Nature 4.0 – Intelligent networked systems for ecosystem monitoring

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Successful conservation strategies and adaptive management require frequent observations and assessments of ecosystems. Depending on the conservation target this is commonly achieved by monitoring schemes carried out locally by experts. In general, these expert surveys provide a high level of detail which however is traded-off against the limited spatial coverage and repetition with which they are commonly executed. Thus, it is common practice to spatially expand these observations by remote sensing techniques. For a resilient monitoring both the expert observations and the spatio-temporal upscaling have to be extended by automated measurements and reproducible modelling. Therefore, Nature 4.0 is developing a prototype of a modular environmental monitoring system for spatially and temporally high-resolution observations of species, habitats and key processes. This prototype system is being developed in the Marburg Open Forest, an open research, education and development platform for environmental observation methods. Here, we present the experiences and challenges of the first year with a focus on the conceptual design and the first implementation of the core observation subsystems and their comparison with the data collected by classical field surveys and remote sensing. The spatially distributed acquisition of abiotic and biotic environmental parameters is based on self-developed as well as third party sensor technology. This includes an automated area-wide radiotracking system of bats and birds and sensor units for measurements of microclimatic conditions and tree sap flow as well as spectral imaging and soundscape recording. The backbone of the automated data collection and transmission is an autonomous LoRa and WiFi mesh network, which is connected to the internet via radio relay. By utilizing powerful data integration and analysis methods, the system will enable researchers, conservationists and the public to effectively observe landscapes through a set of diverse lenses. Here, we present first results as well as an outlook for future developments of intelligent networked systems for ecosystem monitoring.

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