

EGU21-887

<https://doi.org/10.5194/egusphere-egu21-887>

EGU General Assembly 2021

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Measuring and monitoring trees and forests using a novel IoT approach

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International attempts to limit greenhouse gas (GHG) concentrations, aimed at stabilizing human induced climate change, require a detailed understanding of the current and potential future role of forests to sequester carbon. Accurate, high frequency and reliable measurements are therefore vital in developing effective mitigation strategies and help to improve understanding of the other ecosystem services provided by forests which are valued by society. However, forests are typically located in remote, rural environments which can make regular access for surveyors and other forest scientists challenging and logistically difficult. In 2020, Forest Research worked in partnership with the UK government's Department for Environment, Food and Rural Affairs (Defra) and Vodafone to explore how Internet of things (IoT) technology can be used to improve environmental and forest monitoring and to test its suitability at remote rural locations in the UK. A pilot study which ran at Forest Research's two contrasting long-term carbon flux sites, Alice Holt (Hampshire) and Harwood (Northumberland) used IoT technology to measure and transmit high frequency growth and environmental data over the course of an entire growing season. Tree growth sensors (automated dendrometers) and a range of other environmental sensors (e.g. air temperature and humidity, soil moisture) attached to the trees and in the soil (nine replicates per site), were connected to the Vodafone Narrowband-IoT (NB-IoT) network. Data was uploaded every 15 minutes to a Grafana based online web portal, providing researchers with near real time access to the data. Here we present results from these two sites, details of the hardware used in these new devices and evaluation of their performance during this pilot study.