DELIVERABLE 3.3.2

Inclusion of the new observational weather and climate stations into regional and national networks

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Project key facts

Priority:	2. Safety and resilience
Specific objective:	2.1 Improve the climate change monitoring and planning of adaptation measures tackling specific effects in the cooperation area
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Title:	**Strategies to adapt to climate change in Adriatic regions**
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1 EXECUTIVE SUMMARY

1.1 Context

The EU Strategy for the Adriatic Ionian Region (EUSAIR) is a macro-regional strategy adopted by the European Commission and endorsed by the European Council in 2014. The Strategy was jointly developed by the Commission and the Adriatic-Ionian Region countries and stakeholders, which agreed to work together on the areas of common interest for the benefit of each country and the whole region.

As part of the implementation plan of the Strategy, the Interreg Italy-Croatia RESPONSe Project has improved the climate change information, monitoring and management tools for adaptation strategies in the Adriatic coastal areas.

Reliable and quality information is at the basis of the Sustainable Development Goals targets and the Disaster Risk Reduction framework which, among others, recommend the strengthening of the monitoring and modelling capacity across different space-time scales. This deliverable deals with the observational components of the climate monitoring system.

In the past twenty years, Europe has started many initiatives in support of climate monitoring of Essential Climate Variables (ECVs). Here we mention only few of them.

- The European Space Agency (ESA) Climate Change Initiative (CCI) provides an adequate, comprehensive and timely response to the extremely challenging set of requirements for highly stable long-term satellite-based products for climate, that have been addressed to Space Agencies via GCOS and the Committee for Earth Observation Satellites.
- The Copernicus Climate Change Service (C3S) combines climate system observations with the latest science to develop authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide.
- The Copernicus Marine Environment Monitoring Service (CMEMS) has developed in the past 6 years a combination of satellite, in situ and numerical model reconstructions of the ocean state for the past thirty years on large scale grids, such as 3-4 km for the Mediterranean and Adriatic Sea.
- The European Marine Observation and Data Network (EMODnet) provides a unique gateway to retrieve real time and historical data sets in European regional Seas (https://emodnet.eu/en).
- The European SeaDataNet research infrastructure is collecting and quality controlling all the data sets for physics available from 1900 in the Mediterranean and Adriatic Sea. SeaDataNet provides aggregated datasets (ODV collections of all unrestricted SeaDataNet measurements of temperature and salinity by sea basins) and climatologies (regional gridded field products).

1.2 Scope

The Deliverable "D3.3.2 Inclusion of the new observational weather and climate stations into regional and national networks", reports on the integration of new monitoring stations into the existing partners' network of stations purchased in accordance with the "Activity 3.3 – Analysis, enhancement and integration of existing climate and oceanographic monitoring systems".

The specific objectives of this deliverable are:

1. to describe the present state of observing climate variables infrastructure and monitoring network systems at Adriatic basin scale in RESPONSe partner sites;
2. to describe the deployment of new observing system components and their integration into the existing infrastructure and monitoring networks.

1.3 Audience

The main stakeholders of this deliverable are the climate research and service communities on one hand and the public authorities on the other hand. Both stakeholders profit from the wealth of data produced by the existing and enhanced monitoring network via the publicly accessible data published regularly online by RESPONSe partners, the former by disposing of a more comprehensive set of data that can inform the latter audience with more precise and solid climate information.

Additionally, thanks to the Mirror Copernicus endeavors, the now operational Copernicus system at EU level is diffusing at national level, e.g. in Italy, with investments that will allow to integrate data from regional and national institutions and networks.

This report will be made available on the RESPONSe web page.

2 ARPAV WS monitoring network

2.1 ARPAV existing monitoring network

ARPAV is the Regional Agency for the Prevention and Protection of the Environment in the Veneto Region. ARPAV also deals with weather forecasting and meteoclimatic monitoring on the regional territory. In the Provinces of Padua, Venice and Rovigo the ARPAV meteo-climatic monitoring network consists of 44 automatic stations (**Figure 2.4-1)** and 2 meteorological radars. These stations have been operational since the first months of 1992.

2.1.1 Measured variables

Air Temperature at 2 meters above the ground by means of instantaneous measurement every 15 minutes. The average daily temperature of day X is the average of the 96 measurements taken between 00.15 solar hours of day X and 00:00 of day X + 1. The maximum and minimum temperature of day X are the maximum and minimum values from 96 daily measurements. The sensor is a linearized thermistor, inserted in a white PVC antiradiant screen, equipped with fins for natural ventilation. The resolution (quantization error) is 0.1 °C, the measurement uncertainty is ± 0.5 °C.

Precipitation by carrying out a measurement every 5 minutes. The daily precipitation of day X is the sum of the 288 cumulative measurements between the solar hours 00:05 of day X and 00:00 of day X + 1. The rain gauge has a calibrated mouth positioned 2 m above the ground, with a surface area of 1000 cm^2. The measuring system consists of a double oscillating bucket which, through a system of funnels, receives the rain from the mouth of the instrument, oscillates when the weight of the collected water reaches 20 grams (therefore operating as a scale) and subsequently discharges the measured rainfall to the ground. The resolution (quantization error) is 0.2 mm of precipitation. The measurement in 5 minutes is given by the sum of the oscillations of the trays and is therefore a multiple of 0.2 mm. The measurement error, which can be inferred from the calibration curves, is related to the intensity of the precipitation with an increase in the underestimation of the rain fallen as the intensity increases. On various rain gauge instruments there is a system of electrical resistances that guarantee the heating of the collection funnel when temperatures drop below 0 °C. This allows the measurement of the equivalent in water of any snowfall.

Additional meteo-climatic variables monitored by the ARPAV automatic stations are:

Relative Humidity at 2 m above the ground, making an instantaneous measurement every 15 minutes. The data is expressed as a percentage value (%). The capacitive sensor is installed inside a white PVC anti-radiant screen, equipped with fins for natural ventilation, very similar to that of the air temperature sensors.

Global Solar Radiation by making a measurement (average of samples taken every 2 seconds) every 15 minutes. The elementary data is expressed in Wm^{-2}. The sensor is a star pyranometer made up of 72 nickel - chromium thermocouples sheltered by a glass dome. The observed spectral range is included in the range 0,30 - 3,00 µm.

Wind speed and direction are measured by making a measurement (average of samples taken every 2 seconds) every 10 minutes. The wind speed data is a 10-minute scaling average of the speed measurements taken every 2 seconds. The data is expressed in ms^{-1}. The quantization error is 0.1 ms^{-1}. The sensor consists of a three-cup element (Robinson's reel), which rotates around a vertical axis. The rotation speed is proportional to the horizontal wind speed. The three-cup element is connected to a pulse transducer element, integral with the rotation axis, which transforms the rotation speed of the sensor into a digital electrical signal.

The wind direction data is the mode of direction measurements taken every 2 seconds. The data is expressed in sexagesimal degrees (°) referring to the North and indicates the direction of origin of the wind. The quantization error is 3°. The sensor consists of a wind vane, which can rotate around a vertical axis, shaped in such a way as to always align itself according to the direction of origin of the wind. The vane is connected to a transducer element, integral with the axis of rotation, which transforms the angular position of the sensor into a digital electrical signal.

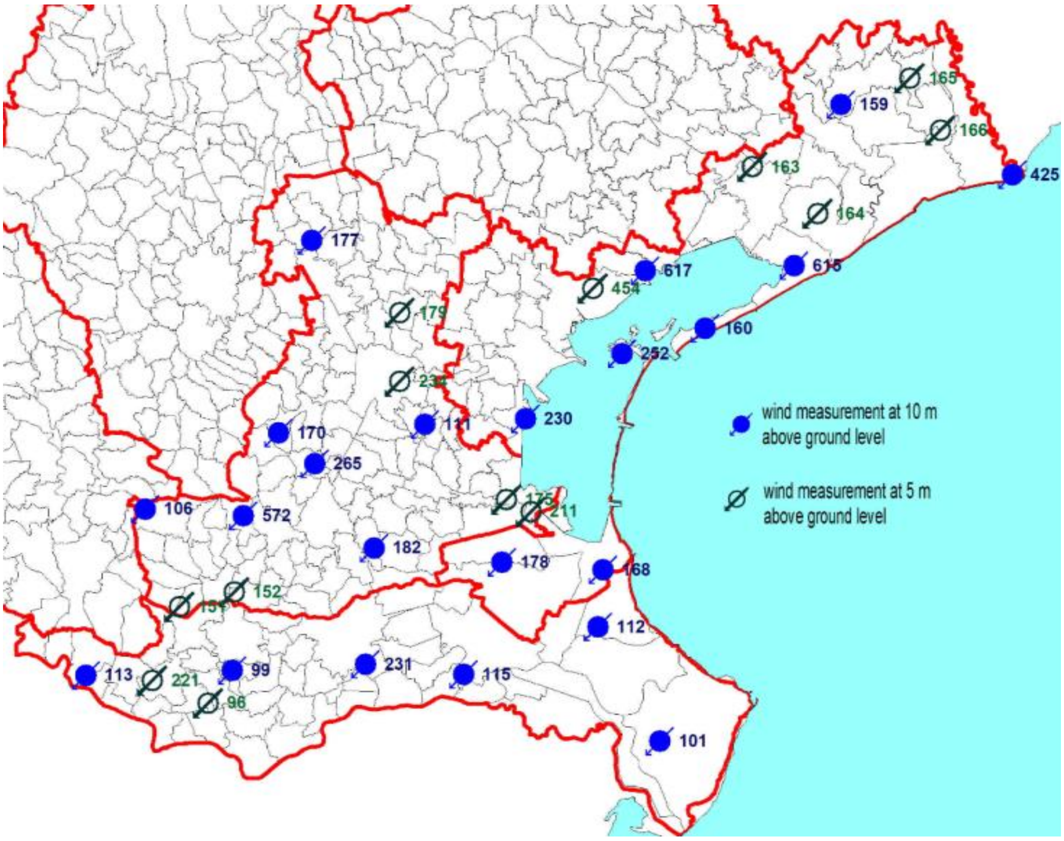


Figure 2.1-1 Veneto Region Province of Padua Rovigo and Venice location of the ARPAV automatic weather stations that measure wind speed and direction at 10 m and 5 m above the ground. To the right of the symbol is the station code.

The transducer element is an optical encoder consisting of a transparent disk with a series of concentric rings with black and white sectors printed on it, arranged so as to represent a Gray type binary sequence (7 bits) along a reading range. Sonic wind speed and direction sensors are used in 2 of the 6 new RESPONSe project installations (Cortellazzo and Zuccarello).

The wind measurements must be carried out at 10 meters above the ground in a place without obstacles for the data to be meaningful for meteorological and climatological applications, as set out by the World Meteorological Organization (WMO) standards. Some ARPAV stations, however, carry out wind measurements at 5 meters above the ground (simplified installation) or 2 meters above the ground (for agrometeorological measures). These measures are affected by the friction produced by the ground and the effect of nearby obstacles.

Atmospheric Pressure is acquired every 30 minutes by averaging samples taken every 30 seconds. The data is expressed in hPa with one decimal value. The measurements are stored both considering the station altitude and its equivalent at sea level. The measuring instrument is a piezoresistive pressure sensor installed about 1.5 m above the ground.

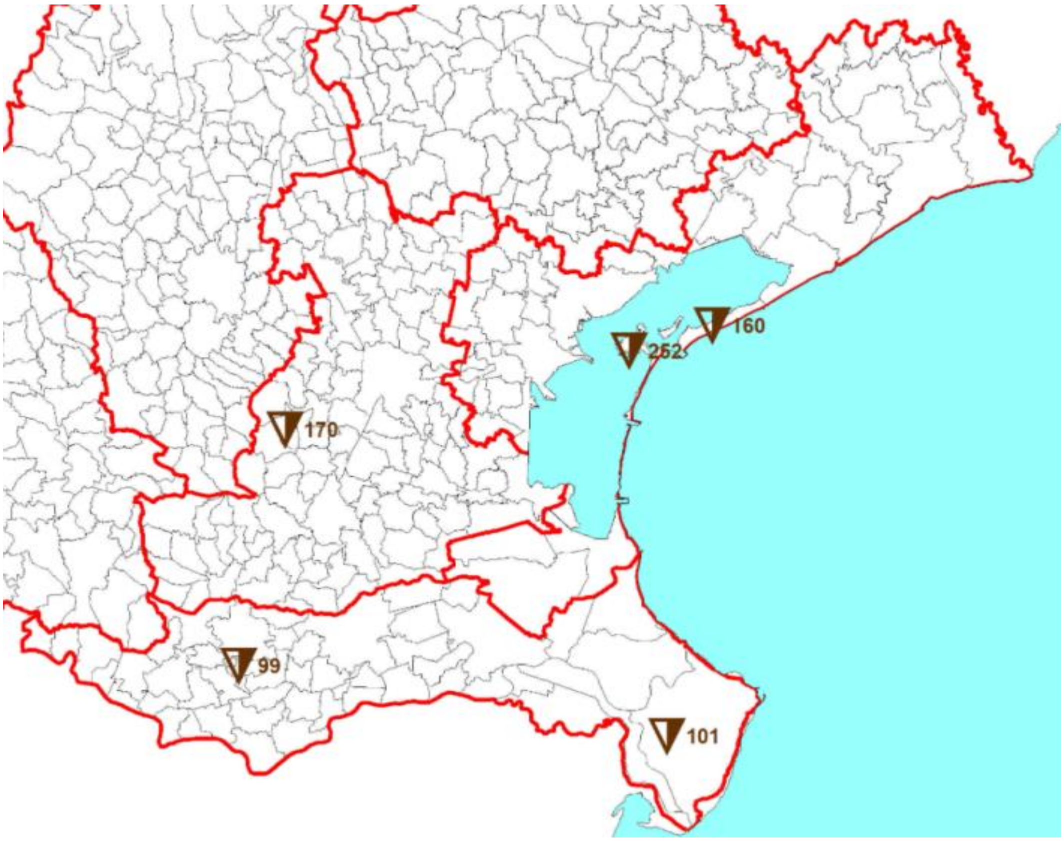


Figure 2.1-2 Veneto Region, Provinces of Padua, Rovigo and Venice, location of the ARPAV automatic weather stations that measure atmospheric pressure. To the right of the symbol is the station code.

2.1.2 DATA TRANSMISSION AND STORAGE

The data collected by the stations are transmitted via radio to the acquisition center. Currently, a selection of stations is queried every hour to get a real-time picture of the meteorological situation in Veneto, while the remaining stations transmit their complete daily archive after midnight.

The data, both at the acquisition scan and as hourly and daily derived values, are stored in an ARPAV database called SIRAV (Veneto Regional Environmental Information System), which is a relational database in an ORACLE environment.

A specific application called VALIDAZIO allows a group of technicians to carry out the daily control of consistency and quality of the data activating, if necessary, the interventions of the maintenance teams. This application, thanks to automatic procedures and easy graphical representations, helps operators to identify absence of data, format errors, exceeding the instrumental rage values, exceeding values such as 10 and 90 percentile, excessive persistence of data with the same value, and excessive variations of the data in a limited period of time. In addition, the VALIDAZIO program allows the technicians to make comparisons between trends of different sensors of the same station (e.g. presence of leaf wetness if rain is recorded or relationships between changes in temperature and relative humidity of the air) and between trends of the same sensor on nearby stations. Comparisons are also possible between the images of the meteorological radar and the point values measured by the rain gauges. It is specified that the VALIDAZIO program carries out automatic reports but the final decision to validate or modify or cancel a data lies with the technician.

2.2 Venice Water Authority monitoring equipment

The six old stations belonged to the “Ufficio Idrografico del Magistrato alle Acque di Venezia” (Hydrographic Office of the Venice Water Authority) which built and managed them since the beginning of the last century. Such institution was tasked with the management of the main rivers of the North East of Italy, hence it was also interested in the measurement of rainfall inflows and hydrometric outflows.

Having now replaced these historical stations and integrated them into another institution (ARPAV), we find it important to record here briefly the history of the Venice Water Authority and its station technology.

With the Law of 5 May 1907, n. 257 the Italian State instituted the “Regio Magistrato alle Acque per le Province Venete e di Mantova” (Royal Water Magistrate for the Veneto and Mantua Provinces), successor to the historic institution of the Venice Republic of *Serenissima*, called: “Magistrato alle Acque” and which was in charge of the hydraulic management of the Venice lagoon.

To this body, according to the provisions of Art. 13, was "*entrusted with the task of providing for the orderly and methodical collection of hydrographical observations in relation to meteorological conditions concerning the rivers and their mountain basins of the Compartment, the lagoon and the sea of Venice*".

The Venice Water Authority represented the first example in Italy of a hydrographical research center performing monitoring activities in the field of thermometry and meteorology and setting up a specific Hydrographic Office.

This operating model was extended to the whole Italian territory with the Decreto Luogotenenziale (legislative act in wartime) of 17 June 1917, n. 1055 that established the Italian Hydrographic Service, active throughout the country in support of the Offices of the Royal Corps of Civil Engineers. The entire structure depended on the Ministry of Public Works.

The Italian territory was initially divided into 10 hydrographically defined regions including entire hydrographic basins; for each of these regions an Autonomous Office or Section of the Civil Engineering was established.

At the end of 1926, 97 thermometric stations and 651 pluviometric stations were active in the three regions in the North-East of Italy: Veneto, Friuli-Venezia-Giulia and Trentino-Alto-Adige.

The Venice Water Authority organization assumed the utmost importance in the 1930s, in the period of maximum exploitation of water resources for hydroelectric purposes. Subsequently, the human and economic resources available progressively decreased with a consequent decay of the observation network.

With Law 18 May 1989, n. 183, "Rules for the reorganization of land conservation" and with the Decree of the President of the Republic of 24 January 1991, 85 National Technical Services were established with consequent reorganization of the Hydrographic Offices which now depend on the Presidency of the Council of Ministers. The body was named “S.I.M.N. - Servizio Idrografico e Mareografico Nazionale” (National Hydrographic and Marine Service). This reorganization did not stop the slow decline of the institution which continued to operate with obsolete mechanical-manual monitoring tools, disseminating observational data through paper publications that reached the public with a delay of years. Finally, with the Law of 15 March 1997, n. 59, it was envisaged, among other things, the transfer of part of the functions of the Hydrographic Service to the Regions while other functions, such as those of the Marine Service remained with the remit of the State.

The Veneto Region decided to entrust ARPAV to carry out the monitoring functions of the former Venice Hydrographic and Marine Service with Regional Law 16 August 2007, no. 20, paragraph 2 of art. 13.

ARPAV inherited an observation network on the regional territory based on about 200 automatic meteorological stations, and decided to decommission most of the manual weather and hydrographic stations, considering the difficulty of finding on-site observers willing to carry out daily measurements. Only 16 historic rain gauge stations remained operational until 2020, when ARPAV automated them making use of funds from the RESPONSe Project for the 6 stations placed in the coastal area.

2.2.1 MEASURING THE PRECIPITATION BY THE HYDROGRAPHIC OFFICE

In 1911 the "Officina Meccanica di Precisione" (Precision Mechanics Workshop) was established in Strà (VE) under the control of the Venice Hydrographic Office with the aim of providing for the construction and maintenance of the increasingly numerous hydro-meteorological measurement equipment that began to be installed widely, on the territory of the Compartment of the Venetian Provinces and Mantua.

Following the creation of the Italian Hydrographic Service in 1917, the workshop began the mass construction of instruments for the entire national territory. The pluviometric instruments of the historic stations of the Hydrographic Office in use in the Veneto are in fact produced by this body.

Figure 2.2-1 Workshop of Strà room of lathes and mechanical processing

Figure 2.2-2 Historical rain gauge station;
on the left totalizer rain gauge and on the right recording rain gauge both built by the Strà workshop.

Totalizer rain gauge

Called rain gauge type C. 10, it is defined by manufacturers as *“the simplest and most exact instrument for measuring precipitation amount. It consists of a cylindrical container of leaded sheet metal, mounted with two pins on a special stand, whose upper edge is a brass ring with a sharp edge delimiting an area of 0.1 m^2 (i.e. a circumference with a diameter of 35.7 cm). The bottom of the container has an inverted truncated cone to reduce evaporation losses and, for the same purpose, a lid, also a cone, is placed at about 10 cm from the upper edge, with a small central hole for the passage of the rain water; in the case of precipitation in the snowy state, this cover is removed.*

The value of the precipitation height is obtained by emptying the water collected from the container in the appropriate graduated measure."

The capturing mouth of these instruments is positioned horizontally at a height of 2 m above the ground level.

Figure 2.2-3 Totalizer rain gauge C. 10 with absorbing surface of 1000 cm^2 diameter 35.7 cm with conical lid inserted about 10 cm from the upper edge

Figure 2.2-4 Totalizer rain gauge C. 10 with cover removed, in configuration for the measurement of snowfall.

Figure 2.2-5 Totalizer rain gauge type C. 10:
front view and detail of the opening spout for emptying the water into a graduated cylinder.

Recording Rain Gauge or Pluviograph[1]

Called pluviograph type M. 20, this instrument is defined as "…*of the scale type which allows the recording of the height of rain by drawing its diagram over time on a special printout wrapped around a rotating cylinder. The instrument transmits an impulse to the writing pen every 0.2 mm of rain that has fallen: this value therefore represents its sensitivity, but lower precipitation heights are not lost because they are retained by the instrument until the first subsequent rain falls, adding to this.*

The nib runs through the cylinder from bottom to top and vice versa, each stroke corresponds to 10 mm of precipitation. The rotation of the cylinder is given by a precision watchmaking movement with an anchor escapement on 13 stones and a thermal compensation balance wheel: the rotation of the cylinder can be weekly or daily but, in any case, the watch lasts about 8 days.

The appliance can be installed inside a building, placing the capture funnel (of 0.1 m^2 surface) on its roof, or inside a wooden shed on the roof of which the capture funnel is placed; this type of system is the one commonly adopted in hydrographic service stations.

The instrument is subjected to a scrupulous calibration with a water flow corresponding to a rain intensity of 50 mm/hour to ensure recordings of strong intensity practically free from error: for much stronger or much weaker intensities the device commits an error in defect or in excess, respectively, which however does not exceed 1%.

The pluviograph, built entirely of carefully painted or nickel-plated brass, is contained in a sturdy painted metal case measuring 30x20x20 cm and is supplied with printed diagrams, nibs and bottles of special ink."

The pluviograph's hut

Most of the pluviographers of the Hydrographic Office operate inside a wooden shed with a base of 60x50 cm, front height of 46 cm, rear height of 30 cm and roof covered in sheet metal, removable by sliding, with a single slope on which it is placed the capturing surface of the instrument. A front door with one leaf allows access to the recording instrument. Four wooden or metal legs support the shed in such a way that the catching mouth is in a horizontal position at a height of 2 meters above the ground level. The water collected by the funnel on the top is passed through the double oscillating scale measuring mechanism and, subsequently, is discharged to the ground by means of two tubes passing through the floor of the shed.

[1] The parts in *italics* are taken from: Ministero Lavori Pubblici Ufficio Idrografico del Magistrato alle Acque Venezia "Officina Meccanica di Precisione Strà (Venezia) Ristampa del 1987 della rassegna degli strumenti più significativi".

Figure 2.2-6 The pluviograph inside the wooden shed - Cortellazzo station year 2019.

Figure 2.2-7 Detail of the precipitation capture funnel for M 20 type logger pluviograph located on the roof of the wooden shed. Capturing surface 1000 cm^2 diameter 35.7 cm

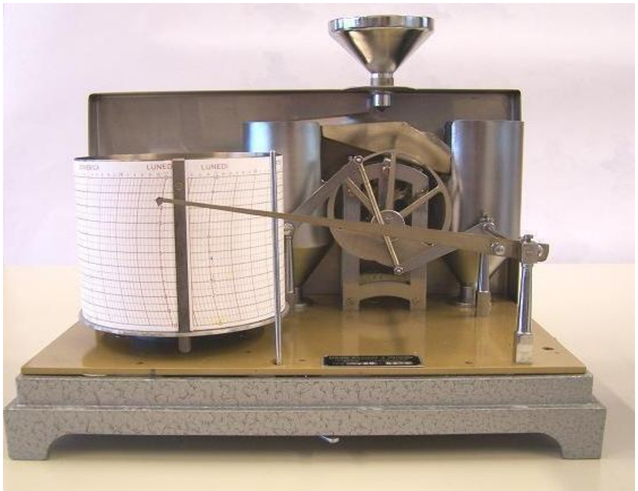


Figure 2.2-8 Recording Rain Gauge type M. 20 built by the Precision Mechanical Workshop of Strà, with tipping buckets. The bucket on the left is loading the rain, on the right is unloading.

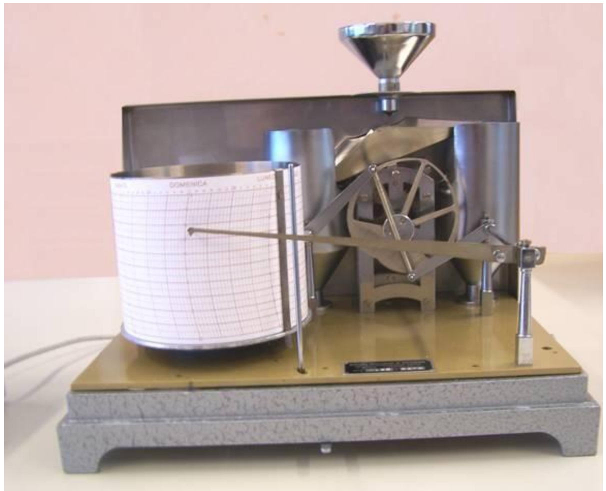


Figure 2.2-9 Recording Rain Gauge with the right bucket loading the rain.

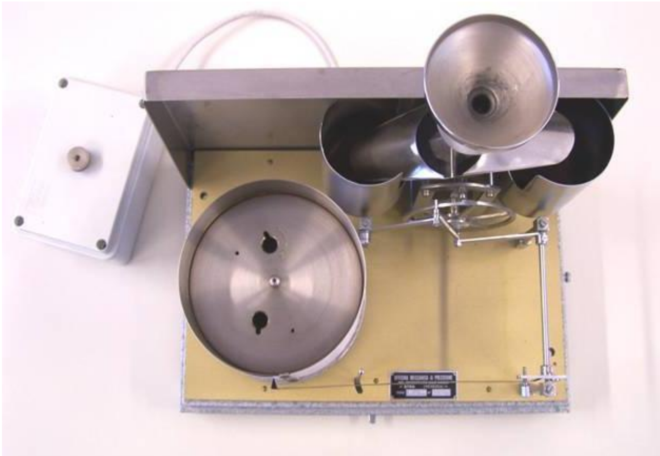


Figure 2.2-10 Pluviograph seen from above: the transmission system of rain measurements from the tipping buckets to the writing pen is clearly evident; the pluviogram cylinder, in this case, is rotated by an electric motor driven by the box on the left instead of by the spring clock mechanism

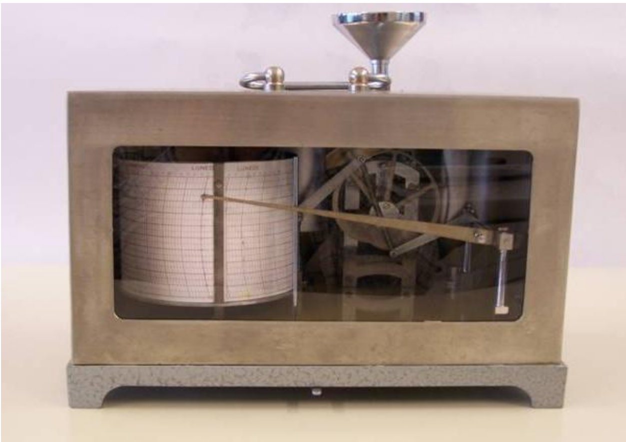


Figure 2.2-11 Pluviograph Recorder type M. 20 complete with metal case.

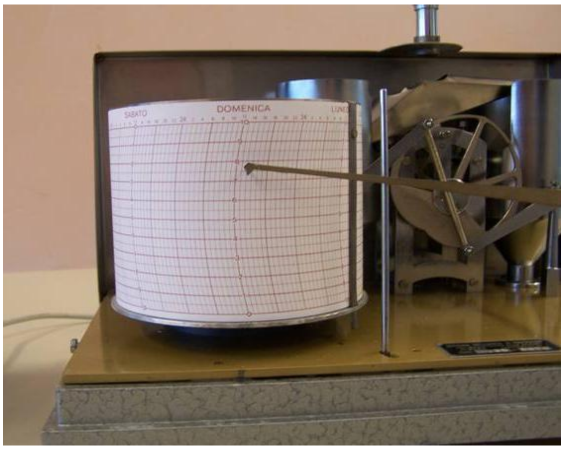


Figure 2.2-12 Pluviograph type M. 20 detail of the rotating cylinder with weekly pluviogram and nib.

Figure 2.2-13 Pluviograph type M. 20 detail of the label with the serial number.

2.2.2 MEASURING THE TEMPERATURE BY THE HYDROGRAPHIC OFFICE

Maximum and minimum thermometers

There is no adequate information about the measuring instruments used over the years by the Hydrographic Office but it is known that maximum and minimum thermometers, also known as Six thermometers (named after the inventor, the English physicist James Six 1731-1793), were in use in the stations.

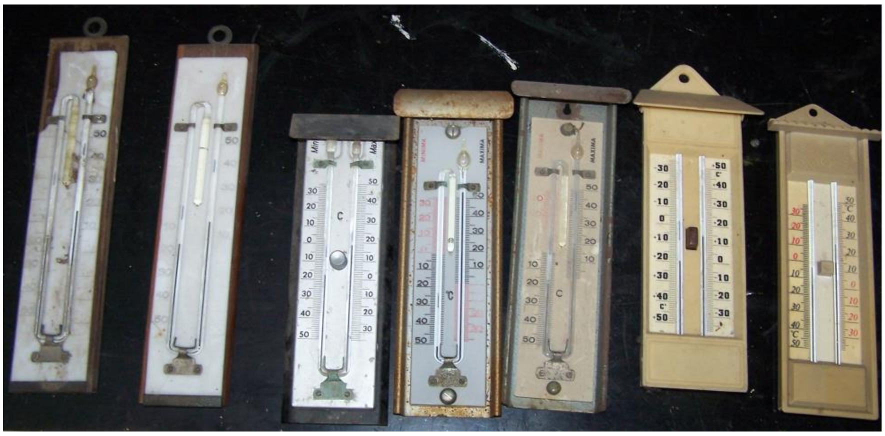


Figure 2.2-14 Some types of thermometers used in the stations of the Hydrographic Office.

These thermometers consist of a U-shaped glass capillary tube with a bulb at the top of each of the two ends. The bulb at the top of the minimum scale, generally larger, contains alcohol while the other is generally under vacuum (or contains low pressure alcohol vapours).

In the central part of the capillary holds a mercury column pushed along the capillary according to the dilation or contraction of the alcohol. Therefore, alcohol acts as a thermometric liquid while mercury indicates the temperature on both the maximum and minimum thermometric scales drawn on both sides of the capillary.

Two indicators consisting of metal needles with a blue glass tube rest on the two ends of the mercury column and are pushed upwards; the maximum needle from the expansion of alcohol, the minimum needle from its contraction, stably marking the extreme temperature values found over the course of a day.

When reading the values, the operator reports the two indicators in contact with the mercury with the use of a magnet. The thermometers recovered following the dismantling of the stations were equipped with a scale from +50 °C to -35 °C (measurement range) with a quantization error of 1 °C.

The quality of the instrumentation seems to have worsened over time with the use, in the last stages, of non-professional instruments as well.

Thermograph or Recording Thermometer

Up to the 1930s the thermographic stations were equipped with Bourdon tube thermographs from the Parisian company Richard, subsequently replaced by SIAP (Società Italiana Apparecchi di Precisione) thermographs. SIAP Factory began its activity in 1925.

The type examined at the Strà workshop was a TM 26 model with bimetallic foil with a measuring range from -15 °C to +40 °C. The operating mechanism of these instruments is based on the deformation that a bimetallic sheet undergoes as the air temperature varies due to the different expansion of the two metals that make up the sheet (generally materials with a low coefficient of thermal expansion are coupled with materials of high expansion coefficient). The movement of the bimetallic sheet is amplified by a system of levers with adjustment screws and transferred on the vertical plane by an arm equipped with an ink pen capable of writing on a weekly chart paper roll applied to a cylinder that is rotated by a spring-loaded clockwork mechanism.

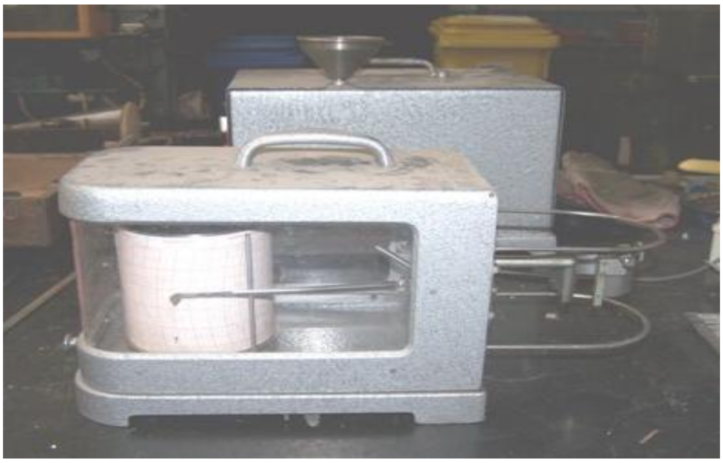


Figure 2.2-15 SIAP Thermograph - on the right you can see the curved bimetallic sheet whose deformation allows the measurement of the air temperature

Figure 2.2-16 Thermometric shed

The thermometric shed

The thermometric station consisted of a hut made of larch or chestnut wood painted in white. The huts recently in operation had a base of 40x50 cm with a double wooden floor, front uprights of 55 cm in height and rear uprights of 50 cm in height.

The natural ventilation of the shed was guaranteed by fixed shutters with 8 fins on 3 sides, reduced to 6 on the front door. A further large gap was also obtained between the walls of the shed and the continuous wooden panel with a single upper slope. The roof consisting of a corrugated slab of asbestos was raised by two wooden spacers 5 cm thick. The box stands on the ground with 4 wooden legs also of white colour. The base of the shed was about 1.25 m from the floor, presumably the thermometric instruments operated at about 1.50 meters above the ground.

Various photos and historical illustrations show larger thermometric or thermo-hygrometric sheds in operation with 2 sloping roofs and double louvered walls.

2.2.3 METEOROLOGICAL OBSERVATIONS IN THE ANNALS OF THE HYDROGRAPHIC OFFICE

The data of the daily observations (9 a.m. manual readings) were initially disseminated by the Hydrographic Office through the printing of Monthly Bulletins then becoming an annual report from 1955. to 1996. via the Hydrological Annals publication. The observations were divided into two volumes, the first containing meteorological data and the second containing hydrometric and groundwater data.

Figure 2.2-17 Cover of the Monthly Bulletin of the Hydrographic Office of January 1931.

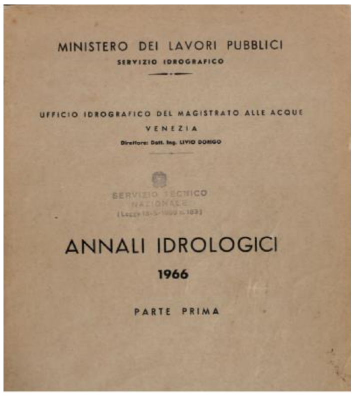


Figure 2.2-18 Hydrological Annal of the Hydrologic Office Part One, year 1966.

For the temperatures, the reading was carried out at maximum and minimum thermometer or more rarely by a recording thermograph, always reporting the maximum and minimum values of the previous 24 hours. The datum was generally rounded to the full °C. The readings taken on the thermometer were assigned to the day of the observation. Consequently, unless there are particular meteorological situations with sudden advection of cold or hot air, it can be assumed that the minimum temperature occurred on the day of reading while the maximum occurred on the day before the reading.

Table 2.2-1 Daily data of maximum and minimum temperature from the chioggia (ve) station sorted by monthly columns, extracted from page 40 of hydrological annal of 1966.

Tabella I. — Osservazioni termometriche giornaliere. *Anno 1966*

CHIOGGIA
(Tr) PIANURA FRA PIAVE E BRENTA (2 *m* s. m.)

Giorno	G		F		M		A		M		G		L		A		S		O		N		D	
	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min
1	2	-1	4	1	13	8	14	8	22	18	20	15	26	20	26	21	24	18	21	15	9	8	7	3
2	5	-1	4	2	12	8	14	10	23	16	23	15	27	22	27	22	23	20	21	18	11	7	13	6
3	4	-1	5	3	10	8	14	10	24	15	24	15	27	22	30	21	24	21	21	18	15	9	10	4
4	7	-1	7	4	9	8	14	10	22	16	22	19	28	22	30	23	24	20	23	18	17	10	10	5
5	7	3	7	5	10	9	18	10	26	15	24	19	29	22	30	22	26	21	22	19	14	10	10	4
6	4	1	7	6	12	9	17	11	20	16	23	19	33	22	25	23	25	20	22	19	14	10	7	4
7	3	-2	7	6	14	8	15	11	20	11	24	20	32	19	26	20	25	20	22	18	10	9	8	2
8	3	-1	8	4	12	9	15	12	14	11	24	21	26	19	26	21	26	21	21	19	12	10	10	5
9	3	-2	8	6	13	7	17	12	16	11	24	21	26	22	26	18	25	21	22	20	11	10	8	3
10	4	1	10	6	14	8	14	12	13	10	26	19	27	21	26	22	25	21	23	19	12	10	8	3
11	2	0	9	5	12	9	16	11	20	11	27	20	27	21	27	22	25	21	22	19	12	10	4	-1
12	3	-4	11	8	10	3	13	12	19	12	28	21	28	20	33	22	25	20	21	17	12	10	6	-1
13	3	-1	9	8	8	2	15	12	19	15	28	24	29	22	30	24	26	22	22	16	11	7	6	2
14	3	-3	9	8	9	4	20	11	22	16	25	22	28	24	32	25	24	20	19	15	9	5	5	2
15	2	-1	12	4	10	3	20	12	24	18	26	23	26	21	31	24	23	20	20	17	7	5	6	-1
16	0	-2	9	5	10	5	13	11	25	19	27	22	27	21	30	17	25	18	21	18	7	5	3	0
17	1	-6	9	8	11	4	22	11	22	19	29	22	25	19	21	18	20	18	18	17	8	5	3	0
18	3	1	8	6	10	4	18	12	22	16	30	24	25	19	27	18	21	18	19	14	9	7	1	-1
19	1	-8	8	6	11	9	19	12	21	16	30	20	23	16	25	18	21	19	19	15	9	6	4	0
20	2	-8	10	7	9	6	18	13	21	16	25	17	22	15	26	17	21	17	20	14	8	6	5	3
21	2	-1	11	8	11	6	17	11	22	19	24	17	23	18	23	20	22	16	18	13	7	5	8	1
22	4	-1	18	9	11	4	13	10	23	19	25	19	27	17	24	20	22	16	16	12	8	5	4	-2
23	5	0	11	9	12	9	16	11	23	19	26	21	27	21	25	20	22	17	14	11	8	7	5	-2
24	1	0	12	7	14	10	18	12	21	17	28	22	27	22	21	19	22	17	16	14	7	6	1	-2
25	6	1	11	5	11	6	14	13	21	17	29	21	26	22	19	16	22	16	17	15	8	6	4	-1
26	8	6	13	7	12	3	23	13	21	15	26	22	24	21	22	15	21	17	17	13	8	5	6	2
27	6	4	13	8	11	5	23	12	21	16	26	21	26	21	21	16	22	18	17	11	7	3	4	1
28	5	2	10	7	14	8	26	16	23	14	28	20	22	19	23	18	21	19	17	13	3	-1	8	4
29	3	1			13	6	26	18	22	13	25	19	29	17	24	18	21	19	15	11	6	-2	8	5
30	3	0			»	5	24	17	19	13	26	18	30	20	21	18	21	17	13	10	5	2	5	1
31	3	1			»	»			20	15			26	20	23	16			12	8			7	0
Medie	3.5	-0.7	9.3	6.0	11.3	6.4	17.2	11.9	21.0	15.3	25.7	19.9	26.7	20.2	25.8	19.8	23.1	18.9	19.1	15.4	9.5	6.5	6.3	1.6
Med. mens.	1.4		7.6		8.8		14.6		18.2		22.8		23.5		22.8		21.0		17.2		8.0		3.9	
Med. norm.	3.0		4.3		8.2		13.1		17.5		21.2		24.0		23.8		20.6		14.9		9.1		4.7	

For rainfall, the reading of the daily data was carried out:

- on Pluviograph by reading the amount of rain fallen in the previous 24 hours;
- in totalizing rain gauges by overturning, in a graduated cylinder, the water content accumulated during the previous 24 hours.

Often the two types of instruments were coupled and the measurement carried out at 9 am is referred to the 24-hours observation from 9 a.m. of the previous day (i.e. for 15 hours) and of the precipitation falling in the first nine hours of the reference day.

The daily precipitation data was measured to the tenth of a mm.

In the Hydrological Annals, the daily precipitation data was always reported for all the rainfall stations in "Sezione B- Pluviometria Tabella I – Osservazioni pluviometriche giornaliere" (Section B- Pluviometry, Table I - "Daily rainfall observations").

Table 2.2-2 Daily precipitation data from the stations of Zuccarello (VE) and Ca 'Pasquali (VE) sorted by monthly columns, extracted from page 143 of Hydrological Annal of 1966.

Tabella I . Osservazioni pluviometriche giornaliere — *Anno 1966*

ZUCCARELLO (Idrovora) (Pr) — Pianura fra PIAVE e BRENTA (2 *m* s. m.)

Giorno	G	F	M	A	M	G	L	A	S	O	N	D
1	—	—	1.0	—	—	—	—	—	0.4	0.2	—	—
2	0.4	—	0.4	—	—	—	—	1.2	—	0.2	—	0.6
3	0.2	—	—	—	—	—	—	—	—	—	7.2	2.2
4	0.2	—	1.6	0.2	—	—	—	—	—	0.2	92.0	—
5	—	—	8.2	0.2	0.2	—	—	—	0.2	—	11.0	3.0
6	—	—	—	—	—	—	—	11.6	0.4	2.6	1.2	9.8•
7	—	—	—	—	20.4	—	—	—	—	0.2	—	—
8	—	0.6	—	0.6	1.6	—	5.0	—	0.2	7.8	—	0.8
9	—	—	—	0.8	1.8	1.6	—	13.4	—	7.4	—	0.2
10	—	0.2	—	9.4	22.8	—	—	—	0.2	—	0.6	—
11	—	—	—	12.8	14.0	—	—	—	0.2	0.2	0.6	—
12	3.0•	5.8	0.2	15.8	—	—	2.2	—	—	32.5	—	0.2
13	—	—	18.6	—	—	—	—	—	0.2	21.6	—	9.0
14	—	29.0	—	0.2	0.2	0.4	—	—	—	0.2	—	—
15	—	1.4	—	—	—	0.8	—	—	—	—	—	—
16	—	—	—	3.4	—	—	1.2	—	—	2.6	—	0.2
17	—	2.8	—	23.2	—	—	—	{	29.4	3.8	26.5	—
18	1.4•	0.4	—	0.2	—	—	1.8	64.9	4.4	1.8	1.2	—
19	—	—	—	—	—	—	18.2	1.0	—	—	—	—
20	—	—	0.4	0.2	—	—	8.4	—	—	4.6	1.6	—
21	—	—	—	0.6	—	—	1.0	—	—	0.2	4.6	—
22	—	1.0	—	6.6	—	—	—	—	—	—	0.2	0.2
23	28.6	1.8	—	—	—	—	—	15.0	—	0.4	0.4	—
24	—	3.6	1.2	—	—	—	—	—	0.2	—	5.2	—
25	0.2	0.2	1.2	—	0.6	4.2	35.4	14.9	0.2	5.0	13.2	0.2
26	—	0.2	—	—	5.8	—	—	2.2	—	1.0	—	—
27	3.8	—	—	—	0.6	—	0.2	—	0.2	24.2	0.2	—
28	—	0.2	—	—	—	—	10.2	—	—	—	0.2	0.4
29	0.2	—	—	—	—	3.0	0.2	—	0.2	17.4	3.6	6.4
30	0.2		2.0	—	21.2	—	—	0.2	9.2	4.4	12.2	0.2
31	—		—		—		4.2	20.0		1.6		0.2
Totali mens.	38.2	47.2	34.8	74.2	89.2	10.0	88.0	144.4	45.6	140.1	181.7	33.6
N. gior. piovosi	4	7	7	6	7	3	10	10?	3	15	12	5

Totale annuo: 927.0 *mm* — Giorni piovosi: 89

CA' PASQUALI (Treporti) (P) — Pianura fra PIAVE e BRENTA (2 *m* s. m.)

Giorno	G	F	M	A	M	G	L	A	S	O	N	D
1	—	—	1.2	—	—	—	—	—	4.8	1.4	—	—
2	—	—	0.2	—	—	—	—	0.8	—	0.6	—	0.2
3	0.2	—	—	—	—	—	—	—	—	—	4.4	2.6
4	0.2	—	1.4	0.2	0.2	—	—	—	—	—	90.0	0.6
5	—	—	6.4	0.2	—	—	—	—	—	0.2	16.8	4.0
6	—	—	—	—	—	—	0.2	—	—	0.8	0.8	11.6
7	—	—	—	0.2	19.2	—	—	—	—	0.2	0.2	—
8	—	1.2	—	—	2.2	—	0.2	—	0.2	7.2	—	0.4
9	—	0.2	—	0.4	2.4	1.2	0.4	9.2	—	5.8	—	—
10	—	0.2	—	14.6	13.2	0.2	—	—	0.2	0.4	1.4	—
11	—	—	—	7.4	10.0	—	—	—	0.2	0.2	—	—
12	[6.0•]	4.4	—	19.4	—	—	3.4	0.2	—	2.8	0.8	0.2
13	—	—	28.0	0.1	—	—	—	—	—	15.6	—	5.8
14	—	22.4	—	—	0.2	—	—	—	—	0.2	—	—
15	—	0.4	—	—	—	0.2	—	—	—	—	—	0.2
16	—	—	—	2.7	—	—	0.8	—	0.6	—	—	—
17	—	3.6	—	18.0	—	—	—	36.4	18.2	3.0	46.4	—
18	[2.0•]	0.2	—	0.2	—	—	9.4	18.2	6.2	3.6	0.6	0.2
19	—	—	—	—	—	—	40.4	—	—	0.2	—	—
20	—	—	—	0.2	—	—	11.0	—	—	6.2	5.4	—
21	—	—	—	2.2	—	4.2	—	—	—	—	8.0	—
22	—	0.2	—	14.4	—	—	—	—	—	0.4	—	—
23	31.0	2.8	—	—	—	—	0.2	1.7	—	0.2	1.4	0.2
24	—	4.8	0.6	—	—	—	—	0.4	—	—	3.2	—
25	0.2	0.2	0.2	—	2.8	2.4	14.6	2.4	0.2	4.2	11.6	—
26	0.2	0.2	—	0.2	8.8	—	—	3.6	—	0.2	—	0.2
27	2.6	—	—	—	0.2	—	0.2	0.2	—	9.8	—	—
28	—	0.2	—	—	3.2	—	11.0	—	0.2	0.6	—	0.2
29	0.2		—	—	—	—	2.0	—	—	24.6	3.0	5.2
30	—		2.8	0.2	3.6	—	—	—	8.8	8.0	16.8	—
31	—		—		—		—	9.0		4.6		0.2
Totali mens.	42.6	41.0	40.8	80.6	66.0	8.2	93.8	82.1	39.6	101.0	210.8	31.8
N. gior. piovosi	4	6	5	7	9	3	7	7	4	13	12	5

Totale annuo: 838.3 *mm* — Giorni piovosi: 82

For stations equipped with a Pluviograph, the maximum annual values for rains lasting 1, 3, 6, 12 and 24 consecutive hours, could also be reported in the annals. More rarely and not systematically, the maximum annual rainfall intensity values were also reported for the duration of 15, 30 and 45 minutes.

Table 2.2-3 Precipitation data of maximum annual intensity for the duration of 1, 3, 6, 12, 24 consecutive hours, extracted from page 208 of Hydrological Annal of 1966.

Tabella III. — Precipitazioni di massima intensità registrate ai pluviografi. *Anno 1966*

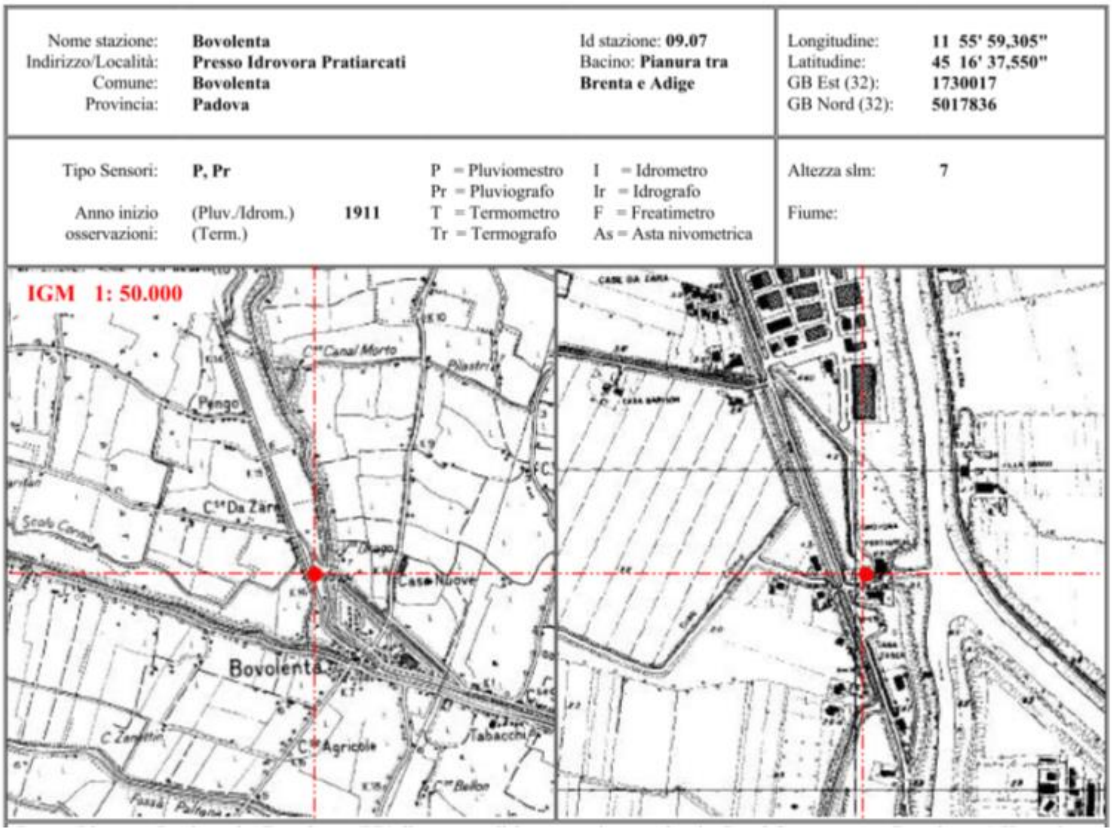
BACINO E STAZIONE	INTERVALLO DI ORE 1			3			6			12			24		
	mm	INIZIO giorno	INIZIO mese	*mm*	INIZIO giorno	INIZIO mese	*mm*	INIZIO giorno	INIZIO mese	*mm*	INIZIO giorno	INIZIO mese	*mm*	INIZIO giorno	INIZIO mese
(*segue*) PIANURA FRA PIAVE E BRENTA															
Portesine (idrovora)	32.2	30	ago.	45.0	3	nov.	53.8	3	nov.	67.4	3	nov.	109.5	3	nov.
Lanzoni (Capo Sile)	21.6	8	ago.	25.6	3	nov.	42.4	3	nov.	59.6	3	nov.	80.2	3	nov.
Cortellazzo (Ca' Gamba)	25.4	3	nov.	41.6	3	nov.	62.4	3	nov.	86.8	3	nov.	118.0	3	nov.
Ca' Porcia (idrov. II bacino)	17.2	24	lug.	34.0	3	nov.	51.6	3	nov.	75.2	3	nov.	100.6	3	nov.
Cittadella	32.2	25	lug.	39.2	8	ago.	49.6	16	ago.	69.6	16	ago.	87.0	16	ago.
Castelfranco Veneto	27.6	30	set.	34.8	16	ago.	41.2	16	ago.	61.0	3	nov.	97.0	3	nov.
Stra	18.6	16	ago.	29.0	3	nov.	43.8	16	ago.	59.2	16	ago.	97.0	16	ago.
Mestre	18.0	16	ago.	24.6	16	ago.	49.8	3	nov.	69.0	3	nov.	91.6	3	nov.
Rosara di Codevigo	19.2	16	ago.	23.2	3	nov.	38.4	3	nov.	55.0	3	nov.	74.0	3	nov.
Zuccarello (idrovora)	26.2	24	lug.	35.6	12	ott.	43.4	3	nov.	54.6	3	nov.	92.0	3	nov.
Ca' Pasquali (Treporti)	19.6	19	lug.	30.6	19	lug.	40.0	3	nov.	56.4	3	nov.	90.0	3	nov.
San Nicolò di Lido (Venezia)	27.2	16	lug.	33.4	16	lug.	37.8	3	nov.	59.8	3	nov.	84.5	3	nov.
Chioggia	44.0	16	ago.	47.8	16	ago.	49.2	16	ago.	96.6	16	ago.	104.6	16	ago.

2.3 RESPONSe impact - integration within the ARPAV network

2.3.1 Bovolenta (PD) Weather Station

The historic station of the Hydrographic Office

The historic station was installed by the Hydrographic Office in 1911 at the facilities of a dewatering plant (water pumping plant) belonging to the Bacchiglione-Brenta Land Reclamation Consortium. The station was equipped with a totalizing rain gauge and a recording rain gauge. ARPAV has manually digitized daily rainfall data for the period from 1920 to 2018.



Nome stazione:	**Bovolenta**	Id stazione: **09.07**	Longitudine: **11 55' 59,305"**
Indirizzo/Località:	**Presso Idrovora Pratiarcati**	Bacino: **Pianura tra Brenta e Adige**	Latitudine: **45 16' 37,550"**
Comune:	**Bovolenta**		GB Est (32): **1730017**
Provincia:	**Padova**		GB Nord (32): **5017836**
Tipo Sensori:	**P, Pr**	P = Pluviomestro Pr = Pluviografo T = Termometro Tr = Termografo	I = Idrometro Ir = Idrografo F = Freatimetro As = Asta nivometrica
Anno inizio osservazioni:	(Pluv./Idrom.) **1911** (Term.)		Altezza slm: **7** Fiume:

Figure 2.3-1 Monographic card of the station drawn up by the technicians of the Hydrographic Office.

Figure 2.3-2 Aerial photo of the dewatering plant;
The red arrow identifies the site of the historic station, the yellow circle identifies the site of the new station.

Figure 2.3-3 The dewatering plant and the historic station on the right

Figure 2.3-4 Detail of the historic station with totalizing rain gauge and recording rain gauge

The new ARPAV weather station

Within the Project RESPONSe, ARPAV has installed an automatic thermo-pluviometric station with real-time data transmission, placing it a few tens of meters from the historic site, within the area of the Land Reclamation Consortium.

Figure 2.3-5 Station view from the South-West

Figure 2.3-6 Station view from the North

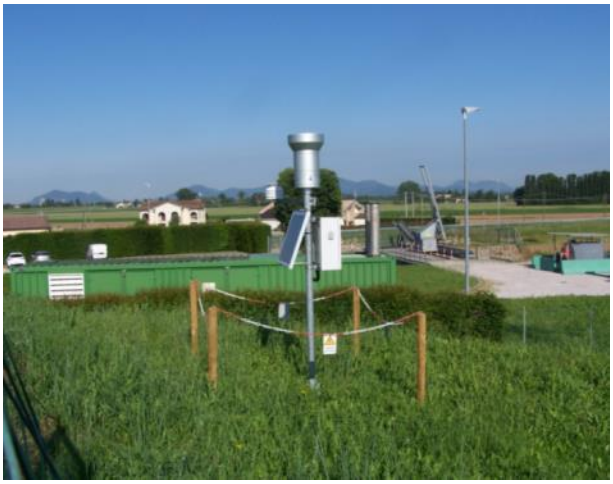


Figure 2.3-7 Station view from the East

Figure 2.3-8 Detail of the electronics box with logo

The new station, located on grassy ground free from obstacles, currently measures:

- a precipitation datum (in mm) every 5 minutes with a quantization error of 0.2 mm;
- a temperature datum (in °C) every 15 minutes with a quantization error of 0.1 °C.

In the ARPAV information system (SIRAV) the station is identified with code n. 611, it is named Bovolenta and it is operational from 00:00 solar time on 17/12/2020.

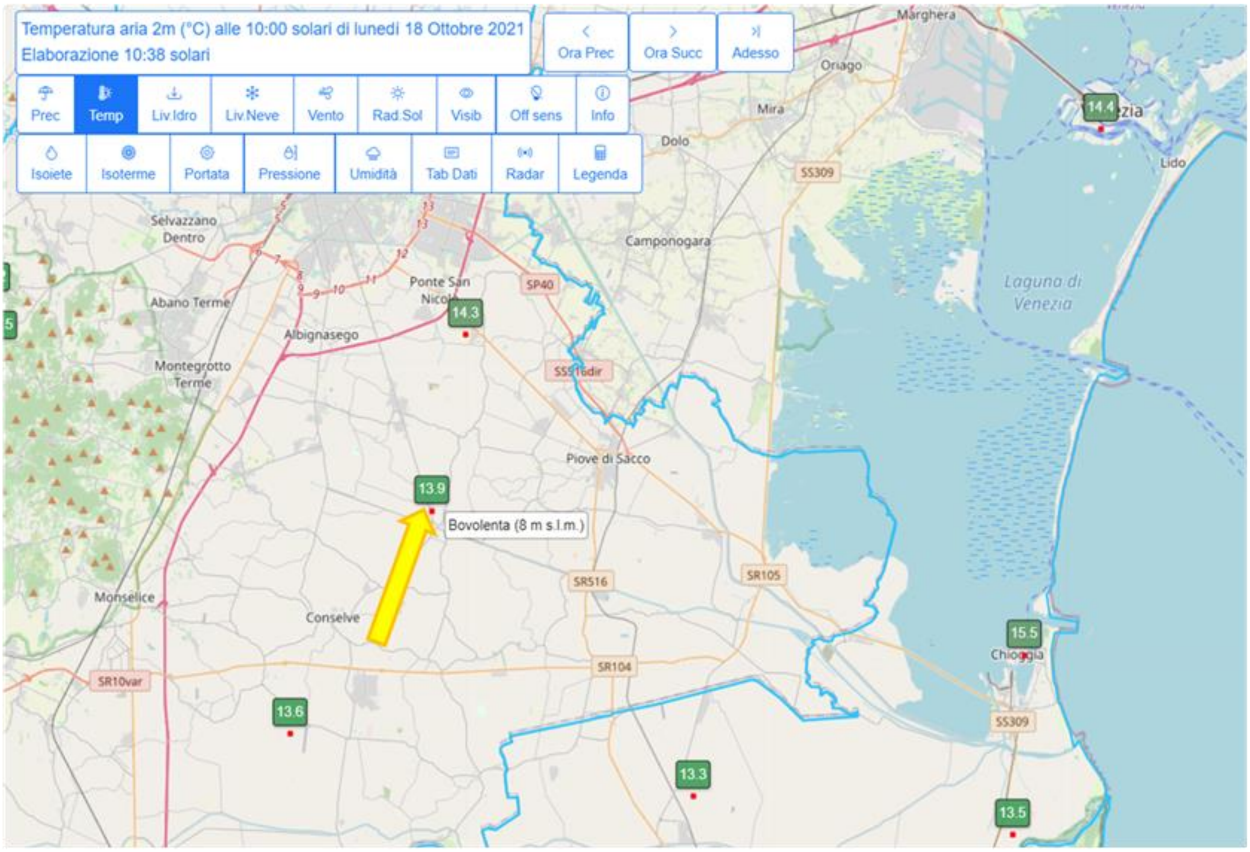


Figure 2.3-9 Real-time visualization of the data of the new Bovolenta station on the website www.ambienteveneto.it (air temperature at 10 am on 18/10/2021).

2.3.2 JESOLO - CORTELLAZZO (VE) WEATHER STATION

The historic station of the Hydrographic Office

The historic station was installed by the Hydrographic Office in 1922 at the facilities of a dewatering plant (water pumping plant) belonging to the Veneto Orientale Land Reclamation Consortium, within the Ca'Gamba basin. The station was equipped with a totalizing rain gauge and a recording rain gauge. ARPAV has manually digitized daily rainfall data for the period from 1922 to 2018.

Nome stazione:	**Cortellazzo (Cà Gamba)**	Id stazione: **05.10**		Longitudine:	**12 39' 37,097"**
Indirizzo/Località:	**Via Cavetta Marina n 9 loc. Cortellazzo**	Bacino: **Pianura tra Piave e Brenta**		Latitudine:	**45 32' 11,261"**
Comune:	**Jesolo**			GB Est (32):	**1785741**
Provincia:	**Venezia**			GB Nord (32):	**5048985**
Tipo Sensori:	**P, Pr**	P = Pluviomestro Pr = Pluviografo T = Termometro Tr = Termografo	I = Idrometro Ir = Idrografo F = Freatimetro As = Asta nivometrica	Altezza slm:	**1**
Anno inizio osservazioni:	(Pluv./Idrom.) **1922** (Term.)			Fiume:	**Sile**

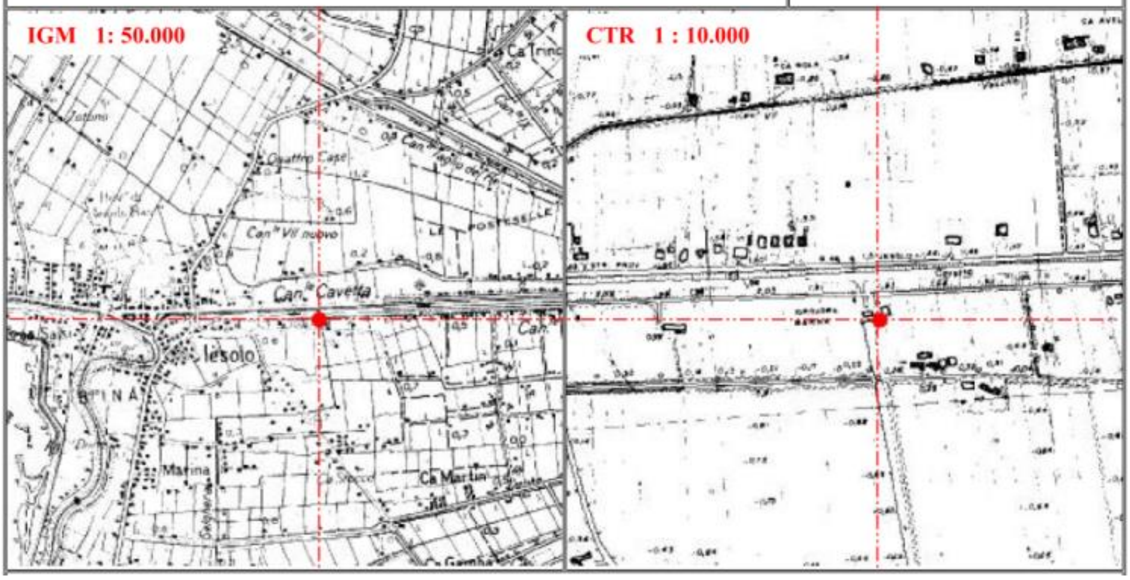


Figure 2.3-10 Monographic card of the station drawn up by the technicians of the Hydrographic Office.

Figure 2.3-11 Aerial photo of the dewatering plant;
The red arrow identifies the site of the historic station, the yellow circle identifies the site of the new station.

Figure 2.3-12 The small drainage system of Ca 'Gamba and the historic station

Figure 2.3-13 Detail of the historic station with recording rain gauge and totalizer rain gauge.

The new ARPAV weather station

Within the RESPONSe Project, ARPAV has installed an automatic weather station with real-time data transmission, placing it a few tens of meters from the historic site, still in the area of the Land Reclamation Consortium.

The new station currently measures:

- a precipitation datum (in mm) every 5 minutes with a quantization error of 0.2 mm; the mouth of the rain gauge is located 2 m above the ground;

Figure 2.3-14 Station view from the East

Figure 2.3-15 Detail of the rain gauge, thermometer and udometer

Figure 2.3-16 Detail of the electronics box with logo

Figure 2.3-17 Detail of the sonic sensor measuring the direction and speed of the wind at 10 m above the ground

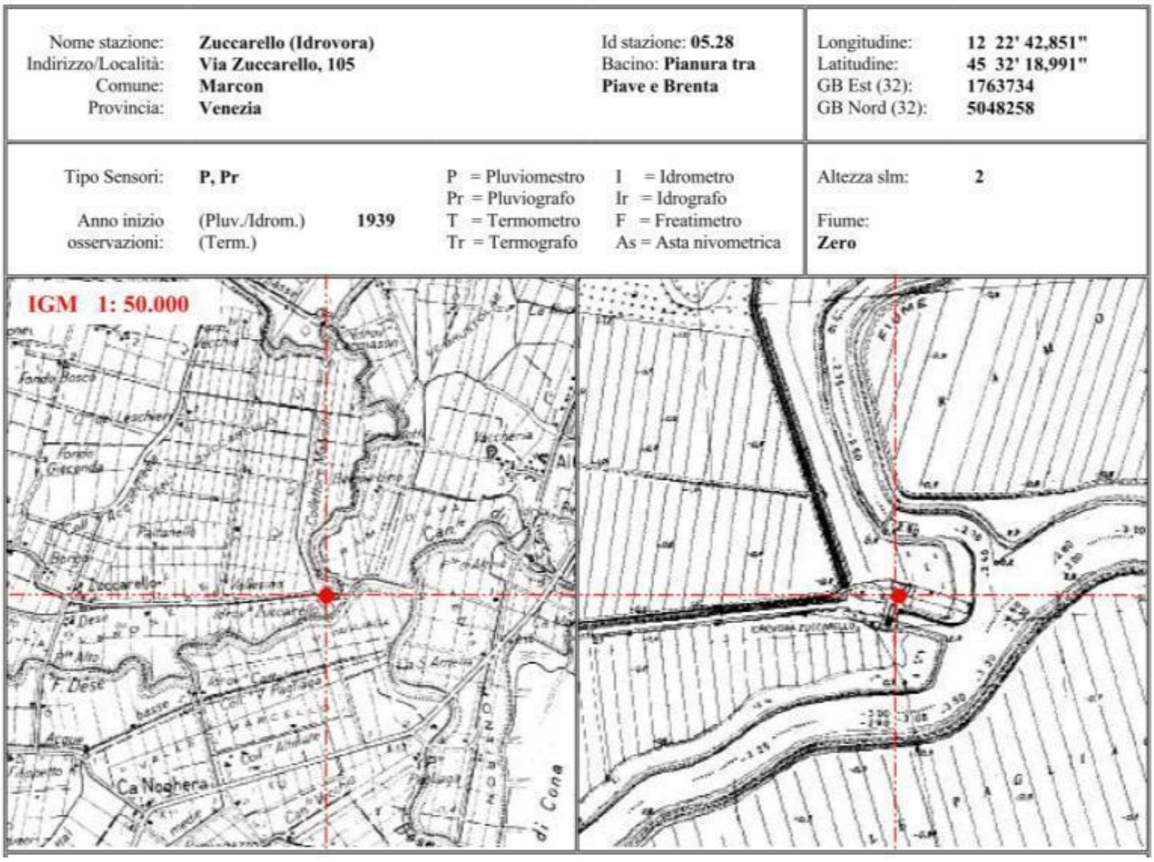
- an air temperature datum (in °C) at 2 m above the ground every 15 minutes with a quantization error of 0.1 °C;
- a datum of relative air humidity (in %) at 2 m above the ground every 15 minutes with a quantization error of 1%;
- a datum of average wind speed (in m/s) at 10 m above the ground every 10 minutes with a quantization error of 0.1 m/s;
- a wind gust datum (in m/s) at 10 m above the ground every 10 minutes with a quantization error of 0.1 m/s;
- a prevailing wind direction datum (in degrees) at 10 m above the ground every 10 minutes with a quantization error of 1 °.

In the ARPAV information system (SIRAV), the station is identified with code n. 615, it is named Jesolo - Cortellazzo (Municipality - Locality), and it is operational from 00:00 solar time on 12/02/2021.

2.3.3 MARCON - ZUCCARELLO (VE) WEATHER STATION

The historic station of the Hydrographic Office

The historic station was installed by the Hydrographic Office in 1939. at the facilities of a dewatering plant (water lifting plant) belonging to the Acque Risorgive Reclamation Consortium. The station was equipped with a totalizing rain gauge and a recording rain gauge. ARPAV has digitized daily rainfall data for the period from 1940 to 2018.



Nome stazione:	Zuccarello (Idrovora)	Id stazione: 05.28		Longitudine:	12 22' 42,851"
Indirizzo/Località:	Via Zuccarello, 105	Bacino: Pianura tra		Latitudine:	45 32' 18,991"
Comune:	Marcon	Piave e Brenta		GB Est (32):	1763734
Provincia:	Venezia			GB Nord (32):	5048258
Tipo Sensori:	P, Pr	P = Pluviomestro	I = Idrometro	Altezza slm:	2
		Pr = Pluviografo	Ir = Idrografo		
Anno inizio	(Pluv./Idrom.) 1939	T = Termometro	F = Freatimetro	Fiume:	
osservazioni:	(Term.)	Tr = Termografo	As = Asta nivometrica	Zero	

Figure 2.3-18 Monographic card of the station drawn up by the technicians of the Hydrographic Office.

Figure 2.3-19 Aerial photo of the drainage plant located near the confluence of the Zero and Dese Rivers; the red arrow identifies the site of the historic station, the yellow circle identifies the site of the new station.

Figure 2.3-20 The location of the rain gauge and the totalizing rain gauge on the driveway leading to the dewatering pump, West of the Guardian's house (low resolution pictures).

Figure 2.3-21 The historic station appears to have been repositioned to the East of the Guardian's house

The new ARPAV Weather Station

Within the RESPONSe project, ARPAV has installed an automatic weather station with real-time data transmission, placing it a few tens of meters from the historic site, still in the area of the Reclamation Consortium but away from the buildings as much as possible.

The new station currently measures:

- a precipitation datum (in mm) every 5 minutes with a quantization error of 0.2 mm; the mouth of the rain gauge is located 2 m above the ground;
- an air temperature datum (in °C) at 2 m above the ground every 15 minutes with a quantization error of 0.1 °C;
- a datum of relative air humidity (in %) at 2 m above the ground every 15 minutes with a quantization error of 1%;
- a datum of average wind speed (in m/s) at 10 m above ground every 10 minutes with a quantization error of 0.1 m/s;
- a wind gust datum (in m/s) at 10 m above the ground every 10 minutes with a quantization error of 0.1 m/s;
- a prevailing wind direction datum (in degrees) at 10 m above the ground every 10 minutes with a quantization error of 1°.

Figure 2.3-22 View of the new station towards the East (Dese River can be seen)

Figure 2.3-23 View of the new station towards the West (drainage plant and guardian house).

Figure 2.3-24 Detail of the electronics box with logo

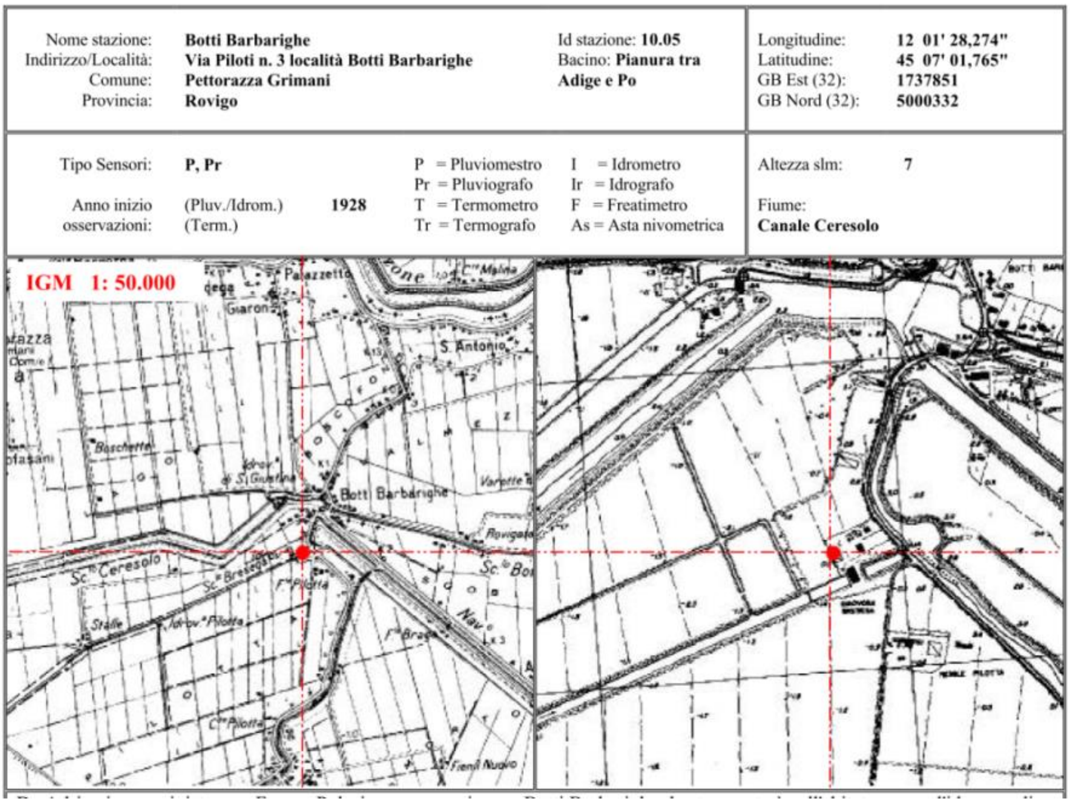
Figure 2.3-25 Detail of the screens of the Temperature and Relative Air Humidity sensors

In the ARPAV information system (SIRAV) the station is identified with code n. 617, it is named Marcon - Zuccarello (Municipality - Locality), and it is operational from 00:00 solar time on 24/07/2021.

2.3.4 Pettorazza Grimani - Botti Barbarighe (RO) Weather Station

The historic station of the Hydrographic Office

The historic station called Botti Barbarighe was installed by the Hydrographic Office in 1928 at the structures of a dewatering plant (water pumping plant) called Bresega, belonging to the Adige Po Land Reclamation Consortium. The station was equipped with a totalizer rain gauge and a recording rain gauge. ARPAV has digitized daily rainfall data for the period from 1929 to 2018.



Nome stazione:	**Botti Barbarighe**	Id stazione: **10.05**	Longitudine: **12 01' 28,274"**
Indirizzo/Località:	**Via Piloti n. 3 località Botti Barbarighe**	Bacino: **Pianura tra Adige e Po**	Latitudine: **45 07' 01,765"**
Comune:	**Pettorazza Grimani**		GB Est (32): **1737851**
Provincia:	**Rovigo**		GB Nord (32): **5000332**
Tipo Sensori:	**P, Pr**	P = Pluviometro; Pr = Pluviografo; T = Termometro; Tr = Termografo; I = Idrometro; Ir = Idrografo; F = Freatimetro; As = Asta nivometrica	Altezza slm: **7**
Anno inizio osservazioni:	(Pluv./Idrom.) **1928**; (Term.)		Fiume: **Canale Ceresolo**

Figure 2.3-26 Monographic card of the station drawn up by the technicians of the Hydrographic Office.

Figure 2.3-27 The historic station of Botti Barbarighe

Figure 2.3-28 Detail of the historic station with recording rain gauge and totalizer rain gauge.

Figure 2.3-29 Aerial photo of the dewatering plant. The red arrow identifies the site of the historic station which is exactly the same as the new installation. Towards the North there is a second drainage plant named Santa Giustina.

The new ARPAV Weather Station

Within the RESPONSe project, ARPAV has installed an automatic thermo-pluviometric station with real-time data transmission, placing it exactly in the same historical site, in the area of the Reclamation Consortium.

The new station, located on grassy ground, currently measures:

- a precipitation datum (in mm) every 5 minutes with a quantization error of 0.2 mm;
- a temperature datum (in °C) every 15 minutes with a quantization error of 0.1 ° C.

Figure 2.3-30 View of the new station from the South-East

Figure 2.3-31 Detail of the electronics box with logo

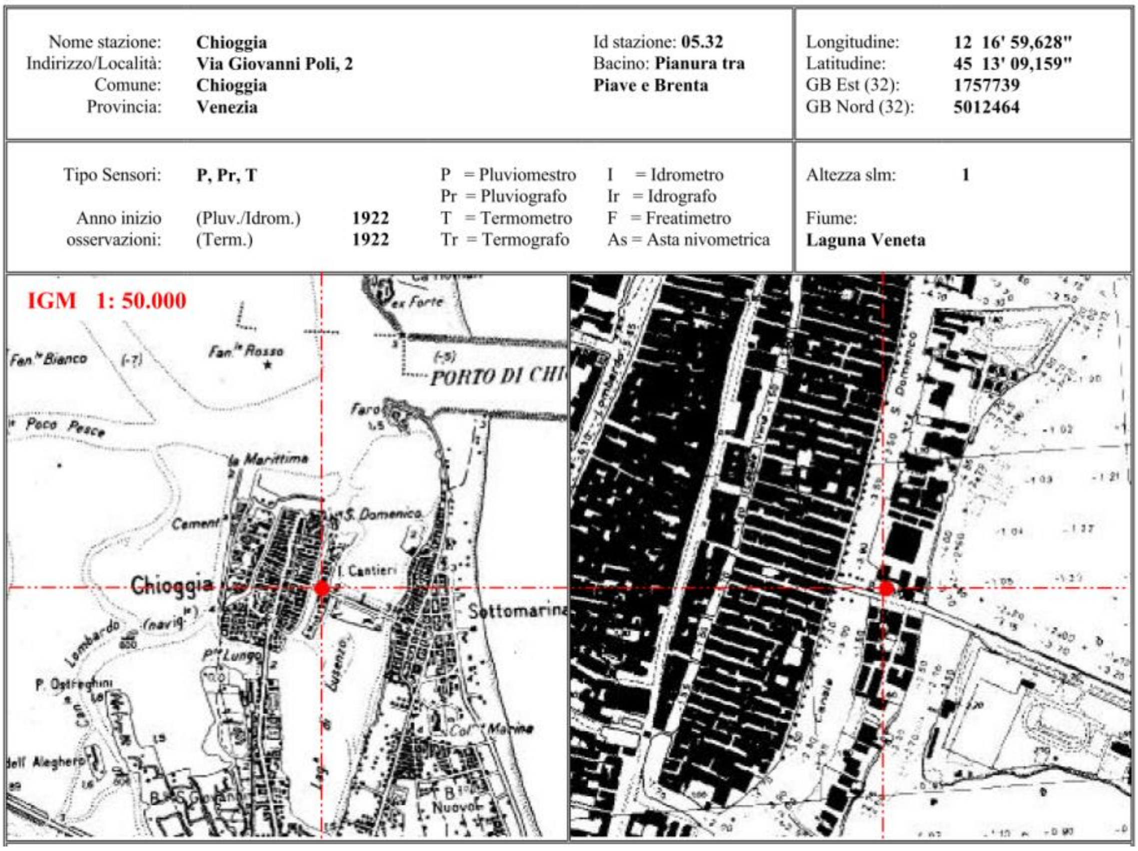
Figure 2.3-32 The new station of Pettorazza Grimani loc. Botti Barbarighe seen from the north, in the background the driveway leading to the dewatering plant (to the right) and the embankment of the drainage canal.

In the information system of ARPAV (SIRAV) the station is identified with code n.622, it is named Pettorazza Grimani (Municipality) Botti Barbarighe (Locality), and it is operational from 00:00 solar time on 17/12/2020.

2.3.5 CHIOGGIA (VE) WEATHER STATION

The historic station of the Hydrographic Office

The historic station was installed by the Hydrographic Office in 1922 at a branch office of the Magistrato alle Acque di Venezia, that was the Triveneto Water Authority, (currently: Provveditorato Interregionale alle Opere Pubbliche - Ufficio Salvaguardia di Venezia) on land immediately overlooking the Venice lagoon. The station was equipped with a totalizing rain gauge, a recording rain gauge and a maximum and minimum thermometer. ARPAV has manually digitized daily rainfall data for the period from 1922 to 2018 and daily thermometric data from 1955 to 2004.



Nome stazione: **Chioggia** Indirizzo/Località: **Via Giovanni Poli, 2** Comune: **Chioggia** Provincia: **Venezia**	Id stazione: **05.32** Bacino: **Pianura tra Piave e Brenta**	Longitudine: **12 16' 59,628"** Latitudine: **45 13' 09,159"** GB Est (32): **1757739** GB Nord (32): **5012464**	
Tipo Sensori: **P, Pr, T** Anno inizio osservazioni: (Pluv./Idrom.) **1922** (Term.) **1922**	P = Pluviomestro Pr = Pluviografo T = Termometro Tr = Termografo	I = Idrometro Ir = Idrografo F = Freatimetro As = Asta nivometrica	Altezza slm: **1** Fiume: **Laguna Veneta**

Figure 2.3-33 Monographic card of the station drawn up by the technicians of the Hydrographic Office.

Figure 2.3-34 The location in Chioggia of the thermograph, the pluviograph and the totalizing rain gauge in 2002 (low resolution pictures).

Figure 2.3-35 Sky view of the city of Chioggia (the red arrow identifies the site of the station); the city is in the southern sector of the Venice lagoon. On the right the Adriatic sea, and at the top the entrances to the lagoon (harbor mouth) hosting one of the three gates of the MOSE tide protection system.

Figure 2.3-36 Detail aerial photo of Chioggia, the red arrow identifies the site of the historic station which is exactly the same as the new installation.

Figure 2.3-37 The historic station of Chioggia in 2020 at the time of replacement with the new instrumentation. Since 2004 the totalizing rain gauge and the pluviograph remained operational.

The new ARPAV Weather Station

Within the RESPONSe project, ARPAV has installed an automatic thermo-pluviometric station with real-time data transmission, placing it exactly in the same historical site.

The new station, located on grassy ground, currently measures:

- a precipitation datum (in mm) every 5 minutes with a quantization error of 0.2 mm;
- a temperature datum (in °C) every 15 minutes with a quantization error of 0.1 °C.

Figure 2.3-38 Detail of the electronics box with logo

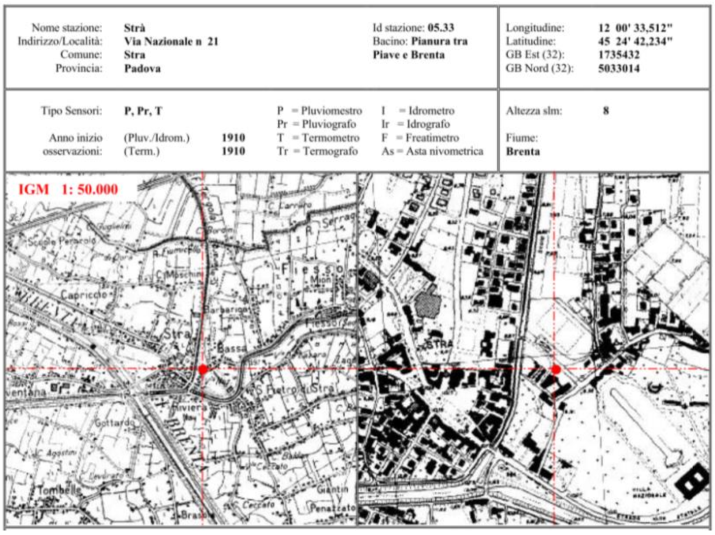
Figure 2.3-39 Chioggia new thermo-rain gauge station seen from South West

In the ARPAV (SIRAV) information system, the station is identified with code n.613, it is named Chioggia centro, and it is operational from 00:00 solar time on 18/12/2020.

2.3.6 Strà (VE) Weather Station

The historic station of the Hydrographic Office

The historic station was installed by the Hydrographic Office in 1910 at its Officina Meccanica di Precisione di Strà (precision mechanical workshop in Strà), which manufactured the instruments for hydro-meteorological measurements. The station was equipped with a totalizing rain gauge, a recording rain gauge and a maximum and minimum thermometer, which was subsequently replaced by a thermograph. ARPAV has manually digitized daily rainfall data for the period from 1920 to 2018 and daily thermometric data from 1955 to 2004.



Nome stazione: Strà
Indirizzo/Località: Via Nazionale n 21
Comune: Stra
Provincia: Padova
Id stazione: 05.33
Bacino: Pianura tra Piave e Brenta
Longitudine: 12 00' 33,512"
Latitudine: 45 24' 42,234"
GB Est (32): 1735432
GB Nord (32): 5033014
Tipo Sensori: P, Pr, T
Anno inizio osservazioni: (Pluv./Idrom.) 1910
(Term.) 1910
P = Pluviomestro
Pr = Pluviografo
T = Termometro
Tr = Termografo
I = Idrometro
Ir = Idrografo
F = Freatimetro
As = Asta nivometrica
Altezza slm: 8
Fiume: Brenta

Figure 2.3-40 Monographic card of the station drawn up by the technicians of the Hydrographic Office.

Figure 2.3-41 Aerial photo of the former precision mechanical workshop in Strà;
the red arrow identifies the site of the historic station which is exactly the same as the new installation. On the right you can see the park of Villa Pisani.

Figure 2.3-42 Historical station of Strà, location of the totalizing rain gauge, the rain gauge and the thermograph in 2002.

Figure 2.3-43 Strà thermometric station detail of the bimetallic foil thermograph operating in this station in 2003.

The new ARPAV Weather Station

ARPAV, within the RESPONSe project, has installed an automatic thermo-rainwater station with real-time data transmission, placing it exactly in the same historical site

The new station, located on grassy ground, currently measures:

- a precipitation datum (in mm) every 5 minutes with a quantization error of 0.2 mm;
- a temperature datum (in °C) every 15 minutes with a quantization error of 0.1 °C.

The measuring site is shaded by a nearby tower and vegetation, furthermore the measuring instruments are very close to the buildings and a hedge. Overall this is a very bad temperature measurement site. ARPAV is considering whether to relocate the station within the municipal area.

Figure 2.3-44 Strà thermo-pluviometric station seen from the North and South

Figure 2.3-45 Detail of the electronics box with logo

In the information system of ARPAV (SIRAV) the station is identified with code n.623, it is named Strà centro, and it is operational from 00:00 solar time on 18/12/2020

2.4 RESPONSe impact - added value of the new stations

2.4.1 Improvement of monitoring system of the Veneto Coast

Six meteo-climatic monitoring stations installed within the RESPONSe project integrate and enhance a Veneto monitoring system managed by ARPAV and operational since the early 90s.

This intervention guarantees an improvement in the weather-climate monitoring of the coastal sector and of the sector behind the delicate area of the Venice lagoon.

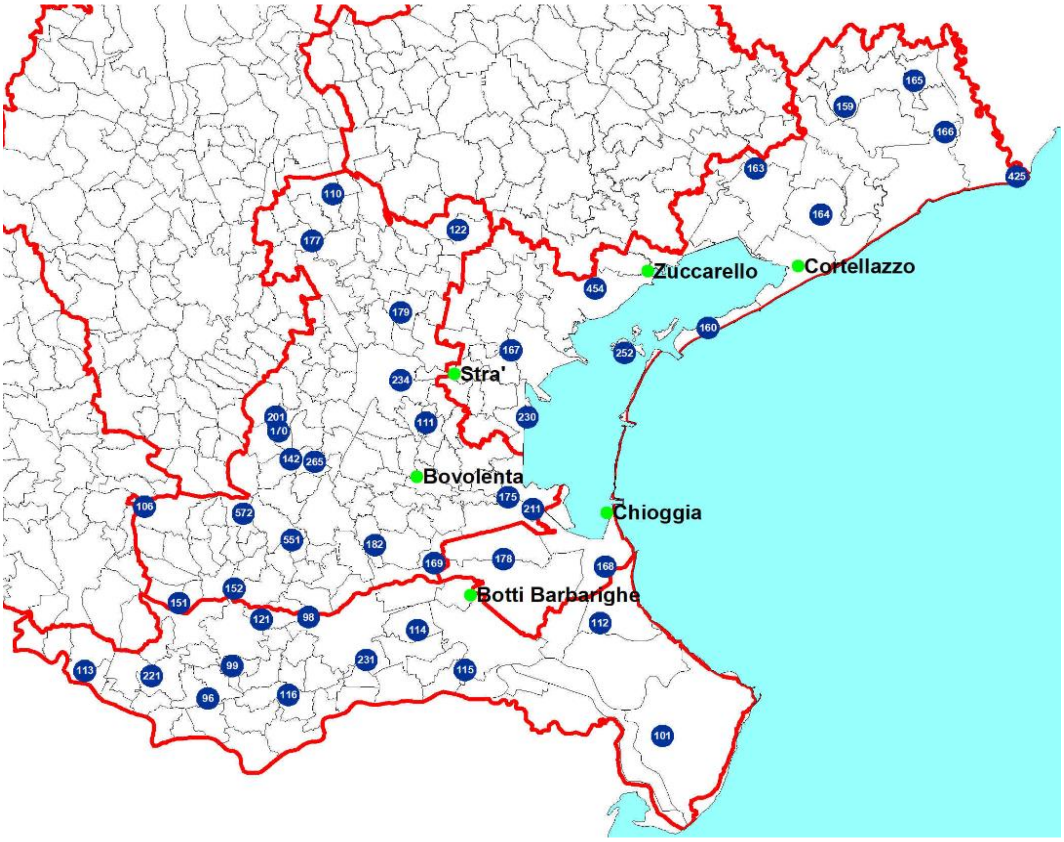


Figure 2.4-1 Veneto Region Provinces of Padua, Rovigo and Venice location of ARPAV automatic weather stations. The blue dots show the existing stations with their code. The green dots identify the 6 new automatic stations, installed in 2021 within the RESPONSe project.

The new stations provide more information in a particular territory for the land-lagoon-sea interaction, characterized by the presence of breezes and thermal gradients within the Po plain. From the pluviometric point of view, this sector was repeatedly affected by extremely severe and localized events, which caused significant damage (e.g. the flooding of the city of Mestre on 26 September 2007).

The maximum precipitation within 6-12 consecutive hours, in the last thirty years in Veneto region, was measured in coastal areas with the following data recorded:

- 301.4 mm fallen in 6 hours and the 322.2 mm fallen in 12 hours in Campagna Lupia (Venice) on 26 September 2007;
- 246.8 mm fallen in Mestre in 6 hours during the same event.

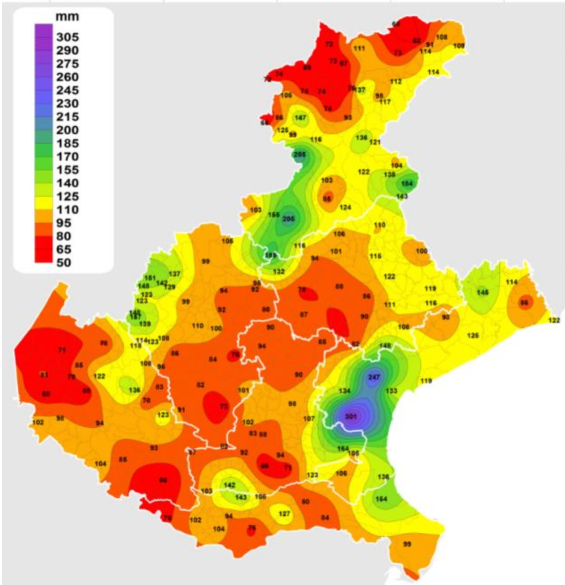


Figure 2.4-2 Absolute maximum rainfall for the duration of 6 consecutive hours measured in the Veneto region starting from 1992 (without new stations). The point values are expressed in mm. Note that the highest values are located on the central coast.

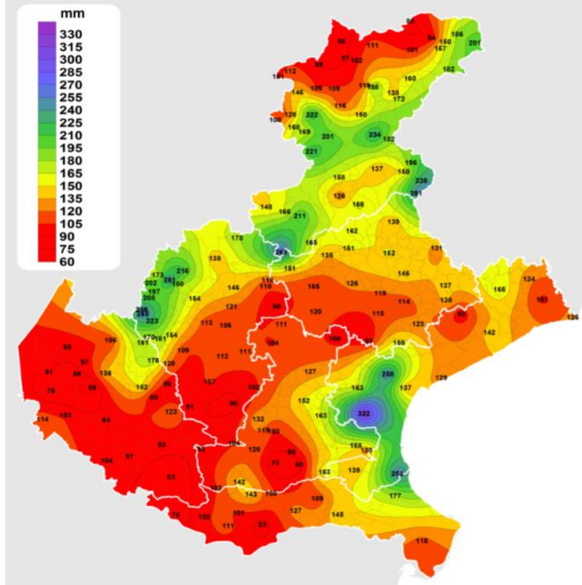


Figure 2.4-3 Absolute maximum rainfall for the duration of 12 consecutive hours measured in the Veneto region starting from 1992 (without new stations). The point values are expressed in mm. Values observed on the coast are similar to or higher than those observed in some sectors of the Pre-Alps.

One of the new thermo-pluviometric stations is installed in the center of Chioggia, historic lagoon city, which is in fact a “small Venice'' type of settlement. This installation improves the lack of weather-climate monitoring action in urban areas, as most of the weather stations, currently operating, are installed in open and rural areas.

Lastly, the two new stations of Cortellazzo and Zuccarello are equipped also with wind sensors (measuring speed and direction) and therefore they improve the monitoring of these important variables.

The wind monitoring action in the coastal area allows to observe the breeze regimes (deriving from the land-sea interaction) and the synoptic winds (particularly Bora and Sirocco), which interact with the tidal regimes, enhancing the high-water phenomena in the Venice lagoon. Strong winds are also the main cause of dangerous storm surges and the consequent coastal erosion phenomena.

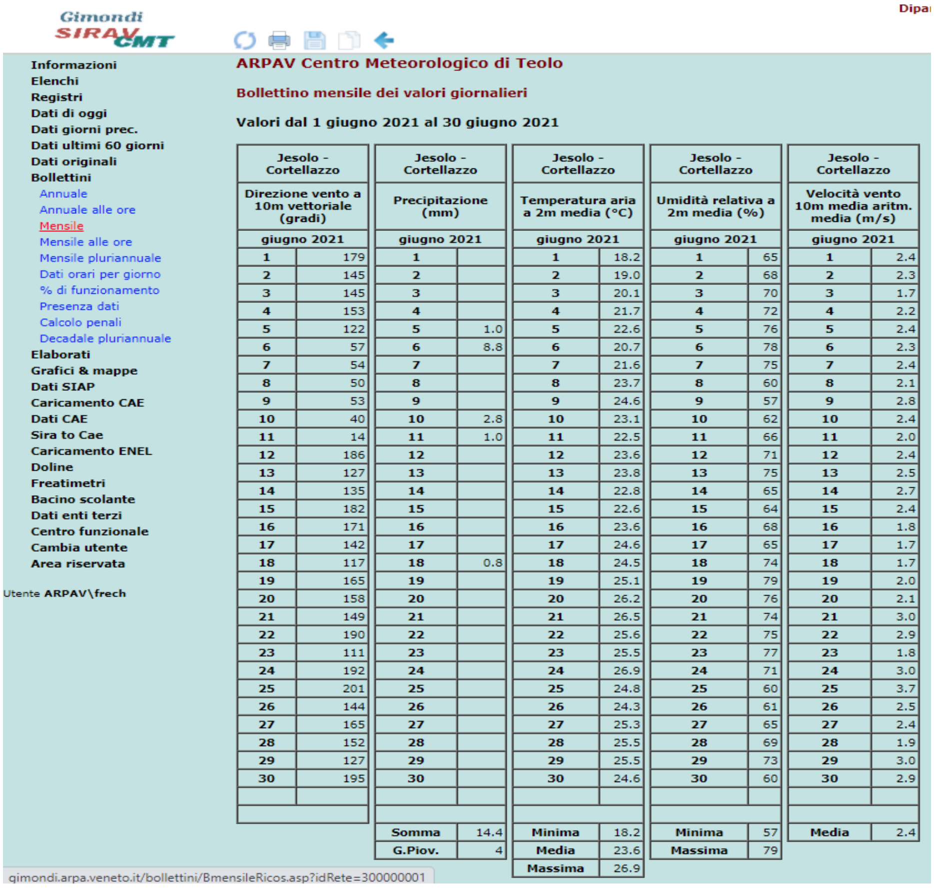
This intervention, however, has an additional value as it gives continuity to the long-term weather-climate monitoring action. The new equipment installed within the RESPONSe project automate 6 mechanical-manual measurement stations installed by the former Hydrographic Office of the Venice Water Authority almost a century ago. The Hydrographic Office mainly detected daily rainfall values. The minimum and maximum daily air temperature values were additionally measured on a subset of these stations, i.e. Chioggia and Strà stations.

The daily historical data were published annually in paper format, in two volumes called Hydrological Annals. The continuation of the rainfall monitoring activity on the same site, for a period of 50 - 100 years, will be useful for observing the long-term trends of rainfall on the coastal area, regarding annual, seasonal and monthly accumulations, and for studying the occurrence frequencies of precipitation lasting between 1 and 5 days. The data from the 6 new automatic stations are consistent (in terms of formats, measurement intervals and quality controls) with the measurements carried out by more than 160 meteorological stations of the ARPAV network and are stored and processed by the ARPAV SIRAV database.

2.5 Data dissemination

2.5.1 USE OF METEO-HYDRO-CLIMATIC DATA FOR INSTITUTIONAL PURPOSES

SIRAV is the primary data archiving tool and it is therefore equipped with technologies that guarantee the security of the archived data. However, SIRAV is also a data consultation tool and it is equipped with a detailed menu that allows the extraction of data in the form of files, tables, graphs, maps and processed data. In other words, the SIRAV is a tool for internal use by ARPAV which tries to meet the main needs of the operators of the regional meteorological and hydrographic service.



ARPAV Centro Meteorologico di Teolo

Bollettino mensile dei valori giornalieri

Valori dal 1 giugno 2021 al 30 giugno 2021

Jesolo - Cortellazzo		Jesolo - Cortellazzo		Jesolo - Cortellazzo		Jesolo - Cortellazzo		Jesolo - Cortellazzo	
Direzione vento a 10m vettoriale (gradi)		Precipitazione (mm)		Temperatura aria a 2m media (°C)		Umidità relativa a 2m media (%)		Velocità vento 10m media aritm. media (m/s)	
giugno 2021		giugno 2021		giugno 2021		giugno 2021		giugno 2021	
1	179	1		1	18.2	1	65	1	2.4
2	145	2		2	19.0	2	68	2	2.3
3	145	3		3	20.1	3	70	3	1.7
4	153	4		4	21.7	4	72	4	2.2
5	122	5	1.0	5	22.6	5	76	5	2.4
6	57	6	8.8	6	20.7	6	78	6	2.3
7	54	7		7	21.6	7	75	7	2.4
8	50	8		8	23.7	8	60	8	2.1
9	53	9		9	24.6	9	57	9	2.8
10	40	10	2.8	10	23.1	10	62	10	2.4
11	14	11	1.0	11	22.5	11	66	11	2.0
12	186	12		12	23.6	12	71	12	2.4
13	127	13		13	23.8	13	75	13	2.5
14	135	14		14	22.8	14	65	14	2.7
15	182	15		15	22.6	15	64	15	2.4
16	171	16		16	23.6	16	68	16	1.8
17	142	17		17	24.6	17	65	17	1.7
18	117	18	0.8	18	24.5	18	74	18	1.7
19	165	19		19	25.1	19	79	19	2.0
20	158	20		20	26.2	20	76	20	2.1
21	149	21		21	26.5	21	74	21	3.0
22	190	22		22	25.6	22	75	22	2.9
23	111	23		23	25.5	23	77	23	1.8
24	192	24		24	26.9	24	71	24	3.0
25	201	25		25	24.8	25	60	25	3.7
26	144	26		26	24.3	26	61	26	2.5
27	165	27		27	25.3	27	65	27	2.4
28	152	28		28	25.5	28	69	28	1.9
29	127	29		29	25.5	29	73	29	3.0
30	195	30		30	24.6	30	60	30	2.9
		Somma	14.4	Minima	18.2	Minima	57	Media	2.4
		G.Piov.	4	Media	23.6	Massima	79		
				Massima	26.9				

Figure 2.5-1 SIRAV consultation pages (The ARPAV database) on the left a drop-down menu for product selection, on the right an example of a table product with the daily data for the month of June from the Jesolo Cortellazzo station.
From left to right values for Wind direction, Precipitation, air Temperature, air Relative Humidity and Wind speed.

Some SIRAV products are expressly designed to support decision-making processes for the management of hydrological and hydraulic emergencies by the Decentralized Functional Center of Civil Protection. Using graphs, tables and maps, such a center creates an information framework in real time that summarizes the current situation in the area and allows one to focus on the main problems. Furthermore, from SIRAV, ad hoc data packets are sent automatically (currently even every 30 minutes) to feed hydrological models and to guarantee at national level (at the Central Department of Civil Protection) the visibility of the monitored data in real time. The stations installed within the RESPONSe project fully fits into these processes as they transmit data in real time with high frequency (every 10 minutes). Further data transmissions to institutional bodies take place in deferred time on a daily or monthly basis in order to monitor, for example, the availability of water resources at the river basin level or to update climatological products (e.g. ARCIS database that collects data from Northern Italy).

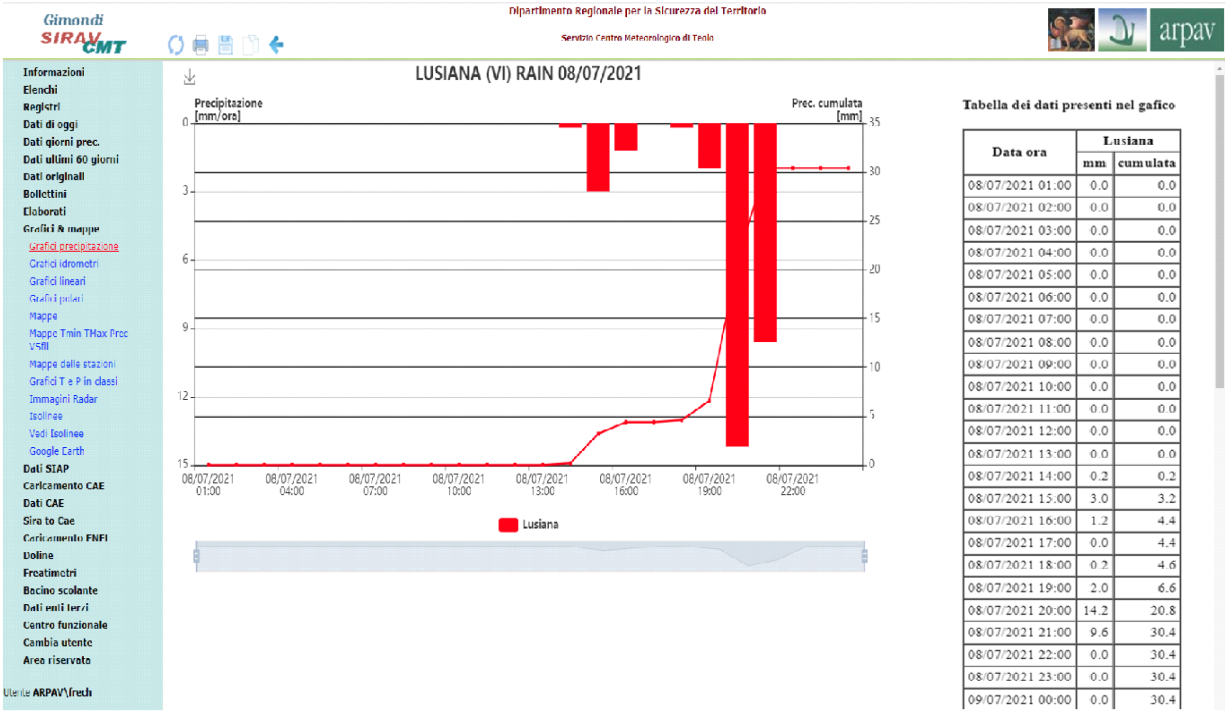


Figure 2.5-2 SIRAV (the ARPAV database) consultation pages;
on the left drop-down menu for product selection, on the right an example of a graphic product.

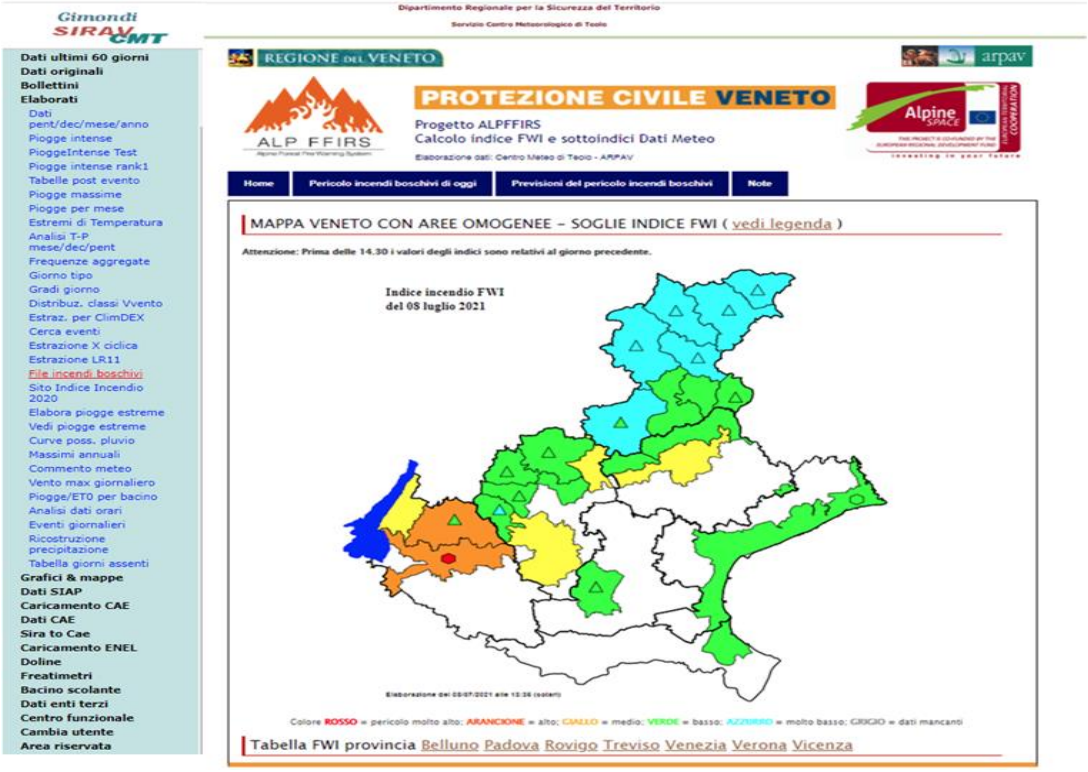


Figure 2.5-3 The SIRAV on the left drop-down menu for choosing products, on the right paper with indications of forest fire danger calculated for some forest areas, for the day 08/07/2021, based on meteorological data, using the Fire Weather Index.

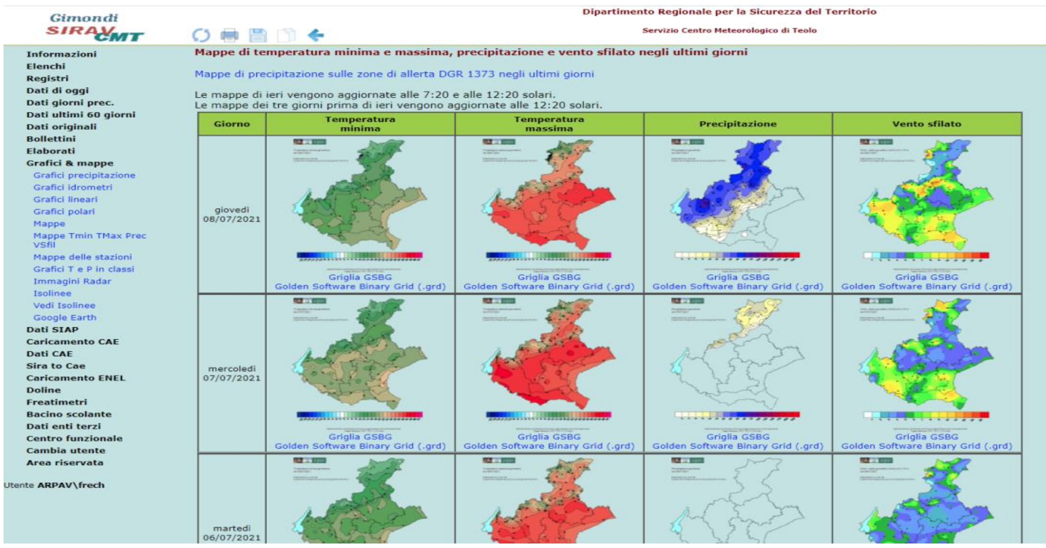


Figure 2.5-4 The SIRAV on the left drop-down menu for choosing products on the right maps of the Veneto with isolines of Tmin., Tmax., Precipitation and Wind speed of the last 15 days.

2.5.2 PUBLIC ACCESSIBILITY TO THE CLIMATIC-WEATHER DATA OF THE VENETO

The six climatic weather stations purchased and installed within the RESPONSe project were included in the ARPAV network, among the operational stations in real time.

By using the website www.ambienteveneto.it, the public can:

1) choose a meteorological variable on the top bar;

2) see on the map the last hour values of the chosen meteorological variable.

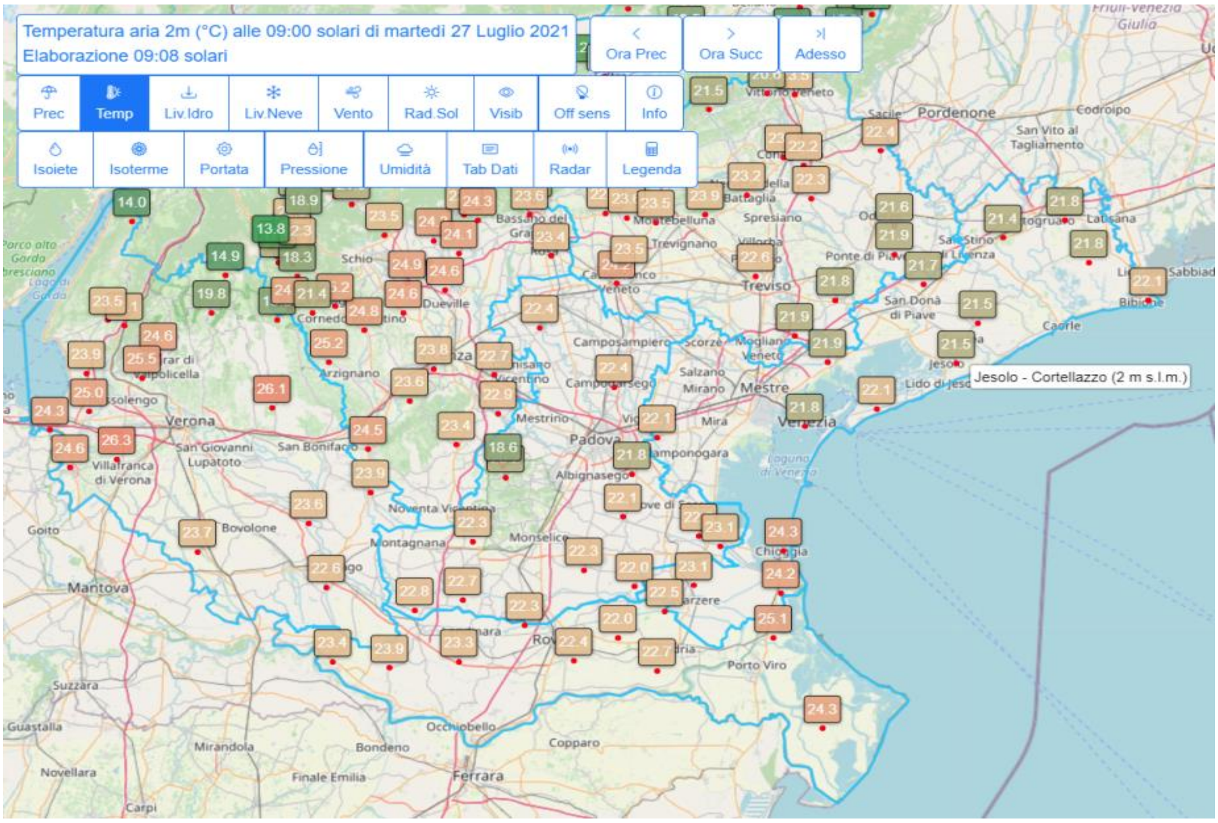


Figure 2.5-5 Visualization available on www.ambienteveneto.it

The rectangles containing the temperature data of the meteorological stations are colored according to a color scale correlated to the temperature values. There is also a specific color scale for precipitation values. The "Ora Prec" and "Ora Succ." buttons allow you to scroll the data display over time, the "Adesso" button brings the display back to the current time. The upper left rectangle provides information on the date and time displayed on the map and turns orange when the days prior to the current are displayed;

3) see the label with the name and altitude of the station by passing with the mouse cursor;

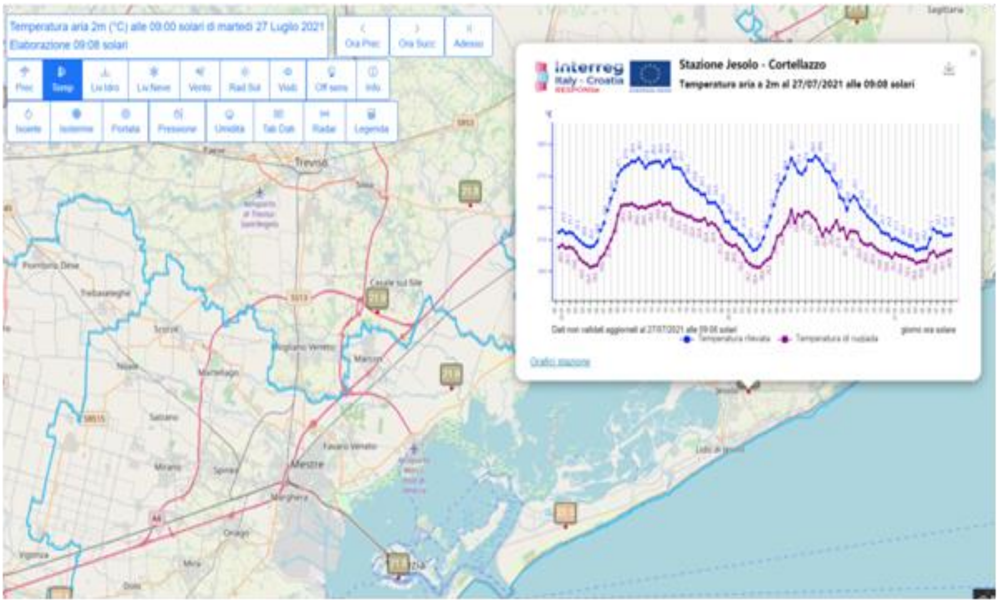


Figure 2.5-6 Temperature data visualization

4) see the reduced image of the graph of the hourly trend of the meteorological variable in the last 2 days by clicking on the data of the single station (beside the Air Temperature, if the station has a Relative Humidity sensor, in addition to the Temperature trend, the trend of the Dew Temperature);

5) by clicking on the words "Grafici stazione" (within the graph) view the following elements:

a) The graphs of the weather variables monitored by the station in the last 2 days:

Air Temperature

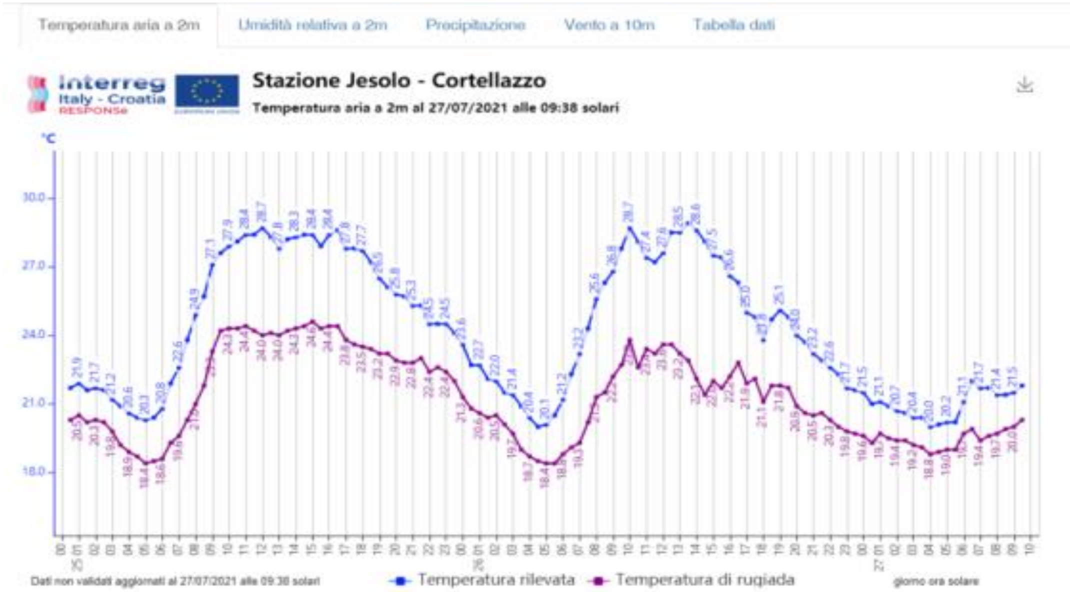


Figure 2.5-7 Graph of hourly Temperature and Dew Temperature

Air Relative Humidity

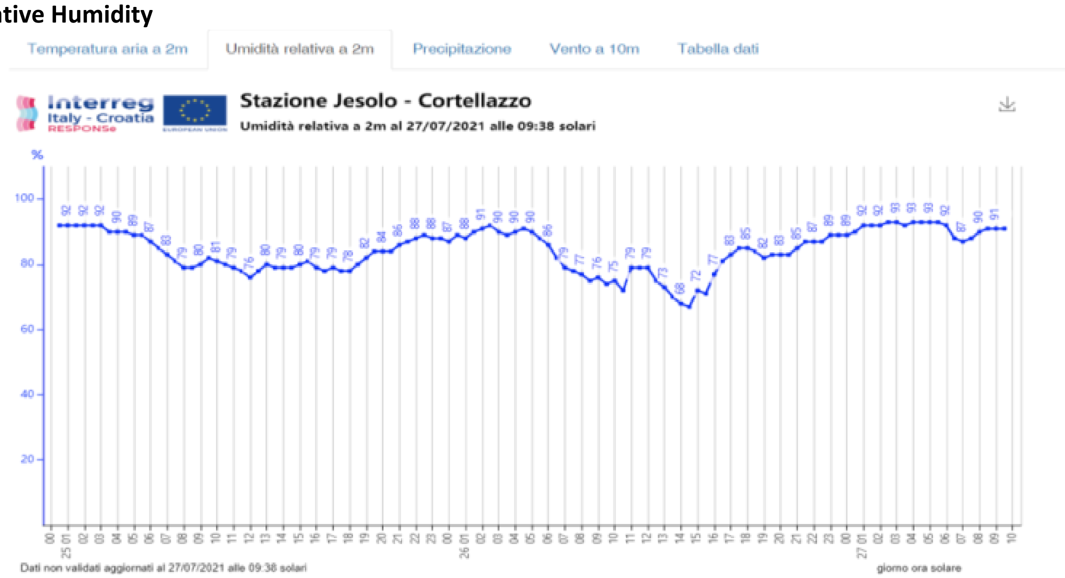


Figure 2.5-8 Graph of hourly Relative Humidity

Precipitation

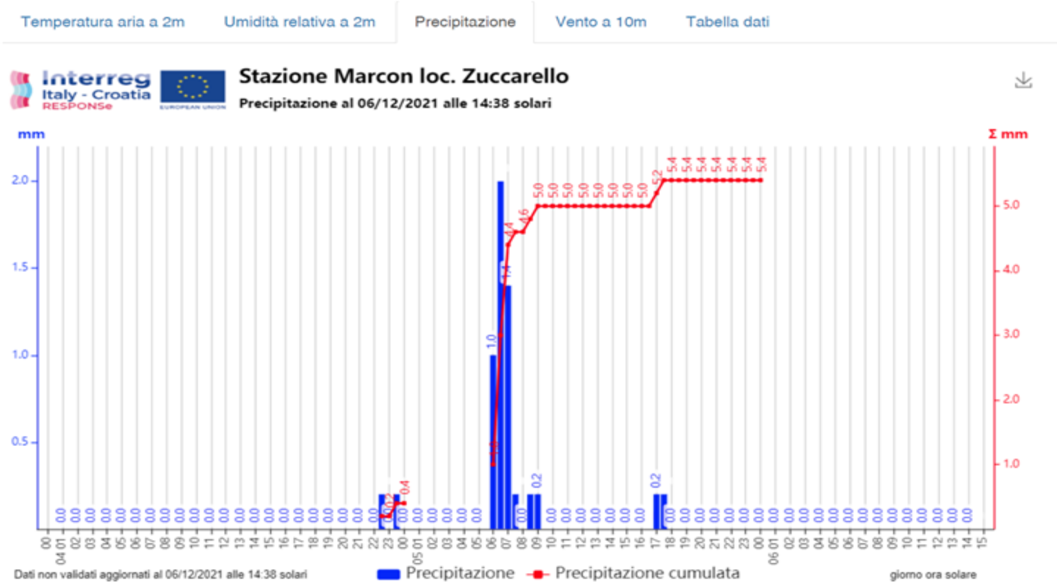


Figure 2.5-9 Graph of hourly precipitation and cumulative precipitation data

Wind direction and speed

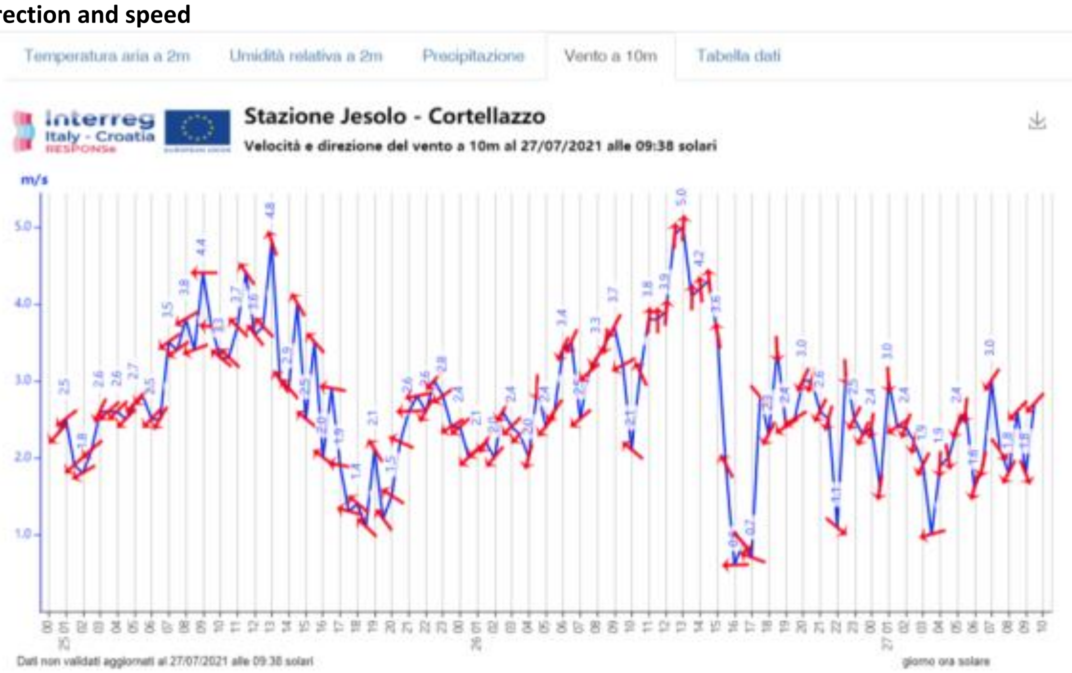


Figure 2.5-10 Graph of hourly wind speed and direction

b) the values of meteorological measurements:

b.1) the values of the hourly data for the last two days;

b.2) the hourly data values of the last two days in .XML format.

It is also possible to superimpose on the station data the images from the two ARPAV weather radars (Teolo - PD and Concordia Sagittaria -VE Radar).

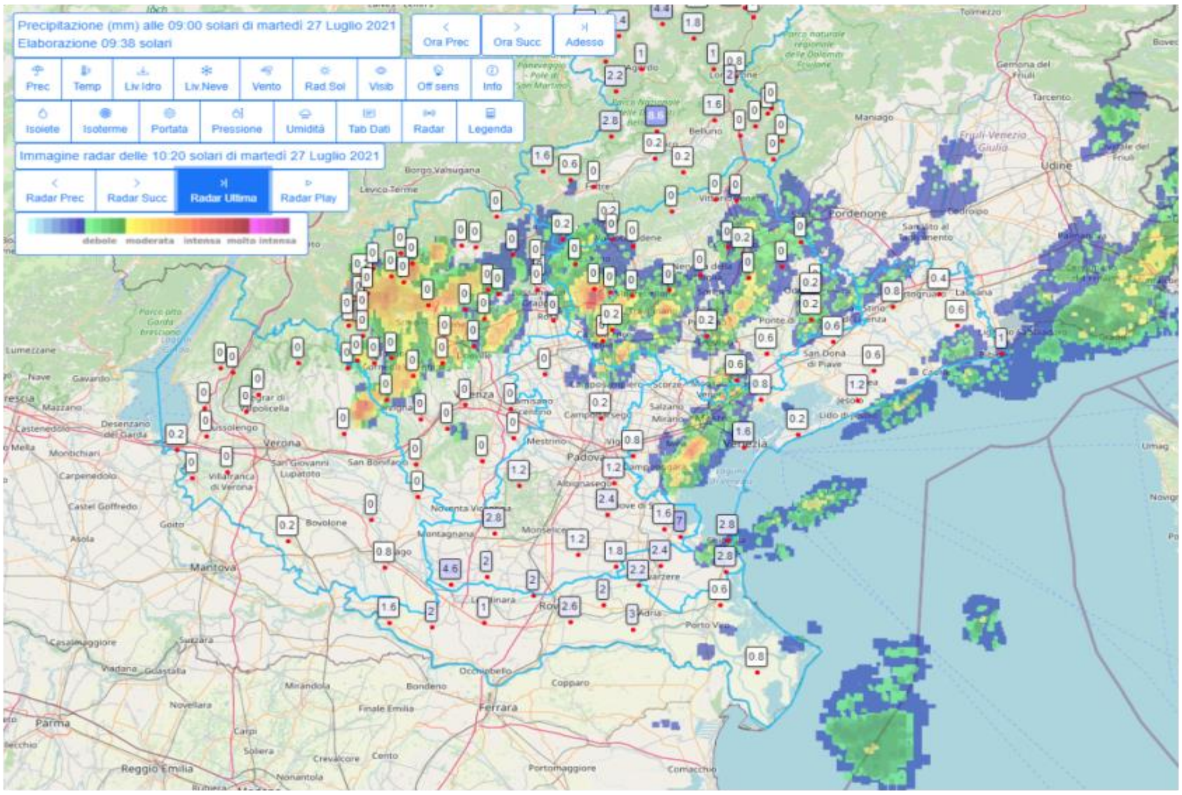


Figure 2.5-11 View of rain gauge data and meteorological radar images

It is possible to create the map of the rainfall fallen from 00:00 to present time.

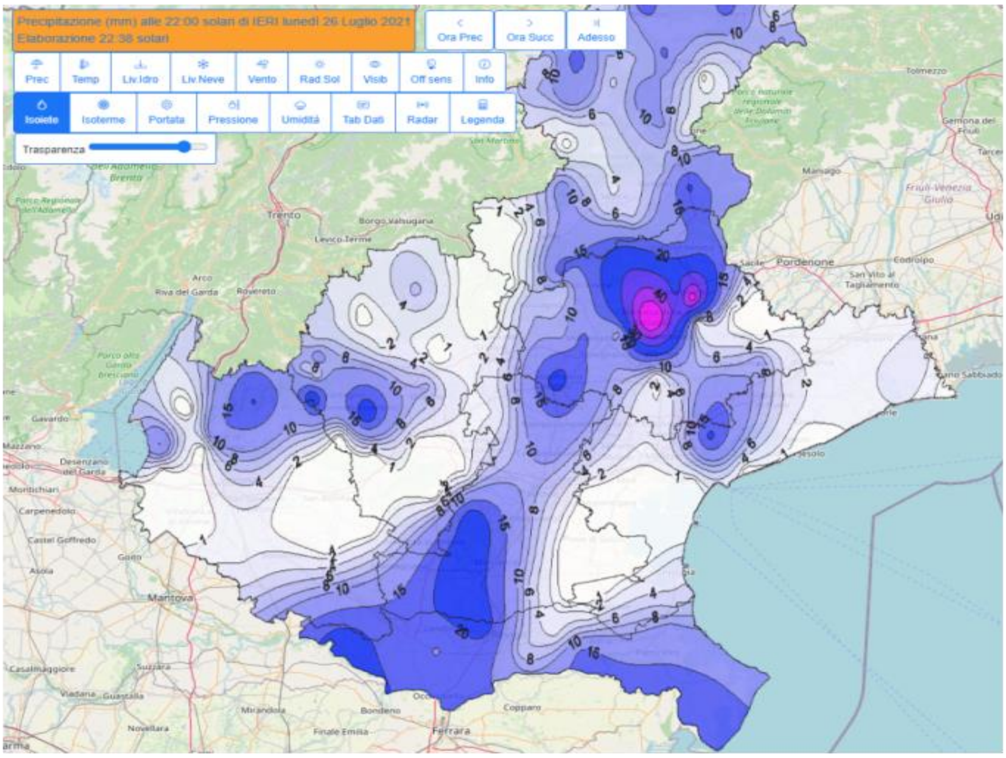


Figure 2.5-12 Map of the rain fallen on July 26th, 2021 between 0:00 and 22:00 solar hours

3 DHMZ monitoring network

3.1 DHMZ existing monitoring network

Croatian Meteorological and Hydrological Service (DHMZ)[2] is the country's National Weather Service (NWS). Despite the fact that there are a few state-owned companies and a number of professional private companies, non-professional societies, and individuals dealing with the environment, which includes some observations, DHMZ, as a government body in Croatia, has the responsibility to manage the meteorological, hydrological, air quality, and other relevant data monitoring infrastructure, as well as the national archives of meteorological, hydrological, air quality, and other relevant data, all in accordance with WMO guidelines.

Information based on meteorological and hydrological measurements and observations is one of DHMZ's key deliverables. A database of meteorological, hydrological, and related data is generated based on data observation, collection, processing, and quality control. DHMZ staff and external users can utilize the database's data for their own purposes. The DHMZ website provides free access to various data, products, and services while some products can be required per request.

Analysis of the current state of the meteorological observation network in Croatia and technical, informational and organizational systems that support it (today in Croatia, under the jurisdiction of DHMZ, there are 40 main meteorological stations (+6 under the jurisdiction of the Croatian Air Navigation Services), 104 climatological and 341 rain gauge stations, two radio sounding stations and 8 radar stations)[3] confirmed that there is a great need to increase the availability of measured data on climatological variables and analysis of climate conditions for various industries and public activities[4].

Having that in mind, as part of the Activity 3.3 Analysis, enhancement and integration of existing climate and oceanographic monitoring systems in the Work Package 3 (WP3) Harmonization of the climate change analysis and monitoring systems of the RESPONSe project, DHMZ initially planned to, within the RESPONSe project, acquire and install two automatic ombrografic systems, and the budget for this equipment was allocated. In the latter phase of the RESPONSe project, it become obvious that this acquisition overlaps with a larger, strategic DHMZ’s project called METMONIC (Modernisation of the National Weather Observation Network in Croatia) cofounded by European Regional Development Fund.

The goal of the METMONIC project is to establish a modern and high-quality system of automatic surface meteorological stations, meteorological-oceanographic buoys, and remote measurement systems, including meteorological radars. 450 sophisticated automatic meteorological systems will be deployed by the completion of the project (June 2023). This will give traceable, dependable, high-quality, and timely information on the state of the atmosphere and the sea across the Republic of Croatia's territory. This will also allow for continuous weather, climate, and climate change monitoring, as well as improved early-warning of hazardous weather in order to support climate change and natural disaster adaptation systems, thereby directly supporting sustainable development, increasing security, and preserving human lives and property.

[2] Državni hidrometeorološki zavod (DHMZ), official website: https://meteo.hr/

[3] https://klima.hr/razno/publikacije/160_god_met_motrenjaHR.pdf

[4] https://meteo.hr/istrazivanje.php?section=projekti&param=projekti_u_tijeku&el=metmonic

All data generated by the METMONIC project (current and archived) will be made publicly available on the DHMZ website, benefiting academic institutions, non-governmental organizations, and interested users, particularly in climate change research and its impact on vulnerable sectors.

Planning parallel steps in two projects (RESPONSe and METMONC) seemed complex and, moreover, unnecessary, since the METMONIC also included the RESPONSe target areas in Croatia, and included acquiring automatic ombrografic systems, plus the fact that the new observed data from the METMONIC project will be publicly available i.e. purchase of the equipment within the RESPONSe could not significantly contribute scientific data available, DHMZ gave up the procurement of new instruments within the RESPONSe project. The majority of aforementioned funds were transferred to another Croatian RESPONSe project partner – IOF (Institute of Oceanography and Fisheries) considering the need for updating and upgrading oceanographic data. The obtained funds IOF used for procurement the new equipment for oceanographic measurements, with particular reference to vertical profiles of the sea salinity and sea temperature.

3.2 METMONIC Equipment in the area near RESPONSe pilot area

3.2.1 Ploče location

In the vicinity of Ploče there is one automatic station with measurement of climatological parameters (Neretva Delta) and one additional Metković will be established, the following parameters will be measured at the stations:

Neretva Delta:

- wind speed and direction at 10 m altitude,
- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- air pressure
- precipitation amount

Metković:

- wind speed and direction at 10 m altitude,
- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- air pressure
- amount of precipitation and type of precipitation
- snow height,
- air temperature at 5 cm above the ground,
- soil temperature
- sea temperature

As stated before, all data will be available in machine-readable format on the DHMZ website with a time resolution of 10 minutes, i.e. via the Central Integration Platform.

3.2.2 Cres location

New station will be located on the outskirts of the town of Cres. The following parameters will be measured:

- wind speed and direction at 10 m altitude,
- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- air pressure
- precipitation amount and type of precipitation
- air temperature at 5 cm above ground
- soil temperature
- sea temperature.

Precipitation measurement will be established in Martinščica.

3.2.3 Šibenik location

In the vicinity of Šibenik, two automatic stations (Vodice and Zečevo Rogozničko) and three automatic rain gauge stations (Skradin, Zlarin, Primošten) will be established. The following parameters will be measured:

Vodice station:

- wind speed and direction at 10 m altitude,
- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- air pressure
- precipitation amount and type of precipitation
- air temperature at 5 cm above the ground

Zečevo Rogozničko:

- wind speed and direction at 10 m altitude,
- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- air pressure
- precipitation amount and type of precipitation
- air temperature at 5 cm above the ground
- sea temperature

Skradin:

- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- precipitation amount

Zlarin:

- the amount of precipitation

Primošten:

- air temperature at the meteorological shelter, 2 m above the ground
- relative humidity at the meteorological shelter, 2 m above the ground
- precipitation amount

4 REFERENCES

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5 ANNEX

Table 3.2-1 List of ARPAV automatic weather stations currently operating in the Provinces of Padua, Rovigo and Venice. The stations installed with the RESPONSe project are listed as No. 623, No. 617, No. 615, No. 613, No.622, No. 611.

Code	Weather station	Operation period Start	Typology	Altitude meters above sea level	Municipality	Province	Gauss Coordinate EPSG:3003 X	Gauss Coordinate EPSG:3003 Y	Geo Coordinate EPSG:4258 Latitude	Geo Coordinate EPSG:4258 Longitude	Geo Coordinate EPSG:4258 Latitude degrees g	Latitude minutes p	Latitude seconds s	Longitude degrees g	Longitude minutes p	Longitude seconds s	Basin
PROVINCE OF PADOVA																	
106	Montagnana	01/11/1990	METEO	12	MONTAGNANA	(PD)	1690157.9	5013351.17	45.2477689	11.4227919	45	14	51.968	11	25	22.051	BRENTA: VENETO
110	Cittadella	01/09/1991	METEO	50	CITTADELLA	(PD)	1717673.92	5059697.67	45.6564667	11.79354713	45	39	23.28	11	47	36.77	BRENTA: VENETO
111	Legnaro	01/07/1991	METEO	7	LEGNARO	(PD)	1731296	5025798.95	45.3473485	11.95217201	45	20	50.454	11	57	7.819	BACINO SCOLANTE IN LAGUNA
122	Trebaseleghe	11/07/1995	METEO	23	TREBASELEGHE	(PD)	1735991.07	5054349.34	45.6024042	12.02573694	45	36	8.655	12	1	32.653	BACINO SCOLANTE IN LAGUNA
142	Faedo (Cinto Euganeo)	01/09/1994	METEO	250	CINTO EUGANEO	(PD)	1711521.3	5020363.09	45.3047174	11.69771962	45	18	16.983	11	41	51.791	BRENTA: VENETO
151	Masi	01/05/1994	METEO	9	MASI	(PD)	1695161.44	4999004.17	45.117402	11.48088305	45	7	2.647	11	28	51.179	BRENTA: VENETO
152	Balduina (Sant'Urbano)	01/05/1994	METEO	7	SANT'URBANO	(PD)	1703223.34	5001186.28	45.1347265	11.58415552	45	8	5.015	11	35	2.96	BRENTA: VENETO
169	Agna	02/02/1992	METEO	1	AGNA	(PD)	1732500.31	5004920	45.1592619	11.95775646	45	9	33.343	11	57	27.923	BACINO SCOLANTE IN LAGUNA
170	Teolo	02/02/1992	METEO	155	TEOLO	(PD)	1709767.07	5024532.34	45.3427276	11.67713457	45	20	33.819	11	40	37.684	BRENTA: VENETO
175	Codevigo	01/02/1992	METEO	0	CODEVIGO	(PD)	1743297	5014716	45.2436726	12.09970856	45	14	37.221	12	5	58.951	BACINO SCOLANTE IN LAGUNA
177	Grantorto	01/12/1991	METEO	32	GRANTORTO	(PD)	1714687	5052726	45.5947204	11.75218331	45	35	40.993	11	45	7.86	BRENTA: VENETO
179	Campodarsego	03/02/1992	METEO	16	CAMPODARSEGO	(PD)	1727659	5042149	45.4955158	11.91336346	45	29	43.857	11	54	48.108	BACINO SCOLANTE IN LAGUNA
182	Tribano	01/01/1996	METEO	3	TRIBANO	(PD)	1723829	5007659	45.1866899	11.8487995	45	11	12.084	11	50	55.678	BACINO SCOLANTE IN LAGUNA
201	Monte Grande (Teolo)	16/01/1995	METEO	465	TEOLO	(PD)	1709358	5026653	45.3619206	11.67281842	45	21	42.914	11	40	22.146	BRENTA: VENETO
211	Codevigo - Ca' di Mezzo	20/06/1996	METEO	1	CODEVIGO	(PD)	1746929	5012991	45.2269036	12.14506095	45	13	36.853	12	8	42.219	BACINO SCOLANTE IN LAGUNA
234	Padova	01/05/2000	METEO	12	PADOVA	(PD)	1727642.04	5032075.05	45.4049635	11.90848323	45	24	17.869	11	54	30.54	BRENTA: VENETO
265	Galzignano - Ca' Demia	15/10/2004	METEO	3	GALZIGNANO	(PD)	1715069.36	5019991.54	45.3001428	11.74268777	45	18	0.514	11	44	33.676	BACINO SCOLANTE IN LAGUNA
551	Sant'Elena	10/07/2013	METEO	8	SANT'ELENA	(PD)	1711682.8	5008331.6	45.196595	11.69453713	45	11	47.742	11	41	40.334	BRENTA: VENETO
572	Ospedaletto Euganeo	27/01/2016	METEO	9	OSPEDALETTO EUGANEO	(PD)	1704622.12	5012334.37	45.2345589	11.60648596	45	14	4.412	11	36	23.349	BRENTA: VENETO
611	Bovolenta	17/12/2020	METEO	8	BOVOLENTA	(PD)	1730051.48	5017879.35	45.276565	11.932629	45	16	35.634	11	55	57.464	BACINO SCOLANTE IN LAGUNA
PROVINCE OF ROVIGO																	
96	Bagnolo di Po - Pellizzare	01/01/1989	METEO	6	BAGNOLO DI PO	(RO)	1699431	4984911	44.9894466	11.52950565	44	59	22.008	11	31	46.22	FISS.TAR.C.BIANCO
98	Concadirame (Rovigo)	01/01/1989	METEO	6	ROVIGO	(RO)	1714125	4996919	45.0931366	11.72081886	45	5	35.292	11	43	14.948	FISS.TAR.C.BIANCO
99	San Bellino	01/01/1989	METEO	6	SAN BELLINO	(RO)	1702997	4989700	45.0315015	11.57662814	45	1	53.405	11	34	35.861	FISS.TAR.C.BIANCO
101	Porto Tolle - Pradon	04/01/1989	METEO	-3	PORTO TOLLE	(RO)	1765950.68	4979312.09	44.9173386	12.36910037	44	55	2.419	12	22	8.761	PO: VENETO
112	Rosolina - Po di Tramontana	18/02/1992	METEO	-2	ROSOLINA	(RO)	1756791.07	4996051.34	45.0711414	12.26177816	45	4	16.109	12	15	42.401	FISS.TAR.C.BIANCO
113	Castelnovo Bariano	01/03/1992	METEO	10	CASTELNOVO BARIANO	(RO)	1681406.97	4988994.95	45.0310164	11.30253145	45	1	51.659	11	18	9.113	FISS.TAR.C.BIANCO
114	Villadose	01/03/1992	METEO	0	VILLADOSE	(RO)	1730059	4995063	45.0714488	11.92220596	45	4	17.216	11	55	19.941	FISS.TAR.C.BIANCO
115	Adria - Bellombra	01/02/1992	METEO	-1	ADRIA	(RO)	1737017.83	4989114.01	45.0156761	12.0076803	45	0	56.434	12	0	27.649	FISS.TAR.C.BIANCO
116	Frassinelle Polesine	01/02/1992	METEO	4	FRASSINELLE POLESINE	(RO)	1711183.25	4985415.41	44.9905831	11.6786399	44	59	26.099	11	40	43.104	FISS.TAR.C.BIANCO
121	Lusia	07/07/1995	METEO	6	LUSIA	(RO)	1707266.17	4996611.55	45.0924191	11.63364487	45	5	32.709	11	38	1.122	FISS.TAR.C.BIANCO
221	Trecenta	26/05/1993	METEO	9	TRECENTA	(RO)	1691214	4988242	45.0216662	11.42663109	45	1	17.998	11	25	35.872	FISS.TAR.C.BIANCO
231	Sant'Apollinare (Rovigo)	01/01/1998	METEO	2	ROVIGO	(RO)	1722631	4990567	45.0334015	11.8259685	45	2	0.245	11	49	33.487	FISS.TAR.C.BIANCO
622	Pettorazza Grimani loc. Botti Barbarighe	17/12/2020	METEO	2	PETTORAZZA	(RO)	1737920.39	5000350.73	45.116383	12.024446	45	6	58.979	12	1	28.006	BACINO SCOLANTE IN LAGUNA
PROVINCE OF VENEZIA																	
159	Portogruaro - Lison	01/02/1992	METEO	2	PORTOGRUARO	(VE)	1792602.09	5072674.76	45.7454889	12.76128681	45	44	43.76	12	45	40.633	LEMENE: VENETO
160	Cavallino Treporti	01/02/1992	METEO	1	CAVALLINO TREPORTI	(VE)	1772598.51	5039845.61	45.4587153	12.48626171	45	27	31.375	12	29	10.542	BACINO SCOLANTE IN LAGUNA
163	Noventa di Piave - Grassaga	01/02/1992	METEO	1	NOVENTA DI PIAVE	(VE)	1779549.39	5063494.43	45.6684116	12.58851069	45	40	6.282	12	35	18.638	PIANURA TRA LIVENZA E PIAVE
164	Eraclea	01/02/1992	METEO	-1	ERACLEA	(VE)	1789119.18	5056667	45.603166	12.70706142	45	36	11.398	12	42	25.421	PIANURA TRA LIVENZA E PIAVE
165	Fossalta di Portogruaro	01/02/1992	METEO	3	FOSSALTA DI PORTOGRUARO	(VE)	1802758.8	5076523.39	45.7756674	12.89394125	45	46	32.403	12	53	38.188	LEMENE: VENETO
166	Lugugnana (Portogruaro)	01/02/1992	METEO	0	PORTOGRUARO	(VE)	1807248	5068864	45.7049116	12.94668823	45	42	17.682	12	56	48.078	LEMENE: VENETO
167	Mira	01/02/1992	METEO	3	MIRA	(VE)	1743805.89	5036506.37	45.4393471	12.1169216	45	26	21.65	12	7	0.918	BACINO SCOLANTE IN LAGUNA
168	Chioggia - Sant'Anna	01/02/1992	METEO	0	CHIOGGIA	(VE)	1757569.51	5004448.54	45.146324	12.27596996	45	8	46.766	12	16	33.492	BRENTA: VENETO
178	Cavarzere	01/01/1996	METEO	-2	CAVARZERE	(VE)	1742665	5005550	45.1615034	12.08720348	45	9	41.412	12	5	13.933	BACINO SCOLANTE IN LAGUNA
230	Campagna Lupia - Valle Averto	17/10/1997	METEO	0	CAMPAGNA LUPIA	(VE)	1746123	5026591	45.3494199	12.14155693	45	20	57.912	12	8	29.605	BACINO SCOLANTE IN LAGUNA
252	Venezia - Istituto Cavanis	01/03/2000	METEO	18	VENEZIA	(VE)	1760369.04	5036126.29	45.4299672	12.32809643	45	25	47.882	12	19	41.147	BACINO SCOLANTE IN LAGUNA
425	Bibione	13/02/2008	METEO	0	SAN MICHELE AL TAGLIAMENTO	(VE)	1817788	5062316.33	45.6413722	13.07746832	45	38	28.94	13	4	38.886	TAGLIAMENTO: VENETO
454	Favaro Veneto	21/05/2009	METEO	2	VENEZIA	(VE)	1756087.59	5045670.61	45.5173083	12.2784802	45	31	2.31	12	16	42.529	BACINO SCOLANTE IN LAGUNA
613	Chioggia (centro)	18/12/2020	METEO	2	CHIOGGIA	(VE)	1757801.54	5012447.85	45.218127	12.283051	45	13	5.257	12	16	58.984	BRENTA: VENETO
615	Jesolo - Cortellazzo	12/02/2021	METEO	2	IESOLO	(VE)	1785698.75	5049015.78	45.535854	12.65882	45	32	9.074	12	39	31.752	BACINO SCOLANTE IN LAGUNA
617	Marcon loc. Zuccarello	not yet installed	METEO		MARCON	(VE)											
623	Stra	18/12/2020	METEO	9	STRA	(VE)	1735445.84	5032997.59	45.410674	12.008505	45	24	38.426	12	0	30.618	BACINO SCOLANTE IN LAGUNA