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FINSCAPES project glossary of key concepts and terms

Adaptation (Sopeutuminen): Climate change adaptation refers to adjustments to expected or actual climate change and its **impacts**. Adaptation can be used both to moderate harm and to exploit potential benefits.

Adaptation-story (Sopeutumistarina): Fictional accounts set in the future about the local experiences of different people and how they have ***adapted*** to a changed climate and society. In some contexts, these may be referred to as climate stories.

Climate projection (Ilmastoennuste): An estimate of future climate conditions usually based on simulations using numerical models of the climate system. Estimates are typically conditional on specific assumptions about future greenhouse gas and particle emissions and concentrations in the atmosphere. Local projections may also be related to an assumed level of future global mean warming.

Climate risk (Ilmastoriski): The potential direct and indirect impacts of climate and weather on human activities, livelihoods and the environment. Climate risk to a subject conventionally comprises three components: a climate ***hazard*** and the ***exposure*** and ***vulnerability*** of the subject to that hazard.

Driver (Ajuri): In this context, forces that affect the development of various phenomena, such as the climate or socio-economic conditions. Drivers used include, among others, economy, technology, security, education and governance.

Exposure (Altistuminen): In the context of climate change risks, exposure is the location of people and communities, industries, the natural environment, ecosystem services and natural resources, infrastructure or capital where they may be subject to a climate-related ***hazard***.

Hazard (Vaaratekijä): A weather or climate-related phenomenon or its development posing a danger to exposed people or systems, for example a storm, heat wave or heavy rainfall event.

Impact (Vaikutus): The effect of climate change on human activities and the natural environment. These may be direct (such as storm damage to infrastructure or drought effects on crops) or indirect (for instance pest damage to forest trees weakened by drought). Impacts can occur abruptly or gradually over time.

Mitigation (Hillintä): Measures to reduce emissions of greenhouse gases from different sources while enhancing carbon sinks (including forests).

Narrative (Narratiivi): A verbal description of a development path that focuses on socio-economic changes. Narratives describe how sets of ***drivers*** can affect societal developments and outcomes in different ways in alternative futures.

Radiative forcing (Säteilypakote): The difference between the solar radiation absorbed by the climate system and the long-wave radiation emitted by the Earth into space is called the Earth's radiation balance. Radiative forcing describes the imbalance in radiation that various climate-changing factors cause to the climate system. Radiative forcing is measured in Watts per square metre (W/m^2)

Scenario (Skenaario): The FINSCAPES project uses descriptive research scenarios that present plausible future developments based on information on changes that have already occurred and alternative assumptions about future developments. Global shared socioeconomic pathways (SSPs) commonly used in climate change research are descriptive scenarios.s. Global ***shared socioeconomic pathways (SSPs)*** commonly used in climate change research are descriptive scenarios.

SSP Socioeconomic development (Sosioekonominen kehitys): Describes changes in society that are relevant to understanding the ***impacts*** of climate change. Examples of socioeconomic factors include the level of social, educational, and economic development, political decisions, and available technology.

SSP (Shared Socioeconomic Pathway): SSPs are five alternative global socio-economic development paths (SSP1, SSP2, SSP3, SSP4 and SSP5) that include both qualitative and quantitative elements. In the FINSCAPES project, SSPs are used in two ways. 1) Socio-economic ***narratives*** describe factors that significantly influence the ***exposure*** and ***vulnerability*** of people and local ***systems*** to the ***impacts*** of climate change. The SSPs used here do not include the modifying effects of climate policy. 2) ***Climate projections*** describe future regional climate under four ***scenarios*** of radiative forcing that are consistent with combinations of SSPs and ***mitigation*** assumptions (labelled SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5). The ***radiative forcing*** information is fed into global climate models to simulate how the climate will evolve. The decimal values refer to four levels of radiative forcing that will be reached by 2100: 2.6 W/m^2 requires strong mitigation efforts to keep global temperatures below the Paris Agreement target of 2°C above pre-industrial levels. Higher levels of forcing (4.5, 7.0 and 8.5 W/m^2) imply higher emissions that fall short of the Paris targets and lead to greater global warming.

System (Järjestelmä): In the FINSCAPES project this describes an entity, formed by a complex network of interconnected sectors, actors and institutions, which plays an important role in the functioning of society at a regional or national level. It can form a part of larger systems and interacts with natural environmental systems.

Vulnerability (Haavoittuvuus): Characteristics of a subject at risk that increases its sensitivity to a phenomenon that causes potential damage or danger. Societal vulnerability is increased, for example, by low income or education levels or various diseases.

Sources: IPCC [1,2,3]; MMM [4,5]; Ministry of the Environment[6]

[1] Agard et al. (2014), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-AnnexII_FINAL.pdf

[2] Hewitson et al. (2014), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap21_FINAL.pdf

[3] IPCC (2023), https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_AnnexesIndex.pdf

[4] MMM (2023), https://julkaisut.valtioneuvosto.fi/handle/10024/165337

[5] Ruuhela et al. (2023), https://julkaisut.valtioneuvosto.fi/handle/10024/164670

[6] Ministry of the Environment (2017), http://urn.fi/URN:ISBN:978-952-11-4748-7

Why are scenarios useful?

The future is uncertain, and North Karelia faces challenges in preparing for potential impacts of climate change. Neither future climate changes themselves nor the socioeconomic conditions that affect exposure and sensitivity to those changes can be predicted with confidence. Instead, it is common to construct scenarios. Uncertainty can be assessed by developing alternative scenarios that explore what could happen in the future and identify possible future trends. Scenarios can help describe changes in the main drivers determining future impacts in a region, both climatic and socioeconomic. They can also help plan adaptation to future climate change, as they provide an opportunity to test the effectiveness of adaptation strategies and measures in different futures. This background document summarises the main features of the FINSCAPES scenarios co-produced for the North Karelia region[7].

Climate change is already affecting North Karelia

The climate of North Karelia is changing, and this is having impacts on nature, on people and on their livelihoods. Some impacts are gradual, revealed by long-term monitoring, such as a lengthening of the growing season[8], changes in the distributions of plant and animal species[9], and a shortening of the winter season for snow-based recreation[10]. In North Karelia, the length of the snow season has shortened by about one week per decade during the period 1961–2020 (Figure 1)[10].

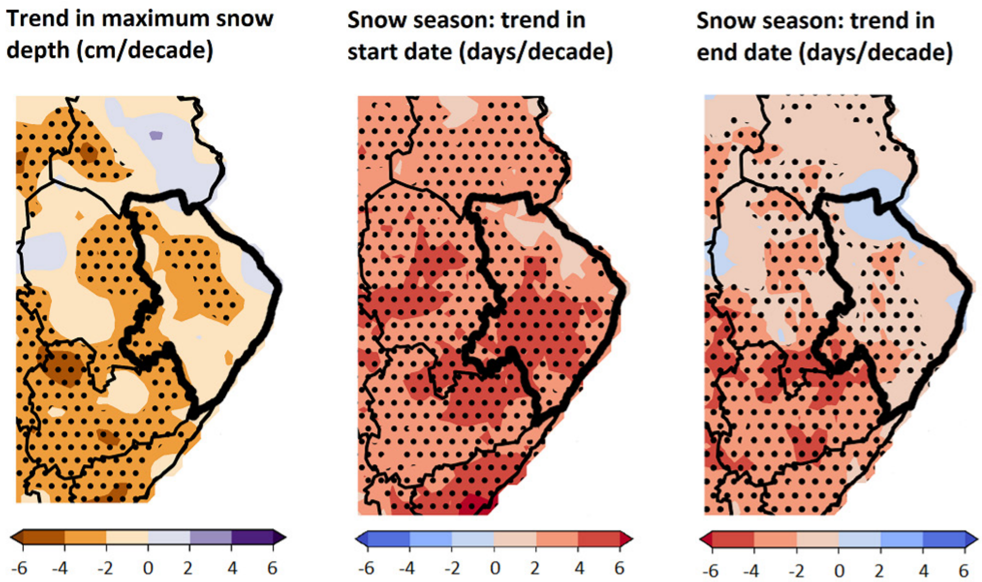

***Figure 1**. Change per decade in annual maximum snow depth (left) and date of permanent snow cover onset (middle) and end (right) from 1961 to 2020. Shading indicates areas where changes have been statistically significant.[10]*

Climate change also affects the frequency and intensity of many extreme weather conditions, the impacts of which can be more acute. These include mortality, illness and reduced productivity of both humans and livestock in heatwaves, flash flooding caused by intense rainfall events or wind damage of forests, infrastructure and property during storms. For example, the year's highest amount of precipitation received in one day increased in many places in North Karelia between 1969 and 2020[11].

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[7] For more information see:http://www.syke.fi/projects/finscapes

[8] Peltonen-Sainio et al. (2018), https://doi.org/10.1007/s10113-017-1275-5

[9] Huikkunen et al. (2024), http://hdl.handle.net/10138/577595

[10] Luomaranta et al. (2019), https://doi.org/10.1002/joc.6007

[11] Note that increases are typically not statistically significant (Dyrrdal et al. 2021), https://doi.org/10.1016/j.ejrh.2021.100965

However, the magnitude of climate impacts is also affected by how exposed systems and communities are to these changes and, if exposed, how sensitive or vulnerable they are to their effects. Exposure and sensitivity can be strongly affected by socioeconomic factors such as demographic structure, social status and access to healthcare. Therefore, in order properly to explain the magnitude and distribution of climate change impacts, it is necessary to understand not only the climate changes themselves but also the socioeconomic context in which they occurred.

Elements of the FINSCAPES scenarios

The FINSCAPES project[12] has worked closely with stakeholders in North Karelia to jointly develop a set of regional scenarios to support climate change preparedness. These scenarios address the impacts on three systems identified by local experts as requiring particular attention: the circular bio-economy, food and nature services systems. The scenarios are based on global shared socioeconomic pathways (SSPs) that describe alternative socioeconomic development trajectories into the future[13] (Figure 2). These are widely used in different parts of the world. Each pathway reflects socioeconomic developments that pose major or minor challenges related to climate change adaptation and mitigation. The SSP framework is used in the FINSCAPES project to describe two aspects of conditions in North Karelia out to the 2050s and beyond – socioeconomic development and climate. These two elements can then be combined into integrated scenarios that are applicable in planning for the future. In addition, examples are also provided of how these scenario futures might look through the eyes of local people. Adaptation-stories are fictional descriptions, set in the future, of how different individuals have learnt to adapt to a changing climate.

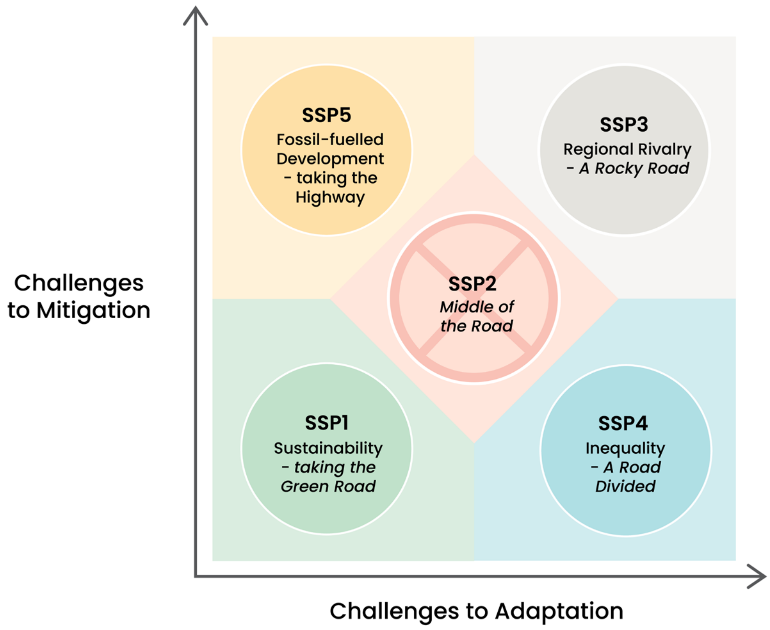

Figure 2. *Five socio-economic development pathways (SSPs). SSP2 was excluded from the FINSCAPES project.*

[12] Finnish scenarios for climate change research addressing policies, regions and integrated systems (FINSCAPES) is a four-year consortium project (2021-2024) financed by the Research Council of Finland's Special funding for system-level research into climate change mitigation and adaptation.
[13] O'Neill et al. (2017) http://dx.doi.org/10.1016/j.gloenvcha.2015.01.004

Socioeconomic narratives for North Karelia

The narratives describe key factors that influence the exposure and vulnerability of local systems and people to the impacts of climate change. They have been created together with stakeholders from North Karelia for four socio-economic development pathways (Figure 2). The process of developing the narratives is presented in Figure 3. Each regional narrative is structured according to the key drivers of socio-economic change that are central to major systems identified for the region. Full SSP narratives are available at the project website[7]; short versions are presented on the following four pages. In addition, local artist Sanna Hukkanen was commissioned to visualise the narratives for each SSP based on his personal interpretation. These illustrations are presented alongside the narratives.

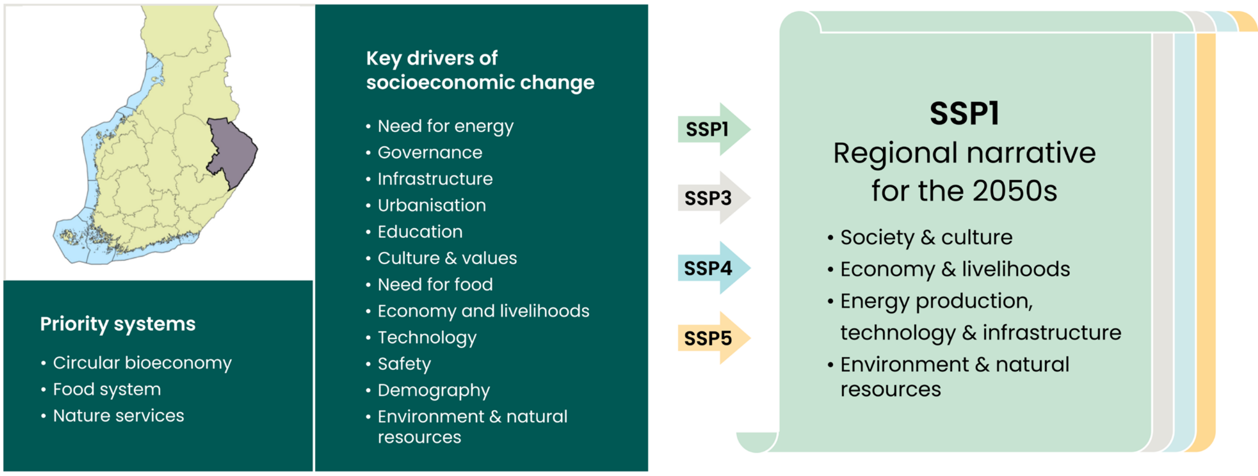

Figure 3: *Main elements of SSP-based socioeconomic narratives for the North Karelia region.*

Although the narratives provide comprehensive descriptions of future socio-economic developments, they do not necessarily meet all the needs of analysts preparing for future changes. Unlike climate projections, which are usually quantitative, the narratives are wholly qualitative descriptions of the future. For applications in regional planning and research, such as risk modelling or economic cost accounting, that require numerical descriptions of future socioeconomic trends, it is necessary to quantify trends that are consistent with the descriptions. One approach is to identify a handful of socio-economic indicators that are important for the analysis. For each indicator experts assess its potential future development trends based on an interpretation of the narrative and often based on historical observations. As a first step, simple arrows describing the direction of change (e.g. up, down or no change) can be used[14]. More elaborate methods are required to generate fully quantitative trends. Given the widely differing and case-specific needs for such quantification, as well as the demands of such procedures, this was not pursued in the FINSCAPES project.

[14] Lehtonen et al. (2021), https://doi.org/10.1007/s10113-020-01734-2

SSP1 Sustainability – Taking the Green Road

Sustainable development in North Karelia is promoted through education and research. Societal change is built on social justice. Regional cooperation is increasing and demand for ecological products growing, while consumption is being channelled in a sustainable direction. Sustainable lifestyles and better access to nature increase citizens' health and well-being. Joensuu’s role as the European Forest Capital is strengthening the region's contribution to the green transition. However, there is some resistance to change and conflicts do still occur.

Figure 4: *Artist’s impression of the SSP1 narrative for North Karelia © Sanna Hukkanen*

There is strong economic growth built on the green transition, creating new business opportunities. North Karelia is a prominent player on the international stage and produces experts who are highly qualified in the sustainability transition. The profitability of livestock farming has suffered, but it remains an important part of food security and helps maintain biodiversity. Organic and local food production is increasing, as is the utilisation of forests for harvesting natural products. There are growing job opportunities in the bioeconomy sector.

North Karelia utilises bioenergy, alternative energy products and energy storage solutions. Technological development supports the optimisation of sustainable energy distribution and the use of smart technologies. The use of renewable energy, such as wind and solar power, is increasing, but it brings with it challenges in land use and creates conflicts with biodiversity protection. The rising cost of fossil fuels is causing energy poverty for some parts of the population.

Sustainable forest management and biodiversity conservation are highly valued. Recreational use of forests and the availability of ecosystem services are on the increase. The condition of forests and water bodies is improving, supporting biodiversity conservation and improving overall environmental quality. However, an increase in nature tourism is leading to restrictions on “everyone’s rights” access in order to protect sensitive biotopes.

SSP3 Regional Rivalry – A Rocky Road

North Karelia faces significant challenges as international trade and cooperation collapse. Regional centres are shrinking and wealth is increasingly concentrating in cities, deepening regional inequalities. Confrontation, distrust and xenophobia are becoming more common in society, while the role of local community structures is becoming more important. Traditional lifestyles are gaining popularity.

Figure 5*: Artist's impression of the SSP3 narrative for North Karelia © Sanna Hukkanen*

A decrease in the use and availability of international expertise is leading to a decline in the overall level of knowledge. The procurement of skilled labour is becoming increasingly difficult. Exports are collapsing and the region's economic structures are coming under increased pressure. On the other hand, efforts are underway to maintain cooperation between various sectors and organisations. Bioenergy and forestry offer some relief from the economic challenges, but the fragmentation of economic structure requires restructuring and innovation, which is difficult to achieve in the prevailing situation.

North Karelia is striving to utilise local bioenergy reserves and hence strengthen Finland's energy security. The difficult economic situation and lack of raw materials is contributing to a growth of the circular economy. The region's isolation and economic decline are reflected in neglected and deteriorating infrastructure as there is little investment in its upkeep.

The intensive use of natural resources continues while a weakening of environmental protection is leading to a loss of biodiversity. National parks and protected areas have either been closed or their protections weakened. The value of natural products is increasing, but they have become luxury products due to their growing scarcity. The recreational use of nature is declining and people's connection with nature is weakening. The health of the population is deteriorating due to an increase in lifestyle diseases and shorter life expectancy. An ageing population and shrinkage of younger age groups is putting a strain on elderly care and public finances.

SSP4 Inequality – A Road Divided

In an increasingly unequal world, North Karelia is also suffering from rising inequality. Power and wealth are increasingly concentrated in the hands of the few, while access to education is becoming increasingly unequal. Healthcare provision is polarising, with lifestyle diseases becoming more common in poor areas, while the wealthy enjoy high quality services. Rural areas are suffering from depopulation as urbanisation accelerates. Social tensions are rising as people perceive weakening opportunities to influence their own lives. Trust in society is declining among a large majority of citizens, while feelings of insecurity are growing.

Figure 6*: Artist's impression of the SSP4 narrative for North Karelia © Sanna Hukkanen*

Multinational companies are carving out space for themselves in a volatile operating environment. With rising inequality, jobs and vitality are becoming concentrated in large population centres. Low-paid work is on the increase. Crime rates are growing with rising economic distress. Forestry remains an important economic activity, but its benefits are unevenly distributed. Food production is concentrated on large intensively cultivated farm units.

Rural depopulation is eroding transport services and infrastructure in the countryside. Technological development is high in some sectors. For example, progress has been made in improving water quality of waterways, leading to an increase in clean water supplies. Energy prices are high relative to the income levels of most people. Household energy needs are met by bioenergy. Remote and digital services are addressing some of the lack of service provision, especially in rural areas.

Environmental degradation and species extinction are accelerating as economic factors outweigh sustainability considerations. The intensive exploitation of forests continues, leading to both social and ecological consequences that deepen regional divisions. Environmental crime is on the increase due to the high expense and inadequacy of waste management. Nature tourism has become a pastime mainly for the wealthy.

SSP5 Fossil-fuelled Development – Taking the Highway

The development of North Karelia is based on the use of fossil fuels, which together with a strong forestry sector supports the economic vitality of the region. Society benefits from energy intensity, which enables widespread consumption and strengthens the economy. Lifestyle diseases associated with overconsumption place a strain on health care. This is being addressed, for example, through the privatisation of healthcare. Natural values and sustainable activities are being neglected as people become alienated from nature.

Figure 7: Artist’s impression of the SSP5 narrative for North Karelia © Sanna Hukkanen

Food production is concentrated on intensive production, with less attention paid to quality. The market determines food prices and choice. Forestry is a key industry and forests are used intensively. Joensuu is known as the forest capital of Europe, and produces top experts in the forest sector. The region’s mining industry is also expanding as consumption grows and technology develops. Energy and raw materials are inexpensive.

The forests of North Karelia support Finland's energy security as a source of bioenergy, even though imported fossil fuels are the main source of energy. Technological progress has reduced energy consumption and improved the efficiency of fertiliser use in food production. Agriculture also utilises renewable energy and new crops and vertical farming are proliferating. The telecommunications infrastructure is of high quality and offers fast connections, which is improving opportunities, for example for remote working. This enhances the availability of skilled labour in many sectors.

Intensive use of fossil fuels is degrading the quality of the environment and increasing ecological stresses. Nature conservation priorities are overshadowed by economic growth. The fossil energy sector exploits forest-based bioenergy as a tool for greenwashing. Waterways suffer damage from peat production and intensive monoculture farming. This leads to conflicts between conservationists and the forest industry. Small areas (bubbles) of protected environment mainly provide highly commercialised experiences of nature for the public.

How will the climate of North Karelia change in the future?

In spring 2024 the FINSCAPES project investigated the need for regional information about Finland's changing weather and climate. For North Karelia the questionnaire survey was aimed, in particular, at stakeholder representatives from the three priority sectors identified for the region (Figure 3). Respondents considered information on the occurrence of winter precipitation, freezing rain, snowfall and heat waves to be particularly important for the region.

In recent decades, the December-February maximum two-weekly precipitation in North Karelia averaged just over 10 mm. Climate model results show that winter precipitation will increase in the future: by the end of the century, the maximum two-week precipitation in winter will be over 20 mm on average in a moderate warming scenario and around 40 mm in a very strong warming scenario[15]. Freezing rain is also expected to increase somewhat in North Karelia[16]. On the other hand, the snow-covered period will shorten and snow thickness will decrease[17]. The nature of winter precipitation and the extent of snow cover in the coming years and decades will be affected by both temperature and precipitation increases. The average December-February temperature in North Karelia from 1991 to 2020 was approximately −8 °C on average[18]. Depending on the success of climate change mitigation measures worldwide, the best estimate of the average temperature for winters by the end of the century, obtained as an average of climate model results, ranges between −6 °C and −1 °C (Figure 8).

Projections of average changes in annual mean temperature and precipitation in North Karelia for the 2050s compared to the present are presented in Table 1. They assume four alternative paths of radiative forcing caused by future greenhouse gas emissions. Note that the four mean temperature change values in this table are marked as coloured symbols in Figure 10 (below).

[15] Lehtonen et al. (2024), https://urn.fi/URN:ISBN:978-952-405-153-8

[16] Kämäräinen et al. (2018), https://doi.org/10.1029/2018JD029131

[17] Räisänen et al. Manuscript under review

[18] Open access data: https://paituli.csc.fi/, https://etsin.fairdata.fi/dataset/63b58d1a-dc23-44eb-87e6-d3c31b9a57f9

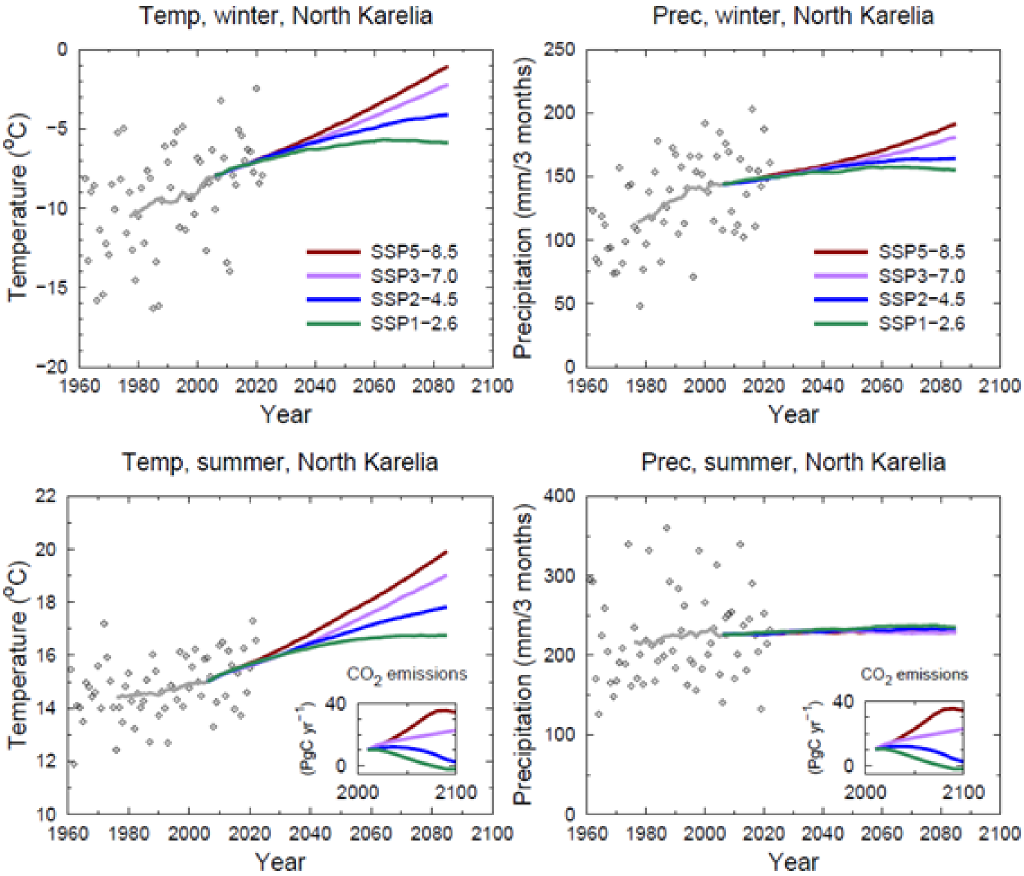

Figure 8. *Average temperature (left) and precipitation (right) in North Karelia in December-February (top) and June-August (bottom). Grey symbols show the regional averages in previous years and the grey curve their 30-year moving average. Estimates of future changes in long-term averages are shown as curves in different colours, which have been prepared based on the results of 28 climate models separately for four different greenhouse gas scenarios. Note the different vertical axes.*

Table 1: Change in annual mean temperature (°C) and precipitation (%) in North Karelia by the 2050s based on four alternative assumptions about the radiative forcing caused by greenhouse gas emissions. In addition to the average value given by climate models, an uncertainty interval is presented, which includes 90% of the model results examined. The reference period is 1991–2020

Radiative forcing due to greenhouse gas emissions by 2100	North Karelia: change by 2050s*	
	Temperature (°C)	Precipitations (%)
Very High	+3.1 (1.7 – 4.6)	+9 (2 - 16)
High	+2.7 (1.3 – 4.0)	+8 (2 - 13)
Moderate	+2.2 (1.0 – 3.5)	+7 (1 - 13)
Low (Paris compliant)	+1.8 (0.7 – 2.8)	+6 (1 - 11)

* North Karelia regionally averaged annual mean changes for 2041-2070 relative to 1991-2020, with uncertainty ranges (10th to 90th percentiles of model projections).

Winters are warming faster than summers, although the variation in winter temperatures from year to year will continue to be large in the future (Figure 8). Although cold winters can still be expected, their probability of occurrence is clearly decreasing. A severe frost period, such as occurred on average every four years in the latter part of the last century, will be experienced approximately once every 20 years if global warming since pre-industrial times can be kept to 2 °C (Figure 9, left panel). As winters become warmer, the need for space heating of buildings will therefore decrease[19].

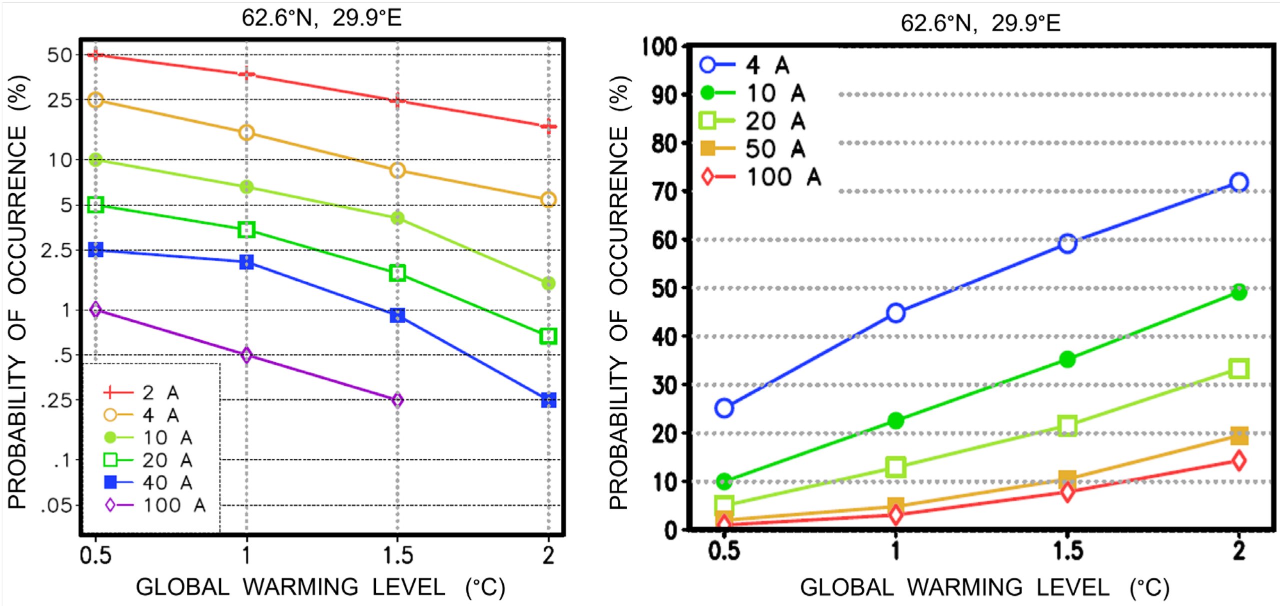

***Figure 9**. Probabilities of occurrence (% of years) of frost periods (left) and heat waves (right) of different severity in North Karelia. The level of severity is defined as events in the climate of the late 20th century that occurred on average once every 4, 10, 20, 50 or 100 years (see legend). The horizontal axis is the level of global warming compared to pre-industrial times. Note that global warming was already around 0.5 °C by the late 20th century and 1 °C by the 2010s.*

As average summer temperatures rise (Figure 8), heat waves will become longer and more intense. A hot spell, such as occurred on average once every 10 years in the latter part of the last century, will be experienced more than once every other year by the end of this century if global warming is kept to 2 °C since pre-industrial times. This means an increase in the cooling demand for buildings[20] (Figure 9, right panel).

Intense rainfall events are projected to increase in summer[21], which would be important to account for when designing stormwater drainage, for example[22]. On the other hand, projected changes in total summer precipitation are quite small compared to how much these totals naturally differ from one year to another (Figure 8).

Integrated scenarios for North Karelia

The FINSCAPES project has used the global framework of shared socioeconomic pathways (SSPs) to produce four alternative narratives for the socioeconomic development of North Karelia up to the 2050s (Figure 10, right). The project has also analysed projections of a number of priority climate variables to the 2050s and beyond; these are based on four different assumptions about radiative forcing (Wm_{-2}) due to greenhouse gas emissions to the end of the century (Figure 10, left). By combining the socio-economic development narratives and climate projections, 14 different plausible futures can be created from which integrated scenarios can be selected (Figure 10, right, combinations of symbols and SSP narratives). A selection of these descriptions can be used, for example, to raise awareness about climate change, simulate impacts and adaptation, assess risks, develop adaptation strategies and plans, develop adaptation or emission reduction pathways, or conduct integrated assessments.

[19] Pirinen et al. (2024), https://doi.org/10.35614/ISSN-2341-6408-IK-2024-05-RL

[20] Ruosteenoja & Jylhä (2023), https://www.geophysica.fi/article/id-58-1-047-ruosteenoja/

[21] Utriainen et al., manuscript under review

[22] Toivonen et al. (2021), https://vesitalous.fi/wp-content/uploads/2021/03/Vesitalous_0221_lowres-1.pdf

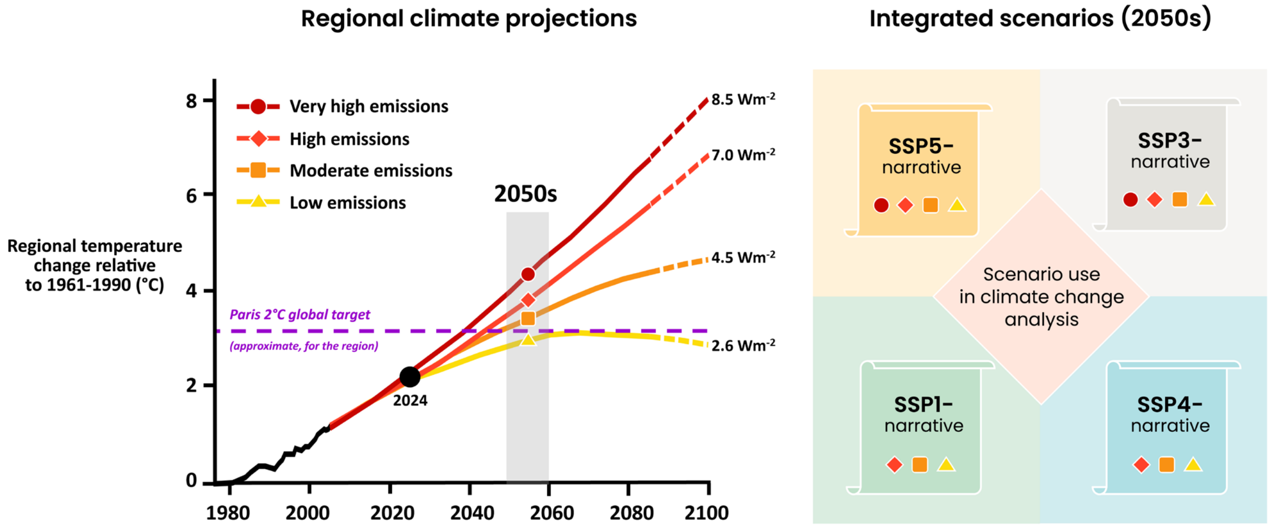

Figure 10. *Integrated scenarios for use in climate change analyses. Schematically presented regional climate projections (left, coloured symbols) are linked to four regional SSP narratives (right). Climate projections by the 2050s do not differ as much as they do by 2100. Thus, most projections for the 2050s can be plausibly linked to any SSP narrative. However, the very high emissions scenario (dark red circle) is inconsistent with the assumptions of the SSP1 or SSP4 worlds.*

So which of these should be chosen? There is no definitive answer to this question, as scenario analyses usually involve trade-offs. A thorough approach, applying many scenarios that address important uncertainties, is likely to yield the most reliable results. On the other hand, time, expertise and financial resources are usually limited. The trade-off is therefore to focus on a small number of well-chosen scenarios. Each scenario application is unique, so no recommendations are made here on the preferred combinations of FINSCAPES scenarios. Instead, Table 2 provides a set of criteria that can help in selecting combinations of scenario components.

Table 2: Some criteria influencing scenario selection for use in climate change analysis

Criterion	Rationale for scenario choice, with reference to FINSCAPES
Number	The use of a single scenario is not normally recommended. Some decisions are made on the basis of “official projections”, “most likely futures” or “business-as-usual scenarios”. However, while a single description of the future may be preferred to no scenario at all, the central principle of scenario analysis is that it can offer plausible alternative pathways when confident predictions are not available. It has also been argued that use of an odd number of scenarios may tempt analysts to select only the middle case. In fact, an early decision in the FINSCAPES project was to exclude the intermediate case, SSP2 (Figure 2).
Time horizon	The FINSCAPES socioeconomic narratives are focused on the 2050s. On this time scale differences are smaller and overlaps larger between the four climate projections than for later periods; hence fewer projections may suffice to cover the range.
Longer-term perspective	A longer-term perspective beyond a given time horizon may also be necessary: a) to advise sectors exposed to climate change over long periods, such as forestry and the built environment, and (b) to avoid maladaptation, by acknowledging that changes in climate can be expected to continue well beyond planning horizons and so ensuring that actions targeting conditions in the 2050s are also flexible enough to adapt to changes beyond that time period.
Prioritised systems	The FINSCAPES scenarios are intended to be used to manage key regional systems as defined by stakeholders. The primary socioeconomic drivers of exposure and sensitivity to climate change may differ between systems, and this may influence the scenario narratives that are most interesting to explore.
Analytical focus	This may determine the relative importance of the climate and socioeconomic dimensions of the scenario. For example, in a study examining the risk of hydropower dam failure due to high peak flows, different climate projections for extreme rainfall may be prioritized over projections for societal changes. On the other hand, the implications of dam failure might require alternative estimates of people and infrastructure exposed to catastrophic flooding combined with a single high radiative forcing climate projection.
Precaution & inevitability	Different scenarios can address different aspects of uncertainty. For example, a socioeconomic narrative emphasising inequality might aid precautionary planning of human security and social justice across a range of climate projections, including those describing extreme weather events that could affect the most vulnerable. In contrast, other scenarios might inform on exposure and vulnerability to climate changes that cannot be avoided; for example, using projections assuming the lowest emissions, compliant with the Paris Agreement, in combination with different socio-economic narratives.
Plausibility	Some combinations can be excluded due to their implausibility. For example, SSP1 and SSP4 pathways are not capable of generating the highest emissions and radiative forcing, so climate projections with such forcing should not be associated with these narratives (Figure 10). However, the time horizon is important here too. For example, while climate projections associated with low radiative forcing by 2100 are unlikely to be realised in societies still reliant on fossil fuels but where mitigation technology is not effective, the scenario combination may still be plausible in the 2050s..
Tiered approach	A possible approach to scenario selection is to prioritise a core set of a few “first-tier” scenarios to be used in common in an assessment, but also to allow for a second tier of additional scenar-ios that may be needed for specific purposes.

Adaptation-stories

One of the key uses of FINSCAPES scenarios is to provide a future context to support adaptation planning and awareness-raising. The climate change adaptation-stories developed in the project represent a novel approach to achieving these goals. These are fictional accounts set in the future describing local experiences of how different individuals have adapted to a changed climate. The adaptation stories are based on projected impacts, SSP-based narratives and interviews with locally relevant stakeholders. The stories developed for North Karelia are set in the year 2050, presenting perspectives on how dairy producers and buyers have adapted to maintain livestock health and milk production in warmer summers. Here, two excerpts are presented that provide a perspective on the lives of the same dairy farming couple, Niilo and Venla Nevalainen, from Lieksa. The first excerpt is based on conditions in North Karelia as described in the FINSCAPES project SSP1-based socio-economic narrative; the second is based on the SSP4 narrative. The adaptation-stories are complemented by an artistic interpretation of each story by an artist from North Karelia, Anne Stolt. Full adaptation-stories can be found on the project website.[7]

A dairy farm in Lieksa is adapting to climate change by combining traditional expertise with technological innovations

…But back to the present. The cows that grazed outside during the night are now queuing their way back to the barn. It's certainly more comfortable inside, where the automated system adjusts ventilation based on the temperature. This ensures the cows have the best possible conditions during the hottest parts of the day. Fortunately, electricity prices in Finland have remained reasonable, so all the technology we use doesn't cause extra worry. After all, as the newspapers have written, Finland has managed to stabilise electricity prices by investing over the decades in renewable and self-sufficient energy production…

Locality is favoured and self-sufficiency strengthened on a farm in Lieksa

...When the local dairy farms began shutting down, multinational companies started appearing in the area. They aggressively sought to make contracts with local milk producers. While these new players bring stability and jobs to the region in these uncertain times, Venla and I didn't want to get involved in that. Profitability tends to decline even further when working with multinational companies, and their operations often leave much to be desired in terms of ethics. Most of the remaining farms here have become large-scale intensive production units. However, we wanted to focus on socially and environmentally sustainable dairy farming. That's why we made a contract with a local dairy, which produces high-quality products. Especially during holiday seasons, well-off people from the cities come here who are willing to pay for cleanly produced food and quality services...

FINSCAPES scenarios to support climate change research and decision-making: Key results for North Karelia

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