The two approaches: assessing resilience of post-disturbance forests across Central Europe using computer-vision foundation models and visual language models

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As a result of climate change, disturbances regimes are changing around the globe. This is challenging the sustainable provisioning of ecosystem services to society. Understanding the disturbance resilience of forest ecosystems is crucial for forest management, yet estimating resilience in the field remains difficult. A rapid assessment of important indicators associated with failing tree regeneration post disturbance would help managers to prioritize efforts on disturbed areas.

Here, we further explore an innovative approach for resilience assessment leveraging the ongoing advances in computer vision models and deep neural networks (DNNs) to estimate post disturbance resilience based on indicators derived from tablet-photos taken in the field. We build on an extensive empirical dataset gathered on disturbed forest sites covering eight central European countries (France, Germany, Italy, Slovakia, Poland, Austria, Czechia, Slovenia) with a total of 4672 plots. We use these images together with empirical data to explore the ability of different computer vision models (foundation models and visual language models) to reliably produce ecological indicators related to forest structure (e.g. light availability, vertical structure, etc.) and post disturbance resilience (e.g. presence of regeneration, ground competition). These computer-vision derived indicators were subsequently related to field-based assessments to assess their utility in assessing post-disturbance resilience. Preliminary results show a medium to strong ability of computer vision derived indicators to assess post-disturbance forest resilience.

Our findings suggest that the ongoing improvements in computer-vision methods and DNNs offer powerful, low-cost, low-threshold tools to support forest managers in prioritizing post-disturbance management decisions.