CLIMAAX
climate ready regions

Deliverable Phase 2 – Climate risk assessment

Gestion Responsable Et Environnementale du Nord 59

(Responsible and environmental Management in the Nord)

France, Departement du Nord

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HORIZON-MISS-2021-CLIMA-02-01 - Development of climate change risk assessments in European regions and communities based on a transparent and harmonised Climate Risk Assessment approach

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1. Document Information

Deliverable Title	Phase 2 – Climate risk assessment
Brief Description	This report presents the results of Phase 2 of the CLIMAAX project for the Nord department. It presents the preliminary results of the risk and impact analysis across the territory, as well as the limitations and guidelines identified. This phase has provided a clearer understanding of the organisation's vulnerabilities and enabled engagement with stakeholders.
Project name	GREEN 59 – **G**estion **R**esponsable **E**t **E**nvironnementale du **N**ord *(Responsible and Environmental Management in the Nord)*
Country	France
Region/Municipality	Département du Nord
Leading Institution	Département du Nord
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5.0	…		Final version to be submitted

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5. Abbreviations and acronyms

Abbreviation / acronym	Description
ADEME	French Agency for Ecological Transition
BRGM	French Geological and Mining Research office
AFB	French Biodiversity Agency
CCA	Citie's catchment area
CCAS	Communal Social Action Centres
CD2E	Development Centre for the Eco-Transition of Enterprises and Territories
CEN	Conservatory of Natural Areas
CERDD	Sustainability Resource Centre
CNRS	National Center of Scientific Research
CRA	Climate Risk Assessment
CRM	Climate Risk Management
DDRM	Departemental Major Risks File
DDTM	Departmental Directorate of Territories and the Sea
DREAL	Department of Environment, Planning and Housing
DGAST	Deputy General Directorate for territorial solidarity of the Departement du Nord
DPE	Energy Performance Diagnosis
ENN	Natural areas of the North
GIEC / IPCC	Intergovernmental Panel on Climate Change
GREC	Regional expert group on climat
HQE	High environmental quality
INSEE	National Institute of Statistics and Economic Studies
IRIS	Statistical information groupings
ORC	Regional Climate Observatory
PCA	Activity Continuity Plan
PCRS	Simplified Street Corps Plan
PLUI	Local inter-communal urban development plan
PPI	Multi-year investment plan
PPRI	Flood Risk Prevention Plan
PPRN	Natural risk Prevention Plan

RéSO	Responsabilité sociétale des organizations / corporate social responsability
RGA	Withdrawal, swelling of clays
SDIS	Departmental Fire and Rescue Service
SIGC	Geographic and cartographic Information Service
SRADDET	Regional plan for planning, sustainable development and territorial equality
TRACC	Baseline Trajectory of Climate Change Adaptation
UL	University of Lille

6. Executive summary

Climate change risk analysis is a topic of relevance to every local government worldwide. This report aims to shed light on the methodology developed by the Département du Nord as part of the European CLIMAAX project. Based on deliverable 2, it summarises the results of studies conducted over the past ten months.
Readers will find information on the risk assessment method and the selection of vulnerabilities, as well as areas for collaboration between internal and external stakeholders on climate change adaptation.

This second step covers many different topics.

The risk assessment was developed using ArcGIS to help operational teams understand and compare the results with their specific operational vulnerabilities. This toolkit is based on the CLIMAAX method but presented in GIS format.

The vulnerability analysis provided factual insights into previously intangible knowledge, highlighting the territorial demographic and social heterogeneity. As expected, the entire territory will be impacted by hazards. However, the territorial diversity requires specific adaptation measures for the different areas.

Given the significance impacts of the hazards, the aims of resilience would require short and mid-term adaptation measures. This second step breaks down these objectives with more details than in Deliverable 1.

These analyses have provided stakeholders with factual information and have helped maintain their engagement. Phase 2 also allowed to address larger audiences than phase 1. Additionally, relationships with stakeholders have been strengthened, paving the way for further progress.

The final phase will involve implementing the elements planned in Phase 2: a roadmap covering communication, raising awareness, training and developing professional expertise, as well as developing specific toolkits for some sectors. A detailed analysis using external tools will also be conducted to lay the groundwork for multi-year actions tailored to the organization’s internal capacities.

Therefore, the main results of this second phase are a better understanding of the risks and vulnerabilities and improved departmental staff awareness. Finally, this second step gives a clearer vision of the next objectives

1 Introduction

1.1 Background

With 2.6 million inhabitants, the Département du Nord, located in the Hauts-de-France Region is France's most populated department. Its average population density of 455.7 inhabitants per km², compared with 106.5 for France as a whole, highlights the strong internal contrasts that characterize the territory. Half the population lives in cities with more than 100,000 inhabitants, which, combined with numerous industrial areas and the presence of strategic transport infrastructure, implies a high level of risk exposure.

The total land area covers 5,742.8 square kilometers, including a 35-km coastline. The territory also presents a vast low-lying plain with limited forest cover (9%), a dense network of waterways and extensive rural areas.

The Nord faces significant socioeconomic challenges, as well as environmental ones. High rates of poverty (18%) and unemployment (12%), particularly in urban areas, along with a high proportion of social housing (20%), further heighten vulnerability to the impacts of climate change. Overall, 90% of municipalities in the Nord are considered vulnerable to climate risks, primarily flooding.

The Département du Nord has committed to an ecological transition policy through the "Nord Durable" strategy, adopted in 2019, first turned to attenuation actions. The current challenge is to develop a climate change adaptation strategy focused on raising awareness of climate risks, by improving understanding of these phenomena and their impacts on the Département's mandatory responsibilities (territorial and social solidarities).

These issues are fully integrated into the GREEN59 subproject led by the Département du Nord, and the CLIMAAX methodological framework therefore provides an ideal foundation for this approach.

In parallel, the Hauts-de-France Region is also participating in the CLIMAAX project, alongside the ATLAS subproject, and both is collaborating on the analysis of heavy rainfall within their respective territories. The project teams have agreed to share regular progress updates and have established a joint scientific committee, supported by GREC, to coordinate and strengthen the approaches used in both projects.

1.2 Main objectives of the project

Although climate hazards have been clearly identified and confirmed through observations of past and recurring events, their impact on Département's areas of responsibility—particularly in terms of social and health issues—remains insufficiently understood. This gap critically limits the Department's strategic foresight and hampers the development of evidence-based adaptation policies.

A lack of consistent adaptation planning, limited past experience with major risks, and a low level of prevention increase the likelihood of worsening impacts from future events, which will be more intense and more frequent. These aggravating factors are likely to weaken the population's response capacity and overall resilience. The Département du Nord must therefore anticipate these challenges and adopt appropriate adaptation measures.

To address these challenges, the Département has set two major objectives:

1) Objective 1: Deepen the understanding of climate-related risks and vulnerabilities in the Département du Nord and build a shared culture of climate risk

- The Département du Nord aims to establish an overview of the territory's vulnerabilities based on different climate change scenarios, including risks linked to the specific characteristics of the Nord territory and those related to the Département's mandatory responsibilities as a local authority; . This objective will be achieved through:
- the development of an initial *Climate Risk Assessment* (CRA) for two workflows identified as having a major impact in the Nord—heavy rainfalls and heatwaves—using observed and projected climate data, along with exposure and vulnerability data across different scenarios.
- empowering the capacity of the project team dedicated to the GREEN59 sub-project

2) Objective 2: Sharing risk knowledge and developing recommendations to support the adaptation of departmental public policies

The GREEN59 sub-project aims to transform climate risk knowledge into action, by sharing results and developing recommendations tailored to departmental policies and territory. This objective will be achieved through:

- translating the results of the *Climate Risk Assessment* into operational recommendations adapted to the areas of responsibility of the Département du Nord, including social services (protection of vulnerable populations, adaptation of reception facilities) and territorial competences (roads and buildings, secondary schools, sensitive natural areas, etc...);
- integrating an "adaptation" component into the Département strategic frameworks -which are currently focused primarily on mitigation- by territorial analyses and risk-based insights;
- sharing results internally, to build awareness among departmental staff regarding the need to adapt public policies within their respective fields of work;
- sharing results externally, particularly with scientific partners (universities, research institutes) and territorial stakeholders (local authorities, State services, etc.).

Evolution of the GREEN59 sub-project through the CLIMAAX methodology

The contributions of Phase 1 and Phase 2 of the CLIMAAX methodology have helped refine the ambitions of the GREEN59 sub-project and the emerging departmental adaptation strategy.

Thanks to CLIMAAX methodology, the Department now has analytical tools to gradually consolidate its understanding of climate risks and suggest concrete adaptation measures to decisionmakers. This framework can be used to explore additional climate hazards not covered by CLIMAAX — such as clay shrink–swell, one of the main risks in the Nord.

CLIMAAX therefore serves as a catalyst for a new approach to departmental public policy, taking into account climate vulnerabilities and their impacts — both at the regional level and within the scope of its own areas of responsibility as a local authority.

Thanks to a second European adaptation-focused project — Pathways2Resilience — the Department will continue its efforts to build a first action plan, with priorities and financial estimations.

1.3 Project team

The GREEN59 project team is coordinated by the General Secretary from the Directorate-General for Territorial Solidarities (DGA ST), bringing together staff from various operational units with complementary skills. The team oversees project leadership, scientific coordination, and

administrative and financial management. Beyond the technical outputs produced, the CLIMAAX methodology has also played a key role in strengthening and reshaping the GREEN59 project team itself.

The project team is composed of:

- Anne-Françoise DEL LITTO, Head of Major Projects and Support unit
- Agathe DUJARDIN, Climate change adaptation Project Manager
- Clément FABREGUETTES, European Project Manager
- Freddy DOLPHIN, Environmental Project Manager
- Jérôme VANDEVILLE, Head of Geographic Information and Cartography service
- Eddy LE BERIGAUD, Nord Durable Project Manager
- Elora WILLAME, CLIMAAX trainee to the General Secretary
- Lilou JOURDAIN-GORDZIEJ, climate change trainee
- Jean-François LECORNU, ESRI
- Jade ZAPATA, European projects trainee
- Angele LEMAN, environment trainee

An external expert committee, composed of academics, researchers, and lab directors within the GREC, contributes critical analysis of the methodology and results, this report wasn't checked in detail before submission, it will benefit of expertise in phase 3:

- Coralie SCHOEMACKER, Director, CNRS-ITES / GREC Co-director
- Robin MIRI – PhD student, University of Lille
- Guillaume Penide – CNRS Atmospheric Optics Lab
- Luc Dauchet – Institut Pasteur de Lille (health & climate change)
- Nathalie Molines – UTC (urban heat island specialist)
- Jérôme Riedi – University of Lille, Physics Dept. (satellite data)
- Claire Alary – Lecturer-researcher, IMT Nord Europe
- Caroline Norrant – Geographer-climatologist, University of Lille
- François Leconte – Urban microclimate expert, University of Lorraine
- Magalie Franchomme – Geographer, sustainable development
- François Olivier Seys – Geographer, demographic dynamics
  Franck Bodin – Geographer and Urban Planner University of Lille

Other interested stakeholders may join the steering or scientific committees during phase 3.

1.4 Outline of the document's structure

The deliverable is structured into six sections: **Section 1** outlines the project context and objectives and introduces the dedicated team; **Section 2** details the operational steps of a CRA: scoping, risk exploration, and risk analysis. It ends with preliminary results from the key risk assessment and the monitoring and evaluation phase; **Section 3** provides a summary of the main conclusions and key findings from this project phase; **Section 4** explains how this deliverable and its outputs connect to planned activities in the next phases; **Sections 5 and 6** list the supporting documents and references produced during this phase.

2 Climate risk assessment – phase 2

2.1 Scoping

2.1.1 Objectives

Building on Phase 1, the CRA's objectives in Phase 2 are to provide a more detailed picture of vulnerable populations and infrastructure. This main objective will underpin adaptation policies. Then, in response to the objectives of Phase 1, Phase 2 involved using the CRA to familiarize staff and managers with the process, followed by elected representatives. The objective of Phase 3 is to lay the groundwork for an adaptation plan.

However, these objectives are constrained by the limitations of the CRA, particularly the low accuracy of hazard data and the current lack of detailed vulnerability data for certain business units. Securing the commitment of the operational departments proved to be a challenge in order to achieve these objectives. While this collaborative effort was necessary and highly rewarding, it was also time-consuming. The reduction in human resources also led to a downward revision of the initial objectives.

2.1.2 Context

This section covers new contextual aspects and external influences identified during Phase 2.

Météo France has been responsible for the collection and processing of data on climatic phenomena for several years now.

This data is used by government agencies or public-interest bodies (such as ADEME, CEREMA and ATMO Hauts-de-France), decentralized services (such as DDTM and DREAL) and university research laboratories to assess damage and vulnerabilities.

Since 2012, the Hauts-de-France Region, ADEME and the State have established a Regional Climate Observatory (ORC), led by CERDD, which compiles and consolidates databases. These are supplemented by mapping tools.

Numerous risk prevention documents relating to property and people (notably the PPRI, PPRN or PPR) are required under town planning documents (PLUI) or the sustainable development strategy and plan (SRADDET), and these are based on this data.

These risk zones and the state's recognition of a disaster also determine the level of insurance cover. The State authorities (the Prefecture) are responsible for vigilance and providing advance information on risks or events, with four levels of danger defined at departmental level. These alert levels trigger procedures for providing information, mobilising resources, and implementing preventive or protective measures by the SDIS (Departmental Fire and Rescue Services), civil protection, health services, and local authority technical departments. In the case of the Nord department, for example, road maintenance staff are put on alert in the event of flooding or extreme rainfall.

In terms of impact management, local authorities tend to focus on responding to events and post-crisis recovery rather than anticipating risks. Procedural delays mean that the updating of prevention documents is failing to keep pace with the accelerating rate of change. Insurance policies also require buildings to be rebuilt exactly as they were, without encouraging adaptation.

Some sub-departmental bodies have begun adapting to climate change.

Like the rest of the country, the Département du Nord is facing an increase in the frequency and intensity of climate hazards, as illustrated by the heatwaves that occurred in May and June 2026. In this context, the impacts of climate change have gradually been characterised in greater detail at national and regional levels. Thus, the Baseline Trajectory of Climate Change (TRACC) was added to the Environment Code by decree on 23 January 2026, specifying the expected levels of warming in the coming years .

At the level of the Nord department, there is yet no shared understanding of climate risks, which limits the planning of adaptation measures and the integration of these issues into the department's operational policies. Early discussions with operational departments have confirmed this. The GREEN 59 project therefore aims to address these challenges by improving awareness of the climate risks and vulnerabilities facing the department.

Moreover, although many national and regional stakeholders (ADEME, CEREMA) are actively involved in addressing climate change adaptation issues and helping to improve understanding of the risks, these initiatives remain insufficiently coordinated at the departmental level, thereby limiting the coherence and effectiveness of the actions undertaken. In this context, the Département du Nord has taken measures to strengthen its internal governance in the area of adaptation.

The governance framework for climate risk assessment has therefore evolved significantly since Deliverable 1. Whilst the regulatory framework remains similar to the one described in the first phase, adaptation to climate change now plays a more prominent role within the internal governance of the Département du Nord.

Indeed, a dedicated section on this subject has now been incorporated into the “Nord Durable” roadmap and its new organisational structure and governance. The associated issues are being addressed within the Cross-functional Technical Group (G2T), which brings together all the relevant operational departments, and will also be discussed at the Comité Nord Durable, which includes elected representatives. Furthermore, the departure of a member of staff from the General Secretariat to the environmental department (Direction Ruralité Environnement) has led to a reduction in the CLIMAAX team’s human resources. Few months later, a full-time climate change adaptation project manager has therefore been recruited on a fixed-term contract dedicated to these issues. Finally, the creation of several Master’s-level internship positions as part of the CLIMAAX project helps to promote a multidisciplinary approach combining geography and political science

To strengthen knowledge of the climate risks affecting the territory, the Département du Nord has initiated several partnerships. An agreement has been signed with the University of Lille to encourage exchanges with experts. In addition, a partnership has been established with the Conservatoire des Espaces Naturels (CEN) to trial adaptation solutions in the management of natural areas at a departmental site, drawing on the Natur’Adapt methodology developed under the LIFE+ programme.

Finally, external governance is becoming more structured, particularly through the involvement of institutional and technical partners (CEREMA, ADEME, CEN, etc.), who could be involved in the operational implementation of adaptation solutions in the CD59. The Department also participated in a webinar organised by the DDTM as part of the CLIMAAX project, providing an opportunity to share the initial results achieved. This initiative aims to strengthen coordination between stakeholders and enhance the effectiveness of actions carried out across the territory.

The identification of local priorities for climate change adaptation faces regulatory, legislative, budgetary and political constraints at both local and national levels:

- Cuts to national budgets and grants; threats to agencies such as ADEME and AFB; a need to improve the coherence of public policies and their alignment with regional strategies; a lack of evaluation, according to the Report of the Court of Auditors dated 15 September 2025; Source) ;
- A tense geopolitical context pushing transition issues into the background
- Between 2026 and 2028, election periods at various levels involving numerous uncertainties;
- Regulatory implementation of the TRACC and the national climate roadmap across all territorial policies and planning documents (updating these will require significant resources and will take time)
- A requirement for local authorities with more than 3,500 inhabitants to implement a progressive 'green' financial analysis (European Green Deal framework)
- Concerns regarding the limitations of the solidarity scheme for natural disasters and the 'Barnier Fund', with rising costs for compensation, contributions and reinsurance.

These various initiatives and obligations are prompting a re-examination of local authorities' policy framework and will influence the way they address climate change and its impacts.

The climate change adaptation approach that the Département du Nord wishes to undertake will, first and foremost, continue to build on the existing policies and action plans identified in Deliverable 1. Although these policies do not explicitly refer to adaptation, they are already helping to strengthen the territory's resilience. Climate change adaptation will also need to incorporate new, targeted measures and interventions. To identify additional and relevant levers for the Département's adaptation, a benchmarking exercise was carried out to draw inspiration from and identify best practices implemented in other French departments. This work allowed to identify a set of concrete solutions, tailored to the various departmental responsibilities:

- Opening and creating haven as urban cooling island (media centers, museums, natural spaces, tree-lined sites and routes, etc.)
- Raising awareness of climate issues amongst healthcare and social care staff and service users, particularly in the Maisons Nord Solidarités
- More active monitoring of vulnerable groups targeted by the Department's health prevention policies (people in precarious situations without accommodation, children under 5 and people over 65, and those with reduced independence)
- Thermal refurbishment of secondary schools and departmental buildings. For secondary schools, continue the greening of playgrounds and the installation of passive thermal regulation systems (sunshades, geocooling systems, etc.) supported by solar radiation studies.
- Strengthening the monitoring of the road network and engineering structures, particularly using innovative technologies such as artificial intelligence.
- Fully integrate adaptation issues into natural area management plans.
- All these measures should serve to shape a cross-cutting adaptation strategy, designed for the long term, and tailored to the specific characteristics of the region.

2.1.3 Participation and risk ownership

Stakeholders were engaged through one to one meetings with operational departments, two global meetings with local authorities, NGO's and scientists. CLIMAAX phase 1 results were presented to the elected representatives. Meetings were held approximately every three months with the scientific committee and the Hauts-de-France region. External stakeholders were involved on an ad hoc basis.

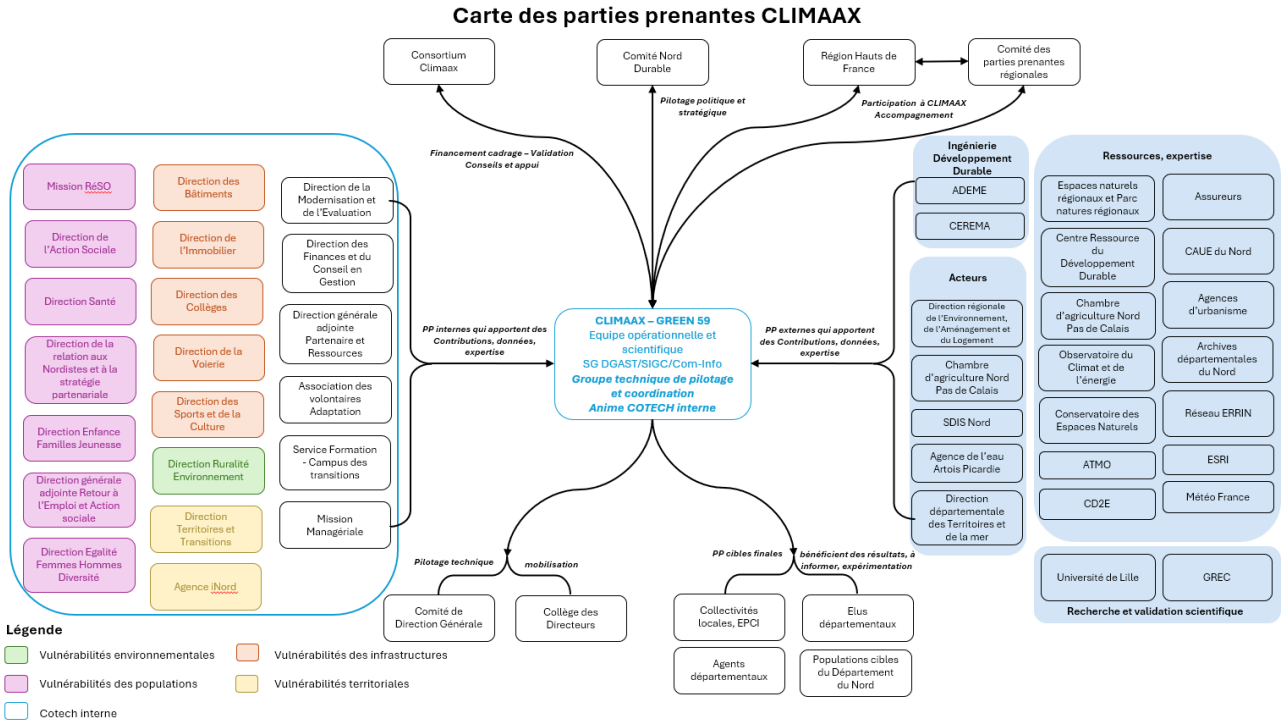


Figure 1: organisational chart showing the institutions working on the CLIMAAX project, along with their responsibilities, their interconnections and the vulnerabilities they represent

Responsibility of identification, evaluation and mitigation of specific risks is shared. First, the Departmental Major Risks Report (DDRM) is done by the prefecture.

Then, internally, general risks are identified and assessed by the modernization and evaluation department, then mitigated by the operational departments related to their scope. A operational continuity plan, is also in place. To complete this mapping, current and future climate risks are being identified and assessed by the CLIMAAX project team, included in General Secretariat of the Deputy Directorate for Regional Solidarity, through discussions with internal operational departments and local authorities.
However, for climate-related risks, the project team has begun the process of identifying, assessing and mitigating risks via CLIMAAX.

Considering the chosen risks, operational departments are the relevant representatives. However, during Phase 3, more representatives from civil society and voluntary organisations will be invited to participate, to change of perspective and see the other side of the coin (listed below).

- Older people: physiological sensitivity to high temperatures and frequent periods of social isolation. Data on this group is primarily provided by the Hauts-de-France Regional Health Agency (ARS), the Municipal Social Action Centres (CCAS), care home operators, the independence support services of the Nord Department, and home care organisations.

- People in precarious circumstances: Economic difficulties can limit access to means of protection against extreme weather events, particularly during periods of extreme heat or cold. The main representative bodies are the CCAS, departmental social services, organisations working to combat social exclusion, social housing providers and integration organisations.
- People who are isolated or suffering from chronic health conditions: They are looked after by the ARS, regional health networks, local healthcare professionals and various organisations providing support to vulnerable people.
- Young children and school pupils: Within the remit of the department, the relevant representatives include the Secondary Schools Directorate of the Nord Department, school management teams and the entire educational community.
- local authorities at risk of flooding and surface runoff. Mayors, local councilors, local authority technical departments, inter-municipal bodies and river basin authorities are the main institutional bodies responsible for managing and preventing these risks.
- Lille European Metropolis, the Valenciennes area, the Dunkirk area and certain parts of the coalfield: urban areas highly exposed to urban heat islands (UHIs). Public inter-municipal cooperation bodies (EPCI), town planning departments and town planning agencies play a central role in the planning and implementation of adaptation measures.
- Critical infrastructure falling within the remit of the departments: Departmental roads, secondary schools and social care facilities may be affected by heatwaves, floods or other extreme weather events. The departmental directorates responsible for roads, secondary schools and social care therefore appear to be key players in this process.
- Finally, several environmental organisations contribute to our understanding of natural habitats and to the identification of areas that are particularly vulnerable to the effects of climate change. These include the Hauts-de-France Nature Conservation Agency, the French Biodiversity Agency, the managers of the department's Sensitive Natural Areas, and wetland managers. Their expertise enables biodiversity and ecological functionality issues to be incorporated into the analysis of territorial vulnerability.

These risks, in France, are not associated with an explicit threshold for what constitutes an 'acceptable' or 'tolerable' level of climate risk. The national adaptation policy, structured in particular by the third National Climate Change Adaptation Plan (PNACC-3, 2025), is based on an approach aimed at reducing vulnerability and strengthening the resilience of regions in the face of intensifying climate hazards. This approach is based on the Reference Warming Trajectory for Climate Change Adaptation (TRACC), which sets out a framework for action based on an average temperature rise of +4 °C in France by 2100. A business continuity plan is in place at departmental level for general risk.
CLIMAAX pave the way to a specific analysis to climate change risk's evaluation and mitigation.

2.1.4 Application of principles

Social justice and equity was taken into account via a bibliographic work on assessing vulnerability not only through the scope of physic infrastructures or health impacts but also through, for example,

the evolution of domestic violence, equity, ... Then, vulnerability indicators were presented to professionals to have their feedback linked to their field experience.
Work was also led on accessibility and mental health through expert analysis by Franck Bodin and bibliographic work .
Inclusivity was studied through the scope of bibliographic analysis on gender medical and societal vulnerability and the beginning of “travail conjoint” with “direction égalité.

Finally, we want to clearly implement inclusivity in phase 3 by working on maps suited to daltonism and on a leaflet written in “facile à lire et à comprendre” FALC (easy to read and understand).

To offer strong quality, several meetings were hold with the scientific consortium created during phase 1 of CLIMAAX. The toolbox changes will also be reviewed by the national Meteorological center. Transparency was underlining all presentations with explanations to methods limitations and a special part on the percentile and mean.

Then, considering the toolbox, quality rigor and transparency will be implemented through the production of an explanatory booklet at the end of the project; furthermore, it is based on a defined technological context .

Finally, even if a national trend had been defined, we chose to examine various alternative scenarios as well, to gain a more nuanced perspective.

Precautionary approach is underlining through information to stakeholders.
The results are always presented as the median accompanied by percentiles. This presentation serves as a reminder of the variability inherent in the models and highlights their value in identifying trends rather than predicting the future with certainty. It enables us to understand where we stand so that we can focus our efforts accordingly.

These principles will also be incorporated into data communication practices, drawing on cognitive science to improve quality and adapting the language used to ensure greater inclusivity

2.1.5 Stakeholder engagement

Different categories of stakeholders were engaged: we can list local authorities and NGOs, intern departments, voluntary staff of Department du Nord and half of the management task force of the institution.
One to one meetings with operational departments, two global meetings with local authorities and presentation of CLIMAAX phase 1 results for the executive were held. For voluntary Département staff, a conference was organized during the month of Europe (may), supported by articles. And finally a TEDx-style talk to half the management workforce.
Most of the speeches were supplemented with articles or publications.
The department for regions and transition also wrote a publication with a regional institute on sustainable development (CERDD), explaining future risks and current state of climate. It will be shared to the executive and staff during june and september.
Ideas of stakeholder's engagement currently being developed are:

- Département's staff: a survey conducted through interviews to identify the level of knowledge, engagement and ecological anxiety, on a selected panel (including elected representatives)

completed with randomly selected Département's staff, participatory workshop in the following idea of Climate Fresk and finally an educational program dedicated to adaptation.

- Executive: releases of CLIMAAX 2 results and of adaptation solutions identified with benchmarking
- Technical taskforce: quarterly workshops on results and toolkit development.

Almost all the spectrum of expected reactions was seen from disinterested, neutral to convinced and proactive. mostly, internal directors were aware but haven't taken those risks into account in public policies; The selected internal referees were, them, mostly convinced and they really wanted to finally be proactive on this theme.
Participants highlighted the complexity but importance of the subject, the fact that it's not in their everyday working life.

Results will be implemented, for example, in building and maintenance strategy, management of natural areas (coordinated methodology with NGO).

The main challenges were the necessary familiarization of participants with scientific terminology and the reduction in staff members resulting in a limited number of possible interactions with stakeholders compared to what was planned.

2.2 Risk Exploration

2.2.2 Screen risks (selection of main hazards)

In addition to the analyses carried out during Phase 1, Phase 2 confirmed the health risks posed by heatwaves, in light of recent heatwaves. Discussions with stakeholders also highlighted the significance of the risk to the environment, particularly in terms of increased evapotranspiration, which could have a massive impact on natural areas and crops.
No new specific risks linked to heavy rainfall were identified.

Since the beginning of 2026 (aka phase 2), the current situation has included events classified as "natural disasters," including a tornado in Maubeuge and severe thunderstorms that affected the entire Hauts-de-France region .

Very recently, episodes of intense heat waves—with a red heat wave alert in effect—have been occurring throughout the département and nationwide .
At the national level, those affected include not only the vulnerable groups identified in the CRA but also individuals outside that scope (potentially due to higher-risk behaviors). In fact, very significant increases in healthcare utilization for hyperthermia/heatstroke were observed across all age groups, particularly among those aged 15–44 between June 21 and June 22 (a three- to fourfold increase in emergency room visits and SOS Médecins consultations, respectively).
The number of hospitalizations following emergency room visits for the iCanicule indicator began to rise on June 18, with between 160 and 220 daily hospitalizations, approximately 60% of which involved people aged 75 and older . In addition, deaths have been reported—among the elderly and children, as well as from drowning .

Considering the Copernicus Climate Atlas outputs, France, including Département du Nord, is facing significant and increasing climate hazards which comfort the previous analyses of Deliverable 1.

The projections of mean daily temperature are clearly following a warming trend.

Considering the Département du Nord, the number of extreme hot days (maximum temperature above 35 °C) may be multiplied by 3 (5 days on average currently, to almost 15days in 2100), as well as 30 times more tropical nights (0 to 30 by 2100). Very extreme hot days (up de 40°C) may appear by 2100. Mean soil shallow moisture content may diminish and severe dry condition is increasing which pave the way to global drought tendency. All those hazards, will have negative impacts on human health and environment state. However frost day, partially responsible of combined risk for clay shrinkage-swelling would drop down to zero.

Heavy precipitation days may be slightly increasing and very heavy precipitation days will appear. For precipitation intensity, annual tendency is going up: slightly increasing in winter, spring, autumn and slightly diminishing in summer. However, heavy precipitation days may increase, mostly in winter.

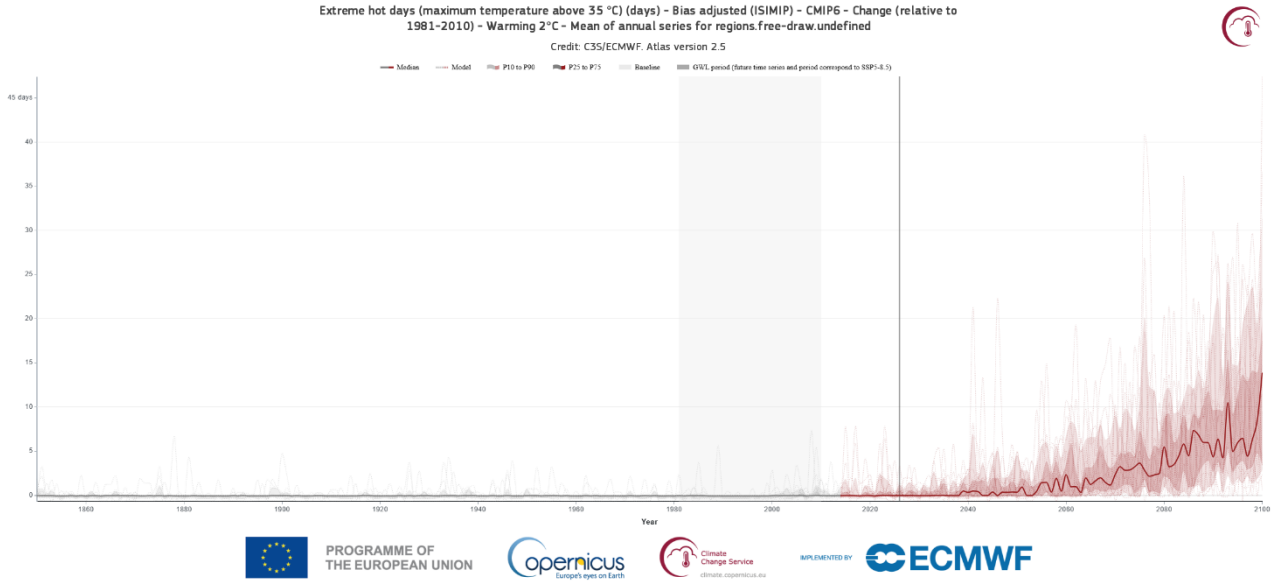


Figure 2: Relative change of number of extreme hot days (above 35°C) for Département du Nord for a 2°C climate warming compared to 1981-2010

Heatwaves and heavy rainfall analysis have been continued to have more precised information based on phase 1 conclusions.

The data on these risks cover topics relating to health, demography and the environment. There is a lack of specific data on vulnerability linked to disability, and data on financial estimates, such as assessments of the cost of the impacts; as well as data on projected trends regarding the state of the environment.

Note: Since population projections are based on a standardized scenario for all French territories that does not take into account either local specificities or the most recent shifts in demographic trends, a partnership with INSEE's regional offices could make it possible to simulate the impact of localized demographic changes.

2.2.3 Choose Scenario

Same scenarios as phase 1 were used (4.5 and 8.5) to ensure continuity in the analysis with phase 1.

Following a 2018 study projecting figures up to 2050, which concluded that the population of the Nord Département would grow , the new study, published in 2022, highlights a demographic decline .

The Département du Nord is projected to see an average annual growth rate of −0.14% by 2070. It would remain, by far, the most populous département in France. Nevertheless, it would lose an average of nearly 3,500 inhabitants each year, amounting to 178,000 inhabitants by 2070. The number of births would remain well above the number of deaths until 2050 (+0.2 per cent) (contradicted by the 2025 figures) but would then decline, falling to almost zero by 2070. Conversely, the Département would be characterised by a higher number of people leaving it.

With 114 people aged 65 or over for every 100 young people under the age of 20 in 2070, the Nord would rank ninth amongst the départements of mainland France with the lowest ageing index. Its strong appeal to students may partly explain this ranking.

Although the aging of the population is expected to be less severe than in other départements in the region, it will also affect the Département du Nord. In fact, the proportion of people aged 65 or older is projected to rise from 14.6% to 23.0% between 2013 and 2050.

Population aging is expected to affect all of the département's districts. It will be most pronounced in the districts of Dunkirk, Avesnes-sur-Helpe, Cambrai, and Douai (Figure 3). It will be more moderate in the district of Lille, where people aged 65 and older are projected to account for only 19.7% of the population.

To assess trends in suburbanization—which can lead to cascading effects—an analysis based on cities' catchment areas was conducted: The total population in the citie's catchment area outskirts are expected to remain stable, while the number of residents is expected to decline in the AAV centers and outside the AAVs.

The current age distribution shows a higher proportion of older adults in areas outside the AAVs, followed by the AAV peripheries, with the smallest proportion of older adults found in the AAV centers. This rural/urban pattern is expected to become more pronounced, with projections indicating a larger increase in the proportion of people aged 65 and older in the first category and the smallest increase in the last.

This trend is particularly interesting in the CRA, where an increase in migration from a central area to its outskirts often goes hand in hand with an increase in land development, it could lead to increased exposure to cascading risks such as UHI and flooding following extreme precipitation. This trend also conflicts with the "zero net land-take" approach.

In addition, this aging population is leading—and will continue to lead—to a decrease in household size simultaneously to the change of forms of cohabitation. Given the importance of social ties in coping with crises, this finding and these projections underscore the importance of incorporating the strengthening of social ties into public policies, as well as the sharing of lists of isolated individuals among various institutions (community centers, fire and rescue services, city council, etc.).

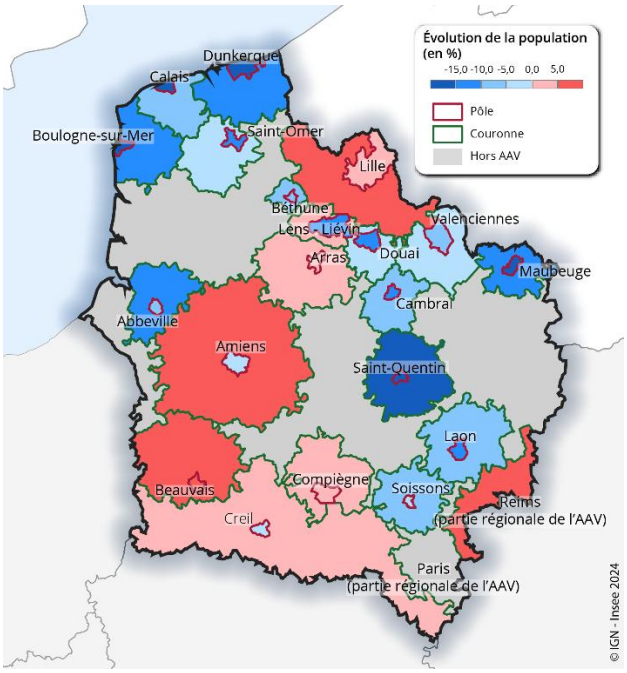


Figure 3: Population dynamic in Hauts-de-France region, considering the city's catchment areas for 2050 compared to 2018 Source: INSEE, Omphale 2022 population projection tool (trend scenario) .

Notes: Between 2018 and 2050, the population of the Lille AAV urban centre is projected to increase by 3.7 per cent, compared with a 5.5 per cent increase in its surrounding areas]

These demographic projections are supported by the current trends detailed in the appendix.

On the economic situation side, in the short term, several factory projects related to electromobility, and battery recycling are already being implemented (Billy-Berclau) or are underway (Douai, Dunkirk).

In the medium term: the “Dunkirk 2030” project, involving the construction of data centers and battery factories, will be developed, along with major infrastructure work for the Seine-Nord Canal. These projects will lead to a concentration of industries that consume large amounts of electricity and are therefore highly vulnerable to extreme events

Studying recent trends can provide additional analytical insights. Regarding quality of life in the HDF, areas facing social challenges are seeing their situation deteriorate. Their categorization is considered in the final presentation of the results (cf carte).

Since there is still very little data on environmental changes related to climate change, the analysis was based on the current status report provided by the Hauts-de-France Biodiversity Observatory. They mainly highlight the drying up of small streams.

The socio-economic context taken into account is based on the key findings identified during Phase 1. In particular, the analysis considers the ageing population, the presence of vulnerable groups, urbanisation dynamics and changes in the region’s economic activities.

Future climate conditions have been cross-referenced with the actual challenges outlined and the vulnerability factors identified during Phase 1. This approach makes it possible to assess the potential evolution of risks, considering both the intensification of climate hazards and the socio-economic characteristics of the region. The analysis focuses on vulnerable populations, departmental infrastructure and the areas most exposed to heatwaves and extreme rainfall.

In this phase, future socioeconomic developments were used solely as a reference. In Phase 3, a cross-referenced cartographic analysis could be conducted. In addition, a graphical analysis comparing the percentage of the population affected by an extreme event—considering both the future population and the projected hazard—will be carried out.

The projections used are taken from the Climate Data Store platform, which aggregates Eurocordex data. They are based on the RCP 4.5 and RCP 8.5 scenarios. The medium-term (2041–2070) and

long-term (2071–2100) timeframes were compared with the historical reference period 1951–2005 or 1971–2005. Scenario 2.6 was also added to the toolkit but was not used for the results of this deliverable.

Scenarios involving very high emissions, such as RCP8.5/SSP5-8.5, are now regarded as stress scenarios or high-end reference scenarios than as the most plausible trajectories for emissions. So, it was kept to assess the robustness of management strategies in the face of severe climate conditions . This approach is consistent with the Reference Warming Trajectory for Climate Change Adaptation (TRACC), national trajectory.

2.3 Regionalized Risk Analysis

To ensure continuity and comparability of results, the methodology set out in the CLIMAAX manual has been retained, while being adapted to the Département du Nord context through the incorporation of local and regional spatial data.

The workflows have been integrated into an Esri GIS platform in order to align with the département's technological infrastructure and the technical expertise of its staff. The aim of migrating from notebooks to toolkits was to make all or part of the workflows more accessible to staff in different roles and to facilitate the integration of workflow results with standard GIS applications (e.g. thematic mapping and data extraction) used by departmental staff. Currently, all the tools are grouped within a single toolkit; however, several toolkits could be developed by selecting and refining tools relevant to each specialist area incorporating climate change.

In the departmental context, the results of the workflows have been produced in the form of raster data at various resolutions that are easily usable in GIS (e.g., GeoTIFF files), but also in the form of attribute enrichment for various administrative (e.g., IRIS, municipalities, etc.) or technical (e.g., health sectors, etc.), in order to facilitate communication with stakeholders (e.g., identification of key indicators for municipal teams, etc.). The temporal dimension was also simplified to cover a 30-year period, in line with the same objectives of building bridges between scientific knowledge and an understanding of the future challenges linked to climate change adaptation.

Based on the available data format (e.g. data from only leap years or non-leap years, or projections other than a rotated pole), the data was sorted to enable an initial analysis without altering the coding. For example, the variable for maximum temperature, 115 complete time series were retrieved out of the initial 203. Further research will be conducted to understand why the datasets differ so much and whether it is necessary to alter the code to integrate them.

The socio-economic trends considered are based on the key findings identified during Phase 1. In particular, the analysis incorporates population ageing, the presence of vulnerable groups, urbanisation trends and changes in the region’s economic activities, with particular attention paid to energy-intensive sectors that are likely to increase certain vulnerabilities to climate-related hazards. These factors were analysed using several complementary sources, notably INSEE data for demographic and socio-economic characteristics, the Département du Nord databases for the location of infrastructure and facilities falling within its remit, and national geographical reference frameworks (BD TOPO, CORINE Land Cover and OCS GE).

Future climate conditions were then cross-referenced with these exposure and vulnerability data to assess the potential evolution of risks. This approach enables a combined assessment of the expected intensification of climate hazards and the socio-economic characteristics of the region, particularly for vulnerable populations, departmental infrastructure and the areas most exposed to heatwaves and extreme rainfall.

No additional specific indicators were used as part of this study. The indicators proposed by the CLIMAAX workflows were used to ensure methodological robustness of the analysis. However, the results were interpreted in the light of the territorial specificities identified during Phase 1, notably population ageing, situations of vulnerability, the differing exposure of urban and rural areas, and the presence of sensitive departmental infrastructure.
Nevertheless, an indicator has been developed in an attempt to characterise the complex vulnerability of natural habitats (methodology developed in supporting documentation).

Indirect impacts were not the subject of any specific quantitative modelling. However, several indirect consequences were identified on a qualitative basis, including increased pressure on health and social care services, potential disruption to transport and public services, and socio-economic repercussions that could affect the most vulnerable populations.

The following tables set out the details of the data used for hazard, exposure and vulnerability components, as well as the main limitations associated with each dataset.

2.3.1 Hazard #1 – HEATWAVES - fine-tuning to local context

Table 2-1 Data overview workflow #1

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
Heatwave days based on CDS data (available on a 12 × 12 km grid).	…		Heat wave risk (10/10 grid with IRIS interpolation)
Use of the EuroHEAT database from Copernicus (12x12km; 1986-2085) Scenario RCP 4.5 and 8.5.	France IRIS	INSEE	Population aged 65 and older, Population aged 0 to 5 years Demographics, Poverty (IRIS)
		CARL – departmental sites	Exposure featuring various sites in the Département du Nord (IRIS)
		Sensitive Natural areas	Exposure of Sensitive Natural Areas (IRIS)

2.3.1.1 Hazard assessment

The analyses carried out in Phase 1 were repeated using the new GIS tool, and a comparison with the detailed vulnerabilities was carried out.

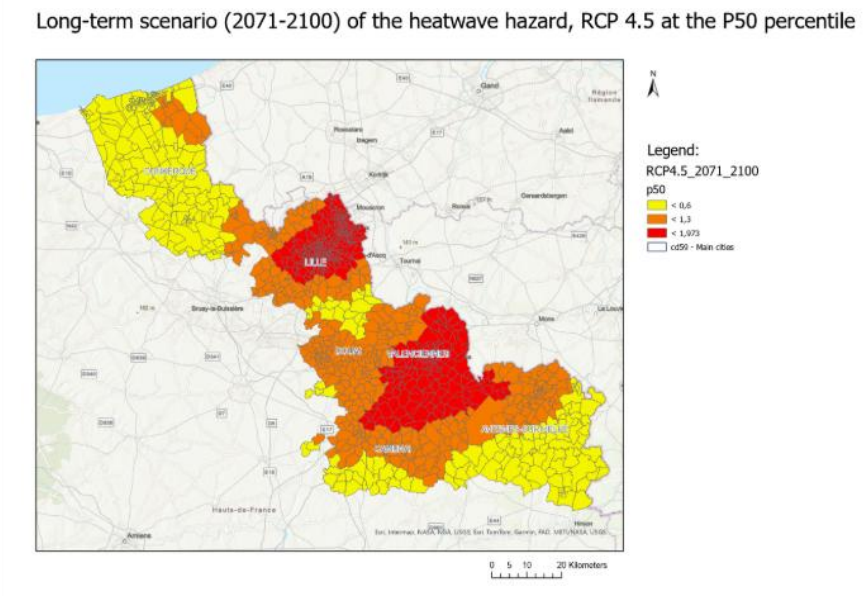
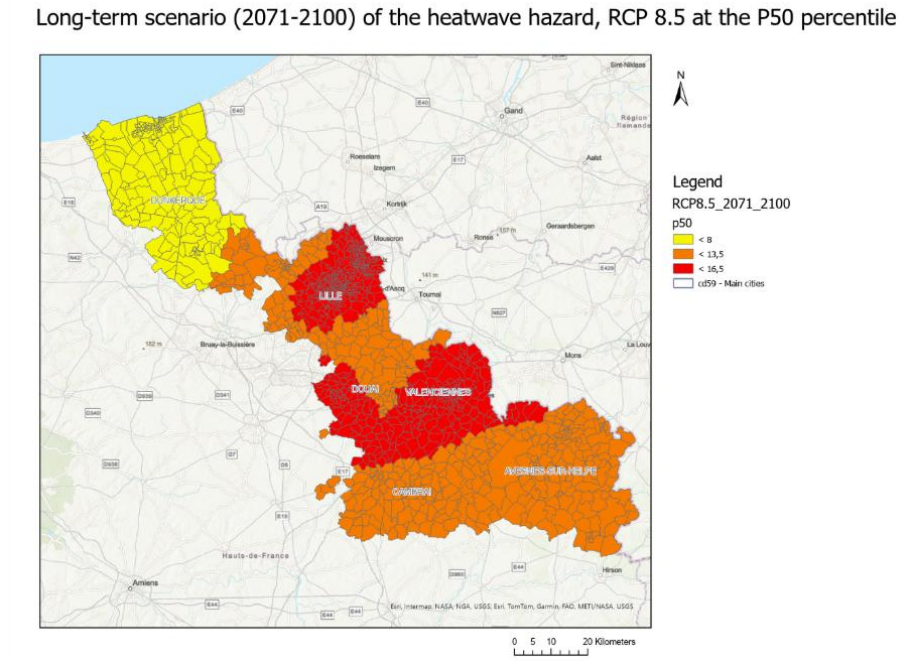


Figure 4: Long-term scenario (2071-2100) of the heatwave hazard, RCP4.5 at the P50 percentile



Climate projections based on the RCP 4.5 and RCP 8.5 scenarios indicate an increase in the frequency, intensity and duration of heatwaves in the medium term (2041–2070) and long term (2071–2100).

Figure 5: Long-term scenario (2071-2100) of the heatwave hazard, RCP8.5 at the P50 percentile

2.3.1.2 Risk assessment

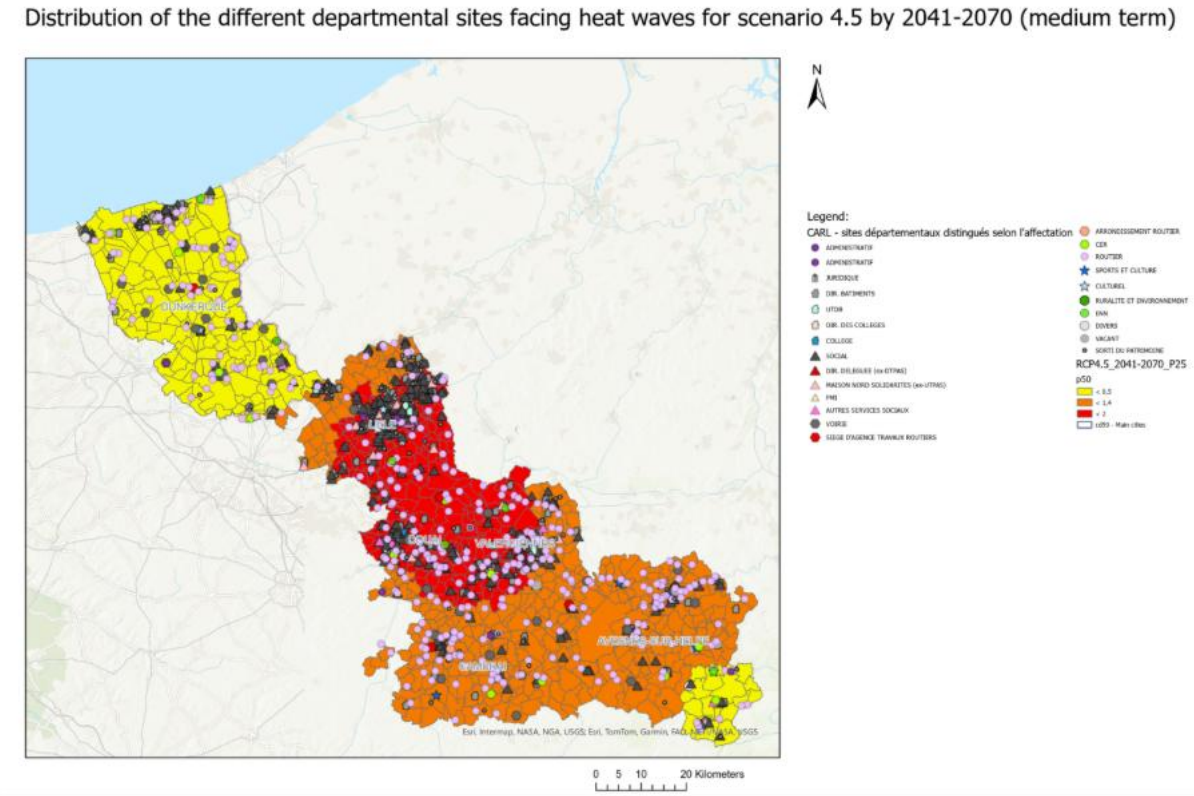


Figure 6: Distribution of the different departmental sites facing heat waves for scenario 4.5 by 2041-2070 (medium term)

The assessment of heatwave risk is based on cross-referencing hazard data from the EuroHEAT project with exposure and vulnerability indicators identified at the level of the Département du Nord.

The results highlight a heterogeneous distribution of risk across the region. The highest risk levels are mainly concentrated in heavily built-up urban areas, where the urban heat island effect is most pronounced and where vulnerable populations are concentrated. The main areas affected include the Lille European Metropolis, the Valenciennes and Dunkirk regions, and certain parts of the mining basin.

The vulnerability analysis shows that people aged over 65, young children, people living alone and those in precarious circumstances are particularly vulnerable to episodes of extreme heat. Overlaying these indicators with climate projections highlights several areas where the future intensification of heatwaves could lead to a significant increase in health and social impacts.

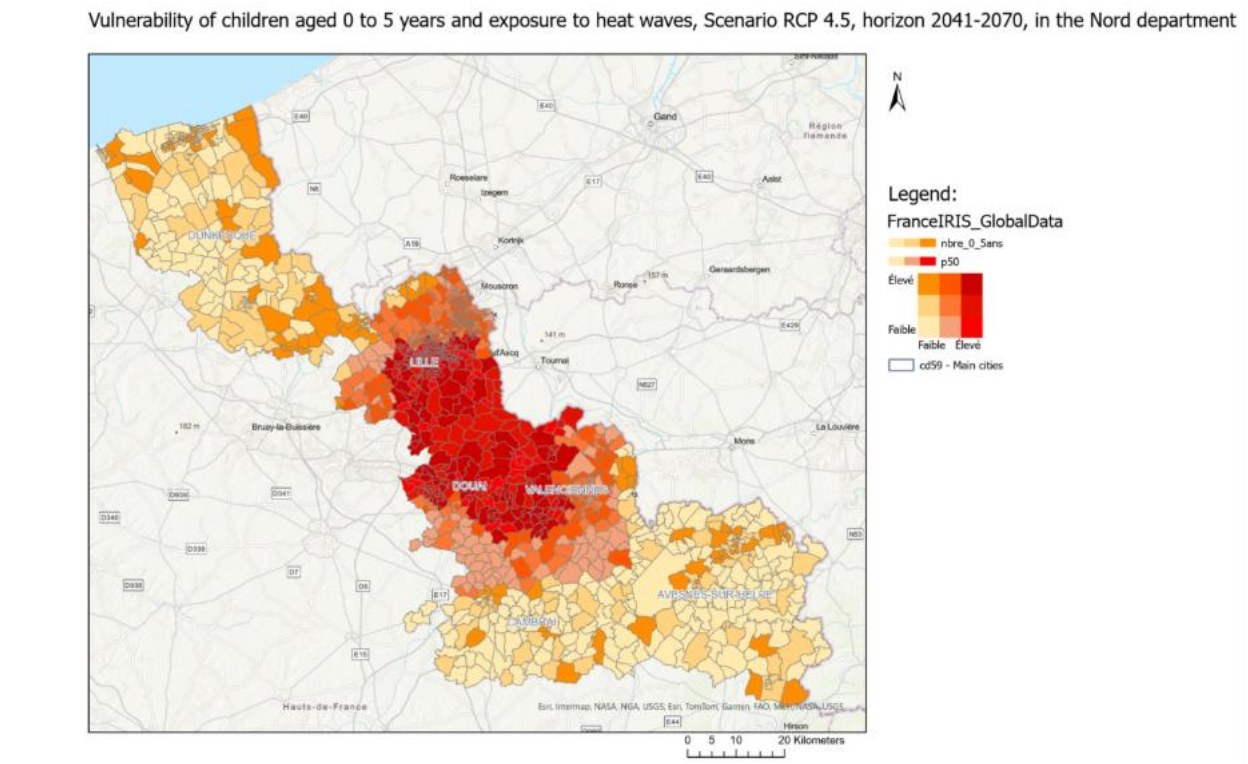


Figure 7: Risk map of heatwaves by the number of children aged 0 to 5 years, Scenario RCP 4.5, horizon 2041-2070

When analysing three vulnerable groups – young people, older people, and those living in isolation – the demographic trends are very similar, resulting in an identical risk profile. However, efforts should not be focused solely on areas with the highest population density of vulnerable people.

These maps are useful for enabling communication strategies to be tailored to the diversity of socio-regions.

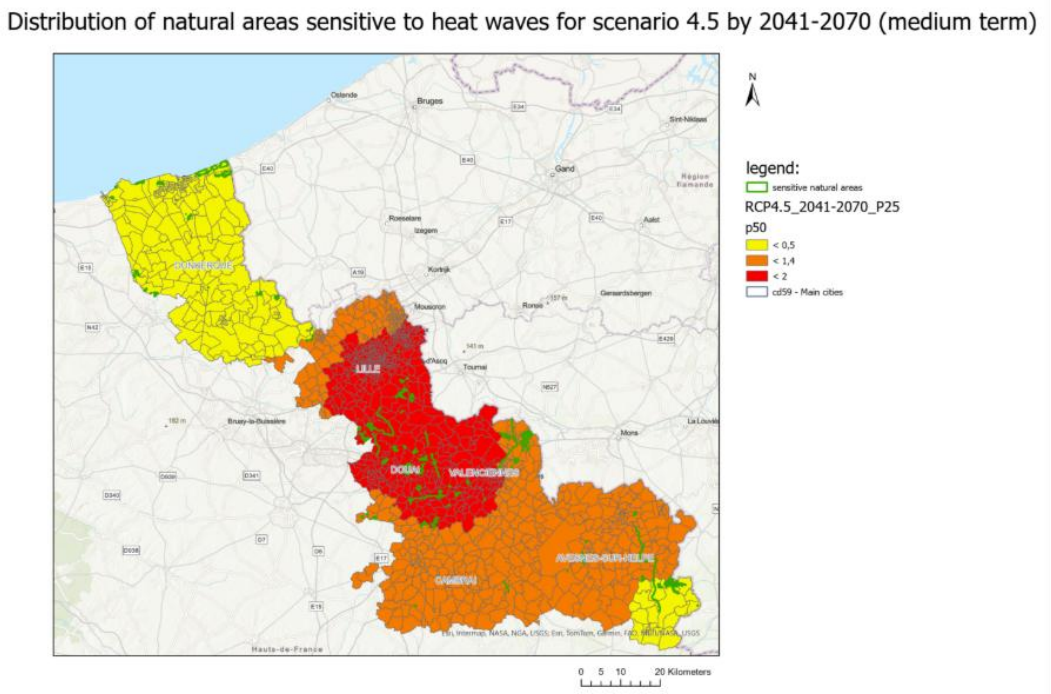


Figure 8: Distribution of natural areas sensitive to heat waves for scenario 4.5 by 2041-2070 (medium term)

Regarding the impacts on natural areas, although heatwaves are events with blurred boundaries and generally cover the whole territory, it is believed that certain areas of vulnerable natural habitats (sensitive natural areas) will be subject to greater pressure due to higher temperatures on the outskirts of urbanised areas. Nevertheless, the results of the more detailed analysis currently underway will be needed to draw conclusions about the actual impact that can be expected.

In a nutshell, the level of risk for heatwave hazards across the entire département is increasing, particularly in densely populated and heavily developed urban areas.

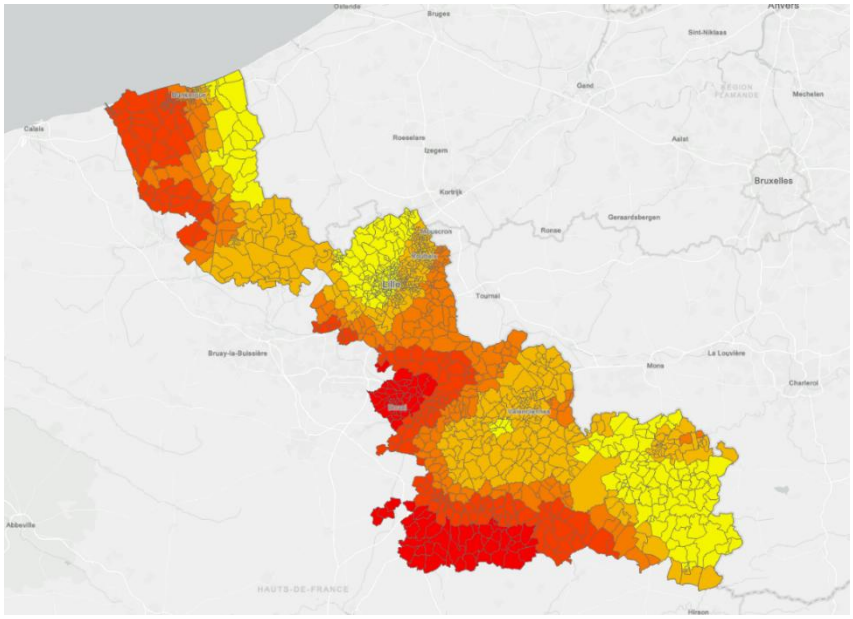
The findings therefore highlight the need to strengthen adaptation measures for the most vulnerable groups and to integrate thermal comfort and climate resilience more fully into spatial planning.

2.3.2 Hazard #2 – HEAVY RAINFALL finetuning to local context

Table 2-2 Data overview workflow #2

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
CDS portal data for precipitation (resolution 12x12km) time frame: historical simulations: 1976-2005 Climate projection: 2041-2070. RCP 8.5		INSEE	Visualization of the maximum annual precipitation for 3h duration and evolution by season for the two selected scenarios
Euro-CORDEX climate projections (12kmx12km)		CARL – departmental sites	Exposure featuring various sites in the Département du Nord (IRIS)

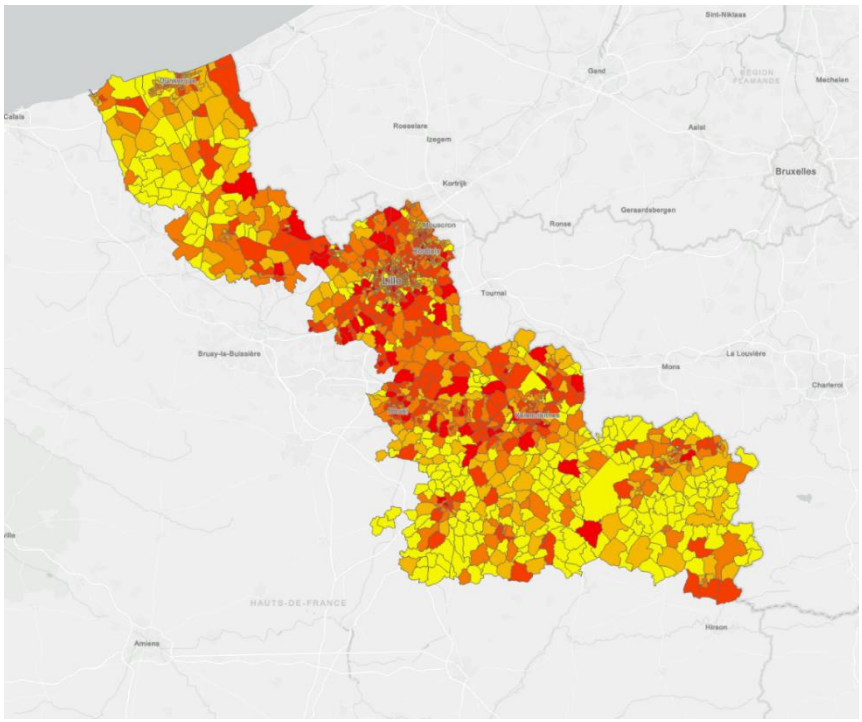
2.3.2.1 Hazard assessment



The choropleth map depicts the spatial distribution of seasonal variation across the territory, highlighting marked spatial heterogeneity. Higher variation levels (orange to red) are concentrated in the western and southern sectors, while lower variation (yellow) prevails in central and eastern areas. This pattern indicates a clear gradient in seasonal dynamics, with potential implications for localized climate sensitivity and exposure.

Figure 9: Choropleth map showing seasonal variation

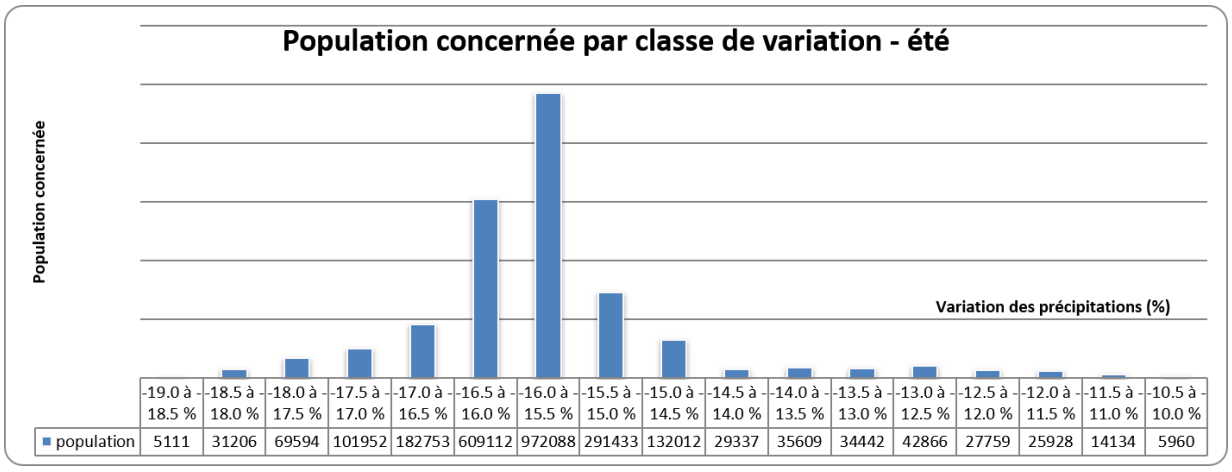
2.3.2.2 Risk assessment



The choropleth map illustrates the spatial distribution of population exposure to projected changes in summer precipitation at the municipal scale. Higher exposure levels (orange to red) are predominantly concentrated in densely populated central and northern areas, indicating a stronger sensitivity to rainfall decreases.

In contrast, peripheral zones display lower exposure (yellow), suggesting relatively lower population vulnerability to summer precipitation changes.

Figure 10: Choropleth map showing population exposure to changes in summer rainfall



	-19.0 à -18.5 %	-18.5 à -18.0 %	-18.0 à -17.5 %	-17.5 à -17.0 %	-17.0 à -16.5 %	-16.5 à -16.0 %	-16.0 à -15.5 %	-15.5 à -15.0 %	-15.0 à -14.5 %	-14.5 à -14.0 %	-14.0 à -13.5 %	-13.5 à -13.0 %	-13.0 à -12.5 %	-12.5 à -12.0 %	-12.0 à -11.5 %	-11.5 à -11.0 %	-10.5 à -10.0 %
population	5111	31206	69594	101952	182753	609112	972088	291433	132012	29337	35609	34442	42866	27759	25928	14134	5960

Figure 11: Population affected by summer variations

The figure presents the distribution of population exposed to classes of summer precipitation change, expressed as percentage variation. The highest concentrations of population are associated with moderate negative changes (approximately −16.0 % to −15.5 %), indicating widespread exposure to decreased precipitation levels. Smaller population shares are observed at both lower and higher extremes of variation, suggesting a unimodal distribution centered on moderate drying conditions.

2.3.3 Additional assessments based on local models and data

Describe any additional analysis you have performed with locally available models, datasets and tools.

2.3.3.1 Hazard assessment

For hazard studies, the data were reprocessed using iris interpolation to produce a more accessible format for stakeholder engagement (with the boundaries always clearly indicated).

For extreme precipitation, a deseasonalization analysis was also conducted. The analyses therefore used the same data with an in-depth analysis to provide a more detailed local assessment

2.3.3.2 Risk assessment

For risks, vulnerability data were presented as choropleth maps or bivariate maps to support decision-makers in the context of public policy. Indeed, the level of resources allocated is determined by the number of people affected.

2.4 Key Risk Assessment Findings

2.4.1 Mode of engagement for participation

During discussions with stakeholders, the feedback received on the risk assessment included:

- for internal stakeholders: the importance of having the assessment results explained in real time, preferably in person; the importance of a preliminary reminder of the facts regarding climate change (and of addressing the inextricable link between mitigation and adaptation); the importance of having mandatory or greatly facilitated adaptation measures to encourage engagement,

- for external stakeholders: the importance of exercising caution when communicating the results and ensuring consistency with information published at national and regional levels to convey a clear and unified message,

- for both: the importance of providing concrete evidence both in identifying risks and in proposing solutions; the importance of detailing solutions and not resorting to doomsday scenarios; the importance of fostering cross-functional collaboration and avoiding silos.

2.4.2 Gather output from Risk Analysis step

The results of the risk analysis highlight an increase in the level of risk associated with heatwaves and extreme rainfall across the Département du Nord by the end of the 21st century.

With regard to heatwaves, the most urbanised and heavily developed areas appear to be the most vulnerable, particularly due to the urban heat island effect and the concentration of vulnerable populations. Older people, young children, people living alone and those in precarious circumstances are the groups most susceptible to the health and social impacts of extreme heat events.

With regard to extreme rainfall, the results highlight the particular vulnerability of areas already prone to surface runoff and flooding. Departmental infrastructure, public facilities and certain heavily built-up areas appear to be particularly vulnerable to the expected intensification of rainfall events.

These findings confirm the need to give priority attention to vulnerable populations, departmental infrastructure and the most exposed areas in the ongoing risk assessment and emergency analysis.

2.4.3 Assess Severity

The initial risk analysis matrices highlight the importance of developing first-line measures (what to do when a risk arises) and measures to prevent such risks.

Actual risk was detailed in the identification of key hazards earlier in the document. The heat waves of recent weeks in France—and in the North in particular—have highlighted the importance of local authorities having up-to-date and tiered decision-making and operational processes, based on assessments that have yet to be conducted.

For both risks, their intensity and frequency will increase.

This will likely result in more deaths per year due to heat waves, and more negative effects on biodiversity, as well as larger areas affected by extreme precipitation, leading to increased damage to agriculture and causing cascading impacts on the local food chain . Furthermore, infrastructure—which was previously built to withstand occasional 100-year floods—will face more frequent and severe stresses, exacerbating future impacts. Similarly, cascading effects will be triggered by blocked roads, leading to reduced access to healthcare.

Crucial challenges for the insurance industry are set to arise in the coming years.

Heatwaves have irreversible consequences in terms of loss of life but also knock-on effects on natural areas: and social sides like the increase of domestic violence or the worsening of mental health, , …

The impacts of extreme rainfall also include irreversible impacts and knock-on effects. Locally, the most recent episodes of extreme rainfall have led to flooding, heavy surface runoff, damage to homes and infrastructure, as well as disruption to transport networks and economic activities . Considering scientific studies, it has been shown that permanent impacts on soils and ecosystems .

Moreover, the different perspectives of your stakeholders, experts or vulnerable groups enriched the initial perception of the severity of the risks. Following a discussion with Franck Bodin, a geographer, our perception of the vulnerability of people with disabilities has been heightened, highlighting the lack of work on the link between climate change and disability .

Discussions with operational departments, by contrast, have provided a broader perspective on the current impacts of hazards considering feedback from the field (e.g. RGA has had more visible impacts than extreme rainfall), but have highlighted the vulnerability of certain infrastructure, thereby exacerbating the risk rating initially estimated.

The information has been passed on to the elected representatives. Decision-makers have received some training in these topics and have only an initial awareness of them but are keen to develop this risk culture by communicating the results and incorporating the topic into a 15-minute presentation for 300 departmental managers.

Furthermore, decision-makers expressed their commitment to continuing the assessment of vulnerabilities, particularly in the social sphere.

Finally, the scientific consortium discussed ethical issues; this will be a topic to be addressed with our in-house ethics officer.

2.4.4 Assess Urgency

The level of urgency associated with the risk of heatwaves is assessed as 'further action required' (3). Climate projections show a significant increase in the frequency, intensity and duration of heatwaves between the current situation and the future timeframes under consideration (2031–2060 and 2071–2100), particularly under the RCP 8.5 scenario.

The impacts on human health are already evident today and mainly affect the elderly, young children, people living in isolation and those in vulnerable circumstances (*Santé Publique 2024*). This trend is expected to become more pronounced in the coming decades because of global warming, combined with demographic and socio-economic trends.

Although heatwaves are recurring phenomena that are relatively predictable in the short term, their consequences can be significant for vulnerable populations and for certain departmental infrastructure. Adaptation measures are in place, including the expansion of green spaces, the adaptation of buildings, the improvement of thermal comfort in sensitive facilities, and the strengthening of early warning systems.

It should also be emphasised that support for vulnerable groups already relies largely on schemes run by other levels of government, notably local authorities and local organisations, which, for example, maintain registers of elderly and vulnerable people and provide targeted monitoring during heatwaves. This multi-level organisation helps to strengthen operational risk management and partially reduces the need for urgent intervention at a strictly departmental level, whilst requiring ongoing coordination.

Given the gradual increase in risk and the need to plan for medium- and long-term adaptations, further action is required now to limit future impacts.

The level of urgency associated with the risk of extreme rainfall is assessed as 'immediate action required' (4).

Climate projections indicate an increase in the intensity of heavy rainfall events, although the uncertainties are greater than for temperature projections. Unlike heatwaves, extreme rainfall events are sudden in nature, and their location and intensity remain difficult to predict with certainty. Their sudden onset heightens the sense of urgency, as the consequences can be immediate for communities, infrastructure and essential services. These events can cause flooding due to surface runoff, disruption to transport networks, and damage to infrastructure and property. The expected impacts relate in particular to departmental infrastructure, facilities catering for vulnerable groups, and areas prone to surface runoff and flooding. The road network is a key component of the regional infrastructure system: its deterioration can trigger a cascade of effects, disrupting mobility and access to essential services, and exacerbating indirect health and social impacts.

Adaptation measures, such as improving stormwater management, enhancing the resilience of infrastructure or developing nature-based solutions, require significant time for planning and implementation.

Feedback on recent flooding events, particularly from local stakeholders (including the SMAGEAA and local authorities), also highlights the existence of challenges relating to the memory of risk. The persistence of a collective memory of past events coexists with tendencies to downplay or distance oneself from risk in certain local perceptions, which highlights the importance of implementing

measures to capitalise on lessons learnt and maintain a culture of risk awareness to strengthen regional disaster response.

Discussions with stakeholders confirm the need to anticipate these developments now to limit future damage. Given the expected increase in risk, its sudden nature and the time needed to adapt, immediate action appears justified.

2.4.5 Understand Resilience Capacity

Resilience was examined on the basis of lessons learnt and observations, in the absence of studies or surveys, with a preliminary assessment that was primarily qualitative, based on a review of existing measures or those currently being developed. Generally speaking, the fundamental elements are in place across the region

- surveillance and early warning services, emergency response structures, crisis management and resource coordination mechanisms centred on government and Prefecture departments).

- the establishment of procedures, organisational structures and internal governance, together with a management plan tailored to the level of disruption and risks faced by the organisation, which can serve as a model for other future events involving similarly complex, large-scale regional systems (the Département's internal Business Continuity Plan (BCP)).

- Centres of scientific, financial and technical expertise (State agencies, CERDD, CD2E, GREC/Universities) to understand and anticipate phenomena, and to support decision-makers and elected representatives in their choices regarding public policies to be implemented

- Initial adaptation measures or pilot schemes, paving the way for more ambitious plans subject to funding.

Heatwave: Despite a national weather warning system (with four levels triggering preventative measures and the mobilisation of resources), the second heatwave of June 2026 highlighted the limitations of a lack of preparedness and the ad hoc nature of measures taken to respond to unprecedented temperature peaks, despite previous heatwaves.

Working arrangements within departments were put in place: workers were allowed to leave an hour earlier during the heatwave, or work from home if necessary.

At the same time, the department ran awareness campaigns for its staff and residents, particularly targeting specific groups, through its local services and social workers (Maison Nord Solidarité). The department can also draw on a local network of organisations and partner associations specialising in health and social care. These organisations work in conjunction with the CCAS (Community Centres for Social Action) in municipalities and inter-municipal bodies, enabling us to gather valuable feedback on overheating in departmental buildings.

Heavy rainfall: In addition to managing incidents and their immediate consequences during crises in coordination with central government departments, the Department implements standard responses that are both technical (gradual upscaling of water management infrastructure and retention basins, subject to available funding) and human-centred (response teams to secure key road links and ensure the continuity of traffic flow) . It draws up an annual plan for development or

maintenance works (albeit with an increasingly tight budget), comprising mainly corrective, repair or adaptation measures. It operates joint monitoring and early-warning systems with the Prefecture, has flood prevention plans, and implements emergency or preventative measures in coordination with its departments, notably the Roads Department, social services and the SDIS. The level of resilience is assessed as substantial, although additional medium-term measures must be considered and budgeted for (e.g. a multi-year plan for the refurbishment of roads, engineering structures and networks).

The impacts of the climate crisis, the shocks already experienced (the floods of winter 2024/2025, heatwaves in May and June 2026) and the prospect of more intense, frequent, prolonged and unseasonal heatwaves have heightened this awareness of the direct and indirect threats to health, as well as to human, social, environmental, physical and economic systems, with cumulative and long-lasting consequences. The Department is drawing lessons from these experiences.

Financial capacity: national government grants (Green Funds) have been cut, as have allocations to local authorities. The Department is also facing budgetary constraints (rising social expenditure). It does not yet have a Multi-Annual Investment Plan dedicated to adaptation (Climate PPI), a proactive measure already in place in other local authorities. Furthermore, the insurance aspect is reaching its limits, with insurance premiums on the rise. *=> Low capacity.*

Human capacity: Awareness amongst residents, staff and elected representatives, as well as understanding of climate change and its impacts, is growing, particularly through first-hand experiences, recurring and recent climate crises, and the dissemination of scientific research. This growing awareness should facilitate the implementation of public adaptation policies. An internal awareness-raising plan is in the pipeline. *=> Medium capacity*

Natural capacity: impacts are being observed on natural habitats and species (loss or arrival of new plant or animal species, such as insect pests), with changes in biodiversity linked to drought (increased risk to wetlands and peatlands, and to water and air quality). Management and adaptation plans are currently being drawn up for natural areas and departmental estates. Declining agricultural yields (food security and quality) and forestry yields, as well as damage to soil and crops linked to heat and rainfall. Climate change is outpacing the ability of the environment and species to adapt. This situation raises the question of short- and medium-term strategies for land management (to combat, support or let nature take its course). *=> Average capacity*

Physical capacity: We are aware of technical solutions to address these risks. The use of vegetation in public spaces to mitigate the ‘canyon’ effect, in school playgrounds, and adaptation solutions inspired by nature – particularly to improve summer comfort in buildings that overheat – are beginning to be implemented, but do not yet adequately meet expectations in the absence of a comprehensive, overarching plan. *=> Average capacity*

Social capacity: The COVID-19 pandemic, beyond the health emergency itself, has highlighted the importance of having the capacity to ensure the continuity of public services over the longer term and through a more systemic approach, in consultation with other stakeholders, across multiple sectors and at multiple levels. The health crisis has thus highlighted the importance of a dense network of voluntary organisations and the dynamics of local social relations in maintaining cohesion and solidarity towards the most vulnerable. This is one of the region’s strengths and assets

on which the Department can rely to ensure the continuity and robustness of its interventions in meeting essential needs.

Resilience to heatwaves depends heavily on local first-response capacity and coordination with local health and social services.

The level of resilience is assessed as moderate (or substantial).

The Département du Nord has already experienced its vulnerabilities and resilience. However, the key challenge will be to develop the capacity to respond to fluctuations in extreme conditions. The challenge is to prepare for the unprecedented, and the never-before-seen – but not for the unforeseen. CLIMAAX, in its Phase 3, will enable this assessment to be developed further.

2.4.6 Decide on Risk Priority

The risk allocation process was carried out in accordance with an internal risk analysis method (to be found in the complementary documents).

Table 4-2 Key Risk Assessment through

HeatWaves

Analysis Category	Financial severity	Human impact on internal staff	Human impact on external individuals	Deterioration in service levels	Impact on public policy	Impact on the institution's reputation	Impact on the IT system	Impact on buildings	Legal / institutional impact	Environmental impact	Impact on road infrastructure (and traffic flows)
Severity (Current)	To be defined	Moderate	Moderate	Important (global impact)	Important	Moderate	Limited	Limited	Limited	Moderate	Limited
Severity (Future)	To be defined	Critical	Critical	Important (global impact)	Important	Moderate	Moderate	Critical / important	Moderate	Critical	Limited / Moderate
Urgency	Watching Brief	Immediate action needed + watching brief	Immediate action needed + watching brief	More action needed	More action needed	Watching Brief	Watching Brief	Immediate action needed	Watching Brief	More action needed	Watching Brief
Resilience Capacity	Low	Medium	Medium	Medium	Low	Medium	To be defined	Low	To be defined	Low	To be defined
Risk ranking	Haut	Haut	Haut	Haut	Haut	Moderate	Moderate	Very High	Moderate	Very High	Low -

Heavy Rainfalls

Analysis Category	Financial severity	Human impact on internal staff	Human impact on external individuals	Deterioration in service levels	Impact on public policy	Impact on the institution's reputation	Impact on the IT system	Impact on buildings	Legal / institutional impact	Environmental impact	Impact on road infrastructure (and traffic flows)
Severity	Important	Limited	Moderate	Moderate	Moderate	Limited	Limited	Moderate	Limited	Moderate	Moderate
Severity (Future)	Critical	Moderate	Important	Important (often geographically localised)	Important	Moderate	Moderate	Moderate	Moderate	Moderate	Critical / important
Urgency	Watching Brief	No action needed	Watching Brief	Watching Brief	Watching Brief	More action needed	Watching brief	More action needed	Watching brief	Watching brief	More action needed
Resilience Capacity	Low	To be defined	Low / Medium	To be defined	To be defined	Medium	To be defined	Medium	To be defined	Low	Medium
Risk ranking	Very High	Moderate	Moderate	Haut	Haut	Moderate	Moderate	Moderate	Moderate	Moderate	Haut

Severity	Urgency	Resilience	Risk ranking	Colour coding :
Critical	Immediate	Low	Very High	
Important	More action	Medium	Haut	
Moderate	Watching brief	Substantial -	Moderate	
Limited	No action needed	High	Low -	

2.5 Monitoring and Evaluation

The second phase of the climate risk assessment has given us a clearer picture of the expertise available within the department on climate change and risk assessment. From a technical perspective, the CRA's findings confirm regional observations regarding both hazards and vulnerabilities.

During the process, the most complex aspects were time management in relation to stakeholder engagement and the detailed analysis of the data.

Stakeholders are improving the monitoring and evaluation process by sharing information about their requirements. They are also enhancing the toolbox to make it more ergonomic. The feedback received has been unexpected: most of the stakeholders were unaware of their own vulnerability. This link must be highlighted to raise awareness.

Next, the stakeholders share their views on the possible solutions, offering a practical, hands-on technical perspective. This enables the implementation of the identified strategies and allows the replicability of the solutions identified during the benchmarking exercise to be assessed. For instance, the buildings department could use a tool to find solutions tailored as closely as possible to the specific constraints of its building stock.

Finally, stakeholder's significant role in providing specific data (exposure and vulnerability) has been highlighted. In fact, the Climate Risk Assessment (CRA) and the evaluation of the effectiveness of implementing adaptation solutions are impossible without reliable, long-term data.

To raise awareness and provide support, we are currently developing a specific awareness-raising program, which began with a presentation on adapting to climate change ("The Department in 2050") at the managers' seminar and a conference on the CLIMAAX and P2R projects for interested staff members. Specific guided interviews are also planned to clarify the type of data that can be collected and to better understand support needs.

For the technical aspects, learning is facilitated through regular meetings with the two operational departments and the development of the new ergonomic toolbox.

In terms of data, more detailed information on biodiversity issues (evapotranspiration) and road infrastructure (elevation and road surface condition) would enable a more precise assessment of the risks.

Finally, research into the interplay between social and climate risks at a local level, as well as data on vulnerability relating to disability, would help to complete the analysis.

Ideally, the final results will be presented to the Nord Durable steering committee to liaise with elected representatives. For staff: a simplified leaflet is being considered in collaboration with the Science Forum. Then, results will be used through adaptation workshops and will constitute the basis for the adaptation strategy.

The general action plan will fall through communication, facilitation, outreach, acculturation, training, and working meetings, intertwined with the corporate social responsibility strategy (RéSO).

The internal risk management systems take climate risks into account to some extent. This is particularly evident in the business continuity plan, the internal risk assessment matrix and the mechanisms for managing work schedules in the event of exceptional occurrences.

The integration of the CLIMAAX toolkit into ARCGIs has yielded the expected results. Awareness-raising initiatives targeting managers and staff have been very well received.

Additionally the first cross-functional collaborations have been successful, but need to be pursued, as well more regular monitoring of stakeholders. Due to the temporary decrease of staff, these meetings were less frequent than planned.

The departure of a project team member slowed down the progress of the work; a replacement was not found until recently. Three master's degree interns were integrated fully or partially into the project team, contributing their interdisciplinary expertise in geography and political science.

In addition, the transfer of the CLIMAAX toolkit to ARCGis will enable us to engage in a more in-depth dialogue with internal operational departments during the third phase.

The reduction in the project team's headcount had a negative impact: limited communication with certain internal stakeholders, a lack of scientific expertise at the start of Deliverable 2 (which was subsequently addressed), and topics that require further exploration.

The inclusion of a staff member from the Rural Affairs and Environment Division on the project team made it possible to focus more specifically on adapting natural areas to climate change

Discussions with the geomatics specialist in charge of transferring the toolkit to ArcGIS led to the creation of maps highlighting significant vulnerabilities for the Department

Although the commitment to this issue is 'preliminary', the CRA is a useful tool for making complex global concepts more tangible and concrete. The creation of visual aids, combined with the need to delve deeper at each stage, enables project managers to develop an understanding of risk, solutions, and commitment. This effectively equips them to help spread the message and thus spur swift action. These factual elements, which are tailored to the local context, also help to streamline discussions and avoid dead ends caused by conflicting opinions.

2.6 Work plan Phase 3

During the next phase, the technical and governance aspects will be developed.

To improve risk assessment:

- Development of the ArcGIS toolkit for sector-specific applications will continue.
- Building vulnerabilities will be identified in greater detail using Bat'adapt.
- The method for assessing climate change risks to natural areas will be rolled out to other study sectors.
- To gain a more detailed understanding of road infrastructure risks, a digital twin proof of concept (POC) will likely be tested to identify the fine-scale impacts of extreme rainfall.
- In-depth vulnerability analyses in other areas will be developed following the project to ensure the method is fully refined.

To ensure better uptake of the risk assessment:

- The action plan covering communication, awareness-raising and training will be finalised with associated deadlines.
- This action plan will include: the identification of training opportunities (professional training, in-house training, accessible resources); the creation of accessible communication materials (accessibility for people with disabilities, public outreach, transparency); and the organisation of workshops to foster a culture of adaptation to climate change.
- Creation of an adaptation action toolkit based on the benchmarking exercise carried out.
- Sources of European and other funding, notably for buildings and the DRE
- Additional consideration of environmental issues

Furthermore, discussions with stakeholders on vulnerability assessment will continue, particularly regarding accessibility.

3 Conclusions Phase 2- Climate risk assessment

The results of the analysis conducted as part of the CLIMAAX project confirm, in line with existing knowledge, the main areas of vulnerability within the region. In particular, the maps produced highlight the expected recurrence and intensification of **extreme precipitation and heatwaves**, confirming its key role in risk exposure, especially for areas already identified as sensitive. These maps thus provide a useful validation of existing assessments, while strengthening the robustness of the territorial analysis of vulnerabilities.

Beyond the technical results, the CLIMAAX initiative has helped address several significant challenges. It helped **spark a wave of emulation centered on a systemic approach to climate risks** by breaking down barriers between different sectors (water, urban planning, health, infrastructure). The production and presentation of the analyses were also tailored to a **broader audience**, making it easier for non-specialists to understand and apply them. Sharing the findings at internal seminars—particularly those aimed at managers—served as a key driver for fostering a **risk culture** and initiating strategic reflection within the organization. Furthermore, external presentations of the initiative generated **significant interest**, particularly regarding the gradual cultural adaptation of teams and the integration of climate issues into professional practices.

However, certain limitations must be highlighted. The project was unable to go as far as anticipated in the **in-depth analysis of the data**, particularly due to changes in available human resources over the course of the project. This resulted in a **limited number of consolidated quantitative results**, which partially restricts the ability to finely prioritize risk levels. Finally, certain limitations inherent in the data and methods used in CLIMAAX were identified, underscoring the need to view them as a **foundation for decision-making** rather than as an exhaustive tool.

Furthermore, the analysis highlighted the need to **better align CLIMAAX results with other existing frameworks**, particularly those developed by the government, Météo-France, or the Climate-Energy Observatory. This consistency is essential to ensure the clarity of the assessments and to avoid the proliferation of divergent analytical frameworks.

With this in mind, the next steps should focus primarily on consolidating the achievements to date. It appears to be a priority to **continue fostering internal cultural adoption**, particularly through training and support for teams, in order to strengthen the cross-functional integration of climate issues. Work on the **vulnerability of regions and systems** also constitutes a relevant area for development, complementing the hazard analyses already extensively documented by leading scientific institutions.

. In this regard, the contributions of Météo-France and local research laboratories—particularly through projects such as MAPUCE on heat waves—provide a robust framework that must now be leveraged and applied operationally, including for extreme precipitation events.

Finally, this approach is part of a broader context of evolving public policies. The **increased frequency of climate events**, improvements in **early warning systems**, and the implementation of supporting measures by public authorities are now contributing to a **growing awareness of the need to integrate risks and their impacts into public decision-making**. In this regard, CLIMAAX serves as a catalyst by facilitating the adoption of these issues and structuring the initial steps toward a more integrated and operational adaptation strategy.

4 Progress evaluation

Table 4-1 Overview key performance indicators

Key performance indicators	*Progress*
At least three notes for policy makers at different stages of the project's progress	1. October 2025: **submission to the Political Assembly of a resolution to approve the participation of the Département du Nord in the CLIMAAX project and the launch of the GREEN59 sub-project** 2. *next phase: information note on the progress of the GREEN59 sub-project following the completion of phases 1 and 2 of the CLIMAAX project* 3. *next phase: information note summarising the conclusions of the GREEN59 sub-project and outlining recommendations for the adaptation of departmental public policies*
At least two summary publications on the project, including a proposal to present the approach to the Departements of the Hauts de France Region and the Départements de France national association	1. March 2026: presentation of the GREEN59 subproject to an audience of 120 participants during a webinar organised by the Départements de France national association 2. *next phase*

Table 4-2 Overview milestones

Milestones	*Progress*
M1: test for the first workflow	April 2025: test done – workflow "heartwaves"
M3: completion of the second workflow	May 2025: extreme rainfall – completion of the workflow
M3: meeting with local stakeholders	May 2025: first stakeholders coordination meeting with the Hauts-de-France Region and the University of Lille to set up a collaborative framework for assessing climate local vulnerabilities
M4: participation in the CLIMAAX workshop held in Barcelona	June 2025: participation of two agents from the Département du Nord in the CLIMAAX European seminar
M5: risk proritisation performed	July 2025: based on risk assessment and primary knowledge of collective resilience, risks were prioritised
M8: subcontracting	January 2026: subcontracting with ESRI
M8: choice of local data to be processed	December 2025: benchark of local data and scientific consortium verification
M10: presentation of the results to the "Nord Durable" steering committee	January 2026: presentation to the departmental administration of the results from deliverable 1 (CLIMAAX methodology, workflows identified, first maps and analysis produced, etc.)

Milestones	*Progress*
M16: meeting with local stakeholders	December 2025: stakeholders meeting with local authorities, state services (DDTM) and the University of Lille
M19: Identification of Key risks	July 2025: based on risk assessment, reassured in phase 2
M20: proposal for an adaptation plan	Phase 3
M22: participation in the CLIMAAX workshop organised in Brussels	Phase 3

5 Supporting documentation

- CommunicationOutputs_[REPLAYS] Connexions 2026, plus de 600 managers réunis pour partager, s'inspirer et agir - Contact.pdf
- CommunicationOutputs_20260326_presentation AFCCRE_CLIMAAX-P2R_CD59 (1).pdf
- CommunicationOutputs_20260619_webinaire_CLIMAAX_ReunionPartiesPrenantes.pdf
- CommunicationOutputs_Article_Interphaz_JME2026.docx
- CommunicationOutputs_Centre Ressource du Développement Durable_DocDépartementDuNord.pdf
- CommunicationOutputs_COPIL Nord durable du 13 janvier 2026 - Contact.pdf
- CommunicationOutputs_Département du Nord _ les enjeux du changement climatique.pdf
- CommunicationOutputs_Le joli mois de l'Europe _ la biodiversité transfrontalière - Contact.pdf
- CommunicationOutputs_Participation in networking events.docx
- CommunicationOutputs_Submission to EWRC.pdf
- Dataset_DATA.zip
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- VisualInputs_SocialAnalysis.docx
- VisualOutputs_Carte mentale CLIMAAX.pdf
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