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Position Paper

The contribution of the European Climate Research Alliance in addressing Climate Action in Horizon 2020

The present paper is offered to the European Commission, to EU Member States, and others, as a basis for further discussion about the implementation of ambitious long-term research and innovation efforts in the field of climate and climate change research.

Rational

The Lund Declaration[1] has put much emphasis on the necessity for the European research community to respond to the Grand Challenges of our time, mentioning global warming as one of them. This has been further elaborated and included into Part III "Societal Challenges" of the new Framework Programme for Research and Innovation – Horizon 2020, mentioning "Climate Action, Resource Efficiency and Raw Materials" as a key research and innovation area[2]. Thus recognising the importance of this research field for achieving the objectives of a smart, sustainable and inclusive growth of the Europe 2020 strategy.

It is equally stated in the Lund Declaration that meeting the Grand Challenges requires the strengthening of frontier research **initiated by the research community itself.** Furthermore, public-public partnerships are considered as an important element to facilitate the establishment of a common European Research Area[3]. Inspired by these principles the European Climate Research Alliance (ECRA) was founded in October 2011 by a group of leading European research institutions performing climate and climate change research. ECRA comprises expertise in different disciplines, ranging from physical oceanography, hydrology, atmospheric sciences to socio-economy, and is unified by the pursuit of tackling key questions in climate research (for a full list of members see the last page of this document).

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[1] Lund Declaration, "Europe Must Focus on the Grand Challenges of our Time", Swedish EU Presidency, 8 July 2009, Lund, Sweden [Online] http://www.se2009.eu/polopoly_fs/1.8460!menu/standard/file/lund_declaration_final_version_9_july.pdf

[2] COM (2011) 809, Proposal for a Regulation of the European Parliament and of the council establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)

[3] COM(2011) 572, Partnering in Research and Innovation

The Objectives of ECRA

The ECRA aims to strengthen, expand and optimise EU climate research capabilities through the sharing of world-class national facilities in Europe and the collaborative realisation of pan-European programmes. ECRA works towards a long term, durable integration of excellent but dispersed research capacities across Europe in order to ensure optimum use of human resources, modelling capacities, field activities, and infrastructures. Thereby ECRA aims at maximising the impact of scientific results and reinforcing the European Research Area for climate change science. ECRA will facilitate sharing of data and methodological and modelling development that can enhance the capacity of European climate change researchers to conduct integrated assessments that can support cost effective climate policy instruments and decision making. In this respect the understanding of user needs and the continuous two-way interaction with users of climate science information will be a process pursued by ECRA. This will ensure the provision of relevant 'actionable information' to the benefit of society and decision making based upon the results achieved in the Collaborative Programmes that form the foundation of the ECRA structure.

Strategic partnerships, such as ECRA or the European Energy Research Alliance (EERA) bringing together European Research Performing Organisations (RPOs) will accelerate efforts to find solutions for the grand societal challenges of our time and should therefore be supported. The bottom-up approach of RPOs championed by ECRA complements well the top-down approach of the Joint Programming Initiatives, e.g. JPI Climate, whose goal it is to coordinate national research agendas of funding organisations towards community challenges.

This ECRA position paper outlines key research areas of utmost importance to face climate change and to create sustainable solutions for a continuing growth in Europe.

Climate Action as a Separate Challenge in Horizon 2020

Furthering our understanding and prediction capabilities of the future evolution of the climate system, its interactions with other components of the Earth system and impacts on society presents a “Societal Challenge” of vital importance. At the present stage of the consultation and discussion process on “Horizon 2020 – The Framework Programme for Research and Innovation” Climate Action is part of the integrated Societal Challenge “Climate Action, Resource Efficiency and Raw Materials”. This challenge aims to combine research topics which have little to no overlap in content. Because of the heterogeneous combination of research themes, together with the limited resources foreseen[4] for this challenge ECRA thus sees a real danger that this challenge will not have adequate impact and will fail to achieve its objectives. Raw

[4] COM (2011) 809, Proposal for a Regulation of the European Parliament and of the council establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)

materials and resource technologies would fit much better e.g. into the “Industrial leadership” part of Horizon 2020. It would then be possible to achieve a more coherent focus and critical mass for both research themes. Providing innovative solutions for society in a changing climate, developing adequate mitigation and adaptation strategies, including the involvement of user needs and decision making presents a huge challenge in itself. It is therefore imperative to provide resources and a more stringent focus for the challenge of Climate Action in Horizon 2020.

Climate Action is much more than just Climate research. Climate change is a long term phenomenon that develops over centuries, and with the already observed signs of climate extremes and other events, it is urgent to provide a scientific basis for climate actions in terms of adaptation and mitigation policies. Making cost effective societal decisions about climate change requires the integration of a wide range of disciplines and models including climate physics, impact modelling, economic modelling, uncertainty analysis, and decision making theory and approaches. Integrated assessments are trying to include all these aspects, and have predominantly been applied to general global and regional impacts at relatively large geographical scale. Coping with extreme events and shorter time h, however, will also require the development of new modelling tools and approaches for example in order to assess climate hot spots in urban areas, land use impacts, impacts on water systems, and flooding. Thus ECRA supports the idea of **implementing Climate Action as a separate challenge in Horizon 2020** reflecting the significance of this research area for human well-being and societal stability, which by many leading policymakers is termed the most pressing long-term challenge for humanity, backed by an adequate budget.

Financing of Research Infrastructures

To support the development of world class research infrastructures – understood in a broad sense – has to be a task of profound importance for Horizon 2020 and other Union instruments, such as the Structural Funds. We recommend exploring linkages between research projects and associated infrastructure projects in order to create a sustainable homogenous European Research and Innovation Union. Bridging Horizon 2020 and Structural Funds should be supported by an appropriate integrated instrument implemented in both funding lines to generate synergies. It is well recognised in the Specific Programme for Horizon 2020 that comprehensive environmental observation and information systems are essential to ensure the delivery of and access to long-term data and information as a prerequisite for effective climate research. Thus adequate infrastructures for Earth observation and monitoring need to be financially equally supported by the EC and member states.

This support asks for a direct financing of research infrastructures of European interest to meet the stated objective of access to world-class research infrastructures to tackle the grand societal challenges. We welcome and strongly support the

attention paid in Horizon 2020 to the development of comprehensive and sustained global environmental observation and information systems. There is an urgent need to support intensive cooperation between the climate modelling community and communities dealing with environmental observations and data management. Strengthening this link is essential for improvements of climate and earth system models especially in the description of various local and regional processes.

An ERA-Net on environmental data monitoring and data acquisition including digitising of analogue data would be an appropriate instrument highly beneficial/efficient in reducing uncertainties especially in re-analysis projects through the recovery of already existing data records. The inclusion of the member states is very important since national authorities are very often owners of data records, e.g. tide gauge measurements, hydrological and soil parameters, meteorology and pollution data.

Key Research Areas in Climate Action

The present draft of the Specific Programme[5] already states the importance of improving the scientific knowledge-base of climate drivers, processes, mechanisms and feedbacks, in order to facilitate more accurate climate projections and predictions and serve pressing knowledge gaps for mitigation, risk reduction and adaptive resilience. A number of priority research fields and topics have been identified by the European Climate Research Alliance considered crucial for society. It requires that user needs for services from climate research have to be more sharply identified. Collaborative efforts are very much needed to create a sound knowledge base in these areas, including socio-economic aspects, which will profoundly impact – and are a prerequisite for – decisions on adaptation and mitigation strategies. The ECRA Collaborative Programmes will deliver a sound scientific basis for actionable science, including innovative application-oriented solutions with benefits for our society and economy.

Arctic Climate Stability and Change

Observed climate change has been progressing most rapidly in the Arctic. This phenomenon is nowadays best known under the expression *Arctic amplification*. Europe's proximity to the Arctic makes it particularly sensitive to Arctic climate change. In fact, the rapid warming trend during the last decades in the Arctic has triggered a number of environmental changes which lead to questions of particular concern: How will sea ice coverage of the Arctic Ocean change in the next decades and what will the consequences for European weather and climate including extreme events? Will loss of Greenland ice sheets continue to advance at a rapid speed and

[5] COM (2011) 811, Proposal for a Council Decision establishing the Specific Programme Implementing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020

what will be its contribution to sea level rise? Does thawing of permafrost release greenhouse gases, which may accelerate climate change? Which impacts on biodiversity and ecosystem functioning have to be expected? Arctic climate change is progressing at such a rapid pace that scientific progress is urgently required to provide Europe's economy and society with reliable information of its consequences.

One of the most important overarching scientific challenges of the coming years will be to improve climate predictions from seasonal to multi-decadal time scales in order to support decision-making. Due to the importance of Arctic climate and climate change for Europe, the European Climate Research Alliance therefore argues that the following issues should be considered for funding in Horizon2020:

- Advance models to improve Arctic climate prediction.
- Explore the impacts of the Arctic on European weather and climate.
- Optimization of (long-term) observing systems in the central Arctic Ocean as a widely unexplored region and development of innovative technologies for automatic observations in inaccessible, hostile environments.
- Improve the operational forecasts of sea ice coverage as an important service for economic development in the Arctic Ocean (transport, energy and living resources).
- Assess potential risk factors in relation to the economic development of the Arctic Ocean, such as impacts of aerosols and pollutants from increased shipping.

High Impact Events and Climate Change

There is growing awareness that climate change cannot solely be considered as a "mean state" modification. Changes in the characteristics, frequency, and severity of extreme events are typically responsible for the most important impacts and climate risks, and consequently are amongst the most significant aspects of climate change to understand and predict. Questions that will be posed include: How do high impact events work? How can they be simulated accurately in numerical models, and how can we reliably predict changes in the future? Including, how are changes in atmospheric composition and climate linked? These tasks are important challenges in climate science and link directly to impact studies. A strategy that starts from fundamental physical concepts, continues via process understanding and goes towards the best possible numerical simulations of the global and regional changes of extreme events, including atmospheric composition-climate interactions and feedbacks, will be formulated in this Collaborative Programme.

The European Climate Research Alliance identified the following key challenges to address these issues:

- Improve the understanding of scale interactions in the atmosphere including dynamics/energetics and composition (e.g. changes in tropospheric oxidising

capacity and stratospheric ozone under CO_2 induced climate change), for example in the context of mid-latitude blockings or tropical cyclones.
- Propagate large scale climate change simulations to the regional scale using statistical and dynamical downscaling and high resolution regional modelling.
- Analyse how altered statistics of severe weather affect tropospheric and stratospheric composition (e.g. water vapour and ozone concentrations in the upper troposphere and lower stratosphere) and vice versa. E.g. heat waves and future air quality, severe (tropical) storms/convective events and the feedback of changing composition (see above) on climate.
- Improve the reliability of projected changes in extreme events for impact studies.

Sea Level and Climate Change

Many coastal regions in Europe are vulnerable to sea level rise and changes in storm surges. Global sea level rise due to raising global temperatures has a non-trivial imprint on the European coasts and sea level rise constitutes a major societal and economic risk for European societies. In addition, changes in atmospheric circulation may affect storm surges in the region. Critical questions that need to be addressed in this context are: Has sea level gone up along European coasts and is sea level rise accelerating? What is the interannual to centennial variability? Can we understand and attribute these changes to specific physical processes and sources? How will sea level change in the coming century along European coasts? Many of these questions are addressed so far for global mean values, but large gaps in understanding of regional sea level rise exist. The complexity of processes affecting coastal regions (coastal morphology, local tectonics and anthropogenic activities to name only a few) calls for a regional effort.

The European Climate Research Alliance identified the following critical challenges to address these issues:

- Integrate and homogenize observational records of sea level rise, both from in situ tide gauges and remote sensing.
- Detect and attribute past regional sea level changes along the Baltic, North Sea, Atlantic and Mediterranean coasts to physical causes.
- Foster modelling activities in order to construct projections of future changes of regional sea level rise and storm surges. Models of regional ocean and atmosphere, tides and land movement are needed to reduce uncertainties in regional sea level projections.

This information and further understanding of geophysical processes will be of paramount importance for impact studies and adaptation policies.

Changes in the Hydrological Cycle

The global and regional hydrological cycle is already significantly affected by climate fluctuations and at the same time it is one of the key factors determining climate and climate change. Precipitation, in particular, is one of the most difficult variables to cope with, both observationally and from a modelling standpoint, but it is also one of the most important parameters in the functioning of the climate system and in the determination of climate change impacts on natural and cultivated ecosystems, water availability and societal well-being and security. Crucial questions to foster the understanding of the hydrological cycle are: What are the small-scale processes and feedbacks (soil surface dynamics, vegetation, convective processes) governing the hydrological cycle? How to bridge the gap between the current resolution of climate models and the small scales of hydrological processes? How can satellite estimates of precipitation, especially as snow, be improved? The resolution of present regional climate models, both atmospheric and oceanic, is not sufficient to properly reproduce convective processes, which are however a crucial component of the hydrological cycle and may be responsible for severe hydro-climatic hazards.

The European Climate Research Alliance identified the following critical challenges to address these issues:

- Reduce the scale mismatch between global and regional climate models (resolution of about 100 km and 10-20 km respectively) and the smaller scales which are of interest for water-related studies (i.e. hydrological models, vegetation dynamics, evapotranspiration fluxes) as well as for a proper modelling of land-atmosphere and ocean-atmosphere interaction processes.
- Improve the understanding of the impact of land heterogeneity on surface-Planetary Boundary Layer coupling processes and on the development and dynamics of extreme events.
- Improve the understanding of atmospheric and oceanic convective processes. In particular, a better description of convective dynamics and the development of new parameterizations of sub-grid convective processes is needed.
- Foster the development of reliable downscaling methods to drive land surface and hydrological models at catchment scale and use regional scale data for local adaptation strategies.
- Reduce uncertainties through a better access to essential observational climate data and the development of reliable/robust ensemble estimates of expected impacts.
- Identify the role of aerosols in the hydrological cycle with special emphasis on the role of aerosols in cloud and precipitation dynamics and on the effects associated with biogenic/natural aerosols of both terrestrial and marine origin.

Final Statement

The development of sustainable adaptation and mitigation strategies to climate change is well addressed in Horizon 2020 and is also regarded as being of crucial relevance by us. However, it should also be emphasized that in order to develop these measures a solid understanding of the underlying basic processes in the climate system is of paramount importance particularly in order to narrow uncertainties in climate projections to facilitate decision making.

Presently, RTD policy development is almost entirely developed by the Member States and their research-funding organisations. However, the RPOs are the ultimate performers and enablers of scientific progress; therefore it is paramount for the success of Horizon 2020 that they are closely involved in defining the specific research agendas, the appropriate measures and the boundary conditions for the proposed activities. Furthermore, for the very same reasons, the programmatic development of focus and funding measures of the ERA-NETs and Joint Programming should allow a more active inclusion of the research performing organisations in conjunction with the research-funding organisations. ECRA therefore recommends a strategic alliance of all groups that initiate the European research agenda and supports a more active role of the research-performing organisations in the agenda-setting process. This Position Paper is developed as a result of our recommendation for an active participation of research performing organisations in the agenda-setting process of Horizon 2020. The ECRA member organisations engaged in climate research wish to contribute the best knowledge to the development of the European programmes.

ECRA Member Organisations supporting this position paper:

1. Helmholtz Association of German Research Centres, DE
2. Italian National Agency for New Technologies, Energy and Sustainable Economic Development, IT
3. Royal Netherlands Meteorological Institute, NL
4. Finnish Meteorological Institute, FI
5. Swedish Meteorological and Hydrological Institute, SE
6. Norwegian Meteorological Institute on behalf of the Norwegian Climate Centre, NO
7. Research Centre for Energy, Environment and Technology of Spain, ES
8. Technical University of Denmark, DK
9. National Centre for Atmospheric Sciences, UK
10. Global Change Research Centre AS CR, v. v. i. (CzechGlobe), CZ
11. National Research Council of Italy, IT
12. AREA Science Park, IT
13. TU Delft Climate Institute, NL