

Informing Climate Change and Sustainable Development Policies with Integrated Data

BILBAO. SPAIN 10-14 JUNE 2024 #UNBigData2024

Measuring Resilience: Big Data Approaches to Risk Assessments:

Climate Change Risk Assessment, and the Need of Data

IÑIGO J. LOSADA IHCantabria-University of Cantabria



THE INCREASING IMPORTANCE OF CLIMATE RISK ASSESSMENTS, ADAPTATION & RESILIENCE

INCREASING DEMAND FOR CLIMATE RISK ASSESSMENTS ACROSS DIFFERENT SECTORS

- public (from local to national)
- development organizations and financial institutions
- private sector

FRAMEWORKS EXIST – IMPLEMENTATION IS HIGHLY VARIABLE ACROSS COUNTRIES AND SECTORS

PUBLIC SECTOR: DRIVEN BY CLIMATE POLICY AND PLANNING NEEDS

• usually high-level assessments and sectorial (See NAPS)

PRIVATE SECTOR: DRIVEN BY A DIVERSE SET OF ISSUES

- access to finance
- new regulation and reporting obligations
- factoring climate risk into internal risk management
- opportunity identification
- shareholder pressure
- strategy setting
- reputational risk
- greenwashing

REQUIRES DATA ANALYTICS

GENERAL PRINCIPLES FOR THE APPLICATION OF CLIMATE CHANGE RISK ASSESSMENTS



SCIENTIFIC BASIS



ROBUSTNESS FOR UNCERTAINTY



SYSTEMIC APPROACH



PROPORTIONALITY





PRECAUTIONARY PRINCIPLE



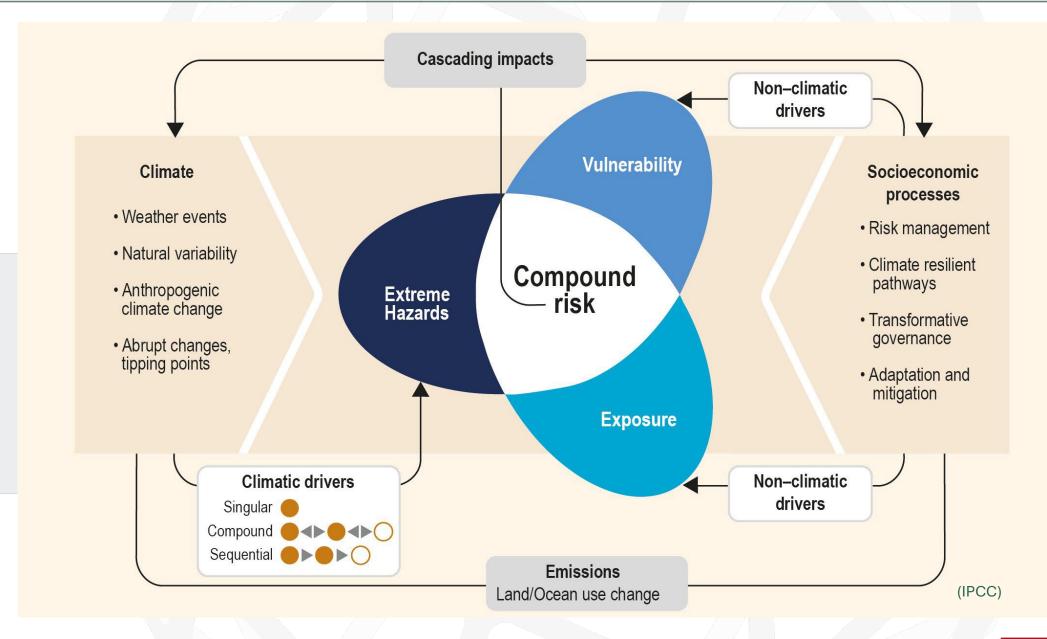
PLANNED ADAPTATION, FROM INCREMENTAL AND FLEXIBLE TO TRANSFORMATIONAL



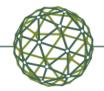
SYNERGIES BETWEEN ADAPTATION AND MITIGATION (CLIMATE RESILIENT DEVELOPMENT)

FRAMEWORKS EXIST – IMPLEMENTATION IS HIGHLY VARIABLE ACROSS COUNTRIES AND SECTORS





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- **DEFINE THE RISK ASSESSMENT BOUNDARIES** (system, subsystems, relevant processes, stakeholders, interrelations..)
- **COLLECT HISTORICAL INFORMATION** (hazards, impacts, consequences..)
- HAZARDS (multihazard, compound, extremes, variability, long-term changes, hindcasts, projections, downscaling..)
- EXPOSURE (characterization of exposed elements within the system and subsystems, downscaling, projections..)
- **IMPACT MODELLING** (expert-judgement, impact indicators, models..)
- **VULNERABILITY** (social, environmental, physical...indicators, damage functions, fragility functions, thresholds, projections..)
- RISKS & CONSEQUENCES (characterization, KPIs, probability, urgency, intensity level...)

ASSESS ADAPTATION SOLUTIONS

BIG GAP BETWEEN CURRENT NEEDS AND PRESENT AVAILABILITY

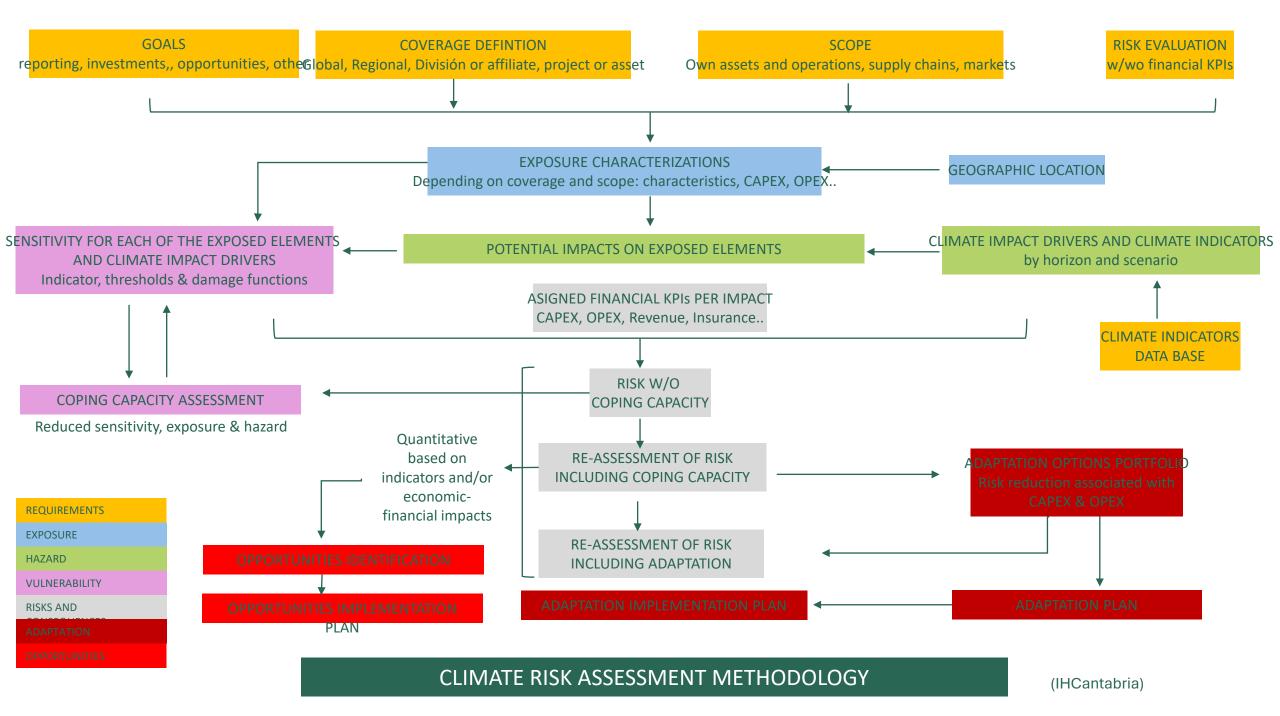
PROPORTIONALITY-PRIVATE SECTOR CASE



, 100	essment items	Options Depth, uncertainty reduction, complexity, resources needed						
I. Coverage II. Assessment method		Assessment by business activity with very low granularity Construction, concessions, services	Assessment by business activity with high granularity (*) Increased granularity in hazard, exposure and vulnerability based on proxies		Selected assets and operations with historical material risk (*) Concessions, assets in exposed areas Selection based on expert judgment			Global coverage and high granularity Assessment for the whole group, business activities and operations. Supply chain and markets
		Qualitative Qualitative assessment based on expert judgement with quantitative inputs for hazards	Based o exposure	uantitative (**) n the convolution of hazards, es and vulnerability based on ive indicators (total or for proxies).	Hybrid (**) Combination of semi-quantitative based on indicators and fully quantitative based on impact models.		lly	Quantitative (**) Assessment based on impact models
III. Assessment level	Hazard	Low resolution One or few geographical points repre- large geographical domain	senting a		Based on low to medium resolution climate model projections. Selected number of geographical points where		High resolution Based on CORDEX (AR5 or AR6) or their downscaling for specific regions of interest. At least one point per asset or activity	
	Exposure	No exposure No geospatial location of exposed assets		Based on typologies or proxies Exposure provides characterization of assets and operations based on typologies or proxies			Based on individual assets and operations Exposure provides individual assets and operations with its geographical locations and characteristics	
	Vulnerability	Sensitivity Quantitative indicators (based on expert judgement) providing sensitivity by business activity		Thresholds and indicators Vulnerability indicators or operation thresholds by asset and operation. Based on existing literature + recommendation + expert judgement			Based on fragility and damage functions Fragility or damage functions by asset or operation based on existing literature or historical damages	
	Risk	Semi-qualitative Qualitative assessments providing a quantitative normalization with a color numbering scale	Qualitative assessments providing a quantitative normalization with a color or		Semi-quantitative Expressed in terms on economic/financial, social or environmental KPIs			Risk transfer to financial consequences Economic/financial consequences on business, supply chain and markets

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(IHCantabria)



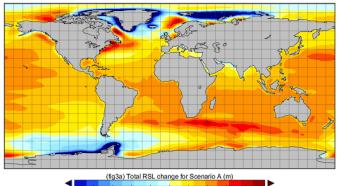
COMPOUND HAZARDS_ COASTAL FLOODING

CMCC-CM

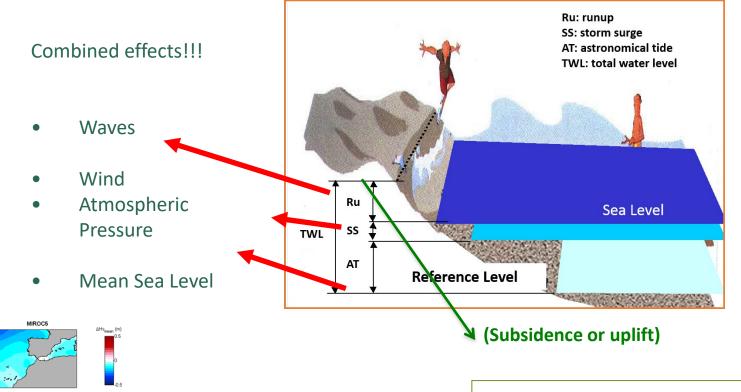
CNRM-CM5

CNRM-CM

EXTREME SEA LEVEL COMPONENTS

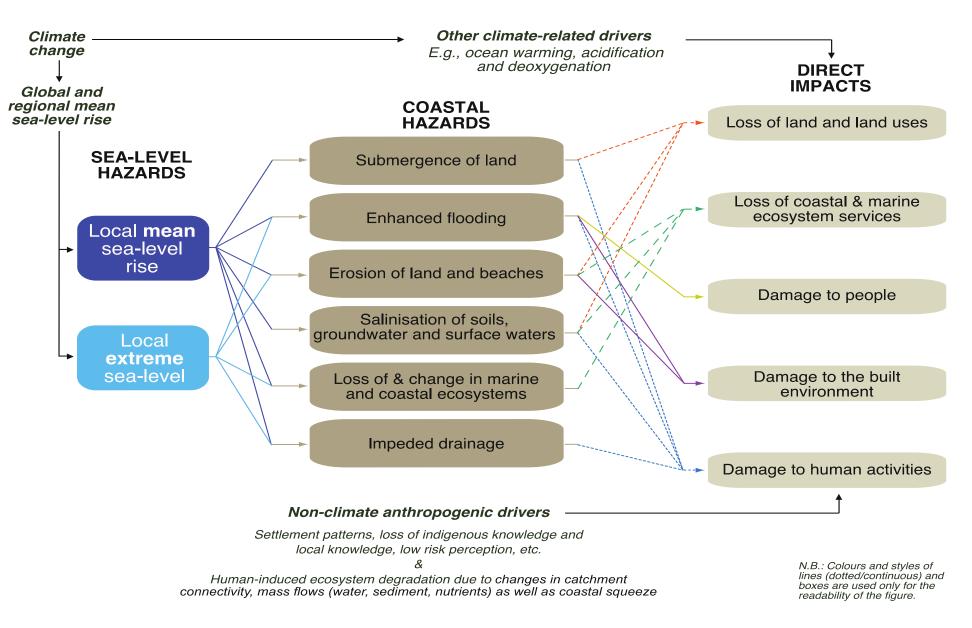


01 3.3E-01 5.0E-01 6.6É-Data Min = -2.1E+00, Max = 8.3E-01

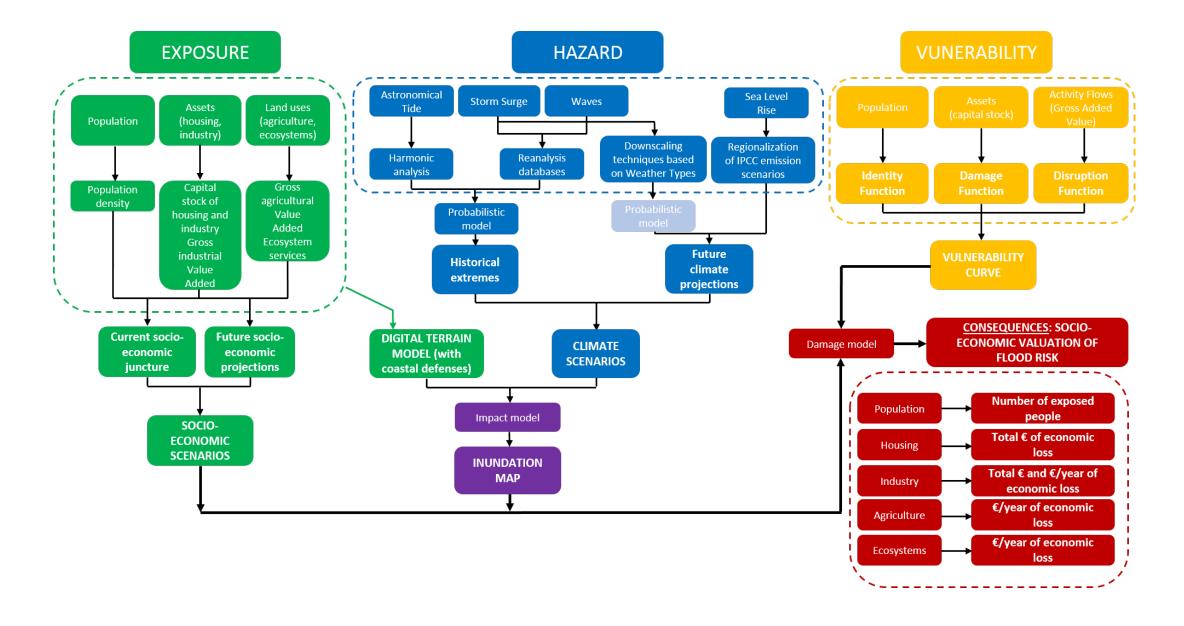


DOWNSCALING IS ALWAYS NEEDED

CASCADING IMPACTS



MULTI-SECTORAL METHODOLOGY



EXPOSURE AND VULNERABILITY CHANGES

Benidorm 60'

La Manga 50'



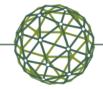


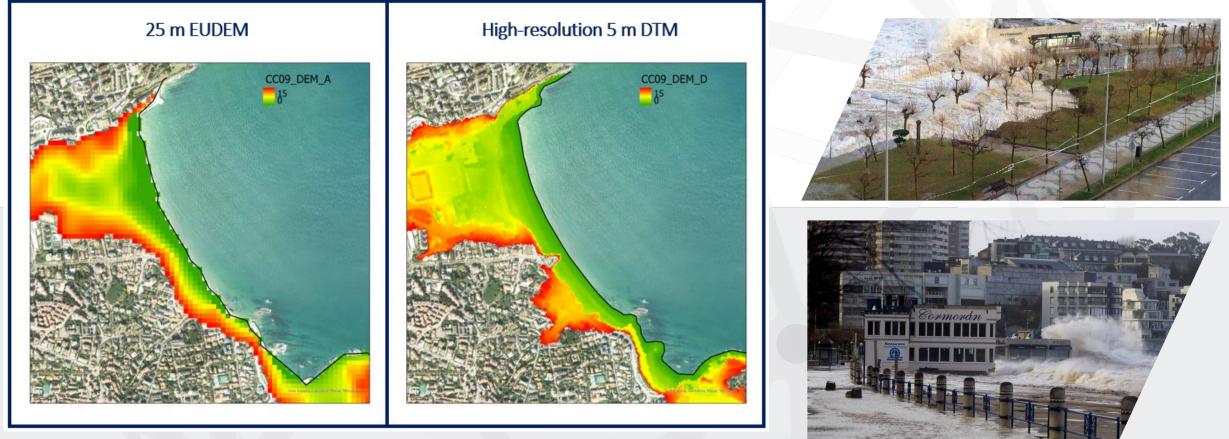
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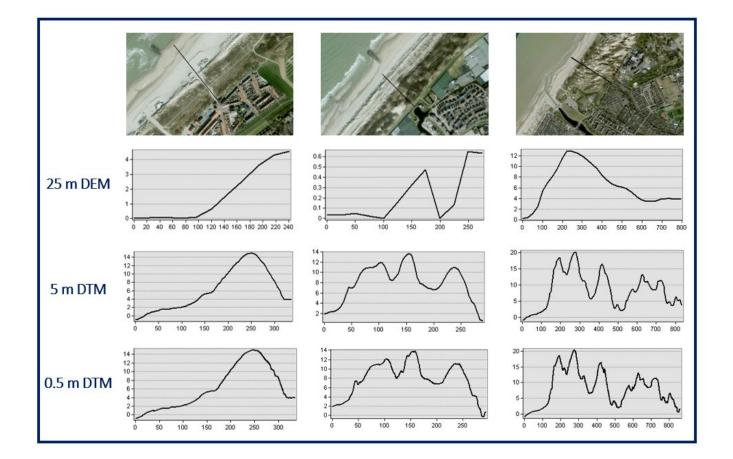






DEMs used in the control case of El Sardinero, in Santander. The right panel shows the 25 m DEM (sourced by Copernicus) and the left panel shows the high-resolution 5 m DTM (sourced by the Spanish UGN).

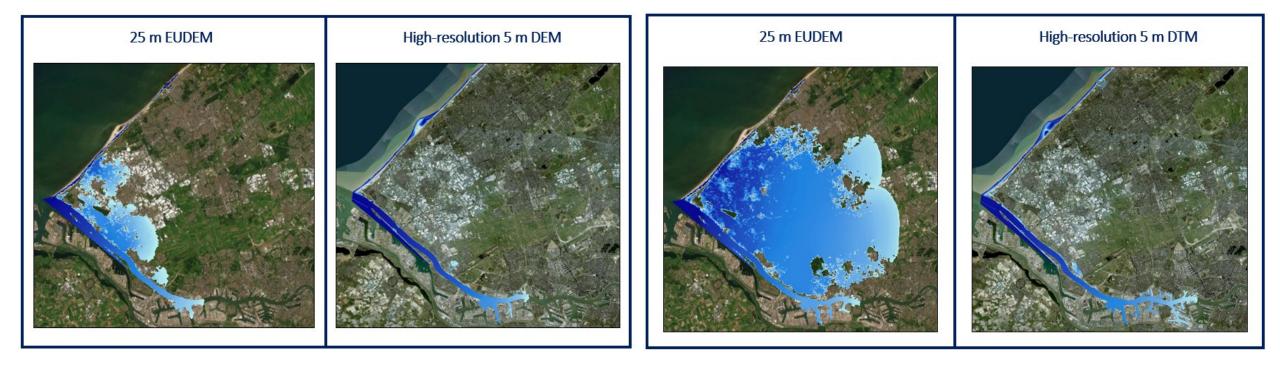
USING INAPPROPRIATE DATA SETS OR IMPACT MODELS CAN LEAD TO A WRONG ASSESSMENT



Approach:

- Analysis of how the dune ring is represented in the 25 m DEM and 5 m DTM and how this poor/good representation can affect flooding.
- Simulation of dune breaching at two locations and comparison of our results with those of a study published in the region. Use of a hydrograph whose peak corresponds to a TWL of 10,000 years (dune protection standard)

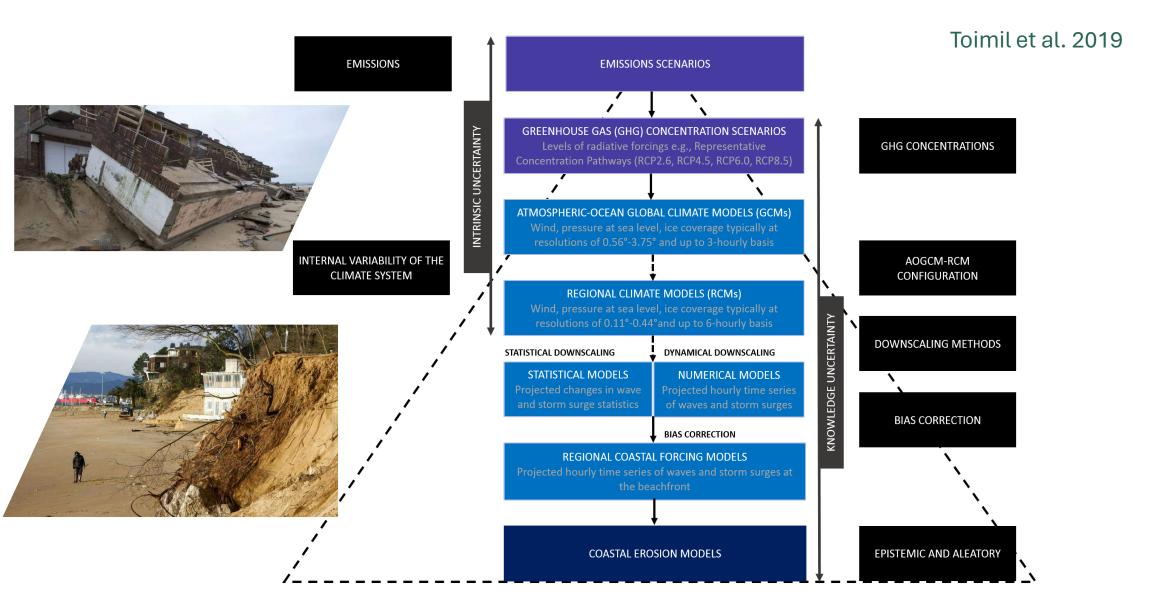
USING INAPPROPRIATE DATA SETS OR IMPACT MODELS CAN LEAD TO A WRONG ASSESSMENT



Flood maps obtained with RFSM-EDA (with irregular subgrid) in Ter Heijde (the Netherlands) considering the 25 m DEM (left panel) and the 5 m DEM (right panel). Flood maps obtained with SFINCS (without subgrid) in Ter Heijde (the Netherlands) considering the 25 m DEM (left panel) and the 5 m DEM (right panel).

USING A BATHTUB APPROACH OR WRONG PROTECTION STANDARDS IS EVEN WORSE

NOT ACCOUNTING FOR UNCERTAINTY CAN LEAD TO WRONG DECISIONS AND MALADAPTATION



IH-LANS

0.9

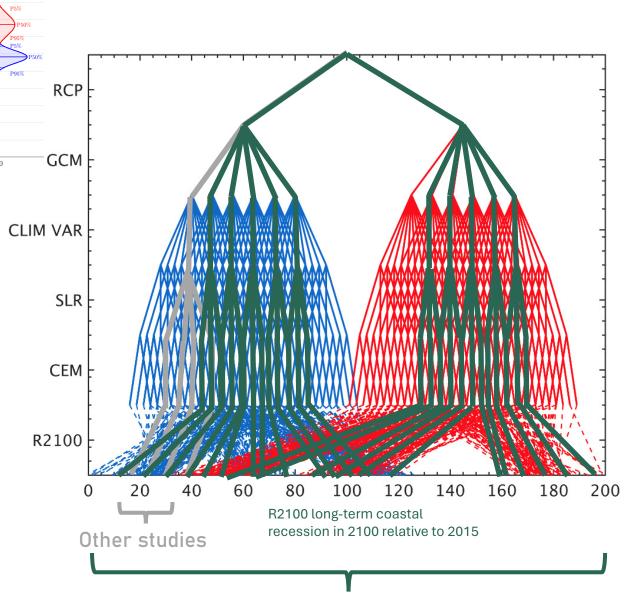
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RCP8.5 envelope RCP4.5 envelope

NOT ACCOUNTING FOR UNCERTAINTY CAN LEAD TO WRONG DECISIONS AND MALADAPTATION

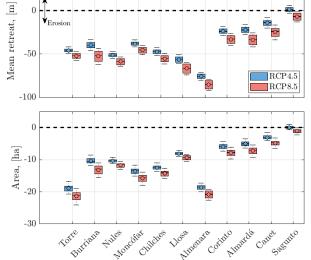
CLIM VAR

Visualisation of the uncertainty cascade in **multiensemble probabilistic** coastal erosion **projections**



This section





Toimil et al (2021)

CONCLUSIONS

- CLIMATE PHYSICAL RISK ASSESSMENT NEEDS ARE INCREASING
- ASSESSMENTS ARE HIGHLY DEMANDING ON HIGH QUALITY DATA AND DATA ANALYTICS FOR THE DIFFERENT RISK COMPONENTS
- TO DATE:
 - LIMITED NUMBER OF HAZARDS OR INCOMPLETE CHARACTERIZATION, SIMPLIFIED APPROACHES IN IMPACT MODELLING OR
 VULNERABILITY ASESSMENT
 - INCOMPLETE CLIMATE INFORMATION, INSUFFICIENT LEVEL OF GRANULARITY, INACCURATE EXTREMES PROJECTIONS..
 - INCONSISTENCIES AND LACK OF HOMOGENEITY IN DATA SETS, FRAGMENTATION
 - LIMITED INFORMATION ON PROBABILISTIC ESTIMATES, INTERACTION BETWEEN HAZARDS, BESPOKE TIME HORIZONS AND CLIMATE SCENARIOS, CASCADING IMPACTS, ASESSMENT OF TIPPING POINTS, PRESENT AND PROJECTED EXPOSURE OR VULNERABILITY, ESPECIALLY FOR NATURAL SYSTEMS
 - AVAILABLE INFORMATION IS MOSTLY DEVELOPED FOR HIGHLY SPECIALIZED USERS
 - LACK OF TRANSPARENCY, UNCERTAINTY AROUND DATA QUALITY AND PROCESSING
 - LIMITED ACCESS EVEN AMONG THE SAME ADMINISTRATION IN A GIVEN COUNTRY
 - LACK OF CAPACITY BUILDING AND TRAINING INITIATIVES
 - PROMISING INITIATIVES ONGOING (COPERNICUS, IPCC ATLAS, MULTILATERAL ORGANIZATIONS' DATA REPOSITORIES...



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