EGU24-13272
EGU General Assembly 2024

Tower-based radar observations of sub-daily water dynamics in boreal forests

Johan E.S. Fransson[1], Albert R. Monteith[2], Henrik J. Persson[3], and Lars M.H. Ulander[2]
[1]Linnaeus University, Department of Forestry and Wood Technology, Växjö, Sweden (johan.fransson@lnu.se)
[2]Chalmers University of Technology, Department of Space, Earth and Environment, Gothenburg, Sweden (albert.monteith@chalmers.se, lars.ulander@chalmers.se)
[3]Henrik Persson, Swedish University of Agricultural Sciences, Department of Forest Resource Management, Umeå, Sweden (henrik.persson@slu.se)

Radar remote sensing observations are predominantly affected by the concentration and spatial distribution of water in natural scenes. This motivates the utilization of high-resolution spaceborne radar observations for monitoring the water status of vegetation and the impacts of climate change on forests globally. While current satellite-based synthetic aperture radar observations are limited to temporal resolutions of days, tower-based radar observations of forests are capable of capturing detailed sub-daily physiological responses to variations in soil water availability and meteorological conditions. Such experiments demonstrate the scientific value of prospective sub-daily space-borne observations in the future.

The BorealScat tower-based radar experiment conducted in southern Sweden from 2017 to 2021 has captured various ecophysiological phenomena in a boreo-nemoral forest, including water stress and degradation induced by spruce bark beetles (*Ips typographus*). To gain a deeper insight into the sub-daily impacts of forest water dynamics on radar observations, the BorealScat-2 tower-based radar experiment was initiated in a boreal forest, located in northern Sweden in 2022. Along with *in-situ* sensors characterizing the water status on the tree level and an eddy-covariance flux tower, this initiative aims to compile a comprehensive and open dataset. The goal is to enhance our understanding and modelling of the relationship between traditional ground-based forest information, eddy-covariance flux measurements and radar remote sensing observables.

The data gathered by BorealScat-2 stands out as the most radiometrically precise high-resolution time series ever recorded in forest environments, resolving the subtle water content-induced signatures in radar measurements. Preliminary findings from the 2022 growing season, highlight the detectability of a diurnal radar signature across all conventional radar remote sensing bands (i.e. C-, L- and P-band). Moreover, metrics akin to tree water deficit, as measured by high-resolution point dendrometers, can be derived from interferometric radar observations. The fine temporal resolution of the data also unveils distinct signatures corresponding to intercepted precipitation in time series measurements. These findings underscore the need for sub-daily observations from space-borne satellites to monitor vegetation water status.