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MEZAP: national method for rockfall hazard mapping in France

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SUMMARY: The MEZAP technical guide, known as the "Rockfall Hazard Mapping Method," is designed for state agencies responsible for conducting rock hazard assessments in the context of creating Public Awareness Campaigns (PAC) or Natural Risk Prevention Plans (PPRn). It is also relevant for operators such as design firms and public organizations involved in these assessments. In certain cases, local authorities may find it useful for issuing hazard maps of this kind.

The document represents the result of collective deliberations initiated in 2014. These discussions were carried out within a working group that brought together state agencies (INRAe, BRGM, Cerema, G. Eiffel University, ONF-RTM) and representatives from decentralized state services, all under the auspices of the Ministry of Ecological Transition.

MEZAP is a response to the state's objective of maintaining a proportional approach to meeting expectations and allocating resources for mapping rock hazards within PPRn or PAC frameworks. It is built on a shared foundation for characterizing rock hazards and a common terminology. MEZAP offers a practical approach to rock hazard mapping, encompassing a wide spectrum of phenomena, from isolated stones to large-scale events, ensuring consistency in production across different territories.

Keywords: rockfall, hazard, regulatory map, method, mapping

Introduction

The MEZAP (Rockfall Hazard Mapping Method) provides an approach aimed at ensuring consistency in hazard mapping across different regions in France. This approach relies on a shared foundation for characterizing rockfall hazards and a common vocabulary. Importantly, MEZAP does not mandate specific implementation resources but leaves them to the discretion of experts based on project specifications.

The guide offers clear definitions to enhance understanding and alignment of references. The method systematically outlines the process of defining rockfall scenarios, determining hazard intensity for mapping, mapping hazard failures, and the resulting run-out. Towards the end, matrices are introduced to combine i) failure and run-out to create a reaching map, and ii) intensity and reaching to generate a hazard map.

Definitions

As per the PPRn "Landslide" guide, to best predict potential phenomena and safeguard the affected populations and properties, it is essential to establish a reference hazard within a given homogeneous area. The reference hazard is defined as the natural phenomenon that serves as a



benchmark for shaping PPRn regulations. In the context of rock hazard mapping under MEZAP, this refers to a phenomenon of specified occurrence and intensity likely to run-out towards assets over the reference period. For rockfall hazard mapping within the framework of MEZAP, the reference period is set at one century.

Multiple reference scenarios can be proposed to construct the reference hazard, with each significant release area treated as a homogeneous unit.

MEZAP Method

The method is founded on the following principles: characterizing rockfall hazard within MEZAP involves an intersection of the intensity of a rock mass mobilization event and the probability of this mass reaching a specific point on the territory.



Figure 1. Définition of hazard in the MEZAP

The following steps are recommended for hazard mapping:

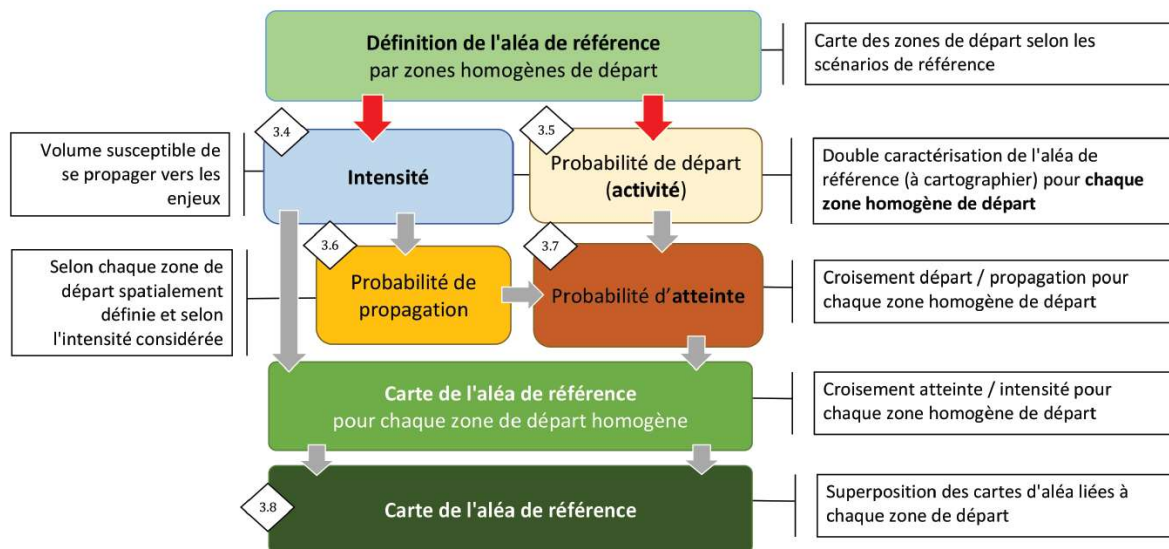


Figure 2. Simplified MEZAP flowchart for mapping rock hazard by reference scenario

The method proceeds by describing the following steps:

- Data collection for the creation of a geomorphological map tailored to rockfall hazards.
- Defining various scenarios that need to be taken into account.
- Establishing the boundaries and characterizing the sources of rockfall.
- Classifying the intensity.
- Restoring the run-out analyze.



Highlights of the MEZAP

MEZAP qualify hazard on every point of the study area following the matrix herebelow:

		Indice d'intensité				
		$V \leq 0.05 \text{ m}^3$	$0.05 < V \leq 0.25 \text{ m}^3$	$0.25 < V \leq 1 \text{ m}^3$	$1 < V \leq 10 \text{ m}^3$	$V > 10 \text{ m}^3$
		Très faible	Faible	Moyen	Fort	Très fort
Probabilité d'atteinte	Très faible	Nul à négligeable	Nul à négligeable	Nul à négligeable	Nul à négligeable	Nul à négligeable
	10^{-6}	Faible	Faible	Moyen	Fort	Fort
	10^{-5}	Faible	Faible	Moyen	Fort	Fort
	Moyenne	Faible	Faible	Moyen	Fort	Fort
	10^{-4}	Faible	Moyen	Fort	Fort	Très fort
	Elevée	Moyen	Fort	Fort	Très fort	Très fort
10^{-3}						
Très élevée						

Figure 3. Definition of the reference hazard level for each homogeneous zone (reference period of 100 years) (in red: annual reach probability)

As a reminder, it's important to note that the hazard qualification refers to potential damages to standard buildings. Therefore, MEZAP focuses on the safety of individuals within buildings, rather than those outside the buildings, considering that main damages to buildings involved systematically fatalities. Key highlights of the method include:

- The imperative need for a detailed informative map of phenomena, complemented by a geomorphological map specifically tailored for rockfall events.
- The decision to link the definition of intensity with the run-out mode, considering either the unit volume for individual boulders capable of reaching assets or the total volume of rockfall for certain specific scenarios.
- Distinguishing between 'diffuse hazard' (potential failure from any point within a delimited, homogeneous release area) and 'local hazard' (identifying a localized compartment).
- Quantitatively assessing the probability of initiation (failure) using an index based on scarp activity.
- The choice to represent the results of run-out analyses through the angle of the energy line in the final output.

Conclusion

The MEZAP technical guide serves as the standard approach for rockfall hazard mapping and risk zoning in France (PAC or PPRn). The method is comprehensively explained, with commentary provided at each step to assist users in conducting their analyses. MEZAP has made certain deliberate choices which, when taken out of context, might be subject to criticism. However, it is through these choices that a common, proportional approach aligning with state expectations has been established.

Ultimately, MEZAP offers a pragmatic method for rock hazard mapping, encompassing a wide spectrum of phenomena, from isolated stones to large-scale events, ensuring consistency in results across different regions.



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