Ref. Ares(2025)3261344 - 23/04/2025

VALIDATED LOCAL RISK ACTIONABLE DATA FOR ADAPTATION



D2.2

Characterisation of the Data Value Chain in each Demonstrator

Christopher Oligschläger
EARSC

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Mission call and number

Grant Agreement No 101112837

Start Date of the Project: 1st June 2023

Duration: 36 months

DELIVERABLE REPORT

Deliverable ID	**D2.2**
Deliverable name	**Characterisation of the data value chain in each demonstrator**

WP	2	Data valorisation and contextualisation
Task	T2.2	Value-chain analysis of existing non-climate data

Dissemination level[1]	PU
Nature[2]	R

Due delivery date (Annex 1)	29/02/2024
Actual delivery date	18/04/2024

Lead beneficiary	EARSC
Contributing beneficiaries	Hereon, TerraNIS, TerraSP, CMCC, TAKT, ASITIS

[1] Dissemination level: **PU** = Public, **PP** = Restricted to other programme participants (including the Commission Services), **RE** = Restricted to a group specified by the consortium (including the Commission Services), **CO** = Confidential, only for members of the consortium (including the Commission Services).

[2] Nature of the deliverable: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Version Management			
Filename	VALORADA_D2.2_final.pdf		
Author(s)	Christopher Oligschläger		
Approved by WP leader	Dr.Cristóbal Reveco	Date	17/04/2024
Approved by coordinator	Dr.Cristóbal Reveco Dr.Jörg Cortekar	Date	17/04/2024
Authorised by coordinator	Dr.Cristóbal Reveco Dr.Jörg Cortekar	Date	17/04/2024

Version	Date	Author(s)	Modification[3]
v0	01/02/2024	Christopher Oligschläger	Creation
v1	23/02/2024	Kim Tatum	Modification/Review
v2	27/03/2024	Christopher Oligschläger	Modification
final	18/04/2024		Submitted
final	01/04/2025	Christopher Oligschläger	Integration of additional inputs from local partners
revised	14/04/2025	Christopher Oligschläger	Modifications in sections 3.2, 3.3, 4.1, 4.2, 4.3, 4.4 and 4.5

EC-Grant Agreement	101112837
Project acronym	VALORADA
Project title	Validated Local Risk Actionable Data For Adaptation
Instrument	HORIZON Research and Innovation Actions
Programme	HORIZON-MISS-2022-CLIMA-01
Client	European Commission
Start date of project	01/06/2023
Duration	36 months

Coordinator – Administrative information	
Project coordinator name	Dr. Jörg Cortekar
Project coordinator organisation name	Helmholtz-Zentrum Hereon GmbH
Address	Max-Planck-Straße 1, 21502 Geesthacht
Phone Numbers	+49 (0)40-226 338-445
Email	joerg.cortekar@hereon.de
Project web-site	https://valorada-project.eu/

[3] Creation, Modifications, Final version for evaluation, Revised version following evaluation, Final.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

TABLE OF CONTENT

Mission call and number 1

1. EXECUTIVE SUMMARY 4

1.1 Content and Objectives 4

2. INTRODUCTION 4

2.1 About VALORADA 4

2.2 Objectives of Task 2.2 4

2.3 How T2.2 fits within the overall WP2 5

2.4 Report Structure 5

3. METHODOLOGY 6

3.1 Analytical framework: the local data ecosystem 6

3.2 Data collection method 7

3.3 Best Practices in Data Management in Europe's Local and Regional Authorities 8

4. FINDINGS 12

4.1 Statutory City of Přerov and Statutory City of Mladá Boleslav, Czech Republic 12

4.2 Occitanie Region, France 25

4.3 Region of Central Greece, Greece 31

4.4 Molise Region, Italy 38

4.5 Gabrovo and Burgas Municipalities, Bulgaria 45

5. GENERAL RECOMMENDATIONS ACROSS DEMONSTRATORS 55

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

1. Executive summary

1.1 Content and Objectives

Task 2.2 describes and characterises the local data ecosystem and local data governance, as well as datasets and information currently in use and prospective datasets and information involved in delivering input to local climate adaptation planning. Through two surveys, group interviews and contextualisation workshops, insights from demonstrator participants were gathered to understand the integration of climate-related (Earth Observation and non-EO) data in their work and identify areas for improvement in the local data ecosystem and associated processes. This report outlines the progress and findings of Task 2.2 of the VALRODA project, which has the goal to generate local narratives of adaptation and the datasets supporting them.

2. Introduction

2.1 About VALORADA

The EU aims to transform 150 European regions into sustainable and climate resilient regions by 2030. VALORADA contributes to addressing this challenge by co-developing tested FAIR customisable data-manipulation tools to access available climate datasets and to enable the sharing, community validation and use of local socioeconomic, demographic and Earth-Observation data. With a rigorous transdisciplinary approach, the respective risks of climate change are analysed with the local actors in five demonstrators in Europe. Data required for the analysis are compiled from the various already existing repositories (e.g., Copernicus Climate Change Climate Data Store) and locally sourced non-climate data catalogues processed by local communities and regions. The project will co-develop and make available prototype climate data and non-climate data manipulation tools to support and improve existing data portals and platforms and to enable user-oriented multi-data integration.

VALORADA aims to achieve Technology Readiness Levels (TRL) 7 and above. VALORADA's tools will enable the acquisition of different useful climate and non-climate data and make them "interoperable" in terms of metadata, as well as tools able to harmonise the geographical and time references chosen for the data. The "Analyst toolbox" will be composed of software tools able to combine different kinds of data all relevant for assessing climate risks and to calculate resulting indicators. VALORADA will contribute to scaling up to 150 regions through the implementation of dedicated scalability and replicability activities with at least 10 European regions and through strong collaboration with other Horizon projects. Additional activities include capacity-building schemes for end users as well as providers of climate services. VALORADA will explore and assess the options to facilitate the connection of the VALORADA data tools to the Copernicus Atmosphere Data Store.

VALORADA's vision statement: VALORADA wants to empower European regions and cities to steer the upcoming societal transformation towards sustainable and climate-resilient development through their own actions.
VALORADA's mission statement: VALORADA will enable the integration of diverse datasets that enable merging local knowledge with climate and non-climate datasets by means of co-developed data-manipulation tools and climate data.

2.2 Objectives of Task 2.2

Local narratives of adaptation are essential for addressing climate change on a community level, as they offer detailed, relatable accounts of how specific regions and cities envision adapting to climate impacts. These narratives hinge on contextualised datasets that incorporate the unique environmental, economic, social and cultural dimensions of each locality. Such tailored data is crucial for understanding the distinct climate risks and

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

adaptation needs of different areas in order to enable the development of targeted and effective adaptation strategies. By linking global or European information systems or Earth observation products with local realities and local datasets, these narratives and datasets ensure that adaptation efforts are both scientifically sound and closely aligned with local needs, fostering more sustainable and relevant responses to climate challenges.

Keeping in mind the significance of the "local reality" and, thus, local datasets, the T2.2 focuses on building an understanding of local conditions as well as local narratives of adaptation, emphasising their contextual relevance. This task analyses, therefore, the local data ecosystem of each demonstrator and the various datasets in use or in prospect for local climate adaptation planning activities. Group interviews and workshops gathered insights on how climate-related data is used in various settings, identifying involved providers and users such as city/region offices and authorities. This is a prerequisite to understand and improve these activities to enhance the delivery and management of key datasets for contextualising climate risks. The task further aimed to understand the decision-making process behind the use of EU-wide or local data sources, focusing on the reasons for their use or non-use and analysing where bottlenecks and challenges remain, and opportunities could evolve. This understanding will aid in making practical recommendations to align data service supply with demand, improving data utilisation.

2.3 How T2.2 fits within the overall WP2

T2.2 is an action within Work Package 2 (Data valorisation and contextualisation). It was preceded by T2.1, which has had the objective to work together with local stakeholders to create valorisation frameworks using various datasets. T2.1 employed a method of co-generating local adaptation narratives to connect climate science with societal risk perceptions. Climate profiles for each region were generated, integrating climate and non-climate data. As part of the overall WP2, interviews and workshops with key participants were conducted to assess current climate risks, develop resilient scenarios, and identify essential data resources. T2.1 validated data combinations for understanding local vulnerabilities. The resulting framework defines climate data value collectively. It will be validated with stakeholders and aims to support data interoperability following FAIR principles.

Building on T2.1 and T2.2, the subsequent T2.3 is going to develop a data management protocol and data catalogue structure, in consonance with the already existing INSPIRE initiative, in order to establish basic standards and uniform schemas to guide the development of data catalogues. Together with local stakeholders, T2.3 will co-define specific features to be included in the catalogues based on a case-to-case basis, depending on the existing data infrastructure in each demonstrator including aspects related to metadata, data files, and complementary files (such as documentation, etc.) that are needed to guide choices to address specific climate risks. With this, the catalogues will be tailored to the existing data infrastructure. In the frame of the implementation workshops foreseen for the summer months 2024, the structures of catalogues in each demonstrator will be defined and implemented. This validated catalogue-structure will be then taken by WP4 (responsible for the tools development), who will turn the information catalogues into a GeoNetwork structure, facilitating their operationalisation in each demonstrator.

2.4 Report Structure

This report summarises and elaborates the results and findings from various data and information sources related to the local data ecosystems of each demonstrator and their data value chains. For this purpose, the report explains the analytical framework employed throughout this task, detailing the steps conducted to arrive at the described findings. The next chapter therefore carefully describes the analytical framework of local data ecosystems and data value chains and subsequently elaborates the data collection method employed. Finally, the results are presented as per demonstrator and finishes with specific recommendations about how to improve the extraction of value from the analysed datasets and pieces of information.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

3. Methodology

3.1 Analytical framework: the local data ecosystem

Local data ecosystems in local and regional authorities are complex networks involving the collection, management, analysis, and dissemination of data. These ecosystems are grounded in the public sector's unique context, emphasising data pertaining to public services, civic operations, and community engagement. They typically involve a variety of stakeholders, including government departments, local businesses, civic groups, and residents. The foundation of these ecosystems is data collection, which can range from traditional means like surveys and administrative data to more modern methods like sensor networks and social media analysis. This data is then managed through (in the best case) robust infrastructure that seeks to ensure quality, security, and accessibility.

Data analysis in these ecosystems is a critical step. It involves turning raw data into actionable insights through techniques like statistical analysis, predictive modelling, and data visualisation. This process is essential for informed decision-making and policy development in local and regional governance. Finally, the **dissemination of data** to the relevant decision-makers is a key aspect. This includes not only the sharing of insights and reports within government departments but also making data available to the public. Open data initiatives are becoming a more common feature, aimed at promoting transparency, fostering innovation, and encouraging community involvement in local governance. Overall, local data ecosystems in local and regional authorities play a vital role in enhancing public service delivery, fostering civic engagement, and supporting sustainable community development. They represent a dynamic interplay of technology, policy, and community collaboration.[4] To get a solid understanding of these parameters, the analysis proceeded as follows:

(1) To characterise the local data ecosystem and associated data value chain, a thorough **description and analysis of the local data governance system and arrangements** is employed. Data governance encompasses the overall management and control of an organisation's data availability, usability, integrity, and security as well as an overview of the key actors, stakeholders and roles involved. It involves setting up policies, standards, and processes to ensure data is accurate, accessible, protected, and compliant with regulations throughout its lifecycle. This holistic approach aims to enhance decision-making, ensure regulatory compliance, improve operational efficiencies, and reduce risks associated with data management and usage. By implementing effective data governance, organisations can maximise the value of their data assets, maintain data quality, and support business objectives.

(2) Understanding how datasets are employed for effective climate risk contextualisation is of paramount importance. A holistic comprehension of these factors serves as the foundation for accurate and insightful assessments of climate-related threats. One key aspect is data quality assurance. Climate risk assessments rely heavily on data, making it crucial to ensure data accuracy, reliability, and consistency. A comprehensive grasp of the local data ecosystem enables rigorous quality control, encompassing data collection, cleaning, validation, and ongoing maintenance.[5] Thus, it is key to understand how data sources and datasets are linked to climate adaptation processes.

(3) Based on the description of the data governance arrangements and the analysis of data connections to climate adaptation planning, the diverse array of **data sources and data sets** is analysed. Climate risks are influenced by various factors, including meteorological data, socioeconomic indicators, environmental variables, and more. Understanding the datasets and sources of information aids in identifying these sources and their inherent limitations, allowing for a more comprehensive and nuanced assessment. Moreover, climate risks are often the result of complex interactions among numerous variables. An understanding of

[4] Liva, G., Micheli, M., Schade, S., Kotsev, A., Gori, M., & Codagnone, C. (2023). City data ecosystems between theory and practice: A qualitative exploratory study in seven European cities. *Data & Policy*, *5*, e17.

[5] https://learn.novisto.com/rethinking-climate-data-and-disclosure-value-chain

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

the data value chain facilitates the seamless integration of disparate datasets, enabling a more holistic view of the risks at hand.[6][7]

> The 'data value chain' describes the process of transforming raw data into actionable knowledge. It includes steps such as collecting, storing, cleansing, analysing, interpreting and visualising data. This chain enhances the value of data by supporting decisions and strategies. It's similar to business value chains, highlighting the systematic transformation of data into useful insights. (*Making Sense of data value chains*, link)

Contextualisation is essential for meaningful risk assessment. Climate risks must be understood within specific geographic, socioeconomic, and environmental contexts. A thorough grasp of the datasets used empowers analysts to account for local nuances and tailor risk assessments accordingly, making them more relevant and actionable. Moreover, calibration and validation of climate risk models rely on historical data. A comprehensive understanding of the data value chain ensures that these processes are executed accurately, enhancing the reliability of the models used for risk assessment. An understanding of the data value chain supports clear and credible risk communication, fostering awareness and facilitating proactive measures to address climate-related challenges.[8]

Long-term planning and resilience-building efforts also benefit significantly from climate risk contextualisation. A comprehensive approach to data management and an understanding of the data value chain enables better planning and the development of adaptive strategies to mitigate and respond to climate-related threats. In conclusion, the understanding of the entire local data ecosystem including used and prospective datasets and information is fundamental for precise, context-aware climate risk assessments. It ensures data reliability, supports effective integration, enhances contextualisation, and ultimately empowers informed decision-making and proactive measures to address the complex challenges posed by climate change.

3.2 Data collection method

The data and information needed to conduct the analysis were obtained through a series of activities to provide a comprehensive overview of the local data ecosystem and the underlying data value chain. This information will be key for the further development of the project and in particular for the data-based decision support tools that are being developed in the next phase of the project to support actors and stakeholders at local and regional level. The four activities can be summarised as follows:

1. Local climate information profiles (LCIPs)
2. Contextualisation workshops
3. Data surveys
4. Interviews

First, Local Climate Information Profiles (LCIPs) were completed by local and regional government partners to provide a general overview of the current situation. The LCIPs provided information on (1) the local climate context and (2) the local data management policies and processes, data stakeholders, as well as data infrastructure that make up the data governance for using local data to address climate risks in each demonstrator. These profiles helped to develop an initial understanding and guide the concepts of the contextualisation workshops by pointing to unique local climate risks and providing insights into various variables such as data used, data governance, existing vulnerability assessments to climate-related threats, and already existing adaptation and resilience strategies. Overall, the LCIPs were an essential tool for planning, facilitating

[6] Arribas, A., Fairgrieve, R., Dhu, T. et al. Climate risk assessment needs urgent improvement. Nat Commun 13, 4326 (2022).

[7] https://www.cpacanada.ca/foresight-initiative/data-governance/mastering-data/data-value-chain

[8] N. P. Simpson, et al., A framework for complex climate change risk assessment, One Earth, Volume 4, Issue 4, 2021, Pages 489-501.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

engagement, and education. They enabled more targeted and thus effective guidance towards the workshops that aimed at local responses to the challenges posed by climate change.

The contextualisation workshops then brought together a diverse community of local stakeholders from different local/regional government agencies, NGOs, and research and academia. They focused on the development of local contextualised climate impact chains, derived indicators (related to risk, exposure, sensitivity, adaptive capacity), data needs (to describe these indicators), and an activity to gather further information on the local data ecosystem, including opportunities as well as bottlenecks where improvements could be recommended to facilitate the provision of datasets and insights and ultimately support better decision making in the context of climate change adaptation.

Following the contextualisation workshops, a data survey (joint activity between T2.2 and T2.3 that is responsible for the data catalogue development) was sent to each demonstrator to gather more detailed information on the **datasets** identified during the workshops that are in use or are considered to be useful in the future. The information requested for each dataset focused on geographic scale, type/format of dataset, category of data, responsible organisation, access restrictions and location of the dataset (though not all these parameters are essential for this Task).

Following the data surveys, interviews were conducted to answer open and remaining questions, as well as to 'dig deeper' and better understand local decision-making processes for or against specific climate-related data sets, and to elicit relevant stakeholder views. In addition, the interviews sought to shed more light on and identify the key agencies, departments and stakeholders involved in climate-related data activities. This task had partially been impeded by political changes as well as elections in a number of demonstrators and unforeseen work overloads in some regions and cities at the beginning of 2024. With some demonstrators, the interviews were conducted in writing for reasons of time efficiency and language barriers.

	LCIP	Contextualisation Workshop	Data Survey	Interview
Přerov & Mladá Boleslav	Completed	11/12.10.2023	Completed	Completed
Occitanie region	Completed	7/8.11.2023	Completed	Completed
Central Greece region	Completed	23/24.11.2023	Completed	Completed
Molise region	Completed	26/27.10.2023	Completed	Completed
Burgas & Gabrovo	Completed	27/28.11.2023	Completed	Completed

Table 1 Status of data collection

The data collection for the LCIPs and contextualisation workshops have been completed. Surveys were sent to the demonstrators in mid-December 2023 and were mainly completed and returned between the end of January and February, due to busy periods at the end and beginning of the year, as well as political changes. At this point, all interviews have been completed.

3.3 Best Practices in Data Management in Europe's Local and Regional Authorities

There are many, often diverging ideas and academic publications in the literature when it comes to best practices and ideal data management systems for local authorities in Europe. However, there is a consensus among researchers and academics for certain elements and principles that make data management more effective. These elements include that data management systems should comply with regulations and best practices to

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

ensure data protection, transparency and efficient service delivery.[9][10] Most importantly and at its core, such a system should focus on five key principles: data governance and compliance, integrated and interoperable systems, security and privacy, data quality, and ultimately data-driven decision making.[11]

Data governance and compliance

Establishing robust data governance is essential for local governments to manage their data assets efficiently, transparently and securely. This involves creating a comprehensive framework that defines how data is collected, stored, accessed, shared and protected throughout its lifecycle. A key aspect of this governance is the establishment of clear policies and procedures on data ownership, access rights and security responsibilities. These policies help to ensure that all stakeholders - whether internal staff, third party vendors or the public - understand their roles and the limits of their access. Local authorities must also ensure full compliance with relevant regulatory frameworks, in particular the General Data Protection Regulation (GDPR)[12] and the EU Data Governance Act (DGA)[13]. The GDPR sets strict standards for the protection of personal data, including how personal data can be processed, stored and transferred, while the DGA promotes the trustworthy sharing and reuse of data across the EU, particularly in the public sector. Together, these laws provide a legal and ethical basis for handling data in a way that respects citizens' privacy and supports innovation. To help implement and harmonise these laws, the European Data Protection Board (EDPB) provides guidance, opinions and best practices.[14] The EDPB's resources help standardise data governance approaches across different jurisdictions, making it easier for local governments to align their strategies with EU-wide expectations. In addition to legal compliance, local governments need to integrate technical safeguards to maintain data integrity and resilience. This includes implementing audit trails that record data access and changes, enabling traceability and accountability in the event of a breach or dispute. In addition, disaster recovery strategies such as performing regular data backups, maintaining off-site storage, and using cybersecurity protocols such as firewalls and encryption are critical to protecting data from loss, corruption, or cyber-attack. These measures help ensure that data remains reliable, accessible and secure even in the face of technical failures or security threats.[15]

Integrated & interoperable systems

Seamless data sharing and integration across departments is essential for local government to function effectively and deliver quality public services. Siloed information can hinder decision-making and slow down service delivery, while streamlined data flows improve operational efficiency and responsiveness. One of the key enablers of this integration is the development of a centralised data platform - a unified infrastructure that consolidates data from multiple sources and enables departments to access consistent, real-time information. This fosters cross-departmental collaboration, reduces duplication of effort and supports data-driven policy making. Open standards and application programming interfaces (APIs) play a critical role in ensuring that disparate systems can communicate effectively. These technologies enable interoperability between legacy systems and new digital solutions, enabling flexible and scalable integration across different public service areas such as health, transport and education.[16][17]

The Local Data Spaces initiative, supported by the Living-in.EU movement, represents a forward-looking approach to data governance and infrastructure. It promotes the creation of secure, interoperable and ethical data sharing ecosystems between the public and private sectors. By encouraging collaboration at the local and regional level,

[9] https://www.mdpi.com/2227-9709/4/4/41

[10] Brous, P., Janssen, M., Vilminko-Heikkinen, R. (2016). Coordinating Decision-Making in Data Management Activities: A Systematic Review of Data Governance Principles. In: Scholl, H.J., et al. Electronic Government. EGOV 2016. Lecture Notes in Computer Science(), vol 9820. Springer, Cham. https://doi.org/10.1007/978-3-319-44421-5_9

[11] https://www.oecd.org/en/publications/smart-city-data-governance_e57ce301-en.html

[12] General Data Protection Regulation (GDPR) Compliance Guidelines

[13] Data Governance Act explained | Shaping Europe's digital future

[14] Guidelines, Recommendations, Best Practices | European Data Protection Board

[15] https://portico.urban-initiative.eu/urban-stories/uia/data-governance-local-level-lessons-european-cities

[16] EU Data Act: Requirements & Best Practices

[17] https://data.europa.eu/en/publications/datastories/local-governments-open-data-providers-and-reusers

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

this initiative increases transparency, efficiency and innovation, while empowering communities to make smarter, citizen-centred decisions.[18] A cornerstone of this integrated approach is the one-stop shop principle (OOP), a strategic objective of the European Union. This principle requires citizens and businesses to submit their personal data to public authorities only once. Once collected, this verified data can be securely re-used by authorised services, significantly reducing administrative burdens, saving users time and improving overall service delivery. To meet both performance and privacy requirements, a hybrid cloud infrastructure - combining on-premises servers with cloud-based services - provides a balanced solution. This model ensures that sensitive data can remain in secure on-premises environments, while still providing scalable access and flexibility through the cloud. Finally, the adoption of citizen self-service portals marks an important shift towards digital inclusion and empowerment. These platforms allow citizens to update personal information, access services and track requests without the need for in-person visits or lengthy bureaucratic processes. As a result, governments benefit from increased efficiency and citizens enjoy greater engagement, autonomy and satisfaction with public services.

Security, privacy and access control

Ensuring robust data security is a fundamental responsibility for local governments as they increasingly rely on digital systems to manage public services and sensitive information. With the growing volume and complexity of data, particularly personal and confidential records, protecting this information from unauthorised access, misuse or cyber threats is a top priority. One of the key mechanisms for maintaining data confidentiality is the use of role-based access control (RBAC). This approach restricts access to data based on a user's role within the organisation, ensuring that only authorised personnel can view or modify sensitive information. By aligning access rights with job responsibilities, RBAC not only limits exposure, but also reduces the risk of internal data breaches or accidental misuse. In parallel, all data - both at rest and in transit - should be encrypted using strong cryptographic standards such as AES-256 (Advanced Encryption Standard with 256-bit keys). This level of encryption provides a high level of security, making it extremely difficult to decrypt data without proper authorisation. In addition, when data is used for analysis or shared in open data initiatives, it should be anonymised or pseudonymised to protect individual identities while still providing valuable insights. In addition to improving efficiency, the once-only principle (OOP) also contributes to data security. By limiting the repeated collection of the same data across different agencies, it minimises exposure points and reduces the risk of data leakage. It ensures that verified information is securely reused rather than redundantly stored or re-entered, streamlining operations while strengthening privacy. In addition to preventative measures, local governments must also prepare for potential cyber incidents by developing a comprehensive cyber incident response strategy. This includes establishing clear protocols for identifying, containing and mitigating data breaches or cyber-attacks, as well as mechanisms for reporting incidents to relevant authorities and affected individuals. A well-defined response plan enables governments to act quickly and decisively in the face of cyber threats, minimising damage and ensuring accountability. Together, these measures create a layered and proactive approach to data security - protecting citizen information, maintaining public trust and ensuring the resilience of digital public services.[19]

Data quality and usability

High-quality, standardised data is the backbone of effective, evidence-based governance. Without accurate and consistent information, local authorities risk making decisions based on flawed assumptions, leading to inefficiencies and reduced public confidence. To ensure data is reliable and fit for purpose, local authorities need to implement automated data validation and cleansing processes. These tools help identify and eliminate duplicates, outdated entries, missing fields and inconsistencies across datasets, reducing manual errors and ensuring data integrity at every stage. A key enabler of data consistency and interoperability is the use of unique identifiers for core entities such as citizens, properties and businesses. By assigning persistent, standardised identifiers, governments can link and integrate information across departments and systems, enabling more coordinated service delivery. For example, a citizen's interactions with health, housing and tax services can be unified under a single profile, reducing redundancy and improving service continuity. To support openness and innovation, the EU Directive on the Re-use of Public Sector Information (also known as the Open Data Directive)

[18] Local Data Spaces | Living in EU

[19] https://www.oecd.org/en/publications/smart-city-data-governance_e57ce301-en.html

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

encourages public bodies, including local councils, to make non-sensitive government data available to the public. By publishing open data in machine-readable formats, governments not only promote transparency and accountability, but also empower entrepreneurs, researchers and civil society organisations to develop new tools and services that benefit the wider community. Another critical component of a modern data ecosystem is the use of geographic information systems (GIS). These systems enable governments to collect, manage and visualise spatial data in real time, providing invaluable insights for a range of applications. In urban planning, GIS supports land use analysis and infrastructure development. In emergency response, it helps map the location of incidents and deploy resources effectively. And in environmental monitoring, GIS can be used to track pollution levels, deforestation or climate-related risks. By layering data geographically, GIS provides a powerful lens through which to understand complex, location-based challenges and make informed, strategic decisions.

Data-driven decision-making

Local authorities across Europe are increasingly turning to data-driven decision making to deliver smarter, more responsive public services. This approach goes beyond AI - it involves systematically collecting, analysing and acting on data to guide policy, allocate resources and anticipate community needs. Real-time dashboards, geographic information systems (GIS) and integrated datasets allow decision-makers to visualise trends and patterns in everything from traffic congestion and waste collection to public health and housing. Predictive analytics can help communities prepare for future challenges, such as demographic shifts or extreme weather events. Data from citizen feedback, IoT sensors and service portals can be synthesised to provide actionable insights. The effectiveness of data-driven decision-making depends on data quality, accessibility and interoperability across departments. Councils need to ensure that relevant data is standardised, up-to-date and securely shared to avoid silos. Empowering staff with data literacy training and analysis tools is also critical. In addition, cities such as Helsinki and Amsterdam have demonstrated the value of open data platforms, where anonymised public datasets are shared for transparency and innovation. By making data accessible to citizens, researchers and businesses, local governments can encourage civic engagement and evidence-based policy development. While artificial intelligence can enhance this process, the foundation lies in reliable data systems and a culture of informed decision-making.[2021]

[20] https://www.govpilot.com/blog/local-government-data-driven-decision-making

[21] https://icma.org/articles/pm-magazine/navigating-data-local-government-decision-making

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

4. Findings

4.1 Statutory City of Přerov and Statutory City of Mladá Boleslav, Czech Republic

In the Czech cities of Přerov and Mladá Boleslav, climate change is manifesting through increased average temperatures, altering the character of both summer and winter seasons. These changes bring about more intense and erratic precipitation patterns, posing challenges for urban water management and increasing the risk of both flooding and droughts. The urban heat island effect exacerbates discomfort during peak summer months, while air quality issues may become more pronounced, affecting public health.

The local ecosystems, including urban green spaces, face pressures from the shifting climate, impacting biodiversity and recreational areas. Economically, sectors such as agriculture, manufacturing, and tourism might need to navigate the challenges and opportunities presented by a changing climate. Both cities, therefore, face the imperative to implement adaptive strategies, from enhancing green infrastructure to innovating in water management and urban planning, to mitigate the impacts of climate change on their residents and economies.

Statutory City of Přerov

Local Climate Impact Challenges

The city of Přerov faces significant local climate challenges that necessitate urgent action to enhance its resilience to climate change. The region is particularly vulnerable to extreme temperature events, including heat waves, which lead to an increased number of tropical days. Drought conditions exacerbate water scarcity in watercourses, lead to higher fish mortality rates, and cause shutdowns of small hydroelectric power plants. Additionally, drought conditions have disturbed the statics of buildings, indicating structural stress. Flash floods represent another critical challenge, posing immediate risks to infrastructure and public safety. Collectively, these events underscore the need for integrated strategies to mitigate the impacts of climate change and safeguard the community's well-being. To address these challenges, the city aims to increase the presence of vegetation and water features in public spaces, improve energy and waste management efficiency, and boost the use of renewable resources.

Data Governance: Policies & Strategies

The city of Přerov shows a lack of established structures and practices in several key areas of **data governance** with regards to climate change adaptation. There are no strategic objectives, quality rules, quality indicators, or quality management practices specifically related to data governance. Furthermore, key data challenges have not been identified, and there is no dedicated budget allocated to improve data governance. Instead, data are acquired on an ad-hoc basis for specific projects, suggesting a reactive rather than a proactive approach to data management and governance.

The city's **data policies** highlight significant gaps in its data management framework. There are no formal data management policies, procedures, or certification schemes in place. While there are some measures addressing data risk and privacy, including basic cybersecurity and aspects of the General Data Protection Regulation (GDPR), these are minimal. The key challenges in data management stem from a lack of financial resources, personnel availability, and the absence of management documentation. This indicates that data management is not prioritised within the city's administration, both in terms of investment and attention.

The city's **data infrastructure** shows a limited and somewhat fragmented approach to data management. There is no defined process for data classification, processing, cataloguing, finding, understanding relevant data, smart-metadata utilisation, or tools for automation and scaling. There is some restriction on data usage, with certain data being exclusive or limited to specific user groups such as top management and social affairs departments. Overall, the city's data infrastructure with regards to climate-related data lacks comprehensive processes and tools that could facilitate effective and efficient data management across different domains.

An analysis of key **data stakeholders** of the city reveals the following. The municipality itself is the primary data owner, particularly for city data, indicating a centralised control over data assets. However, the city lacks

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

dedicated IT architects and data analysts, with only one or two GIS specialists mentioned. Additionally, there is only a general IT administrator in place, with external providers such as GIS offering specialised support. Third-party data providers, like ASITIS, are mentioned as sources of project-specific data collection or analysis, which the city owns upon delivery. This indicates reliance on external entities for the acquisition of data. Unlike some larger cities in the Czech Republic and Slovakia, Přerov does not have local data-observatory networks, limiting public access to data. Collaboration with citizens and other stakeholders in data collection is minimal, primarily occurring through industry-specific conferences usually held by SMEs, and ordinary city channels for citizen engagement. This setup suggests limited interaction and collaboration in the broader data management ecosystem within the city.

Current Datasets Used (or Usable) for Local Climate Adaptation Planning

The city of Přerov uses a variety of information and datasets for local climate adaptation planning, including Sentinel 2 and Landsat 8 satellite data, digital elevation models, OpenStreetMap vector data, and CMIP6 climate projections. For specific insights into the local climate challenge, datasets such as the population by age group per street and address points are utilised. Unlike other regions, local stakeholders in Přerov do not directly use these climate datasets. The population data are provided by the municipality, while the digital elevation model is supplied by ČÚZK (Czech State Administration of Land Surveying and Cadastre). Moreover, the use of climate and climate-related data and information in Přerov does require support from external expertise which is explored further below.

Besides these datasets, a variety of other datasets currently already used in the municipality exist that may be re-purposed as they may have relevance for local climate adaptation planning. One such dataset is the Digital Technical Map maintained by the Municipality of Přerov. It provides detailed spatial information on the city's built environment. It is primarily used to monitor and analyse the amount of built-up area, supporting urban planning, land-use management and infrastructure development. Though the exact format was not specified in the data survey, such datasets are typically maintained as vector data (e.g., polygons representing buildings, parcels, infrastructure) within a GIS platform. The dataset likely falls into the political/administrative and geospatial categories and is essential for planning decisions at the municipal level. Ownership, management and decision-making about the dataset's use are handled by the City of Přerov, potentially with involvement from technical departments or urban planning offices. The dataset is routinely updated to reflect changes in land use and development patterns. Organisations using the data likely include municipal planning departments, construction and development firms and utility service providers. Information about access limitations and the data repository was not provided, but such datasets are often subject to limited access, with permissions granted to official entities or through licensed agreements.

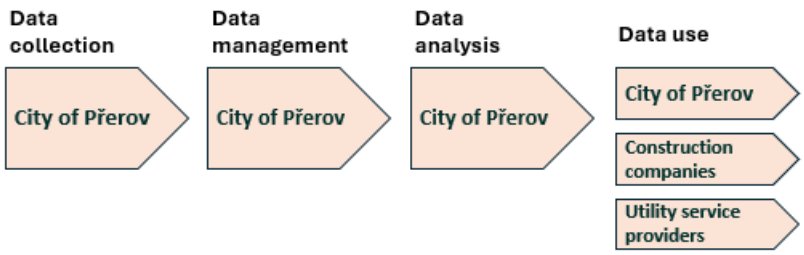


Figure 1 Schematic presentation of "Digital Technical Map" data value chain

While primarily designed for land management and infrastructure coordination, the Digital Technical Map has high potential for supporting climate adaptation planning. Built-up area data can help identify areas of high surface sealing, estimate urban heat island effects and guide green infrastructure placement such as urban parks, green roofs or permeable surfaces. In the face of increasing heatwaves, heavy rainfall, and flooding - climate risks particularly relevant to dense urban areas - this dataset can inform decisions on where to prioritise cooling measures, expand vegetative cover or improve stormwater management. For example, it can be cross-referenced

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

with demographic or health data to locate vulnerable populations in highly built-up, heat-prone neighbourhoods. Additionally, the dataset supports resilience-oriented urban planning by enabling scenario modelling for land-use change, helping the city avoid overdevelopment in climate-vulnerable zones. It can also be integrated with hydrological or meteorological data to evaluate climate impacts on specific built environments, such as critical infrastructure or transport hubs. It is a strong example of a locally owned, operational dataset with untapped potential to guide adaptation measures.

Another dataset of interest to look at more closely is for instance the river gauge dataset owned by the Morava River Basin Enterprise. It monitors the height of the river level at various gauging stations in the town of Přerov. This dataset is critical for flood monitoring, hydrological assessment and water management. While the exact data format was unfortunately not specified in the data survey, datasets such as this one are typically maintained as tables or time series with precise readings collected at regular intervals (e.g. hourly, daily). This dataset falls under the category of geomorphological and hydrological data, and may also overlap with climate and risk management data, depending on how it is used in forecasting. The dataset is managed, updated and controlled by the Morava River Basin Enterprise and one can assume that it is shared with relevant regional water authorities or municipal emergency services. It is currently used by water management authorities and by city level planning or crisis teams during high-risk weather events.

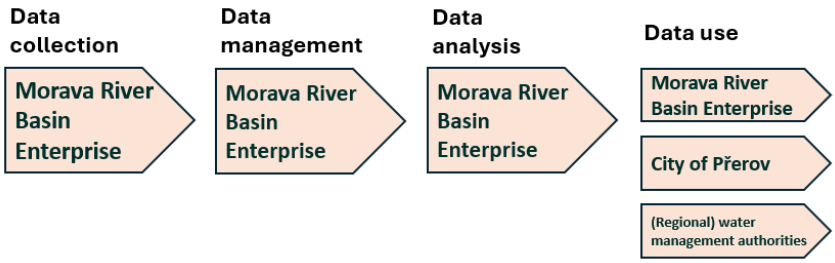


Figure 2 Schematic presentation of "river gauge" data value chain

With more frequent and severe flood events expected due to climate change, this dataset is highly relevant for adaptation planning. It provides real-time and historical data on river behaviour that can support early warning systems, flood risk mapping and infrastructure vulnerability assessments. By integrating river level data with land use, topography and population data, planners can identify flood-prone areas, assess the vulnerability of critical infrastructure and guide the placement of protective measures such as dikes, retention basins or flood-resistant building designs. In addition, river level trends can inform urban development policies, preventing expansion into high-risk areas and ensuring adaptive zoning regulations. It can also support community preparedness planning by identifying areas that may need evacuation assistance or public communication strategies in the event of river flooding. It is another dataset that exemplifies how sector-specific operational data, traditionally used for hydrological monitoring, could be leveraged to support multi-hazard climate resilience strategies at the city level.

The City of Přerov outsources various data-related activities, primarily due to a lack of expertise, funding and technical infrastructure. Complex tasks such as geospatial analysis, drone surveys or satellite data interpretation require specialised knowledge and tools that the municipality does not have in-house. In these cases, the city works with private companies or national research institutions to carry out advanced data collection, particularly for climate-related monitoring such as land use or flood vulnerability. Financial constraints also play a role. Instead of investing in its own monitoring systems, Přerov relies on national agencies such as the Czech Hydrometeorological Institute (CHMI) for meteorological, air quality and hydrological data. These institutions already maintain sensor networks and data infrastructure, allowing the city to access high-quality data sets at a lower cost. In terms of broader statistical data, Přerov uses outputs from the Czech Statistical Office, which conducts nationwide surveys on topics ranging from demography and tourism to environmental and economic indicators. This allows the city to base its planning on comprehensive data sets that it would not be able to collect independently. In specific situations - such as floods - the city works with the T.G. Masaryk Water Research

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Institute, which provides expert flood discharge assessments used in spatial planning and emergency response. For biodiversity and ecological data, the city also draws on the resources of the Agency for Nature and Landscape Protection (AOPK ČR). Overall, outsourcing enables Přerov to fill capacity gaps and access specialised data essential for effective climate adaptation and urban planning - while aligning with national standards and maintaining flexibility.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

The city of Přerov faces several significant *bottlenecks* in its data value chain, crucial for effective climate adaptation strategies. **Poor internal communication** between departments leads to fragmented efforts and reduces the efficiency of response strategies, as essential information remains siloed within individual departments rather than shared where it could be most effective. This lack of synergy exacerbates the challenges posed by the **limited availability of critical climate and environmental data**, which is essential for informed decision-making and strategic planning. Moreover, **inadequate data documentation** undermines the utility of available data, as poor record-keeping and unclear data sources lead to difficulties in data interpretation and utilisation. This situation is compounded by a noticeable **lack of experts** specialised in climate change, data management, and urban planning, which hampers the city's ability to devise and implement sophisticated adaptation measures. Additionally, the existing data management infrastructure is found lacking, characterised by outdated systems and inefficient data handling processes, leading to underutilised data resources. Lack of **political prioritisation** of climate adaptation is another critical bottleneck; without strong political will and adequate funding, adaptation strategies may not receive the necessary support to be successfully implemented and sustained.

However, these challenges also present unique *opportunities*. Enhancing internal communication can foster a more collaborative and integrated approach to climate adaptation, leveraging cross-departmental strengths and resources. Improving access to information and investing in robust data documentation practices can significantly enhance decision-making processes. Recruiting and developing expertise within the city's workforce can lead to innovative adaptation solutions and stronger response strategies. Upgrading data management systems and practices offers the potential for more efficient and effective use of data resources.

Lastly, elevating the political priority of climate adaptation can ensure the necessary commitment and resources are allocated, leading to more sustainable and resilient urban development. Addressing these bottlenecks while capitalising on these opportunities can significantly improve Přerov's ability to adapt to the changing climate and safeguard its community.

Summary: Statutory City of Přerov

	Data collection	Data management	Data analysis	Integration in decision-making	Data governance overall
Key Actors	City of Přerov (Department of Building Authority & Environment: Environmental Protection, Water management, Agriculture; Department of Concept and Strategic Development; Project and	Centralised (City of Přerov) and storage of data is with the city	City of Přerov + Support from external experts	City of Přerov	City of Přerov

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

	Investment Management Department; Department of Property Management and Municipal Services; Technical Services of the City of Přerov) EU geospatial providers ČÚZK Ministry of Environment Czech Hydrological Institute Morava River Basin authority Czech Office of Surveying and Cadastre External providers (such as surveying/geodetic companies)				
Status and Key Challenges	Primarily ad hoc nature of data collection Often difficulty in accessing the data	Lack of financial resources, personnel availability, and the absence of management documentation Organisational hurdles as cooperation between departments lacks Often, data is not compatible or without spatial reference	Lack of capacity and competency for local stakeholders to use data Need of training and more professional staff	Ad hoc (when needed) Disconnect between the different departments for providing decision-making support Often the value of data is underrated and therefore not considered Certain departments should be more involved in the decision-making process (such as Department of	Lack of strategic approach, instruments, and capacity

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

				Building and Environment; Department of Water and Agriculture)	

Conclusion

In Přerov, data governance structures related to climate adaptation are largely underdeveloped. There is no formal strategy to guide the use of climate-related data, and key components such as quality assurance mechanisms, standard procedures and governance roles are lacking. Data collection tends to be reactive and linked to specific projects rather than embedded in a long-term governance framework. The city also lacks a dedicated budget or institutional capacity to support data governance improvements. While there are some basic data privacy and security policies in place - mainly related to GDPR - they appear minimal, and do not represent a robust compliance or risk management strategy. Overall, the lack of formal policy, strategic planning and leadership in this area highlights a significant gap in Přerov's ability to use data for long-term resilience and climate action.

Data systems across municipal departments in Přerov function in silos, with limited integration or interoperability. Internal communication on data matters is weak, which impedes cross-departmental collaboration and reduces the effectiveness of shared climate strategies. There is no centralised data platform or clear framework to facilitate data exchange between departments. Most data is acquired externally or managed within isolated units, leading to duplication and missed opportunities for synergy. Without defined standards for interoperability - such as shared formats, APIs, or cataloguing systems - the city struggles to build a cohesive view of its climate risks and responses. Addressing this fragmentation is essential for more coordinated and data-informed planning.

Data security and privacy measures in Přerov are present but limited in scope. While the city has some basic procedures in place to meet GDPR obligations, these are not part of a broader cybersecurity strategy. There are no formalised processes for handling data access, encryption, anonymisation, or breach response. Sensitive data appears to be restricted to certain departments, but without clear, documented access controls or a tiered permission system. Given the increasing reliance on digital and external data sources, enhancing privacy safeguards and building a more comprehensive data security framework would significantly strengthen the city's resilience and trustworthiness.

The quality and usability of climate-related data in Přerov are currently undermined by a lack of standardisation and documentation. While the city uses valuable datasets such as satellite imagery and elevation models, these are often applied in isolated projects with little continuity or institutional knowledge. Internal stakeholders report difficulty accessing, interpreting, or working with available data due to missing metadata, unclear formats, or incompatibility with local systems. Moreover, limited technical training and a lack of data literacy within departments further reduce the effectiveness of data use. Improving documentation practices, establishing quality standards, and investing in training would dramatically increase the utility and impact of available data.

Data in Přerov is not yet systematically embedded into decision-making processes. Its use is largely reactive and linked to specific projects or external expert support, rather than informing everyday governance or strategic planning. Decision-making often takes place without comprehensive data analysis, and departments with relevant expertise - such as environment, water management, or agriculture - are not consistently included in the process. This limits the city's ability to develop proactive and evidence-based responses to climate challenges. Strengthening internal data competencies, increasing interdepartmental collaboration, and creating tools like dashboards or KPIs aligned with climate goals would help make data a more integral part of city planning.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Criteria	Status	What is needed/priorities?
Data governance	Lacking	Create governance framework and budget
Data integration & interoperability	Fragmented	Establish shared platform & standards
Security and Privacy	Basic	Improve cybersecurity & GDPR compliance
Data quality & usability	Inconsistent	Implement quality control & training
Data-driven decision-making	Ad hoc	Embed data into everyday decision processes

Strategic opportunities for Přerov:

- Launch a municipal data strategy focused on climate adaptation.
- Apply for EU funding (e.g., Horizon Europe, Digital Europe) for smart governance tools.
- Foster partnerships with local universities or civic tech NGOs to strengthen internal capacity.
- Explore open data initiatives to engage the public and improve transparency.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Statutory City of Mladá Boleslav

Local Climate Impact Challenges

The local climate challenges include extreme temperature fluctuations, marked by heat waves, drought, and flash floods. The consequences of these events have been significant: heat waves have led to an increase in the number of tropical days, affecting urban comfort and energy demand. Drought conditions have resulted in lower crop yields and increased water consumption to maintain urban vegetation, highlighting the need for sustainable water management practices to mitigate these impacts. The city of Mladá Boleslav is focusing on increasing its resilience to climate change through strategies such as enhancing green spaces with sufficient vegetation and water features, alongside improving energy and waste management with an emphasis on renewable resources.

Data Governance: Policies & Strategies

The **data governance** framework in the city of Mladá Boleslav in the context of climate change adaptation data appears to be lacking across several dimensions. There are no strategic objectives related to data governance, nor are there any established data quality rules, indicators, or management practices. Key data challenges have not been identified, indicating a potential gap in strategic planning and oversight. Additionally, there is no dedicated budget allocated for improving data governance; instead, data are acquired on an ad-hoc basis for specific projects. This suggests that the city's approach to data governance is reactive rather than proactive, with a reliance on external data sources for immediate needs without a long-term strategy or investment in data management infrastructure.

The city's approach to **data policies and processes** lacks formal structure and emphasis. There are no established data management policies or procedures, nor is there a data certification scheme in place. However, some basic cybersecurity measures and aspects of the General Data Protection Regulation (GDPR) have been implemented, indicating a minimal level of attention to data risk and privacy. The key challenges faced in data management include a lack of financial resources, personnel availability, and the absence of management documentation. These challenges suggest that data management is not currently a priority for the city's administration, both in terms of investment and organisational focus.

The main **data infrastructure** of the city, particularly in the context of climate adaptation, shows a lack of comprehensive processes and tools. There is no defined process for data classification, processing, cataloguing, workflows for data discovery, smart-metadata tools, or automation and scaling tools. While there is a process for data collection, it is limited to data that has already been identified as necessary for specific processes. Additionally, some data usage is restricted to exclusive or specific user groups such as top management and social affairs, indicating limited access to data across the organisation. The absence of data catalogues and tools to facilitate the understanding and utilisation of data points to significant gaps in the city's data management infrastructure, which could hinder effective climate adaptation planning and implementation.

In terms of key **data stakeholders**, the city has a relatively basic and focused structure. The primary data owner is the municipality itself, which oversees city data. Despite this centralised ownership, the city lacks IT architects and has only a limited number of GIS specialists for data analysis, indicating a narrow scope of technical expertise. There are no dedicated systems experts, with only a general IT administrator in place, supplemented by external GIS providers for specific needs. Third-party data providers, such as ASITIS, play a role in delivering project-specific data, which the city then owns. However, Mladá Boleslav does not have local data-observatory networks, limiting public access and the potential for wider data sharing and analysis. Collaboration with citizens and other stakeholders in data collection is relatively limited, primarily occurring through industry-specific conferences usually organised by SMEs, and through ordinary city channels for citizen engagement. This suggests that while there are some efforts towards engaging with stakeholders for data collection, these efforts are not extensively developed, especially in the domain of climate adaptation.

Current Datasets Used (or Usable) for Local Climate Adaptation Planning

Similar to Přerov, the city of Mladá Boleslav employs various datasets and sources of information for its local climate adaptation strategy, incorporating Sentinel 2 and Landsat 8 satellite data, digital elevation models,

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

OpenStreetMap vector data, and CMIP6 climate projections as key data elements. To specifically address and understand local climate challenges, the city utilises datasets detailing the population by age group per street and address points. Local stakeholders in Mladá Boleslav do not use these climate datasets directly. The municipality provides the population data, while ČÚZK supplies the digital elevation models. Furthermore, the use of this climate and climate-related data in Mladá Boleslav necessitates support from external expertise which is examined below.

Zooming in on an interesting dataset is for instance the regional patient numbers records. It is used extensively by health facilities in Mladá Boleslav for critical decision making related to the provision of health services. The data reflect both social and demographic characteristics (such as age structure and morbidity trends) and are used in conjunction with weather-related planning, particularly in forecasting needs related to population ageing and seasonal disease patterns. It is collected and aggregated by regional hospitals - including both public and private providers - and submitted to the Ministry through the Office of the Authorised Municipality. Current users of the data include the National Institute for Drug Control, health care providers, health insurance companies, care institutions, municipalities and integrated emergency services such as the police and fire brigade. Access to this dataset is restricted and requires authorisation, as it is only available to payers and service providers within the health system. It is stored and made available through platforms such as the Klaudianova Regional Hospital portal (klaudianovanemocnice.cz).

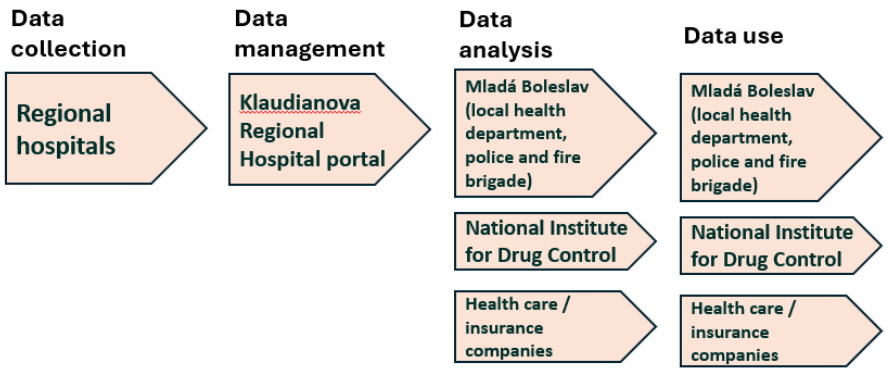


Figure 3 Schematic presentation of "patient records numbers" data value chain

While currently used to support health planning and emergency response, this dataset can be a valuable asset for climate adaptation planning. Climate change is expected to increase the frequency of extreme heat events, air pollution episodes and climate-sensitive diseases - all of which disproportionately affect the elderly and those with chronic health conditions. By using patient data at a regional level, decision-makers can map health vulnerabilities across different demographic groups and areas. This allows for more targeted interventions such as pre-emptive medical staffing, deployment of mobile care units during climate-related events, or prioritisation of urban heat adaptation measures in high-risk areas. In addition, this dataset could inform cross-sectoral adaptation strategies, linking health planning with infrastructure, social services and emergency response. For example, data on population ageing and disease burden can inform decisions on where to locate cooling centres, ensure access to emergency care during heatwaves, or identify communities in need of additional support during floods or wildfires.

Another interesting dataset is the transit vehicle information dataset. This local dataset, managed and owned by the transport company of the city of Mladá Boleslav, contains detailed records on public transport vehicles, including information relevant to the indicator 'Number of air-conditioned public transport vehicles' that was identified during the contextualisation workshops. The data is in tabular form and is part of a wider set of transport-related datasets used to monitor and manage the city's transport fleet. While specific current users beyond the transport company are unclear, the dataset supports operational planning, service improvement and public reporting, such as updates on vehicle upgrades or passenger comfort measures. The dataset is open access

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

and publicly available via the transport company's website: dpmlb.cz. It is updated and maintained directly by the city's transport company, which also decides how the data is used.

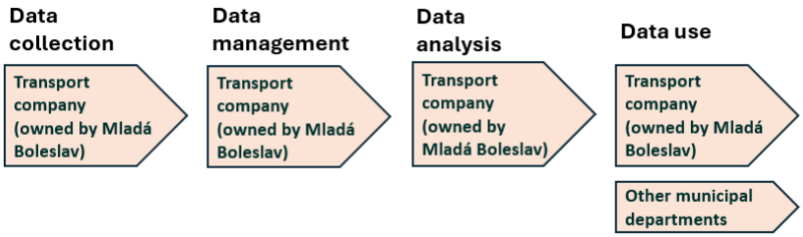


Figure 4 Schematic representation of transit vehicle information data value chain

While the dataset is currently used for operational transport management and service planning, it has great potential for use in climate adaptation strategies, particularly in addressing urban heat risks and promoting climate-resilient mobility systems. As climate change leads to more frequent and intense heat waves, access to air-conditioned public transport will become a critical factor in protecting vulnerable populations - such as the elderly, children and people with health conditions - who rely on public transport for their daily mobility. By incorporating this dataset into climate adaptation planning, city planners can identify gaps in service coverage, prioritise upgrades for non-air-conditioned vehicles, and align transit development with public health goals. For example, mapping the deployment of air-conditioned vehicles along routes could help ensure equitable access during extreme heat events. It could also inform investment decisions related to fleet modernisation, green infrastructure around transit corridors, or cooling measures at transit stops and hubs. In addition, this dataset could support cross-sectoral coordination between transport, health and urban planning departments, enabling more integrated heat adaptation and resilience strategies. As a publicly available dataset, it also provides a transparent and accountable mechanism for tracking progress towards climate adaptation goals. Within VALORADA, the transit vehicle dataset could be a practical example of how locally managed infrastructure data, while operational in nature, can be used for climate-smart planning that protects citizens and enhances urban sustainability.

Like Přerov, Mladá Boleslav outsources aspects of data collection, management and analysis due to limited internal capacity, both in terms of expertise and infrastructure. Tasks that require specialised technical knowledge - such as remote sensing, land use mapping or climate data interpretation - are often beyond the capabilities of the city's departments and are therefore outsourced to external experts or national institutions. The city also faces financial constraints that make it difficult to maintain its own long-term environmental monitoring systems. As a result, it relies on national institutions such as the Czech Hydrometeorological Institute (CHMI) for access to key data sets on weather, air quality and hydrology - critical for climate adaptation planning and public health protection. For broader statistical and socio-economic data, Mladá Boleslav uses information from the Czech Statistical Office, which conducts large-scale surveys in various fields, including the environment, tourism, demography and infrastructure. This allows the city to base local policies on comprehensive, standardised datasets that it would not be able to generate independently. For urgent or specialised data needs, such as flood risk assessments, the city, like Přerov, turns to expert institutions such as the T.G. Masaryk Water Research Institute, which evaluates flood runoff and provides data used in spatial planning and zoning regulations. Similarly, in areas such as biodiversity monitoring or habitat mapping, the city uses data provided by the Czech Nature and Landscape Protection Agency (AOPK ČR). In summary, outsourcing in Mladá Boleslav is a pragmatic approach that helps the city access high-quality, policy-relevant data while overcoming its internal limitations and ensuring alignment with national and EU frameworks.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

In Mladá Boleslav, the data value chain for local climate adaptation presents both bottlenecks and opportunities. A positive aspect is the willingness to cooperate among stakeholders, which lays a solid foundation for **collaborative efforts** in climate adaptation strategies. However, this is contrasted by the challenges posed by

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

GDPR regulations, which, while protecting personal data, can complicate the collection and sharing of necessary information for climate adaptation initiatives. **Technical tools** represent another dual-edged sword; while they are essential for collecting, analysing, and managing climate-related data, the lack of advanced technical tools can hinder the efficiency and effectiveness of adaptation measures. The provision of **sufficient funds** was identified as a hurdle that could enable the city to invest in necessary infrastructure, resources, and training to combat climate challenges effectively. **Universal software** could bring to light the potential for streamlining data management and analysis processes. This could significantly enhance the city's ability to respond to climate change if implemented effectively. However, without the adoption of such universal tools, data operations can remain fragmented, leading to inefficiencies and missed opportunities for integrated climate action. Overall, Mladá Boleslav's journey towards effective climate adaptation is influenced by a mix of internal and external factors. The city's proactive stance, reflected in its readiness to collaborate, sets a positive trajectory. However, addressing legal constraints, upgrading technical infrastructure, and adopting universal software solutions are critical steps needed to overcome existing bottlenecks and fully leverage the opportunities for a resilient future.

Summary: Statutory City of Mladá Boleslav

	Data collection	Data management	Data analysis	Integration in decision-making	Data governance overall
Key Actors	City of Mladá Boleslav (depending on assignments) including: • Project Management Department • Department of Construction and City Development (City Development and land use planning) • Department of Environment (Local Government Activities in Environment and Energy; Water Management; Nature Conservation, Hunting and Fisheries; Soil, Forest, Air and Waste Protection)	City of Mladá Boleslav	City of Mladá Boleslav + support from external providers	City of Mladá Boleslav (mainly political representation and senior administrators)	City of Mladá Boleslav

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

	Ministry of Environment Czech Hydrometeorological Institute Czech Statistical Office External parties/providers (e.g. Elbe River Basin company or CEZ group) ČÚZK AOPK ČR				
Status and Key Challenges	Ad hoc nature of data collection	Absence of defined processes and policies	Lack of capacity and competency for local stakeholders to use data	Climate and non-climate data not yet sufficiently appreciated and thus exploited for decision-making	Lack of strategic approach, instruments, and capacity

Conclusion

Mladá Boleslav lacks a coherent data governance framework, particularly in the context of climate change adaptation. There are no formal strategic objectives, policies or data quality indicators to guide data use. Data is collected reactively, mostly for individual projects, and governance-related tasks such as documentation, accountability, or performance tracking are lacking. While basic GDPR compliance is in place, it is minimal and not part of a structured data privacy or risk management strategy. Without a dedicated budget, leadership or governance architecture, the city's data efforts remain under-prioritised. Establishing formal governance policies, defining data roles, and allocating resources would significantly improve transparency, efficiency, and resilience.

Data systems across city departments are not well integrated. Although data is centrally owned by the city, each department appears to operate in its own silo, with no clear interoperability framework or central platform for data sharing. The lack of metadata, classification protocols and APIs limits the potential for cross-sector collaboration. Access is also restricted to specific user groups, further exacerbating fragmentation. Overcoming these barriers would require defining internal interoperability standards, fostering cross-departmental collaboration, and developing a common infrastructure for real-time and long-term data exchange.

Mladá Boleslav has implemented some GDPR-aligned practices, but there is no comprehensive security or privacy strategy in place. There are no formal access controls, encryption standards, or cybersecurity audits. Data is siloed, and sensitive datasets such as health records or patient numbers require manual authorisation for access. While GDPR ensures necessary legal safeguards, it also poses challenges when municipalities are not equipped to handle data-sharing frameworks that are both compliant and functional. The city needs to adopt formal role-based access control (RBAC), develop clear data classification and privacy policies, and establish incident response procedures.

Data in Mladá Boleslav is technically rich, but under-utilised due to usability challenges. While advanced datasets such as CMIP6 climate projections, satellite data and population breakdowns are available, they are not consistently integrated into decision-making. There is a lack of documentation, metadata standards and user-

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

friendly tools to explore or reuse these data. In addition, local stakeholders have limited capacity to interpret or act on the data, and training opportunities are scarce. Data quality assurance mechanisms and usability standards - such as consistent formats and dashboards - would help unlock the full potential of these valuable datasets.

Although promising datasets exist - such as health system records and public transport vehicle data - data are not systematically integrated into the city's decision-making structures. These datasets have the potential to support targeted climate adaptation, especially for vulnerable groups, but are still primarily used for operational or sector-specific purposes. Policy makers and senior administrators drive strategic planning, but climate-related data is not yet considered a core asset. There is a gap between the availability of data and its perceived value, which limits its uptake in planning. To improve, the city should adopt climate-related KPIs, integrate datasets into real-time planning tools, and ensure that all relevant departments - not just senior officials - can use data for practical decision-making.

Criteria	Status	What is needed/priorities?
Data governance	Missing	Develop formal governance strategy, allocate budget
Data integration & interoperability	Limited	Build shared infrastructure, improve departmental cooperation
Security and Privacy	Minimal	Improve cybersecurity
Data quality & usability	Underdeveloped	Introduce standards and user training
Data-driven decision-making	Fragmented	Connect existing datasets with climate planning goals

Strategic opportunities for Mladá Boleslav:

- Willingness to collaborate across stakeholders offers a good foundation
- Use of health and transport datasets is innovative and scalable
- Integration of local datasets into climate planning is already conceptually present - it now needs operational support
- Open data is a good practice for transparency and public accountability

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

4.2 Occitanie Region, France

The Occitanie region in France is facing significant climate change impacts, including increased temperatures, changing precipitation patterns, and heightened risk of droughts and heatwaves, particularly near the Mediterranean. These changes are part of France's broader climate challenges, which also involve rising sea levels and severe weather events affecting diverse geographical areas from the Atlantic coast to the Alps. France's National Climate Change Adaptation Plan aims to build resilience in sectors like agriculture, industry, and tourism, while addressing the broader environmental and societal impacts. The SCO France projects contribute by focusing on biodiversity conservation, disaster adaptation, water management, and land use, reflecting efforts needed in regions like Occitanie to monitor and mitigate the effects of climate change on both natural and human systems.

Local Climate Impact Challenges

The region faces significant climate change challenges, particularly urban heat islands, exacerbated by more intense, longer, and more frequent heat waves. These conditions lead to higher temperatures in urban areas compared to surrounding rural zones due to the accumulation of heat from solar radiation, anthropogenic activities like heavy traffic, heating, air conditioning, and the excessive use of non-permeable materials in urban construction. The lack of sufficient vegetation and water features in public spaces further contributes to this problem by limiting nocturnal cooling, creating a stark temperature contrast with cooler rural areas. The impacts of urban heat islands on the population are considerable, reducing thermal comfort in urban environments, increasing the demand for energy and water during summer months for cooling purposes, and elevating public health risks during heatwaves.

In response, strategies to adapt cities in Occitanie to climate change and mitigate the effects of heat islands have so far included enhancing greenery, water bodies, and permeable surfaces in urban planning. Bioclimatic design for residential and office buildings, creating permeable, tree-lined open spaces such as parking areas, and greening facades, roofs, and building surroundings with light colours are recommended. These responses aim to institutionalise long-term adaptations to improve urban climate resilience.

Data Governance: Policies & Strategies

The Occitanie region is actively working towards enhancing its **data governance** framework, particularly in the context of climate adaptation. There are strategic objectives related to data, with an audit currently underway to assess the Metropolis' Data strategy. Data quality rules are established for some Geographic Information System (GIS) data, including the format used, the implementation of a conceptual data model (MCD), and data quality control measures. However, there are no specific data quality indicators in place yet. A study to identify key data challenges is in progress, indicating a proactive approach to understanding and addressing data-related issues. Data quality management practices are also applied to some GIS data, reflecting a commitment to maintaining high data standards. Additionally, there is a budget allocated for improving data governance, which underscores the region's dedication to enhancing its data management capabilities in support of effective climate adaptation strategies.

Data management policies and processes are informed by indicators based on a European label with a defined methodology. Although there is no data certification scheme in place, there are measures for data risk and privacy, indicating a level of commitment to safeguarding data integrity and confidentiality. The primary challenge in data management is the implementation of a data master plan in the Montpellier Metropolis, suggesting an ongoing effort to enhance its data governance that aligns with broader climate adaptation goals. This approach reflects an initiative to standardise data management practices and address privacy and risk concerns effectively.

The Occitanie region has established a robust key **data infrastructure** for dealing with climate adaptation, with a focus on Geographic Information System (GIS) data. There is a defined process for data classification within GIS, organising data into thematic catalogues. Data collection processes are in place for OpenStreetMap data, and there is a specific procedure for the storage of GIS data on dedicated servers, ensuring data security and integrity. Data processing varies depending on the type of data, indicating a flexible and contextual approach. Data usage policies are established, allowing for the sharing of common GIS repositories with specific consultation and modification rights based on user profiles, which helps in managing access and maintaining data integrity. The

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

region has implemented data catalogues for GIS data, notably on GeoSource, which facilitates the organisation and retrieval of reference and master data. While the presence of workflows to find and understand data is unclear, the use of the GeoSource tool for managing GIS metadata and the availability of JSON flows for regular data export in open data formats suggest efforts towards enhancing data accessibility, understanding, and automation. These tools and processes collectively support the region's climate adaptation initiatives by ensuring that relevant, high-quality data are available and manageable.

The region must rely on a variety of key national and institutional **data stakeholders** (from different national administrations, pending on the types of data) for different aspects of data management for a variety of reasons and in specific circumstances. GIS business advisors within business departments are responsible for the collection and analysis of Geographic Information System (GIS) data, while the PND (Parc National de Données) handles the storage and collection of certain transversal GIS data. Data ownership is distributed among regional entities like 3M and external state organisations, including INSEE (National Institute of Statistics and Economic Studies), CNES (National Centre for Space Studies), DGI (General Directorate for Public Finances), BRGM (for soil and water resources) and IGN (National Institute of Geographic and Forest Information), indicating a collaborative approach to managing cross-functional data. These data providers have the responsibility of providing (for free) the region with valuable data, each one in its own competence domain. However, the specifications and the updating frequency of these data are defined by these third-party providers, without any real synchronisation among them. The region employs IT architects, with several Database Administrators (DBAs) located at the PND, showcasing a structured approach to data infrastructure, with the mission of putting in consistency (spatial and timewise) these different data sources. Although there are currently GIS business references in place, there is ongoing consideration for recruiting additional Data Analysts to enhance data analysis capabilities. System experts, such as system architects, are present at the PND, providing technical support and expertise. Local data-observatory networks exist, facilitated by business observatory projects, which support data sharing and analysis across different sectors. Additionally, there are established channels to collaborate with citizens and other stakeholders in data collection, exemplified by integration with OpenStreetMap, promoting community involvement and open data initiatives. This comprehensive stakeholder engagement underscores the region's commitment to a collaborative and inclusive approach to data management in support of climate adaptation and other strategic goals.

Current Datasets Used (or Usable) for Local Climate Adaptation Planning

Local datasets and general information currently used for climate adaptation planning in the Occitanie region include data on greenhouse gas emissions, carbon sequestration and land use as key data for the local adaptation plan. Specific datasets such as Local Climate Zones (LCZ), Urban Heat Islands, vegetation and thermographic satellite images are used to understand, communicate and address the local climate challenge. Local actors (usually sponsored non-profit associations) directly measure and generate these local datasets for various purposes: examples are ORCEO Occitanie (for land use maps), ATMO Occitanie (for local air quality monitoring) and OccSol (for soil quality measurements) providing these crucial datasets. The use of these local data and information in this region does not require the support of external expertise.

The region disposes however of several other datasets that at first sight may not be that interesting in the area of climate adaptation planning but may play a greater role when examined further. There is for example the “Agriculture” dataset based on surveys carried out by the regional Chambers of Agriculture. It provides data on agricultural productivity in different areas of the Occitanie region. It is presented in tabular form and includes indicators such as crop yields, farming practices, land use, irrigation rates and inputs such as fertilisers or pesticides. The dataset falls squarely into the category of agricultural data and supports key decision-making in farm advisory services, agricultural planning, subsidies and development programmes. The Chambers of Agriculture own, manage and update the dataset. They also control who can access or use the data, usually providing it on request or through formal cooperation agreements. Access is restricted and permission is required to obtain the data. However, general information and contact points are available on the official website.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

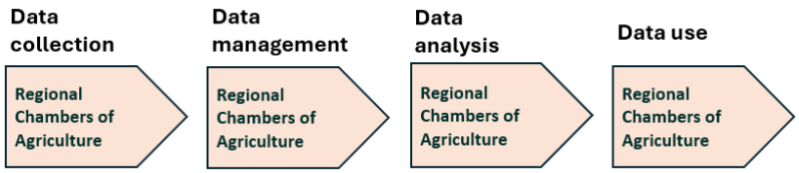


Figure 5 Schematic representation of the "Agriculture" dataset value chain

Although primarily designed for agricultural monitoring and support, this dataset has great potential for climate adaptation planning in the region. As climate change brings increased variability in rainfall, more intense heat waves and growing risks of drought or pest outbreaks, data on agricultural productivity will be essential for tracking vulnerability and building resilience in the sector. By analysing trends in yield decline, crop stress or water use over time, this dataset can help identify climate-sensitive agricultural zones and guide the promotion of adaptive practices such as crop diversification, future-proof crop types, agroecology or precision farming. It can also support early warning systems for drought impacts and inform spatial planning by helping to prioritise irrigation infrastructure, protected areas or sustainable land use policies. In addition, this dataset could be linked with climatic or hydrological data to model future climate scenarios and assess the socio-economic impact of changing agricultural conditions on rural communities. It is a good example of a sector-specific, semi-restricted dataset that - when linked to the wider data value chain - can inform targeted, climate-smart agricultural policies and contribute to long-term adaptation strategies in one of the region's most climate-sensitive economic sectors.

An additional dataset currently in use in the region, but with potential relevance for other purposes is the national land use database covering of course also the region of Occitanie. This regional scale vector dataset, part of the CORINE Land Cover programme, provides detailed information on land use and land cover in Occitanie. Managed and regularly updated by the National Ministry, the dataset includes classifications of urban, agricultural, forest, industrial and natural areas. It is categorised as land use data with overlaps in environmental, planning and policy areas. The dataset is used by many organisations for urban planning, environmental monitoring, agricultural assessment and infrastructure development. Importantly, the data are open and freely accessible through France's national data portal. Its wide availability and standardised classification system make it a key resource for multi-level planning and spatial analysis.

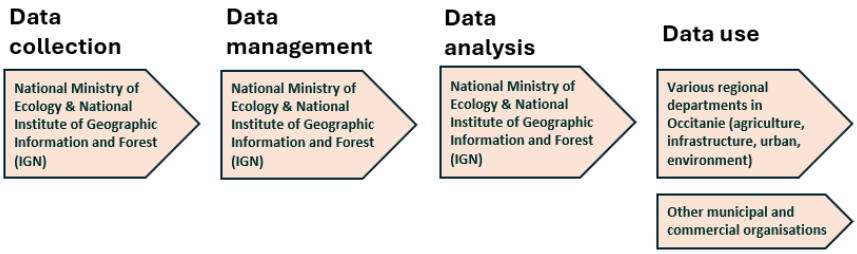


Figure 6 Schematic representation of "national land use database" value chain

While already used for a variety of planning and environmental management purposes, this dataset is highly valuable for climate adaptation. Land use data are essential for assessing exposure and vulnerability to climate risks such as flooding, urban heat islands, erosion or wildfires. It allows decision-makers to identify areas where natural land cover has been replaced by impervious surfaces, helping to guide mitigation through green infrastructure, restoration projects or zoning reforms. In agricultural and peri-urban areas, the dataset can inform adaptive land management strategies, such as promoting transition to drought-resistant crops or maintaining natural buffers along waterways. It also enables scenario modelling to visualise how land use changes - such as urban sprawl or deforestation - could exacerbate climate risks or reduce ecological resilience. Combined with hydrological, climatic and demographic datasets, the CORINE land use database supports integrated spatial planning and the prioritisation of nature-based solutions. In urban areas, it can help cities plan cooling corridors,

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

urban greening or flood risk reduction, while in rural areas it supports sustainable agriculture and ecosystem conservation.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

As mentioned above, the potential datasets for climate adaptation planning in the Occitanie region include a variety of sources and types, each with unique challenges and potential solutions. For imagery and mapping, Pleiades imagery (produced by Airbus under a CNES contract) and BD aerial orthoimagery (produced by IGN) face some cost issues, but these could be mitigated by using regional servers for data sharing and by taking advantage of free access programmes. The Tree Directory and Vegetation Mask (IGN-based BD Topo) datasets suffer from update frequency and accuracy issues, but solutions include integration with OpenStreetMap platforms and the creation of custom vegetation masks. For land and agricultural data, the reliability of the OCCSOL and RPG databases (from the Ministry of Agriculture) depends on the underlying data, but they are still considered high quality resources. Challenges with the AI accuracy of the IGN COSIA dataset can be addressed through cross-referencing and field verification.

Accessibility and confidentiality issues affect CAP declarations and agricultural surveys but can be approached by community-driven initiatives and open data platforms to unlock usage restrictions and complement other datasets. In predictive modelling and resource management, INRAE's prediction models and water resource data require validation and integration with practical data to improve utility. Similarly, challenges with accessing basin, dam, and groundwater information can be tackled through open data initiatives and satellite hydrological models. Finally, thermal loss maps and energy consumption data face methodology-related challenges, suggesting a need for integration with other datasets to enhance climate adaptation planning. Overall, while there are some bottlenecks, there are also clear pathways for leveraging other processes or datasets to support effective climate adaptation strategies in the region when challenges do arise.

Summary: Occitanie Region

	Data collection	**Data management**	**Data analysis**	**Integration in decision-making**	**Data governance overall**
Key Actors	Occitanie region and local data-observatory networks National geospatial data providers: IGN, INSEE, CEREMA, DGI, CNES ORCEO Occitanie, ATMOS Occitanie, OccSol	Occitanie region PND 3M INSEE CNES DGI IGN Min. Agriculture, BRGM	Mainly within Occitanie region departments with support from other public organisations (see aside)	Occitanie region (with support of data analysis companies and IT expertise)	Occitanie region
Status and Key Challenges	Quite diverse with a rich diversity of data sources	Lack of an overall data master plan	Advanced with rich in-house expertise and support from externals	Value of data appreciated overall for decision-making processes	Advanced with initiatives to enhance data governance overall

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Conclusion

The Occitanie region demonstrates an advanced and proactive approach to data governance, particularly in the context of climate adaptation. Strategic objectives are in place and audits are underway to strengthen the regional data strategy. While not all governance components are fully implemented - such as formal data certification or consistent quality indicators - the region has established clear rules and conceptual data models, particularly within its GIS systems. A dedicated budget supports ongoing improvements, a notable strength compared to many other local authorities. However, compliance measures, such as GDPR implementation, could be strengthened through more structured risk assessments and access controls. The lack of a comprehensive data master plan, particularly in areas such as Montpellier Metropolis, remains the most significant gap and represents a key opportunity for strategic alignment.

This strong foundation in governance is reflected in Occitanie's highly collaborative and integrated data ecosystem, involving multiple agencies such as INSEE, CNES, CEREMA and local observatories. The region's GIS systems are well developed, and platforms such as GeoSource offer thematic catalogues and open data exports that increase both transparency and accessibility. Defined user roles help to ensure that data access and modification rights are well managed. However, while sector-specific integration - for example in agriculture, health or urban planning - is clearly robust, broader integration of cross-sector workflows remains limited. Strengthening the region's capacity for data discovery and interpretation, through automated tools or semantic search capabilities, could unlock even more value from this interconnected ecosystem.

Building on this, data security and privacy protocols are moderately implemented, especially for sensitive datasets such as agricultural surveys or health records. These are managed through formal agreements and secure storage arrangements. However, systematising security practices - including encryption, role-based access control (RBAC), anonymisation and documented incident response plans - would better support the region's growing reliance on shared infrastructure and open data. As Occitanie continues to expand access and collaboration across departments and institutions, strengthening cybersecurity will be essential to maintaining trust and operational resilience.

The region also excels in data quality and usability, with an impressive variety of climate-related datasets ranging from satellite imagery and urban heat maps to agricultural productivity and thermographic imagery. The use of platforms such as GeoSource and OpenStreetMap, combined with structured metadata, contributes to a solid technical foundation. However, issues such as inconsistent update frequencies, data accuracy and gaps in dataset completeness (e.g. BD Topo, DPE) suggest that further investment in validation, cross-referencing and field verification is needed. Improved user documentation and training would also enable departments and partners to work more effectively with these high-quality datasets.

Crucially, Occitanie stands out for its use of data to inform strategic decision-making, particularly in areas such as urban heat mitigation, land use planning, agriculture and public health resilience. Datasets such as the inventory of air-conditioned public transport vehicles, agricultural productivity statistics and regional health indicators are already informing policy across sectors. Notably, the region has largely relied on in-house expertise, reflecting its strong analytical capacity. To build on this success, the next step would be to improve the use of real-time data - through dashboards, forecasting tools or predictive models - and to formalise how data informs key performance indicators (KPIs) and scenario-based planning. Institutionalising a seamless data-to-decision pipeline would consolidate Occitanie's position as a leader in climate-smart governance.

Criteria	**Status**	**What is needed/priorities?**
Data governance	Proactive	Finalise master plan, add quality indicators
Data integration & interoperability	Well-integrated	Promote cross-sector integration
Security and Privacy	Moderate	Formalise a strategy
Data quality & usability	Strong	Improve update frequency, add documentation and training

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Data-driven decision-making	Embedded	Expand use of decision tools

Strategic opportunities for Occitanie region:

- Finalising a comprehensive regional data master plan
- Formalising data privacy and cybersecurity protocols
- Improving data discovery, documentation, and usability for broader internal audiences
- Bridging certain interoperability gaps and ensuring data is used cross-sectorally, not just within silos

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

4.3 Region of Central Greece, Greece

The impact of climate change in the Central Greece Region, reflecting broader national trends, involves significant changes in temperature and precipitation patterns, as well as increasing soil erosion in certain areas, particularly in mountainous regions like Central Pindus. Greece has witnessed a rise in average annual temperatures, with projections indicating further increases, especially during summer and autumn. These temperature rises are expected to strain electricity supply due to increased demand for cooling and reduce the efficiency of thermal power plants. Moreover, the country is facing challenges from extreme weather events, including increased frequency and severity of forest fires, which are exacerbated by higher temperatures, land use changes, and reduced rainfall. The fire season is projected to lengthen, with significant implications for Greece's forests and biodiversity.

Sea level rise poses another critical challenge, threatening coastal erosion across Greece's extensive coastline, which is vital for the country's economy, particularly the tourism sector. The southern parts of Greece are more vulnerable to the impacts of sea level rise, including beach erosion, which could severely affect the tourism industry and coastal agriculture. In the mountainous Mediterranean catchment of Central Pindus, a study assessed the effects of climate change on soil erosion, revealing a predicted decrease in annual precipitation by 21.2% and an increase in mean annual temperature by 3.6°C by the end of the 21st century. Interestingly, these changes are anticipated to lead to a slight decrease in soil erosion potential, contrary to what might be expected with warmer and drier conditions. These impacts underscore the urgency for Greece, including regions like Central Greece, to adapt to the changing climate, particularly in safeguarding biodiversity, managing water resources, and protecting its coastal and mountainous areas from erosion and other climate change-related challenges.

Local Climate Impact Challenges

The Region of Central Greece is facing significant local climate challenges, primarily coastal and soil erosion, alongside water scarcity. These issues are exacerbated by more intense climate events than in the past, including extreme temperatures and variations in rainfall patterns, leading to a consistently increasing rate of erosion. This highlights the urgent need for targeted climate adaptation and mitigation strategies to address these growing environmental concerns.

Data Governance: Policies & Strategies

The **data governance** in the Region of Central Greece in the context of climate adaptation is currently under development, with certain aspects yet to be determined. There are strategic objectives for data governance outlined in the Strategic Environmental Impact Study and the Regional Operational Program for the 2021-2027 period. However, specifics regarding data quality rules, data quality indicators, key data challenges, data quality management practices, and budget allocation for data governance improvements are yet to be defined. This suggests that while there is an overarching strategy, the detailed framework and resources for data governance are still in the planning or evaluation stages.

The region's **data policies and processes** appear to be lacking or underdeveloped. Currently, there are no data management policies or procedures in place, no data certification schemes, and no established data risk and privacy metrics. Additionally, there are no explicitly identified key challenges regarding data management mentioned. This suggests a significant gap in the region's data governance framework, which could impact effective data handling and decision-making processes, particularly in areas critical to regional development and climate adaptation.

The regional key **data infrastructure** lacks comprehensive development and implementation across several critical areas in relation to climate adaptation. There are no defined processes for data classification, collection, processing, or usage, and the status of data storage processes remains to be determined. Furthermore, there are no data catalogues in place, nor are there established workflows to aid in finding and understanding relevant data. The absence of smart-metadata tools and tools for automation and scaling indicates a significant gap in the region's data management capabilities. This suggests a need for substantial development in the region's data infrastructure to support effective data governance and utilisation.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

The framework for **data stakeholders** involved in climate adaptation is partially defined. The specific stakeholders involved in data management such as collection, storage, and analysis are yet to be determined. However, data ownership is attributed to a range of entities, including Greek Cadastre datasets, WWF Greece, the European Environmental Agency, the General Secretariat of Civil Protection, the Ministry of Environment and Energy, National Weather Service datasets, the Hellenic Geological & Mining Research Authority, the Hellenic Statistical Authority, and Eurostat. The region has IT architects, data analysts, and systems experts in place, indicating a foundational structure for data management and analysis. However, details regarding third-party data providers, local data-observatory networks, and channels for collaboration with citizens and other stakeholders in data collection remain to be clarified. This suggests that while there is some established capacity for data management and analysis, further development and clarification are needed in the stakeholder engagement and collaboration aspects for climate adaptation data governance.

Current Datasets Used (or Usable) for Local Climate Adaptation Planning

The climate adaptation planning for the region of Central Greece utilises a comprehensive range of datasets, both climate-related and non-climate. Key data includes the Corine Land Cover, Greek Cadastre datasets, information from WWF Greece, Greek Fire service, Oikoskopio, the European Environmental Agency, European Nature Information System, various Forest Management datasets, Regional archive datasets, the Hellenic Ornithological Society, ACCOBAMS, the Database for Greek Nature – FILOTIS, datasets from the General Secretariat of Civil Protection, the Ministry of Environment and Energy, National and Hellenic weather services, the Forest Research Foundation of Athens, the Hellenic Geological & Mining Research Authority, the Hellenic Statistical Authority, Institute of SETE-INSETE, Eurostat, and the Hellenic Electricity Distribution Network Operator. These datasets are not only used for planning but also for understanding, communicating, and tackling local climate challenges. Local stakeholders in Central Greece directly use these climate datasets for various purposes, and all the mentioned providers supply these datasets. For some datasets linked to climate, some external expertise is required (the reasons for this are examined further below).

An interesting dataset identified during the contextualisation workshops was the state budget allocation for civil protection of the region of Central Greece. Although in the data survey no specific formatting was confirmed, such budgetary data is usually available in tabular form, often published as part of regional financial reports or annual expenditure breakdowns. The dataset is likely to be owned and managed by the Financial Directorate of the Region of Central Greece, possibly in collaboration with the General Secretariat for Civil Protection. Decisions on access and use would be controlled by these bodies, as well as relevant departments within the Ministry of the Interior or the Ministry of Climate Crisis and Civil Protection. Data updates would typically follow the annual budget cycle. Organisations that may use the data include regional civil protection authorities, municipal emergency services, regional planning departments and possibly NGOs or EU monitoring bodies. Access may be limited, especially at a detailed level, although summaries or aggregated figures may be available through official regional portals or national transparency platforms. While primarily used for budget management and compliance reporting, this dataset can serve as an important proxy for assessing institutional readiness and investment levels in climate-related disaster risk management. Civil protection spending includes funding for early warning systems, emergency preparedness, wildfire prevention, flood management and public safety infrastructure - all of which are increasingly critical in the face of climate change. By tracking year-on-year trends in budget allocations, decision-makers can assess whether funding is keeping pace with escalating climate risks, identify underfunded sectors or regions and advocate for increased investment in adaptation and resilience. The dataset could also be cross-referenced with risk exposure data (e.g. flood zones, wildfire-prone areas) to assess the alignment between funding and actual climate vulnerability. In the context of VALORADA, this dataset illustrates how financial and administrative data can reveal systemic strengths or gaps in climate adaptation planning.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

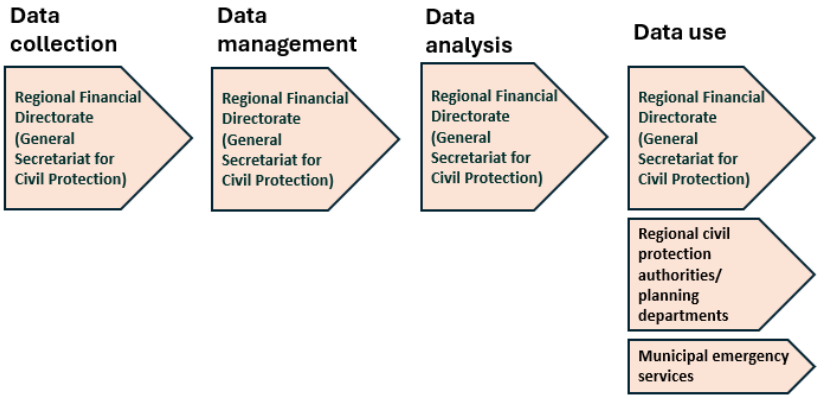


Figure 7 Schematic representation of "state budget allocation for civil protection" dataset value chain

Another relevant dataset relates to the indicator “population and housing data for flood risk exposure assessment” also identified during the workshops. The dataset that could inform such indicators is the population and housing census and can provide information on the percentage of dwellings and critical infrastructure (e.g. hospitals, fire stations, police stations) located near high-risk flood areas. It is likely to be based on national-level census and cadastral data, possibly combined with flood hazard maps. Mostly, the core data on population and buildings are maintained in tabular and vector formats (e.g. shapefiles of building footprints, addresses or geolocated infrastructure points). The Hellenic Statistical Authority (ELSTAT) is the likely owner of census data, while spatial information may also include the Hellenic Cadastre (Ktimatologio) and the Ministry of Environment and Energy, which manages flood risk maps. Access to these datasets is typically partially open - aggregated data may be freely accessible through ELSTAT, while more granular spatial layers often require user registration, licensing or special permissions, especially when linked to the national cadastre or civil protection services. This dataset has high strategic value for climate adaptation, particularly in the context of flood risk management and spatial resilience planning. By combining residential and infrastructure location data with maps of flood-prone areas, planners and emergency services can identify vulnerable populations, at-risk facilities and gaps in service accessibility during flood events.

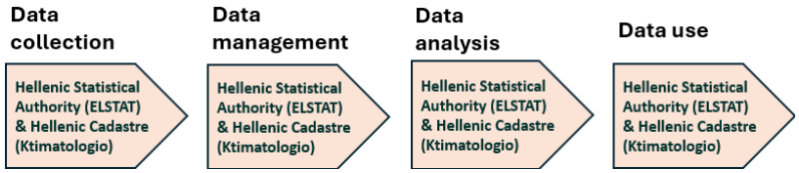


Figure 8 Schematic representation of "population and housing census" data value chain

This type of analysis supports proactive decision making in a number of ways:

- Informing urban planning policies that restrict future development in high-risk areas,
- Prioritising infrastructure upgrades or relocation of essential services,
- Supporting early warning systems and community-based disaster preparedness plans,
- Guide planning of emergency evacuation routes and resource allocation.

Outsourcing of data-related tasks - such as collection, management or analysis - is a common and necessary practice, driven by specific institutional and resource constraints. These outsourcing decisions are made on a case-by-case basis, rather than as part of a pre-defined strategic policy, and typically respond to limitations in technical expertise, funding, infrastructure, or urgent data needs that exceed the capabilities of the regional authorities. One of the most common reasons for outsourcing is the lack of in-house expertise and specialised technical knowledge. Certain tasks, such as remote sensing, drone surveys or geospatial modelling, require skills that the regional government does not have in-house. For example, satellite imagery and drone surveys to

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

monitor land use or deforestation are often carried out by private sector companies or academic institutions with expertise in GIS and environmental monitoring. These external actors are better equipped to manage complex data collection processes and provide high-quality inputs to regional planning and environmental strategies.

A second key factor is the limited financial capacity of the region. Central Greece does not always have the resources to sustain large, long-term data programmes or to maintain the necessary infrastructure itself. In such cases, outsourcing becomes a cost-effective solution. For example, the region relies on national institutions such as the Greek Ministry of Environment and Energy or the National Observatory of Athens for large-scale environmental monitoring. These institutions operate extensive sensor networks and provide data sets - such as air quality measurements or weather data - that are used for regional risk assessment and public health planning.

The region also faces infrastructure and capacity constraints. Large-scale surveys, socio-economic data collection or public health data analysis often require more robust processing and storage systems than are currently available at the regional level. In these cases, Central Greece partners with bodies such as ELSTAT (the Hellenic Statistical Authority) or universities, which provide both the technical infrastructure and trained personnel to manage complex datasets. This ensures that key regional indicators - such as employment levels, demographic trends or housing conditions - are collected and processed reliably. Outsourcing is also used when compliance with national or EU frameworks is required. For example, data on renewable energy, climate change mitigation or sustainable agriculture may be collected or verified by national ministries to meet the standards of EU directives such as the Renewable Energy Directive (RED II). In central Greece, this may involve working with the Ministry of Environment and Energy to collect data from solar or wind farms for national reporting. In addition, in emergency or high priority situations, the region outsources specialised research and data collection. For example, in the event of forest fires, external agencies or national emergency services may be contracted to map fire-prone areas, assess post-fire damage, or collect environmental health data for recovery planning. Such data are essential for informing future land-use regulations and adaptation strategies.

Finally, where data gaps exist - particularly in remote or ecologically sensitive areas - the region turns to specialised institutions such as the Greek Biotope/Wetland Centre (EKBY) or relevant NGOs to conduct field surveys. These actors bring expertise in biodiversity monitoring and ecosystem services, providing critical data to support regional conservation efforts and inform spatial planning. In short, the Region of Central Greece outsources data-related activities when specific needs - technical, financial, infrastructural or regulatory - exceed its internal capabilities. This flexible, problem-driven approach allows the region to access high-quality data and expert support while advancing its climate adaptation and regional development goals.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

In Central Greece, effective climate adaptation planning for floods involves various additional key datasets and pieces of information besides the ones currently in use, each with specific bottlenecks and opportunities. State budget allocations for civil protection require consolidation from diverse sources, suggesting the need for an open common database for streamlined access. Meteorological historical data, essential for predicting flood patterns, are collected from multiple levels but face operational challenges; enhancing station maintenance and network expansion is crucial. Data on the proximity of residences and critical infrastructures to high-risk flood zones, despite being available from multiple sources, confront GDPR and cost barriers, requiring legislative adjustments and increased collaboration for improved access and utilisation.

Additionally, data and information regarding professions highly dependent on weather conditions, sourced from the Regional Chamber of Commerce, are limited by the lack of registration of some professionals. Addressing this, increasing awareness and encouraging registration can enhance data completeness. Lastly, national legislation compliance data, pivotal for enforcing flood regulations, is available but often delayed in application, highlighting the need for strengthened self-compliance mechanisms. Collectively, addressing these datasets' challenges through technological, legislative, and collaborative efforts is vital for bolstering flood resilience and implementing effective climate adaptation strategies in Central Greece.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Summary: Region of Central Greece

	Data collection	Data management	Data analysis	Integration in decision-making	Data governance overall
Key Actors	Central Greece region Greek Cadastre datasets WWF Greece European Environmental Agency General Secretariat of Civil Protection Ministry of Environment and Energy National Weather Service Hellenic Geological & Mining Research Authority Hellenic Statistical Authority Eurostat	Central Greece region (support of ELSTAT and universities)	Central Greece region (support of ELSTAT and universities)	Central Greece region	Central Greece region
Status and Key Challenges	Ad hoc nature of data collection	Foundational structure in place, but lacking/underdeveloped policies and processes and lack of analysis of key challenges	Lack of capacity and competency for local stakeholders to use data	Well-established for decision-making/planning as well as communication	Under development/planning with many remaining open questions

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Conclusion

The region of Central Greece is in the early stages of developing a structured approach to data governance, particularly in relation to climate adaptation. While strategic goals have been outlined in documents such as the Strategic Environmental Impact Study and the Regional Operational Programme 2021-2027, the operational backbone of governance - such as data quality rules, indicators, management practices and dedicated funding - remains largely undefined. This indicates a gap between planning and implementation. Moreover, without established policies for data privacy, risk assessment, and certification, the region's ability to ensure consistent, secure, and reliable data management remains limited. Bridging this gap will require formalising responsibilities, securing budget allocations and translating strategic intentions into concrete, enforceable procedures.

This incomplete governance framework also affects the integration and interoperability of the region's data systems. While Central Greece has access to a wide range of relevant data sets - from national cadastres and meteorological services to EU institutions and NGOs - there is no central platform or infrastructure to connect them. Core functions such as data classification, cataloguing and workflow automation are lacking, making data sharing cumbersome and reactive rather than strategic. Without common standards or metadata tools, siloed data systems inhibit collaboration across sectors such as spatial planning, civil protection and agriculture - sectors that urgently need to coordinate in the face of increasing climate risks such as flooding and erosion.

Further complicating the picture is the region's limited implementation of data security and privacy protocols. While GDPR compliance is generally assumed, there is little evidence of a formalised security strategy that includes role-based access control, encryption or incident response planning. This has practical implications - especially when it comes to datasets with spatial and demographic sensitivity, such as population distribution near flood zones or civil protection budgets. Legislative and administrative simplification, coupled with more robust technical safeguards, will be essential to unlock the full benefits of such high-value datasets, while maintaining data integrity and citizen trust.

Despite these governance and infrastructure shortcomings, Central Greece benefits from a wealth of high-quality data on land cover, population, climate exposure and environmental monitoring. These datasets, collected by agencies such as the Hellenic Statistical Authority and the Ministry of Environment, are already being used for tasks such as risk assessment and climate communication. However, their fragmentation, inconsistent update frequency and lack of standardisation reduce their usability across departments. Local actors also face skills gaps in data interpretation and re-use, limiting their ability to turn data into actionable knowledge. To address this, the region needs to prioritise training programmes, better documentation and the introduction of visualisation tools that make complex data more accessible to both experts and decision-makers.

Encouragingly, despite these technical and organisational constraints, data is already being used to inform decision-making, particularly in areas such as flood risk planning and emergency preparedness. The use of budget allocation datasets as a proxy for adaptation investment, or of census data to assess infrastructure vulnerability, reflects a growing awareness of the strategic value of data. These examples show that the foundations for data-driven governance are in place, even if they have not yet been systematised. By embedding data in performance indicators, real-time dashboards and cross-departmental planning tools, Central Greece can move from being a reactive data user to a proactive, climate-smart region.

Criteria	Status	What is needed/priorities?
Data governance	Under development	Define operational governance framework, budget, and responsibilities
Data integration & interoperability	Weak integration	Establish shared infrastructure, catalogues, and metadata standards
Security and Privacy	Minimal	Develop security strategy and simplify data access protocols

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Data quality & usability	Patchy quality, low capacity	Standardise formats, provide training, develop visualisation tools
Data-driven decision-making	Embedded	Expand to include KPIs, dashboards, and institutional workflows

Strategic opportunities for Central Greece region:

- The lack of defined data policies, processes, and interoperability standards significantly weakens the impact of data already available.
- Stakeholder engagement and data literacy must be improved to enable wider, more inclusive use of data.
- Greater automation, cataloguing, and metadata use will help unlock underutilised datasets and reduce reliance on informal knowledge.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

4.4 Molise Region, Italy

The climate change impacts in the Molise Region, as part of Italy, can be understood within the broader context of climate change across the country. Italy experiences a mix of climatic conditions, including Alpine, Mediterranean, Peninsular, and Po valley climates. These conditions contribute to a diverse range of environmental and socio-economic impacts due to climate change. Italy is witnessing significant climate change effects, including rising temperatures, melting glaciers, an increase in extreme weather events such as floods and droughts, and more frequent and prolonged periods of drought. July 2021 saw heavy rains causing damage, followed by record temperatures a month later, illustrating the variability and extremity of recent climate events. The winter of 2022 also saw a notable decrease in precipitation, alongside an increase in average temperatures during both winter and summer months.

Regarding sea level rise, Italy, with its extensive Mediterranean coastline, is at risk. The IPCC's CMIP6 model projections under the SSP3-7.0 scenario indicate a potential sea level rise of 0.6±0.3 meters by 2100. This rise in sea levels could significantly impact coastal areas, leading to erosion, flooding, and affecting freshwater supplies due to saltwater intrusion. Energy-related CO2 emissions in Italy have shown fluctuations, with a strong growth until 2005 followed by a decline, reflecting shifts in energy consumption patterns and sources. The transport sector, including road, aviation, and shipping, contributes significantly to Italy's CO2 emissions, with road transport accounting for a major share. Efforts to regulate emissions, particularly in aviation and shipping, are ongoing to reduce the carbon footprint.

Local Climate Impact Challenges

The Molise region faces a spectrum of local climate challenges that significantly impact its environment, economy, and communities. Rising temperatures are a central concern, leading to heightened drought conditions that strain water resources and agricultural productivity. The Adriatic coastal area is particularly vulnerable to water level increases and extreme weather events, exacerbating the risk of land erosion. This variability in climate conditions directly affects agricultural production, creating uncertainty and potential losses for local farmers. Furthermore, the increased frequency and intensity of wildfires pose a serious threat to both natural and human-made landscapes, contributing to the loss of biodiversity. Together, these challenges underscore the urgent need for comprehensive climate adaptation and mitigation strategies to safeguard the Molise region's future.

Data Governance: Policies & Strategies

An analysis[22] of **data governance** in the Molise region indicates a lack of strategic objectives, quality rules, quality indicators, and management practices related to data governance. Key data challenges have not been identified, and no budget has been allocated to improve data governance structures. However, there are practices related to weather forecasts, climate data of the regional monitoring network, maintenance tenders for this network, and data quality analysis and evaluation that have been included for validation.

In terms of **data policies,** the Molise region shows an absence of formal data management policies or procedures, as well as a lack of a data certification scheme and metrics for data risk and privacy. However, it does implement specific standards, including WMO 1083 for the correct installation of measurement sensors and ISO 25010 for database quality. The key challenges identified in managing data within the region include data normalisation, the production of effective datasets, and enhancing open data availability.

With regards to key **data infrastructure** aspects, Molise region disposes of a limited framework primarily focused on meteorological data. There is no defined process for data classification, processing, usage, finding, understanding relevant data, smart-metadata tools, or automation and scaling tools. However, there are specific procedures in place for the collection and storage of meteorological data through the regional civil protection meteorological and rain gauge monitoring network. Additionally, a preliminary document exists within the regional civil protection GIS catalogue, although it is not effectively structured. Overall, the data infrastructure in

[22] This section refers to data governance and management in relation to locally-sourced non-climate and climate data within the context of understanding climate risks and climate adaptation measures.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Molise shows a focused approach on meteorological data with significant gaps in broader data management practices.

The Molise region has a focused approach to main **data stakeholders**, primarily centred around the Regional Civil Protection. The Molise Region and its Civil Protection Service are the primary data owners, managing the regional meteorological and rain gauge monitoring network. IT architects, data analysts, and systems experts are present, with specific roles within the Regional Civil Protection, indicating a structured approach to data management within this domain. However, there is an absence of third-party data providers, suggesting a reliance on internally managed data sources. The existence of local data-observatory networks, such as the regional civil protection meteorological and rain gauge monitoring network, highlights a specialised area of data focus. Collaboration with citizens and other stakeholders in data collection is emerging, with partly developed platforms under the Interreg ITA-HR E-Citizens project and the Interreg ITA-AL-ME To Be Ready project, indicating efforts towards participative data collection.

Current Datasets Used (and Usable) for Local Climate Adaptation Planning

The climate adaptation planning of the Molise region involves an integrated approach using several datasets and sources of information. Key data encompasses climate, socio-economic, and demographic information. Specifically, for climate understanding, the region uses the E-OBS observation dataset in combination with data from Molise Civil Protection for observed climate conditions, while future climate projections are based on the CMCC Dataclime. Socio-economic and demographic data are sourced from the National Institute of Statistics (ISTAT) 2019. Local stakeholders in Molise do not directly use these climate datasets, indicating a centralised approach to data analysis and application within the adaptation planning process. The climate data is provided by Molise Civic Protection, while socio-economic and demographic data are accessible from open-source platforms. The effective use of this climate data and information requires support from external expertise, underscoring the need for specialised knowledge in interpreting and applying these datasets within local adaptation strategies.

To take a closer look at one of the datasets identified during the contextualisation workshops, the dataset “Utilised Agricultural Areas” contains spatial and statistical information on the Utilised Agricultural Areas (UAA) in the region of Molise and is relevant for assessing the number of agricultural holdings at risk from climate-related hazards. The data are mainly used for the management of Common Agricultural Policy (CAP) payments and subsidies, the monitoring of agricultural land use and the monitoring of agricultural productivity and land eligibility. The dataset is owned and managed by AGEA (Agenzia per le Erogazioni in Agricoltura), the Italian agency responsible for CAP payments. It typically exists as a combination of vector data (e.g. agricultural parcels, land blocks, crop types) and tables with associated farm and subsidy information. AGEA oversees decisions on access and use, in coordination with regional agricultural departments and sometimes with Istat (the Italian National Statistics Institute) for analytical purposes. The dataset is restricted - access is usually limited to official users (e.g. regional authorities, CAP paying agencies, certified consultants) and is protected due to privacy concerns and EU subsidy regulations. Access usually requires institutional credentials or formal agreements with AGEA. Although originally created for subsidy management and agricultural monitoring, this dataset has clear value for climate adaptation, particularly in identifying and supporting farms at risk from climate impacts such as droughts, floods, heatwaves and shifting growing seasons.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

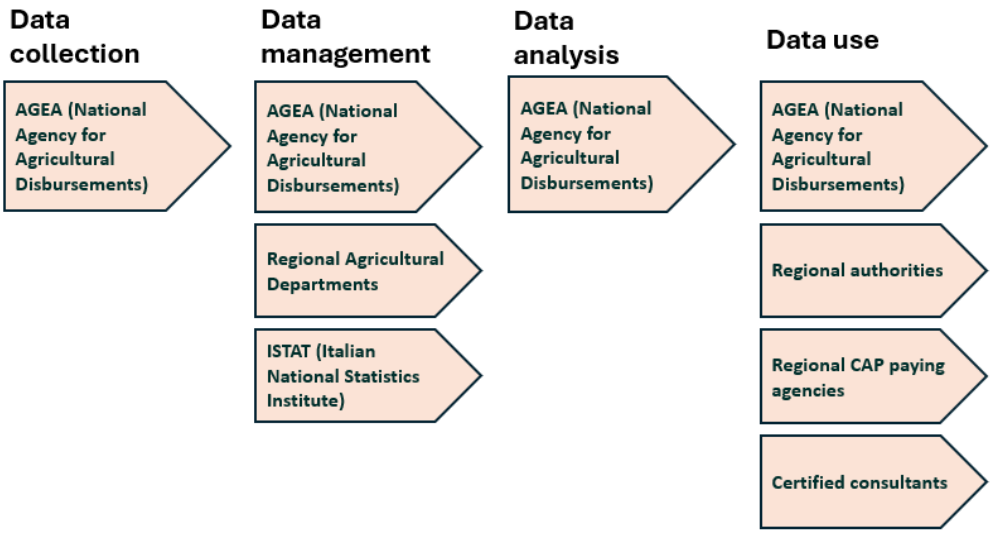


Figure 9 Schematic representation of "Utilised Agricultural Areas (UAAs)" data value chain

By linking land use parcels to farm identifiers and crop types, this data can help to:

- Assess which types of farms are most exposed to climate risks
- Identify farms operating in flood-prone or water-scarce areas
- Support regional risk mapping and analysis of the climate vulnerability of farming systems

It can also be overlaid with other spatial datasets - such as soil quality, slope or flood hazard maps - to assess compound risks and guide territorial adaptation planning. It illustrates nicely how a limited but high quality operational dataset maintained for administrative purposes can play a strategic role in contextualising climate risks particularly for rural economies.

The Regional Technical Map (Carta Tecnica Regionale) of Molise, another dataset of interest for Molise, provides detailed geospatial data on the region's road network, including road types, classifications and their spatial distribution. This dataset was identified to describe the "number and type of roads" indicator and is widely used in infrastructure planning, mobility management and regional development. Maintained in vector format for use in GIS, the dataset is categorised as political/administrative and geospatial data and plays a crucial role in territorial governance. It is owned and managed by Molise region (General Directorate for Territorial Government, Mobility and the Environment) which also decides how the data can be accessed or shared. Editing and updating of the dataset is likely to be carried out by technical units within the same Directorate. Although not fully open, the dataset is accessible on request, usually with formal permission from the relevant regional office. Although primarily intended for land and transport planning, this dataset has significant value for climate adaptation. As extreme weather events become more frequent, understanding the location and vulnerability of road infrastructure will be essential. The dataset can help identify transport corridors at risk of flooding, landslides or other hazards, and support decisions on where to strengthen infrastructure or implement preventative measures. It can also inform emergency response planning by identifying priority routes for evacuation and critical services.

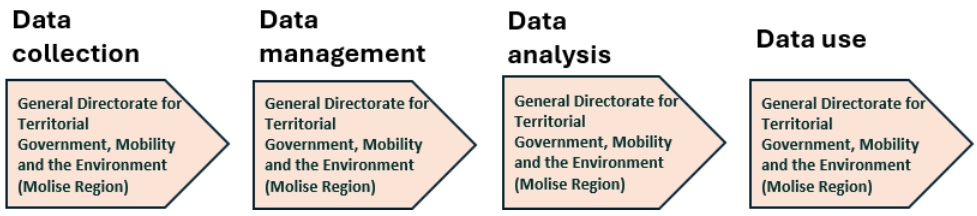


Figure 10 Schematic representation of the "Regional Technical Map" data value chain

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

With regards to collaborating with external entities, the region outsources aspects of data collection, management and access mainly due to limited internal expertise, funding and technical capacity. As in other regions such as Central Greece mentioned above, the regional administration lacks sufficient resources and specialised staff to manage complex datasets, particularly those related to climate monitoring, socio-economic trends and spatial planning. To fill these gaps, Molise often relies on external actors, including national agencies and research institutions, for data such as weather forecasts, air quality, environmental risks and socio-demographic indicators. For example, data used in climate adaptation planning may come from national ministries, the Italian Statistical Institute (ISTAT) or EU reporting bodies. Importantly, Molise benefits from the support of Molise Dati, an in-house public company that provides technical assistance in data management and IT infrastructure. This collaboration helps the region maintain operational continuity and ensures access to digital tools and platforms that it would otherwise lack. Overall, outsourcing in Molise is a strategic necessity, enabling the region to meet its climate and development objectives despite structural and resource constraints.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

In the region of Molise, climate adaptation planning includes a range of datasets and sources of information, each facing specific challenges, but also opportunities when targeted solutions are employed. Urban planning tools, provided by Municipal Administrations, face organisational constraints such as limited financial and human resources, and technological challenges including the need for adequate hardware and software. The suggested solutions involve overcoming these organisational limits and ensuring the availability of competent human resources. Civil Protection Plans, formulated by the Regional Civil Protection Service along with Provincial and Municipal Administrations, encounter similar organisational and technological hurdles, emphasising the need for improved resource allocation and the acquisition of skilled personnel. Soil permeability data, crucial for understanding flood risks and land use planning, are collected by various entities including ISPRA and ARPA Molise. The use of such datasets is hindered by cultural and organisational constraints, limited resources, and technological challenges. Solutions proposed include overcoming cultural barriers and organisational limits, as well as hiring knowledgeable staff. Terrain morphology data, essential for risk assessment and urban planning, sourced from CTR, orthophotos, and DTM, face similar challenges as soil permeability data. Addressing these issues requires overcoming cultural and organisational barriers and ensuring access to adequate technological tools and skilled professionals.

Summary: Molise Region

	Data collection	**Data management**	**Data analysis**	**Integration in decision-making**	**Data governance overall**
Key Actors	Molise region including CFD (Decentralised Functional Centre of Molise, Forecasting and Monitoring) Regional Civil Protection CMCC ISTAT ISPRA ARPA	Molise region with strong cooperation with Regional Civil Protection	Molise region with strong cooperation with Regional Civil Protection Partly support from external expertise	Molise region	Molise region

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

	Citizens (project-based) Molise Dati				
Status and Key Challenges	Integrated approach using several data sources; organisational hurdles to collect data faster/more efficiently	Lack of formal policies and procedures	Limited financial and human resources Technological challenges (need for adequate hardware and software)	Data used in climate adaptation planning, but various challenges remain for more effective use Climate and non-climate data are underappreciated currently, but could have greater impact when prioritised more (also due to poor use of software/specific tools to share and present data/analysis Absence of climate decision support system desirable for technical staff and local decision-makers for planning and design	Lack of strategic approach and objectives, key challenges not identified Quite poor currently with great room for improvement (if there were e.g. a data portal and relevant decision support tools

Conclusion

The Molise region faces a complex set of climate challenges - rising temperatures, prolonged droughts, coastal erosion and increasingly frequent wildfires - that threaten both its environment and its rural economy. Yet as the urgency of climate adaptation grows, the region's current data governance framework remains limited and underdeveloped. While some technical standards are being applied - such as WMO 1083 for meteorological sensor installation and ISO 25010 for database quality - there are no clear strategic goals, quality indicators or management practices. Budgetary support to improve governance is also lacking. Although some validation processes exist within the regional monitoring network, they are narrow in scope and mostly linked to weather and emergency monitoring. Without a coordinated governance structure or formal risk, privacy and quality control policies, Molise's ability to manage and mobilise data for long-term climate resilience remains limited.

This weak governance structure results in limited data infrastructure and integration capabilities. Most data activities revolve around the Regional Civil Protection Service, which manages meteorological and precipitation data through its monitoring network. However, outside of this domain, there are no defined processes for data

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

classification, processing, automation or use. There are no intelligent metadata tools or catalogues to support discovery and re-use. While GIS catalogues are emerging within the civil protection sector, they are not yet effectively structured or accessible. There is also little evidence of integrated data platforms or shared repositories across departments. As a result, although multiple datasets - on agriculture, terrain or infrastructure - are technically available, they remain isolated within administrative silos, limiting their wider potential for cross-sectoral adaptation planning.

Security and privacy measures are largely absent or informal. Although Molise follows basic compliance protocols tied to specific datasets (particularly those related to CAP payments or infrastructure), there is no system-wide approach to cybersecurity, data access control, or privacy management. Datasets such as the Utilised Agricultural Area (UAA) or flood-prone infrastructure information are often restricted by EU policy or data protection legislation, creating barriers to wider use. The lack of role-based access control or anonymisation policies limits the ability to safely expand access to valuable datasets that could inform targeted interventions, especially in rural and climate-vulnerable areas.

Despite these structural limitations, Molise has access to rich climate and non-climate datasets that can support adaptation. From E-OBS climate observations and CMCC projections to ISTAT socio-economic data and technical datasets such as the Regional Technical Map, the foundations are in place. However, many of these resources are under-utilised. Capacity gaps - both in terms of human resources and technical infrastructure - limit the ability of local stakeholders to fully interpret and apply this data. Tools for visualisation, data sharing and scenario analysis are largely lacking. The lack of a climate decision support system leaves staff without the analytical guidance needed to effectively integrate data into policy and planning. Cultural and organisational barriers, coupled with outdated or inadequate software and hardware, further weaken the data-to-decision value chain.

Nevertheless, there are promising steps towards embedding data in planning, particularly within the Regional Civil Protection Service and through European-funded projects such as Interreg ITA-HR E-Citizens and ITA-AL-ME To Be Ready. These projects introduce elements of citizen engagement and help build momentum for a more open, collaborative data culture. But to really move forward, the region needs to prioritise a strategic shift - from siloed data practices to coordinated, system-wide approaches. This includes establishing a regional data portal, adopting open standards, developing a decision support tool for technical staff, and investing in staff training and cross-sector integration. Addressing these structural gaps, Molise will be better positioned to leverage its existing data assets for proactive, inclusive and evidence-based climate adaptation.

Criteria	Status	What is needed/priorities?
Data governance	Under-developed	Establish a regional data strategy, define quality indicators, allocate funding
Data integration & interoperability	Weak	Create cross-sector data infrastructure and catalogues
Security and Privacy	Partial	Implement role-based access
Data quality & usability	Patchy	Improve documentation, staff training and introduce visualisation/analysis tools
Data-driven decision-making	Emerging	Build decision-support systems and dashboards

Strategic opportunities for Molise region:

- The region should prioritise the development of a formal data governance framework, including clear roles, quality standards, and dedicated funding.
- To support informed planning, a decision-support tool tailored to local needs - particularly in civil protection and land use - should be created.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

- Investing in staff training and technical infrastructure will boost data literacy and enable better use of existing datasets like agricultural land use and infrastructure maps.
- Expanding citizen engagement in data collection through participatory platforms will strengthen local ownership and improve the quality and relevance of climate adaptation efforts.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

4.5 Gabrovo and Burgas Municipalities, Bulgaria

The impacts of climate change in Gabrovo and Burgas are diverse. The cities and the surrounding region have a mix of continental and Mediterranean climates, with significant variations in temperature and precipitation. Gabrovo is subject to a continental climate, characterised by greater temperature fluctuations, while Burgas has a more Mediterranean climate, known for its hot and dry summers and cool winters.

Over the past century, both cities have experienced a gradual warming trend, with an increase in the intensity and duration of heat waves, particularly in Burgas. This trend is expected to continue, affecting various sectors including agriculture, forestry and water resources. Seasonal variations in precipitation have led to short-term increases, resulting in flooding, particularly around Burgas, while both cities face challenges related to water scarcity. These impacts require robust adaptation measures based on sound data management and data sets to mitigate the impacts of climate change on the environment, economy and people of Gabrovo and Burgas.

Burgas Municipality

Local Climate Impact Challenges

The Burgas region faces some local climate challenges, mainly related to excessive and intense rainfall. Other challenges faced by the municipality are higher temperatures and the risk of droughts and fires, taking into account the impact of climate hazards on the wetlands of the nearby lakes, which are part of the NATURA 2000 protected areas.

In the territory of Burgas Municipality, climate change is mainly manifested in the rainy component of climate contrasts - flash floods and sea floods. As a result of heavy rainfall, large and small floods occur: streets are filled with water, traffic is stopped, asphalt surfaces are damaged; serious damage to buildings and infrastructure, accidents and deaths are recorded; sewage overflows during heavy rainfall cause sanitary problems for drinking water and coastal waters. Heavy rainfall causes problems in the operation of sewage treatment plants where there is no separate storm water drainage system. One of the most unpleasant effects of heavy rainfall is the over-wetting of the slippery surfaces between the layers of earth of stabilised landslides, increasing the risk of their reactivation.

Data Governance: Policies & Strategies

There are **strategic objectives** on climate adaptation outlined in the Integrated Development Plan of Burgas Municipality 2021-2027, the River Basin Management Plan, and the Sustainable Energy and Climate Strategy and Action Plan 2021-2030, but there are no strategic objectives on data governance, established data quality rules, indicators or management practices, and no dedicated budget is allocated.

In terms of **data policies and processes**, Burgas Municipality shows a lack of formal data management policies or procedures, as well as a lack of data certification scheme and metrics for data risk and privacy. However, there are some specific guidelines and policies in place, such as for extreme temperatures and water availability, as well as the digitalisation and modernisation agenda. In response to these challenges, a Plan for the Protection of the Municipality of Burgas in the Event of Disasters has been prepared. The plan includes a specific part called "Flood Protection Measures" (medium term), with defined measures, rules for action in case of emergency - emergency restoration of infrastructure and protection of life and health of people. The measures are approved on a case-by-case basis when a critical situation occurs.

The regional key **data infrastructure** includes the Smart Burgas - Integrated Urban Platform. The city platform integrates data from sensor networks and enables real-time video streaming from city CCTV cameras. The dashboard synthesises data on road conditions, city traffic, roads under repair, parking, sports facilities, weather, air pollution and water levels. The platform provides the city administration with online real-time city management information, data visualisation, interaction between systems, application of intelligent scenarios, ability to make quick decisions, planning and development support, statistics and reports.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Among the **data stakeholders** involved in climate change adaptation is the Burgas Municipality Department for Strategic Development and Ecology, Digitalisation and Climate Change Adaptation, which is responsible for climate change adaptation planning, as well as the Burgas Smart Platform experts. The information on the platform is available to the residents and guests of Burgas for: real-time signalling in the surveys and polls module; participation in decision making; review of traffic and parking situation; support for clean mobility; navigation and route provision; smart public space; public data access.

Current Datasets Used for Local Climate Adaptation Planning

Climate adaptation planning for flooding makes use of a wide range of data sets, both climate-related and non-climate related. The municipality has flood risk maps, which were compiled from geo-tagged photographs, other images and a walkthrough - visual survey of the surrounding area, structure of the relief - slope, size of the watershed, passability of the riverbed, presence of residential buildings near the riverbed, etc., as well as specific sites for geodetic survey - location of cross profiles, frequency of profiles. In addition, specific locations were marked for geodetic surveying - location of cross sections, frequency of sections of different locations, surveying of specific partition walls, bridge structures, etc. with a drone.

Other datasets collected by official authorities include socio-economic and demographic data (National Institute of Statistics), including population registers, meteorological data, etc. Local stakeholders do not directly use these climate data sets, indicating a centralised approach to data analysis and application within the adaptation planning process. Some of the climate data and information for Burgas requires support from external expertise in order to be used or analysed (more details on this below).

As an example, the dataset “Number of days with extreme temperatures” which was identified during the contextualisation workshops will be explored here in greater detail. It records the number of days per year with extreme temperatures in the city of Burgas and is used to monitor climate variability and assess heat-related risks. It is available in both tabular and GIS-based formats, allowing spatial analysis and integration with other layers in geographic information systems. The data fall under the categories of climatic and geographic data and are an important input for local decision-making in urban planning, public health and risk management. The dataset is owned and managed by the Municipality of Burgas, with technical support provided by Innovative Systems Burgas Ltd, a municipal company responsible for managing the city's digital infrastructure. Policy-level decisions on the use of the data are made by the City Council, in cooperation with experts from the city administration and data system managers. The data is automatically derived from sensor networks and meteorological systems managed by the city's smart infrastructure. It is currently used by systems such as the Integrated Information System for Water Management and Flood Risk and the Smart Burgas Urban Platform where it supports both climate risk monitoring and real-time response mechanisms. While parts of the dataset are available through open access channels, full access to the entire dataset is restricted. Selected data can be obtained for a fee and wider use is restricted to registered experts, data operators and city administrators. Access requires passwords and permissions, and the dataset is stored within the city's data infrastructure, with no external API currently available.

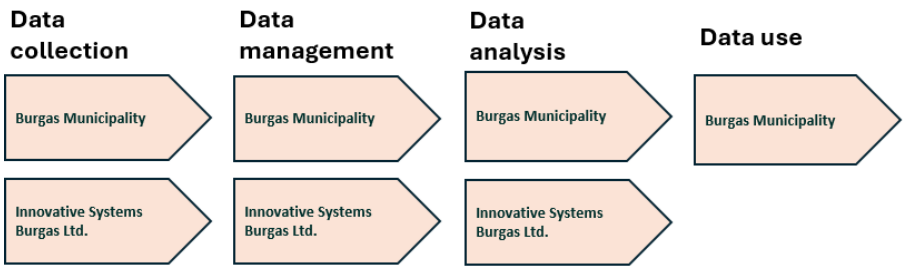


Figure 11 Schematic representation of "numbers of days with extreme temperatures" data value chain

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

It has significant value for climate adaptation planning, particularly in addressing urban heat risks. By tracking the frequency of extreme temperature days, city authorities can monitor how climate change is intensifying heat events over time and identify vulnerable urban areas. This information can inform the design of urban cooling strategies, such as the placement of green infrastructure, reflective surfaces or heat-resistant public spaces. It can also support public health interventions, such as targeted awareness campaigns or the provision of cooling shelters during peak heat periods.

A second dataset to be looked at more closely here is the records on the number of fires within the territory of Burgas Municipality, as recorded through reports received by the Municipal Dispatchers' Call Centre. It provides a detailed, event-based record of fire incidents and is maintained in tabular form, typically as digitised Excel files. The data falls into several overlapping categories, including social and demographic data, risk and protection, environmental impact, public safety and critical infrastructure resilience. Ownership, management and control of the dataset is fully centralised within the Municipality of Burgas. The Municipality is responsible for updating the dataset, determining its use and managing access policies. The data is currently used exclusively within the municipality, in particular by experts responsible for civil protection, emergency planning and urban security management. The dataset is not openly accessible, is restricted to internal use by authorised experts within the municipality and not available through a public repository or platform. It remains stored locally in the municipality's data infrastructure and is not currently connected to external systems or open data platforms. However, it is well organised and digitised, allowing for analysis and cross-referencing with other spatial or demographic datasets as required.

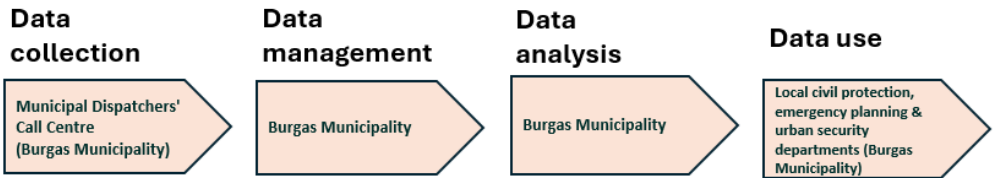


Figure 12 Schematic representation of "Number of fires" data value chain

From a climate adaptation perspective, this dataset would be highly valuable for understanding and mitigating fire risk in the urban and peri-urban environment of Burgas. As climate change continues to increase the frequency and severity of droughts and heat waves, fire risk is a growing concern - particularly in areas where vegetation, urban expansion and critical infrastructure overlap. By tracking fire events over time and analysing their geographical distribution, the municipality can identify fire-prone areas, assess the vulnerability of infrastructure and communities and plan preventive or adaptive measures accordingly. This dataset can support a range of strategic planning activities, from improving the allocation of firefighting resources and updating evacuation plans, to informing public awareness campaigns and adjusting zoning regulations. When integrated into broader urban resilience frameworks or smart city platforms, it can further enhance the city's capacity for real-time response and long-term risk reduction.

In addition, Burgas outsources certain data-related activities - such as collection, management and analysis - mainly due to limited internal expertise, capacity constraints and the technical complexity of certain tasks. While Burgas operates the sophisticated Smart Burgas Integrated Urban Platform, certain functions, especially those related to hydrological modelling, remote sensing or post-disaster assessments, require specialised knowledge not available in-house. Rather than being guided by a comprehensive strategy, outsourcing in Burgas is done on a case-by-case basis, depending on the task at hand and the internal resources available. As noted by local experts, the city turns to external providers when municipal staff do not have the skills or capacity to perform certain tasks. These services are procured through formal procedures in accordance with the Public Procurement Act of the Republic of Bulgaria, ensuring legal compliance and transparency. In areas such as climate risk monitoring, emergency response or environmental data analysis, Burgas works with national institutions, private consultants or research organisations that bring the necessary technical expertise. This enables the municipality to respond effectively to urgent or complex challenges, while aligning its data practices with national and EU

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

standards. This approach allows Burgas to pursue evidence-based planning and operations even in the absence of comprehensive in-house capabilities.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

The Municipality's data collection process is not fully effective due to limited public access to data, a lack of developed methodology, and some databases still being non-digitised. Additionally, there is a lack of expertise in data management, storage, processing, and analysis. The Municipality is taking various climate adaptation measures, including raising public awareness about climate change and its impacts, monitoring and forecasting, introducing management best practices for adaptation, and providing information on climate change and its impact.

The strategic documents of the Municipality outline indicators associated with climate change adaptation, including good practices. The aim of this project is to reduce damage caused by floods, landslides, collapses, and coastal erosion, as well as limit the risk of forest and field fires during extreme temperatures. Additionally, the municipality aims to reduce its carbon footprint and provide a reliable drinking water supply while also minimising the risk to biodiversity. To achieve these goals, it will introduce 24/7 monitoring of water levels in riverbeds and dams.

The Municipality is involved in several EU projects related to climate resilience and adaptation. This participation helps to improve their knowledge and expertise through the project results and provides opportunities for collaboration with leading EU organisations in the field of climate adaptation. It also allows for exchange with pilot regions from Europe. To ensure professionals have sufficient expertise in digital technologies, expert training is required. To enhance interaction and communication between data owners and users and provide access to information, a legislative framework should be developed, including standardised data collection methodologies. These steps, along with the development of specialised tools, will support the climate adaptation capabilities of the Municipality.

Summary: Burgas Municipality

	Data collection	Data management	Data analysis	Integration in decision-making	Data governance overall
Key Actors	Burgas Municipality Burgas Smart Platform experts Civil Protection Service Fire safety authority Ministry of Interior Regional Directorate for Environmental Protection River Basin Directorates	Burgas Municipality in cooperation with Innovation Systems – Burgas LTD	Burgas Municipality River Basin Directorate Third-party organisations/experts	Burgas Municipality	Burgas Municipality

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

	National Institute of Statistics				
Status and Key Challenges	Not fully effective due to limited public access to data, lack of developed methodologies and non-digitised data	Absence of data management plan, policies or procedures Lack of expertise in general	Lack of capacity and competency Need of professional training	Fairly advanced, e.g. use of (non)climate data reflected in Strategy for Intelligent Transformation of Burgas	Strategic data objectives mentioned in other plans, but no dedicated data governance; data plays a big role in many projects, programmes and strategies. Burgas's data use is example for many other Bulgarian municipalities

Conclusion

The Municipality of Burgas is acutely aware of its local climate risks, in particular intense rainfall, urban and sea flooding, and increasing risks of drought and forest fires - many of which affect the nearby NATURA 2000 wetlands. These threats have led to a range of strategic planning initiatives, from disaster risk management plans to climate strategies. But while climate adaptation is firmly on the municipal agenda, data governance itself is not formally structured. Strategic goals for climate adaptation exist in several official plans, but there are no clearly articulated data governance goals, quality rules, or allocated budgets to ensure long-term consistency or oversight. Climate data governance remains fragmented and often reactive, activated primarily in emergency contexts such as floods or landslides.

Despite this governance gap, Burgas has made strong progress in terms of digital infrastructure and integration. A key achievement is the Smart Burgas Integrated Urban Platform which consolidates real-time data from sensor networks, cameras and weather systems into a single dashboard. The platform supports mobility, air and water monitoring, infrastructure management and even citizen engagement. Beyond this flagship initiative, however, there are no broader interoperability standards, metadata tools or a central data catalogue, which limits the reusability of other datasets (such as flood maps or socio-economic data). The Smart Burgas platform is a strong foundation, but expanding its scope to support other departments and use cases would enable more systemic climate planning.

In terms of data security and privacy, access to sensitive datasets - such as those tracking extreme temperatures or fire events - is restricted and managed by Burgas Municipality. Some datasets are partially open (e.g. climate observations), but full access is controlled by internal permissions and password-protected systems. While access protocols exist, there is no formalised privacy policy or cybersecurity framework, nor are there role-based access systems that would allow for different levels of transparency. As Burgas processes increasing amounts of personal and sensor-based data, building a consistent privacy and access control model will become increasingly important - especially as the city seeks to expand public participation and transparency.

In terms of data quality and usability, Burgas scores relatively well, particularly for datasets used in flood prevention and real-time monitoring. High-quality resources, such as the extreme temperature days dataset (integrated into the GIS) or the municipal fire incident records, are well maintained, digitised and used for climate

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

risk monitoring. However, the overall ecosystem still suffers from fragmentation, lack of common methodologies and non-digitised legacy data. Public access is limited, and data literacy remains uneven across departments. Many local stakeholders require external expertise to interpret complex datasets or use them effectively in planning, reflecting a need for internal capacity building.

Encouragingly, Burgas has a clear political commitment to data-driven climate action, particularly through its participation in EU projects and its Intelligent Transformation Strategy. The municipality is already using datasets for heat risk monitoring, smart mobility, infrastructure planning and flood management. While much of the data analysis and modelling is still centralised, these examples show that Burgas is already aligning real-world climate planning with digital innovation. Formalising this by developing a municipal data management plan, integrating climate KPIs into strategic workflows, and building a decision support system for technical staff would help sustain and scale this momentum. In many ways, Burgas is an example for other Bulgarian municipalities, but to unlock the full potential of its data, it needs to move from project-based excellence to a system-wide, institutionalised model.

Criteria	**Status**	**What is needed/priorities?**
Data governance	Developing	Data strategy, appropriate budget, quality and access standards
Data integration & interoperability	Limited	Expansion of Smart Platform scope; develop metadata/catalogues for wider system use
Security and Privacy	Weak	Access control frameworks, data protection policy, and open data layers
Data quality & usability	Patchy	Increased digitisation, standardise methods, and build staff capacity
Data-driven decision-making	Emerging	Create KPI-linked planning tools and decision-support systems across departments

Strategic opportunities for Burgas Municipality:

- Burgas should formalise its data governance structure by introducing dedicated goals, standards, and a sustainable budget for data management.
- It can expand the Smart Burgas platform to support planning beyond infrastructure and mobility, incorporating climate and socio-environmental data.
- Investing in staff training and methodology standardisation will help departments better understand and apply data in decision-making

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Gabrovo Municipality

Local Climate Impact Challenges

Gabrovo is experiencing significant local climate challenges, including increasing temperatures and droughts. These conditions are negatively impacting forests, urban ecosystems, and public health. Key issues include higher temperatures in urban areas and surrounding settlements, with urban ecosystems experiencing drought and warming. The city and its surrounding region are experiencing warmer winters and more frequent summer droughts, especially in the mountainous areas. To calculate the probabilities of drought, prolonged drought periods, and heat waves, different metrics are necessary. These metrics are defined by days when the maximum temperature exceeds a certain local climatic threshold. As a result, the city is experiencing changes in its climate patterns, which have significant implications for its natural environment and community well-being.

Data Governance: Policies & Strategies

The municipal authorities in Gabrovo are responsible for managing energy resources efficiently and addressing climate change impacts. They are mandated to engage in municipal energy planning as per the Energy Efficiency Law. This includes programs such as refurbishing buildings for energy efficiency and implementing energy-saving measures in public infrastructure. Gabrovo Municipality joined the Covenant of Mayors initiative in 2013 and presented a Sustainable Energy Action Plan for the period 2015-2020. The plan aims to reduce CO2 emissions by 24% by 2020 compared to 2008 levels. Gabrovo is also integrating adaptation measures to climate change through initiatives outlined in the Strategic Urban Development and Energy Concept Plan. These initiatives focus on aspects such as urban greenery, flood prevention, and fire safety. Gabrovo is one of 100 cities committed to achieving carbon neutrality. In 2021, the municipality won the European Commission's environmental award, the 'European Green Leaf'. Last year, the Municipality of Gabrovo adopted an Action Plan for sustainable energy and climate until 2030.

However, when it comes to the objectives for governing climate change adaptation data in Gabrovo Municipality are not defined, and there are no established data quality rules, indicators, or management practices. The municipality has not identified key data challenges, nor has it allocated a dedicated budget for improving **data governance**. Additionally, the municipality's approach to **data policies and processes** lacks formal structure and emphasis. The city's administration currently lacks established data management policies, procedures, and certification schemes. Data management is not a priority due to challenges such as limited financial resources, personnel availability, and management documentation.

Gabrovo's primary **data infrastructure** for climate adaptation includes the Gabrovo GIS and Gabrovo Green, an interactive portal for visualising environmental data in the Municipality of Gabrovo. The aim is to inform citizens and encourage engagement with environmental and climate issues. The municipality is **collaborating** with government agencies, businesses, NGOs, and the scientific community to increase capacity and awareness of climate change adaptation and mitigation strategies. External expertise is required to utilise climate and climate-related data.

Current Datasets Used for Local Climate Adaptation Planning

Gabrovo Municipality's Geographic Information System (GIS) provides valuable data through interactive maps on web-based spatial applications. The GIS modernises conventional management methods, enabling informed decision-making for citizens and businesses, and effective management and analysis of urban processes. This aligns with the municipality's vision for sustainable development.

The National Statistical Institute collects socio-economic and demographic data, as well as meteorological data, which is not directly used by local stakeholders in the adaptation planning process, indicating a centralised approach to data analysis and application.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

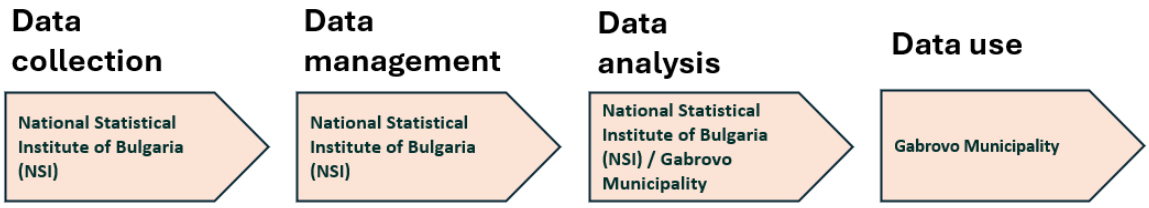


Figure 13 Schematic representation of "socio-economic data" value chain

External expertise is required to support some of the climate data and information for Gabrovo. This outsourcing happens mainly in relation to data collection, management or analysis illustrates a pragmatic response to internal limitations in expertise, capacity and infrastructure. While the municipality has developed tools such as the Gabrovo GIS and actively participates in environmental and climate initiatives, many specialised tasks - such as geospatial analysis, environmental modelling or advanced data processing - are beyond the skills or workload capacity of municipal staff. Importantly, there is no overarching policy on outsourcing; instead, like in Burgas, it is handled on a case-by-case basis, depending on the complexity of the task and the internal resources available. As confirmed by local experts, when responsibilities exceed what can be managed by the municipality's staff, external providers are engaged according to the Bulgarian Public Procurement Act. Outsourcing is typically used for climate-related research, sectoral assessments or urgent data needs - for example, studies on biodiversity, forest health, flood risk or energy performance. These tasks often involve working with national agencies, academic institutions or specialist consultancies mentioned above that can provide the technical depth and tools not available locally.

Key Bottlenecks & Opportunities for Maximum Data Value Extraction

Improving policy coherence and coordination of climate change initiatives across different sectors is a recurring issue in sectoral assessments, including reports on forests and healthcare. Reports on urban environments highlight the issue of diverse strategies developed at the municipal level, such as green infrastructure, natural disasters, and energy efficiency, which overlap in content but lack coordination. The water sector report highlights the lack of synchronisation among different legal acts. Similarly, the report on Biodiversity, Ecosystem Services, and Climate Change (BESCC) emphasises the distribution of institutional capacity among different institutions. These institutions' mandates do not include the preservation and development of ecosystem services crucial for adaptation and may even lead to their reduction. Measures for implementation should have clear delineation of responsibilities and mandates for different entities. A specific gap, outlined in the context of BESCC and related to gaps in knowledge and data, is the need to simplify and expedite decision-making. This can be achieved by applying a unified environmental database to be used by decision-makers, as well as developing tools for analysing compromises in decisions.

There is a need to improve the integration of climate change adaptation and mitigation into sector-specific legislation and other documents. The transportation sector has specific gaps in regulations and guidelines, particularly in the design of roads, railway bridges, watercourses, and drainage facilities. The approach is to address infrastructure issues on a case-by-case basis, rather than as part of structured and planned efforts to tackle the impacts of climate change. The water sector, for example, has gaps in legislation, such as those related to rainwater collection and the use of purified water, as well as in design standards. To make resource-efficient decisions at the regional and local levels, it is important to consider co-benefits and assess compromises. This requires better coordination of policies.

Gabrovo is currently working on several EU projects related to climate resilience and adaptation. As part of this effort, the municipality is improving internal communication among its departments to ensure better dissemination of information and data. The data collection process for Gabrovo Municipality is not fully effective due to limited public access to data and the absence of a developed data collection methodology. Additionally, some databases remain undigitised. There is a lack of expertise in data management, storage, processing, analysis, and climate data. However, these challenges can be addressed by developing regulations for data

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

management, training experts, transferring knowledge, and creating climate adaptation tools to enhance Gabrovo Municipality's capacity to adapt to climate change.

Summary: Gabrovo Municipality

	Data collection	Data management	Data analysis	Integration in decision-making	Data governance overall
Key Actors	Gabrovo National Statistical Institute	Gabrovo	Gabrovo Third-party expertise	Gabrovo	Gabrovo
Status and Key Challenges	Not fully effective due to limited public access to data and absence of a developed data collection methodology	Lack of established data management policies and procedures Lack of financial and human resources	Lack of capacity and competency for local stakeholders to use data	Fairly good with room for improvement with some analyses and reports based on climate-related data	Lack of strategic approach, (financial and human) resources, instruments, and capacity

Conclusion

Gabrovo is increasingly exposed to climate challenges such as higher temperatures, prolonged droughts and seasonal shifts that affect forests, ecosystems and human health - especially in its urban and mountainous areas. The municipality has shown strong environmental ambition, with active participation in initiatives such as the Covenant of Mayors and the development of a Sustainable Energy and Climate Action Plan (SECAP). However, while Gabrovo's planning documents demonstrate environmental awareness, there is currently no defined data governance strategy in place. No formal objectives, quality standards or data-specific budgets have been allocated to support the consistent use, management and expansion of climate-related datasets. Without an overarching data governance framework, progress on climate adaptation will be hampered by fragmented responsibilities and underdeveloped systems.

In terms of infrastructure and interoperability, Gabrovo has launched digital tools such as Gabrovo GIS and Gabrovo Green, which provide interactive environmental data to the public. These platforms provide valuable spatial insights and are in line with the city's vision for transparency and sustainable urban development. However, many datasets remain undigitised and integration across departments or sectors is minimal. While the GIS supports local visualisation and planning, it is not yet fully embedded in cross-sectoral decision-making or linked to national systems, such as those managed by the National Statistical Institute. Without common data standards, metadata systems or a unified platform, Gabrovo's ability to scale up its use of climate data remains limited.

In the area of data security and privacy, there is little evidence of formalised systems or safeguards. While Gabrovo handles a mix of environmental, demographic and GIS data, there is no mention of defined access protocols, anonymisation policies or cybersecurity measures. This is particularly important when integrating open data platforms or inviting citizen participation in climate monitoring. A consistent framework for data protection, access rights and licensing is needed, especially as the city begins to involve more stakeholders and public actors in its climate strategies.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

When it comes to data quality and usability, the picture in Gabrovo is mixed. While the municipality makes use of environmental data through its GIS tools and reports, the overall capacity to manage, store and analyse data remains weak. Data literacy is low, and many departments rely on external expertise to interpret or operationalise climate data. There is also a lack of standardised methods for data collection, and many datasets are not easily accessible to the public or across city departments. These challenges can be addressed by investing in digitisation, formalising internal data workflows and launching targeted training initiatives for municipal staff.

Despite these hurdles, Gabrovo has begun to integrate climate data into strategic planning, particularly through EU projects aimed at building local resilience. The city's recognition as a European Green Leaf Award winner signals its potential to be a leader in sustainability practices, and its ongoing efforts to coordinate climate-related efforts across departments are encouraging. However, policies on energy, water, transport and biodiversity remain uncoordinated and often overlap without common indicators or accountability. To realise its ambitions for carbon neutrality and ecosystem resilience, Gabrovo needs a unified, data-driven approach built on a foundation of institutional clarity, digitised systems and cross-sectoral alignment.

Criteria	**Status**	**What is needed/priorities?**
Data governance	Under-developed	Define data strategy, allocate resource
Data integration & interoperability	Low integration & digitisation	Develop unified platform, standardise formats, improve cross-department sharing
Security and Privacy	Lack of policies	Create data protection policy, introduce access tiers and privacy safeguards
Data quality & usability	Low	Train staff, digitise data, introduce collection standards and visualisation tools
Data-driven decision-making	Emerging	Integrate data into all planning processes, establish indicators and dashboards

Strategic opportunities for Gabrovo Municipality:

- Gabrovo should establish a Municipal Data Governance Strategy to provide coordination, sustainability and the foundation for future data-driven climate adaptation.
- The municipality should improve internal capacity through staff training to empower departments and reduce depend on external actors and strengthen in-house expertise on data management.
- Gabrovo should continue to digitise and standardise data collection and management to improve the usability of data.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

5. General Recommendations across Demonstrators

The interactions and exchanges with representatives in local and regional authorities have been very constructive. The activities related to data collection (LCIPs, workshops, data surveys and (ongoing)interviews) provided a great amount of information for analysis. The local data ecosystems in the five demonstrator cities and regions face both challenges and opportunities regarding the use of data for climate adaptation planning. The analysis findings provide practical recommendations to shape and enhance activities in the data value chain for climate adaptation. These can be summarised and distilled into the following key recommendations:

1. Enhance internal communication and collaboration: cities like Přerov need to foster internal communication to break down silos between departments. This would lead to a more integrated approach to climate adaptation, leveraging cross-departmental resources and expertise.

2. Improve data management and accessibility: inadequate data management and documentation are common issues. Cities should invest in upgrading data management systems, implementing robust data documentation practices, and ensuring data accessibility. This will facilitate informed decision-making and strategic planning for climate adaptation.

3. Invest in technical tools and expertise: the lack of advanced technical tools and expertise hampers effective climate adaptation measures. Cities should invest in modern technical tools and training for their workforce to enhance their capability to analyse and manage climate-related data effectively.

4. Address legal and organisational constraints: challenges such as GDPR regulations in Mladá Boleslav and organisational limits in Molise need to be addressed. This involves reviewing and possibly revising regulations, improving resource allocation, and ensuring the availability of skilled personnel.

5. Leverage and integrate external resources and expertise: utilising regional servers, open data platforms, and collaboration with EU projects and other external entities can provide valuable resources and knowledge, as seen in Occitanie and various municipalities.

6. Develop and implement standardised methodologies: the lack of developed methodologies and standardised data collection processes is a common bottleneck. Cities should develop and implement standardised methodologies for data collection, storage, processing, and analysis to enhance consistency and reliability.

7. Prioritise political commitment and resource allocation: The lack of political prioritisation and inadequate funding are significant obstacles. Elevating the importance of climate adaptation in political agendas and ensuring adequate resource allocation are essential for implementing effective strategies.

8. Strengthen sectoral coordination and policy coherence: As noted in sectoral assessments, there is a need for improved policy coherence and coordination across different sectors and levels of government to ensure that climate adaptation efforts are integrated and effective.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

9. Enhance public awareness and participation: increasing public awareness and encouraging the participation of residents and professionals can help to improve data completeness and the overall effectiveness of climate adaptation measures.

10. Adopt and adapt to legal and regulatory frameworks: adjusting to national legislation and GDPR constraints, while also advocating for changes that facilitate better climate adaptation planning, is crucial for overcoming data accessibility and utilisation challenges.

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837