VC_CLIMAAX

Viana do Castelo Climate Action

Phase 2: Regionalized Risk Assessment

Municipality of Viana do Castelo, Portugal

Ricardo Almendra / Liliana Sousa

10-12 MARCH 2026
VIRTUAL REGIONS FORUM

CÂMARA MUNICIPAL
VIANA DO CASTELO

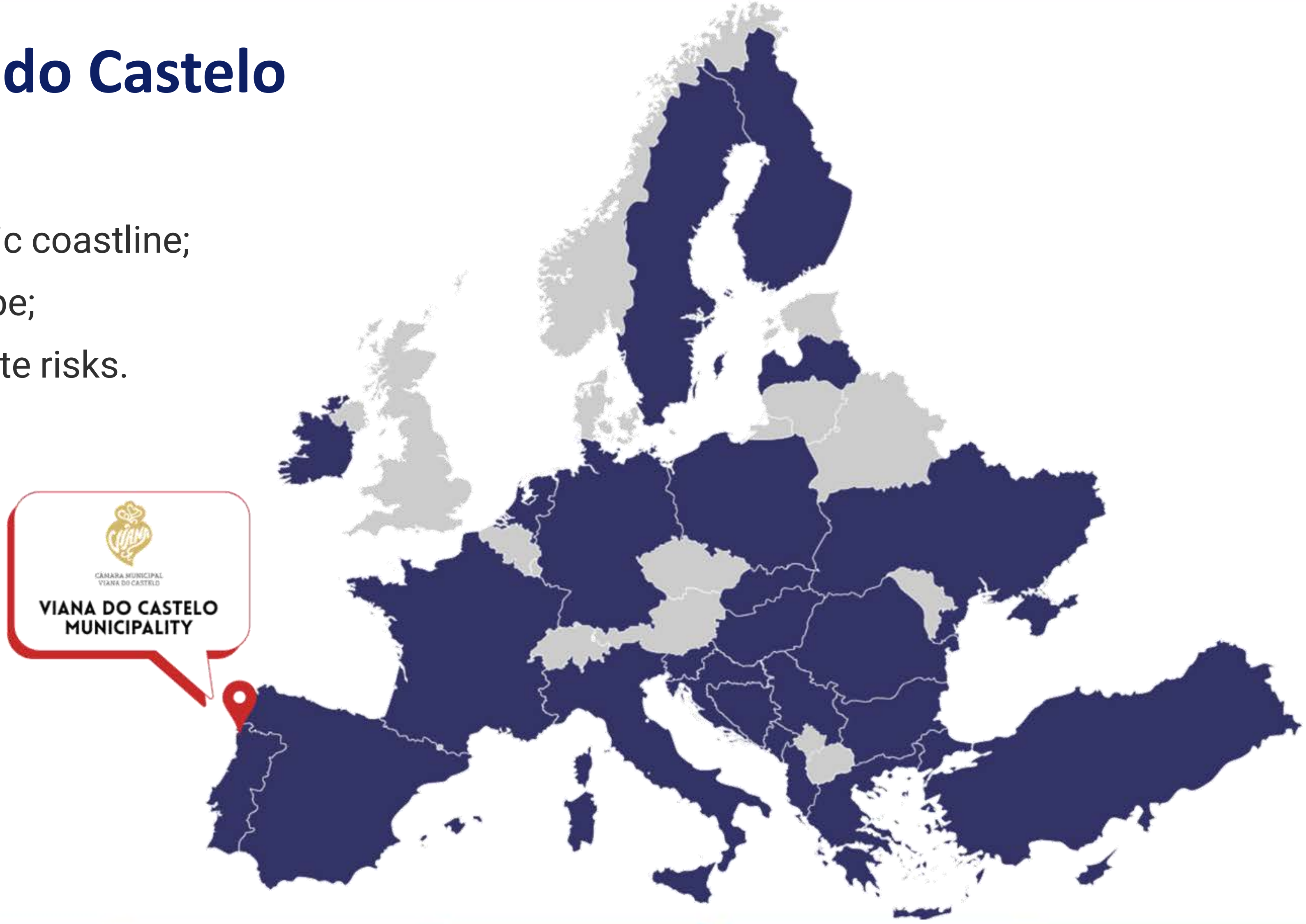
ICT
Instituto de Ciências da Terra
Institute of Earth Sciences

GEO ATRIBUTO

1. DECISION CONTEXT & PROBLEM DESCRIPTION

1.1. Welcome to Viana do Castelo

- Located in the North of Portugal;
- 319 km² territory & 24 km of Atlantic coastline;
- Atlantic and mountainous landscape;
- Exposed to multiple complex climate risks.





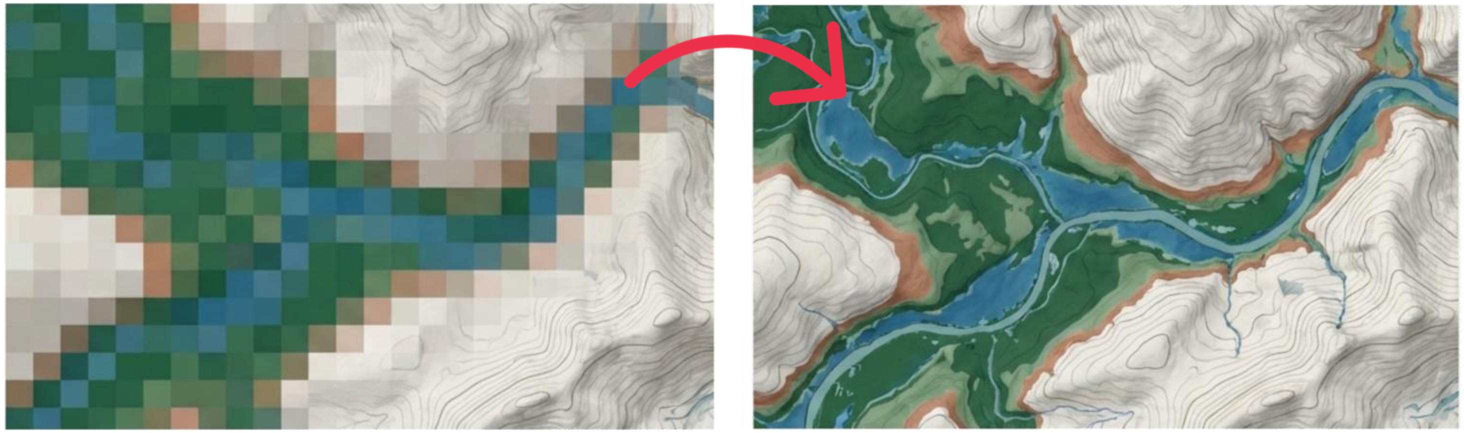



1.2. Decision Context & The "Utility Gap"

- **Phase 1:** Global Pan-European data (e.g. 100m resolution);
- **Stakeholder feedback:** Not detailed enough for local planning;
- **The Challenge:** The “*Utility Gap*”;
- Need for highly accurate local data.

Move from 'MACRO' to 'MICRO'

Phase 1	**Phase 2**
Global Scale	**Local Precision**

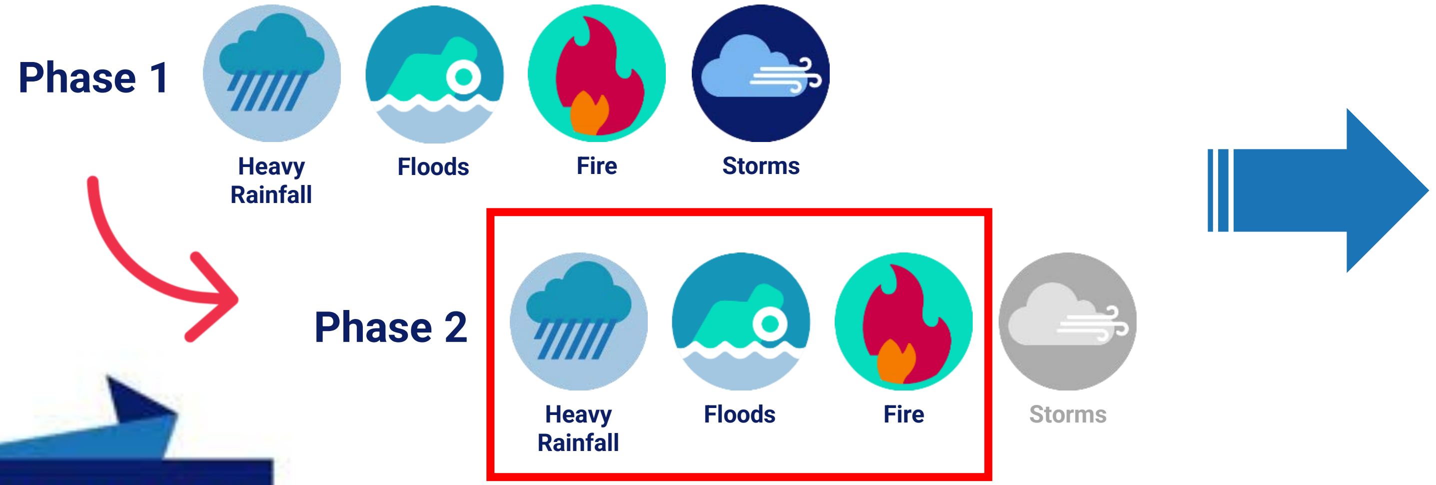


Original: Pan-European data

Enhaced: Downscaling with high-resolution local data

1.3. Our Goal for Phase 2

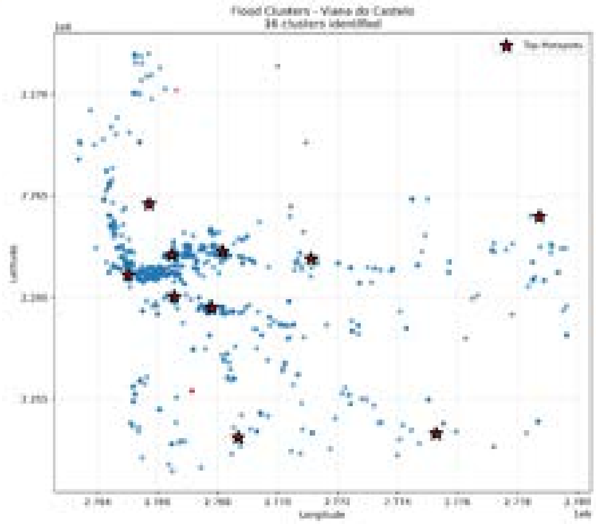
- Following the CLIMAAX framework methodology;
- **Prioritized top 3 risks**: Heavy Rainfall, River Floods and Wildfires;
- Based on stakeholder consensus and historical data;
- **Main Goal:** Achieve a high-resolution scale.

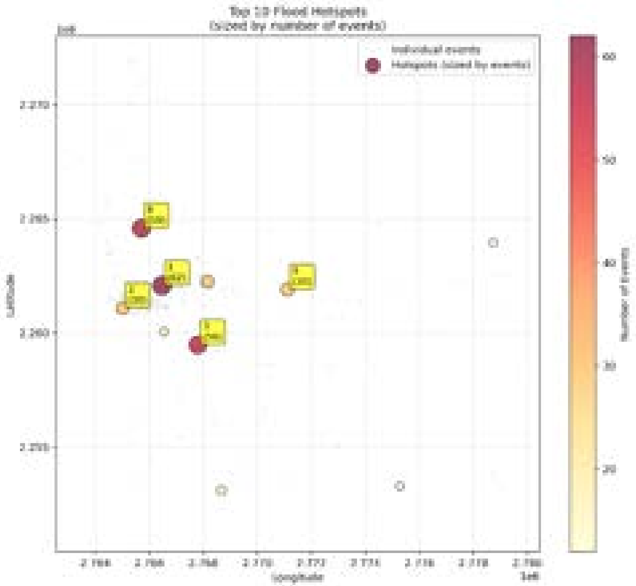


2. MAIN RESULTS

2.1. Results - Heavy Rainfall

- **The Challenge:** Overcoming the “Scale Paradox” (12.5 km climate pixels);
- **The Solution:** Mapping “Localized Vulnerability”;
- Used a inventory of 1,321 **georeferenced historical records** from Civil Protection (2000–2025);
- Algorithmic clustering (DBSCAN) identified **10 critical hotspots**;
- This method identified geographic clusters of recurring incidents, empirically validating where the municipal drainage system presents systemic failures.
- **Key finding:** A +2% rain increase requires a +9% drainage capacity.

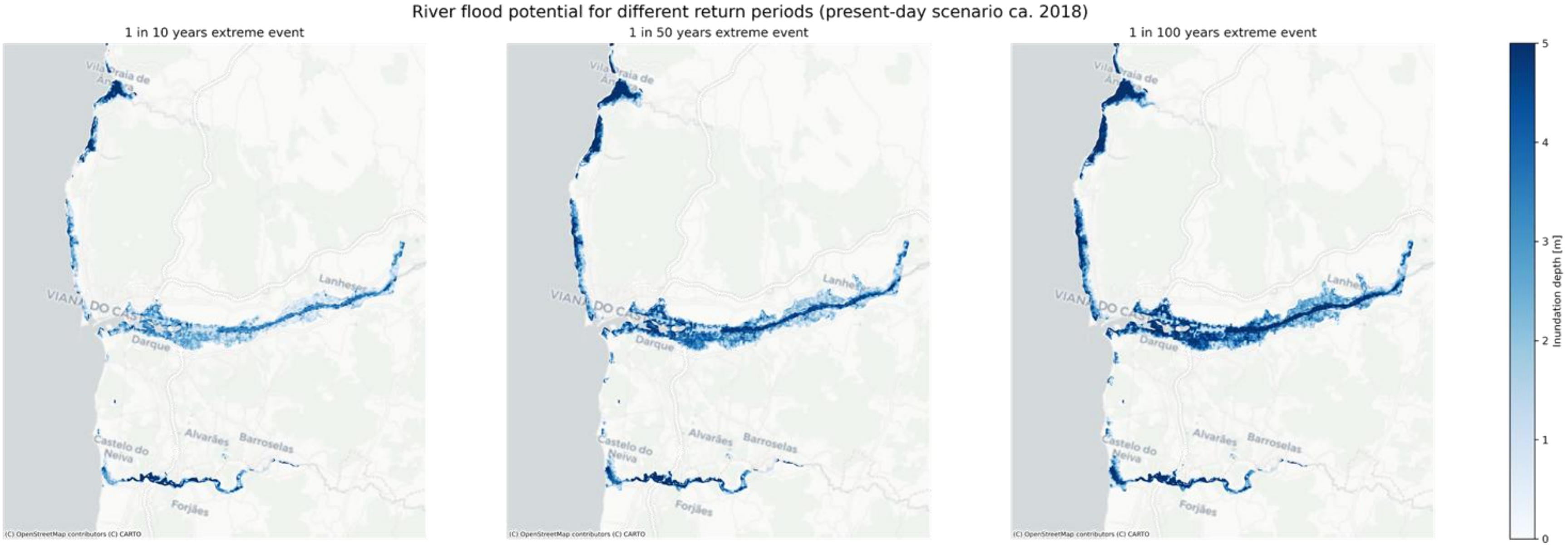




CLIMAAX climate ready regions
EU MISSIONS ADAPTATION TO CLIMATE CHANGE

2.2. Results - River Floods

- **Topographic fidelity and physics-based downscaling:** High-resolution maps using local **LiDAR-derived HR-DEM** (10m) and Flood-Fill algorithms to prevent "ghost floods" in high areas;
- **Economic Impact:** €25.28 million Expected Annual Damage (EAD);
- **Human Impact:** 285 people displaced annually (EAPD).



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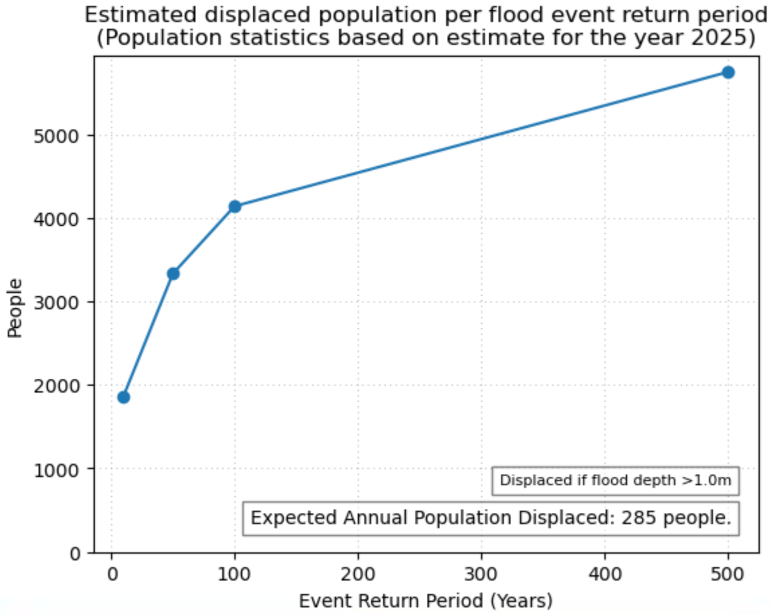

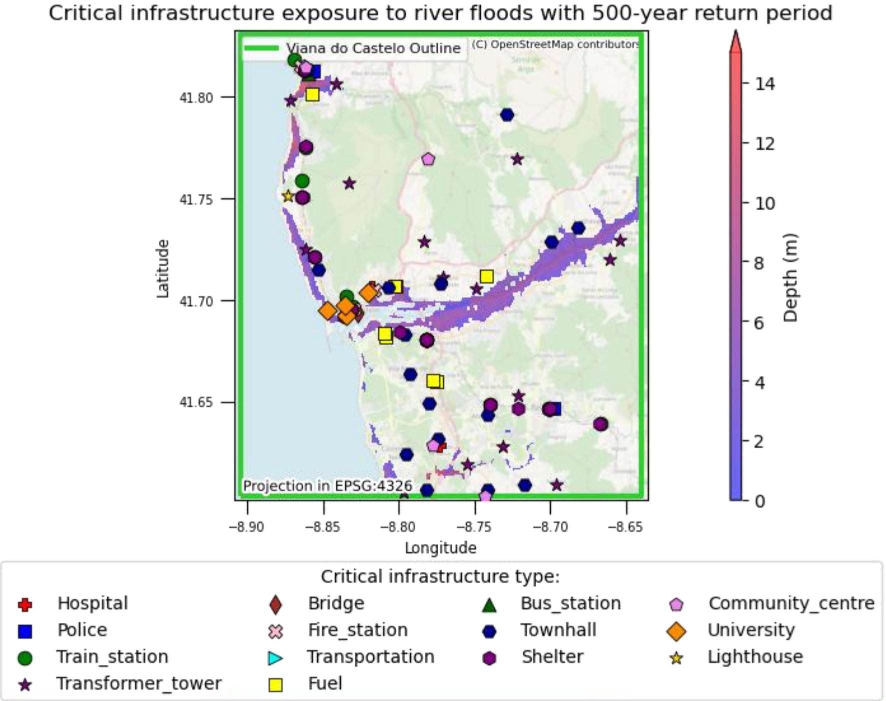

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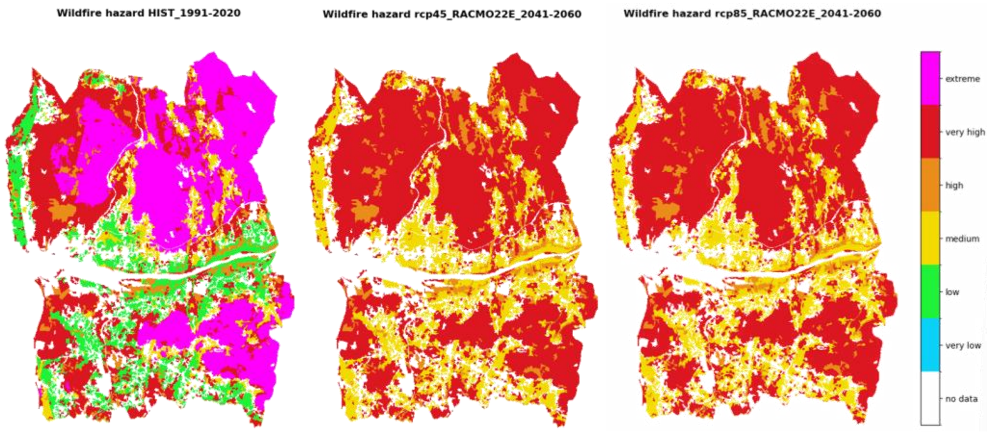
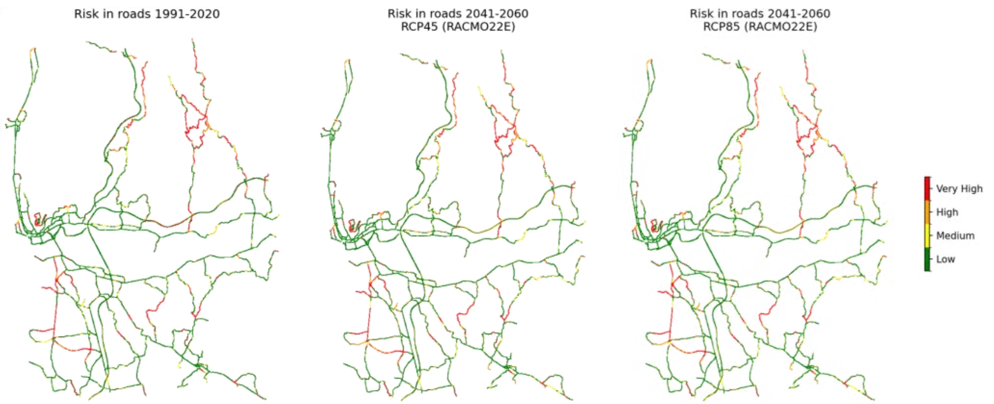
2.3. Results - Wildfires

- **Machine Learning** (Random Forest) applied to the Wildland-Urban Interface ➔ Models trained on **historical burned perimeters** (2009-2024) to predict localized susceptibility.
- **Local spatial resolution:** transitioning from a 100m scale to a 10-meter operational scale by integrating the National Land Use Map (COS 2023);
- **Scientific fuel calibration:** replacing generic European values with a manual conversion dictionary based on national research, assigning maximum hazard to critical species;
- **Comprehensive exposure network:** expanding analysis to a detailed municipal inventory of 11 specific critical infrastructure layers.





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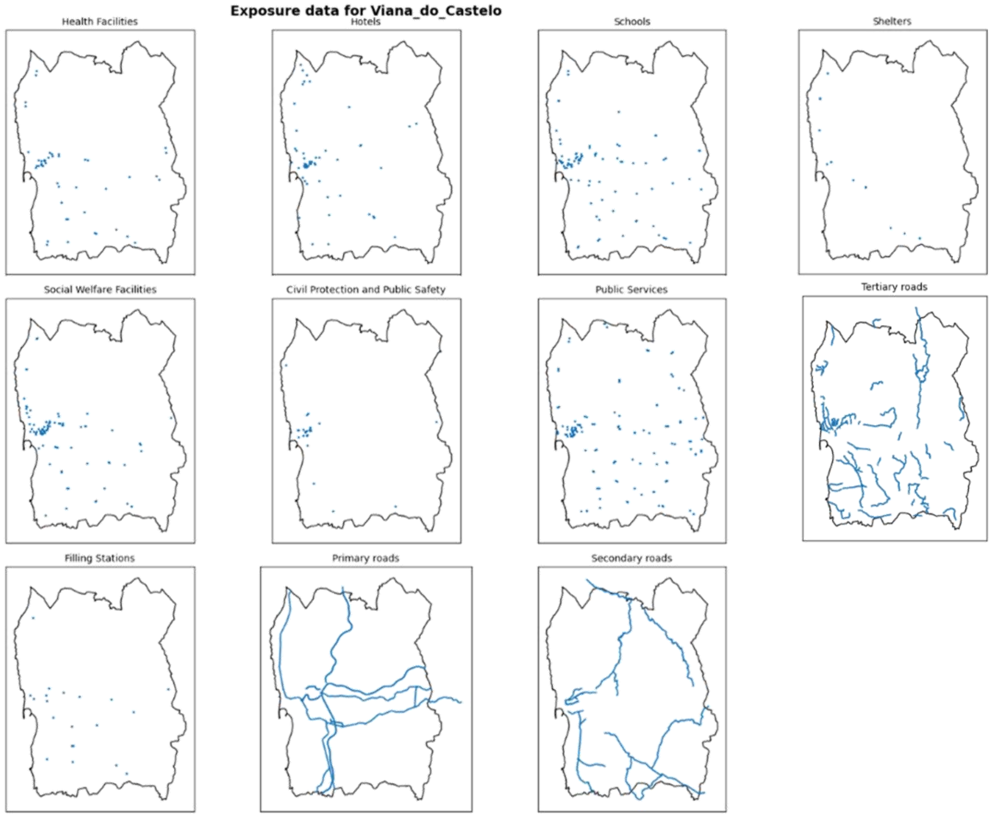

2.4. Results - Key Risk Assessment (Risk Priority)

- **Heavy Rainfall:**
  - Severity (Substantial) | Urgency (Immediate action) | Resilience (Medium) ➔ Priority: HIGH
- **River Floods:**
  - Severity (Critical) | Urgency (More action needed) | Resilience (Medium) ➔ Priority: HIGH
- **Wildfires:**
  - Severity (Critical) | Urgency (Immediate action) | Resilience (Medium) ➔ Priority: VERY HIGH

Hazard	*Severity*		*Urgency*	*Resilience capacity*	*Priority*
	current	*future*			
Heavy rainfall	Substantial	Substantial	Immediate action needed	Medium	High
Floods	Moderate	Critical	More action needed	Medium	High
Fires	Substantial	Critical	Immediate action needed	Medium	Very high

Severity	Urgency	Resilience Capacity	Risk Ranking
Critical	Immediate action needed	High	Very high
Substantial	More action needed	Substantial	High
Moderate	Watching brief	Medium	Moderate
Limited	No action needed	Low	Low

3. USABILITY

3.1. Usability - The "Portugalization"

- **Physical Calibration:**
  - Replaced EU map (Corine Land Cover) with National Land Use (COS 2023 - 93 classes);
  - Max hazard assigned to local species (like Eucalyptus & Maritime Pine).
- **Economic Calibration:**
  - Formulas adjusted using Regional Wealth Factor (0.868);
  - Costs updated to Portugal's 2024 inflation rate.

3.2. Usability - Local Planning

- Mapped **11 layers** of municipal critical infrastructure at 10m resolution;
- Integrated over **480 individual assets** (e.g., 51 health facilities, 87 schools, 16 shelters);
- Analyzed more than **46,000 road segments**;
- Transforms abstract climate data into actionable territorial intelligence;
- Directly updates our **Municipal Emergency Plan (PMEPC)** and **Climate Action Plan (PMAC).**

4. NEXT STEPS

4.1. Our next steps

- Transition from **diagnosis to practical** solutions;
- Use **Multi-Criteria Analysis (MCA)** to prioritize investments;
- Focus on **Nature-Based Solutions (NbS)**;
- Update 2 local **emergency and risk management plans**;
- Deliver policy notes for **political decision-makers**.

Phase 2:
Risk Analysis

1. Evaluate
Identify and prioritize local adaptation options.

2. Improve
Update 2 local emergency and risk management plans based on new data.

3. Advise
Deliver 3 targeted policy notes for political decision-makers.

5. LESSONS LEARNED

5.1. Main Lessons Learned

Resolution is Key	Local 10m resolution is mandatory to make broad climate models operationally useful. The jump from 100m to 10m is the difference between academic mapping and operational emergency tools.
Ground-truthing is essential	Historical records from local Civil Protection are vital to overcome the "Scale Paradox" of climate models and to validate abstract theoretical projections
Co-production & Ownership	Stakeholders are data providers, not just audiences. Local actors reoriented our technical focus to real needs. Direct technical validation resolves the "Utility Gap".

5.2. Open Science & Full Results

- **Full transparency & Open Science:** All methodologies and data are publicly available;
- **Download our Reports:** Deliverables 1 & 2;
- **Access our Datasets:** Python workflows, high-resolution models, and local datasets (Zenodo repository);
- **Contact us:** vc_climaax@cm-viana-castelo.pt.

Phase 1 Report (Baseline Risk)

https://zenodo.org/records/15426297

Phase 2 Report & High-Res Datasets

https://zenodo.org/records/18302894

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