PERC Report on Valencia Floods

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What's inside

Foreword

At Zurich Insurance, we firmly believe that **risk management** cannot be limited to reacting to catastrophes; it must begin much earlier, with awareness, prevention, and preparedness. The **DANA** that struck the **Valencian Community** in October 2024 has been a tragic reminder of our communities' growing exposure to **extreme weather events.** This event not only left a deep mark on the region and thousands of families, but also compels us to collectively reflect on how we can build a more **resilient** society.

Europe is warming faster than other continents, and the **Mediterranean** is one of the regions most vulnerable to climate change. **DANAs**, far from being isolated phenomena, are becoming more frequent and intense. What was once considered exceptional is now becoming part of a **new climate normal.** That is why we need a more transparent and rigorous discourse about the risks we face, what could happen, and, above all, how to learn to live with them.

The **PERC report** we present today was created with this purpose in mind. This own methodology, allows for an in-depth analysis of what worked, what aspects can be strengthened, and what lessons we can draw from each event. In the case of **Valencia,** carried out in collaboration with Asertos' team, the analysis highlights the importance of strengthening **coordination** among stakeholders, improving **territorial planning** with climate adaptation criteria, and moving towards a more inclusive and anticipatory recovery.

> "Risk management cannot be limited to reacting to catastrophes; it must begin much earlier, with awareness, prevention, and preparedness."

Likewise, the report underscores the key role the **insurance sector** can play, not only in response but also in prevention: promoting a more inclusive insurance culture, developing products adapted to new risks, and actively collaborating with public administrations to provide data, knowledge, and solutions that help reduce the **vulnerability** of our communities.

We hope this report will not only serve the **Valencian Community** but also contribute to the **global debate** on how to adapt to an increasingly uncertain environment. Because every extreme event is an opportunity to learn, improve, and better protect people. And at **Zurich,** we are committed to being an active part of that transformation.

Vicente Cancio
CEO of Zurich Insurance Spain

Executive summary

Between **October 29 and 30, 2024**, the province of **Valencia** experienced one of the most **extreme rainfall episodes** documented in Spain over the past century. In less than 12 hours, **torrential rains** of up to 720 mm accumulated, overwhelming drainage systems, overflowing stormwater channels, and causing **widespread flooding** in the northern interior of the province. The runoff spread rapidly, flooding the ravine network that drains toward the coast and triggering sudden floods in **densely urbanized areas of l'Horta Sud.** Although the rainfall also affected the Balearic Islands and other regions in southeastern Spain, the most devastating impact was concentrated in the **Valencian Community,** with **229** of the **237** fatalities (as October, 6th). More than **2,600 people were injured, 6,300 evacuated, and approximately 306,000 were directly affected.**

Material damages exceeded **€20 billion,** including €1.8 billion in water systems and public infrastructure, €4.8 billion in housing and vehicles, and €14 billion in direct and indirect productivity losses. Additionally, the disaster generated over one million tons of waste, severe pollution issues, and an estimated loss of 17,000 tons of fertile soil.

Despite its extreme nature, this event **cannot be considered inconceivable: DANAs** (, an isolated high-altitude depression system (Depresión Aislada en Niveles Altos) are a characteristic Mediterranean phenomenon, and scientific literature has extensively documented that under **global warming,** these episodes tend to increase in both **intensity and frequency.** The province of Valencia has a significant historical record of DANAs over the last century, notably the **Great Valencia Flood of 1957,** which resulted in 81 deaths, and the **Tous Dam disaster of 1982,** which caused 12 fatalities. During this 2024 episode, although the historical maximum for daily rainfall was not exceeded, the hourly total rainfall set a new record, nearly double the old one, demonstrating the extraordinary, torrential behavior. In the context of global warming, the recurrence of such events is increasingly likely, underscoring the urgency of **rethinking regional resilience.**

Although the Valencian Community already had built up substantial expertise prior to the 2024 disaster—including flood zone mapping and operational protocols such as the **Special Plan for Flood Risk**—this knowledge was not always translated into practice consolidated at the institutional or citizen levels. Limitations in the social dissemination of existing knowledge and its integration into decision-making have emerged as structural deficits in disaster risk management (DRM), contributing to an increased exposure of the population and reduced effectiveness of first response.

Nevertheless, significant **strengths** were observed in the management of the emergency. Several municipalities were able to activate their protocols in advance thanks to alerts issued by the **Spanish National Weather Agency AEMET, 112 GVA, and Civil Protection**, which demonstrated effective technical coordination. Furthermore, the intervention of the **Military Emergency Unit (UME),** firefighters, local services, and social organizations during the first 72 hours—alongside widespread citizen mobilization—enabled the rescue of thousands of people, containment of damage, and restoration of essential services in highly exposed areas.

Balancing both strengths and weaknesses identified, there is still good potential for an improved, **integrated disaster risk management,** which could be strengthened through greater redundancy and accessibility of early warning systems, enhanced coordination across institutions—via a unified operational command structured around **CECOPI**—and improved territorial harmonization of municipal protocols. The experience of Local **Emergency and Reconstruction Committees** confirms the strategic value of citizen participation and the need to structurally involve the population in DRM. Additionally, this PERC highlights the importance of **integrating psychosocial support** services into DRM plans to reduce the impact of post-traumatic stress, especially among vulnerable groups.

Although corrective measures have been incorporated during the recovery phase to facilitate the concept of "build back better", there remains a tendency to prioritize **rapid reconstruction** over resilience and supra-municipal planning, which hinders efforts to tackle the root causes of the structural vulnerabilities. It would be advisable to systematically integrate territorial planning and

climate adaptation criteria into decision-making, limit the encroachment into flood-prone areas where possible, and promote nature-based solutions. Alongside strengthening the technical capacities of key personnel, it is equally important to promote citizen education on climate risks and foster a culture of self-protection. Flood drills can serve as an effective tool for practical learning and collective preparedness.

The **October 2024 DANA confirms** that DRM cannot be limited to the emergency phase; it must be integrated transversally into **territorial planning, sectoral policies, and civic culture.** Strengthening anticipatory governance, consolidating inclusive and reliable early warning mechanisms, and promoting active social participation are key steps toward evolving from reactive actions to integrated DRM focused on **structural resilience.** This PERC underscores that past collective experience and lessons learned not only help us understand the recent past but also serve as a practical guide to reducing disaster risk in an increasingly **accelerated climate change** context, projecting the Valencian Community—and the broader Mediterranean arc—toward a **solid, equitable, and sustainable climate adaptation model.**

During the PERC analysis, we also identified a **protection gap** that amplifies **vulnerability** to both ordinary and extreme risks. Closing this gap requires fostering a **culture** that recognizes the **value of insurance** and ensuring broad, **inclusive access.** The insurance sector plays a strategic role not only in disaster response but also in prevention—by creating products tailored to evolving risk scenarios and **working closely** with public authorities to share data, expertise, and solutions that strengthen **community resilience.**

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Acronyms

AEMET	Spanish National Meteorological Agency
ARPSI	Significant Potential Flood Risk Area
CCS	Insurance Compensation Consortium
CEAM	Spanish Commission for Refugee Aid
CEAR	Local Operational Coordination Centre
CECOPAL	Local Operational Coordination Centre
CECOPI	Integrated Operational Coordination Centre
CHJ	River Basin Authority
ES-Alert	National Public Alert System (Cell Broadcast technology)
FETAP-CGT	National Federation of Technicians and Professionals of the General Confederation of Labour
GEIES	National Group for Social Emergency Intervention
GVA	Generalitat Valenciana
IPCC	Intergovernmental Panel on Climate Change
JBA	JBA Risk Management (risk modelling consultancy)
LOCSUS	Laboratory for Sustainable Development Cooperation and Social Urbanism (UV)
MITECO	Ministry for Ecological Transition and Demographic Challenge
PATRICOVA	Territorial Action Plan for Flood Risk Prevention in the Valencian Community
PERC	Post-Event Review Capability
SAREB	Asset Management Company for Assets Arising from Bank Restructuring
SEPES	Public Land Management Entity
SUDS	Sustainable Urban Drainage Systems
UME	Military Emergency Unit
UV	University of Valencia
UCRP	Urban Climate Resilience Program
ZCRA	Zurich Climate Resilience Alliance

1. Introduction

1.1. Purpose of the report

This report applies the PERC (Post-Event Review Capability) methodology, developed by the Zurich Group together with ISET International, and later refined and applied as part of the Zurich Climate Resilience Alliance (ZCRA). Its objective is to rigorously and comprehensively analyze the impact of the Depresión Aislada en Niveles Altos (DANA), or "isolated high-altitude depression system", that affected the Valencian Community between October 29 and 30, 2024.

Purpose and scope

Analyze the factors that contributed to the development of the event and reflect from a systemic perspective on causal relationships and their consequences, identifying positive aspects and areas for improvement in preparedness, during and after the event, avoiding personal attributions. Propose strategic and operational recommendations, based on the Urban Climate Resilience Program (UCRP) and the Zurich Climate Resilience Alliance (ZCRA), covering the full disaster risk management cycle (preparedness, response, recovery, prospective and corrective risk reduction) and including improvement proposals and systemic approaches.

Promote the development or improvement of emergency plans, resilient territorial and urban planning, multi-level governance, and public policies focused on territorial equity and protection of vulnerable groups.

Collective learning approach

Apply the collaborative PERC approach to generate transferable lessons and foster continuous improvement of disaster risk management (DRM) and climate adaptation systems, maintaining neutrality and avoiding value judgments.

Since its creation by the Zurich Flood Resilience Alliance in 2013, the PERC approach has been applied in 18 post-event reviews of different types of floods, including river floods, torrential rains, wildfires and tropical and winter storms, in urban and rural contexts of countries with different levels of development .

This framework has proven useful for understanding how a natural event becomes a disaster, identifying systemic factors that amplify impacts, and proposing practical recommendations to strengthen resilience. In this analysis, the methodology is adopted based on well-documented and verifiable sources, including official reports, institutional sources, in-depth interviews, and direct observation, guided by principles of objectivity, empirical contrast, and joint learning.

[1] The reports can be accessed on the Climate Resilience Alliance website: https://zcralliance.org/perc/

Proven facts

To carry out the report, the analysis team started from proven facts about the event to describe its physical characteristics, later contrasted with key stakeholders. The following sources were used:

- Meteorological records from AEMET: sea surface temperature, rainfall, and extreme winds during the event.
- Risk modeling studies from JBA: hydrodynamic and rainfall simulations validated with field data.
- Status and compliance of territorial and urban planning instruments.

1.2. Methodological approach: the PERC perspective

The PERC methodology starts from established physical facts based on the atmospheric and climatic event (in this case, the DANA phenomenon), then combines different qualitative, retrospective, and participatory approaches to understand how and why these natural phenomena turn into disasters. It is based on the premise that disasters are not, in essence, natural, but are the result of exposed vulnerabilities, institutional decisions, and pre-existing structural conditions in the territory.

STEP 1. Documentary and technical review

- Official reports: AEMET, Júcar River Basin Authority (CHJ), etc.
- Academic studies and university opinions.
- Risk modeling (JBA) and terrain analysis (LOCSUS-IIDL-UV).

STEP 2. Semi-structured interviews

- Institutional actors.
- Technical staff from the administration: territorial planning managers, health professionals, etc.
- Private sector professionals.
- Technical staff from social entities.
- Researchers and specialists.
- Community representatives from Zone 0 and surrounding areas (Utiel, Buñol, El Palmar).

STEP 3. Triangulation of sources

- Contrasting social perceptions, technical evidence, and regulatory frameworks.
- Analysis of the Recovery and Reconstruction Plan for the area affected by the DANA from the Generalitat Valenciana.
- Instruction-resolution from the Judge of Catarroja: clarifications on the declaration of emergency and structural vulnerabilities in critical infrastructures.

STEP 4. Identification of good practices and barriers

- Resilience analysis in urban ravines and their interaction with densely populated areas (~1.5 million inhabitants in 1000 km²).
- Evaluation of Sustainable Urban Drainage Systems (SUDS).

STEP5. Formulation of recommendations

- Actionable recommendations for both public and private institutions, communities, and civil society, prioritizing adaptability and risk reduction without assigning individual responsibility.

What is PERC?

The Post-Event Review Capability (PERC) is a systematic method for learning from disasters once they have occurred, identifying success and failure factors in DRM. It includes five stages:

1. Preparation of the review: definition of scope, objectives, and resources.
2. Evidence collection: gathering meteorological, technical, judicial, and testimonial data.
3. Multidimensional analysis: evaluation of physical, institutional, and social contexts to determine vulnerabilities and strengths.
4. Formulation of lessons learned: derivation of practical and transferable recommendations.
5. Dissemination and follow-up: communication of results and monitoring the implementation of improvements.

> "The capacity of a system, community, or society to pursue its social, ecological, and economic development objectives while managing its (disaster) risk in a mutually reinforcing way."
>
> *Definition of (disaster) resilience (ZCRA)*

The PERC approach analyzes the resilience of people, systems, and institutions before, during, and after a disaster, understood as the capacity of a society to achieve its social, ecological, and economic objectives while managing its risk over time. It is not just about "recovering," but about building back better and avoiding the recreation of previous vulnerabilities.

In the PERC framework, the analysis of **what happened** and **why it happened** is organized around **the disaster risk management cycle,** which comprises five phases:

1. Preparedness

Corresponds to the "before" and includes measures to minimize risk, both operational (response protocols) and social (community awareness and self-protection).

2. Response

Corresponds to the "during" and covers immediate actions to contain impacts: evacuation, search and rescue, distribution of urgent aid.

3. Recovery

Corresponds to the "after" and focuses on restoring services, rebuilding infrastructure and housing, and supporting the population in overcoming impacts. It is also the opportunity to apply the principle of "build back better," integrating lessons into future planning.

4. Prospective risk reduction

Prevents the build-up of new risks (e.g., adapted territorial and urban planning).

5. Corrective risk reduction

The actions taken to reduce risk to already at-risk assets (e.g., reinforcement of infrastructure or updating building codes).

Risk reduction requires anticipatory planning, institutional continuity, and sustained resources over time. However, when an extreme event occurs, the system's seams become visible: coordination failures, coverage gaps, or infrastructure limits. That is precisely a propitious moment to review and strengthen risk reduction strategies, leveraging real experience to introduce structural changes and ensure that the next event does not reproduce the same effects.

To delve into the causes and consequences of disasters, PERC applies a "resilience lens" based on two complementary conceptual frameworks. The **five capitals framework** (physical, financial, human, social, and natural) ensures an interdisciplinary and multisectoral analysis, highlighting gaps that indicate entry points to reinforce resilience.

The **systems, agents, and institutions framework** adds a level of understanding about how people interact with infrastructures, ecosystems, and social or legal norms.

[2] The acronym PERC stands for Post Event Review Capabilities..

This approach highlights that disasters result not only from natural phenomena but from the dynamic interaction between capitals, systems, and agents under formal and informal rules that can reduce or amplify risk.

Together, both frameworks allow PERC to generate practical recommendations, adapted to the context, and promote learnings applicable at different levels of governance and DRM. This applied nature is based on a **forensic approach,** in which fieldwork occupies a central place: direct observation of affected territories and conversations with key actors provide a level of detail, understanding, and evidence that would be impossible to achieve solely from documentary analysis.

The systematic collection of observations, hypotheses, and testimonies constitutes a process of deconstructing what happened, where triangulation between semi-structured interviews and participant observation allows validating, qualifying, or refuting explanations about the causes and dynamics of the disaster. This exercise not only reinforces the credibility of the conclusions but also provides a solid basis for formulating operational recommendations, sensitive to local conditions and transferable to different institutional scales.

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1.3. Geographic and climatic context of Valencia

The province of Valencia is located on the eastern coast of the Iberian Peninsula. It it highly vulnerable to extreme atmospheric phenomena of great intensity. The Valencian geographical space is characterized by its Mediterranean location (its morphology and diversity of environments), with the presence of a system of stepped reliefs that, like a grandstand, reaches to the coast.

Within this territorial environment, there is a complex hydrographic network that crosses the area from west to east, as well as dense human settlement and pronounced urban development, resulting in a wide system of diverse infrastructures. The province is the third most populated in Spain, after Barcelona and Madrid. It has 267 municipalities and covers a total area of 10,763 km².

The total population of the province is 2,710,808 inhabitants (INE - Instituto Nacional de Estadística, 2025)). The metropolitan area of Valencia includes the city of Valencia and the municipalities of Horta Nord and Horta Sud, covering 44 municipalities, with a population of 1,635,239 inhabitants. Urban settlement has adapted to a historic drainage network, formed by ramblas, ravines, and intermittent channels that converge toward densely populated areas, particularly in coastal areas and the metropolitan area of Valencia.

The ravines of the Valencian Community, under normal conditions, have dry or low-flow channels, but during episodes of intense rainfall can carry large volumes of water, acting as natural drainage channels that collect and direct surface runoff toward lower-lying areas.

Due to the low infiltration capacity of the soil and the rapid accumulation of water in the channels, the ravines can cause sudden floods that affect infrastructure and housing.
Water can transport sediments, rocks, and vegetation, causing blockages in hydraulic infrastructures (bridges, culverts) and increasing the risk of damage. Strong currents can erode the banks of the ravine, compromising the stability of slopes and adjacent land.

In areas where urban growth has encroached ravine zones, the risk of material and human damage increases significantly. In extreme events, water can overflow the usual channel and open new paths for runoff.

The Mediterranean climate (temperate with dry and warm summer) of most of the region is characterized by strong seasonality and irregular rainfall: precipitation can be very intense, concentrated in short periods (especially in autumn), and long, dry summers. This pattern favors the occurrence of extreme hydrometeorological phenomena, such as DANAs, whose frequency and intensity have increased due to climate change aggravated by human action (IPCC, 2022). This increase is related to the warming of the Mediterranean Sea, thermal ascent of the air, and increased atmospheric humidity. All these elements fuel more violent and localized storms (Romero & Camarasa, 2024).

From a territorial perspective, it is important to highlight the marked contrasts between highly impermeable areas (urban centers and industrial zones), traditional agricultural spaces (foothills usually dry and a whole system of peri-urban orchards in the Horta de València), and a set of equally relevant forest areas, more present further inland.

This heterogeneity of environments accentuates differential exposure and vulnerability to extreme events. For example, the drought prior to the October 2024 DANA may have caused soil hardening and consequently reduced water absorption.

[3] The last major drought in the Valencian Community was particularly severe during the 2023–2024 hydrological year, marking the driest start since 1950, with a precipitation deficit of 69%. This situation has severely impacted agriculture, with crop reduction estimates of up to 33% compared to the previous year, which was already considered disastrous (according to periodic reports from AEMET and the Júcar Hydrographic Confederation in their basin plan-related reports).

1.4. Scope of the analysis: temporal, territorial, and sectoral

From a temporal perspective, the analysis of the episode focuses on the period during October 29 and 30 in the province of Valencia, with immediate consequences on multiple local systems. However, the analytical horizon extends to September 2025, to incorporate the phases of early recovery, partial reconstruction, and institutional and community post-event learning processes. This temporal extension responds to the PERC methodological principle of analyzing both immediate impacts and absorption and response capacities over time.

Historically, the report contextualizes this episode in relation to previous events in the Valencian territory, especially the years 1957, 1982, and 1987, which are relevant precedents both for their physical impacts and their implications for risk planning. Regional climate projections are also integrated, predicting intensification and increased frequency of similar phenomena, according to trends observed and reported by official sources such as AEMET, CEAM, or studies from various Valencian universities.

Although the 2024 DANA affected different territories in the Balearic Islands and the Iberian Peninsula such as Albacete, Castellón, Málaga, Tarragona, or Barcelona, this report focuses its analysis on the province of Valencia, as it suffered the most damage and, unfortunately, the highest number of human losses. The evaluation has paid special attention to the most affected municipalities, called Zone 0: Alaquàs, Paiporta, Benetússer, Massanassa, Catarroja, Xirivella, Alfafar, and Torrent. However, the adopted territorial approach is not limited exclusively to these municipalities. The analysis also incorporates evidence from other affected or related localities, such as Chiva, Buñol, Utiel, or El Palmar, allowing a more comprehensive and multi-scalar approach to the dynamics of the hydrological system. This territorial expansion responds to the methodological need to consider risk-contributing factors from different levels and interconnected areas, consistent with the systemic perspective of the PERC approach.

In any case, the municipalities with the highest levels of physical impact are located in the flattest and alluvial areas, such as l'Horta Sud de Valencia. This geographical space allows for territorial contrasts in terms of exposure, impact, response capacity, and institutional and community preparedness. These territorial variations in impact and response offer analytical elements that help identify possible structural patterns linked to vulnerability and inequality, constituting one of the interpretative axes of this report.

The sectoral analysis is structured based on the Five Capitals approach of the Sustainable Livelihoods framework (Knutsson & Ostwalk, 2006), allowing the effects of the event to be evaluated from a multi-scalar, systemic, and comparative perspective:

- **Physical capital:** impact on critical infrastructure (transport routes, electricity grid, sanitation), public facilities, housing, and essential services.
- **Natural capital:** impact on orchards, marshes, and ravines; alteration of channels; erosion; loss of vegetation cover and soil contamination.
- **Social capital:** impact on neighborhood aid networks, neighborhood associations, spontaneous initiatives, and informal forms of community solidarity.
- **Human capital:** impacts on physical and emotional health, institutional and technical capacities, access to information, and community awareness and preparedness.
- **Financial capital:** direct and indirect economic consequences, impact on small and medium-sized enterprises, role of the of the insurance sector, costs derived from the emergency and reconstruction, as well as impact on the banking sector.

Source: Shutterstock / d13, ID: 2538859737

For the response analysis, two differentiated levels are established:

- **Institutional response,** addressed according to the disaster risk management cycle, including the phases of preparedness, response, recovery, prospective and corrective risk reduction.

- **Community response,** understood as the set of actions organized by civil society, including self-organization mechanisms, daily resilience, and citizen action networks that emerged spontaneously during the crisis.

It is important to emphasize that this analysis does not aim to assign individual responsibilities, but to understand the systemic functioning of disaster risk management in the Valencian context. Therefore, it has been built on a well-documented and verifiable basis, including official reports, institutional sources, in-depth interviews, and direct observation, in accordance with the PERC methodology and the principles of objectivity, empirical contrast, and continuous learning.

2. Description of the event

2.1. Chronology of the DANA in Valencia

Between October 29 and 30, 2024, extraordinary rainfall was recorded in the province of Valencia, as a result of a Depresión Aislada en Niveles Altos (DANA) episode. This type of atmospheric phenomenon, an isolated high-altitude depression system, originates from the interaction between a mass of cold air at high levels of the atmosphere and a mass of warm, humid air at lower levels— in this case, coming from the Mediterranean Sea— generating high atmospheric instability that leads to very intense, localized, and persistent rainfall. In this context, the system of stepped reliefs near the sea played a decisive role by lifting humid winds, rapidly condensing them, and causing high-intensity precipitation.

Although the rainfall affected both days; the Balearic Islands and several regions of southeastern Spain—such as Cuenca, Málaga, Granada, Murcia, and Albacete—the bulk of the impact in the province of Valencia was concentrated on October 29, when the most extreme values were recorded. At the Turís meteorological station, 772 mm were recorded in 24 hours (AEMET, 2024, p. 30), far above the approximately 200 mm observed in other affected regions, and even exceeding the annual average precipitation. This accumulated volume in such a short time overwhelmed both natural and artificial drainage systems, far exceeding their absorption and drainage capacity.

Most of the precipitation was concentrated inland, in areas with steep slopes, where the combination of rugged topography and soils hardened by prolonged droughts favored extremely rapid surface runoff, with high volumes. Seasonal channels, usually dry for much of the year, began to carry massive volumes of water toward lower elevations, causing a sudden and very violent hydrological response (Figure 1).

At 07:36 on Tuesday, October 29, the State Meteorological Agency (AEMET) activated the red alert for heavy rain in the northern interior of the province of Valencia, extending it to the entire province at 09:41, in view of the critical evolution of the episode. By mid-morning, runoff reached the network of ravines and ramblas draining toward the coast, activating critical points of flow accumulation. Among them, the Poyo ravine, descending from the interior toward densely urbanized areas of southern metropolitan Valencia, became the main vector of flooding. According to the CHJ, the flow at this point reached 264 m^3/s at noon, exceeding the alert threshold.

By 18:43, it had risen to 1,686 m^3/s, well above its maximum capacity and equivalent to the ordinary flow of the Ebro River in many of its stretches, causing severe flooding in municipalities such as Alaquàs, Aldaia, Picanya, Paiporta, Benetússer, Sedaví, Massanassa, and Catarroja. Simultaneously, other channels such as the Barxeta, Casella, Estret, Murta, and Les Bases ravines also overflowed, affecting both urban areas and agricultural land.

In the Ribera Alta region, the Magro River exceeded 2.3 meters above the channel level in municipalities such as Algemesí, turning streets into torrents and isolating entire neighborhoods. Although the Júcar River did not completely overflow, its high flow contributed to the saturation of the entire basin, generating hydraulic backflows and collapses in drainage infrastructure.

Many traditional infrastructures, such as the Tous canal and various historic agricultural irrigation systems, proved insufficient to contain the excess water, aggravating the extent and severity of the flooding.

2.2. Intensity, precipitation, and meteorological variables

The DANA episode that affected the Valencian Community between October 29 and 30, 2024—with residual meteorological effects until November 4—constitutes one of the most extreme events recorded in the region in terms of precipitation intensity and temporal concentration. While the core of the event can be considered to have taken place during October 29 and 30, a broader perspective shows that rain began moderately on the 28th and continued weakly until November 4. However, nearly all catastrophic impact was concentrated in less than 12 hours, during the early morning and afternoon of October 29. This circumstance requires nuance in the concept of "persistence" in technical analysis, differentiating between the total duration of the phenomenon and its destructive core.

Synoptic characterization of the evento

According to the technical report from the AEMET (2024), the DANA formed from the isolation of a depression at high levels of the atmosphere over southwestern Spain, which slowly moved eastward until it was above the Valencian coast in the early hours of the 29th. The interaction of this depression with a warmer and more humid Mediterranean generated a particularly unstable atmosphere. The sea, with higher than usual temperatures, acted as a huge engine providing energy and water vapor to the atmosphere[4]. That extra fuel led to highly intense storms that grew rapidly in height, reaching several kilometers thick. Most relevant was that these storms did not move quickly but remained almost stationary for hours over the same territories. This combination of very active and nearly stationary storms was responsible for the rainfall being so intense and persistent, far exceeding the natural and urban drainage capacity of that area.

Spatial distribution and precipitation records

Rainfall records far exceeded established emergency thresholds, reaching values equivalent to return periods over 500 years, according to studies by CHJ and AEMET. In this episode, precipitation intensity—more than its total duration—was the main determining factor of impact:

- At the Turís meteorological station, 772 mm were recorded in 24 hours, the maximum value of the episode and one of the highest documented in the region in recent historical series.
- In Carcaixent, more than 320 mm were recorded in 24 hours, with concentrations above 200 mm in just five hours.
- In Gandía, 244 mm were recorded in 24 hours, while in Ontinyent, Alzira, and Tavernes de la Valldigna, more than 400 mm accumulated in 72 hours.
- Intensities above 60 mm per hour were documented during nighttime and early morning periods, which aggravated risk by hindering mobility, visibility, and early activation of institutional and community responses.

Critical meteorological variables during the DANA episode[5]

During this event, extreme atmospheric conditions were recorded that favored the development of severe storms and amplified their destructive effects. The main variables observed are listed below:

- Wind gusts above 80 km/h in open areas, causing tree falls, structural damage to buildings, and power outages. The combination of strong winds and saturated soils increased vulnerability of urban trees and exposed infrastructure.
- Atmospheric pressure below 1000 hPa, favoring moisture accumulation in lower atmospheric layers and prolonging the DANA's presence over the region.
- Sea surface temperature 1.5°C above the historical average. The anomalous warming of the Mediterranean intensified deep convection, generating more violent storms, according to

[4] High atmospheric instability (CAPE > 2500 J/kg), stationary multicellular systems due to atmospheric blocking, surface pressure < 1000 hPa, and Mediterranean Sea Surface Temperature +1.5 °C above the historical average: a combination of factors that intensified the convective system associated with the DANA.

[5] Methodological note: The meteorological variables indicated have been cross-checked through source triangulation (documentary, testimonial, and meteorological modeling), in line with the principles of retrospective forensic analysis under the PERC methodology. Their identification as critical is based on the analysis of synergistic interactions that amplified the impacts on the territory's social, economic, and environmental systems.

CEAM (2023). This increasingly frequent thermal anomaly was a key factor in the episode's severity.

- Relative humidity above 90% in lower and middle layers. This humidity favored the formation of intense stationary storms and concentrated precipitation, aggravating the risk of flash floods.

Considerations for DRM

As this section is part of the objective description of the event (section 2), it is limited to descriptive elements, with most implications and analytical reflections transferred to later chapters. Nevertheless, it is anticipated here that the October 2024 DANA should not be understood as an isolated event, but as a manifestation of a new climate regime of high variability and intensity. This phenomenon is replicable in other regions of the western Mediterranean, so its study provides relevant lessons not only for the Valencian Community but for all regions exposed to similar phenomena.

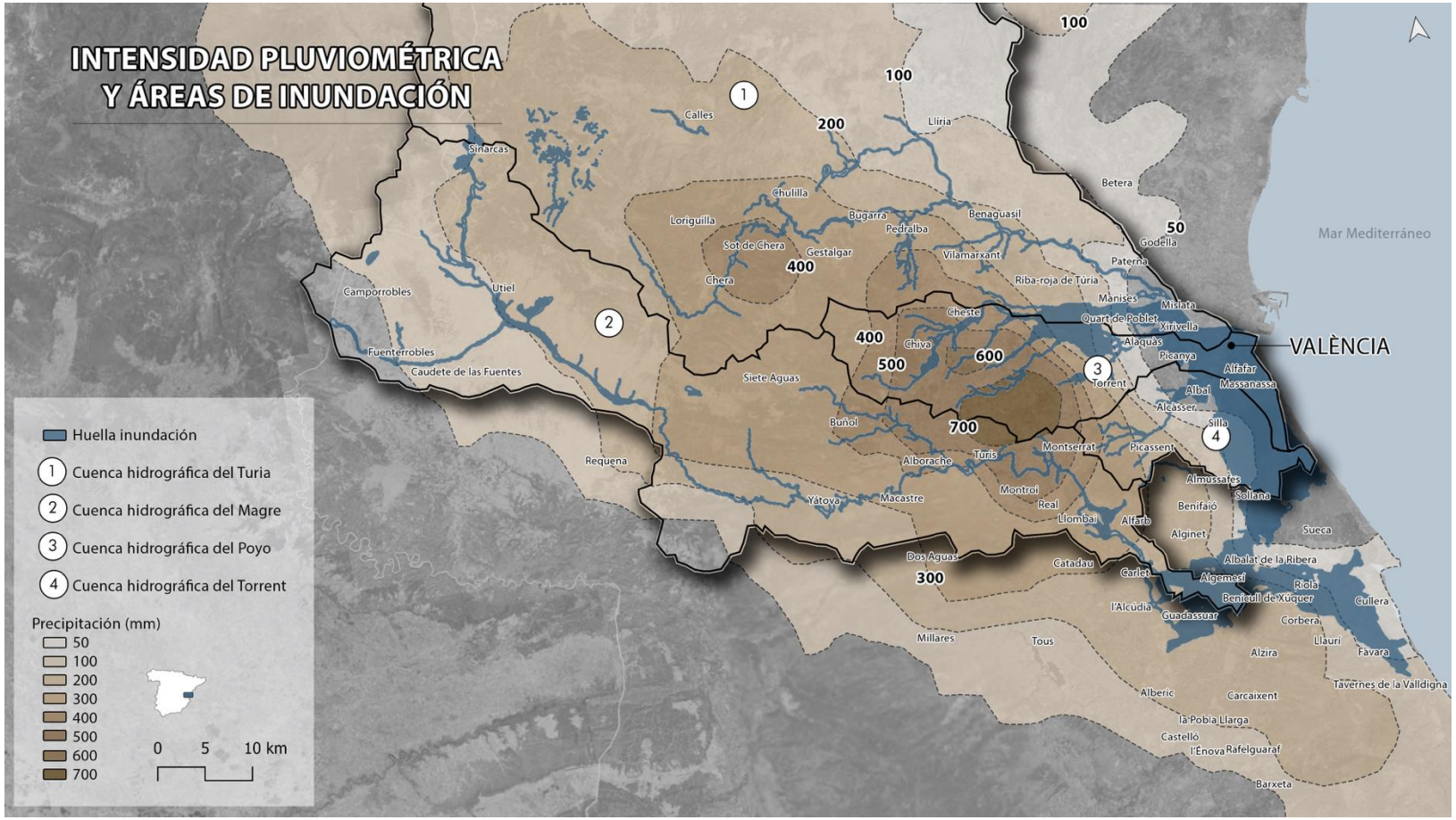

Figure 1. Rainfall intensity and flood areas

2.3. Comparison with past events

We are currently witnessing a sustained increase in the intensity of precipitation on the Mediterranean coast, driven by global warming. This phenomenon is manifested through increased evaporation and atmospheric moisture availability, as well as by the alteration of general wind circulation patterns. The reduction of the thermal gradient between the poles and mid-latitudes is generating broader and slower planetary waves, which favor the persistence of extreme rainfall systems. At the same time, rising surface temperatures induce progressive drying and compaction of soils, reducing their absorption capacity and amplifying the speed and violence of surface runoff during torrential rain episodes.

A recent analysis by World Weather Attribution (2024) concludes that episodes of intense precipitation in a single day are now 12% more intense and twice as frequent as in the pre-industrial climate (approximately 1.3°C cooler).

In this context, the episode of October 29 and 30, 2024, in the province of Valencia constitutes one of the most intense rainfall events recorded in Spain so far in the 21st century, both for accumulated volume and rainfall cadence. The data collected at the Turís station represent a national record for hourly rainfall totals. Since 1950, at least four major torrential rain episodes have been documented in the province of Valencia, among which three historical events stand out for their intensity:

- **October 14, 1957 (Valencia city):** 494 mm in 24 hours, during the tragic Turia flood, which, among other reasons, motivated the diversion of the riverbed.
- **October 20, 1982 (Tous/La Ribera Alta):** 635 mm in 24 hours, in the episode that caused the Tous dam break and severe flooding in the region.
- **November 3, 1987 (Oliva, Safor region):** an estimated 817 mm in 24 hours.

The 2024 episode did not surpass this last record for 24-hour accumulated precipitation, but it nearly doubled previous national records for 1, 6, and 12-hour totals, with respective values of 185 mm, 621 mm, and 720 mm.

In terms of human consequences, the "Great Flood of Valencia" in 1957 left at least 81 dead, while the dam break in the "Tous Flood" in 1982 caused around 12 fatalities[6]. For the 1987 Safor flood, no reliable[7] official mortality data has been found, despite holding the national record for daily accumulation.

In contrast, the 2024 DANA caused the deaths of at least 229 people in the province of Valencia. Considering that this episode doubled historical precipitation records for 1, 6, and 12-hour totals, it can be concluded that the high mortality was directly related to the event's extreme torrentiality. Beyond the total volume precipitated, the intensity and speed of the discharge generated sudden, aggressive, and very difficult-to-manage floods.

[6] An additional 18 fatalities were recorded during this event, which were not related to the rupture but occurred upstream as a result of a bus being swept away while transporting workers leaving the Cofrentes Nuclear Power Plant.

[7] Methodological note: This comparative analysis has been developed based on official data from the Spanish Meteorological Agency (AEMET) and verified historical studies. Events prior to the 20th century have been excluded due to the lack of verifiable instrumental records, in accordance with the validation criteria of the PERC methodology.

2.4. Impact map[8] (urban/rural areas most affected)

The territorial distribution of the impacts generated by the DANA in the province of Valencia is represented in the following map, which classifies the affected municipalities according to the level of emergency officially activated by the Generalitat Valenciana, in accordance with the resolutions published in the Official Gazette of the Generalitat Valenciana (DOGV). This categorization has been used as a starting point, although it should be interpreted with caution, since the declared emergency level may not always accurately reflect the real impact experienced by each municipality. The emergency is activated based on forecast meteorological conditions and operational capacities, not on the material or social damage ultimately recorded.

Three operational levels are identified, in ascending order of severity:

- **Emergency Level 1:** Municipalities with local emergency activation and significant but contained impact, managed with their own resources.

- **Emergency Level 2:** Municipalities with severe impact, requiring regional reinforcement with possible activation of the CECOPI (Integrated Operational Coordination Center) and widespread damage to services, mobility, and urban environments.
- **Emergency Level 3:** State activation in the face of large-scale catastrophes requiring the establishment of the CECOPI and the intervention of extraordinary state resources, including the Military Emergency Unit (UME).

The activation of emergencies is structured according to territorial scope and event severity. At the municipal level, the mayor can declare and activate local emergency plans up to levels 1 or 2. During the October 2024 DANA, regional management remained at level 2, reinforced with state resources (including the UME) through inter-administrative coordination mechanisms, without formally declaring level 3.

The authority to declare the different levels, phases, or emergency situations lies with the regional minister responsible for civil protection and emergency management. It is also the responsibility of the same minister to decide on the establishment of the CECOPI when the evolution of the emergency requires it, thus providing the system with a centralized body for coordinating resources and actions to effectively address the situation.

If the emergency transcends the regional territory or requires mobilization of state resources and powers, the central government can intervene by declaring a State of Alarm or other civil protection measures, ensuring inter-administrative coordination and mobilization of resources at the national level.

Moving to level 3 has significant technical and political implications. Operationally, it means centralizing the response under the authority of the central government, with loss of direct operational control by the regional administration. This requires reorganizing resources and command structures, which can increase bureaucracy and slow decision-making if there is no smooth coordination.

Politically, raising a catastrophe to level 3 implies acknowledging that the emergency exceeds regional management capacity. This declaration, while allowing access to extraordinary funds, international aid, and additional resources, also generates public and media pressure on the central government, forcing it to explain the situation. In this report, in addition to the emergency levels, the **"Zone 0"** category is included, used in institutional and media accounts during the crisis to refer to municipalities with catastrophic impact.

[8] The maps have been developed based on official emergency resolutions (DOGV), cross-referenced with cartographic, photographic, testimonial information, and fieldwork carried out as part of the study. Since official categorization does not always reflect the actual extent of the damage, additional elements have been incorporated to represent the observed effective impact. The cartographic representation aims to provide a rigorous, synthetic, and scalable visualization of the spatial pattern of territorial impact, enabling multiscale analysis and facilitating territorial comparison with other exposed Mediterranean regions. They have also been generated by the technical team using GIS data, official databases, and georeferenced testimonies. The maps will include differentiated layers for urban, agricultural, and peri-urban environments; a detailed legend; graphic scale; data source indication; and classification criteria. Their design ensures visual clarity, territorial accuracy, and comparative usefulness for post-event evaluation and planning processes

These cases were characterized by the functional collapse of critical infrastructure, prolonged interruptions of basic supplies, and severe damage to urban and residential fabric. The “Zone 0” category does not replace official levels but serves as an analytical tool to describe the concentration of extreme impacts within the official level 2 classification (Figure 2).

As observed, the most exposed municipalities are located in the regions of La Ribera Alta and especially l'Horta Sud, coinciding with areas of high hydrographic exposure, strong urban concentration, and limited drainage capacity.

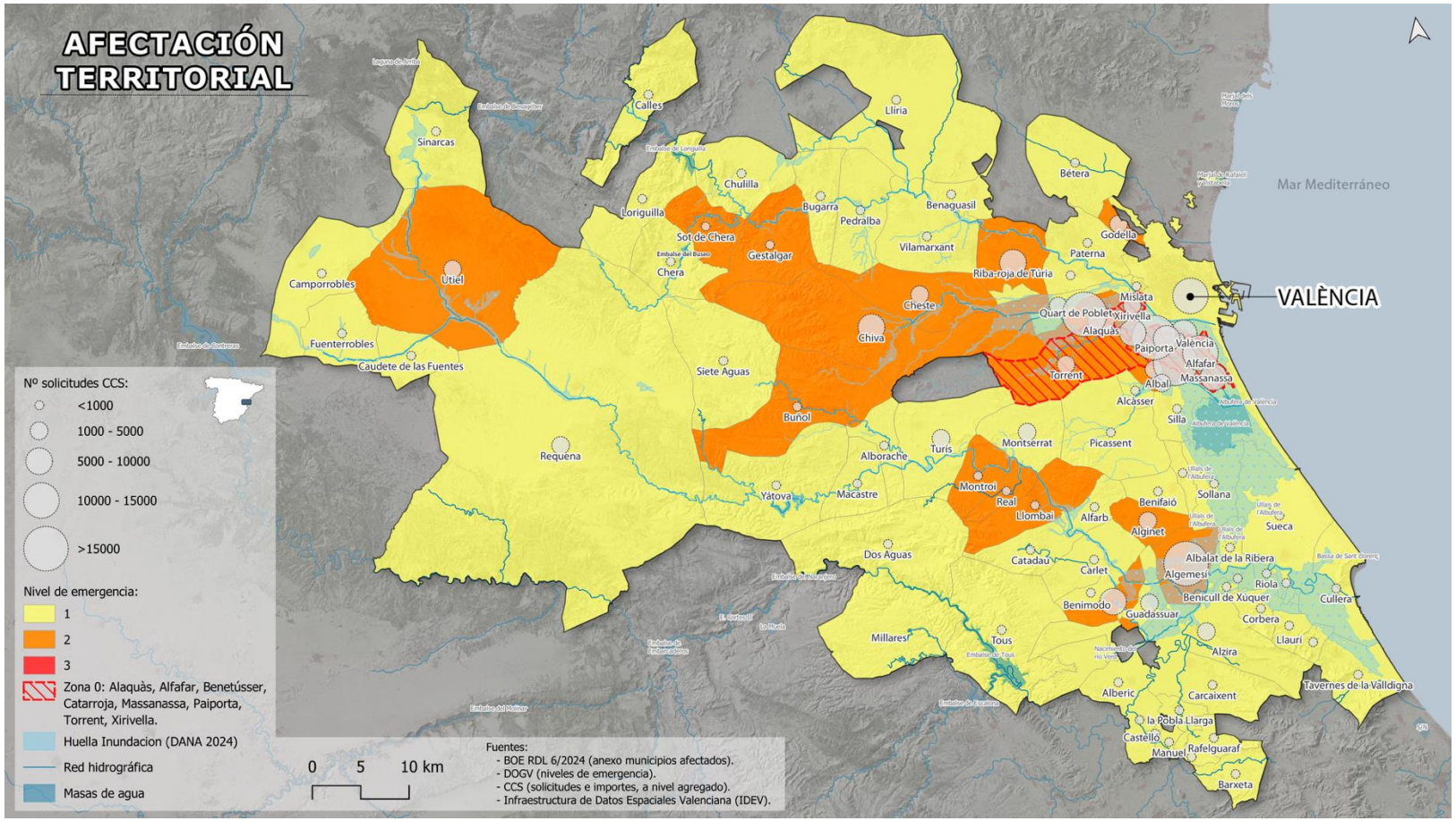

Figure 2. Territorial impact due to the DANA and declared emergency levels

3. Impacts of the event

3.1. Physical impacts (infrastructure, transport, housing)

The floods caused by the DANA resulted in large-scale material damage, with a direct impact on the region's physical assets estimated at approximately €20.3 billion. This figure includes both damage to public infrastructure and insured and uninsured losses in private properties, representing an approximation of the event's total economic cost (Figure 3). This estimate was generated from internal reports by the Generalitat Valenciana, the Insurance Compensation Consortium (CCS), and the EMPLEA UPV Chair (2025), triangulated with municipal sources and methodologically validated within the PERC analysis framework.

The CCS recorded more than 249,984 compensation claims, of which 238,516 were located in the province of Valencia, mostly for property damage. It is also noteworthy that 33,569 claims were denied due to duplication or lack of coverage. According to the twenty-third information note published by the CCS on September 18, 2025, 207,558 claims had been paid, for a total amount of €3,644,520,196, although the CCS estimates that the final cost will exceed €4.8 billion once all pending claims are closed. These figures are complementary to losses recorded in public and private assets that are not insured, since the CCS covers all insured assets. Part of the public infrastructure was not insured (Ministerio de Economía, Comercio y Empresa, 2025).

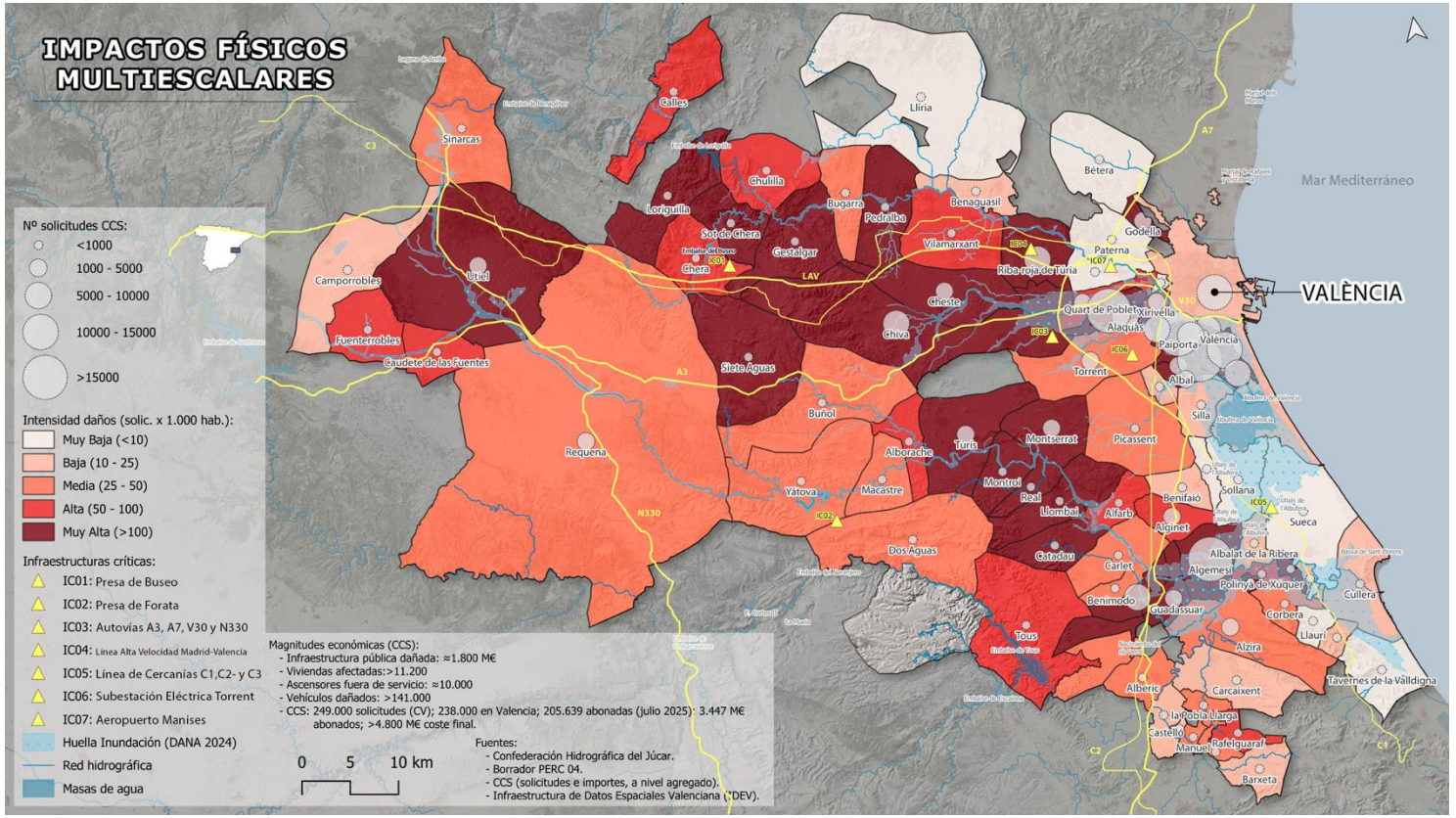

Figure 3. Multi-Scale Physical Impacts

In particular, the infrastructure of the affected municipalities suffered damage valued at more than €1.8 billion, with more than 80% of the damage concentrated in essential water systems—such as water treatment plants, sanitation networks, pipelines, reservoirs, and dams—as well as in transport networks, especially roads, railways, and logistics hubs. In the case of several dams, situations of hydraulic stress were documented that raised concerns about their structural integrity.

Damage to water infrastructure limited access to drinking water in several municipalities, increasing the risk of infections for both ecosystems and the population. At the same time, the interruption of transport networks hindered the arrival of supplies, health personnel, and humanitarian aid during the initial phases of the emergency, slowing down response capacity.

More than 11,200 homes were affected, and it is estimated that approximately 10,000 elevators were put out of service, severely restricting vertical mobility, especially among the elderly or people with disabilities. Flooding was documented in underground garages up to 8 meters deep, compromising the structural stability of numerous residential buildings and forcing emergency evacuations. In addition, more than 142,000 vehicles were affected.

The volume of waste generated by the massive destruction of automobiles—including oils, fuels, batteries, and plastic components—constitutes a significant environmental risk. Some sources, such as the fishing community of El Palmar, have reported an increase in water pollution levels in the Albufera lake after the event, leading to the prohibition of the commercialization of certain species due to health risks. This aspect, barely addressed in local publications, has been noted by international studies and requires specialized monitoring, given its potential cumulative impact on vulnerable ecosystems.

In terms of financial coverage and access to aid, relevant differences have been identified between population groups. While many insured people were able to access compensation quickly, others—especially migrants, tenants without their own policy, or with precarious documentation—faced greater difficulties. This gap in access to recovery has increased the vulnerability of already disadvantaged sectors, which will be analyzed in more detail in the sections on social impact. The eligibility conditions for public aid and barriers to accessing insurance will be specifically analyzed in the methodological and recommendations section.

Finally, although this section focuses on physical impacts, it should be emphasized that the region's associative and community fabric played a key role in mitigating damage and in the post-event response. Through organized mutual aid networks, local entities mobilized resources worth more than €150 million—according to data from the Valencian Coordinator of NGOs—contributing to urban, housing, and basic services reconstruction. This capacity for social mobilization will be analyzed in greater depth in later sections of the report, within the framework of community resilience and institutional strengthening.

Source: Zurich Insurance Spain

3.2. Social impacts (vulnerable population, health, evacuations)

The October 2024 DANA caused 237 confirmed fatalities, according to official data from the Government of Spain.. This figure includes 229 in the Valencian Community, 7 in Castilla-La Mancha, and 1 in Andalusia (Moncloa, 2025).

In addition, more than 2,600 people were injured, according to official data collected by emergency services and verified by the Generalitat Valenciana.

According to the Diagnostic Report of the Economic and Social Recovery Plan of the Generalitat Valenciana, the total number of people affected by the DANA exceeded 306,000 within the Valencian Community. This figure is based on people living in highly affected areas (32 municipalities), which may differ from the actual number of people affected.

The conditions of rainfall intensity, sudden discharge, and water accumulation in vulnerable structures (such as garages, basements, and storage rooms) have been described in reports by Civil Protection (2024) and the technical analysis of the National Geographic Institute as critical factors contributing to fatal risks, especially in densely urbanized areas with poor rainwater drainage. While it is not possible to establish direct causalities without a complete judicial investigation, available data show a possible pattern of impact on certain population groups. These pattern were triangulated with testimonies, official sources, and direct observation during fieldwork:

1. People over 65

   Various records and judicial analyses indicate that the elderly were overrepresented among the DANA victims, with 48% of the deceased being aged 70 or older.This overrepresentation reflects the high vulnerability of this age group, associated with both physical and mobility limitations and structural factors in housing (living more frequently on ground floors, difficult evacuation) and late receipt of alerts. Although available data focus on fatalities, this evidence underscores the need for age-differentiated approaches in DRM and early warning.

2. Population under 16

   Although there are no official data on the exact proportion of minors affected by the 2024 DANA, various reports highlight their psychosocial and educational vulnerability. Studies by Plan International, Educo, Entreculturas, and Save the Children indicate that among adolescents aged 12 to 21, 40% showed mental health problems and nearly half required psychological support, while 37% had concentration difficulties. 80% of families observed significant emotional changes among children (fear, anxiety, insomnia, sadness), and more than 163,000 minors suffered educational impacts, including 40,000 with temporary interruptions in school attendance. These findings show that children and adolescents were especially vulnerable to the emotional and social impacts of the disaster.

3. Migrant population

   There are no official data quantifying the exact percentage of migrants among the population affected by the DANA. According to the INE (2024), the foreign-born population constitutes approximately 11% of residents in the Valencian Community, which can be taken as a general demographic reference. Various reports from social organizations (such as the Valencian NGO Coordinator) and testimonies collected during fieldwork indicate that the migrant population experienced disproportionate exposure to impacts due to factors such as language barriers, residential overcrowding, job insecurity, and difficulties accessing official information and public aid. These qualitative elements suggest the need to further analyze how structural vulnerability affects this population group, although there are currently no official disaggregated figures.

4. Women victims of gender-based violence

   There was an increase in reported cases in the weeks following the event, particularly in areas of forced evacuation or loss of habitual residence. According to the Ministry of Equality, at least 94 new risk situations were identified in affected municipalities.

5. Family units with dependents

   Reported high levels of emotional overload, difficulty accessing public aid, and lack of safe spaces for their children and elderly in temporary evacuation centers (Cátedra EMPLEA UPV, 2025).

In all age groups, persistent symptoms of emotional suffering were detected: anxiety, insomnia, a sense of institutional abandonment, and breakdowns in support networks). The floods caused the destruction or disruption of educational centers in many municipalities, resulting in the relocation of students and the consequent loss of bonds and community fragmentation, which are generating lasting effects on the social fabric of children and youth.

The destruction of playgrounds and play areas was one of the visible and prolonged consequences of the event. For months, numerous facilities were unusable, reducing opportunities for socialization and recreation for children. This temporary loss of community spaces not only impacted children's well-being but also created additional social harm for families by depriving them of safe and familiar environments for coexistence.

Various professionals, members of the teams of the associations interviewed, also pointed out a cultural barrier to recognizing emotional suffering, especially among adult men, which limits the use of psychological resources and deepens the effects of untreated trauma.

In terms of forced displacement, more than 6,300 people were evacuated preventively or in emergencies, many with little time to prepare. Conditions in reception centers varied significantly between municipalities, and although spontaneous solidarity networks were activated, structural aid arrived with varying intensity. Community response played a relevant role, especially in areas with a strong associative fabric, partially reducing the vulnerability of people previously integrated into these spaces (CVONGD, 2025).

Source: Shutterstock / Natursports, ID: 2546165919

3.3. Economic impacts (Commerce, Agriculture, Industry)

The Isolated Depression at High Levels (DANA) that affected the province of Valencia between October 29 and 30, 2024, caused an economic collapse of great magnitude (Pérez et al., 2025). The consolidated estimates by the PERC team, based on internal reports from the Generalitat Valenciana, the Insurance Compensation Consortium (CCS), and the EMPLEA UPV Chair (2025), place the total economic losses at around €20.6 billion. This figure includes:

- Damage to public infrastructure and critical facilities: approximately €1.8 billion.
- Insured damages in homes and vehicles (managed by the CCS and insurance entities): €4.8 billion.
- Insured damages in agriculture and livestock (managed by Agroseguro): €53 million.
- Direct and indirect economic losses in productive sectors (commerce, agriculture – uninsured-): an additional €14 billion.

This last category includes both the loss of productive capacity and the interruption of commercial, industrial, and agri-food activities, as well as the negative consequences on supply chains and the drop in regional demand during the following months.

During the investigation, we identified small and medium-sized enterprises (SMEs), self-employed persons, and family farming operations as particularly impacted. The most affected regions are l'Horta Sud, Ribera Alta, and Utiel-Requena, leaving more than 3,000 businesses closed six months later and between 700 and 1,150 at risk of definitive closure, which could affect up to 5,000 jobs. In several cases, we noted an absence of specific insurance for business interruption or climate coverage .

Zurich, as a participating entity in the PERC, has pointed out the importance of advancing towards a greater culture of risk management and risk transfer. Promote training and a risk culture, avoiding damage as much as possible, but at the same time ensuring proper risk transfer.

It is important that people, assets, companies, and businesses have a greater insurance and risk management culture, facilitating access to insurance including vulnerable people, especially in a context of increasing exposure to extreme climate events.

It is important to note that there is still some confusion regarding the operation of the Insurance Compensation Consortium. For coverage against catastrophic risks to exist, it is essential to have a correct policy. In addition, the insured amounts and contracted guarantees must be properly adjusted to the level of the risk to be covered. This specific part is key to ensuring adequate protection and avoiding misunderstandings about the real scope of available coverage. The concept of the **Insurance Compensation Consortium is unique in Spain** and practically without a direct equivalent in the world and is a source of inspiration for other countries for better coverage of climate risks.

The following sectors were affected differently:

- **Local commerce:** loss of inventories, deterioration of premises, drastic drop in sales, and business interruption for more than 40 days in some cases. In many cases, lack of insurance coverage for Business Interruption was observed.
- **Agriculture:** loss of entire harvests, waterlogging of soils, destruction of irrigation channels, and prolonged impact on the production of citrus, rice, and vegetables.
- **Industry:** interruption of production processes, loss of machinery, and low recovery capacity among small manufacturing plants.

During our analysis, we identified indications of a possible drag effect on employment, local tax collection, and the financial stability of the most affected municipalities, especially those

whose budget structure depends largely on the economic dynamism of these sectors. The differentiated analysis between insured physical losses and uninsured economic losses allows for a more precise measurement of the real scope of the catastrophe and guides public reconstruction measures that also contemplate the strengthening of inclusive insurance mechanisms.

Sectoral impacts

Commerce and hospitality

The urban areas of Zone 0 (Benetússer, Catarroja, Paiporta, Alaquàs, among other localities) housed a dense network of shops and hospitality venues located at street level. The floods caused:

- Total loss of inventory, machinery, and furniture in more than 21,000 establishments (Fundación Horta Sud, 2025).
- Temporary or permanent closure of businesses that did not have the ability to recover.
- Loss of traditional trades when knowledge and expertise is not passed on to younger generations via apprentices.
- Structural damage to premises and loss of regular clientele due to population displacement.
- Local associations estimated average losses per business between €38,000 and €70,000, with very uneven recovery driven by the administrative capacity of each entity, which has limited access to public and private aid and the processing of insurance claims.

Industry and logistics

The industrial estates of Sedaví, Massanassa, and Catarroja, as well as logistics centers near the V-30 road and the port of Valencia, suffered severe damage:

- Partial or total flooding of 812 industrial warehouses (CCS, 2025).
- Significant damage to machinery, servers, vehicles, production lines, and data networks.
- Interruption of logistics activity in strategic corridors supplying both the domestic market and international trade.

The estimated economic losses for the industrial sector exceed €10.5 billion, especially affecting exporting companies with unmet or postponed international commitments (Cámara Valencia, 2024).

Source: Shutterstock / d13, ID: 2538860901

Agriculture, fisheries, and agri-food

The industrial estates of Sedaví, Massanassa, and Catarroja, as well as logistics centers near the V-30 road and the port of Valencia, suffered severe damage:

- Loss of crops and washing away of fields in more than 14,000 hectares of irrigated land, which according to the Valencian Association of Farmers would amount to €1.379 billion in economic impact (AVA-ASAJA, 2024).
- Contamination of agricultural soils by runoff carrying waste, pesticides, and heavy metals, even affecting the ecosystem and agri-food and fisheries resources of the Albufera de València.
- Damage to irrigation infrastructure, pumps, ditches, and rural warehouses.

Total losses exceed €2.8 billion, according to cooperatives and agricultural unions. Many family farms lacked updated agricultural insurance, which worsens their post-disaster situation.

Local associative fabric

The economic impact also reached the network of community associations and social entities. According to data collected by Fundación Horta Sud, 333 associations in 23 municipalities reported damages exceeding €8.4 million. However, the associative fabric was also key in attracting reconstruction resources (more than €150 million channeled from NGOs, according to CVONGD, 2025), and in making associated people less vulnerable. The impact temporarily compromised their operability as networks of social and cultural support, especially in territories with a high density of organized citizen participation.

Impacts on employment and business structure

More than 33,000 people were affected by contract suspensions, furloughs (ERTEs), or layoffs, especially in sectors with high numbers of seasonal workers and among those self-employed. Difficulties in accessing public aid intensified in those sectors where informal labor or precarious contractual links predominate (Ministerio de Economía, Comercio y Empresa, 2025).

64% of the affected companies were micro-SMEs with fewer than 10 employees, without sufficient financial capacity to absorb losses or sustain activity without income for prolonged periods. These companies faced obstacles in accessing aid, mainly for not meeting administrative requirements or not being registered as required (CES-CV, 2025).

In economic sectors with high levels of informal employment and labor migration (such as the agri-food sector and certain personal services), access to institutional support was unequal or non-existent, leaving many workers without protection or immediate recovery alternatives.

Factors of Economic Vulnerability

During the analysis, structural and organizational factors were identified that intensified the economic impacts of the DANA:

- High concentration of economic activities in flood-prone areas, without territorial and urban regulation or flood protection measures.
- Low insurance culture, with underinsurance among some businesses, SMEs, and agricultural holdings. Many business owners were unaware of the conditions for activating climate damage coverage or lacked valid policies. According to the CCS and the UV-CCS study (2025), a high percentage of affected businesses lacked active coverage.
- Lack of financial preparedness for prolonged business interruption. The absence of contingency funds or immediate access to liquidity lines hindered business continuity after the emergency.
- Disconnection between the economic sector and alert, evacuation, and emergency planning systems. Few businesses knew the protocols or had their own plans to act in extreme events.
- Response protocols during the emergency phase were not adapted to the heterogeneity of businesses and impacts suffered.

3.4. Environmental Impacts

The DANA of October and November 2024 caused extensive, persistent, and partly invisible environmental impacts in initial diagnoses. They affected both the natural environment and agricultural, urban, and water systems, with ecological and health consequences that are still difficult to quantify.

The event has posed significant challenges in areas such as territorial planning, modernization of infrastructure, and strengthening management systems for extreme events. Likewise, aspects have been identified where it may be useful to advance post-disaster evaluation processes and the management of latent environmental risks, in order to reinforce response and adaptation capacity.

Water pollution and degradation of aquatic ecosystems

During and after the DANA, the hydrographic network of the metropolitan area of Valencia, including the Barranc de Torrent, Barranc de Chiva, and sections of the Turia River, suffered uncontrolled discharges of wastewater, oils, chemicals, and sludge. This resulted from the collapse of pumping and treatment stations (Quart-Benàger and Pinedo) and unitary collectors without sufficient capacity for rainwater and wastewater.

Industrial estates (Fuente del Jarro, Vara de Quart, Mas del Jutge) and agricultural areas of l'Horta Sud contributed with runoff of fertilizers, pesticides, organic waste, and microplastics into the channels. Fish mortality was documented between Manises and Riba-roja, and signs of eutrophication in the Albufera, affecting its ecological balance. Pollution limited the capture of species such as carp and introduced microbiological alterations in a Ramsa[9] - designated area and protected by the Natura 2000 Networ[10] . The loss of buffer wetlands and the overload of gray infrastructure (such as drainage systems, water and energy supply networks) amplified these effects. The absence of adaptive water cycle management and ecosystem resilience strategies exposes the vulnerability of the current model, with persistent risks if contaminated spaces are not rehabilitated or contaminant residues (such as stored vehicles) are removed before future floods.

Erosion, soil runoff, and loss of fertility

Heavy rains caused intense erosion in the agricultural areas of Ribera Alta, l'Horta Sud, and Utiel-Requena, generating surface furrows and runoff gullies on slopes without vegetation cover[11]. An estimated loss of more than 17,000 tons of fertile soil affected the A horizon, key for agricultural productivity. This vulnerability was more visible in soils compacted by machinery, without crop rotation or regenerative practices. The previous drought accentuated soil disaggregation. Although a well-managed agricultural mosaic can maintain some edaphological resilience, land abandonment and loss of plant cover reduce this capacity. The lack of maintenance of irrigation ditches may have aggravated soil runoff, revealing the urgency of adopting agroecological practices, restoring terraces, and controlling runoff.

Damage to green infrastructure and urban trees, SUDS and urban trees

The DANA caused extensive damage to green infrastructure and urban trees in more than 20 municipalities. Losses were recorded in green corridors, parks, and ecological buffer zones. In municipalities such as Torrent, Paiporta, and Aldaia, the fall of large and medium-sized trees was documented due to soil saturation, wind, and weak root structures. Collateral damage occurred to street furniture and urban wiring. Sustainable Urban Drainage Systems (SUDS) such as those in Parc Central de Torrent or the barranc de l'Alqueria in Paiporta collapsed or were blocked by excess sediment.

Air pollution and waste accumulation

The post-emergency phase left more than 1 million tons of household waste accumulated on roads, riverbeds, and public spaces in municipalities such as Massanassa, Alcàsser, Silla, Catarroja, and Torrent. There are no exact figures, as there is no

[9] The designation of a wetland as a Ramsar site entails its conservation and the provision of ecosystem services that ensure sustainable use, greenhouse gas mitigation, and adaptation to climate change.

[10] European network of protected areas created to conserve biodiversity, based on the Habitats Directive and the Birds Directive. It includes Special Areas of Conservation (SACs) and Special Protection Areas for Birds (SPAs), promoting compatibility between conservation and sustainable land use.

[11] Water erosion on agricultural slopes caused by >200 mm/24 h of rainfall, bare steep slopes, and lack of vegetation cover, resulting in the formation of rills and gullies.

La complete documentation in accordance with the European waste management directive, and it has not yet been published because documentation was skipped. Waste treatment was not always carried out according to formal standards or safety regulations for the sector. For example, the management of damaged vehicles did not include proper handling of hazardous waste, nor correct stacking and sorting .

Secondary toxic pollution was visibly caused by exposure of fuels and oils from vehicles, even in residential areas. There was no monitoring of further toxic chemical exposures or possible soil contamination in industrial estates and agricultural areas. As a result of fuel exposure, piles of vehicles began to burn, causing dangerous fires near inhabited areas. Respiratory symptoms were documented, and community health teams reported headaches and eye irritation. There was no active environmental monitoring in the affected areas.

Disaster waste management was not included in the emergency management process. Data and information on services or coordination for the removal of hazardous waste or substances were not accessible. Waste types were not evaluated, and landfill capacity was insufficient. Excessive amounts of sludge deposited on crops have not been removed as of the publication of our source reports. The deposition of sludge in the lagoon and protected areas has not been sufficiently evaluated or documented (Lemke & Müllers, 2025).

As reflected in Fekete's study, waste managers pointed out the need to incorporate a specialized waste management profile within the Integrated Operational Coordination Center (CECOPI). The presence of this technical figure would optimize decision-making in comprehensive emergency management, ensuring a more coordinated and effective response regarding the treatment, transport, and disposal of waste generated during the crisis (Fekete, 2025).

Impact on wildlife and disruption of ecological corridors

The DANA temporarily fragmented key ecological corridors such as the Turia, the Poyo ravine, or the Albufera (Figure 4), forcing wildlife to move into urban and agricultural areas, increasing their exposure to being run over or lacking shelter.

The Turia Natural Park and the Albufera Natural Park are two of the most ecologically valuable areas in the Valencian Community. Both have the highest level of protection within the regional regulatory framework, which implies the priority preservation of their ecosystems, biodiversity, and water resources. This special protection recognizes not only their environmental and scenic relevance but also their role as key spaces for water regulation, ecological connectivity, and territorial balance, ensuring their conservation against uses or activities that may compromise their integrity.

In areas of the Natura 2000 Network (Devesa-Albufera, Turia River Park) priority habitats were altered, affecting species such as Ardea purpurea (purple heron) or Lutra lutra (fish otter). Post-event biodiversity monitoring protocols were not activated.

Source: Zurich Seguros España

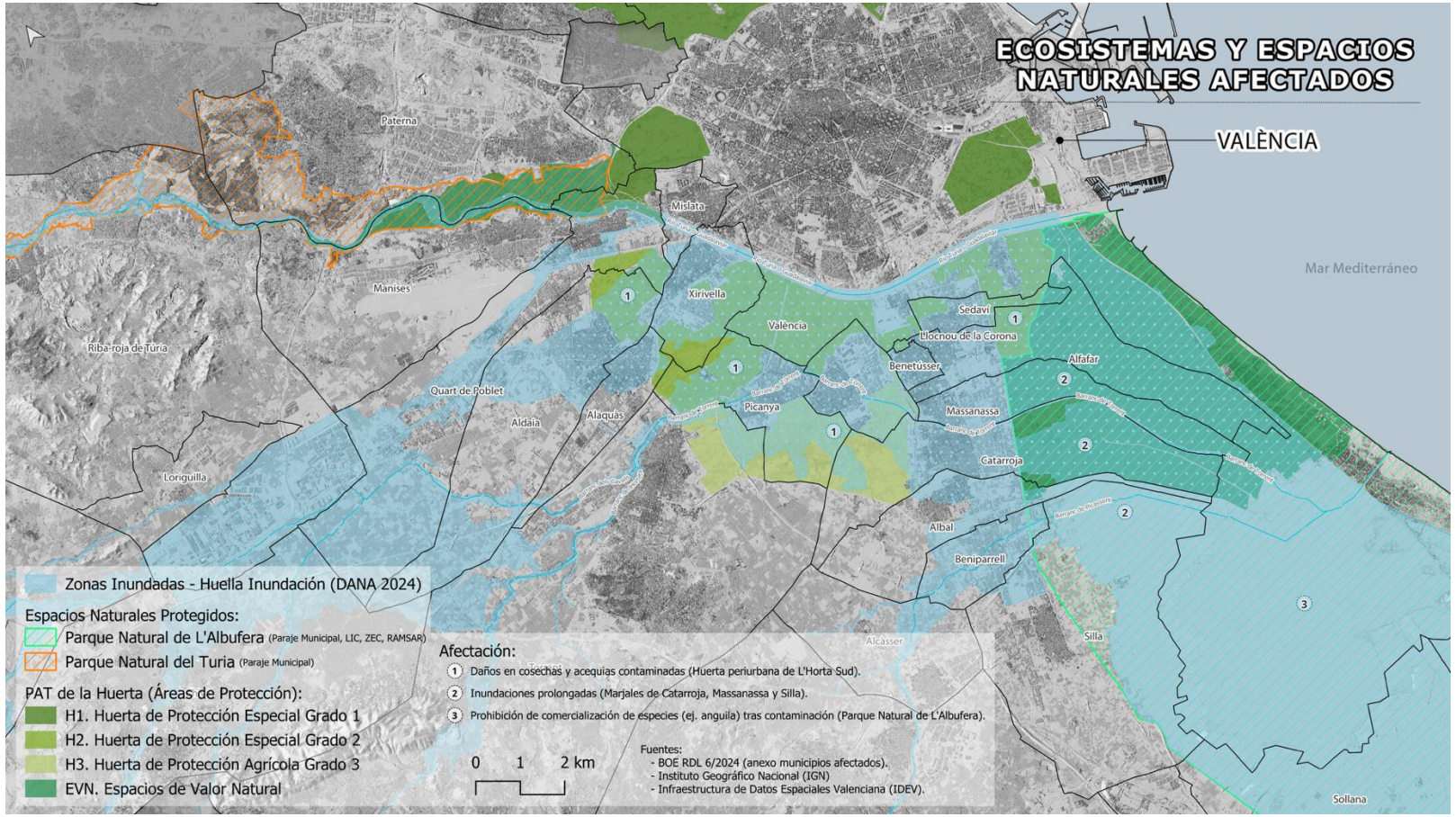

Figure 4. Ecosystems and natural spaces affected by the DANA

Persistence of environmental risks and absence of post-disaster evaluation

To date, it is unknown whether a post-DANA environmental assessment has been issued, leaving certain important aspects to be addressed in the analysis, as they could represent risks such as:

- Contaminated soils in industrial areas (metals, hydrocarbons, leachates).
- Stagnant water ponds in undrained areas (vectors such as Anopheles and Culex).
- Decomposing organic waste (emission of gases such as NH_3 and H_2S).
- Uninventoried hazardous waste in warehouses and agricultural facilities.

4. Overview of disaster risk management

The institutional response to the DANA that affected the province of Valencia between October and November 2024 tested the capacities of multi-level governance in a severe climate event. Although significant efforts were deployed by national agencies (Government Delegation, Military Emergency Unit—UME), regional bodies (112 Comunitat Valenciana, Valencian Agency for Security and Emergency Response, Valencia Fire Consortium), municipal entities (city mayors and local police), and the associated network (neighborhood networks, NGOs coordinated by CVONGD), the episode also revealed operational mismatches, deficits in inter-administrative coordination, sectoral limitations, and gaps in attention to vulnerable groups (Generalitat Valenciana, 2025; Fundación Horta Sud, 2025).

4.1. Institutional coordination

The emergency system was activated unevenly depending on the territory and local capacities. The Advanced Command Post (PMA) was set up quickly and served as a coordination node among the main regional agencies (112 Comunitat Valenciana, UME, Civil Protection, Fire Consortium), but its effectiveness depended on the degree of prior preparation and articulation in each municipality.

Localities such as Torrent, Alzira, or Catarroja managed to execute evacuation protocols, road closures, and resource deployment effectively thanks to prior experience, greater staffing, and updated municipal emergency plans. In contrast, municipalities without prior planning, or with exclusively volunteer civil protection and limited resources, experienced greater difficulties in activating operational devices.

The Government Subdelegation acted as an intermediary between administrations, although its visibility was perceived as limited in several municipalities. The lack of clarification on specific competencies and communication channels during the first 48 hours caused delays in assigning responsibilities, in the arrival of logistical resources, and in the deployment of basic aid. Testimonies collected in municipalities such as Benifaió and Almussafes report delays in opening temporary shelters, distributing supplies, and providing first aid and psychosocial support, which increased the sense of uncertainty among the affected population.

The situation observed did not fully align with the specific regulations on civil protection. The combination of different levels and emergency scenarios, along with limitations in inter-institutional communication, led to a slowdown in activation and made it difficult to coordinate the necessary intervention by each competent authority. In this regard, it is pertinent to consider the regulation of the State of Alarm provided for in Article 4 of the Spanish Constitution for cases of flooding, as well as the provisions of Royal Decree 524/2023, of June 20, which approves the Basic Civil Protection Standard. In particular, the operational situations I, II, and III in relation to the emergency phases defined in its Article 7.d) are referenced.

Beyond immediate operability, the DANA highlighted structural deficits in territorial governance and inter-administrative coordination capacity. The Spanish regional model, effective in ordinary scenarios, showed limitations in crisis situations due to fragmented competencies and insufficient vertical and horizontal cooperation. The experience demonstrated the need for supra-municipal planning and coordination bodies that integrate people's safety with territorial, environmental, hydrological, and mobility criteria.

While the current regulatory framework offers sufficient instruments—metropolitan plans, sectoral conferences, or other cooperation mechanisms—their effectiveness depends mainly on political will and the ability to generate strategic consensus. In this sense, overcoming polarization and promoting a culture of cooperation among science, citizens, administrations, and the media are essential to advance prevention, risk reduction, and adaptation to climate change. Democratic innovation and a cultural shift toward shared responsibility and long-term dialogue emerge as necessary conditions for effective governance of complexity and to strengthen resilience against future extreme events (Romero, 2025).

4.2. Community participation and security forces

The Local Police played a key role in evacuation tasks, traffic control, road closures, and support in temporary emergency shelters. However, their response capacity was very uneven, conditioned by the availability of personnel, vehicles, and equipment. In smaller municipalities or those with fewer resources, efforts were insufficient to address the magnitude of the event.

The Civil Protection network, both volunteer and professional, played a crucial role in community response and operational support. In municipalities like Alzira, outstanding performance was observed thanks to an active group, well-equipped and with prior experience in climate emergencies. In contrast, towns like Alcàsser or l'Eliana had significant shortcomings, as their groups lacked specific training for extreme weather events scenarios or did not have adequate equipment, limiting their effectiveness as a territorial resilience resource. Strengthening this network structurally represents a key opportunity for improvement.

The Provincial Fire Consortium carried out more than 3,200 interventions related to rescues incl. water rescue, and structural stabilization. Coordination with other bodies was considered adequate, although bottlenecks were detected during the first 48 hours, especially in areas with multiple simultaneous critical points.

Immediately after the event, spontaneous neighborhood groups came to life to respond to crisis situations arising locally. This self-organization was fundamental in the face of the collapse of emergency and civil protection services, which in many cases could not access the affected areas. However, a lack of coordination with professional services was identified, especially with the arrival of external volunteers, whose intervention, although well-intentioned, complicated some operational tasks.

Despite these tensions, community involvement has been recognized by most local agents as a key element, not only to cover basic needs immediately but also to provide emotional support and mitigate the feeling of abandonment among affected people.

4.3. Social services, healthcare, and vulnerable groups

Municipal social services played an essential role in providing care for vulnerable groups, the elderly, migrants, homeless people, minors at risk, activating psychosocial emergency support in towns like Paiporta, Picassent, or Alfafar. However, this response was very uneven and, in many cases, limited by lack of staff, logistical resources, or protocols that were not adapted to climate emergencies (Generalitat Valenciana, , 2025).

The healthcare system maintained basic operability in designated hospitals, although preventive evacuations of health centers were reported due to power failures or infrastructure damage. The 061 mobilized mobile units to provide care in isolated areas, but emergency rooms operating beyond capacity, the suspension of home visits, and failures in the supply of medical supplies limited access to essential treatments and medicines, especially for the chronically ill and people dependent on care. According to testimonies collected during interviews, several people with chronic conditions reported interruptions in their usual treatments and difficulties accessing insulin, antihypertensives, and medical devices for more than 48 hours after the event.

Institutional communication and citizen perception

Official communication was perceived as arriving late and being insufficient in many municipalities. Although alerts were activated through 112CV and official social networks, the digital divide and lack of multilingual or adapted information hindered access for those groups that use electronic devices only rarely or not at all. In periruban and vulnerable neighborhoods, this deficiency amplified the sense of isolation, affecting self-protection capacity (Fundación Horta Sud, 2025). In some municipalities, alternative communication strategies were attempted, such as using local radios, neighborhood volunteers for door-to-door dissemination, or community instant messaging groups, although not systematically or institutionally.

In some municipalities, witnesses talked about the lack of visible institutional presence during the first 24–36 hours of the event. In other cases, citizens positively valued the deployment and coordination of resources. This disparity reinforces the need to improve community communication channels, multichannel and locally devolved, like a capillary network.

4.4. Disruption in critical infrastructures

The extreme rainfall and flooding episode caused widespread interruptions of critical infrastructures in the Valencian Community, as shown in the map obtained from the GVA Cartographic Viewer (Figure 5). The simultaneous collapse of multiple systems—electricity supply, drinking water, sanitation, telecommunications, urban and interurban transport, and emergency healthcare—revealed accumulated structural vulnerabilities and cross-functional dependencies that amplified the initial impact and complicated recovery.

These disruptions severely affected both institutional operability and daily life, especially in densely urbanized areas and territories with pre-existing deficiencies in territorial and then urban planning, as well as maintenance or redundancy of essential services.

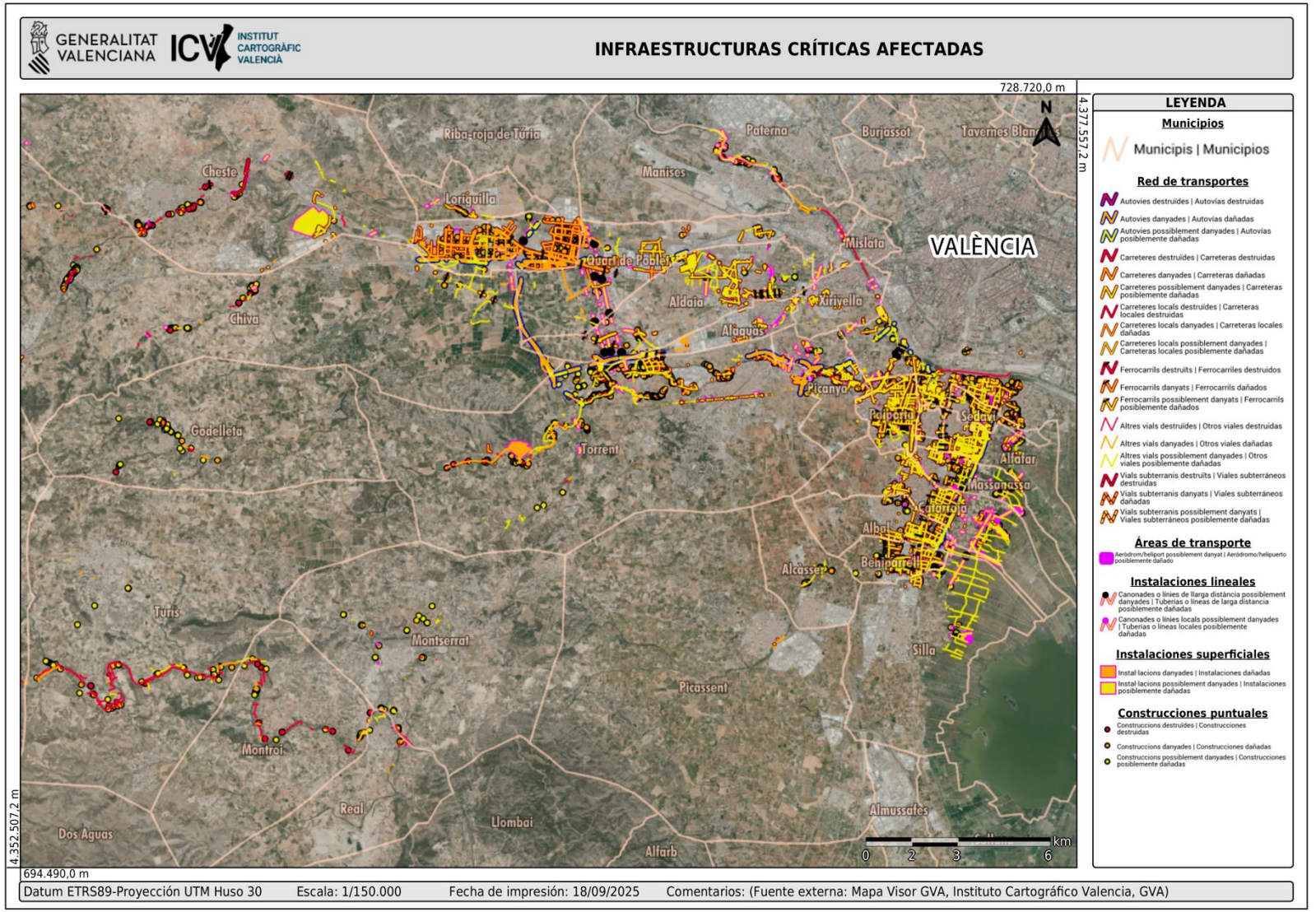

Figure 5: Critical infrastructures affected

Electricity and power outages

During the critical phases of the emergency, more than 170,000 households in the metropolitan area of Valencia suffered prolonged power outages, especially in municipalities identified as Zone 0. The main causes included both breakdowns due to flooding in substations, transformer centers, and inspection chambers, and preventive power cuts by distributors due to the risk of short circuits and electrical fires in vulnerable infrastructure.

Restoration of service took up to 72 hours in high-density urban areas such as Alfafar, Benetússer, or Sedaví. Reinstatement was dependent on accessibility to critical points due to ongoing flooding and obstacles; the collapse of secondary and interurban roads; and the absence of scalable energy response protocols for extreme events like a DANA.

Water supply and sanitation disruptions

During the DANA, the water network of numerous municipalities in the Valencia Metropolitan Area (AMV) presented significant operational failures, as a direct consequence of hydrological overload and structural damage caused by the event. Interruptions in drinking water supply were recorded due to breakdowns in pumping stations, flooding of elevated tanks, and collapses in pumping systems.

In several municipalities, the water distribution network was contaminated, due to infiltrations of sewage and leakages in vulnerable sections or without constant positive pressure. This situation led to the issuance of non-potable water health alerts in municipalities such as Silla, Aldaia, or Torrent, which lasted up to 72 hours in some cases (Generalitat Valenciana, 2025).

At the same time, the urban sewage system was widely overwhelmed, particularly in areas with unitary networks or without adequate rainwater drainage infrastructure for extreme events. This caused untreated wastewater overflows in public roads, affecting homes, businesses, and public facilities.

The absence or insufficiency of redundant retention or relief systems limited the system's containment capacity, generating direct health risks and compromising the operation of several wastewater treatment plants, many of which were already operating at the limit of their hydraulic capacity before the event (CHJ, 2025).

Telecommunications interruptions and information gap

During the most critical phases of the event, the telecommunications system experienced intermittent failures mainly attributable to power outages at repeater antennas, network node saturation, and limited backup energy systems in key infrastructure. These disruptions affected both mobile telephony and data connectivity , especially in rural areas, scattered settlements, and peripheral neighborhoods with structurally deficient coverage (Generalitat Valenciana, 2025).

Loss of connectivity created an operational digital gap that disabled citizens from timely access to official information channels, emergency alerts, and evacuation or mobility restriction notices. This situation particularly affected groups in situations of social or technological vulnerability, amplifying the perception of isolation and uncertainty in already highly stressful contexts (Fundación Horta Sud, 2025).

Some municipalities, such as Albal, activated emergency protocols that included contingency measures for internal communication. In this case, priority was given to restoring telecommunications antennas and using radio devices (walkie-talkies) to maintain communication between different collection points and emergency response teams This type of strategy reflects the importance of having redundant local communication systems to maintain functionality during the interruption of conventional networks.

Regarding coordination among emergency services, limitations were observed due to the absence of technology standards to maintain interoperability between devices from different administrations in case of network failure. This situation, rather than being attributable to operational actors, highlights the need to establish specific inter-institutional protocols to ensure continuity of communications in scenarios of widespread malfunction.

Transport, isolation, and mobility system impact

During the event, the metropolitan and regional transportation networks experienced critical disruptions, with simultaneous impacts on public transport, road networks, and strategic hub locations. Operational suspensions occurred on key railway lines—such as Metrovalencia lines 1, 2, and 7, and Renfe commuter services C-1, C-3, and C-6—due to flooding of platforms, damage to electronic signaling systems, and impact on electrical substations (Ministerio de Transportes y Movilidad Sostenible, 2025).

The Metrovalencia lines could be partially restored on December 3, 2024, between Marítim-Sant Isidre (Line 7) and València Sud (Lines 1 and 2). Full service to València Sud was restored on February 18, 2025. Finally, on June 27, 2025, the most affected section between València Sud, Paiporta, and Torrent Avinguda was reopened, reinstating service completely.

For commuter services, the Silla-Gandía (C-1) and Carcaixent-Moixent (C-2) sections were partially reopened on November 13, 2024. On December 10, 2024, service was restored between Valencia-Norte and Catarroja (C-1), and between Valencia-Norte and Aldaia (C-3) on December 12, 2024. The C-1 and C-2 linees were fully reopened on December 16, 2024. Line C-3 suffered severe damage and its recovery is more prolonged, with partial service between Aldaia and Buñol expected by the end of 2025, and full reopening to Utiel by the end of 2026. Free bus services were provided as alternatives.More than 200 km of local, regional, and urban roads were temporarily impassable due to flooding, pavement collapse, or accumulation of debris. These conditions compromised the mobility of emergency vehicles, health personnel, and logistical resources. The forced closure of key infrastructure—urban tunnels, level crossings, intermodal stations, and access to reference hospitals—created operational bottlenecks and caused partial isolation of residential centers for several hours in municipalities of l'Horta Sud and La Ribera

In some sections, the perpendicular layout of road infrastructure to the natural water drainage channels created a “barrier effect,” amplifying accumulation and hindering drainage. Although a complete inventory of evacuation routes has not yet been identified, field experience collected by Civil Protection teams and health personnel indicates that, in several sectors, access and exit were seriously compromised for more than 36 consecutive hours. This underscores the importance of reviewing territorial planning in areas where emergency mobility is critical.

Healthcare and continuity of care

During the event, designated hospitals in the province maintained essential services. However, significant disruptions were reported in the primary and community healthcare network. In various municipalities, peaks in emergency room attendance were documented, as well as preventive evacuations of health centers due to power failures, leaks, and problems maintaining minimum hygienic-sanitary conditions (GVA, 2024).

At least four primary care centers suspended activities for more than 24 hours, affecting regular service provision in towns such as Silla, Alfafar, Algemesí, and Catarroja. In parallel, scheduled consultations, diagnostic tests, and outpatient treatments were canceled, and home visits for people needing continuous care temporarily suspended.

Several pharmacies in affected areas reported inventory problems and supply disruptions for restocking medicines, partly due to inaccessibility and power outages. This situation may have limited access to basic treatments during the most critical days of the emergency in some cases.

Although there is no systematic analysis of cumulative effects on vulnerable populations, it has been noted that groups such as the elderly, chronic patients, or people with reduced mobility may have experienced a temporary decrease in continuity of care. No specific protocols have been identified at municipal or regional level for continuity of primary and pharmaceutical care during prolonged climate emergencies, nor consolidated mechanisms for coordination between health and logistical dispatch teams in these contexts.

Cross-functional dependencies and systemic failure points

During the DANA episode, cascading failures were recorded in various essential infrastructures, affecting the operability of basic services in several municipalities in the Valencia metropolitan area. For example, loss of electricity supply caused dysfunctions in drinking water pumping stations in towns like Algemesí or

settlements in La Ribera Alta, also affecting telecommunication repeaters, especially in areas like Picassent and Alzira.

In healthcare, some primary care centers in towns like Benifaió and Sollana reported interruptions in their regular operations during the event, mainly due to power outages or water leakage in their facilities (Departamento de Salud de la Ribera, 2025). Likewise, the Carcaixent WWTP reported difficulties in wastewater treatment due to hydraulic system collapse combined with electrical impacts on pumping and treatment equipment.

Additionally, flooding was reported in strategic infrastructure such as electrical substations, intermodal stations, and logistics centers, complicating response and supply distribution tasks in some sectors. In some cases, access to waste transfer points was also temporarily restricted, according to municipal services and regional operators.

Besides the floods recorded during the morning of the 29th in various towns in the lower Magro River, tornadoes caused the collapse of more than 30 high-voltage towers, significantly affecting communications in all municipalities between Algemesí and Montroi. The most severely impacted town by these phenomena was Alginet.

Although there is no integrated analysis of technical interdependencies between these systems, the simultaneous occurrence of failures in different services suggests the existence of functional connections whose understanding could improve preparedness for future events. Identifying and systematizing these technical interactions is part of our recommendations section of this report.

Source: Shutterstock / Vicente Sargues, ID: 2538817455

5. Essential elements of disaster preparedness

5.1. Pre-event preparedness

The pre-disaster phase is a critical component of the DRM cycle, and its analysis allows the identification of structural limitations in preparedness, gaps in institutional and community prevention, as well as deficits in the anticipation of hydrometeorological events intensified by climate change.

There are official plans such as PATRICOVA (Territorial Action Plan for Flood Risk in the Valencian Community), the Special Flood Risk Plan, and Municipal Emergency Plans (PME), however, their implementation has been partial, uneven, or not updated.

From the perspective of the Sendai Framework and the PERC methodology, four key areas are identified where risk reduction and prior preparedness show room for improvement:

- Heightened territorial exposure, and urban planning with low adaptive capacity.
- Scarce implementation of multi-actor drills and community alert protocols.
- Limited integration of risk in political-administrative processes.
- Partial disconnection between early warning systems and local response capacities.

In this context, the extreme climate event revealed shortcomings in systemic resilience, due to deficits in preventive investment, fragmented institutional structures, and the lack of a culture of preparedness at some levels of citizenship. This is the context that affected the effectiveness of subsequent phases of the DRM cycle.

Absence of territorial planning and urban planning deficits

Exposure to risk in the affected territories is closely related to historical patterns of urban settlement, especially since the 1960s, based on an expansion into alluvial plains, old riverbeds, and wetlands. This model was consolidated in the absence of effective environmental regulations, favoring urbanization in structurally flood-prone areas (Oliva & Olcina, 2023).

After the 1957 flood, the diversion of the Turia riverbed effectively protected the historic center and consolidated a perception of safety in the city. However, this measure encouraged urban expansion toward the south and the metropolitan area, where population and infrastructure grew without equivalent flood protection. During the DANA, this spatial setup resulted in an unequal distribution of flood risk: while the central area remained safe, peripheral and low-lying areas suffered a disproportionate impact. The experience of Valencia shows how the effectiveness of a defense system can, in the absence of integral and adaptive planning, shift and amplify vulnerability in other areas of the same region—a paradigm of the so-called “levee effect” (Fekete, 2025).

PATRICOVA, approved in 2003 and revised in 2015, estimates that approximately 12% of the regional territory, nearly 600,000 people, reside in hazard zones. However, many municipalities in l'Horta Sud retain urban plans predating PATRICOVA coming into force, making it difficult to effectively integrate its guidelines. This regulatory rigidity, also known as “petrification” of urban plans, has generated situations such as the “levee effect” in old channels occupied by buildings.

A notable case is the Poyo ravine, classified as a high-hazard zone for decades. In 1989, the first sensor of the SAIH (Automatic Hydrological Information System) of the Júcar River Basin Authority was installed there. Despite the availability of data and technical reports, associated hydraulic projects, such as those planned in Paiporta, Aldaia, or Torrent, were not carried out integrally or in a coordinated manner. Hazard and risk maps generated were not systematically integrated into urban planning instruments.

During the DANA episode, the SAIH system did not have a predictive hydrological model aimed at the general population, although according to the Júcar River Basin Authority, real-time rainfall information was provided to technicians and managers.

This limitation hindered an early and effective local response. Some sources, such as interviews with municipal and Civil Protection technicians, also noted the scarcity of sensors in secondary ravines, restricting a precise prediction.

Proposals after the floods of 2000 included reforestation of upper basins, agricultural conservation, creation of green corridors, and construction of reservoirs (such as Pozalet). However, only partial measures were executed, such as expropriation of land for the diversion of the Saleta ravine in 2009. The Cheste dam project was discarded due to technical infeasibility and associated risks, and other structural solutions remained undeveloped for multiple reasons, especially conflicting interests between administrations and private parties.

Urbanization has substantially altered the area's hydrological dynamics. In areas of l'Horta Sud, soil impermeabilization and lack of retention space have increased surface runoff, reducing natural absorption, leading to water backlogging in urban areas. Ecosystems such as the Albufera have suffered hydrological overload and sediment contamination, affecting their health.

In many cases, planning did not respect the natural logic of basins. Infrastructure was built in hydrological buffer zones and rivers and creeks were canalized, accelerating water flow and increasing associated risks. The lack of an effective supra-municipal framework prevented integral planning. As of the report date, the Integral Territorial Action Plans that would complement PATRICOVA have not been approved.

> "Territorial planning and community preparedness for extreme risks could benefit from more integrated, transparent, and collaborative approaches that strengthen both institutional capacities and citizen empowerment in the face of future threats."

While regulatory progress has been achieved at the regional level, opportunities exist to strengthen coordination among municipalities, regional ministries, state agencies, hydraulic domain managers, and urban planning officials. Improving this collaboration could contribute to both prevention and operational capacity in emergencies, especially in contexts of high territorial complexity. There is also room to reinforce a culture of self-protection and risk awareness among the population.

Promoting more accessible and systematic communication about climate change-related hazards, through outreach campaigns and regulations more easily understood, could facilitate a more effective citizen response in critical situations, especially in flood risk areas. In short, the report's findings indicate that territorial planning and community preparedness for extreme risks could benefit from more integrated, transparent, and collaborative approaches, strengthening both institutional capacities and citizen empowerment for future threats.

Source: Shutterstock / Aitor Serra Martin, ID: 2542944737

Institutional and community preparedness for risk

The Generalitat Valenciana has the Emergency Coordination Center (CCE) and constitutes the headquarters of CECOPI when so decided by emergency management. In the case of the 2024 DANA, CECOPAL was also activated in numerous municipalities and the Special Flood Risk Plan served as the operational reference framework.

Of the 28 municipalities at emergency level 2, 17 were legally required to have Municipal Action Plans (PAM), being classified as high risk (Agència Valenciana de Seguretat i Resposta a les Emergències, 2022). Not all had these plans updated, and where they existed, they were not always activated or internalized by technical teams. This shows that regulatory existence does not guarantee operational capacity.

AEMET issued orange and red alerts from 06:42 on October 29, 2024. The ES-Alert system, under CECOPI's responsibility, was not activated until after 20:00. This time lag between data availability and the decision to alert the population directly via mobile devices was a serious preventive limitation.

Some institutions, such as the University of Valencia, the City Council of Utiel, or the Horta Sud Foundation, took anticipatory measures. But these decisions were exceptional, did not respond to administrative protocols, and were not replicated across the region. In many municipalities, the lack of drills, risk management training, and coordination mechanisms hindered immediate response.

It was also noted by some interviewees that the cancellation of the creation of the Valencian Emergency Unit (UVE), approved in 2023 as a response to difficulties observed during the 2019 DANA, may have prevented an improvement of previously detected insufficient capacities.

At the community level, self-protection was weak. Many people did not identify their residence as subject to flooding, and there were no pre-established participation channels to facilitate neighborhood organization or activation of mutual aid networks. Institutional alerts were complemented, spontaneously, by social networks and messaging, in the absence of a clear risk communication strategy.

Furthermore, the configuration of homes on ground floors or semi-basements, often without basic safety measures (vertical escapes, watertight closures, non-return valves), exposed especially vulnerable segments of the population, such as the elderly or people with reduced mobility. These deficits reflect poor integration of risk into urban and housing regulations.

Source: Zurich Insurance Spain

5.2. Forecasting and early warning

The October 2024 DANA activated various meteorological forecasting and hydrological monitoring mechanisms, although their articulation was not sufficiently effective to guarantee a functional early warning in terms of citizen activation and operational decision-making.

At the European level, the EFAS (European Flood Awareness System) issued early warnings anticipating severe rainfall in the region, in line with high-resolution meteorological models from AEMET. The latter issued the first orange alert at 06:42 on October 29, which was raised to red at 07:37 the same morning. Technically, the alerts were adequate and issued with sufficient time ahead of the onset of the event. However, they did not translate into immediate activation of all emergency management mechanisms, especially regarding effective communication to the population.

The public alert system in the Valencian Community operates through an inter-institutional chain: AEMET issues meteorological alerts; the Automatic Hydrological Information System (SAIH), managed by the Júcar River Basin Authority, monitors the state of water channels in real time; and the ES-Alert system (Ministerio del Interior, 2021) is responsible for mass SMS alerts in situations of serious and imminent risk (AEMET & Generalitat Valenciana, 2024).

Although established systems were in place, opportunities were identified to improve information flow among agencies, to facilitate a better coordinated response. SAIH provided open data on the evolution of the water flow in main rivers and ravines, but there was no clear mechanism for its immediate translation into operational decisions from coordination centers. This gap is evident in the event's chronology: while the Generalitat's Emergency Coordination Center issued a special hydrological alert at 17:35, ES-Alert activation did not occur until 20:11, when much of the population was already affected by flooding.

In that critical interval, called by various actors the "information blackout," situations occurred where many people were affected by floodwaters without having received official evacuation or self-protection instructions. Some institutions, such as the University of Valencia and the City Council of Utiel, adopted preventive decisions based on available meteorological information, suspending activities from early morning.

Source: Zurich Insurance Spain

The suspension of extracurricular activities was also not homogeneous across affected municipalities. While some councils, such as Utiel, decreed immediate cancellation, others maintained them partially or did not issue specific instructions. This disparity in decision-making created confusion among families and schools, highlighting the need to clarify criteria and protocols.

However, these responses were isolated and did not form part of a joint territorial strategy. The Generalitat publicly communicated a forecast of meteorological improvement around 18:00. This message, although based on official predictions, was later withdrawn and may have contributed to a premature perception of a stabilization in the weather situation, affecting risk perception.

Post-event analyses agree that meteorological and hydrological forecasts were not sufficiently updated in real time to reflect the event's intensity and effect on the region (Martin-Moreno et al., 2025). The lack of dynamic forecast updates, combined with the late activation of ES-Alert, critically limited the response capacity of both citizens and emergency services.

5.3. Response levels

Institutional and social response during the October 2024 DANA in the Valencian Community showed both positive elements and aspects that could benefit from reinforcement, especially regarding operational articulation, application of existing protocols, and community mobilization. Based on document analysis, interviews, and regulatory review, three key axes have been defined to guide its evaluation: compliance with official protocols, emergency services operability, and social response.

Evaluation of the institutional response system

The main regulatory instruments to be activated were the Territorial Emergency Plan of the Valencian Community (PTECV) and the Special Flood Risk Plan (PEI-CV), which provide coordination mechanisms such as the Integrated Operational Coordination Center (CECOPI), Advanced Command Posts (PMA), and municipal coordination centers (CECOPAL). However, activation of these mechanisms was partial and, in many cases, disconnected from field operations.

CECOPI was activated at 17:00 on October 29. According to 112's social media networks, emergency level 2 was declared at 19:30 for the province of Valencia, which limited full system activation until that moment. PMA's establishment was partial, not reaching the expected levels of interaction with affected municipalities.

At the municipal level, of the 58 municipalities identified as high flood risk, only two activated their CECOPAL according to PEI-CV. This lack of activation hindered integration of local information, effective resource mobilization, and territorialized decision-making. At the same time, the Júcar River Basin Authority detected extreme levels in ravines such as the Poyo, whose flows approached those of major rivers like the Ebro, accelerating overflow and increasing technical response difficulty. In general, regional departments did not manage to activate immediate post-emergency mechanisms with agility, limited by lack of access to some affected areas.

Technical operability and emergency services

The Military Emergency Unit (UME), fire brigades, and Civil Protection deployed relevant actions in especially affected areas. During the catastrophe, 117,000 people received medical attention and 37,000 were rescued. Analysis identified that information circulation among regional, provincial, and municipal levels was not always agile enough. This circumstance generated pressure on resource management, unit mobility, and operational priority distribution, especially in contexts of high simultaneous demand.

The General Council of Social Work activated its State Group for Social Emergency Intervention (GEIES) just 48 hours after the DANA, deploying more than 350 professionals in coordination with municipal social services. The experience shows both the rapid mobilization capacity of the professional system and the structural limitations of the regional response, marked by the absence of sufficient reinforcements in the first days and the need for more defined protocols to integrate the social dimension into emergency management.

The ES-Alert system was activated at 20:11, when multiple urban areas were already affected. As detailed in section 5.2 on early warning, activation occurred in an advanced phase of the event and the message content, focused on the state of dams, did not provide clear operational instructions for immediate protection of urban areas. This situation limited the response capacity of both citizens and local response teams. Interviews reflect a widespread perception that instructions arrived late, with little clarity and heterogeneously by municipality.

The Advanced Command Post (PMA) operated partially during the first hours of the event. While technical presence and mobilization capacity were confirmed, review of operational records and testimonies indicates that fully effective interaction with town halls was not achieved. The absence of a consolidated operational structure and a clearly defined chain of command in the initial moments resulted in fragmented decision-making, some slowness in resource deployment, and variable levels of coordination among the different services involved.

Private sector response

The private sector played a prominent role in the affected area. Although there are many examples involving large, medium, and small companies, supermarket chains at various levels assumed a key role in the immediate response. Among the most significant measures, they distributed 500 tons of food and essential

products, pallets of water, and basic goods at strategic points such as L'Alquería del Basket and the Estación del Norte. Thanks to the initiative of the Valencian Association of Entrepreneurs, 10,000 daily meals were provided through chef Ricard Camarena's "Solidarity Kitchen" and 12,000 daily meals through Frescos Delisano's "Emergency Kitchen."

With the collaboration of several businesspeople, a 7,000 m² warehouse in Picassent was made available to the Regional Ministry of Social Services to channel donations, in addition to providing logistics support for the installation of military operations. Their ability to maintain basic supplies, reorganize infrastructure, and sustain employment highlights the relevance of the private sector when it comes to safeguarding not only the productive fabric but also the daily life of the population in crisis contexts.

The responsiveness of the sector was also evident in industrial zones. Warehouses elevated to 1.20 meters managed to avoid flooding, demonstrating the importance of infrastructure resilience.The example of Mercadona and its suppliers illustrates how having ongoing construction activity—constantly renovating stores and logistics platforms—enabled them to have well-prepared technical and human resources to face the emergency. In the Ribarroja industrial zone, for instance, they took on much of the cleanup, creating controlled landfills to organize waste. Priority was given to access and exit routes in the zone, allowing for the arrival of more resources and faster recovery of operations.

At the same time, response teams began acquiring essential knowledge for the recovery stages and corrective risk reduction, identifying critical weaknesses in urban infrastructure: the Pozalet ravine acted as a dead end, the Poyo ravine required structural modifications, and the collectors and pumping basins presented failures that limited their effectiveness. These observations have been transformed into concrete recommendations that remain active demands today, in coordination with the City Council and the Júcar River Basin Authority.

Social and community response

Civil society deployed remarkable self-organization and community solidarity. In many towns, neighbors actively participated in rescues, home protection, assistance to vulnerable people, and cleaning public spaces.

Social organizations, local NGOs, and neighborhood networks mobilized resources quickly and without waiting for official instructions, offering shelter, food, and psychological support. Digital tools such as WhatsApp or Telegram facilitated real-time communication, local coordination, and dissemination of practical alerts. Collaboration between citizens and technical services helped identify critical areas and provide key territorial information for operational decisions.

GEIES, in collaboration with the Red Cross and municipal staff, implemented a door-to-door intervention and territorial mapping device to identify people in high states of vulnerability (dependent elderly, people with mental health problems, households without access to basic services). Coordination with neighborhood networks was key to locating urgent cases in a context of logistical and institutional limitations, showing the importance of articulating professional response with community self-organization.

Local group organization depended on volunteer staff mobilized in the first days after the event. In some towns, municipal technicians acted by informing, coordinating, and mobilizing groups. The lack of technical knowledge among volunteer staff and the absence of drills generated multiple dysfunctions, especially with the arrival of external volunteers, who were a great workforce but were not adequately equipped and lacked proper technical coordination. There was also a lack of communication between professional emergency response teams and volunteer groups, both local volunteers from among the affected population as well as and external volunteers coming to help.

Additionally, various professional sectors responded voluntarily: the Territorial College of Architects of Valencia (CTAV), the Illustrious College of Lawyers of Valencia (ICAV), and the Valencian Institute of Building (IVE) offered technical and legal advice. The academic community also mobilized: from the Department of Geography of the University of Valencia, the first flood zone maps were generated within hours, later used by the Valencian Cartographic Institute (ICV).

These initiatives reflect the existence of community and technical-scientific capacities that, although not formally integrated into institutional systems, provided essential operational and strategic

value for emergency management. The experience suggests clear opportunities to strengthen the link between institutions, citizens, and the technical community within a more inclusive and effective risk governance framework.

Structural obstacles and public perception

The analysis of the response to the October 2024 DANA reveals structural barriers that inhibited the effectiveness of DRM in the Valencian Community. These barriers are not only operational or technical in nature, but also systemic, institutional, and social, making long-term territorial and community resilience difficult.

- **Institutional architecture and decision-making gaps.**
  One of the main obstacles was fragmentation between government levels and low interoperability between protocols, competencies, and information systems. Although the existing regulatory framework (PTECV, PEI-CV) establishes a clear structure of roles, in practice, institutional response was affected by coordination gaps, overlaps, and disparate response times. The partial activation of CECOPI without a formal emergency declaration (levels 1 or 2), as well as the limited functionality of the Advanced Command Post (PMA), evidenced a lack of alignment between procedural frameworks and practical implementation.

  Hydrometeorological information generated by AEMET and the Júcar River Basin Authority was available and transmitted correctly to decision-making bodies. However, the use of this information for key decisions was delayed, reducing the margin opportunity for preventive activation of resources.

- **Limitations in institutional communication and citizen risk understanding.**
  Official communication during the episode showed deficits in both clarity and punctuality. While early warning channels functioned technically (such as ES-Alert and AEMET notices), the transfer of these warnings to citizens did not always result in easy-to-understand messages, adapted to the local context or with precise advice what actions to take. This lack of putting technical information into practice contributed to confusion among the population and affected their ability to take effective self-protection measures.

  There was also little segmentation in communication, without distinction for especially vulnerable groups (such as the elderly, people with reduced mobility, or those without digital access), limiting the reach of preventive measures. Some interviews reflect that even when alerts were issued, the instructions were ambiguous (e.g., “stay at home” in areas already flooded, instead of “seek a high or safe point”), generating doubts about how to act.

- **Weak risk management culture and fragmented event perception.**
  The episode highlighted a persistent gap in disaster prevention culture. Despite recent precedents (such as the 2019 DANA), systematic awareness campaigns had not been developed, nor had self-protection content been incorporated into formal education, professional training, or social care. This deficit led much of the population to interpret the event as a random and unpredictable phenomenon, reducing their sense of agency and responsibility.

  The dominant narrative in media and social networks focused on the spectacular nature of the damage and the heroic response of emergency services, without a structural analysis of causes or a preventive narrative. This hindered a collective understanding of risk as a systemic phenomenon.

- **Governance Gaps for Resilient Recovery.**
  Finally, the post-event phase revealed additional obstacles related to the governance of the recovery process. The pressure to quickly restore normality, combined with the absence of common criteria for prioritising interventions, highlighted the tension between society’s expectations for immediate repair and the need to plan for resilient reconstruction. This tension, together with rigid funding frameworks and a lack of discussion spaces for the various actors involved, limited opportunities to incorporate institutional learning or promote structural reforms.

5.4. Recovery, corrective and prospective risk reduction

The recovery phase after the October 2024 DANA in the Valencian Community involved a multiplicity of actions from various administrative, community, and industry, with differentiated responses in scope, speed, and approach. This stage included physical reconstruction tasks, as well as social, economic, technical, and psychological interventions aimed at restoring basic living conditions and institutional functioning.

As a direct consequence of the impact on housing, the Valencian Housing and Land Entity (EVha) registered 261 requests for rehousing in public housing, corresponding to 828 affected people. In the eight months following the event, 116 fully equipped homes were allocated by EVha, although many other people remained in temporary solutions or informal support networks.

The Ministry of Housing and Urban Agenda has made 177 homes available and has coordinated their rehousing, in collaboration with the Generalitat Valenciana and the municipalities of the area. 173 homes owned by SAREB have been assigned and 4 homes have been purchased by SEPES. This body is in the process of purchasing another 24 homes.

From the regional administration, mechanisms such as the Municipal Cooperation Fund for Catastrophes and extraordinary aid lines for homes, businesses, and agricultural operations were activated (GVA, 2024). Technical damage assessments were also promoted with the municipalities, accompanied by cleaning, infrastructure repair, and restoration of basic services. However, these actions were not carried out uniformly, with notable differences between municipalities in terms of intervention times and territorial coverage.

For the recovery phase, the Generalitat Valenciana approved an extraordinary regulatory package that includes the reform of the Law of the Huerta in 2025. These measures have direct consequences on the protected area: administrative simplification eliminates bodies and procedures, accelerating the authorisation of projects and infrastructures; the flexibilization of land use in Grade 3 Huerta areas allows degraded areas to be used for facilities, educational or residential purposes; and the removal of limits on tertiary activities together with the authorisation of reconstruction expands the possibilities for transformation of the territory. Overall, the changes facilitate the viability of regeneration and urban agriculture projects but introduce a risk of progressive loss of the traditional agrarian character of the Huerta by opening the door to urbanization in previously restricted spaces (Sistero Ródenas, 2025).

In certain local contexts, specific citizen support was established, such as technical offices, damage maps, and inter-administrative coordination tables. However, other affected municipalities did not have these instruments, generating inequalities in access to information and in the processing of aid.

At the state level, part of the territory was declared a Zone Severely Affected by a Civil Protection Emergency (ZGATPCE), enabling complementary measures such as tax aid, mortgage moratoriums, and subsidies for affected economic activities. Despite this, some institutional and community actors reported delays and lack of coordination between administrative levels, as well as bureaucratic obstacles in damage documentation and technical validation of requests.

In parallel, there was continuity in social involvement after the emergency episode. Neighbourhood groups, grassroots organisations, and informal networks maintained their activities, supporting cleaning, food distribution, care for elderly or vulnerable people, and temporary shelter. Collective fundraising campaigns, citizen brigades, and community spaces for the exchange of experiences were also organised. In some cases, professional volunteers promoted emotional support networks for affected people.

Collaboration between professional associations, universities, and technical entities was ongoing, working towards the preparation of expert reports, studies of residual risks, and advice to local entities. It is worth noting that some municipalities initiated participatory processes to review their municipal action plans (PAM), although this dynamic was not systematically replicated throughout the region.

In the economic space, the agricultural, commercial, and industrial sectors suffered severe impacts, particularly in the region of

l'Horta Sud. Numerous agricultural holdings were rendered unusable, prompting demands for insurance review, revaluation of losses, and proposals for the diversification of production. Local small businesses reported difficulties in accessing available resources, pointing to the lack of technical support, prolonged administrative response times, and the complexity of application procedures.

Finally, limitations were observed in post-emergency psychosocial care. In several affected municipalities, public mental health and social care services did not have specific protocols for disaster situations and were overwhelmed by increased demand. Care for displaced people, those affected by material or human losses, and first responders was mostly provided with ordinary resources, without special plans activated.

Overall, the recovery stage was marked by broad institutional and social mobilisation, albeit with uneven levels of coordination, coverage, and sustainability. Documentation of these actions, as well as their obstacles and lessons learned, constitutes a fundamental resource for the future improvement of DRM and post-disaster recovery systems in climate change contexts.

Inter-administrative coordination and fragmentation in recovery

The recovery phase after the October 2024 DANA showed limitations in articulation between administrative levels. Although institutional mechanisms were launched by the Generalitat Valenciana and the Government of Spain, reconstruction was mostly addressed from local initiatives, not always integrated with regional or state programs. This lack of convergence generated risks of duplication, territorial imbalances, and unequal use of available resources.

At the municipal level, several mayor's offices reported difficulties in accessing clear information about aid lines, eligibility criteria, and institutional communication channels. Although the Generalitat articulated grant lines through different departments Ministries (GVA, 2024), a single framework was not consolidated to guarantee coherence and equity in the distribution of support. This model contrasts with processes such as the one launched by the Horta Sud Foundation, which managed to provide 1.4 million euros in aid to 333 affected associations, from an approach based on proximity and trust relationships, also ensuring traceability and monitoring of grants.

As for the "mancomunidades" (association of municipalities), they play a crucial role in the region in coordinating and managing public services among the municipalities that form part of them. However, the response to the DANA highlighted the need to strengthen collaboration and joint planning in emergency situations. The lack of effective coordination at the supra-municipal level hindered the implementation of preventive measures and the equitable distribution of resources, which underscores the opportunity offered by consolidating these entities as key actors in DRM , especially in the response and recovery phases.

On the technical level, dysfunctions were observed among the different services involved in recovery (infrastructure, social services, urban planning, environment), whose reaction times and operational priorities were not always aligned. The lack of specific protocols or the lack of knowledge of them for this phase limited the ability to establish synergies between public, private, and community actors.

One of the areas that best illustrates this fragmentation was psychosocial care and mental health. Despite widespread recognition of the emotional impact of the event, a coordinated public response was not developed. The actions deployed came mainly from citizen initiatives, NGOs, and volunteer professionals, without a common strategy or systematically assigned resources.

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Likewise, situations were documented in which local technical professionals made operational decisions autonomously, in the absence of clear higher-level guidelines. This initiative allowed key devices to be activated at critical moments, but also highlighted the weakness of the command chain and institutional coordination.

The private sector's response in providing immediate economic and social support also reflects the importance of its operational coordination capacity and it being rooted deeply in the region. The example of Marina de Empresas, the entrepreneurial hub led by Juan Roig, shows how, by being connected to the area and the local community, they were able to implement agile aid mechanisms for businesses, self-employed individuals, and affected communities. The company launched a rapid aid system to help businesses reopen as soon as possible: €35 million were allocated to 4,600 companies, with the effect of 96% of the supported businesses able to resume operations. The process was designed with criteria of agility, clear purpose, and controllability, avoiding unnecessary bureaucracy and prioritizing the difference between reopening or closing permanently.

In parallel, €40 million in non-repayable grants were awarded to affected employees to repair homes, vehicles, or shared elements in impacted communities, regardless of any compensation they might receive from the Insurance Consortium. This operational framework, supported by a shared corporate culture, enabled the mobilization of 250 people to manage the aid, 1,000 volunteers to help reopen stores, and logistical resources across various locations, further strengthening engagement with local authorities, NGOs, and security forces.

Observed resilience factors

The PERC analysis made it possible to identify various factors that softened the impacts and facilitated early recovery. These are grouped into five capitals of resilience: physical, natural, social, human, and financial.

Physical capital

- Use of schools, sports centers, and civic centers as improvised logistics points.
- Better performance in areas with green infrastructure or sustainable urban drainage systems.

Natural capital

- Buffering function of natural infrastructures such as wetlands and secondary channels.
- Notable role of the Albufera as a natural containment system, especially in El Palmar.

Social capital

- Immediate activation of in-person and digital support networks for basic assistance and evacuation.
- Effective coordination in environments with prior organizational culture, such as Algemesí, Parque Alcosa, or municipalities in l'Horta Sud.

Human capital

- Previous experience in extreme events that prompted spontaneous and effective responses.
- Active participation of technical and citizen volunteers in rescue, cleaning, and logistics tasks.
- Technical autonomy in critical decision-making at municipal and regional levels.
- Correct activation of sectoral protocols in areas such as health, social services, and occupational health (INVASSAT).
- Examples of structured response in municipalities with effective activation of CECOPAL such as Algemesí, Albal, and Valencia.
- Early psychosocial support from GEIES, made up of social workers with joint training with the UME and previous experience in national and international disasters, coordinated with municipal teams.

Financial capital

- In the face of the **increase in extreme weather events** such as the DANA in Valencia, many insurers have reinforced their commitment to climate resilience, offering comprehensive advice to anticipate, protect, and recover effectively.

- In this sense, Zurich promotes a **culture of active prevention,** based on vulnerability analysis and anticipatory planning:

    - **Climate risk assessment** using digital tools such as Climate Spotlight.
    - **Resilience audits and Business Continuity Plans for companies,** identifying critical points in infrastructure, processes, and supply chains, minimizing impact and reducing the time to restart activity after an event.
    - Promoting **training and preparation** of people and employees to act in the event of an event.

- It is important that **access to insurance reaches as many people as possible,** including vulnerable groups, so that they then also have coverage for risks covered by the Consorcio.
- **Proper advice on risk transfer** is important to avoid coverage gaps or inadequately covered capital.
- Likewise, Zurich promotes the principle of **"Build Back Better",** which consists of **rebuilding in a safer, more sustainable, and resilient** way after a an extreme event, so that if it happens again, it can have a lesser impact.
- The existence of the Insurance **Compensation Consortium (CCS)** was consolidated as a key mechanism to **channel the response to the DANA,** allowing **immediate compensation to households** with active policies, which constituted a structural factor of resilience.
- **Home insurance penetration** was high: 79.5% of homes in Spain and 78.4% in the province of Valencia(UNESPA, 2025), which allowed approximately three out of four affected households to **access compensation and achieve an economic and social recovery after the event.**
- The **CCS's technical capacity** to **manage** more than 48,000 claims for insured homes in a **short period** avoided administrative collapse, reinforcing the initial response (Cúneo, 2024). The CCS increased its workforce, doubling the customer service staff at the Valencia regional office (CCS, 2025).
- In larger **businesses and SMEs, resilience** was reinforced by the existence of **multi-risk policies** which, although less widespread than home insurance, offered a significant protection base.
- The Valencia Chamber of Commerce estimated that 5,228 businesses were affected, of which more than 3,500 suffered serious damage (Levante-EMV, 2024).
- At the national level, the **multi-risk branch has a high presence,** which allowed part of the companies to receive **compensation for material damage.**
- The **joint action of the CCS and private insurers, implemented through the Special Operational Protocol (POE),** ensured **agile processing of claims,** avoiding delays that could have compromised the recovery capacity of the local economic sector. **Private insurers mainly managed** claims from individuals and SMEs for damage from flooding, rain, hail, and wind, while **claims** from large companies—due to their complexity and volume—were processed directly by the CCS. As of September 2025, approximately **33% of the total estimated** compensation was **still pending resolution.**
- According to the **Bank of Spain,** the DANA caused a significant increase in **bank credit to households and non-financial companies** in the affected areas, especially in Valencia, in response to the **need for reconstruction and replacement of goods.**
- From December 2024, a limited **increase in doubtful loans** and those classified as **"special surveillance"** was observed, although without signs of systemic risk.

5.5. Physical and functional reconstruction

The reconstruction phase after the 2024 DANA has been marked by the difficulty of reconciling the urgency to restore normality and the importance of resilient reconstruction. However, a restorative approach predominated, focused on restoring pre-disaster conditions, with few structural modifications.

One of the main constraints has been the limited integration of an institutional and social culture of resilience. In the absence of a systematic risk adaptation approach, many interventions have reproduced existing exposure conditions (Imperiale & Vanclay, 2020).

Decree Law 20/2024 and Law 2/2025 promoted urgent urban planning measures through Special Urban Reconstruction Plans and Local Reconstruction Plans. According to the Court of Instruction No. 1 of Catarroja (2025), these tools did not always incorporate technical recommendations or criteria for integrated risk planning, leading to only limited transformation. Specialists in territorial planning from the University of Valencia refer to the need to integrate instrumental territorial and metropolitan planning regarding the measures taken (or possible) around local-scale urbanism.

On another note, the reinstatement of infrastructure, vehicles, and equipment was carried out mostly under conventional parameters, without considering improvements in design, location, or functionality for future climate scenarios. This trend also reflects a limited dissemination of technical knowledge about resilient reconstruction.

The post-disaster context is characterized by the complexity of reconciling citizen pressure to rapidly restore basic services with the need to introduce structural changes. Added to this are regulatory frameworks focused on immediate replacement, the absence of incentives to innovate in crisis situations, and limited community participation in decision-making processes.

During the reconstruction process, differences were observed in the capacity of municipalities to access resources and suggest improvements. Some municipalities had more consolidated administrative structures or prior experience in fund management, which facilitated a more agile response.

Municipalities have developed Urban Agendas to be able to apply for EDIL[12] plans aimed at the area affected by the DANA. However, the lack of supra-municipal coordination for the development of regional and urban planning poses a difficulty in achieving coherence throughout the region, affecting different systems such as the hydraulic network, but also transportation.

On the other hand, emerging good practices have been identified, such as the inclusion of nature-based solutions (NbS) in certain pilot river restoration projects, or the reinforcement of natural channels with bioengineering techniques. However, these

Source: Shutterstock / Santirj, ID: 2546957147

[12] The EDIL Plans, funded by ERDF 2021-2027 and launched in Spain at the end of 2024, are local development strategies that promote urban resilience and risk management, including a specific line for the prevention and mitigation of floods and other hydrometeorological events following the DANA in the Valencian Community.

Source: Shutterstock / Pedro Pascual, ID: 2552770583

approaches remain marginal compared to the traditional approach, more focused on hard infrastructure that conveys a greater sense of security, and still lack a strong regulatory framework to guarantee their generalization. Overall, the region's water and drainage system presents resilient points, but unevenly distributed, with structural deficits in maintenance, adaptive design, and technical governance.

In the context of recovery, managing funding streams and strengthening the local fabric are key factors for sustainable and resilient reconstruction. The experience shows that the concentration of grants in consultancies, large companies, and national or international NGOs tends to generate standardized programs, with limited transfer of knowledge and capacities to local entities. The withdrawal of these actors can leave municipalities and community organizations with reduced capacity to manage future emergencies.

In this sense, the Community Foundation model, which has been demonstrated by the work of the Horta Sud Foundation from the beginning of the emergency to the present, offers an innovative approach to efficiently channel resources, enhance local participation, and strengthen the operational and organizational capacity of local entities, constituting a strategic reference for the reconstruction phase and strengthening the community fabric.

6. Key insights from the PERC 2024 DANA

This section presents observations based on verified facts, without issuing conclusions or normative recommendations. It relies on judicial, institutional, and testimonial sources, focusing exclusively on the disaster event in question.

6.1. Inter-institutional coordination and operational functioning

- During the emergency, the Integrated Operational Coordination Center (CECOPI) was activated, although a formal emergency declaration at the regional level was not made, which limited its capacity for action. It is worth considering whether a formal emergency declaration would have facilitated a faster and more robust articulation of support in the region. It is worth exploring how to optimize the connection between available technical knowledge and its translation into institutional action, especially in situations of high operational demand. This circumstance has been documented by the Court of Instruction No. 1 of Catarroja (2025).

- Institutional responses varied between sectors. Health and social services activated their protocols quickly, while other areas, such as municipal civil protection or urban planning, faced greater difficulties in operational coordination.

- The regulations approved after the event (Decree Law 20/2024 and Law 2/2025) promoted physical recovery focused on the replacement of infrastructure and urban planning (not at any territorial scale or approach). The effective implementation of adaptation strategies has been limited, as evidenced by interviews from the PERC study and judicial documentation.

- In numerous municipalities, pre-event conditions were recreated, with little incorporation of uban resilience criteria or a structural review of the area. This observation is linked to the provisions reflected in the Hydraulic Public Domain Regulation (RDPH), the Flood Risk Management Plan (PGRI), the National System of Flood Zone Cartography (SNCZI), and PATRICOVA (Figures 6a and 6b).

Governance showed clear limitations:
Inter-institutional coordination was uneven, command activation was restricted, and recovery prioritized infrastructure without integrating urban resilience criteria or supra-municipal planning.

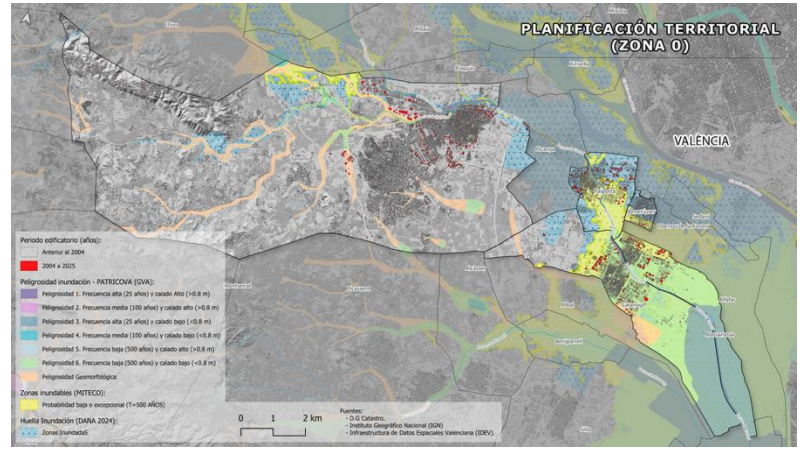


Figure 6a. Territorial planning against risk

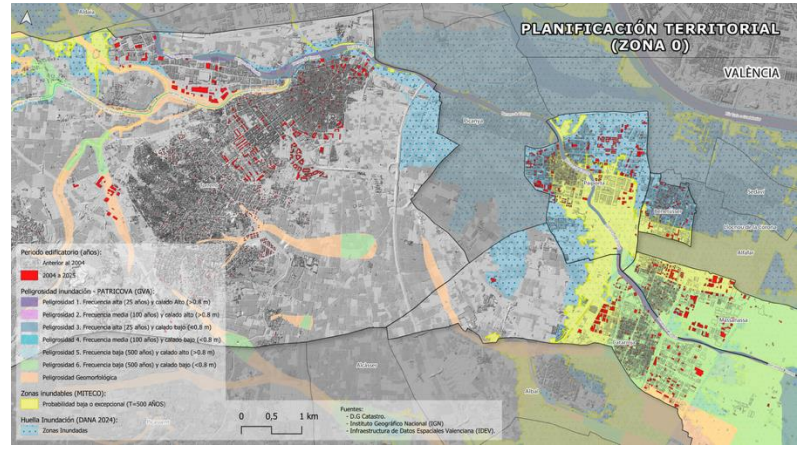


Figure 6b: Territorial planning in the face of risk in greater detail

6.2. Local capacities and regional asymmetries

- The response depended strongly on technical, operational, and local leadership capacities. Municipalities such as Algemesí and Albal activated their emergency protocols in advance, while others faced greater restrictions due to institutional weaknesses or limited resources.
- This disparity affected the efficiency of interventions and equity in access to available resources, reinforcing pre-existing gaps. Differences were documented between more vulnerable urban areas, such as Parque Alcosa and the Raval de Algemesí, compared to other metropolitan areas.
- Valuable technical resources were generated during and after the emergency. Notably, the cartography produced by the Department of Geography at the University of Valencia served as a basis for planning by the Valencian Cartographic Institute (ICV). These maps included impact zones, flow estimates, urban vulnerability, and critical infrastructure, as reported to the Department of Territorial Policy.
- Technological tools such as the Hidro Alerta app and neighborhood coordination platforms were activated autonomously and used by citizens and institutional actors. It is unknown whether these applications were formally adopted by regional or national authorities.

The lack of preparedness left the system surprised: Technical, operational, and local leadership capacity was uneven. Some municipalities could activate protocols in advance, while others faced limitations due to insufficient resources and institutional weaknesses, affecting intervention efficiency and equitable access to resources.

6.3. Emergency communication and alert systems

- Complementary communication systems such as loudspeaker messages, local radio alarms, and walkie-talkie networks were key for a strong response and ensuring information transmission during the emergency, though they also revealed limitations in reach and capacity, underscoring the need for a more robust and stable communication plan.
- The ES-Alert system was activated at 20:11 on October 29, 2024, at a time when several municipalities were already experiencing severe flooding. This information is available from the Generalitat Valenciana (2024) records and was analyzed in section 5.2. To avoid duplication, please refer to that analysis for system functioning and limitations.
- Community digital networks and citizen groups supplemented available institutional information. Platforms such as Telegram, WhatsApp, and local event-tracking apps promoted by local actors were especially notable. However, these same networks also contributed to the spread of misinformation and rumors, generating negative impacts on crisis management.

The late activation of the ES-Alert system meant that several municipalities received the message only when they were already affected by severe flooding, highlighting limitations in the institutional early warning capacity. Community digital networks and citizen groups supplemented available information but also facilitated the spread of rumors.

6.4. Attention to the psychosocial dimension

- There was no comprehensive public strategy to address the emotional and psychological effects of the emergency. Most actions identified were promoted by volunteer networks, independent professionals, and civil associations.
- Most teachers in educational centers lack specific training in emotional support during crises. Generally, schools lack resources or specific protocols to address the aftermath of disasters in the school environment.
- The PERC study (2024–2025) and judicial requirements document the relevance of this dimension, especially in municipalities with the greatest human and material impact.

No comprehensive institutional strategy was implemented to address the emotional and psychological effects of the emergency. The response depended mainly on volunteer networks, independent professionals, and civil associations.

Source: Zurich Insurance Spain

7. Specific observations on preparedness, response, and recovery during the 2024 DANA

This section analyzes the most relevant elements observed during the DANA of October–November 2024 in the Valencian Community, distinguishing the phases of preparedness, response, as well as recovery and risk reduction. The analysis is based on documented facts from judicial, institutional, and testimonial sources collected within the PERC study. The objective is not to issue judgments or normative recommendations, but to identify learnings from the real functioning of the system during an extreme event, thus contributing to the continuous improvement of DRM.

7.1. Preparedness: available capacities and structural vulnerabilities

The pre-emergency phase revealed significant technical advances, but also structural limitations, which form the basis of the system's anticipatory capacity. For clarity, the observations are classified into two categories:

Long-term risk reduction measures

These actions are aimed at reducing exposure and structural vulnerability to extreme events:

- Limited updates and operationalization of municipal emergency plans in municipalities such as Benetússer, Alaquàs, and Silla.
- Lack of adapted evacuation routes and specific protocols for vulnerable groups or nighttime evacuations.
- Misalignment between territorial, urban planning, and extreme climate scenarios.
- Low citizen participation in risk planning.
- Digital divide that hindered access to alerts among vulnerable sectors.
- Lack of prevention protocols for waste management and protection of sensitive areas.
- Although no dam failures occurred, the situation highlighted the need to review safety protocols for dams and reservoirs.

Immediate preparedness and anticipatory actions

This type of interventions is activated when the event is already foreseeable or imminent:

- Effective technical coordination between AEMET, 112 GVA, and civil protection to activate multichannel alerts (SMS, loudspeakers, apps), enabling municipalities such as Catarroja, Torrent, or Paiporta to activate local plans.
- Use of technological tools such as water gauges in the watersheds (SAIH Júcar), supported by universities, to facilitate real-time decision-making.

These observations are supported by interviews from the PERC study (2024–2025) and technical documentation from the Generalitat Valenciana. Please refer to the analysis in section 5.1 of the report.

7.2. Response: operational deployment, coordination, and citizen agency

The acute phase of the event revealed both effective practices and significant misalignments in coordination and regional coverage. The activation of formal and informal mechanisms allowed the emergency to be partially addressed, though with inequalities.

Positive aspects observed

- Effective intervention by the Military Emergency Unit (UME), firefighters, and local services during the first 72 hours in critical areas such as Massanassa and Benetússer.
- Establishment of temporary shelters in coordination with social organizations (Red Cross, CEAR, Caritas).

- Community mobilization in neighborhoods such as La Coma, San Ramón, Parque Alcosa, and El Raval (Algemesí), where citizens organized supplies, accommodation, and basic support.
- Activation of neighborhood networks with prior crisis management experience, facilitating early assistance.
- Reliable information channels managed by local groups that helped counteract rumors and misinformation..

Areas for Improvement Identified

- Lack of coordination between administrations, resulting in duplication of efforts and operational delays.
- Difficulties in digital interoperability between administrative platforms.
- Perception of abandonment among the population in areas without immediate institutional coverage.
- Response not sufficiently adapted to the cultural and linguistic needs of migrants, the elderly, or people with disabilities.
- Presence of untrained volunteers, which in some cases hindered official emergency management.

These observations have been cross-checked with judicial sources (Court of Instruction No.1 of Catarroja, 2025), the Generalitat Valenciana (2024), qualitative interviews, and testimonies collected during the PERC research (2024–2025).

7.3. Recovery and risk reduction: timelines, transparency, and rights-based approach

The recovery phase revealed tensions between institutional urgency, citizen expectations, and structural limitations. The analysis focuses on processes of physical, economic, and psychosocial restitution.

Observed aspects in recovery

- Participation of community leaders in local reconstruction processes in municipalities such as Catarroja or Xirivella, based on pre-existing self-organization dynamics.
- Inclusion of corrective elements of infrastructure after the event (e.g., expanded loudspeaker systems in Albal).
- Consolidation of Local Emergency and Reconstruction Committees in some municipalities, with greater citizen access to technical information and collective advocacy processes.

Challenges Observed

- Delays exceeding 90 days in the activation and delivery of economic aid, according to the PwC EMPLEA report.
- Complex and opaque administrative procedures, lacking public transparency.
- Weakness of the rights-based approach in institutional narratives and reparation measures.
- An observed risk of reconstructing without formalized territorial planning instruments (although contemplated in the Valencian legal framework), perpetuating pre-existing conditions of territorial vulnerability (see analysis of the Plan Endavant).
- Late psychosocial support and lack of operational integration into the emergency system.
- Absence of a centralized coordination procedure (one-stop-shop), hindering smooth management of the requirements across the region.
- Differences between municipalities highlight the need to strengthen interterritorial support and multilevel cooperation, leveraging reconstruction as an opportunity for a more articulated and transformative strategy.
- These elements are documented in institutional and judicial reports, as well as in testimonies collected in the PERC fieldwork. Please refer also to the technical analyses in sections 6.3 and 6.5.

7.4. International comparative perspective

Reference to other European cases allows the dynamics observed in Valencia to be placed in a broader framework. Some relevant examples are presented here:

- **Ahrtal (Germany, 2021):** The disconnect between meteorological, hydrological, and public alert systems contributed to a tragedy with more than 180 deaths. Reconstruction measures integrated ecological resilience criteria and participatory planning (Las Provincias, 2025).

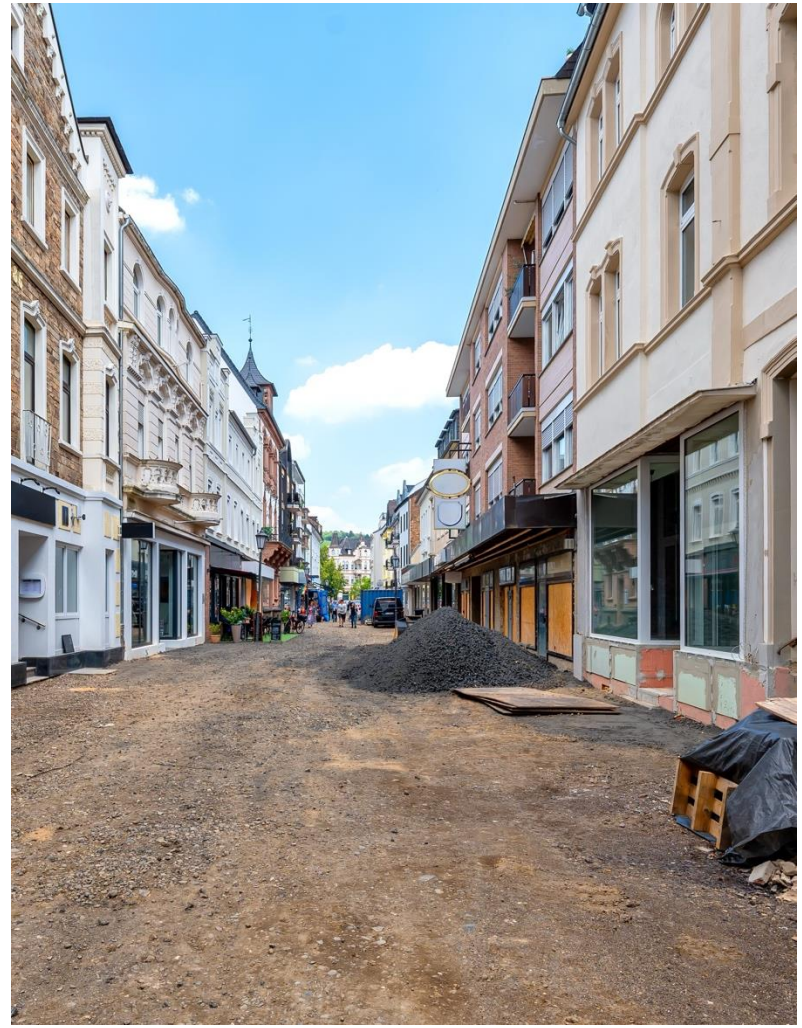
- **2019 DANA in Vega Baja del Segura (Alicante) and Campo de Cartagena (Murcia):** Aid was processed quickly but with little traceability, limiting evaluation. Proposals for metropolitan urban drainage plans were generated, framed in the Plan Vega Renhace, which includes a network of drains and floodable parks. The Orihuela City Council conducts CECOPAL drills on DANA anniversaries.

- **"La Marjal" Urban Flood Park:** A green space combining flood risk management and urban recreational features. Opened in 2015 in Playa de San Juan (Alicante), it uses Sustainable Urban Drainage Systems to retain up to 45,000 m³ of water, promotes biodiversity, and offers recreational and educational activities, serving as an example of nature-based solutions.

- **Netherlands:** The principle of "living with water" involves participatory design from prevention, annual drills, and public audits. Citizens are involved from design to evaluation.

- **Barcelona:** Implementation of climate resilience plans based on open data, structured participation, and hybrid solutions (grey-green infrastructure). The city has 15 underground stormwater tanks and external evaluation mechanisms with community participation (Ajuntament de Barcelona, 2023).

These references help identify common patterns in exposure, alert failures, institutional coordination, and recovery processes. They highlight the usefulness of pre-planned scenarios to accelerate and guide reconstruction. There are similarities between the cases compared and the specific observations on preparedness, response and recovery during DANA 2024, which show that Valencia shares conditions with other exposed territories and therefore reinforce the hypothesis that structural improvements can be anticipated.



Ahrtal, Germany (2021)
Source: Shutterstock / SSKH-Pictures, ID: 473628817

8. Strategic recommendations

This section presents a set of recommendations structured according to the key points identified during the phases of **preparedness, response,** as well as **recovery and prospective and corrective risk reduction** in relation to the DANA of October–November 2024. These are formulated based on verified evidence within the PERC study, drawing on technical analysis, cross-checked testimonies, and institutional and judicial documentation.

These recommendations are not a judgment on past actions, but a technical contribution aimed at strengthening future disaster prevention. They are grouped according to four key areas, in line with the PERC framework: **(1) Anticipatory Governance, (2) Climate Risk Training and Collective Drills, (3) Early Warning Systems, and (4) Psychosocial Support and Vulnerability.**

The recommendations are presented from the perspective of Amartya Sen's capabilities approach (1999; Robeyns, 2005), applied to the full disaster risk management (DRM) cycle. A distinction is made between capacity—understood as the availability of resources, knowledge, and potential to act—and enablement, which implies the effective conversion of those capacities into concrete actions and observable results.

Within this framework, the recommendations seek to identify the necessary enabling environment for the existing capacities of institutions, communities, and citizens to translate into more effective, resilient, and equitable DRM. The recommendations include practical measures that can be implemented immediately or in the short term, aimed at reducing exposures and vulnerabilities and strengthening collective responses.

8.1. Anticipatory governance

Preparedness

CECOPI como nodo central. Consolidar su papel como espacio interadministrativo e intersectorial, garantizando una activación temprana y coordinada, basada en criterios y protocolos claros previamente definidos en escenarios de referencia. La difusión y el conocimiento de estos protocolos por parte de todos los actores implicados es esencial para que el CECOPI pueda operar desde el inicio de la emergencia. No se trata de restar competencias a otras instituciones, sino de asegurar un centro de coordinación donde la información converja y desde el cual quienes ostentan la responsabilidad puedan actuar con agilidad y coherencia. Evitar activaciones parciales permitirá que este nodo cumpla plenamente su función de articulación entre administraciones y con actores sociales organizados.

- **CECOPI as a Central Node**: Consolidate its role as an inter-administrative and intersectoral space, ensuring early and coordinated activation based on clear criteria and protocols predefined in reference scenarios. The dissemination and knowledge of these protocols by all involved actors is essential for CECOPI to operate from the onset of an emergency. Avoiding partial activations will allow this node to fully perform its function to coordinate amongst administrations and official social actors.

- **Transparency and Learning:** Promote independent external audits of the actions of involved organizations. This reinforces decision traceability, improves public trust, and turns experience into verifiable learning.

- **Evidence-Based Management:** Create a permanent, interdisciplinary, and multiscalar Autonomous Office of Scientific Advice, inspired by international models such as the UK Parliamentary Office of Science and Technology, the Italian Senate's Applied Science Office, or the European Parliament's Science Office. Its key functions would be:

    - Transfer knowledge between science and administration.

    - Detect knowledge gaps and guide research towards territorial needs.

    - Strengthen the institutional responsibility to base policies on technical evidence.

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- **Applicability of Normative and Technical Frameworks:** Advance the practical implementation of existing frameworks through inter-institutional coordination, team training, and social participation. It is not enough to have solid instruments: they must be used and systematically tested through drills to validate or modify them as appropriate.

- **Implementation of PATRICOVA**: Strengthen its implementation alongside other technical instruments to integrate climate adaptation criteria into urban ordinances and planning processes. The encroachment of flood-prone land and the location of critical infrastructure within hazard zones highlight the need for preventive controls and the precautionary principle.

- **Nature-Based Solutions (NbS):** Promote solutions that combine water retention, ecological restoration, and multifunctional land uses in high hazard areas, as an alternative and complement to grey infrastructure. NbS provide more flexible defense, increase adaptive capacity in scenarios with higher uncertainty, and generate added benefits such as biodiversity, climate regulation, and social and economic value.

- **Territorial Action Plan:** Design a supramunicipal plan that coordinates land management, mobility, housing, and climate adaptation among municipalities, facilitating shared responses to challenges that go beyond the local scale.

- **Anticipatory Infrastructure:** Adapt urban green and blue infrastructure to more extreme return scenarios, incorporating ecological connectivity and shared governance criteria in adaptation strategies.

Response

- **Collective Real-Time Assessment:** Develop digital tools for agile data collection and coordination on infrastructure status during emergencies. This reduces response times and improves inter-administrative coordination compared to slower traditional reports.

- **Pre-existing Response and Recovery Plans:** Develop plans based on impact scenarios that integrate immediate response and subsequent recovery protocols. Prior planning allows for greater agility, coherence, and effectiveness in institutional action and ensures an orderly and equitable recovery, avoiding timeline conflicts between urgent decisions, medium-term measures, and long-term reconstruction processes.

- **Communication and Aid Traceability:** Establish a coordinating authority to oversee the arrival and distribution of public and private aid. Clear information channels, records, and monitoring mechanisms will ensure timely, equitable, and transparent distribution.

Recovery and risk reduction

- **Reconstruction Committees:** Consolidate permanent reconstruction structures with plural representation of social, technical, and affected citizen agents. These spaces promote inclusive recovery that not only repairs damage but also reduces structural vulnerabilities for the future.

8.2. Climate risk training and collective drills

Preparedness

- **Predefined Command Structures:** Establish single command protocols for all levels of government (local, regional, and national), with clearly assigned responsibilities and compatible digital tools, so that citizens and response teams perceive a single voice and clear guidance during emergencies.

- **Pre-Drill Training:** Implement education and awareness programs before practical exercises, ensuring that drills are conducted, based on a solid foundation of risk understanding by all actors involved.

- **Continuous Citizen Training and Self-Protection Culture:** Consolidate a culture of self-protection through ongoing risk management training programs that accompany citizens throughout their lives, from school to adulthood, through practical content, community workshops, and annual flood drills closely linked to early warning systems.

- **Strategic Sectoral Training:** Promote specific training and awareness in key sectors—financial, insurance, construction, and architecture—that act as protective barriers and resilience agents against extreme events.

- **Strengthening Institutional Capacities:** Incorporate training programs for technical staff and those responsible for emergency plan development, ensuring that regulatory and strategic documents are designed from a climate and resilience perspective.

- **Political Awareness:** Ensure that public representatives and officials are familiar with operational tools (such as ES-Alert or CECOPI) and understand the basic principles of DRM, avoiding knowledge gaps in critical situations.

Response

- **Intersectoral Drills:** Expand joint training exercises among institutions, citizens, and the private sector, with an inclusive approach adapted to different socio-territorial realities, consolidating the culture of rehearsal as a preventive practice.

- **Drills at All Scales:** Organize periodic exercises at national, regional, municipal, and community levels, including the activation of CECOPI, CECOPAL, or PMA, to test the decision-making chain, the effectiveness of warning messages, and operational coordination, ensuring that protocols work in real situations and not just on paper.

- **Up-to-Date Emergency Plans:** Update and standardize municipal emergency plans, ensuring their operability, suitability for different vulnerability profiles, and integration with urban planning, providing a solid foundation for effective response.

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8.3. Early warning system

Preparedness

- **Redundancy of ES-Alert and Technological Coverage:** Maintain, expand, and ensure equitable access to early warning systems through a network of entities that disseminate alerts. Incorporate innovative technologies to monitor currently unsupervised areas, such as rivers, streams, and small ravines, using low-cost sensors (e.g., LiDAR[13]) or other locally replicable solutions.

- **Diversified Channels and Accessibility:** Ensure the dissemination of alerts through multiple and redundant channels: SMS, apps, social networks, loudspeakers, local radio. Also implement visual and auditory formats such as pictograms and recorded audio messages to reach people not subscribed to digital channels or with limited access to information.

- **Integration of Alerts:** Combine messages with practical exercises, including the use of new technological systems and redundant channels, ensuring that the population knows how to interpret different alert levels and take quick and safe decisions (linked to 8.2).

Response

- **Clear Chain and Operational Protocols**: Establish protocols connecting AEMET → CHJ → 112/Civil Protection → municipalities, channeled through CECOPI, CECOPAL, or PMA, depending on the emergency scale. Ensure that alert activation is based on objective information, including hydrometeorological forecasts, real-time sensors (SAIH), and local vulnerability analysis.

- **Alert Scale and Impact-Based Communication:** Improve alert levels to include extreme scenarios, differentiating between intense rainfall and flood risk, with clear messages about event criticality and specific actions to take. Explain and train on these advanced levels (e.g., purple and violet) so the population understands the magnitude of the risk and adopts appropriate self-protection measures.

- **Clear and Actionable Messages:** Develop understandable, multilingual alerts adapted to different user profiles, indicating specific actions, reference points, and self-protection measures. Disseminate these messages through redundant channels and accessible formats to ensure coverage even in areas with digital gaps or compromised infrastructure.

- **Community–Technology Integration:** Combine technological systems with local networks and community leaders, ensuring that messages effectively reach and foster understanding and rapid action, including vulnerable and multilingual groups. Include territorial communication chains connecting upstream and downstream areas so the population better understands the evolution of floods.

- **Real-Time Science:** Incorporate an operational scientific liaison to technically support alert interpretation, validate protocols, and provide reliable data for decision-making, reducing uncertainty and improving inter-institutional coordination.

- **Non-digital Redundancy and Inclusive Formats:** Implement and reinforce non-electronic communication systems, such as public loudspeakers, complemented by visual and auditory formats to ensure the issuance of warnings and the location of evacuation points even in the event of a breakdown of the digital network.

[13] Low-cost, open-license LiDAR system designed for remote regions of Peru: https://zcralliance.org/resources/item/lidar-systems-in-peru-elements-of-effective-early-warning-systems/

8.4. Psychosocial support and vulnerability

Preparedness

- **Addressing Inequality:** Incorporate territorial equity and attention to socioeconomic inequalities in emergency planning and preparedness. Recognizing that neighborhoods with different conditions present distinct capacities and vulnerabilities allows for more inclusive and effective preventive strategies, as well as balancing recovery aid access for affected communities.

Response

- **Early Support:** Ensure the immediate activation of psychosocial and emotional support services from the onset of the emergency. Rapid intervention contributes to the emotional recovery of affected households and reinforces the human dimension of DRM.

- **Integration with Local Networks:** Strengthen coordination with neighborhood networks and community organizations to complement the institutional response. Citizen self-organization has proven key in areas with limited institutional coverage, highlighting the importance of linking social initiatives with official emergency capabilities.

Recovery and risk reduction

- **Support in Networks:** Reinforcing community capacities and differentiated attention to inequalities not only enables more effective recovery after an event but also consolidates long-term resilience, promoting equity, social cohesion, and sustainability in future DRM.

These recommendations are not intended to close the debate or replace political consultation processes. Their purpose is to provide inputs based on facts and proven experiences that can serve as a technical basis for improving risk governance in the Valencian Community. The fact that we have seen repeating patterns, at a structural level, and also observed in other European regions, underscores the importance of moving towards a preventive, fair, and evidence-based model.

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9. Conclusions: analytical synthesis, transformative vectors, and strategic approach

9.1. Methodological approach applied

This report has been developed by rigorously applying the Post Event Review Capability (PERC) methodology, an analytical tool designed to review the impacts of extreme events from a multi-source evidence perspective, without attributing responsibilities or issuing subjective assessments. The focus of this PERC is to understand how the systems of preparedness, response, recovery, and both corrective and prospective risk reduction actually functioned during the DANA of October–November 2024 in the Valencian Community.

A methodological triangulation has been employed, combining hydrometeorological data, institutional cartography, legal analysis, review of current regulations, direct testimonies from affected individuals, interviews with key actors, and documentation from judicial sources. The multi-scalar and multi-actor integration has enabled the construction of a coherent technical narrative, aware of the contexts and duly cross-checked.

Throughout this work, it has been confirmed that the Valencian territory possesses significant resources that act as capacities with potential for activation in the face of extreme events such as the DANA. The different capitals—physical, human, social, natural, and financial—were activated through multiple prevention and response actions. However, this mobilization occurred in a fragmented manner, without sufficient coherence or equitable reach for the entire affected population.

9.2. Structural findings of the PERC analysis

From this structured analysis, six key findings are identified:

1. Risk Identification and Tools: The risk was identified, and relevant tools were available, such as risk maps, technical precedents, and operational early warning systems, which allowed for adequate **preparedness.** However, aspects such as the activation of mechanisms, territorial coordination, and preventive mobilization faced challenges that limited their effectiveness, creating opportunities to strengthen these processes in the future through a culture of anticipatory governance **and climate risk training and collective drills.**

2. Critical Infrastructure and Exposure: Critical infrastructures faced difficulties in exposed areas lacking sustainable urban drainage. In several urbanized areas, the operational limits of water evacuation systems were exceeded, highlighting the importance of advancing towards more integrated planning adapted to environmental conditions and land use, especially in contexts of increasing soil impermeabilization. In this context, climate change acts as an intensifying factor for hydrometeorological risks, requiring the incorporation of adaptation and resilience criteria in the design, maintenance, and management of these infrastructures. For physical capital invested in urban development to contribute to **preparedness** for extreme events, **anticipatory governance** capable of deploying **early warning systems** with deep territorial knowledge is necessary.

3. Territorial Planning and Regulatory Coherence: Territorial planning has room for improvement in terms of regulatory coherence and strategic alignment. Some disconnects have been identified between existing instruments, such as PATRICOVA, and new legislative proposals after the DANA, including the reform of the Law of the Huerta and Law 2/2025 on reconstruction, which could generate tensions in the construction of resilient ecosystems and the consolidation of shared territorial governance. These findings offer an opportunity to move towards greater integration and coordination between regulatory frameworks, to achieve prospective **risk reduction dynamics.**

4. Operational Coordination and **Governance**: Operational coordination mechanisms and inter-administrative governance showed opportunities for improvement. The absence of permanent protocols and consolidated collaborative structures between administrative levels limited the response capacity during the first 48 hours, highlighting the importance of strengthening anticipatory coordination and joint action frameworks for future scenarios.

5. Recovery Process and Social Equity: There were challenges related to administrative management, traceability, and territorial equity of social care during the **recovery** process. Access to economic aid was not always perceived as equitable, with complex procedures difficult to follow for the most vulnerable sectors. These learnings highlight the importance of advancing towards accessible mechanisms for sectors in need, from sensitivity and coordination, to increase effectiveness in future emergency situations. They also underscore the role of non-profit territorial entities as part of anticipatory governance, such as community foundations, which have crucial human capital based on knowledge, relationships, and trust that can only be built from proximity and the long term.

6. Active Role of Citizenship and Community Networks: Citizenship played an active and relevant role during the emergency, especially through neighborhood and community networks that acted quickly. It was also crucial in terms of **psychosocial support** for affected populations, who felt supported by committed and selfless volunteers. However, their contribution was not always formally integrated into official procedures nor received institutional recognition during the **response and recovery phases.** Volunteering was very effective in many cases, but in other phases it could hinder recovery efforts or generate significant logistical stress for the system. This learning highlights the potential to strengthen the links between citizen action and institutional and technical frameworks, promoting more structured and visible collaboration in future situations, understanding the relational role they offer, focused on the human aspects.

9.3. Identified strategic vectors for improvement

Beyond specific recommendations, the analysis has allowed the identification of a set of strategic vectors that synthesize the learnings and map out directions for structural transformation. These directions do not replace operational recommendations, but regroup them into five major lines of action to guide public policies, investments, and governance frameworks in the medium and long term:

Adaptive infrastructure based on nature

- Integrate green solutions into urban and river planning.
- Prioritize ecological restoration as a strategy for structural risk reduction.

Territorial planning oriented to climate resilience

- Strengthen regulatory coherence among territorial, urban, environmental, and civil protection instruments.
- Establish binding criteria in high-hazard flood zones.

Effective multilevel coordination

- Consolidate metropolitan consortia, associations, and regional networks with clear competencies, as recognized by Directive 18 of the Territorial Strategy of the Valencian Community, promoting supramunicipal collaboration partnerships for the management and coordination of projects in functional areas.
- Design pre-planned activation and recovery protocols based on risk scenarios.
- Promote the development of drills at all levels of response, from the community to the administration, including educational, social, and health centers.

Citizen participation and social equity

- Recognize neighborhood and community networks as strategic actors in DRM.
- Promote the development of community infrastructures adapted to early response at the community scale.
- Ensure linguistic, legal, and digital accessibility in all post-event procedures.

Transparency, traceability, and continuous evaluation

- Implement monitoring systems for aid, works, and decisions with accessible indicators.
- Include technical and social audits in reconstruction processes.

Strengthening Insurance Against Climate Risks:

- Increase insurance penetration in non-mandatory branches (home, commerce, SMEs) to reduce the percentage of citizens and businesses without access to the Insurance Compensation Consortium.
- Systematically update the sums insured, promoting an annual review of replacement values to avoid underinsurance and ensure that compensation matches the real loss costs.
- Review the adequacy of coverage as stated in the insurance contracts, incorporating critical coverage aspects such as business interruption, especially relevant for SMEs and businesses dependent on continued operation.
- Strengthen the risk management culture in the local economic fabric, promoting DRM practices among companies and those self-employed, with special emphasis on sectors most exposed to climate risk.
- Develop complementary support policies to insurance coverage, aimed at facilitating the recovery of vulnerable households and businesses that, due to lack of insurance or insufficient policies, are left out of the risk transfer system.

Source: Shutterstock / Victor Suarez, ID: 2542554491

9.4. Towards an operational agenda for structural resilience

This report does not constitute a closure, but an open input for continuous improvement. The post-event review has shown that the impacts of the 2024 DANA cannot be interpreted as an exception, but as a symptom of a transforming climate regime that requires systemic responses. The 2024 DANA confirms that resilience cannot be understood as a one-off reaction to an extreme event, but as a structural process that runs through all phases of the DRM cycle.

Valencia shares patterns with other exposed regions such as the Ahr valey (Ahrtal in Germany) or the Netherlands. This compels us to rethink local strategies not as reactive responses, but as structural transitions towards models of coexistence with climate risk. To rise to the occasion, it is not enough to respond; it is essential to prepare, correct existing risk based on experience, have a prospective vision based on evidence, and reduce risks equitably. Sen's capabilities approach helps interpret this experience: it is not enough to have technical resources, information, or citizen networks (capacity); it is necessary for institutional, regulatory, and social conditions to exist that turn those resources into effective action and tangible results (enablement).

The classic distinction between negative and positive freedom (Berlin, 1958) is useful as a reference framework: the former refers to the elimination of external barriers that limit action (coercion), while the latter emphasizes the possibility of using resources, information, and protocols effectively. Sen's capabilities approach is based above all on positive freedom, understood as the existence of substantive opportunities that allow people to exercise their capabilities and achieve valuable outcomes.

From this perspective, positive freedom is not simply an individual attribute, but a shared practice that requires responsibility both from institutions—to generate conditions and provide resources—and from citizens, who must exercise their agency actively, autonomously, and committed to the common good, even in contexts of social, environmental, or political constraints.

The strategic challenge for the Valencian Community is not so much to create new capacities as to enable existing ones to function in an integrated, anticipatory, and equitable manner. Only in this way will it be possible to transition towards a model of coexistence with climate risk, where the technical memory of lived experience becomes the engine of structural transformation.

The PERC methodology has proven helpful as a tool to build useful technical memory, as a basis for informed decisions, and as a bridge between lived experience, technical and academic knowledge, and the transformations necessary to ensure resilient territories and communities.

Annexes

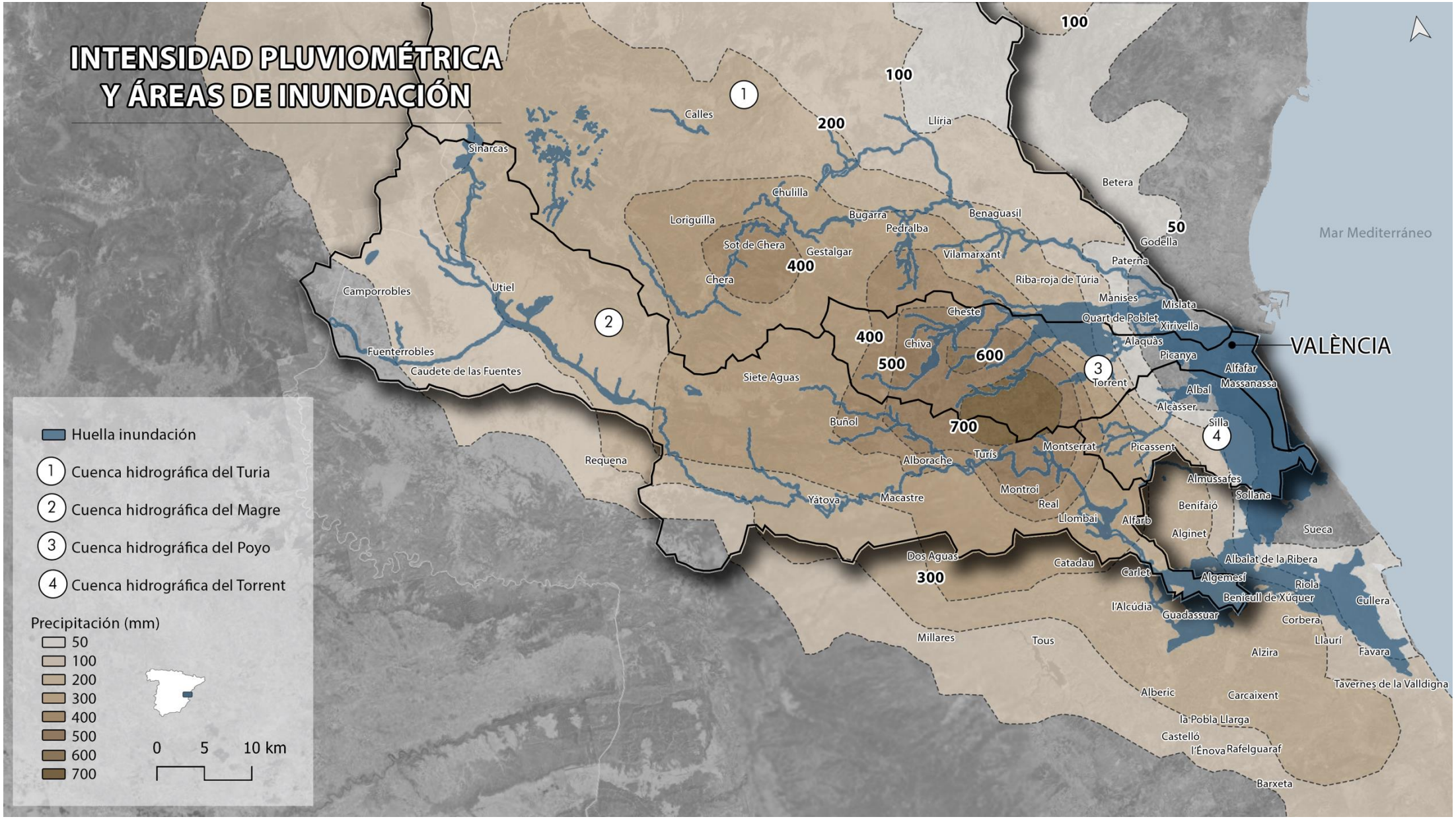

Figure 1. Rainfall intensity and flood areas

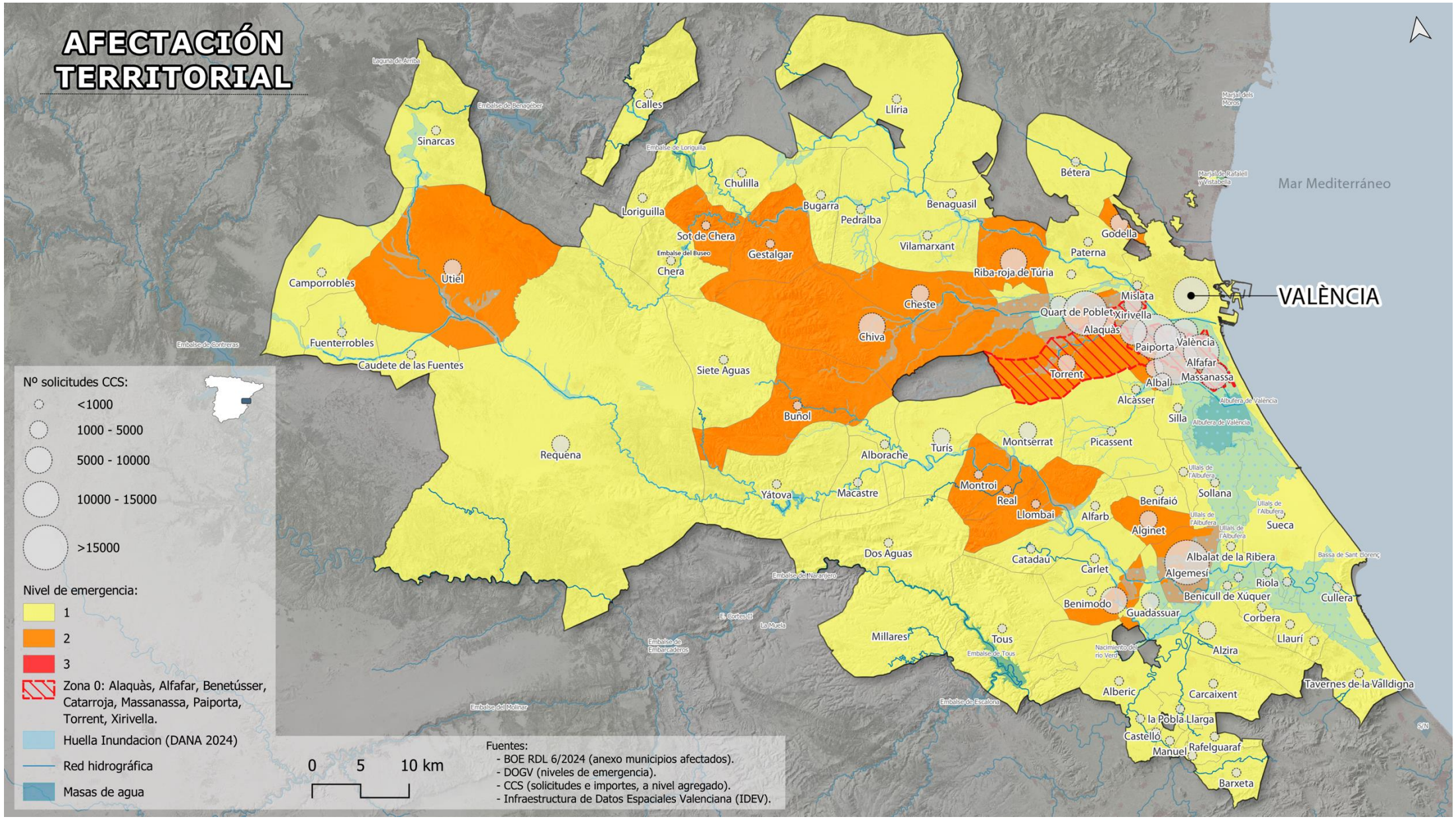

Figure 2. Territorial impact due to the DANA and declared emergency levels

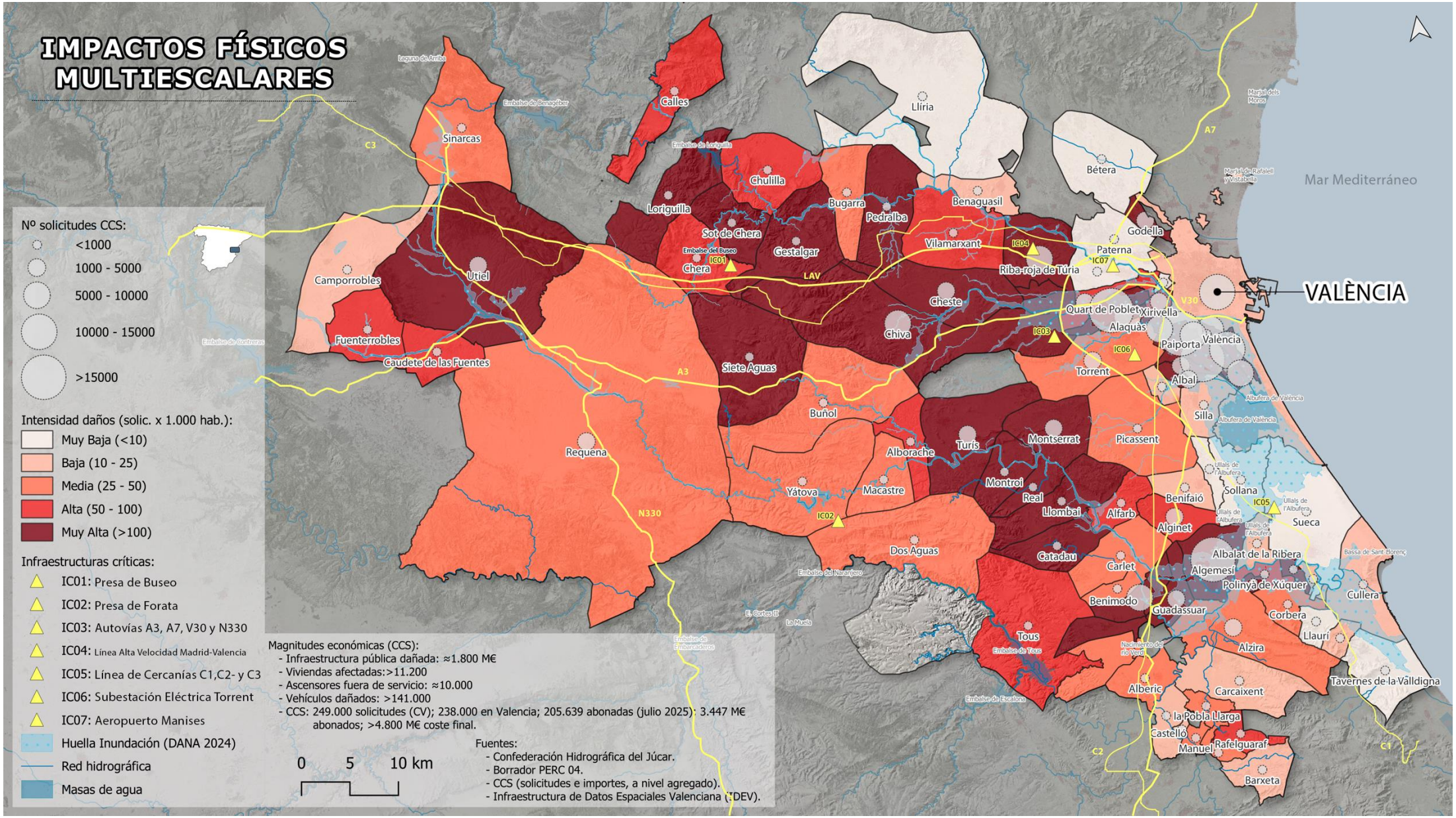

Figure 3. Multi-Scale Physical Impacts

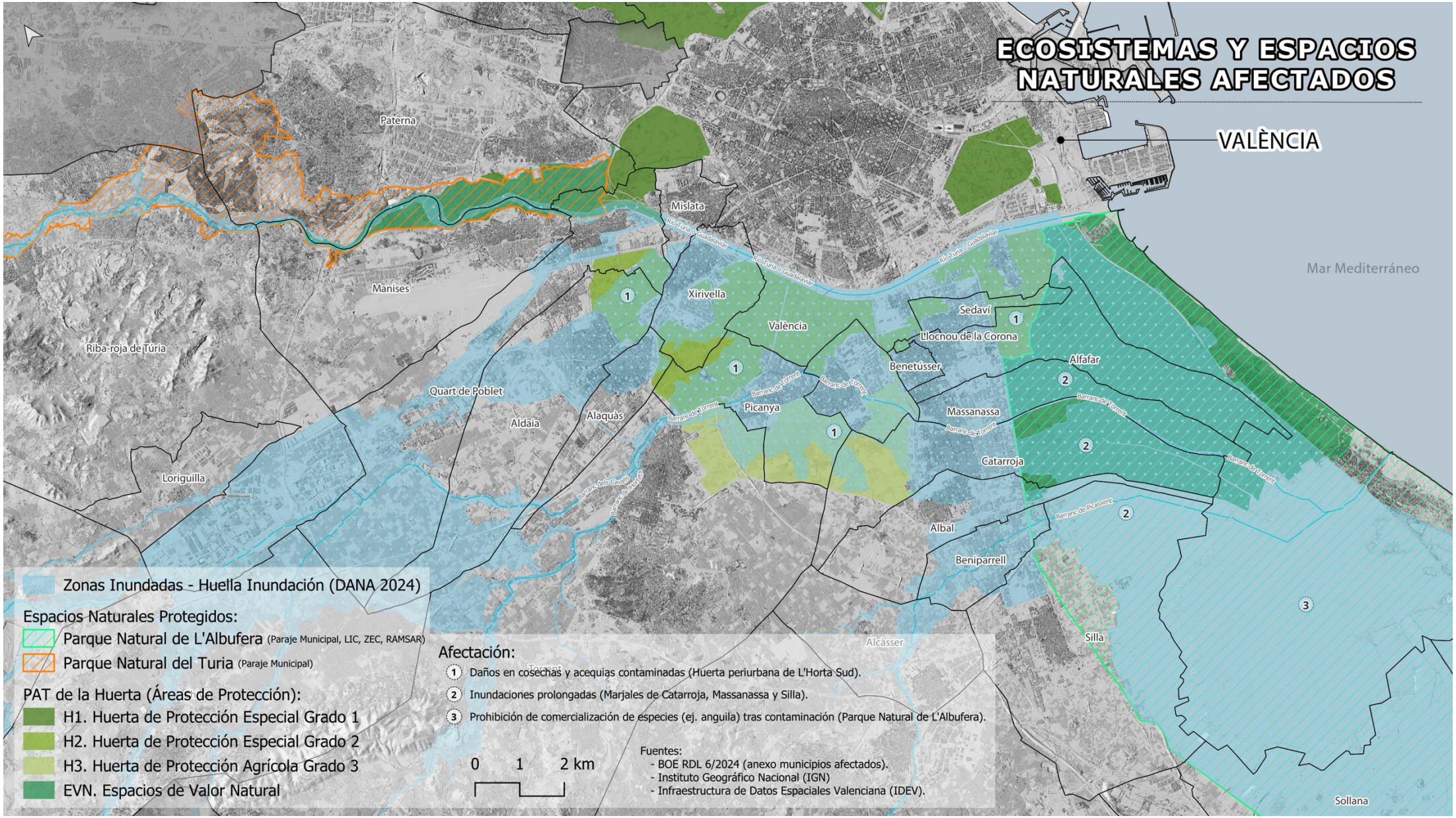

Figure 4. Ecosystems and natural spaces affected by the DANA

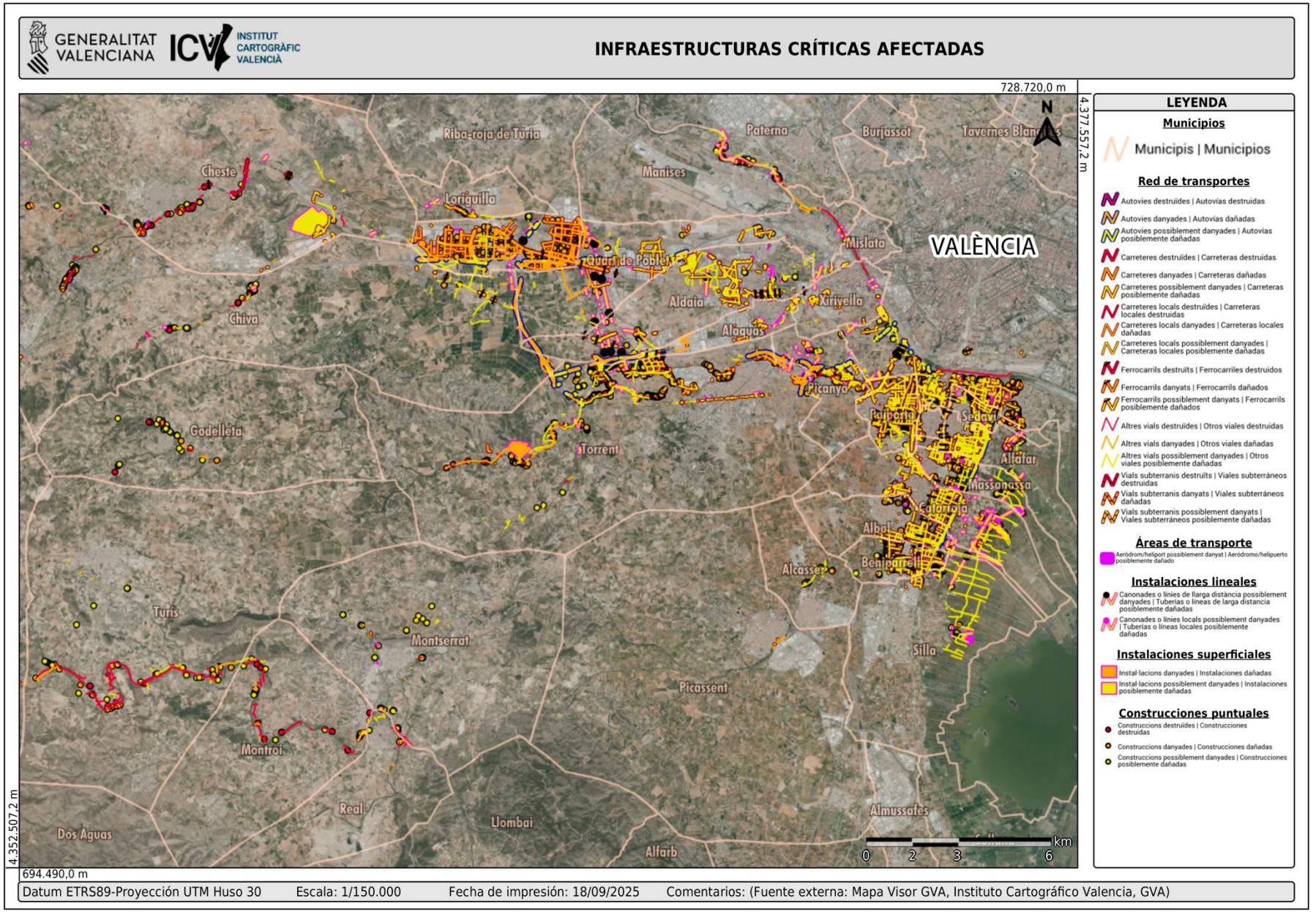

Figure 5: Critical infrastructures affected

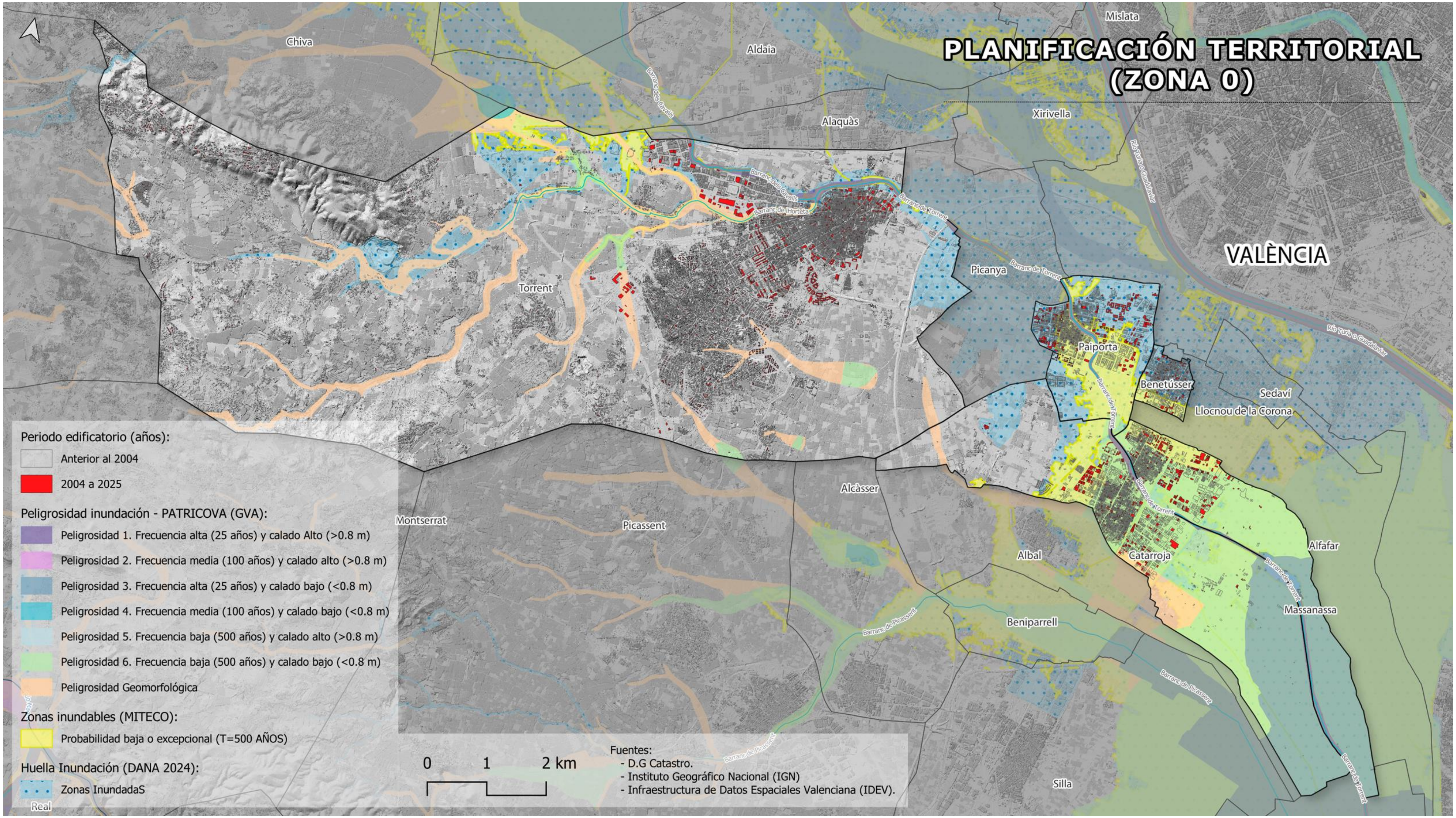

Figure 6a. Territorial planning against risk

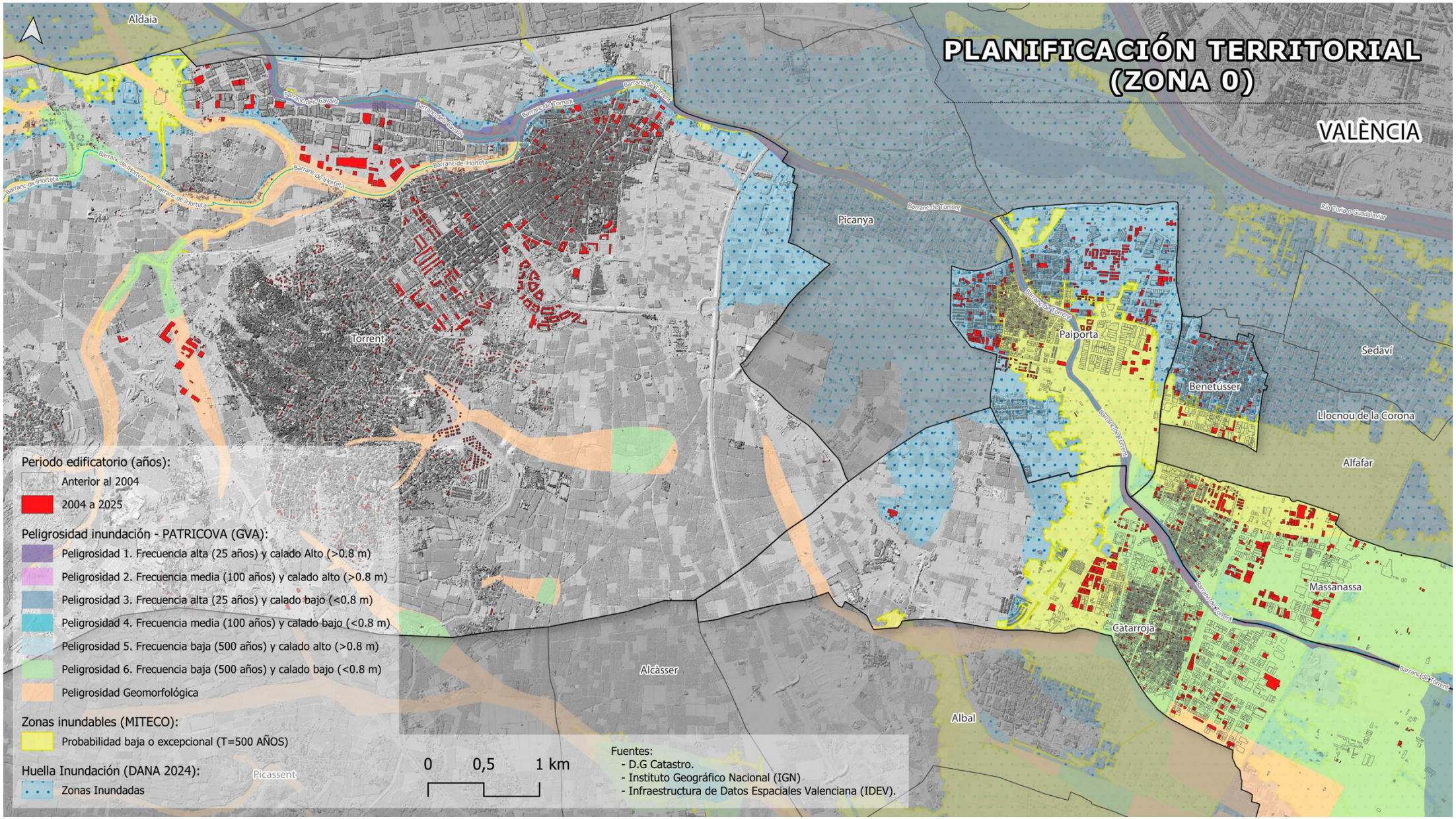

Figure 6b: Territorial planning in the face of risk in greater detail

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