Content

1.- Objetives

The main objective of this manual is to value the work carried out by previous ICTS_RBD projects and develop a layer for presentation, consultation and download of data from hydro-meteorological stations (HIDROMET).

2.- What is HIDROMET?

It is a database [bbdd] where data of hydro-meteorological from different stations, distributed in the Doñana National Park, are stored.

Different instruments are installed in each station that record data every 5 minutes. These data are stored in the "HIDROMET" database, and are considered raw data.

3.- Data included in the BBDD

HIDROMET stores the data of 8 stations:

- Cancela Millán
- Hondón del Burro
- Lucio del Rey
- Resolimán
- Vetalengua
- Juncabalejo
- FAO
- Brenes

En la base de datos “HIDROMET” existen datos desde marzo de 2020. El total de datos a 22/05/2023 es de 46,8 millones de registros.

In the "HIDROMET" database there are data from March 2020. The total data to 05/22/2023 is about 46.8 million records.

Figure 1. Number of records, distribution of the Stations and data start-end date.

The distribution of data by months according to each Stations since March 2020 is the following:

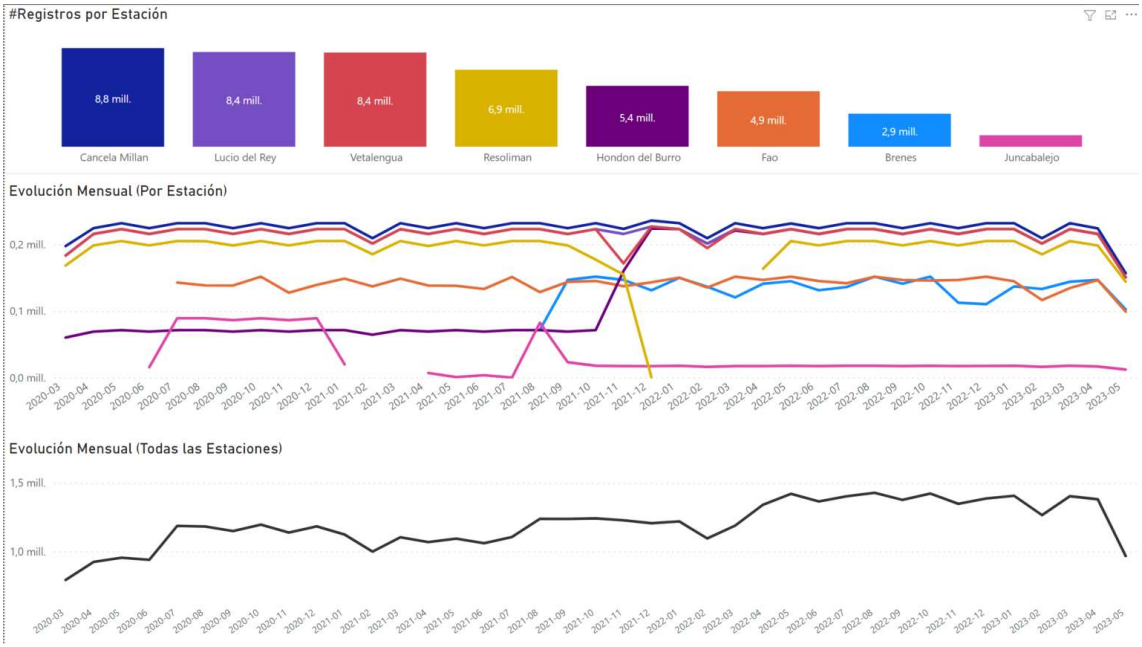

Figure 2. Number of data recorded at each station (a). Evolution of the number of data by months and seasons(b). Evolution of the total number of data recorded by month.

4.- Data update process

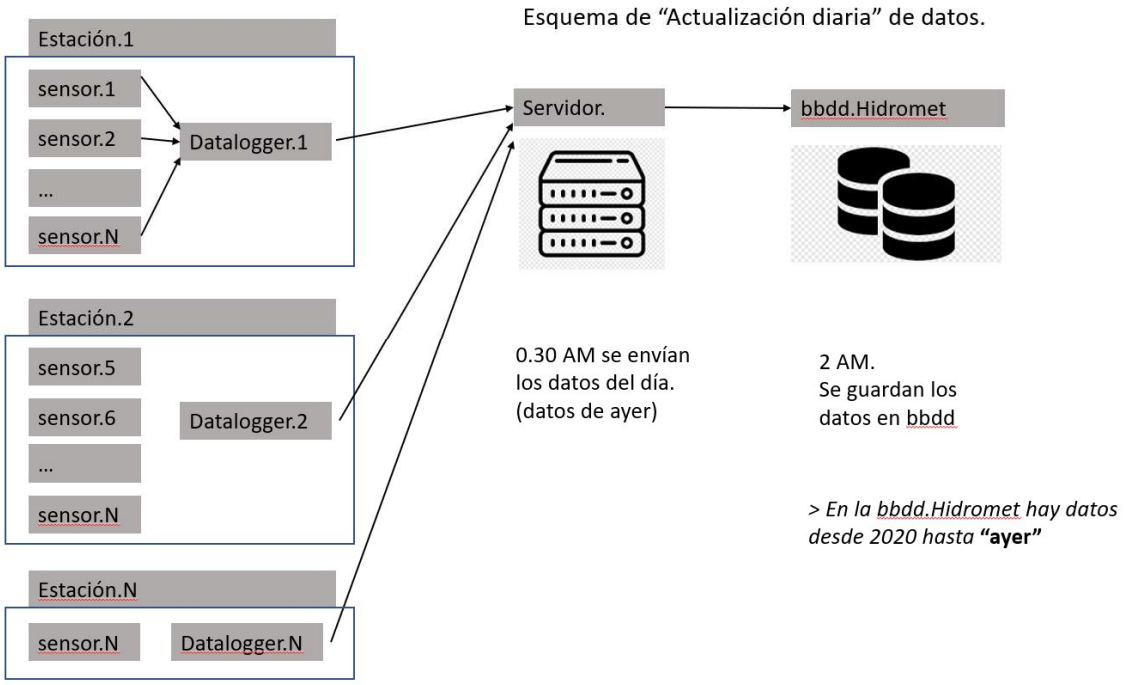

Figure 3. Data flow from reading to saving in the database.

The data flow is the following:

• Reading made by the instrument.

• Centralized storage where all data is stored. The new data arrives once a day (a new file is created when new data arrive).

• Addition of the new data in the HIDROMET database.

Every day more than 45,000 new records arrive at the HIDROMET database, which correspond to the data collected from the previous day.

5.- Terminology

This section describes the concepts needed to carry out filters in data queries.

5.1. What is a station and what elements compose it?

Figure 4. Hydrometeorological Station.

5.2. What are the instruments?

Figure 5. Different instrument in Doñana National Park.

6.- What data is included in the HIDROMET database?

HIDROMET stores the data that we call “raw” data, which refers to the data as it is stored by the different instruments of each one of the stations. In the case of HIDROMET instruments, the raw data is saved every 5 minutes.En HIDROMET se almacenan los datos que

denominamos datos “brutos” que se refieren a los datos tal como son almacenados por los diferentes instrumentos de cada una de las estaciones. En el caso de los instrumentos de HIDROMET los datos brutos se guardan cada 5 minutos.

Date	Place	Sensor	Calc procedure	Value	Unit	Variable group	Variable	Acronym	Calc procedure method
12/05/2023 09:00	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:05	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:10	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:15	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:20	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:25	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:30	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:35	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:40	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:45	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:50	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 09:55	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:00	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:05	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:10	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:15	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:20	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:25	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average
12/05/2023 10:30	Resoliman	HmtCond4US-000001010	waterTemperature_HamiltonConducell4US_Average	NAN	degree_Celsius	temperature	waterTemperature	HamiltonConducell4US	Average

7.- What variables are stored in HIDROMET?

If we break down the variables by seasons, we observe that HIDROMET stores information on a total of 28 different variables. Some of these variables are only present in specific stations, so not all Stations measure the same variables.

Grupo de variables. Y variables. (Por Estación)

group	Brenes	Cancela Millan	Fao	Hondon del Burro	Juncabalejo	Lucio del Rey	Resoliman	Vetalengua	**Total**
airPressure	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**
airPressure	1	1	1	1		1	1	1	**1**
airRelativeHumidity	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**
airRelativeHumidity	1	1	1	1		1	1	1	**1**
precipitation	**8**	**9**	**8**	**8**		**8**	**8**	**8**	**9**
hailAccumulated	1	1	1	1		1	1	1	**1**
hailDuration	1	1	1	1		1	1	1	**1**
hailIntensity	2	2	2	2		2	2	2	**2**
rainfallAccumulated	1	2	1	1		1	1	1	**2**
rainfallDuration	1	1	1	1		1	1	1	**1**
rainfallIntensity	2	2	2	2		2	2	2	**2**
radiation		**4**		**4**	**1**	**4**	**4**	**4**	**5**
albedo		1		1		1	1	1	**1**
inciseRadiation		1		1		1	1	1	**1**
photosyntheticallyActiveRadiation		1		1		1	1	1	**1**
reflectedRadiation		1		1		1	1	1	**1**
sensorBodyTemperature					1				**1**
temperature	**1**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**3**
airTemperature	1	1	1	1		1	1	1	**1**
soilTemperature					1				**1**
waterTemperature		1		1		1	1	1	**1**
waterConductivity		**1**		**1**		**1**	**1**	**1**	**1**
waterConductivity		1		1		1	1	1	**1**
waterLevel		**2**		**2**		**2**	**2**	**2**	**2**
waterLevel		2		2		2	2	2	**2**
wind	**6**	**6**	**6**	**6**		**6**	**6**	**6**	**6**
windDirection	3	3	3	3		3	3	3	**3**
windSpeed	3	3	3	3		3	3	3	**3**
Total	**17**	**26**	**17**	**25**	**2**	**25**	**25**	**25**	**28**

Table 1. Variables and group of variables by Stations.

Note: the category "group of variables" has been included, which include the variables of the same family.

8.- What is the calculation procedure?

To know in more detail what data is being stored in the database, we use the term "**Calculation procedure**". The calculation procedure include three elements, which are the following:

• "**Variable**": indicates what is being measured.

•"**Instrument**": shows the instrument that performs the measurement.

• "**Calculation method**": indicates the parameter used (mean, maximum, minimum, mode or accumulated total) to store the raw data corresponding to the 5-minute record.

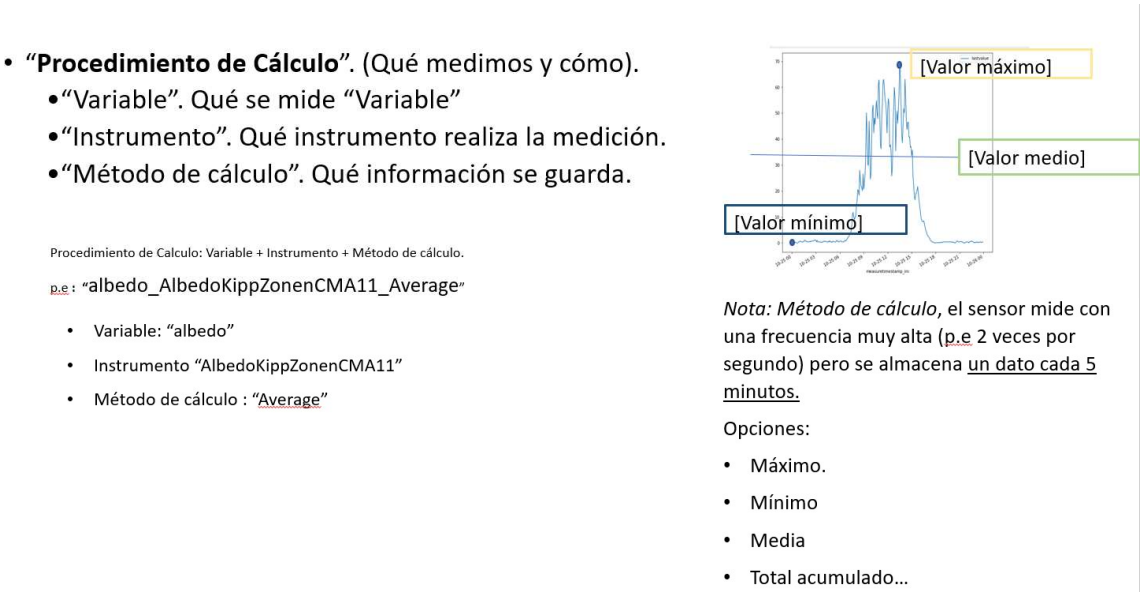

Figure 6. Calculation procedure.

Note: The data that we are saving is defined by the combination of "Variable+Instrument+Calculation Method", since the same variable can be measured by several instruments and also the data stored in databases can be obtained by various calculation methods.

The calculation procedures that we can find by Station are the following:

group	Brenes	Cancela Millan	Fao	Hondon del Burro	Juncabalejo	Lucio del Rey	Resoliman	Vetalengua	Total
wind	**6**	**6**	**6**	**6**		**6**	**6**	**6**	**6**
windSpeed_VaisalaMeteo_Minimum	1	1	1	1		1	1	1	1
windSpeed_VaisalaMeteo_Maximum	1	1	1	1		1	1	1	1
windSpeed_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
windDirection_VaisalaMeteo_Minimum	1	1	1	1		1	1	1	1
windDirection_VaisalaMeteo_Maximum	1	1	1	1		1	1	1	1
windDirection_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
waterLevel		**2**		**2**		**2**	**2**	**2**	**2**
waterLevel_WaterLevelMobrey_Average		1		1		1	1	1	1
waterLevel_WaterLevelMestech_Average		1		1		1	1	1	1
waterConductivity		**1**		**1**		**1**	**1**	**1**	**1**
waterConductivity_HamiltonConducell4US_Average		1		1		1	1	1	1
temperature	**1**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**3**
waterTemperature_HamiltonConducell4US_Average		1		1		1	1	1	1
soilTemperature_IRRadiom-ApogeeSI411_Average					1				1
airTemperature_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
radiation		**4**		**4**	**1**	**4**	**4**	**4**	**5**
sensorBodyTemperature_IRRadiom-ApogeeSI411_Average					1				1
reflectedRadiation_AlbedoKippZonenCMA11_Average		1		1		1	1	1	1
photosyntheticallyActiveRadiation_PAR-LICOR-LI190SZ_Average		1		1		1	1	1	1
inciseRadiation_AlbedoKippZonenCMA11_Average		1		1		1	1	1	1
albedo_AlbedoKippZonenCMA11_Average		1		1		1	1	1	1
precipitation	**8**	**9**	**8**	**8**		**8**	**8**	**8**	**9**
rainfallIntensity_VaisalaMeteo_Maximum	1	1	1	1		1	1	1	1
rainfallIntensity_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
rainfallDuration_VaisalaMeteo_Totalize	1	1	1	1		1	1	1	1
rainfallAccumulated_VaisalaMeteo_Totalize	1	1	1	1		1	1	1	1
rainfallAccumulated_RainGaugeYoung-52203_Totalize		1							1
hailIntensity_VaisalaMeteo_Maximum	1	1	1	1		1	1	1	1
hailIntensity_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
hailDuration_VaisalaMeteo_Totalize	1	1	1	1		1	1	1	1
hailAccumulated_VaisalaMeteo_Totalize	1	1	1	1		1	1	1	1
airRelativeHumidity	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**
airRelativeHumidity_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
airPressure	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**
airPressure_VaisalaMeteo_Average	1	1	1	1		1	1	1	1
Total	**17**	**26**	**17**	**25**	**2**	**25**	**25**	**25**	**28**

Table 2. Groups of variables and calculation method by Stations.

Note: It can be seen that not all stations have the same instruments installed, from the above the calculation procedures and the data stored by station are different.

9.- Data that can be consulted in the HIDROMET application

9.1. Raw data

They refer to the data every 5 minutes that are stored in the database, just as they are saved by the sensors.

9.2 Aggregated data:

To facilitate the reading of the data, the data and metadata team has carried out an aggregate data calculation process at three levels of aggregation:

- Hourly
- Diary
- Monthly

The aggregated data according to the "**Calculation Procedures**" are the following:

Variable Group	Variable	Variable-Instrument-Calculation Method	Calculation Method
airPressure	airPressure	airPressure_VaisalaMeteo_Average	Average, Maximum, Minimum
airRelativeHumidity	airRelativeHumidity	airRelativeHumidity_VaisalaMeteo_Average	Average, Maximum, Minimum

precipitation	hailAccumulated	hailAccumulated_VaisalaMeteo_Totalize	Totalize
precipitation	hailDuration	hailDuration_VaisalaMeteo_Totalize	Totalize
precipitation	hailIntensity	hailIntensity_VaisalaMeteo_Maximum	
precipitation	hailIntensity	hailIntensity_VaisalaMeteo_Average	
precipitation	rainfallAccumulated	rainfallAccumulated_RainGaugeYoung-52203_Totalize	Totalize
precipitation	rainfallAccumulated	rainfallAccumulated_VaisalaMeteo_Totalize	Totalize
precipitation	rainfallDuration	rainfallDuration_VaisalaMeteo_Totalize	Totalize
precipitation	rainfallIntensity	rainfallIntensity_VaisalaMeteo_Maximum	
precipitation	rainfallIntensity	rainfallIntensity_VaisalaMeteo_Average	
radiation	albedo	albedo_AlbedoKippZonenCMA11_Average	Average
radiation	incidentRadiation	inciseRadiation_AlbedoKippZonenCMA11_Average	Average
radiation	photosyntheticallyActiveRadiation	photosyntheticallyActiveRadiation_PAR-LICOR-LI190SZ_Average	Average
radiation	reflectedRadiation	reflectedRadiation_AlbedoKippZonenCMA11_Average	Average
radiation	sensorBodyTemperature	sensorBodyTemperature_IRRadiom-ApogeeSI411_Average	Average
temperature	airTemperature	airTemperature_VaisalaMeteo_Average	Average, Maximum, Minimum
temperature	soilTemperature	soilTemperature_IRRadiom-ApogeeSI411_Average	Average, Maximum, Minimum
temperature	waterTemperature	waterTemperature_HamiltonConducell4US_Average	Average, Maximum, Minimum
waterConductivity	waterConductivity	waterConductivity_HamiltonConducell4US_Average	Average
waterLevel	waterLevel	waterLevel_WaterLevelMestech_Average	Average
waterLevel	waterLevel	waterLevel_WaterLevelMobrey_Average	Average
wind	windDirection	windDirection_VaisalaMeteo_Average	Mode
wind	windDirection	windDirection_VaisalaMeteo_Minimum	Mode
wind	windDirection	windDirection_VaisalaMeteo_Maximum	Mode
wind	windSpeed	windSpeed_VaisalaMeteo_Average	Average
wind	windSpeed	windSpeed_VaisalaMeteo_Maximum	Average
wind	windSpeed	windSpeed_VaisalaMeteo_Minimum	Average

Table 3. Aggregates available by Calculation Procedure.

10.- Navigation and queries

To search for HIDROMET information you can access by the url:http://datos-automaticos.icts.ebd.csic.es/.

In this portal we establish three different areas:

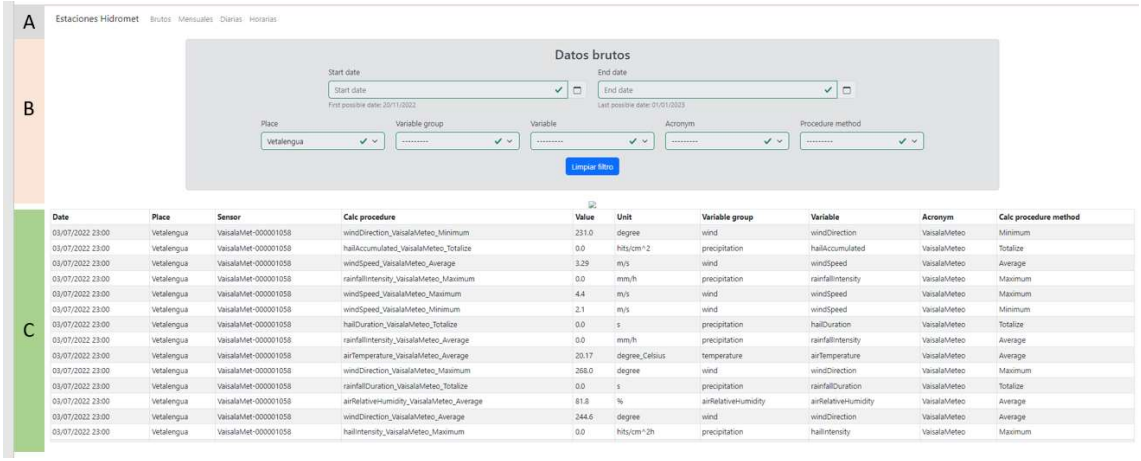

Figure 7. Data display areas via web

A: selection zone of the "Data detail level" in which we can select between:

- Raw data
- Hourly data
- Daily data
- Monthly data

B: filter area by:

- Seasons
- Group of variables
- Variable
- Instrument
- Calculation method.

To find out the details of the possible combinations, see Tables 1 and 2.

In the case that we are consulting the aggregate data, we will need to filter one more element, the “aggregate method”. The aggregate level by calculation procedure can be found in Table 3.

C: Data area, selecting a complete combination of fields from the previous section, we will see the data in this area. Additionally, we can download them in csv format.

Finally, in the aggregated data tabs [hourly, daily, monthly] we will see the following differences:

1. One more field “**Agg_method**”, with which we decide what data we want to consult.

2. A visualization of the data in a table.

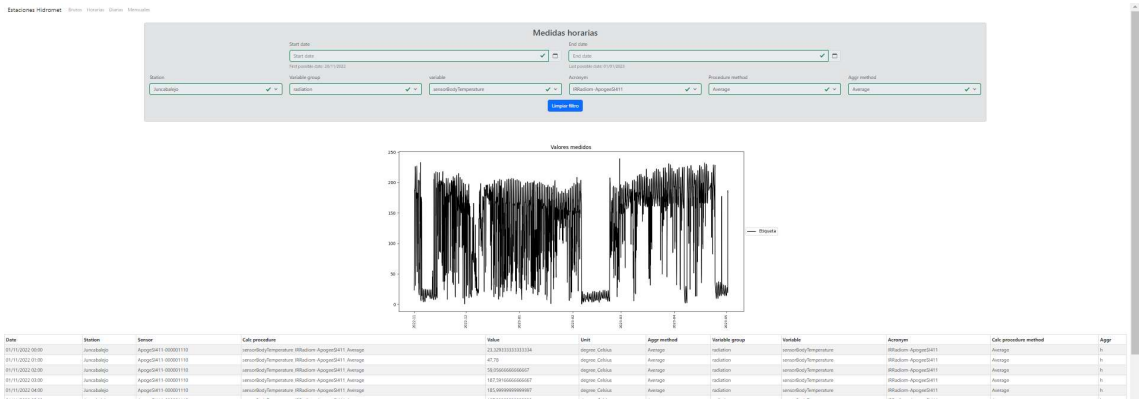

Figure 8. Visualization of aggregated data.