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Making space for social inclusion in conceptualising climate change vulnerability

Abstract (150 words)

Impacts from climate change pose a raft of challenges for societies, governments and policy makers internationally. The anticipated changes are well documented, including rising sea levels, increased floods and other extreme weather conditions. Much research and policy emphasis has focused on technical and economic aspects. Less debated are questions about different communities' vulnerabilities, inequitable distributional impacts, social justice issues and how vulnerability links to social inclusion/exclusion. This paper explores a case study which maps social exclusion and vulnerability in Brisbane, Queensland, and found that while communities can be vulnerable through physical aspects of an area, when social dimensions are added to the equation it amplifies or exacerbates the scale of vulnerability. The findings also suggest that in developing research agendas and policy debates around climate change there could be benefits from interlinking the currently separate areas of work on social vulnerability to extreme weather events, to forms and processes of social inclusion/exclusion.

Key Words: climate change, social inclusion, social exclusion, climate change vulnerability, community vulnerability

Introduction

What we know from the increasing research evidence base about climate change is that the predicted variations in temperature and weather patterns will have serious social and economic consequences. The extent of the anticipated changes thus far range from negative outcomes for coastal regions due to rising sea levels and increased storm erosion, to extreme weather events such as floods and droughts and increased precipitation. A large body of work by climate change scientists has investigated the likelihood of the occurrence of these sorts of climate related events from a quantitative perspective along with their physical and economic impacts (Allen 2003; Nicholls et al. 1999). Bell (2010) argues that both the research and policy agenda is mainly focused on technical, scientific and economic aspects. Important as these findings are about the economic and technical facets, in comparison little is known about the unequal impacts of climate change from a fairness, ethical and social justice perspective. There are critical questions for discussion regarding distributional and differential impacts as it is becoming increasingly evident for a variety of reasons that the most *vulnerable* societal groups will be most affected by climate change (Lindley et al 2011).

In seeking to conceptualise and increase understanding of vulnerability some of the broader critical questions requiring further debate are: how will the impacts of climate change be experienced across socio-economically diverse groups, different households and distinct spatial areas (e.g. metropolitan versus rural areas) and countries. In turn, what are the best policies for ameliorating the worst effects of climate change and its unequal impacts for the most vulnerable groups' health and life expectancy? What are the best ways to enable and foster the capability and choices of different communities and countries' governments to cope with climate change? From a social justice perspective it would be grossly unfair to encumber the poor or developing countries with responsibilities that they may be unable to meet due to a lack of resources or capabilities (Adger et al 2006). From this viewpoint we need to ensure that knowledge and support are available, and societal context is taken into account in devising climate change policies.

While it is not yet possible to answer these specific questions as a contribution to the debates we argue that it is important to consider the body of literature on social vulnerabilities along with work that has been completed on framing social inclusion/exclusion policy approaches. In this paper we provide a nuanced investigation of the relationship between climate change, the social inclusion framework and social vulnerability research. The discussion commences by considering some of the broader literature in order to add a hazard dimension in linking between place, social exclusion and climate change. Then we present a practical case study that maps social exclusion and climate change vulnerability in Brisbane south east Queensland. In the final section of the paper the utility of adopting such an approach is reassessed along with its potential for leading to innovative policy solutions.

Social Exclusion/Inclusion

Understanding and measuring vulnerability to climate change requires an account of the different social dimensions of well-being that are jeopardised in the event of an extreme weather event or other climate related disaster (Adger et al 2006). While income is often taken as a general measure of well-being, a more nuanced understanding of climate vulnerability requires a broader multi-dimensional approach that accounts for not only material wellbeing, but also considers other inter-related aspects. In recent years within the social policy and social disadvantage literature, the paired concepts of social exclusion/inclusion have been used to represent the broad, multiple and interrelated dimensions of inequality and disadvantage that move beyond a focus on poverty. Both terms are ‘inextricably intertwined’ as inclusion can only be conceptualised by identifying groups that are ‘socially excluded’ (Lister 2007). Social exclusion is thus described as:

> a complex and multidimensional process. It involves the lack or denial of resources, rights, goods and services, and the inability to participate in the normal relationships and activities, available to the majority of people in the society, whether in economic, social, cultural or political arenas. It affects both the quality of life of individuals and the equity and cohesion of society as a whole (Levitas et al. 2007, 9).

Social exclusion refers to current circumstances whereby some people are marginalised and unable to reach their full potential in life for a variety of reasons. These situations may include, but are not restricted to, a lack of material and financial resources, such as inadequate family support, social isolation, ill health and disability, not having a home or living in unsafe or inadequate housing, low levels of education, and inability to gain employment.

It is the complexity and multi-dimensional nature of social exclusion, which makes it an important concept to consider when addressing climate vulnerability. It will be argued in this paper that vulnerability needs to be envisaged as a multifaceted concept that goes beyond a focus on the physical and built environment to socio-demographic characteristics of particular population groups and households. This viewpoint recognises that peoples' experiences of the impacts of global climate change and propensity for adaptation depend on their situations in the social and physical words and will vary on a continuum from positive to negative (Clark et al. 1998). For instance, the impacts of climate change will be more pronounced for low income households, those in poor health and the homeless (Sherrard & Tate 2007). Social exclusion provides a multifaceted framework to incorporate the multiple dimensions of inequality, economic, social, political and cultural, and the often complex linkages that exist between these. Thus this seems a useful frame to adopt in order to increase understandings of vulnerability in relation to climate change and defining the population groups most at risk.

Another pertinent aspect of a social inclusion framework is that in recognising the multiple dimensions of inequality it follows that it implies complex policy solutions, an approach that tends not to be sufficiently recognized in the development of climate adaptation policy. While attention to environmental or physical factors is important and should not be overlooked, the development of adaptation policy needs to appreciate in a more precise way the dimensions that a focus on social factors brings to the policy making frame. Indeed, as identified by Lindley et al. (2011, 3) 'once the social dimensions of vulnerability are recognized, climate adaptation policy needs to address a broader range of concerns than is often the case'. In a policy context, vulnerability to

climate change and extreme weather events sits squarely within the realm of ‘wicked problems’. By this it is meant the issues are extremely complex, always changing and thereby hard to resolve. The resolutions adopted under the banner of social inclusion in social policy have promoted ‘whole of government’ models to ameliorate problems that are manifestations of socio-economic disadvantage. These policies have sought to enhance mechanisms for coordination across various levels of government (local, State and Federal) and diverse portfolio areas that often function as separate policy domains. These spheres include but are not limited to portfolios of housing, health, employment and education. The rationale for ‘whole of government’ approaches is to provide more effective, streamlined and holistic services that commence with the needs of the individual or family rather than providing services in ‘silos’ that individuals need to access separately.

Also relevant to the focus of this current paper it is widely accepted that social inclusion/exclusion and vulnerability to climate change are both linked to place and space. In the social inclusion/exclusion literature there is a well-established agenda regarding the uneven geographies of vulnerable population, linked to spatial segregation and regeneration of older neighbourhoods often characterized by highly concentrated clusters of social housing (Arthurson & Jacobs 2004). Likewise, the growing focus within the hazards research literature shows that as far as vulnerability to extreme events is concerned place does matter. That is, some locations are more vulnerable to climate change or extreme weather events than others. This focus on social-spatial vulnerability has the potential to enable researchers to carefully combine aspects of a social inclusion/exclusion framework with environmental concerns. Such an approach may assist in illustrating the degree to which place, social, economic and climate factors result in an uneven mosaic of prospective vulnerability. Subsequently, the way that this mosaic is laid out in any given city could act as a guide to the development of policy that adequately accounts for the multifarious and complex nature of climate change vulnerability. The utility of considering such an approach as part of the adaption planning process is deftly summed up by Lindley et al. (2011) as follows:

> Neighborhood specific signatures help to explain which factors drive social vulnerability in particular localities and allow a picture to be constructed of the

> complex landscape of factors adding to and detracting from the potential for harm (p. 3)

It is for these reasons that other commentators on climate change argue that future research should incorporate in-depth case studies of different communities and also identify "hotspots of climate change vulnerability" so that policy initiatives can be targeted to where they are most needed (Brody et al. 2008). Adopting the case study approach would also enable important comparative analyses to be conducted across different urban sites (Bolin, Nelson et al. 2002). It is against this background that the current paper is set.

Place, social exclusion and climate change

> Extreme exogenous factors such as the climate have become disastrous partly because the emerging isolation and privatization, the extreme social and economic inequalities, and the concentrated zones of affluence and poverty pervasive in contemporary cities create hazards for vulnerable residents in all seasons… Klinenberg (2002, 230).

At the heart of an understanding of place, social inclusion and climate vulnerability is a broader and growing contemporary literature dealing with the place-based measurement and analysis of regional or community risk and vulnerability to extreme weather events and hazards. There is a growing recognition within this literature that hazards are not only physical events but include socially constructed situations. The key conceptual starting point within this literature has been the inter-play between the variable physical geography of an extreme event or the potential of such an event and the wider urban social structure. Such 'hazards-of-place' or 'vulnerability of place' analysis can extend conventional investigation of the spatial characteristics of social exclusion with the addition of a hazard dimension to the patterning of vulnerability in human settlement. Informed by early research (White 1945, 1964, Burton et al. 1978), Cutter et al. (2003) views place vulnerability as a combination of biophysical vulnerability and social vulnerability (or social exclusion) which, in turn, are a function of the interplay between the potential for a given hazard to occur and the socio-geographic weave of the fabric of place. The estimation of place vulnerability is, consequently, firmly tied to an adequate

understanding of the existing patterns of community settlement and development. The implications of this approach are summarised by Cannon (1994).

> There are no really generalised opportunities and risks in nature, but instead there are sets of unequal access to opportunities and unequal exposures to risks which are a consequence of the socio-economic system…It is more important to discern how human systems themselves place people in relation to each other and to the environment than it is to interpret natural systems (Cannon, 1994, pp. 14-15).

More formally the place vulnerability or hazards of place model is an attempt to integrate the physical nature of hazards and vulnerability with the social aspects of vulnerability by tying them to particular places. In the model, risk, that is the potential of an event happening, its frequency and intensity combine with any potential mitigation action, or in other words efforts to reduce or lessen impacts, to create an initial hazard. Any potential hazard interacts with the social context of place resulting in place specific social exclusion characteristics and place specific biophysical vulnerability. Place specific social exclusion and biophysical vulnerability combine to produce overall vulnerability of place.

An understanding of the dynamics of the social exclusion dimension of the schematic framework are informed by the myriad of research into social inequality, race, gender and social justice which illustrates that 'disasters are the product of the social, political and economic environment, as well as the natural events that cause them' (Fothergill and Peek 2004, 89; see also Morrow 1999). [1] Issues such as race and ethnicity, socio-economic class, gender and housing condition and tenure are recognised as among the most important characteristics for defining socially excluded populations (Cutter et al. 2003, Tapsell et al. 2002, Morrow 1999, Rygel et al. 2006, Satterthwaite et al 2009). These factors can amplify or reduce the level of vulnerability and thus the capacity to

[1] As expressions of 'natural events', 'natural disasters' and 'forces of nature' do not honor the socially constructed approach that we ascribe to (i.e. vulnerability determine impacts of extreme events) they are placed in inverted comments to note this. From this perspective so called "natural" disasters are not natural at all or unique in themselves, but social processes triggered as a result of manifestation of an extreme event of natural, socio-natural or man-made origins, which find favorable conditions of vulnerability (favorable to a negative impact) in a population and its infrastructure (Kelman 2010).

adapt to shifting climate conditions. For example, it is not surprising to find that low income households are generally more vulnerable to the impacts of a physical hazard than other income groups (Clark et al. 1998) and that income is also associated with coping capacity. Low income households and individuals often lack the capacity to deal with the negative outcomes of extreme events in an appropriate manner and the requisite resources to recover from even modest loss. Recent research in a number of disadvantaged coastal communities found that residents lacked understanding about the effects of climate change and how to adapt. It seemed that their lives were subsumed in addressing pressing day-to-day issues such as gaining enough income or maintaining employment rather than worrying about climate change (Zsambaky et al 2011).

Investigation into the aftermath of 'natural disasters' supports the foregoing hypotheses. It finds that households with lower incomes: suffer higher mortality rates; are more likely to sustain injuries and psychological trauma than the norm; and experience greater housing loss (see Blaikie et al. 1994, Fothergill and Peek 2004); and post the event have less access to transport (see Morrow et al. 1997, Morrow 1999). In turn they are more likely to experience greater obstacles during the post recovery and reconstruction phases (Fothergill and Peek 2004). Low income also limits the range of dwelling types available to an individual or family and the choice of residential community. People on low incomes tend to live in poorer quality, inadequately insured and maintained housing located in areas that are more exposed to risks of climate change (Donner and Rodríguez 2009). As such the economics of low income and housing choice, are expressed in lower standards of housing and greater locational exposure to the 'forces of nature' (for instance, living on a flood plain), aspects that in turn tend to increase vulnerability. In the after math of Hurricane Katrina in New Orleans, low income groups were more vulnerable, as they had limited resources at their disposal and tended to reside in poorer areas, which made it harder for them compared with others to get on with their lives (Campanella 2006).

While income or lack thereof is readily seen as a key component associated with social exclusion other factors are also important and in combination can lead to increased levels of social exclusion. At the individual level elderly people, with reduced physical capacity, which is often manifested in a lack of mobility, are likely to experience

elevated levels of vulnerability to the impacts of extreme weather events. Elderly individuals are also more likely to be vulnerable due to their increased social isolation. The evidence suggests that if they experience social isolation prior to the event then they are less likely to receive assistance from their neighbours during the emergency (Naughton et al. 2002, Fernandez et al. 2002). Similarly single parent households are more at risk not only because they are frequently low income households (Rygel et al. 2006), but also because of the added responsibilities in caring for dependent children (Clark et al. 1998). Significant health problems such as long term illness or disability have also been found to be associated with elevated risk in the event of extreme weather impact (Morrow 1999).

The extent to which social vulnerability is associated with race or ethnicity is ambiguous. Thus, for example, there is no shortage of evidence that African-Americans groups were severely impacted by hurricane Katrina. However, in this not atypical context being African American was highly correlated with, almost a proxy for, lack of income. It is important to recognise, however, that African Americans have also experienced historical discrimination that contributes to their vulnerabilities; low income is only one aspect.

In other contexts there is some, albeit less stark evidence to suggest that social vulnerability might be higher for particular ethnic or racial groups as a direct result of poor language skills or differing cultural practices (Gladwin and Peacock 1997, Yelvington 1997) or due to discriminatory practices (Fothergill 1996, Clark et al. 1998, Peacock and Girard 1997). Other pertinent factors related to social exclusion include community isolation, patterns of housing (Fothergill, Maestas et al. 1999) and a lack of economic, cultural or social capital in newly arrived migrants (Donner & Rodríguez 2009). In some instances, connections to broader mainstream community may be lacking and for a variety of reasons, including fear of government officials based on past experiences with repressive regimes, some groups may be reluctant to seek assistance outside of their immediate ethnic group (Morrow 1999).

Mapping social exclusion and climate change vulnerability: A case study example

Background

In order to better illustrate the conceptual framework as outlined above, in this section we present an analysis of climate change vulnerability in Brisbane, South East Queensland. To operationalize the framework this paper focuses on three principal segments of the model namely physical vulnerability, social exclusion and overall place vulnerability. We use an index of general deprivation to account for socio-spatial exclusion and over-lay, an indicator of physical vulnerability—in the current situation heat waves –to illustrate overall place vulnerability. Such an approach was followed by Lindley et al. (2011) in the UK who argued that 'a socio-spatial vulnerability index… provides insights into the uneven geographies of social vulnerabilities. When superimposed on to expressions of potential hazard-exposure it is possible to assess which…neighborhoods currently experience greatest climate disadvantage.' (p. 3).

The measure of socio-spatial exclusion used here is an index of general deprivation that combines a series of relevant aggregate level social indicators to form a single index number that can be mapped to illustrate the spatial distribution of social exclusion across the Brisbane region. The index of general deprivation uses a method first outlined by Langlois and Kitchen (2001) and applied to Montreal Canada and subsequently used in Australia by Baum (Baum 2004, 2012). Briefly the approach utilises a series of indicators taken from the 2006 Australian Bureau of Statistics Census of Housing and Population at a given spatial level (in our case suburbs). Using principal components analysis as a data reduction technique the individual indicators are combined into a series of components representing different facets of deprivation or exclusion. One component is considered to be a general indication of deprivation (usually accounted for by income measures) and is taken as a necessary condition for socio-economic exclusion. The remaining components define more specific dimensions of exclusion and include indicators such as labour market participation, age, disadvantaged families, and ethnic status. The final index is a weighted combination of the individual components, with each suburb within the Brisbane region receiving a social exclusion score that places it along a continuum from high social exclusion to

low social exclusion. A full account of the methodology can be obtained from Langlois and Kitchen (2001)[2].

As the focus of this paper is to consider the interplay between indicators of social exclusion and climate change vulnerability we also consider the ways in which an indicator of potential heat wave hazard is represented in relation to the social exclusion index. In terms of potential heat surface the literature uses indicators of heat thermal comfort (HTC-see Harlem et al. 2006) or the surface heat island effect provided by thermal satellite images (McGregor et al. 2007). It should be noted that the idea is not to provide an indicator of an actual heat wave but rather to produce an indicator that shows the potential risk of heat wave impacts across a city or region. For this paper we utilize the indicator developed as part of the South East Queensland Climate Adaptation Research Initiative that is an extension of the indicator of the surface heat island effect (Loy Choy et al. 2011). The suburb level heat wave potential takes into consideration the percentage of impervious surfaces across suburbs, combined with population density and observed differences in temperature registered through satellite images taken in June and September 2009 depicting thermal profiles[3]. A full explanation of the methodology used to develop the indicator of physical heat wave risk is given in Loy Choy et al. (2011).

The final measure of place vulnerability is developed using a simple unweighted additive index building approach to combine the physical vulnerability and social exclusion dimensions into one measure.

The analysis of the individual social exclusion and physical vulnerability measures, together with the measure of overall place vulnerability is undertaken using mapping visualization. For each indicator we present two diagrams, one a simple thematic map and the other a map illustrating significant spatial hotspots of the particular indicator. The analysis and mapping of spatial hotspots makes use of local indicators of spatial

[2] Both the work by Langlois and Kitchen (2001) and Baum (2004, 2012) used a similar set of indicators to develop the index of social deprivation. As such the individual components that made up the overall social deprivation or social exclusion index were similar.

[3] The data for the percentage of impervious surfaces and the thermal profile were initially measured at 10 metre and 60 metre grids and were up-scaled to suburb level spatial unit.

association (LISA), an approach that allows the research to identify clusters of suburbs that have significant local spatial relationships (i.e. clusters of suburbs all measuring high on an indicator, or all measuring low on an indicator) and to map the resultant clusters.[4]

Regional context

Insert Figure 1 here

The extended urban area of Brisbane is located in South East Queensland and is part of Australia's fastest growing urban regions (figure 1). Comprising the Brisbane City Council, and contiguous suburban localities in Logan, Ipswich and Moreton Bay regional councils it covers a total of almost 6000 square kilometres and has an estimated resident population of over 2 million. Characterised by a sub-tropical climate the region faces generally mild winters and warm summer temperatures. Although historically extreme temperature events have been infrequent they have none-the-less been recorded. The most severe heat wave in terms of fatalities hit the region in January 1940 when at least 80 people died, while more recently a 2000 heat wave lasting 3 days killed 22 people. The most recent example of prolonged above average temperatures occurred in February 2004 when the region witnessed 20 days of high temperatures resulting in the highest medical emergency on record in the region. During this period it is estimated that there was an excess number deaths due to non-external cause mortality and cardiovascular mortality associated with heat stress of 75 and 41 respectively (Tong et al. 2010). In addition, climate change is expected to lead to an increase in average minimum and maximum temperatures in the region and thus in the number of days with temperatures above 35°C (Suppiah et al, 2007; DERM, 2009).

Socio-spatial exclusion

A list of the individual variables included in the exclusion index for Brisbane are presented in table 1, and figure 2 shows the spatial distribution of the index. In general the picture provided by the index reflects the finding of other studies, which have attempted to investigate the spatial distribution of inequality or exclusion in the region

[4] A full description of this approach can be seen in the paper by Cutter and Finch (2008) and in the work by Anselin (1995).

(Baum et al, 1999). Taken as a whole the index ranges from 0 to 1, and has a mean of 0.45 with a standard deviation of 0.19. Sixty five of the 428 suburbs located in Brisbane (15.2%) have a score on the exclusion index more than one standard deviation above the mean of all Brisbane suburbs indicating higher relative levels of deprivation or exclusion. Those suburbs with the highest scores on the index can be thought of as containing households and families who may be most vulnerable due to an inability to prepare and are least able to respond in appropriate ways during a climate event such as a heat wave. The map on the left-hand side of figure 2 uses natural break divisions to display the overall distribution of social exclusion across Brisbane, while the map on the right-hand side shows the spatially significant clusters of social exclusion using the LISA analysis. It is evident that several significant clusters of suburbs within the Brisbane region are characterized by high levels of social exclusion relative to other places. The most significant concentrations of high social exclusion are located in the far north sector of the Brisbane area and in a corridor running west located to the south of the region.

(Insert table 1 here)

(Insert figure 2 here)

Physical vulnerability: heat waves

The map on the left-hand side of figure 3 uses natural break divisions to display the overall distribution of the potential for physical heat exposure across Brisbane, while the map on the right-hand side shows the spatially significant clusters of potential exposure using the LISA analysis. Considering these maps in tandem provides an indication of both the overall and significant spatial patterns of potential exposure. While the natural break map suggests a general gradient of exposure across the Brisbane region with variations of high and low exposure throughout the urban footprint, the LISA cluster map shows where these are spatially significant. Reflected in both maps there are significant clusters of high exposure suburbs located in the western corridor running through the Logan / Ipswich city councils, in a number of developed residential areas to the north and north/east of the Brisbane CBD and in urbanised coastal locations to the north. The western corridor cluster represents suburbs in the urban and peri-urban

region and includes localities such as Eight Mile Plains, Goodna, Ipswich and Willowbank. The significant clusters in the northern suburbs of Brisbane include both older established suburbs such as Kippa-ring and Rothwell as well as newer housing estates such as Mango Hill. The coastal clusters are centered on suburbs in the developed coastal zone around Caloundra (Aroona, Moffat Beach and Dicky Beach).

(Insert figure 3 here)

Place vulnerability

While the maps discussed above illustrate the individual characteristics of the place vulnerability model discussed in this paper, bringing this data together into the overall place vulnerability index provides a picture of the potential of heat wave vulnerability that accounts for both the physical hazard and the important dimension introduced by considering social exclusion. Again, the natural breaks map (left hand side, figure 4) shows the general pattern of potential place vulnerability, while the LISA cluster map (right hand side) provide an indication of the spatially significant clusters. As expected the general gradient of heat wave vulnerability is reflected in the presence of several 'hot-spots' across the Brisbane urban region. A significant hotspot is located to the south east of the CBD and running out towards the west of the region. This hot spot includes suburbs such as Sunnybank, Woodridge, Kingston and Logan Central to the south east of the CBD, the suburbs of Inala and Richlands further west and suburbs such as Moores Pocket and Bundamba towards the western urban periphery. To the north of the CBD three significant hotspots exists, one around the built up coastal region of Kippa-Ring and Scarborough, one in the area of newly developed residential estates around Morayfield and one in the established northern suburbs of Zillmere and Chermside.

(Insert figure 4 here)

When a visualisation of this analysis is undertaken the differences in the significant clustering are apparent. While the hot-spots still reflect the overall pattern of the basic exposure variable the addition of the social components into the analysis acts to vary the initial physical vulnerability. Going beyond consideration of the particular example, the

dimensionality provided by the inclusion of social vulnerability in the analysis may be more generally appreciated with a plot of the (physical) exposure variable against the broader social vulnerability index. This plot of the variation introduced into the measure of heat vulnerability by moving from a simple measure based on a physical event to a broader social indicator is shown in Figure 5. If the introduction of the social exclusion indicator had been redundant the plot would approximate a straight line at a 45 degree angle. At low levels of vulnerability this is virtually the case. However, as the risk of heat exposure increases so does the variation between the measure of physical vulnerability and the broader social vulnerability. The immediate conclusion is, of course, that for a given level of heat risk, vulnerability can vary considerably depending on social structure.

(Insert figure 5 here)

Discussion and conclusions

In summary, thus far research and policies on social inclusion and climate change have developed separately without considering the two in tandem. However, in returning to the definition of social inclusion provided at the start of this paper, some of the studies in the social vulnerability literature include factors and variables that represent this concept, even though they do not specifically refer to social inclusion. Cutter et al. (2003), for instance in their U.S. based county-level index of social vulnerability to environmental hazards utilise a range of variables relating to socioeconomic status, gender, race and ethnicity, age, employment loss, education, social dependence, and special needs. Thus, in order to enhance understandings of how the unequal impacts of climate change will be experienced across socio-economically diverse groups and distinct spatial areas there seems benefits in explicitly combining the social vulnerability and social inclusion approaches.

Some of the key elements of a social inclusion/exclusion approach that seem useful in the context of climate change and in particular as a way to focus on vulnerability and adaptations are that it: can incorporate a multitude of dimensions of inequality; enacts complex policy solutions; has a spatial focus; explores the balance of responsibility between social structure and individual agency and incorporates citizen participation and democracy; and has developed benchmarks and measurement tools of social

inclusion. Each of these aspects is discussed in relation to the findings of the case study model and also the broader implications.

Recognising multiple dimensions of inequality

As this paper has discussed in the context of considering climate change, vulnerability is best thought of as a multidimensional concept that goes beyond a focus on the physical and built environment to socio-demographic characteristics of particular population groups and households. Relevant social characteristics may include, but are not restricted to, a lack of material and financial resources, such as inadequate family support, social isolation, ill health and disability, not having a home or living in unsafe or inadequate housing and low levels of education. However, the literature suggests that such an understanding of vulnerability in climate change research and the social justice implications is thus far limited (Eriksen and Kelly 2007). To assist in addressing this deficit we have drawn on a case study model mapping climate change vulnerability, which includes an index of social exclusion.

The benefit of the concept of social exclusion is that it provides a multifaceted framework to incorporate multiple dimensions of inequality: economic, social, political and cultural, and the often complex linkages that exist between these. All of these factors, alone and in different combinations, relate to the aspects discussed earlier that were considered as increasing vulnerability of particular groups and in making some more vulnerable than others to the uneven distribution of climate change effects. In taking this into account social exclusion was one of segments adopted in our case study model to try and increase understandings of vulnerability in relation to climate change and defining the population groups and areas most at risk.

Our case study illustrates that a focus on physical vulnerability isolated from social and economic dimensions provides an incomplete picture of climate vulnerability. The nub of the issue is that differences in vulnerability exist due to the interconnections with all these dimensions. In our model including an index of social exclusion allowed for a more nuanced understanding of vulnerability through accounting for groups characterised by certain socio-demographic and socioeconomic indicators. The analysis

showed that whilst groups can be vulnerable through physical aspects of an area when the social dimensions are added to the equation it amplifies or exacerbates the scale of vulnerability. The findings point to important issues of equity and social justice. Households on low incomes, for instance, that do not have enough money to pay high energy bills or have access to adequate cooling mechanisms for their homes in the case of heat waves will be more vulnerable than others to the effects of these sorts of events.

Complex policy solutions

In recognising the multiple dimensions of inequality it follows that a social inclusion approach implies complex policy solutions. In related social policy arenas resolutions adopted under the banner of social inclusion/exclusion have promoted 'whole of government' models to ameliorate problems that are manifestations of social and economic disadvantage. These policies have sought to enhance mechanisms for coordination across various levels of government (local, State and Federal) and diverse portfolio areas that are often separate functional policy domains. These spheres include but are not limited to portfolios of housing, health, employment and education.

The rationale for these approaches is to provide more effective, streamlined and holistic services that commence with the multiple needs of the individual or family rather than providing services in 'silos'. As climate change is considered a 'wicked problem' that is multifaceted and challenging to tackle, this direction appears pertinent with the potential for leading to innovative policy solutions.

Spatial/geographic focus

Another relevant aspect of a social inclusion approach is that it promotes a geographic focus on locations of spatially concentrated social disadvantage or vulnerability. If climate change policy is going to focus on local communities, then as illustrated by our case study, as part of defining vulnerability we need to be more precise about the characterisations of socio-spatial distributions of environmental risks, as well as mapping differences of vulnerability in a geographical sense.

Identifying different communities or 'hotspots' of climate change vulnerability will enable the important question to be addressed of where are the most socioeconomically

vulnerable and marginalised communities located. That is, communities which are likely to bear a disproportionate burden of climate change that will exacerbate social inequalities and social exclusion. Such an approach will enable policy initiatives to be targeted to where they are most needed along with comparative analyses conducted across different urban sites.

Balance between structure and agency

A social inclusion/exclusion framework also pprovides an understanding of inequality as dynamic, rather than static as it focuses attention on processes that cause or lessen vulnerability as well as opportunities for policy interventions. This is because it includes a focus on both social structure and individual agency. Individual agency refers to the question of the extent that disadvantaged individuals' circumstances arise through their own behaviours and lifestyle choices as compared with the level of responsibility for changing their situation through modifying their behaviour. Social structure commonly envisages the broader societal determinants of inequality and vulnerability, which are largely outside of individual control and often incorporates the institutions and economic and social structures of society. This is pertinent to understanding vulnerability to climate change as the ability or inability that an individual has to take remedial steps to ameliorate the effects of climate change action is an important component of vulnerability (Weber 2006). This aspect requires consideration in further research.

Consultative and democratic decision making

The administrative structures for social inclusion/exclusion approaches have also involved new ways of people participating in decisions that affect them, either as clients of services and/or as residents of particular areas. There is an extensive literature within this realm on participation and community empowerment and capacity building and innovative models of community development.

Whilst our case study model was quantitatively based another important feature of a holistic and balanced understanding of climate change vulnerability requires exploration of the lived experiences of different groups through nuanced qualitative methods. Environmental activist groups have been vocal in arguing that we need to understand

these issues from the perspectives of those that will be most affected by climate change (Wilson et al 2010). Thus, once the most vulnerable locations and communities are recognized then we need more subtle explanations of how different groups understand or interpret climate change to pick up nuances missing at the broader levels of quantitative analyses.

Targets and benchmarks

As a way of measuring success, those charged with implementing social inclusion policies have developed targets against which progress can be measured, using specific indicators. As argued elsewhere to capture the multiple dimensions of vulnerability to climate change a set of metrics is required "that can help analyse and explain vulnerability characteristics within and between systems. The most effective metrics will be those that are generic enough that they can be applied to a wide range of settings" (Luers, Lobell et al. 2003).

In conclusion the case study model, mapping social exclusion and climate change, suggests that there are benefits in bringing the conceptual framing of social inclusion and analysis of climate change vulnerability together. It seems likely to lead to increased understandings of the sorts of processes that will contribute to innovative policy solutions in addressing the effects of climate change and in turn enhancing social inclusion for the most disadvantaged and vulnerable groups. Understanding the impacts of climate events on the most vulnerable communities and developing adaptation options drawing on a social inclusion framework remains an important and urgent pursuit. This should be a growing area of research for researchers interested in understanding processes and outcomes of climate change for disadvantaged communities

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Table 1: Variables included in the Analysis

Demographic/household

- Indigenous population (%)
- Persons aged older than 64 years of age (%)
- Person requiring assistance with daily activities (%)
- Recent immigrants to Australia (arrived in the between 2001 and 2006) (%)
- Population who do not speak English well (%)
- Single parent families (%)

Income

- Median family income ($)
- Families with low incomes (bottom 10% of the distribution) (%)
- Median individual income ($)
- Individuals with low incomes (bottom 10% of the distribution) (%)

Housing

- Households in public housing (%)

Engagement with work

- Youth unemployment rate (persons aged 15 to 24) (%)
- Male unemployment rate (%)
- Male labour force participation rate (%)
- Female unemployment rate (%)
- Female labour force participation rate (%)

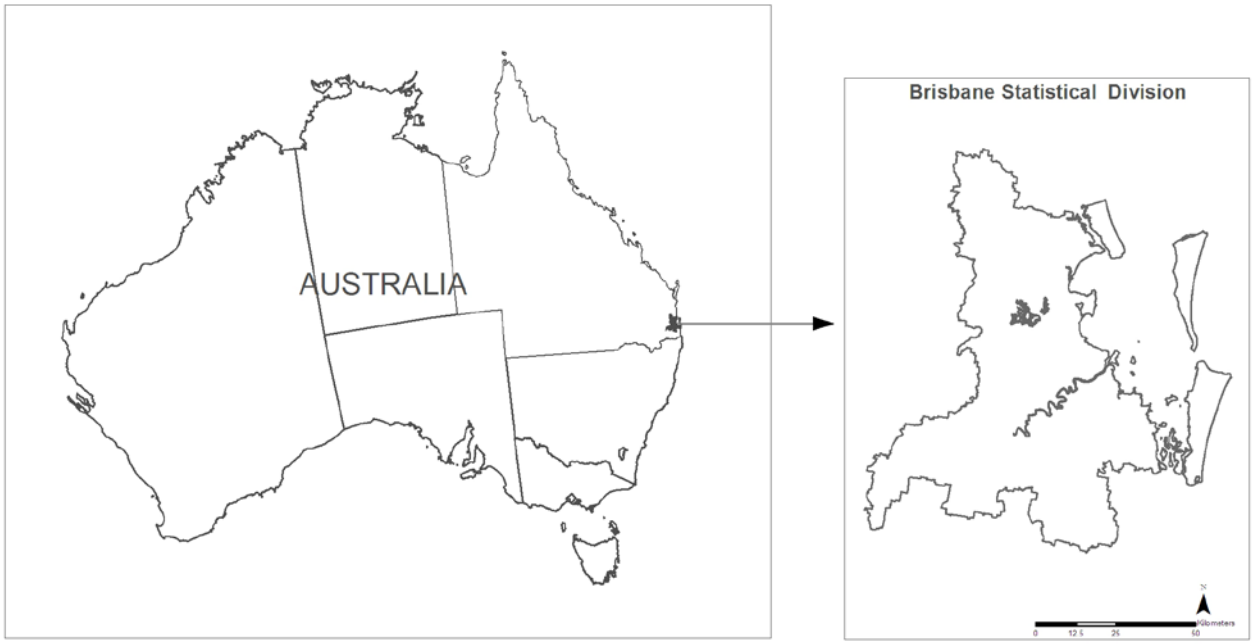

Figure 1: Brisbane Urban Region

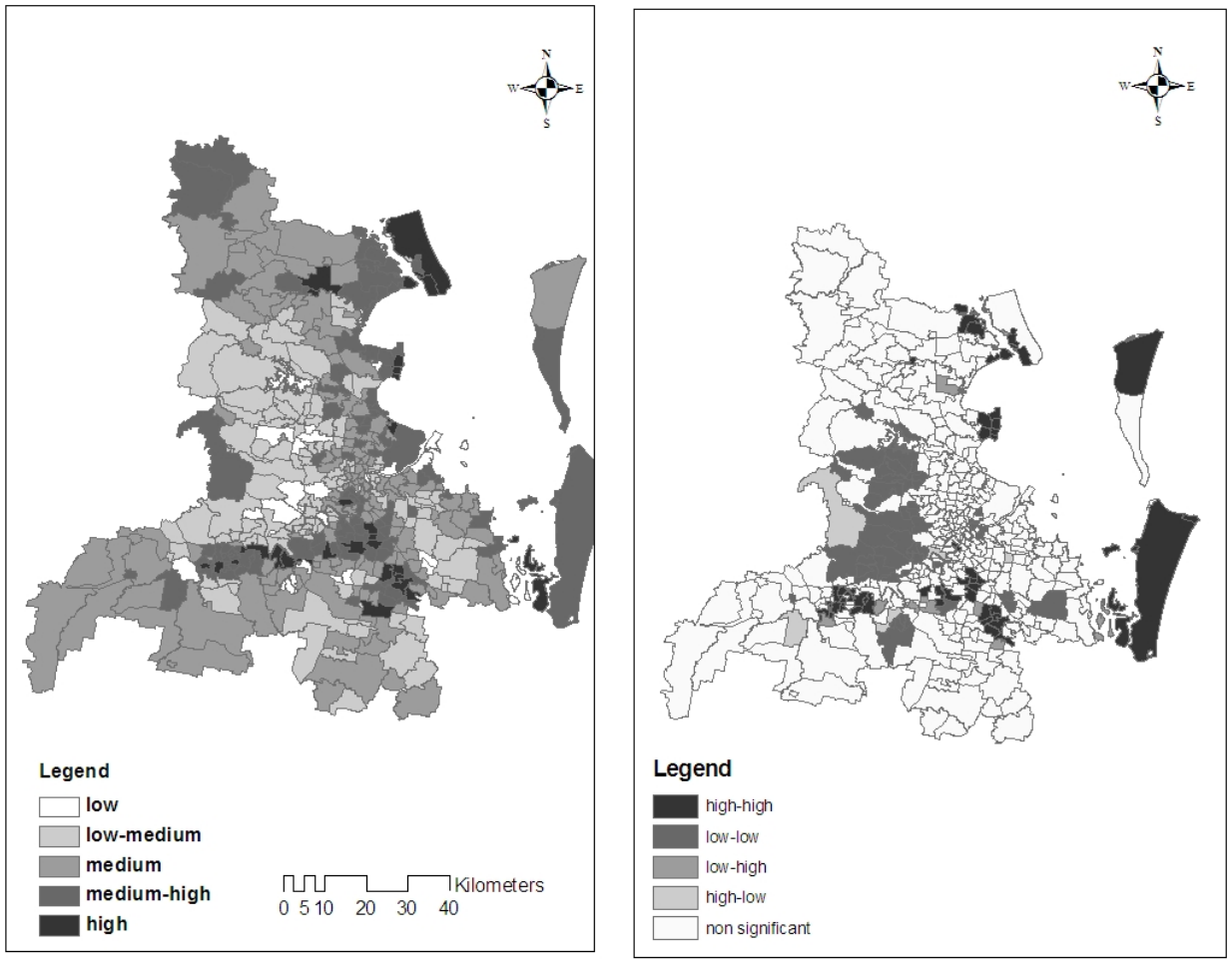

Figure 2: Thematic map and Local Indicator of Spatial Association map for social exclusion, Brisbane

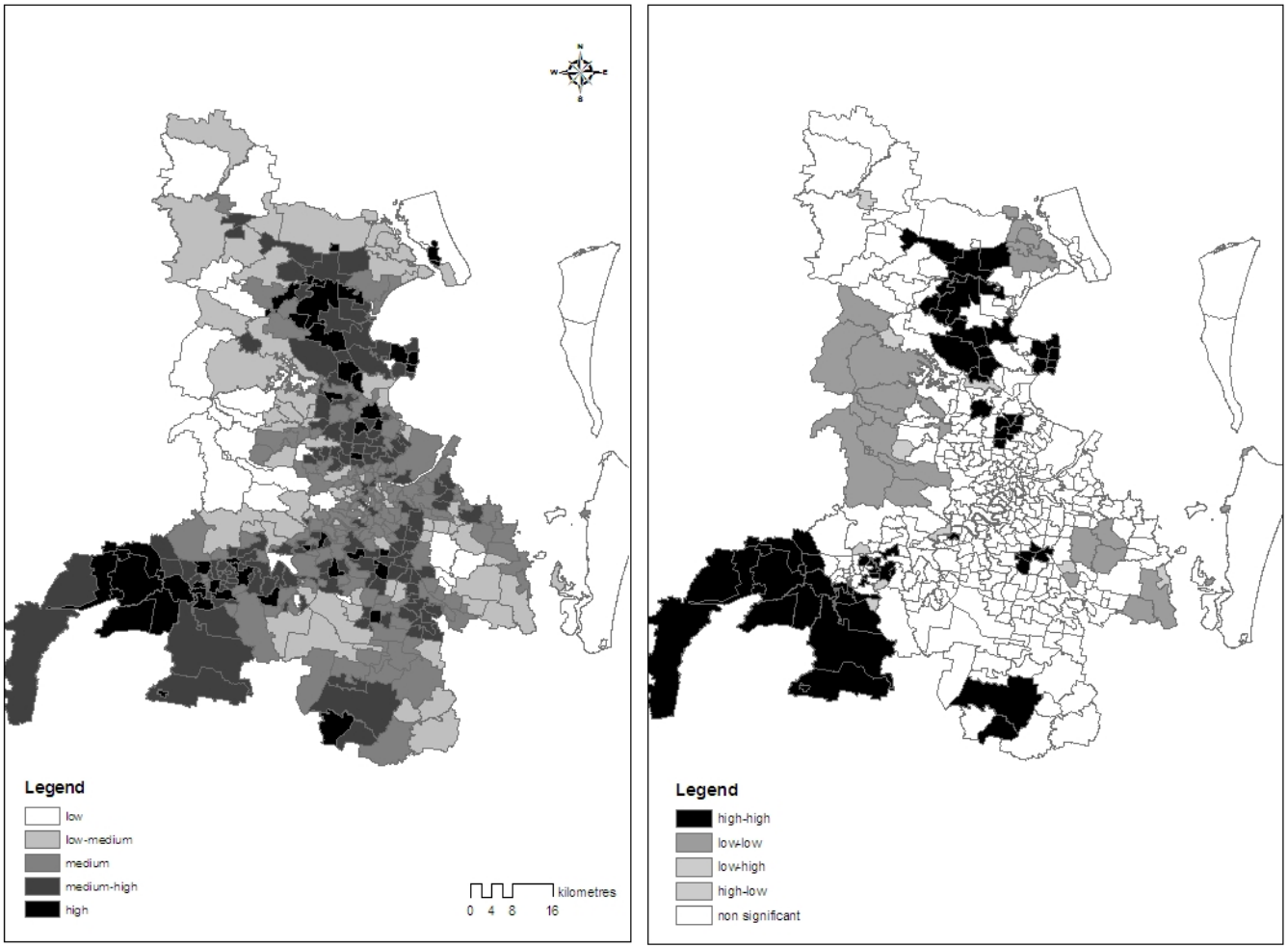

Figure 3: Thematic map and Local Indicator of Spatial Association map for heat wave exposure, Brisbane

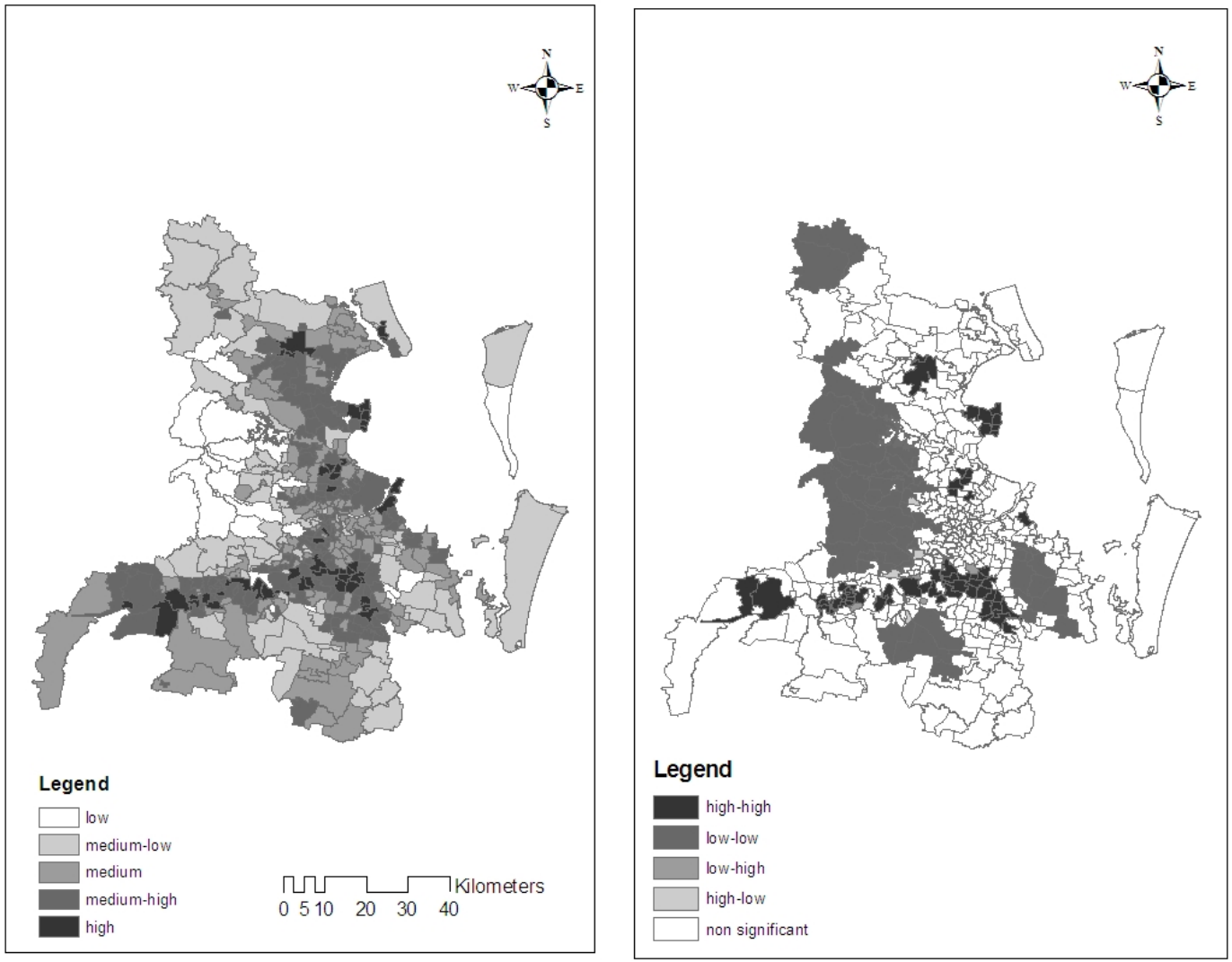

Figure 4: Thematic map and Local Indicator of Spatial Association map for heat wave vulnerability, Brisbane

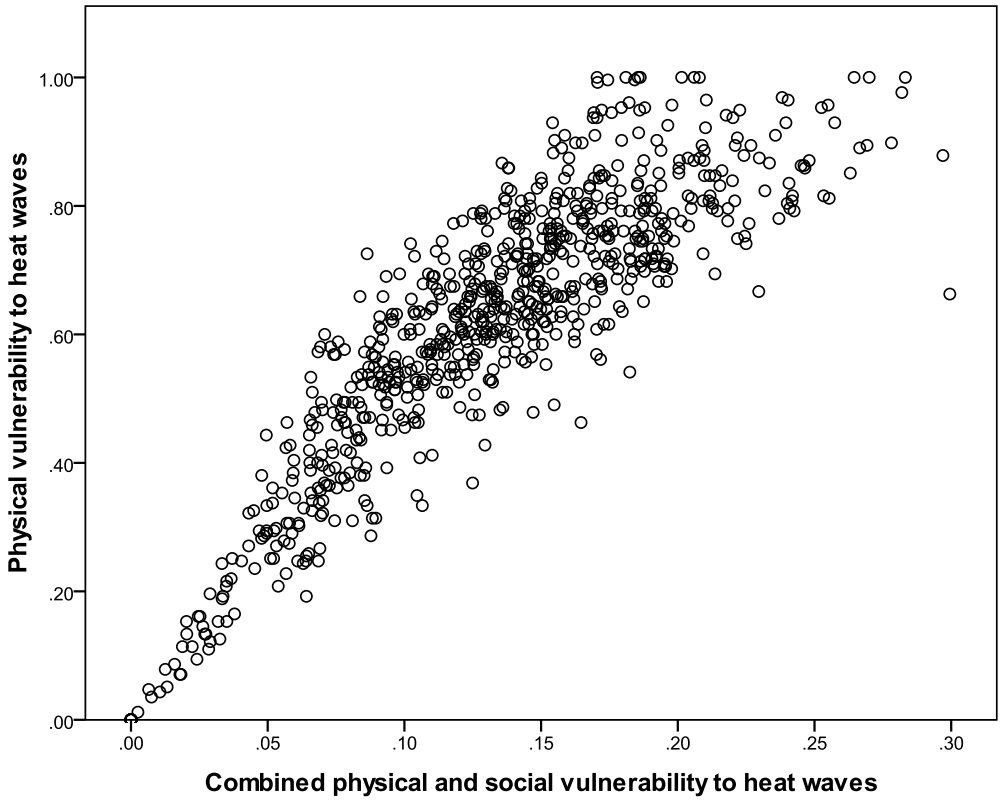

Figure 5: comparison between the physical vulnerability to heat waves and the vulnerability index