



D.1.1.4

Survey on measuring campaign



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Executive Summary

This deliverable provides an overview of the monitoring activities, environmental context and preliminary data processing carried out to support the assessment of climate-related impacts and hydrogeological dynamics within the territory of the Ferrara Plain Reclamation Consortium. The analysis combines regional and European datasets with the first outputs of the monitoring system implemented under the STRENGTH project, offering an integrated perspective on the conditions affecting the coastal and lowland areas of the district.

Regional-scale information on subsidence, coastal evolution, land use and hydrogeological risk highlights long-term environmental pressures that influence the vulnerability of the Ferrara plain. Land subsidence, monitored since the 1980s through levelling networks and satellite interferometry, ranges between 5 and 20 cm across most of the district for the period 1992–2021, with values exceeding 25 cm in some coastal areas. This continued lowering of the ground surface contributes to increased exposure to flooding and coastal erosion, as reflected in the shoreline evolution analysis, which shows that the Vene di Bellocchio sector has experienced more than 300 metres of coastline retreat between 1996 and 2023. Land use changes observed between 2017 and 2020 further indicate a reduction of natural habitats and an expansion of anthropogenic uses, mirroring the environmental pressures acting on the coastal strip. The hydrogeological risk classification prepared in line with Directive 2007/60/EC identifies approximately 85% of the district as low to moderate risk, with the remaining 15% falling within medium to higher risk categories, including sensitive areas within the Po Delta Regional Park.

Complementing these regional datasets, the deliverable presents the structure and initial outputs of the monitoring system established to observe atmospheric, soil and groundwater conditions in the Ferrara coastal test area. The system includes the Bellocchio environmental station, which records precipitation, air temperature, vapour pressure, wind parameters, soil moisture and temperature at different depths, as well as groundwater level and electrical conductivity. These measurements provide the basis for documenting short-term hydrometeorological variability and for establishing a reference framework that will support future analyses related to water availability, salinity dynamics and drying-wetting processes in the coastal environment.

The first processed outputs presented in this deliverable illustrate typical time-series patterns and demonstrate the operational readiness of the monitoring system. Standard data-processing steps—such as temporal aggregation, smoothing and the computation of simple multi-parameter indicators—are applied to provide examples of the analytical



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potential of the collected data. These examples do not constitute environmental interpretation but serve to show how the monitoring network supports the development of indicators relevant to the study of climate-related processes in low-lying coastal areas.

Overall, the deliverable outlines the environmental context in which the monitoring campaign operates and describes the datasets that will underpin the analytical activities planned for subsequent phases of the project. Continuous multi-parameter monitoring and the integration of regional and local-scale information are essential components for improving the understanding of climate-driven processes affecting the Ferrara plain and its coastal systems.



1. Climate Change Effects, Subsidence and Coastal Dynamics in the Ferrara Reclamation District

1.1. Premise

The **impact of climate change and hydrogeological risk** are of great relevance, particularly for institutions responsible for territorial safety such as the Consorzio di Bonifica Pianura di Ferrara. Climate change is altering the regular patterns of natural events to which we have long been accustomed.

An evident example can be found in the **recent rainfall distribution trends** across the Ferrara area, which have increasingly stressed the pumping stations and infrastructures designed to ensure hydraulic safety.

Another clear effect of climate change is observed along the **coastline**, where the delicate balance between sediment input—already in crisis for some time—and marine weather conditions further threatens the coastal strip.

Sea level rise, storm surges, and the low elevation of the territory are three fundamental factors influencing the definition of hydraulic risk maps and the identification of potentially flood-prone areas.

These changes are also visually detectable through the analysis of land use maps. Areas once characterized by freshwater vegetation are shrinking due to progressive desertification. Along the coast, the shoreline position shifts significantly year by year, pushing sandy and saline environments further inland.

All these phenomena are inevitably linked to **both natural and anthropogenic subsidence**, a process observed in the Ferrara plain as well as along the coastal zone of Emilia-Romagna. These areas are geologically characterized by thick Quaternary alluvial deposits—reaching several kilometers—which gradually compact over time. This slow compaction, combined with the downward movement of the underlying geological units, results in natural subsidence.

1.2. Subsidence



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Subsidence became a matter of serious concern in the 1980s, when the Emilia-Romagna Region established a dedicated monitoring network. Initially, the system consisted of benchmark points measured through high-precision geometric leveling. Later, with the advent of radar systems onboard satellites, these measurements were enhanced through interferometric analysis techniques.

The results of these investigations were published as vector maps showing the average subsidence rate (mm/year) across the entire Emilia-Romagna plain for different time periods:

- **1992–2000**
- **2002–2006**
- **2006–2011**
- **2006–2021**

These datasets were processed within a GIS environment, combined into a single polygonal layer summing all subsidence values from 1992 to 2021, thus obtaining the total millimeters of lowering for each area over the past 29 years.

This analysis made it possible to quantify ground lowering across the entire reclamation district, and to examine in detail two specific zones: the coastal macro-area and the project micro-area. Results were classified in 5 cm subsidence intervals. It is worth noting that this process is still ongoing.



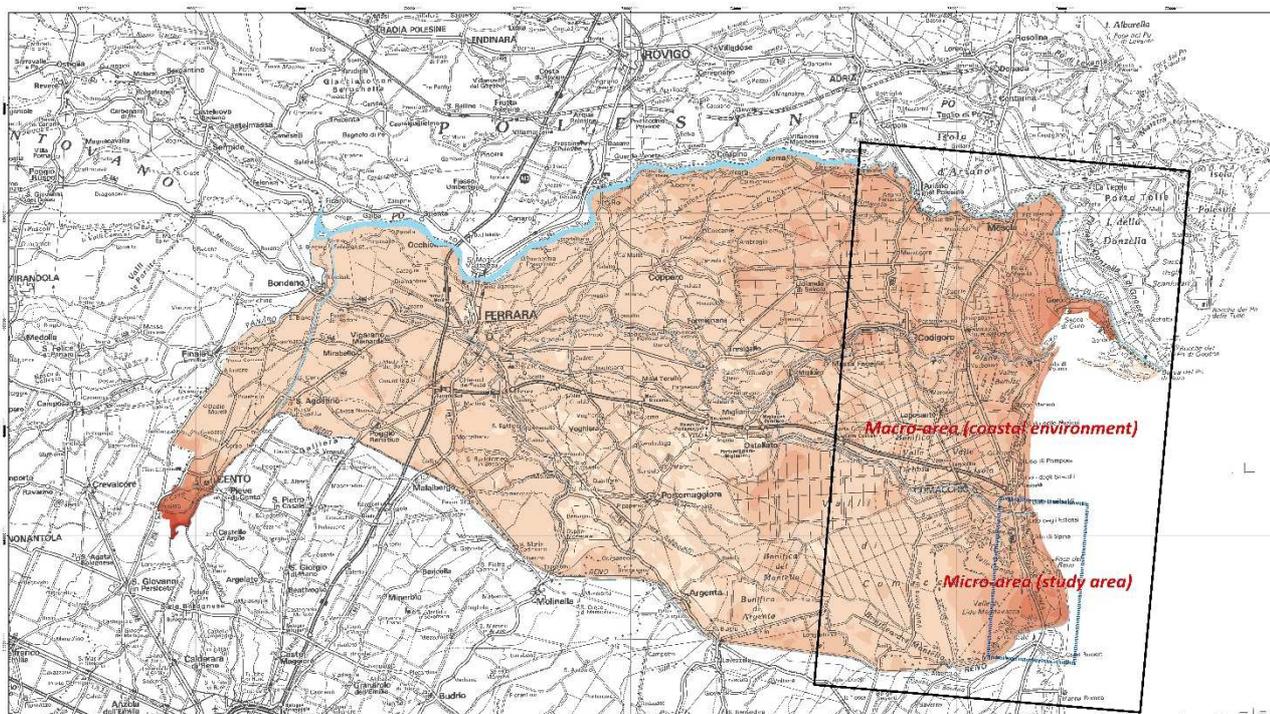


Figure 1: Map of ground lowering from 1992 to 2021

N	Lowering from 1992 to 2021	Area [ha]	Percentage
1	Lowering between 0 and 5 cm	10.612	4,14%
2	Lowering between 5 and 10 cm	145.501	56,80%
3	Lowering between 10 and 15 cm	70.556	27,54%
4	Lowering between 15 and 20 cm	22.775	8,89%
5	Lowering between 20 and 25 cm	4.282	1,67%
6	Lowering between 25 and 30 cm	1.796	0,70%
7	Lowering between 30 and 35 cm	361	0,14%
8	Lowering between 35 and 40 cm	180	0,07%
9	Lowering between 40 and 45 cm	92	0,04%
10	Lowering between 45 and 50 cm	29	0,01%
11	Lowering between 50 and 55 cm	1	0,00%
	Total area	256.185	

Table 1: Statistics of areas affected by subsidence between 1992 and 2021



According to Table 1 and Figure 1, about **57%** of the Consorzio di Bonifica Pianura di Ferrara district **experienced a lowering between 5 and 10 cm**. This is a significant portion of the territory, stable over time, including both older reclaimed lands and the areas above sea level.

In the **macro-area**, about **61% of the territory shows a subsidence between 10 and 20 cm**. These are the “younger” reclaimed lands—some drained at the end of the 19th century, others between the 1930s and 1960s. It is well known that land reclamation by drainage induces lowering due to the reduction of the groundwater table and the compaction of surface soils, making them suitable for agricultural use. This macro-area corresponds to the lowest part of the district, with ground elevations reaching up to 4 meters below sea level.

In the **micro-area**, data show a different situation: **about 70% of this zone has experienced a lowering between 15 and 25 cm**. These lands were not affected by reclamation activities but have suffered from (and continue to suffer from) the extraction of hydrocarbons and freshwater for industrial and drinking purposes. These withdrawals, concentrated along the coastline and offshore, have intensified the subsidence process, worsening coastal equilibrium and increasing exposure to flooding and erosion.

1.3. Coastal evolution

Studying the evolution of the shoreline is essential to better understand the interactions between the marine and terrestrial environments. Much of the information used in this analysis originates from the **SIC** (Marine and Coastal Information System) database of the Emilia-Romagna Region, developed within the European project **Coastance**. This dataset is organized into several thematic sections.



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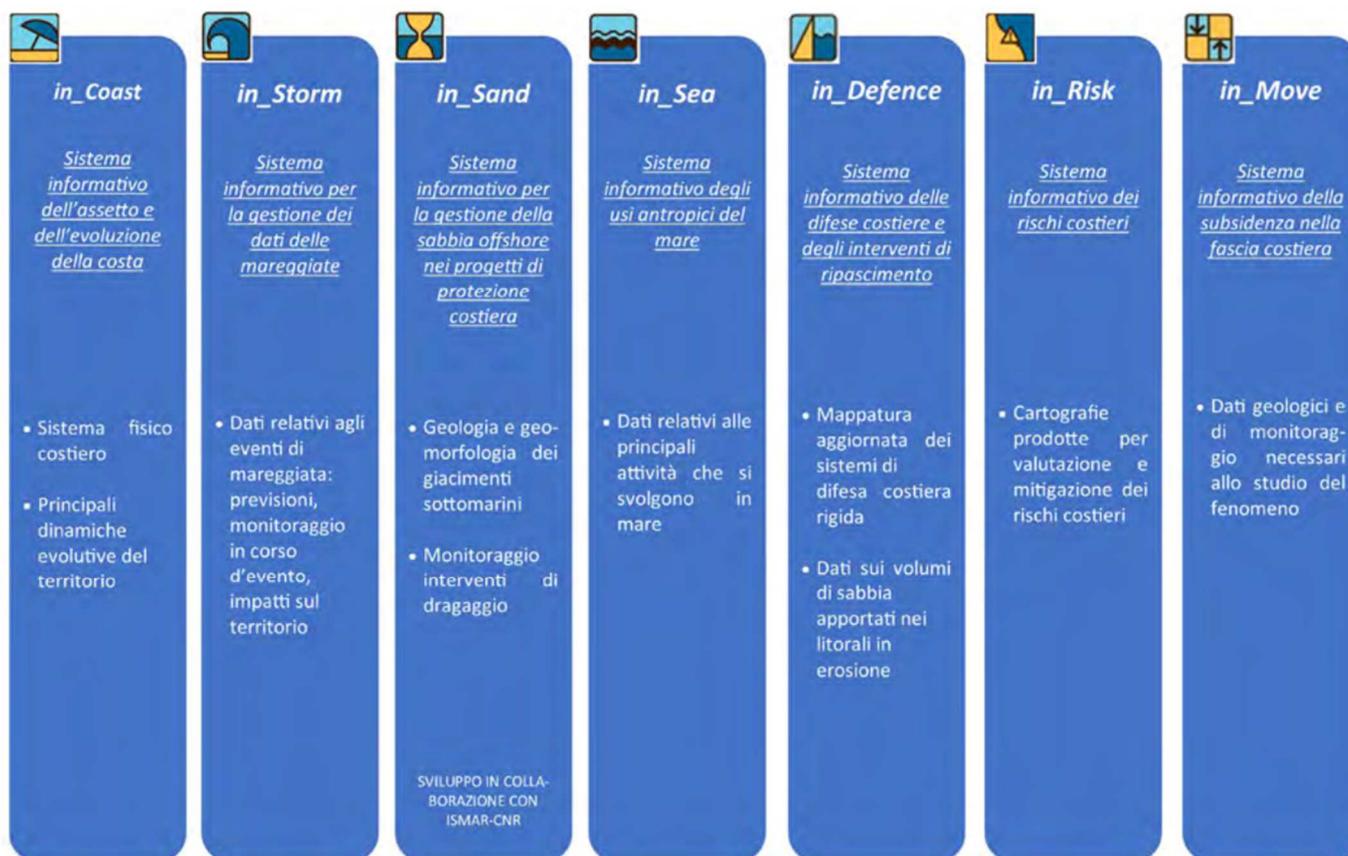


Figure 2: List of subprojects developed within Coastance.

Within the *in_Coast* subproject, numerous datasets are available, including shoreline evolution from 1943 to 2023, the physical coastal system, and the main geomorphological dynamics. The entire Emilia-Romagna coastline is divided into seven macro-cells.



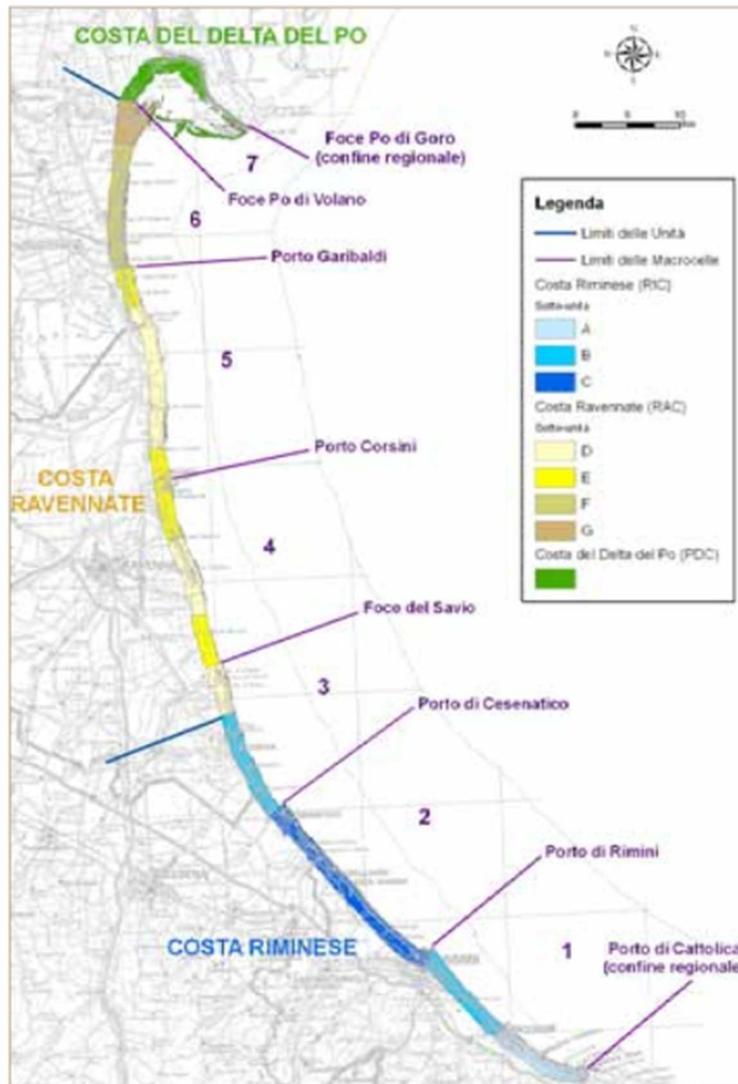


Figure 3: Division of the Emilia-Romagna coastline into 7 macro-cells.

The area known as Vene di Bellocchio extends between Lido di Spina and the Reno River mouth. It falls within macro-cell no. 5 (from Porto Corsini to Porto Garibaldi), which is further divided into smaller cells—from no. 81 (Porto Corsini) to no. 100 (Lido degli Estensi).





Figure 4: Section of macro-cell no. 5. In the center: Vene di Bellocchio, part of the project's micro-area.

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89	Casal Borsetti Fio 82	Cella con spiaggia	Tratto compreso tra la quarta scogliera emersa e il secondo pennello di Casalborsetti	Ravenna	RA	M5	RAC	D	630	A
90	Poligono Militare	Cella priva di spiaggia	Tratto lungo 2,5 km posto a nord del secondo pennello di Casalborsetti nord, difeso da scogliera radente	Ravenna	RA	M5	RAC	D	2.500	P
91	Poligono Militare Nord	Cella con spiaggia	Tratto lungo 1,1 km posto a sud della foce del fiume Reno	Ravenna	RA	M5	RAC	D	1.100	E
92	Foce Reno	Foce Fluviale	Tratto corrispondente alla foce del fiume Reno	Ravenna	RA	M5	RAC	D	235	
93	Nord Foce Reno	Cella con spiaggia	Tratto lungo 2 km posto a nord della foce del fiume Reno	Ravenna	RA	M5	RAC	D	2.000	S
94	Foce Gobbino Sud	Cella con spiaggia	Tratto lungo circa 850 m posto a sud della foce del canale Gobbino	Ravenna	RA	M5	RAC	D	860	E
95	Foce Gobbino	Foce canale di scolo	Tratto corrispondente alla foce del canale Gobbino	Ravenna	RA	M5	RAC	D	100	A
96	Foce Gobbino - Bagno Giamaica	Cella con spiaggia	Tratto corrispondente alla foce del canale Gobbino e il bagno Giamaica	Ravenna / Comacchio	RA / FE	M5	RAC	D	1.575	E
97	Lido di Spina Sud	Cella con spiaggia	Tratto lungo 900 m posto a nord del bagno Giamaica	Comacchio	FE	M5	RAC	D	900	E
98	Lido di Spina Nord	Cella con spiaggia	Tratto lungo circa 2 km posto a sud della foce del canale Logonovo	Comacchio	FE	M5	RAC	E	2.070	A
99	Foce Logonovo	Foce canale di scolo	Tratto corrispondente alla foce del canale Logonovo	Comacchio	FE	M5	RAC	E	200	
100	Lido degli Estensi	Cella con spiaggia	Tratto compreso tra la foce del canale Logonovo e il molo sud di Porto Garibaldi	Comacchio	FE	M5	RAC	E	1.540	A

Table 2: Details of macro-cell no. 5. On the right, the physical state of each cell: A = Accretion; S = Stable; P = Unstable equilibrium; E = Erosion.

Comparing the shoreline positions from 1996 and 2023 confirms an erosive trend, as shown for cells 94 and 96, with shoreline retreat exceeding 300 meters in the last 27 years.



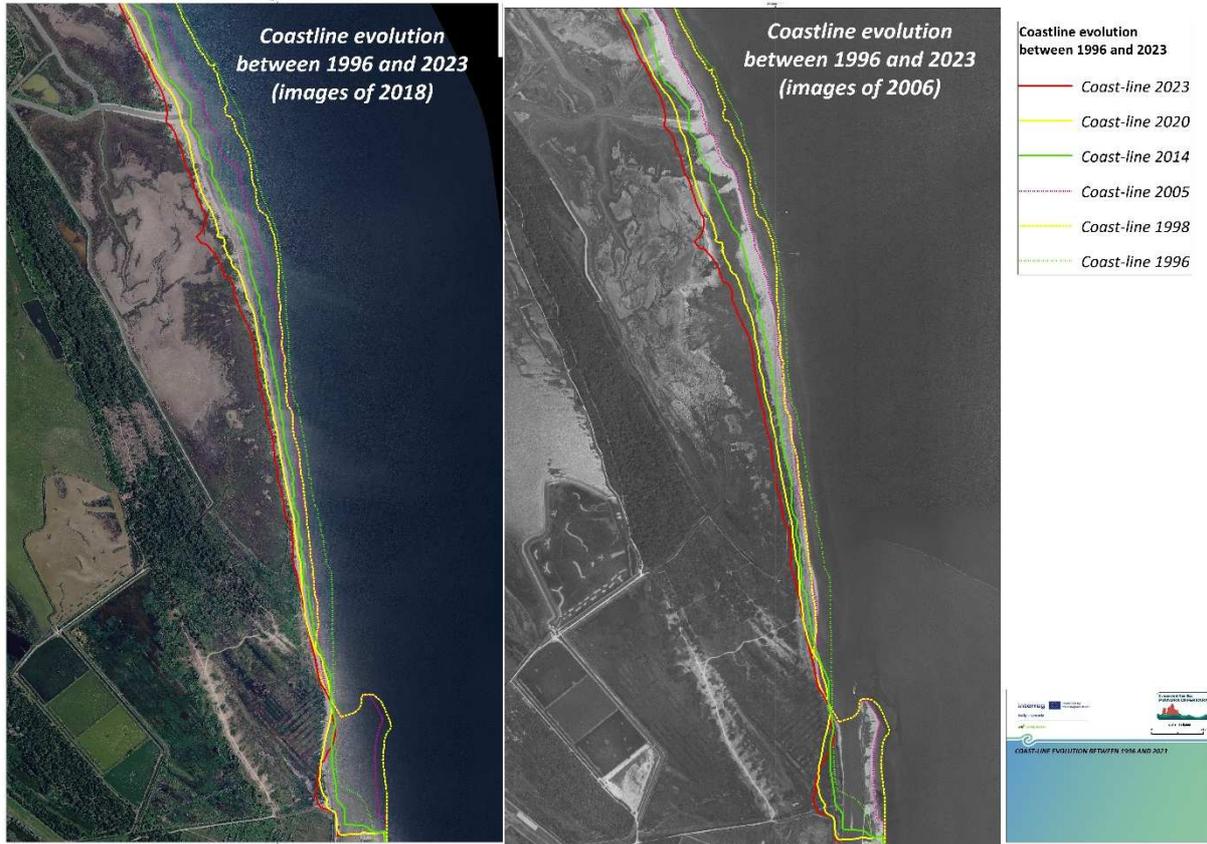


Figure 5: Shoreline evolution from 1996 to 2023. Left: 2018 imagery; Right: 2006 imagery.



1.4 Land use

A fundamental tool for territorial planning, management, and monitoring is the **land use database**, which maps the various uses of the territory following the hierarchical classification of the European CORINE Land Cover (CLC) project. It serves as a general reference for public administrations, professionals, enterprises, and universities. The Emilia-Romagna Region periodically updates this mapping to track land use transformations.

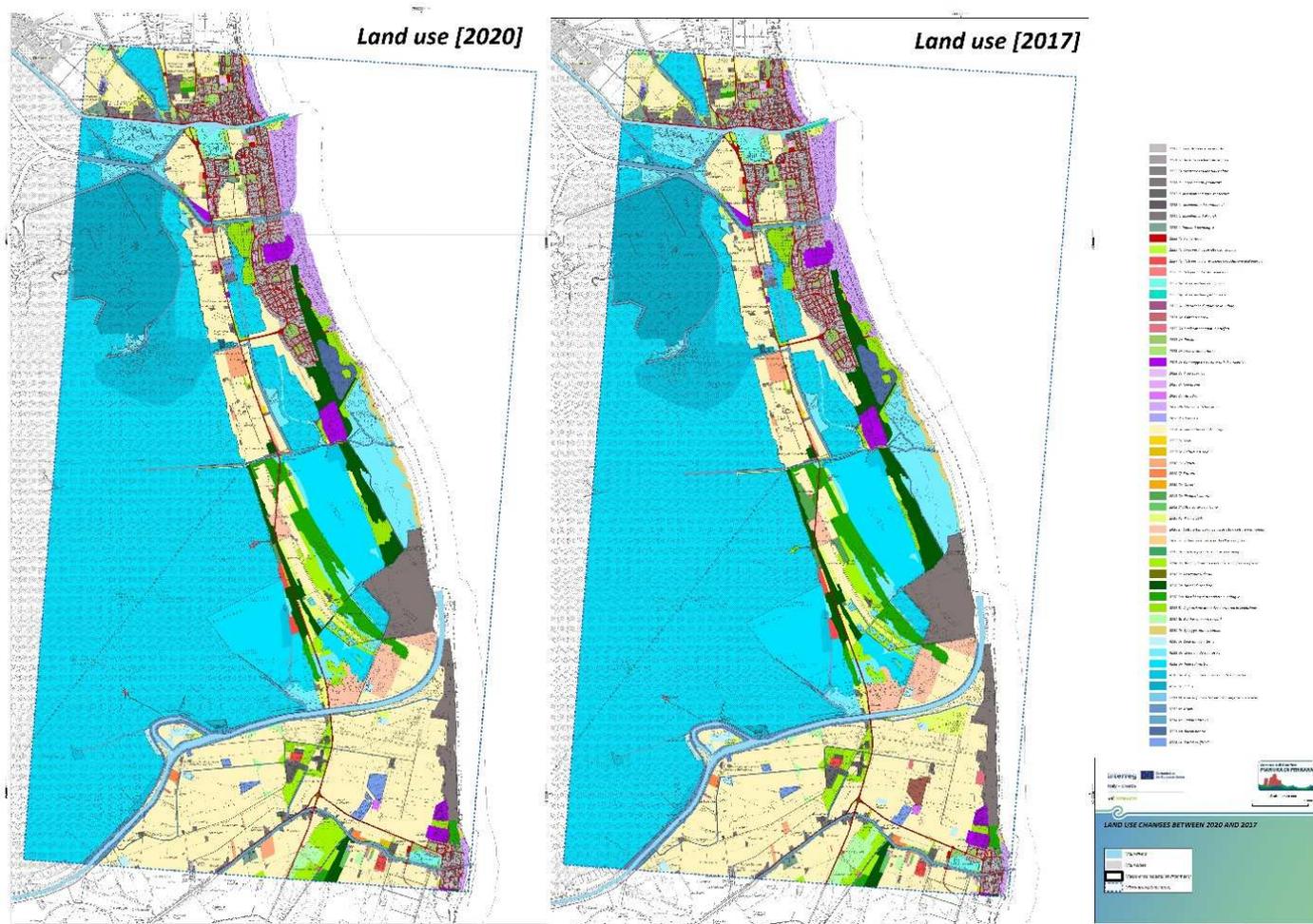


Figure 6: Comparison between 2020 (left) and 2017 (right) land use in the micro-area.

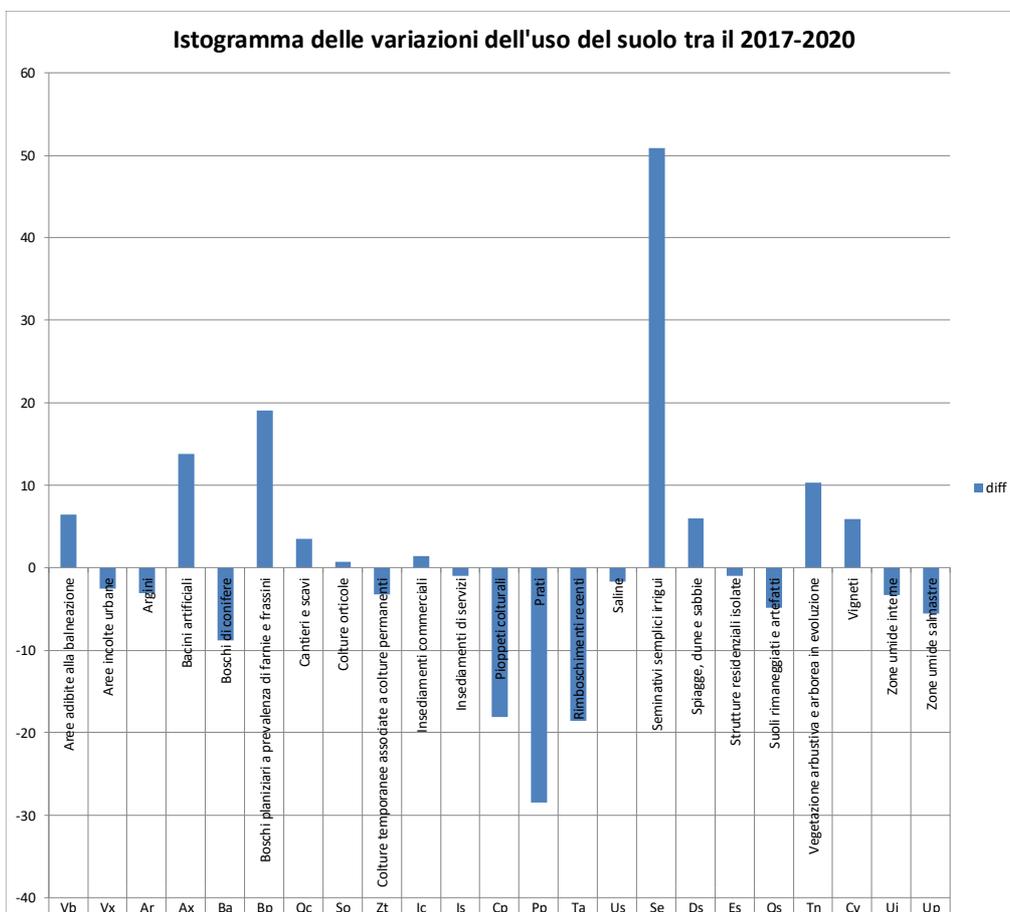


Figure 7: Histogram showing surface changes (ha) between 2017 and 2020.

Between 2017 and 2020, several land use changes occurred within the study area—some likely linked to coastal erosion and saltwater intrusion, others to anthropogenic activities. Figure 7 illustrates both positive and negative changes:

Positive values correspond to anthropogenic expansion—e.g., beach facilities, artificial basins, vineyards, and cropland (the latter showing an increase of over 50 hectares).

Negative values correspond to natural environments (conifer woods, poplar groves, grasslands) reduced in favor of more profitable uses.

Overall, a loss of natural habitats is observed, replaced by human activities.



1.5 Hydrogeological risk

Directive 2007/60/EC requires each Member State to establish a framework for the assessment and management of flood risks. The Emilia-Romagna Region, in cooperation with River Basin Authorities and other competent bodies, developed a key tool for this purpose: **hazard maps**.

These maps represent the potential extent of flooding under three scenarios—rare, infrequent, and frequent events—and associate these with exposed elements such as population, services, infrastructures, and economic activities. The outcome is a hydraulic risk map divided into four categories:

R1: Low or negligible risk

R2: Medium risk

R3: High risk

R4: Very high risk

The district borders the Po River to the north, the Reno River to the south, and the Adriatic Sea to the east. This location makes it particularly vulnerable to both fluvial floods and storm surges. Moreover, extraordinary rainfall events can cause local flooding due to the secondary drainage network.



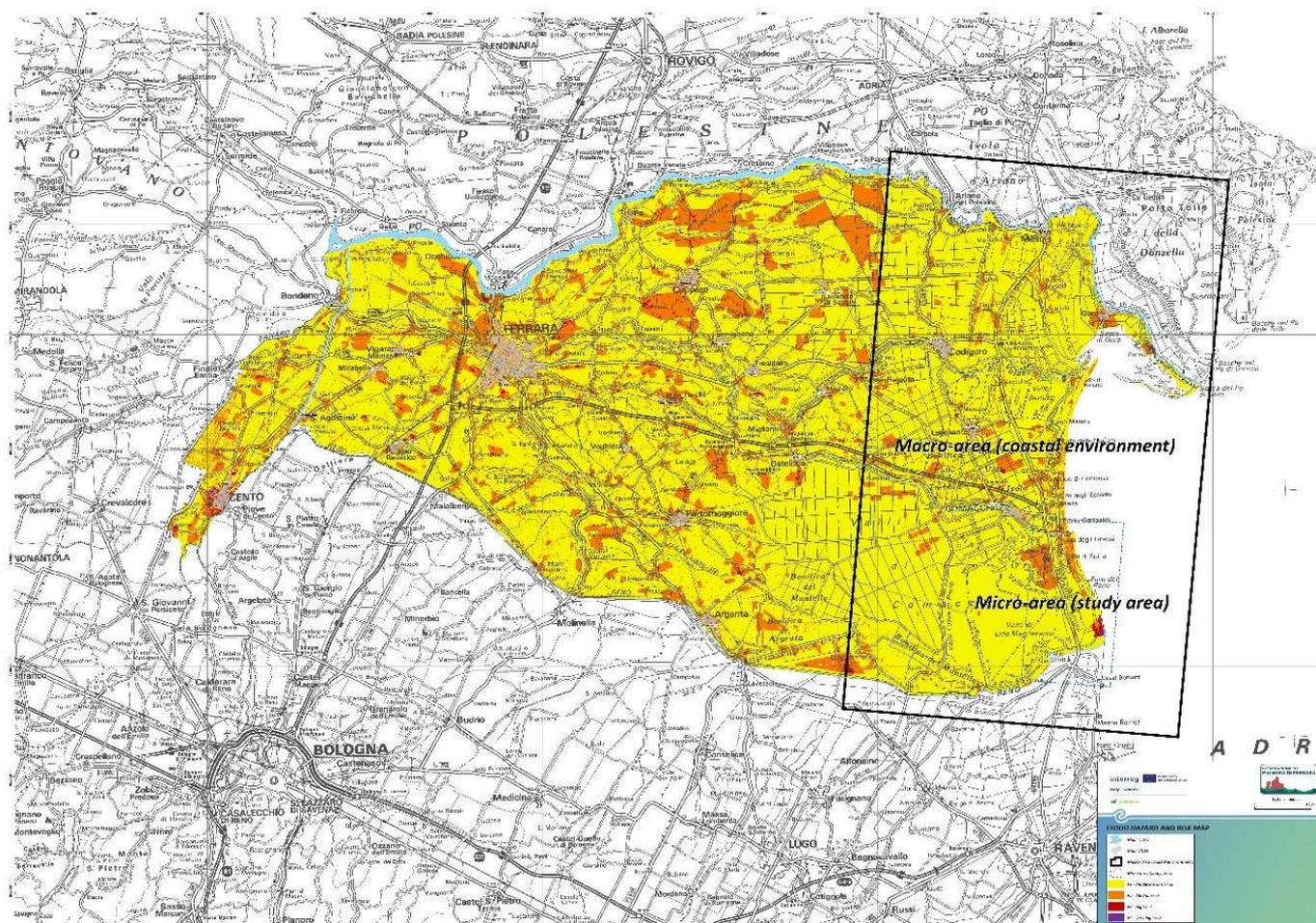


Figure 8: Hydraulic risk map of the Consorzio di Bonifica Pianura di Ferrara district.

According to Figure 8, about 85% of the territory falls under moderate risk, while 15% is classified as medium risk. In the macro-area, the distribution is as follows: 71% moderate risk (R1), 21% medium risk (R2), 6% high risk (R3), and 2% very high risk (R4).

The highest risk levels correspond to the Po Delta Regional Park, particularly the natural areas of Vene di Bellocchio, Sacca di Bellocchio, Pineta di Bellocchio, and the Reno River mouth. These are protected areas, part of the study micro-area, and located near the monitoring station recently installed as part of this project.

2. Desertification Risk in the Ferrara Coastal Test Area and Monitoring Strategy

2.1 Introduction and Conceptual Framework

Desertification, as defined in European and international frameworks, refers to land degradation occurring in dry, semi-dry and sub-humid areas as a consequence of complex interactions between climatic variations and human activities. In the Ferrara coastal test area, this concept translates into the progressive loss of soil productivity and ecosystem functions due to combined processes such as reduced freshwater availability, saltwater intrusion, soil salinisation and the decline of natural vegetation cover. Although the Ferrara coastal plain is not arid in the strict climatic sense, several characteristics make it intrinsically vulnerable to desertification-like processes. The area is low-lying, in many sectors at or below mean sea level, and extensively reclaimed through an artificial drainage network. In the Vene di Bellocchio sector and surrounding coastal systems, the equilibrium between marine and continental waters is already fragile, and small changes in sea level, storminess or freshwater inputs can strongly affect soil and habitat conditions. Climate change is expected to intensify this vulnerability. Altered rainfall regimes, characterised by more irregular and concentrated precipitation, increase the alternation between intense events and prolonged dry periods. Higher air temperatures and associated increases in potential evapotranspiration enhance water loss from soils and vegetation, favouring the onset of moisture-deficit conditions. At the same time, sea-level rise and more frequent or energetic storm surges promote the inland penetration of saline waters, particularly in subsiding and poorly drained areas. Saltwater intrusion into shallow aquifers and surface soils leads to salinisation, reduced plant tolerance and, ultimately, the degradation of freshwater and transitional ecosystems.

These processes are closely interconnected with the physical dynamics described in the previous sections of this deliverable. Subsidence (Section 1.2) lowers ground elevations and increases the hydraulic gradient favouring marine water encroachment. Coastal erosion and shoreline retreat (Section 1.3) reduce the width and protective function of the beach-dune system, exposing inland environments to direct marine influence. Land-use changes (Section 1.4), including the reduction of natural habitats and the expansion of artificial and agricultural areas, diminish the resilience of the territory, making soils more sensitive to hydrological extremes and salinisation. Hydrogeological risk patterns (Section 1.5) further



indicate areas where flooding, poor drainage and high groundwater levels interact with these drivers.

Within this framework, desertification risk in the Ferrara coastal test area can be understood as the likelihood that climate-driven pressures (changes in rainfall, temperature, sea level and storminess) and local physical processes (subsidence, coastal erosion, saltwater intrusion) will contribute to long-term degradation of soils and coastal ecosystems. The monitoring strategy developed in the project is therefore designed not only to support the assessment of hydrogeological risk at district scale but also to capture the key environmental variables controlling the onset and evolution of desertification-related processes. The monitoring system described in this chapter, together with the first outputs presented in Section 2.4, provides observational support for analysing the atmospheric and hydrometeorological conditions that influence soil moisture and salinity regimes over time.

2.2 Environmental Context Relevant to Desertification Processes in the Test Area

The Ferrara coastal test area is characterised by environmental conditions that influence soil moisture availability, salinity dynamics and ecosystem stability. These conditions derive from the natural evolution of the coastal system, the geomorphological characteristics of the Po Delta plain and the land-use configuration of the territory.

Land-use mapping for the period 2017–2020 (Section 1.4) highlights the presence of a mixed landscape composed of coastal vegetation, wetlands, agricultural areas, artificial basins and touristic structures. Within this mosaic, natural environments such as conifer woods, grasslands and wetlands coexist with human-modified land uses, reflecting the progressive adaptation of the territory to environmental and socio-economic drivers.

The shoreline evolution described in Section 1.3 illustrates long-term coastal dynamics, with measurable retreat recorded over recent decades. These dynamics are typical of low-lying deltaic systems, where sediment availability, wave–current interactions and meteorological forcing influence the position and morphology of the coastline. Changes in the coastal profile can modify the interaction between marine and inland waters, with potential implications for soil salinity and habitat distribution in areas immediately behind the shoreline.

Subsidence trends (Section 1.2), observed across the district and more markedly in specific coastal sectors, reflect the geological characteristics of the Po Delta plain, where thick alluvial deposits are subject to natural compaction. Variations in land elevation influence local



hydrological dynamics and the balance between freshwater and marine components, contributing to the emergence of zones with differing degrees of soil saturation or salinity exposure. Hydrogeological risk mapping (Section 1.5) provides additional information on areas where surface-water dynamics, drainage characteristics and proximity to marine or lagoonal systems shape the overall behaviour of the territory during high-water events. Taken together, these elements offer an integrated view of the physical and ecological conditions of the Ferrara coastal test area. They constitute the baseline framework for analysing processes related to soil moisture variability, salinity dynamics and ecosystem transitions, which are commonly considered in assessments of environmental change in coastal lowlands. The monitoring data and illustrative indicators presented in Section 2.4 are framed within this environmental setting and provide local-scale observations of the climatic and hydrometeorological drivers acting on the test area.

2.3 Monitoring System Objectives and Measured Variables

The monitoring system implemented within the project provides a coordinated framework for observing the environmental conditions that characterise the Ferrara coastal test area. Its primary objective is to collect consistent and long-term measurements of the physical parameters that influence soil moisture dynamics, salinity conditions, hydrological behaviour and atmospheric variability. These parameters are essential for understanding the processes that affect the stability of coastal lowland environments and for supporting future analytical work on climate-related impacts, including the assessment of soil drying, salinization and freshwater–saltwater interactions.

The system has been designed to acquire data describing both surface and subsurface components of the coastal environment. In particular, the monitoring framework aims to document:

- **the temporal variability of rainfall, air temperature, vapor pressure and wind**, which influence the local water balance and atmospheric demand
- **the behaviour of groundwater levels and electrical conductivity**, relevant for identifying changes in recharge conditions and the potential inland migration of saline water
- **the evolution of soil moisture and soil temperature**, which support the assessment of drying or saturation phases and the response of the root zone to climatic forcing
- **hydrometeorological patterns** that may be integrated into early-warning tools or numerical models in future project activities.



To meet these objectives, the monitoring strategy includes a dedicated environmental station installed at Bellocchio by CBPF. This station provides high-frequency observations of the key variables that control soil and groundwater processes in the coastal test area. Three TEROs 12 sensors measure soil moisture, soil temperature and soil electrical conductivity at different depths, offering a vertical profile of near-surface conditions. Two groundwater probes (CTD-10 and HYDROS 21) record water level fluctuations, water temperature and electrical conductivity, enabling the monitoring of shallow aquifer dynamics and salinity variations. Atmospheric measurements are provided by an ATMOS 41 G2 weather station, which records precipitation, air temperature, wind speed and direction, gust intensity, solar radiation, vapor pressure, atmospheric pressure and related microclimatic variables.

Together, these datasets form a coherent and multi-parameter monitoring framework capable of capturing the principal environmental drivers acting on the Ferrara coastal area. The integrated observation of atmospheric conditions, soil processes and groundwater behaviour establishes a robust basis for subsequent analytical work within the project, including the evaluation of soil moisture availability, salinity patterns and hydrometeorological variability under changing climatic conditions. On this basis, the system also supports the computation of derived indicators—such as combined rainfall, temperature and vapor-pressure metrics—presented in Section 2.4 as examples of early outputs from the measuring campaign.

2.4 Data Processing and Example Outputs

The Bellocchio monitoring station provides high-frequency measurements of soil moisture and temperature, groundwater level and salinity, and a range of atmospheric variables including precipitation, air temperature, wind parameters, solar radiation, vapor pressure and atmospheric pressure. To illustrate the type of information generated by the monitoring system and to verify the operational functionality of the sensors, a series of standard data-processing steps was applied to selected variables. The examples presented in this section are not intended as environmental interpretations; rather, they serve to demonstrate the format, structure and analytical potential of the datasets acquired within the project.

The raw measurements, collected at 30-minute intervals, were first harmonised into a consistent datetime format and subjected to routine quality checks. For graphical



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representation, different resampling strategies were applied depending on the nature of each variable. Precipitation was aggregated to 12-hour totals to highlight rainfall episodes at a scale relevant for soil wetting and infiltration. Temperature, vapor pressure, wind-related variables, soil moisture and groundwater parameters were resampled to 3-hour means, which effectively smooth short-term fluctuations while maintaining the temporal resolution required to observe the dynamics of coastal environmental processes. In addition to the resampled series, rolling averages corresponding approximately to a 24-hour window were computed to provide a clearer depiction of diurnal-scale patterns.

Based on these procedures, several illustrative diagrams were produced to demonstrate the monitoring system's capabilities:

1. **Summary of Environmental Variables – Bellocchio Station.**

Multi-panel representation of selected atmospheric, soil and groundwater variables, including 12-hour precipitation totals and 3-hour averages of air temperature, vapor pressure deficit, soil moisture, groundwater level and groundwater electrical conductivity. Resampled values and 24-hour rolling averages illustrate typical data patterns and demonstrate the operational functionality of the monitoring system.



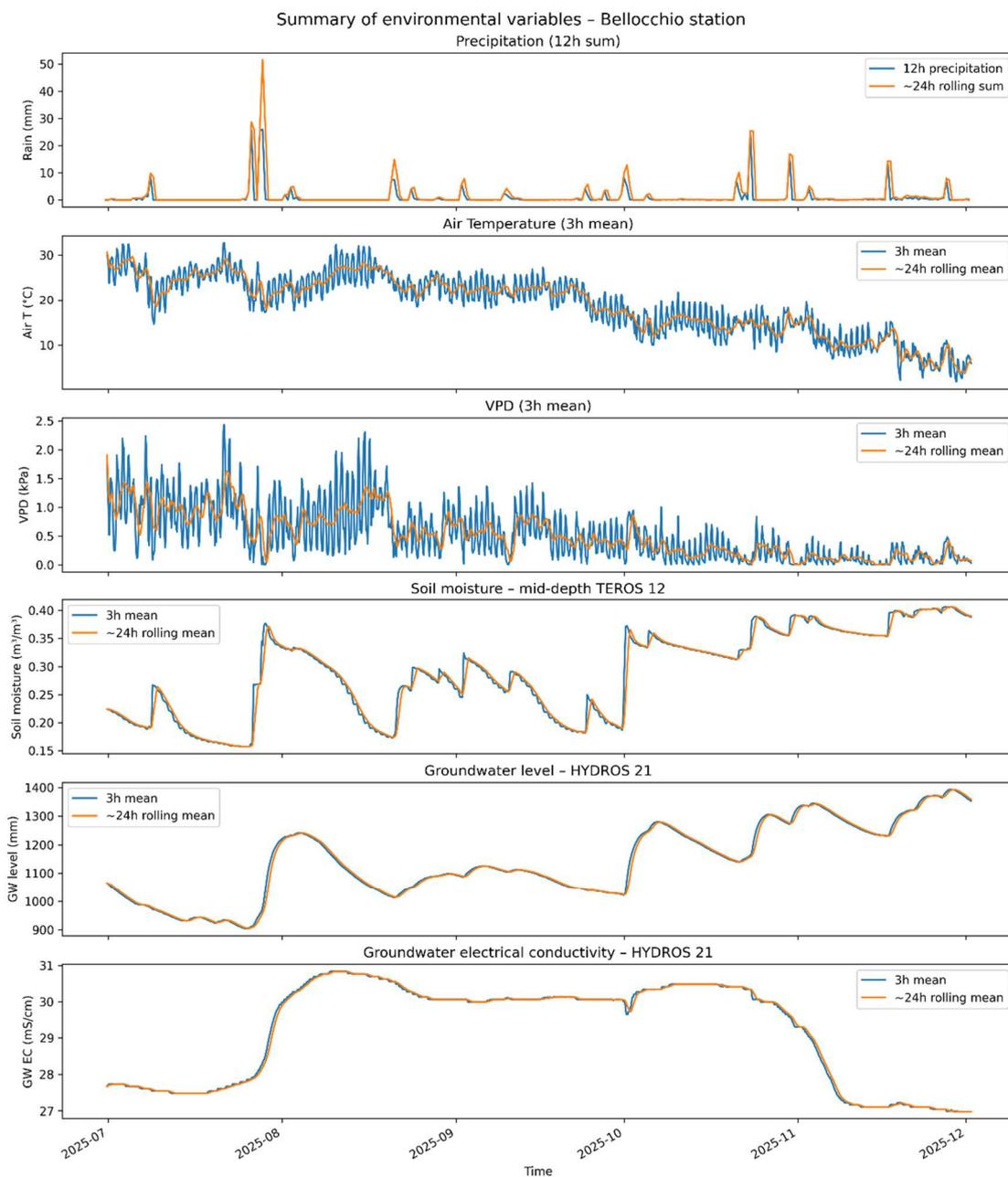


Figure 9: Summary of Environmental Variables Recorded at the Bellocchio Monitoring Station.

2. Soil Moisture, Temperature, and Groundwater Time Series (Examples of Subsurface Monitoring)



Time series of soil moisture and soil temperature at multiple depths obtained from TEROS-12 sensors, together with groundwater level and electrical conductivity from CTD-10 and HYDROS-21 probes. The figure illustrates the capacity of the monitoring system to capture near-surface and subsurface hydrological variability across different sensor depths.

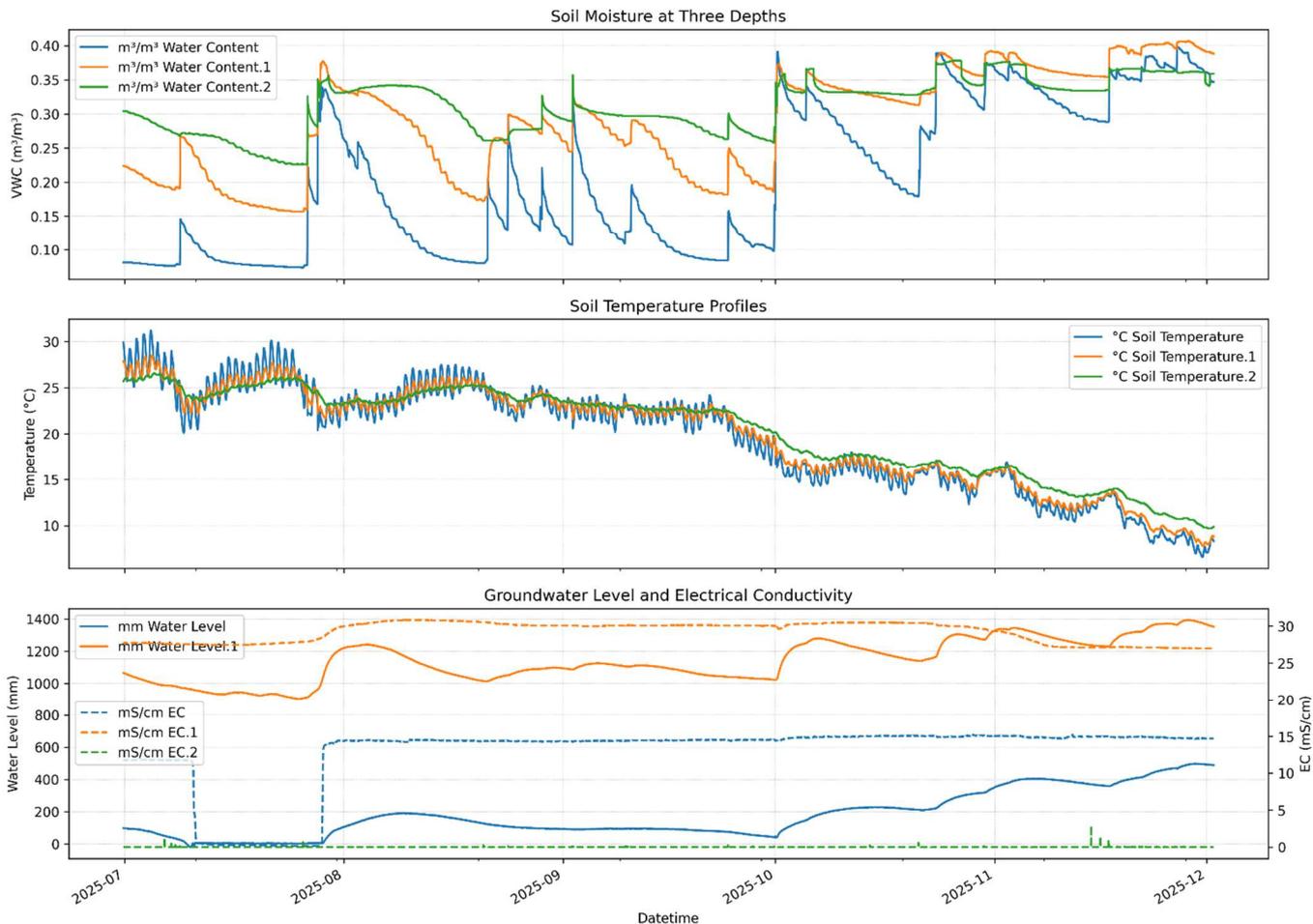


Figure 10: Examples of Subsurface Measurements from Soil and Groundwater Sensors at Bellocchio.

3. Example of a Combined Indicator Derived from Monitoring Data

To illustrate how multiple atmospheric variables can be combined into simple time-



based indicators, a preliminary “dryness indicator” was computed using 12-hour aggregated precipitation, air temperature and vapour-pressure data. The indicator marks intervals during which predefined threshold conditions were simultaneously met. These thresholds are used only as an example of a methodological approach for multi-parameter analysis. The resulting plot shows:

- 12-hour rainfall totals,
- corresponding temperature and vapour-pressure series,
- a binary time series (0/1) marking periods that meet the chosen threshold combination.

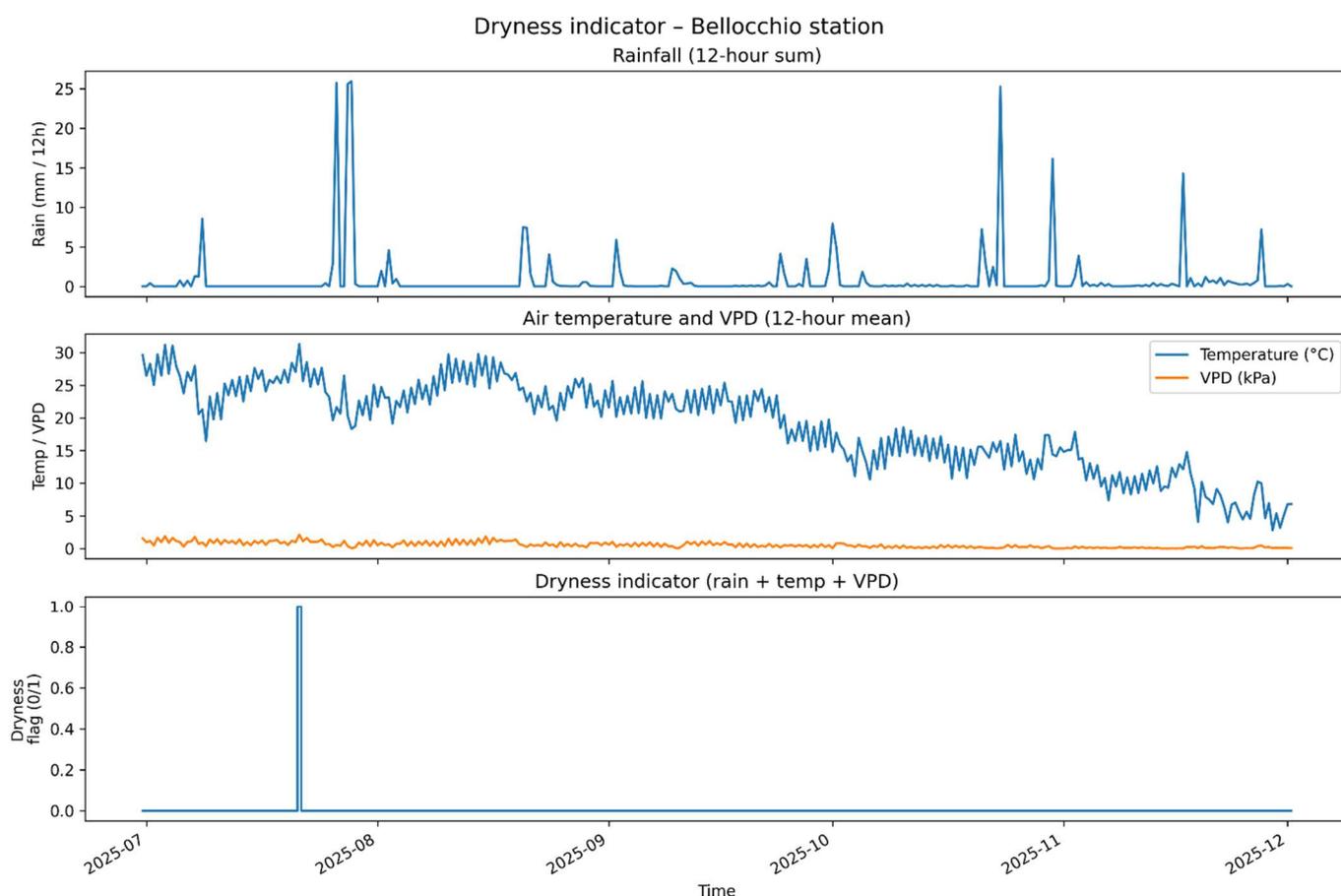


Figure 11: Example of a Simple Combined Indicator Derived from Atmospheric Variables.

The purpose of these example outputs is to demonstrate how the measurements provided by the Bellocchio station can be transformed into derived products suitable for detecting specific environmental conditions, without constituting an assessment of the local



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environmental status. The diagrams illustrate the correct functioning of the monitoring equipment, the continuity and temporal resolution of the recorded time series, and the suitability of the datasets for generating derived indicators related to soil moisture dynamics, hydrological variability and atmospheric conditions. Taken together, they provide an initial overview of the data structure and processing workflows that will be applied in later phases of the project and show the capability of the monitoring system to support future analyses relevant to the Ferrara coastal area. Detailed environmental interpretation, including assessments of soil moisture conditions, groundwater salinity variations or other indicators of environmental change, will be undertaken in the analytical work foreseen in subsequent deliverables.

2.5 Conclusion

The monitoring activities described in this chapter establish an integrated observational framework for characterising the environmental conditions of the Ferrara coastal test area. The Bellocchio station combines atmospheric, soil and groundwater measurements, producing continuous and coherent datasets that document the principal physical variables influencing the behaviour of coastal lowland environments. The example outputs presented in this chapter illustrate the type of information generated by the monitoring system and the procedures adopted for basic data processing, including temporal aggregation, smoothing and the construction of simple derived indicators. These examples demonstrate the system's ability to collect multi-parameter time series and to transform them into preliminary analytical products, such as combined rainfall-temperature-vapour-pressure indicators.

The parameters currently measured—including precipitation, air temperature, vapour pressure, wind, soil moisture and temperature, groundwater level and electrical conductivity—provide the foundation for documenting short-term variability as well as longer-term trends in water availability, hydrological behaviour and salinity dynamics. These datasets complement the regional and historical information presented in earlier sections of the deliverable, offering a local-scale perspective directly linked to the specific conditions of the coastal test area.

The monitoring framework established in WP1 will support the analytical work foreseen in subsequent phases of the project. Future activities will integrate these in-situ observations with shoreline evolution data, subsidence trends, hydrogeological information and land-use dynamics, thereby supporting the development of indicators and tools relevant to the study of environmental change in coastal zones. The first outputs presented here confirm the



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operational readiness of the monitoring system and its suitability for producing consistent time series and derived variables. Their interpretation in relation to hydrogeological processes, soil moisture dynamics and other aspects relevant to the coastal environment will be carried out in the analytical tasks planned in the next project stages.

