

ECRA White paper on regional climate information for society.

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Background

There are ongoing changes in the Earth system that imply an increasing need for climate change adaptation. This trend has been acknowledged and there is a renewed focus on dealing with climate change with the Paris 2015 agreement and the upcoming COP26, and has recently been underscored by the tragic flooding event in Germany, the Netherlands, Belgium and Austria. The awareness of dealing with climate change was also boosted by the recent change of course in the USA, and the need to adapt to a changing climate was underscored at a high-level online Climate Adaptation Summit in January 2021 (CAS2021; <https://www.cas2021.com/>).

The CAS2021 was the first of its kind and may herald a new emphasis on vulnerability, adaptation to and impact of climate change. Recent extreme heatwaves in North America and the high-impact extreme event in Europe also indicate that both poor and rich countries are affected by climate change.

The UN general secretary and head of states took part in the CAS2021 summit, but the climate scientists were less visible. Some of the talks posted on YouTube suggested that mitigation and adaptation were two concepts that were entangled and that there is still a strong emphasis on mitigation of greenhouse gas emissions. This is important as to limit global warming, although there is also a clear need for more efforts on climate adaptation because we are already committed to significant climate change. Policy-makers rely on reports produced by the *Intergovernmental Panel on Climate Change* (IPCC), which are based on the efforts coordinated by the *World climate Research Programme* ([WRCP](#)) and its programmes such as the *Coupled Model Intercomparison Project* (CMIP), the *Coordinated Regional downscaling Experiment* (CORDEX) as well as *The Climate and Ocean: Variability, Predictability and Change* (CLIVAR) project.

The WCRP is changing structure and plans to establish a '*home of expertise*' for regional information for society (RifS). Also, the new structure will include '*lighthouse activities*' such as '*My Climate Risk*'. The past projects CORDEX and CMIP will still be a part of the WCRP, but will be accommodated within the new homes of expertise somehow. The WCRP emphasises that it *will not* get involved in climate services, but only play the academic role and conduct research into how climate science can produce actionable science for society. However, it is easy to get

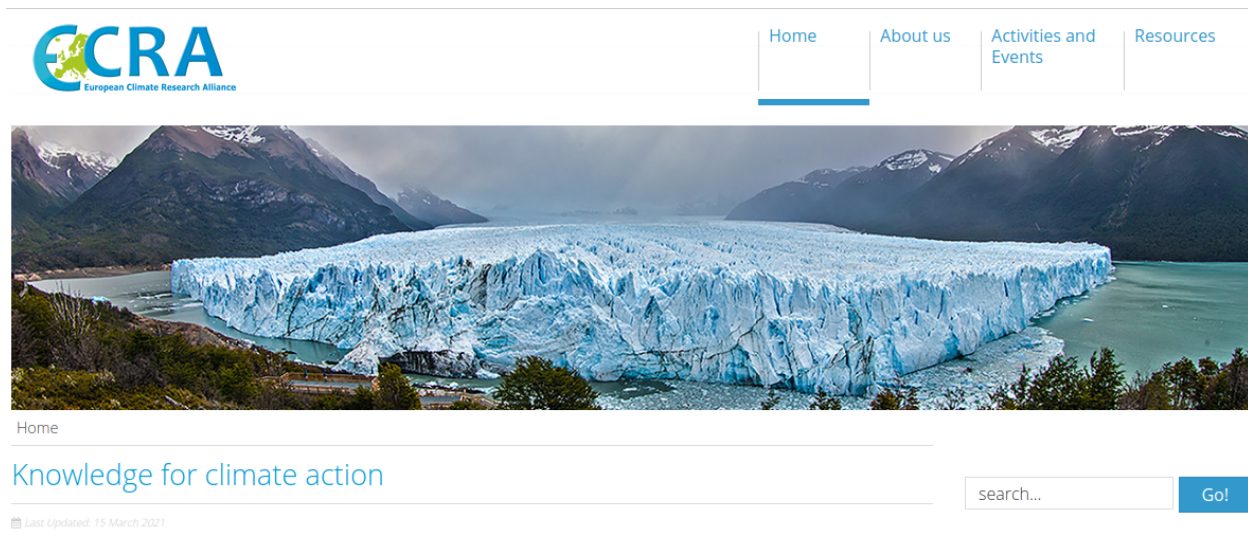
other impressions. Nevertheless, it is important to have good fact-based discussions about how to deal with RifS since it has real life effects.

There will probably be new efforts on cross-cutting climate-related research in the near future, and the new Horizon Europe Cluster 5 “*Climate, Energy and Mobility*” will announce several calls on climate change adaptation. In particular there are two calls which involve the use of local and regional climate information: “*Better understanding of the interactions between climate change impacts and risks, mitigation and adaptation options*” and “*Supporting the formulation of adaptation strategies through improved climate predictions in Europe and beyond*”.

The EU has also established a [climate adaptation strategy](#) and the new EU Climate Adaptation Strategy aims to mobilise the climate adaptation community and provide a forum for reflecting on the role of science and innovation in general. The EU has also invested greatly in setting up new climate services, and the *World Meteorological Organization* (WMO) is still in the process of promoting the *Global Framework on Climate Services* (GFCS) around the world. In particular, there is ongoing development on different levels such as:

- European Environment Agency (EEA) Climate-ADAPT
- Copernicus C3S
- Copernicus Mirror (at National Level)
- National and regional services

These new developments are in line with ECRA's activities and with one of ECRA's slogans: “Knowledge for climate action” (see graphic below). ECRA can potentially take part in setting the future direction for the interface between climate science and society. There may be an opportunity to have a voice on this matter and this provides the context for this white paper.



See <https://www.nature.com/articles/s41467-025-57450-0>

Diversity of communities

It's not easy to navigate between the landscape of different communities and research disciplines. Some of them are visible through the IPCC assessment reports, but it's typical that the adaptation, impact research and vulnerability communities are absent in meetings and conferences hosted by the meteorological and climatological communities. A question therefore is whether we have a problem in the chain of information. One of the objectives of ECRA is *"to bring together, expand and optimise expertise in climate research through a bottom-up approach"*.

There are several professional communities that address climate change, and the European Environment Agency (EEA) Climate-ADAPT provides a list of upcoming events connected to climate change adaptation <https://climate-adapt.eea.europa.eu/more-events>. One example is the European Climate Change Adaptation Conference ([ECCA 2021](#)). But there is a long list of climate change conferences world-wide: <https://waset.org/climate-change-conferences>. In addition to climate change adaptation, there are conferences on climate impact research, e.g. [Climate change: impacts and responses](#) (2022), and a [Climate Vulnerable Forum](#). Recently, the Copernicus C3S was facilitating a network for some of these communities through a [C3S Conference & General Assembly](#). These fora are relevant, but the point is not to compete with these efforts but rather align our efforts for best mutual gain. There is also a need for debates and discussions on what is the best climate information and how to use it the correct way.

Objective of this white paper

The overall goal of this white paper is to enhance the awareness of which role ECRA plays in terms of climate research, climate services, climate adaptation and how climate information is being used by society. One role for ECRA could be to act as a 'bridge builder' between the various 'communities' connected to the climate change 'problem sphere', including research and society. We should ask the question how ECRA (and its members) can contribute to discussions in different groups (e.g. Mission Board on climate adaptation, the European Commission, Copernicus, WCRP or the EEA). Also, do we have an (expert) opinion on what knowledge and information should be used and how? Can ECRA provide some guidance on how to use the 'right' climate information and how it can be used in the best way?

Building bridges.

As a starting point for a bridge building role we need to establish what kind of linkages already exist between the impact research community and the climatology/meteorology community. A targeted survey of the members about their experience with such linkages would be a first step. Also a stock-taking of where science stands regarding regional and local climate information and downscaling to get an overview of existing resources and possibilities (one example from Norway is presented in a [GMD discussion paper](#)). One objective could be to strengthen the existing links if that is beneficial, sharing of knowhow and promoting the use of science in

general. Sustaining discussions about such matters may provide more awareness and strengthen the community.

For ECRA, such efforts could also involve new outreach activities in its Collaborative Programmes. We want to know whether the knowledge, information and data that climate scientists produce could be used more extensively. The more data and information is used, the higher their impact. But do we know how our knowledge can be used by society? (And what is required?) ECRA can play a role by explaining that it's important to use the right information in a good way, as opposed to using poor information in a bad way (maladaptation). This consideration may become increasingly important with the increased use of artificial intelligence (AI) and machine learning (ML).

Sectors

Climate change and its impact is expected to vary between sectors and geographically. Some sectors that may be of interest include health, energy (EEA), transport ([ICNet](#)), and agriculture. ECRA may link up with societies for such sectors and facilitate sharing experiences from different countries. Some of this is already being done through ECRA's conferences and meetings.

Collaborative Programmes and opportunities for ECRA

The Arctic Council appreciates the value of science for decision-making in the Arctic and hosts the *Arctic Monitoring and Assessment Programme* (<https://amap.no>) with common issues with ECRA's **Arctic Climate Stability and Change** Collaborative Programme. In addition, there are biennial [Conferences of Parliamentarians of the Arctic Region](#) for parliamentarians representing the eight Arctic countries, the European Parliament and observers where scientists are invited to give presentations. One challenge is to have a good and constructive dialogue in terms of mutual understanding of complicated topics. An interesting question is whether ECRA could have a role in a dialogue with these communities. What has ECRA to offer, and can the politicians give some indication about what climate information they really need? (e.g. an arbiter, facilitator of knowledge exchange)

High Impact Events and Climate Change - this CP is relevant for climate change adaptation, and can be more focussed by addressing who exactly is affected and by what type of events (Floods, landslides, droughts, heatwaves, hail, storms, the jetstream?). Perhaps connect with the adaptation and disaster risk reduction (DRR) communities or first responders. Other relevant sectors include transport, health, agriculture, insurance and municipalities.

Sea Level Change and Coastal Impacts - who exactly is affected?

Changes in the Hydrological Cycle - this CP aims at improving our scientific understanding of hydrological processes under current and future climatic conditions in order to better identify the possible impacts of changing hydrological cycle components (precipitation, runoff, snow, soil moisture, etc) on the environment and the society, in particular focusing on so-called hot-spot

regions (like the mountains or the Mediterranean area). These hot-spots are not only areas of the globe that are experiencing amplified climate change signals, but also those where impacts are and are expected to be more pronounced, since their vulnerability is amplified by other stressing factors, like the overexploitation of resources. A better knowledge of the changes in hydrological cycle especially under different climate change scenarios is important for providing a scientific base to decisions especially in terms of adaptation, and may support several sectors like water resource management, hydropower production, agriculture.

Different strategies using climate information

ECRA can share this white paper with decision-makers, politicians and stakeholders and ask if it makes sense and get some feedback. It may be useful to regard the white paper as part of a learning process and use it to maintain a dialogue with people in Brussels, e.g. contacts at the European Commission. Perhaps learn from other disciplines where science and society meets, such as from health science? Joint dinners with policymakers, in conjunction with workshops or conferences, where dialogues can be held in an informal setting.

ECRA can provide this white paper on its web page for further discussion - it is a living document that will be updated periodically, e.g. after annual meetings

Suggested protocol for downscaling for regional information for society

For climate change adaptation it is important to use *both* dynamical downscaling (DS; RCM results) and empirical-statistical downscaling (ESD) or stochastic downscaling (e.g. for precipitation) together in a synthesis since they have different strengths and weaknesses, independent of each other. E.g. as shown in figure 1. Also it's crucial to use large multi-model ensembles to counter "the law of small numbers" and to quantify uncertainties associated with projections. Some perspectives on downscaling and regional information for society are presented [here](#) and [here](#) on RealClimate.org. Some relevant topics that need more research and discussion are: (i) how to combine, (ii) how to evaluate, (iii) how to include historical observations, (iv) how to combine different models in large multi-model ensembles. ECRA can contribute by providing an overview of the state of the science on regional climate modelling, e.g. through concise review/perspective paper based on individual reviews/perspectives from its members who want to join in and share their strategies.

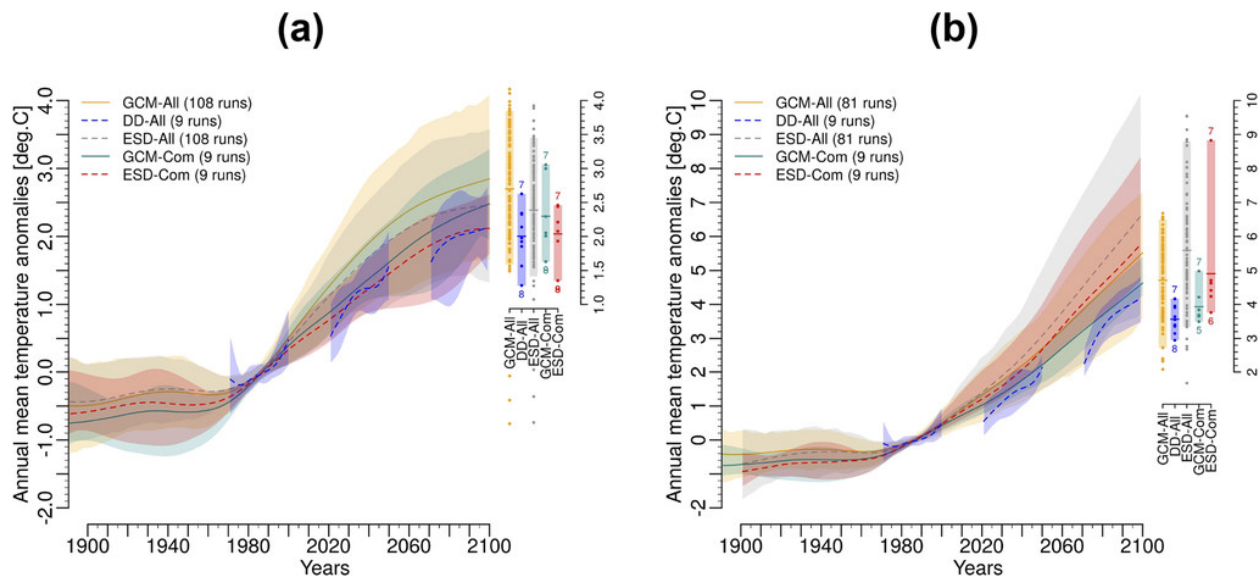


Figure 1. An example of a synthesis of DS and ESD. Source: <https://doi.org/10.1175/JAMC-D-18-0179.1>

Dialogue with stakeholders/”the society”

A way to enhance the awareness of the value of climate information is through sustained dialogue with other disciplines and stakeholders. This also could include facilitating scientific discussions. One approach may be to challenge decision-makers by asking them questions: *On what information and knowledge have decisions been based in the past? How does weather/climate affect your decisions? How different should the information be to sway a decision? What if the information were wrong and how wrong would it have to be to matter?*

ECRA could increase the awareness within both the research community and others about the diversity of viable approaches. Should it be ‘bottom up’ or ‘top down’? A ‘bottom up’ approach could involve *sensitivity tests* to identify key parameters. It could challenge the traditional linear chain of information: GCM → downscaling → impact models. Other useful approaches involve using story lines, case studies and specific examples which also can involve applying scenarios, stress testing or other narrative approaches (e.g. future weather, scenarios, storylines, case studies, stress testing, sensitivity studies for impacts). It is important to not forget that the traditional linear chain of information also is valuable.

ECRA has a different role to Copernicus C3S and can contribute to enhanced understanding through facilitating discussions about how to use the data and provide examples from around Europe. ECRA could perhaps have an opinion and a voice concerning co-designing climate services. For instance Copernicus C3S has a strong voice that could over power national services (e.g. [July 2021 Newsletter](#) and taking part in the discussions already going on), and ECRA through its members can promote continuous discussions and awareness of the range of possible solutions (e.g. on [adaptation](#)). For instance, current regional projections include climate

and energy indicators for Europe from 2005 to 2100 derived from climate projections with an ensemble of 11 members and [only RCMs](#), which is unfortunate as RCMs have shortcomings and the best approach is to combine them with empirical-statistical downscaling (<https://gmd.copernicus.org/preprints/gmd-2021-176/>). On a regional scale, this is on par with offering a small statistical sample that is deemed to give non-robust answers according to the law of small numbers. ECRA could host seminars discussing whether this is sufficient, or if there ought to be demands for more, in addition to discussions about national versus European / international approaches.

Another case could be that research projects typically involve a small number of scientists that may be an insufficient representation of the scientific community and the scientific knowledge. ECRA can ensure scientific debates and dialogues when such results are being applied as a service to society. Moreover, ECRA can promote the idea of involving statisticians to a greater degree than in the past, as they are the experts of making sense out of data ([Benestad et al. 2017](#)).

Cases

Examples. Seasonal forecasts? Lessons learned. Also include failures? Why were some of them good or bad?

National examples

Country	Short description.
Norway	Tekna Klima, a professional network within a trade union for more than 80.000 engineers and scientists offers a means to discuss climate and its implications for various topics. This is done through social/science events/meetings. A GMD discussion paper on downscaling approach adopted by MET Norway: https://gmd.copernicus.org/preprints/gmd-2021-176/
Finland	Seasonal forecasts: FMI could present those currently also part of ARCC (ice breaker service), and those from ERA4CS INDICES (agriculture)
Germany	https://environmentalsystemsresearch.springeropen.com/articles/10.1186/2193-2697-1-9

How should ECRA work?

Start with the ECRA Paper and promote a learning process. What can ECRA do? Encourage and support dialogues between ECRA members and relevant communities on what information is available, what the limitations and caveats are and how it can be used. Also to make climate science more visible at climate change adaptation summits.

Use this white paper to create and foster opportunities for collaborations, facilitate the exchange of information and knowledge. This may include knowledge and experience from relevant research projects in combination with practitioners (e.g., regional decision-makers or planners), and the exchange of research gaps, information on existing activities.

ECRA can offer its services as a networking platform: ECRA's members – all are scientists – are interested in participating in exchange fora in both directions, bottom-up and top-down: Supporting decision-makers on different levels (EU, national, regional, local, etc.) with scientific advice. Municipalities, other research projects, and various kinds of organisations may be interested in both learning from ECRA, as well as expressing their needs.

Exchange information and best practices, lessons learned, gaps, join existing activities, ...

Decadal outlook for the ECRA Mission ...

Are we trying to write a draft of a review paper?

Are we addressing specific knowledge gaps in the literature?

Should ECRA try to establish some definitions: e.g. '*Actionable information*' - what is it really? (examples?). Why is it hard to obtain? (is it?). What is meant by 'distillation'? E.g. intensity-duration-frequency (IDF) curves used in engineering. Risk analysis/matrices. Stress-testing and sensitivity experiments with impact models.

Models' minimum skillful scale: explain why

Law of small numbers: explain why.....

Involve the statistics community?

Highlight certain topics/problems? ECRA is active in various topics around climate research, most of the members in the ECRA network have been engaged in this collaboration since more than ten years which allows the ECRA network to assess and understand the challenges in high-level decision-making on the long time scale on Climate Change relevant policy-making. ECRA, being an initiative without a termination date, can offer a long-standing representative voice. Structural changes, such as the support for connection between researchers and local communities, regional forecasters, research or community projects can be aided by ECRA. Vulnerable communities or parts of projects can be addressed through ECRA activities. However, the research questions and venues of collaboration do not come naturally. Regional actors, mayors, projects partners need to be found through

ECRA should explain the value of meteorological and climatological science. The more the data is being used, the more it's worth.

Academic research versus agency coordinated research -> how is both transferred into a product

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