finapp

fin4slide

Fin4Slide is Finapp's pre-alert service for the risk of surface landslides and mudflows, providing four possible levels of alert: ordinary, low, medium, and high, for the current day and the next two days





Via del Commercio, 27 - 35036,
Montegrotto Terme (PD), Italy
P: +39 0490991301
info@finapptech.com



What we do?

Finapp has invented a new way to measure water.
We are the first company in the world to **use cosmic rays to calculate:**

Soil Moisture

a. **On a large scale**: approximately 5 ha (125m radius)
b. **In depth**: up to about 50 cm
c. **In real-time** and continuously

Using a single CRNS -Cosmic Ray Neutron Sensing- Probe

a. **Non-invasive** – measurements are taken without direct contact with the soil
b. Easy to install – lightweight and compact, weighing only 5 kg and 35 cm in size
c. User-friendly – energy self-sufficient, requiring no electrical connection
d. Low maintenance – not buried, requiring no maintenance as it has no consumable or moving parts

Finapp is the first company in the world to offer an early warning service for the risk of:



Surface landslides / mudflows



Floods



Wildfires

With unique features:

1. Provides **site-specific analysis**
2. Takes into account **both meteorological thresholds and soil moisture levels**
3. Delivers **warning up to 72 hours in advance**





Fin4Slide

Definition

Fin4Slide is Finapp's early warning service for the risk of surface landslides and mudflows, offering four possible alert levels: ordinary, low, medium, and high, for the current day and the following two days.

Mudflows and surface landslides are rainfall-induced phenomena, meaning they are triggered by precipitation.

However, understanding soil moisture is a crucial factor for accurately assessing these risks. There is extensive scientific literature on this topic, but measuring soil moisture with precision, in real time, and at a representative scale is extremely challenging.

For this reason, soil moisture is often excluded from traditional alert bulletins, which typically focus solely on rainfall data.



How it works?

Our early warning service integrates multidisciplinary knowledge to better represent the complexity of these phenomena. Below are the key steps.

- **Analysis of past events**
- **Definition of thresholds**
- **Soil moisture measurement**
- **Site-specific model**
- **Weather forecasts and future risk calculation**

1. Analysis of Past Events

Information is gathered regarding the number of landslide, their dating, and intensity in the area of interest, along with precipitation and soil moisture data derived from satellite remote sensing, reanalysis models, or measurements from weather stations.

Using a **logistic regression model**, various combinations of precipitation and soil moisture are tested to determine which best predict past landslide events.
For each precipitation and soil moisture scenario, we calculate the corresponding landslide probability, identifying potential false alarms or missed detections in the event of an actual landslide.



Figure 1. Scatter plot with related model classification.

2. Definition of Thresholds

Based on the statistical relationships identified in the previous step, we determine the rainfall and soil-moisture threshold values that most effectively discriminate between conditions that have historically led to landslides and those that have not.

These thresholds are extracted from the logistic regression outputs, selecting the precipitation–soil-moisture combinations associated with a marked increase in landslide probability.

They form the quantitative basis for activating early-warning alerts in the area of interest.

3. Soil Moisture Measurement

A Finapp probe is installed to measure soil moisture on a large scale, at depth in the ground, and in real time.

4. Site-Specific Model

Thanks to advanced artificial intelligence algorithms, the soil moisture measured by the Finapp probe is compared with meteorological parameters such as precipitation, temperature, wind, and solar radiation recorded over the same period.

This comparison aims to **find an empirical law that describes the soil moisture behavior specific to the installation site.**

5.Weather Forecasts and Future Risk Calculation

Finapp has access to site-specific weather forecasts, not generic ones, which consider **multiple meteorological models (multi-model approach)** to reduce the inherent uncertainty in each forecast.

The predicted weather data feeds into the soil moisture model, as obtained in the previous step, to predict its behavior over the next two to three days.

If the forecasted soil moisture values, combined with precipitation, exceed the previously defined threshold levels, the corresponding alert level will be triggered.

The risk thresholds will be updated over time if new events of landslides occur in the area of interest.

Thus, the first **early warning service** is created:



a. **Site-specific**, as it takes into account the uniqueness of the location in terms of both alert threshold definitions and future forecasts.



b. Where **soil moisture thresholds** are combined with rainfall thresholds, providing a more detailed view of the event.



c. With **early warnings up to 72 hours** in advance.

Data Access

The early warning index is calculated in real-time and fully automatically.

By accessing our Fin4Slide portal, the customer can view a map showing markers that indicate each place in which risk forecasts are provided.

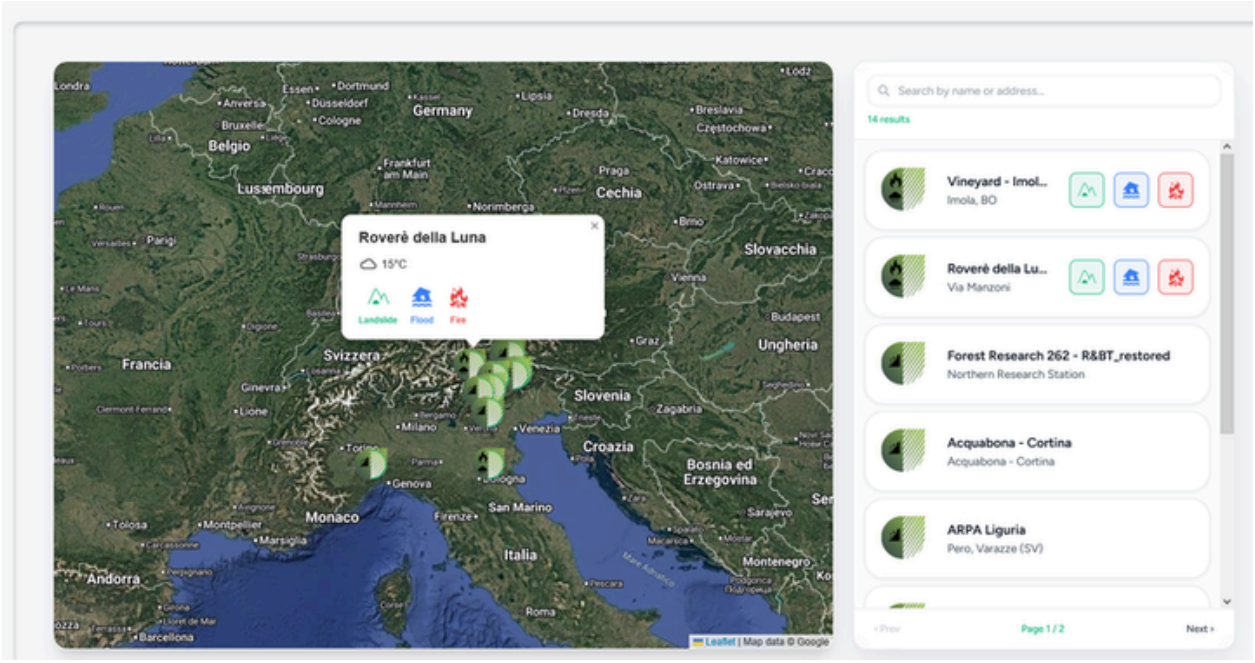


Figure 2. Fin4Slide Home page

By clicking on a marker of interest, the user is taken to a detailed page showing the **landslide risk level** for the current day and the following two days, classified into four categories:

- **Low**
- **Medium**
- **High**
- **Critical**

The page also displays a soil moisture chart measured by the Finapp probe installed in the field, along with additional information on the ongoing conditions.

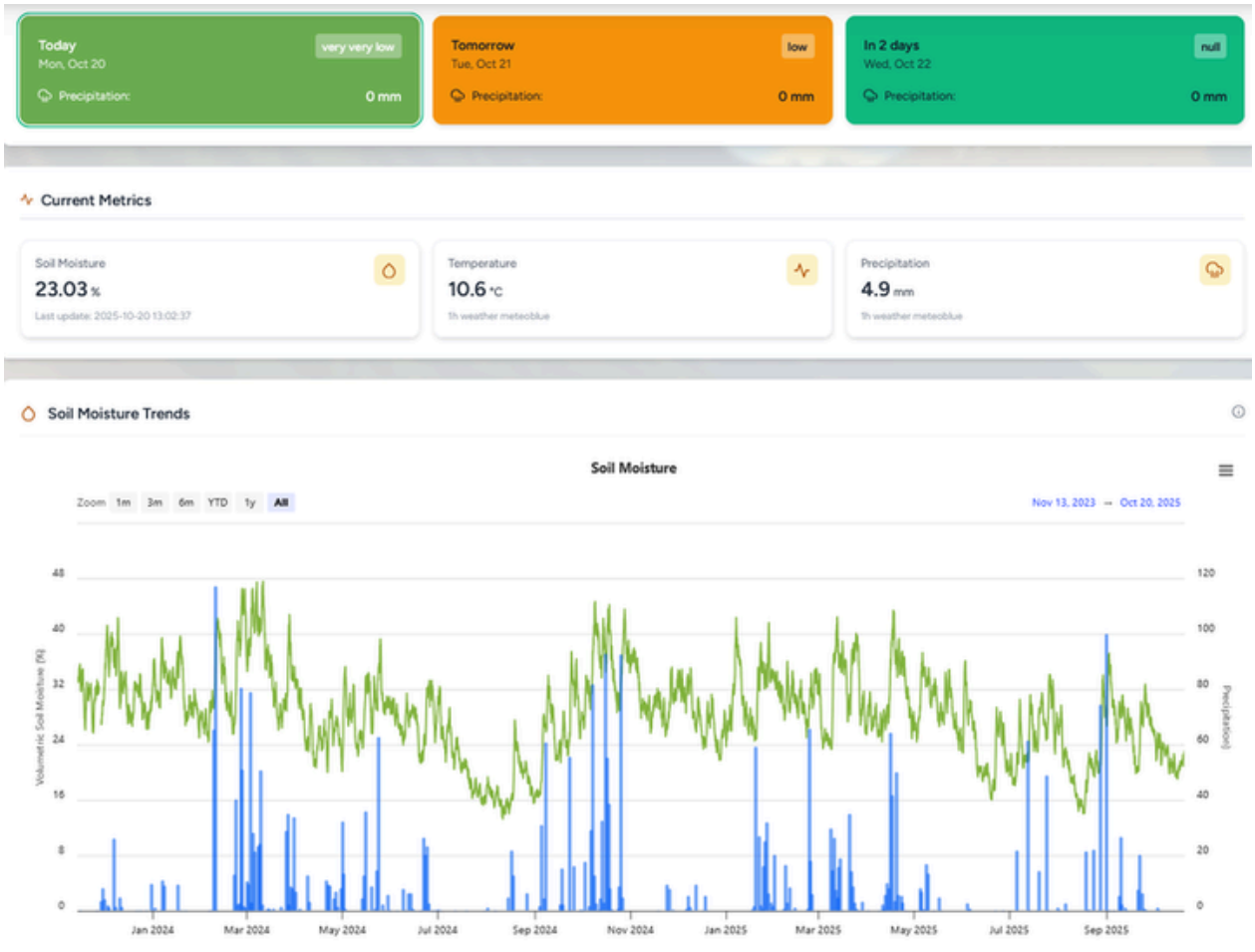


Figure 3. Fin4Slide site specific page

Comprasion with Existing Solutions

Warning Bulletins

The definition and subsequent calculation of early warning thresholds, as described above, represent a significant evolution of the traditional hydro-geological hazard alert bulletins issued by designated authorities.

Firstly, the availability of large-scale representative soil saturation levels is a crucial factor for better defining the early warning level.

Secondly, the approach considers the specific characteristics of an individual site, rather than an entire province or macro-area, both in terms of past events and future forecasts.

	Finapp	Warning Bulletins
Site specific	✓	✗
Quantitative assessment of soil moisture	✓	✗

The Finapp system is the only "site-specific" solution on the market, as opposed to "generic" systems. This distinction ensures a significantly higher degree of specificity and accuracy.

By considering the unique characteristics of each area at risk, it is possible to more precisely identify the locations that truly require attention, allowing resources and personnel to be concentrated only where necessary.

Site-Specific Monitoring Systems

Traditional monitoring involves the installation of weather stations, point-based soil moisture probes, and specialized instruments to detect ground movement, such as inclinometer chains and extensometers.

These systems enable the establishment of rainfall and ground movement thresholds, beyond which specific alarm levels are triggered.

However, the differences with Finapp are substantial.



Scale Representation: Traditional instruments do not provide a large-scale (5-20 hectares) representative view, as they measure point-specific data, which can vary significantly across space. This results in a fragmented understanding of the overall situation.

Cost Efficiency: To address this limitation, multiple instruments would need to be installed to achieve large-scale representation, leading to significantly increased costs.

Ease of Installation: The weight and bulk of traditional equipment often make installation in remote areas challenging or even impossible.

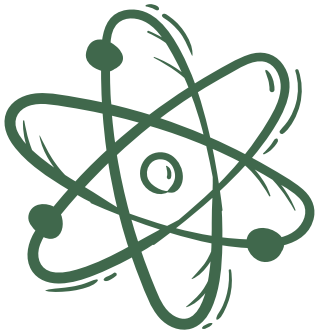
However, the most significant difference is the lack of true early warning capabilities. Traditional instruments measure the current state but cannot project risk into the future.

For this reason, Finapp's early warning system perfectly complements site monitoring, as it operates on a different temporal scale.

Learn More

What is CRNS Technology?

CRNS stands for Cosmic Ray Neutron Sensing, which refers to the detection of cosmic rays. Cosmic rays originate from deep space, and when they reach Earth's atmosphere, they generate a cascade of "secondary" particles, including fast neutrons.



Fast neutrons have the characteristic of primarily interacting with water molecules, specifically with the hydrogen they contain. When they come into contact with water in the soil, some of the fast neutrons are absorbed, and others are reflected back into the atmosphere, losing part of their initial energy. This process produces slow neutrons.

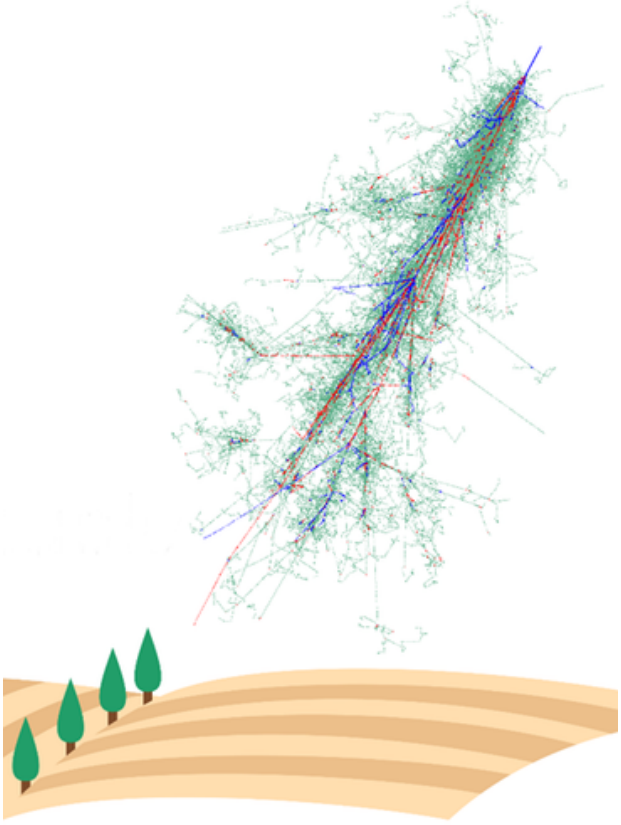


Figure 4. Cosmic rays hit the Earth's atmosphere and break into various particles, including fast neutrons.

The Cosmic Ray Neutron Sensing (CRNS) technology, based on the principles described above, is capable of measuring the water content in the soil.

A significant difference between the number of fast and slow neutrons indicates a large amount of water present in the soil, and vice versa. Since fast neutrons have enough energy to penetrate the soil for many centimeters, the data provided is representative of depth, not just the surface.

Similarly, because slow neutrons are spatially distributed and scatter over large distances in the air, it is possible to monitor water content over vast areas—approximately 5 hectares at sea level and under standard conditions, up to over 20 hectares at higher altitudes, where the rarer air allows the slow neutrons to travel further. The data obtained is interpreted as the average value across the entire described area.



The CRNS technology has been around for decades and has been validated by the scientific community over the past twenty years through numerous publications. The FAO – Food and Agriculture Organization of the United Nations – goes even further, stating that CRNS technology is currently the best available for practicing "smart agriculture."

Source: *https://www.iaea.org/sites/default/files/21/09/nuclear-science-and-technology-for-climate-adaptation-and-resilience.pdf*

Who We Are

Finapp is an innovative startup founded in 2019 as a spin-off from the University of Padova.

UNIVERSITÀ DEGLI STUDI DI PADOVA

finapp

The name of our company is an abbreviation of "Fisica Nucleare Applicata" (Applied Nuclear Physics), as the founding members were all professors and researchers in the Department of Nuclear Physics.

In the 2010s, the research team developed a probe capable of detecting radioactive sources from a great distance, to ensure security at airports, train stations, and other sensitive sites. This same technology was later applied in a completely new field, environmental sustainability: instead of detecting radioactive material, the focus shifted to measuring water.

Finapp invented a new way to measure water using cosmic rays. The CRNS (Cosmic Ray Neutron Sensing) probes patented by Finapp provide unique insights into the water content in soil and snow on a large scale, at depth, in real time, and without contact.

All of this is done using a lightweight, compact instrument that can be installed anywhere with no maintenance required.

In June 2023, Finapp won the European Innovation Council – EIC award.



In 2025, Finapp became a joint-stock company (SpA) to support its international growth and welcome new strategic partners.

The company has deployed over 300 probes across 20 countries, spanning all seven continents.