Climate Change and Urban Adaptation: Science and Practice: Exploring the Challenges

Raglan, New Zealand

9th to 11th December 2013

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Climate Change and Urban Adaptation: Science and Practice: Exploring the Challenges

A workshop on Climate Change and Urban Adaptation: Science and Practice: Exploring the Challenges was held in Raglan, New Zealand, 9th - 11th Dec 2013. This workshop provided a unique venue for scientists and practitioners to discuss the emerging issues related to climate change and urban adaptation where scientific, technical and practical issues are equally valued. About 30 scientists and practioners from New Zealand, Australia, China, Thailand, and Vietnam attended. The workshop was supported by Asia Pacific Network for Global Change Research (APN), Monsoon Asia Integrated Regional Study (MAIRS), and International Global Change Institute (IGCI), through the project: 'Development of an Integrated Climate Change Impact Assessment Tool for Urban Policy-Makers (UrbanCLIM)'.

The participants included climate science researchers, climate service providers, consulting practitioners, representatives of local government, government policy makers, legislative experts, adaptation project implementators and evaluators. Challenges, lessons learnt, and new opportunities for climate change adaptation action in different countries were discussed in great depth during and after the workshop. Through this workshop the experts from different backgrounds formed a community of practice (CoP) for climate change adaptation.

The themes of the presentations covered:

- The importance and gaps in climate change information and communication for adaptation
- Policy and legislation barriers and advances
- Climate change adaption practice in various urban sectors
- Urban planning, decision making and climate change
- Emerging climate change science and methodological issues as they relate to adaptation practices, especially for 1-10 year predictions
- Climate change vulnerability and risk assessment methodologies and tools

Over the third day of the workshop, a project work plan was discussed among the key collaborators of the APN project UrbanCLIM team. Planning was informed by past progress that shall inform future software development, evolution of data libraries and case studies. Collaborative opportunities and ideas also thoroughly explored. The third workshop for this APN project was proposed to be held in Vietnam later in 2014, in conjunction with the Vietnam national climate change meeting. After the workshop some the attendees also visited the IGCI office in Hamilton for more discussions on collaboration.

The workshop participants understood very clearly that effective collaboration through the development of an adaptation community of practice (CoP) will be critical to achieving 'best practice' in adaptation (See figure 1). This figure illustrates the key elements in climate change practice: (1) Scientist group, including pure and application climatological and meteorological research shall provide the observations, modelling and theory of climate change which are the foundation of climate change adaptation. This group's products include large sets of climate related data, methodologies and tools for that require further analysis for efficient application. (2) Practioners and Facilitator group, including the consultancy firms and individual practitioners, who focus on implementing adaptation projects and translating the climate change information to stakeholder accessible formats including documentation for local governments, and national and international agencies. (3) Government Policy Makers and international agencies group, the funding dispensers and outcome receivers. (4) Gap fillers, or climate change service providers. Because the perceived intellectual distance between scientists, practioners and policy makers there exist a number of gaps between the scientific community and organisations and individuals operating in the practice realm. There is a need for a group of people who can understand and communicate among and between these groups, which should include practical yet scientifically robust data services and practical tool development. The barriers among different groups could be filled through the efforts of a CoP approach.

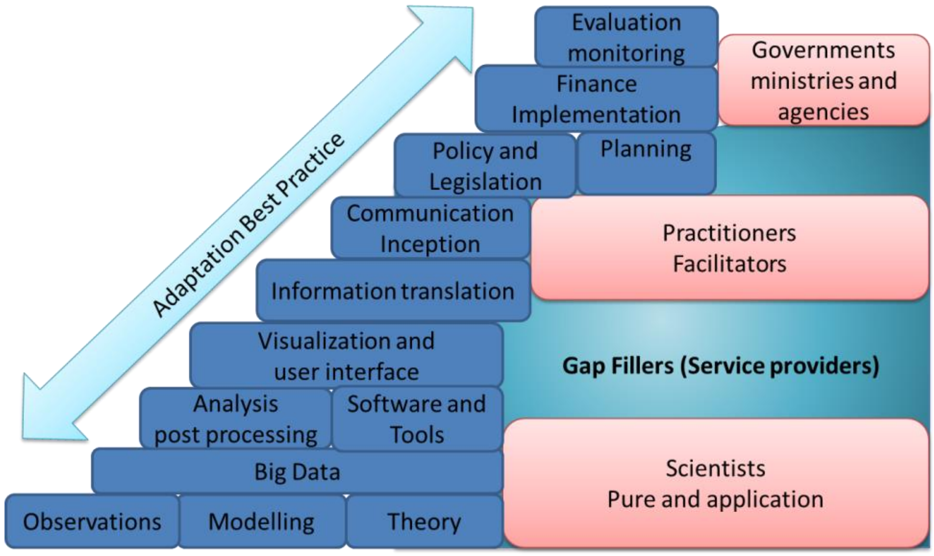

Figure 1. Climate change adaptation best practice community: opportunities and challenges

Group photo


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Panel discussions

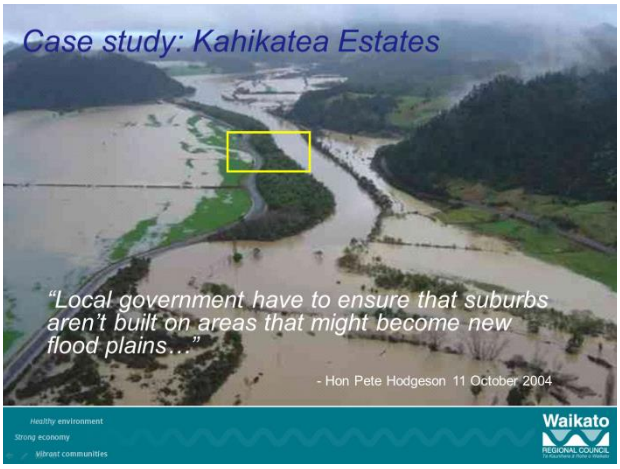
Session 1: Climate adaptation in New Zealand and Australia: practices and challenges

Blair Dickie: Climate change adaptation and local government policy challenges New Zealand

Principal Policy Advisor, presented the policy and practice of climate change adaptation status in New Zealand. He summarized the features of New Zealand policy status and difficulties, including, continuation of existing activities, unpopular – constraining, agency focus, future orientation, current costs, future benefits, and difficulties in quantifying risks and outcomes.

Regional Policy Statement: Adaptation as a Significant Resource Management Issue

Allocation of space, expansion of present and future natural hazards, fluvial, coastal, landslip, expansion of biotic transition zones, corridors, coastal transition zones; allocation of resources as demand will change over time, water quantity will vary, quality will change and need to recognise the future nature of water resource will change into the future.



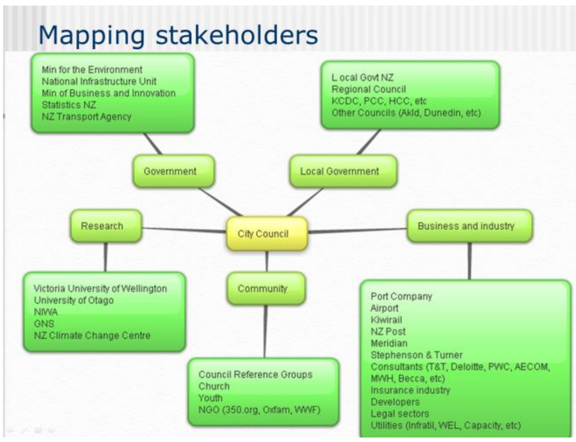
Policy recently reviewed WRP (Variation 6)

Integrated surface and ground water policy, common expiry dates for 9 sub-regions

Adaptive management, max duration of volume consents 15 years (excluding municipal, electricity & domestic), review of allocatable flows for two years with longer planning for the allocation for up to 15 years. Allocation includes any changes in assimilative capacity, provisions for recouping investment in infrastructure.

Chris Cameron: Urban sea level rise responses in Wellington

Highly uncertain rates of sea level rise present significant challenges for long-term coastal management. Combined with more intense storms, sea level rise will cause increased coastal damage and flooding, and impose greater costs on society over time – particularly in urban areas.



Wellington has so far experienced sea level rise of about 20cm, and scientists predict that by 2100 this will increase by up to 1 metre. Beyond this, ongoing warming is now expected to raise temperatures by 4°C or more. Recent science suggests that some 2.3 metres of sea level rise could be expected from each degree of warming.

Simply building up coastal defences against sea level rise will not be sufficient – flooding may still be likely through changes to water tables. Options to avoid such flooding may be expensive and difficult to implement, although defensive structures may be a viable option – or stopgap measure – for some locations.

In Wellington sea level rise will occur in the same location as several other hazards including flooding, tsunami, earthquake, and liquefaction. It therefore has a multiplying effect on the total risk exposure.

There is a need to establish the impact of sea level rise for at-risk coastal areas across the city, and to then impartially evaluate a range of response options and prioritise these responses. This in turn can inform a city-wide strategic and planned developments.

The issues

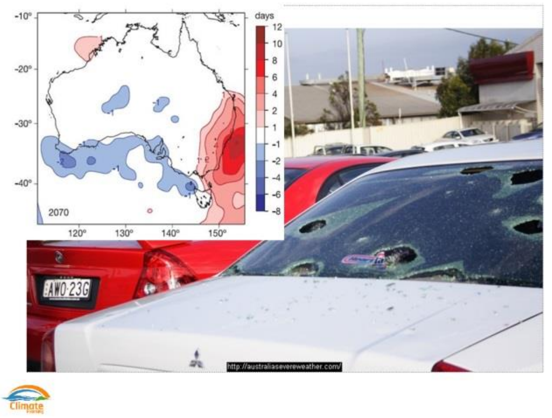
- Government advice – but no national adaptation framework
- Complexity and uncertainty
- Significant economic / social / environmental impacts
- Resourcing, collaboration and partnerships
- Community engagement – understanding and action
- Time-frames: Short-term: Asset Management, Urban Plans, etc, Strategic: Beyond existing planning horizons (eg 100 years+)

Donovan Burton: Climate Change Adaptation and Australian Local Government

Differing nature of direct climate-related exposure and risk

Geographical differences

Large rivers and flood plains (e.g. Brisbane); Coastal (inundation, storm surge, erosion) (e.g. Kingborough); Northern (tropical cyclones); Heavy vegetation (bushfires); Other hot spots (e.g. hail, heatwaves)



Climate Legal Risk

Development planning challenges, Criminal negligence, Common law – compensation.

Economic Risks

Infrastructure charging, Cost of climate studies, Staff capacity / training, Asset depreciation, Financial investment, Court fees/awards, Insurance premiums.

Council Responses

At least 150 councils have done a “scoping assessment” of the risks; Actual adaptation is ad hoc at best, Paralysed by legal issues, Some champions (e.g. Onkaparinga, Kingborough, Clarence, Darebin) .

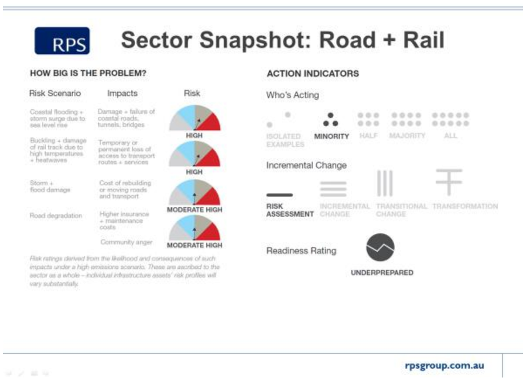
The research revealed that **the cross-scale barriers faced by local government in relation to climate change adaptation are not unique to the field of climate change adaptation in Australia**. It also showed that many of the barriers are faced by councils around Australia, and can be considered to fall into four main thematic areas: (1) poor understanding of the risks of limited access to and the uncertainty of climate change impact-related information; (2) inconsistent governance structures, coordination, communications and leadership between the vertical tiers and horizontal levels of government; (3) inconsistent problem definition and appropriate climate change adaptation frameworks to use for planning; and (4) competing priorities in planning and implementing responses due to limited operational resourcing, in areas such as staffing and funding.

Emerging issues

Goal conflicts; Adaptation champions; Information vs mis-information; Adaptation / mitigation nexus; Poor consideration of climate change and emerging technologies.

Stella Whittaker: Sector Adaptation Practices and Barriers in Australia

Government policy is fragmented. The business response is uneven. Infrastructure is highly interdependent, but action on adaptation is isolated at the organisational level. Concern about climate change has fallen among those sectors most exposed. Annual costs of unmitigated climate change on Australia’s infrastructure would reach nearly $9 billion in 2020 and $40 billion in 2050. (2008 Garnaut Review)



Action Plan- Business

Assess exposure and vulnerability to climate risk impacts. Identify material climate risks for your operations, supply chain, customers, employees as well as interrelated infrastructure systems. Determine how resilient your business is.

Implement a Climate Risk Management Plan. Establish a 3-5 year plan to manage climate adaptation requirements. Embed ongoing management of climate risk into your business.

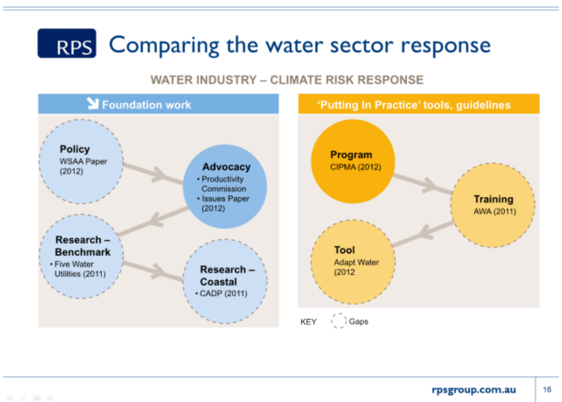
Disclose material climate risks to the market. Ensure shareholders and investors are informed of material climate risks and risk management strategies to protect shareholder value.

Collaborate to build capacity. Participate in cross-industry and public discussions to build understanding and resilience.

Action Plan- Government

- Refresh the National Climate Change Adaptation Framework: Work across jurisdictions to develop agreed approaches for including climate risk in planning, development and approval processes
- Coordinate between levels of government to improve consistency in practical requirements for infrastructure planning and development
- Sector-specific guidelines for assessment of climate risk in key regulated industry sectors
- Investigate a national initiative to identify climate risk impacts for interdependent infrastructure
- Expand analysis of infrastructure interdependencies to climate risk
- Expand the approach taken by CIPMA to all other key infrastructure assets and sectors
- Work with asset owners and operators to better manage cross-sectoral interdependencies and climate risk impacts.
- Publish a National Resilience Report Card: Develop a national adaptation scorecard and report on progress; Publish resources for small business and the community
- Deliver leadership through collaboration; Collaborate with government and private sector to build skills and capacity; Establish city-wide taskforces with public and private participation for each major city.

Translation – Manuals, Guidance, Decision trees



"I hope that the discussions and presentations bear fruit for the effort that ENA & Manidis Roberts invested. It seemed to me that the whole climate change adaptation topic was bogged down over the inability to agree on a set of projections and that no-one, Regulator, Government or Network Operator was going to make any progress until that was sorted out. Hopefully, hearing that message from someone else may help." Phil West, Western Power UK .

Technical & regulation issues – a 'wicked' challenge

AER considered that the impacts of climate change will be gradual and will emerge progressively over time, and as such the large proposed step-change increase in capital expenditures proposed was unjustified. These impacts can instead be dealt with progressively as they arise.

The models are not fit for short term forecasting and the claimed effects have been rejected on this basis.

AER accepts that climate scenarios used for Victorian effects on DNSPs are plausible – suitable for broad considerations but not short term forecasting.

"The DNSPs had not established with certainty that any particular modeled scenario has higher or lower probability – simply being plausible is not persuasive".

An immediate change in technical design and operations not established – AER was not convinced that industry design bodies are actively pursuing changes to design standards – a prudent operator would not unilaterally amend design.

Lessons learnt

- Importance translation – helps deal with climate uncertainties and acceptable risk, navigate the climate science – 'fit for purpose'
- Need for ongoing engagement –all relevant parties
- 'Business as usual' and importance getting on with it….

Barriers

- Resources - Industry needs better understanding weather and impacts relationship as well as impacts projected to change in future with uncertainty estimated, $s – such as Ofgem innovation fund
- Leadership/mandate - regulatory frameworks – short term focus and limitations of methods
- Values and beliefs – most pervasive

Session 2: Climate change adaptation in Asia and Pacific

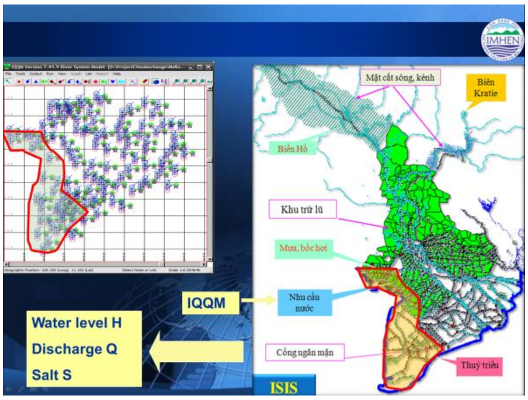
Tran Hong Thai: Vietnam's response to climate change National Action Plan on Climate Change 2012 – 2020

Strategic Tasks for Climate Change

- Proactive disaster preparedness and climate monitoring
- Food and water security
- Positive response to sea level rise consistent vulnerable areas
- Protection and sustainable development of forest, increasing carbon removals and biodiversity conservation
- GHG emission reduction to protect global climate system
- Strengthen the leading role of the Government in response to climate change
- Community capacity development to effective respond to climate change
- Scientific and technological development for climate change response
- Strengthening international cooperation and integration to enhance the country's status in climate change issues
- Diversification of financial resources and higher effective investment

Priority programmes

- The National Target Programme to Respond to Climate change, development of extended plan for 2016-2025
- The National Scientific Programme on Climate Change
- The Hydrometeorological Observation Network and Forecasting Technology Modernisation Programme by 2020
- The water resources management and climate change adaptation programmes for Mekong and Red River Deltas



- The GHG emission inventory, reduction and management of emission reduction activities
- The climate change response programme in megacities
- The sea dyke and river embankment upgrading and reinforcement programme under climate change and sea level rise conditions
- The public healthcare improvement programme in the in climate change and sea level rise conditions
- The socio-economic development programme in inhabited island to cope with climate change and sea level rise
- The pilot programme for community's effective response to climate change with an aim for further expansion

National target program to respond to climate change (NTPRCC): Results of the NTPRCC Implementation

At Central level

- Training and education programs at all levels; CC awareness program;
- Framework to integrate CC issues into development plans;
- CC impacts assessment, adaptation measures identification, and Action Plans development; CC and sea level rise scenarios;
- National Strategy on CC; National Action Plan on Climate Change;
- Scientific and Technological Research Program on CC;
- International cooperation, negotiation and fund raising.
- Ministry of Education and Training developed training and education programmes at all levels.
- Ministry of Information and Communications conducted specialized information dissemination programmes raise awareness on climate change.
- Ministry of Planning and Investment developed framework to integrate climate change issues into development and implement projects on climate change related socio-economic development.
- Other Ministries: have conducted the following key tasks:
- Assess the impact of climate change and sea level rise on the areas under their management;
- Identify measures to respond to climate change and sea level rise;
- Develop Action Plans to Respond to Climate Change and implement some of the tasks in the APRCCs.

At local level

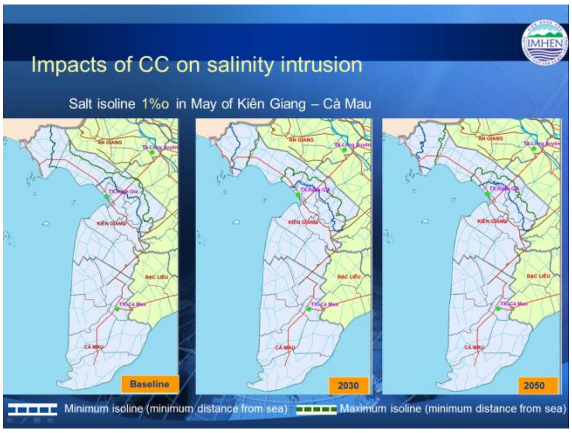
At Nov 2012, 33/63 provincies and cities have issued Action Plan on CC;

Communication, awareness raising campaigns have been conducted in a number of location.

Starting from 2012, pilot models for climate change and sea level rise adaptation are implemented. High priority has been given to coastal provinces, especially the Mekong River Delta.

Policies and Actions

- Approved National Target Program to Respond to Climate Change (Decision 158, 02/12/2008 by Prime Minister);
- Implementing the National Science and Technology Programme on Climate Change as a basis to implement scientific research for the development of institutions, policies and action plans to respond to climate change in Viet Nam;



- Developed and announced Climate change and sea level rise scenarios for Việt Nam (2009); updated scenarios (2012);
- Approved National Strategy on Climate Change (Decision 2139, 05/12/2011 by Prime Minister);
- Established National Committee on Climate Change (Decision 43, 09/01/2012 by Prime Minister);
- Approved National Target Program

to Respond to Climate Change for 2012 – 2015 (Decision 1183/QĐ-TTg, 30/8/2012);

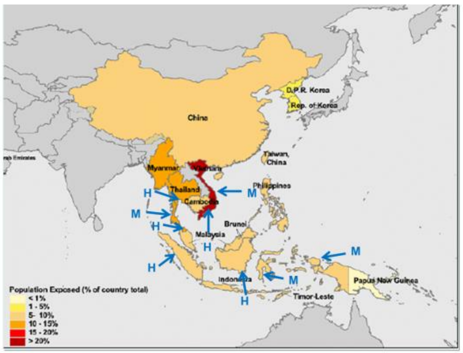
- Approved National Green Growth Strategy (Decision 1393, 25/9/2012 by Prime Minister);
- National Action Plan to Respond to Climate Change for 2012 – 2020 has been promulgated, (Decision 1474/QĐ-TTg 05/10/2012).
- Approved management scheme for emissions of greenhouse gases; manage the credit carbon business for world market (Decision 1775/QĐ-TTg, 21/11/2012)

Vilas Nitivattananon: Vulnerability and Adaptation to Climate Change for Water Management in Coastal Cities of Southeast Asia (ICI SEA Project)

This research conducted vulnerability and adaptation scoping assessments in urban water management of Indonesia, Vietnam and Thailand from 2010 to 2012, in order to get an overview of the existing vulnerabilities of coastal cities in Southeast Asia to climate-related hazards. The results of the assessment would also be used to select cities, where climate change risk assessments would be conducted for piloting adaptation actions.

Using rapid vulnerability assessment (RVA) method, the study investigated 5 coastal cities in each of the three countries. The RVA process consisted of review of literature and published reports to identify the cities climate-related hazards, vulnerable sectors and adaptation-related activities, and primary data collection in the form of unstructured interviews with households and key informants, group discussions, and on site observations to investigate the extent of vulnerability of affected sectors and areas. The level of vulnerability was summarized using a 3-scale rank based on the results of data analysis.

The assessment revealed that seven out of the fifteen coastal cities assessed have high vulnerability to coastal and riverine flooding, affecting housing, road and transportation infrastructures, and aquaculture industries. Three cities also have high vulnerability to drought, severely affecting their water supply. Another three cities have high vulnerability to coastal erosion. Most of the cities have already implemented adaptation-related interventions for floods and coastal erosion and disaster risk management plans. It can be concluded that while major cities such as Ho Chi Minh and Bangkok already have substantial related studies, smaller and secondary cities have a dearth of information.



Population exposed to SLR and flood risks 4

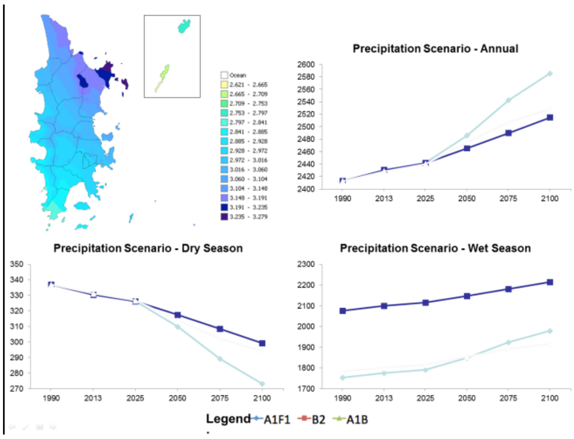
Dasgupta, et al (2007) and on-going study at AIT

By providing a landscape of the existing vulnerability and adaptation, country and city managers within the region and in other regions facing similar vulnerabilities would have an opportunity to assess their overall needs in order to successfully adapt the design and operational assumptions on urban water-related sectors to climate change.

- Funded by the International Climate Initiative (ICI)
- Consists three phases and is set to achieve expected results over 4 years (2011-2014)
- Objectives:

- Aims to enhance local adaptive capacities through learning from the cooperative research results on climate change impacts in Southeast Asian coastal cities
- Aims to share the information and experiences on climate change risk assessment and adaptation related to urban water management based on research results and dissemination activities
- Conducted at selected coastal cities in three countries of Southeast Asia, namely Indonesia, Thailand and Vietnam
- Partners includes: Urban and Regional Research Institute (URDI), Chumchonthai Foundation (CTF), HCM University of Technology (HCMUT)

Phase 1: Investigation (concluded): Review climate change vulnerability and risk assessment process. Study 15 cities of SEA countries on vulnerabilities and risks to CC related to water resource management; Conduct rapid vulnerability assessment in the 15 cities and select 2 pilot cities/towns in each country.



Phase 2: Piloting (on going): CC risk assessment for water management on selected 6 cities; Evaluate efficacy of assessment methods/tools used; Implement pilot adaptation actions

Phase 3: Dissemination (planned), Publish and disseminate results through different media and learning nodes/networks, Develop CC adaptation guidelines/programs

Summary of Existing Adaptation Actions

- Structural flood protection: polders and embankments, elevation of houses by landfilling, building houses on stilts, and/or building additional floors to take refuge during floods, structural improvement of riverbanks
- Non-structural flood management : disaster and emergency preparedness for communities flood, earthquake and tsunami prone areas, cleaning and dredging of water ways, improving solid waste management collection, relocation of illegal settlements along waterways
- Mitigating coastal erosion: breakwaters to ward off inland sea flow, mangrove reforestation , cribs and joints installation
- Hazard sensitive land use planning and management
- Improving crop yields: improved irrigation, crop rotation, flood and drought resilient crop varieties
- Improving water supply: water conservation, improvement of NRW

Major Findings

- Dearth of baseline and statistical data on many study areas
- Officials and residents can perceive what their problems are, but lack assessments yet on the long-term effects
- Confusion on what is happening arising from word usage and lack of information…

- Is flooding caused by a) SLR? b) Tidal rise? c) Land subsidence? d) All of the above e) None of the above
- Local stakeholder knowledge and responses to CC issues also vary based on exposure to these issues, i.e., those who are exposed to other natural disasters are better informed and more 'welcoming'
- Anthropogenic activities are still not fully understood in the context of climate change
- SLR/saline intrusion/drought on water supply & quality with over extraction & pollution
- Flooding in relation to urbanization

Common barriers

- Funding for technical support and implementation
- Baseline information and tools (for proper assessment and adaptation planning)
- Focus more on gaps of existing disaster, with limited different types of adaptation
- Political will, interest and priority
- Sustaining the momentum of the adaptation projects (esp advocacies and international-supported programs)

Entry-points for successful buy-in

- Tie-ins with CSRs of big-name companies for adaptation projects
- Grassroots level engagement (targeting specific critically exposed communities)
- Champions (government and non-government)
- Co-benefits (with CC mitigation and/or basic development issues)

Olivia Warrick: Community-Based Adaptation in the Pacific and the Role of the World Bank: What is Community-Based Adaptation (CBA)?

Building adaptive capacity; Empowerment: helping people to help themselves; Participatory: done 'with' rather than 'to' or 'for' communities; Based on local priorities and builds on local knowledge; Increases local voice in decision making processes

- High level leadership on climate change adaptation
- Mainstreaming risk considerations into economic development policy and plans
- Integration of disaster risk reduction and CCA institutions
- Long term engagement through phased programs
- Better coordination and partnerships between donors and implementing agencies

Example: Vanuatu 'Increasing Resilience Project'

National scale: Strengthen National Advisory Board on CC and DRM Secretariat, Consolidate methods, processes and protocols for CBA.

Provincial scale: Establish provincial disaster coordination centres; Establish provincial and Area Council-level CCA/DRR plans.

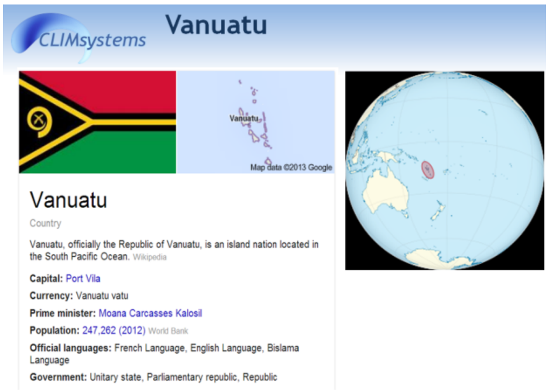
Community scale: Community Resilient Development Plans

Partnered with dedicated community-based facilitator working alongside provincial-level staff for duration. 6 ‘sites’ – each site includes ‘community clusters’, ~30 communities total; Ecosystem-based approach, landscape level

Small grants mechanism for implementation; Larger grants for multi-community initiatives; Intended to be absorbed by another donor/government at conclusion.

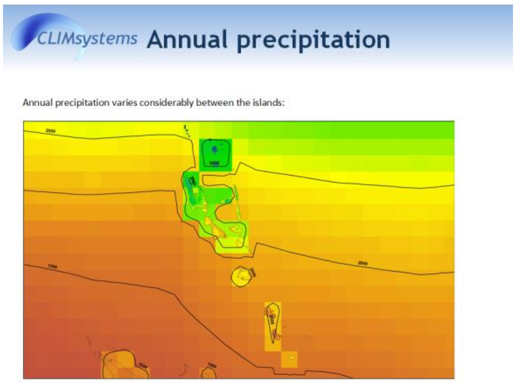
Peter Kouwenhoven: Vanuatu Risk Profiling

Vanuatu is often characterized as one of the world’s most hazardous countries. These include geological hazards such as earthquakes, volcanic eruptions, earthquake-induced landslips and tsunamis as well as climate-related hazards such tropical cyclones, droughts and extreme rainfall and associated flooding and heavy rainfall associated landslips. As a mountainous country with a long coastline most of the population is located in the hazardous coastal fringe of the main islands.



As part of a wider Pacific Project the UNDP commissioned a study of the hazards of Vanuatu and a through pulling together of the literature related to all known hazards. The country is diverse climatologically with the archipelago stretching from 12 to 20 degrees south latitude.

Given its marine situation the temperature changes expected through to 2100 are not as extreme as continental areas. However extreme rainfall return periods are expected to shorten considerably with concomitant impacts on flooding and impacts on agricultural production. Extended dry periods are also expected to lengthen with impacts on agriculture and water supplies that could affect the growing tourism sector. Ocean acidification and degradation of the extensive coral fringing reefs of the islands is a potentially critical environmental change. The wave energy dissipation capacity of the reef could be lost and coastal erosion which is already been accelerating on some islands could further expand and threaten coastal infrastructure. The seasonality of precipitation could also shifty with different modes in the northern set of islands than in the south. Agricultural development is a key development area and climate risk with shifts in seasonality and precipitation and temperature regimes is already being felt with pest and disease outbreaks and problems with staple food crops. The tectonic activity so prevalent in the islands is leading to ground subsidence in some key urban areas and this in conjunction with projected sea level rise means that the limited yet quickly growing urban areas of the country will face increasing risk from inundation and compromised drainage during heavy rainfall events.



Xiaogfeng Yi: Guangzhou's Planning Responses to Climate Change: Observations and Suggestions

Planning is going local while the climate changes globally. Still planning at local level can make sense to climate change through changing the city spatially, socially and economically. Guangzhou, the 3rd largest city in China, which is a coastal city more prone to the effect of climate change, has done something on the above aspects recently. The city has greener spatial strategies, healthier economic structure to the nature, greener transport system, more low-carbon-oriented urban designs and more local policies coping with the climate change or low carbon. But some problems at local level are still unsolved. 1) It is hard to evaluate what extend low-carbon oriented plans could be; 2) in context of development, local policies on climate change would not implemented well; 3) the officials and people have limited understanding of climate change and causes of climate change. We suggest more scientists, planners, policy-makers and more stake holders should work together to get closer to the real problems and find more effective solutions.

Urban planning (urban, city, and town planning) is a technical and political process concerned with the control of the use of land and design of the urban environment, including transportation networks, to guide and ensure the orderly development of settlements and communities.”—Wikipedia

We can make a difference by making the land use, urban built environment better.

Session 3: Advances in Climate Change Science: Modeling and Analysis

Yinpeng Li: Development of an Integrated Climate Change Impact Assessment Tool for Urban Policy Makers (UrbanCLIM)

What are real problems of climate change?

- Local governments don’t know what causes climate change
- So what they respond could not be really effective
- On the other hand, if the plans are really good, how can we know? Any scientific way to judge or evaluate it?

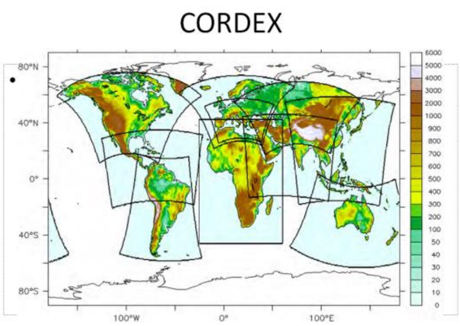
Climate Change is far away, until the extreme weather hits

If Your Pictures Aren't Good Enough, You're Not Close Enough --Robert Capa

- Practice-driven Research: If society has a technical need, that helps science forward more than ten universities. (Friedrich Engels)
- Provide solutions to fill up the gaps, Out of clutter, find simplicity (Albert Einstein)
- Help Out People Effectively (HOPE) (David Bishop)

CORDEX

- Placing end-users expectations and needs at the heart.
- Appropriate tailoring of climate information at relevant spatial and temporal footprints with more effective two-way communication
- Contributing to the WMO-led UN Global Framework for Climate Services (GFCS) and the Future Earth (FE) initiative.



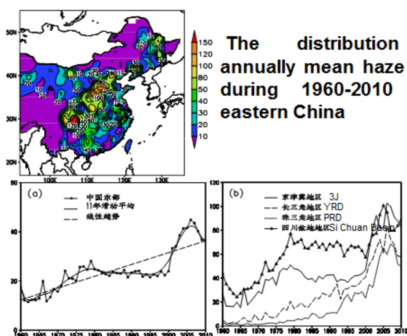
The use of multiple RCMs or multiple downscaling methods appears to increase uncertainty, especially at smaller scales and there is a need to develop robust methods to characterize and communicate uncertainty to the various end-users and stakeholders.

Better uncertainty characterization would also help set priorities for improving downscaling. Multi-model ensembles of dynamical and statistical downscaled products require further innovative post-processing approaches to distil, fuse and possibly reconcile imperfect, and sometimes contradictory, information.

Downscaling tools should also aim at increasingly finer scales to provide added value and useful information for VIA applications.

Li Dan: Regional Climate Modeling in Urban Agglomerations of China

Weather Research and Forecasting Model, coupled to the Urban Canopy Model, is employed to simulate the impact of urbanization on the regional climate over three vast city agglomerations in China. Based on high-resolution land use and land cover data, two scenarios are designed to represent the nonurban and current urban land use distributions. By comparing the results of two nested, high-resolution numerical experiments, the spatial and temporal changes on surface air temperature, heat stress index, surface energy budget, and precipitation due to urbanization are analyzed and quantified. Urban expansion increases the surface air temperature in urban areas by about 1°C, and this climatic forcing of urbanization on temperature is more pronounced in summer and night time than other seasons and daytime. The heat stress intensity, which reflects the combined effects of temperature and humidity, is enhanced by about 0.5 units in urban areas. The regional incoming solar radiation increases after



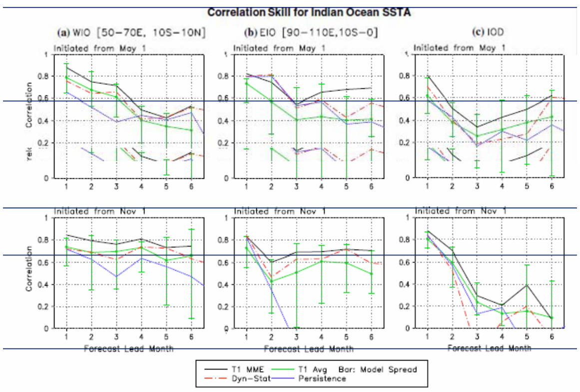
The distribution of annually mean haze days during 1960-2010 over eastern China

Annual variation of average haze days in eastern China (a) and four urban agglomerations (b) during 1960-2010. (Fu and Dan, 2014,paper under review)

urban expansion, which may be caused by the reduction of cloud fraction. The increased temperature and roughness of the urban surface lead to enhanced convergence. Meanwhile, the planetary boundary layer is deepened, and water vapor is mixed more evenly in the lower atmosphere. The deficit of water vapor leads to less convective available potential energy and more convective inhibition energy. Finally, these combined effects may reduce the rainfall amount over urban areas, mainly in summer, and change the regional precipitation pattern to a certain extent.

JINJUN JI: UNDERSTANDING CLIMATE PREDICTION AND CLIMATE PREDICTING OPERATION IN CHINA

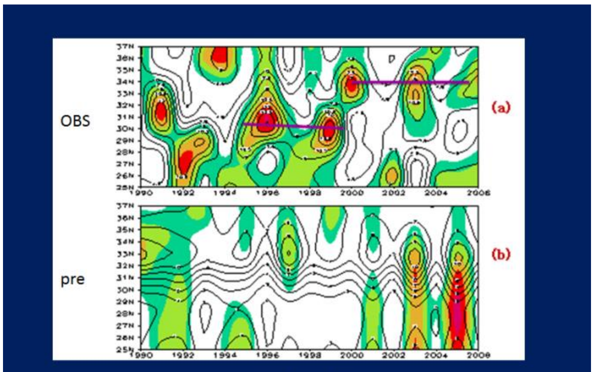
The indisputable evidence of global warming and the knowledge that surface temperatures will continue to rise over the next several decades under any plausible emission scenario is now a factor in the planning of many governments, businesses, and socio-economic sectors for which climate sensitivity and vulnerability is high. It does not imply, however, that future changes will be uniform around the globe. On the time scale of a few years to a few decades ahead, regional and seasonal variations in weather patterns and climate, and their corresponding impacts, will be strongly influenced by natural, internal variability. Decision makers in diverse arenas thus need to know the extent to which the climate events they are seeing are the product of this natural variability, and hence can be expected to reverse at some point, or are the result of potentially irreversible, forced anthropogenic climate change.



Many formidable challenges exist. For example, climate system predictions on the decadal time scale will require initialization of coupled general circulation models with the best estimates of the current observed state of the atmosphere, oceans, cryosphere, and land surface – a state influenced both by the current phases of modes of natural variability and by the accumulated impacts to date of anthropogenic radiative forcing. However, given imperfect observations and systematic errors in models, the best method of initialization has not yet been established, and it is not known what effect initialization has on climate predictions. It is also not clear what predictions should be attempted or how will they be verified. The brevity of most instrumental records furthermore means that even the basic characteristics and mechanisms of decadal variations in climate are relatively poorly documented and understood. As a consequence, the representation of natural variability arising from the slowly-varying components of the climate system differs considerably among models, so the inherent predictability of the climate system on the decadal time scale is also not well established.

The nature of ENSO has varied considerably over time, however, and in recent years many studies have documented decadal and longer-term variability of ENSO and Pacific climate in general. Decadal to inter-decadal variability in the atmospheric circulation is especially prominent in the North Pacific where fluctuations in the strength of the wintertime Aleutian Low pressure system co-vary with North Pacific SST in what has been termed the “Pacific Decadal Oscillation” or PDO. Very similar time scale fluctuations in SST and atmospheric and ocean circulation are present across the whole Pacific Basin, and these variations are known as the Inter-decadal Pacific Oscillation (IPO). Phase changes of the PDO/IPO are associated with pronounced changes in temperature and rainfall patterns across North and South America, Asia and Australia, as well as important ecological consequences, including major shifts in distribution and abundance of zooplankton and important commercial species of fish. Furthermore, ENSO teleconnections on interannual time scales around the Pacific basin are significantly modified by the PDO/IPO.

This brief survey of observed decadal climate variability makes it clear that, on the regional scales on which most planning decisions are made, anthropogenic climate change signals will be strongly modulated by natural climate variations, and especially those driven by the slowly varying oceans on a time scale of decades. This non-uniformity of change highlights the challenges of regional climate change that has considerable spatial structure and temporal variability.

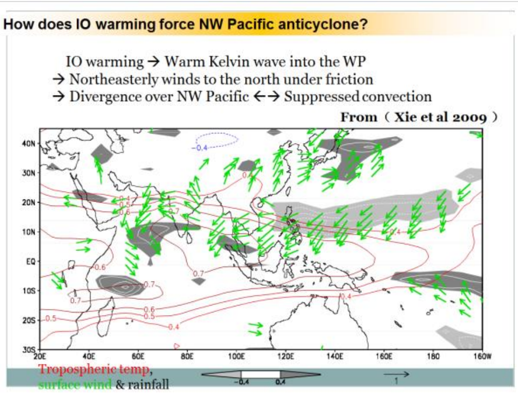


Mei-Yu rainfall (mm/d) 1990-2006

Despite the many issues and challenges outlined above, opportunities exist for major advancements in decadal climate prediction over the next several years. As part of the Coupled Model Intercomparison Project phase 5 (CMIP5), modelling centers around the world are planning coordinated suites of decadal hindcast and prediction experiments covering the period from 1960 to 2035. The results from these prediction experiments will be available to the international research community, and analysis of these results should prove valuable in advancing our understanding of decadal scale variability and predictability. These initialized climate predictions will complement suites of longer term simulations that will explore other aspects of climate system change, including the carbon cycle and other biogeochemical processes and feedbacks that will determine the ultimate degree of climate change in the second half of the 21st century. Ultimately, combining such approaches, including the use of higher resolution models capable of simulating regional scale climate phenomena, will provide a unified pathway for ever-improving decadal to centennial climate change predictions.

Gang Huang: Strengthening of tropical Indian Ocean teleconnection to the Northwest Pacific since the mid-1970s: An atmospheric GCM study and the simulations in CMIP5 models

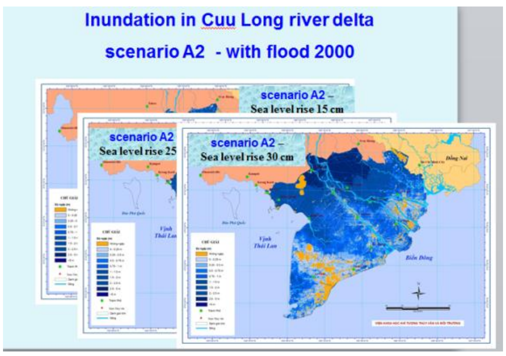
The correlation of northwest (NW) Pacific climate anomalies during summer with El Nin˜ o–Southern Oscillation (ENSO) in the preceding winter strengthens in the mid-1970s and remains high. This study investigates the hypothesis that the tropical Indian Ocean (TIO) response to ENSO is key to this interdecadal change, using a 21-member ensemble simulation with the Community Atmosphere Model, version 3 (CAM3) forced by the observed history of sea surface temperature (SST) for 1950–2000. In the model hindcast, the TIO influence on the summer NW Pacific strengthens in the mid-1970s, and the strengthened TIO teleconnections coincides with an intensification of summer SST variability over the TIO. This result is corroborated by the fact the model's skills in simulating NWPacific climate anomalies during summer increase after the 1970s shift.



During late spring to early summer, El Ninõ–induced TIO warming decays rapidly for the epoch prior to the 1970s shift but grows and persists through summer for the epoch occurring after it. This difference in the evolution of the TIO warming determines the strength of the TIO teleconnection to the NW Pacific in the subsequent summer. An antisymmetric wind pattern develops in spring across the equator over the TIO, and the associated northeasterly anomalies aid the summer warming over the north Indian Ocean by opposing the prevailing southwest monsoon. In the model, this antisymmetric spring wind pattern is well developed after but absent before the 1970s shift.

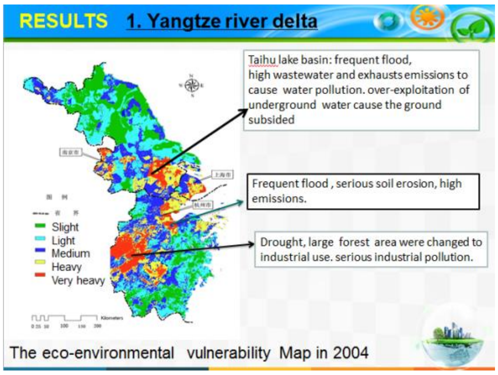
Duong Van Khanh: Impacts of indundation on land use under climate change context in Cuu Long Delta

Cuu Long Delta is a fertile delta with comprehensive river and canal system having great potential for the development in agriculture, industry, fisheries and ecotourism. The delta plays an extremely important role in the national economy of Vietnam, contributing more than 50% of food productivity and 65% of fish productivity. Its territory covers 13 provinces with the total natural area of 3.96 million hectares and a population of about 18 million people. Under irrigation development planning of Cuu Long Delta in 2012-2020 period and orientations to 2050 in terms of climate change and sea level rise approved by Prime Minister in 2012 has set a target of 2050 to ensure the safety of people's life, production and infrastructure for 32 million people and to respond to climate change, sea level rise and salinity intrusion. Therefore, assessment of impact of climate change on water resources in Cuu Long Delta has been becoming imperative. This paper presents results of study on impact of climate change on population distribution and land use in Cuu Long Delta. The results are part of state-level research project "Assessing impact of climate change on Water resources in Cuu Long Delta" under Science and Technology Program for the National Target Program to respond to climate change.



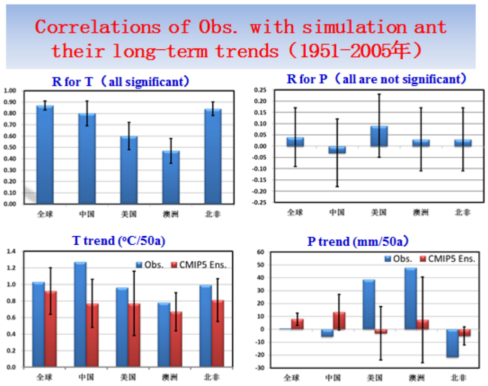
Mei Huang: Integrated Assessment of Eco-Environmental Vulnerability in Yangtze and Pearl River Delta

The Yangtze River and Pearl River Delta are two major economic zones in China. Many megacities like Shanghai, Guangzhou and Shenzhen located in the two deltas. Based on the remote sensing data and with the help of geographic information system an integrated assessment was conducted on the eco-environmental vulnerability of the delta areas. Spatial principal component analysis was used to generate the evaluation indicators and analytic hierarchy process (AHP) was applied to determine the weights of the evaluation factors. The possible reasons for causing the vulnerability were discussed.



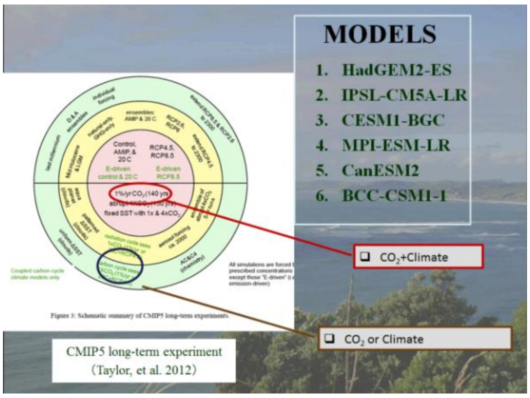
Tianbao Zhao: Simulation of historical and projected climate change in arid and semiarid areas by CMIP5 models

Based on CRU3.1 temperature and GPCC V6 precipitation data, the abilities of climate models from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) to simulate climate changes over arid and semiarid areas were assessed. Simulations of future climate changes under different representative concentration pathways (RCPs) were also examined. The key findings were that most of the models are able capture the dominant features of the spatiotemporal changes in temperature, especially the geographic distribution, during the past 60 years, both globally as well as over arid and semiarid areas. In addition, the models can reproduce the observed warming trends, but with magnitudes generally less than the observations of around 0.1–0.3°C/50a. Compared to temperature, the models perform worse in simulating the annual evolution of observed precipitation, underestimating both the variability and tendency, and there is a huge spread among the models in terms of their simulated precipitation results. The multi-model ensemble mean is overall superior to any individual model in reproducing the observed climate changes. In terms of future climate change, an ongoing warming projected by the multi-model ensemble over arid and semiarid areas can clearly be seen under different RCPs, especially under the high emissions scenario (RCP8.5), which is twice that of the moderate scenario (RCP4.5). Unlike the increasing temperature, precipitation changes vary across areas and are more significant under high-emission RCPs, with more precipitation over wet areas but less precipitation over dry areas. In particular, northern China is projected to be one of the typical areas experiencing significantly increased temperature and precipitation in the future.

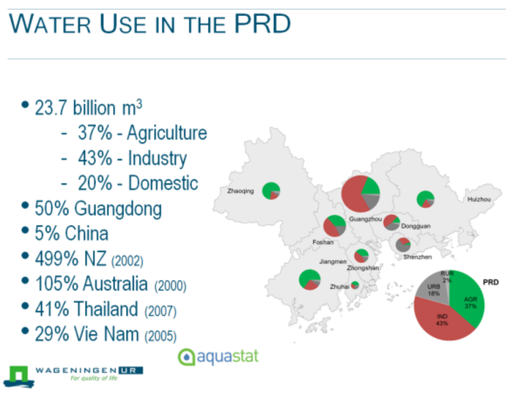


Jing Peng: Impacts of rising atmospheric CO2 concentration and climate change on NPP and NEP of global and regional ecosystems based on the CMIP5 Model Intercomparison

Based on the simulations of for the fifth coupled model intercomparison project (CMIP5), we estimate the response of net primary production (NPP) and net ecosystem production (NEP) to rising atmospheric CO2 concentration and climate change at global and regional scales. The modeled NPP and NEP significantly increase about 0.4PgCyr-2 and 0.09PgCyr-2, respectively, involving the rising atmospheric CO2. However, adverse trends of the two variables are driven by climate changes at the global scale. Regarding the spatial pattern, these decreases are mainly located in the tropical and temperate regions including a part of eastern Asia and southern Asia. The terrestrial carbon sink is accelerated not only by rising atmospheric CO2 concentration but also by the global warming at the high latitude and altitude regions (e.g. Tibet, Alaska and Greenland). Although the simulations indicates that an increase of NPP and NEP are shown owning to CO2 fertilization effect, the strength of trends significantly differs from the CMIP5 models. The enhanced trend in terrestrial carbon sink simulated by MPI-ESM-LR is about 47 times larger than that by CESM-BGC considering the CO2 fertilization effect alone. In eastern Asia, such variations reach between 0.2TgCyr-2 in CESM-BGC and 14.2TgCyr-2 in MPI-ESM-LR. Differences in the modeled responses of NPP and NEP result from the various processes of the land surface component accounting for nitrogen limitation effect and plant function types (PFTs). We also found the difference in accelerating terrestrial carbon loss forced by global warming between CMIP5 models, ranging between 6.0TgCyr-2 in CESM-BGC and 52.7TgCyr-2 in MPI-ESM-LR. Regionally in eastern Asia, extent of trend in NEP ranges from -2.2TgCyr-2 in BCC-CSM1-1 to -0.1TgC yr-2 in MPI-ESM-LR. Such a divergence is somewhat responsible for the difference in simulated climate between the CMIP5 models.



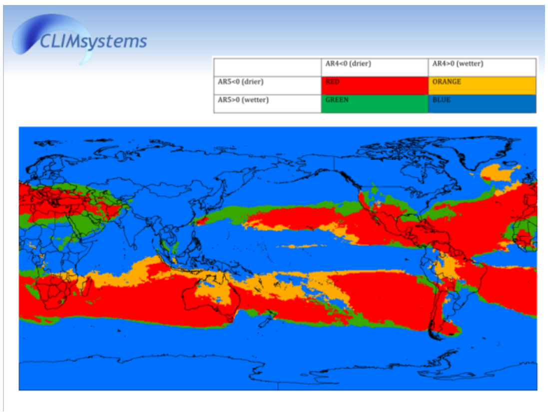
Mingtian Yao: Sectoral Water Use in the Pearl River Delta



Assessing and managing water use is crucial for supporting sustainable oriented river basin management and regional development. The first consistent and comprehensive assessment of sectoral water use in the Pearl River Delta (PRD) was performed by analysing regional water use data from 2000 to 2010. The regional-scale water use model PRDWUM was developed to explore the possible driving forces underlying water use changes in the domestic, industrial and agricultural sectors. We calculate water intensities from annual socio-economic and water use data. We find that the PRD managed to stabilize its absolute water use by dramatic improvements in industrial water use intensities, and early stabilisation of domestic water use intensities. Results reveal large internal differentiation of sectoral water use among the cities in this region, with industrial water use intensity varying from -80 to +95% and domestic water use intensity by +/- 30% compared to the delta average. In general the early developed cities have higher water use intensities in domestic sector. But all are expected to approach a saturation value of the per capita water use much below what is suggested in recent global studies. Therefore, these previous global assessments may have overestimated future domestic water demand in developing countries. Although scarce and uncertain input data and model limitations lead to a high level of uncertainty the regional water use model is useful in exploring the underlying driving forces of water use changes and can help explore future water use scenarios.

Peter Kouwenhoven: AR4 & AR5 changes and new outputs

The new results from the 5th Assessment by IPCC allows for analysing the changes in global temperature in more depth. For the image, two outcomes were extracted: what is the change in the mean temperature, and what is the change in the maximum temperatures. The image separates the results into two sets: 1) areas where the daily mean temperature increases more with climate change than the daily maximum temperature (green), 2) areas were the daily maximum temperature increases more with climate change than the mean temperature and is likely to cause an increase in daily temperature amplitudes (red).



A higher intensity of the green over red colours indicates a bigger difference in the increase.

The image shows that it is mainly the moderate areas where the daily maximum temperatures increase more than the daily mean temperatures. This will also impact the frequency (and intensity) of extreme temperature events like heatwaves.

Tmin:Tmean:

Comparing the Tmax:Tmean image, the same can be done for the minimum temperature versus the mean temperature. Red is where the daily minimum temperature are increasing faster than the daily mean temperatures. This happens in the colder climate areas, threatening the ice-fields, and impacting the seasons, shifting to a milder climate.

Tmax:Tmin:

The final image shows the ratio between the daily maximum and daily minimum temperatures. This shows the same trend as the Tmin:Tmean image: in the red areas the daily minimum temperature increases faster than the daily maximum temperatures, decreasing the daily amplitude, which is likely to impact crop growing cycles and patterns.

AR4 SLR 2100 (A1FI-high)

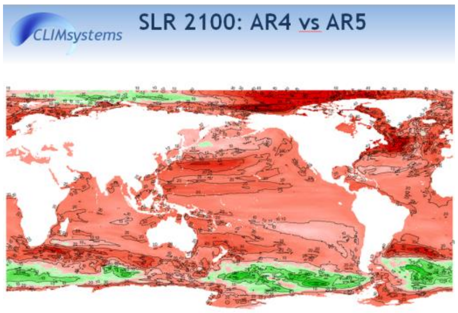
The image shows the most extreme projected sea level rise by 2100. For IPCC's 4th Assessment that is with the A1FI emission scenario (were all fossil fuels are burned at a high rate - the current practise) under the high climate sensitivity assumption. The global mean sea level rise is 83 cm.

An ensemble of 13 models was used.

Sea level rise is partly caused by thermal expansion (warming of the water), which is different in different locations, thus those parts of the world that heat up most also show the highest SLR.

AR5 SLR 2100:

With the same legend as an AR4 image, this AR5 showed a stronger increase in sea level rise under its most extreme scenario with RCP8.5-high, which has global mean of 98 cm (while the projected temperature increase is actually lower than AR4).



An ensemble of 24 models was used.

The most noticeable change is the far north of North America (the Arctic area), and along the East coast of the USA and Canada.

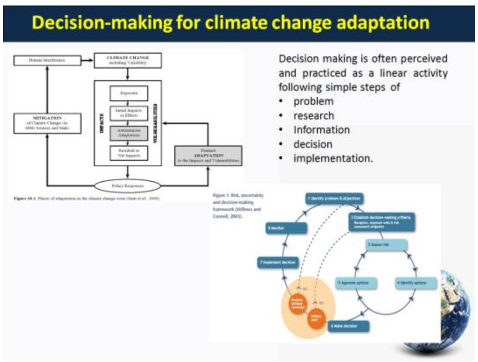
SLR 2100 distribution:

This graph here shows the distribution of the difference in magnitude of sea level rise around the globe, using the values in all the grid cells (of 0.5°x0.5°) for both AR4 and AR5.

It is evident that the AR5 levels are higher, both in the median values but also in the higher extremes.

CHONGHUA YIN: DECISION-MAKING SUPPORT SYSTEM FOR CLIMATE CHANGE ADAPTATION - A SYSTEM-DYNAMICS-BASED PLATFORM - GENIES

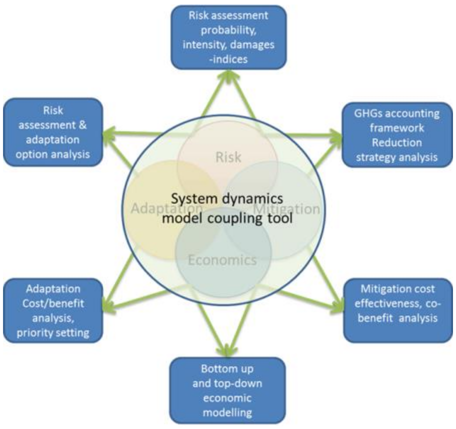
Urban areas concentrate populations, economic activities and built environments, thus increasing the risk from floods, heat waves, and other climate and other weather hazards that are expected to be aggravated by climate change. The very limited levels of awareness of climate change impact and risk, and the absence of urban policy making support systems that integrate climate change considerations are barriers for implementing climate change policy in Asia's rapidly growing urban centres. Organizations confronting the challenges of climate change will continue to face uncertainties about the direction and magnitude, the effect of levels of exposures, and their implications on policy, despite attempts to bring climate models down to the local level. Thus, there is an urgent need to develop robust and integrated climate change adaptation strategies for urban areas.



During the past two decades a wide range of concepts and ideas have been developed, many theoretical frameworks have been explored through case studies and trials, and many tools and datasets have been created. However these efforts have focused mainly on frameworks, and lack in-depth assessment models, especially in their socio-economic and cost-benefit analyses. Typically they are focused on single sectors, but lack integration; or lack clear risk assessment in the model. There is an urgent need for an integrated climate change decision support tool, which should include multi-faceted adaptation, mitigation and risk assessment in an open framework. We understand that the capacity of human beings to understand the global ecosystem and its relationship to human activities is limited by our environmental and socio-economic development stage, and therefore knowledge generation and sharing are critical for improving our collective ability to face these challenges.

GENIES was designed as a decision support system for climate change in urban areas, to enable risk assessment and socio-economic analysis of climate change impact, adaptation and mitigation. Its design enables it to easily extend to other major sectors such as climate related hazards, resilience, water, transport, and health as we work to serve the needs of the GENIES community of practice.

The GENIES platform was built on the system dynamics simulation library “Sage,” from Highpoint Software Systems. Sage is a state of the art simulation engine, with powerful simulation capabilities and great flexibility in simulation architecture, control, construction and integration. Built on Microsoft’s industry standard .NET technology, GENIES also uses Windows Presentation Foundation (WPF) technology to implement a friendly, flexible and extensible GUI.



The GENIES architecture was designed to provide robust support for three classes of users – Developers, Modellers and Analysts/PolicyMakers. Developers are able to reach into the deepest software layers to extend existing, or build new, simulation, modelling and interactive capabilities that integrate seamlessly with (essentially becoming part of) the GENIES application. Modellers are able to use blocks and connectors, user interaction and model aggregation capabilities to create robust models, and Analysts and Policy Makers use simple and powerful analytical tools that smoothly integrate models and other decision making tools into a decision support engine for formulating practical approaches to real world challenges. Therefore, the GENIES core can act as a generic platform for many other areas other than climate change issues by adding outer components.

The GENIES platform was designed to support layered applications. The central layer of the system provides the fundamental scientific understanding of climate change and related issues, the graphical user interface (GUI) and the model development environment. The interactive layer allows efficient and effective interaction between the model developer and end user. The policy making layer supports policy making processes by providing outputs in a variety of formats, such as graphs, maps, and technical information. GENIES supports a participatory assessment approach through users’ dialogue with urban policy makers and planners from targeted cities.

A unique advantage of applying a system dynamics approach is the ease with which one can extend and revise models as the domain is explored and questions arise. GENIES will allow in-flight alteration of models and their data and presentations, the use of a visual coupling tool for data conversion, and dynamic updating of workflows. A set of climate change impact models (flood, storm surge, heat waves and others as identified during the current project), economic models and multiple criteria decision analysis tools will be developed and incorporated into GENIES. The flexibility of the system will be augmented by establishing standard model and data libraries that provide the building blocks for a wide range of related applications.

Photo Gallery: Raglan, New Zealand