



W E S E

W A V E E N E R G Y I N S O U T H E R N E U R O P E

Development of models and tools for
the identification of the most suitable
areas for the development and
deploying of wave energy projects

13th – 14th October 2021



*This project has been funded
by the European Union*



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Offshore Renewables

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Biscay Marine
Energy Platform

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WAVEROLLER®
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HIDROMOD
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WAVE ENERGY
IN SOUTHERN EUROPE

WESE Project



WESE project is co-funded by the European Climate,
Infrastructure and Environment Executive Agency (CINEA)

Scientific partners



Industrial partners



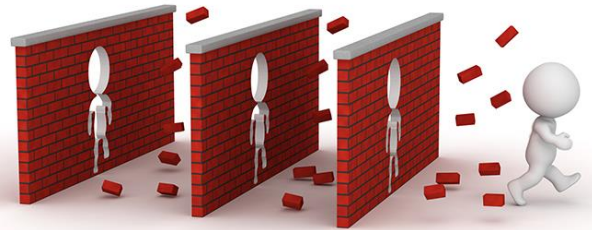
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WESE Project

The main objective of WESE project is to contribute to overcome the non-technological barriers that could hinder the future development of Wave Energy (WE) in EU

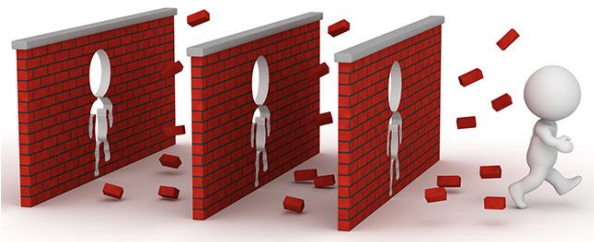


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(1) Environmental risk and uncertainty about the potential environmental impacts of WE developments



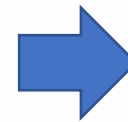
Monitoring:

- (i) Underwater noise
- (ii) Seafloor Integrity
- (iii) EMF



Modelization:

- (i) Underwater noise
- (ii) Marine dynamics
- (iii) EMF



Sharing data:

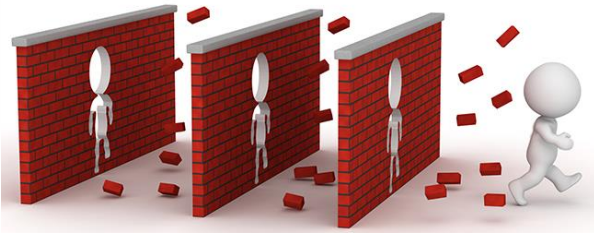


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(3) Complex and long environmental consenting processes

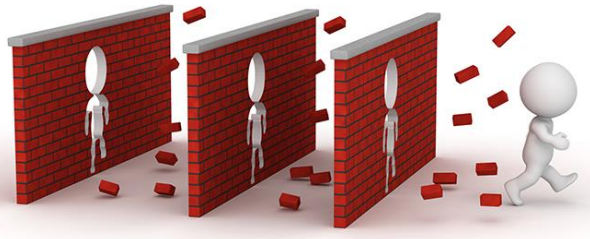


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(3) Need of a Maritime Spatial Planning (MSP) approach



Wave energy
risk assessment

WEC-ERA tool

<https://aztidata.es/wec-era/>



Ecological assessment
and maritime spatial
planning tool

VAPEM tool

<https://aztidata.es/vapem/>



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Introduction

The main **non-technological barriers** in the development of Wave Energy Converters (WECs):

- (i) The uncertainties regarding **environmental impacts** and the risks of wave farms.
- (ii) Potential **competition and conflicts** with other marine users.
- (iii) Complexity of the **consenting process**.

Development of Decision Support Tools in the framework of Marine (or Maritime) Spatial Planning (MSP) approach

WEC-ERA tool: <https://aztidata.es/wec-era/>

VAPEM tool: <https://aztidata.es/vapem/>

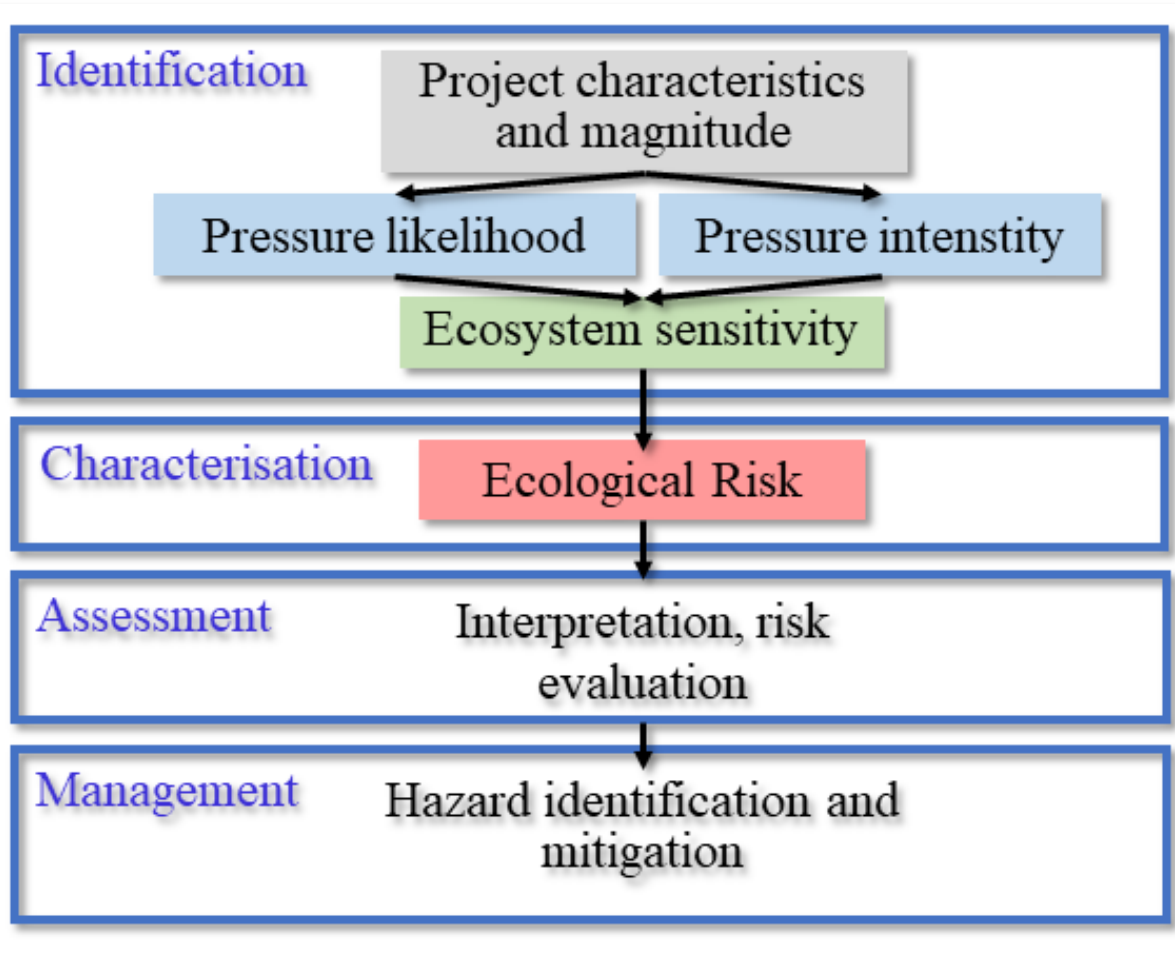


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Ecological Risk Assessment (ERA)

Methods

Adaptation of the ISO 31000 standard for risk management and risk assessment techniques, for an **ecosystem-based, risk management approach**



Full ecosystem elements

- 16 pressure types
- 27 ecosystem elements

Adopted from Marine Strategy Framework Directive (MSFD)

Developed for:

- 3 technology types
- 3 life-cycle phases



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Ecological Risk Assessment (ERA)

Methods

Scientific literature review:

Limited scientific evidence of quantitative environmental impacts produced by wave energy converters

Search terms	Nº of papers	
	Scopus	Science Direct
wave energy AND environmental impact	239	2,236
wave energy AND ecological impact	17	376
wave energy AND environmental risk	12	208
wave energy AND ecological risk	3	62

Alternative:

An expert consultation process



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- **7,776 risk indicators** (16 pressures x 27 ecosystem elements x 3 technologies x 3 phases x 2 (likelihood and magnitude of impacts))
- **7,776** values of uncertainty
- **432** indicators of sensibility of ecosystem elements to pressures (16 x 27)

Difficult to use due to the amount of data

Development of an online free access web app tool for the assessment of ecological risks of wave energy projects

WEC-ERA tool

<https://aztidata.es/wec-era>



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Results

Detailed description of the expert consultation process

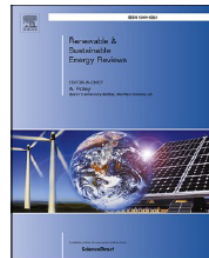
Analysis performed and tool development



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser



A new framework and tool for ecological risk assessment of wave energy converters projects



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<https://doi.org/10.1016/j.rser.2021.111539>



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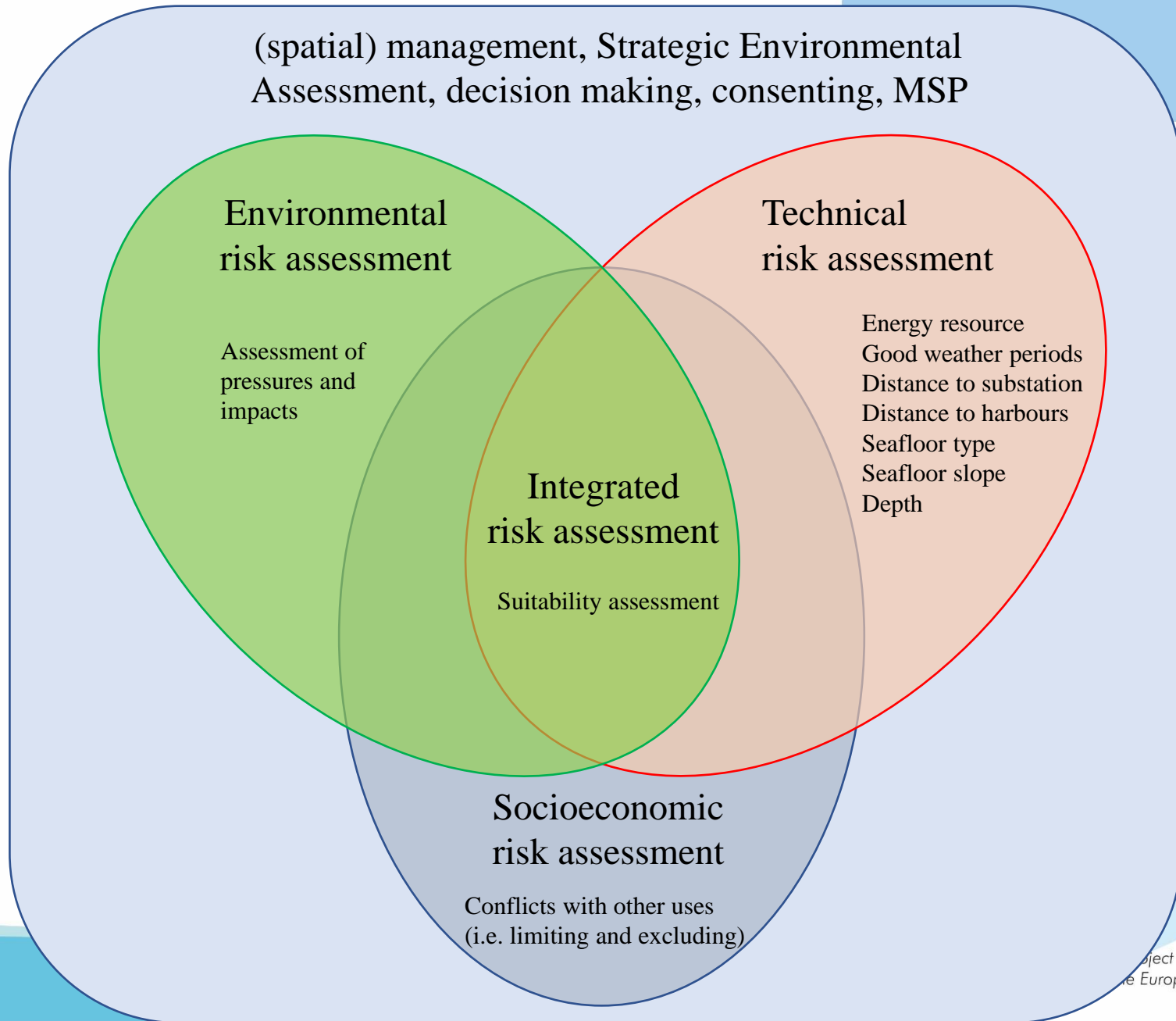
Results

- WEC-ERA framework is not spatially explicit
- It has been integrated into a model (bayesian belief network)
- GIS information layers have been collated to produce spatially explicit assessments



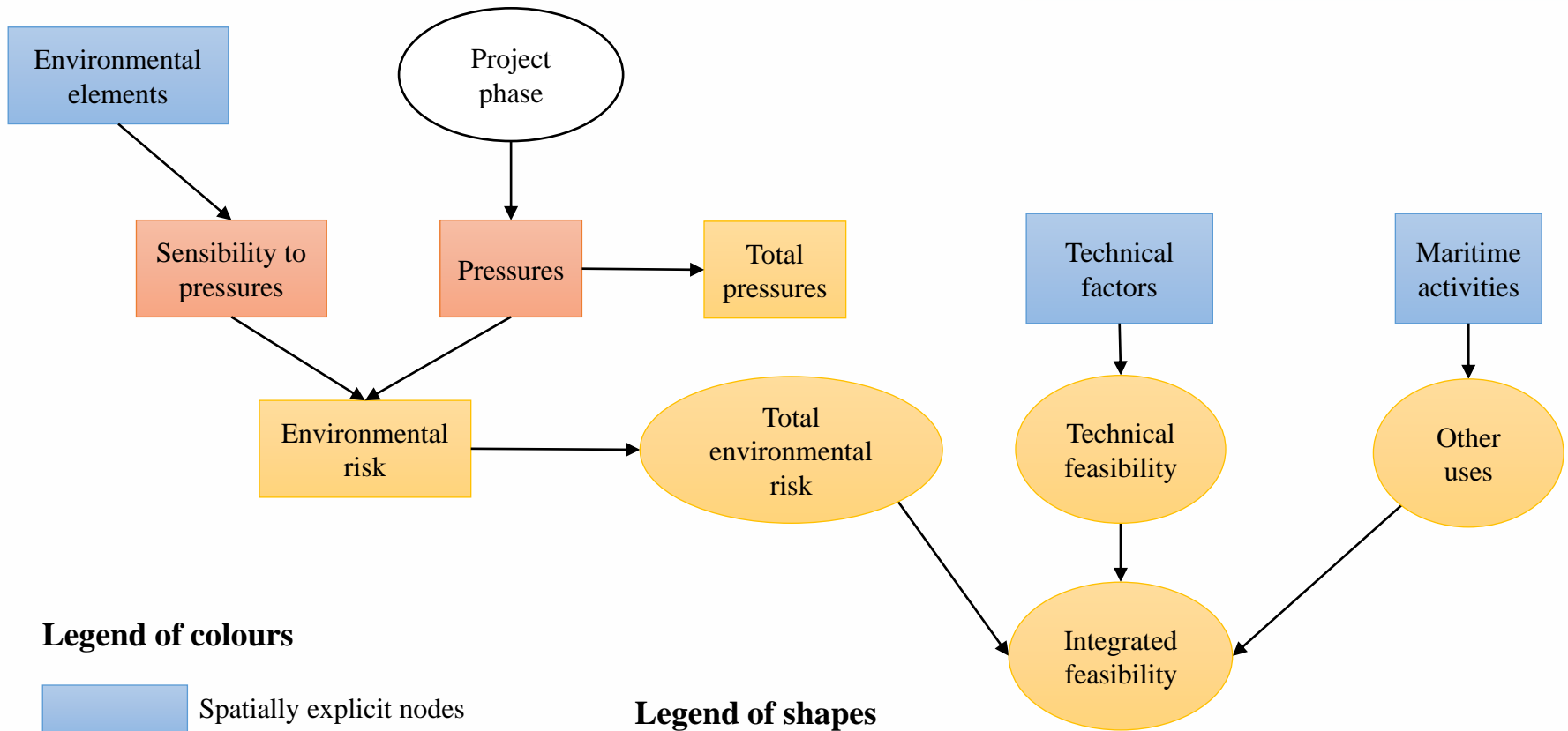
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Conceptual model for the identification of the most suitable areas for the development and deploying of wave energy projects




Structure of the model

Model



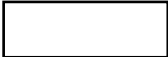
Legend of colours


 Spatially explicit nodes

 Deterministic nodes

 Expert elicitation

Legend of shapes

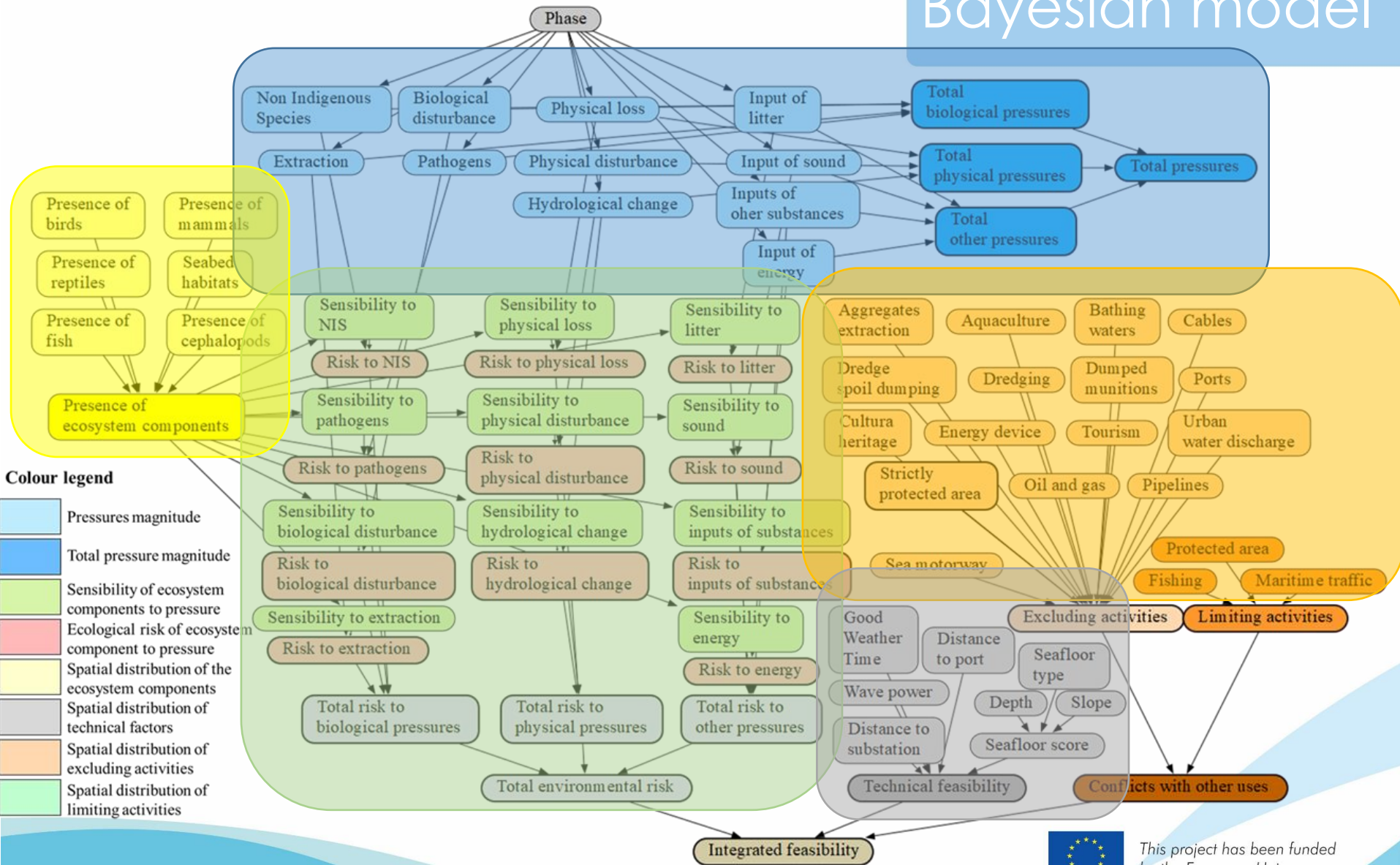
 Squares represent a set of nodes

 Ellipses represent a single node



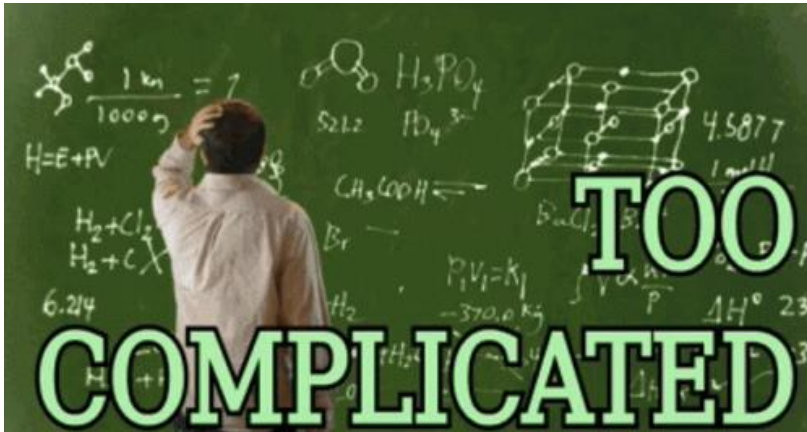
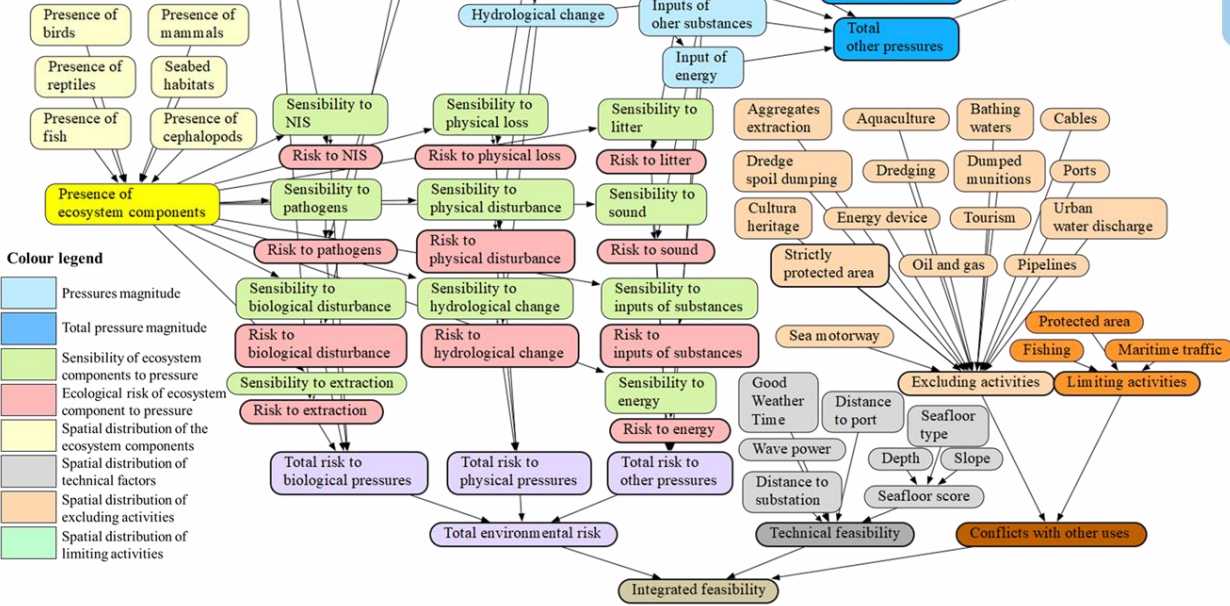
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Bayesian model



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Bayesian model



Too complex for most of the targeted end users

Results

- Decision support tool: Identification of suitable areas for WEC projects
- Interface between complex models and GIS layers
- Free access, publicly available
- Software licenses are not needed



Move towards an integrated understanding of maritime activities and their links to the ecosystem

This tool provides a user-friendly environment to explore complex models, define management scenarios and visualize maps, making it especially useful for managers and decision makers

<https://aztidata.es/vapem>



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Conclusions

- A **new framework** for integrated assessment of **ecological risks** of wave energy converters is proposed
- A model has been developed for the renewable projects **site identification** according to technical, environmental and conflicts of use criteria
- Two publicly available web app **tools** have been developed to promote the informed decision-making and management



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Conclusions

- Contributes to the **legal requirements**. Information could be used for the Strategic Environmental Assessment of projects within **planning processes** (MSP).
- Contributes to **Risk Retirement** for Environmental Effects of Marine Renewable Energy
- Could be used to inform **permitting** (consenting) processes that will enable deployment of Wave Energy Converters.
- Definition of **management scenarios and tradeoff analysis** that could be used during stakeholder **consultation** processes.



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Thank you very much for your
attention!!!

Feedbacks are welcome!!!

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