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Examining uncertainty in design rainfalls in Australia

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Engineers use estimates of extreme rainfalls for the design of infrastructure and to guide planning of appropriate land use decisions by local and regional governments. Intensity-Duration-Frequency (IDF) design rainfall relationships relate the intensity and length of the rainfall events to the frequency of occurrence. IDF relationships are then used to estimate the size and extent of future floods. The IDF relationships are derived by applying a number of statistical models to time series of data measured at rainfall gauges. However there are many uncertainties resulting from the way that IDFs are derived due to errors in observations, assumptions in the statistical models and finally due to the possible impacts of climate change. This research looks at the practical implications of attempts to quantify these uncertainties.

Uncertainty in data and models has a large impact on the practical implementation of hydrological research. Decisions on appropriate flood planning and infrastructure inherently require consideration of the concepts of risk and uncertainty. In theory, levels of acceptable risk are decided by the community and infrastructure design accounts for this accordingly. However in many cases engineers are poorly equipped to consider risks or uncertainties due to the historic rigidity of engineering design guidelines and community consultation is not always successful. The ability of the community and members of the public to understand risks is also variable and depends, for example, on how recently flooding has been experienced in a particular area.

The key question is - would decisions be made differently if estimates of uncertainty in design rainfalls were available? For example if there are large uncertainties in the estimate of a rare flood, would a certain community prefer to adopt higher design standards? How would the decision differ in the rainfall intensity was known perfectly, with no uncertainty? Are there cases where uncertainties are too large to assist in decision making? What is the best way to communicate uncertainty – in terms of probability or in terms of scenarios of impacts? This presentation will consider some of these questions with respect to hydrological analysis and engineering design.

The questions that are being considered in this research are important for scientific research in disciplines where community safety and infrastructure investment decisions will be made based on the outcomes of the research. Statistical models can quantify at least some of the uncertainty in the processes of interest to a particular research discipline but to be useful this uncertainty should be able to be used in decision making or to guide future investment or future research questions.