

## Issues from PCE's Report

### Statements re Kapiti

1. *Councils are obliged under law to plan and prepare for the impacts of a rising sea. But it is far from easy to introduce changes that may lower the value of sought-after coastal areas. In August 2012, the Kapiti District Council put coastal erosion risk on the Land Information Memorandum (LIM) reports of 1,800 houses, which was challenged by those who were affected. Such conflicts are understandable and inevitable.*
2. *Some councils have begun such planning, focussing on coastal flooding, impacts on groundwater, and erosion. However, the implications make conflict inevitable. When the Kapiti District Council put coastal erosion risk on Land Information Memorandum (LIM) reports, local property owners challenged the Council in the High Court. An affected resident, Mike Weir, said: I am 100 metres, according to the science, the law and the facts badly wrong.*
3. These statements claim *With residents seeking to avoid the consequences of planning provisions on the value of their properties while Councils are just looking after the public interest. This is not the situation. In Kapiti the problem and the conflict has arisen because of incompetent planning based on poor science needlessly impacting on private properties. Kapiti Coast District Council now accepts that the majority of the coast is not at risk from coastal erosion in terms of the NZCPS 2010.*
4. In particular *are completely incorrect in the context of claims about inevitable conflict driven by a desire to protect property values. When asked whether the quote was correct he responded:*  
*The quote is correct but the context is crucial. The context was my claim that the scientists and KCDC have misinterpreted the NZ Coastal Policy Statement 2010 and the law (by placing worst case scenarios on LIMs and in the Proposed District Plan) and that potential sea level rise does not negate the fact that Kapiti is mostly an accreting coastline and was accreting several thousand years ago when sea levels and temperatures were much higher than they are now.*
5. No attempt was made by PCE to clarify the context, rather as noted above the report as written exacerbates the issue Mike Weir was concerned about. This is unacceptable.

### Statements re IPCC

1. *Suggests IPCC statements can be directly applied to New Zealand*
6. At a number of points in the PCE report (e.g. Overview, page 5, page 9) the reader is left with the impression that IPCC projections can be directly downscaled to New Zealand. On the contrary the IPCC AR5 WG1 Chapter 13 explicitly states: *I am not aware of any evidence that IPCC projections can be directly downscaled to New Zealand.*

level change will have a strong regional pattern, with some places experiencing significant deviations of local and regional sea level change from the baseline. (p 1140)

## 2. Mischaracterization of IPCC projections

7. The IPCC report projects temperatures and sea level rise based on four scenarios for RCPs. The IPCC expresses a medium level of confidence in these projections (The report describes these in a variety of ways). These terms imply that they are something more than the product of scenario based models and assumptions about the future. It can only confuse public debate to treat them as synonymous.
8. *The [IPCC] expects [global sea level] to rise another 30 centimetres or so by the middle of the century and up to a metre or more by the end of the century.*
9. *The IPCC prediction of a 30 centimetre rise in average sea level by the middle of the century - it is expected to occur regardless of action taken to reduce greenhouse gas emissions.*
10. *The Intergovernmental Panel on Climate Change (IPCC) currently expects sea level to rise a further 30 to 100 centimetres by 2100, and to continue rising for several centuries* (page 5)
11. *As part of its regular reviews of the current state of knowledge about climate change, the Intergovernmental Panel on Climate Change (IPCC) predicts future sea level rises*
12. *Under the 2013 Best-Case Assumptions, the IPCC estimated that sea level would rise by between 52 and 98 centimetres by 2100.*
13. *In its latest report, the IPCC predicts that sea levels will rise by a further 20 to 40 centimetres by the middle of the century. This is forecast under all IPCC scenarios.*
14. *After 2050, the forecast rises in sea level become increasingly dependent on assumptions. Under IPCC Best-Case Assumptions, sea level is forecast to be as much as a metre higher in 2100 than it is now. (page 44)*
15. This issue of terminology is important as is discussed in, for example, Bray and von Storch *Predicting the Next Generation of Climate Science* Science Communication, June 2009; vol. 30, 4. They note:
 

*The IPCC defines a scenario as a potential future evolution of a quantity or set of variables. A scenario is not a forecast. A scenario is the result of an attempt to produce an estimate of the actual evolution of the climate in the future, for example, at seasonal, interannual or long-term scales. The IPCC does not use the term "forecast" to describe climate predictions in order to emphasize that climate projections depend upon the emission/concentration/radiative forcing scenario used, which are*

based on assumptions concerning, for example, future socioeconomic and technological developments that may or may be expected

16. As a further, non-IPCC example the PCE report states *The National Institute of Water and Atmospheric Research (NIWA) has projected that in 30 years' time, this level of flooding in Auckland will occur about once every ten years* (page 44, emphasis added).

### 3. IPCC projections incorrectly presented as certain and extreme

17. In a number of places the report quotes IPCC projections as inevitable and represents extreme values and assumptions as likely.
18. All the following references to projections from the report are in fact at the upper limit of what the IPCC regards as likely; are based on the most extreme scenario (RCP8.5); and suggest that these increases are from now (not 20 years ago). In a number of cases they suggest the increases are inevitable (i.e. no uncertainty). They therefore fail to correctly represent the IPCC projections particularly their range and hence the uncertainty.
19. *Over the last century, the average sea level around the world has risen by about 20 centimetres. The Intergovernmental Panel on Climate Change (IPCC) expects it to rise another 30 centimetres or so by the middle of the century and up to a metre or more by the end of the century.*
20. *The IPCC expects a 30 centimetre rise in average sea level by the end of the century.*
21. *The Intergovernmental Panel on Climate Change (IPCC) currently expects sea level to rise a further 30 to 100 centimetres by 2100.*
22. *A rise of a further 30 centimetres by 2050 is now inevitable.*
23. The rate of sea level rise over the period of satellite measurement (1992) is  $3.2 \pm 0.4$  mm/year (Nerem, R. S., D. Chambers, C. Choe, and G. T. Mitchum. "Estimating Mean Sea Level Change from the TOPEX and Jason Altimeter Missions." *Marine Geodesy* 33, no. 1 supp 1 (2010): 435. Accessed from <http://sealevel.colorado.edu/content/2015rel1-global-mean-sea-level-time-series-seasonal-signals-removed> 19 April 2015).
24. Projecting linearly on this basis the increase from now (2015) to 2050 would be only 64 mm. Assuming linear rates of increase derived from the IPCC projections the current rate of sea level rise is comparable to the IPCC RCP2.6 5% projection (62 mm from now to 2050), the very bottom of its range. The 64 mm sea level rise is well short of the RCP8.5 95% projection (138 mm from now to 2050) and about 1/5<sup>th</sup> of the 30 centimetres the PCE is claiming as inevitable.
25. *Sea-level variability and trends: Wellington Region A report prepared for Greater Wellington Council sets out this issue saying:*

There is no evidence that there has been any recent statistically significant acceleration in global sea-level rise, despite the recent satellite data analysed since 1993. (page 57) and further,

No acceleration in SL can be detected in the wider New Zealand sea-level record, taking into account variability due to climate change.

26. This report would have been available to the PCE and its advisors and clearly

4. Highest emissions scenario incorrectly identified as a

27. The report explicitly represents RCP8.5 as Business-as-Usual in a number of places:

28. Under 2013 Business-as-Usual scenario, the IPCC estimated that sea level would rise by between 52 and 98 centimetres by 2100.

29. Under IPCC Business-as-Usual scenario, sea level is expected to be as much as a metre higher in 2100 than it is now.

30. The IPCC models four scenarios. The Business-as-Usual scenario assumes emissions continue to rise as they are now and emissions are zero by 2080. There are also two moderate emissions scenarios. (Footnote 87)

31. RCP8.5 is described in Riahi et al. RCP 8.5: A scenario of comparatively high greenhouse gas emissions. The term business as usual is used to describe RCP8.5 in either of the relevant IPCC AR5 WG1 (Chapters 1 or 8).

32. RCP8.5 is tracking approximately on the RCP6.0 pathway, while temperatures and sea level rise are below the RCP2.6 scenario.

**Lack of balance in some post-IPCC citations**

33. The IPCC is inherently cautious since it relies on hundreds of scientists from many countries reaching consensus. However the process does ensure that a balance is reached in interpretations of the literature. In a number of cases the PCE report cites literature not considered by the IPCC, but a few of the papers selected or the interpretations placed on them do not appear to have the balance that might have been expected from the IPCC.

34. The majority of the post-IPCC literature focuses on ice melt particularly in the polar region. This is not surprising as the IPCC considers only published peer-reviewed papers, and physical processes that are not understood well are either omitted or simplified in their analysis.

35. The IPCC is not consistent in its approach to the IPCC

report. Sections 13.4.3 and 4 of IPCC AR5 WG1 Chapter 13 give a considered view of the range of literature rather than showcasing the findings of a small number of more recent papers. In what follows we draw attention to three papers cited in the report that lack the more even hand that might be expected from the IPCC.

36. The first issue K K K K K K K K K K multidecade projections on those derived from a range of outputs from GCMs. There is a group of scientists (e.g. Horton, Rahmstof) who instead favour semi-empirical models. These use the temperature projections from the GCMs but apply them to the historic relationships between global temperature and sea level to form their projections.
37. The IPCC says of these models *Despite the successful calibration and evaluation of semi-empirical models against the observed 20th century sea level record, there is no consensus in the scientific community about their reliability, and consequently low confidence in projections based on them* K (WG1 Chpt 13 page 1140, emphasis added).
38. A further source of differences between the IPCC and this modelling group is the inclusion of ice sheet collapse. The IPCC K include this in its projections citing insufficient evidence that initiation is likely this century.
39. The PCE report is indirectly critical of the IPCC in putting aside these models suggesting that the more extreme expert judgements reported in Horton, Rahmstorf, Engelhart and Kemp, 2014. *Expert assessment of sea-level rise by AD 2100 and AD 2300* provides a better assessment of what the future holds.
40. Horton et al is described in the PCE report as a *recent survey of 90 experts on sea level rise found that most estimated a larger sea level rise by 2100 than the projections in the 2013 IPCC report* K The footnote adds: O e e a b ca ec d ea e e e e ed participate in the survey.
41. What the PCE does K K K K K K Gregory, JM, Church, JA, Clark, PU, Payne, AJ, Merrifield, MA, Nerem, RS, Nunn, PD, Pfeffer, WT & Stammer, D 2014, C e "E e a e e ea- e e e b AD 2100 a d AD 2300", b H e a. (2014) Quaternary Science Reviews, vol 97., pp. 193-194. The authors include both coordinating authors of IPCC WG1 Chapter 13 and the majority of the lead authors. None of the authors of Horton et al were authors of Chapter 13.
42. Nor does it mention K K K se: Horton, Rahmstorf, Engelhart and Kemp *Reply to comment received from J.M. Gregory et al. regarding E e a e e e ea- e e e b 2100 a d 2300 AD* (2014), Quaternary Science Reviews 84, 1-6.
43. The PCE report suggests that Horton et al is evidence of post-IPCC expert opinion that the sea level projections were much too low. In fact it would be better described as an attempt by some disaffected authors to bolster their position. The IPCC process, for all its weakness, tends to avoid disputes amongst authors of this kind being given undue weight.
44. K K K (and others) reluctance over K

contribution D. Bolin, P. Guttorp, A. Januzzi, D. Jones, M. Novak, H. Podschwit, L. Richardson, A. Särkkä, C. Sowder, and A. Zimmerman, *Statistical prediction of global sea level from global temperature*, *Statistica Sinica*, 25, 351-367 (2015) gives a post-IPCC critique of his work from the statistical fraternity, and thus from outside the immediate fray.

45. K K K K K K K The main finding is that IPCC GCM based and semi-empirical methods for sea level projection which on the face of it disagree have confidence intervals that overlap once the different sources of variability are taken into account. The semi-empirical projections when done soundly using the same assumptions K significantly higher than the IPCC projections.
46. The one area of potential difference noted above is the assumption about when ice sheet melt might be initiated. Bolin et al makes a useful comment in this regard that is relevant to the issue PCE raises (Section 4.3) relating to the West Antarctica melt that is being observed:
- If there are sources of sea level rise, such as substantial land ice melt, and the gravitational changes resulting from that (Mitrovica et al. (2009)), which have not been observed in the historical data, the empirical model cannot account for such changes, but neither are these very well represented by current climate models ((Stocker et al., 2013, Ch. 13)).*
47. The implication is that to the extent they have been observed other processes will be included in the base level projections. In other words while the changes underway in Greenland and the West Antarctic may be concerning (page 37) this effect is taken into account in the sea level projections, implicitly in the case of semi-empirical models and explicitly in the case of the IPCC modelling.
48. The PCE report also leaves the impression that these processes are exclusively due to increasing global temperatures when the contribution of natural processes remains unclear e.g. IPCC AR5 WG1 Chapter 13 page 1172 discusses the role of the Circumpolar Deep Water on the area and goes K K *It is not possible to determine whether this upwelling was related directly or indirectly to a rise in global mean temperature*, while Damiani, Jordan, Ferraccioli, Young, and Blankenship *Variable crustal thickness beneath Thwaites Glacier revealed from airborne gravimetry, possible implications for geothermal heat flux in West Antarctica* 2014 *Earth and Planetary Science Letters* Volume 407) describes the role of geothermal activity in the area.
49. In addressing ice melt more directly the PCE report cites a number of post-IPCC papers that deal with the global ice inventory. These are not controversial although Grinstead, 2013. *An estimate of global glacier volume*. *The Cryosphere*, 7:141- K K K K Next where it states *Alpine glaciers will continue to retreat, but in total they hold only enough ice to raise sea level by about 35 to 60 centimetres* (page 42)
50. Grinstead says:
- I estimate that the total volume of all glaciers in the world (or more accurately in the inventory) is  $0.35 \pm 0.07$  m SLE. This is substantially less than the  $0.60 \pm 0.07$  m SLE from Radic and Hock (2010). It is also less than, but*

compatible with, the  $0.43 \pm 0.06$  m SLE estimated in Huss and Farinotti (2012) for the same inventory. Excluding the peripheral glaciers of the Greenland and Antarctic ice sheets results in 0.23 m SLE. (emphasis added). So the upper limit of 60 centimetres is an estimate that is disputed by the later Grinstead paper and the quoted estimate in the text incorrectly includes polar glaciers.

51. Of more significance the PCE report says about East Antarctica:

*I n a n t a r c t i c a E a s t A n t a r c t i c a the Aurora Basin and the Wilkes Basin lie below sea level and contain ice up to 2.5 kilometres thick. The ground beneath the ice slopes down inland from the coast. Should the ice shelves protecting these regions break up, seawater could get in below the ice, and the same destabilisation that is underway in the West Antarctic could begin.* Mengel and Levermann, 2014. *Ice plug prevents irreversible discharge from East Antarctica.* Nature Climate Change, 4:451-455.

52. Mengel states:

*The unstable ice sheet retreats under unperturbed boundary conditions towards a new equilibrium that lies in a region that is covered by up to 2.5-km-thick ice at present (Fig. 2a,b, thick grey contours). This causes sea-level rise between 3 and 4m (Figs 3 and 4a y axis). The main retreat occurs on a timescale of 10 kyr and the grounding line stabilizes after 25 kyr in all experiments (Fig. 4). The expected rate of sea-level rise from the Wilkes Basin has an upper bound of 0.5mm/yr (Supplementary Fig. 1). This is twice the rate of Antarctica's present total contribution to sea level rise. Considering the necessary forcing time of 200 years and longer (Supplementary Table 2), the Wilkes marine-based ice may therefore significantly modulate the sea-level signal on timescales longer than a century whereas our results suggest that the implications of the instability for short-term sea-level rise are limited (emphasis added)*

53. These are interesting, conditional, speculative and very long-term processes. In the context of the PCE report their uncaveated inclusion with a warning that something akin to West Antarctica could be about to unfold lacks balance.