RISC RA – Reunion Island’S Climate Risk Atlas

The case of an outermost intense tropical island

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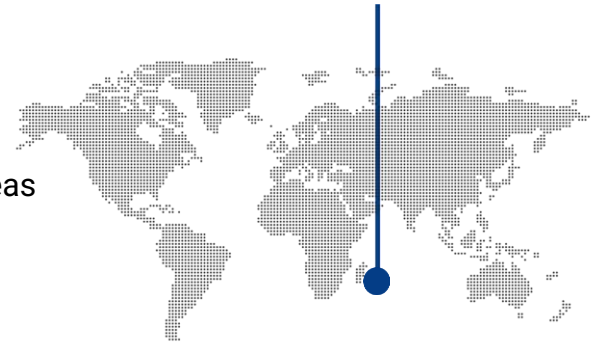
CLIMAAX
climate ready regions

La Réunion : a French overseas region in the South West Indian Ocean (SWIO)

- French Outermost Region
- Tropical volcanic island covering an area of 2 512 km²
- Significant and complex topography (up to 3000 a.s.l.)
- Population of ≈ 885,000 inhabitants mainly concentrated on the coastal areas



SOCIO-ECONOMICS

High poverty rate (36%)
24% of the population resides in Social housing units

High vulnerability to natural hazards

ENVIRONMENT

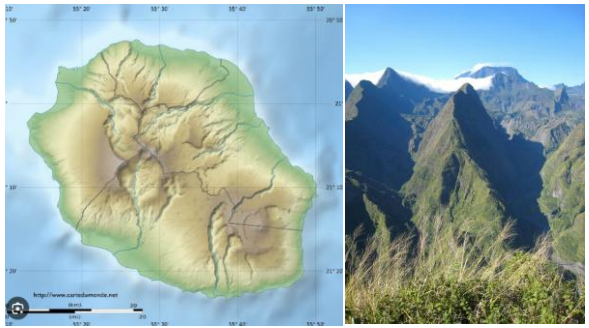
Biodiversity hotspot highly impacted by natural hazards

Tropical cyclones pose the most significant threat

ECONOMIC IMPACT

Average annual cost of historical damage:
€9 million

Projected to reach 30M€ per year for cyclones alone



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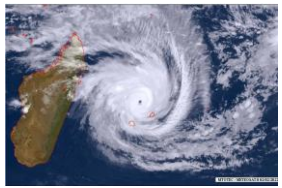
Climate challenges, projects and solutions

Climate Challenges exacerbated by Climate Change

- **Tropical cyclones**, bringing intense winds, heavy rainfall, flash floods and landslides
- **Severe weather conditions** leading to damage roads, habitats and infrastructure
- **Coastal risks** including storm surge, sea-level rise and coastal erosion
- **Threats to biodiversity** such as rising sea surface temperatures, ocean acidification or invasive species
- **Health risks** including climate-driven vector-borne diseases
- **Increasing length and amplitude of the dry season** impacting access to water ressources



Converging initiatives to increase climate resilience

- Ongoing revision of the **Regional Land Development Plan (SAR)**, to incorporate a Climate Risk Assessment and an Adaptation Strategy
- **A Regional Expert Groups on Climate Change** to be launched in 2025 for a strengthened Science-Society Interface

- Established local atmospheric physics and weather observation **infrastructures**
- La Réunion's **observatory** for the Sciences of the Universe and La Réunion's coastal observatory

- **High Resolution Climate Projection from the BRIO project** (Building Resilience in the Indian Ocean) *(Leroux et al. 2024)*
- **"Knowledge and Solution for Climate Change Adaptation of Overseas Territories"**, French National Research Center (CNRS) and Ministry of Interior and Overseas Region

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Leveraging CLIMAAX for Réunion Island

CLIMAAX provides the opportunity to conduct a comprehensive risk impact study, linking hazards, vulnerability and exposure through the use of local datasets.

Lack of background document structuring regional climate risk knowledge and linking risk management strategies to local challenges.

Regional deliverables of the RISC-RA project will include:

A REGIONAL CLIMATE RISK ATLAS	A comprehensive risk assessment incorporating risk maps and aggregated indicators.
A **STRENGTHENED SCIENCE-SOCIETY INTERFACE**	Achieved through risk workflow workshops and fostering the development of the RPCC

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Challenges: adapting CLIMAAX methodology to local specificities

- **Data Gaps:** Limited availability of common datasets, particularly those outside standard European frameworks.
- **Resolution Challenges:** Inadequate dataset resolution means the island is often poorly represented in Global Climate Models (GCMs) or in Global Flood, Land or Demographic datasets.

- **Workflow Suitability:** Standard continental risk assessment workflows are often ill-suited for a mountainous tropical environment. Consequently, Phase 1 utilized local datasets and involved an analysis of more appropriate workflows.

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An island characterized by sharp rainfall contrasts

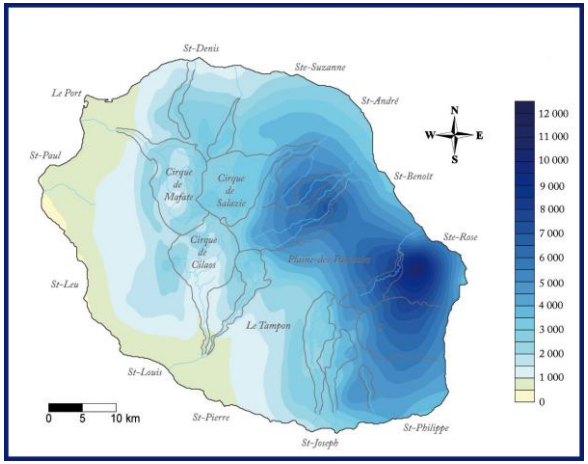
- **Strong heterogeneity** of water resources
- **Delayed** onset of the wet season (exemplified by the 2025 drought)
- **Population growth exacerbating vulnerability of existing water infrastructures**
- **Impacts**: water rationing, tank deployment, irrigation restrictions, decline in crop yields
- **World records** for extreme rainfall over periods ranging from 12 hours to 15 days:

  - Greatest 12-Hr rainfall at 1.144 m
  - Greatest 24-Hr rainfall at 1.825 m
  - Greatest 72-Hr rainfall at 3.930 m
  - Greatest 96-Hr rainfall at 4.936 m

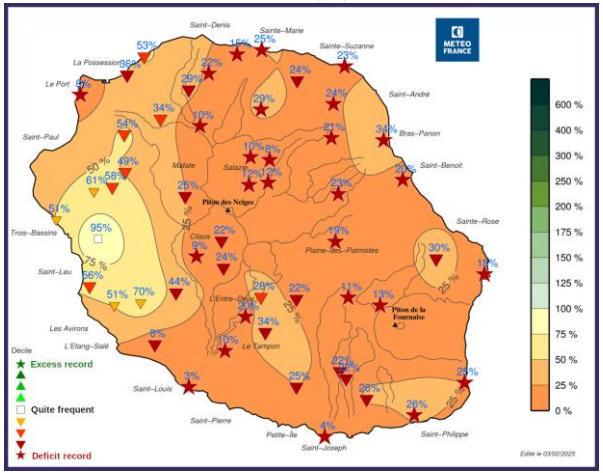
  (WMO Extreme Archives)

⇒ **High risk of catastrophic rainfall events**

Mean annual rainfall (mm) *(1981-2010)*



Rainfall - ratio to normal (%) in *Dec 2024-Jan 2025*

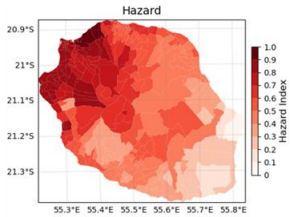


Relative Drought Workflow – general overview

HAZARD

Climate data

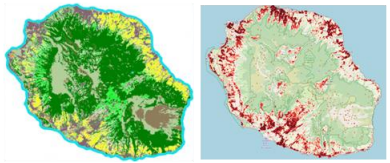
Drought hazard index



EXPOSURE OF ISSUES

Demographics
Land use mapping

Exposure of issues (population, infrastructure, farmland)

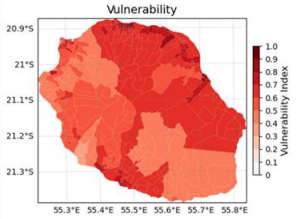


VULNERABILITY

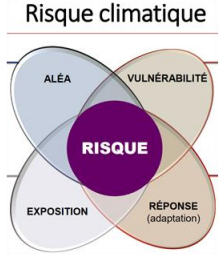
Social Eco. Infra

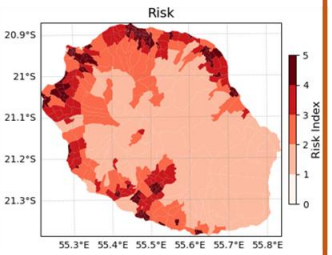
Poverty rate, social housing rate, state of water networks, etc.

Economic, social and infrastructural vulnerability



CLIMATE RISK MAPPING





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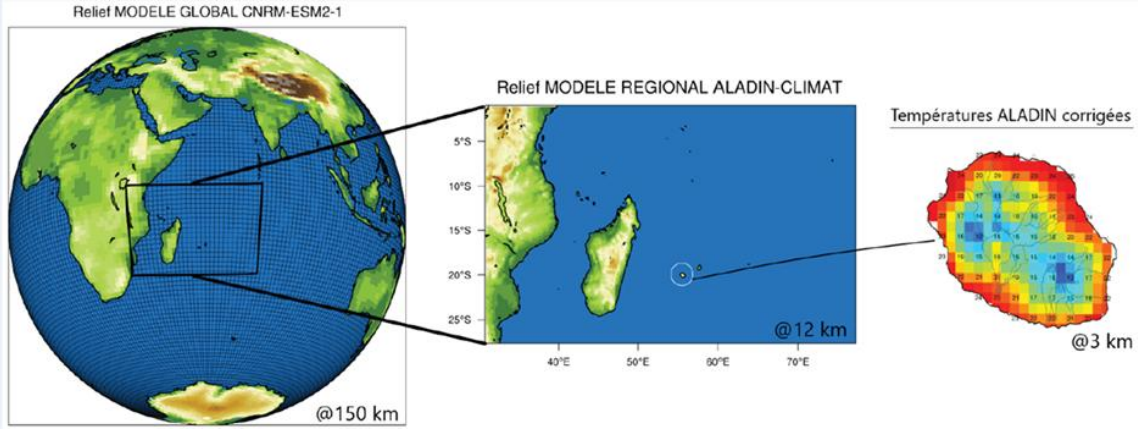
Focus: Regionalized Downscaled Climate Simulation from the BRIO Project *(Leroux et al., 2024)*

The BRIO project (Building Resilience in the Indian Ocean) has produced :

- A high-resolution gridded observational climate dataset (*T°, Rain, Relative Humidity, …).*
- A high-resolution (3 km) historical and future climate dataset, developed using statistical downscaling and bias-correction techniques applied to CMIP6 models.



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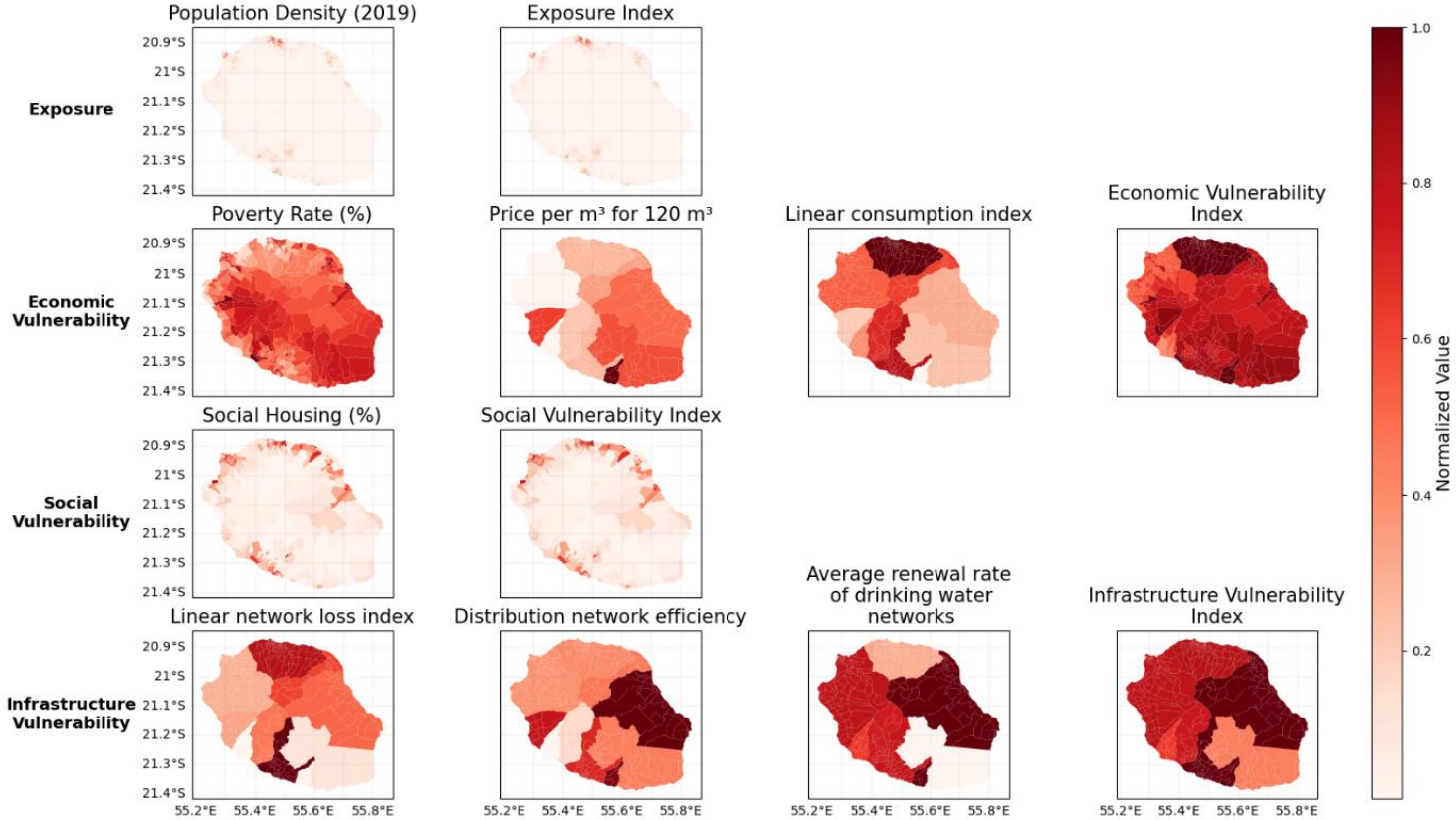
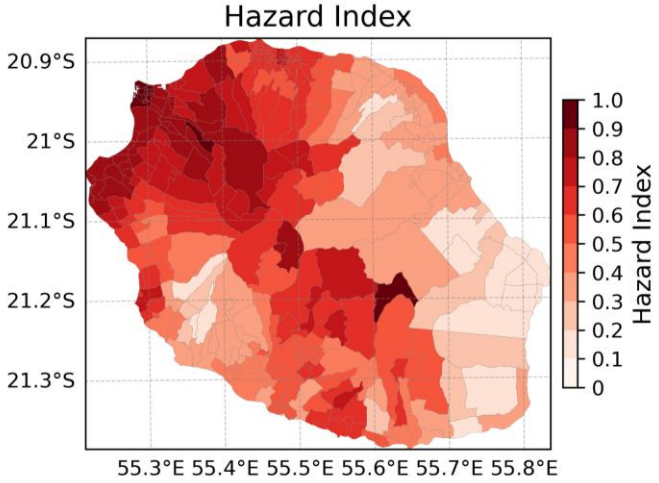
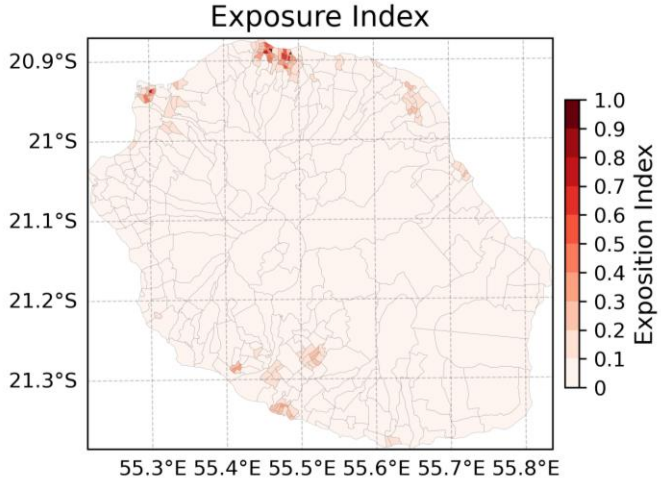
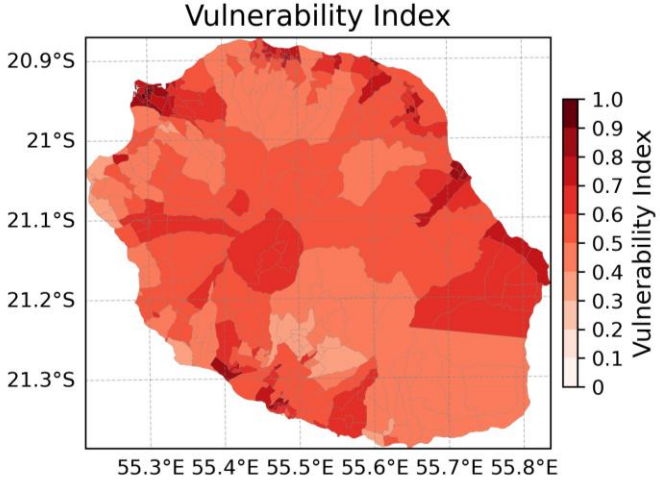
From local data to aggregated vulnerability index

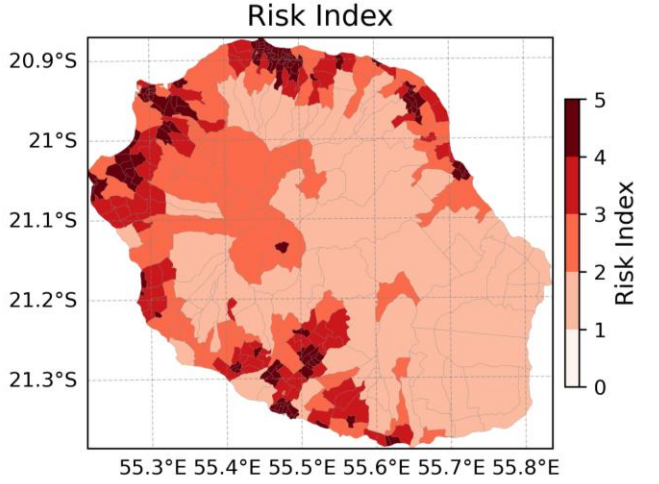


Risk components for SSP585, 2035-2065, DJD

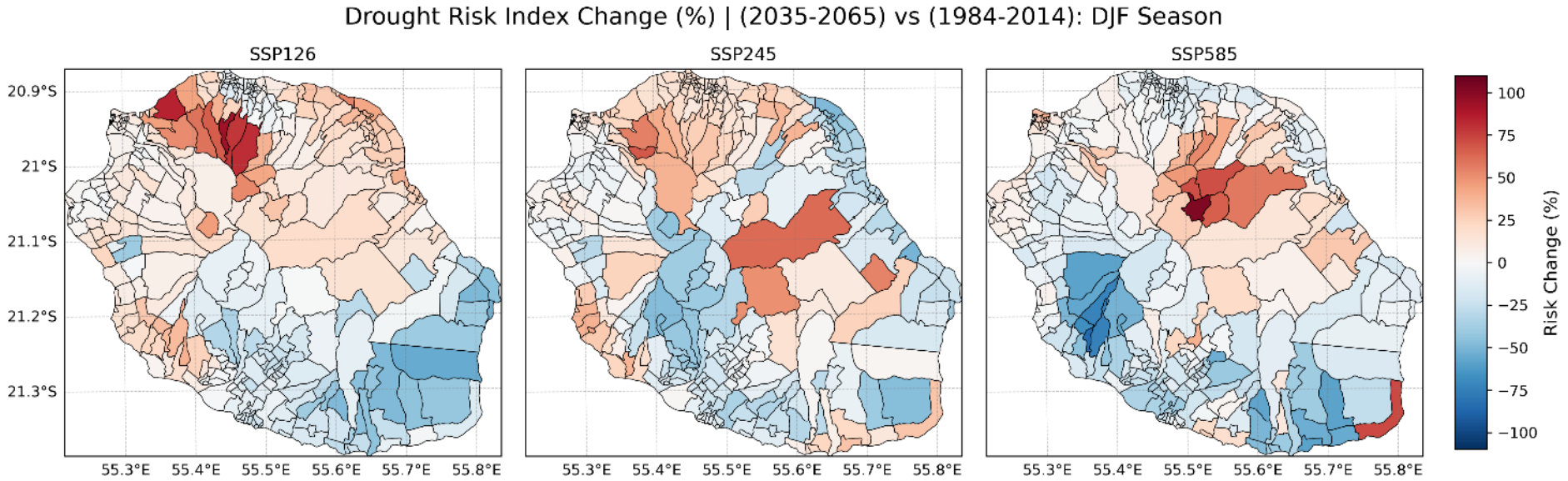








Relative Drought Risk Evolution



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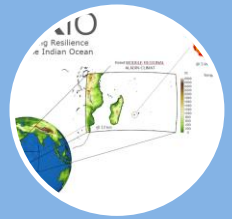
Extreme Precipitation Workflow – general overview



Climate data

Historical gridded observations

Climate Projection (3km x 3km)

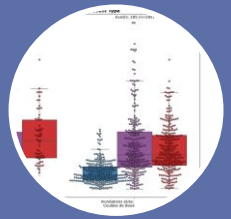
Impact data

Insurance claims data

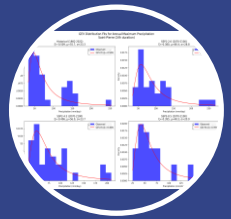
Natural disaster insurance scheme data

Overseas relief fund data

Number of injuries and/or fatalities



Definition of impact thresholds based on historical data

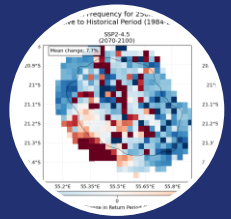


- **Analysis** of the statistical distribution of rainfall (maximum annual series)

- **GEV Analysis**

Frequency shift [years]

Amplitudes [mm]



Regional scale Analysis

Shifts changes for multiple scenarios and time horizon

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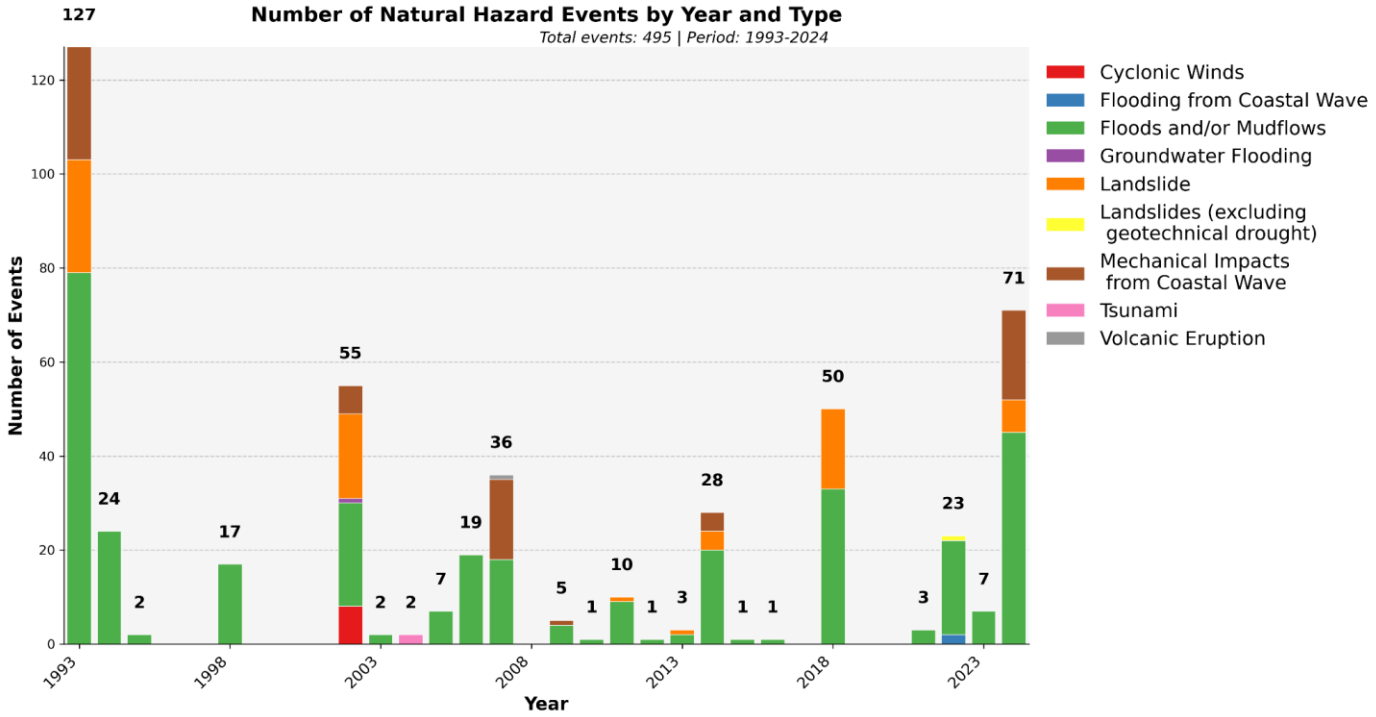
Natural Disaster Records



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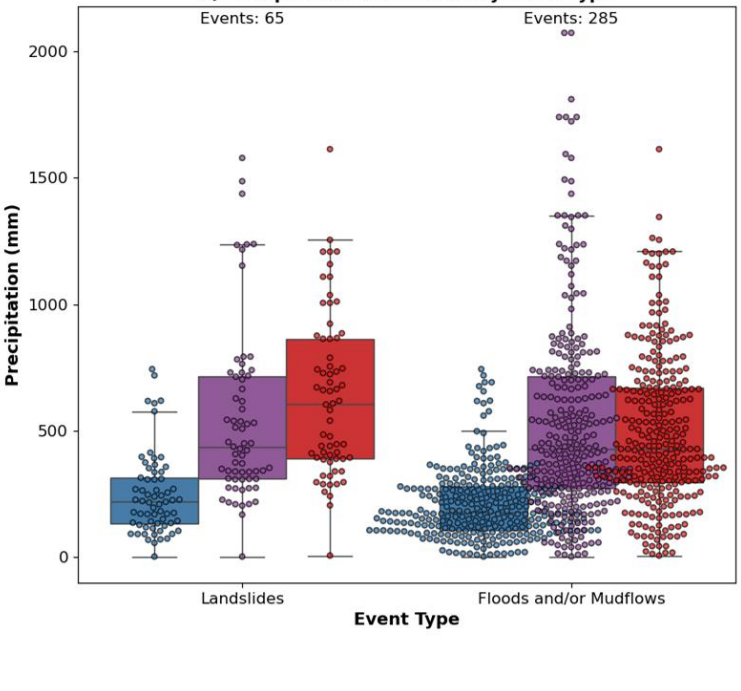
Major Impact Threshold from Natural Disaster Events

Location	High Impact	
	Impacts	Threshold
Regional Average	Flooding to runoff and mudflows	230 mm in 24h (based on mean daily value)
Regional Average	Landslide due to Extreme Precipitation	210 mm in 24h (based on mean daily value)

a) Precipitation Distribution by Event Type



b) Precipitation Statistics by Event Type

Metric [mm]	Mean	Median	Max	Q25	Q75
Landslides					
Daily Avg	247.3	218.3	743.4	132.7	313.7
Avg Cumu	546.4	436.6	1579.2	309.0	713.4
Max Daily	639.6	607.2	1613.8	388.1	863.6
Floods and/or Mudflows					
Daily Avg	210.1	176.7	743.4	106.6	279.1
Avg Cumu	534.1	428.0	2074.0	271.6	716.0
Max Daily	495.8	427.4	1613.8	295.9	671.2

Metric
Average Daily Precipitation Observed during the entire event
Average Cumulated Precipitation during the entire event
Maximum Daily Precipitation during the entire event

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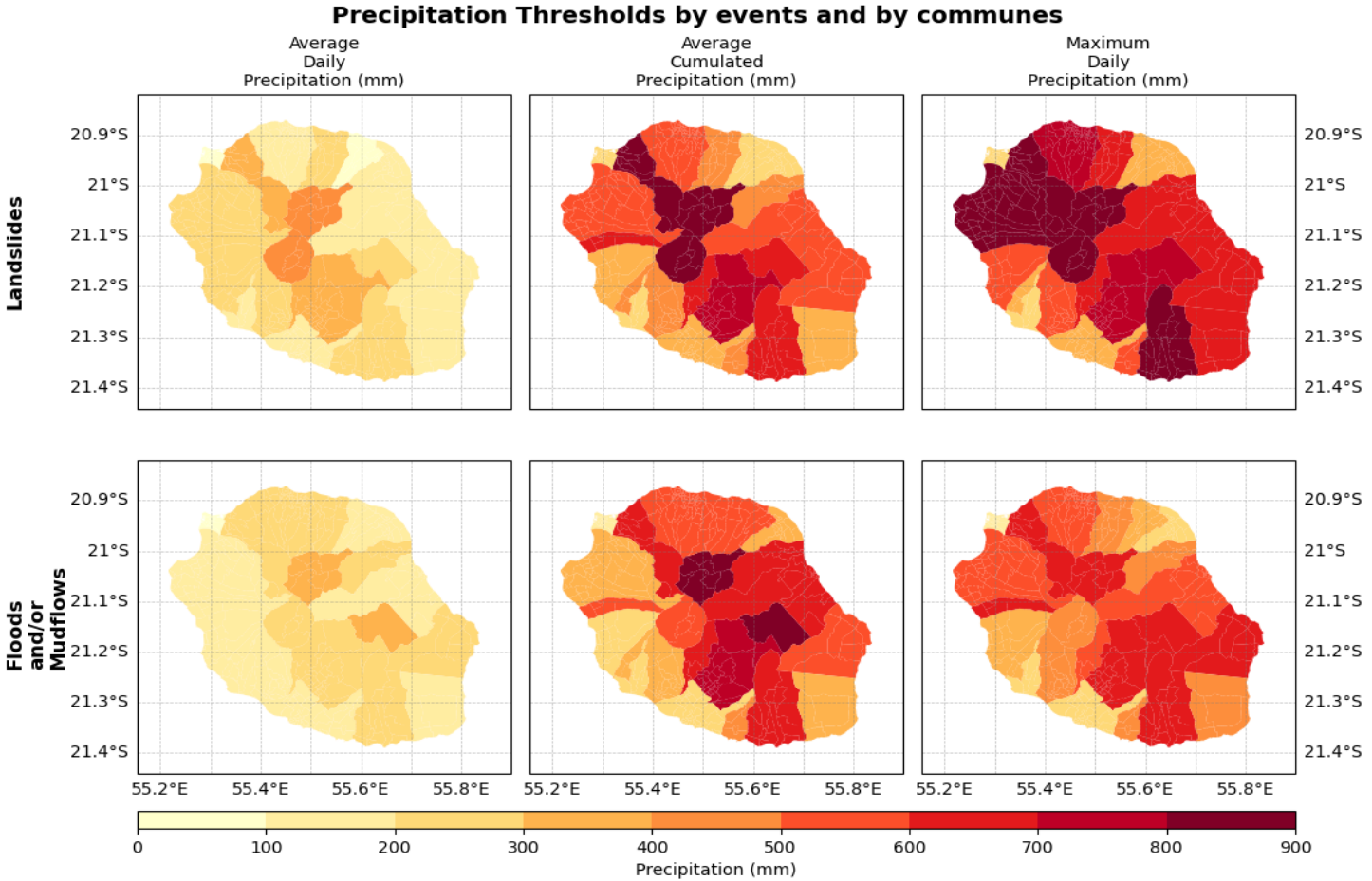
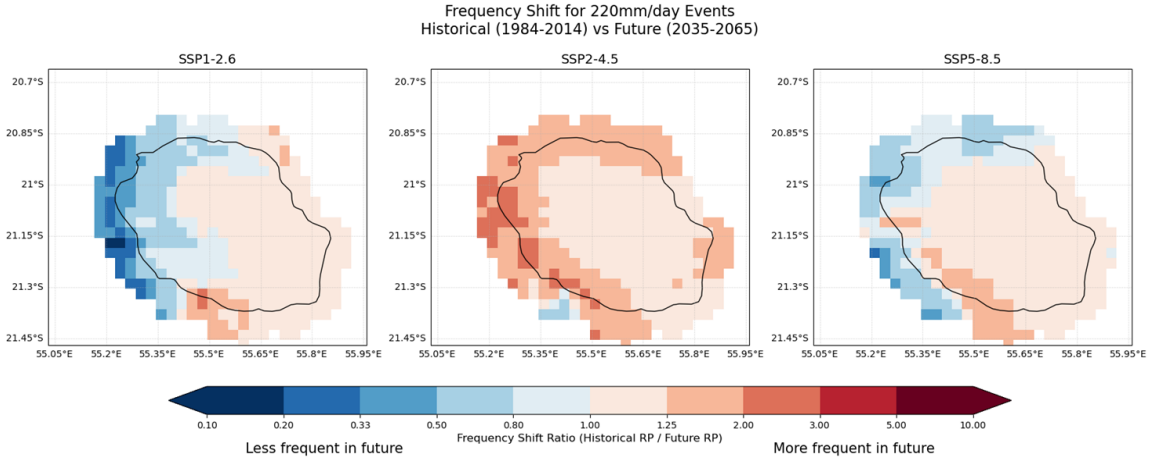
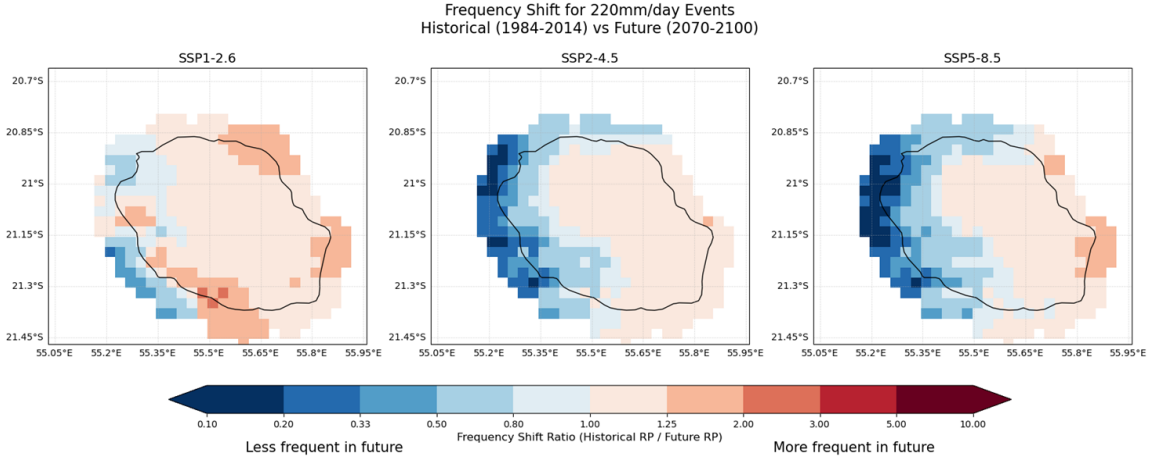
Spatialised Impact Threshold



Phase 1 results : Frequency Shifts for a 220 mm/day Rainfall Event Across Multiple Time Horizons and Scenarios





Looking ahead to phase 2

1

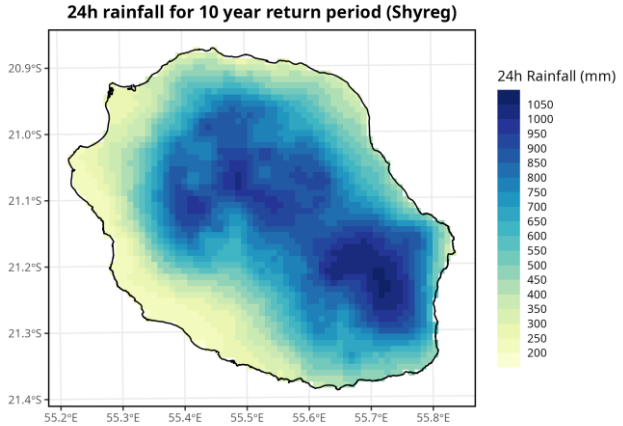
Conduct Thematic workshops with local stakeholders to help:

- Optimizing drought vulnerability indicators based on recent events
- Validating extreme rainfall impact thresholds – per sector and degree of impact

2

Implement additional workflows :

- Coastal and pluvial floods
- Cyclonic winds



- What methods are suitable for assessing the sensitivity of scientific results derived from the Extreme Precipitation and Relative Drought workflows?
- What engagement strategies can effectively involve populations most vulnerable to climate risks? At which project stages and through what means?

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Thank you for your attention

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