From Pixels to Practice: Bridging Urban Remote Sensing with Urban Decision-Making

Karen C. Seto

Frederick C. Hixon Professor of Geography & Urbanization Science
Co-Director, Yale Center for Geospatial Solutions
Director, Yale Hixon Center for Urban Sustainability

Coordinating Lead Author, IPCC 6th Assessment Report (2022)
Coordinating Lead Author, IPCC 5th Assessment Report (2014)

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<u>Decision IPCC-LXI- 5</u>. Seventh assessment report (AR7) products – Outline of the Special Report on Climate Change and Cities

Document: IPCC-LXI/Doc. 2, Rev. 1

The Intergovernmental Panel on Climate Change at its Sixty-first Session decides:

(1) to agree on the outline of the Special Report on Climate Change and Cities as contained in Annex 1 to this document.

<u>Decision IPCC-LXI- 5</u>. Seventh assessment report (AR7) products – Outline of the Special Report on Climate Change and Cities

Document: IPCC-LXI/Doc. 2, Rev. 1

The Intergovernmental Panel on Climate Change at its Sixty-first Session decides:

(2) that the time schedule for the production of the Special Report is as follows:

9 August – 20 September 2024	Call for nominations of authors
23 September – 19 December	Selection of authors
10–15 March 2025	First Lead Author Meeting
21–25 July 2025	Second Lead Author Meeting
17 October – 12 December 2025	Expert Review of the First Order Draft
12–16 January 2026	Third Lead Author Meeting
8 May – 3 July 2026	Government and Expert Review of the Second Order Draft
3–7 August 2026	Fourth Lead Author Meeting
11 December 2026 – 5 February 2027	Final Government Distribution of the Final Draft and Government Review of the Summary for Policymakers
15–19 March 2027	Approval of the Summary for Policymakers and acceptance of the Special Report

Established in 1988 by the WMO & UNEP

- Assess scientific literature on climate change

Purpose of IPCC Reports

- Provide scientific basis for governments to develop climate-related policies
- Support UN Framework Convention on Climate Change (UNFCCC)
- Inform international climate negotiations

Purpose of IPCC Reports

- Help establish emissions reductions targets and temperature limits for international climate negotiations

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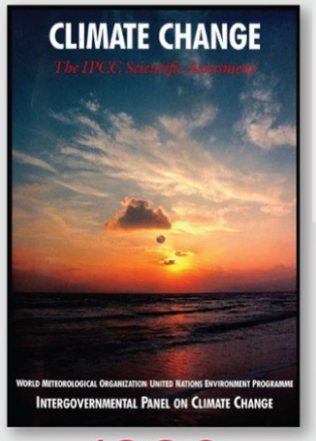
The Physical Science Basis	Impacts, Adaptation, and Vulnerability	Mitigation of Climate Change	
TSU	TSU	TSU	TSU

Authors, Contributors, Reviewers

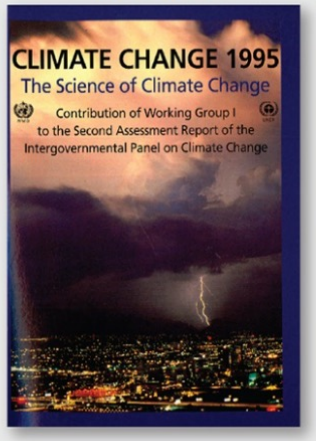


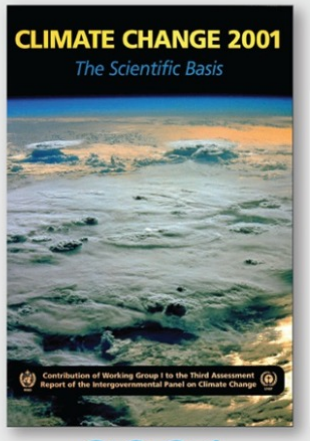
1990

AR1

AR2

1995



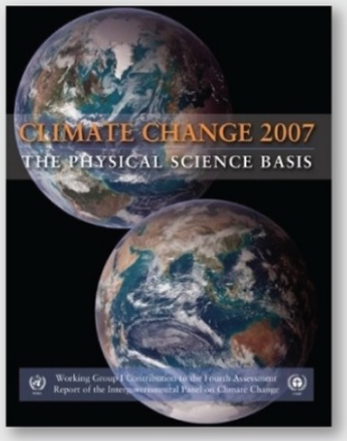


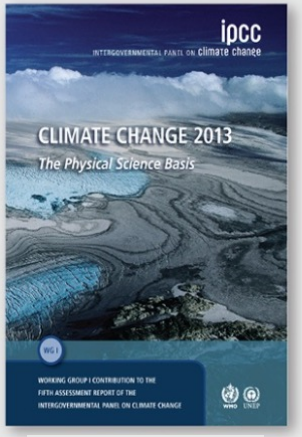
2001

AR3

AR4

2007



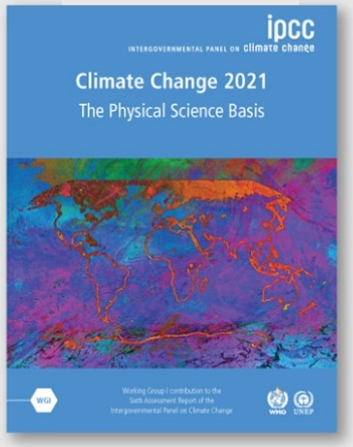


2013-14

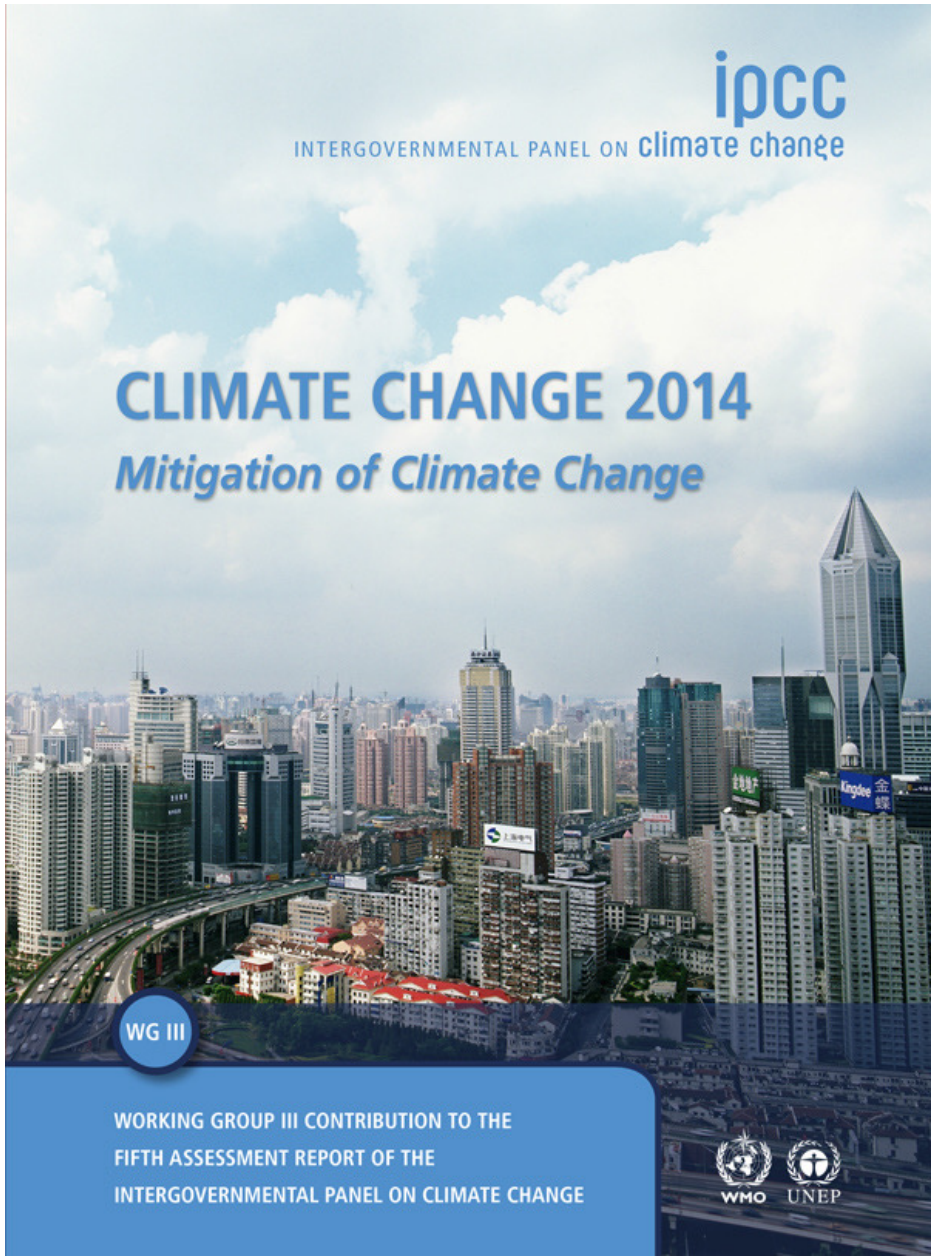
AR5

AR6

2021-22



IPCC AR5 (2014): First standalone chapter on urban mitigation



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Human Settlements, Infrastructure, and Spatial Planning

Coordinating Lead Authors:
Karen C. Seto (USA), Shobhakar Dhakal (Nepal/Thailand)

Lead Authors:
Anthony Bigio (Italy/USA), Hilda Blanco (USA), Gian Carlo Delgado (Mexico), David Dewar (South Africa), Luxin Huang (China), Atsushi Inaba (Japan), Arun Kansal (India), Shuaib Lwasa (Uganda), James McMahon (USA), Daniel B. Müller (Switzerland/Norway), Jin Murakami (Japan/China), Harini Nagendra (India), Anu Ramaswami (USA)

Contributing Authors:
Antonio Bento (Portugal/USA), Michele Betsill (USA), Harriet Bulkeley (UK), Abel Chavez (USA/Germany), Peter Christensen (USA), Felix Creutzig (Germany), Michail Fragkias (Greece/USA), Burak Güneralp (Turkey/USA), Leiwen Jiang (China/USA), Peter Marcotullio (USA), David McCollum (IIASA/USA), Adam Millard-Ball (UK/USA), Paul Pichler (Germany), Serge Salat (France), Cecilia Tacoli (UK/Italy), Helga Weisz (Germany), Timm Zwickel (Germany)

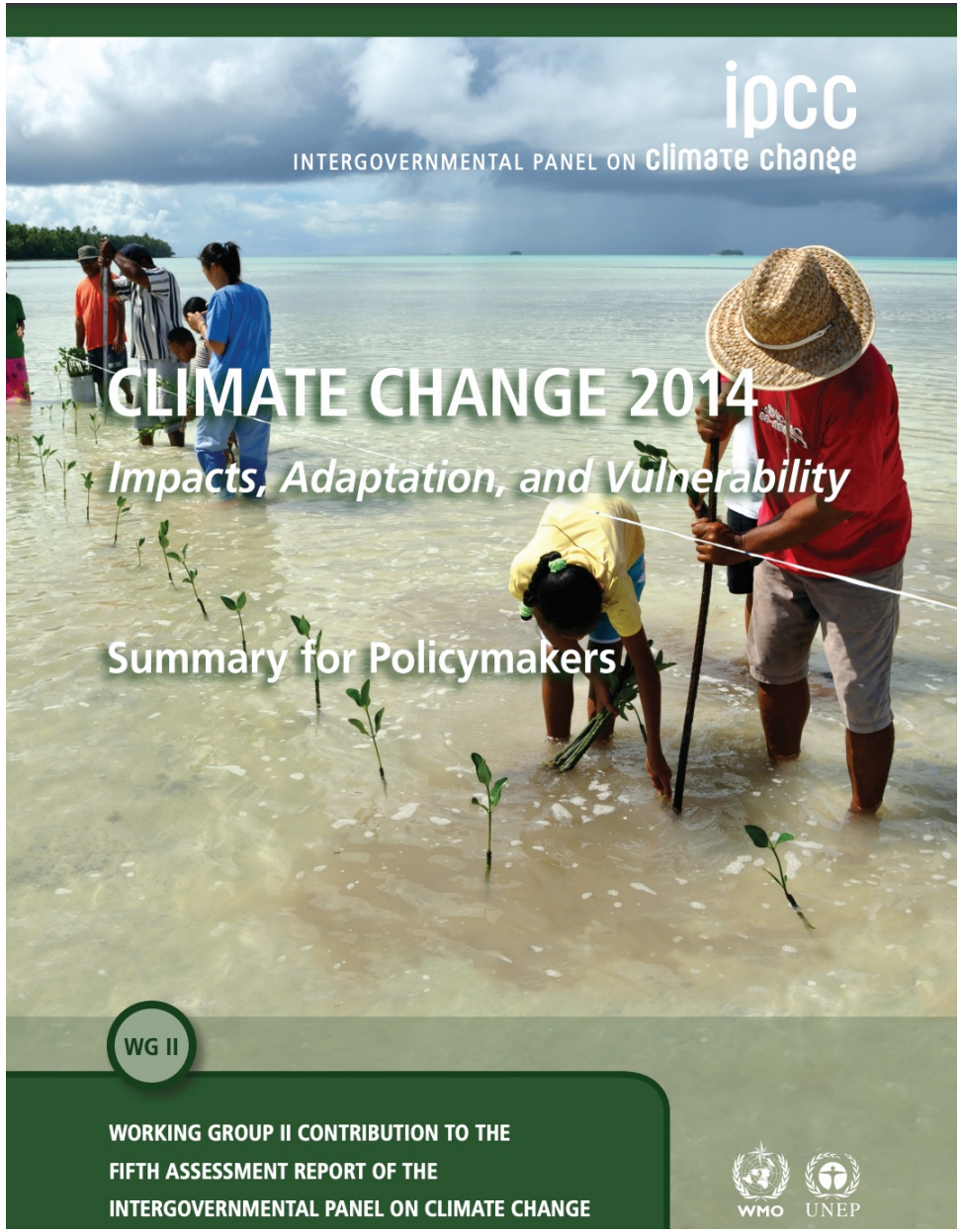
Review Editors:
Robert Cervero (USA), Julio Torres Martinez (Cuba)

Chapter Science Assistants:
Peter Christensen (USA), Cary Simmons (USA)

This chapter should be cited as:

Seto K.C., S. Dhakal, A. Bigio, H. Blanco, G.C. Delgado, D. Dewar, L. Huang, A. Inaba, A. Kansal, S. Lwasa, J.E. McMahon, D.B. Müller, J. Murakami, H. Nagendra, and A. Ramaswami, 2014: Human Settlements, Infrastructure and Spatial Planning. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

…and standalone chapter on urban adaptation



8

Urban Areas

Coordinating Lead Authors:
Aromar Revi (India), David E. Satterthwaite (UK)

Lead Authors:
Fernando Aragón-Durand (Mexico), Jan Corfee-Morlot (USA/OECD), Robert B.R. Kiunsi (United Republic of Tanzania), Mark Pelling (UK), Debra C. Roberts (South Africa), William Solecki (USA)

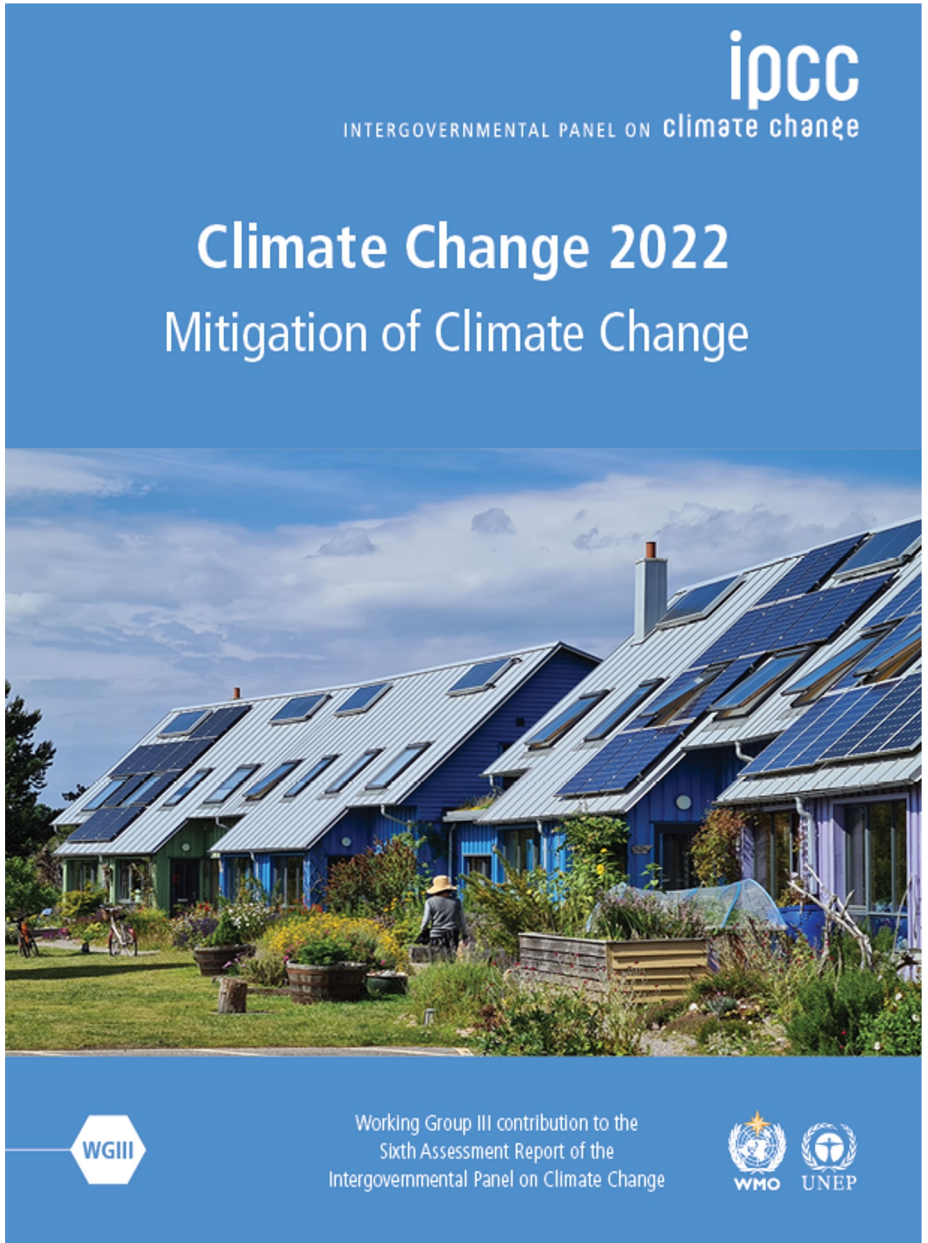
Contributing Authors:
Jo da Silva (UK), David Dodman (Jamaica), Andrew Maskrey (UK), Sumetee Pahwa Gajjar (India), Raf Tuts (Belgium)

Review Editors:
John Balbus (USA), Omar-Dario Cardona (Colombia)

Volunteer Chapter Scientist:
Alice Sverdlik (USA)

This chapter should be cited as:
Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, and W. Solecki, 2014: Urban areas. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 535-612.

IPCC AR6 (2022): More focus on urban in all 3 WGs



8

Urban Systems and Other Settlements

Coordinating Lead Authors:
Shuaib Lwasa (Uganda), Karen C. Seto (the United States of America)

Lead Authors:
Xuemei Bai (Australia), Hilda Blanco (the United States of America), Kevin R. Gurney (the United States of America), Şiir Kılkış (Turkey), Oswaldo Lucon (Brazil), Jin Murakami (Japan), Jiahua Pan (China), Ayyoob Sharifi (Japan/Iran), Yoshiki Yamagata (Japan)

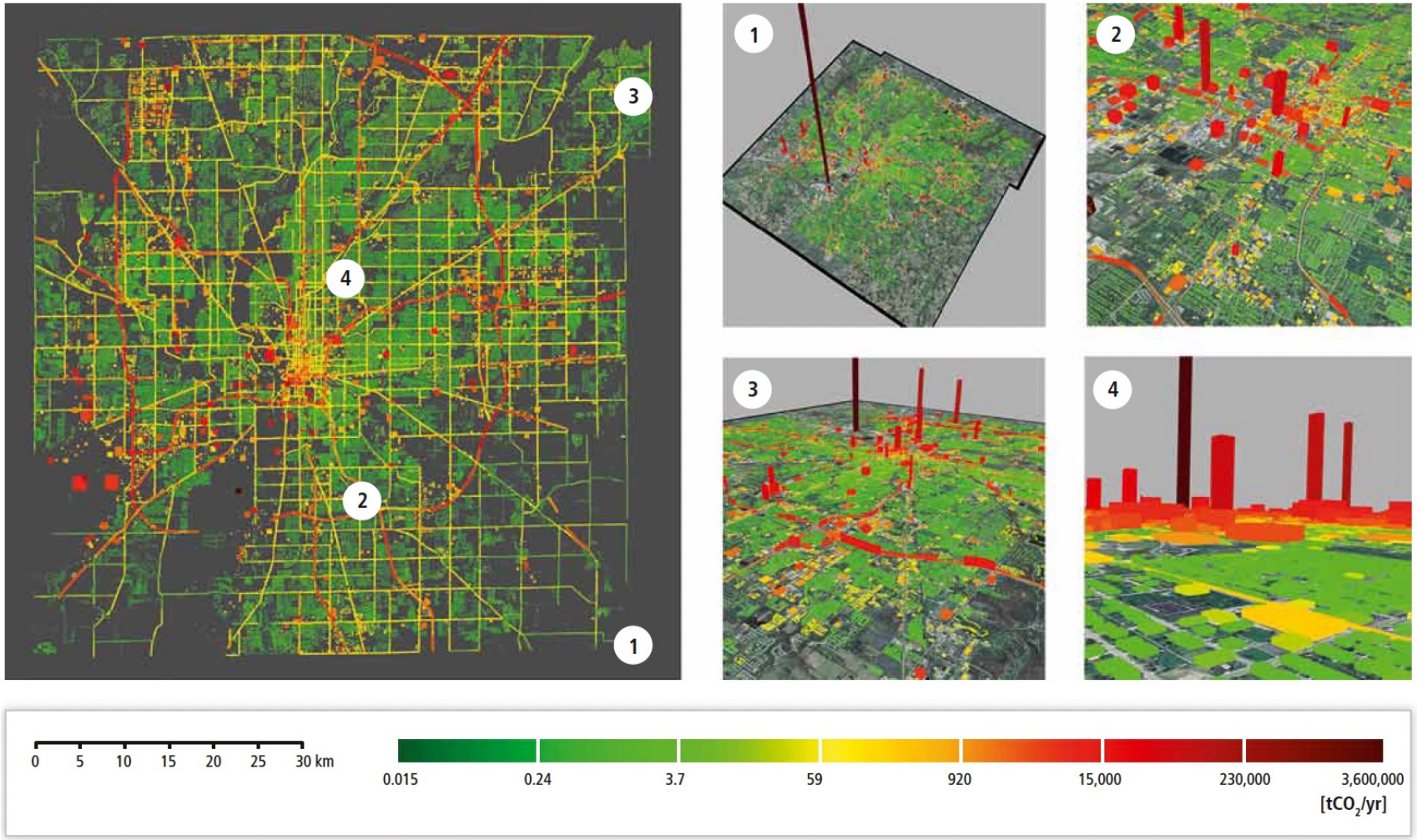
Contributing Authors:
Vanesa Castán Broto (United Kingdom/Spain), Winston Chow (Singapore), Galina Churkina (the Russian Federation/Germany), Felix Creutzig (Germany), David Dodman (Jamaica/United Kingdom), Burak Güneralp (Turkey/the United States of America), Rafiq Hamdi (Belgium), Bronwyn Hayward (New Zealand), Angel Hsu (the United States of America/Singapore), Lucy Hutyra (the United States of America), Nadja Kabisch (Germany), Meredith Keller (the United States of America), Timon McPhearson (the United States of America), Peter Newman (Australia), David Nowak (the United States of America), Alan Organschi (the United States of America), Minal Pathak (India), Mark Pelling (United Kingdom), Clara Pregitzer (the United States of America), Anu Ramaswami (the United States of America), Mia Reback (the United States of America), Diana Reckien (Germany), Jen Shin (the United States of America), Michael Westphal (the United States of America), Lee White (Australia)

Review Editors:
Carolina Burle Schmidt Dubeux (Brazil), Diana Ürge-Vorsatz (Hungary)

Chapter Scientists:
Meredith Keller (the United States of America), Enock Ssekuubwa (Uganda)

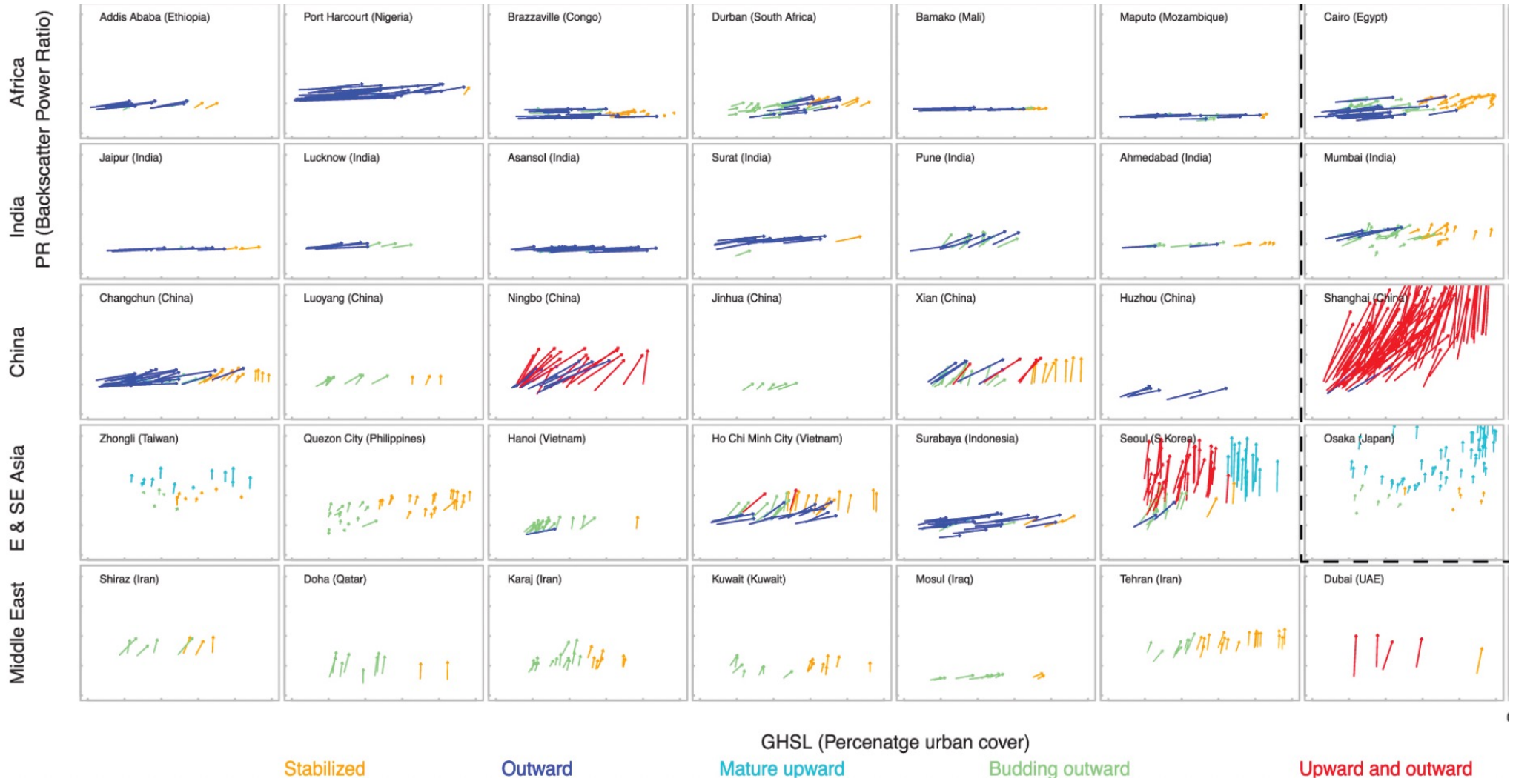
This chapter should be cited as:
Lwasa, S., K.C. Seto, X. Bai, H. Blanco, K.R. Gurney, Ş. Kılkış, O. Lucon, J. Murakami, J. Pan, A. Sharifi, Y. Yamagata, 2022: Urban systems and other settlements. In IPCC, 2022: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.010

EO have informed IPCC Assessment Reports: *Urban emissions*



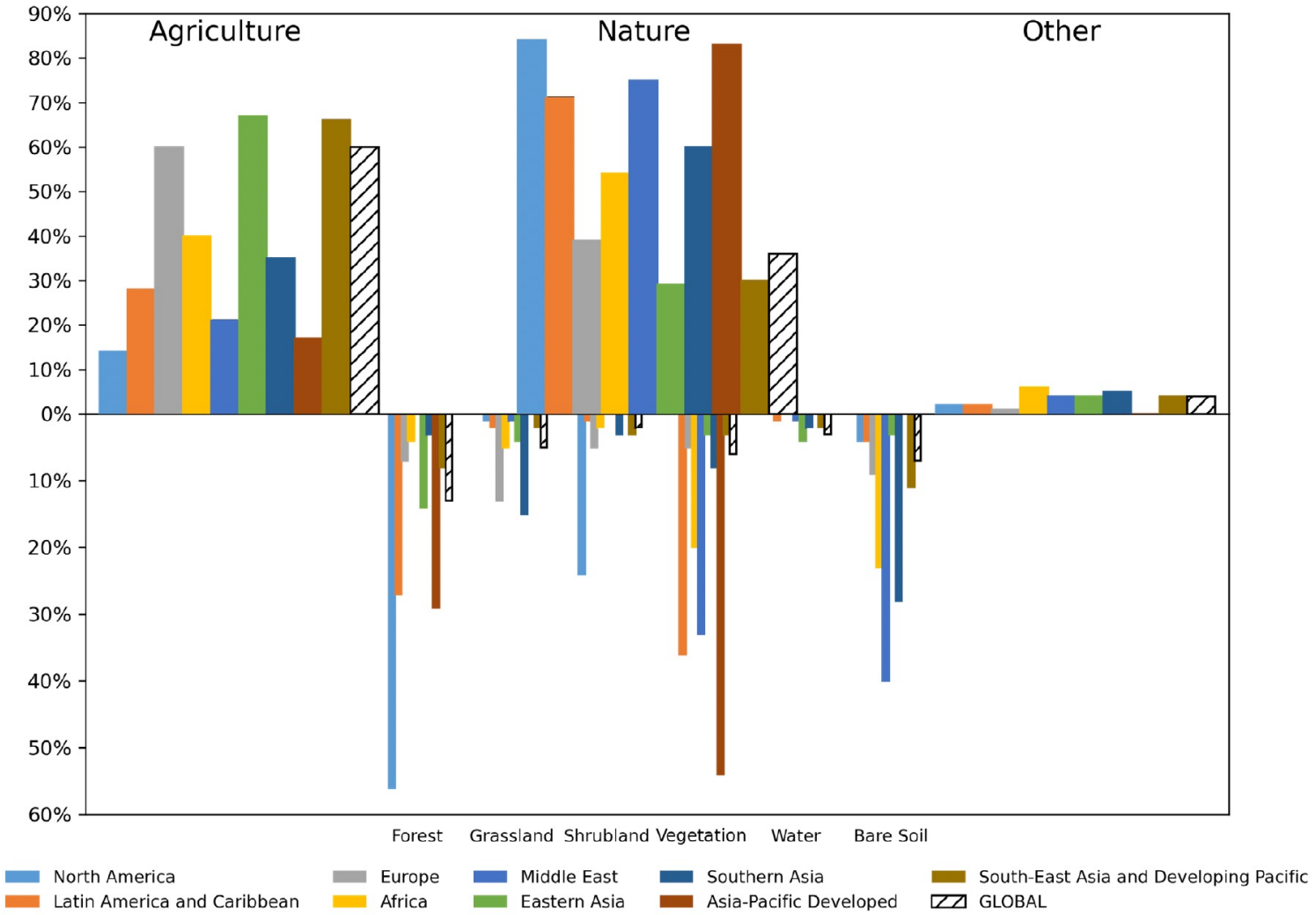
IPCC AR5, 2014; adapted from Gurney et al., 2012

EO have informed IPCC Assessment Reports: *Typologies of urban growth*



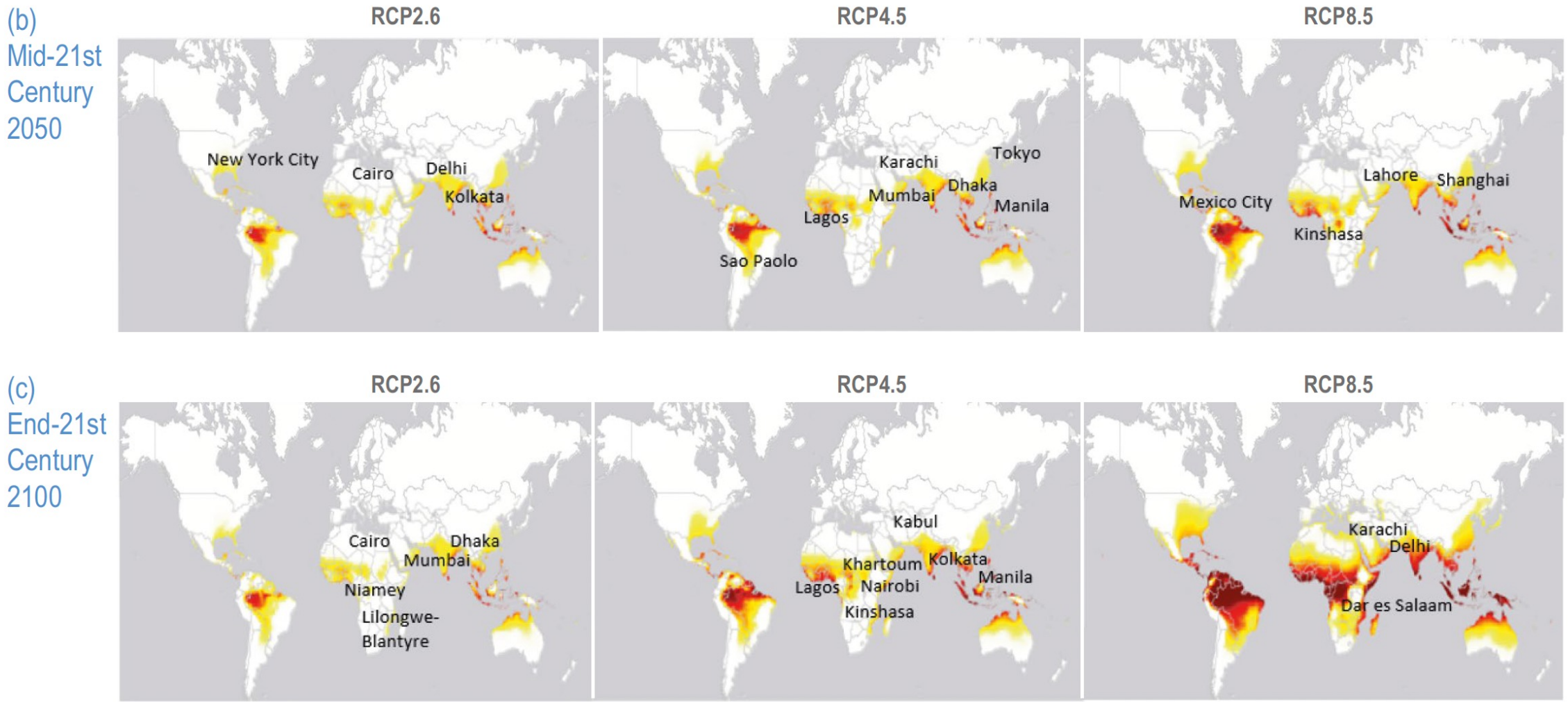
IPCC AR6, 2022; adapted from Mahtta et al., 2019

EO have informed IPCC Assessment Reports:
Urban expansion and land cover change



IPCC AR6, 2022; adapted from Guneralp et al., 2020

EO have informed IPCC Assessment Reports:
Future populations exposed to extreme heat



IPCC AR6, 2022; adapted from Mora et al., 2017

Approved Outline

Chapter 1: Cities in the context of climate change

Chapter 2: Cities in a changing climate: trends, challenges and opportunities

Chapter 3: Actions and solutions to reduce urban risks and emissions

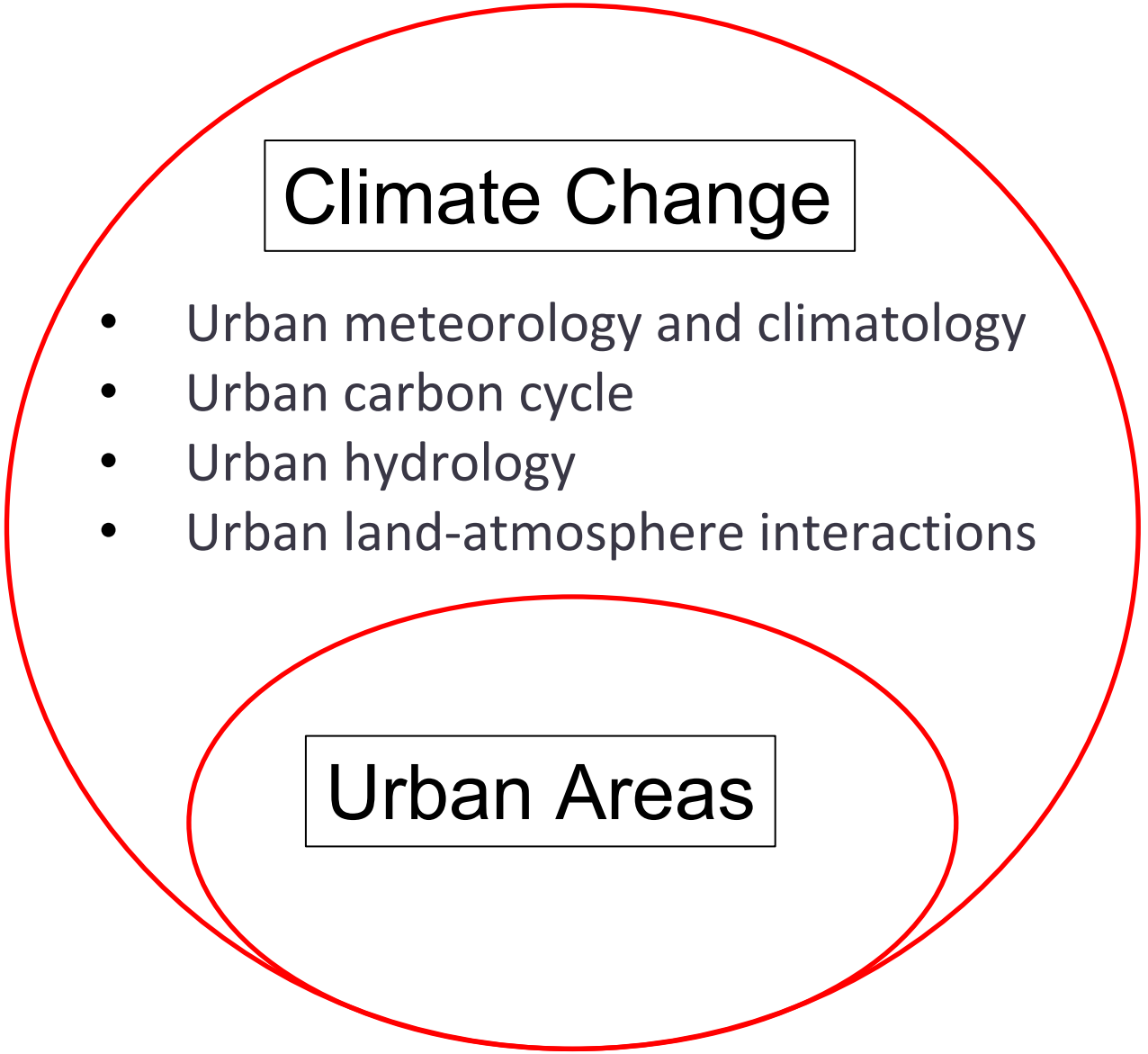
Chapter 4: How to facilitate and accelerate change

Chapter 5: Solutions by city types and regions

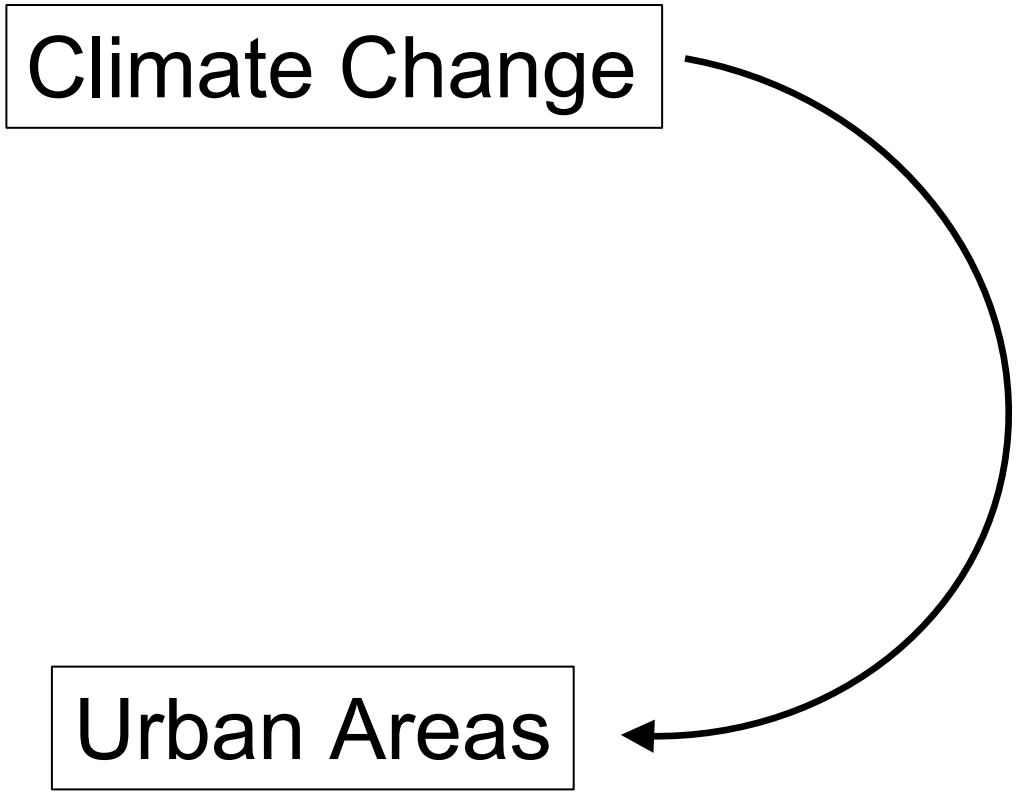
Major knowledge gaps

Knowledge that is comparable across spatial scales and regions while remaining meaningful at the local scale

The Physical Science Basis



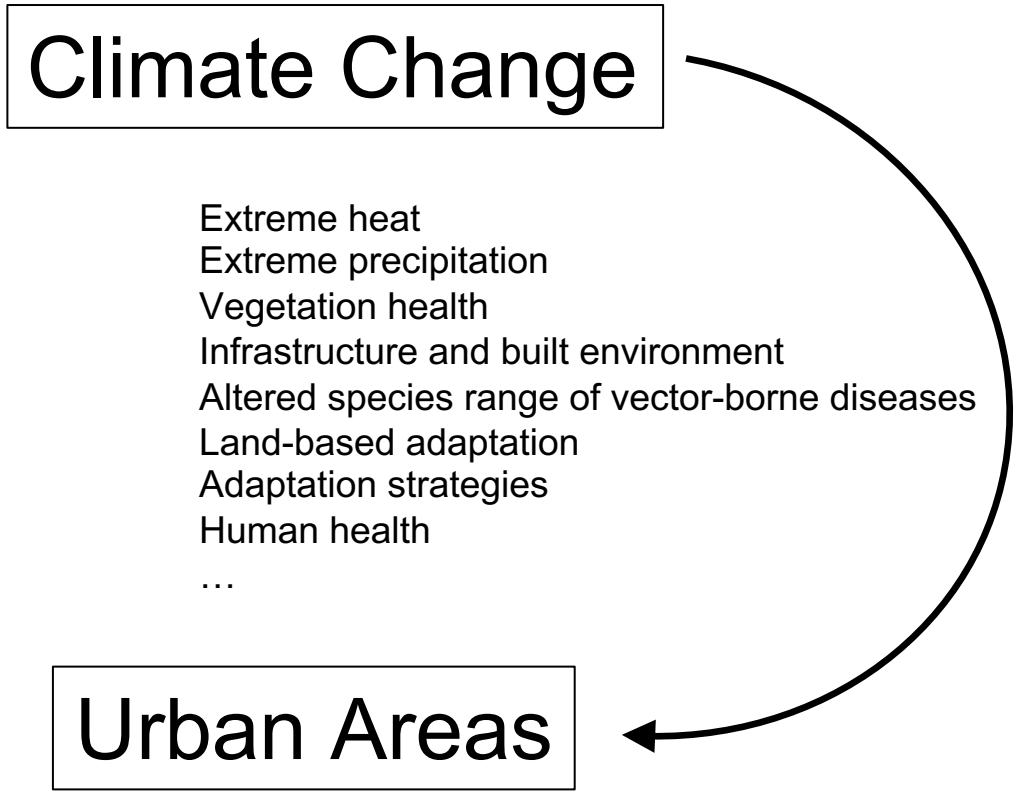
Impacts, Adaptation, and Vulnerability



Impacts and Risks, including

1. **Economic and Non-Economic Losses and Damages**
2. **Compounding and Cascading Aspects**

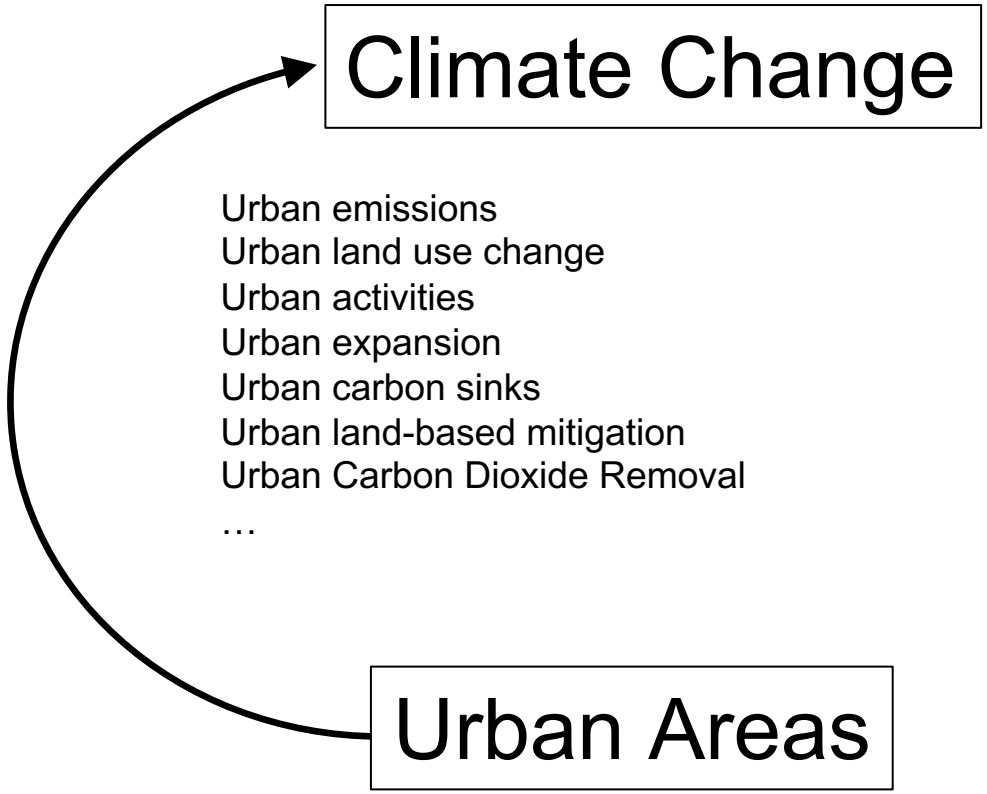
Impacts, Adaptation, and Vulnerability



Impacts and Risks, including

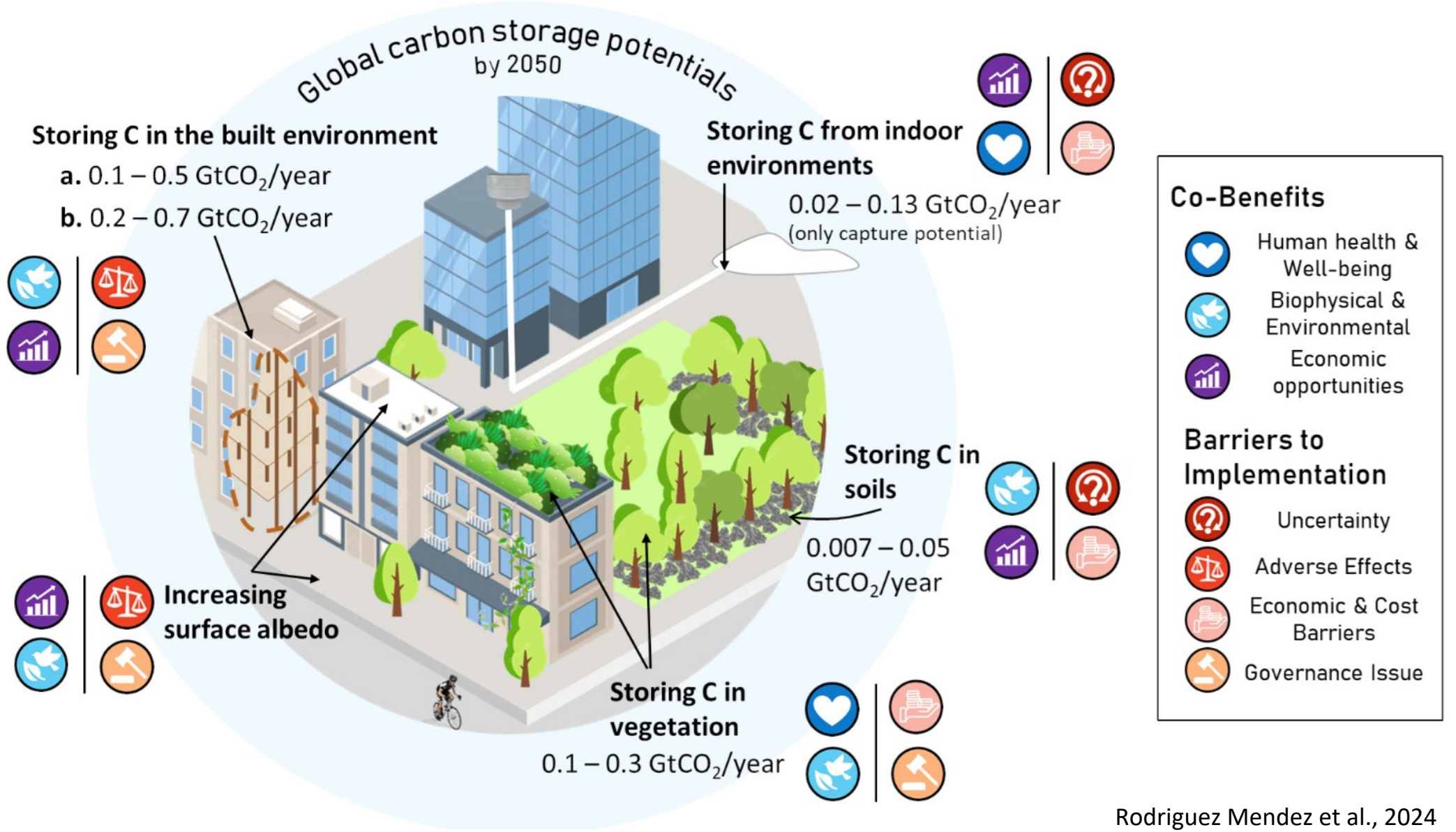
1. **Economic and Non-Economic Losses and Damages**
2. **Compounding and Cascading Aspects**

Mitigation of Climate Change



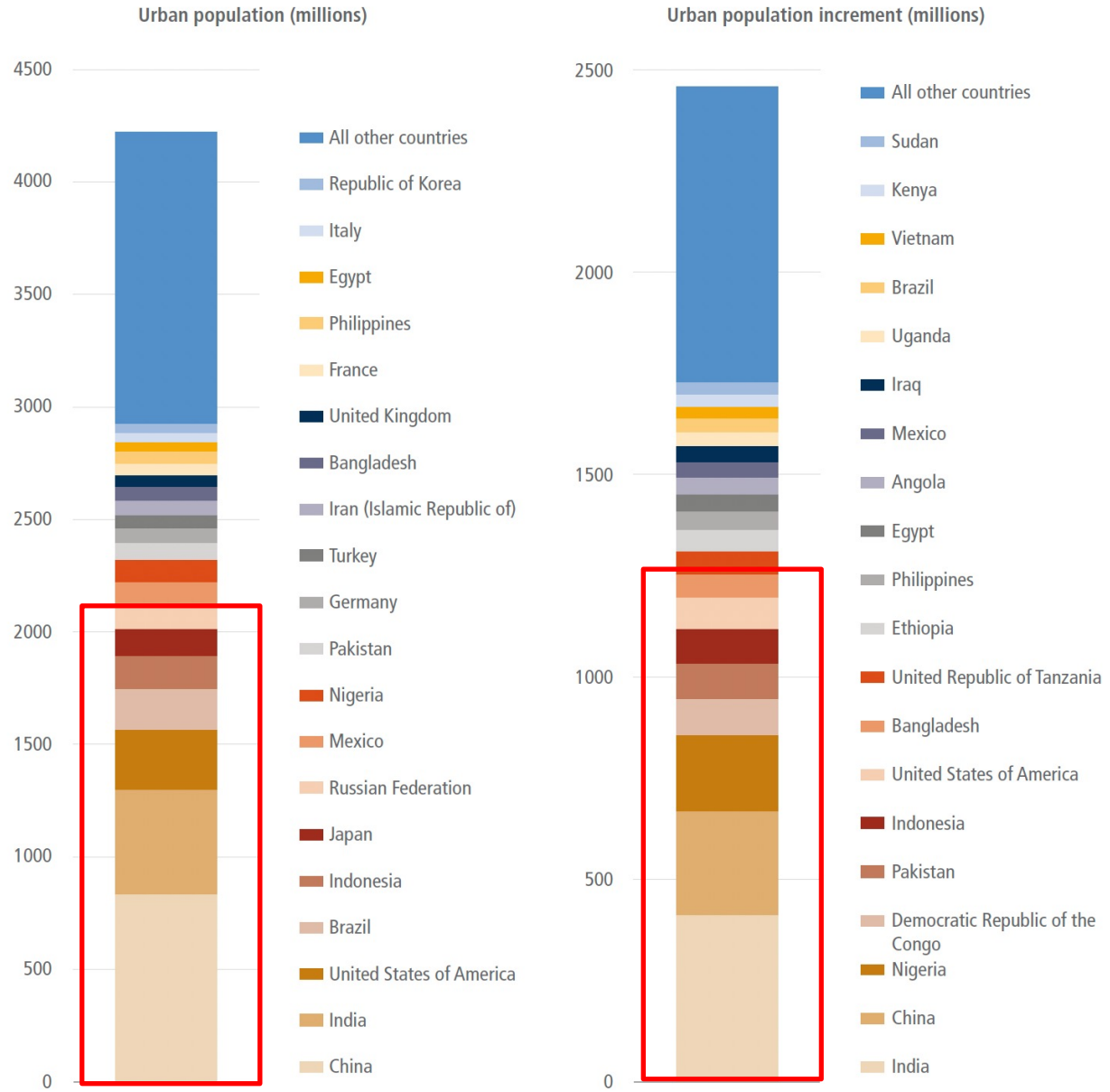
Urban Energy and Emissions, Mitigation Options

Urban Carbon Dioxide Removal (CDR)



Rodriguez Mendez et al., 2024

Information for cities across income levels and sizes especially in the GS



2018

2050

IPCC AR6, 2022

Intra- and inter urban variability

Informality

Blue and Green Infrastructure

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Look out for the various cut off dates for literature for the different reports.

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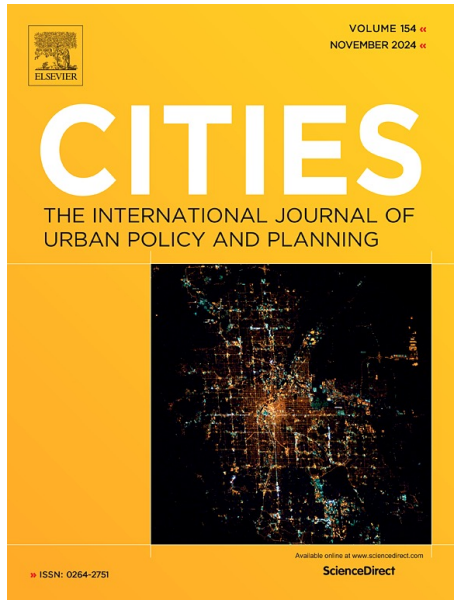

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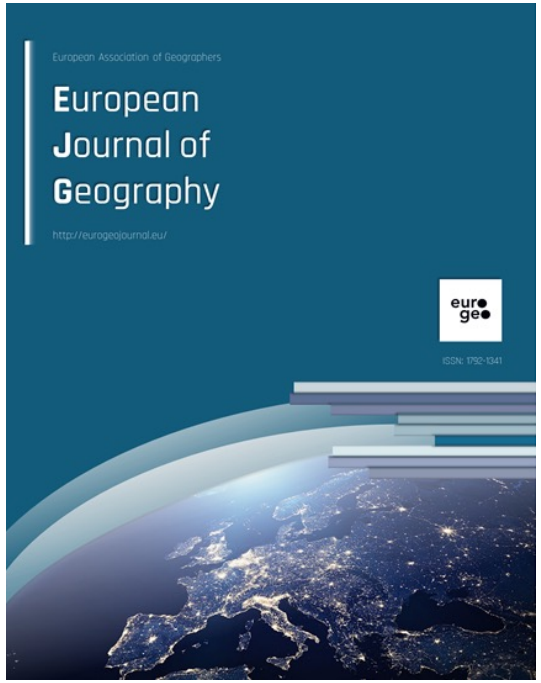

Enriching Urban Residents' Low-Carbon Lifestyle Choices Through Interdisciplinary Approaches

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Sage Urbanisation

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ADVANCES IN CLIMATE CHANGE RESEARCH

Special Issue on Cities and Climate Change

Published 08 December 2023

Meta-Analyses

SCIENTIFIC REPORTS

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Meta-analysis of urbanization impact on rainfall modification

Jie Liu[1,2] & Dev Niyogi[1,3]

Received: 7 June 2018
Accepted: 28 March 2019
Published online: 13 May 2019

Even though it is known that urbanization affects rainfall, studies vary regarding the magnitude and location of rainfall change. To develop a comprehensive understanding of rainfall modification due to urbanization, a systematic meta-analysis is undertaken. The initial search identified over 2000 papers of which 489 were carefully analyzed. From these papers, 85 studies from 48 papers could be used in a quantitative meta-analysis assessment. Results were analyzed for case studies versus climatological assessments, observational versus modeling studies and for day versus night. Results highlight that urbanization modifies rainfall, such that mean precipitation is enhanced by 18% downwind of the city, 16% over the city, 2% on the left and 4% on the right with respect to the storm direction. The rainfall d approximately 20–50 km from the city center. Study results help develop a e of the role of urban processes in rainfall modification and highlight that rainfall vnwind of the city but also over the city. These findings have implications for as hydroclimatological studies. This meta-analysis highlights the need for e results are presented in future studies to aid the generalization of findings.

itnessed a dramatic increase in urbanization and resulting land use/cover change. It is nly about 1% of the land can be regarded as urban area, the impacts affect a large popula- mically important. Further urbanization impacts are expected to increase in terms of the nsity and at a faster rate in the future[1]. Urbanization not only changes the surface energy ed surface albedo and heat storage, but it also contributes to regional pollution, anthro- heat release.

able impact on the local and regional climate. A well-known feature of such change is the and' (UHI), where urban areas are warmer than the surrounding rural areas typically by s[2–4]. This understanding of urban impacts on temperature has matured and is also used in an climate mitigation strategies including green buildings and the design of green spaces[5]. ure effects due to urbanization are well studied and understood, the effect of landscape evolving. This is because the rainfall changes are dynamic and depend on a number of urban landscape, the impact is not collocated and depends on the wind; and heating at ndary layer due to surface characteristics, as well as aerosols above the urban surface. ls on urban – rural surface flux gradients and the moisture availability in the rural area. discussed the potential for rainfall modification due to New York City. A more definitive fter several decades from the Metropolitan Meteorological Experiment (METROMEX)[9] , MO, USA, in the 1970s. The METROMEX results found rainfall increase by 10–17% Reviews by Landsberg[7] and Shepherd[1], and a series of studies following them[10–14] have fidence in the findings that urbanization has a notable impact on rainfall changes. knowledge about urban rainfall modification, a quantitative assessment and analysis is , the same urban area can yield different rainfall effects due to dynamical environmental ol emissions, surface and boundary layer feedbacks, mesoscale convergence, and ther- ions. An objective assessment is however, increasingly important as cities continue being xtremes witnessing both floods[15] and droughts[16–18], and an emerging topic of interest is ges are affected by the urban environment[19,20].

t al.[21] reviewed 96 summer storms spanning over a decade for the Indianapolis urban multiscale rainfall datasets. Their results showed that the majority of thunderstorms

tmospheric, and Planetary Sciences, Purdue University, West Lafayette, IN, 47907, USA. cs, Purdue University, West Lafayette, IN, 47907, USA. [3]Department of Agronomy – Crops,

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Current Opinion in Environmental Sustainability

ELSEVIER

The literature landscape on 1.5 °C climate change and cities

William F Lamb[1], Max W Callaghan[1,2], Felix Creutzig[1,3], Radhika Khosla[4] and Jan C Minx[1]

Cities are key for achieving the 1.5 °C warming limit of the Paris Agreement. However, synthesizing policy insights from the urban literature is a challenge, due to its rapid growth, breadth of topics and relative lack of assessments so far. Here we introduce methods from computational linguistics to build a systematic overview of research on transport, buildings, waste management and urban form. We find that the epistemic core of the mitigation-focused urban literature is currently centered on urban form and emissions accounting, while extensive research into demand-side options remain overlooked, including congestion and parking polices, active travel, and waste management. In the IPCC Special Report on 1.5 °C, and for meeting the target itself, all such city-scale opportunities need to be examined.

Addresses
[1] Mercator Research Institute on Global Commons and Climate Change, Torgauer Str. 14, 10829 Berlin, Germany
[2] School of Earth and Environment, University of Leeds, Leeds LS2 9JT, UK
[3] Sustainability Economics of Human Settlements, Technical University Berlin, Str. des 17. Juni 135, 10623 Berlin, Germany
[4] Centre for Policy Research, New Delhi 110021, India

Corresponding author: Lamb, William F (lamb@mcc-berlin.net)

Current Opinion in Environmental Sustainability 2018, **30**:26–34

This review comes from a themed issue on **1.5°C Climate change and urban areas**

Edited by **Karen Seto** and **Diana Ürge-Vorsatz**

sustained net negative emissions across the second half of the 21st century [1,2]. Such ambition levels can only be achieved if all available mitigation options are reaped at all governance levels — from the global to the local. Cities, as hotspots of human activities and infrastructures, have direct leverage over end-use energy consumption in transport systems, buildings and other sectors, and therefore play a key role in limiting warming to 1.5 °C [3–6].

Cities are also emerging as one of the more ambitious policy communities in global climate change governance, even as national progress continues to lag. A number of initiatives have pledged substantial emission reductions, such as the C40 [7] and the Global Covenant of Mayors [8]. Such actions could prove decisive for ratcheting up the currently inadequate short-term mitigation ambitions expressed in the nationally determined contributions [9,10]. Cities and local governments are thereby increasingly recognized as important building blocks for the organization of ambitious climate policies in a multi-level governance system [6,11,12*].

The assessment of an urban mitigation literature, however, faces two fundamental challenges: first, like in other fields of climate change research, the body of relevant literature is large and fast-growing. Minx *et al.* [13] estimate that the quantity of new peer-reviewed research (as recorded by the ISI Web of Science) published during the

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PLoS one

A Meta-Analysis of Global Urban Land Expansion

Karen C. Seto[1]*, Michail Fragkias[2], Burak Güneralp[1¤a], Michael K. Reilly[3¤b]

1 Yale School of Forestry and Environmental Studies, Yale University, New Haven, Connecticut, United States of America, **2** International Human Dimensions Programme on Global Environmental Change, Urbanization and Global Environmental Change Project, Global Institute for Sustainability, Arizona State University, Tempe, Arizona, United States of America, **3** Department of Environmental Earth System Science, Stanford University, Stanford, California, United States of America

Abstract

The conversion of Earth's land surface to urban uses is one of the most irreversible human impacts on the global biosphere. It drives the loss of farmland, affects local climate, fragments habitats, and threatens biodiversity. Here we present a meta-analysis of 326 studies that have used remotely sensed images to map urban land conversion. We report a worldwide observed increase in urban land area of 58,000 km^2 from 1970 to 2000. India, China, and Africa have experienced the highest rates of urban land expansion, and the largest change in total urban extent has occurred in North America. Across all regions and for all three decades, urban land expansion rates are higher than or equal to urban population growth rates, suggesting that urban growth is becoming more expansive than compact. Annual growth in GDP per capita drives approximately half of the observed urban land expansion in China but only moderately affects urban expansion in India and Africa, where urban land expansion is driven more by urban population growth. In high income countries, rates of urban land expansion are slower and increasingly related to GDP growth. However, in North America, population growth contributes more to urban expansion than it does in Europe. Much of the observed variation in urban expansion was not captured by either population, GDP, or other variables in the model. This suggests that contemporary urban expansion is related to a variety of factors difficult to observe comprehensively at the global level, including international capital flows, the informal economy, land use policy, and generalized transport costs. Using the

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A systematic review of the health co-benefits of urban climate change adaptation

Ayyoob Sharifi [a,b], Minal Pathak [c,*], Chaitali Joshi [c,d], Bao-Jie He [e,f]

[a] Graduate School of Humanities and Social Sciences & Network for Education and Research on Peace and Sustainability (NERPS), Hiroshima University, Japan
[b] Graduate School of Advanced Science and Engineering, Hiroshima University, Japan
[c] Global Centre for Environment and Energy, Ahmedabad University, Commerce Six Roads, Navrangpura, Ahmedabad, Gujarat 380009, India
[d] Department of Architecture, The Maharaja Sayajirao University of Baroda, Pratapgunj, Vadodara, Gujarat 390002, India
[e] School of Architecture and Urban Planning, Chongqing University, Chongqing, 400045, China
[f] Key Laboratory of New Technology for Construction of Cities in Mountain Area, Ministry of Education, Chongqing University, Chongqing, 400045, China

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ABSTRACT

The recent and projected upward trends in the frequency and intensity of climate-induced events in cities have enhanced the focus on adaptation. In addition to enhancing the capacity of cities to prepare for and absorb risks, adaptation measures provide multiple co-benefits. However, health co-benefits are among the least explored. These are now seen as increasingly important with the renewed focus on public health since the COVID-19 pandemic. This study reviews literature focused on the health co-benefits of urban climate change adaptation measures. Health co-benefits of seven different categories of adaptation measures are discussed. Results showed that existing evidence is mainly related to some categories such as critical infrastructure, nature-based solutions, and urban planning and design measures. Other adaptation categories like early warning systems; policy, management & governance, including local adaptation policies; and measures and strategies related to 'knowledge, perceptions & behavior' that mainly involve people's understanding and individual responses to climate change, are relatively underexplored. Moreover, it was discussed that some adaptation measures may result in health trade-offs and these needs to be further studied. Overall, through identifying health co-benefits, results of this review can make a strong case for further promotion of climate change adaptation in cities.

1. Introduction

Cities are now on the crossroads of multiple crises; of an unexpected pandemic and deepening climate emergency. With cities having to address multiple issues, an understanding of adaptation measures could help identify and prioritize actions in cities. According to the Intergov-

gains from mitigation (Ganten et al., 2010). Similarly, Cheng and Berry (2013) identify health co-benefits as "advantages outside of the scope of the original health outcomes targeted to be improved". This paper refers to the IPCC definition where co-benefits are "the positive effects that a policy or measure aimed at one objective might have on other objective, irrespective of the net effect on social welfare" (Mayrhofer & Gupta,

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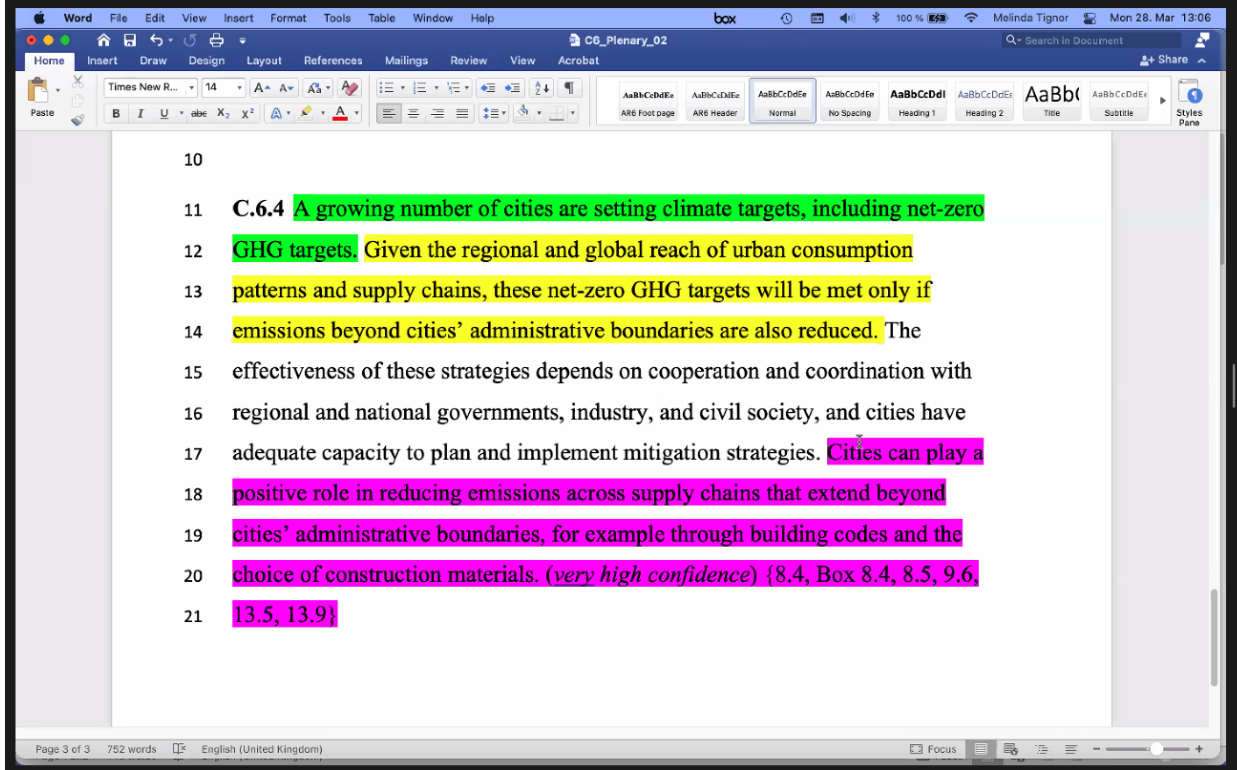
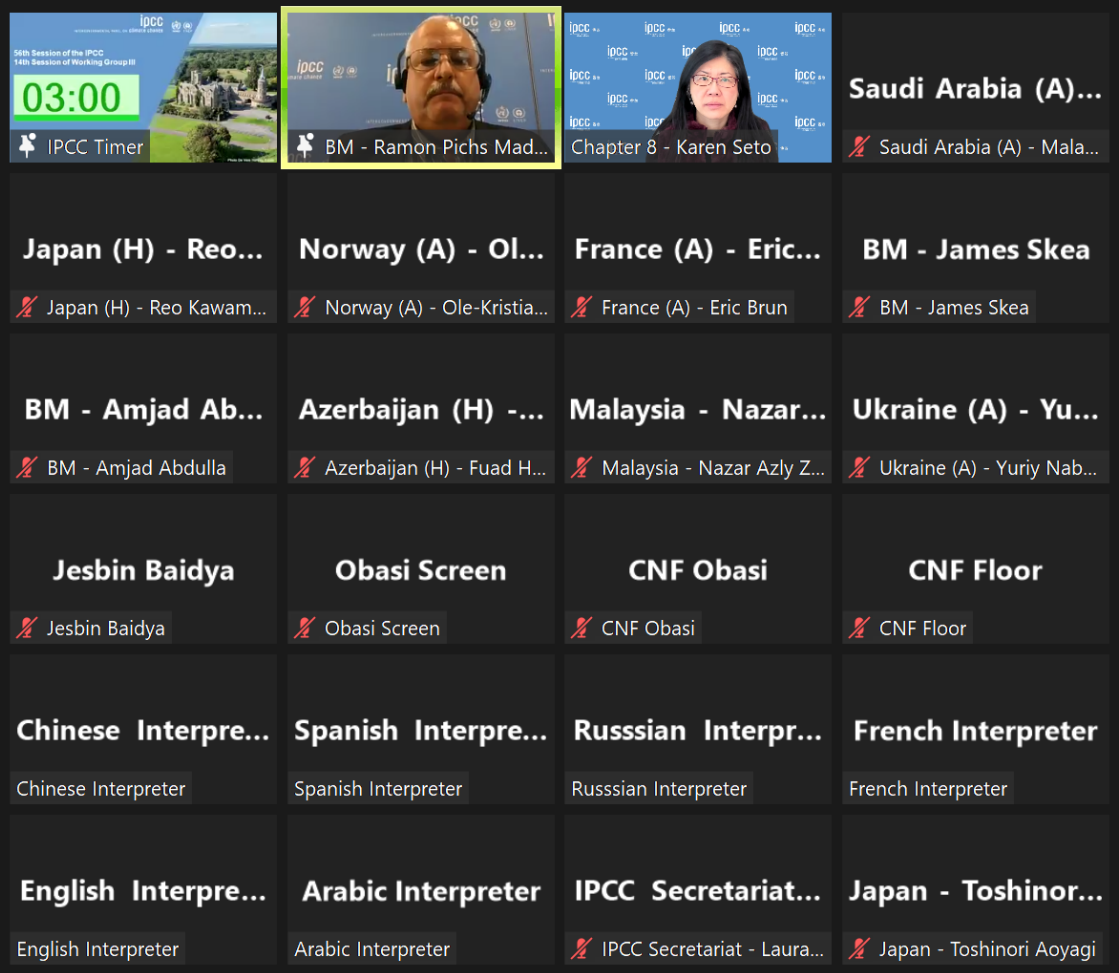


10

11 **C.6.4** A growing number of cities are setting climate targets, including net-zero
12 GHG targets. Given the regional and global reach of urban consumption
13 patterns and supply chains, these net-zero GHG targets will be met only if
14 emissions beyond cities' administrative boundaries are also reduced. The
15 effectiveness of these strategies depends on cooperation and coordination with
16 regional and national governments, industry, and civil society, and cities have
17 adequate capacity to plan and implement mitigation strategies. Cities can play a
18 positive role in reducing emissions across supply chains that extend beyond
19 cities' administrative boundaries, for example through building codes and the
20 choice of construction materials. (*very high confidence*) {8.4, Box 8.4, 8.5, 9.6,
21 13.5, 13.9}



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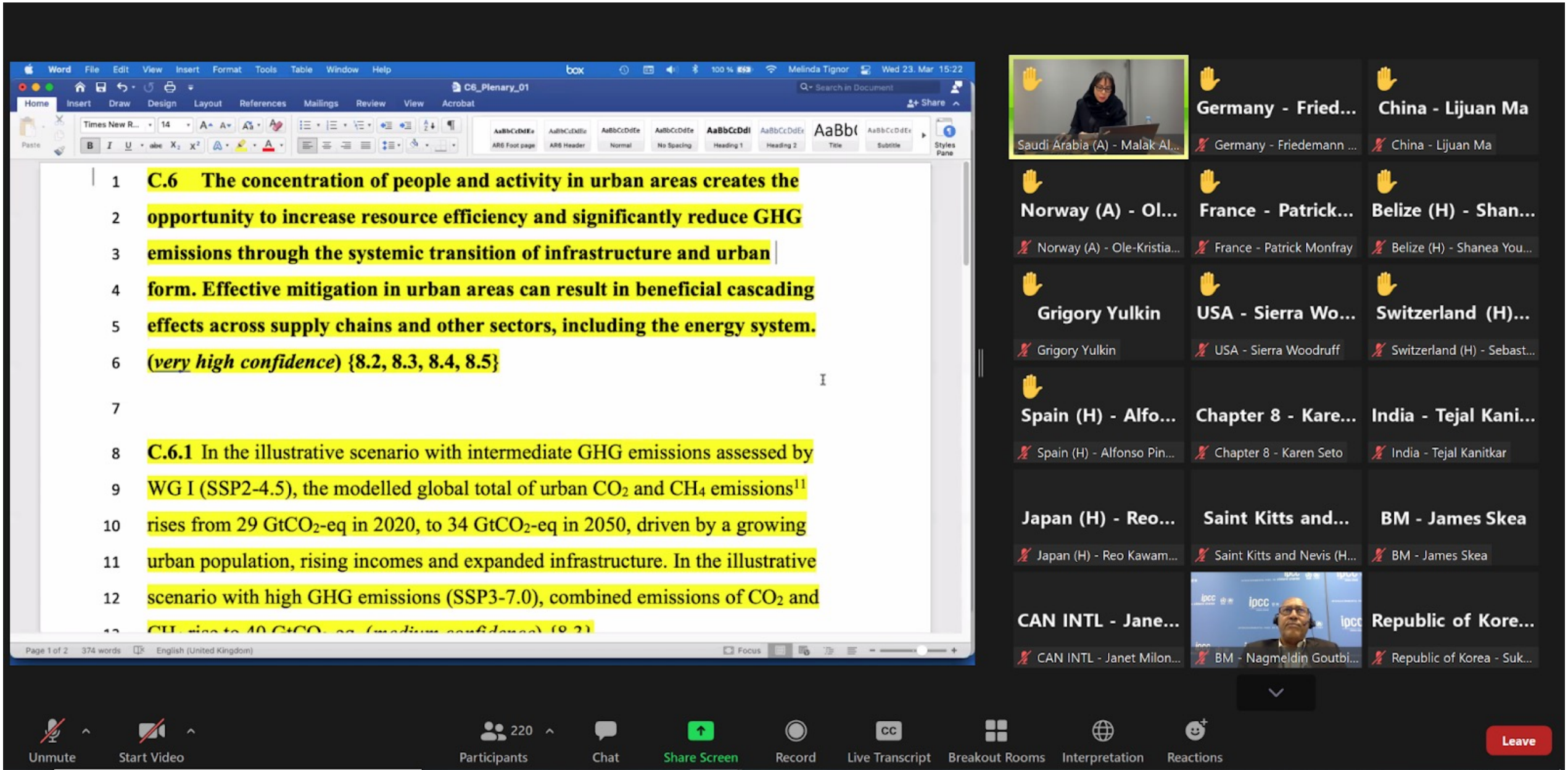

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Thank you for your attention

Karen C. Seto

Frederick C. Hixon Professor of Geography & Urbanization Science
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Coordinating Lead Author, IPCC 6th Assessment Report (2022)
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