



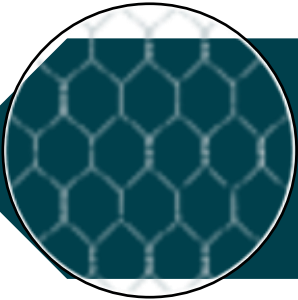
Enhanced Community Resiliency in the Face of Debris Flows

Stephen Robert Doroteo
Sr. Technical Business Development Engineer - Rockfall

MACCAFERRI



OVERVIEW OF Mass Wasting and Debris Flow and its Risks

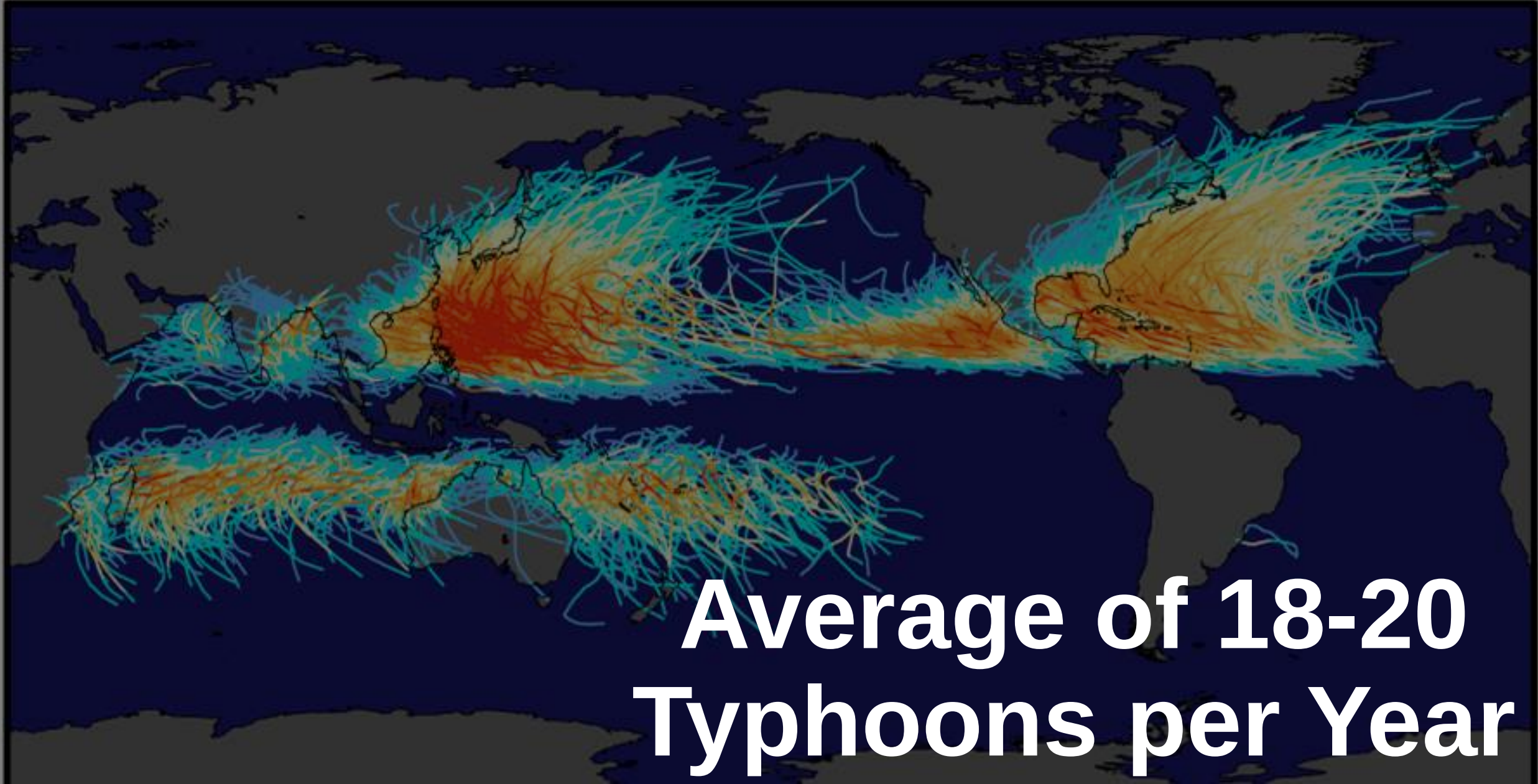


Revisiting the Debris Flow Tragedy in New Bataan, Compostela Valley



Preventive Solution

Tracks and Intensity of All Tropical Storms





Average of
18-20
Typhoons
per Year

INTRODUCTION

WHAT IS MASS WASTING?

“Movement of rock or soil down slopes under the force of gravity”



Material



Movement



Structures

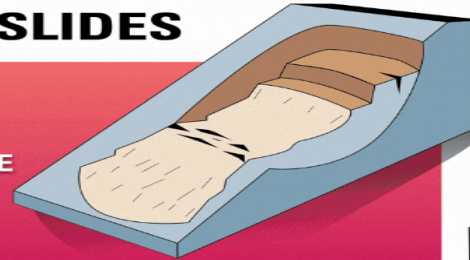
STRICTLY CONFIDENTIAL

TYPES OF LANDSLIDES

1.

ROTATIONAL LANDSLIDE

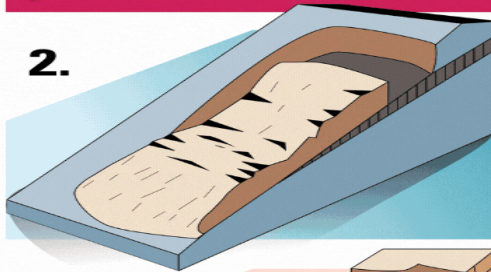
Ground rotates and slides along a curved failure plane.



2.

TRANSLATIONAL LANDSLIDE

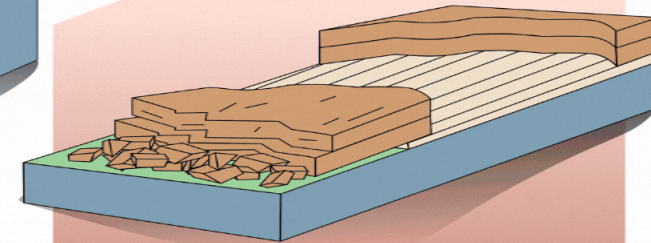
Ground slides with little rotation along a flat plane parallel to the surface.



3.

BLOCK SLIDE

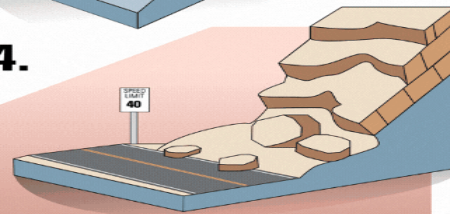
A type of translational landslide made of mostly one block of surface material that moves downslope.



4.

ROCKFALL

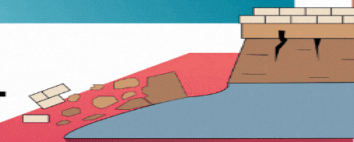
Gravity sends rocks and other materials tumbling downslope.



5.

TOPPLE

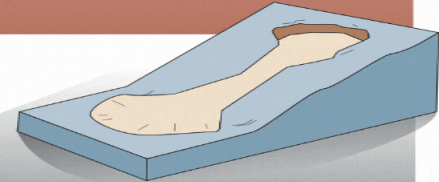
Pieces of a cliff or rock face fall forward as large blocks.



6.

EARTHFLOW

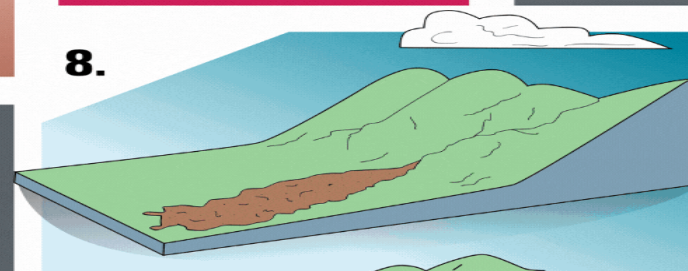
Form on moderate slopes when fine-grained material liquefies and runs out in hourglass shape.



8.

DEBRIS FLOW

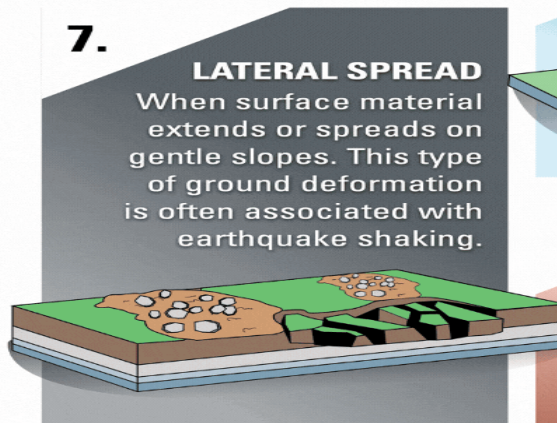
Rapidly moving mix of water, mud, trees, and other materials that flows downvalley and can travel great distances.



7.

LATERAL SPREAD

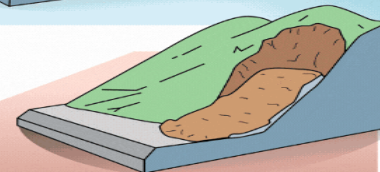
When surface material extends or spreads on gentle slopes. This type of ground deformation is often associated with earthquake shaking.



9.

DEBRIS AVALANCHE

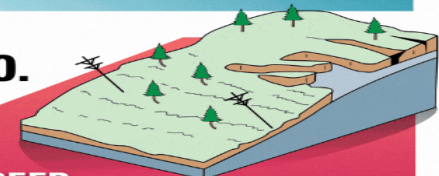
An extremely large and fast moving debris flow.



10.

CREEP

Soil and surface material that slowly moves down a slope.



INTRODUCTION

WHAT IS Debris Flow?

MACCAFERRI

“Moving mass of loose mud, sand, soil, rock, water and air that travels down a slope under the influence of gravity.”



Flow

STRICTLY CONFIDENTIAL

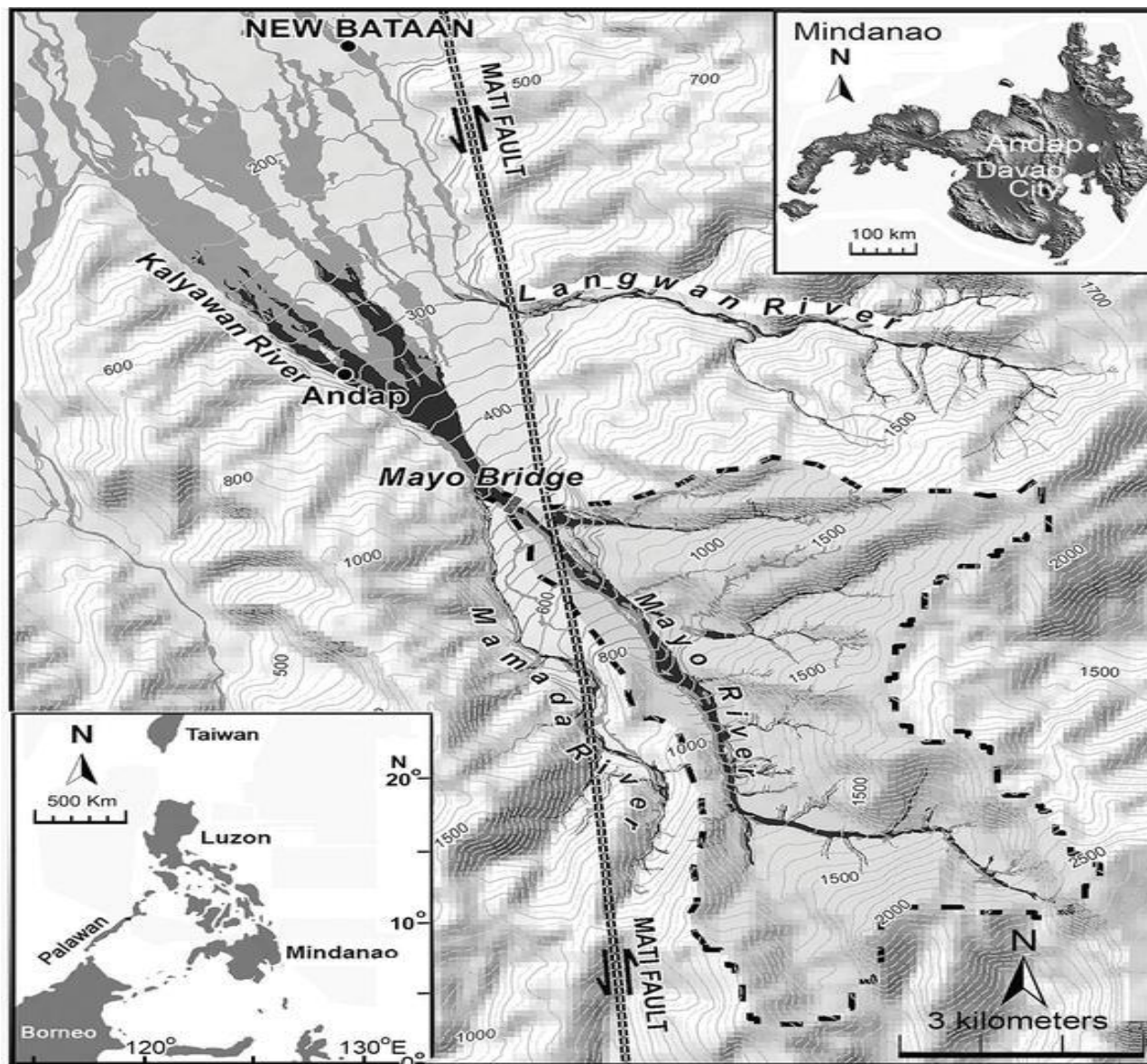


WHAT DEBRIS FLOWS CAN DO TO OUR COMMUNITY?

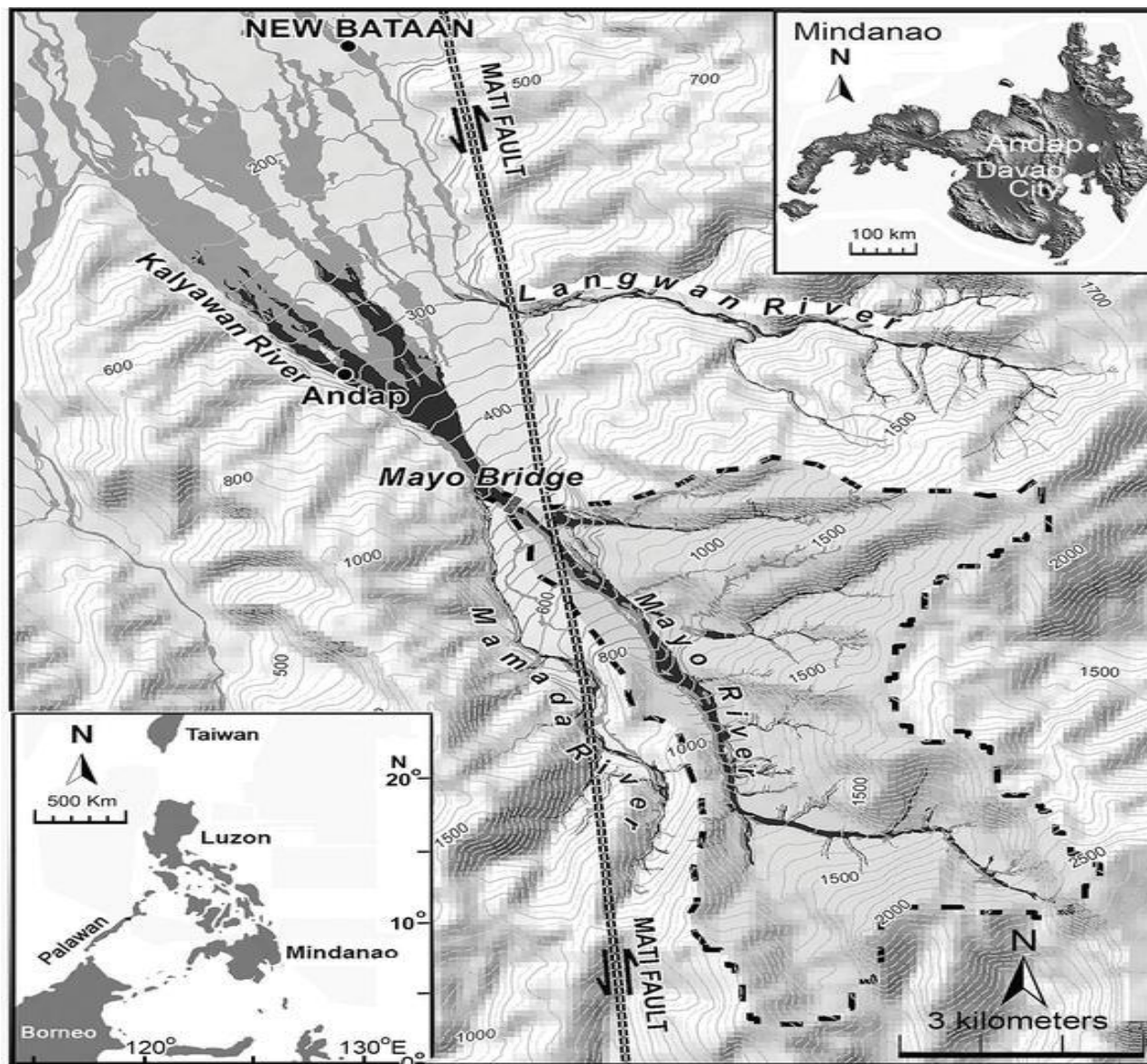


A photograph of a tropical landscape in Compostela Valley, Philippines. The scene shows a small, simple house with a corrugated metal roof on the left. In the foreground, a person is crouching near a river or stream. The water is murky and appears to be flowing over rocks and debris. A car is partially submerged in the water on the right side of the frame. The background is filled with tall palm trees and distant mountains under a cloudy sky. The overall tone is somber and documentary.

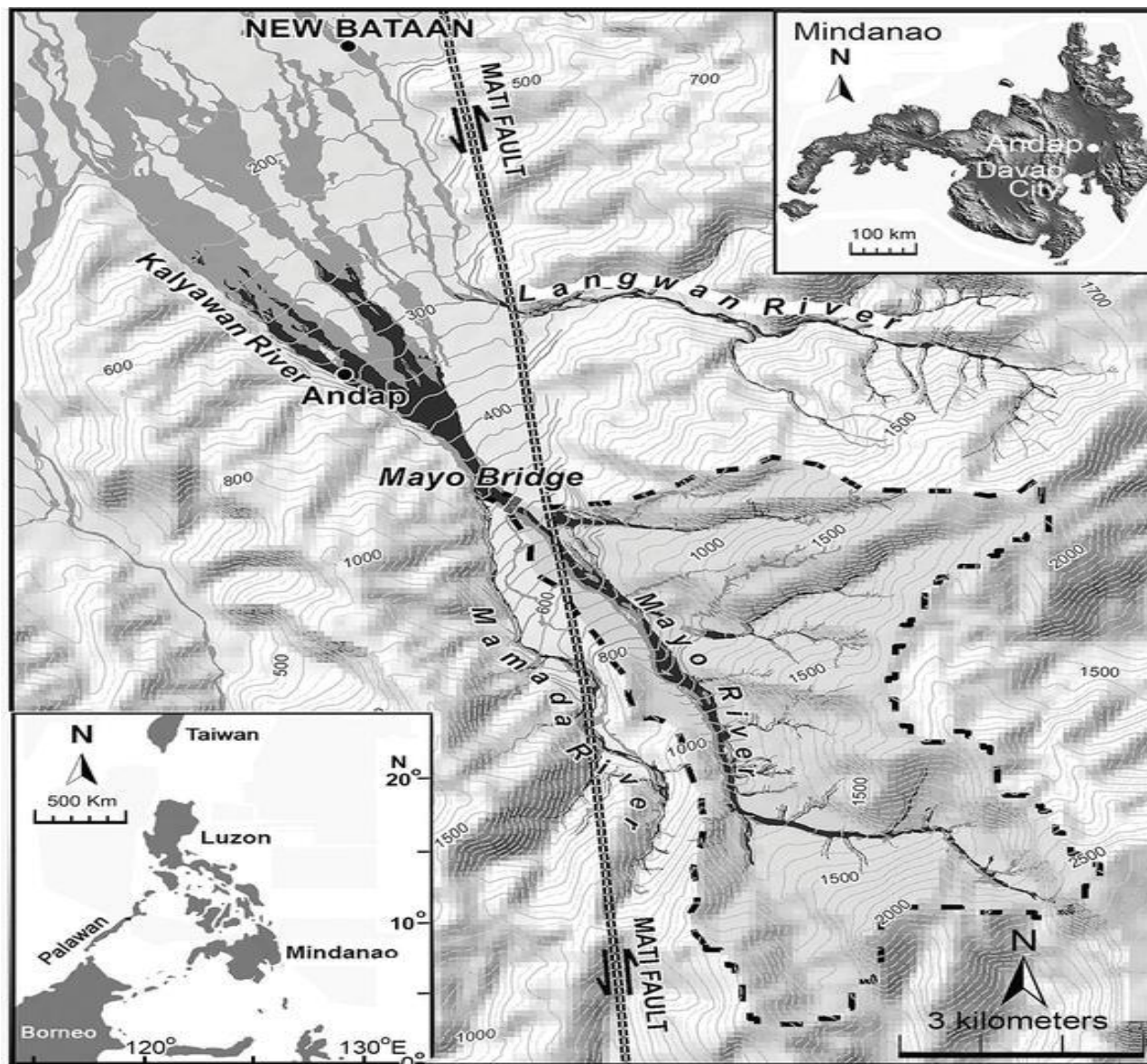
Compostela Valley



New Bataan, Compostela Valley



New Bataan, Compostela Valley

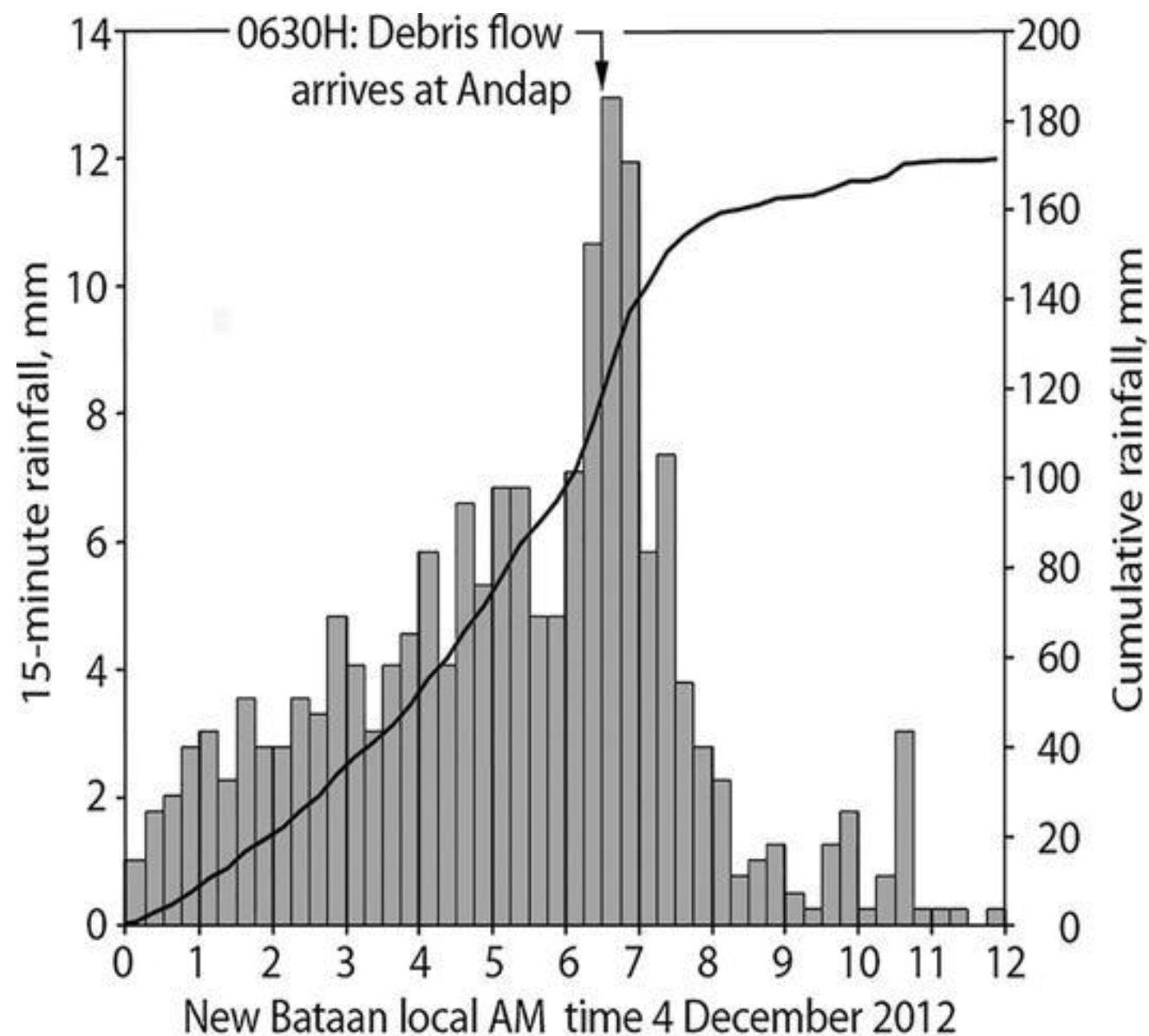


New Bataan, Compostela Valley



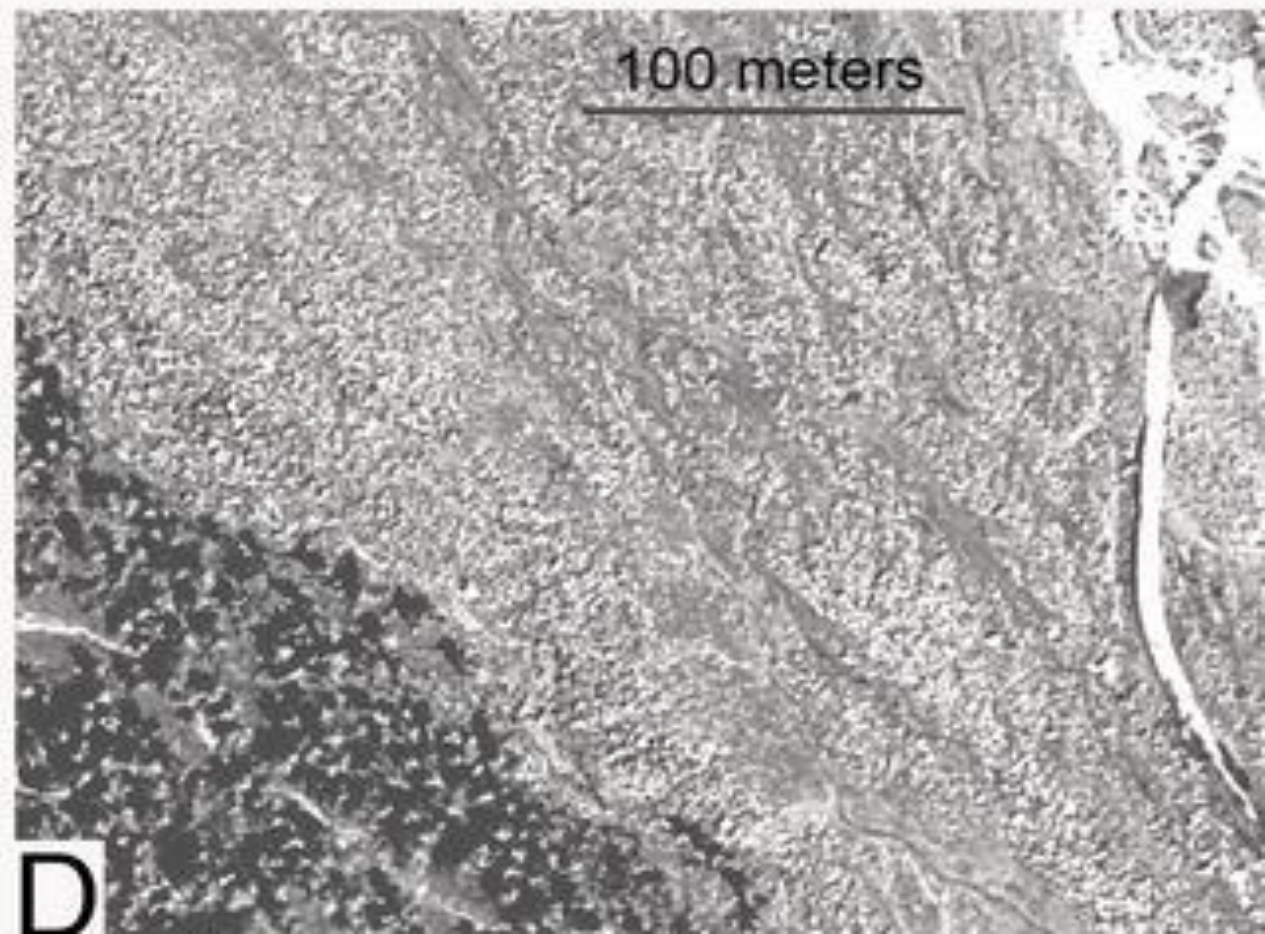
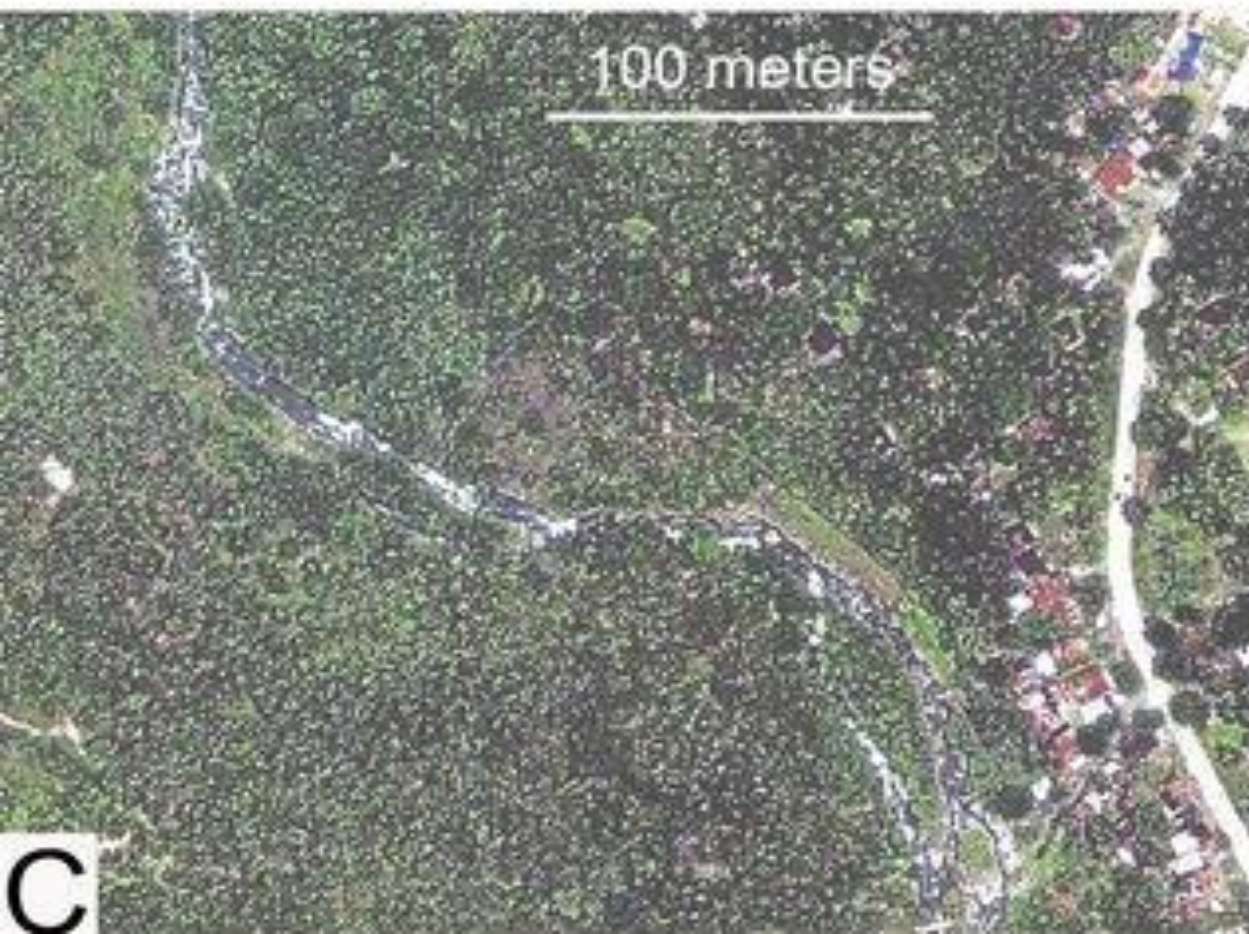
120 mm of rain
from 12:00 upto
06:30

at rainfall rate of
43mm/hr



ANC

HEADSTAFF
WITH KAREN DAVILA

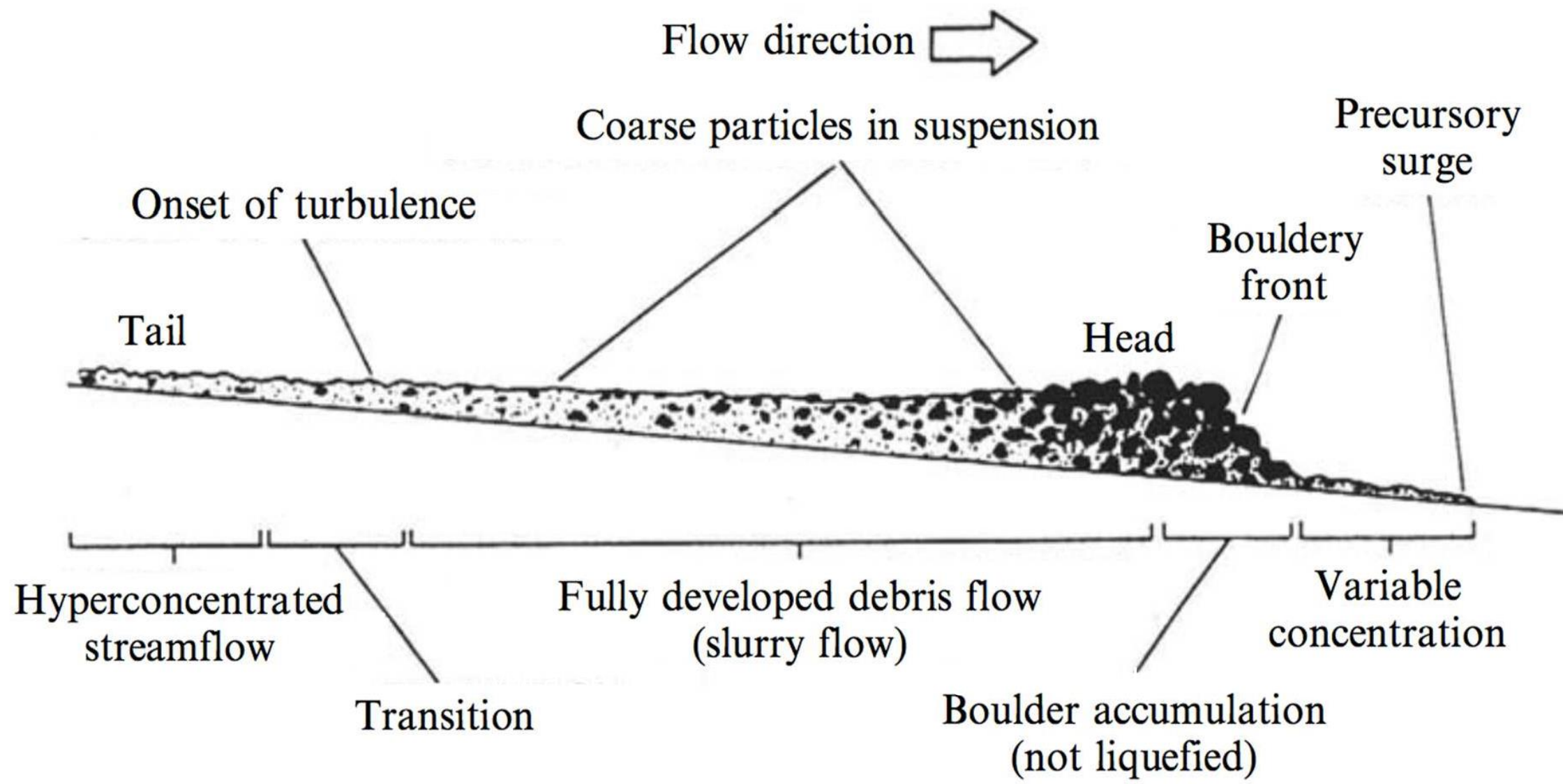


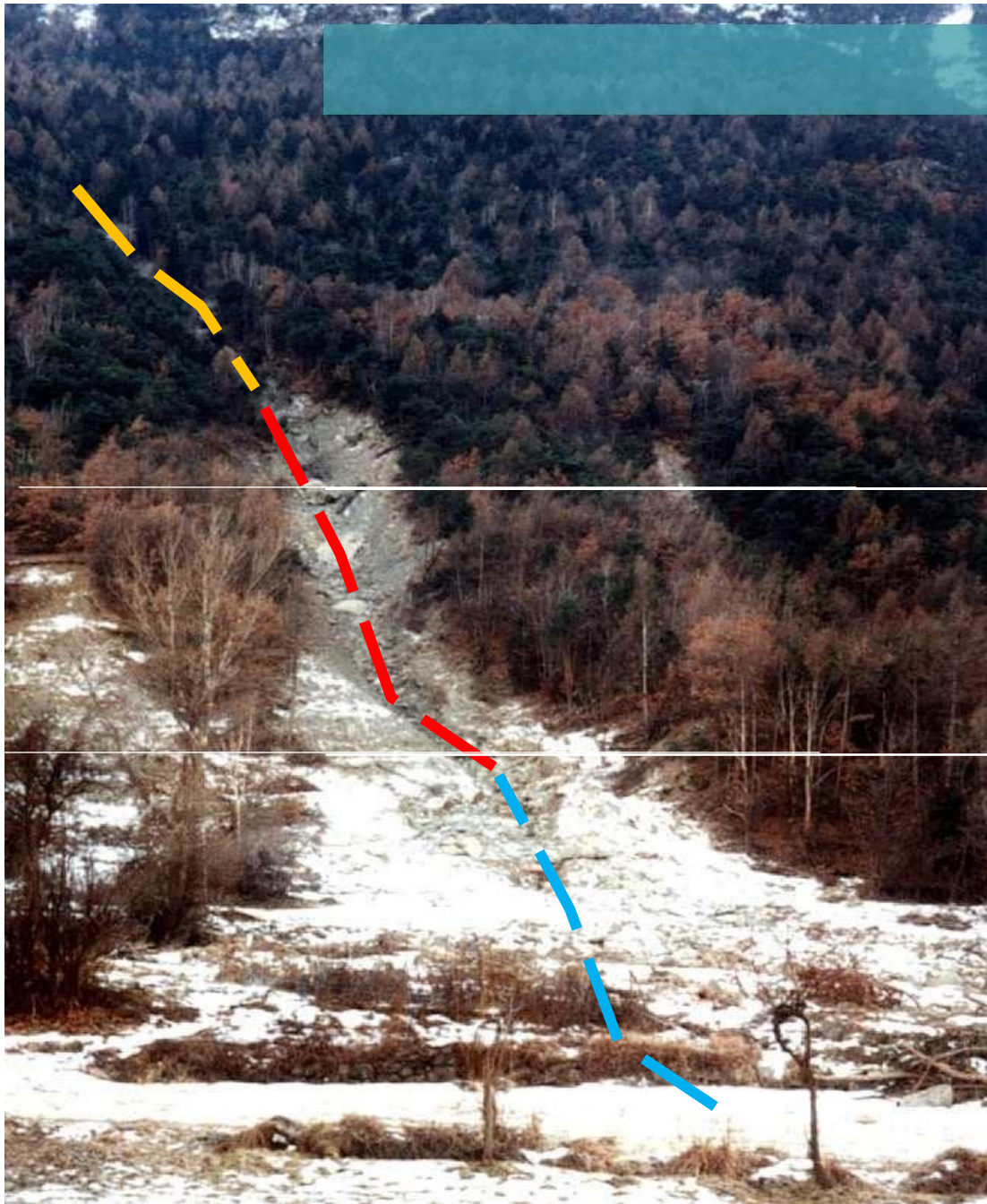


Maccaferri Debris Flow Barriers



DEBRIS FLOW





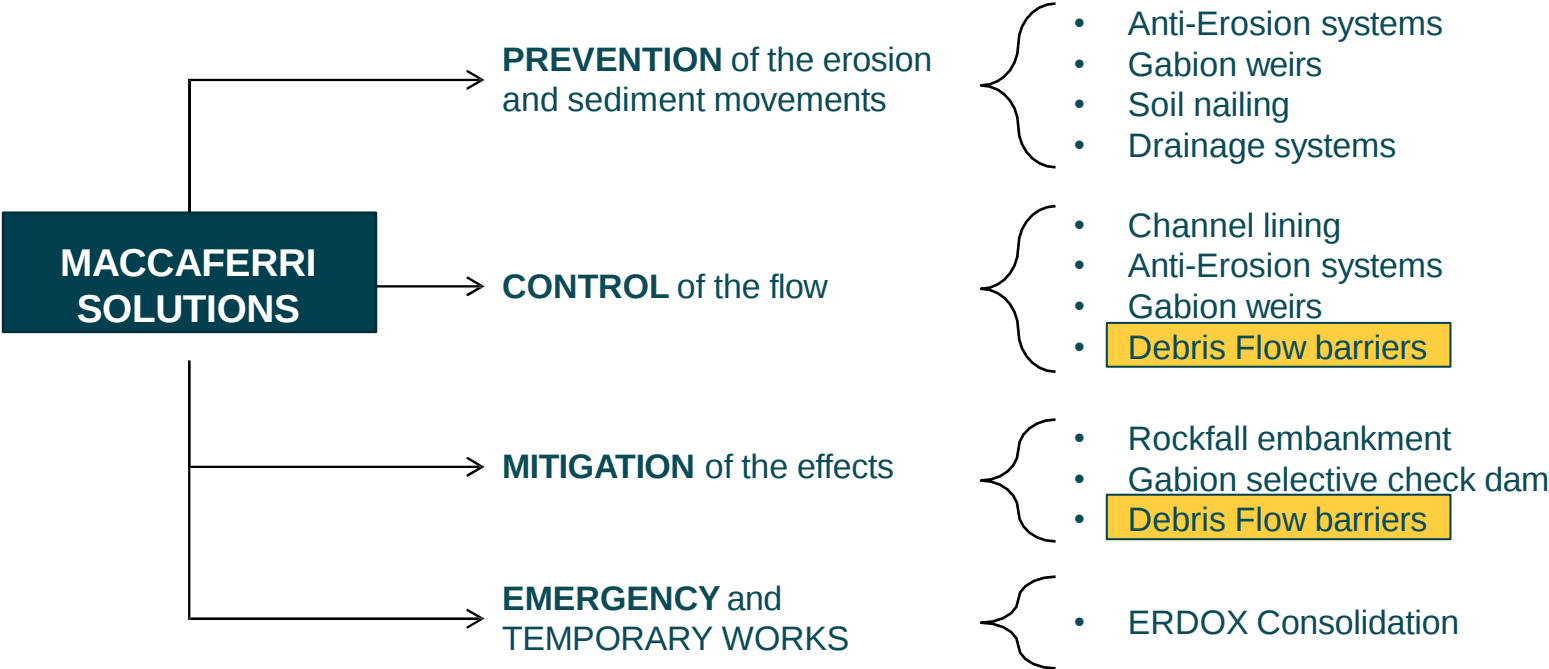
MANAGING THE RESIDUAL RISKS

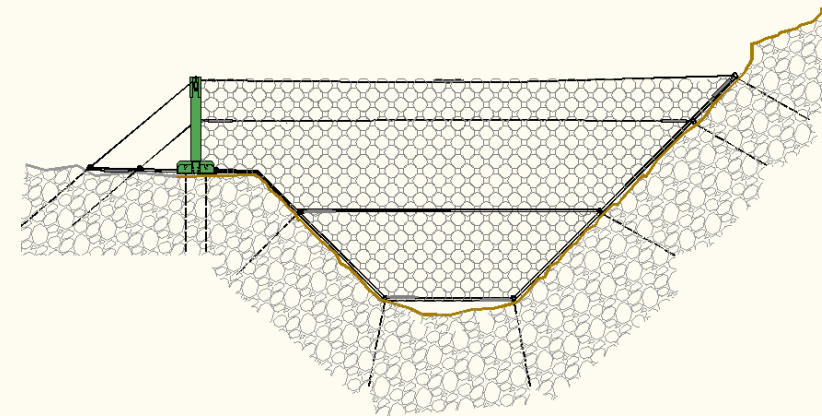
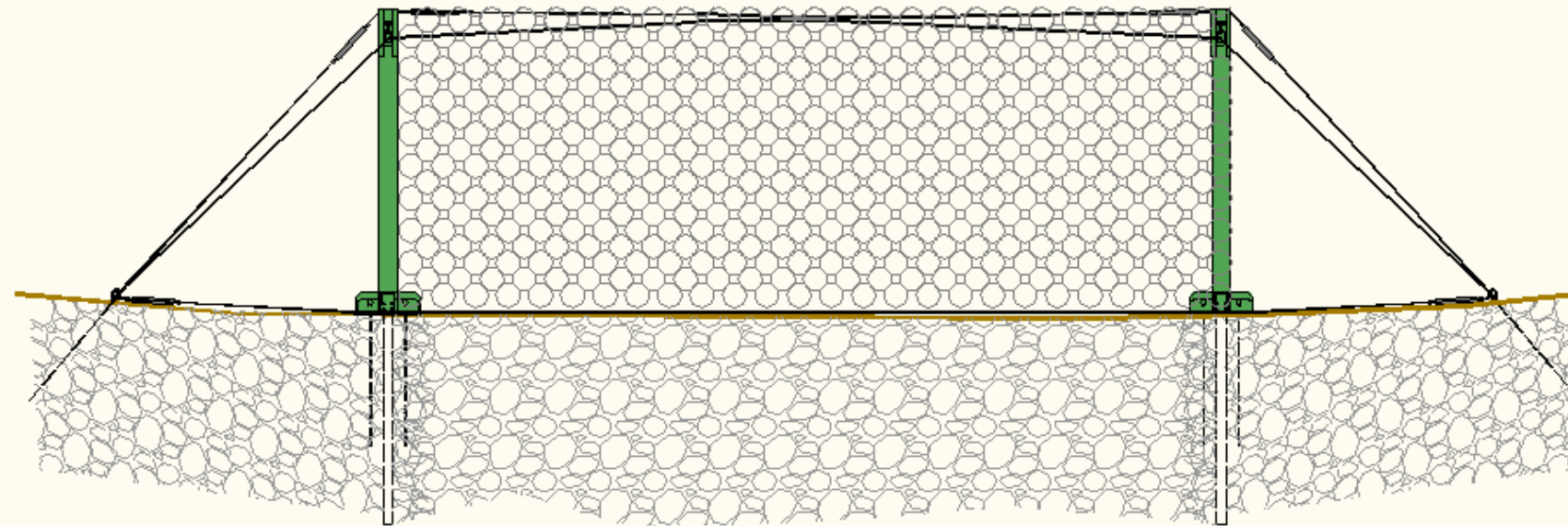
Triggering	Erosion	Prevention of the erosion, reduction of the water velocity, stabilization of the erosion and landslide.	• Known Input Data • High Installation Costs • Low Maintenance Costs
Transit	Erosion and deposit	Control of the flow, reduction of the water speed, control of the erosion capacity, control of transportation of debris.	• Uncertain Input Data • High Installation Costs • Low Maintenance Costs
Run off	Deposit	Mitigation of the effects, by mean of deviation of the flows, basins for the accumulation of the debris flow, planning of the inhabited areas.	• Known Input Data • Low Installation Costs • Low Maintenance Costs

DEBRIS FLOW PROTECTION

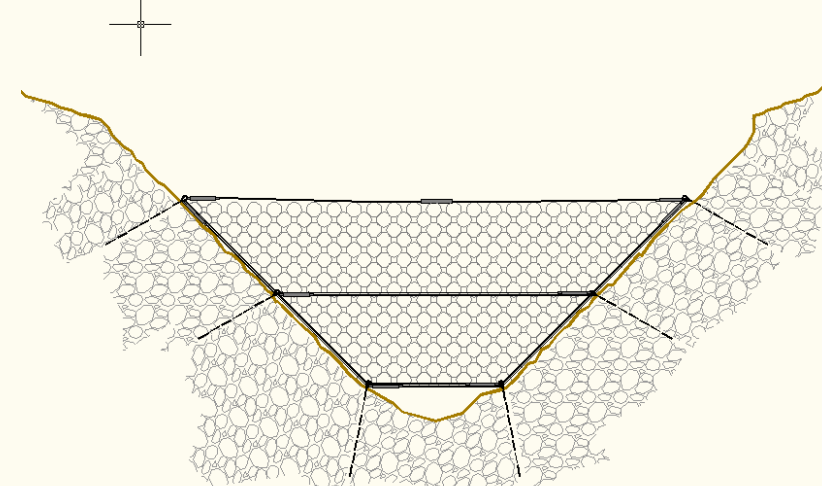
Solutions for mitigating the risk

FROM PREVENTION TO MITIGATION

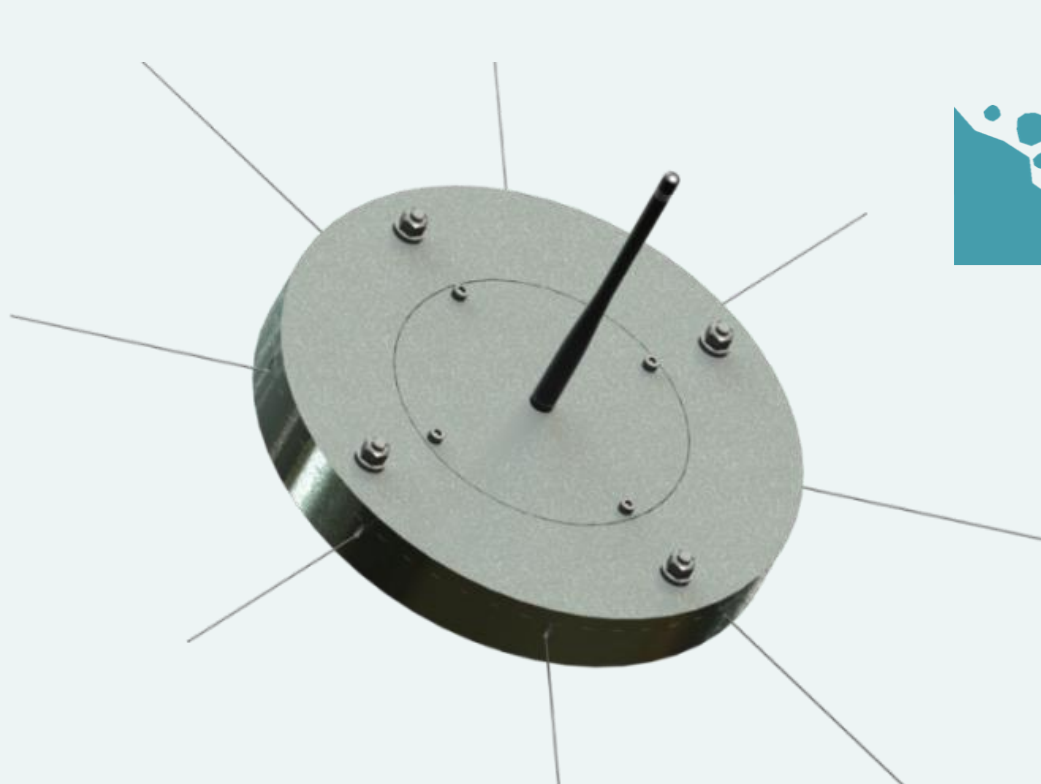




BARRIERA TIPO 1



Configuration of the barrier



HELLOMAC

EARLY WARNING SYSTEM FOR ROAD
SLIPS, ROCKFALL AND LANDSLIDES

visit maccaferri.com/hellomac

HELLOMAC is a disk-shaped alert system for safeguarding lives, infrastructures and buildings protected by any kind of barriers.

It is installed on the rockfall protection and easily activated.

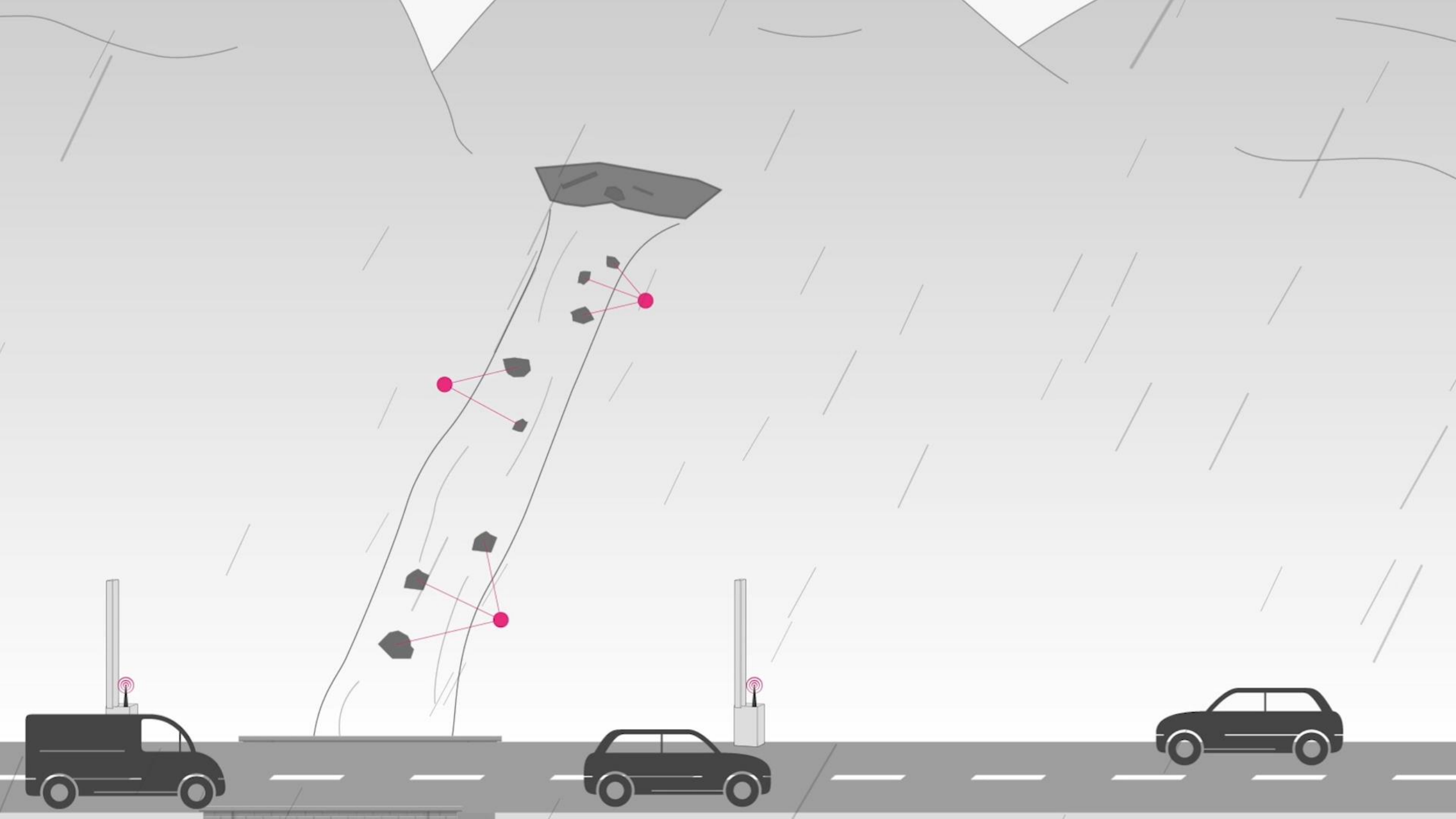


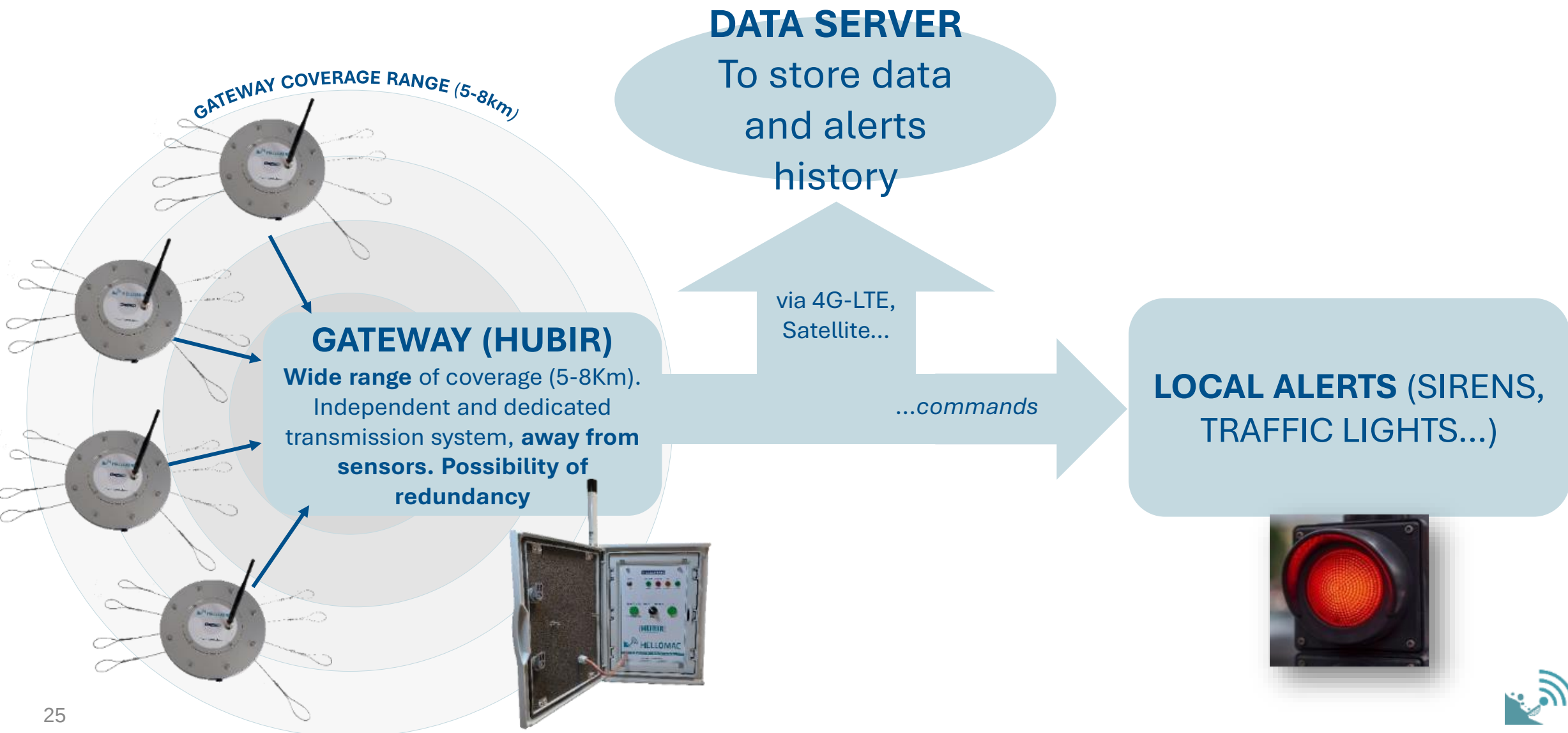
TESTED

HELLOMAC was tested at **Politecnico di Milano** and specifically calibrated on Maccaferri Solutions.

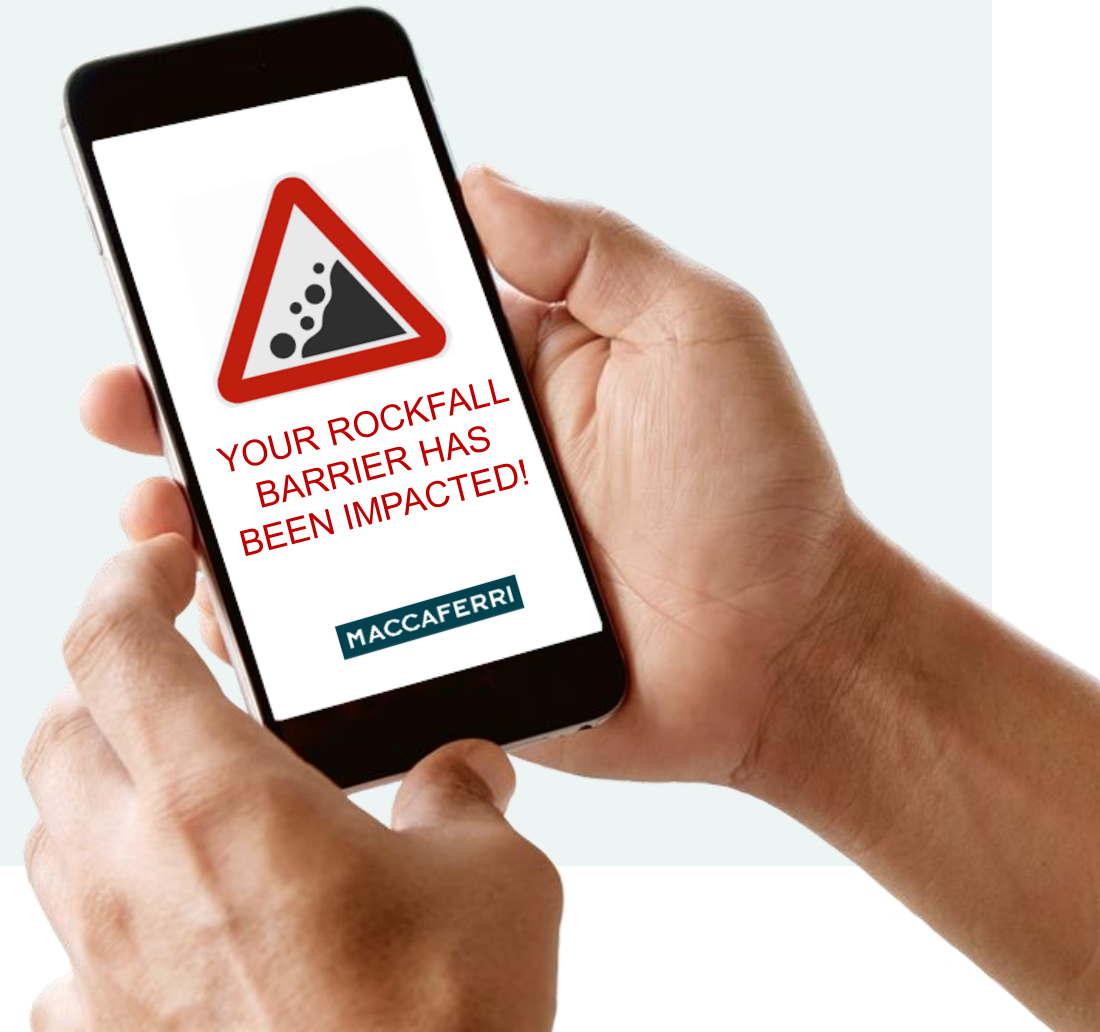
visit maccaferri.com/hellomac







In the geotechnical engineering field, the integration of **IoT technologies** in automated monitoring systems plays a key role in overcoming the manual approach.



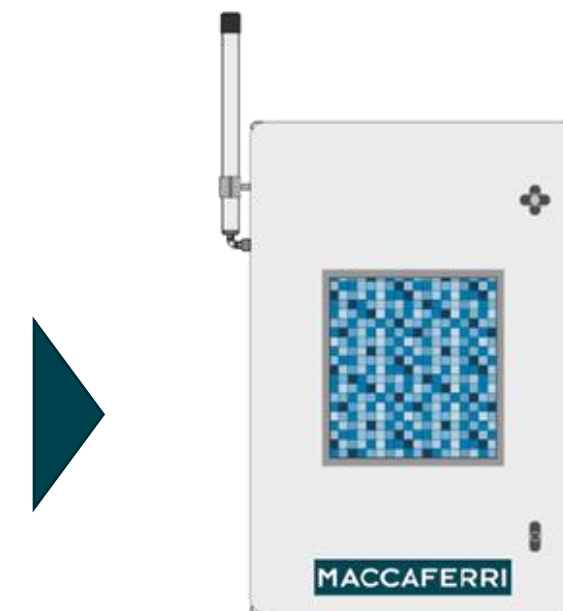
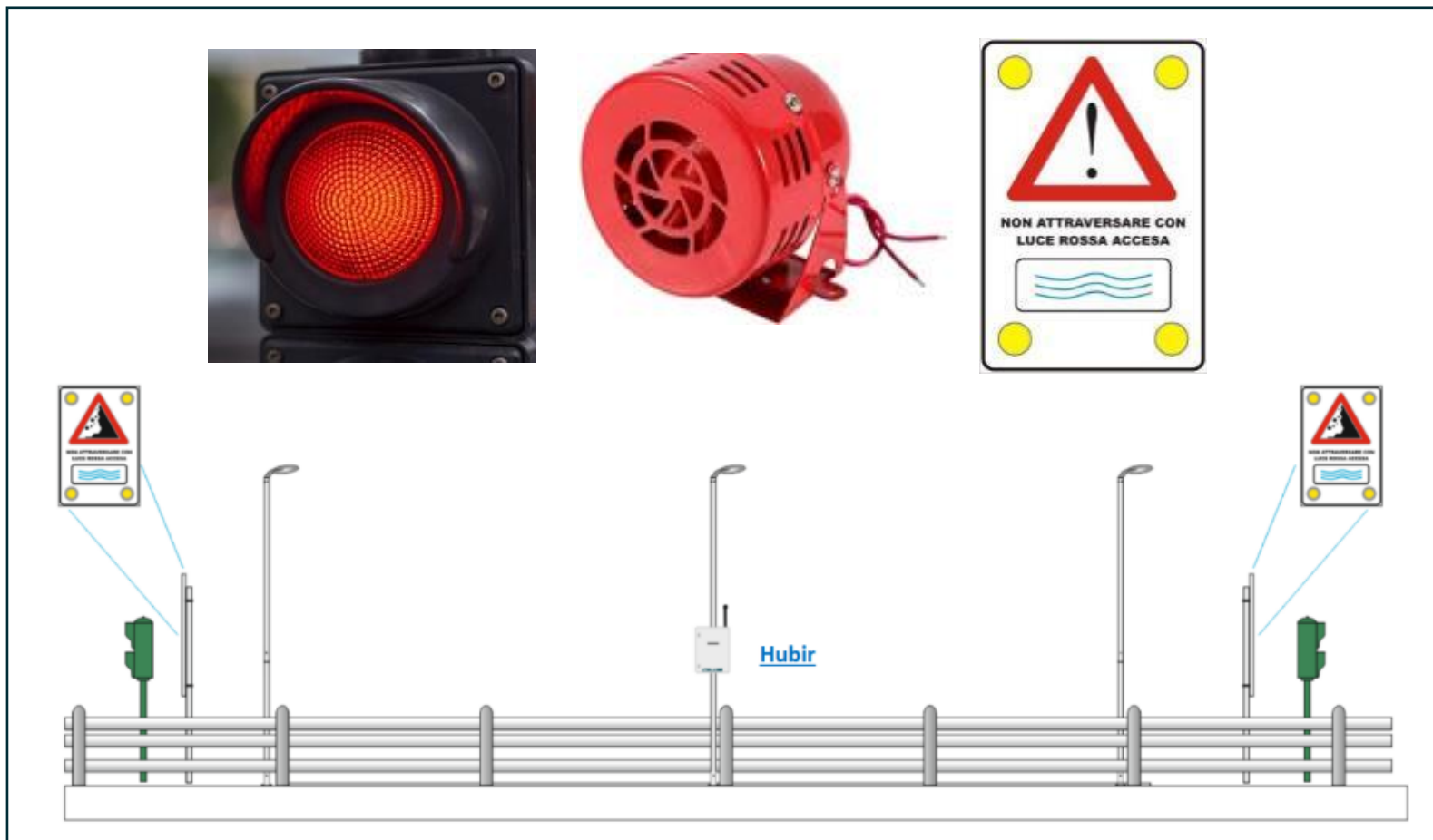


SUITABLE FOR INTEGRATION WITH EXISTING SYSTEMS

- M** HELLOMAC can be deployed on new rockfall protection system but can also be **retrofitted** on existing ones (also barriers from other suppliers)
- M** HELLOMAC system can be **integrated** with other existing monitoring/alert systems



Local signals and alarms



EVO-HUBIR
*Equipped with 2 relays to
control direct alarms*



..other sensors are compatible



Strain gauge, inclinometer,
etc.

Equipped with radio transmitter "SFL"



Compact meteorological
station

Rain, temperature, humidity

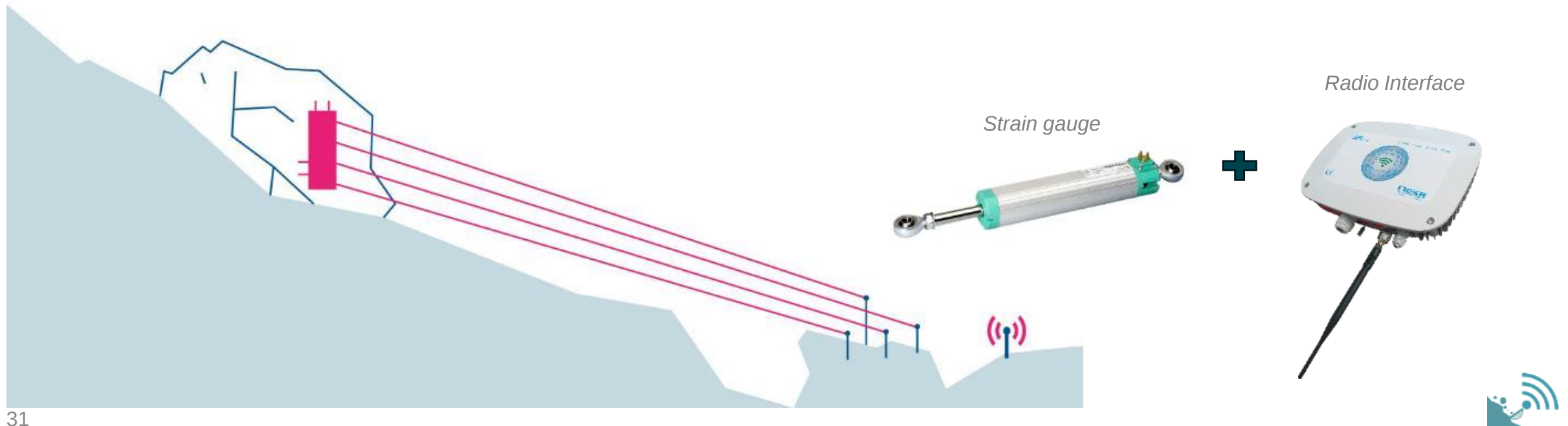


HUBIR
Standard



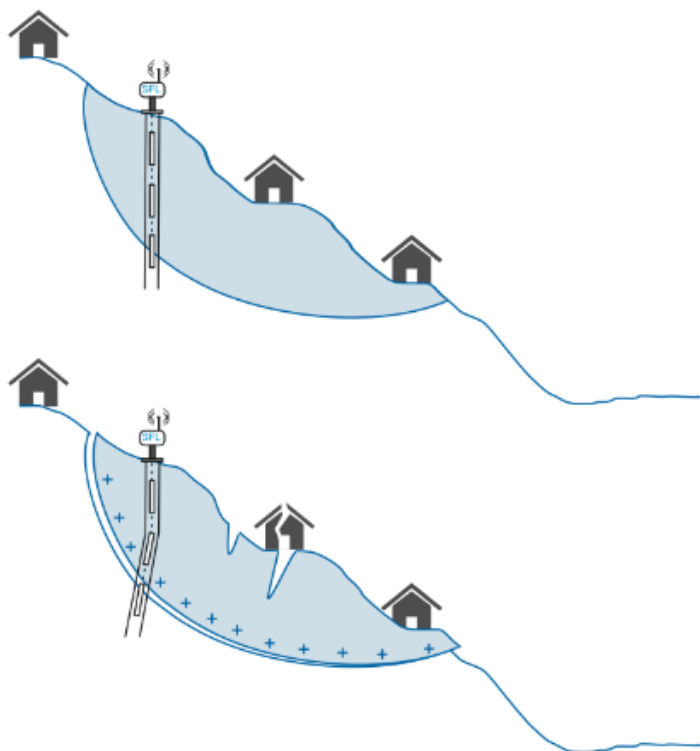
STRAIN GAUGES

- M monitoring of hazard areas.** Landslides or fronts with slow motion, that can be dangerous for the underlying areas.



INCLINOMETERS & UNDERGROUND WATER LEVEL

Important land volume or deep landslides with even sudden movement



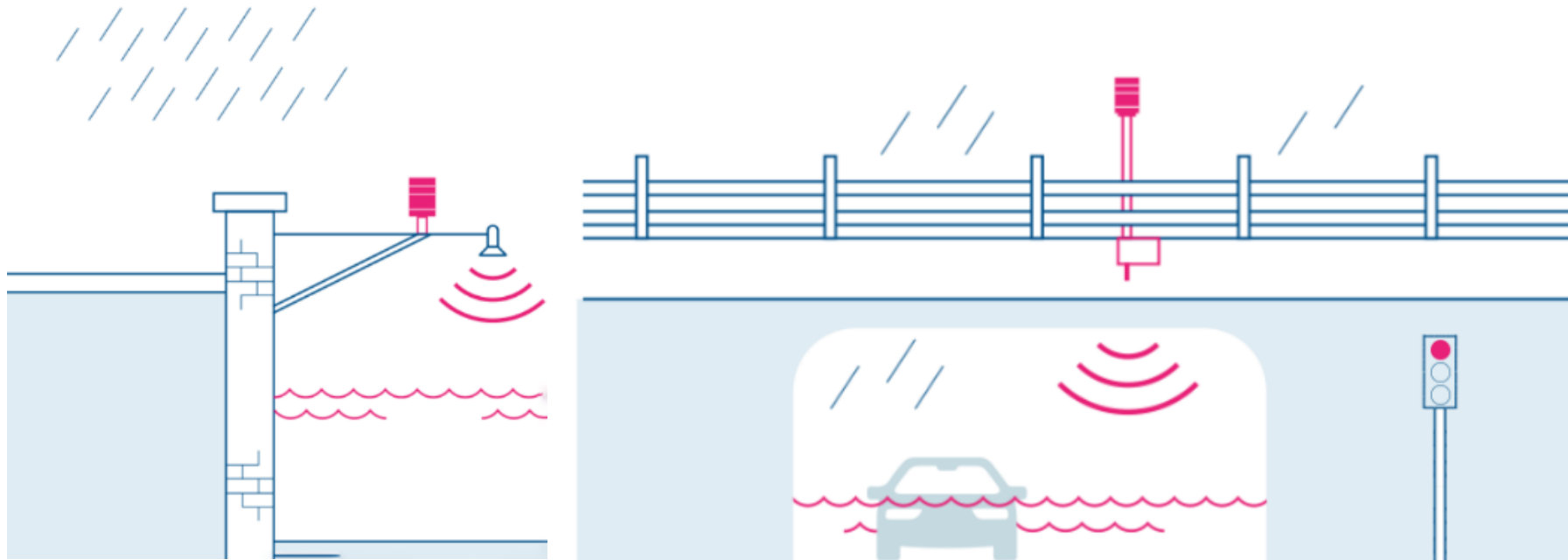
Radio Interface



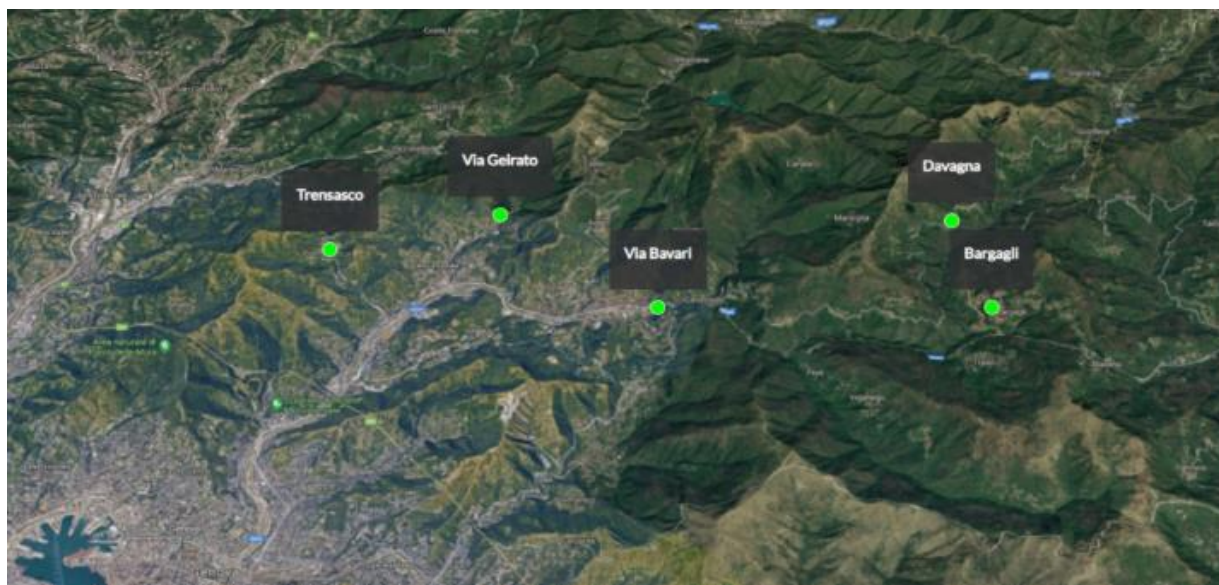
Rain Gauge and surface water level

set of instruments able to alert when **intense rains** and **floods** occur

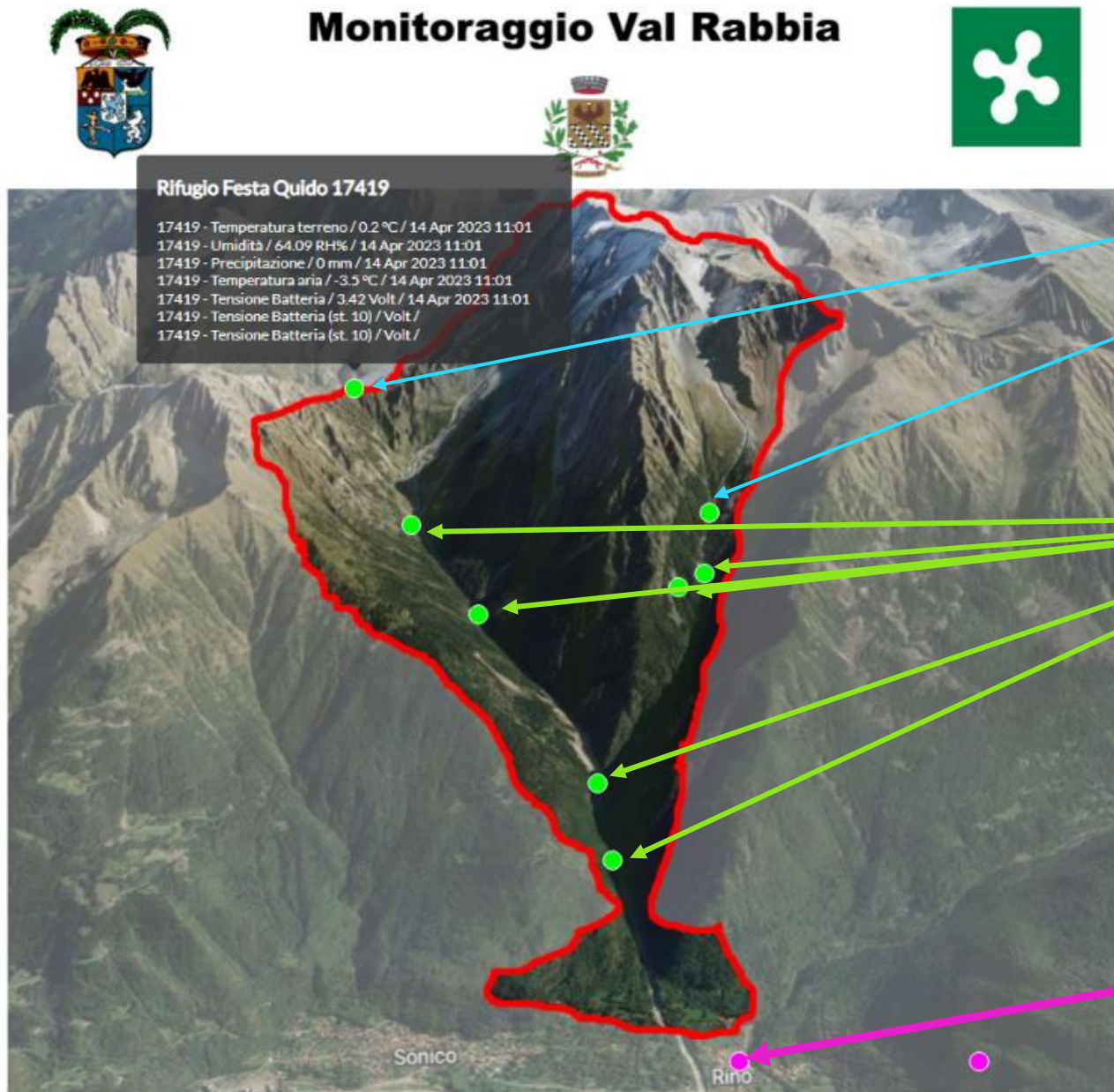
- M** warning can be sent via remote messaging, app or on-site warning (local alarms and command through Hubir).
- M** can be easily and quickly installed.
- M** works combined with the water level measurement in rivers or streams or just as a single instrument for measuring rainfall.



Rain Gauge and surface water level



RELEVANT PROJECTS: VAL RABBIA (ITALY)





Early Prevention and detection save lives.

THANK YOU!

Stephen Doroteo

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