

# How Geographic Scale Matters in Seeking Community Resilience

CARRI Research Report 7



**HOW GEOGRAPHIC SCALE MATTERS IN SEEKING  
COMMUNITY RESILIENCE**

Thomas J. Wilbanks

Oak Ridge National Laboratory  
wilbankstj@ornl.gov

Date Published: August 2009



## **RESEARCH FINDINGS ABOUT COMMUNITY AND REGIONAL RESILIENCE**

One of the commitments of the Community and Regional Resilience Initiative (CARRI) is to understand what resilience is and how to get there, based on research evidence.

As one resource for this effort, CARRI has commissioned a number of summaries of existing knowledge about resilience, arising from a number of different research traditions. This report is one in a series of such summaries, which will be integrated with new resilience explorations in several CARRI partner cities and with further discussions with the research community and other stakeholders to serve as the knowledge base for the initiative.

For further information about CARRI's research component, contact Thomas J. Wilbanks, [wilbankstj@ornl.gov](mailto:wilbankstj@ornl.gov), or Sherry B. Wright, [wrightsb@ornl.gov](mailto:wrightsb@ornl.gov).



## COMMUNITY AND REGIONAL RESILIENCE INITIATIVE

Oak Ridge National Laboratory's (ORNL) Community and Regional Resilience Initiative (CARRI) is a program of the Congressionally funded Southeast Region Research Initiative. CARRI is a regional program with national implications for how communities and regions prepare for, respond to, and recover from catastrophic events. CARRI will develop the processes and tools with which communities and regions can better prepare to withstand the effects of natural and human-made disasters by collaboratively developing an understanding of community resilience that is accurate, defensible, welcomed, and applicable to communities across the region and the nation.

CARRI is presently working with three partner communities in the Southeast: Gulfport, Mississippi; Charleston/Low Country, South Carolina; and the Memphis, Tennessee, urban area. These partner communities will help CARRI define community resilience and test it at the community level. Using input from the partner communities, lessons learned from around the nation, and the guidance of ORNL-convened researchers who are experts in the diverse disciplines that comprise resilience, CARRI will develop a community resilience framework that outlines processes and tools that communities can use to become more resilient. Of critical importance, CARRI will demonstrate that resilient communities gain economically from resilience investments.

From its beginning, CARRI was designed to combine community engagement activities with research activities. Resilient communities are the objective, but research is critical to ensure that CARRI's understanding is based on knowledge-based evidence and not just ad hoc ideas—we want to get it right. To help with this, CARRI has commissioned a series of summaries on the current state of resilience knowledge by leading experts in the field. This kind of interactive linkage between research and practice is very rare.

In addition to its partner communities and national and local research teams, CARRI has established a robust social network of private businesses, government agencies, and non-governmental associations. This network is critical to the CARRI research and engagement process and provides CARRI the valuable information necessary to ensure that we remain on the right path. Frequent conversation with business leaders, government officials, and volunteer organizations provide a bottom-up knowledge from practitioners and stakeholders with real-world, on-the-ground, experience. We accept that this program cannot truly understand community resilience based only on studies in a laboratory or university. CARRI seeks to expand this social network at every opportunity and gains from each new contact.

[www.resilientUS.org](http://www.resilientUS.org)



## LIST OF RESEARCH REPORTS BY NUMBER

- CARRI Report 1: Susan L. Cutter, Lindsey Barnes, Melissa Berry, Christopher Burton, Elijah Evans, Eric Tate, and Jennifer Webb, *Community and Regional Resilience: Perspectives from Hazards, Disasters, and Emergency Management*, September 2008.
- CARRI Report 2: Susanne C. Moser, *Resilience in the Face of Global Environmental Change*, September 2008.
- CARRI Report 3: Craig Colten, Robert Kates, and Shirley Laska, *Community Resilience: Lessons from New Orleans and Hurricane Katrina*, September 2008.
- CARRI Report 4: Betty Hearn Morrow, *Community Resilience: A Social Justice Perspective*, September 2008.
- CARRI Report 5: Lance Gunderson, *Comparing Ecological and Human Community Resilience*, January 2009.
- CARRI Report 6: Kathleen Tierney, *Disaster Response: Research Findings and Their Implications for Resilience Measures*, March 2009.



## CONTENTS

	<b>Page</b>
RESEARCH FINDINGS ABOUT COMMUNITY AND REGIONAL RESILIENCE .....	iii
COMMUNITY AND REGIONAL RESILIENCE INITIATIVE.....	v
LIST OF RESEARCH REPORTS BY NUMBER.....	vii
LIST OF ACRONYMS .....	xi
1. THE FOUR DIMENSIONS OF RESILIENCE.....	1
2. CONCEPTS ABOUT HOW SCALE MATTERS IN PROCESSES RELATED TO SUSTAINABILITY .....	1
2.1 The Research Literatures .....	1
2.2 The Current Knowledge Base .....	2
2.2.1 Scale and Climate Change .....	2
2.2.2 Scale and Other Sustainability Issues .....	3
2.2.3 Studies of Particular Sustainability Issues .....	4
2.3 Some General Concepts .....	4
3. CONNECTING THE CONCEPTS WITH THE DIMENSIONS .....	7
3.1 General Perspectives .....	8
3.2 Anticipating Threats and Opportunities .....	8
3.3 Reducing Vulnerabilities .....	8
3.4 Responding.....	9
3.5 Recovering.....	9
3.6 Toward an Integrated View .....	9
4. NEW ORLEANS: A CASE STUDY .....	10
5. CHALLENGES AND UNCERTAINTIES .....	11
6. REFERENCES .....	12



## LIST OF ACRONYMS

AIACC	Assessment of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors
CARRI	Community and Regional Resilience Initiative
CCSP	U.S. Climate Change Science Program
GCLP	Global Change in Local Places
GEF	Global Environment Fund
GIS	geographic information science
IPCC	Intergovernmental Panel on Climate Change
LUCC	land use and land cover change
MA	Millennium Ecosystem Assessment
NACC	U.S. National Assessment of Possible Consequences of Climate Variability and Change (also known as The National Assessment)
NGO	nongovernmental organization
NRC	U.S. Nuclear Regulatory Agency
SAP	synthesis and assessment product



## 1. THE FOUR DIMENSIONS OF RESILIENCE

This paper considers how (a) current knowledge about how geographic scale matters for climate change and other sustainability issues relates to (b) the four dimensions of resilience defined for the initial stages of the Community and Regional Resilience Initiative (CARRI).

The four dimensions of a resilient community are (CARRI 2007, 2009):

- *It anticipates*: problems, opportunities, and potentials for surprises.
- *It reduces vulnerabilities*: related to development paths, socioeconomic conditions, and sensitivities to possible threats.
- *It responds*: effectively, fairly, and legitimately.
- *It recovers*: rapidly, better, safer, and fairer.

Section II of the paper summarizes the body of literature about how scale matters, along with the concepts of scale featured in that literature. Section III relates these concepts to the resiliency dimensions and briefly considers key issues in how scale matters for resilience. Section IV very briefly considers New Orleans as a case in point, and Section V summarizes the main challenges and uncertainties.

## 2. CONCEPTS ABOUT HOW SCALE MATTERS IN PROCESSES RELATED TO SUSTAINABILITY

### 2.1 The Research Literature

A considerable body of literature has emerged since the early 1990s about how geographic scale matters in processes related to sustainability. In general, the literature on geographic scale considers how processes and phenomena differ *between scales*, such as between local and global scales, and how processes and phenomena at different scales are affected by relationships and interactions *across scales* – for example, how actions at national and local scales may relate to each other. As a broad generalization, more is known (based on research evidence) about differences between scales than about interactions across scales.

Geographic scale is not the only kind of scale that matters for resilience. Other scales are important as well, such as temporal scale (e.g., short term vs. long term) and institutional scale (e.g., global vs. local) (Wilbanks 2003a). Clearly, the different kinds of scales are often related, and these relationships are often significant. Ecologists in particular have investigated how the importance of “fast” vs. “slow” variables may relate to the geographic scale of processes (Gunderson 2009).

How the concept of a sustainable “community” relates to geographic scale is often complex. A community is defined most generally as a group of people with common interests and characteristics – notionally, a social unit larger than a family but smaller than a relatively large region. It is defined by social structures and relationships that seldom correspond neatly with administrative boundaries, and it can be expressed in a variety of geographical ways (see the box on Geographic Scale and Sustainable Communities).

Some of the current literature derives from more or less academic research, but much of it also derives from issue-oriented group-process assessment practices over the past decade that have sometimes focused more attention on scale issues than has the literature that arises from conventional paradigms of academic disciplines.

## 2.2 The Current Knowledge Base

Significant foci for learning have included studies of climate change responses, studies of other broad-based issues for sustainable development, and studies of particular issues for sustainability, as discussed here.

### 2.2.1 Scale and Climate Change

**The Global Change in Local Places project of the Association of American Geographers (GCLP).** This path-breaking team research project, organized and led by Robert Kates and Thomas Wilbanks, and supported by the National Aeronautics and Space Administration over the period 1996–2000, considered how local places could contribute to reducing greenhouse gas emissions through local action. The project focused on four local case studies in the United States. Among the key findings was that local actions have considerable potential, but their promise depends on how they are linked to structures at larger scales. Publications emerging from this research effort have included Wilbanks and Kates 1999, AAG 2003, and Kates and Wilbanks 2003.

**The first U.S. National Assessment of Possible Consequences of Climate Variability and Change (NACC or “The National Assessment”).** NACC was conceived as an assessment that, to a considerable degree, would be built from stakeholder interactions at a regional scale, including workshops in 20 regions and assessments for most of those regions, considering processes and issues at a variety of scales. A variety of publications resulted (see <http://www.usgcrp.gov/usgcrp/nacc/default.htm>); and lessons learned, including lessons about scale issues and interactions, have been incorporated in four reports: Morgan et al. 2005, Moser 2005, Wilbanks 2006b, and NRC 2007.

**The IPCC Third Assessment and AIACC.** The Third Assessment of the Intergovernmental Panel on Climate Change (IPCC) raised IPCC’s attention to climate change impact issues significantly, compared with previous reports. This assessment observed that many impacts are relatively localized (IPCC 2001) but that research documenting those impacts – and potentials to cope with them by adaptation – was very limited, especially in developing regions where the

### GEOGRAPHIC SCALE AND SUSTAINABLE COMMUNITIES

The term *community* means different things to different people. To some, a stable, cohesive, socially interrelated neighborhood is a community. To some, a place of worship is a community. To some, a place of employment can be a community. At the same time, *community* is often used as a social equivalent of a city or town, which is obviously a collection of communities that in some cases may share little more than physical proximity.

Other uses of the concept are even broader. In this mobile world, connected by modern transportation systems and information technologies, communities can develop that have a strong self-identification but are networks of connections rather than pieces of a mosaic (Wilbanks 2003a). One well-known figure in climate change impact research observed: “If I were to die tomorrow, 15 people in my local community would come to my funeral, but 200 people from my professional community worldwide would send a message to my wife.”

How community *size* relates to its sustainability is an interesting issue. For instance, a larger size means access to a wider range of resources, but a smaller size means simpler decision-making processes, which can translate into greater agility.

vulnerabilities might be greatest. One direct consequence was that the Global Environment Fund (GEF) provided funding for a project on Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC), led by START, which provided capacity-building support to regional assessment teams in Africa, Asia/Pacific, and Latin America/Caribbean to conduct studies of impact and adaptation issues at a local scale, linked with issues at larger scales. A large number of reports and publications have resulted, generally of a very high quality (<http://www.aiaccproject.org/>).

**The U.S. Climate Change Science Program (CCSP).** In December 2003, CCSP held a national workshop in Washington, D.C., to discuss its draft strategic plan, attended (to their considerable amazement) by 1500 people. In summarizing what he had heard during the workshop, CCSP's Director, Jim Mahoney, said that the message was "regions, regions, regions...". During the period 2004–2007, CCSP went on to commission 21 "Synthesis and Assessment Products" (SAPs), summarizing what is currently known and not known about scientific areas of interest to CCSP, many of which highlight the importance of geographic variance and specificity (<http://www.climate-science.gov/>). In November 2005, a second CCSP workshop was held, also in DC, to discuss progress with CCSP overall and the SAPs in particular. In summarizing several dominant messages from this second meeting, Jim Mahoney said that one of them was "location, location, location," echoing the earlier finding. CCSP and its supporting agencies continue to wrestle with improving the understanding of climate change implications for relatively specific places while at the same time improving decision support at geographic scales from national to local. In two cases of the 21, SAPs turned out to be focused at a regional scale rather than the nation as a whole because authors concluded that interregional variation was too difficult to capture in the time available (SAPs 4.1 and 4.7).

## 2.2.2 Scale and Other Sustainability Issues

**The Sustainability Science Movement.** For more than a decade and a half, a multidisciplinary effort that has come to be called "sustainability science" has sharpened the focus of sustainability/vulnerability research on *place-based* integration of complex mixtures of processes and driving forces. Roots of this movement extend back to more than half a century of research on human responses to natural hazards (e.g., White 1945), including such important scale-related research contributions as Kasperson et al. (1995) and Meyer et al. (1992). A key report was a U.S. Nuclear Regulatory Commission (NRC) analysis of pathways to a sustainable world in 50 years (NRC 1999), which advocated "a research framework that integrates global and local perspectives to shape a 'place-based' understanding of the interactions between environment and society." More recently, particular attention has been focused on such issues as vulnerability (e.g., Turner et al. 2003) and adaptation (e.g., Downing 2004), both in distinctly place-based contexts.

**The Millennium Ecosystem Assessment (MA).** Following the example of IPCC, in 2001 a very large effort was initiated to assess ecosystem changes and scientific bases for action to enhance sustainable use of ecosystem resources (<http://www.millenniumassessment.org/>). One of MA's innovations was to include a working group specifically focused on issues at "sub-global" scales: in principle, attention to relatively local ecosystem changes "loosely nested" within attention to regional ecosystem changes, in turn associated with changes at a global scale. In addition to the resulting working group report (MA 2005), this approach – together with the concepts it embodied and the lessons learned – is described by Capistrano et al. (2003),

the journal *Ecology and Society* in a special issue (2006, v. 11:2), and Reid et al. (2006), based in part on an international conference in Alexandria, Egypt, in March 2004.

### 2.2.3 Studies of Particular Sustainability Issues

Attention to issues of geographic scale is, of course, not limited to comprehensive integrative studies. Like the focus of MA on ecosystem changes, assessments of issues from agriculture to water have considered geographic scale – from global to individual – in trying to understand processes that involve relationships between scales. For example, cropping choices by individual farmers are shaped by global markets for agricultural commodities, and global markets are affected by the aggregate of farmer choices. Two examples of explicit attention to scale issues are the following:

**Land Use and Land Cover Change (LUCC).** Over the past two decades, benefiting from the growing availability of data from space satellites and aircraft, a diverse international community has greatly advanced the study of land use and land-cover change, making considerable use of techniques associated with geographic information science (GIS). Integral to GIS is a need to combine variables measured at different scales, related to processes that operate at different scales; and a central issue in LUCC research has been how local land use decisions and practices are affected by, and often affect, global processes (Lambin et al. 2001; Lambin and Geist 2006; Turner, Lambin, and Remberg 2007).

**Hunger as a Hazard.** Studies of such fundamental hazards representing challenges for sustainability have also considered geographic scale as an issue. As one example, hunger has been shown in fact to be a cascade of hazards from regional to household to individual scales, imbedded in problems and practices at a variety of scales (Millman and Kates 1990; Fig. 9.1 of Burton, Kates, and White 1993).

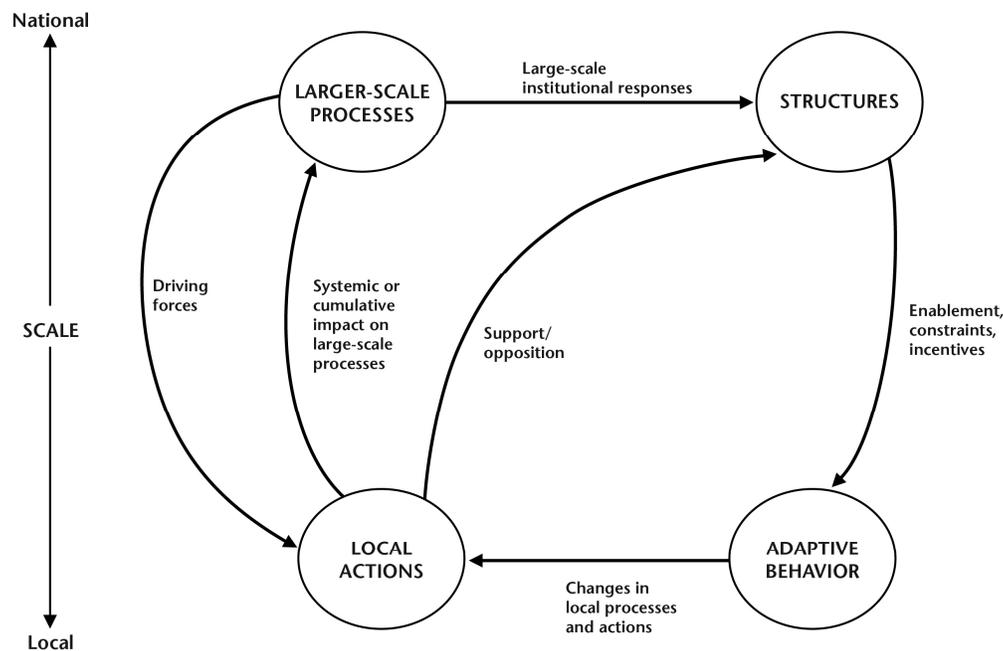
## 2.3 Some General Concepts

A number of published references summarize general concepts related to how scale matters (e.g., Wilbanks and Kates 1999; Wilbanks 2003a; Wilbanks 2006a; Wilbanks 2007), but some of these general concepts seem especially salient for understanding resilience. The following are some concepts that appear relevant for conceptions and operational definitions of resilience, although their meaning for community resilience in each particular case requires translation into local realities. These concepts will be related to CARRI's dimensions of resilience in the next section of the paper.

(1) *Resilience can differ between geographic scales.* It is common to observe that ecological stability differs between scales, especially that larger scales can moderate localized instabilities, at least in the longer run. One of the findings of MA, in fact, was that the world has natural and human systems which are unstable at a local scale, even though they are stable at the same large-regional scale; but MA also found that systems can be stable at a local scale, even though they are unstable at the same large-regional scale (MA 2005). This suggests that local action can truly make a difference, beyond what larger scales attempt to do. A classic challenge is that the very same challenges to resilience can have significantly different probabilities at different scales. For instance, the probability of a major hurricane in a specified time period may be low for a particular location, while its probability is relatively high for a much larger coastal region. Similarly, the economic impacts of a targeted catastrophic event may be very high for the locality that is directly affected, while it is relatively low for the nation as a whole. As a result,

resilience needs to be assessed at multiple scales, not just a single scale; and it involves processes and events at multiple scales, not just a single scale.

(2) Resilience requires integration of processes, actions, and decisions **across** geographic scales. As a general rule, resilience requires integrating things that are going on at different scales, from local to regional and national/global, because so many of those things at one scale can have a positive or negative effect on other scales. Figure 1 (adapted from Wilbanks 2003b) illustrates some of the important cross-scale interactions. For instance, local actions add together to “drive” larger-scale processes, while the local actions themselves are shaped by “driving forces” such as government policies and market signals that arise at larger scales. Where these interactions reinforce the right kinds of perspectives and actions, rather than working at cross-purposes, the likelihood of resilience is much greater. For example, although a great many of the specific actions that shape resilience take place at a local scale, this local “agency” occurs in a context of larger-scale structures, such as economic markets, national and state public policies, and available technologies and information. According to AAG 2003, local action is most likely to be appropriate and effective if four conditions exist: localities are aware that inaction is associated with risks; broader policy and/or market frameworks associate local actions with local benefits; incentives and assistance are on hand for local innovation; and technologies and practices are available under conditions that make them attractive for local application.

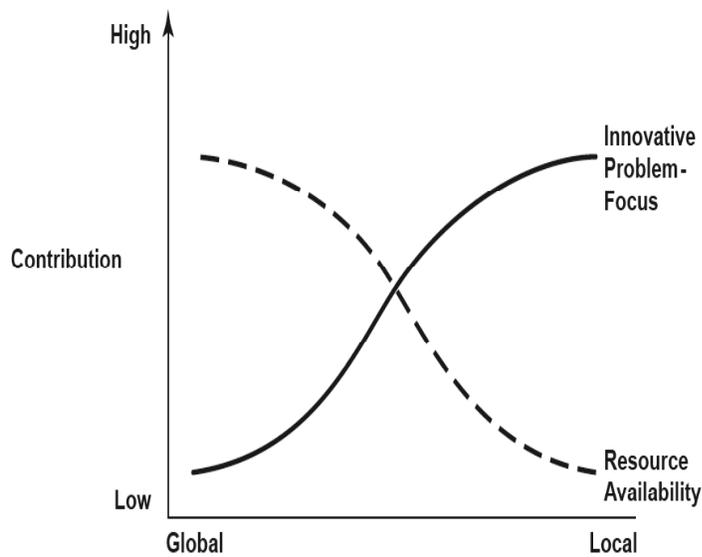


**Fig. 1. Cross-scale interactions in community resilience.**

(3) Resilience may be easier to understand in all its complexity at a more local scale than at a very large scale. One of the most powerful findings about scale has been that scale affects not only how sustainability (or resilience) works but also how we learn about it (Wilbanks and Kates 1999, Kates and Wilbanks 2003). Extensive experience has shown that understanding complex relationships among environmental, economic, and social processes is more likely to be tractable in a place-specific context. Moreover, observations at a relatively local scale are likely to detect more variance from one situation to another than observations at a relatively large

scale, where differences tend to average out; and this variance is itself an opportunity for learning about how to achieve resilience in particular places. In fact, relatively detailed studies of resilience at the scale of a locality or small region will usually show differences in resilience within scales as well as between them (e.g., Colten et al. 2008). This suggests that a city/town/community-scale focus is especially useful for understanding and enhancing resilience, even if other scales are important as well.

(4) *Roles and contributions to resilience of different geographic scales of action differ in their potentials and limitations.* Actions at different scales often differ in their underlying driving



**Fig. 2. Differences between scales in potentials to support action.**

forces, agendas, and reward systems. The most common and often most troublesome paradox is that resource availability is predominantly top-down, while innovativeness and problem focus are predominantly bottom-up (Wilbanks 2007) (Fig. 2). The experience to date with climate change responses suggests that large-scale top-down initiatives often discourage local actions by bogging them down in bureaucratic procedures that reflect a preoccupation with input accountability rather than with outcome metrics of performance. At the same time bottom-up local initiative may lack full awareness of larger-scale processes that underlie effective

responses, along with a lack of full awareness of the full range of response alternatives. One challenge is to develop effective co-management structures that bridge between the varying agendas of different scales (see box).

**CHALLENGES FOR CROSS-SCALE CO-MANAGEMENT (Wilbanks 2007)**

- (a) A kind of mutual trust that is, unfortunately, rare between different scales of at least governmental decision-making, perhaps reflecting a history of hard experience; avenues for improvement include structures for communication and investments in capacity-building, especially at relatively local scales.
- (b) Roles of intermediary third parties, facilitating cross-scale interactions through personal relationships and associated structures. There is some evidence that communications through expert-to-expert linkages are more effective than communications through government-to-government linkages (Cash and Moser 2000; also see Cash et al. 2006), which suggests the importance of local-scale capacity building where local expertise is limited.
- (c) Infrastructures for identifying and disseminating information about success experiences, so that individual cases generate benefits beyond their own narrow boundaries.
- (d) Leadership at any and all scales, which is often the “hidden” factor in determining whether sustainability barriers are overcome and potentials are realized, including challenges in scale integration.

(5) *Existing spatial-administrative frameworks and boundary systems are not necessarily a good fit with scales of important systems and processes.* Many resilience actions are taken by decision-makers whose jurisdictions are defined by boundary systems, such as cities, counties, or states. Some systems and processes are defined by those boundaries, including the jurisdictions of many traditional providers of emergency services. But many important systems and processes are likely to be a poor fit with these boundaries, which introduces problems in making and implementing decisions.

Examples include river basins, where drainage issues are often carved into pieces by administrative boundaries even though the underlying hydrologic processes are integrated; economic markets, where both providers and consumers tend to move across administrative boundaries at will; social networks, which extend beyond neighborhoods to linkages across all kinds of boundaries; regional patterns of air pollution, which cross boundaries between sources and affected areas; and information flows through both media and personal contact channels. Meanwhile, metropolitan areas are often highly fragmented among governmental jurisdictions, which further complicates effective action (e.g., Solecki and Leichenko 2006).

(6) *The importance of geographic scale for resilience can vary according to the stage of a threat or the dimension of resilience.* GCLP documented how scale domains of climate change and its consequences differ across the various aspects of the process from drivers of change to impacts and responses. For instance, greenhouse gas emissions are relatively localized, radiative forcing is global or large-regional, and most impacts are regional or local. Although all four of the dimensions of resilience include driving forces across scales, this suggests that the nature of effects and the relative importance of different scales may differ among the dimensions. In other words, in some communities processes for anticipating threats might emphasize roles of institutions at mid-size scales that collect and analyze threat-related information, while processes for reducing vulnerabilities might emphasize quite place-specific small-scale actions, such as placing generators for emergency electric power at certain electricity-dependent critical facilities.

(7) *Resilience is relative between and across geographic scales, because driving forces that differ between scales are constantly changing.* Resilience is an adaptive process, a trajectory of constant change that keeps vulnerabilities manageable and response capacities adequate as external and internal driving forces continuously respond to a wide range of dynamics (Wilbanks 1994) (see Fig. 1). Examples include demographic changes, economic changes, technological changes, and institutional changes, any of which can require adaptations in order to keep resilience high. Changes that could affect community resilience positively or negatively can include national, regional, or local leadership; processes associated with social friction; market developments that shape industrial and commercial developments; and changes in tourism preferences. Because these driving forces are linked across locations and scales, resilience at one location and scale can affect resilience at others (e.g., through population relocation or resource requirements).

### 3. CONNECTING THE CONCEPTS WITH THE DIMENSIONS

Because very little of the literature concerned with implications of geographic scale is focused on resilience per se, extending these knowledge bases to the four dimensions of resilience at this time is unavoidably going to be more suggestive than definitive, but some points could be useful at least in framing the resilience discourse, even if they need to be assessed with some care.

### 3.1 General Perspectives

Across all four dimensions, local resilience strategies and actions take place within larger-scale market, policy, information, and technology structures; and they depend in part on larger-scale resources. Across all four dimensions, resilience faces challenges in reconciling local agendas with agendas and accountabilities at larger scales, such as state and national scales. As a result, resilience in each of the four dimensions needs to be assessed not only at one scale, although its focus may be a particular scale for decision-making, but with an explicit awareness of the importance of other scales as well – both larger and smaller.

### 3.2 Anticipating Threats and Opportunities

The anticipation dimension is a good example of both scale differences and cross-scale relationships. Local scales are uniquely important as sources of expertise based on local experience and practice, along with associated knowledge of localized threats, local assets and process for responses, and local priorities. Effective anticipation is therefore impossible without local participation. At the same time, anticipation depends on information about threats – e.g., the historical experience, probabilities of occurrence, and possible impacts – likely to be available only from external sources. Effective anticipation is therefore impossible without external resources and support.

As indicated above, one aspect of this is that high-consequence, low-probability events such as earthquakes and major hurricanes are likely not to be a part of the historical experience of many individual communities, even though they face that threat in the future. *Connecting with external data and experiences* is therefore an obvious key to anticipation, although external information often needs to be passed through a local filter to be relevant for local strategy development.

### 3.3 Reducing Vulnerabilities

Again, in this aspect of pursuing community resilience, local knowledge, sensitivities, and priorities must be combined with larger-scale incentive structures and resources, in a context of issues regarding the appropriate scales for dealing with different kinds of vulnerability (Table 1). Some types of stockpiling, for instance, make better sense at a regional scale, since it is difficult to anticipate where a local event might occur within the region. One issue, then, is determining *which aspects of reducing vulnerabilities and therefore enhancing resilience should be localized* vs. handled at a regional scale. A vitally important corollary issue is: Where the appropriate scale is regional, how does a locality ensure that its resilience needs will be met, when it may have limited control over the decisions that are required?

**Table 1. Possible differences in scale for vulnerability reduction**

Area of Concern	Relevant Scale for Reducing Vulnerabilities		
	Local	Regional	National
Evacuation planning	X	X	
Emergency materials		X	X
Emergency health care	X		
Emergency shelters: immediate response	X		
Emergency shelters: longer-term recovery			X

### 3.4 Responding

The first responses are inherently local: dealing with human needs and associated infrastructure impacts right where they occur, with whatever resources are immediately on hand. If the previous dimension has been taken care of, many of the capacities will be ready to perform as needed. But larger areas are a part of the response challenge from the outset, both as sources of emergency resources (e.g., emergency supplies from stockpiles) and as destinations (e.g., for evacuated citizens). In both cases, a key to the cross-scale interaction is effective *systems for moving people and things* from one place to another, which may be jeopardized by either physical damage to movement infrastructures or administrative controls associated with emergency response systems (or both).

### 3.5 Recovering

The longer recovery process is enmeshed in different agendas across scales, especially over the longer term as the drama of the catastrophic event fades and larger-scale entities move on to other, more immediate issues. Here, the issue is the degree to which local aspirations can be pursued without *sustained attention* on the part of external parties at larger scales, and the most common answer is likely to be that local action can take care of a lot of the recovery needs but not all. Examples of particular challenges are likely to include costs of restoring major physical infrastructures and any requirements for extensive environmental remediation.

### 3.6 Toward an Integrated View

Clearly, local communities are not isolated islands. They are linked to processes and decisions at larger geographic scales – and to other communities at similar scales. A key to resilience is understanding and incorporating in resilience efforts and strategies a variety of cross-scale interactions, as illustrated in part by Table 2. Another key may be to enhance the sharing of experiences and views among communities at similar scales, both historically and in real time as threats to resilience emerge.

Moreover, local cities and towns – viewed as “communities” – are themselves collections of communities, and resilience at a medium scale is intricately related to resilience at a variety of smaller scales.

**Table 2. Cross-scale relationships that may affect community resilience**

Resilience Dimension	From Small to Large Scale	From Large to Small Scale
Anticipating	Information needs as priorities for larger-scale monitoring and data-gathering systems	Information about possible threats and historical experiences with those threats
Reducing	Information about needs for regional-scale stockpiles of emergency supplies	Information about what can be expected from the region in responding to possible emergency needs
Responding	Evacuation of displaced population	Provision of emergency supplies
Recovering	Contributions to regional economic growth	Access to financial resources for investment in new infrastructures

For community resilience, it appears that the key *geographic scale issues* include both scale differences and cross-scale linkages. For *scale differences*, the main issues are at what scales are vulnerabilities most appropriately identified and at what scales do certain kinds of actions make the most sense. For *cross-scale linkages*, the issues include:

- To what degree and in what ways does resilience need a joint commitment across scales? How much can a community achieve on its own? What are the incentives for integration/cooperation, especially for parties who are not local?
- To what degree is a community’s resilience linked to its region’s resilience (e.g., the effectiveness of regional governance structures)?
- How can a community address weaknesses in the regional support structure where that is a problem (e.g., working through the private sector and nongovernmental organizations [NGOs] to provide alternative means of meeting non-local needs)?

#### 4. NEW ORLEANS: A CASE STUDY

Two recent reports have described the results of a comprehensive study of community resilience issues in the experience of New Orleans with Hurricane Katrina (Kates, Colten, Laska, and Leatherman 2006; Colten, Kates, and Laska 2008). These reports provide vivid examples of differences between scales in resilience roles and the importance of cross-scale relationships for resilience in its fullest sense.

- **Differences between scales.** In the New Orleans case, scale differences were profound in both their nature and their significance for local resilience.
  - *Roles of the local scale.* In the case of New Orleans, it was clear that certain roles related to community resilience could only be played effectively at a local scale. Some examples were quite vivid, such as needs for immediate search and rescue, roles of social communication networks, and the importance of timely local decision-making. Others related to preparedness aspects of resilience, such as the role of local knowledge in identifying threats to resilience, local actions for threat reduction (such as building codes and standards), and emergency warnings and drills.
  - *Roles of external scales.* At the same time, some roles were rooted in external parties. Obvious examples include some aspects of identifying threats that required external

- knowledge (such as land subsidence, climate change effects, levee strength, and regional flood mapping), prominent roles of national organizations such as the Army Corps of Engineers in flood protection, and the fact that evacuation required destinations as well as transportation.
- **Cross-scale relationships.** No observer of the New Orleans experience and the associated political complexities over the longer run can avoid a conclusion that relationships between a local scale and national/regional scales were central to (a lack of) resilience in this case. Many of the roles of the different geographic scales were quite straightforward, but in many cases they were nested in a host of cross-scale interactions, where roles and relationships were less clear and often poorly coordinated and ineffective. In the largest sense, resilience called for shared roles in risk management and risk-sharing, where roles of larger jurisdictions should be motivated by economic effects of a disaster on a larger region. Emergency supplies called for stockpiles at a regional scale; and evacuation and shelter meant mutual vulnerabilities and response requirements, not only in the time of the hurricane itself but in the long months afterward. A central cross-scale theme was aspects of response and recovery that required a combination of resources, local and larger, such as financial recovery and assistance in meeting human needs. Another cross-scale theme was that roles of nongovernmental institutions, both private sector and NGO, were both vitally important and often poorly represented in prior planning.

## 5. CHALLENGES AND UNCERTAINTIES

For CARRI and its community-oriented resilience efforts, the main challenges associated with geographic scale include at least three:

1. How to include communications and other interactions with *regional*-scale parties in the overall effort.
2. How to reflect regional roles and needs in the community resilience accreditation process.
3. In the accreditation process, how to avoid penalizing a community that wants to be accredited as resilient when its region is not supportive of components involving a larger scale.

The most salient uncertainties relate to both knowledge and decision-making based in part on that knowledge. As indicated in the discussion of concepts above, one challenge is that for most decisions information is packaged for administrative boundary systems when environmental processes, communities, and movement systems cross those boundaries. Another uncertainty has to do with gaps in available information and knowledge about key players in a community and their relationships with other scales, such as data shortages for vulnerable social groups and limitations to access by public-sector decision-makers to data for private-sector economic groups. Finally, a classic challenge in all aspects of emergency preparedness is chronic uncertainties about mechanisms and processes for integrating strategies and decisions across scales: before emergencies, during emergencies, and in recovering after emergencies.

But perhaps the greatest uncertainty of all at this point is how to provide incentives for all relevant scales to join together to meet resilience needs that cross geographical boundaries—and which call not only for action by different scales, in coordination with each other, but joint commitments to share credit for successes and blames for failures, because the linkages are too extensive to ignore. If the potential record of one scale in the event of an emergency depends considerably on the performance of the other scales to which it is linked, then chances are much greater that each scale will not only do its own part but will ensure that cross-scale linkages are made and sustained over time.

## 6. REFERENCES

- AAG. 2003. *Global Change and Local Places: Estimating, Understanding, and Reducing Greenhouse Gases*, Association of American Geographers. Cambridge: Cambridge University Press.
- Burton, I., R. Kates, and G. White. 1993. *The Environment as Hazard*, 2d ed. New York: Guilford.
- Capistrano, D., et al. 2003. "Dealing with Scale," pp. 107–126 in *Conceptual Framework, Millennium Ecosystem Assessment*. Kuala Lumpur: Island Press.
- CARRI. 2007. Project working materials, Community and Regional Resilience Initiative, fall 2007.
- CARRI. 2009. *Enhancing Community Resilience to Disasters*, Annual Meeting of the American Association for the Advancement of Science, Chicago.
- Cash, D., and S. Moser. 2000. "Linking Global and Local Scales: Designing Dynamic Assessment and Management Processes," *Global Environmental Change* 10: 109–120.
- Cash, D., et al. 2006. "Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World," *Ecology and Society* 11(2): 8–19.
- Colten, C., R. Kates, and S. Laska. 2008. *Community Resilience: Lessons from New Orleans and Hurricane Katrina*. CARRI Research Report 3.
- Downing, T., 2004. "Enhancing Capacity for Adaptation to Climate Change in Developing Countries," *Report on Adaptation Research Workshop, New Delhi, November 2003*. Oxford: Stockholm Environment Institute.
- Gunderson, L. 2009. *Comparing Ecological and Human Community Resilience*. CARRI Research Report 5.
- IPCC (Intergovernmental Panel on Climate Change). 2001. *Impacts, Adaptation, and Vulnerability, Contribution by Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- Kasperson, J., R. Kasperson, and B. Turner, eds. 1995. *Regions at Risk: Comparisons of Threatened Environments*. United Nations University.
- Kates, R. W., C. E. Colten, S. Laska, and S. P. Leatherman. 2006. "Reconstruction of New Orleans after Hurricane Katrina: A Research Perspective," *Proceedings of the National Academy of Sciences* 103(40): 14653–14660.
- Kates, R., and T. Wilbanks. 2003. "Making the Global Local: Responding to Climate Change Concerns from the Bottom Up," *Environment* 45(3): 12–23.
- Lambin, E., et al. 2001. "The Causes of Land-Use and -Cover Change: Moving Beyond the Myths," *Global Environmental Change* 11: 261–269.
- Lambin, E., and H. Geist, eds. 2006. *Land-Use and Land-Cover Change: Local Processes and Global Impacts*. Berlin: Springer.

- MA (Millennium Ecosystem Assessment). 2005. *Ecosystems and Human Well-being, v. 4: Multiscale Assessments*. Washington: Island Press.
- Meyer, W., D. Gregory, B. Turner, and P. McDowell. 1992. "The Local-Global Continuum," pp. 255–279 in R. Abler, M. Marcus, and J. Olson, eds., *Geography's Inner Worlds*. New Brunswick: Rutgers University.
- Millman, S., and R. Kates. 1990. "Toward Understanding Hunger," in L. Newman, ed., *Hunger in History: Food Shortage, Poverty, and Deprivation..* Oxford: Blackwell.
- Morgan, M. G., et al. 2005. "Learning from the U.S. National Assessment of Climate Change Impacts," *Environmental Science and Technology* 39: 9023–9032.
- Moser, S. 2005. *Stakeholder Involvement in the First U.S. National Assessment of the Potential Consequences of Climate Variability and Change: An Evaluation*, prepared for the NRC Panel on Public Participation in Environmental Assessment and Decision-making. Boulder, Colorado: NCAR.
- NRC. 1999. *Our Common Journey: A Transition Toward Sustainability*. Washington, D.C.: National Academy Press.
- NRC. 2007. *Analysis of Global Change Assessments: Lessons Learned*. Washington: National Research Council.
- Reid, W., F. Berkes, T. Wilbanks, and D. Capistrano, eds. 2006. *Bridging Scales and Knowledge Systems: Linking Global Science and Local Knowledge in Assessments*. Washington: Island Press.
- Solecki, W., and R. Leichenko. 2006. "Urbanization and the Metropolitan Environment," *Environment* 48(4): 8–23.
- Turner, B. L., et al. 2003. "A Framework for Vulnerability Analysis in Sustainability Science," *PNAS* 100(14): 8074–8079.
- Turner, B., II, E. Lambin, and A. Remberg. 2007. "The Emergence of Land Change Science for Global Environmental Change and Sustainability," *PNAS* 104(52): 20666–20671.
- White, G. 1945. *Human Adjustment to Floods*. University of Chicago Department of Geography Research Paper No. 29.
- Wilbanks, T. 1994. "'Sustainable Development' in Geographic Context," *Annals Association of American Geographers* 84(1994): 541–57.
- Wilbanks, T. 2003a. "Geographic Scaling Issues in Integrated Assessments of Climate Change," pp. 5–34 in J. Rotmans and D. Rothman, eds., *Scaling Issues in Integrated Assessment*. Swets and Zeitlinger.
- Wilbanks, T. 2003b. "Geography and Technology," pp. 3–16 in S. Brunn, S. Cutter, J. Harrington, eds., *Technology and Geography: A Social History*. Dordrecht: Kluwer.
- Wilbanks, T. 2006a. "How Scale Matters: Some Concepts and Findings," pages 25–40 in Reid, Berkes, Wilbanks, and Capistrano, eds., *Bridging Scales and Knowledge Systems: Linking Global Science and Local Knowledge in Assessments*. Washington: Island Press.
- Wilbanks, T. 2006b. "Stakeholder Involvement in Local Smart Growth: Needs and Challenges," pp. 113–130 in M. Ruth, ed., *Smart Growth and Climate Change*, Aldershot, UK: Edward Elgar.
- Wilbanks, T. 2007. "Scale and Sustainability," *Climate Policy* (special issue on Integrating Climate Change Actions into Local Development) 7(4): 278–287.
- Wilbanks, T., and R. Kates. 1999. "Global Change in Local Places," *Climatic Change* 43(3): 601–628.



**Community and Regional Resilience Institute**

National Security Directorate

P.O. Box 2008

Oak Ridge National Laboratory

Oak Ridge, TN 37831-6252

[www.ResilientUS.org](http://www.ResilientUS.org)



**Homeland  
Security**



**SRNL**  
SAVANNAH RIVER NATIONAL LABORATORY