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Clim4Cast

Output 1.2 - A transnational strategy on improved climate change awareness in the area of DHF events and their compound effects for the Clim4Cast region

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OUTPUT 1.2 - A TRANSNATIONAL STRATEGY ON IMPROVED CLIMATE CHANGE AWARENESS IN THE AREA OF DHF EVENTS AND THEIR COMPOUND EFFECTS FOR THE CLIM4CAST REGION

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Introduction

Output 1.2 A transnational strategy on improved climate change awareness in the area of drought, heatwave and wildfire events and their compound effects for the Clim4Cast region (hereafter Strategy) was prepared within working package 1, but is built on the deliverables of all three working packages. It reflects the results of activities analysing the past drought, heatwave, and wildfire/forest fire (DHF) events (DHF impact database – Activity 1.1/Milestone 1, attribution of the occurrence of extreme events to climate change – A 1.3, and lessons learnt from the past DHF events – A 1.4), best practices in DHF monitoring in each country of the Clim4Cast region (A 2.1) as well as the current state of DHF management on national level (A 3.1 and A 3.3).

Summary of the strategy for policy-makers and other relevant stakeholders

A transnational strategy on improved climate change awareness in the area of drought, heatwave and wildfire events and their compound effects for the Clim4Cast region builds on the following pillars:

1. Objective data about DHF impacts from the DHF impact database covering the whole Clim4Cast region.
2. Attribution analysis of climate change impacts on the occurrence of DHF events, which emphasize the urgent need to raise awareness about DHF events and their potential consequences under changing climate conditions.
3. Stakeholder consultations identifying the gaps and stakeholder needs related to DHF management.
4. Stakeholder survey related to needs and preferencies in the field of communication.

Compiling the information from these four pillars, the highest stress was put on stakeholders opinions and recommendations as the most relevant for the final strategy. As one of the main weak points in the DHF management in the Clim4Cast countries was stated an insufficient communication flow on both internal and external level. Therefore, we assume that the recommendations listed in the strategy (see a following section) are very relevant and can significantly improve the awareness about the DHF events and the climate change leading to better improvement to extreme events occurrence.

Policy Recommendations related to communication:

- Prioritize trusted channels for official communications while integrating controlled, high-quality content into emerging platforms to broaden reach without compromising credibility.
- Standardize language and definitions across all communication to strengthen public trust and reduce confusion.
- Focus on timely, data-driven indicators for early warning systems, while improving the availability and usability of social vulnerability data to ensure equitable adaptation strategies.
- Invest in visual and interactive tools that translate complex risk data into accessible, actionable guidance for the public.

The Clim4Cast outputs and deliverables can highly contribute in the field of the strategy implementation and they can help the stakeholders to follow and implement the strategy leading to the filling the gaps in the current DHF management in the region.

Recommendations to improve the awareness about the DHF events in the Clim4Cast region

Earlier mentioned facts lead us to conclusion that the focus of activities for improving the awareness should be targeted at relevant stakeholders and policymakers in the case of drought. Regarding heatwaves, the focus should be targeted not only at the policymakers, but also at the general public. The wildfire management was evaluated as quite well developed in most countries, but the prevention activities, including information campaigns were evaluated as insufficient. Therefore, it is recommended to focus on the improving awareness activities on the public. Following actions are recommended for the improvement of the awareness about DHF events and their impacts:

1. Establishment of DHF monitoring on regional level for mapping cross-border events and early action in case of developing DHF events
2. Establishment/improvement of drought monitoring on national level
3. Establishment/improvement of heatwaves monitoring on national level
4. Establishment/improvement of wildfires monitoring on national level
5. Identification of key stakeholders relevant for each DHF phenomena
6. Information campaign/dissemination of results from the DHF impact database
7. Information campaign/dissemination of information about climate change attribution to the DHF events occurrence
8. Information campaign introducing new monitoring tool available in the Clim4Cast region/in the country
9. Regularly updated public information about the current conditions during expected, ongoing, or terminated DHF events in the country / the Clim4Cast region and its spreading via (mass) media

Background information for the Strategy

Stakeholder survey on preferred information channels and information needs to improve communication about DHF events

Due to the fact that the Clim4Cast region is quite heterogeneous considering societal habits, the preferred communication channels vary among the countries. The stakeholder survey conducted within the Activity 1.5 a provides insights into public perceptions of the usefulness of various sources of information related to risk and climate change. Respondents (127 in total) were asked to assess how important different communication channels are in providing reliable information. The responses were categorized into three levels of importance: high and very high, moderate, and no or low importance.

Online news and government websites, along with traditional media such as television and radio, as well as scientific publications emerged as the most highly valued sources of information about DHF risk, with 64%, 59%, 58% of respondents respectively rating them as highly or very highly important. This reflects a strong level of trust in both official digital content and traditional broadcast media and scientific publications. Social media platforms were rated by a notable portion of respondents, indicating their growing role in public communication (54%). On the other hand, flyers and posters (22%), newspapers and magazines (28%), received the lowest ratings in the highly or very highly important. This suggests that while these sources are accessible and familiar, they may lack the perceived depth, reliability, or authority associated with more structured and institutional sources.

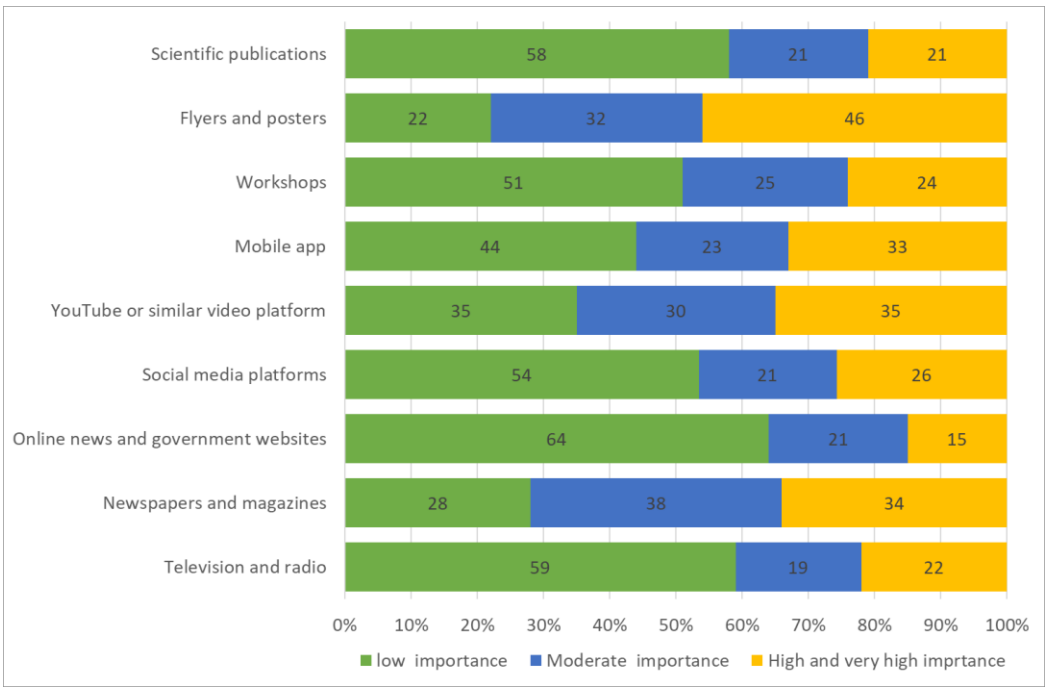


Figure 5. Importance communication channels for source of information concerning climate change risk

When considering sources rated as moderately important, newspapers and magazines were most often selected (38%), followed by flyers and posters (32%) and YouTube (30%). These figures indicate a mixed

perception of these channels—trusted by some, but viewed with skepticism by others—likely due to differences in content quality, format, and delivery.

The relatively even distribution of responses (35%, 30%, 35%) for YouTube and similar video platforms, without a clear majority rating them as a "very good" communication channel, suggests significant diversity of opinion among respondents.

Concluding the findings related to preferred communication channels, the survey reveals a clear preference for traditional and authoritative sources of information on complex topics like climate change and DHF risk. Trust is strongest in structured, credible. In contrast, more informal or fast-paced media such as social platforms, video channels, and printed promotional materials tend to be met with greater caution and lower credibility.

Participants of the consultation workshops were asked to share their requests regarding both the ways of communicating about DHF events and the topics that should be addressed in such communication. This represents the next area of analysis in the study, focusing on how the content, style, and timing of communication can be improved to better support preparedness and engagement.

The survey results indicate that respondents largely rated the proposed improvements in DHF preparedness communication as important or very important, with an average of over 70% of responses falling into the "High and Very high" category (Fig. 6). The highest-rated request was to use consistent terminology for DHF event warnings across all communication channels (84%), followed closely by clearly defining abnormal situation and indicating when adaptation measures are necessary (77%), and discussing DHF events while they are actually occurring to ensure the audience's attention (77%).

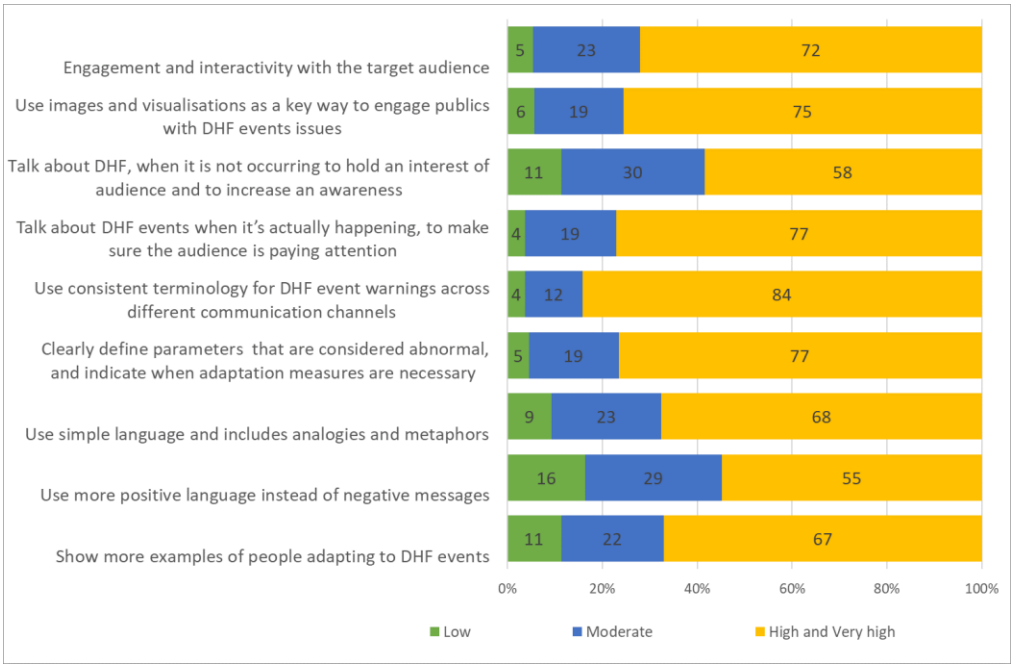


Figure 6. Distribution of respondents' ratings (Low, Moderate, High/Very high) for proposed measures to improve DHF preparedness communication

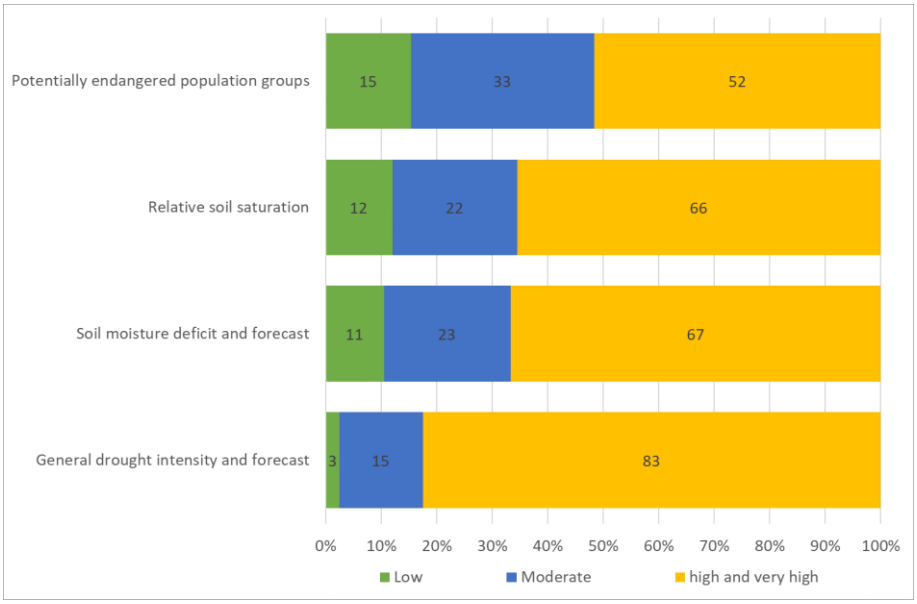
While still viewed positively, relatively fewer respondents rated as highly effective the suggestion to use more positive language instead of negative messages (54.8%), which may indicate that respondents prioritize clarity, accuracy, and actionable information over tone alone. The share of "Low" ratings was

generally small (averaging 7.9%), reinforcing the finding that most proposed measures are widely accepted.

These findings emphasize the need for communication that is clear, timely, and consistent, using visual tools and interactive methods to raise awareness and promote adaptive behavior. Further, these insights suggest that while tone and storytelling are important, timing, clarity, and consistency are considered more critical in crisis communication about DHF events. To improve public engagement and preparedness, communication strategies should prioritize actionable, easy-to-understand messages delivered at the right time, supported by visuals and standardized language. These elements are essential in fostering public understanding and encouraging timely adaptive responses to climate extremes.

The next topic addressed in the survey was the assessment of indicators related to drought, heatwaves, and forest fires.

The results indicate that respondents generally consider the proposed indicators to be valuable for describing drought conditions, although their perceived usefulness varies. General drought intensity and forecast were rated the highest (Fig. 7), with 82.5% of responses falling into the “High” or “Very high” category and only 2.5% into “Low,” confirming its strong relevance in drought assessment. This underscores the critical importance of broad and timely information on drought for effective planning and risk communication. Soil moisture deficit and forecast also received substantial support (66.7% “High/Very high”), although the proportion of “Low” (10.5%) and “Moderate” (22.8%) responses was higher compared to drought intensity. Relative soil saturation was rated similarly (65.5% “High/Very high”), but with a slightly greater share of “Low” responses (12.1%), indicating more varied perceptions of its importance.



Figures 7. Respondents’ ratings of the usefulness of selected indicators for describing drought conditions (% of responses by importance level)

By contrast, the indicator 'Potentially endangered population groups' received the lowest high/very high rating (52%), with 15% of respondents considering its usefulness to be low. While still seen as relevant, this suggests a potential gap in data availability, clarity, or perceived actionability of social vulnerability indicators. Overall, the findings suggest a clear prioritization of meteorological and hydrological indicators over socio-demographic ones in the context of drought description. However, to ensure

equitable and targeted adaptation, it is also important to improve data and communication on social vulnerabilities, enabling support for the most at-risk groups.

The data indicate that respondents generally rated meteorological and climatological indicators as more useful for describing heatwave conditions than socio-demographic ones. General heatwave intensity and forecast was identified as the most important, with 82.5% of participants rating it as "High" or "Very high" and only 2.5% as "Low," highlighting its strong perceived relevance. Temperature anomaly magnitude and forecast (66.7% "High/Very high") and Relative humidity levels (65.5% "High/Very high") were also valued highly, though they attracted a higher share of "Low" ratings (10.5% and 12.1%, respectively) compared to heatwave intensity. The lowest-rated indicator was Potentially endangered population groups, with 51.6% in the highest category and the largest shares of "Moderate" (33.0%) and "Low" (15.4%) responses, suggesting more mixed perceptions of its direct usefulness for heatwave description. Overall, the results reflect a clear preference for concrete, measurable physical indicators over socio-demographic ones in heatwave assessment.

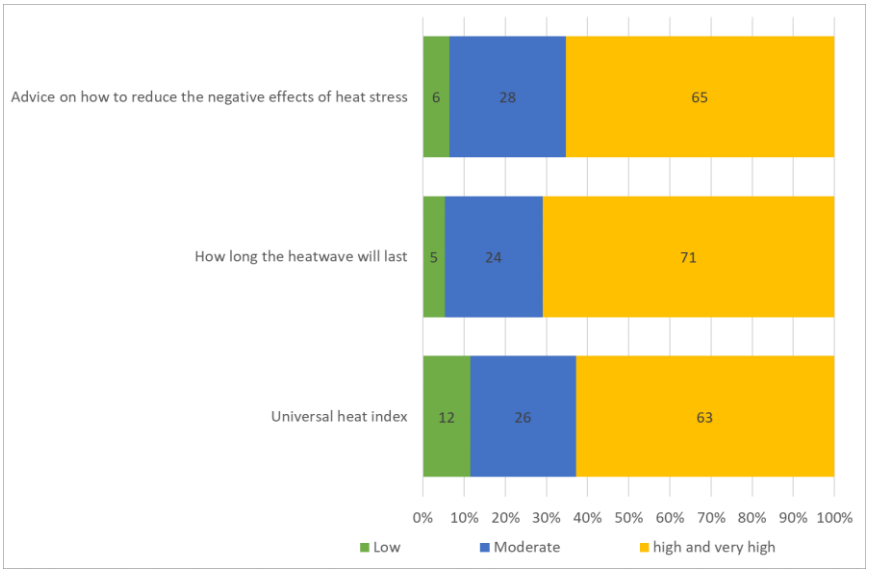
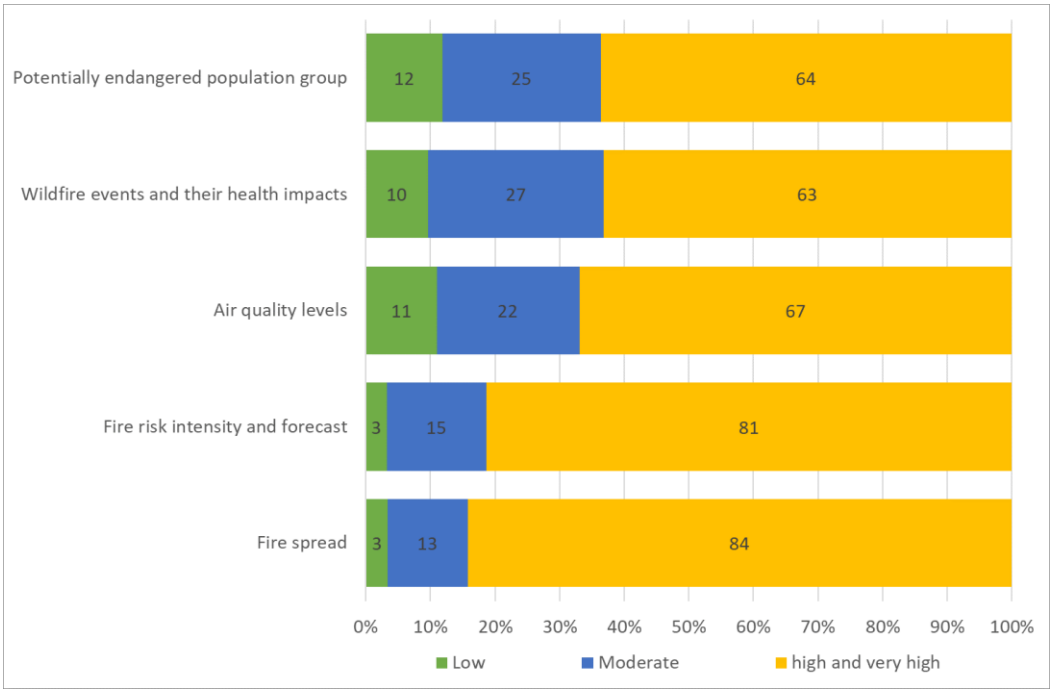


Figure 8. Respondents' ratings of the usefulness of selected indicators for describing heatwave conditions (% of responses by importance level).

The results show that respondents considered physical and meteorological indicators to be the most useful for describing wildfire events. Fire spread ranked highest (Fig. 9), with 84.2% of responses in the "High" or "Very high" category and only 3.3% in "Low," indicating its critical perceived importance. Fire risk intensity and forecast followed closely (81.3% "High/Very high"), also with minimal "Low" ratings (3.3%). Indicators related to environmental impacts, such as Air quality levels (66.9% "High/Very high") and Wildfire events and their health impacts (63.2% "High/Very high"), were also valued, though they received higher shares of "Moderate" responses (22.0% and 27.2%, respectively). The lowest-rated indicator was Potentially endangered population group, with 63.6% in the highest category and the largest share of "Low" responses among all listed indicators (11.8%). Overall, these findings suggest a clear prioritization of immediate, measurable wildfire dynamics—such as fire spread and risk forecasts—over longer-term or indirect impact measures.



Figures 9. Respondents' ratings of the usefulness of selected indicators for describing wildfires conditions (% of responses by importance level).

Conclusions from stakeholder survey

Stakeholder feedback underscores the importance of crisis communication that is clear, timely, consistent, and actionable, supported by standardized terminology, unambiguous definitions of abnormal events, and real-time updates during crises. Visual tools and interactive methods are valued for enhancing understanding and encouraging adaptive behavior.

When assessing indicators for extreme events, respondents prioritized meteorological and climatological measures, such as drought or heatwave intensity, fire spread, and risk forecasts, over socio-demographic indicators. While social vulnerability data is seen as relevant, its lower ratings point to a need for improved data quality, clarity, and perceived actionability.

Objective data related to the DHF impacts and climate change attribution

Assessing the current state of DHF management in each Clim4Cast country (D 3.1.1 and D 3.3.1) reveals that no country is perfectly prepared for the occurrence of the DHF events. The differences in awareness and preparedness vary among countries, but also among DHF extremes as well. The assessment of the current state of DHF management (a part of D 3.3.1) detected that the biggest gaps are in the heatwaves management across the whole disaster risk management cycle (defined in D 3.2.1) in all seven countries involved in the Clim4Cast project, where only a few actions were assessed as well implemented. The best situation is in the wildfire management, where the majority of actions are well implemented. While the heatwave and wildfire management shows some homogeneity in the level of implementation across the region, drought management is more heterogeneous, with the weakest drought management in

Slovakia and Croatia. These findings confirm the fact that there seems to be a big gap in awareness and preparedness on the DHF events in the Clim4Cast region.

The results presented in D 2.1.1 show that almost none of the countries in the analysed region has a monitoring system covering each DHF extreme. The only exception is Slovenia, where each DHF extreme has at least one indicator monitoring the DHF events. Within the Clim4Cast region, the lowest level of awareness about current conditions was found in case of heatwaves. Some products are available only for Croatia on a national level, or on a global level in the case of products by big research centres such as the National Oceanic and Atmospheric Administration (NOAA), but with lower spatial resolution. This likely contributes to the low implementation of the proactive heatwave management and why the general awareness about heatwaves is low in the whole region. The opposite situation is in the case of drought monitoring systems, which are available in each country. The problem of lower awareness about drought and lower implementation of proactive drought management in some countries may lay in a poorer recognition of drought impacts among policy-makers. In contrary to floods, the drought is mostly slowly developing and the economic losses are not as directly visible as in the case of, e.g., floods and they are usually not assessed. Even in case that the country has a drought monitoring system, the data about drought impacts are not systematically collected. This complicates understanding the causalities, especially among public, which can result in lower interest and engagement of stakeholders and the public as well.

The relevance of DHF impacts in the Clim4Cast region is revealed by the DHF impact database (D 1.2.1) established within the project. The wildfire impacts show the dominance among the DHF extremes (Fig. 1). They represent 56% of all identified DHF events in the period 2000–2023. Regarding the impacts within the individual years, the most impacts were reported for the drought in 2022, representing 9.2 % of all DHF impacts (Fig. 2). Looking at the impacts countrywise, the dominance of reported wildfire events is evident, with the exception of Germany, where drought events were recorded at higher rate. The interesting finding is that, although the wildfire events were reported with higher occurrence, the drought impacts are more dominante in Slovakia, Austria and Slovenia. This might reflect different rate of public interest in individual DHF phenomena and more reported impacts during individual drought events. Further, there is a lot of room for improvement in understanding and reporting heatwave impacts. The DHF impact database shows that despite the numerous occurrence of heatwaves in the past, lower number of impacts was reported. This is supported by the fact that the reported impact categories are strongly limited to the information about the heatwave occurrence, while other impacts are rather rare (Fig. 4). This points out on potentially low understanding of threats caused by heatwaves, which results in lower interest and awareness related to this topic.

On the other hand, there stands a drought with quite wide range of reported impacts in the past. This points out quite well recognition of drought impacts among the public. It is a kind of paradox to the current state of drought management, which is not well developed in the most countries of the Clim4Cast region despite the recognition of occurring impacts. Regarding wildfires, the reported impact categories are strongly related to the occurrence of wildfires. The rest of impacts is rather marginal. In some countries (e.g. in Slovakia), this can be related to the fact that wildfires do not hit a large area

and they do not often directly endanger the public. Therefore, the public can be less interested in the topic, leading to the need to pay a higher attention to informing about prevention.

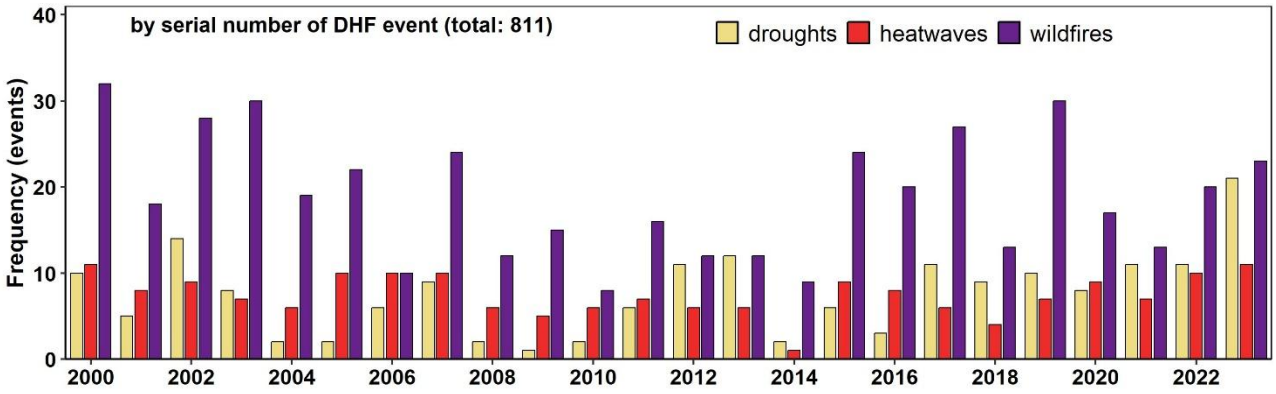


Figure 1 Number of DHF events in the period 2000 – 2023 in the Clim4Cast region.

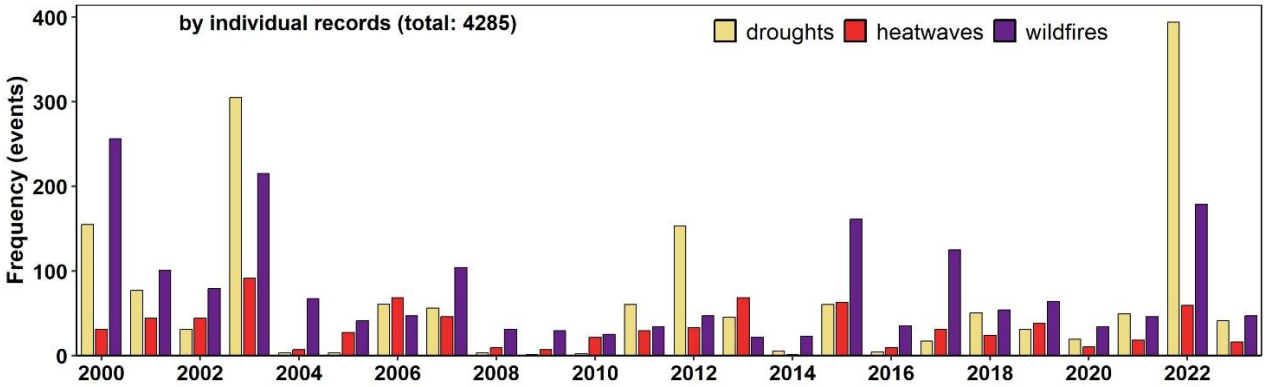


Figure 2 Number of DHF impacts in the period 2000 – 2023 in the Clim4Cast region.

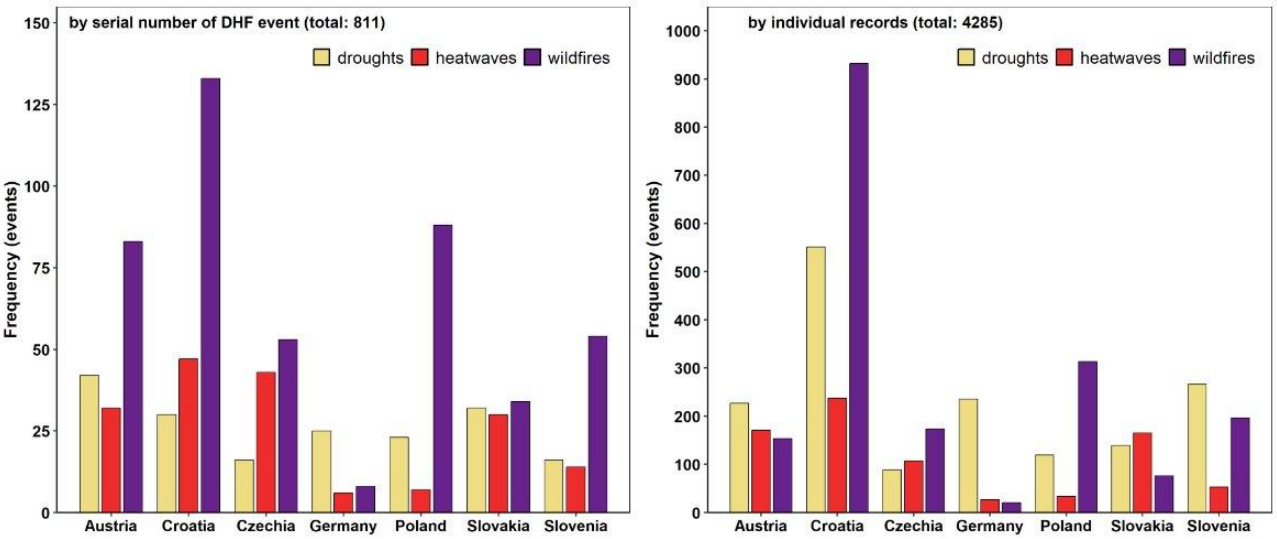


Figure 3 Number of DHF events (left) and DHF impacts (right) for each country within the Clim4Cast region.

The next part presents the initial findings from the attribution analysis of climate change impacts on the occurrence of DHF events (complete results are presented in the Milestone 4). The results emphasize the urgent need to raise awareness about DHF events and their potential consequences under changing climate conditions.

The attribution analysis is based on a comparative approach that evaluates the likelihood of extreme events across several distinct time periods:

- Natural Period (1881 – 1895 and 1851 - 1880): Represents pre-industrial conditions, serving as a baseline for understanding the natural variability of extreme events.
- Actual Period (2011 – 2024 and 1981 - 2010): Reflects current climate conditions influenced by anthropogenic factors.

This methodology follows the framework established by Stott et al. (2016), which enables the quantification of changes in the probability of extreme events due to human-induced climate change.

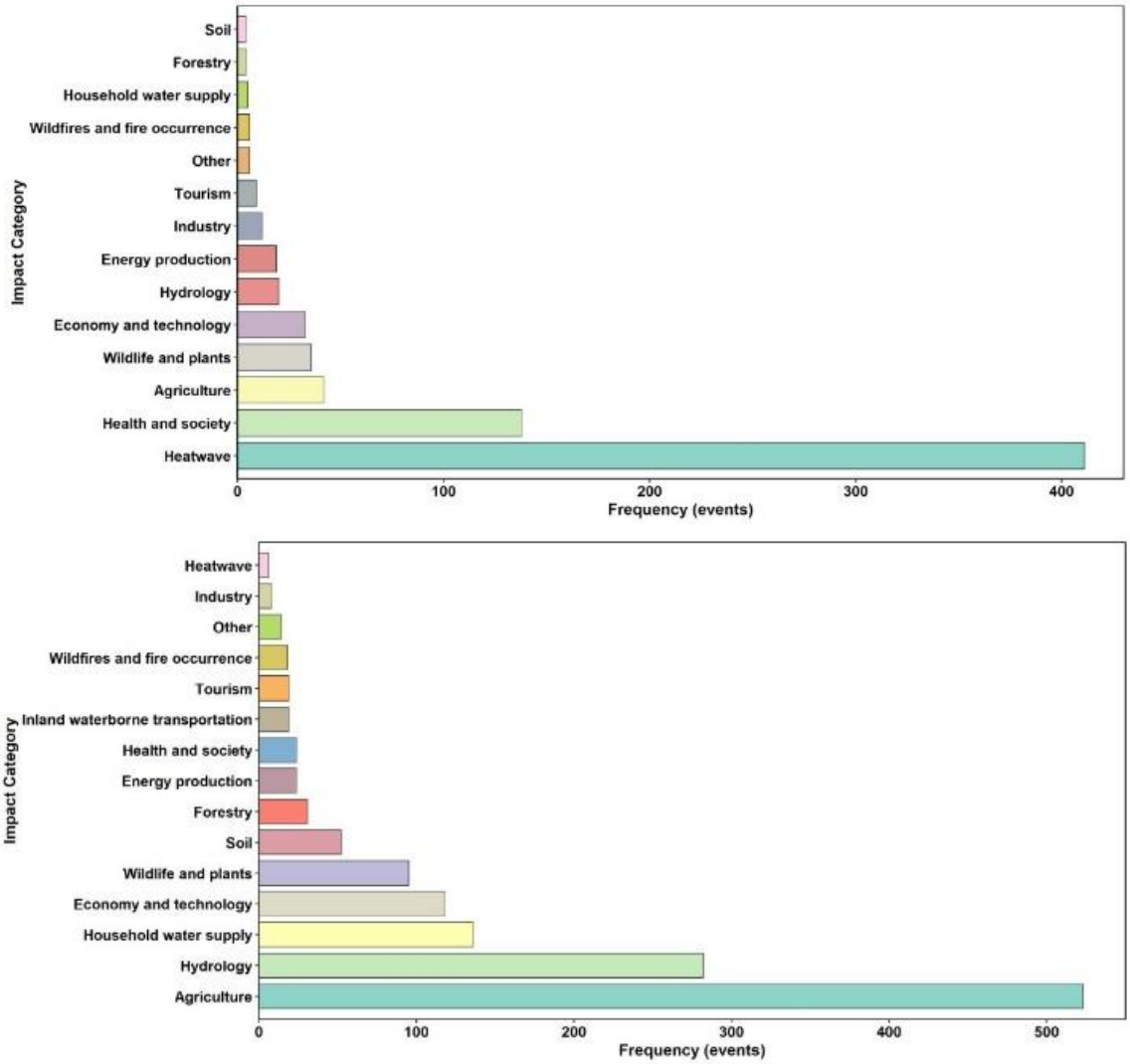


Figure 4 Impact categories reported for heatwave (top) and drought events (bottom)

Initial results have been generated for two key climate extremes: droughts and heatwaves. These results provide insight into how the frequency and intensity of such events have changed over time and are expected to evolve in the future. The findings support the hypothesis that recent climate change has

significantly influenced the occurrence of DHF events, and, for example, the likelihood of heatwave occurrence is higher in the actual period by 4.0–17.2% compared to the natural period in selected capitals situated in the Clim4Cast region.

The preliminary outcomes of this project highlight the critical role of attribution studies in understanding the link between climate change and extreme weather events. Continued analysis will be essential for improving the accuracy of future projections and informing climate adaptation strategies.

References

Stott PA, Christidis N, Otto FEL, Sun Y, Vanderlinden J-P, van Oldenborg GJh, Vautard R, von Storch H, Walton P, Yiou P, Zwiers FW. 2016. Attribution of extreme weather and climate-related events. WIREs Clim Change 2016, 7:23–41. doi: 10.1002/wcc.380.