Climate Risks - Port of Aveiro

Interreg Sudoe
ecclipse

03 Risk analysis

02 Identifying Critical Climates

01 Introduction

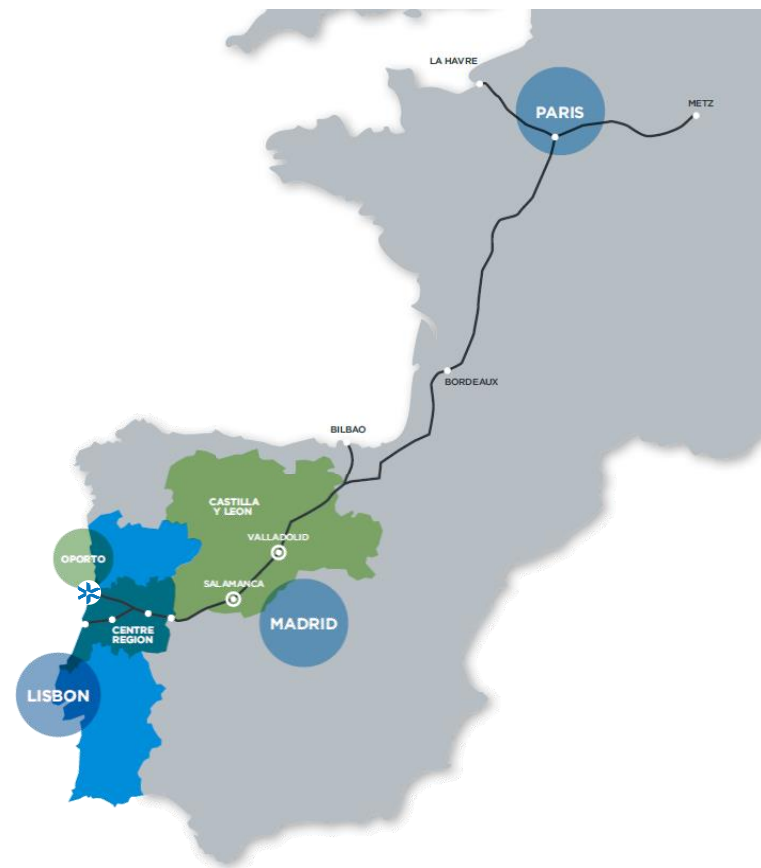# The Port of Aveiro
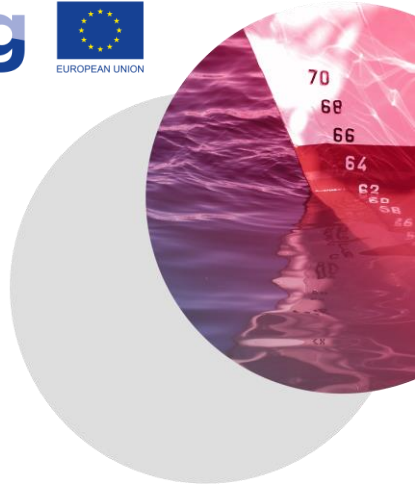
Europe

Portugal

Atlantic Ocean

The Port of Aveiro

2,2 million in the center region

519km to Madrid

1,100km to Barcelona

The Port of Aveiro - Foreland

The Port of Aveiro

1.000 vessels

6 jetties

5,8 million tons

5 terminals
3,5 kms quay

66 ha for expansion

storage facilities

multimodal services

free of congestion

#1 in break bulk

The Port of Aveiro

AREA OF JURISDICTION 1,726 ha

CS WIND
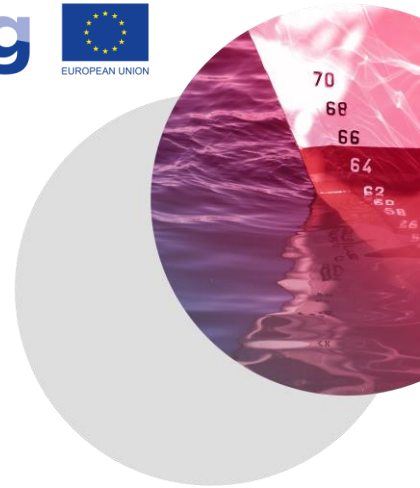
COMMERCIAL NORTH SECTOR
1 MULTIPURPOSE TERMINAL
2 CONTAINERS/RO-RO TERMINAL
3 ZALI – LOGISTICAL AND INDUSTRIAL ACTIVITIES ZONE
4 SOLID BULK TERMINAL
5 LIQUID BULK TERMINAL

COMMERCIAL SOUTH SECTOR
6 MULTIPURPOSE TERMINAL
7 SHIPPING REPAIR AND CONSTRUCTION ZONE
8 EXPANSION ZONE

FISHING SECTOR
9 HIGH SEA FISHING PORT
10 SPECIALISED FISH TERMINAL
11 COASTAL FISHING PORT
12 SMALL HARBOUR

OTHER AREAS
13 OUDINOT GARDEN ("JARDIM OUDINOT")
14 SMALL HARBOUR OF S. JACINTO
15 FUTURE INTERMODAL TERMINAL

ACESSES AND JURISDICTION
RAILWAY CONNECTION
RAILWAY LINE BEAMS
PORT RING ROAD
A25
AREA OF JURISDICTION

Identifying Critical Climates

Main Climate Changes concerns

The Port of Aveiro is paying particular attention to **Climate Changes** Impacts that might affect the Port activities.

Particularly on
1. **Operational conditions in the Port:**
    1. Navigation → Changes in the strength of Currents and Waves direction;
    2. Dredging volumes and frequency → Sediments transport patterns;
    3. Port Handling Operations → Strong wind and precipitation;

2. **Port and maritime infrastructures:**
    1. Damage and collapse of port and maritime infrastructures → Changes in Meteo-maritime parameters;
    2. Corrosion of infrastructure → Increased Temperature and Salinity;
    3. Reduced rainwater drainage capacity and flooding of low-lying harbour structures → Sea level rise and Storm surges.

Identifying Critical Climates
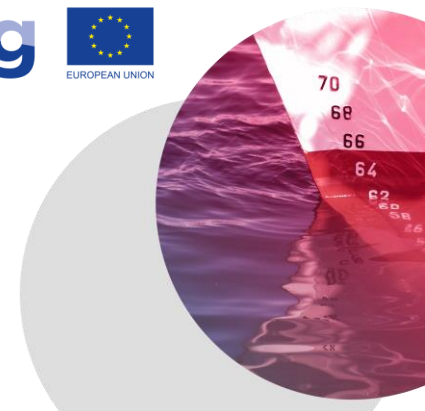
Methodology

The Port of Aveiro has handled several meetings with:

1. Internal team with the APA's Directors to have a preliminary evaluation of main climate change concerns of the Port

2. Port Community meetings:
   1. To discuss the preliminary evaluation;
   2. To define the critical climates that may affect the port operations and infrastructures;
   3. To define the operational thresholds to be studied;
   4. To discuss the results of the simulations (in the last meeting)

Identifying Critical Climates
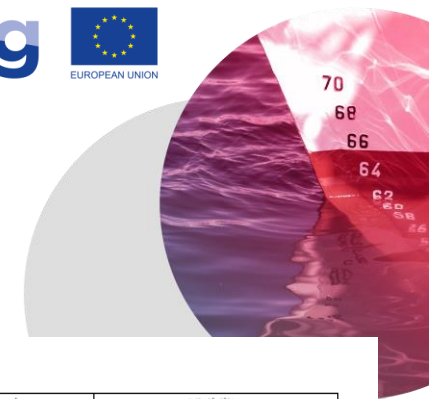
Results – parameters to evaluate:

1. Restrictions to navigation
→ Currents intensity, Waves, Wind and Visibility changes

2. **Restrictions to Port Operations**
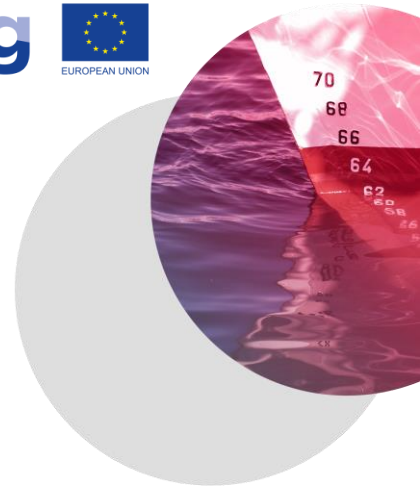→ Wind, Fog or Rain increasing

3. **Infrastructure's thresholds design**
→ Waves, Sea level rise

Table 1 –Relevant metocean parameters for Port of Aveiro, as defined in Deliverable 3.3.1

|	Currents	Waves	Wind	Sea level	Visibility
Restrictions to navigation					
Description	The currents generated near the inlet are mainly driven by tide. It has been identified that the mean water level is crucial to determine the tidal prism and as consequence the intensity of the currents. Two thresholds of current velocity have been established: (1) Above 1 knot for ships over 150 m length and 9.0 m draft; (2) Above 4 Knot for ships over 135 m length and 7.5 m draft.	Port of Aveiro is located inside the Ria de Aveiro and is well protected from swell, however the pilot's operation (boarding vessel at sea) is impacted by the waves. During periods of Hs above 4 meters pilots do not board vessels at sea.	Strong winds also affect ship's entrance and exit. The Port adopts two thresholds: (1) 30 knots for vessels larger than 135 meters; (2) 40 knots for all vessels.	--	Visibility shorter than 500 m restricts the entrance of ships longer than 135 meters.
Processing	Evaluate the navigation windows available with currents below 1 knot, based on high resolution modelling for the navigation channel.	Basic wave statistics and evaluate events where Hs exceeds 4 m, their duration and frequency.	Basic wind statistics and evaluate events where wind exceeds 30 and 40 knots, their duration and frequency.	--	Evaluate events (duration and frequency) where visibility is lower than 500m, using a visibility proxy (difference between air temperature and dew point).
Operational Threshold					
Description	--	--	Land operations limited by winds higher than 54.4 knots. Exception: Beyond 28.8 km/h the operation with solid bulk in North Terminal could be suspended by the Port Authority if the wind direction is from SSO (180º to 225º) or NNW (315º to 360º).	--	It may occur due to fog or heavy rainfall. Visibility shorter than 200 m restricts road traffic operations.
Processing	--	--	Basic wind statistics and evaluate events where wind exceeds 28.8 and 54.4 knots, their duration and frequency. Evaluate if wind direction is expected to change above 28.8 knots, their duration and frequency.	--	Evaluate events (duration and frequency) where visibility is lower than 200m, using a visibility proxy (difference between air temperature and dew point).
Infrastructure's thresholds design					
Description	--	Wave climate change leading to higher or more frequent damages in harbour protection structures	--	Sea level increase: (1) impacts in low level dock structures; (2) reduces rainwater drainage capacity in low land areas	--
Processing	--	Wave climate statistics and extreme event analysis	--	Extreme events of sea level (including tide, meteorology and mean sea level)	--

Risk analysis

Risk evaluation matrix – ECCLIPSE PROJECT

Likelihood categories	Sensitivity categories				
	Low	Minor	Moderate	Major	Critical
	1	2	3	4	5
Almost certain	Medium	Medium	High	High	High
Likely	Moderate	Medium	Medium	High	High
Possible	Low	Moderate	Medium	High	High
Unlikely	Low	Low	Moderate	Medium	High
Rare	Low	Low	Moderate	Medium	Medium

Risk analysis
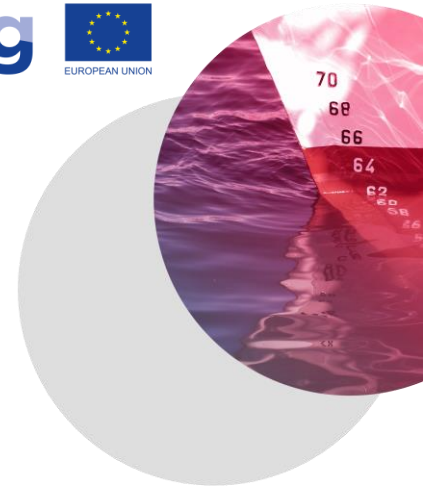
Climate variable	Currents	
Hazard	Restrictions to navigation due to currents increasing – slackwater reduction below 1 knot	
	10-30%	30-50%
Level	Operations	
Port area	Port Terminals	
Cascade effect	Reduction of navigation windows available for bigger vessels and consequent delays on entry and exit of vessels/ longer stay at the port	
Sensitivity	3 - Moderate	4 - Major
Likelihood (2040-2060)	3 - Possible	1 - Rare
Likelihood (2080-2100)	4 - Likely	2 - Unlikely
Risk (2040-2060)	Medium (3)	Medium (3)
Risk (2080-2100)	High (4)	Medium (3)
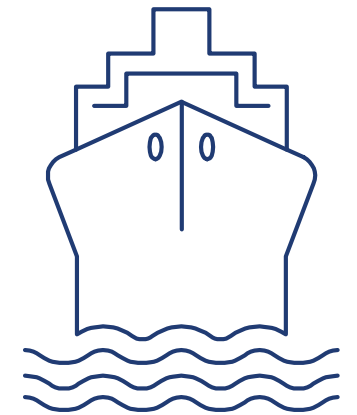
Risk analysis
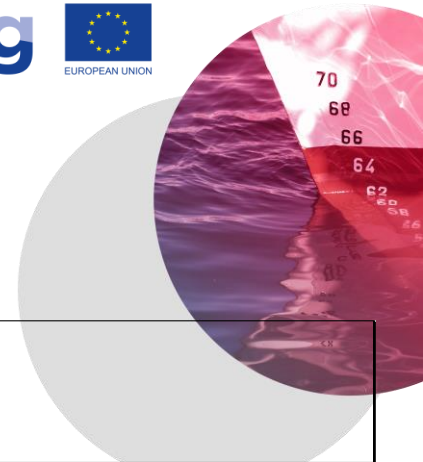
Climate variable	Waves /Storm Surges				
Hazard	Restrictions to navigation due to significant wave height			Surge Overtopping breakwaters/quays in severe storms	Higher or more frequent damages in harbour protection structures
	10%	30%	50%		
Level	Operations			Infrastructures	Infrastructures
Port area	Port Terminals			Breakwaters	Port. Maritime infrastruct.
Cascade effect	Congestion in the port roads and maritime access			-	-
Sensitivity	3 - Moderate	4 - Major	4 - Major	2 - Minor	5 - Critical
Likelihood (2040-2060)	5 – Almost Certain	5 – Almost Certain	5 – Almost Certain	4 - Likely	4 - Likely
Likelihood (2080-2100)	5 – Almost Certain	5 – Almost Certain	5 – Almost Certain	4 - Likely	4 - Likely
Risk (2040-2060)	High (4)	High (4)	High (4)	3 - Medium	High (4)
Risk (2080-2100)	High (4)	High (4)	High (4)	3 - Medium	High (4)

Risk analysis
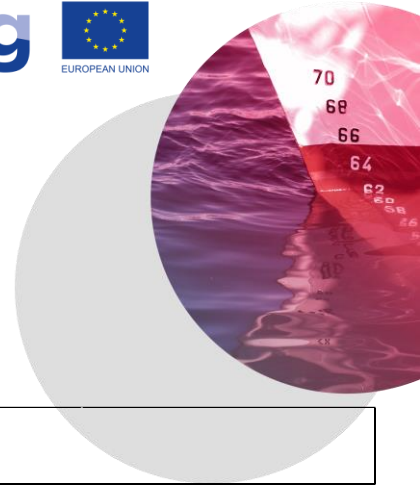
Climate variable	Sea Level						
Hazard	Sea level increase (cm)						Reducing rainwater drainage capacity
	10-30	30-50	50-100	10-30	30-50	50-100	
Level	Operations /Infrastrutures						Infrastructures
Port area	Old Port			New Port Terminals			Whole port
Cascade effect	-			-			-
Sensitivity	3 - Moderate	4 - Major	5 - Critical	1 - Low	2 - Minor	4 - Major	3 – Possible
Likelihood (2040-2060)	5 – Almost Certain	3 – Possible	1 - Rare	5 – Almost Certain	3 – Possible	1 - Rare	3 – Possible
Likelihood (2080-2100)	5 – Almost Certain	4 - Likely	2 - Unlikely	5 – Almost Certain	4 - Likely	2 - Unlikely	3 – Possible
Risk (2040-2060)	High (4)	High (4)	Medium (3)	Medium (3)	Moderate (2)	Medium (3)	Medium (3)
Risk (2080-2100)	High (4)	High (4)	High (4)	Medium (3)	Medium (3)	Medium (3)	Medium (3)

Risk analysis
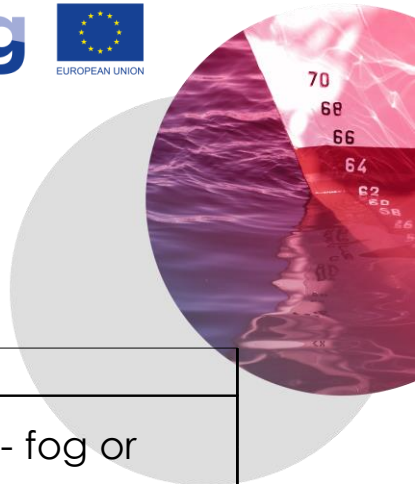
Climate variables	Wind		Visibility	
Hazard	Load/unload operations stopped/restricted	Port closed of restricted to navigation	Port closed of restricted to navigation	Low visibility - fog or heavy rain
Level	Operations	Operations	Operations	Operations
Port area	Multipurposal and Solid bulk Terminals	Breakwaters	Port Terminals	Road traffic operations
Cascade effect	Specific operational limits for operation - due to particulate matter emissions	Restrictions to ship's entrance/exit depending on lenght	Restrictions to the port roads or maritime access	Restrictions to Port operations and road traffic
Sensitivity	1 - Low	1 - Low	1 - Low	1 - Low
Likelihood (2040-2060)	1 – Rare	1 – Rare	1 – Rare	1 – Rare
Likelihood (2080-2100)	1 – Rare	1 – Rare	1 – Rare	1 – Rare
Risk (2040-2060)	Low (1)	Low (1)	Low (1)	Low (1)
Risk (2080-2100)	Low (1)	Low (1)	Low (1)	Low (1)

Next steps

Adaptation and Resilience to Climate Change Effects

1. Port Development Strategic Plan – start including the ECCLIPSE simulations results, and others studies results, considering the risk analysis;

2. Port Operations planning – consider the expected restrictions and manage to minimize its impacts in the port development and daily operation;

3. Maritime infrastructures design –
   a. Consider the new thresholds - include the new design parameters in the project design
   b. Adapt old ports.

Adapting an old port

- Old Port at 4.5 m (H.Z.) with serious problems considering the rise in tide level (storm surge)
- New project underway to raise the Terminal in order to eliminate flooding.

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