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SimKat: a virtual laboratory to explore the impact of rainfall variability associated with the A2 climate change scenario on the Western Australian wheat-belt

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Abstract: The wheat-belt of Western Australia is one of the most vulnerable regions to climate change in Australia (DAFWA, 2007). Over the last century, the landscape is Western Australian has changed drastically with almost 20 million hectares of native vegetation being converted into pastures and annual crops to create the so-called "Western Australian wheat-belt" (Turner and Ward, 2002) This significant land-use change has contributed to the modification of the regional water cycle. McFarlane and Williamson (2002) estimated that about 10% of cropping land in south-west Australia is affected by dry-land salinity which could increase to up to 30% in the coming decades. This loss is estimated to cost A$80 million per year in lost production, and A$500 million a year due to damaged infrastructure. Moreover, since the mid 1970's, winter rainfall has declined by more than 15% (Smith et al., 2000). Predicted changes in winter rainfall, for 2070, range from a 60% reduction up to an increase by 10% (Pittock, 2003). However, one of the more likely scenarios is a reduction in winter rainfall of about 15% by 2030 and 30% by 2070 (IOCI, 2002). In order to explore the long-term effects and consequences of rainfall uncertainty and climate change on these already threatened socio-ecological systems, we have developed SimKat, an agent-based model developed with the CORMAS platform. SimKat combines simplified biophysical processes of paddock cover with likely CO_2 impact on potential yields, dry-land salinity changes, likely rainfall scenarios and farmers' decision making processes. Variations in temperature are not accounted for at this stage of model's development. Simulated agents - farmers make decisions about their future landuse pattern based on their land cover productivity and market returns. Agents are also attributed various risk-related attitudes towards market and mitigation signals. To account for rainfall variability, we use 50 rainfall series from 2005 to 2055, generated through a downscaling technique that relates changes in atmospheric predictors from a General Circulation Model. The model explores the impact of each rainfall series in association with the A2 climate change scenario on the viability of the simulated agricultural region based on the following simulated indicators: farm numbers, salinity extension, regional income, crop-pasture ratio. Yield potential and technological trends influencing farmers' ability to crop are also studied. Simulated scenarios discuss the impact of rainfall variability and atmospheric CO_2 increase on individual and regional farm viability. The scenarios provide means to closely analyse the resilience of the simulated agricultural region to potential impacts of climate uncertainty.

Keywords: *climate change, agent-based modelling, scenarios analysis, wheat-belt, Western Australia*

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Abstract only