	2040-2060	2080-2100
	10%	35,6%	25,8%	29,2%	52,8%

Attending to projections, there will be **less storms** and **shorter in duration**, but **more energetic**

3. RESULTS



Operational thresholds



Variation of the anual number of operational stops

Area	RCP 4.5		RCP 8.5	
	2040-2060	2080-2100	2040-2060	2080-2100
A1	-8%	-4%	-8%	-1%
A2	0%	10%	0%	10%
A3	-7%	4%	3%	6%
A4	-14%	-12%	-10%	-6%
A5	-10%	-8%	-6%	1%

Variation of the duration of operational stops

Area	RCP 4.5		RCP 8.5	
	2040-2060	2080-2100	2040-2060	2080-2100
A1	-15%	-10%	1%	-5%
A2	78%	11%	183%	72%
A3	-4%	4%	12%	15%
A4	-12%	-7%	4%	3%
A5	-13%	-5%	4%	-2%

Operational conditions in actual identified areas **are improved** in general terms. **New areas may be penalized.** -> **observatory of climate change impact** is required to detect new vulnerable areas

CONCLUSIONS



- The proposed **AI-methodology** provides climatic projections with **low impact in time**.
- Climate change **will slightly modify** the **wave climate direction**.
- **Storminess** will be **lower in number and duration of events**, but storms events will **be more severe**.
- Operational conditions at analyzed areas are **not penalized** with expected wave climate in the future. But **new issues may arise in other locations**. A record track of events is required to identify these new vulnerable areas
- Results have to be analysed from a **qualitative** point of view. GCM uncertainties don't allow quantitative analysis.



José María García-Valdecasas

Coastal Services Manager

Jose.gvaldecasas@nologin.es