

EGU21-15950

<https://doi.org/10.5194/egusphere-egu21-15950>

EGU General Assembly 2021

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Developing a novel monitoring system to determine rainfall interception from different forest types

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Natural Flood Management (NFM) seeks to utilise natural processes within the landscape to reduce flood risk and is increasingly being viewed as a sustainable, cost effective, and complementary addition to flood defence infrastructure. One NFM measure is to increase the proportion of forested lands within catchments draining to the communities at risk. Tree cover has good potential to reduce flood risk by increasing canopy evaporation, enhancing below and above ground flood storage and slowing the flow of water towards streams. However, the extent to which these mechanisms are superior for forestry, compared to other land uses, and how they vary throughout the year and for different forest types remains difficult to predict, which is a major gap in our ability to quantify how forest cover can help reduce flood risk.

Here, we present a study that utilises LoRaWAN, a developing wireless sensor network technology, to provide real time collection of canopy interception and streamflow data at the Pennal catchment in Wales, UK. LoRaWAN is an emerging Low Power Wide Area Network (LPWAN) protocol designed for Internet of Things (IoT) applications. The capability of LoRaWAN to operate under harsh attenuation and interference conditions make it well suited to the forest catchment area which is characterised by dense vegetation and varied topography.

This study will utilise a network of tipping bucket rain gauges and stream flow monitors distributed in different forest types and densities. The rain gauges and water level monitors are the end devices (IoT things) in the network which perform a direct communication with LoRaWAN Gateways, from which the data is 'pushed' to a server for storing and assimilation. The data will be used to develop and validate a coupled canopy and soil hydrology model. This will guide forest management and aid in quantifying the effects of natural flood management techniques, initially within the Pennal catchment, with a view to expanding to the regional scale.