



THE VALUE OF CROSS-BORDER EMERGENCY MANAGEMENT IN ADAPTING TO CLIMATE CHANGE



Dr. Conor Murphy, Ms. Caroline Creamer, Dr. Andrew McClelland and Prof. Mark Boyle

Adapting to climate change is challenging in border regions where emergency situations can become amplified on a cross-border basis. Such amplification is largely the result of more agencies becoming involved in the response; groups that are often geographically dispersed, bring more divergent agendas to the 'table' and are often less well acquainted with each other. However, acting to build adaptive responses across international borders serves to increase resilience and decrease vulnerability to climate change. Over the coming decades climate change is likely to increase flood risk. On the island of Ireland, border regions are amongst the most vulnerable to hazards such as flooding. Developing effective cross-border emergency management will require collaborative planning, capacity building and innovative leadership. This paper sets out the urgency of adapting to climate change in border regions and provides an overview of progress and capacity building in moving towards greater shared services in border communities in Ireland.

Introduction

Anthropogenic climate change will pose profound challenges to society over the coming decades. Adapting to climate change will involve transformational change, requiring significant capacity to be empowered, to act, and to be resilient in the face of increasing risk (O'Brien *et al.*, 2009; Adger *et al.*, 2009; Adger *et al.*, 2013; Twigger Ross *et al.*, 2014). Adapting to climate change is seen as most challenging in close proximity to international boundaries. However, acting to build adaptive responses across international borders serves

to increase resilience and decrease vulnerability to climate change (Wilder *et al.*, 2010). Challenges for adaptation in border regions stem from emergency situations which are likely to be amplified on a cross-border basis as 'more participants become involved, while participants tend to be more dispersed, have more divergent agendas and are less well acquainted with each other' (Ansell *et al.*, 2010). Furthermore addressing climate change in border regions will involve new and transformational forms of collaborative planning that stretch current governance arrangements and institutions.

With increasing greenhouse gas emissions, the island of Ireland will face significant risks as a result of climate change, especially in the areas of fluvial, coastal and pluvial flooding. Across the island, recent extreme events have highlighted our vulnerability to such conditions. Winter 2013/14 brought unrelenting storms and rainfall and is likely the stormiest winter on record in the domain of Ireland and the UK (Matthews *et al.* 2014). Floods in November 2009 affected much of the island with record insurance losses (see Figure 1). While it is a challenge to link these events to human driven climate change, they uncover our vulnerability to weather extremes driven by a high level of exposure.

On the island of Ireland, border regions are amongst the most vulnerable to hydro-climatic hazards such as flooding. Recent floods have exacted a heavy toll on communities and individuals in Fermanagh and Tyrone; with Strabane, for example, showing acute socio-spatial



Figure 1: Flooding in Carrick-on-Shannon, Co. Leitrim in November 2009



(Source: Leitrim County Council, 2009)

flood vulnerability. Economic development over the past decade and a half has been frustratingly slow and border communities continue to exhibit acute and high levels of socio-spatial disadvantage (AIRO, 2014). Historically, the border region has suffered from a lack of joined-up thinking and action - including around shared environmental issues and climate adaptation. Whilst the Peace Process has bequeathed cross-border

cooperative mechanisms these remain fragile and embryonic.

The role of emergency management in reducing current and future losses from floods is widely recognised. Among the border counties, Fermanagh has a particularly high exposure to flooding, especially along the heavily managed Lough Erne system. In October and



November 2009 widespread flooding had a profound influence on life in the county at both individual and community level. In a review of the 2009 floods, a cross-departmental taskforce established by the Office of the First Minister and Deputy First Minister (OFMDFM) concluded that flood risk in Fermanagh cannot be eliminated through engineering approaches alone. It went on to recommend that all organisations engaged in flood response should ensure that emergency plans and networks are further developed to deal with the consequences of future serious flooding (OFMDFM, 2010). Additionally, the importance of maintaining essential services to local communities, particularly emergency services and contingency plans, during times of flood was highlighted, together with the need to ensure preparedness and information on assets exposed to flooding.

Against this backdrop and cognisant of the fact that climate change will not respect borders, this paper aims to provide an overview of ongoing development of cross-border relationships in emergency management. It builds on the work undertaken in 2014 where the International Centre for Local and Regional Development (ICLRD) and the All Island Research Observatory (AIRO) collaborated with the recently established Cross Border Emergency Management Working Group (CBEMWG) to develop institutional capacity in coordination and liaison arrangements in cross-border emergencies. Such innovative, and indeed transformative, approaches to managing extreme events underpin effective adaptation to climate change through building cooperative strategies to increase capacity and resilience to extreme events in some of the most vulnerable regions of our island.

A future with more floods

Climate change is expected to result in increases in flood risk across the British-Irish isles. While there is limited research, to date, that examines observed and projected changes in climate on an island of Ireland basis, some is beginning to emerge. For instance, Murphy *et al.* (2013) developed a hydrometric reference network of river flow gauges for the Republic of Ireland (heretofore referred to as Ireland). Such networks identify the best available river flow measurements that are free from confounding factors such as urbanisation, land-use change etc.

and thus can be used for examining climate signals in river flow records. In their analysis, Murphy *et al.* (2013) combined their network with reference stations in Northern Ireland that comprise the UK benchmark hydrometric network. The analysis of changes in floods across 43 catchments on the island revealed that significant increasing trends are apparent, particularly since the early 1990s. Such increasing trends are likely a manifestation of natural climate variability but nonetheless indicate an increase in the magnitude of floods over the last decade and an half. Long-term rainfall records also support this idea of a wetter, more flood prone island. Noone *et al.* (2015) developed a homogenised, long-term rainfall network for the island of Ireland which comprises 25 monthly rainfall gauges, both North and South of the border, dating from 1850-2010. Again, analysis of trends in this very valuable long-term series indicates a strong signal of wetter winters and drier summers over the full period of record.

In terms of projected changes in flooding over the coming decades no research has been carried out on an island of Ireland basis. However, work done in both jurisdictions, together with broader scale European analyses, suggest that continued wetting will result in increased flood risk; the magnitude of floods is likely to increase, while flood events are likely to occur more frequently. In particular, increased flooding is likely to be associated with increases in extreme rainfall events. While we generally associate flooding with fluvial forms i.e. river flooding, other types of flooding are also identifiable. These include pluvial flooding, which is associated with large amounts of surface runoff due to heavy rainfall that typically exceeds the infiltration capacity of the surface; and groundwater flooding, which is typically associated with long rainfall events that cause the water table to reach the surface for prolonged periods of time. Flooding is also associated with failure of infrastructure and joint events in coastal areas where storm surges can combine with sea level rise and onshore flooding to cause extensive damage in coastal areas.

For Ireland, Murphy (2014) has assessed the likely changes in flooding for various catchments. While results are dependent on how emissions of greenhouse gases



Figure 2: Storm Desmond flooding on Lifford/Strabane Bridge (Donegal/Strabane border) and in Castlefin, County Donegal in 2015



(Source: Donegal County Council, 2015)



are likely to evolve over the coming century (i.e. the successfulness of global mitigation strategies), individual catchment properties such as land-use and soil type, and on methodological choices such as which Global Climate Model employed, the overall indication is of increased flooding. In many catchments it is suggested that floods that are experienced once every one hundred years at present are likely to occur as frequently as once every twenty years or so by the middle of this century. Given the similar hydrology North and South of the border, it is not a great leap to assume that similar changes can be expected for flooding in Northern Ireland also.

Particularly noteworthy of recent flood events has been their large spatial extent; the 2009 floods and their wide spatial influence spring to mind, as well as the winters of 2013/14 and 2015/16 (see Figure 2). Both of these island-wide floods were driven by exceptionally cyclonic conditions. Cyclones are essentially the mid-latitude equivalent of tropical hurricanes. Across the UK and Ireland as much as 70 percent of total winter rainfall can be derived from the passage of such storms. Indeed these islands find themselves located right on the storm track all year round. Of high importance then to understanding flood risk under climate change is to understand how the characteristics of the storm track and individual cyclones is likely to change. While there is uncertainty over this, the consensus is that storms are likely to become more intense in a warmer world. Therefore, the risk of megafloods - floods that are large in spatial extent and affect multiple sectors at the same time - is likely to increase in future.

Meeting future challenges: adapting to climate change

Given the likelihood of increased flood risk, furthering efforts to adapt to climate change is essential. There are multiple definitions of adaptation in operation within the vast climate change literature. One of the most widely used is that of Smit *et al.* (2001) who define adaptation as:

"adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and

*structures to moderate potential damages or to benefit from opportunities associated with climate change (Smit *et al.*, 2001: 879).*

This definition, used by the Intergovernmental Panel on Climate Change (IPCC), draws attention to the technologies, regulations, policies and practices that enable society to live with change. In terms of timing, adaptation can be both reactive and anticipatory. In terms of the latter, emphasis has been placed on developing adaptation strategies for specific sectors or resource systems, the production of tools to help decision-making processes and planning in developing policy measures. One limitation of such conceptualisations of adaptation is that they are incremental; adding to systems that are already in place. For systems in which vulnerability is high and risk exceeds resilience, continued functioning of the system may only be possible through transformational adaptation.

Recently, consideration of transformative adaptation has become more widespread. Pelling (2014) draws out distinct uses of the concept of transformation in the context of adaptation. Of particular importance here is that transformation is often used as an approach to adaptation that aims to shift fundamental relations to open new scope for adaptation, innovation and collaboration. Such shifts may include combinations of technical innovations and tools, institutional reforms, behavioural shifts and cultural changes by individuals, institutions and governments. Transformational adaptation requires a strengthening of existing capacities to effect change (Rickards & Howden, 2012). Improving the capacity of civil society and governments is crucial for transformative change. At a local level, undertaking adaptive actions can be influenced by factors including leadership capacities, learning capacities, social network capacities, economic capacities, technical capacities, individual capacities, government institution and legislative capacities, private sector capacities and knowledge capacities amongst others (O'Brien *et al.*, 2009; Folke *et al.*, 2010; Gelcich *et al.*, 2010; Pelling & Manuel-Navarrete, 2011; IPCC, 2012; Revi *et al.*, 2014).



Transforming cross-border emergency management

With the above in mind, climate change and increased flood risk increases the need for innovative and transformative approaches to emergency management in border regions. In recent years, there has been increasing international attention on the need for cross-border cooperation on emergency planning and crisis management in general, including within the European Union (EU). Yet, while it is an obvious truism to state that natural disasters or man-made crises are no respecters of jurisdictional boundaries, questions remain as to how effective the EU can be when faced with transboundary crises (Boin *et al.*, 2014). This raises the question as to whether the challenge of emergency planning is best addressed by national government, or indeed regional and local government? Geography, for example, is a common driver for cross-border cooperation on emergency planning, especially in locations where a neighbouring local authority can more readily fulfill an emergency service provision. In identifying opportunities for shared services between and among local governments, for example, the notion of functional service areas underpin the logic of *'proximity creates opportunities'* for providing and maintaining services, even at a time of budget cutbacks (Peel *et al.*, 2012: 8). The concept of working with neighbouring local authorities in providing services supports the spatial planning concept of 'clustering'. And while there are many documented cases of where local and regional governments cooperate across borders in emergency planning (Princen *et al.*, 2014; Ansell *et al.*, 2010; Palm & Ramdell, 2007), there are inconsistencies in the trend overall (Princen *et al.*, 2014) and to the depth of collaboration taking place. As argued by Ansell *et al.* (2010), crises management becomes increasingly difficult when events cross geographical borders and indeed, policy boundaries. More participants, which tend to be geographically dispersed and often operating to divergent agendas, become involved. This raises questions around not only the management of these networks of actors but also the role of various participants as transformative leaders - individuals who effectively operate across complex inter-organisational and geographic boundaries.

Ansell *et al.* (2010) contend that the response to a transboundary crisis requires a specific set of organisational and procedural tools, with the actors involved being both nimble and adaptive to the various type of situations that may arise. These individuals - or 'leaders' - must be critical facilitators of cross-boundary coordination; or as Williams (2010) would call them, "boundary spanners". With a growing emphasis being placed on civic engagement and the need for communities to become resilient to global events - including environmental conditions such as climate adaptation - there is, as noted by Peel (2013), a growing corollary around new forms of civic leadership.

At the local level, involving for example local government, a well-developed emergency management programme must involve the sharing of resources including workforce, equipment, and expertise (Palm & Ramdell, 2007). In the United States, the Federal Emergency Management Agency (FEMA) is a strong proponent of equipping local communities for civil emergencies; with an emphasis placed on preparedness, protection, response, recovery and mitigation (McClelland, 2014). Across the UK, Local Resilience Forums (LRFs) are being established. These are multi-agency partnerships made up of representatives from local public services, including the emergency services, local authorities, the NHS, the Environment Agency and others (Creamer & Driscoll, 2013). Their aim is to plan and prepare for localised incidents and catastrophic emergencies, and work to identify potential risks and produce emergency plans to either prevent or mitigate the impact of any incident on their local communities (Cabinet Office, 2011). In Germany and the Netherlands, cross-border cooperation in the fields of policing and emergency management was formalised in 2000 as part of the work programme of the Euroegio. The Ariem-112 project involving the areas of Galicia, Castilla y Leon and the North of Portugal, for example, has not only led to joint training programmes and drills but also to the development of a computer application for handling emergency information (see http://www.ariem112.eu/Paxinas/Ariem_gal.cshtml). The Nordic countries of Finland, Sweden, Iceland, Norway and Denmark are all signatories to the Haga II Declaration which promotes cooperation across six areas relating

to civil emergencies: rescue services, exercises and training, responses to CBRNⁱⁱ emergencies, crisis communication with the general public, recruitment of volunteers and civil-protection related research (Bailes, 2014).

The efficient use and pooling of often limited resources in tackling common challenges makes financial sense - an increasingly key impetus for collaboration among local authorities - particularly in sparsely-populated areas (Princen *et al.*, 2014). Collaboration, based on a shared interest and responsibility is, according to Sullivan and Skelcher, "central to the way in which public policy is made, managed and delivered" (2002: 1). Such shared services are increasingly becoming key tools in the delivery of local services - with the rigidity of both organisational and physical boundaries becoming more porous (Creamer & Driscoll, 2013). For the island of Ireland and more specifically the peripheral border counties, cross-council and indeed cross-border collaboration is increasingly to the forefront of strategic planning policy and practice. With a growing emphasis being placed on the roll-out of a shared services programme in both jurisdictions, cross-border cooperation initiatives are viewed as the creation of a connected and resilient approach to emergencies which will ultimately derive mutual benefits and reassurance to all those living and working in a border region (McClelland, 2014).

Building capacity: Emergency planning pilot in the Irish Border Region

There is a long tradition of emergency services in the Irish border region supporting each other on a case-by-case (or emergency-by-emergency) basis – largely based on proximity and response times. While this could be considered a disjointed approach to emergency management, its value added cannot be disputed. The Northern Ireland Fire and Rescue Service (NIFRS), for example, has a Service Level Agreement with Donegal Fire Service by which NIFRS provides first response to calls in Donegal in the border areas of Londonderry, Strabane & Belleek. The NIFRS & Donegal Fire Service also regularly participate in joint exercises & familiarisation visits, as well as the sharing of best practices. Between 2007 and 2013, Co-operation

and Working Together (CAWT), the cross border partnership for the Health Authorities located along the border between Northern Ireland and the Republic of Ireland, held a series of cross-border training events and courses to foster shared approaches to various types of emergencies. The objective was to ensure that the presence of the border would not become an obstacle to the efficiency of responders. In 2011, the Councils of Louth and Newry and Mourne signed a Memorandum of Understanding (MOU) setting out key areas of collaboration with the objective of supporting and promoting the economic development and competitiveness of this cross-border region. One such area of cooperation was in emergency planning, with the Councils committing to "optimise the use of resources through sharing of services, facilities and personnel in responding to emergencies".

These experiences, together with the aforementioned heightened frequency and severity of flooding incidences in the border counties led, in 2014, to the identification of emergency planning as an arena for closer cooperation and the sharing of services between local government and other agencies and the subsequent establishment of the Cross Border Emergency Management Working Group (CBEMWG). Its role was to 'act as a strategic multi agency grouping for agencies involved in emergency management on a cross-border basis' (CBEMWG, 2014). This Working Group represents a more formalised basis for multi-agency collaboration; a formalisation deemed necessary to enhance regional emergency management capabilities and ensure an effective responses to emergency situations (O'Flynn, 2014). In pursuance of the principle of reciprocity, the CBEMWG has been structured to ensure equal representation from key government agencies in Ireland and Northern Ireland (see Table 1). Its membership includes ten representatives from the Southern and Western Emergency Preparedness Groups in Northern Ireland, and a further ten representatives from the North West and North East Major Emergency Management Regional Working Groups in Ireland. In addition, nominated representatives from the Office of the First and Deputy First Ministers' Civil Contingencies Policy Branch, the Headquarters of the Police Service of Northern Ireland, the Department of Environment,

Community and Local Government, and the Garda Headquarters Branch have also been invited to attend meetings.

As 'boundary spanners' who work in 'fresh spaces' between existing functions and who perform this additional role as part of a wider portfolio of activities (Williams, 2010), the CBEMWG began drafting and subsequently agreed a three-year strategy document. The resulting Strategic Plan articulates a number of strategic priorities concerning the internal functioning of the group, the implementation of cross-border emergency management arrangements, enhanced training and information sharing, and the principle of continuous improvement. Amongst the short, medium and long-term actions also identified, is the development of a cross-border risk register, the strengthening of existing Memoranda of Understanding on the provision of mutual aid, and the creation of a multi-agency programme of regular training exercises. The Strategic Plan covers the period 2015-2018, and sets the group a challenging agenda that will undoubtedly require adequate resourcing and the buy-in of each of the organisations represented on the CBEMWG to ensure its successful implementation.

Within months of its establishment, the International Centre for Local and Regional Development (ICLRD) and the All Island Research Observatory (AIRO) began working with the CBEMWG on an emergency planning pilot project in the Irish border region. This

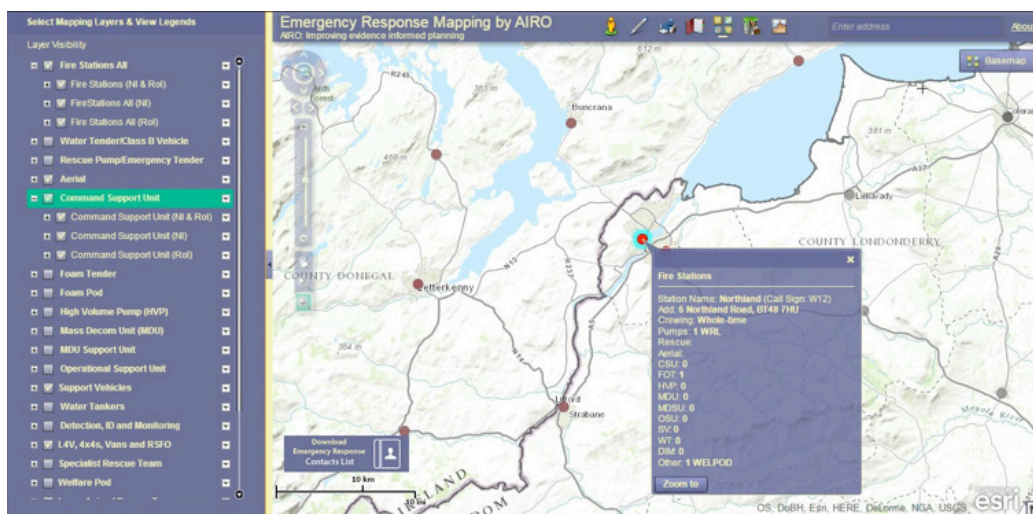
work programme was funded under the EU-funded INTERRREG IVA project, CroSPlanⁱⁱⁱ; the focus of which was on the role of local government in driving a shared services programme of activity. The emergence of the CBEMWG represented a promising local authority-led initiative to advance a shared services agenda in emergency management and planning, especially in the context of the (then) impending local government reform in both jurisdictions.

The principal focus of the emergency planning pilot project in the Irish border region was the development of a 'proof of concept' mapping tool by the ICLR and AIRO for the CBEMWG (see Figure 3). The online mapping tool integrates, for the first time in the Irish border region, a range of easily navigable datasets that will enable local emergency managers to better plan for, and react to, major cross-border emergency incidents. Amongst the assets located on the tool are fire stations, command support units, specialist rescue teams, community facilities, sandbag locations, and local authority offices. In addition to details of the various assets available to emergency managers, the mapping tool identifies Seveso/COMAH sites in the region, which necessitate the compilation of detailed risk assessments, management plans and other information required under associated EU Directives. The mapping tool is further complemented by the inclusion of a comprehensive emergency contact directory for the cross-border region, which will be updated on a regular basis by the CBEMWG.

Table 1: The Groups represented on the CBEMWG

Ireland	Northern Ireland
Local government (including Fire Service)	Local government (Southern and Western Group Environmental Health Groups)
An Garda Síochána	Police Service of Northern Ireland
Health Service Executive	Northern Ireland Ambulance Service
	Public Health Agency & Health and Social Care Trusts
	Northern Ireland Fire and Rescue Service

Figure 3: A screen-shot showing the ICLRD & AIRO-developed GIS-based mapping tool



(Source: AIRO, 2014).

The mapping tool is of immediate utility for members of the CBEMWG, providing an overview of existing resources to aid the strategic decision-making of emergency managers, particularly in the preparedness and response phases of a major emergency. The pilot initiative facilitated the collation of sometimes difficult to access data from government agencies, especially the information held on a more fragmented basis in the border counties in Ireland (in comparison with the centrally available information in Northern Ireland).

As a proof of concept, the mapping tool provides a solid platform from which the CBEMWG can develop a more powerful GIS-based system to aid multi-agency interoperability. Indeed, as McClelland (2014) points out, the integration of dynamic features, such as remote sensing, air dispersion models, and social media platforms, into a future GIS-based mapping tool, would significantly enhance its capacity to aid emergency managers in the Irish border region in all the phases of the emergency management process – assessment, mitigation, preparedness, response and recovery. Indeed, the mapping tool serves several existing functions for emergency managers in the border region, thereby enhancing the efficiency and effectiveness of service delivery. It provides an overview of existing resources

to aid strategic decision-making in their allocation and use, particularly in relation to the preparedness and response phases of a major emergency incident such as a flood. Moreover, the tool provides a solid platform from which the CBEMWG can develop a more comprehensive and powerful GIS-based system, integrating additional datasets and analytic capabilities relevant to their ongoing work, while drawing upon the parallel research conducted during the pilot while the mapping work was underway. Indeed, much of the most difficult to access data has already been collated thanks to the pilot initiative, especially the information held on a more fragmented basis in the border counties in Ireland, in comparison with the centrally available information in Northern Ireland.

Nonetheless, technological innovation must also go hand-in-hand with solving 'people issues', ensuring that resilient organisational structures and good communication channels are in place as it is these, rather than technical considerations, that are often the most difficult to overcome (Allen *et al.*, 2014: 425). As such, in support of the mapping component of the pilot, the ICLRD produced a detailed report for the CBEMWG entitled *Cross-Border Emergency Planning on the island of Ireland: Existing arrangements, critical issues*



BORDERLANDS

The Journal of Spatial Planning in Ireland

and learning from international experience (McClelland, 2014). The report provides a comprehensive account of the necessity for cross-border cooperation in emergency planning on the island of Ireland, outlines some of the history of cooperation in this area, and identifies certain policy gaps evident in the key guidance and framework documents used by public agencies in both jurisdictions, insofar as cross-border cooperation is concerned.

Pertinent recommendations are made on the necessity for additional policy guidance and protocols. Furthermore, the learning derived from the academic and practice-based literature, and the insights emanating from several European case studies, provides the CBEMWG with a range of 'sign-posts' to progressing cross-border cooperation in emergency planning. For example, the innovative use of IT in emergency management, practical issues concerning insurance, liability and legal and professional safeguards for emergency personnel when crossing borders, and the critically important task of achieving 'interoperability' amongst emergency responders, are each considered in the report. The report also provides practical examples of how others have resolved, or are attempting to resolve, such issues in their own cross-border contexts. Consequently, in terms of finding applicable solutions to problems through joint actions, a more expansive range of reference points is available to the CBEMWG from which to derive the transferable lessons for their own purposes.

Conclusions

Emergency management is a key tool in adapting to climate change. It is obvious that we cannot physically engineer flood risk to zero and, therefore, emergency management will play an enhanced role in reducing losses as the risk of flooding increases in a changing climate. In the Irish border region, vulnerability to floods is high and incremental adaptation will not suffice in avoiding losses. Steps towards development of cross-border emergency management undertaken by the CBEMWG show evidence of transformative change in flood risk management where transformative leaders play an active role in negotiating policy.

The success of CBEMWG to date is based on developing cross-sectoral spaces for information sharing and collaborative discussion in building policy networks. Within these networks sharing of expertise and information is critical. As developed by the ICLRD and AIRO, mapping tools provide an opportunity to build capacity and move away from a reliance on 'who you know' to having actual shared resources to which all have equal access. The potential of this pilot to inform and drive further collaborative efforts in emergency planning in the border region cannot be overstated – with the process and learning also demonstrating a pathway to heightened cooperation and peer-to-peer sharing for other sectors.

Dr. Conor Murphy is a Senior Lecturer in the Department of Geography at Maynooth University and researcher with the Irish Climate Analysis and Research Units (ICARUS). His research interests have a particular focus on modelling impacts of climate change, quantifying uncertainty and exploring how uncertainty in future impacts can be integrated into decision making; the detection and attribution of climate change signals from observations and the reconstruction and analysis of long-term records of key climate variables; and understanding the social dynamics of adaptation to climate change. Conor sits on the National Adaptation Committee, and is an expert reviewer for the reports of the Intergovernmental Panel on Climate Change. He serves on the editorial board of the Journal of Extreme Events and is Review Editor for the Urban Climate Change Research Network Global Assessment Report. He is also a member of the Irish National Committee for the International Hydrological Programme.

Ms. Caroline Creamer is Director of the International Centre for Local and Regional Development (ICLRD) and a Research Fellow with the National Institute for Regional and Spatial Analysis (NIRSA) at Maynooth University. A qualified town planner, Caroline has been working with local government, communities and other key stakeholders in the Irish border



BORDERLANDS

The Journal of Spatial Planning in Ireland

region for the past decade. Her research interests include spatial planning practice and policy, regional and local development and regeneration, collaborative and participative decision-making, building community resilience, and inter-territorial and cross-border development.

Dr. Andrew McClelland began his career at the Ulster Architectural Heritage Society, where he was Heritage Projects Officer with responsibility for the Built Heritage at Risk Northern Ireland project in the period 2002-2009. He subsequently worked on several SEUPB INTERREG-funded cross-border spatial planning projects on the island of Ireland, in association with the International Centre for Local and Regional Development (ICLRD) and the Centre for Cross Border Studies (CCBS). Andrew holds an MA in Town and Country Planning from the University of the West of England, Bristol and was awarded his Doctorate from Ulster University in June 2014. His research and consultancy interests include planning and architectural history, public policy and cross border cooperation on the island of Ireland. In September 2016, Andrew will be taking up a Marie Skłodowska-Curie Fellowship at Maynooth University.

Prof. Mark Boyle is Professor of Geography at Maynooth University and National Contact Point for Ireland for the Urbact III programme (www.urbact.eu). His research interests include urban and regional development, spatial planning and urban policy.

Endnotes

- i This is based on considering both the intensity and frequency of cyclones together.
- ii CBRN emergencies are Chemical, Biological, Radiological and Nuclear disasters.

- iii As part of the CroSplaN II Shared Services Project two pilot initiatives were undertaken: one focusing on Tourism; and a second on Emergency Management Services that worked towards the development of an emergency planning mapping portal for the cross-border region of Ireland.

References

- Adger, N.W., *et al.* (2013). Changing social contracts in climate change adaptation. *Nature Climate Change*, 3, 330-333.
- Adger, W. N. *et al.* (2009). Are there social limits to adaptation to climate change? *Climatic Change* 93, 335-354.
- Allen, D.K., Karanasios, S. and Norman, A. (2014). 'Information sharing and interoperability: the case of major incident management', *European Journal of Information Systems*, Vol. 23, No. 4, pp.418-432.
- Ansell, C., Boin, A. and Keller, A. (2010). 'Managing Transboundary Crises: Identifying the Building Blocks of an Effective Response System', *Journal of Contingencies and Crisis Management*, Vol. 18, No. 4, pp.195-207.
- Bailes, A.J.K. (2014). *Nordic Cooperation on Civil Emergencies*. Small State Brief, Centre for Small State Studies, University of Iceland, June 10, 2014.
- Boin, A., Rhinard, M. and Ekengren, M. (2014). 'Managing Transboundary Crises: The Emergence of European Union Capacity', *Journal of Contingencies and Crisis Management*, Vol. 22, No. 3, pp.131-142.
- Cabinet Office (2011). *The Role of Local Resilience Forums: A Reference Document*. London: HMSO.
- Creamer, C. & Driscoll, J. (2013). *Working Together for the Common Good: Local Government as Drivers of Shared Services*, Armagh: International Centre for Local and Regional Development.



BORDERLANDS

The Journal of Spatial Planning in Ireland

Cross Border Emergency Management Working Group [CBEMWG] (2014). *Strategic Plan 2015-2018*, Cross Border Emergency Management Working Group.

Folke, C., Carpenter, S., Walker, B., Scheffer, M., Chapin, T., Rockström, J. (2010). Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society*. 15(4), 20.

Matthews, T., *et al.* (2014). Stormiest winter on record for Ireland and UK. *Nature Climate Change*, 4, 738-740.

McClelland, A. (2014). *Cross-Border Emergency Planning on the Island of Ireland: Existing arrangements, critical issues and learning from international experience*, Armagh: International Centre for Local and Regional Development.

Murphy, C, Harrigan, S., Hall, J. and Wilby, R.L. (2013). Climate-driven trends in mean and high flows from a network of reference stations in Ireland. *Hydrological Sciences Journal* 58(4), 755-772.

Noone, S., Murphy, C., Coll, J., Matthews, T., Mullan, D., Wilby, R. L. and Walsh, S. (2015). Homogenization and analysis of an expanded long-term monthly rainfall network for the Island of Ireland (1850–2010). *International Journal of Climatology*, doi: 10.1002/joc.4522

O'Flynn, D. (2014). 'Cross-Border Pilot to Map Emergency Management Resources', [online] Available at: <http://emergency-services.ie/wp-content/uploads/2014/08/Cross-Border-Management-3.pdf> [Accessed 9 December 2014].

O'Brien, K., *et al.* (2009). Rethinking social contracts: Building resilience in a changing climate. *Ecology and Society*, 14, 12.

OFMDFM (2010). *Report of the Flooding Taskforce on the Fermanagh Flooding of November 2009*. Office of the First Minister and Deputy First Minister, Northern Ireland.

Palm, J. & Ramsell, E. (2007). 'Developing Local Emergency Management by Co-Ordination Between Municipalities in Policy Networks: Experiences from Sweden', *Journal of Contingencies and Crisis Management*, Vol. 15(4), December 2007, pp.173-183.

Peel, D. (2013). 'Spanning the Boundaries: Spatial Planning as Reticulism', *Borderlands: The Journal of Spatial Planning in Ireland*, No. 3, January 2013, pp.65-76.

Peel, D., O'Keeffe, B., Shi, L., Leith, K. & Keaveney, K. (2012). *Shared Services Across Local Government: Sharing International Experiences*. Armagh: International Centre for Local and Regional Development.

Pelling, M. (2014). Transformation: A Renewed Window on Development Responsibility for Risk Management. *Journal of Extreme Events*, 1, 1, 1402003.

Pelling, M., Manuel-Navarrete, D. (2011). From resilience to transformation: the adaptive cycle in two Mexican urban centers. *Ecology and Society*. 16(2), 11.

Princen, S., Geuijen, K., Candel, J., Folgerts, O. and Hooijer, R. (2014). 'Establishing crossborder co-operation between professional organizations: Police, fire brigades and emergency health services in Dutch border regions', *European Urban and Regional Studies*, Online first, pp.1-16

Revi, A., Satterthwaite, D., Aragón-Durand, F., Corfee-Morlot, J., Kiunsi, R.B.R., Pelling, M., Roberts, D., Solecki, W., Gajjar, S.P., Sverdlík, A. (2014). Towards transformative adaptation in cities: the IPCC's Fifth Assessment. *Environment and Urbanization*. 26(1), 11–28.

Rickards, L., Howden, S.M. (2012). Transformational adaptation: agriculture and climate change. *Crop and Pasture Science*. 63(3), 240–250



BORDERLANDS

The Journal of Spatial Planning in Ireland

Smit, B., Pilifosova, O., Burton, I., Challenger, B., Huq, S., Klein, R., Yohe, G. (2001). *Adaptation to Climate Change in the Context of Sustainable Development and Equity*. IPCC Third Assessment Report, Working Group II.

Sullivan, H. & Skelcher, C. (2002). *Working Across Boundaries: Collaboration in Public Services*. Basingstoke: Palgrave & Macmillan.

Wilder, M., Scott, C. A., Pablos, N. P., Varady, R. G., Garfin, G. M., & McEvoy, J. (2010). Adapting across boundaries: climate change, social learning, and resilience in the US–Mexico border region. *Annals of the Association of American Geographers*, 100(4), 917-928.

Williams, P. (2010). *Special Agents: The Nature and Role of Boundary Spanners*. Paper to the ESRC Research Seminar series - 'Collaborative Futures: New Insights from Intra- and Inter-Sectoral Collaborations', University of Birmingham, February.