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Modelling climate change impacts on agricultural production using deep learning

Lei Gao [a], Yichang Gao [a,b], Yun Chen [c] and Javier Navarro Garcia [d]

[a] CSIRO Environment, Waite Campus, Urrbrae, Australia
[b] Business School, Shandong Normal University, Ji'nan, China
[c] CSIRO Environment, Canberra, Australia
[d] CSIRO Agriculture and Food, St. Lucia, Brisbane, Australia
Email: lei.gao@csiro.au

Abstract: Climate change poses significant challenges to global agriculture, necessitating accurate predictions of the impacts of climate change on agriculture to inform effective planning and strategies to support farmers in adapting to changing environmental conditions. Deep learning models have shown immense potential in capturing complex patterns, and offer promising solutions for modelling climate change impacts. By utilizing convolutional structures, these models can effectively analyze the spatiotemporal dynamics of climate variables and their influence on agricultural production. This paper focuses on the development, evaluation, and comparison of three deep learning models with convolutional structures (convLSTM, convGRU, and CNNLSTM) for capturing the spatiotemporal relationships between climate change patterns and their effects on the yield of wheat in Australia's Murray–Darling Basin. The study evaluated the performance of these models in predicting the wheat yield in response to climate change. The verification results highlight the advantages of using deep learning models with convolutional structures for spatiotemporal modelling and prediction. These models demonstrate their ability to capture the intricate relationships between climate variables and wheat yield fluctuations, offering valuable insights into the potential impacts of climate change on agricultural productivity.

Furthermore, the research identified influential factors that contribute to the variation in spatiotemporal yield of wheat within the Murray–Darling Basin. These factors can provide valuable information for policymakers, farmers, and agricultural stakeholders in understanding the key drivers behind wheat yield fluctuations and making informed decisions regarding adaptation strategies and resource allocation.

The findings of this study have significant implications for agricultural planning and management in the face of climate change. By leveraging deep learning models with convolutional structures, policymakers and farmers can gain valuable insights into the potential impacts of climate change on agricultural production at both regional and global scales. This knowledge can inform the development of sustainable practices, resilient farming systems, and targeted interventions to mitigate the adverse effects of climate change on agricultural productivity. This research also underscores the potential of convolutional structures in capturing spatiotemporal relationships and provides valuable insights into the impacts of climate change on agricultural production.

Keywords: *Climate change, deep learning, convolutional neural network, spatiotemporal modelling, agricultural production*