Progress in Landslide Research and Technology, Volume 2 Issue 2, 2023

The Open Access book series of the International Consortium on Landslides (ICL)

ICL
International Consortium on Landslides

Springer

A Global Mission to Reduce Landslide Disaster Risk

The ICL's book series is the common platform for publishing recent progress in landslide research... for the benefit of society.

Kyoto Landslide Commitment 2020

A Guiding Force

The global promotion of understanding and reducing landslide disaster risk.

2030 Agenda Sustainable Development Goals

Sendai Framework for Disaster Risk Reduction

A Synthesis of Global Expertise

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Public Sector

- International Union of Geological Sciences (IUGS)
- Geological Survey of Canada
- University of Ljubljana

Private Sector

- Nippon Koei Co., Ltd (Japan)
- Ellegi srl (Italy)

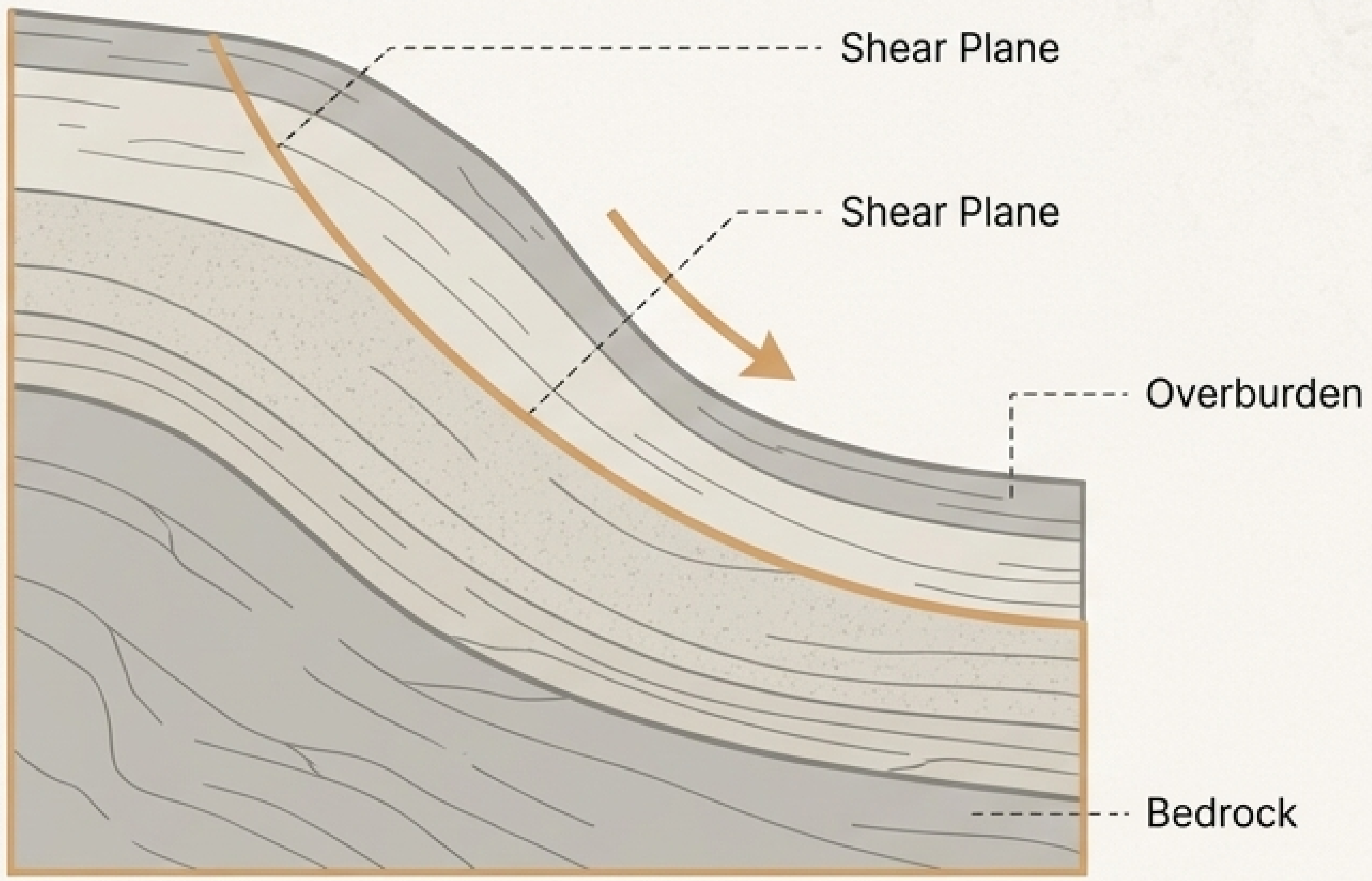
A collaboration of 61 members from 30 countries/regions, united under the International Programme on Landslides (IPL).

Chapter 1: How Do Slopes Fail?

Deconstructing the Hazard: An exploration of the fundamental mechanics and measurement of shear strength.

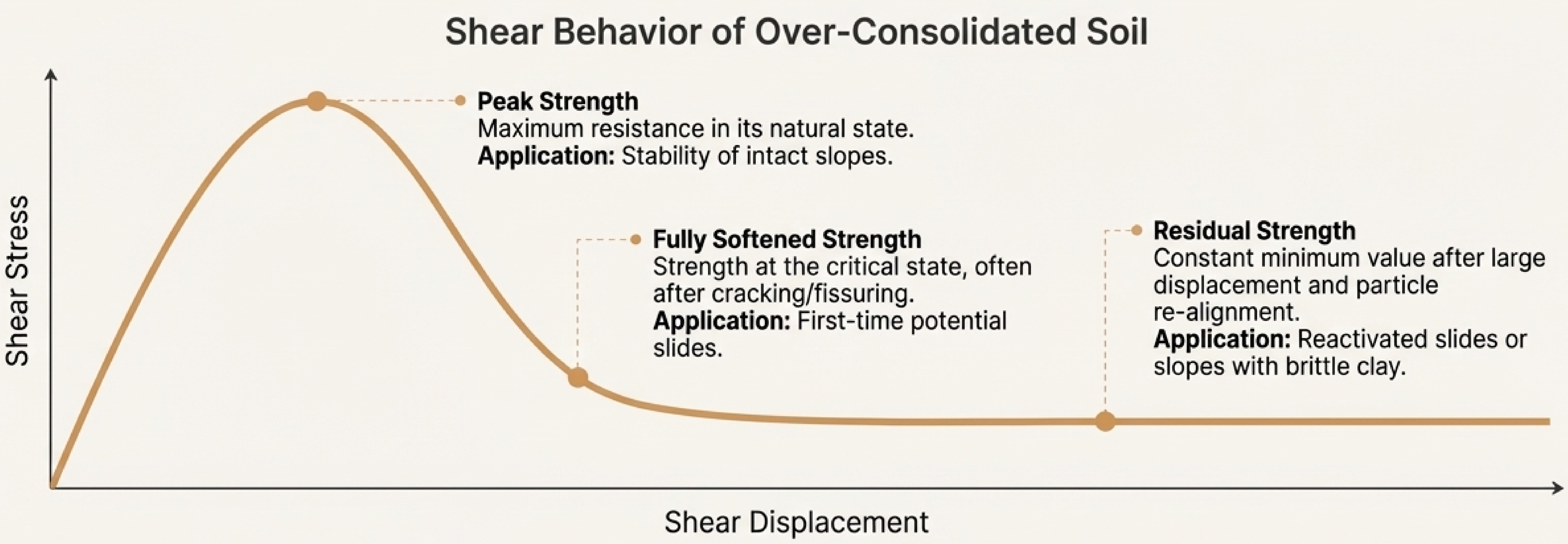
The internal resistance of a soil to a shearing force is known as the shear strength.

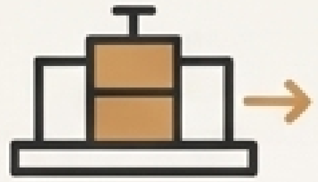
It is vital to evaluate the potential for slope failures and to determine the appropriate measures to mitigate risks.



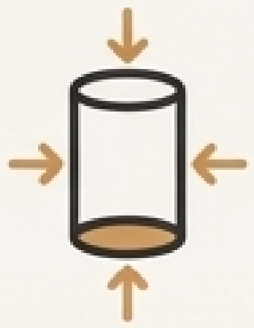
The Three States of Strength: Peak, Softened, and Residual

Source: Advancements in Shear Strength Interpretation, Testing, and Use for Landslide Analysis by B. Tiwari & B. Ajmera





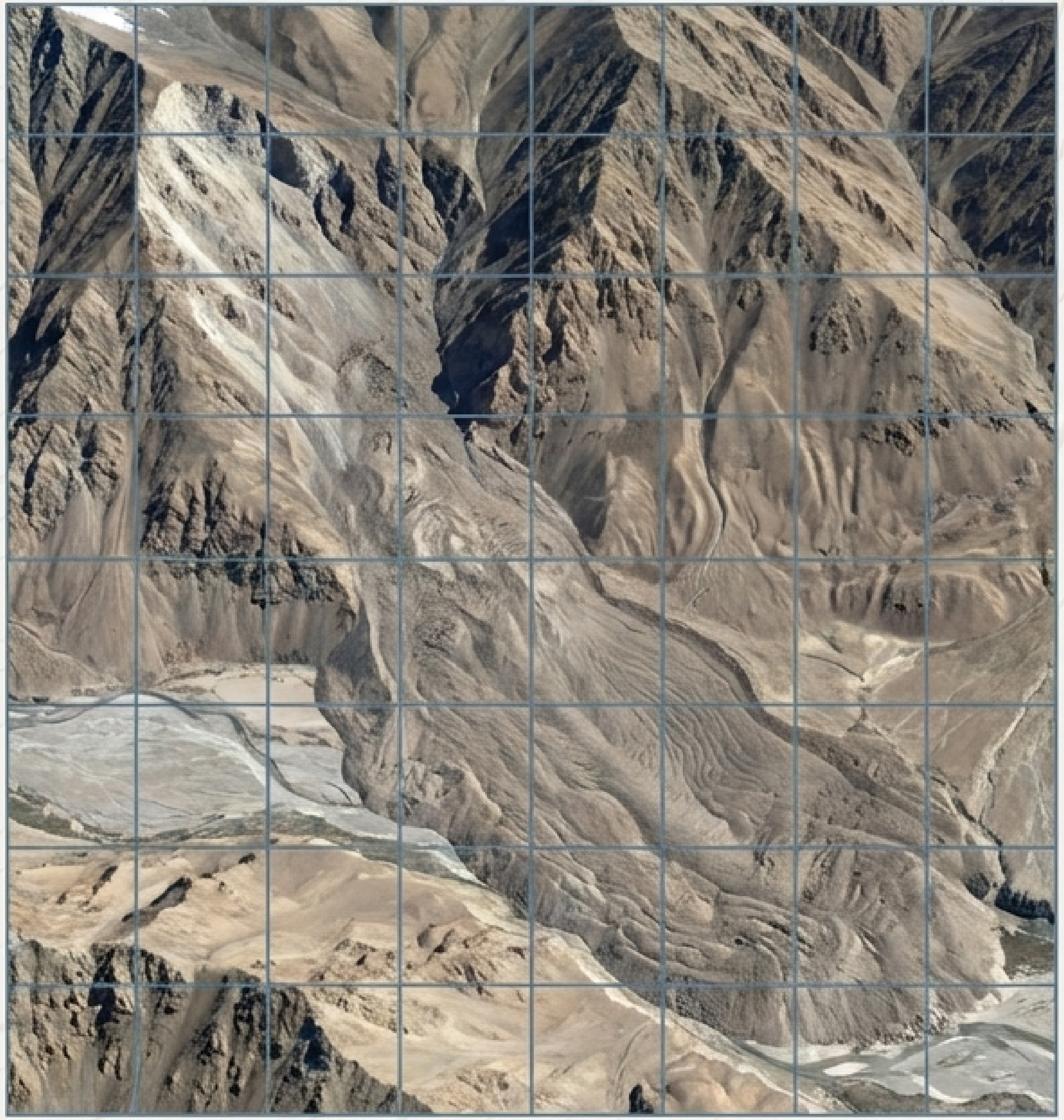
Direct Shear Test: For peak and fully softened strengths.



Triaxial Test: For peak and fully softened strengths.

Ring Shear Device: The preferred method for residual shear strength.

NotebookLM



Chapter 2: How Do We Map Hazards at Scale?

From a single failure to a vast plateau: Characterizing the spatial distribution of rock avalanches and susceptibility zones across entire regions.

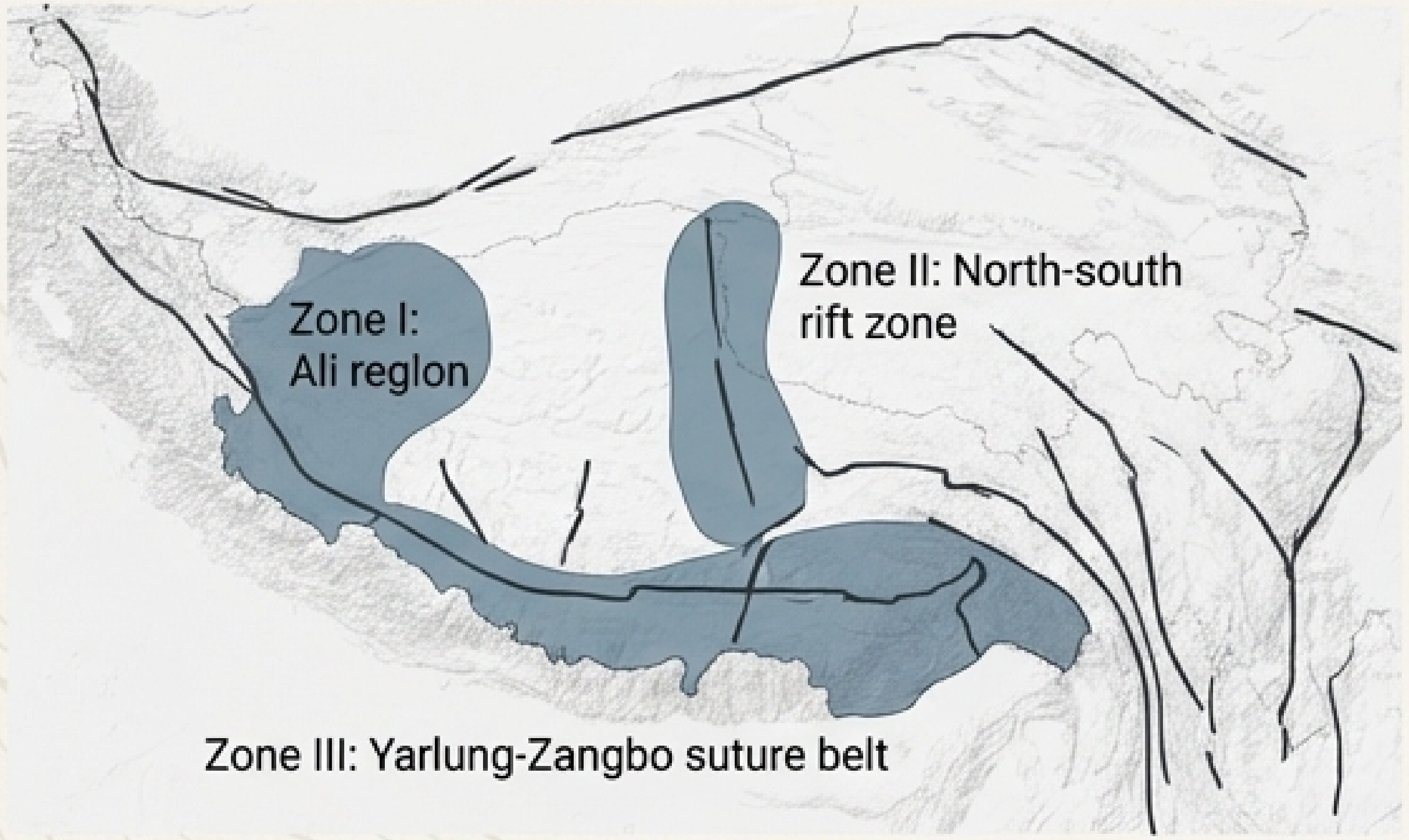
- Rock Avalanches: Sudden, huge volumes (>10^6 m^3), high velocities (>20 m/s), and extremely low friction.
- Susceptibility Zonation: Identifying areas prone to landslides based on controlling factors like slope, lithology, and rainfall.

Two Regions, Two Methodologies: Uncovering Patterns of Instability

Tibetan Plateau Rock Avalanches

Source: *Rock Avalanches in the Tibetan Plateau of China* by Y. Wang et al.

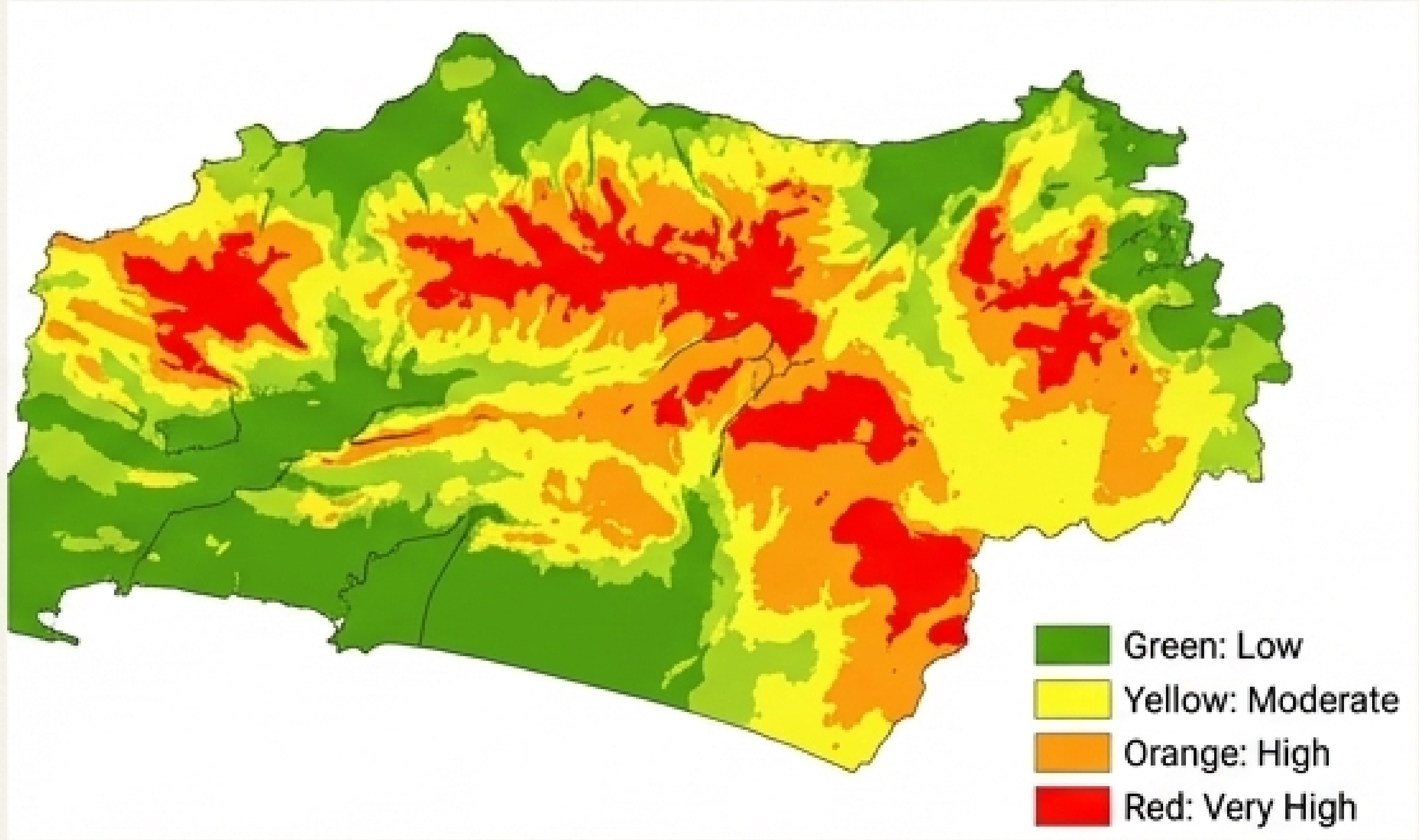
The spatial distribution of rock avalanches shows a strong correlation with major fault systems. Faults are the most significant factor in their generation.



Indonesian Landslide Susceptibility

Source: *Landslide Susceptibility Zonation Using GIS-Based Frequency Ratio Approach in the Kulon Progo Mountains Area, Indonesia* by E. Erzagian et al.

The Frequency Ratio (FR) method, combining 9 controlling factors (slope, lithology, rainfall, etc.), effectively zones the region into low to very high susceptibility areas, achieving an 81.3% predictive accuracy (AUC).

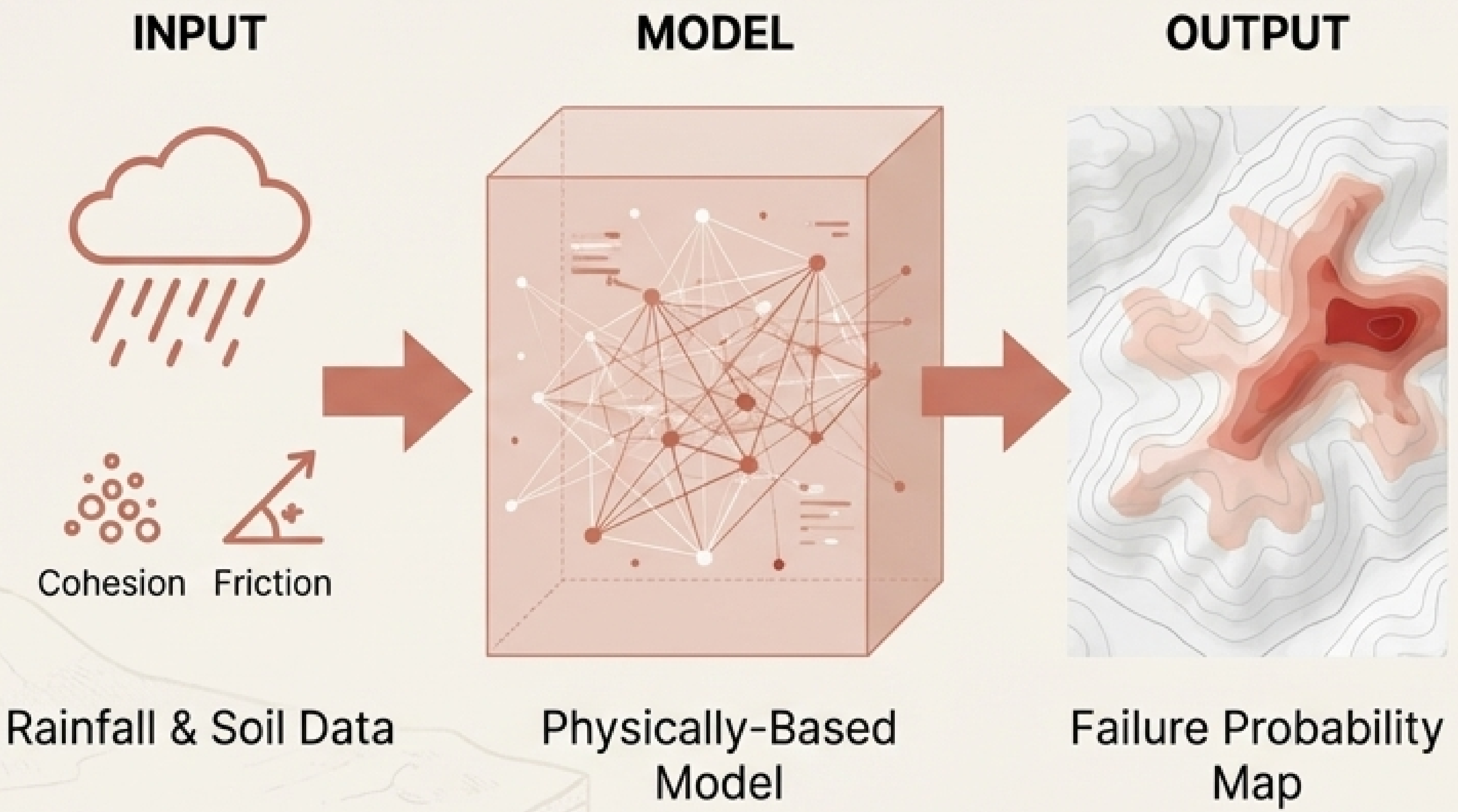


Chapter 3: Can We Predict the Unpredictable?

The frontier of forecasting: Using physically-based models to simulate slope stability in response to rainfall.

Physically-Based Models: Combine hydrological models (water infiltration) and slope stability analysis (geotechnical response) to predict hazard areas.

Probabilistic Approach: Using simulations like Monte Carlo to manage the uncertainty of soil parameters over large areas.



Forecasting in High Resolution: The HIRESSS Model in the Italian Alps

Source: Physically-Based Regional Landslide Forecasting Modelling: Model Set-up and Validation by V. Tofani et al. | **Location:** Aosta Valley, Italy.

How the Model Works

INPUTS
Rainfall Data, Soll Parameters (cohesion, friction, conductivity), Root Cohesion.

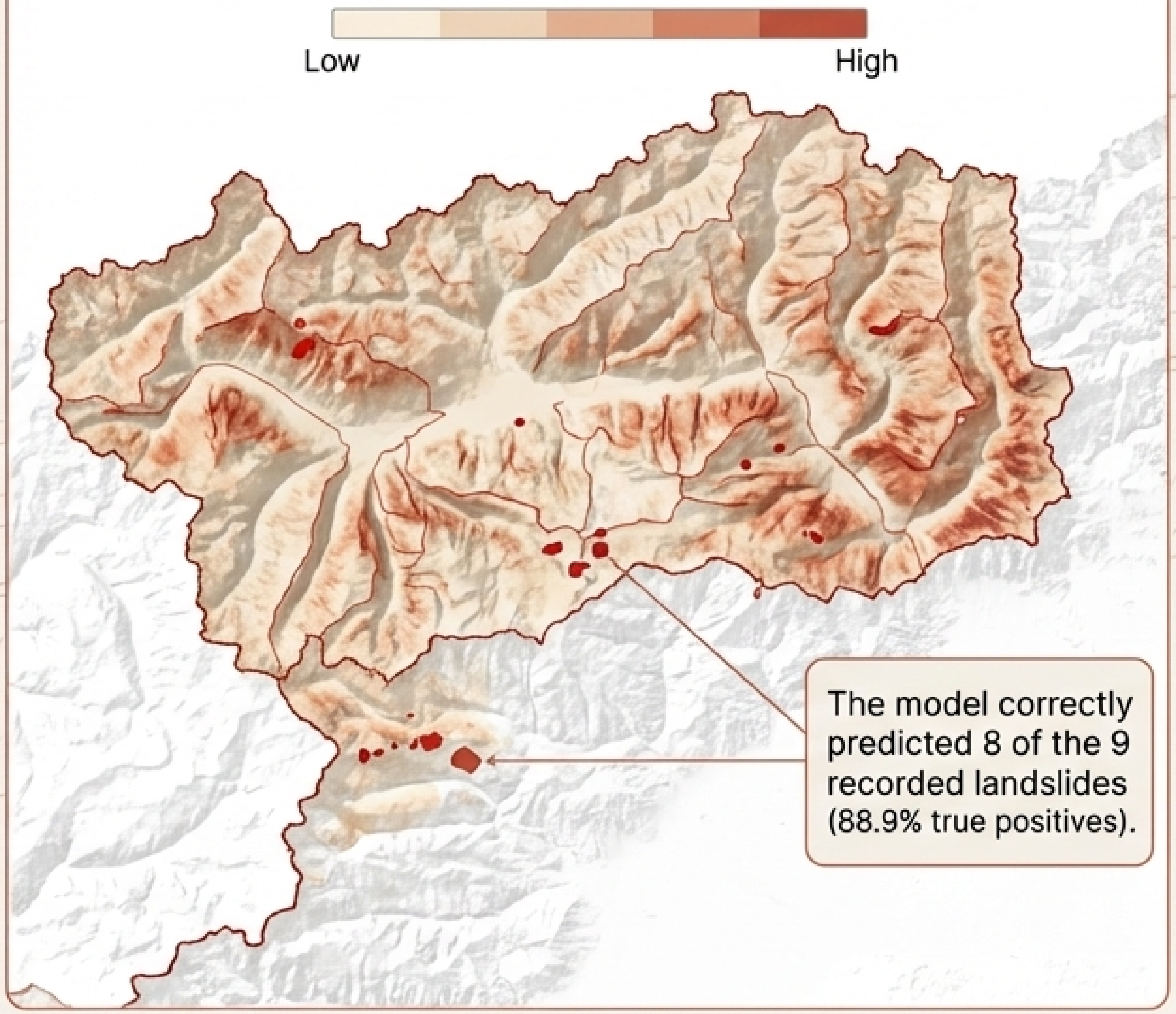
MODULE 1: HYDROLOGICAL MODEL
Based on Richards equation, calculates pressure head.

MODULE 2: GEOTECHNICAL MODEL
Infinite slope model, accounts for unsaturated conditions.

SIMULATION
Monte Carlo analysis (1000+ iterations recommended) to manage parameter uncertainty.

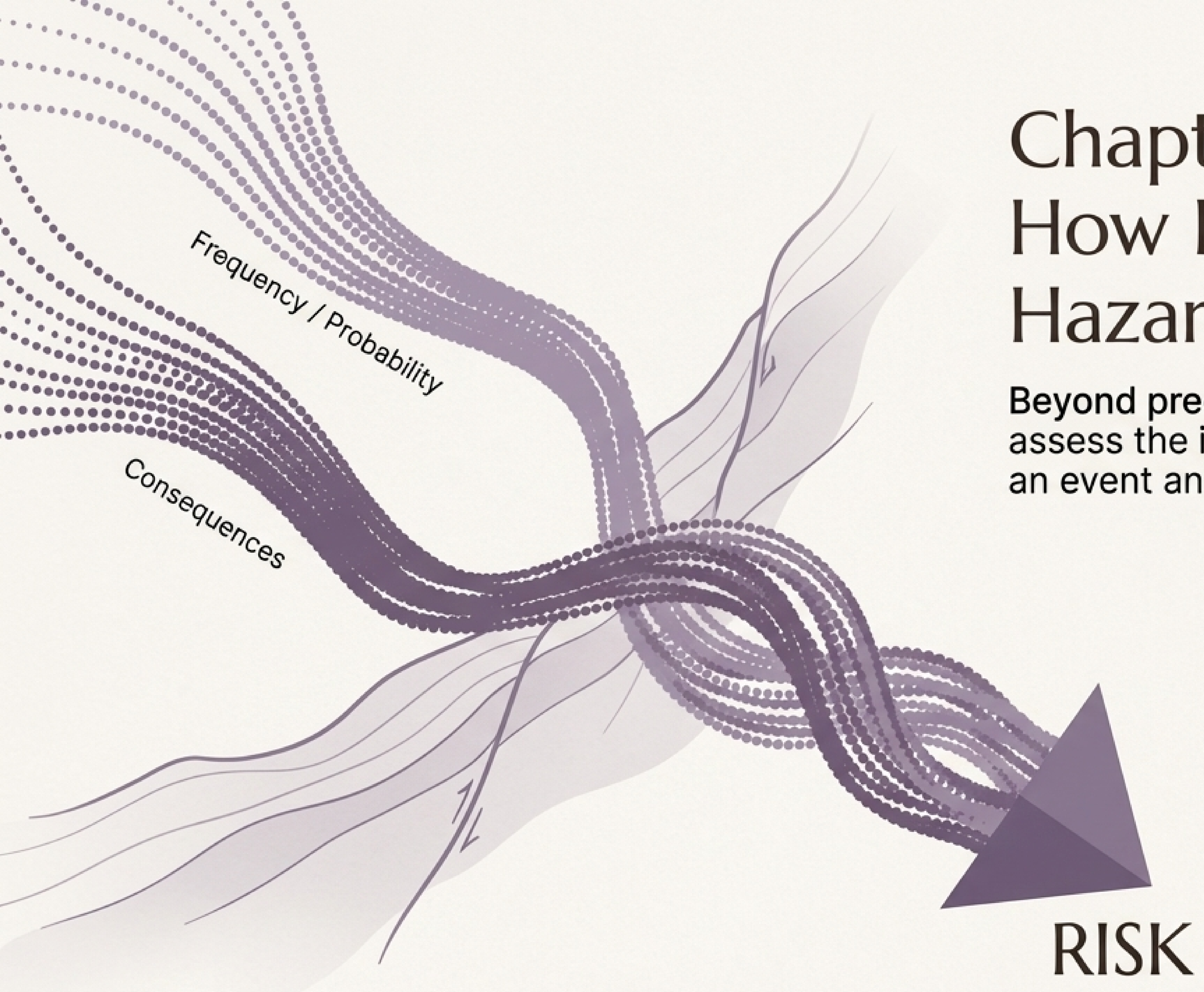
OUTPUT
Spatially distributed slope failure probabilities.

Model Output: April 27, 2009 Event



Chapter 4: How Do We Translate Hazard into Risk?

Beyond prediction: Developing frameworks to assess the interplay between the frequency of an event and the severity of its consequences.



Risk: A measure combining Hazard (probability/frequency) and Consequences (potential worth of loss to life, property, or environment).

Risk Matrix: A tool to classify and rank risks based on expert knowledge, even with limited quantitative data.

A Framework for Decision-Making: The Consequence-Frequency Matrix

Source: *Consequence: Frequency Matrix as a Tool to Assess Landslides Risk* by M. Jaboyedoff.

Frequency (Likelihood) \ Consequences	Incidental	Minor	Moderate	Major	Catastrophic (Multiple fatalities)
Almost Certain (>1 per year)	Very Low Risk	Moderate Risk	High Risk	Very High Risk	Very High Risk
Likely	Very Low Risk	Moderate Risk	Moderate Risk	High Risk	Very High Risk
Possible	Low Risk	Moderate Risk	Moderate Risk	Moderate Risk	High Risk
Unlikely	Very Low Risk	Low Risk	Low Risk	Moderate Risk	High Risk
Very Unlikely (<1 in 10,000 years)	Very Low Risk	Very Low Risk	Very Low Risk	Low Risk	High Risk

A semi-quantitative tool to classify, rank, and compare risks, enabling informed decision-making for risk reduction and management.

Verbal terms *must* be attached to numerical values to be effective.

Chapter 5: How Do We Live with the Hazard?

The Human Element: Exploring how local awareness, risk perception, and community-led science shape exposure and resilience.

Exposure: The situation of people, infrastructure, and housing located in hazard-prone areas.

Awareness: Knowing that a hazard exists and is important; strongly linked to risk perception.

The Myth of Personal Invulnerability: The belief that a disaster will impact others but not oneself, leading to a lack of preparedness.

Forgetting and Engaging: The Duality of Community Resilience

The Peril of Fading Memory in Mexico

Source: *Do not Let Your Guard Down: Landslide Exposure and Local Awareness in Mexico* by R.J. Garnica-Peña & I. Alcántara-Ayala.

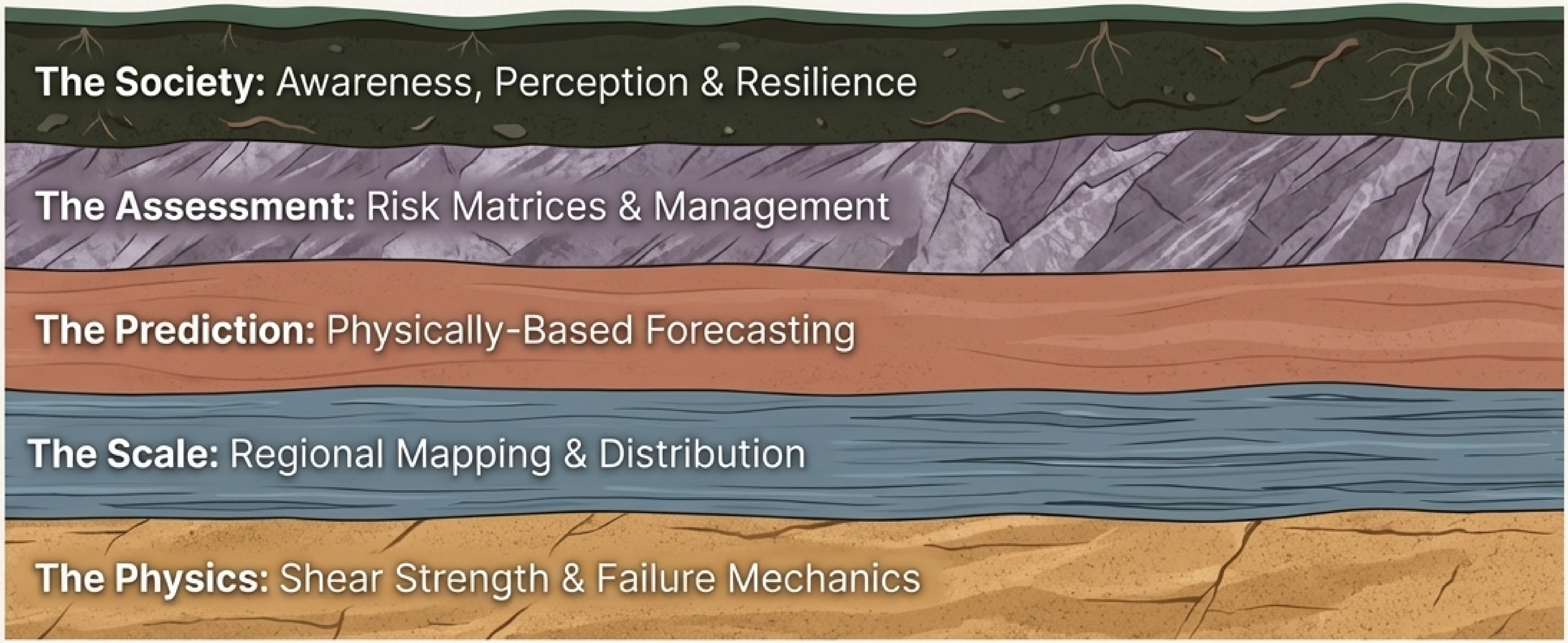
In Teziutlán, Mexico, the last major landslide was in 2013. In the decade since, urban expansion has increased into high-risk zones. "When landslides do not often occur… people's awareness is biased."

The Power of Citizen Science

Source: *Community Scale Landslide Resilience: A Citizen-Science Approach* by M.V. Ramesh et al.

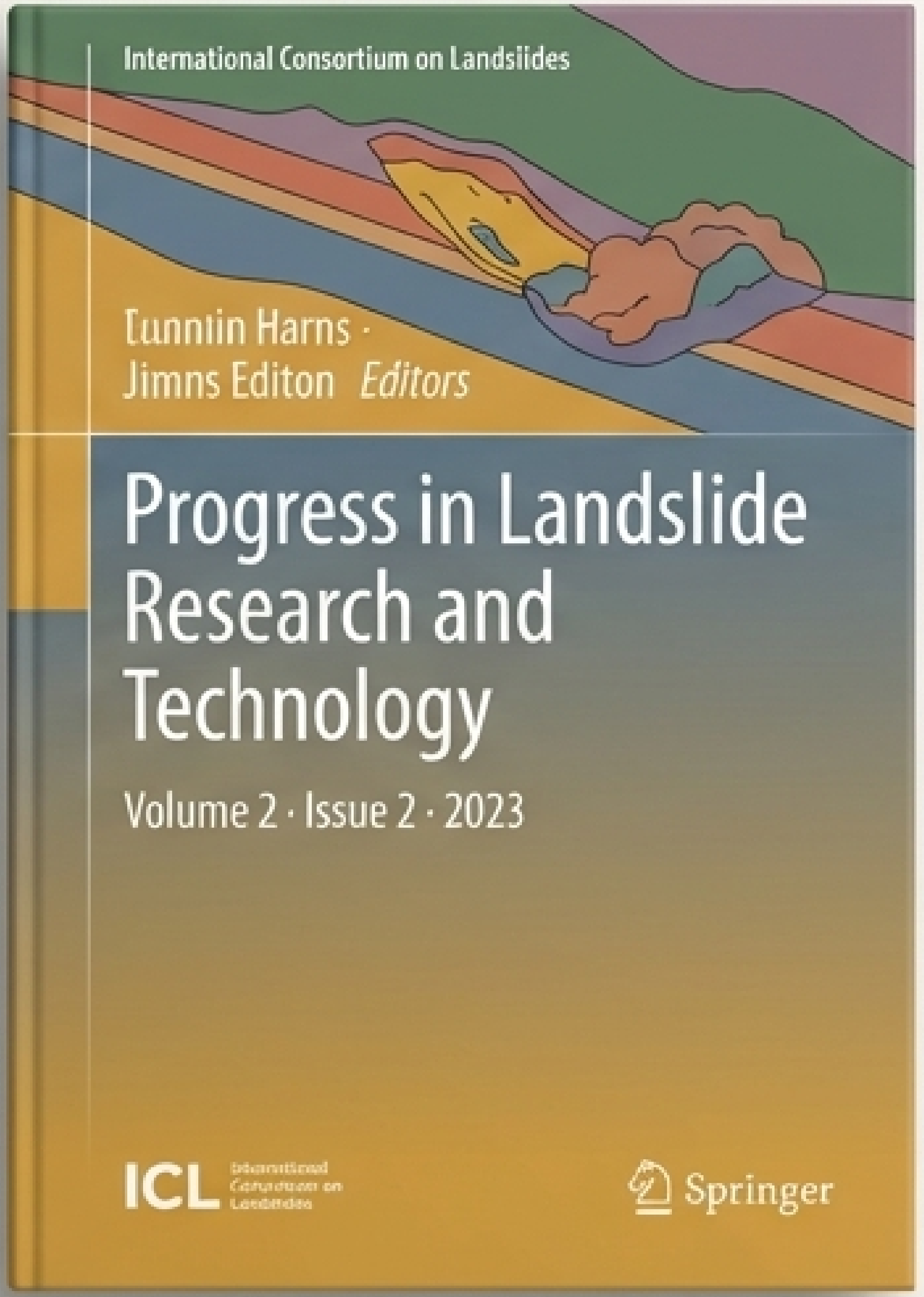
This approach empowers local communities to participate directly in monitoring and resilience-building, enhancing awareness and local capacity.

The Expanding Horizon of Landslide Research



Understanding landslide risk requires an integrated approach—a journey from the fundamental mechanics of a single slope to the complex societal dynamics of communities living with the hazard.

The Mission Continues: Share the Knowledge



Access the full volume and contribute to the global promotion of understanding and reducing landslide disaster risk.

https://doi.org/10.1007/987-3-031-44296-4

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