Abstract

Semi-automatic Storm Damage Detection in Western Norway´s Spruce Forests – Using Landsat 7 and Comparing Natural Indices in a Change Detection

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Detecting forest storm damages with remote sensing techniques gained rather low attention in the last years. This work aims to fill this gap. The project of storm damage detection, focusing on spruce forests was initiated by the Norwegian Forest and Landscape Institute 'Skog og Landskap'. The triggering event for this investigation was the storm '*Dagmar'* from December 2011. This storm event and its impact on spruce forests on Norway´s west coast are investigated to develop a semi-automatic storm damage detection model.

For detecting storm damages, primarily the question about an adequate data pre-processing of Landsat 7 ETM+ is discussed. The pre-processing finally is done applying haze reduction, image-to-image registration, atmospheric and topographic correction. Seven vegetation indices are applied in a change detection. Pixel information from known storm areas are extracted and compared with focus on data distribution, homogeneity of data, the trend behavior and variance (ANOVA) for different damage categories. After statistically evaluating all indices, the 'Wide Dynamic Range Vegetation Index' (WDRVI), a modification of the NDVI, was most homogenous with least outliers. The data trend of the WDRVI and the increasing damage percentages in the forest are correlating. Therefore the WDRVI provides the best possibilities to detect storm damages in the study area. Through a non-linear regression analysis and 'Partitioning Around Medoids' classification (PAM), thresholds are derived from the WDRVI change image. Implementing those thresholds in an ERDAS 2013 spatial model, a tool is developed, which detects forest changes without the requirement of further user input. The only requirements are pre-processed Landsat 7 images before and after the storm and area of interest data (AOI), e.g. a vector-mask of spruce forests. The semi-automatic detection model was applied on two study areas in Norway´s spruce forests and achieved an overall accuracy of 96.3% (Cohen´s KAPPA of 0.94) and 92.7%. With very good detection results, this investigation contributes to forest management and a faster response on storm damaged forest areas.

Keywords: Remote Sensing, Environmental Monitoring, Forest Disturbance, Storm Damage, Satellite images, Landsat, Pre-Processing, Change Detection, WDRVI, Spruce