

Project description: Climate services in Hordaland – HORDAKLIM

PART 1: The planned innovation

1. Underlying idea

Norwegian municipalities have great formal responsibility for ensuring that local communities are adapted to climate change. Among other things, they are obliged to have risk and vulnerability analyses in place for all development and land use plans. The challenge that municipalities face is that they lack knowledge about climate change and what effects such change will have locally. In addition, local climatic conditions differ greatly from municipality to municipality, particularly in Hordaland county, and local knowledge is not being updated. There is a considerable risk that municipalities will make development decisions that could have fatal consequences. The municipalities need access to new knowledge in order to be able to make better decisions about development and prevention measures in relation to expected climate change.

Our research communities are among the world's leading climate modelling environments, and supply data on a global scale. But the current climate models only provide data on such a large spatial scale that they are irrelevant to Hordaland county. This is a serious problem that we want to remedy.

Report No 33 to the Storting *Klimatilpasning i Norge* ('Climate adaptation in Norway' – in Norwegian only) points out that research-based knowledge should form the basis for more specialised climate services for use by the municipalities.

The objective of *HORDAKLIM* is for the research communities to downscale climate models and produce customised climate data for a selection of municipalities in Hordaland county. The municipalities, on their part, are to tell researchers what specific problems they are facing and where their need for knowledge is greatest. The specific knowledge will be made applicable through dialogue between the users (the municipalities) and the supplier (the researchers).

In the *HORDAKLIM* project, the research communities aim to: 1) resolve the challenges relating to the spatial resolution of current climate data, so that the climate model results can be *downscaled* to a resolution sufficient to reproduce the weather phenomena that influence climatic conditions in Hordaland, and 2) customise climate data to make them relevant to the Hordaland municipalities' efforts to adapt to climate change.

By reducing the level of uncertainty in the knowledge base, the project will help to make municipalities better equipped to fulfil their task of ensuring robust and sustainable local communities in a future where climate change considerations will be an integral part of the municipalities' area of responsibility.

The project seeks to comply with the Regional Research Fund for Western Norway's call for applications by addressing the following issues: - Ensuring more learning and transfer of competence between the climate research communities, the county authorities and municipalities, taking 'defined strategically important issues in the municipal area of responsibility' as our starting point and 'contribute to research-driven innovation that generates value creation in the public sector through competence-raising and knowledge transfer'. Moreover, *HORDAKLIM* will contribute to achieving 'municipal goals by introducing new solutions to specific challenges' with a 'focus on tasks that can be carried out by different actors on assignment for the municipal sector' and comply with the request to 'form broad alliances' in our R&D activities.

We feel certain that we thereby also base our work on 'Early intervention in a life cycle perspective: prevention rather than repairs'; 'Role and responsibility in the education/knowledge society:

Ensuring expertise for all municipalities regardless of size and resources', and contribute to a 'More robust organisation: Ensuring forward-looking and sustainable local communities, for example by means of the capacity to cooperate with actors in the private sector and voluntary organisations'. We do this by strengthening the municipalities' ability to make use of the best expert knowledge that science has to offer in their local development work.

2. Level of innovation

HORDAKLIM seeks to provide new and optimised climate data customised for selected municipalities in Hordaland county (**the Product**).

HORDAKLIM will facilitate good knowledge transfer (**delivery**). We seek to achieve good dialogue between the research community and the selected municipalities by establishing thematic groups where specific challenges are discussed (**organisation**).

1) *Product*: The existing climate data are of such a coarse resolution that they are not suitable for use in the planning of robust climate adaptation at the municipal level. The goal is to produce a new data basis for climate adaptation by downscaling the large-scale climate data to make them relevant for Hordaland county and Western Norway. This is described in more detail in the research needs section and in Part 2: R&D activities.

2) *Delivery*: The dialogue and knowledge transfer in the project will build on Hordaland county authority's practical experience of organising and disseminating information to the municipalities in Hordaland. The climate research community will facilitate the transfer of knowledge about climate and climate change. The researchers who produce the results in this project will also be available for the transfer of new knowledge generated. The knowledge must be as relevant to each end user as possible, and must be presented in a user-friendly format. The transfer of knowledge about climate change is important, but it is the municipalities that possess knowledge about practical solutions. It is also the municipalities that know their own challenges best, and this must be communicated to the research network to enable researchers to respond directly to the individual municipalities' needs. In this way, we can ensure that the product is relevant to the individual end user. The municipalities' challenges, and thus the key research questions, will be identified through dialogue. The project is developed specifically to link the knowledge provider (the climate research community) with the end users (in this case, municipalities in particular) from beginning to end. The project will test how new scientific data can be made available to municipal specialists with completely different competence. What will they understand? How can the data be made relevant to municipal case processing? How can the data be transferred to thematic maps for use in municipal planning processes? How can the knowledge influence practical use in municipalities? Hordaland county authority, in cooperation with the County Governor, will facilitate arenas for meetings and exchange between researchers and municipalities. The primary arena will be thematic workshops where representatives of the relevant municipalities and administrative agencies (thematic groups) will be the primary arena.

3) *Organisation*: It is a goal to create arenas for good networks and regional cooperation that can make each municipality more capable of adapting to the expected climate change. We will build on existing networks and establish resource groups in areas where climate adaptation is deemed to be particularly difficult. The main task of the county authority and the County Governor of Hordaland is to create good arenas for and facilitate contact.

On start-up, each municipality will receive basic information about existing data and the research communities' knowledge base, and about the uncertainty relating to the data and scenarios. This preliminary study will form the basis for establishing network groups (thematic and resource groups) of members that have similar challenges and a natural potential for learning from each other.

The information will also form the basis for the first discussions between the research community and the end users to efficiently arrive at a common understanding, realism and platform for what the knowledge side can deliver and what the user side wants. This dialogue will define what climatic areas the research community will emphasise in its analyses of the results for each party, and also clarify for the end users what information they can expect to receive. These network groups will also ensure the efficient transfer of results from the scientific research community, while ensuring that the scientific documentation is correctly interpreted as a basis for planning and decision-making processes in the municipalities.

3. Potential for value creation

Many political strategy documents have stated that targeted knowledge transfer (here: goal-oriented climate knowledge) can optimise municipal priorities and investments.

Municipal and regional planning is to ensure robust and sustainable local communities. Today, data and information about the expected effects of climate change are not available at a level of detail that enables the planning authorities to make good decisions. Most municipalities emphasise climate in their land use plans, but these plans are mainly based on climate projections using a much too coarse grid, or on climate history that is not relevant to the climate that the municipalities will be faced with in the near future. Consequently, the current local planning often fails to achieve its goal of adapting to future climate change.

The project is in line with the guidelines set out in the Climate Plan for Hordaland. The content of the climate plan does not directly address a value creation potential in Hordaland, but forms a framework for making climate adaptation an underlying consideration in public planning and business development. The points in the climate plan can be summarised as follows:

- Adaptation to climate change shall be a consideration in all relevant regional plans and in all municipal master plans.
- Hordaland county authority will help to develop the Climate Service into a user-driven R&D project intended to increase knowledge in all parts of the county.
- All new plans, projects and developments in the county shall be based on new knowledge. New knowledge shall form the basis for measures to prevent flooding and landslides and to improve the location of infrastructure such as roads, railways, and the electricity and telephone networks.
- Climate data will also form the basis for better surface water handling.

The scientific production of knowledge and the public administration have traditionally been separate entities in Norwegian society. This separation is becoming more and more of a challenge, as obtaining and analysing available scientific data requires a high degree of specialised research-based expertise. On the other hand, the public administration's tasks are becoming increasingly specialised in response to local and regional needs and challenges. This could give rise to suboptimal transfer of the scientific basic data as a starting point for planning processes. There is a risk that differences could develop between municipalities, where small municipalities lack the big municipalities' capacity to search for, analyse and make use of existing knowledge.

Two-way communication between researchers and the local municipal level is required in order to improve the ability to provide relevant climate data that the individual municipalities and industries deem to be of critical importance. Most small municipalities lack the resources to obtain such knowledge and expertise, but will nevertheless have access to them through this project. This could reduce the differences between big and small municipalities' ability to develop the most rational and cost-effective climate measures possible at the local level.

The project aims to reduce the risk of municipalities implementing measures that are sub-optimal or of little relevance. There are socio-economic gains to be made from upgrading of infrastructure and

changes in land use. This is a well-known fact, cf. the main findings in the IPCC's Working Group II Report.

If the decisions regarding and implementation of measures relating to local development and land use are based on misinterpretations of climate projections, or if the municipality chooses focus areas that are sub-critical to the local climate vulnerability, infrastructure and business interests, the result will be a significant increase in socio-economic expenses both now and in future. It is therefore of material socio-economic importance that the local prioritisation of measures is, to the greatest possible extent, based on a good and rational understanding of the effects that climate change will have on the individual local community. There are great variations between municipalities.

4. Need for research

The geography of Hordaland county and Western Norway in general is characterised by high mountains and long, narrow fjords. There is great climatic variation in the area. Only 100 kilometres separate Haukeland in Masfjorden municipality from Vivali in Eidfjord municipality, but the two places have an average annual precipitation of 3,537 mm and 840 mm, respectively – a huge difference over a short geographical distance. Global climate models divide Earth into a horizontal grid, where each cell typically represents a rectangle where the sides are 100–300 km long. This means that, in such models, Haukeland and Vivali will be represented by the same grid cell, and both places will be assigned the same meteorological variables, including precipitation, wind and temperature. It is obvious that such models do not produce projections that are relevant for Hordaland county. Regional down-scaled climate data at a resolution of about 50 km are also available through the international cooperation project CORDEX (Giorgi et al., 2009), in which Uni Research Climate participates, but even this resolution is inadequate for the purpose of creating a realistic representation of our regional climate. In addition, it is a problem that the CORDEX data were 'bias-corrected' before being downscaled (see the supplementary discussion of this problem in Part 2).

This means that, in practice, the existing climate projections for Norway only describe large-scale changes, which have no practical relevance for individual municipalities. This is a serious knowledge gap that must be addressed. Uni Research Climate has considerable expertise and is part of a large network that has the tools necessary to customise downscaled climate data for individual municipalities.

PART 2: The R&D activities

5. Objectives

Main objective: The research communities are to provide new and updated downscaled climate data and customise them to municipalities in Hordaland county to make it easier for them to adapt to climate change.

In order to achieve this, we need to attain a number of secondary objectives:

1. *Communicating with users to map their need for information* about future regional changes in weather and climate parameters.
2. *Identifying the horizontal model resolution that enables us to represent the great local variations in Hordaland county in the best possible manner.* Previous studies indicate that the optimum resolution is between 1 and 5 km. We will use several resolutions to downscale short periods, for example autumn 2005, when Western Norway was hit by two episodes of intense precipitation that caused landslides and deaths in the City of Bergen, in order to make it possible to evaluate the extent to which the model is capable of reproducing the observed weather.
3. *Arriving at a parametrisation that reproduces the weather and climate of Hordaland county in the best possible manner* in terms of wind, precipitation and temperature. The different schemes could make for a big sample space, and it is a great challenge to find the optimal

configuration. As for the previous secondary objective, we will run the model with different schemes and evaluate the result in relation to the observed weather.

4. *Setting up and optimising a coupled hydrological/atmospheric modelling system* in the form of WRF-HYDRO, which was designed to represent hydrological processes on different spatial scales, such as floods resulting from torrential rain and/or melting of snow. The geography of Western Norway entails very special challenges relating to torrential rain due to the area's topography, snow melting in the mountains and run-off into narrow rivers. As for the two preceding secondary objectives, studies of individual events and comparisons with observations will be a key activity in achieving this sub-goal.
5. *Developing robust and trustworthy bias correction methods for low-resolution climate models at high latitudes.* This involves developing existing methods created for subtropical areas, including those developed by the regional downscaling group at the National Center for Atmospheric Research (NCAR) (Bruyère et al., 2013). The greatest challenge in relation to this sub-goal is bias correction of sea temperatures along the coast and in the fjords, and in areas covered by sea ice during the winter. Our group has experience of this (Barstad et al., 2009), but considerable research efforts will be required to refine this methodology.
6. *Producing a collection of high-resolution, dynamically downscaled climate projections for Hordaland county.* We will produce at least three projections using the optimised modelling system and the bias-corrected boundary conditions from the climate models.
7. *Communicating the climate projections to the end users.* This is about testing ways of communicating efficiently with end users. No such forum exists at present. This work will therefore largely consist of identifying good knowledge transfer methods.

6. R&D challenges and scientific methods

The main research challenge in the HORDAKLIM project is *to develop a modelling system that ensures that the great local geographical variations in future climate change in Hordaland county are represented in a user-friendly and expedient manner.*

Like all other climate research communities, Uni Research Climate and the Bjerknæs Centre for Climate Research use regional climate models to *downscale* projections from global climate models to a regional scale. The modelling tool used is WRF – *Weather Research and Forecasting model* – which was developed and is maintained by the National Center for Atmospheric Research (NCAR) in the USA. Uni Research Climate and the Bjerknæs Centre have a formal cooperation agreement with NCAR and close ties to the group working on WRF. High horizontal resolution is required in order for simulations to be relevant at the local level. For Hordaland, that would be somewhere between 1 and 5 km. One of the main tasks is to identify what horizontal resolution is sufficient – the higher the resolution, the higher the cost of downscaling for longer periods. It is also necessary to identify the optimal model configuration. The model uses parametrisation schemes to represent physical processes that take place on a smaller scale than the model's grid. This includes microphysics, planetary boundary layer physics and convection. The many possible combinations of these schemes mean that the model can, in principle, be run in thousands of ways, with the consequences this entails as regards how realistic the simulations are. It is essential that the modelling system is capable of reproducing documented weather events in an adequate manner.

The regional model provides wind, precipitation and other fields, but parameters related to the hydrologic cycle are usually calculated using a separate hydrological model. Because these models are not coupled and communicating with each other, there are huge gaps in our knowledge about the consequences of extreme precipitation and melting of snow. New coupled modelling systems exist that could represent this chain of consequences, but these systems have seldom, if ever, been tested in areas with such a demanding topography as Hordaland.

This is an ambitious project. Many of the issues it aims to address are not only relevant to downscaling for Hordaland, but also in a national and international context. All current climate models have strengths and weaknesses. Some of the models are fine-tuned to represent the climatic conditions of certain regions, and this could lead to other areas being given lower priority. For example, most models, with the Norwegian model NorESM as an honourable exception, have far too much sea ice on high latitudes during winter. Most of them generate too few low-pressure areas in Western Norway during the stormy season from autumn to spring, which means that they predict far weaker winds and less precipitation than is actually the situation in this part of the country. In order for downscaling of global climate projections to be useful and relevant, it is therefore necessary to carry out *bias correction* of the data used in the regional model. There are methods that do this in a satisfactory manner for some parts of the world, but the poor representation of the sea ice on high latitudes means that these methods are not directly applicable this far north, with the consequences this has for regional downscaling, for example for Western Norway. These issues are at the cutting edge of research, and are a priority for Uni Research Climate and the Bjerknes Centre, and the efforts to resolve these issues is therefore entered as a considerable in-kind contribution to the project. *HORDAKLIM* gives us a highly relevant test arena for obtaining climate data that are, without comparison, of top quality.

7. Organisation and project plan

Hordaland county authority is the project owner and *project manager*. The county authority chairs the *steering committee*, which also comprises one representative each of the County Governor of Hordaland, Uni Research and the Norwegian Climate Service Centre, and two representatives of municipalities in Hordaland; one from the City of Bergen and one from another municipality in the county. The project is rooted in county plans and political networks, such as the Climate Plan for Hordaland (2014–2020) and Hordaland Climate Council.

The *political reference group* for the steering committee and the project is Hordaland Climate Council. The council was established in order to contribute to reaching national and global climate goals, the goals set out in the Climate Plan for Hordaland and the goals in the municipal climate plans. Hordaland Climate Council consists of political leaders from the City of Bergen, the other municipalities in Hordaland (two mayors appointed by the inter-municipal regional councils), municipalities that do not participate in the inter-municipal councils, and Hordaland County Council. The project has been presented to Hordaland Climate Council on two occasions, and the council supports and endorses the initiative.

The project will be *led* by Uni Research Climate (Uni Climate). Uni Climate, in cooperation with the Norwegian Climate Service Centre, will obtain all the climate data, analyses of effects and climate projections down to the regional level. Uni Climate, met.no and the Norwegian Water Resources and Energy Directorate (NVE) are partners in the Norwegian Climate Service Centre. The project management reports to the steering committee.

An *expert group* will be established under the project management, consisting of the Norwegian Climate Service Centre (represented by Uni Climate, met.no and NVE), the County Governor of Hordaland, the City of Bergen, and a representative of the insurance industry. Uni Climate is part of the Bjerknes Centre, which is known as one of Europe's leading climate research centres. Met.no, NVE and the

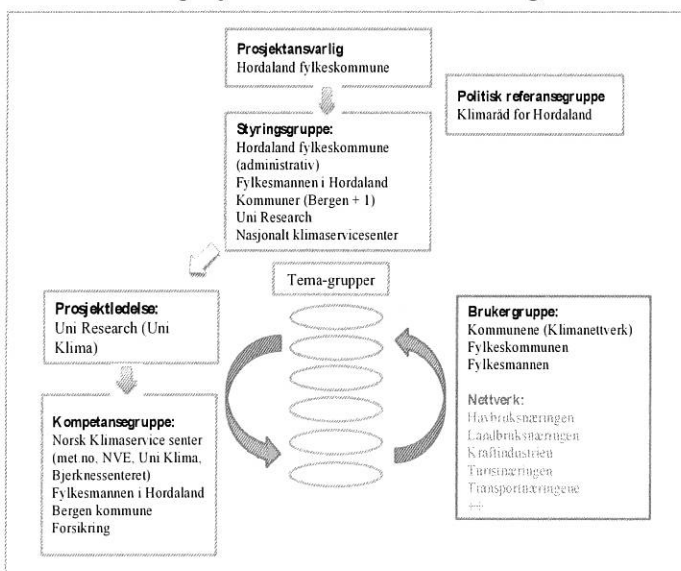


Figure 2 Project outline

insurance industry are all important expert environments in relation to the municipal user group. The City of Bergen possesses so much specialist and expert knowledge that it is natural to include it in the expert group.

The project has a clear target group, the orderer, which is the municipalities in Hordaland county, the county authority and the inhabitants that they represent. The project relies on an actively participating *user group* to help to identify needs and ensure support for the project in their municipality and region. We would like to realise this through *thematic groups* for mapping and dialogue and *networking* with the main industries. The thematic groups must, in cooperation with local business players, address the areas where the individual municipalities are facing challenges (for example in issues relating to agriculture, power production, urban planning, landslide/rockslide protection or general risk and vulnerability work in the municipalities). It is through these thematic groups that municipalities will raise their general competence.

The plan for achieving the above-mentioned secondary objectives is organised into sub-tasks, numbered as follows (Q refers to quarters when work on the secondary objectives is scheduled to take place):

1. The county authority will facilitate arenas for meetings between researchers and municipal specialists. Climate Network Hordaland and the planning network will be used for information purposes and for creating thematic groups for dialogue, cooperation and development of the project. The researchers will meet with the thematic groups on a regular basis throughout the project, and will be in direct contact with individual municipalities and key personnel as necessary. (Q1-Q12)
2. Defining a set of episodes (at least three, no more than eight) that are representative of the phenomena we want to be able to reproduce in the modelling system, for example torrential rain and strong, turbulent winds (strong gusts). Adequate observations must be available for use in the evaluation. (Q1)
3. Downscaling of the selected episodes to a number of horizontal and vertical resolutions, for example 50, 25, 10, 5, 3 and 1 km, and evaluation of the effects of higher resolution (the optimal resolution will be identified by evaluating them in relation to observations). (Q2–Q3)
4. Evaluation of how the different combinations of parametrisation schemes reproduce the selected episodes. It will be particularly important in this connection to evaluate turbulence (gusts of wind), convection (the rapid rising of air masses), precipitation intensity, types of precipitation (rain, snow, hail) and ground temperature (which depends on the soil model used). (Q4–Q5)
5. Set-up and optimisation/further development of the coupled hydrological/atmospheric modelling system WRF-HYDRO, and evaluation in relation to the selected extreme events. (Q2–Q7)
6. Bias correction of climate model data in relation to a 20-year period, for example 1971–1990 or 1981–2000, with particular focus on large local variations in sea temperature along the coast and in the fjords, and on sea ice along the east coast of Greenland and in the Barents Sea. (Q1–Q7)
7. Production of climate projections for selected 20-year periods that represent the near future (around 2030), the middle of the century (around 2050) and the end of the century (around 2080). These periods are dictated by the availability of six-hour data from the climate models. (Q7–Q11)
8. Adaptation of projections for communication with the end users. (Q9–Q12)

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The table below illustrates the objectives and deliveries for the main activity and how costs break down by activity, and the responsible and participating partners for each activity in the project plan.

No	Main activity, objectives and deliverables	Cost (*1,000)	Responsible partner	Participating partners
1	Project coordination	600	Uni Climate	Steering committee
2	Identify resources (personnel) to represent municipalities and industries in thematic groups	0	FK	All
4	Arenas: dialogue groups within thematic groups. The costs relate to travel expenses, workshops etc. over a period of three years	600	Uni Climate	All
5	Production of downscaled data and adaptation of modelling methodology	3 000	Uni Climate	All
7	Web portal support, thematic reporting and recommendations	1 250	NKS	Uni Climate/FK
Total		5 450		

FK: County authority, NKS: Norwegian Climate Service Centre

8. Key milestones for R&D activities

Aktiviteter	2015				2016				2017			
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Varighet av HORDAKLIM-pilot												
Plassering av kommuner i Temagrupper												
Temagruppe-aktivitet, workshops, møteplasser												
Definere tydelig ovenfor brukere hvilke type data som vil bli generert												
Nedskalering i ulik oppløsning												
Evaluerer av tester og ulike parametriseringsvalg												
Oppsett av WRF-HYDRO/evaluering												
Biaskorrekasjon av klimamodeller												
Produksjon av klimafremskrivninger (20års interv.)												
Tilrettelegging av fremskrivninger for kommunikasjon												
Temarapporter												
Sluttrapport og anbefalinger												
Identifisere nye utfordringer												

9. Costs incurred by each research-performing partner (in NOK 1,000)

Partner	Payroll and indir. exp.	Equipment	Other op. expenses	Total
Uni Research (Climate)	2 000		1 200	3 200
Norwegian Climate Service Centre	1 000		1 100	2 100
Hordaland County Authority	50			50
The County Governor	25			25
City of Bergen	25			25
Tryg Forsikring (insurance company)	50			50
Total	3 150		2 300	5 450

10. Financial contribution from each partner (in NOK 1,000)

Partner	In-kind contribution	Cash	Total
Hordaland County Authority	50	800	850
The County Governor of Hordaland (note 1)	25	100	125
City of Bergen (note 2)	25	800	825
Uni Research Climate	200		200
Norwegian Climate Service Centre (Met.no, NVE, Uni)	200		200
Tryg Forsikring (note 3)	50	200	250
Applied Regional Research Fund		3 000	3 000
Total funding (= total costs)	500	4 700	5 450

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Note 1: The County Governor has allocated NOK 100,000 to the project in 2015. It would like to continue this level of support for all the years, but has so far not been able to consider this funding on its merits. The County Governor also makes discretionary funds available that the City of Bergen will apply for on behalf of all the municipalities in Hordaland.

Note 2: The City of Bergen will apply for discretionary funds corresponding to NOK 800,000 on behalf of the municipalities. We expect the application to be granted. Note 3: Tryg Forsikring will place NOK 200,000 at the project's disposal.

11. Other forms of collaboration

This pilot project is carried out in close collaboration with the Norwegian Climate Service Centre, where Uni Research Climate, met.no and NVE are partners and the Norwegian Environment Agency is represented on the centre's steering committee. Uni Research Climate is also part of the Bjerknes Centre, and the project will have access to the expertise and international network of the whole Bjerknes Centre for Climate Research, in which the University of Bergen, the Institute of Marine Research and the Nansen Centre are partners.

Uni Research also cooperates with other institutions that work on different aspects of climate adaptation. One of them is Uni Research Rokkan Centre, which has its own project under way to look into the challenges faced by society in connection with climate change (Climate and Governance).

PART 3: Realisation of the innovation and utilisation of results

12. Plan for realisation of the innovation

Based on the experience from the project, an 'optimised practice' will be established which will provide guidelines for how the challenges outlined in Report No 33 to the Storting can be met and operationalised at the national level, thus reducing the costs of the future rolling out/receipt of research-based data that will form the basis for local decision-making processes.

This project will cover many levels of learning. The research communities that participate in this project have also been assigned considerable responsibility for disseminating knowledge in line with the guidelines set out in the white paper on climate adaptation. This is a national assignment, and knowledge is to be disseminated to all Norwegian counties and municipalities in the longer term. The experience we gain from this project could be important as a basis for the rolling out of climate services in other municipalities. Are the thematic networks and the organisational structures that we will be trying out in this project also relevant in relation to other municipalities? We also believe that the thematic networks that are established during this project can remain in place after the project period. Experience shows that network learning strengthens regional collaboration, and it has proven effective in strengthening Norwegian municipalities' capacity for adaptation. Networking and collaboration allow the municipalities to learn from each other.

Report No 33 to the Storting also announced that state planning guidelines for climate adaptation would be prepared. A pilot study of this type can provide additional experience that could become input to the central government authorities. The Norwegian Climate Service Centre reports directly to the Norwegian Environment Agency, which will play a role in the work on the new planning guidelines. This means that, through this project, Hordaland county could participate in setting the agenda and get a head start in relation to many processes that county authorities and municipalities will surely be tasked with implementing.

The potential for value creation after the project period is estimated to be related to the use of and knowledge about the Norwegian Climate Service Centre's portal klimaservice.no. The further development of this platform can be carried out in the arenas for dialogue between municipalities and between the municipalities and climate researchers established during the project. New challenges can also be expected to be identified as an integral part of the municipalities' risk and vulnerability work.

Milestones (Q refers to quarters):

- 1Q (2015): The municipalities of Kvinnherad and Kvam and the City of Bergen have already been chosen to participate in the pilot project. Other municipalities will be included in the project through dialogue.
- 1–2Q (2015): The participating municipalities will meet with the expert group for clarification of expectations, and participants for the thematic groups will be selected.
2015–2017: The thematic groups and representatives of the expert group will meet at least six times a year throughout the project period. The thematic groups are given assignments to complete between meetings. At an early stage, these assignments will be related to identifying challenges in their regions. Later, they may be related to how new knowledge influences their emergency response plans, land use plans etc., as called for in the letters of support from the municipalities.
- Twice a year, meetings will be held where the thematic groups and the user group (business and industry) get together for updates and dialogue.
- The expert group will be driving the research forward throughout the project period, and the group will have regular meetings.
- The expert group will report to the steering committee at least twice a year.
- The steering committee will submit an annual status report to the political reference group (the Climate Council). It must be a goal for the Climate Council to highlight some political issues relating to new knowledge during the pilot project.
- Before the project is concluded and the participating municipalities are left with new competence, it must be a goal to see this competence reflected in the municipalities' risk and vulnerability work and included in climate plans. This is also where the great potential for value creation after the project period lies.
- 1–4Q (2017): New knowledge is secured in national reference works (Atlas) that can be used interactively via national online solutions (for example via the klimatilpasning.no website). The end product and tool for the municipalities to use in their further climate adaptation work.

13. Risk factors

There are sound and established structures in the form of existing organisations both in the public and science sectors. There has also been extensive dialogue between the parties in this project over the past two years. Good contact has thus already been established. We therefore rule out the possibility of any start-up problems.

Most of the partners' in-kind contributions in the form of cash contributions have already been confirmed. The exception is the discretionary funds that the City of Bergen has applied to the County Governor for. We have received positive feedback and expect this to fall into place as well. Also, it has recently become clear that Uni Research has been accepted for basic funding. The research that Uni Research presents here is within their priority area and is in a strong position to be allocated basic funding. This has not been included in the budgets, however.

We are open to the idea that the way in which we organise this project is not necessarily the most efficient form of communication between research and the public administration. However, the City of Bergen and the county authority's experience shows that this form of organisation works well in many other contexts. We will have the opportunity to assess on a continuous basis whether other solutions would be more expedient. The other risk factor items that we were particularly asked to comment on – 'need for amendment of the statutory framework' and 'market risks for any private sector players taking part' – do not seem relevant and involve no risk in this project.

14. Other socio-economic benefits

The municipalities are responsible for bringing their local business and industry into the work on the pilot project, which will ensure that they have special access to state-of-the-art knowledge about future challenges. In the same way, the coordination between public authorities and business and industry players can facilitate a shared understanding and predictability when encountering the natural changes that will occur.

The Norwegian Climate Service Centre has a national responsibility for the production and transfer of knowledge about basic science information to all responsible parties in Norway. Therefore, this project has great implicit transfer value. The project will also place the Hordaland region in the driving seat in relation to the advice and instructions given in Report No 33 to the Storting. The realisation of this project will be based on great national investments in climate research and make it relevant for Hordaland.

15. Dissemination and communication of results

Dissemination and communication are fundamental aspects of this project. We would like to strengthen communication and interaction between the research community and the municipal sector.

It is natural to communicate both the underlying ideas and the learning process during such an ambitious pilot project. It is important for the owners and end users, who are ultimately the municipalities' inhabitants, to have a sense of ownership of the project and the measures that will finally be adopted. We envisage active use of local and regional media to achieve this. It should also be considered whether to hold public meetings in the final phase of the project where representatives of both the scientific expert community and the county/municipal sector can provide information about the results and challenges identified during the project.

A more detailed dissemination and communication plan is provided in the dissemination plan in the application form.

PART 4: Other information

16. Environmental impact

The project has no negative environmental impact. By virtue of the underlying objective of optimising the municipalities' robustness when faced with climate change, there is considerable potential for positive environmental impact. Measures such as organising municipalities into groups with challenges in similar areas will limit the need to travel.

17. Ethical perspectives

No ethical issues have been identified.

18. Recruitment of women, gender balance and gender perspective

Several of the researchers involved are women. The head of the Norwegian Climate Service Centre is a woman, and two out of the three members of the centre's senior management are women. Several of the mayors in the Climate Council are women, as are several of the county administration staff members appointed to participate in the project.

19. Additional information specifically requested in the call for proposals

This is a regionally rooted research project in which a scientific climate research community at the forefront of research located in Hordaland county will customise climate data for municipalities in Hordaland to make it easier for them to adapt to climate change in the region. The project will thereby meet regional challenges in the public sector while at the same time indirectly developing the research community's expertise through dialogue with end users.

References

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