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Impacts of climate change on tropical cyclone hazard in Australian region: Implications for wind loading code

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Abstract: There has been much debate on the influence climate change may have on global tropical cyclone activity (Webster et al. 2005, Landsea 2005, Emanuel 2005, Knutson et al. 2001), but the impacts on human settlements is even less clear. Regional differences in projected changes are also apparent, further clouding the issue of identifying changes in hazard and risk. As part of a contribution to the Garnaut Climate Change Review (Garnaut 2008), Geoscience Australia examined the changes in a number of indices of tropical cyclone activity as diagnosed from Intergovernmental Panel on Climate Change 4th Assessment Report (IPCC AR4) simulations. These results can be used to infer likely changes in tropical cyclone hazard.

General circulation models (GCMs) are normally too coarse to accurately resolve peak winds associated with tropical cyclones (Walsh and Ryan 2000). Tropical cyclone-like vortices may be present in the finer resolution models, but these are a poor facsimile of observed tropical cyclones and thus are unsatisfactory predictors of changing tropical cyclone characteristics (Camargo et al. 2007). To understand the potential changes in tropical cyclone behaviour under different future climate regimes, we use GCM outputs to examine environmental indices that have been linked to the intensity and frequency of tropical cyclones.

The environmental analysis suggests that more intense tropical cyclones are possible, with modest increases in MPI likely. The magnitude of the increase appears to be closely linked to increases in global mean surface temperature. Changes in GPI suggest an increase in tropical cyclone frequency. Preliminary work using a stochastic approach broadly agrees with these results, although intensity trends are less clear. The finding of increasing intensity with global warming is consistent with the literature, however a suggested increase in frequency is at odds with previous modelling studies for the Australian region (Abbs et al. 2006; Leslie et al. 2007; Walsh and Ryan 2000).

We also use an alternative methodology (stochastic approach) that utilises synthetic tropical cyclone tracks representing approximately 50 years of activity under three different climate scenarios (obtained from WindRiskTech; Emanuel et al. 2006). These synthetic events are used as an input dataset to Geoscience Australia's Tropical Cyclone Risk Model. A preliminary analysis indicates that an increase in tropical cyclone frequency in the Australian region is likely. There is little clear trend in the peak intensity of tropical cyclones, but there is a poleward (southward) shift in the latitude of the peak intensity.

The WindRiskTech datasets were analysed for landfall probability and proximity to major communities. The probability of landfall may increase along the east coast, but due to the sensitivity to ENSO, the trend remains unclear (GCMs are notoriously poor at representing ENSO). Analysis of events that pass within 200 km of Port Hedland, Darwin and Cairns indicate a trend towards increased frequency of intense tropical cyclones, but the low number of events in the available event sets limits our confidence in the analysis.

Our results to date suggest tropical cyclone hazard will increase with global warming. However, there remains a significant amount of work to be completed before we have a clear picture of the changes in tropical cyclone hazard. Our work program will continue to use the latest research on the meteorology of tropical cyclones and climate change to inform our hazard and risk assessments.

Implications for the building code (wind loading) of these changes to the region wind hazard are discussed.

Keywords: *Climate change, tropical cyclones, hazard, wind loading*

Abstract only