Title:	Post-typhoon forest damage estimation using multiple vegetation indices and machine learning models
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Abstract:	The frequency and intensity of typhoons have increased due to climate change. These climate change-induced disasters have caused widespread damage to forests. Evaluation of the effects of typhoons on forest ecosystems is often complex and challenging, mainly because of their sporadic nature. In this paper, we compared existing forest damage estimation techniques with the goal of identifying their respective advantages and suitable use cases. We considered Hokkaido in northern Japan as a case study, where three typhoons successively struck in 2016 and led to forest destruction. Forest damage was estimated from Landsat 8 imagery by three approaches, namely using vegetation damage indices (DVDI, DNDVI and ΔEVI), using supervised classification with Random Forest (RF) and Support Vector Machines (SVM) and finally by using the commercial CLASlite software with built-in methods to detect forest disturbance. Machine learning classifiers obtained the highest damage assessment accuracy, but intensive computation and complex processing steps were required. The RF and SVM classifiers gave the highest accuracies when using Fractional Cover as a predictor variable (Overall Accuracy = 80.36% in both cases, and ROC AUC values of 0.89 and 0.88, respectively.) Among the vegetation damage indices, DNDVI produced the highest accuracy (AUC = 0.85, OA = 77.68%). The most damaged areas were on the windward slopes, where forest patches were exposed to the brunt of the typhoon winds. Forest damage also peaked at the highest elevations in the study area, possibly representing exposed hilltops. Methods and findings presented in this study can help stakeholders to implement more effective forest damage monitoring after typhoons and other extreme weather events in the future.
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