Adapting the English suburbs for climate change: A conceptual model of local adaptive capacity

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Recent climate change modelling suggests that we will all experience changing climatic conditions such as higher temperatures, altered patterns of rainfall and increasingly frequent extreme weather events regardless of the extent of mitigation efforts that may take place. In this paper we seek to conceptualise the potential for adaptation to climate change at the neighbourhood level building on a current research project funded by the UK's EPSRC (Suburban Neighbourhood Adaptation for a Changing Climate (SNACC) Project). The paper focuses on the capacity of suburban communities/localities to identify and implement adaptation measures by: firstly reviewing the existing literature on adaptive capacity; secondly identifying 'suburban' places; and thirdly conceptualising what the adaptive capacity of an English suburban neighbourhood might be. This will draw on literatures associated with neighbourhood governance (Lowndes and Sullivan 2008 and Smith et al 2007) and on insights drawn from actor-network theory in order to make sense of differing conceptualisations of 'neighbourhood' that are at play when thinking about collective action within and by 'neighbourhoods'.

Introduction

While public and government attention around climate change has tended to centre on minimising the extent of future change in climate caused by human activities, there has been a recent growth in interest around adaptation (see Schipper, 2006). Recent climate change modelling suggests that regardless of existing and potential mitigation activities, we will experience changing climatic conditions such as higher temperatures, altered patterns of rainfall and increasingly frequent extreme weather events (Jenkins et al 2008). Adaptation will therefore be necessary if communities are to adequately cope with this environmental change.

This paper explores the capacity of English suburban neighbourhoods to cope with likely changes in the English climate over the next 30 to 40 years. This is part of a larger EPSRC funded project (SNACC) under the 'Adaptation and Resilience in a Changing Climate' programme (see www.ukcip-arcc.org.uk). The

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SNACC project* (Suburban Neighbourhood Adaptation to a Changing Climate) will be exploring the adaptation options available for modifying suburban neighbourhoods. This paper concentrates on one component of the SNACC project: how can we understand the capacity of communities located in small areas (referred to as 'neighbourhoods') to respond or adapt to potential [but plausible] environmental change.

In this paper we seek to conceptualise the potential for adaptation to climate change at the neighbourhood level, focusing on the capacities of communities to identify and implement adaptation measures. Following a brief discussion of the role of 'adaptive capacity' as a theoretical lens for climate change research, we examine the claim that 'neighbourhood' is an appropriate level through which to tackle adaptation to climate change in terms of both urban form scale and governance level. We then develop a conceptual model of local adaptive capacity for climate change at the neighbourhood level and discuss the issues and challenges of measuring the adaptive capacity of English neighbourhoods.

The English suburb and climate change challenges

Suburbs (defined as the residential areas within larger urban settlements) are where much of the English population currently live. Given the slow turnover of housing in England it is also where they are likely to be living as the climate changes. English suburbs are characterised by low-medium density housing with a high level of private ownership. The density of these areas is relatively low compared to European standards but often much higher than suburbs in the United States and Australia. The housing stock in suburban areas varies from terraced housing (often in historic suburbs with very small backyards) to semi-detached homes (with slightly larger backyards) to detached homes (with large backyards).

Suburban neighbourhoods throw up interesting challenges for policy makers considering how best to adapt in the face of environmental change. They are characterised by high levels of owner occupation and this pattern of many small-scale property owners presents particular problems for framing and organising collective action and support to modify the housing stock (including private open space such as gardens) and built environment more generally (including public and publicly managed spaces) in these areas. Change in the built environment of the suburbs is made through processes of 'autonomous' adaptations (i.e. those done by private householders, or companies, for their individual benefits), 'planned' adaptations (undertaken by public bodies, usually local authorities, for the public good), and occasionally 'communal' adaptations (undertaken jointly by community members) (Williams et al, 2010). However, these processes are not well understood in the context of climate change and in relation to 'typical' neighbourhoods.

The co-production of change in English suburban environments provides a particular challenge for adaptation work. It requires looking at the neighbourhood as a collective unit rather than simply adapting individual suburban houses. In English policy terms the neighbourhood is a smaller subset of a local authority area, which often covers a whole city-region. Neighbourhoods can be defined in terms of policy

(i.e. ward boundaries), built form (i.e. a collection of 100 houses) or communities (i.e. identity of a place). These definitions are explored in this paper in order to understand how adaptation might occur in English suburbs.

Adaptive capacity as a theoretical lens for climate change research

The concept of 'adaptive capacity' has been widely embraced by both researchers (e.g. Adger 2003, 2006; Smit & Wandel, 2006) and policy-makers (e.g. IPCC, 2001; 2007) thinking about the public policy response to climate change. The concept has ecological origins and refers to the ability for individual species and ecological systems to adapt to external changes in their environment (see Adger, 2000; Folke, 2006). The International Panel on Climate Change (IPCC 2001) defines adaptive capacity in relation to climate change as 'the ability of a system to adjust to actual or expected climate stresses or to cope with the consequences'. Discussions about adaptive capacity also commonly involve other ecological concepts such as exposure, resilience and vulnerability that have been brought into climate change studies to act as a theoretical framework for understanding adaptation (see Adger et al, 2004).

Clearly adaptive capacity is related to how one might conceptualise the concept of adaptation. The existing literature considering how communities and societies may adapt to climate change considers two aspects of adaptation: the *nature of adaptation measures* (and their effectiveness) and the *process of adaptation* (i.e. how adaptation measures are identified and implemented). Thus one might consider the capacity to achieve specific adaptation outcomes and the capacity to engage in the process of adaptation. Secondly the literature addresses adaptive capacity both in terms the capacity of the built (and natural) environment and in terms of the social environment to adapt to anticipated changes in climate. This paper focuses on adaptive capacity as it relates to the *process of adaptation* (although the SNACC project is also covering the *nature of adaptation measures*).

Translating the concept of adaptive capacity for empirical research has largely focused on developing indicators that identify common components or determinants of the capacity for communities to respond to changes in climate. These components include factors relating to: demographics, local/regional economics, access to resources, available technologies, and institutional arrangements (Tierney and Bruneau, 2007). Drawing upon the elements of adaptive capacity commonly cited in the literature, Yohe and Tohl (2002) have developed a list of determinants of adaptive capacity based upon the work of Smit et al (2001). These include:

- Available technological options for adaptation;
- Availability of resources to implement adaptation measures;
- Structure and functionality of critical institutions (i.e. decision-making authority/political influence, flexibility, decision-making criteria);

- Social capital (i.e. educational achievement, access to personal security, kinship networks);
- Access to risk-spreading processes (i.e. insurance);
- Decision-makers' ability to manage information and determine its credibility; and
- The public's perceived understanding of climate change (and their readiness to take action in implementing adaptation measures).

Work developing indicators has been undertaken for the purpose of identifying priority groups, regions or countries that are likely to be more vulnerable to climatic changes. The common conclusion has been that vulnerable areas (particularly developing countries) need assistance with developing their capacity to adapt (see Brooks & Adger, 2005).

Much of this existing work has only served to identify the conditions and drivers that facilitate or constrain adaptations. However, this potential adaptive capacity does not tell us about what actions are really taken and more work needs to be done on linking determinants to available response (Moser et al, 2008). There are two components of adaptive capacity that need to be considered – the set of resources available for adaptation and ability (and willingness) to use these resources effectively to pursue adaptation (Brooks and Adger, 2005). The nature of the relationship between this potential capacity and actual adaptation action is not currently well understood.

It has recently been suggested that adaptation should be understood as a social process, which centrally involves social learning and the spread of adaptation innovations between actors and amongst communities (Moser et al, 2008). Viewing adaptation as a social process requires exploring the qualitative aspects of communities. Giddens (2009) argues that socio-cultural factors (i.e. belief systems and cultural values) responsible for communities either adapting or not adapting are often overlooked in climate change studies (in comparison to economic and technical factors). He asserts that the qualitative character of a group - the ability of people to make the best of adverse circumstances or actively triumph over them – will be particularly influential in determining their capacity to act together and to be able to modify or transform existing ways of life if and where necessary. Tierney and Bruneau (2007) refer to this qualitative character as resourcefulness - the ability of individuals or groups to diagnose and prioritise problems and initiate solutions by identifying and mobilising resources (material, monetary, informational, technological and human). With these qualitative aspects in mind, it has been suggested that there is a need to develop a theory of change for adaptation (Gallopin, 2006). This theory would involve looking at where change originates and what roles different actors (individuals, communities, institutions, markets) would play in delivering adaptation.

In seeking to develop a theory of change it is important to recognise a number of tensions in the literature that relate to how climate change adaptation is conceptualised. The first tension concerns how the climate change risk is understood. Cutter et al (2008) assert that there are two different perspectives of adaptive

capacity – a *hazard* perspective (focused on responding to single climate events) or a *global environmental change* perspective (focused on longer-term response to ongoing climatic change). These two perspectives reflect Brooks and Adger's (2005, p173) classification of climate change: *extreme weather events* – storms, heatwaves and droughts; and *weather trends* – temperature increases and altered rainfall patterns. They argue that governments and planning bodies are the key actors for dealing with extreme weather events while individuals and communities are the key actors for responding to weather trends. The second tension relates to what adaptation means in terms of the outcome of adapting. Does adaptation mean to bring the standard of living of those affected by climate change back to their original condition or to simply adjust to the new circumstances? Gunderson (2002) argues that there are two types of adaptation – response to single climate perturbances (i.e. storm) where the aim is to build resilience in order to return to a stable (if not the same) state or a slower process of change where the aim is to build capacity to cope with and respond to change. Linked to these different viewpoints, the literature also illustrates both positive and negative associations with the idea of climate change adaptation - negative in terms of coping with the new conditions (i.e. introducing measures to deal with warmer temperatures and more erratic weather) and positive in terms of responding actively and positively to these changes (i.e. transforming places to improve quality of life).

The existing literature on adaptation to climate change has limitations in terms of understanding how English communities can adapt their neighbourhoods. First, many of the studies of adaptive capacity look at extreme events associated with climate change, such as flooding and storms, rather than more gradual ongoing changes, such as those related to more gradual increases in temperature and rainfall patterns. As such, there is a tendency to view adaptation as a single response to climate hazards rather than a process of ongoing gradual change, which is also particularly relevant to how suburban areas will experience climate change. Second, many of the empirical studies of adaptive capacity focus on developing countries, which have distinctly different capacity barriers (i.e. access to technology) to developed countries. The challenges for adaptation in developing countries are likely to be quite different from those in English neighbourhoods. Third, there is a lack of work translating national models of adaptive capacity to local or neighbourhood scales, where government institutions interact with communities at multiple scales. The determinants cited in national reports may play out differently at the local level and also differentially across suburban areas. Fourth, much of the literature fails to adequately address neighbourhood governance and social learning, reflecting a divide between the physical sciences origin of climate change research and the social sciences understanding of change management. There is a need to conceptualise adaptive capacity at the local level if we are to better understand how communities can transform or adapt their neighbourhoods.

A conceptual model of local adaptive capacity

Having demonstrated the tensions and diversity of the literature on adaptive capacity we now turn to local adaptive capacity as a measure of the potential for neighbourhoods and communities in places to change in

the light of anticipated climate change. We conceptualise that communities and localities with higher levels of adaptive capacity are those that are more likely to be able to adapt and either flourish or cope with changed conditions while those with lower levels are likely to be more vulnerable to future projected changes.

In considering local adaptive capacity we first need to conceptualise what is meant by 'neighbourhood' as our notion of 'locality'. Kearns and Parkinson (2001, p2103) note that "there is no single, generalisable interpretation of the neighbourhood". Sullivan and Taylor (2007) outline some of the key theories of neighbourhood that have been present across a range of urban policy interventions in the UK that emphasise that "neighbourhoods are complex and multi-dimensional and dynamic and their construction depends on the nature of the interactions between individuals and their environments" (2007, p21). They are also likely to be different according to the context in which the concept is deployed. Within British urban policy Whitehead (2003, p280) argues that the concept of neighbourhood has been deployed by government as "a supple scale within which a flexible geography of state interventions can be legitimated and realised". In applying the concept of neighbourhood and locality to debates on adaptation we would argue that the 'wickedness' of climate change as a policy problem (after Rittel and Webber 1973) open up the possibility of adaptation policy operating without polity (after Hajer 2003). Given that adaptation touches on changes in behaviour as well as potential changes in the physical fabric of suburban neighbourhoods and because it potentially extends the sphere of public policy interest across a wider range of neighbourhoods (than urban policy is typically interested in), this is a policy area where there may be "no generally accepted rules and norms according to which policy making and politics is to be conducted" (2003, p175)

Forrest and Kearns (2001) identify three main types of neighbourhood definition: neighbourhoods as community, neighbourhoods as context and neighbourhoods as commodity/consumption niche. In the case of English suburban neighbourhoods the potential for either collective or spatially coincidental action around climate change will flow from the inter-relation of these three conceptualisations of neighbourhood. In the case of framing neighbourhood level policy interventions/collective action around climate change adaptation we would suggest some re-working of the Forrest and Kearns typology (outlined in Figure 1). Thus the conceptualisation of adaptation is focused upon the relationship between three notions of neighbourhood: *neighbourhood as community* (or as lived space); *neighbourhood as context* (or as formally governed/serviced space); and *neighbourhood as commodity* (or as assemblages of buildings and roads, pipes, parks, etc). The relationship between these three conceptualisations of neighbourhood are regulated through different means. For example the relationship between neighbourhood as governed space and neighbourhood as lived space occurs through the democratic and contractual arrangements between the institutional actors (such as local authorities) and the communities that live within localities. Adaptation within any one conceptualisation of neighbourhood will have an impact on the others (as they are all interrelated).



Figure 1: Neighbourhood as interdependent network of actants

Innovation and change may emerge from within any of the three types of neighbourhood (labelled as social, policy or technological innovation respectively) and adaptive capacity will also be different depending upon the type of neighbourhood concept being considered (community/ context/ commodity). Each of these neighbourhoods is an actant around which coalitions of individual and institutional actors coalesce depending on which type of neighbourhood concept dominates. In exploring the power relationships associated with the three conceptualisations of neighbourhood, this bears some resemblance to the work of Lindseth (2005) who has conceptualised local adaptation strategies in Norway in relation to three discursive strategies (scientific-economic, communicative-scientific and communicative-economic). Just as Lindseth sees the discursive strategy as a resource with the process of adaptation, we would see the three faces of neighbourhood as three actants within the process of local adaptation.

The following section will outline the possibilities for adaptation and change (adaptive capacity) relating to climate change issues under the three different conceptualisations of neighbourhood.

Adaptive capacity of the neighbourhood as lived space

The first neighbourhood concept through which to explore the potential for adaptation is that of the neighbourhood as community (or lived space). Clearly within a neighbourhood community, wealth measured as economic or human capital (essentially held in households and by individuals) will be an important measure of what communities in place might be able to achieve. Given that housing is an important component of wealth and there is a high degree of owner occupation in suburban areas (averaging

76% in 2001), the resources underpinning adaptation by communities is related to the value of neighbourhood as a commodity (and housing markets).

Beyond simple measures of wealth and human capital, there are two potential aspects of neighbourhood as community that are pertinent to the potential for change. These are the degree to which residents in a neighbourhood interact and form bonds with other residents in their neighbourhood and the psychological attitude of individuals to the issue of climate change. These constitute two of the seven 'determinants' of adaptive capacity (outlined above by Yohe and Tohl, 2002 as 'social capital' and 'perceived understanding of climate change').

Social capital has been a concept that has been popular in a range of work relating to urban policy but the use of the term is fraught with definitional problems. On a simple level researchers use the concept of social capital either as a measure of being in a set of networked relationships built of trust and reciprocity (after the work of Putnam) or as a measure of the resources that can be mobilised through being in networks of social relationships (after the work of Bourdieu) (see Carpiano 2006 for a review of social capital based on the work of Putnam and Bourdieu). Taking social capital as the networks, and trust and reciprocity that flow from these networks, Pelling and High (2005, p317) argue that whatever the many limitations of the concept, "social capital offers ways into understanding the role of fundamental social attributes that contribute towards building capacity for social collectives and individuals to respond to climate change". Carpiano (2007) argues that social capital (defined as the resources that flow from membership of social networks) derived from relationships with neighbours is useful for framing behavioural responses to public health issues (such as binge drinking and smoking). However social capital does not always contribute to making the changes desired by public policy-makers. For example Wolf et al (2010) suggest that strong 'bonding' social capital (within similar members of a localised community) had the potential to prevent the adaptive responses of the older people in their study to adapt their homes to hotter weather (collectively denying their capacity to react to hotter conditions). Who you know and the resources you gain from who you know is likely to influence the adaptive capacity of neighbourhoods as lived spaces but this influence cannot be guaranteed to be positive. Thus framing social capital as either the networks or the resources that are embedded in neighbourhood-focused networks offers valuable insight into both collective action and behaviour change.

On one level, the degree to which individuals in a locality are prepared to volunteer for groups can be taken as a measure of social capital as networks. Table 1 presents evidence of volunteering from the Department for Environment, Food and Rural Affairs (Defra) 2007 Survey of Pro-Environmental Attitudes comparing those who live in suburban areas with those who live in 'big cities' and the 'rural fringe'. English suburban residents were 1.3 times more likely to have volunteered for groups than those who lived in 'big cities' although suburbanites were less likely to volunteer than those who lived in the rural fringe. For the most part (over 30% of those who volunteered) volunteering took place in the context of schools (rather than a 'local community or neighbourhood' group). Thus the early evidence suggests that the residents of English suburbs have a greater propensity to volunteer their services than those who live in 'big cities' (but less than within rural areas) albeit that around two thirds of residents do not appear to be formally engaged in local collective action. Equally we do not have any evidence as to the spatial patterns of volunteering (variations between neighbourhoods).

		Which phrase			
G2 In the last 12 months, have you volunteered with, given time to or taken part in any groups?		Big city	Suburban or smaller city	Rural and rural fringe	Total
Yes	Count	88	775	377	1240
	%	26.6%	32.8%	41.6%	34.5%
No	Count	243	1586	529	2358
	%	73.4%	67.2%	58.4%	65.5%
Total	Count	331	2361	906	3598

Table 1: Volunteering in suburban areas

(Source: Defra, 2007 Survey of Public Attitudes and Behaviours toward the Environment)

Other than the value of either being networked or demonstrating a propensity to volunteer within a community, we argue that any conceptualisation of localised adaptation capacity needs to understand the degree to which individuals are willing to mobilise their resources to respond to climate change. Willingness to act may be linked to environmental attitudes in terms of belief in climate change. However, the choice to adapt may be motivated by many factors, including the protection of economic well-being or improvement of safety (Adger et al, 2005). Work on pro-environmental attitudes in England clearly points to a range of views on the importance of climate change as an issue and on differing levels of behavioural responses to climate-related issues. It may seem fairly self-evident but Blennow and Perrson (2008) researching the adaptation responses of Swedish forest owners found that owners who believed that climate change was an important issue and believed that adaptation in the face of climate change was possible were more likely to have adapted their forestry practices than other forest owners.

Drawing again from the 2007 Survey of Pro-Environmental attitudes, Table 2 sets out the degree to which respondents claimed to be knowledgeable about climate change, cross tabulated against the type of area the respondent lived in. This suggests that English suburban residents are less likely to know a lot about climate change (only 14% of suburban respondents claimed to know 'a lot' about climate change in contrast to just over 23% of 'big city' residents) in comparison to residents in 'big cities' and 'rural areas'. Respondents who claimed that they either knew a lot or a fair amount about climate change were 1.6 times more likely to believe that something could be done about climate change in comparison to respondents who knew little about climate change (also from the 2007 Survey of Pro-Environmental Attitudes). These findings combined suggest that English suburban communities have fewer residents who are psychologically ready to address climate change issues than is the case for 'big city' and rural residents.

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		Which phrase			
F1.1 How much would you say you know about this term? – "Climate change"		Big city	Suburban or smaller city	Rural and rural fringe	total
Know a lot	Count	78	342	158	578
	%	23.6%	14.5%	17.4%	16.0%
Know a fair amount	Count	136	1086	419	1641
	%	41.2%	45.9%	46.2%	45.5%
Know just a little	Count	84	769	290	1143
	%	25.5%	32.5%	32.0%	31.7%
Either just heard of term or who have never heard of term	Count	32	168	40	241
	%	9.7%	7.1%	4.4%	6.7%
Totals		330	2365	907	3603

 Table 2: Knowledge of climate change in suburban areas

(Source: Defra, 2007 Survey of Public Attitudes and Behaviours toward the Environment)

Thus the potential for English suburbs to adapt to climate change based on the conceptualisation of the neighbourhood as community appears to be mixed. There appears to be a greater propensity to volunteer for group activities amongst suburban residents (in comparison to 'big city' residents) although this is lower than compared to residents in the rural fringe. The most cited form of volunteering is based around schools and activities for young people consistent with the idea of the suburb as being the location for families. Associational activity might be seen as a potential asset for collective action around suburban adaptation. However suburban residents seem less informed (on average) about climate change issues than residents of big cities or the urban fringe and this would suggest a lower potential to engage in the adaptation of their property or their neighbourhood.

Adaptive capacity of the neighbourhood as governed space

We have already noted (following Whitehead 2003) that the concept of 'neighbourhood' has been a flexible geography that government policy has applied to range of different problems. Thus we want to consider the capacity for adaptation through seeing neighbourhood as a context for policy action and formal governance. This will primarily be the sphere of institutions such as local government that are strongly identified with local adaptive capacity (see for example Berkhout et al 2006). As with communities and individuals, institutions need to have resources to engage with adaptation but also need to mobilise those resources.

'Neighbourhoods' have featured across a range of local government modernisation, urban regeneration and renewal and sustainable community programmes over the past 30 years (see Smith et al 2007 on neighbourhoods and urban policy and Lucas et al 2003 or Evans and Percy 1999 for localities and LA21 action). Neighbourhood governance can be understood as a particular policy-driven institution of neighbourhood-organised action. Instances of policy programmes deploying neighbourhood governance as the frame for policy delivery is such that there are a number of ways of categorising these entities. Lowndes and Sullivan (2008) classify policy-facilitated instances of neighbourhood governance as one of four

rationales (social, political, economic or civic) whilst Smith et al (2007) conceptualise the deployment of neighbourhood governance in terms of outcomes on the existing governance structures implicating neighbourhood governance as site, space or sphere. This illustrates the flexibility of how neighbourhood is deployed as a context for policy programmes and public service delivery.

Thus policy-makers can and do conceptualise 'neighbourhoods' as contexts for policy action and service delivery. This can be identified in terms of spatial planning (area planning committees and area action plans) and more generally across a range of local government services (area forums, neighbourhood panels). The capacity to frame adaptation at neighbourhood level is not only a matter of having institutionalised the concept of neighbourhood. Von Borgstede and Lundqvist (2006) looked at the degree to which individual practitioners operating in both private and public sectors were willing to choose high and low cost climate change response strategies (mainly around mitigating climate change) in Swedish municipalities. Using insights from environmental psychology they found that the propensity of these professionals to adopt low cost mitigation strategies depended upon their individual attitudes to climate change (consistent with the insights of Blennow and Perrson 2008). However the propensity of professionals to advocate high-cost mitigation strategies depended upon their organisational affiliation (these professionals tended to be employed in public sector organisations) and upon their profession (environmental professionals tended to opt for high cost strategies rather than land use planners). In addition to this, the work of Smith (2008), which considered how spatial planners in England learnt how to make sense of building sustainable communities, suggested that the capacity of individual practitioners to adopt innovation is shaped by their working context.

This work suggests that the adaptive capacity of suburban neighbourhoods as governed spaces depends both upon the framing of local adaptation as a neighbourhood issue (rather than an authority-wide one) and on the propensity of practitioners associated with the implementation of adaptation either to identify low-cost adaptation strategies (that are more likely to be found acceptable) or to have the freedom to innovate. All local authorities (and other stakeholders) in England have a duty to consider adaptation to climate change under the Climate Change Act 2008. Equally 56 out of 152 English 'upper tier' local strategic partnerships had adopted climate change adaptation as one of their local priorities in 2008/09. Thus local authorities have recognised climate change as an important issue but it is not yet clear how this might be framed as a 'neighbourhood' issue.

Clearly neighbourhood has been considered a flexible lens through which to deliver urban policy over the past 12 years in England (and elsewhere). However we would also accept that the capacity of neighbourhoods organising to tackle any given 'problem' is not in isolation from action at other territorial levels. The inter-relation between neighbourhood action and action at other territorial levels (such as the local authority, national government or societal level) must also considered.

Initial analysis of the institutional policy framework suggests that local authorities find it more challenging to deal with adaptation in contrast to the mitigation of climate change. While helping to facilitate the transition to a 'low carbon future' through encouraging businesses and residents to reduce carbon emissions seems to be accepted as a legitimate role for local authorities (albeit one that is often reduced to encouraging energy efficiency, renewables and non-motorised transport), local authorities may be less comfortable with the comparatively newer demands of preparing communities and businesses to adapt to anticipated new (and more erratic) weather patterns. In some cases the focus of adaptation concern in councils seems to be on minimising potential litigation (i.e. the consequences of approving development in an area vulnerable to flooding) through risk management rather than helping communities to transition to more resilient built environments or even improve their adaptive capacity (although this latter role is also recognised). This may be due in part to the limitations of planning regulation, in which development control can only require householders and businesses to install more resilient built forms in the cases of new developments or extensions to existing buildings.

Adaptive capacity of the neighbourhood as built form

Finally we must consider the adaptive capacity of the built form itself. The neighbourhood as a commodity is shaped by the regulation of the neighbourhood as governed space (through land use planning for example) and is shaped by the neighbourhood as lived space mediated through the property rights that householders and communities hold on the built environment. Seeing the neighbourhood as built space is the form in which the neighbourhood has its most physical and material form. Williams and Dair (2006) argue that the built form of the neighbourhood can facilitate sustainable behaviour (in the neighbourhood as lived space). So, while some neighbourhood forms can encourage certain behaviours (such as walking), in practical adaptation terms this form will influence how easily neighbourhoods can be adapted to address climate change. English suburban neighbourhoods demonstrate a range of morphologies that reflect patterns of development over the past 200 years. Within this range of morphologies that are dominated by the house/bungalow, there is likely to be a range of different adaptabilities.

Seeing the neighbourhood as commodity tends to stress the importance of the technical performance of the neighbourhood as a place offering shelter. In adaptation terms, one can hypothesise that certain types of housing and certain types of urban morphology might be better suited to projected future climates than others. Typical neighbourhood adaptation options could include modifications to: homes (i.e. heating and cooling, flooding protection), yard and front verge spaces (food production, landscaping and shade) and also public streets and green spaces (see Williams et al, 2010). These technological options are somewhat dependent upon the built form that is already present and each technological choice may reduce the future options for on-going change. This is a matter of practical import (for example it is generally not possible to re-orient a brick-built building in relation to sunlight) but when combined with the institutions that build

neighbourhoods and the stakeholder agencies who prioritise the neighbourhood as governed space, it is possible to generate socio-technical 'lock in' (discussed by Unruh 2000 in the case of energy technologies).

The relationship between neighbourhood as built form and neighbourhoods as [socially sustainable] 'lived space' is covered by Bramley et al (2009) and Bramley and Power (2009). This work suggests that interacting with neighbours and participating in groups is higher in medium density areas whilst the use of local services is more likely in higher density areas (Bramley et al 2009, p2125). Given the earlier discussion suggesting that participating and associational community activity is a potential precursor to neighbourhood adaptation, medium density suburbs might have higher adaptive potential (on average).

Concluding comments

Local adaptive capacity is a complex issue due to the diversity that exists within neighbourhoods and the multiple factors that are involved in mobilising change. We have argued that it needs to be understood as a process but that the process is one of potential mobilisation of assets held variously by individuals, households, communities, institutions and by the built form itself. Thus, adaptive capacity must be understood in the interaction of neighbourhoods as lived spaces, as governed spaces and of spaces of built form within an interdependency network. The potential for responding to climate change comes from the interaction of the three neighbourhood 'forms' leading to three models of adaptation: social innovation-led, policy innovation-led and technology innovation-led. Within the context of social innovation-led adaptation there are two sub-classes: that of neighbourhood-focused innovation and that of spatially coincident social innovation (i.e. where innovation is generated through individuals but happens to be visible in one neighbourhood location).

Adaptation as a process can be seen as one of innovation. At the level of the suburban neighbourhood, where there is no clear institutionalised form of governance (given the relatively large municipalities in England), it is possible to conceive that neighbourhood adaptation may emerge without formal polity given that adaptation will cross over a number of policy sectors (land use planning, service delivery and emergency response for example). Thus the initiation of an adaptive process may be initiated from any one of the three notions of neighbourhood (community/lived space, context/governed space or commodity/built space). The SNACC project will explore the plausibility of adaptation from these three initiation points. They can only be initiation points because of the way we are conceptualising neighbourhood as an inter-dependent outcome of the three concepts of neighbourhood.

Projecting some of the evidence set out above, large-scale neighbourhood adaptation (resulting from planning policy-led innovation) will require planning permission and policy framing. From the perspective of the neighbourhood as context, such a framing of adaptation may suffer from a lack of commitment by institutional stakeholders where the policy options are high cost and may be problematic to impose given the

fragmented land ownership in the suburbs. Smaller scale developments where development rights are outside the planning systems (small-scale extensions, internal wiring for example), may emerge from social innovation within neighbourhoods (potentially spread through local network relationships). Thus one might postulate the emergence of an adaptation movement in some neighbourhoods akin to transition communities who emergence may be facilitated by policy makers and the availability of technology. This route may appear to resemble the social innovations outlined by Moulaert et al (2006).

From the perspective of the adaptive capacity of neighbourhood as governed space, the resources, organisational priorities and the organisational cultures of key stakeholders become important. These stakeholders can frame adaptation of neighbourhood as lived spaces (and as built form) but need to work with the demands placed on them through a mix of democratic (representative, participative or market-based) structures or markets. Within some local authorities, those charged with delivering adaptation are currently attempting to open up spaces for dialogue with their neighbourhoods as lived space. The relationship between the different neighbourhood concepts may see the content of neighbourhood adaptation strategies shift as different partners negotiate the meaning of what is an adaptation strategy and frame the problem to be addressed (in a similar way to the CCPC outlined by Lindseth 2005).

Local adaptive capacity emerges through the interaction of these three neighbourhood forms. Whereas stakeholders (such as local authorities) sketch out maps of policy interest (such as defining area forums and area action plans) and service delivery, and urban designers map coherent assemblages of built form, the geographies of neighbourhood as lived space are likely to be more complicated. Hence the adapted neighbourhood that emerges from the inter-relation of the three neighbourhood forms is likely to reflect the differing geographies of the three forms.

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