Object-based analysis and change detection of Minnesota's wetlands over 100 years

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Long-term remote sensing-based analysis of wetlands is challenging due to complex land cover and limited historical data. These limitations impact the accuracy of wetland analyses from remote sensing. Consequently there exists substantial uncertainty about wetland ecosystems and their response to natural and anthropogenic stressors. Recent advances in object-based image analysis (OBIA) offers new image classification tools. This research investigated the capabilities of multiple remote sensing data and OBIA methods to assess inter-annual dynamics of wetland ecosystems. Combining historical black and white aerial photos with more recent LiDAR and high-resolution imagery, this research mapped wetland with high accuracy from 1930s to 2011using an OBIA approach. We studied prairie pothole wetlands and forested wetlands in Minnesota and identified wetland change over 100 years. Two study areas, dominated by the preceding wetland types, were compared to explore wetland response mechanisms under the scenarios of climate and human activities (e.g. land use policy). This research shows good potential in combining gray level information with OBIA methods to accurately map historical wetlands (accuracy: >85-90%). For prairie pothole wetlands, we found that there were more small wetlands in 1938, but more large wetlands in 1978. In 2011, there were similar amounts of small wetlands as 1938. Though 2011 had fewer large wetlands than 1978, 2011's individual large wetlands had much larger areas than those in 1978, and thus contributed to a much larger total wetland area in 2011 than in 1978. We found that forested wetlands tended to be comparatively less variable. Contemporary climate record showed a significant increase in temperature ($p<0.01$) and precipitation ($0.01<p<0.05$) statewide. Considering the impact from climate and human activities, we found that each wetland type responds differently to external impacts. We also conclude that OBIA with multiple source data types is very beneficial for landscape level wetland analyses over long time series.