



CITIES IN FUTURE EARTH Third Australian Earth System Outlook Conference

PROGRAM

Shine Dome, Canberra 8–9 December 2014



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FOREWORD

The Australian Outlook Conferences are a high-profile activity that was proposed in the Australian strategic plan for Earth system science: To Live Within Earth's Limits: An Australian plan to develop a science of the whole Earth system. In this plan, we emphasise that numerous global environmental and socio-economic changes are now of such a magnitude and so pervasive that they are merging both spatially and in terms of their effects on each other-they are highly interactive. As such, their understanding and potential solution or mitigation will benefit from the full set of global change issues being studied as an integrated dynamic system. Thus, to understand the dynamics of the Earth system properly, it is important to include the human dimensions of global change with the non-human elements of the dynamic system-the atmosphere, the hydrosphere, the biosphere, the lithosphere etc.

In selecting a theme of *Cities in Future Earth*, the National Committee was mindful of the major transitions occurring on a global scale as populations move increasingly to an urban base. One hundred years ago just two in ten people lived in an urban area. In 2010, this statistic passed 50%, and by 2050 the proportion is expected to reach 70%. Australia is one of the most urbanised countries in the world, with already 70% of its population in major cities, and so management of the challenges for sustainability in a highly urbanised society carries particular national relevance.

More generally, on an international scale, the interconnectedness of global systems makes the challenge sustainability and its interaction with global environmental change a fundamental issue for Earth System Science and the new global Future Earth initiative.

This conference brings together outstanding speakers with expertise across a wide range of fields in sustainability, global change and urbanisation. It aims to examine the role of cities in global development, to look at the interconnections within and around urban systems and the response of urban systems to global change. The sessions will not only examine the challenges and issues, but also the opportunities and possible future directions for development of cities.

This Third Australian Earth System Outlook Conference, *Cities in Future Earth* is generously supported by the Department of the Environment. The Academy is delighted to have this funding available to enable a stimulating dialogue around this important topic.

Dr Tas van Ommen Chair, National Committee for Earth System Science Australian Academy of Science

CONVENERS

- Professor Xuemei Bai
 ANU College of Medicine, Biology and Environment
- Dr John Finnigan
 CSIRO Complex Systems Science
- Professor Jean Palutikof
 National Climate Change Adaptation Research Facility
 Griffith University
- Dr Mark Stafford Smith
 Chair, Future Earth Science Committee
- Professor Will Steffen
 ANU Climate Change Institute

Dr Tas van Ommen

Chair, National Committee for Earth System Science Department of the Environment Australian Antarctic Division

Academy Secretariat

Mrs Samires Hook Projects Officer, Australian Academy of Science

Mr Mitchell Piercey Events Manager, Australian Academy of Science

PROGRAM DAY ONE: MONDAY 8 DECEMBER

8.30 am	Registration, coffee
9.00 am	Welcome and opening
	Dr Tas van Ommen, Chair, National Committee for Earth System Science
	Professor Andrew Holmes AM PresAA FTSE FRS, President, Australian Academy of Science
Session 1	Role of cities in global development Chair: Dr John Finnigan CSIRO Complex Systems Science
9.30 am	Dr Heinz Schandl CSIRO Sustainable Ecosystems <i>Urbanisation and global change</i>
10.30 am	MORNING TEA
11.00 am	Professor Pascal Perez SMART, University of Wollongong The Factor 8 Conundrum: How will cities meet the needs of twice today's population with half today's resources while providing twice the liveability?
	Professor Chris Ryan Victorian Eco-Innovation Lab, University of Melbourne <i>City systems are socio-cultural-physical-</i>

12.30 pm LUNCH Session 2 **Urban interconnections** Chair: Professor Will Steffen ANU Climate Change Institute 1.30 pm A/Professor Tommy Wiedmann University of New South Wales Cities and their hinterlands—Accounting for and managing the global resource consumption of urban systems **Professor Michael Neuman** University of New South Wales Are integrated infrastructure networks governable in contemporary city regions? 3.00 pm AFTERNOON TEA 3.30 pm Aromar Revi Indian Institute for Human Settlements Video presentation 4.30 pm End session 2 5.00 pm – Poster display presentations

and cocktail reception

7.30 pm

technical: you can't deal with one without the other

PROGRAM DAY TWO: TUESDAY 9 DECEMBER

8.30 am	Future Earth—Responding to the challenges Dr Mark Stafford Smith Chair, Future Earth Science Committee
Session 3	Urban Responses to global change Chair: Professor Jean Palutikof National Climate Change Adaptation Research Facility, Griffith University
9.30 am	Dr Helen Cleugh CSIRO Oceans and Atmosphere Flagship <i>Cities and Climate Change</i>
	Professor Peter Newton The Swinburne Institute for Social Research, Faculty of Health, Arts & Design, Swinburne University Challenges and prospects for a sustainable development transition of Australia's cities
10.30 am	MORNING TEA
11.00 am	Sasha Ivanovich

SIA Architects, AURA Urban & Regional Alliance, FHSI Architects Dubai Urban renewal: how will climate change and commercial imperatives change the vision of the 21st century ideal Australian city

	Krista Milne Manager Sustainability, City of Melbourne <i>Creating an Eco-City; the Melbourne Challenge</i>
12.30 pm	LUNCH
Session 4	The future of cities: living within planetary boundaries
1.15 pm	Professor Barbara Norman University of Canberra
2.00 pm	Panel discussion Chairs and invited speakers
3.00 pm	AFTERNOON TEA
3.20 pm – 4 00 pm	Questions and closing remarks

WELCOME

Dr Tas Van Ommen

Chair, National Committee for Earth System Science Department of the Environment, Australian Antarctic Division

Tas van Ommen is chair of the Australian Academy of Science National Committee for Earth System Science. He is senior principal research scientist at the Australian Antarctic Division in Hobart, where he is program leader for Antarctica and the Global System. His research interests lie in glaciology and past climate from ice cores. He has worked extensively on high resolution climate records, with significant results arising from timing hemispheric climate changes through the last deglaciation and also work linking recent Australian climate and drought to climate variability in Antarctica. Dr Ommen has participated in six research expeditions to Antarctica in diverse roles from drilling ice cores to deep field traverse work and airborne geophysical surveys. He is also co-leader of the Oceans and Cryosphere Program within the Antarctic Climate and Ecosystems Cooperative Research Centre.



Tas Van Ommen

OPENING SPEAKER

Professor Andrew Holmes AM PresAA FTSE FRS

Australian Academy of Science

University of Melbourne School of Chemistry, Bio21 Institute (Melbourne Laureate Professor Emeritus, Professor of Chemistry); Imperial College Department of Chemistry (Emeritus Professor and Distinguished Research Fellow).

Andrew Holmes was professor of Organic and Polymer Chemistry and director of the Melville Laboratory for Polymer Synthesis at the University of Cambridge. In 2004 he was awarded an ARC Federation Fellowship and Inaugural veski Innovation Fellowship at the Bio21 Institute in the University of Melbourne. He was a CSIRO Fellow, a University of Melbourne laureate professor at the University of Melbourne, distinguished research Fellow at Imperial College and was the Newton Abraham visiting professor, University of Oxford in 2011–12. His research interests involve applications of synthesis to materials science and biology. He has made extensive contributions in the area of light emitting and photovoltaic devices. He was elected a Fellow of the Royal Society in 2000, and a Fellow of the Australian Academy of Science and of the Australian Academy of Technological Sciences and Engineering in 2006. He is president of the Australian Academy of Science. From 2000–2003 he was chairman of the editorial board of *Chemical Communications* and he has been an associate editor of *Organic Letters* since 2006.



Andrew Holmes

SESSION 1: ROLE OF CITIES IN GLOBAL DEVELOPMENT CONVENERS DR JOHN FINNIGAN, DR MARK STAFFORD SMITH, PROFESSOR WILL STEFFEN



John Finnigan

Chair: Dr John Finnigan CSIRO Complex Systems Science

John Finnigan received his BSc from the University of Manchester in 1968 and his PhD from the Australian National University in 1978. He joined the CSIRO Division of Environmental Mechanics in 1972 and from 1989 to 1995 he was head of the Centre for Environmental Mechanics. From 2001 to 2011 he was the director of the CSIRO Centre for Complex Systems Science and a chief research scientist at the CSIRO divisions of Land and Water, Atmospheric Research and Marine and Atmospheric Research. He is currently a CSIRO Fellow in CSIRO's Oceans and Atmosphere Flagship.

He is a Fellow of the Australian Academy of Science, a Fellow of the American Geophysical Union, a visiting professor at the School of Geophysical Sciences, University of Edinburgh, Scotland, and an affiliate scientist at the National Center for Atmospheric Research, Boulder Colorado.

His research activities have spanned atmospheric science, from the dynamics of turbulence to the role of biosphere– atmosphere exchange in climate dynamics, and now include complex systems science. In particular he is engaged in research on the ways that human decision making and societal dynamics can be captured quantitatively in models of the human–Earth system. He is currently leading the team that built the capability for integrated global modelling in CSIRO.

What is shaping the growth of cities? How is this connected with other global trends? A few of the most important of these are demographics, environmental change, growth of income and wealth inequality. We are living through a relative depopulation of the countryside that is comparable to the times of the enclosures and clearances in the 17th and 18th centuries in Britain, but now it is happening on a global scale. In part this is a response to the more efficient food production that is needed to feed a population of 9–10 billion as this requires less labour. This can lead to people being forced off the land into cities. Conversely, cities may offer an attractive alternative to rural poverty. This global trend is having profound impacts on demographics.

Urbanisation also increases consumption per capita and increases the vulnerability of people to interruption in the supply of food and other essentials. How do factors like these interact to define the role of urbanisation in the trajectory of the Anthropocene—the proposed new geological epoch and how does urbanisation help or hinder the push for sustainable development?

This session will analyse and discuss some of these questions, exploring the role of cities in global development.



Heinz Schandl

Dr Heinz Schandl CSIRO Sustainable Ecosystems

Heinz Schandl is a senior principal scientist at CSIRO in Canberra, Australia. His research links social theory, social metabolism and public policy to explore pathways for sustainable consumption and production and green economy based on measuring and modelling of sustainability and policy analysis. He is the lead author of *Resource Efficiency: Economics and Outlook in Asia and the Pacific* commissioned by the UNEP Office in Bangkok and has been a consultant for the OECD, the World Bank and the Asian Development Bank.

Dr Schandl is an adjunct associate professor at the Australian National University, School of Sociology and a permanent visiting professor at the Institute of Environmental Studies at Nagoya University in Japan. He is chair of the 2016 Gordon Research Conference for Industrial Ecology and a member of UNEP's International Resource Panel.

Urbanisation and global change

Historically, urban growth went hand in hand with the industrial revolution that was based on abundantly available energy, agricultural surpluses and the ability to transport resources over long distanced. The new industrial metabolism enabled urbanisation and the two processes reinforced each other and cities became a condition of modernity and a force in global environmental change. The aim of this talk is to investigate the role of urbanisation in global change through the Holocene into the Anthropocene now and into the future. The forces that led to the emergence of cities as an enduring solution to population distribution and a key factor in economic and social growth are discussed from a sociological and metabolic point of view. The process of urbanisation and industrialisation that has been completed in some parts of the world and has meant a homogenisation of city and countryside is now massively under way in the developing world and a second wave of urbanisation will lead to a further growth in urban populations and corresponding aspirations, lifestyles and consumption patterns. Business as usual projections estimate that the next 2 billion people on the planet will be housed in cities too. Hence cities are one of the major engines of societal growth, organisation and planetary impact and are a key to understanding the Anthropocene.



Pascal Perez

Professor Pascal Perez SMART, University of Wollongong

Pascal Perez is currently the research director of the SMART Infrastructure Facility, University of Wollongong. He is a specialist of integrative social simulation, using multi-agent systems technologies to explore complex infrastructure systems. He is a member of the Technical Committee of the Australian Urban Research Infrastructure Network (AURIN). He is also a member of the Modelling and Decision Support Division of Simulation Australia and of the Modelling and Simulation Society of Australia and New Zealand (MSSANZ). In 2002, he received an ARC International Fellowship to develop social modelling research at the Australian National University. Professor Perez has published 100 refereed papers and book chapters. In 2006, he co-edited with his colleague David Batten the book *Complex Science for a Complex World* (ANU E Press).

The Factor 8 Conundrum: How will cities meet the needs of twice today's population with half today's resources while providing twice the liveability?

'How's life?' This rather mundane question has become a focus of renewed attention since the first release, in 2011, of the *Better Life* survey by OECD and its recent updating (OECD, 2013). This survey finds its origin in the famous Stiglitz-Sen-Fitoussi report (2009) that suggests the creation of new indicators to measure social and economic progress, complementary to the traditional GDP marker. Beyond the Easterlin Paradox, justification for such a novel approach lies in the inability of GDP to deal with social inequities and, more fundamentally, with the multi-dimensional nature of progress. In a recent meeting of the G20 in Australia, the Director of IMF, Christine Lagarde, made it clear that viable economic development could not be separated from environmental sustainability, social well-being and equity.

Another driver of our growing interest into wellbeing is a remarkable and probably irreversible change that happened in 2010. That year, and for the first time in human history, half of the world's population lived in cities. At the same period, this proportion had already reached 90% in Australia (*ABS Year Book*, 2010). There is no questioning the fact that these figures have had and will continue to have a significant impact on the way we plan for and manage our cities. Future cities will have to be liveable and sustainable in order to cope with population growth and resource scarcity. Given that urban environments, and infrastructure systems at large, are not 'engineering artefacts' but rather 'agents of change', is it possible to imagine urban environments that can meet the needs of twice today's population with half today's resources while providing twice the liveability?



Chris Ryan

Professor Chris Ryan Victorian Eco-Innovation Lab, University of Melbourne

Chris Ryan is professor and director of the Victorian Eco-Innovation Lab at the University of Melbourne (in the Faculty of Architecture Building and Planning). He was foundation professor of Design and Sustainability at RMIT University from 1996–2004 and founding director of its ARC National Centre for Environmental Design until 1997. He was professor and then director of the International Institute for Industrial Environmental Economics at Lund University, Sweden 1997–2002. In 2002, he was consultant to the UNEP, coordinating and writing the Global Progress Report on Sustainable Consumption for the Johannesburg UN world summit in 2002.

He has worked for over 30 years across various areas of science, technology and environmental policy and design and in projects that span the community sector, academia, government and international agencies, and business. He is a member of the editorial board of the MIT/Yale Journal of Industrial Ecology and visiting professor at Delft University, the Netherlands.

City systems are socio-cultural-physical-technical: you can't deal with one without the other

In the shifting politics of the national and global response to climate change it is remarkable that so much attention has come to focus on cities. What can we learn from this recent climate-related appraisal of 'the city'? If we consider research on the implications of climate change for the city-the trajectories of transition to future postcarbon, resilient urban futures—then the first critical issue is to understand what has been 'embedded' in a city, over the eras of its development. Then the question is what has to be transformed for a city to thrive in a new energy era and new climate conditions? That leads research towards an analysis of the (bio)physical infrastructures of the city—both its constructed objects (building and products) and its systems of provision (energy, water, food, transport, waste and so on). But cities are cultural and economic constructs; history, belief systems and values, power relationships and so on, have been layered over time as part of its fabric, intermingled with its physical structures. The result is that buildings, urban morphology, resource provision, social interaction, patterns of consumption, personal history and collective identity are all interlinked in complex ways. Failure to understand the multi-dimensionality of 'place' leads to apparently perverseor 'irrational'-outcomes of programs and policies aimed at change.

SESSION 2: URBAN INTERCONNECTIONS CONVENERS PROFESSOR WILL STEFFEN, PROFESSOR XUEMEI BAI



Will Steffen

Chair: Professor Will Steffen ANU Climate Change Institute

Will Steffen has a long history in international global change research, serving from 1998 to 2004 as executive director of the International Geosphere-Biosphere Programme (IGBP), based in Stockholm, Sweden, and before that as executive officer of IGBP's Global Change and Terrestrial Ecosystems project.

Prior to taking up the ANU Climate Change Institute directorship in 2008, Professor Steffen was the inaugural director of the ANU Fenner School of Environment and Society. From 2004 to 2011 he served as science adviser to the Australian Government Department of Climate Change. He is currently a climate commissioner with the Australian Government Climate Commission, chair of the Antarctic Science Advisory Committee, co-director of the Canberra Urban and Regional Futures (CURF) initiative and member of the ACT Climate Change Council.

Professor Steffen's interests span a broad range within the fields of sustainability and Earth System Science, with an emphasis on the science of climate change, approaches to climate change adaptation in land systems, incorporation of human processes in Earth system modelling and analysis; and the history and future of the relationship between humans and the rest of nature.

Urban areas are highly concentrated 'hot spots' of human activity, drawing in resources from their hinterland and much further away, processing them, and releasing by-products in such quantities that the functioning of the Earth system as a whole is now affected. What are the links between urban areas and their base of resources and ecosystem services, increasingly based on international trade? What are the major pathways of environmental impacts from local to global scales? And how are these pathways affected by social processes, such as governance and market valuation of externalities, given that resources often flow from places outside the immediate control of urban populaces, and urban wastes flow from urban areas to affect the whole world via atmospheric and oceanic circulation. Even solid wastes get transported around the world for dumping (legally or illegally) or processing by cheap labour elsewhere.



Tommy Wiedmann

A/Professor Tommy Wiedmann University of New South Wales

Tommy Wiedmann is associate professor of sustainability research at UNSW Australia with ten years of experience in integrated sustainability assessment and environmental footprint analysis. His main research question is how to achieve human wellbeing with fewer environmental impacts. He develops and applies environmental input-output analysis as part of a holistic concept to life cycle assessment, industrial ecology and sustainable consumption and production research. A/Professor Wiedmann coordinated a number of research projects funded by the European Commission and Australian and UK Governments. In 2012 he received the Thomson Reuters Citation Award in Australia.

Cities and their hinterlands—Accounting for and managing the global resource consumption of urban systems

Cities are thought to be associated with most of humanity's consumption of natural resources and impacts on the natural environment, with some research suggesting that up to 80% of global greenhouse gas emissions could be attributable to cities. This makes them primary agents of change in a resource- and carbon-constrained world.

In order to set meaningful targets, design successful policies and implement effective mitigation strategies, it is important that resource use and emissions accounting for cities is accurate, comparable, comprehensive and complete. However, a lack of consistent guidelines is hampering efforts to identify stakeholders and responsibilities and assign stewardship.

Building on recent developments, this presentation introduces a conceptual framework that allows for a consistent reconciliation of a city's direct and indirect resource use and emissions. A particular emphasis is placed on the evaluation of indirect or trans-boundary impacts and on the city's wider environmental footprint.

The accounting and allocating of urban environmental impacts is illustrated by creating 'impact maps' that show regional, national and global origins and destinations of flows of embodied resource use and emissions. Results for Melbourne are presented and options for a sustainable management, dematerialisation and decarbonisation of cities are discussed.



Michael Neuman

Professor Michael Neuman University of New South Wales

Michael Neuman is professor of Sustainable Urbanism in the Faculty of the Built Environment at the University of New South Wales in Sydney, Australia and principal of the Michael Neuman Consultancy.

Professor Neuman is the author of numerous articles, reports and plans translated into eight languages. His books include *The Futures of the City Region, The Imaginative Institution, Building California's Future*, and *Coordinating Growth and Environmental Management Through Consensus Building.* Dr Neuman has been awarded Fulbright and Regents fellowships, and best article awards in *Town Planning Review, European Planning Studies* and the *Journal of the American Planning Association.* His professional and scholarly work has won numerous awards ranging from the National Endowment of the Arts and the National Science Foundation to the American Institute of Architects, the American Planning Association, and the Spanish and Catalan governments. Dr Neuman's consultancy and professional practice span three decades, specialising in planning, design and infrastructure for sustainable towns, cities and regions, with an emphasis on adaptation, resilience and disaster recovery and preparedness in coastal areas. He currently advises the mayor of Naples, and has recently advised the mayor of Barcelona and Barcelona Metropolitan Plan, along with the Regional Plan Association of New York, and governments and private clients around the world. He received his PhD in City and Regional Planning from the University of California at Berkeley. His research and teaching interests include sustainable regions and communities, network infrastructure and governance institutions.

Are integrated infrastructure networks governable in contemporary city regions?

The complexity of infrastructure today, particularly its management and governance, can be observed in the large number of jurisdictions at several levels of government in a single city region. Jurisdictions are typically uncoordinated and often competing—complicating strategy formation, planning policy and service delivery. Notwithstanding, the most consequential matters regarding infrastructure provision today are not 'mere' governance and management. The most important factors are politics and finance, always coupled. Yet, speaking truth to power or connecting knowledge to action is not enough in an era where governments act against or in disregard of facts and evidence. In these circumstances, what are the most effective institutional structures and processes to allow for the innovation, financing and building of infrastructures that perform sustainably, equitably and affordably?



Aromar Revi

Aromar Revi Indian Institute for Human Settlements

Aromar is director of the Indian Institute for Human Settlements—India's prospective independent national University addressing the opportunities of urbanisation. He is a member of the Leadership Council of the UN Sustainable Development Solutions Network; co-chair of its Urban thematic group, where he leads a global campaign for an urban Sustainable Development Goal; a Fellow of the India China Institute at New School University and a member of the International Council of the International Convention of Asian Studies. He is an international practitioner, researcher and educator with three decades of interdisciplinary experience in public policy and governance, political economy of reform, development, technology, sustainability and human settlements.

Aromar is one of South Asia's leading experts on global environmental change and Climate adaptation and mitigation. He is a Coordinating Lead Author of the IPCC Assessment Report 5 on Urban Areas and co-PI of a 5-year international \$3 million Climate Adaptation research programme that spans India and Africa.

He is one of South Asia's most experienced risk and disaster management professionals having led teams to plan and

execute rehabilitation programmes for 10 major earthquake, cyclone and flood events affecting over 5 million people and is on the Advisory Board of UNISDR Scientific and Technical Advisory Group and its bi-annual Global Assessment of Risk.

Aromar has led over 100 major research, consulting and implementation assignments in India and abroad; has published over 50 peer reviewed publications and books; lectured and taught at over 35 of the world's leading universities and think tanks across six continents; helped structure, design and review development investments of over \$8 billion; worked on three of the world's 10 largest cities; and across all of India's 29 states and multiple international projects in half a dozen countries.

SPECIAL SESSION: FUTURE EARTH

Dr Mark Stafford Smith Chair, Future Earth Science Committee

Mark Stafford Smith looks after Adaptation Research Coordination for CSIRO, based in Canberra, Australia; he oversees a highly interdisciplinary program of research on many aspects of adapting to climate change, as well as regularly interacting with national and international policy issues. He has over 30 years' experience in drylands systems ecology, management and policy, including senior roles such as CEO of the Desert Knowledge Cooperative Research Centre in Alice Springs. Dr Stafford Smith's international roles include being past vice-chair of the International Geosphere-Biosphere Programme's Scientific Committee. In 2012 he was co-chair of the Planet Under Pressure: New Knowledge Towards Solutions conference on global environmental change in the lead up to Rio+20. In 2013 he was appointed Chair of the inaugural Future Earth Science Committee, which aims to help coordinate research towards global sustainability worldwide.

Future Earth—Responding to the challenges

In this Anthropocene age the human race is having an accelerating rate of impact on our planetary system. Without attention, these impacts will challenge global development and human well-being. Much of our attention to date has been on climate change, which remains an important issue. The world needs to de-carbonise at an unprecedented rate, opening opportunities for sustainable solutions. However, climate change is only one of numerous global environmental change problems that share characteristics of being clearly on a trajectory with long-term and often delayed implications for human well-being, where there is uncertainty in future scenarios



Mark Stafford Smith

that requires risk management, where it is hard to engender global agreements, and yet where decisions being taken today narrow our options for the next generation. How do we establish a global innovation system able to tackle such issues more nimbly, learning from the emerging experiences with climate adaptation? The new Future Earth global initiative aims to speed up our responses to such challenges.

Urban environments are clearly one key to success, representing both some of the greatest challenges and also the greatest opportunities. As an urbanised society, Australia has a special interest in getting pathways towards sustainable urbanisation right and resilient. Dr Stafford Smith will outline developments in Future Earth globally, in the region and in Australia, including the latest suggested research priorities at each of these scales. It would be good to build a collaborative research community on global sustainability here in Australia that transcends the natural, technological, and social sciences as well the humanities.

SESSION 3: URBAN RESPONSES TO GLOBAL CHANGE

CONVENER PROFESSOR JEAN PALUTIKOF



Jean Palutikof

Chair: Professor Jean Palutikof National Climate Change Adaptation Research Facility, Griffith University

Professor Jean Palutikof is director of the National Climate Change Adaptation Research Facility at Griffith University. She took up the role in October 2008, having previously managed the production of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report for Working Group II (Impacts, Adaptation and Vulnerability), while based at the UK Met Office.

Prior to joining the Met Office, she was a professor in the School of Environmental Sciences, and director of the Climatic Research Unit, at the University of East Anglia, UK, where she worked from 1979 to 2004, and a lecturer at the Department of Geography, University of Nairobi, Kenya, from 1974 to 1979.

Her research interests focus on climate change impacts and adaptation, and the communication of knowledge to adaptation decision-makers. A particular interest is extreme events and how to manage these in a changing world . She was a Lead Author for Working Group II of the IPCC Second and Third Assessment Reports, and a Review Editor for the Fifth Assessment. She has authored more than 200 papers, articles and reports on the topic of climate change and climate variability. Her proudest moment to date was attending the ceremony in 2007 at which the IPCC was awarded the Nobel Peace Prize.

The increasing concentration of people in cities offers both risks and opportunities for responding to global environmental changes. Many urban centres are located on coasts, floodplains and (sinking) deltas, and so are at risk from changes in flood frequency and storm surge as sea levels rise, especially where land use planning fails to take these changes into account. But, given that the world needs to build the equivalent of a new city of a million people every 10 days between now and 2100 to accommodate the rising urban population, there are immense opportunities to reduce vulnerabilities, and to undertake climate adaptation and mitigation actions that reduce the impact of cities and their resource linkages identified in Session 2. This session looks at some of the challenges facing future cities under global change and explores potential solutions to deliver sustainable and liveable environments.



Helen Cleugh

Dr Helen Cleugh CSIRO Oceans and Atmosphere Flagship

Helen Cleugh is currently the science director in CSIRO's Oceans and Atmosphere Flagship, based in Canberra. Prior to joining CSIRO as a research scientist over 20 years ago, she was a senior lecturer at Macquarie University. She has published over 60 refereed journal papers, books and book chapters and has research expertise in micrometeorology and convective boundary layer dynamics; microclimates of urban and non-urban ecosystems; and urban water use, microclimate and energy use.

Cities and climate change

By 2050, the world will be warmer and it will be mostly urban, with around 70% of the world's population projected to live in urban areas. This means that an increasing proportion of the world's communities are potentially more vulnerable to the impacts of urban warming superimposed on global warming; poor air quality; and infrastructure damage due to sea level rise and increased severity and frequency of extreme events.

The past and future trajectory of global urbanisation, mirrored here in Australia, and anthropogenic climate change are of course linked via the important agents of change in the Anthropocene, including land use change, industrialisation, increasing energy and fossil fuel use.

But if urban development is part of the problem—it is also part of the solution. This talk will consider these links between cities and climate change by exploring three elements: firstly, it will summarise the state of knowledge that has been derived over the last three decades that provide a strong physical understanding of the way cities affect local and regional climates. Secondly, it will address the way that cities are both an analogue for, and amplifier of, global climate change. The last part of this talk will discuss how cities are an important agent for both adapting to and mitigating urban climate change through climate sensitive and water sensitive urban design.



Peter Newton

Professor Peter Newton The Swinburne Institute for Social Research, Faculty of Health, Arts & Design, Swinburne University

Peter Newton is a research professor in Sustainable Urbanism at Swinburne University of Technology in Melbourne where he leads research on sustainable built environments. He is involved in three cooperative research centres: CRC for Low Carbon Living, CRC for Spatial Information, and CRC for Water Sensitive Cities, and is on the board of the Australian Urban Research Infrastructure Network. He is also a Fellow of the Academy of Social Sciences Australia. Prior to joining Swinburne University in 2007 he held the position of chief research scientist in CSIRO. Professor Newton received his PhD in urban systems analysis from the University of Canterbury and undertook post-doctoral studies at the University of Waterloo. He has subsequently authored or edited over 20 books on cities and the built environment. His most recent books include Resilient Sustainable Cities (2014), Urban Consumption (2011), Technology, Design and Process Innovation in the Built Environment (2009) and Transitions: Pathways Towards More Sustainable Urban Development in Australia (2008).

Challenges and prospects for a sustainable development transition of Australia's cities

High liveability rankings of Australia's major cities are obscuring a persistent set of sustainability challenges that feature in successive national reports on the performance of our human settlements. Key among these challenges are our world-leading levels of resource consumption and greenhouse gas emissions—factors that reflect our contemporary built environments and urban forms which currently limit prospects for our rapidly increasing urban populations to live more sustainable, low carbon lives (if they are so motivated). Transition to more sustainable forms of urban development now requires transformational rather than incremental change in a number of domains: new technologies for urban infrastructure, and innovative regenerative urban design at city, neighbourhood and building scales. Socio-technical urban transition is also contingent on breaking through barriers to change that reside within the institutional and community regimes that surround the established urban technologies and planning structures of our cities.



Sasha Ivanovich

Sasha Ivanovich SIA Architects, AURA Urban & Regional Alliance, Founder FHSI Architects Dubai

Sasha Ivanovich is director of SIA Architects and AURA Urban & Regional Alliance, founder of FHSI Architects Dubai. He is a practising architect and urban designer with over 20 years' experience, developing from the early 1980s a design approach based on sustainability principles.

Mr Ivanovich has taken an active role in the ongoing debate in the planning of the city, through various advisory committees in Perth and South West Western Australian local government authorities and postgraduate urban design studies. His proposal for WA Parliament square incorporating a museum focusing on west Australian indigenous history, in the City of Perth 'What If' urban studies, received 'best popular' public vote.

Mr Ivanovich is the recipient of the Australian Federal Government Endeavour Executive Award which enabled a residency study of the city of Masdar. He has been public speaker at a number of institutions on sustainability in design, including UNSW postgraduate school of Environmental Design, University of Western Australia Urban Design Research Centre (AUDRC), Making Cities Liveable Conference (Melbourne 2013), and Urban Design Conference, (Sydney 2013, Adelaide 2014).

Urban renewal: how will climate change and commercial imperatives change the vision of the 21st century ideal Australian city

In the 21st century, cities will need to be more 'smart machines for living' where public and private transport, landscape, buildings and infrastructure integrate and where utility and market place is mediated by design for people. The search for alternative energy sources and reduction of infrastructure costs/densification has brought out a new approach in a re-vision for our cities calling for appropriate practical solutions.

In Australia, the cost of infrastructure, ever increasing distance of travel from home to work, economy of health, cost of pollution, energy consumption and sheer inconvenience will be driving the economic analysis of Australian cities to densification.

One of most radical models of a 21st century city-to-be is Masdar, a fossil fuel-free city of 50,000 people yet to rise on the outskirts of Abu Dhabi. It promises a radical model for a 21st century city, proposing a carbon neutral design-forclimate integrated city model and development program. By contrast, the port city of Fremantle Western Australia is a typical Australian city with a rich history, a mixed demography, extensive heritage building stock and car-oriented past. It is seeking to address adaptation to climate change and maintain its commercial viability and liveability, and create high quality urban spaces for people.

With Masdar UAE and Karratha WA city renewal plan as reference, and AURA's Urban Alliance ideas for Fremantle CBD, the presentation will trace recent urban renewal initiatives in Fremantle that promise to bring the city to the forefront of urban renewal in Australia and address climate change.

The presentation will interrogate where urban renewal in Australia is heading in the context of climate change, and commercial imperatives that will impact on the overarching vision of an ideal 21st century city for Australia.



Krista Milne

Krista Milne Manager Sustainability, City of Melbourne

Krista Milne is manager of sustainability at City of Melbourne. Krista has carriage of the city's sustainability agenda including developing strategies, implementing business and community programs and supporting the council to embed sustainability into the way it does business. Prior to the City of Melbourne, Ms Milne was at the EPA Victoria for 10 years, so has a long history in environment and sustainability issues.

Creating an Eco-City; the Melbourne Challenge

Cities: they are the economic, social and cultural engines of the globe. By 2050, 70% of the population will live in cities. They only occupy two per cent of the world's land mass but they leave an enormous footprint. According to the C40 Cities Climate Leadership Group, cities consume over two-thirds of the world's energy and account for more than 70% of global CO2 emissions. Cities and their populations are significantly exposed to the risks of climate change. This paper will discuss how Melbourne is planning for the future ahead, responding to the impacts of climate change and creating the world's most liveable city in the process. It will also outline the challenges ahead that the world needs to come together to solve in cities.

SESSION 4: THE FUTURE OF CITIES: LIVING WITHIN PLANETARY BOUNDARIES

Professor Barbara Norman University of Canberra

Barbara Norman is the foundation chair of Urban and Regional Planning in the Faculty of Business, Government and Law, University of Canberra. She is director of Canberra Urban and Regional Futures (CURF) and an adjunct professor with The Australian National University. Professor Norman is chair of the ACT Climate Change Council and deputy chair of Regional Development Australia (ACT). She is a Life Fellow and past national president of the Planning Institute of Australia and Life Honorary Fellow of the Royal Town Planning Institute (UK). Her research and teaching interests include urban and regional planning, sustainable coastal planning, climate change adaptation and urban governance. Barbara was a contributing author to IPCC 5 WG 2 report on Impacts 2014. Professor Norman advises the public and private sector in Australia and has strong international linkages within Asia, Europe and the United States. She was awarded an Australian Centenary Medal for her contribution to the community through urban and regional planning.

The future of cities: living within planetary boundaries

In this presentation Professor Norman will share some of her own ideas and research, and draw together the key themes of the conference to map out an agenda



Barbara Norman

for sustainable cities. The twin global challenges of urbanisation and climate change require radical rethinking in how we plan, design and govern our cities in a low carbon future. Living within planetary boundaries will involve deep connections between leading environmental science and urban research, policy and practice. A major challenge is translating knowledge on the complexity of urban and environmental systems into effective implementation of sustainable solutions within cities. National policy on cities in developed and developing nations will play an important role in facilitating such change. New urban governance arrangements may well be required. This presentation will outline some of the key challenges and opportunities in 'living within planetary boundaries'.

POSTER DISPLAY PRESENTATIONS (ALPHABETICAL ORDER BY SURNAME OF PRESENTER)



Daniel Argüeso

Dr Daniel Argüeso University of New South Wales

Daniel Argüeso completed his PhD in 2011 at University of Granada (Spain) where he studied future changes in climate at high resolution with particular emphasis in changes of precipitation extremes. After his PhD he joined the Climate Change Research Centre and the ARC Centre of Excellence for Climate System Science at UNSW to work in the NARCliM project, which is aimed at generating high-resolution projections of climate change for southeast Australia. During this time he has also been directly involved in the study of Sydney urban expansion and its effects on temperature and humidity under future climate conditions. To that purpose he uses regional climate models at very fine spatial resolution coupled with urban canopy models. In addition to urban climate, Daniel is investigating other phenomena that also have considerable repercussions for the population, such as the characteristics and potential changes of East Cost Lows and the large-scale drivers of Australian heat waves.

Heat stress changes due to urban expansion and climate change

D. Argüeso^{1,2}, JP Evans^{1,2}, A Di Luca²

- 1. ARC Centre of Excellence for Climate System Science, University of New South Wales, Sydney, Australia
- 2. Climate Change Research Centre, University of New South Wales, Sydney, Australia

We examine the combined effect of urban expansion and climate change on heat stress over the Sydney region. A regional climate model was used to downscale information from a global climate model at very high-resolution for both present and future climate conditions. An urban canopy model coupled to the regional climate model was chosen to represent the interaction between urban structures and the atmosphere. The impact of urban expansion on near-surface variables, such as temperature and vapor pressure, was investigated and the role of city sprawl in modulating the climate change signal at local scales was quantified in terms of heat stress. An index that combines the aforementioned variables was chosen to estimate human heat-stress. Our results show that urban development and climate change will generate nighttime conditions of increased heat-stress risk in the Sydney region, with substantially more frequent adverse conditions in urban areas. Urban expansion enhances heat-stress increases due to climate change at night, but partly compensates its effects during the day. Differences between day and night are due to a stronger contribution from vapor pressure deficit during the central hours of the day and from temperature increases between sunset and sunrise, which are induced by urban surfaces. The need to include variables beyond temperature to determine changes in future human comfort is highlighted in this study and suggest that, in order to adequately assess climate change impacts in city areas, models need to include explicit representation of urban effects.



Dana Cordell

Dr Dana Cordell University of Technology Sydney

Dana Cordell is a research principal at the Institute for Sustainable Futures, University of Technology Sydney, where she undertakes and leads transdisciplinary sustainable food, sanitation and resource research projects from urban to global scales. Many projects involve high-level stakeholder engagement to improve the societal relevance of the research outcomes and foster mutual learning. Dana won the 2012 Eureka Prize for Environmental Research together with Professor White for their global phosphorus security work. Dr Cordell co-founded the Global Phosphorus Research Initiative (GPRI) in 2008 with colleagues in Sweden and Australia, as an outcome of her doctoral research 'Sustainability implications of global phosphorus scarcity for food security'. The GPRI now represents six leading research institutes across Europe, Australia and North America. In addition to transdisciplinary research, the GPRI facilitates networking and public debate among policy-makers, industry, scientists and the public regarding the risks and opportunities for food systems associated with global phosphorus security.

P-FUTURES: Integrating sustainable phosphorus management into urban decision-making and planning

Dr Dana Cordell¹, Dr Geneviève S Metson², Dr David M Iwaniec³

- 1. Institute for Sustainable Futures, University of Technology Sydney, Australia
- 2. Department of Natural Resource Sciences and McGill School of Environment, McGill University, QC, Canada
- 3. Global Institute of Sustainability, Arizona State University, Tempe, USA

The implications of global phosphorus scarcity for food security is emerging as one of the biggest global sustainability challenges this century. Without access to phosphorus, farmers and nations could not produce food, yet there are no effective global or local governance mechanisms in place to ensure long-term access to the resource and to stimulate and support sustainable phosphorus practices. At the same time, losses of phosphorus along the food chain contribute to widespread nutrient pollution of the world's waterbodies. Cities, as centres of food consumption and waste generation, can play a key role in more sustainable management of phosphorus such as efficiently capturing phosphorus from wastewater and food waste for reuse as renewable fertilizers in peri-urban agriculture. This poster highlights a new project, P-FUTURES, funded under the International Social Science Council's Transformations to Sustainability program as a contribution to Future Earth. Working collaboratively with city stakeholders in Vietnam, Australia, Ghana and the US, including urban planners and managers, this project assesses the urban vulnerability to phosphorus insecurity. The lower-middle income economies have relatively higher food insecurity, lower farmer purchasing power and low coverage of sanitation systems, leading to increased water pollution, both central aspects of phosphorus vulnerability. In the more developed cities of Phoenix and Sydney, persistent and intermittent water scarcity, respectively, coupled with expensive large-scale water and waste infrastructure, are larger drivers influencing phosphorus vulnerability, through decisions about water conservation and recycling. Intensive stakeholder workshops in each city will foster co-learning, and strengthen and create new networks within and between cities between researchers

and stakeholders. Linking phosphorus to existing city priorities including food security and water scarcity aims to start a dialogue towards the development of desirable scenarios and sustainable phosphorus adaptation strategies.



Cynthia Isley

Ms Cynthia Isley PhD candidate, Macquarie University

Cynthia Isley has a background in air pollution dispersion modelling and in contaminated site remediation. As chair of the Hunter branch of the Clean Air Society of Australia and New Zealand, she takes an active role in communicating air quality issues to environmental professionals and the wider community. Ms Isley's interest in improving air quality in Australia and overseas has led her to her current research of the air quality in Suva, Fiji, as a PhD at Macquarie University. She aims, through air sampling, statistical analysis and air emissions inventory development, to determine the contribution of waste burning and of fossil fuel usage to air emissions in Suva, which will allow emission-reduction programs to be more effectively targeted and air quality and health in Suva to be improved.

Waste disposal challenges in Pacific Island Countries

Cynthia F Isley¹, Peter F Nelson¹, Mark P Taylor¹, Francis Mani², Matakite Maata²

- 1. Macquarie University, Sydney, Australia
- 2. University of the South Pacific, Suva, Fiji

Islands in the tropical South Pacific face many challenges due to our changing climate and rising sea levels; with waste disposal being a major issue. Atoll island countries, such as Kiribati, face increasing difficulties in waste disposal as land area decreases. In Fiji, like other Pacific island countries (PIC's), burning of wastes is common, in rural areas and in the capital city, Suva. 52% of Fiji's population lives in urban areas and urban population is increasing at twice the rate of the national population. Survey results indicate that 53% of Suva households burn some or all of their household waste and 45% burn yard and garden waste, although 89% of households surveyed had waste collection services. Apart from re-use of glass bottles, recycling programs are minimal. The challenge of relatively small population and land resources, spread over vast distances, makes recycling programs costly. As the urban population in Suva and across PIC's increase reliance on imported food and goods, such as foreign cars, the volume of wastes is increasing. Subsequent burning of these materials contributes to air pollution, causing health concerns, with preliminary data, measured in October 2014 in Suva, indicating fine airborne particulate levels (PM_{2,5}, particulate matter less than 2.5 microns), may exceed World Health Organization guidelines by up to five times in residential areas. Additionally, emissions from burning contribute to global warming, exacerbating issues related to sea level rise. Ensuring a healthy and sustainable future for the Pacific Island community will involve education programs on waste disposal and significant reduction of imported packaging. Investigation of such ideas as packaging-return agreements to country-of-origin and multi-island collaborative recycling programs continues and requires further development.



Sarah James

Dr Sarah James Australian National University

Sarah James is a post-doctoral research fellow on Food Systems at the National Centre for Epidemiology and Population Health, at the Australian National University. Prior to this she lectured in geography and environmental studies at Macquarie University, Sydney. She earned her PhD at the University of Western Sydney. Her doctoral research focused on the impact of peri-urban development on Sydney's small-scale farmers.

Resilient urban food systems to promote population health in a changing climate

Authors: Sarah James and Sharon Friel

This poster brings together evidence from an Australianbased three year mixed methods research project focused on climate change adaptation, cities, food systems and health. The study examined the production, distribution and consumption sectors in the food chain in order to identify the efficacy of various food sub-systems (industrial, alternative commercial and civic) in achieving climate resilience and good nutrition. The key findings of the tripartite study were: 1) industrial food production systems can be more environmentally sustainable than alternative systems indicating the importance of multiple food subsystems for food security. 2) A variety of food distributors stocking healthy and sustainable items are required to ensure that these items are accessible, affordable and available to all. 3) It is not enough that healthy and sustainable foods are produced or sold; consumers must also want to consume them. In summary, a resilient urban food system requires that healthy and sustainable food items are produced, that consumers can obtain it and that they actually wish to purchase it. A whole of system approach is necessary to achieve urban food systems that are more sustainable, equitable and healthy for both population and environmental health.



Mathew Lipson

Dr Mathew Lipson University of New South Wales

Mathew Lipson completed a Bachelor of Physics with Honours in Climate System Science at the University of New South Wales in 2014. He undertook a variety of research projects in urban climate with the Centre of Excellence for Climate System Science throughout his degree. Mat's interest in urban climate is informed by his previous experience as an architect.

Efficiently simulating the impact of Australian urban areas on climate

Authors: Mathew Lipson (UNSW), Melissa Hart (UNSW), Marcus Thatcher (CSIRO)

As the combined effects of urbanisation and climate change act to alter the climate of cities, policymakers, planners and urban designers are proposing a variety of measures to mitigate negative impacts but the effectiveness of measures need quantitative assessment. High resolution fluid dynamics models can make meteorological predictions at a local scale, but can be impractical in making city-wide climatic assessments as the complex nature of cities and the climatic timescales require vast computational resources. This study assesses the ability of a highly idealised urban climate model to predict how average building densities, urban materials and vegetation affect the partitioning of energy at half-hourly intervals. The model has been developed by CSIRO with the intention of eventual integration with land surface, weather prediction and regional climate models such as ACCESS, CABLE and WRF. Flux tower observational data from a medium density residential site in Melbourne are used to quantify model errors in radiative and turbulent heat fluxes over an 18 month period. Model performance is compared to 32 other similar urban models used by research groups internationally. Methods to aggregate average urban characteristics are explored, and the affect of real-world building practices on theoretical thermal characteristics are discussed. The model compares favourably to other similar urban models, although further testing is advisable in other urban areas before the model is considered robust for use in experiments Australia wide.

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Contacts

General enquiries

Samires Hook **0412 438 626** Mitchell Piercey **0466 271 430**

Media inquiries

Bella Counihan 0419 212 219

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