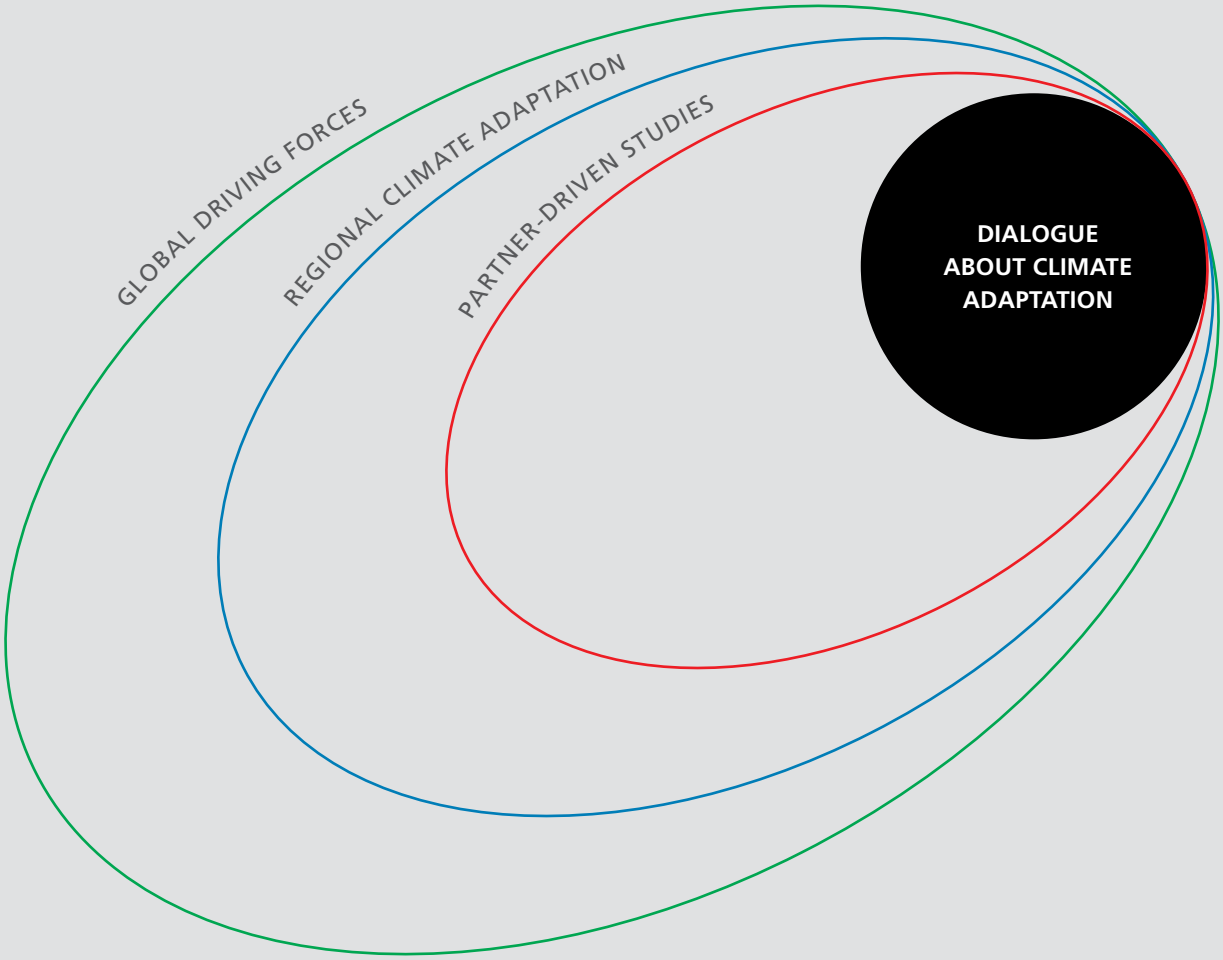
MISTRA SWECIA

CLIMATE, IMPACTS & ADAPTATION

Annual Report 2013



Mistra-SWECIA

Mistra-SWECIA is a multidisciplinary programme that develops research-based knowledge which is used to support decisions about adaptation to climate change. The researchers involved in the programme study how the climate is changing, the effects of climate change and potential strategies for adaptation to climate change.

Mistra-SWECIA builds on expertise from several research areas, including climatology, ecosystem science, economics, sociology and political science, as well as close collaboration between decision-makers and others who are involved in the process of adaptation to climate change.

Climate change is a reality and it is important to analyse the effects these changes will have on the environment and on society and investigate how we will be required to adapt our activities to the altered conditions. Mistra-SWECIA's research focusses on land use and on the ways in which Swedish forests and forestry are affected by climate change and, more generally, how the effects of climate change are relevant to those involved in forestry, agriculture and nature conservation. Mistra-SWECIA is funded by the Swedish Foundation for Strategic Environmental Research (Mistra).

SWECIA stands for Swedish Research Programme on Climate, Impacts and Adaptation. The programme involves SMHI (The Swedish Meteorological and Hydrological Institute), SEI (Stockholm Environment Institute), Lund University and Stockholm University. It began in 2008 and runs until 2015. SMHI is the programme host.

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A WORD FROM THE PROGRAMME DIRECTOR:

The global climate is a regional concern

Climate change has been – yet again – confirmed, as has the facts that our greenhouse gas emissions are the reason behind it and that we can stabilise the climate over time. These are essential messages from the first part of the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report.

Even though we can constrain the climate change to come by reducing emissions, we cannot escape the need to consider adaptation to climate change. We are already experiencing a changing climate, and at least some further change is unavoidable. As these changes unfold, we will be in need of updated knowledge. During the past year, Mistra-SWECIA has continued to generate knowledge relating to adaptation to climate change in forestry. This has involved new research, exchanges with other research efforts, and meetings with practitioners and policy-makers. This has fostered mutual learning and we have been met with great interest and engagement. The actors' agenda is now clearly changing towards the 'what', 'how' and 'when' when it comes to adaptation, from the 'whether' that held the centre stage just a few years ago. This challenges each and every one in the research community: What kind of knowledge support can we provide? Similarly, this challenges each and every one in the practitioner and policy community: Which strategies are chosen, and which decisions are made and implemented?

I project an exciting year during 2014 on all these fronts. The IPCC will present the remaining contributions to its overall Fifth Assessment Report, which is bound to raise the red flag for the climate challenge. New research will be laid forth and results will catalyse and enrich new meetings between researchers and stakeholders across borders. Among other arenas to look forward to are two major conferences Mistra-SWECIA co-organises. One of these deals with the latest developments and prospects of regional climate modelling and will take place in Lund in Sweden in June. The other will be the Third Nordic International Conference on Climate Change Adaptation, which will take place in Copenhagen, Denmark, in August. I look forward to seeing you there, if not sooner.

Foto: Kjell Gustavsson

MARKKU RUMMUKAINEN
PROGRAMME DIRECTOR MISTRA-SWECIA

A WORD FROM THE CHAIR OF THE PROGRAMME BOARD:

Creative meetings

We are now in the middle of Phase 2 of the Mistra-SWECIA programme. A significant part of the work over this year has focused on adaptation to climate change in the area of forestry. It is not just on studying how climate change impacts the forest, but also how forestry practices embrace new research results and translate them into daily action.

In the past decade, a number of storms, wet winters and dry summers spawned a debate among forest owners and forestry authorities on how to adapt to new conditions. This covers many topics including monocultures, selection of trees, insect pests, and damage by vehicles, for example. Climate change has given rise to openness towards new thoughts and ideas within the forest industry. Research on climate adaptation is extensive, but how will that knowledge reach users?

For Mistra-SWECIA, how we find the best ways to communicate new knowledge about climate adaptation to the forest industry is an important question. It can be done in many different ways. Already during the first phase, the programme organized a series of meetings with various focus groups among researchers and forest stakeholders. This approach has resulted in mutual learning through exchange of opinions and experiences related to climate adaptation. Another way to communicate knowledge on climate adaptation is through the web-based information SMHI provides, which will be used in meetings with forest owners. To develop different venues where new scientific findings can be discussed and made available is important for the climate adaptation of Swedish forestry. This gives rise to the need for creative meetings between researchers and practitioners.

BENGT HOLGERSSON
CHAIRMAN OF THE BOARD, MISTRA-SWECIA

TEXT: MARKKU RUMMUKAINEN AND ÅSA SJÖSTRÖM (GUEST AUTHOR)

Adaptation to climate change is consistently becoming an everyday word. During the past few years, climate adaptation efforts have become more structured and resourced as well as gained a more prominent place on society's agenda. Winds of change are blowing, albeit not yet at storm strength.

Adaptation to climate change in Sweden today

Only a few years ago, rather little attention was paid to adaptation to climate change in Sweden. To do something about climate change was all about mitigation, in other words, reduction of emissions. Today, climate adaptation is high up on the agenda, which complements mitigation. It is not about either/or; it is about both. After all, even in today's modern society, we remain exposed and vulnerable to extreme weather and the impacts of climate change.

The public sector responds

The Swedish climate adaptation portal was established quite a few years ago by a group of national authorities, as a resource for relevant information. The Government's Commission on Climate and Vulnerability issued its final report in 2007, with 59 recommendations on adaptation-related actions, such as revised legislation and tasks for authorities. A review of what came of these recommendations revealed in the autumn of 2012, that 34 had come into being. In addition, the National Knowledge Centre for Climate Change Adaptation was established at the Swedish Meteorological and Hydrological Institute in 2012. It collects and collates information and examples, organizes seminars and workshops, conveys research results, and overall provides a rallying point for climate adaptation efforts in Sweden. Not least, the Centre supports the efforts by the County Administrative Boards, which have a regional coordination role in climate adaptation. In Sweden, climate adaptation is warranted not least by the prospects of changing flooding due to extreme precipitation events and a rising sea level. However, there is no national authority with overarching responsibility for these efforts. Rather, different authorities are tasked with implementing climate adaptation in their respective areas of responsibility. Today, around 30 authorities are engaged in building up relevant competence and knowledge, as well as increasing climate change preparedness. The regional and the local level are especially important in the coordination and implementation of measures.

The regional level

In 2009, the County Administrative Boards were tasked to regionally coordinate adaptation to climate change. This is not something that can be done in isolation. Rather, there are many linkages to their other areas of responsibility, including other environmental issues, animals, agriculture, social planning, cultural heritage, protection against disaster and emergency preparedness and civil defence, infrastructure, and housing. The Boards are also tasked with compiling and reporting on climate adaptation efforts at the municipal level, and providing guidance for regional and local-level action. These efforts are very much ongoing.

The local level

On the local level, the situation is more varied as to what kind of effort is underway. It is very evident that climate

adaptation is an active area of work in municipalities which have recently experienced major flooding events. In Sundsvall, Kristianstad and Arvika, flood protection infrastructure has been strengthened. Climate adaptation is a recognized aspect in major infrastructure projects in Stockholm and Gothenburg. In various coastal communities, the guidelines for how to build along the coastline are revised, to better take into account rising sea levels. For example, in Skåne in southern Sweden, the new guidelines say that infrastructure should not be built at a lower elevation than three meters above today's mean sea level. How to deal with the already developed areas is also a matter of concern, which was clearly manifested as recently as December 2013, when a major storm drove the sea level much above its normal level in some areas.

Less white on the map

The winds of change are blowing around us as well. The EU is actively working on the climate issue, which encompasses adaptation to climate change. Already in 2007, a green paper on climate adaptation was issued, which was followed two years later with a white paper. In the spring of 2013, the European Commission put forth its proposal for a climate adaptation strategy. Its details are now being put into place. According to the European Environment Agency (EEA), several countries in Europe already have a national climate adaptation strategy (the countries in green in the figure). Somewhat surprisingly perhaps, Sweden is also indicated to have one, despite the fact that there is no document which has such a heading. Rather, there are a number of decisions, such as those made in conjunction with the government's bills on climate and energy from 2009, which collectively add up to a strategy.

Source: EEA

Indeed, rather than distinct greens or yellows on the map, there are a number of hues. EUROSAI (European Organisation of Supreme Audit Institutions) issued a report in 2012 on climate adaptation developments in nine European countries, Sweden was not among these. In many countries commissions had been set up and studies made. However, only three of the countries decided on a policy and established a strategy. When measures had been implemented, they were responses to experienced impacts, in other words, for application within today's climate, not for anticipated future changes and impacts. The study highlighted shortcomings in national coordination and lack of cost analyses for climate impacts and adaptation action. This is also recognizable in the case of Sweden; there are calls for: more clarity in roles and responsibilities on different levels of governance and among the actors, more coordination, cost estimates, recommendations on climate scenarios, and overall more expert advice and support.

Implementation is what counts

A climate adaptation strategy is not equal to solutions, of course. Rather, solutions require informed decisions on measures and their implementation. In addition to the decisions made so far on roles and responsibilities in Sweden, some earmarked climate adaptation support has also been provided. For 2014, such support to climate adaptation amounts to around 100 MSEK. The effective resource for adaptation to climate change in Sweden is, however, larger. This is called 'mainstreaming', which means that climate adaptation is included in many other matters also on the agenda. This has benefits, as climate adaptation is a sectorial, regional and local issue, which furthermore engages authorities, cities and municipalities, as well as the private sector; all of whom work on many different issues at the same time. Adaptation to climate change has decisively gained a beachhead both in Sweden and around us, and more is underway than meets the eye at first glance. This is a foundation for continued efforts. □

ADDITIONAL READING

EUROSAI (European Organisation of Supreme Audit Institutions), 2012, Adaptation to climate change – are governments prepared? A cooperative audit.
EEA's climate adaptation portal: climate-adapt.eea.europa.eu
The Swedish climate adaptation portal: www.klimatanpassning.se

Climate models are used to calculate how climate may evolve into the future. Now a totally new set of global scenarios has been produced. It includes new global climate models and new emission scenarios. Utilizing the new set of global scenarios, a large amount of regional climate scenarios have also been produced. These are now used by Mistra-SWECIA.

Model development in recent years

In its Fifth Assessment Report (AR5), the UN Intergovernmental Panel on Climate Change, IPCC, describes how climate models have been improved since the last report, AR4, which was released six years ago. In the Chapter 'Evaluation of Climate Models', it is concluded that models reproduce observed continental-scale surface temperature patterns and trends over many decades, including the more rapid warming since the mid-20th century. Climate scenarios refer to the anthropogenic effect on climate due to release of greenhouse gases. Climate models also simulate the natural internal variability of the climate system due to the interaction between ocean and atmosphere. Such internal variability may, at times, strengthen or weaken the long-term warming.

Observed warming

Over shorter time periods, such as 10-15 years, observed and simulated trends may differ, which is expected due the natural internal variability. As an example, the observed reduction in the surface warming trend over the period from 1998 to 2012 does not necessarily coincide with climate models' simulated trends for the same period.

The reduced warming trend is estimated to have been caused by two comparable, in terms of size, effects. One is related to a reduced trend in radiative forcing at the top of the atmosphere primarily due to volcanic eruptions and the timing of the downward phase of the 11-year solar cycle. The other one is related to a possible redistribution of heat within the ocean due to natural internal variability. As for the atmosphere, the temperature of the ocean increases with time, but the temperature increase is not equally distributed with depth. The circulation of the ocean enforces energy exchange between different layers of water. Observations indicate that such energy exchange, or redistribution of heat, within the ocean can be one of the reasons for the reduced warming trend of the last 15 years.

Our ability to simulate regional climate and extreme weather events has improved

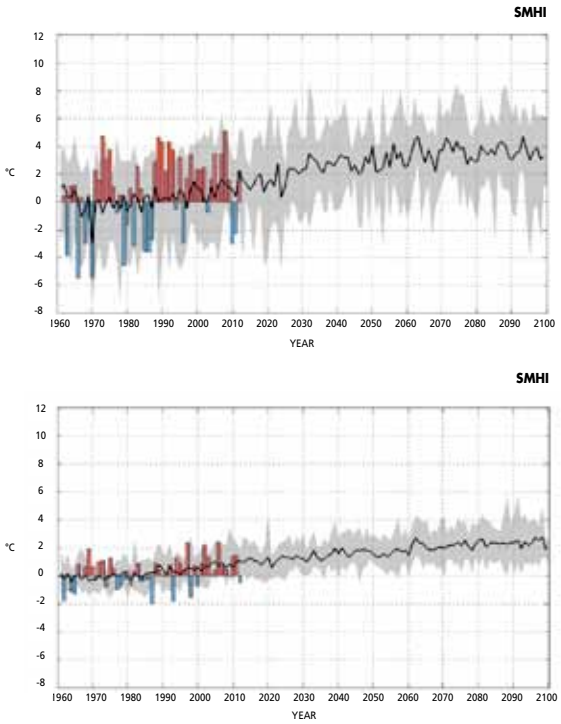
Simulated regional trends of temperature have, in general, lower confidence than simulated global trends, since the regional natural variability is relatively larger. Differences in trends between different regions cancel each other when averaged globally. However, there is still high confidence that regional-scale surface temperature is better simulated in AR5 than at the time of the AR4. For example, the ability to simulate extreme cold and warm events has improved considerably. The ability of the models to simulate continental-scale patterns of precipitation has slightly improved. Based on multi-model simulations, in AR5 it is concluded that there is high confidence that the statistics for monsoons and the Pacific El Niño-Southern Oscillation (ENSO) have improved since AR4. It is also concluded that climate

models now include more cloud and aerosol processes, and their interactions, than at the time of the AR4; however, there remains low confidence in the representation and quantification of these processes in models.

For Arctic summer ice extent, about one-quarter of the climate models show a trend as large as, or larger than, the trend in the observation. The majority of models still underestimate the negative trend, although their ability to simulate ice extent has improved. Since AR4, a number of climate models have been complemented with a description of the carbon cycle, and now belong to the group of models entitled Earth System models. Simulations of global sinks and sources of carbon generally do coincide with estimates based on observations. The Earth System models are used for more detailed studies on how the carbon cycle is affected by climate change and how future greenhouse gas emissions are related to sinks and sources in the ocean and in the ecosystems.

New scenarios

The new set of global scenarios is based on climate models that have been further developed since the AR4. Research groups all over the world, coordinated in the Climate Model Intercomparison Project 5 (CMIP5), have performed a large number of climate simulations. These simulations have utilized a new set of emissions scenarios for the anthropogenic climate impact (coined Representative Concentration Pathways, RCP). Some of these scenarios have been produced at the Rossby Centre, SMHI, with the EC-Earth model system (see earlier annual reports from Mistra-SWECIA). In addition, a new set of regional climate scenarios have been produced at the Rossby Centre with the regional climate model RCA4. Nine different CMIP5 models have been used as boundary conditions for RCA4. The simulations are performed for a European domain, but are presented as averages for different regions such as for Sweden as a whole, and for individual Swedish administrative counties. One example is given in the figure for the county of Västmanland. As supported by observations, the scenarios show warming trends for both winter and summer. The differences between interannual variability between the seasons are also obvious.



Simulated tendencies in winter (upper panel) and summer mean temperatures for the county of Västmanland under the RCP emission scenario 4.5. The bars represent observations, with red bars indicating higher and blue bars indicating lower temperature than for the average period 1961-1990. The black line shows the ensemble mean value of the nine simulations, and the grey area shows the span between minimum and maximum values of the simulations.

Earlier and new

The new scenarios show similar results to the earlier scenarios. The larger amount of scenarios in last CMIP process increases the ability to describe similarities and uncertainties from a statistical point of view. □

FURTHER READING

The IPCC Fifth Assessment Report, Climate Change 2013: The Physical Science Basis.

TEXT: FREDRIK LAGERGREN AND ANNA MARIA JÖNSSON

Climate change impact is of particular importance in forestry given the long-term consequences of decisions and investments. Forest owners need to consider risks and opportunities related to management concerning plant selection, thinning and final harvest. Process-based models can be useful.

Climate, decisions and strategies in forestry

The long-term aspect in the forestry sector is special. For example, the income from an investment, as in the establishment of a new forest stand, is claimed after 50 to 120 years. A wrong decision today may be of little importance the first couple of years, but can have significant negative consequences over the long term. Another aspect is that forests have the objective to not only give the owner a reasonable income, but also supply other values such as biodiversity, recreation and mitigation of climate change. Each decision has an impact on all of these utilities and goals.

Weather, climate and forest management

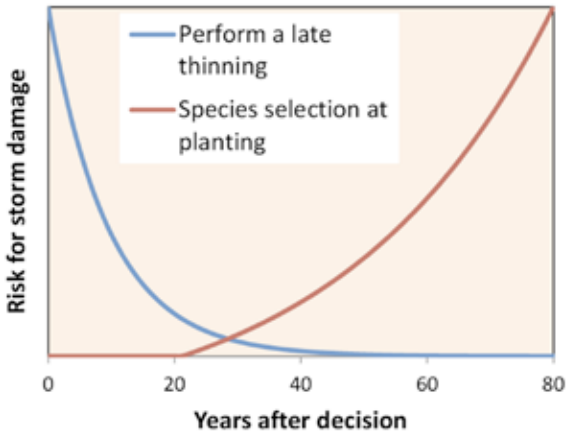
Climate change will affect risks as well as opportunities in the forest industry. Trees planted today may not be the best suited for the future climate. Examples of plausible changes in climate and impacts are more frequent extreme weather events, rise of new pests, existing pests becoming more harmful, animal and plant species going extinct, but also that the forest growth will increase. In addition to climate and weather, the outcome depends on a long list of forest management decisions (see figure). In this context, process-based models developed in the Mistra-SWECIA research programme can be valuable tools. The use of the models is to translate climate and management into consequences and risks regarding areas such as productivity, tree defence capacity against pests, pest population growth rate, sensitivity to storm damage and forest value for biodiversity, recreation and carbon sequestration. The results can support decision making in forestry, though it is important to use them while keeping the uncertainty of climate projections and other external factors in mind.

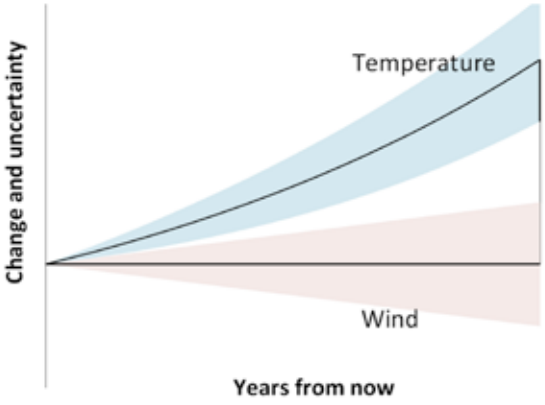
Strategies for climate adaptation

If a forest owner were to know exactly what the future would look like and all the consequences it will bring, adaptation of forest management such as minimizing risks, for example, would be an easy task. In reality this is not possible, but information about the probability for a certain change is enough to make active adaptive decisions. Examples of such active adaptation to climate are changes in species selection and length of rotation period. Another type of active adaptation is the short term adaptation to prevailing weather, like postponing a final harvest until the soil frost has become deep enough to avoid soil damage from heavy machines.

Active strategies for climate adaptation in Swedish forestry have to be complemented by a readiness for reactive measures. An example is the need to quickly

process and transport the damaged or infested timber out of the forest after a storm felling or an insect attack, which will be even more important when pest populations will reproduce faster in a warmer climate. Another strategy is proactive planning for the future. This is something a forest owner can do by management that creates future possibilities and spreads the risks. Additionally, the entire forest sector can do similarly by developing new plant material, methods, machinery, products and strategies to handle the threat from new pests. □





The time horizon for management decisions in forestry can vary a lot. The left picture shows an example when risk for storm damage is given. The risk associated with opening up a relatively high forest stand after choosing whether to make a late thinning or not is highest directly after the decision, and will then fade out when the trees in the stand close the gaps. On the other hand, the risk associated with the alternative of selecting a storm-sensitive or a storm-resilient species first starts to increase after several years when the trees are high enough to be overturned by wind. For risks depending on climate, there is an additional time aspect of the climate change and its uncertainty (see figure to the right).

Within the Mistra-SWECIA research programme, these aspects are studied for various different decisions made with regards to forestry. Results are implemented in an interactive tool with the intention to highlight and increase the awareness of climate and weather impact on forest management. In this context, there will also be an overhaul of the forest company Holmen's 'Guidelines for a sustainable forestry', with the aim to raise the climate aspect in a revision of their instructions.

Mistra-SWECIA researchers interact with experts and practitioners from county councils, the Swedish Forest Agency, as well as large and small forest owners.

Climate adaptation in Swedish forestry

Mistra-SWECIA, the Swedish Forest Agency, and the Västmanland County Administrative Board arranged a September excursion to the woods surrounding Skinnskatteberg in Västmanland to discuss how climate change will affect Swedish forestry. The tour went to Spjutmossen in Surahammar, Färna Ekopark, and to Högfors to study difficulties with damages from vehicles and pests, as well as to discuss how to work preventively using long-term planning.

The excursion gathered some 50 participants representing both large and small forest owners, the insurance industry, academia and government. Hillevi Eriksson, climate expert at the Swedish Forest Agency, as well as being a member of Mistra-SWECIA's Programme Board, was one of those who took part in the excursion. Hillevi explained that climate change is expected to increase forest production in Sweden by 25-30 percent, but that it also has a negative side. Risk of storm damage increases due to reduced frost and higher groundwater levels; furthermore, insect pests will benefit from a warmer climate.

Spruce bark beetles an increasing problem

In order to study attacks by pests, the excursion visited Färna Ekopark where Rune Andersson, ecologist at Sveaskog, showed an area where a tornado in 2007 knocked down 10,000 cubic meters of forest. Rune told the participants that it took until 2010 until the area was attacked by the spruce bark beetle. The hot summers of 2011 and 2013 extended the affected area that now covers 20 hectares of forest. Åke Lindelöw, field entomologist at the Swedish University of Agricultural Sciences, said that the number of bark beetle species in Sweden is growing steadily, and that international trade with plants, wood packaging and timber helps to spread pests.

– The ability to resist attacks by pests should be researched more, Åke Lindelöw claimed.

> *'The goal is a sustainable forestry that can produce a variety of ecosystem services.'*
>
> *Anna-Maria Jönsson, Associate Professor at Lund University*

The two-day excursion ended with Anna-Maria Jönsson, from Lund University and Mistra-SWECIA, who presented a model to describe objectives and strategies for risk management in silviculture. She showed how climate adaptation in forestry needs to be reactive, active, and proactive.

– The goal is a sustainable forestry that can produce a variety of ecosystem services, concluded Anna-Maria Jönsson. □

Since 2012, research carried out within Mistra-SWECIA has had a focus on issues related to climate adaptation in Swedish forestry. The programme is strengthening contacts between researchers, practitioners and decision makers. Oskar Wallgren from SEI and Mistra-SWECIA managed the excursion to Västmanland. He believes it is important that researchers and others working in the forestry sector are able to meet with each other.
– I have a general feeling there is a desire to share experiences, says Oskar Wallgren.

Attacks by spruce bark beetles in Färna Ekopark. Many trees fell here during a tornado in 2007. Now an area of 20 hectares is infested with spruce bark beetles.

'It's in the forest farmers' way of thinking, to adapt all the time ... to really try to see what happens and do it a little different in various ways.'

Forest owner, Kronoberg County

TEXT: KARIN ANDRÉ

Adaptation is a natural part of Swedish forest management, and forest stakeholders perceive that they are continuously adapting to different weather and climate conditions, economic conditions and market demands. This is shown in focus group discussions with private forest owners and officials in Kronoberg and Västerbotten counties.

Adaptation processes in forestry

To increase the knowledge on how climate adaptation processes are enacted, there is a need to learn both from how different stakeholders perceive their opportunities to adapt, and from the experiences of ongoing decision-making processes. Adaptation can be seen as a process starting from organizations' awareness of the problem, gathering knowledge and information, planning and developing strategies and measures, and finally implementing and revising. Results from focus group discussions with local stakeholders in the Swedish forestry sector that were recently presented in the dissertation *Climate change adaptation processes: regional and sectoral stakeholder perspectives,* show that in practice, climate adaptation is a complex process where adaptation rarely is introduced as a response to climate change alone. Several factors influence and contribute whether and how adaptation is implemented, such as previous experience of extreme weather events, positive expectations for the future in combination with, in part, flexible space for successive adaptation. These factors also influence how stakeholders view their adaptive capacity.

Perceptions of risks and the need for adaptation

The forestry sector is sensitive to, and directly affected by, changes in weather and climate conditions. Both the Government Commission on Climate and Vulnerability in 2007 and reports from the Forest Agency have indicated a mix of positive and negative effects of climate change, emphasizing the need for climate adaptation considerations both today and in the future.

Part of the dissertation has particularly studied how different stakeholders perceive their adaptive capacity related to various types of risks, including climate change and views on adaptation. The study shows that several of those risks that are expected in a changing climate are perceived as being problematic among forest owners and forest officials, for example problems with changed water levels, storm damage, browsing damage, spring frost, crushed tree tops caused by heavy snow and rutting caused by logging operations. At the same time, there are expectations that climate change may be beneficial for forestry both directly in terms of increased forest growth and indirectly as a result of an expected increased demand for bio fuels and use of forest based products. What is perceived as being most problematic in the future relates primarily to new and unknown insects and pests. All in all, there seems to be a general awareness of climate change, although concern and the perceived need for adaptation varies among forest actors. There also seems to be a general belief that many of the expected climate effects are manageable, under the right conditions in the form of access to knowledge and technology, for example.

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Climate adaptation in forestry

The focus group discussions also show that forest actors consider the question of climate adaptation as something new that generally has not been discussed, at least to any large extent, in relation to daily activities and routines. However, in many cases they report that discussions have started within their organizations, and that the need for more knowledge and to follow climate adaptation development has gained increasing attention. Similar results have been shown in many other adaptation studies, primarily within the public sector, emphasizing that the focus so far has been on these types of activities aiming at building adaptive capacity, such as developing organizational and institutional frameworks and building knowledge, in order to enable future adaptation measures. At the same time, the focus group discussions show that adaptation is seen as a natural part of forestry activities and that there is continuous adaptation to different weather and climate conditions, economic aspects, trends and market demands.

'It's in the forest farmers' way of thinking, to adapt all the time … to really try to see what happens and do it a little different in various ways.' (Forest owner, Kronoberg County)

'For those of us in forestry, we're constantly adapting to wind and weather, and prevailing conditions, and we have to manage that. We've tried to think, but maybe we can think a bit more if it gets even more difficult. One could perhaps reason like that.' (Forest official, Västerbotten County)

Forest owners also discuss that they have introduced changes in their forestry to adapt to risks by introducing more tree species and by having a conscious and active forest management. The driving force behind these changes was nevertheless general risk awareness and economic considerations rather than due to climate change. The storm Gudrun had for example affected forest management among forest owners in Kronoberg County with the aim to increase flexibility in their forestry and to make it possible to obtain financial revenue earlier.

'Forest management methods have also been adapted, at least by me. Before, I thought that it is probably good to have some old-growth forest. But now it must be felled when it is 70–80 years old, otherwise it is high risk, and it is the same thing with late thinning, which you could do before; I have stopped doing that.' (Forest owner, Kronoberg County)

In sum, there is a complex relationship between perceptions of risks, the perceived need for adaptation and the actor's capacity to adapt. Even if adaptation in forestry is perceived as a process that takes time, forest owners think that there is flexibility in introducing different forestry measures and opportunities to successively manage climate-related risks. In fact, many already have experience with climate change and managing the risks that can be related to it, which seems to lower the concern for future climate change. However, there is a need to learn more about the processes and motivations that lay behind adaptation decision-making. Throughout 2014, Mistra-SWECIA will continue to study adaptation processes, with a focus on synergies and conflicts between different strategies, as linked to different risks and challenges within forestry. This will take place through a wider study of how forest owners perceive risks, climate change, and adaptation in three Swedish regions, and will also include carrying out a national survey. □

METHOD

The results build on a qualitative study of those involved in climate adaptation, stakeholder perceptions of adaptive capacity, and whether and how stakeholder interaction between actors can facilitate adaptation processes. These issues have been discussed in a series of focus group meetings with private forest owners and forest officials in Kronoberg and Västerbotten counties in 2010.

FURTHER READING

André K (2013) *Climate change adaptation processes: regional and sectoral stakeholder perspectives.* Linköping Studies in Arts and Science, no 579. Linköping University.
André K and Simonsson L (forthcoming) Stakeholder perceptions of adaptation space: The relevance of direct experience and perceived ability to adapt to climate change in Sweden. Manuscript.
André K and Jonsson C A (2013) Science-practice interactions linked to climate adaptation in two contexts: municipal planning and forestry in Sweden. *Journal of Environmental Planning and Management.*

Mistra-SWECIA has spoken to Kjell Mohlin, conservation manager in Jönköping County. Kjell and his colleagues recognize clear signs that the climate is changing, and that this change affects both animals and nature.

Conservation management is affected by climate change

About 10 percent of the total land area in Sweden is protected land, such as national parks, nature reserves or conservation areas. One of those involved in managing Sweden's protected forests is Kjell Mohlin, conservation manager in Jönköping County.

– There are only rather small areas in Jönköping County with high conservation values, most of the forests are affected by production, says Kjell.
To manage nature reserves in Jönköping, the environmental protection administration therefore needs both to preserve land with high biodiversity, as well as restore other forests helping them become more diversified. Sometimes they completely remove planted spruce and start all over again.

Increasing proportion of spruce

Kjell and his colleagues recognize clear signs that the climate is changing and that this change affects both animals and nature in the county.

– Previously, it was said that the linden could not rejuvenate here, but now we see natural regeneration of both linden and oak. With a milder climate, conditions for hardwood forests will become better at the highlands of Småland, says Kjell.

Nevertheless, we continue to increase the proportion of spruce, which now constitutes 60 percent of the county's forest composition. In the early 1900s, pine was as common as spruce here, now pine constitutes about 30 percent of the forests in Jönköping County. There is land in the county where the forest is dominated by pine because of water shortages, but in the landscape in general, where there are favourable conditions for a mixed forest, spruce is dominating. According to Kjell, that's because forestry favours spruce and because their self-seeding is best able to get through when there is a lot of moss or grass in the undergrowth. Climate change, with milder winters, has benefited both moss and grass and thus the spread of spruce.

Winters without snow affects the hare

Different species' occurrence in the forests have also been affected by a milder climate. The Greylag goose, whooper swans and cranes, for example, have increased significantly.

– Also, more species of bats have established themselves, and we hope the black grouse will become more common again when our reserves contribute the more mixed forest that they need, says Kjell.

Hares have been impacted both positively and negatively by the milder climate. The original hares declined sharply in the 1990s when there were several snow-free winters, even though foxes, due to scabies, also decreased simultaneously. Hares which are now implanted, however, have no difficulties finding food during snow-free winters.

Prospects are also good for both fallow deer and roe deer. Many landowners are concerned that the hooved

game will eat young seedlings, and that they prefer pine and hardwood.

– In the current situation, game impact on forest composition, in my opinion, is negligible compared to the impacts of forestry, yet I understand the landowners' concern. An increasing phenomenon is that during winter the moose eat the young planted spruce seedlings. This may become more common in the future, even with a decimated moose population, says Kjell Mohlin.

Too favourable conditions for spruce bark beetles

The objective with a nature reserve governs what you can do to preserve and restore the forest. Previously established reserves were often supposed to be left without any action.

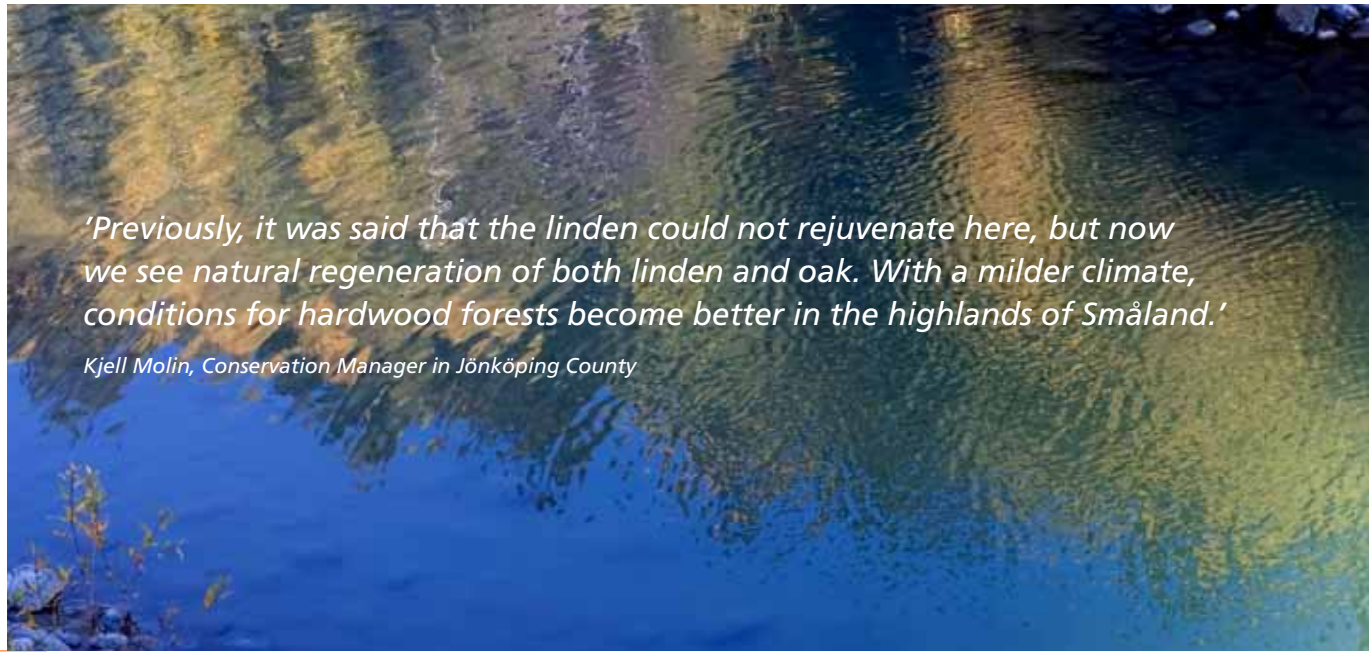
– As the basic material here is so unnatural, with a lot of spruce, we have created conditions too favourable for the spruce bark beetle. These reserves must be actively managed, says Kjell.

During warm periods in recent years, the spruce bark beetles have multiplied by two generations in one season.

– We are now more active in trying to prevent large populations of spruce bark beetles. We are reducing our brood material by debarking or removing infested trees. We also put out fresh spruce logs when the spruce bark beetles swarm. In this way, we can collect a large percentage of spruce bark beetles without removing the wood that was supposed to be left in the forest and there will be a minimal impact on the reserve. At one point we left 22,000 spruce logs which we later took out of the forest. If the logs are not allowed to remain too long, we get a fair price from the sawmill, despite the logs being infested by bark beetles, says Kjell.

Kjell thinks the environmental protection administration has had a good dialogue with other landowners in the area about, among other things, cooperation to prevent widespread infestation of bark beetles. When landowners are aware that the conservation management is actively trying to limit the spruce bark beetle, they also become more understanding of the need for conservation and nature reserves. Kjell explains that the private landowners he meets are often interested in knowing more about the consequences of climate change, but many are still quite conservative in terms of how they conduct their forestry. After heavy storms, many rejuvenate with spruce even in the most exposed height positions, even if spruce is the least preferred tree species regarding storm heartiness, drought and insect pests.

– The trend is towards landowners who know less about practical forestry, but are more open to change. Therefore, it is important that forestry representatives embrace the impacts of climate change on forestry, says Kjell. □



'Previously, it was said that the linden could not rejuvenate here, but now we see natural regeneration of both linden and oak. With a milder climate, conditions for hardwood forests become better in the highlands of Småland.'

Kjell Molin, Conservation Manager in Jönköping County

TEXT: ÅSA GERGER SWARTLING, PATRICK SAMUELSSON, LUDVIG ISAKSSON AND GUSTAV STRANDBERG

Mistra-SWECIA develops methods to communicate new knowledge about climate change mitigation and adaptation to stakeholders in the Swedish forestry sector.

Communicating climate change research – experiences from Swedish forestry

Knowledge of climate-related risks is essential for decisions about forest management and reforestation. In Mistra-SWECIA's first phase, an interdisciplinary research methodology was developed with science-based stakeholder dialogues with forest owners and other professionals in the forestry sector. The methodology combines social science-based research on adaptation with scientific research on climate change and the expected impacts on Swedish forestry. Climate-related risks are presented in scenario-based projections and modelling of ecosystem services and changes in vegetation.

The interdisciplinary research methodology increases the integration of perspectives from different disciplines and contributes to as complete a picture as possible of expected climate change, its effects on forests, and consequences in terms of adaptation needs and actions. One central aim of this approach is to – with a scientifically informed participatory process – draw lessons from scientific knowledge and determine how and to whom this knowledge needs to be communicated. The approach is expected to contribute to effective planning and decision support for Swedish forest stakeholders. In the longer term, this experience can contribute to better ways to communicate research in order to improve climate change preparedness in forest management.

Mutual learning

The methodology is based on a series of focus groups. The purpose of these meetings is to facilitate a combination of informative, informal and interactive discussions on climate change, and adaptation needs and opportunities. In addition to providing insights into the participants' perceptions of risk and decision-making strategies in forest management, the process promotes mutual learning between researchers and stakeholders. These meetings also contribute to the diffusion of knowledge about climate risks and possible adaptation strategies that are both relevant, in-demand, and valuable for current and future forest stakeholders. Through follow-up interviews, we have found that a large majority of the participants expressed about their participation in positive terms, saying that it promoted networking, information gathering and the exchange of opinions and experiences related to climate change adaptation.
One lesson learned is that climate-related research should be communicated in a more user-friendly and comprehensive way than is often the case when researchers disseminate their scientific results. At the same time, it is important to relate to other experts as users of this research and that the knowledge on climate change is communicated in a popular scientific style. The com-

→ munication appears of best use in an informal and open discussion about climate risks and expected impacts on forestry, where all participants are free to put forward questions and comments concerning the research tools as well as research results and their implications. It is also important to keep in mind that, for the individual forest owners, it is primarily the local dimension of climate change that is relevant, although it may also be essential to put climate change into a broader context. The research has directly benefitted from the stakeholder meetings in terms of an increased understanding of the issues that forest stakeholders perceive as relevant and problematic. This has, consequently, led to formulation of new research questions and new analyses on the part of researchers.

Web-based information sharing

Mistra-SWECIA is collaborating with SMHI on a research initiative aimed to further develop methods and technologies for communication of climate sciences to the wider public audience. In the second half of 2013, a web application was developed and launched on www.smhi.se. The application provides comprehensive information on climate scenarios. The purpose of the application is to disseminate scientific and easily accessible information on future climate change to several potential user groups, professionals, researchers and the interested public. In the application, the user can compare climate trends under the assumption of different scenarios for greenhouse gas emissions. The results are presented in the form of maps and diagrams. The application contains explanatory information about the results and how they have been calculated. The application is designed to inspire the user and make it easy to explore the material beyond the user's original framing of the problem. Mistra-SWECIA will benefit from the new resource tool for the upcoming meetings with forest stakeholders in the counties of Skåne, Västerbotten, Gävleborg and Jämtland in 2014.

This application will contribute by clearly presenting predicted changes related to temperature and precipitation at focus group meetings in each county and comparing these with projected changes in other regions and other parts of Europe. After these meetings, the forest owners can revisit the web-based application and explore the material further at their own pace to form a picture of the projected changes. Developing arenas for science-stakeholder engagement and interactions is important for communication and dissemination of scientific knowledge that is easily accessible and yet presented in a well-founded manner, as part of efforts to bring new and deeper insight into the intricate nature of climate change and possible adaptation measures. This is true for both researchers and practitioners. □

MORE INFORMATION CAN BE FOUND AT:
'Framtidens klimat' webpage at www.smhi.se
www.smhi.se/klimatdata/Framtidens-klimat

A Seminar gathered researchers and forest stakeholders to discuss the role of research in supporting wise decisions for forestry in a changing climate.

Forestry in a changing climate

Researchers, governments, industry and forest stakeholders gathered in October for a one day seminar at the Royal Swedish Academy of Agriculture and Forestry. Mistra-SWECIA's Programme Director Markku Rummukainen started the seminar with a presentation on the climate. Further extent of climate change depends mainly on three factors: the emissions of carbon dioxide and other greenhouse gases, climate sensitivity, and how the carbon cycle is affected by climate change. For Sweden, climate scenarios shows that it will be warmer with a larger temperature increase here than globally, precipitation will increase, winters will be shorter, and the growing season will be longer. How storms may develop remains uncertain.

Adaptation measures can mitigate negative effects

Hillevi Eriksson, climate expert at the Forest Agency and member of the Mistra-SWECIA Programme Board, highlighted that one of the most important tasks is to communicate that climate change is happening. Climate change contributes to higher growth, yet also to increased damage risk (storm felling, bark beetles, new pests, drought, root rot, frost and fires) as well as negative effects for threatened species via increased competition. Furthermore, the need for well-constructed forest roads and techniques to avoid damage from machinery in the forest will increase. Continued major rejuvenation with spruce in areas where pine should be planted or rejuvenated with deciduous or mixed forests, is problematic. Risk of damage from game feeding is one of the reasons that many landowners continue to plant spruce. With a warmer climate, the problem of damage from game feeding will move north in Sweden. Adaptation measures that can mitigate the negative effects of climate change are: management of the game population, planting of mixed forests for reduced vulnerability to pests, development of maintenance for increased storm strength in harsh wind conditions, increased maintenance of forest roads, and planning and new technology to prevent damage from machinery.

Strategies for risk management

Mistra-SWECIA's Anna Maria Jönsson, Associate Professor at Lund University, gave a presentation on her research concerning climate adaptation and related risks to forestry. By modelling how changed temperatures, precipitation and wind affect forest growth and risk for damage, you can compare different strategies to adapt forestry to climate change. Risk management strategies can be reactive, active or proactive. These three approaches are needed for a sustainable forestry. The goal with risk management is not to fully avoid a risk – that

is not doable – but to minimize damages difficult to manage once they have happened. Results of the modelling of different forest management alternatives show large differences when it comes to future storm damages, felling and timber volumes. In order to obtain as good decision support as possible for forestry, Anna-Maria points to the need for a continued dialogue between those in research and those who take action.

When research and the forest industry meets

Oskar Wallgren from Mistra-SWECIA and SEI shared experiences of creating meetings between researchers and the forestry industry to discuss climate adaptation. Researchers must dare to let go of the need to market themselves and instead put the needs in focus, said Oskar, as he highlighted four important approaches to utilizing research:

1) Understand and adapt the message for the recipient's needs.
2) Step away from the frontier – for many, the general knowledge is very important.
3) Emphasize the researcher, not the results – people who can speak in an understandable way are needed.
4) Focus on the message, not the logos – the rest of the society wants answers to questions, not knowing how the work is organized.

Göran Örlander, forest manager at Södra skog, concluded the seminar by sharing his concern that we are looking at one issue at a time and do not see the big picture – what is happening in Africa and Asia and how does that affect our forestry in Sweden? We need an international outlook to see how the world fits together. He also said that it is important that the research shows what the discretions are, and that the decisions you make now are of importance in the future. Seminar participants agreed that researchers and industry need to meet – we must learn from and listen to each other. □

OTHER PRESENTERS CONTRIBUTING TO THE SEMINAR:

Erik Normark, Holmen
Johnny de Jong, Swedish University of Agricultural Sciences
Håkan Wallander, Lund University
Per Erik Karlsson, Gothenburg University and IVL
Salim Belyazid, Lund University
Cecilia Akselsson, Lund University
Johan Berg, Swedish University of Agricultural Sciences

ORGANIZERS:

The research programmes Mistra-SWECIA, BECC and CLEO together with the Royal Swedish Academy of Agriculture and Forestry, KSLA.

'One of the main tasks is to communicate that climate change is taking place.'

Hillevi Eriksson, climate expert at the Forest Agency and member of the Mistra-SWECIA Programme Board

At best, taxes on conventional oil have only moderate positive effects on the climate. In contrast, taxes on coal and other fossil fuels with high extraction costs can be expected to significantly reduce emissions and hence help limit climate change, even if such taxes are only imposed regionally.

Optimal taxation of fossil fuels

Climate change affects our welfare and a properly designed economic policy can have an impact on both greenhouse gas emissions and technological developments, and ultimately potentially prevent large losses of future welfare. In order to design climate policy, we of course need to identify how emissions, via a changed climate, influences our welfare, but we also need to look at the channels through which different policy instruments operate. In this brief report we argue that one important determinant of the efficacy of different taxes is how different forms of fossil fuel are supplied.

Taxes on oil

Oil is a fossil fuel with relatively limited reserves and low extraction costs. The price of oil is set on the world market and primarily reflects demand rather than producers' costs. A tax on oil thus primarily affects producers' profits rather than the price consumers pay. Technological developments that reduce the demand for oil will affect the price, but probably without this having any significant impact on the output when the producers have large price margins. If a region, like the EU, increases gasoline taxes or requires cars to be more fuel-efficient, world market prices will fall, but global oil consumption will hardly change, nor will production. This effect is illustrated in Figure 1. A tax or new energy-saving technology shifts demand from line D1 to D2. As the supply line S is constant, the equilibrium quantity is not affected but the price falls to a level such that the same quantity as before is requested. Taxes or technological development do not affect the total consumption in the longer term. As long as oil prices have not been pushed down to the level of the extraction cost, all accessible oil will sooner or later be used.

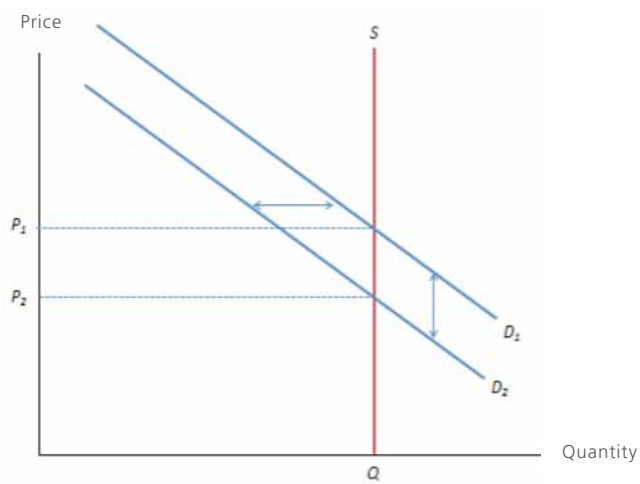


Figure 1. Supply and demand when supply is not sensitive to price.

→

Taxes on coal

With other fossil fuels, such as coal, the situation is quite different. Compared to the amount of conventional oil, there are huge amounts of rather easily accessible coal and the price of coal is rather close to producers' extraction costs. As coal is relatively expensive to transport, most of the coal is consumed in the region where it is produced. Under these supply conditions, the effect of a carbon tax on coal is quite different from the effect of a tax on oil, regardless of whether the tax is introduced regionally or globally. When the market price is close to the extraction cost, there is not much room for producers to lower their prices at unchanged production. A tax will therefore make some production unprofitable, so that both production and consumption are reduced. Since the coal market is not a well-functioning global market like the oil market, a regional tax in, say, Europe will therefore lower the use of coal in Europe without increasing it much elsewhere. Technical developments that increase energy efficiency and lower the market price of coal could similarly make it unprofitable to mine coal.

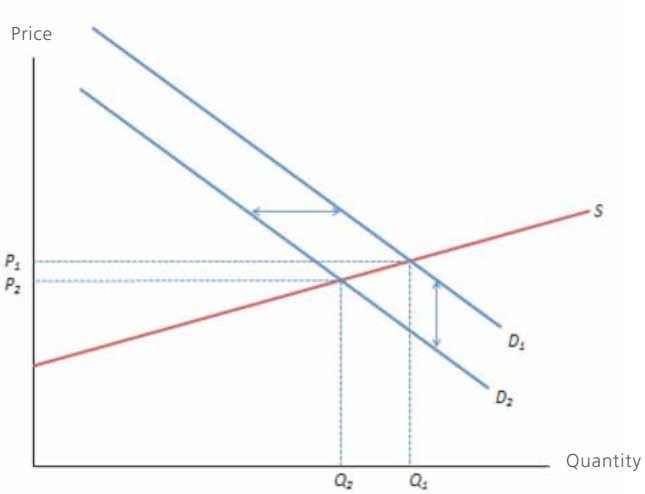


Figure 2. Supply and demand when supply is sensitive to price.

Figure 2 illustrates a market situation where the supply is sensitive to the price. A tax or technological development reduces demand (from line D1 to line D2), as in Figure 1, but because the range (S) is price-sensitive the demanded quantity decreases. We conclude from the overall discussion that economic policy is incapable of affecting the global consumption of conventional oil, economic policy instruments, while coal consumption can be affected by carbon taxes or other policy instruments.

Potential climate impact

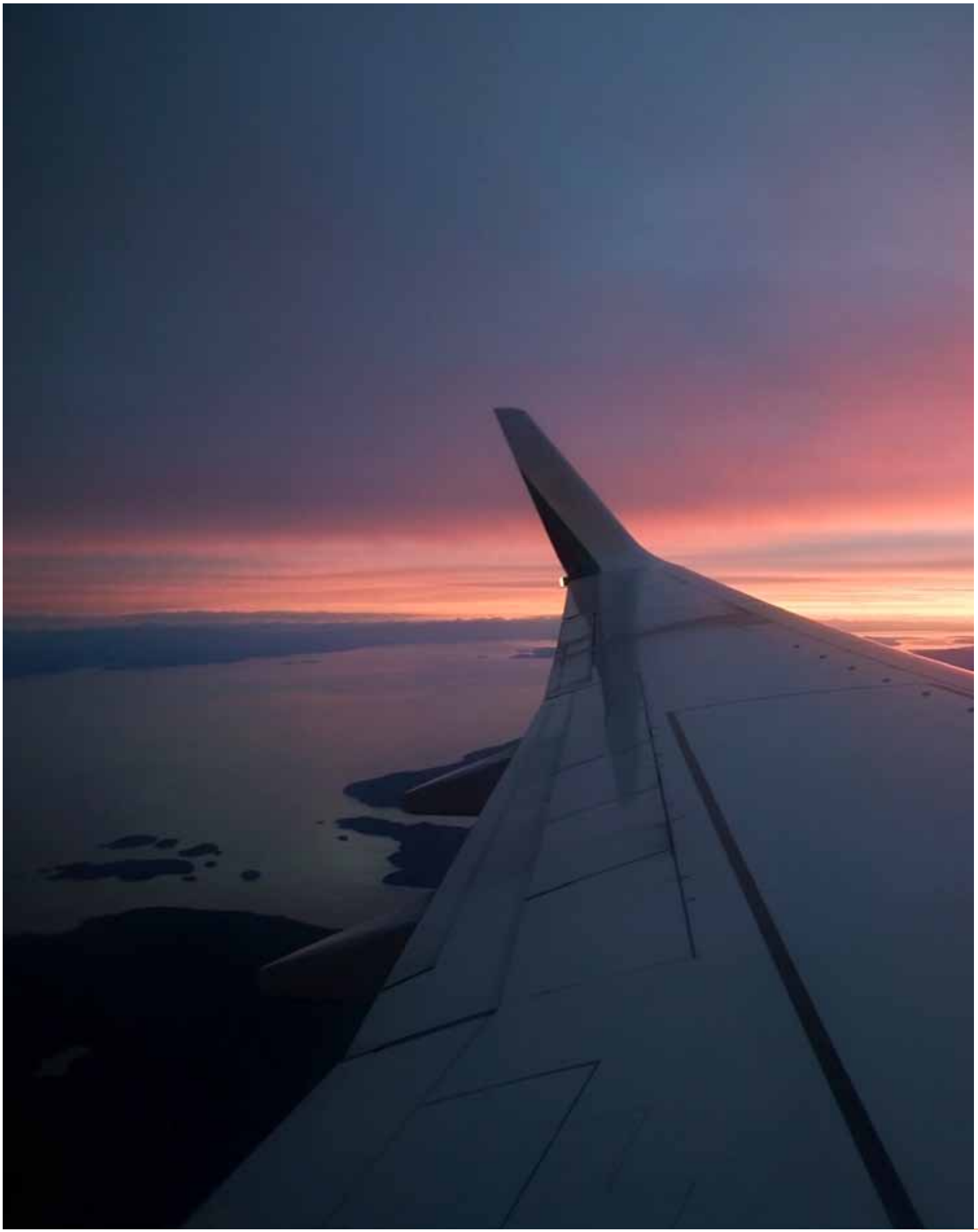
The amount of carbon in the atmosphere since pre-industrial times has increased from about 600 billion tons to 800 billion tons. The amount of conventional oil left to extract is equivalent to about 200 billion tons of coal. The amount of accessible coal is estimated to be at least 20 times that amount. Thus, comparatively speaking, coal is a much more severe threat to our climate. Policy measures should therefore focus on reducing the consumption of coal. Supporting the development of alternative technologies for energy should make it unprofitable to mine coal efficiently. Measures to influence the use of conventional oil and its end products, such as gasoline and jet fuel, are not nearly as critical for reducing carbon emissions.

New fossil fuels

Coal and conventional oil are opposite extremes in terms of their respective supply structure. High oil prices, combined with technological development, have led to the exploration of new types of fossil fuels, with a supply structure somewhere in between these extremes. This includes, for example, deep offshore oil, tar sands, and hydraulic fracturing (fracking). From a climate perspective, there are reasons to be concerned: these new types of fossil fuels involve potentially large new reserves. On the positive side, these new forms of fossil fuels are still expensive to extract, so their use can be curbed rather effectively if emissions are taxed even moderately. That is, unlike for conventional oil, it is likely that a combination of emissions taxes and a removal of subsidies make some of these new techniques for extracting fossil fuel unprofitable. Along with measures to combat coal use, this is a prerequisite for a successful climate policy for the future. □

FURTHER READING:

SNS Analysis No. 14 2013, published by the Centre for Business and Policy Studies

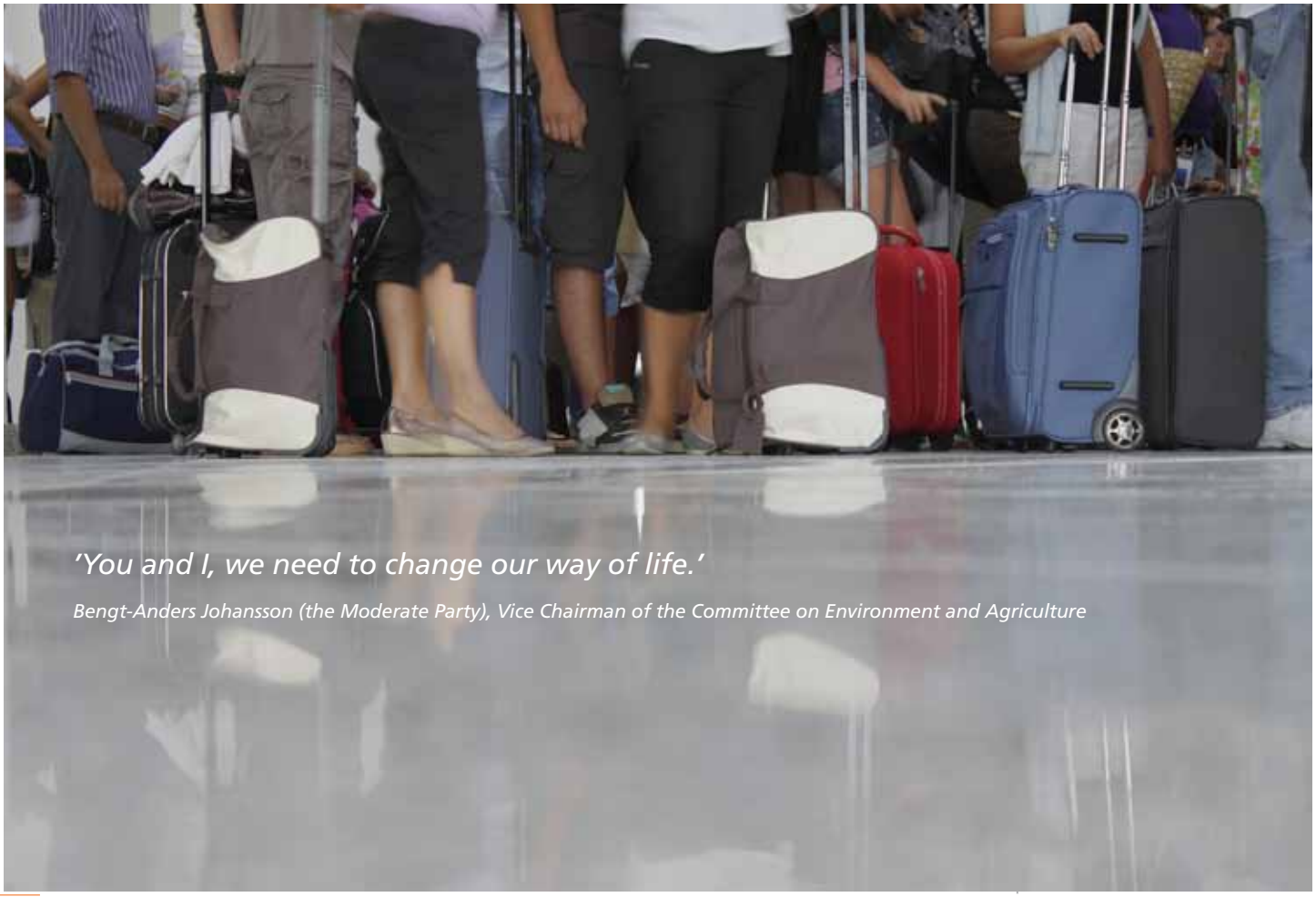


TEXT: HANNA HOLM

The UN's Intergovernmental Panel on Climate Change concludes that the Earth's climate continues to change and that human action is causing this change. But the climate policy goal of limiting global warming to below two degrees may still be attainable, provided rapid and significant reduction of emissions.

SCIENTISTS AND POLITICIANS IN CLIMATE DIALOGUE:

International cooperation can mitigate climate change



'You and I, we need to change our way of life.'

Bengt-Anders Johansson (the Moderate Party), Vice Chairman of the Committee on Environment and Agriculture

The Earth's climate is changing and human emissions of greenhouse gases are what is causing this change. This is confirmed by the Intergovernmental Panel on Climate Change, IPCC's, recent review of the scientific state of knowledge on climate change, presented in Stockholm in September. The report 'Climate Change 2013: The Physical Science Basis' was discussed at a well attended lunch seminar Mistra-SWECIA held at the Committee on Environment and Agriculture in the Swedish Parliament on the 2nd of October.

Markku Rummukainen, Professor of Climatology at Lund University, Climate Advisor at the Swedish Meteorological and Hydrological Institute, SMHI, and one of the IPCC report's Lead Authors, began by outlining the report's extensive scientific evidence that has involved several hundred writers and considered more than 9,000 scientific papers. More than 1,000 scientists and experts have contributed to the review of the report, describing climate change with greater accuracy than previous IPCC reports could do.

The IPCC concludes in the report that the Earth's climate continues to change and that human emission of greenhouse gases is causing this change. The report emphasizes that the international climate policy goal of limiting global warming to below two degrees still may be possible, provided rapid and significant reductions of emissions are achieved. The alternative is ever-increasing climate change.

Joakim Sonnegård, Head of Agency at the Swedish Fiscal Policy Council and member of the Mistra-SWECIA Programme Board, stressed that the concentration of greenhouse gases in the atmosphere is affected by all emissions, regardless of where emission takes place. We suffer not only by our own emissions, but also by those of others. Therefore, international cooperation to achieve the required emission reductions is necessary.

Matilda Ernkrans (the Social Democratic Party), Chair of the Committee on Environment and Agriculture, introduced the discussion by emphasizing that the IPCC has produced convincing scientific evidence. This was followed by questions and comments from committee members Jens Holm (the Left Party), Sarah Karlson (the Social Democratic Party), Helena Leander (the Green Party) and Irene Oskarsson (the Christian Democrats). Anita Brodén (the Liberal Party), wanted to know:

– What is most important for us to remember? What can you do?

Joakim Sonnegård and Markku Rummukainen agreed that the most effective action would be a global tax on carbon, but it seems difficult to reach international agreement on such taxation.

– We could start by eliminating subsidies for greenhouse gas related activities. In Sweden we subsidize peat extraction and the EU is subsidizing coal mining, Joakim Sonnegård noted.

Coordinating international negotiations and behavioural changes among billions of people may seem distant and impossible to achieve. But it is also about us, here and now. Bengt-Anders Johansson (the Moderate Party), Vice Chairman of the Committee on Environment and Agriculture, concluded the seminar by saying:

– You and I, we need to change our way of life. □

PARTICIPATING:

Markku Rummukainen, Professor of Climatology at Lund University, Climate Advisor at the Swedish Meteorological and Hydrological Institute, SMHI, and Lead Author of the IPCC report 'Climate Change 2013 : The Physical Science Basis'

Joakim Sonnegård, Head of Agency at the Swedish Fiscal Policy Council, and member of the Mistra-SWECIA Programme Board

MPs from the Committee on Environment and Agriculture

Cissi Askwall, Secretary General at Public & Science, moderator

ORGANIZERS:

The Collaborative Group for Research and Future Issues in the Swedish parliament in collaboration with Mistra-SWECIA and Public & Science

Budget

PROGRAM PHASE II (PERIOD 2012-2015)

PROGRAMME FUNDING (SEK '000)	
From Mistra	*48 000*
From Mistra (transferred from Phase I)	*2 000*
From SMHI	*4 740*
From Stockholm University	*1 910*
Various	*150*
Total	**56 780**

PROGRAMME COSTS (SEK '000)						
		2012	**2013**	**2014**	**2015**	TOTAL
Programme		outcome	preliminary	budget	budget	
management		1 440	1 230	1 630	1 660	**5 960**
Communication		1 080	1 470	2 210	2 130	**6 900**
Component I: Regional climate change adaptation	Climate change adaptation processes	2 220	4 190	4 530	2 840	**13 780**
	Regional climate modelling: High resolution climate projections, impact modelling and risk assessment	2 110	1 760	3 310	2 900	**10 080**
Component II: Global drivers	Climate-economy modelling	2 860	2 590	2 900	2 220	**10 570**
	Global climate projections	In kind from SMHI				
	Land use narratives	420	1 230	970	630	**3 240**
Component III: Partner-driven studies and synthesis		880	1 140	1 190	1 210	**4 420**
Total per year		**11 000**	**13 610**	**16 740**	**13 590**	
Strategic reserve						**1 860**
Total						**56 780**

Note 1. Each amount is rounded to the nearest SEK 10,000.
Note 2. Programme management includes the Programme Director, the Secretariat and the Programme Board.
Note 3. Communication includes the Communicator, communication activities, website, meetings and events, as well as syntheses and collaborative studies.

Organisation

PROGRAMME BOARD
Bengt Holgersson, chair
Bodil Aarhus Andrae, SMHI
Tim Carter, the Finnish Environment Institute (SYKE)
Klas Eklund, SEB (resigned from the board during 2013)
Hillevi Eriksson, Swedish Forest Agency
Tom Hedlund, Swedish Environmental Protection Agency
Thomas Nilsson, Mistra (adj.)
Gunilla Saltin, Södra
Joakim Sonnegård, the Swedish Fiscal Policy Council (joined the board during 2013)

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Hanna Holm, Research Communicator
Elin Löwendahl, Programme Scientific Secretary and deputy Programme Coordinator
Anna Ramm-Ericson, deputy Programme Scientific Secretary

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Oskar Wallgren / Olle Olsson

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Victor Blanco González, Institute of Geography and the Lived Environment at University of Edinburgh, the UK
Åsa Gerger Swartling, Stockholm Environment Institute, SEI and Stockholm Resilience Centre

Communication

SCIENTIFIC ARTICLES

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PRESENTATIONS

130124 Rummukainen M "Klimatförändringen (inte bara om 100 år)", Greppa Näringen, Skövde, Sweden
130204 Rummukainen M twitterchatt, #climatemonday, SVT
130206 Jönsson A M "Impact modeling of trees, crops and insect pests", What are the ecological consequences of climate-driven phenological shifts?, BECC SWE-NPN Symposium, Linköping, Sweden
130207 Miller P, Schurgers G, Smith B, Weiss M, Le Sager P, Stefanescu S et al. "Vegetation Dynamics and Carbon Balance in the First Coupled ECE 2.4 - LPJG Run" Joint meeting of the EC-Earth Land Surface and Atmospheric Chemistry Working Groups, Lund, Sweden
130211 Hassler J "The Fossil Episode", University of Cambridge, the UK
130214 Gerger Swartling Å "Participation and learning for climate change adaptation: A case study of the Swedish Forestry Sector", SEI Science Forum, Stockholm, Sweden
130311 Hassler J "The Fossil Episode", Uppsala University, Sweden
130314 Hassler J "The Fossil Episode", Royal Holloway University, the UK
130318 Gerger Swartling Å "Exploring diverse knowledge systems for adaptation: the case of the Swedish Mistra-SWECIA programme", European Climate Change Adaptation Conference, Hamburg, Germany
130318 Wallgren O "Adaptation without borders: perspectives on indirect climate impacts", European Climate Change Adaptation Conference, Hamburg, Germany
130326 Rummukainen M "Klimatförändringarna, vår tids ödesfråga?", Tredje rummet, Malmö, Sweden
130407-12 Chaudhary N, Smith B and Miller P "Development of an advanced regional climate-ecosystem model for Arctic applications", EGU General Assembly 2013, Vienna, Austria
130407-12 Claesson J "A vegetation sensitivity approximation for gross primary production in water limited conditions", EGU General Assembly 2013, Vienna, Austria
130407-12 Wang S and Dieterich C "The development and evaluation of new SMHI atmosphere-ocean-ice coupled model RCA4_NEMO", EGU General Assembly 2013, Vienna, Austria
130407-12 Wu M, Smith B, Schurgers G, Lindström J, Rummukainen M and Samuelsson P, "Vegetation-climate feedback causes reduced precipitation in CMIP5 regional Earth system model simulation over Africa", EGU General Assembly 2013, Vienna, Austria
130410 Blennow K "Climate change: Believing and Seeing Implies Adapting", the Final Conference of the EU FP7 Programme Models for Adaptive Forest Management (MOTIVE), Freiburg, Germany
130415-19 Kupiainen M "Energy estimates and weak Boundary procedures for LAM", Joint 23rd ALADIN Workshop & HIRLAM All Staff Meeting, Reykjavik, Iceland
130416 Hassler J "The Fossil Episode", CREI, Pompeu Fabra University, Barcelona, Spain
130420 Rummukainen M "Klimatförändringarna och fossil energi", Greenpeace, Stockholm, Sweden
130423 Rummukainen M "Klimatförändringar – hur extraordinär är vår tid?", Folkuniversitetet, Halmstad, Sweden
130424 Rummukainen M "Klimatförändringar – hur extraordinär är vår tid?", Folkuniversitetet, Lund, Sweden
130425 Rummukainen M "Klimatförändringar – hur extraordinär är vår tid?", Folkuniversitetet, Växjö, Sweden
130507 Rummukainen M "Nytt i klimatforskningen inför IPCC:s AR5", Naturskyddsföreningen, Stockholm, Sweden
130515 Krusell P, Session about climate change, KVA, Stockholm, Sweden
130522 Hassler J "The Fossil Episode", European Summer Symposium on Macroeconomics, Izmir, Turkey
130605 André K "Samarbete viktigt för anpassningsförmågan" Innovationsdialog för klimatanpassning, National Knowledge Centre for climate adaptation at SMHI and the Government Office, Stockholm, Sweden
130607 Zhang WX, Jansson C, Miller P et al. "Using a coupled regional climate and vegetation model to assess the future of Arctic terrestrial ecosystem carbon exchange", 9th International Carbon Dioxide Conference, Beijing, China
130610-14 Wang S, Dieterich C and Döscher R "Simulation of present and future climate variability over the Baltic Sea area with new SMHI atmosphere-ocean-ice model RCA4_NEMO", 7th Study Conference on BALTE X, Borgholm, Denmark
130619 Rummukainen M "Om klimatkänsligheten", Swedish Environmental Protection Agency, Stockholm, Sweden
130723 Hieronymus J "The potential for sulfate reduction and pyrite deposition to alter the ocean-atmosphere carbon balance", IAPSO conference: Knowledge for the Future, Gothenburg, Sweden
130830 Hassler J and Krusell P, Session about climate change, EEA, Gothenburg, Sweden
130901-05 Rammer W, Seidl R and Blennow K "A simulation tool for assessing future wind disturbance impacts on forest landscapes", ClimTree, Zürich, Swizerland
130902 Rummukainen M "Om klimatet igår och idag; mätningar och processer", Swedish Environmental Protection

Agency, Stockholm, Sweden
130918 Rummukainen M "Klimatförändringarna – naturvetenskapliga kunskapsläget 2013", Ministry of the Environment, Stockholm, Sweden
130918-19 Bärring L "Klimatanalys för Västmanlands län", excursion "Klimatanpassning av svenskt skogbruk", Västmanland, Sweden
130918-19 Jönsson A M "Anpassningsstrategier i skogsbruket i ett förändrat klimat", excursion, "Klimatanpassning av svenskt skogbruk", Västmanland, Sweden
130918-19 Lagergren F "Klimatanpassning i skogliga beslut", excursion, "Klimatanpassning av svenskt skogbruk", Västmanland, Sweden
130918-19 Vulturius G "Hur tar vi till oss och ändrar våra beslut i förhållande till risk", excursion, "Klimatanpassning av svenskt skogbruk", Västmanland, Sweden
130919 Hassler J and Krusell P, "Klimatet och ekonomin", SNS, Stockholm, Sweden
130920 André K "Anpassningsprocesser", Tyréns kunskapsdagar, Stockholm, Sweden
130922 Rummukainen M "IPCC:s arbetsgrupp I: Climate Change", breakfast meeting in the Swedish parliament organized by SSESSS, Stockholm, Sweden
130925 André K "Mistra-SWECIA exkursion om klimatanpassning i skogsbruket – några kommentarer", Klimatanpassning Sverige 2013, Stockholm, Sweden
130925 Bärring L, in a panel, Klimatanpassning Sverige 2013, Stockholm, Sweden
130925 Rummukainen M "I väntan på IPCC-rapporten", Klimatanpassning Sverige 2013, Stockholm, Sweden
130925 Rummukainen M, meeting with the Social Democratic party, Stockholm, Sweden
130925 Wallgren O, in a panel "Omvärldsanalys: Jorden runt på 30 minuter", Klimatanpassning Sverige 2013, Stockholm, Sweden
130927 Rummukainen M, climate chat, Swedish Environmental Protection Agency and SMHI
130925-27 Blennow K "Understanding the social dimension of forest risks", the European Forest Institute (EFI) 20 Years Science and Policy Forum: Our forests in the 21st century – ready for risks and opportunities?, Nancy, France
130925-27 Gardiner B, Schuck A, Schelhaas M-J, Orazio C, Blennow K, Nicoll B and Kamimura K "Living with storm damage to forests", the European Forest Institute (EFI) 20 Years Science and Policy Forum: Our forests in the 21st century – ready for risks and opportunities?, Nancy, France
130928 Rummukainen M, "Climate Change: the State of the Science", IPCC, IGBP, et al. Stockholm, Sweden
130928 Rummukainen M climate chat, Sydsvenskan
131001 Rummukainen M "The 2013 IPCC Climate Change report", Swedish Consortium for Artificial Photosynthesis (CAP), Uppsala, Sweden
131001 Rummukainen M "IPCC:s Climate Change 2013; några reflektioner", Naturskyddsföreningen, Stockholm, Sweden
131002 Hassler J and Krusell P "Klimatet och ekonomin", the Agency of Finance, Stockholm, Sweden
131002 Rummukainen M "IPCC 2013; Vad nu?", seminar "Klimatet fortsätter att förändras – hur mycket och vad bör vi göra?" the Committee on Environment and Agriculture in the Swedish parliament, Stockholm, Sweden
131003 Rummukainen M "IPCC:s Climate Change 2013; nedslag & reflektioner", Skåne Regional Council, Malmö, Sweden
131003 Rummukainen M "IPCC 2013; Nedslag & reflektioner", KRINOVA, Kristianstad, Sweden
131004 Rummukainen M "IPCC:s Climate Change 2013; Nedslag & reflektioner", Det hållbara sjukhuset, Malmö, Sweden
131010 Rummukainen M "Nytt från forskningen – modeller, scenarier och vetenskapliga resultat IPCC 2013; en fördjupning", SMHI, The county administrative boards and the City of Stockholm, Stockholm, Sweden
131011 Rummukainen M "IPCC:s Climate Change 2013; Nedslag & reflektioner", Det hållbara sjukhuset, Lund, Sweden
131015 Rummukainen M "Framtida förändringar i klimatsystemet", the Swedish Meteorological Society, Stockholm, Sweden
131016 Jönsson A M "Skogsbruk i ett förändrat klimat – hur kan vi hantera riskerna" at "Skogsbruk i ett förändrat klimat – hur påverkas mångfald och miljö", KSLA, Stockholm, Sweden
131016 Rummukainen M "Framtidens klimat", at "Skogsbruk i ett förändrat klimat – hur påverkas mångfald och miljö", KSLA, Stockholm, Sweden
131016 Wallgren O "Forskare möter användare om klimatanpassning" at "Skogsbruk i ett förändrat klimat – hur påverkas mångfald och miljö", KSLA, Stockholm, Sweden
131016 Rummukainen M "Climate Change 2013; nedslag & reflektioner", Greendrinks, Stockholm, Sweden
131021 Rummukainen M "Climate Change 2013; nedslag & reflektioner", Young ideas, Malmö, Sweden
131021 Rummukainen M "Climate Change 2013; nedslag & reflektioner", Skåne Regional Council and the Green party, Lund, Sweden
131023 Rummukainen M "Climate Change 2013, IPCC:s femte rapport", Vinddagarna, Stockholm, Sweden
131023 Rummukainen M "The 2013 IPCC Climate Change report, Overview and reflections", Sida, Stockholm, Sweden
131024 Rummukainen M "Climate Change 2013, Inte helt

kört med klimatet, än", Gasdagarna, Båstad, Sweden
131107 Hassler J, "Climate change", CEPR, Modena, Italy
131108 Krusell P, Round table on Climate Change, University of Minnesota, USA
131111-12 Bärring L "New climate scenarios – from global to local", Future Forests-EFI Nord Workshop "Climate Change and Forestry in Northern Europe", Uppsala, Sweden
131111-12 Smith B, Jönsson A M and Lagergren F "Ecosystem model-based assessment of adaptation alternatives for forestry under global change", Future Forests-EFI Nord Workshop "Climate Change and Forestry in Northern Europe", Uppsala, Sweden
131112 Hassler J, "The Fossil Episode", OXCARRE, Oxford University, the UK
131114 Wallgren O, "Facket och klimathotet", Mänskliga Rättighetsdagarna, Stockholm, Sweden
131125 Olsson O "Skogsägare och klimatanpassning: Erfarenheter från Mistra-SWECIA", Jämtland County Administrative Board "Varmt och gött, eller?", Östersund, Sweden
131126 Blennow K "Understanding the human dimension of forest risks", the Centre for Environmental and Climate Research Fellows, Lund University, Lund, Sweden
131128 Rummukainen M "Klimatförändringen – naturvetenskapliga kunskapsläget 2013", Agenda 21, Västerås, Sweden
131203 Rummukainen M "Vetenskapens senaste diagnos på klimatfrågan IPCC:s femte rapport", Sustainability Day Öresund 2013, Malmö, Sweden
131204 Hassler J "The Fossil Episode", Umeå University, Sweden
131204 Rummukainen M "Vi förändrar klimatet", Malmö Nya Latin, Malmö, Sweden
131210 Bärring L "Klimatet i Sverige, 10, 20, 50, 100 år framöver?", ArtDatabanken, Swedish University of Agricultural Sciences, Ultuna, Sweden
131216 Rummukainen M "Observationer, processer och klimatkänslighet", SMHI, Norrköping, Sweden
131218 Hassler J, "Climate change and optimal taxes on fossil fuel", the 4th Caixin Summit, Beijing, China
131218 Rummukainen M "Vetenskapens senaste diagnos på klimatfrågan. IPCC:s femte rapport" Stockholm County Council, Stockholm, Sweden
131219 Hassler J, Persson T and Krusell P, meeting with Premier Li Keqiang, Zhongnanhai, Beijing, China

EVENTS

130321 Breakfast seminar "Globala drivkrafter", SMHI, Norrköping, Sweden
130403 Breakfast seminar "Globala drivkrafter", Lund University, Sweden
130410 Breakfast seminar "Globala drivkrafter", Stockholm University, Sweden
130918-19 Excursion "Klimatanpassning av svenskt skogbruk" Västmanland, Sweden
131002 Seminar "Klimatet fortsätter att förändras – hur mycket och vad bör vi göra?" the Committee on Environment and Agriculture in the Swedish parliament, Stockholm, Sweden
131016 Seminar "Skogsbruk i ett förändrat klimat – hur påverkas mångfald och miljö", KSLA, Stockholm, Sweden

OTHERS

André K, 2013, Samarbete viktigt för klimatanpassningsförmågan, *Mistra-SWECIA nr 01 2013*

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Jönsson A M, 2013, Skogsägare behöver praktiska råd, in Hall M and Björck I (red.) *15 nedslag i klimatforskningen – dåtid nutid framtid,* Lund University, 155-168

Jönsson A M, 2013, Ökad risk för skadeinsekter, *SkogsEko nr 1,* Mars 2013, 20

Nilsson L J and Rummukainen M, 2013, *Fritt tankeutbyte är grundläggande för klimatforskningen och för IPCC,* Sydsvenskan, aktuella frågor, 7 July 2013

Rummukainen M, 2013, Metanbomb i Arktis? in Hall M och Björck I (red.) *15 nedslag i klimatforskningen – dåtid nutid framtid,* Lund University, 117-126

Rummukainen M, Björck S, Hall M, Neij L, Nilsson L J, Olsson L, Smith B, Sterner T and Swietlicki E, 2013, *Temperaturhöjning på fyra grader inte osannolik,* Dagens Nyheter, debatt, 25 January 2013

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