4-2018

Africa's Urban Adaptation Transition Under a 1.5° Climate

Mark Pelling
King's College London

Hayley Leck
King's College London

Lorena Pasquini
University of Cape Town

Idowu Ajibade
Portland State University, iajibade@pdx.edu

Emanuel Osuteye
University College London

See next page for additional authors

Citation Details
Pelling, M., Leck, H., Pasquini, L., Ajibade, I., Osuteye, E., Parnell, S., ... & Boubacar, S. (2018). Africa's urban adaptation transition under a 1.5° climate. Current Opinion in Environmental Sustainability, 31, 10-15.

Authors
Mark Pelling, Hayley Leck, Lorena Pasquini, Idowu Ajibade, Emanuel Osuteye, Susan Parnell, Shuaib Lwasa, Cassidy Johnson, Arabella Fraser, Alejandro Barcena, and Soumana Boubacar

Available online at www.sciencedirect.com

ScienceDirect

Current Opinion in Environmental Sustainability

Africa's urban adaptation transition under a 1.5° climate

Mark Pelling[1], Hayley Leck[1], Lorena Pasquini[2], Idowu Ajibade[3], Emanuel Osuteye[4], Susan Parnell[5], Shuaib Lwasa[6], Cassidy Johnson[4], Arabella Fraser[7], Alejandro Barcena[1] and Soumana Boubacar[8]

For cities in sub-Saharan Africa a 1.5 °C increase in global temperature will bring forward the urgency of meeting basic needs in sanitation, drinking water and land-tenure, and underlying governance weaknesses. The challenges of climate sensitive management are exacerbated by rapid population growth, deep and persistent poverty, a trend for resolving risk through relocation (often forced), and emerging new risks, often multi-hazard, for example heat stroke made worse by air pollution. Orienting risk management towards a developmental agenda can help. Transition is constrained by fragmented governance, donor priorities and inadequate monitoring of hazards, vulnerability and impacts. Opportunities arise where data and forecasting is present and through multi-level governance where civil society collaborates with city government.

Addresses
[1] King's College London, Strand, London WC2R 2LS, UK
[2] African Climate & Development Initiative, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa
[3] Portland State University, Oregon, 1721 SW Broadway, Portland, USA
[4] Development Planning Unit, University College London, 34 Tavistock Square, London, UK
[5] University of Cape Town, Private Bag X3, 7701, South Africa
[6] Makerere University, P.O. Box 7062, Kampala, Uganda
[7] Overseas Development Institute, 203 Blackfriars Road, London SE1 8NJ, UK
[8] Faculty of Agronomy, University Abdou Moumouni, Niger

Corresponding author: Pelling, Mark (mark.pelling@kcl.ac.uk)

Current Opinion in Environmental Sustainability 2018, **31**:10–15

This review comes from a themed issue on **Sustainability governance and transformation**

Edited by **Bronwyn Hayward** and **Linda Sygna**

For a complete overview see the Issue and the Editorial

Available online 9th December 2017

https://doi.org/10.1016/j.cosust.2017.11.005

Introduction

The case for focusing on 1.5 °C as opposed to 2 °C for urban sub-Saharan Africa (sSA) is strong. Any increase above current temperatures would exacerbate already highly vulnerable urban systems, especially in informal settlements and smaller cities where most of the urban population live in unregulated and poorly services environments [1]. The dysfunctional current context makes it doubly important to base a 1.5 °C strategy on resolving existing climate threats through a development oriented approach to risk management [2,3]. The observed nexus is clear for everyday risks where the health burden of inadequate sanitation and drinking water access is compounded by recurrent events (seasonal flooding or heat/cold shocks) and episodic events (urban food security crises linked to rural climatic extremes, often teleconnected through global markets) [4,5]. Risks can be reduced where leadership is strong and inclusive and where data architecture exists to support planning processes. For cities in sSA to manage a 1.5 °C increase, a combined vulnerability reduction and risk reduction agenda is observed to be most appropriate. Where this normative shift has taken root it is seen as part of a transition in the risk-development nexus that balances reducing risk with correcting developmental failings that have generated risk — for example through inadequate basic needs fulfillment [6].

The detailed implications of a 1.5 °C increase in global temperature for cities across sSA are highly uncertain. For sSA, the incompleteness of data and data collection mechanisms will likely mean that any improved granularity on observed city level consequences of a 1.5 °C increase in global temperature will be slow to arrive. The reduced costs of monitoring and rise of citizen-led approaches including online data management and recording of events brings early warning on hazards and risk modeling closer, but improvements of these kind remain limited to larger and richer cities. Similarly, pre-financing for event response, and associated insurance mechanisms, as yet have limited penetration in urban sSA, especially so in smaller cities [7–10].

In this context, as important as refining the predictive power of risk models is the need to squarely recognise the underlying vulnerabilities of urban populations and their root causes; and to reflect on the capacity of city authorities and wider governance systems to transition towards more sustainable urban pathways [11]. Responding to this agenda will require detailed analysis of the inter-relations between risk and vulnerability and other elements of human development and well-being and to capture the underlying drivers of risk across multi-scalar networks and spaces that are both formal and informal and connected across city regions [12]. This reflects the Sustainable Development Goals which integrate risk management throughout, and especially in Goal 1: Eradicating Poverty and Goal 11: Sustainable Cities and Communities.

Risk and urban development are intertwined in multiple and complex ways. Yet, disaster risk management continues to be presented largely as a physical domain problem, to be resolved through engineering interventions. Missing from this perspective is the social context of risk; the institutions shaping risk prioritisation, constrained residential choices and power over mobility [13]. Engineering solutions have much to offer but opportunities for sustainable risk reduction are missed where these tend towards large scale investment that either exclude the at-risk poor majority or actively displace the urban poor. There is a real opportunity for inclusive planning to harness engineering for pro-poor risk reduction. The rise of networked civil society in many African cities, for example through Shack and Slum Dwellers International (SDI) [14] has begun to deliver inclusive planning for risk reduction offering examples of success. These independent, skilled actors, often refuse government or donor finance where these might compromise independence or local accountability. If development donors can reform practices to finance independent actors and smaller scale, collaborative and locally determined infrastructure programs, rapid progress can be possible.

Both the causes for risk accumulation and opportunities for reducing risk in urban sSA lie clearly in development policy and practice. The tools of risk management:— early warning, preparedness, response and recovery, — are necessary for coping with residual risk, but where risk is as ubiquitous as it is amongst the majority poor populations of cities in sSA, it is through development interventions that lives and livelihoods will be protected and wellbeing enhanced [15]. Shifting focus for the responsibility of risk and its policy framing from risk management to development is as much a socio-cultural as a technical concern. For many African cities, building capacity for transition has begun with innovative multi-partner governance arrangements that have taken advantage of opportunities to creatively link new agendas to existing goals, plans, and programs [16•]. These emergent framings can support the incorporation of social justice concerns in towns and cities as a critical dimension of inclusive and equitable development and risk reduction [12,17••].

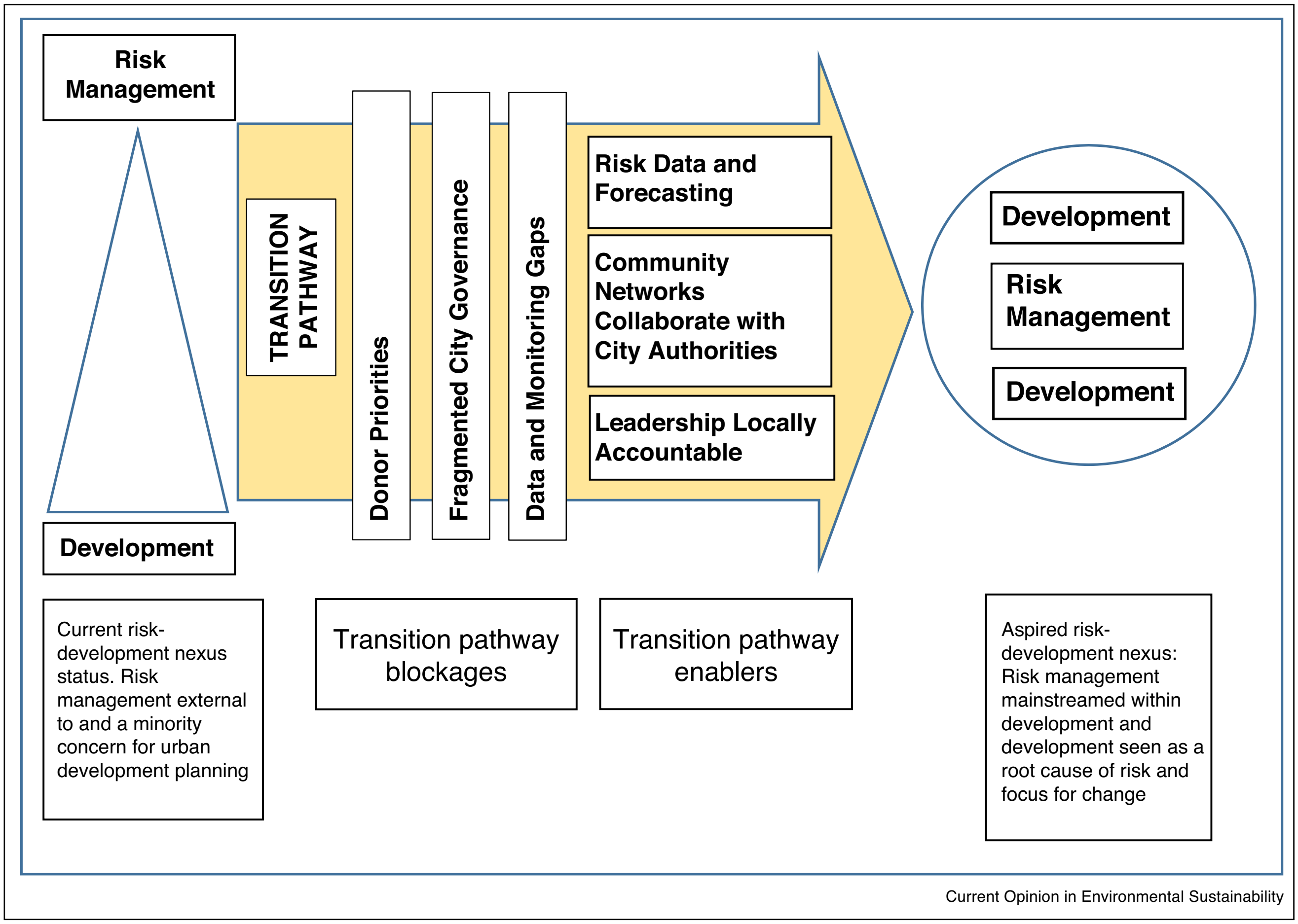
The next sections outline observed pathways of transition in development and risk management relevant for a 1.5 °C warmer world; review assessments of the barriers and opportunities for integrating risk management into development; and use Lagos as an illustrative case-study of capacity for transition towards a more equitable and sustainable future. Figure 1 summarises this review paper. Understanding development as a core concern for risk management is constrained by existing donor priorities, fragmented city governance and data and monitoring gaps. Improvement is observed where risk data forecasting, and community networks collaborating with city authorities, are found.

Pathways of interaction

Development pathways and climate effects coevolve. Relationships can be direct and may be attributable, for example when experienced as a variation from mean air temperature (though air quality will influence health risks). Most climate change effects, including sea-level rise, are mediated through local or regional atmospheric and hydrological regimes; flooding is further modified by topographical features [18,19]. Many more potential impacts of warming are indirect. Much of Africa relies on agriculture, particularly subsistence agriculture, and warming is likely to significantly impact agricultural production. In sSa urban food security increasingly depends on globalised supply chains, though local production remains important [20]. Urban food security is then a complex of global food prices and local environmental pressures. Water security ties cities into regional climatic-hydrological systems with failures forcing residents to cope with inadequate quality and quantity; 1.5 °C will bring many more families into water poverty. Among the many expected health impacts of a warming climate, human health dynamics are closely tied to the temperature sensitivity of key disease vectors, such as the *Anopheles* mosquito that transmits malaria (e.g. [19]). Rural and urban populations are co-dependent, such that negative impacts of a 1.5 °C warming in the countryside may result in greater numbers of rural–urban migrants, and a greater reliance on urban remittances in rural household livelihood systems [21••]. Urban in-migration is likely to increase the existing high levels of urban vulnerability to a range of risks, as the Dar es Salaam case (Supplementary Material) exemplifies. Should economic crises in the city overlap with increased climate pressures, the impacts will likely be felt in the city region and beyond.

These potential impacts of 1.5 °C warming are mediated by exposure, social vulnerability, coping and adaptive capacity. To date it is these features of urban development that have determined urban risk, more than variability associated with climate change [22•]. This means that reducing risk is within the grasp of national, city and local actors: a considerable but not insurmountable challenge. Current trends are for increasing vulnerability as existing infrastructure and services are unable to cope with growing populations under current climate [23]. This means that any reflection on 1.5 °C must be seen

Figure 1



Transition in the risk management for sub-Saharan African cities facing 1.5° warming. Moving risk management from its position as a minor concern removed from mainstream development to understanding development as a core concern for risk management is constrained by existing donor priorities, fragmented city governance and data and monitoring gaps. Movement is observed where risk and data forecasting and community networks collaborating with city authorities are found.

alongside the struggles of city government, community groups and individuals for land rights, access to infrastructure and housing, inclusive decision-making and inclusive and ecologically sustainable economic growth. An integrated assessment of the impact of 1.5 °C is especially important for urban sSA. Here the vulnerability gap is so substantial that extensive, everyday risks and very small events can have a larger net erosive effect on households, than more concentrated, large catastrophic events [24]. This vulnerability gap and the high prevalence of everyday risks and small events (e.g. tidal flooding, seasonal waterlogging or chronic temperature/air pollution hazards) is a distinguishing characteristic of the region. 1.5 °C warming may make everyday risks and small events more widespread, more frequent or escalate these towards catastrophic impact. Each city and town will have its unique profile of emergent risk. However, for the region there is an opportunity to correct unmet development needs to contain everyday risk and so minimise risk accumulation. Climate change adaptation is being mainstreamed into urban planning where political will exists, for example in South Africa [25].

City risk and transition

This section presents an analysis of five expert assessments of contemporary and future risk under 1.5 °C, and highlights opportunities and constraints for risk management transition. Summary data can be found in the accompanying Supplementary Material file: city risk and transition. Assessments synthesise ongoing research undertaken as part of the Urban Africa: Risk Knowledge programme (www.urbanark.org).

Nairobi (inland) and Dar es Salaam (coastal) are large East African cities, but with diverse characteristics and capacities. Karonga is a small central/sub-Saharan African town experiencing rapid growth, but lacking a dedicated city authority and planning capacities. Dakar and Niamey are West African, Francophone cities. Dakar's position as a relatively stable city in the region has attracted international capital investment, prioritised above local environmental concerns. Niamey, amongst the poorest cities in sSA, is growing rapidly with immigration from unstable, drought-prone rural districts. In the Supplementary Material, the most critical climate-related risks are considered for each city. Climate risks are considered in relation to their key social driver(s), in the context of a 1.5 °C world, and with a note on current risk management capacity and key constraints to management.

The five cities offer similar profiles despite contrasting geography and demography. This demonstrates that for well-known hazards (e.g. flooding, landslides), existing infrastructure is inadequate for the poor majority, but that risk, adaptation and capacity gaps are at least visible. Emergent hazards, most importantly heat stress, are inadequately understood. Too often for all hazard types there is inadequate data collection and monitoring for loss, and the absence of both civil society champions and government agencies that 'own' the hazard. The gap in monitoring capability, civil society and policy leadership is especially the case for compound hazards such as heat stress combined with air quality linked to vehicle emissions, as observed in Dar es Salaam [26,27]. Several key constraints make difficult the transition towards development paths that can break cycles of risk accumulation. These include: rapid population growth, high rates of economic poverty, fragmented donor funding (that privileges physical infrastructure interventions over support for social policy and protection), and the complexity of city level governance (which masks responsibility and dilutes the leadership required for transition).

Governance innovations offer opportunities for transition. Each city reports awareness and will for change amongst urban planners and risk managers. For instance, in Dar es Salaam, the availability of data, including modeling for sea level rise, has helped to focus the attention of city planners and organised civil society on the tensions between relocation and upgrading in coastal, low-income settlements at risk. Nairobi and Karonga demonstrate existing opportunities to reform governance in both very large and very small urban centres. In Nairobi, organised civil society in collaboration with Nairobi City County have developed innovative approaches to the planning and upgrading of informal settlements. For example, in March 2017 Nairobi City County declared Mukuru informal settlement a Special Planning Area (SPA). This was a direct outcome of the recently formed collaborative approach to governing this area initiated by Akiba Mashinani Trust (AMT) (an SDI affiliate). The intent is to integrate risk management into securing land tenure and upgrading and redevelopment schemes through innovative multi-level governance, linking community members with both low and high levels of government. An approach that has included partnership with research programmes such as Urban Africa: Risk Knowledge (www.urbanark.org). This is a notable transition in state-civil society relations in Nairobi and could serve as a catalyst for similar shifts in governance relations across sSA. Multi-level governance has been observed in other cities and is an important trend in decision-making that can reduce risk in advance of 1.5 degrees. Where multi-level governance is yet to emerge strongly (e.g. Dakar and Niamey), civil society often remains fragmented and city decision-making is characterized by top-down concerns overriding local risk management priorities, rooted in addressing everyday development failures. Karonga illustrates the importance of relations between traditional tribal chiefs and regional authorities for opening discussions on risk management, presenting a small-town version of multi-level governance. Discussions focus on the potential for more decentralised planning systems potentially more sensitive to local priorities while leveraging strategic funds (e.g. for local flood protection measures).

The following section explores the centrality of multi-level governance in the context of an approaching 1.5 °C warming through a synthesis of literature on Lagos.

Transition prospects for Lagos, Nigeria

This Lagos study draws from a multi-city analysis of capacities for transition in risk management towards more equitable and sustainable futures by mid-century (www.truc.org). Lagos, a city estimated to have 13–21 million people [28] is exposed to frequent and intense rainfall, heatwaves, storm surges, coastal flooding and a predicted 1.5 m sea level rise (SLR) by the end of the century [29]. Lagos faces high and uneven levels of vulnerability rooted in an industrial development trajectory, macroeconomic fragility, ecological deterioration, population growth, mass poverty, and a high exposure to climate-related hazards [30•], with women particularly at risk [31]. Under a 1.5 °C global climate, temperature could exacerbate local air pollution and heighten heat-related morbidity and mortality. Additional SLR would increase erosion and inundation, posing serious risks to infrastructure, industries, and the lives and livelihoods of over 6 million people along the coast [29,32]. Furthermore, frequent storm surges and increased coastal erosion could lead to the salinization of agricultural lands and freshwater affecting food security [33].

The contemporary risk management regime in Lagos is insufficient for dealing with these future risks [30•]. In the past two decades, risk-management efforts have been directed at protecting properties and other physical assets and not at addressing underlying drivers of exposure and vulnerability — these include rapid urbanization, rural–urban migration, high social inequality, poor waste-management and inadequate physical planning and land-use (especially investment-driven land reclamation in flood prone-areas) [34]. Between 2007 and 2015, the Fashola regime initiated a 'green' policy agenda that included city beautification, environmental protection, waste management, climate change adaptation and mitigation, and disaster risk reduction. Critics of the programme claim its success distracted planners from a more far-reaching and socially progressive agenda of change that could have enabled effective and equitable land use development and planning, balanced migration, reduced poverty, reduced risk of flooding, and sustainable development [30•]. The difficulty in transitioning towards a more development-oriented risk management strategy was compounded by weak governance institutions, partisan politics, lack of political will among city officials, economic instability, systemic corruption, and a lack of data on development parameters and hazard patterns to support inclusive and evidence based planning and the appropriate use of available technology [30,35•].

Conclusion

The city transition case studies highlight critical climate-related risks in the diverse urban centres of Dar es Salaam, Nairobi, Niamey, Dakar and Karonga. The snapshots reveal diverse risks which are likely to be exacerbated by 1.5 °C warming, yet risk responses and institutional transformation to cope with the new challenges remain inadequate. These assessments revealed systemic vulnerability gaps existing in the cities of sSA that will be exacerbated by a 1.5 °C warming, but also emphasised several emerging opportunities and initiatives for tackling the challenges. The more detailed Lagos example demonstrated the importance of an increased rule-of-law and for rigorous administrative procedures at the heart of any risk management transition.

The pressures on urban governance in urbanizing regions across Africa will grow under a 1.5 °C scenario. This challenge has been increasingly highlighted for the sSA region where research on urban disaster risk and climate change has begun to chart gaps in formal governance capacities, knowledge communities and data and monitoring capacities, though it has also highlighted opportunities (see for e.g. [16,25,36,37]). Drawing from insights across parallel policy domains, transitions theory emphasizes change being connected to innovation in relationships between governance actors. For risk reduction in sSA the emergence of multi-level governance arrangements, where strong networked civil society organisations act in concert with local and city authorities, provides a specific opportunity for risk reduction. These lessons reveal practical and achievable mechanisms through which reducing risk can also help meet SDG targets.

Conflicts of interest statement

None.

Acknowledgements

Funding: This work was supported by the Belmont Forum project *Transformation and Resilience on Urban Coasts* (NE/L008971/1) and the UK Department for International Development and Economic and Social Research Council grant *Urban Africa: Risk Knowledge* (ES/L008777/1).

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at https://doi.org/10.1016/j.plantsci.2004.08.011.

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. Fohlmeister S, Pauleit S, Coly A, Touré H, Yeshitela K: **The way forward: climate resilient cities for Africa's future**. In *Urban Vulnerability and Climate Change in Africa.* Edited by Pauleit S, Jorgensen G, Kabisch S, Gasparini P, Fohlmeister S, Simonis I, Yeshitela K, Coly A, Lindley S, Kombe WJ. Berlin: Springer; 2014:369-399. (chapter 12).

2. Revi A, Satterthwaite D, Aragón-Durand F, Corfee-Morlot J, Kiunsi R, Pelling M, Roberts D, Solecki W, Pahwa Gajjar S, Sverdlik A: **Towards transformative adaptation in cities: the IPCC's Fifth Assessment**. *Environ Urban* 2014, **15**:11-28.

3. Roberts D: **The new climate calculus: 1.5 °C = Paris agreement, cities, local government, science and champions (PLSC2)**. *Urbanisation* 2016, **1**:71-78.

4. Oni T, Smit W, Matzopoulos R, Adams JH, Pentecost M, Rother HA, Albertyn Z, Behroozi F, Alaba O, Kaba M, van der Westhuizen C: **Urban health research in africa: themes and priority research questions**. *J Urban Health* 2016, **93**:722-730.

5. Watts N, Adger WN, Agnolucci P, Blackstock J, Byass P, Cai W, Cox PM: **Health and climate change: policy responses to protect public health**. *Lancet* 2015, **386**:1861-1914.

6. Adelekan I, Johnson C, Manda M, Matyas D, Mberu BU, Parnell S, Pelling M, Satterthwaite D, Vivekananda J: **Disaster risk and its reduction: an agenda for urban Africa**. *Int Dev Plan Rev* 2015, **37**:33-43.

7. Pasquini L, Cowling RM, Ziervogel G: **Facing the heat: barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa**. *Habitat Int* 2013, **40**:225-232.

8. Adu-Boateng A: **Barriers to climate change policy responses for urban areas: a study of Tamale Metropolitan Assembly, Ghana**. *Curr Opin Environ Sustain* 2015, **13**:49-57.

9. Vedeld T, Coly A, Ndour NM, Hellevik S: **Climate adaptation at what scale? Multi-level governance, resilience, and coproduction in Saint Louis, Senegal**. *Nat Hazards* 2016, **82**:173-199.

10. Wisner B, Pelling M, Mascarenhas A, Holloway A, Ndong B, Simon D, Faye P, Ribot J: **Small Cities in Africa: the challenge and opportunity of climate change**. In *Urban Vulnerability and Climate Change in Africa.* Edited by Pauleit S, Jorgensen G, Kabisch S, Gasparini P, Fohlmeister S, Simonis I, Yeshitela K, Coly A, Lindley S, Kombe WJ. Berlin: Springer; 2014.

11. Solecki W, Pelling M, Garschagen M: **Transitions between risk management regimes in cities**. *Ecol Soc* 2017, **22**:38.

12. Fraser A, Leck H, Parnell S, Pelling M, Brown D, Lwasa S: **Meeting the challenge of risk-sensitive and resilient urban development in sub-Saharan Africa: directions for future research and practice**. *Int J Disaster Risk Reduct* 2017.

13. Pelling M, Abeling T, Garschagen M: **Emergence and transition in london's climate change adaptation pathways**. *J Extreme Events* 2017, **3** http://dx.doi.org/10.1142/S2345737616500093.

14. Makau J, Dobson S, Samia E: **The five-city enumeration: the role of participatory enumerations in developing community capacity and partnerships with government in Uganda**. *Environ Urban* 2012, **24**:31-46.

15. Jones RN, Preston BL: **Adaptation and risk management**. *Wiley Interdiscip Rev: Climate Change* 2011, **2**:296-308.

16. • Carmin J, Anguelovski I, Roberts D: **Urban climate adaptation in the Global South: planning in an emerging policy domain**. *J Plan Educ Res* 2012, **32**:18-32.
Drawing on institutional theory and case study research the article examines the development of adaptation planning in two cities of the global south: Durban and Quito. Highlights the importance of taking advantage of windows of opportunity and creatively linking new agendas to existing goals, plans, and programs.

17. •• Ziervogel G, Pelling M, Cartwright A, Chu E, Deshpande T, Harris L, Hyams K, Kaunda J, Klaus B, Michael K, Pasquini L, Pharoah R, Rodina L, Scott D, Zweig P: **Inserting rights and justice into urban resilience: a focus on everyday risk**. *Environ Urban* 2017, **29**:123-138.
Discusses resilience as a negotiated product of governance and considers how far human rights discourses are involved in these negotiations to date.

18. WHO: *Improving Public Health Responses to Extreme Weather Heat-Waves, EuroHeat*. Copenhagen: WHO Regional Office for Europe; 2009.

19. Kjellstrom T, Butler AJ, Lucas RM, Bonita R: **Public health impact of global heating due to climate change: potential effects on chronic non-communicable diseases**. *Int J Public Health* 2010, **2**:97-103.

20. Simatele D, Simatele M: **Climate variability and urban food security in sub-Saharan Africa: lessons from Zambia using an asset-based adaptation framework**. *S Afr Geogr J* 2015, **3**:243-263.

21. •• Parnell S, Walawege R: **Sub-Saharan African urbanisation and global environmental change**. *Glob Environ Change* 2011, **21**: S12-S20.
Drawing on demographic data the paper considers the significant of global environmental change (GEC) for poorly managed African urban areas and suggests that research be redirected from migration to the interface between GEC and urban areas.

22. • Pelling M: *Adaptation to Climate Change: From Resilience to Transformation*. Routledge; 2010.
Seminal book which develops a resilience–transition–transformation framework, supported by detailed case study chapters.

23. OECD: *African Economic Outlook 2016, Paris*. 2016.

24. UN-ISDR: *Global Assessment Report on Disaster Risk Reduction*. Geneva: ISDR; 2013.

25. Pasquini L, Ziervogel G, Cowling RM, Shearing C: **What enables local governments to mainstream climate change adaptation? Lessons learned from two municipal case studies in the Western Cape, South Africa**. *Climate Dev* 2015, **1**:60-70.

26. Ndetto EL, Matzarakis A: **Urban atmospheric environment and human biometeorological studies in Dar es Salaam, Tanzania**. *Air Qual Atmos Health* 2015, **8**:175-191.

27. Ndetto EL, Matzarakis A: **Basic analysis of climate and urban bioclimate of Dar es Salaam, Tanzania**. *Theor Appl Climatol* 2013, **114**:213-226.

28. World Population Review: Lagos Population 2017. Available at: http://worldpopulationreview.com/world-cities/lagos-population/; 2017.

29. Rosenzweig C, Solecki WD, Hammer SA, Mehrotra S (Eds): *Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network*. Cambridge University Press; 2011.

30. • Ajibade J, Agboola J, Pelling M: **Sustainability transitions: exploring risk management and the future of adaptation in Lagos**. *J Extreme Events* 2017, **3**:1-25.
Analyses development and risk management governance in Lagos.

31. Ajibade I, McBean G, Bezner-Kerr R: **Urban flooding in Lagos, Nigeria: patterns of vulnerability and resilience among women**. *Glob Environ Change* 2013, **6**:1714-1725.

32. Awosika LF, Dublin-Green CO, Folorunsho R, Adekoya EA, Adekanmbi MA, Jim-Saiki J: **Study of main drainage channels of Victoria and Ikoyi Islands in Lagos Nigeria and their response to tidal and sea level changes**. *CSI-UNESCO Spec Rep* 2000.

33. Major D, Omojola A, Dettinger M, Hanson R, Sanchez-Rodriguez R: **Climate change, water, and waste water in cities**. In *Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network.* Edited by Rosenzweig C, Solecki WD, Hammer SA, Mehrota S. UK: Cambridge University Press; 2011:113-143.

34. French G, Awosika L, Ibe C: **Sea-level rise and Nigeria: potential impacts and con-sequences**. *J Coastal Res* 1994:14. Special Issue.

35. • Ajibade I, McBean G: **Climate extremes and housing rights: a political ecology of impacts, early warning and adaptation constraints in Lagos slum communities**. *Geoforum* 2014, **55**:76-78.
Analyses political and social constraints on adaptation in Lagos and through the lens of political ecology sheds light on diverse challenges to early warning and adaptation in the city.

36. Ricci L, Sanou B, Baguian H: **Climate risks in West Africa: Bobo-Dioulasso local actors' participatory risks management framework**. *Curr Opin Environ Sustain* 2015, **13**:42-48.

37. Leck H, Roberts D: **What lies beneath: understanding the invisible aspects of municipal climate change governance**. *Curr Opin Environ Sustain* 2015, **13**:61-67.