finapp

fin4fire

Fin4Fire is Finapp's early warning service for wildfire risk, providing four possible alert levels: ordinary, low, medium, and high, for the current day and the following two days





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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**





Fin4Fire

Definition

Fin4Fire is Finapp's early warning service for wildfire risk, providing four possible alert levels: ordinary, low, medium, and high, for the current day and the following two days.

The ongoing climate change, in addition to causing a global rise in average temperatures, is intensifying extreme phenomena such as prolonged droughts. In this context, wildfire risk becomes an increasingly tangible threat, even in areas historically unaffected by such events.

In recent years, various indices have been developed to estimate wildfire risk. However, the parameters considered are always meteorological, such as air temperature, precipitation, and wind speed, without accounting for soil moisture. The paradox is that these meteorological variables are used to estimate the soil's water content.



Although it may seem straightforward, measuring soil moisture is quite challenging. Current technologies range from point-based approaches, like TDR probes, which provide accurate values at depth and in real-time but are not representative on a large scale, to satellite remote sensing, which covers vast areas but cannot deliver data at depth or in real-time.

Finapp overcomes these limitations by using next-generation CRNS (Cosmic Ray Neutron Sensing) probes, which measure soil moisture on a large scale, at depth, and in real time.





How it works?

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

- **Measurement of soil moisture**
- **Estimation of the propagation index**
- **Calculation of wildfire risk**
- **Soil moisture model**
- **Weather forecasts and future risk calculation**

1. Measurement of soil moisture

A Finapp probe is installed to measure soil moisture on a large scale, at depth, and in real time. According to our studies, the Soil Moisture value is perfectly correlated with the water content of organic layers, typically at medium to deep depths, such as the litter and deeper layers.

These two factors provide a precise indication of how much material will be consumed in the event of a fire, respectively for small shrubs and large trees.



Figure 1. Comparison of the medium and deep "fuel moisture indices" calculated by Finapp and the most commonly used

2. Estimation of the propagation index

It is an index related to the initial propagation speed of a potential fire front. To determine it, we use the usual meteorological parameters such as wind speed, relative humidity of the air, air temperature, and accumulated precipitation.

These variables provide an estimate of the water content in the uppermost layer of the undecomposed litter, in addition to the contribution of the wind in the flame propagation.

3. Fire Risk Calculation

Fire risk arises from the combination of the two parameters outlined in the previous points, namely the availability of dry organic layers that can fuel a potential fire and the speed of flame propagation.

This risk should be understood as the current one, based on measured environmental data.

4. Soil Moisture Model

Thanks to advanced artificial intelligence algorithms, the soil moisture, as measured by the Finapp probe, is compared with meteorological parameters such as precipitation, temperature, wind, and solar radiation recorded within the same time frame to find an empirical law that describes the soil moisture trend specific to the installation site.

5.Weather Forecasts and Future Risk Calculation

Finapp has access to specific weather forecasts for the site, not generic ones, which consider various meteorological models – a multimodel approach – to reduce the inherent uncertainty in each forecast.

The predicted weather data feed into the soil moisture model, as obtained in the previous point, to understand its trend in the next two to three days.

In this way, we are able to calculate fire risk in advance, up to three days ahead.

This gives rise to the **first fire risk pre-alert service:**



1. Where **soil moisture is actually measured** and not deduced from a limited set of meteorological parameters.



2. With an **early warning up to 72 hours in advance**, not just a measurement of the current state.

Data Access

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

By accessing our Fin4Earth portal, the customer can view a map showing markers that indicate each place in which risk forecasts are provided.

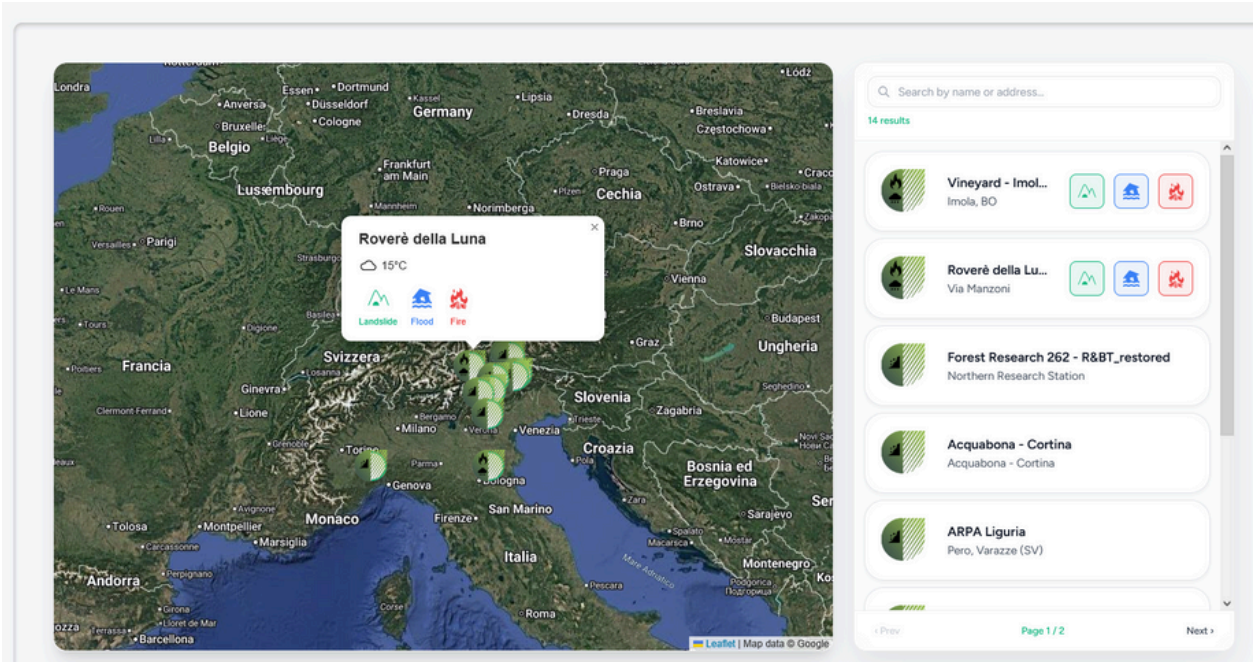


Figure 2. Fin4Earth Home page



By clicking on a marker of interest, the user is taken to a detailed page showing the **fire 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.

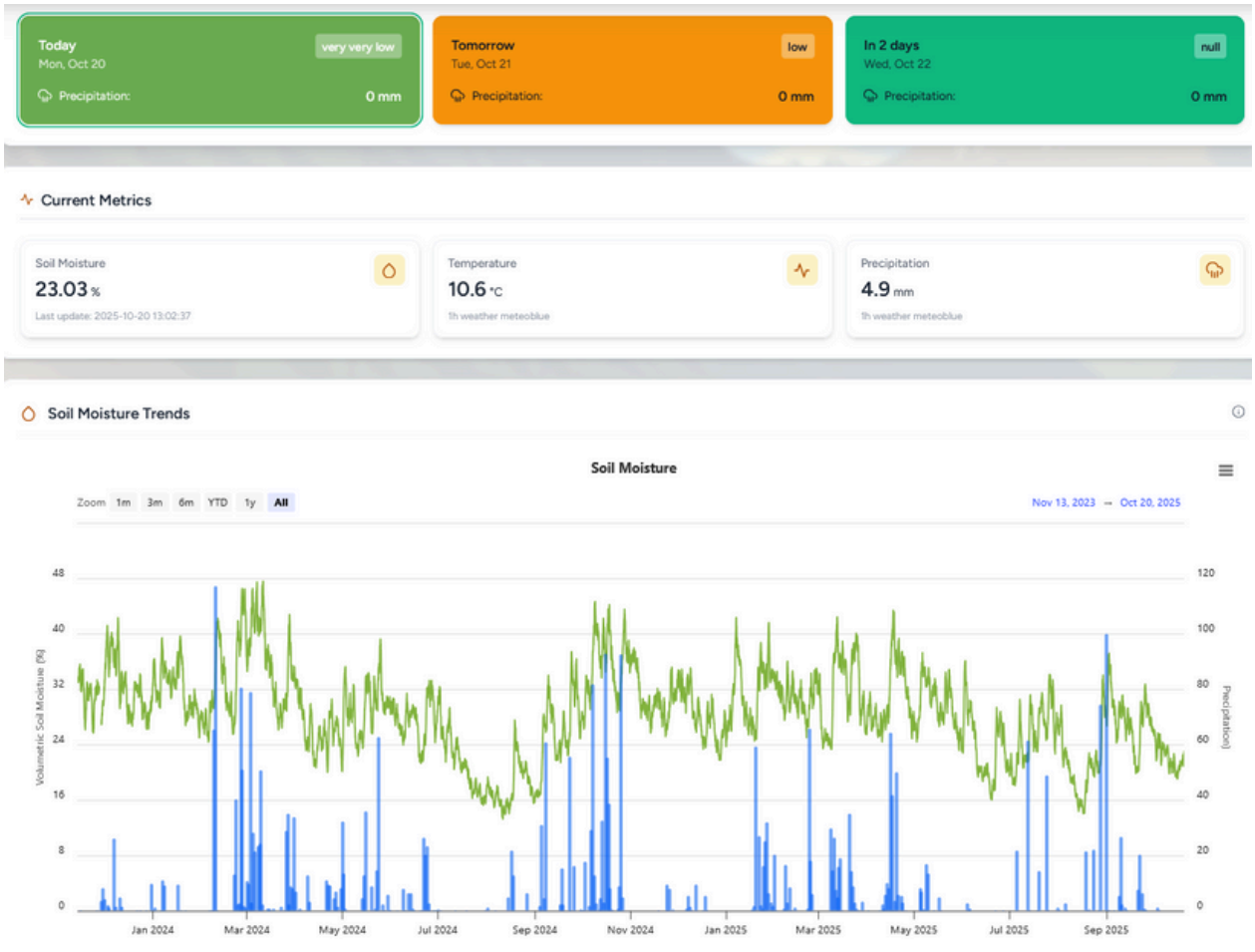


Figure 3. Fin4Fire site specific page

Comprasion with Existing Solutions

Warning Bulletins

The definition and subsequent calculation of the pre-alert, as described above, should be understood as a significant evolution of the traditional alert bulletins issued by the responsible authorities.

The availability of the soil saturation level, representative on a large scale, is a fundamental aspect for the better definition of the pre-alert level.

In addition, the forecast up to 72 hours ahead, without limiting itself to evaluating the current fire risk, allows for better management of personnel and resources.

	Finapp	Warning Bulletins
Fire Risk Forecast up to 72 Hours Ahead	✓	✗
Quantitative assessment of soil moisture	✓	✗

Site-Specific Monitoring Systems

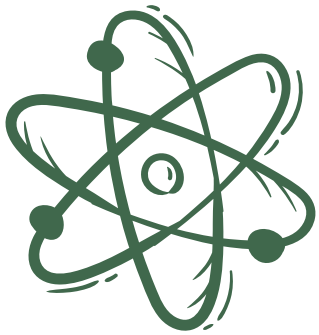
Traditional monitoring involves the installation of weather stations, surveillance systems for detecting smoke, thermal cameras for hot-spot identification, etc.

Alarm thresholds can be set in real time. However, this type of equipment cannot provide a true pre-alert, as it measures the current state and is unable to project future risk. **For this reason, Finapp's pre-alert system integrates perfectly with site monitoring, as it operates on a different timescale.**

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.

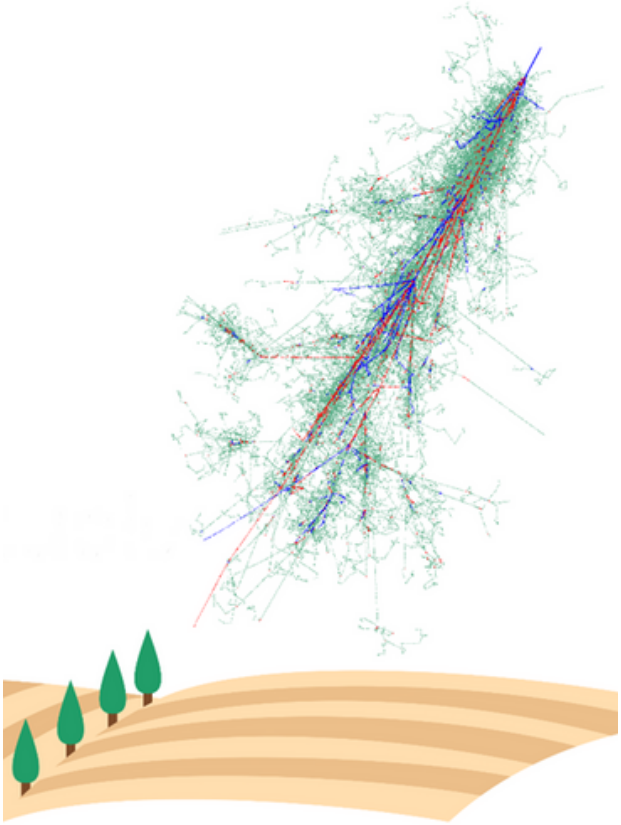


Figure 4. Cosmic rays hit the Earth's atmosphere and break into various particles, including fast neutrons.

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.

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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.