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| **Assessing forest regeneration status using UAV-based multispectral sensors.** |
| Forest regeneration monitoring focuses on assessing and tracking the process of natural or assisted regeneration of trees within a specific forest land area. Monitoring approaches typically involve field surveys to assess the tree seedling density, height, growth rates, and species composition. The forest stand regeneration monitoring is important for forest management in the future, providing insights into the effectiveness of regeneration techniques, and thus enabling more adaptive management strategies. Monitoring data are essential to improve the overall regeneration success under conditions of various disturbing factors. The utilization of Unmanned Aerial Vehicles (UAVs) for monitoring of young forest stand regeneration is gaining increasing focus as a cost-effective and efficient method. There are several benefits of using UAVs for forest regeneration monitoring, including rapid and frequent data acquisition, reduced labour-intensive field surveys. UAV-based monitoring provides a cost-effective alternative to traditional methods while maintaining data accuracy and reliability. In this study, we evaluate the potential of utilizing Unmanned Aerial System (UAS)-acquired very high spatial resolution imagery to provide structural information on pine forest regeneration in previously clear-cut stands in Lithuania. Around 200 clear-cut areas with 4-20 years old regeneration were imaged using rotor-wing type UAV. Using the acquired images (RGB and NIR), dense photogrammetric point clouds and orthophoto were produced for every clear-cut area. Each area was field sampled using conventional regeneration inventory approach. Several regeneration inventory approaches were tested both emulating conventional ground sampling and introducing new schemes, all utilizing information extracted from the images and point clouds. Several approaches were investigated to extract the information of regenerated pine seedlings, like object-based image analyses, deep learning and more simplistic image classifications based on spectral and structural information. Operational proposals on using UAV-based imaging and data processing for forest regeneration inventories were elaborated and evaluated for economic efficiency and implementation feasibility. |