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Crop yield predictions using sequential UAV imagery and deep learning

This study investigates the use of sequential UAV (Unmanned Airborne Vehicle) imagery and deep learning for crop yield predictions. Accurate crop yield predictions are crucial for mitigating food shortages and making informed agricultural decisions. This research uses different sequence lengths of UAV images across five wavelength bands to model winter wheat, spring wheat, and barley crop yield in South Sweden. The images were processed and calibrated to reflectance values, providing high-resolution data. CNN-LSTM (Convolutional Neural Network and Long Short-Term Memory) models were used to leverage the data's spatial and temporal dimensions. Models were trained on data from 2022 and combined data from 2022 and 2023 to explore the general applicability of the model.

The study aimed to understand better how the accuracy of crop yield predictions evolves throughout the growing season. It explored the effects of varying sequence lengths on the final prediction accuracy and whether adding images to the sequence improves the accuracy. Additionally, the research tested the models' performance on barley and spring wheat to assess their generalisability to other cereals. Results indicate that prediction accuracy improves significantly as the growing season progresses, with the highest accuracy observed closer to the harvest date. However, extending the sequence length of UAV data did not consistently enhance model performance. The study also revealed that models specifically tuned to winter wheat did not perform well when applied to other crops, highlighting the need for crop-specific model training.

The research contributes valuable insights into optimising UAV and deep learning technologies for agricultural applications, emphasising the need for precise and targeted data collection strategies. Such advancements are essential for improving yield predictions and aiding farmers and policymakers in making timely and informed decisions to enhance food security and sustainability.

Keywords: Physical Geography and Ecosystem Analysis, crop yield predictions, machine learning, deep learning, UAV imagery, CNN-LSTM, sequential data

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