

Invited Talk 6



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ECOSENSE – A SMART DISTRIBUTED SENSOR NETWORK FOR FORESTS

Abstract:

Global climate change threatens ecosystem functioning worldwide. Forest ecosystems are particularly important for carbon sequestration. However, recurrent stresses, such as heat waves, floods, and droughts, increasingly endanger forests worldwide. Many relevant processes occur at small scales and high spatial heterogeneity and their interactions can be key players to amplify or dampen a system's response to stress. Currently, we are lacking the appropriate measuring, data and modelling tools allowing for comprehensive, real time quantification of relevant processes at high spatio-temporal coverage.

Consequently, the interdisciplinary research project ECOSENSE develops, implements, and evaluates a versatile, distributed, autonomous, intelligent sensor network based on novel microsensors tailored to the specific needs in harsh forest environments. All measurements need to happen in a minimally invasive manner in order not to disturb the ecosystem we are exploring. This requires consideration of size, weight, inertness, cleanliness, and robustness. The complex environment of a remote naturally structured forests with rain, wind, insects and mammals thereby poses its own challenges that the ECOSENSE sensors are facing.

The network comprises miniaturized sensors for 1) the quantification of gas and water fluxes, specifically isotope discriminated CO₂ and volatile organic compounds (VOC, here isoprene) at ppb concentrations, and 2) for the detection of typical stress markers, such as active, laser induced chlorophyll fluorescence. ECOSENSE explores these distributed sensors from leaf level including low power electronics, to medium sized laser spectrometers, up to drones and eddy covariance towers.

In our field site, the ECOSENSE Forest, we are currently operating 4500 continuous data streams, partially with a temporal resolution of a few seconds. Measured data is transferred in real-time to a sophisticated data base and can be explored for process analysis and AI enhanced simulation models providing the basis for future predictions of process-based alterations in ecosystem functioning and sustainability.