Urbanisation, Natural Hazards, Adaptation & Green Growth: Micro-Scale

Paul Watkiss

Adaptation, Green Growth and Urbanization Workshop
28th – 29th January 2014

Paul Watkiss Associates

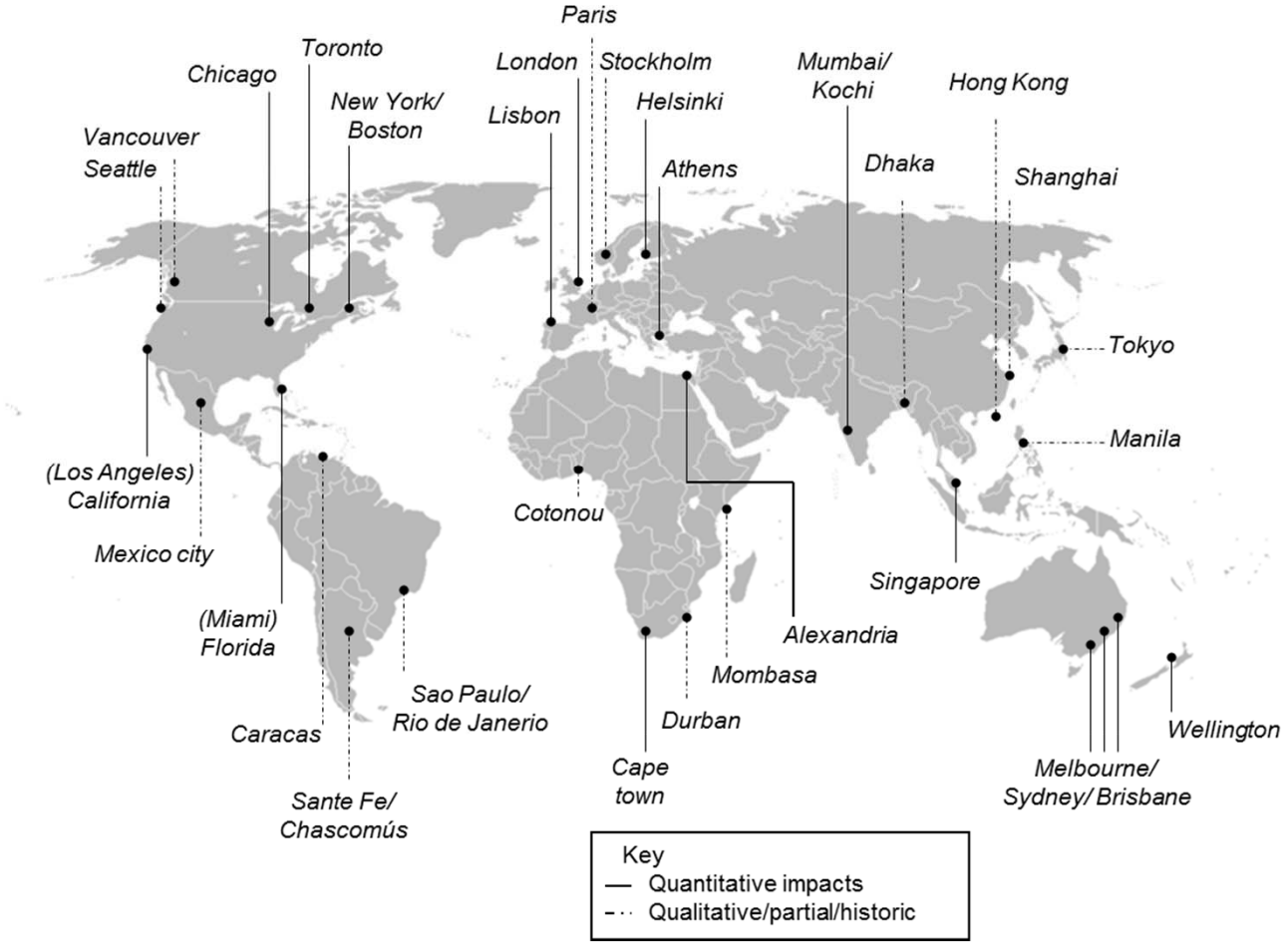
ECONADAPT

National Hazards, Adaptation, Green Growth

- Natural hazards have high impacts and economic costs today (adaptation deficit)
  - Direct (tangible & intangible), indirect & macro-economic effects
- Climate change expected to increase many of these extremes (IPCC SREX, 2012)
- Collaboration (formerly competition) is between DRM, adaptation & development
- But what about the green growth linkages?
- They do exist but potential for conflicts as well as synergies, and important barriers

Urban areas are vulnerable to current & future risks

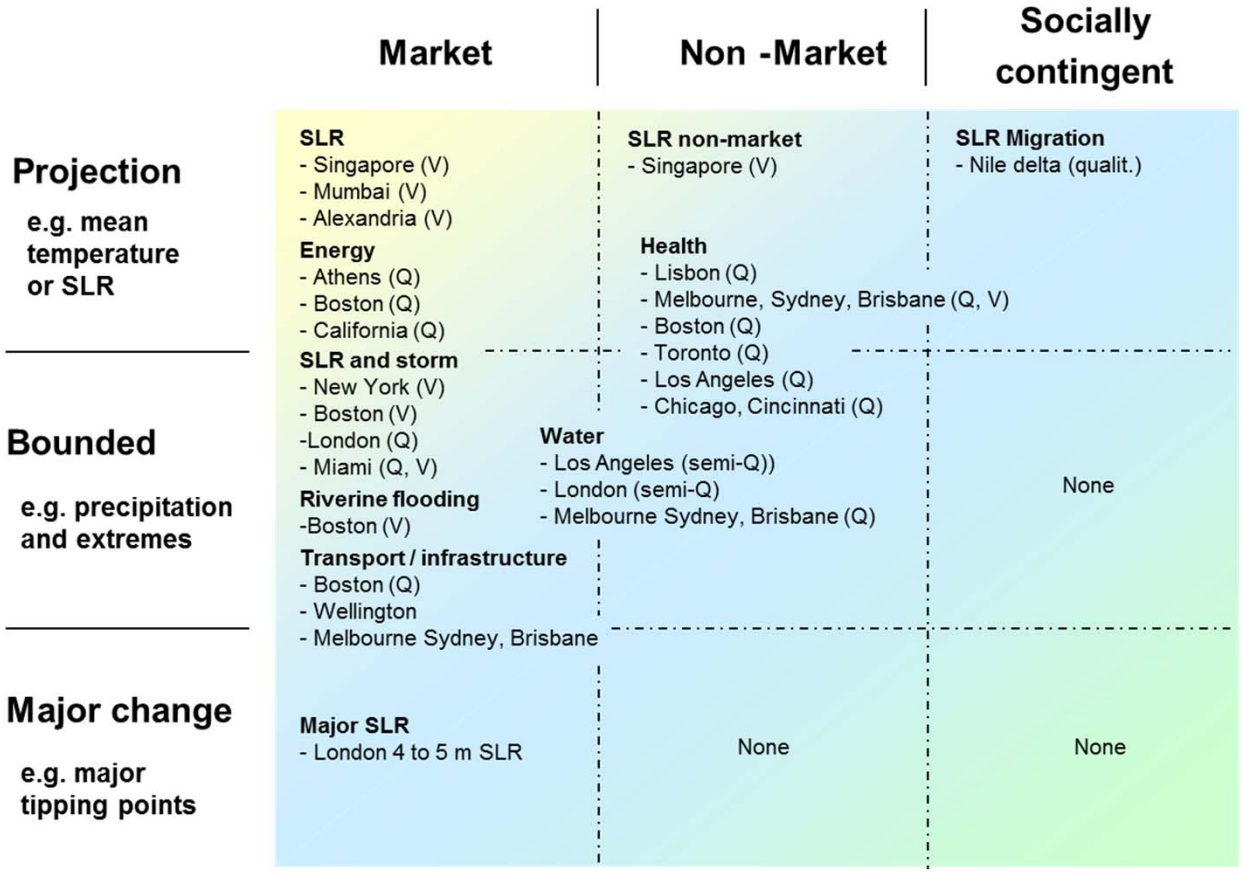
- Recognition of natural hazards and climate change impacts at the city scale



Source: Hunt, A., and Watkiss, P. (2011). Climate change impacts and adaptation in cities: a review of the literature. Climatic Change. Special Issue: Understanding Climate Change Impacts, Vulnerability and Adaptation at City Scale. Volume 104, Number 1 (2011), 13-49, DOI: 10.1007/s10584-010-9975-6.

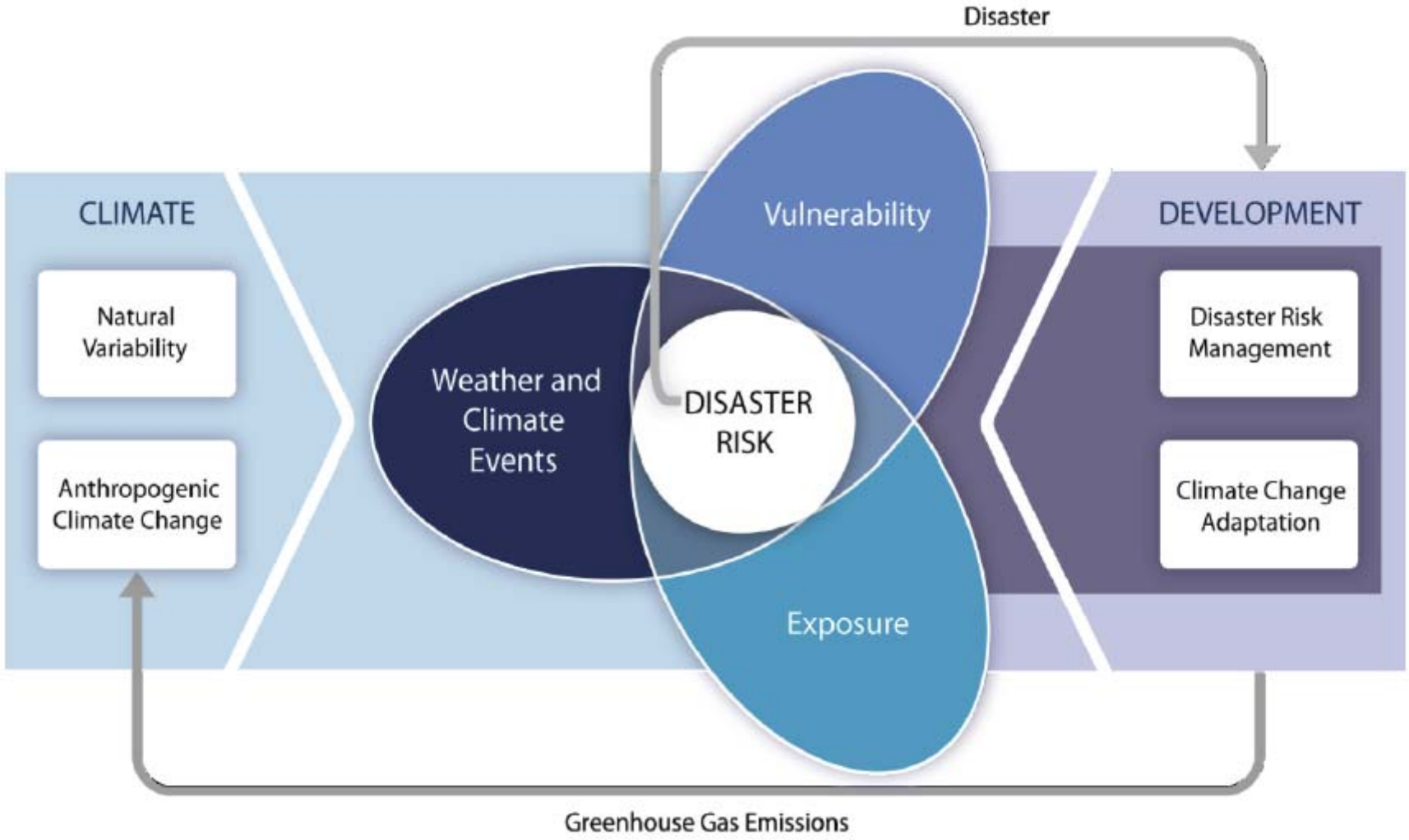
Key risks for natural hazards and climate (adaptation)

- Focus: coastal floods/slr, river/urban flooding, heat extremes, wind storm



Source: Hunt, A., and Watkiss, P. (2011). Climate change impacts and adaptation in cities: a review of the literature. Climatic Change. Special Issue: Understanding Climate Change Impacts, Vulnerability and Adaptation at City Scale. Volume 104, Number 1 (2011), 13-49, DOI: 10.1007/s10584-010-9975-6.

Natural hazards, DRM and Adaptation Convergence



Source IPCC SREX, 2012: IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

National to Local Level linkages - Methods

- Methods for DRR-Adaptation
- Iterative risk / adaptive management approaches
- E.g. GGGI CRS Ethiopia
- Early focus on low and no-regret, mainstream, capacity building, iterative planning
- Synergies with mitigation through Multi-attribute analysis
- But green growth, DRR, adaptation and urban?

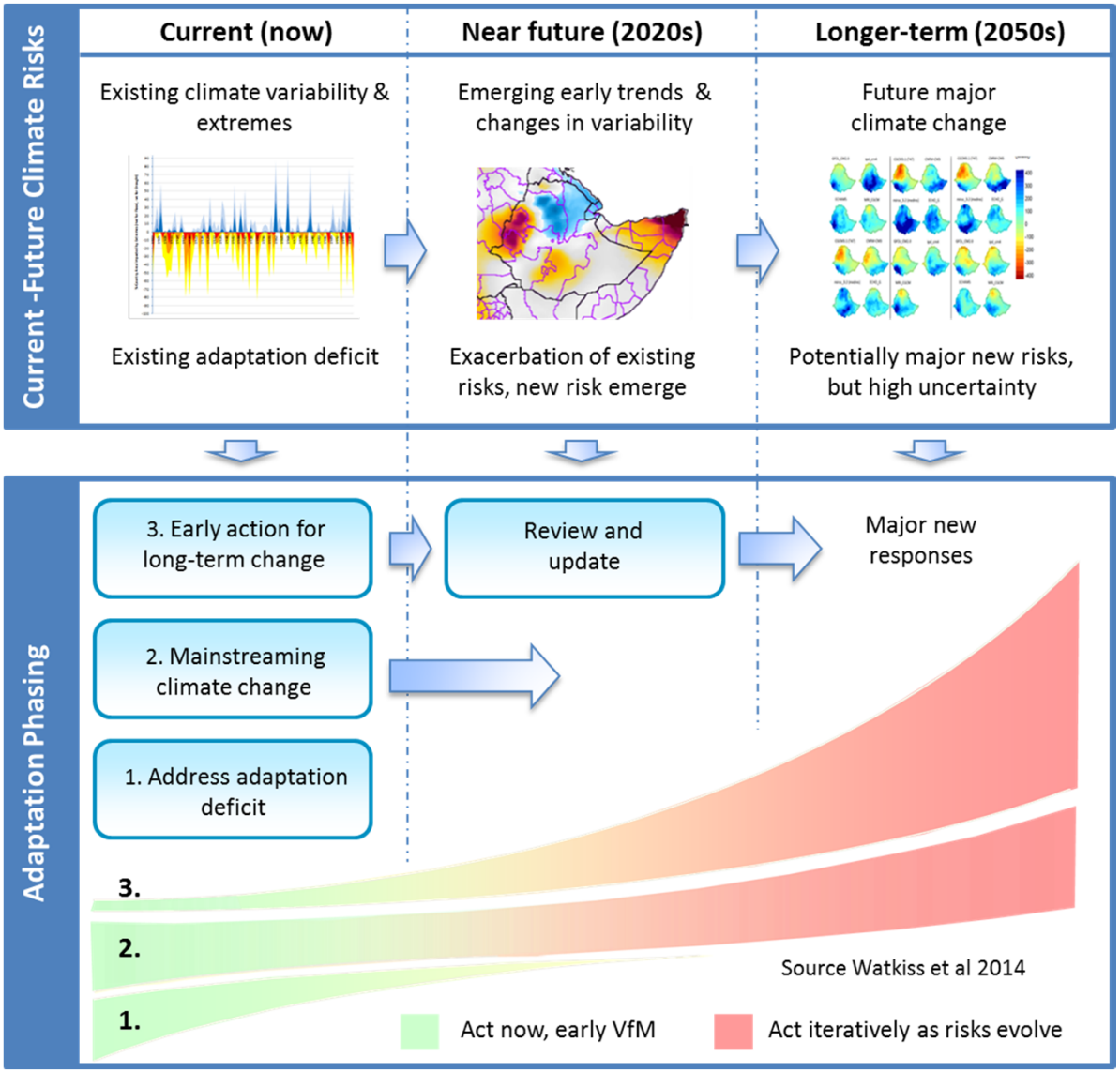


Figure source: Watkiss, P., Hunt, A., and Savage, M. Early no regret adaptation. Discussion note for DFID.

Global Scale: NH-Adaptation-GG linkages

- Urban areas are one of main sources of greenhouse gas emissions (GHG)
- Green growth reduces GHGs
- Thus GG reduces natural hazard risks by reducing long-term climate change
- However, the benefits of mitigation do not appear until after 2040
- Mitigation not reduce short-term hazards or early climate change

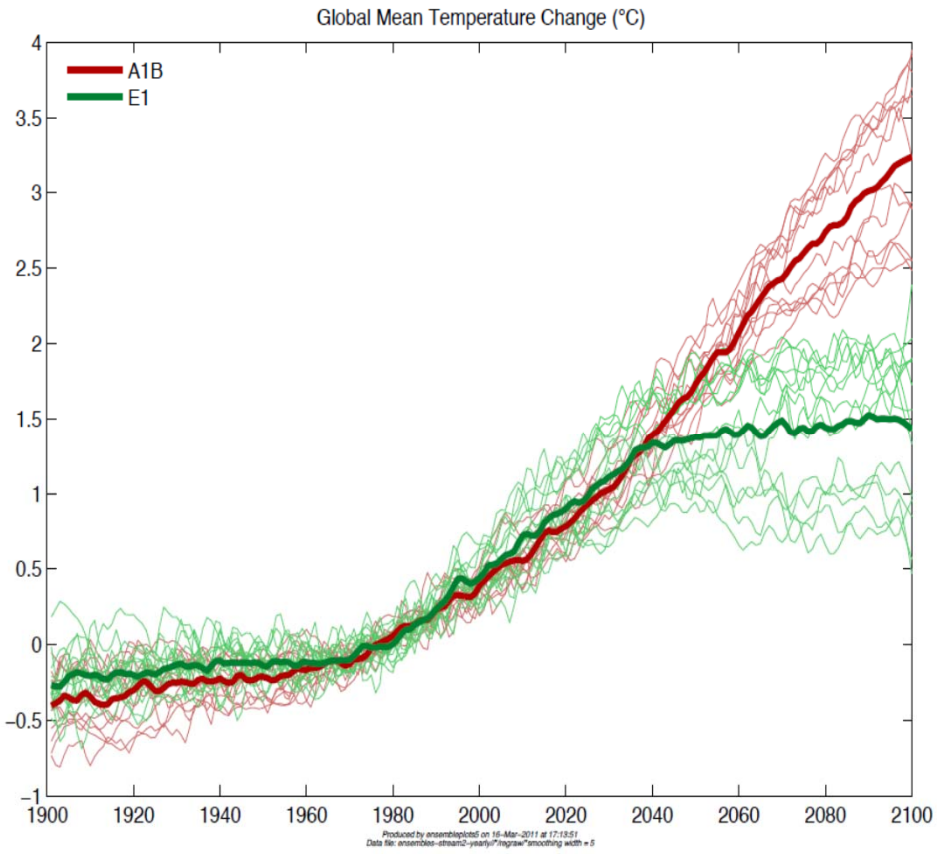


Figure Source: Christensen, O. B, Goodess, C. M. Harris, I, and Watkiss, P. European and Global Climate Change Projections: Discussion of Climate Change Model Outputs, Scenarios and Uncertainty in the EC RTD ClimateCost Project. In Watkiss, P, Ed. The ClimateCost Project. Final Report. Volume 1: Europe. Published by the Stockholm Environment Institute, Sweden, 2011. ISBN 978-91-86125-35-6.

But what about links to green growth in urban areas?

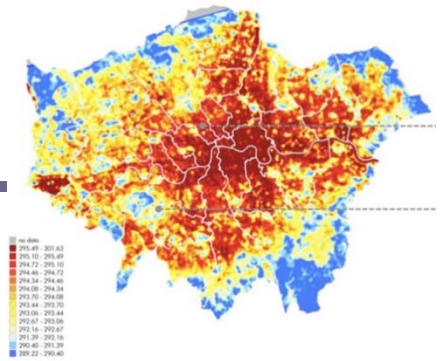
- Primary policy domain is national to local. Cities drive emissions and growth
- NH/CC not primary driver: socio-economic change
  - Future population will be urban (60% by 2030, w/ 37 megacities*)
- And our research and policy is compartmentalised (methods, timing, governance)**
  - Natural hazard, climate change and adaptation
  - Mitigation, green industrial policy
  - Noting power imbalance in developing countries between MoE and MoF/PC
- So where is urban-DRM-adaptation-Green Growth nexus and what are the issues?

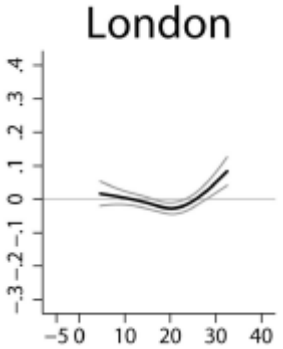
* UN population urbanisation statisitics

**Neufeldt, H., Jochem, E., Hinkel, J., Huitema, D., Massey, D., Watkiss, P., McEvoy, D., Rayner, T., Hof, A. and Lonsdale, K. Climate policy and inter-linkages between adaptation and mitigation. Chapter 1. In. Making Climate Change Work for Us. European perspectives of adaptation and mitigation strategies (ADAM). Editors: Mike Hulme and Henry Neufeldt. Published by Cambridge University Press, 2010.

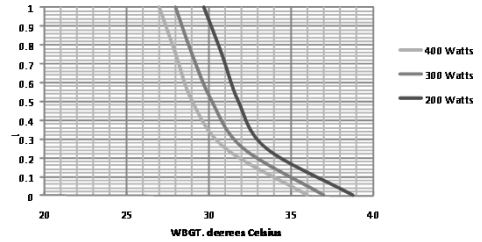
Heat extremes

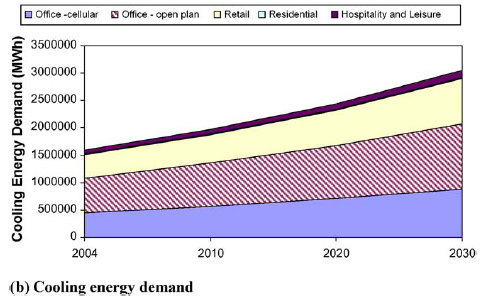
- Heat extremes have large impacts today, e.g. London
- Increased by urban heat island in large cities
- Heat related mortality and morbidity
- Lower productivity: outdoors ** and for cities indoors
  - e.g. UK 30%⬇@32C=£125M/day*
- Or else increased energy for cooling***





Work ability (%) as a function of WBGT (degrees Celsius) at 3 work intensities (Watts), acclimatized. The y-axis is proportion of time that is productive.



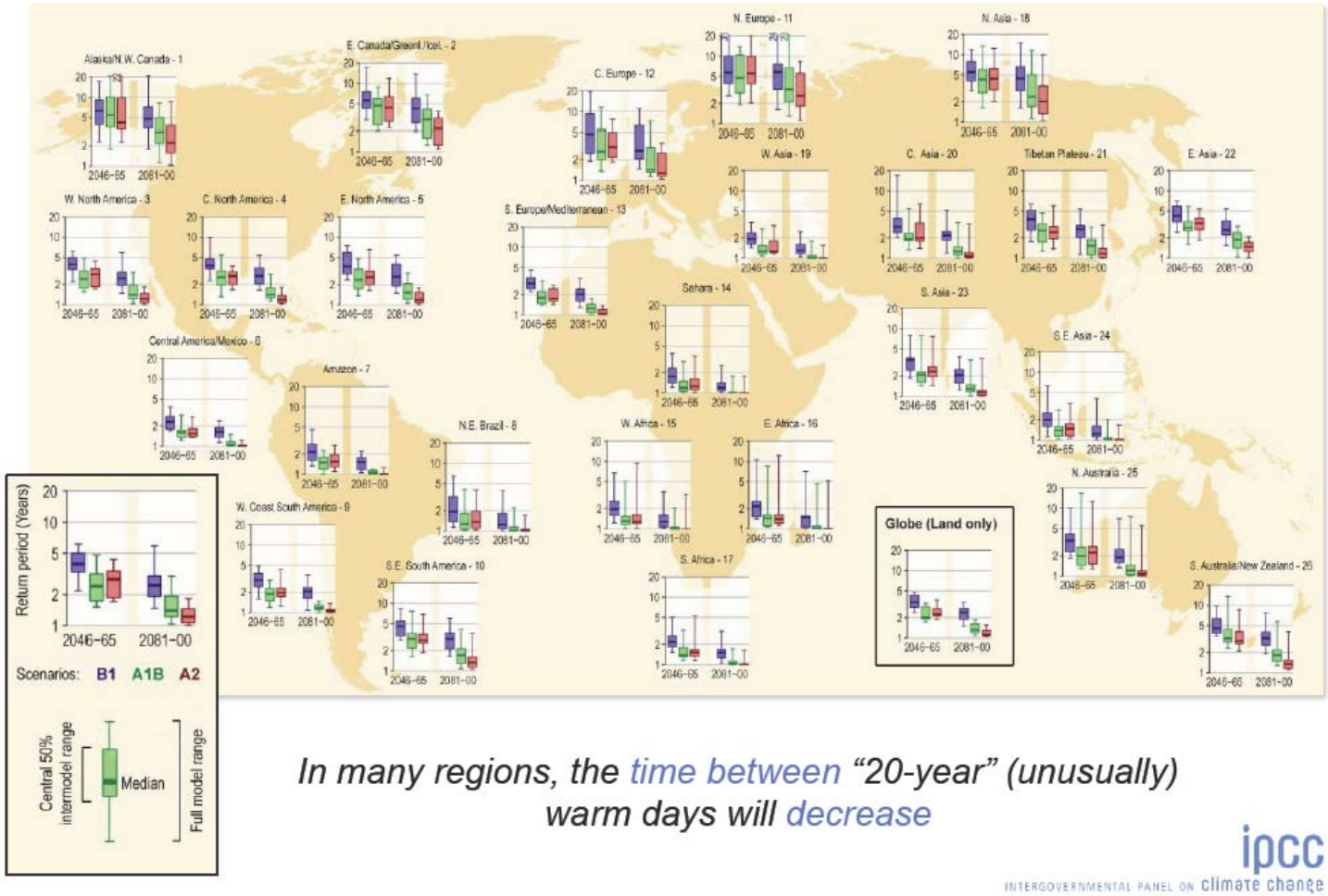


(b) Cooling energy demand

CEBR (2003).
Figures Figure: LUCID project (2007 – 2010. Baccini, M.; et al (2008). Effects of apparent temperature on summer mortality in 15 European cities: results of the PHEWE project. Epidemiology 19 (5).
**Kjellstrom, T., R. S. Kovats, S. Lloyd, T. Holt, and R. S. Tol, 2009, The direct impact of climate change on regional labour productivity: Archives of Occupational and Environmental Health, v. 64, no. 4, p. 217-227.
***Day et al. Forecasting future cooling demand in London. Energy and Buildings 41 (2009) 942–948

Heat extremes are likely to increase

Climate models project more frequent hot days throughout the 21st century



In many regions, the time between "20-year" (unusually) warm days will decrease

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Source IPCC SREX, 2012: IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

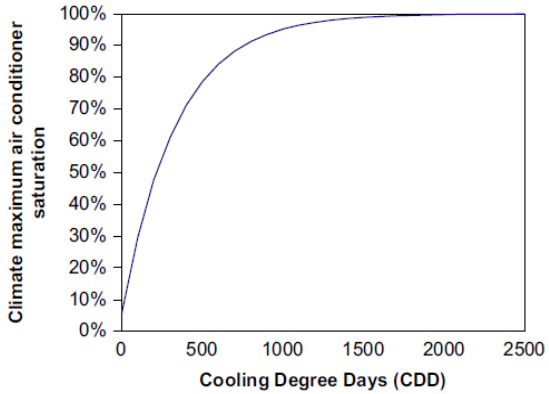
Heat extremes and climate change

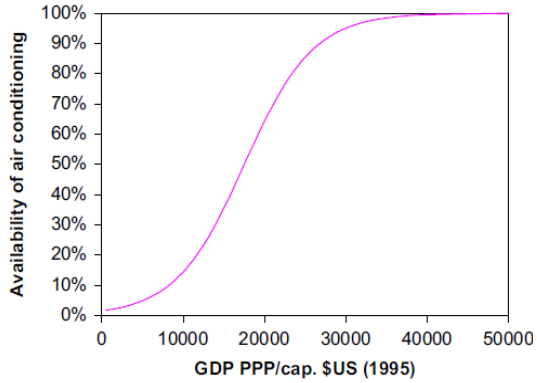
- Complex interactions between growth, climate change, autonomous adaptation, planned adaptation & mitigation
- Climate change lead to 30000 to 90000 additional urban deaths/yr by 2050s in EU with economic costs up to € 90 bill. year [VSL]*
- Short-term planned adaptation is heat alert (low cost) but not sufficient in long-term
- Climate change will also reduce urban productivity and decrease comfort levels
    - But quantification challenging because of building and spatial specificity
- Likely to lead to autonomous response of air conditioning

*Kovats, S, Lloyd, S, Hunt, A and Watkiss, P. (2011). The Impacts and Economic Costs on Health in Europe and the Costs and Benefits of Adaptation, Results of the EC RTD ClimateCost Project.

Air Conditioning

- AC reduces mortality (by ~50% **)
- AC reduces productivity loss
- AC increases with climate change (autonomously)
- And AC penetration increases with income***
- Behavioural responses (events triggers uptake, cars)
- BUT AC has a cost, e.g. additional cost of climate change on cooling in EU = €110 bill/year by 2100 (Cap+Op)**
- B/C AC increases GHG unless decarbonised electricity

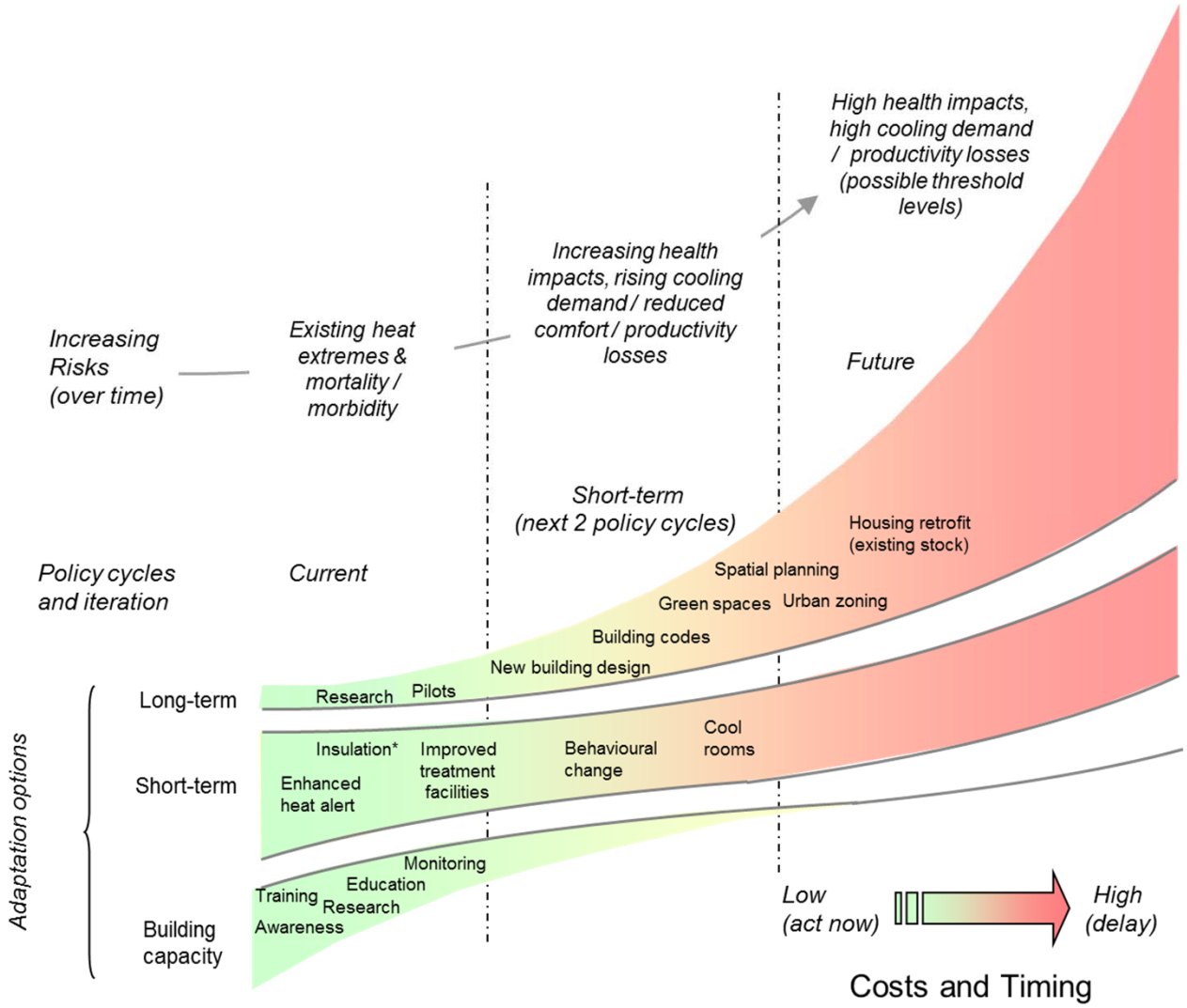




* Mima S, Criqui P, and Watkiss P (2011). The Impacts and Economic Costs of Climate Change on Enery in Europe. Summary of Results from the EC RTD ClimateCost Project. In Watkiss, P (Editor), 2011. The ClimateCost Project. Final Report. Volume 1: Europe. Published by the Stockholm Environment Institute, Sweden, 2011. ISBN 978-91-86125-35-6.
**Ostro, O., Rauch, S., Green, R., Malig, B., & Basu, R. 2010. The Effects of Temperature and Use of Air Conditioning on Hospitalizations. American Journal of Epidemiology, 172(9), 1053-1061. ***Isaac and van Vuuren. Modeling global residential sector energy demand for heating and air conditioning in the context of climate change Energy Policy. 37(2009)507–521

Iterative methods for planned synergistic alternatives

- Can start to assess some of these issues with iterative adaptive management



Watkiss, P. and A. Hunt, 2011: Method for the UK Adaptation Economic Assessment. Final Report to Defra. May 2011. Deliverable 2.2.1

Planned adaptation responses involve challenges

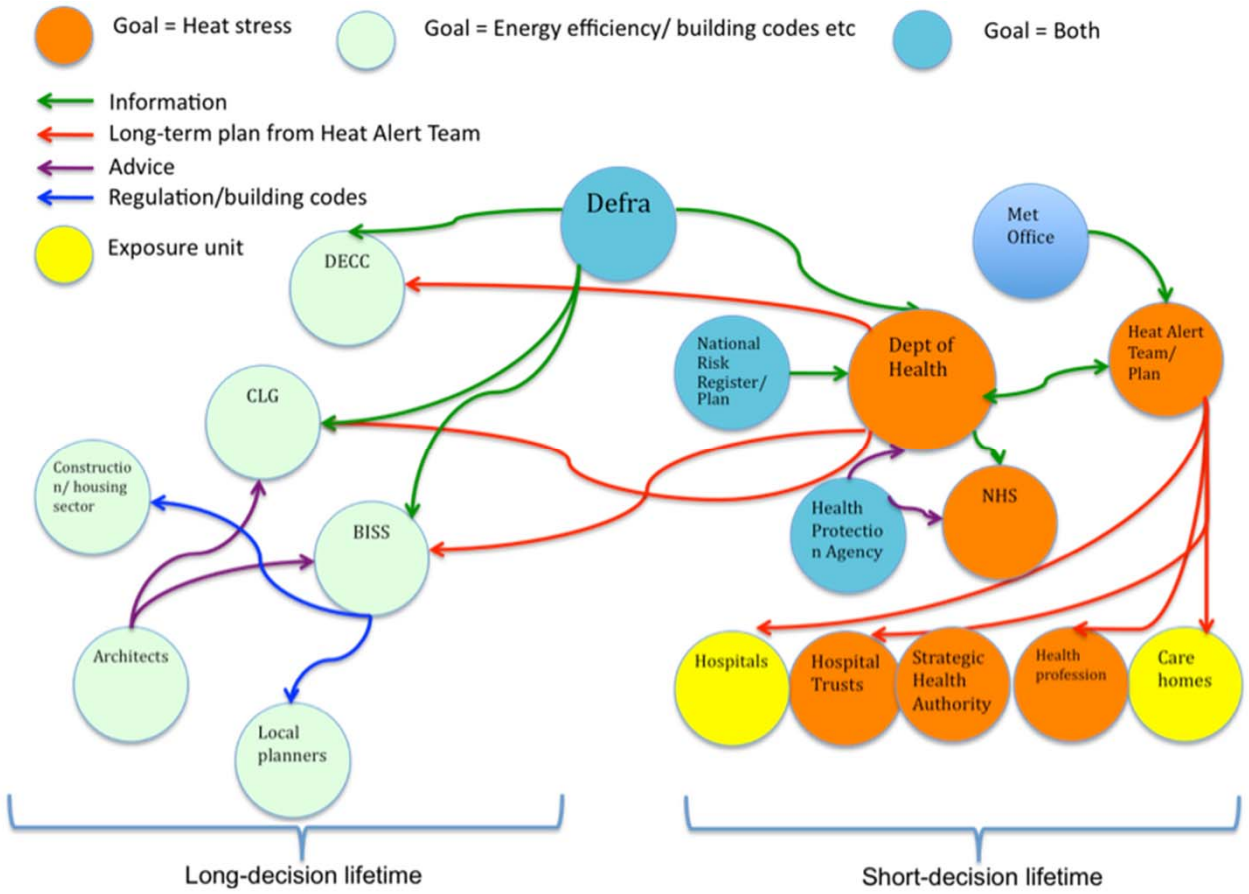
- Some options are synergistic with mitigation, e.g. building design, passive vent. BUT
  - Only cost-effective during design (not retrofit), builder (cost) vs owner (benefit)
  - Designing for uncertain future climate is difficult*
  - Green space, positive but localised and land costs

- Some options are in conflict with mitigation**
  - Low density cities reduce heat island effects and reduce cooling demand
  - But increase greenhouse gas emissions

*Hallegatte, S., Hourcade, J.-C., Ambrosi, P., 2007. Using climate analogues for assessing climate change economic impacts in urban areas. Climatic Change 82 (1–2 (May)), pp. 47–60, doi:10.1007/s10584-006-9161-z.
** Neufeldt, H., Jochem, E., Hinkel, J., Huitema, D., Massey, D., Watkiss, P., McEvoy, D., Rayner, T., Hof, A. and Lonsdale, K. Climate policy and inter-linkages between adaptation and mitigation. Chapter 1. In. Making Climate Change Work for Us. European perspectives of adaptation and mitigation strategies (ADAM). Published by Cambridge University Press, 2010.

Implementing synergistic policy is difficult

- Decisions taken by different actors, with different objectives/temporal perspective
- Social Network Analysis reveals we should not underestimate this challenge



Bharwini and Watkiss, 2012. Social Network Mapping. Deliverable 1. Mediation Project.

Similar challenges for developing countries

- Rwanda: Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development

- Recommends low carbon urban systems - High density walkable cities

- Reduce fossil fuel use through transport and city design

- Reduced urban sprawl limits development of housing on steep slopes which are vulnerable to flooding and landslides

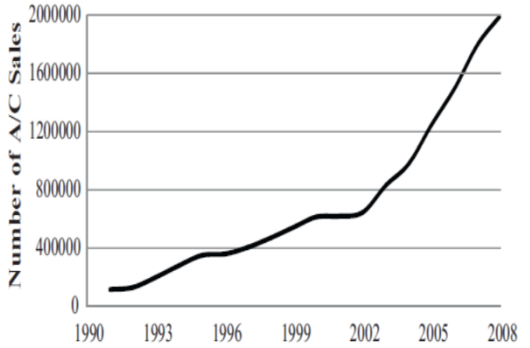
- But this will increase building density and increase heat island effects (i.e. conflict)

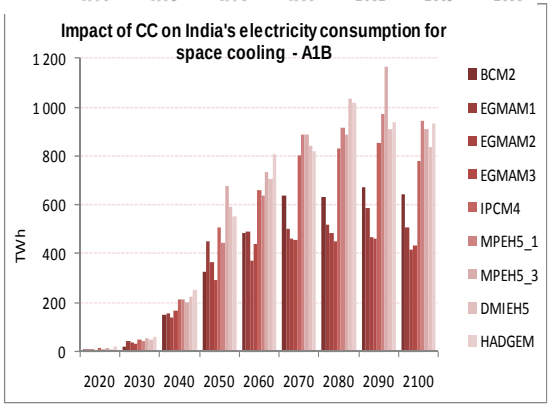
- Leads to general issue of heat extremes for developing cities – link to health, productivity and cooling for comfort

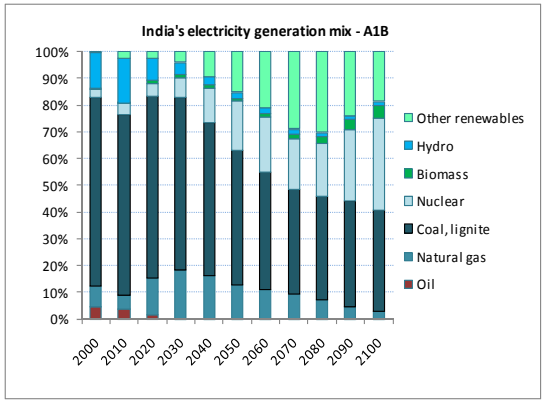
Republic of Rwanda. Rwanda Green Growth and Climate Resilience (National Strategy for Climate Change and Low Carbon Development), 2011.

Convergence, e.g. India

- Income growth plus CC leads to huge increase in demand for cooling
- 25500 TWh for space cooling by 2100 (total A1B inc CC)
- Also increases peak demand and thus capacity
- Baseline least-cost generation is often coal or fossil
- And in rapidly developing countries, synergistic policy is very challenging, e.g. building codes, spatial planning
- Key issue for major developing cities in warm climates, e.g. Asia, Africa…….







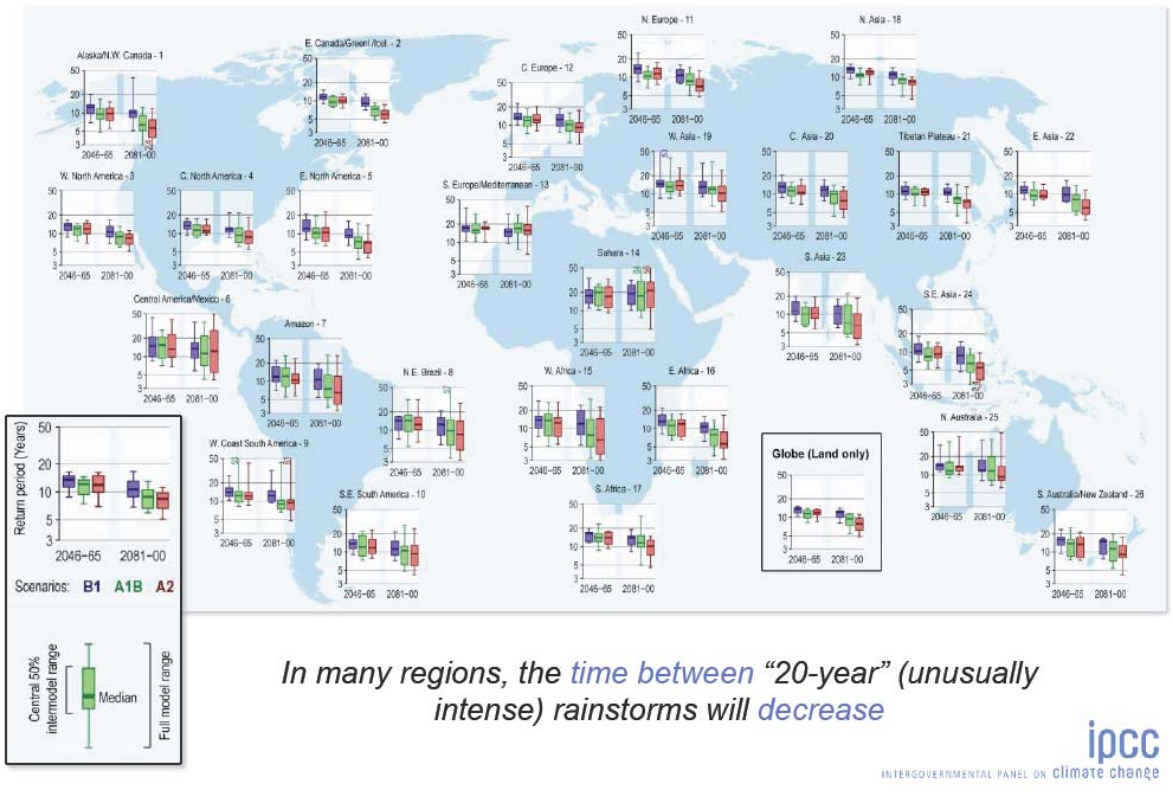
Figures Akpinar-Ferrand Ezgi and Singh Ashbindu 2010 (Top)
Source: ClimateCost Project. Deliverable 3C Energy. Mima et al. 2011. (Centre and bottom)

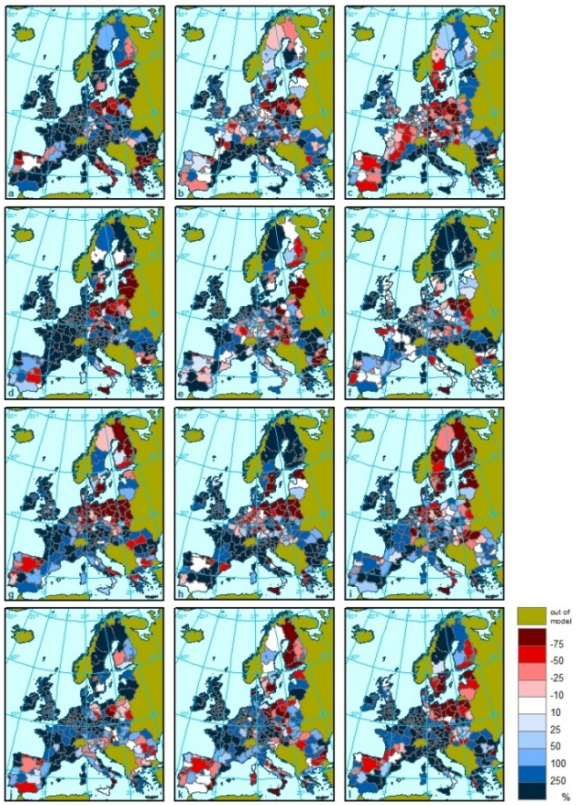
Research gaps and issues

- Critical problem and research gap
  - Projections of future electricity demand based on today's climate, not future w/ CC
    - LDC least cost power plans underestimate income effects and exclude CC
    - (noting we do this as well in the UK and Europe…..)
    - So we are underestimating the green growth challenge
- Following from this, what is the best, realistic option?
  - Carbon tax (but what about effects on health and productivity?), efficient AC, decarbonisation, spatial planning, everything?

Flood events

- Key current natural hazard is flooding (river, flash-floods, coastal surge)
- Climate change will potentially exacerbate risks, but high uncertainty





Source IPCC SREX, 2012: IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
Rojas, R, Feyen, L and Watkiss, P. Climate Change and River Floods in the European Union: Socio-Economic Consequences and the Costs and Benefits of Adaptation. Global Environmental Change. GEC-D-13-00086R2.

DRM-Adaptation

- Focus on DRM-Adaptation and use of iterative risk management
- A set of no and low-regret options emerging, e.g.
  - Early warning systems, community based responses and management forums
  - Risk screening and planning growth towards less vulnerable areas
  - Planning, building design, etc.
- But most do not have a strong focus on mitigation/green growth
- So where are the synergistic GG-NH-urban-adaptation policies?

It is not around future infrastructure protection

- Lack of learning from the DRM literature in adaptation economics
- Too often river flooding response is for technical engineered infrastructure
- Similar focus on coastal dikes as the solution for climate change (B:C > 10:1)
  - Based on assumption of perfect foresight (if-then)
  - Assume existing good baseline protection (no adaptation deficit)
  - Ignore DRM literature (what works, maintenance, over-topping risks)
- Over-optimistic on costs (e.g. Dar 1.3km =$3.4 mill., next London barrier $9 bill)
- And pouring concrete increases embedded emissions

Green growth linkages around natural capital

- Management of natural capital (ecosystem services)
  - Upstream watershed management (afforestation) to reduce downstream floods
  - Coastal buffer zones (mangrove) and shoreline and sea-scape vegetation
- Integrated land/water resource management
- Integrated coastal zone management

However challenges for Synergistic policy

- Institutional capacity, enforcement, governance with IWRM/ICZM
- Opportunity costs of coastal buffer zones *
- Challenges in payment for ecosystem services approaches
- Sustainable management of forests or mangroves (CBF, REDD+**)
- Ensuring natural capital is climate resilience (e.g. future forests**)
- Designing buildings for multiple uncertain risks at low cost**
- Enforcement of planning regulations or building codes**

*Anton Cartwright, James Blignaut, Martin De Wit, Karen Goldberg, Myles Mander, Sean O'Donoghue and Debra Roberts (2013). Economics of climate change adaptation at the local scale under conditions of uncertainty and resource constraints: the case of Durban, South Africa. Environment and Urbanization 2013 25: 139. DOI: 10.1177/0956247813477814
**Watkiss (2013). Supporting analysis for the Zanzibar Climate Change Strategy

Conclusions

- The current focus is on DRM-adaptation linkages
- Methods have emerged for addressing these together
- But so far, linkage to green growth not extensively explored
- While focus on floods, for urban areas, we should consider heat extremes as well
  - May be important conflict between mitigation and adaptation
  - Green growth policy needs to be planned with future climate in mind (CDD)
- Synergistic policy with green growth is possible, but requires planned intervention, and important cost, governance, enforcement barriers
- Critical research priority is needed to assess risks and responses