Impacts of Climate Change on Urban Infrastructure & the Built Environment

A Toolbox

Tool 1.2: General climate change information and guidance for New Zealand

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Contents

1.	Introduction	1
2.	The Intergovernmental Panel on Climate Change	1
2.1	IPCC SRES Scenarios	2
3.	Guidance for New Zealand	5
3.1	How the Toolbox relates to existing material and issues	5
References		6

1. Introduction

Climate change is a vast subject. Understanding climate change and communicating its challenges and opportunities for society requires the input of many researchers, applied scientists, policy makers and community leaders each with their own specialist knowledge. Increasingly such individuals have applied a multi-disciplinary approach to understanding the topic, such are the links between the science, policy and nations that need to work cohesively together if climate change, and its diverse impacts and implications on and for society are to be fully appreciated.

Given that climate change, and any associated preparedness for such change encumbers a degree of risk and opportunity issues of moral judgement, equity and fairness need also be considered.

In part, for this reason, an international group that could work effectively between research disciplines and countries (including developed and developing counties) was required to ensure a balanced understanding of the science, impacts and potential mitigation options was to be reached. This organisation has become synonymous with climate change and is known as the Intergovernmental Panel on Climate Change (IPCC). The IPCC is open to the 192 nations who are members of the United Nations. The New Zealand government and New Zealand-based researchers have very much been part of this truly global process. Therefore, New Zealand, and many aspects of this report, draw on the conclusions of the IPCC whose global and regional assessments of climate change help inform and provide for general climate change information and guidance for New Zealand.

2. The Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations and World Meteorological Organisation in 1988 to organise and compile impartial expert assessments of global climate change knowledge.

Approximately every six years the IPCC has produced a full assessment of the state of scientific, social and economic knowledge on climate change and what the projected impacts of climate change will mean for the world. The IPCC does not carry out research as such, but rather, synthesizes existing research that can be found in peer-reviewed literature and other credible sources.

Through the four previous assessment reports, the IPCC has stated with increasing levels of confidence that climate change is happening and that human activity now plays a significant role in driving the observed climate change. Specifically, the most

recent IPCC assessment, the Fourth Assessment (AR4) released in 2007 concluded that warming of the climate system is now "unequivocal" as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Solomon et al. 2007). Beyond this, the IPCC concluded that "Most of the observed increase in global average temperatures since the mid-20th century is *very likely* (90% probability) due to the observed increase in anthropogenic [from human activity] greenhouse gas concentrations" (Solomon et al. 2007).

As strong as the above statements are, and noting that further evidence supporting and reinforcing such conclusions has been published in the scientific literature since 2007 (the next IPCC Assessment, the 'Fifth Assessment Report' is due for release in 2013 and 2014), climate change nevertheless contains inherent uncertainties. Taking account of such uncertainty should be central to any assessment of climate change.

The uncertainties arise from difficulties in predicting future temperature change based on future greenhouse gas emissions which are in turn dependant on economic & social development pathways as well as uncertainties in the science and associated computer modelling (for example, how will ice sheets respond to increased warming?).

To take account of such uncertainty the IPCC has developed a range of plausible future scenarios which incorporate both the uncertainty in potential future emission pathways as well as uncertainty in computer modelling.

2.1 IPCC SRES Scenarios

The IPCC developed 40 future emissions pathways or scenarios, referred to as 'SRES' (Special Report on Emission Scenarios, Nakicenovic et al., 2000) scenarios, which fall into four 'families' (A1, A2, B1, B2) each of which envisages a different future based on levels of population growth, resource availability, economic development etc. No scenario incorporates any climate-specific (or related) international action to combat greenhouse gas emissions such as the Kyoto Protocol.

There are six illustrative scenarios, each broadly representative of its 'family'[1] and spanning a reasonable range of plausible futures (Figure 2.1). From lowest to highest in terms of temperature projections for this century, they are: B1, A1T, B2, A1B, A2, and A1FI.

[1] The reason there are six illustrative scenarios, despite there being only four families, is that the first family (A1) is subdivided into three scenario groups (A1T, A1B, A1FI).

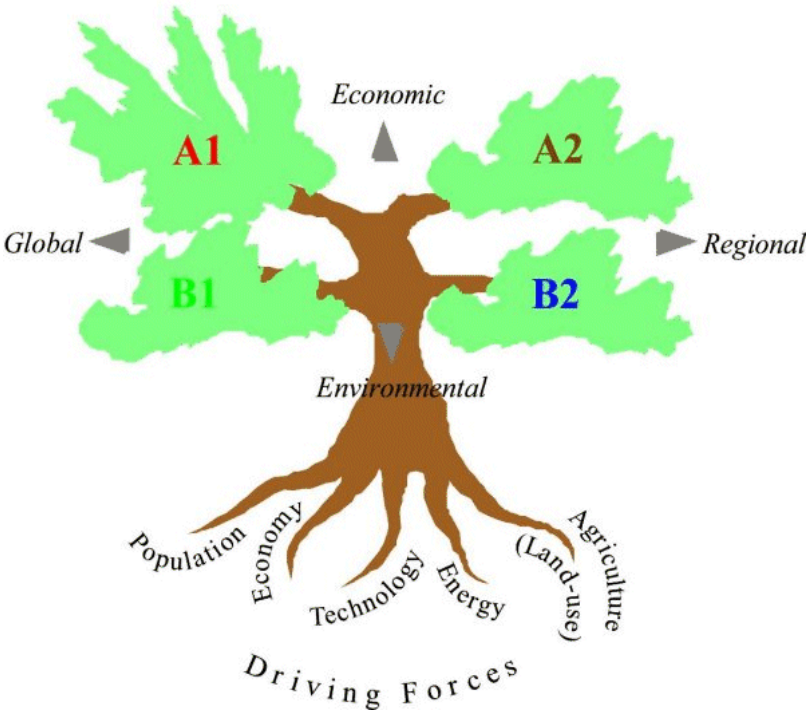

Figure 2.1: Schematic illustration of the four SRES scenarios as branches of a two-dimensional tree. The two dimensions indicate the relative orientation of the different scenario storylines toward economic or environmental concerns and global and regional scenario development patterns, respectively. The A1 storyline branches out into different groups of scenarios to illustrate that alternative development paths are possible within one scenario family.

SRES scenarios have been used in this report with a broad focus on the B2, A1B and A2 scenarios.

The IPCC does not propose which of these scenarios is any more likely than another to eventuate (for such a statement would be overly policy prescriptive). Rather it assesses each scenario, identifies the potential impacts associated with a given scenario and then leaves it to decision makers (National and local governments) to act upon such information. In this manner, the IPCC does not tell a Government what future is most likely to play out, but it can inform decision makers on what impacts are likely to be experienced under each scenario and therefore leave the decision makers to determine what level of risk they are willing to accept to either avoid, mitigate or adapt to such impacts.

Figure 2.2 (from Solomon et al., 2007) indicates the range of global temperature increases likely out to 2100 corresponding to the SRES scenarios. This range

encompasses not only the range of plausible emissions scenarios, but also the uncertainty in the climate response as represented by a number of global climate models. The global-average temperature increase at 2100, relative to the average over 1980-1999, varies from +1.1°C (least sensitive model combined with the lowest emission scenario B1) to +6.4°C (most sensitive model with the highest emission scenario A1FI). The multi-model average (or IPCC 'best estimate') of the temperature increase for the A1B scenario is +2.8°C.

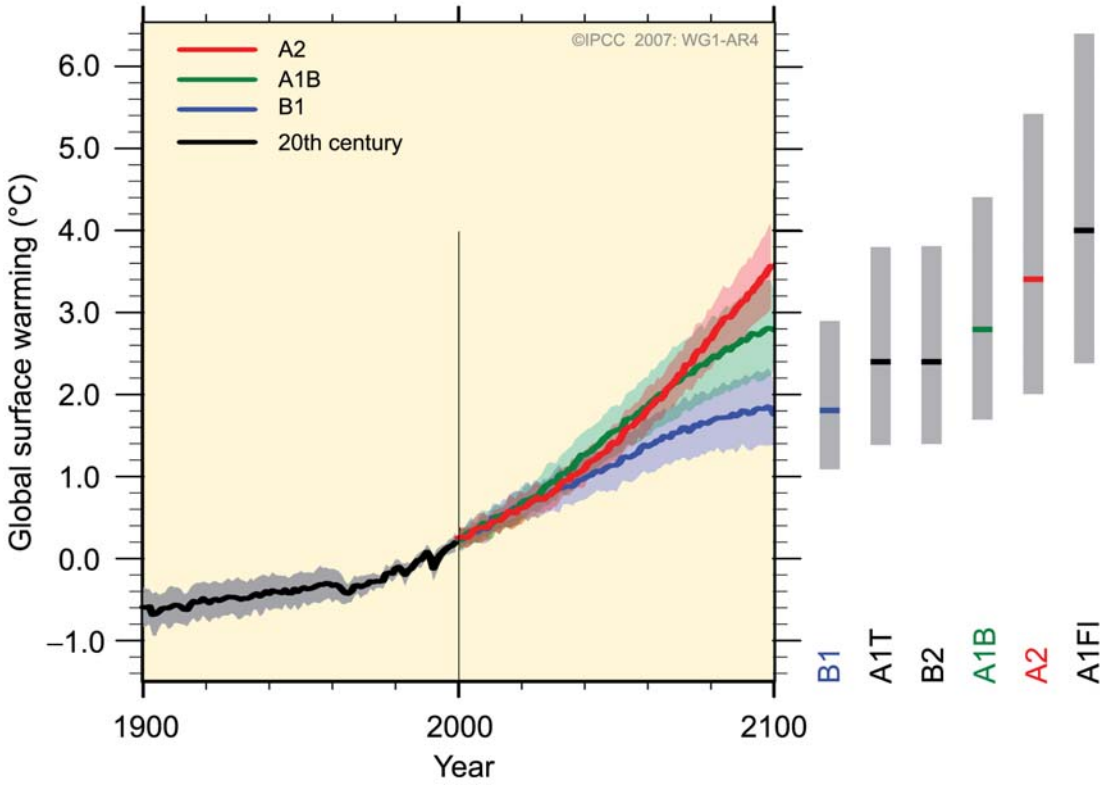

Figure 2.2: IPCC projections of global temperature increase. Solid coloured lines are multi-model global averages of surface warming (relative to 1980-1999) for emission scenarios B1, A1B and A2, shown as continuations of the 20th century simulations (black line). The coloured shading denotes the ±1 standard deviation range of individual model annual averages. The grey bars at right indicate the best estimate (solid horizontal line within each grey bar) and the 'likely range' across 6 scenarios that span the full range of all IPCC emission scenarios. (Adapted from Figure SPM-5, Solomon et al., 2007).

The IPCC is presently developing new scenario's called 'Representative Concentration Pathways (RFPs) which are likely to supersede the SRES scenarios in the future, and, will be used predominantly in the AR5.

3. Guidance for New Zealand

Whilst highly useful at the global scale, the IPCC SRES scenarios need to be 'downscaled' to the New Zealand situation to be of any use when projecting impacts at a National level.

In 2008 NIWA produced a guidance manual for local government which was an assessment of the likely climate change effects and associated impacts for New Zealand (Mullan et al. 2008).

To carry out the assessment, projected changes in New Zealand's climate were devised for six greenhouse gas scenarios for 2040 (2030-2049 average) and 2090 (2080-2099 average), relative to the climate of 1990 (1980-1999 average). Most of this information was derived from statistical downscaling of output from 12 global climate models and was supplemented by initial analyses from two simulations using NIWA's regional climate model.

The results from this assessment have been used in part or whole, and built-upon throughout the tools used in the Climate Change and Urban Impacts Toolbox.

The assessment, and the summary report "Preparing for Climate Change" derived from it, can be accessed from:

http://www.mfe.govt.nz/publications/climate/ (scroll to "Local Government Reports").

The collective output of the guidance manual (Mullan, B. et al. 2008) and its subsequent summary documents ((MfE 2008, MfE 2009, MfE 2010) has helped local governments to identify and quantify opportunities and hazards that climate change poses for their functions, responsibility and infrastructure by taking the user through a series for steps for carrying out a typical climate change assessment.

3.1 How the Toolbox relates to existing material and issues

The Toolbox builds on such an assessment by taking the user through a more detailed assessment for the urban environment.

Councils already address extreme weather events and climate variations as they develop plans and provide services. Consistent with previous guidance, climate change effects should be considered as part of these existing regulatory, assessment, and planning activities rather than seen as a need to create new procedures for the assessment of the impacts of climate change.

References

MfE (2008). Preparing for climate change: A guide for local government in New Zealand. Wellington, 38 p.

MfE (2009). Preparing for coastal change: A guide for local government in New Zealand. Wellington, 30 p.

MfE (2010). Preparing for future flooding: A guide for local government in New Zealand. Wellington, 34 p.

Mullan, B.; Wratt, D.; Dean, S.; Hollis, M. (2008). Climate change effects and impacts assessment: a guidance manual for Local Government in New Zealand. MFE07305. Wellington, NIWA. 156 p.

Nakicenovic, N., and Coauthors (2000) *Special report on emissions scenarios: A special report of Working group III of the Intergovernmental Panel on Climate Change.* Cambridge University Press, 599 pp.

Solomon, S.; Qin, D.; Manning, M.; Chen, Z.; Marquis, M.; Averyt, K.B.; Tignor, M.; Miller, H.L. (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. . Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 996 p.