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Update of the Italian Agro-meteorological Network

CAE has won an important tender, launched by **CREA**, relating to the four-year framework agreement for the “turnkey” supply and maintenance of **39 stations**, located throughout the Italian national territory, for the acquisition of the data necessary for the reconstruction of **meteorological events** (temperature, rainfall, relative humidity, etc.) of the **national agro-meteorological network (RAN)**.

The Council for Agricultural Research and for the Analysis of the Agricultural Economy (**CREA**) is a public research body subject to the supervision of the Italian Ministry for Agricultural, Food, Forestry Policies (**MIPAAF**) and the current **national agro-meteorological network** reports to it; this network consists of a set of automatic monitoring stations, located in mainly agricultural areas, whose construction began in 1991 and then continued in the following years with the creation of a wider network, spread throughout the national territory.

Currently, the 39 monitoring stations that compose the network



need an adaptation. For this reason, the framework agreement was signed with CAE, which won the tender and will take care of the disposal of the old stations, as well as of the supply, installation and maintenance of the new ones.

The monitoring network, located throughout the country, will be populated by the brand new CAE stations powered by a **solar panel** rechargeable **battery**, equipped with a **Compact datalogger** and new sensors such as: radiometer, **THS thermo-hygrometer**, leaf-wetness sensors, anemometer, PG2R rain gauge, barometer, thermometers for surface and soil temperatures.

The stations will be equipped with a **UMTS/GPRS modem**, that will send the detected data to the CREA control unit in Rome, on a Cloud web platform, where, thanks to the new **software** for **acquisition** and **display** via **WEB** provided by CAE, it will be possible to perform **continuous and real-time monitoring**, as well as to allow **station configuration, alarm management** and **data validation**. CAE will guarantee not only supply but also services: the stations will be maintained thanks to

a preventive and corrective **maintenance** service, together with remote maintenance and assistance, and an H24 availability service.

The **agro-meteorological quantities** measured by the **RAN** stations will be used for the **reconstruction of meteorological events** (temperature, rainfall, relative humidity, etc.), as well as for the **monitoring of the agricultural season**. The data collected will be acquired on an hourly basis and systematically checked as far as their correctness, physical and weather/climate consistency, before being archived in the CREA Cloud web platform and subsequently in the National Agro-meteorological Database of the National Agricultural Information System (SIAN).

In these days the first executive contract is being signed, resulting from the signing of the framework agreement. This first contract is about the **“turn-key” supply and maintenance of the first 12 stations**, which will replace as many non-operative control units of the national agro-meteorological network, as well as of the **software infrastructure** for data acquisition and display. ■

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Measurements of soil moisture and snow water equivalent: the revolution starts with cosmic rays

We often talk about the consequences of **climate change** and, in Italy, the data of 2021 indicate that it has been a year characterized by critical climatic trends and meteorological events, as well as by very high maximum temperatures, average temperatures higher than those of past years and prolonged periods of **drought** (source [ISPRA](#)). Up to these weeks, we must observe that in Italy the current **water availability** has been negatively affected by a winter so far lacking in significant rainfall (source [ANBI](#)).

These situations of hardship are always increa-

sing, and that increases the number of the institutions that need to be updated on the availability of water in order to better manage it, taking into account the different needs: agricultural, industrial, electrical, domestic, etc. For this reason, it's increasingly important to have data that allow us to accurately calculate water availability, and to this end **CAE** suggests the **Finapp probe**, produced and patented by the same innovative start-up which uses **CRNS (Cosmic Ray Neutron Sensing)** technology. 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:

- on an areal basis
- in depth
- 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. 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).

CAE has been implementing multi-risk monitoring and earlywarning systems for civil protection purposes for decades, in Italy and abroad, and has de-

veloped an integrated solution, optimized in terms of low electricity consumption and overall reliability in the field, in order to suggest the innovative probe for both new and existing remote measurement networks.

The data measured by the Finapp probe and integrated in this way with those of the other sensors become fundamental not only to estimate **water availability** in summer, thanks to the **calculation of the equivalent of water present in the snow (SWE)**, but also to develop **phytopathological models**, therefore proving to be a truly strategic tool for the **agricultural sector**. These same measurements also provide important information for assessing the risk of triggering **avalanches** and **landslides**, the evolution of possible **floods** and the susceptibility to **wildfire** hazard. To sum up, it is a very versatile and innovative product, as demonstrated by the patent obtained.

To find out more, write to sales@cae.it or go to **Finapp** website page. ■

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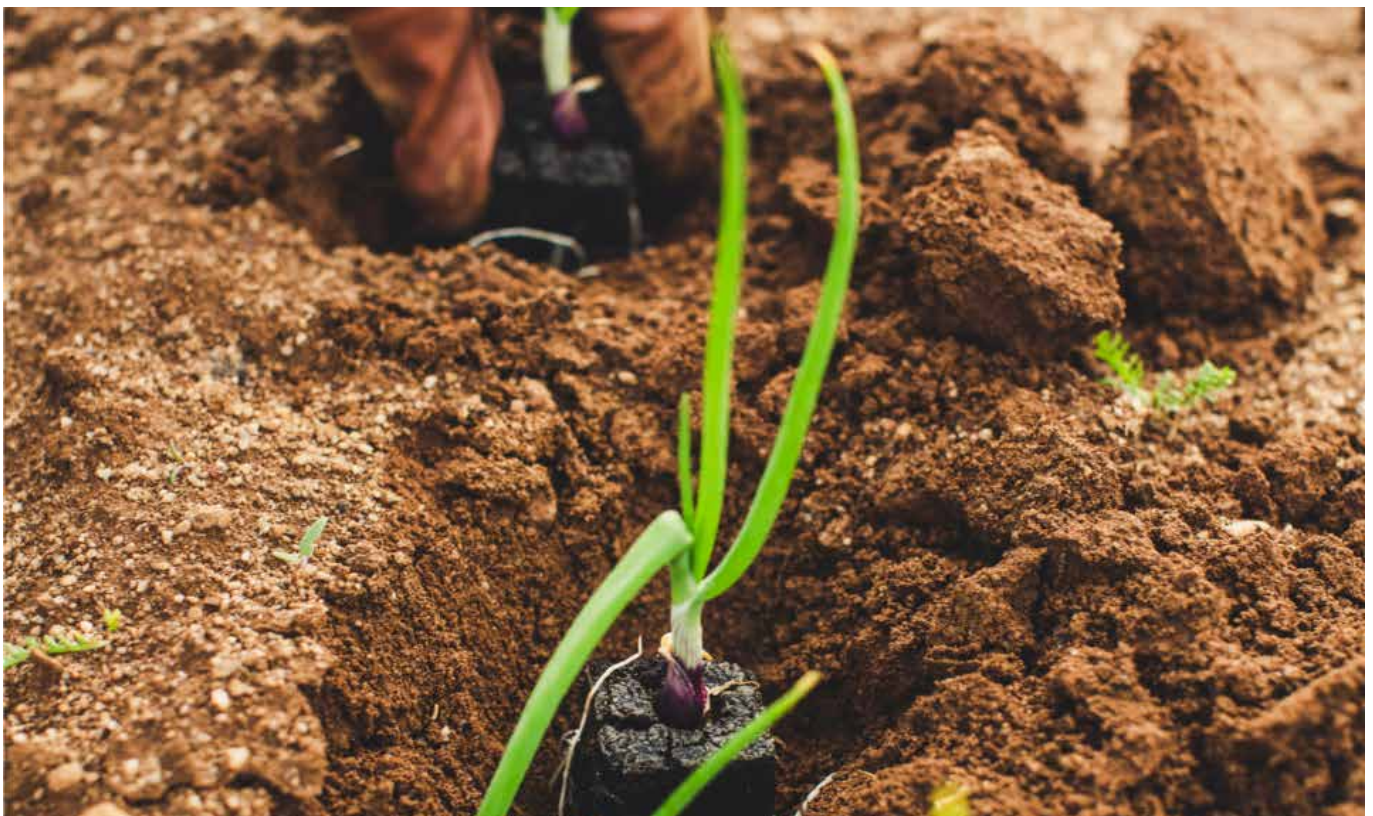
Emilia-Romagna: the new agro-meteorological network is open hardware

In Emilia-Romagna Region the stations of the RIRER network (**Integrated Regional Hydro-Meteo-Pluviometric Network of Emilia-Romagna**) can be grouped into 3 different and homogeneous networks in terms of structure and purpose:

- those with the main purpose of civil protection - data transmission mainly via UHF radio;
- those with predominantly agro-meteorological and climatological purposes, including agro-meteorological and urban networks - GSM/GPRS transmission;
- those with climatological purposes, composed of mechanical stations and Stima V3 automatic stations - GSM data transmission.

CAE, in temporary joint venture with DigitEco, has won the tender for the **updating of the agro-meteorological network** of the Region of **Emilia-Romagna**,

as indicated above in point 2. This **network**, established at a regional level since 1985 and completely renovated in 2004, now requires plant and instrumental adaptations to allow to maintain a **high quality standard**, as well as to exploit the innovative solutions that are now made available by the current technological landscape, in the same open hardware perspective that has already been developed internally by Arpae for the Stima V3 stations. All this offers optimization in the measurement of quantities, greater flexibility in managing the data flow, and innovative and safer transmission techniques. The choice of open source stations is expected to be an optimal solution also for private sectors: the aggregation of data between public and private networks will be facilitated, as well as its management and maintenance.



The supply and installation of **new automatic stations**, replacing the existing ones, will allow the **agro-meteorological network** to implement with full **efficiency** the **monitoring** functions of atmospheric variables for **meteorological** and **agro-meteorological applications**, as well as to continue the historical climatic assessments.

In the first implementation phase, the project involves the evolutionary development of the already **existing Stima open source monitoring station project**, both at the **hardware** and **software** level; then it will follow the updating of the agro-meteorological network stations, replacing the existing ones with **44 new automatic stations**, of which:

- 35 basic agro-meteorological stations equipped with rainfall, air temperature and relative humidity sensors;
- 9 complex agro-meteorological stations equip-

ped with rainfall, air temperature, relative humidity, solar radiation and wind sensors.

Meteorological events have a crucial influence on the agricultural management of the territory and strongly affect its productions, in both qualitative and quantitative terms. Knowing the characteristics of the local climate has always guided crop choices and livestock farming, and the planning of agricultural activities cannot ignore the weather trend of the agricultural season. Agro-meteorology has taken an increasingly important role in agricultural planning, due to the greater **meteorological variability** in recent years, and in particular to the growing spreading and intensification of **extreme phenomena**. With the **update** of this **monitoring network**, the Emilia-Romagna Region wants to guarantee the agricultural world all the information needed and be certain that it is **reliable data**. ■

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Swiss precision chooses CAEtech rain gauges

Eawag, the Swiss Federal Institute of Aquatic Science and Technology, is a world-leading aquatic research institute and offers an excellent environment for gaining a comprehensive understanding of aquatic ecosystems and water resources, identifying emerging problems, and developing broadly accepted solutions. Eawag purchased **three PG4i, stand-alone rain gauges** and decided to use CAEtech technology as part of a study relating to the quality of groundwater. In particular, the goal of the project is to make an analysis to understand how rainfall affects the presence of contaminants, such

as pesticides and bacteria, in the water.

Karstic aquifers make-up 20-25 % of the drinking water resources worldwide and contribute **to 18 % of the Swiss drinking water**. Due to their geological development, they exhibit a high hydraulic conductivity that often leads to hydraulic shortcuts between surface and groundwater, and associated karstic springs. Due to fast transport, contaminants like pesticides and bacteria could reach the springs in high concentrations.

In Switzerland, the current groundwater monitoring strategies implemented allows for the long-term



monitoring of water quality, but short-term changes are potentially missed. Within hours after a precipitation event, water quality could deteriorate to the extent that it should not be used as raw water in drinking water production anymore.

For this reason EAWAG decided to study these fast changes in water quality automatically and by measuring pesticides and their transformation products in-situ. In particular, with a 4-wheel mobile laboratory that allows to withdraw and analyze

various samples per hour in situ for extended periods of time, even several weeks, hoping to observe whether abrupt changes in concentrations due to precipitation events occur or not.

The aim is to learn about temporal dynamics of pesticides and their transformation products in karstic aquifers, which will help to make decisions on how to monitor the water quality and manage agricultural practices in these vulnerable environments. ■

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Po River: new investments to protect water quality



A new **multiparameter probe for water quality** was installed at the Pontelagoscuro ARPAE station, which is part of the Emilia-Romagna Integrated Regional Hydro-Meteo-Pluviometric Network (RIRER). The Po River District Basin Authority (**ADBPO**), in collaboration with **ARPAE-SIMC**, owner of the station, has promoted the installation and maintenance of the aforementioned probe for at least three years, in a spot where the monitoring of the Po River is strategic, in order to detect chemical-physical parameters such as: **water temperature, electrical conductivity, pH, dissolved oxygen, redox potential, turbidity.**

According to the Legislative Decree 152 of April 3rd,

2006 "**Legislative Decree 152/2006 Environmental Regulations**", Part Three, Annex 5, Table 3, "Emission limit values in surface waters and sewers",



the measurement of these parameters will allow to have feedback on the states of change of the monitored river section.

Thanks to the basic parameters provided by this probe, information will be obtained on the state of the water, which will be analysed and framed within the seasonal trends, the historical data and the fluctuations of the values. Particularly:

- the measurement of the physical parameter of **water temperature** allows the monitoring and definition of the maximum variations between average temperatures in the sections of the watercourse upstream and downstream of any entry points;
- the physical parameter of **electrical conductivity** is used to determine the water salinity, the monitoring of which is essential as far as industrial waste is concerned, as well as to determine the saltwater intrusion;
- **pH** is a measure of the acid-base balance of an aqueous solution. Knowing this data is important



for any type of assessment regarding the quality of water, first of all the drinking water;

- the measurement of the **dissolved oxygen** concentration is necessary for the respiratory metabolism of most living organisms. It therefore represents an essential parameter to define the suitability for life of an aquifer, as well as to establish its level of pollution. Continuous monitoring of this parameter allows to record changes in its concentration and be alerted in effecti-





ve time, before the monitored ecosystems suffer irreversible damage;

- the **redox potential** is a unit of **measurement** of the electron activity in the aqueous medium when water comes into contact with other substances and is directly dependent on pH. These two parameters, combined with the electrical conductivity, define the tendency of a well-determined aquatic environment to develop chemical reactions. Knowing the redox potential is essential for the purification activities related to purifiers and the reuse of the water coming from them, as well as to define the liveability characteristics of the aquatic habitat for living species and therefore its degree of pollution;
- the **turbidity** measurement gives indications on the clarity of the water. This parameter measures the quantity and, therefore, the concentration of particles suspended in water, such as micro-organisms, silica, sludge, organic substances, minerals, oils, bacteria... Its determination is crucial to provide feedback on water pollution and on the impacts that the presence of these particles have on aquatic life.

This need has emerged in order to pursue the requirements of the **Water Framework Directive (WFD)**, whose objectives highlight the importance of the water resource from a socio-economic point of view and of the identification of water bodies and relative chemical - physical - biological characteristics, as well as their level of alteration.

Since up to now this kind of control activities has

been carried out by the competent Bodies through measurement campaigns, ADBPO believes that an **automatic and continuous monitoring of the chemical-physical parameters** subject to these analyses can become a valid aid and a powerful tool to support those who deal with this on a daily basis. As a matter of fact, through constant, punctual, real-time and fast **monitoring** in terms of data return, it is possible to identify spills in surface waters, thus allowing timely intervention by the competent authorities, as well as to enhance a database from an informative point of view, which will be useful for design and planning actions.

Therefore, by installing this probe, the District Authority wanted to launch an experiment to test the **effectiveness of monitoring with fixed multiparameter probes** supporting the pre-existing hydrometric stations on the Po River; its installation will allow to:

- obtain a **complete cognitive picture** in the same point, which includes both qualitative and quantitative data, linked to the hydrometric level;
- **investigate the variation of the basic parameters**, due to anthropogenic pressures, by measuring organic load, oxygen balance, acidity, water salinity and microbial load, as well as hydrological characteristics of the transport of solids;
- evaluate the **water quality index of the Po River** in order to promptly **alert** the exceeding of predefined limit values for the detected parameters, as well as the evolutionary trend resulting from the implementation of the planned interventions;
- evaluate the **loads of pollutants** carried by the Po River into the Adriatic Sea;
- make use of an **automatic and continuous monitoring** of the waters, as well as of a reliable and timely transmission of the detected data such as the radio carrier with which these stations are equipped.

The data collected will be sent via the ARPAE radio monitoring network, then acquired and displayed on the systems used by the aforementioned Body and finally made available to ADBPO for subsequent analyses. ■

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