

PROCEEDINGS

5th Early Career Researchers' National Forum & Workshop University of New South Wales 11-13 May 2011

Australian Climate Change Adaptation Research Network for Settlements and Infrastructure



Easter Island

Photo courtesy of Lincoln Quilliam, UNSW

ACCARNSI 5TH NATIONAL ECR FORUM AND WORKSHOP PROGRAM

Day 1: Wednesday 11 May 2011

8.30	<i>TEA AND COFFEE ON ARRIVAL</i>
8.45	Forum Welcome: ACCARNSI Network Convenor Associate Professor Ron Cox
9.00	CREATIVE DEVELOPMENT WORKSHOP FACILITATED BY NIDA Team Building, Creative Presentation Delivery and an Introduction to Voice
11.00	<i>MORNING TEA</i>
11.30	Introduction: Node 3 - Built Environment, Innovation and Institutional Reform - Dr Peter Graham
11.45	The information and communication barrier that prevents successful adaptation: its magnitude and causes <i>Emma Austin, University of Newcastle</i>
12.05	Operationalising Climate Adaptation through Institutional Change: Conceptual and Empirical Insights <i>Tony Matthews, Griffith University</i>
12.25	The adaptive capacity of communities affected by environmental change: a case study of the Coorong and Lower Lakes <i>Melanie Gale, University of South Australia</i>
12.45	Community-Based Flood Vulnerability and Adaptation Assessment -Methodological Contribution in its Evaluation: A Case Study from Bangladesh <i>MAF Younus, University of Adelaide</i>
1.00	<i>LUNCH</i>
2.00	Climate Change Vulnerability Assessment (CCVA): Challenges, and research directions <i>Fahim Tonmoy, University of Sydney</i>
2.20	Environmental Conscious Planning of Sustainable Supply Chains <i>Behnam Fahimnia, University of South Australia</i>
2.40	Investigating energy-related GHG emission of low-cost housing in Kuala Lumpur using UNEP-SBCI's Common Carbon Metric <i>Suzaini Zaid, University of New South Wales</i>
3.00	Stormwater harvesting as a strategy for climate change adaptation in cities <i>Martin Ely, University of Adelaide</i>
3.20	South Australian farmers' markets: Imagining a multifunctional future for Australian Agriculture <i>Simon Fielke, University of Adelaide</i>
3.35	<i>AFTERNOON TEA</i>
4.05	GUEST SPEAKER - Associate Professor Bruce Judd, Visiting Senior Research Fellow, City Futures Research Centre, University of New South Wales
4.45	<i>DISCUSSION</i>
5.00	CLOSE

Day 2: Thursday 12 May 2011

8.45	FIELD TRIP Coach will pick up from Randwick Lodge, 211 Avoca St Randwick
1.30	Introduction: Node 2 - Urban Management, Transport and Inclusion Professor Graeme Hugo
1.45	Adapting to climate change – implications for transport infrastructure, transport systems and travel behaviour <i>Michelle Philp, University of South Australia</i>
2.05	Adapting to changes in transport access – a focus on business owners in town centres <i>Claudine Moutou, University of Sydney</i>
2.25	The Usage of Underground Pedestrian Systems in a Mega City in a Developing Country – A Case Study of Shanghai, China <i>Jianqiang Cui, University of South Australia</i>
2.45	Adopting climate change in local level urban planning practice <i>Reazul Ahsan, University of South Australia</i>
3.05	Climate Change Crisis: Its implications for African economy <i>Paul Atem, University of South Australia</i>
3.20	<i>DISCUSSION</i>
3.30	<i>AFTERNOON TEA</i>
4.00	Introduction: Node 4 - Infrastructure - Katie Vines, Office of Environment and Heritage, NSW Dept of Premier and Cabinet
4.15	Adaptation in heavily regulated aquatic ecosystems - what do we prioritize? <i>Dominic Skinner, University of Adelaide</i>
4.35	The assessment of climate and land use changes on flood risk in SEQ <i>Yi-Ru Lily Chen, Griffith University</i>
4.55	Climatic drivers and their effects on future water availability in the Murray Darling Basin <i>Mohammad Kamruzzaman, University of South Australia</i>
5.15	Climate change impacts on the durability of structural materials <i>Ivan Iankov, University of South Australia</i>
5.35	Climate change impact on Infrastructure cost appraisal <i>Xinlei Zhang, University of New South Wales</i>
5.50	<i>DISCUSSION</i>
6.00	CLOSE
6.45	GROUP DINNER - Chao Praya Thai Restaurant, 33 Perouse Rd Randwick Meet at Restaurant

Day 3: Friday 13 May 2011

9.00	<i>TEA AND COFFEE ON ARRIVAL</i>
9.15	Introduction: Node 1 - Coastal Settlements Professor Rodger Tomlinson
9.30	Past, Present and Future Landscapes: Understanding Alternative Futures for Climate Change Adaptation of Coastal Settlements and Communities <i>Phil Morley, University of New England</i>
9.50	Climate Change Adaptation: Measuring Individual Community Response in Coastal Australia <i>Alianne Rance, University of Western Australia</i>
10.10	Quantifying climate related risk in the coastal zone: the gap between the knowing and the doing <i>Heather Stevens, University of Newcastle</i>
10.30	Collaborative climate risk management in canal developments: Towards a more sustainable coastal zone through dialogue and deliberation <i>Jiska de Groot, University of the Sunshine Coast</i>
10.45	<i>MORNING TEA</i>
11.15	A risk based approach to prediction and planning for climate change impacts on the NSW coast <i>Marc Daley, University of Sydney</i>
11.35	Monitoring and forecasting beach behaviour in a variable climate <i>Melissa Mole, University of New South Wales</i>
11.55	An Energy Based Empirical Model of Storm Induced Shoreline Erosion – Gold Coast, Australia <i>Ed Kearney, University of New South Wales</i>
12.15	GUEST SPEAKER - Professor Michael Taylor, Director, Barbara Hardy Institute, University of South Australia
12.45	<i>LUNCH</i>
1.45	Planned retreat as a management response to coastal risk: A case study from the Fleurieu Peninsula, South Australia <i>Rhiannon Niven, University of Adelaide</i>
2.05	Coast Protection Board Advice and Uptake into Coastal Development Decision-making in South Australia <i>Nicole Pelton, University of Adelaide</i>
2.25	Planning for Sea Level Rise in South Australia <i>Merinda Edwards, University of South Australia</i>
2.45	Climate Change Adaptation for Easter Island <i>Lincoln Quilliam, University of New South Wales</i>
3.00	<i>DISCUSSION</i>
3.15	<i>AFTERNOON TEA</i>
3.45	Forum Close: ACCARNSI Network Convenor Associate Professor Ron Cox
4.15	AIRPORT SHUTTLE to Sydney Domestic Airport Terminals 2 and 3 for those returning on the Friday (leaves from UNSW outside Australia Post Office)

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**THE INFORMATION AND COMMUNICATION BARRIER THAT PREVENTS SUCCESSFUL ADAPTATION:
ITS MAGNITUDE AND CAUSES**

Analysis of historical climate records demonstrates the highly variable nature of Australia's climate. Together with natural climate variability and change, anthropogenic climate change will continue to impact Australia's climate. Australia's coasts and inland areas will experience increased incidences of drought, flooding, bushfire and heatwaves. These extreme events threaten human health, infrastructure and socio-economic interactions. Successful adaptation aimed at minimising and avoiding the impacts of climate change, is dependent on effective decision-making and policies based on the best available climate science. However, a fundamental barrier exists within the adaptation process between climate science and decision-makers in both the private and public sector. This disconnect is the result of a lack of understanding, firstly, by climate scientists of the needs of decision-makers (end users), and secondly, by decision-makers (end users) of the climate science, in particular an incomplete understanding of the associated scientific limitations and uncertainties. Recent research into the barriers and limits of climate change, identifies this disconnect as preventing well documented facts, themes and recommendations from being implemented and translated into successful adaptation outcomes. This presentation will summarise the findings, to date, of a current project investigating the magnitude and causes of this information and communication disconnect. Although the project focuses primarily on rural communities, the disconnect is widely acknowledged as existing in the adaptation process generally, as it transverses sectoral, governmental and geographical boundaries.

BUILT ENVIRONMENT, INNOVATION AND INSTITUTIONAL REFORM

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OPERATIONALISING CLIMATE ADAPTATION THROUGH INSTITUTIONAL CHANGE: CONCEPTUAL AND EMPIRICAL INSIGHTS

Adaptation is increasingly understood as a necessary response in respect of climate change impacts on urban settlements. Australia is heavily urbanised and climate change is likely to impact severely on its urban environments. Accordingly, climate adaptation must become a key component of urban management. This working paper is part of a wider project and reports early insights into the problem of how adaptation may be operationalised within a planning regime through institutional processes. In this instance, the operationalisation of adaptation refers to adaptation becoming incorporated, codified and implemented as a central principle of planning governance. This paper has three key purposes: first, to set out a conceptual approach to climate adaptation as an institutional challenge; second, to identify the intersection of this problem with planning; third, to report on an on-going empirical investigation in Southeast Queensland (SEQ). Informed by key social scientific theories of institutionalism, this paper develops a conceptual framework that understands the metro-regional planning system of SEQ as an institutional regime capable of undergoing a process of change to respond to the adaptation imperative. It is posited that the success or failure of the SEQ regime's response to the adaptation imperative is contingent on its ability to undergo institutional change. A capacity for change in this regard is understood to be subject to the influence of various internal and external barriers and pathways that promote or hinder processes of institutional change. Specific attention is paid to the role of 'storylines' in facilitating or blocking institutional change.

BUILT ENVIRONMENT, INNOVATION AND INSTITUTIONAL REFORM

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THE ADAPTIVE CAPACITY OF COMMUNITIES AFFECTED BY ENVIRONMENTAL CHANGE: A CASE STUDY OF THE COORONG AND LOWER LAKES

The severe drought Australia has endured over the past few years has impacted adversely on the environment and is the major cause of the reduction of water levels in the Coorong and Lower Lakes (Brodie, Gow, Haese & Wallace 2008). Although the drought has broken and the region has received significant rainfall in the past twelve months, paradoxically State governments are still fighting over water allocations.

The research will explore the adaptive capacity of settlements affected by climate change, the over-allocation of water resources and environmental degradation in the Coorong and Lower Lakes region.

Social, economic and environmental interdependencies have been identified as an issue and are a significant element in the functionality of the Coorong and Lower Lakes communities. Interdependencies are complicated by legislative ambiguity about Federal and State legislation and responsibilities for the area, significant proportions of, which are subject to international environmental agreements. Further research is required on the functionality of these communities, which are challenged by significant environmental change and ambiguous responses from Federal and State Governments.

Drawing on Beck's (2007) risk theory, this paper analyses the adaptive capacity of settlements in the Coorong and Lower Lakes area and how they respond to the stresses and risks caused by environmental degradation and climate change. Theories such as this can help planners to understand risk and hence how to implement management systems and approaches that will be effective in managing the predicted severe impacts of climate change.

BUILT ENVIRONMENT, INNOVATION AND INSTITUTIONAL REFORM

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**COMMUNITY-BASED FLOOD VULNERABILITY AND ADAPTATION ASSESSMENT -
METHODOLOGICAL CONTRIBUTION IN ITS EVALUATION: A CASE STUDY FROM BANGLADESH**

IPCC (2007), in its contribution to the fourth assessment report of the intergovernmental panel on climate change, warned that the mega deltas in South Asia (e.g. the Ganges Brahmaputra Meghna River basin) will be at greatest risk due to increased flooding; the frequency and multi-peak floods have increased over time, and the region's poverty would reduce the adaptation capacity. IPCC, United States Country Study Program and UNEP have formulated vulnerability and adaptation (V & A) to climate change guidelines where 'adaptation' is being emphasized; IPCC's adaptation chapter 17 has been published as a report. It is emphasized that adaptation efforts particularly in developing countries should be accelerated. Based on the above guidelines, the study has adopted V & A assessment steps.

The evaluation of V & A assessments is mainly accomplished in this study by a weighted matrix index value; this weighted matrix index value is derived from two participatory rapid appraisals (PRAs) in 2006. The vulnerable farmers, including their various professional associates expressed their opinions on categorized V & A assessment issues with various types of extreme flood events. The evaluation processes and their prioritization are based on the outcomes of a random questionnaire survey of over 140 households in seven Unions in the case study *Islampur (Thana on Jamuna River, located in north-central Bangladesh)*.

The study has dealt with a range of V & A issues and methods: 1) the understanding of issues of vulnerability and adaptation techniques in response to three extreme flood events; 2) these issues were categorized on the basis of a weighted matrix index; 3) vulnerability issues were classified into four categories in accordance with degree of severity and these together offered a genuine picture of vulnerability in a flood stricken area; 4) adaptation issues were classified into three categories and this revealed that some inbuilt, routine and tactical adaptation techniques are already being executed but there are other high priority adaptation techniques that affected people are asking for; 5) where the adaptation capacity threshold is exceeded, some tactical interventions (V & A issues) have been identified and adopted; 6) the methodology used in this study through PRAs makes an important methodological contribution for assessing vulnerability and adaptation; 7) the required adaptation techniques can be adopted for immediate policy making and appropriate actions should be undertaken.

The method (PRAs) adopted in this study can be applied for assessing V & A in Australia, particularly in evaluating the recent flood events in Queensland.

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CLIMATE CHANGE VULNERABILITY ASSESSMENT (CCVA): CHALLENGES AND RESEARCH DIRECTIONS

Quantitative Climate Change Vulnerability Assessment (CCVA) can help in better allocating adaptation resources, identify “hot spots” and better understand systemic weaknesses in the ability to cope with climate hazards. The framework adopted by the Intergovernmental Panel on Climate Change (IPCC) includes three dimensions of vulnerability, namely the external, i.e. geophysical and climatic, determinants of risk, called “exposure”, and the internal dimensions of vulnerability (“sensitivity” and “adaptive capacity”). Furthermore, vulnerability is compounded by multiple climate stressors such as heat waves, forest fires, droughts etc. Proxy indicators are often used in the literature to construct indices of vulnerability to different stressors under each dimension. One of the most significant challenges of vulnerability metrics is to combine multiple indicators into indices of vulnerability for a given stressor under a given dimension, and then combine multiple indices in order to build an overall picture of vulnerability. The predominant approach in the literature is a Summative Additive Weight method (SAWM) which presents significant theoretical problems. Other challenges of CCVA present in the literature are problem associated with measuring scale, uncertainty and change in time of vulnerability. Appropriate framework, indicators, methods and available data varies with the scale of CCVA (i.e., global, national, local etc). Moreover, major uncertainties that exist at different levels of the system such as, indicator score and weight estimation, location of thresholds are often neglected in the literature as it is dominated by deterministic CCVA methods. This presentation will illustrate the said challenges of CCVA and some of the proposed approaches developed in this PhD research to address them with references to local government areas in Metropolitan Sydney.

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ENVIRONMENTAL CONSCIOUS PLANNING OF SUSTAINABLE SUPPLY CHAINS

Supply Chain Management (SCM) concerns with the selection of strategies and methodologies to facilitate the optimal flow of material from raw material suppliers to the end-users through procurement, production and distribution activities. Since the introduction of SCM, many corporations have thrived by competing on cost and customer service level, while paying poor attention to how supply chain (SC) decisions affect other aspects of human life such as the environment and sustainability of natural resources. It is recognised over the past few years that the long term success of SC executives must be built not only on profitability but also on their contribution to the future of people and our planet (i.e. social and environmental issues). This was where the concept of Sustainable Supply Chain (SSC) emerged.

The literature on planning for a SSC is still limited in quantity. However, it can be realised that the major challenge in developing a complex SSC model is the need to develop adequate measures quantifying the social and environmental impacts of SC activities. Our current research aims to develop a commercially acceptable bi-objective SC model in which the first objective is to minimise the overall system costs while the second objective concerns with the minimisation of the environmental effects of the system. The latter objective deals with the minimisation of pollutants produced by manufacturing plants as well as the emissions generated for the transportation of products from the manufacturing plants to the end-users.

BUILT ENVIRONMENT, INNOVATION AND INSTITUTIONAL REFORM

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INVESTIGATING ENERGY-RELATED GHG EMISSION OF LOW-COST HOUSING IN KUALA LUMPUR USING UNEP-SBCI'S COMMON CARBON METRIC

Malaysia announced a voluntary commitment to reduce 40% of its greenhouse gas (GHG) emissions by year 2020 at the 2009 United Nations Climate Change Conference in Copenhagen (COP-15). This commitment has not been greeted with much optimism based on existing legislation, environmental awareness, and industrial demands. Currently, there is no legislation that holds environmental sustainability mandatory for major GHG emitting sectors such as energy, transportation, and oil and gas. Moreover, no government agency has indicated a leadership role or provides any operational framework that addresses the emissions reduction agenda. Without operational strategy and enforced legislation, it is less likely that Malaysia will know whether it is making significant emissions reduction. The aim of this research is to validate United Nations Environment Programme's (UNEP) Common Carbon Metric in the Malaysian context, measuring the operational carbon emission of selected low-cost housing projects. This research presents measureable, quantifiable and verifiable data of operational carbon equivalent emission through energy related consumption, for policy and performance-based building codes development. Employing a top-down and bottom-up approach analysis informs the contemporary context, and contributes to national baseline emissions data for existing building typology. Through baseline emission Malaysia will be able to monitor its progress towards its 40% GHG reduction target.

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STORMWATER HARVESTING AS A STRATEGY FOR CLIMATE CHANGE ADAPTATION IN CITIES

The urban heat island effect results in higher temperatures in cities compared with surrounding rural or natural areas. This may create a local overlay on the higher temperatures resulting from climate change, with impacts on human health and well-being in cities. Urban vegetation, in the form of trees and green spaces can assist in modifying urban microclimates through the phenomena of shading and evapotranspiration. The evapotranspiration mechanism plays a significant though often unrecognized role in urban cooling. Evapotranspiration, and vegetation survival, depends on an adequate supply of available soil moisture. In the modern city, however, the natural water cycle has been significantly modified due to the combined effects of impervious surfaces and efficient drainage systems effectively exporting water away from cities. This combined with conditions of drought, climate change and watering restrictions results in dry urban soils, which further impact on urban microclimates and vegetation. Current research efforts such as the Cities as Water Supply Catchments program aim to quantify the climatic and human benefits of Water Sensitive Urban Design (WSUD) initiatives such as stormwater harvesting which help to recharge urban soil moisture. This paper examines the role of stormwater harvesting as a means of better replicating the natural water cycle in cities, and as a climate change adaptation strategy in urban areas.

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SOUTH AUSTRALIAN FARMERS' MARKETS: IMAGINING A MULTIFUNCTIONAL FUTURE FOR AUSTRALIAN AGRICULTURE

This work critically examines the role of farmers' markets in South Australian agriculture using the theoretical framework of political ecology. All of the stallholders at three farmers' markets situated in Adelaide, Willunga and Berri were surveyed regarding their production and marketing techniques. Overall responses supported literature highlighting the extreme importance of farmers' markets to the producers who chose to exploit this marketing niche. A strong co-reliance on 'wholesale sales' was also recognised, suggesting an important integration of productivist and post-productivist approaches to agricultural development. Of most promise for long-term agricultural sustainability was evidence that certain groups of farmers were found to be realising the potential of these and other alternative markets, in terms of their risk reducing capacity, and diversifying to include various conservation values into their agricultural enterprises. These groups were less concerned with market fluctuations and more concerned about: issues of social equity; adapting to climate change; environmental health; and having fun, which meant they epitomise the goals of political ecology, by challenging the dominant agricultural methods of production and marketing. It seems these groups also recognised that the direct nature of their transactions would sow beneficial social, environmental and economic 'seeds' for change. Finally, it was argued that policies to improve access to farmers' markets and reduce the cost of participation would assist an important component of Australian agriculture to evolve smoothly into a post-productivist era and adapt to climate change.

URBAN PLANNING, TRANSPORT AND INCLUSION

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**ADAPTING TO CLIMATE CHANGE – IMPLICATIONS FOR TRANSPORT INFRASTRUCTURE,
TRANSPORT SYSTEMS AND TRAVEL BEHAVIOUR**

This paper reviews land based transport related issues from considerations of climate change adaptation in Australia. The two main issues for climate change adaptation are sea level rise and the increased frequency and intensity of extreme weather events. These issues are considered in the paper. It considers the risks to existing transport infrastructure and the resulting considerations necessary in planning new infrastructure, transport systems operations under changing climatic conditions, and potential changes in travel behaviour. The use and capability of regional rural networks in emergency evacuation planning emerges as one particular area for further research. More generally, recognition of the risks associated with climate change is required for better planning of new infrastructure and mitigating potential damage to existing infrastructure. Climate change poses a significant risk to infrastructure and its owners, managers, operators and users. There is a need to undertake research into the likely impacts of climate change on Australia's transport infrastructure, establish the categories of infrastructure most at risk and outline opportunities for adaptation responses, and examine the current governance structures. Then the administrative, legal and other issues that may impact on climate change adaptation can be identified.

URBAN PLANNING, TRANSPORT AND INCLUSION

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ADAPTING TO CHANGES IN TRANSPORT ACCESS – A FOCUS ON BUSINESS OWNERS IN TOWN CENTRES

Reducing the amount of car-based travel is a strategy for transitioning urban societies to one that can better adapt to a climate change future. It is a significant challenge. Convincing people to reduce their car-based travel not only requires a change in traveller behaviour and transport choices, but also a change in how transport modes are valued. Business owners who rely on customers making trips to their stores by car, are a case in point. Car parking matters to business owners. Irrespective of the benefits that a pedestrian and bike friendly, transit connected town centre offers, observations about the level of business owner resistance suggests it is perceived as less than adequate compensation for the loss of car parking. Local business resistance is politically difficult for local government, but a local centre experiencing rapid economic decline is even less desirable.

This PhD research aims to understand the business owner perspective to changes to transport access. Unlike other studies that focus on economic impacts, this study focuses on what business owner-orientated goals are perceived to be threatened. A goal-focused approach differentiating between protective and opportunity creating goals is hypothesized as having an influence on the choice and efficacy of strategies used to cope with change. For those such as local government, who want to reduce car dependency whilst maintaining vibrant local economies, this research will offer new understanding of an important group of stakeholders, as well as strategies for seeking business owner co-operation.

URBAN PLANNING, TRANSPORT AND INCLUSION

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THE USAGE OF UNDERGROUND PEDESTRIAN SYSTEMS IN A MEGA CITY IN A DEVELOPING COUNTRY – A CASE STUDY OF SHANGHAI, CHINA

The threat of catastrophic climate change through anthropogenic induced global warming has led to many countries pursuing the principles and practice of environmentally sustainable development, of which transportation is a critical component. Pedestrian transport is recognized as the most environmentally sustainable transport mode. In dense urban settings, underground pedestrian systems (UPS) is an important part of an urban pedestrian network, offering considerable potential to ease often conflicting supply and demand requirements for urban land, whilst creating opportunities to integrate urban functions and invigorate urban life. Accordingly, UPS have been successfully implemented in many cities around the world.

From the 1980s on, Chinese mega cities have built some UPS within their central business areas and extended their scale gradually. Chinese cities with dense and massive populations have during the process of urbanization experienced increased conflicting supply and demand requirements for urban land resulting in enormous pressures for urban space and basic movement circulation for pedestrians. As traffic congestion and motor vehicle traffic has increased almost exponentially, this situation has resulted in continuous UPS development during the preceding 30 years. UPS have significantly affected urban life in the larger Chinese cities but unfortunately, research on the usage and critical review of UPS has been lacking. This paper discusses some preliminary findings to emerge from a recent survey of Shanghai's UPS that provides important insights revealing the usage and performance of an UPS in a mega city within a developing country.

URBAN PLANNING, TRANSPORT AND INCLUSION

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ADOPTING CLIMATE CHANGE IN LOCAL LEVEL URBAN PLANNING PRACTICE

The impact on human settlements has been startling, demonstrated by climate events such as flash flood and cyclone in Queensland, Hurricane Katrina in Florida and Cyclone SDR and AILA in Bangladesh. But the results of such climate change induced events are not confined to the immediate or primary effects. Hundreds of millions of people, mostly from those exposed coastal zones, face forced displacement and will need to migrate in search of alternative livelihoods which considered as indirect impact of climate change. Such climate induced push factors lead to a chaotic overwhelming urbanization with attendant congestion and pollution choking urban growth as the tertiary level of impact of climate change. This tertiary level of climate impact is not only challenges for developed nations but it is a challenge for low-elevated coastal countries as well. The question is how the local government and planning system could address such flux of migration and urbanization result from primary impacts of climate change. Queensland in Australia and Khulna from Bangladesh are both low-elevated cities and threatened by the extreme climate events and forced displacement though they are from two different regions and has different local government system. Using those two regions as example this study seeks to develop local level planning approach, which seek to cope with the escalating scale of the problems, are examined and the interconnections between climate change, displacement and urban policy are explored.

URBAN PLANNING, TRANSPORT AND INCLUSION

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CLIMATE CHANGE CRISIS: ITS IMPLICATIONS FOR AFRICAN ECONOMY

Development in African countries depends significantly on agriculture, fisheries, forestry and tourism which are currently under threat due to climatic change in the region. Understanding the impact of climate change emerges as crucial to sustainability and to the economic development in Africa. The traditional practices and especially traditional modes of energy production and consumption have been recognized as the primary sources of greenhouse gas emissions affecting climate change in Africa. The problem of climate change is anticipated to have serious impacts on droughts, floods, water resources, food security, health, infrastructure and other economic development. A majority of African countries are susceptible to the impact of climate change primarily due to the profound poverty across the continent, lack of rainfall which has implications on agriculture and lack of access to technology which leaves African people dependent on their traditional agricultural practices. Recent scientific studies have reported gravely high rates of climate change in the region requiring urgent national and international response. It is important to reduce greenhouse gas emissions around the world to decrease the danger of very damaging and potentially irrevocably impacts on ecosystems, societies economies (Stern Review, 2006. This scrutiny and analysis is supported by newly released Fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC, 2007). In Africa the implications are dire. The African countries are at risk of experiencing climate change crisis and are exposed to becoming poorer. This paper explores the implications for climate change on African social and economic development.

INFRASTRUCTURE

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ADAPTATION IN HEAVILY REGULATED AQUATIC ECOSYSTEMS - WHAT DO WE PRIORITIZE?

The extent of adaptation management to climate change required by an aquatic ecosystem is dependent on its condition. Extensive regulation that alters the hydrological regime can fundamentally disturb the biogeochemical cycling, species distribution and food web interactions in water bodies, which consequently reduces the resilience of these systems to adapt to external perturbations, such as climate change. As an example, Lake Alexandrina and Lake Albert are heavily regulated, degraded systems at the end of the Murray Darling Basin. I argue that climate change adaptation of these systems would be futile without a stronger focus on returning these ecosystems to something resembling their pre-regulated condition.

INFRASTRUCTURE

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THE ASSESSMENT OF CLIMATE AND LAND USE CHANGES ON FLOOD RISK IN SEQ

Flooding can result in damage to properties, health problems and loss of life. For example, in 2011, summer floods caused many people homeless in SEQ. Projected rapid land use change over the coming decades, when coupled with climate change, could potentially lead to increased risk of flooding in urban catchments. Urbanization has resulted in a significant boost to the impervious surfaces, thereby increasing surface runoff and, consequently, increasing flood risk. It is therefore of interest to the local and state governments and communities to develop robust methods for flood management plans. This research aims to examine the impact of climate and land use changes on flood risk in two urban catchments in South-East Queensland. Three scenarios of land use and climate were considered to evaluate the future flood risks due to climate and land use changes. Flood hydrographs and flood maps were generated by using one hydrologic model and two climate models. The preliminary results showed that flood frequency will increase for small flood events. This is expected because the low rainfall events will increase in the future. Given the uncertainties of climate and land use projections, however, more scenarios will have to be built and more modeling approaches will have to be used in order to cover a wider range of possibilities of flooding in SEQ. The outcomes of this research will then be able to be used as a reference by urban planners, property investors and others whose activities are directly or indirectly affected by flooding in SEQ.

INFRASTRUCTURE

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CLIMATIC DRIVERS AND THEIR EFFECTS ON FUTURE WATER AVAILABILITY IN THE MURRAY DARLING BASIN

The aim of this research is to assess various climatic drivers and their sensitivity using regression techniques. The climatic indices are functions of sea surface temperature and sea level pressure differentials. In this study, there are six Pacific Ocean indices, three Atlantic Ocean indices, one Indian Ocean index and one from the Southern Ocean. Trends in the climatic indices are investigated by fitting seasonal trend models using a generalized least square (GLS) method. Relationships between the indices are described by correlation analysis and factor analysis. Correlation analysis of the pre-whitened series is presented, and this is used to guide the choice of climatic indices for the regression models. Regression analyses are then used to compare the response of runoff to rainfall at the monthly level during the period 1957 to 2009. This is undertaken using data from three stations Tooma River Basin, Jingellic Catchment, and Ovens Catchment in the MDB. Regression models are fitted using all or a sub-set of the climatic indices and their interactions, and these are compared using factor scores. Typical R^2 values of 20% were obtained and the Akaika Information Criterion suggests that little information is lost by restricting the predictor variables to the Southern Oscillation Index. The results also suggest that the Southern Oscillation Index could be used to predict the Pacific Ocean indices. This conclusion is specific to the South East of the MDB but the methods used are generally applicable.

INFRASTRUCTURE

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CLIMATE CHANGE IMPACTS ON THE DURABILITY OF STRUCTURAL MATERIALS

The presentation outlines the impact of climate change on the durability of the most common structural materials that are used in council hard infrastructure. Firstly, factors that cause material deterioration are identified. Secondly, climate change impacts on those factors are determined. And thirdly, based on the results from the first two stages, conclusions for changes to processes of material deterioration are drawn. The adopted methodology includes literature review to identify available studies and best practice worldwide that consider physical, climate induced impacts on the performance and physical integrity of concrete, timber, steel and bitumen.

The study concludes that in many cases Australian standards provide satisfactory protection against climate change. The most significant threats from climate change could arise in circumstances where assets will be exposed to hazardous environments that they are not designed and planned to sustain. The research reveals that quantification of climate change impact is challenging and subject to many assumptions. Despite this limitation, the study provides useful new knowledge to councils by indentifying areas in asset management that might require alterations in the future.

The presented research is funded by NCCARF and the Local Government Association (LGA) Australia, and it is part of the project “Development of tools that allow local governments to translate climate change impacts on assets into strategic and operational financial and asset management plans”. The reported results will be utilised to determine vulnerability of council assets. This will assist councils to translate key climate change impacts on council assets into financial and asset management plans based on a rigorous methodology that can be adopted.

INFRASTRUCTURE

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CLIMATE CHANGE IMPACT ON INFRASTRUCTURE COST APPRAISAL

The effects of climate change, including higher temperatures, more frequent extreme weather events, altered rainfall and rising sea levels, will lead to changed construction standards and changed maintenance practices. The uncertainty in costs related with infrastructure has increased because of uncertain climate change predictions. This leads to a greater need to treat such costs probabilistically, rather than deterministically, as may have been the case in the past. This research discusses infrastructure cost risk by analysing the probability of cost change, and provides business decision support information. It highlights the uncertainty of cost evaluation with climate change, and focuses on the relationship between climate change projections and cost change assessment.

This research firstly summarizes information on weather predictions including sea level rises, temperature rises, extreme weather event occurrences and rainfall changes. Then it considers what climate change does to infrastructure: roads, seawalls, buildings, ports etc and how climate change impacts on lifetime benefits and maintenance costs. Real options, review technique ideas and the second order moment approach are applied to establish cost probability distributions based on climate change projections. Finally, the option value of the investment, rather than net present value (NPV) can be obtained, which assists in investment decision making.

COASTAL SETTLEMENTS

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PAST, PRESENT AND FUTURE LANDSCAPES: UNDERSTANDING ALTERNATIVE FUTURES FOR CLIMATE CHANGE ADAPTATION OF COASTAL SETTLEMENTS AND COMMUNITIES

Current climate change vulnerability and adaptation studies tend to examine future climate change induced disturbance and impacts on present day landscape patterns of ecosystems, settlements and other land uses. Such approaches are likely to compound uncertainty. History demonstrates that future landscape patterns will be very different; particularly due to rapidly changing human settlement areas and communities. Though shaped by past elements, the effects of climate change in the future will be impacting on quite different landscapes. How those landscapes will be different from today will be examined in the Past, Present and Future Landscapes: Understanding Alternative Futures for Climate Change Adaptation of Coastal Settlements and Communities project funded by a Climate Change Adaptation Research Grants Program.

Although still in early stages the project will build upon methods of mapping past and current land use trends, to predict the future trajectory of settlement patterns. The spatial patterns of likely future settlements and other landscape elements will be analysed to quantify areas of land use affected by climate change impacts such as increased flood events, sea level rise and storm surges. Alternative landscape futures scenarios will be designed and analysed to provide a quantifiable understanding of adaptation towards more resilient landscape futures to avoid or minimise future climate event impacts.

COASTAL SETTLEMENTS

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CLIMATE CHANGE ADAPTATION: MEASURING INDIVIDUAL COMMUNITY RESPONSE IN COASTAL AUSTRALIA

With climate change and its impacts accepted by the scientific community and majority of society alike (Philp *et al.* 2011, Nelson *et al.* 2007), focus is now shifting toward action. One approach to attenuating the impacts of climatic change is through ‘adaptation’ and the development of policies that promote ‘adaptation’. With over 85% of our population living within the coastal region (DCC 2009), it is argued that adaptation to climate change for coastal Australian communities is not desirable, but *vital*. Many coastal communities are heeding this warning by developing strategies to attenuate the impact of future changes to our climate. What remains a fundamental gap in our knowledge however, is the level to which coastal communities have adapted and/or complied to adaptation plans. This research attempts to address this gap by developing an adaptation evaluation matrix for coastal communities in an attempt to highlight comprehensive approaches to adaptation and identify areas of inaction.

Through a review of published adaptation plans, and coastal adaptation theory, a collection of adaptation measures were defined and categorized by impact sector. A metric was then linked to each individual measure and combined to develop an evaluation matrix. The viability of the matrix was tested through an application to two Australian communities exhibiting varying degrees of adaptation. The Western Australian town of Bunbury, lacking an adaptation plan, demonstrated the matrix use as a first pass or baseline assessment, whilst the Victorian City of Greater Geelong, highlighted compliance to an adaptation strategy already in place.

COASTAL SETTLEMENTS

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QUANTIFYING CLIMATE RELATED RISK IN THE COASTAL ZONE: THE GAP BETWEEN THE KNOWING AND THE DOING

2011 has already been named Australia's 'Year of the Flood' with extensive flooding followed by Cyclone Yasi creating destruction across large parts of Queensland. Flooding is certainly not a new hazard in Australia, however as a result of climate change, flooding may become a much greater risk into the future.

Councils are at the forefront of managing flood risk. They have the ability to impose development restrictions or even limit development in high risk areas with the aim to reduce future risk to property and people. However these decisions are far from easy, as they are often made in the face of uncertainty and incorporating a range of probabilities.

This research looks at three coastal case sites and models their baseline flood risk, taking into consideration coastal flooding (tide anomalies), catchment flooding and climatic variability (that is, changes in weather patterns over periods of time). It then reviews the historical and current flood policies to evaluate their effectiveness.

Looking forward, it will then model flood risk scenarios as a result of climate change, incorporating rising sea levels and changes in extreme weather events. It will then review current sea level rise and climate change policy to evaluate its effectiveness in addressing these scenarios.

The outcome of this research is to better understand the risk of flooding to aid in identifying adaptation and management actions in the coastal zone.

COASTAL SETTLEMENTS

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COLLABORATIVE CLIMATE RISK MANAGEMENT IN CANAL DEVELOPMENTS: TOWARDS A MORE SUSTAINABLE COASTAL ZONE THROUGH DIALOGUE AND DELIBERATION

It is now widely accepted that human settlements on Australia's coast face an increased risk of flooding as a result of climate change. Management of climate risks becomes increasingly important, particularly in canal estates which forms a significant part of the South East Queensland coastal landscape. This type of coastal development will increasingly experience the impacts of climate change such as sea-level rise, increased storm surge and extreme weather events. This stresses the need for collaboration among all stakeholders involved the governance of canal developments to analyse climate risk and identify future opportunities for innovation adoption. However, to identify ways forward, it is important that we know how the community can provide meaningful input in a climate risk management dialogue and can inform higher level policy. A process of informed dialogue will be established for residents and other stakeholders to gain increased understanding of climate risks and responsibilities in addressing these risks. Analysis of this process will increase our understanding of how we can make meaningful collaboration happen that drives change instead of reacts to it, creates incentives for joint action and identifies strategies and possible actions.

COASTAL SETTLEMENTS

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**A RISK BASED APPROACH TO PREDICTION AND PLANNING FOR CLIMATE CHANGE IMPACTS ON
THE NSW COAST**

Over the course of the next century projected climate change impacts on NSW beaches and coastal settlements are expected in response to changes in sea-levels, wave climates and sediment budgets. In terms of impacts, prediction of coastal response is routinely undertaken for planning purposes, engineering design and management of large-scale problems, which most commonly concerns the systematic recession of beaches and coastal foreshores. In a predictive context, estimates of coastal response pose a number of significant challenges for both coastal planning and management in NSW. These challenges arise due to uncertainty associated with three sources; Uncertainty about how the climate will change, uncertainty about its effects on sea-levels and coastal processes, and uncertainty associated with how the coastal environment will respond to these changes. To circumnavigate these issues a risk-based approach to coastal response has been developed which takes into account the above uncertainties. In short, the procedure involves approximating an envelope of response to provide more meaningful estimates than of a single prediction.

Application of these principles is illustrated through simulations involving the response of the iconic Bondi beach in relation to the 2050 and 2100 planning horizons. The results obtained were also used to look at the future costs of mitigating projected climate change impacts for beaches through artificial sand nourishment, the costs of which are dependent on both the sand source and delivery technology. Ongoing work is looking to extend these forecasts to provide comparisons in costs of protecting beaches fronted by developed, greenfield or public lands.

COASTAL SETTLEMENTS

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MONITORING AND FORECASTING BEACH BEHAVIOUR IN A VARIABLE CLIMATE

A thorough understanding of beach variability and change is essential to the formulation of responsible adaptation plans for coastal settlements to the future effects of climate change. Across Australia, widespread routine measurement of weather and climate variables is well established and the network of wave measurement locations is expanding. In contrast, measurements of the highly variable sandy beaches have generally been restricted to sites of interest after severe erosion events. Routine measurements at a wide spatial scale and high temporal resolution are required to quantify existing variability and to better forecast potential risks associated with a changing climate.

This presentation will introduce a collaborative project currently underway in NSW, which includes:

- Monthly three-dimensional surveys of ten beaches spanning the NSW coastline;
- Pre- and post-storm surveys to improve existing knowledge of storm demand;
- A rigorous assessment of existing surf camera infrastructure for shoreline and wave measurement;
- Analysis of historical photogrammetric and survey data for quantifying longer term behaviour and hourly image-derived beach measurements for shorter term behaviour; and
- Investigation of an empirical shoreline prediction model to improve upon linear estimates and explore possible beach evolution associated with a changing wave climate and rising sea level.

The focus of this project is building a template for a national coastal observatory to provide automated, sustained and ongoing wave and beach monitoring at a variety of sites around the country. This observatory would gather the data required to better understand existing variability and change and to prepare efficient adaptive strategies for the future.

COASTAL SETTLEMENTS

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AN ENERGY BASED EMPIRICAL MODEL OF STORM INDUCED SHORELINE EROSION – GOLD COAST, AUSTRALIA

Quantification of storm induced shoreline erosion is an integral part of coastal zone planning for coastal settlements. Anticipating potential increases in risk to coastal infrastructure due to a non-stationary climate remains an important subject of investigation.

The empirical model compares shoreline position change with cumulative wave energy, which is a function of wave height, wave angle and storm duration. Wave data was collected from offshore wave buoy data, and storm events located using the Peaks Over Threshold method. Approximately 100 storm events were identified over the period of 1999 to 2008. Shoreline positions were mapped using the Northern Gold Coast coastal imaging station (Argus), and beach width changes were calculated over a beach width of 500m at three different beach positions. An exponential model with two empirical parameters was fitted to the data, relating storm energy and the associated shoreline erosion. The results were compared to a previous study of the same model conducted at an embayed beach in NSW.

The empirical model achieved a high prediction score when forecasting beach width changes. When compared to the embayed beach, the open coast site showed less variability in erosion with respect to wave angle, largely due to the lack of sheltering effects.

The paper and presentation will provide an overview of this modelling approach, which due to its numerical simplicity and strong prediction ability make sit a useful tool for first pass assessment of potential impacts on coastal settlements due to increased climate variability.

COASTAL SETTLEMENTS

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PLANNED RETREAT AS A MANAGEMENT RESPONSE TO COASTAL RISK: A CASE STUDY FROM THE FLEURIEU PENINSULA, SOUTH AUSTRALIA

Climate change is one of the many uncertainties that contribute to the contemporary Risk Society, as defined by Ulrich Beck. Australian coastal areas have been identified as highly vulnerable to climate change with major impacts including sea level rise, extreme weather events, increased erosion, and change in coastal processes and wave patterns. Such risks will cause coastal settlements and ecosystems to face increasingly uncertain conditions. In response to the increase of risk, effective coastal management is needed, with governing bodies providing significant leadership. This research explores the governance of the coast required for the adaptation to climate change of vulnerable systems on the South Coast of the Fleurieu Peninsula, South Australia. In particular, the option of planned retreat as a management response to coastal risk is reviewed. A mixed methods approach to the research was undertaken by integrating documentary interrogation with the analysis of interview responses from key stakeholders of coastal governance bodies. It was determined that despite the increase in adaptation planning and the development of management strategy options to manage sea level rise on the South Coast, including a planned retreat policy, there is a significant lack of implementation of adaptation responses. In addition, planning seems to focus largely on the implications of sea level rise on infrastructure, often overlooking possible ecological impacts. Significant inconsistencies in governance are reflected nationally at all government levels, indicating a need for comprehensive political change to ensure the incorporation of appropriate risk responses into all governance systems.

COASTAL SETTLEMENTS

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COAST PROTECTION BOARD ADVICE AND UPTAKE INTO COASTAL DEVELOPMENT DECISION-MAKING IN SOUTH AUSTRALIA

The Australian coast is at risk of serious degradation due to the cumulative impacts of poor coastal management and planning practice, which are being intensified by the threatening impacts of climate change and increasing human pressure from population growth and amenity migration. This paper proposes that an in-depth understanding of governance arrangements, coastal populations and the current process of coastal management decision-making within each state may facilitate the design of strategies for more sustainable coastal settlements in the future. The presentation will focus on the process of coastal development decision-making in South Australian Local Government Areas, and analyse outcomes of coastal development decision-making in metropolitan, outer-metropolitan and country South Australia between 2005 and 2009.

COASTAL SETTLEMENTS

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PLANNING FOR SEA LEVEL RISE IN SOUTH AUSTRALIA

Evidence from the scientific community indicates that anthropogenic or cyclic climate change is associated with sea level rise. This paper discusses a case study of urban and regional planning for sea level rise in South Australian coastal communities. Projections indicate that regardless of whether carbon emissions are reduced today sea level rise will still occur. South Australia's coastline spans over 5,067 kilometres (Geoscience Australia, 2009) and contains more than 60,000 buildings which will be affected by impacts of the changing climate. Supported by a review of relevant coastal planning policy and literature, the research addresses the effects of sea level rise on coastal development, and the role of private enterprise and the three tiers of government in planning for rising sea levels. It is argued that there is fragmentation in the roles of government and the private sector. Private agencies lack information on sea level rise issues, and are not involved early enough in the planning process. There is no official national policy for coastal issues in Australia (Harvey and Clarke, 2007). For property owners along the coast there are no regulations in places that necessitate notification when purchasing or developing a property on action to address sea level rise. Planning for sea level rise in South Australia requires an understanding from all sectors to achieve a sustainable coastal planning system and that State Government should take a greater role in coordinating the process. Lessons are drawn for planning in coastal communities more generally.

COASTAL SETTLEMENTS

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CLIMATE CHANGE ADAPTATION FOR EASTER ISLAND

Easter Island is the most isolated inhabited island on earth. It is a high relief volcanic island but is extremely vulnerable to climate change as almost all the population and it's most significant cultural heritage is located on the coast. Easter Islands' permanent and tourist populations are growing and the water supply is fragile.

This presentation will detail the changes in climate Easter Island could experience according to IPCC AR4 projections. It will also give a high level analysis of the major impacts of those changes identified as water supply security, coastal erosion and inundation. These changes, impacts and adaptation options were discussed with government authorities and private organisations on Easter Island during a recent ACCARNSI funded field trip.

The climate as projected by IPCC AR4 for Easter Island in 2100 will generally be less than on the continents. This is due to its stable marine subtropical climate and location in the great southern pacific gyre.

Groundwater is the only water supply for the only settlement where quality is already an issue. Sea level rise will elevate the salty zone reducing potential storage volume. Projected changes in annual and seasonal mean precipitation and dry periods could create severe water supply shortages with limited feasible alternative sources available.

Sea level rise will increase risk to the settlement and significant cultural heritage sites due to coastal erosion and inundation. These sites are the most important sites for tourism which is the major contributor to the islands economy.