enhance

Partnership for Risk Reduction

ENHANCE

Enhancing Risk Management Partnerships
for Catastrophic Natural Disasters in Europe

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4.1.1 Executive summary

The frequency and economic damage of natural disasters has increased sizeably, in Europe. Losses are expected to continue to rise as a result of urban- and economic activities and climate change. Disaster risk reduction (DRR) is required to reduce the risk from natural hazards. DRR, however, is a complex task that involves many actors and often cuts across sectors and geographical scales. For this, the ENHANCE project The ENHANCE recommends (new) Multi-Sector Partnerships (MSPs) for managing DRR, based on 10 case studies. MSPs involve a mix of partners from the public and private sectors and civil society organizations. Project results show MSPs have the potential to significantly improve disaster risk management. Using the 'capital approach', MSPs were assessed on their healthiness to cope with natural disasters, resulting in the following general recommendations that support the UNISDR Sendai Framework for DRR and the UNFCCC Loss and Damage discussion:

Risk Assessment:

- Risk extremes and economic damage should be taken into account in international risk reduction and risk financing initiatives. This supports both the Sendai Framework as the UNFCCC Loss and Damage approach.
- Reliable and accurate risk information is key for the well-functioning of an MSP. For this, the availability of empirical loss data is imperative, and a concerted action is needed to make such data public.
- Risk assessment methods of extremes through extreme value analysis and joint probability distributions (Copula's) significantly enhance the reliability of risk scenario's.
- In-direct economic effect from disasters in areas that are not directly affected, but are linked to the disaster area through supply of goods and services, may account up to 40% of the total damage. More research is needed to further assess adaptation options to reduce this risk.

Perception and Behaviour

- Risk perception is an important driver for DRR. Risk perception is largely influenced by factors such as: experience with previous disasters, financial incentives and socio-economic conditions, of individuals.
- By better targeting Individual behaviour of households towards DRR through e.g. communication and providing financial incentives such insurance deductibles, risk reduction can be improved up to 35%.
- EU regulation such as the Flood directive should provide more incentives to households, activating the enormous potential of DRR through individuals.
- Insurance schemes should be better linked to EU regulation (flood directive, Solvency II, EU Solidarity fund), as they already have close ties with individual households, and can stimulate DRR at local levels.

- For this, we need an improved understanding of individuals' perception and behaviour towards disaster risk. Agent Based Models are powerful tools to simulate effects from human behaviour on DRR

Insurance & Economic Instruments

- Risk transfer schemes such as insurance and the EU solidarity fund, are only viable in the future with an considerable increase in physical protection measures / DRR
- Without DRR, premiums for e.g. flood insurance in several EU countries such as Germany and France may increase up to 120%.

Disaster Risk Reduction / Adaptation

- DRR measures may significantly decrease risk; more efforts are needed to involve individual households.
- Adaptation/DRR efforts should include the whole realm: from warning systems, protection to spatial planning effort

4.1.2 Summary description of project context and objectives

ENHANCE: Disaster Risk and Multi Sectoral Partnerships (MSPs)

During the past decades, the frequency and economic damage of natural disasters has increased sizeably, both worldwide (Munich Re, 2014) and in Europe. A number of major disasters have left their marks across Europe, prompting high economic damage and losses, casualties, and social disruption. Examples include the 2010 eruptions of the Eyjafjallajökull volcano in Iceland; earthquakes in Italy in 2009 and 2012; droughts and forest fires in Portugal and Spain in 2012; heavy rainfall that caused record floods in Central Europe in 2013; floods in the UK in the summer of 2007, and the winters 2014/15 and 2015/16 (Munich Re, 2015).

Natural disaster risks and losses in Europe are expected to continue rising as a result of the projected expansion of urban and economic activities in disaster-prone areas. In addition, climate change might increase the frequency and severity of certain extreme climate and weather related events, such as droughts, heat-waves, and heavy precipitation (IPCC, 2012; IPCC, 2014). These phenomena will continue to unfold as human induced climate change will become more pronounced. Hence, it is imperative to take comprehensive action on disaster risk reduction (DRR) to improve the resilience of European societies to natural hazards.

Increasing resilience to disasters that are caused by natural hazards is a complex task that involves many actors and often cuts across sectors and geographical scales. The ENHANCE project has contributed to DRR by further developing Multi-Sector Partnerships (MSPs) for disaster risk management, which are key to addressing the Sendai challenges. MSPs involve a mix of partners from the public and private sectors and civil society organizations. MSPs have the potential to significantly improve disaster risk management, but in practice, the cooperation across partners is often ineffective. The ENHANCE project had the following *main objectives*:

a) to assess the characteristics of (un-) successful partnerships in improving DRR
b) to develop (future-) risk scenarios, including disaster extremes
c) to enhance DRR by linking MSPs to economic instruments, including insurance
d) to provide policy recommendations for the horizontal integration of risk management and climate-proofing in policies.

The Sendai Framework for Disaster Risk Reduction and the Warsaw Mechanism

Global disaster risk reduction activities have been informed by the efforts of the United Nations Office for Disaster Risk Reduction (UNISDR). Until 2015, UNISDR coordinated the implementation of the Hyogo Frame-work for Action: 2005-2015 (HFA), which was organized around the main challenges that countries face in terms of natural disaster risk management (UNISDR, 2011). These challenges include: (1) improved risk assessment based on a multi-hazard and multi-risk approach; (2) a more vigorous pursuit of multi-sector partnerships; and (3) improved financial and disaster risk reduction schemes.

As a follow up to the HFA, the Third UN World Conference on Disaster Risk Reduction (WCDRR, 14–18 March 2015, Sendai, Japan) identified new commitments and targets, which led to the Sendai Framework for Disaster Risk Reduction 2015-2030. Together with partner UNISDR, the ENHANCE project supported the Sendai conference and provided scientific backup and policy recommendations (e.g. Mysiak et al., 2016) to the targets of the Sendai Framework. Which are: to reduce the impact of future disasters, mortality, economic damage, and damage to health and educational facilities (e.g. Jongman et al., 2015). Other targets aim to extend local and national DRR strategies, and are an extension of the HFA's call for better coordination of disaster risk activities with development and other sectorial policies (UNISDR, 2015).

Part of ENHANCE team at Sendai Conference with partner UNISDR

In addition, ENHANCE has pushed the role of DRR within the climate change community, through a leading role in the United Nations Framework Convention on Climate Change (UNFCCC) (Mechler et al., 2014; Mechler and Schinko, 2016). The Paris Agreement, negotiated at the end of 2016 under the UNFCCC, sets a global goal of adaptation for the first time to build adaptive capacity, strengthen resilience, and reduce vulnerability to climate change. This new policy emphasizes that responses must account for local, subnational, national, regional, and international dimensions and actors across scales. One particular issue in relation to disaster risk is the 'loss and damage' discussion, which has also been formally recognized with the inclusion of the 'Warsaw Loss and Damage Mechanism' into the agreement. This mechanism informs the action of efforts to manage risk from losses beyond adaptation, and in addition to discussing responsibility and liability, a large part of the debate has focused on bolstering comprehensive DRR (UNFCCC, 2015).

Multi Sectoral Partnerships

An important part of the Sendai Framework guiding principles calls for partnerships to achieve improved risk management. The challenge is to improve the way that different institutions and sectors (jointly) cooperate to develop and implement DRR measures. To achieve this, the ENHANCE project has specifically studied multi-sector partnerships (MSPs). MSPs are partnerships that involve a mix of actors from the public and private sectors and civil society organizations. MSPs have the potential to significantly improve disaster risk management, but joint action with the aim of lowering risk involves different stakeholders and can also be challenging (Pahl Wostl et al., 2007; UNISDR, 2011).

Example of flooded infrastructure

The different responses to heat-waves in Europe in 2003, 2006, and 2010 and the UK floods in 2015 demonstrate that the roles of public, private, and civil society actors (including individuals) in preparing for and responding to catastrophic impacts are often not clear or effective. Moreover, actors must often base their risk management strategies on scarce, limited, or inaccurate risk information. This is not surprising, since empirical data on low probability-high impact events is not recorded in avail-able datasets. Together, these factors can lead to the development of ineffective and unacceptable disaster risk management measures and an unexpectedly large impact of natural disasters (financial, ecological, health, and social). In preparing for and responding to natural hazard impacts, there is also often a lack of clarity on financial responsibilities about who pays for what, how often, and when. Knowing that the challenge of managing risks that result from natural hazards has increased, it is clear that these risks cannot be handled by the private sector or the government as single actors, and strategies to in-crease resilience should therefore incorporate all sectors of society (including cooperation between sectors). The main goal, therefore, of the ENHANCE project was to develop and analyze new ways to enhance society's resilience to catastrophic natural hazard impacts. The key to achieving this goal is to analyze new multi-sector partnerships that aim to reduce or re-distribute risk and increase resilience. Within ENHANCE, we define MSPs as:

'Voluntary but enforceable commitments between partners from different sectors (public authorities, private services/enterprises, and civil society), which can be temporary or long-lasting. They are founded on sharing the same goal in order to gain mutual benefit, reduce risk, and increase resilience'.

The ENHANCE approach

Figure 1. Setup of the ENHANCE framework for assessing the healthiness of MSPs, to assess current and future risk levels, and to reduce and manage risk through DRR design and action.

Figure 1 describes the general approach that was followed by ten ENHANCE case studies (see Table 1). Following the components of Figure 1, the main activities of each case study were (1) to assess the capacity of each existing MSP to reduce or manage risk; (2) to assess current and future risk, including extremes and effects from both climate change and socio-economic developments; and, (3) to explore DRR measures that were developed and governed by the MSP with the aim of reducing risk. The relationship between resilience and good governance of MSPs is assessed in ENHANCE by the Capital Approach Framework (CAF) that was developed during the project to assess governance performance. The CAF assesses risk governance performance and the influence of risk perception of MSPs on risk management strategies. Furthermore, for the risk assessment activities, different modelling and statistical techniques were implemented to assess the magnitude and frequency of extreme events, such as 'extreme value analysis' and joint distribution of risk ('copula's'). Finally, the project explored different economic instruments, such as pricing and insurance, as part of the different DRR actions, and explored what type of EU- (Solidarity Fund, Flood Directive, etc.) and national policies are required to develop and maintain such instruments to enhance MSPs.

Table 1. Ten ENHANCE case studies on different natural hazards, scales, and multi-sector partnership types. Note: MSP types: E = Emergency response MSP; R = Risk reduction strategy MSP; F = Financial MSP.

Hazard	MSP	Issue topic	Hazard	Scale	Location	Partners	Public and Private Stakeholders
HYDRO	R	Drought management in Jucar River Basin District (Spain)	Drought	Basin	South Europe	**UPVLC,** JRC, ADV	Conf. Hidrográfica del Júcar, USUJ, Iberdrola power
	R	Risk culture, perception & management (North Sea coast)	Storm surge	North Sea	North Europe	**HZG,** WSF	LKN, NLWKN, Sylt
	F	Flood risk and climate change implications for MSPs (UK)	River flood	National-City	West Europe	**LSE,** UOXF,WIL	ABI, Willis, C. Of London, DCLG, Defra, EA
NON-HYDRO	E	Health preparedness and heat-wave response plans (Europe)	Heat-wave	EU-wide	EU	**UCL,** JRC	WHO Europe Bonn and Denmark, EEA
	R	Air industry response to volcanic eruptions (Europe)	Volcanic eruption	EU-wide	EU	**HI,** IVM	Icelandic Aviation Administration
	F	Insurance & forest fire resilience, Chamusca, Portugal	Forest fire	City, local	South Europe	**ISA-CEABN,** MC	City of Chamusca, CPA, ACHAR, Ch. Firefighters, DRF-LVT, Empremédia
MULTI	E	Climate variability & technological risk in the Po basin, Italy	Multi-hazard	Basin	South Europe	**FEEM,** ARPA ER	Munich Re Italy, Civil Protection Agency
	E	Flood risk management for Rotterdam Port infrastructure (NL)	Multi-hazard	City	North Europe	**HKV,** IVM	Port of Rotterdam, Safety Region, SNS-Reaal
	R	Building railway transport resilience to alpine hazards, Austria	Multi-hazard	National	Alpine, Central Europe	**UP,** ORT	Austrian Railways – ÖBB, WLV, PLANALP
	F	Testing the Solidarity Fund for Romania and Eastern Europe	Multi-hazard	EU	Eastern Europe	**IIASA,** *PCC, ASE*	EC DG Regio, DG CLIMA, World Bank

4.1.3 A description of the main S&T results/foregrounds

Assessing the healthiness of MSPs

In order to assess whether MSPs have the capacity to anticipate natural disaster risk, the ENHANCE project merged resilience concepts and indicators with a framework for analysing (un)successful governance processes. Twigg (2009) describes 11 factors that provide a basis for identifying '(un)-healthy' characteristics of an MSP for building resilience or shaping new partnership development: integration of activities, shared vision, consensus, negotiation, participation, collective action, representation, inclusion, accountability, volunteerism, and trust. We converted these 'resilience – governance factors' into MSP indicators, using the Capital Approach Framework (CAF). The CAF draws from different theories such as risk governance (e.g. Fürth, 2003; IRGC, 2005), and aims to assess: (a) the concept of the institutional fit of an MSP, which is 'the degree of compliance by an organization with the organisational form of structures, routines, and systems prescribed by institutional norms' (Kondra and Hinings, 1998); (b), use the capital theory, which is the idea of linking sustainable development to the concept of the five capitals (see Table below) (Goodwin, 2003; OEDC, 2008).

The different capitals provide MSPs with the capacity to react to natural hazards. Capital or capacity is hereby understood as the assets, capabilities, and properties, which collectively represent the good functioning of an MSP. The CAF differentiates between five capitals: financial, social, human, natural (environmental), and political capital. Political capital has been added by the ENHANCE project and refers to the capability of institutions to enact rules, laws, or frameworks that might change the course of actions. The resilience indicators that are described by Bahadur et al. (2010) and the 11 factors that are described by Twigg (2009) can be allocated within one of these five capitals. The rationale behind this approach is that the maintenance or enlargement of the five capitals will assure the capability of a partnership to react to environmental hazards. In an ideal situation, a sustainable MSP will focus on maintaining and/or enhancing its capitals. The quality of these five capitals is contingent upon existing development and health baselines, as well as the legacy of past disaster impacts.

BOX: The five capitals needed for healthy MSPs are:

- **Social:** the relationships, networks, and shared norms and values that qualify and quantify social interactions, which have an effect on partnership productivity and well-being.
- **Human:** focused on individual skills and knowledge. This includes social and personal competencies, knowledge gathered from formal or informal learning, and the ability to increase personal well-being and to produce economic value. In the case of partnership, the human capital will be the addition of its individual skills and knowledge.
- **Political:** focuses on the governmental processes, which are done/per-formed by politicians who have a political mandate to enact policy. It also includes laws, rules, and norms, which are juristic outcomes of policy work.
- **Financial:** involves all types of wealth (e.g. funds, subsidies, etc.) that are provided, as well as financial resources that are bounded in economic systems, production infrastructure, and

banking industries. Financial capital permits fast reactions to disasters.
- **Environmental:** comprehends goods and values that are related to land, the environment, and natural resources.

BOX: Managing Air traffic disruption and Volcanic ash outbursts.

With increasing interconnectedness, a disturbance of air traffic in one part of the world can have long-ranging financial and social effects on other parts. The eruption of the Eyjafjallajökull volcano in April 2010 (Iceland) illustrated this memorably. The eruption prevented millions of passengers, as well as goods, from reaching their destination, as air traffic was halted in Europe for several days (Ulfarsson and Unger, 2011). As part of the EU project ENHANCE, this case study has sought to obtain insights into how the European aviation sector can advance its risk management with regard to volcanic ash since the eruption in 2010. The MSP members consist of EU wide information providers, crisis coordination and network management, air navigation service providers, global-, international and national regulators and aircraft operators.

To evaluate the functioning of the MSP, two extreme volcanic ash scenarios were developed (the most extreme scenario is depicted below). One of the recommendations is to further elaborate training of MSP members with extreme scenarios. After the eruption in 2010, 70 airlines participated in the VOLCEX exercise. Around 50 airlines were involved in the last exercise. For the MSP to be successful, as many stakeholders as possible should participate in the exercise and use the platform simultaneously to exchange experience, knowledge, views and opinions.

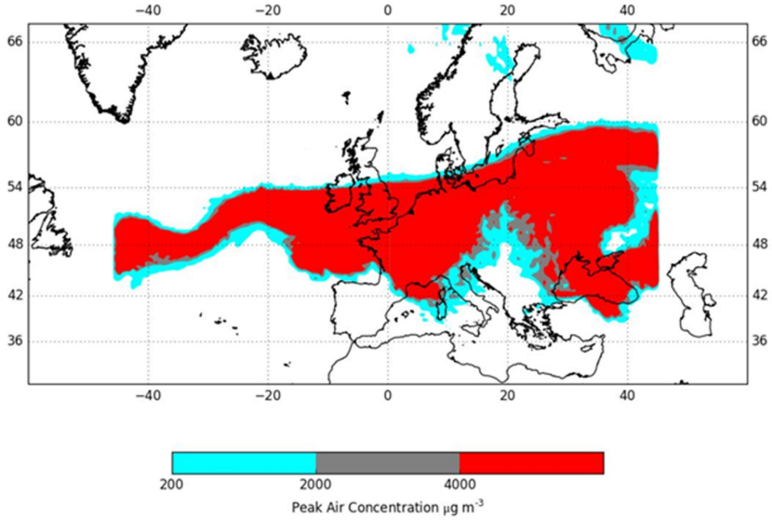

Figure 2. The extreme Öræfajökull scenario that was used in a workshop with aviation specialists. Example of modelled ash distribution, at day 5 after the eruption. High ash concentrations of more than 4000 µg/m³ are predominant throughout the whole forecast period up to flight level of 20,000 feet.

Risk Assessment

In order for an MSP to manage risk, accurate risk assessment and information is critical to any DRR decision. Risk assessment looks to understand future permutations by constantly updating projections of risk scenarios through risk assessment and reflection (e.g. Tschakert and Dietrich, 2010). Risk assessment can play an important role in measuring the relative influence of an MSP on risk reduction through its actions, for example through applying risk information in decision support, evaluation, and cost-benefit analysis processes (e.g. Watkiss et al., 2014). Risk information also plays an important role in assessing the DRR strategies in anticipation of future risk conditions.

Generally speaking, there are two approaches to assess natural disaster risks: statistical risk assessments and catastrophe models. The first approach looks only at the past and estimates risk from historical loss data using extreme value theory (e.g. Embrechts et al., 1997). A fundamental challenge is how to model the rare phenomena that lie outside of the range of available observation. While much real world data approximately follows a normal distribution, which implies that the estimation of distributional parameters can be done based on such assumptions, for natural hazard extremes, the tails (rare outcomes) are much fatter than normal distributions predict. This is accounted for in extreme value theory, according to which, natural disaster risk distributions are estimated using, for example, Gumbel, Weibull, or Frechet distributions. Typical steps in such an assessment are provided in ENHANCE for all case studies for which sufficient hazard or loss data is available. In the second approach, catastrophe models are applied, which are computer-based models that estimate the loss potential of natural disasters (Grossi and Kunreuther, 2005). This is usually done by overlaying the properties or assets that are at risk (exposure module) with hazard and vulnerability information captured in damage curves (Figure 3).

It is important to understand the dynamics of the underlying causes of risk. For example, the projections of climate variability and change should ideally be based on an ensemble of (regional) climate models that capture a broad spectrum of underlying uncertainties. Moreover, information about exposed economic assets and their vulnerability to hazards is needed. In ENHANCE, new approaches (Copula's) were applied to flood- and forest fires cases to avoid the underestimation of such low-probability/high-impact events (e.g. Jongman et al., 2014). With this new approach, EU flood risk was estimated 17% higher as compared to conventional methods.

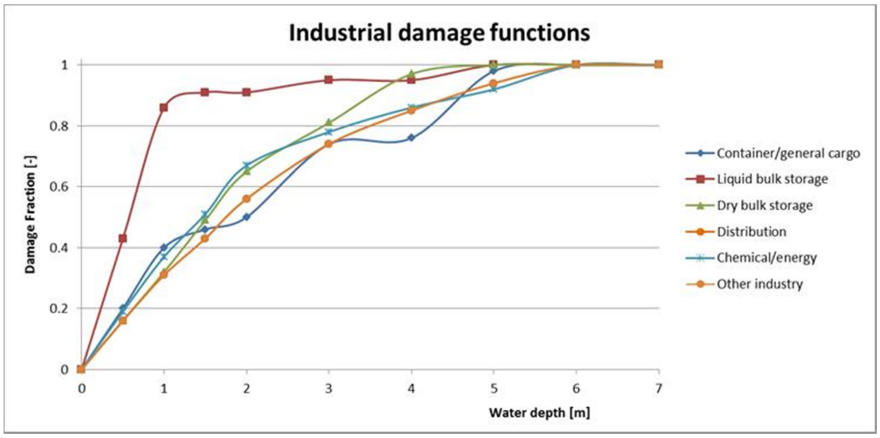

Figure 3. Stage damage functions for the Port of Rotterdam, showing the relation for 6 exposed assets, and the % damage of flooding as a function of the flood depth (De Moel et al., 2014).

BOX: Case study: Austrian Railways and Alpine hazards

The railway transportation system of the Alpine country Austria plays an important role in the European transit of passengers and freights. The mountainous environment poses a particular challenge to railway transport planning and management. Railway lines often follow flood-plains or are located along steep unsteady slopes, which considerably exposes them to flooding and in particular to alpine hazards, e.g. debris flows, rockfall, avalanches or landslides. As a result, railway infrastructure and operation has been repeatedly impacted by alpine hazards. For example, in June 2013, floods and debris flow events caused substantial damage to the railway infrastructure in Austria. The national railway operator ÖBB reported a total damage of about EUR 75 million to its railway network.

In order to better plan, negotiate, and decide on investments in protection measures, reliable models for estimating potential flood losses to railway infrastructure are needed. Therefore, the ENHANCE case study 'Building railway transport resilience to alpine hazards' has developed an empirical modelling approach for estimating direct structural flood damage to railway infrastructure and associated financial losses. The Figure below shows potential structural damage at the Northern Railway in Austria for three synthetic flood scenarios: a) a 30-year event, b) a 100-year event, and c) a 300-year event. In damage class 1 the track`s substructure is (partly) affected, but there is no or only little notable damage. In damage class 2 the track section is fully inundated and significant structural damage has occurred (or must be expected), while in damage class 3 additional damage to substructure, superstructure, catenary and/or signals occurred so that a full restoration of the cross-section is required (Kellermann et al., 2015).

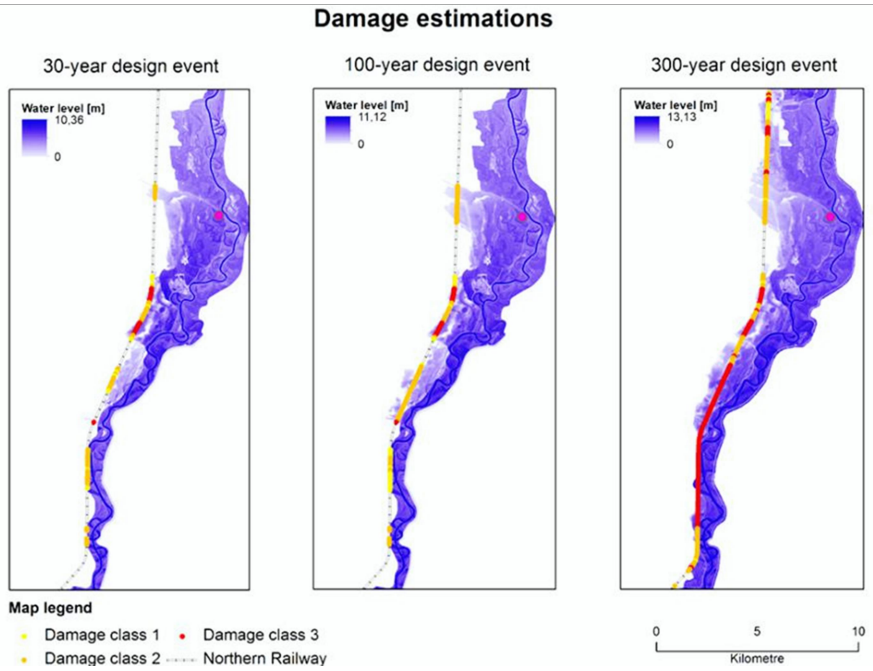

Figure 4. Three different flood inundation scenarios (1/100, 1/1000, 1/10000) for a segment of a railway in Austria, and the projected damage classes (1-low to 3- high losses)

BOX: Direct and in direct effects of flooding: case study Port of Rotterdam

The port of Rotterdam in the Netherlands is the second largest in the world and the Largest Port in Europe. The harbour is situated in the south-western river delta of the Netherlands and is prone to natural hazards (wind storms, flooding) and the impact of climate change on these natural hazards. Potential elements at risk are industries, energy plants, port facilities, railways, tunnels, and container terminals. Severe economic damage can occur from long-term closures of the port and its industry. Similar to the Austrian case study, flood inundation maps with different return periods (probabilities) were used to estimate potential flood losses. In risk assessment studies, one can distinguish between direct and indirect effects (Koks et al., 2014). Direct effects can be defined as the impacts on buildings infrastructure and people. Indirect effects (Figure), on the other hand, are often caused by the direct impacts, but are the result of interferences within industrial supply chains (Okuyama and Santos, 2014). Most importantly, indirect effects may also occur outside the hazard area: e.g., companies that are not flooded (e.g. Carrera et al., 2015), but that have economic relations with households and industries that are flooded. These linked supply businesses, cannot supply or demand their goods and services to the business and people in the flooded area, and therefore, indirectly suffer from the flood (Koks et al., 2016). These costs (e.g. business interruption) can amount to 40% of the total damage (Hallegatte et al., 2012).

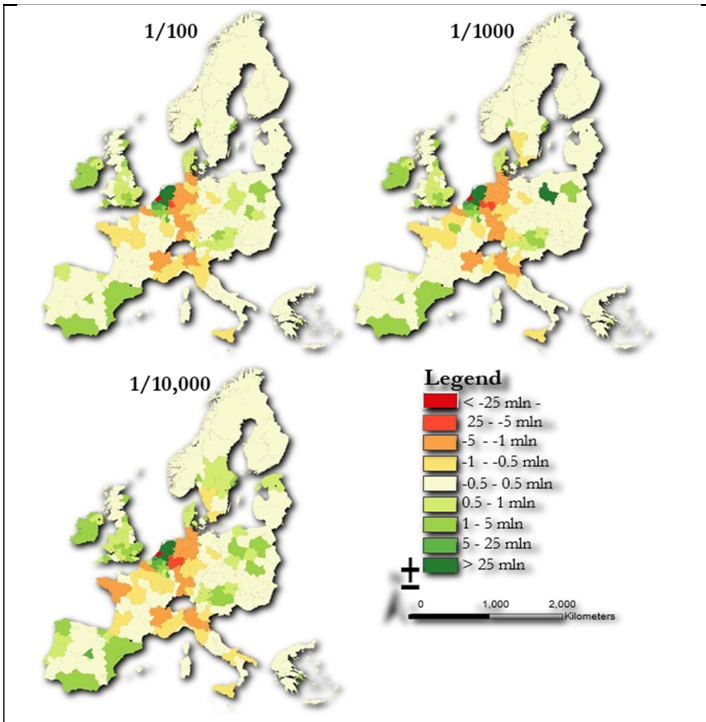

Figure 5. Indirect economic effects per region in the European Union for three extreme floods in the region of Rotterdam: 1/100, 1/1000 and a very extreme flood of 1/10000 (Koks et al., 2017, in review).

The UNFCCC Loss and Damage discussion (Mechler et al., 2015)

ENHANCE has further pushed the role of DRR within the climate change community, through a leading role in the UNFCCC (Mechler et al., 2014; Mechler and Schinko, 2016). An important decision in the COP 21 Paris Agreement was the endorsement of the Warsaw International Mechanism (WIM) for Loss and Damage (L&D). As disaster risk is special, a comprehensive approach involves targeting risk management interventions according to disaster return periods — 'risk layering'. Risk layering can help to differentiate between distinct levels of risk organized around return periods (or probability) and the degree of stress imposed by risk. Risk layering is a concept underlying many areas of risk policy, especially agricultural and insurance risk management. This approach can reveal risk management options that are differentially effective for low-, medium- and high-probability events as well as tailored to the different risk bearing capacities of communities, governments and international organizations. Such nuanced understanding of risk management can also be helpful in identifying risks that are 'beyond adaptation'.

The approach classifies different layers of risk: Frequent, low-impact risk for which DRR is typically the preferred adaptation (benefit–cost studies have shown great potential for reducing risks at this lower level); Medium-layer risks for which risk reduction can be combined with insurance and other risk-financing instruments that transfer residual risk, rare and catastrophic events; and finally, a very high- level risk layer for which the capacity of international aid agencies can be exceeded.

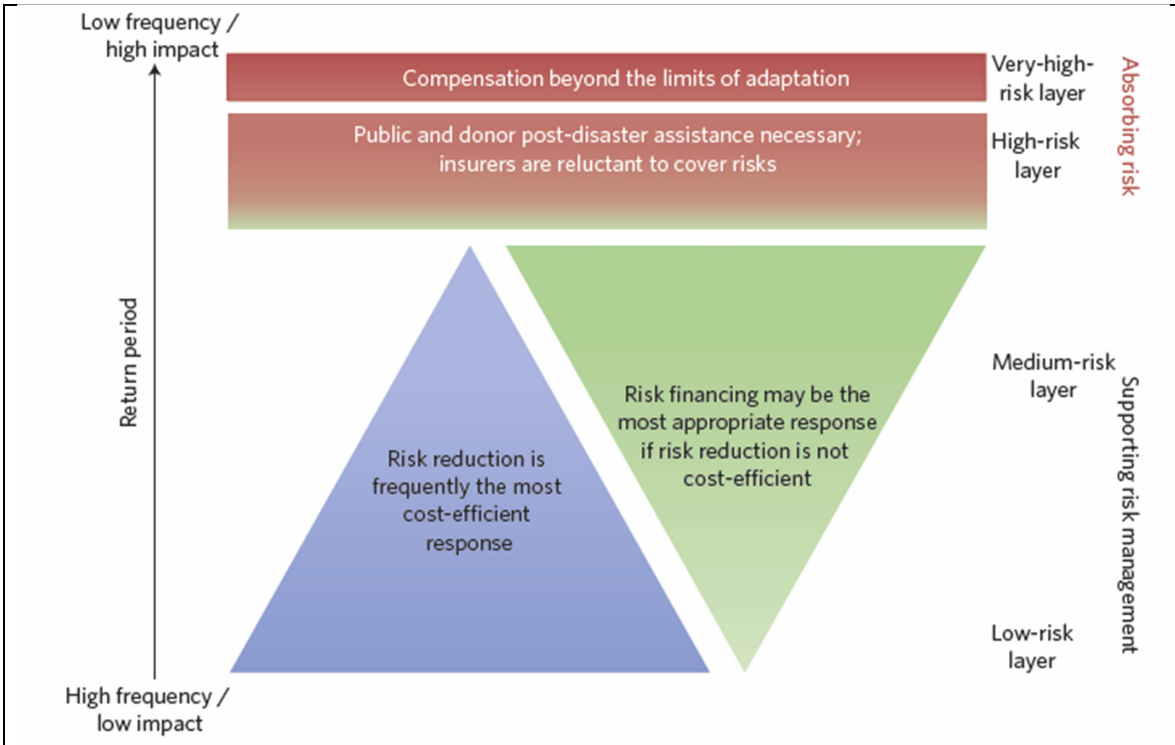

Figure 6. Schematic representation of Risk Layering, as an approach to support the UNFCCC Loss and Damage discussion (Mechler et al., 2016; Mechler and Schinko, 2016)

Risk Assessment and Policy implications for risk assessment

The importance of quality-assured, systematically collected and thorough datasets on impacts of natural hazards, the loss data systems (LDS) have been highlighted by the Sendai Framework for Disaster Risk Reduction 2015-2030 and the OECD. Currently, empirical data on losses from natural hazards in Europe are fragmented and inconsistent. Because open and accessible records on disaster impacts and losses are prejudiced by data gaps, European policy-makers have little choice but to resort to proprietary data collection. The Sendai Framework calls on the national and regional government to better appreciate the (knowledge of) risk. Empirical and evidence-based risk analysis and assessment are a vital part of the disaster risk reduction efforts (e.g. JRC, 2015). Therefore, the open-ended intergovernmental expert working group (IEWG) was instituted to develop a set of indicators for measuring global progress.

The Sendai Framework is not alone in this quest. The OECD invited the member countries to better prepare for catastrophic and critical risks (OECD, 2010, 2014). The draft Sendai Framework indicators focus currently on direct damage and structural/physical losses. However, the OECD recommended considering the whole distributional and implied ripple or spillover effects of natural hazards, which is now also discussed between countries and UNISDR. Furthermore, the European Union Civil Protection Mechanism (EC, 2013) compels the EU member states to conduct risk assessments, where possible also in economic terms, at national or appropriate sub-national level.

They also have to make a summary of the relevant elements thereof available to the Commission by December 2015 and every three years thereafter. For both purposes, the Joint Research Centre (JRC) is developing loss indicators that should be part of operational disaster loss databases (De Groeve et al., 2013; 2014).

Figure 7. Volcanic outburst in Iceland and the effect on Air Traffic was one of the ENHANCE case studies

DRR and Risk Perception

Disaster risk is perceived differently by people, and risk management approaches are influenced by what people perceive as 'risky'. Risk perception influence risk management, and for example, when protected by high levees, people behind the levee often perceive they are save. However, probabilities increase over time because of climate change, and exposure changes as well, because more people settle behind the 'safe levee'. This is also referred to as the 'levee effect' (Tobin, 1995). Another important factor influencing risk perception is past experiences of extreme events. Protection Motivation Theory, shown schematically in Figure 8, has become an important socio-psychological model of individual flood risk-preparedness decisions (Bubeck et al., 2012). It offers a useful framework to analyse how risk communication, as a form of verbal persuasion, can influence a person's threat or coping/DRR appraisal, and how risk management preparedness is affected. Communicating for instance the probability of a flood, as is done by the FEMA flood maps in the United States, aims to change people' s threat appraisal. Communicating about the costs and the effectiveness of certain protection measures aims to change people's coping appraisal.

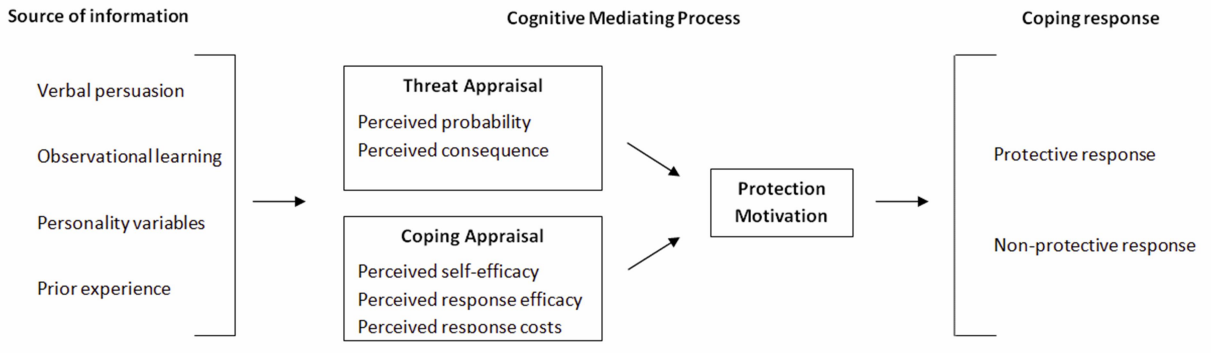

Figure 8. A schematic overview of Protection Motivation Theory (adapted from Rogers and Prentice-Dunn (1997)

ENHANCE has assessed the perceived risk of MSP representatives in an online survey. It appeared that risk assessment and regular monitoring are considered as the most useful tools for objective formulation of risk perception and are mandatory in many cases. In some MSPs, perception is always at a certain base level, because of the continuous presence of natural hazards (e.g. the drought case study in Spain), and DRR measures are anchored as part of their risk culture. The survey also showed other DRR measures that are perceived valuable to managing risk: knowledge and technology transfer, information and networking, and applying future climate scenarios and simulations. Most MSPs have some form of risk management and risk emergency plans (Figure 9). Most of these plans, however, are older than 10 years, and in 60% of the cases they are considered mandatory. Emergency plans are considered mandatory in all the cases (100% of the cases analysed). Regarding action to support DRR (Figure 10), awareness raising is implemented for more than 10 years in 50% of the cases. 92% of the analysed MSPs implement this measure. On the other hand, insurance is only used in 17% of the cases.

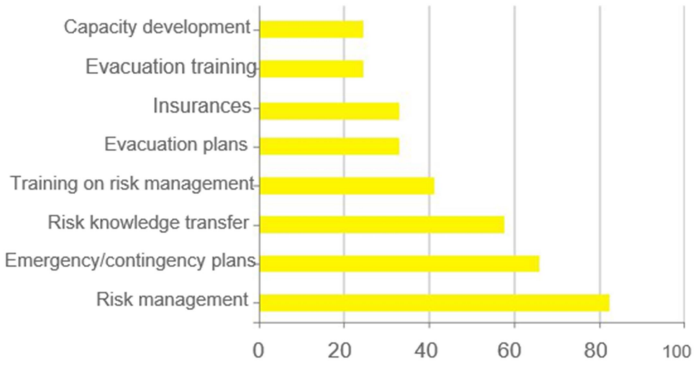

Figure 9. Policies and programs implemented to enhance risk preparedness (%).

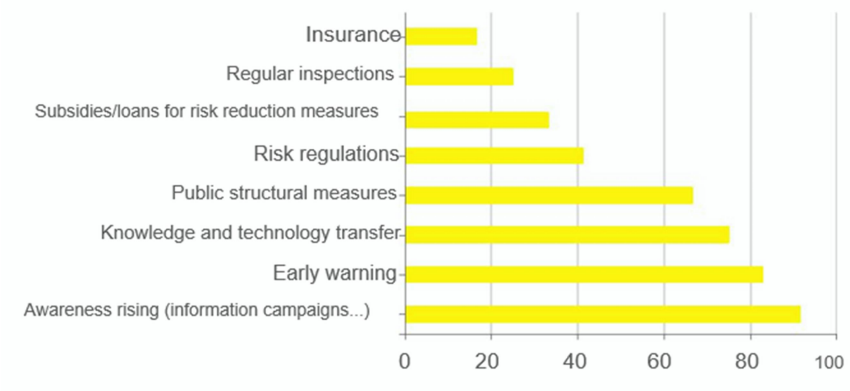

Figure 10. Policies and programs implemented to support prevention and mitigation

Risk perception: Policy Implications.

The effectiveness of MSPs are partly shaped by the perception of risk of the people involved in the partnership. There is a need to support MSPs and governments could assist the creation of multi-sector partnerships to manage risks and take advantage of the synergies between stakeholders. For example, through providing better risk communication to MSPs but also individuals, and by including guidelines and criteria for the creation of MSPs that will in turn help to further analyse the effectiveness of MSPs. Online accessibility of risk maps is important, as well as information for people of how households can develop and implement DRR measures themselves. In the latter context, insurance can play an important role, as they are equipped to target individuals and have the financial tolls (e.g. premium discount, deductibles) to provide incentive for DRR and to communicate risk to their policy holders. The theme of risk perception and DRR was further discussed between UNISDR, ENHANCE and the European Forum for Disaster Risk Reduction (EUFDRR) in both 2014 and 2015. As a follow up, we asked our survey respondents from the EUFDRR on the activities of those national platforms. National platforms are responsible for the coordination of actions oriented to develop guidelines for monitoring and management, to foster agreements between stakeholders, and elaborate information and its dissemination. It appeared More than 70% of the survey respondents agreed risk perception and communication of risk is key for effective DRR policies in Europe.

BOX: Agent Based Models: MSPs and behaviour on Risk Management

Agent Based Models (ABMs) can be used to characterize different stakeholders in a risk sharing arrangement such as an MSP for flood insurance. Simulation of the risk in an ABM can be used to assess the effect of different risk sharing options, which encourage overall risk reduction. This approach has been applied to the ENHANCE cases of London and Rotterdam (e.g. Haer et al., 2016; Jenkins et al., 2016). ABMs were found to be highly attractive, because stakeholders could easily see how different management options changed risk over time and showed what the implication are for policy. The ABM was for Greater London was applied to a case study of the Camden area of London, an area at high risk of surface water flooding. The ABM includes six different agents: people, houses, an insurer, a bank, a developer and a local government, each with their own behavior (Jenkins et al., 2016). The model was used to assess the interplay between different adaptation options; how risk reduction could be achieved or incentivized by different agents; and the role of flood insurance and DRR. The study by Haer et al (2016) focuses on the Port of Rotterdam, and evaluates the effect of different flood risk communication strategies on DRR, using an agent-based modelling approach (Figure 11). The results show that tailored, people-centred, flood risk communication can be significantly more effective than the common approach of top-down government communication. Furthermore, communication on how to protect against floods, in addition to providing information about flood risk, is much more effective than the traditional strategy of communicating only about flood risk. Another main finding is that a person's social network can have a significant effect on whether or not individuals take protective action. This leads to the recommendation that social media can play an effective role in DRR.

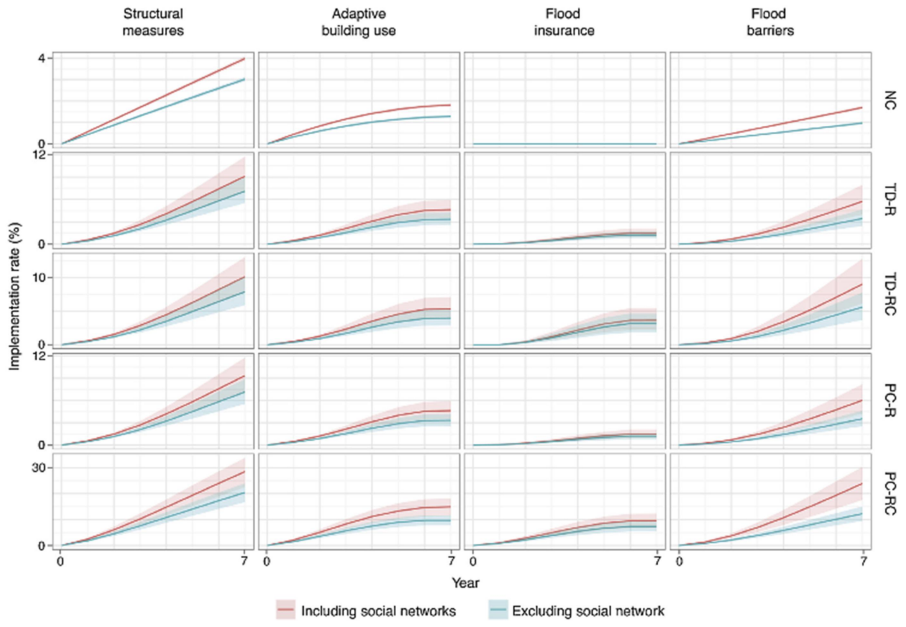

Figure 11. Comparison of the implementation rates (%) of disaster risk reduction options over time, with and without including the effect if social networks between households (Haer et al., 2016).

Insurance, DRR and behaviour

While households have only limited control over the occurrence of a natural disaster, their actions determine the extent of losses during and after the event. An ENHANCE study for Germany applied Propensity Score Matching techniques to estimate flood damage reduction of DRR actions by households. Think for example of elevating houses of flood proofing the basement or lower floors of a building. The results show that DRR measures lowered damage during floods between €6,700 and €14,000 per flood event (Hudson et al., 2017). Another study also shows that flood damage mitigation measures implemented by households in France substantially saved damage during a variety of different flood events, and that these measures can be cost-effective (Poussin et al., 2015). However, households commonly do not invest in DRR measures, even when they are cost-effective. They insufficiently prepare for natural disasters, for example, because they underestimate low-probability natural disaster risk and the benefits of DRR.

Furthermore, the implementation of household DRR measures differs between individuals with, and without, flood insurance coverage in Germany (Hudson et al., 2014). The results show that individuals with flood insurance coverage in Germany are significantly more likely to have employed mobile flood barriers that keep flood water out of their home, while other risk reducing measures were often implemented by insured and non-insured individuals equally. These findings suggest that the moral hazard effect of insurance coverage is absent since households with flood insurance prepare more for floods. Additional analysis indicates that the better flood preparedness of the insured is related with activities of seeking information about flood risk, which can signal that the individuals who purchase flood insurance are more careful.

	Germany		France	
	2015	2040	2015	2040
Average risk-based premium	€280	€490	€1100	€1600
SD	€110	€200	€370	€530
Minimum premium	€110	€190	€650	€940
Maximum premium	€530	€960	€1900	€3000

Figure 12. A summary table of the estimated average insurance premiums (EUR/per year) for Germany and France in 2015 and 2040 (Hudson et al., 2016).

Another ENHANCE study examined whether financial incentives offered by risk-based pricing of insurance in Germany and France can stimulate policyholder adaptation to flood risk (Hudson et al., 2016). This risk-based pricing implies that households receive a premium discount when they take measures that reduce flood risk. The effectiveness of such incentives is analysed using an integrated model of household level mitigation behaviour and public-private flood insurance. The results indicate that insurance based incentives are able to promote adaptation by correcting for individual

misperceptions of flood risk and related benefits of DRR. The incentives could reduce residential flood risk by 12% in Germany and 24% in France by 2040. The higher level of flood risk in France results in a strong present incentive to reduce risk. Rapid growth of flood risks in Germany results in more effective incentives in later periods. An overall drawback of risk-based pricing is that flood insurance becomes potentially unaffordable for households who face a high risk. The study shows that such concerns for affordability can be overcome by providing insurance vouchers that help low-income households pay for flood insurance coverage. This voucher system that overcomes affordability concerns with risk-based flood insurance has a lower cost by 2040 than the benefits it brings of additional risk reduction. A main policy recommendation that follows from this study is that strengthening the link between insurance and DRR is worthwhile, but secondary policies may be needed to compensate additional costs for low-income households.

EU Solidarity Fund

The European Union Solidarity Fund (EUSF), is an ex-post loss-financing vehicle for EU member states and candidate countries for use in cases where a disaster exceeds the government's re-sources to cope. Until 2014 the fund operated with an annual budget of €1 billion. However, the latest Multiannual Financial Framework (MFF 2014–2020) has halved its budget to €500 million (2011 prices). It covers only a fraction of the total damages in Europe: compensation has averaged about 3% of total direct losses since 2002. ENHANCE research shows an increase in expected losses, especially for extremes in 2050. This due to socioeconomic growth (~2/3) and climate change (~1/3). The increasing losses also give rise to a strong rise of 1/200 insured loss (Solvency II capital requirement) from ~€ 116 billion in 2013 to ~€ 236 billion by 2050 due to the large increase in losses. ENHANCE identified three different options for multi-stakeholder partnership development of the EUSF to cope with these future challenges:

- Option 1: eliminate the upper limit of the Fund, which is currently €500 million annually (with option-al borrowing from previous/subsequent years)
- Option 2: further strengthen the link between the EUSF and disaster risk reduction contributions to the Fund not only to take into account the economic performance of member states but also the risk reduction measures implemented by the country.
- Option 3: completely or partially transform the EUSF into a pre-disaster instrument that supports (reinsures) a national (public/private) insurance system with more affordable

premiums.

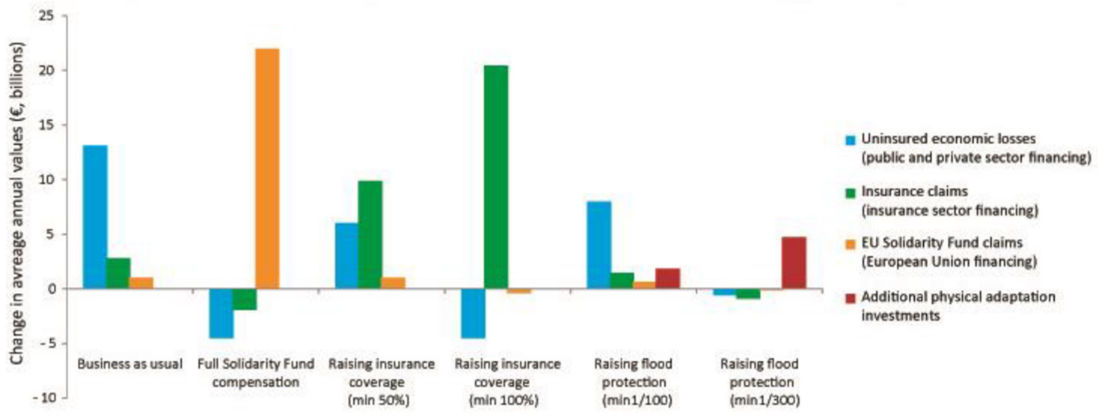

Figure 13. Different adaptation schemes to reduce flood risk in Europe (Jongman et al., 2014)

Insurance and DRR

Insurance is a key economic instrument in the context of DRR, offering a shift in the mobilization of financial re-sources away from ad hoc post-event payments, where funding is often unpredictable and delayed, toward more strategic and, in many cases, more efficient approaches that were arranged in advance of disastrous events (Linnerooth–Bayer and Hochrainer-Stigler, 2015). The main function of insurance is the financial transfer of risks and compensation for losses. However, if correctly designed and implemented, it can also support DRR and climate adaptation (Surminski et al., 2015). Within this context, insurance may be delivered using a range of approaches, such as risk pools, private insurance, or public insurance schemes, addressing different hazards at different scales, including proper-ty, agriculture, and sovereign risk insurance. Feasibility, effectiveness, and the potential for incentivizing behavioural change vary across the different types and forms of insurance. Methodologies for comparing and assessing these characteristics are currently starting to emerge (for Europe see Paudel et al., 2012). While it is clear that insurance can contribute to disaster risk management, a range of challenges also exists, including a lack of comprehensive information and cognitive biases, as well as financial constraints and moral hazard.

ENHANCE introduces six different methodologies for assessing the linkages between insurance and risk reduction: Stress testing, investigation of flood insurance and moral hazard, estimation of effectiveness of house-hold-level flood risk mitigation measures, assessment of risk-based insurance pricing incentives for flood risk mitigation, analysis through a risk reduction framework, and investigation of the design principles of insurance.

Based on the case studies, our analysis reveals a range of important insights that are relevant to individuals who consider, design, operate, or participate in insurance schemes. An area of particular

interest is the role of MSPs for the provision of disaster insurance. Here, our case studies highlight the importance of increased evidence and understanding of underlying risk issues, enhanced collaboration of stakeholders, and openness about limitations and costs. The issue spans many dimensions, which makes innovation and re-form challenging for political decision-makers and private companies.

Policy implications Insurance and DRR

The discourse about disaster insurance in Europe highlights the key challenges of managing current risks and preparing for future climate risks: at the core lies the issue of collective versus individual responsibility, and solidarity versus market-based approaches. The ENHANCE analysis shows that flood insurance and DRR need to be closely linked and integrated in the face of rising losses in order for insurance schemes to remain viable in the future. However, as our case studies show, there are significant barriers facing public and private stakeholders. This requires policy action—at EU and national, as well as regional level. The key question therefore is how to determine and define the roles of industry and policy-makers, recognizing that this is likely to differ from country to country (Surminski et al., 2015). At European level the facilitation of DRR and adaptation, which will determine risk levels and viability of insurance going forward, can be supported by EU-led policies. However, the design and operation of insurance schemes can also play a role in this. Here national governments have a role to play.

BOX: Wildfires Portugal

Every year, forest fires have a major impact on urban areas and the environment in Portugal. In 2003, the district of Santarém, Central Portugal, was severely affected by wildfires, with almost 64 thousand hectares burned. The goal of the Portuguese case study was to analyse the Multi-Sector Partnership (MSP) and the economic instruments (e.g. insurance) which could promote the society's resilience to forest fires. Risk assessment show estimated losses above €100 million for the Santarém district, for the three most extreme years (1991, 2003 and 2005). Fire Weather System index (DSR) analysis for the period 2002-2012 shows that large burned areas only occur as a result of wildfire in the few days that the weather is extreme (See Figure below).

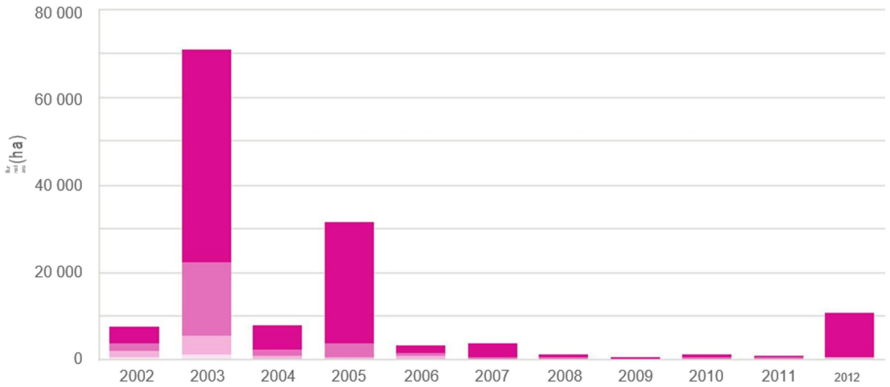

Figure 14. Burned areas per DSR (Daily Severity Rating) class (left graph) and number of days per DSR class (right)

An economic instrument that is already used by the MSP, is the Permanent Forest Fund, which supports the Forestry Technical Offices. Research suggests the European Solidarity Fund (EUSF) has supported the recovery of fire losses (EC, 2016), but the perception within the MSP is that, although there were many resources available after a major disaster, there was no incentive for new DRR for preventing future disasters. The recommendation to the EUSF is to provide mandatory rules for DRR when losses are compensated.

The ENHANCE analysis on the EU Solidarity Fund (Jongman et al., 2014) shows that socio-economic development and climate change can substantially increase pressure on risk transfer or financing mechanisms, unless more risk reducing measures are applied, such as flood defences, stricter building codes and/or land use (zoning) policies. Improved risk assessment and data sharing amongst stakeholders are essential for developing those forward-looking solutions in an integrated way. National, local and household level DRR activities could be used as a mechanism for reducing the pressure placed on risk transfer schemes. In other words, risk reduction efforts are essential in maintaining the insurability of these risks, especially in the context of flooding and other extreme weather events. Effective adaptation may actually become a condition for granting insurance cover in the future (Surminski et al., 2015). However, the ENHANCE analysis suggests that until today efforts to reform disaster compensation mechanisms in Europe have been predominantly focused on dealing with the financial losses, without considering the implications of these mechanisms for managing and reducing the underlying risks.

Table 2. Relation between EU legislation, Insurance and DRR (Surminski et al., 2016)

Policy	Relevance for flood insurance	Impact on flood insurance
Solvency I (Directive 73/239/EEC and others) and Solvency II (Directive 2009/138/EC)	Explicit	Insurance systems will have to accommodate the remit of Solvency II ensuring that schemes are economically risk secure. It demands a structured risk-based approach to assessing the solvency risks faced by insurance and reinsurance companies, including flood insurance. It imposes an upper limit on the probability that the annual losses exceed company's operating capital
Competition rules, state aid	Implicit	Competition law can influence how public and private sectors may collaborate through public–private partnerships (PPP). State aid regulation controls public recovery aid to economic undertakings without distorting the internal market.
Environmental liability directive (ELD, Directive 2004/35/EC)	Implicit	ELD imposes an obligation of preventing or remedying of environmental damage at source and by the polluter, in accordance with the Article 191(2) of the Treaty on the Functioning of the European Union (TFEU).
Water framework directive (Directive 2000/60/EC)	Implicit	Establishes River Basin Management Plans (RBMPs) based on a better understanding of pressures, impacts and economic analysis. The WFD stressed the role of economic instruments in achieving a 'good ecological status'.
Floods directive (Directive 2007/60/EC)	Implicit	Flooding risk maps are required by the FD and assessments are instrumental for a sound determination of risk premiums. The flood risk management plans produced under the FD will specify and prioritize interventions for flood risk reduction
European Union Solidarity Fund (EUSF)	Implicit	EUSF provides assistance to MS for coping with major natural and/or extraordinary regional disasters. Solidarity Fund aid can be mobilized up to a maximum annual total of 500 million EUR (in 2011 prices).
EU legislation on disaster risk prevention and management	Implicit	The Union Civil Protection Mechanism facilitates systematic risk assessments and risk management planning amongst others. The Decision 1313/2013/EU on a Union Civil Protection Mechanism requires that, starting from 2015, an integrated threat and risk assessment report is compiled by Member States

Our modelling approach and findings are highly relevant for wider discussions on the potential of insurance schemes to incentivize flood risk management and climate adaptation in the EU and beyond. In Table 2, we show the links between EU policies and insurance, and where there is a potential to steer insurance schemes to increase incentives for DRR and risk assessment. There is a clear current momentum at international level to use insurance to incentivize risk prevention and adaptation, as highlighted by the increased efforts to design new insurance schemes in developing countries through the new G7 'insu-resilience' initiative, and underpinned by the UNFCCC's Paris Agreement (see Surminski et al., 2016). As we have shown across the different ENHANCE case studies, the engagement of multi-sector partners and the clarification of their roles and responsibilities will determine if and how those new schemes can support climate resilience. This is an opportunity, and the lessons from across Europe provide important insights that can help to harness disaster insurance for risk reduction and climate adaptation.

DRR and other economic instruments

Economic instruments, such as risk financing instruments, water pricing and water markets, private-public partner-ships, taxes, and others, can produce incentivizing behaviour and increase the uptake and efficiency of adaptation measures by MSPs. The effectiveness of these instruments at reducing risk is frequently debated in the policy and science spheres. Yet, the evidence base on their effectiveness remains limited (even for insurance-related instruments) and there are few conceptual and numerical analyses (Agrawala and Fankhauser, 2008; Kunreuther and Michel-Kerjan, 2009; Bräuninger et al., 2011). By synthesizing recent literature, we have considered two broad types of instrument categories that are relevant for DRR (see also Chambwera et al., 2014; Bräuninger et al., 2011):

1. Market-Based Instruments (MBI) are instruments administered by government regulators that provide a monetary/economic incentive promoting risk management and adaptation. According to the EU white paper, the definition of MBI is broad (see EU Commission, 2009) and in the interpretation of this chapter it includes natural resource pricing, taxes, subsidies, marketable permits, payments for ecosystem services, licences, property rights and habitat banking.

2. Risk Financing Instruments (RFI) comprise all instruments that promote the sharing and transfer of risks and losses. They generally can be classified as pre-disaster arrangements, and comprise insurance, weather derivatives and catastrophe bonds, and many of those are indeed market-based as well.

Using these two instruments, ENHANCE identified three channels through which these economic instruments can contribute to risk management: (1) direct risk reduction: for example, risk financing provides direct compensation payments, which reduce follow-on impacts from an event; (2) indirect risk reduction: incentives for risk management and increased resilience help to reduce and manage risks, (3) managing systemic risk: both down-and upside risk are managed; the insurance takes the

down-side (bad risks) risks out of investment decisions, and focuses on harnessing upside risks (good risks).

BOX: Jucar basin; Droughts and water pricing

The Júcar River Basin is a complex water resources system located in eastern Spain, highly regulated and with a high share of water for crop irrigation (about 83%), in which water scarcity, irregular hydrology and groundwater overdraft cause droughts to have significant economic, social and environmental consequences. The basin has been used as a test case to apply scarcity-based water pricing policies and water markets as potential instruments to manage drought risk. Scarcity-based water pricing policies are based on the marginal economic value of water (Pulido-Velazquez et al., 2013, Macian-Sorribes et al., 2015). When water storage is high, the marginal value of water is low, while low storage (drought periods) is associated with high marginal values.

In order to assess the impacts of these economic instruments, two new tools were developed and applied to allocate available water resources through simulation and optimization approaches. The simulation tool (SIMGAMS) allocates water resources according to system priorities and operating rules, evaluating the scarcity costs through economic demand functions. The optimization tool (OPTIGAMS) allocates water resources to maximize net benefits (or minimize total water scarcity cost plus operating cost at river basin scale). SIMGAMS allows for simulating incentive-based water pricing policies based on water availability in the system (scarcity pricing), while OPTIGAMS is used to simulate the effect of ideal water markets by economic optimization.

As the Júcar River Basin has a high share of water use for crop irrigation (around 80%), we also assessed the impact of drought on irrigated agriculture production using an econometric approach (Lopez-Nicolas et al. 2015). For this purpose, a two-stage approach has been applied (Gil-Sevilla et al., 2010 and 2011): first, an econometric model has been fitted to explain the impacts of water resource availability and crop price volatility on the agricultural production value. Monte-Carlo algorithms are then used to consider the contribution of the variability of the hydrology on drought risk and impacts.

The results show the potential of applying economic instruments to deal with drought risk management. Water pricing policies and water markets have a positive impact on drought risk management, reducing the total scarcity cost during drought periods. Scarcity-based water pricing policies send a scarcity signal to water users (when the storage decreases water price increases). So this works as an incentive to-wards a more efficient water use.

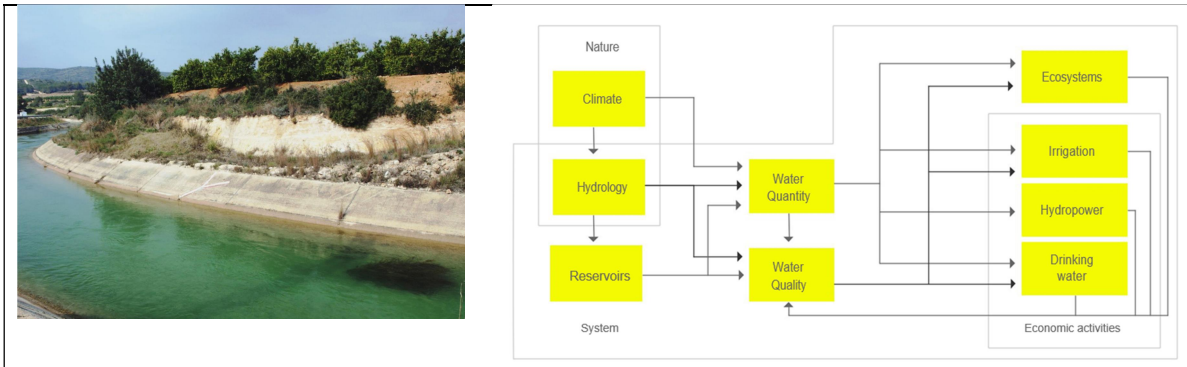

Figure 15. Jucar river (left) and the elements considered in the drought risk analysis

ENHANCE results show risk transfer could play an important role in risk reduction by incentivizing the take-up of risk reduction measures. Risk transfer removes or reduces the risk of experiencing an uncertain financial loss. However, if designed and operated appropriately, it can also play a role in physical risk reduction and adaptation. Measuring this effectiveness remains a challenge, particularly in the context of public-private partnerships because success or failure often only becomes evident after another risk event, and it requires in-depth data collection on the ground.

ENHANCE examined the scope of different economic instruments for enhancing resilience and managing risk, and applied a common framework based on multi-criteria analysis to assess economic instruments in the case studies, in order to specify the suitability of those instruments. The criteria (and associated) indicators comprised the following aspects: economic efficiency, including the link to incentivize disaster risk management, social equity, political and institutional applicability, and environmental effectiveness. Operationalizing the criteria universe with a multi-criteria decision-making approach allowed ENHANCE analysts to apply a qualitative scoring matrix to economic instruments across five ENHANCE case studies.

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4.1.4 The potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and exploitation of results

ENHANCE was a project with scientific objectives, but strongly engaged with EU policymaking communities across the different sectors (energy, water, agriculture, transportation, and health) covered by the project. The primary impacts of the project are in terms of its scientific outputs, as evidenced by the many scientific outputs (detailed in the periodic reports) produced by project partners on the basis of ENHANCE research. Also our research contributed to, or has been acknowledged and quoted in, several high-level policy reports or documents. A dissemination plan, including an open communications platform, was developed at the start of the project, and updated throughout the project to be sure we were reaching the audiences and policy domains potentially interested in the results, and to be able to link to new opportunities which came into existence during the project. Also, project partners were stimulated to synthesize and disseminate the scientific knowledge into policy relevant information, understandable for a broad public This was the framework within which the dissemination and impact of the project was managed.

Scientific impact

The ENHANCE project has produced a considerable scientific output, and has supported many scientific conferences across the globe. With over 78 peer reviewed papers and book chapters, under which 7 in Science PNAS and Nature, the scientific output can be considered as good. In the Science paper by Aerts et al. (2014) we showed how risk assessment and Cost benefit Analysis can help policy makers in develop DRR and adaptation strategies to reduce risk from flooding in coastal cities. This paper was applied to New York City, a partner city of the ENHANCE case study Rotterdam. Furthermore, in Jongman et al. (2015) we showed that vulnerability, albeit difficult to determine, is an important driver of disaster damage and that annual hazard variability alone only explains a minor part of the observed variation in the recorded damage. Munch RE was supporting the paper by providing the latest empirical data of global flood losses. Finally, in the papers by Mechler et al. (2014; 2016) contributions were made to the Warsaw Mechanism for Loss and Damages. Both publications were used during COP 21 and 22 in Paris and Marrakesh, respectively.

All scientific results have been compiled in an ENHANCE synthesis book. This book has been published with VU University press, and is also online available: www.enhanceproject.eu/deliverables/3

High impacts papers are:

Aerts, J.C.J.H., Botzen, W.J.W., Emanuel, K., Lin, N., de Moel, H., Michel-Kerjan, E.O., (2014). Evaluating flood resilience strategies for coastal megacities. Science, 344, 473-475.

Aerts, J.C.J.H., Botzen, W.J.W., (2014). Cities' response to climate risks. Nature CC. 4 (9), 759-760.

Jongman, B., Winsemius, H., Aerts, J.C.J.H., Coughlan de Perez, E., van Aalst, M.K., Kron, W., Ward P.J., (2015). Declining vulnerability to river floods and the global benefits of adaptation. PNAS. E2271–E2280.

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Mechler, R., Schinko, T. (2016). Identifying the policy space for climate loss and damage. Science 354 (6310), 290-292.

Surminski, S., Bouwer, L.M., Linnerooth-Bayer, J., (2016). How insurance can support climate resilience. Nature CC, 6, 333–334.

ENHANCE furthermore has coordinated a special issue in the high-level journal 'Earth Future'. The special issue will comprise about 15 papers on disaster risk reduction and Multi Sectoral Partnerships (MSPs). The issue is closed and the review procedures are ongoing.

Figure 16. Earth Future journal (left) that is used as special issue for ENHANCE on Multi Sectoral Partnerships. And a cover of the high level paper in PNAS on flood vulnerability (right)

In addition, ENHANCE has presented in numerous scientific conferences, and has co-organized scientific session. A selection of those events include: the European Geophysical Union (EGU), which is yearly held in Vienna. The Understanding Risk conferences, The American Geophysical Union (AGU, San Francisco), and The Global Conference for Environmental Economy.

Specific scientific contributions by ENHANCE:

Risk Assessment: Assessing Extremes and Copulas

In a publication in Nature CC (Jongman et al., 2014) we extended existing approaches to estimate risk from extremes. Current methods estimate risk from historical loss data using extreme value theory, according to which, natural disaster risk distributions are estimated using, for example, Gumbel, Weibull, or Frechet distributions. Risk and losses, however, are spatially correlated and this is often not accounted for in these techniques. In ENHANCE, a new approach (Coppula's) was

applied to assess flood risk in the EU (e.g. Jongman et al., 2014). With this new approach, EU flood risk was estimated 17% higher as compared to conventional methods.

In addition, Jongman et al. (2014) shows that it is important for risk assessments to understand the dynamics of the underlying causes of risk. For example, the projections of climate variability and change should ideally be based on an ensemble of (regional) climate models that capture a broad spectrum of underlying uncertainties. Moreover, information about exposed economic assets and their vulnerability to hazards is needed. Jongman et al. (2014) highlighted that combining these three dimensions is a non-trivial task, especially for the assessment of extremes. In response to this, ENHANCE recommends to develop open access databases with information on historical losses from natural hazards.

Indirect economic effects.

In risk assessment studies, one can distinguish between direct and indirect effects (Koks et al., 2014). Direct effects can be defined as the impacts on buildings, infrastructure, and people. Indirect effects are effects outside the impacted area, because business and other stakeholders that have economic ties to the impeded region cannot produce or deliver/receive goods to/from the impacted region (Okuyama and Santos, 2014). In several novel publications (e.g. Carrera et al., 2015; Koks et al., 2014; 2015; 2016) we show the economic relations between households and industries located outside a flooded area, with the activities inside a flooded area. These linked supply businesses, cannot supply or receive their goods and services to/from the business and people in the flooded area, and therefore, indirectly suffer in case a flood happens (Koks et al., 2016). These costs (e.g. business interruption) can amount up to 40% of the total damage. ENHANCE recommends EU policies to improve the assessment of indirect economic damages, and to develop new policies that require companies to evaluate whether they are equipped to recover business when supply areas (such as port cities) are flooded.

Influence of behaviour / perception on risk: Agent based Models

In an analysis of global food vulnerability in the high level journal PNAS (Jongman et al., 2015), we showed that vulnerability has a large influence on assessing risk. For example, when zooming in on Pakistan, it appeared that large fatalities were recorded in during the 1993 floods. However, a few years later in 1995, a larger flood occurred in Pakistan, but fatalities were much lower. This can predominantly be explained by different perception and behaviour of people. Because individuals had the experience from the previous flood, and the communication and warning systems had been improved, people could better prepare themselves, reducing losses significantly.

ENHANCE research applied Agent based Models (ABM) to simulate the effects from such individual household behaviour. We used ABMs to aggregate the effect of all these individual DRR (Disaster Risk Reduction) activities, and estimate their effect on the overall risk in a region or country. This

research confirms trends in flood risk in the Netherlands showing that without considering individual behavioural aspects of households, (future-) risk is overestimated by a factor 2 (Haer et al., 2016).

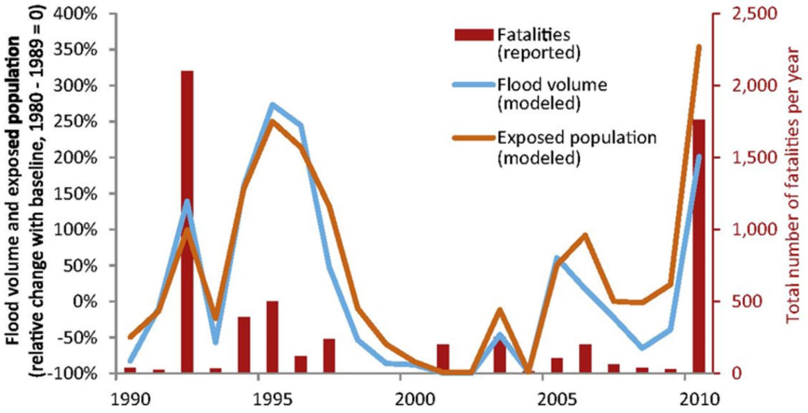


Figure 17. relation between fatalities and floods in Pakistan. While there were many fatalities in 1993 during a flood, an even larger flood in 1995 did result in much lower number of fatalities, This can only be explained by risk reduction and reduced vulnerability (Jongman et al., 2015).

Learning about the behaviour of individuals towards adaptation, risk, and how people perceive risk can also contribute to an improved risk communication to those living and working in hazard prone areas. Targeted communication to individuals should show the consequences of disasters to them and their property if they do not undertake protective measures now, but should also demonstrate the socio-economic benefits of adaptation. Behavioural risk modelling using ABM can compare the effects of different communication strategies (Jenkins et al. 2016; Haer et al., 2016), and tap into the enormous –aggregate- potential of individuals that can significantly contribute to risk reduction.

ENHANCE, therefore recommend to further develop current EU policies such as the flood directive and EU Solidarity fund, to ask member states informing individuals about their risk, But also inform them how they can implement DRR at the local scale. Note in this respect, that much DRR efforts are targeted at large urban centres, and less on the rural areas –these latter areas still account for a significant portion of all disaster losses in the EU.

Insurance, DRR and households

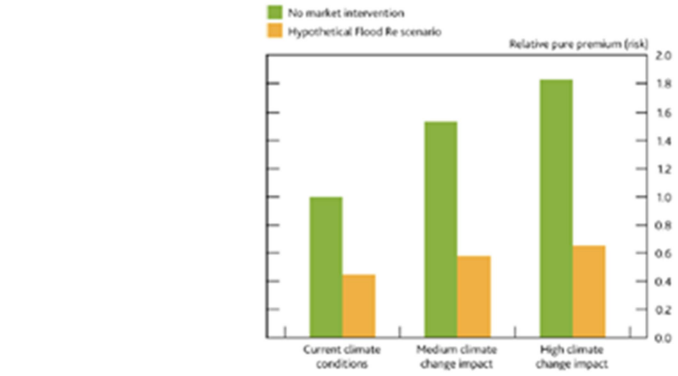
While households have only limited control over the occurrence of a natural disaster, their actions determine the extent of losses during and after the event. An ENHANCE study for Germany estimated flood damage reduction of DRR actions by households. The results show that DRR measures lowered damage during floods between €6,700 and €14,000 per flood event (Hudson et

al., 2015). Another study also shows that flood damage mitigation measures implemented by households in France substantially saved damage during a variety of different flood events, and that these measures can be cost-effective (Poussin et al., 2014; 2015). However, households commonly do not invest in DRR measures, even when they are cost-effective. They insufficiently prepare for natural disasters, for example, because they underestimate low-probability natural disaster risk and the benefits of DRR.

The implementation of household DRR measures differs between individuals with, and without, flood insurance coverage in Germany (Hudson et al., 2016). The results of this study show that individuals with flood insurance coverage are significantly more likely to have employed mobile flood barriers that keep flood water out of their home, while other risk reducing measures were often implemented by insured and non-insured individuals equally. These findings suggest that the moral hazard effect of insurance coverage is absent since households with flood insurance prepare more for floods.

Insurance policy recommendation

The analysis of ENHANCE case studies shows that for flood- and fire disaster, insurance schemes and DRR need to be closely linked and integrated in the face of rising losses in order for insurance schemes to remain viable in the future. An example is given in the Figure below on the Flood RE scheme in the UK, where without DRR, premiums will steeply rise in the future. However, as our case studies show, there are significant barriers facing public and private stakeholders. This requires policy action—at EU and national, as well as regional level. The ENHANCE analysis on the EU Solidarity Fund (Jongman et al., 2014) shows that socio-economic development and climate change can substantially increase pressure on risk transfer or financing mechanisms, unless more risk reducing measures are applied, such as flood defences, stricter building codes and/or land use (zoning) policies. Effective adaptation may actually become a condition for granting insurance cover in the future (Surminski et al., 2015; Hudson et al., 2015). However, the ENHANCE analysis suggests that until today efforts to reform disaster compensation mechanisms in the EU have been predominantly focused on dealing with the financial losses, without considering the implications of these mechanisms for managing and reducing the underlying risks.



Sources: Jenkins *et al* (2015) and Surminski *et al* (forthcoming).

Figure 18. Example UK flood insurance: UK taxpayers exposed to rising risks as Flood Re fails to incentivise risk reduction.

EU Solidarity Fund

ENHANCE research (Jongman et al., 2014; Hochrainer-Stigler et al., 2015) shows an increase in expected losses, especially for extremes in 2050. This due to socioeconomic growth (~2/3) and climate change (~1/3). The increasing losses also give rise to a strong rise of 1/200 insured loss, which is the Solvency II capital requirement, from ~€ 116 billion in 2013 to ~€ 236 billion by 2050 due to the large increase in losses (see Figure below). ENHANCE identified three different options for multi-stakeholder partnership development of the EUSF to cope with these future challenges:

- Option 1: eliminate the upper limit of the EUSF, which is currently €500 million annually (with option-al borrowing from previous/subsequent years)
- Option 2: further strengthen the link between the EUSF and disaster risk reduction contributions to the Fund not only to take into account the economic performance of member states but also the risk reduction measures implemented by the country.
- Option 3: completely or partially transform the EUSF into a pre-disaster instrument that supports (reinsures) a national (public/private) insurance system with more affordable premiums, and hence a higher market penetration.

UNFCCC Loss and Damage: risk Layering

ENHANCE has further pushed the role of DRR within the climate change / UNFCCC community, through a leading role in the UNFCCC (Mechler et al., 2014; Mechler and Schinko, 2016). In a concept called Risk layering, it was demonstrated this can help to differentiate between distinct levels of risk organized around return periods (or probability) and the degree of stress imposed by risk. Risk layering is a concept underlying many areas of risk policy, especially agricultural and insurance risk management. This approach can reveal risk management / adaptation options that are differentially effective for low-, medium- and high-probability events as well as tailored to the different risk bearing capacities of communities, governments and international organizations. Such nuanced understanding of risk management can also be helpful in identifying risks that are 'beyond adaptation'.

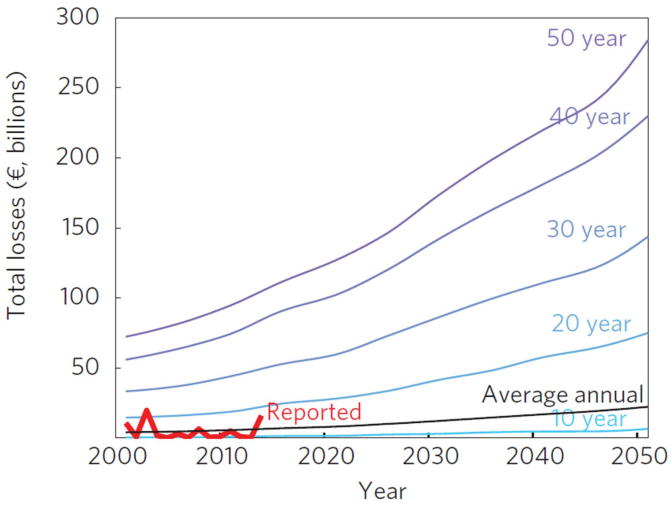


Figure 19. increase flood losses in the EU, for different flood probability scenarios (1/10; 1/20; 1/30, etc), until the year 2050 (Jongman et al., 2014)

Main dissemination activities

The ENHANCE project had a number of different mechanisms for interactions with policymakers, stakeholders and the wider public.

Meetings and conferences with policymakers and stakeholders
ENHANCE has presented its results at international conferences for policy makers and stakeholders throughout the project (UNISDR, Geneva 2013; Adaptation Futures 2014), Delta conference (Rotterdam, 2014), Third UN World Conference on Disaster Risk Reduction (WCDRR, Sendai/Japan, March 14-18, 2015), the European Climate Change Adaptation Conferences (Copenhagen, May 2015), ENHANCE has presented on several European Forum on Disaster Risk Reduction (EFDRR) meetings, in 2014, 2015 and 2016, at sessions at several COPs, and at the OECD High level conference on flood risk (Paris, May 12-13 2016). We also organised a high policy level workshop on possible reform of the European Solidary Fund (Brussels, October 2015).

More specific on the topic of insurance we have undertaken the following activities:

- The ENHANCE core group on insurance has officially responded to **the EU green paper on Insurance**: ENHANCE Consortium's response to "Green paper on the insurance of natural and man-made disasters (COM(2013) 213 final)" in July 2013 (http://enhanceproject.eu/news/articles/22).
- Concurrently and in order to discuss implications for the Green Paper, the project took the lead in organising the successful High Level 'Think Tank' meeting with the insurance industry

on “Public-Private partnerships in Flood Risk Management and Insurance” at the Munich RE office in Munich, Germany (December 2013).

- EC DG CLIMA workshop on disaster insurance (2016).
- Meetings with the EU Loss Data Systems initiative under auspices of the DRMKC.

During the project we had several direct meetings with policymakers, examples are the invitations to give evidence on flood insurance at a meeting of the Oireachtas Joint Committee on Finance, Public Expenditure and Reform in the Irish Parliament; and to participate in the stakeholder meeting at the Prime Minister Office Coordination unit on flood risk. Besides these meetings we have had bilateral meetings with EU ambassadors (Malta, Bulgaria, Netherlands, etc) and European Commission/Parliament.

Meetings and conferences with scientific audiences

- EGU (Vienna, 2015, 2016), Society for Risk Analysis Europe (Istanbul 2014; Denver 2015) to mention the most important. See table A2 for the full list of dissemination activities of the project.
- The ENHANCE project organized summer schools, capacity building workshops, stakeholder meetings and webinars to engage and bring together young-professionals from the private and scientific domain.

Project website

A well designed and active project website (www.enhanceprojcect.eu) was developed and maintained throughout the project. During the course of the project we received 50.000 unique visitors. This website will continue to be hosted at the VU University website for at least 3 years. It contains the following information:

- Interviews with project partners on their achievements
- External interviews with people who are involved with the topics we are working on, and to make our website even more attractive to external visitors. As for example the interview with Kristalina Georgieva, Commissioner for International Cooperation, Humanitarian Aid and Crisis Response (2008-2014)
- Public deliverables are made available to the general public
- Policy briefs (6) on specific topics available to the general public
- Informative videos with infographics to present ENHANCE and to explain with case studies examples the positive impacts multi-sector partnerships can have.

Booklet

Early on in the project (October 2015) we have developed a booklet, for increasing ENHANCE's visibility at international conferences and events. The booklet contains general information about the project, its case studies and the methods that are used and developed. It also explains concisely the importance of multi-sector partnerships and explain what disaster risk reduction means. This booklet was very helpful in reaching a wider public and to make clear what the project was about.

Policy briefs

A series of policy briefs (6) on variouw topics were developed throughout the project. These were made available via the mailing list, which contains 900 people, and the website. Feedback suggests that these policy briefs were well received as substantive contributions to policy debates to the general public.

Synthesis book

We have published a synthesis book on the final results of the ENHANCE project at VU University press. This book is also available online. The book summarises and shows the key results of the scientific WPs and the case studies.

Social media

Twitter was used by ENHANCE as a part of its dissemination strategy to raise the project's visibility online. For the first half of the project, EBN tried to engage with stakeholders interested in the topics covered by the ENHANCE project and its case studies using the hashtags #enhanceproject and #DisasterRiskReduction. As the results are scheduled later on in the project and as EBN focused mainly on the key deliverables and tasks on the year one of the project, Twitter has not been used extensively. Twitter was mainly used to share information about ENHANCE and the case studies.

Exploitation of results

Our research has inspired, set-off or otherwise informed new research and innovation actions including the Climate-KIC funded pathfinder Cost Adapt (FEEM), the Copernicus Climate Change Services (IVM-VU), and the others. Motivated by our results, the Port of Rotterdam – a private company - has invested more than 200.000 Euro in research to further investigate the risk from flood and climate change. The Wadden Sea Forum, established to advise the Trilateral Wadden Sea Convention, extended its focus to include disaster risk, as a result of the Enhance research. These

are major acknowledgements of the impacts our research has on public and private choices, and a proof of broad knowledge-transfer

Our research contributed to, or has been acknowledged and quoted in several high-level policy reports or documents including the OECD 'Securing water, sustaining growth', the EFDRR Outcome document, the 2016 EEA Report on Flood risks and environmental vulnerability -Exploring the synergies between floodplain restoration, water policies and thematic policies; the Bank of England's 2015 report The impact of climate change on the UK insurance sector, and in the upcoming 2017 EEA Report on Disaster Risk Management and Climate Adaptation policies. Enhance project contributed to the EU Data Loss System initiative under auspices of the Join Research Centre (JRC), and the European Environmental Agency's assessment of the disaster losses in Europe. We have submitted a contribution to the consultation initiated by the UN Open-Ended Intergovernmental Expert Working Group (OIEWG) on Indicators and Terminology. We have provided recommendations of how to integrate and reform various European and international policies on sharing and storing disaster loss data.

ENHANCE was referred to in the EEA's review of the disaster losses in Europe. Furthermore, we have contributed to the consultation initiated by the UN Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology (Mysiak et al., 2015) and developed recommendations on how to integrate and reform various European and international policies on sharing and storing disaster loss data. Finally, the ENHANCE project organized summer schools, capacity building workshops, stakeholder meetings and webinars to engage and bring together young-professionals from the private and scientific domain.

Based on the case study results, the ENHANCE project played a major role in further streamlining the merging realms of Climate change adaptation (CCA) and disaster risk reduction (DRR). For this, the ENHANCE project has been actively engaged with its partner UNISDR in the UN Sendai Framework for Disaster Risk Reduction 2015-2030, the Addis Ababa Action Agenda on risk financing, and the Paris Agreement on Climate Change on climate adaptation (Loss and Damage Discussion). The ENHANCE project contribution can be summarized as; (i) better understanding of risk and evidence-based and risk-informed public policies by introduction new risk assessment methods and data; and (ii) managing risk by means of assessing he pros and cons of novel Multi Sectoral Partnerships (MSPs). This risk-based approach has been actively communicated to high policy level through UNISDR and UNFCCC, but also to the private sector such as Munich RE, Port of Rotterdam and Austrian railways.

Project public website and contact details

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4.2 Use and dissemination of foreground

4.3 Use and dissemination of foreground

Section A (public)

Table 3. A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.

	Template A1: list of scientific (peer reviewed) publications, starting with the most important ones							
	Title	**Main author**	**Title of the periodical or the series**	**Number, date or frequency**	**Year of publication**	**Relevant pages**	**Permanent identifiers[1] (if available)**	**Is/Will open access[2] provided to this publication?**
1.	Evaluating flood resilience strategies for coastal megacities	Aerts, J.C.J.H	Science	344	2014	473-475	10.1126/science.1248222	yes
2.	Identifying the policy space for climate loss and damage.	Mechler, R.	Science	354	2016	290-292.	10.1126/science.aag2514	yes

[1] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[2] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

3.	A lower bound to the social cost of CO_2 emissions	Botzen, W.J.W.	Nature Climate Change	4	2014	253-258	doi:10.1038/nclimate2135	yes
4.	Managing unnatural disaster risk from climate extremes	Mechler, R.	Nature Climate Change	4	2014	235–237	10.1038/nclimate2137	yes
5.	How insurance can support climate resilience.	Surminski, S.	Nature Climate Change	6	2016	333-334	10.1038/nclimate2979	yes
6.	Increasing stress on disaster-risk finance due to large floods	Jongman, B.	Nature Climate Change	4(4)	2014	264-268	10.1038/NCLIMATE2124	yes
7.	Reply to 'Statistics of flood risk'	Jongman, B.	Nature Climate Change	4(10)	2014	844-845	10.1038/nclimate2376	yes
8.	Declining vulnerability to river floods and the global benefits of adaptation.	Jongman, B.,	Proceedings of the National Academy of Sciences of the United States of America,	112 (8)	2015	E2271-E2280	10.1073/pnas.1414439112	yes
9.	Changing mechanism of global water scarcity events: Impacts of socioeconomic changes and inter-annual hydro-climatic variability.	Veldkamp, T.I.E.	Global Environmental Change	32	2015	18-29	10.1016/j.gloenvcha.2015.02.011	yes
10.	Effectiveness of flood damage mitigation measures: Empirical evidence from French flood disasters.	Poussin, J.K.	Global Environmental Change	31	2015	74-84	10.1016/j.gloenvcha.2014.12.007	yes
11.	Climate change: The necessary, the possible and the desirable Earth League climate statement on the implications for climate policy from the 5th IPCC Assessment.	Rockströ m, J	Earth Future	2:12	2014	606-611	10.1002/2014EF000280	yes
12.	The world's road to water scarcity: shortage and stress in the 20th century and pathways towards sustainability.	M. Kummu,	Scientific Reports	6	2016		10.1038/srep38495	yes
13.	Incremental water charging in agriculture. A case study of the Regione Emilia Romagna in Italy.	Perez-Blanco, C.	Environmental modelling & software	78	2016	202–215	10.1016/j.envsoft.2015.12.016	yes

14.	Towards a global water scarcity risk assessment framework: incorporation of probability distributions and hydro-climatic variability.	T I E Veldkamp	Environ. Res. Lett.	11/2	2016		10.1088/1748-9326/11/2/024006	yes
15.	Managing water quality under drought conditions in the Llobregat River Basin.	Momblanch, A.,	Science of the Total Environment.		2015	503-504, 300-318	10.1016/j.scitotenv.2014.06.069.	yes
16.	Key issues for determining the exploitable water resources in a Mediterranean river basin..:	Pedro-Monzonís, M.	Science of The Total Environment		2015	503-504, 319-328	10.1016/j.scitotenv.2014.07.042.	yes
17.	"Water accounting for stressed river basins based on water resources management models	Pedro-Monzonís, M.	Science of the Total Environment	565	2016	181-190	10.1016/j.scitotenv.2016.04.161	yes
18.	The impact of uncertain precipitation data on insurance loss estimates using a Flood Catastrophe Model	Sampson, C. C	Hydrology and Earth Systems Sciences Discussions	11	2014	31-81	10.5194/hessd-11-31-2014, 2014	yes
19.	Definition of efficient scarcity-based water pricing policies through stochastic programming.	Macian-Sorribes, H.	Hydrology and Earth System Sciences	19	2015	3925-3935	10.5194/hess-19-3925-2015.	yes
20.	Sensitivity of water scarcity events to ENSO-driven climate variability at the global scale.	Veldkamp, T.I.E.	Hydrology and Earth System Sciences	19	2015	4081-4098	10.5194/hess-19-4081-2015	yes
21.	Political affiliation affects adaptation to climate risks: Evidence from New York City.	W.J.W. Botzen	Climatic Change	138/Issue 1-2.	2016	353-360	10.1007/s10584-016-1735-9	yes
22.	Multi-hazard assessment in Europe under climate change.	Forzieri, G.	Climatic Change		2016	105-119	10.1007/s10584-016-1661-x.	yes
23.	Incentivising flood risk adaptation through risk based insurance premiums: trade-offs between affordability and risk reduction.	Hudson, P	Ecological Economics	125	2016	1-13	10.1016/j.ecolecon.2016.01.015	yes
24.	Applying recent insights from climate risk management to operationalize the Loss and Damage Mechanism	Schinko, T.	Ecological Economics		2016		10.1016/j.ecolecon.2017.02.008	yes
25.	Combining hazard, exposure and social vulnerability to provide lessons for flood risk management.	Koks, E.	Environmental Science and Policy	47	2015	42-52	10.1016/j.envsci.2014.10.013	yes

26.	'Heimat' as a boundary object? Exploring the potentialities of a boundary object to instigate productive science-stakeholder interaction in North Frisia (Germany).	Döring, M	Environmental Science & Policy	54	2015	448–455	10.1016/j.envsci.2015.08.009	yes
27.	The effectiveness of flood risk communication strategies and the influence of social networks—Insights from an agent-based model.	Haer T.	Environmental Science and Policy	60	2016	44-52.	10.1016/j.envsci.2016.03.006	no
28.	Projection of occurrence of extreme dry-wet years and seasons in Europe with stationary and nonstationary Standardized Precipitation Indices	Russo, S.	Journal of Geophysical Research: Atmospheres	118	2013	7628-7639	10.1002/jgrd.50571	yes
29.	Magnitude of extreme heat waves in present climate and their projection in a warming world	Russo, S.	Geophysical Research Abstracts	16	2014	12500 - 12511	10.1002/2014JD022098	yes
30.	Multinational and large national corporations and climate adaptation: are we asking the right questions? A review of current knowledge and a new research perspective.	Averchen-kova, A.	Wiley Interdisciplinary Reviews: Climate Change	7 (4)	2016	517-536	10.1002/wcc.402	yes
31.	Adaptation portfolios in water management	Aerts, J.C.J.H.	Adaptation Strategies for Global Environmental Change		2014		10.1007/s11027-014-9540-0	yes
32.	A review of water scarcity and drought indexes in water resources planning and management.	Pedro-Monzonís, M.,	Journal of Hydrology	527	2015	482-493	10.1016/j.jhydrol.2015.05.003.	yes
33.	Adapting water accounting for integrated water resource management	Momblanch, A	Journal of Hydrology	519	2014	3369-3385.	10.1016/j.jhydrol.2014.10.002.	yes
34.	The use of AQUATOOL DSS applied to the System of Environmental-Economic Accounting for Water (SEEAW)	M. Pedro-Monzonís	Journal of Hydrology	533	2016	1-14	10.1016/j.jhydrol.2015.11.034	yes
35.	Using ecosystem services to represent the environment in hydro-economic models	A. Momblanch	Journal of Hydrology	538	2016	293-303	10.1016/j.jhydrol.2016.04.019	yes
36.	What if Dutch investors started worrying about flood risk? Implications for disaster risk reduction.	Husby, T.	Regional Environmental Change		2015		10.1007/s10113-015-0769-2	yes

37.	Methodology for drought risk assessment in within-year regulated reservoir systems. Application to the Orbigo River System (Spain).	Haro, D.	Water Resources Management	28	2014	3801-3814	10.1007/s11269-014-0710-3	yes
38.	Estimating flood damage to railway infrastructure – the case study of the March River flood in 2006 at the Austrian Northern Railway.	Kellerman , P.	Nat. Hazards Earth Syst. Sci	15	2015	2485-2496	10.5194/nhess-15-2485-2015	yes
39.	Partnerships for disaster risk insurance in the EU	Mysiak, J	Nat. Hazards Earth Syst. Sci	16(11)	2016	2403–2419	10.5194/nhess-16-2403-2016	yes
40.	Regional disaster impact analysis: comparing input–output and computable general equilibrium models.	Koks, E.E.	Natural Hazards and Earth System Science.	16(8)	2016	1911-1924	10.5194/nhess-16-1911-2016	yes
41.	Sendai Framework for Disaster Risk Reduction – success or warning sign for Paris?	Mysiak, J.	Nat. Hazards Earth Syst. Sci	16	2016	2189–2193	10.5194/nhessd-3-3955-2015	yes
42.	Preface: Flood-risk analysis and integrated management.	Bubeck, Ph.	Nat. Hazards Earth Syst. Sci.	16	2016	1–6	10.5194/nhess-16-1005-2016	yes
43.	An evaluation of flood damage mitigation measures in Germany: A first application of Propensity Score Matching	Hudson, P.	Nat. Hazards Earth Syst. Sci	14	2014	1731–1747	10.5194/nhess-14-1731-2014	yes
44.	Large-scale application of the flood damage model RAilway Infrastructure Loss (RAIL)	Kellerman n, P.	Nat. Hazards Earth Syst. Sci	16(11)	2016	2357-2371	10.5194/nhess-16-2357-2016	yes
45.	The Role of Insurance in Reducing Direct Risk - The Case of Flood Insurance. International	Surminski, S.	Review of Environmental and Resource Economics	7(3–4),	2014	241-278		yes
46.	Structured Coupling of Probability Loss Distributions: Assessing Flood Risk in Multiple River Basin.,	Timonina, A.,	Risk Analysis	35(11)	2015	2102-2119	10.1111/risa.12382	no
47.	Integrating Household Risk Mitigation Behavior in Flood Risk Analysis: An Agent-Based Model Approach.	Haer T.	Risk Analysis		2016	1-16	10.1111/risa.12740	yes
48.	Integrated Direct and Indirect Flood Risk Modeling: Development and Sensitivity Analysis	Koks, E.E.	Risk Analysis	35(5)	2015	882-900	10.1111/risa.12300	yes
49.	Stakeholders' Perception on National Heatwave Plans and Their Local Implementation in Belgium and The Netherlands.	Van Loenhout JA.	Int J Environ Res Public Health.;	13(11)	2016	1120	10.3390/ijerph13111120	yes
50.	General population knowledge about extreme heat: A cross-sectional survey in Lisbon and Madrid.	Gil Cuesta, J.	Int J Environ Res Public Health.;	14(2)	2017	122	10.3390/ijerph14020122	yes

51.	Reflections on the current debate on how to link flood insurance and disaster risk reduction in the European Union.	Surminski, S.	Natural Hazards	79(3)	2015	1451-1479	10.1007/s11069-015-1832-5	yes
52.	The failed-levee effect: Do societies learn from flood disasters?.	R. A. Collenteur	Natural Hazards	76/1	2015	373-388	10.1007/s11069-014-1496-6	yes
53.	Improving flood damage assessment models in Italy.,	Amadio, M.	Natural Hazard	23	2016		10.1007/s11069-016-2286-0	yes
54.	Storm surge risk perception and resilience: a pilot study in the German North Sea coast.	González-Riancho,P	Ocean & Coastal Management	112	2015	40-60	10.1016/j.ocecoaman.2015.05.004	yes
55.	The water abstraction licence regime in Italy: a case for reform?	Santato, S..	Water	8(3)	2016	1–15	10.3390/w8030103	yes
56.	Surprise and Uncertainty. Framing Regional Geohazards in the Theory of Complexity	Ratter, Beate M. W.	Humanities	2(1)	2013	1-19	10.3390/h2010001	yes
57.	Steps towards global flood risk modelling	Hall, J.W.	Journal of Flood Risk Management	7	2014	193–194	10.1111/jfr3.12119	yes
58.	Flood insurance in England - an assessment of the current and newly proposed insurance scheme in the context of rising flood risk	Surmnski, S.	Journal of Flood Risk Management	144	2015		10.1111/jfr3.12127	yes
59.	How resilient is the general population to heatwaves? A knowledge survey from the ENHANCE project in Brussels and Amsterdam	Van Loenhout JA.	BMC Res Notes	9(1)	2016	499	10.1186/s13104-016-2305-y	yes
60.	Moral Hazard in natural Disaster Insurance Markets: Empirical Evidence from Germany and the United States	Hudson, P.	Land Economics	93 (2)	2017	179-208		yes
61.	Making coastal research useful - cases from practice.	Storch, H. von	Oceanologia	57	2015	3-16	10.1016/j.oceano.2014.09.001	yes
62.	Multi-risk, multi-scale and multi-stakeholder – Contribution of the bow-tie analysis in risk management processes in the trilateral	Gerkens-meier B.	Journal of Coastal Conservation		2016		10.1007/s11852-016-0454-8	yes
63.	Optimal management of the Jucar River and Turia River Basins under uncertain drought conditions.	D., Solera,	Procedia Engineering	89	2014	1260-1267	10.1016/j.proeng.2014.11.432.	yes

64.	The Environment, Tourist Transport and the sustainable development of tourism	Ioncică D.,	AMFITEATRU ECONOMIC	18	2016	898-912		yes
65.	Challenging the current climate change – migration nexus: exploring migrants' perceptions of climate change in the hosting country.	de Guttry C.	Die Erde	147 (2)	2016	109-118	10.12854/erde-147-8	yes
66.	Weather indicators for insured hailstorm damage to motor vehicles and potential climate change impacts.	Botzen, W.J.W	Geneva Papers on Risk and Insurance		2015		10.1057/gpp.2015.16.	no
67.	Investigating the risk reduction potential of disaster insurance across Europe.	Surminski, S.	The Geneva Papers on Risk and Insurance Issues and Practice.		2017	1-28	1018-5895	no
68.	Frequency Analysis of Critical Meteorological Conditions in a Changing Climate—Assessing Future Implications for Railway Transportation in Austria	Kellerman n, P.	Climate	4(2)	2016	25	10.3390/cli4020025	yes
69.	River water quality modelling under drought situations – the Turia River case	Paredes-Arquiola, J.	Hydrological Sciences Journal/Journal des Sciences, Hydrologiques	374	2016	187-192	10.5194/piahs-374-187-2016	yes
70.	Assessment of Ecosystem Services and Water Accounting Methodologies for Integrated Water Resources Management in water scarce basins.	Momblanc h			2016		10.4995/Thesis/10251/75523.	yes
71.	Flutversicherung – Wie der Staat und die Versicherer zusammenkommen können (Flood insurance: how public and private sector can collaborate)	Surminski, S	Zeitschrift fuer das Versicherungswesen (Journal of Insurance)	04	2014	105		yes
72.	Zukunftsorientierte Flutversicherung? Gedanken zur Einführung von Flood Re in Großbritannien	Surminski, S.	Zeitschrift für Versicherungswesen	12	2016	382-386	10.13039/501100000269	yes
73.	.Análisis económico del impacto del cambio climático en una cuenca. Caso de estudio: Sistema de explotación Júcar, in University of Cordoba.. La precipitación y los procesos erosivos. Ed. University of Cordoba	Lopez-Nicolas, A	Actas de las IV Jornadas		2015	225-234-	ISBN: 978-84-608-3043-6.	no

74.	Análisis de impactos del cambio climático en las sequías meteorológicas, edáficas e hidrológicas en el sistema de explotación del río Júcar, in University of Cordoba.	Marcos-García, P	Actas de las IV Jornadas.		2015		ISBN: 978-84-608-3043-6.	no
75.	Análisis de riesgos de calidad de agua en ETAPs	Macián Cervera, V.J.	Proceedings of III Jornadas de Ingeniería del Agua,.		2013		ISBN 978-84-267-2071-8	no
76.	The European Union Solidarity Fund: an important tool in the recovery after large-scale natural disasters	Ioncică M.	Romanian Statistical Review	1	2016	69-80	ISSN (online): 1844-7694,	yes
77.	Chapter 15 on Adaptation Planning and Implementation	Surminski, S.,	(contributing author). In: Fields, C. et al. (eds.) IPCC WP2 5th Assessment Report – Impacts, Adaptation and Vulnerability. Intergovernmental Panel on		2014		http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap15_FGDall.pdf	yes
78.	Chapter 17. Economics of Adaptation	Mechler, R.,	Field, Chris et al. (2014). IPCC WGII AR5: Impacts, Adaptation, and Vulnerability		2014		http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap17_FGDall.pdf	yes

Table 4. Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
#	Type of activities[3]	Main leader	Title	Date/ Period	Place	Type of audience[4]	Size of audience	Countries addressed
1	Workshop	IVM	ENHANCE kick off meeting / General Assembly	15&16 -01-2013	Amsterdam	Project partners	*60*	Europe
2	Workshop	IVM	ENHANCE General Assembly	13 to 15-01-2014	Lisbon	Project partners	*50*	Europe
3	Website	EBN	Creation and development of the ENHANCE project, which is constantly updated with news, interviews, press articles mentioning ENHANCE, events and relevant definitions. website. http://enhanceproject.eu			Project partners, scientific community, practitioners, policy makers		
4	9 Interviews published at the ENHANCE website	EBN	http://www.enhanceproject.eu/					

[3] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[4] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

5	Conference	IVM	Global Platform for Disaster Risk Reduction: Enhancing risk management partnerships in Europe	21-5-2013	Geneva	Scientific community, policy makers	*50*	
6	Conference	FEEM	Global Platform for Disaster Risk Reduction: Competitive and disaster resilient business enterprises	19 to 23-5-2013	Geneva	Scientific community, policy makers	100	
7	Workshop	IVM	Enhance Scientific Think Tank meeting 'Public-Private partnerships in Flood Risk Management and Insurance'	12-12-2013	Munich	Scientific community, policy makers,Industry		
8	Workshop	IVM	Social sciences contributing to natural hazard challenges" in Brussels on 22 and 23 October 2012.	22&23-10-2012	Brussels	Scientific community, policy makers	50	
9	Workshop	IVM	Wharton Flood Insurance Workshop	15-07-2013	Philadelphia	Scientific community	25	Europe, USA
10	Workshop	IVM	Swiss Re Flood Insurance Workshop	16-09-2013	Zurich	Industry	25	Europe
11	Workshop	IVM	Dutch Insurers Union Flood Insurance Workshop	15-04-2013	Amsterdam	Industry	50	Netherlands
12	Conference	IVM	3rd National Climate Change Congress of Mexico	17-10-2013	Mexico City	Scientific community	100	Europe, USA
13	Conference	IVM	World Congress of Environmental and Natural Resource Economists	28/06/2014-02/07/2014	Istanbul, Turkey	Scientific Community		Global
14	Summer school	FEEM	Belpasso International Summer School (BISS) Frontiers in Economics of Natural Hazards and Disaster Risk Reduction (DRR)	2 to 9-09-2013	Belpasso or Catania, Sicily, Italy	Scientific community	30	Europe, Australia, Trinidad and Tobago, US

15	Workshop	FEEM	Management of natural hazard risk [Piano della Gestione Rischio Alluvioni - III Forum di informazione]	15-01-2013	Parma	Scientific community	30	Italy
16	Workshop	FEEM	World Water Day, Academia dei Lincei	22-03-2013	Rome	Scientific community	50	Italy
17	Conference	FEEM	Italian Association of Environmental and Resource Economists (IAERE) Conference	13&14-02-2014	Milan	Scientific community	50	Italy
18	Conference	FEEM	European Geophysical Union (EGU) Annual Congress. Session on Costs of Natural Hazards	27 to 30-04-2014	Vienna	Scientific community	100	Europe
19	Workshop	FEEM	Partnerships for flood risk management	18-03-2014	Reggio Emilia	Risk practitioners	20	Italy
20	Workshop	FEEM	Partnerships for drought risk management	29-04-2014	Parma	Risk managers, Drought Steering Commitee	25	Italy
21	Workshop	HZG	CoastDoc Workshop	30-09-2013	Hannover	Scientific community		
22	Conference	HZG	Keynote Speaker at Seminar Climate-Water	24-06-2013	Granada	Scientific community, policy makers		
23	Conference	HZG	ECCA Conference	18 to 20-03-2013	Hamburg	Scientific community, policy makers		
24	Colloquium	HZG	Special lecture on the System Science Colloquium of the University of – Germany (5th February 2014)	5-02-2014	Osnabrück	Scientific community		

25	Colloquium	HZG	Western Indian Ocean Marine Association Workshop	19 to 23-05-2014	Durban	Scientific community		
26	Workshop	IIASA	Presentation at the public hearing on the Reform of the European Solidarity Fund. European Parliament, BEL, Brussels	22-01-2014	Brussels	Policy makers	150	EU
27	Conference	IIASA	Adaptation Futures 2014 conference	12 to16-05-2014	Fortaleza	Scientific community, policy makers	600	Global
28	Workshop	LSE	Workshop on insurance and risk reduction in London	12-07-2013	London	Scientific community		
29	Conference	LSE	Understanding Risks conference	03-07-2014	London	Scientific community		
30	Conference	LSE	Flood Conference	9&10-05-2013	York	Scientific community		
31	Workshop	LSE	Wharton Flood Insurance Workshop,	??-07-2013	Philadelphia	Scientific community		
32	Web blog	LSE	Managing flood risk: Why flood insurance needs to send the right signals. http://blogs.lse.ac.uk/politicsandpolicy/archives/39709					
33	Web blog	LSE	The new flood insurance scheme will not cope with rising flood risk due to climate change and building in floodplains. http://blogs.lse.ac.uk/politicsandpolicy/archives/36482					
34	Interview published at the German insurers website	LSE	http://www.gdv.de/2014/02/wir-brauchen-eine-staerkere-lobby-fuer-hochwasserschutz/					

35	Workshop	UNISDR	European Environmental Agency (EEA) meeting with EU Representatives of the Ministry of Environment and CCA national Focal Points	July-2013	Denmark	Policy makers		
36	Website	EBN	www.enhanceproject.eu	June 2013				
37	Web twitter	EBN	Tweeting/retweeting via the ENHANCE Twitter account with any relevant Enhance / partner news, especially during ENHANCE meetings, #enhanceproject, https://twitter.com/search?f=realtime&q=%23enhanceproject	April 2013		Policy-makers, civil society, media, academics, experts		
38	Web twitter	EBN	#DisasterRiskReduction	April 2013		Academics, policy-makers and civil society		
39	Leaflet version 1t	EBN	2 page Factsheet on ENHANCE project, available on website	05-2013				
40	Leaflet version 2	EBN	4 page leaflet containing main information of the project, distributed under project partners and available on website	04-2014				
41	Article in magazine	EBN	Zeitschrift für Versicherungswesen issue produced an article about ENHANCE. http://enhanceproject.eu/news/articles/40	04 | 2014				
42	E-news alert	EBN	ENHANCE e-news alert. The news alert features the latest interviews and relevant news and events related to the project. Possibility to subscribe on the enhance website: http://enhanceproject.eu			E-news alert	EBN	
43	Seminar	ISA	Organization and oral presentations in the forest insurances	11-12-2013	Lisboa	Policy-makers, civil	60 persons	

			seminar held in the Institute of Agronomy			society, media, academics, experts		
44	News item on website	ISA	Website Agua & Ambiente www.ambienteonline.pt/aguaeambiente					
45	Workshop	UP	Assessing intangible costs organised by the Federal Ministry of Agriculture, Forestry, Environment and Water Management	24-04-2013	Vienna	Scientific community, policy makers	30	Austria
46	Conference	UP	State-of-the-Art for Natural Hazard Engineering (Poster presentation)	23 to 25-04-2014	Vienna	Scientific community, policy makers	NA	Alpine countries
47	Conference	UP	Poster presentation at the 13th "Forum Katastrophenvorsorge"	11 & 12-12-2013	Hamburg	Academics, policy-makers and civil society	200	Germany
48	Workshop	UCAM	2013 ClimateWise Annual Member Meeting - promotion of Enhance to senior insurance industry representatives	9-10-2013	London	Industry		
49	Workshop	UCAM	ClimateWise Managing Committee quarterly meetings - updates on Enhance progress and case studies to senior insurance industry representatives.	07-01-13; 13-05-13	London	Industry		
50	Web	UCAM	Promoted the work of Enhance via the ClimateWise website www.climatewise.org.uk	07-01-13 – 31-07-14		Industry		
51	Web twitter	UCAM	Tweeting/retweeting via the @ClimateWise Twitter account with Enhance / partner news.	03-03-14 – 09-07-14		Industry		

52	Workshop	UCAM	ClimateWise workshop on communicating disaster risk reduction.	03-07-2014	London	Insurance community, academics		
53	Workshop	UPVLC	2nd Workshop on Droughts in the Jucar River Basin	27-06-2013	Valencia	Scientific community, civil society, industry		
54	Conference	UPVLC	Participation with 2 posters and 2 oral presentations in the EGU Conference	Apr. 2014	Wien	Scientific community		
55	Conference	UPVLC	Participation with 1 poster in the 4th SCARCE International Conference	Nov. 2013	Cadiz, Spain	Scientific Community		
56	Conference	UPVLC	Participation with 3 oral presentations in the III Jornadas de Ingeniería del Agua (National conference)	Oct. 2013	Valencia, Spain	Scientific community		
57	Conference	ADV	Jucar river basin's drought" Conference	27-06-2013	Valencia	Scientific community		
58	Workshop	WSF	Stakeholder workshop with Wadden Sea Forum	13&14-02-2014	Rømø	Scientific community, policy makers, civil society		
59	Newsitem on website	WSF	www.waddensea-forum.org/index.php/cooperation/enhance					
60	Seminar	MC	FORRISK seminar on forest insurance	30-04-2014	Bilbao	Landowners, Scientific community, Industry		
61	Workshop	FEEM	WP7/WP2-3 meeting held in Venice, at premises of the	16&17-05-2013	Venice	Project		

			Fondazione Eni Enrico Mattei, Island of San Giorgio Maggiore.			partners		
62	Workshop	FEEM	WP2-WP3-WP7 Case Study Research Meeting held on at premises of the Fondazione Eni Enrico Mattei, Milan	25-09-2013	Milan	Project partners		
63	Workshop	JRC	WP3 Scenario Workshop held successively at premises of the Joint Research Centre	26&27-09-2013	Ispra	Project partners		
64	14 scientific publications		See table 7:overview scientific publications					
65	Workshop	LSE	WP5 meeting	02/06/2014	London	Scientific community,industry		Europe
66	Conference	FEEM	6th IAHS_EGU International Symposium on Integrated Water Resources Management	4-6/06/2014	Bologna	Scientific community	200	Globall
67	Presentation	IIASA	IRDR Conference 2014 – Integrated Risk Science: A Tool for Sustainability	7-9/06/2014	Beijing	Scientific community		Globall
68	Conference	FEEM	Society for Risk Analysis Europe	16-18/06/2014	Istanbul	Scientific community, policy makers, industry	259	Globall
69	Conference		World Congress of Environmental and Resource Economists (WCERE)	29/06-3/07/2014	Istanbul	Scientific community		Globall
70	Presentations	UNISDR	5th annual meeting of the European Forum for Disaster Risk Reduction (EFDRR)	6-8/10/2014	Madrid	Scientific community, practitioners, policy makers		Europe
71	Presentation	IIASA	Water Innovation Europe 2014 Conference - Water in Europe: green tape or blue gold	25-26/06/2014	Brussels	Scientific community,		Europe
72	Meeting	IVM	OECD task force on global water security	02/09/2014	Stockholm	Industry, policy makers,		Global
73	Conference	IVM	Delta conference Rotterdam,	25-26/09/2014	Rotterdam	Scientific community		global

						(research), policy-makers, industry, practitioners		
74	Forum		Public information forum for the revision and updating of the Po river basin district management plan	15/10/2014	Parma	Stakeholders, Policy makers		Italy
75	Workshop	UP	Case study meeting on the Austrian railways	16&17/10/2014	Potsdam, Germany	Project partners and stakeholders (civil society, industry)	6	Austria
76	Seminar	LSE	Extreme Events and Climate Risk Seminar: Cities under siege-extreme events, resilience and the role of insurance	21-27/10/2014	New York City			global
77	Workshop	WSF	Stakeholder workshop with the Wadden Sea Forum	20-21/11/2014	Heide	Project partners, scientific community, practitioners, policy makers		Wadden sea region
78	Conference	FEEM	The water services in Italy: information systems and governance	26/11/2014	Rome	scientific community, policy makers		Italy
79	Conference	LSE	German Insurance Association Annual Meeting	03/12/2014	Berlin			
80	Conference	HZG	Geographische Gesellschaft	3/12/2014	Bremen	Scientific community		Global
81	Conference	FEEM	Society for Risk Analysis Europe - Annual meeting (SRA)	7-11/12/2014	Denver	scientific community, policy makers, industry	Over 200	global
82	Workshop	IVM	General Assembly ENHANCE project	09-10/12/2014	Valencia	Project	30	Europe
83	Workshop	HZG	Stakeholder Meeting Case Study Júcar	10-12/12/2014	Valencia			Spain
84	Workshop	FEEM	Can implementation of the Water Nexus support economic growth in the Mediterranean region?	12-13/2/2015	Ankara	Scientific community,		Europe

						policy makers		
85	Conference	n.a.	Third UN World Conference on Disaster Risk Reduction	12-18/03/2015	Sendai	Scientific community (research), policy makers, civil society		global
86	Parliamentary meeting	LSE	Invited to give evidence on flood insurance at a meeting of the Oireachtas Joint Committee on Finance, Public Expenditure and Reform in the Irish Parliament	15/04/2015	Dublin			Ireland
87	Conference	UP	General Assembly of the European Geosciences Union (EGU)	10-17/04/2015	Vienna, Austria	Scientific community (research)	35	Europe
88	Workshop	HI	1st WMO - VAAC best practise workshop with representatives from all VAACs worldwide as well as representatives from Rolls Royce and IATA.	6-8/05/2015	London	Industry, policy makers, scientific community		Global
89	Conference	WSF	AMK conference: presentation risks of stakeholders in coastal area	6-8/05/2015	Hamburg			Global
90	Conference		Annual Conference Arbeitskreis Meere und Küsten, -	07-08/05/2015,	Hamburg			Germany
91	Conference	n.a.	ECCA Conference	12-14/05/2015	Copenhagen	Project partners, scientific community, practitioners, policy makers		Global
92	Workshop	WSF	Stakeholder workshop with the Wadden Sea Forum	21-22/05/2015	Ameland			Wadden Sea region
93	Workshop	IVM	General Assembly ENHANCE project	08-10/06/2015	Reykjavik	Project partners	50	Europe
94	Presentation	HI	24th Society for Risk Analysis (SRA)- Europe Conference on "Science, Policy and Society – Bridging the gap between Risk	15-17/06/2015	Maastricht	Scientific community		Europe

95	Workshop	LSE	Defra workshop on flood Re scheme and application of the ABM; gain stakeholder insights; and discuss available data.	19/06/2015	London	Scientific community, policy makers		UK
96	Workshop	LSE	European Municipal Insurance Group (EMIG) seminar,	16/09/2015	Dresden			Global
97	Presentation	IVM	EARE conference	24-27/06/2015	Helsinki	Scientific community		Global
98	Conference	LSE	Our common future under climate change. Presentation as part of the 'Risk and Insurance' session '	7-10/07/2015	Paris			Global
99	Workshop	HI	Stakeholder Workshop and scenario run on Vulcanic ash and airtravel	10/07/2015		Industry, policy makers, scientific community		Europe
100	Presentation	LSE	Tyndall assembly	9-11/09/2015	Brighton	Scientific community		UK
101	Conference	IVM	ESSA conference	14-18/9/2015	Groningen	Scientific		Europe
102		LSE	European Municipal Insurance Group (EMIG) seminar,	16/09/2015	Dresden			Global
103	Workshop		Joint Programming Initiative Urban Europe	29-30/09/2015				Global
104	Workshop		Asia and Europe crossing paths on the way to COP21 event	30/09/2015	Paris	Scientific community, practitioners, policy makers		Global
105	Conference		6th annual meeting of the European Forum for Disaster Risk Reduction (EFDRR)	7-9/10/2015	Paris	Scientific community, practitioners, policy makers		Europe
106	Workshop		Committee of the Region Open Days event	13/10/2015,	Brussels			Europe
107	Workshop	WSF	Wadden Sea Forum Future Workshop	5-6/11/2015	Aurich	practitioners, policy makers		Wadden Sea region
108	Conference		Annual Conference Arbeitskreis Meere und Küsten, -	07-08/05/2015,	Hamburg			Germany

109	Conference		Deutscher Kongress für Geographie,	03-04/10/2015	Berlin	Scientific community,		Germnay
110	Workshop		Working group meeting ICZM Wadden Sea Forum (Hamburg: 02.06.2014, 27.11.2014, 26.03.2015; Bremen: 17.09.2015, Oldenburg: 13.10.2015)	2014-2015		practitioners, policy makers		Wadden Sea region
111	Workshop	IIASA	Financing natural disaster losses in the European Union – the role of insurance and the European Union Solidarity Fund	6/10/2015	Brussels	Industry, policy makers, project partners		Europe
112	Workshop	UP	Oral presentation at the DFG Round Table Discussion "Integrated Research for Enhancing the Resilience of Critical Infrastructures through Strategic Assessments and Innovative Planning Approaches"	26 & 27/10/2015	Stuttgart, Germany	Scientific community (research) and policy-makers	25	Germany
113	Conference	IIASA	IDRiM 2015 Conference – Disaster Risk Reduction: Challenges and Opportunities for Sustainable	28-30/10/2015	New Delhi	Scientific community, practitioners, policy makers		Global
114	Workshop	LSE	UK/China seminar on climate insurance,	27/11/2015	Beijing			UK
115	Presentation	HI	NEEDS conference, NORDRESS PhD seminar on Advances in Disaster Research	7/12/2015	Copenhagen	Scientific community		Scandinavia
116	Workshop	HI	Participation at the VOLCEX planning meeting. Representatives from ICAO, VAAC London and Toulouse, several CAA´s, TNT; American Airlines, IATA and more. Full list of attendees in the VOLCEX planning meeting report.	8-9/12/2015	Paris	Industry, policy makers,		Europe
117	Meeting	UNISDR	COP21	30 Nov – 11 Dec 2015				
118	Workshop	UP	"Climate Impact and Loss Data for Europe" University of Potsdam/JPI Climate Workshop	16-17 Dec 2015				

119	Seminar	IVM	"Climate Change and Natural Disasters: Toward a Risk Adaptation Approach" (invited), Seminar, University of Southern California	01/2016	Los Angeles			
120	Meeting	IVM	Enhance yearly meeting	01/13/2016	Innsbruck			
121	Meeting	ISA	Travel to the Santarém district to identify the local Disaster Risk Management measures, discussion with the local stakeholders about this topic	01/19/2016	Santarém			
122	Presentation	UCAM - EN	Presentation to the Cambridge Forum for Sustainability and the Environment.	01/19/2016	Cambridge			
123	Meeting	WSF	Meeting with scientists in the field of climate change adaptation	01/20/2016	Bremen			
124	Meeting	ISA	Travel to the Santarém district to identify the local Disaster Risk Management measures, discussion with the local stakeholders about this topic.	01/25/2016	Santarém			
125	Conference	UNISDR	UNISDR Science and Technology Conference	27/01/2016	Geneva			
126	Workshop	FEEM	EC DG CLIMA workshop on disaster insurance	02/02/2016	Brussels			
127	Meeting	HZG	Wadden Sea Forum	02/10/2016	Oldenburg			
128	Meeting	WSF	Meeting with scientific community to discuss the role of WSF in MSP	02/20/2016	Oldenburg			
129	Meeting	IVM	WP8 meeting	02/17/2016	Milan			
130	Visit	ISA	Field visits to the burned areas	03/2016	Monchique			
131	Visit	ISA	Field visits to the burned areas	03/2016	Tavira			
132	Meeting	UPV	UKIA (irrigation association)	03/02/2016	Petersborough			
133	Meeting	UCAM-EN	City Innovation Platform' meeting. In attendance numerous insurers including Munich Re, Marsh, Santam and Sanlam and global network of sustainable municipalities ICLEI.	03/03/2017	Johannesburg			
134	Meeting	FEEM	EU Loss Data Systems working group meeting	03/11/2016	Ispra			

135	Meeting	IVM	Final meeting with DG CLIMA and ENHANCE management team	03/11/2016	Brussel			
136	Presentation	UCAM-EN	A presentation organized by the Interdisciplinary Climate and Energy Research Group.	03/12/2016	Bergen			
137	Meeting	ISA	Meetings with stakeholder to gather information on forest fire risk evaluation and about the economic instruments	03/21/2016	Villa Real			
138	Meeting	IVM	Meeting for D6.3 and ENHANCE book WP6	03/22/2016	Venice			
139	Visit	ISA	Field visits to the burned areas	04/2016	Serpa			
140	Meeting	ISA	Work with the colleague Anna Timonina to create the probability loss curves related with forest fires	04/2016	Santarém			
141	Meeting	ISA	Meetings with stakeholder to gather information on forest fire risk evaluation and about the economic instruments	04/04/2016	Braganca			
142	Conference.	IVM	ECCA Conference.	04/04/2016	Laxenburg			
143	Conference	ASE	ASE 27th IBIMA conference	04/04/2016	Milan			
144	Conference	IIASA	The annual European geosciences union (EGU)	04/17/2016	Vienna			
145	Conference	IVM	ECCA Conference	04/18/2016	Laxenburg			
146	Conference	IIASA	Understanding Risk Conference	04/18/2016	Venice			
147	Conference	HZG	Annual Conference Arbeitskreis Meere und Küsten	04/20/2016	Warnemünde			
148	Workshop	FEEM	EU-Japan Climate change research workshop	04/24/2016	Tokyo			
149	Meeting	UCAM-EN	Roundtable on 'Investing for Resilience'	05/05/2016	London			
150	Meeting	HI	Participation and presentation at the annual NORDRESS meeting. Full list of attendees in the meeting agenda.	05/09/2016	Copenhagen			
151	Conference	IVM	Adaptation futures 2016 conference	05/10/2016	Rotterdam			
152	Workshop	FEEM	DG CLIMA insurance workshop	05/10/2016	Brussels			
153	Meeting	WSF	Meeting with scientists in the field of climate change adaptation	05/11/2016	Varde			
154	Meeting	FEEM	Union for Mediterranean (UfM) Climate Change Group	05/12/2016	Paris			

			meeting					
155	Forum	FEEM	Understanding Risk Forum 2016	05/16/2016	Venice			
156	Forum	IIASA	Representatives from government agencies, multilateral organisations, the private sector, non-governmental organisations, research institutions, academia, community-based organisations, civil society, and the greater community, with interest in the field of disaster risk identification.	05/16/2016	Istanbul			
157	Conference	UPV	World Environment and Water Resources Conference	05/22/2016	Florida			
158	Conference	HZG	Islands of the World Conference	05/23/2016	Lesbos			
159	Meeting	ORT	Aksentijevic, Schöbel	05/23/2016	Sibenik			
160	Summit	IIASA	World Humanitarian Summit	05/23/2016	Istanbul			
161	Conference	ADV	CERICS Conference + coordination meeting	05/27/2016	Hamburg			
162	Conference	UNISDR	Fondazione Centesimus Annus Pro Pontifice International Conference on the Business Initiative in the Fight Against Poverty	06/2016	Vatican City			
163	Questionnaire	ISA	Adaptation of the heat waves questionnaire for the Portuguese and Spanish reality and application of it in Lisbon	06/2016	Lisbon			
164	Conference	UNISD	Re-launch of the Making Cities Resilient Campaign	06/2016	Florence			
165	Conference	ASE	International conference on non-bank finance	06/02/2016	Bucharest			
166	Meeting	FEEM	Stakeholder meeting Italian Environmental Protection Agency	06/07/2016	Rome			
167	Workshop	IVM	WONV workshop present ENHANCE work	06/10/2016	Bordaeux			

168	Meeting	UCAM-EN	Meeting to discuss insurance role in sustainable and resilient infrastructure	06/13/2016	Bellagio			
169	Seminar	UPVLC	Seminar on Droughts in the Júcar River Basin	06/15/2016	Valencia			
170	Forum	UNISDR	European Development Days	06/15/2016				
171	Forum	FEEM	High Level Forum “Implementing Sendai Framework at Local Level”	06/16/2016	Florence			
172	Conference	HI	Society for Risk Analysis conference. Participation and oral presentation.	06/20/2016	Bath			
173	Conference	IIASA	EAERE conference	06/23/2016	Zürich			
174	Meeting	FEEM	Stakeholder meeting Prime Minister Office Coordination unit on flood risk	06/27/2016	Rome			
175	Meeting	HZG	Wadden Sea Forum	06/27/2016	Hamburg			
176	Conference	ASE	International conference on marketing and business development	06/30/2016	Bucharest			
177	Forum	UNISDR	EU Civil Protection Forum. Civil protection community; participants from governments, academia, civil protection authorities, first emergency responders, int’l organisations, European Institutions and stakeholders	07/2016	Brussels			
178	Conference	IIASA	IRDR Conference	07/2016	Beijing			
179	Meeting	FEEM	Stakeholder meeting Green finance and climate adaptation	07/06/2016	Milan			
180	Conference	UCAM-EN	ICLEI Resilient Cities conference. Presentation on insurance and resilient cities.	07/06/2016	Bonn			
181	Workshop	UCAM-EN	‘City Innovation Platform workshop’. Multiple private and public sector participants.	07/10/2016	Dar es Salaam			
182	Meeting	FEEM	Stakeholder meeting Prime Minister Office Coordination unit on flood risk	07/18/2016	Rome			

183	Conference	tbc	The 6th International Disaster and Risk Conference (IDRC)	08/28/2016	Davos			
184	Conference	HZG	British Royal Geographic Society Annual International Conferenc	08/30/2016				
185	Conference	UCL	28th Conference of the International Society of Environmental Epidemiology	09/01/2016	Rome			
186	Meeting	IVM	Meeting with other researchers at the KIT	09/08/2016	Karlsruhe			
187	Meeting	FEEM	Stakeholder meeting Climate KIC Italy	09/08/2016	Bologna			
188	Forum `	UCL	Discussion forum for relevant stakeholders in Belgium and the Netherlands on heat and health.	09/09/2016	Brussels			
189	Conference	HZG	Annual Science Conference	09/19/2016	Riga			
190	Workshop	HZG	Workshop on landscape research	09/22/2016	Hamburg			
191	Seminar	IVM	"Why Flood Insurance and Risk Mitigation Are Complements", Seminar (invited), University of California, Santa Barbara	09/2016	Santa Barbara			
192	Meeting	IVM	Stakeholder meeting Business partner network	30/09/2016	Milan			
193	Forum	FEEM	European Forum on Disaster Risk Reduction	10/03/2016	Helsinki			
194	Forum	HZG	Wadden Sea Forum 29th Plenary	10/13/2016	Husum			
195	Conference	IVM	ECMWF	10/18/2016	Hook			
196	Conference ,	UOXF	FLOODRisk - 3rd European Conference on Flood Risk Management Innovation, Implementation, Integration	10/18/2016	Lyon			
197	Congress	IVM	"Individual Flood Preparedness Decisions During Hurricane Sandy in New York City" (invited keynote speaker) 6th National Climate Change Congress of Mexico, UNAM,	10/2016	Mexico City			

198	Presentation	IVM	"Klimaatverandering: Risico's en Kansen om te Innoveren voor Verzekeraars" (invited), presentation for the board and 300 top managers of insurance company Achmea	10/2016	Tilburg			
199	Seminar	IVM	"Flood Risk Assessment and Management in New York City", Seminar (invited), Texas A&M University	10/2016	Galveston			
200	Conference	UOXF	Flood Risk	10/2016	Lyon			
201	Meeting	HI	Participation at the VOLCEX exercise at Eurcontrol.	10/11/2016	Brussels			
202	Conference	UNISDR	The UN International Day for Disaster Reduction	10/13/2016	Online			
203	Meeting	IVM	'coastal management'	10/16/2016	Los Angeles			
204	Conference	FEEM	Italian Society for Climate Sciences (SISC) conference	10/19/2016	Sassari			
205	Workshop	HI	Organization and conduction of workshop on how to organize stakeholder workshops.	10/20/2016	Copenhagen			
206	Visit	ISA	Travel to visit the Wildland Urban Interface areas to study the community's preparedness pilot program against forest fires	10/23/2016	Guarda			
207	Meeting	FEEM	OECD & EC meeting on loss data systems	10/26/2016	Paris			
208	Visit	ISA	Travel to visit the Wildland Urban Interface areas to study the community's preparedness pilot program against forest fires	10/30/2016	Viseu			
209	Seminar	UOXF	HEEDNet seminar on Surface water flood risk management and flood insurance under future climate change - Insights from an Agent-Based Model	11/01/2016	London			
210	Meeting	FEEM	Stakeholder meeting Drought Steering Committee Po River Basin	11/10/2016	Parma			

211	Meeting	HZG	Wadden Sea Forum	11/15/2016	Bremen			
212	Meeting	HI	Participation at the Debrief meeting of the Volcex exercise.	11/16/2016	Reykjavik			

Section B (Confidential or public: confidential information to be marked clearly)

Part B1, The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

Template B1: List of applications for patents, trademarks, registered designs, etc.					
Type of IP Rights[5]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
NONE					

[5] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2 Please complete the table hereafter:

Type of Exploitable Foreground[6]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[7]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
	Ex: New superconductive Nb-Ti alloy			MRI equipment	1. Medical 2. Industrial inspection	2008 2010	A materials patent is planned for 2006	Beneficiary X (owner) Beneficiary Y, Beneficiary Z, Poss. licensing to equipment manuf. ABC
NONE								

In addition to the table, please provide a text to explain the exploitable foreground, in particular:

Its purpose

How the foreground might be exploited, when and by whom

IPR exploitable measures taken or intended

Further research necessary, if any

Potential/expected impact (quantify where possible)

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[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[7] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

4.4 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information (completed automatically when Grant Agreement number is entered.	
Grant Agreement Number:	308438
Title of Project:	ENHANCE
Name and Title of Coordinator:	Prof.dr. J.C.J.H. Aerts

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	0Yes XNo
2. Please indicate whether your project involved any of the following issues (tick box) :	YES
Research on Humans	
Did the project involve children?	
Did the project involve patients?	
Did the project involve persons not able to give consent?	
Did the project involve adult healthy volunteers?	
Did the project involve Human genetic material?	
Did the project involve Human biological samples?	

Did the project involve Human data collection?	
Research on Human embryo/foetus	
Did the project involve Human Embryos?	
Did the project involve Human Foetal Tissue / Cells?	
Did the project involve Human Embryonic Stem Cells (hESCs)?	
Did the project on human Embryonic Stem Cells involve cells in culture?	
Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
Privacy	
Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
Did the project involve tracking the location or observation of people?	
Research on Animals	
Did the project involve research on animals?	
Were those animals transgenic small laboratory animals?	
Were those animals transgenic farm animals?	
Were those animals cloned farm animals?	
Were those animals non-human primates?	
Research Involving Developing Countries	
Did the project involve the use of local resources (genetic, animal, plant etc)?	
Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
Dual Use	
Research having direct military use	0 Yes X No
Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men

Scientific Coordinator	0	1
Work package leaders	2	5
Experienced researchers (i.e. PhD holders) 63	21	42
PhD Students	12	7
Other		

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	30
Of which, indicate the number of men:	17

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	X	Yes
	O	No

6. Which of the following actions did you carry out and how effective were they?

	Not effective		at all		Very effective
❑ Design and implement an equal opportunity policy	O	O	X	O	O
❑ Set targets to achieve a gender balance in the workforce	O	O	O	O	O
❑ Organise conferences and workshops on gender	O	O	O	O	O
❑ Actions to improve work-life balance	O	O	O	O	O

O Other: Where possible encouraged women researchers to take a leading role, and aimed to have equal men and women presentations at sessions we organised

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

O Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

O Yes- please specify

	X No	
9.	Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?	
	X Yes- please specify	E-learning tool, and short animated videos on the website
	○ No	
F	Interdisciplinarity	
10.	Which disciplines (see list below) are involved in your project?	
	X Main discipline[8]: 1.4	
	X Associated disciplines[8]:4.1, 5.2, 5.4	
G	Engaging with Civil society and policy makers	
11a	Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	X Yes ○ No
11b	If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?	
	X No	
	○ Yes- in determining what research should be performed	
	○ Yes - in implementing the research	
	○ Yes, in communicating /disseminating / using the results of the project	
11c	In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ Yes ○ No
12.	Did you engage with government / public bodies or policy makers (including international organisations)	
	○ No	
	X Yes- in framing the research agenda	
	X Yes - in implementing the research agenda	
	X Yes, in communicating /disseminating / using the results of the project	
13a	Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?	

[8] Insert number from list below (Frascati Manual).

X Yes – as a **primary** objective (please indicate areas below- multiple answers possible)

○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)

○ No

13b If Yes, in which fields?

Global: Disaster risk reduction (e.g. developing and implementing Sendai framework) , Insurance,

Loss and damage

Europe: Reduction impacts of volcanic eruption on flying, the use of the EU Solidarity fund

National/local: Forest fire risk reduction, flood risk reduction, reduction in Alpine railway risk

Agriculture	X	Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	X
Competition		Environment	X	Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	X
Customs	X	Fisheries and Maritime Affairs	X	Regional Policy	X
Development Economic and Monetary Affairs		Food Safety		Research and Innovation	X
Education, Training, Youth		Foreign and Security Policy		Space	
Employment and Social Affairs		Fraud		Taxation	
		Humanitarian aid		Transport	X

13c If Yes, at which level?

X Local / regional levels

X National level

X European level

X International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	78
To how many of these is open access[9] provided?	71
How many of these are published in open access journals?	
How many of these are published in open repositories?	
To how many of these is open access not provided?	7
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available X no suitable open access journal available X no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[10]: ……	

15. How many new patent applications ('priority filings') have been made? ("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).		0
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	0
	Registered design	0
	Other	
17. How many spin-off companies were created / are planned as a direct result of the project?		0
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	❑ In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project

[9] Open Access is defined as free of charge access for anyone via Internet.

[10] For instance: classification for security project.

X	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs: Difficult to estimate / not possible to quantify	Indicate figure: 70 FTE on manmonths has been worked on this project by all the partners. ❑

I	Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

X Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

X Yes ○ No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
❑	Media briefing	X	Coverage in general (non-specialist) press
X	TV coverage / report	X	Coverage in national press
X	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	X	English
X	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

Fields of science and technology

1. Natural Sciences

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 Engineering and technology

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. Medical Sciences

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. Agricultural sciences

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. Social sciences

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. Humanities

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]