

Urban policy and governance in a global environment: complex systems, scale mismatches and public participation

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The urbanization process and urban activities generate environmental impacts both within and beyond city boundaries. Urban policy plays an important role in shaping and changing the regional and global linkages of cities. Integrating regional and global environmental concerns into urban policy and management practices remains a challenging issue because of the inherent temporal, spatial and institutional scale mismatch between urban policies and regional and global environmental issues. This paper argues that firstly, urban policy has increasing relevance to regional and global environmental issues, and a systems approach is essential in urban policy making to maximize co-benefit and negotiate trade-offs and secondly, although the current institutional settings in urban policy making are not necessarily best suited for managing these issues, enhanced governance processes such as increased public participation and networking and learning across cities can be effective.

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Global impact of cities and the role of urban policy

Urbanization processes and urban activities generate environmental impacts both within and beyond city boundaries. They change land use patterns, alter regional and global hydrological and biogeochemical cycles and affect biodiversity conservation [1,2^{••},3]. Urban activities attract increasing amounts of raw materials and energy into the city, and discharge various products and waste out of the city. While estimates vary depending on the methodology used [4–6], cities are considered to be the

locus for a majority of world energy demand and subsequent greenhouse gas emissions [2^{••}]. In places like China, urbanization is creating an ever greater demand for construction materials, which is quickly outpacing the supply in the country [7].

Socio-economic and cultural factors have strong influences over the type and extent of urban environmental problems. Recent research comparing historical energy and material flows across a range of cities suggests an increasing per capita intensity of flows and suggests a growing level of environmental impacts of cities [8,9], which is often associated with economic and income growth [10,11]. Urban land use change is closely linked to economic growth of the city [12,13]. Many low income cities are also very vulnerable to climate change impacts, adding a new and urgent task for climate adaptation into other pressing issues these cities are faced with. These complex relations and competing tasks emphasize the need for an integrated, systems approach in tackling environmental problems of cities.

Urban policies, both sectoral policies that affect urban transportation or energy, and integrated policies and practices that affect urban economic development, social aspects, and environmental quality and management, play an important role in shaping and changing the regional and global linkages of cities. Urban metabolism and impacts on biogeochemical cycles are partly shaped and governed by urban policy and management practices [14,15]. Along with urban population and economic growth, land use policies and regulations are important driving forces of urban land use expansion in some cities [16]. In low income cities and communities, these influences can be even more important, as local governments have more control across wide range of issues including housing, access to basic infrastructure, education, safety, and finance. [17].

Despite the apparent linkages between cities and regional and global environmental issues, and the important role urban policy can play in shaping these linkages, there remain challenges to integrating regional and global environmental concerns into urban management practices. First, the complexity of cities as dynamic, open systems often means there are linkages and interactions between different components of the urban system. On the one hand, this provides opportunities for realizing co-benefit through targeting problems from an integrated

system point of view. On the other hand, it also presents a risk that policy decisions have intended and unintended consequences within and beyond the specific target sector, and thus any gains might be realized by trade-offs with other important issues. Integrating global issues into urban policies requires careful weighing and evaluation among options in terms of what are the benefits, and trade-offs and for whom, before decisions are made. This is discussed further in 'Complex system understanding in urban policy making' section.

Second, there is an inherent temporal, spatial, and institutional scale mismatch between urban decision-making and global environmental concerns [18], where urban decision makers are often confined within their relatively short temporal scale of concern, within the spatial scale of their jurisdictions, and within nested governmental and other institutional settings. Further, these mismatches also raise difficult questions for spatially bounded municipalities about who has a legitimate say in local decisions with regional or global consequences. The scale and institutional aspect is discussed in 'Scale and institutions in urban governance' section.

Third, it is important to note that within the scale mismatches and institutional constraints discussed above, there is a wide disparity in environmental performance of cities, with many good examples. This leads to the proposition that institutions are only part of the equation and good governance and policy-making process (e.g. the capacity for citizens and governments to grasp, debate and fashion policies that influence these consequences) is critical. There is an urgent need for a better understanding of the co-evolutionary process of urban environmental problems and urban policy, and what kind of governance or other mechanism can steer this co-evolutionary process towards a more effective integration of global environmental concerns into urban policy and management practices. This is further discussed in 'Co-evolution of urban policy and public participation' section.

Complex system understanding in urban policy making

Cities are increasingly recognized as complex adaptive systems that integrate, respond to, and influence a diverse range of social, economic and ecological processes operating across a range of spatial and temporal scales [19,20**]. Connections between urban systems and regional and global change are therefore characterised by significant nonlinearities and cross-scale interactions among slow and fast moving processes [21] which complicate current activities and policies to address urban growth and transitions to more sustainable cities and regions [22]. Yet, our emerging understanding of cities as complex systems is helping identify fundamental relationships in how cities work and which activities, including urban policy options, are important and effec-

tive for shaping future urban trajectories. For example, recent research by Bettencourt *et al.* [23] has demonstrated fundamental relationships among economic development, social organisation, and environmental impacts among cities, and such insights have the potential to provide novel levers for policy efforts aimed at addressing local, regional and global effects of urbanisation [24].

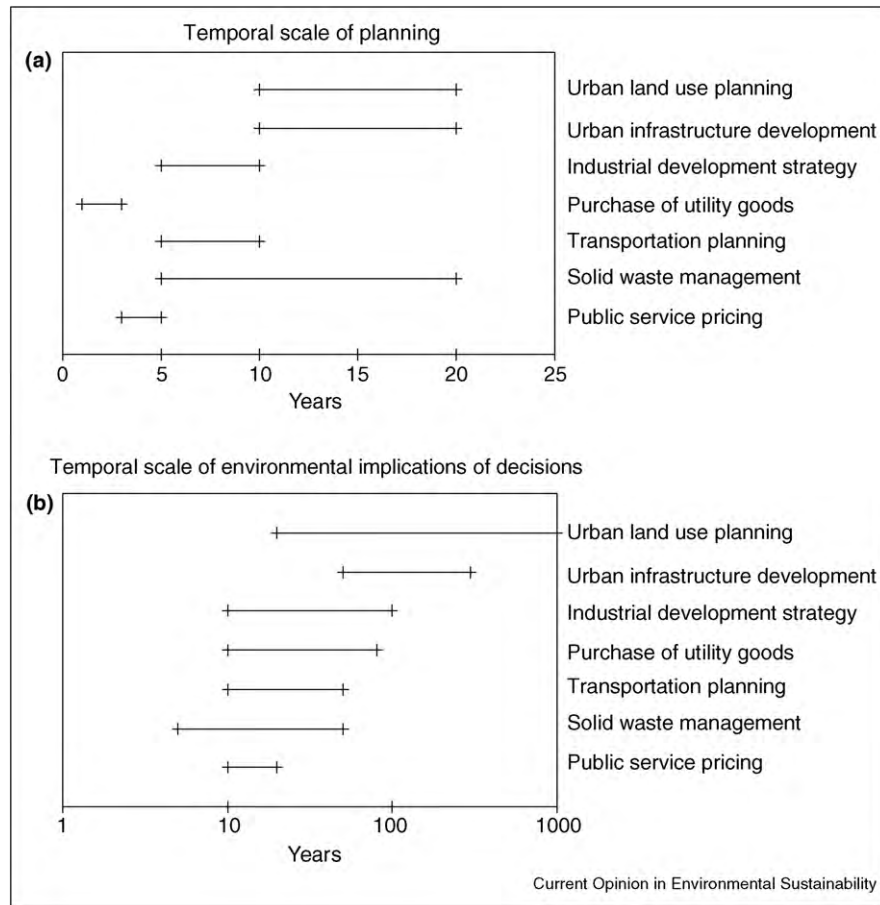
This evolving understanding of urban systems can also aid in identifying likely positive and negative consequences of a given urban environmental policy, as well as finding ways of negotiating trade-offs and achieving co-benefits with other goals at local, regional and global scales [25,26]. Ultimately, such studies can be used to create new social theories of urbanisation and help identify approaches and experiments that may be able to be replicated in a range of cities [23,27]. For example, linking city-scale transportation infrastructure decisions to public health objectives by creating walking/cycling lanes may create significant co-benefits to human health (e.g. more physical activity and less air pollution) and traffic congestion (e.g. fewer cars on roads) [28,29]. In addition to these local impacts, reductions in traffic and outlays for new roads reduce greenhouse gas emissions, a co-benefit related directly to global climate change. Similar co-benefits and trade-offs have been described for health-energy system linkages [30,31], carbon management and urban development [32], solid waste management [33], and low-carbon transport systems [34].

These examples also suggest that a systems understanding of urban environmental policy linkages to regional and global change may also help identify strategic intervention points to achieve desirable outcomes across a range of scales [35–37]. Rather than forming policies that narrowly focus on one type of environmental problem in isolation, it may be possible to identify multiple intervention points and utilize a palette of options that may not be currently considered together. All of these goals could be pursued as 'no-regrets' adaptive management strategies that are flexible enough to incorporate new developments in science, social and economic trends, and new forms of urban governance and policy making. Furthermore, any policy components of adaptive management need to be embedded within a system where non-state actors are critical in elevating governance to the global scale [38].

Scale and institutions in urban governance

As mentioned above, there is an inherent temporal, spatial, and institutional scale mismatch between urban decision-making and global environmental concerns [18], where urban decision makers are often confined within their relatively short temporal scale of concern, within the spatial scale of their jurisdictions, and within nested governmental and other institutional settings. Figure 1 contrasts the typical temporal scale of urban planning and

Figure 1



Temporal scale of urban decision-making. **(a)** Temporal scale of planning; **(b)** temporal scale of potential environmental impacts of decisions. Source: [18].

decision-making (e.g. the time frame considered for the planning or decision) and the temporal scale of potential impacts of decisions. Scale mismatches raise difficult questions for spatially bounded municipalities about who has a legitimate say in local decisions with regional or global consequences. There are many cases where such mismatches are causing environmental problems, and neither the institutional settings nor governance practices are suited to solving them. For example, industrial relocation, a widely adopted approach in Asia to improve environmental quality in cities by relocating polluting industries out of cities, often causes negative environmental impacts at the recipient site beyond city boundaries [39]. Another such example is the case of cross border air pollution in Pearl River Delta Region in China, where the institutional deficit is proven not to be effective in solving the problem [40].

In terms of managing scale mismatches, or functional misfit between institutions and issues in question [41], current global environmental issues such as climate

change present new challenges [42,43^{*}]. Unlike many traditional urban issues such as water and sanitation provision, the environmental costs of increased greenhouse gases will be dissipated unevenly across the globe. The solutions to climate change involve a combination of both mitigation, which is largely considered as a top-down approach, and adaptation, where a bottom up approach is considered to be more effective [44^{**},45]. Hence new institutional challenges are already upon us which require the coordination of local and global scale responses [46], as well as effectively integrating mitigation and adaptation tasks.

A variety of institutions, which include social norms, non-regulatory and regulatory rules, play an important role in linking cities to the regions and globally. For example, to some degree people make consumption decisions which factor in regional environmental consequences. Examples of this are certification systems, which are self-regulatory institutional responses to cross-scale environmental externalities (e.g. Beef [47]). Particularly in the context

of market economies, government policy can also seek to incorporate environmental consequences into prices [43^{*}], though policy objectives such as food security and drought relief can sometimes support environmentally degrading practices. Most critically, cities sit within a largely nested (and normally hierarchical) structure of government regulations from global through to local scales. A system of governance, which includes urban policy as well as other levels of government, has evolved to address various urban problems that arise from a complex modern society, albeit imperfectly.

Regardless of the purpose, institutions can never be perfect for at least two reasons. First, even institutions created for a specific purpose are not merely the product of a single issue. Institutions respond to geopolitical contexts, ecology and economic drivers, path dependency and also to forces from other competing and complementary institutions [48]. Complexity can foster resilience, but not perfection. Second, issues and drivers change continually, so a perfect institutional solution can only ever be 'perfect' for a moment in time and space. Therefore, there is a strong case for building adaptive capacity into the governance of environmental problems [49,50].

Co-evolution of urban policy and public participation

Urban policy responses evolve to address the sets of environmental challenges faced by cities. With current institutions not responding properly or in a timely way to global change issues, there is growing pressure on city level actors to re-imagine and re-scale urban environmental policy. Doing so however has profound implications for traditional ways of governing environmental issues in urban areas. One critical question is what are the different governance mechanisms that might support a co-evolution of urban policy making and problem understanding over time? Who is to be involved, and, what local governing structures will assist or perhaps obstruct this process of co-evolution?

Urban policies and policy-making processes are closely linked to and influenced by the larger economic and political context. Local and regional responsiveness to environmental change is predicated strongly on an understanding of decision-making processes by local actors, in concert with experts and governments [51]. Effective public participation or civic models of engagement can improve public policy formation, reduce conflict and encourage local action [52–54]. Despite this, citizen participation in urban planning and policy making may still not remove contextual constraints on the capacity for effective action by individuals [55].

There are already studies examining how local and regional stakeholders might participate in, and thereby

influence to greater effect, environmental decision-making more broadly [56] and more specifically climate impacts [51,57^{*}]. Public participation in complex environmental decision-making can help manage uncertainty, as demonstrated in the implementation of policies such as the European Water Framework Directive [58] or anticipating municipal responses to climate change through community-based scenario planning in coastal United Kingdom [57^{*}]. Long-term studies of urban policy making and transformation [59] point to the importance of meaningful deliberation among the involved public and other local stakeholders. In fact it is these inclusive local debates around place identity and place quality that, over time, mobilise the knowledge and relational resources needed to reframe problem understandings and propose new policy directions.

The move towards greater inclusion of citizens or the 'public' has in part been driven by a shift towards the democratization of urban planning [60]. There are however real challenges around making these processes inclusive, legitimate and accountable when they need to engage both local and extra-urban actors. While it could be argued that this trend will become increasingly necessary, it also may become increasingly problematic. The standard rules of political decision-making may cease to apply during some events [60]. And despite trends towards greater public involvement in recent decades, more cases are emerging where governments hold that the scale of policy (such as in metropolitan strategic plans) is too complex to allow public involvement [60]. It is this tension between the tendency to centralize complex policy decisions or large planning projects with calls for greater local involvement that will be increasingly contested through city and regional governance arenas. Local public participation and debate on urban policy change are also impeded by the institutional inheritance of sector-based politics and mistrust over control of the policy agenda [59].

A second consideration is then what governing structures or process might help urban municipalities navigate through changing issue and policy contexts across multiple scales? One such structure is the emergence of networks or coalitions between individual local governments in order to arrest or influence the trajectory of a given environmental or development problem, for example water security, transport planning, environmental protection or urban renewal. These networks are sometimes between neighbouring local areas or urban centres, forming a 'policy' or 'issue' region. This approach is often advocated by scholars of new regionalism who argue it provides the capability of resource sharing and deliberative policy making which can encompass complex issues beyond a single urban boundary, while maintaining local autonomy and issue-relevance [61]. This strategy of aggregation can also

improve the voice of local actors and therefore increase the likelihood of influencing policy and action at broader spatial or institutional scales. Such structures in Australia, for example have included the emergence of Regional Organisations of Councils improving coordination of land use policy, waste management or transport infrastructure across local government boundaries, while providing an interface for local actors with higher level governing processes [62].

The tendency of some forms of regional cooperation to entrench local interests and deny necessary reform is also recognized [63,64]. International networks of local governments have also been closely studied. Individual cities engaging in the Cities for Climate Protection program for instance can access new knowledge through a global network to improve local action on climate change. Transnational municipal partnerships between North and South countries are a long standing example of benefits of cooperation in building capacity of local governments to manage major environmental or development challenges [65,66]. In addition, such networks also provide the possibility to aggregate that learning and share municipal-level experiences that might bring about positive impacts at broader scales. In addition, such networks also provide the possibility to aggregate that learning and share municipal-level experiences that might bring about positive impacts at broader scales. Within the European Union however transnational municipal networks engaged on issues of climate change have been described as 'networks of pioneers for pioneers' [67] where policy and practice change is often limited to dedicated participants with passive municipalities lagging on the network periphery.

Concluding remarks

Urban policies will become increasingly important for solving regional and global environmental issues. Urban policy making, even for those seemingly unrelated to global issues, has an added agenda which requires a thorough understanding of various interactions, careful weighing and evaluation among options in terms of what are the benefits and trade-offs and for whom, before decisions are made. This points to the need for an enhanced scientific understanding of cities as complex socio-ecological systems, and reinforces the importance of improved urban governance. Although the current institutional setup in urban policy making is not necessarily best suited for managing these issues, an enhanced governance process such as increased public participation, networking and learning across cities can be effective in mainstreaming these issues into urban policy.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.cosust.2010.05.008](https://doi.org/10.1016/j.cosust.2010.05.008).

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- of special interest
- of outstanding interest

1. McDonald RI, Kareiva P, Forman RTT: **The implications of current and future urbanization for global protected areas and biodiversity conservation.** *Biol Conserv* 2008, **141**:9.
2. Grimm NB, Faeth SH, Golubiewski NE, Redman CL, Wu JG, Bai XM, Briggs JM: **Global change and the ecology of cities.** *Science* 2008, **319**:756-760.
- This paper provides a comprehensive review of the field of urban ecology, with particular focus on the role of cities in global change and how the ecology of cities can effectively address these challenges.
3. Kaufmann RK, Seto KC, Schneider A, Liu Z, Zhou L, Wang W: **Climate response to rapid urban growth: evidence of a human-induced precipitation deficit.** *J Climate* 2007, **20**:2299-2306.
4. Dodman D: **Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories.** *Environ Urban* 2009, **21**:185-201.
5. Satterthwaite D: **Cities' contribution to global warming: notes on the allocation of greenhouse gas emissions.** *Environ Urban* 2008, **20**:539-549.
6. Kennedy, C, Steinberger, J, Gasson, B, Hansen, Y, Hillman, T, Havránek, M, Pataki, D, Phdungsilp, A, Ramaswami, A, Mendez, GV: **Methodology for inventorying greenhouse gas emissions from global cities.** *Energy Policy* in press, [doi:10.1016/j.enpol.2009.08.050](https://doi.org/10.1016/j.enpol.2009.08.050).
7. Fernández JE: **Resource consumption of new urban construction in China.** *J Ind Ecol* 2007, **11**:99-115.
8. Kennedy C, Cuddihy J, Engel-Yan J: **The changing metabolism of cities.** *J Ind Ecol* 2007, **11**:17.
9. Baynes T, Bai X: **Trajectories of change: Melbourne's population, urban development, energy supply and use from 1960-2006.** *Global Energy Assessment Working Paper Series*. 2010.
10. McGranahan G, Marcotullio P, Bai X, Balk D, Braga T, Douglas I, Elmquist T, Rees W, Satterthwaite D, Songsore J et al.: **Urban systems.** In *Ecosystems and Human Well-being: Current State and Trends*. Edited by Hassan R, Scholes R, Ash N. Island Press; 2005.
11. Bai XM: **The process and mechanism of urban environmental change: an evolutionary view.** *Int J Environ Pollut* 2003, **19**:528-541.
12. Deng X, Huang J, Rozelle S, Uchida E: **Growth, population and industrialization, and urban land expansion of China.** *J Urban Econ* 2008, **63**:96-115.
13. Seto KC, Kaufmann RK: **Modeling the drivers of urban land use change in the Pearl River Delta, China: integrating remote sensing with socioeconomic data.** *Land Econ* 2003, **79**:106-121.
14. Kaye JP, Groffman PM, Grimm NB, Baker LA, Pouyat RV: **A distinct urban biogeochemistry?** *Trends Ecol Evolut* 2006, **21**:8.
15. Bai XM: **Industrial ecology and the global impacts of cities.** *J Ind Ecol* 2007, **11**:1-6.
16. Liu J, Zhan J, Deng X: **Spatio-temporal patterns and driving forces of urban land expansion in China during the economic reform era.** *AMBIO J Hum Environ* 2005, **34**:450-455.
17. Satterthwaite D: **Meeting the MDGS in urban areas: the forgotten role of local organizations.** *J Int Affairs* 2005:58.

18. Bai XM: **Integrating global concerns into urban management: the scale and the readiness arguments.** *J Ind Ecol* 2007, **11**:15-29.
19. Newton P, Bai X: **Transitioning to sustainable urban development.** In *Transitions: Pathways Towards Sustainable Urban Development in Australia*. Edited by Newton P. CSIRO Press; 2008:3-19.
20. Grimm NB, Grove JM, Pickett STA, Redman CL: **Integrated approaches to long-term studies of urban ecological systems.** *Bioscience* 2000, **50**:571-584.
This widely cited paper presents a systematic review of urban ecology, in particular the interaction between cities and global change. It presents an integrated framework for understanding cities as coupled social-ecological systems. The authors draw upon research from the two urban NSF Long Term Ecological Research programs in Phoenix, AZ and Baltimore, MD, as well as international studies on urban ecology, industrial ecology and urban environment.
21. Garmestani AS, Allen CR, Gunderson L: **Panarchy: discontinuities reveal similarities in the dynamic system structure of ecological and social systems.** *Ecol Soc* 2009, **14**:15 URL: <http://www.ecologyandsociety.org/vol14/iss1/art15/>.
22. Irwin EG, Jayaprakash C, Munroe DK: **Towards a comprehensive framework for modeling urban spatial dynamics.** *Landsc Ecol* 2009, **24**:1223-1236.
23. Bettencourt LMA, Lobo J, Helbing D, Kuhnert C, West GB: **Growth, innovation, scaling, and the pace of life in cities.** *Proc Natl Acad Sci U S A* 2007, **104**:7301-7306.
24. Fragkias M, Seto KC: **Evolving rank-size distributions of intra-metropolitan urban clusters in South China.** *Comput Environ Urban Syst* 2009, **33**:189-199.
25. McEvoy D, Lindley S, Handley J: **Adaptation and mitigation in urban areas: synergies and conflicts.** *Proc Inst Civil Eng Municipal Eng* 2006, **159**:185-191.
26. Ruth M, Coelho D: **Understanding and managing the complexity of urban systems under climate change.** *Clim Policy* 2007, **7**:317-336.
27. Bai X, Wieczorek A, Kaneko S, Lisson S, Contreras A: **Enabling sustainability transitions in Asia: the importance of vertical and horizontal linkages.** *Technol Forecast Social Change* 2009, **76**:255-266.
28. Frank LD, Sallis JF, Conway TL, Chapman JE, Saelens BE, Bachman W: **Many pathways from land use to health – associations between neighborhood walkability and active transportation, body mass index, and air quality.** *J Am Plan Assoc* 2006, **72**:75-87.
29. Younger M, Morrow-Almeida HR, Vindigni SM, Dannenberg AL: **The built environment, climate change, and health.** *Am J Prev Med* 2008, **35**:517-526.
30. Smith KR, Haigler E: **Co-benefits of climate mitigation and health protection in energy systems: scoping methods.** *Annu Rev Public Health* 2008, **29**:11-25.
31. McMichael AJ, Powles JW, Butler CD, Uauy R: **Energy and health 5 – food, livestock production, energy, climate change, and health.** *Lancet* 2007, **370**:1253-1263.
32. Lebel L, Garden P, Banaticla MRN, Lasco RD, Contreras A, Mitra AP, Sharma C, Nguyen HT, Ooi GL, Sari A: **Integrating carbon management into the development strategies of urbanizing regions in Asia – implications of urban function, form, and role.** *J Ind Ecol* 2007, **11**:61-81.
33. Yedla S, Park HS: **Co-benefit as an approach to align climate change concerns with national development objectives: solid waste management.** *J Mater Cycles Waste Manage* 2009, **11**:123-129.
34. Machado H: **Brazilian low-carbon transportation policies: opportunities for international support.** *Clim Policy* 2009, **9**:495-507.
35. Kates R, Parris T: **Long-term trends and a sustainability transition.** *Proc Natl Acad Sci U S A* 2003, **100**:8062-8067.
36. Ash C, Jasny BR, Roberts L, Stone R, Sugden A: **Reimagining cities – introduction.** *Science* 2008, **319**:739-1739.
37. Dye C: **Health and urban living.** *Science* 2008, **319**:766-769.
38. Biermann F: **'Earth system governance' as a crosscutting theme of global change research.** *Global Environ Change Hum Policy Dimens* 2007, **17**:326-337.
39. Bai XM: **Industrial relocation in Asia: a sound environmental management strategy?** *Environment* 2002, **44**:8-21.
40. Lee Y-sF: **Tackling cross-border environmental problems in Hong Kong: initial responses and institutional constraints.** *China Q* 2002, **172**:24.
41. Ekstrom JA, Young OR: **Evaluating functional fit between a set of institutions and an ecosystem.** *Ecol Soc* 2009, **14**:16 URL: <http://www.ecologyandsociety.org/vol14/iss2/art16/>.
42. Adger WN, Arnell NW, Tompkins EL: **Successful adaptation to climate change across scales.** *Global Environ Change Hum Policy Dimen* 2005, **15**:77-86.
43. Bailey I, Maresh S: **Scales and networks of neoliberal climate governance: the regulatory and territorial logics of European Union emissions trading.** *Trans Inst Br Geogr* 2009, **34**:445-461.
This study explores the interplay between state and non-state actors specifically in the context of the EU emission trading scheme negotiation. It provides insights into the governance of complex, multi-scalar problems.
44. Parry M: **Closing the loop between mitigation, impacts and adaptation.** *Clim Change* 2009, **96**:23-27.
Climate mitigation and adaptation, while different objectives, are tightly inter-related. This paper argues a lack of knowledge about this inter-relationship hinders strong action on combating climate issues.
45. Patwardhan A, Downing T, Leary N, Wilbanks T: **Towards an integrated agenda for adaptation research: theory, practice and policy: strategy paper.** *Curr Opin Environ Sustain* 2009, **1**:219-225.
46. Bulkeley H, Betsill M: **Rethinking sustainable cities: multilevel governance and the 'urban' politics of climate change.** *Environ Politics* 2005, **14**:22.
47. Herrero M, Thornton PK, Gerber P, Reid RS: **Livestock, livelihoods and the environment: understanding the trade-offs.** *Curr Opin Environ Sustain* 2009, **1**:111-120.
48. Mehta L, Leach M, Newell P, Scoones I, Sivaramakrishnan K, Way SA: *Exploring Understandings of Institutions and Uncertainty: New Directions in Natural Resource Management* Institute of Development Studies; 1999.
49. Brown H: **Climate change and Ontario forests: prospects for building institutional adaptive capacity.** *Mitig Adapt Strat Global Change* 2009, **14**:34.
50. Ostrom E, Janssen MA, Anderies JM: **A diagnostic approach for going beyond panaceas.** *Proc Natl Acad Sci* 2007, **104**:3.
51. Shackley S, Deanwood R: **Stakeholder perceptions of climate change impacts at the regional scale: implications for the effectiveness of regional and local responses.** *J Environ Plan Manage* 2002, **45**:381-402.
52. Lane MB: **Public participation in planning: an intellectual history.** *Aust Geogr* 2005, **36**:283-299.
53. Vigar G: **Deliberation, participation and learning in the development of regional strategies: transport policy making in North East England.** *Plan Theor Pract* 2006, **7**:267-287.
54. Douglas M, Friedmann J (Eds): *Cities for Citizens: Planning and the Rise in Civil Society in a Global Age*. Wiley; 1998.
55. Owens S: **Engaging the public: information and deliberation in environmental policy.** *Environ Plan A* 2000, **32**:1141-1148.
56. Lidskog R, Elander I: **Representation, participation or deliberation? Democratic responses to the environmental challenge.** *Space Polity* 2007, **11**:75-94.
57. Tompkins EL, Few R, Brown K: **Scenario-based stakeholder engagement: incorporating stakeholders preferences into coastal planning for climate change.** *J Environ Manage* 2008, **88**:1580-1592.

This paper is valuable as it not only provides evidence of how local actors engage in the framing and management of complex regional and global environmental problems like climate change but also offers a methodological framework to support such discussions, productively, in a context of uncertainty.

58. Newig J, Pahl-Wostl C, Sigel K: **The role of public participation in managing uncertainty in the implementation of the Water Framework Directive.** *Eur Environ* 2005, **15**:333-343.
59. Healey P, de Magalhaes C, Mandipour A, Pendlebury J: **Place identity and local politics: analysing initiatives in deliberative governance.** In *Deliberative Policy Analysis: Understanding Governance in the Network Society*. Edited by Hajer, Wagenaar. Cambridge University Press; 2003.
60. Sandercock L: **The democratization of planning: elusive or illusory?** *Plan Theor Pract* 2005, **6**:437-441.
61. Herrschel T: **Regions between imposed structure and internally developed response. Experiences with twin track rationalisation in post-socialist eastern Germany.** *Geoforum* 2007, **38**:469-484.
62. Marshall N, Dollery B, Witherby A: **Regional organisations of councils (ROCS): the emergence of network governance in metropolitan and rural Australia?** *Aust J Region Stud* 2003, **9**:169-188.
63. Cashin SD: **Localism, self-interest, and the tyranny of the favored quarter: addressing the barriers to new regionalism.** *Georgetown Law J* 2000:88.
64. Keating M: **The political economy of regionalism.** In *The Political Economy of Regionalism*. Edited by Keating M, Loughlin J. Routledge; 1997.
65. Campbell T: **Learning cities: knowledge, capacity and competitiveness.** *Habitat Int* 2009, **33**:195-201.
Campbell develops a typology of city learning, which is then applied to several empirical cases globally. The analysis not only provides important baseline understanding of progress to date in this arena but also highlights the importance of systematic and deliberate learning strategies employed by cities and the implications for institutional capacity on developed and developing cities.
66. van Lindert P: **Transnational linking of local governments: the consolidation of the Utrecht-León municipal partnership.** *Habitat Int* 2009, **33**:173-180.
67. Kern K, Bulkeley H: **Cities, Europeanization and multi-level governance: governing climate change through transnational municipal networks.** *J Common Market Stud* 2009, **47**:309-332.