Deliverable Phase 2

Climate Risk Assessment - District St. Wendel (CliRAs - WND)

Germany, District St. Wendel

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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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Document Information

Deliverable Title	Phase 2 – Climate risk assessment - Results of phase 2 of the CliRAs-WND
Brief Description	The document is the second report submitted by the district of Sankt Wendel in the Federal Republic of Germany. It summarizes all essential contents and results of the second phase of the CLiRAs-WND project. The focus is on the refined climate risk analysis with high-resolution data on key risks such as heavy rain and heat.
Project name	CliRAs-WND – Climate Risk Assessment for the district of St. Wendel
Country	Germany
Region/Municipality	District Sankt Wendel
Leading Institution	District Sankt Wendel IZES gGmbH Department of Infrastructure and Municipality Development
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Table of contents

List of figures

List of tables

Abbreviations and acronyms

Abbreviation / acronym	Description
AHZ	Retirement Home Centre (Altenheimzentrum)
AWC	Available Water Capacity
BGI	Blue-Green-Infrastructure
CRA	Climate Risk Assessment
CliRAs-WND	Climate Risk Assessment – District of St. Wendel
CMIP6	Sixth Phase of the Coupled Model Intercomparison Project
CWaTM	Community Water Model
DWD	German Weather Service (Deutscher Wetterdienst)
EFFIS	European Forest Fire Information System
ERA5	Fifth-Generation ECMWF Reanalysis
ET0	Cumulative Standard evapotranspiration
EURO-CORDEX	Part of the Coordinated Regional Downscaling Experiment with regional climate projections for Europe
EVS	Waste Management Association (Entsorgungsverband Saar)
FAO	Food and Agriculture Organization of the United Nations
FWI	Fire Weather Index
GAEZ	Global Agro-Ecological Zoning
GAP	Common Agricultural Policy (Gemeinsame Agrarpolitik)
GCM	Global Climate Model
GDP	Gross Domestic Product
GIS	Geographic Information System
HN100	100-year rainfall intensity conditions
HYRAS	Hydrometeorological Raster Datasets
IDF	Intensity-Duration-Frequency
IPCC	Intergovernmental Panel on Climate Change
ISIMIP	The Inter-Sectoral Impact Model Intercomparison Project
IZES	Institute for Future Energy and Material Flow Systems (Institut für Zukunftsenergie und Stoffstromsysteme, IZES gGmbH)
KEEN	Municipal Energy Efficiency Network
KOSTRA	Coordinated Analysis of Heavy Rainfall of DWD (Koordinierte Starkregenauswertung)
KPI	Key Performance Indicators
KSK	Saarland Climate Protection Concept (Klimaschutzkonzept)
LST	Land Surface Temperature
MAPSPAM	Spatial Production Allocation Model
MUKMAV	Saarland Ministry for Environment, Climate, Mobility, Agriculture and Consumer Protection

NUTS3	Nomenclature of Territorial Units for Statistics (3- small regions)
NWE	Northwest Europe
PIK	Potsdam Institute for Climate Impact Research (Potsdam-Institut für Klimafolgenforschung)
SKSG	Saarland Climate Protection Act
SSP	Shared Socioeconomic Pathways Scenario
RACI	Responsible, Accountable, Consulted, Informed
RADKLIM	Radar-based Precipitation Climatology (Radargestützen Niederschlagsklimatologie)
RCP	Representative Concentration Pathway
RCM	Regional Climate Models
RP	Return Period
WASP	Weighted Anomaly Standardized Precipitation Index
WND	District of Sankt Wendel
WRI	World Resources Institute

Executive summary

This deliverable presents the results of Phase 2 of the CliRAs-WND project, the climate risk assessment for the district of Sankt Wendel. Building on the broad risk screening carried out in Phase 1, Phase 2 refined the assessment of the most relevant climate-related risks, increased the local relevance of the analysis, integrated available local datasets and stakeholder knowledge, and prepared the basis for the adaptation strategy and measures in Phase 3.

Phase 2 focused on three main elements: the review of existing studies, regional climate information and DWD climate projections; the refinement and application of selected CLIMAAX workflows; and the integration of local data and stakeholder knowledge through GIS analyses and several stakeholder events. Particular attention was given to heavy rainfall and heat, as both risks are highly relevant for civil protection, vulnerable groups, critical infrastructure and municipal planning. Additional workflows for relative drought, agricultural drought and wildfire were applied to support a broader multi-hazard perspective.

The assessment confirms heavy rainfall as the highest-priority climate risk for the district. The refined workflow used the current local 100-year rainfall threshold of approximately 115.3 mm within 24 hours for the city of Sankt Wendel as a reference. According to the bias-corrected three-model ensemble under RCP 8.5 for 2041–2070, the return period of this event could decrease substantially. The projected precipitation intensity also increases strongly, with Sankt Wendel among the more affected areas in Saarland. Local heavy rainfall hazard maps were therefore combined with data on critical and social infrastructure to identify vulnerable locations and support emergency preparedness.

Heat was also confirmed as a high-priority risk requiring immediate action. The assessment was expanded to the entire district using Landsat-based land surface temperature data from the July 2019 heatwave. Heat exposure is most visible in the town of St. Wendel, but also occurs in smaller municipal centres and around sensitive infrastructures in other municipalities. The analysis included social and health institutions. Since many buildings and public spaces are not yet sufficiently adapted to prolonged heat, heatwaves represent an increasing challenge for health protection, social infrastructure and municipal planning.

Windstorm remains relevant due to past local events. However, additional projections reviewed in Phase 2 do not show a robust future signal for average wind speed. Windstorm therefore remains part of preparedness planning, but was not refined in the same detail as heavy rainfall and heat. Drought and wildfire were assessed as emerging risks.

Stakeholder engagement confirmed the prioritisation of heavy rainfall and heat. The municipal survey showed that climate adaptation is already considered in local planning to some extent. Stakeholders expressed a strong need for practical, understandable and locally specific information, including maps, datasets, flyers and planning guidance.

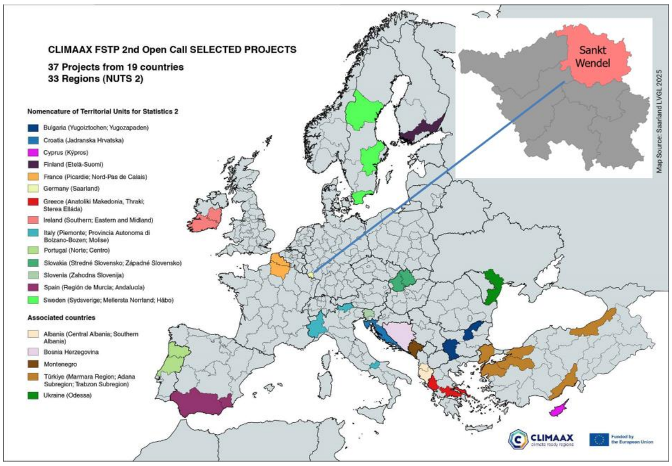
Phase 2 also revealed limitations, particularly regarding climate model uncertainties, diverging workflow results, coarse datasets and limited stakeholder capacities.

Overall, Phase 2 significantly improved the evidence base for climate adaptation in the district of Sankt Wendel. Heavy rainfall and heat require immediate attention, windstorm should remain part of preparedness planning, and drought and wildfire should be included in monitoring activities. In Phase 3, the results will be translated into a local climate adaptation strategy and concrete adaptation measures.

1. Introduction

1.1 Background

The district of St. Wendel is located in the northern part of the federal state of Saarland. Most of it belongs to the Nahebergland region, with the foothills of the Hunsrück mountains to the north. In terms of central-place classification, the district is part of a medium-order functional area (“mittelzentraler Verflechtungsbereich”) and is classified as a rural area.



District of St. Wendel:

- District in Saarland: administrative unit for the district town of St. Wendel and the municipalities of Freisen, Marpingen, Namborn, Nohfelden, Nonnweiler, Oberthal, and Tholey (total of 63 municipal districts)
- 476.48 km²
- around 88,000 inhabitants
- share of elderly people: 27 %
- old building fabric

Figure 1: Location and main characteristics of district of St. Wendel (© CLIMAAX; Saarland LVGL 2025; Data sources: (Landkreis St. Wendel n.d.; Bertelsmann Stiftung 2025)

The district of St. Wendel took its responsibility for the climate and the environment very seriously from the outset. An integrated climate protection strategy has been in place since 2012; this serves as a guide for implementing the district’s climate protection initiative and is being rolled out gradually. Since 2019, aspects of climate adaptation have also been taken into account in the issues addressed. Currently, civil protection and crisis management in response to increasing climate risks are becoming increasingly important.

Several departments within the district administration are already working closely together on the issue of climate adaptation: Department 41 (Building Management and Climate Protection), Department 43 (Rural Development) and Department 45 (Civil Protection). CliRAs-WND will close the remaining gap through systematic climate risk assessment involving all key stakeholders, as well as a local adaptation strategy for the entire district, thereby acting as a pioneer for climate adaptation at the Saarland level.

1.2 Main objectives of the project

The main goal of CliRAs-WND is to understand the risks caused by climate change in the district of Sankt Wendel through a comprehensive analysis and to improve climate resilience by developing a climate risk management plan and a local adaptation strategy. Phase 1 provided a broad basis for this. The application of the CLIMAAX workflows offered an important foundation for the structured assessment of current and future risks. The workflows proved particularly useful in demonstrating how risks are expected to intensify under climate change conditions, thereby supporting a more robust prioritization of hazards. The process also revealed challenges, which mainly consisted of the limited spatial resolution of the available datasets and the need to better integrate information at the local level in order to capture small-scale impacts.

Phase 2 therefore aimed at collecting high-resolution regional data and adapting the climate risk analysis (CRA) at the local level. Based on the results of Phase 1, existing regional studies and data were analyzed and existing local datasets were integrated. The hazard and risks assessments for heavy rainfall and heat were fine-tuned using different climate models and additional datasets (e.g. for critical infrastructures). More specific maps for critical infrastructures and agricultural areas were overlaid with heavy rainfall hazard maps. In addition, workflows for additional risks such as wildfires and droughts, which were identified as emerging hazards within the stakeholder process, were applied. Finally, the workflow results were compared and contextualised using DWD climate projections and key findings from existing studies as a basis for the key risk assessment.

Furthermore, in the second phase, the aim was to strengthen the awareness and capacities of the key stakeholders and the population regarding climate adaptation, in order to promote initiatives and accelerate the implementation of the measures to be developed. Interested stakeholders and the population were therefore involved. Thematic workshops and technical discussions with different participants were organized to validate and expand the analysis results.

The focus of the entire process continued to be on the two additional objectives of CliRAs-WND – 'Strengthening disaster prevention and emergency planning' as well as 'Incorporating climate risks into municipal planning.' Both require precise risk assessment as well as increased awareness of extreme weather events. Through the continued use of the CLIMAAX workflows and a detailed examination of the risks in Phase 2, the climate risk analysis was able to provide a solid basis for the development of appropriate adaptation measures.

In phase 3, strategies and measures for vulnerable areas, critical infrastructures, and particularly at-risk population groups can be derived from the results in order to reduce climate vulnerability.

In a broader context, CliRAs aims to promote networking and knowledge transfer at regional, national, and international levels. The existing networks of the district and the contractor IZES have been expanded and continue to be used to disseminate the project results, so that the knowledge is passed on to relevant stakeholders at state, federal, and international levels, thereby accelerating general adaptation to the consequences of climate change.

1.3 Project team

The project is led by the district of St. Wendel. Dirk Schäfer, head of the Office for Civil Protection of the District Administration and district fire inspector, is responsible for overall coordination and strategic direction. The coordination between the district, the scientific partner, IZES gGmbH, the actors in the district, and the CLIMAAX consortium is handled by Diana Jung.

The Department of Infrastructure and Municipal Development of IZES gGmbH, a non-university research institution funded by the Saarland, is responsible for the substantive work of CliRAs – WND. It includes the authors of this report: the researchers Simon Spath, Luisa Seegmüller, Dorothee Siemer, and Lili Meiser; the department is headed by Mike Speck.

1.4 Outline of the document's structure

After the Executive Summary and the introduction, the partial results achieved in the CRA during the second phase of the project are presented. The document follows the structure of the CLIMAAX handbook and presents in chapter 2 the CRA findings in the following sequence: scoping, risk exploration, regionalized risk analysis, key findings of the risk assessment, monitoring and evaluation. Subsequently, the work plan for the third project phase is presented. In chapter 3 the conclusions from phase 2 are followed by the progress evaluation in chapter 4. Chapter 5 lists all the results produced in this phase, and Chapter 6 lists the references used.

2 Climate risk assessment – Phase 2

This section describes the steps taken in conducting the climate risk assessment using the CLIMAAX methodology and in evaluating the results.

2.1 Scoping

2.1.1 Objectives

The objectives, purpose and expected outcomes of the CRA are described in detail in Deliverable 1. In this document, Section 1.2 sets out the objectives – as specified for Phase 2. This section therefore focuses solely on the constraints and limitations encountered during Phase 2.

The limitations and constraints of the CRA also included the severely limited availability of high-resolution local climate and socio-economic data, as well as the inherent uncertainties of future climate scenarios. These issues were addressed by comparing the workflow results with existing studies, DWD climate projections and historical events. In addition, local datasets on critical infrastructure, social and health institutions, heavy rainfall hazard maps and erosion susceptibility were integrated where available. The results were further validated through regular exchange with local stakeholders.

Furthermore, as in Phase 1, significant financial constraints, limited human resources, the presence of other urgent tasks, and the non-binding nature of adaptation measures within the district and its municipalities present obstacles. These factors are to be taken into account in Phase 3 when formulating the adaptation strategy and measures.

Furthermore, challenges arose, particularly with the perceived urgency of other tasks among certain stakeholder groups.

2.1.2 Context

The context is described in detail in Deliverable 1. The following section adds context-related aspects and external influences that have emerged in Phase 2.

International: Since November 2025, the LivableCities project has been running under the leadership of IZES gGmbH. Within LivableCities, six cities in Northwest Europe (NWE) and various partners from key sectors of society are working together to address shared territorial challenges resulting from unsustainable urban development in the past. These challenges include, in particular, biodiversity loss, air pollution and increased vulnerability to the impacts of climate change. CliRAs-WND was presented at the international LivableCities kick-off meeting on 20 May 2026. A lively exchange took place with representatives of the participating European cities on how the overlay and combination of maps developed for CliRAs-WND can support the integration of blue-green infrastructure elements into urban planning.

RCP8.5 is increasingly discussed in the scientific literature not as the most likely pathway, but rather as a high-emission or stress-test scenario. Due to climate policy measures, technological progress and the expansion of renewable energy, a development pathway close to RCP8.5 is now considered less plausible than in many earlier climate impact studies. Nevertheless, RCP8.5 was still used in this assessment because the CLIMAAX workflows were initiated on this scenario basis, ensuring consistency and comparability across the analyses. In addition, it provides a precautionary perspective on potential high-end climate risks and is therefore useful for risk communication and adaptation planning. The results are therefore not interpreted as the most likely future, but as an estimate of possible severe climate impacts. (Umweltbundesamt 2026)

Germany: From summer 2026 onwards, the German Weather Service (DWD) will provide nationally consistent and quality-assured climate projections for Germany. In order to reduce uncertainties regarding future developments, several possible pathways of societal, technological and resource use developments are considered, together with several climate projection models. This forms the so-called DWD reference ensemble. Since early 2026, the German Climate Atlas has presented current deviations from the reference period 1971–2000 as well as possible future developments in maps and diagrams. Parts of these climate projections have already been evaluated and integrated into the CRA for the relevant climatic natural regions (see chapter 2.2.1). (Deutscher Wetterdienst (DWD) 2025a)

Saarland: At the administrative level of Saarland, the first Saarland Climate Protection Concept (KSK) pursuant to Section 6 of the Saarland Climate Protection Act (SKSG) was presented to the public in summer 2025 (Ministerium der Justiz Saarland 12.07.2023; Saarländische Landesregierung 2025). It serves as the state government's guiding framework for achieving Saarland's climate protection targets and also includes the topic of climate adaptation. The concept contains 16 measures on climate adaptation. In view of the difficult budgetary situation faced by all actors, the proposed measures primarily build on funding programmes with high subsidy rates, particularly those currently provided by the German federal government. The concept was finalised with the participation of the state parliament, the public, experts and all government departments, and with scientific support from IZES.

As a direct consequence of the Climate Protection Act, the Saarland state government is currently developing various state funding programmes intended to support the financing of climate adaptation measures at municipal level. Once these programmes are available, the district of Sankt Wendel will be able to apply for these funds, which is urgently needed given the precarious financial situation.

At the same time, in June 2026, the state government began conducting a CRA for Saarland, which will form the basis for the development of a climate adaptation strategy for the state. The CRA for the district of Sankt Wendel can provide valuable input to this process. At the same time, the development process at state level is expected to support municipal climate adaptation activities.

District of Sankt Wendel: Based on CliRAs-WND, the district of Sankt Wendel is currently applying for various funding opportunities related to the resilience of critical infrastructure in the district and improved networking between the different actors involved in addressing expected climate impacts. The focus of the CliRAs-WND project will therefore continue to be addressed in future activities.

2.1.3 Participation and risk ownership

As a first step in Phase 1, the district and the subcontractor IZES gGmbH jointly identified the stakeholders relevant to the project. The aim was to ensure broad representation of actors from civil protection and other relevant fields of interest, as well as to activate local knowledge. The stakeholders were divided into two categories: main stakeholders and other stakeholders. The main stakeholders form the "core group" throughout the entire project period and help establish contact with the other stakeholders. All identified stakeholder groups were invited to an initial workshop in phase 1, informed about CliRAs-WND, and their knowledge of local climate hazards was collected and mapped.

In Phase 2, the participation process focused on directly addressing individual stakeholders. In line with the RACI matrix developed in Phase 1, the assigned responsibilities were taken into account in order to improve decision-making and coordination between the stakeholder groups. This step ensured that both institutional expertise and local knowledge were integrated into the assessment and that preliminary results could be validated. With regard to Phase 3, all activities also addressed potential opportunities and barriers related to adaptation measures.

The main actors continued to include selected administrative units of the district administration, such as the Civil Protection Office, the Climate Protection Manager, the Rural Development Manager and the Economic Development Agency. In line with the objectives of CliRAs-WND, particular attention was also given to the involvement of municipal planning departments. The input from municipal planning departments regarding their previous climate adaptation activities was particularly relevant in this phase, as it can serve as a basis for the development of planning guidelines in Phase 3.

Furthermore, the work focused on identifying the locations frequented by vulnerable groups, such as social institutions for young children, elderly people, sick people and people with disabilities, as well as critical infrastructure and public service facilities, including electricity and water supply, waste management, food supply, petrol stations, railway stations and public administration. This was done by contacting the relevant actors directly. The public was involved in Phase 2 through media work and an interactive workshop in the Citizens' Lab. In addition, CliRAs-WND aims to highlight the importance of climate risk assessments and adaptation strategies at national and international level. For this reason, extensive networking activities took place at Saarland level as well as nationally and internationally, for example at conferences and other project meetings.

Overall responsibility for the CRA process lies with the district of Sankt Wendel, specifically the Civil Protection Office. By involving a broad range of stakeholders, the process strengthens local ownership of climate adaptation, promotes institutional cooperation and creates a shared basis for future climate resilience measures Figure 2 provides an overview of the involvement of the individual stakeholders.

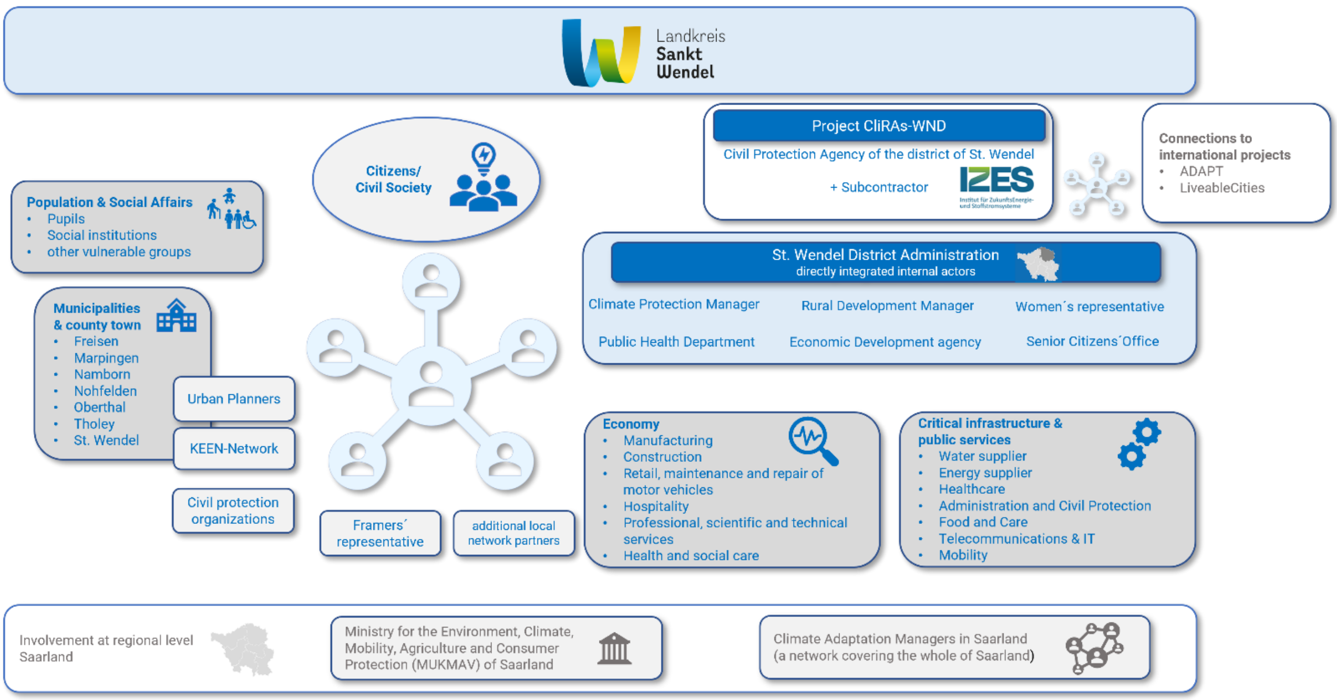


Figure 2: Organisational chart of stakeholders (© IZES gGmbH)

2.1.4 Application of principles

Social justice, equity and inclusiveness: In line with the CLIMAAX framework, CliRAs-WND involves residents and relevant stakeholders of the district of Sankt Wendel on an equal basis, regardless of factors such as age, disability, origin, gender, level of education or income. For an open multi-stakeholder process, stakeholders are carefully selected and conditions are supported that enable everyone to access information and participate actively and independently. For example, all social institutions with a high concentration of vulnerable population groups, such as nurseries, schools, elderly and care homes, hospitals, rehabilitation centres, facilities for people with disabilities and other social institutions, were identified and mapped with regard to their exposure to heavy rainfall and heat. So far, the public has been broadly informed and actively involved through various media channels and a low-threshold interactive citizens' workshop on the topic of "Climate Risk Check for Your Home". A specialist meeting was also held with the public health department as a representative body for particularly vulnerable groups. For Phase 3, it is planned to reach further sections of the population with different socio-economic backgrounds. In addition, there is the possibility of involving the district's Equal Opportunities Officer and Senior Citizens' Office in the development of the adaptation strategy in order to design fair adaptation measures for vulnerable groups. With regard to municipal planning, the focus will be on developing planning guidelines that also address existing built-up areas and densely populated residential areas in order to reduce existing environmental inequalities.

Quality, rigour and transparency: Scientific practices were applied in the CRA to ensure the traceability of the data used and to enable comparability. Climate risks were assessed using the CLIMAAX workflows, existing regional studies, regional datasets and local knowledge, allowing for mutual validation of the results. Particular attention was given to the multi-model analysis in order to ensure a high quality of results. At the end of Phase 2, new regional data from the German Weather Service (DWD) became available; these data were additionally evaluated and integrated to increase the informative value of the CRA. The entire process, including the assumptions made and the difficulties encountered, was documented transparently.

Precautionary approach: The handling of complexity, uncertainties and changing framework conditions, as well as the direct involvement of different stakeholder groups, were closely and continuously coordinated between the Civil Protection Office and IZES. In order to address not only historical climate impacts, but also different possible development pathways and expected future impacts, several models and time horizons were applied in the CRA. Both present and future conditions were taken into account when assessing severity, urgency and adaptive capacity. The data-based analyses were cross-checked thematically with the assessments of relevant stakeholders.

2.1.5 Stakeholder engagement

In Phase 2, a multi-channel approach was applied to further address and involve the relevant stakeholders. This included a mix of dialogue-oriented and informative participation formats, such as workshops, expert meetings, surveys, information events and conference contributions. The aim was to organise communication and cooperation between the very different stakeholder groups, as well as the collection of their knowledge, in a targeted, transparent and effective manner.

In March 2026 an internal district workshop was held with several of the main stakeholders. The results from Phase 1 and from the beginning of Phase 2 were presented and discussed in detail in order to identify which CRA results are particularly relevant for the district and its actors, and in what form they should be provided. The next working steps and the approach for contacting additional stakeholders were also defined. In addition to the researchers from IZES, the workshop was attended by staff from the Civil Protection Office, the Climate Protection Manager and the Head of the Rural Development Department.

Figure 3: Workshop activities on 11 March 2026 (Photo: IZES gGmbH)

In general, these committed actors remain in continuous exchange throughout the entire project process.

In addition, expert meetings were held with individual stakeholders in order to address their specific thematic requirements, gather specialised knowledge, validate results and assess their willingness for further cooperation as well as their need for additional information. Discussions were held with the Entsorgungsverband Saar (EVS), the municipal service provider for wastewater treatment and waste disposal in Saarland, the public health department of the district, and the Wirtschaftsförderungsgesellschaft St. Wendeler Land mbH. Overall, the stakeholders showed strong interest and will be involved in the further process.

The public health department, with which the project team would also have liked to organise a workshop, has so far not been able to commit due to a high workload. As part of a bachelor’s thesis supervised by IZES, the topic of climate risk assessment for the commercial sector in the district of Sankt Wendel is currently being examined. This is of particular interest to the Wirtschaftsförderungsgesellschaft, as climate adaptation has not yet been addressed by companies in the district in a structured and precautionary manner. One challenge in this context is the limited availability of reliable company data for the district.

Meetings were also requested with the Chamber of Agriculture and the Saarland Farmers’ Association. Although feedback was received, a specific date has not yet been agreed. Additional expert meetings with the municipal utilities and Wasser- und Energieversorgung Kreis St. Wendel GmbH, as further representatives of critical infrastructure, are planned for Phase 3.

As, alongside civil protection, another key focus of CliRAs-WND is the integration of climate risks into local planning, the planning departments of the eight municipalities within the district were asked, with a view to Phase 3, to complete a questionnaire providing information on the extent to which climate adaptation is already being taken into account in local planning and what obstacles exist in this regard. Six local authorities had responded by 24 June 2026. The assessments of local climate hazards provided important additional information for the climate risk analysis. It is particularly encouraging to note that all the local authorities that took part in the survey currently incorporate climate adaptation, at least to some extent or even extensively and systematically, into their planning. However, to date only one local authority has a (non-binding) climate adaptation strategy that is taken into account here. Overall, the responses show that, whilst the individual local authorities differ in terms of staffing, responsibilities and financial resources, their need for support services is high and similar across the board. A summary analysis of the responses can be found in the report “Survey of planning departments in local authorities”.

In order to strengthen public awareness and capacities regarding climate adaptation, citizens were informed through regional media coverage and invited to an event at the Citizens’ Lab in Sankt Wendel on 23 June 2026 entitled “Climate Risk Check for Your Home – Understanding Digital Maps and Protecting Your Own House”. Due to very high temperatures during a heatwave, only six citizens attended the workshop-style event. The participants were informed in particular about the assessment of heavy rainfall and heat risks, adaptation measures for buildings and warning apps. Further formats for informing citizens are planned for Phase 3.

To promote exchange at Saarland level, a CliRAs-WND poster was presented at the 2nd Saarland Climate Congress in Saarbrücken on 19 May 2026, where the CliRAs-WND team connected with relevant actors. On 10 June 2026, the team organised a first exchange with the network of climate adaptation managers from Saarland’s cities and municipalities, together with the Ministry for the Environment, Climate, Mobility, Agriculture and Consumer Protection (MUKMAV). This exchange format will be continued in the future; the next meeting is envisaged for October 2026, when the results of Phase 2 will be discussed. The exchange focused in particular on the CLIMAAX methodology and its transferability to other districts and municipalities. In addition, analyses already carried out by participants were discussed, for example the development of a heat map for the city of Saarbrücken.

Furthermore, synergies with the Interreg projects ADAPT and LivableCities are being used. In LivableCities, for example, six cities in Northwest Europe and various partners from key sectors of society work together to address shared territorial challenges resulting from unsustainable urban development in the past. Specifically, LivableCities aims to create, expand and connect blue-green infrastructure (BGI). At the kick-off meeting on 20 May 2026, the core idea of linking the projects was presented: CLIMAAX workflows and risk information are combined with local land-use and infrastructure data in order to identify where BGI can provide the greatest benefit.

Figure 4: Citizen workshop - Climate Risk Check for Your Home (Photo: IZES)

Figure 5: CliRAs-WND at 2. Saarland Climate Congress (Photo: Ann-Sophie Ruf)

Figure 6: CliRAs-WND at the LiveableCities Kick-off-Meeting (Photo: IZES)

For Phase 3, an expert meeting with the Municipal Energy Efficiency Network (KEEN) has already been planned. In addition, the information mobile, a 3.5-tonne vehicle equipped with its own stage, sound system and photovoltaic system, which is available as part of Smart Wendeler Land, the

"Smart Cities" initiative in the district of Sankt Wendel, will be used to further inform the public during the German Week of Climate Adaptation on 17 September 2026.

Figure 7 provides an overview of stakeholder involvement in Phase 2.

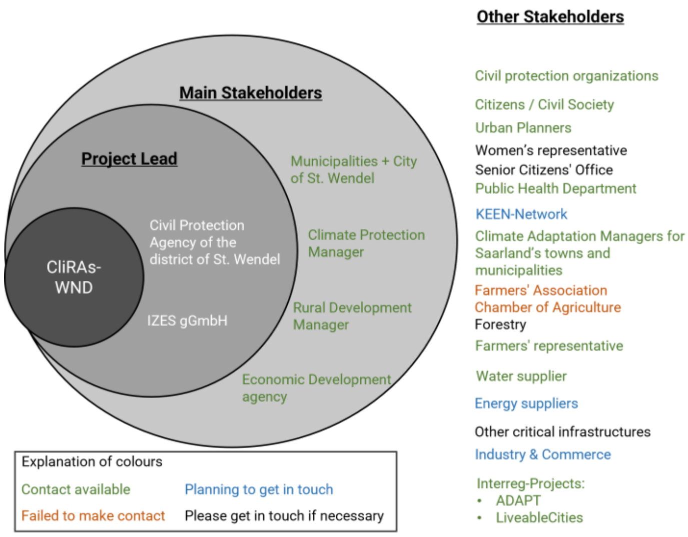


Figure 7: Stakeholder engagement in Phase 2 (© IZES gGmbH)

2.2 Risk Exploration

The risk exploration in Phase 2 includes two main steps. First, additional existing studies and the DWD climate projections were analysed and compared with the results of the CLIMAAX workflows. The main findings are summarised in the risk screening section, while a more detailed overview is provided in the Annex. Furthermore, the municipal survey is evaluated in order to integrate local knowledge, existing adaptation activities and perceived climate risks at municipal level into the further assessment. The key findings of the risks screening were used to compare and validate the workflow results for the key risk assessment (subchapter 2.4.2).

2.2.1 Screen risks (selection of main hazards)

Summary of different studies:

Based on the reviewed studies, heat and heavy rainfall are the most relevant climate hazards for the district of Sankt Wendel. Heat shows the clearest and most robust increase, particularly regarding annual mean temperature, summer days, hot days and the possible duration of heatwaves. Heavy rainfall is also highly relevant, as an increase in heavy rainfall days is expected and such events can occur throughout the entire district. Drought and wildfire risks are also relevant, but subject to greater uncertainty. Drought shows a tendency towards more dry days, especially in summer, while wildfire risk may increase due to the combined effects of heat and dryness. Wind and storm hazards remain the most uncertain, as the reviewed studies do not provide clear evidence of future changes, although rare local extreme events may still occur. A detailed analysis is provided in the annex (Annex 1 - Evaluation of climate studies).

DWD climate projections

As an additional risk screening regarding the different hazards, DWD climate projection data were evaluated for the three climatic natural regions occurring within the district of Sankt Wendel. The three climatic natural regions considered in the analysis and their spatial extent within the district are shown in the figure below. This approach allows regional climatic differences within the district to be considered.

The projections are based on the DWD climate projection dataset for Germany. Historical reference values use HYRAS data for 1971–2000, while future changes are based on the DWD Reference Ensemble v2018 for the RCP scenarios. The projections are provided for 30-year periods up to 2071–2100 and expressed as changes relative to the 1971–2000 reference period. Model uncertainty is represented by the 15th and 85th percentiles of the multi-model ensemble range. (Deutscher Wetterdienst (DWD) 2025a)

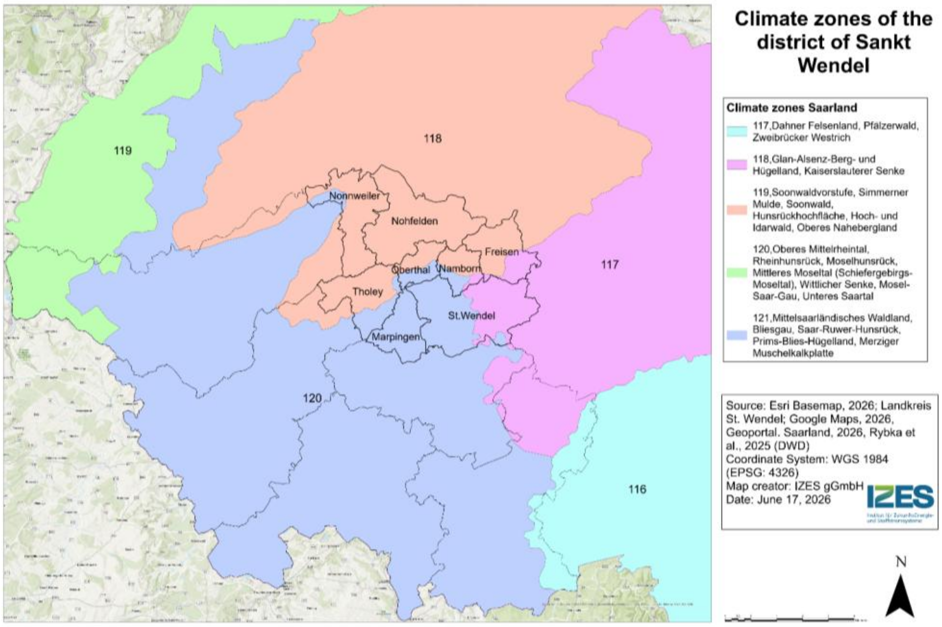


Figure 8: Climate zones of the district of Sankt Wendel (© IZES gGmbH based on DWD climate projections)

For this assessment, selected indicators related to temperature, precipitation and wind were analysed for RCP 4.5 and RCP 8.5, from the historical baseline to the end of the century. The main results are presented in the following figures. Additional diagrams and the underlying data tables are provided in the Annex 2 – DWD climate projections.

Table 1: DWD climate projections – Comparison zone 118; 119 and 121 (Deutscher Wetterdienst (DWD) 2025a)

Zone 118	*Zone 119*	*Zone 121*
Annual Precipitation: The three climatic natural regions differ mainly in their absolute precipitation levels. Zone 118 shows the lowest annual precipitation amounts, while Zone 119 is wetter and Zone 121 shows the highest annual precipitation levels (reference period up to 900mm/year in Zone 121). Across all three regions, the projected 15th–85th percentile ranges indicate a tendency towards increasing annual precipitation over the course of the century under both RCP 4.5 and RCP 8.5 (up to > 1000 mm/year in Zone 121). This upward tendency is particularly visible in the later periods, although the ranges remain broad and partly overlap between scenarios and periods.		

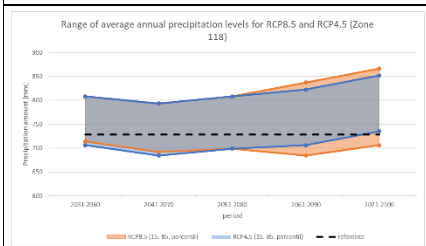
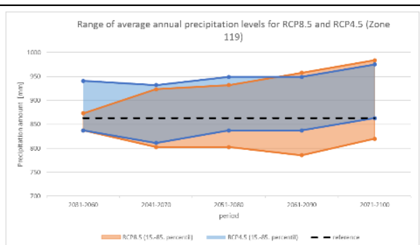
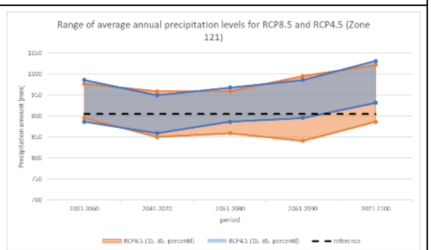

		

Figure 9: DWD climate projections – annual precipitation (own illustration; based on (Deutscher Wetterdienst (DWD) 2025a))		
Heavy rainfall days (>20mm): The three climatic natural regions differ in the absolute number of heavy rainfall days. Zone 118 shows the lowest number of days (4 days per year) with precipitation exceeding 20 mm, while Zone 119 is slightly higher and Zone 121 shows		

the highest values. Across all three regions, the projected 15th–85th percentile ranges indicate a tendency towards an increasing number of heavy rainfall days over the course of the century under both RCP 4.5 and RCP 8.5. This increase is particularly visible in the later periods.

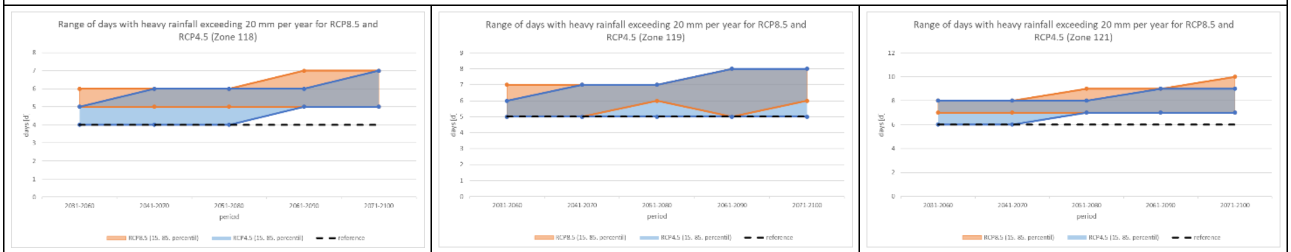


Figure 10: DWD climate projections – heavy rainfall days (*own illustration; based on (Deutscher Wetterdienst (DWD) 2025a)*)

Dry days: The three climatic natural regions differ slightly in the absolute number of dry days per year. Zone 118 shows the highest number of dry days, while Zones 119 and 121 are slightly lower and relatively similar. Across all three regions, the projected 15th–85th percentile ranges do not indicate a clear continuous increase in dry days over the whole century. Instead, the ranges show a slight decrease or stable development in several mid-century periods, followed by higher upper-range values towards the end of the century, particularly under RCP 8.5.

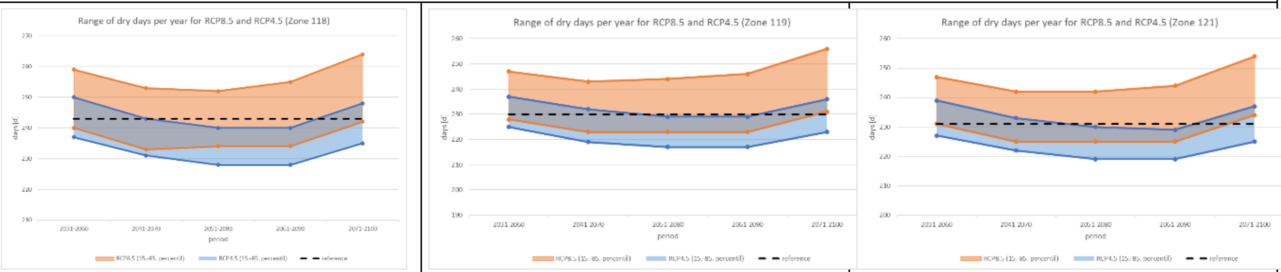


Figure 11:: DWD climate projections – dry days (own illustration; based on (Deutscher Wetterdienst (DWD) 2025a))

Hot days: The projections show a clear increase in the number of hot days per year across all three climatic natural regions. Compared to the historical reference level, both RCP 4.5 and RCP 8.5 indicate substantially higher values throughout the century. The increase is particularly pronounced under RCP 8.5, where the upper percentile range rises strongly towards the end of the century. The three regions differ in their absolute number of hot days. Zone 119 shows the lowest values, while Zones 118 and 121 reach higher numbers of hot days, especially in the late-century periods. Under RCP 4.5, the increase appears more moderate and tends to stabilise in the later periods, whereas under RCP 8.5 the number of hot days continues to rise steadily. Overall, hot days represent one of the clearest climate change signals in the assessment.

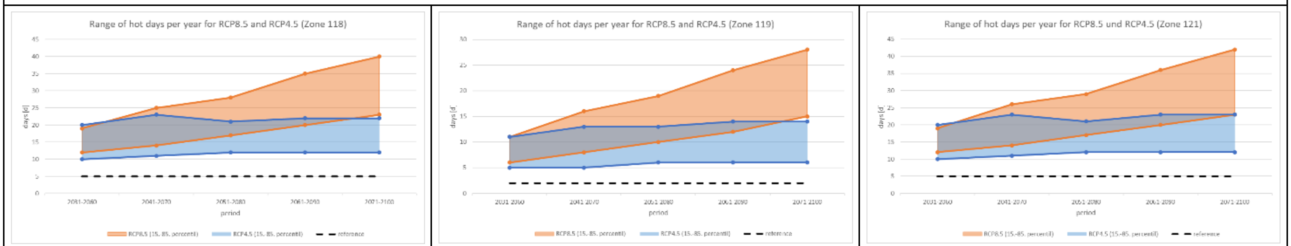


Figure 12: DWD climate projections – hot days (own illustration; based on (Deutscher Wetterdienst (DWD) 2025a))

Average wind speed: The projections for average wind speed show only small changes across the three climatic natural regions. In all zones, the 15th–85th percentile ranges remain close to the historical reference level, with values generally ranging between slight decreases and slight increases. The ranges also overlap strongly between RCP 4.5 and RCP 8.5. Overall, no clear or robust trend towards increasing average wind speed can be identified. Under RCP 8.5, the lower percentile range tends to indicate slightly decreasing wind speeds in the later periods, while the upper range mostly remains close to zero or slightly positive. The differences between the three zones are minor. Therefore, average wind speed does not appear to be a dominant climate change signal in the assessment. However, this indicator does not directly represent extreme wind events or gusts, which need to be assessed separately.

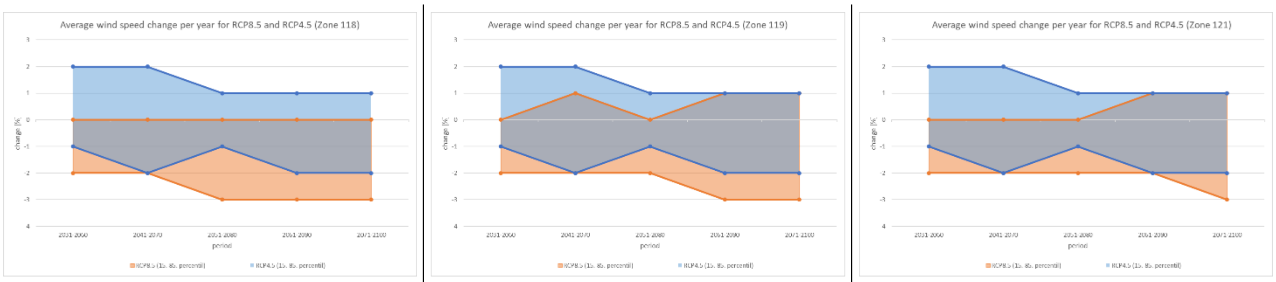


Figure 13: DWD climate projections – average wind speed (own illustration; based on (Deutscher Wetterdienst (DWD) 2025a))

Climate-related hazards in local communities:

As was already the case at the stakeholder workshop in Phase 1, the survey revealed that heavy rainfall was the greatest climate-related risk. Four local authorities feel strongly affected by this, whilst two feel very strongly affected (possible responses: very low, low, medium, high, very high). Furthermore, the municipalities are also directly affected – to a significant extent in four cases and, in one instance, to a very significant extent – by the consequences of heavy rainfall on the streams flowing through their municipal areas, namely by high water levels and flooding. In addition, one local authority stated that it feels very severely affected by storm events, whilst two local authorities stated that they feel severely affected by storm events. Furthermore, two local authorities each are severely affected by heat and two by drought. The remaining four municipalities in each case feel moderately affected by heat and drought. Three municipalities feel moderately affected by forest and vegetation fires, whilst three feel only slightly affected. The figure below summarizes the responses.

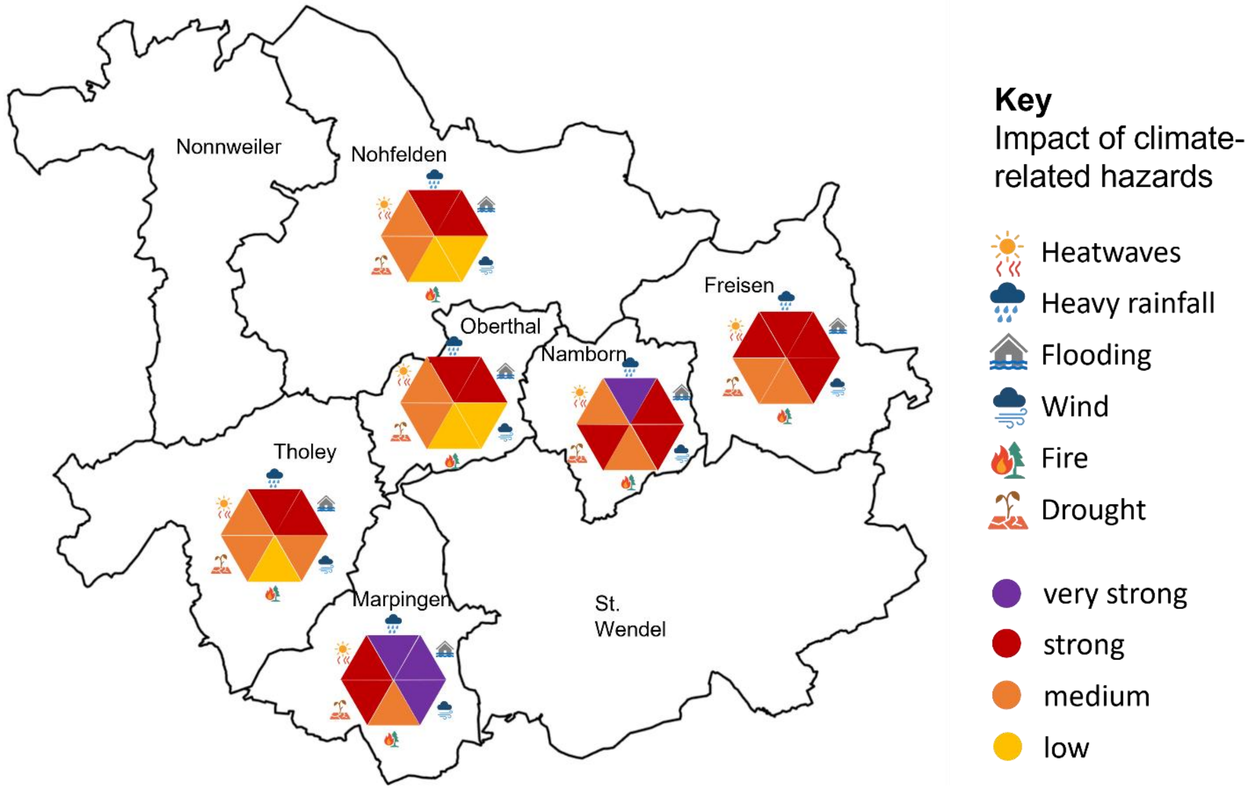


Figure 14: Impact of climate risks on municipalities (© IZES gGmbHbased on ESRI Basemap 2026 and LVGL 2026)

2.2.2 Choose Scenario

As described in Deliverable 1, the assessment primarily focuses on mid- and end-of-century time horizons and mainly uses the RCP8.5 scenario. This approach was retained in Phase 2 to ensure consistency with the previous assessment steps and comparability across the different CLIMAAX workflow results. In some parts of the assessment, the RCP4.5 scenario was additionally considered to provide a comparison with a more moderate climate change pathway and to better contextualise the results.

2.3 Regionalized Risk Analysis

In Phase 2, the CLIMAAX workflows that had not yet been carried out in Phase 1 were implemented for relative drought, agricultural drought and wildfire risk (see Chapter 2.3). These assessments were used to obtain an initial overview of additional climate-related risks for the district.

At the same time, the risks identified as most relevant in Phase 1 and also based on the further risk screening of Phase 2, namely heavy rainfall and heat, were further refined. These hazards were analysed in more detail by considering several models and by integrating additional local data where possible. The specific methodological steps and results are described in the respective subchapters.

In addition to the CLIMAAX Handbook workflows, further assessments were carried out independently. These included the evaluation of new DWD climate projections for the district of Sankt Wendel, the analysis of past extreme events, and the overlay of local heavy rainfall hazard maps with critical infrastructure and sensitive facilities. This combination of workflow-based analyses, regional climate information and local datasets helped to improve the robustness and practical relevance of the CRA results

2.3.1 Heavy Precipitation Workflow - fine-tuning to local context

Table 2: Data overview heavy precipitation workflow

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
EURO-Cordex Data (12km spatial resolution): Non-bias corrected dataset: • mohc-hadgem2-es/knmi-racmo22e • mpi-m-mpi-esm-lr/smhi-rca4 r1i1p1 • mpi-m-mpi-esm-lr/gerics-remo2015 r3i1p1 • ipsl-cm5a-mr/gerics-remo2015 r1i1p1 • ichec-ec-earth/knmi-racmo22e • ichec-ec-earth/dmi-hirham5 • cnrm-cerfacs-cm5/ knmi-racmo22 • ichec-ec-earth/smhi-rca4 r12i1p1 Bias-corrected dataset: • *ec-earth/racmo22* • *hadgem2-es/racmo22e* • *mpi-esm-lr/rca4* KOSTRA-DWD-2020: gridded data on precipitation magnitude and intensities depending on the rainfall duration and the return period (historical 1951 – 2020) (Deutscher Wetterdienst (DWD) 2023)	Not applied for workflow – infrastructure data used for further risk assessment based on local heavy rainfall maps.	Not applied for workflow – infrastructure data used for further risk assessment based on local heavy rainfall maps.	Expected return periods and changes compared to baseline 1976-2005 Expected future magnitudes Most affected regions

The main objective of the second deliverable was the calibration and refinement of the heavy rainfall workflow. A detailed explanation of these steps follows in the next section.

Table 3: Heavy rainfall workflow steps

	ensemble	Confidence level	cross checks
tested but not used	6h 8-model ensemble	Not conclusive	DWD projections, KOSTRA Threshold, Pentecost Floods 2024, local hazard maps
tested but not used	24h 8-model ensemble	Not conclusive	
final results used for Key risk assessment	24h bias-corrected 3-model ensemble	Plausible	

2.3.1.1 Hazard assessment

6h 8-model ensemble

The Hazard Assessment is based on the CLIMAAX Handbook (see CLIMAAX Handbook: Hazard Assessment HEAVY RAINFALL). Our initial approach involved conducting individual hazard assessments for each of the eight Regional Climate Models (RCMs) under the high-emission RCP 8.5 scenario with 6-hour time resolution for the future period 2041–2070 compared to the baseline 1976–2005. This model set included one model carried over from Deliverable 1 (*ichec-ec-earth/smhi-rca4 r12i1p1*) and seven additional models selected with the lowest bias factor. These seven models were chosen based on a rigorous bias analysis against ERA5 reanalysis data for the Saarland region, ensuring that the selected models demonstrated the highest fidelity for this specific geographical area (Majid Niazkar et al. 2026) - [Model bias and uncertainty for EURO-CORDEX CMIP5](). We proceeded to execute the hazard assessment workflow using these raw model outputs (Annex 3 – Heavy rainfall hazard).

24h 8-model ensemble

The hazard assessment was repeated using the same model selection but with 24-hour temporal resolution (Annex 3 – Heavy rainfall hazard).

2.3.1.2 Risk assessment

The revision of the Heavy Rainfall workflow was guided by the CLIMAAX Handbook (see CLIMAAX Handbook: Risk Assessment HEAVY RAINFALL). To assess the risk associated with extreme precipitation events and understand how current local critical impact-based thresholds will vary under climate change, we must consider two key factors: **rainfall intensity (magnitude)**, measured in millimeters over a specific timeframe, which determines the potential impact on infrastructure and communities; and **frequency**, expressed through return periods (RP) that indicate how often an event of a certain magnitude is expected to occur on average. Building on this framework and using the historical KOSTRA-DWD-2020 dataset as a reference (1951-2020), we established the thresholds for a 100-year heavy rainfall event for the City of St. Wendel: 74.5mm/6h for the 6-hour resolution and 115.3mm/24h for the 24-hour resolution. These thresholds serve as our baseline for investigating how the frequency (return period) and intensity of such extreme events are projected to change under the RCP 8.5 scenario by the period 2041–2070. Due to the low spatial resolution of the data, the analysis was carried out for the entire federal state of Saarland.

In the first step of the risk assessment, the Magnitude-frequency shifts were calculated from the calculated IDF (Intensity-Duration-Frequency) curves of each model for every raster pixel, the change in RP and precipitation intensity for the given threshold. To reduce model-specific uncertainties and obtain a more robust projection, a multi-model-ensemble was constructed for each of the three datasets by computing an arithmetic mean across all model chains. Afterwards the spatial distribution of the projected ensemble RP for the current thresholds (74.5mm/6h or 115.3mm/24h) under the RCP 8.5 scenario for the period 2041–2070 was mapped for Saarland.

24h 3-Bias-Model Ensemble

As the risk assessment of the 8-model ensemble produced inconsistent results for both the 6-hour and 24-hour values, we relied on the bias-corrected, pre-calculated datasets from the CLIMAAX consortium instead of calculating them ourselves, to ensure that our risk analysis would produce clear and valid results. Therefore, the same method as in the Hazard Assessment was used (Annex 3).

These datasets had undergone advanced statistical downscaling and bias correction procedures that accounted for the non-linear relationship between precipitation totals and frequency. This switch allowed us to bypass the issues identified earlier and helped us to deliver more realistic projections for the risk analysis.

Three regional **bias-corrected climate model** chains from the EURO-CORDEX data under the RCP 8.5 scenario with 24-hour temporal resolution were used (*ec-earth/racmo22e, hadgem2-es/racmo22e, mpi-esm-lr/rca4*). The use of 24-hour precipitation datasets was motivated by two factors. First, it ensures comparability with existing studies in the literature, as suggested by colleagues from the German Weather Service (DWD) at a climate conference. Second, the bias-corrected CORDEX datasets used in this assessment are only available at a daily temporal resolution, limiting the analysis to 24-hour precipitation extremes.

In contrast to the previous analysis (24h 8-model ensemble) this ensemble indicates a reduction in RPs of approximately -70 to -80 years for the period 2041–2070 for RCP 8.5 compared to the 1976–2005 baseline (Figure 15). Nearly all districts exhibit a notable shortening of RPs in the future period. The district of Sankt Wendel appears to be the most severely affected, which aligns with its already high baseline precipitation magnitudes within Saarland (Table 1- Annual precipitation). That would mean that such an event could occur 3–5 times more frequently.

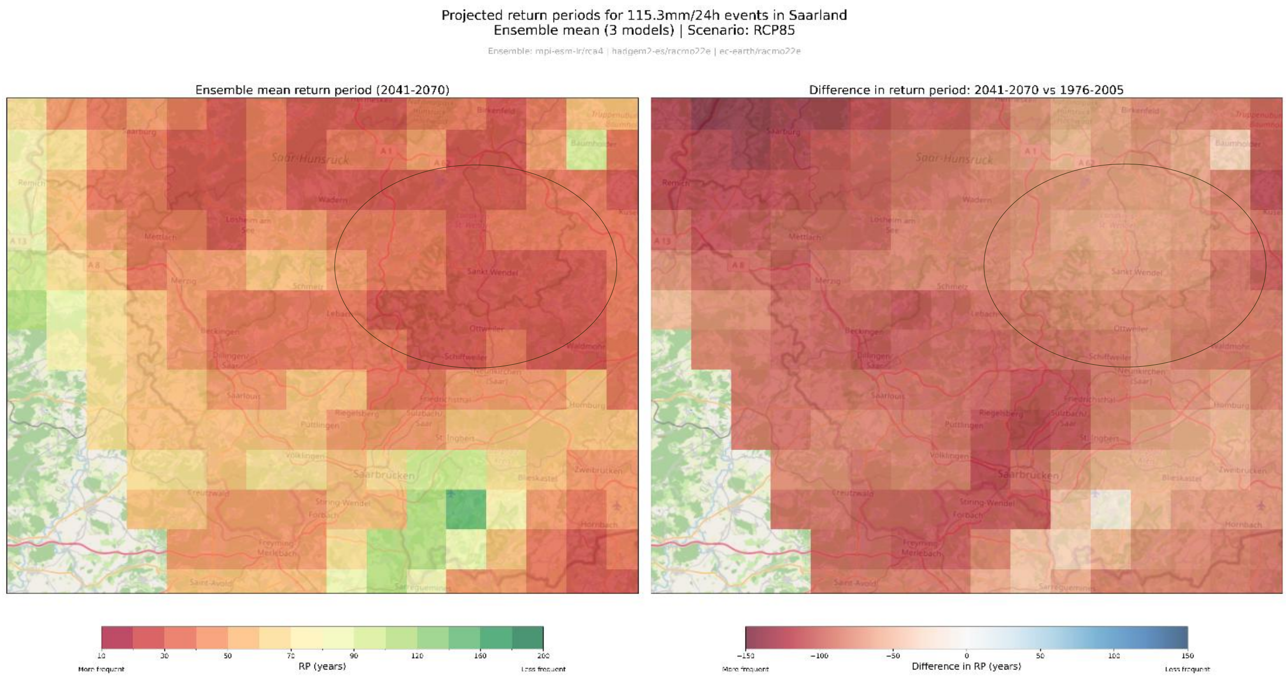


Figure 15: Projected return periods for 115.3 mm/24h threshold in Saarland. 1976-2005 vs. 2041-2070

Generally, the intensity of such extreme precipitation events is projected to increase across

Saarland, which is consistent with the previously observed shortening of RPs (Figure 16). For the region as a whole, the ensemble projects an average intensity increase of 59.5% for the period 2041–2070 compared to the 1976–2005 baseline. The district of Sankt Wendel follows this trend, with localized increases reaching even higher values. In this area, the low standard deviation (~ 0.0 to 0.5%) indicates strong agreement among the three models regarding the magnitude of change across most pixels. These results are consistent with broader climate science. The IPCC (AR6) reports that heavy rainfall frequency will increase non-linearly with warming—10-year events could double and 50-year events could triple at 4°C global warming (IPCC 2023). Our 3-model ensemble signal, with its consensus and nearly 60% intensity rise, reflects a similar or even stronger intensification than projected globally. However, it must be acknowledged that this statistical weight derives from only three simulations; consequently, while the direction of change is robust, the absolute quantitative precision retains inherent uncertainty.

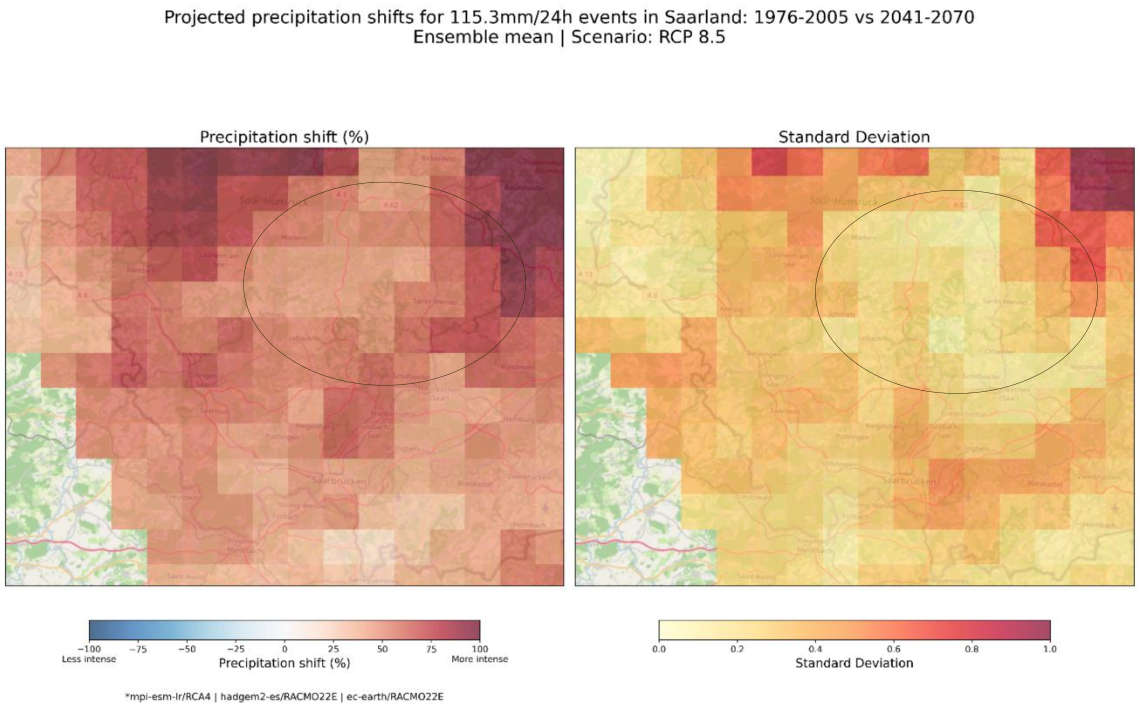


Figure 16: Change in precipitation shift [%] for 115.3 mm/24h in Saarland. 1976-2005 vs. 2041-2070

Figure 17 combines the projected RPs and intensity increases for extreme precipitation events (115.3 mm/24h) across Saarland to identify areas requiring prioritized action. While most districts exhibit RPs ranging from 40 to over 80 years with only partial intensity increases, Sankt Wendel stands out as particularly affected. Alongside Neunkirchen, this district shows a marked change of a RP of less than 20 years combined with an intensity increase exceeding 58%. These results align with the initial Priority Map expectations, as St. Wendel already experiences some of the highest rainfall levels in Saarland (Annex 1 - Evaluation of climate studies) due to its geographical location at the transition between the Hunsrück and Hochwald low mountain ranges, through orographic precipitation. Furthermore, the increase in precipitation intensity aligns with expected regional warming trends, as higher temperatures generally enhance atmospheric moisture capacity and thereby the likelihood of heavy rainfall extremes (IPCC 2023).

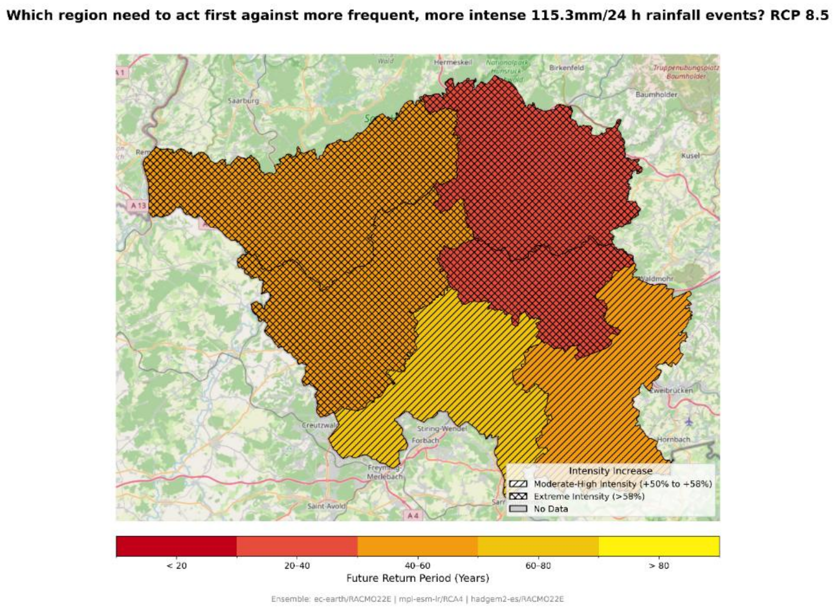


Figure 17: Prioritized risk assessment of extreme precipitation (115.3 mm/24h) across Saarland districts

Plausibility of the results

In order to better assess how realistic the results are, an additional robustness assessment was conducted by comparing the Heavy Rainfall Workflow results with climate projections from the German Meteorological Service (DWD), the Saarland heavy rainfall hazard map, and a specific extreme rainfall event in 2024 (2.2.1- Climate Projections). This multi-source validation confirms the plausibility of our 3-model ensemble results. For instance, the district of Sankt Wendel, which is divided into three distinct climate zones (118, 119, and 121) shows a consistent projection of increasing heavy rainfall (>20 mm per period) across all zones under the RCP 8.5 scenario, aligning with both our model outputs and DWD projections. As can already be seen from the priority map, the district of St. Wendel is at high risk of heavy rainfall, as illustrated by an example from 2024 (Figure 38). The town of St. Wendel, which gives its name to the district, recorded the highest rainfall of 107 mm/24h during the Pentecost flood, a level that comes very close to our current threshold of 115.3 mm (Figure 39). Furthermore, linking local hazard maps to critical infrastructure reveals that social facilities are exposed to HN100 events (39.6–44.2 mm/h), demonstrating that the projected intensities translate directly into realistic risk scenarios (subchapter 2.3.6.2).

Although the small ensemble size (n=3) limits statistical breadth, several factors collectively support the plausibility of our findings. First, all three models project the same directional change—consistent with the IPCC definition of a robust signal requiring at least 66% model agreement (IPCC 2023). Second, the exceptionally low standard deviation across the ensemble (~0.0–0.5% for intensity changes) indicates quantitative consensus. Third, independent convergence across multiple external data sources (DWD climate projections, regional hazard maps and documented extreme events) provides corroborating evidence that extends beyond the model ensemble itself. Together, these converging lines of evidence strengthen confidence in the projected intensification of extreme precipitation for the Sankt Wendel district, even acknowledging the limited ensemble size. For Phase 3, formal quantitative robustness metrics and an expanded ensemble will be explored to further solidify these preliminary findings.

2.3.2 Heatwave Workflow - finetuning to local context

Table 4: Data overview heat workflow

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
EURO-Heat dataset (Climate Data Store 2026)	Vulnerable population (WorldPop 2018)	Landsat 7 satellite data for temperatures (Parastatidis, D., Mitraka, Z., Chrysoulakis, N., Abrams, M 2018)	Risk maps based on hot areas with vulnerable population
DWD weather station Tholey – historical temperature data (Deutscher Wetterdienst (DWD) 2025c)	Social and Health infrastructures (based on own data)		Risk maps based on hot areas with social and health infrastructures

2.3.2.1 Hazard assessment

In addition to the hazard assessment carried out in the first project phase, historical maximum air temperature data for the period 1975–2024 were analysed for the warm season from May to September. The objective of this additional analysis was to identify historical hot periods and support the selection of suitable Landsat scenes for the subsequent land surface temperature-based risk assessment.

Figure 18 shows the yearly peak temperature values for each month between May and September. The highest peak temperatures occur mainly in July and August, confirming these months as the most relevant period for heat-related hazard and risk analysis. The highest value in the time series was recorded during the 2003 heatwave, reaching 36.8 °C on 9 August 2003. Another exceptional heat event occurred in July 2019, when the maximum temperature reached 36.5 °C on 25 July 2019.

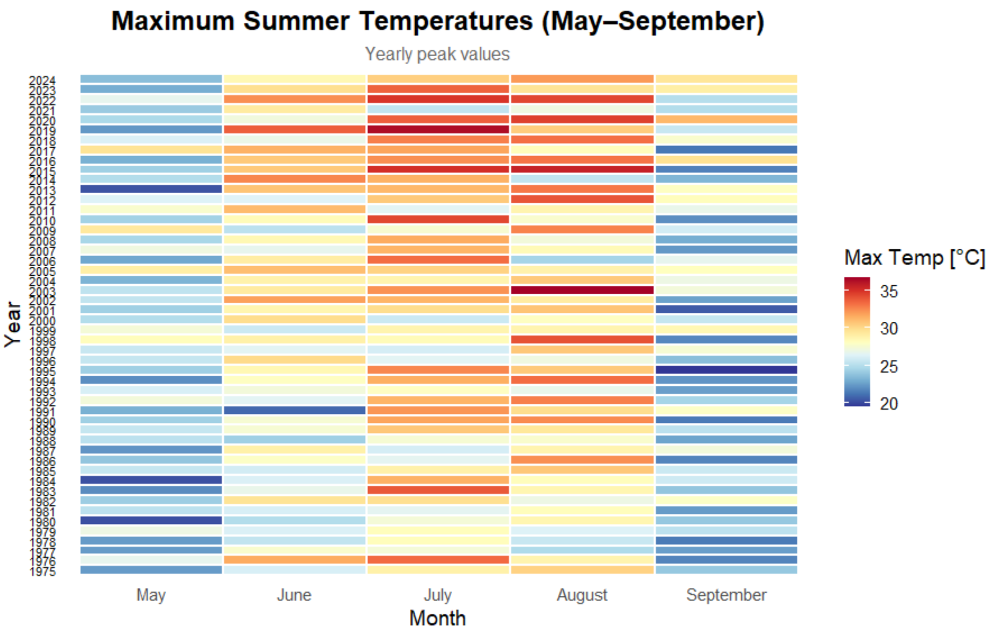


Figure 18: Historical maximum summer temperatures from May to September for the period 1975 -2024 (© IZES gGmbH based on (Deutscher Wetterdienst (DWD) 2025c))

The 2019 event was selected as a relevant reference period for the Landsat-based analysis, as it represents one of the strongest recent heat events in the available historical record. This makes it suitable for assessing spatial differences in surface heating.

Figure 19 shows the daily maximum temperatures in July 2019. The graph indicates a distinct heatwave period from approximately 21 July to 27 July, with the highest daily maximum temperature occurring on 25 July. This confirms that the selected period captures an extreme heat situation and is therefore appropriate for deriving land surface temperature patterns from satellite data.

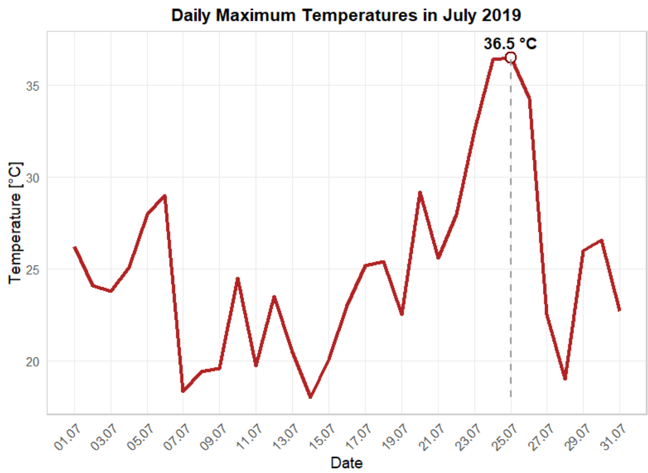


Figure 19: Daily maximum temperatures in July 2019 (© IZES gGmbH based on (Deutscher Wetterdienst (DWD) 2025c))

2.3.2.2 Risk assessment

The main refinement of the heat risk assessment compared to Phase 1 was the extension of the analysis from the city of St. Wendel to the entire district of Sankt Wendel. This broader spatial coverage allows the identification of heat-related risk hotspots not only in the district town, but also in smaller municipalities.

For the land surface temperature analysis, Landsat 7 data were used for the July 2019 heatwave. This event was selected because it represents one of the strongest recent heatwaves in the historical temperature record for which suitable satellite data were available. Landsat 8 and Landsat 9 data were not available for the selected period and location. The analysis is based on LST – Land Surface Temperature, which describes the temperature of the land surface measured by satellite.

Figure 20 shows the two main spatial input layers used for the heat risk assessment: overheated areas as an indicator of exposure and population density as an indicator of vulnerability. Both layers are classified from *very low* to *very high*. The exposure map shows that the town of St. Wendel forms the most visible heat island within the district. In addition, smaller heat island effects can be observed in several municipal centres, especially where built-up areas, sealed surfaces, and lower vegetation cover coincide. The population density map highlights the areas where more people are potentially affected by heat stress, particularly in the larger settlements.

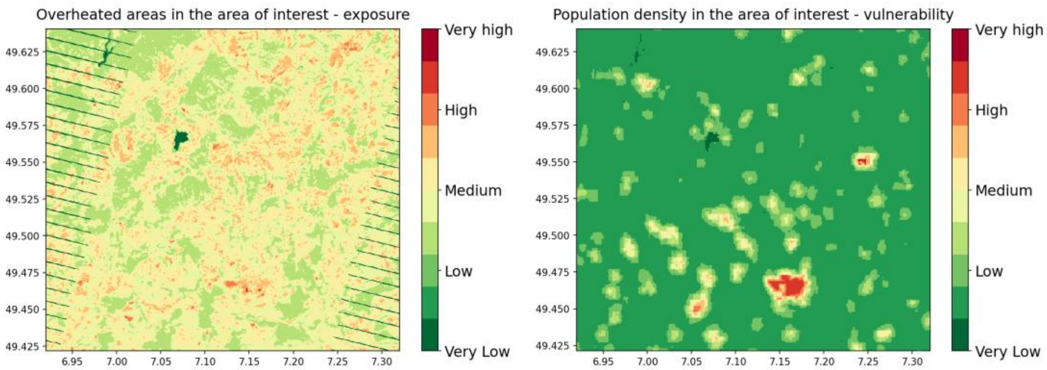


Figure 20: Spatial input layers for the heat risk assessment (based CLIMAAX heat workflow)

Based on these layers, an interactive heat risk map was created. The map includes several relevant layers: population-related risk, LST, possible heat risk level, social institutions, and health facilities. In addition, facilities located in areas with high or very high heat exposure were highlighted separately. The list of health and social infrastructure is based on data compiled from our own online research and existing lists provided by the Sankt Wendel district. The list contains a total of 108 social institutions and 24 health institutions. The social institutions include nurseries, schools, care homes for the elderly, residential homes, care centers and social services, whilst the health institutions include hospitals, rehabilitation clinics, hospices and pharmacies.

The interactive map shows that a considerable share of these facilities is located in town centres and more densely built-up areas. As these areas often show higher land surface temperatures, the analysis indicates that several sensitive infrastructures are already exposed to increased heat stress during extreme heat events.

A methodological limitation is that Landsat-based land surface temperatures represent a specific satellite overpass situation and do not capture the full daily temperature cycle. Nevertheless, the approach provides valuable spatial information on local heat hotspots and supports the prioritisation of adaptation measures at facility level.

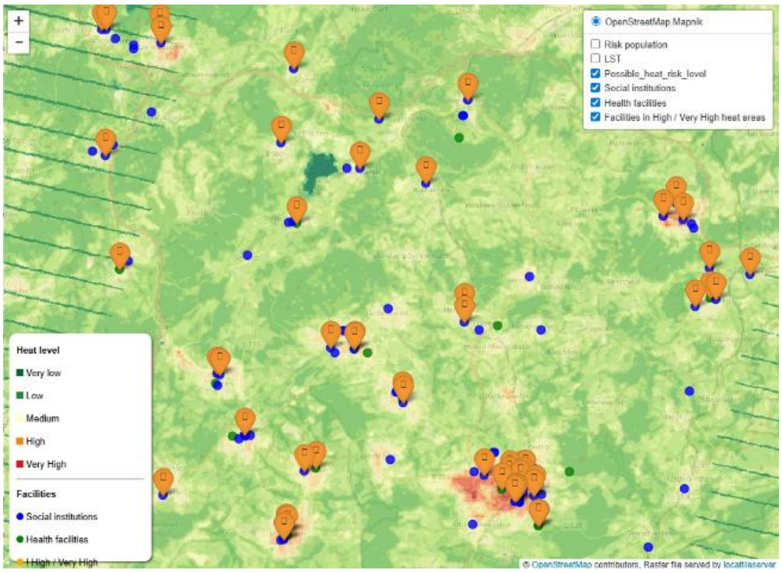


Figure 21: Screenshot of Interactive heat risk map including land surface temperature, population-related risk, possible heat risk level, social institutions, and health facilities (© IZES gGmbH based CLIMAAX heat workflow)

To better understand the local situation, selected social and health facilities were analysed in more detail. As examples, the Gemeinschaftsschule Nohfelden-Türkismühle and the AHZ Stiftung Hospital St. Wendel were selected. The detailed ArcGIS-based analysis shows that during the July 2019 heatwave, maximum land surface temperatures of above 50 °C occurred in the area of the school and the adjacent sports facilities. Around the hospital in St. Wendel, surface temperatures were also high, reaching values just below 50 °C in the surrounding urban environment.

These results underline the relevance of heat adaptation measures for sensitive infrastructures. In the next project steps, the analysis will be used to identify the most heat-exposed social and health facilities in the district and to prioritise them for adaptation planning. Possible measures include blue-green infrastructure, shading, vegetation, surface unsealing, passive cooling measures, and, where necessary, active cooling solutions for buildings.

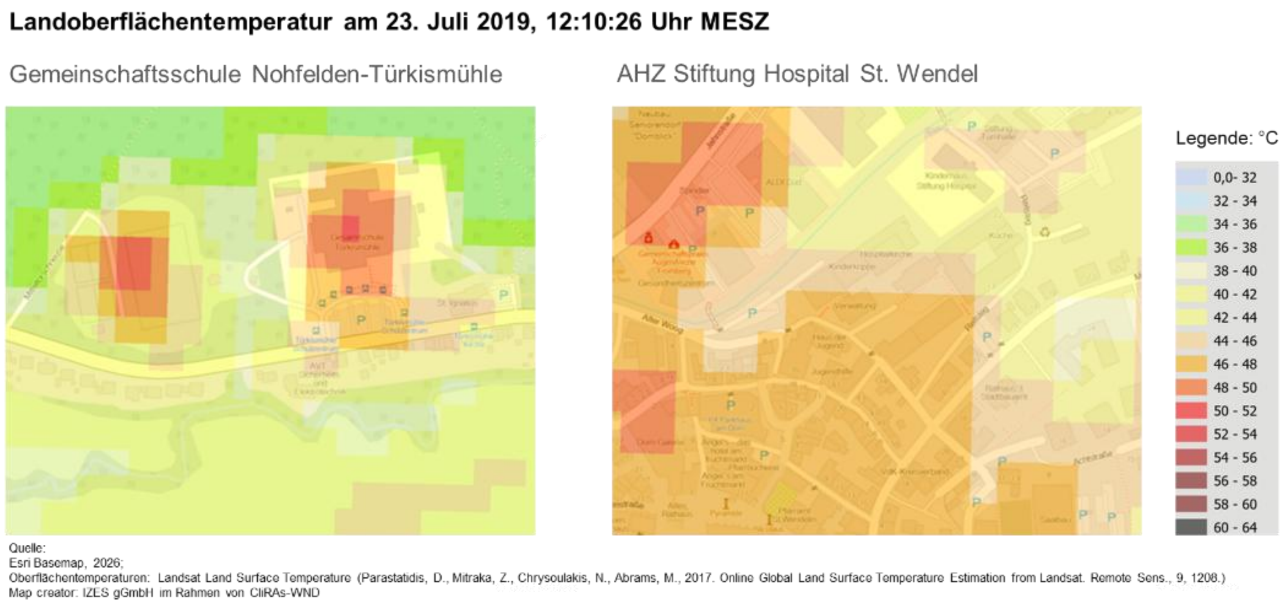


Figure 22: Detailed examples of heat exposure at selected sensitive infrastructures (© IZES gGmbH based CLIMAAX heat workflow and ESRI base map)

2.3.3 Relative Drought Workflow

Table 5: Data overview relative drought workflow

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
Monthly precipitation data at NUTS3 level based on ISIMIP3b bias-adjusted climate input data (Stefan Lange und Matthias Büchner 2021); ensemble mean of five CMIP6 GCMs; historical period 1981–2015, near future 2031–2060, far future 2071–2100; scenario SSP5-8.5; drought hazard calculated using the WASP index.	GDP per capita and rural population share at NUTS3 level. Data are provided as pre-processed CLIMAAX vulnerability input files and are based on Global CWatM gridded GDP, population and rural/urban population data.(Wang und Sun 2022)	Cropland, livestock density, population and water stress at NUTS3 level. Data are provided as pre-processed CLIMAAX exposure input files and are based on SPAM cropland data, FAO Gridded Livestock of the World, Eurostat / Global CWatM population data and WRI Aqueduct v4 water stress data.	Relative drought risk score based on hazard × exposure × vulnerability;

2.3.3.1 Hazard assessment

The relative drought hazard assessment was conducted for Germany at NUTS3 level and then evaluated in more detail for the Saarland districts, including the district of Sankt Wendel. The workflow is based on monthly precipitation data for the historical reference period and future climate projections. Drought hazard is calculated using the WASP index, which identifies severe precipitation deficits and allows a comparison of drought hazard between regions.

For the analysis, the historical period as well as future projections under SSP5-8.5 were considered. The future periods represent the near future around 2050 and the far future around 2080. The hazard assessment therefore provides the climate-related basis for the subsequent drought risk assessment. Since the workflow was carried out for all German NUTS3 regions, the resulting hazard and risk values are relative to the national dataset and not only to Saarland.

2.3.3.2 Risk assessment

The drought risk assessment combines drought hazard, exposure and vulnerability into a relative drought risk index. Exposure includes indicators such as cropland, livestock density, population and water stress, while vulnerability includes socio-economic indicators such as GDP per capita and the share of rural population. The final output is a relative risk score between 0 and 1 and a risk category from 1 to 5.

The bar chart (figure 23) shows the relative drought risk scores for the Saarland districts for the historical period, SSP5-8.5 in 2050 and in 2080. For the historical period, the Saarpfalz-Kreis shows the highest drought risk within Saarland, followed by Saarlouis, the Regionalverband Saarbrücken and Sankt Wendel. Merzig-Wadern and Neunkirchen show comparatively low values.

For SSP5-8.5 around 2050, the risk scores increase clearly for most Saarland districts. Sankt Wendel, Saarpfalz-Kreis and Saarlouis show the highest values, indicating that these districts may become more relevant drought risk hotspots within the Saarland context. For SSP5-8.5 around 2080, the values remain elevated compared to the historical period, although they are lower than in the 2050 scenario for several districts. Sankt Wendel remains among the districts with the highest relative drought risk in Saarland.

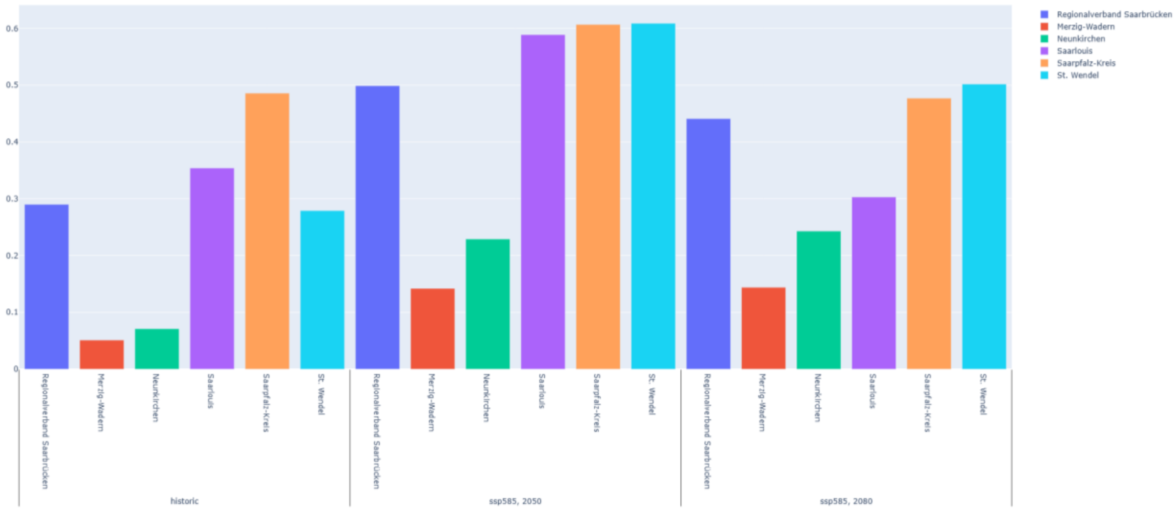


Figure 23: Relative drought risk scores for the Saarland districts

The map visualisation confirms this spatial pattern. Historically, the highest relative drought risk is concentrated mainly in the south-eastern part of Saarland. In the 2050 scenario, the risk level increases across large parts of the federal state, with Sankt Wendel and Saarpfalz-Kreis standing out as areas with particularly high relative risk categories. In the 2080 scenario, the spatial pattern remains relevant, but the intensity is less pronounced than in the 2050 scenario.

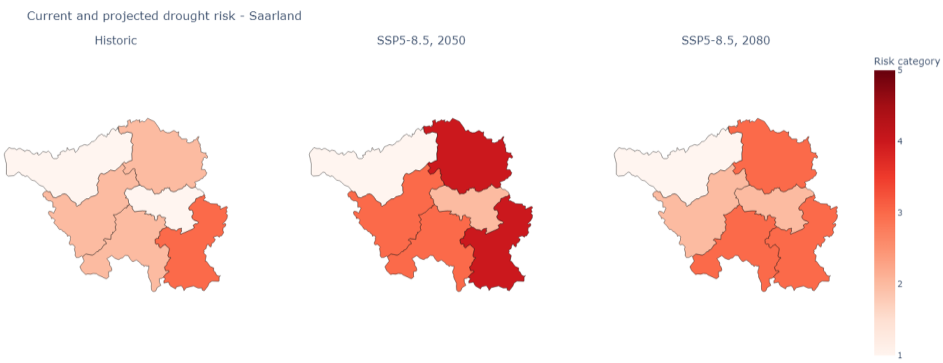


Figure 24: Current and projected relative drought risk categories for the Saarland districts

The risk index should be interpreted as a relative score. Because the workflow was applied to all German NUTS3 regions, the index values in the Saarland bar chart are not expected to reach 1. A value close to 1 would only occur for regions that are among the highest-risk areas within the full German reference dataset. Therefore, the results are most useful for comparing Saarland districts with each other and for identifying priority areas for further drought adaptation planning, rather than for estimating absolute damages.

2.3.4 Agricultural Drought Workflow

Table 6: Data overview agricultural drought workflow

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
EURO-CORDEX climate projection data: precipitation, maximum/minimum temperature, relative humidity, wind speed and solar radiation; supplemented by soil available water capacity, elevation and thermal climate zones. Used to calculate crop water deficit and potential yield loss.	Share of cropland with irrigation systems as proxy for vulnerability to rainfall scarcity. Low irrigation availability indicates higher vulnerability. Data are based on GAEZ v5 irrigation availability for 2015.	Crop production and crop value data. Crop production is based on MapSPAM 2020, while aggregated crop value is based on FAO-IIASA GAEZ v5 data for 2020.	Potential yield loss [%] from irrigation deficit and potential revenue loss without irrigation [EUR]. The output maps show where agricultural production is most affected by precipitation deficit and where economic losses may occur.

Due to the relatively coarse spatial resolution of the workflow outputs, the agricultural drought workflow was applied to the whole of Germany rather than only to the district of St. Wendel. This Germany-wide application allows the results to be interpreted in a broader spatial context and enables a more meaningful comparison between different regions.

2.3.4.1 Hazard assessment

The agricultural drought hazard assessment was carried out for Germany in order to compare the district of Sankt Wendel and the Saarland with other regions. The workflow combines climatic water demand, precipitation conditions and soil water storage capacity (AWC) to identify areas where agricultural drought stress may occur.

Figure 25 shows the historical soil available water capacity for Germany. In the Saarland and the district of Sankt Wendel, AWC values are mostly in a medium range, approximately between 240 and 400 mm. This indicates that soils in the region have a moderate ability to store water, but generally do not reach the higher storage capacities found in some other regions.

Figure 26 shows the cumulative standard evapotranspiration (ET0) during the growing season under RCP8.5 for 2071–2090. Compared to northern and central Germany, the Saarland is located in an area with relatively high evapotranspiration demand, approximately around 780–840 mm. This indicates a strong atmospheric water demand during the growing season in the far future scenario. However, the highest ET0 values are projected for parts of southern Germany and neighboring regions, where values can exceed 900 mm.

Figure 27 shows the annual mean cumulative precipitation under RCP8.5 for 2071–2090. The Saarland shows moderate to high precipitation levels, mainly around 600–1,200 mm, with locally higher values in more elevated areas. These values are broadly comparable to parts of western and central Germany, but lower than the wettest regions, especially the Alpine area and some low mountain ranges, where precipitation values are clearly higher.

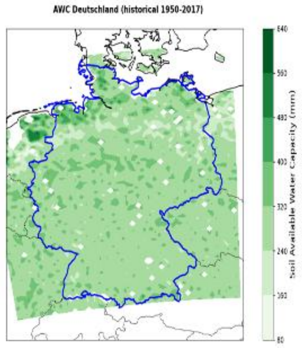


Figure 25: Soil available water capacity in Germany

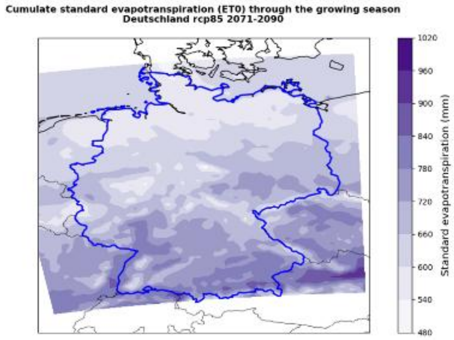


Figure 26: Cumulative standard evapotranspiration during the growing season

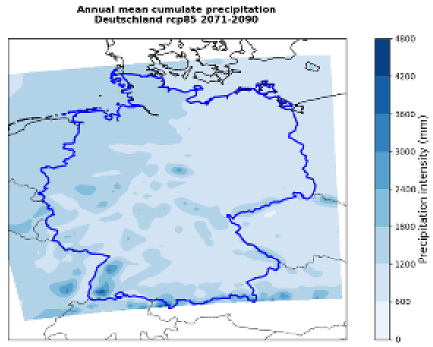


Figure 27: Annual mean cumulative precipitation

2.3.4.2 Risk assessment

The agricultural drought risk assessment was conducted for the three crop types that are most relevant in the region: maize, rapeseed and wheat. For each crop, two types of outputs were analysed: potential yield loss from precipitation deficit and potential revenue loss without irrigation.

The yield loss maps show the percentage reduction in crop yield under rainfed conditions compared to fully irrigated conditions. Under RCP8.5 for 2071–2090, maize shows the highest potential yield losses, with several areas in southern and south-western Germany reaching values above 20%. In the Saarland and the district of Sankt Wendel, maize yield losses are also clearly visible and generally higher than in northern Germany. Rapeseed shows lower yield losses than maize, but still relevant losses in parts of southern and central Germany. Wheat shows a similar spatial pattern, with increased yield losses especially in southern Germany and parts of the west, including the wider Saarland region.

The revenue loss maps show the estimated financial losses resulting from precipitation deficit under the assumption of absent irrigation. The strongest revenue losses are mainly visible in parts of eastern Germany, especially for wheat and rapeseed, where relevant crop production areas overlap with drought-related yield losses. For maize, additional hotspots also occur in parts of western and south-western Germany, but the Saarland is not among the most strongly affected regions.

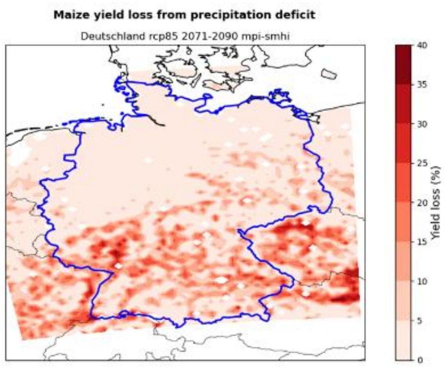


Figure 28: Potential maize yield loss under RCP8.5 for 2071 -2090.

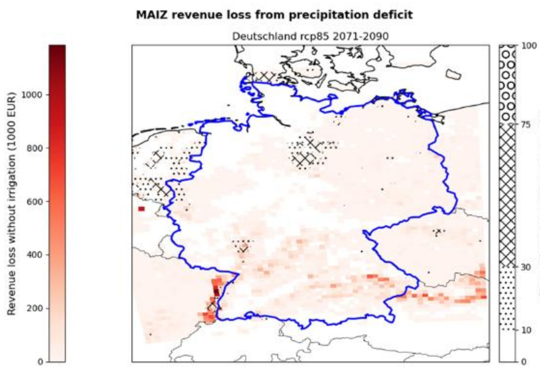


Figure 29: Potential maize revenue loss under RCP8.5 for 2071 -2090.

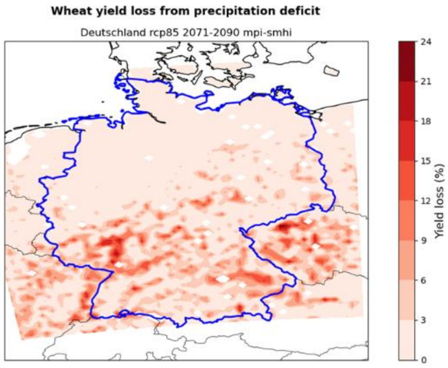


Figure 30: Potential wheat yield loss under RCP8.5 for 2071 -2090.

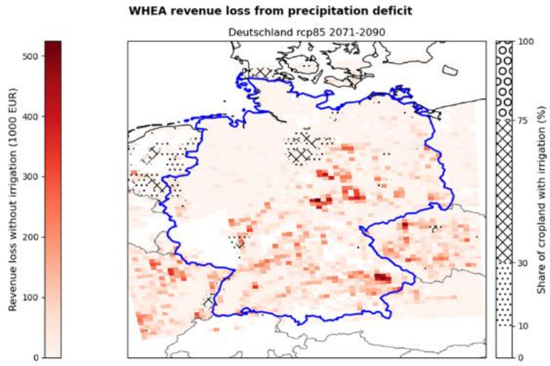


Figure 31: Potential wheat revenue loss under RCP8.5 for 2071 -2090.

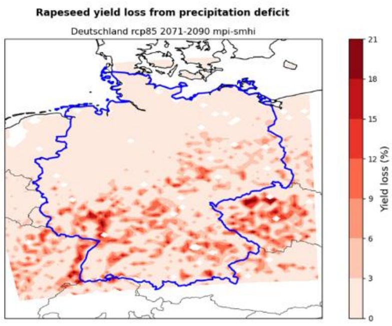


Figure 32: Potential rapeseed yield loss under RCP8.5 for 2071 -2090.

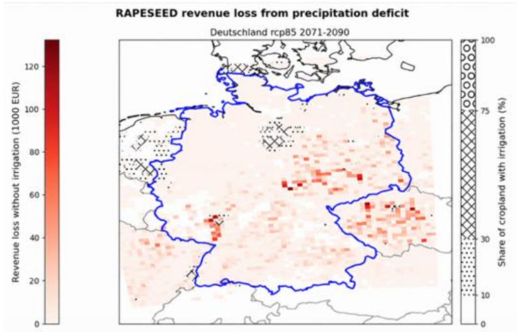


Figure 33: Potential rapeseed revenue loss under RCP8.5 for 2071 -2090.

2.3.5 Wildfire (FWI) Workflow

Table 7: Data overview wildfire (FWI) workflow

Hazard data	*Vulnerability data*	*Exposure data*	*Impact metrics/Risk output*
Seasonal Fire Weather Index (FWI), Copernicus Climate Data Store / C3S fire danger indicators; EURO-CORDEX projections; RCP 4.5 and RCP 8.5; 2045–2054 and 2080–2097; EFFIS fire danger classes	Not applied	Not applied	Not applied

2.3.5.1 Hazard assessment

The wildfire hazard assessment indicates a tendency towards increasing fire weather conditions, particularly under RCP 8.5 towards the end of the century. However, the average seasonal FWI values remain below 21.3 in all analysed scenarios and time periods. According to the FWI fire danger classes used in the CLIMAAX workflow and based on the EFFIS pan-European categorisation, this corresponds to low to moderate fire danger. High, very high or extreme fire danger classes are not reached in the average seasonal FWI maps. The district of Sankt Wendel shows comparatively lower FWI values than other parts of the surrounding model domain, which is plausible due to its partly elevated location with generally cooler and wetter conditions. Therefore and because of the stakeholder feedback, wildfire was not prioritised for a more detailed risk assessment.

Near future (2045 - 2054) | Far future (2080 - 2097)

RCP 4.5

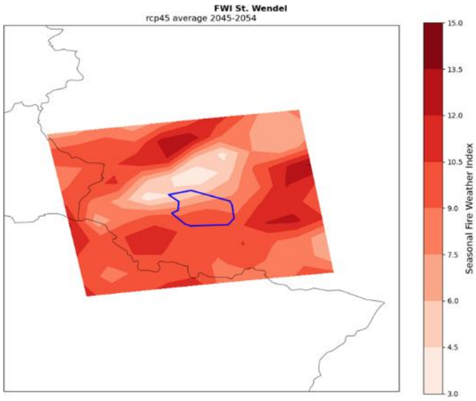


Figure 34: FWI – RCP 4.5 – 2045 to 2054

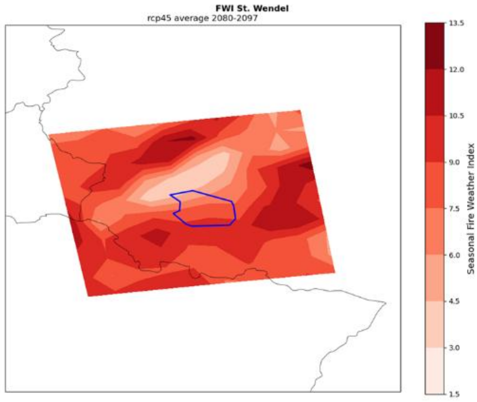


Figure 35: FWI – RCP 4.5 – 2080 to 2097

RCP 8.5

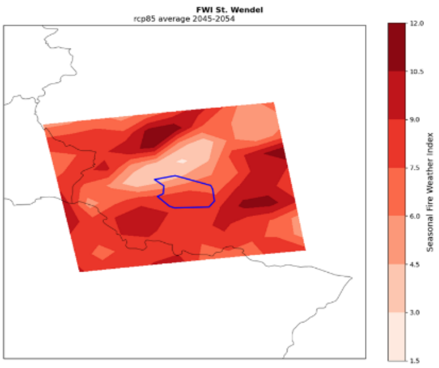


Figure 36: FWI – RCP 8.5 – 2045 to 2054

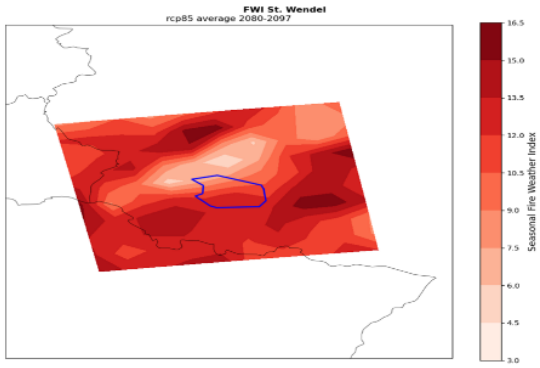


Figure 37: FWI – RCP 8.5 – 2080 to 2097

2.3.6 Additional assessments based on local models and data

2.3.6.1 Additional hazard assessment

Pentecost Flood 2024

The Pentecost flood in May 2024 was evaluated as a relevant recent flood event for the district of Sankt Wendel. The event was associated with widespread flooding and local damage in the district and was therefore analysed using precipitation data from local weather stations of the German Weather Association to better understand the magnitude and temporal development of the event. (Deutscher Wetterdienst (DWD) 2025c)

Figure 38 shows daily precipitation sums for several weather stations in the district between 15 and 19 May 2024. The highest daily precipitation occurred on 17 May, with values exceeding 100 mm at the St. Wendel station. This is close to the local 100-year rainfall threshold of approximately 115 mm within 24 hours for St. Wendel. Other stations also recorded high daily totals, although the spatial distribution shows that the highest rainfall amounts were concentrated around St. Wendel.

Figure 39 shows the hourly precipitation pattern for St. Wendel. It illustrates that the event was not only characterised by a high daily rainfall total, but also by several intense rainfall peaks on 17 May. The highest hourly intensity reached almost 15 mm, followed by further rainfall peaks during the same day. This combination of prolonged rainfall and short-term intensity contributed to the high flood relevance of the event.

Overall, the analysis confirms that the Pentecost flood 2024 represents an important reference event for the local hazard assessment. The recorded rainfall totals were close to an extreme return-period event and demonstrate the potential for severe flood impacts in the district, especially when high daily rainfall totals coincide with intense hourly precipitation peaks.

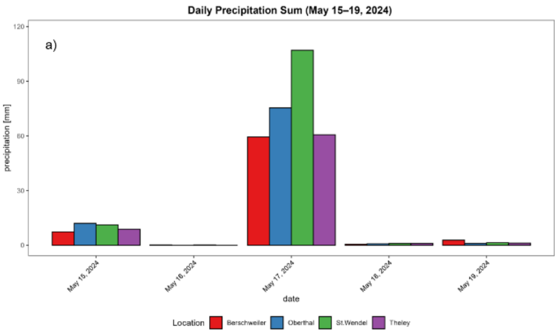


Figure 38: Pentecost flood 2024 – daily precipitation sum (© IZES gGmbH based on Deutscher Wetterdienst (DWD) 2025b)

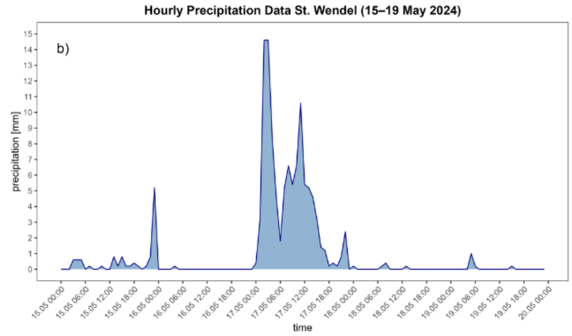


Figure 39: Pentecost flood 2024 – hourly precipitation (© IZES gGmbH based on Deutscher Wetterdienst (DWD) 2025b)

2.3.6.2 Additional risk assessment

A dedicated risk assessment was carried out with a particular focus on heavy rainfall. For this purpose, the existing Saarland state-wide heavy rainfall hazard map for a 100-year event was used. The underlying rainfall intensity ranges between approximately 39.6 and 44.2 mm/h, and the data were obtained from the Geoportal Saarland. The hazard map was clipped to the district of Sankt Wendel and combined with different vulnerability and exposure datasets:

Heavy rainfall and soil erosion

The first analysis focused on the interaction between heavy rainfall and soil erosion. Agricultural areas at risk of erosion, based on the water erosion hazard classes according to GAP conditionality, were overlaid with the heavy rainfall hazard map. This made it possible to identify erosion-prone agricultural areas where the heavy rainfall simulation also indicates water depths above 5 cm. These areas are often located on slopes and may therefore be particularly relevant for surface runoff and soil erosion processes.

The district plans to discuss and implement erosion control measures. The resulting map can support this process by identifying potential priority areas.

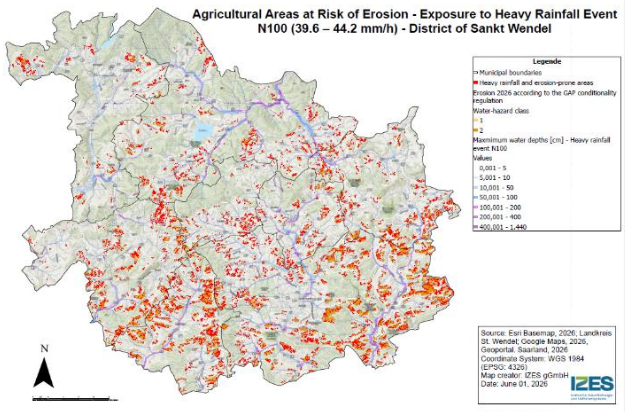


Figure 40: Heavy rainfall and soil erosion (© IZES gGmbH based on ESRI base map and (LVGL 2026)

Heavy rainfall and critical infrastructures

The list of health and social infrastructure is based on data compiled from our own online research and existing lists provided by the Sankt Wendel district. The list contains a total of 108 social institutions and 24 health institutions. The social institutions include nurseries, schools, care homes for the elderly, residential homes, care centers and social services, whilst the health institutions include hospitals, rehabilitation clinics, hospices and pharmacies. Although none of these facilities fall directly within the mapped flood zones, their proximity to hazard areas is nonetheless

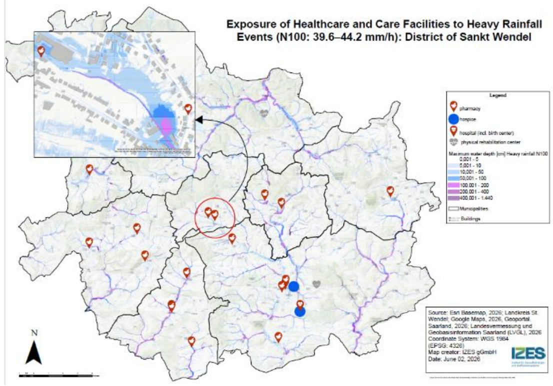


Figure 41: Heavy rainfall and care facilities (© IZES gGmbH based on ESRI base map and (LVGL 2026)

critical. Vulnerable population depend on uninterrupted access to these services, and indirect impacts such as road flooding, power outages, or disrupted transport routes can severely compromise facility operations during emergencies. Overlaying infrastructure locations with hazard maps therefore supports emergency planning and helps prioritize protective measures for those least able to cope independently.

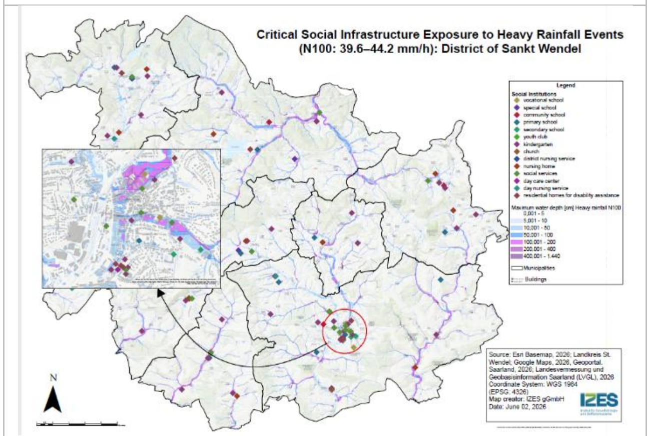


Figure 42: Heavy rainfall and social facilities (© IZES gGmbH based on ESRI base map and (LVGL 2026)

The list of the state and administration facilities is based on data compiled from our own online research and existing lists provided by the Sankt Wendel district. The list contains a total of 29 state and administrative institutions, which includes fire stations, aid agencies, civil protection, emergency rescue centers, public health department, town hall, administrative district and security authority. These facilities serve vulnerable sections of the population and fulfil important emergency functions. If they were located in high-risk areas, this would lead to operational disruptions, particularly during extreme weather events, block access for emergency vehicles and cause delays to the entire operational process.

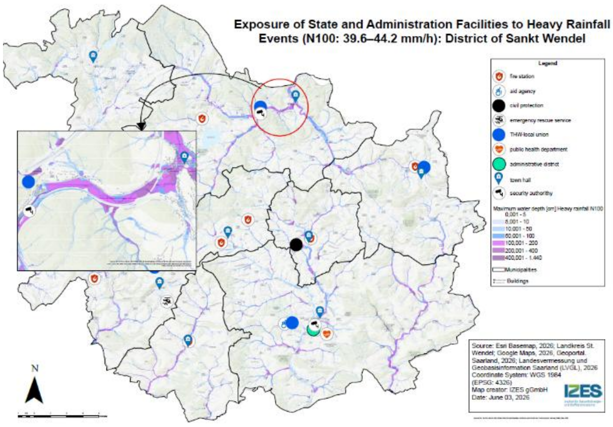


Figure 43: Heavy rainfall and state and administration facilities (© IZES gGmbH based on ESRI base map and (LVGL 2026)

The list of the food and energy infrastructure is based on data compiled from our own online research and existing lists provided by the Sankt Wendel district. The list contains a total of 40 food distributors and 13 energy provider. The food distributors include supermarkets, food banks and food distribution center, whilst the energy provider are gas station and heating oil provider. By mapping this infrastructure, the district of Sankt Wendel can proactively protect its vital supply chains, ensuring that power, heat, and food remain available during crises rather than facing a total breakdown of local services.

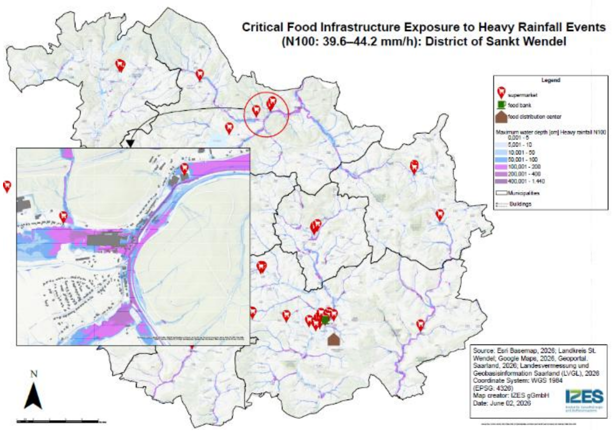
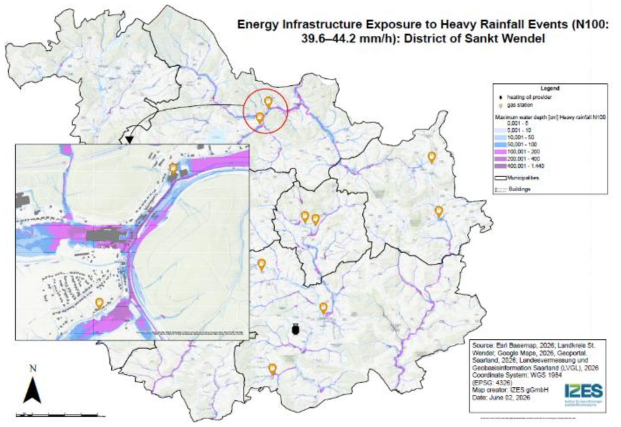


Figure 44: Heavy rainfall and food infrastructure (© IZES gGmbH based on ESRI base map and (LVGL 2026)

	 *Figure 45: Heavy rainfall and energy infrastructures (© IZES gGmbH based on ESRI base map and (LVGL 2026)*

2.4 Key Risk Assessment Findings

2.4.1 Mode of engagement for participation

Stakeholder involvement has been described in detail in Section 2.1.5. In summary, the following insights were derived from the stakeholder engagement process and the feedback collected for the risk assessment:

- There is a high level of interest in the results. The presentation and provision of the Phase 2 results is planned in different formats for the second half of the year.
- There was broad agreement regarding the hazard assessment and the prioritisation of heavy rainfall and heat. At the local level, municipalities also highlighted risks related to flooding of small streams, drought and, in some cases, storms.
- Topic-specific aspects could be integrated into the climate risk assessment. Data available from stakeholders were largely provided and incorporated where suitable.
- Stakeholders emphasised the importance of critical and sensitive infrastructure, as well as civil protection. Climate adaptation is already being considered in municipal planning processes, but it is not yet uniformly structured or firmly established.
- There is a need for easily understandable and user-friendly information, such as datasets, maps, flyers and other communication materials.
- Stakeholders also expressed a need for data and maps with a direct regional and thematic reference, for example for agriculture, businesses, social infrastructure and other locally relevant sectors.
- One key challenge was the high workload of stakeholders and the presence of other, more urgent tasks. This partly complicated communication, data provision and the validation of preliminary results, and led to delays in the overall working process.
- The stakeholder process confirmed that there is currently no binding climate adaptation strategy at either municipal or district level. Since different factors limit the stronger integration of climate adaptation into municipal planning in the individual municipalities, Phase 3 will focus on developing measures that address the support needs mentioned quite consistently by the municipalities.

2.4.2 Gather output from Risk Analysis step

Main outputs and information used for the key risk assessment:

- **Additional CLIMAAX workflows:** Relative Drought, Agricultural Drought and Wildfire workflows were applied to obtain a first, broad classification of additional climate risks and to compare their relevance with the risks already analysed in Deliverable D1.
- **Workflow fine-tuning and scenario comparison:** For heavy rainfall, several climate models and model combinations were analysed. The results were compared with historical data and local reference values. Based on this comparison, the bias-corrected multi-model analysis was selected as the most meaningful output for the key risk assessment. For heat, the assessment was further refined by producing a district-wide risk map, including the potential exposure of social and medical institutions.
- **Validation and contextualisation with external climate information:** DWD climate projections, regional climate information and study results were used to validate and complement the workflow outputs. For example, the DWD projections support the general tendency of increasing heavy rainfall intensities, while windstorm projections show no clear future trend. This helped to interpret the workflow results more cautiously and realistically.

- **Detailed local risk assessment:** Local datasets were used to refine the assessment, especially for heavy rainfall. Detailed heavy rainfall hazard maps were combined with different layers of critical infrastructure, social facilities, health facilities and other exposed assets in order to identify local hotspots.
- **Stakeholder input and local knowledge:** The results of municipal surveys, stakeholder workshops and project meetings were used to complement the technical assessment. This input helped to check the plausibility of the modelled results and to include local experiences, known hotspots and perceived vulnerabilities.

Together, these outputs provide both a broad overview and a more detailed local understanding of the relevant climate risks in the district Sankt Wendel. They form the evidence base for the subsequent key risk assessment and the classification of risks according to severity and likelihood.

Table 8: Comparison of main findings (studies, workflows, DWD projections, stakeholder feedback)

Risk	*Study summary*	*CLIMAAX workflows*	*DWD projections*	*Stakeholder workshop and municipal survey*
Heavy rainfall	Increase in heavy rainfall days expected. Reviewed studies cite a change of up to **+7.4 days/year ≥20 mm/day**, resulting in up to **15.7 days/year**.	Current local 100-year threshold: **115.3 mm/24 h** for St Wendel. Bias-corrected 3-model ensemble under RCP8.5, 2041–2070: return period shortened by approx. **70–80 years**, meaning today's 100-year event could occur **3–5 times more often**. Projected intensity increase: in average **+59.5%** across Saarland. Pentecost flood 2024: **107 mm/24 h** in St. Wendel, close to the 100-year threshold.	DWD projections for climatic zones **118, 119 and 121** show absolute values for heavy rainfall days **>20 mm/day**. Values tend to increase under both RCP4.5 and RCP8.5, especially towards the end of the century. Highest values and strongest absolute increase in **Zone 121** (up to 10 heavy rainfall days per year).	Heavy rainfall was rated as the greatest local climate risk. **4 municipalities** feel strongly affected and **2 very strongly affected**.
	Summary heavy rainfall: Strong agreement across all sources. Heavy rainfall is the clearest priority risk. Workflow, DWD projections, studies, historical event data and stakeholder feedback all point towards increasing relevance.			
Windstorm	No clear evidence for future changes in mean wind speed, storm intensity or number of storm days. However, rare local events may cause gusts **>35 m/s**, corresponding to **Beaufort 12**.	No further workflow fine-tuning in Phase 2, because the wind workflow had already been conducted in Phase 1.	DWD projections show only small changes in average wind speed. The 15th–85th percentile ranges remain close to the historical reference level; no robust trend is visible. Extreme gusts are not directly represented by this indicator.	Storms remain relevant locally. **1 municipality** feels very strongly affected and **2 municipalities** strongly affected by storm events.
	Summary windstorm: Wind remains important because of past local damage and possible severe impacts, but the future climate signal is uncertain. It should remain part of preparedness planning, but was not prioritised for further workflow finetuning.			
Heat	Strongest and most robust climate signal. Reviewed studies cite up to **+5.9 °C** annual mean temperature, up to **102.5 summer days/year**, up to **56.7 hot days/year**, up to **59.2 tropical nights/year**, and heatwaves lasting up to nearly **20 days/year**.	Heat risk assessment expanded to the entire district. Historical reference: **36.8 °C** on 9 August 2003 and **36.5 °C** on 25 July 2019. Landsat 7 analysis for July 2019 shows heat hotspots in St. Wendel and smaller municipal centres. Detailed examples show land surface temperatures **>50 °C** around social infrastructures.	DWD projections show a clear quantitative increase in hot days across all three climatic zones. In the reference period (1971–2000), values are typically around **5 hot days/year**. Under RCP8.5, **hot days/year** increase up to **42 hot days/year** towards the end of the century, depending on the climatic zone.	**2 municipalities** feel strongly affected by heat; the remaining **4 municipalities** reported medium impact. Stakeholder process confirmed high relevance for vulnerable groups and sensitive institutions.
	Summary heat: Strong agreement across studies, workflow and DWD projections. Heat is a high-priority risk, especially for vulnerable groups and buildings without sufficient cooling or shading.			
Drought	Studies do not provide a fully clear signal, but indicate a tendency towards more dry days. Maximum values cited:	Relative drought workflow: risk score **0–1** and risk category **1–5**. Sankt Wendel becomes one of the higher-risk Saarland districts around	DWD projections for dry days show no clear continuous increase across the whole century. Values remain broadly within the historical	**2 municipalities** feel strongly affected by drought; **4 municipalities** report medium impact.

	+32.5 dry days/year, resulting in nearly **256 dry days/year**. Possible reduction in groundwater recharge of about **10%** for 2021–2050.	**2050** under SSP5-8.5 and remains among the higher-risk districts around **2080**. Saarland affected, but not among strongest revenue-loss hotspots.	range, with possible higher upper-range values towards the end of the century, especially under RCP8.5.	
	Summary drought: Drought is an emerging risk. Studies and workflows indicate increasing relevance, but the DWD signal is less clear than for heat or heavy rainfall. Monitoring and adaptation planning are recommended, but it is not the main immediate priority.			
Wildfire	Forest fire danger expected to increase. KlimafolgenOnline values cited: up to 19.1 days/year at danger level 4 and 16.1 days/year at danger level 5. Forest fire index rises from 1.7 to 2.3, remaining in the low danger range.	Wildfire workflow shows increasing fire weather conditions, especially under RCP8.5 towards the end of the century. Average seasonal FWI remains below 21.3 in all analysed scenarios and periods, corresponding to low to moderate fire danger. High fire danger starts at 21.3.	No separate detailed DWD projection for wildfire was evaluated in the same way. Fire danger is indirectly linked to heat and drought indicators.	**3 municipalities** report medium impact from forest and vegetation fires; **3 municipalities** report low impact. Stakeholders also mentioned fire risks during harvest periods.
	Summary wildfire: Wildfire is an emerging but lower-priority risk. Studies and workflow point towards increasing fire weather conditions, but average FWI values remain low to moderate. Monitoring, awareness and preparedness are recommended.			

2.4.3 Assess Severity

<u>Heavy precipitation (C: Substantial / F: Critical):</u>

The severity assessment from Deliverable 1 was confirmed and further strengthened in Phase 2. Heavy rainfall remains the most relevant climate risk for the district of Sankt Wendel. This is supported by stakeholder feedback, the municipal survey, the refined CLIMAAX workflow results using three bias-corrected climate models, and the additional DWD climate projections. These analyses indicate a clear tendency towards an increase in heavy rainfall days and extreme precipitation intensity under both RCP 4.5 and RCP 8.5. Due to its geographical location and comparatively high precipitation levels within the wider region, the district of Sankt Wendel appears to be particularly exposed.

The local fine-tuning also showed that heavy rainfall is not only a future climate signal, but already a relevant current risk. The overlay of the state-wide heavy rainfall hazard map for a 100-year event with local exposure data showed that several critical infrastructures, social institutions and erosion-prone agricultural areas are located in areas where relevant water depths may occur. Past events, especially the Pentecost flood in 2024, further demonstrate that heavy rainfall can cause substantial damage in the district and may pose risks to human health and safety. Therefore, the current severity remains substantial, while future severity is assessed as critical.

<u>Wind (C: Substantial / F: Critical):</u>

The severity assessment from Deliverable 1 was largely confirmed in Phase 2. Windstorm remains a relevant risk for the district of Sankt Wendel, especially because past local events such as tornadoes, downbursts and severe winter storms have already caused substantial damage. Potential impacts include damage to buildings, forests and infrastructure, blocked roads, disruption of services and risks to human health and safety. The stakeholder feedback and municipal survey also confirmed that storm events are perceived as relevant in several municipalities, although they were not prioritised as strongly as heavy rainfall.

Compared to Deliverable 1, the future severity assessment remains critical, but the underlying climate signal is less clear than for heat and heavy rainfall. The additional DWD climate projections and reviewed studies do not show a robust trend towards increasing average wind speed. However, rare local extreme events can still occur and may cause severe impacts, especially where vulnerable buildings, forests and critical infrastructure are exposed. Therefore, the current severity remains substantial, while future severity is kept at critical, but with higher uncertainty than for heavy rainfall and heat.

Heat (C: Moderate / F: Substantial):

The severity assessment from Deliverable 1 was confirmed and further strengthened in Phase 2. Heat remains a moderate current risk, but is expected to become a substantial future risk. The additional DWD climate projections show that hot days are one of the clearest climate change signals for the district of Sankt Wendel, with a strong increase under both RCP 4.5 and especially RCP 8.5. This confirms the initial assessment that heat will become increasingly relevant over the course of the century.

The local fine-tuning showed more clearly where heat-related impacts may occur. The Landsat-based analysis of the 2019 heatwave demonstrated that high land surface temperatures are not limited to the town of Sankt Wendel, but also occur in smaller municipal centres and around sensitive infrastructures. Social and health facilities, schools, nurseries and care homes are particularly relevant because vulnerable groups are more sensitive to heat stress. The proportion of older people in the district is already higher than average. This is likely to increase further in the future. Therefore, the current severity remains moderate, while future severity is assessed as substantial.

Drought (C: Limited / F: Moderate):
The severity assessment from Deliverable 1 was generally confirmed in Phase 2. Drought remains a limited to moderate current risk, but is expected to become a moderate future risk. The additional drought workflows and DWD climate projections indicate that drought-related risks may become more relevant over the course of the century, especially in connection with increasing temperatures and possible changes in dry periods. The municipal survey also showed that drought is already perceived as a relevant risk by several municipalities, although it is not prioritised as strongly as heavy rainfall or heat.

Wildfire (C: Limited / F: Moderate):

The severity assessment from Deliverable 1 was refined in Phase 2. Wildfire remains a limited current risk and a moderate future risk. The Fire Weather Index assessment indicates a tendency towards increasing fire weather conditions, particularly under RCP 8.5 towards the end of the century. However, the average seasonal FWI values remain below the threshold for high fire danger in all analysed scenarios and time periods. According to the FWI fire danger classes used in the workflow, this corresponds to low to moderate fire weather conditions.

Compared to Deliverable 1, the Phase 2 assessment therefore confirms that wildfire should be considered an emerging risk, but does not support prioritising it as a high-severity risk in this phase. Stakeholders had already pointed to fire risks during harvest periods and increasing dryness in forests. These concerns remain relevant, especially in combination with heat and drought.

2.4.4 Assess Urgency

Heavy rainfall – immediate action needed:

Compared to Deliverable 1, the urgency rating for heavy rainfall was raised from more action needed to immediate action needed. This change is based on the additional evidence gathered in Phase 2. The refined workflow results, DWD climate projections and local heavy rainfall hazard maps indicate that heavy rainfall days and extreme precipitation intensities are expected to increase. Heavy rainfall is already causing impacts in the district and can occur suddenly with limited lead time. Phase 2 strengthened this assessment through the Pentecost flood 2024, the refined workflow results, DWD projections and local heavy rainfall hazard maps. Since critical infrastructure, social institutions, buildings and erosion-prone agricultural areas may be affected, immediate action is needed.

Windstorm – more action needed:

No new findings from Phase 2 substantially changed the urgency rating for windstorm. Storm events can occur suddenly and have already caused local damage in the district, including tornado and downburst events. Therefore, preparedness remains necessary, particularly with regard to buildings, forests, critical infrastructure and civil protection.

Heatwaves – immediate action needed:

Compared to Deliverable 1, the urgency rating for heatwaves was raised from more action needed to immediate action needed. This is mainly due to the strong projected increase in hot days and the refined Phase 2 analysis, which showed that several social and health institutions are located in areas with increased heat exposure. In addition, the district's building stock and many public spaces are not yet sufficiently adapted to prolonged heat, as such conditions have historically been less common than in southern European regions. Because vulnerable groups such as elderly people, children, people with illnesses and people in care facilities are directly affected, and because building-level and spatial adaptation measures require longer planning and implementation periods, immediate action is needed.

Drought – watching brief:

The urgency assessment from Deliverable 1 was confirmed. Drought remains a slower-onset risk, but may become more relevant in the future, especially in combination with increasing temperatures. Phase 2 confirmed its relevance for agriculture, forestry and water management, but also showed that the signal is less clear than for heat and heavy rainfall. Drought should therefore be monitored and included in adaptation planning.

Wildfire – watching brief:

The urgency assessment from Deliverable 1 was refined. Wildfire remains an emerging risk, particularly in combination with heat and drought. However, the Phase 2 Fire Weather Index results remain in the low to moderate range. Therefore, wildfire does not require immediate prioritisation, but awareness and preparedness should be maintained, especially for agriculture, forestry and civil protection.

2.4.5 Understand Resilience Capacity

Heavy rainfall – substantial:

The capacity assessment from Deliverable 1 was confirmed. Civil protection structures, local experience and heavy rainfall hazard maps already provide an important basis. In recent years, rain radar and water level sensors have also been expanded in order to improve situational awareness and enable a faster response during heavy rainfall events. Phase 2 improved the knowledge base by overlaying heavy rainfall maps with critical infrastructure, social institutions and erosion-prone agricultural areas. However, the building stock is only partly adapted to heavy rainfall, and financial and human resources remain limited. Vulnerable groups in social and health institutions and critical infrastructure require particular attention.

Windstorm – substantial capacity:

The capacity assessment from Deliverable 1 remains valid. Emergency response structures and local experience with storm events are available. However, vulnerabilities remain for buildings, roofs, forests and critical infrastructure. Phase 2 did not substantially change this assessment.

Heatwaves – low to medium capacity:

The capacity assessment was refined in Phase 2. Compared to heavy rainfall and storms, the district has less historical experience with prolonged heat. Many buildings, public spaces and sensitive facilities are not yet sufficiently adapted to high temperatures, especially because heat risks have traditionally been less prominent than in southern Europe. Vulnerable groups in schools, nurseries, care homes and health facilities are particularly relevant. Phase 2 improved the spatial knowledge base, but practical adaptation measures still need to be implemented more systematically. The main obstacles especially consists regarding a lack of financial and human resources, a lack of specialist knowledge and a lack of data.

Drought – medium capacity:

The capacity assessment from Deliverable 1 was largely confirmed. Some relevant knowledge exists in agriculture, forestry and rural development, but drought adaptation is not yet systematically organised across the district. Phase 2 provided additional information through the drought workflows, but local data and concrete adaptation measures remain less developed than for heavy rainfall.

Wildfire – medium capacity:

The capacity assessment from Deliverable 1 was refined. Fire brigades and civil protection structures are available, and current average fire weather hazard remains low to moderate. However, large-scale wildfire events are not yet a central experience for the district. Capacity should therefore focus on maintaining awareness and coordination with agriculture and forestry, while wildfire remains a lower priority than heavy rainfall and heat.

2.4.6 Decide on Risk Priority

Based on the key risk assessment described in the preceding subchapters, the resulting risk matrix is as follows.

Risk Workflow	Severity		Urgency	Capacity	Risk Priority
	C	F		Resilience/ CRM	
River flooding	x	x	x	x	x
Coastal flooding	x	x	x	x	x
Heavy rainfall	3	4	4	3	Very high
Heatwaves	2	3	4	2	High
Drought (Assessment Phase 2)	1	2	2	2	x
Fire (Assessment Phase 2)	1	2	2	2	x
Snow	x	x	x	x	x
Wind	3	4	3	3	High

Severity	Urgency	Resilience Capacity	Risk Ranking
Critical	Immediate action needed	High	Very high
Substantial	More action needed	Substantial	High
Moderate	Watching brief	Medium	Moderate
Limited	No action needed	Low	Low

Figure 46: Risks priorities for the district of Sankt Wendel

Heavy rainfall is assigned a very high risk priority. It shows substantial current and critical future severity, immediate urgency. Institutional response capacity is substantial, but preventive adaptation capacity at building and infrastructure level remains limited to medium.

Heatwaves are assigned a high risk priority. Although current severity is still moderate, future severity increases clearly, and urgency was raised to immediate action needed because vulnerable groups, social institutions and a poorly adapted building stock are directly affected.

Windstorm is assigned a high risk priority. Current severity is substantial and future severity remains critical, mainly because past local events have already caused damage and sudden extreme wind events can affect buildings, forests and infrastructure.

Drought was assessed in Phase 2 as an emerging risk with limited current and moderate future severity. It is not assigned a high priority at this stage, but should be monitored and considered in adaptation planning due to its relevance for agriculture, forestry and water management.

Fire was also assessed in Phase 2 as an emerging risk. The current severity remains limited and future severity moderate, so it is not prioritised for detailed risk assessment, but awareness and preparedness should be maintained, especially in combination with heat and drought.

River flooding, coastal flooding and snow were not prioritised in this assessment. Coastal flooding is not relevant for the inland district, while river flooding and snow were not selected as key risks compared to the dominant hazards of heavy rainfall, heat and windstorm.

2.5 Monitoring and Evaluation

Phase 2 was accompanied by an iterative process in which the CRA was continuously reviewed and, where necessary, improved. On the one hand, the severity and urgency of the individual climate-related risks were repeatedly reviewed through the analysis of different studies and datasets. This formed the monitoring component. On the other hand, the CRA process itself was continuously reflected upon during the implementation of the workflows and through stakeholder engagement. This formed the evaluation component. For Phase 3, it is planned to firmly embed monitoring and evaluation within the adaptation strategy so that the CRA can continue and be further improved beyond the project duration.

The following main lessons were identified:

Difficulties: Difficulties arose particularly in the interpretation of workflow results when different models were used. Different models sometimes produced different results, which raised questions especially in the heavy rainfall workflow, where the model outputs varied considerably. During the process, a better understanding was gained of how to deal with diverging model results, for example by using additional statistical indicators such as the median instead of the mean, by applying robustness checks, and by comparing model outputs with historical data and existing studies.

Further challenges were caused by low-resolution datasets, which often show general trends but provide limited information for a small region such as the district of Sankt Wendel. In some cases, the workflows appeared to be designed for larger regions, which made their application to the relatively small district more difficult.

At the beginning of the process, there were also challenges in understanding certain fundamentals of climate modelling, such as the rotated coordinate system used in CORDEX data. Only after more intensive familiarisation with these topics was it possible to apply the CORDEX models together with local reference data, such as KOSTRA-DWD data.

New data and research needs: New climate projection data from the German Weather Service (DWD) were used for the three climatic natural regions occurring within the district, as described in Chapter 2.3.6.1.

In particular, trends in heavy rainfall events remain uncertain depending on the models used. Better data and further research will be needed in the future to assess more reliably how climate change will affect such events at the local level. The workflows and DWD climate projections provide useful indications of a trend towards more frequent heavy rainfall events, but the signal is less robust than for temperature-related indicators. A dedicated robustness analysis for heavy rainfall assessments would be useful to identify clearer and more reliable signals.

Monitoring systems related to the assessed risks: Historical weather data are currently available and were used to contextualise the workflow results. In addition, weather station data were used to analyse past extreme weather events, including the 2019 heatwave and the Pentecost flood in 2024.

In the near future, the district will also have access to indoor sensors in social institutions as part of the Interreg project ADAPT. These sensors will monitor air temperature, relative humidity, mean radiant temperature, wind speed and brightness. The data can be used to validate and refine the heat workflow results and to improve the understanding of the relationship between outdoor and indoor heat exposure.

What worked well and room for improvement: As in Phase 1, cooperation between the technical partner IZES gGmbH and the project lead, the district of Sankt Wendel, worked very well in Phase 2. Across the district, there are many committed stakeholders who recognise the importance of climate adaptation.

Room for improvement remains mainly in the area of data collection and, in some cases, cooperation with individual stakeholders. High workloads and competing priorities made data provision and validation more difficult in some instances.

Efficiency: All planned workflows were carried out. This included risks that were ultimately considered less relevant, such as wildfire and drought. This broad assessment was defined in Phase 1 and was useful for obtaining a comprehensive overview. However, it also meant that less time was available for detailed fine-tuning of the most relevant risks.

Overall, resources were used efficiently. Nevertheless, the fine-tuning of the heavy rainfall workflow required considerable time. The intensive work on this workflow improved the understanding of the CRA outputs, particularly because the large range of model simulations made it clear that no single model result should be trusted without further validation.

The integration of the new KOSTRA-DWD-2020 data improved the validity of the historical reference comparison and therefore increased the realism of the model interpretation.

Role of stakeholders and risk understanding: The close cooperation between the district administration and the subcontractor IZES gGmbH was particularly valuable. It allowed for efficient coordination, quick consideration of new political or administrative developments, and direct communication of results.

Stakeholder feedback supported the continuous review of the analysis results. There was strong agreement regarding the prioritisation of key hazards, especially heavy rainfall and heat. During the evaluation of the working process, it became clear that the municipalities should be involved more strongly. As a result, a survey of the planning departments in all eight municipalities was organised and carried out.

One finding from Phase 1 was that the general public should be more actively involved. Phase 2 therefore started this process through workshops, expert discussions, a citizens' event, media articles and presentations. This process will continue in Phase 3. The CRA results will be summarised and presented together with the adaptation strategy, and practical information, for example on heat and heavy rainfall events, will be made available through flyers.

Overall, the CRA, the involvement of different stakeholders, and the public presentation of the work process and interim results have already helped to improve risk understanding in the region, particularly in terms of public awareness. In Phase 3, this will be further strengthened through the joint development of an adaptation strategy and suitable adaptation measures.

2.6 Work plan Phase 3

In Phase 3, the results of Phases 1 and 2 will be further developed and expanded, particularly with regard to ensuring that the findings can be effectively used, communicated, and transferred to the relevant stakeholder groups. It will focus on developing the adaptation strategy and defining specific adaptation measures. This phase will include:

- **Organising thematic workshops** with stakeholders to present the findings and develop adaptation measures.
- Continue to contact **municipal administrations** engaged in integrating climate risks into planning processes.
- Formulation of a **local strategy for adapting to climate change** based on the risk assessment carried out.
- Identifying **specific adaptation measures** and assessing their feasibility.
- Development of a **planning guideline** for municipalities on the integration of climate risks.
- Developing **guidelines for the creation of an emergency response plan**, taking climate risk data into account. (It is not possible to update an emergency response plan, as there is currently no such plan in place in the district of Sankt Wendel.)
- Summary of the findings in a **climate risk management plan**.
- Development of **policy briefs** for decision-makers.
- Conducting a **training session for emergency responders and civil protection agencies**.
- Continuing **public information initiatives** to raise public awareness and encourage public engagement, for example by publishing articles in regional media.
- **Continuing of regional dialogue regarding a regional networking platform** for the exchange of knowledge on climate adaptation.

3 Conclusions Phase 2 - Climate risk assessment

Phase 2 of the CliRAs-WND project built directly on the results of Phase 1. While Phase 1 provided a broad overview of the main climate-related risks for the district of Sankt Wendel, Phase 2 aimed to increase the level of detail for the most relevant risks and to make the climate risk assessment more locally applicable. The main objective was therefore to refine the existing assessment, integrate higher-resolution local data where available, compare workflow results with regional climate information and stakeholder knowledge, and create a stronger basis for the development of adaptation strategy and measures in Phase 3.

The work in Phase 2 focused on three main elements. First, existing studies, regional climate information and climate projections were reviewed in more detail in comparison to phase 1 in order to better classify the main hazards for the district. This additional screening confirmed the general findings from Phase 1 and provided more detailed information : heavy rainfall and heat are the most relevant and urgent climate risks for the district of Sankt Wendel. Windstorms remain an important risk due to past local events and possible severe impacts, but available climate projections do not show a robust future signal for average wind speed. Drought and wildfire were identified as emerging risks that may become more relevant under future climate conditions, especially in combination with increasing temperatures.

Second, the CLIMAAX workflows were further refined and expanded. Particular attention was given to heavy rainfall and heat, because these risks were confirmed as the most relevant for the district. Windstorm was not further fine-tuned in Phase 2, as the workflow had already been carried out in Phase 1 and the additional DWD climate projections did not provide a robust signal for future changes. Instead, windstorm remains part of the overall risk assessment and preparedness considerations, but was not prioritised for detailed methodological refinement in this phase.

For heavy rainfall, several model ensembles and methodological approaches were tested. This was one of the most challenging parts of Phase 2. The analysis showed that different climate models and ensemble methods can lead to partly diverging results, especially when local thresholds and coarse-resolution model data are combined. The interpretation of the heavy rainfall workflow therefore required careful validation. The results were compared with KOSTRA-DWD data, DWD climate projections, existing regional studies and historical events. This process showed that bias-corrected model data provided the most plausible and useful results for the district. Overall, both the refined workflow analysis and the DWD projections indicate a tendency towards more frequent and more intense heavy rainfall events in the future.

For heat, the assessment was refined by extending the analysis to the entire district of Sankt Wendel. A Landsat-based land surface temperature analysis was carried out for the July 2019 heatwave. The resulting maps show that heat exposure is particularly visible in the town of Sankt Wendel, but also occurs in smaller municipal centres and around sensitive infrastructures in other municipalities. Local datasets on social and health institutions were added to the analysis. These included nurseries, schools, elderly care homes, care centres, hospitals, rehabilitation clinics, hospices and pharmacies. The overlay showed that several sensitive facilities are located in areas with increased heat exposure.

The heat assessment confirms that adaptation is urgently needed, especially for facilities used by vulnerable groups. This is particularly important because many buildings in the region are not equipped with passive or active cooling systems and were not designed for longer and more intense heatwaves. During future heat events, this may become a major challenge for schools, care homes, health facilities and other sensitive buildings. The DWD climate projections further support this finding, showing a clear increase in hot days under both RCP 4.5 and RCP 8.5, with a particularly strong increase under the high-emission scenario.

In addition to the refined assessments for heavy rainfall and heat, the relative drought, agricultural drought and wildfire workflows were carried out to provide a broader classification of further climate risks. These workflows were not fine-tuned in the same level of detail, as drought and wildfire were not prioritised as the most urgent risks in Phase 2. Nevertheless, the results confirm that these hazards may become more relevant in the future. Drought-related risks are particularly relevant for agriculture, forestry and water management. The wildfire assessment shows increasing fire weather conditions towards the end of the century, especially under RCP 8.5, although average seasonal Fire Weather Index values remain within low to moderate danger classes in the analysed scenarios. Drought and wildfire should therefore be monitored and included in future adaptation planning, but they are not the main priority for immediate action.

The key risk assessment confirmed the main findings from Phase 1, but added more detailed and locally specific information. Heavy rainfall was assessed as the highest-priority risk for the district. It has substantial current severity, critical future severity and requires immediate action. Heat was also upgraded in urgency and assessed as a high-priority risk requiring immediate action, mainly due to the clear climate signal, the exposure of vulnerable groups and the limited adaptation of buildings and public spaces. Windstorm remains a high-priority risk due to possible severe impacts, but with greater uncertainty regarding future climate change signals. Drought and wildfire were assessed as emerging risks that require monitoring and should be considered in adaptation planning.

The entire Phase 2 process was accompanied by stakeholder engagement, expert exchange, municipal involvement and public information activities. This included an internal stakeholder workshop, expert meetings, a survey of municipal planning departments, a public citizens' workshop, conference presentations and networking activities at regional and international level. These activities helped to validate the results, collect local knowledge, identify data gaps and understand the needs of different stakeholder groups. Stakeholder feedback confirmed the prioritisation of heavy rainfall and heat. Municipalities also highlighted local concerns such as flooding from small streams, drought and storm events. The municipal survey showed that climate adaptation is already being considered in planning processes to some extent, but is not yet uniformly structured or firmly embedded.

Phase 2 also identified several challenges that could not be fully resolved. The interpretation of model outputs remains difficult, especially for heavy rainfall, where different models can produce different signals. The spatial resolution of several workflow datasets is still limited for small-scale local planning. In addition, stakeholder involvement was sometimes constrained by high workloads and competing priorities. Finally, financial and human resources for climate adaptation remain limited, and adaptation measures are not yet binding at district or municipal level.

Despite these challenges, Phase 2 significantly improved the evidence base for climate adaptation in the district of Sankt Wendel. The combination of CLIMAAX workflows, DWD climate projections, local datasets, historical event analysis and stakeholder knowledge made it possible to develop a more detailed and practical understanding of local climate risks. The results provide a strong basis for Phase 3, in which the findings will be translated into concrete adaptation activities.

4 Progress evaluation

All milestones and key performance indicators (KPIs) of Phase 2 have been achieved, and the work in Phase 3 can proceed as planned. More detailed information in the respective subchapters and the supporting documentation.

Table 4-1 Overview key performance indicators

Key performance indicators	*Progress*
	Phase 1
1 Kick-off event for main stakeholders conducted	Completed: The event was originally scheduled for the first week of June. Due to the need to enable several people with tight schedules to participate and to offer a sufficiently prepared group of stakeholders the opportunity to participate, the workshop could not be held until July 30.
1 Scoping process (identification of main risks) conducted	Completed: Even before the workshop with the main stakeholders, there was an intensive exchange between disaster control and IZES regarding which risks should be considered. To this end, past events were reviewed and the latest data analyzed. The workshop provided us with final confirmation of the relevant risks.
1 CLIMAAX methodology for multi risk assessment applied	Completed: The CLIMAAX methodology for multi-risk assessment was successfully applied. The heavy precipitation workflow required considerable time, as several difficulties arose during its implementation. As a result, the final deadline at the end of September was fully utilised.
	Phase 2
1 Comprehensive climate risk report including multi-hazard risk assessment for the district of St. Wendel	Completed: A comprehensive climate risk report was prepared as Deliverable 2, including the refined multi-hazard risk assessment and key findings for the district of Sankt Wendel. Multiple risks related to hazards such as heavy rainfall, heat, wind, drought and wildfire have been included. The results will be integrated into the final Phase 3 document and used as the basis for the local adaptation strategy.
Stakeholder workshop conducted to validate climate risk findings	Completed: The workshop to validate the results and agree on the next steps took place on 11 March 2026.
3 Existing studies for the region compiled and analysed	Completed: More than 10 existing studies for the region were compiled and analysed(see Annex 1 - Evaluation of climate studies) . The results were used to contextualise and validate the workflow outputs.
4 Local datasets integrated into the climate risk analysis for higher resolution	Completed More than four local and regional datasets were integrated into the climate risk analysis, including heavy rainfall hazard maps, historical event data based on local weather stations (heatwaves and flooding events), DWD climate projections, critical infrastructure, social and health institutions, and erosion-prone agricultural areas. This improved the spatial resolution and local relevance of the assessment.
1 Stakeholder workshops conducted (e.g. for critical infrastructures)	Completed Workshop for citizens was conducted on 23 June 2026. A second stakeholder workshop is planned for the third project phase.
	Phase 2 and 3
1 Climate risk management plan developed and adopted	Phase 3
Local climate adaptation strategy formulated based on risk assessment	Phase 3

Key performance indicators	*Progress*
5 Specific adaptation measures identified and evaluated for feasibility	Phase 3
3 Municipal administrations engaged in integrating climate risks into planning processes	Started: The planning departments of all eight city and local authorities were involved in the process through a survey on climate impacts and adaptation. Further involvement is planned for Phase 3 through the existing KEEN network, which includes all municipalities; a meeting is scheduled for August 2026.
3 Technical meetings with urban and regional planners conducted	Completed: Technical meetings were held with the Public Health Department on 20 January 2026, the Saar Waste Management Association on 21 January 2026 and the Sankt Wendeler Land Economic Development Agency on 30 April 2026. More meetings are planned for the third project phase.
1 Planning guideline created for municipalities to incorporate climate risks	Phase 3
1 Updated emergency response plan incorporating climate risk data	Phase 3
1 Training session conducted for emergency responders and civil protection agencies	Phase 3
200 Citizens reached through awareness campaign and information sessions	Started: A citizens' workshop on climate risks, digital maps and private adaptation measures was conducted on 23 June 2026. In addition, several social media posts and articles in print media were published; further citizen information activities are planned for Phase 3.
3 Articles in regional media published on climate risks and adaptation	Completed – more articles planned for phase 3 • **09.04.2025** – *Analyse soll Klarheit schaffen: Welche Klimarisiken gibt es im Landkreis St. Wendel?* – Saarbrücker Zeitung • **08.08.2025** – *Auftakt für Klimaanpassung im Landkreis Sankt Wendel: Über 40 Teilnehmer beim ersten CliRAs-Workshop* – wnd.de • **08.08.2025** – *Klimaanpassung in St. Wendel* – RadioSALÜ Nachrichten • **11.08.2025** – *Landkreis St. Wendel startet Klimaanpassung: Über 40 Akteure entwickeln Strategie* – wnd.de / St. Wendeler Land Nachrichten • **08.05.2026** – *Landkreis unterzieht sich Risiko-Check* – Saarbrücker Zeitung • **09.05.2026** – *Wie sich St. Wendel gegen Hochwasser, Hitze und Waldbrände schützt* – Saarbrücker Zeitung • **09.05.2026** – *Das Risiko kennen und verringern* – Saarbrücker Zeitung • **09.06.2026** – *Klimarisiko-Check fürs Zuhause* – Website des Landkreises Sankt Wendel / Saarbrücker Zeitung und weitere Medien
2 Presentations at national and European climate adaptation events	Completed: Presentation of CliRAs-WND within the "„Week of climate adaptation" to different Stakeholders of the region (Saarland) on 17 September 2025; at the 2nd Saarland Climate Congress on 19 May 2026; at the international kick-off event for the Interreg project LiveableCities on 20 May 2026. More presentations are planned for phase 3.
3 Policy briefs with recommendations for decision-makers developed	Phase 3
1 Regional networking platform established for knowledge exchange on climate adaptation	Started: A first regional exchange with climate adaptation managers in Saarland took place on 10 June 2026. Further information exchange and networking activities are planned for Phase 3 to strengthen knowledge transfer on climate adaptation.
4 Project dissemination actions (newsletters, workshops, stakeholder forums) conducted	**Started:** Dissemination activities have already been initiated through stakeholder engagement, workshops, regional media publications and project-related communication activities described under the respective KPIs. Further dissemination formats are planned for Phase 3.

Table 4-2 Overview milestones

Milestones	*Progress*
M1 - Kick-off meeting with subcontractor	Completed: The online kick-off meeting took place on May 26.
M2 - Kick-off event for information and involvement of stakeholders	Completed: Due to scheduling conflicts and the summer holiday period, the workshop was held slightly later than originally planned, on 30 July 2025, but was successfully conducted.
M3 - Completed implementation of the CLIMAAX common methodology for multi-risk assessment and analysis of the results	Completed: The CLIMAAX methodology for multi-risk assessment was successfully applied. The heavy precipitation workflow required considerable time, as several difficulties arose during its implementation. As a result, the final deadline at the end of September was fully utilised.
M4 - Completed refined regional/local high-resolution analysis and risk assessment and comparison of results	Completed: A comprehensive climate risk report was prepared as Deliverable 2, including the refined multi-hazard risk assessment, regional/local high-resolution analyses and comparison of results for the district of Sankt Wendel. The results will be integrated into the final Phase 3 document and used as the basis for the local adaptation strategy.
M5 - Workshop for presenting results of phase 1 and 2 to stakeholders	Completed: The workshop to validate the interim results and agree on the next steps took place on 11 March 2026. Following the workshop, there was continuous exchange with the main stakeholders throughout the finalisation of Deliverable 2. This ongoing coordination supported the refinement of the climate risk assessment, the validation of key findings and the integration of additional local knowledge. Further exchange is planned for Phase 3.
M6 - Local adaptation strategy and risk management plans have been developed	Deliverable 3
M7- Final dissemination and presentation of results + adaptation strategy to stakeholders	Deliverable 3
M8 - Subcontracting completed	Deliverable 3

5 Supporting documentation

For deliverable two the following documents were created:

- Main Report Deliverable 2 (PDF)
- Annex 1 – Evaluation of climate studies (PDF)
- Annex 3 – Heavy rainfall workflow –additional documentation (PDF)
- Annex 4 – Communication outputs phase 2 (PDF)
- Annex 5 – Survey of planning departments (PDF)
- GeoNode upload of datasets (will be uploaded un July 2026)
    - Annex 2 – DWD climate projections (Excel)
    - Annex 6 – GIS based risk maps (PDF/GIS-Files)
    - Zip-Files for Python Workflows including datasets
        - Heavy rainfall
        - Heat

6 Reference list

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