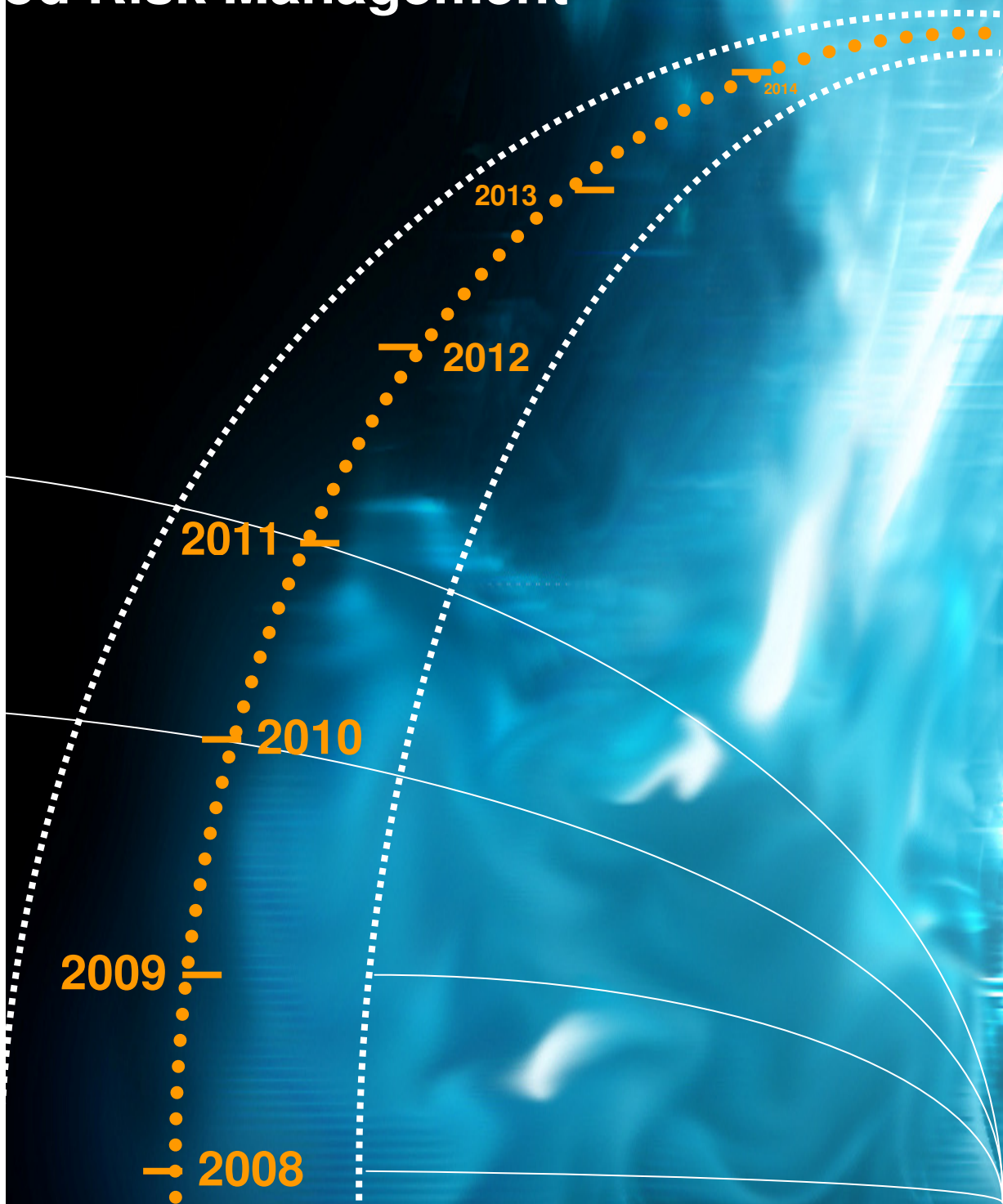
CRUE
FLOODING ERA-NET

CRUE Research Agenda

Strengthening European Research for Flood Risk Management



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Strengthening European Research for Flood Risk Management

This publication is part of the working programme of the CRUE Era-Net. It provides the vision for a common and European wide strategic policy-relevant research programme on Flood Risk Management (FRM) and covers the intended way forward to implement the programme.

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Preamble

In recent years, Europe has suffered a number of severe river and coastal floods that have caused loss of life and property. Increased flood risk is likely to be one of the most damaging impacts through a combination of climate change and increased vulnerability in Europe and will affect sustainable development if no action is taken to manage the rising risk.

Strengthening our research and evidence base on Flood Risk Management (FRM) and enabling effective implementation of successful management approaches is crucial for continued prosperity and sustainable development in Europe.

The vision for the CRUE ERA-Net is to facilitate the strategic integration of research at the national funding and policy development levels within Europe, and to promote the sustainable management of flooding risks at the scale of river basins, estuaries and coastal process cells. The last 5 years have seen significant progress in developing common goals and principles in funding of flood-risk related research across Europe. The partners in the CRUE ERA-Net are committed to working towards consolidating the variety of actions and initiatives to meet the needs and aspirations of both policy and practice on FRM in order to face the challenge of flooding in Europe.

This Research Agenda addresses the common vision and research needs of research funders from12 European Member States in the field of FRM over the next 7 years. Its purpose is to guide all those who are collaborating on a shared research initiative, whether from a governmental, policy, funding, science or practice perspective. CRUE's Research Agenda also provides a clear set of directions and priorities on programme implementation and will serve as reference for additional flood research related actions taken on a European or national level. With its key goal of providing the basis for effective management of flood risk and delivering sustainable development in Europe it will make an important contribution to strengthening the European Research Area (ERA) and help Member States facing the challenge of flooding.

The overall aim of this Research Agenda is to support CRUE partners as well as EU Member States in the implementation of the EU Floods Directive by providing scientific evidence and approved tools in the area of risk assessment, mapping, and visualisation.

This Research Agenda has been approved by the CRUE Steering Committee on the 20th April 2009.

Executive Summary – Tapping into the Best

The management of flood risk is a critical component of public safety and quality of life. Floods are amongst the most frequent natural events with far-reaching consequences, to which the people in Europe, and internationally, are exposed. There is no doubt that Europe – and the rest of the world – is living in a changing climate that will increase the potential for flood damage from many rivers both in mountainous areas (flash-floods) and river valleys as well as from coastal areas.

Increasing risk of flooding and vulnerability will have a severe impact on the welfare of people and economies across Europe. Besides the direct and indirect costs caused by flood events, the challenge of coping with the short- and long-term impacts of a disaster will be one of the most critical tasks in upcoming years in order to avoid significant impacts on long-term human and economic development. These challenges increase the pressure on both the European Commission and national governments to adopt effective and sustainable measures to cope with future flooding problems.

In order to tackle the challenge of rising flood risk and to develop effective policies and risk management practices, policy-makers and key stakeholders need a strong evidence base. Evidence-based policy-making is the key to modern, forward-looking strategies for dealing with increasing flood risk. Research is one of the most important tools to help establish an appropriate evidence base to support policy-makers and stakeholders in Europe. Trans-boundary and trans-national FRM issues are becoming more and more important, requiring particular joint research and development initiatives.

CRUEs overall **Vision 2015** is to provide a co-ordinated and comprehensive transnational evidence base on FRM issues to underpin the work of key national and European policy-makers. Research within this framework will address the river basin scale and take into account cross-sector approaches to integrated river and coastal management. CRUE will continue to provide a platform for research and policy networking and dialogue and promote the implementation of research into the range of FRM policies, processes and technologies.

CRUE will deliver this **Vision 2015** via three objectives:

Objective 1: To further integrate the European research area to support the implementation of national and European policies on FRM.

Objective 2: To develop evidence and innovation required to underpin sustainable flood risk management across Europe, reducing the potential for duplication of research effort.

Objective 3: To improve the integration of knowledge and to develop further the systematic exchange of information [horizontal and vertical] and good practice on flood management research.

With this Vision 2015 and its objectives, CRUE will enable evaluation of physical and engineering approaches alongside increased understanding of wider environmental processes and social and economic factors pertinent in FRM.

The creation and implementation of a European research area in FRM - as intended by the CRUE ERA-Net - is a first step towards an improved trans-national perspective for flood-related research in Europe. As part of the Vision 2015 objective 2, the CRUE ERA-Net has developed a Research Agenda in order to provide a focused and strategic approach to investigate flooding issues which will enable research funding organisations to avoid duplication by understanding exactly how their efforts integrate with other similar research projects and programmes, and how these efforts jointly contribute to developing system-wide knowledge of FRM. Its purpose is to guide all those who are collaborating on a shared research initiative, whether from a governmental, policy, funding, science or practice perspective. CRUE's Research Agenda is providing a clear set of directions and priorities on programme implementation and will serve as a reference for additional flood research related actions taken on a European or national level.

CRUE's Research Agenda describes the research which must be undertaken to realise the vision of

effective management of flood risk in Europe. The on-going stakeholder driven approach to developing a research agenda empowers all stakeholders to define the future of research, and to share in the actual research and implementation activities. In particular, CRUE has identified five Strategic Research Areas (SRAs) to meet the major challenges European FRM faces:

- Developing resilience and adapting to increasing flood risks: climate change and new development
- Risk assessment and mapping
- Implementing trans-national based strategies on flood event management and recovery
- Meeting the multifunctional demands on flood prevention and protection and their sustainable management
- Addressing public knowledge of flood risk and enhancing awareness, perception and communications

This Research Agenda - through its implementation by the CRUE Network - will help research funding organisations use financial contributions to maximum advantage and guide researchers into areas of international interest and priority. A major goal of this Research Agenda is to strengthen the link between academics, practitioners and policy-makers by addressing the full spectrum of research, from basic to applied research through effective demonstration to successful piloting and implementation strategies and by including efficient and effective dissemination, communication, and networking issues.

By providing an improved evidence base for effective and sustainable management of flood risk across Europe, CRUE's Research Agenda will make an important contribution to strengthening the European Research Area (ERA) and support EU Member States in implementing the EU Floods Directive.

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Terms and Definitions

This section provides definitions of terms frequently used in this paper. The given definition to each term will help the reader to understand how the CRUE partners will interpret and use these terms in the development of a common Research Agenda. Some of these definitions are defined in the document „Language of Risk“, prepared by GOULDBY & SAMUELS from the FLOODsite Consortium in 2005, to date ERA-Net CRUE and FLOODsite have used the same „language“ in the setting up and the development of an European research area concerning FRM. Definitions as recommended by the FLOODsite Consortium are marked with (*).

Term		Definition
CIS	◄	Common Implementation Strategy for the EU-Water Framework Directive
CRUE Board	◄	The implementation body of CRUE's Research Agenda. Each CRUE Network Member as well as a Member of the EC has a seat on this Board.
CRUE Partners/CRUE Network Members	◄	ERA-Net CRUE currently consists of 17 partners from 12 European Member States. It is anticipated that the existing CRUE partners will become Network Members if CRUE ERA-Net moves into of a Network of Research Funders (after the official end of the ERA-Net project in 2009).
Management Group	◄	The coordinating body during the implementation of CRUE's Research Agenda
CRUE snapshot	◄	A publication, provided by the CRUE ERA-Net Team on an annual basis, to give a quick, comprehensive update on European based flood risk-related policies and research.
EU-FD	◄	The European Directive on the Assessment and Management of Flood Risks (EU Floods Directive – 2007/60/EC)
EU-WFD	◄	EU Water Framework Directive – 2000/60/EC
ERA-Net	◄	ERA-Net (European Research Area – NETworking) is a major element of the FP6 specific programme „Integrating and strengthening the European Research Area“ and is designed to provide targeted support for the coordination and sharing of national and regional research programmes. It also aims at establishing long-term co-operation between national programmes, ultimately leading to joint trans-national research programmes.
ERA-Net+	◄	The ERA-NET+ scheme allows for Community top-up financial support in joint calls for research proposals. It provides the framework for full integration of national research programmes in a given research field into a single joint programme with appropriate Community participation.
ERA-Net CRUE	◄	CRUE is the acronym for "Coordination de la Recherche sur la gestion des inondations financée dans l'Union Européenne" (Coordination of the research financed in the European Union on flood management)
Flood	◄	The temporary inundation (either partial or complete) of normally dry land with water and sediments. Floods are caused normally by precipitation, storm surge, groundwater seepage, water backup in sewer systems, tsunami, ice jams and failure of structural flood management measures such as dikes, dams or retention basins.
FRM	◄	Flood risk management. Continuous and holistic societal analysis, assessment and mitigation of flood risk (*).
FP7	◄	The EU's Seventh Framework Programme for Research and Technological Development
Funding body/funder	◄	A funding body can be a public, private or non-profit organisation funding research open to external and/or internal competition
Integrated risk management	◄	An approach to risk management that embraces all sources, pathways and receptors of risk and considers combinations of structural and non-structural solutions (*).
Research	◄	Research encompasses activities that increase the sum of human knowledge [OECD Definition].
Research programme	◄	A cluster or series of interconnected research projects or activities with a common thematic focus and common funding, management, evaluation and dissemination mechanisms.
Research project	◄	A structured research unit or activity (not necessarily part of a research programme) with defined goals, objectives and timeframe.
Risk	◄	Probability multiplied by consequence (*). Theoretically, the consequence can be both positive and negative.
Safety chain	◄	The "safety chain" describes possible types of measures in flood risk management, moving from the prevention of floods, through protection and preparedness, to emergency response and recovery.
WG F	◄	EU Working Group on Floods

Flooding in Europe – Policy Context and Challenges

Seriousness of recent flood events

Floods are amongst the most frequent natural events with the most far-reaching consequences, to which the people in Europe, but also in the rest of the world, are exposed. Every year flood events occur globally, sometimes with disastrous consequences. In 2006, flood events caused 6,800 fatalities, US$ 10.5 billion total loss and US$ 750 million insured loss worldwide.[1]

The number of people worldwide vulnerable to a devastating flood is expected to grow to 2 billion by 2050 due to climate change, deforestation, rising sea levels and population growth in flood-prone areas.[2] At the moment 60% of the world population lives in (flood-prone) river delta areas.

Recent flood events in the UK, Switzerland, Germany, as well as in Mediterranean countries, have shown that flooding – with all its consequences – is not only a matter for developing countries but is also a serious issue in developed countries. Whilst the mass media provides wide coverage, documentation, and analysis, there is a general lack of public awareness regarding the seriousness of flood risk. For example, a survey conducted in England & Wales in 2008 reported that only 29% of people living in flood prone areas had checked to establish whether or not their insurance policy covered losses arising from flood damage.[3]

Given the risks flooding poses to human life, commodities, and the environment, Europe's objective of achieving sustainable development could be seriously affected – and the same applies to the *Lisbon objectives*[4] which the European Union set itself in the year 2000.

Rising risks due to Climate Change and socio-economic development

Climate is always changing, but a substantial change may come from the warming of the atmosphere.

It is anticipated to cause significant changes and variability in the average rainfall and temperature patterns and in their extremes. Wind and storm climate (extremes) may be affected as well. A changing climate will also affect sea level rise and coastal storm surge levels, and it increases the probability and severity of droughts.

A recent study by the British insurance industry[5], suggests increased flood risk is likely to be one of the most damaging impacts of climate change in Europe (cf. Stern Review 2006[6]). The study suggests that by the end of the century the costs of flooding in Europe could increase 10 – 20 fold to over € 100 billion each year if no action is taken, because of a combination of climate change and increased vulnerability.

Due to social and economic development, the potential for flood damage is increasing on many rivers both in mountainous areas (e.g. flash-floods) and valleys as well as in coastal areas. The total value of economic assets located within 500 metres of the European coastline, including beaches, agricultural land and industrial facilities, is currently estimated at € 500 to 1,000 billion.[7] In addition, we are experiencing increases in urban and pluvial flooding.

[1] Munich Re Group (2007): Topics Geo Annual review: Natural catastrophes 2006. Knowledge Series, Munich 2007.

[2] Press release available at http://www.ehs.unu.edu.

[3] Flood Awareness Campaign Tracking Survey 2007-2008, Report prepared for the Environment Agency, 2 July 2008.

[4] Strategic goal of the European Union to turn the Union into "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable growth with more and better jobs and greater social cohesion" (Lisbon European Council, 23 and 24 March 2000).

[5] „Financial risks of climate change", June 2005, Association of British Insurers, http://www.abi.org.uk/flooding.

[6] The Economics of Climate Change. The STERN REVIEW (2006), Cambridge University Press.

[7] Living with coastal erosion in Europe. Results from the EUrosion study, presented in 2004. Study available at http://www.eurosion.org/.

The increasing demand for land causes a tension for governments and policies, because of the loss of land for flood mitigation.

Humans have extensively modified the natural landscape, often amplifying the impacts of extreme weather events on communities and the environment. Agriculture and urban sprawl, with its associated development, impair the natural ability of the land to slow down, store, or dissipate flood water - which is considered as an important ecosystem service that benefits society. Reducing the natural resilience of the land and its capacity to recover from extreme events can lead to greater future impacts.

Settlements are extending more and more into historically known hazard zones. This will likely lead to increased damages from floods in the future. Increases in wealth and population in floodplains puts more property and possessions at risk from floods, and increases individual and societal vulnerability to flooding.

Land use planning has therefore become a strategic element in mitigating flood risk, but because of the multiple demands on land resources (by urbanisation, agriculture, infrastructure, energy, re-creational areas etc.) options to overcome the problem in terms of reducing the impact of floods on people and assets within a land use category or introducing compensation mechanisms between upstream riparian/downstream riparian communities are limited.

Increased risk of flooding and vulnerability will have a severe impact on well-being and population as well as on the economy. Beside the direct and indirect costs, which have to be covered by individuals and society, the challenge of coping with the secondary effects (short- and long-term impacts of a disaster on the overall economy and socio-economic conditions) will be one of the most important tasks in upcoming years in order to avoid significant impacts on long-term human and economic development.

In this context, reducing the vulnerability of existing buildings and infrastructure is also of great importance for a sustainable, future-oriented FRM approach.

Adapting to the impacts of climate change is integral to risk-management practice that will assist Europe's long term sustainability.

The European political dimension on flooding

National legislation and European directives underpin integrated FRM across Europe. In addition to EU Directives which are valid European-wide (e.g. Water Framework Directive, Habitats Directive, Floods Directive, SEA Directive etc), bi-lateral and multi-lateral agreements on the management of transboundary rivers, EU and national policies implementing Sustainable Development as well as national and regional spatial planning policies have been directly influencing the management of flood risk.

With the EU Floods Directive[8] - as part of a European Flood Action programme - Europe is seeking to minimise the risks of widespread flooding. By embracing an approach to sustainable and integrated water resources management, the European Commission's new directive builds on the Water Framework Directive[9] (WFD, the cornerstone of EU water protection policy). The Floods Directive proposes new measures to help EU Member States choose the right tools with which to reduce the likelihood of floods and limit their impacts. It aims to ensure cooperation in shared river basins and coastal areas in order to improve flood protection across Europe.

The WFD, adopted in 2000, was a response from the EC to the increasing demand by citizens and environmental organisations for cleaner rivers and lakes, groundwater and coastal beaches across Europe. The key objectives of the WFD include general protection of the aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources, and protection of bathing water on European level. All these objectives must be integrated for each river basin in EU Member States by 2015.

The implementation of the WFD raises a number of shared technical challenges for the Member States, the Commission, the Candidate and European Economic Area (EEA) Countries as well as stakeholders and Non-Governmental Organisations (NGOs). In addition, 80% of the European river basins are international, crossing administrative and territorial borders and, as such, a common understanding and approach is crucial to the

[8] **Directive 2007/60/EC on the assessment and management of flood risks.**

[9] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

successful and effective implementation of the Directive. Therefore the Member States, Norway and the Commission agreed on a Common Implementation Strategy (CIS) for the WFD in order to address the challenges in a co-operative and coordinated way. The CIS focus on a common understanding of the technical and scientific implications of the WFD. The aim is to clarify and develop, where appropriate, supporting technical and scientific information to assist in the practical implementation of the Directive. This is carried out in several Working Groups (under the umbrella of the national Water Directors), of which Working Group on Floods (Working Group F) is one. Working Group F aims to provide a platform for information exchange for the European Floods Action Programme and to support the implementation of the Flood Directive on the assessment and management of flood risks. One of the initial activities under Working Group F has been the development of expert, information exchange networks on best practice in flood forecasting and mapping.

The Strategic Environmental Assessment Directive[10] (SEA) aims to provide a high level of environmental protection and to contribute to the integration of environmental considerations in the preparation and adoption of plans and programmes promoting sustainable development in Europe. Water management issues, and especially extensive flood protection measures, that are likely to have significant effects and impacts on the environment, are covered by this EU Directive.

Achieving the strategic goals of a common European Policy is the responsibility of each, individual Member State. These strategic goals (Lisbon goal, 2000; Barcelona goal, 2002; and renewed Lisbon Strategy, 2005) will help Europe to become one of the most economically competitive regions in the world and to strengthen people's quality of life.

Sustainable development, environmental protection and delivery of multiple benefits

European policies are underpinned by the principles of sustainable development, where economic approaches are considered alongside measures to benefit the local environment and improve the quality of life. Sustainability is driven by finite characteristics of natural and human resources. Population growth, demand for land use, urbanisation, social awareness, health and safety imperatives and the development of new technologies have all been affecting sustainable development in Europe in the last decade. By implementing the goals of AGENDA 21 (Rio de Janeiro, 1992 and Johannesburg, 2002) with the EU strategy identified in Gothenburg (2001), Europe has taken an important step in tackling today's challenge in ensuring a sustainable response to flood hazard and climate change. As a consequence, sustainability is now an established fact, with discernible benefits for businesses, communities, and the natural environment across Europe.

Notably, the rising risk of flooding and increasing impacts of climate change will have harmful effects on sustainable development and negative long-term consequences on our quality of life and economic development. The challenge of sustainable FRM is to find the balance between flood control by physical structures and damage prevention by alternative means and options (e.g. planning, adaptation resilience, insurance, preparedness etc.) to alleviate floods of different magnitudes and sources. The ultimate goal of sustainable development requires a holistic view of management of flood risk, taking account of social and economic development and long-term change in the natural environment. Floods cannot be prevented completely, but an appropriate mix of protection, mitigation and adaptation strategies can be put in place to reduce their harmful effects.

Thus an integrated approach should be applied to all potential means of flood risk mitigation. This should identify policies, infrastructure and management methods that are technically feasible, economically and environmentally sound.

Understanding and assessing multiple benefits of FRM (like flood damage reduction, erosion control and sediment management, improved water quality and water supply, fish and wildlife habitat, habitat for endangered species, outdoor recreation etc.), or measures that support multiple user-functions of a water system and its surroundings are the key to a holistic FRM approach. This is especially critical in densely populated areas (not only deltas) where multiple requirements have to be satisfied in one go.

Traditional and uncoordinated protection strategies

From a historical perspective the European states have developed independent and successful strategies to improve the understanding of flood-

[10] European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment".

related risks. Over centuries, a suite of FRM approaches (technical and bio-engineering measures (so-called structural measures), as well as regulatory, economic, and informatory instruments (so-called non-structural measures) has been developed and adopted in flood-risk related areas.

However, as such protection strategies were mostly adapted to national needs, there has been little transnational coordination, which can lead to duplication and even conflicting approaches in the implementation of national protection strategies. Streams, rivers or coastal reaches do not respect national borders. As a consequence successful measures could be taken in an upper part of a river catchment, which just transfer the problem downstream (e.g. problems of sediment continuity caused by checkdams in upper reaches, which leads to erosion problems downstream etc.). This highlights the importance of coordination and harmonisation of measures for flood protection. About 80% of the large river catchments in Europe extend over several countries. Concerted strategies and measures at trans-national level would bring a considerable additional benefit and improve flood protection as a whole.

The flood events in the course of the past few years have shown repeatedly, that even complex and expensive protective measures cannot prevent extreme events. We need to accept that some floods will occur, but we can reduce their impacts by preparing and mitigating the consequences (which can be considered as a concept of "flood resilient communities").

As a first important step towards integrated FRM, the European Floods Directive is looking to improve national and cross-border flood protection through developing a consistent approach to risk assessment, mapping and response planning.

Increased public awareness of floods

As Europe gets wealthier, its populations voice their wish for preventive measures more loudly. People are now more sensitive to the risk posed by natural hazards, which is reinforced by world-wide reporting by the media and rising awareness of climate change. Due to more effective education and communication systems, the speed at which information is exchanged is increasing.

The media, conveying realistic details of such events or scenarios in their coverage, intentionally or unintentionally, also convey the failure of human efforts to ensure the quality of life of the affected population. The reasons for such failure are manifold, covering natural, political, administrative, technical, legal or individual cases.

But the public needs to get a better understanding of what the processes and likely impacts of floods can be and how they may be affected. This awareness-building process is a very important issue in the face of a rising risk of flooding and a key element of an integrated risk management approach (like in the past, as riparian inhabitants had a locally based historical awareness of floods because of the experience the people made with floods in the course of decades or centuries). This would help keeping the levels of both protection and risk awareness high and would avoid the loss of local knowledge because of migration effects due to frequent flood events.

But the media is also influencing the expectations of the public towards increased levels of flood protection as Europe becomes wealthier and therefore vulnerable. New risk management approaches and technical advances have opened up new opportunities in terms of protection, but this requires a re-evaluation of how to effectively manage flood risks as well as an improved awareness of wider societal issues.

Flood risk management as a financial factor

Flood protection measures in general require the public investment of considerable financial, material, and personal resources. Each year a tremendous amount of national financial allocation is needed to cover the costs both for new protection measures as well as the maintenance of existing structures. Considering the large number of existing flood protection measures across Europe and the state of repair of these structures, it is inevitable that the public sector, given budgetary constraints, will face challenges in meeting the financial commitments required to maintain the functionality of these structures over time.

Exploring and providing concepts in risk-based asset management and sustainable financing mechanisms are integral to enabling long-term operation and routine maintenance of flood protection systems. Furthermore, these will support national or regional authorities to continue their efforts in providing flood safety standards to their people and from their assets. There is also a need to investigate compensation mechanisms between upstream/downstream riparian communities, in

order to allow a well-balanced and benefit-oriented distribution of costs among flood-protection anticipating parties.

Uncertainties in the use of new and existing technologies

Managing the risk of flooding requires a broad-range of methodologies, technologies and practices. By using new - and of course existing - technologies e.g. to improve flood forecasting, it is now possible to forecast floods ahead of time and put measures in place to manage an incident. The simple presence of such technologies in areas of flood risk has increased public belief and trust in the role that technology can provide to reduce the risk of flooding.

Emerging technologies are characterised by unexplored scientific engineering and risk aspects in their practical use. This also applies to current flood forecasting and warning systems, which have several limitations, such as insufficient lead-time to provide accurate flood warnings, inadequate spatial and temporal resolution of the real-time rainfall observations and forecasts for flood producing storm and little integration of different sources of forecast information. Moreover their ability to consider the uncertainties in estimating and forecasting precipitation and flood discharges is very limited, their application at regional level is also limited and the costs of improving forecasting may be prohibitive. Besides the uncertainties in hydraulic loading of water defences (including storm-surge and wind-wave effects), one should not overlook the uncertainties in the actual strength of water defences, which often are at least as important. Cutting edge research is helping us to understand and evaluate the risks and opportunities presented by emerging technologies and approaches, e.g. probabilistic flood forecasting and warning.

Importance of education and bringing research into use

As societies have developed and knowledge about flood events has improved over the centuries, the task of engaging governments, communities and others to reduce risk and vulnerability of peoples living in Europe and more over the world has made variable progress. Over the last decade or more, there has been a movement towards a "culture of risk prevention", meaning that the focus of many protection strategies has moved from response and recovery towards prevention and mitigation.

Each disaster can be considered also as a new "window of opportunity" for the society advocating not only social, but also political and economic change. "Learning" from the past is a step towards preventing the same mistakes in the future. A little knowledge and a few precautionary measures can enormously increase the chances of people surviving a flood hazard or help them to place their possessions in a safe place. The key is education and advocating preparation in advance.

Education is essential for the use and uptake of research. Given the current shortage of trained staff in a number of flood-related science disciplines it is critical we encourage the development of a varied FRM skills base capable of addressing the technical elements of FRM and of building resilience in communities at risk from flooding.

Bringing flood-related research better into use – both on policy and practical level – is still subject to major discussion between academics, policy-makers, practitioners or end-users. Considering the importance FRM has for the public, research results do not just have to meet scientific requirements only, but must contribute to actively raising awareness amongst those bearing strategic responsibility for FRM. It is similarly important to ensure research effectively informs the work of practitioners and understanding amongst general public. At the moment, policy, practice and research work on different timescales and languages, and often use different routes when communicating their needs. This scenario can impede the effective implementation of research results into policy and practice and lead to duplication and misinterpretation of research findings.

Strengthening the link between academics, practitioners and policy-makers in flood risk research will help to optimise the output and outcome of research efforts and will also contribute to a new paradigm of risk prevention and mitigation.

Vision 2015 – Benefiting from common research goals

Supporting FRM policy and practice with research

The development and implementation of European and National policy must be based on a strong, scientific evidence base. The EC recognised the importance of European collaboration through its Framework Programme 6 and funding of European Research Area Networks (ERA-Net). ERA-Net networks have established platforms for information exchange, collaborative research and continue to encourage wide dissemination of research outputs with a view to achieving tangible benefits at a policy and practitioner level.

CRUE is the policy-responsive network for information exchange and research collaboration in FRM.

CRUEs **Vision 2015** is to provide a co-ordinated and comprehensive transnational evidence base on FRM issues to underpin the work of key national and European policy-makers. Research within this framework will address the river basin scale and take into account cross-sector approaches to integrated river and coastal management. CRUE will continue to provide a platform for research and policy networking and dialogue and promote the implementation of research into the range of FRM policies, processes and technologies.

CRUE will deliver this **Vision 2015** via three objectives (cf Figure 1):

Objective 1: To further integrate the European research area to support the implementation of national and European policies on FRM.

Objective 2: To develop evidence and innovation required to underpin sustainable FRM across Europe, reducing the potential for duplication of research effort.

Objective 3: To improve the integration of knowledge and to develop further the systematic exchange of information [horizontal and vertical] and good practice on flood management research.

With this Vision 2015 and its objectives, CRUE will enable evaluation of physical and engineering approaches alongside increased understanding of wider environmental processes and social and economic factors pertinent in FRM.

The CRUE network will utilise a range of initiatives to meet its objectives and endeavour to work with the EC to ensure optimal integration across FRM issues, as follows:

1. Science to Policy – National initiatives, European initiatives; EU Working Group F, CRUE snapshot report
2. Research Agenda, (Common calls, additional research funding through the EC (e.g. ERA-Net+), Lobby Programme Committee (via national contacts) and other EU funding instruments e.g. FP7, European Territorial Cooperation Objective, LIFE+.
3. Information Exchange – within CRUE (by CRUE Partners via CRUE meetings), National cascade of information from CRUE for Inter-ERA-Net (attending other meetings or joint 'related' ERA-Net activity, CRUISE, Website).

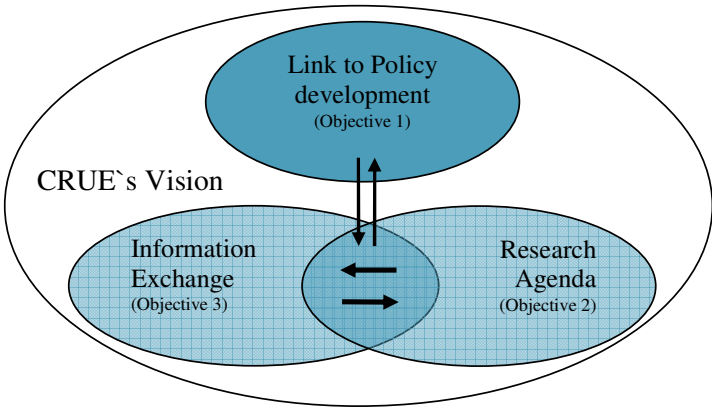


Figure 1: Illustration of the interdependency between CRUE's Vision 2015 and the three objectives to make the vision a reality.

The benefits of a joint Research Agenda

CRUE has established itself as an active network of research funders on FRM across 12 European Member States. In many cases, the research is funded by the Ministry or Agency responsible for flood management, and therefore has strong links to policy development.

The development of a joint, flood-related research agenda will help funding organisations use financial contributions to maximum advantage and guide researchers into areas of international interest and priority. Through better integration and collaboration, a focused and strategic approach to FRM research will reduce duplication of research across Europe and enable researchers to provide applicable and timely evidence and innovation for policy-makers and practitioners.

CRUE's Research Agenda will provide participating partners with the following added value:

- increased cooperation amongst policy makers across European countries
- increased integration between policy and research
- increased knowledge exchange for the implementation of the EU Floods Directive both on a policy and practical level
- reduced duplication and overlap and established common ground in research
- improved access to research programmes and initiatives from other European countries
- improved exchange and evaluation of practices and lessons learned
- increased potential for sharing data and common methodologies
- improved coordination of water-related research through clear articulation of needs (and what it available) in the water-related (flood) research area
- achieved value for money through sharing costs of research actions among several funding partners
- created wider links and promoted trans-disciplinary research in FRM

Identifying and monitoring benefits arising from CRUE network activities is important. A description of CRUE's intended approach to benefits management and realisation is included in Annex C.

CRUE`s Strategic Areas of Flood Risk Research

Research Scope

CRUE has identified five Strategic Research Areas (SRAs) to meet the major challenges European FRM faces:

- Developing resilience and adapting to increasing flood risks: climate change and new development
- Risk assessment and mapping
- Implementing trans-national based strategies on flood event management and recovery
- Meeting the multifunctional demands on flood prevention and protection and their sustainable management
- Addressing public knowledge of flood risk and enhancing awareness, perception and communications

Additional detail to each SRA can be found in Annex D. Research priorities will be assessed each year to enable joint funding initiatives and other research activities to align with European and National strategic requirements.

Strategic Research Area 1 - "Developing resilience and adapting to increasing flood risks: climate change and new development"

The overall aim of this SRA is to build and strengthen our capacity to manage flood risks effectively in response to climate change and economic development. Furthering our understanding of adaptation and resilience measures will underpin our ability to realise opportunities for building increasingly flood- and climate change-resilient communities across Europe.

Many of the impacts of climate change will be felt by changes in the water cycle and extreme weather. In Europe and around the world some impacts consistent with climate change are already being observed. There is broad scientific consensus that further change will occur. In terms of floods, projected changes in rainfall, sea level rise and more extreme weather events will increase the risks to sustainable development and the health and wellbeing of our society. These risks could be severe for Europe. Adaptation is required to deal with the likely impacts of climate change. It is a mechanism to manage risks, adjust economic activity to reduce vulnerability and to improve policy and business certainty.

To achieve future flood-resilient communities, it is essential to take an integrated approach – by considering a range of regulatory, social and economic responses. This includes tighter planning controls in floodplains, the role of insurance in spreading risk, improved information and maps on flood risk to inform and involve citizens, combined with better emergency preparedness and emergency management.

Strategic Research Area 2 - "Risk assessment and mapping"

The overall aim of this SRA is to support implementation of the Floods Directive by providing scientific evidence and approved tools in the area of risk and hazard assessment, mapping, and visualisation. This SRA has a strong link to *Article 6* of the EU Floods Directive.[11]

Assessing and mapping hazard and risk of floods for potentially endangered areas is still in its infancy. Typical outcomes of a risk assessment are the expected annual damage or a more detailed risk curve that shows the exceedance probabilities and corresponding losses for different events. Hazard maps portray the likelihood of flood occurrence or zones of "flood hazard". Such maps do not take into account vulnerability aspects. Flood risk maps portray the likelihood of occurrence or zones of "risk", which are determined by the "hazard" and the "vulnerability" of the population, infrastructure, and environment.

Risk as well as hazard maps are extremely useful, however methodologies and data vary on basin scale (e.g. torrent or river branches) and over regional or

[11] EU Floods Directive (2007/60/EC), chapter III „Flood Hazard Maps and Flood Risk Maps".

national scale. Although "EXCIMAP" initially evaluated this issue, there is a general need across Member States to be supported in the development and public evaluation of such maps.

Flood risk maps are key in identifying which areas are most at risk and will help professionals to plan for and to tackle flood risks head on. In some European countries (e.g. Austria, England, France, Italy, Scotland, The Netherlands) flood risk maps are currently in use, in many other countries there is a vital need to develop such maps for the first time. CRUE is keen to support Member States in the preparation of hazard and risk maps by providing and sharing strong evidence on common hazard and risk mapping approaches.

In addition to flood risk mapping, there are a range of issues that would benefit from European collaboration and sharing of good practice, tools and techniques. For example, there is a need to improve linkages across Europe on risk based, broad scale modelling and also to understand the effectiveness of a range of measures in the FRM toolkit.

Strategic Research Area 3 - *"Implementing trans-national based strategies for flood event management and recovery"*

The overall aim of this SRA is to improve transnational based modelling (e.g. existing flood forecasting systems with a trans-boundary focus), a better data exchange, and to introduce structure on international crisis communication and responsibility issues.

Effective flood event management and recovery are major elements in an integrated FRM approach. Flood event management is a complex process among different policy areas, stakeholders, information sources and operating systems. The efficiency of regional/national operating teams is limited especially in the case of huge flood events, because of limited technical systems, infrastructure, personnel or crisis communication tools. In this case, international relief can be of great importance to support regional/national operating teams in delivery of effective flood event management. Besides the latter, trans-boundary data exchange, common modelling tools and coordinated trans-boundary emergency actions (requiring good trans-boundary co-operation) are at least as important for successful trans-boundary flood-event management.

Strategic Research Area 4 - *"Meeting multiple demands on flood prevention and protection and their sustainable management"*

The overall aim of this SRA is to provide FRM policy makers and practitioners with sound, scientific evidence to underpin sustainable asset management. Tackled at a number of levels, this SRA will support the development of wider strategies and interconnected approaches to sustainable asset management across Europe. It will further knowledge and understanding on how best to tackle multiple demands on flood prevention and protection measures and it will champion the need to develop our understanding and application of good practice to whole life cycle assessment and management of assets.

The scientific, legal and technical issues underpinning flood protection strategies have undergone considerable change during the past few years. With the increase in environmental consciousness, the demands on flood protection have also become more stringent. Public awareness of floods is increasing and the expectations of the public are changing towards increased levels of flood protection as Europe becomes wealthier and therefore more vulnerable.

Future FRM strategies must be able to take into account uncertainties, risks and opportunities under different social, environmental and economical scenarios and must address multiple (sometimes conflicting) requirements, like safety, nature, economic, agriculture, living, recreation, transport by both road and waterways, and the various legal requirements related to these topics.

Strategic Research Area 5 – *"Addressing public knowledge of flood risk and enhancing awareness, perception and communications"*

The overall aim of this SRA is to examine people's awareness and perception of flood risk and how this perception affects FRM and, specifically, flood event management. We are keen to further develop understanding of how perception may be changed and how this may impact awareness and response by both individuals and society. This SRA has a strong link to *Article 9 and 10* of the EU Floods Directive.[12]

[12] EU Floods Directive (2007/60/EC), chapter V „Coordination with Directive 2000/60/EC, Public Information and Consultation".

Flood risk awareness and perception amongst the public is critical for the sustainable development of flood protection strategies. Many actions have addressed these issues in the last few years and there is recognised progress towards a "living with flood risk" culture. However, people still need a better understanding of what the likely impacts of flooding can be and how they may be affected. This awareness-building process has to be considered as a very important issue in the face of a rising risk of flooding.

Turning tomorrow's Vision into Reality – Implementation of CRUE's Research Agenda

Using science to make a difference

Research is key to help us live with flood risk in a changing climate and environment. We can never entirely eliminate flood and coastal erosion risk, but we can seek to manage it effectively and in a sustainable way. Well defined SRAs will serve as an instrument to implement CRUE ERA-Net's "Vision 2015" in a European and national context. This Agenda is intended to support both key policymakers and FRM practitioners throughout Europe and could also add value internationally. It will help them develop appropriate and sustainable policies to manage flood risk, by coordinating and focusing research activities and by stimulating research amongst all stakeholders involved.

The essence of the Agenda is to establish long-term research objectives, and to organise, implement and evaluate research actions that correspond both with European and national policy developments. It enables the long-term vision of establishing CRUE as a powerful network of flood-related research funders and expertise. The Agenda intends to bridge any gaps between the natural and technical sciences, engineering, and governance, economics and social sciences.

CRUE's Research Agenda addresses the full spectrum of research, from basic to applied research through effective demonstration to successful piloting and implementation strategies and will include efficient and effective dissemination, communication, and networking issues to strengthen the link between academics, practitioners and policy-makers. To provide appropriate and timely contributions to a science-based European evidence base on FRM, a stepwise and flexible approach is proposed. Such exchanges of ideas, methodologies and successful approaches in FRM will be facilitated through the implementation of CRUE's Research Agenda.

Implementation principles for CRUE's Research Agenda

The implementation of this Agenda will utilise the tools and the solid networking foundation developed between Partners and with stakeholders in the European Commission during the Framework Programme 6 CRUE ERA-Net project[13]. Success of the CRUE Network going forward will depend on the continued use of these relationships and tools.

Management Structure & Processes

The CRUE Research Agenda will be monitored and adjusted, if required, by the CRUE Board. The network will be led by a Lead Partner who will chair the CRUE Board. The Lead Partner, together with the Work Package Leaders and co-leaders (if required) will manage the implementation of the Research Agenda (see Annex A for a full description of roles and responsibilities). Through its activities CRUE will maintain strong links with the European Commission, national stakeholders and continue its wider, international collaboration.

Workshops, symposia and special sessions at major conferences will continue to be important for fostering collaboration and enabling the successful implementation of CRUE's Research Agenda.

Deliverables & Milestones

As a minimum, CRUE`s Research Agenda will provide the following deliverables at least as direct outcomes of the implemented Research Agenda (excluding the deliverables resulted from the research commissioned):

- Annual CRUE "Snapshot" publication highlighting key research outputs and associated policy implications across Europe.
- Increased accessibility of research outputs from CRUE joint research initiatives (synthesis reports for policy-

[13] Contract No. ERAC-CT-2004-515742

makers and stakeholders, suggestions for practical implementation etc.).
- Increased accessibility of up-to-date information on FRM research projects and programmes via the CRUISE database[14] and the CRUE website[15].
- Facilitate workshops/symposia in response to scientific community and stakeholder needs, e.g. highlighting significant research findings and implications for FRM policy and practice.
- Common protocols and standards for data management to ensure quality and comparability of research outputs across SRAs.
- Dissemination initiatives & promotional materials such as press releases and articles in the print as well as meeting and conference reports.

Stakeholder Engagement & Communications

Strategic approach to communications

Successful FRM requires all stakeholders to fulfil their respective roles successfully. These stakeholders cover a broad spectrum from the government, to administration, FRM practitioners, NGO's, scientific community as well as the public.

The CRUE Communication Strategy (cf Annex B) sets out an approach for direct and indirect communication between the Partner network team and its stakeholders. It outlines the principles that govern communication activities, and proposes options that meet the requirements of the range of FRM stakeholders. Stakeholder involvement in the implementation of CRUE's Research Agenda is critical and, accordingly, considerable emphasis is given to the distribution and discussion of research results with stakeholders via workshops and events

Ensuring uptake of jointly funded research

CRUE will provide each research project or initiative within the Research Agenda with an appropriate framework for communication and dissemination as well as an implementation plan for utilising the knowledge gained early on in project development (cf. Communications Strategy, Annex B). The dissemination plan will outline the objectives of the research, where the outputs should be targeted, and what specific communication or dissemination approaches may be required (e.g. workshop, article in trade magazine, press notice, key recipients of interim/final reports). The implementation plan will focus on those areas where the research output will contribute to.

General information about each research project or initiative within the SRAs is held on the CRUE website. Project information in detail is available to the public via CRUISE. Via CRUISE, Partners will also ensure that research gaps are constantly kept under review and that national research will regularly inform any developments to the Research Agenda.

Monitoring & Evaluation

The evaluation of the progress in implementing CRUE's Research Agenda is the primary task of the CRUE Board, with support of the Advisory Groups (from both policy and science perspective).

It will be important to develop metrics of performance that provide the CRUE Board with some indication of the Agenda's impact. The following are proposed as valuable indicators of performance showing the impact of CRUE's Research Agenda:

- Maintained credibility as a valuable advisor to European and national FRM policy & research strategies.
- Evidence of uptake & application of jointly funded research outputs in FRM policies and practices on a European and a national level.
- Increased CRUE Network membership as an indication of added value derived.
- Successful partnerships with other policy areas, including leverage of funds to implement the Research Agenda from other sources and nations.
- Number and quality of peer-reviewed publications arising from joint funding initiatives ("Common Calls").
- Number of articles in the popular press as well as website hits and CRUISE access.
- Attendance at CRUE workshops and forums held, and reports produced.
- The ratio of the CRUE research funds to the National and Regional FRM research funds.
- The percentage of national and regional research agenda's for which the CRUE output is explicitly mentioned as a cornerstone.

[14] http://www.crue-eranet.net/cruise.asp

[15] http://www.crue-eranet.net

An outline framework for monitoring and evaluating the benefits from the CRUE network is suggested in Annex C.

Annexes

Annex A

CRUE Network Management - Organisational structure underpinning implementation of the Research Agenda

Figure 2 and Table 1 gives an overview of the intended organisational structure for the CRUE network. The structure is designed to enable the CRUE network to effectively reflect interests of the different stakeholders from the EC, national policy-makers, national research funding bodies, Water Authorities, the research community and FRM practitioners.

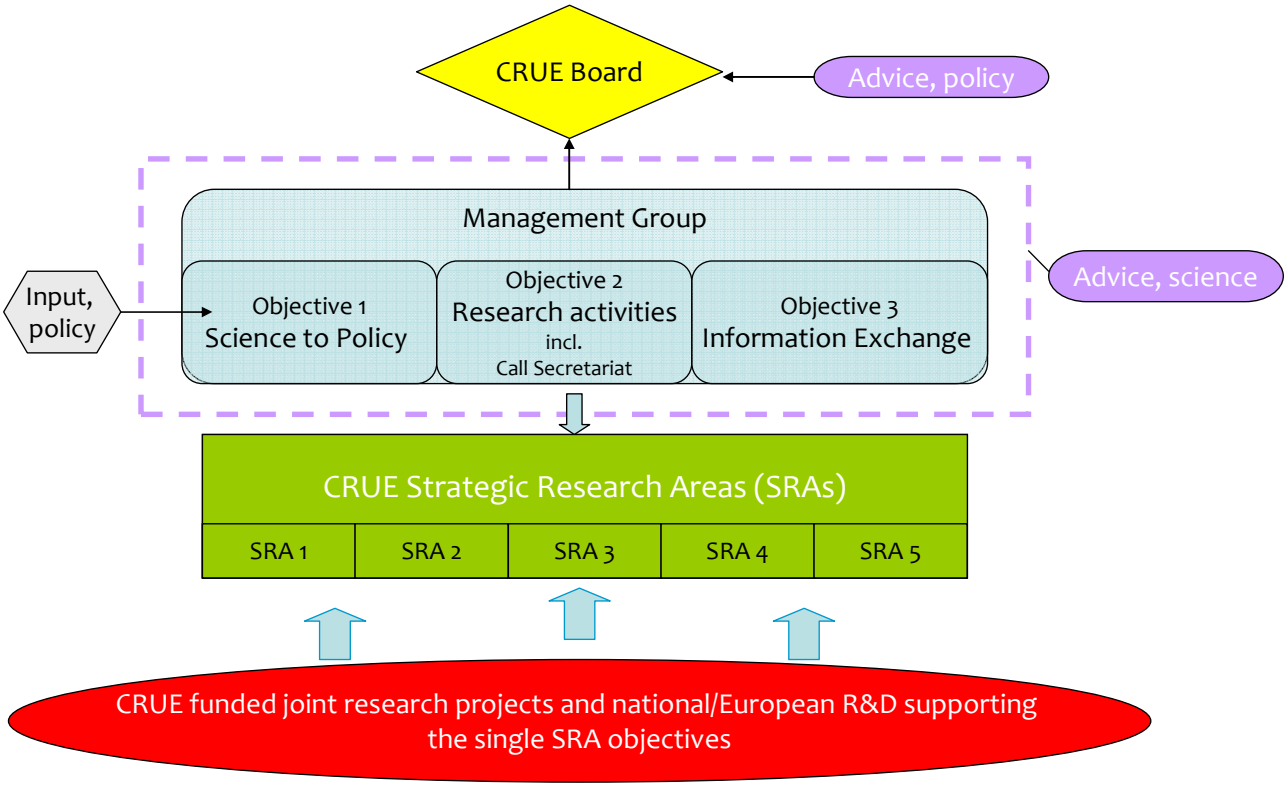


Figure 2: Organisational structure to implement the Research Agenda

CRUE Board

The CRUE Board is responsible for achieving the aims and objectives of the Research Agenda and guiding the development and implementation of CRUE`s research agenda. Each CRUE Network Member as well as a Member of the EC (DG Environment/DG Research) has a seat on this Board. The respective Member of the EC should facilitate links to relevant parties in the Commission. The Board will meet once a year. In order to sit on the CRUE Board, Partners will be required to sign the Co-operation Agreement for CRUE Network. Guests may be invited to attend all or part of Board meetings.

The CRUE Board will receive recommendations and proposals from the Work Package Leaders (see below). Since it is composed of governmental organisations, it will have the national empowerment to agree to joint funding of calls for research, as developed in the FP6 funded project and the Research Agenda.

As set out in the Co-operation Agreement for CRUE Network, the main roles and responsibilities of the CRUE Board are to:

a. Set the overall direction and guide future coverage of the Research Agenda and to ensure that the network remains a "policy-responsive network for information exchange and research collaboration".
b. Champion the CRUE research agenda and implementation of its outputs within Europe and nationally (vertical information exchange).

c. Agree and approve the key science messages to be communicated to the European Commission.
d. Ensure that network and research outputs are accompanied by appropriate and planned dissemination and communications activities, so as to maximise the impact of R&D in practice or innovation.
e. Identify and share news of developments in national FRM-related policies and research programmes at CRUE Board meetings. This includes the horizontal exchange/sharing of knowledge and information, within and on the fringes of the thematic area.
f. Monitor annually the effectiveness of the network and approve the publication of an interim 'review' report after two years of operation.
g. Agree any modifications to the handling of joint research initiatives.
h. Members will provide a 'national' contribution to the "CRUE snapshot" publication. The Board will review and approve the annual snapshot publication.
i. Discuss and agree, as appropriate, any proposed changes to the management of the network.
j. One of the regular tasks of the Board will be to monitor the degree of collaboration within the network to ensure that the project partnership operates in a fully inclusive manner.

Advisory Groups

One, virtual, independent Scientific Advisory Group will be formed in association with each separate joint funding initiative, "common call". It will address the quality of the science, and will provide peer review and evaluation of the call and its outcomes. Roles and responsibilities associated with each call are specified in a "Call Arrangement" (as laid down in CRUE's Co-operation Agreement, Schedule 2). Independent advice will be requested to support the CRUE Board in the technical aspects of development of the Research Agenda, this will be facilitated via invitation to symposiums. This latter advice is likely to fall into the following areas:

- Advise on overall priorities and research areas.
- Advise on gaps not covered that should be addressed.
- Identify longer-term issues to be investigated from horizon scanning.
- Advise on research being carried out externally to the ERA-Net and identify possible external linkages or synergy.
- Review ERA-Net outputs and effective dissemination and communication of them.

Network partners will nominate advisors to fulfil the above role, it is expected that such advisors will be selected on the basis of their:

- Ability to contribute to the development of the research agenda by bringing appropriate personal knowledge and expertise.
- Awareness of the latest research and/or operational developments within their field and the potential for R&D to contribute to improvements in knowledge.
- Willingness to provide an independent viewpoint from either a researcher's or a user's perspective.

Strategic policy advice (Policy Advisory Group) will be gathered through annual meetings, as required. Such personnel may include members of other ERA-Nets or other European Groups such as EU-FD or EU-WFD. Representatives will be asked to advise CRUE on overall European/global policies and strategies, ranging from research and development in other water-relevant policy areas, or implementation needs to link up with other areas of work. For instance the EC Working Group on Floods (WG F) (represented by a delegated representative) is considered as one major advisor on CRUE's Research Agenda in terms of implementing the EU-FD.

CRUE also seeks wider collaboration and information exchange with the EC's Framework Programme 7 and other "water and climate"-relevant ERA-Nets, like CIRCLE, IWRM.net, SNOWMAN, SPLASH, or SKEP. This approach allows better co-ordination of research areas and topics that are of common interest to the funding organisations involved.

Management Group

The Management Group co-ordinates the implementation and delivery of the CRUE Research Agenda.

a) CRUE Lead Partner

The Lead Partner will be the Partner that coordinates the activities of the CRUE network (Secretariat-Management). Main role and responsibilities of the Lead Partner are:

- Chair the CRUE Board.
- Lead the administration and internal discussion of the Network, including meeting organisation.

- Maintain the effective cooperation of all partners in the network.
- Monitor the effectiveness of the Co-operation Agreement.
- Chair the Management Group, and report to the CRUE Board on the development and delivery of the Research Agenda. This working group will secure and allocate resources, if applicable, between the Work Packages, manage links between Work Packages, and resolve disputes.
- The Lead Partner will assemble and scrutinise any network proposals and plans prior to submission to the CRUE Board for approval.
- Assist Work Package Leaders with any problem solving requirements or assistance with communication.
- Maintain a Risk register.

b) Work Package Leaders

Work Package Leaders will be appointed to manage each network Work Package (as set out under CRUE Vision 2015) and will be elected by the CRUE Board. Work Package leaders will develop a proposed programme of work for the duration of the Research Agenda. They will be able to manage the work as they require, they may choose to do so with the assistance of a co-lead Partner from a different Partner country.

Main role and responsibilities of the Work Package Leaders are:

- Champion the objective.
- Lead on communications with relevant areas of the European Research Area and other thematic areas.
- Manage (co-ordination, execution, monitoring and reporting of that specific work package) the delivery of agreed programme of work defined at the start of the Research agenda for the appropriate objective.
- To provide key messages (Science or general) to the Lead Partner.
- Work with the other Work Package Leaders to deliver the programme of work.
- To formulate proposals to the timeframes requested by the Lead Partner.
- Deliver a Work Package report to the annual CRUE Board.
- Provide the Lead Partner with an interim Work Package report at the end of their term.

The Secretariat-Call has to manage activities required for the implementation of common calls. Such tasks include activities such as common call preparation, announcement and proposal/project management, review of progress on the single SRAs, and disseminating, communicating, and monitoring of the single joint research actions. These tasks are defined in further detail in the CRUE Co-operation Agreement, Schedule 2 and Call Arrangement.

The term "Joint projects/actions" is used to describe all collaborative actions that have emerged from CRUE Network activity. It also considers other national/European/ worldwide research where it contributes to the CRUE`s SRAs.

Table 1: Summary of management activities related to the implementation of CRUE's Research Agenda

Function		Network Work packages		
		Science to Policy (WP1)	Research agenda (WP2)	Information Exchange (WP3)
CRUE Board	Overall governance and steerage of CRUE			
Lead Partner (Secretariat-Management)		Oversees the integration of the three Work Packages and coordinates the management of work. Works with WPLdrs to ensure that CRUE is represented at appropriate EC meetings and steer the discussion with other water-relevant ERA-Nets on a future "Water-Management ERA-Net".		
Work Package Leaders	WLdrs 1 and 2 will manage the CRUE advice needs, they will have to maintain communication and co-operation. This approach will support CRUE's aim of linking Policy, Science and Practice in a better way.	Represent CRUE in EC policy fora (WGF, DG Env)	Represent CRUE in EC science fora (DG Res)	Represent CRUE in EC services fora (DG Env/Res, JRC). Also represent CRUE in any network management context e.g. Water ERA-Net developments

Function		Network Work packages		
		Science to Policy (WP1)	Research agenda (WP2)	Information Exchange (WP3)
Policy and Scientific Advisory Groups		EC links via WG F and/or attendance at CRUE events	Via common call and invitation to symposia that will focus on the delivery and development of the Research Agenda	Possible synergies/advice from CIRCA or EC (DG Env) Comms representatives
Secretariat – Calls (Lead: Work Package Leader 2)	Functions co-operate under the leadership of the Work Package Leaders for effective communication and dissemination		Call web pages Call science co-ordination Call key messages Call input to research agenda development Call synthesis report *Elaborating ways in which knowledge gained from the single research actions is put into use and is responsible for the evaluation of such activities or practical examples. As such this might help influence other EC funding instruments such as the European Territorial Cooperation Objective.*	

Outline Programme of Work

This provides an outline of intended activity and will be further developed by the respective Work Package Leaders from November 2009.

Objective 1: To further integrate the European research area to support the implementation of national and European policies on FRM.	*Previously covered by CRUE's Work Packages 1 and 4*
Description • **Link to policy**. i. Communication of outputs of CRUE and national research programmes to EC policy development teams ii. Conduit for communicating new research and its application and relevance to policy and action on FRM • **Influence**: Role in influencing the research agenda of other national, European (FP7 and beyond) and international programmes.	
Work Package Leader Resource: 20 days/ annum	
Activities 1. CRUE are an active member of Working Group F (WorkProgramme07-09). This will be maintained through until the completion of the programme. **Tool:** CRUE to have a representative at each meeting. 2. Provide a vehicle for informing EC and Member States (MS) of new evidence in relation to existing and proposed FRM policy. **Tool:** The CRUE annual snapshot publication, illustrating Science to Policy links. 3. CRUE nominee(s) represent research needs in a variety of fora, both vertically within Europe and horizontally through engagement with related research areas. 4. Each Partner will agree to pass up the chain any requirements stated in the research agenda that are relevant to the FP7 'basic-applied' research agenda, i.e. Lobbying DG Research, via National Environment Programme Committee representatives, to support long-term basic research through the Framework Programmes.	

Options to ensure delivery

5. Develop connections between CRUE and National [Water Directors] policy-makers; CRUE representatives to establish national links with their country representatives [this may assist with continuity once the work programme of WG F is completed]
6. Exchange Circle workshops
7. Develop scientific connections to related policy area ERA-Nets [Link to Obj3]
8. Potential Draft mandate for Expert panel within EC Common Implementation Strategy

Tools: Website and Partner vertical and horizontal exchange of information

Objective 2: To develop evidence and innovation required to underpin sustainable FRM across Europe, reducing the potential for duplication of research effort.	*Previously covered by CRUE's Work Packages 3, 5, 6 & 7.*

Description

- *Research:* Implementation of an agreed programme of research on FRM, with links to related thematic areas.
- The network may decide to submit applications for other sources of funding.

Work Package Leader Resource: 30 days/annum

Activities

1. Completion of the second common call, including the production of draft key policy messages arising from the call. Lead on any further calls.
2. Scientific review and evaluation of the Research Agenda (Implementation of the Research Agenda)
3. Support an ERA-Net + bid if Partners require. Additional resource would be required from participating Partners.

Options to ensure delivery

4. Develop links to other related ERA-Net Research agendas and calls.
5. This can be achieved by attending other ERA-Net meetings or inviting them to CRUE ones, however there are many meetings and so it would be useful to utilise the programmes of other ERA-Nets and plan activity to maximize effectiveness.
6. Monitor any other transnational research activity that arises from network activity. Use research to evaluate progress made in SRAs.

Tools: Website, CRUISE, Call Secretariat

Objective 3: To improve the integration of knowledge and to develop further the systematic exchange of information (horizontal and vertical) and good practice on flood management research.	*Previously covered by CRUE's Work Packages 1, 2 & 8.*

Description

- Information exchange: Sharing knowledge across the network and other interested Parties, via Network Partners. Network Partners cascade information nationally.
- Information management: maintain tool(s) to evaluate research activities in Europe and around the world and to identify research needs and gaps.

Work Package Leader Resource: 32 days/ annum

Activities

1. Use website and research publications to obtain visibility amongst policy community
2. Use the CRUE website as a focal point for information on research of CRUE and others (national, European and international).
3. Establish a network of well-informed partners who can act as "champions" of research in their own country (Work with Lead Partner to keep all informed).
4. Maintain CRUISE as a functional database of national, European and international research programmes and projects. [Evaluate the purpose and function of the tool; (i) as a single access point to research, (ii) evaluation, and (iii) gap

analysis - by the end of the current contract].
5. Collaborate with FRM related ERA-Nets to gain the benefits of a larger critical mass with common organisations, stakeholders and national reporting chains. • Exploring links to other ERA-Nets • Exploring the integration of related ERA-Net websites • Seek to co-host website with other related ERA-Nets, if no 'industrial' Partner applicable. • Look at the potential to link up with other ERA-Nets to investigate whether an alternative framework for the related ENV ERA-Nets will attract EC funding?
Options to ensure delivery 6. Potential to develop via the EC ERAWATCH project a 'permanent host for CRUISE (Lobby EC representatives and Feedback to EC developers, or find viable alternative) 7. WISE-RTD will link to research information, accessible from CRUISE (not before 2010). E-comms with relevant project leaders. 8. 6 monthly e-news (prepare and agree messages with Lead Partner and WPLdrs).
Tools: Website, CRUISE

Annex B

Communications Strategy and Stakeholder management

Introduction

CRUE's Communication Strategy sets out an approach for communication between the CRUE partners and stakeholders, direct and indirect, throughout the implementation of CRUE's Research Agenda. It outlines the principles that govern communication activities, and proposes options that meet the requirements of the various stakeholders. The purpose of the Strategy is to ensure that a clear and consistent message is shared not only within CRUE, but also when communicating externally to a broad range of other stakeholders. It will be updated from time to time as required while implementing the Research Agenda.

Communication Objectives

- Raise awareness that FRM research requires international coordination and integration because of the cross-border nature of many flood events.
- Increase the perception that collaborative research strategies, rather than individual ones, are more likely to lead to greater benefits for funding bodies, FRM authorities and communities, and can underpin European-wide directives.
- Emphasise the value of real-time information exchange and the longer term benefits of data exchange and information sharing.
- Encourage CRUE partner-focused activities.
- Conduct research community-focused activities to promote the availability of information, and encourage the exchange of data, knowledge and experience.
- Encourage communications to increase public awareness and understanding.
- Maintain a contact with each partner's domestic research community, practitioners and users.
- Reinforce the relationship with the EC representatives.
- Promote the network in order to attract additional partners, gain recognition and increase existing status with external bodies.
- Undertake careful and appropriate targeting of reports, deliverables and research outputs.
- Broaden the methods and routes by which CRUE can gain exposure within Europe and globally.

Communication principles

When dealing with a diverse multicultural group of collaborators and stakeholders, separated by distance, there are some basic principles which will be adopted by all to help facilitate good communication. These include, but are not limited to:

- Identifying and removing communication barriers between international partners which can include differences in language, culture and protocol. Since the CRUE network was created there have been changes in personnel, and additional partners have joined, and it is likely that not everyone has become acquainted with the full team. It is important, therefore, that during the lifetime of the network any barriers are identified and addressed in order to preserve mutual respect and ensure clear and unambiguous communication.
- Ensuring that communication is a two-way process and that personal communication is used wherever and whenever possible.
- Showing an interest in, and an understanding of, the background, experiences, and expectations of partners and being sensitive to their particular concerns or limitations.
- Establishing an open information policy within the network so that partners have equal access rights.
- Producing accurate, up to date and user-friendly network documents, reports, guidelines and products, for which English will be the primary language adopted. The use of Plain English guides will help to simplify language and minimise the use of confusing or ambiguous regional jargon.
- Establishing a strong identity for network presentations and outputs.

Stakeholders

The following is a list of primary stakeholders and is not meant to be comprehensive. CRUE will target communications at the broad European scale whilst it remains the responsibility of individual partners to ensure that information reaches relevant secondary stakeholders within their own countries.

- Policy makers: i.e. central government departments directly responsible for flood and water management research as well as those with an associated interest (e.g. climate change (sea-level rise), marine environment (coastal processes), fisheries (effects on spawning, migration, habitat), farming (land use), social sciences (effects on communities, health)).
- CRUE network partners.
- EC representatives.
- Representatives of EC, EU and national working groups.
- Other countries/organisations (i.e. potential partners) who have not joined CRUE yet.
- European NGO's (charities, pressure groups).
- European Insurance Industry.
- Other ERA-Nets.
- European Media (press, scientific press, websites).
- Scientific community.
- Private sector (like water companies, energy industry, consultancies etc.).
- Public – pressure groups, local interest groups, support groups and general interest.

Communication routes

CRUE currently uses the following priority tools for communicating to/with external stakeholders:

- Word of mouth/personal contact – CRUE partners acting as ambassadors (e.g. participation in bi-lateral and multi-lateral meetings).
- CRUE Website – including higher profile publications page.
- Partner websites.
- CRUE snapshot.
- Synthesis report.
- E-newsletters.
- CRUISE.
- Leaflets.
- Posters.
- Conferences stands (EU and national).
- Conference papers/presentations.
- Workshops and Seminars.
- Articles in trade and popular press, both European and National.

Annex C

CRUE's approach to benefits monitoring and evaluation concerning the CRUE Network and research activities

Across Europe, research underpins our policy and operational work and contributes to improving the way we manage flood risks. The CRUE Network has been set up to facilitate the sharing of knowledge and information and to increase co-operation and collaboration across Europe. It is important to each CRUE Partner to identify, monitor and effectively measure benefits arising from participation and development of the Network.

The framework for identifying and monitoring CRUE network benefits is outlined below. The Lead Partner (working with the Work Package Leaders) has scope to finesse and review the approach to benefits monitoring and reporting as required. It is anticipated that an annual review of benefits will be delivered to the CRUE Board.

Defining a road map for CRUE

A 'benefits road map' to show how initiatives of the CRUE network combine to deliver outcomes is shown in Figure 3 below. The 'benefits roadmap' is simply a diagrammatic view of initiatives and outcomes of the CRUE network. Initiatives and outcomes flow from left to right and culminate in the achievement of two key, strategic outcomes:

1. EU research area strengthened and led by CRUE flood –related research.
2. Optimised return on public investment in FRM policy development & implementation.

Four outcomes contribute to the delivery of these core objectives, these are supported by a number of CRUE network and research initiatives:

1. Increased understanding of holistic FRM driven by CRUE research agenda.
2. Created a robust, transnational evidence base for use in policy development and implementation.
3. Decreased duplication of FRM research through CRUE knowledge integration and information exchange.
4. Maintained credibility as valuable advisors to FRM policy- and decision-makers across Europe.

CRUE network and research initiatives:

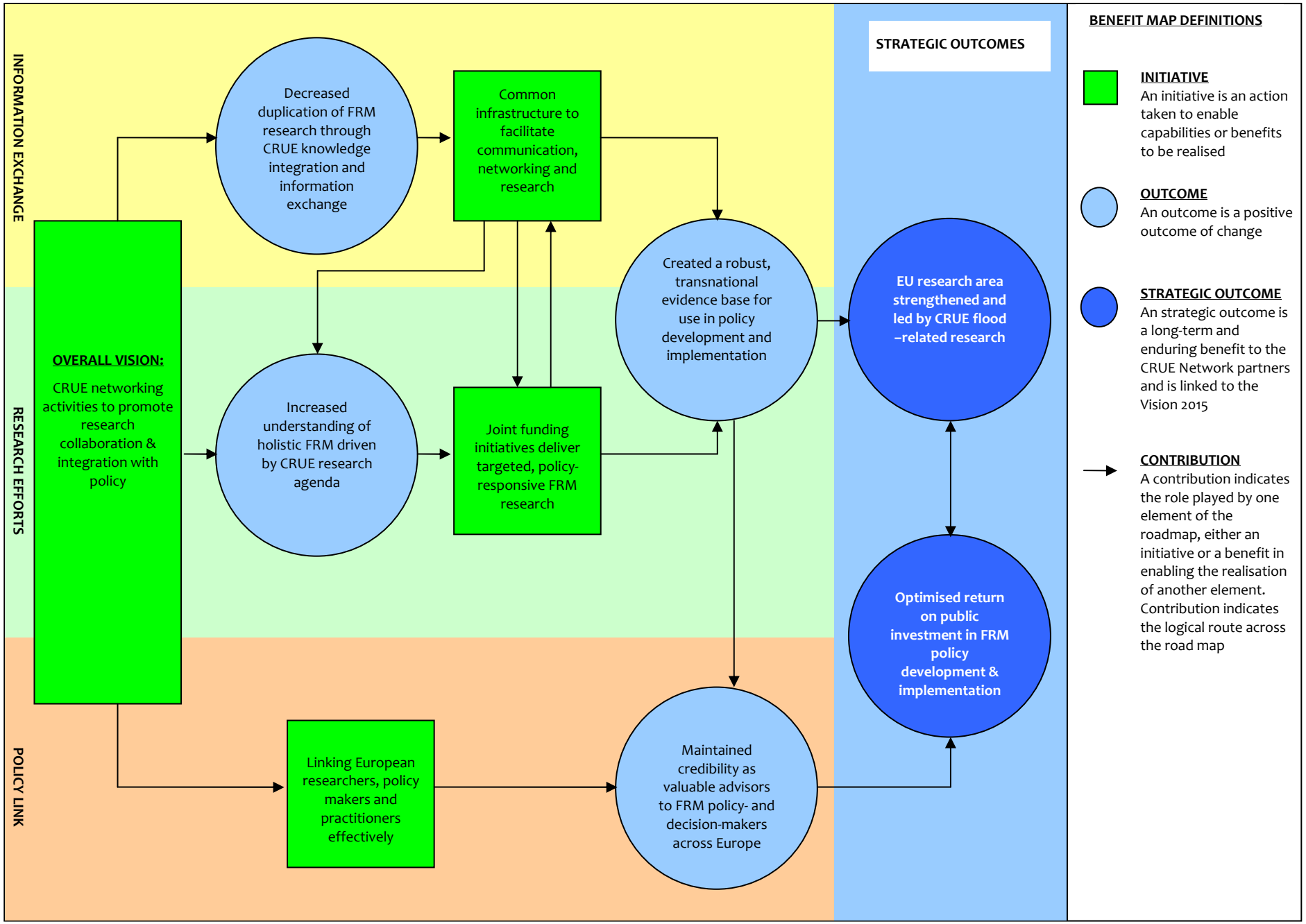
- Networking activities to promote research collaboration and integration with policy.
- Common infrastructure to facilitate communication, networking and research dissemination (e.g. CRUISE and CRUE website). Supports analysis of gaps and opportunities to inform CRUE's Research Agenda.
- Joint funding initiatives deliver targeted, policy-responsive FRM research.
- Linking European researchers, policy makers and practitioners effectively.

The 'benefits roadmap' identifies the path to follow and the steps to take to realise the expected benefits from the CRUE network. Against selected outcomes (or benefits) identified, the CRUE Board will agree a 'benefits realisation plan' which provides the outline framework for monitoring benefits of the CRUE network and its research activities. This sets out what will happen, when the benefits will occur, what will be measured to demonstrate successful delivery and who will benefit (e.g. key stakeholder).

It is acknowledged that some benefits associated with the CRUE network and its activities are difficult to quantify. The annual report to the CRUE Board will need to consider how best to represent these wider benefits derived from CRUE network involvement and development. It is suggested that development of the CRUE website could effectively facilitate collation of benefits information and could be explored by the Management Group in due course.

It is also recognised that national funders of joint research initiatives may have their own mechanisms in place to monitor the impact of collaborative research activities. All Partners will provide information to the annual benefits review to enable the value of the CRUE network to be effectively evaluated.

Figure 3: CRUE's benefit roadmap



Evaluating the effectiveness of the CRUE network

Effective implementation of CRUE's Research Agenda will enable the achievement of the two, strategic objectives articulated in the 'benefits roadmap',

1. EU research area strengthened and led by CRUE flood-related research.
2. Optimised return on public investment in FRM policy development & implementation.

Meaningful benefits management of any programme of work ensures a systematic and measured process is put in place to ensure optimal delivery. Evaluating individual activities carried out by the CRUE team, the researchers participating in joint funding initiatives and the policy-makers/ practitioners using the research outputs should be considered in the context of the overall network framework. Forming the basis of a 'benefits realisation plan', recent work by Partners[16], suggests that six criteria (qualitative and quantitative) can be useful in considering whether outcomes (or benefits) have been achieved:

1. Relevance
2. Coherence
3. Effectiveness
4. Efficiency
5. Utility
6. Durability

Each of the above criteria could be considered against CRUE outcomes described and used to structure the annual benefit report to the CRUE Board. It will be for the CRUE Board to decide how best to execute this, suggestions for criteria against contributing outcomes include:

1. Increased understanding of holistic FRM driven by CRUE research agenda

The CRUE Research Agenda drives delivery of timely and targeted FRM research as research funders agree to collaborate on issues identified under the five SRAs.

The number, type and membership of Joint Funding initiatives could provide a useful indicator of how relevant the CRUE Research Agenda is in supporting both European and National FRM stakeholders. Comment from policy makers on the outputs of CRUE research would also serve as an indicator of relevance and research coherence. The effectiveness with which Joint Funding initiatives enacted under the CRUE network deliver increased understanding against each SRA could also be evaluated. For example, 1st CRUE funding initiative: Effectiveness & Efficiency of Non-Structural Measures in FRM (SRA3); 2nd CRUE funding initiative: Flood Resilient Communities, Managing the Consequences of Flooding (SRA4/5). It would also be useful to evaluate the durability of the network and its' ability to deliver the CRUE Research Agenda.

The suggested evaluation baseline would be Partner sign-off of the Research Agenda in Rome 2009.

2. Created a robust, transnational evidence base for use in policy development and implementation

To evaluate the achievement of this objective, we would need to evaluate the effectiveness with which research projects delivered through the CRUE network underpin European/National FRM needs. The coherence of research findings could be evaluated through scientific peer review and indicated through publication of papers, conference proceedings etc. The effectiveness of CRUE initiatives, i.e. synthesis reports, workshops etc. and evaluation of their success could serve to indicate the applicability and utility of CRUE outputs.

The suggested evaluation baseline for these criteria would be experiences from the 1st CRUE Funding Initiative and from follow-on evaluation of research-policy impact during 2009.

3. Decreased duplication of FRM research through CRUE knowledge integration and information exchange

The CRUE network has developed a central, web-based database to capture FRM research programme and project activity across Europe (CRUISE). This already provides a means of sharing information and user statistics may provide a quantitative means of evaluating achievement of this outcome. Sharing European perspectives through research collaboration contributes to overall coherence and could be considered by the CRUE Scientific Advisory Board as effectiveness is evaluated. Information collated through CRUISE will be used to review the relevance of the CRUE Research Agenda. It will also be important to consider efficiency criteria in determining achievement against this objective, i.e. financial savings in both research delivery and co-ordination. This information will contribute to evaluating

[16] Evaluation du portefeuille de recherches en appui aux politiques publiques sur les risques liées aux inondations, Bolo, de Bonvillier, ISL, financed by MEEDDAT.

achievement of strategic CRUE objectives, i.e. 'optimised public return on investment'.

The suggested evaluation baseline for these criteria would be a) the contribution of the CRUISE 'research compass' in developing and agreeing the CRUE Research Agenda, b) user statistics from CRUISE and the CRUE website and c) funding allocations for research/co-ordination under CRUE Joint Funding initiatives.

4. Maintained credibility as valuable advisors to FRM policy- and decision-makers across Europe

Critical evaluation criteria for the achievement of this objective would be relevance and utility. It is through the impact of our research and the effectiveness of our communications that CRUE will be able to maintain its credibility in the future. By its nature, this will be a purely qualitative evaluation to assess whether CRUE research outcomes are a) useful for European and National FRM decision makers, for the European Research Area, for European researchers and the European Commission and b) integrated in other ERA-Nets or EC research funding initiatives, National research projects, programmes and policy. In considering the durability of advice and guidance it would interesting to try to capture how lessons learned in the European context are applied to national research-policy-practitioner integration.

The suggested evaluation baseline for these criteria would be to capture effective links developed under the CRUE ERA-Net, e.g. to the EC Working Group of Floods, and to document any incidences of CRUE funded work in policy development. A matrix of science and policy contacts could also support the CRUE network in activities and initiatives to promote partnership working and information exchange.

In formalising the baseline for future evaluation, the CRUE network will also capture the following information from Partners before October 2009:

- The extent to which organisations had pre-existing relationships with Partners of the CRUE network.
- Whether participation in the ERA-Net has triggered transnational co-operation outside of the ERA-Net.
- To what extent has participation in the network influenced your National Programme?
- Have you see evidence of increased collaboration amongst researchers on a national level?
- Has your organisation changed it's research management practices to participate more fully in the ERA-Net?
- What percentage of your national budget has been contributed to CRUE Joint Funding initiatives since 2004?

Annex D

CRUE's Strategic Research Areas in Detail

The CRUE Network acknowledge that the Strategic Research Areas capture the broad range of FRM issues and will establish specific research questions to tackle collectively as it implements its Research Agenda. It is envisaged that a similar process of collecting ideas and opinion from research funders, policy makers and practitioners will be followed to define prioritised research questions for Joint Funding Initiatives in the future.

To enable the CRUE Network to respond effectively, it may be that a varying number of Partners collaborate through a range of funding mechanisms to underpin emerging policy development and implementation requirements. Sharing of national programmes and highlighting opportunities for collaboration will also be encouraged in the future.

At this stage it is not possible to capture definite priorities for future research activities under CRUE. However, the following research suggestions have been made for each Strategic Research Area, these will be considered by the CRUE Board and Work Package Leaders at the appropriate point in time.

Strategic Research Area 1 - "Developing resilience and adapting to increasing flood risks: climate change and new development"

- Effects of climate change on future design floods and design criteria in different climatic and geographic contexts.
- Assessment of optimal FRM strategies, including socio-economic impacts and maintenance strategies for existing structures.
- Reducing scientific uncertainty related to climate change, risk analysis approaches and forecasting (e.g. wind/storm surges etc.).
- Providing better adaptation strategies by explicitly accounting for forecast uncertainty.
- Enhancing monitoring techniques aiming at recognising the effects of changes (mainly in the mountain environments).
- Evaluating large scale adaptations that may be needed and how best to achieve them in practice (e.g. land use etc.)
- An emphasis on understanding 'Actual Risk', i.e. where the risk is most intolerable, Rt - I = Ra [Rt - Risk theoretical, I - Intervention, Ra - Risk actual].
- Improved understanding and development of stakeholder engagement for adaptation and resilience.
- Integration of future changes (hydroclimatic, social, economic etc.) in current and future FRM strategies; prospective studies of future vulnerability taking into account socio-economic evolutions and climate change.
- Compatibility of different types of land use with flood water storage under actual and future climate and inundation conditions (frequency, seasonality, water quality etc.).

Strategic Research Area 2 - "Risk assessment and mapping"

- Research on all types of vulnerability (e.g. people, habitats, settlements, infrastructures, public goods etc.) including evaluation methods and tools for social, economic, and ecological impact assessment.
- Scenario analysis to evaluate the effect of measures compared to a 'do nothing' or 'business as usual' situation.
- How to correlate between natural hazards and human caused hazards, such as floods and chemical factories/nuclear power plants?
- Impact of the new water defences on the downstream vulnerability.
- Mapping of flood risk in mountain and in sparsely monitored areas.
- Transnational analysis of the role of risk mapping in flood risk prevention strategies.
- What is the actual impact (on the general public, enterprises, spatial planners etc.) of the risk and hazard maps requested by the EU Floods Directive?
- What innovative approaches (e.g., remote sensing) can be developed to cost-effectively assess the actual strength of

large numbers of (historical) water defences within short notice? What is, once the real strength of water defences is known, the actual flooding probability and expected flood impact/damage for a given location or given area? *[NOTE: Knowledge of the actual strength of water defences is essential for both prevention and flood event management, i.e. for both SRA2 and SRA3].*
- Linkage across Europe on risk-based, broad-scale modelling, suggested methodologies on how to achieve this.
- Linking probabilistic forecasting to 1) mapping and 2) real-time communication.

Strategic Research Area 3 - "Implementing trans-national based strategies for flood event management and recovery"

- Forecasting, warning and early warning systems: opportunities and limitations.
- Integrating the uncertainty information in flood event management processes.
- What can be done to optimise the transnational aspects of flood event management, for example aspects like monitoring networks, forecasting systems, and information-response-recovery strategies?
- Understanding and linking wider strategies and sustainable approaches.
- Development of best practice guidance on asset design, construction and management, emphasis on whole life cycle assessment.
- Research of the potential for combining built up areas with flooding without losing channel detention (individual and collective measures).

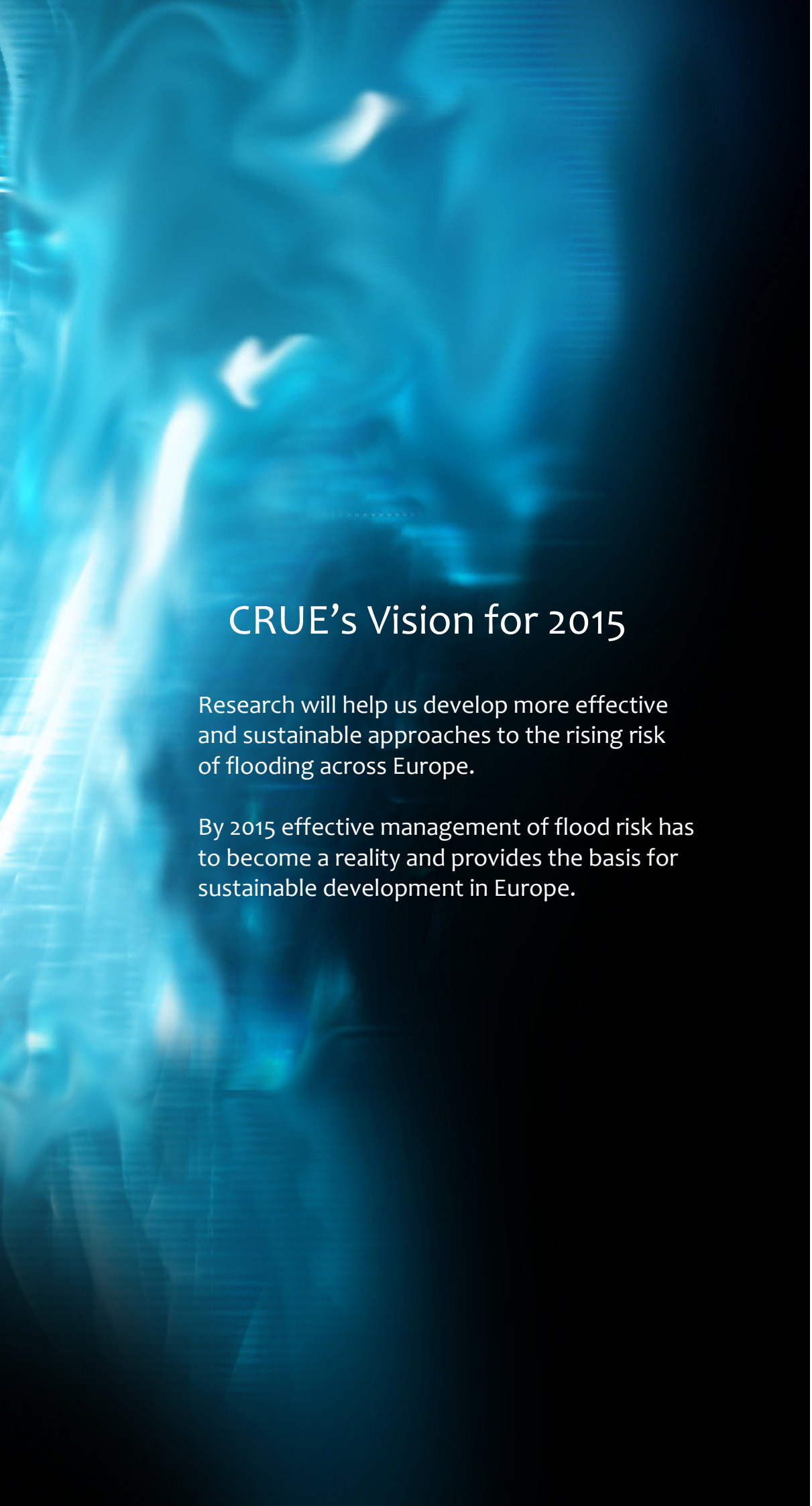
Strategic Research Area 4 - "Meeting multiple demands on flood prevention and protection and their sustainable management"

- Definition of residual risk and incorporation of it within the planning of flood protection measures.
- Definition of the spatial demand of various river types for morphological changes during extreme events.
- Where should we target investment, for example, which element(s) of the safety chain should we focus on?
- Sediment and woody debris transport processes in relation to flash floods (incl. research on debris flows and hyperconcentrated flows as well as interaction with woody debris) – implications for developing building codes and other legal requirements.
- Impact of (not) removing sediments on the different uses of the water body and on safety. What are the effects of a chosen strategy on the flood frequency and on the surrounding area?
- Variation over time of vegetation in the water channel and its resistance under low, mean and high discharge conditions.
- What are the consequences of floods on health? What are the conditions, modalities of flood event management and FRM measures for an effective recovery and for making communities, populations, territories resilient?
- Interaction and responsibilities of the different actors (state, civil security, regional and local authorities, etc.) implied in flood event management.
- Review of experience / lessons learnt from flood event management; what are the best practices for implementing a 'review of experience' process?
- What methods are available to combine all costs, benefits and other spatial-planning considerations in a decision-support system? How can FRM-related considerations and their uncertainties be weighed in such systems? How can 'soft' factors be included, such as preferred locations for enterprises, and also public perceptions about (i) flood risks, (ii) landscape/nature and (iii) living conditions?
- What multiple uses are possible for flood defence structures and flood retention areas? What options are available to share the costs in such multiple-user conditions over all users (rather than only the organisation which is responsible for FRM measures)?
- What is the efficiency and effectiveness of FRM strategies (indicators, methods)?

Strategic Research Area 5 - "Addressing public knowledge of flood risk and enhancing awareness, perception and communications"

- How to communicate the risk cycle and improve public flood risk awareness?
- How to communicate residual risk to the range of FRM stakeholders?
- How to balance the interests of upstream riparian/downstream riparian?

- Can the instruments of public action such as maps be the subject of consultation? Does the consultation process lead to a transfer of responsibilities (link with SRA2)?
- What are the social conditions for public support and participation to the objectives and the implementation of public policies? What are the conditions of social acceptance of FRM constraints? What are the forms of social mobilisation? What are the types of conflicts and alliances between actors?
- Informing on flood risk: which responsibilities for which effectiveness?
- Research of the societal and household level effects of new measures in integrated water management and policy.
- What is the (beneficial or adverse) impact of different communication strategies on flood risk awareness, public perception, public participation and flood-resilient behaviour of citizens and enterprises? What is the effect of flooding events/disasters on awareness/perception/participation/ behaviour?
- What is the impact of (large-scale) FRM measures on the general public, and what options are available to influence the perception and acceptance of these measures?
- What options are available to quantify (flood risk) perceptions & attitudes of the general public; what methods are available to weigh those perceptions/attitudes in decision making about FRM-issues and spatial planning?
- Extend recent European work (e.g. COMRISK and FLOODsite) to tackle governance issues associated with trans-national strategies.
- Understanding effective responses and how to elicit these public/partners/businesses etc.



CRUE
FLOODING ERA-NET

CRUE's Vision for 2015

Research will help us develop more effective and sustainable approaches to the rising risk of flooding across Europe.

By 2015 effective management of flood risk has to become a reality and provides the basis for sustainable development in Europe.