



emBRACE

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Summary of case studies of the emBRACE project

Deliverable 5.1

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About emBRACE

The primary aim of the emBRACE project is to build resilience to disasters amongst communities in Europe. To achieve this, it is vital to merge research knowledge, networking and practices as a prerequisite for more coherent scientific approaches. This we will do in the most collaborative way possible.

Specific Objectives

- ⇒ Identify the key dimensions of resilience across a range of disciplines and domains
- ⇒ Develop indicators and indicator systems to measure resilience concerning natural disaster events
- ⇒ Model societal resilience through simulation experiments
- ⇒ Provide a general conceptual framework of resilience, tested and grounded in cross-cultural contexts
- ⇒ Build networks and share knowledge across a range of stakeholders
- ⇒ Tailor communication products and project outputs and outcomes effectively to multiple collaborators, stakeholders and user groups

The emBRACE Methodology

The emBRACE project is methodologically rich and draws on partner expertise across the research methods spectrum. It will apply these methods across scales from the very local to the European.

emBRACE is structured around 9 Work Packages. WP1 will be a systematic evaluation of literature on resilience in the context of natural hazards and disasters. WP2 will develop a conceptual framework. WP3 comprises a disaster data review and needs assessment. WP4 will model societal resilience. WP5 will contextualise resilience using a series of Case studies (floods, heat waves, earthquakes and alpine hazards) across Europe (Czech Republic, Germany, Italy, Poland, Switzerland, Turkey and UK). WP6 will refine the framework: bridging theory, methods and practice. WP7 will exchange knowledge amongst a range of stakeholders. WP8 Policy and practice communication outputs to improve resilience-building in European societies.

Partners

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- ⇒ University of Northumbria at Newcastle (UoN) - **UK**
- ⇒ King's College London (KCL) - **UK**
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1. Introduction

This report intends to summarize some of the key empirical findings of the case-study work conducted in the emBRACE-project. It is based the Deliverables summarized in table 1.1. For more information of the single case study reports please go consult the actual case study reports (www.embrace-eu.org).

Deliverable Nr.	Title of report	Authors
Del. 5.2	Resilience and River Floods in Central Europe	Kuhlicke et al.
Del 5.3	Earthquakes in Turkey	Karanci et al.
Del 5.4	Alpine Hazards in South Tyrol (Italy) and Grison (Switzerland)	Pedoth et al.
Del 5.5	Heat-waves biophysical and social aspects	Grimmond et al.
Del 5.6	Floods in Northern England	Deeming et al.

Table 1.1: Overview on case study report

Table 1.1 indicates that the single case studies focused on different hazards, namely floods, earthquakes, alpine hazards (i.e. landslides) and heat-waves, engaged with different management and governance settings across Europe and are situated in different economic, social and cultural settings. This makes comparison of case study results in the strict sense a challenging if not impossible endeavor, this all the more as the single case studies followed to certain extent different methodological approaches (for an overview see single Deliverable submitted in Work Package 4 – www.embrace-eu.org) and are hence based on different data and methods (see see table 1.2), have developed and are shaped by different epistemological emphases (not to mention disciplinary differences). Furthermore, also seemingly similar concepts do not necessarily mean the same in different cultural contexts – implying interpretative equivalence should not be taken for granted. For example, while in some cultures renting a home is considered as a sign of lower social status (e.g. in the UK), in others (e.g. Germany) this interrelation is not as strong—rental housing is widespread also among middle and partly even upper classes. Hence, homeownership does not have the same meaning in terms of status in different cultural contexts and the indicator does not allow for assuming interpretative

equivalence¹. There are furthermore many many ‘immaterial’ aspects, such as local knowledge, culture, traditions, norms and mores, which shape the resilience of communities at risk, these factors are hard to grasp and even more difficult to measure. Therefore this report aims at outlining common themes that run through all or at least some of the reports summarized in table 1.1. Section 2 summarizes the central research questions/interests as well as the main empirical findings. Section 3 then proceeds with elaborating on some of the common themes that I was able to identify.

Deliverable Nr.	Title of report	Methods/empirical basis of the case studies
Del. 5.2	Resilience and River Floods in Central Europe	<ul style="list-style-type: none"> - 26 semi-structured interviews with representatives of municipalities, local disaster agency, regional governments and planning agencies; - A survey with 990 questionnaires received back from flood affected households in Saxony (Germany); - An additional survey with 390 questionnaires received back from flood affected households in Bavaria (Germany);
Del 5.3	Earthquakes in Turkey	<ul style="list-style-type: none"> - 90 in-depth interviews with disaster survivors and members from relevant organisations; - 8 focus group interviews with staff of local public organisations and NGOs; - Survey with 360 questionnaires received back from disaster survivors;
Del 5.4	Alpine Hazards in South Tyrol (Italy) and Grison (Switzerland)	<ul style="list-style-type: none"> - A survey with 1096 questionnaires received back the community of Badia (South Tyrol) - Additional semi-structured interviews with representatives of relevant organisations in the case study region
Del 5.5	Heat-waves biophysical and	<ul style="list-style-type: none"> - 49 semi-structured expert interviews with risk planning officials from local authorities

¹ Kuhlicke, C., et al. (2011). "Contextualizing social vulnerability: findings from case studies across Europe." *Natural Hazards* **58**(2): 789-810.

	social aspects	and NHS organisations in London; - 33 semi-structured interviews and 43 structured interviews conducted with independent elderly people, community center managers, carers and local government officer;
Del 5.6	Floods in Northern England	- 65 interviews with affected individuals, representatives of government organisations as well as service-delivery organisations; Participant observation at 7 Community-Resilience focused events;

Table 1.2: Overview on methods employed in the case studies and empirical basis of case study findings

2. Summary of findings from the emBRACE case-studies

This section provides an overview on the central research questions as well as the main empirical findings.

2.1. River floods Central Europe

The case study on river floods in central Europe focused on the State of Saxony (Germany). In 2002, Saxony experienced a major flood event resulting in 8.7 Billion of euro. The 2002 flood was followed by series of smaller, regional but still devastating flood events such as the 2006 flood at the upper parts of the Elbe River and the 2010 flood at the Neiße River and finally the 2013 flood resulting again in approx. €1.9 Billion of financial damages. As a consequence of the 2002 flood and subsequent repeated smaller flood events, Saxony started to rethink its approach to flood management. The case study focuses on the following aspects/questions.

- Flood experience and resilience: How and to what extent does the very experience of “repeated” flood events lead to fundamental learning processes

on the one hand and to the “erosion of resilience” of resilience on the other hand?

- Protection, private mitigation and resilience: How effective are behavioural, constructive (building), and financial (i.e. insurance) preventive actions in increasing the resilience of individual households and to what extent are they able to mitigate lacking (technical) protection of entire communities?
- Responsibilisation and resilience: How do exposed households perceive their own responsibility in flood management, how should responsibilities be distributed between private and state actors and how is this interlinked with the very experience of flood events and the resilience of households?
- Trend towards inclusive decision-making: How does the experience of a flood event increase or decrease the motivation to participate in decision-making processes and to what extent does it influence the resilience of households?
- Disaster management and change: How is the performance of disaster management affected by a whole range of change how can we identify the performance limits by setting up an agent-based model?

The Deliverable 5.2 “Resilience and River Floods in Central Europe” shows how in many communities learning processes were triggered by the 2002 flood, processes that resulted in an increased preparedness in subsequent flood events. However, learning was clearly on improving the operational and technical procedures within existing institutional structures and hence on incremental changes.

After the 2013 flood the analysis reveals more fundamental learning processes. In general the perception of the threat potential of the flood risk has changed considerably in consequence of the 2013 flood. While after 2002 the focus was on improving the existing flood management systems (e.g. new and better dikes, improved warning systems, improved emergency management), the 2013 flood shattered the idea quite substantially that increased effectiveness and efficiency will reduce the risk of flooding, at least on the local level. Many communities, quite openly, admit that the risk of flooding is not reducible to zero through improving the established approach, on the contrary flood event as the ones in 2002 or 2013 can happen on a quite regular basis. In this sense, the reflection and learning processes in consequence of the 2013 flood are more fundamental and question, to a certain extent, not only the dominant, institutionalized way of how floods are managed, it

also questions the very relation between settled/urbanized areas, the way such areas are protected and the role and prospective “behavior” of the river and its surrounding floodplain.

The relevance of learning is also underlined by the results of the household survey; which at the same times points towards the limits of individual learning, more general to the limits of individual actions and responsibilities. Many households in the exposed areas have experienced multiple flood events since 2002, some of them up to three or even four floods in 11 years. Households that were strongly affected by the flood also report more often to have implemented private mitigation and also more often purchased an insurance against natural hazards. They also feel better prepared with each flood event.

However, the results do not suggest that such measures helped to reduce the negative consequences, to reduce the time to return to normality and did not help to be similar or better off than before the flood event compared to those households that took no measures. This implies households that took private mitigation measures since they experience multiple flood events have also experienced high negative consequence, have taken longer to return to normality and are worse off than those who have taken no measures. There is hence a positive correlation between high impact and active engagement with regard to preventive activities. This report hence suggests no straightforward relationship between mitigative actions and household resilience. We think this relationship should be explored more in-depth; all the more as households are increasingly demanded to protect themselves. Whether this is actually effective for building up the resilience of households is quite often taken for granted (“yes, it does”); however the findings of this study suggest no direction positive correlation.

More important with regard to resilience than actual actions is the feeling of protection. Respondents with lower impacts also reported more often to feel well protected. The level of protection and the perceived level of protection correlates directly with the actual technical protection and shows a strong correlation with the impact/ability to bounce back: The lower the perceived level of protection the higher the economic damages, the more severe the perceived overall, physical and psychological consequences, the longer it takes a household to return to normality and the more often its household situation was similar or worse than before the flood event. Similarly respondents who feel well prepared also reported less severe consequences. The proportion of financial support received after the flood events

seems to have a positive influence on the general household situation in consequence of flood events: Household that received higher proportion are more often similar or better off than household that received less financial support. Also the satisfaction with the compensation received (and interestingly not the actual proportion of compensation received) correlates with the resilience of households. The lower the actual impacts the higher the satisfaction with monetary compensation received after the flood events.

The report underlines the relevance of the findings, as through the establishment of risk-based prioritisation measure the socio-spatial inequality with regard to protection schemes will further increase. Quite often, the less protected households are left behind with the demand to protect themselves. As the result of this study suggest: the effectiveness of such individualised approaches may be quite limited with regard to mitigating the immediate consequences and the long-term impacts on a household.

This leads to questions of responsibility and inclusive decision-making processes. Households that perceive the implementation of private mitigations as a matter of course have also more often taken actual action both before and during flood events. Households that feel well prepared also tend to agree with the statements that see private mitigation as a matter of course and that citizens should take over more responsibility in flood protection. Self-efficacy and attitudes towards responsibility also strongly correlate: Respondents with high self-efficacy see private mitigation as matter of course and agree with the statement that individuals should take over more responsibility; at the same time they more often disagree with the statement that private mitigation overwhelms people, that citizens can do nothing about floods and with the statement that flood protection is a public and not a private duty.

A decisive variable shaping attitudes towards responsibilities is the actual flood experience. Whilst households with multiple flood experience tend to agree with the statements that private mitigation overwhelms people and that flood protection is a public and not a private duty; they also agree with the statements that individuals should take over more responsibility in flood protection and that private mitigation should be a matter of course. Experience and self-efficacy play hence a large role in whether respondent are likely to perceive that private actors should take more responsibility. What it shows is that many people believe that private actions make sense and should be undertaken. However, it also shows that such a responsibility

overwhelms people. Not everyone is convinced that private actions can make a difference.

With regard to inclusive decision-making, households that were severely affected by past flood events considered participation to be more relevant than those less affected. They were also more willing to take the time and would like to contribute with their knowledge and personal experience to participatory processes. In addition, respondents who had experienced repetitive flood events were also less likely to agree with the statement that flood management should be left to the experts and that participatory processes could be dominated by individual interests. The report also unravels significant correlations between the actions taken by a household before and during a flood event as well as the evaluation of the relevance of participation and a household's attitudes towards it. Households that took action before the event to mitigate impacts either through private mitigation measures or through purchasing insurance against natural hazards were more likely to believe that they have the appropriate knowledge required to take part in such a process and were also more likely to take the time to become involved. An interesting variable in this context is the question which explores the respondent's satisfaction with the momentary compensation after the single flood events. Respondents who reported lower degrees of satisfaction were more likely to express interest in contributing to participatory processes. At the same time, respondents with higher satisfaction values agree with the statements that support leaving flood management to the experts. They were also more likely to agree with the statements that were focused on in the media after the 2013 (e.g. individual interests may dominate participative processes and slow down planning and implementation of measures, admittedly the correlation is of relatively low and of weak significance).

The agent-based model set up in the case study has shown that change has several effects on the performance of DMOs, but throughout all analyses the major driver that determines coping time are the number of organisations. If demographic change leads to shortages in available helpers and a loss in DMOs, the performance that is expected from disaster management might not be guaranteed anymore. Even tried and tested routines might then fall short under such circumstances. We have seen that for example information availability can be a crucial factor to overcome shortages in helper numbers in some cases but this does not alleviate all shortcomings. Civil volunteers are a relevant group of actors that need to be

incorporated into future planning for disaster management, but more detailed analysis is needed here to obtain a clearer picture.

In sum, Del. 5.2 has started to specify some of the connections between flood experiences, attitudes towards the distribution of responsibility and the participation in flood management as well as the consequences of long-term changes and what consequences this might have for the resilience of households, organisations and communities at risk.

2.2. Earthquakes in Turkey

The case study on earthquakes in Turkey focused on two case sites, one with a recent quake experience (Van, 2011) and the other having a more remote experience. There were two main focus of the case study.

- Evaluating how community and individual psychological resilience was perceived by individuals from the community, members of non-governmental organizations, local governmental institutions, and municipalities with a recent and remote earthquake experience.
- Evaluation of the long-term recovery processes and how resilience of the systems changes over time in the context of earthquakes experienced in different geographical regions of Turkey and in different time periods.

The research generally aimed to cover the perceptions of resources and capacities, action, and learning elements of the main refined framework for resilience.

The results of the extensive case work in the two sites, employing in-depth interviews, focus group discussions, and a quantitative survey, revealed a rich number and variety of indicators perceived by the stakeholders and survivors as related to individual and community resilience. The majority of the indicators were related to resources and capacities elements of the framework, and appeared to be applicable to all the elements of actions and to a lesser extent to learning. Thus, rather than finding indicators that are specific to certain elements of actions and learning, the results revealed resources and capacity indicators that generally may relate to individual and community resilience.

The results showed that “political peace, equality, and a culture of no corruption” is a context defining resource and capacity that emerged from in-depth and focus group

interviews from both of the sites. The issue of political peace, having equality amongst citizens and NGOs, and lack of corruption, which all seem to affect trust, appeared as a robust indicator of community resilience in both case sites. The emphasis on political peace and equality seemed to penetrate all areas of disaster risk management, ranging from the aid distribution (e.g., fair distribution of aid, absence of nepotism) to the accreditation of NGOs (e.g., not making distinctions based on political affiliations), to recovery activities (e.g., damage assessment procedures, provision of permanent housing), and to building inspections. Therefore, this contextual characteristic seems to be a prerequisite for ensuring good governance, risk mitigation, and preparedness activities.

As for resources and capacities, socio-political (e.g., having good governance, specific disaster legislation, supervision of the implementation of legislation, coordination and cooperation, being a civic society, having mutual trust, having moral and cultural traditional values, etc.) and human (e.g., gender, income, education, personality characteristics [neuroticism, extraversion, optimism, satisfaction with life, etc.], etc.) resources and capacities were the most pronounced ones obtained from the case study. Although some of these were specifically related to certain elements of actions, such as response (e.g., having an effective provision of post-disaster aid and services), recovery (e.g., provision of temporary accommodation/shelters and permanent housing after an earthquake, etc.), mitigation (e.g., having proper implementation of legislations/regulations for disaster risk mitigation), and preparedness (e.g., having hazard risk awareness and being prepared), some others were general indicators of community resilience (e.g., having a legal foundation and specific legislation for disaster risk management, having effective governance of disaster risk management system, etc.) which applied to all action elements. Since the case study focused both on the social and individual characteristics that are perceived to be related to both community and individual resilience, the emergence of individual characteristics such as personality traits (e.g., optimism, extraversion) and individual demographic characteristics (e.g., education, income, etc.) provided a rich understanding of facilitators of both community and individual resilience. Social support appeared as an indicator of individual psychological resilience, thus, pointing out that social resources and capacities may support individual level resilience. The same is true for resources at the individual level affecting community resilience, such as having a spirit of volunteerism, which in turn can feed into being a civic society, thus, contributing to social resources.

Indicators related to financial (e.g., having catastrophe insurance, having financial resources for preparedness and mitigation, etc.) and physical (e.g., having earthquake-resistant buildings, having transportation networks, etc.) resources were relatively fewer compared to the sociopolitical and human resources. This may be related to the focus of the case study on community resilience, which may have suppressed the reporting of financial and physical assets. “Having earthquake-resistant buildings” is an important indicator in the physical resources and capacities domain and understandably this is an important indicator of community resilience for earthquake hazard. However, the mechanism to ensure that there are earthquake-resistant buildings and the supervision of construction and legal codes also appeared as sociopolitical resources.

Among the learning elements, problematizing risk/loss, critical reflection, risk/loss perception, experimentation and innovation, and dissemination all appeared as indicators which were grouped in our results under the relevant resources and capacities elements. Promotion of disaster research appeared as an interesting indicator for learning.

All the results from the case work pointed out that earthquake survivors and stakeholders perceive community and individual resilience as related to a vast array of indicators. Furthermore, the interrelations between these indicators seem to be very dynamic, an earthquake experience in one region of the country leading to learning mostly by the state and change and the adoption of new legislation and new organization for disaster management. Such an experience seems to have very robust effects on attitudes towards disasters, changing the focus from disaster management to disaster risk management. The same change process seems to apply to individuals as well, although to a smaller extent, in that an earthquake experience leads to an increase in hazard awareness. However, from our case work it appeared that this change at the individual level may not be sustainable and significant forgetting may occur. Therefore, it is important to keep the vividness of these experiences for the community members. Thus, overall, especially for the state institutions, the impact of a past event may lead to significant changes in disaster risk management, such as the introduction of an insurance system, the development of urban renewal and transformation projects, the facilitation of NGOs, which in turn is likely to contribute to fostering of community resilience. The case study highlights the relevance of the context on the different elements contributing to resilience of households and communities at risk.

2.3. Alpine Hazards in South Tyrol (Italy) and Grison (Switzerland)

The small alpine community of Badia was hit in December 2012 an exceptionally big landslide. The municipality being located in a very landslide-prone area has experienced several events in the past, one big landslide event in exactly the same area in 1821. This case study was therefore particularly interested in people's risk perception and if risk perception increased after the recently experienced event. Furthermore, risk perception was scrutinized as a major factor that influences people's motivation to support or implement preparedness, prevention and adaptation measures in the context of natural hazards. Nevertheless, at the same time people tend to be less worried about risks they know and they are familiar with. Besides risk knowledge and past experience, this case study also aimed at investigating which other factors such as values, attitudes and feelings as well as cultural determinants influence natural hazard perception and risk attitudes. These aspects are of particular value for the case study community as it belongs to a linguistic and cultural minority within the region of South Tyrol.

The research questions of the case study can be summarised into two groups. The first is focusing in risk perception and investigates the following questions:

- How did the population of Badia perceive the landslide event in 2012?
- Which aspects influence peoples' risk perception?
- How did the risk perception change due to the event in 2012?
- What is the role of local knowledge and past hazard experience for community resilience?
- How did people perceive the interventions carried out by authorities and organisation in response to the landslide event?

The second group of research questions looks at the role of social networks for community resilience and addresses the following questions:

- How are present responsibilities and relationships between authorities and between persons in charge for natural hazard management shaped?
- How do networks within the population interact with the network of organisational actors and the community of supporters?

- How do social and policy networks influence the resilience of communities?

Empirical findings of the case study show that people have high risk awareness, they are aware of living in an area of high risk and they know about past hazard events, some of them experienced them personally while the majority has heard or read about it. Nevertheless, results show that before 2012 they did not expect a real event happening and as a consequence did not actively prepare for it by undertaking preparedness measures. While risk awareness is positively correlated with the age of respondents, elderly people being more aware of living in a high risk area, the perceived risk for future landslides event is not related to age and is distributed in a similar way among all age groups: the most common answer was that they did not expect such an event happening. In line with these results is also the fact that people do not perceive themselves, as individuals, responsible for the mitigation and protection against natural hazards and the knowledge about existing mitigation and protection measures is quite low. Indeed, people have a high trust in authorities and civil protection actors and perceive them as responsible for mitigation and protection measures. The event experienced in 2012 had a huge impact on peoples' risk perception, showing an increase especially for people that were affected directly by the landslide and for people that live in close proximity to the landslide area.

Results of the case study work show the importance of local and traditional knowledge for resilience building. The most important information sources for past hazard knowledge are other village members and family, resulting more important than media. While media are more used by young people, surprisingly there is no difference by age groups for family and village members, being these the most important information sources also among young people. The family and the community show to be also an important information source after an event happening. In December 2012 people used them as much as the media to obtain information.

Being part of the community and having a strong family network, as well as with the other members of the community, and therefore having access to information coming from "real faces", resulted to be very important for forming community identity. The feeling of community belonging and the strong presence of social networks proved to be very important as a crucial support to deal with the impacts of natural hazard events and to contribute positively to community resilience.

The case study looked at the interactions between the population and the community of supporters and how people perceived the period after the event. It also considered the activities carried out by authorities and supporters. Results show that people are satisfied with the way authorities and supporters dealt with the event, particularly with the coordination of action forces. Also results from the interviews with key actors of the community of supporters point in the same direction and confirm the well functioning and good management of the response phase. This is partly due to the fact that in the first days and weeks after an event happening, the public and media attention is high and during this period additional resources and funds are available. This is true for financial and human resources, but also in terms of solidarity and sympathy. In fact, results show that 16 months after the event the satisfaction with provided information and recovery actions decreased. In terms of resilience, it is important to look not only at the short term after a disaster, but also to the mid and long term. Moreover, it is essential to foresee and improve strategies for the mid and long term, especially concerning information, because the impacts on peoples' risk perception, their feelings of danger and concern about future hazards last beyond the first weeks and months after an event happening.

Results from the social network mapping and analysis show that there is a high connectivity between the geographical community of Badia and the community of supporters. The results of the population network, showing to which organization people go for help and support in case of an event, reflect well and are coherent with the actions foreseen inside the existing local emergency plans. All results from the different analysis carried out for the network, such as frequency, centrality and importance of actors, show that the two most important actors are the volunteer fire brigade and the municipality of Badia. Both of them are locally based and people working for them are not only members of the community of supporters but also members of the community they support. In terms of resilience, this confirms the importance of the local presence on the territory and the interconnection between the geographical community and the community of supporters: knowing people working in the organization increases trust, and being part of the community people support leads to a better understanding of their needs and perceptions. These two elements are crucial for crises situations.

The results of the mapping and analysis of the organizational network carried out with key actors of the community of supporters show a highly interlinked core network involving actors from different organizational scales (local, provincial and

national). The individually drafted maps show a high level of coherence, revealing that the actors have a similar view of the network, which is very important in a crises or disaster situation. Additional key factors for resilience turned out to be the existence of a local civil protection plan and regular emergency exercises, the fact that the core network needs little time to become active and fully operative, as well as the personal knowledge and trust in the other members of the network. Thanks to these characteristics, the network resulted to be very resilient with no missing links or marginalized members.

One could argue, and it could be interesting for further research, that some of the characteristics that proved to be positive for resilience in this circumstance could also weaken the stability and the resilience of the network under other circumstances. The fact for example that the network is “highly personalized” and actors know and trust each other could become critical for the network if one or more of the actors is not available or has to change.

The study focused on the network and its functioning after the landslide event in 2012. Results are also valid for other kind of hazards, because its structure and underlying regulations are the same and should guarantee more in general the protection of people and goods. The composition of its members can vary slightly according to the type of hazards and include additional experts. Despite this wider validity of the network and its hazard independency, its experiences are strongly linked to alpine hazards and therefore linked to well-known hazards. It would be interesting for further research to understand if the network performs in the same way and results resilient even if confronted with unknown hazards.

It is the main aim of the Grisons case study report to investigate how resilience indicators at the local level can be developed. The emphasis was hence rather on methodological issues than on collecting empirical findings, therefore the reader should consult the Deliverable directly (see Del 5.4 for more insights).

2.4. Heat Waves in London

The aim of case study on heat-waves in London was to analyse the key controls on heat-waves in Greater London and the impact of governance to individual behaviours including support networks in the context of heat-wave resilience in the city. The case-study report therefore both addresses social science and biophysical science

approaches to heat-waves. It contains relevant information on observations and modelling results as well as the findings of social science work, along with interviews of vulnerable groups in London that highlight the importance of social networks in urban resilience.

The bio-physical analysis focuses on the assessment of the conditions directly influenced by heat-waves. This was undertaken by using long-term synoptic meteorological data and specialised urban flux observations that allowed identifying the outgoing long-wave radiation and the net storage heat fluxes as those most perturbed. Unexpectedly, the turbulent sensible heat flux does not exhibit a strong signal, for this flux there appears to be compensation in the temperature gradients.

SUEWS, and urban land surface model was evaluated and shown, overall, to simulate well the surface energy balance fluxes. It was and to undertake simulations at borough scale spatial resolution for Greater London. Higher spatial resolution modelling can yield insights into those areas that are being exposed to greater thermal stress. The reports conclude that undertaking modelling at even higher spatial resolution (e.g. wards or grids of the order 1 km²) is warranted as it will provide even greater insights into areas that may be exposed to greater risk. Combining this data with social characteristics (e.g. elderly isolated people), would allow those most needing attention to be identified for priority attention.

The modelling tool also allows analysis of numerous attributes of the urban environment to evaluate their effects on risks and exposure. Thus it has the potential as a powerful tool to assess if different proposed governance actions are likely to positively or negatively impact exposures and those who are at risk.

The work has allowed a wide range of other areas of work, particularly in the realm of biophysical model development to be identified that would be useful areas of exploration and/or development and include: running the model for more extreme conditions; running it at higher resolution, with greater attention to variations in anthropogenic heat flux (day and night; weekdays and weekends) and individual (agent-based) controls; more detailed consideration of the properties and energy response of building materials; use of indoor temperatures to better understand emissions and gradients; considering variations in albedo and emissivity with different radiation conditions; transit times of weather systems across a city, particularly if concerned with rain or cloud and specific timing of events..

The social study addresses community resilience through work aimed at better understanding the social framing of communication, learning and behaviour change. To do this research is undertaken from two viewpoints.

- First from the viewpoint of local authority risk managers to understand the ways in which social relationships mediate in allowing borough level officers to perform their responsibilities for heatwave risk management and reduction.
- Second, from the viewpoint of the vulnerable elderly and from this position including accounts of risk communication, learning and behaviour change led or mediated by carers, family members and responsible local authorities.

In this way both questions connect with analysis on the performance of local authorities – the administrative units behind the Borough level analysis developed in the biophysical research.

An important context for the research conducted in the London Heat-wave case study is the dominant policy framing for heatwave risk management in London (and the UK more generally). The field of medicine has played a crucial role in defining vulnerability and impact to heat-related risks, which in turn has solidified the notion of individual wellbeing as predominantly health related. This argument is then extended to the impact the medicalization of heat-related risk and its quantification and rationalisation has had on policy discourse. The evidence presented in the case study report challenges such an approach through the integration of non-quantitative results, which reflect everyday experiences of public administration and institutional dimensions of social learning in the production of heatwave management.

The results of the analysis suggest that learning in organisational heat-wave planning in London unfolded as incremental change in established risk management approaches. Learning consolidated existing heat-wave plans at the local level, reinforced the status-quo and can thus be associated with rigidity, rather than with change. Social learning was constrained by the interaction of formal and informal institutions. Shadow institutions such as trust relationships and networks supported formal risk planning arrangements to function. In the short-run, this added flexibility to disaster risk planning because it provided opportunities to deliver risk management even if formal strategies were dysfunctional or failed. However, support from trust relationships and informal networks seemed to consolidate existing heat-wave planning strategies in the long-run and thus stabilised, rather than challenged them. Informal institutions of the shadow system were not used to innovate local risk

planning, explore alternatives to existing strategies and to propose paradigm shifts in heat-wave risk management.

The analysis found that local heat-wave plans in London were modelled on the National Heat-wave Plan. They framed heat-wave risk through a focus on public health and emphasised preparedness and response, rather than prevention. A shift towards preventive risk management strategies that acknowledge social, environmental and technical dimension of heat-wave risk was identified as an opportunity for deep social learning. Findings from the analysis indicate a gradual emergence of such a learning process: Some respondents acknowledged that the optimisation of existing risk planning strategies had its limits, and pointed to the need to develop preventive risk planning that goes beyond public health considerations. Transformation was constrained, however, by low risk perception, organisational cultures of fire-fighting, and a reliance on events as catalysts for change. This role of events suggests an element of uncertainty and randomness in transformation, and highlights limited agency in deep social learning processes in disaster risk management.

Second, the report analyses how the concepts of loneliness, vulnerability and social network take shape in the life of the elderly during periods of heat extremes in London. This allows the report to reconfigure how resilience is materialised at the community level in the life of those normally defined as vulnerable, and will contrast with a definition of resilience viewed solely through the logic of risk prevention.

The research has also demonstrated that most interviewees were aware of what to do during a period of heat-wave and tended to develop their own coping strategies, independent of others. There is also a sense of resilience, very well ingrained in the generation that was surveyed and interviewed, whereby people have generally developed their own way of coping with problems; they deal well with tensions and stresses and have developed a particular relation to time that seems to take them closer to a philosophy of “take it as it comes” which contradicts the preparedness logic normally prioritised by the state and the HWP.

The elderly have also shown a great need of independence, which, as has been documented elsewhere, often prevents them to seek further information. There is a general feeling that they know what to do with the heat and that the state is not in tune with their needs.

The report has suggested that there is a need to better document elderly people's everyday life, so that the ways in which advice is sent to them might be transmitted through their social network and community centres. This is important, as they tend to put much more trust in their social networks than in information produced the state recommending what they should do.

2.4. Floods in Northern England

The floods that occurred in January 2005 and November 2009 are the most recent examples of extreme flooding in Cumbria. Several towns, villages and rural areas were affected in 2005, with Carlisle experiencing ~3,500 homes flooded and considerable disruption to energy and communications infrastructure. The 2009 floods are the focus of this research. Aims of the case study were to

- To identify the resource sets required by a community to build resilience toward flood events and the capacities required to mobilise these resources.
- To assess how social factors such as trust, accountability, cooperation, power and influence interact to influence the mobilisation of resources.
- To devise indicators for components of the resource sets, action phases (mitigation, etc.) and social learning dimensions, which are at the heart of the emBRACE general framework.

In respect to the first project aim, the research confirmed a complex mix of resource and capacity sets that comprise the core of community disaster resilience and identified that, while civil protection dimensions remain key facilitators, they cannot effect fully resilient outcomes unless developed in concert with the broader formal social protection objectives and alongside a cohort of engaged community members. The report on "River Floods in Northern England" report has corroborated the understanding that, even in the close spatial confines of a short river catchment, different geographical communities need to access and utilise different resource sets and capacities to maintain their resilience to hazards. There are, however, some resources/capacities that were identified as particularly relevant:

The engaged Communities of Resilience Practice (CoRP), comprising statutory agencies and representatives of the hazard-exposed populations, offers significant potential in working collaboratively toward disaster-risk reduction outcomes at these

catchment scales. A challenge is also offered however in the way that CoRP's have been identified as requiring a truly inclusive remit. This involves the formal agencies understanding and supporting each other's roles, in deliberating and delivering a full range of capacity-building civil- and social-protection solutions that reflect sustainable, equitable and achievable outcomes at every point along the Integrated Emergency Management spectrum (i.e. not just preparedness and response) and for all communities they serve. From this perspective the report should be regarded as an illustration that Cumbria Resilience Forum's CoRP offers an example of good practice that could be emulated.

A strong-advocacy centred mode of social-networking led campaigning was also evident. Whether it was reflected in the FAGs persistence in developing location-specific emergency plans and advocating for various structural and non-structural risk mitigation measures, or in local-commerce focussed organisations intent on returning their businesses to profitability, or in partnerships of land-owners and managers working to ensure their land remained as productive as possible, the role of social networks engaging in the process of risk-mitigation was clearly evident. From the perspective of the emBRACE framework, it was clear that resilience, in terms of the communities' capacity to achieve effective actions (Preparedness, Response, Recovery, Mitigation) is well evidenced, within a complex and largely complementary mix of approaches to flood risk mitigation, even if those actions are more effective for some than for others.

Furthermore, and revealed through social network maps, the complex lateral bonding and bridging nature of key individuals' social networks within a geographically hazard-exposed community was identified as a key resource/capacity. The research shows how effective some of these people are at linking hierarchically into power relationships; often on first-name terms via key boundary actors and brokers within formal governance institutions. The potential role of people like this, in both the community and within the formal 'protective' organisations, in facilitating concerted community engagement with risk mitigation and resilience building should not be underestimated or devalued. However, the evidence also shows that this engagement can come at considerable personal cost to these people, especially if they have been directly hazard affected themselves. Furthermore, if so much of a community's resilience is based on one or a small number of individuals, does this not also point to a vulnerability, or at least a lack of redundancy at its heart, which the

presence of strong, accountable, institutionalised support services ('social protection' broadly understood) can go some way to alleviate?

Social and organisational learning was also identified as a key process in the case study. The natural-hazard governance context was shifting in Cumbria prior to 2009 event. An earlier wide-area flood in 2005 had already exposed many in the county to high-consequence flood effects and the social and organisational learning this experience had precipitated was already leading to close collaborations between the previously hazard affected and still exposed population and the risk-managing authorities. After the January 2005 event, a number of Flood Action Groups (FAGs) had already started to develop effective response measures in close collaboration with the emergency services and LRF.

It was furthermore found that to build trust in FRM bureaucratic processes and civil protection procedures at a catchment scale, which inevitably encompasses a range of communities with varying access to resources and capacities, requires a dynamic appreciation of balance and social equity. Without this there is a risk that isolated and vulnerable communities will be left to spectate as those with louder voices, greater savvy and more political linkage receive more investment (e.g. financial, emotional, temporal), simply because they are more able to manipulate the 'rules of the game' in their own favour. Such challenges lie at the heart of the social equity concerns that underpin the Sustainable Livelihoods Approach.

Austerity and the intense competition for the financial resources in the UK Government's Flood Risk Management (FRM) budget provided a backdrop against which many smaller communities were being encouraged to do what they could for themselves. Even large physical schemes in England now seek a community contribution, but this case study describes how one such scheme has come to fruition. This was achieved through concerted efforts by the town's Flood Action Group, enabled and facilitated by the local authority and other flood-management agencies. The fact that physical defence structures formed such a focus of attention cannot, however, be ignored from a resilience perspective. This is because one should be cognisant of the conclusive critique in the literature regarding the tendency of structural measures to increase rather than to reduce flood risk. In terms of resilience in the Derwent catchment, however, it remained the presence or lack of engineered solutions that went furthest toward underpinning people's psychological ability to manage the risks to which they remain exposed.

Taking a Sustainable Livelihoods Approach (SLA) this case study can also identify that a full range of resources and capacities were mobilised by the flood-affected population, with different resources being vital in the development of action-based responses that reduced the risk of disaster. Whether such disaster threatened at the scale of a household or a community, the ‘resourcefulness’ exhibited by many community members, as well as people in governance positions, illustrated an admirable capacity for civil protection, but also concern over more the time-extended well-being (i.e. social protection) of this population; as was evidenced by the local authority staff’s brokering role in coordinating the 3rd Sector activities during the long months of the recovery period. Whilst a range of management techniques and technologies have been deployed, principal amongst all measures adopted by town residents was the focus on the protective role of concrete, metal and glass as components of structural defence measures. This focus on hazard management (i.e. rather than risk management), has been critiqued since the mid twentieth century. However, it appears that the legacies of place-based and other resources that are situated along this (and probably many other catchments in Europe) are of such value (financial, economic, cultural, even ontological) that there is little public appetite for doing anything other than defending the built environment largely as is.

3. Common themes in the emBRACE case-studies

3.1 Community resilience – a multi-faceted context specific construct

The results of the extensive case work in the different case-studies underlines that community resilience is a construct shaped through a complex mix of resource and capacity sets, based on a multitude of actions, all of them linked to learning processes and embedded in wider governance frameworks that interact within specific localities. In all case studies, at least implicitly, the relevance of socio-political context conditions was highlighted. This underlined the relevance of good governance, specific disaster legislation, supervision of the implementation of legislation, coordination and cooperation, involvement of the civic society, building mutual trust and trust.

Yet, there are also clearly context-specific emphases that have been identified. The Turkish case study revealed that the majority of the indicators selected were related

to resources and capacities elements of the framework, and appeared to be applicable to all the elements of actions and to a lesser extent to learning. In Turkey the relevance of “political peace, equality, and a culture of no corruption” emerged as a context defining resource and capacity and was thus identified as a robust indicator of community resilience in the case sites. The North England case study emphasizes that while civil protection dimensions remain key facilitators, they need to be accompanied with the broader formal social protection objectives and alongside a cohort of engaged community members.

3.2. Hazard experience and learning: incremental, fundamental or limited?

All case studies report that learning processes had occurred on various levels, mostly in the direct context of actual disastrous events. The experience of hazard events was usually accompanied by increased risk awareness among residents and organisations alike. In the German case study households that were heavily affected by the flood also report more often to have implemented private mitigation and also more often to have purchased an insurance against natural hazards. They also feel better prepared with each flood event. Learning also occurred on the level of organisations and institutions with the adoption of new measures, implementation of new legislation and new forms of how hazard and risk management is institutionalised and with changing attitudes. However, case study results also underline that learning processes may be limited. First, since they are not sustainable and significant, forgetting may occur in relatively short time spans after the actual hazard experience. Second, learning processes may be rather incremental with a focus on increasing the effectiveness and efficiency within existing structures. In this sense learning rather consolidated existing plans at the local level, and hence reinforced the status-quo.

The London case study highlights how social learning was constrained by the interaction between formal and informal institutions. Shadow institutions such as trust relationships and networks supported formal risk planning arrangements in functioning. In the short-run, this added flexibility to disaster risk planning because it provided opportunities to deliver risk management even if formal strategies were dysfunctional or failed. However, support from trust relationships and informal networks seemed to consolidate existing heat-wave planning strategies in the long-run and thus stabilised, rather than challenged them. Informal institutions of the

shadow system were not used to innovate local risk planning, explore alternatives to existing strategies or to propose paradigm shifts in heat-wave risk management.

The Case study on floods in Central Europe, however, highlights that more fundamental learning processes can be observed, although mostly on the local level and hardly accompanied by state efforts. The 2013 flood shattered some of established ideas about flood management quite substantially. From this, reflection and learning processes in consequence of the 2013 flood are more fundamental and question, to a certain extent, not only the dominant, institutionalized way of how floods are managed, it also questions the very relation between settled/urbanized areas, the way such areas are protected and the role and prospective “behavior” of the river and its surrounding floodplain. As a result, new socio-spatial formations of community development are thought about. Also the London case study illustrates that more fundamental learning processes occur. The report understands the shift towards preventive risk management strategies that acknowledges social, environmental and technical dimensions of heat-wave risk as an opportunity for deep social learning. Yet, more research is necessary to better understand to what extent incremental learning processes may help of increase the resilience of communities, where they reach their limits and what helps to initiate more fundamental learning processes in a sustainable manner.

3.3. Resilience and the idea of protection

The idea of protection has come under critique in recent discourses on risk management and resilience. It is stated that the idea of protection is either misleading (“100% is not possible”) or even reinforcing the problem (e.g. the levee-effect). However, the case study work underlines the relevance of feeling and actually being protected, at least from the point of view of those exposed to various flood hazards. Whilst in all the flood case studies a range of management techniques and technologies have been deployed, principal amongst all measures adopted by town residents was the focus on the protective role of concrete, with most of it forming components of structural defence measures. The German case study highlights that with regard to resilience the feeling of protection is a decisive driver of being resilient. Respondents with lower impacts also reported more often to feel well protected. The level of protection and the perceived level of protection correlates directly with the actual technical protection and shows a strong correlation with the

impact/ability to bounce back: The lower the perceived level of protection the higher the economic damages, the more severe the perceived overall, physical and psychological consequences, the longer it takes a household to return to normality and the more often its household situation was similar or worse than before the flood event. The report on Floods in North England comes to similar conclusions, but makes an additional direct connection between the presence of structural measures and the availability of insurance, which is also perceived as a key resilience indicator.

These findings have some relevance as through the establishment of risk-based prioritisation measures in many areas across Europe, which are quite often accompanied with intense competition for the financial resources, the socio-spatial inequality with regard to protection schemes will further increase. Quite often, the less protected households are left with the only option being to protect themselves. As the result of our study the effectiveness of such individualized approaches should be critically examined as they may be quite limited with regard to mitigating the immediate consequences and the long-term impacts on a household. The fact that physical defence structures formed such a focus of attention cannot, however, be ignored from a resilience perspective. In terms of resilience it is quite often the presence or lack of engineered solutions that went furthest toward underpinning people's ability to manage the risks to which they remain exposed.

3.4. Cooperation and the question of responsibility

The case study report highlights the relevance of cooperation and participation and started to engage with what resilience-building implies with regard to shared responsibilities.

Particularly for the idea of community resilience, social support and cooperation appeared as key variables at the intersection of individual psychological resilience and the resilience of the wider community. While social resources and capacities may support individual level resilience, individual resources such as having a spirit of volunteerism can feed into community resilience. This is highlighted both in the Turkish case study as well as in the London case study. Also the South Tyrolean case study reveals that being part of the community and having a strong family network, as well as bridging links with the other members of the community resulted to be very important in forming community identity. The feeling of community belonging and the strong presence of social networks proved to be very important as

a crucial support to deal with the impacts of natural hazard events and to contribute positively to community resilience.

Also the close interaction between formal and informal networks is highly relevant to community resilience. Results from the social network mapping and analysis conducted in South Tyrol show that there is a high connectivity between the geographical community of Badia and the community of supporters. As the two most important actors the volunteer fire brigade and the municipality of Badia were identified; both of them are locally based and people working for them are not only members of the community of supporters but also members of the community they support. Similarly, in Northern England, the engaged Community of Resilience Practice (CoRP), comprising statutory agencies and representatives of the hazard-exposed populations, offers significant potential in working collaboratively toward disaster-risk reduction outcomes. In terms of resilience, this confirms the importance of the local presence on the territory and the interconnection between the geographical community and the community of supporters: knowing people working in the organization increases trust, and being part of the community people support leads to a better understanding of their needs and perceptions. These two elements are crucial for crisis situations.

Yet, the northern England case study also underlines that network and cooperation structures are quite often dependent on single individuals, which might weaken the stability and the resilience of the network under other circumstances. The fact for example that the network is “highly personalized” and actors know and trust each other could become critical for the network if one or more of the actors is not available or has to change.

While cooperation seems intuitively a good thing, it is closely interlinked with the normative question of how responsibilities should be distributed and hence accountability of decisions made ensured if a multitude of actors are involved in hazard management. Some of the case studies therefore started to explore attitudes towards responsibility. The South Tyrolean case study shows that people do not perceive themselves, as individuals, responsible for the mitigation and protection against natural hazards. Indeed, people have a high trust in authorities and civil protection actors. Similarly, the German case study underlines that attitudes towards responsibilities are closely interlined with the actual flood experience. Whilst households with multiple flood experience tend to agree with the statements that the idea of private mitigation overwhelms people and that flood protection is perceived as

a public and not a private duty. What it shows is that many people believe that private actions make sense and should be undertaken. However, it also shows that such a responsibility overwhelms people. Not everyone is convinced that private actions can make a difference when it comes to form and build-up individual resilience.

emBRACE

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