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Regional news portrayals of global warming and climate change

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ABSTRACT

In this study we utilize content analysis techniques to examine how the issue of global warming and climate change has been characterized during the period of 1992 through 2005 by the *Houston Chronicle*—the largest regional newspaper in the Texas coastal region. A total of 795 global warming and climate change news articles from the *Houston Chronicle* are collected, coded and analyzed. Data analyses are organized and presented with regard to issue salience, various issue attributes (issue image, scope, linkage, participant, proposed solution and responsible party), use of science, and scientific information sources cited in the news stories. We find that regional media attention to the global climate change issue generally increases over time and an overwhelming majority of the news articles view the issue as a harmful problem. However, given the scientific consensus that global warming will result in significant devastating climate change consequences to the coastal regions, there are still a fair number of news articles delivering mixed, undetermined or even non-harmful messages. We also find that climate change is often discussed as a national or international-global issue, and frequently linked to a number of other public issues rather than just being viewed as an environmental–ecological problem. Moreover, we find that emphasis on issue solutions is placed more on mitigation strategies than on adaptation behaviors, and that both governmental and non-governmental actions and responsibilities are suggested for dealing with climate change. In addition, our findings indicate that the regional newspaper in Texas obtains scientific information on climate change primarily from academic institutions. Implications of our findings and recommendations for future research are discussed in the concluding section.

1. Introduction

Recognizing the significant influence of news media in shaping public attitudes and policy agendas about various social and environmental issues, scholars in communication research, political science, policy analysis, and many other fields have examined news media coverage of global warming and climate change from various perspectives. However, most existing studies focus only on national news media and national policies, and very few studies empirically investigate how this critical global environmental issue is reported and portrayed by regional U.S. news media, including discussion of local effects.[1]

As a world-wide environmental issue, global warming and climate change demand attention and action at all levels—

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[1] "Regional" is used here to indicate a limited geographical area, one small enough to experience climate change effects in fairly uniform ways but large enough to include most of the readership of the area's largest newspaper.

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international regimes, national governments, states and local communities are all critical in dealing with the problem. As part of a larger research project for the U.S. Environmental Protection Agency,[2] this study examines a major U.S. regional newspaper's coverage of global warming and climate change. We believe that this coverage, once identified and tracked, can be the first step in examining how this global environmental issue has been approached, framed, and brought to the local community and local policy agendas by regional news media.

We begin with a brief review of media agenda setting research and existing news media studies on global warming and climate change. We then describe our research design, data collection, and news article coding procedures. Main findings on relative issue salience, multiple issue attributes, types of proposed solutions, identified responsible parties, and use of scientific information in the news stories are presented in our data analysis section. Some implications of our findings are discussed in the concluding section.

2. News media coverage and global climate change

In recent years, the role of news media in reporting and portraying public issues has been widely recognized by communications research scholars, political scientists, and policy analysts. The power of the news media in shaping national public opinions and policy agendas has been well-documented in media agenda setting studies (Erbring et al., 1980; MacKuen, 1981, 1984; Iyengar and Kinder, 1987; Baumgartner and Jones, 1993; McCombs and Zhu, 1995; Gilliam and Iyengar, 2000; Soroka, 2002; McGraw and Ling, 2003).

According to these studies, the news media generally play two roles in setting public and policy agendas. First, through repeated news coverage over time, the news media have the ability to influence the relative salience of a particular pubic issue (McCombs and Shaw, 1972; Baumgartner and Jones, 1993; Roberts et al., 2002; Soroka, 2002, 2003). Second, and more importantly, the news media have the ability to portray a particular public issue in different ways and thus influence how the public and policy makers think about the issue (McCombs and Shaw, 1972; Cobb and Elder, 1983; Dearing and Rogers, 1996; Kiousis, 2004). This portrayal can also affect the perception of what might be done—in other words, the possible solutions or alternatives regarding the issue (Carvalho, 2005:2).

Recognizing that the news media are important sources of information for policy makers and the public to learn about the nature of a particular public issue, scholars in various fields have conducted numerous studies on news coverage of the global climate change issue over the last two decades. Some scholars focus their studies on the media attention cycle and factors that may cause the rise and fall of news attention to the global warming and climate change issue (Ungar, 1992; Mazur and Lee, 1993; Trumbo, 1996; McComas and Shanahan, 1999; Liu et al., 2006). Others investigate how news media transmit or mis-transmit the science of climate change (Bell, 1994), including how journalistic norms (e.g., neutrality or objectivity) produce inaccurate reportage of scientific consensus on climate change (Boykoff and Boykoff, 2004). There are also studies of how news media help shape public understanding of climate change risks (Smith, 2005) or how value systems affect news coverage on the climate change problem and solution orientations (Wilkins, 1993; Carvalho, 2005; Carvalho and Burgess, 2005). The Carvalho and Burgess study, for example, revealed changes in the way British newspapers framed climate change risk that seemed to stem from changes in both climate science and governmental policy positions.

Other examinations include Weingart, Engles and Pansegrau's (2000) analysis of changes in climate discourse in scientific, political and news media in Germany. Their study indicated a convergence of climate change coverage that began with identification of the problem in the scientific literature, followed by political discourse that narrowed the issue to elements under some control by the state, and the news media discourse that emphasized consensus rather than controversy within the climate science community.

Uncertainty has been the specific focus of some research. Zehr (2000) examined articles on climate change published between 1986 and 1995 in four large-circulation newspapers (*New York Times*, *Wall Street Journal*, *Chicago Tribune* and *Los Angeles Times*) to assess the ways in which uncertainty was represented in the press and implications for public perception of scientific authority, finding that indications of uncertainty were generally linked with assertions that policy development was premature. Antilla (2004) examined newspaper coverage of climate change in 255 U.S. newspapers during the 12-month period of March 2003 through February 2004. Focusing on themes and frames, she found a significant portion of articles emphasizing controversy and uncertainty within the climate community as well as a sample of articles that reported climate change information without reference to skepticism. Some scholars report that climate change opponents have conducted orchestrated efforts to undermine the science of climate change by promoting the work of skeptics and attacking mainline scientists to create a greater sense of controversy and conflict than really exists (see, for example, McCright and Dunlap, 2000; McCright and Dunlap, 2003).

These studies contribute greatly to our understanding of the news media's coverage of climate change. However, some important questions remain unaddressed in the existing literature. For instance, while much of the burden of climate change impacts will fall on local and regional communities, little is known of how these communities receive and process climate change-related information and apply it to their regional scale needs and issues. The question of regional scale impacts, vulnerabilities and reactions is the next wave of emphasis for public policy decision makers.

Issues of scale are relevant to the question of solutions or actions in response to climate change. Mitigation efforts that

[2] The EPA project, under the Cooperative Agreement No. R-83023601-0, is entitled "Use of Science in Gulf of Mexico Decision Making Involving Climate Change." This research, assisted with the methods of multi-stage interviews, document analyses and focus group observations, assesses how representative stakeholder groups currently use science information about global climate change in their decision making. As part of the document analyses, regional news articles on global warming and climate change, including the ones from the *Houston Chronicle* that we use in the paper, were collected and analyzed to provide contextual information for the research project.

would stabilize concentrations of greenhouse gases include actions undertaken at the local level (e.g., adoption of alternative energy sources by cities) as well as state, national and even international policies and incentive structures that would facilitate these actions. For mitigation strategies to have maximum impact, coordination of effort at local, national and international levels is called for. Adaptation to climate change impacts also involves decision making at local, regional, national and global levels. For example, decisions to make changes in land use patterns (e.g., zoning to prohibit residential development too close to the shore) may be entirely local but may also involve state and/or national decision makers (e.g., changes in state regulated insurance underwriting or legislation regarding building in a flood plain). Examination of a regional newspaper will allow us to explore largely unanswered questions such as: Is the local relevance of climate change effects being reported? Who is perceived as responsible for dealing with climate change and its effects? What is the nature of regional and local scale problems and solutions being proposed and communicated by the media?

As scientific consensus over climate change grows and disagreements within the climate science community are resolved (Wilson, 2000; Oreskes, 2004; IPCC, 2007: 8&12), media coverage of the phenomena will also change. The research reported here extends the analysis of media coverage into a more recent time period, which covers growing consensus within the climate science community, as well as recent storm events (Hurricanes Rita and Katrina) that have the potential to focus media attention on climate change in much the same way that the unusually hot summer of 1986 did. In addition, by analyzing newspaper coverage in terms of a widely used conceptual framework for understanding agenda setting, this research shifts the focus from journalistic norms and public perceptions to the media's more specific relevance to policy and decision making. Finally, our focus on media coverage at the regional level introduces an important aspect of the debate that needs to be addressed: that is its relevance to decision making at smaller scales – in this case, one state's coastline – where uncertainty about specific climate change effects is still greatest.

In this study, we analyze certain aspects of the news coverage on global warming and climate change published in the *Houston Chronicle*—the largest newspaper in the state of Texas. We are particularly interested in identifying the following: (1) changing salience of the issue of climate change in this top regional newspaper; (2) major attributes of the issue as characterized by the *Houston Chronicle*; and (3) utilization of science information and major sources of the scientific information used in these news articles. By identifying these important components in the news stories on global warming and climate change, we attempt to ascertain the patterns and potential problems in regional news discourse of the global climate change issue.

3. Time span and data collection

To collect relevant news articles on climate change published in the *Houston Chronicle*, we used the Lexis-Nexis online searchable newspaper archive.[3] The time span of our study covers a 14-year period, from January 1, 1992 through December 31, 2005. This particular time period was chosen because of the limited availability of the *Houston Chronicle* articles in Lexis-Nexis database.[4]

The *Houston Chronicle* is the newspaper with the largest circulation along the Texas Gulf coastal region, with readership extending well beyond the Houston metropolitan area. Historically, this region is vulnerable to extreme weather events such as hurricanes and tropical storms. Recent storms like Hurricane Rita and Tropical Storm Allison created much havoc in this region, and the most devastating hurricane in the history of the U.S. destroyed much of Galveston, Texas, at the turn of the twentieth century. This region has also experienced land loss attributable to the effects of subsidence and sea-level rise, a change that is expected to exacerbate the effects of storms even if increases in sea surface temperature do not increase storm frequency and severity. In addition, it is an area whose economy is dependent on a rich mix that includes agriculture, fishing, tourism, and petrochemical industry. Decisions made in the light of climate change effects will certainly have impacts on one or more of these economic sectors. According to the Audit Bureau of Circulation, the *Houston Chronicle* is the largest daily newspaper in the state of Texas and the 10th largest newspaper in the United States, with a reported daily circulation of 737,580. The bulk of the distribution is in the Houston-Galveston coastal region.[5]

The unit of analysis of this study is the news article. We used three key terms – 'climate change,' 'global warming,' and 'greenhouse gas' – to search *Houston Chronicle* articles on climate change in the Lexis-Nexis database. This search extracted a total of 1197 articles published during the period from 1992 to 2005.[6] These three key terms were chosen in our article search for two reasons. First, previous studies of news

[3] The Lexis-Nexis newspaper database can be accessed at the following website: http://web.lexis-nexis.com/universe/form/academic/index.html.

[4] Lexis-Nexis includes *Houston Chronicle* articles published from September 15, 1991 to the date when our study was conducted. News articles from September 15 to December 31, 1991 were collected and coded in our database but excluded from this study because they only covered part of the 1991.

[5] The City of Houston is the fourth largest city in the United States, with approximately 4.4 million residents in the Houston metropolitan area. The Houston-Galveston area ranks tenth in overall population in the United States. The population of the Houston-Galveston-Brazoria Consolidated Metropolitan Statistical Area (CMSA) was estimated by the U.S. Census Bureau at 5,026,759 residents, as of July 2003.

[6] Specific search procedures in Lexis-Nexis are as follows: Under 'Guided News Search', we selected 'General News Search' for 'Step One: Select a news category,' and 'Major Papers' for 'Step Two: Select a news source.' Under 'Source List,' we selected '*Houston Chronicle*.' Under 'Step Three: Enter search terms,' there are three boxes to enter search terms. Leaving the box reading 'Headline, Lead Paragraph(s), Terms' as is, and changing the relational box 'and' to 'or,' we entered 'climate change' in the first box, 'global warming' in the second, and 'greenhouse gas' in the third. Under 'Step Four: Narrow to a specific date range,' we specified the search date range.

coverage on the issue of climate change (e.g., Shanahan and McComas, 1999) used similar key terms (i.e., global warming, climate change, greenhouse) to collect news articles in Lexis-Nexis, and our use of similar terms makes it easier to compare our work with other work in this area. Second, we tried several additional key words related to climate change (e.g., 'sea-level rise', 'Kyoto protocol,' etc.) and found that these additional key words did not result in a significant number of additional relevant articles. Thus, we are confident that our search results based on these three key terms captured the majority of the news articles on global warming and climate change.

Guided by typical content analysis methods and procedures (e.g., Neuendorf, 2002), we developed a comprehensive codebook and trained a research assistant as the primary coder to code each of the 1197 articles collected from Lexis-Nexis search.[7] During the coding, 402 articles were found irrelevant to climate change.[8] Elimination of the irrelevant articles yielded a final working dataset with 795 valid articles on climate change. We also trained another research assistant as the secondary coder, and conducted formal inter-coder reliability tests. Our inter-coder reliability tests demonstrated good consistency between the two coders.[9] The following analyses are derived from the coding results of the 795 valid articles.

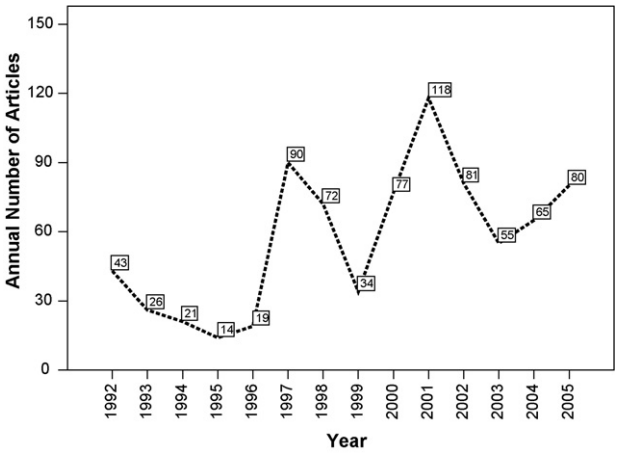

Fig. 1 – Annual number of articles on climate change, Houston Chronicle, 1992–2005.

4. Data analysis: issue salience, issue attributes, and use of scientific information

4.1. *Issue salience*

The first research question is about the salience of climate change as an issue in the major newspaper on the gulf coast of Texas. To measure the issue salience, we calculated the annual number of climate change articles published in the *Houston Chronicle* during the period from 1992 through 2005.[10] This method of using the annual number of articles to measure issue salience has been used in numerous news media agenda setting studies (Baumgartner and Jones, 1993; Soroka, 2002). Fig. 1 is a graphic presentation of the ups and downs of the annual number of articles on the issue.

Fig. 1 exhibits three characteristics with regard to the salience of the climate change issue in the regional newspaper. First, the salience of the issue ebbed and flowed in a cyclical pattern over the last 14 years. In 1992, 43 climate change articles appeared in the *Houston Chronicle*. Media attention to the issue then decreased in the next 3 years, from 26 articles in 1993 and 21 articles in 1994 to a record low 14 articles in 1995. This decline of attention in the early 1990s is compatible with other observations of U.S. national media attention to climate change.[11] While media attention to the

[7] In coding the news articles, we followed standard procedures and techniques for quantitative media content analysis. First, we conducted a pilot-coding with 50 randomly selected sample articles. Second, we thoroughly examined these 50 sample articles and developed a preliminary codebook with a list of variables, definition of each individual variable, and specific coding procedures. Third, two researchers coded the 50 sample stories independently according to the preliminary codebook. Fourth, during the pilot coding, two researchers had routine meetings to compare coding notes to identify and resolve areas of disagreement, and to refine the coding scheme and procedure. Finally we trained a research assistant as the primary coder in the use of the final codebook, and this research assistant completed the formal coding of all 1197 articles from 1992 through 2005.

[8] Due to the indiscriminate nature of the electronic search process in Lexis-Nexis, some articles in the keyword-based search results were actually irrelevant articles, in which the terms, 'climate change,' 'global warming' or 'greenhouse gas,' were only occasionally mentioned in stories that were mainly about something else. We treated these articles as irrelevant articles and excluded them from our dataset.

[9] Upon completion of the coding by the primary coder, we conducted a formal inter-coder reliability test: 75 articles were randomly drawn and independently coded by the secondary coder. The results of the inter-coder reliability tests showed that overall average agreement rate was 0.96 and agreement rates on individual variables ranged from 0.84 to 1 (mostly above 0.90). According to Reinard (2001) and Neuendorf (2002), in content analysis, variables with agreement coefficients of 0.90 or greater are highly reliable, and analyses and tests based on the coding data are acceptable. To further assess the inter-coder reliability, we also calculated another measure based on Scott's pi formula—a method that accounts not only for agreement rate but also for disagreement probability between coders. The overall average Scott's pi in our test was 0.79. Since Scott's pi is a more rigorous assessment of inter-coder reliability, lower scores for Scott's pi are expected.

[10] Because the size of article varies, one may argue that the length of news article might be a better indicator of issue salience than simply count of number of articles. After collecting all the articles from Lexis-Nexis, we re-formatted each article in the same way (font, font size, line space, etc) and counted the lines of each article. We then aggregated the total lines of all the news articles each year and compared the results with the annual number of articles. The aggregation of the total lines of all the news articles each year revealed an almost identical pattern to the simple aggregation of the number of articles of each year. We are confident that both measures are equally good indicators. In this study, we choose to use the number of articles to measure the issue salience.

[11] Previous studies of U.S. national media attention cycles on climate change indicated that the first media attention given to the issue occurred in the late 1980s, and the issue salience fell dramatically in the early 1990s (see Ungar, 1992; Williams, 2001).

issue increased a bit (yet still maintained a low salience level) in 1996 (19 articles), media coverage on climate change dramatically increased in 1997 (90 articles) and 1998 (72 articles). After another low attention year in 1999 (34 articles), media started paying more attention to climate change again in 2000 (77 articles), and the coverage reached a record high with 118 news articles in 2001. The following 2 years witnessed another dive in the media attention cycle with 81 articles in 2002 and 55 articles in 2003, but attention to the climate change issue began to climb up in 2004 (65 articles) and 2005 (80 articles).

Second, the overall salience of the climate change issue increased over time in the last 14 years despite the periodic rise and fall of media coverage in the *Houston Chronicle*. In the 2000s, the average number of climate change articles published in the *Chronicle* almost doubled from the number published in the 1990s, rising from approximately 40 articles per year, during the period of 1992 through 1999, to roughly 80 articles per year, during the period of 2000 through 2005.

Third, there were three surges of news coverage in the *Chronicle* over the last 14 years, and these attention surges seemed to be caused by certain attention-grabbing events (or ''focusing events,'' in John Kingdon's term, 1995).[12] The three intensified attention surges occurred in 1997, 2001, and 2005, respectively, as shown in Fig. 1.[13] To further probe what actually drove the media coverage during each of the attention surges, we reviewed all the articles published in these 3 years. Our review revealed that the attention surges seemed to be largely simulated by specific major international and domestic events. The first rise of media attention in 1997 coincided with to the heavy media coverage of the Kyoto Conference—Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto in December 1997. During the month of December 1997 when the Kyoto Conference took place in Japan, the *Chronicle* published 30 articles on climate change, while the average number of climate change articles in all other months of the same year was 5.7. The second surge of media attention occurring in 2001 was substantially stirred by the Bush Administration's highly controversial move to abandon the Kyoto protocol.[14] Reports and stories on domestic and international responses to the Bush Administration's decision mounted in the *Houston Chronicle* during the spring and summer of 2001. The third surge of media attention to climate change occurred in the hurricane and post-hurricane seasons of 2005, particularly after the two costliest and deadliest hurricanes, Katrina and Rita, caused severe damage along much of the Gulf Coast of the United States. This wave of attention surge appeared to be a media reaction to the possible linkage between catastrophic hurricanes and global warming—for instance, in one of articles published during the post-Karina and Rita months, the *Chronicle* reported that some of the largest insurance companies sided with environmental groups to argue that global warming does exist and that man-made causes of climate change are adding to the severity and cost of natural disasters such as Hurricanes Katrina and Rita.

4.2. *Issue attributes*

Our second key question is about how the climate change issue has been portrayed by the *Houston Chronicle*. A particular public issue can be framed in many different ways based on different attribute dimensions, and different issue attributions can significantly affect the agenda setting process and lead to different policy outcomes (McCombs and Shaw, 1972; Cobb and Elder, 1983; Iyengar and Kinder, 1987; Baumgartner and Jones, 1993; Kingdon, 1995; Iyengar, 1989; Iyengar and Kinder, 1987). However, previous studies on media coverage of climate change have not systematically explored how the issue was actually framed in the mass media along various attribute dimensions. In this section, we present and discuss the findings of our content analysis of *Houston Chronicle* articles on climate change with regard to the following issue attributes: issue image, issue scope, issue linkage, issue participants, and proposed solutions and responsible parties.

4.2.1. *Issue image*

Issue image is the fundamental impression of an issue and has a powerful influence on shaping public understanding and policy agendas (Baumgartner and Jones, 1993; Jones, 1994). The issue of climate change has been debated among members of the public, political decision makers and climate scientists. Perhaps the most critical question in this debate is whether and to what extent global climate change is harmful.

In coding the image of climate change communicated in the *Houston Chronicle* articles, we asked our coders to evaluate the overall view of each article to discern whether the issue was portrayed as harmful, not harmful, or somewhere between (mixed and undetermined). Articles clearly indicating real or possible negative consequences of climate change (such as 'environmental disaster,' 'health risk,' 'loss of life,'

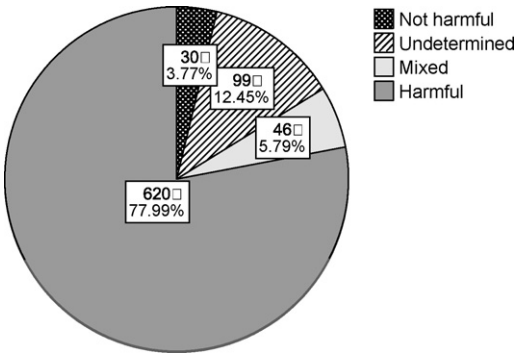

Fig. 2 – Number of articles on issue image, Houston Chronicle, 1992–2005.

[12] In his seminal work, *Agendas, Alternatives, and Public Policies* (1995, pp. 90–103), Kingdon finds that ''focusing events'' such as disaster or crisis, along with ''problem indicators'' and ''feedback,'' can facilitate a public issue to achieve higher attention level in the news media and policy bodies.

[13] Similar attention surges in 1997 and 2001 were also found in Boykoff and Boykoff's study (2004) of climate change news coverage by four major U.S. national papers.

[14] In a letter to the senate on March 13, 2001, Bush stated that ''I oppose the Kyoto Protocol because it exempts 80% of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy.''

'threat to infrastructure,' 'land degradation,' 'greater severity and frequency of tropical storms,' 'drought,' etc.) were coded as 'harmful.' Articles indicating that climate change is not dangerous or arguing that global warming may actually benefit human beings in certain ways (e.g., greater agricultural productivity) were coded as 'not harmful.' Articles presenting both negative and positive views on the effects of climate change were coded as 'mixed,' and those lacking a clear indication of whether climate change is good or bad were coded as ''undetermined/unknown.''

Fig. 2 shows that an overwhelming majority of the news articles in the *Chronicle* discussed real or possible negative consequences of climate change and thus communicated a harmful image for climate change. More specifically, among the 795 articles, 78.0% (620 articles) portrayed climate change as a 'harmful' issue, 5.8% (46 articles) were 'mixed,' 12.5% (99 articles) were 'undetermined,' and 3.8% (30 articles) viewed the issue as 'not harmful.'

To track the way the climate change issue image has been portrayed by the *Chronicle* over time, we graphed the percentage of articles with different issue images from year to year. Fig. 3 shows that the image of climate change as a harmful issue dominated the media coverage in each and every year except 1994. The percentage of articles portraying climate change as a non-harmful issue never comprised more than 10% of the articles each year, and the general trend was that the percentage of non-harmful portrayals gradually declined over the 14-year period. However, we also found a fair percentage of the articles that either presented both negative and positive views or lacked a clear discussion of whether climate change is good or bad. In some years, the mixed and undetermined image categories were relatively strong (e.g., 1994 and 1996).

Overall, the climate change issue was predominantly painted as a negative and harmful problem in the regional newspaper. However, it was not uniformly seen as a valence issue. Whether or not an issue is portrayed or defined as a valence issue may have important agenda setting consequences. A valence issue is defined as a social problem which elicits ''a single, strong, fairly uniform emotional response and

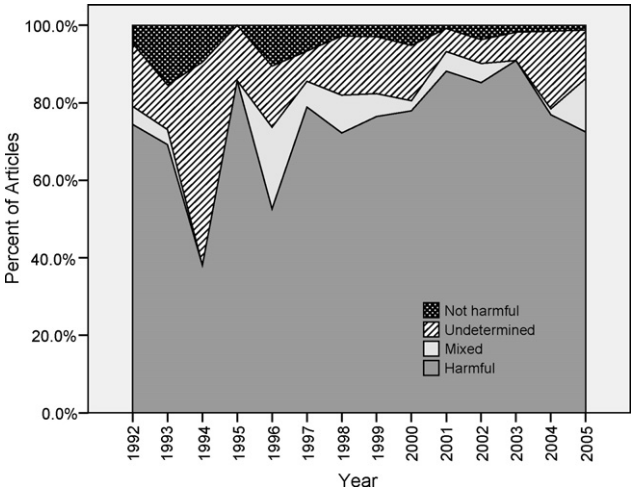

Fig. 3 – Changing issue image over time, Houston Chronicle, 1992–2005.

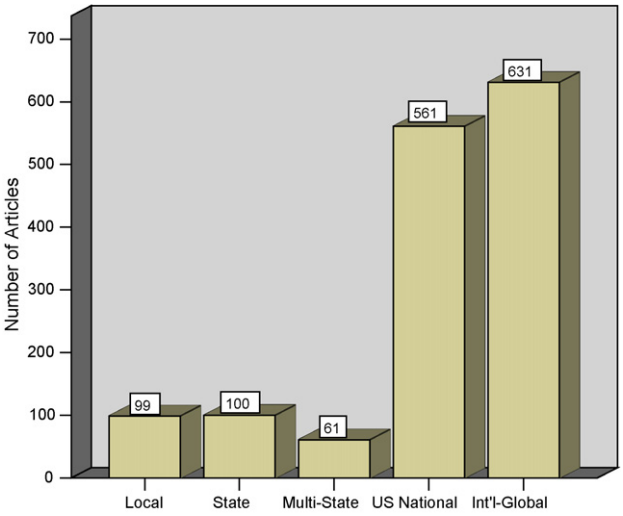

Fig. 4 – Number of articles on issue scope, Houston Chronicle, 1992–2005.

does not have an adversarial quality'' (Nelson, 1984: 27). When there is no question about whether a valence issue is good or bad, attention and debate surrounding the issue will primarily focus on appropriate solutions rather than on other characteristics of the problem itself. We shall come back to this point in the conclusion section.

4.2.2. *Issue scope*

Issue scope identifies the geographical and/or jurisdictional area affected by the issue, and an issue's scope may have a broad or narrow range that can ultimately be tied to policy responsibility. How the scope of the climate change issue is specified in the news media may affect the thinking about the level of authority responsible for dealing with the issue.

In our coding system, the issue scope variable contains five scope-specified subcategories: local, state, multi-state, U.S. national, and international-global. Since one article may discuss climate change and global warming at several levels, multiple checks were allowed in our coding among the five subcategories. For example, if an article discussed global warming and sea-level rise around the world, and then discussed possible consequences of sea-level rise for the Galveston Bay area, we coded the issue scope of this article as both 'international-global' and 'local.'

Fig. 4 represents a simple count of articles by the five subcategories of issue scope. It shows that climate change and its effects were rarely discussed at the local (99 articles), state (100 articles) or multi-state (61 articles) levels. Rather, the majority of the news articles in the *Houston Chronicle* portrayed climate change as an issue with a U.S. national scope (561 articles) and/or international-global scope (631 articles). This portrayal of the issue scope mainly at the national and international-global levels implied that major climate change solutions and policy responsibilities were expected by regional news media to lie with the federal government and international regimes. On the one hand, this portrayal makes good sense, because climate change by its nature is a large-scale, trans-national, trans-jurisdictional problem, and only the

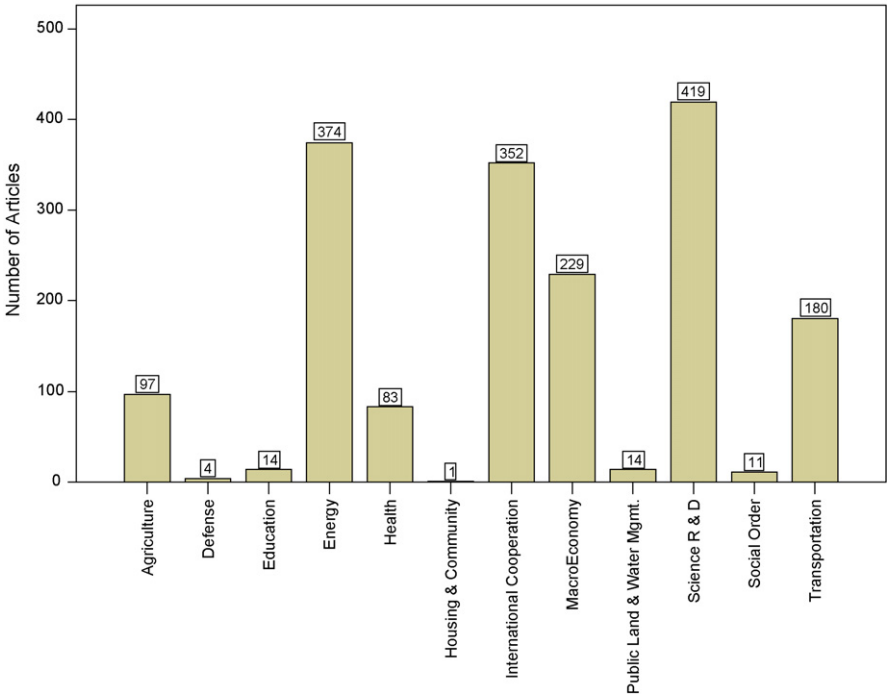

Fig. 5 – Number of articles linking climate change to other public issues, Houston Chronicle, 1992–2005.

federal government (among the multiple tiers in the U.S. political system) and international regimes possess the power and capacity to formulate comprehensive national policies or international frameworks to deal with various climate change challenges. On the other hand, this focus on national and international scopes may weaken the expectation for sub-national authorities to take initiatives and policy actions.

4.2.3. *Issue linkage*

A policy issue can always be linked to, or associated with, other social, economic, or public issues. For example, unemployment can be associated with health insurance; it can also be linked to poverty. Civilian use of nuclear power can be linked with the cost of energy; it can also be linked with health and environmental risks. Linking tobacco and smoking to agriculture production or to public health may have quite different agenda setting implications and policy consequences (Baumgartner and Jones, 1993). For the climate change issue, Smith (2005) shows that it can be directly linked to a large array of other issues, ranging from international affairs to health.

In our coding of *Houston Chronicle* articles, we examined how the climate change issue, primarily an environmental–ecological issue, was linked to other public issues in these articles. Based on our pilot studies, literature review, and reference to the Policy Agenda Project's comprehensive Topics Codebook on media news stories,[15] we constructed an issue linkage category in our codebook. This issue linkage category included 12 other public issues that climate change might be linked to, including agriculture, defense, education, energy, health, housing and community, international cooperation, land and water management, macro-economy, science research and development (R&D), social order, and transportation. Because one article could link climate change with many other issues, multiple checks were allowed in coding the issue linkage category. For example, if an article stated that climate change had to be handled by all countries and required more scientific research, then both 'international cooperation' and 'science R&D' would be coded.

Fig. 5 shows the coding results. 'science R&D' has the strongest linkage (419 articles), followed by 'energy' (374 articles) and 'international cooperation' (352 articles). 'Macro-economy' (203 articles) and 'transportation' (180 articles) show moderate linkages. 'Agriculture' (97 articles) and 'health' (83 articles) also exhibit some association with climate change, but 'defense,' 'education,' 'housing and community,' 'public lands and water management,' and 'social order' issues were almost never linked to climate change.

The dominant features of Fig. 5 summarize a significant portion of the climate change debate as represented in the media. The strong linkage to 'energy' (and to a lesser extent to 'transportation') captures the focus of much of the debate on CO_2 emissions reductions. The emphasis on 'international cooperation' reflects the global public goods and collective action dilemma at the international level to mitigate global warming risks. The fairly strong linkage to 'macro-economy' indicates the importance of the economic dimension in the debate. From our perspective, the most interesting finding here is the very strong linkage constructed by the news media between climate change and 'science R&D.'' This finding of a

[15] The Policy Agendas Project is directed by Bryan Jones, Frank Baumgartner, and John Wilkerson, which collects data from various sources such as newspapers and congressional records to trace changes in U.S. national policy agendas and policy outcomes since the World War II. The Policy Agenda Project's Topics Codebook can be found at: http://www.policyagendas.org/codebooks.

strong linkage between climate change and climate science seems to be consistent with previous findings on how climate science and scientific uncertainty were reported and characterized in journalistic stories. In his examination of climate change coverage in four major newspapers, Zehr (2000) found that the dominant response to scientific uncertainty was to assert that policy and action should wait until more scientific research is complete and uncertainties are resolved. In another study, Boykoff and Boykoff (2004) argued that the overemphasis on climate science uncertainty in the news media would promote skepticism and inspire inaction (Boykoff and Boykoff, 2004, p. 133). Implications of the linkage patterns will be discussed at greater length in the conclusion section.

4.2.4. *Issue participants*

Schattschneider (1960) noted that the essence of policy conflict over a public issue is the scope of participation. Cobb and Elder (1983, p. 82) wrote that a public issue is "a conflict between two or more identifiable groups over procedural or substantive matters relating to the distribution of positions or resources." Kingdon (1995) continued this line of inquiry and found that identifying "the visible participants" in a policy process is a key to understanding the dynamics of agenda setting. In our coding system, we attempted to identify various interest groups and governmental participants in these news stories in order to present a snapshot of the key forces in the debate over climate change as portrayed by the media. Each article was examined and coded to identify whether certain interest groups (environmental, scientific-professional, industry, and other) were mentioned in the story and what governmental actors (the president, Congress, federal agency, court, and local-state government) were involved in climate change debates.

Fig. 6 depicts the overall coverage of various interest groups as measured by the number of articles mentioning them. It shows that environmental, scientific-professional, and industry groups were the three primary interest group participants in the news coverage on climate change. More specifically, environmental group (185 articles) was the most frequently mentioned interest group, followed by scientific-professional group (147 articles) and industry group (79 articles). All other types of interest groups (e.g., consumer rights group, home owner association) appeared in a total of 50 news articles.

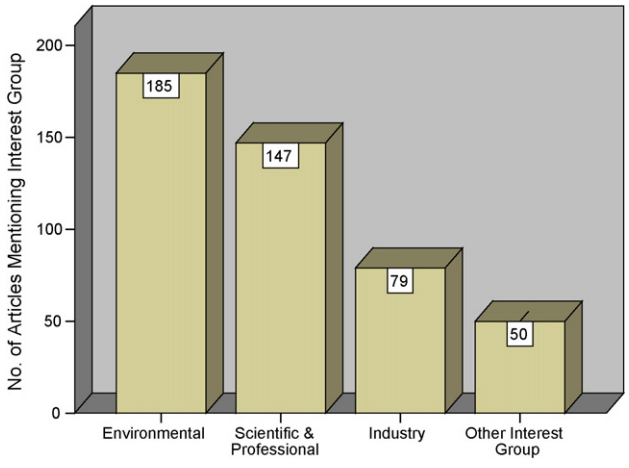

Fig. 6 – Frequency of interest groups mentioned in articles, Houston Chronicle, 1992–2005.

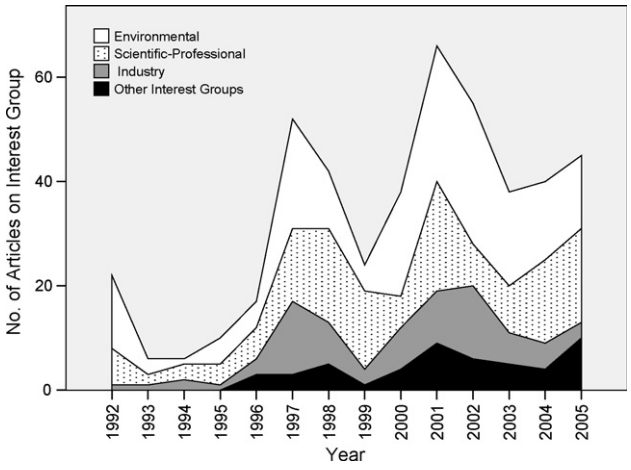

Fig. 7 – Changing coverage of interest groups in Houston Chronicle, 1992–2005.

Fig. 7 shows the changing coverage levels of these interest groups in the news stories from 1992 to 2005. While the relative proportion of the references to various interest groups in the news articles did not change significantly over the years, the environmental and the scientific-professional groups seemed to be far more prominent than the industry and other interest groups. In the 14 years examined, the environmental category dominated in 8 years (1992–1993, 1995, 1997, and 2000–2003) while the scientific-professional group was the most prominent participant in the other 6 years (1994, 1996, 1998–1999, and 2004–2005). The industry category never played a dominant role in the news articles but always maintained a visible role throughout the 14 years. Fig. 7 also reveals that "other" category of interest groups was completely excluded from the issue debates as reported in the *Houston Chronicle* from 1992 to 1995. However, an interesting transformation regarding the pattern of interest groups occurred in 1996 when the "other" interest group began to join in the news debates and became a visible participant. From 1996 through 2005, while the environmental, scientific-professional and industry groups continued to be the three primary interest group participants, "other" interest groups gained relatively more visibility than any of the aforementioned groups in the news stories on climate change—an indication of issue expansion to a greater population in the society and increased relevance and importance of "other" types of interests to the issue.

The literature also points to the important policy role played by public officials at various governmental levels in the salience, framing, and agenda status of policy issues like climate change. For that reason, we examined mentions of local, state, and national officials in these news articles. Figs. 8 and 9 show our coding results on the roles of various U.S. governmental actors in the news stories.

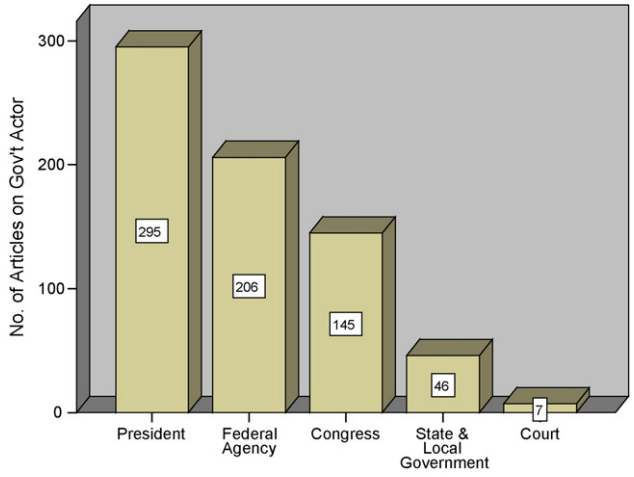

Fig. 8 – U.S. Governmental actors mentioned in articles, Houston Chronicle, 1992–2005.

Fig. 8 presents the aggregated number of articles mentioning different U.S. governmental actors in the 14-year period. As shown in Fig. 8, three U.S. governmental actors – the president (295 articles), federal agencies (206 articles), and the Congress (145 articles) – seemed to have played leading roles in the news reports, while local-state governments (46 articles) and the court (7 articles) showed marginal or little visible participation in the debates. To take a closer look at the news references of these governmental actors across the 14 years, we graphed the annual number of articles mentioning each of the five governmental actors in Fig. 9. The time series chart in Fig. 9 reveals that while the president, Congress, and federal agencies have consistently dominated the news references in each and every year, local-state governments and the court have increased their activities in the issue debates and policy developments in more recent years. More specifically, local-state governments have become relatively more visible and active in the news reports in the 2000s than in the 1990s, and the court system has joined the debates in the recent years with the first court reference in the news articles in 2000. The recent increased involvement of local-state governments and the court system indicates the conflicts surrounding climate change issue have expanded to a greater number of political powers and policy venues in the federal system. The federal system in the United States provides multiple partially autonomous venues for policy action. Since there are differences in receptivity to particular policy solutions among different governmental venues, sometimes, as Baumgartner and Jones (1993) argued, "the federal system can promote change because no group can control all parts of the system, closing out consideration of policies that it does not favor" (217).

4.2.5. *Proposed solutions and responsible parties*

The news media are not only discussion sites for various public issues but also places to propose treatment strategies or solutions to policy problems and to identify parties responsible for dealing with the problems. Proposed treatment strategies and identified responsible parties to a particular issue comprise another key dimension of issue attributes. In this section, we attempt to identify what solution strategies were proposed and what parties were called to take actions on climate change in these *Houston Chronicle* articles.

4.2.5.1. *Proposed treatment solutions*. There are two basic solution responses noted in the news articles—mitigation

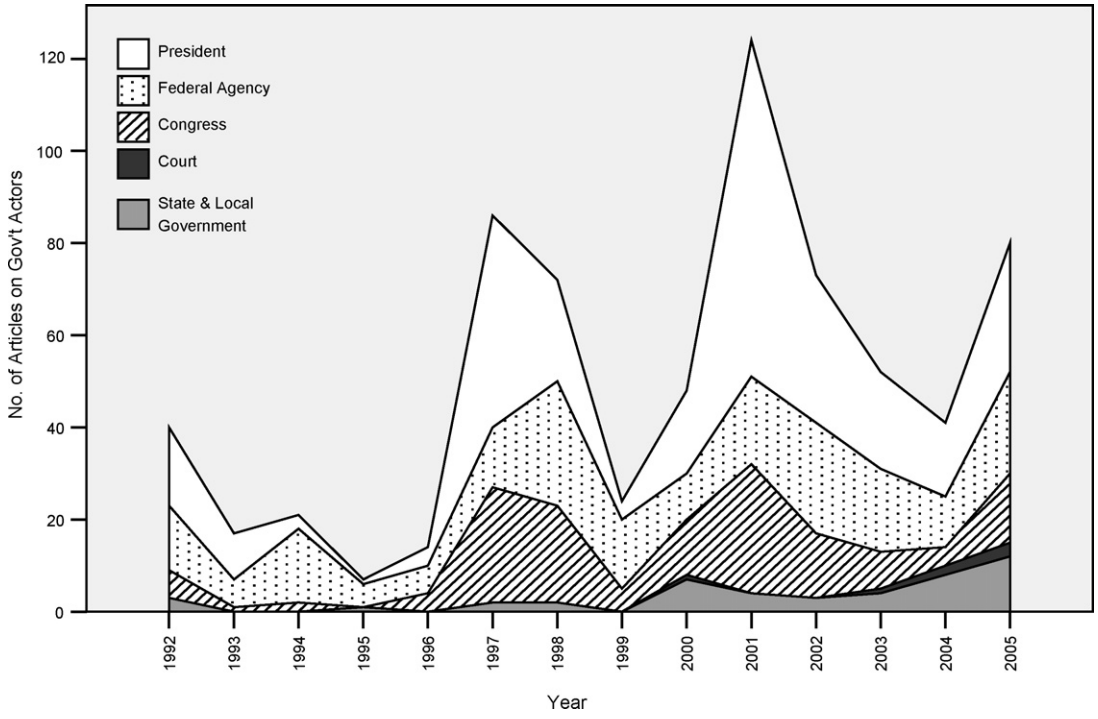

Fig. 9 – Changing roles of U.S. governmental actors in news articles, Houston Chronicle, 1992–2005.

and adaptation. These two response strategies have been widely discussed in the climate change literature.[16] In this study, we operationally defined the two solution strategies in the following way for our news article coding.

First, mitigation strategy was defined as intervention to actively and directly reduce the causes of climate change. The primary goal of mitigation is to solve or alleviate climate change problems by reducing the pace and magnitude of climate stressors that induce climate change. Examples of mitigation strategies in the news articles include proposed solutions to regulate quantities of greenhouse gas emissions, utilizing alternative energy sources (wind, solar, biomass, and geothermal), improving vehicle fuel-efficiency, reducing vehicle miles traveled, switching from coal and oil to natural gas, and so on.

Second, adaptation strategy was defined as a reaction/adjustment in response to actual or expected climate change impacts. The primary goal of adaptation is to lessen the harm or possible harm of climate change and exploit beneficial opportunities from the effect (or projected effect) of the changing climate. A prime example of adaptation is climate forecasting. Climate forecasting itself does not change the pace, magnitude, or likelihood of climate change. Climate forecasting precedes climate events, so humans can adjust their behavior accordingly. Other examples of adaptation strategy include: improvement of water management flexibility and adaptability; reservoir and levee construction; adjustments in farming operations and land use to accommodate changes such as increased temperature; improvement of forest management; construction of buffer zones for species and habitats; adjustment for sea-level rise and coastal erosion; adjustment in coastal insurance rates and flood insurance rates; seawall construction; and improvements in climate information systems, research, and decision tools.

In coding the 795 climate change articles, we classified each article into one of the following categories: 'mitigation strategy,' 'adaptation strategy,' 'both mitigation and adaptation,' or 'no solution strategy.' Fig. 10 summarizes our coding results.

The coding results shown in Fig. 10 indicated that slightly more than half of the articles (409 articles; 51.45%) did not propose any solutions. Among articles mentioning solutions, mitigation (351 articles; 44.15%) was the dominant solution strategy proposed. Adaptation as a strategy received little attention (26 article; 3.27%), and only a few articles (6 articles; 1.13%) proposed both mitigation and adaptation solutions.

4.2.5.2. *Responsible parties for solutions*. In coding climate change articles, we were also interested in how the news media viewed the role of government to take actions on the climate change issue. We classified each of the articles into

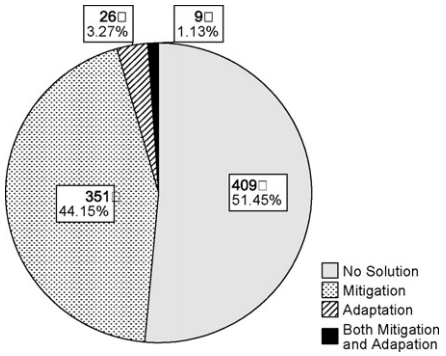

Fig. 10 – Proposed solutions in news articles, Houston Chronicle, 1992–2005.

"no responsible party identified," "government" or "non-government." If an article clearly called on the government to take responsibility or initiate action for handling the climate change problem (e.g., calling on the U.S. government to develop alternative energy sources), the article was coded as "government." Those articles that indicated non-governmental entities as parties responsible for taking action on climate change (e.g., calling for people to carpool to reduce emissions) were coded as 'non-government.' Fig. 11 summarizes our coding results.

Fig. 11 shows that, among the 795 climate change articles, 391 articles (49.18%) did not identify any responsible parties, while 211 articles (26.54%) called for governmental responsibility for dealing with the climate change problem and 193 articles (24.28%) placed responsibility with non-government parties (private sector or the public).

4.3. *Use of science and scientific sources in media coverage*

Our third key question is concerned with the media's use of climate science information. The issue of climate change involves many scientific elements. While little empirical work

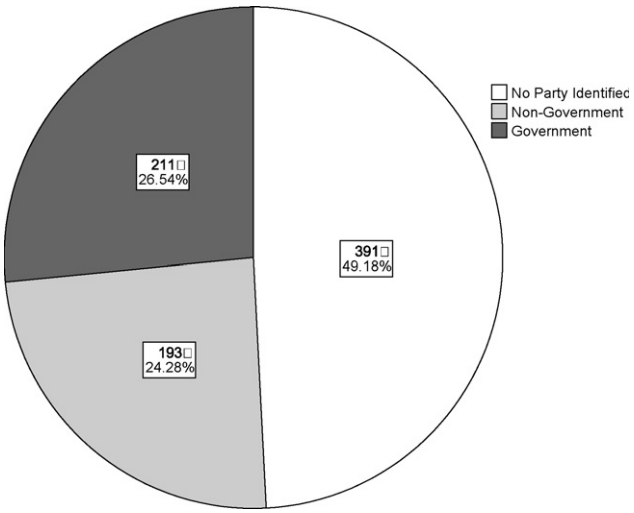

Fig. 11 – Responsible parties identified in news articles, Houston Chronicle, 1992–2005.

[16] For examples, see *Confronting Climate Change in the Gulf Coast Region: A Report of the Union of Concerned Scientists and the Ecological Society of America 2001*, in which Twilley et al. outlined three basic strategies for stakeholders and policymakers to deal with climate change and its consequences: mitigation, minimization, and adaptation. See also *Global Warming and Climate Change* (1994), in which Morgan and Smuts listed three available strategies including abatement, adaptation, and geo-engineering.

on specific issues has been done, researchers remain very interested in uncovering the relationship between the media and scientific information, to learn how the media utilize scientific information, and to determine the major sources of scientific information for news coverage on climate change. In this final section of our data analysis and discussion, we attempt to address these questions. In our article coding process, we examined each article to see whether the story used any scientific information and where the scientific information came from.

We broadly defined scientific information as empirical observation, identification, description and theoretical explanation generated by scientists, experts and analysts. Coders were given a list of key words that are often closely associated with scientific information in newspaper stories: finding, model, professor, researcher, university, laboratory, analysis, assessment, study, evaluation, etc. Articles were coded ''Yes'' if scientific information was presented or cited, or ''No,'' if there was no clear indication of use of science. We found that references to scientific information were clearly present in a slight majority of the 795 news stories on climate change—417 articles (52.5%) used scientific information, as defined above.

To identify the origin of the scientific information used in the 417 articles, we classified the scientific source(s) and coded them using the following categories:

- academic source—including sources from university professors and researchers, science societies and associations, the United Nations and other international organizations (e.g., the Intergovernmental Panel on Climate Change), and other independent research organizations;
- government source—including sources from scientific research establishments of U.S. or foreign governments (e.g., national research laboratories);
- environmental source—including sources from scientists of environmental advocacy groups, coalitions, and organizations;
- industry source—including researchers from corporations, companies, and business groups; and
- other source—including all other scientific information sources and unidentified information sources.

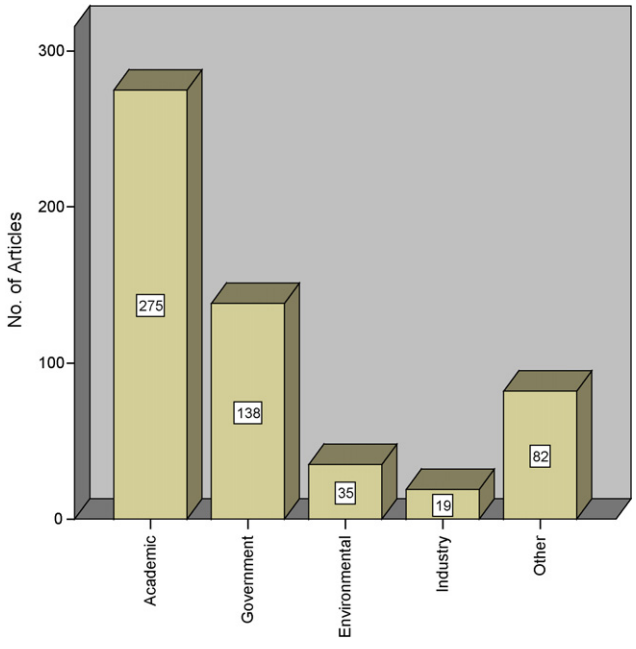

Fig. 12 – Scientific information sources in news articles, Houston Chronicle, 1992–2005.

As more than one source might be cited in an article, multiple checks of scientific sources were allowed in the coding. Fig. 12 graphs the categories of the science sources in the *Chronicle*'s coverage of the issue. Among the 417 articles, 275 articles cited scientific information from academics, 138 from governmental scientists, 35 from environmental experts, 19 from industry analysts, and 82 from all other sources. Clearly, the news media obtained scientific information on climate change primarily from academic institutions such as universities and independent research organizations, and industry was the least used source for scientific information.

5. Discussion and conclusion

For a particular public issue, the news media generally play two roles: drawing attention to the issue and portraying the issue in various ways along different attribute dimensions. In this paper we employed content analysis techniques and examined the content patterns of newspaper articles on climate change for the Houston-Galveston region of Texas over a 14-year period. We sought to measure the amount of news attention to the issue of climate change, its development over a time, the characterization of the climate change problem, potential solutions, responsible parties, and utilization of scientific knowledge and expertise in the news discourse of climate change risks.

We found that the overall salience of the climate change issue increased over the 14-year period examined and that the major surges in *Houston Chronicle* coverage of global warming and climate change appeared to be primarily driven by significant natural and policy events, namely international-level discussions of climate change, domestic policy moves, and the major hurricane events of 2005: Katrina and Rita.

The image of global climate change as characterized in the *Chronicle* was overwhelmingly an image of a harmful problem. However, climate change and its effects were rarely discussed in the regional newspaper as a local, state or multi-state issue. Rather, the majority of the news articles portrayed the issue as one with national or international-global scope. Even in years when reportage was not driven by international events such as the Kyoto Accord, the implications of climate change for the region was not explored.

We also found that climate change, primarily an environmental–ecological issue, was constructed by this regional newspaper to be closely associated with other public issues. The strongest issue linkage was between climate change and various climate science and scientific uncertainty problems.

Our analysis indicates that environmental, scientific-professional and industry groups were the major interest group actors, and that the president, Congress, and federal

agencies were the key governmental actors involved in the news debates on climate change. Other interest groups, local-state governments and the court system remained the least frequently mentioned throughout the period but seemed to have increased their participation in the most recent years.

With regard to the solutions proposed and responsible parties identified in the news reports, we found that the focus of attention for problem solution was on mitigation, rather than adaptation, and that both government and non-government entities were called to take responsibility to address climate change issue.

We also found that the majority of the articles cited scientific information and expertise and that the primary sources of scientific information on climate change cited in the articles were academic sources, chiefly university scientists and science societies and associations rather than governmental, environmental, or industry sources.

Some implications emerged from our findings. First, we found that, while there were short-term declines in interest, overall, the salience of climate change issue, as measured by frequency of mention, increased in the regional newspaper over the period examined. In spite of the tremendous political and economic resistance in the U.S. to dealing with global warming and climate change in recent years, this growing media attention is a positive indication that the issue is not being pushed aside or marginalized in the regional news media in the competition with other issues or concerns in this region—a region that is heavily dependent on the conventional energy industry as part of its economy. We believe that the trend will continue and attention to global warming and climate change will probably continue to grow in the future, particularly after the disastrous 2005 hurricanes, Katrina and Rita were linked to the climate change issue.

More importantly, we found that that the characterization of the global warming problem in the top regional newspaper in Texas was overwhelmingly one of a harmful problem. However, given the scientific consensus that global warming will result in significant negative climate change consequences to the coastal regions, there were still a fair number of news articles in this regional newspaper delivering mixed/undetermined or non-harmful messages to the readers about the global warming problem. Although these messages did not dominate the media discourse, they persistently co-existed with the overall harmful issue image over the 14 years. The conflicting issue images portrayed in the news stories may reflect the fact that the climate change issue is not immune to various social influences. Sometimes even a small number of non-harmful articles may give readers the wrong impression about the valence nature of the climate change problem and thus shift the issue discourse from finding appropriate solutions to questions about whether the problem exists or whether something should be done about the problem.

Second, when linked to other major policy issues, the climate change problem was strongly constructed by this newspaper as a climate science issue with uncertainty problems, and this strong linkage may have both positive and negative policy implications. On the one hand, constructing the issue as an embedded science and scientific uncertainty problem may help pave the way to increase the governmental research and development budget and strengthen the climate science program (Meyer, 2006). On the other hand, focusing on the scientific uncertainty aspect of the climate change issue may serve as a deterrent to taking appropriate and immediate policy actions on the issue. While there is great consensus among climate scientists that global climate change is happening and human activities indeed contribute to global warming (IPCC, 1990, 1995, 2001; National Academy of Sciences, 2001; Oreskes, 2004), overemphasizing the uncertain aspects of climate science in the news media may cause confusion about climate change risks, promote skepticism about the existence of the problem, and may even ''inspire inaction'' toward the issue (Boykoff and Boykoff, 2004: 133. see also Wilkins, 1993; Zehr, 2000; and Demeritt, 2001).

Third, the regional news coverage of climate change we documented focused the reader on the more nation-wide or world-wide aspects of the climate change debate, and this portrayal of large issue scope has implications for both local public attitudes and for the way local policy makers view their roles and responsibilities. The coverage we examined primarily emphasized the large-scale nature of the problem, and to some extent, large-scale solutions, such as changes in national or international energy production and consumption policies. While it is accurate to portray global warming and the resulting climate change as primarily a national or global problem, this focus of issue scope at national and global levels may divert local public and policy attention from its linkage with more regional and local impacts. Admittedly, these more local impacts are harder to document and predict. However, it is at regional and local levels that the impact on human populations will be felt and from which pressures for actions will come. Similarly, the tendency for news coverage to focus on mitigation is consistent with more academic scientific studies that emphasize causes, and it is a short step from the discussion of causes to the discussion of solutions. Nevertheless, this emphasis on mitigation efforts, such as large-scale reductions in CO_2 emissions, also frames climate change as a large-scale and non-local issue. As shown in our analysis, adaptation as a response to global warming and regional and local roles in dealing with climate change are given little coverage. This is so, even as adaptation and regional and local responsibility for assessing the risks of climate change impacts become increasingly important components of the discussions surrounding this issue. This is particularly the case for governmental agencies (see for example, Easterling et al., 2004; U.S. Climate Change Science Program, 2004; Watson et al., 1997). A common lament is that both the public and policy makers generally fail to see the immediate relevance of climate change to their daily lives and are, therefore, less likely to be persuaded that decisions need to be made and action taken (Immerwahr, 1999). As we have shown here, even regional coverage of climate change emphasizes the global and far-away nature of the problem and fails to make the global-local connection. Much more needs to be done to increase the awareness of the relevance of climate change information to local and regional problems and issues and, therefore, to local and regional decision making options.

Fourth, our analysis on the issue participants in the news reports seemed to indicate another trend—that is, the conflicts surrounding climate change expanded to a greater number of

interest groups and political institutions in the society. Previous studies on agenda setting demonstrated that expansion of issue conflict and reconfiguration of issue participants often lead to changes in issue definition and policy outcome (Cobb and Elder, 1983; Baumgartner and Jones, 1993; Rochefort and Cobb, 1994). As Schattschneider (1960, p. 2) noted, ''the central political fact in a free society is the tremendous contagiousness of conflict ... every change in the number of participants, every increase or reduction in the number of participants, affects the result.'' As reflected in the news stories, three major interest groups (environmental, scientific-professional, and industry) and the federal executive and legislative branches were the most visible issue participants. However, in recent years other types of interests (e.g., home owners association) and powers (e.g., the court) started gaining access to and getting more involved in the issue debate and policy development. We can probably expect that more issue participants—including those previously excluded as well as newly mobilized interests, will appear in the future news reports when the conflicts on climate change issue further expand in the society.

Fifth, this regional newspaper in Texas was primarily focused on describing the problem of global warming and climate change itself and was less concerned about how to deal with the problem. In democracies, the news media are supposed to serve multiple functions in policy debate and policy making process (Lambeth, 1978; Fico, 1984; Jones, 1984), including not only problem-alerting, but also solution-informing and policy-proposing. In our study, however, we found the regional newspaper seemed to be largely focused on the problem-alerting function–while all these 795 *Houston Chronicle* articles discussed global warming and climate change as a problem, roughly half of the articles did not propose any solutions to the problem or identify any responsible parties to deal with climate change.

While this study expands our understanding of how the climate change issue has been portrayed by a regional newspaper, it should be noted that there are several limitations, and a great deal of further research remains to be done. First, our study only examined one regional newspaper in Texas. Whether the findings apply to other newspapers in different regions remains unanswered. Future research should include more newspapers to compare the news coverage in different regions before making generalizations. Second, our study only examined a limited time period—from 1992 to 2005. Climate change has long been covered and debated in the news media and will continue to be an issue in the media agenda in the years to come. Future research should extend the time span to include more years in data analysis to detect long-term media trends in terms of attention change and issue portrayals. Third, our analysis in this study is merely descriptive. Are there relationships between issue scope and issue linkage? Would different issue images portrayed in the news coverage affect the way of thinking about issue solutions and response strategies proposed in these news stories? Is there any relationship between a particular issue image and scientific information source used in the news reports? All these questions require further analysis beyond simple descriptive statistics. Fourth, news media is one of the multiple venues in society where issue of climate change is brought up, debated, and portrayed. What are the inter-agenda relationships among various venues? How do changing media attention to and portrayal of climate change affect public opinions and policy decisions or vice versa? Several studies have provided invaluable results and insights (e.g., Krosnick et al., 2006), but more effort needs to be pursued in this direction. Fifth, the analysis reported here is derived from and restricted to aggregated quantitative data. To strengthen the findings and assessments presented here, future research should incorporate in-depth, qualitative content analysis methods to demonstrate how natural and policy events, real-world cues, problem indicators, and other factors (such as journalistic norms, reporter's attitude and belief, new information and findings from climate science, competing social problems, etc.) affect specific news media's reports and portrayals of climate change problems.

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