PROJECT 3.2: CLIMATE EXTREMES: POTENTIAL FORECAST SKILL AND CLIMATE CHANGE SCENARIOS

Principal Investigator

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Key research findings and highlights

Milestone 3.2.1: Literature review documenting current work on predictors of extreme rainfall

A report documenting current work on predictors of extreme rainfall was submitted (October 2010).

Milestone 3.2.2: Potential forecast skill for extreme rainfall at seasonal timescales

Observed extreme rainfall over SWWA has been investigated, and it appears that that there is evidence of a decrease in extreme rainfall, and that this decrease may be related to the decline in inflow to Perth dams. The various climatic drivers that we have investigated so far do not show a relationship with the changes in extreme rainfall. Seasonal estimates of dam inflow could be used to estimate seasonal extreme rainfall.

Milestone 3.2.3: Dissemination of climate change scenarios for seasonal extreme rainfall as regional maps

Due for completion by December 2011, but work has commenced. To ensure that the outputs are relevant to stakeholders, we will work with the Climate Change Unit to liaise with potential stakeholders.

Milestone Reports

Milestone 3.2.1: Literature review documenting current work on predictors of extreme rainfall

Completed.

Milestone 3.2.2: Report on the Potential forecast skill for extreme rainfall at seasonal timescales

The aim of this analysis was to examine the variability of the generalised extreme value (GEV) distributions with time; to assess the potential forecast skill for rainfall extremes at seasonal timescales; and to identify predictors of extreme rainfall in the observed climate record and from climate models. The drivers identified in the review of the literature on potential drivers of extreme rainfall (3.2.1) were examined in this analysis.

The result of the fitting process, for each station, are two curves describing the variation of the dispersion and scale parameters of the GEV through time. A summary of the changes in the parameters can be found by calculating the return levels (RTL), in this case the 50 year RTL, at each time point for each station. The average curve, over all stations is shown in Figure 1. There is a decrease in RTLs from the mid 1980s, which is reflected in a similar pattern in the scale parameter.

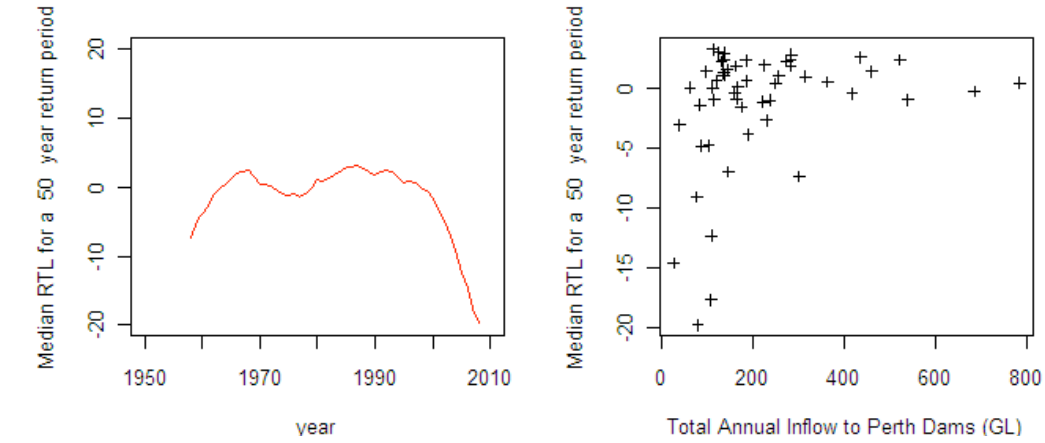

Figure 1: Summary plots of 50 year RTLs from smoothed GEV fits, individually standardised by subtraction of median value. (a) Median standardised 50 year RTL. (b) Median standardised 50 year RTL plotted against annual Perth dam inflow.

Though this trend in RTLs appears to be consistent with a decrease in rainfall since the late 1980's, further examination of the relationship with seasonal rainfall was made. The annual inflows from 1958-2008 were plotted against the smoothed RTLs and shown in Figure 1(b). It should be noted that the RTL's are derived from fitting a smoothing process through time, whilst the seasonal inflows are not smoothed: this could explain the points corresponding to very large inflows departing from a linear relationship, and if we exclude these points (i.e., inflows above approximately 300 GLs) there is a clear linear relationship between decreasing RTLs and decreasing inflow.

We have also investigated the relationship between the scale parameter of the GEV and the various climate drivers identified in the literature review. We were unsuccessful in finding a significant relationship. It is clear that these climate drivers are not going to be useful in estimating rainfall extremes at a seasonal scale, but it may be that seasonal estimates of dam inflow can be used as driver.

Previously, we used Pook and Risbey's (personal communication) classification for 1979-2008 to split daily rainfall data into frontals and cut-off low datasets. A separate analysis on the extreme values from each set showed differences in the characteristics of extreme rainfall for the two classifications. This indicates we need to consider extremes of both types in our analyses, and further analysis is awaiting synoptic classification for 1958-2008 to be completed. Taking this into account in our analyses of climate drivers may change our conclusions about their importance.

The caveat that needs to be applied is that the results of Pook and Risbey are valid for the Central Wheat Belt (CWB) and cannot be applied directly to the IOCI region of SWWA since the IOCI boundary only intersects the far southwest of the CWB. The evidence from Katanning, Perth Airport and York (in the far west of the CWB) confirms that the frontal component is much higher in the IOCI region than in the CWB and the cutoff component is naturally much

lower. In addition, cutoff lows are more important in the northern part of the central WA wheat belt, especially in autumn and spring.

Milestone 3.2.3: ***Dissemination of climate change scenarios for seasonal extreme rainfall as regional maps***

Amalgamation of daily and pluvio data sets have commenced, as has derivation/calculation of site dependent covariates (e.g., distance from coast, height above sea level). We have obtained output from regional climate models (RCMs) and will be integrating it into the spatial model to used in 3.2.2 to provide regional maps. To ensure that the outputs are relevant to stakeholders, we will work with the Climate Change Unit to liaise with potential stakeholders.

Summary of any new research opportunities that have arisen

Statistical issues in modelling different types of synoptic systems require development of statistical models that recognise the existence of different types of systems. Currently we analyse them separately.

List of publications accepted and submitted

Feng, J., J. Li, and Y. Li, 2010: Is there a relationship between the SAM and Southwest Western Australian winter rainfall? *Journal of Climate* **23**, 6082- 6088.

Feng, J., J. Li, and Y. Li, 2010: A monsoon-like Southwest Australian circulation and its relation with rainfall in Southwest Western Australia. *Journal of Climate* **23**, 1334-1353.

List of IOCI-related presentations at national or national and international conferences, symposia and workshops

Palmer M.J. et al., (2010). *Spatial-Temporal Modelling of Extreme Rainfall*. Poster at an Interdisciplinary Workshop, held at the Banff International Research Station on Extreme Events in Climate and Weather, sponsored by SAMSI, August 2010.