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High-Resolution Future Land Use Forecasting by Integrating Spatial Deep Learning and Temporal Regression Techniques

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Abstract. High-resolution land use maps are essential for many applications in fields such as hydrology, water resource management, and urban planning that rely on future scenario modeling. However, predicting future land use is complex due to the interacting drivers of change over time. This study develops a novel method to forecast high-resolution land use maps by combining the strengths of convolutional long short-term memory (ConvLSTM) neural networks and machine learning regression techniques. The ConvLSTM model is trained on eight historical land use maps to learn intrinsic spatial patterns and predict the likelihood of each pixel belonging to different land use categories. This captures the spatial dependencies in the data. A separate regression model then correlates the percentages of land use categories within a given area with its population over different years. By analyzing these trends, the model can forecast future land use percentages based on anticipated population, accounting for temporal changes. By combining the outputs of the ConvLSTM and regression models, high-resolution land use maps are constructed that not only depict probable future scenarios but also incorporate population-driven changes in land use. The resulting land use maps will provide critical information for hydrology, water resource management, urban planning, and environmental management applications that require realistic future land use scenarios.