

Framing climate change

A comparative analysis of natural science articles in Nature & Nature Climate Change and media coverage in Süddeutsche Zeitung (2022–2024)

Luca Rahm

Degree project/Independent project· 30 credits Swedish University of Argicultural Sciences, SLU Faculty of Natural Resources and Agricultural Sciences European Master in Environmental Science (EnvEuro) Uppsala, 2025 Framing climate change. A comparative analysis of natural science articles in Nature & Nature Climate Change and media coverage in Süddeutsche Zeitung (2022–2024)

Luca Rahm

Supervisor	Klara Fischer, Swedish University of Agricultural Sciences, Department of Urban and Rural Development		
Assistant Supervisor	Marianne Penker, BOKU University (Austria), Institute of Sustainable Economic Development		
Examiner	Anke Fischer, Swedish University of Agricultural Sciences, Department of Urban and Rural Development		
Credits	30 credits		
Level	Second cycle, A2E		
Course title	Master thesis in Environmental Science, A2E		
Course code	EX0897		
Programme/education	European Master in Environmental Science (EnvEuro)		
Course coordination dept	Department of Aquatic Sciences and Assessment		
Place of publication	Uppsala		
Year of publication	2025		
Online publication	https://stud.epsilon.slu.se		
Keywords	Climate Change Communication, Framing, Problema- tisation Theory, Discourse Analysis, Science Commu- nication, Media Communication		

Swedish University of Agricultural Sciences

Faculty of Natural Resources and Agricultural Sciences Department of Urban and Rural Development Division of Environmental Communication

Abstract

Peer-reviewed scientific journals and mainstream news media are two significant spheres of public discourse where this thesis examines the framing of anthropogenic climate change. Using a mixed-methods design, I first performed quantitative text analyses on a corpus of review article abstracts from *Nature* and *Nature Climate Change* (2022–2024) as well as tagged *Süddeutsche Zeitung* articles (June and December 2022–2024). Among these analyses were Discourse Network Analysis and frequency analysis of words and bigrams. Following the identification of recurrent word clusters and lexical patterns, six scientific papers and ten newspaper articles were chosen as purposive subsamples for a thorough qualitative analysis.

I used an integrated discourse-analytical framework that combined three different devices: firstly, the logic of problematisation proposed by Collier and Cox (2021), secondly, the distinction between global environmental management and prodigality discourses formulated by Adger et al. (2001), and lastly, Carol Bacchi's "What is the Problem Represented to Be?" questions (Bacchi 2012). According to this method, the majority of scientific and journalistic texts portray climate change as a technical or epistemic problem, highlighting data gaps, model uncertainty, and discrete impacts. Proposed solutions, on the other hand, typically focus on better measurement, modelling, and policy coordination. The crisis is divided into specific research problems (such as carbon feedback loops and grid decarbonisation) in scientific abstracts, and news articles replicate this fragmenting by focusing on specific phenomena like tipping points, marine heatwaves, and Arctic sea-ice loss. The global environmental management framework predominates in both areas; discussions of excessive consumption, equity, or systemic change are occasionally mentioned but stay on the periphery. These results imply that technocratic solutions are given precedence over more expansive moral, justice-focused, and narrative frames that have been demonstrated to encourage engagement in the examined domains of climate communication. Future research directions are suggested in the study's conclusion, including comparing full-length articles and long-form journalism, incorporating activist, policy, or social media framings, and purposefully examining underutilised frames like intersectionality, equity, and climate justice. These initiatives may aid in bridging the gap between the complexity of science and the general public's understanding and enhance communication's ability to motivate group climate action.

Keywords: Climate Change Communication, Framing, Problematisation Theory, Discourse Analysis, Science Communication, Media Communication

Contents

A	ostra	ct		ii
Li	st of	figures	5	v
Li	st of	tables		vi
AI	obrev	viations	5	vii
1	Intro	oductio	on	1
	1.1	Proble	m statement	. 2
	1.2	Resear	rch question and objectives	. 2
	1.3	Signifi	cance and contribution of the study	. 3
2	The	oretica	al framework	4
	2.1	Discou	rse analysis as an umbrella approach	. 4
	2.2	Framir	ng analysis	. 4
	2.3	Proble	matisation theory	. 5
	2.4	Integra	ated approach	. 6
3	Mat	erial &	methods	7
	3.1	Literat	ture review	. 7
		3.1.1	Inclusion criteria	. 7
		3.1.2	Exclusions	. 8
		3.1.3	Documentation and reporting	. 9
	3.2	Reflex	ivity and role of the researcher	. 10
	3.3	Quanti	itative analysis	. 11
		3.3.1	Word Frequency Analysis	. 11
		3.3.2	Discourse Network Analysis	. 11
	3.4	Qualita	ative analysis	. 12
		3.4.1	Selection process for qualitative analysis	. 12
		3.4.2	Thematic analysis	. 13
		3.4.3	Analysis framework	. 13
4	Res	ults		15
	4.1	Quanti	itative analysis	. 15
		4.1.1	Word Frequency Analysis	. 15
		4.1.2	Discourse Network Analysis	. 18

	4.2	Qualita	ative analysis	20			
		4.2.1	Scientific discourse	21			
		4.2.2	Media discourse	22			
		4.2.3	Comparative summary	23			
5	Disc	cussio	1	24			
	5.1	Framir	ng as a constitutive element of climate communication	24			
	5.2	Proble	matisation and the fragmentation of climate change	25			
	5.3	Domin	ance of the global environmental management discourse	25			
	5.4	Framir	ng uncertainty	26			
	5.5 Journalism's role: interpretation or transmission?						
	5.6	Summ	ary of findings and ways forward	27			
6	Con	clusio	n	28			
Pc	Popular science summary 3						
Aŗ	pene	dix		I			

List of Figures

3.1	PRISMA flow diagram of the screening and selection process	9
4.1	Word Frequency Analysis graph of the scientific paper abstracts	16
4.2	Word Frequency Analysis graph of the newspaper articles	16
4.3	Bigram Analysis network graph of the scientific paper abstracts	17
4.4	Bigram Analysis network graph of the newspaper articles (full translation list in	
	appendix, table 6.8)	17
4.5	Discourse Network Analysis graph of the abstracts of the scientific papers	19
4.6	Discourse Network Analysis graph of the newspaper articles	20

List of Tables

3.1	Thematic analysis approach after Clarke and Braun 2013
6.1	Reasons for exclusion
6.2	Custom stop words English.
6.3	Custom stop words German.
6.4	Table of twenty most frequent words in analysed scientific paper abstracts XI
6.5	Table of twenty most frequent words with translation in analysed newspaper
	articles
6.6	Table of twenty most frequent words in analysed scientific paper abstracts XIII
6.7	Table of twenty most frequent bigrams with translation in analysed newspaper
	articles
6.8	Translation table of words appearing in Fig. 4.6 and 4.4

Abbreviations

|--|

- **PRISMA** Preferred Reporting Items for Systematic reviews and Meta-Analyses
- **WFA** Word Frequency Analysis
- **BFA** Bigram Frequency Analysis
- **DNA** Discourse Network Analysis
- CC Climate Change

1 Introduction

One of the most urgent crises of our time is anthropogenic Climate Change (CC). Ecosystems, economies, and human welfare are all profoundly affected. Effects like increasing temperatures, changing precipitation patterns, and an increase in the frequency of extreme events are putting social and political systems under stress in addition to endangering food security and biodiversity (Calvin et al. 2023). It is therefore crucial to communicate climate change science effectively to influence public opinion, direct policy choices, and promote group action (Polk and Diver 2020; Lewandowsky, Gignac, and Oberauer 2013). The idea of framing, which Entman (1993) defines as the process of identifying causes, characterising issues, rendering moral judgements, and proposing solutions, is essential to effective communication (Polk and Diver 2020). Framing shapes how audiences understand information by highlighting some parts of a complicated issue while de-emphasising others. According to Yang and Hobbs (2020), framing is inevitable in science communication because choosing and arranging narratives to direct understanding is a necessary step in the simplification of vast volumes of data. Additionally, Badullovich et al. (2020) pick up Entman (1993)'s definition of framing as four essential purposes of frames in climate communication ("identifying causes", "defining issues", "making moral judgements", and "suggesting remedies") and that the choices regarding the framing have a significant impact on public support for climate solutions.

Framing is used in both scientific publications and media articles, but they frequently do so in different ways. Due to domain-specific standards and communication objectives, these two distinct communication channels may utilise the same frame while employing different communication devices or selecting varying contexts within that frame. The style of peer-reviewed journals on the one hand is usually evidence-based and emphasises methodological accuracy, quantified forms of uncertainty, and knowledge accumulation. Uncertainty frames, as defined by Gustafson and Rice (2019), are frequently present to indicate the boundaries of existing knowledge and the need for additional study. The process through which researchers define the issue of climate change, determining which aspects to emphasise and which to downplay, also influences subsequent framing. Research on problem framing indicates that hastily formulated research problems have an inclination to not consider all stakeholders and to not have the space to consider social and political aspects (Rai 2017). Furthermore, there are cognitive biases, like fragmenting bigger problems into solvable sub-problems or using familiar methods, that also steer the problem framing towards staying on known paths (Borgert, Wise, and Becker 2015). Media texts, on the other hand, usually use narrative structures, first-person accounts, or localised case studies to emotionally connect with readers and give abstract ideas a concrete form (Nisbet and Mooney 2007; Chong and Druckmann 2007). While this narrative approach can broaden reach and foster engagement, it may also simplify or omit technical warnings, thereby potentially introducing

new misunderstandings. Media discourse is a key channel for disseminating knowledge and influencing public opinion and scientific discourse is an essential component of knowledge generation. Examining the framings in both channels helps in determining not only where meaning might be lost or changed during translation but also how these framings may affect public perception, participation, and, in the end, climate-change related decision-making.

1.1 Problem statement

While a growing body of literature has explored how framing strategies function within each domain separately (e.g., Yang and Hobbs 2020; Gustafson and Rice 2019), there is limited research that directly compares how climate change is framed in scientific literature versus in media coverage. Scientific publications generate and validate findings, while journalistic outlets act as mediators that translate, simplify, or sometimes reframe that knowledge for broader audiences. Misalignments between these framings can significantly affect public understanding, particularly if key uncertainties, assumptions, or nuances are lost in translation. At the same time, the use of divergent frames may also reflect different communicative goals and audience expectations. Understanding how climate change is represented in these two influential discursive contexts is essential for identifying gaps, misunderstandings, or opportunities for more effective communication.

This study addresses these gaps by examining how climate change is framed in scientific papers published in *Nature* and *Nature Climate Change*, and comparing them to articles from the *Süddeutsche Zeitung*, a major German newspaper, over the same period of time. By analysing both the scientific and journalistic construction of climate change, the thesis aims to deepen our understanding of how climate narratives are built and how they shape public discourse.

1.2 Research question and objectives

The central research question guiding this thesis is:

What dominant framing strategies regarding climate change emerge in natural science papers published in Nature and Nature Climate Change (2022–2024), and how do they compare to those in Süddeutsche Zeitung published in June and December from 2022 to 2024?

To address this question, the study has four objectives:

- 1. Identify and categorize dominant frames in both scientific and journalistic texts, drawing on Entman's (1993) functions of framing and Gustafson and Rice's (2019) uncertainty typology.
- 2. Compare framing patterns across domains, highlighting convergences and divergences in problem definitions, underlying assumptions, and proposed remedies.
- 3. Examine the translation of scientific concepts, such as uncertainty, attribution, and mitigation pathways, into media narratives, with reference to Chong and Druckmann's

(2007) and Badullovich et al.'s (2020) framing analysis methodologies.

4. Discuss the implications of these framing patterns for public understanding and engagement, considering how narrative, moral, and equity-based frames (Nisbet and Mooney 2007) may be under- or over-represented.

1.3 Significance and contribution of the study

By carrying out a systematic comparison of framing in scientific versus media discourse, this thesis fills a critical gap in climate communication research. By offering a way to better understand where framing aligns or conflicts, this study will enable scientists, journalists, educators, and policymakers to arrive at more coherent strategies that bridge scientific complexity and public comprehension. Furthermore, by identifying opportunities to integrate frames, such as those centred on climate justice, intersectionality, and equity, this work contributes to the broader effort of developing more inclusive and effective climate communication practices (Angermuller 2015; Nisbet and Mooney 2007).

2 Theoretical framework

This chapter outlines the theoretical background for analysing how climate change is communicated in scientific and journalistic texts. This study is grounded in discourse analysis, which treats language not simply as a vector for facts but as an active practice that constructs social reality (Angermuller 2015). Under this umbrella, two specific approaches, framing analysis and problematisation theory, provide methodological tools for examining how communicators select, emphasise, and organize particular aspects of climate change.

2.1 Discourse analysis as an umbrella approach

Discourse analysis investigates the ways in which social realities are constructed through communicative practices (Angermuller 2015). From this perspective, both scientific papers and newspaper articles are seen as sites where climate change is not merely described but actively shaped into particular problem–solution narratives. By focusing on patterns of language, recurring metaphors, and the interplay of genres, discourse analysis reveals how specific interpretations of climate change gain authority while others remain invisible.

2.2 Framing analysis

Framing analysis, as a branch of discourse analysis, focuses on how communicators strategically emphasise certain aspects of an issue in order to shape how it is understood. Rather than simply transporting information, texts construct meaning by selecting which problems to highlight, which causes to assign, which values to evoke, and which solutions to propose. As Entman (1993) defines it, framing involves "selection and salience" (p.52): drawing attention to specific features of a situation in order to guide interpretation. In this sense, framing is not a neutral act, but a rhetorical and political tool embedded in every act of communication.

In this thesis, I apply framing analysis to uncover how both scientific and journalistic texts construct climate change through different configurations of attention, relevance, and suggested action. To do so, I draw on a range of framing typologies and approaches that have proven particularly relevant to environmental communication. Firstly, Badullovich et al. (2020) identify four key framing functions, defining the problem, diagnosing causes, making moral judgments, and proposing remedies, each of which I used as a reference point when analysing how climate change is made meaningful across genres. Secondly, central to this analysis is the role of uncertainty, a recurring theme in scientific discourse. Gustafson and Rice (2019) distinguish between different ways of framing uncertainty: ranging from "deficient" uncertainty (highlighting

a lack of knowledge) to "technical" or "scientific" uncertainty, which normalises uncertainty as a feature of the scientific process. These distinctions proved particularly useful for identifying how scientific texts maintain epistemic credibility, and how media representations of science might shift that balance. Thirdly, another form of framing is how information is delivered. Yang and Hobbs (2020) contrast logical-scientific with narrative framings, noting that while the former appeals to analytical reasoning, the latter tends to foster emotional connection and engagement. This distinction surfaced repeatedly in my comparison of scientific papers and media articles, with journalistic texts often incorporating storytelling/narrative elements to make climate impacts more tangible. Such differences raise important questions about accessibility, accuracy, and public engagement. Finally, I considered broader thematic frames such as those identified by Nisbet and Mooney (2007), who point to narratives like economic development, public accountability, or social progress. While such value-based frames are rarely foregrounded in scientific texts, they occasionally surface in journalistic accounts, often in the context of national policy or individual action. Their presence - or absence - can significantly shape how the public perceives both the urgency and the feasibility of climate action.

2.3 Problematisation theory

Problematisation theory, another branch within discourse analysis, examines how complex phenomena are carved into more bounded, actionable "problems". Carol Bacchi's "What's the Problem Represented to Be?" (WPR) approach provides guiding questions to uncover the assumptions hidden in problem representations, the voices foregrounded, and the solutions rendered thinkable or unthinkable (Bacchi 2012). By asking what is defined as the problem, what presuppositions underlie that definition, and what is left unproblematic, WPR makes the politics embedded in discourse visible. Adger et al. (2001) distinguish two globally dominant environmental discourses: global environmental management, which emphasises technical and policy fixes, and prodigality, which critiques overconsumption and structural inequity. I have mapped my coding schema onto this distinction, tagging instances where texts foreground data-driven, managerial framings versus those invoking broader critiques of social or economic systems. This has allowed me to track not only whether a text engages in critique but also how frequently and under what conditions these discursive orientations appear. Collier and Cox (2021) demonstrate how urban resilience discourse fragments climate change into discrete policy arenas, such as insurance systems or infrastructure planning, each of which channels climate governance into a particular mode of intervention. They base their comprehension of problematisation on Callon's (2009) definition of the concept but expand it to the particular context of urban resilience. Guided by Collier and Cox's (2021) work, I looked for similar discursive "fragmenting" within the analysed literature, identifying where scientific and journalistic texts isolate specific climate-related phenomena (e.g., marine heatwaves, biodiversity loss) and pair them with targeted responses. This lens of problematisation helped me trace how climate change is rendered governable through segmentation and what consequences such fragmentation might have for public understanding. Finally, Alvesson and Sandberg (2011) remind researchers that the very act of formulating a research question is itself a form of problematisation. I took this

insight to critically reflect on my framing choices, particularly those that shaped text selection, coding priorities, and the boundaries of comparison (see section 3.2).

2.4 Integrated approach

By situating both framing and problematisation within the broader tradition of discourse analysis, I applied an integrated analytical model that reflects the complexity of climate change communication and supports a layered reading of the texts.

- 1. Discourse analysis (Angermuller 2015) offers a macro-level lens that sensitises me to the ways in which language, genre, and context construct climate change as a particular kind of social reality.
- 2. Framing analysis (Entmann 1993; Chong and Druckmann 2007; Badullovich et al. 2020) provides me with a set of tools to identify which aspects of climate change are emphasised alongside with formulated frames such as uncertainty types (Gustafson and Rice 2019) and narrative vs. technical structures (Yang and Hobbs 2020).
- 3. Problematisation theory (Bacchi 2012; Adger et al. 2001; Collier and Cox 2021; Alvesson and Sandberg 2011) enables me to explore how climate change is segmented into manageable sub-problems, and to expose the assumptions and silences that underpin these representations.

In the analysis framework outlined in Chapter 3, I operationalise this approach through a structured application of Bacchi's WPR chart, coding for Adger et al. (2001)'s discourse categories, and identifying instances of Collier and Cox (2021)'s problematisation logic. Through this approach I move between the structural and the granular, tracing how climate change is constructed across domains and how those constructions shape meaning and the perceived scope of action.

3 Material & methods

This chapter outlines the methodologies employed for data collection, analysis, and interpretation in this thesis to address the research question: "What dominant framing strategies regarding climate change emerge in natural science papers published in *Nature* and *Nature Climate Change* (2022–2024), and how do they compare to those in *Süddeutsche Zeitung* articles published in June and December from 2022 to 2024?". The primary approach employed was a systematic literature review. A combination of quantitative and qualitative methods was employed to analyse the data. The abstracts of all papers in the literature review, along with the complete newspaper articles, were analysed using Word Frequency Analysis (WFA), Bigram Frequency Analysis (BFA), and Discourse Network Analysis (DNA). Following the identification of trends through quantitative analysis, six papers and ten articles were selected for qualitative examination using thematic analysis. This approach aimed to further contrast the observed trends and develop a thematic framework for interpreting and contextualising the identified patterns.

3.1 Literature review

This thesis adheres to the standards outlined in the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) checklist (Page et al. 2021). The dataset includes abstracts, introductions, and conclusions of scientific research papers, where framing is prominently observed, along with complete newspaper articles. The scientific papers were obtained from the Scopus and Web of Science Core Collection (WOS CC) platforms. The search results were exported on February 12, 2025. The newspaper articles were obtained from the archive of *Süddeutsche Zeitung* and exported on March 12, 2025.

3.1.1 Inclusion criteria

To examine the framing of climate change in scientific and journalistic discourse, I chose two significant domains: high-impact natural science journals and mainstream national print media. The objective was to compile publications that significantly impact expert and public perceptions of anthropogenic climate change. For the scientific corpus, I utilised the WOS CC and Scopus databases. I applied the search term "climate change" in both databases, employing the subject function in WOS CC and the "Title, Abstract, Keywords" search section in Scopus. The topic function in WOS CC retrieves records in which the search term is present in the title, abstract, author keywords, or *Keywords Plus* (a WOS-specific feature that generates index terms from the titles of cited articles), thereby ensuring that the selected documents maintain a distinct thematic focus on the subject. I included only review papers, as they are highly cited and

provide comprehensive overviews of current knowledge, thereby excluding shorter and largely methodological studies, which helped to reduce dataset noise. Furthermore, the source titles were limited to Nature and Nature Climate Change because their publications are well-regarded in the natural sciences and acknowledged for their contributions to climate-related research. I restricted the time span to 2022-2024 to concentrate on current trends in climate discourse and facilitate a concurrent comparison with the media texts. Preliminary trials with expanded journal inclusion, such as integrating Science or eliminating source limits entirely, were either very broad for the confines of a master's thesis or, conversely, too restrictive when solely applying disciplinary filters. These modifications finally validated that concentrating on Nature and Nature Climate Change facilitated a manageable, suitable, and representative corpus. The corpus comprised 28 scientific papers. As for the journalistic corpus: I collected articles from the science section of the Süddeutsche Zeitung utilising the tag climate change ("Klimawandel") to ensure thematic relevance. The selection of the Süddeutsche Zeitung was influenced by three primary factors. As a German citizen, I hold the most expertise in the German newspaper landscape and can provide substantial insights in this context. Furthermore, as of 2024, Süddeutsche Zeitung held the second-highest daily circulation among all German newspapers (Statista and IVW e.V. 2025), indicating a broad and stable readership. Thirdly, the Süddeutsche Zeitung is renowned for its quality journalism and an intellectual readership. Germany's highest-circulating publication, Bild Zeitung, is a tabloid. Due to their sensationalist tone, brevity, and inconsistent engagement with scientific content, factors that would have hindered comparability with scientific texts, I chose to exclude tabloids from the study. The readership of the Süddeutsche Zeitung is often politically moderate to centre-left, urban, and somewhat well-educated, aligning with traits associated with more engagement in climate change discourse (Snyder et al. 2014; Czarnek, Kossowska, and Szwed 2021). By selecting this source, I aimed to illustrate the presentation of climate science to an audience more predisposed to engage with environmental problems through print media. June and December were chosen, as December often features numerous articles that reflect on the year's weather and contextualise it within climate change. In contrast, June was designated as the focal point for equidistant releases throughout the year. The corpus of newspaper articles contained 63 contributions. The dual source selection facilitated a focused yet substantial comparison of how expert and mainstream public discourses impact climate change perception.

3.1.2 Exclusions

Both scientific papers and newspaper articles entailed exclusions. Thirteen scientific papers/ contributions retrieved in the search results from the data banks were excluded from the analysis. The exclusions were due to ten papers not being classified as natural science, two due to not addressing anthropogenic climate change, and one result being a newspaper article rather than a scientific paper. Two entries from the *Süddeutsche Zeitung* archive were not analysed: one was a newsletter announcement, and the other was an overview page for publications regarding climate change by the newspaper. The appendix contains a list of the excluded contributions.

3.1.3 Documentation and reporting

Data was compiled in spreadsheets, utilising a colour-coding system alongside a remark system for organisation. Criteria for organisation encompassed the exclusion of data or its presence across multiple platforms. The analysis conducted using R Statistical Software (v4.3.0, R Core Team 2021) was recorded in scripts and described in depth in this thesis. Figure 3.1 presents a PRISMA flow diagram illustrating the selection process of the included studies as previously elaborated.



Figure 3.1: PRISMA flow diagram of the screening and selection process. This figure was created using the Shiny application by Haddaway et al (2022).

3.2 Reflexivity and role of the researcher

Regardless of the research type, the researcher is not, as it is sometimes thought of, an objective subject. In contrast, researchers systematically and intentionally direct the interpretive process in various ways. Ensuring the transparency and integrity of research requires recognising the influence of positionality, disciplinary background, and interpretative choices. I integrated this into my research via four reflective approaches: narrative autobiography, collaborative reflection, methodological reflexivity, and contextual engagement.

As my academic background is in natural sciences, scientific research and evidence-based reasoning have significantly shaped my understanding of climate change. Furthermore, through my political engagement, I have encountered various perspectives in civic and activist environments, ranging from vehement endorsement of science to critical scepticism as well as diverse interpretations of effective climate action. These experiences fostered my interest in the management and communication of scientific knowledge within the public sphere. Two questions specifically captured my attention: what factors contribute to the success of certain narratives while others remain unpopular, and, how framing influences public understanding of scientific issues, such as climate change. This thesis was developed under collaborative supervision. Frequent interactions with my supervisor and fellow master's students enabled me to contemplate the project's direction, address methodological uncertainties, and engage in discussions regarding theory, analysis, and positionality. These discussions frequently challenged my assumptions and provided new perspectives on framing analysis and the role of language in knowledge formation. This group environment enhanced my analytical framework and fostered more theoretical and empirical precision.

Maintaining transparency on my decisions and their underlying rationale facilitated the integration of methodological reflexivity throughout the study process. For example, when considering journal influence, relevance, and scope, it was thought prudent to limit the scientific sample to *Nature* and *Nature Climate Change*. Selecting *Süddeutsche Zeitung* as the journalistic counterpart ensured a level of discursive intricacy and reader engagement that would not have been attainable with a tabloid source. Recognising the interpretive nature of frame identification, I documented my coding process in a methodical and replicable fashion. While typologies and theoretical frameworks guided the research, I recognised that categorising and interpreting problem representations inevitably involved subjective interpretation.

Throughout my thesis, my engagement with the research environment deepened significantly. While my education provided me with the conventions and standards of scientific texts, addressing climate communication through a social science lens required me to adapt to new theoretical vocabularies and analytical approaches. As natural science curricula typically exclude discourse analysis, framing theory, or problematisation - to employ these frameworks meant shifting my reading approach from focussing on mere factual accuracy to focussing on meaning construction, rhetorical function, and the establishment of authority. This approach resulted in a shift of perspective: recognising that scientific and journalistic publications not only depict climate change but also actively shape the understanding and response to it.

My background in scientific education and political activism has influenced my methodology and

interpretative choices in this analysis. As a natural science student, my study of science literature prepared me with a thorough understanding of the conventions and standards of scientific texts. Engaging with framing analysis and discourse theory in the context of this thesis provided me with the tools necessary to critically examine these patterns, leading to a nuanced understanding of the discursive construction of climate change in scientific and media contexts.

3.3 Quantitative analysis

The quantitative study aimed at improving my understanding of the large body of contributions and guided the subsequent qualitative analysis. It laid the groundwork for identifying trends, directing the selection of materials for the qualitative analysis, and contextualising individual texts within larger discourses.

3.3.1 Word Frequency Analysis

I conducted a Word Frequency Analysis using the *tidytext* package (Silge and Robinson 2016), version 0.4.2, in R Statistical Software. This analysis quantified the frequency of individual words within the given dataset. I transformed all the words in the analysed abstracts and articles to lowercase and segmented them into individual tokens. Subsequently, I eliminated common stop words. Stop words are terms that hold minimal significance in identifying documents that align with a users need (Manning, Raghavan, and Schütze 2008); thus, in the context of this thesis, they refer to words that are irrelevant to the discourse on anthropogenic climate change. I utilised *tidytext*'s *stop_words* lexicon to eliminate prevalent stop words from the English abstracts. For the German articles, I utilised the German stop word lexicon from the *stopwords* package (Benoit, Muhr, and Watanabe 2021), version 2.3, to eliminate common stop words, in addition to removing custom stop words (refer to tables 6.2 & 6.3 in the appendix). Finally, I calculated the frequency of words.

I also performed a Bigram Frequency Analysis with the *tidytext* package in R Statistical Software. Bigrams are pairs of adjacent words. The analysis measured the frequency of bigrams in the given dataset. Firstly, I divided the abstracts into consecutive word pairs. Secondly, to eliminate the stop words, I separated the tokens into individual words, removed the stop words using the same stop word lexicon as for the WFA, and then reassembled them as bigrams. I finally quantified the bigrams.

3.3.2 Discourse Network Analysis

Using the Louvain Clustering Algorithm, I carried out a Discourse Network Analysis. The Louvain Clustering Algorithm is based on optimizing modularity (Zhang et al. 2018). Modularity describes the quality of a community structure by comparing the number of edges within communities to the expected number of edges if the network were randomly connected. Edge weights describe the number of co-occurrences of two words. The algorithm maximises the modularity score, indicating a strong community structure. In the context of this study, this

means finding clusters of words that frequently appear together in contributions, allocating them into communities. Words in one community are likely to represent a common theme.

Before I applied the algorithm, I prepared the data. For that, I removed common and custom stop words as described in section 3.3.1. After that, I extracted co-occurring words. Co-occurring words refer to words that appear together in one abstract. After that, I created a network with words as nodes. Edges between nodes indicate which words frequently appear together.

Following the preparation, I used the Louvain Clustering Algorithm to identify key clusters. The algorithm assigns a community to each node in the network and then moves them to neighbouring communities to evaluate modularity gain. After assessing all nodes, the algorithm aggregates them into newly determined communities. This process is repeated until no further improvement of modularity can be achieved and the algorithm outputs the final community structure, where nodes within the same community are more densely connected than nodes in different communities.

3.4 Qualitative analysis

I conducted a qualitative analysis to gain deeper insights into the framing strategies used in the selected contributions. The scientific papers I examined had abstracts, introductions, and conclusions. I analysed newspaper articles and interviews based on the introductory and closing paragraphs or interview questions, respectively.

3.4.1 Selection process for qualitative analysis

Following the quantitative study, I selected data for qualitative analysis based on the insights gained. A clustering technique based on co-occurrence and network modularity identified three distinct communities within the corpus of scientific papers. Purposively selecting two papers from each community allowed me to ensure analytical depth and representativeness, resulting in a total of six scientific papers for qualitative research. Results from the WFA and BFA, which highlighted consistent lexical and thematic patterns across the dataset, supported the decision. These patterns gave me direction for identifying texts that reflected the framing tendencies common to each community identified in the DNA. In addition to numerical observations, the selection process was influenced by a deep understanding of the dataset gained through extensive interaction with the material. This knowledge enabled a deliberate selection of contributions that reflected the dataset's variety while also providing textual richness and discursive complexity.

A further selection of newspaper articles was made to include media depictions of scientific viewpoints in the research. Five papers on science and viewpoints were selected from relevant sections of the *Süddeutsche Zeitung* for each of the two communities. The first paragraph of each of these papers was examined to assess the media discourse's immediate framing strategies. This method ensured that both scientific and journalistic contributions were viewed through a consistent lens, allowing for a comprehensive comparison of framing techniques across multiple platforms.

3.4.2 Thematic analysis

I carried out a thematic analysis as described by Clarke and Braun 2013. This approach, as can be seen in table 3.1 entails six steps: First, I familiarised myself with the data. This was firstly done by screening the data and then by the quantitative analysis via WFA, BFA, and DNA, as well as the skimming of all abstracts of the scientific papers and the beginning (about 200 words) of the newspaper articles. I read the papers and articles for the qualitative analysis in full. Second, I generated initial codes through line-by-line coding and used the analysis framework to extract information of interest. Also, I made first connections to frames described in literature. Third, I searched for themes within the previously generated codes that describe the research question. The codes were then organised under the themes to gather the relevant data for each theme. These themes were preliminary and were reviewed in the fourth step. Questions that supported the review process were: Does the data support the themes? Is one theme trying to describe too much? Is there an overlap between different themes? Fifth, after reviewing the thematic framework was formulated, defining how themes and subthemes relate to one another. The sixth and last step was writing up the process and its results.

Step 1	Familiarise with data	
Step 2	Generate initial codes	
Step 3	Search for themes	
Step 4	Review themes	
Step 5	Define themes	
Step 6	Writing-up	

Table 3.1: Thematic analysis approach after Clarke and Braun 2013.

3.4.3 Analysis framework

I created an analytical framework to guide the thematic analysis by combining three complementary discourse-analytic tools: Bacchi's "What's the Problem Represented to Be?" (WPR) approach (Bacchi 2012), Adger et al.'s (2001) dual environmental discourses, and Collier and Cox's (2021) problematisation logic. This integrated model enabled me to systematically transition from the identification of surface-level frame elements in each text to the discovery of deeper assumptions and governance implications.

First, I used a changed version of Carol Bacchi's WPR chart (Bacchi 2012). Every scientific paper and newspaper article in the corpus were posed two fundamental questions: "What is represented to be the problem of climate change in this contribution?" and "What presuppositions underlie this representation?" In practical terms, this meant stressing language that characterises the issue, e.g. as "model uncertainty", "permafrost tipping points", or "human-wildlife conflict", and then following the implicit logic that renders that issue relevant. An article, for instance, might frame climate change mostly as a data-gap issue, which implies that more knowledge will automatically result in better action. I then superimposed Adger et al.'s (2001) typology of

environmental discourses on my WPR coding. Deciding for every case of problem definition and solution proposal whether it is in line with either the global environmental management discourse, where technical, policy-orientated solutions hold power, or the prodigality discourse, which emphasises criticisms of overconsumption and structural inequalities. Comparing the frequency and context of these alignments helped me to chart how texts provided managerial solutions, for instance, ensemble modelling or renewable-energy transitions, versus systemic critiques, for instance, challenging economic models or fossil-fuel dependency. Thirdly, I used Collier and Cox (2021) to find examples of problematisation as an approach of dividing the protean issue of climate change into smaller, actionable sub-problems. Here I sought textual proof of fragmenting: isolating one dimension of the crisis, such as "marine heatwaves" or "grid decarbonization", and then pairing it with a customised set of policy or technical interventions. This combined approach investigated the framing of climate change as both a problem and a site for potential solutions. Utilising the WPR approach, I analysed the issues each text chose to address and those that were omitted. Utilising the dual frame perspective proposed by Adger et al. (2001), I examined the fundamental assumptions underlying framing. Through Collier and Cox (2021)'s problematisation lens, I examined how the ungraspable climate crisis is made sense of.

4 Results

4.1 Quantitative analysis

This section presents the main findings from the three quantitative approaches: Word Frequency Analysis, Bigram Analysis, and Discourse Network Analysis. The analyses were conducted on two distinct datasets: scientific paper abstracts and news articles on climate change. The word frequencies, co-occurrences, and network structures were analysed to identify recurring themes and frames in academic and journalistic contexts.

4.1.1 Word Frequency Analysis

Figure 4.1 shows the most frequent words in the abstracts of the analysed scientific papers, for the full list with the exact frequency see Table 6.4 in the appendix. The two most frequent words, *climate* and *change*, underscore the central topic of the abstracts. Also high-ranking are *carbon* and *water*, indicating that greenhouse gas dynamics and water-related issues (e.g., drought, water security) are significant themes in the analysed scientific publications. The presence of *future*, *risk*, and, *uncertainty* points to a forward-looking orientation and acknowledges the challenges of predicting climate impacts.

Figure 4.2 shows the most frequent words in the analysed newspaper articles. The recurring term year (*jahr*, *jahren/jahre*) suggests frequent references to specific years or time spans, often tied to reporting on extreme weather events or policy deadlines. The high-ranking terms degree (*grad*) and *celsius* reflect a strong focus on temperature changes and thresholds in popular discourse. Germany (*deutschland*) and Europe (*europa*) indicate the interplay between national, continental, and global contexts in climate reporting, often linking local impacts to larger-scale phenomena.

The most common bigram (see Figure 4.3 and Table 6.6), highlighting the primary focus of these abstracts, is *climate change*. *Carbon dioxide*, *river water*, *water quality*, and *water markets* indicate a prevalence of carbon and water management topics. References to *antarctic ice*, *dryland productivity*, and *terrestrial ecosystem* suggest specialised research areas. Through the diverse topics in the analysed papers is indicated that climate change is studied across diverse geographical and ecological contexts.



Figure 4.1: Word Frequency Analysis graph of the scientific paper abstracts.



Figure 4.2: Word Frequency Analysis graph of the newspaper articles.

Degree celsius (*grad celsius*) and 1.5 degrees (1,5 grad) dominate the bigram list for the analysed newspaper articles (see Figure 4.4 and Table 6.7), pointing to a focus on temperature thresholds, possibly tied to global warming targets. Repeated mentions of particular years (*jahr 2023*, *jahr 2024*, *vergangenen jahr*) and timespans (*vergangenen jahren*, 20 *jahren*) highlight the event-driven, time-sensitive character of news reporting. References to high temperatures (*hohen temperaturen*) and marine heatwaves (*marine hitzewellen*) suggest reports on extreme climate events. Bigrams like fossil energies and renewable energies (*fossilen energien*, *erneuerbare energien*) indicate the influence of energy transition discussions on the media.



Figure 4.3: Bigram Analysis network graph of the scientific paper abstracts.



Figure 4.4: Bigram Analysis network graph of the newspaper articles (full translation list in appendix, table 6.8).

4.1.2 Discourse Network Analysis

Using Discourse Network Analysis, words were mapped into clusters and assigned to communities depending on their co-occurrence patterns. This brought out the semantic connections between words and helped find word communities that correspond to different discourses.

Figure 4.5 shows the graph for the DNA of the scientific paper abstracts. The analysis produced three discourse communities with edge weights between 5 and 20 co-occurrences. Terms like *assessments* and *evidence* in Community 1 stressed the systematic and evidence-based approach in scientific discourse. Building on this, *science* and *ecosystems* underline the scientific foundation of these debates, while the co-occurrence of *human*, *potential*, and *challenges* indicates a focus on human dimensions of climate change. Community 2 had several facets: words like *land* and *environmental* suggest framing climate change in ecological and resource terms. On the other hand, *effects* and *opportunities* indicate an analytical perspective that includes both risks and potential solutions or adaptations and *feedbacks* and *warming* point to a concern for interconnected processes. Words like *scale*, and *social* emphasise the multidimensional, societal significance of climate concerns. Community 3 focuses on conceptual or theoretical orientations, centring on *knowledge* and *viewpoint*. While *future* and *current* indicate temporal aspects, *carbon* and *systems* refer to fundamental climate processes. *Global* points to the planetary scope of these debates. Overall, these three communities exhibit a technical and analytical emphasis, with words centred on temporal scales, systems-based approaches, and methodological accuracy.

In Figure 4.6, you can see the graph for the DNA of the newspaper articles. Four discourse communities emerged with edge weights ranging from 20 to 35 co-occurrences. This suggests a higher co-occurrence of words in the articles than in the papers, which is likely due to the higher word count in the full articles in comparison to the abstracts of the papers (median word count 681 and 157, respectively). The Community 1 cluster indicates localised discussions about climate change (klimawandels) in Germany. The terms strong (stark) and year (jahr) refer to specific years marked by significant events or severe weather phenomena, which may highlight issues or policy changes at a national level. Community 2 has a diverse concentration; terms like university (universität) and scientist (wissenschaftler) indicate a discourse focused on academia or research. Air (luft), atmosphere (atmosphäre), and Earth (erde) denote planetary and environmental contexts. The term Europe (europa), combined with specific temporal indicators (2023, today (heute), indicates a focus on contemporary European contexts. Global warming (erderwärmung) and emissions (emissionen) raise concerns about greenhouse gases, indicating that Community 3 prioritises global issues, whereas humans (menschen) denotes a focus on human-centred perspectives. Water (*wasser*) appears as a recurring theme in climate discussions. The Community 4 cluster focuses on temperature measurements (degree (grad), celsius) and is closely related to the scientific assessment and characterisation of warming. The term end (ende) in this context may refer to discussions of potential tipping points or endpoints in climate scenarios. The four communities demonstrate the interconnectedness of German-language articles in local and national contexts (Community 1), broader European or research-focused discussions (Community 2), global issues (Community 3), and technical assessments of warming (Community 4).

Discourse Communities in Climate Change Abstracts



Figure 4.5: Discourse Network Analysis graph of the abstracts of the scientific papers.

Both media and scientific texts examine climate change from various perspectives; however, the analysis indicates that scientific abstracts are primarily orientated towards methodological and systems-focused themes, whereas articles encompass broader geographic, temporal, and policy-related debates.

Discourse Communities in Climate Change Articles



Figure 4.6: Discourse Network Analysis graph of the newspaper articles (full translation list in appendix, Table 6.8).

4.2 Qualitative analysis

This section of the study utilised qualitative discourse analysis on the contributions gathered within each community identified in the quantitative analysis. Using the analytical framework established in Chapter 3, I investigate the representation of climate change as a problem, proposed solutions, and the underlying assumptions that underpin these representations. I also explore the presence of the global environmental management and prodigality discourses as outlined by Adger et al. (2001), and assess whether the process of problematisation as defined by Collier and Cox (2012) is taking place.

The analysis was separated into two main types of discourses: scientific discourse in the form of scientific papers from *Nature* and *Nature Climate Change* and, media discourse in the form of newspaper articles from *Süddeutsche Zeitung*.

The analysis was structured by discourse, with each contribution assessed according to the following guiding questions:

- 1. What is the problem represented to be?
- 2. What is offered as a solution to that problem?
- 3. What underlying assumptions are made about the nature of the problem and the feasibility of the solution?
- 4. Which of Adger et al.(2001)'s discourse frames are present, if any?
- 5. Does the contribution engage in problematisation in the sense of dividing climate change into manageable, actionable sub-problems?

4.2.1 Scientific discourse

The first group of contributions is from the scientific discourse (see full list with numeration in the appendix). Within this, one community, focuses on model-centred and technical perspectives on climate change. These contributions tend to conceptualise climate change primarily as a problem of scientific uncertainty, insufficient modelling, or limited attribution capabilities. Paper 7 identifies inadequate robustness in climate mitigation scenarios as a critical issue. Increasing the ensemble size of model simulations is proposed to improve the accuracy of representing the spectrum of possible futures. This strategy assumes that improved scientific modelling will lead to better decision-making. The paper fits clearly within the global environmental management discourse identified by Adger et al. (2001), framing climate change as a technical challenge that can be solved with better tools. The problematisation process here is straightforward: a specific issue, in this instance model uncertainty, is carved out from the larger climate crisis and addressed through scientific optimization. A similar logic underpins Paper 20, which defines the problem as a failure to adequately attribute the phenomenon of "tropical Pacific surface warming pattern". The authors do not suggest political or structural solutions, but rather stress the need to refine the scientific methods used in attribution studies. The underlying assumption remains that climate change is primarily a knowledge problem, which implies that epistemic advances expected lead to more appropriate responses. Following this logic, Paper 5 characterises climate change as a problem of uncertain carbon feedback loops that connect terrestrial and oceanic systems and highlight the need for improved attribution models and high-quality data. These papers all align with the global environmental management discourse and reflect a strong faith in science and modelling as central tools in addressing climate change. Problematisation in this context is active and precise, but it remains confined to discrete and technical aspects of the broader climate issue. A different group of scientific papers provides a systems-orientated and multidisciplinary perspective. These papers are more openly concerned with societal processes and larger systems, while still being rooted in scientific discourse. For instance, Paper 8 uses a paleo viewpoint to investigate historical climate dynamics. They describe the problem as a lack of understanding about previous climatic feedbacks, which are necessary for comprehending current developments. The proposed approach is to improve synergy across scientific areas and disciplines. Problematisation happens here as it isolates the understanding of feedback as a distinct sub-problem. Paper 14 presents an interesting perspective on the challenges of decarbonising power systems. They describe the problem as one of insufficient institutional coordination and systemic rigidity, requiring multidisciplinary collaboration and transformation. This paper aims to bridge the gap between global environmental management and prodigality. While it acknowledges the need for changes in social and political systems, it ultimately relies on research.

4.2.2 Media discourse

The second major group is the journalistic discourse, which consists newspaper articles (see full list with numeration in the appendix). One subgroup within this discourse, which can be described as academically orientated climate journalism, combines science communication with journalistic storytelling. These articles often attempt to translate complex scientific findings for a broader audience. For example, the interview with climate scientist Helene Hewitt (Article 37) frames climate change as both a scientific and communicative issue. While the discussion centres on the scientific observation and simulation of climate phenomena, the article also highlights the challenge of public understanding and political inaction. The implied solution is not technical but communicative: improving the way climate science is communicated to the public. Problematisation is present in both the scientific and communicative layers of the issue. Article 25 on tipping points presents climate change as an increasingly urgent and potentially self-reinforcing crisis. The article warns that multiple ecological tipping points may soon be reached, urging action to set off positive tipping points in response. This viewpoint acknowledges the importance of scientific knowledge while also recognising the structural barriers to social change. This emphasises the importance of transformation in knowledge, production, consumption, and governance systems, drawing on elements of both global environmental management and prodigality discourses. This article effectively problematises the tipping point concept, emphasising the imminent risk of irreversible damage through both rhetorical and scientific approaches. Other articles within this community highlight specific events. Article 33 examines the increasing frequency of lightning strikes in the Alps, highlighting their role in exacerbating wildfires as an indirect effect of climate change. The paper effectively elucidates the relationship between extreme weather events and their ecological repercussions, despite not providing remedies. Article 40 similarly discusses the reduction of Arctic sea ice in September, presenting it as an inevitable seasonal change unless climate protection measures are enacted. This article demonstrates focused problematization by isolating a specific event and emphasising the importance of scientific estimation and International Panel on Climate Change findings. Variations in temperature, as described in Article 46, have an impact on the genetic diversity of European beech trees. The suggested ecological solution is to ensure long-term resilience by preserving biodiversity. This work humanises the scientific process by incorporating a personal narrative about a researcher, thereby enhancing the depth of the environmental issue presented. The article demonstrates the use of ecological sub-issues to articulate broader climate concerns, highlighting the evident problematisation.

A final journalistic sub-community is more observational and attribution-based. These articles typically report on specific studies with minimal editorial framing and little journalistic interpretation. For instance, Article 34 explains how the upper layers of the atmosphere are cooling while the lower layers are warming, emphasising satellite data limitations. The article stays close to the scientific content and implicitly emphasises the need for better data collection tools. Another article, Article 31, focuses on marine heatwaves, presenting them as isolated extreme events without offering a solution. Problematisation in this case follows Collier and Cox (2021)'s concept: an abstract challenge like climate change is split into discrete, observable issues like marine heatwaves. Article 62 on permafrost thawing offers a rare meta-level analysis of how the media portrays climate events. It challenges the widely held belief that permafrost melting is a single tipping point by highlighting the numerous thaw events and their varying effects. The article criticises the oversimplification of complex scientific knowledge while avoiding directly identifying human causes. The article acknowledges implicit and critical problematisation as discourse creation. Finally, Article 49 addresses a recent scientific debate: the unexpected acceleration of global warming since 2023, possibly due to a drop in low clouds. No definitive answers are provided; the problem is framed as a lack of scientific knowledge. The article clearly illustrates the global environmental management conversation, in which more knowledge leads to better governance.

4.2.3 Comparative summary

When comparing the two discourse communities, it is clear that both scientific and journalistic contributions portray climate change primarily as a technical or knowledge-based issue. In both cases, the key solution is to improve understanding - whether through modelling, data collection, or clear communication. This demonstrates how widespread the discussion about global environmental management is in both domains. Nevertheless, there are differences in how problems are approached and evaluated: scientific papers typically address very specified technical questions, whereas newspaper articles often provide a broader context for these issues, which can include emotional, narrative, or political aspects. Furthermore, scientific journalism occasionally discusses the structural, social, and communicative barriers to taking action. Sometimes articles address aspects of the prodigality debate. However, criticisms of the system are uncommon and frequently go unstated. Problematisation, in both communities, serves to break down the complex issue of climate change into smaller, more manageable chunks. While this may aid in planning and information dissemination to the public, what does it mean for how we represent and communicate the climate crisis's deeper political, social, and justice implications?

5 Discussion

This chapter aims to evaluate how scientific and journalistic discourse frames climate change and the implications these framings have for science communication. Drawing on theories of framing (Entmann 1993; Chong and Druckmann 2007; Badullovich et al. 2020), discourse analysis (Angermuller 2015), and problematisation (Adger et al. 2001; Bacchi 2012; Collier and Cox 2021), the following sections critically discuss the common discourse patterns, their implications for science communication and specifically climate communication, and their placement within the larger social and political context.

5.1 Framing as a constitutive element of climate communication

The results confirm the widely accepted view that framing is not only a rhetorical device but a vital aspect of how climate change is communicated and understood (Yang and Hobbs 2020; Badullovich et al. 2020; Entmann 1993). While ignoring structural causes or justice issues, both scientific publications and journalistic stories framed climate change by stressing particular elements over others: uncertainty, management issues, or particular environmental consequences were highlighted particularly often. Framing, according to Entman (1993), is a process that defines issues, diagnoses causes, passes moral judgements, and offers solutions. Throughout the examined content, these functions seemed inconsistent. Usually connected to information gaps or model uncertainties, the definition of the issue in scientific literature was found extensively in technical refinement. Journalistic publications, especially those in Community 2, generally showed more efforts to connect described issues to anthropogenic or policy shortcomings. Nevertheless, clear moral judgements or demands for justice were uncommon, the focus stayed on informing or describing instead of on mobilising or criticising. This supports Yang and Hobbs' (2020) finding that framing in science communication usually gives logical and scientific modes of communication priority over narrative ones. Both scientific and journalistic writings' underuse of narrative framing limits their capacity to emotionally involve readers or animate value-based thinking.

5.2 Problematisation and the fragmentation of climate change

According to Collier and Cox (2012) climate change cannot be presented as a single, coherent problem, due to its complexity and size. Therefore, it has to be "problematised": fragmented into smaller, more precisely definable problems that can be planned for and acted upon. Both scientific and media conversation applied this quite apparently. Scientific literature addressed climate change in separate sub-issues like mitigation scenario uncertainty (Paper 7), carbon cycle loops (Paper 5), or electric grid decarbonisation (Paper 14). Scientific papers often presented a fragmented sub-issue as stand-alone, fixable problems, thereby reinforcing a technocratic perspective. Problematisation also happened frequently in journalistic contributions. Studies on occurrence of marine heatwaves, permafrost thaw, or Arctic sea ice loss were described as confined episodes having separate effects. Although this helps understanding, it also runs the risk of omitting the interdependence of these problems and their shared causes in anthropogenic activity, socio-economic structures, and political inaction. The critique in Article 62 of the permafrost "tipping point" narrative demonstrates some awareness of this limitation, but such reflexivity was rare. This is problematic because these sub-frames can depoliticise the climate discourse (Wetts 2020). Dividing climate change into technical or environmental components helps to keep the political and economic systems fuelling this environmental crisis unquestioned. This fits the view that language builds social reality as well as reflects it, determining which issues are perceived as pressing and which solutions as feasible (Angermuller 2015).

5.3 Dominance of the global environmental management discourse

The framing patterns seen in scientific papers and newspaper articles correspond strongly to the global environmental management discourse outlined by Adger et al. (2001). Within this discourse, climate change is seen as a question of coordinating governance, data, and policies. Solutions are managerial and technocratic, focussing on improved models, predictions, and institutional collaboration. The majority of scientific contributions were shaped by this framing. Contributions that discussed larger socio-political issues or the structural drivers of climate change were rare. Journalistic contributions, especially in Community 4, frequently employed this lens writing about climate science without placing it in a broader context. Solutions stayed mostly within management language even in pieces that offered a more differentiated perspective, e.g., those on biodiversity or tipping points. Though certain articles suggested a larger change, like encouraging "positive tipping points" or institutional cooperation, the prodigality discourse noted by Adger et al. (2001), which criticises overconsumption and systematic inequality, was largely missing. Examining how the process of "problem formulation" favours particular viewpoints and modes of thought could help shed light on why technocratic solutions so strongly dominate both scientific and media framings. Research on problem framing, for example, indicates that rapidly defined problems tend to overlook various stakeholder interests and push social or political

aspects to the background, therefore guiding focus towards data-driven, technical solutions (Rai 2017). Cognitive biases, as for example anchoring on familiar methods or trading complexity for solvable sub-issues, can also reinforce this disproportionate support for technocratic solutions (Borgert, Wise, and Becker 2015). Furthermore, the high-paced scientific and journalistic workflows, which demand a fast iteration between defining a problem and suggesting a solution may discourage the deeper thought required to bring forth progressive or justice-orientated alternatives (Slawinski et al. 2023). Understanding and addressing these fundamental dynamics may facilitate a shift in climate communication in the media and science domains, directing it away from the current bias towards technocracy.

5.4 Framing uncertainty

Uncertainty played a prominent role in many of the frames identified. Applying the typology by Gustafson and Rice (2019), it was possible to distinguish different kinds of uncertainty framing across the analysed material. Scientific contributions frequently employ scientific and technical uncertainty frames: referring to model limitations, data gaps, or unknown feedbacks. This reflects the norm of epistemic caution in scientific writing but can inadvertently reinforce perceptions of inaction or doubt in broader public discourse. Journalistic contributions more commonly employed deficient uncertainty frames, particularly when referring to what scientists "still don't know", as in the case of unexplained warming trends or cloud feedback mechanisms. In some cases, such as in the tipping point article, consensus uncertainty appeared, especially in references to how poorly understood such concepts are among policymakers. While uncertainty framing is a natural feature of science communication, it also carries the risk of reducing public trust or delaying action. Framing climate change in terms of scientific uncertainty, as pointed out by Nisbet and Mooney (2007), could be misused by those trying to preserve the status quo - especially when isolated from moral or policy-orientated framing.

5.5 Journalism's role: interpretation or transmission?

The study shows a wide spectrum in how journalistic publications communicated scientific information. For instance, articles in Community 2 (which were allocated in the quantitative analysis) showed more interpretative framing: linking climate data to policy, social narratives, or larger consequences. By contrast, articles in Community 4 tended to reproduce scientific papers with minimal interpretation, taking on more of the function of transmitters than framers. This corresponds to a finding from Chong and Druckmann (2007) on the limited, but none the less, significant influence media frames have on public perception. It also fits to Badullovich et al.'s (2020) view that frames can help to improve communication. On the other hand, if journalistic framing is sparse or too technical, it might fail to engage readers or push current discursive limits. To contrast this, Article 46, in which personal storytelling and ecological framing coexist, shows how more narrative or human-centred journalism can help to communicate climate complexity in more easily accessible and emotionally resonant ways. However, such instances were few in

the dataset, supporting Yang and Hobbs's (2020) claim that narrative framing is still underused in scientific communication.

5.6 Summary of findings and ways forward

This study has shown that managerial and technocratic framings of climate change were typically employed in both, the analysed scientific papers and newspaper articles. The problem was often broken down into discrete, manageable issues, like data gaps, model uncertainties, or sector-specific risks, and presented as a matter of technical improvement and institutional coordination. Consistent with framing theory this fragmentation stressed certain aspects over others, influencing both by what it included and excluded. Expanding on this, climate communication in the analysed contributions prioritised technocratic solutions over emotional, value-based, or story framings, which have been shown to increase public participation and understanding (Yang and Hobbs 2020). Furthermore, justice, equality, and systemic critique discourses were very limited, contributing further to a lack of focus on the communities most affected by climate change (Tschötschel et al. 2025; Israel and Sachs 2013). To conclude, the analysed scientific and journalistic contributions were good at conveying complex and factual knowledge, but they failed to portray climate change as a moral or political issue requiring societal reform in an adequate extent.

Further research could expand upon these findings by, for example, increasing the sample size or comparing long-form journalism and comprehensive scientific publications, which could clarify the intricacy and framing in the climate change debate. Additionally, looking at how this conversation appears in other international media outlets may give a more comprehensive view. Furthermore, given their tendency to incorporate emotional, moral, or overtly political framings, activist discourse, policy documents, and social media communication may also provide insightful viewpoints and a more balanced discourse picture. Lastly, studying how under-represented frames, such as equity, intersectionality, and climate justice, are expressed and integrated into public and scientific climate communication can promote an inclusive discourse.

6 Conclusion

This thesis has demonstrated that, despite the technical sophistication and analytical depth found in both, scientific and journalistic climate communication, these discourses frequently lack the socially grounded and transformative framings needed to reflect the scale and urgency of the climate crisis. Closing this gap will require not only new content but also a rethinking of the discursive strategies that shape how climate change is defined, understood, and responded to. Rethinking the discursive techniques that influence how climate change is defined, perceived, and addressed is just as important as creating innovative material in order to bridge this gap. In the future, it might be valuable to rethink climate communication as a site for democratic dialogue and group meaning-making, as well as a way of exchanging perspectives shaped by subjective realities. This would result in a number of transformative changes in how we communicate about and tackle climate change: Passive transmission would have to give way to active participation, technical risk management to questions of justice, and fragmented problem definitions to systemic narratives. By doing this, climate discourse can start to play a more generative role, helping to resolve the crisis rather than just describing it.

Bibliography

- Adger, W. Neil et al. (2001). "Advancing a Political Ecology of Global Environmental Discourses". en. In: *Development and Change* 32.4. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1467-7660.00222, pp. 681–715. ISSN: 1467-7660. DOI: 10.1111/1467-7660.00222. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-7660.00222 (visited on 05/02/2025).
- Alvesson, Mats and Jörgen Sandberg (Apr. 2011). "Generating Research Questions Through Problematization". In: *Academy of Management Review* 36.2. Publisher: Academy of Management, pp. 247–271. ISSN: 0363-7425. DOI: 10.5465/amr.2009.0188.
- Angermuller, Johannes (2015). "Discourse Studies". In: *International Encyclopedia of the Social & Behavioral Sciences* 6, pp. 510–515. DOI: http://dx.doi.org/10.1016/B978-0-08-097086-8.03216-5.
- Bacchi, Carol (2012). "Why Study Problematizations? Making Politics Visible". en. In: *Open Journal of Political Science* 02.01, pp. 1–8. ISSN: 2164-0505, 2164-0513. DOI: 10.4236/ojps. 2012.21001. URL: http://www.scirp.org/journal/doi.aspx?DOI=10.4236/ojps.2012.21001 (visited on 04/04/2025).
- Badullovich, N., W. J. Grant, and R. M. Colvin (2020). "Framing climate change for effective communication: a systematic map". In: *Environmental Research Letters* 15.12. DOI: 10.1088/1748-9326/aba4c7.
- Benoit, Kenneth, David Muhr, and Kohei Watanabe (Oct. 2021). *stopwords: Multilingual Stopword Lists*. URL: https://cran.r-project.org/web/packages/stopwords/index.html (visited on 03/27/2025).
- Borgert, Christopher J., Kimberly Wise, and Richard A. Becker (Aug. 2015). "Modernizing problem formulation for risk assessment necessitates articulation of mode of action". In: *Regulatory Toxicology and Pharmacology* 72.3, pp. 538–551. ISSN: 0273-2300. DOI: 10.1016/j.yrtph.2015.04.018. URL: https://www.sciencedirect.com/science/article/pii/S0273230015000951 (visited on 05/14/2025).
- Callon, Michel (Apr. 2009). "Civilizing markets: Carbon trading between *in vitro* and *in vivo* experiments". In: *Accounting, Organizations and Society* 34.3, pp. 535–548. ISSN: 0361-3682. DOI: 10.1016/j.aos.2008.04.003. URL: https://www.sciencedirect.com/science/article/pii/S0361368208000317 (visited on 05/20/2025).
- Calvin, Katherine et al. (July 2023). IPCC, 2023: Climate Change 2023: Synthesis Report, Summary for Policymakers. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland. en. Tech. rep. Intergovernmental Panel on Climate Change, pp. 1–34. DOI: 10.59327/ipcc/ar6-9789291691647.001. URL: https://www.ipcc.ch/report/ar6/syr/ (visited on 05/01/2025).

- Chong, Dennis and James N. Druckmann (2007). "Framing Theory". In: *Annual Review of Political Science* 10:103-126. DOI: https://doi.org/10.1146/annurev.polisci.10.072805.103054.
- Clarke, Victoria and Virginia Braun (2013). "Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning". In: *Psychologist*.
- Collier, Stephen J. and Savannah Cox (Apr. 2021). "Governing urban resilience: Insurance and the problematization of climate change". In: *Economy and Society* 50.2. Publisher: Routledge _eprint: https://doi.org/10.1080/03085147.2021.1904621, pp. 275–296. ISSN: 0308-5147. DOI: 10.1080/03085147.2021.1904621. URL: https://doi.org/10.1080/03085147.2021.1904621 (visited on 04/07/2025).
- Czarnek, Gabriela, Ma Igorzata Kossowska, and Paulina Szwed (Jan. 2021). "Right-wing ideology reduces the effects of education on climate change beliefs in more developed countries". en. In: *Nature Climate Change* 11.1. Publisher: Nature Publishing Group, pp. 9–13. ISSN: 1758-6798. DOI: 10.1038/s41558-020-00930-6. URL: https://www.nature.com/articles/s41558-020-00930-6 (visited on 05/20/2025).
- Department, Statista Research and Informationsgemeinschaft zur Feststellung der Vorbereitung von Werbeträgern e.V. (Feb. 2025). Überregionale Tageszeitungen: Auflage 2024 — *Statista*. URL: https://de.statista.com/statistik/daten/studie/73448/umfrage/auflage-derueberregionalen-tageszeitungen/.
- Entmann, Robert M. (1993). "Framing: Toward clarification of a fractured paradigm". In: *Journal* of Communication 43.4, pp. 51–58. DOI: https://doi.org/10.1111/j.1460-2466.1993.tb01304.x.
- Gustafson, Abel and Ronald E. Rice (Dec. 2019). "The Effects of Uncertainty Frames in Three Science Communication Topics". en. In: *Science Communication* 41.6. Publisher: SAGE Publications Inc, pp. 679–706. ISSN: 1075-5470. DOI: 10.1177/1075547019870811. (Visited on 02/05/2025).
- Haddaway, Neal R. et al. (June 2022). "PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis". In: *Campbell Systematic Reviews* 18.2. Publisher: John Wiley & Sons, Ltd, e1230. ISSN: 1891-1803. DOI: 10.1002/cl2.1230.
- Israel, Andrei L. and Carolyn Sachs (2013). "A Climate for Feminist Intervention: Feminist Science Studies and Climate Change". en. In: *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*. Ed. by Margaret Alston and Kerri Whittenbury. Dordrecht: Springer Netherlands, pp. 33–51. ISBN: 978-94-007-5518-5. DOI: 10.1007/978-94-007-5518-5_3. URL: https://doi.org/10.1007/978-94-007-5518-5_3 (visited on 05/20/2025).
- Lewandowsky, Stephan, Gilles E. Gignac, and Klaus Oberauer (Oct. 2013). "The Role of Conspiracist Ideation and Worldviews in Predicting Rejection of Science". en. In: *PLOS ONE* 8.10. Publisher: Public Library of Science, e75637. ISSN: 1932-6203. DOI: 10.1371/ journal.pone.0075637. URL: https://journals.plos.org/plosone/article?id=10.1371/journal. pone.0075637 (visited on 05/01/2025).
- Manning, Christopher D., Prabhakar Raghavan, and Hinrich Schütze (2008). *Introduction to Information Retrieval*. Cambridge University Press. ISBN: 0521865719.
- Nisbet, Matthew C. and Chris Mooney (2007). "Framing Science". In: *Science* 316.5821, p. 56. DOI: https://doi.org/10.1126/science.1142030.

- Page, Matthew J. et al. (Mar. 2021). "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews". en. In: *BMJ* 372. Publisher: British Medical Journal Publishing Group Section: Research Methods & Reporting, n71. ISSN: 1756-1833. DOI: 10.1136/bmj.n71.
- Polk, Emily and Sibyl Diver (Feb. 2020). "Situating the Scientist: Creating Inclusive Science Communication Through Equity Framing and Environmental Justice". English. In: *Frontiers in Communication* 5. Publisher: Frontiers. ISSN: 2297-900X. DOI: 10.3389/fcomm.2020. 00006.
- R Core Team (2021). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Vienna, Austria. URL: https://www.R-project.org/.
- Rai, Arun (June 2017). "Editor's Comments: Avoiding Type III Errors: Formulating IS Research Problems that Matter". In: *Management Information Systems Quarterly* 41.2, pp. iii–vii. ISSN ISSN 0276-7783/ISSN 2162-9730. URL: https://aisel.aisnet.org/misq/vol41/iss2/2.
- Silge, Julia and David Robinson (2016). "tidytext: Text Mining and Analysis Using Tidy Data Principles in R". In: *Journal of Open Source Software* 1.3, p. 37. DOI: https://doi.org/10. 21105/joss.00037.
- Slawinski, Natalie et al. (June 2023). "Rapid problem formulation for Societal Impact: Lessons from a decade-long research-practice partnership". In: *Journal of Business Venturing Insights* 19, e00390. ISSN: 2352-6734. DOI: 10.1016/j.jbvi.2023.e00390. URL: https://www.sciencedirect.com/science/article/pii/S2352673423000197 (visited on 05/14/2025).
- Snyder, Steven et al. (May 2014). "City-Wide Collaborations for Urban Climate Education". en. In: *Geophysical Monograph Series*. Ed. by Diana Dalbotten, Gillian Roehrig, and Patrick Hamilton. 1st ed. Wiley, pp. 103–109. ISBN: 978-1-118-85430-3 978-1-118-85428-0. DOI: 10.1002/9781118854280.ch11. URL: https://agupubs.onlinelibrary.wiley.com/doi/10.1002/ 9781118854280.ch11 (visited on 05/20/2025).
- Tschötschel, Robin S. et al. (Jan. 2025). "Public Communication of Climate and Justice: A Scoping Review". In: *WIREs Climate Change* 16.1. Publisher: John Wiley & Sons, Ltd, e932. ISSN: 1757-7780. DOI: 10.1002/wcc.932. URL: https://wires.onlinelibrary.wiley.com/doi/10. 1002/wcc.932 (visited on 05/20/2025).
- Wetts, Rachel (Feb. 2020). "Models and Morals: Elite-Oriented and Value-Neutral Discourse Dominates American Organizations' Framings of Climate Change". In: *Social Forces* 98.3, pp. 1339–1369. ISSN: 0037-7732. DOI: 10.1093/sf/soz027. URL: https://doi.org/10.1093/sf/ soz027 (visited on 05/20/2025).
- Yang, Yang and Jill E. Hobbs (2020). "The Power of Stories: Narratives and Information Framing Effects in Science Communication". en. In: *American Journal of Agricultural Economics* 102.4. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/ajae.12078, pp. 1271–1296.
 ISSN: 1467-8276. DOI: 10.1002/ajae.12078. URL: https://onlinelibrary.wiley.com/doi/abs/10. 1002/ajae.12078 (visited on 02/05/2025).
- Zhang, Xiao et al. (Aug. 2018). "A Review of Community Detection Algorithms Based on Modularity Optimization". en. In: *Journal of Physics: Conference Series* 1069.1. Publisher: IOP Publishing, p. 012123. ISSN: 1742-6596. DOI: 10.1088/1742-6596/1069/1/012123. URL: https://dx.doi.org/10.1088/1742-6596/1069/1/012123.

Popular science summary

How is climate change communicated and what is left out in journalism and science? One of the most urgent issues of our time is climate change. Yet, how we discuss it and which aspects of the problem we emphasise or overlook influences how people perceive and react to the crisis. This thesis examines the framing of climate change in newspaper and scientific review articles and what this suggests about the broader impact of climate communication. The study used a mixed-methods design combining quantitative text analysis (word- and bigram frequencies, network clustering) with in-depth qualitative discourse and framing analysis. I examined recent contributions from one of Germany's major dailies (Süddeutsche Zeitung, June and December issues, 2022–2024) alongside review-paper abstracts from leading journals (Nature and *Nature Climate Change*, 2022–2024). After mapping common word clusters and thematic communities, I selected six scientific papers and ten newspaper articles for a close reading of how they define climate change as a problem, propose solutions, and reveal underlying assumptions. The findings indicate that both, scientific and journalistic texts, frame climate change in managerial and technocratic terms. In science papers, the crisis is fragmented into narrowly defined research problems, such as "carbon feedback loops" or "grid decarbonisation", and presented as solvable through better data, modelling, or policy coordination. The same is true for newspapers: concentrating on sub-issues like "marine heatwaves", "the reduction of Arctic sea ice", and "tipping points". While these frames are good at highlighting the complexity and sophistication of climate science, they often miss out on the social, emotional, and moral aspects and push issues of fairness, justice, and collective action aside. This is important to note because studies show that justice-orientated and narrative frames, that means stories that link people's values and experiences to climate solutions, can boost participation and support for needed changes. The way we talk about climate change at the moment, focussing primarily on technical solutions, might overlook chances to unite more people and encourage them to work together. So, the next time you come across a headline about extreme weather or carbon budgets, I invite you to pay attention to which parts are emphasised. Is the focus more on scientific facts or personal stories? Which viewpoints are missing? Reflecting on these questions can help you to engage more critically with climate news and maybe you even start to notice trends or patterns.

This thesis offers valuable insights for, especially, scientists, journalists, and communicators in the current climate communication and on how to create messages that educate and motivate people to take action. Effective communication can shift the discourse from fragmented challenges to cohesive narratives, from risk management to justice, and from passive information to active participation: enhancing discussions about climate change and inspiring people to take action.

Appendix

List of included papers

- Rising, J., Tedesco, M., Piontek, F. et al. The missing risks of climate change. Nature 610, 643–651 (2022). https://doi.org/10.1038/s41586-022-05243-6
- Tipaldo, J.F., Balk, D. & Hunter, L.M. A framework for ageing and health vulnerabilities in a changing climate. Nat. Clim. Chang. 14, 1125–1135 (2024). https://doi.org/10.1038/s41558-024-02156-2
- Li, L., Knapp, J.L.A., Lintern, A. et al. River water quality shaped by land–river connectivity in a changing climate. Nat. Clim. Chang. 14, 225–237 (2024). https://doi.org/10.1038/s41558-023-01923-x
- Stokes, C.R., Abram, N.J., Bentley, M.J. et al. Response of the East Antarctic Ice Sheet to past and future climate change. Nature 608, 275–286 (2022). https://doi.org/10.1038/s41586-022-04946-0
- 5. Regnier, P., Resplandy, L., Najjar, R.G. et al. The land-to-ocean loops of the global carbon cycle. Nature 603, 401–410 (2022). https://doi.org/10.1038/s41586-021-04339-9
- Wang, L., Jiao, W., MacBean, N. et al. Dryland productivity under a changing climate. Nat. Clim. Chang. 12, 981–994 (2022). https://doi.org/10.1038/s41558-022-01499-y
- Guivarch, C., Le Gallic, T., Bauer, N. et al. Using large ensembles of climate change mitigation scenarios for robust insights. Nat. Clim. Chang. 12, 428–435 (2022). https://doi.org/10.1038/s41558-022-01349-x
- Kaufman, D.S., Broadman, E. Revisiting the Holocene global temperature conundrum. Nature 614, 425–435 (2023). https://doi.org/10.1038/s41586-022-05536-w
- Abrahms, B., Carter, N.H., Clark-Wolf, T.J. et al. Climate change as a global amplifier of human–wildlife conflict. Nat. Clim. Chang. 13, 224–234 (2023). https://doi.org/10.1038/s41558-023-01608-5
- Tsui, J.LH., Pena, R.E., Moir, M. et al. Impacts of climate change-related human migration on infectious diseases. Nat. Clim. Chang. 14, 793–802 (2024). https://doi.org/10.1038/s41558-024-02078-z

- Urban, M.C., Alberti, M., De Meester, L. et al. Interactions between climate change and urbanization will shape the future of biodiversity. Nat. Clim. Chang. 14, 436–447 (2024). https://doi.org/10.1038/s41558-024-01996-2
- Willing, C.E., Pellitier, P.T., Van Nuland, M.E. et al. A risk assessment framework for the future of forest microbiomes in a changing climate. Nat. Clim. Chang. 14, 448–461 (2024). https://doi.org/10.1038/s41558-024-02000-7
- Bruno, E.M., Jessoe, K. Designing water markets for climate change adaptation. Nat. Clim. Chang. 14, 331–339 (2024). https://doi.org/10.1038/s41558-024-01964-w
- Xie, L., Majumder, S., Huang, T. et al. The role of electric grid research in addressing climate change. Nat. Clim. Chang. 14, 909–915 (2024). https://doi.org/10.1038/s41558-024-02092-1
- Kopp, R.E., Gilmore, E.A., Shwom, R.L. et al. 'Tipping points' confuse and can distract from urgent climate action. Nat. Clim. Chang. 15, 29–36 (2025). https://doi.org/10.1038/s41558-024-02196-8
- Solecki, W., Roberts, D. & Seto, K.C. Strategies to improve the impact of the IPCC Special Report on Climate Change and Cities. Nat. Clim. Chang. 14, 685–691 (2024). https://doi.org/10.1038/s41558-024-02060-9
- Dietze, M., White, E.P., Abeyta, A. et al. Near-term ecological forecasting for climate change action. Nat. Clim. Chang. 14, 1236–1244 (2024). https://doi.org/10.1038/s41558-024-02182-0
- Sietsma, A.J., Ford, J.D. & Minx, J.C. The next generation of machine learning for tracking adaptation texts. Nat. Clim. Chang. 14, 31–39 (2024). https://doi.org/10.1038/s41558-023-01890-3
- Burgess, M.G., Van Boven, L., Wagner, G. et al. Supply, demand and polarization challenges facing US climate policies. Nat. Clim. Chang. 14, 134–142 (2024). https://doi.org/10.1038/s41558-023-01906-y
- Watanabe, M., Kang, S.M., Collins, M. et al. Possible shift in controls of the tropical Pacific surface warming pattern. Nature 630, 315–324 (2024). https://doi.org/10.1038/s41586-024-07452-7
- Nitzbon, J., Schneider von Deimling, T., Aliyeva, M. et al. No respite from permafrost-thaw impacts in the absence of a global tipping point. Nat. Clim. Chang. 14, 573–585 (2024). https://doi.org/10.1038/s41558-024-02011-4
- Kopp, R.E., Oppenheimer, M., O'Reilly, J.L. et al. Communicating future sea-level rise uncertainty and ambiguity to assessment users. Nat. Clim. Chang. 13, 648–660 (2023). https://doi.org/10.1038/s41558-023-01691-8

- Vidal, F., van der Marel, E.R., Kerr, R.W.F. et al. Designing a circular carbon and plastics economy for a sustainable future. Nature 626, 45–57 (2024). https://doi.org/10.1038/s41586-023-06939-z
- 24. Taufique, K.M.R., Nielsen, K.S., Dietz, T. et al. Revisiting the promise of carbon labelling. Nat. Clim. Chang. 12, 132–140 (2022). https://doi.org/10.1038/s41558-021-01271-8
- 25. Vogt, E.T.C., Weckhuysen, B.M. The refinery of the future. Nature 629, 295–306 (2024). https://doi.org/10.1038/s41586-024-07322-2
- Hudiburg, T., Mathias, J., Bartowitz, K. et al. Terrestrial carbon dynamics in an era of increasing wildfire. Nat. Clim. Chang. 13, 1306–1316 (2023). https://doi.org/10.1038/s41558-023-01881-4
- 27. Creutzig, F., Simoes, S.G., Leipold, S. et al. Demand-side strategies key for mitigating material impacts of energy transitions. Nat. Clim. Chang. 14, 561–572 (2024). https://doi.org/10.1038/s41558-024-02016-z

List of excluded papers

- Prentice, C.M., Vergunst, F., Minor, K. et al. Education outcomes in the era of global climate change. Nat. Clim. Chang. 14, 214–224 (2024). https://doi.org/10.1038/s41558-024-01945-z
- 2. Rudge, K. Leveraging critical race theory to produce equitable climate change adaptation. Nat. Clim. Chang. 13, 623–631 (2023). https://doi.org/10.1038/s41558-023-01690-9
- Murunga, M., Macleod, C. & Pecl, G. Assumptions and contradictions shape public engagement on climate change. Nat. Clim. Chang. 14, 126–133 (2024). https://doi.org/10.1038/s41558-023-01904-0
- 4. Nielsen, K.S., Cologna, V., Bauer, J.M. et al. Realizing the full potential of behavioural science for climate change mitigation. Nat. Clim. Chang. 14, 322–330 (2024). https://doi.org/10.1038/s41558-024-01951-1
- 5. Boon-Falleur, M., Grandin, A., Baumard, N. et al. Leveraging social cognition to promote effective climate change mitigation. Nat. Clim. Chang. 12, 332–338 (2022). https://doi.org/10.1038/s41558-022-01312-w
- 6. Müller, R.D., Mather, B., Dutkiewicz, A. et al. Evolution of Earth's tectonic carbon conveyor belt. Nature 605, 629–639 (2022). https://doi.org/10.1038/s41586-022-04420-x
- Alemseged, Z. Reappraising the palaeobiology of Australopithecus. Nature 617, 45–54 (2023). https://doi.org/10.1038/s41586-023-05957-1

- Robinson, Sa., Roberts, J.T., Weikmans, R. et al. Vulnerability-based allocations in loss and damage finance. Nat. Clim. Chang. 13, 1055–1062 (2023). https://doi.org/10.1038/s41558-023-01809-y
- Crandon, T.J., Scott, J.G., Charlson, F.J. et al. A social–ecological perspective on climate anxiety in children and adolescents. Nat. Clim. Chang. 12, 123–131 (2022). https://doi.org/10.1038/s41558-021-01251-y
- 10. Stott, P.. Kyoto review: 'thrilling' play shows fight for landmark climate treaty. Nature 631, 499-500 (2024). doi: https://doi.org/10.1038/d41586-024-02251-6.
- 11. Fankhauser, S., Smith, S.M., Allen, M. et al. The meaning of net zero and how to get it right. Nat. Clim. Chang. 12, 15–21 (2022). https://doi.org/10.1038/s41558-021-01245-w
- Reckien, D., Magnan, A.K., Singh, C. et al. Navigating the continuum between adaptation and maladaptation. Nat. Clim. Chang. 13, 907–918 (2023). https://doi.org/10.1038/s41558-023-01774-6
- 13. Zimm, C., Mintz-Woo, K., Brutschin, E. et al. Justice considerations in climate research. Nat. Clim. Chang. 14, 22–30 (2024). https://doi.org/10.1038/s41558-023-01869-0

Reason for exclusion	Papers from list above		
Not natural sciences	1, 2, 3, 4, 5, 8, 9, 11, 12, 13		
No discussion of anthropogenic CC	6, 7		
No scientific paper	10		

Table 6.1: Reasons for exclusion.

List of included articles

- 1. Kalk gegen den Klimawandel Paul Voosen (29.12.22). https://www.sueddeutsche.de/wissen/geoengineering-projekt-kritik-kalk-klimawandel-1.5723654?reduced=true.
- Wie lief es 2022 f
 ürs Klima? Christoph von Eichhorn (23.12.22). https://www.sueddeutsche.de/wissen/klimawandel-emissionshandel-biden-montrealinflation-1.5721449.
- 3. Monsterwellen im Mittelmeer Andreas Jäger (15.12.22). https://www.sueddeutsche.de/wissen/mittelmeer-schifffahrt-riesenwellen-1.5716039?reduced=true.
- Warum reagiert Pakistan kaum auf die Klimakrise? David Pfeifer (14.12.22). https://www.sueddeutsche.de/wissen/pakistan-flut-ursache-klimawandelueberschwemmung-1.5714596?reduced=true.

- Eine Müllabfuhr für Kohlendioxid Thomas Hummel (09.12.22). https://www.sueddeutsche.de/wissen/kohlendioxid-geothermie-erderwaermung-1.5712638
- Ignoriert die "Letzte Generation" die Wissenschaft? Charlotte Bez, Jan Steckel (06.12.22). https://www.sueddeutsche.de/wissen/extinction-rebellion-letzte-generationklimaproteste-1.5710340?reduced=true.
- 7. Wenn Gletscher aufhören, Gletscher zu sein David Zauner (06.12.22). https://www.sueddeutsche.de/wissen/gletscher-schmelzen-flachland-wassermangel-1.5710103?reduced=true.
- 8. Wie der Rhein den Grundwasserspiegel retten soll Christian J. Meier (05.12.22). https://www.sueddeutsche.de/wissen/wasserknappheit-grundwasser-auffuellen-hessen-1.5709603?reduced=true
- 9. Warum Veganismus für alle nicht die Lösung ist Nora Ederer (02.12.22). https://www.sueddeutsche.de/wissen/fleisch-klimawandel-vegetarsich-1.5707337?reduced=true.
- So viel Klimawandel steckt im Wetter Benjamin van Brackel (28.06.22). https://www.sueddeutsche.de/wissen/klimawandel-extremwetter-hitzewelle-1.5610754?reduced=true.
- 11. Schluss mit dem Leichtsinn Marlene Weiß (18.06.22). https://www.sueddeutsche.de/wissen/hitze-juni-klimawandel-hitzewelle-1.5604556.
- 12. Abtauen for Future Christoph von Eichhorn (17.06.22). https://www.sueddeutsche.de/wissen/energiesparen-tipps-habeck-heizkosten-1.5604686.
- Wie viel CO₂ darf Deutschland noch ausstoßen? Marlene Weiß (17.06.22). https://www.sueddeutsche.de/wissen/co2-budget-deutschland-sru-klimawandel-1.5603423.
- Ausbau der Erneuerbaren gerät global ins Stocken Christoph von Eichhorn (11.06.22). https://www.sueddeutsche.de/wissen/ukraine-krieg-weizen-hunger-afrikaklimawandel-1.5600914.
- Von der Klimakrise zur Hungersnot Christoph von Eichhorn (11.06.22). https://www.sueddeutsche.de/wissen/ukraine-krieg-weizen-hunger-afrika-klimawandel-1.5600914.
- Der Tag, an dem China und die USA die Welt retteten David Wüllner (29.12.23). https://www.sueddeutsche.de/projekte/artikel/wissen/brettspiel-co2-emissionemission-e278196/?reduced=true.

- Die Klimawende muss auch sozial eine Erfolgsgeschichte werden Vera Schroeder (29.12.23). https://www.sueddeutsche.de/wissen/klimawandel-soziale-gerechtigkeit-1.6325964?reduced=true.
- 18. "Man kann nicht mehr aus dem Haus gehen, ohne den Klizu mawandel spüren" _ Christoph (27.12.23).von Eichhorn https://www.sueddeutsche.de/projekte/artikel/wissen/2023-klimawandel-bilanztemperaturen-meeresspiegel-jahresrueckblick-e772052/?reduced=true.
- 19. Abschied vom Klima-Märchenland Christoph von Eichhorn (15.12.23). https://www.sueddeutsche.de/wissen/cop28-dubai-fossile-energien-klimakonferenz-1.6320502.
- 20. "Frühere Zivilisationen sind untergegangen, weil sich das Klima abrupt gewandelt hat"
 Benjamin van Brackel (12.12.23). https://www.sueddeutsche.de/wissen/erdgeschichtemichael-mann-interview-klima-1.6318292?reduced=true.
- 21. "Alles ist unter Wasser" Thomas Hahn (07.12.23). https://www.sueddeutsche.de/wissen/salomonen-cop28-dubai-klimawandelmeeresspiegel-1.6315740?reduced=true.
- 22. Kann nur Atomkraft das Klima retten? Theresa Palm (08.12.23). https://www.sueddeutsche.de/wissen/atomkraft-cop28-dubai-deutschland-energiewende-klimawandel-1.6316457?reduced=true.
- 23. Für das Klima ist noch alles möglich Jakob Wetzel (08.12.23). https://www.sueddeutsche.de/wissen/cop28-dubai-klimakonferenz-putin-1.6316285.
- 24. Warum so viele Bäume unter dem Schnee zusammenbrechen Sina Metz (06.12.23). https://www.sueddeutsche.de/wissen/wettereinbruch-schneechaos-bahn-baeume-schneebruch-klimawandel-1.6315452.
- 25. Forscher warnen: Fünf Kipppunkte könnten den Planeten drastisch verändern Benjamin van Brackel (06.12.23). https://www.sueddeutsche.de/wissen/klimawandel-kipppunkte-drastische-veraenderung-erderwaermung-1.6314921?reduced=true.
- 26. Megaschneefälle trotz Klimawandel wie kann das sein? Benjamin van Brackel, Marlene Weiß (05.12.23). https://www.sueddeutsche.de/wissen/schnee-schneefall-schneechaos-klimawandel-muenchen-bayern-1.6314650?reduced=true.
- 27. Treibhausgas-Emissionen erreichen neue Rekordwerte Christoph von Eichhorn, Sören Müller-Hansen (05.12.23). https://www.sueddeutsche.de/wissen/cop28-dubaitreibhausgase-kohlendioxid-ausstoss-rekord-staaten-1.6314233?reduced=true.
- 28. Sehr früh, sehr viel, sehr schnell Marlene Weiß, Ralf Wiegand (03.12.23). https://www.sueddeutsche.de/wissen/wetter-wintereinbruch-schneechaos-bayern-klimawandel-meere-1.6313425?reduced=true.

- 29. Vom Urlaub in Zeiten der Klimakrise Vera Schroeder (30.06.23). https://www.sueddeutsche.de/wissen/klimawandel-marine-hitzewelle-ozeane-klimakrisemeerestemperatur-wassertemperatur-sz-klimakolumne-sz-klimafreitag-klimanewsletter-1.5979720.
- 30. "Nichts verstanden, nichts dazugelernt" Christoph von Eichhorn, Gianna Niewel (30.06.23). https://www.sueddeutsche.de/projekte/artikel/wissen/ahrtal-flut-wiederaufbau-e093937/?reduced=true.
- 31. Wer kann, schwimmt weg Tina Baier (29.06.23). https://www.sueddeutsche.de/wissen/hitzewelle-meere-klimawandel-artensterbenbiodiversitaet-1.5980544.
- 32. Wie funktionieren Hitzewellen im Meer? Vera Schroeder (23.06.23). https://www.sueddeutsche.de/projekte/artikel/wissen/hitzewelle-ozean-klimakrisee327595/?reduced=true.
- Gefährliche Blitze Christoph von Eichhorn (22.06.23). https://www.sueddeutsche.de/wissen/gewitter-deutschland-klimawandel-alpen-1.5957737.
- 34. Unten wärmer, oben kälter Benjamin van Brackel (19.06.23). https://www.sueddeutsche.de/wissen/klimawandel-extremwetter-atmosphaere-1.5947284?reduced=true.
- 35. 2,3 Grad wärmer als vor der Industrialisierung Marlene Weiß (19.06.23). https://www.sueddeutsche.de/wissen/europa-wmo-copernicus-klima-2022-1.5947382.
- 36. Klimakurven auf die Titelseiten Vera Schroeder (16.06.23). https://www.sueddeutsche.de/wissen/klimawandel-klimakrise-medienreflexenormalitaetsaktivismus-medienkrise-1.5937954?reduced=true.
- 37. "Besorgt. Aber nicht überrascht" Vera Schroeder (15.06.23). https://www.sueddeutsche.de/projekte/artikel/wissen/klimakrise-daten-ozeanee370703/?reduced=true.
- 38. El Niño hat begonnen Christoph von Eichhorn (12.06.23). https://www.sueddeutsche.de/wissen/el-nino-2023-auswirkungen-ursache-1.5924405.
- Die Arktis taut, doch politisch herrscht Eiszeit Christoph von Eichhorn (09.06.23). https://www.sueddeutsche.de/wissen/arktis-eisfrei-klimawandel-thwaitesantarktis-1.5908623.
- 40. Eisfrei im September Thomas Hummel (02.06.23). https://www.sueddeutsche.de/wissen/klimawandel-arktis-arktischer-ozean-arktischesmeereis-erderwaermung-1.5905626?reduced=true.

- 41. Auf dem Weg ins Plastozän Thomas Hummel (02.06.23). https://www.sueddeutsche.de/wissen/plastik-abkommen-un-verpackungssteuerkunststoffe-1.5895123.
- 42. 2024 war das wärmste Jahr seit Messbeginn und viel zu nass (30.12.24). https://www.sueddeutsche.de/wissen/wetter-klima-2024-rekord-li.3174619.
- 43. "Vertreibung durch den Klimawandel wird es fast in allen Ländern geben" Leon Scherfig (29.12.24). https://www.sueddeutsche.de/wissen/klimawandel-fluechtlinge-ueberschwemmung-duerre-spanien-fluechtlingskonvention-li.3169692?reduced=true.
- 44. 2024 ist das heißeste Jahr seit Beginn der Aufzeichnungen (17.12.24). https://www.sueddeutsche.de/wissen/hitzerekord-2024-deutschland-messbeginnli.3168374.
- 45. Größter Eisberg der Welt in Bewegung (17.12.24). https://www.sueddeutsche.de/wissen/groesster-eisberg-bewegung-antarktis-a23li.3168174.
- 46. Wettkampf der Rotbuchen Manuel Kronenberg (16.12.24). https://www.sueddeutsche.de/wissen/wettkampf-rotbuchen-grunewald-klimawaldli.3158803?reduced=true.
- 47. Im Flieger nach Bali auf die Politik verweisen hilft der Erde auch nicht weiter Christoph von Eichhorn (10.12.24). https://www.sueddeutsche.de/wissen/tourismus-milliarden-tonnen-co-jahr-li.3163236.
- 48. Tourismus richtet immer größeren Klimaschaden an Christoph von Eichhorn (10.12.24). https://www.sueddeutsche.de/wissen/tourismus-milliarden-tonnen-co-jahr-li.3163236.
- 49. Weshalb sich die Erde schneller erwärmt als gedacht Benjamin van Brackel (05.12.24). https://www.sueddeutsche.de/wissen/klimaforschung-temperatursprung-2023-li.3159781.
- 50. Ist die Arktis in drei Jahren eisfrei? Benjamin van Brackel (04.12.24). https://www.sueddeutsche.de/wissen/arktis-klimawandel-meereis-schmelzen-folgenli.3158797?reduced=true.
- 51. Mitten im Paradies Vera Schroeder (27.06.24). https://www.sueddeutsche.de/projekte/artikel/wissen/klimawandel-adria-hohemeerestemperaturen-pula-valsaline-e189582/?reduced=true.
- 52. Zwei Stunden zum Wasserholen Benjamin van Brackel (24.06.24). https://www.sueddeutsche.de/wissen/klimawandel-waldbraendenlux.DBnSgKQSF35HbZ2Yb8Bzup?reduced=true.

- 53. "Diese extremen Brandereignisse tragen die Spuren des Klimawandels" Benjamin van Brackel (24.06.24). https://www.sueddeutsche.de/wissen/klimawandel-waldbraenden-lux.DBnSgKQSF35HbZ2Yb8Bzup?reduced=true.
- 54. Die Menschheit verbrennt so viel Kohle, Öl und Gas wie nie Christoph von Eichhorn (20.06.24). https://www.sueddeutsche.de/wissen/emissionen-rekord-fossile-brennstoffe-energieverbrauch-lux.3uXyC8Yw9CesKp4nQTwpXG.
- 55. Wie viele Bäume passen in eine Stadt? Katja Richter (18.06.24). https://www.sueddeutsche.de/wissen/baumentscheid-berlin-baeume-stadt-klimabaeumelux.DEkHAeUAaSwg7pydAyKNrH?reduced=true.
- 56. Hitze lässt die Sprache schmelzen Carolin Lerch (16.06.24). https://www.sueddeutsche.de/wissen/studie-hitze-sprache-politik-klimalux.4Geg5TngM9smXSM1w3Ks6p.
- 57. Alles wie in Havanna? Michael Bauchmüller (14.06.24). https://www.sueddeutsche.de/wissen/verbrennermotor-2035-e-fuels-lindnerlux.QebeiziBmuoHXhdqV2Xm3Z.
- 58. "Dem Klima selbst ist es egal, wie gewählt wurde" Christoph von Eichhorn, Vera Schroeder, Theresa Palm (12.06.24). https://www.sueddeutsche.de/projekte/artikel/wissen/klimakriseklimawandel-europawahl-e256302/?reduced=true.
- 59. Wie der Klimawandel zum Hochwasser beigetragen hat Carolin Lerch (07.06.24). https://www.sueddeutsche.de/wissen/klimawandel-hochwasser-sueddeutschlandlux.VfPGQeSAKDgA25PD26EgbF?reduced=true.
- 60. Warum ist es so schwer, aus Naturkatastrophen zu lernen? Vera Schroeder (07.06.24). https://www.sueddeutsche.de/wissen/klimakrise-hochwasser-erderwaermung-klimawandel-moore-naturnahe-loesungen-lux.RKZreFtwdkigkRLZkgeSpN.
- 61. Das Hitzejahr ist komplett Christoph von Eichhorn, Sören Müller-Hansen (05.06.24). https://www.sueddeutsche.de/wissen/klimawandel-temperaturen-rekord-2024-lux.JhbQ6RvbSpu7osfbUDqGp8.
- 62. Permafrost: Nicht eine Zeitbombe, sondern viele? Benjamin van Brackel (04.06.24). https://www.sueddeutsche.de/wissen/klimawandel-permafrost-awi-kipppunkt-lux.9xGyQugsbfWuj8jZdsryWP?reduced=true.
- 63. Vor uns die Sintflut Christoph von Eichhorn (03.06.24). https://www.sueddeutsche.de/wissen/hochwasser-ueberschwemmungen-klimawandelbayern-baden-wuerttemberg-lux.6K62GjdPbyNVy6m5dt4c8T.

List of exluded articles

- 1. Alles zur Klimakrise. 15.12.2022. https://www.sueddeutsche.de/projekte/artikel/wissen/klimakrise-sz-klimamonitor-e670150/.
- 2. Klimafreitag -das wöchentliche Update. 01.12.2023. https://www.sueddeutsche.de/wissen/klimakrise-newsletter-klimafreitag-1.4364917.

Custom stop words

review	framework	research	assessment	essential	suggest	discuss
discuss based ar		argue	including	address	highlight	discusses
identify related examines						
No. of words			18			

Table 6.2: Custom stop words English.

dass	mehr	sagen	etwa	seit	schon	sein	viel
immer	zwei	geben	werden	ab	müssen	vergangen	wenig
gerade	ja	kommen	gut	erst	gehen	groß	bereits
schnell	können	dabei	liegen	со	lassen	sehen	bleiben
sz	sabine	egerer	sagt	bleibt	kam	bedeutet	sogenannte
zuvor	warum	später	zeigen	wie	zumindest	wahrscheinlich	zudem
weil	heißt	vielen	sieht	überhaupt	sowie	genau	kürzlich
führt	liegt	gilt	deshalb	gibt	neuerdings	daher	zumindest
wurden	könne	demnach	eher	führen	erreicht	zeigt	allerdings
darauf	je	denen	kaum	gar	lässt	besonders	leben
kaum	oft	könnten	dafür	ganz	wäre	sei	erklärt
dürfte	fünf	viele	seien	wohl	beim	einfach	mal
ersten	erste	unsere	halten	frage	macht	beispiel	neue
neuen	bislang	zusammen	teil	davon	einzelne	kommt	laut
fast	lange	geht	sogar	wurde	großen	vergangenen	zehn
nie	pro						
No. of words						139	

Table 6.3: Custom stop words German.

Word Frequency Anaylsis

Rank	Word	Frequency	
1	climate	76	
2	change	48	
3	carbon	41	
4	global	24	
5	future	23	
6	challenge	22	
7	human	19	
8	water	19	
9	ecosystem	18	
10	risk	18	
11	health	17	
12	system	17	
13	assessment	16	
14	impact	15	
15	perspective	14	
16	process	14	
17	warm	14	
18	uncertainty	13	
19	energy	13	
20	discuss	13	

Table 6.4: Table of twenty most frequent words in analysed scientific paper abstracts.

Rank Word		Translation	Frequency
1	jahr	year	129
2	grad	degree	124
3	jahren	years	124
4	wasser	water	121
5	hoch	high	98
6	prozent	percent	98
7	menschen	humans	97
8	neu	new	96
9	klimawandel	climate change	87
10	global	global	85
11	stark	strong	79
12	jahre	years	76
13	deutschland	Germany	64
14	emissionen	emissions	59
15	erwärmung	warming	59
16	celsius	-	55
17	welt	world	53
18	europa	europe	51
19	meer	sea	49
20	aktuell	currently	49

Table 6.5: Table of twenty most frequent words with translation in analysed newspaper articles.

Bigram frequency

Rank	Word	Frequency
1	climate	76
2	change	48
3	carbon	41
4	global	24
5	future	23
6	challenge	22
7	human	19
8	water	19
9	ecosystem	18
10	risk	18
11	health	17
12	system	17
13	assessment	16
14	impact	15
15	perspective	14
16	process	14
17	warm	14
18	discuss	13
19	energy	13
20	uncertainty	13

Table 6.6: Table of twenty most frequent words in analysed scientific paper abstracts.

Rank	Word	Translation	Frequency
1	grad celsius	degree celsius	55
2	el niño	-	23
3	1,5 grad	1,5 degree	21
4	pro jahr	per year	12
5	jahr 2023	year 2023	10
6	marine hitzewellen	marine heatwaves	10
7	vergangenen jahr	past year	10
8	fossilen energien	fossil fuels	9
9	pro quadratmeter	per square meter	9
10	vergangenen jahren	past years	9
11	arktische meereis	arctic sea ice	8
12	erneuerbare energien	renewable energies	8
13	globale erwärmung	global warming	8
14	milliarden tonnen	billion tons	8
15	nie zuvor	never before	8
16	20 jahren	20 years	7
17	hohen temperaturen	high temperatures	7
18	jahr 2024	year 2024	7
19	university of	-	7
20	wenigen jahren	few years	7

Table 6.7: Table of twenty most frequent bigrams with translation in analysed newspaper articles.

Translations

German word	English translation		
Emissionen	emissions	Jahren	years
Temperaturen	temperatures	Europa	europe
Erde	earth	Wasser	water
Globale(n)	global	Grad	degree
Luft	air	Zeit	time
Atmosphäre	atmosphere	Erderwärmung	global warming
Jahre	years	Jahr	year
Universität	university	Klimawandels	climate changes'
Erwärmung	warming	Sommer	summer
Prozent	percent	Menschen	humans
Klimawandel	climate change	Klima	climate
Welt	world	Ende	end
Heute	today	Stark	strong
Wissenschaftler	scientist	Deutschland	Germany
milliarden	billions	tonnen	tons
nie	never	zuvor	before
pro	per	quadratmeter	squaremeter
vergangenen	past	arktische	arctic
meereis	sea ice	fossilen	fossil
energien	energies	erneuerbaren	renewable
marine	marine	hitzewellen	heatwaves

Table 6.8: Translation table of words appearing in Fig. 4.6 and 4.4.

Publishing and archiving

Approved students' theses at SLU can be published online. As a student you own the copyright to your work and in such cases, you need to approve the publication. In connection with your approval of publication, SLU will process your personal data (name) to make the work searchable on the internet. You can revoke your consent at any time by contacting the library. Even if you choose not to publish the work or if you revoke your approval, the thesis will be archived digitally according to archive legislation. You will find links to SLU's publication agreement and SLU's processing of personal data and your rights on this page:

https://libanswers.slu.se/en/faq/228318

- YES, I, Luca Rahm, have read and agree to the agreement for publication and the personal data processing that takes place in connection with this.
- □ NO, I, Luca Rahm, do not give my permission to publish the full text of this work. However, the work will be uploaded for archiving and the metadata and summary will be visible and searchable.