UNCHAIN
UNPACKING CLIMATE IMPACT CHAINS

Case Study 1

Potential risk of loss of tourism destination attractiveness due to climate change.

Gabriel Jordà, Miguel Agulles, Camilo Melo

INSTITUTO ESPAÑOL DE OCEANOGRAFÍA

CSIC

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The project UNCHAIN is part of AXIS, an ERA-NET initiated by JPI Climate, and funded by FORMAS (SE), DLR/BMBF (D), AEI (ES) and ANR (FR) with co-funding by the European Union (Grant No. 776608).

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AXIS

Potential risk of loss of tourism destination attractiveness due to climate change.

- **Narrative: Sand and Sun tourism** is one of the main economic drivers for Southern Europe. There are some evidences that suggest that it may be affected by climate change, so we assess the different elements that may impact the sector. It has to be done in a robust way to be **convincing** and to be able to engage the relevant stakeholders for further actions.

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- **Policy:** Regarding the implications for the policy, the methodology proposed will allow to assess the **sensitivity** to different indicators which will help to define the ***paths for adaptation*** and will provide a measure for the **robustness** of the risk estimate
- **Science:** The main scientific contribution is the implementation of the uncertainty framework in the Impact Chain methodology, and the concept of **risk saturation**

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PHASE 0: Engaging top-level stakeholders

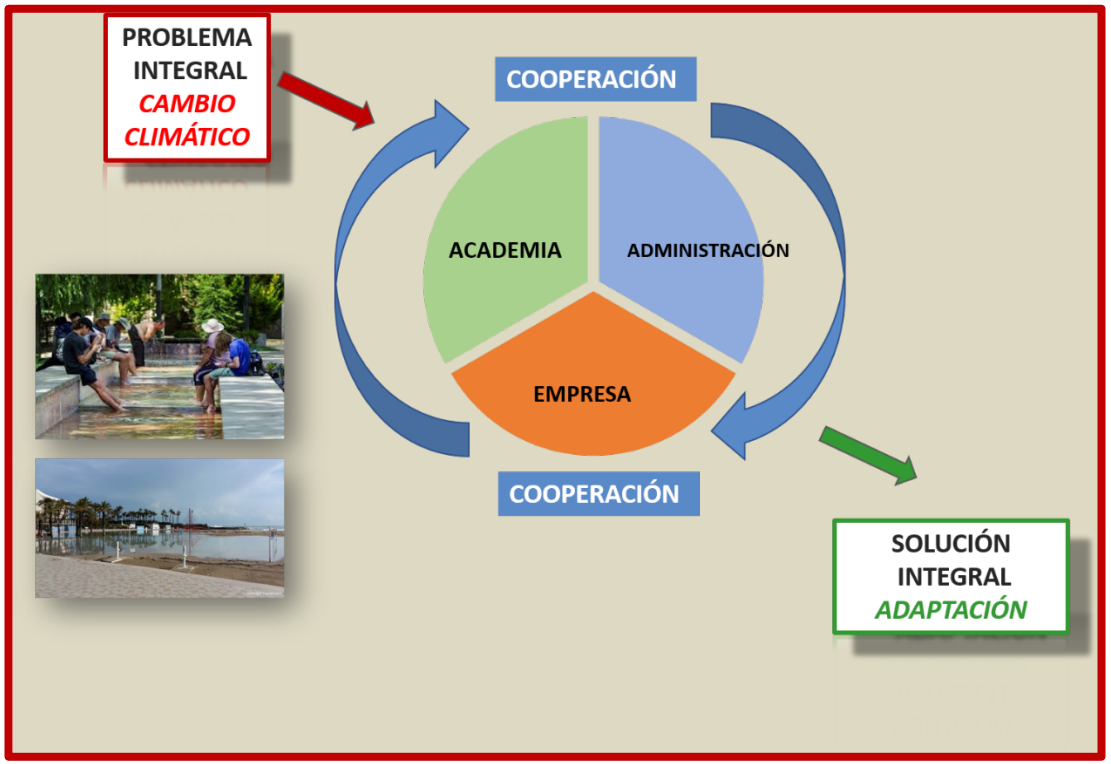
Interviews with top-level stakeholders from regional administration and touristic companies :

Key for Effective Action

idi Institut d'Innovació Empresarial de les Illes Balears

GOIB VICEPRESIDÈNCIA I CONSELLERIA INNOVACIÓ RECERCA I TURISME | AETIB AGÈNCIA D'ESTRATÈGIA TURÍSTICA ILLES BALEARS

Fehm. Federación Empresarial Hotelera de Mallorca



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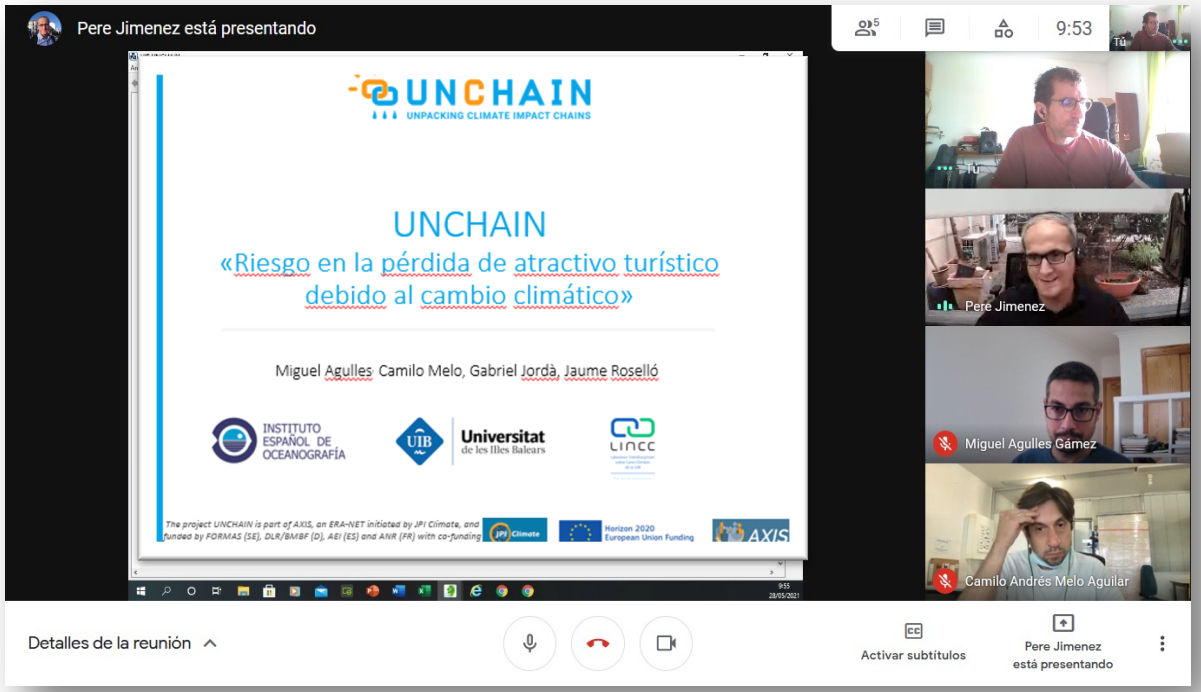
PHASE I: Impact Chain Design

Face 2 Face Interviews with hand-picked stakeholders (12)

Design of the interviews with the help of
Åsa Gerger Swartling and Karin André (SEI)



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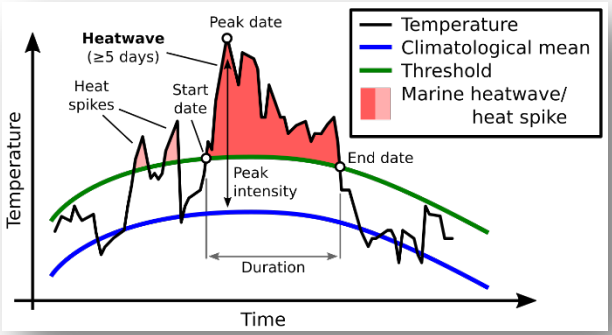
PHASE I: Impact Chain Design

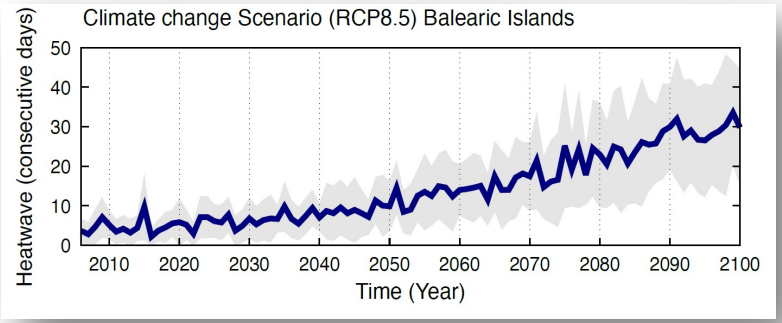
Two main **threats** have been identified:

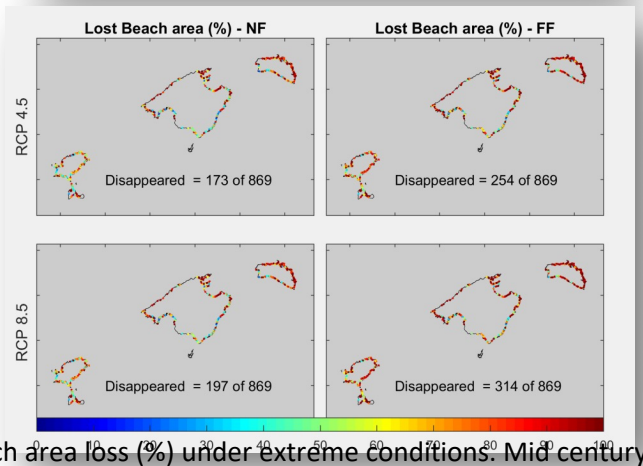
Increase of temperatures (loss of comfort)

Sea level Rise (beach loss)

Water scarcity, extreme events and forest fires have been discarded







Beach area loss (%) under extreme conditions. Mid century (left panels) and for the end of the century (right panels)

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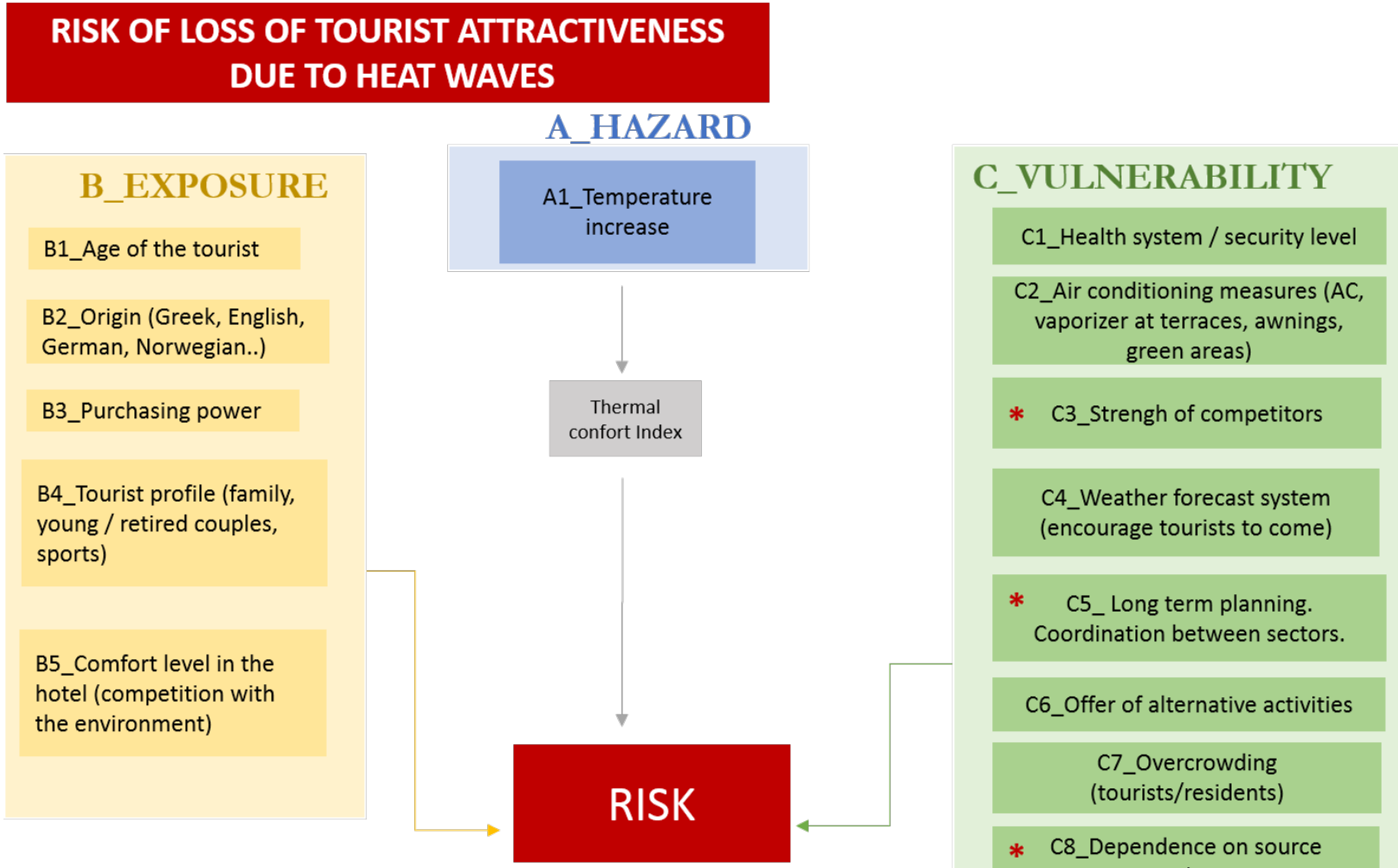
Impact Chains are constructed by the IEO team from the results of the interviews



*** Phase III**

The project UNCHAI
funded by FORMAS (
by

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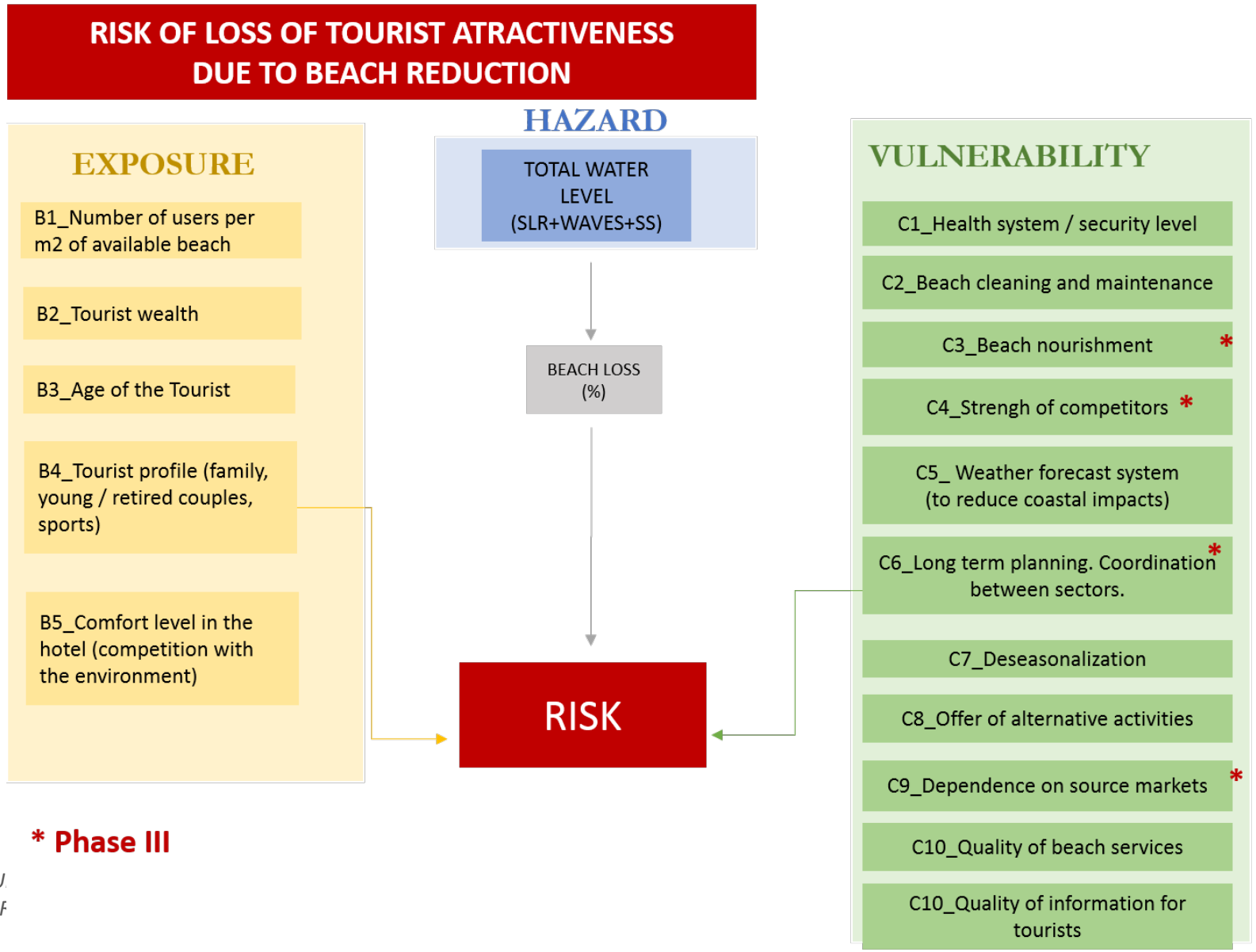
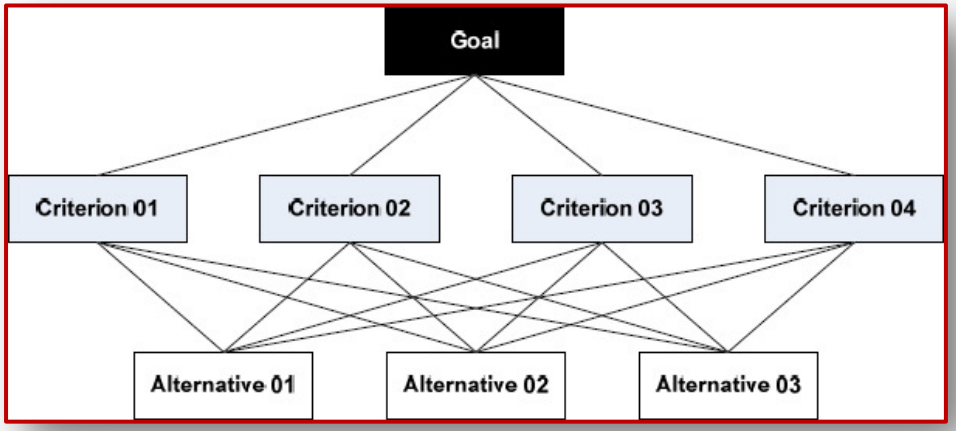


*** Phase III**

The project U
funded by FOF

PHASE II: Weight and Normalization estimates

Analytical Hierarchical Process (AHP) has been set up to assign relative weights for the indicators of the same class and between indicators aggregations.



MATRIZ DE COMPARACION DE CRITERIOS (FACTORES EXPOSURE)

CRITERIOS	sistema de al	sistema sanit	aires acon	elementos d	promoción turismo	promoción turismo	promoción turis	MATRIZ NORMALIZADA						PONDERACION
sistema de alerta	1	0,2	0,2	1	7	5	7	0,080092	0,069444	0,055248619	0,114504	0,212121	0,206612	0,267176	0,14
sistema sanitario	5	1	1	5	7	5	7	0,400458	0,347222	0,276243094	0,572519	0,212121	0,206612	0,267176	0,33
aires acondicionados	5	1	1	1	7	7	7	0,400458	0,347222	0,276243094	0,114504	0,212121	0,289256	0,267176	0,27
elementos de protección	1	0,2	1	1	5	5	3	0,080092	0,069444	0,276243094	0,114504	0,151515	0,206612	0,114504	0,14
promoción turismo joven	0,142857143	0,14	0,14	0,2	1	0,2	1	0,011442	0,048611	0,038674033	0,022901	0,030303	0,008264	0,038168	0,03
promoción turismo alto esta	0,2	0,2	0,14	0,2	5	1	0,2	0,016018	0,069444	0,038674033	0,022901	0,151515	0,041322	0,007634	0,05
promoción turismo países c	0,142857143	0,14	0,14	0,33333333	1	1	1	0,011442	0,048611	0,038674033	0,038168	0,030303	0,041322	0,038168	0,04
TOTAL	12,48571429	2,88	3,62	8,73333333	33	24,2	26,2								1,00

sistema de alerta	sistema sanitario	aires acondiciona	elementos de	promoción turismo	promoción turismo alto	promoción turismo países calurosos
0,14	0,33	0,27	0,14	0,03	0,05	0,04
0,11	0,25	0,3	0,08	0,1	0,01	0,15
0,12	0,2	0,22	0,16	0,08	0,09	0,13
0,25	0,15	0,2	0,25	0,06	0,05	0,04
0,12	0,22	0,33	0,08	0,02	0,09	0,14
0,33	0,2	0,2	0,02	0,1	0,1	0,05

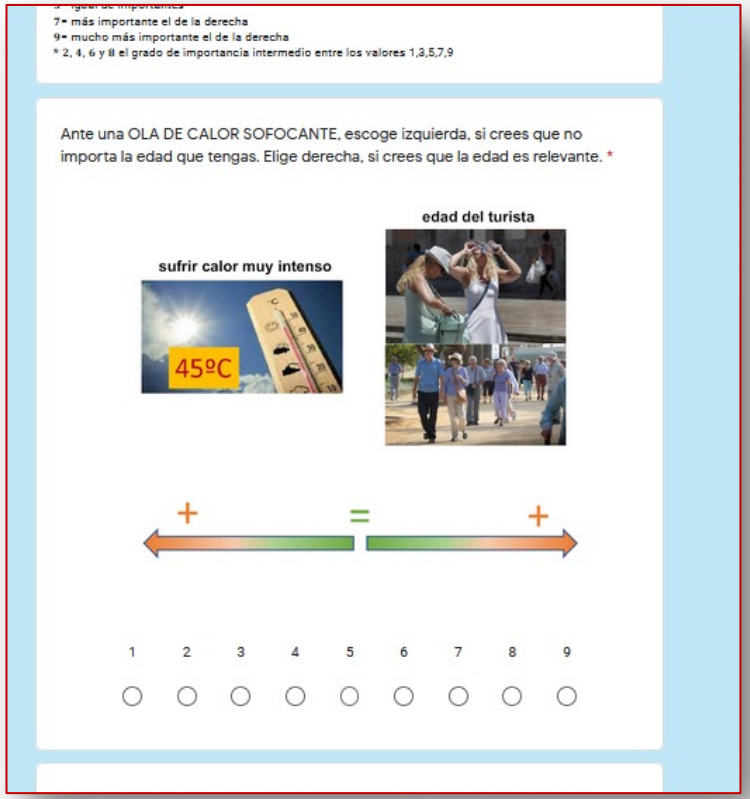
AHP-EXPOSURE | AHP-VULNERABILITY

70 %

PHASE II: Weight and Normalization estimates

AHP fed by the results of an on-line poll

(to be launched this month, after the high season ends)



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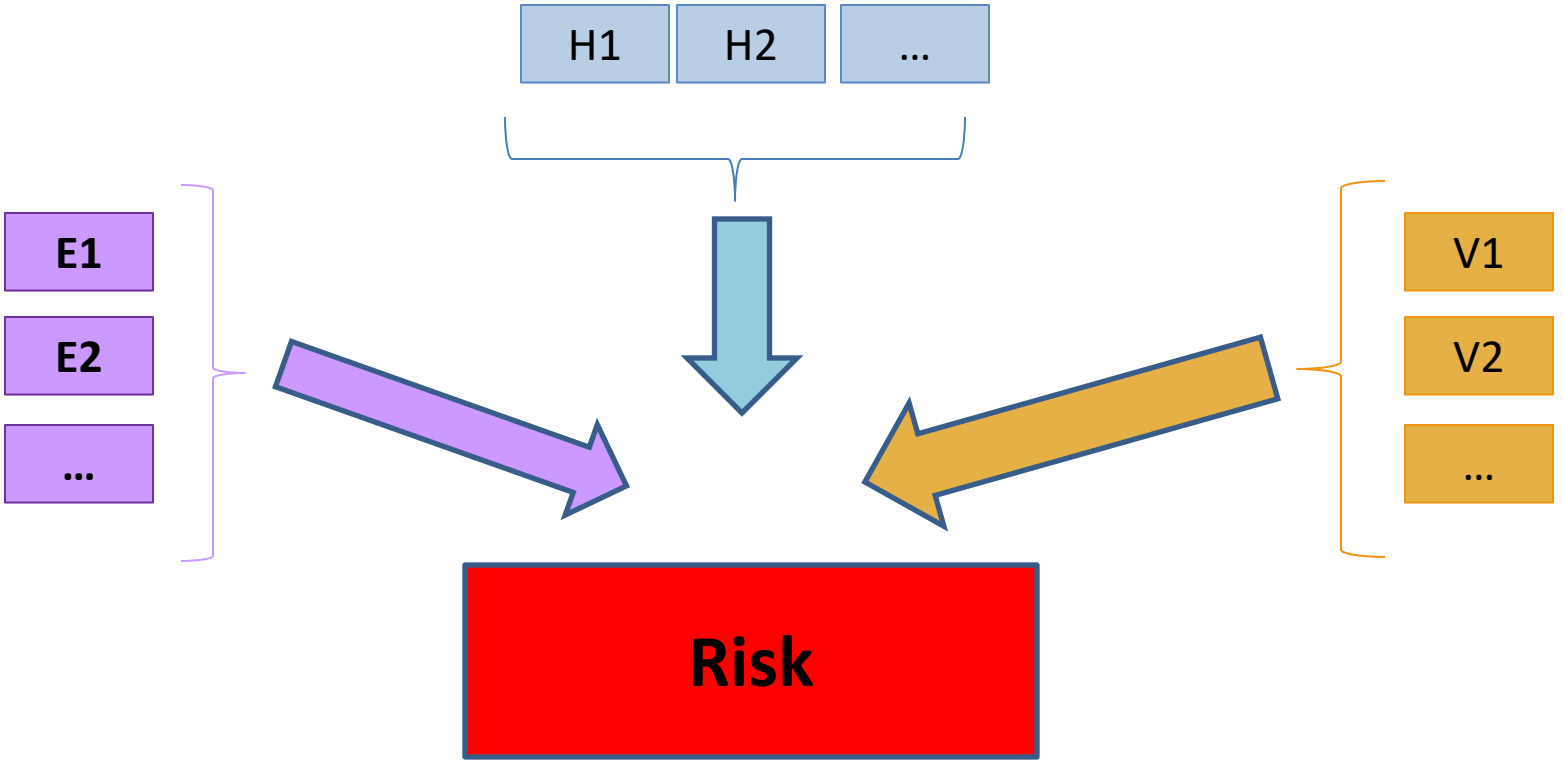
Risk estimate: Introducing uncertainties



$$R = W_{H\to R}\sum w_k H_k + W_{E\to R}\sum w_j E_j + W_{V\to R}\sum w_l V_l$$

$$R = \sum \alpha I, \quad with\ I \in H_k, E_j, V_l$$

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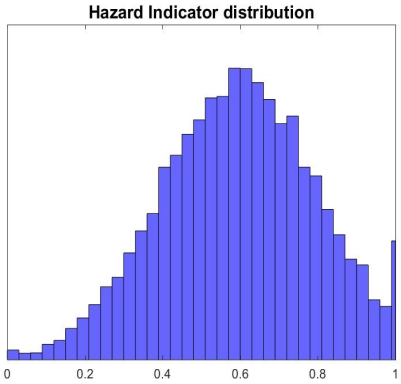
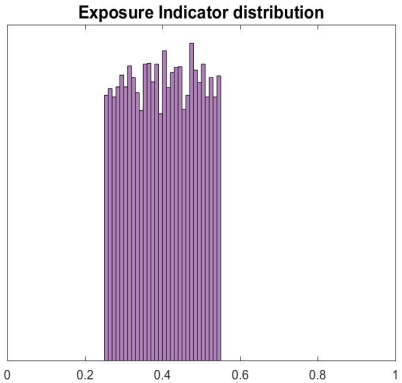
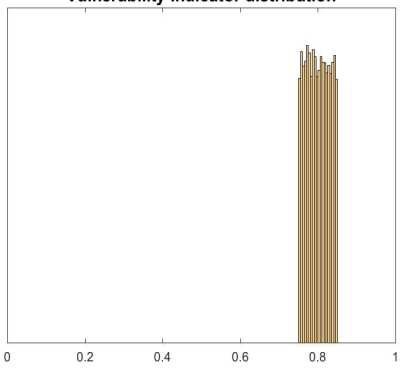
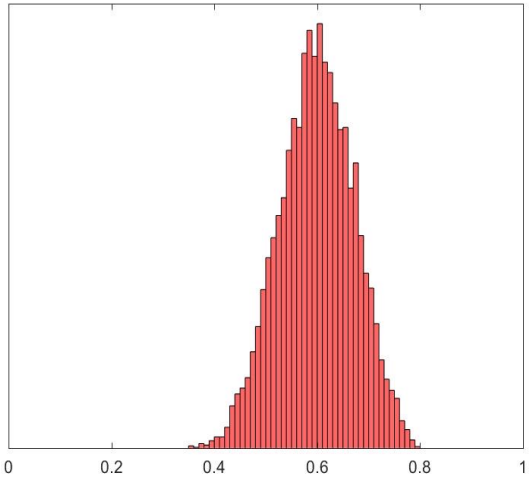
Risk estimate: Introducing uncertainties

Propagation of uncertainties through Monte Carlo approach









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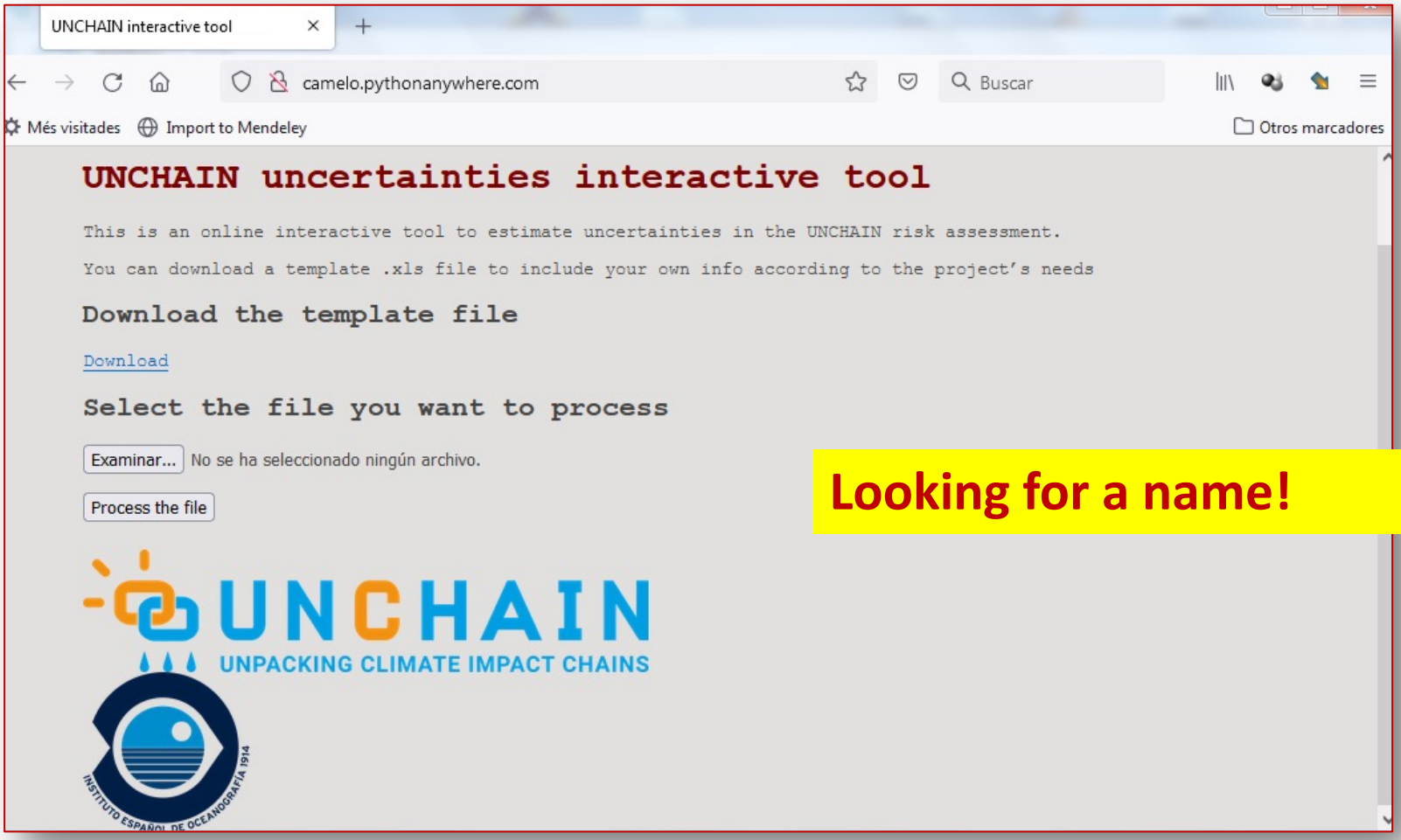
Risk estimate: Introducing uncertainties

- Final risk estimate: On-line Tool

http://camelo.pythonanywhere.com/ Temporary!!



Looking for a name!

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Risk estimate: Introducing uncertainties

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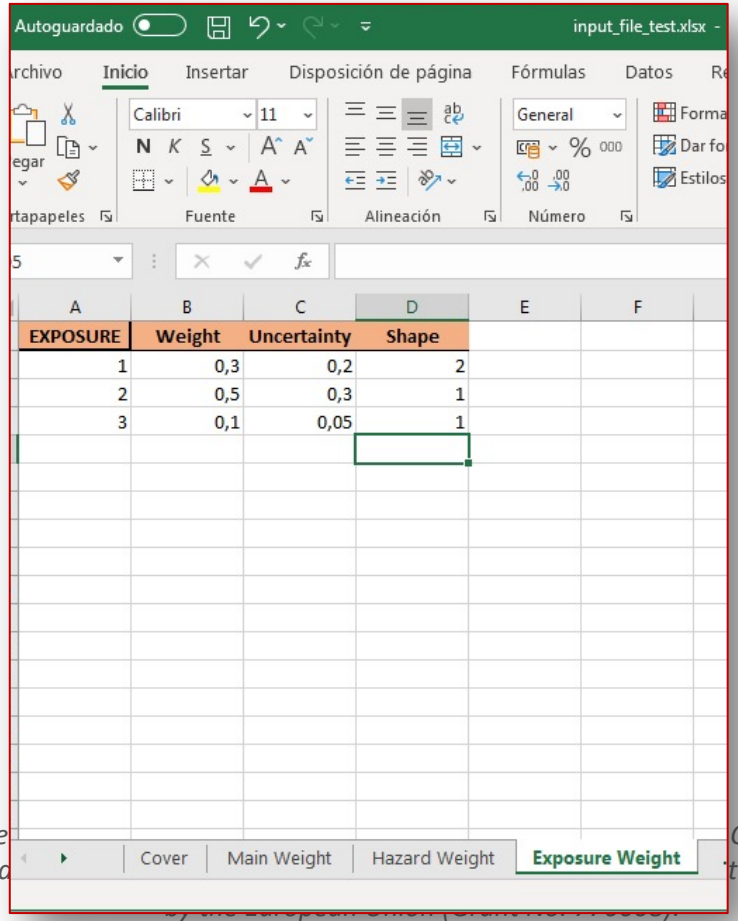
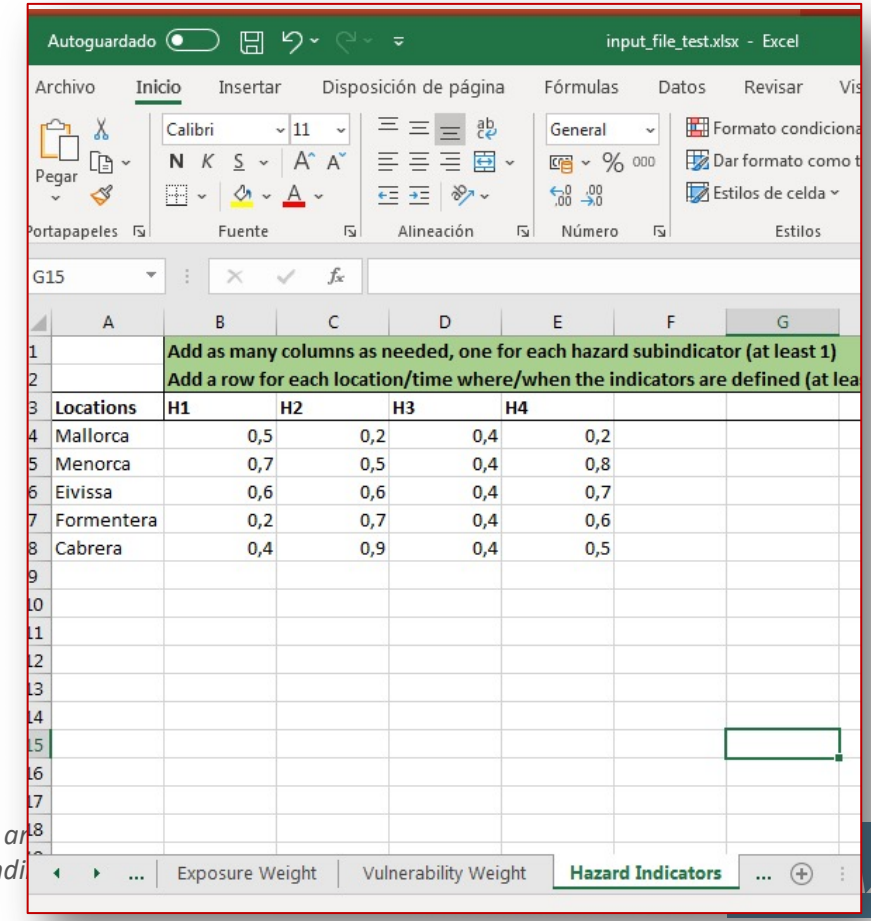
Input file -> Excel file with weights, indicators, and estimated uncertainties for each component (if available)



EXPOSURE	Weight	Uncertainty	Shape
1	0,3	0,2	2
2	0,5	0,3	1
3	0,1	0,05	1

Cover | Main Weight | Hazard Weight | Exposure Weight



Add as many columns as needed, one for each hazard subindicator (at least 1)
Add a row for each location/time where/when the indicators are defined (at lea

Locations	H1	H2	H3	H4
Mallorca	0,5	0,2	0,4	0,2
Menorca	0,7	0,5	0,4	0,8
Eivissa	0,6	0,6	0,4	0,7
Formentera	0,2	0,7	0,4	0,6
Cabrera	0,4	0,9	0,4	0,5

Exposure Weight | Vulnerability Weight | Hazard Indicators

The ... Climate, ar... funda... th co-fundi...

Risk estimate: Introducing uncertainties

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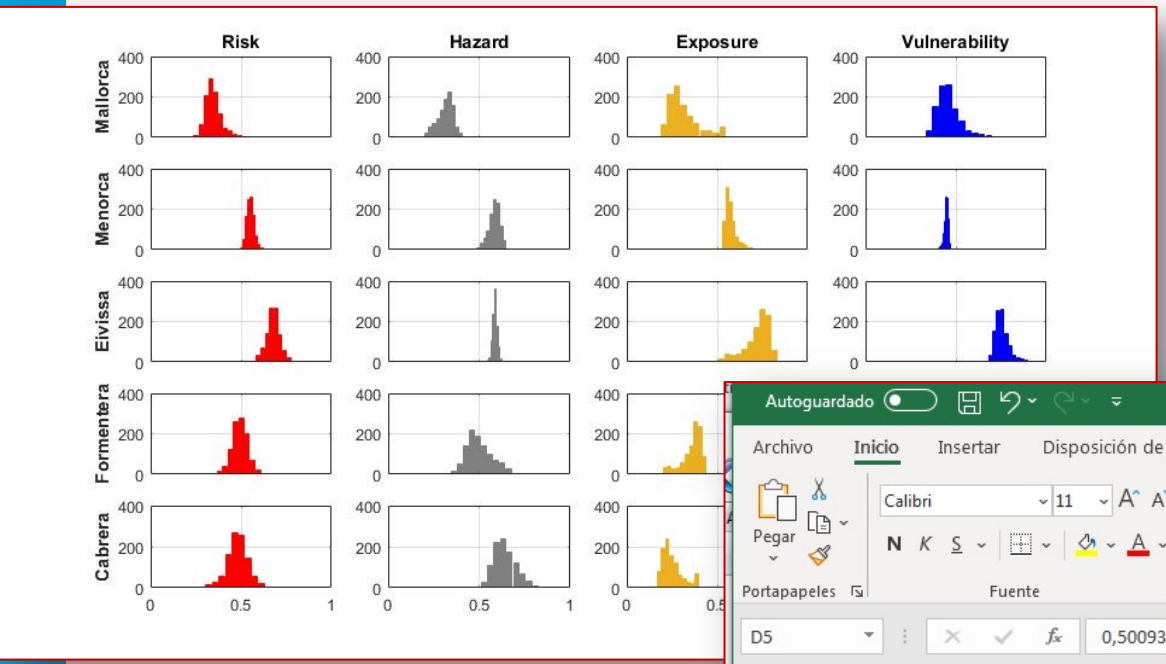
Output file -> Excel file with aggregated indicators and risk + uncertainty



Autoguardado output_file_test.xlsx - Excel Gabriel Jordà Sánchez

Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Ayuda ACROBAT

Pegar Calibri 11 General Formato condicional Dar formato como tabla Estilos de celda Insertar Eliminar Formato

Portapapeles Fuente Alineación Número Estilos Celdas

D5 0,500936072381282

	A	B	C	D	E	F	G	H	I	J
1	Locations	Risk Mean	Risk STD	Hazard Mear	Hazard STD	Exposure Me	Exposure STI	Vulnerability	Vulnerability STD	
2	Mallorca	0,34384112	0,04253572	0,31481346	0,04217139	0,31345646	0,08255235	0,45702027	0,06149013	
3	Menorca	0,55318334	0,02082486	0,58409907	0,03099858	0,5755178	0,03085737	0,44859595	0,01229803	
4	Eivissa	0,67765492	0,03687642	0,58824851	0,01318592	0,72430245	0,0688454	0,75421216	0,03689408	
5	Formentera	0,49427452	0,0423941	0,50093607	0,06806183	0,36175496	0,05340755	0,75140405	0,01229803	
6	Cabrera	0,4818942	0,05599309	0,64278424	0,06117176	0,25072921	0,05806742	0,64297973	0,06149013	
7										
8										
9										

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Risk estimate: Introducing uncertainties

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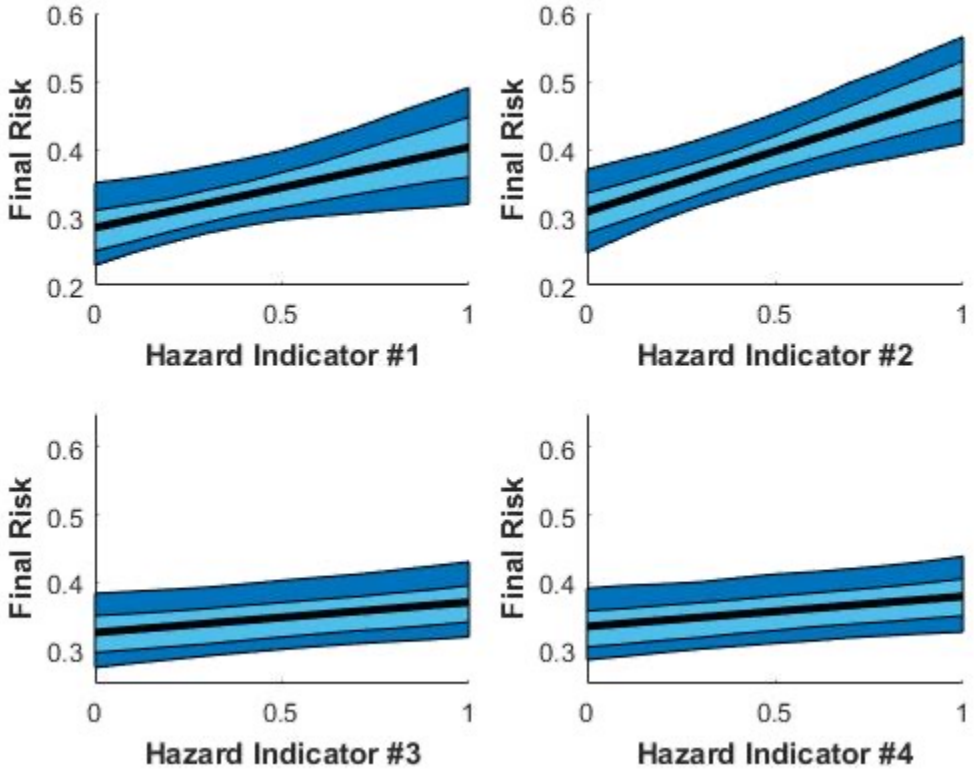
Output file -> Sensitivity to changes in each indicator *(in progress)*



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Conclusions

Main Outcomes

- a **new participatory process** about a topic not addressed before in the region
- dealing with **uncertainties** in a systematic way
- development of an **user friendly tool** for the uncertainty propagation

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Conclusions

Research innovations:

(2) Co-production - Integrating participatory methods into impact and adaptation modelling (participatory methods of co-design:

Prior meetings with top-level stakeholders , face2face, polls final workshop

(3)Incorporating societal trends into scenario analysis -What impact does socioeconomic scenarios have on risk estimates? How do impact and climate uncertainties compare?

We consider climate scenarios and set different scenarios for the indicators to assess sensitivity to their changes.

(4) Testing the Impact Chains approach

We introduce and test a probabilistic framework to naturally include uncertainties.

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Research Questions - IC Model

How to combine a multitude of (sector-specific) information and still present them in a clear and concise manner?

How to identify potentially beneficial vs. potentially problematic interdependencies?

Not clear yet how to be done.

How to better integrate quantitative, semi-quantitative, qualitative and narrative approaches?

Transfer non-quantitative to discrete classes. The key point is the experts cross-validation of relative weights.

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Research Questions - IC Model

How to make assessments and results comparable?

Not clear yet how to be done.

How to address limitations in the availability of reliable data? (heterogeneity, spatial / temporal resolution, mismatch between resolution)

Establishing a mathematical framework that helps to quantify the interlinks between indicators and between indicators and the final risk. In this way, the elements that can't be quantified or that are missed, will appear as a residual variance that can be incorporated as an uncertainty..

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Research Questions - IC Model

How to better address uncertainties and confidence levels for each step in the impact chain assessment?

Keep track of the uncertainties and to quantify them at each step of the procedure. This applies to quantitative estimates (e.g. uncertainty associated to sea level rise projections), to qualitative ones (e.g. discrepancies among experts about the potential impact on atractiveness due to beach reduction).

How to overcome the problems of deep uncertainty about future climatic and socio-economic conditions, as well as the lack of data – even of present conditions – when doing risk assessments?

We deal with the unknowns or missed information as a residual variance treated as uncertainty in the formalism.

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Research Questions – User interface and stakeholder involvement

How to critically reflect on and be clear about stakeholder roles in the process as well as expected outcomes when doing impact chain analysis, and how to consider and compensate the potential bias of the participatory elements within the impact chain assessment?

How can knowledge co-production in climate change risk assessments better inform decision-making and adaptation action?

What are the critical factors concerning how knowledge co-production processes may lead to improvements in adaptation action?

We have no expertise to do research on this, but we need to address these issues to be sure the Case Study is robust enough.

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