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Is climate change framed as 'business as usual' or as a challenging issue? The practitioners' dilemma

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Abstract. There is growing recognition that routine climate change framing is insufficient for addressing the challenges presented by this change, and that different framings of climate change shape stakeholders' practices and guide policy options. This research investigated how stakeholders conceptualise climate change in terms of its seriousness and related uncertainty, and a resilience approach as a possible policy option to confront this uncertainty. An application of the conceptual framework provided by Handmer and Dovers' typology of emergencies is novel to the climate change field. Results show that there is a tendency to frame climate change as complex (with uncertainty representing part of that complexity) and to confront this complexity with less complex policies and solutions. No pattern of a conceptual link between uncertainty and resilience was observed. The results presented in this study offer empirical evidence to inform theory and provide helpful insights to inform policy design and practice.

Keywords: Climate change, complexity, framing, disaster management, resilience, uncertainty

Introduction

The patterns of climate-related hazards are acknowledged as already changing and they are expected to continue increasing in frequency, magnitude and duration (Intergovernmental Panel on Climate Change (IPCC), 2014). These changes in hazard characteristics constitute one of the drivers that could result in exacerbating disasters, and increasing disaster impacts and losses.

Unfortunately, the exacerbation of disaster impacts, as a consequence of climate change, does not represent the only challenge for disaster risk management (DRM). Uncertainty also emerges about the rate and patterns of these changes, and this uncertainty, associated with projections based on the return period of specific hazards, must be coupled with others uncertainties associated with climate change. Both the exacerbation of hazards because of a changing climate and the uncertainty attached to it represent a challenge for DRM. As a result of conceptualising climate change as a challenging issue, DRM practitioners may be unsure of how to incorporate climate change into their work (Prabhakar et al., 2009), and they may embrace different positions when they have to make decisions under changing conditions and uncertainty (Head, 2014; Juhola et al., 2011). Resilience is proposed as one possible approach that policy makers and practitioners might enlist to assist in managing climate change challenges, especially those related to uncertainty (Adger et al., 2005b; Castán, 2013). This has contributed to our interest in investigating how practitioners frame climate change in the context of DRM; how they conceptualise responses for dealing with climate change; and whether or not the resilience framework is considered as a possible approach to address climate change uncertainty. We explore these questions with those stakeholders involved in the Natural Disaster Resilience Program (NDRP) in Queensland, Australia. Methodologically, we use the concept of framing and frames in this study to express how an issue is perceived and what can be done (Dewulf et al., 2009; Fischer, 2003). For the framing of emergencies under climate change we adapted Handmer and Dovers (2007) typology which classifies events as 'routine', 'non-routine' and 'complex' emergencies. Routine ones are considered as non-challenging issues or 'business as usual'; and the non-routine and complex to be challenging ones (more details of this framework are provided in 'Methodology and conceptual framework' section). The paper is organised into six sections. After this introduction, the second section briefly describes the context of disasters and climate change of the study area. Then the third section analyses the literature on the relation between DRM, climate change and uncertainty. The fourth section describes the methodology and conceptual framework used. Then the fifth section presents the analysis of results of the climate change framing based on the attributes of scale and uncertainty; and of policy and management. Sixth section discusses these results, in the context of the literature and in terms of the implications that emerge from them. The potential link between uncertainty and resilience is also assessed. The conclusion follows.

Background: Insights on climate change and disasters in Queensland

The context of disasters

The case study in this research focused on three sites in Queensland, north-east Australia: the cities of Brisbane and Gold Coast, and the town of Charleville. Queensland's natural disaster risk profile is dominated by flood, cyclone, severe storm and bushfire (Risk Frontiers, 2011).

Charleville was originated as a regional transport hub due to there being permanent water available in a drought prone region. However, this also resulted in it being located in a highly flood prone area on the flood plain of the Warrego River. This river, as well as Bradley Gully, runs through the town (Sargent Consulting, 2010). This physical vulnerability of the town, together with the presence of high rainfall events, has resulted in an extensive history of large floods (Keogh et al., 2011) (see Figures 1 and 2).

The city of the Gold Coast was first settled as a seaside holiday destination with good rail connections to Brisbane from the 1800s. The city experiences highly destructive cyclones and major storms. Being built over a coastal plain with 446 kilometres of canals (see Figure 3), this has contributed to disasters that have taken place almost every decade, resulting in severe damage to public and private property, infrastructure and widespread erosion (Hunt et al., 2008). Tourism is one of the Gold Coast's main industries and the city attracts about 10 million tourists each year. The special nature of its population is what makes the Gold Coast particularly vulnerable to disasters. The 10 million people who visit the city each year may never have experienced such a disaster, for example, a major storm, and therefore have no idea how to conduct themselves during one of these disasters.

The city of Brisbane is situated on a flood plain of the Brisbane River, which has contributed, together with the presence of frequent storms and cyclones, to an extensive history of severe floods. The most recent flood of significant magnitude occurred in 2011. This event was the result of an extremely wet spring in 2010 that saturated the catchments, followed by heavy rainfall during January (Van den Honert and McAneney, 2011).

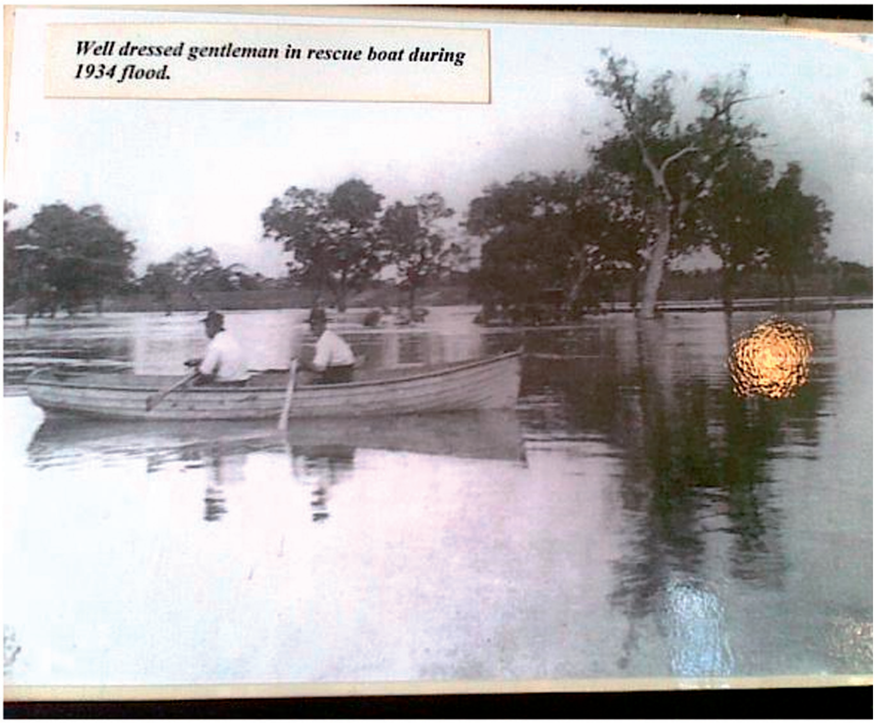

Figure 1. One of the earliest photographs of floods in Charleville (1934); original photo exhibited in Hotel Corones, Charleville. Photo: November 2010.

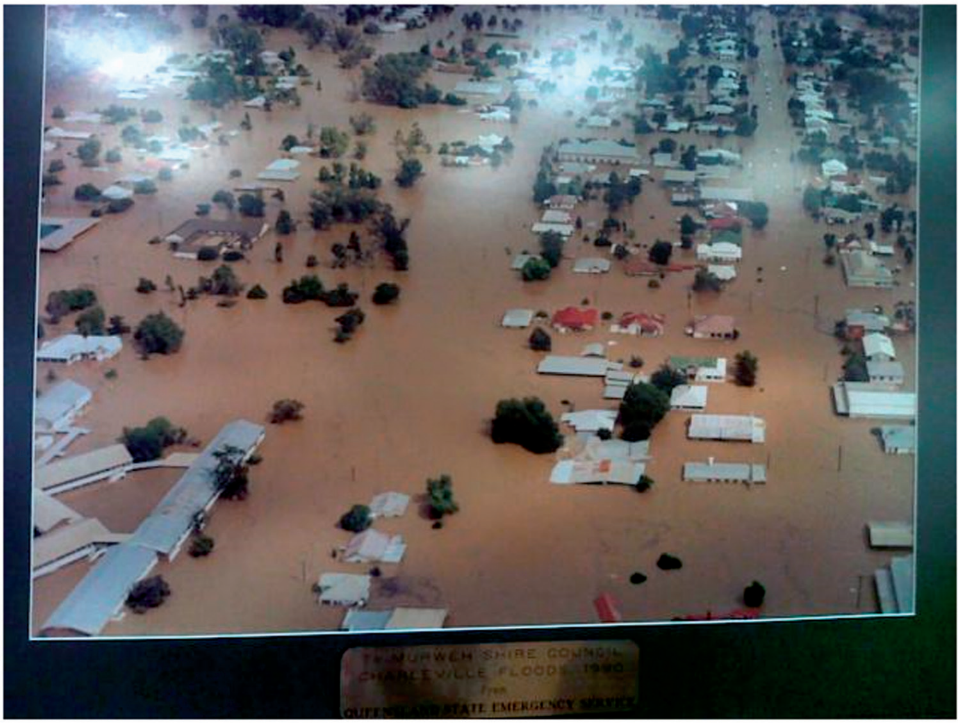

Figure 2. Flood of 1990 with water level depth to roof of building, original photograph exhibited in Hotel Corones, Charleville. Photo: November 2010.

Figure 3. View of Gold Coast City. SkyPoint visitor information center. Photo: November 2011.

A changing climate in Queensland

Queensland is one of the Australian states most vulnerable to climate change (Office of Climate Change (OCC), 2010). One of the most relevant changes is in relation to temperature. Queensland is warming. The average surface temperature has risen by 0.9°C (Australian Bureau of Meteorology (Australian BOM), 2013), with this rise especially affecting the south-west of the State, The years 2000–2009 represent the hottest decade on record. Change in rainfall trends is also relevant. Queensland has experienced a significant decrease in total annual rainfall in the last century and an increase in rainfall intensity (OCC, 2010).

Queensland's climate change strategy, 'ClimateQ', indicates that variations in temperature, rainfall and evaporation are expected to occur in the 13 regions of the State and with subsequent impacts on biodiversity, infrastructure, water supplies, primary industries, human health and emergency management (OCC, 2010). Projected climate changes are summarised in Table 1 and climate projections and impacts for the study sites are presented in Table 2.

Table 1. Projected changes in temperature and rainfall across Queensland.

• Increased temperature, more hot days and warm nights
• Increased frequency of heatwave events
• Reduced rainfall across most of Queensland
• Longer dry periods interrupted by more intense rainfall events
• Rising sea levels of at least 0.8 metres by 2100
• Increased number of severe tropical cyclones
• Cyclones occurring further south
• Increased hail days in south-east Queensland
• Increased intensity of extreme rainfall events in some locations™

Source: adapted from OCC (2010: 23).

Table 2. Climate projections and projected impacts for 2050 for study sites.

Site/ QLD Region	Temperature			Rainfall			Example of climate change impacts
	Baseline mean(ºC)	2050		Baseline mean (mm)	2050		
		Low (ºC)	High (ºC)		Low (mm)	High (mm)	
Brisbane and the Gold Coast/South East	19.4	+1.1	+1.8	1135	−3	−5	● Declining pasture quality and quantity due to increased evaporation and decreased rainfall ● Increased pressure on water supplies ● Conditions may become more favourable for plant diseases, weeds and pests ● Flooding, erosion and damage to infrastructure associated with sea level rise/ increased storm surge ● Increased risk of heat related illness ● Increased risk of tropical cyclone impact due to southward shift
Charleville/ South West	21.6	+1.4	+2.2	383	−4	−6	● Declining pasture quality and quantity due to increased evaporation and decreased rainfall ● Increased pressure on water supplies ● Increased risk of heat related illness ● Increase in amount of rain falling on extremely wet days is likely to increase the severity of flooding (especially in summer and autumn) ● Increased risk and intensity of bushfires

Source: adapted from OCC (2010).

'Background: Insights on climate change and disasters in Queensland' section briefly presented the landscape of disasters and climate change for the study area. 'DRM, climate change and uncertainty' section examines the literature on DRM in the context of a changing climate, the uncertainties this produces and potential stakeholder responses to this.

DRM, climate change and uncertainty

As a result of the possible change in hazards and increased uncertainty, stakeholders give different emphasis to the seriousness of the climate change challenge and consequently develop different policies, strategies and practices to deal with this challenge (Debels et al., 2009; Juhola et al., 2011).

Climate change is now and will continue to vary the patterns and frequencies of climate-related hazards (IPCC, 2012, 2014), with the result that we cannot rely on the return period derived from historical records as an adequate representation of risk; and this represents a source of uncertainty (Aldunce et al., 2014). Additional uncertainties are emerging because of a changing climate (see Table 3).

Table 3. Sources of climate change uncertainties

Return period	The patterns of extreme events of climate-related hazards such as frequency, regularity, magnitude and geographical and seasonal distribution, will not be possible to assess based on historical records of these events (Eakin et al., 2009; Heal and Kristrom, 2002)
Characterisation of impacts	It will not be possible to characterise the consequences of disasters related to climate in advance (Barnett, 2001; Klein et al., 2003; O'Brien et al., 2010). This is due to changing hazards, but also because climate change will affect population's vulnerability across many other dimensions of their lives, not restricted to hazard vulnerability (Adger et al., 2005a; Heal and Kristrom, 2002)
Effectiveness of responses	Uncertainty also emerges as related to the effectiveness of societal responses in a changing climate (Aldunce et al., 2008; Barnett, 2001; Eakin et al., 2009; Heal and Kristrom, 2002)
Imperfect nature of climate change prediction	Uncertainty is exacerbated by the imperfect nature of climate change predictions. These predictions are based on scenarios and models which contain uncertainties for example, we do not know the future concentration of greenhouse gases or we do not have sufficient records from the past (Heal and Kristrom, 2002; O'Brien et al., 2006; Prabhakar et al., 2009)
Scientific assessments	Different assessments, carried out by different scientists, give different and sometimes conflicting results; this generates confusion among stakeholders (O'Brien et al., 2008; Tompkins and Adger, 2005)
Emergent findings	The scientific literature is constantly finding new relationship between climate change and climate-related hazards, putting new uncertainties to the table. This results in a more complex scenario for decision-making, where a decision may be enhanced or superseded by new information (O'Brien et al., 2008)

Uncertainty related to climate change and DRM can be conceptualised as a challenge for decision-makers, because the multiple manifestations of uncertainty (see Table 3) are confusing and this can delay important decisions (Handmer and Dovers, 1996; Prabhakar et al., 2009). Moreover, when including climate change uncertainty in decision-making, practitioners could frame responses in diverse ways which may complicate responses and communication. Possible responses are detailed in Table 4.

Table 4. Possible stakeholder responses to climate change uncertainty.

Wait and watch	This suggests waiting for more evidence or scientific information before taking action (Barnett, 2001; Eakin et al., 2009; Prabhakar et al., 2009)
Anticipatory strategy	This option is focused on trying to reduce uncertainty and to anticipate impacts. This is based on assessing which impacts and problems may arise and responding to them. This strategy could be inappropriate and unsuccessful in the absence of some levels of certainty, as it could lead stakeholders to select the wrong impacts. Also, this strategy reflects a human tendency to try to control nature. Centralisation of power, absence of learning processes and limited flexibility are characteristics associated with these kind of strategy (Barnett, 2001; Prabhakar et al., 2009)
Precautionary principle	Here uncertainty is recognised and the lack of certainty is not an excuse to postpone implementation of measures. This strategy invites stakeholders to take action (Barnett, 2001)
Resilience	This strategy, rather than only focusing on reducing uncertainty, provides the opportunity to recognise and explore this uncertainty, and therefore to learn to live with a more public acknowledgement of uncertainty. The goal here is to consider uncertainty as presenting opportunities to learn, adapt and improve DRM (Adger et al., 2005b; Berkes, 2007)

Therefore, these strategies offer diverse backgrounds for response, such as routine or conventional approaches based on trying to reduce uncertainty as much as possible (Barnett, 2001; Prabhakar et al., 2009). A different approach is to recognise that there are large and irreducible uncertainties (Handmer, 2008; Juhola et al., 2011). The latter approach can result in uncertainty being reconceptualised, transitioning from solely considering it as a threat, to accepting it and even exploiting it (Handmer, 2008). This conceptualisation of uncertainty parallels the way it is understood within resilience theory (Wildavsky, 1985), where it is considered a catalyst for change, and an opportunity for innovation and learning (Adger et al., 2005b; Berkes, 2007).

Methodology and conceptual framework

The case study for this research was the NDRP during its implementation phase at the State level in Brisbane, and at two sites at a local level, Charleville and Gold Coast, in Queensland, Australia. The NDRP provided a novel opportunity. It was the first Australian programme that included resilience ideas as central components of DRM and at the same time incorporated considerations of climate change. An explanation of how the sites were selected at the local level is described here (for more details of the case study refer to Aldunce, 2015). Organisations at the local level can apply for funding to the NDRP, which results in some sites (local government areas) presenting applications representing a few organisations, and other sites submitting different types of applications from a spectrum of organisations. Within the time period assigned for the field work it was possible to be included the first (2009–2010) and second (2010–2011) rounds of proposals in this process. The selection of local sites to be studied with this investigation was based on the criteria detailed in Table 5.

Table 5. Criteria for the selection of local study sites.

1. Sites with organisations that had applied to the NDRP
2. Sites that had been frequently affected by climate-related extreme events such as rainfalls, floods and cyclones
3. Sites with characteristics that make them vulnerable to disasters for example physical characteristics resulting in flood prone areas
4. Sites that differ from one to the other in characteristics such as geographical, socioeconomic conditions; rural and urban, and coastal and inland sites
5. Sites with a relatively high number of applications for the NDRP; this was in order to broaden options for conducting interviews
6. Sites where applications had considered both social dimensions and 'hard measures' (e.g. engineering measures)
7. Access for conducting interviews, as advised by the Local Government Association of Queensland (LGAQ)

Criteria 4, 5 and 6 aimed to achieve a diversity of contexts and frames, as well as to allow for triangulation of information. In addition to the two local sites selected, applicants at the state level were interviewed.

The methods used in this research were in-depth interviews, observation and document analysis. Field work was conducted from November 2009 to February 2011. During this time observation took place of formal and informal meetings, and by visiting the physical settings of the case study sites. Documents relating to DRM (State-wide and National) and specific to the NDRP were collected. The most relevant of these (11 documents) were selected based on an analysis of their content.

Semi-structured interviews using open-ended questions were conducted face-to-face and recorded. The study follows the tradition of qualitative and interpretative research, collecting detailed data from medium or small samples to acquire in-depth understanding of social realities (Arksey and Knight, 1999; Creswell and Piano Clark, 2007). Interviewee selection was based on purposive sampling, which is non-probability sampling, that depends on the researcher making informed judgements about relevant participants (Neuman, 1997; Subban, 2009). This selection process resulted in 30 participants being interviewed, 26 of these interviews being included in the final analysis. The latter because that after the first review of the interviews it was concluded that four of them did not fulfil the requirements for analysis, which included the need to provide a focused discussion of disaster resilience in the context of climate change, rather than a general discussion of climate change. Participants were directly involved in the programme, including personnel from non-government, government, private and research agencies at the state and local levels, and who had either participated in different phases of the NDRP during design and development, or who had applied for funds from the programme.

A thematic analysis was conducted for all materials, including collected documents, transcribed interviews and observations. The categories for the thematic analysis were defined following Handmer and Dovers' (2007) typology (a summary is presented in Table 6). The analysis consisted of coding passages from the material analysed in nodes using the software NVivo and looking for patterns emerging from the analysed material. The typology categorises disasters as 'routine', 'non-routine' and 'complex' according to a list of attributes (for a complete list of attributes refer to Aldunce, 2013). From the list of attributes described by these authors, the analysis focused only on those attributes that were useful for addressing the aim of the research. Consequently, the attributes included were scale, uncertainty, policy and management.

Table 6. Summary of Handmer and Dovers' (2007) typology of disasters and emergencies

	Routine	Non-routine	Complex
Scale	Increasing in magnitude and frequency of disasters within societal memory. Not too dissimilar to existing variability. Modest additional impacts	Exacerbated variability and impacts, not outside of historical human experience, but very challenging. Problems are large and complex	Variability beyond human experience, extreme, not predictable in magnitude and consequences. Extensive impacts and substantial consequences
Uncertainty	Well defined events with regard to likelihood. Uncertainty known and quantified	Large but defined events. Uncertainty known but less quantified	Extremes not predictable, very large uncertainty, undefined risk. Many types of uncertainties
Policy and management	Anticipatory approach and standard procedures. Agreement on the definition of problems and solutions	Shift in operational procedures. Flexibility, adaptability, involvement of multiple agencies	Difficult to identify appropriate strategies. Limited agreement on the definition of problems and strategies. Knowledge becomes limited. Standard approaches difficult; using probabilities or describing uncertainty is not adequate. Clear and strong leadership for coordinating all sectors of society

Adapted from Handmer and Dovers (2007: Chapters 5 and 9).

Framing climate change in the context of disasters

This section presents the results that emerged from this study in terms of DRM framing in the context of a changing climate. The first step of the analysis was the topic coding in which each interview was classified into one of the following nodes: 'non-routine', 'routine' or 'complex'. For each of these nodes, the initial plan was to amalgamate all the information from each respondent with respect to the attributes studied; however this proved to be a difficult task because during analysis greater complexity emerged than initially expected, expressed as a dichotomy of attributes within interviewee responses. A redesign in the analysis was therefore required; responses were coded separately into two different nodes: scale and uncertainty, and policy and management (see Table 7).

Table 7. Distribution of interviewees by category of emergencies under climate change.

	Routine	Non-routine	Complex
Scale and uncertainty	0	9	17
Policy and management	8	14	4

The dichotomy between the framing of climate change based on the attributes of scale and uncertainty and based on the attributes of policy and management, represents one of the most important results of the study. For example, one respondent talked about the scale and uncertainty of emergencies, under climate change, as one that could be classified as a 'non-routine' emergency, but the same person also mentioned ideas about policy and management for these emergencies in a way that reflected the 'routine' category. This dichotomy had important repercussions in the way the analysis was conducted and in implications for policy and practice, and therefore it is relevant to briefly explain how this division was observed.

The following section presents the results of the framing of climate change as not challenging (routine) or as challenging (when corresponding to the categories of non-routine or complex emergencies).

Climate change as a challenge: Scale and uncertainty

For the attributes of scale and uncertainty, the analysis resulted in all participants being included in the categories of non-routine or complex (climate change as a challenging issue), with no participants catalogued in the routine node (see Table 7).

Non-routine

The arguments of the nine interviewees classified here were that under the pressure of a changing climate, an exacerbation of the hazards would be manifested through different elements such as variability, frequency, magnitude and impacts, but any changes were framed as being within historical human experience. Some of the participants also mentioned that climate change is affecting the geographical and seasonal distribution of weather and hazards. Participants said that uncertainty even where it is known to some extent will be less amenable to quantification, or that climate events could be less defined in space and time.

> "… this is a summary of the threats that we've identified for the city. Every year we go through this and we try to readjust the level of threat. So yeah, there's an uncertainty…" (lg15)

These interviewees also explained that uncertainty related to the definition of space and time is not the only uncertainty emerging with climate change. Some other uncertainties mentioned included, for instance, those related to scientific assessments, the effectiveness of responses and the imperfect nature of climate change predictions.

> "They [people] don't want scientists saying on the one hand this, on the other hand that… They want one-handed scientists." (sr5)

Complex

The majority of the participants (17 interviewees) frame climate change as a complex issue. Respondents in this group noted that climate change is increasing the magnitude and frequency of hazards, but in contrast to those in the "non-routine" category ('Non-routine' section) characterise this as being outside of historical records; and, substantial impacts and consequences beyond current human experience can be expected.

> "… intensity in events is greater and so it will take people outside their historical experience of disasters and we are seeing that in bushfires in Australia already the forest fire danger index of the fires last year [2009] was well outside anything that anyone had experienced …" (sr2)

Similar to participants in the non-routine category, respondents assigned to the complex category explained that climate change is affecting the weather and climate patterns in relation to seasonal and geographical distribution. They described this as increasing population exposure to climate-related hazards.

> "The kinds of hazards which Australia faces are natural hazards, are the kinds of hazards that will be exacerbated by climate change; cyclones, storm surge, floods, hail, drought, all of these things are things which are likely to be made worse or to move from some areas to others with climate change…it is going to be different." (lr16)

Another aspect that emerged from the interviews is interviewees' perception of the complexity that climate change adds to systems. Respondents stressed that because of change in hazard characteristics, not only could different parts of the system be affected at the same time by a hazard, but also that a combination of hazards could affect a specific part of the system, creating within this combination an escalation of impacts and the multiplication of their consequences. One of the most important impacts mentioned was that climate change will force people to migrate into different areas.

> "… we're going to see some dramatic changes in not only the climate but the environment because of the change in climate … So people in Queensland, living out west, they might have to move because they're unable to grow crops and that all creates social issues. So it's not just a natural disaster, in effect climate change may be the more frequencies of cyclones or the less rain out here, it's the ongoing rippling effect that comes from it." (sn20)

Analogous to what was described as non-routine, change in the return period is not the only uncertainty mentioned by interviewees in relation to climate change. Nevertheless, participants in the complex category described a wider range of uncertainty types, and also a combination of them and their ramifications. These are in regard to the characterisation of impacts and the performance of the constructed or built infrastructure; political reactions and effectiveness of responses; the imperfect nature of climate change predictions and the problem of modelling downscaling; and the varying results of scientific assessments.

> "... But there are other sources of uncertainty. I suppose, impacting or ramifying, I should say, ramifies in the space, and that is around allocation of budget funding. And ramifying on that is policy prioritisation; goal setting, you know, that ramifies as well. Community, managing community expectations, the government, that's another one. We don't know … what's going to happen, what the hell do you tell the community? What do you tell them to do?" (sg14)

The uncertainty described by these participants is one that is characterised by greater unknowns, unpredictability, and that resists quantification or presents an unbounded definition.

> "… gone are the days where we could anticipate when disasters or certain types of disasters were going to happen and that we're hearing now even that there's been a massive shift [in hazards' trends] …" (lg22)

As presented in this section, reflecting perceived changes to the attributes of scale and uncertainty, all respondents considered climate change to be a challenge; however, the same could not be said for the attributes of policy and management discussed in the next section.

Climate change as a challenge (or not): Policy and management

'Climate change as a challenge: Scale and uncertainty' section presented the results of framing for the attributes of scale and uncertainty. This section focuses on the attributes of policy and management. Results indicate that the three categories of 'routine', 'non-routine' and 'complex' emerged for the framing of climate change based on the attributes of policy and management (see Table 7).

Routine

The eight participants within the routine category indicated various reasons why climate change does not constitute a real challenge for DRM. They do not consider climate change a main driver for DRM policy and practice. Other drivers were mentioned as being more pivotal, such as exposure and limited resources.

> "… disasters are occurring all the time and actually the biggest impact on our disaster management is the population. The increase in population means a greater exposure and that's really what we need to be addressing. It doesn't matter whether the climate is changing or not, every time a major event occurs where there are more people, there is greater exposure and greater impact. That's what it's all about." (sg24)

Some participants said responses to climate change should be based on standard procedures and planning, including elements such as improving infrastructure and raising awareness. Finally, other respondents pointed out that climate change is a future threat, and that, in contrast, disaster management represents an existing problem. They also argued that there is not enough evidence about climate change in order to constitute a sufficient driver to modify current practices.

Later on in the interviews an opportunity was provided for interviewees to specifically discuss climate change uncertainty as a driver for DRM. Interviewees described two different ideas. On the one hand, they suggested describing uncertainty and using probabilities for assessing impacts, in order to guide their policy and management responses. On the other hand, some participants mentioned that climate change uncertainty does not significantly alter how DRM is or should be conducted; because DRM is intended to deal with uncertainty and risk, and hence, climate change is essentially 'business as usual'.

The last theme discussed with interviewees related to climate change as a challenge for DRM, was whether or not they considered climate change uncertainty when conceptualising resilience ideas. Only four participants linked their understanding of uncertainty with their use of or understanding of resilience, arguing that uncertainty is a driver for disaster preparedness, which in turn enables communities to keep functioning during and after disasters.

Non-routine

More than half of the interviewees understood climate change as non-routine and as a challenge for disaster policy and management. The argument that climate change will impact communities at a level that requires an adjustment of current DRM models prevailed in this group. Interviewees argued that climate change is a catalyst for change and that a different level of response is needed. This means that responses should go beyond the way disasters have been managed in the past, but that it is still possible to define and identify appropriate strategies, even though it is more difficult. The strategies mentioned include, for instance, change in preparation, revision of processes, adaptation of response capabilities, continual improvement of responses and an increasing need for external help.

> "… we've had to adjust our risk management philosophy because there's no doubt that Australia in the next twenty, thirty years is going to experience more natural disasters, there's no doubt that that will happen so we have to accept that we're going to be required to do more risk disaster mitigation and disaster recovery than we have before." (lg3)

In regard to the understanding of climate change uncertainty, rather than climate change in general as a challenge for DRM, participants commented that adjustments in DRM should occur because of the extra pressure imposed by this uncertainty. They noted that this adjustment should include a number of aspects. For example, responses need to consider more than the expected risk; uncertainty should not be the cause of inaction; the recognition of uncertainty cannot be eradicated; awareness of uncertainty needs to be broadly acknowledged in society. Finally, some participants added that these adjustments should not be framed as completely 'reinventing the wheel'; rather, responses should be based on how DRM has been conducted, but open to revision and adaptation.

In the analysis of the relationship between uncertainty and resilience, no clear pattern emerged among interviewees in their descriptions of diverse and contradictory ideas. Their spectrum of ideas covered diverse arguments. These included that management plans, which represent a way of building resilience, should be based on a quantified uncertainty of threat as calculated by risk assessments. These respondents indicated that people must strengthen their capacities, taking into account what is known but also what is unknown. They understood that resilience, through building networks in the community, helps to remove fear of uncertainty in regard to decisions that need to be made. This uncertainty undermines resilience because it makes people feel less confident. One person stated that uncertainty opens up opportunities for learning.

> " … look uncertainty is great, uncertainty is where we learn, it's where we're put in a position and we have to make some choices and again live with the actions that we take." (sp13)

Complex

The arguments of the four respondents classified in this category included the recognition that identification of appropriate strategies will become a very difficult task; that there is a need for a more fundamental change in DRM and for long-term DRM strategies; that knowledge becomes limited and insufficient; and that systems need to be more flexible and adaptable.

Within this group, two respondents linked climate change and resilience. One of these respondents stated that resilience is about learning from patterns of responses, and that because climate change is changing the seasonal distribution of weather, people can no longer rely on what they have previously learnt. The second person explained that because of climate change, more people will be exposed to novel extreme events and this will undermine their resilience.

Implications of climate change and climate change uncertainty framing

This section takes the results presented above and compares them to the existing literature and presents the implications that emerge from this analysis.

Framing attributes of scale and uncertainty

This study indicates that without exception and based on the attributes of 'uncertainty' and 'scale', all respondents framed climate change as a challenge. These findings concur with what is broadly recognised in the literature: that dealing with climate change represents an additional challenge to DRM (Bosomworth, 2012; Eriksen et al., 2011; Thomalla et al., 2006; Tompkins, 2005).

Scale

When discussing the attribute of scale, the predominant argument that emerged from interviews is that part of the challenge is rooted in the physical exacerbation of hazards in terms of their magnitude and frequency, as well as in the change in seasonal and geographical distribution of these hazards. This coincides with the results from other Australian studies conducted by Bosomworth (2012) and O'Neill and Handmer (2012) in Victoria. The implications emerging here include the recognition that an exacerbation of climatic hazards will result in more people being exposed to potential disasters and therefore in an increase in the vulnerable population. Another implication is that even if there are more frequent and larger magnitude hazards, a recommendation could be to not focus responses and policies so prominently on the physical dimensions of the hazards. The latter, as also stated by others (Eriksen et al., 2011; Hulme and Neufeldt, 2010; Lavell, 2011), could result in neglecting other important drivers of disasters such as the cultural and societal context, vulnerability, changing settlement patterns, incremental exposure of communities and socio-demographic population characteristics.

Uncertainty

An important finding is that part of the challenge that climate change is adding to DRM is rooted in the uncertainty attached to this change, which also has been mentioned extensively in the literature (Adger et al., 2005a; Eakin et al., 2009; Juhola et al., 2011; O'Brien et al., 2010). In this case study there is also recognition that part of the challenge is owed to the fact that the uncertainty related to return period is not the only uncertainty emerging with climate change. Within the non-routine framing, respondents mentioned other sources of uncertainty that concur with some of those summarised in the literature review (see Table 3). These include uncertainty in regard to effectiveness of responses (Barnett, 2001; Eakin et al., 2009; Fünfgeld and McEvoy, 2014; Heal and Kristrom, 2002); confusion created by contradictory messages delivered by scientists and others (O'Brien et al., 2008; Tompkins, 2005); and uncertainty associated with the imperfect nature of climate change projections (Head, 2014; O'Brien et al., 2006; Prabhakar et al., 2009). In turn, participants within the complex framing described a wider range of uncertainty types, covering all the uncertainty sources described in the literature review chapter (see Table 3). These ideas reinforce the importance of acknowledging and raising awareness of climate change and different sources of uncertainty, alongside the need to include climate change and climate change uncertainty in DRM and to recognise that uncertainty complicates the definition of the problem and possible strategies or responses. All these issues support the need for discussions of the different response pathways and framings of climate change as a challenge for DRM policy and management. This is addressed in the following section.

Framing attributes of policy and management

An important finding that emerged from the analysis is the unexpected dichotomy, expressed by some interviewees, between scale and uncertainty, and policy and management. The frequency of the numbers for the attributes of policy and management is closely related to a normal distribution, whereas the attributes of scale and uncertainty show a distribution that is exclusively concentrated in the categories of non-routine and complex.

The distribution of climate change as a challenge for policy and management can be explained in various ways. First, a few participants noted that under climate change, DRM would not need shifting because people are already living at risk and because DRM has always addressed uncertainty; uncertainty is already part of 'normal business'. This idea is not new in the literature with Bosomworth (2012) and Handmer and Dovers (2007) presenting similar findings. In contrast, some authors emphasise that dealing with an increased uncertainty presents an additional challenge to DRM (Klein et al., 2003). Second, some respondents from the 'routine' category pointed out that there is not enough evidence on climate change and that it is not an immediate threat, paralleling Tompkins's (2005) results. The main implication of the latter idea is that this could lead to potentially dangerous inaction, defined as a position of 'wait and watch' in the literature review (see Table 4) (Eakin et al., 2009; Fünfgeld and McEvoy, 2014; Prabhakar et al., 2009). Nevertheless, the latter statement is not absolute as in some situations the 'wait and watch' option may be the best one. What is important is that the decision to embrace this option requires an assessment of what is needed, monitoring and evaluation of the situation and a discussion and negotiation of the different options available to the actors involved. In any case, in choosing this or any other option, it is relevant to conduct a re-evaluation and then further discuss these evaluations.

Climate change not as challenge: Routine

The respondents' who framed climate change impacts on DRM as not challenging focussed on affirming that in the light of climate change, policy and management require standard procedures; and that these should be guided by an assessment of uncertainty (through risk assessment) via climate change impact studies. The importance given to basing decisions on risk assessments was corroborated in the document review. The NDRP guidelines (Department of Community Safety Queensland Government (DCS/QG), 2009b, 2010b) state that one of the requirements to be eligible to apply for NDRP funding is to have undertaken a hazard risk assessment incorporating climate change impacts. The two guidelines provided an attached document to assist applicants in the consideration of climate change through risk assessments (DCS/QG, 2009a, 2010a). This framing coincides with what was described in the literature review as the 'anticipatory strategy' in Table 4 (Barnett, 2001; Prabhakar et al., 2009). The relevance of this is that it could become problematic because in its effort to anticipate impacts, and act upon them, this strategy not only reflects the human tendency to control nature, but also is generally characterised by centralisation of power and constriction of flexibility. Another negative implication of this instrumentalist stance, which relies on climate models and expert knowledge, is that it dominates the public policy arena regardless of whether it represents the interests of the public. The public may be more concerned with adapting effectively, and therefore their preoccupations go beyond scientific knowledge to other aspects such as the social and economic dimensions (Howden et al., 2012; Meyer, 2011). This framing also denotes a mechanistic approach; and this has been noted as reinforcing order and structure in public administration (Beilin et al., 2012; Bosomworth, 2012), leading to a possible inappropriate rigidity when facing uncertainty.

Lastly, within this framing there is a lack of a wider recognition that uncertainty cannot be eliminated, and that the only path forward is to attempt to reduce uncertainty even though this cannot always be accomplished (Howden et al., 2012; O'Neill and Handmer, 2012). In other words, what is significant within this framing is that there is a strong tendency to believe that through risk assessments that use probability density functions, uncertainty can be controlled and known. By contrast, even if we acknowledge that risk assessments can help to address risk, climate change uncertainty is acquiring such magnitude that this suggests that future hazards could end up being outside of the probability density function and hence that based decision primarily on the risk assessments could develop inappropriate responses. This represents a form of uncertainty that resists quantification. This last idea of acknowledging uncertainty leads to the framing of climate change as a challenge and is discussed next.

Climate change as challenge: Non-routine and complex

The majority of interviewees frame disasters under climate change as challenging and their arguments resonate with what has been argued by others in the literature (Juhola et al., 2011; O'Neill and Handmer, 2012). The implication of these ideas, as respondents pointed out and as found in the literature (see the 'wait and watch' position, as defined in Table 4), is that uncertainty cannot be a driver for inaction. On the contrary, climate change and its associated uncertainty may be considered as a catalyst for change, leading to adjustments in DRM.

Interviewees who frame the issue as 'non-routine' stated that adjustments need to go beyond the way disasters have been managed in the past and that identifying effective DRM strategies, even if this is challenging and difficult, may still be possible. Similar to these findings, Bosomworth's (2012: 148), Dovers' (2009) and Juhola's et al. (2011) interviewees argued that it is unnecessary and inconvenient to try to 'reinvent the wheel' and consequently position stakeholders in a completely new unknown policy scenario; they considered it would be better "to begin with familiar territory" by revising and building on existing policies and practices.

The arguments of interviewees who frame climate change as a 'complex' issue include the view that for such issues scientific knowledge is limited and insufficient for dealing with climate change, and also because of climate change uncertainty and complexity, the definition and identification of appropriate strategies becomes an extremely difficult task. While we note that these results emerged from only a small number of participant interviews, we consider that they contribute to plausible solutions and strategies. Firstly the emphasis of DRM could be shifted towards reducing the relative contribution of biophysical sciences and elevating the importance of social sciences (Castán, 2013; Howden et al., 2012; Meyer, 2011). This is because even though DRM has increasingly been informed by other disciplines, there is still a tendency to rely on the biophysical sciences (Adger et al., 2005b; Dixit, 2003). An example illustrating possible changes could be policy science research that focuses on decision-makers and the values that underpin their decisions in relation to climate change. Another is using action research, its inclusive and bottom-up approaches, to assist decision-makers in developing ways of managing complex problems and uncertainty that engage participants as they undertake practice change. This is especially relevant when dealing with high levels of uncertainty where the tendency is to hotly contest the allocation of resources because biophysical science cannot detail the risk. Therefore, social sciences and economics need to be included to help develop robust responses.

Secondly, increasingly as the climate changes, the imperative is to move from assessment to action (Howden et al., 2012), and to narrow the gap between scientists and the rest of society. As the development of climate change adaptation literature advances, not only do more definitions and approaches emerge but there is also greater complexity. This could confuse stakeholders and decision-makers. Therefore, in narrowing this gap it is especially critical to simplify and increase the relevance of the messages delivered to stakeholders, while maintaining scientific integrity, and including stakeholders' perspectives in the development of these approaches.

Thirdly, based on the fact that climate change is a cross-cutting issue that affects populations across a variety of dimensions (Adger et al., 2005a; Beilin et al., 2012), it would be undesirable to pigeonhole climate change in DRM. Rather, it is preferable and necessary to mainstream climate change and DRM with the policy and practices of the other policy domains with which it interacts.

Interviewees characterised within complex framing further noted that climate change complexity is profoundly affecting DRM, that therefore a significant change is required and that DRM systems need to be more flexible and adaptable. These results are comparable with Bosomworth's (2012: 148) finding as her respondents proposed that it requires "consideration of potential fundamental changes to policy, thinking and actions within the sector". These ideas are similar to transformative climate change adaptation or transformation that has been the focus of increasing interest among scholars (see for example IPCC, 2012; Nelson, 2009; Pelling, 2011). Nevertheless, respondents from the study did not give details on how this strategic change would look or how it could be implemented. This suggests that while these ideas have currency, there is a significant gap between the literature and the practitioner level, at least within the practitioners for the case study.

In reflecting on transformation, we argue that it appears that its applicability in practice, although not completely impossible to achieve, needs to overcome considerable challenges. For example, in general, institutional settings are not appropriate for transformational processes because transformation confronts and challenges the *status quo*, power and political interests (O'Neill and Handmer, 2012); transformation also requires strong social changes which involve questioning values, beliefs and identities (O'Brien, 2012). Directing such social change from the top-down is unlikely to be successful. Social changes are more likely to occur if they come from the bottom up, as is the case in social movements. On the other hand, transformational changes may happen quickly following a major event.

Based on results from this research (in relation to change in the numbers associated with the distribution of respondents answers between the attributes of scale and uncertainty versus policy and management), the implication is that framing complex problems should be coupled with an effort to create simpler solutions. This idea was pertinently captured by Oliver Wendel Holmes's statement that "I would not give a fig for simplicity this side of complexity, but I would give my life for simplicity on the other side of complexity". Consequently, we argue that to manage emergencies under climate change, a balance between the non-routine approach and complex approach could be an appropriate framework. This would allow for consideration of possible solutions in existing policies and practices, and also be open to reimagining and reconfiguring complexity and to negotiating the configuration of transformative changes to practices across DRM management. The position of disasters as part of a continuum for preparedness, action and ongoing social learning can signify an opportunity for transformative changes, as disaster can constitute an important input that drives change.

Linking uncertainty and resilience

It was interesting to observe that in general, interviewees did not conceptually connect uncertainty with resilience and that no clear patterns emerged to link these two ideas. As has been argued by others in similar cases (Eakin et al., 2009) this may be due to the relative infancy of resilience discourse in the DRM policy arena. They mentioned very different arguments, and sometimes even contradictory ones in regard to the link between resilience and uncertainty. In general, the ways of framing uncertainty and resilience within the case study denote a tendency to contain and control uncertainty and nature, as described by other authors (Handmer, 2008; Prabhakar et al., 2009). The main implication of this as argued by Quarantelli (1998) is that it leads to rigidity in the way that DRM systems are conducted, making the systems even more susceptible to failure in complex situations or in the presence of high uncertainty. Some more positive connotations that did emerge from respondents are that in facing uncertainty it is important to focus on strengthening community networks, and people’s preparation and response capacity; and, one interviewee also imagined uncertainty as an opportunity for learning. Nevertheless, generally speaking, interviewees did not specifically conceptualise uncertainty as an opportunity for improvement and learning as part of adopting the resilience framing. In contrast, in the literature, resilience is posited as an effective strategy to deal with uncertainty, by considering uncertainty not only as a threat but also as an opportunity for reflection, innovation and adaptation (Adger et al., 2005b; Wildavsky, 1988). The resilience literature also emphasises that learning to live with uncertainty should be privileged over only trying to reduce it (Berkes, 2007). Participants pointed out that disaster provides opportunities for innovation and adaptation, and they see climate change as a catalyst for change, as a driver for revision of policies, processes and practices, and as an opportunity for renewal, adaptation and learning. The same understanding was not observed in their discussion of resilience and uncertainty.

The main implications of the results presented above are that even if theoretically a clear link between uncertainty and resilience has been described, this link has not permeated through to the practitioners in this study. One possibility for exploiting uncertainty is to conceptualise it as an opportunity for innovation and improvement based on learning. However, as Handmer and Dovers (2007: 125) stress, although learning is a crucial requirement of DRM, at the same time it is extremely difficult to achieve. Therefore, a resilience-style discourse opens up opportunities to reinforce the relevance of innovation and learning in this case study and elsewhere, for example, through the evaluation of what constitute the main aspects that contribute to risk and which of these could be opportunities to decrease the impacts and risk after every disaster. In this sense, this concurs with Wildavsky (1988) who in an early discussion of resilience and disasters stated that resilience is about learning from errors in a way that is useful to assist with bouncing back to an improved situation compared with what was in place before.

Conclusion

Several implications for theory, policy and practice emerge from this study. The most relevant of these is that climate change adds complexity to DRM, and that this complicates both the definition of issues and problems within the sector and, consequently, the definition of solutions that drive policy and practice. Nevertheless, this study indicates that practitioners have the intention to face the complexity of climate change, by means of deriving less complex policy and management solutions. Another relevant implication of this study is that caution is required to avoid heavily directing the DRM focus towards the physical elements of hazards (scale and uncertainty), if doing so further reduces the attention paid to the social drivers of disasters; this could imply a step backwards within the evolution of DRM literature.

What is also relevant is the urgency of raising awareness about the escalating uncertainty in relation to climate-related hazards and related issues, and that this increased uncertainty cannot constitute a driver for inaction, but as resilience theory suggests, it can be a catalyst for change and continual improvement. Adjustments are required in order to go beyond the way disasters have been managed in the past, but bearing in mind that it would be unnecessary to change all existing DRM practices and policies; rather, revising and adjusting specific practices and policies may be a more convenient, effective and less painful strategy. Complex responses to address climate change challenge emerged from only a few interviews, and at this point in time, participants were unable to state clearly what form this strategic complexity should take or how it should be implemented. Also a few respondents frame climate change as not challenging current disaster policy and management, and it is important to acknowledge what this position can lead to in practice. Underpinning this framing is a technocratic style of management that relies on climate change modelling and risk assessments, as well as a mechanistic approach dominated by standard procedures, rigidity and the centralisation of power. We argue that this is problematic when addressing the changing conditions imposed by climate change, as it can lead to path dependency and 'lock-in' within decision making processes, and can limit the scope of management and policy options available to a given sector.

Also emerging from this study is the imperative to recognise and openly discuss with practitioners the limitations of scientific knowledge underpinning conventional DRM in the context of climate change. This discussion would help to clarify the dependency associated with calculating risk using prediction and probability models. As a consequence in acknowledging this limitation there is an opportunity to elevate the role of social science and social processes in decision-making, because climate change is increasingly requiring that we acknowledge the importance of incorporating value judgments. Biophysical and social sciences can work together to better inform those choices.

Finally, practitioners did not conceptually link uncertainty with resilience; promoting this link could reinforce the importance of developing the conditions necessary for innovation and learning. For example, a participatory learning style and social learning acquire special relevance in the presence of greater uncertainty and complexity, because broadening the set of actors involved facilitates a wider range of knowledge, points of view, experience and solutions as we face the unknown.

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