FACULTY OF SCIENCE AND TECHNOLOGY

MASTER'S THESIS

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SUMMARY

The risk of climate change encompasses an entirely new approach to risk that has never been experienced before; its consequences do not only affect and threaten the people living on the planet now but also future generations. At the forefront of climate change is Longyearbyen, an Arctic settlement on the Norwegian archipelago Svalbard which is viewed as "a living lab" for climate change as it is warming much faster than the global average. Further south, on the northernmost part of the Norwegian mainland, is Nordkapp. A small municipality that, in recent years, has had to take preventive measures to prevent avalanches. In the very south of Norway is Norway's capital, Oslo, which is regarded as more protected against the most harmful effects of climate change.

This thesis researched how the public authorities in Longyearbyen, Nordkapp, and Oslo perceive and communicate climate risks. In a world that is getting warmer and where urbanization is expected to increase, public authorities will be a bridge builder between experts and the public. Empirics from qualitative document analysis and semi-structured interviews with three informants from Longyearbyen, Nordkapp and Oslo were discussed using theories on risk, risk perception and risk communication.

This study found that climate change's impact on the overall risk affects risk communication strategies and risk perception. In Longyearbyen and Nordkapp, societies this study found climate risks to manifest objectively more significant, prioritized short-term climate disaster handling. In contrast, in Oslo, which is less exposed to the harmful effects of climate change, issues related to climate adaptation were given more awareness. However, the correlation between climate risk and public authority action can be based on more than just risk perception but also resources and priorities. The study also highlights the importance of local knowledge in assessing climate change risks, as experts alone do not provide a comprehensive understanding of how climate risks affect Longyearbyen, Nordkapp and Oslo.

ACKNOWLEDGEMENTS

This master's thesis marks the end of two instructive years of studies in societal safety at the University of Stavanger. I am grateful to have been given the opportunity to take part in such a solid academic environment. My studies took me to Longyearbyen and the University Centre in Svalbard, a stay I would never be without. Thanks to the educational environment at UNIS and the people of Longyearbyen for warmly welcoming us students. Experiencing the impacts of climate change made a strong impression, and I hope we manage to limit the changes so that future generations can also experience the unique environment of the Arctic.

Many thanks to my supervisor Bjørn Ivar, who has motivated, inspired and been a professional resource of great value. Thanks to my parents and siblings for their support and assistance. A big thank you to my Ivar, my biggest supporter these years. Thanks to the informants in Longyearbyen, Nordkapp and Oslo for insight and understanding into their everyday working life.

As a survivor of the terrorist attack on Utøya, it was not obvious that I should be sitting here today writing these words. When I now hand in my master's thesis and with that end two years of studies in societal safety, I think of all the irreplaceable people who never got the chance to grow up, study, live and grow old. For those who became victims of the bullets of hatred and a bomb that tore The Government Quarter to shreds. I will never forget you.

Oslo, June 15, 2023
Miriam Einangshaug

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1.0 INTRODUCTION

Our climate is changing, and it poses the most significant danger to our civilization that we have ever encountered. In Longyearbyen, the largest settlement on the Arctic archipelago, Svalbard, extensive measures have already been implemented to limit hazards caused by the changing climate (Albrechtsen et al., 2022b). Longyearbyen has been given the status as a "living lab" for future climate change (Norwegian University of Science and Technology, n.d.) because climate change is happening almost four times faster than in the rest of the world in the Arctic (Rantanen et al., 2022).

The understanding of how risk is perceived and risk communication is crucial for managing risks (Boyesen, 2003; Renn, 2008). Research suggests that the distinction between how people perceive human-induced and natural hazards is slowly disappearing (Wachinger et al., 2013, p. 1062) and that knowledge of risk communication of natural hazards and climate risk is currently little explored (Höppner et al., 2010; Krøgli et al., 2020). Since 2018, the Norwegian authorities have worked to make the population better able to take care of themselves during a crisis. The purpose is to make society more resilient because, by enabling more people to take care of themselves, emergency operators can prioritize resources to help those who need them most (Direktoratet for samfunnssikkerhet og beredskap, 2018). To achieve this, the risk must be communicated in a way that makes the population best equipped to handle the risk (Aven et al., 2004, p. 42). By law, Longyearbyen, Nordkapp, Oslo and other Norwegian municipalities are obliged to have risk assessments and plans for communicating risk (Sivilbeskyttelsesloven, 2010).

Inspired by this, this thesis seeks to contribute to more knowledge on risk perception and risk communication related to climate risks. The study is part of Arct-Risk, a research project in Longyearbyen that seeks to develop knowledge and tools to deal with climate change (Norwegian University of Science and Technology, n.d.). The Governor of Svalbard and Nordkapp municipality are collaborative partners of the research project and therefore became natural starting points for the study. As urbanization and climate change are expected to rise (IPCC, 2021), I assumed that including a city that is not as exposed to extreme weather could be a useful parallel to draw. Therefore, the capital of Norway, Oslo, was added. In the autumn of 2022, I lived in Longyearbyen and completed three courses in Arctic safety at the University Centre in Svalbard. This meant that I was familiar with the place, and the

challenges that exist in the settlement due to climate change. Previously I have worked with strategic communication, and in my bachelor's thesis, I wrote about risk perception. Therefore, I already had some knowledge and an interest in the topics.

1.1 PREVIOUS RESEARCH

The concept of climate risk is relatively new. Previous literature has mainly focused on aspects related to the interpretation of climate risk (Aven, 2020, p. 1389), including probabilities (Dessai & Hulme, 2004), modelling (Frigg et al., 2015; Spiegelhalter & Riesch, 2011;) and uncertainty (Smith & Stern, 2011; Van der Sluijs, 2012). The local effects and long-term consequences of climate change in Longyearbyen, Nordkapp and Oslo are documented by the Norwegian Centre for Climate Services (Hanssen-Bauer et al., 2015; Hanssen-Bauer et al., 2019; Hisdal et al., 2021) and is operationalized through local risk and vulnerability analyses (Beredskapsetaten, 2021; Klimaetaten, 2020; Statsforvalteren i Troms og Finnmark, 2022; Sysselmesteren på Svalbard, 2022). In 2021 The Norwegian Environment Agency issued a report where one of the main conclusions was that Norwegian municipalities today do not assess the full breadth of climate risk (Miljødirektoratet, 2021, p. 50). Previous research indicates that belief about climate change determines which threat people associate with it, and that local weather conditions influence whether people believe and worry about climate change (Egan & Mullin, 2012; Hamilton & Stampone, 2013; Howe & Leiserowitz, 2013; Joireman et al., 2010; Zaval et al., 2014). Some studies done on the population of Norway indicates that they have a higher-than-average population that does not believe climate change is caused by humans, and their perception of threats that climate change poses towards their safety is lower than average (Duffy et al., 2022; Howe, 2018; YouGov, 2019).

Communication of risk has been controversial. New knowledge about risks challenges established traditions, identity, and capitalist structures; The connection between tobacco and risk was known to the vast majority by the end of the 1950s. Yet the tobacco industry spent great resources funding research that said the opposite and tried to mislead consumers (Cummings et al., 2007, p. 1071). Similar tenders have been seen in the oil industry, which in 2021 had to face the US Congress because they were accused of misleading people into believing that climate change is not man-made (Supran & Oreskes, 2021).

Little research has been done on risk communication and risk perception of natural hazards in the Arctic. Some studies have been carried out that deal with risk perception in people living

in global mountain regions (Schneiderbauer et al., 2021) and on tribal leaders and non-resident resource managers in Arctic Alaska (Blair & Kofinas, 2020). Similar studies addressing risk perception and risk communication in Arctic societies have been limited to Longyearbyen (Aakre, 2022; Antonsen et al., 2022). No research has been done on how authorities in Longyearbyen, Nordkapp, and Oslo perceive and communicate climate risk.

1.2 RESEARCH PROBLEM AND QUESTIONS

The research problem is:

How are the public authorities in Longyearbyen, Nordkapp and Oslo perceiving and communicating climate risk?

To answer the research problem, I would like to take a closer look at the following research questions:

1. How does climate change affect the climate risk picture in Longyearbyen, Nordkapp and Oslo?
2. How do public authorities perceive climate risk in Longyearbyen, Nordkapp and Oslo?
3. What strategies and goals are there for communicating climate-related risks in Longyearbyen, Nordkapp and Oslo?

To answer the research problem, I first want to clarify how climate change affects the risk picture in Longyearbyen, Nordkapp and Oslo in research question 1. Climate change is global, but the consequences are local. This forms the basis for the light in which the other research questions must be read. Research question 2 is chosen because perception is a central part of risk communication, which will be explained in the theory chapter. How humans perceive risks says something about how they assess the risk being communicated. By clarifying key features of how public authorities in Longyearbyen, Nordkapp, and Oslo perceive climate risk in their communities, I believe it is possible to say something about why they communicate in the way they do. Strategies and goals for risk communication can say something about the role climate risk communication has in the risk management process, how risk communication is currently carried out in practice in the various places and why it is done this way. This is the basis for research question 3.

1.3 LIMITATIONS

To narrow down the study, I choose to deal with the perception and communication of climate risk. Risk communication and crisis communication is often used as synonyms, but I will primarily focus on risk communication in the thesis. However, since the two concepts are closely linked, it will be expedient for the thesis to have some emphasis on crisis communication. Longyearbyen, and not Svalbard, is used as the context to study climate risk communication in. This is because it is on the west coast of the archipelago that the most significant rises in temperatures due to climate change are measured (Hanssen-Bauer et al., 2019).

The study is limited to dealing with societies in Norway because these societies have mutual laws and obligations to comply. It was therefore assumed that this would make it easier to draw parallels between the different cases. This is also a culture I knew well, which I assumed would be positive because it was more likely that the informants and I had some of the same reference knowledge. The main emphasis is on public authorities' risk perception and risk communication of climate risk, not experts or the public. The study limits itself to the negative effects of climate change, and communication on climate change is limited to their negative effects, not to inform the public that climate change is happening.

1.4 STRUCTURE OF THESIS

This master's thesis consists of 8 chapters. In this chapter (1), I have explained the overall research problem, research questions, and the motivation and limitations of the thesis. In Chapter 2, I will present the selected cases, Longyearbyen, Nordkapp and Oslo. Chapter 3 deals with climate change and explains holistic aspects of climate change that are relevant to this thesis. Next, the conceptual framework for the thesis is presented in Chapter 4, where I have used risk, risk perception and risk communication and put it in context with climate change and climate risk. The procedure for answering the research problem is presented in the methodology chapter (5); here, the Arct-Risk research project the master's thesis is a part of, and the methodological choices made in the study are further explained. Chapter 6 presents the findings from the document analysis and interviews with the informants from Longyearbyen, Nordkapp and Oslo. This is followed by the discussion chapter (7), where I use the research questions to discuss the empirical findings in light of the theoretical framework. Finally, a conclusion of the study is presented in Chapter 8.

2.0 LONGYEARBYEN, NORDKAPP AND OSLO

In this chapter, I will present Longyearbyen, Nordkapp and Oslo and explain today's climate and climate risk picture of these places. They are all a part of the Kingdom of Norway but are governed differently. Longyearbyen is neither a municipality nor a county and is administratively under the Norwegian Ministry of Justice and Public Security (Thuesen & Barr, 2023). Nordkapp is regarded as a municipality and is administrated by a municipal council (Nordkapp kommune, n.d.), while Oslo is a municipality and a county (Thorsnæs, 2023).

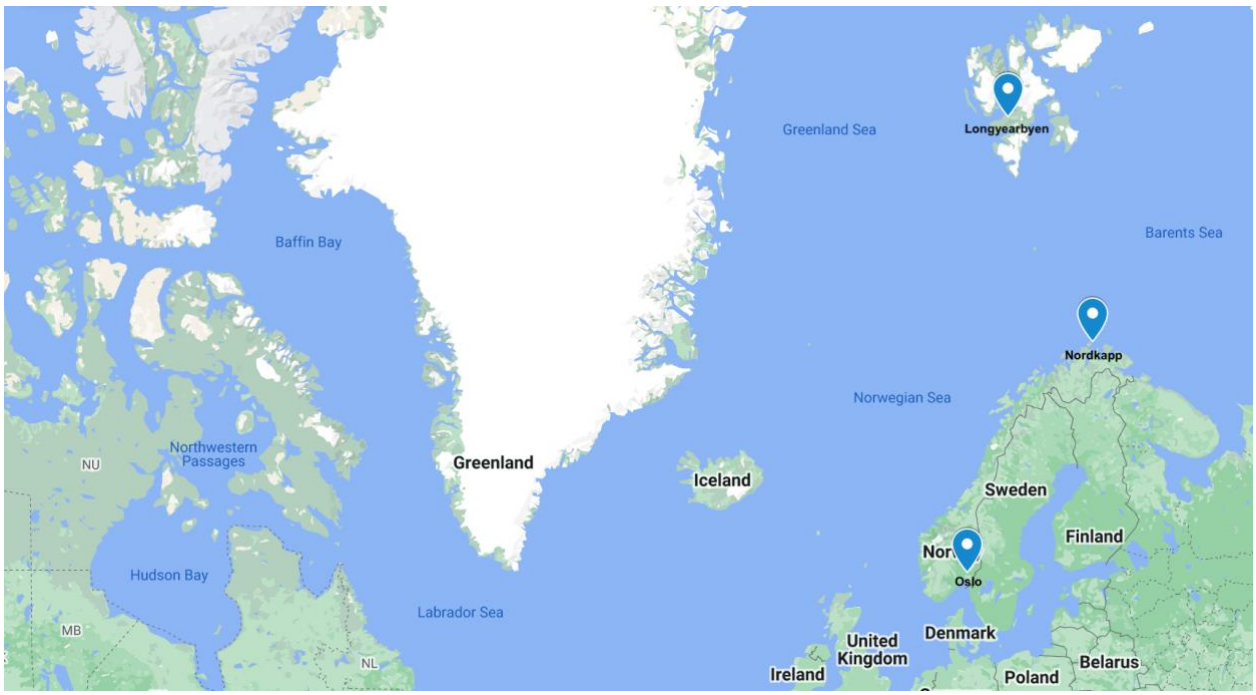

Figure 1 Longyearbyen, Nordkapp and Oslo (Google Inc, 2023a).

2.1 LONGYEARBYEN

Longyearbyen is located on Svalbard, a Norwegian archipelago in the Arctic between 74° and 81° north latitude, with a land area of a total of 61 022 km2. Longyearbyen is the administrative centre and the largest settlement on the archipelago and houses 2500 people on a land area of around 260 km^2 (Longyearbyen Lokalstyre, 2017, p. 15). The location this far north means that between October and February, the settlement experiences polar night (Sysselmesteren på Svalbard, n.d., p. 2), i.e., that the sun is located below the horizon for more than 24 hours, which means that it is dark all day (Polarnatt, 2020). A characteristic of the population demography is a high turnover. Every year around 20% of Longyearbyen's

population moves, meaning that within five years, the entire population is considered to have been replaced (Johansen, 2017; Sysselmesteren, 2022).

Much of the settlement was built after 1943 due to a German attack during the Second World War (Hanssen-Bauer, 2019, p. 153). Longyearbyen consists of a maritime tundra climate but experiences milder weather than areas on the same latitude due to the Gulfstream (Thuesen & Barr, 2023). The yearly amount of precipitation is estimated to be around 200 mm a year, which is less than anywhere else on the Norwegian mainland (Hanssen-Bauer et al., 2019, p. 155). The low amount of precipitation means that Longyearbyen is considered part of the Arctic polar desert (Sottosanti, 2023). Most of the land area consists of permafrost, which means that infrastructure such as houses and sewers must be built above ground so that they do not move when the permafrost thaws in the summer (Humlum et al., 2003). In recent years, Svalbard has experienced several avalanches which have been linked to climate change, including two large avalanches in Longyearbyen in 2015 and 2017 that claimed residential buildings and lives (Albrechtsen et al., 2022b).

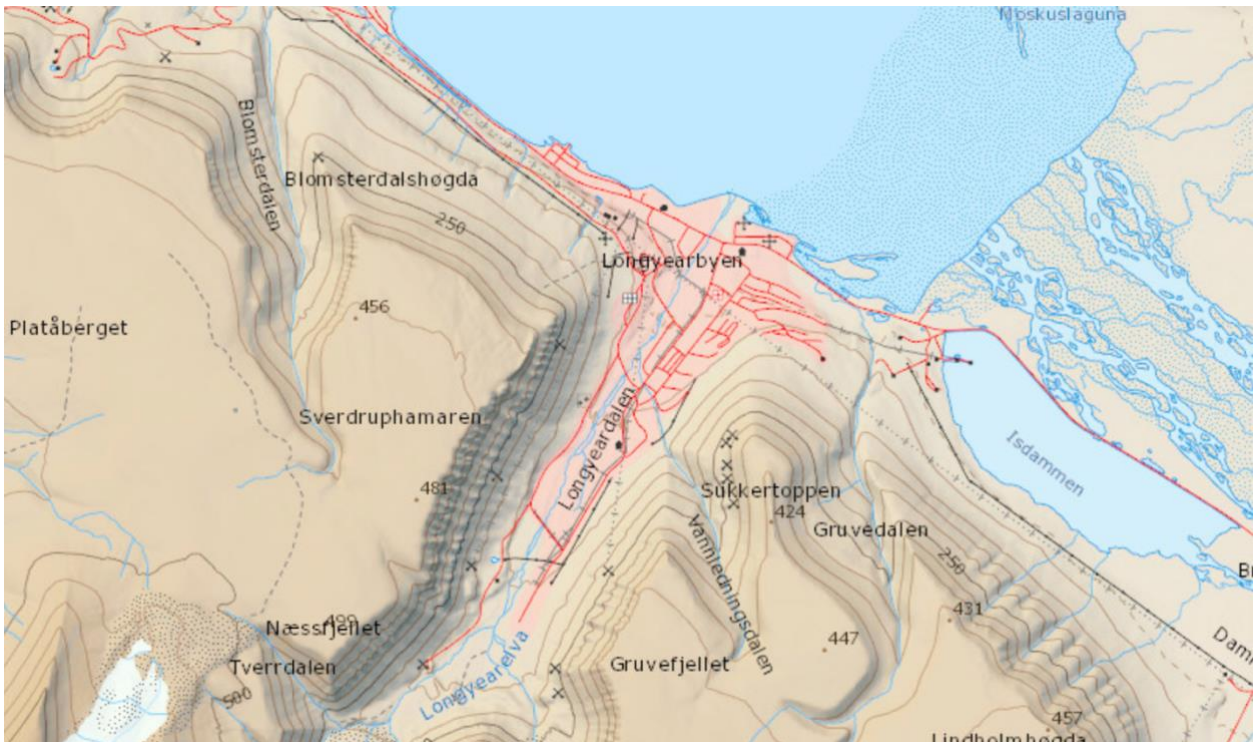

Figure 2 Longyearbyen (Norwegian Polar Institute, 2023).

2.2 NORDKAPP

At 71 °, Norkapp is situated at Norway's northernmost point on the mainland. It is a part of the county of Troms and Finnmark, and the population consists of 2947 inhabitants. The municipality has a land area of 892 km2, but the population is mainly concentrated on the island Magerøya and the settlements Honningsvåg, Nordvågen, Gjesvær, Skarsvåg and Kamøyvær. The strong population concentration is related to the Second World War (Askheim, 2023), where large parts of Finnmark, including Nordkapp, were burned, bombed or otherwise destroyed as a result of the Germans' use of scorched earth tactics (Petterson, 2020). This means that all buildings are from after 1945, except the church (Den norske kirke, 2019). Honningsvåg is the municipality's administrative centre and has city status (Askheim, 2022). Like Longyearbyen, Nordkapp also experiences long periods without sun from the end of November to the end of January (Aksnes & Hammerstrøm, 2022).

The entire coast is exposed to wind, which, combined with the Gulfstream, contributes to a milder climate in Nordkapp than its latitude implies. The municipality's location toward the Barents Sea creates an environment where rough weather is not uncommon, especially in the winter (Dannevig, 2022a). Historically, there have been many avalanches in Troms and Finnmark, and in the winter of 2020-2021, an avalanche warning system was established in Honningsvåg (Bergbjørn & Gundersen, 2021).

Figure 3 Nordkapp (Google Inc, 2023b).

2.3 OSLO

Oslo is the capital of Norway and is located in the southeastern part of Norway at the heart of the Oslofjord. It is one of Norway's oldest cities and has an area of 426 km2; two-thirds are mountains, forests, and islands (Thorsnæs, 2023). Oslo is the municipality in Norway with the highest population growth (Strand, n.d.). It is, therefore, part of an international trend where more and more people are moving to the cities (IPCC, 2021, p.1462). Today the population in Oslo is estimated to be just over 700 000 (Statistisk sentralbyrå, 2023), more than 30% of these belong to the immigrant population (Oslo kommune, n.d.).

The climate is characterized by cold winters and hot summers; the location at the heart of a fjord means the city experiences little wind (Dannevig, 2022b). In both 2016, 2017 and 2018, the city experienced high temperatures that led to the risk of forest fires; in 2015, Alnaelva flooded, which led to the loss of electricity and evacuations in Kværnerbyen, and in 2014 torrential rain led to the closure of roads (Klimaetaten, 2020). Despite this, Oslo has previously been named the city in the world that is second least exposed to climate and environmental changes (Versik Maplecroft, 2021, p. 12). Like Longyearbyen and Nordkapp, the Gulfstream also in Oslo contributes to a milder climate (Weber & Bjørndalen, 2021).

Figure 4 Oslo (Google Inc, 2023c).

3.0 CLIMATE CHANGE

The United Nations Framework Convention on Climate Change defines climate change as "[…] a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (United Nations, 1992, p. 7). While the term "climate" refers to an average of the atmospheric conditions over a long period of time (Wells et al., 2023), the term "weather" refers to short-term changes in the atmosphere (Britannica, 2023).

Throughout its existence, Earth has been exposed to changes in climate that have caused it to warm up and cool down again. This has gone on in long cycles and has resulted from natural variations linked to the interaction between the cryosphere, atmosphere, hydrosphere, biosphere, and lithosphere (Zalasiewicz & Williams, 2016, p. 13). Through analyses of ice cores, tree rings, coral reefs and other sources that explain how the climate and the concentration of substances in the atmosphere were before, combined with direct observations of climate change inserted into climate models, it has become certain that the cause of climate change is man-made (IPCC, 2021, p. 515). Since the industrial revolution in the middle of the 18th century, these changes have occurred more quickly due to the use of fossil fuels by humans, which has resulted in an increased concentration of carbon dioxide (CO2), nitrous oxide (N_2O) and methane (CH4) in the atmosphere (IPCC, 2014, p. 45). Creating a warming of the Earth at a rate we have never seen before, referred to as global warming, which has led to the climate changing (IPCC, 2014, p. 44).

Warming has been most significant at high northern latitudes, as illustrated in Figure 5. Since 1979, the Arctic has experienced a temperature increase almost four times faster than in the rest of the world, a phenomenon known as Arctic Amplification that describes the relationship between warming in the Arctic and the global average. One of the main reasons for the rapid increase in temperature is that as temperatures rise, the ice will disappear (Rantanen et al., 2022). Ice will normally reflect solar radiation; when it doesn’t, the heat from the sun will be absorbed by the sea, which absorbs more heat from the sun than ice and snow covers do (Screen & Simmonds, 2010, p. 1).

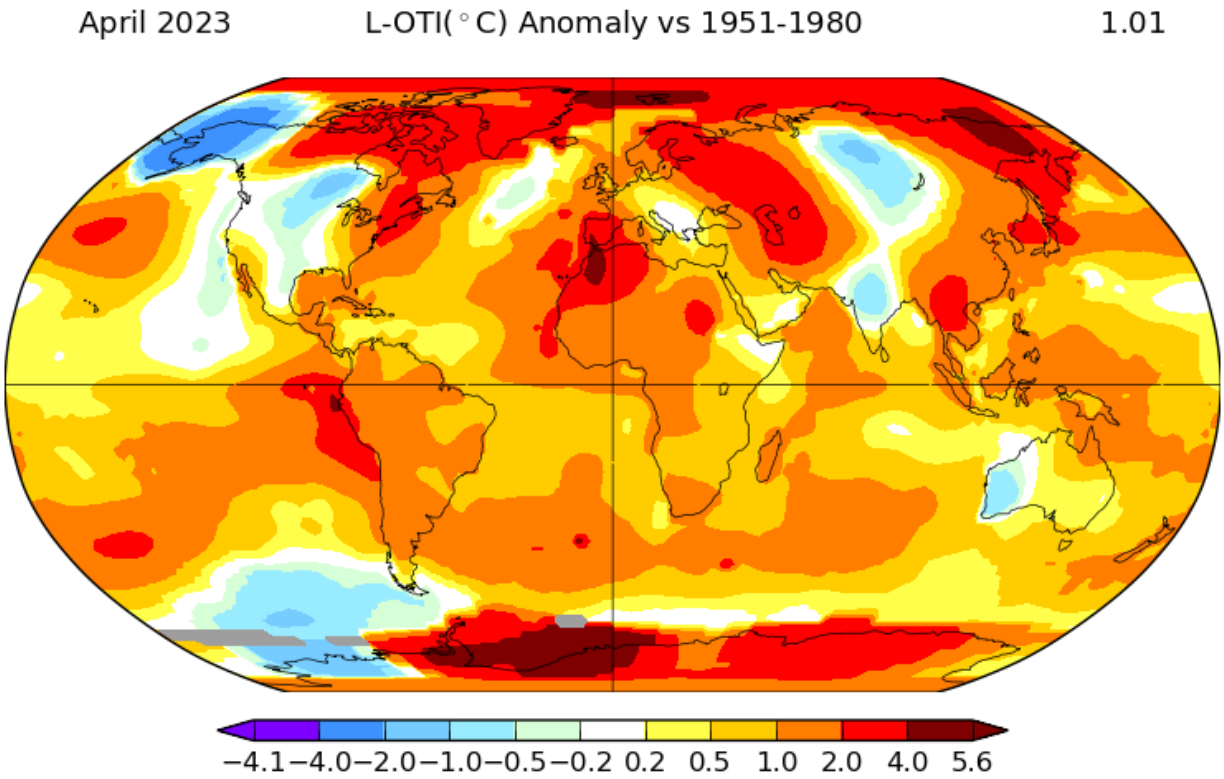

Figure 5 “Temperature change from 1951-1981 to today”, 2023, by GISTEMP Team, (data.giss.nasa.gov/gistemp/).

In recent decades, an increasing number of events have been seen to occur or be exacerbated by climate change (IPCC, 2014, p. 53). Including the Australian wildfires in late 2019 and early 2020 (van Oldenborgh, 2021) that were created by, among other things, a drought that started in 2017 (Australian Bureau of Statistics, 2020). The wildfires killed nearly three billion animals (van Eden et al., 2020, p. 2), burnt 12,6 million hectares (Wintle et al.,, 2020, p. 753) and created a deeper hole in the ozone layer (Coleman, 2022). The floods in Pakistan in 2022 are another recent example of catastrophes created by climate change (Otto et al., 2022). The flood was the result of heavy monsoon rains, about 243% more than usual (Pakistan Meteorological Department, 2022b, p. 1) and melting glaciers (NASA earth observatory, 2022) combined with heat waves (Pakistan Meteorological Department, 2022a; Zacharia et al., 2022) that resulted in around 10% the country being submerged under water affecting over 30 million people (Bithrey, 2022).

3.1 PROJECTING FUTURE CHANGES IN CLIMATE

The UN climate panel (IPCC) is the world's most important resource of knowledge on climate change and was established in 1988. Its main task is to summarize existing knowledge about climate and climate change regularly. The IPCC is an organization consisting of governments that are members of the UN or WMO and currently has 195 members. The reports from the IPCC are the most important academic basis for international climate negotiations. The UN climate panel does not carry out its own research (IPCC, n.d.). The first report was published in 1990. Climate change is global, but the effects will be noticeable locally, which is the reason for the Norwegian authorities to use the knowledge in the IPCC's reports and supplement it with knowledge about Norwegian conditions to better adapt it to the Norwegian context as a framework for Norway's handling of climate change (Meld. St. 13. (2020-2021), p. 176-177).

Through advanced data analysis consisting of several variables related to temperature, natural processes, sea level, snow and many others, scientists can say something quite precisely about the future climate through climate models (IPCC, 2021, p. 244). These datasets can be combined with local data to say something about the future climate in smaller geographical areas, for example, in Longyearbyen, Nordkapp and Oslo (Hanssen- Bauer et al., 2019; IPCC, 2021; Klimaetaten, 2020).

In Norway, the Norwegian Centre for Climate Services (NCCS) creates the national climate profiles for Norway. Much of the information in these climate profiles is based on the IPCC's fifth main report from 2013 (AR5). Until further notice, AR5 lays the foundation for Norwegian climate adaptation (Norsk Klimaservicesenter, 2022). In 2021, the IPCC's sixth assessment report was published (AR6). The main difference between the two reports is that AR6 contains more advanced climate models that provide better projections of what the future climate will be like; AR6 is more solution-oriented in that it considers how the physical consequences of climate change affect society and ecosystems. In addition, AR6 provides a more accurate estimation of historical warming and increased evidence of how human influence has been the source of climate change (Zhou, 2021). Climate change will have different consequences for Longyearbyen, Nordkapp and Oslo due to different climatic and demographic conditions. These will be presented as part af the results from the document analysis in Chapter 6.

4.0 THEORY

The conceptual framework for this thesis deals with risk, risk perception and risk communication and links it to climate change and climate risk. The structure of the chapter is done according to the thesis research questions. Nonetheless, since this is a social sciences thesis, there will inevitably be some overlaps, both in theory and when examining the empirical findings in the context of the theoretical framework.

4.1 RISK

Throughout history, the concept of risk has been defined in several different ways; the earliest conceptualities of the notion are linked to the end of the Middle Ages when risk was used to identify the hazards that could compromise a voyage in the early maritime ventures. Risk was at this time viewed as something that humans could not control. Instead, risk was considered an act of God or other objectives that had in common that it was outside human control (Ewald, 1993, p. 226). With the introduction of probability theory and statical calculations, the view on risk shifted to something controllable (Beck, 1992, p. 99) and unforeseen results was seen as something that may result from human actions (Giddens, 1990, p. 30).

The traditional way of measuring risk was as a product of probability and consequence. This measurement method is based on a natural-scientific way of thinking which involves objectifying the order of magnitude of risk in the same way as height and weight (Njå et al., 2020, p. 43). This reflects engineering safety studies' impact on the academic discipline (Kates & Kasperson, 1984; Otway & Thomas, 1982, cited in Bradbury, 1989, p. 382). As explained by Aven et al., a weakness in this view is that by objectifying the concept of risk, you assume that risks are value-free and thus not subjective (2004, p. 38). According to Paul Slovic, risk is inherently subjective and continues; that risk is a concept invented by humans and that it cannot exist independently of humans' ways of assessing them (1992, p. 119), while Ortwin Renn points out that different cultures may consider risk differently (2008, p. 2).

The understanding of the concept of risk has consequences for how the risk is treated (Aven et al., 2004, p. 37). In Chapter 3 on climate, the change in climate is understood as something that happens, regardless of whether people believe in climate change and the consequences they imply or not. Simultaneously, the thesis research problem and questions suggest that someone must interpret the risk. This creates a need for a definition that considers an

ontological view of risk (risk exists regardless of whether a person has assessed it to be a risk) and an epistemic view of risk (risk can only exist if someone has assessed it to be a risk). Therefore, risk in this thesis is understood according to Aven & Renn's definition, where risk refers to "uncertainty about and severity of the consequences (or outcomes) of an activity with respect to something humans value" (2010, p. 3). "Uncertainty" refers to what we do not know about an event and the consequences of an activity in relation to the severity of that event or consequences. While "severity" relates to the chosen measure of magnitude, size, scope, intensity etc., in relation to something humans value. The main point is that risk must be based on uncertainty beyond a numerical probability and that risk is a product of both the physical and social interpretations of it (Aven & Renn, 2010).

Uncertainty can be divided into two categories: aleatory uncertainty, which refers to uncertainty which stems from natural variations or coincidences, i.e. rainfall or wind speed. This category of uncertainty can be reduced by gaining more information or increasing the sample size. However, none of these will be able to remove this type of uncertainty which is why it is also known as irreducible uncertainty. The second category is epistemic uncertainty which is characterised by the lack of knowledge and, therefore, can be reduced by acquiring more knowledge (Albrechtsen et al., 2022a; Renn, 2008;). Figure 6 illustrates the different sources of uncertainty:

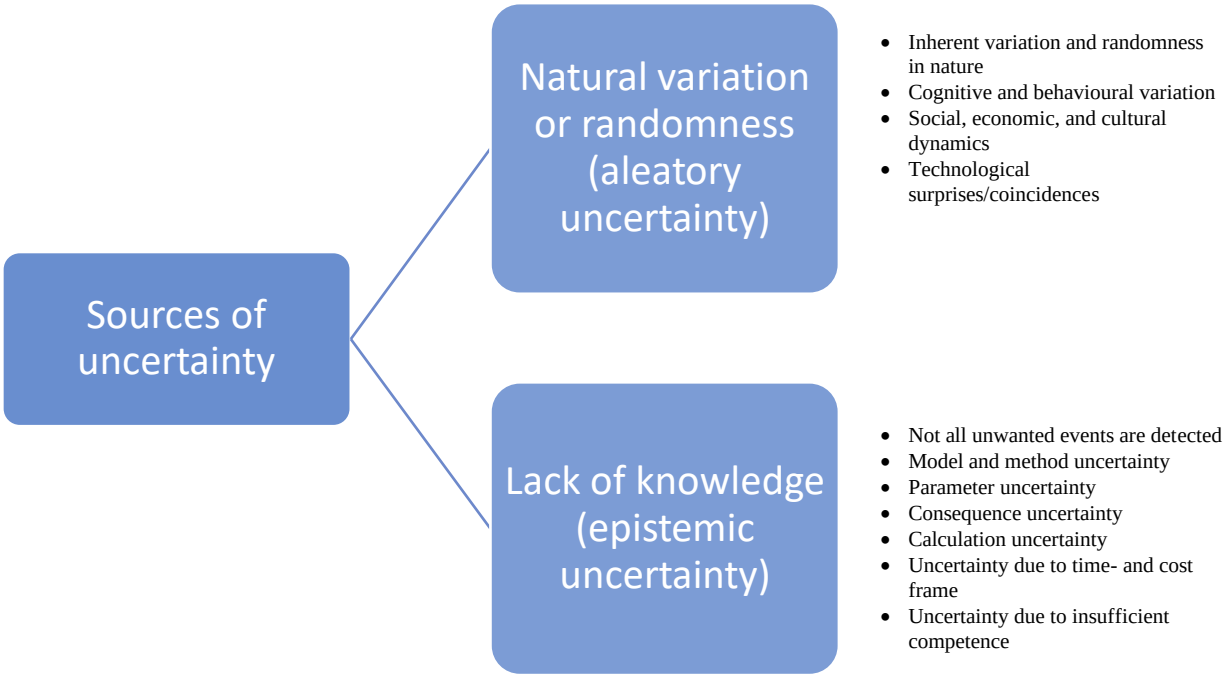

Figure 6 Sources of uncertainty. [Translated and adapted] From "Usikkerhet knyttet til risikostyring, naturfarer og samfunnssikkerhet: Oppsummering av Arct-Risk workshop I Longyearbyen 1.- 3. nov. 2022," by E. Albrechtsen et al, 2022a, p. 14 (https://www.ntnu.edu/documents/140173/0/Usikkerhet+knyttet+til+risikostyring%2C+naturfarer+og+samfunnssikkerhet.pdf/2030a6da-b612-920b-81c5-af5da430d4cd?t=1683185508575)

4.1.1 Conceptualising climate risk

The basic understanding of this master thesis' view of the concept of risk was explained in the previous chapter. In order to have the best prerequisites to handle risk, Engen et al. argue that it is necessary to describe and categorise the risk phenomenon as this will make it easier to calculate and assess the risk (2021, p. 96). For a long time, the changes in the climate have been an invisible danger, which is both difficult to measure and to foresee the consequences of. We know that risks are associated with them, but we do not know the consequences of how they will be in the future (Beck, 1997). Climate risk differs from traditional risk assessments and strategies to combat them because, traditionally, the handling of risk has been applied in a short-term perspective. They can manifest as acute situations and persistent crises (Engen et al., 2021).

Boin et al. characterise the effects of climate change as a creeping crisis which is "[…]a threat to widely shared societal values or life-sustaining systems that evolves over time and space, is foreshadowed by precursor events, subject to varying degrees of political and/or societal attention, and impartially or insufficiently addressed by authorities" (2020, p. 122). Another way of categorising climate risks is as a wicked problem (Engen et al., 2021, p. 293), which

are problems that are difficult to solve due to their complex and intertwined nature (Rittel & Webber, 1973).

Climate risk is risk related to the consequences of changes in the climate (Engen et al., 2021, p. 289). Climate risk can be divided into three risk representing parts (Carney, 2015; NOU 2018: 17):

- Physical risks are the physical changes and consequences of climate- and weather-related events. Including rising temperatures, droughts, floods, storms and rising sea levels. In this perspective lie both the acute changes that extreme weather causes us, but also the long-term changes of climate change, such as changed growing seasons and acidification of the ocean,
- Transition risks are risks linked to international agreements, technological development and changes in the market that have been made to deal with climate change. Examples are opening rivers in cities to deal with torrential rain or implementing international climate agreements.
- Liability risks are risks from not accounting for or planning for the consequences of climate change. This could, for example, be a lawsuit against a municipality for not having taken sufficient account of the risk of avalanches or a lawsuit against states for having contributed to the escalation of climate change.

Renn proposed a categorisation of risk, where he uses different classifications of types of risk are used to say something about strategies and stakeholders' involvement in the proposed handling of the risk (2008):

1. Linear risk problems
2. Complexity induced risk problems
3. Uncertainty induced risk problems
4. Ambiguous induced risk problems

Linear risk problems are simple risk problems with a low grade of uncertainty, where the central aspect of the risks is known. According to Renn, such risks hardly require any form of deviation from traditional decision-making. Complexity induced risk problems are often characterised by complicated combinations of cause and effect. The complexity of the risk refers to the causal connections between the risk agent and the risk-absorbing system and its vulnerabilities (Renn, 2008, p. 178). Uncertainty induced risk problems are risks where the

extent of the risk is not known, requiring the management to implement hazard criteria's. Ambiguous induced risk problems refer to how risk is interpreted differently among different stakeholders. In order to solve such risks, a broad inclusion of stakeholders is required (Renn, 2008). To illustrate, Renn created a model:

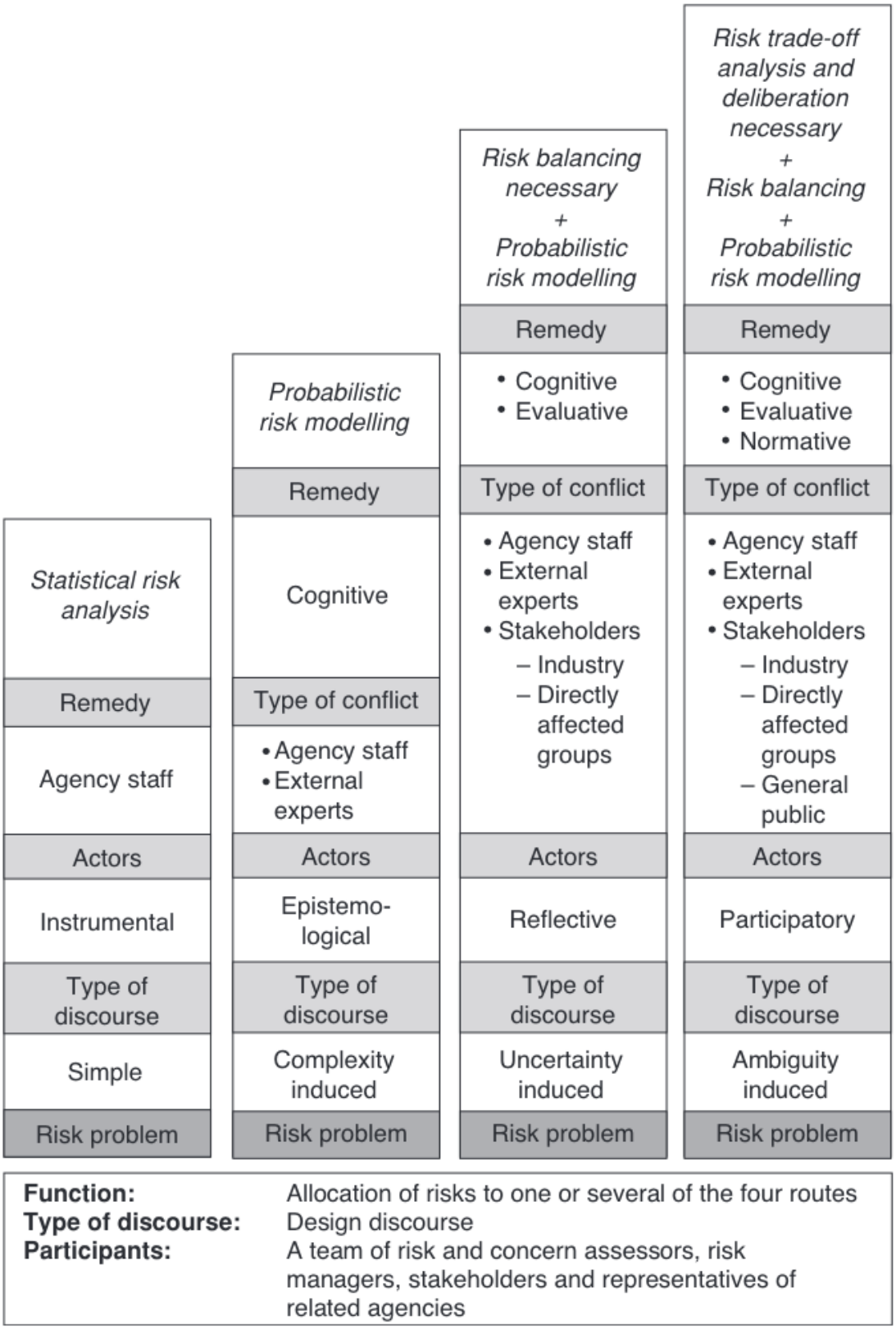

Figure 7 The risk mangement escalator and stakeholder involvement (Renn, 2008, p. 280).

Another way of classifying climate risks are as systemic risks, a term first introduced by The Organization for Economic Co-operation and Development in 2003 as a response to the changes in risks nature and context that they appear in and a need for a new approach to handle such risks (2003). Systemic risks can be defined as "the risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components, and is evidenced by comovements (correlation) among most or all the parts" (Kaufmann & Scott, 2003, p. 371). Climate change's contribution to higher frequency and intensity of natural hazards, combined with increasing population and population density and mutual dependencies in social, technological, and cultural hazards, are some of the main drivers for systemic risks. While rapid urbanisation and the pressure it puts on infrastructure in the cities are some of the vulnerabilities Renn highlights in this type of risk (2008).

Systemic risks are characterised by being:

1. Global in nature.
2. Highly interconnected and intertwined, which leads to complex causal structures.
3. Non-linear in the relationship between cause and effect.
4. Stochastic in their effect structure.

(Renn, 2015, cited in Renn, 2016, p. 29).

It is the interaction between the properties that creates the systemic risks. According to Renn, the characteristics of systematic risks mean that traditional risk management methods are insufficient. As a solution to the governing of systemic risks, Renn suggests using The Risk Governance Framework (Renn, 2016).

4.2 RISK GOVERNANCE FRAMEWORK

The understanding of risk as a concept in this thesis creates a need for a framework in which climate risk can be governed. Through the years, several types of frameworks have been proposed, including The Social Amplification of Risk Framework (Kasperson et al., 1988), The Consequence- Uncertainty Framework (Aven, 2010) and ISO 31000 (Standard Norge, 2018). The Risk Governance framework offers a transdisciplinary way of governing risks. It offers a comprehensive framework for creating and obtaining knowledge about risk and making decisions about how it should be handled (Renn, 2008, p. 364).

The framework is considered particularly useful for managing systemic risks (Aven & Renn, 2010, p. 55) and is used as a framework for managing risk in Arct-Risk (Norwegian University of Science and Technology, n.d.). The Arct-Risk research project outlines six key elements of risk governance. These include: (1) framing processes to address current knowledge of the issue at hand, (2) sensing systems to gather real-time and long-term data on risk, (3) sensemaking processes to interpret this data, (4) decision-making to weigh conflicting alternatives and formal requirements, (5) risk treatment to implement risk-reducing measures, and (6) risk communication and stakeholder involvement throughout the whole governance process. For this thesis, the main emphasis will be on systemic risks and risk communication

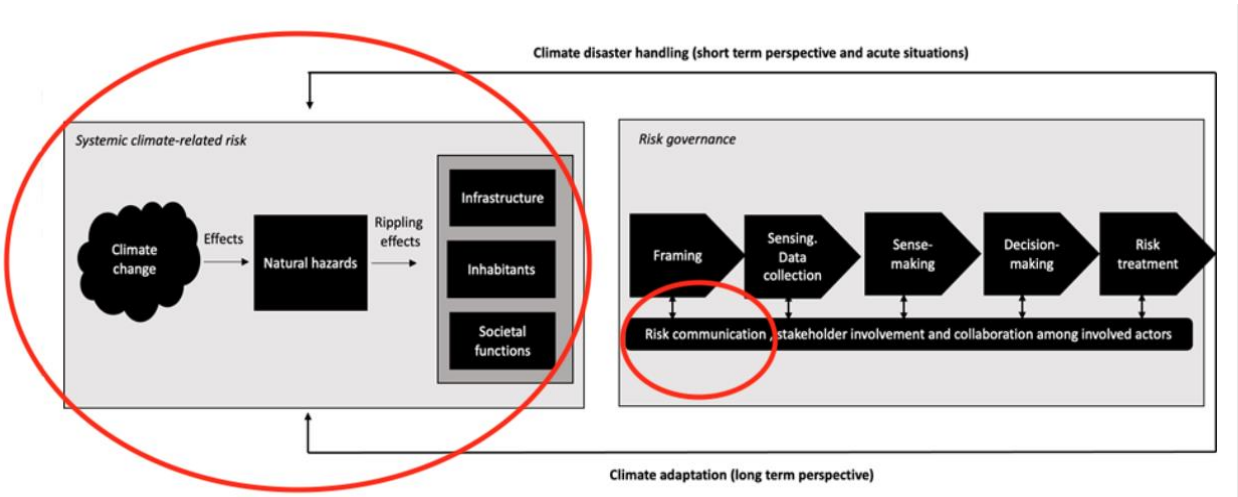

Figure 8 Framework for risk governance in Arct-Risk with emphasis on systematic risks and risk communication [red circles are add-ons and not in the original model] (Norwegian University of Science and Technology., n.d.).

Arct-Risk differentiates between climate disaster handling (i.e., short-term perspective) and climate adaption (i.e., long-term perspective). The former involves dealing with the adverse effects in the short and medium run, such as evacuating vulnerable areas due to the likelihood of snow avalanches. The latter pertains to the long-term processes of adapting to the actual changes in climate and their impact on society, as explained by the Norwegian University of Science and Technology (n.d.).

4.3 RISK PERCEPTION

Risk perception refers to people's subjective perception of risk. The term refers to how we physically perceive the world around us and the mental processes that underlie how we

interpret risk (Engen et al., 2021, p. 108). Humans act mainly based on perception, not facts (Renn, 2008, p. 93). Research has shown that people perceive risk differently based on the context in which it is used (Boholm, 1998; Drottz- Sjöberg, 1991; Renn, 2004; Slovic, 1987). In the context of this thesis, this is interesting to look at in more detail because how people perceive risk determines how they act on the risk (Boyesen, 2003, p. 4). The perception of climate risk's effects is primarily related to the perception of natural hazards. A literature review of European studies after the year 2000 on risk perception of natural hazards and disaster preparedness found two factors to have a significant influence on how individuals perceive natural hazards:

1. Personal experience

   Personal experience is the most significant factor in how people perceive natural hazards. Wachinger et al.'s literature review found that people with personal experience of hazardous events were more concerned about such dangers and risks than those without experience of such events.
2. Trust in authorities and experts

   When people trust the authorities, they are more likely to trust warnings and take them seriously. This factor becomes more significant if the people do not have their own experiences with the risk because the more an individual thinks they know about a risk, the less they trust the government (Wachinger et al., 2013).

A paradox is that trust can lead to vulnerability due to reduced risk awareness because long periods without dangerous incidents can create a false illusion of safety. This is a challenge for public authorities because it is a goal in itself to show citizens that you have control over threats and dangers in society (Kruke et al., 2005, p. 14). Research shows that public beliefs about climate change and global warming are highly influenced by local temperatures (Egan & Mullin, 2012; Hamilton & Stampone, 2013; Joireman et al., 2010; Zaval et al., 2014). When the weather is warm, the number of articles about climate change and people's concerns about climate change increases. However, when the weather is cold, people's concerns cool (Donne & McDaniels, 2013, p. 549).

Several factors determine how people perceive risk. Based on research on psychological, social, and cultural factors within risk perception, Renn & Rohrmann developed a framework for the perception of risk. According to them, people's risk perception is mainly influenced by four elements (2000):

Level 1: Heuristics of information processing

The first level comprises collective and individual heuristics, i.e. mental shortcuts, that the brain allows the individual to have without having the complete picture that people apply in the risk judgement formation. Heuristics deal reasonably with strategies based on common sense that have developed through biological and cultural evolution, and research that has been done in this field shows a high degree of universality in using these heuristics across different cultures.

Level 2: Cognitive- affective factors

The second level is cognitive and affective factors that influence the perception of specific conditions for the relevant risk. The perceived truth about a risk is governed by the characteristics of the risk (i.e. dread or the option to personally control the risk) and helps to determine how the individual assesses the severity and whether the risk can be accepted. The ambiguity in the interpretation of the risk is resolved through a focus on the characteristics that send the strongest affective signals.

Level 3: Socio-political institutions

The third level deals with the social and political institutions that groups and individuals associate with either the cause of risk or the risk itself. In research done at this level, the focus has primarily been on social and political structures, socio-economic status, organisational constraints, personal and social value commitments and trust in institutions. Social reference groups, organisations and media are also contributing to shaping the individual and societal experience of risk. Whether the risk is perceived as fair will also determine how the individual judges it.

Level 4: Cultural background

The fourth and final level refers to cultural factors which govern and co-determine the influence of the many lower levels. There are some disagreements regarding this level (Sjöberg, 2000; Slovic et al., 2000). However, all these researchers agree that specific culture-based preferences and bias are significant factors in risk perception. The levels are divided into two subsections collective influences and personal manifestations. Furthermore, the levels should not be viewed as isolated from the others, as they often act as a continuous process and often complement each other (2000, cited in Renn, 2008, p. 141).

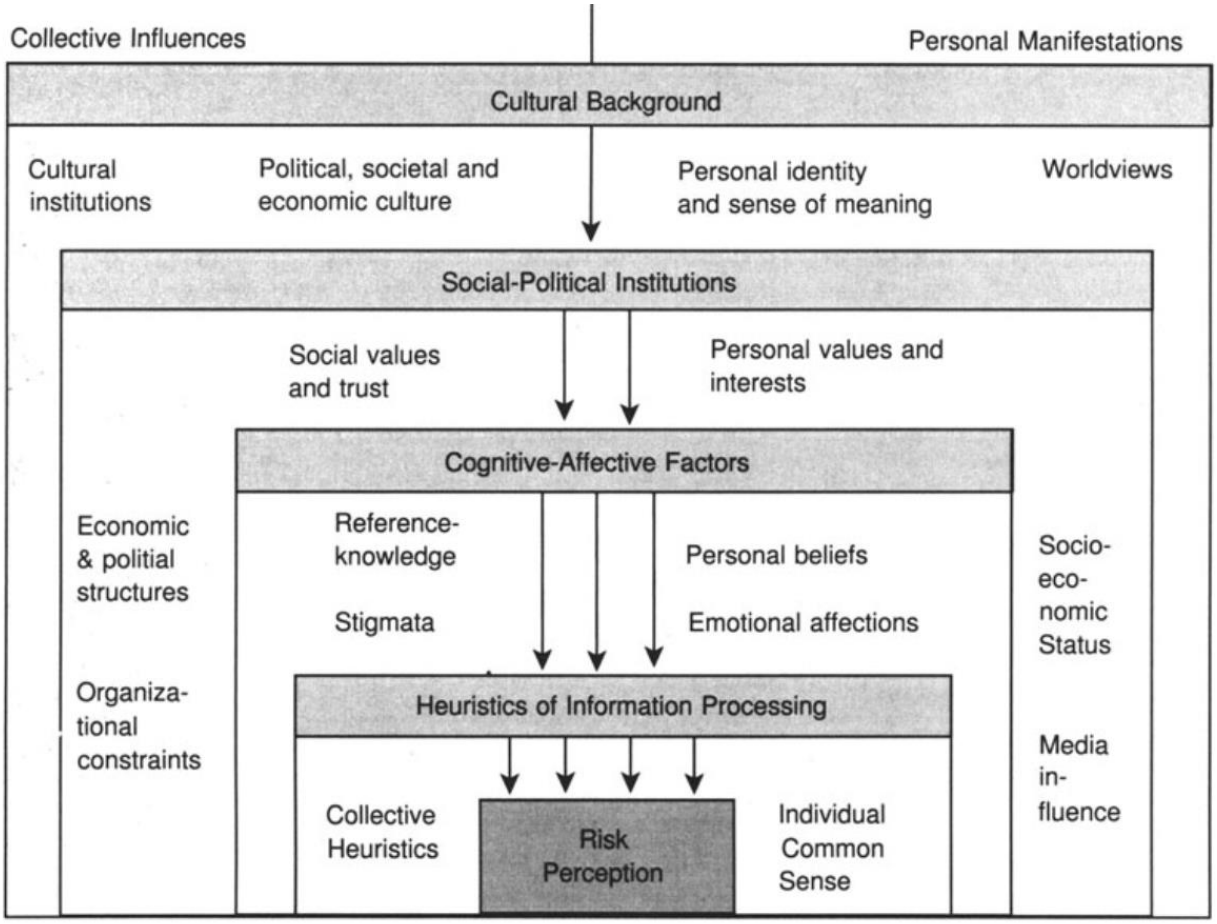

Figure 9 Four context levels of risk perception. From "Cross-Cultural Risk Perception: State and Challenges," by O. Renn and B. Rohrmann, 2000, *Technology, Risk, and Society, 12*, p. 221. (https://doi.org/10.1007/978-1-4757-4891-8_6).

4.4 RISK COMMUNICATION

In its simplest form, communication is the process where a person, group, or organisation (sender) transfers some form of information (message) to another person, group, or organisation (receiver), where the recipient(s) get some kind of understanding of the message (Kaufmann & Kaufmann, 2015, p. 395). Written sources on the theoretical basis of communication can be traced back to Ancient Greece and Aristotle's treatise Rhetoric (2000). Since then, several theories and models of communication have been developed. Among the best-known models is Shannon & Weaver's mathematical theory of communication, which describes communication as a model of information transfer consisting of five elements: an information source, a transmitter, a channel, a receiver, and a destination (1949, p. 7). However, the model is a tool that outlines the communication process rather than a factual representation of how communication is organised in society (Renn, 1992, p. 469). Figure 10 displays the key actors involved in risk communication within the traditional communication

model. The sources of risk-related information typically include scientists and scientific institutions. Interest groups and eyewitnesses are also essential sources in the event of hazardous incidents, and they code information, which is then transmitted to transmitters or final receivers (Renn, 1992, p. 469).

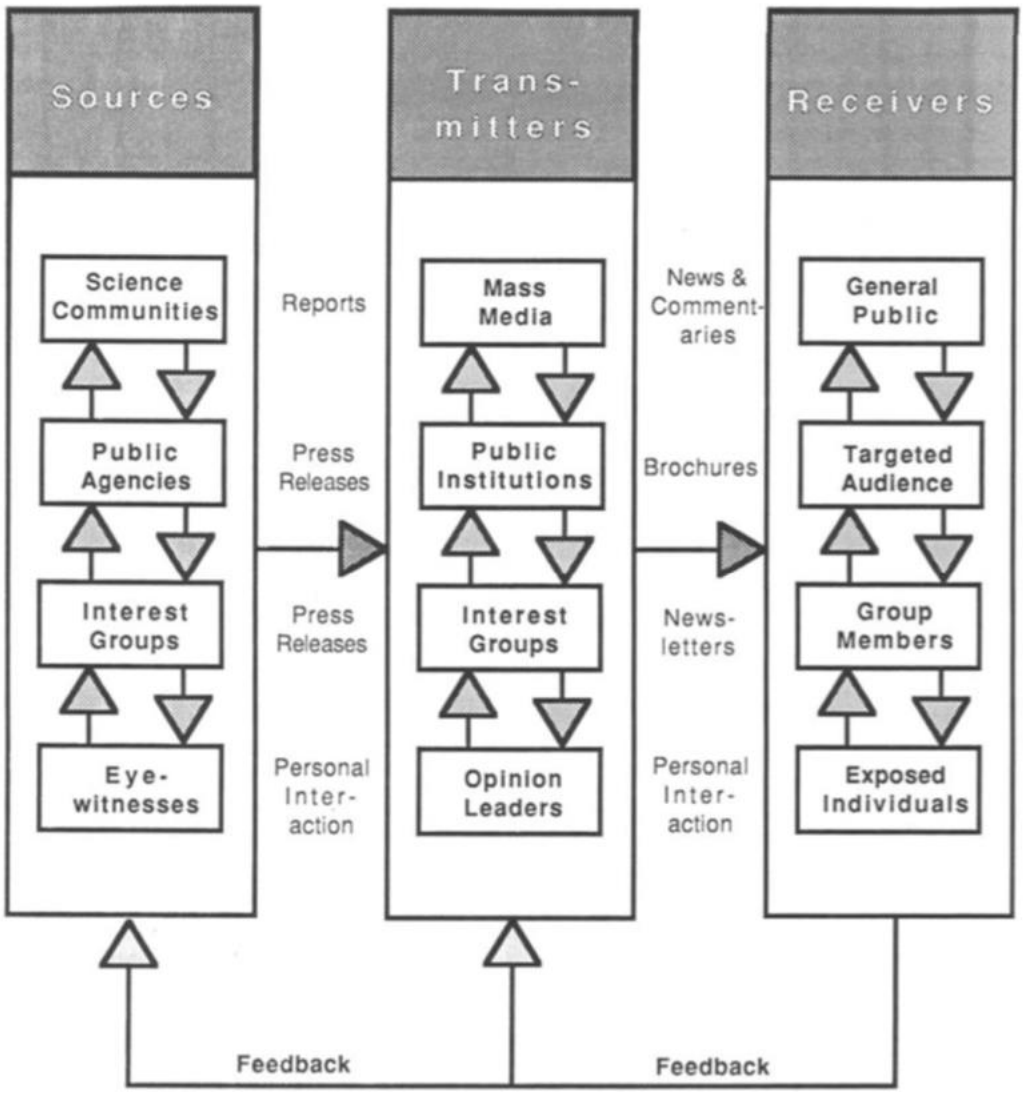

Figure 10 Organizational structure of risk communication. From "Risk communication: Towards a rational discourse with the public," By O, Renn, 1992, *Journal of Hazardous Materials, 29,* p. 470 (https://doi.org/10.1016/0304-3894(92)85047-5)

Transmitting stations undergo a coding and recoding procedure during the second step of the model. There are various potential transmitters of risk-related information, such as media, public institutions, interest groups, and opinion leaders. The final stage involves decoding the

messages received by the recipient. The data will be presented to each target audience uniquely to capture their interest and meet their expectations. At this point, the approach varies based on the type of recipient (Renn, 1992). Central to the discussion about the communication process is whether it should be one-way or allow both sender and receiver to be active in a two-way communication. Today, however, there is a precedent that in order to be successful, risk communication must consist of a two-way process (Engen et al., 2021; Leiss, 1996; Renn, 1992).

Risk communication can be defined as communication

[...] about possible unwanted incidents and situations that may involve harm to life, health, environment and items of value. The aim is to make the recipients aware of possible risks and incite them to change their ways of doing things, in order to prevent these incidents from happening or diminish their negative consequences. (Ministry of Government Administration and Reform, 2009, p. 17).

Risk communication is a tool to:

- Ensure involvement, responsibility and understanding among stakeholders that are relevant to the risk management process (internal risk communication); and
- Make sure that people not directly involved in the risk management process are informed and involved (external risk communication (Renn, 2008, p. 202).

With successful risk communication, the authorities can increase the population's knowledge of the risk and make them better able to handle the risk (Renn, 2008, p. 203). The term is often used synonymously with the term crisis communication, which is communication whose purpose is to get the actors to adapt their behaviour to the information that is communicated in a crisis (Engen et al., 2021, p. 369). Nevertheless, there are some key differences between the two. Table 1 illustrates some key features of risk communication and crisis communication. Risk communication in this thesis is understood as communication about something that can develop into a crisis, while crisis communication is communication related to an emerging crisis. Undirected information about avalanche danger in a mountain will be considered risk communication. If the avalanche does happen and it affects something people value (human life, buildings, economic consequences, etc.), it will be considered crisis communication. The connection between the two terms is strong: risk that is not handled adequately can lead to a crisis, and during an ongoing major crisis, risk communication will

have a central role (Coombs, 2015). In this thesis, both terms will be elucidated, but the main emphasis will be placed on risk communication, as risk is the main topic of the thesis.

Table 1 Distinguishing features of risk communication and crisis communication. From "Introducing a Message- Centered Approach to Risk Communication," by M. Seeger et al., 2003, as cited in T. L. Sellnow et al., 2009, *Introducing a Message-Centred approach to Risk Communication*, p. 4. http://dx.doi.org/10.1007/978-0-387-79727-4_1

Risk Communication	**Crisis Communication**
Risk centred: Projections about some harm occurring at some future date.	Event centred: Specific incident that has occurred and produced harm
Messages regarding known probabilities of negative consequences and how they may be reduced.	Messages regarding current state or conditions: Magnitude, immediacy, duration, control/ remediation, cause, blame, consequences
Based on what is currently known	Based on what is known and what is not known
Long- term (pre- crisis stage) Message preparation (i.e., campaigns)	Short term (crisis stage) Less preparation (i.e., responsive)
Technical experts, scientists	Authority figure, emergency managers, technical experts
Personal scope	Community or regional scope
Mediated: Commercials, ads, brochures, pamphlets	Mediated: Press conferences, press releases, speeches, web sites
Controlled and structured	Spontaneous and reactive

5.0 METHODOLOGY

This chapter will elaborate on the methodological approach chosen to answer the thesis research problem and research questions. Research methods comprise the techniques and actions employed in identifying, gathering, creating, arranging, and interpreting data (Blakie & Priest, 2019, p. 10). Qualitative data is employed in this study to answer the thesis research problem and questions. A qualitative methodology was employed in this thesis because it is considered to be a method that allows the researcher to go into the depth of social systems and explore the data in the field from which they are obtained (Blaikie & Priest, 2019).

5.1 RESEARCH DESIGN

The research design is a critical component of all research and describes how the researcher goes from the research problem to the empirical findings and on to the conclusion. Yin has defined it as "*a logical plan for getting from here to there*, where *here* may be defined as the set of questions to be addressed, and *there* is some set of conclusions about these questions" (Yin, 2018, p. 26). The research problem- and questions determine which research design will be used (Grønmo, 2016, p. 89). The study aimed to identify how Longyearbyen, Nordkapp and Oslo public authorities perceived and communicated climate risk. A combination of document analysis and interviews was found most suitable to do this. Therefore, a case-design approach was chosen, as it is regarded as applicable when examining several types of data (Yin, 2018, p. 15). This empirical method explores a phenomenon (case) within the context of the real world (Yin, 2018, p. 15). For this thesis, perception and climate risk communication is the phenomenon, and Longyearbyen, Nordkapp and Oslo are the contexts in which it is examined.

5.2 RESEARCH STRATEGY

Research strategy refers to the steps or logic of inquiry the researcher chooses to address the research questions and is considered the second most important research design decision. Blaikie & Priest addresses four different types of logics of inquiry which can be used to answer the research questions: Abductive, Retroductive, Deductive and Inductive logics (2019, p. 21). The research questions in this thesis are based on "how" and "what" questions. According to Blaikie and Priest's definition, an abductive research logic is well suited to answering "what" questions. All the different research logics can answer questions based on

"how" (2019, p. 112). An abductive logic seeks to find out why people do what they do by uncovering the largely tacit, mutual knowledge, symbolic meanings, intentions and rules that guide their actions (Blaikie & Priest, 2019, p. 99), considering this and the different logics of inquiry and the purposes they can serve (Blaikie & Priest, 2019, p. 113), my understanding is that an abductive logic is most appropriate to use as the inception for the research problem-, and questions is to understand, explore and describe the phenomenon of perception and climate risk communication in different contexts.

5.3 ARCT-RISK

This master's thesis is part of the research project Arct-Risk on Svalbard, which is a collaboration between the University Centre of Svalbard, the University of Stavanger, the Norwegian University of Science and Technology, the Samfunnsforskning Department at the Norwegian University of Science and Technology and SINTEF (Norwegian University of Science and Technology, n.d.). In the autumn semester of 2022, I took three courses in Arctic Safety at The University Centre in Svalbard, which led to this opportunity. The main objective for Arct-Risk is "to develop knowledge and tools to make sense of and deal with effects of climate change on society's ability to protect the life and health of its citizens and to maintain critical infrastructure and function" (Norwegian University of Science and Technology, n.d.).

The research project is interdisciplinary and consists of both technological, natural science, social science, and safety science perspectives to develop approaches to risk management to reduce systemic risks. Five work packages have been selected to reach the main objective. This master's thesis is a part of work package 5, Transferability and innovation potentials, which aims to answer research question 7 (RQ7) of the project "How can experience from climate change adaptation in an Arctic Settlement contribute to climate adaptation in communities which have not yet experienced the full effects of climate change" (Norwegian University of Science and Technology, n.d.). The research problem and questions were developed after dialogue with researchers at the Arctic Safety Centre in Svalbard and the thesis supervisor.

5.3 SELECTION OF CASE

The problem statement and research design changed somewhat during the project. Initially, the purpose was to obtain information about perceived risk from climate change and experience in receiving climate risk communication from local authorities in Svalbard and Oslo and compare this with strategies and goals for communication from these local communities. This was changed in dialogue with the supervisor as it was considered likely that it would be difficult to get answers to a survey among the inhabitants in Longyearbyen as there had already been a group of students who had collected answers, and that the challenge to get sufficient answers to surveys from the inhabitants of Longyearbyen was known from another master's thesis in the Arct – Risk project (Aakre, 2022, p. 38). After dialogue with the supervisor, I chose instead to lift the focus and focus primarily on the role of public authorities, risk perception and risk communication of climate risk. In addition, Nordkapp was included as a context to explore the phenomenon because the municipality is part of the Arct-Risk research project. The thesis consists of both primary and secondary data sources. Primary data in this thesis comes from interviews with three informants in Longyearbyen, Nordkapp and Oslo. The choice of informants was made based on relevance to the study considering the informants' experience and knowledge of climate risk and communication of climate risk in the various contexts. The choice of secondary sources for data was made based on the relevance of these documents to answering research question 1.

5.4 RESEARCH METHODS

5.4.1 Document study

Documents as a data source can be used in qualitative research by identifying phenomena and establishing connections (Blaikie & Priest, 2019, p. 203). Before I began the collection of data, I used the research problem and research question 1 to clarify a focus and identify a purpose for the document study. Grønmø refers to this as the most essential part of a document study as this type of data collection is characterised by great flexibility (2016, p. 175). While finding the documents for the study, documents were continuously systematically assessed and rejected or retained. A review of public data on the consequences of climate change in Norway revealed that these were mainly based on climate projections from the IPCC's fifth main report and the climate projections in the report «Climate in Norway 2100». Much of the data overlapped, and I, therefore, limited the data to a few documents that dealt with climate concretely. In Table 2, the selected documents are presented, where a Norwegian

version of the document is used an English translation is appended to the name of the document.

Table 2 Documents for analysis

Document	**Author/ publisher**	**Year**
Central Government Communication Policy	Ministry of Government Administration and Reform	2009
Climate in Svalbard 2100	Hanssen- Bauer et al.	2019
Forskrift om kommunal beredskapsplikt/ Regulation relating to municipal preparedness duty	Lovdata	2011
Forskrift om sivilbeskyttelsesloven på Svalbard/ Regulation on preparedness for Longyearbyen local government	Lovdata	2012
FylkesROS for Troms og Finnmark 2022-2025/ Risk and vulnerability analysis for Troms and Finnmark	Statsforvalteren i Troms og Finnmark	2022
Klima i Norge 2100/ Climate in Norway 2100	Hanssen- Bauer et al.	2015
Klimaprofil for fylker/ Climate profile for counties	Hisdal et al.	2021
Klimasårbarhetsanalyse for Oslo/ Climate vulnerability analysis for Oslo	Klimaetaten	2020
Kommunalt risikobilde 2021/ Risk and vulnerability analysis for Oslo	Beredskapsetaten	2021

Plan og bygningsloven/ The Planning and Building Act	Lovdata	2008
Sivilbeskyttelsesloven/ The Civil Protection Act	Lovdata	2010
Svalbardmiljøloven/ The Svalbard Enviromental Act	Lovdata	2001
SvalbardROS 2022-2026/ Risk and vulnerability analysis for Svalbard 2022-2026	Sysselmesteren på Svalbard	2022
The Constitution	Lovdata	1814

5.4.2 Interviews

The interviews were conducted as semi-structured interviews where the questions were predefined but where the informant had room to elaborate and take other paths if necessary. This is one of the strengths of semi-structured interviews because it provides opportunities to examine specific dimensions of what is to be studied, while at the same time, the method creates space for the informants to give new opinions to what is being studied (Blaikie & Priest, 2019; Galletta, 2013). According to Galletta, a challenge when conducting semi-structured interviews is regulating the time spent on each question. Therefore, the interviewer must attentively listen to the informant's story and steer the conversation towards the intended topic of investigation, depending on their progress thus far (2013, p. 76). Table 3 presents the informant's workplace, role, date, and time used in the interviews.

Table 3 Informants

Place of employment	**Role**	**Date**	**HH: MM**
The Governor of Svalbard	Adviser	21.04.2023	00:48
Nordkapp municipality	Adviser in the administration	20.04.2023	00:54
Municipality of Oslo	Adviser in the Agency for Climate	18.04.2023	00:47

Before conducting the interviews, I prepared an interview guide based on the research questions and the theoretical framework for the thesis. The interview guide was then sent to Sikt – together with a plan for the handling of personal data, which is mandatory when processing personal data in a research project as a student at the University of Stavanger (Sikt, n.d.; Universitetet I Stavanger, 2021). I had the opportunity to travel physically to conduct all the interviews. After some consideration, I chose not to do this for a variety of reasons, including climate impacts, where I found it difficult to defend the climate footprint these journeys would entail when I, after all, was writing a thesis on climate change, but also because it would have taken much time to travel. Digital interviews have advantages in that they are cost-effective, save time and increase the flexibility of the informant and the researcher. At the same time, research shows that technical challenges and the lack of opportunity to read body language can contribute lack of richness as opposed to physical interviews (Thunberg & Arnell, 2021). On the other hand, I was not to collect sensitive data that would potentially require more attention to the informant's body language. Therefore, conducting interviews digitally was found sufficient.

All informants were sent the interview guide in advance and a description of the project. As the interview dates approached, I lost Wi-Fi access at home. This meant I had to rely on the mobile network during the interviews. Ahead of the interviews, I spent a lot of time testing that the technology worked, and I made plans for what to do if using the mobile network on several devices did not work. All interviews were done with a recorder approved by Sikt, which all the informants approved before the recorder was switched on. In addition, I noted down key aspects during the interview.

5.4.3 Data analysis

Standardised analytical techniques for the examination of qualitative data do not exist. Qualitative data analysis is characterised by more flexibility and more general strategies than quantitative data analysis (Grønmø, 2016, p. 265). After the selection of data for the document study, I was left with an enormous amount of extensive and unorganised text. This is a characteristic of data material in qualitative studies, according to Grønmø, which refers to coding as an essential procedure for creating an overview of the content of the texts (Grønmø, 2016, p. 266).

The data analysis from the document study began with creating some overall categories for the data collection. These were: most important consequences of climate change, effect on the risk picture, uncertainties, and physical consequences. This was followed by a systematic review of each document, where relevant aspects of the documents were highlighted and put in the analysis form. The systematic review of documents created a basis for the establishment of subcategories. This process was done in parallel with the selection of texts and was inspired by Grønmo's suggestion for the content analysis of qualitative data (2016).

The analysis of the interviews was carried out in a three-part process: First, I transcribed the interviews, which is a method for analysis as the review of the audio file can give the interviewer a comprehensive understanding of the material being transcribed (Seidman, 1998, as cited in Weelard & McKenna, 2002, p. 183) and highlighted elements during the transcription process that I thought would be relevant for the further analysis process. I then summarised each interview; in the summaries, questions from the interviews were used as a headline and a small summary of the main essence of the informant's answers to these questions was added.

Because a qualitative interview can provide answers to the same question several times (Galletta, 2013, p. 78), I added a timestamp under each summary to easily find where information or quotes were taken from. Initially, the reason for choosing this method was that, as participants in the master's thesis, the informants had the right to gain insight into information about themselves. This method ensured that they could get a structured overview of how I had interpreted them in light of the interview. A final argument for choosing this method was that it gave me another arena to review the interviews. Grønmo points out that repeated readings of the material will help give the researcher a deeper insight into the material (2016, p. 266).

Interpretive coding was the starting point for the last part of the analysis process and contributed to an understanding of the content of the interview in light of a larger contextual context (Grønmo, 2016, p. 267). Based on the thesis' research problem and questions, I found using the following key theoretical terms most appropriate: informant's understanding of risk, role in the risk management process, risk communication and uncertainty. Subcategories were added to split up the text material further. I combined this with ongoing analytical notes. The three-part process ensured that the material was read through several times and contributed to reflection on the material.

5.6 VALIDITY AND RELIABILITY

Validity and reliability are criteria for the quality assessment of data (Grønmø, 2016, p. 261). The results from qualitative studies can be more fluid than from quantitative studies because the research design is developed during the study and partly depends on how the researcher interprets and analyses the collected data (Blaikie & Priest, 2019). Therefore, during the entire writing period, I have been conscious of taking field notes and describing the choices I have made for the thesis along the way so that I could go back in my notes to investigate why I made the choices I made for the thesis. This is in line with strategies for improving data quality in qualitative studies presented by Grønmø, thorough field notes and systematic adaptation of the data collection (2016), but also the General guidelines for research ethics, number 1 on the quest for truth, wich states that honesty, openness, documentability and systematicity are fundamental prerequisites for obtaining new knowledge (The Norwegian National Research Ethics Committees, 2014).

Reliability is about the reliability of the data material and is considered high if, using the same methods, the same results are obtained. The concept is usually divided into two main types to assess the study's reliability, stability and equivalence. Stability is about whether the research design is stable over time. It is an expression of the data material not being influenced by who uses the research design. If there is a great deal of agreement between data on the same phenomenon that has been collected using the same research design but by different people, the reliability in the form of equivalence is considered high (Grønmo, 2016). As described in Chapter 5.4.3, I reviewed the data material from the document analysis and the interviews several times, which can contribute to increasing the study's stability, according to Grønmø, because it provides a basis for assessing whether the database in the study may be influenced by various sources of error (2016, p. 250).

The interviews of the informants were conducted after Easter in 2023. This Easter was characterised by several avalanches and great avalanche danger in large parts of Norway's northern regions, including Nordkapp and Longyearbyen (Elde, 2023; Guttormsen et al.,2023; NRK, 2023). This may have influenced the informants' risk assessment and, thus, the stability of the study. Equivalence has been attempted to be made to ensure transparency around various aspects of the study. This is not limited to the methods chapter but has been attempted to be ensured throughout the study, including in the discussion of limitations for the study in Chapter 1, the ethical reflections in Chapter 5.7 and in the discussion in Chapter 7.

Validity refers to the extent research data measures what it intends to measure, i.e. the research problem. It is an expression of how well the obtained research data answers to the researchers' intentions with the research design and data collection (Grønmo, 2016, p. 241) and can be obtained by using internal- and external validity. Internal validity refers to the accuracy of conclusions regarding cause-and-effect relationships based on the gathered data (Yin, 2018, p. 42). For this, looking to other studies on the same topic has been natural. The internal validity of this thesis can be said to be supported by the study by Wachinger et al. (2013), where this study corresponds with their results regarding risk perception and personal experiences' role in perception. Emphasis on short-term risk communication in Longyearbyen was one of the conclusions from a previous master thesis which coincides with some of the factors found in this study (Aakre, 2022, p. 84).

After each interview, I summarised the main essence of the answers. Upon request, one of the informants was sent a summary of the answers and the transcription. In addition, through the study, I have had a continuous dialogue with the supervisor. These factors, I believe, have strengthened the internal validity of the study. External validity refers to whether the results of the study can be generalised (Yin, 2018, p. 42). Generalisation was not an aim for the thesis. Neither is for qualitative studies (Yin, 2018, p. 38). Nevertheless, there are findings in the thesis that support already existing theories on the subject, and it is conceivable that some of the findings can be transferred to a certain extent to others. For example, that in Nordkapp, it is more important to communicate to those who are not evacuated why they will not be, than to those who get evacuated.

5.7 ETICHAL REFLECTIONS

Since 2019, I have been elected in Oslo municipality, and the Climate Agency, where the informant from Oslo worked, is subject to a department in which my party have the Vice Mayor. This was an impartiality challenge that I was open about and discussed with the supervisor. I explained this to the informant in writing before there was a formal agreement for an interview. I considered this the most honest, in the form that I assessed that it would be easier to withdraw than if this was explained during the interview. I explained to the informant how politically active I had been and which political party I was a member of. I also mentioned that I am not running for re-election at the municipal election in 2023.

Artificial intelligence (AI) has been a subject of debate in academia since the launch of the chatbot ChatGPT in the autumn of 2022 (Cano et al., 2023; Kvalnes, 2023). Therefore, I feel the need to explain my use of such services in this master's thesis: To the extent that ChatGPT was used, it was primarily to test it and see what it could do. For example, I asked it questions and found that it lied and could not provide sources for its claims. I also tried to use it to improve the language in the thesis but found that other writing tools were better at this task. When using ChatGPT, I always worked from the point of view that the activity log had to withstand being seen by a sensor. To the extent that AI was utilised in this thesis, it was as a writing tool to improve the language by using Google Translate, Microsoft Word's built-in editor and Grammarly. None of the services knows "my" subject; therefore, these services have only been a supplement to dictionaries, glossaries, etc. AI was not used in the transcription process. Writing tools were only used on data that had been analysed and thus did not contain personal information.

5.8 STRENGTHS AND WEAKNESSES OF RESEARCH DESIGN

No research design is perfect and will always consist of strengths and weaknesses. I believe the choice to use a qualitative method is a strength, as a quantitative method would not have had the same characteristics to go in-depth into the phenomenon I wanted to investigate. I believe my interest in the topic and the fact that I have previously worked with strategic communication was a strength for the study. Living in Longyearbyen and Oslo also gave me insight into these places beyond what can be read. The dialogue I have had with my supervisor has been good, which I believe has improved the thesis. I think that my experience in politics has contributed to insight into how and why decisions are made at different levels, which I believe has been a strength in this assignment because Longyearbyen, Nordkapp and Oslo are governed differently. I found that the interviews, in combination with the document analysis, gave a high level of insight into the phenomenon I was studying. The amount of data eventually became large, but the negative effects of this, such as lack of manageability, I felt were minimised by the fact that I was careful to document the choices I made through field notes.

A weakness has been that I have not had a dialogue with fellow students about the assignment. Apart from my stay in Longyearbyen, I lived in Oslo because I started my studies during the Covid-19 pandemic. Therefore, I have had less informal dialogue than I would have had the opportunity to if I lived in Stavanger. Not living at the place of study also meant

I had less access to library resources, creating frustration at the beginning of the study. However, it turned out that The University of Oslo Library had a lot of relevant literature for this thesis. Some will also point out that the proportion of informants should have been higher or that I should not have limited myself to one informant from each place. This could have strengthened the generalisation. At the same time, the limitation in the proportion of informants meant that I could go more in-depth into the answers from the informants.

The knowledge base about Nordkapp is less than in Longyearbyen and Oslo regarding climate risks. The last two have their own climate analyses of themselves, and extensive amounts of data cover both places. The sources about Nordkapp were less specific, and often Nordkapp was treated as part of Finnmark, a county where the climatic conditions are very different from one place to another. This has been a weakness in the data material dealing with Nordkapp. Another weakness is that I have never been to Nordkapp, and my knowledge is based on what I have been able to read and dialogue with the informant and others who have knowledge of the place.

6.0 RESULTS & ANALYSIS

This chapter presents the results that will form the basis of the discussion in Chapter 7. First, the results from the document analysis are presented in Chapters 6.1 and 6.2, followed by key findings from the interviews with the informants from Longyearbyen, Nordkapp and Oslo.

6.1 LAWS AND POLICIES

6.1.1 The Constitution of the Kingdom of Norway

The fundament for communication from state authorities in Norway is found in The Constitution §100, sixth paragraph, which states, "The authorities of the state shall create conditions that facilitate open and enlightened public discourse" (1814).

6.1.2 Central Government Communication Policy

The communication policy is based on The Constitution and contains central goals and principles for public authorities' communication with citizens, businesses, non-governmental organisations and other public agencies. The document states that the goal of risk communication is "to make the recipients aware of possible risks and incite them to change their ways of doing things in order to prevent these incidents from happening or diminish their negative consequences" (Ministry of Government Administration and Reform, 2009, p. 17). It is recommended that before a risk evaluation is done, a precautionary approach in its communication should be considered by public authorities. After the risk evaluation, risk communication should consist of specific advice on what is considered desirable action by each individual (Ministry of Government Administration and Reform, 2009, p. 17).

The aim of the central government communication policy is threefold; First, it emphasises that the information that citizens get about their responsibilities, rights and opportunities should be correct and precise; goal number two states that citizens shall be secured access to information about the government's activities. The last goal states that citizens should be invited to participate in formulating policies, arrangements and services (Ministry of Government Administration and Reform, 2009, p. 8). To achieve these objectives, certain premises are added. Among other things, these say that public authorities should have knowledge about the targets groups for communications needs, prerequisites and points of view, that the language used should be well written and clear so that everyone can understand

it and that public authorities have to communicate and inform in a goal-oriented and effective way so target groups can be reached (Ministry of Government Administration and Reform, 2009, p. 8). The communication policy outlines five principles for what is considered good communication: openness, participation, reaching all, active and coherency. In addition, the communication policy states that internal communication must be open and built on trust and mutual respect (Ministry of Government Administration and Reform, 2009).

6.1.3 The Civil Protection Act

Paragraph 14 of the Civil Protection Act requires Norwegian municipalities and Longyearbyen to carry out a risk and vulnerability analysis where they map out which unwanted events may occur, assess the likelihood of these events occurring and how they will, if so, affect the municipality/Svalbard (Sivilbeskyttelsesloven, 2010). Based on the overall risk and vulnerability analysis, a contingency plan must be drawn up with an associated plan for population notification (Forskrift om kommunal beredskapsplikt, 2011; Forskrift om sivilbeskyttelsesloven på Svalbard, 2012).

6.1.4 The Planning and Building Act

The Planning and Building Act is the municipalities' most important tool in managing climate risk because it provides frameworks and guidelines for future land use. The purpose clause § 1-1 emphasises that the Act shall promote sustainable development for the benefit of the individual, society and future generations. Paragraph 3-1 g legislates requirements to consider climate change through reducing greenhouse gas emissions and adaptation to expected climate change through energy supply, land use, and transport. In § 4-3, requirements to perform risk and vulnerability analyses when preparing development plans are stated (Plan- og bygningsloven, 2008).

6.1.5 The Svalbard Environmental Act

Longyearbyen is not subject to the Planning and Building Act. There, it is the Svalbard Environmental Act that provides the basic guidelines for land use on the archipelago. The purpose of the law, as stated in §1, is to maintain an almost untouched environment on Svalbard in terms of contiguous wilderness, landscape, flora, fauna, and cultural heritage. Per § 49, the land use plan must contain a plan description that explains how consideration for the

environment (natural environment, cultural heritage, and aesthetics) and the local community (safety and children's needs) is taken care of (Svalbardmiljøloven, 2001).

6.2 CLIMATE CHANGE EFFECT ON RISK

The climate risk projections in the document analysis are primarily based on climate projections carried out by the Norwegian Centre for Climate Services, where risk is understood as "a measure that combines the probability and impact of an event" (Hanssen-Bauer et al., 2015, p. 143). Uncertainty in the projections is linked to three main categories (Hanssen-Bauer et al., 2015):

1. **Future emission scenarios caused by humans.**
   How significant emissions will be in the future is unknown, and it depends on socio-economic factors such as the choice of energy sources and the future economy.
2. **The natural variations in the climate system.**
   The climate system is complex and unpredictable; therefore, it is difficult to accurately predict future changes in natural events like solar radiation and volcanic eruptions.
3. **The inherent uncertainty in climate models.**
   The ability to implement our comprehension of the climate system in a mathematical framework is limited, and we do not have enough computing power on today's supercomputers.

6.2.1 Longyearbyen

Climate change represents one of the biggest threats to society in Longyearbyen and Svalbard, and the archipelago has already experienced several events directly linked to climate change (Sysselmesteren på Svalbard, 2022, p. 7). Since 1971 precipitation has increased by 20% at Svalbard Airport (Hisdal et al., 2021, p. 169), and heavy rainfall counts for 25% of the yearly precipitation at Svalbard Airport (Hanssen-Bauer et al., 2019, p 74). Since 2009, the temperature in the permafrost that covers most of the land area on Svalbard has increased by between 0.06 and 0.15 degrees at a depth of 10 metres, which makes the upper soil layers more unstable and more prone to different types of landslides. Near Longyearbyen, in Adventdalen and at Janssonhaugen, the thickness of the active layer has been measured to increase by 0.6 (sediments) and 1.6 (rock) every year since 2000 (Hanssen-Bauer et al., 2019).

In the coming decade, it is expected that climate change will lead to an increased probability for most types of avalanches and landslides (Hanssen-Bauer et al., 2019, p. 12). The risk and vulnerability analysis indicates that when the safety measures inside Longyearbyen at Sukkertoppen and in Vannledningsdalen are in place, and the slide-prone homes have been vacated, the risk of avalanches and landslides from these places will be assessed as very low. After this, the risk of different types of slides in Longyearbyen will be linked to sea and harbour areas, Nybyen, certain road sections and cottage areas outside the city (Sysselmesteren på Svalbard, 2022, p. 3).

Climate change has meant that Svalbard has experienced a reduction in the amount of sea ice. The document analysis has found several risks that this creates; less sea ice means that the coast becomes more vulnerable to waves (Hanssen- Bauer et al., 2019), and more ice-free areas also mean larger areas where it is possible to travel on Svalbard, which makes the operational area for search and rescue at sea larger. In case of an accident, experience from an emergency preparedness exercise in 2021 showed that the rescue organisations in Longyearbyen have the capacity to care for 200 passengers. However, the hospital in Longyearbyen only has two intensive care beds creating a high vulnerability (Sysselmesteren på Svalbard, 2022).

Towards 2100, it is assumed that Longyearbyen will experience higher temperatures, an increase in avalanche frequency, less permafrost, more erosion, more flooding, increased amount- and increased heaviness in precipitation and an increased amount of different types of landslides. (Hanssen-Bauer et al., 2019; Hisdal et al., 2021; Sysselmesteren på Svalbard, 2022). Unlike most other places on Earth, the sea level will not rise in Longyearbyen. The reason is that the archipelago is in a period of uplift because of the last ice age ~ 20,000 years ago, which means that less ice and snow on the mainland will mean faster land uplift on Svalbard (Hanssen-Bauer et al., 2019). Towards the end of the century, the probability of dry avalanches will decrease in areas where the snow season becomes shorter, and the amount of snow decreases. However, the probability of wet- and slush avalanches increases (Hanssen-Bauer et al., 2019, p. 124).

The uncertainty associated with climate risk on Longyearbyen is primarily linked to how accurately the climate models can calculate the current and future sea ice extent (Hanssen-Bauer et al., 2019; Hisdal et al., 2021). This is because of sea ices important role as a temperature regulator in the Arctic (Hanssen-Bauer et al., 2019, p. 25). For physical

consequences of climate change, the climate profile mentions strong winds, rock falls, rockslides and quick clay slides as uncertain risks (Hisdal et al., 2021, p. 167).

6.2.2 Nordkapp

Vulnerability in critical infrastructure, including roads and power supply, is highlighted as a challenge for Nordkapp in terms of the consequences of climate change. Like many other municipalities in Troms and Finnmark, the road infrastructure is limited, which means that in the event of a nature-related incident, there are limited detour options which creates a high probability of help not getting through in the event of an avalanche, landslide or a flood (Statsforvalteren i Troms og Finnmark, 2022, p. 50). A harsh climate, few inhabitants and limited access to resources, if an unwanted event should occur are characteristic of the vulnerabilities in the region. At the same time, the risk and vulnerability analysis for Troms and Finnmark highlights that municipalities in the region are used to deal with the challenging climatic conditions (Statsforvalteren I Troms og Finnmark, 2022, p. 18).

Nordkapp is one of four municipalities in Finnmark where the risk of avalanches is monitored. In the risk- and vulnerability analysis, an event with a big avalanche in Nordkapp is utilised as a case. The municipality has a high risk of avalanches, and as climate change causes warmer temperatures, avalanches are expected to rise. The same occurs for landslides which are assumed to occur every ten years due to flooding. The decline in sea ice also creates vulnerabilities for Nordkapp. The cruise port in Honningsvåg is the second largest in Troms- and Finnmark, and with less ice, the ship traffic expects to increase. Cruise ships that sail to Nordkapp have an average of 1,500 people on board. This increases vulnerability because health preparedness is dimensioned based on the number of inhabitants in Nordkapp (Statsforvalteren i Troms og Finnmark, 2022). Nordkapp experiences polar twilight two months a year. The darkness during the day is an additional dimension to the risk picture and increases the complexity, which the risk and vulnerability analysis mentions (Statsforvalteren i Troms og Finnmark, 2022, p. 52).

By the end of the 21st century, there is an increased probability of extreme precipitation, storm surge, events with stormwater, earth, - mud, - and flood slides (Hanssen- Bauer et al., 2015; Hisdal et al., 2021; Statsforvalteren i Troms og Finnmark, 2022). Somewhat increased probability for drought and forest fires are also found in the document analysis. The increased heat will make the snow season shorter, especially on the coast, and a reduction in the snow

season by 3 to 4 months is expected. A reduced snow season and amount of snow will lead to a decline in the risk of avalanches (Hisdal et al., 2021).

Significant uncertainties are associated with the climate projections for wind in Finnmark, and the climate models show little to no change in wind conditions in this century. The climate profile adds that the most important thing the municipalities can do is to ensure that knowledge of local wind conditions is part of the planning (Hisdal et al., 2021, p. 32). The risk and vulnerability analysis for Troms and Finnmark highlights that an increase in strong winds will increase the probability of power cuts. On the other hand, it is expected that national authorities ensure that the infrastructure can withstand stronger winds if this turns out to be damaged due to climate change (Statsforvalteren i Troms og Finnmark, 2022, p. 18).

6.2.3 Oslo

Stormwater and urban flooding are the challenges due to climate change Oslo have the most experience with so far, and these challenges yearly costs the municipality, companies, and private households hundreds of millions of Norwegian Kroner each year. Since the beginning of the 20th century, Oslo's average temperature has increased by 1,7 degrees, and the amount of precipitation over the course of a year has increased by 15 per cent. However, this development is mainly linked to the fact that Oslo has experienced an increasing number of episodes of torrential rain (Klimaetaten, 2020). Oslo's location in the heart of a fjord means the city is better protected against extreme weather than many other places in Norway. However, the topography where the city centre is placed at the bottom, surrounded by steep hills creates challenges for the runoff of large amounts of precipitation (Klimaetaten, 2020, p. 168).

Oslo currently has two sources of drinking water, one of which accounts for 90% of the city's drinking water (Klimaetaten 2020, p. 47). In Oslo's risk and vulnerability analysis, loss of water supply is regarded as one of the scenarios with the highest risks (Beredskapsetaten, 2021, p. 23). This creates vulnerabilities in terms of drought, even though the amount of precipitation in Oslo is expected to increase. Another challenge that nuances the risk picture for drought are that climate change causes precipitation patterns to vary more from one year to the next and that weather types occur longer in one place. This can create situations where, for example, high pressure and hot weather can linger for a long time and cause drought (Hanssen- Bauer et al., 2015; Hisdal et al., 2021). A new source of drinking water is under

development and is scheduled to be completed in 2028 (Klimaetaten, 2020, p. 47). Towards 2060, Oslo will experience heavier and more frequent episodes of torrential rain, discharge in rivers rising about 1%, and the temperature is expected to rise by 2 degrees (Klimaetaten, 2020, p. 13).

The documents analysed in the document analysis all highlight increased amounts of precipitation as a consequence of climate change, which will increase the risk of several natural hazards, including rain floods, land-, flood,- and mudslides. Sea level rise will affect the probability for storm surge, affecting infrastructure close to the ocean. Oslo is growing in population, which leads to higher pressure on the construction of infrastructure, housing, transport, and water, to name a few. This complicates the risk picture (Beredskapsetaten, 2021; Hanssen-Bauer et al., 2015; Hisdal et al., 2021 Klimaetaten, 2020).

Depending on the river, what is considered a 200-year flood is expected to occur more frequently and as often as every 5 to 50 years. There are multiple challenges associated with this, first; much of Oslo's infrastructure is built close to rivers and streams, including the transport infrastructure that is important for the city's daily operations. Second, 10 of Oslo's main rivers go through the construction zone, i.e., areas regulated for housing, creating a higher damage potential as densely populated areas are more vulnerable. Some of these are regulated, but a river like Alnaelva is especially vulnerable to river floods as most of its drainage basin is situated in the construction zone. A third challenge is that many of Oslo's rivers are underground, and failure or lack of maintenance in the drainage systems can increase the risk of flooding (Klimaetaten, 2020).

Towards the year 2100, Oslo is expected to have an increased probability for extreme precipitation, rain floods, storm surges, land-, flood-, and mudslides (Hisdal et al., 2021, p. 95). In addition to the climate challenges mentioned in the climate profile, there is an increased likelihood of challenges due to gradually rising average temperatures, such as heat waves and challenges with rot due to more moisture (Klimaetaten, 2020). The risk of strong winds, rock falls, and rockslides are regarded as uncertain (Hisdal et al., 2021, p. 95). In the climate vulnerability analysis, the Climate Agency points out that the calculations show little change in wind strength but that this will depend significantly on locations and design of new buildings (Klimaetaten, 2020, p. 14).

6.3 RISK PERCEPTION

6.3.1 Longyearbyen

When asked how the informant assesses the impact of various risks on the local community, the answers from the informant from Longyearbyen correspond to a high degree with the results from the document analysis. The probability of increased precipitation is assessed as high, and in the last ten years, rainy weather episodes with heavy rain over a day or two have been experienced. According to the informant, the increased precipitation will create problems in winter and in the summer. It will lead to different types of landslides, alone and in combination with other risks.

Sea level rise is not a current issue in Longyearbyen; the same applies to drought. The former is linked to the country rising, and the latter is linked to the archipelago being an arctic desert, and drought is therefore considered normal. The document analysis showed that there were uncertainties related to wind strength and wind direction. When asked about the risk of strong winds, the informant explains that this year's winter has been unusual because the wind direction has changed. Usually, the wind goes from the east, southeast and then down into the valley. This year, the wind direction has changed every other day, which has created challenges related to the loading of snow. The informant, who has lived in Longyearbyen for more than ten years, elaborated further:

This winter has been very special. I have never experienced that one day the wind comes from the northwest, the next day, it comes from the southeast, and then the wind direction goes back to the northwest.

Wind direction is by the informant perceived as the most significant source for uncertainty regarding climate risks, while the consequences of increased precipitation are what the informant highlights as the biggest climate-related risk factor in the local community, regardless of the risks that was presented earlier in the interview. Among other things that the informant points out as major climate-related risk factors, the river that flows through Longyearbyen is mentioned. When the glacier melts, they face challenges with eroding and flooding. A consistent theme in the interview with the informant from Longyearbyen is the increased risk of avalanches. The informant points out that awareness of avalanches has increased since 2015:

But then there was a change of dogma In December 2015 when the big avalanche came that took two lives […] And then several measures were initiated, and NVE eventually became responsible for avalanche warning and avalanche prevention measures.

According to the informant, there have been an increase in evacuations, closing of roads and travel ban due to the risk of avalanches. At the same time, the informant emphasised that not all avalanches occur because of climate change. In the terrain, there have been avalanches all the time, and many people have died as a result of, for example, driving their snowmobiles incorrectly. Inside Longyearbyen, in Vannledningsdalen, actions to prevent avalanches have been taken for almost a hundred years.

In order to deal with and reduce uncertainty, the informant from Longyearbyen explains that they obtain information from researchers and by gaining access to relevant information from, for example, reports. Information is also exchanged internally among the actors who have a seat in Svalbard's Emergency Preparedness Council:

We are starting to get a much better drill on this now than we had in 2015, so we have had eight years to go from actually having very little focus to having an extreme focus on this with climate risk.

When asked if uncertainty affects how The Governor communicates climate risk, the informant answers that as a result of the role the Governor has by being both the chief of police and county governor in the archipelago, one has several roles. Within that role description, it does not fall to the Governor to communicate uncertainty as such falls to the scientific experts. The Governor must rely on the advice they receive from the experts and expert organisations and use this as a basis for communicating about specific cases.

The informant is unsure whether the uncertainties in local climate projections have consequences on how The Governor work but points out that among residents who have lived on Svalbard for a long time, there is talk about how climate has changed:

Those who have lived here for thirty years, they see that things have changed. And the biggest sign of that is the sea ice that is gone. So, I think people are aware of it and see the changes, and I think there is increasing reflection about it in the local community, at least among those who have been here for a little while.

Longyearbyen is characterised by a high turnover of people. Therefore, there are still only a few who have experienced climate change the way the informant describes. However, the informant points out that people are aware that it is projected that Svalbard will experience a temperature rise that is four times higher than in the rest of the world, what types of temperatures are expected in 2040 etc.

6.3.2 Nordkapp

With a warmer climate, one must expect more precipitation, explained the informant from Nordkapp. In return, it takes a lot for increased precipitation to become a problem in the municipality, as low pressure from the Barents Sea tends to bring quite a lot of moisture with it, regardless of whether it is winter or summer. As the informant assesses, it is most likely that increased precipitation will occur in the summer, but on the other hand, it is not so severe if there is more rain at that time of the year. In winter, however, when the precipitation comes as snow, the risk of avalanches increases, which means that the negative consequences of the increased precipitation will be significantly greater than in summer.

Strong winds are both very likely and entail a great risk, according to the informant from Nordkapp. Strong winds are something that often occurs in the municipality. For example, vehicles are blown off the road several times during the year, but also about the many side effects of wind on snow. When asked what risk drought poses to Nordkapp, the informant says that drought is very unlikely in Nordkapp, and that the severity would not be that high. This is in contrast to the results from the document analysis and may be related to the fact that the climate progressions that form the basis for the climate projections are based on projections for Finnmark, not Nordkapp alone. Nordkapp has experienced challenges with avalanches due to snow melting, but then it has been the strong wind that has been the triggering factor for the risk because it has moved the water around.

The sea level will rise in Nordkapp but is not perceived as a major risk. This is connected to the fact that the country is still rising. In contrast, a combination of high sea levels, spring tides and strong winds will have the potential to cause major negative consequences for the municipality. However, then it will be the wind that will be the triggering factor. Strong wind is, by the informant, highlighted as the most prominent climate risk isolated for Nordkapp. Nordkapp has always been prone to harsh weather, but one must expect that the amount of wind will increase because of climate change, according to the informant. However, as the informant points out: the wind is never isolated. It is in combination with other factors, especially water, regardless of if it is frozen or not, that wind will create problems and risks for the local community.

When asked what the informant considers to be the most significant source of uncertainty, the informant points to the fact that the weather is always uncertain but that it is polar lows[1] that are most difficult to control and the combination of wind, water and snow. Regarding changes in the risk picture, the informant claims that there have been more events in total in recent years and that in the past, the avalanches could be linked to the same cause but that they in recent years have been triggered by different reasons. Like the informant on Svalbard, the informant in Nordkapp is unsure if it is like that, or if it is because of implemented preventive measures that they can keep a better eye on things.

In the even-numbered years, we have had challenges in Nordkapp, and in the odd-numbered years, they have had challenges in Svalbard. This is because it is the same weather system that creates challenges, but never Svalbard and the northern part of Norway at the same time, but this year there have been challenges in both places simultaneously.

To reduce uncertainty in Nordkapp, the avalanche warning system in the most avalanche-prone residential areas in the municipality ensures fewer unknown factors when making a decision. According to the informant, this can work out both ways because it can contribute to having a shorter threshold for evacuating. After all, they now possess knowledge of the risk. There have also been cases where they have chosen to evacuate someone for the first time. This can contribute to a feeling of uncertainty for the individuals. Information may also have emerged that they should, have been evacuated on other occasions as well, but that at that

[1] Polar lows are small, but intense maritime cyclones that arise when cold air from the Arctic interfere with warmer sea. The weather in a polar low pressure is characterized by strong winds and heavy snowfall (Noer, 2018, as cited in Meterologisk Institutt, 2021).

time did not have the technology and knowledge they have today. In addition to the avalanche warning system, Nordkapp municipality has an open dialogue with The Norwegian Water Resources and Energy Directorate and Skred AS, and these measures also contribute to raising Nordkapp's expertise on avalanches. The informant from Nordkapp was not entirely sure how uncertainty concretely affects how the municipality communicates climate risk:

I do not know exactly, but on a small scale, like on the one house we did not evacuate 16 days ago, We have to say it like it is, that we cannot guarantee that it will not be an avalanche, it depends on the snow and wind direction, but we try to distinguish between what you can be sure of and what you can't necessarily be sure of.

The informant does not believe that the uncertainty of the climate projections will have consequences for the municipality but would like more knowledge of the local consequences of rising sea and air temperatures.

6.3.3 Oslo

When asked about the informant's assessment of various risks, the informant replies that it is not particularly relevant what he thinks is likely, as the Climate Profile for Oslo and Akershus is the basis for planning in Oslo. According to the Climate Profile, the precipitation pattern is expected to undergo a significant increase, characterised by more intense precipitation occurring within a shorter time span. Strong wind is associated with uncertainty in the Climate Profile, the informant says, but they have been in dialogue with the Norwegian Meteorological Institute and have received signals that wind conditions are unlikely to change. In contrast, the informant points out that wind damage is high on the list of nature-related damage, so even if the risk is not that high, there is some wind-related damage.

Drought is something that Oslo has little experience with but which the climate projections indicate will become a greater challenge in combination with higher temperatures. In 2018 the city experienced a very hot summer, but also in recent years, they have also had challenges with drought. For example, in April last year, Oslo experienced a high risk of forest fires. The challenges associated with drought are something that the Climate Agency is conscious of raising internally within the organisation:

Drought is especially noticed on the Firs. The firs are very drought-stressed in Oslomarka. For example, are there many trees that we see visible signs on after the drought because they do not recover.

More precipitation is the biggest climate-related challenge in Oslo and is something the city has had to deal with for several years. Stormwater is what the Climate Agency works with the most, says the informant. This triggers more landslides and washouts but also creates problems related to flooding. The informant points out that Oslo has regulated rivers, which creates some control. However, their most significant problem in terms of flooding is linked to small streams with almost no water flowing in them which can suddenly flood and create local challenges. The fact that there is more precipitation in a shorter time is also noticed during winter when the snow falls:

When it first snows, large amounts fall, and it is a challenge for the operation of the city. Then it's a problem to get the snow away in time, because suddenly the zero-degree crossing comes, and everything freezes to ice.

Drought is what the informant points to as the most significant uncertainty factor. According to the informant, drought, higher temperatures and heat waves are something climate projections say will happen, but that the uncertainty is linked to how to adapt to this because you have not experienced it before. More precipitation and more intense precipitation are what the informant describes as changes in the risk picture in Oslo in recent years. There is data on this, where the bars showing how much water comes in a day are getting longer and longer. In addition, and this the informant pointed out that he could not quantify, it feels as if Oslo has experienced more drought in the last five years.

A challenge that the informant highlights is linked to the three-part climate risk definition. According to the informant, the physical climate risk in Oslo is primarily linked to precipitation, while the increased temperature will not cause the same physical risk. At the same time, increased temperatures will, among other things, contribute to reduced ability to concentrate and health challenges, and these are elements that will make Oslo a less good place to live and more vulnerable if you don't take them into account.

I feel the concept of climate risk when it comes to adaptation can seem limiting then. It is not only physical risk that we must take into account.

When asked what consequences the uncertainty in the local climate projections has for Oslo, the informant replies that they are very grateful for the information and data they receive from the Norwegian Centre for Climate Services, and while working on the climate vulnerability analysis in 2018, they asked The Norwegian Meteorological Institute about the consequences of the got warmer and wetter:

And then they say, "But we don't know that. That is something you have to find out because you are the ones who work in the city, and therefore you are the ones who know where it gets hot when it gets hot, and you are the ones who know where it gets wet when it gets wet."

The informant points out that this shows how important local knowledge is in working with climate change and adds that it is positive that Oslo has the resources to both possess the expertise and to actively move around the city to really find out how climate change will affect the place where they live.

How one attacks uncertainty depends on which climate challenge one is facing, the informant points out. In working with problems related to stormwater, risk acceptance levels are used. A challenge with these that the informant highlights are that the level of acceptance is getting higher and higher. This is something that is discussed internally. In addition, there is a climate add-on of 1.5 which is a recommendation from the national guidelines and which is stated in the climate profile. The informant points out that uncertainty is part of all forms of planning and that no one knows what the future will be, but that he generally feels that Oslo is used to plan around a certain form of uncertainty.

Uncertainty is generally communicated little because it is very unfortunate, according to the informant. Therefore, one tries to use round formulations at the same time as the informant feels that there is no particular need to be specific.

6.4 CLIMATE RISK COMMUNICATIONS ROLE IN RISK MANAGEMENT

6.4.1 Longyearbyen

Climate risk communication is part of the ongoing risk governing in Longyearbyen and is primarily linked to risk in Longyearbyen, not out in the terrain:

We do not aimlessly inform people if there is a high avalanche danger on Nordenskiöld Land. We made one exception at Easter. It was while people were going home from their cabins. And where we made changes to the Motor Traffic Regulations to allow people to get home safely and avoid avalanche-prone areas.

Ongoing dialogue with relevant stakeholders such as Longyearbyen Local Council, researchers from, among others, The Norwegian Geotechnical Institute, Svalbard's Emergency Preparedness Council and The University Centre in Svalbard ensure that climate risk communication is anchored and communicated at several levels in the local community. As a result of the avalanches in 2015 and 2017, avalanche warning systems were implemented, which are currently operated by NGI. In cases where the probability of landslides goes from low to medium, staff are appointed, and risk communication becomes one of the topics. In the event of an acute risk, the Emergency Preparedness Council is activated, and internal communication among the members of the emergency council takes place via CIM.

There is also a dialogue with local and national media channels. In case of an acute risk, the informant has a positive experience of contacting the local media, in the form of Svalbardposten, where you can easily get "on" when it is relevant. The informant says that there is a function on the Governor of Svalbard's official web page where it is possible to subscribe to the news and, in that way, receive a notification when something is published. The informant is aware that national media channels subscribe to this function. This contributes to the fact that information about climate risk can also go beyond the local area.

An aspect of communication that the informant points out makes Longyearbyen a bit special is the use of Facebook. People that move to the archipelago are told that Facebook is the main information channel, this is also information that goes out to students, and the informant

points out that new students have used to receive an information email where they are informed that "Longyearbyen is all about Facebook".

6.4.2 Nordkapp

The informant from Nordkapp believes that communication of climate risk communication is part of the municipality's overall work with risk and that it is carried out through the case management processes that exist in the municipality. As a small organisation and municipality, employees often meet physically outside the formal situations, for example, at the parking lot. As the first municipality in mainland Norway, Nordkapp established an avalanche warning system based on the model from Svalbard, which ensures that information from, among other things, the professional actors in The Norwegian Geotechnical Institute and Skred AS is part of the overall process. They are also in dialogue with other participants, such as the tourism industry, where you can get assistance with an interpreter if needed, this is enshrined in the contingency plan, and the informant provided examples of how this relationship has been practised. In the interview with the informant from Nordkapp, several examples emerge that the municipality tries to emphasise and facilitate transparency in the communication that goes from the municipality to the citizens:

We try to be as open as possible about what we are doing.

For example, are the municipal council meetings in the municipality streamed and are available as recordings afterwards, says the informant. In this way, the citizens themselves can listen to the reasons for various decisions made in the municipality. As in Longyearbyen, local media are used very actively in addition to the official media channels in Nordkapp. Due to the fact that avalanches are such a central part of the risk picture in Nordkapp, a certain amount of expertise has been built up, and the informant says that in cases where neighbouring municipalities experience similar challenges with avalanches, Nordkapp will be able to assist the neighbouring municipality with expertise. When asked if there are challenges in communicating internally about climate risk in Nordkapp, the informant answers no, and that when it comes to avalanche challenges in Nordkapp, it is easy to be heard:

Whether it is to the chief municipal executive, finance manager or politicians, I feel that it is easy to be heard up in the system. The politicians have disagreed about a lot in the last four years, but when it comes to avalanche issues, it's a piece of cake.

6.4.3 Oslo

Climate risk communication is part of Oslo municipality's overall work with risk. Oslo municipality has a Climate Strategy with 16 priority areas, one of which deals with communication. In the risk and vulnerability analysis the biggest risks for Oslo are defined, for which there is a response plan that also includes communication. Decisions related to climate risk are part of the existing decision-making processes in Oslo, for example, in connection with the municipality's work with its land-use plan. In such decision-making processes, the Climate Agency has a responsibility to raise awareness regarding climate. They have also established something called Grønt Teknisk Forum (Green Technical Forum), which is a decision-making body between the infrastructure agencies in Oslo, where the chiefs of the Agency for Planning and Building Services, the Agency for Water and Wastewater Services and the Agency for Urban Environment decides which projects should be worked on further.

A challenge the informant highlights is conceptual discipline and ambiguities in whether one is talking about preparedness or long-term prevention. This begins at the national level, where The Norwegian Directorate for Civil Protection is subordinate to the Ministry of Justice and Public Security, while the Norwegian Environment Agency, which works with climate adaptation, is subordinate to the Ministry of Climate and Environment. This spreads down to the local level. For example, in the event of an acute incident, it is the job of the Emergency Planning Agency/ Agency for Fire and Rescue Services. However, the Climate Strategy also states that emergency response work in Oslo shall be dimensioned according to climate change.

When asked what the most significant challenges related to communicating internally about climate risk are, the informant says that they feel that there is quite a lot of agreement at the same level and that there has been a development since they began work on the Climate Change Vulnerability Analysis for Oslo. Previously it had to be said more clearly internally that climate change would present challenges. This is not necessary to the same extent now because the people who work with this see the consequences themselves. The decision-

makers are perceived to be more challenging to reach because they do not always understand the scope or why measures are necessary. However, the informant feels that this, too, has become easier over the years.

6.5 CLIMATE RISK COMMUNICATION

6.5.1 Longyearbyen

The Governor's goal with climate risk communication is to reach out to the entire population about changes in the risk picture and to get it out on relevant platforms. This is done in collaboration with Longyearbyen Local Council. For external communication, the Governor has official channels on Facebook and Instagram, but a distinction is made between which information goes out where. Where Facebook is an important channel for communicating information about avalanche danger, closed roads and other matters, Instagram is used more as a way to show off what they are doing and who visits them, for example, when politicians visit the Governor or when they do Emergency Preparedness exercises. Information from the Governor's official channels on Facebook is also shared in relevant groups on Facebook. In addition, the Governor's websites and media are used. In case of local danger, for example, in the case of a closed road or risk of landslides, physical notices are used on site. External communication from the Governor is shared in Norwegian and English, according to the informant.

No formal analyses have been used for channel use, and the use of channels is based on personal experience. On the other hand, the informant emphasised that their experience is that the permanent residents know where to turn when they need information, whether it is varsom.no, Facebook groups or the Governor's own channels on Facebook. The informant's impression is that many of the permanent residents follow Svalbardposten and that the Governor's website is only used if there is something specific the residents want to find. As a permanent resident in Longyearbyen, climate change is experienced at close range, which means that you are also well used to the risks that exist and the personal responsibility to deal with information from the Governor. One challenge that the informant highlights are reaching the tourists:

We close the road, there are barriers, there are flashing lights, it says "closed due to natural hazards," and the tourists just walk right past.

There is work to be done to ensure better communication with the tourism industry, says the informant, and points out that tourism companies should also inform tourists face to face. A challenge related to this is to get in touch with the high proportion of tourists who use AirBnB. Tourists who stay at the accommodation connected to the travel industry are easier to reach. Another aspect of this issue is how much information to provide. The informant points out that you also have an independent responsibility for your own safety when you travel, and walking on a road that is clearly marked as closed is taking an active risk.

As a follow-up to this question, I asked the informant whether the challenges of getting visitors to follow recommendations from the Governor also applied to students who are affiliated with UNIS:

No, I do not think that. The students, they get a fairly good introduction through both the safety course that runs in autumn and the one in the winter and information that goes directly to the students via UNIS's own channels. My impression is that the Health, Safety and Environment regime at UNIS is very good.

The informant did not rule out that permanent residents also break the rules and emphasised that they have not taken random samples but feels that the problem primarily applies to tourists.

6.5.2 Nordkapp

There are no concrete targets for the communication of climate risk on Nordkapp. In acute situations, the Nordkapp municipality's website and Facebook channel are used, and it is possible to call the municipality directly:

External communication depends on the situation. In an event in 2022, it was the finance manager who acted for the municipal director due to illness. Then he took care of the communication while I was out in the field.

In addition, local media is actively used by the municipality. Should there be an event where it is important that people get access to information, Radio Nordkapp is used because it is a news medium without a payment portal, which means that everyone gets access to matters

that are published without being a subscriber. In cases where there is an evacuation that involves personal risk or if there has been an avalanche, it is clarified with the police who says what. Other media channels, such as Finnmarksavisa, are also used. The informant is unsure whether numbers on the populations' use of information channels are actively registered by the municipality but points out in the interview that it is perhaps something that should be done in the future. However, the informant is quite confident that there are more people who read local and national media than there are who read the municipality's website.

In Nordkapp, they work geographical target group-specific, but the informant points out that this is not a separate strategy per se. In communication with vulnerable groups, they get assistance from The Norwegian Labour and Welfare Administration, and in a situation where there are people that do not speak Norwegian, Nordkapp can get assistance from the tourism industry. Nordkapp also have resources in the organisation who write well in English. Both being evacuated and being the one or those who are not evacuated can affect the feeling of security and be perceived as burdensome, the informant points out. In a situation where people are evacuated due to the risk of avalanches, it is a challenge to communicate to those who are not evacuated why their house is considered safe while the house next door is not considered safe:

Explaining why an area is considered safe is almost more important than explaining why an area is being evacuated.

A challenge for the external climate risk communication that the informant highlights are people's memory. The informant points out that even if people have a good memory, it does not go that far back in time. In Nordkapp, all buildings, apart from the church, were built after 1945. This means that many buildings that are considered prone to avalanches but have "never" experienced avalanches. This comes into conflict with the fact that work related to avalanche and landslide prevention is based on a hundred- and thousand-year perspective.

One perspective that the informant highlights is linked to fire prevention, where comprehensive measures to reduce risk and deal with the damage are implemented. Annually, only 1.5 per thousand of Norwegian buildings are damaged by fire, and one way of looking at it is that anything that has a greater risk than fire, i.e., 1.5 per thousand, should be taken very seriously. As in Longyearbyen, the inhabitants of Nordkapp have also had experience of

climate risks. This means that there is no need to explain to the inhabitants that the risks can happen, because they are already happening in the local community.

6.5.3 Oslo

Oslo's Climate Strategy have the following goals for communication:

> *The City of Oslo will encourage climate-friendly behaviour by its inhabitants and business community by means of communication, dialogue, training and cooperation.*

The informant points out that the goal is broad and is not directly linked to climate risk, but also points out that an attitude in the municipality has been that they do not want to create frightening images because they are aware that this can create paralysis of action. Communication from the Climate Agency externally is primarily about how to adapt to climate change, for example, how to create a garden that handles stormwater and thus does not cause problems for others, rather than about what you have to do if you have to evacuate as the latter falls within the Emergency Planning Agency/ Agency for Fire and Rescue Services.

The Climate Agency has its own website, KlimaOslo, which aims to motivate and inform the population about what they can do to cut emissions and adapt to climate change. Twitter, Facebook and Instagram are also used, and attempts are made to write chronicles and submissions to the media if there are current issues that come up. In addition to these channels, a Climate House has been set up in collaboration with the University of Oslo, which is an initiative aimed at children and young people to teach them about climate, and there is something called Climate Pilots, which are young people, often doing a master's degree, who hold lectures at schools on emission reductions and climate adaptation. In addition, there is a separate channel for cooperation with businesses called "Næring for klima" (Business for climate). This has been established because it is not enough for Oslo municipality to cut emissions and become robust in the face of climate change. The private sector must also adapt, according to the informant.

The Climate Agency consists of a communications department which ensures that the agency actively works with figures on the population's channel use, clicks on content etc. In addition, the Climate Agency sends out an annual climate survey to investigate the population's attitude to the climate work in Oslo. This survey also examines whether there are any changes in

attitudes to climate change and whether there are questions related to climate adaptation. This year's survey also asked about experiences related to climate change:

We had some questions this winter where we changed it a bit, about how the residents, for example, experienced this with icier winters that we experience when there are zero-degree crossings.

The informant points out that there is a greater capacity to work towards target groups at the emergency preparedness end and that the same resources are not available in the Climate Agency. There are many different vulnerable groups, and there has become a greater focus on working toward these. Currently, work is being done to establish communication with vulnerable groups, including people whose mother tongue is not Norwegian. In connection with the action plan for stormwater management, the informant points out that work is being done to establish a support scheme so that residents can establish stormwater measures on their property, and it is suggested that such a support measure should be directed towards areas where Oslo municipality already has a stormwater project underway so that everyone contributes to making the initiative a success.

The challenge that the informant from Oslo highlights is finding the balance between climate risk being an important priority, at the same time, the consequences of climate change locally in Oslo will not be fatal. Oslo has not experienced any severe incidents, and the informant does not believe that the city is in danger of experiencing anything very serious either. At the same time, it is the case that the effects of climate change will go beyond the individual's general experience of comfort, in addition to the fact that the consequences of climate change cost a lot of money.

7.0 DISCUSSION

In this part of the thesis, the results from the document analysis and the interviews will be discussed in the theoretical framework presented in Chapter 4. The chapter is organised according to the research questions; First, I will discuss how climate change affects the risk picture in Longyearbyen, Nordkapp and Oslo, then how public authorities perceive climate risk before ending in a discussion on what strategies and goals there are for communicating climate-related risks in Longyearbyen, Nordkapp and Oslo.

7.1 HOW DOES CLIMATE CHANGE AFFECT THE RISK PICTURE?

The foundation for the discourse in this chapter is "climate change" and "risk". "Climate change" in this context is as referred to in Chapter 3 changes "[…] which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods» (United Nations, 1992, p. 7). While the term risk is understood as "uncertainty about and severity of the consequences (or outcomes) of an activity with respect to something humans value" (Aven & Renn, 2010, p. 3).

The starting point for the understanding of risk in the climate projections in the document analysis is one where risk is understood as "a measure that combines the probability and impact of an event" (Hanssen-Bauer et al., 2015, p. 143), which reduces climate risk to an objective order of magnitude and a narrow and very traditional way of describing the concept. This may be an indication of the strong natural scientific impact that climate research has. Nevertheless, such a view assumes that risks are value-free, which contradicts the definition of risk used in this thesis as it refers to "something humans value" (Aven & Renn, 2010, p. 3).

Looking at the different cases, the "uncertainty about" are different. In Longyearbyen, uncertainty is highly linked to how precise the climate models are at predicting the present and future extent of sea ice (Hisdal et al., 2021, p. 175) due to sea ice's important role as temperature regulator in the Arctic (Rantanen et al., 2022; Screen & Simmonds, 2010). While in Nordkapp, the physical uncertainties are related to the climate projections for wind. In the climate projections, it is pointed out that to reduce this uncertainty, obtaining knowledge about local wind conditions is the most important thing that the municipalities can do (Hisdal et al., 2021, p. 32). The uncertainties in Oslo are linked to strong winds, rockslides, and rock

falls (Hisdal et al., 2021, p. 95); however, the physical risks are not considered to have a high severity due to Oslo's location in the heart of the fjord (Klimaetaten, 2020, p. 168). In contrast to Longyearbyen and Nordkapp, physical risks where lives may be at stake are not something the population is used to either.

The "severity of the consequences" is, in many ways, two-fold. In Longyearbyen and Nordkapp, on the one hand, there are avalanches, where there is a high probability that they will occur, while at the same time, avalanche prevention measures have been implemented, which makes the risk more controllable where people live. According to the definition of risk in this thesis, one can say that "the severity of consequences (or outcomes) of an activity with respect to something humans value" is, in many ways, handled by the preventive avalanche measures, which decreases the severity. Therefore, it can be argued that the risk manifests as objectively bigger in Longyearbyen and Nordkapp, as they experience more natural hazards than in Oslo. But because people have assessed the risks, it is possible to reduce them. For Longyearbyen, this point is emphasised by the fact that The Governor of Svalbard assesses the risk of different types of slides in areas with preventive measures as very low (Sysselmesteren på Svalbard, 2022, p. 3).

Risk is a product of both the physical and the social interpretations of it (Aven & Renn, 2010). This is reflected by using Renn's categorisation of risk and the illustration of the risk management escalator and stakeholder involvement (2008, p. 280). Due to the implementation of risk-reducing measures it can be argued that the risk of avalanches in Longyearbyen and Nordkapp can be categorised as a complexity induced risk problem which is characterised by often involving intricate relationships between causes and consequences (Renn, 2008, p. 178). The reason is that even if the risk is known, and in that sense, is simple, the risk is still considered so complex that there is a need for external expertise beyond the resources that exist internally at the Governor and the municipality organisation in Nordkapp.

On the other hand, it can also indicate an uncertainty induced risk problem because the extent of the risk is not known. An uncertainty induced risk problem will require the implementation of hazard criteria's (Renn, 2008, p. 179). Implementation of such criteria may perhaps be even more necessary in a municipality like Nordkapp than, for example, Oslo because people are already used to a lot of weather (Dannevig, 2022a; Statsforvalteren i Troms og Finnmark, 2022), so that an assessment of what is acceptable can help to increase resilience during an event with a lot of wind. In the risk and vulnerability analysis for Troms and Finnmark, it is

pointed out that the road infrastructure in the county is limited, which means that in the event of an avalanche, landslide or flood, there is a risk that the entire local community will be cut off from receiving help (Statsforvalteren i Troms og Finnmark, 2022, p. 50). Also, this can indicate an uncertainty induced risk problems as there is a need for the implementation of hazard criteria's due to a need for deciding how high the tolerance in society is for being cut off from the rest of the county.

Because climate risk is not considered to pose an immediate danger to people's health and lives in Oslo, it may be stated that the risk is linear and therefore does not require a high involvement of actors in conformity with Renn's illustration of the risk management escalator and stakeholder involvement (2008, p. 280). Oslo municipality is also a large organisation by virtue of being the capital, a municipality, and a county, as well as having obligations to serve over 700 000 inhabitants (Statistisk sentralbyrå 2023; Thorsnæs, 2023), which means that it can be assumed that experts already exist internally in the organisation. Considering this, it can be assumed that Oslo can solve significant risk problems at a lower level in Renn's model than Longyearbyen and Nordkapp because there is a greater need to include external actors in Longyearbyen and Nordkapp due to the size of their organisation limits their opportunity to have all the expertise within the organisation. On the other hand, precisely because Oslo is a city where many people live and where the municipality's organisation is large and works in a complex system by different agencies, districts, etc., this may contribute to the fact that the risk should perhaps be classified as an ambiguity induced risk problem because risks will be interpreted differently among different stakeholders and inclusion of them in the process is necessary in order to avoid conflict.

The risks associated with climate change are often categorised as systemic risks (Organisation for Economic Co-operation and Development, 2003), which is understood as "the risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components, and is evidenced by comovements (correlation) among most or all the parts" (Kaufmann & Scott, 2003, p. 371). Seen in the light of the document analysis, this description fits well. The loss of sea ice in Longyearbyen has consequences locally, for example, in that the coast becomes more exposed to waves (Hanssen- Bauer et al., 2019), but also globally as sea ice acts as an important temperature regulator (Rantanen et al., 2022; Screen & Simmonds, 2010). When the sea ice decreases, larger areas will become navigable, meaning the operational area will become larger (Sysselmesteren på Svalbard, 2022, p. 19). The latter

is an issue that is relevant for both Longyearbyen and Nordkapp because the ship traffic is expected to increase (Statsforvalteren i Troms og Finnmark, 2022; Sysselmesteren på Svalbard, 2022).

Another way of looking at it is that climate change is a systemic risk on an overall level. However, the actual consequences in a local community have more significant similarities with other risk typologies. This can correspond better with the operationalisation of risk described in the climate vulnerability analysis in Oslo and the risk and vulnerability analysis for Svalbard and Troms- and Finnmark which can be linked to the limitations in laws and regulations that public authorities govern by. The risk and vulnerability analyses that are required by The Civil Protection Act §14 (Sivilbeskyttelsesloven, 2010) are narrow in the sense of focusing on acute events that may occur, which means that municipalities and Longyearbyen do not have an incentive to see climate risk in a broader perspective. The same applies to the Planning and Building Act, where §3-1 lays down an extended perspective, without further concretising this in the form of concrete requirements for the involvement of actors (Plan- og bygningsloven, 2008). The same applies to the Svalbard Environmental Act §1 (Svalbardmiljøloven, 2001).

7.2 PUBLIC AUTHORITIES RISK PERCEPTION

Risk perception relates to an individual's personal perception of risk. This pertains to the physical perception of the world around us and the cognitive processes involved in interpreting risk (Engen et al., 2021, p. 108). How individuals perceive risk influences their behaviour in response to that risk (Boysen, 2003, p. 4). Considering this, it is natural to ask whether climate risk is understood in the same way in the three different contexts presented in the thesis.

The informants from Longyearbyen and Nordkapp were very event-oriented, and when asked what risk they considered various hazards to be, they often referred to previous events. Considering this, it may seem that previous events have an impact on one's assessment of vulnerability, following what Renn and Rohrmann write about how cognitive–affective factors contribute to how people perceive risks (2000, p. 222). Such an assessment is only partially correct, as using past events to assess future risks can be delusive (Aven et al., 2004, p. 147). At the same time, it may have something to do with the fact that the informants were interviewed just after Easter. Easter 2023 was characterised by a high avalanche danger and

several avalanches in the northern regions of Norway, including Nordkapp and Longyearbyen (Elde, 2023; Guttormsen et al.,2023; NRK, 2023). This may have created a state of elevated awareness regarding avalanches.

The event-oriented approach was emphasised by the time spent on various questions, where both the informant from Longyearbyen and the informant from Nordkapp used around 20 minutes to answer the questions that dealt with their own assessment of the local risk picture, while the informant from Oslo spent only half the time on the same questions. The "truth of a risk" is determined, among other things, by the characteristics of the risk, such as how horrific it is and to what extent it can be controlled (Renn & Rohrmann, 2000, p. 222). Longyearbyen and Nordkapp have experienced several avalanches in recent years and, as a result, have focused more on prevention against such hazards. This was emphasised by the informant from Longyearbyen, who said that the avalanche in 2015 represented a change in dogma. This can be linked to Wachinger et al.'s literature study, which found that people who have experienced natural hazards were more worried about such events than people with little or no experience of such events (Wachinger et al., 2013) and emphasises the extreme manifestation of risk that exists in Longyearbyen and Nordkapp.

Trust authorities and experts are regarded as important factors in how people perceive natural hazards when they do not possess personal experience (Wachinger et al., 2013). This was emphasised by the informant from Oslo, which stressed that he could not assess the various events in the risk matrix because it did not matter what he thought were the risks, as adaptation and planning in Oslo based on the analyses of the Norwegian Climate Service Centre. This was further confirmed by the repeated readings of the documents used for the document analysis, as several similarities between the documents and the interviews were found. However, trust can also increase vulnerability; In recent years, Longyearbyen and Nordkapp have put in place extensive avalanche warning systems, which can mean that they both have a knowledgebase from which to make decisions, and therefore reducing the uncertainty related to lack of knowledge (epistemic uncertainty) (Albrechtsen et al., 2022a, p. 14). In Longyearbyen, physical measures to prevent avalanches are implemented, such as at Sukkertoppen and in Vannledningsdalen. This contributes to reducing the uncertainty that comes with natural variations (aleatory uncertainty) (Albrechtsen et al., 2022a, p. 14). In Longyearbyen, trust in these systems is so high that the level of danger that different types of slides represent is assessed as very low where these systems are implemented (Sysselmesteren

på Svalbard, 2022, p. 3). This can be associated with what Kruke et al. write about how trust can contribute to lower risk awareness and thus contribute to increased vulnerability (2005, p. 14). In a society like Longyearbyen, where climate change is happening faster than anywhere else (Rantanen et al., 2022) this can be extra vulnerable, precisely because the planet has never warmed up as quickly as it is now (IPCC, 2014, p. 44). They are at the forefront of experiencing the consequences of climate change, which means that it will be demanding to protect oneself completely from both types of uncertainty.

Four factors influence how people perceive risk according to Renn & Rohrmann: Level 1 is heuristics of information processing, level 2 is cognitive-affective factors, level 3 is socio-political institutions and level 4 is cultural background. These are not isolated from each other but must be seen in the context of how people perceive risks (2000). The informants from Longyearbyen and Nordkapp emphasised that the risk of avalanches in various places could not automatically be said to result from climate change. This can be referred to level 3 of Renn & Rohmann's model and the interference of economic and political structures. This can be substantiated by the findings in the report from the Norwegian Environment Agency, which concluded, among other things, that the municipalities today do not assess the full consequences of climate risk (Miljødirektoratet, 2021, p. 50). However, it can also be about reference knowledge in level 2 of the model. Longyearbyen and Nordkapp have experienced several avalanches, the informant from Longyearbyen emphasised this by saying that avalanches had perhaps taken the most lives on the archipelago. Another aspect in terms of reference knowledge is that the building stock in Longyearbyen and Nordkapp was bombed during the war (Hanssen-Bauer, 2019; Petterson, 2020). This can be thought to provide more epistemic uncertainty in the assessments around previous avalanches because today's buildings can only provide answers about avalanches that occurred less than a hundred years ago. This makes the knowledge base less than in a city like Oslo, where the building mass is older (Thorsnæs, 2023) and can serve as a reference further back in time.

One aspect of the responses from the informant from Oslo was a focus on the overall framework within which climate risk operates., including the lack of conceptual discipline regarding preparedness and long-term prevention and the public governing of climate risk. One reason for this focus may be that people in Oslo do not live as close to the risk as they do in Longyearbyen and Nordkapp. Hence the personal experience is low, and they, therefore, are more dependent on information from the experts in accordance with Wachinger et al.

findings of factors that influence risk perception of natural hazards (2013). Another reason could be that there are more people in the staff in Oslo, which frees up resources to assess such overall aspects of the climate risk. A third aspect can be that aspects related to governing climate risk *is* the risk they face in Oslo, precisely because adapting to the climate is a more significant part of the work tasks than short-term climate disaster handling.

The informants' assessment of climate risk largely reflects the results from the document analysis. An aspect that stood out however was the focus on wind, both as a triggering factor for natural hazards (Nordkapp), wind direction changing from day to day (Longyearbyen), and the likelihood of wind conditions shifting is low, however, damage caused by wind ranks high among nature-related damage (Oslo). This may reflect that communication between experts and professional authorities works well in all three places while at the same time emphasising the importance of local knowledge and personal experiences in the face of climate risks.

7.3
STRATEGIES AND GOALS FOR CLIMATE RISK COMMUNICATION

Risk communication encompasses internal risk communication, a crucial part of the risk management process, and external risk communication, which pertains to the actual information being communicated (Renn, 2008, p. 202). And is defined as communication:

[...] about possible unwanted incidents and situations that may involve harm to life, health, environment and items of value. The aim is to make the recipients aware of possible risks and incite them to change their ways of doing things, in order to prevent these incidents from happening or diminish their negative consequences. (Ministry of Government Administration and Reform, 2009, p. 17).

Climate risk communication in the context of this thesis can, in many ways, be said to be a dissemination of expert advice, including through the climate projections from the Norwegian Climate Service Centre, the experts in The Norwegian Geotechnical Institute and Skred AS, who emerged as crucial from the informants in Longyearbyen and Nordkapp, or The Norwegian Metrological Institute as the informant from Oslo mentioned. The public authorities in Longyearbyen, Nordkapp and Oslo can be said to end up in the middle between experts and the public, and in many ways, function as a bridge builder between the two. Viewed through the lenses of Renn's model for the organisational structure of risk

communication (1992, p. 470), they can be viewed as both the source and the transmitters to lay people about risks (external risk communication) and as a final receiver of information when getting information from experts about the risks (internal risk communication).

Framing describes the processes to address the current knowledge of an issue (Norwegian University of Science and Technology, n.d.). The premise for this process was different in Longyearbyen, Nordkapp and Oslo. This refers both to how climate risk is understood in the different places, as discussed in Chapters 7.1 and 7.2 and also the access to information. The framing is more concrete in Longyearbyen. This is both about having a separate climate profile for Longyearbyen itself and hazard preventive measures within the settlement, in addition to the risk being visible because the melting of glaciers and less permafrost is something that the public authorities and the citizens who live in the city see and experience on a daily basis which has a major influence in how people perceive risks from natural hazards (Wachinger et al., 2013, p. 1062). This can make it easier to implement risk-reducing measures. The knowledge base is less concrete in Nordkapp. The climate profile considers Finnmark as a whole, an area that is geographically very large. Troms and Finnmark's risk- and vulnerability analysis use Nordkapp concretely as a case but does not deal with climate risk specifically. The avalanche warning system minimises uncertainty regarding climate disaster handling. This can make it easier to get approval for measures dealing with avalanches, which was emphasised by the informant in that it was easy to get influence from the politicians.

In Oslo, on the other hand, the knowledge base is more significant, as are the resources to work with both climate disaster handling and climate adaptation are large. Nevertheless, climate risk does not pose an immediate danger. The informant from Oslo explained how this created a dilemma for the communication of climate risks because even if one has not experienced the major events, climate risks are still something that must be prioritised because climate change will contribute to making the city a less good place to live, and that not adapting to climate change will also cost a lot of money when events occur. This is in line with what Kruke et al. write; that a long-term sense of perceived safety can contribute to increased vulnerability (2005, p. 14). The paradox described by Kruke et al. (2005, p. 14) occurs when you have to get political authorities to prioritise measures that will reduce climate risk. On the one hand, the political authorities also feel that Oslo is a safe city in regard to climate change, while at the same time, it is a goal in itself for them to show that

they have control over dangers and threats in society. This is expressed in practice when the informant from Oslo says that it can be more difficult to get through to the decision-making authorities than those who have climate risks as part of their everyday work because it is not as easy for the decision-making authorities to understand the scope or why the measures are necessary.

Different perspectives on what climate risk is were highlighted in the informants' answers about risk communication. In both Longyearbyen and Nordkapp, risk communication is event-oriented and can be said to end up on the border between risk and crisis communication. In Oslo, on the other hand, communication is broader, which can be seen in the examples of the establishment of a separate Climate House to teach children about climate change and the use of the climate agency's own website, KlimaOslo, to motivate and teach the population about climate change and climate adaptation. This difference can also be about resources and political priorities. By law, Longyearbyen, Nordkapp and Oslo have obligations regarding communication, but these are in the emergency plan and deal with purely concrete crisis communication (Forskrift om kommunal beredskapsplikt, 2011; Forskrift om sivilbeskyttelsesloven på Svalbard, 2012; Sivilbeskyttelsesloven, 2010). This was made clear in the literature search as the state provides guides in crisis communication, not risk communication. Nevertheless, in regard of the Central Government Communication Policy, where the goal of risk communication is "to make the recipients aware of possible risks and incite them to change their ways of doing things, in order to prevent these incidents from happening or diminish their negative consequences" (Ministry of Government Administration and Reform, 2009, p. 17) it can also be argued that this is evidence on that Longyearbyen, Nordkapp and Oslo communicates in a way that best reflects their risk picture.

The characteristic of systemic risks is that they are global and require a high level of stakeholder involvement and global interdependence in order to manage the risk and reduce the source of risks (human emissions) (Renn, 2015, cited in Renn, 2016, p. 29). The Arct-Risk model for risk governance was presented in Chapter 4. An argument after reviewing the model and how it is presented is that it does not address this element (cuts in greenhouse gas emissions) sufficiently. Instead, viewing the long-term management of climate risk in the Arct- Risk model, climate adaption can be interpreted as building the walls higher instead of going to the core of the cause of the risk problem. There is a logical paradox in this way of thinking about risk; on the one hand, the purpose of the Arct-Risk project is "to develop

knowledge and tools to understand and manage the effects of climate change on society's ability to protect its citizens' lives and health and maintain critical infrastructure and function" (Norwegian University of Science and Technology, n.d.). While on the other hand, one does not go to the core of what the cause of the risk is. Therefore, I would like to propose a moderated version of the Arct-Risk model:

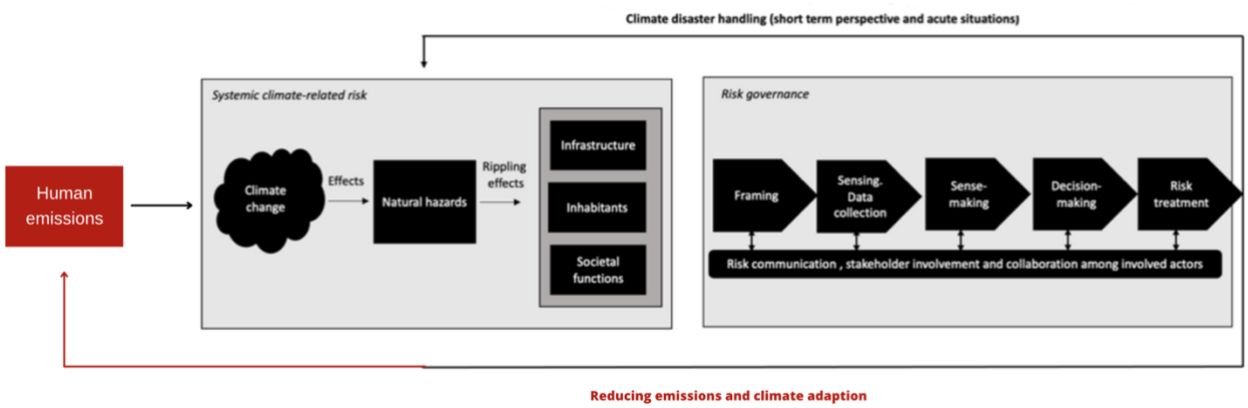

Figure 11 Framework for risk governance in Arct-Risk with emphasis on human emission and reducing emissions [red box, lines and writing are add-ons and not in the original model] (Norwegian University of Science and Technology, n.d.).

A counterargument to this could be that it falls outside the job description of those who work with or study risk. However, in the presentation of the project, a transdisciplinary approach is mentioned for how the project will reach its objectives (Norwegian University of Science and Technology, n.d.). The contradiction in how we treat risks was illustrated by the informant from Nordkapp about the risk of fire, and how society accept comprehensive risk-reducing measures in housing and society otherwise, even though very few Norwegian buildings are harmed by fire every year, while the same don't apply for climate risks. Another example are health risks like smoking which was exemplified in Chapter 1 where radical measures are taken to prevent people from exposing themselves to risk in the first place (Cummings et al., 2007). The Arct-Risk model is based on a view of climate change as systemic risks. By adding human emissions to the course of events for the risk and reduction of greenhouse gas emissions in the long-term management of the risk, my assumption is that one has better prerequisites for internalising the interdependence that systemic risks present globally, thus the local becomes connected to it global through the long-term perspective.

8.0 CONCLUSION

This thesis has attempted to explain "how are the authorities in Longyearbyen, Nordkapp and Oslo perceiving and communicating climate risk". Public authorities have a central role in handling climate risk, and initially, in the thesis, it was considered important to explore their risk perception and risk communication. Initially, in the thesis, it was problematized that the distinction between how people assess man-made and natural hazards is slowly disappearing and that knowledge about risk communication of natural hazards and climate risks is a field that, as of today, is little explored. This thesis aimed to contribute to more knowledge on risk perception and risk communication related to climate risks. To answer the research problem, three research questions were utilized:

1. How does climate change affect the risk picture in Longyearbyen, Nordkapp and Oslo?

2. How do public authorities perceive climate risk in Longyearbyen, Nordkapp and Oslo?

3. What strategies and goals are there for communicating climate-related risks in Longyearbyen, Nordkapp and Oslo?

This study found that how climate risk affects the overall risk impacts strategies and targets for communication, as well as risk perception. Longyearbyen and Nordkapp, societies in which this study found climate risks to manifest objectively more significant, mainly focused on short-term climate disaster handling. While in Oslo, which is not regarded as very exposed to the harmful effects of climate change, communication and issues related to climate adaptation were found to be higher in the field of interest. However, the correlation between how climate risk appears and how public authorities act on it cannot be said to be just an expression of risk perception. It can also be a question of public authorities' resources or priorities. In addition, this study found that local knowledge is important, and experts alone are not enough to assess how climate change will affect the risk picture in Longyearbyen, Nordkapp and Oslo.

8.1 FURTHER RESEARCH

In the interview with the informant from Nordkapp, it emerged that it was more important to communicate to those who were not evacuated why they were not than to share the reason for evacuation with those who were evacuated. This is something that could be interesting to do more research on. As the research on risk perception and risk communication in the Arctic is limited, it would be interesting to apply a similar research problem and methodology to other societies in the Arctic to see if the same results would be obtained. As we write June 2023, the world is ravaged by forest fires, and many are now experiencing the consequences of climate change at close range. It may, therefore, also be interesting to use the problem and method of the thesis in societies other than Norway to investigate whether the same parallels can be drawn.

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APPENDICES

APPENDIX 1: INTERVIEW GUIDE (IN NORWEGIAN)

Introduksjon av prosjektet

1. Kort presentasjon av meg selv og prosjektet
2. Opplysninger om lagring av opptak, ivaretagelse av data
3. Har du noen spørsmål før intervjuet starter?

Introduksjon av intervjuobjekt

4. Kan du fortelle kort om hva dine arbeidsoppgaver er?

Lokalt risikobilde

5. Hvor ville du plassert følgende risikoer i risikomatrisen?
    a. Økt nedbør
    b. Sterk vind
    c. Havnivåstigning
    d. Tørke

4. Svært sannsynlig				
3. Sannsynlig				
2. Lite sannsynlig				
1. Usannsynlig				
Sannsynlighet/ Konsekvens	A. Minimal	B. Moderat	C. Alvorlig	D. Svært alvorlig

6. Uavhengig av risikoene jeg presenterte, hva anser du å være den største klimarelaterte risikofaktoren for ditt lokalsamfunn?

7. Hva anser du å være den største kilden til usikkerhet knyttet til klimarisiko i ditt lokalsamfunn?
8. Hvilke eventuelle endringer ser du i risikobildet knyttet til klimarisiko de siste årene?

Strategier og mål

9. Er kommunikasjon av klimarisiko del av kommunens helhetlige arbeid med risiko?
    a. Internt
    b. Ekstern
    c. Hvis ja. Hvordan?
10. Har dere noen mål for kommunikasjon av klimarisiko?
    a. Hvor kommer disse fra?
11. Hvilken målsetning har dere når dere kommuniserer klimarisiko?
    a. Internt
    b. Eksternt

Intern kommunikasjon

12. Hvilke kanaler benyttes til å kommunisere klimarisiko internt?
13. Hva er den største utfordringen med å kommunisere internt om klimarisiko?

Ekstern kommunikasjon

14. Hvilke kanaler benyttes til å kommunisere klimarisiko til innbyggerne?
15. Foreligger det tall på befolkningens kanalbruk som dere bruker i dette arbeidet?
16. Hvilke erfaringer har dere med å bruke de ulike kanalene?
17. Når dere kommuniserer klimarisiko til innbyggerne, jobber dere målgruppespesifikt?

    Hvis ja:

    a. Hvordan går dere frem for å kommunisere til mennesker som ikke har norsk som morsmål?
    b. Hvordan går dere frem for å kommunisere til mennesker med nedsatt funksjonsnivå?
    c. Hvordan går dere frem for å kommunisere til tilreisende?
    d. Hvordan går dere frem for å kommunisere til unge?
18. Hva er den største utfordringen med å kommunisere klimarisiko til innbyggerne?
    a. Kan du si noe om hvordan dere går frem for å løse disse utfordringene?

Usikkerhet

19. Hvordan jobber dere med å redusere usikkerheten knyttet til klimarisiko?

20. Hvordan påvirker usikkerhet hvordan dere kommuniserer klimarisiko?
    a. Internt
    b. Eksternt
21. Bruker dere mentale modeller i kommunikasjon av usikkerhet knyttet til konsekvensene av klimaendringene lokalt?
    a. Internt
    b. Eksternt
22. Lokale estimater av konsekvensen av klimaendringene og fremtidig klimarisiko er mindre nøyaktig enn globale, hvilke konsekvenser får det for dere?

Oppsummering

23. Oppsummering av funn
24. Har jeg forstått deg korrekt?
25. Er det noe du ønsker å legge til?
26. Kan jeg kontakte deg om jeg skulle ha noen flere spørsmål?