Predicting Future Changes of Rainfall Erosivity and Hillslope Erosion across South-East Australia

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Recently, the downscaled 10 km rainfall projections from New South Wales (NSW) and Australian Capital Territory (ACT) Regional Climate Modelling (NARCliM) project have become available for South-East Australia (SEA) region for the baseline (1990-2009), near future (2020-2039) and far future (2060-2079) periods. The aim of this study was to model and assess the impacts of climate (rainfall) change on rainfall erosivity and hillslope erosion risk in SEA based on NARCliM projections from all the 12 model member ensembles. This study will assist in long-term climate change adaptation and regional planning.

A daily rainfall erosivity model has been specifically developed and applied to calculate monthly and annual rainfall erosivity values from the NARCliM projected daily rainfall data for the baseline and two future periods. Monthly and annual hillslope erosion risks for the same periods were estimated using the Revised Universal Soil Loss Equation (RUSLE). Finer scale (100-m) surfaces of rainfall erosivity and hillslope erosion have been produced using spatial interpolation techniques. Automated scripts in a geographic information system (GIS) have been developed to calculate the time-series rainfall erosivity and hillslope erosion so that the large quantity of NARCliM data are realistic, repeatable and portable. The predicted mean annual rainfall erosivity values from the NARCliM projections were compared with those calculated using the gridded daily rainfall data from Bureau of Meteorology for the baseline period (1990-2009). The overall model efficiency coefficient was 0.9753 (R^2=0.9762, RMSE= 13.2% or 143 MJ mm ha^{-1} hr^{-1} yr^{-1}) indicating good agreement and accuracy.

Rainfall erosivity values calculated from the 12 NARCliM member ensembles varied significantly (Figure 1). Compared with the results from the gridded daily rainfall data from the Bureau of Meteorology, the percent changes of mean rainfall erosivity values from the 12 member ensembles ranged from about –8% to about 8%, with an overall change of about 2% (2.26%). The overall overestimate of rainfall erosivity was due to a 1.65% overall increase in the NARCliM projected mean annual rainfall (525 mm yr^{-1}) compared with the BoM rainfall (519 mm yr^{-1}) in the same period (1990–2009). The modelled baseline rainfall erosivity in SEA varied from less than 300 on the western parts to over 15,000 on the north-east coast, with a mean of 1050 MJ mm ha^{-1} hr^{-1} yr^{-1}. Both rainfall erosivity and hillslope erosion risk were predicted to increase about 7% in the near future, and about 19% increase in the far future compared with the baseline period. The change was highly uneven in space and time, with the highest increase occurring in the far west in autumn, with an increase about 22% in the near future and about 29% in the far future. The rainfall erosivity was generally higher in summer and lower in winter, with about a 10 times difference between February and July (Figure 2).

This study has demonstrated an appropriate approach for modelling and mapping monthly and annual rainfall erosivity from daily rainfall data for SEA which is also readily applicable to other regions. The methods have been successfully implemented in GIS for efficient calculation and mapping of the spatial and temporal variation of rainfall erosivity and hillslope erosion across SEA. With the automated GIS process developed in this study, the

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erosivity maps and erosion modelling can be readily upgraded when better rainfall data and models become available.

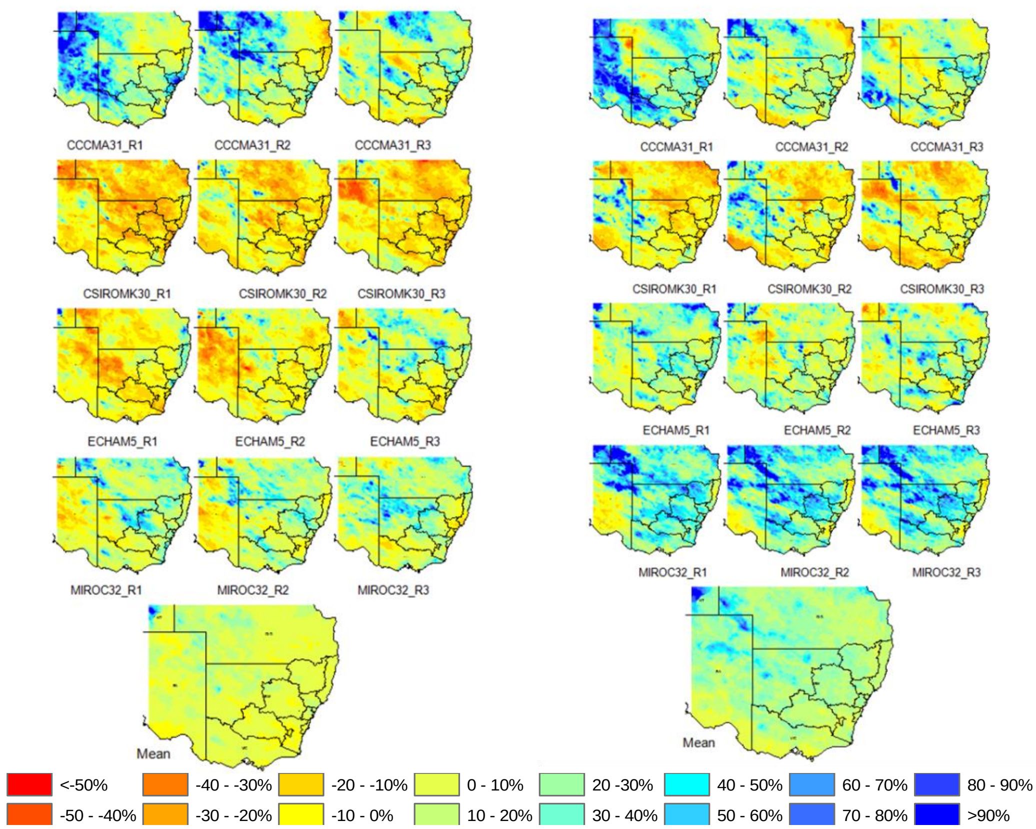

Figure 1. Predicted percent change of mean annual rainfall erosivity in the near future (left) and far future (right) periods from NARCliM projections.

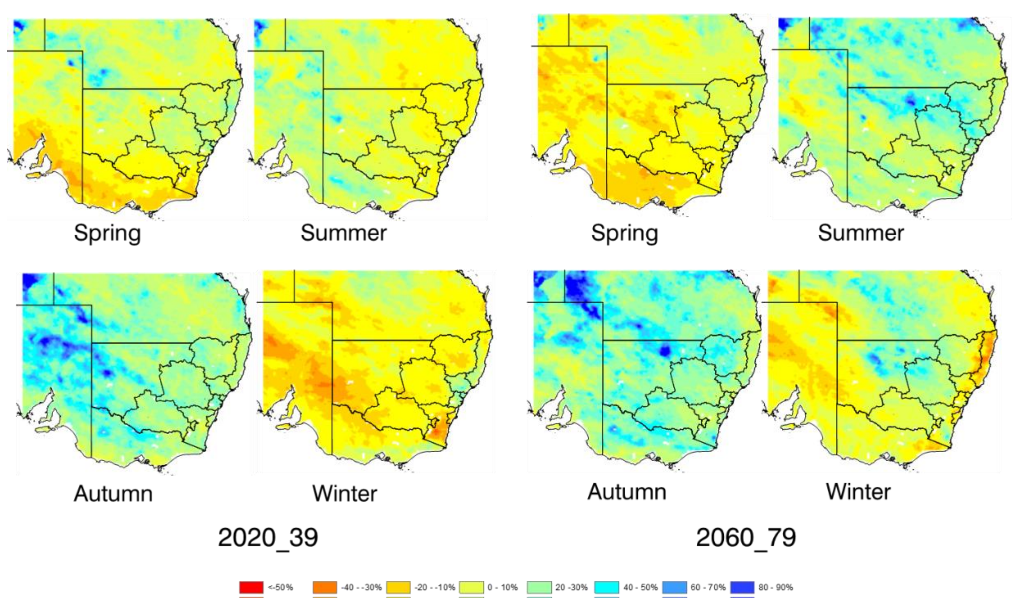

Figure 2. Predicted seasonal change of mean annual rainfall erosivity in the near future (left) and far future (right) periods from NARCliM projections.