Climate Change and Cities
Second Assessment Report of the Urban Climate Change Research Network

---

The Urban Climate Change Research Network's *Second Assessment Report on Climate Change in Cities* (ARC3.2) is the second in a series of global, science-based reports to examine climate risk, adaptation, and mitigation efforts in cities. The book explicitly seeks to explore the implications of changing climatic conditions on critical urban physical and social infrastructure sectors and intersectoral concerns. The ARC3.2 Report presents downscaled climate projections and catalogs urban disasters and risks, along with the effects on human health in cities. ARC3.2 gives concrete solutions for cities in regard to mitigation and adaptation; urban planning and urban design; equity and environmental justice; economics, finance, and the private sector; critical urban physical and social sectors such as energy, water, transportation, housing and informal settlements, and solid waste management; and governing carbon and climate in cities. Other key topics include ecosystems and biodiversity, and urban coastal zones. The primary purpose of ARC3.2 is to inform the development and implementation of effective urban climate change policies, leveraging ongoing and planned investments for populations in cities of developing, emerging, and developed countries.

This volume – like its predecessor – will be invaluable for a range of audiences involved with climate change and cities: Mayors, city officials, and policy-makers; urban planners; policy-makers charged with developing climate change mitigation and adaptation programs; and a broad spectrum of researchers and advanced students in the environmental sciences.

Cynthia Rosenzweig is a Senior Research Scientist at the NASA Goddard Institute for Space Studies, where she heads the Climate Impacts Group. She is Co-Chair of the New York City Panel on Climate Change (NPCC), a body of experts convened by the mayor to advise the city on adaptation for its critical infrastructure. She co-led the Metropolitan East Coast Regional Assessment of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change, sponsored by the U.S. Global Change Research Program. She was a Coordinating Lead Author of Working Group II for the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). She is Co-Director of the Urban Climate Change Research Network (UCCRN), Co-Editor of the First and Second UCCRN Assessment Reports on Climate Change and Cities (the ARC3 series), and Co-Chair of the Urban Thematic Group for the United Nations UN Sustainable Development Solutions Network (SDSN) and the Campaign for an Urban Sustainability Development Goal (SDG). She serves as Chair of the Board of the New York City Climate Museum. She was named as one of "Nature's 10: Ten People Who Mattered in 2012" by the journal *Nature*, for her work preparing New York for climate extremes and change. A recipient of a Guggenheim Fellowship, she joins impact models with climate models to project future outcomes of both land-based and urban systems under altered climate conditions. She is a Professor at Barnard College and a Senior Research Scientist at The Earth Institute at Columbia University.

William Solecki is a Professor in the Department of Geography, Hunter College, City University of New York (CUNY). He has led or co-led numerous projects on the process of urban environmental change and transformation. As Director of the CUNY Institute for Sustainable Cities, he has worked extensively on connecting cutting-edge urban environmental science to everyday practice and action in cities. He most recently served as Co-Chair of the New York City Panel on Climate Change, as Co-Principal Investigator of the Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State (ClimAID), and as Co-Leader of the Metropolitan East Coast Assessment of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change. He is a Coordinating Lead Author of the IPCC Special Report on the Impacts of 1.5 Degree Warming and was a Lead Author of the IPCC Working Group II Fifth Assessment Report (AR5). He is also a member of International Geographical Union (IGU) Megacity Study Group and a member of the Scientific Steering Committee of the Urbanization and Global Environmental Change core project of the International Human Dimensions Programme (IHDP).

Patricia Romero-Lankao is an "interdisciplinary sociologist" by training. She has been a research scientist at the National Center for Atmospheric Research (NCAR) and is currently leading the "Urban Futures" initiative there. Her research explores the dynamics of urbanization and urban systems that shape urban emissions, vulnerabilities, and risk. She has also done research on why and how particular cities attempt to meet the challenges of reducing emissions while improving their response capacity (resilience) to environmental impacts. She was co-lead author of Working Group II of the Nobel prize–winning IPCC Fourth Assessment Report (AR4) and is convening author of IPCC: AR5, North American chapter. She has been a member of several scientific committees designing a research agenda on the interactions and feedbacks between urban development and the environment, including the carbon cycle, the climate system, and the water cycle (e.g., Global Carbon Project, Urbanization and Global Environmental Change and U.S. Carbon Cycle Science Program).

Shagun Mehrotra is Professor of Sustainable Development at The New School University, New York, and the founding Director of the Sustainable Development Solutions Center. He is a Lead Author of the IPCC Special Report on the Impacts of 1.5 Degree Warming. He serves on UNSDSN's Urban Thematic Group charged by the UN Secretary General as an external advisory group for the post-2015 development agenda. Over the past two decades, his research and advice has widely engaged governments and private sector in North America, Africa, Asia, and Latin America on climate change, infrastructure economics and finance, and poverty reduction in cities, particularly large slums. He has led more than fifty multidisciplinary teams to assess climate risk and craft response in global cities and a dozen teams on infrastructure reforms. Previously, he served on the staff of the World Bank, leading infrastructure reform of public utilities in Africa with a focus on expanding services to the urban poor. He has facilitated global strategic partnerships for the Sustainable Development Goals SDGs and Habitat III's New Urban Agenda. He has published extensively on solutions for global urbanization, including two recent books, the first ARC3 with Cambridge University Press and another on infrastructure economics with Oxford University Press. His work has featured in *Nature* and *Scientific American*, and he is a reviewer of policy-relevant research for *Science.* He has a PhD from Columbia University in Urban Planning and Infrastructure Economics.

Shobhakar Dhakal is an Associate Professor in the Energy Field of Study at the Asian Institute of Technology in Thailand. His areas of expertise are in urbanization, cities and climate change, and energy policies and modeling. He has been a visiting researcher at the National Institute for Environmental Studies, Japan, since 2012. He is a Coordinating Lead Author of Working Group III for the IPCC's Fifth Assessment Report AR5 of the IPCC. He serves as a member of the scientific steering committee of the Global Carbon Project, the premier scientific program under Future Earth. He was a guest research scholar at the International Institute for Applied System Analysis in Austria from 2010 to 2013. He has served as a lead author for the *Global Energy Assessment*, principal scientific reviewer for UNEP's Global Environmental Outlook-5, member of the Consensus Panel on Low-Carbon Cities of the Academy of Sciences of South Africa, member of the Cities Energy Modeling Group of the International Energy Agency, and an international expert to the Taskforce on Urban Development and Energy Efficiency of the China Council for International Cooperation on Environment and Development, among others. He is also one of the editors-in-chief of the journal *Carbon Management*.

Somayya Ali Ibrahim is the Associate Director of the Urban Climate Change Research Network (UCCRN). Based at the Earth Institute at Columbia University and the NASA Goddard Institute for Space Studies (NASA GISS), she develops and manages climate change projects and partnerships with large city groups, universities, development banks, and federal and UN agencies. She manages the UCCRN Secretariat in New York and its global network of projects and partnerships, including more than 800 urban scientists and practitioners and involving the establishment of the UCCRN Regional Hubs in Africa, Asia, Australia-Oceania, Europe, Latin America, and North America. She also manages the development and publication of the UCCRN Assessment Report on Climate Change and Cities (ARC3) series, an ongoing set of major global, interdisciplinary, science-based assessments on climate change and urban areas. She was one of ten individuals chosen to represent Columbia University at the UNFCCC 21st Conference of the Parties (COP21) in Paris in December 2015, and works with a leadership team striving to establish a Climate Museum in New York, one of the first of its kind in the world. She holds a B.Sc. (Hons.) in Management Sciences and an MBA from the University of Peshawar, and a Master's degree in Climate and Society from Columbia University.

Praise for the ARC3.2 Report

Anne Hidalgo, Mayor of Paris and Chair of C40

"ARC3.2 provides the critical knowledge base for city actions on climate change around the world."

Eduardo Paes, Former Mayor of Rio de Janeiro and Former Chair of C40

"The remarkable ARC3.2 will make a difference in developing effective and efficient climate change mitigation and adaptation policies in cities."

James Nxumalo, Former Mayor of Durban

"The full ARC3.2 report ... is the gold standard for science-based policymaking as we enter into the post-2015, climate change implementation era."

Joan Clos, Former Executive Secretary of UN-Habitat; Former Mayor of Barcelona

"... a great example of the benefit of interdisciplinary science-policy co-operation. ... ARC3.2 will help to ensure our future cities enable us to live more sustainably and to be more resilient."

Gino Van Begin, Secretary General of ICLEI-Local Governments for Sustainability

"The Climate Change in Cities report zooms in at the city level, providing us with a wealth of local climate data. And what these data tell us is that if we are to overcome the climate change challenge, we need more than ever the concerted efforts of all levels of government, multilateral institutions, civil society and the business sector."

Mark Watts, Executive Director for C40 Cities Climate Leadership Group

"With the international community now galvanized to put the world on a climate safe pathway, the evidence is stacking up that cities have a key role to play. The second edition of the ARC3 report from the Urban Climate Change Research Network provides a critical knowledge base for global cities as they respond to climate change challenges and seize the economic opportunities of low carbon, climate resilient development. Leading mayors, through network such as the C40, are learning from each other, exchanging ideas and thereby accelerating local action on the ground."

Senator Loren Legarda, Chair, Senate Committees on Foreign Relations, Finance, and Climate Change Global Champion for Resilience, United Nations Office for Disaster Risk Reduction (UNISDR)

"Urban areas will not stop from growing, but growth need not compromise the future. The climate crisis presents the opportunity to promote sustainable growth. Key science knowledge and practical insights are needed to allow our urban areas to meet the adaptation imperative to climate change. The ARC3.2 Report of the Urban Climate Change Research Network (UCCRN) provides vital inputs to this process."

Climate Change and Cities
Second Assessment Report of the Urban Climate Change Research Network

Edited by

Cynthia Rosenzweig
NASA Goddard Institute
for Space Studies
The Earth Institute, Columbia University

William Solecki
Hunter College,
City University of New York

Patricia Romero-Lankao
National Center for Atmospheric Research

Shagun Mehrotra
Milano School of
International Affairs, Management, and
Urban Policy, The New School

Shobhakar Dhakal
Asian Institute of Technology

Somayya Ali Ibrahim
The Earth Institute, Columbia University
NASA Goddard Institute
for Space Studies

CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

79 Anson Road, #06–04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9781316603338

Co-Editors: Cynthia Rosenzweig, William Solecki, Patricia Romero-Lankao, Shagun Mehrotra, Shobhakar Dhakal, Somayya Ali Ibrahim

Project Manager: Somayya Ali Ibrahim

First published 2018

Printed in the United States of America by Sheridan Books, Inc.

A catalogue record for this publication is available from the British Library.

ISBN 978-1-316-60333-8 Paperback

Disclaimer: The views presented here are those of the authors and do not reflect official views or policy of any organization, institution, or federal agency, unless otherwise noted.

Cover Photo:

Rio de Janeiro, a city with 6.5 million residents (14.5 million in the Greater Rio de Janeiro area), is a frontrunner in climate change mitigation and adaptation. Temperatures in Rio de Janeiro are projected to rise by 3.4°C, with sea level rise of 37cm–82cm, by the 2080s. Along with developing a Climate Adaptation Plan, Rio de Janeiro is committed to reducing greenhouse gas emissions by 20% of 2005 levels by 2020. (Photo: Somayya Ali Ibrahim)