Finapp Probe

Soil moisture and snow water equivalent (SWE)
CRNS Technology – Cosmic Ray Neutron Sensing

PATENTED
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PATENTED

Floods | Wildfires | Landslides | Avalanches | Water availability | Agriculture

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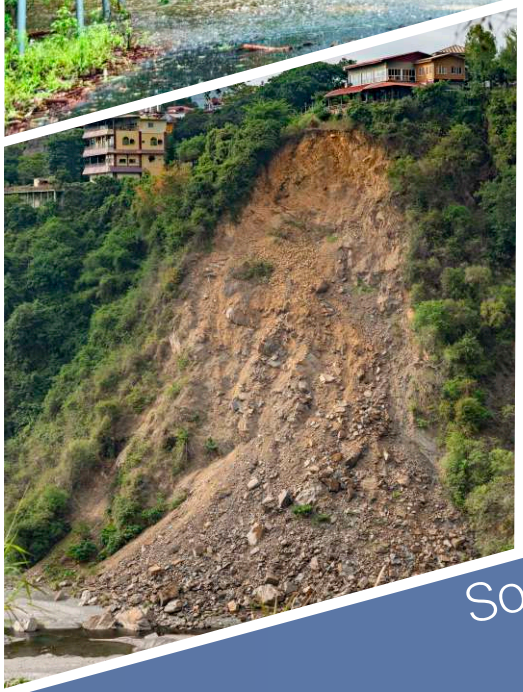

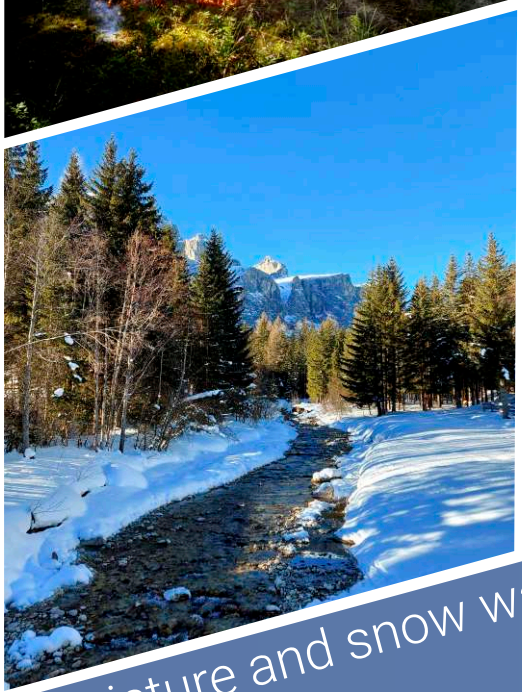

Soil moisture and snow water equivalent (SWE)

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REQUIREMENTS

Overcoming the limitations related to the current methods of measuring soil moisture and / or SWE (Snow Water Equivalent) with an unique innovative tool capable of knowing the soil moisture over large areas and not only at the surface level, but also deep. As for the SWE, this is an increasingly important data, not only for the forecast of the avalanche risk, but also for predicting the water availability for spring summer and consequently being able to better manage it for aqueducts, hydroelectric energy production, irrigate, etc.

SOLUTION

CAE suggests the integration in its monitoring systems of the Finapp probe, produced and patented by the same innovative start-up, which uses CRNS technology for the measurement of soil moisture and SWE (Snow Water Equivalent), a unique instrument in the world.

FUNCTIONALITY

Finapp transformed the CRNS technology from heavy, bulky and expensive - and therefore only useful for academic purposes - into a real product, suitable to meet different market needs at low costs and, at the same time, with an important level of innovation compared to traditional probes, therefore allowing to measure **soil moisture** and **SWE - Snow Water Equivalent**:

A. **on areal basis**: 5 hectares at sea level, over 20 hectares at 2000m;

B. **in depth**: about 50 cm in the ground, meters and meters in the snow;

C. **in real-time;**

and all this with a light, compact, and eco-friendly instrument, installed above the ground.

2 sensors in 1, as the hardware used for measuring soil moisture and SWE is the same, only the algorithms used for their interpretation change. This implies that, by purchasing a single instrument, it is possible, for example, to collect the SWE data in winter to estimate the avalanche risk, as well as the soil moisture data in summer to predict the risk of wildfires or floods (soil wetting).

Finapp CRNS Probe
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The data measured by the Finapp probe, and integrated in the system, **are essential for**:

A. define trigger points to **predict avalanches, landslides, floods and wildfires**;

B. develop **phytopathological models** for the agricultural sector;

C. estimate **water availability** in the summer.

WHAT IS CRNS TECHNOLOGY?

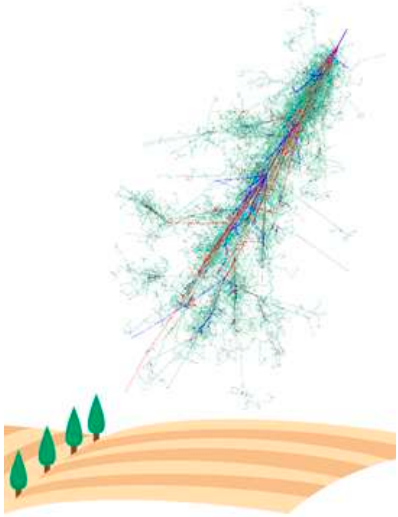


Figure 1. Cosmic rays reach the earth's surface after interacting with the atmosphere.

CRNS is the acronym for Cosmic Ray Nutron Sensing, meaning cosmic neutron detection. Cosmic rays reach the Earth's atmosphere after a long journey: they are generated from different sources (stars, quasars, supernovae, etc.) and are made up of different types of particles. The interaction between cosmic rays and the Earth's atmosphere generates a cascade of "secondary" particles, including fast neutrons.

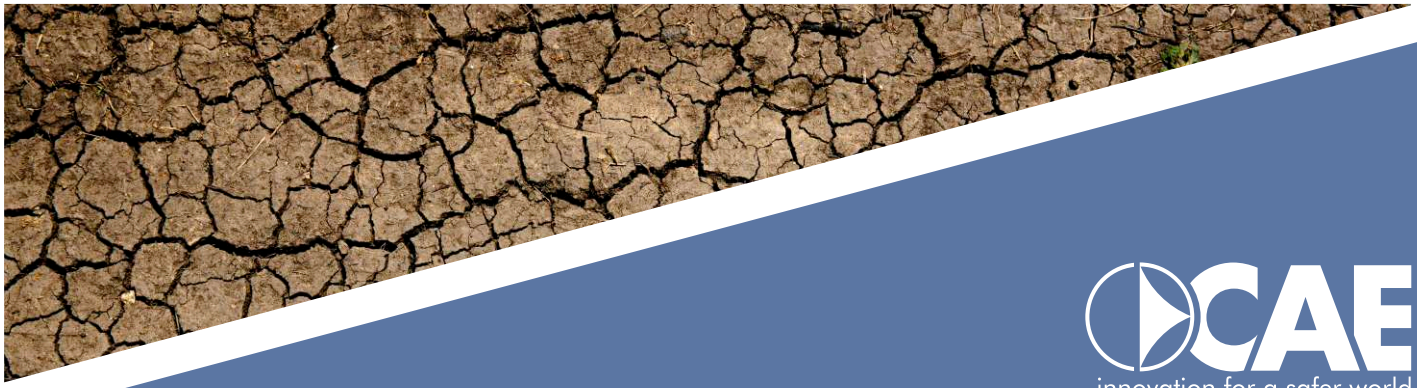
From the interaction between the fast neutrons and the water present in the ground or in the snow, a suspended "fog" of slow neutrons is formed that "wanders" for tens of meters before decaying.

The Finapp probe counts the number of fast neutrons that reach the earth's surface (total incoming), and of the slow ones generated as described above.

The CRNS technique measures the water content in the ground and in the snow: in particular, a decrease in the neutron counting is related to an increase of water content and vice versa. This slow neutron count is "normalized" to the amount of fast neutrons available at that time.

Since slow neutrons travel tens and tens of meters before decaying, the information on soil moisture or SWE is areal, i.e. representative of a large area, about 5 hectares at sea level and in standard conditions, up to beyond the 20 hectares at high altitudes, as the thinner air allows slow neutrons to travel longer. The data thus obtained should be understood as the average data, valid over the entire area described above.

Figure 2. The Finapp probe measures the neutrons formed by the interaction between cosmic rays and water.



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COMPARISON WITH OTHER TECHNOLOGIES

Below is a synthetic representation of the comparison between the Finapp probe and the technologies currently used for the measurement of soil moisture and SWE respectively:

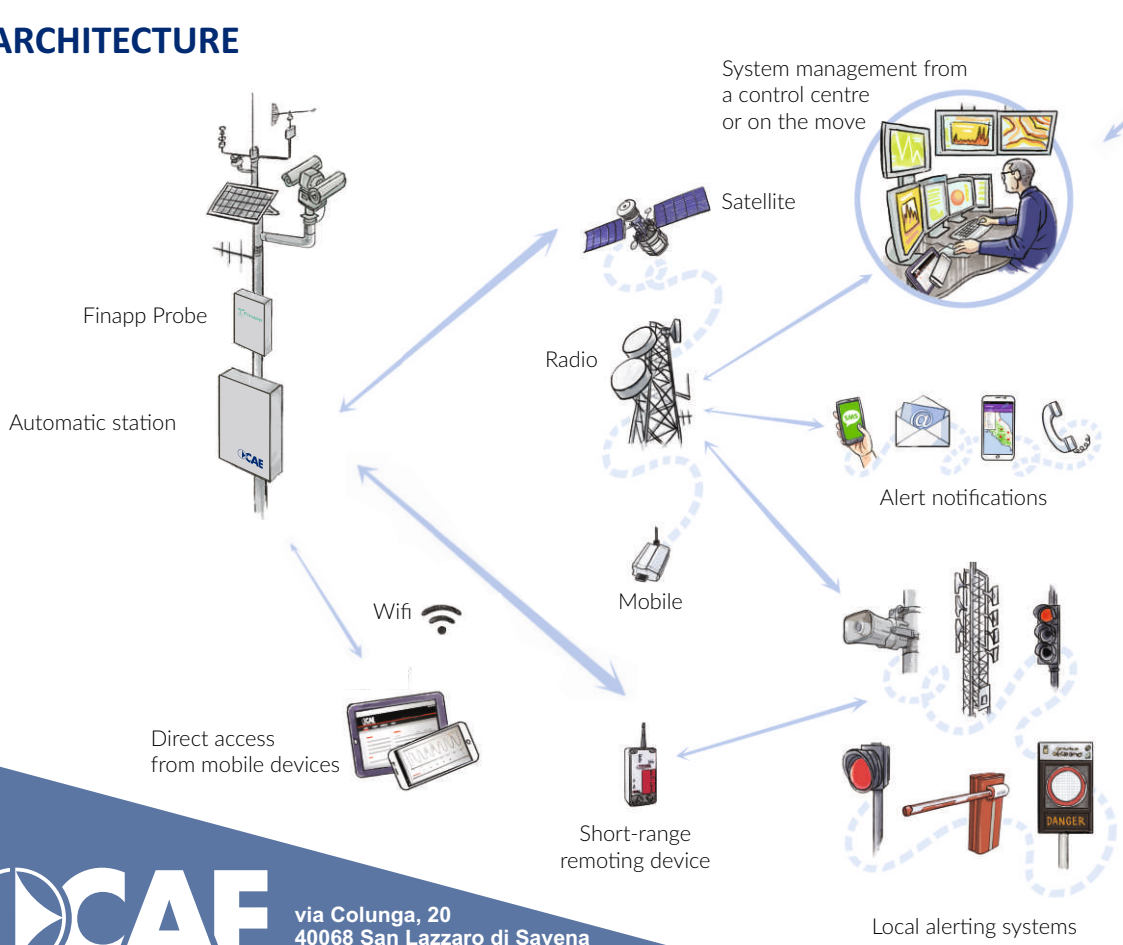
	Finapp	Point probes	Satellite
in real-time	✓	✓	✗
deep	✓	✓	✗
on a large scale	✓	✗	✓
hig resolution	✓	✗	✗

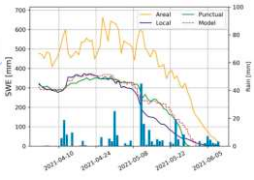
	Finapp	Snow pillow	Simulations
in real-time	✓	✓	✓
on a large scale	✓	✗	✓
high resolution	✓	✗	✗

SYSTEM INTEGRATION

The data collected by this product can be fully integrated into the CAE systems and allow to activate alarm devices when certain thresholds are exceeded, and are also sent to the control unit, where they are integrated with the other data collected by the system, providing essential information for effective mitigation of the risk and water resource management.

ARCHITECTURE





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