

PROCEEDINGS

4th Early Career Researchers' National Forum & Workshop
University of South Australia, City East Campus
24-26 November 2010

Australian Climate Change Adaptation Research Network for Settlements and Infrastructure



Cyclone damaged building, Solomon Islands

Photo courtesy of Stacey Atkinson, UNSW

ACCARNSI 4TH NATIONAL ECR FORUM AND WORKSHOP PROGRAM

Day 1: Wednesday 24 November 2010

8.30	<i>Tea and Coffee on Arrival</i>
9.00	MORNING WELCOME - Professor Michael Taylor, University of South Australia
9.10	GUEST SPEAKER - Professor Steffen Lehmann, Director, Zero Waste SA Centre
9.30	Discussion lead by Professors Steffen Lehmann and Michael Taylor
10.00	Introduction: Node 2 - Urban Management, Transport and Inclusion Professor Michael Taylor
10.10	Presentation 1 - Natalie Osborne
10.25	Presentation 2 - Dhakshy Sooriyakumaran
10.40	<i>Morning Tea (30 minutes)</i>
11.10	Presentation 3 - Chloe Hanson-Boyd
11.25	Presentation 4 - Susilawati
11.40	Presentation 5 - Chansiri Suksri
11.55	Presentation 6 - Jintawadee Suksri
12.10	<i>DISCUSSION</i>
12.30	<i>Lunch (50 minutes)</i>
1.20	Introduction: Node 4 - Infrastructure Dr Bill Peirson
1.30	Presentation 1 - Dominic Skinner
1.45	Presentation 2 - Faisal Ahammed
2.00	Presentation 3 - David Busuttil
2.15	Presentation 4 - Nandana Jayasinghe
2.30	Presentation 5 - James Ward
2.45	<i>DISCUSSION</i>
3.05	<i>Afternoon Tea (30 minutes)</i>
3.35	GUEST SPEAKER - Associate Professor Ron Cox, Convenor, ACCARNSI
4.30	CLOSE
7.00	<i>GROUP DINNER - Concubine Chinese Restaurant, 132 Gouger St Adelaide Vegetarians will be catered for in the Set Menu Restaurant has been notified of special dietary requirements</i>

Day 2: Thursday 25 November 2010

8.30	<i>Tea and Coffee on Arrival</i>
9.00	MORNING WELCOME - Associate Professor Ron Cox
9.10	Introduction: Node 1 - Coastal Settlements Professor Rodger Tomlinson
9.20	Presentation 1 - Chris Button
9.35	Presentation 2 - Johanna Mustelin
9.50	Presentation 3 - Phil Morley
10.05	Presentation 4 - Anne Weckert
10.20	Presentation 5 - Oz Sahin
10.40	<i>Morning Tea (30 minutes)</i>
11.10	Presentation 6 - Louise Gates
11.25	Presentation 7 - Tayanah O'Donnell
11.40	Presentation 8 - Carolyn Hofmeester
11.55	Presentation 9 - Sarah Adams
12.10	Presentation 10 - Cimarron Corpé
12.25	<i>DISCUSSION</i>
12.45	<i>Lunch (45 minutes)</i>
1.30	<i>FIELD TRIP - Pick up at UniSA City East Campus, Frome Rd Adelaide</i> Freeway to McLaren Vale to visit Penny's Hill and Fox Creek wineries Return trip along the Coast with commentary by Dr Murray Townsend, DENR-SA
6.30	<i>On return to Adelaide bus will drop off at the Breakfree on Hindley</i>

Day 3: Friday 26 November 2010

8.30	<i>Tea and Coffee on Arrival</i>
9.00	MORNING WELCOME - Associate Professor Ron Cox
9.10	Introduction: Node 3 - Built Environment, Innovation and Institutional Reform - Dr Peter Graham
9.20	Presentation 1 - Che Biggs
9.35	Presentation 2 - Matthias Irger
9.50	Presentation 3 - Nadine White
10.05	Presentation 4 - Hem Lata
10.20	Presentation 5 - Nan Chen
10.35	<i>Morning Tea (30 minutes)</i>
11.05	Presentation 6 - Cunrui Huang
11.20	Presentation 7 - Simon Chui
11.35	Presentation 8 - Martin Freney
11.50	Presentation 9 - Pip Watson
12.05	Presentation 10 - Sylwia Solarska
12.20	<i>DISCUSSION</i>
12.40	<i>Lunch (50 minutes)</i>
1.30	GUEST SPEAKERS - Dr Jacqueline Balston, UniSA and Adam Gray, LGA SA
2.00	<i>FINAL DISCUSSION, WRAP UP AND THANK YOU</i>
2.45	<i>BUS DEPARTS UNISA CITY EAST CAMPUS FOR AIRPORT</i>

NATALIE OSBORNE

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EMPOWERING CIVIL SOCIETY TO ADDRESS VULNERABILITY AND FURTHER ADAPTATION TO LOCAL IMPACTS OF CLIMATE CHANGE

This PhD project is based on the notions that climate change creates a raft of social impacts we will need to adapt to, like unemployment, and that vulnerability to these impacts is socially and spatially determined. Many groups of people who are marginalised in today's society are expected to be more vulnerable to climate change impacts than privileged groups (Dilling and Moser 2007: 7; Levine et al. 2007: 5; Tompkins and Adger 2003: 3; Yamin et al. 2005: 2). Planners and policy makers belong to relatively privileged groups, generally speaking, and because many vulnerable people are excluded from planning activities (Abers 1998: 53; Healey 2006: 98; Moulaert and Nussbaumer 2005: 50-1; Sandercock 1998: 16, 41; Sandercock 2000: 14), I argue that planning processes need to be reformed to allow for better inclusion of marginalised people by empowering groups within civil society that are prepared to act in an adaptive capacity in their local community.

I further argue that vulnerable people and civil society organisations focused on addressing marginality and vulnerability possess practical knowledge that can inform adaptation and planning reform. Although it is, perhaps, too soon for any organisation to have successfully responded to a climate change impact, civil society has responded to comparable impacts in the past, and thus possesses important knowledge.

This research is informed by social constructionism and feminist standpoint theory. Through an analysis of grey literature and semi-structured interviews, it aims to inform a radical planning practice and the empowerment of excluded, marginalised and vulnerable people to act adaptively, and suggest practical reforms to current planning practice. I am in the early stages of research, and my presentation would cover my conceptual framework, expanding on the themes of inclusion and planning reform.

DHAKSHY SOORIYAKUMARAN

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BARRIERS TO ADAPTATION PLANNING FACED BY REGIONAL AND RURAL COMMUNITIES IN THE MURRAY DARLING BASIN

A group of councils, including Carrathool, Griffith, Leeton, Murrumbidgee and Narrandera, obtained Federal Government funding under the Strengthening Basin Communities Program's planning component to assist in 'systematically assess the risks and implications associated with climate change, with a particular focus on water availability'. Sinclair Knight Merz (SKM) was engaged to help the councils think about what the future may hold for their communities, economy and environment. Scenario planning and risk assessment were the key tools used to assist in this.

Community workshops undertaken in each municipality revealed that climate change was only one of many concerns. Another more immediate concern was the potential for a step change in water availability due to the impending Murray-Darling Basin Plan (MDBP). In a region where agriculture is the primary economic driver, reductions in consumptive water use of the magnitude discussed in the MDBP context could significantly accelerate Basin-wide trends for reduced agricultural employment and declining population.

The presentation will focus on barriers to adaptation planning (for climate change and other risks) that became apparent during the project. These included:

- 'City peoples' perception of 'Country people' (and vice versa) was seen as a significant barrier to gaining support for agriculture-based communities. There was a strong feeling that more dialogue about the value of the agricultural sector was required.
- The limited alternatives to agriculture as a sustainer of local economy and communities.
- The lack of integration of social and economic objectives into planning processes.

CHLOE HANSON-BOYD

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ADAPTATION PLANNING AND POLICY IN AUSTRALIA

Vulnerability and uncertainty, due to climate change, is a key threat to infrastructure and settlements and requires robust and consistent planning and policies to enable smooth adaptation strategies across metropolitan, regional and coastal settlements. Adaptation planning and policy development in Australia has a wide and varying approach, where the Federal Government provides guidance to State and Local Governments; based on COAG's National Adaptation Framework. Most states are developing and building adaptation programs around COAG agreements.

Largely, economic factors drive adaptation investment, with significant Federal funding programs into water and agricultural infrastructure upgrades. Uncertainty associated with climate change impacts has seen a trend for governments to allocate considerable funding into vulnerability assessments and research, which focus heavily on biodiversity and natural environment. The emphasis on such assessments has given authorities a pathway to avoid effective investment in vulnerable regions. In contrast, human settlements, particularly coastal areas, are attracting both Federal and State funding to ensure infrastructure and community resilience are safeguarded from climate impacts. The lack of role clarity and leadership has led to the political offloading of risk onto localised economies and an uncoordinated approach to planning between all levels of governance.

The opportunity for adaptation is becoming more cost-intensive as planning authorities postpone vigorous infrastructure planning and opt for assessments and research. The need for locally specific planning has seen the State and Federal Governments shift risk towards Local Governments; a decision legacy of which will only eventuate in a lack of comprehensive adaptation planning and significant economic impacts.

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**THE CURRENT PRACTICE IN THE RESILIENT EMERGENCY PLANS CONCERNING THE ROLE OF
TRANSPORT MODELLING; DATA COLLECTION, MODELLING AND EXISTING TRAVEL TIME
RELIABILITY METRICS**

Evacuation process planning and management become necessary in order to reduce the potentially severe impacts of an increased frequency of the natural disasters on the community (eg. as a result of more extreme weather events due to climate change). The largest concern in evacuation planning and management is how to ensure that the evacuation process can be successfully done during the time available under conditions of demand and capacity uncertainty. Micro and macro transport demand models can be used to simulate the evacuation process. These models require a large amount of traffic data such as road network configuration, traffic volume, travel time, speed and delay. However, some of the literature suggests that the biggest drawback in modelling the evacuation process is the lack of actual traffic data collected in evacuation situations.

Thus, this presentation covers the range issues of the emergency planning modelling in relation to the wider field of transport modelling by reviewed best practices, lessons learnt, drawbacks and some technical suggestions to minimize those drawbacks. In addition, by considering the connections between the evacuation process travel time, demand and capacity uncertainty, then this presentation proposes to incorporate travel time reliability metrics in this process. The recent travel time reliability data analysis from the longitudinal travel time data collection will be presented as a potential source of information on the metrics.

CHANSIRI SUKSRI

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THE ROLES OF URBAN TRAFFIC MANAGEMENT ON REDUCING GREENHOUSE GAS EMISSIONS

The situation of global warming and climate change results in a number of severe natural disaster. Transport is one of the fast growing sectors of greenhouse gas emissions that raise the concerns of all the actors involved. In Australia, the transport sector contributes to 14 percent of greenhouse gas emissions while road transport in particular accounts to 88 percent of total transport emissions. The awareness of greenhouse gas emissions and its impact on climate change lead to an extensive research in the recent years aiming to mitigate the negative impacts of greenhouse gas emissions. Reduction in greenhouse gas emissions requires several changes from all stakeholders especially behavioural and technological changes. In transport sector, a number of technologies have been invented to improve the efficiency of transport systems. Electric vehicle is one of innovative solution that offers potential environmental benefits therefore reduction in greenhouse gas emissions. Even the development of electric vehicles is still ongoing. In the year to come, the use of electric vehicles may be widely used for short distance travel in urban areas where signalized intersections perform as a bottleneck. However, the signal control systems have been implemented prior to electric vehicles are commercial available. The upcoming growth of electric vehicles proportion may involve alteration of the existing signal control systems. This presentation will give an introduction of climate changes related to traffic signal control. Technology related to electric vehicle and signal control system that will result in the level of greenhouse gas emissions will then be presented and effects of electric vehicles on existing traffic control systems will be discussed.

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BENEFITS OF USING ELECTRIC VEHICLES AND URBAN DISTRIBUTION CENTRE TO REDUCE GREENHOUSE GAS EMISSION

Climate change is a prominent global issue that raises the awareness of all the sectors in the society. The serious consequences of global warming led to new developments and policies that aim to alleviate emissions. Transport sector, as a major source of greenhouse gas emissions has been actively conducted research and introducing vehicles technology, alternative fuels and other related technologies that will improve transport operation. For the transport sector, urban freight transport accounts for a substantial proportion of greenhouse gas emissions and it is expected to grow significantly. The seemingly unsustainable impacts of urban freight transport have led to extensive research for more sustainable urban freight policies.

This presentation will firstly introduce previous research on sustainable urban freight distribution initiatives followed by a case study. A summary of major existing initiatives and measures proposed or implemented both nationally and internationally will be presented. The case study of urban freight distribution in the City centre of Adelaide, South Australia will be briefly introduced with some preliminary observations. Particular interest will be paid to the use of electric vehicles and urban consolidation centres for urban freight distribution. The potential costs and benefits involved in the operation with examples of the experiment or implementation in other countries will be presented.

DOMINIC SKINNER

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COMPOUNDING FACTORS OF CLIMATE CHANGE AND RIVER REGULATION ON SEDIMENT DYNAMICS IN A SHALLOW LAKE

Water level decline in Lake Alexandrina, as a result of climate change, anthropogenic water extraction and drought, has altered the sediment dynamics in this shallow lake. The effects are compounded by a legacy of river regulation, both within Lake Alexandrina and further upstream along the reaches of the River Murray. The consequent changes to the sediment dynamics in the lake may influence the light availability for primary production through wave-induced sediment resuspension and a corresponding increase in turbidity. This has fundamental implications for the structure of the entire regional food-web which is dependent on the aquatic photosynthetic organisms to produce sufficient energy to maintain organisms in higher trophic levels. This research uses data from sediment traps deployed fortnightly throughout the lake to elucidate some of the cumulative impacts of river regulation on the natural dynamics of an ecosystem. Future decisions regarding the management of river infrastructure must be made in light of the already degraded state of many ecosystems, as well as the additional changes that will result from continued climate change.

FAISAL AHAMMED

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DESIGNING WATER SENSITIVE CITIES FOR ADAPTATION TO CLIMATE CHANGE

There is strong evidence that climate change is significantly altering the hydrological cycle of the earth. Reducing the total rainfall may create the shortage of fresh water and increasing the extreme rainfall may result flash flooding leading to infrastructural damage in many urban areas. Moreover, urbanization is reducing the infiltration area and hence, the challenge is growing to manage the extra rainfall runoff during the extreme rainfall events. The potential adaptation can be considering the cities as water sensitive and designing the infrastructure in such a way that it will not alter the natural hydrological cycle even at the extreme rainfall events. Few technologies including permeable pavement, infiltration system, bio-retention basin, vegetated swale and rainwater harvesting tank are widely available to capture and temporary retain extra runoff. These technologies can reduce flood frequency at extreme rainfall events due to climate change and make the water available for other uses resulting to minimizing the fresh water security gap. Several technical assessments of these technologies have been performed in the laboratory and provided satisfactory performances. However, only the technical performance may not fulfill the ultimate policy goal for climate change adaptation and therefore, an integrated policy: social, economic, marketing, environmental and technical, is necessary for implementation of the above technologies in the urban landscape. This paper deals with how the water sensitive technologies can be used for adaptation to climate change risks in urban areas, particularly for reducing the flood frequency at extreme rainfall events and minimizing fresh water security gap.

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THE ROLE OF ADHESION IN ENHANCED EVAPORATION

Loss of water resources due to evaporation is becoming an issue of great concern in Australia with lots of evaporation mitigation devices, such as floating modular devices, being evaluated. This report aims to evaluate the effectiveness of floating modular devices with various surface materials and therefore different magnitudes of adhesion between these devices and water. This research is vital as floating modular devices work by decreasing the wet surface area available through which evaporation can occur, however some materials with high adhesion to water, will draw the water up onto itself.

An open water control test was performed to calibrate Penman's equation, thus allowing an approximation of the open water evaporation rate to be calculated and compared with evaporation data recorded during testing of the devices. The devices tested include tennis balls; which represent hydrophilic materials; smooth polyethylene balls, which represent hydrophobic materials; and smooth polyethylene balls with a slime-mould growth, which represents hydrophilic materials which have aged and acquired a biological coating.

Analysis of the test results showed that floating tennis balls actually increased the evaporation rate above that of the open water approximation, whereas both the clean and slime-mould coated polyethylene balls successfully reduced the rate of evaporation. This is likely because a moist capillary fringe developed on the tennis balls increasing the wetted surface area.

From these experiments we can conclude that the adhesive force at the device skin-water interface plays a pivotal role in determining whether an actual reduction in evaporation is experienced.

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VULNERABILITY OF ROOFING CONNECTIONS OF CONTEMPORARY HOUSES TO WIND LOADS

Extensive damage to housing and the social disruption caused by windstorms demonstrate the need for a better understanding of housing performance and improved tools for predicting housing vulnerability, if the goal of mitigating wind damage is to be achieved. Recent reports on climates suggest more intense but less frequent windstorm events occurring in most parts of Australia. Houses and components are currently designed and built to standards aligned with the Building Code of Australia. Post disaster surveys reveal that the roof is the most vulnerable part of the houses to wind events. Therefore, this study assesses the vulnerability of roofing components built in cyclonic regions of Australia for increasing wind speeds. The wind loads and the component strengths are treated as random variables with their probability distributions derived from available data, testing, structural analysis and experience. Design details including types of structural components of houses are obtained from surveying houses and analyzing engineering drawings. Wind loads statistics on different areas of the roof are obtained by wind tunnel model studies and compared with AS/NZS 1170.2. Reliability methods are used for calculating the vulnerability of roofing components independently over the roof for different wind approaching directions. The increasing proportion of the houses subjected to large internal pressure is incorporated in this analysis. The outcomes of this project provide data for developing a tool for assessing the vulnerability of houses during a wind event.

JAMES WARD

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THE IMPORTANCE OF EMISSIONS SCENARIOS IN PROJECTED CLIMATE CHANGE IMPACTS ON WATER RESOURCES

Water resource managers must make long-term decisions surrounding infrastructure investments (e.g. dams, water recycling, desalination plants). There is widespread concern over potential changes to water security in the future due to human-induced climate change, and the time horizon of large infrastructure decisions can easily be 50-100 years. Unfortunately, at this range, climate change projections for water resources are extremely variable. Reducing uncertainty in climate projections is vital for effective water resource management.

The two main sources of variability in long-term climate projections are inter-model variations and emissions scenarios. The IPCC's Special Report on Emissions Scenarios (SRES) identified 40 very different hypothetical pathways, ranging from decreasing emissions to exponentially increasing emissions.

Since SRES, a growing body of literature now points to severe fossil fuel constraints that may prevent the upper emissions families (A1, A2 and B2), limiting future emissions to the lowest family (B1). The present study seeks to identify the extent to which this argument – if correct – could reduce uncertainty in projections for climate change impacts on water resources.

This investigation involves a systematic review of published literature on climate change impacts on water, summarizing the emissions scenario/s used in the study, and the sensitivity of model results to the emissions scenario.

The review concludes that many published studies have used emissions scenarios that are extremely high compared to the most recent fossil fuel projections, however the potential significance of the choice of scenario is frequently either not discussed, or else is lost in the complexity of the modelling study.

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SOCIAL LEARNING AND ADAPTATION TO CLIMATE CHANGE IN AUSTRALIA: THE ROLES OF THE PILOT STUDY

This paper presents a critique of the multiple roles of a pilot study in the context of climate change adaptation and vulnerability research, and of the crucial insights and lessons learned from one such pilot study. It argues that preliminary studies are an invaluable and underutilised tool, particularly in social vulnerability research that is examining a highly complex and sensitive topic for the community. PhD research in progress is investigating the social dimensions of coastal vulnerability, including local adaptive capacity and perceptions of climate change risk. Regional case studies are being applied to compare and contrast perceptions of vulnerability and opportunities for adaptation involving survey work aiming to utilise representative samples within two local government areas in South Australia and Western Australia. Methodologies, techniques and theoretical approaches utilised in the research were tested and improved upon through a pilot study partly undertaken at a joint local government and South Australian Natural Resource Management Board day-long symposium. Pilot studies can be a key tool to facilitate social learning for both the researcher and the stakeholder community. Importantly in the case, as a reflexive process of learning and understanding is applied, the pilot study acts as a means by which inexperienced researchers may gain experiential knowledge of their particular research areas. It will also be particularly useful since researchers are increasingly required to communicate their research outputs effectively and integrate them into adaptation decision-making in a timely manner.

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**PLANNING FOR ADAPTATION IN SOUTH EAST QUEENSLAND'S COASTAL SETTLEMENTS:
STRATEGIES, OPTIONS OR MISHAPS?**

Global climate change has casted local governments in a key role in handling, planning and paying for adaptation to climate change. As coastal settlements particularly are subject to increased future vulnerability due to such impacts as sea level rise, storm surge and increased number of extreme events, there have been calls to seriously consider the relevance and functionality of coastal settlements. However, although some of the strategies, such as planned retreat have generated growing interest and conflicts, there has been surprisingly little research in looking at other kinds of adaptation strategies that are emerging as possible options.

This presentation sets out to examine the array of options and strategies that are being weighed by local governments as responses to climate change particularly in coastal settings. It uses data from 23 semi-structured interviews with key stakeholders and analysis of coastal and climate change policies in the South East Queensland region. It is argued that those adaptation strategies taken seriously by local governments are based on the business-as-usual scenario and not necessarily framed as climate change related. Settlement structure changes are discussed as possible strategies, while noting that the timing, scale and mechanisms to foster efficient adaptation are tied to institutional structures, processes and personal beliefs of climate change. In addition, barriers and enablers for adaptation are identified, which often make or break the current adaptation efforts.

PHIL MORLEY

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CLIMATE CHANGE VULNERABILITY ASSESSMENT FOR POSSIBLE FUTURE LANDSCAPES: HUNTER AND CENTRAL COASTS

This study, one of six case studies to support a 'First Pass' National Climate Change Coastal Vulnerability Assessment (NCVA), examined the sea level rise and flood vulnerabilities for the local government areas of Newcastle, Lake Macquarie and Wyong in New South Wales. The study involved biophysical and social-ecological modelling of both the present and three projected future landscapes for the study area. The study investigated a wide range of social characteristics drawn from the 2006 census; surveyed the attitudes of the local population to assist in the social analysis; and analysed key concepts, such as the costs and benefits of adaptation to climate change. This data represented as maps and 3D 'surfaces' demonstrated the areas of ecological, economic and social vulnerability from future climate change. By representing this information on both current and possible future landscapes, an area's future sensitivity to the impacts of climate change can be incorporated into current day decision making.

ANNE WECKERT

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REGIONAL COASTAL COUNCILS IN SOUTH AUSTRALIA – WHO THINKS WHAT ABOUT CLIMATE CHANGE?

From July to October 2010 a series of one hour, structured, confidential interviews were undertaken with a development professional and an elected member on the Development Assessment Panel from ten small regional councils with coastal settlements in South Australia. A small group of stakeholders including key actors from coastal management, state government, commercial planning and the local government association were also interviewed. The interviews explored the context in which the councils are currently operating, what these key actors think about climate change, how councils are responding, and opinions on who should be doing what to adapt to climate change. The research is situated within a broad framework of understanding the position of local government organizations within the context of multiple stakeholders and spatial changes to both climate and population.

Anne talking to a key actor from the Development Professionals segment about stakeholder buy-in.

Anne: When you have somebody who has drive that changes everything.

Development Professional: Oh yeah, it does. And that depends on the interest that you have got in your elected members, because they can drive it. If you have got an officer trying to drive it and you have got a load of lard heads upstairs you will get nowhere.

Anne: So it really comes down to the elected members.

Development Professional: Elected members have got to have the acceptance and say Anne is a bright spark lets encourage her, let's get on with it, but if Anne was banging on the door and they say she is one of those bloody greenies, she'd get nowhere.

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DYNAMIC ASSESSMENT OF COASTAL VULNERABILITY AND ADAPTATION TO SEA LEVEL RISE: AN INTEGRATED SPATIAL-TEMPORAL DECISION MAKING APPROACH

Coastal regions are highly vulnerable to sea-level rise (SLR) therefore developing and implementing effective adaptation alternatives is crucial for their future development. However, there is uncertainty in the timing, duration, spatial location and extent of SLR and storms. The complexity that arises from climate, coastal systems and their interactions in space and time can easily become overwhelming for decision makers to investigate the aspects of adaptation alternatives thoroughly. Dilemmas confronting decision makers are: how to adapt and when to adapt to SLR?

Considering the complexity and dynamic nature of coastal systems interacting and changing over time, a dynamic model was developed to capture temporal and spatial variations of coastal flooding in assessing vulnerability of these systems to SLR by coupling System Dynamics (SD) and Geographical Information Systems (GIS). Subsequently, adaptation alternatives were evaluated by utilising Analytic Hierarchy Process (AHP).

Three stakeholder groups (politicians, experts and residents) were consulted to determine the goal, criteria and adaptation alternatives required for the AHP analysis. These are:

- Goal : Reduce Vulnerability to SLR
- Criteria : Applicability, Effectiveness, Sustainability, Flexibility and Cost
- Alternatives : Planned Retreat, Improve Building Design, Improve Public Awareness, Build Protective Structures or Take No Action

Preliminary analyses of survey data reveal that across the three stakeholder groups, *Effectiveness* and *Sustainability* are the criteria of highest priority, respectively. Interestingly, there exist distinct differences between stakeholder groups when considering adaptation alternatives. The highest priority for politicians and residents is *Improving Building Design* whilst for experts *Improving Public Awareness* is of most importance.

LOUISE GATES

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LEGAL OPTIONS FOR MANAGING THE IMPACTS OF SEA LEVEL RISE ON COASTAL PROPERTIES IN NSW

Rising sea levels and associated coastal storms are threatening to engulf coastal land and property along the NSW coastline. This will not only have devastating economic impacts, but will foster conflict as it undermines assumptions held by landowners and communities of their property rights and rights to foreshore access existing in perpetuity. The law can aid in managing this problem by adopting a preventative focus.

By disclosing the risks and laying out policy rules before changes take effect, individual expectations and ideas of fairness may evolve. Communicating the future risks of sea-level rise on certificates of title, for instance, allows individual landowners to take ownership of the problem. Further, the development of a clear anticipatory management framework will ensure that mechanisms are in place to minimise any inevitable impacts of sea-level rise on coastal property. For instance, the law may support the insurance industry by mandating insurance as for any property sold in a coastal risk area. The law may also embed mechanisms which allow property boundaries to be amended where erosion intrudes into private properties and public access to the beach is lost. Finally, a clear legal framework may provide clarification about liability issues with regard to the acts of both government authorities and private property owners.

Clearly, each of these options is controversial as they involve limiting existing rights. As such, policy rules must be iterative and flexible, incorporating triggers for implementing or increasing adaptive measures in response to observed changes. Further, it is likely that governments will be unable to address these issues on their own, and combined efforts with the private industry are required if any effective legal reforms are to take place. The likely effectiveness of several legal adaptation options will be explored with these concerns in mind.

TAYANAH O'DONNELL

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PLANNING FOR THE COAST: THE SOCIO-LEGAL VALUE OF LAND AND DEVELOPMENT

Dramatic changes and events to the NSW coast caused by global climate change has led to the introduction of a number of local planning policies, and attempts at legislative reform aimed at reducing risks and liabilities resulting from sea level rise. Such policies may also serve to influence the acceptance (or otherwise) of coastal communities for the inevitable adaptation to sea level rise at the social level, and the property market at the economic level. Such policies have had varying successes; the juxtaposition of long standing and inherent (legal) private property rights, and policies or planning instruments which seek to provide community as well as individual benefit, have and will continue to cause conflict. Due to the impact of sea level rise increasing in the event of storm surges, tidal systems and the nature and type of localised environment, a “black and white” national approach to adaptation is fraught with difficulty, and a bottom up strategy would appear to be effective for the local community. However, such localized strategies will not be effective in the long term without a federal, state and local coordination of adaptive governance and law. My research will offer insights into the implications of the economic and societal impacts when the preservation of the value of land, and the developments thereon, become threatened. Specifically, I adopt a socio-legal analysis to examine the importance of the value of coastal property to various stakeholders within a local community.

CAROLYN HOFMEESTER

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STRENGTHENING COASTAL GOVERNANCE: REFLEXIVE AND RELATIONAL DECISION MAKING FOR CLIMATE CHANGE ADAPTATION

For most Australians, living or holidaying on the coast enacts dreams of carefree, healthy lifestyles and aesthetic pleasures. For others the coastal environment has strong economic values in generating wealth from property development and ownership. Climate change is threatening these dominant socio-cultural values and raises concerns, doubts, resistance as well as transformative potential within our community. This social turbulence manifests in political and community attitudes to climate change, observed most visibly in the popular media and political discourse. Policy and planning inertia within coastal governance is also evident. Climate change has thus become as much a social/behavioural phenomena as a biophysical one.

Effective and timely responses to climate change require strong governance. Given the “wickedness” of the climate change problem, the governance system must be capable of dealing with less than full scientific certainty, multiple layers of complexity in time and scale, multi-tiered jurisdictional responsibilities as well as the competing values of the coast. In this context, and given the increased urgency of climate change action, the conditions which enable scientific knowledge to become sufficiently “powerful” to influence climate action are salient.

Drawing on the field of discursive psychology and social constructionism together with an innovative multi-layered discourse analysis method, this research examines the role of knowledge, power and worldviews in complex policy making for coastal adaptation. The development of a new model for coastal governance that is more reflexive and relational will be a key outcome of this research with a view to implementation in vulnerable regions of the South-West.

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WHAT IS THE GOAL?: EXPLORING WHAT UNDERLIES DECISION-MAKING FOR CLIMATE CHANGE ADAPTATION AND SETTLEMENT PLANNING

Climate change has been called a super-wicked problem, a label that acknowledges the scale, complexity and urgency of the challenge. Climate change is being tackled through two broad strategies: mitigation and adaptation. Adaptations are considered manifestations of adaptive capacity which was defined by the IPCC as the ability of a system to adapt to climate change stimuli or their effects or impacts. Few definitions of adaptive capacity discuss the social goals; those that do use broad statements such as increase or maintain the quality of life, take advantage of opportunities, or maximize well-being. In the absence of explicit social goals, economics and capitalism have defined the desired goals for adaptation and greater human society.

Drawing on decision-making theory and practice, this study explores what underlies decision-making for planning and adaptation in coastal communities. This study will design and test a free-form simulation game that uses a 3D table-top representation of a local Sunshine Coast landscape. During workshops, participants will be given conceptual tools and information about problems on the landscape. Participants will be asked to discuss, negotiate, and make decisions, looking towards 2100. This landscape-based simulation integrates climate change adaptation with other planning issues such as transportation, food and water supply, housing and development. The workshop discussions will be analysed to better understand what factors are important in decision-making, what 'goals' they identify, what trade-offs they make, and how they consider the long-term perspective.

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VISUALOGRAPHIES; IMAGE + PLACE + CULTURE

Visualography is an inter-disciplinary approach grounded in phenomenology, geography, and visual methods to frame an investigation of notions of place. It focuses on lived experience elicited through photographs, photographic moments, and the locale where photographs are made.

The Sunshine Coast, Queensland, Australia is the fastest growing region in Australia. It is a community in flux, divided by a desire to preserve an idyllic sense of place while contending with increasing development pressure to accommodate a growing *sea change* migration. As a coastal settlement it is also under pressure to prepare for impacts associated with climate change - sea level rise, storm surge events, and increasing temperatures.

Place attachment and identity are linked to sustainability and concern for the environment and if disrupted, can compromise community resilience. Relph (2009) suggests that climate change is a global issue, but its effects will be experienced differently in locations around the world and that a carefully articulated sense of place and place-based strategies will be needed to support mitigation strategies.

Photographs alter the way we see, remember, and imagine the world and evoke lived or imagined experiences of place. This paper argues that visualography is a useful means of exploring notions of place and links with climate change adaptation. Photographs of iconic Noosa landscapes will be used to elicit feelings of attachment and/or detachment with place as a way to understand constructs of landscape, attitudes toward climate change risk, resilience, and adaptive capacity.

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DISTRIBUTED SYSTEMS: A DESIGN MODEL FOR RESILIENT INFRASTRUCTURE

This research highlights how the challenge of mitigating and adapting to climate change and resource scarcity can be addressed simultaneously by transforming critical infrastructure design. It draws on existing examples of social and technical innovation that point a way for building more resilient cities of the future.

Local government and communities in many countries are exploring localised and networked approaches to energy, water and food provision as a way to lower carbon emissions, build community resilience and strengthen local economies. This 'distributed' systems model is over-turning old ideas of infrastructure and services. It sees people become far more engaged and active in addressing local problems, generating critical resources and becoming more connected to community and place.

Distributed systems represent an innovative approach for responding to risk and uncertainty. They can build adaptive capacity by increasing diversity and flexibility without locking utilities, customers and future governments into technical path-dependencies. By creating distributed systems through infrastructure design choices at the building-to-precinct-to-regional level, societies can reduce social, economic and environmental vulnerability to climate change and energy supply shocks.

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THE EFFECT OF URBAN FORM ON URBAN MICROCLIMATE - CLIMATE CHANGE ADAPTATION AND MITIGATION THROUGH URBAN DESIGN

It is now widely accepted that human activities are contributing to accelerated climate change, with a range of impacts, risks and costs for Australia's environment, residents and economy.

Current climate change mitigation responses include the objective of a more compact urban form to reduce reliance on motor vehicles. Additionally, most capital cities of Australia have development strategies seeking to absorb the majority of new population growth within existing urban footprints to lower environmental impacts and increase efficiency of infrastructure and service provision.

This study seeks to explore the complex interplay between urban form and the urban microclimate and will test the common assumption of a positive relationship between a more compact urban form and elevated urban temperatures.

The research proposes to employ airborne remote high-resolution imaging to examine the spatial structure of urban thermal patterns in a selected Australian city region, and test their relation to urban form, surface characteristics and vegetation content within the urban environment at street and precinct scale. This data will be combined with microclimatic field measurements using the software ArcGIS as a platform for spatial analysis, data management, and mapping.

The study will develop taxonomies of urban forms focusing on the temperature distribution in neighbourhoods and the resilience of the built environment to the effects of climate change. Finally it will produce design proposals for selected case study areas incorporating scenario modelling for climate change mitigation and adaptation measures within the context of population growth scenarios and increased dwelling densities.

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ADAPTIVE PLANNING AND THE PHYSICAL IMPACTS OF CLIMATE CHANGE IN NSW: WHY PLANNING SYSTEM REFORM IS NEEDED?

Planning adaptive responses to the physical impacts of climate change (PICC) is central to stemming the impact on built and natural environments and consequently the social and economic impact of climate change. Due to the projected pace and scale of these impacts, effective policy responses of governments require effective and innovative adaptation plans. In Australia, all levels of government have a role through regulation and policy in adapting to climate change. However it is at the local government level where much of the responsibility is expected to fall.

This paper presents the results of original research conducted in New South Wales (NSW), Australia, on the limitations of the NSW Planning System and the planning response of local governments for adapting to the PICC. The study investigates the perceptions of local government planners regarding the actions taken within their local government area to plan for the PICC, the effectiveness of that response, and what changes they perceive should be made to the NSW Planning System. The results show a broad lack of confidence in planning measures including the existing legislation and environmental planning instruments (EPIs). The results indicate that institutional reform of the NSW Planning System is required, and that more needs to be done to plan for the physical impacts of climate change, including conducting risk assessments, policy development and collaboration between councils. This applied evaluation research is conducted within a postpositivist paradigm and is analysed through the theoretical framework of adaptive management.

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THE CHALLENGE OF CLIMATE CHANGE ADAPTATION IN THE GANGA BASIN: LEGAL OPTIONS FOR INDIA

India, with a developing economy and the second largest population in the world, is expected to be highly vulnerable to potential climate change impacts. In this research, India's only national river – the River Ganga – with its historical, ecological, economic, cultural and spiritual significance and highest populated basin in the world – is studied to showcase the potential impacts of climate change on India. The anticipated impacts of floods – followed by droughts – as a result of the melting of source glaciers of the River Ganga, pose a threat to the people of India's constitutionally guaranteed right to life and livelihood. The use of legal and institutional frameworks to facilitate adaptation strategies that will help communities and the government to prepare for such impacts are being studied as part of this research. This is especially important in light of the series of dams being developed by the government of India in the upper stretches of the River Ganga.

In this presentation, the following key issues will be discussed:

- Potential climate change impacts on the River Ganga and the viability of dams in light of these impacts
- The ability of existing legal and institutional frameworks in India to deal with the anticipated climate change impacts.

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SOFT INFRASTRUCTURE FOR URBAN RESILIENCE AND ADAPTIVE CAPACITY IN AUSTRALIA'S COASTAL ZONES—THE ROLE OF THE DEVELOPMENT CONTROL PLANS (DCPs)

This research outlines the conflicts between risk and resilience approaches to climate change adaptation planning in vulnerable coastal areas in Australia. Based on initial findings from the literature review conducted as part of PhD research, it questions 'whether current planning processes shaping vulnerable coastal settlements in Australia are building adaptive capacity for communities under climate change impacts'.

In the field of Climate change adaptation there is NO shortage of research on technical and physical responses. To perceive vulnerabilities, however, the limitation is a lack of implementation. I will argue that it is what I call "soft infrastructure", which requires research efforts. A fundamental challenge in this context is to raise awareness of the long view. We should build knowledge, incentives, and learning capabilities into institutions, and organizations for managing the capacity of local, regional and global ecosystems to sustain human well-being in the face of complexity and change.

Vulnerabilities are determined using risk approach. It's acknowledged in the literature that this approach while convenient for establishing probabilities and worst case scenarios, the approach is limited in understanding complex, uncertain and dynamic systems. The impacts of climate change are complex, highly uncertain and dynamic. Reviews of the discourse relating to risk and resilience in the context of settlement planning, as well as coastal planning processes in Australia suggests that, climate change is unpredictable and likely to be 'more rapid and severe, costly and dangerous than previously thought. According to some measures climate change is now at or above worst case scenarios projected only a couple of years ago' (CSIRO and Australian Government Bureau of Meteorology 2009). Therefore, I will argue that Risk Approach needs augmentation with methodologies that deal more effectively with such environments.

Sciences of system ecology have been developing methodologies to understand complex, uncertain and dynamic systems. I will argue that the resilience methodology can be applied to the built environment in order to provide a more holistic base for identifying not only risks but also opportunities to adapt to climate change in prosperous ways.

Therefore, the research will make a contribution to knowledge by addressing the lack of research in 'soft infrastructure' for climate change adaptation in the planning sector; and, by investigation of applicability of 'resilience approaches' to climate change adaptation strategies for the built environment.

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LINKS BETWEEN THE BUILT ENVIRONMENT, CLIMATE CHANGE AND PUBLIC HEALTH

In recent years, there has been a growing recognition of the links between the built environment, climate change and public health. The built environment can influence human activities, which in turn affect the global climate change and health outcomes. The development of the built environment involves many sectors, including urban planning, transportation systems, building construction, and land use changes. The IPCC has reported that greenhouse gas emissions have grown largely as a result of aspects of the built environment. In addition, vulnerable populations such as children, the elderly and people with low socioeconomic status are most at risk of the health impacts of climate change, and also are disproportionately affected by inappropriate designs and constructions of the built environment. Because the built environment is a major contributor to climate change and is an important determinant of human health, strategies that promote climate change mitigation through personal transportation choices, energy-efficient building materials, and urban green space planning will provide significant health co-benefits. The Health Impact Assessment framework may serve as a decision support tool for urban planners and health professionals who need to take into an account the public health implications of any policy options on climate change. Fostering such multidisciplinary collaboration has the potential to contribute to mitigating greenhouse gas emissions, promoting healthier living, and thereby enhancing population health.

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CULTURAL ADAPTATION TO DROUGHT AND CLIMATE CHANGE IN THE MELBOURNE SUBURBAN LANDSCAPE

Climate change has resulted in significantly less water flowing into Melbourne's reservoirs in the past decade. In response, water restrictions were enacted by the Victorian government to reduce water demand while infrastructure projects were commissioned to increase the water supply.

These water restrictions limit the use of water outdoors, and have had negative impacts on the suburban landscape, especially on the vegetation. There are a range of technical and behavioural adaptations that can be made to mitigate these negative impacts by reducing the need for the use of potable mains water in the landscape. This research hypothesises that suburban dwellers in Melbourne are making behavioural adaptations to drought leading to observable changes to the landscape, as a result of changing attitudes towards climate change and water use in the suburban landscape.

Three methodologies will be used to investigate the relationship between changes in the suburban landscape and Melbourne suburban dwellers' attitudes:

1. an observation of the suburban landscape of Melbourne using Google Street View and aerial photographs to identify the visible adaptations that have taken place;
2. a questionnaire survey to assess Melbourne suburban dwellers' attitudes towards the landscape of their front yards in relation to climate change and water restrictions; and,
3. a content analysis of articles relating to water restrictions in Melbourne newspapers to contextualise physical and attitudinal changes within the public discourse. A better understanding of how and why suburban dwellers make landscape adaptations will allow more effective efforts to encourage further adaptation to be made.

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LIFE CYCLE ASSESSMENT OF EARTHSHIP ARCHITECTURE

Climate Change presents many challenges to the Australian homeowner; higher electricity bills due to greater need for heating/cooling, keeping the garden alive during water rationing, and increased danger from more frequent natural disasters such as bushfires and storms. Sustainable architecture, featuring low embodied-energy materials, and energy efficiency, coupled with behaviour change, has potential to reduce the ecological footprint of Australians. The autonomous house concept presents many potential solutions. In particular the Earthship, developed by architect Michael Reynolds, has demonstrated that homeowners can live within the limits of their autonomous home's systems in a harsh desert environment. With only modestly sized renewable energy systems and water storage, Earthships efficiently catch and store all the water and electricity they need. A biological filter located in an attached greenhouse, treats and recycles greywater which is used for irrigating food producing plants, and for toilet flushing. The main walls of the Earthship are made from waste car tyres which are filled with compacted dirt from the building site. These load bearing walls are bermed to provide extreme thermal mass and rendered internally to look like adobe. The combination of subterranean earth-tubes, attached greenhouse, extreme thermal mass, and a well insulated roof, results in virtually no need for active heating or cooling. This presentation reports on research that will evaluate the Earthship's environmental impacts compared with other types of sustainable architecture using Life Cycle Assessment.

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HOUSING ADAPTATION FOR ENERGY EFFICIENCY IN TASMANIA

In Australia a significant proportion of existing housing is in poor condition and requires adaptation if it is to support resilient climate responses, and limit the environmental impacts, of householders. The state of Tasmania faces socio-economic challenges that are exacerbated by poor housing conditions and make it hard for households to prepare for future climate challenges effectively. Tasmania, in comparison to other states of Australia, has: the highest proportion of people living in poverty; a lower mean disposable household income; and an ageing population. Among other issues of housing condition, Tasmania's housing stock tends to be energy inefficient and supplemental heating is used for extensive periods during the year, leading to unnecessary energy use, higher energy bills, and green house emissions. Energy efficiency adaptations in Tasmania have, as yet, occurred in a disparate manor and at a slow rate. If detrimental social and environmental situations, such as climate change, are to be improved, then adaptation activity in Tasmania needs to gain momentum rapidly. The research project being presented, called 'Sustainable housing for equity and energy efficiency' examines energy-efficient housing adaptation activity in Tasmania. The research is qualitative and data has been collected on: the perceptions, practices and capacities of householders; housing adaptation processes; government, commercial and nongovernment adaptation support; and housing stock conditions. The research outcomes are intended to assist policy makers and housing stakeholders to better understand and support householders undertaking energy efficiency adaptations.

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ENGINEERING SUSTAINABLE ENVIRONMENTS

Australia is the driest continent on earth with a rapidly growing population, yet its people have recorded the second highest per capita water consumption. The onset of wide spread drought and below average rainfall across many regions of Australia are likely to intensify the water crisis for many cities that are already vulnerable to water shortages.

To cope with these climate change constraints and meet the increase in demand for water, cities across Australia will need to diversify their water supply sources and invest into non-traditional methods, such as water reclamation for indirect potable use.

The push for new and sustainable water management practises has resulted in the design of innovative commercial office buildings such as the Pixel Building which is at the forefront of the Greenstar rating system in Australia. Water management measures implemented by Pixel include water efficiency, water harvesting and recycling and the use of innovative water technology.

Pixel has been designed by sustainability experts Umow Lai, to be self sufficient for water supply. A complete water balance was achieved through the adoption of efficient fixtures and fittings, collection and reuse of rainwater, recycling of grey water, conversion of black water to energy via anaerobic digestion and the implementation of small scale vacuum technology.

Water demand in commercial office buildings could be drastically reduced if the full spectrum of water recycling measures were introduced into the design and operation of new buildings, thus setting a bench mark standard and paving the way for an increasingly sustainable future.